CATALOGUE OF STANDARD ORDNANCE ITEMS

OFFICE OF THE CHIEF OF ORDNANCE

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— see inside cover

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Technical Division

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ARTILLERY—SUBMARINE MINES—SIGHTING AND FIRE CONTROL INSTRUMENTS

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AIRCRAFT ARMAMENT

MOBILE ARTILLERY

60 MM MORTAR M2—MOUNT M2—STANDARD

The 60 mm Mortar, M2, is of French origin, developed by the Edgar Brandt Company, but manufactured in the United States under rights purchased from the Brandt organization. Its design has been altered and improved to conform to our standards. In addition to its normal function, it is now utilized as a projector for the illuminating shell, M83, employed to disclose aerial targets at night.

MORTAR, M2—The mortar consists of the barrel, base cap and firing pin. The base cap, ending in a spherical projection which fits into a socket in the base plate, is screwed to the breech end of the smooth-bored barrel. The firing pin fits in the base cap, which is bored and threaded axially to receive it.

MOUNT, M2—The bipod mount comprises the leg, elevating mechanism and traversing mechanism assemblies. The leg assembly consists of two tubular steel legs connected by a clevis joint attached to the elevating screw guide tube. Spread of the legs is limited by the clevis joint, which is provided with a spring latch to lock the legs in the open position. The legs terminate in spiked feet. The left leg has a cross-leveling mechanism consisting of a sliding bracket connected by a link to the elevating screw guide tube.

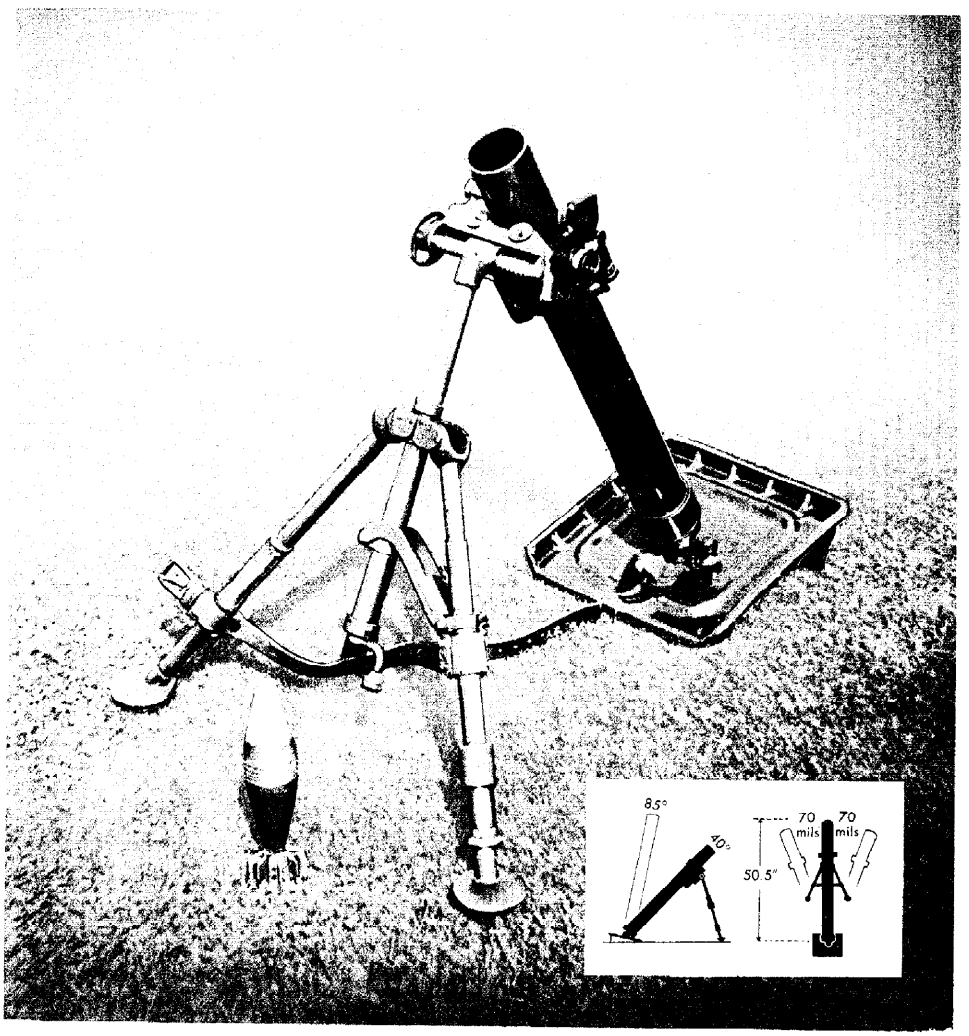
The elevating mechanism assembly consists mainly of an elevating screw nut which moves vertically on a screw within a guide tube, the elevating screw being actuated by a crank attached to its lower end.

The traversing mechanism consists of a horizontal screw operating in a yoke and actuated by a traversing handwheel.

The sight bracket fits in a dovetail slot provided in the yoke.

The barrel is clamped to the bipod by means of a clamping collar and saddle, shock absorbers being used to stabilize the mortar and mount during firing.

The base plate consists of a pressed steel body to which are welded a series of ribs and braces, a front flange and a socket. A locking lever fastens the spherical projection of the base cap in the socket.



60 mm MORTAR, M2, IN FIRING POSITION, WITH SHELL, M49A2

Sighting and Fire Control Equipment

Sight (Collimator), M4

Ammunition

Projectile and propelling charge are in one unit constituting a complete round. The shell is furnished with stabilizing fins and a nose fuze. Propelling charges are divided into parts to provide for zone firing.

REFERENCES—TM 9-2005, v.3; FM 23-85.

PRINCIPAL CHARACTERISTICS

MORTAR, M2

Weight of Mortar, M2, and Mount, M2	42.0 lb.
Weight of mortar	12.8 lb.
Overall length of mortar	28.6 ins.
Diameter of bore	2.36 ins.
Rate of fire, maximum	30 to 35 rds./min.
Rate of fire, normal	18 rds./min.

MOUNT, M2

Weight of mount	29.2 lb.
Weight of bipod	16.4 lb.
Weight of base plate	12.8 lb.
Elevations, approximate	40° to 85°
Mortar clamp position A	40° to 65°
Mortar clamp position B	45° to 70°
Mortar clamp position C	50° to 85°
Maximum traverse, right	70 mils
Maximum traverse, left	70 mils

AMMUNITION

Shell	Range, Approximate
H.E., M49A2	100 to 1,985 yds.
Illuminating, M83	
Training, M69	

81 MM MORTAR M1—MOUNT M1—STANDARD

During the first World War, the standard mortar adopted by the U. S. Army for infantry use as an indirect fire weapon was the British 3″ Stokes trench mortar, Mk. I. Designs for a new mortar were started in 1920, but were abandoned in favor of attempts to improve bomb vanes in an effort to attain greater accuracy. While these tests were under way, the French firm of Edgar Brandt succeeded in developing a refined version of the Stokes mortar, together with suitable ammunition, which satisfied the requirements of the U. S. War Department. After tests of the Stokes-Brandt mortar and mount were completed successfully by the Ordnance Department, and the using arms, manufacturing rights were purchased from the Brandt Company.

The 81 mm Mortar, M1, has a heavier barrel than the Stokes, Mk. I, and a heavier base plate of new design. It also has a greater range and a higher rate of fire.

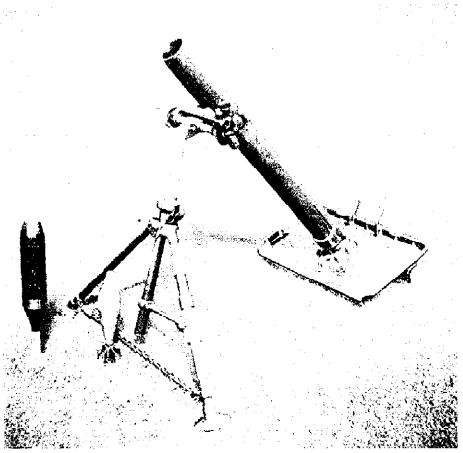
MORTAR, M1—The complete weapon consists of a barrel, bipod and base plate. The barrel is demountable from the bipod to form one load, while the bipod and base plate comprise two loads. Each load is light enough to be carried by one man. The smooth-bore muzzle-loading barrel is a seamless drawn-steel tube fitted at the breech end with a base cap within which is secured a firing pin protruding into the barrel.

MOUNT, M1—The mount consists of a base plate and a tubular steel bipod formed by two legs attached to a center trunnion by means of a compass joint. The left leg carries a cross-leveling mechanism which consists of a sliding bracket connected with the guide tube by a connecting rod. The mortar clamp, in two sections, clamps the barrel to the bipod and can be adjusted to three positions on the barrel.

The base plate is a rectangular pressed-steel body to which are welded a series of ribs and braces, a front flange, three loops, two handle plates and a socket for the spherical end of the tube base cap.

Sighting and Fire Control Equipment

Each mortar is equipped with a sight which includes a collimator, elevating and lateral deflection mechanisms, and longitudinal and cross-levels. The sight



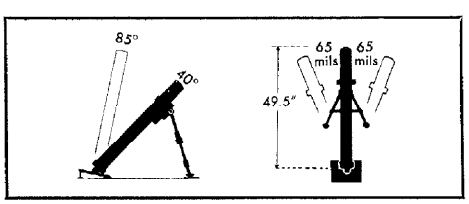
81 mm MORTAR, M1, IN FIRING POSITION, WITH SHELLS, M43 AND M56

mechanism, supported by a bracket fitted into the mortar yoke, provides accurate laying for elevation and deflection.

Sight, M4, and Aiming Posts, M7, M8 and M9, are used with the 81 mm mortar.

Transportation

The 81 mm mortar can be carried by two men or can be transported on Hand Cart, M6A1. It is also part of the armament of the Half Track 81 mm Mortar Carrier, M4.



Ammunition

Stabilization in flight is obtained by fins on the shell which cause the projectile to strike nose first. A point-detonating impact type of fuze is fitted to the nose of the shell. The propelling charge attached to the base end of the projectile consists of an ignition cartridge and propellant increment. The increments of the charge are removable to provide for zone firing.

REFERENCES—TM 9-2005, v.3; TM 9-1260.

PRINCIPAL CHARACTERISTICS

MORTAR, M1

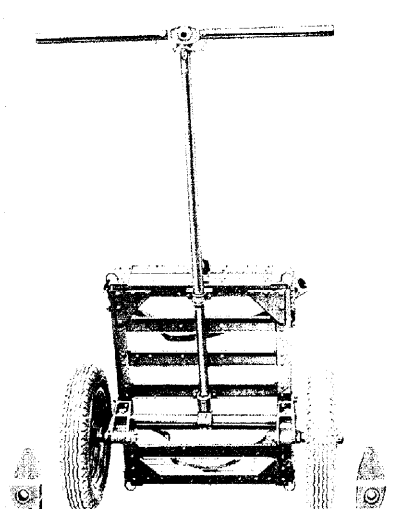
Weight of Mortar, M1, and Mount, M1	136.0 lb.
Weight of mortar	44.5 lb.
Overall length of mortar	49.5 ins.
Diameter of bore	3.2 ins.
Rate of fire, maximum	30 to 35 rds./min.
Rate of fire, normal	18 rds./min.

MOUNT, M1

Weight of mount	91.5 lb.
Weight of bipod	46.5 lb.
Weight of base plate	45.0 lb.
Elevations, approximate	40° to 85°
Mortar clamp position A	40° to 70°
Mortar clamp position B	50° to 80°
Mortar clamp position C	55° to 85°
Maximum traverse, right	65 mils
Maximum traverse, left	65 mils

AMMUNITION

Weight	Ranges, Approximate
H.E. shell, M43A1, 6.87 lb.	100 to 3,290 yds.
M36, 10.62 lb.	300 to 2,558 yds.
Chemical shell, M57, 10.75 lb.	300 to 2,470 yds.



HAND CART, M6A1

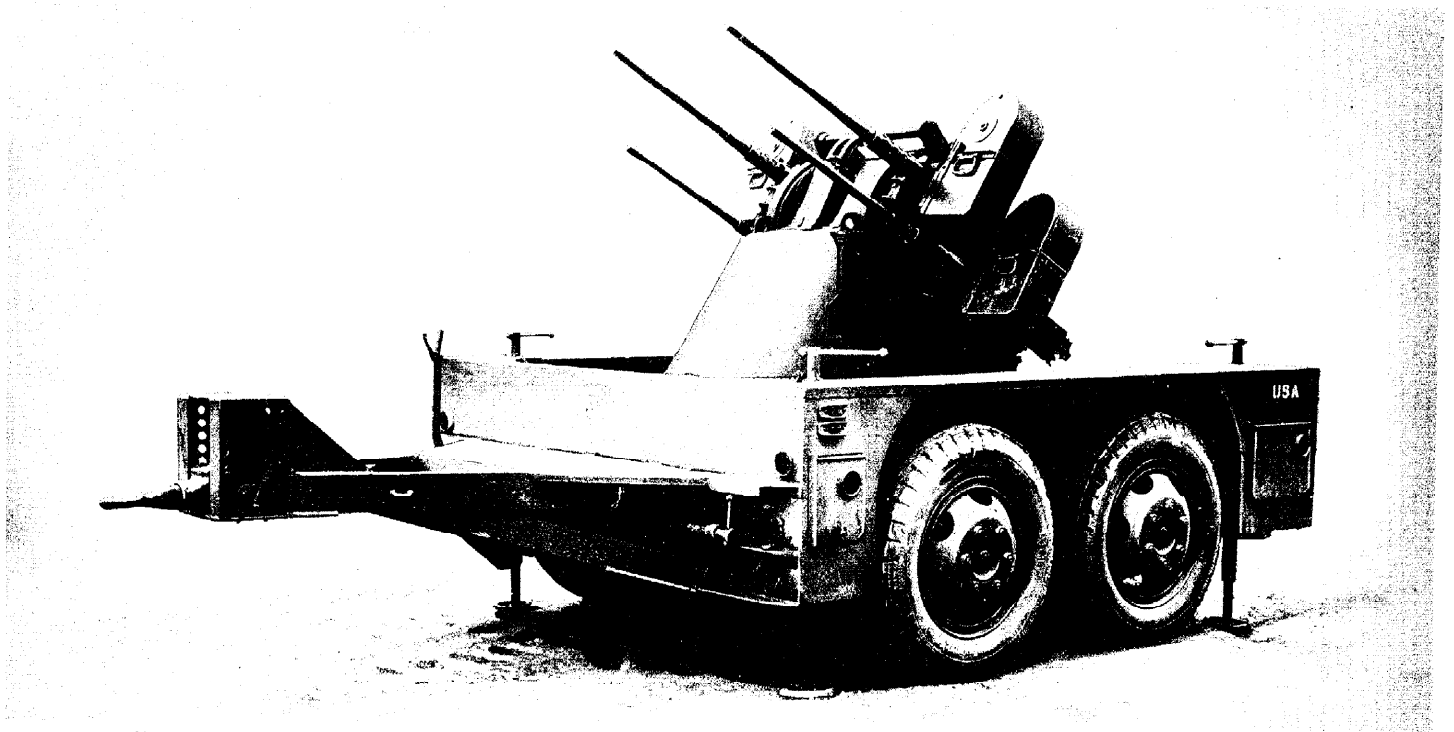
HAND CART, M6A1 STANDARD

The Hand Cart, M6A1, is a utility vehicle which differs from the basic Hand Cart, M3A4, only in the addition of suitable brackets and straps to adapt it for transport of the 81 mm mortar. It can also be used as an ammunition cart for the 37 mm Gun, M3A1, the 60 mm mortar, or the 81 mm mortar.

CHARACTERISTICS

Overall length (including pole)	69.5 ins.
Dimensions of body	24 ins. x 32 ins. x 5 ins.
Overall width	39.1 ins.
Weight	70.8 lb.
Tire Size	4 ins. x 12 ins.

MULTIPLE CAL. .50 MACHINE-GUN CARRIAGE M51—STANDARD



MULTIPLE CAL. .50 MACHINE-GUN CARRIAGE, M51 (MULTIPLE CAL. .50 MACHINE-GUN MOUNT, M45, ON TRAILER MOUNT, M17)

Mobile and semi-mobile automatic weapons battalions armed with the Caliber .50 Machine Gun, M2, on the Mount, M3, lacked firepower for effective action against enemy attack aviation. In order to provide an antiaircraft weapon of concentrated firepower which could be used for convoy defense, the Multiple Caliber .50 Machine-Gun Carriage, M51, was designed and standardized.

The Multiple Machine-Gun Carriage, M51, is composed of the Multiple Caliber .50 Machine-Gun Mount, M45, with four Caliber .50 Browning Machine Guns, HB, M2, on the Mount, Trailer, M17. The carriage is drawn by a prime mover.

The Mount, M45, is a power-driven, armored gun mount with a self-contained power unit. It can be traversed through 360°, and elevated from −10° to +90°. Firing of the guns and movement of the mount are controlled from a pair of hand grips in front of the gunner's seat within the mount.

All the rotatable elements of the mount are located in a turret which rests on a welded steel base plate anchored to the floor of the trailer. A centrally located gunner's seat is situated between two trunnion sectors which carry the guns and ammunition chests. A sight base—in the center of which is the Navy Reflector Sight, Mk. IX, the control handle, and the firing switch—extends over the gunner's head from one trunnion to the other and moves with the trunnions.

Two Caliber .50 Browning Machine Guns, HB, M2, are mounted outboard on each trunnion. An ammunition Chest, M2, with a capacity of 200 rounds, is mounted outboard of each gun. The guns are normally fired electrically by solenoids, but may be fired by a hand-firing mechanism on each gun in the event of power failure.

A variable speed drive unit beneath the mount turntable drives the mount in elevation and azimuth at speeds from 0° to 60° per second. The variable speed drive obtains its power from two heavy-duty 6-volt storage batteries in the rear of the mount. These batteries are charged by a 300-watt, 12-volt, gasoline motor-driven charger located beside the batteries.

PRINCIPAL CHARACTERISTICS OF MOUNT, M45

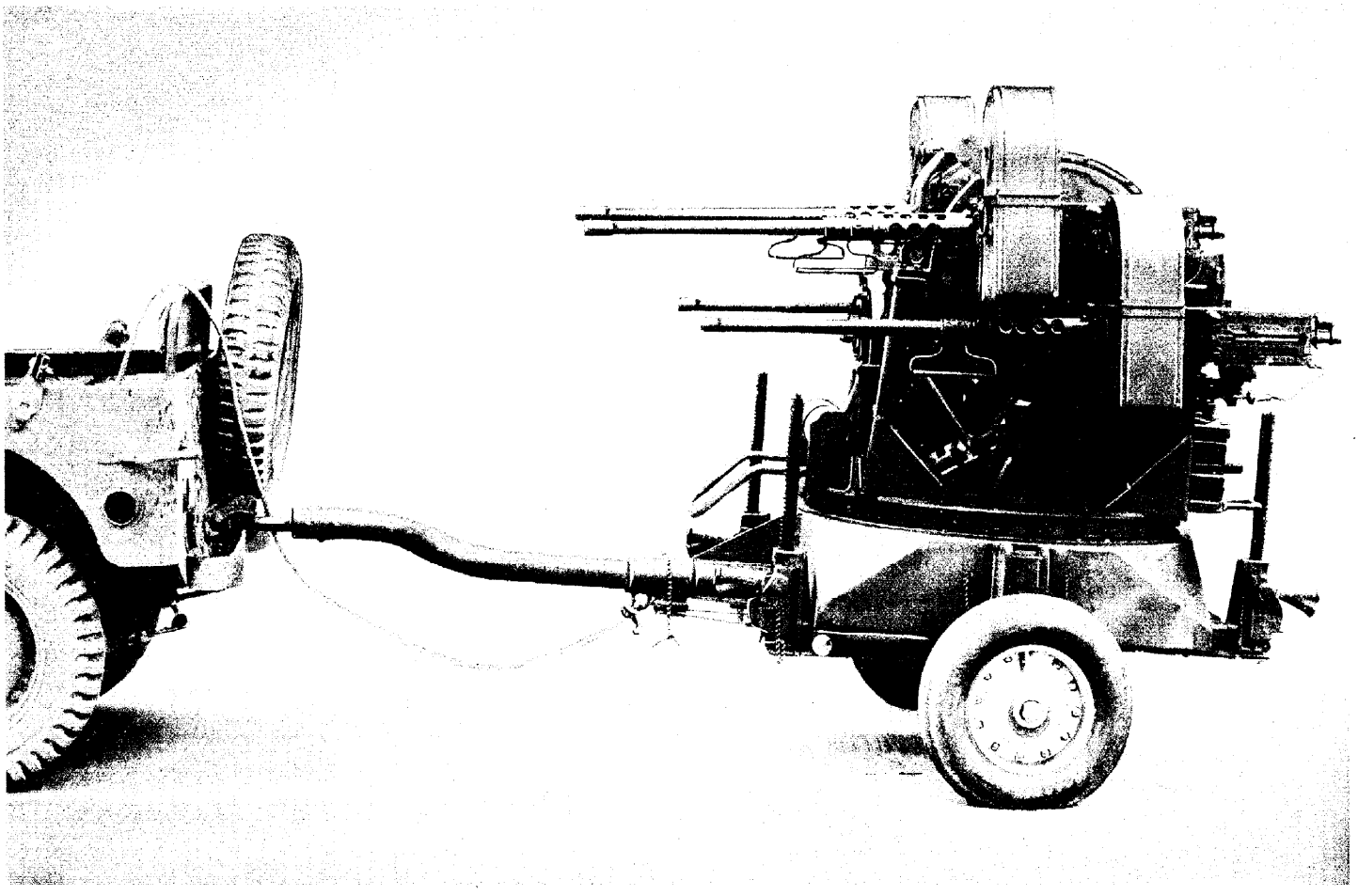
Weight, without armor, guns, ammunition chests, fuel, and operator	1,468 lb.
Weight, fully equipped, including gunner (approx.)	2,396 lb.
Weight of armor	132 lb.
Overall width	79½ ins.
Overall height (guns level)	4 ft., 7 ins.
Power drive	Maxson Var. Speed Drive, Model 120A with 1-hp., 12-volt, 90-amp. electric motor
Weight of power drive	139 lb.
Power charger	Briggs & Stratton, Model 304, type 25592, driven by a 1-cylinder, 4-cycle gasoline motor
Charger output	300 watts, 15 volts
Weight of power charger	75 lb.
Batteries, storage, lead, acid, 3-cell, 17 plates per cell (6 volts each)	2
Armament, Cal. .50, HB, M2, Fixed Browning Machine Guns, mounted outboard on right and left trunnions	4
Ammunition	Cal. .50, 800 rounds (200 rounds each in Cal. .50 Ammunition Chests, M2, mounted outboard on guns)
Azimuth speed	0° to 60° per sec.
Elevation speed	0° to 60° per sec.

A removable shield of armor plate, with hinged doors on the top, fits between the trunnion to provide protection for the gunner and the driving mechanisms.

