

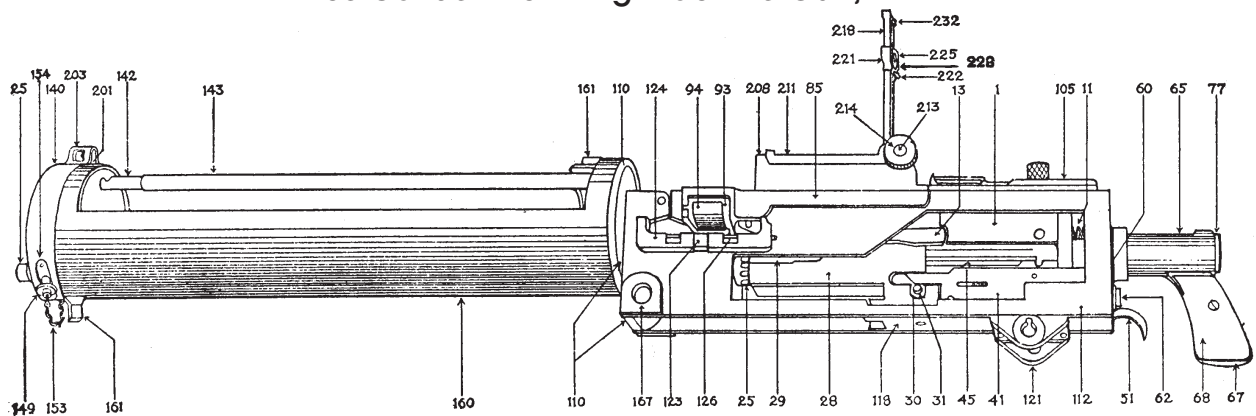
Antiaircraft Weapons of the Coast Artillery Corps

Bolling W. Smith

The first army efforts toward antiaircraft defense, in 1913, involved modifying the trail and recoil system of field guns to allow them be fired against airplanes.(1) By 1916, however, specific antiaircraft guns were on the drawing board. What follows is a summary of the principal American antiaircraft weapons used by the Coast Artillery Corps. Omitted are a number of foreign weapons used during WWI, as well as the multitude of machine guns used occasionally in AA roles.

The data given must be read with care. Antiaircraft guns were only part of a system, other parts being the fire control system and the ammunition. Frequently the figures given for velocity and range were based on the performance of the ammunition, and more specifically, the fuzes. Changes in ammunition could make significant changes in the performance of the guns without any actual change in the guns. Therefore, the performance data is only accurate for the date indicated.

.30 Caliber Browning Machine Gun, M1917

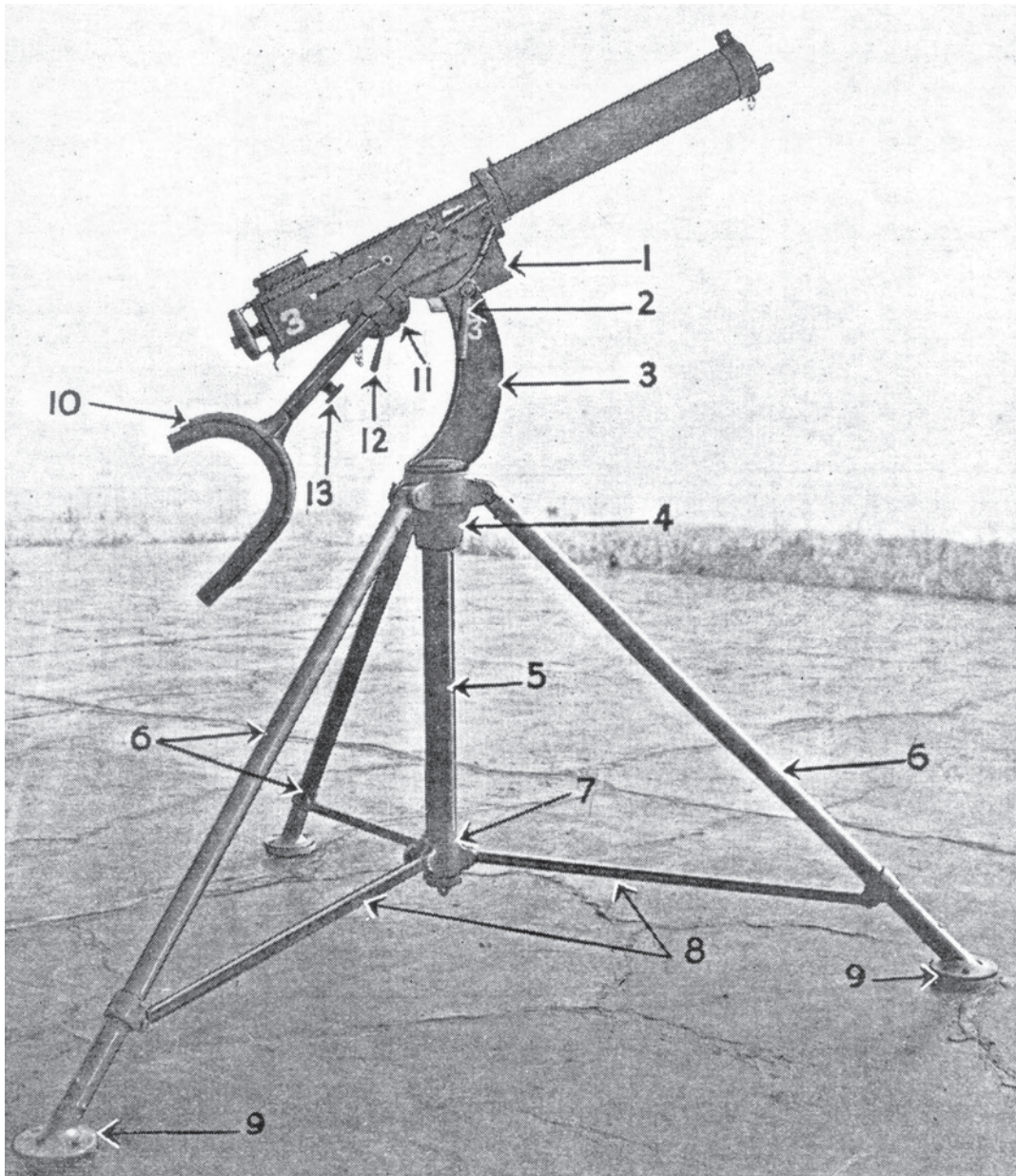


.30 cal. MG, M1917, Antiaircraft Defense, (Harrisburg: Military Service Publishing Co., 1940), p. 149.

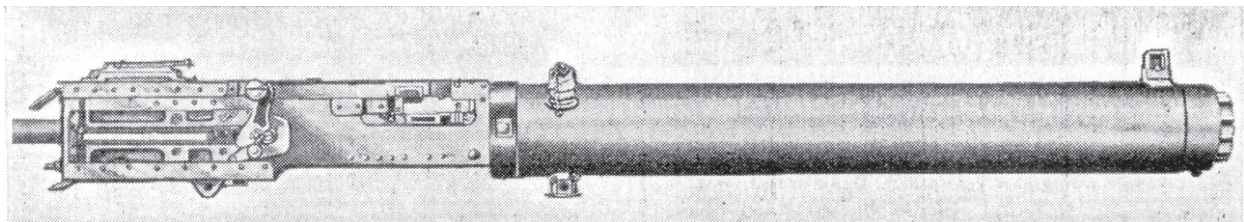
During WWI, the United States used a wide variety of .30 caliber machine guns for close-in antiaircraft protection. Types used included American Colt and Lewis guns, British Vickers guns, and French Chauchats. Eventually, relative standardization was achieved by the use of the water-cooled, belt-fed M1917 Browning .30 caliber machine gun [fig 1] on improvised mounts. These guns, while adequate considering the state of aircraft development and the allied air supremacy, would nonetheless clearly be unsatisfactory against the new generation of aircraft. While the mounts were often unstable, the ammunition was the principal problem. The wartime tracers were very inaccurate, with a large percentage of blinds, and tracers did not follow the trajectory of the ball ammunition. Adding insult to injury, the tracers fouled the guns badly. By 1925, the ammunition had been completely reworked, with flatter trajectories for both ball and tracer, while the tracers were brighter and longer lasting, and no longer fouled the guns.

By 1926, the .30 caliber machine gun had been slated for replacement, although some .30 caliber guns remained into WWII; they were used a dual role on Corregidor in 1942. The .30 caliber MG weighed 37 lbs, and had an vertical range 4,000 yds, 800 yds to tracer burnout, and an estimated effective range of 500 yds, with a muzzle velocity of 2,700 fps. The cyclic rate of fire was 525 rpm (1940).(2)

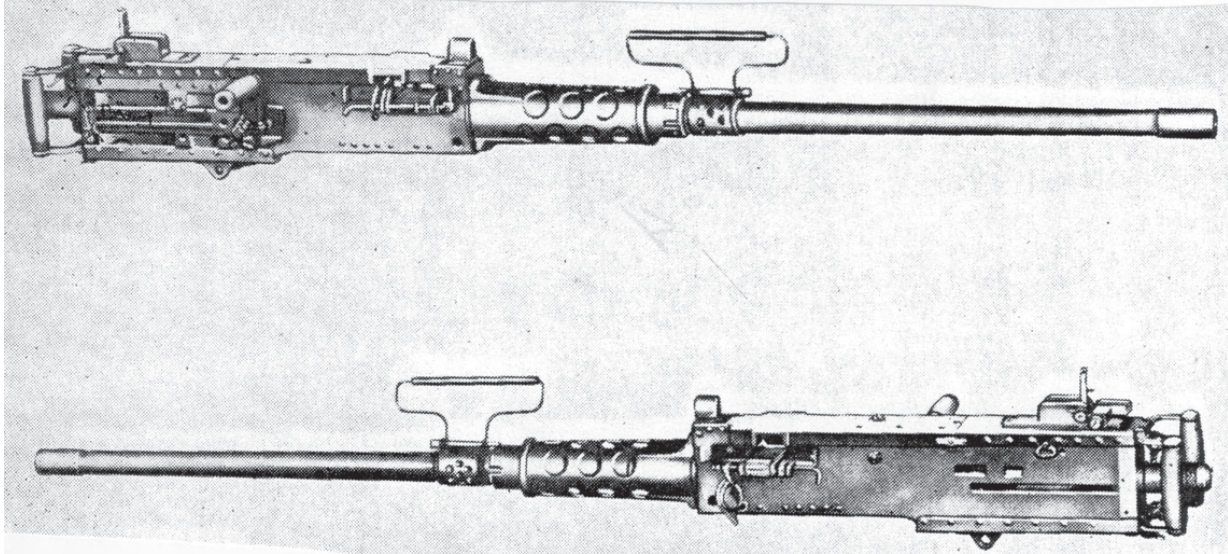
.50 Caliber Browning Machine Guns



Browning M1921



Browning M2 (water cooled)



