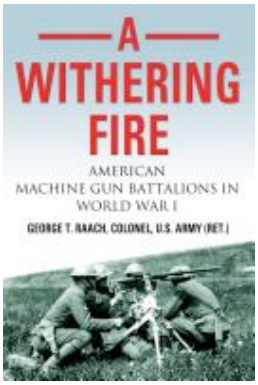
A WITHERING FIRE

AMERICAN MACHINE GUN BATTALIONS IN WORLD WAR I

GEORGE T. RAACH, COLONEL, U.S. ARMY (RET.)



A Withering Fire is the history of American machine gun battalions in World War I. It describes how these units evolved from a few small detachments armed with obsolete weapons to more than 200 battalions that supported all operations, and by their power saved countless American lives. It explains in detail the organization, training, equipment, and combat employment of machine gun units and in so doing adds to the understanding of how Americans actually fought.

A Withering Fire: American Machine Gun Battalions in World War I

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For My Grandchildren

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Table of Contents

Prologue

Chateau-Thierry

On the evening of May 31, 1918, all that stood between German infantry and the south bank of the Marne was a smattering of disorganized French infantry and 24 Hotchkiss machine guns of the 7th Machine Gun Battalion [MGB], 3rd Infantry Division, American Expeditionary Forces (AEF). The third German spring offensive, begun only a few days earlier, shattered French and British lines along the *Chemin des Dames* ridgeline. To help stem the advancing tide John J. Pershing, AEF commander, gave the French two American infantry divisions—the 2nd and the 3rd.[1] The 3rd Division was to reinforce the French in the vicinity of Chateau-Thierry. However, except for the divisional machine gun battalion, the 3rd had yet to reach the battlefield. If German infantry crossed the Marne at Chateau-Thierry, the road to Paris lay open before them.

The 7th MGB had only received a full allotment of machine guns and Ford vans within the past 10 days. Its mission was to support the 10th Colonial Division, the French unit charged with the rear guard. The 10th had few remaining effectives, and the burden for defense passed to the Americans. When the 7th arrived in late afternoon on May 31, the French commander ordered it to protect two bridges that spanned the Marne at Chateau-Thierry. As darkness fell American machine gunners moved into position along the south bank of the Marne and onto an island formed by the river and a narrow canal. Crews hastily set up their machine guns behind garden walls, in houses, in an

abandoned factory, and in nearby woods. They occupied a 1,600-yard front, twice the defensive frontage normally given to infantry regiments.[2] Isolated on unfamiliar ground and armed with weapons they barely understood, nervous doughboys awaited the German attack.

The 7th's machine guns were French. They ended up in American hands as the result of a political compromise that sent better-quality Vickers guns to the French in exchange for the Hotchkiss. Although rugged and reliable, the Hotchkiss had two major disadvantages. First, because it was air-cooled, it tended to overheat. After a few minutes' rapid fire the guns had to be allowed to cool or accuracy suffered. Second, it was fed with metal strips that held only 25 or 30 rounds of ammunition. If the loader was skilled, he could reload almost without a halt in firing, but that required sure hands and poise in the face of mortal danger. Both skills were born of combat experience, of which the 7th MGB had none.

Despite these disadvantages, the 7th went into action for the first time early on the morning of June 1. An official account summarized events, "the battalion took up positions in the town [and] those positions were maintained, although subjected to severe bombardment during the entire night, and at dawn … a fierce attack in an attempt to cross the Marne was repulsed."[3] When relieved 48 hours later, the 7th still held the south bank of the Marne, and the north bank was littered with German dead. When the 7th's crews left their positions after a second night of fighting, some guns glowed red and nearly all ammunition had been fired. Although fighting continued in the area for several weeks, the attack at Chateau-Thierry had been broken and with it Germany's best chance for success. French Marshall Ferdinand Foch praised the 7th in a special order, noting that "in

the course of violent combat [the 7th MGB] disputed foot by foot with the Germans the northern outskirts of Chateau-Thierry and covered itself with incomparable glory."[4] Had they not done so, the Germans may well have reached Paris.

The 7th was one of more than 100 American MGBs. The number is remarkable because before America declared war in April 1917, the U.S. had not a single machine gun battalion and only a few hundred obsolete machine guns. In 17 months the Army went from almost no machine guns, and practically no idea of how to employ them, to an organization that had more than 50,000 heavy machine guns and hundreds of machine gun units, most of which were reasonably proficient. The 14 machine gun companies in each division accounted for about 10 percent of the division's personnel, but produced more than two-thirds of its direct firepower. A single machine gun was thought the equivalent of 100 riflemen or more. They were, in the words of one veteran, *the concentrated essence of infantry*.

This is the story of these units and the part they played in the AEF's campaigns. It is the saga of the men, their equipment, and how they employed it. The story is not about weapons *per se*, although that is certainly part of it. The text goes beyond that to discuss Army policies, doctrine, and directives, and explores their implications through firsthand accounts. In some cases, doctrine was appropriate, but in many others it inhibited effective use of the weapons and led to expedient fixes. Through it all, machine guns saved American lives that would almost certainly have been lost in the war's final campaigns without them, and they enabled infantry units to accomplish their missions within acceptable risk parameters.

Chapter I: Environs of War

The Beastly Little Weapon

At its most fundamental level, war is about compelling. German military theorist Karl von Clausewitz noted that above all else, war is "an act of force to compel our enemy to do our will."[1] One employs the means available, whatever they may be, to force an adversary to behave according to one's wishes. In order to do this, sufficient force must be applied to weaken his resistance while simultaneously conserving enough power to exploit the carnage. Yet knowing that war requires this is not the same as understanding how to do it. In fact, to compel efficiently one must focus on high-value targets whose degradation will reduce both the enemy's means and his will to resist. Given this requirement, the central challenges have always been to identify an enemy's critical assets correctly, and then devise effective ways to threaten them. Professional soldiers devote their lives to perfecting practical methods to do exactly this. Defeats and pyrrhic victories can often be explained by the failure to calculate this equation correctly.

All professional soldiers in the years before the Great War understood this logic. However, the years leading up to 1914 witnessed lively debates over the best methods to apply it. Many believed fervently in the power of the attack. They shunned defense except as a tactical expedient. Only attacks, they believed, could deprive defenders of the initiative, disrupt their tactical schemes, and offer hope that fresh forces might penetrate battered lines. Others, perhaps more prescient,

cautioned that improved defensive methods and new weapons made offensive war too expensive and too risky. Although not unaware of the value of attacks, they favored robust defenses to sap an opponent's strength first. Allow the enemy to weaken himself in assaults, they argued, and then counterattack his decimated forces. In pre-war debates those who believed in the primacy of the offense came out on top. Yet to succeed, attacks had to place at risk something essential, and at the tactical level that was the enemy's combat forces. In the words of American General John J. Pershing, "complete victory can only be achieved by beating the enemy's army."[2] A persuasive argument could be made that an opponent decisively defeated on the battlefield was unlikely to be able to prevent victor from compelling vanquished. Thus, although Germany sought Paris, the French Army had to be defeated in order for Paris to fall. Similarly, French strategists believed that crushing the German Army would force it to withdraw to at least pre-war borders. In large measure these perceptions remained constant throughout the war. Also unchanged was the idea that, in the absence of maneuver opportunities, defeat of an adversary's army depended on inflicting horrendous casualties.

By the winter of 1914-1915 the war had become a war of attrition. Killing on an industrial scale was paramount. As French General Henri Gouraud, 4th Army commander, told his forces, "Kill them; kill them in abundance until they have had enough."[3] Although tactics were often badly flawed, the fact remained that killing great numbers of enemy soldiers was a *sine qua non* of the Western Front. While more manpower was initially available, the supply was finite. Belligerents were able to recruit or conscript new formations, but each knew that a tipping point would be reached eventually. It became increasingly clear that

to overcome an opponent's ability to replace losses, casualties had to be massive and they had to be produced quickly and continuously. If this could be done by attacks, so much the better; however, defenses worked just as well.

A war of attrition based on defense cut both ways. Defensive positions had to be formidable. If an attack could not be repulsed, and if attackers reinforced their gains with fresh formations, defenders had to fall back. Thus, ineffective defenses were likely to result not only in a loss of ground, but significant casualties when fleeing defenders were attacked from flank and rear. However, if attackers were repulsed their casualties were likely to be tremendous, too. Western Front adversaries thus sought to reduce risks by thickening the battlefield with more artillery and more machine guns.

Artillery had played important roles in warfare for hundreds of years. By 1914, artillery batteries hurled imposing projectiles thousands of yards at unseen targets. They collapsed the deepest bunkers or obliterated in seconds scores of men unfortunate enough to be within the bursting radius of a high explosive shell. Artillery became even more dangerous when poison gas was introduced. Still, it was not without flaws. Two major challenges were flexibility and responsiveness. Because gunners had to register their weapons on their targets before they could deliver fire accurately, they often could not shift their fires from one target to another quickly. Although shifts were mathematically possible, it took time and required new data to reposition fire. Diligent training could reduce this time, but new data depended on capable observers and reliable communication. The latter was remarkable for its absence. Therefore, artillery was often limited to pre-planned concentrations, rolling barrages fired on fixed time schedules,

and pre-registered standing or box barrages to protect friendly positions. If unexpected activity required instantaneous response, artillery's ability to deliver accurate fire was problematic, especially if the target was moving. Killing on an industrial scale required a weapon to offset these shortcomings.

Machine guns offered ideal solutions. One historian recorded that as the war unfolded "a premium would be placed on those weapons that could annihilate the enemy as quickly and as cheaply as possible. During World War I the machine gun was the most important such weapon."[4] Liddell Hart, a British historian and Great War veteran, believed the machine gun was the most revolutionary weapon of the war. He noted that the deadlock following the initial battles was due primarily to machine guns, not artillery. Tripod-mounted heavy machine guns were accurate beyond two miles. Because they were located in close proximity to the troops they supported they were more responsive than artillery. However, although they were widely available and their value had been proven in lesser conflicts, no army in 1914 had sufficient machine guns to fight a war of attrition. The shortage was influenced more by cultural predilections than technical deficiencies.

The first step in the process of acquiring more machine guns was to overcome the dislike of many professional soldiers for what one British general called "that beastly little weapon."[5] Officers senior enough to have a say in how the war was fought had matured on a diet of glory and individual daring. The lore of regiments was the saga of rifle, bayonet, and saber. In this spirit, beastly little weapons were somehow beneath a true soldier's dignity. Infantry did the real work on the battlefield. Only infantry could conquer ground, and for many soldiers conquering ground was paramount. Anything that did not

contribute to that goal was superfluous. It required time and bedlam to change minds, for in the Great War old approaches and customs counted for very little. Impersonal slaughter by vastly improved weapons augmented with new types of obstacles and tactics replaced all that. Soldiers eventually were forced to admit, as another historian noted, "… three men and a machine gun can stop a battalion of heroes."[6] Without question, machine guns made defenses more formidable. They could cut down droves of advancing infantry before most artillery could open fire. Over time soldiers also learned to use them to deliver accurate indirect fire against targets they could not see and to fire over the heads of friendly troops during attacks. This made them valuable not only for defending ground but for taking it. In short, machine guns had great value for all types of combat. They could interfere much more effectively and economically than artillery with an enemy's ability to move freely, even behind his own lines. They could seal off portions of the battlefield with belts of fire more than 50 yards wide into which bullets fell like hail. They were far more deadly than the best riflemen whose accuracy and speed were susceptible to fear and fatigue. However, even after this was generally understood the acquisition of guns and the skill to employ them effectively took time.