The Trailer Mount, M17, is a short coupled, 4-wheel type vehicle. It is a modification of the General Trailer, M7, used to transport Generating Unit, M7, in Antiaircraft Gun Battalions. Jacks at each corner of the trailer allow it to be emplaced firmly for firing.

REFERENCES—OCM 17969; OCM 18020; OCM 18845; OCM 18964; OCM 19140; TM 9–222.

MULTIPLE CAL. .50 MACHINE-GUN TRAILER MOUNT M55—STANDARD



MULTIPLE CALIBER .50 MACHINE-GUN TRAILER MOUNT, M55, IN TRAVELING POSITION ATTACHED TO ¼-TON 4 X 4 TRUCK

The Multiple Caliber .50 Machine-Gun Trailer Mount, M55, was designed as an antiaircraft ground mount to be transported by airplane. It consists of the Multiple Caliber .50 Machine-Gun Mount, M45C, mounted on the Trailer Mount, M20.

The Multiple Caliber .50 Machine-Gun Mount, M45C, is identical with the Multiple Caliber .50 Machine-Gun Mount, M45, used with the Multiple Caliber .50 Machine-Gun Carriage, M51, except for a special armor shield protecting the mechanism and the gunner.

Armament consists of 4 Browning Caliber .50 Machine Guns, HB, M2, with a rate of fire of 450 to 575 rounds per minute for each gun. Two guns with their ammunition chests are mounted outboard of each trunnion. The gunner sits between the trunnions, from which position he controls the movement of the mount and the firing of the guns through the medium of a handlebar control.

Elevation is from −9° to +90°. A continuous traverse of 360° is possible for the power-operated turret. Power for the elevating and traversing mechanisms is supplied by two truck type 6-volt storage batteries connected in series to furnish 12 volts to the constant speed drive motor. Two differentials, each driven by two Reeves split pulley variable speed drives, permit variation in speed of the elevation and traverse gears. Deflection of the handlebar control governs the speed of the pulleys. Movement of the output shaft of the differential is in proportion to the amount of speed change of the pulleys. Rates of tracking in both elevation and traverse are from a minimum of ¼° per second to a maximum of 60° per second.

The Trailer Mount, M20, is a portable two-wheeled mount that may be moved for short distances by hand or by a prime mover. It is capable of stowage in a CG–4A Glider or a C47 Transport Airplane. The removable pneumatic-tired wheels are equipped with hydraulic brakes. Mechanical jacks allow the mount to be emplaced and leveled in firing position when the wheels are removed. A steel pole extends from the front of the mount and ends in a lunette for attachment to the pintle of a prime mover. Tow ropes are supplied for aid in manual manipulation of the mount.

REFERENCES—OCM 22521; OCM 22117; OCM 21716; OCM 20241; OCM 20025.

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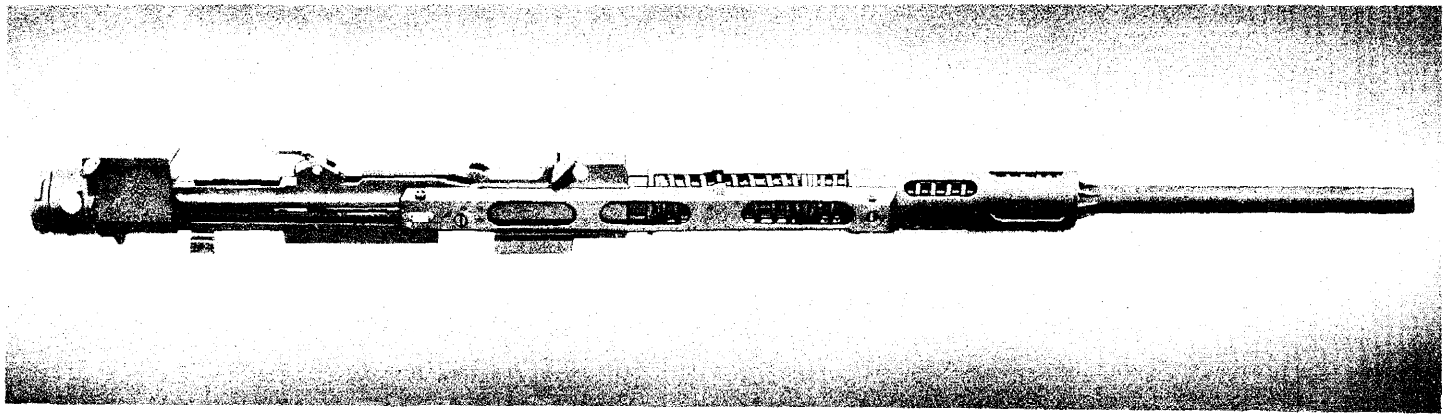
20 MM AUTOMATIC GUN MK. IV—STANDARD



20 mm AUTOMATIC GUN, MK. IV (Oerlikon)

The 20 mm Automatic Gun, Mk. IV, for close-range, high-angle fire, is the Swiss Oerlikon Gun as manufactured in England and adapted to American manufacturing limits.

The Mk. IV Oerlikon will operate automatically so long as the trigger is held back in the firing position or there is a cartridge in the magazine. Ejection is automatic, and the gun is furnished with a safe-fire gear. The cyclic rate is approximately 450 rounds per minute.

The gun is composed of recoiling and nonrecoiling parts. The recoiling parts comprise the breech bars and springs, and the barrel spring with its casing. The nonrecoiling parts consist of the barrel, mounted on the breech casing; the breech casing; various stops; a locking gear, and the trigger group.

The barrel is of forged steel, with fins outside the outer section to support the barrel spring and permit air circulation for cooling. The first two inches of the muzzle flare outward as a flash shield. The barrel can be readily removed and replaced by a new barrel.

A detachable drum-type magazine with a capacity of 60 rounds is carried on top of the breech casing.

The Oerlikon employs the force of the explosion to check and reverse the movement of a relatively heavy breechblock that is never locked. This breechblock recoils and counterrecoils with a purely reciprocating motion. The barrel spring alone tends to keep the breechblock closed.

Before opening fire, the breechblock is pulled back until the sear is held by the trigger hook, compressing the barrel spring and causing a pull on the recoiling parts. Pressure on the trigger releases the breechblock, which is then moved forward by the barrel spring. The forward-moving breechblock picks up a round from the magazine and seats it in the chamber. Just before the block reaches its fully forward position the hammer-operated striker pin fires the round.

When the round is fired the gas pressure first absorbs the forward momentum of the barrel and then blows it backward until the compressed barrel spring checks its movement. At full recoil the barrel is to the rear of the position at which it is caught by the trigger hook. As each round is fired the empty cartridge case is blown from the chamber, upon which the case is tipped out of the breech face by striking against an ejector in the breech casing.

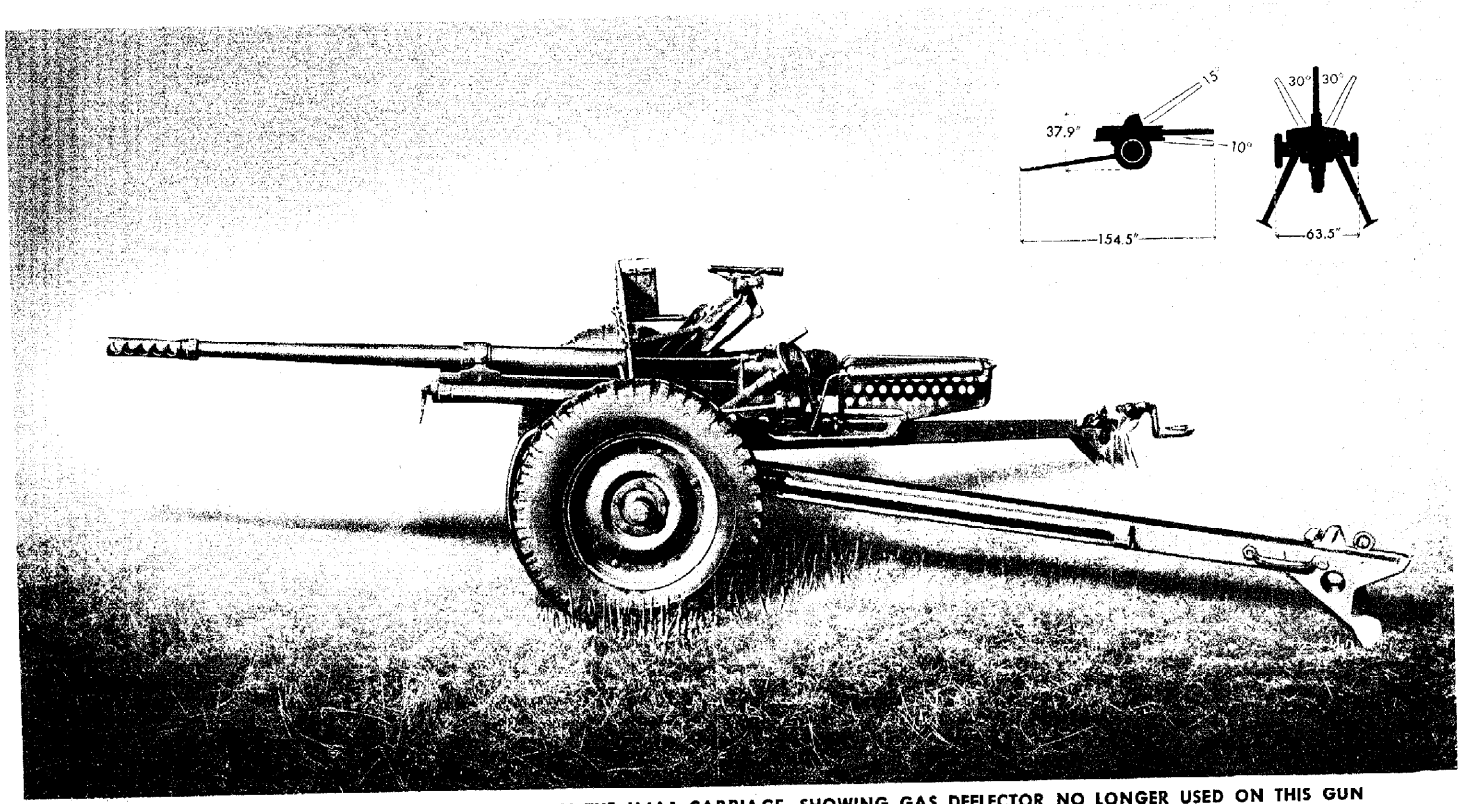
When all rearward momentum has been absorbed the barrel is again brought forward by the counterrecoil action of the barrel spring. On its way forward the breechblock picks up the next round from the magazine.

AMMUNITION—Ammunition is in the form of complete fixed rounds. It consists of Shell, H.E., Mk. IV, with tracer, and H.E., Mk. III, without tracer.

PRINCIPAL CHARACTERISTICS

Weight of gun	147 lb.
Weight of tube	37 lb.
Rate of fire, rds./min	390–500; aver. 450 (approx.)
Muzzle velocity	2,725 f./s.
Pressure	48,160 lb./sq. in.
Length, overall	87 ins. w/o shoulder rest 97 ins. with " "
Number of lands and grooves	9
Rifling	1 in 36 uniform
Length of rifling	48.728 ins.
Cooling system	Air
Principle of operation	Blowback
Magazine	60 round
Weight of round	H.E., Mk. IV, with tracer—.514 lb. H.E., Mk. III—.526 lb.
Weight of projectile	H.E., Mk. IV, with tracer—.2621 lb. H.E., Mk. III—.2714 lb.
Weight of charge	H.E., Mk. IV, with tracer—.060 lb. H.E., Mk. III—.0626 lb.

37 MM ANTITANK GUN M3A1—CARRIAGE M4A1—STANDARD



LEFT SIDE VIEW OF THE 37 mm GUN, M3A1, ON THE M4A1 CARRIAGE, SHOWING GAS DEFLECTOR NO LONGER USED ON THIS GUN

PRINCIPAL CHARACTERISTICS

GUN, M3A1

Weight	191 lb.
Length (overall) of gun	6 ft., 10½ ins.
Length of bore	53.5 calibers
Muzzle velocity	2,900 f./s.
Volume of chamber	19.92 cu. ins.
Travel of projectile in bore	69.95 ins.
Maximum powder pressure	50,000 lb./sq. in.
Type of mechanism	Drop block
Rate of fire (approximate)	25 rds./min.
Range	12,850 yds.

RECOIL MECHANISM

Type	Hydrospring
Weight	77½ lb.
Normal recoil (− 1 in. + ½ in.)	20 ins.
Maximum recoil	20½ ins.
Spring pressure (average)	217 lb.
Maximum piston-rod pull	6,000 lb.

CARRIAGE, M4A1

Total weight without gun	721 lb.
Height of lunette (limbered position)	29½ ins.
Length of carriage from muzzle to lunette	154½ ins.
Width over hub caps	63½ ins.
Height (traveling position)	37⅞ ins.
Trail spread (maximum) (included angle)	60°
Elevation (maximum), carriage on wheels	15°
Depression (maximum), carriage on wheels	−10°
Traverse (maximum, right)	30°
Traverse (maximum, left)	30°

AMMUNITION

	M63, H.E.	M74, A.P.	M51B2, A.P.C.
Weight of complete round	3.13 lb.	3.14 lb.	3.43 lb.
Weight of projectile (as fired)	1.61 lb.	1.92 lb.	1.92 lb.
Weight of bursting charge	.085 lb.	.0 lb.	.0 lb.
Weight of powder charge	.49 lb.	.32 lb.	.53 lb.
Type of ammunition	Fixed	Fixed	Fixed
Muzzle velocity	2,600 f./s.	2,900 f./s.	2,900 f./s.
Armor penetration homogeneous plate 20° from normal— 500 yds.		1.4 ins.	2.4 ins.
1,000 yds.		1.0 in.	2.1 ins.

The 37 mm guns are the lightest weapons of the field-gun type used in the U.S. Army. The original 37 mm gun supplied to the U.S. Army in 1917–18 was the M1916, of French design. It was a comparatively low-velocity weapon not suited for antitank employment.

The 37 mm Gun, M1916, is classified as Limited Standard for manufacture, but as Standard for issue, with its cradle, as subcaliber equipment. The Carriages, M1916, M1916A1 and M1916A2 are also Limited Standard.

The desirability of a light, highly mobile antitank gun, using armor-piercing and high-explosive shells, resulted in the production of the 37 mm antitank matériel whose design features closely resemble the German Rheinmetall weapon.

The 37 mm Antitank Gun, M3, represents the most powerful piece that has been manufactured to weigh less than 1,000 pounds. Recent developments in ammunition have increased the muzzle velocity from 2,600 feet per second to 2,900 feet per second, with consequently greater armor penetration.

GUN, M3—The rifled barrel is a one-piece forging threaded to screw into a breech ring recessed for a vertically sliding block which is operated manually. The recoil system is of the hydrospring type, including a buffer mechanism which prevents possible damage to the weapon due to sudden stopping of the recoiling parts. The estimated life of the gun at normal pressure is approximately 2,500 rounds.

GUN, M3A1—Addition of gas deflectors to the M3 gun changed its designation to M3A1. These gas deflectors were subsequently removed, but all 37 mm, M3, guns with muzzles threaded for gas deflectors are now designated M3A1.

CARRIAGE, M4—This carriage has a split trail and pneumatic tires. It can be towed by a prime mover on roads or across country, and by its crew. Elevating and traversing mechanisms are attached to the mount. Adjustments in traverse are normally made by the use of the traversing handwheel, although a traversing release handle allows rapid changes in traverse through free movement of the gun. The handle must be held in position during free traverse, for on release of the handle the gun is automatically locked to the traversing mechanism.

In order to increase stability of the gun during firing, wheel segments which swing on the axle raise the tires off the ground. The segments are locked in both travel and firing positions by a handle-actuated plunger.

The Telescope, M6, is held in position by the Telescope Mount, M19, which is attached to the gun carriage by means of a bracket, assuring movement of the sight with the gun during traverse.

While a 37 mm gun squad consists of six men, the Carriage, M4, is designed for one-man control of aiming, elevating, traversing and firing.

Carriage, M4, is classified as Limited Standard.

CARRIAGE, M4A1—This carriage is identical with the Carriage, M4, except that for quick adjustment of the gun in traverse a release mechanism permits traverse to be effected by pressure of the right shoulder and arm against the shoulder traversing bar so long as the traversing release handle is locked to the rear. With the traversing release handle in its forward position, the gun may be traversed by use of a traversing knob.

The classification of this carriage is Standard.

Sighting and Fire Control Equipment

On Carriage Equipment

Telescope, M6
Telescope Mount, M19

Off Carriage Equipment

Lensatic compass
Bore sight

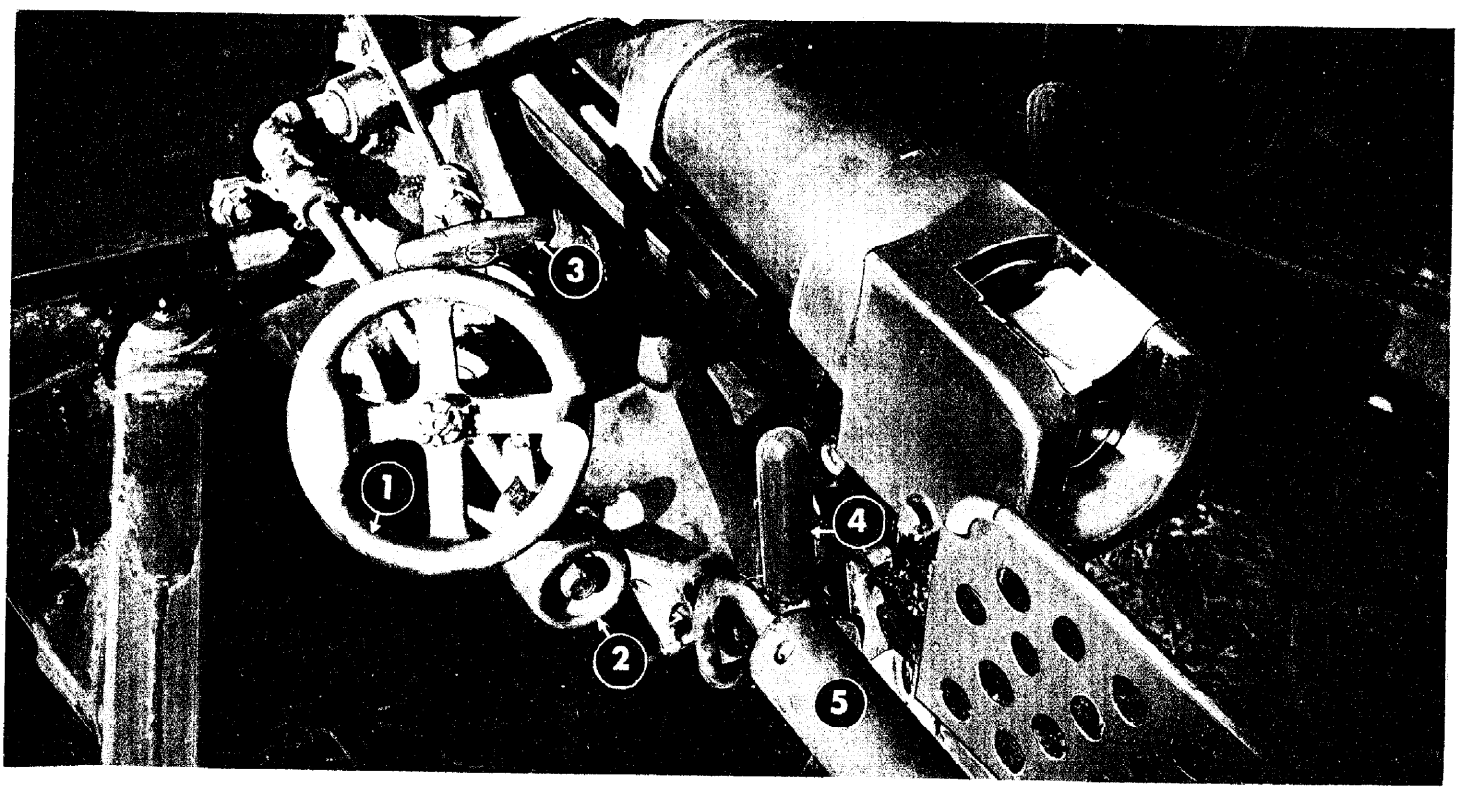
Ammunition

Ammunition for the 37 mm gun is in the form of fixed rounds. It consists of A.P.C. Shot, M51B1, with tracer; H.E. Shell, M63, with B.D. fuze, M58; canister, M2; A.P. Shot, M74, with tracer; T.P. Shot, M51, with tracer, and Drill Cartridge, M13.

Trainers

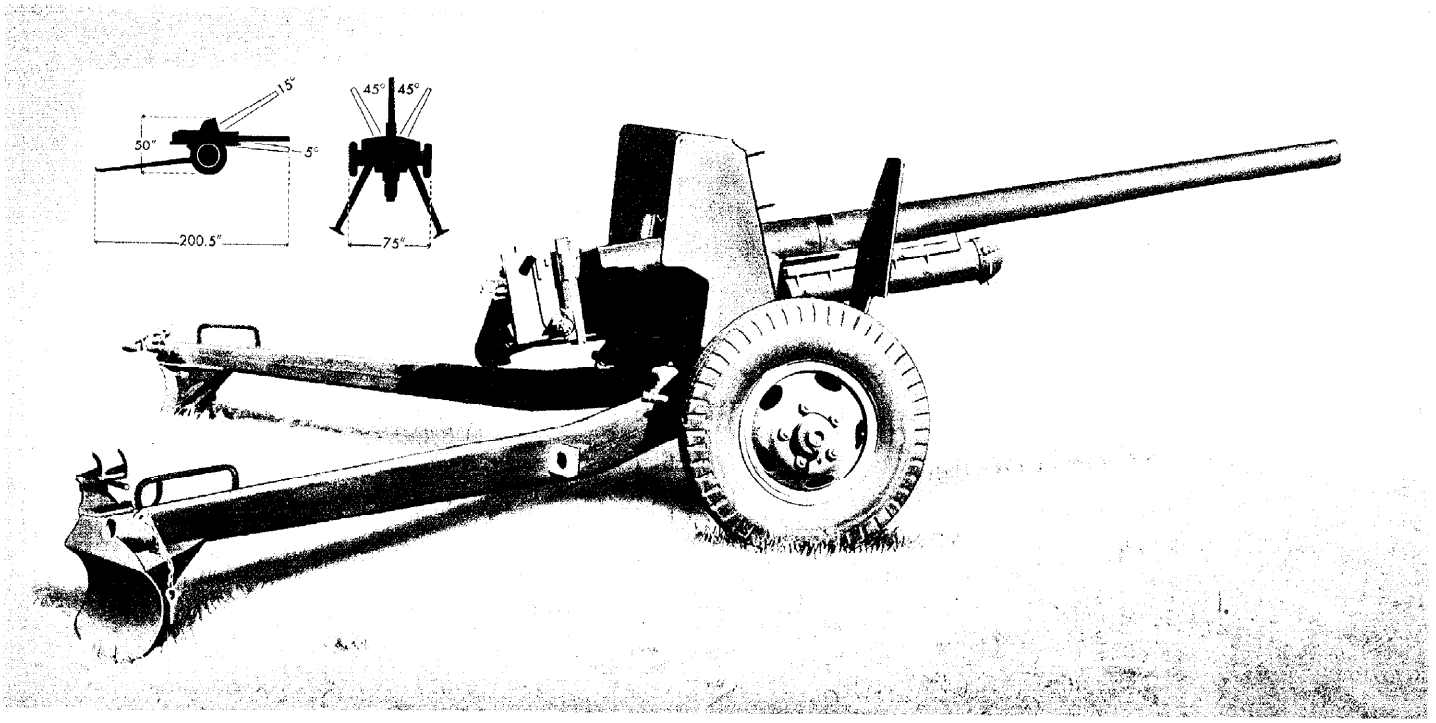
Subcaliber equipment for 37 mm guns comprises the rifle, subcaliber, cal. .22, M2A1, and the rifle, subcaliber, cal. .30, M1903A2, both minus the stock and front and rear sights, together with mount, subcaliber, cal. .22–.30, M6. Rifles and mount are classified as Standard.