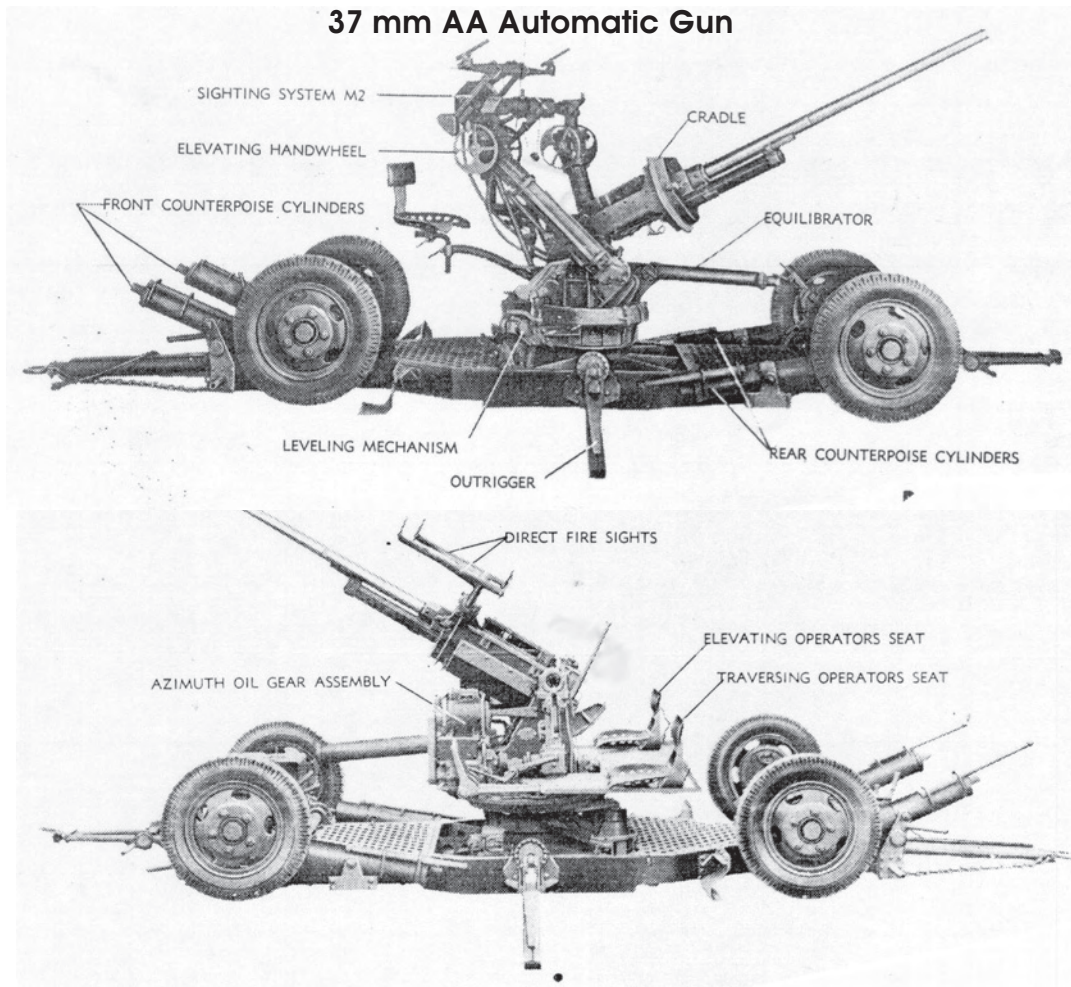
Browning M2 (heavy barrel)

In 1922 the army adopted the water-cooled, belt-fed Browning M1921 machine gun for both ground and antiaircraft use. On a high tripod mount, it served in an antiaircraft role into early WWII. By 1926, it had supplanted the .30 caliber gun as the standard machine gun for antiaircraft defense.

In 1932, the army adopted an improved version, the M2. This multipurpose weapon gradually replaced the M1921. It was available in three forms: aircraft gun, water-cooled antiaircraft gun, and M2 HB (heavy barrel) air-cooled ground mount (still in service today). The water-cooled gun was designed as the antiaircraft weapon, with its water jacket allowing more sustained fire, but actual use showed that this feature was unnecessary, since aircraft targets were too fleeting to need the sustained fire, making the water-cooled version obsolete by 1943.

The M2 HB was issued for antiaircraft service before WWII, and proved an excellent weapon. In addition to providing the AA self-protection for most vehicles, the M2 HB was mounted in multiple arrangements on a variety of mounts. In late 1941, the army adopted the multiple machine gun mount M33 for two .50 caliber guns, mounted on half tracks as multiple gun motor carriages M13 and M14, depending on the model of half track. By 1944, it had been largely replaced by the multiple machine gun mount M45, with four .50 caliber guns and a shield to protect the gunner. Mounted on half tracks, this was known as the multiple gun motor carriage M16 and M17. A trailer mounted model was designated the multiple .50 cal. machine gun carriage M51. Airborne troops were issued the lighter M45C quad mount, without a shield, on a light-weight trailer, as multiple cal. .50 machine gun trailer mount M55. In all its roles, the multiple .50 caliber M2 HB gun was highly effective, and when the threat of low-flying enemy air attack diminished toward the end of the war, they were used with devastating effectiveness against ground targets. During the Korean War, this role was repeated.

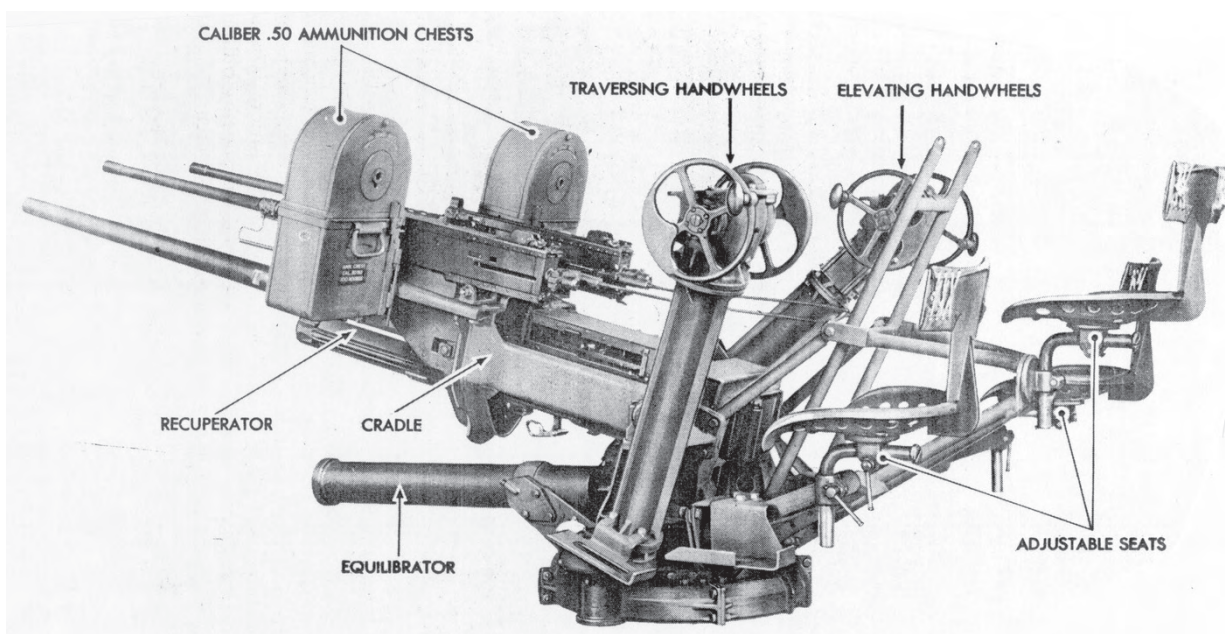
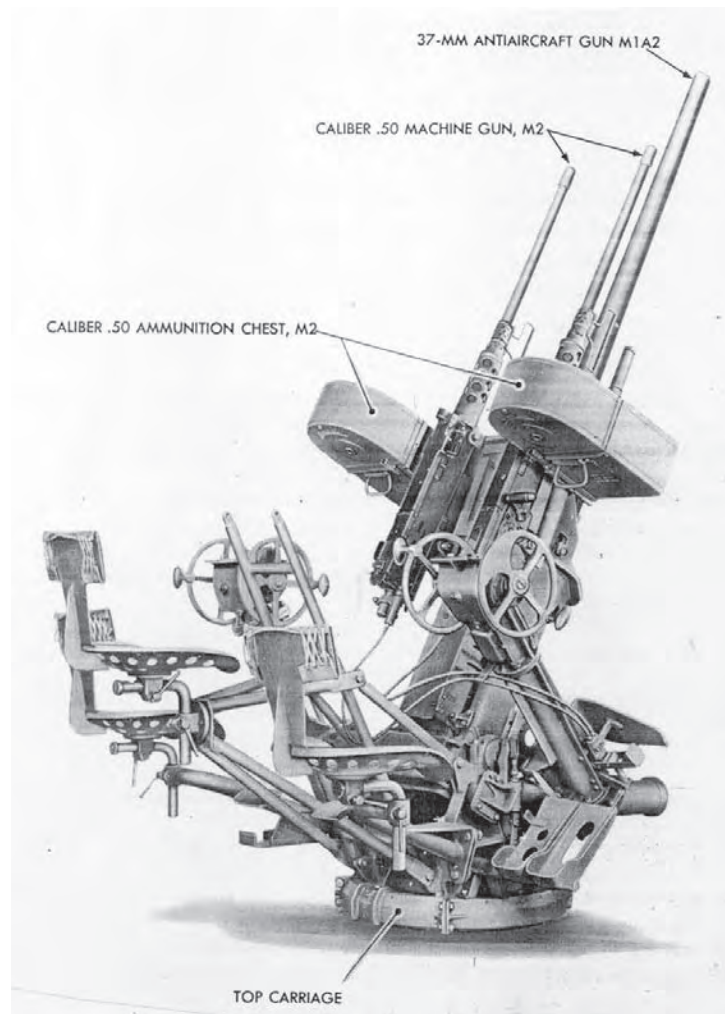
The water-cooled M2 weighed 81 lbs, the M2 HB 121 pounds. They had a cyclic rate of fire of 450-600 rounds per minute, giving a muzzle velocity of 2,800 (M1 ammunition) to 2,900 (M2 ammunition) fps with a 750 grain, non-explosive projectile, effective out to 2,000 ft.(3)