Fire is Everything

Nevertheless, infantry were still needed to capture ground, and formidable defenses reinforced by machine guns required greater numbers of attacking infantry to succeed. Commanders who attacked had to collect the requisite number of soldiers without simultaneously compromising their defenses. Then they had to ensure that the men they sent forward were covered by fire and adequately equipped to repel counterattacks once on

their objective. If these conditions could not be met the most brilliant tactical schemes were inadequate. Requirements to attack and defend simultaneously were daunting, and became more so as casualties mounted. Gradually, as tacticians came to grips with Western Front conditions, they realized that more machine guns and better methods for their use were crucial. Fire superiority was an important part of the tactician's creed. The side that achieved it first with adequate reserves to exploit it was more likely to prevail. As a British officer told the American Army War College in 1917, "In war, fire is everything." Heretofore fire superiority was the province of the infantry. Firepower in the prewar period was measured by numbers of rifles and the effectiveness of the men who shouldered them. The more rifles one had, the greater the volume and presumably effectiveness of fire. However, as trenches proliferated and casualties mounted, it became apparent that this pre-war calculus was inadequate. Firepower now was not a function of numbers of rifles, but of the volume of projectiles one could put into a target area in a very brief period of time. What counted was not number of soldiers but number of bullets, and those could be delivered more effectively by machine guns. Proper use of these weapons allowed riflemen to be organized for attacks with less risk.

Four persuasive arguments eventually convinced most European officers that machine guns were worthwhile. First, they could deliver higher volumes of fire than infantry with greater precision at longer ranges. Once mounted on its tripod the nervousness of the gunner was not transmitted to the gun. Second, they could replace large numbers of infantry in defensive positions without diminution of firepower. A single machine gun properly served provided almost as much

firepower as an infantry company. Third, machine guns were easier to control than an equivalent number of infantry. For example, if a line of infantry was suddenly outflanked it was usually impossible for them to reorient quickly.[7] Conversely, machine guns could be trained at new targets very rapidly without changing positions. That was much more effective and less dangerous than getting platoons of infantry on their feet and maneuvering them under fire. Fourth, machine guns were much more responsive than artillery. A demonstration for Field Marshall Douglas Haig proved the point. Several machine guns successfully engaged a target directly to their front with indirect fire on a training range. Haig, who was not then a machine gun enthusiast, wondered whether the crews could shift their fire to another target, say, 90 degrees from the first one. The officer in charge of the demonstration asked Haig to pick the target. He did, and the gunnery officer transmitted appropriate data to the guns. No one knows what Haig thought would happen, but in a little over a minute the guns engaged the new target, covering it with a blanket of fire. This shift was much faster than any contemporary artillery battery could have made. Impressed, Haig immediately directed his senior commanders to ensure their infantry understood the value of machine guns as rapid response weapons.[8] If an emergency required a heavy volume of fire, the first rounds to hit the target were likely to be fired by machine guns.

Machine guns could also fire an almost unlimited amount of ammunition, which was easier to bring forward than artillery projectiles. A few Vickers guns supporting the infantry attack on Messines, for example, fired 749,000 rounds before the battle. Captured German infantrymen recounted that this fire was so effective they had not received rations for several days. During

the preparation at High Wood in August 1916 a battery of 10 machine guns fired nearly a million rounds in less than 12 hours, an average of more than 160 rounds per minute per gun. Artillery would have required large numbers of transports to move an equivalent number of shells to firing positions.

By mid-1915 most realized that machine guns provided front line soldiers with responsive, accurate, sustained fire as long as crew, gun, and ammunition held out. The weapons could do this from bunkers, in trenches, in shell holes, in woods or on open ground, and they could do it day or night. On the Western Front infantrymen who lacked machine gun support were usually doomed to dreadful losses. Numbers of machine guns increased as fast as factories could produce them. Pre-war German divisions had only about two dozen and many divisions lacked the full complement. By 1916 the number per division had grown to 70; in 1918 it had increased to 350. These were reinforced by formations known as *Maschinengewehr – Scharfschutzen* (machine gun sharpshooters) controlled by army and corps commanders. British Expeditionary Forces (BEF) in the summer of 1914 had only two machine guns per infantry battalion, but their numbers increased rapidly, too, and were organized into a separate machine gun corps.[9] Of the major powers, by 1917 only America lacked substantial quantities.

Like most European forces, the U.S. Army had little interest in machine guns prior to the war. The Field Service Regulations (FSR), the Army's capstone doctrine manual, dismissed them tersely with a single paragraph that began, "Machine guns are emergency weapons … their effective use will be for short periods of time—at most a few minutes—until silenced by the enemy."[10] Weapons with short life spans were not numerous in

a resource-constrained peacetime army that focused on less-intensive conflicts. In fact, pre-war infantry regiments had only four automatic weapons. The Army's lack of enthusiasm is difficult to understand, given the weapon's proven value on the Western Front. Nevertheless, when the United States declared war the Army was not ready for the demands of the Western Front for machine guns—not in materiel, not in trained personnel, and not in doctrine.

American attitudes toward machine guns and machine gunners stemmed from cultural preferences and a focus on a completely different kind of warfare. The Army acknowledged that there was a place, albeit inconsequential, for rapid firing weapons. However, American officers were prisoners of ideas born during the Spanish American War when Captain John H. Parker used Gatling guns, heavy, horse-drawn, hand-cranked weapons developed in the 1860s. Although Parker remained an advocate of better machine guns, tradition-bound Army officers thought the Gatling adequate. They saw no reason to buy expensive new designs. Like their European counterparts many officers clung to the tradition that the battlefield was the jurisdiction of infantry. In the words of one commentator, they believed that machine guns "must not be allowed to undermine the old certainties of the battlefield—the glorious charge and the opportunities for heroism."[11] Many who held such beliefs were responsible for Army war fighting doctrine. They lacked vision and thought of machine guns as one-dimensional weapons of limited utility. Nevertheless, the Army did possess some heavy machine guns. A few Model 1895 Colts and 1904 Maxims were available. However, in 1909 these had been largely replaced by the light Benet-Mercie. The Benet, a machine rifle not a true machine gun, was difficult to maintain and unable to deliver

sustained automatic fire. Nevertheless, it was the Army's primary automatic weapon and its frequent failures flavored opinions of such weapons throughout the force.

Library of Congress

Photograph 1.1 Benet-Mercie machine rifles. These two weapons constituted half the automatic firepower in pre-war infantry regiments.

Even with some machine guns in the arsenal, no officer—at least no influential officer—seems to have thought of innovative ways to employ them. Long after European forces found new methods for their use, the American military gave little thought to anything but direct fire. No American doctrine writer appears to have considered the value of machine guns in indirect, overhead, barrage fire, or to complement artillery. Similarly, few American officers thought that machine guns could be used continuously throughout a fight. In their view, the guns were as

good as lost once they opened fire. Protective measures were given little consideration by the American military, although soldiers in all European armies found ways to minimize risks. For American officers, European innovations were strange enough to require a series of lectures at the Army War College where the focus was normally on strategy, not tactics.[12] In short, tradition, unfamiliarity, and lack of imagination contributed to the Army's pre-war failure to procure machine guns, train adequate crews, and develop enlightened employment concepts.

A Matter of Doctrine

Military doctrine describes concepts for the tactical employment of a force, and by extension how it is trained and equipped. Ideally, doctrine is based on national goals and likely threats. If objectives are narrow and enemies not formidable, then important drivers for doctrine development are lacking. Pre-war America's objectives and enemies were much less grandiose than they became in 1917. Threats to national security lay in attacks on the southern border and colonial disturbances, and thus tactical doctrine focused on homeland defense and order in overseas possessions. Almost no serious thought was given to how machine guns fit into that concept.[13] In fact, neither threat required large forces with state-of-the-art weapons. In the absence of doctrine to rally influential champions, machine guns were not worth scarce funds. The few proponents, led by John H. Parker, were orphans, and Parker's abrasive personality did not help advance their cause. He was, in the words of Army Chief of Staff Franklin Bell, "a pestiferous, immodest ass."[14]

Recent experience with Villa's forays into the American Southwest seemed to demonstrate the soundness of the Army's tactics. The punitive expedition involved little more than

skirmishes, miniscule by Western Front standards. For many that seemed to be the future. The country was, after all, a hot bed of non-intervention. Even after WW I began very few officers thought seriously about American involvement. The Army was organized, trained, and equipped to fight a different kind of war in which the firepower of rifles seemed adequate. By contrast, in 1917 machine guns dominated the Western Front. European tactics were driven by the machine gun, not the rifle or cannon. They were no longer seen as arms to episodically support infantry; rather infantry supported machine guns. However, despite reports from credible observers, most American officers still did not share that enthusiasm. A few automatic weapons had accompanied the 1916 expedition against Pancho Villa, but often they were not well served nor were they used innovatively. In fact performance was so poor that the Army created travelling machine gun schools to teach machine gunners their trade. The Army's *Drill Regulations for Machine-Gun Platoons, Infantry, 1909,* did not rise to the standards of tactical instructions useful for machine gun employment in Europe. Old traditions survived. Rifles won battles, American officers claimed, just as Europeans had four years earlier. The shortage of machine guns and trained gunners reflected this prejudice when the U.S. entered the war. Even as soldiers embarked for France, many still believed that infantry was not only sufficient, but supreme. The American Army had to absorb the lessons of the Western Front at its own pace. Providentially, the Army did so in a very short period of time, aided by British and French tutors and American industrial capability. By the time the war ended, thousands of doughboys had been trained as machine gunners and the country owned

about 55,000 modern heavy machine guns, most of them made in America.