REFERENCES—FM 23-70; TM 9-2005, v.3.



BREECH VIEW OF 37 mm GUN, M3A1, Showing (1) Elevating Wheel; (2) Traversing Wheel; (3) Traversing Lock and Lever; (4) Trigger-actuating Handle; (5) Shoulder and Arm Traversing Bar

57 MM ANTITANK GUN M1—CARRIAGE M1A3—(BRITISH) SUBSTITUTE STANDARD



57 mm ANTITANK GUN, M1, ON CARRIAGE, M1, IN FIRING POSITION; CARRIAGE, M1A3, IS CARRIAGE, M1, WITH MINOR MODIFICATIONS

British battle experience indicated the need for a light gun more powerful than the 2-pounder (37 mm) which could be employed as an antitank weapon or be mounted in a tank or gun motor carriage. This requirement was met by the 6-pounder gun, standardized in America for Lend-Lease manufacture as the 57 mm Gun, M1.

O.C.M. 16489, dated 20 February 1941, authorized the preparation of drawings of the British 6-pounder gun, carriage and on-carriage fire control equipment converted to American gears, threads and tolerances. On 15 May 1941, O.C.M. 16722 recommended standardization of the British-American 57 mm matériel as Gun, M1, Carriage, M1, Telescope, M18, and Telescope Mount, M24.

Modifications were made to the M1 Carriage which culminated in the present Carriage, M1A3. These changes included substitution of free traverse for gear traverse, and new lunette, drawbar, and trail lock assemblies.

Ammunition

Ammunition for the 57 mm, M1, Gun is in the form of fixed rounds. It consists of A.P. Projectile, M70.

PRINCIPAL CHARACTERISTICS

GUN, M1

Weight of gun	755 lb.
Overall length	117 ins.
Length of bore	50 cals.
Muzzle velocity	2,700 f./s.
Volume of chamber	100 cu. ins.
Travel of projectile in bore	96 ins.
Maximum powder pressure	46,000 lb./sq. in.
Breech mechanism	Vertical sliding wedge
Rate of fire (approximate)	30 rds./min.
Rifling	Right-hand; 1 turn in 30 cals.
Range	10,260 yds.

RECOIL MECHANISM, M1

Type	Hydrospring
Weight, with slipper	373 lb.
Normal recoil (−1 in. + ½ in.)	29¾ ins.
Maximum recoil	31½ ins.

CARRIAGE, M1A3

Total weight without gun	1,945 lb.
Height of lunette (limbered position)	22 ins.
Length of carriage (muzzle to lunette)	200½ ins.
Width over hub caps	75 ins.
Height (traveling position)	50 ins.
Trail spread (maximum) (included angle)	90°
Elevation (maximum), carriage in firing position	15°
Depression (maximum), carriage in firing position	−5°
Traverse (maximum, right)	45°
Traverse (maximum, left)	45°
Width of tread (c/l—c/l of wheels)	57.7 ins.

AMMUNITION

Weight of complete round A.P., M70	12.56 lb.
Weight of projectile (target practice or armor piercing)	6.28 lb.
Weight of powder charge (approximate)	2.25 lb.
Type of ammunition	Fixed
Armor penetration—homogeneous plate 20° from normal— 500 yds.	3.4 ins.
1,000 yds.	2.7 ins.
2,000 yds.	1.9 ins.

Sighting and Fire Control Equipment

On Carriage Equipment

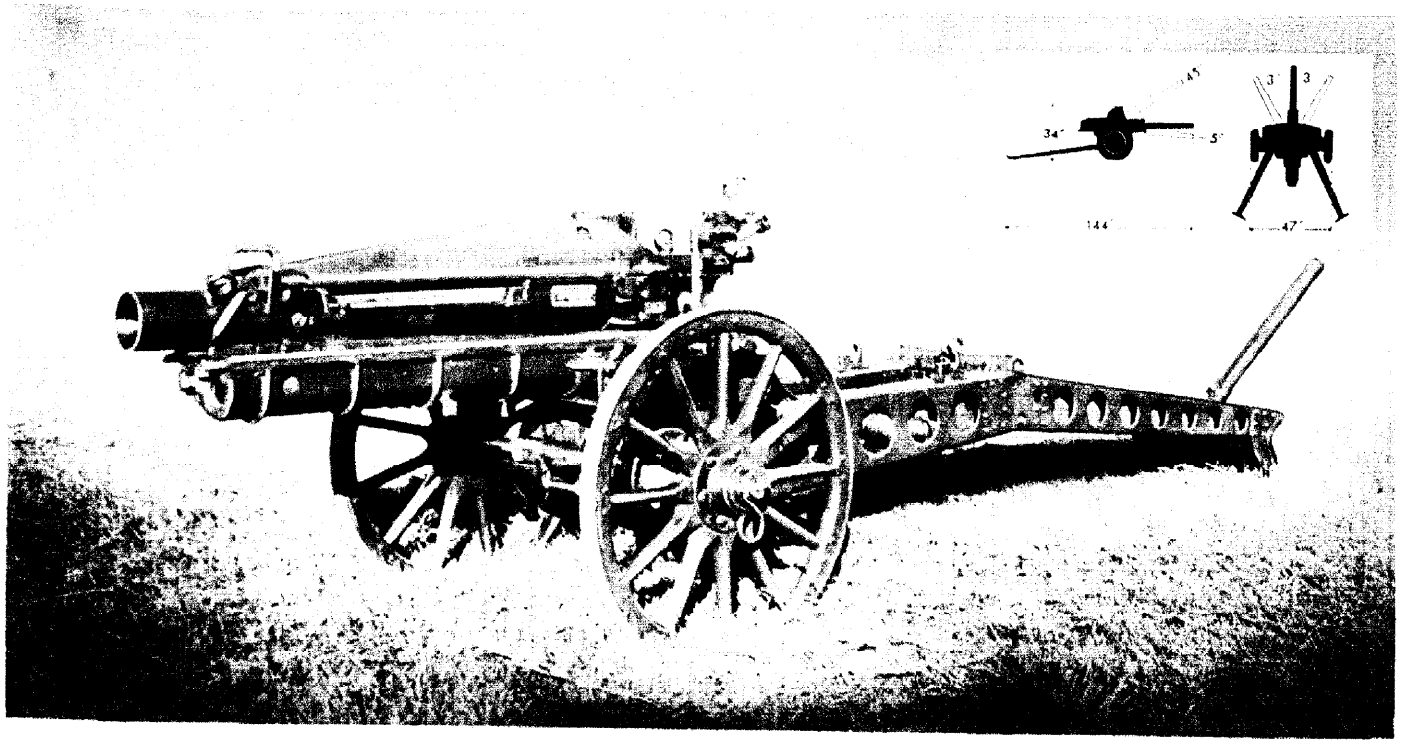
Telescope, M18
Telescope Mount, M24A1

Off Carriage Equipment

Gunner's Quadrant, M1

REFERENCES—TM 9-2005, v. 5; TM 9-303.

75 MM PACK HOWITZER M1A1—CARRIAGES M1, M8—STANDARD



75 mm PACK HOWITZER, M1A1, ON CARRIAGE, M1

The 75 mm pack howitzer was originally designed for pack transport, animal draft, and low-speed towing. Animal draft has been discontinued and the special accessories made obsolete. In modified form it has been adopted for many uses.

Development of the weapon, begun in 1920, culminated in standardization of the M1 in 1927. Slight changes in the M1 were made later, and the new model given the designation of M1A1. The primary use of this howitzer was for operation in mountainous terrain. With the round H.E., A.T., M66, the M1A1 howitzer is capable of engaging antitank targets, as the projectile will penetrate 3 inches of armor plate at howitzer range.

HOWITZER, M1 The Howitzer, M1, consists of a tube assembly and a breech mechanism, joined by interrupted threads for rapid assembly and disassembly. The breechblock is of the hand-operated, sliding-wedge type. Firing is accomplished by a continuous-pull mechanism known as Firing Lock, M13. The tube and breech mechanism comprise two loads for transport.

HOWITZER, M1A1—This howitzer differs from the M1 only in slight modifications of the breech ring and the breechblock. These parts are not interchangeable in the two models.

PACK HOWITZER CARRIAGE, M1—This carriage is separated into six loads for pack transport. It has a hydropneumatic recoil system composed of a recoil cylinder and a recuperator cylinder connected with the bottom sleigh which forms a seat for the howitzer and maintains alinement of the tube and breech ring when assembled. A top sleigh covers the howitzer and retains it in the bottom sleigh. Steps on the bottom sleigh are fitted to ways on the cradle, and the recoil-cylinder piston rod is connected to the cradle by means of the piston rod latch. In recoil and counterrecoil, the cylinders and bottom sleigh move with the howitzer, while the cradle remains stationary.

Traverse is along the axle, accom-

PRINCIPAL CHARACTERISTICS OF 75 mm PACK HOWITZER, M1A1, AND CARRIAGE, M1

HOWITZER

Caliber	75 mm
Weight	341 lb.
Overall length	52 ins.
Length of bore	15.93 cals.
Muzzle velocity	700, 810, 950, 1,250 f./s.
Volume of chamber	57.3 cu. ins.
Travel of projectile in bore	39.2894 ins.
Maximum powder pressure	26,000 lb./sq. in.
Type of block mechanism	Sliding block
Rate of fire	6 rds./min.
Range, Shell, M41A1	9,760 yds.

RECOIL MECHANISM

Type	Hydropneumatic
Weight	211 lb.
Normal recoil	32 ins.
Maximum recoil	33.65 ins.
Maximum piston-rod pull	5,188 lb.

CARRIAGE, M1

Total weight without howitzer	927 lb.
Length of carriage (muzzle to spade)	144 ins.
Width over hub caps	47 ins.
Maximum height at 0°	35 ins.
Type box trail	Axle traverse
Elevation (maximum)	45°
Depression (maximum)	−5°
Traverse (right)	3°
Traverse (left)	3°
Total weight of howitzer, recoil mechanism, and carriage in firing position	1,269 lb.

AMMUNITION

	M41A1	M48	H.E., A.T., M66
Weight of complete rounds	17.32 lb.	18.12 lb.	16.3 lb.
Weight of projectile	13.76 lb.	14.60 lb.	13.27 lb.
Weight of projectile explosive charge	1.11 lb.	1.47 lb.	1 lb.
Weight of propelling charge		.92 lb.	.41 lb.
Type of ammunition			semi-fixed

plished by a traversing nut operated by a handwheel.

Rockers, which pivot on trunnion pins, are located on either side of the cradle.

The box trail is divided into two groups, the front trail and the rear trail, fastened together by fittings strong enough to withstand firing stress. The elevating mechanism, rockers, and equilibrators are assembled to the front trail and are carried with it in the pack. The wheels are of wood with steel tires.

AMMUNITION—Ammunition for the 75 mm Pack Howitzer, M1A1, is in the form of semi-fixed rounds. It consists of H.E. Shell, M41A1, with P.D. Fuze, M48; H.E. Shell, M48, with P.D. Fuze, M48, and T. & S.Q. Fuze, M54; and H.E., A.T. Shell, M66, with B.D. Fuze, M62.

Sighting and Fire Control Equipment

On Carriage Equipment

Panoramic Telescope, M1
Telescope Mount, M3

Off Carriage Equipment

Bore Sight
Gunner's Quadrant, M1
Aiming Circle, M1
Compass, M2
1-Meter-Base Range Finder, M7 or M1916
B.C. Telescope, M65 or M1915A1

Trainer

The 37 mm Subcaliber Gun, M1916, and Subcaliber Mount, M5, are used for practice in laying and firing the 75 mm Pack Howitzers, M1 and M1A1.

REFERENCES—TM 9-2005, v.3; TM 9-320; TM 9-1320.

CARRIAGE (AIRBORNE), M8—The 75 mm Pack Howitzer Carriage, M8, was developed to provide airborne troops with a light, powerful weapon which could be transported as a unit to the combat area by glider or airplane. When the airplane lands at its destination the howitzer and carriage can be unloaded and maneuvered into position by hand or be towed by a prime mover. The howitzer and carriage can also be disassembled, packed in paracrate loads, and dropped by parachutes from an airplane in flight. When the paracrates reach the ground the individual loads are unpacked and the howitzer and carriage are assembled for action.

The standard 75 mm Pack Howitzer, M1A1, is mounted on the Carriage, M8. This carriage is identical to the 75 mm Pack Howitzer Carriage, M1, except for the substitution of steel disk and rim type wheels equipped with 6.00 x 16 pneumatic tires in place of the 29 inch wooden wheels used on the M1 carriage.

REFERENCES—OCM 20196; TM 9-319.

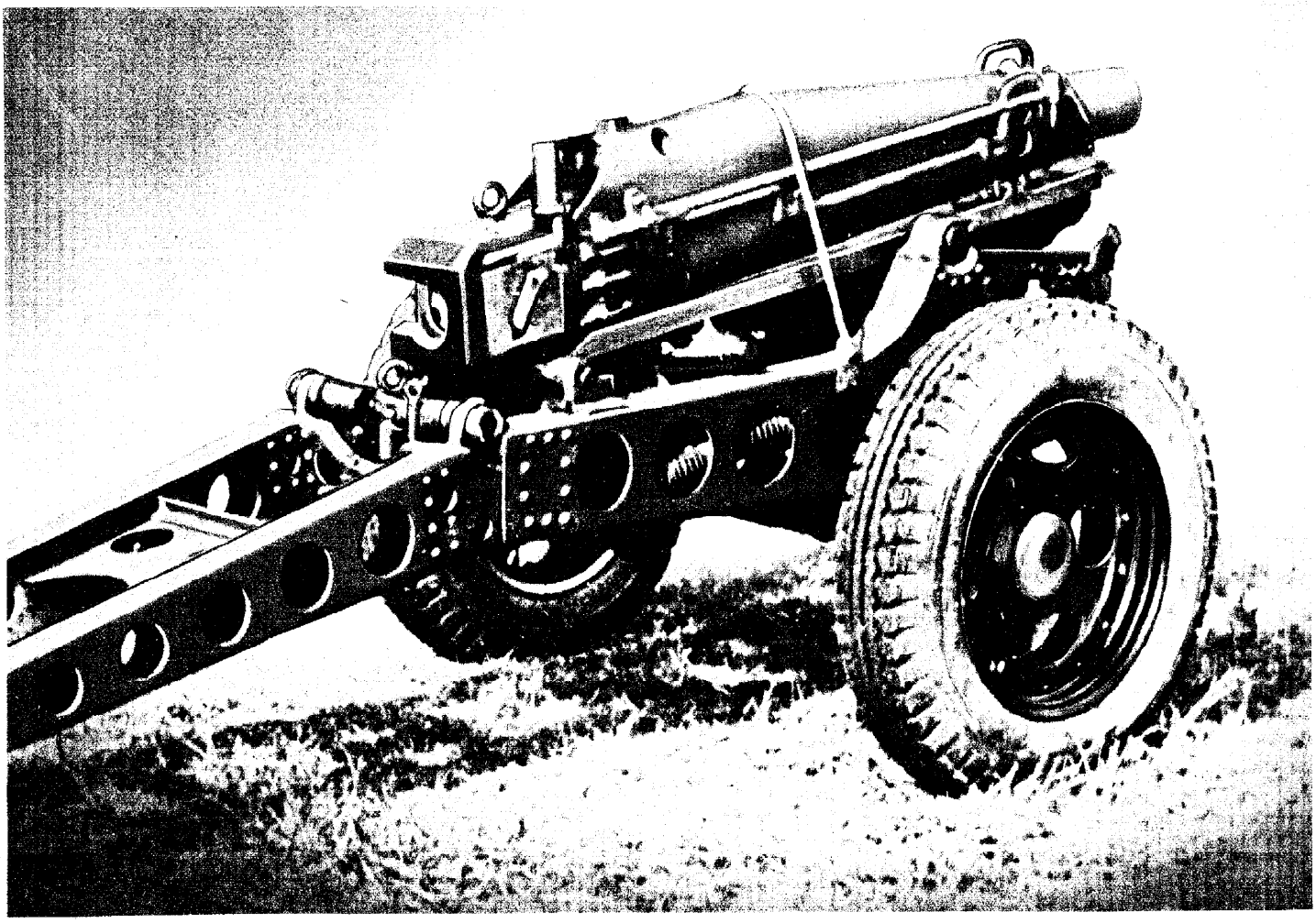
Sighting and Fire Control Equipment

On Carriage Equipment

Telescope Mount, M3
Telescope Adapter, M9
Elbow Telescope, M62

Off Carriage Equipment

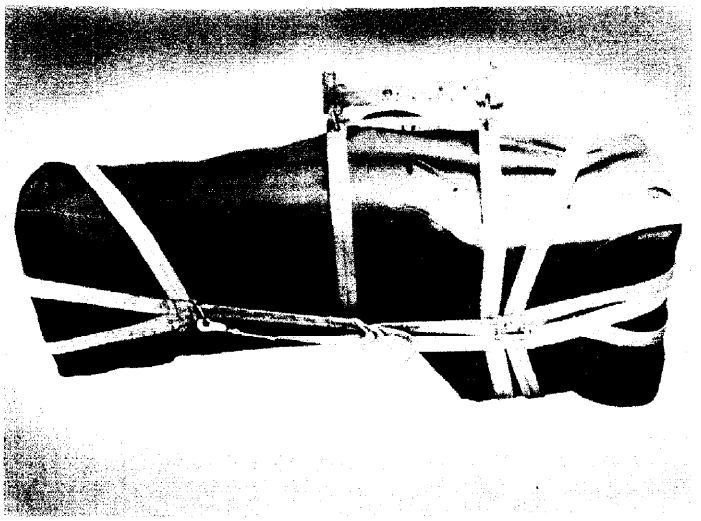
Gunner's Quadrant, M1
Aiming Circle, M1
Hand Fuze Setter, M1912A4, M15, or M16



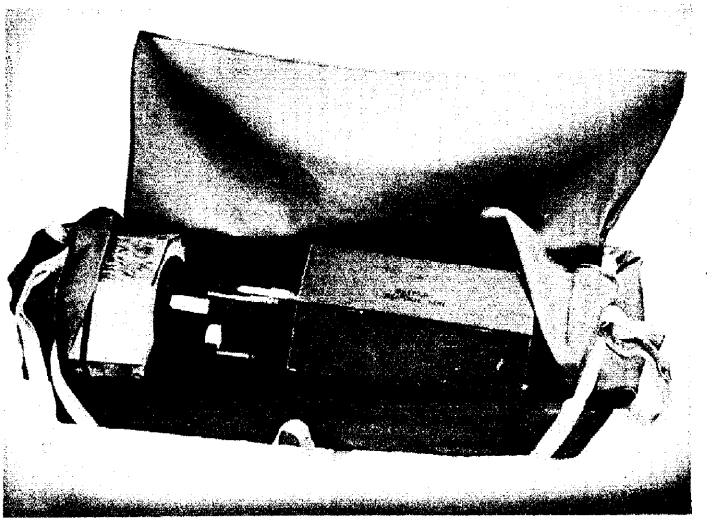
75 mm PACK HOWITZER, M8, FOR AIRBORNE USE

UNCLASSIFIED

PARACRATES M1, M2, M3, M4, M5, M6, M7, PARACHEST M8, PARACAISSON M9



PARACRATE, M1 (FRONT TRAIL), CRATE SUSPENDED



PARACRATE, M2 (REAR TRAIL AND AXLE), CRATE LOADED

In order that the disassembled 75 mm Pack Howitzer, M1A1, and Carriage, M8, together with fire control instruments, and accessories, could be safely delivered by parachute from an airplane in flight, a series of containers known as paracrates, parachest, and paracaisson, were evolved to hold the nine loads to be dropped. Fabrication of these containers was begun in September, 1942, and they were standardized in May, 1943, as Paracrates, M1 to M7, Parachest, M8, and Paracaisson, M9.

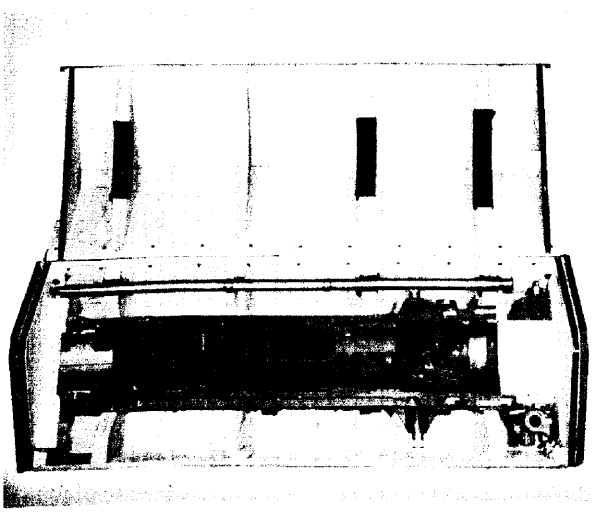
Paracrates, M1 to M7, are constructed of plywood, each paracrate being designed to accommodate a specific load. When the load is packed it is secured to bomb shackle and parachute harnesses by means of a quick-release fastening. A standard 24-foot cargo parachute is attached to each load, the parachutes being colored to differentiate between the loads and hasten identification.

Paracrate Loads, M1 to M5, together with Paracrate Load, M9, are fastened to and dropped from parachute pack racks beneath the airplane. Paracrate Loads, M6 and M8, are carried as a daisy-chain load inside the fuselage, from which they are pushed out through the doorway of the airplane.