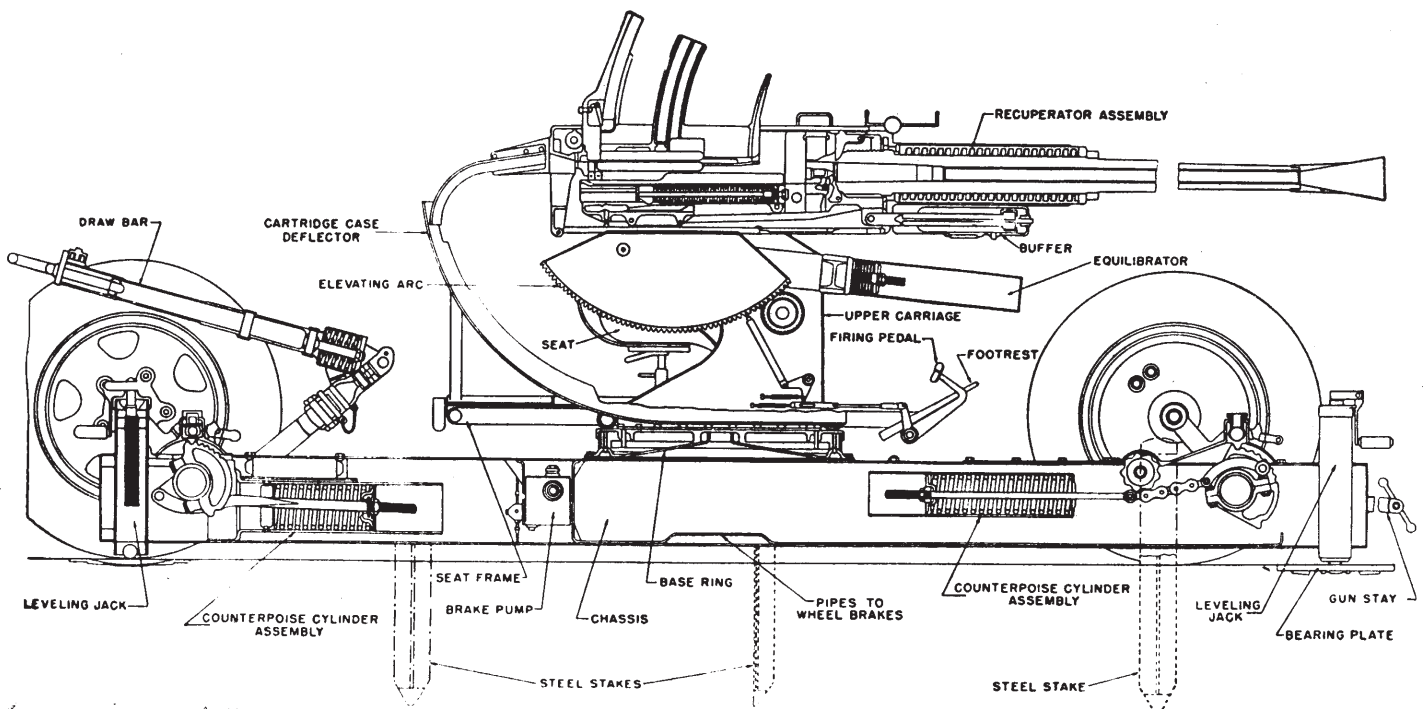
In response to army requirements growing out of WWI, in 1922 John Browning began development of a 37 mm AA gun. Following his death in 1926, the development was continued by Colt until it was finally adopted in 1938. The gun was mounted on the M3 two-axle trailer, was manually loaded with ten round clips, and was manually aimed. The M1 gun was used in 1941-42, including the defense of the Philippines. By the invasion of North Africa in November 1942, the original M1 model had been upgraded to the M1A1, with new sights and power traverse and elevation for off-carriage fire control. Although it had been decided to replace the 37 mm gun with the 40 mm Bofors, the inability to produce sufficient 40 mm guns kept the 37 mm gun in service. As modified, the M1A1 and M1A2 models remained in use throughout WWII, although production ended in 1944.

The most effective use of the 37 mm gun was probably in combination with a pair of .50 cal. M2 HB machine guns. The original 37 mm combination gun mount M42 mounted two water-cooled M2 MGs above a single 37 mm gun. Subsequent improvements placed the 37 mm gun over the .50 cal. guns, and replaced the water-cooled MGs with air-cooled M2 HBs. Mounted on half tracks as combination gun motor carriage M15, the M42 mount and its successor, the M54 mount, performed well against both air and ground targets.

The 37 mm gun fired a 1.34 lb explosive shell at a cyclic rate of 120 rpm, with a muzzle velocity of 2,600 fps and a vertical range of 4,000 yards. Elevation was from -5° to over 90° .(4)



40 mm Automatic Gun



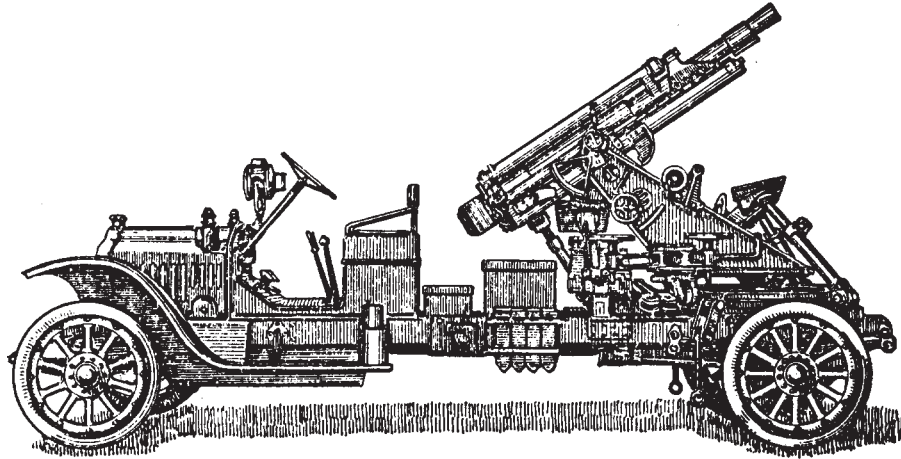
The 37 mm gun was superseded by a better weapon, the Bofors 40 mm automatic gun. This gun was developed in Sweden in the 1930s, and after a good showing in the Spanish Civil War, it was adopted by most combatants on both sides. By the time Britain had arranged for it to be manufactured in this country in 1940 under Lend-Lease, the army had already evaluated it and expressed their interest. The gun was re-engineered to American standards and adopted as the M1 in December 1940. Navy needs took priority, however, and the army received only a limited number of the guns before 1943.

The 40 mm gun was larger and heavier than the 37 mm gun, with a higher muzzle velocity and longer range. Due to its longer range, it worked best when coupled with off-carriage fire control. Because of the navy needs, production was high, and all anticipated army needs had been filled by early 1944. By the time the army received large numbers of this weapon in late 1943, the threat of enemy air attack had declined sharply, and the guns, like the 37 mm, were used extensively against ground targets.

The standard version was mounted on a two-axle trailer, the M2, while the light-weight, single-axle airborne trailer was the M5. The navy twin-40 mm mount was mounted on the chassis of the army's Chaffee light tank and termed the gun motor carriage M19. Few, if any, saw service in WWII, but both the M1 gun and the M19 GMC were retained long after WWII.

The 40 mm gun had a cyclic rate of fire of 120 rpm, with a 2 lb explosive projectile and a muzzle velocity of 2,960 fps. Its AA range was 3,500 yds (1942) and 4,200 yds (1944), limited by tracer burnout, increased to 5,100 yds (1949). The elevation was from -6° to 90° . The ammunition was fed in four-round clips.(5)

75 mm AA Gun M1916, Mobile

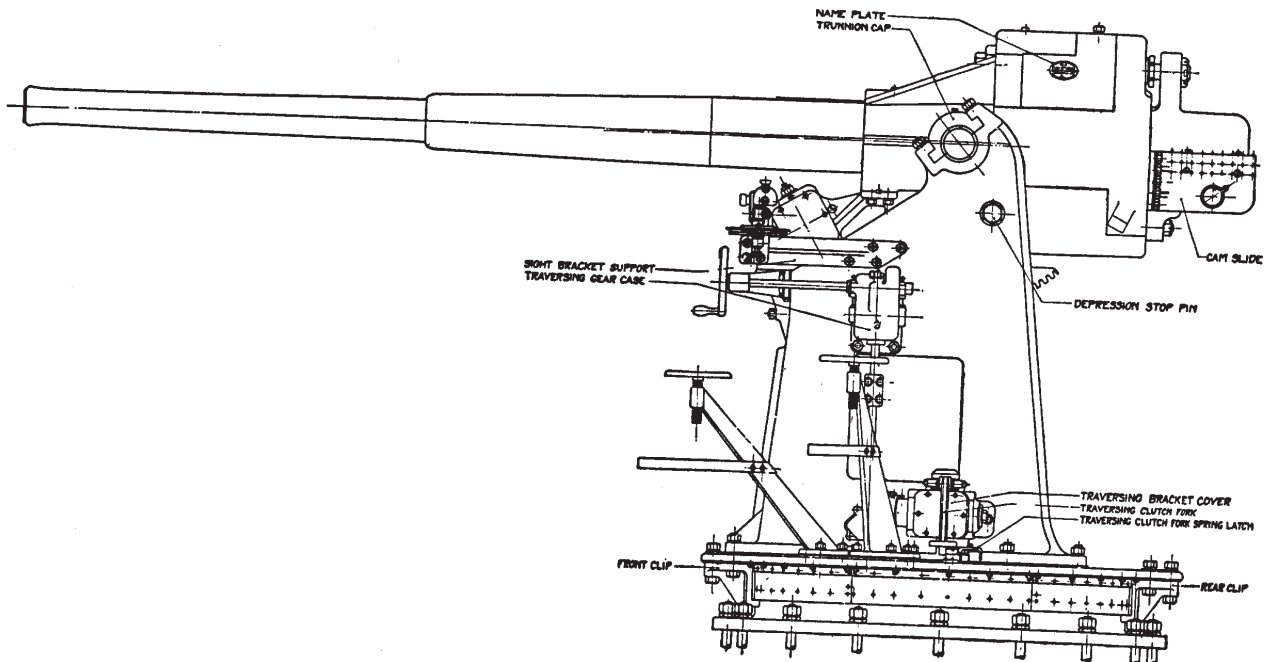
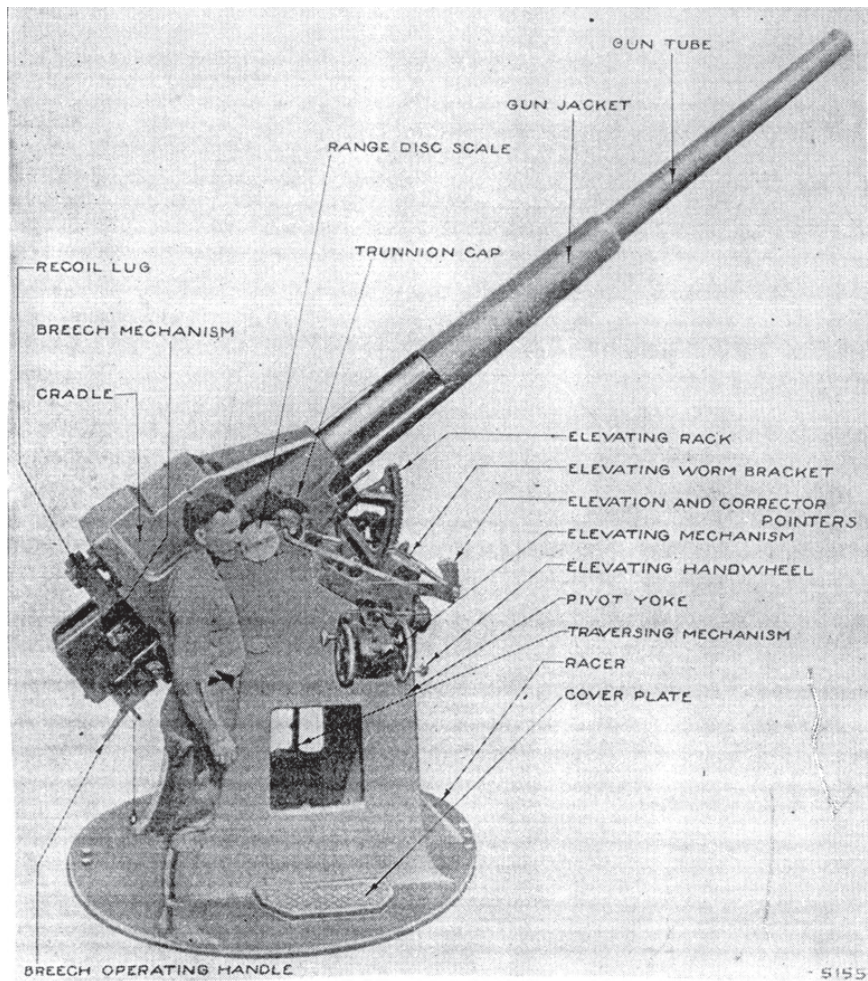