The history of the AEF's machine gun units falls into four parts. First, machine gun units had to be designed, organized, and staffed. The few machine guns available in prewar infantry regiments were organized into platoons staffed by men drawn from infantry battalions. In the words of one officer who served during this period, "many times the temptation to get rid of an unwanted problem child was solved by … sending them to the machine gun platoon. A pretty sorry outfit it was, as a rule."[15] Inadequate numbers of guns served by men of questionable proficiency were not useful on the Western Front. Second, machine guns had to be produced. The most commonly available automatic weapon was the light, problem-plagued Benet-Mercie, which was not suitable for combat in Europe. To resolve the shortage of reliable heavy machine guns, American factories had to retool to build weapons with which they had little experience. Third, although the Army did have a useful machine gun manual, when war was declared it had almost no trained machine gunners. By comparison, infantry training was continuous, relatively easy to accomplish, and there were large numbers of experienced officers and NCOs available to do it. On the other hand, machine gun training required complex programs of instruction, expert instructors, sufficient weapons, and adequate facilities, all of which were in short supply. The Army borrowed British training programs; however, it was not able to satisfy the other requirements until late in the war. Fourth, existing American machine gun doctrine was not useful for Western Front conditions. Without relevant doctrine to guide training and employment, AEF machine gunners had almost no chance of surviving more than the few minutes predicted by

sceptics. The guns could only be effective if they accommodated unforgiving tactical conditions. Tactical machine gun doctrine evolved quickly, but was often contradictory or just plain wrong. If it was appropriate, soldiers generally adhered to it. However, if it prevented them from doing their jobs, doughboy gunners quickly found other ways to do business.

The prospect of imminent combat with an experienced opponent was a powerful forcing function. It enabled machine gun proponents to overcome resistance buttressed by tradition. Most initial shortcomings were largely resolved by the start of the war's final campaign in autumn 1918—a remarkable feat given normal bureaucratic inertia. Nevertheless, change was often encumbered by dissension and conflicting visions. Agreeing upon suitable machine gun organizations and finding men with the right qualifications to staff them were among the first challenges the Army addressed.

Chapter IV: One Hell of A Load

The Nature of the Beast

In April 1917, the United States had just 430 heavy machine guns, less than the number in three German divisions. Although Colt had a contract for about 4,000 Vickers machine guns none had been delivered and lengthy delays were expected. Apart from Colt, Marlin, and Savage, American industry had little experience manufacturing machine guns. From a standing start, however, by December 1917 U.S. factories were producing approximately 5,000 machine guns each month. Some were made in traditional arms factories. Others were produced by companies that had no experience in weapons-making such as Westinghouse. By war's more than 60,000 heavy machine guns were on hand, most American-made.[1] That these complicated weapons were produced quickly and integrated effectively is extraordinary.

Table 4.1 U.S. Heavy Machine Gun Inventories

GUN	Available in April 1917	Available in Nov 1918
Colt Model 1914	148	148
Maxim Model 1904	282	282
Vickers Model 1915	0	12,000
Hotchkiss Model 1914	0	5,255
Browning Model 1917	0	43,000
Total	430	60,685

Source: War Office. America's Munitions, 1917 – 1919

Great War machine guns were categorized by how their mechanisms worked and how their barrels were cooled. The Colt and Hotchkiss relied on gas produced by the detonation of the cartridge to operate their mechanisms. Maxim, Vickers, and Browning guns were operated by recoil—the natural tendency of the cartridge to move toward the rear when fired. Machine guns generated tremendous amounts of heat that affected accuracy and barrel life unless barrels were adequately cooled. Great War machine guns were cooled either by air or water. Air cooled guns like the gas-operated Colt and Hotchkiss dissipated heat by a combination of barrel weight and diameter, cooling fins, and the position of the lock after the weapon was fired. While reliable, air cooled guns could not be fired continuously for as long as water-cooled weapons. After a few minutes' rapid fire, crews either had to reduce the rate of fire, stop firing altogether, or replace the barrel. Once removed, a hot barrel was allowed to cool naturally or by pouring water or oil through it.[2] Although air cooling eliminated the need for water cans and condensers, air cooled guns were heavier: the Hotchkiss weighed more than 120 pounds (Table 4.2).

Water-cooled guns had metal jackets that encased the barrels and contained between seven and eight pints of water. Inside the jacket just above the water line was a steam tube. When water boiled during firing, steam entered the tube, travelled forward, and vented into a hose that ran to a can called a steam chest. The hose and chest constituted the condenser system, and steam transformed into water could be used to refill the water jacket. As a rule, water in the jacket began to boil after the first 600 rounds of rapid fire (i.e., more than 250 rounds per minute). It then boiled off at a rate of 1.5 pints for every 1,000 rounds.[3] If barrels became heated and condensers were not

properly attached, guns produced a plume of steam that revealed their positions. Infantry in all armies were trained to look for this telltale sign, thus an absent or torn condenser hose posed significant risk. There were other shortcomings as well. If a gun was very hot, the crew was obliged to delay a few minutes before refilling the water jacket to avoid scalding. In winter frozen water could crack hot barrels, and gunners were required to add anti-freeze. Finally, barrels of water-cooled guns recoiled a fraction of an inch during firing. This movement could damage seals causing water and steam to leak out. Guns could be fired without water for a few hundred rounds, and when guns accompanied attacking infantry, the condenser system was usually not used.[4] (Water-cooled guns mounted on aircraft were converted to air cooling by removing the water jackets.) Water-cooled guns provided greater volumes of sustained fire than their air cooled counterparts. During long barrages, water-cooled weapons sometimes fired at an average rate of more than 150 rounds per minute for periods in excess of 10 hours.[5] But this endurance came at the price of increased amounts of equipment and the need for a source of clean water to avoid clogging the steam tube or damaging the copper coating of the jacket interior. In emergencies any water could be used and was. Anecdotal evidence includes water taken from trench bottoms and shell holes; even urine was used as a cooling agent. However, when this was done, guns had to be completely disassembled and cleaned as soon as possible.

Barrel life of water-cooled guns, while generally longer than that of air cooled weapons, depended on the temperature of the water in the jacket and how frequently the bore was oiled during firing. A water-cooled weapon that fired an average of 1,000 rounds per hour and was properly oiled had a barrel life of

20,000 to 25,000 rounds before wear affected accuracy significantly. However, firing an average of 3,500 rounds an hour would reduce barrel life to between 12,000 and 15,000 rounds.[6] Barrels of water-cooled guns could be changed if necessary, but doing so required appreciably more time than replacing barrels of air cooled guns. Well-trained crews could change barrels on water-cooled guns in six minutes: two minutes to remove the old barrel; four minutes to install the new. In the process, they had to be careful not to damage the front and rear asbestos seals that kept the jacket from leaking. Guns came with adequate supplies of asbestos, but it required an additional five minutes to replace the front seal; 10 minutes for the rear.[7] The Army insisted that machine gun officers take an active interest in the condition of their weapons regardless of type. Guns were to be cleaned and lightly oiled. Springs were to be tested at every opportunity, but at least once each day.

Over Here and Over There

American ground forces had five types of heavy machine guns: the Colt Model 1895/1917, the Maxim Model 1904, the Hotchkiss Model 1914, the 1915 Vickers, and the Browning Model 1917. The Colt and Maxim were used only for stateside training. The others were used in Europe, and some units used more than one type of weapon. Each had its own features and shortcomings that influenced training and how they were employed in battle.

Colt Model of 1895/1914/1917 The Colt was invented by the prolific firearms inventor, John M. Browning, who may be the only man to design both gas and recoil operated machine guns. Browning began to experiment with gas operating systems in the 1870s, and received a patent in 1880. In 1889, his gas

operated machine gun was ready for production, and in the 1890s he offered it to Colt. Colt already made the Gatling gun and declined to invest in an unproven system. Undeterred, Browning took his gun to Connecticut and put on a demonstration. His gun fired 200 rounds in less than half a minute, much faster than Gatlings. Colt executives were suitably impressed.[8] The weapon was christened the Colt Model 1895. Air-cooled Colts had heavy, thick barrels to enable prolonged firing. The original barrel was smooth, but Colt later added heat dissipating fins, which reduced weight and improved marketability. The Colt continued in the inventory even after the Army adopted the Maxim. Although outdated when the U.S. entered the war, the Colt was the basis for successful aircraft and tank machine guns produced by the Marlin Company.[9]

The Colt was gas operated, air cooled, belt fed and there were three versions. The Model 1895 was the original gun, although it had been modified over the years by the addition of cooling fins and changing the caliber. The Model 1914, chambered for the Russian 7.62 cartridge, was produced for the Tsar's Army early in the war. Some 2,500 were still in American factories in the spring of 1917. The Colt Model 1917 was chambered in .30 U.S. Government (.30-06). Throughout the war the Colt Model of 1917 was sometimes referred to as the Model of 1895. However, government manuals officially designated it the "Colt Machine Gun Model of 1917 Caliber .30."[10]

The Colt was complicated. It had 138 parts; the tripod and the mount that married gun to tripod added 36 more. The pre-war Army considered it so complex that it could only be disassembled in the presence of an officer or competent NCO. In emergencies crews were allowed to remove the bolt from the gun to clear jams, but even that was a 12-step process.[11]

Soldiers called the Colt “the potato digger,” a reference to the reciprocating operating lever located beneath the barrel. If the gun lacked sufficient ground clearance, this lever would dig a trench beneath the gun that resembled a furrow in a potato field.

Library of Congress

Photograph 4.1 New York National Guardsman with Colt 1895 machine gun

The Model of 1917 had a cyclic rate of 450 rounds. However, because of the danger of overheating, crews were cautioned to fire in bursts of no more than 10 to 20 rounds before pausing. Failure to do so resulted in excessive wear, heat mirages, decreased accuracy, and danger to the crew. The Colt’s front

sight was a simple steel wedge. The rear leaf sight was similar to that on the Springfield rifle. Graduated from 100 to 2,800 yards, it had a precision elevating mechanism that made it superbly accurate. The gun was fed by a stitched canvas belt that contained 250 cartridges and weighed 15 pounds. A complete basic load of ammunition for each gun included 23 loaded belts and one belt loading machine to refill them when they were empty.[12] The weight of belts, ammunition, and the loading machine exceeded Army-imposed limits for mules. The Colt was reliable if properly maintained, but it could jam. If it did, the most likely cause was faulty ammunition or a broken extractor, a part that was fragile. Other parts were not known to fail often. The Colt fired from a closed breech, which created significant safety issue. This meant that after each shot, the bolt closed on a new round of ammunition. In sustained rapid fire the gun could become hot enough to cause a chambered round to spontaneously "cook-off" without the trigger being pulled. Then the gun might continue to fire uncontrollably. This problem was serious enough that gunners were cautioned to remove the belt from the gun and open the bolt to allow air to circulate through the barrel after long strings.[13]