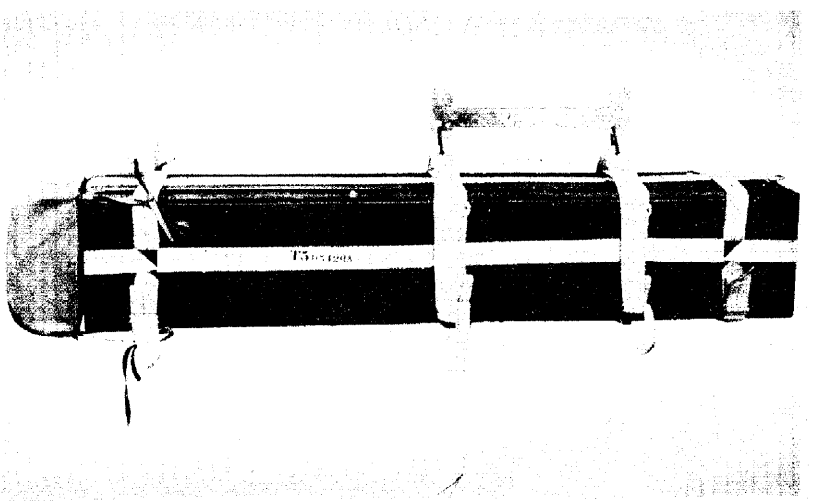
PARACRATE, M1—This paracrate consists of front and rear reinforces and a wooden brace for the howitzer front trail assembly, together with a canvas paracrate cover with parachute harness attached. When packed it holds the front trail and a lifting bar.

PARACRATE, M2—Paracrate, M2, includes a canvas cover with parachute harness attached, wooden supports, and a wooden hexagonal reinforcing housing. The load comprises the howitzer rear trail, axle and traversing mechanism assembly, trail handspike, sponge staff, aiming post sleeves, and a box containing spare parts and tools.

PARACRATE, M3—This paracrate is in the form of a plywood box with pentagonal ends and a hinged cover. The load



PARACRATE, M4 (CRADLE AND TOP SLEIGH), CRATE LOADED



PARACRATE, M5 (TUBE), CRATE SUSPENDED

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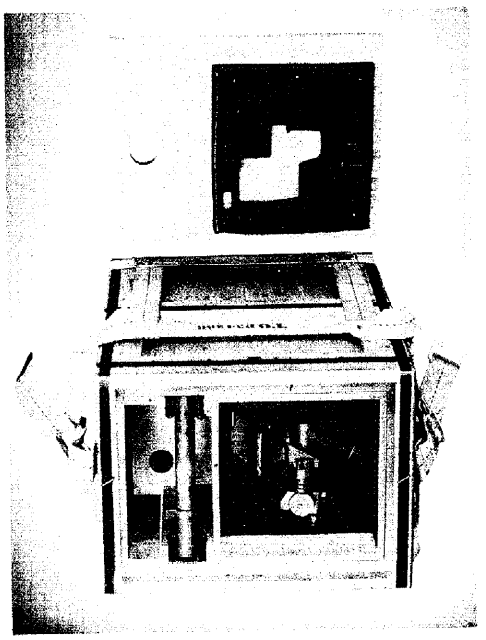
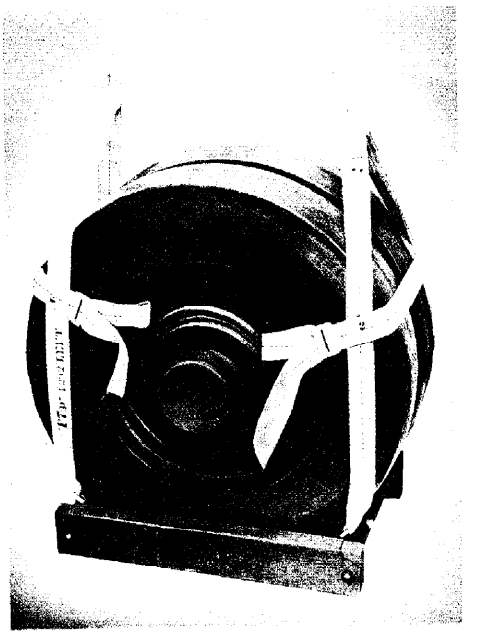
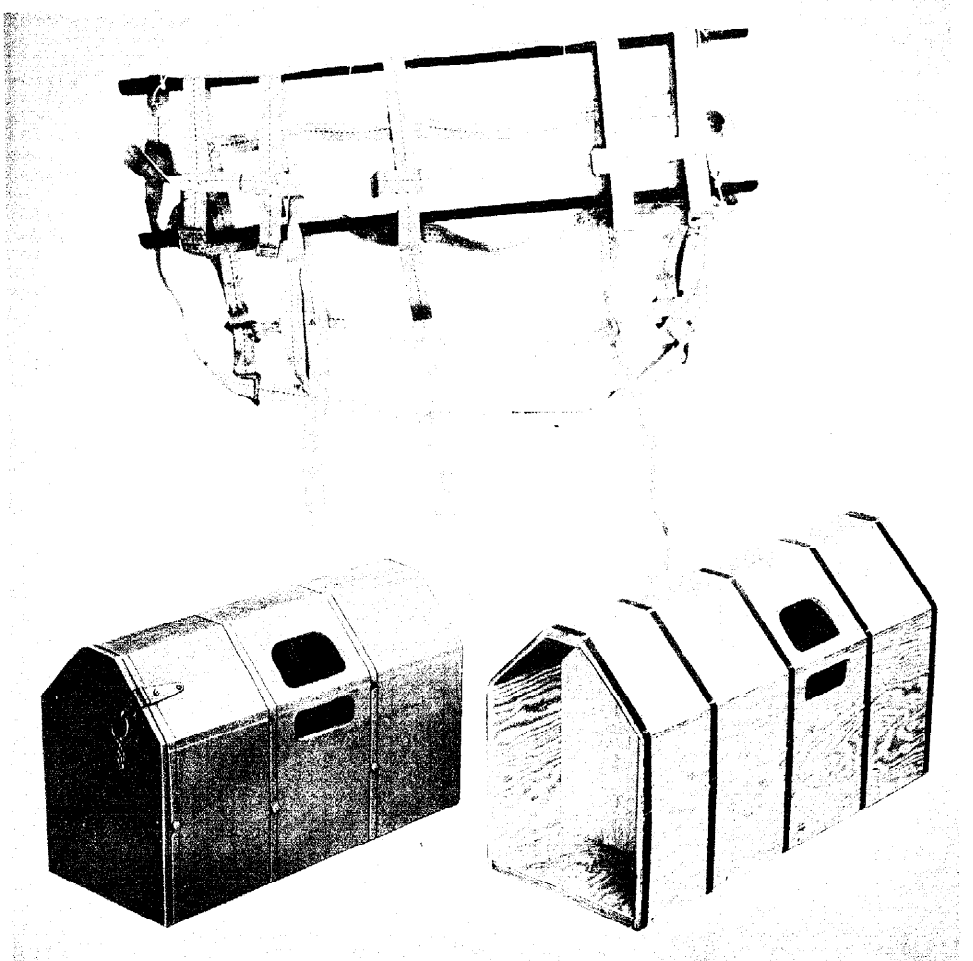


PARACRATE, M6 (BREECHBLOCK AND SIGHT), CRATE LOADED



PARACRATE, M7 (WHEELS), CRATE SUSPENDED



PARACHEST, M8, (AMMUNITION), CRATE COMPONENTS

consists of the howitzer bottom sleigh and recoil mechanism, a lifting bar, an aiming circle with case, circular wooden supports, a shock block, and a shock pad.

PARACRATE, M4—Paracrate, M4, is similar in shape to Paracrate, M3. The load is made up of the top cradle and sleigh of the howitzer, a shock block, and a shock pad. Paracrates, M3 through M6, have the bomb shackle and parachute harnesses separated from the paracrates.

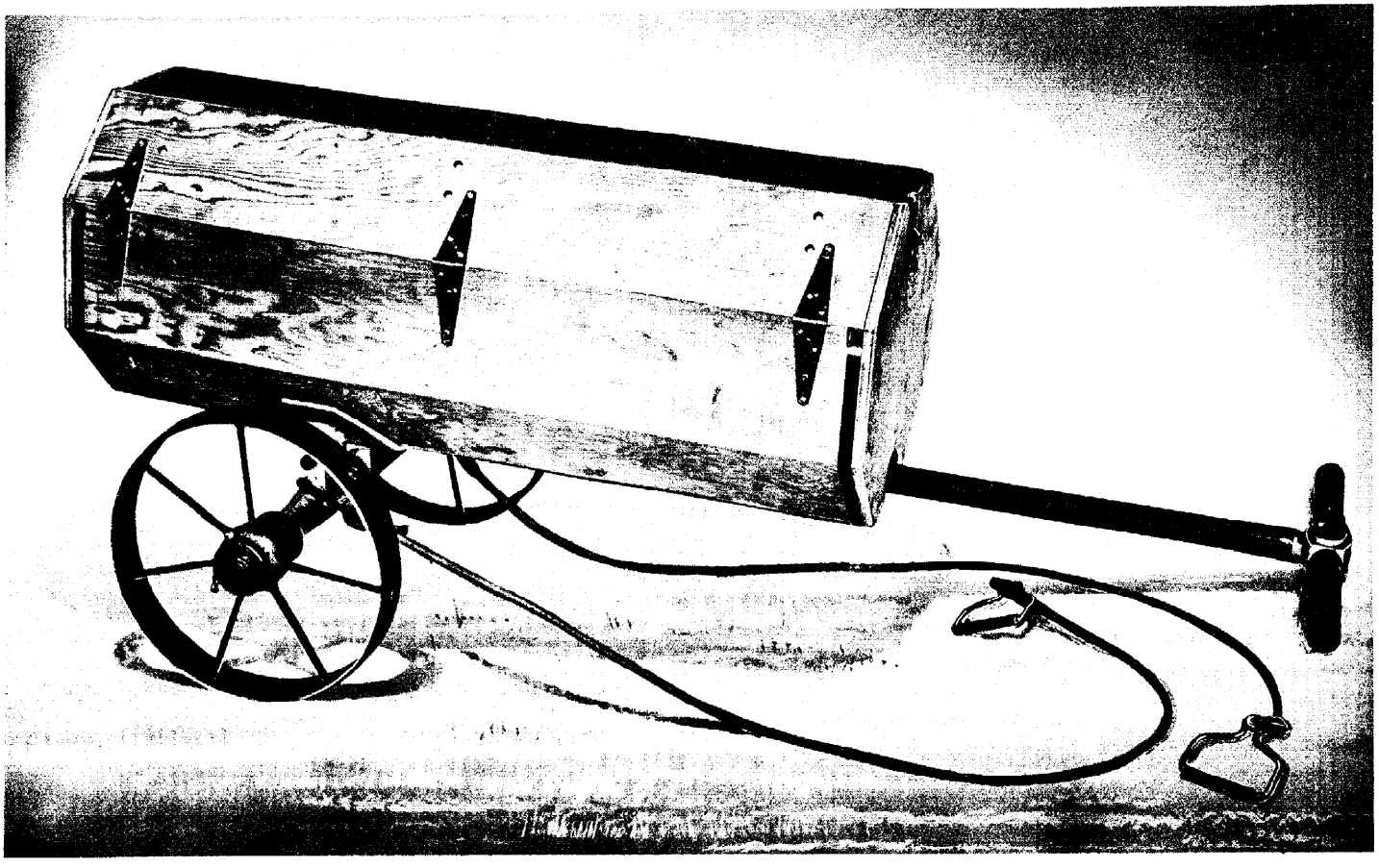
PARACRATE, M5—This paracrate is a rectangular plywood box with a hinged lid. Its load is composed of the howitzer tube, a muzzle cover, a tube thread cover, a lifting bar, lifting straps, a shock block, and a shock pad.

PARACRATE, M6—Paracrate, M6, is a rectangular plywood box with a detachable padded lid. The load consists of the howitzer breech mechanism, the hub caps, the panoramic telescope and telescope mount in a special container, the telescope mount support, and a lifting strap.

PARACRATE, M7—Paracrate, M7, consists of a square wooden frame, the inner sides of which are beveled. The parachute harness is attached to the frame. The load is composed of the howitzer wheels and hub plugs.

PARACHEST, M8—This parachest is made of plywood, and consists of a large section to which a slightly smaller section is added as a continuation. The cross section of each portion is six-sided, in the form of a square on which is imposed a truncated triangle. The front end of the large section is hinged, so that it can be opened for loading. The parachute harness is separate and when assembled on the parachest has skids lashed to it to facilitate landing. The load is composed of ten complete rounds of 75 mm howitzer ammunition, each of which is packed in a fiber container.

PARACAISSON, M9—Paracaisson, M9, is a manually drawn, knockdown cart with a plywood body of hexagonal cross section, demountable steel wheels, and an axle assembly, drawbar, tongue,



PARACAISSON, M9 (AMMUNITION CART), CART ASSEMBLED

and drawlines, all of which can be packed in the body when the paracaisson is disassembled for transport. A wheel spacer, a brace support, a drawbar tray, an axle tray, tray side braces, and tray top braces are utilized in packing the components of the paracaisson. The bomb shackle and parachute harness are separate.

The paracaisson is used to transport ammunition, eight complete rounds in individual fiber containers constituting a full load. When assembled, the paracaisson is normally pulled by two men who grasp the drawbar at the free end of the tongue. When it is necessary for four men to tow the cart two drawlines are attached to the axle by means of drawline hooks which hook through holes in the axle.

The howitzer, caisson and cart, with ammunition, are packed in nine paracrate loads having a total weight of 2,571 pounds. The component parts of these loads and the equipment required for assembling them are as follows:

Paracrate Load, M1

Front trail	236 lb.
Paracrate, M1, including cover, front reinforce, rear reinforce and wooden brace	58 lb.
Lifting bar	9 lb.
Parachute	23 lb.
Total weight	326 lb.

Paracrate Load, M2

Rear trail	95 lb.
Axle	65 lb.
Trail handspike	7 lb.
Sponge staff	6 lb.
Spare parts and tool box	40 lb.
Paracrate, M2, including cover, wooden supports, and wooden hexagonal housing	38 lb.
Parachute	23 lb.
Total weight	274 lb.

Paracrate Load, M3

Bottom sleigh and recoil mechanism	203 lb.
Aiming circle with case	18 lb.
Paracrate, T3	73 lb.
Lifting bar	9 lb.
Parachute	23 lb.
Total weight	326 lb.

Paracrate Load, M4

Cradle	100 lb.
Top sleigh	121 lb.
Paracrate, M4	87 lb.
Parachute	23 lb.
Total weight	331 lb.

Paracrate Load, M5

Tube	221 lb.
Paracrate, M5	49 lb.
Lifting bar	9 lb.
Parachute	23 lb.
Total weight	302 lb.

Paracrate Load, M6

Breech assembly	121 lb.
Paracrate, M6	13 lb.
Telescope panoramic w/mount	45 lb.
Parachute	23 lb.
Total weight	202 lb.

Paracrate Load, M7

Wheels (two)	180 lb.
Paracrate, M7	14 lb.
Parachute	23 lb.
Total weight	217 lb.

Paracrate Load, M8

Ammunition, 10 rounds in indiv. fiber cont.	220 lb.
Parachest, M8	47 lb.
Parachute	23 lb.
Total Weight	290 lb.

Paracrate Load, M9

Paracrate cart	105 lb.
Ammunition, 8 rounds in indiv. fiber cont.	176 lb.
Parachute	23 lb.
Total weight	304 lb.

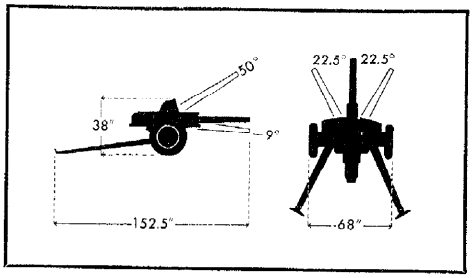
75 MM FIELD HOWITZER M1A1—CARRIAGES M3A2, M3A3 (Continued)

The 75 mm field howitzer is a light artillery piece used by horse artillery and is similar to the 75 mm pack howitzer except for the carriage. With the shell, H.E., A.T., M66, it can be employed as an antitank weapon at normal battle ranges.

CARRIAGE, M3A1—Designed for towing at high speed, this carriage is a redesign of the Pack Howitzer Carriage, M1. The M1 recoil mechanism, top and bottom sleighs are utilized. A split trail and pneumatic-tired wheels mounted on spindles which can be rotated, permit the carriage to rest on a firing base and the trails. This three-point suspension gives great stability during firing. Internal-expanding brakes are used on this carriage. The M3A1 carriage is now classified as Limited Standard.

CARRIAGE, M3A2—Addition of shields to Carriage, M3A1, in accordance with O.C.M. 17990 changes the model designation of the carriage to M3A2. It is now classified as Standard.

CARRIAGE, M3A3—When Carriages, M3A1 or M3A2, are equipped with combat tires and wheels with divided rims, the designation of either carriage becomes M3A3 (O.C.M. 18154). This carriage is classified as Standard.



Sighting and Fire Control Equipment

On Carriage Equipment

Panoramic Telescope, M1
Telescope Mount, M16
Range Quadrant, M3
Elbow Telescope, M5

Off Carriage Equipment

Bore Sight
Gunner's Quadrant, M1
Aiming Circle, M1
Compass, M2
1-Meter-Base Range Finder, M7 or M1916
B. C. Telescope, M65 or M1915A1
Bracket Fuze Setter, M1916A2
Hand Fuze Setter, M15 or M16

Ammunition

Ammunition for the 75 mm Field Howitzer, M1, is in the form of semi-fixed rounds. It consists of H.E. Shell, M41A1, with P.D. Fuze, M48, and T.-S.Q. Fuze, M54; H.E. Shell, M41, with P.D. Fuze, M48; H.E. Shell, M48, with P.D. Fuze, M48, and T.-S.Q. Fuze, M54.

Trainer

The 37 mm Gun, M1916, with Mount M5, is used for training in laying and firing the 75 mm Howitzer, M1A1. The 37 mm Gun, M1916, and its recoil mechanism are fastened to the 37 mm Subcaliber Mount, M5, which is in turn fastened to the bottom sleigh after removal of the top sleigh for training purposes.

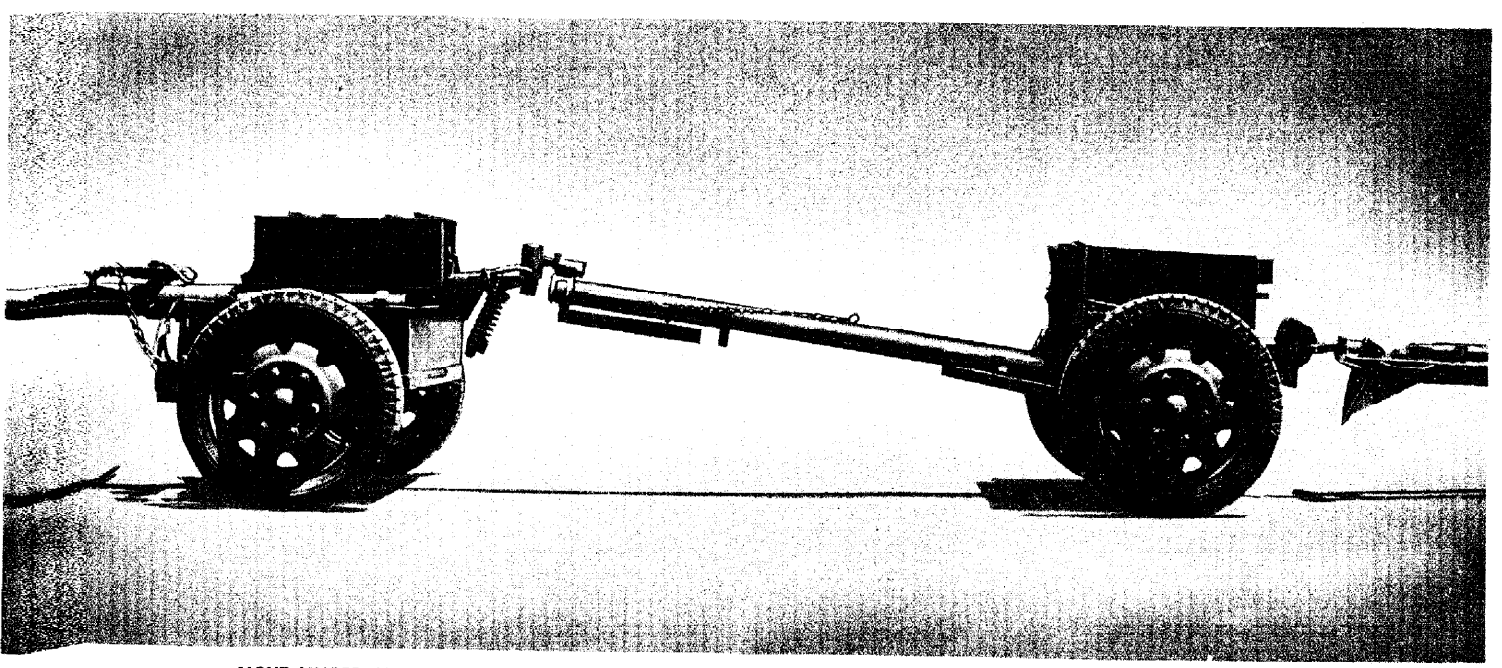
Light Limber, M2

This is a two-wheeled vehicle to which the trail of the howitzer carriage is connected to form a four-wheeled unit when traveling. It is equipped with pneumatic-tired disk and rim type wheels for high-speed transport. The limber chest has a capacity of 22 rounds of ammunition. The weight of the limber is 770 pounds when empty and 1,245 pounds with full ammunition load. Classification of this limber is Limited Standard. The model M4 is Standard.