In 1917, the army was faced with the need to provide mobile anti-aircraft guns for the field army. In the rush, there was insufficient time to develop and test a new design, so plans were made to use a field gun that was already in production, mounting it on a truck body. The design was completed on May 1, 1917, and production began immediately. It was recognized at the time that the gun was inadequate, but there seemed no alternative if the mobile forces were to be equipped at all. The American M1916 field gun was used because in July 1917, the recuperators for the French 75 mm gun had not yet been adapted to American standards. As a stop gap, 50 of these carriages were sent to France immediately upon completion, where they were mounted with French 75 mm guns. By the end of 1918, 51 of the M1916 75 mm AA guns were completed. It was the only American-made AA gun to reach France, but it did not see active service during the war. All American AA equipment used against the enemy was secured from our allies, primarily France.

The American gun was a makeshift job, an M1916 75 mm field gun with a hydro-spring recoil mechanism, mounted on 2½ ton White trucks, designated AA truck mount M1917. The barrel was only 28.4 calibers long, giving a velocity of 1830 fps (1920) with a 14.7 lb shell. At 82° it had a maximum height of 5,500 yds, limited by the 20 sec fuze (1920). Its limited elevation (31° to 82°) and low muzzle velocity severely limited its effectiveness.

The gun was fired from the ground, behind the truck, and was limited to 240° in azimuth. The elevating and traversing mechanism jammed frequently, and although the truck body was equipped with jacks to relieve the strains of firing and to prevent the truck from overturning when firing at low elevation, it was so encumbered with heavy iron that it was scarcely mobile. By 1940, it was no longer in service, although a few were still in use for training.(6)

3-inch AA Gun, Fixed, M1917

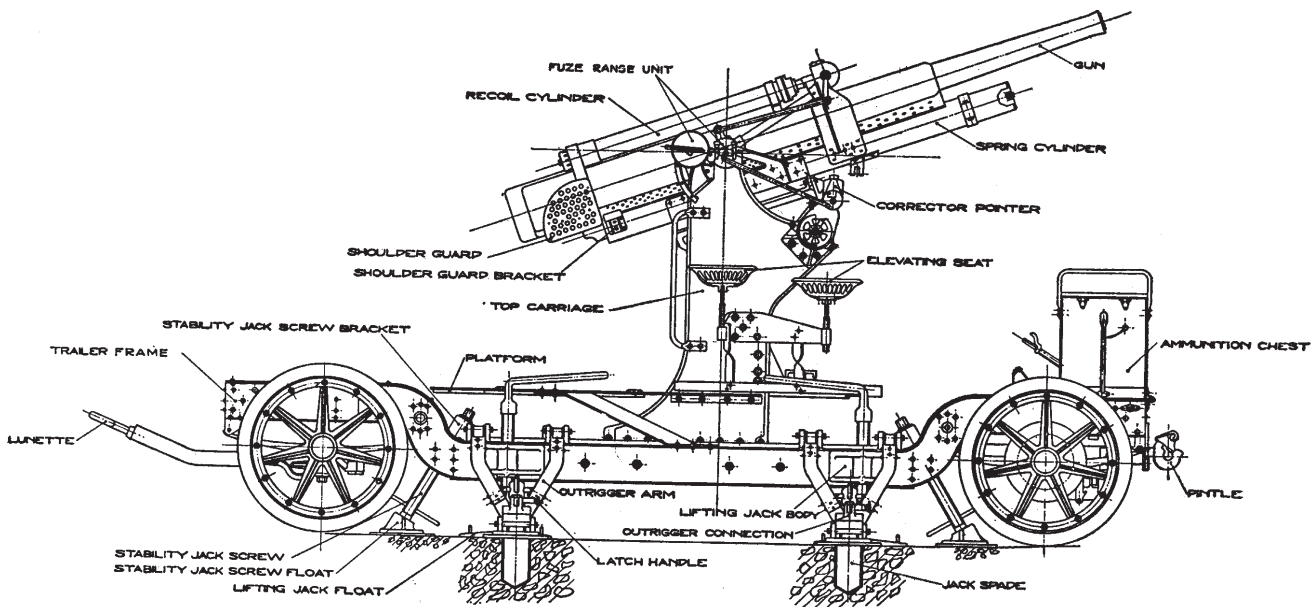


Before 1917, the U.S. Army had concentrated its anti-aircraft efforts on the protection of its coast defenses. By April 1916, the Ordnance Department had designed a 3-inch gun for fixed emplacements, and by mid-1916 Watertown Arsenal had undertaken the manufacture of one 3-inch AA mount, model E. Between May 1916 and June 18, 1917, 160 of these guns were ordered from Watervliet Arsenal and Bethlehem Steel, of which 116 were delivered by April 10, 1919, and sent to the fortifications. The M1917 gun, improved and upgraded, lasted through WWII.

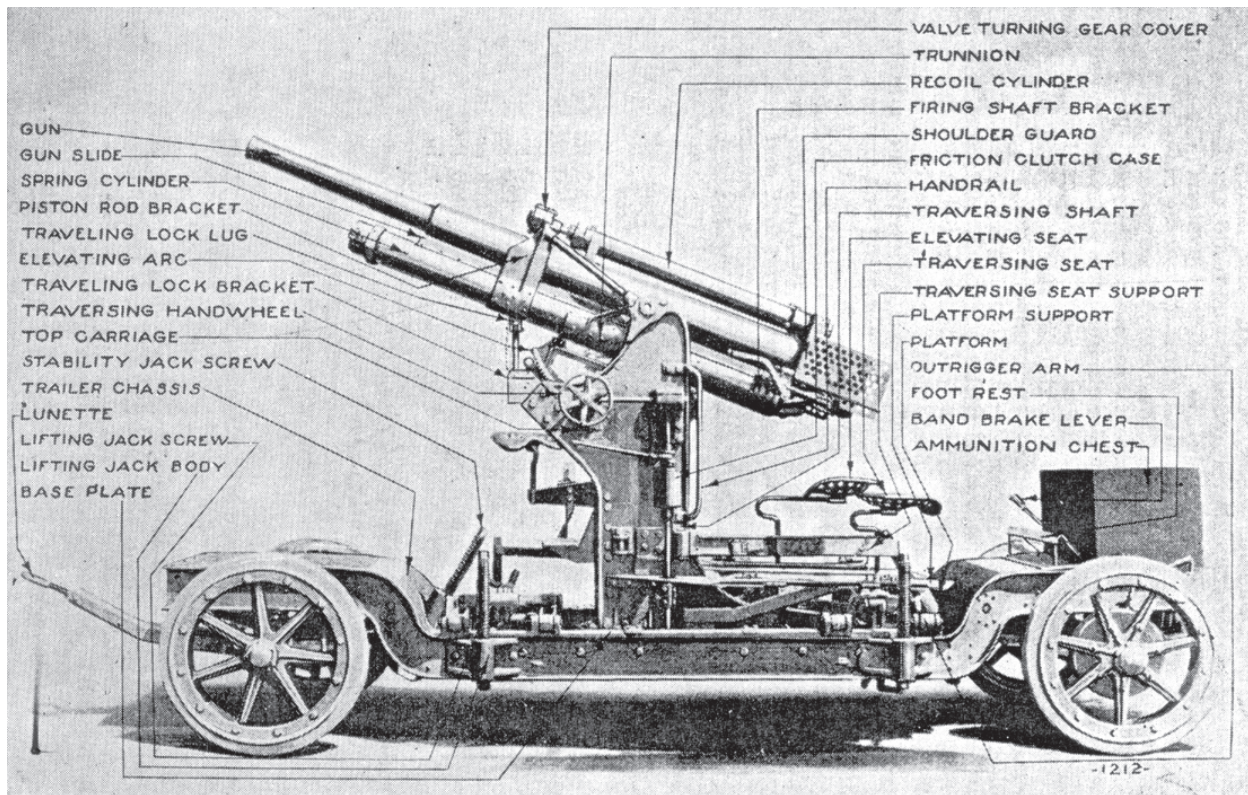
The M1917 gun was 55 calibers long, with a drop-block breech mechanism. The firing mechanism was of the continuous-pull type, permitting a repetition of blows to the primer without opening the breech, in the case of a misfire. The gun was fired by means of a firing handle. It fired from 0° to 90° elevation, with 360° traverse, and threw a 15 lb projectile, high explosive or shrapnel, at a muzzle velocity of 2,600 fps (1920). The M1917 gun, along with the later M2 and M4 fixed 3-inch AA guns, had the same chamber dimensions and used the same cartridge case as the M1903 3-inch (15-Pdr) seacoast gun.

The recoil mechanism was of the hydro-spring type, with a single recoil cylinder above and two counterrecoil cylinders below. The M1917 MI mount added a second recoil cylinder above. The M1917 gun was trunnioned near the breech, allowing it to recoil when firing at high elevation. The barrel was balanced with a breech weight, avoiding the equilibrator used on later M1 and M3 mobile 3-inch guns. The M1917 3-inch AA gun mount was designed to be mounted, using 16 bolts, on a concrete base 30 inches thick and 18 feet in diameter. Emplacements for the M1917 3-inch AA gun remain at many of our coastal forts.(7)

3-inch AA Gun, Mobile, M1918



The truck-mounted 75 mm gun was clearly inadequate from inception. The Ordnance Department immediately began to develop a 3-inch replacement, which was to be trailer-mounted. The gun was “of the ballistic design” of the M1898 3-inch (15-Pdr) seacoast gun, which had become obsolescent, if not yet obsolete. The extent to which actual M1898 tubes were equipped with new breech mechanisms and recoil systems to be reused as AA guns



remains under dispute, but the M1918 gun, along with the later M1 and M3 mobile 3-inch AA guns, had the same chamber dimensions and used the same cartridge case as the M1898 and M1902 3-inch (15-Pdr) seacoast guns. The new semi-automatic breech mechanism was a drop-breech design, practically identical to that on the M1916 75 mm gun, and was operated by a lever on the right side of the gun. Pulling that back and down opened the breech. The barrel was only 40 calibers long, and gave a muzzle velocity of 2,400 fps (1920).