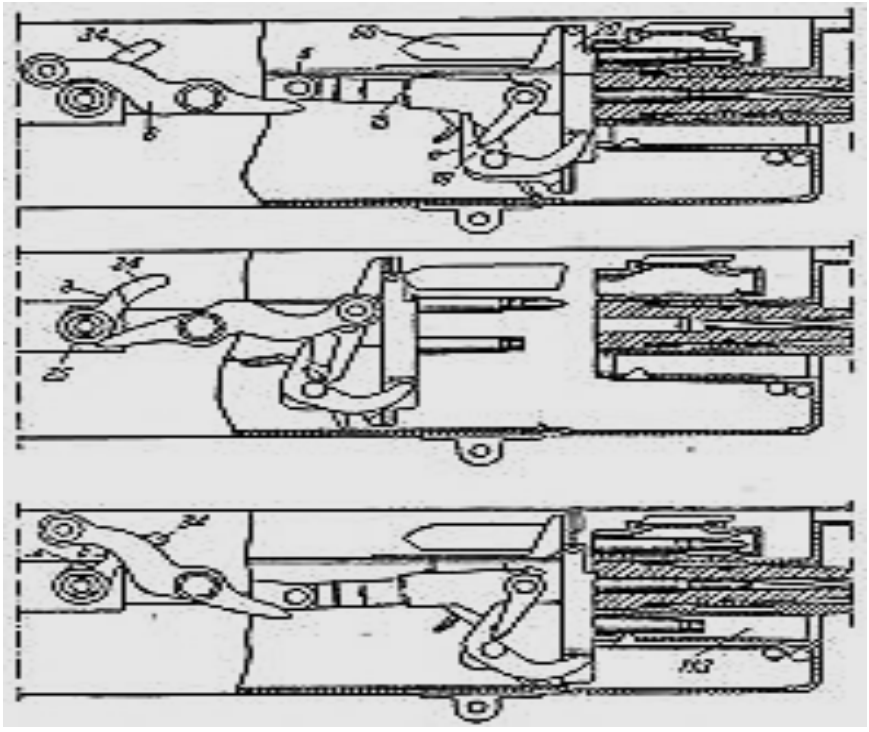
Although the United States produced no Colt guns during the war, it did requisition the 2,500 guns left over from the Russian contract. These were used for stateside training, and government records show that about 50 Colts were sent to each National Guard training area.[14] Summing up his feelings for the Colt, PFC John Staffa, 11th MGB who trained on it in South Carolina reported that he "didn't like it because [you] had to change the barrel due to overheating. The water-cooled machine gun was much improved over the Colt."[15]

The American Maxim Maine-born Hiram Maxim's machine guns were ubiquitous. Liddell Hart, British historian and Great War veteran, noted that Maxim's "name is more deeply engraved on the real history of the World War than that of any other man" including kings and generals.[16] Largely self-taught, Maxim combined an innovative mind with astounding engineering skills. He did not start his professional life as an arms inventor, although that business gave him fortune, fame, and eventually a knighthood. In 1881, while working for the United States Electric Lighting Company, Maxim went to Europe to investigate markets for power generation equipment. While in Europe, he cast about for ideas that would generate not just power but wealth. Years later Maxim recalled that a fellow American counseled him to "hang your chemistry and electricity! If you want to make a pile of money, invent something that will enable these Europeans to cut each other's throats with greater facility."[17]

Maxim went to work. His mechanism involved a toggle lock that kept the bolt and barrel joined together when the weapon fired, and then allowed the action to be opened to reload. Maxim knew of this system because it was used in early Winchester rifles. He was also familiar with the rearward force of kick imparted when large caliber cartridges were fired. Over the years Maxim had wondered whether this power might not be harnessed in some useful way. The toggle lock and recoil were the central ideas for Maxim's machine gun. By 1885 he held a U.S. patent for the Maxim Machine Gun, which would fire continuously as long as the trigger was depressed and ammunition was available. He found little enthusiasm for his invention in America, however, and moved to Britain to be closer to the market he hoped to exploit. He set up a small shop

in London and eventually produced an arm that fired an incredible 600 times per minute.

The Maxim was rugged and very reliable. As one American ordnance expert noted 60 years later, it was so sound that "very little has been done to alter any of the basic features of the Maxim since the day of its introduction."[18] It operated on



Source: United States Army Ordnance Department

Figure 4-1. Toggle Locking System. The same basic mechanism was used in both Maxim and Vickers machine guns. The upper drawing shows the toggle at the moment of firing. The middle drawing shows toggle fully open and about to go forward. A new cartridge is in line with the barrel and the empty cartridge case is about to drop out of the gun. The bottom drawing shows the action just prior to locking.

on what is known as the short-recoil system. At the beginning of the operating cycle, barrel and lock were held together by the toggle. The energy produced when the weapon fired propelled the barrel and lock rearward about three quarters of an inch. At this point the barrel was blocked from moving further to the rear and the lock was de-coupled from the barrel by the opening of the toggle. As the lock continued to the rear it extracted the fired cartridge case from the chamber and gravity caused it to drop into a discharge chute. The lock's rearward movement compressed a powerful fusee spring located in an oblong compartment on the left side of the receiver. When fully compacted the spring propelled the lock forward to pick up a cartridge from the feed belt, load it into the firing chamber, mate with the barrel, and fire.

Maxim first demonstrated his weapon for the British in 1885. The gun operated successfully; however there were no orders until 1887. The initial contract was for just three guns, barely enough to pay his rent. To stoke enthusiasm, Maxim demonstrated his gun on the continent where it proved superior to all competitors. Impressed with rate of fire and reliability, Kaiser Wilhelm ordered the German Army to procure them. An exhibition in Russia netted additional orders from the Tsar. In less than 10 years Hiram Maxim revolutionized war fighting. His machine guns killed on an industrial scale and interest in his invention exploded. The British purchased more Maxim guns in 1891 and used them in their African colonies, where they reportedly mowed down over 3,000 Matabele Zulus in about an hour. In England, Maxim went into a partnership with the Vickers brothers which soon changed its name to Vickers Sons & Maxim. He also licensed plants in Germany and Russia and received royalties from them. By 1900 Maxims were found in

most modern armies, and in 1904 even machine gun-shy America had purchased 282 of them.

Library of Congress

Photograph 4.2 1904 Maxim machine gun and crew in Texas about 1911

The water-cooled 1904 Maxim eliminated overheating that prevented sustained fire in air-cooled guns. Like the Colt, the Maxim used a canvas belt holding 250 rounds. In capable hands under ideal conditions with a special booster fitted to the muzzle (as shown in photograph 4.2) the Maxim could fire between 500 and 600 rounds per minute. If it did not fire, faulty ammunition or dirty belts were the most likely culprits; Maxim parts rarely failed. About 90 of the 282 Maxims in U.S. armories were manufactured in Britain by Vickers Sons & Maxim; the rest were produced in America by Colt. They were used for training during the war. Although no American-owned Maxims were

used in combat, German Maxims captured by doughboys were often turned on their previous owners.[19]

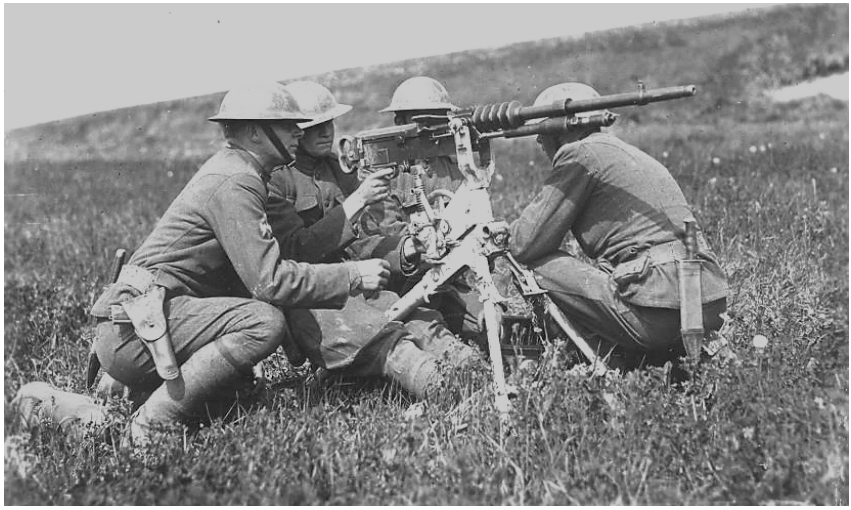
The French Hotchkiss Model 1914 The Hotchkiss, like the Maxim and Browning, was a product of American engineering skills. Laurence V. Benet, an ex-patriot engineer who worked for the Paris-based *Hotchkiss et Cie*, refined a design submitted in 1893 by Baron A. Odkolek von Augenza, an Austrian cavalry officer. Benet was the son of the U.S. Army's Chief of Ordnance. It seems reasonable to assume, in the absence of contrary evidence, that he received his charter because company directors saw a way to tap the American market. Benet re-engineered Augenza's original design to produce a machine gun driven by a piston housed in a cylinder located beneath the barrel. When the Hotchkiss fired, a small amount of the gas produced by the detonation of the cartridge flowed through a hole in the bottom of the barrel into this cylinder. The expanding gas forced the piston to the rear. The piston was linked to the weapon's bolt, and as it travelled rearward the bolt extracted and ejected the fired cartridge case. A strong spring forced the bolt forward again, stripping a new round of ammunition from a feed strip. As long as the gunner maintained pressure on the trigger, the cycle continued until the ammunition was exhausted or the gun malfunctioned. Apart from its method of operation, the Hotchkiss differed from the Maxim in two important respects. First, instead of 250-round canvas belts, Hotchkiss ammunition was fed from a metal strip that held far fewer cartridges. However, the strip was less susceptible to moisture that caused canvass belts to swell and malfunction. Second, like the Colt the air-cooled Hotchkiss had limited sustained fire capabilities. Nevertheless, it was well-suited for

North Africa where the French had restive colonies and water was at a premium.

Hotchkiss barrels were heavy and thick to promote cooling, which made the gun more bulky and less transportable. The original Hotchkiss' used an unadorned barrel, but five cooling rings were added later to dissipate heat more efficiently. Larger than the diameter of an average man's forearm, the company advertised that these reduced heat by a factor of 10 compared to a smooth barrel.[20] Although the Hotchkiss was not ideal for sustained fire, it had fewer parts than the Maxim and was made so that it could not be improperly assembled. Its simplicity combined with the fact that it did not need water and did not use canvas belts compensated for increased weight in the minds of many. Whether Benet influenced his father to include the improved Hotchkiss in American tests is unknown, but it was examined at Springfield Arsenal. It performed well mechanically, but because of the limited number of rounds in its feed strips the Hotchkiss was not accepted for use by American forces.

American ordnance experts described the Hotchkiss as a "basic weapon," and it was.[21] Phillip Wainwright, a member of the 101st MGB, liked the Hotchkiss, recalling that its "simplicity and dependability were at once apparent."[22] It was easy to operate and maintain, and was accurate at long ranges. However, none were in the American inventory when the war began, and there were no plans to acquire it. That changed quickly. In his official report to Congress after the war, Benedict Crowell, Assistant Secretary of War and Director of Munitions, noted that the United States initially intended that all forces be issued Vickers guns. Nevertheless, the first 12 deploying divisions were equipped with the Model 1914 Hotchkiss because Vickers were unavailable and the French urgently needed aircraft machine

guns. The Vickers was much better suited for this purpose, but the British were unable or unwilling to provide them. Therefore, the War Department promised the first 1,000 Vickers guns to the French, who pledged to replace them with new Hotchkiss.