Light Caisson, M1

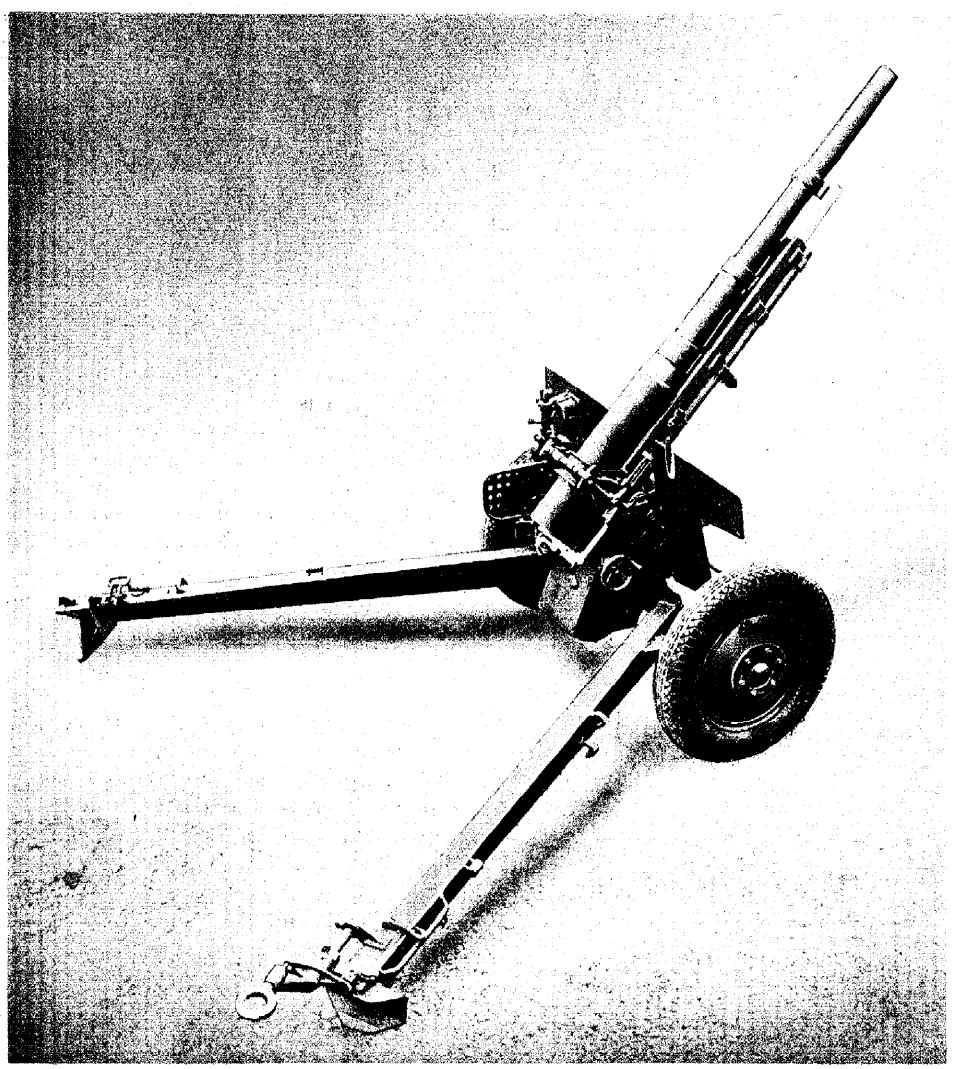
Designed primarily to carry ammunition, this is a two-wheeled vehicle equipped with pneumatic tires and standard automobile internal-expanding brakes. It weighs 860 pounds when empty and 1,965 pounds with 52 rounds of ammunition in the caisson chest. It is now classified as Substitute Standard. The model M2 is Standard.

REFERENCES—TM 9-2005, v.3; TM 9-320; TM 9-1320; FM 6-110; FM 6-70.



LIGHT LIMBER, M4, AND LIGHT CAISSON, M2, WITH EXPERIMENTAL COUPLER, FOR 75 mm HOWITZER TRANSPORT

75 MM GUNS M1897A2, M1897A4—CARRIAGE M2A3—STANDARD



75 mm GUN, M1897A2, ON CARRIAGE, M2A3, IN FIRING POSITION

These weapons are modernizations of the 75 mm Gun, M1897. The M1897A2 is standard for the manufacture of the complete gun, while the M1897A4 is standard for conversion of existing M1897 guns (O.C.M. 14510).

In 1917 the A.E.F. in France and certain regiments in the United States were equipped with the French 75 mm M1897 gun as the standard for light field artillery matériel. The performance of this gun in battle was such that it was considered the most effective light field gun used in World War I. A considerable number of these guns were purchased from France, while similar guns were manufactured in the United States. The parts of the American and French manufactured guns are identical and interchangeable.

As mounted on modernized carriages which may be towed at any speed, the 75 mm gun is today a far more formidable weapon than was its counterpart in the last war. New ammunition, including armor-piercing projectiles, has been developed to give greatly increased range. These guns are now being withdrawn from service to be placed on self-propelled mounts. No further production of these guns has been undertaken.

GUN, M1897—This gun and its variations are of built-up construction with breechblocks of the cylindrical Nordenfeld eccentric screw type threaded on the exterior to fit the breech recess. The breechblock is opened by rotating 120° around its axis and automatically ejects the empty

PRINCIPAL CHARACTERISTICS OF 75 mm GUN, M1897A2, AND CARRIAGE, M2A3

GUN, M1897A2

Caliber	75 mm
Weight	1,026 lb.
Overall length	107.125 ins.
Length of bore	34.5 cals.
Muzzle velocity	1,778, 1,950, 2,000 f./s.
Volume of chamber (M61, A.P.C.)	88.05 cu. ins.
Travel of projectile in bore (M61, A.P.C.)	88.99 ins.
Maximum powder pressure (M61, A.P.C.)	38,000 lb./sq. in.
Type of block mechanism	Nordenfeld screw block
Rate of fire	6 rds./min.
Range (M61, A.P.C.)	13,870 yds.

RECOIL MECHANISM

Type	Hydropneumatic
Weight	237.21 lb.
Normal recoil	44.9 ins.
Maximum recoil	48 ins.
Maximum piston-rod pull	11,250 lb.

CARRIAGE, M2A3

Total weight without gun	2,338 lb.
Height of lunette (limbered position)	29 ins.
Length of carriage (muzzle to lunette)	220.5 ins.
Width over hub caps	80 ins.
Tread width (c/—c/ of wheels)	70 ins.
Height in traveling position	56 ins.
Trail spread (included angle)	60°
Elevation (maximum) (on wheels)	45°30′
Depression (maximum) (on wheels)	−9°14′
Traverse (maximum, right) (on wheels)	30°9′
Traverse (maximum, left) (on wheels)	30°15′
Total weight of gun, mechanism, and carriage	3,400 lb.

AMMUNITION

	M48, H.E.	M72, A.P.	M61, A.P.C.
Weight of complete round	19.49 lb.	18.80 lb.	19.98 lb.
Weight of projectile	14.60 lb.	13.93 lb.	14.92 lb.
Weight of projectile explosive charge	1.47 lb.		.17 lb.
Weight of propelling charge	1.93 lb.	1.90 lb.	2.16 lb.
Type of ammunition	Fixed	Fixed	Fixed
Armor penetration—homogeneous plate 20° from normal— 500 yds.	3.2 ins.		2.8 ins.
1,000 yds.	2.7 ins.		2.5 ins.
2,000 yds.	2.1 ins.		2.1 ins.

cartridge case. The normal life of the gun is approximately 10,000 rounds.

GUN, M1897A4—Rollers, sweeper plates with felt pads and part of the jacket are removed from the M1897 gun and replaced by steel rails and bronze strips attached to supports on the gun.

GUN, M1897A2—This gun is identical with the M1897A4 and is standard for new manufacture.

CARRIAGE, M1897—About 2,800 of the French-manufactured M1897 carriages were purchased. They were issued and stored without distinction as to their source. The gun slides on a steel-forged cradle trunnioned on a rocker assembly enabling changes of elevation to be made without disturbing the angle-of-site setting. The rocker is trunnioned on a single trail supported by the axle housing. The hydropneumatic (Puteaux) recoil system assures constant recoil. The carriage has steel-tired wheels and is equipped with a combination road brake and firing support.

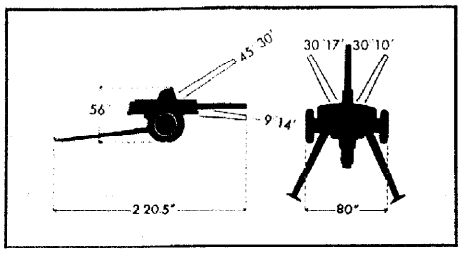
CARRIAGE, M1897M1—This is the American manufactured version of Carriage, M1897, differing from the M1897 in the recuperator system which has a respirator assembly instead of a front plug, shields, lunette, wheels, wheel guards, spares and accessories. Parts of this carriage are not interchangeable with those of the M1897.

CARRIAGE, M1897A2—When equipped with a handspike, the M1897 takes the designation M1897A2.

CARRIAGE, M1897M1A2—This is the M1897M1 equipped with a handspike.

CARRIAGE, M1897A4—Fitting high-speed adapters to the M1897, M1897A2, M1897M1 and M1897M1A2 changes the model designation of any of these carriages to M1897A4. The modification consists essentially of a high-speed adapter, the substitution of pneumatic tires on disk and rim wheels in place of steel- or rubber-tired wheels and the replacement of the former brake system by one using internal-expanding brakes.

All modifications of the M1897 carriage through M1897A4 possessed the inherent disadvantages of limited elevation and traverse, with a maximum normal gun range of only 6,930 yards. By burying the trail, it was possible to obtain a range of 9,200 yards. It was, therefore, considered essential to design a new carriage to mount the M1897 gun which would overcome these handicaps. This was done in 1934,



when the first of a new M2 series was originated.

CARRIAGES, M2A1 AND M2A2—A distinguishing feature of these carriages is the split trail which permits an elevation of +45°, resulting in approximately 39% greater range than that obtained in earlier models with a solid trail. For high-speed transport, the carriages are equipped with pneumatic-tired disk and rim wheels with internal-expanding brakes. Equilibrators neutralize unbalanced weight in the gun and recoil system. Traverse is increased to 85°. In firing position with the trails spread, an adjustable jack may be used to support the carriage weight, thus forming a three-point support consisting of the jack and spades. On level ground the gun may be fired safely from the wheels with the trails in either of the spread positions.

CARRIAGE, M2A3—The carriage is a modification of the Carriage, M2. It is of the split trail type, equipped with a drawbar for use with a motorized unit. The lower part of the top carriage is modified to provide clearance for the pivoted axle. The trails and spades are 19 inches shorter than those of the M2. The firing jack is replaced by segments, and the carriage has a pivoted axle which automatically adjusts itself to permit laying the piece with the wheels at an angle of up to 10° to the horizontal. The Recoil Mechanism, M2, combines the cradle, recoil and recuperator cylinders which check movement in recoil and counter recoil gradually to prevent displacement of the carriage.

Sighting and Fire Control Equipment for Carriage, M2A3

On Carriage Equipment
Panoramic Telescope, M12A1, on Telescope Mount, M22
Elbow Telescope, M14, on Telescope Mount, M23
Range Quadrant, M5

Off Carriage Equipment
Aiming Post, M1
Gunner's Quadrant, M1
Bore sight
Aiming Circle, M1
Compass, M2
1-Meter-Base Range Finder, M7 or M1916
B. C. Telescope, M65 or M1915A1

Ammunition

Ammunition for the 75 mm Guns, M1897A2 and M1897A4, is in the form of fixed rounds. It consists of H.E. Shell, Mk. I, with P.D. Fuzes, M46 and M47; H.E. Shell, M48, with P.D. Fuze, M48, and T.-S.Q. Fuze, M54; chemical Shell, Mk. II, with P.D. Fuze, M46; Shrapnel, Mk. I, with 21-second Combination Fuze, '07M; A.P. Shot, M21, and semi-A.P. Shot, M72.

Trainer

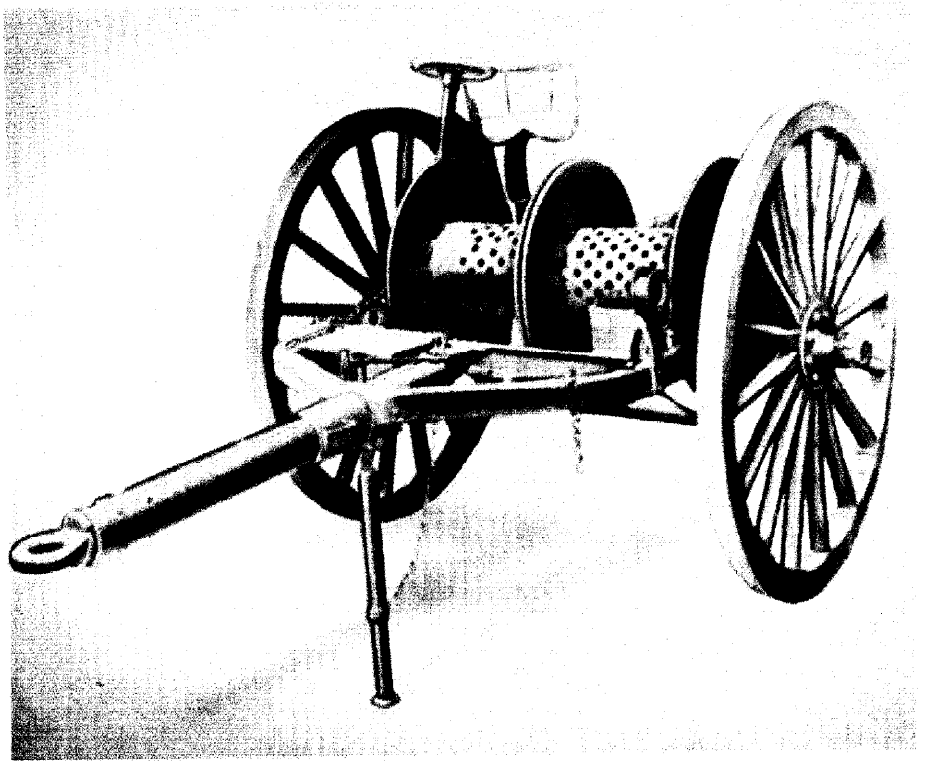
For training purposes only, the 37 mm Subcaliber Gun, M1916, is used to provide practice in laying and firing the 75 mm matériel. The 37 mm Subcaliber Mount, M2, is used on 75 mm Gun Carriage, M1897, only. The 37 mm Subcaliber Mount, M8, is used on Carriages, M1897M1A2 and M1897A4. The 37 mm Subcaliber Mount, M7, is used on 75 mm Gun Carriages, M2, M2A1, M2A2 and M2A3.

REFERENCES—TM 9-2005, v.3; TM 9-1305.

Comparison of Gun Carriages

	M1897	M1897M1A2	M1897A4	M2A1	M2A2	M2A3
Weight of gun and carriage complete (in pounds)	2,657	2,657	3,007	3,675	3,675	3,400
Length of recoil (in inches)	44.9	44.9	44.9	41.5-46	41.5-46	44.9
Height of axis from ground (in inches)	40.4	40.4	44.4	47	47	47
Maximum elevation	19°	19°	19°	46°	46°	49°30′
Maximum depression	10°	10°	10°	10°	10°	9°15′
Maximum traverse, right	3°	3°	3°	45°	45°	30°9′
Maximum traverse, left	3°	3°	3°	40°	40°	30°15′
Muzzle velocity (f./s.)	1,955	1,955	1,955	1,955	1,955	1,778 1,950 2,000
Maximum range (in yards)	9,200	9,200	9,200	12,780	12,780	13,950

ARTILLERY REEL M1909M1—STANDARD
BATTERY REEL M1917A2—STANDARD

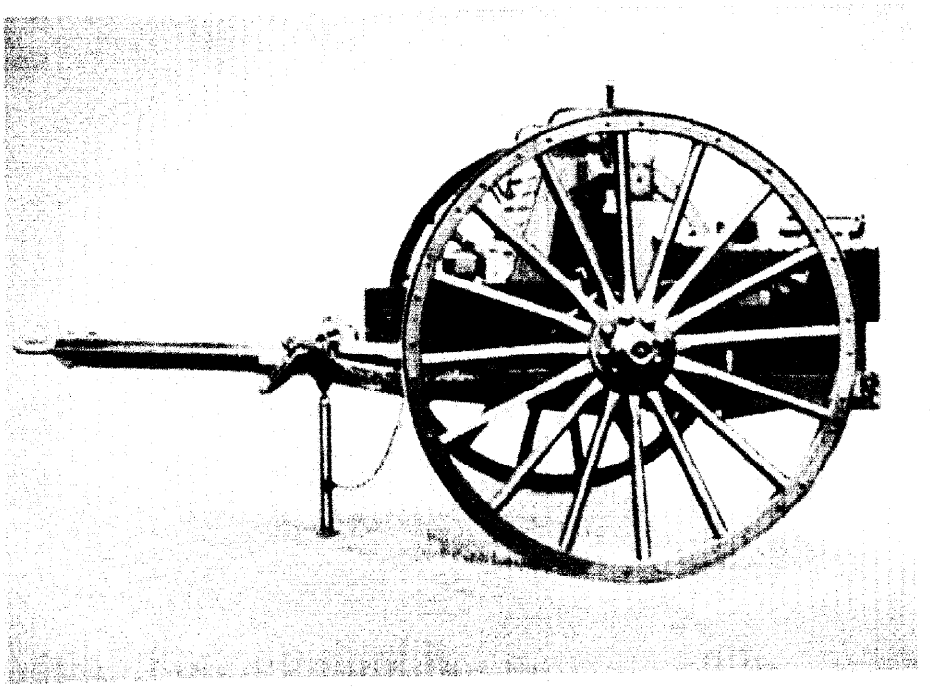


ARTILLERY REEL, M1909M1

ARTILLERY REEL, 1909M1—STANDARD

Headquarters units of certain horse-drawn light field artillery organizations use the Artillery Reel, M1909M1, instead of the Battery Reel, M1917A2, for laying wire. The artillery reel consists of a frame, tool chest, drums, drum clutch, drum driving mechanism, drum brake, seat, wheels, drawbar or pole, doubletree, singletree and neck yoke. The two drums, mounted between the wheels, carry 4 miles of 11-strand insulated wire. They are driven from the wheel axle sprocket to the jackshaft sprocket and from the jackshaft sprocket to the drum sprocket, a chain drive being employed in each instance. The right drum is rotated from the drum sprocket through the clutch to the drum. It may be revolved singly or both drums may be revolved simultaneously by engaging the left drum to the right drum by means of a second clutch. A drum latch lever operates a latch for locking the right drum. Attached to the drum latch lever is a leather-faced brake shoe which comes against the flanged rim of the right drum end plate to act as a brake. A brake shoe which engages the left drum end plate is controlled by the foot lever near the operator's seat.

REFERENCE—TM 9-305.



BATTERY REEL, M1917A2

BATTERY REEL, M1917A2—STANDARD

The Battery Reel, M1917A2, is used in 75 mm gun batteries of horse-drawn artillery to carry, lay and recover insulated wire for communication by field telephone or buzzer. It is also employed to transport certain other communication, fire control and topographical equipment. It consists essentially of a frame, drum, operating gear, front chest, rear chest, seat, wheels, pole, doubletree, singletree and neck yoke.

The drum is 1 foot in diameter and holds 1.7 miles of wire. A driving gear attached to the left wheel operates the drum through the medium of a driving clutch. The driving clutch is engaged and disengaged by a hand lever which simultaneously disengages or engages a brake clutch used for braking the drum when it is desired to stop it from rotating. As the wire pays out it is guided by a guide bar which runs the length of the drum.

REFERENCE—TM 9-305.

3 INCH ANTITANK GUN M5—CARRIAGE M6—STANDARD

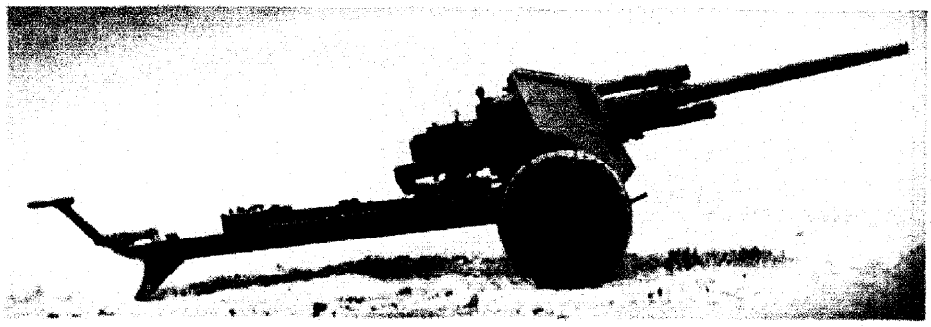
Inadequacy of existing antitank guns when opposed by heavily armored vehicles resulted, in September, 1940, in the preparation of specifications for a 3" gun sufficiently powerful to destroy the most formidable tanks then in use. It was recommended that a gun be constructed to combine the 3 inch antiaircraft gun tube, T9, the 105 mm breechblock, and the 105 mm Howitzer Carriage, M2. This gun and its carriage were standardized in December, 1941, as 3 Inch Antitank Gun, M5, and Carriage, M1. Further tests by the Tank Destroyer Command resulted in the adoption of the M5 gun and M1 carriage as a standard antitank weapon late in 1942. In 1943 the M1 Carriage was modified and designated 3 Inch Gun Carriage, M6. This carriage is now Standard.

3 INCH GUN, M5—The gun consists of a long-barreled tube, a modified breech ring, and a breech mechanism pertaining to the 105 mm Howitzer, M2A1.

3 INCH GUN CARRIAGE, M1—The carriage is a combination of the 105 mm Howitzer Carriage, M2, and the 105 mm Howitzer Recoil Mechanism, M2, with minor modifications. This carriage is now Limited Standard.

3 INCH GUN CARRIAGE, M6—The 3 Inch Gun Carriage, M6, standardized 18 November 1943, is basically a modification of the 3 Inch Gun Carriage, M1.

Additional protection is afforded by a new sloping shield and a shield apron with fittings secured to the axle. This apron insures approximately five inches clearance between the bottom of the apron and the ground when the gun is in firing position with the carriage resting on the tires.



3 INCH ANTITANK GUN, M5, ON CARRIAGE, M6, IN FIRING POSITION AT 0° ELEVATION

In order to limit the cant of the axle to 5° on either side, axle stops are provided. To secure the segments in firing and traveling positions, wheel segments with necessary fittings are provided for 9.00x 20 combat tires.

Handspikes, ratchet wrenches and a castor wheel facilitate manual movement of the carriage for short distances. The castor wheel (4.00x8 tire) is designed to be carried on top of the trails when not in use.

The Recoil Mechanism, M9A1, has a five-inch extension on the recoil piston rod, replacing the four-inch extension used on the Recoil Mechanism, M9, with no other change.

New traveling locks are provided in order to carry the muzzle of the gun approximately 12 inches higher in the traveling position.

There also is a shoulderguard, with opening for removal of the breechblock. Gun Section Chest, M7, has been modified for stowage of sighting equipment and it is secured to the trails when traveling. The maximum elevation is 30°.

Ammunition

The standard ammunition for this gun is in the form of complete fixed rounds. It consists of H.E. Shell, M42A1, with M.T. Fuze, M43, and A.P.C. Projectile, M62, with B.D. Fuze, M66.

REFERENCES—OCM 16517; OCM 17251; OCM 21870; OCM 22132; TM 9-2005, v.3; TM 9-303.

Sighting and Fire Control Equipment

On Carriage Equipment

Telescope Mount, M41A1
Panoramic Telescope, M12A3
Telescope, M41
Telescope Mount, M50
Elbow Telescope, M29
Range Quadrant, M6

PRINCIPAL CHARACTERISTICS

GUN

Caliber of gun	3 ins.
Weight of gun	1,475 lb.
Overall length	158.4 ins.
Length of bore	50 cals.
Muzzle velocity	
A.P. 15 lb. projectile	2,600 f./s.
H.E. 12.7 lb. projectile	2,800 f./s.
Volume of chamber	200 cu. ins.
Travel of projectile	127.3 ins.
Maximum powder pressure	34,000 lb./sq. in.
Type of block mechanism	Horizontal sliding, hand-operated
Rate of fire	12 rds./min.
Maximum range (A.P.C., M62)	16,100 yds.