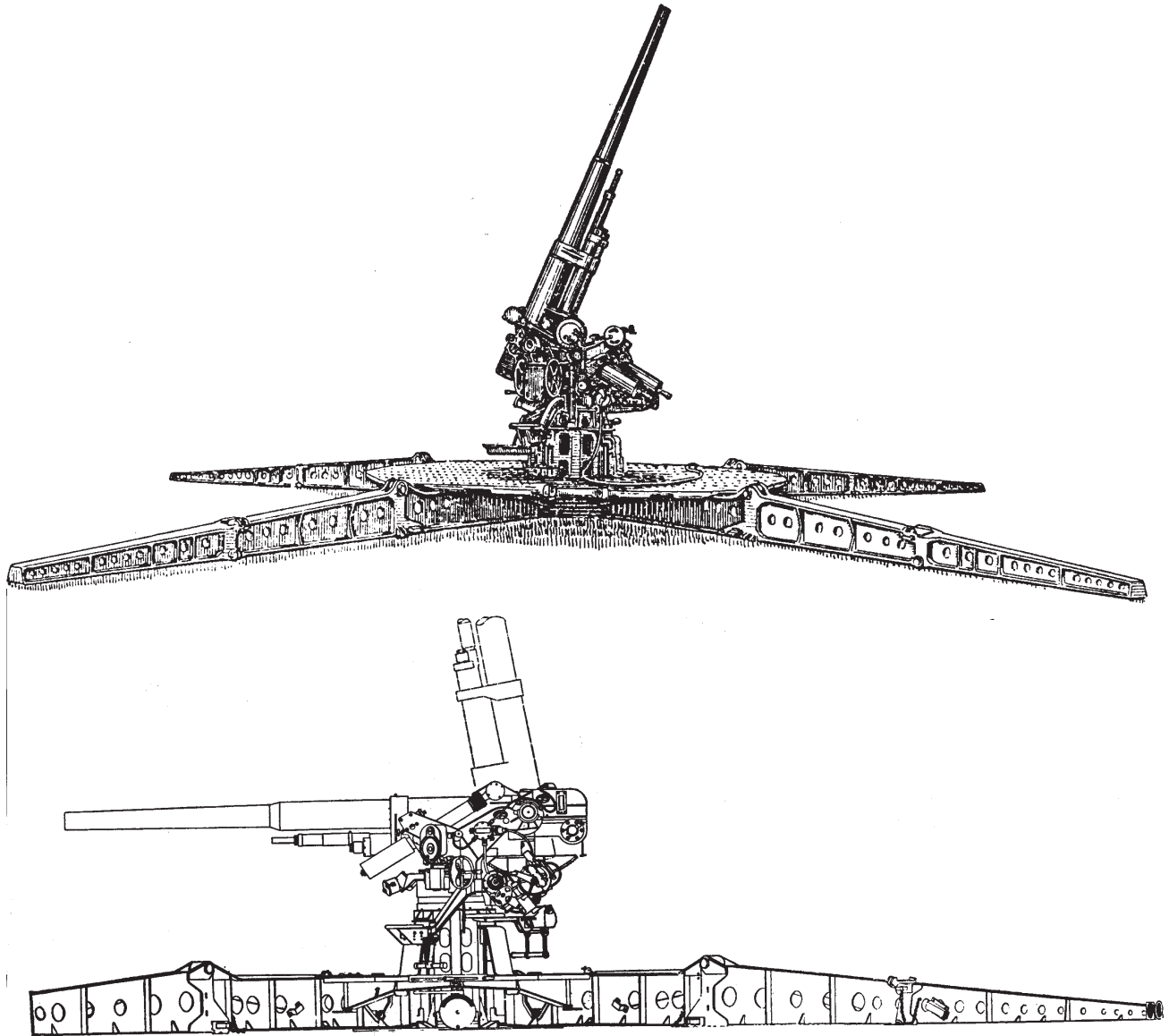
The gun was mounted on the 3-inch auto-trailer carriage, M1917. The mount allowed an elevation range of 10° to 85°, giving a maximum vertical altitude of 8,600 yds, limited by the fuze (1920). The recoil varied from 16 inches at 85° to 40 inches at 10°.

The gun and carriage were in turn mounted on the four-wheeled M1917 trailer. The drop-center trailer could be pulled by a tractor, or could be steered by the rear wheels if the rear-wheel lock was disengaged and a steering bar inserted. It was equipped with outriggers and jacks resting on detachable floats on the ground, which stabilized the unit and prevented it from overturning when firing at low elevations.

In actual operation, the gun was less than perfect. Despite the outriggers and jacks, the mount was unsteady during firing. The counterrecoil mechanism functioned irregularly, and loading at high elevations was difficult. Despite this, the gun remained a significant part of the American arsenal until the beginning of WWII, especially for National Guard regiments. A few were even assigned to the defense of permanent fortifications, and a mount for this purpose survives at Fort Worden, Washington.

On December 1, 1924, a change of nomenclature was approved, and the 3-inch AA gun mount was henceforth known as the M1918, and the trailer was known as the 3-ton AA gun trailer, M1918.(8)

3-inch AA gun, Mobile, M1 & M3



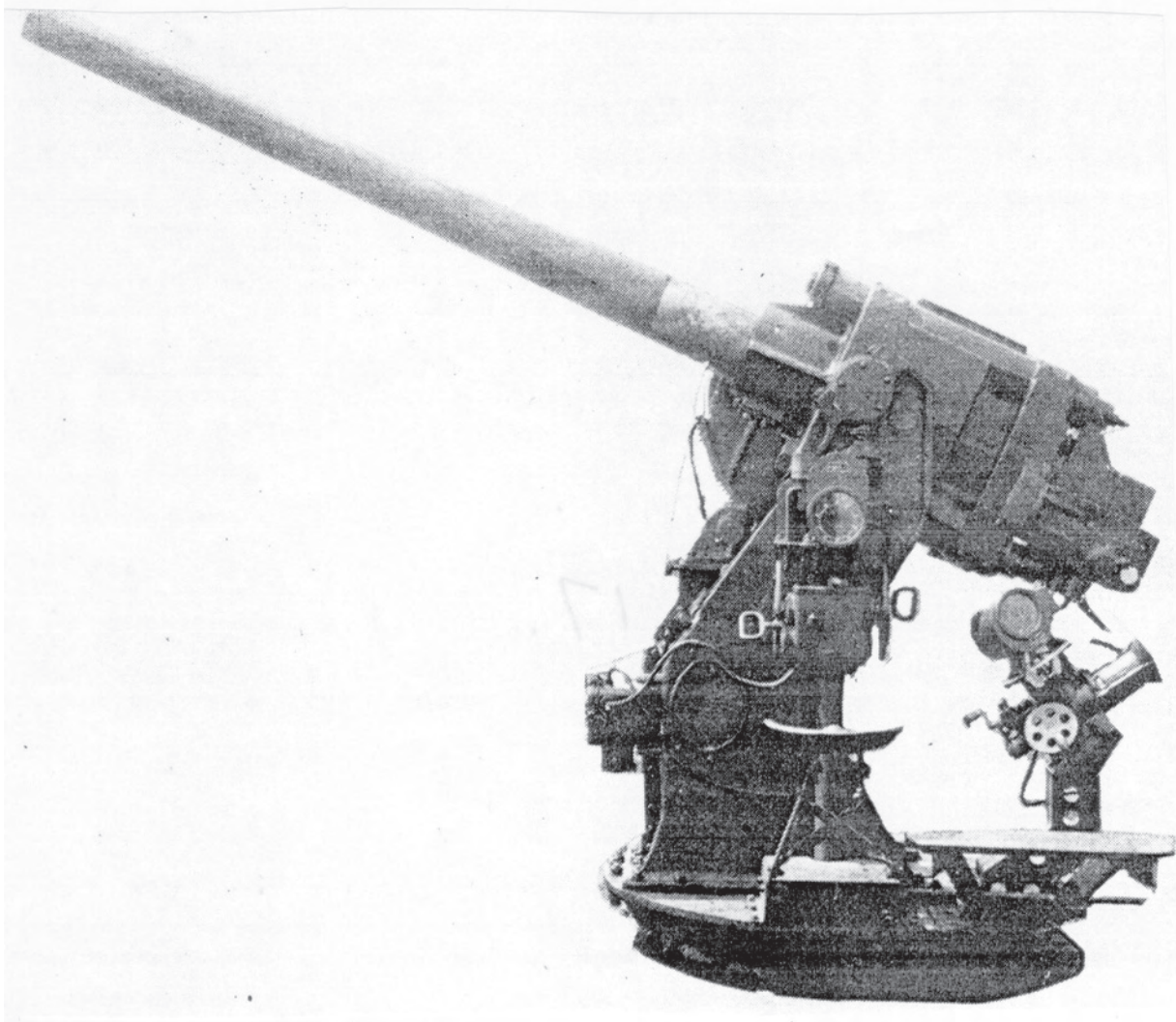
After WWI, the army moved forward with the development of a new 3-inch AA gun. The M1923-E 3-inch AA gun was standardized in 1927 as the M1. The guns were produced by the new method of cold-working, or autofrettage, and featured removable liners. The M1 and the M3 guns were very similar, the principal difference being that the M3 gun was larger, allowing for a larger liner. There were relatively few M1 guns produced; firing tables as early as 1928 showed the M3 & M4 guns. Both the M1 and the M3 were 50 calibers long and had a muzzle velocity of 2,600 fps with shrapnel (1941) and 2,800 fps with high explosive. The breech was a drop-block type, with the M14 continuous pull firing mechanism, fired by a short lanyard.

The gun recoiled in a cradle, which was attached to the mount by a hydro-pneumatic, constant recoil system. The barrel was trunnioned relatively near to the breech, allowing the gun to be mounted closer to the ground and still clear the platform when fired at high elevations. To balance the barrel, equilibrators were provided.