U.S. Military History Institute

Photograph 4.3 American Hotchkiss crew training in France, 1918

It seems somewhat incongruous that the first divisions to deploy were equipped with an unfamiliar gun that required spare parts and ammunition unavailable in the American supply system and had been rejected previously by the Army. But political compromises are difficult for soldiers to reverse, and the Army was not eager to offend France. Although a few Hotchkiss guns found their way into the U.S. training base, most units received them only after arriving in France. In fact, Hotchkiss guns were sometimes issued to doughboys only a few days before they went into combat. That was the case with the 7th MGB, for example, which received its weapons within two weeks of its fight at Chateau-Thierry. Sergeant Leroy Bicknell, 9th MGB

reported that he had only a few weeks of Hotchkiss training before going into action.[23] Although doughboys may have thought they were receiving new weapons, many of their guns came from the field and had seen hard use. The Marine Corps' 6th MGB, part of the 2nd Division, complained that they were forced to exchange new Lewis guns for old Hotchkiss.[24] The 35th Division's 129th MGB, for whom the Hotchkiss was the third machine gun issued, voiced similar complaints.[25] Presumably new guns earmarked for American divisions found their way to French units, and doughboys made do with hand-me-downs. PFC Roy Brogley, a gunner in the 4th Infantry Regiment's machine gun company, thought the guns his unit received were no better than satisfactory.

The Hotchkiss were the heaviest machine guns Americans used during the war. The gun itself weighed about 55 pounds, and the rugged tripod with deflection disc added another 70 pounds to the load. In addition to 60 pounds of personnel gear, one soldier carried the gun, another the tripod, and a third carried the 28-pound spare barrel.[26] The load was tolerable when mule carts or motorized vans were available. However, when required to move the guns across country on their backs, the weight was very uncomfortable. Private Gordon Christopher, 101st MGB, thought the Hotchkiss "a brute to carry." Gunnery Sergeant John C. Ashworth, USMC, 6th MGB, seconded Christopher's criticism, reporting that "the Hotchkiss was serviceable but heavy and awkward in the hand to carry." He found that it fired slowly, also. The Hotchkiss' weight often adversely impacted tactics. Captain Malcolm Helm who served in the 5th MGB in the Soissons salient reported that "carrying our [Hotchkiss] machine guns and heavy cases of ammunition we soon fell behind the infantry we were supposed to overtake when they

reached their objective … [to support] them in case of one or more counterattacks."[27] The 77th Division's historian noted that in operations near St. Pierremont during the Meuse-Argonne campaign the 304th MGB accompanied the first line of infantry "over marshy fields, through woods and across brooks, covering twenty-five kilometers." When it reached St. Pierremont, the battalion went into action immediately without rest to protect the flanks and fend off German counterattacks while the infantry refitted and reorganized.[28] It was difficult enough for riflemen to carry the prescribed load over rough terrain. Hotchkiss gunners had a much more difficult task. Summing up the Hotchkiss experience, one American machine gunner complained simply, "it was a hell of a load."[29]

Nevertheless, the Hotchkiss was easy to use. The trigger was contained in a pistol grip located about three quarters of the way to the rear on the underside of the receiver. Although gunners often used the "D" shaped handle on the rear of the receiver to help them control it during free traverse, when the gun was connected to the tripod's elevation mechanism they were instructed to keep their left hand on the elevation wheel in order to change the location of the beaten zone quickly.[30] The weapon's sights consisted of a steel blade affixed near the muzzle and a leaf sight graduated in meters and capable of precise corrections in both elevation and deflection. Considered to be very accurate at ranges up to 1,000 yards, the Hotchkiss could effectively reach beyond 3,000 yards. Captain Wendell Westover of the 4th MGB recalled that French instructors told him the gun with its solid bronze bullet could hit targets at 3,800 yards.[31] Many soldiers considered the Hotchkiss tripod the best available by virtue of design, sophisticated traversing and elevation mechanisms, and hefty weight that added to its

steadiness. As originally issued, however, the tripod gave the gun a very high profile that increased its vulnerability. It could not, one division historian noted, be concealed in a field of wheat. American soldiers solved this problem by shortening the legs with hacksaws.

Although feed belts were developed for the gun late in the war, most Hotchkiss were fed with metal strips inserted into the left side of the gun. These strips contained either 25 or 30 cartridges and were packaged 10 to a box weighing about 15 pounds. In order to function properly, strips had to be unbent and clean—no easy task in a war of limitless mud. Unlike the Colt, the Hotchkiss fired from an open bolt. If the trigger was released, the bolt was held in the open position with the chamber unloaded. This eliminated heat-induced cook-offs common in the Colt, and air that circulated through the barrel helped to cool the weapon. Yet even with barrels that could be changed quickly, sustained fire capabilities were limited. Major Ziba Drollinger, an MGB commander in the 3rd Division, reported that “the guns being air-cooled, it was necessary to cease firing frequently and let the red hot gun barrels cool.” If a barrel had to be changed during combat, a special wrench was required. Well-trained Hotchkiss crews could replace a barrel in about one minute, although doing so required some crewmembers to expose themselves to enemy fire. To facilitate barrel changes Hotchkiss crews were issued thick asbestos mittens to enable them to pull the hot barrel from the gun and a chainmail shoulder pad to allow it to be carried. The procedure was not nearly as expeditious as the quick-change barrels of modern machine guns, but it was much faster than changing barrels of water-cooled guns. The disadvantage, of course, was that Hotchkiss barrel changes were required more frequently.

The Hotchkiss' cyclic rate was about 400 rounds, but the common operational rate was between 200 and 250 rounds per minute. The French claimed that rapid fire was 300 rounds per minute, but that rate was to be used "only in extraordinary cases against momentary targets" in order to prevent overheating.[32] In fact, sustained firing guaranteed overheating. Major John Mendenhall, 7th MGB, recalled that at Chateau-Thierry some of his guns were so hot that they could not be safely moved to new locations.[33] Despite simple design, the Hotchkiss was prone to stoppages caused by bent or dirty feeder strips. Because the weapon fired from an open bolt, a jam that occurred with a cartridge partially chambered and the bolt partially open could result in a cook off with serious implications for the gunner and loader whose eyes and face were at risk.[34]

The French sold 5,255 Model 1914s to the Americans, far fewer than the numbers of Vickers or Brownings available in the American inventory at war's end. However, because they were issued to the first deploying divisions, more Hotchkiss guns were used in combat by doughboys than any other machine gun.[35] Despite its drawbacks, many Hotchkiss crewmembers liked the weapons.[36] One combat-experienced gunner called it "the best machine gun of the war." PFC Frederick Grant, a gunner in 119th MGB, thought the Hotchkiss "excellent for the times."[37] A Sergeant Major of the 129th MGB wrote that when they received them "the men at first were a little prejudiced against the Hotchkiss. . . [but] after the Meuse-Argonne, they claimed it was the best gun we ever had." The 129th had trained on both Colts and Vickers before receiving the Hotchkiss and thus had a basis for comparison.[38] Nevertheless, despite enthusiastic testimonials from Hotchkiss crewmen, there is no evidence that any machine gun battalion armed with Vickers or

Browning guns offered to exchange them. Summing up his sentiments for the Hotchkiss, PFC Fred Eggers, a gunner in the 109th MGB, said simply it was "better than nothing. [It] heated rapidly and jammed readily."[39]

The Vickers Machine Gun Model of 1915 The Vickers, a derivative of the Maxim, was recoil operated, water-cooled, and belt fed. After a rocky start, Colt Patent Firearms Manufacturing Company made approximately 12,000 Vickers guns before production ceased on September 12, 1918. About 7,650 of these were sent to Europe, enough to equip 12 divisions. More were available in divisions that did not deploy before the Armistice.[40] The Vickers was adopted by the U.S. in late 1916 as a result of a test conducted the previous April. According to an officer who was present during the test the Vickers fired 20,000 rounds with only 23 jams or stoppages and no broken or bent parts. By comparison, the Lewis gun in the same test jammed more than 200 times and had 50 parts that were broken or too badly worn to function properly.[41]

The American Vickers Model of 1915 was identical to the British Vickers Mark I except for caliber, sight graduations, manufacturer's markings, and shape of the muzzle booster. Although complicated to manufacture, it required only eight steps to put the gun into action. Lieutenant Edmund Lilly found the Vickers issued to his company of the 17th MGB "serviceable, effective, and rather easy to maintain." He noted, however, that he found "the rate of fire was rather slow."[42] It is not clear what Lilly expected since only the Browning fired faster. Private Lester Parker, Company C, 130th MGB who trained initially on the Browning M1917, thought the Vickers "quite good." Private Carl J. Lukens, 16th MGB, had a slightly different view. Lukens reported the Vickers "very effective but

clumsy to handle and quite heavy." He complained that the "belts had to be loaded exactly [right] or the gun would not work."[43]

Library of Congress

Photograph 4.4 Firing a Vickers machine gun at Springfield Arsenal

Mechanically the Vickers was a slimmed down Maxim. British engineers re-oriented the toggle lock to reduce the height of the receiver. The lock was also redesigned to make it easier to remove, disassemble, and repair. The Maxim's solid brass water jacket was replaced with sheet steel to reduce weight. The Vickers weighed 38 pounds with 7.5 pints in the water jacket, and the tripod weighed 35 pounds. Though heavier than the Browning, it was much lighter than the Hotchkiss[44]. In place of the Maxim's narrow ejection chute, the Vickers' receiver was open at the bottom so that spent cases dropped free of the gun. Like most WW I machine guns, each Vickers came with spare

feed boxes, as the gun's feeding mechanism was called, and spare locks. Both could be replaced rapidly. When stoppages occurred the gunner decided whether the problem lay in the box or the lock by looking at the position of the operating handle. This handle, located on the right side of the receiver, allowed the gunner to load and cock the weapon. During firing, it rocked back and forth and its position told the gunner where the gun was in its cycle of operation, and thus the most likely cause of the stoppage.[45] Based on his assessment, a gunner removed the offending part, passed it to another crew member to repair, and replaced it with one of the spares.[46] American standards required gunners to replace feed boxes in 10 seconds; locks in 30.[47]

Although easy to repair in the field the Vickers was nevertheless complex. It had 190 parts arranged into 15 major components, plus 92 parts in the tripod and mount.[48] It was fed from a 250-round canvas belt, similar to the one used by the Maxim, loaded into the right side of the gun. A belt with its storage box weighed about 20 pounds. The gun's high cyclic rate (500 rounds per minute) was made possible by a booster added to the muzzle. This device imparted additional energy to the front of the water jacket as it recoiled with the barrel to speed up the firing cycle. The gun could be fired without the booster, but the rate was approximately 100 rounds per minute slower. Because it was water-cooled the Vickers could fire continuously for long periods. An Army War College report stated the Vickers could fire "an almost unlimited number of rounds without cessation."[49] During the 1916 test a Vickers was fired continuously for one hour and five seconds. (An observer at the test noted that the additional five seconds was the time it took to get the gunner's attention to tell him to cease fire. He was deafened by the

continuous reports of the weapon.) During this period the gun fired 13,728 rounds with only “small stoppages,” at least one pause to refill the water jacket, and only one lock failure. Post-firing examination of the barrel revealed it to be in “almost perfect condition” with no significant degradation.[50] An air cooled weapon would have been able to fire only a fraction of that time before the barrel overheated. When operating the weapon at ranges under 1,000 yards Vickers gunners usually fired bursts of 10 to 20 rounds or about two to three seconds of firing. Fifty round bursts were fired at ranges greater than 1,000 yards. Gunners were instructed to fire no more than 250 rounds per minute to prevent undue wear and tear.[51] Although barrels that were properly cared for had a life of at least 25,000 rounds, British experts cautioned that barrels that had fired more than 15,000 rounds were unsafe for firing over the heads of friendly forces.[52]

Vickers’ firing mechanisms were more complicated than the Hotchkiss. Unlike the Hotchkiss’ simple trigger, Vickers guns incorporated a complex trigger system mounted between two handles (called spade grips) on the rear of the receiver. To fire the weapon, the gunner grasped the spade grips and placed his index fingers on the tops of the handles. He then raised the safety catch with his middle fingers and pressed the firing button down with his thumbs, gripping the bottom portion of the handles with his ring and little fingers. He controlled the motion of the gun by manipulation of the spade grips or by using the tripod’s traverse and elevation mechanisms.[53] Sights were offset to the left of center to compensate for the ballistic characteristics of service ammunition. The front sight was a simple blade at the end of the water jacket. The rear sight was graduated to 2,600 yards if the gun was manufactured in the US or 4,000 meters if

manufactured in Great Britain. The sight allowed deflection changes so that gunners could make precise adjustments to account for the effects of wind.