RECOIL MECHANISM

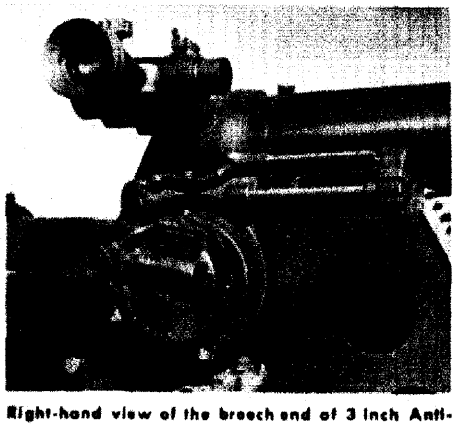
Type	Hydropneumatic
Weight	473 lb.
Normal recoil	
at 0°	30.5 ins.
at 30°	34.5 ins.
Maximum recoil	44 ins.

CARRIAGE

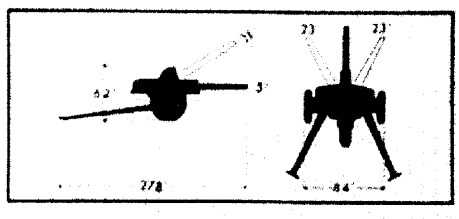
Total weight without gun	4,375 lb.
Height of lunette (limbered position)	27 ins.
Length of carriage (muzzle to lunette)	272 ins.
Width over hub caps	89 ins.
Tread width (c/—c/ of wheels)	70 ins.
Overall height (limbered position)	62 ins.
Elevation (maximum)	30° 13'
Depression (maximum)	5° 35'
Traverse (maximum, right)	23°
Traverse (maximum, left)	23°
Total weight of gun, mechanism, and carriage	5,850 lb.

AMMUNITION

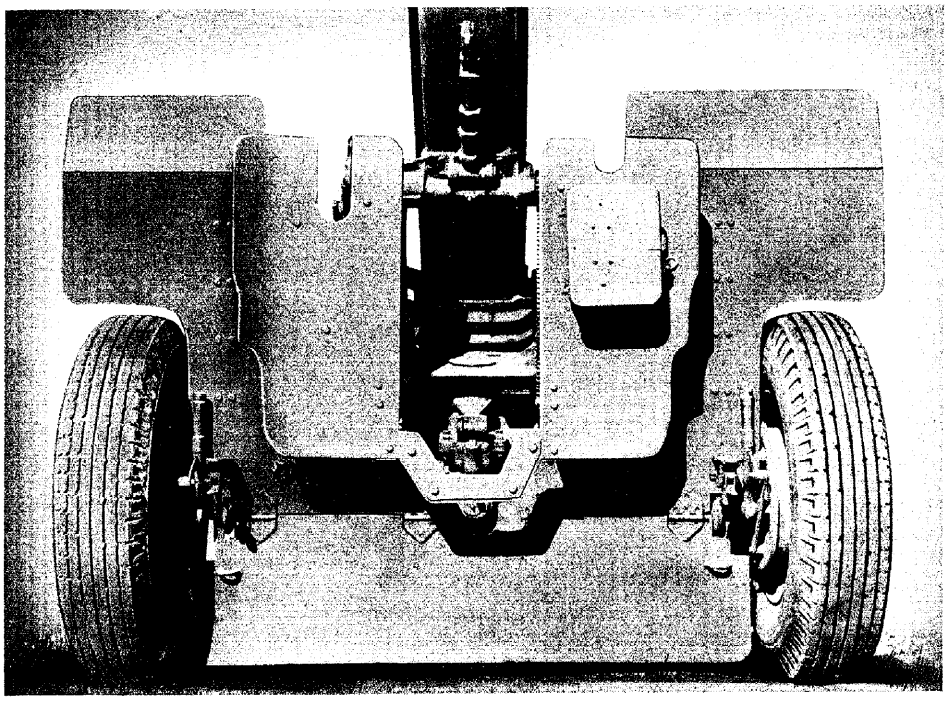
	M42A1 H.E.	M62 A.P.C.
Weight of complete round	24.36 lb.	27.23 lb.
Weight of projectile	12.87 lb.	15.43 lb.
Weight of bursting charge	.84 lb.	.17 lb.
Weight of propelling charge	4.57 lb.	4.62 lb.
Type of ammunition	Fixed	Fixed
Armor penetration—homogeneous plate 20° from normal, 500 yds.	4.2 ins.	
1000 yds.	3.85 ins.	
2000 yds.	3.1 ins.	



Right-hand view of the breech end of 3 Inch Antitank Gun, M5, on Carriage, M6, showing Elbow Telescope, M29, and Range Quadrant, M6.



105 MM HOWITZER M2A1—CARRIAGE M2A2—STANDARD



LEFT REAR VIEW OF 105 mm HOWITZER, M2A1, ON CARRIAGE, M2A2

PRINCIPAL CHARACTERISTICS

HOWITZER, M2A1

Caliber	105 mm
Weight	1,080 lb.
Overall length	101.35 ins.
Length of bore	22.5 cals.
Muzzle velocity	1,550 f./s.
Volume of chamber	153 cu. ins.
Travel of projectile in bore	81.67 ins.
Maximum powder pressure	28,000 lb./sq. in.
Type of breech mechanism	Sliding
Rate of fire	4 rds./min.
Range	12,500 yds.

RECOIL MECHANISM, M2A1

Type	Hydropneumatic
Weight	457 lb.
Normal recoil	42 ins.
Maximum recoil	44 ins.
Maximum piston-rod pull	12,980 lb.

CARRIAGE, M2A2

Total weight (with howitzer and recoil mechanism)	4,970 lb.
Height of lunette (limbered position)	18 ins.
Length of carriage (muzzle to lunette)	236 ins.
Width over hub caps	82 ins.
Tread width (c/l—c/l)	70 ins.
Height in traveling position	65.75 ins.
Trail spread (included angle)	28° left, 29° right
Elevation (maximum) on wheels	65°
Depression (maximum)	−5°
Traverse (maximum, right)	23°
Traverse (maximum, left)	23°
Total weight of gun, mechanism, and carriage	4,260 lb.

AMMUNITION

Weight of complete round (with M1 H.E. shell)	41 lb., 12 oz.
Weight of projectile	33 lb.
Weight of projectile explosive charge, M1	4.8 lb.
Weight of propelling charge (approximate)	2.94 lb.
Type of ammunition	Semi-fixed

Sighting and Fire Control Equipment

On Carriage Equipment

Panoramic Telescope, M12A2
Telescope Mount, M21
Range Quadrant, M4
Telescope Mount, M23
Elbow Telescope, M16

Off Carriage Equipment

Aiming Circle, M1
Compass, M2
1-Meter-Base Range Finder, M7 or M1916
B. C. Telescope, M65
Hand Fuze Setter, M17
Graphical Firing Table, M4

Ammunition

Ammunition for the 105 mm Howitzer, M2A1, is in the form of fixed and semi-fixed rounds. It consists of H.E. Shell, M1, with P.D. Fuze, M48, and T.-S.Q. Fuze, M54; Chemical Shell, M60, with P.D. Fuze, M57; Smoke Shell, B.E., M84, with Fuze, T.-S.Q. M54, and H.E., A.T. Shell, M67, with B.D. Fuze, M62.

REFERENCES—TM 9-2005, v.3; TM 9-325.

The major development in 105 mm howitzer matériel has been in carriage design. The present Carriage, M2A2, capable of transport at speeds up to thirty-five miles an hour, is a modification of the Carriage, M1, designed for draft by horses or slow tractors.

The 105 mm Howitzer, M2A1, is also mounted on the self-propelled motor carriage, M7, and the medium tanks, M4 and M4A3.

HOWITZERS, M2 AND M2A1—Possession of the same general characteristics makes these howitzers interchangeable. The only difference between the two models is in the design of their breech rings. A sliding-type breechblock is used with either howitzer. The piece is fired by a lanyard attached to a firing mechanism on the cradle.

CARRIAGE, M2—The M2 carriage has a split trail, pneumatic-tired disk and rim wheels, and brakes operated from the driver's seat of the prime mover.

The unbalanced weight of the howitzer is neutralized by a single-unit, spring-type equilibrator. The elevating arcs serve as a seat for the trunnions of the carriage. The elevating mechanism on the cradle may be operated from either side of the carriage. The axle and the support are designed to compensate for irregularities of the terrain when the howitzer is in firing position.

The M2A1 hydropneumatic recoil mechanism is of the constant-length type. The howitzer and recoil system are attached to a sleigh. The piston rod is attached to the cradle and remains stationary during recoil and counter recoil.

CARRIAGE, M2A2—The 105 mm Howitzer Carriage, M2A2, is the M2A1 Carriage with newly designed shields which give considerably more protection than did the shields used on the M2A1.

The Carriage, M2A2, is classified as Standard.

UNCLASSIFIED

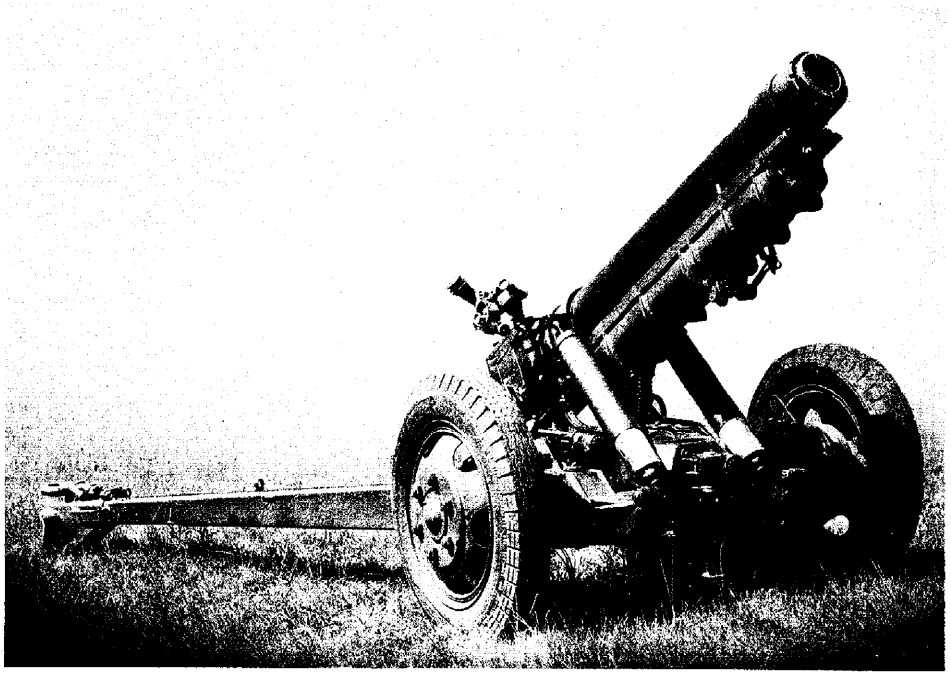
105 MM HOWITZER M3—CARRIAGE M3A1—STANDARD

CHARACTERISTICS

Caliber of howitzer	105 mm
Weight of howitzer	955 lb.
Weight of projectile	
H.E., M1	33 lb.
H.E., A.T., M67	29 lb.
Muzzle velocity	1,020 f./s.
Twist of rifling	Uniform, right-hand 1 turn in 20 cals.
Length of bore (approx.)	16 cals.
Maximum range, 30°	7,250 yds.

CARRIAGE, M3A1

Weight of howitzer and carriage without accessories	2,495 lb.
Length, overall (traveling position)	155 ins.
Width, over hub caps	67 5/16 ins.
Tread width (c/l—c/l)	56 11/16 ins.
Height, overall	49 3/4 ins.
Height to center of bore	34 1/8 ins.
Height of lunette (limbered position)	29 ins.
Elevation	30°
Depression	—9°
Traverse right or left from center line	22° 30′
Size of combat tires	7.50 x 16
Type of recoil mechanism	Hydropneumatic
Normal recoil at 0° elevation	27 ins.
at 30° elevation	30 ins.
Equilibrators	Spring
Weight of recoil mechanism and cradle	379 lb.



105 mm HOWITZER, M3, ON CARRIAGE, M3A1

The 105 mm Howitzer, M3, on Carriage, M3A1, was developed to provide a weapon for direct or indirect fire against combat vehicles. It was made sufficiently compact and light in weight for transport by air. Development of this howitzer and carriage, then designated as 105 mm Howitzer, T7, and 105 mm Howitzer Carriage, T6, was initiated by O.C.M. 17261, dated 25 September 1941. O.C.M. 19910, dated 3 March 1943, standardized the Howitzer, T7, as M3; the Carriage, T6, as M3A1; the Recoil Mechanism, T13, as M13; the modified Range Quadrant, M3, as M8, and the modified Elbow Telescope, M5, as M61.

HOWITZER, M3—This howitzer consists of the tube, the breech ring assembly screwed to the tube and locked in place, and the breech mechanism. The rectangular, horizontal-sliding breechblock, operated by a lever, contains a firing-lock recess for the Firing Lock, M13.

CARRIAGE, M3A1—This carriage was especially designed for high-speed travel. It is of the split-trail type with pneumatic-tired wheels. Its component parts are the sleigh, recoil mechanism, cradle, top and bottom carriages, elevating and traversing mechanism, equilibrators, firing base, trails and wheels.

The hydropneumatic recoil mechanism is housed in a recoil cylinder and a counter-recoil cylinder fixed underneath the bottom sleigh. Slides on the bottom sleigh are fitted to ways on the cradle. Trunnion bearings at the top of the top carriage support the cradle, while bearings at the bottom support the lower ends of two spring-type equilibrators. The elevating gear case is fitted to the top carriage. Elevation is accomplished by a handwheel located on the right side of the carriage.

The bottom carriage is fitted with a pintle bearing, trail brackets, trail lock pin bracket, firing base hinge brackets, traveling lock stops and a traversing rack. A handwheel on the left side of the carriage operates the traversing mechanism.

A combined firing-base and traveling lock can be lowered to provide a base for the howitzer during firing. Wheel carriers facilitate changing the carriage from the firing to the traveling position, or from the traveling to the firing position.

The wheels are of the divided rim type, with pneumatic combat tires equipped with bead locks and combat inner tubes. The internal-expanding parking brakes are actuated by handbrake levers.

Sighting and Fire Control Equipment

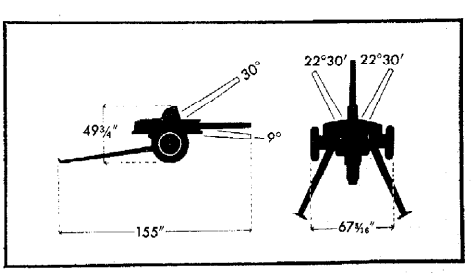
On Carriage Equipment

Telescope Mount, M16
Telescope Adapter, M9
Elbow Telescope, M62
Range Quadrant, M8
Elbow Telescope, M61

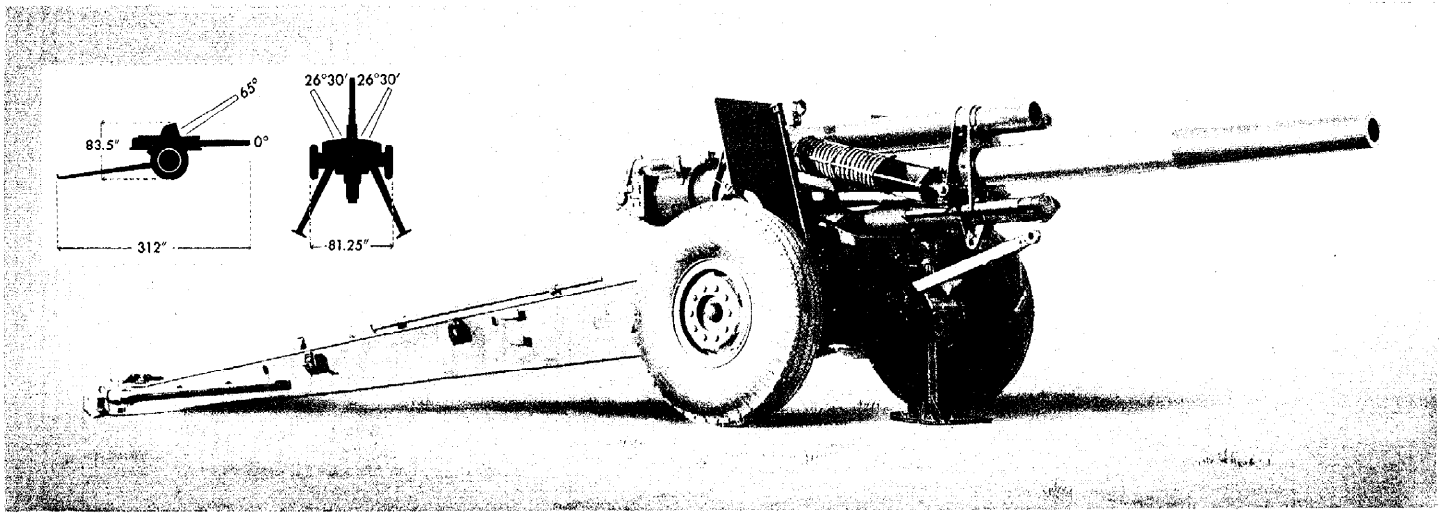
Ammunition

Ammunition is in the form of semi-fixed rounds. It consists of H.E. Shell, M1, with P.D. Fuze, M48, and H.E., A.T. Shell, M67, with B.D. Fuze, M62. The powder charges are made up in five zones for H.E. shell with muzzle velocities corresponding to Zones I to V for the 105 mm Howitzer, M2A1.

REFERENCE—TM 9-326.



4.5 INCH GUN M1—CARRIAGE M1A1—STANDARD



4.5 INCH GUN, M1, ON CARRIAGE, M1A1, IN FIRING POSITION AT 0° ELEVATION, THE CARRIAGE RESTING ON THE FIRING JACK

PRINCIPAL CHARACTERISTICS

GUN, M1

Caliber	4.5 ins.
Weight	4,200 lb.
Overall length	193.69 ins.
Length of bore	42 cals.
Muzzle velocity	1,820 and 2,275 f./s.
Volume of chamber	531 cu. ins.
Travel of projectile in bore	162.16 ins.
Maximum powder pressure	40,000 lb./sq. in.
Type of block mechanism	Stepped-thread interrupted screw
Rate of fire	4 rds./min.
Range (maximum)	21,125 yds.

RECOIL MECHANISM, M5

Type	Hydropneumatic
Weight	1,671 lb.
Normal recoil, variable	43 ins. at 0° to 29 ins. at 65°
Maximum piston-rod pull	48,000 lb.

CARRIAGE, M1

Total weight without gun	8,270 lb.
Length of carriage (muzzle to lunette)	312 ins.
Overall width	95½ ins.
Width of tread (c/—c/ of wheels)	81½ ins.
Height of lunette (limbered position)	29 ins.
Overall height (traveling)	83½ ins.
Trail spread (included angle)	60°
Elevation (maximum) (firing base)	65°
Depression (maximum) (firing base)	0°
Traverse (maximum, right)	26°30'
Traverse (maximum, left)	26°30'
Total weight of gun, mechanism, and carriage (limbered)	12,455 lb.

AMMUNITION

Weight of complete round (M65, H.E.)	61.963 lb., 66.315 lb.
Weight of projectile	54.90 lb.
Weight of projectile explosive charge	4.49 lb.
Weight of propelling charge	7.063 lb., 11.415 lb.
Type of ammunition	Separate loading

Sighting and Fire Control Equipment

On Carriage Equipment

Panoramic Telescope, M12
Telescope Mount, M25

Off Carriage Equipment

Aiming Circle, M1
Compass, M2
1-meter-base Range Finder, M7 or M1916
B. C. Telescope, M65 or M1915A1
Hand Fuze Setter, M21
Graphical Firing Table, M13 (short range), or M20 (long range)

Ammunition

Ammunition for the 4.5 inch Gun, M1, is in the form of separate loading rounds. It consists of H.E. Shell, M65, with P.D. Fuze, M55A1.

Trainer

The 37 mm Subcaliber Gun, M13, with 37 mm Subcaliber Gun Mount, M12, is standard for training in laying and firing the 4.5 inch Gun, M1.

REFERENCES—OCM 16644, 23 April 1941; OCM 21769, 7 Oct. 1943; TM 9-2005, v.3; TM 9-328.

The 4.5 inch medium field gun, M1, is a corps weapon of very modern design based on that of the British gun of the same caliber. While weighing little more than half as much as the 155 mm G.P.F. gun standard as a corps weapon in the last war, the 4.5 inch Gun, M1, has nearly 3,000 yards greater range.

GUN, M1—The barrel is equipped with a stepped-thread, interrupted screw type breechblock. The recoil mechanism is of the hydropneumatic (Filloux) type. The unbalanced weight of the gun and recoil system is neutralized by spring equilibrators.

CARRIAGE, M1—The Carriage, M1, identical in design with the 155 mm Howitzer Carriage, M1, has a split trail and is of unsprung, ball-bearing design. When in a firing position, the weight of the gun and carriage is supported on a mechanically operated firing jack and on the trails. Elevation is from 0° to 65°, while total traverse is 53°. Pneumatic combat tires and air brakes which can be operated from a prime mover enable the weapon to be towed at high speed.

CARRIAGE, M1A1—When electric brakes are substituted for air brakes on the Carriage, M1, the modified carriage is designated 4.5 inch Gun Carriage, M1A1.

155 MM HOWITZER M1—CARRIAGE M1—STANDARD
155 MM HOWITZER M1918—CARRIAGE M1918A3—SUBSTITUTE STANDARD

PRINCIPAL CHARACTERISTICS OF 155 mm HOWITZER, M1, AND CARRIAGE, M1

HOWITZER, M1

Caliber	155 mm
Weight	3,825 lb.
Overall length	150 ins.
Length of bore	20 cals.
Muzzle velocity	680, 770, 880, 1,020, 1,220, 1,520, 1,850 f./s.
Volume of chamber	725 cu. ins.
Travel of projectile in bore	120.675 ins.
Maximum powder pressure	32,000 lb./sq. in.
Type of block mechanism	Interrupted screw
Rate of fire	2 rds./min.
Range (maximum)	16,000 yds.

RECOIL MECHANISM

Type	Hydropneumatic, T2
Weight	1,570 lb.
Normal recoil variable (supercharge, Zone VII)	58 ins. at 0° to 41 ins. at 65°
Maximum piston-rod pull	64,000 lb. at 65° elevation

CARRIAGE, M1

Total weight without howitzer	8,141 lb.
Height of lunette (limbered position)	29 ins.
Width of carriage (overall)	95½ ins.
Tread width	81½ ins.
Trail spread (included angle)	30° right, 30° left
Elevation (maximum) (on firing base)	65°
Depression	0°
Traverse (maximum, right) (on firing base)	26°30′
Traverse (maximum, left) (on firing base)	26°30′
Total weight with weapon (without cover or accessories)	11,966 lb.