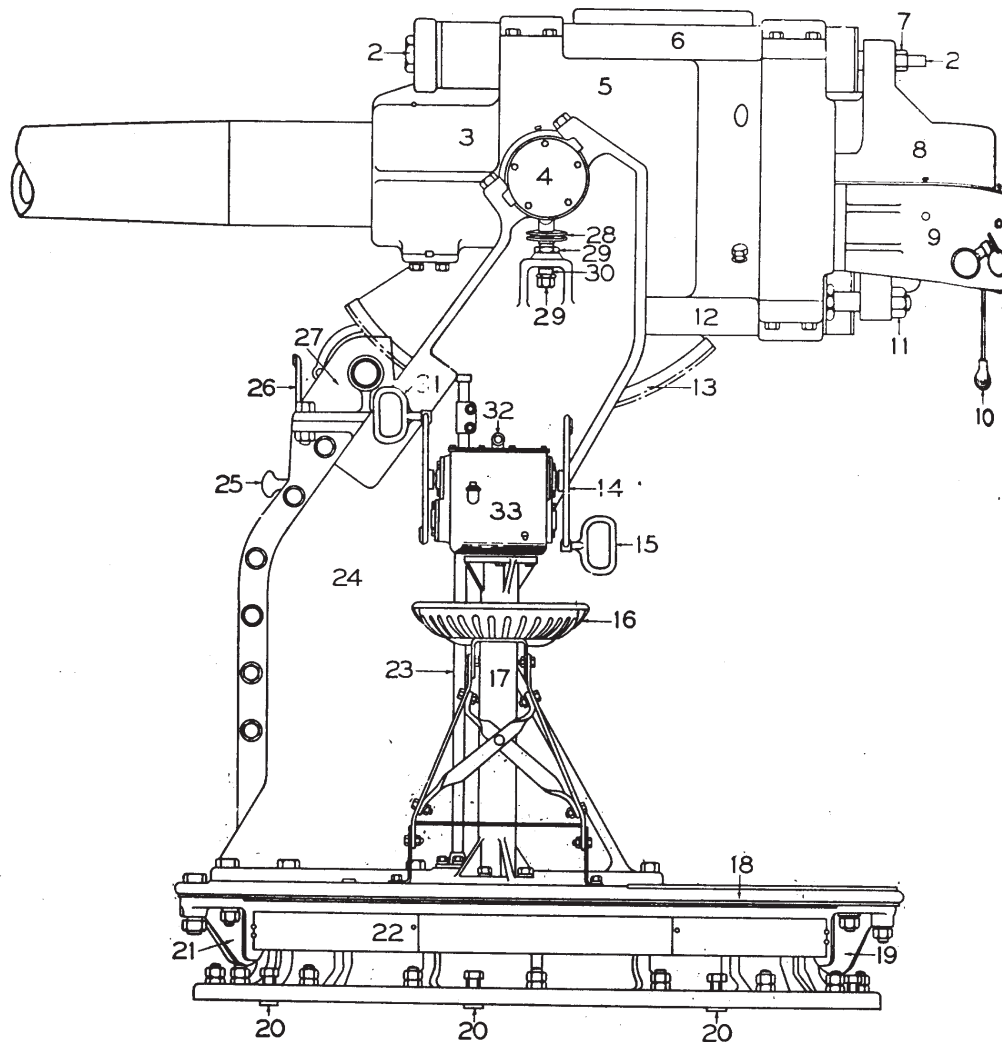
The M1 gun was mounted on the M1 mount, the M3 gun on the M2 mount. Like the guns, the differences between the mounts were only in their fabricated parts and the type of commercial brakes. The most common mount was the M2A2, a mobile trailer mount with balloon tires, capable of high speeds on good roads and good speed over irregular terrain. The most distinctive features were the perforated steel plate platform and four large outriggers. The gun could be elevated from -1° to 80° , and traversed through 360° .

The 3-inch gun M3 gun was the mainstay of the AA regiments at the beginning of WWII, until replaced by the 90 mm gun. Although eventually giving way to a larger, more powerful gun, the M3 was an excellent weapon.(9)

3-inch Guns, Fixed, M2 & M4



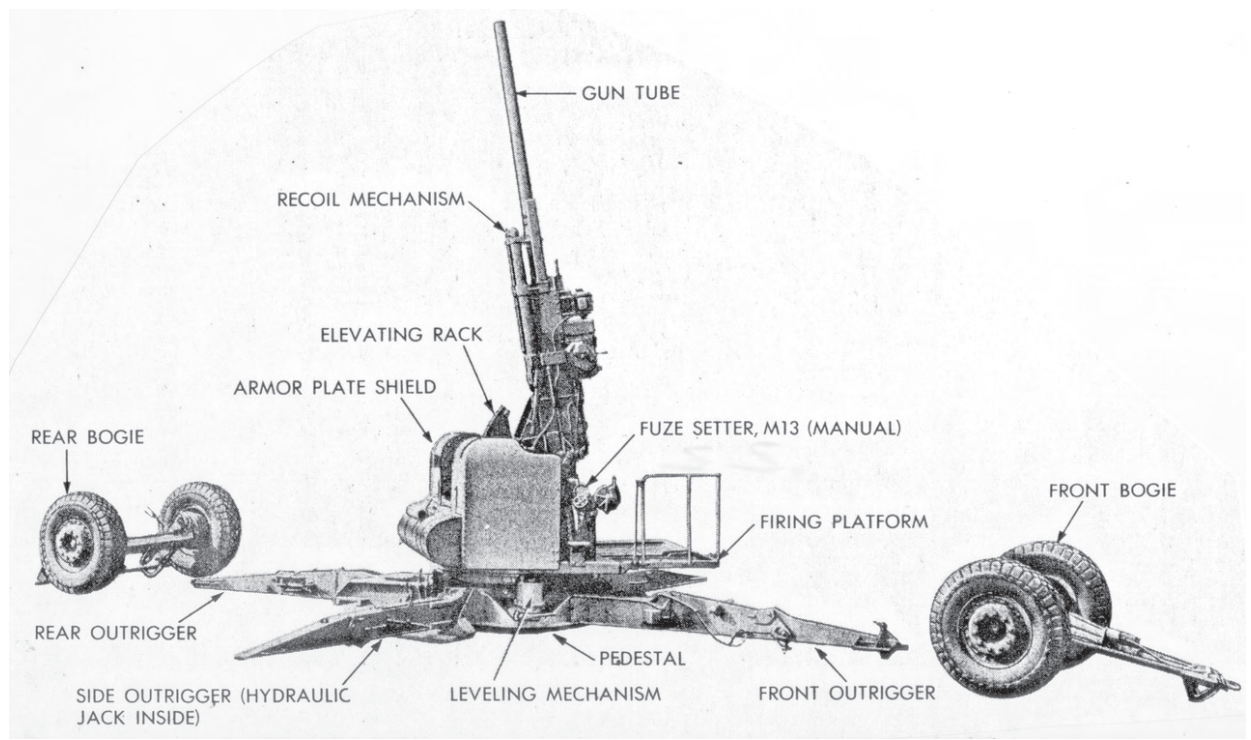
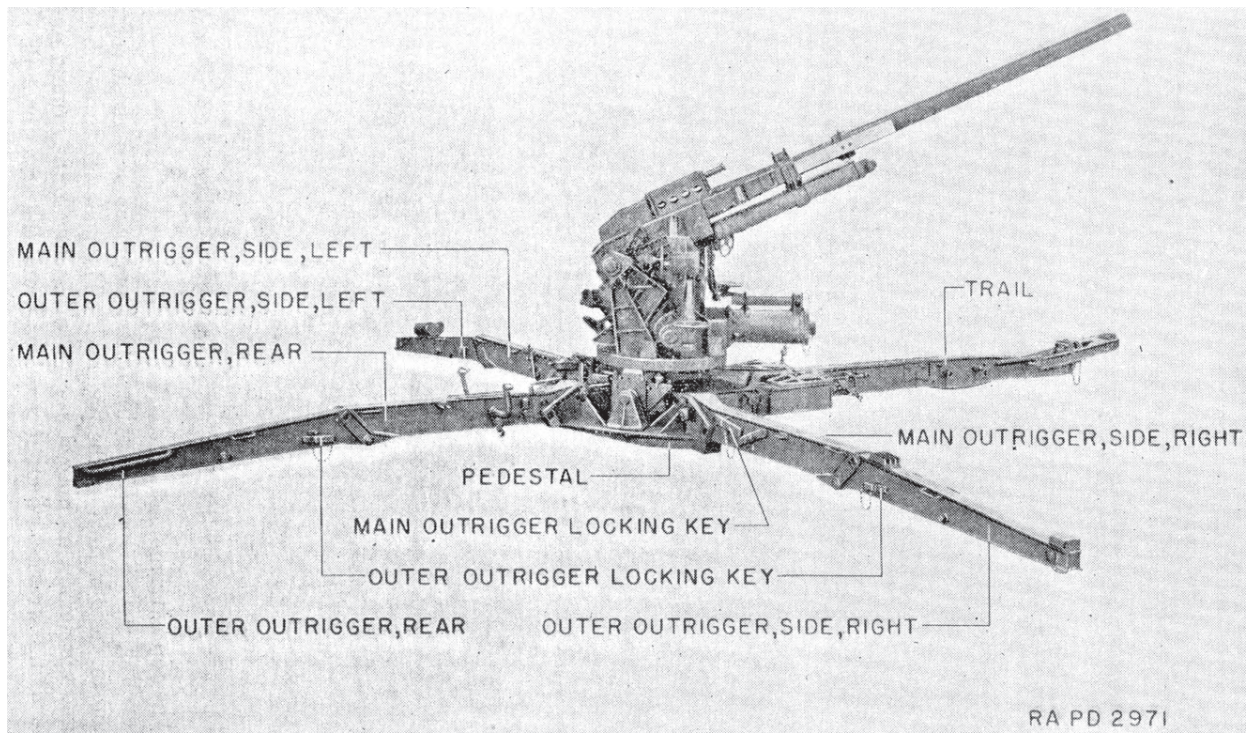
At about the same time the as the adoption of the M1 gun, the army adopted a new fixed 3-inch gun, the M2. Like the M1, this was rapidly superseded by the M4, which was virtually identical except for being a little larger because of a larger liner. The documentary evidence of the M2/M4 is relatively scanty, especially compared with the M1917 fixed and the M3 mobile guns, apparently because these guns were produced only in small numbers. As noted above, the M4 gun was in production by 1928. The author's files of Reports of Completed Works for AA batteries contain only one for M2 and M4 guns. In 1936, one battery at Fort