The Vickers tripod allowed the gun to traverse in a 45 degree arc. However, it could be pivoted 360 degrees if traversing checks were released. Without the tripod's mechanical aids to control fire, accuracy was degraded in this mode and it was reserved for dense, close-range targets.[54] Some guns also had a light mount beneath the water jacket that allowed the gun to be used without the heavy tripod, a distinct advantage when advancing. Although adequate for these purposes, this mount was not sturdy enough for indirect fire missions. If this type of fire was required, the gun could be placed on a standard tripod without removing the auxiliary mount.[55]

When properly maintained Vickers were very reliable. Major Wentworth Pierce, 115th MGB, whose battalion's Vickers fired approximately 250,000 rounds in 46 minutes in October 1918 wrote that "during the barrage we had only three or four minor stoppages which were promptly remedied."[56] However, Vickers maintenance could be daunting to the untrained. The tool box issued with each gun contained 13 tools. By contrast, the Browning M1917 required only a single tool and a cartridge. In addition to a complete lock and a complete feed box, the Vickers' spare parts box contained a spare firing pin, asbestos water jacket packing, a pair of asbestos mittens to remove hot barrels, two complete steam outlet plugs, a trigger bar plunger, and between one and three spares of 15 different springs. It also contained brass strips and eyelets to repair ammunition belts. The Army intended each gun to come with a belt loading machine, which had another five special tools and a separate spare parts box.[57]

Like all machine guns Vickers could malfunction. If mounted too low on dry ground, the gaping spent case ejection port allowed dirt to enter the action. Seasoned British machine gunners advised doughboys to keep a piece of burlap or a poncho underneath the gun to prevent this mishap. The guns were also sensitive to excessive lubrication. If too much oil was applied, machined surfaces collected dirt that created an abrasive paste. Crews were instructed to apply "a thin film of oil using an oily rag and avoid applying oil directly from the can."[58] Whale oil was preferred. Damp ammunition belts and dirty ammunition also caused stoppages. Nevertheless, like Hotchkiss gunners, most Vickers crewmen liked the gun. PFC Phillip Bradshaw, a gunner in Company B, 134th MGB, spoke for many when he said the Vickers "were super. The machine gun was very effective. We could sweep a whole area in front of us."[59] However, like French Hotchkiss guns, Vickers provided by the British were often battle worn. Private Carl Lukens, 16th MGB, recalled that all guns issued to his unit were old. "New guns weren't delivered until the end of the war."[60]

The Browning Machine Gun Caliber .30, Model of 1917 Soon after he patented the Model 1895, Browning went to work on a second weapon: the recoil-operated, water-cooled, belt-fed Browning Model of 1917. The gun was comparatively uncomplicated, reliable, easy to maintain, and simpler to make than the Vickers.[61] Private Richard H. Dodds, 39th MGB, recalled that the Browning was "very efficient."[62]

Browning demonstrated his new gun for the War Department's Machine Gun Board in February and May 1917.[63] It performed flawlessly. Test observers reported that Browning fired two guns for the board in May. The first fired about 20,000 rounds without a stoppage, then another 20,000 at a cyclic rate in excess of

500 rounds per minute. Browning next brought out the second gun and fired it continuously for about 50 minutes. The only pauses were brief ones to refill the water jacket, re-load, and replace a single extractor, the only part that malfunctioned during the entire test.[64] Impressed by the gun's performance and simplicity, the board recommended immediate procurement.

National World War I Museum and Memorial, Kansas City, Missouri, USA

Photograph 4.5 A Browning M1917 crew training in France.

The Browning 1917 was a short-recoil weapon like the Maxim and Vickers. However, the internal mechanism was substantially different and contained fewer parts. This simplified manufacturing and the U.S. produced about 43,000 M1917s during the war. Most of these were made by Westinghouse, a firm with no previous firearms experience.[65]. There were some initial problems with metal fatigue, but these were eliminated by mid-1918. Browning replaced the toggle lock with a simple steel

block that moved up and down beneath the bolt. It coupled the bolt and barrel together during firing, then slid down to unlock the pair. Instead of the complex crank system of the Vickers,the Model 1917 was cocked by a handle connected directly to the bolt. The trigger was a simple mechanism that when lifted allowed the firing pin to move forward. Unlike the triggers of the Vickers and Maxim, the Browning's trigger could be operated with the index finger of either hand. Like other water-cooled guns the Browning was equipped with a condenser system. It was fed from the same 250 round belts used by the 1917 Colt. This belt was of simpler construction than the Vickers and considered more reliable and better able to tolerate battlefield abuse.[66] A fully loaded belt weighed about 15 pounds and the wooden storage chest about four pounds, so a single soldier could carry at least 500 rounds. Sights consisted of a covered blade front sight and an adjustable leaf rear sight graduated to 2,600 yards. The rear sight permitted elevation corrections of 1 mil, which made the weapon very accurate. It also had deflection settings of from zero to 20 mils to compensate for wind. As was the case for the Vickers, sights were slightly off set to correct for the natural drift of the bullet.

The War Department reported that 30,582 Brownings were sent to Europe by war's end, enough to equip all AEF units. However, fewer than 1,200 Model 1917s were used in battle, and the first of these did not debut until September 1918.[67] In fact, only American divisions that deployed to Europe after June 1918 had Brownings. There were three reasons for the lack of Brownings in the hands of frontline troops. First, not enough Brownings were produced to equip AEF divisions until 1918. Second, until autumn of 1918 many Allied military officers thought the Germans would hold on through the winter of 1918

– 1919 and the final, decisive offensive would be conducted in the spring of 1919. Most Brownings were held in depots with the intention to issue them to divisions during winter preparation for the spring campaign. They might have been put into the lines earlier; however, senior American officers were concerned that if captured by the Germans, the Browning might be reverse engineered and used against doughboys. Third, most American forces were actively engaged in the autumn of 1918, and there was no time to exchange Hotchkiss and Vickers for Brownings and train crews in their use.

Army General Hunter Liggett and other combat commanders thought the Browning the finest machine gun of the war. Even more significant, the Browning received high marks from doughboys who used them. In one case, a soldier reported that 16 guns fired an average of 10,000 rounds per gun in a continuous overhead barrage and noted matter-of-factly that "the guns performed well." Unaffected by rain or mud, they functioned properly even when rusty, something that was not true of the Vickers. After an extended period in the frontlines, 17 Brownings were sent to the rear in the autumn of 1918 where they were inspected and found sound with the exception of considerable rust and a few minor dents from shrapnel. The barrels were cleaned, but no other maintenance was performed. Each gun then fired a belt of 250 rounds. There were no stoppages The Browning was reliable enough that, although modified to make it lighter and more accurate, it remained in the Army's inventory through the Vietnam War.

In the aggregate, by the Armistice doughboys had an adequate supply of good quality machine guns. This was due in large part to acquisition of the Hotchkiss for early deploying divisions; production or acquisition of adequate quantities of Vickers; and

the speed with which Browning guns became available. By war's end the United States had gone from machine gun poverty to an impressive surplus.

Table 4.2 Comparison of Heavy Machine Guns

GUN	Caliber	Cyclic Rate	Operated/Cooled By	Total Weight* (lbs.)
Colt 1917	.30	450	Gas/Air	91
Maxim 1904	.30	450	Recoil/Water	152.5
Hotchkiss 1914	8mm	250-400	Gas/Air	125
Vickers1915	.303 & .30	500	Recoil/Water	98
Browning 1917	.30	550	Recoil/Water	88

Source: U.S. Army Ordnance Department * Gun and tripod

Ensuring Accuracy

The Army defined heavy machine guns as weapons mounted on stable platforms, using standard rifle cartridges, and delivering high rates of accurate fire for prolonged periods.[68] All heavy machine guns used tripod mounts. Despite their weight tripods were an important source of the machine gun's phenomenal effectiveness, and one was useless without the other. Guns mounted on tripods delivered predictable, accurate beaten zones at any range.[69] As one Western Front veteran remarked, "[the machine gun] is fired from a fixed mounting which holds it firmly without any effort on the part of the firer."[70] All gunners had to do was to put the target beneath the beaten

zone. Tripods also allowed gunners to shift rapidly from one target to the next or deal with emerging threats anywhere within a gun's field of fire.[71] In action tripods were carried by the gunner to allow him to place it according to his preferences. The loader carried the gun and both he and the gunner coupled it to the tripod. A well-trained crew could accomplish this in less than 30 seconds under all conditions. Adjustable legs allowed the gun to be positioned level and close to the ground. Downhill legs could be lengthened while the uphill were shortened to eliminate cant. Adjustable legs also allowed gunners to fire from prone, sitting, or kneeling positions, providing versatility and improved survivability. Each tripod leg had a broad shoe that kept the gun from vibrating or sinking into the mud, and if time permitted crews also often dug legs into the ground or placed sand bags on top of them to increase their steadiness.[72]

At the junction of the legs was a mounting bracket called a cradle or saddle to which the gun was attached. Integral elevation and deflection mechanisms made it possible to deliver precision indirect fire, overhead fire, and night fire. The elevation mechanism allowed the gunner to precisely adjust the position of the beaten zone. On most tripods discs divided into mils were used to control deflection. For long range or night firing the gun was laid for direction by aligning it with the proper mark on the disc. Some tripods had hand wheels to permit small changes in deflection; however on most it was controlled by friction. When the gun was mounted a friction bolt made contact with the mounting pintle. If the bolt was fully tightened, the gun remained at the same azimuth. If fully loosened, the gun would swing free.[73]

A second factor influencing accuracy was ammunition. Although specialized ammunition was issued from time-to-time, heavy

machine guns on the Western Front usually fired standard rifle ammunition: .303 caliber for British guns; 8 millimeter (mm) caliber for French guns; .30 caliber for doughboys armed with American made guns. (Caliber refers to the diameter of the bore of the barrel in either English or metric measurement.) Each country's ammunition had different characteristics and was not interchangeable.