AMMUNITION

Weight of complete round, H.E., M107	108.42 lb.
Weight of projectile	95 lb.
Weight of projectile explosive charge	15.87 lb.
Weight of propelling charge	13.42 lb.
Type of ammunition	Separate loading

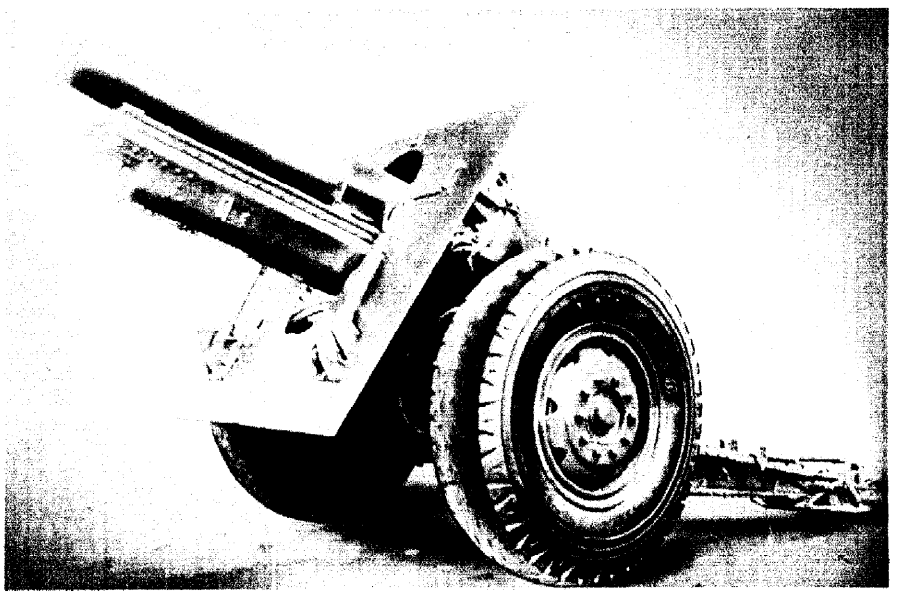
155 mm HOWITZER, M1918, AND CARRIAGE, M1918A3

HOWITZER, M1918

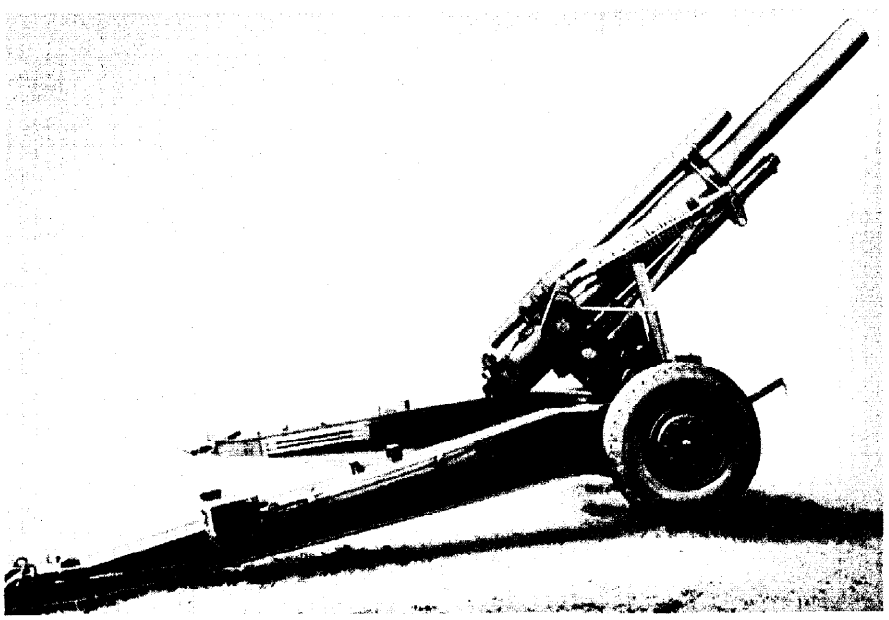
Weight	2,740 lb.
Length of barrel	91.81 ins.
Length of bore	13.64 cals.
Travel of projectile	69.88 ins.
Volume of chamber	425 cu. ins.
Maximum pressure	26,500 lb./sq. in.
Maximum range	12,400 yds.

CARRIAGE, M1918A3

Weight of sleigh and recoil mechanism	863 lb.
Weight of howitzer and carriage in firing position	8,184 lb.
Total weight, matériel in traveling position, complete	9,518 lb.
Height above ground, highest point, top of shield	77.36 ins.
Range of elevation	0° to +42° 20′
Traverse to right or left	3°
Width of tread	75½ ins.
Tires, pneumatic	13.00x24



155 mm HOWITZER, M1918, ON CARRIAGE, M1918A3



155 mm HOWITZER, M1, ON CARRIAGE, M1

The first 155 mm howitzers used by the U. S. Army were the M1917 and M1917A1, designed and manufactured in France by the Schneider Company during the last war. These were succeeded by the M1918, constructed in America, which was in turn superseded by the M1 as the standard 155 mm howitzer matériel.

155 mm HOWITZERS, M1917 AND M1917A1—These are short, heavy cannon with built-up barrels, interrupted-screw, carrier-supported breechblocks of the lever-pull type and continuous-pull, vertical-sliding firing mechanisms. These weapons are classified as Limited Standard.

155 mm HOWITZER, M1918—The M1918 howitzer is similar in build, weight, dimensions and ballistics to the M1917 and M1917A1. The firing mechanism is of the screw-type, provided with a block-latch assembly as a safety measure. This howitzer is classified as Substitute Standard.

155 mm HOWITZER, M1—The barrel of this howitzer is of monobloc construction. It is considerably longer and heavier than the barrels in previous models, and is equipped with an interrupted-thread, screw-type breechblock. The range is nearly 4,000 yards greater than that of the M1918. This howitzer was classified as Standard in O.C.M. 16724 dated 15 May 1941.

155 mm CARRIAGE, M1917—This is a French manufactured carriage with a box trail, steel-tired wood wheels and a curved shield. Recoil and counter recoil of the howitzer on its recoil are regulated by a hydropneumatic recoil system, housed in a sleigh to which the howitzer is connected. The trail flasks contain bearings in which the cradle trunnions are seated. This carriage is classified as Limited Standard.

155 mm CARRIAGE, M1917A1—This is the carriage, M1917, with a straight shield, a sight port, rubber-tired wheels and provision for Quadrant Sight, M1917A1, and Panoramic Sight, M1917. This carriage is classified as Limited Standard.

155 mm CARRIAGE, M1917A2—When the M1917A1 carriage is furnished with a cradle lock and drawbar for motor draft, it is designated Carriage, M1917A2. These modifications eliminate the need for a limber. This carriage is classified as Limited Standard.

155 mm CARRIAGE, M1917A3—This is the M1917 carriage with the addition of a high-speed axle, wheels with pneumatic tires, a drawbar and a cradle traveling lock. This carriage is classified as Limited Standard.

155 mm CARRIAGE, M1917A4—The addition of torque rods to Carriage, M1917A2, changes the model designation to M1917A4.

155 mm CARRIAGE, M1918—In its main constructional details this carriage is similar to the M1917. The wheels have rubber tires, and the shield consists of right and left shield plates suitably tied together. A panoramic-sight case is attached to the left shield plate. This carriage is classified as Limited Standard.

155 mm CARRIAGE, M1918A1—Experiments begun by the Ordnance Dept. in 1933 for the purpose of adapting 155 mm howitzer matériel to high-speed transport resulted in connecting the carriage to the prime mover by means of a drawbar and in new bearings designed to reduce friction. In 1934 the M1918E4 was produced with pneumatic-tired wheels possessing lubricant-retaining features in the bearings. Improvements in these modifications were incorporated in the M1918E5, standardized in 1936 as Carriage, M1918A1.

155 mm CARRIAGE, M1918A3—This is the Carriage, M1918A1, when equipped with torque rods. This carriage is classified as Substitute Standard.

155 mm CARRIAGE, M1—This carriage is interchangeable with the Carriage, M2, used for the 4.5″ Gun, M1. The recoil mechanism is of the hydropneumatic type. Length of recoil varies automatically with the elevation and the zone of fire. Equilibrators of the spring type neutralize the unbalanced weight of the gun. The carriage has a split trail, pneumatic tires with self-sealing inner tubes and air brakes controlled by the driver of the prime mover. This carriage was classified as Standard by O.C.M. 16724 dated 15 May 1941.

REFERENCES—TM 9-2005, v.3; TM 9-330; TM 9-331; TM 9-1331.

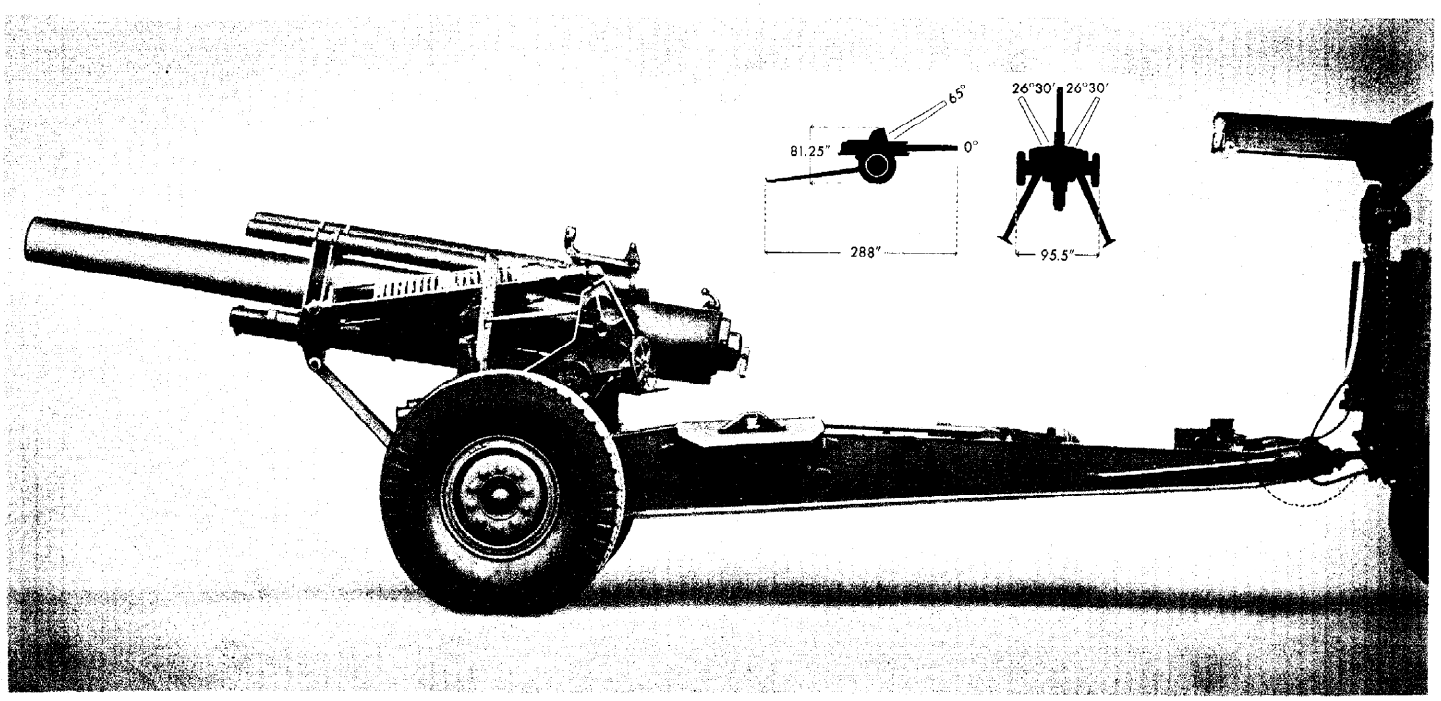
Sighting and Fire Control Equipment

On Carriage Equipment

Panoramic Telescope, M12
Telescope Mount, M25

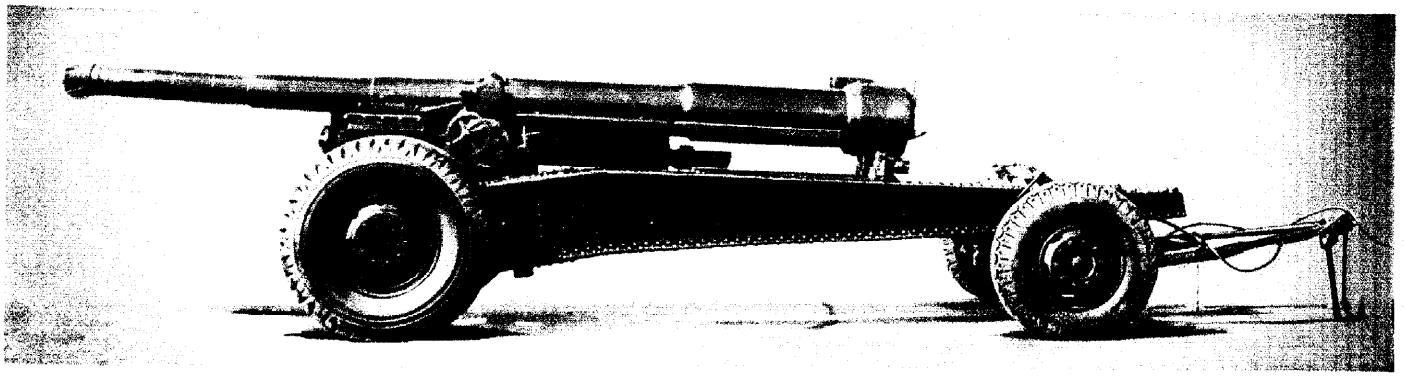
Off Carriage Equipment

Gunner's Quadrant, M1
Aiming Circle, M1
Bore Sight
1-meter-base Range Finder, M7 or M1916
Hand Fuze Setter, M1913A1
B. C. Telescope, M65 or M1915A1
Hand Fuze Setter, M21
Graphical Firing Table, M5 (with M1917 and M1918 matériel)
Graphical Firing Table, M12 (with M1 matériel)



155 mm HOWITZER, M1, IN TRAVELING POSITION

155 MM GUN M1918M1—CARRIAGE M3—SUBSTITUTE STANDARD



155 mm GUN, M1918M1, ON CARRIAGE, M3, IN TRAVELING POSITION WITH LIMBER, M3

The 155 mm Gun, M1918M1, is of French design, similar to the 155 mm Gun, M1917, G.P.F., manufactured in France and used by the American Expeditionary Force in 1917–18. Only slight variations exist between the basic G.P.F. and the gun as modified or constructed in the United States. In addition to their use as field pieces, all models of the G.P.F. are now mounted on the 155 mm Gun Motor Carriage, M12.

GUNS, M1917 AND M1918M1—The differences between these models are superficial, and the breech mechanisms are interchangeable. The M1917 is the French manufactured 155 mm G.P.F., numbers of which were purchased by the United States, while the M1918M1 is of American manufacture.

The built-up, alloy-steel barrel has a breech ring screwed on to the jacket. A cylindrical, interrupted-thread type breechblock contains a French screw-type firing mechanism. This gun is classified as Substitute Standard.

GUN, M1917A1—When an American manufactured breechblock is installed in the French 155 mm gun, the weapon takes the designation M1917A1. This gun is classified as Limited Standard.

CARRIAGES, M1917 AND M1918—These carriages are identical. They are of the split-trail type, with a cast-steel top carriage mounted and traversing on the chassis section of the bottom carriage assembly. The elevating and traversing mechanisms are affixed to the top carriage. A hydropneumatic, variable recoil, independent type recoil system with a floating piston is housed in a cradle supported by trunnions resting in bearings in the top carriage. The bottom carriage is a large steel casting which, when in traveling position, is suspended from the axle by a multiple leaf spring. These carriages are classified as Limited Standard.

CARRIAGE, M1917A1—This is the M1917 carriage equipped with anti-friction bearings, solid rubber tires, and driver-operated power brakes for high-speed transport. This carriage is classified as Limited Standard.

CARRIAGE, M1918A1—When the M1918 carriage is modified for high-speed transport in the same manner as the M1917A1, it takes the designation M1918A1. This carriage is classified as Limited Standard.

CARRIAGES, M2 AND M3—The addition of pneumatic tires and air brakes to the Carriage, M1917, changes its designation to M2. When similar modifications are made on the Carriage, M1918, it becomes the M3. These carriages are classified as Substitute Standard.

LIMBER, M3—This limber was specifically designed for high-speed transport. The axle is a steel forging. The axle body is I-sectional in form, terminating in right-angle bands with boss ends horizontally bored for spindles. Semi-elliptic leaf type springs are clamped to the axle by spring clips. Front and rear members are welded and riveted to the spring brackets and the fifth wheel base. A fifth-wheel assembly permits the limber to pivot under the front end of the trails to follow the movement of the drawbars.

Sighting and Fire Control Equipment

On Carriage Equipment
- Panoramic Telescope, M6
- Instrument Light, M9
- Quadrant Sight, M1918A1 or M1918

Off Carriage Equipment
- Aiming Post, M1
- Aiming Post Light, M14
- Gunner's Quadrant, M1 or M1918
- Graphical Firing Table, M6 (short range) and M15 (long range)
- B.C. Telescope, M65 or M1915A1
- Bore Sight

Ammunition

Ammunition is of the separate loading type. It consists of Projectile, A.P., M112 with Fuze, B.D., M60; Shell, gas, persistent, HS, M104, unfuzed, adapted for Fuze, P.D., M51, with Booster M21, or Fuze, P.D., M51A1, with Booster, M21A1; Shell, gas, persistent, H.S., Mk. VIIA1, unfuzed, adapted for Fuze, P.D., M51, with Booster M21, or Fuze, P.D., M51A1, with Booster, M21A1; Shell, H.E., M101, unfuzed, adapted for Fuze, P.D., M51, with Booster, M21 or M51A1, with Booster, M21A1, or Fuze, time, mechanical, M67, with Booster, M21A1; Shell, H.E., Mk. III, with Fuze, P.D., M46 or M47; Shell, H.E., Mk. IIIA1, with Fuze, M51A1, with Booster, M21A1, or Fuze, time, mechanical, M67, with Booster, M21A1; Shell, Smoke, FS, Mk. VIIA1, with Fuze, P.D., M51A1, with Booster, M21A1; Shell, Smoke, phosphorous, WP, M104, with Fuze, M51A1, with Booster, M21A1.

Trainer

The 37 mm Gun, M1916, on Subcaliber Mount, M1, is used for practice in laying and firing the 155 mm Guns, M1917, M1917A1, and M1918M1.

REFERENCES—TM 9-2005, v.3; TM 9-345; TM 9-1345; FM 6-90.

PRINCIPAL CHARACTERISTICS

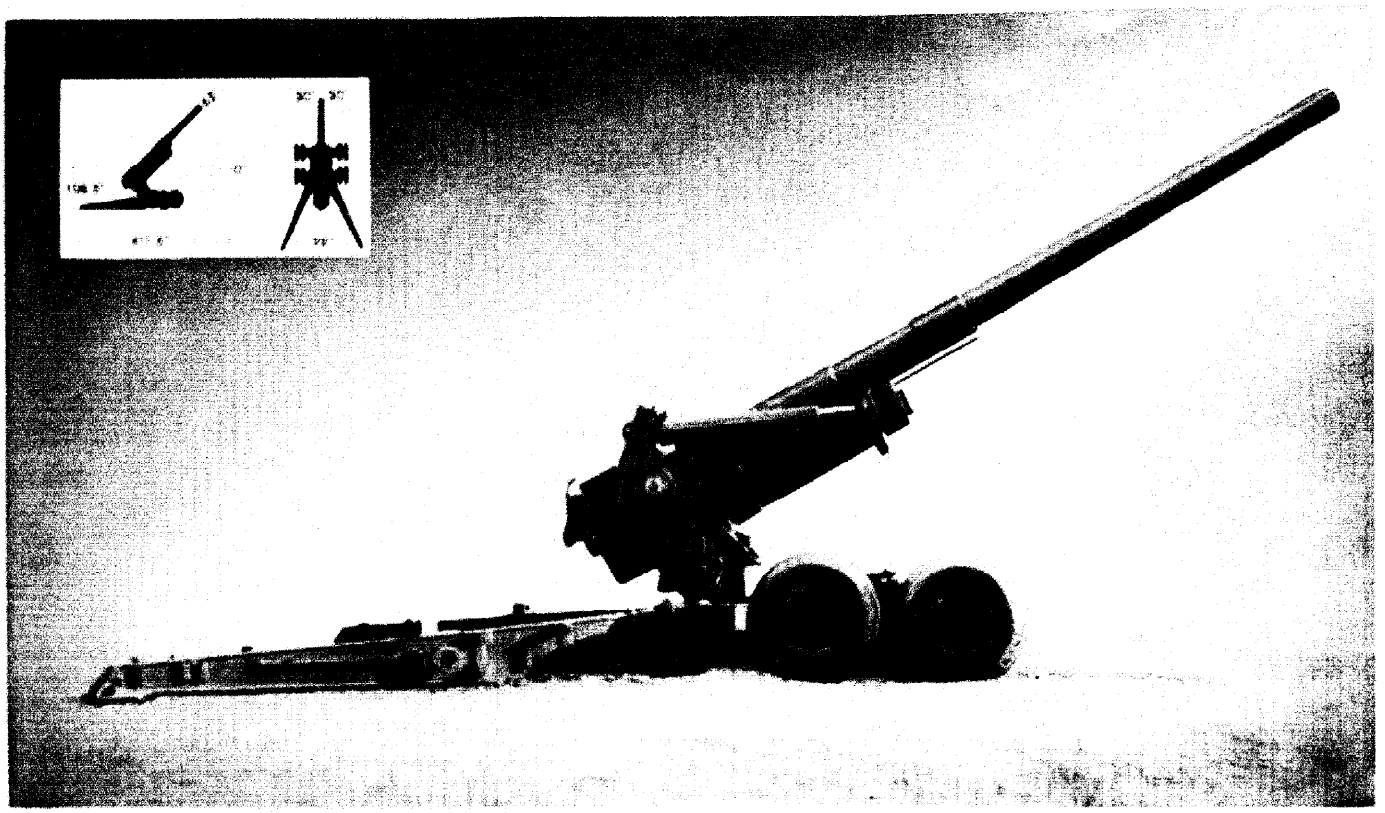
155 mm Gun, M1918M1

Weight, complete	8,715 lb.
Length	232.87 ins.
Chamber volume	1,329 cu. ins.
Travel of projectile in bore	185 ins.
Maximum pressure	31,500 p.s.i.
Muzzle velocity (projectile, A.P., M112)	2,360 f./s.
Maximum range (with supercharge shell, H.E., M101)	20,100 yds.
Rate of fire (with supercharge)	4 rds./min.