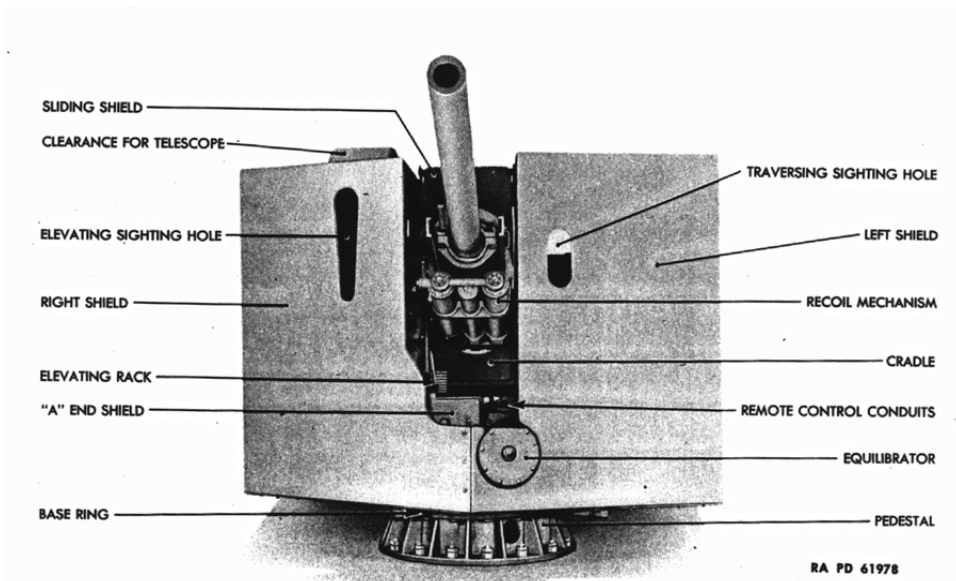
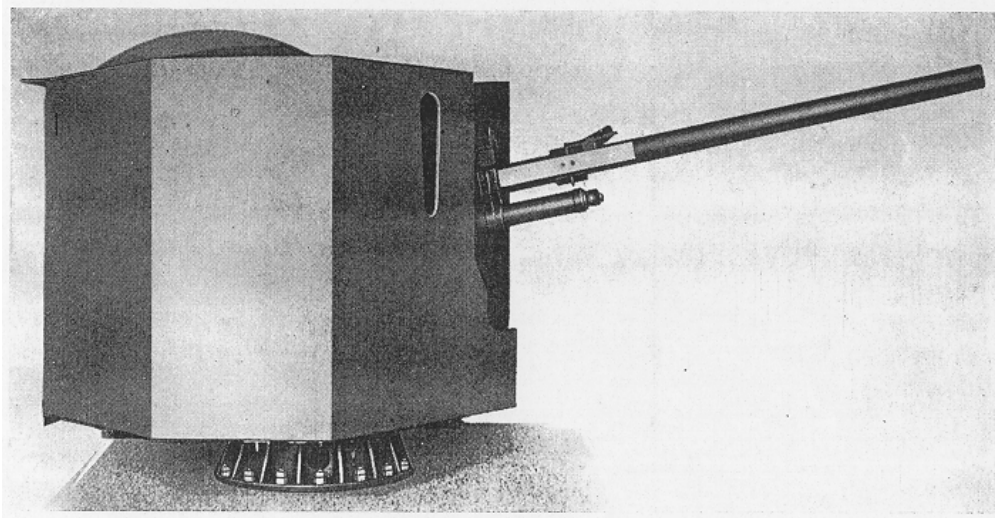
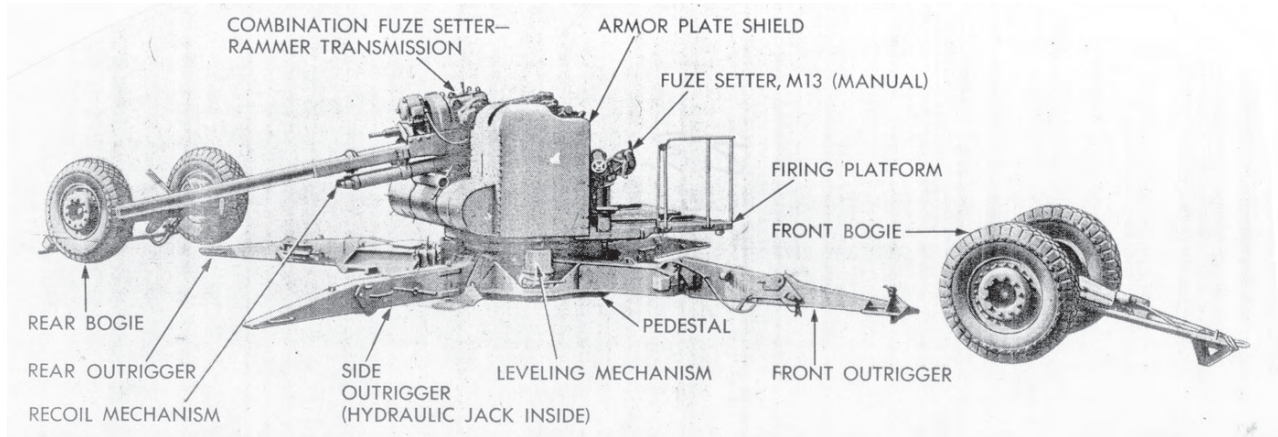


Monroe, Virginia, showed one M2 gun and two M4 guns. This M2 gun, if correctly listed, had several interesting characteristics. The serial number was 170, obviously a continuation of the M1917 serial numbers. The mount, meanwhile, was a M1917 MI. The M4 guns were serial number 1 and 2, on mounts 1 and 2. Whether more M2 and M4 guns were produced is unclear, but it is clear that the coast artillery relied on the M1917 guns to protect its fixed fortifications until they were eventually replaced by 90 mm guns, in some cases not until the end of WWII.

The M2/M4 guns were improved versions of the M1917, which they resembled. They did not improve on the M1917 as much as the M1/M3 guns improved on the M1918. They were also cold-worked, with removable liners, and used the M14 continuous pull firing mechanism. Apparently, the M2 gun was mounted on the M1917 MI mount, while the M4 gun was mounted on the M3 mount, which was similar in all respects to the M1917 MI mount, except for larger and heavier cradle and bearings to accommodate the heavier M4 gun.(10)

90 mm AA Gun





90 mm Gun M1 and 90 mm Gun Mount T3

In 1938, the U.S. Army issued requirements for the development of anti-aircraft guns to counter continued improvements in aircraft size, speed, and altitude. The 90 mm model T-1 was tested that same year, and modifications and improvements suggested by the testing produced the T-2, which was adopted and put into production as the M1 in 1940. By the time the United States entered the war in December 1941, the army had 171 M1 90 mm guns, and the very high-priority production of M1 guns continued into 1942. The M1 gun was a powerful weapon, with a 50 caliber barrel and a drop-block breech mechanism, using an inertia-type firing mechanism, a modification of the continuous pull type. All models of the 90 mm gun fired a 23 lb HE shell at 2,700 fps, to a range of 19,000 yds, limited by the proximity fuze (1944), or 12,000 yds, limited by the 30 sec time fuze (1949). Manual loading was standard for the M1 gun, but a rammer was designed for it. The rammer worked on the basis of recoil, so one round had to be loaded and fired in the normal manner before the rammer was operational.

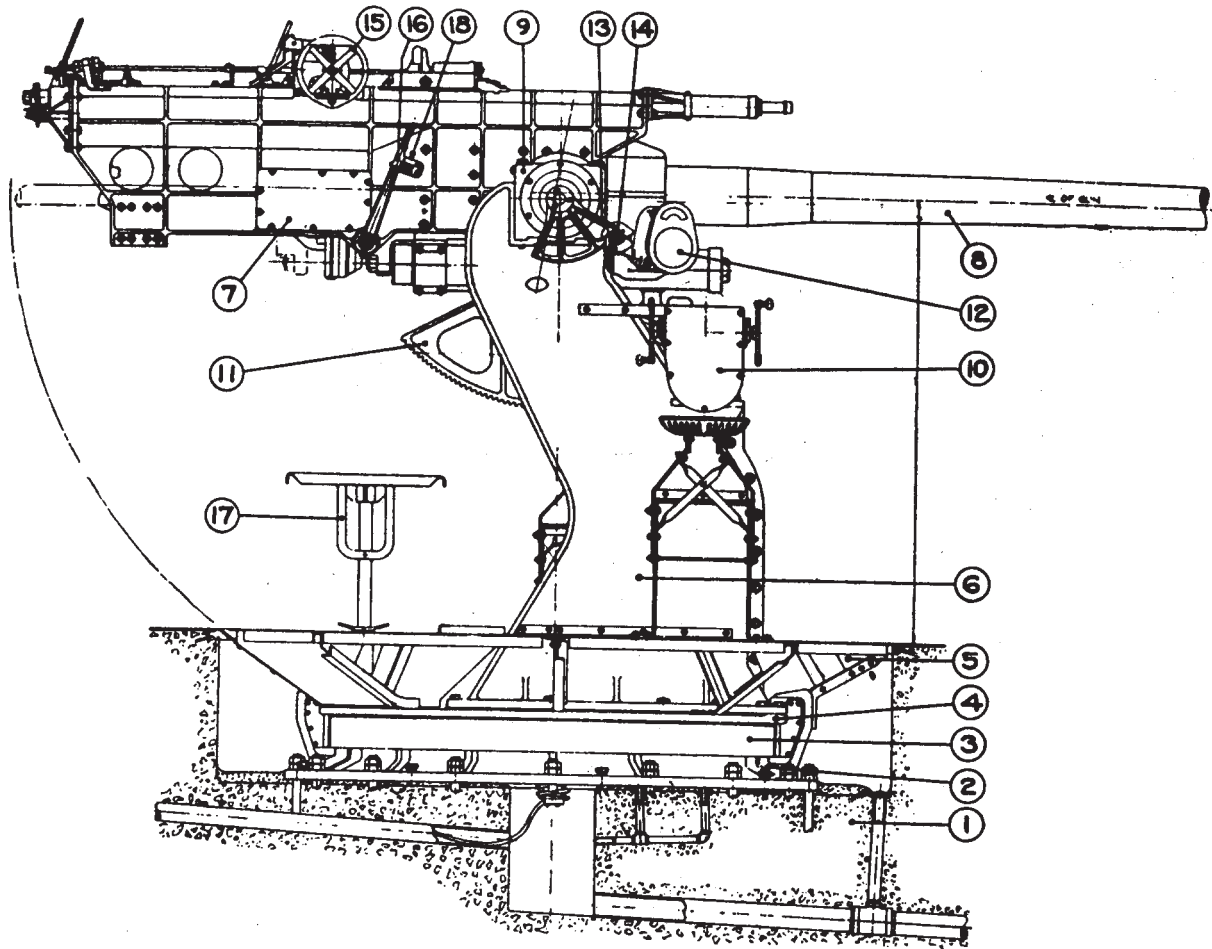
The recoil was controlled by a hydro-pneumatic system, which used a recoil cylinder, a gas cylinder, and a floating piston cylinder, all placed under the barrel. The recoil was variable, ranging from 40-44 inches at 0° elevation to 24½-26 inches at 80°. A single equilibrator balanced the weight of the barrel, allowing the gun to be trunnioned near the breech.

The M1 and M1A1 mounts differed in that the M1A1 mount was designed to work with the M2 remote control system, while the M1 mount operated manually only. The gun sat, unprotected, on a single-axle trailer mount, with three outriggers for stability.

The M1 gun was also mounted on the M3 (originally the T-3) mount. This fixed mount was mounted on a concrete emplacement, and featured a shield to protect the gun and crew. This manually-loaded mount was used in seacoast role, but could also be used against aircraft. Like the M1A1 mount, it used a remote control system, in this case, the M13. The 90 mm gun on the M-3 mount had a maximum rate of fire of 30 rpm, and a normal rate of 25 rpm. On the M1 mount, the gun had a rate of fire of 22 rpm.