Table 4.3 Comparison of Machine Gun Ammunition

Country	Caliber	Muzzle Velocity	Bullet Weight
Great Britain	.303	2,440 feet /sec.	174 grains
France	8 mm	2,380 feet/sec.	198 grains
United States	.30	2,700 feet/sec.	150 grains

Source: *Cartridges of the World*

Of the three types, the French 8mm *Balle D* had the greatest range. Its heavy bronze bullet, aerodynamically engineered with a sharp point and a beveled base, gave better stability at longer ranges.[74] The British .303 cartridge used an elongated bullet that made it accurate at ranges in excess of 2,000 yards without adding weight to the projectile.[75] The American .30 (or .30-06) was accurate, but its lighter weight prevented it from reaching the maximum ranges indexed onto rear sight blades. Faulty testing in pre-war years led the Army to conclude the ammunition had a greater range than it did. (Complaints from GHQ AEF caused the Ordnance Department to send a few hundred thousand rounds with heavier bullets, but that was not sufficient for weapons that fired hundreds of thousands of rounds in a single engagement. The experience caused the Ordnance Department to develop a new, heavier round that became the standard American service cartridge in World War II.)[76] One shortcoming common to all three calibers was the

difficulty of identifying where their bullets actually landed. Tracers—bullets with an incendiary compound in the base—were in their infancy and had a burn-out range of only 500 yards. Those that were available were used mostly in aircraft machine guns.

Although ammunition seemed rugged enough, it was vulnerable to the effects of chemicals, weather, transport, and rough handling. For example, ammunition exposed to gas quickly corroded, and damp ammunition belts were likely to bind. Because it was susceptible to so many battlefield mishaps, the Army directed machine gunners not to unbox ammunition until shortly before firing.[77] Machine gun platoon leaders inspected their ammunition daily, and unboxed ammunition was turned in its belts to prevent binding. All machine gun units appointed ammunition officers and NCOs to ensure an uninterrupted supply of ammunition. They oversaw ammunition details composed of the Number 4, 5, and 6 crewmembers from each gun. These details brought ammunition forward from resupply points to firing positions.[78]

Ammunition arrived at resupply points either preloaded or loose. Crews preferred preloaded ammunition because it entailed less work. Ammunition for Hotchkiss machine guns came in metal strips packed 10 to a wooden box. Vickers and Browning canvas belts were sealed in metal cans. (The United States produced approximately one million belts during the war and procured more from the British.)[79] Ammunition details unpacked ammunition cans from wooden pallets, inspected the contents, cleaned corroded cartridges, repaired belts, filled belts or strips, and carried ammunition forward.[80] In heavy action, these men were continuously employed. Inspection of arriving ammunition was especially crucial because of the likelihood that it was

damaged in transit or storage. As one British officer told his American counterparts, improper transport would "render [a belt] quite incapable of being fired." A contemporary manual pointed out that "too much care can not [sic] be taken in the correct filling and overhauling of belts."[81]

Ammunition that reached the front in loose bulk had to be loaded into belts or strips before it could be fired. Vickers and Browning platoons had belt loading machines to facilitate the task. These machines were hand-cranked mechanisms designed to be secured to the edge of the storage box. On the top of the device was a hopper or metal strip that was filled with loose cartridges. Offset below was a flat tray into which the belt was fed. When a soldier turned the crank, the belt was pulled through the loading tray and cartridges were pushed into it. Although a necessary evil and just one more item to be carried and cared for, belt loading machines were preferred to the finger-numbing task of manually inserting cartridges. Ideally one machine was provided for each gun, although crews often shared them.[82] A 1919 War Department report noted that 25,000 belt loading machines were produced during the war, far fewer than the number of machine guns. Hotchkiss feeding strips were easier to load since the cartridges were simply pushed into metal clips arranged in a row on one side of the feeding strip.

Travelling in Style – Mules, Carts, and Trucks

Machine gun units had to be agile. They had to arrive on the battlefield in a timely manner, and once there, relocate rapidly when required. Ideally, the means to do so had to be something other than an already heavily laden doughboy. In the years leading up to the war transport for machine guns was a pack

saddle on the back of a horse or mule. However, by 1917 brigade and regimental machine gun units had mules and carts, and by early 1918 divisional MGBs were authorized motorized vans.

A non-motorized machine gun company was authorized seven riding horses, three riding mules, and 26 draft animals that were usually mules. These companies were sometimes derisively called "jackass artillery" by the infantry—at least until they proved their mettle. Authorizations notwithstanding, most companies had less because there was always a shortage of animals in the AEF. For example, it was common for companies to have but one riding horse.[83] While they made life easier for doughboys, mules were not an unmixed blessing. They were often mean-spirited and difficult to control. Captain Malcolm B. Helm, a 1917 West Point graduate who served in the 1st MGB reported that during a review for General Petain,

> a mule recently acquired from the French broke loose from his driver in a Machine Gun Company and dashed madly past and to the left of the units marching ahead of his outfit, and, with his two-wheel cart bouncing from one wheel to the other behind him, passed the dignitaries on the reviewing stand, all by himself. Finding his forward flight cut off by the regiment on the side of the square facing him, he made a U-turn at full speed and headed back along the route he had come. When he was opposite his unit, he wheeled again to his left, slowed down, and took his accustomed place in the formation.[84]

Captain Wendell Westover a machine gun officer in the 2nd Division, recalled that “mules are fundamentally dependable when well handled [sic] and familiar with their drivers, upon whom a great responsibility rests. If improperly handled the mules can be equally sure to cause trouble. Runaways were infrequent but spectacular when they occurred.” Mules could also be dangerous. Private Joseph Anderson, Company D, 103rd MGB, recalled that “on one instance I was kicked in the jaw by a mule. [The] dentist had no tools for teeth damage, but took some stitches in [my] face with needle and thread.”[85] It is likely that Anderson spent several unpleasant days as a result of his encounter.

Although seemingly sturdy and dependable, draught mules were not always available or up to the tasks demanded of them. Sergeant Major Walter D. Weber,129th MGB wrote that when his battalion was trucked forward in the Meuse-Argonne campaign, their mules moved by train and arrived late. Weber recalled that, “on the night of September 21st, companies A and B departed Camp Bessemer, pulling their machine gun carts by hand …The carts were heavily laden with guns, ammunition, and supplies, but the grit and determination of these men overcame all obstacles.”[86] Grit and determination aside, it is likely that a night march on muddy roads and the requirement to pull mule carts had little entertainment value for soldiers in the traces. The 77th Division’s machine gun units also had no carts or animals when they went into the Meuse-Argonne. The machine gun companies,

> attached to the infantry were obliged to carry their heavy guns, tripods, ammunition boxes and equipment by hand as they struggled bravely through dripping bushes in the wake of

> the infantry line. At night, these heroes of the Hotchkiss, exhausted as they were, posted their guns on the flanks of the bivouacked infantry and guarded the lines against counter-attack. Their vigilance accounted for many a Boche sniper, sneaking up along secret lanes in the forest, who tried to use his automatic maxim [sic] on our positions in the dark.[87]

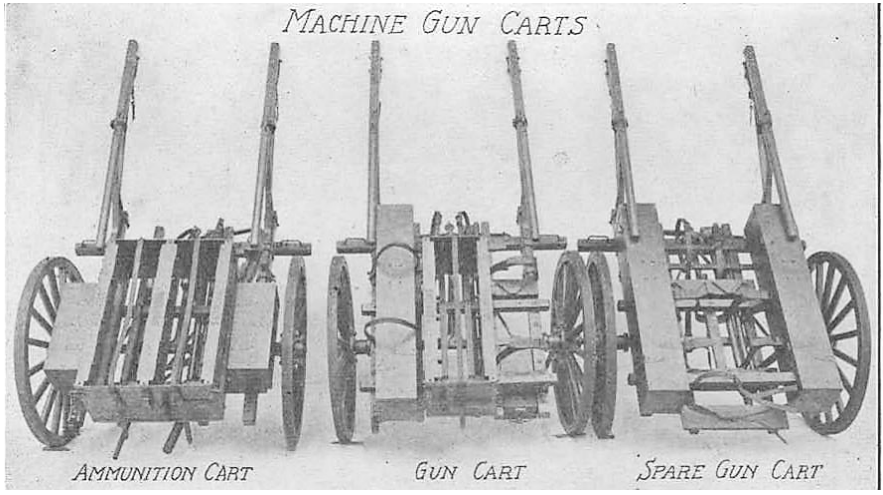
For those fortunate enough to have mules, some divisions provided muleteers. When that did not occur one gun crew member was typically assigned to guide—not ride—the animal while on the march. Wendell Westover noted that drivers for each company's mules were selected from among men who had previous experience with animals. Private Richard H. Dodds, 39th MGB, whose family ranch had several hundred horses, was assigned as a teamster. He recalled that it took about two weeks to break mules and accustom them to pulling carts. Mule skinners were also given instructions on the guns, and Dobbs reported that while engaged in breaking mules to harness, he also attended classes in the "operation and care of the Browning heavy machine gun."[88] All platoon members helped care for the animals—no easy task after a full day's march. Each mule had to be curried daily to prevent mange, bathed frequently, and all required a daily ration of between 20 and 30 pounds of fodder.