By mid-1941, the United States had seen the Germans use their 88 mm guns in both anti-aircraft and anti-tank roles, and wanted a mount for the 90 mm gun which could be used against tanks. Although the production of the improved guns was delayed by the high priority assigned to the M1 gun, in May 1943 the army adopted the 90 mm gun M2, with the M2 AA mount. The gun was normally lowered to ground for firing, but could be fired while still on its wheels in an emergency. The mount included a small shield for use in the ground role, as well as an automatic fuze setter-rammer. Extremely versatile, the gun had all the M1 gun's anti-aircraft equipment, along with sights and a mount that maximized its effectiveness as a field gun. The M2 had a rate of fire of 20-24 rpm. Production of M2 guns wound down in 1944, but both the M1 and M2 guns served on for years, in both anti-aircraft and seacoast roles.(11)

105 mm Antiaircraft Gun

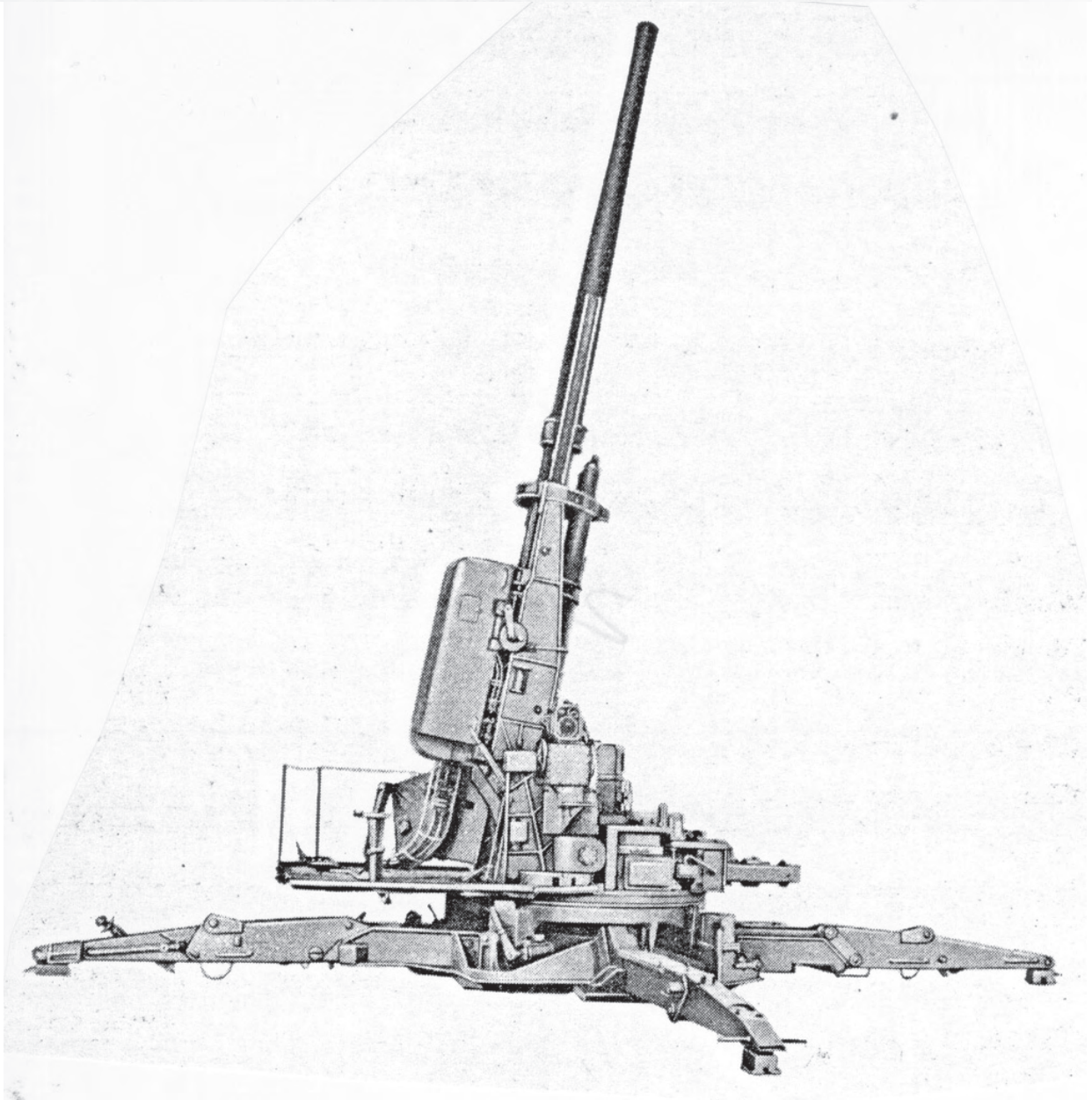
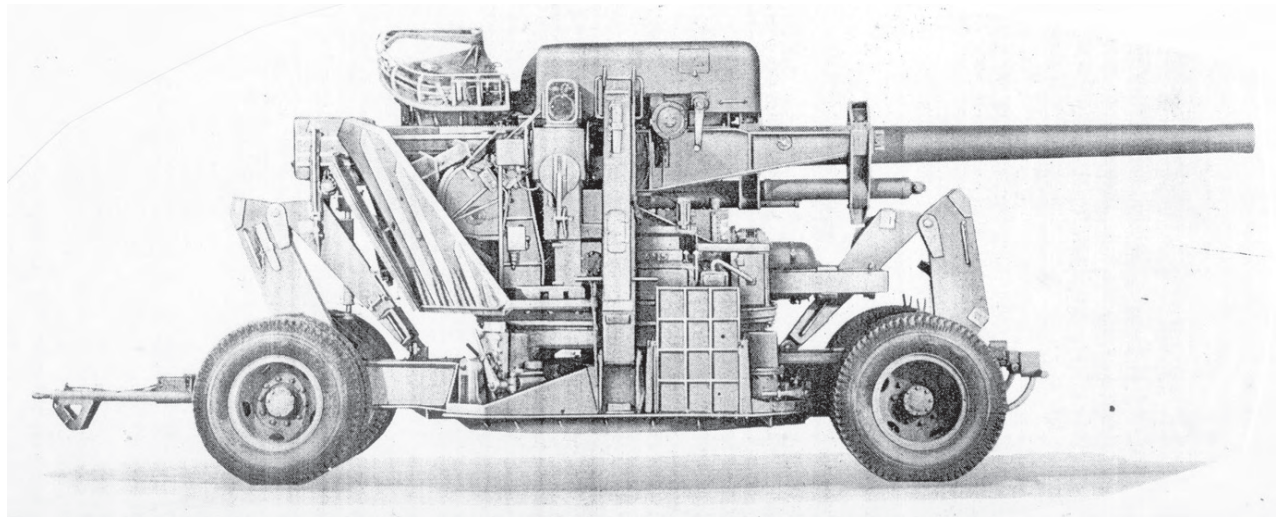


In 1928, the Ordnance Department announced the adoption of a new gun, 105 mm, intended to be the standard equipment for fixed AA defenses. The weapon adopted was 60 calibers long, with a 4.1-inch bore. It fired a 33 lb projectile to an altitude of over 12,000 yds, at a muzzle velocity of 3,000 fps (1928). Using fixed ammunition and a compressed air rammer, the gun could fire 15 rpm. Congress, however, declined to fund the gun (or much of anything else), and it remained dormant until 1938.

When finally approved in 1938, the 105 mm gun barrel was of one piece, cold worked, monotube construction. Although the muzzle velocity was reduced to 2,800 fps, the altitude had increased to 14,000 yds (1938). The M1 mount was very similar to the M3 3-inch mounts, the principal differences being the larger dimensions to accept the larger barrel and the addition of a power rammer. Using the rammer, which was actuated by air compressed during the movement of the gun in recoil, a sustained rate of fire of 15-20 rpm was achieved, with a maximum of 30 rpm for short periods of time. A single hydraulic recoil cylinder was provided under the barrel, with two spring-cylinder recuperators.

Few 105 mm guns were built, and those actually constructed were sent to Panama to defend the canal. By 1944, it no longer appeared in listings of standard artillery.(12)

4.7-inch (120 mm) Antiaircraft Gun



The largest American anti-aircraft gun was the 4.7-inch, later termed the 120 mm, or "stratosphere" gun. The concept for the gun originated during WWI, based on suggestions from General Pershing. Some development was carried out in the early 1920s, but on January 15, 1925, the Ordnance Department suspended work on the 4.7-inch AA gun M1920E, which had been under test since the latter part of 1922, concluding that there was no need for a gun this large. At the same time, the department announced 40% completion of AA fire control data for the gun.

In 1938, as funding began to become available, the army issued requirements for both 90 mm and 120 mm AA guns, in expectation of future aircraft developments. The production of 90 mm guns was a very high priority, while the 120 mm gun remained a low priority until after 1942. A handful of prototype guns were built in 1942, but the gun was not put into production until the USAAF adopted the high-flying B-29 bomber. Fearful that the Axis might develop a similar weapon, the army adopted the 120 mm M1 AA gun early in 1944, and by the end of the year, finished guns were being issued to the Coast Artillery Corps.

By the time the weapon was available, it had become clear that the enemy could not produce the type of aircraft it was designed to defend against. As a result, only 550 of these guns were built, many after the end of the war, and none were deployed farther overseas than Hawaii. The gun remained an important element in the American arsenal for many years.

Twice the size of the 90 mm gun, the 120 mm gun was a massive piece of equipment. The gun traveled on a twin bogie mount, with dual tires. Both bogies were removed when the gun was emplaced, a process that only took 25 minutes. When traveling, the gun was racked 70 inches out of battery, in order to distribute its weight over the two bogies, which prevented the gun from firing off its wheels. When emplaced, the mount was supported by the pedestal and stabilized by four outriggers. The mount allowed fire up to 80° elevation. The hydropneumatic recoil mechanism was "somewhat temperamental," and required special attention, while as of 1950, the fuze setter-power rammer was mechanically complex, and "a source of malfunctions in the field." It was, however, being constantly improved. The 120 mm battalions were semi-mobile, due to insufficient organic transportation. The M6 tractor, 38 tons loaded, could tow the gun at 15 mph on good primary roads, while 4 mph across firm terrain was considered good. On road marches, weight limits on bridges were a constant problem.

The 60-caliber barrel alone weighed 7,856 lbs, while the entire gun, mount, rammer, and remote control system weighed over 30 tons. The breech was of the drop-block variety, and the gun had a normal rate of fire of 10 rpm using the power rammer, although a well trained crew using proximity fuzes could reach 15 rpm. Due to the gun size, the ammunition was semi-fixed, that is, the 50 lb projectile was rammed first, then the cartridge case with the powder. The muzzle velocity was 3,100 fps in 1945, giving a maximum altitude of 19,150 yds (1950), or 15,800 (1944, limited by 30 sec. fuze). The 1950 altitude exceeded the capabilities of the fire control equipment.

Despite the 120 mm's higher velocity, it was slightly less accurate than the 90 mm, within the 90 mm's limited range, for reasons that were not entirely known.(13)

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