National World War I Museum and Memorial, Kansas City, Missouri, USA

Photograph 4.6 Teamsters with their mules and machine gun carts

Mules and horses suffered tremendous casualties. The 9th MGB lost the equivalent of two companies' worth of mules during the defense of the Marne. The battalion commander recalled that "50 of these animals were made up by the catching of loose animals in the area, the owners of which could not be ascertained."[89] Whether this amounted to rustling or opportunism is not recorded. Company A, 8th MGB, recorded that during the Soissons campaign German shells killed several mules and destroyed the unit's rolling kitchen near the village of Chatrieves.[90] Lieutenant Colonel Millard Tydings remembered that so far as draught animals were concerned "there is no sufferer in the entire war who deserves more moral credit and who probably gets less." He reported that during the time the 29th Division's machine gun units were in combat 142 horses or mules were killed and 27 suffered wounds.[91] When mules

became casualties crews pulled the carts using a T-shaped pole and a rope carried on each cart until replacement mules were found. Because manually moving a fully loaded cart over muddy roads or rough terrain appealed to very few soldiers, most took excellent care of their animals. For all the violence there was sometimes tenderness between man and beast. Machine gun company commander Malcolm Helm recalled that after the ordeal of Soissons his unit was ordered to proceed to a reserve area some distance behind the lines. Helm, who had not slept in several days, was reunited with his horse for the trek. “I thanked goodness,” he recalled, “that I had a very gentle horse because, in spite of every effort, I caught myself falling asleep in the saddle.”[92]



Source: Ordnance Department

Photograph 4.7 Machine Gun Carts Model 1917

Guns and ammunition were carried on two-wheeled carts. The Model 1917 machine gun cart came in three variations. All were drawn by one mule, and crews walked to conserve the animals’

strength. To protect the animals the AEF issued instructions that packs and other items of individual equipment would be carried by soldiers, not loaded on the carts. Nevertheless, there is little doubt that personal gear found its way onto the carts if crewmen were injured or NCOs were not observant. Gun carts transported one machine gun, at least 1,000 rounds of ammunition, and items needed immediately to put the gun into operation. Ammunition carts carried additional ammunition for a platoon's guns. Spare gun carts hauled two reserve machine guns and ammunition. If all authorized carts were on hand, each crew had a cart to carry its gun, and each platoon had two additional ammunition carts. The two spare gun carts were kept at company headquarters.[93]

In addition to weapons and ammunition, gun and ammunition carts carried shovels, mattocks, and broad axes to enable crews to prepare fighting positions. Spare gun carts had only a broad axe. All carts had a tool box with a small supply of repair parts.

Table 4.4 Gun Cart Contents

Purpose	Items
Items to put the gun into action	Machine Gun, Gun Cover, Tripod, Spare Barrel, 2 Water Boxes, Steam Condenser, Fire Control Instruments, ammunition boxes
Items to prepare fighting positions	Broad Axe, Short-Handle Shovel, Mattock
Items for gun maintenance	Asbestos Mittens, Cleaning Rod, Spare Parts Box, Cleaning Rags, Solvent, Oil
Items for the animal	Gas Mask, Picket Pin, Picket Pin Rope, Collapsible Water Bucket, Feed Bag, Grain Bag, Curry Comb, Brush, Spare Harness Parts, Spare Horse Shoes, Hose Shoeing Kit, Harness Repair Kit
Items for the cart	Cart Tarpaulin, T-Bar, Emergency Tow Rope, Spare Parts, Tool box

Source: Ordnance Department *Handbook on Machine Gun Cart Model of 1917.*

Carts were intended to accommodate either Vickers or Browning guns, and could be modified to accept the Hotchkiss. The gun and extra barrel were carried in a protective chest on the left side of the cart; the tripod was strapped onto the right. In between the gun and tripod was an ammunition tray with at least 1,000 rounds. Some gun carts were modified to carry more, and in practice they probably carried all the ammunition that could be piled onto them. As issued, ammunition carts had space for 4,800 rounds of ammunition in two wooden trays mounted over the center line of the cart. They also carried belt loading machines, a carpenter's tool kit, an extra gun repair kit, spare parts, spare harnesses, and other items needed for draft animals. In addition to the company's two spare guns, machine gun carts assigned to company headquarters carried extra

cleaning equipment, spare steam condensers, and fire control equipment.[94]

Animals had to be well cared for and this entailed considerable equipment, including: tarps to protect them, picket pins, ropes, animal gas masks, canvas water and feed buckets, grooming tools, and two complete sets of horseshoes and nails. Loaded in among other equipment were spare cart shafts, signal flag kits, blacksmithing tools, unfilled sand bags, extra asbestos mittens, cleaning rods, cleaning rags, cleaning solvent, lubricating oil, grease for the cart axels, and two bicycles for messengers. Platoon fire control equipment was also distributed among the carts and included a plane table with tripod; two types of protractors; at least one panoramic sight with tripod; a range finder; surveyor's equipment; and several quadrants, spirit levels, and clinometers. A fully loaded cart had about 300 pounds of equipment. Experienced soldiers were always able to find spares of everything, including unauthorized but handy to have items. However, if a cart became inoperable, loads had to be whittled down to what could be carried on the backs of the animal and crew.

Very few machine gun battalions received their animals and carts in the United States, and almost none had a full complement of either. Sometimes units received them just before combat. For example, the 347th MGB arrived in France toward the end of June 1918, but did not receive its mules and carts until the eve of the St. Mihiel Offensive.[95] Other battalions were more fortunate. The 8th MGB received its carts and guns about five weeks before going into battle at Chateau – Thierry.[96] In some cases no carts were ever provided, requiring crews to either carry the loads themselves or, if they were fortunate, pack it on the back of a mule.

Divisional machine gun battalions were motorized to allow them to respond quickly throughout the division sector. A variety of motor vehicles were issued, including Ford Model T vans. This van could carry a 1,000 pound payload, though combat exigencies often caused it to be overloaded. Some units received nearly new Fords. Others received "second hand Ford ambulances … many [of which] were sadly out of repair." The 101st MGB operation's diary noted that on February 5, 1918, "fifty-two ford ambulances arrived today and they were in punk shape." The same entry noted that 141 men in the battalion's Company C volunteered to drive them.[97] This was the case in many other units as well. The day after it received its vans, the 4th MGB was sent forward to St. Mihiel with no opportunity to train drivers or conduct maintenance. "Consequently," one officer wrote, "a fortnight's training was of necessity condensed into one evening."[98] This was also the case for both the 7th and the 101st MGB, and lack of training often led to mechanical problems that might have been avoided.

Library of Congress

Photograph 4.7 Model T Van in Chateau-Thierry

Trucks and vans were not without problems even when in top shape. The Ford's 20 horsepower engine was under-powered and its transmission unreliable. Engines could stall on steep grades if fuel tanks were less than half full. Because they lacked adequate power, crew members often dismounted and pushed their vehicles up steep grades, even when engines were running properly.[99] The 101st MGB historian noted it was sometimes "necessary to lift the Fords over craters" on badly damaged roads.[100] It is safe to assume that gun crews probably marched alongside as much as they rode. Often trucks were not able to go as close to the front as mule-carts, and troops had to carry their equipment further and were more fatigued when they reached their battle positions.[101] Even when they rode very few

motorized machine gunners were comfortable. Any time spent in the rear of a rough-riding Ford Model T on crude roads was difficult. The lack of good suspension systems also affected guns and ammunition, which took a beating. Like carts, each van had a tool box with a few repair parts. Most carried at least one extra five-gallon can of gasoline. Pioneer tools, including shovels, mattocks, and axes, were also kept onboard to repair roads and construct fighting positions.

Motorized battalions had numerous other vehicles also. Battalion headquarters were authorized one five-passenger auto; three motorcycles with side cars; one ¾-ton truck; six 1½-ton trucks; and a light repair truck. These vehicles carried headquarters personnel, their equipment, and supplies. Machine gun companies had five motor cars, two in company headquarters and one per platoon. In addition, there were 12 motorcycles with sidecars, six motorcycles without side cars, and five cargo trucks. Companies also had 16 vans, one of which carried spare machine guns. The other 15 were apportioned to the platoons.[102]

National World War I Museum and Memorial, Kansas City, Missouri, USA

Photograph 4.8 Doughboys with motorcycles and vans outside a French village

In the platoons, the passenger car transported the platoon leader and whatever personnel he thought necessary to have with him. Four vans carried machine gun squads; the fifth carried ammunition. Machine gun vans carried weapon, tripod, condenser, fire control equipment, the crew, their personal gear, and about 5,000 rounds of ammunition. Normally, one crew member was assigned to drive and maintain each vehicle. Platoons were also given motorcycles from the company allocation. The ability to carry some personnel in them made road marches more comfortable. During combat operations they

were used by messengers and to shuttle personnel, equipment, and ammunition.

Despite the unreliable nature of their vehicles, motorized battalions were able to move more quickly than those that were mule drawn. In moving to Chateau-Thierry the 3rd Division's 7th MGB arrived more than a day before the rest of the division, which depended on rail cars and foot slogging.[103] The 101st MGB reported several incidents when its mobility enabled the battalion to move gun sections quickly about the battlefield to reinforce infantry. At Chateau-Thierry, for example, the 101st used its vehicles to transport eight guns 25 kilometers across unpaved and congested roads to reinforce an infantry battalion. Each of these guns represented the equivalent of at least 50 infantrymen. It is doubtful if 400 infantrymen could have travelled the distance in less time and arrived in condition to go to work immediately.[104] However, as was true for brigade MGBs some divisional battalions never received their vans. The commander of the 105th MGB noted after the war that the battalion was supposed to be motorized, "but the war did not last long enough for this motorization to go into effect."[105]

In the case of both mule-drawn and motorized battalions, common practice was to take carts or vans as close as possible to the front, but not so far as to hazard animals or conveyances. Once crews reached the dismount point they carried weapons, ammunition, and supplementary gear on foot. Evenly distributed among all crew members, each man carried a heavy burden in addition to about 60 pounds of personal equipment. If the dismount point was several kilometers behind the lines, the distance took a toll on the men's strength. This was one of the reasons why physical conditioning and discipline were such important factors in machine gun units. Once engaged in

combat all subsequent movement of machine guns was usually by foot. Drivers stayed with their vehicles as close to the fighting positions as possible, brought up ammunition or other supplies, and evacuated wounded.

Table 4.5 Motorized Machine Gun Battalion Vehicles

Vehicle Type	Total per MGB
Cars, Motorized , 5-Passenger	11
Vans, Motorized	32
Motorcycles with side cars	27
Motorcycles without side cars	6
Trucks ¾-Ton Cargo	1
Trucks 1 ½-Ton Cargo	8
Trucks 1 ½-Ton Baggage and Ration	2
Trucks, Repair	3
Trucks, Supply, Light	2
Total Vehicles	92

Source: American Expeditionary Forces, *Manuals for Service in Europe, Series A, No. 2. Equipment*

In the aggregate, machine gun organizations were saturated with equipment, and it is easy to understand why the Army preferred that men selected for them be physically fit and possess mechanical aptitude. Officers and NCOs were expected to ensure that animals and equipment were well cared for and ready to move on short notice. When carts or motor vehicles were not available, it fell to them to ensure that soldiers carried the necessary items.

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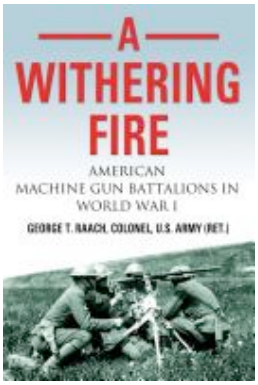
Photograph 4.9 Motorized Machine Gun Battalion in a victory parade following the war. Browning M1917 guns were mounted on the hoods for the ceremony.



A Withering Fire is the history of American machine gun battalions in World War I. It describes how these units evolved from a few small detachments armed with obsolete weapons to more than 200 battalions that supported all operations, and by their power saved countless American lives. It explains in detail the organization, training, equipment, and combat employment of machine gun units and in so doing adds to the understanding of how Americans actually fought.

A Withering Fire: American Machine Gun Battalions in World War I