Carriage, M3

Recoil mechanism	hydropneumatic, variable recoil
Weight of recoil mechanism	3,114 lb.
Total weight (less gun and limber)	14,587 lb.
Weight of limber	2,630 lb.
Length overall, traveling position, gun, carriage and limber	31 5/6 ft.
Width (outer walls of tires)	106 ins.
Height, extreme (traveling position)	74 3/8 ins.
Diameter of turning circle	60 1/4 ft.
Road clearance	
Carriage	12 1/2 ins.
Limber	9 1/4 ins.
Elevation	0° to 35°
Traverse (maximum right)	30°
Traverse (maximum left)	30°

155 MM GUN M1A1—CARRIAGE M1—STANDARD



155 mm GUN, M1A1, IN FIRING POSITION

The 155 mm Gun, M1A1, and Carriage, M1, are the results of an endeavor to secure a weapon for army artillery which would combine great firepower with a high degree of mobility. This gun is a development based on the French 155 mm Gun, M1917, G.P.F., used by the A.E.F. in 1917-18. With a muzzle velocity less than 400 feet per second greater than that of its predecessor, the M1A1 has a range of 25,395 yards instead of the 17,460 yards range of the M1917. The 155 mm Gun, M1A1, on Carriage, M1, is also utilized as a coast defense weapon.

GUN, M1—The M1 gun is basically an improved M1918M1 with a longer barrel; a larger powder chamber, an interrupted screw, carrier-supported, two-cycle type breech mechanism equipped with a spring-actuated counter-balance, a modernized type of firing mechanism, and a plastic type obturator with a mushroom head. This gun is classified as Substitute Standard.

GUN, M1A1—The only difference between this gun and the M1 is that the breech ring bushing has been eliminated in the former, the breech threads being cut directly in the breech ring. This gun was classified as Standard in OCM 16830 dated 12 June 1941.

PRINCIPAL CHARACTERISTICS

Gun, M1A1

Caliber	155 mm
Weight of gun complete	9,595 lb.
Length of bore	45 cals.
Length of gun	22.9 ft.
Muzzle velocity	2,800 f/s.
Weight of projectile	95 lb.
Weight of powder charge	30 lb.
Maximum rated pressure	38,000 lb/sq. in.
Number of grooves	48
Twist	Right-hand—uniform
Rate of fire	1 rd/min.
Range	25,395 yds.

Recoil Mechanism

Type	Hydropneumatic, variable recoil, M3
Weight	3,890 lb.
Normal recoil	54 ins. at 0°; 31½ ins. at 65°
Maximum recoil	57½ ins.
Maximum piston-rod pull at 65°	96,500 lb.

Carriage

Type	Split trail
Weight of carriage with gun	30,600 lb.
Maximum elevation	65°
Traverse (max., right)	30°
Traverse (max., left)	30°
Maximum spread of trails	60°
Overall height (traveling position)	102 ins.
Overall length (traveling position)	34.3 ft.
Overall width (traveling position)	99 ins.
Bogie	4 dual wheels
Brakes	Air, on each bogie wheel

Ammunition

	M101 H.E.	M112B1 A.P.
Weight of complete round	126.97 lb.	131.28 lb.
Weight of projectile	94.71 lb.	100 lb.
Weight of projectile explosive charge	15.13 lb.	14.4 lb.
Weight of propelling charge	32.26 lb.	31.75 lb.
Type of ammunition	Semi-fixed	Semi-fixed

Armor penetration, homogeneous plate, 90° from normal: 3 ins. at 6,000 yds.

CARRIAGE, M1—This carriage is able to mount the 155 mm Gun, M1A1. It consists mainly of the bogie, bottom carriage, top carriage, cradle, recoil mechanism, equilibrators, and trails. The gun is supported in a cradle trunnioned in bearings in the top carriage. Two pneumatic type equilibrators, one on each side of the carriage, neutralize the unbalanced weight of the gun. The Recoil Mechanism, M3, is of the hydropneumatic, variable recoil type, assembled and attached to the cradle. The top carriage, which supports the tipping parts and mounts the elevating and traversing mechanisms, pivots about a vertical axis on the chassis section of the bottom carriage. When the bogie wheels are raised, the bottom carriage rests on the ground and, together with the spread trails, provides a three-point suspension. Air brakes, equalized on each of the four rear bogie wheels, are controlled from the driver's seat of the prime mover. Two handbrake levers are also provided to operate the brakes on the two front bogie wheels and for use when parking or in case of an emergency. All bogie wheels have pneumatic tires.

For travel, the gun is disconnected from the recoil mechanism by removing the piston-rod nuts, and retracted until the weight of the breech end is supported by the traveling lock. When it is desired to go into firing position, the gun is pulled into battery by the prime mover, the piston-rod nuts are replaced and the traveling lock is removed. The trails are then lowered to the ground by a screw mechanism on the limber and the limber is removed. Two jacks on the bogie lower the mount until the bottom carriage rests on the ground. Further rotation of the jacks raises the bogie clear of the ground.

This carriage is classified as Standard.

LIMBER, HEAVY CARRIAGE, M2—This limber is a two-wheeled, pneumatic-tired vehicle with a limber-lifting mechanism which holds the spade ends of the trails when the gun and carriage are in traveling position. The limber weighs 1,975 pounds, and its wheels are interchangeable with those on the bogie of the carriage. When the gun is truck drawn the limber is not needed.

Sighting and Fire Control Equipment

On Carriage Equipment
Telescope Mount, M18A1
Quadrant Mount, M1
Panoramic Telescope, M12

Off Carriage Equipment
Aiming Circle, M1
B.C., Telescope, M65 or M1915A1
Aiming Post, M1
Gunner's Quadrant, M1

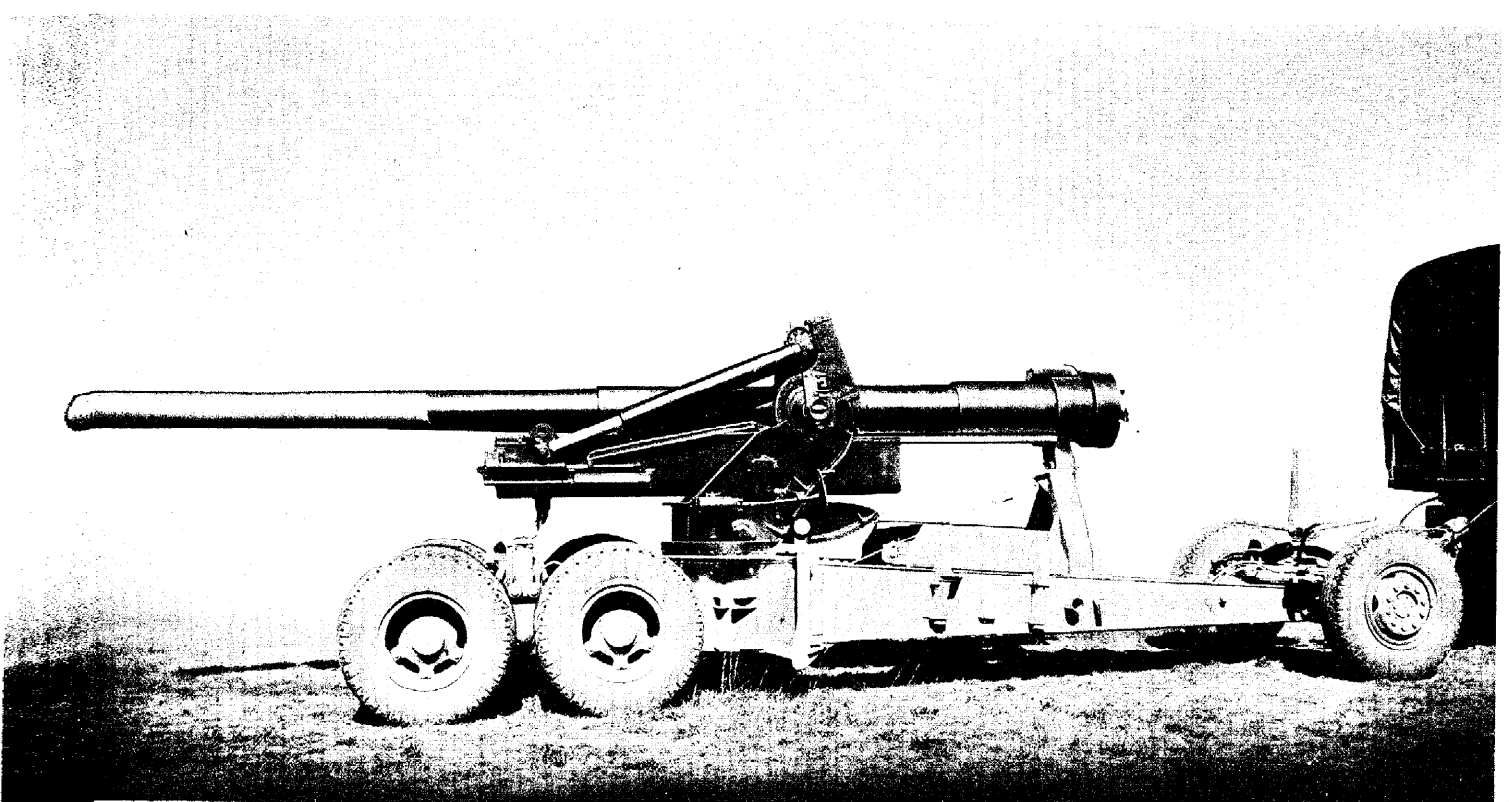
Ammunition

Ammunition for the 155 mm Gun, M1A1, is of the separate-loading type, the propellant being ignited by a percussion primer. The standard projectiles for the gun are H.E. Shell, M101, with either point-detonating Fuze, M51A1, or mechanical time Fuze, M67; armor-piercing Shell, M112B1, with base-detonating Fuze, M60, and chemical Shell, M104, with point-detonating Fuze, M51A1.

Trainer

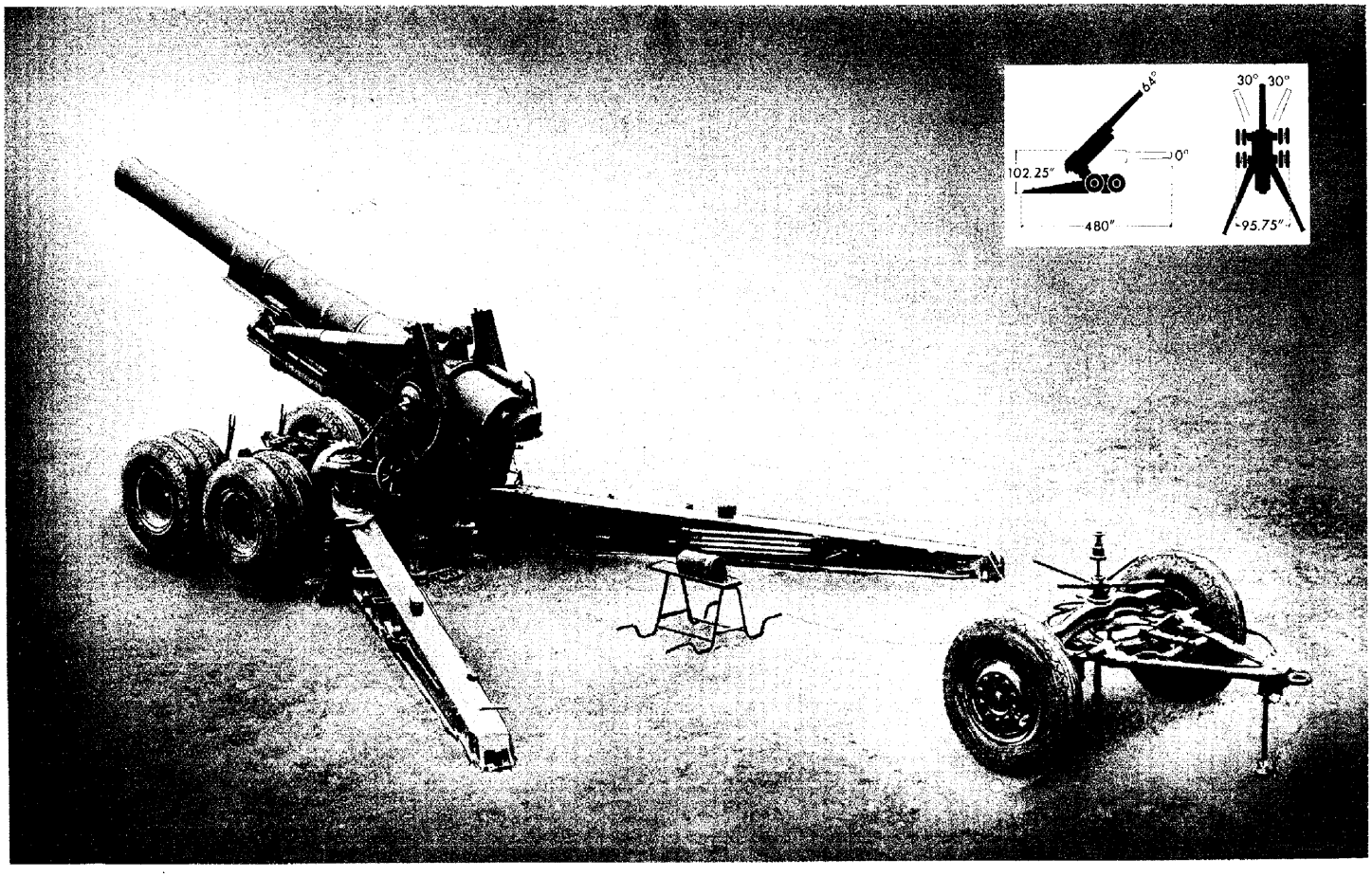
The 37 mm Gun, M1916, on Subcaliber Mount, M10, is used for practice in laying and firing the 155 mm Gun, M1A1.

REFERENCES—TM 9–2005, v.3; TM 9–345; TM 9–1345; TM 9–350; TM 9–1350; FM 6–90.



155 mm GUN, M1A1, ON CARRIAGE, M1 AND HEAVY LIMBER, M2, in Traveling Position with Gun Retracted and Supported by the Traveling Lock

8 INCH HOWITZER M1—CARRIAGE M1—STANDARD



8 INCH HOWITZER, M1, IN FIRING POSITION, WITH LOADING TRAY AND HEAVY LIMBER, M2

PRINCIPAL CHARACTERISTICS

HOWITZER, M1

Caliber	8 ins.
Weight	10,240 lb.
Overall length	209.59 ins.
Length of bore	25 cals.
Muzzle velocity	820, 900, 1,000, 1,150, 1,380, 1,640, 1,950 f./s.
Volume of chamber	1,527 cu. ins.
Travel of projectile in bore	173.83 ins.
Maximum powder pressure	33,000 lb./sq. in.
Type of block mechanism	Interrupted-screw type
Rate of fire	1 rd. in 2 mins.
Range	18,510 yds.

RECOIL MECHANISM, M4

Type	Hydropneumatic
Weight	3,890 lb.
Normal recoil	63 ins. at 0° to 32 ins. at 64°
Maximum recoil	70 ins.
Maximum piston-rod pull at 65°	139,850 lb.

CARRIAGE, M1

Total weight of carriage and limber without howitzer	21,460 lb.
Height of lunette (limbered position)	27 ins.
Length of carriage (muzzle to lunette)	40 ft.
Width over hub caps	95¾ ins.
Width overall of bogie	98⅞ ins.
Tread width (c/—c/ of wheels) (limber)	83½ ins.
Height in traveling position	102¼ ins.
Trail spread (included angle)	60°
Elevation (maximum) (firing base)	64°
Depression (maximum) (firing base)	0°
Traverse (firing base) (right)	30°
Traverse (firing base) (left)	30°
Total weight of gun, mechanism and carriage	31,700 lb.

AMMUNITION

Weight of complete round	213.96 lb. 228.75 lb.
Weight of projectile shell, M106	200 lb.
Weight of projectile explosive charge	29.6 lb.
Weight of propelling charge	10.75 lb. (approx.)
Type of ammunition	Separate loading

The present 8″ howitzer used by the U. S. Army is the M1, a development from the Howitzers, Mk. VI, Mk. VII and Mk. VIII-½ issued to the A.E.F. during the first World War. These howitzers were manufactured in both England and the United States. While they differ in certain respects, they have the same types of breechblocks and firing mechanisms.

8 INCH HOWITZER, MK. VI—This howitzer is mounted on the Mk. VI carriage. The barrel is of built-up construction, consisting of a jacket shrunk on over a tube. A shrunk-on breech ring carries a lug for connecting the gun to the recoil mechanism. A breech bushing is provided for reception of a lever-operated breechblock of the interrupted-screw type having an asbestos obturator pad in the mushroom head. Two types of noninterchangeable firing mechanisms are utilized. In one a T-tube friction primer inserted in the breech is fired by means of a lanyard pulling a friction wire out of the tube. The other type is of the percussion variety, in which a percussion primer fitting into the breechblock is fired by a lanyard-operated hammer striking a firing

pin. Front and rear guide rings support the howitzer in the cradle. This howitzer is classified as Limited Standard.

8 INCH HOWITZER, MK. VII—This howitzer, of wire-wound construction, was superseded by the Mk. VIII-½ because it was found necessary to thicken the powder chamber walls to prevent their cracking. It is classified as Limited Standard.

8 INCH HOWITZER, MK. VIII-½—This howitzer is also of the built-up type, but has an inner and an outer tube over which the jacket is shrunk. No guide rings are included, as the jacket supports the weight of the cannon. Other details are identical with those of the Mk. VI. This howitzer is mounted on the Mk. VII carriage, and is classified as Limited Standard.

8 INCH HOWITZER, M1—This weapon is of built-up construction. The tube screws into a breech ring fitted with lugs for support of the breechblock carrier and attachment of the recoil mechanism. The carrier-supported breechblock is of the two-cycle, interrupted-screw type. It is equipped with a spring-actuated counterbalance, a percussion type of firing mechanism and an obturator mechanism. With the exception of the spindle, pads and other parts of the obturator, the breech mechanisms of the 8″ Howitzer, M1, and the 155 mm Gun, M1, are interchangeable. This howitzer is classified as Standard (O.C.M. 15938).

8 INCH HOWITZER PLATFORM, M1917—When in firing position, the Mk. VII and Mk. VIII-½ howitzers rest on a demountable firing platform buried flush with the surface of the gound. For transport, the platform is loaded on a two-wheeled cart attached to the howitzer carriage. The cart and platform are each classified as Limited Standard.

CARRIAGES, MK. VI AND MK. VII (British)—These carriages differ mainly in the weight and clearance of the trails, those of the Mk. VII being raised and strengthened to accommodate the Mk. VIII-½ howitzer. The cradle rests in the trunnion bearings of a top carriage which is pivoted in the front transom of the trail to permit traverse. A hydropneumatic, long-recoil type recoil mechanism carried by the cradle contains both the recoil brake and the recuperator. The trail is of the box type cut away to allow clearance for recoil of the howitzer when it is fired at high angles of elevation. All-steel wheels, 66″ in diameter, with tires 12″ wide, are fitted with brakes acting independently on each wheel. These carriages are classified as Limited Standard.

CARRIAGE, M1—This carriage is identical in design and construction with the 155 mm Gun Carriage, M1. Since the howitzer is considerably heavier than the gun, it is necessary to increase the nitrogen pressure in the howitzer recoil mechanism, M4. The howitzer remains in the battery position during transport. This carriage is classified as Standard (O.C.M. 15938).

HEAVY CARRIAGE LIMBER, M2—This is the same limber used with the 155 mm Gun Carriage, M1.

Sighting and Fire Control Equipment

On Carriage Equipment

Quadrant Mount, M1
Panoramic Telescope, M12
Telescope Mount, M18A1

Off Carriage Equipment

Gunner's Quadrant, M1
Bore Sight
Aiming Post, M1
Aiming Circle, M1
B. C. Telescope, M65 or M1915A1
Hand Fuze Setter, M21
Graphical Firing Tables, M8 (short range) and M9 (long range)

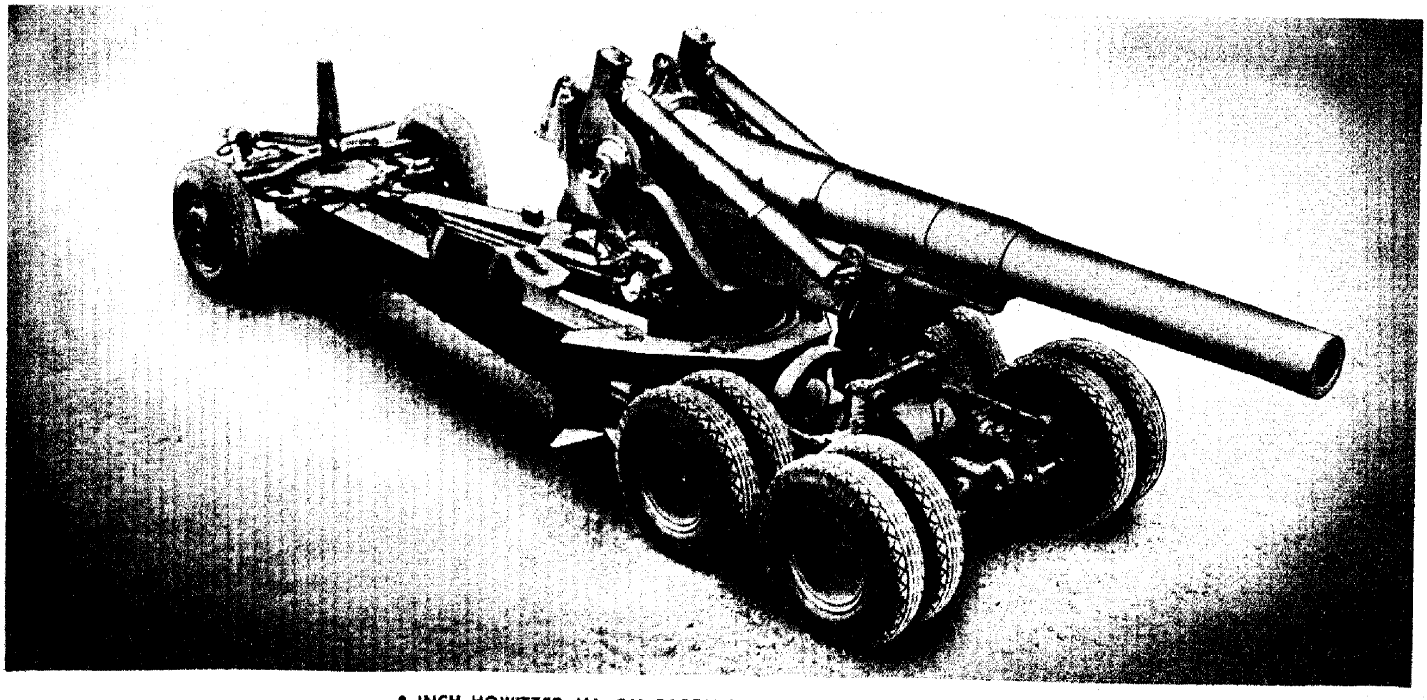
Ammunition

The 8″ Howitzer, M1, uses separate-loading, high-explosive ammunition with different weights of powder charges to give seven zones of fire. It consists of H.E. shell, M106, with P.D. fuze, M51A1, and M.T. fuze, M67.

Trainer

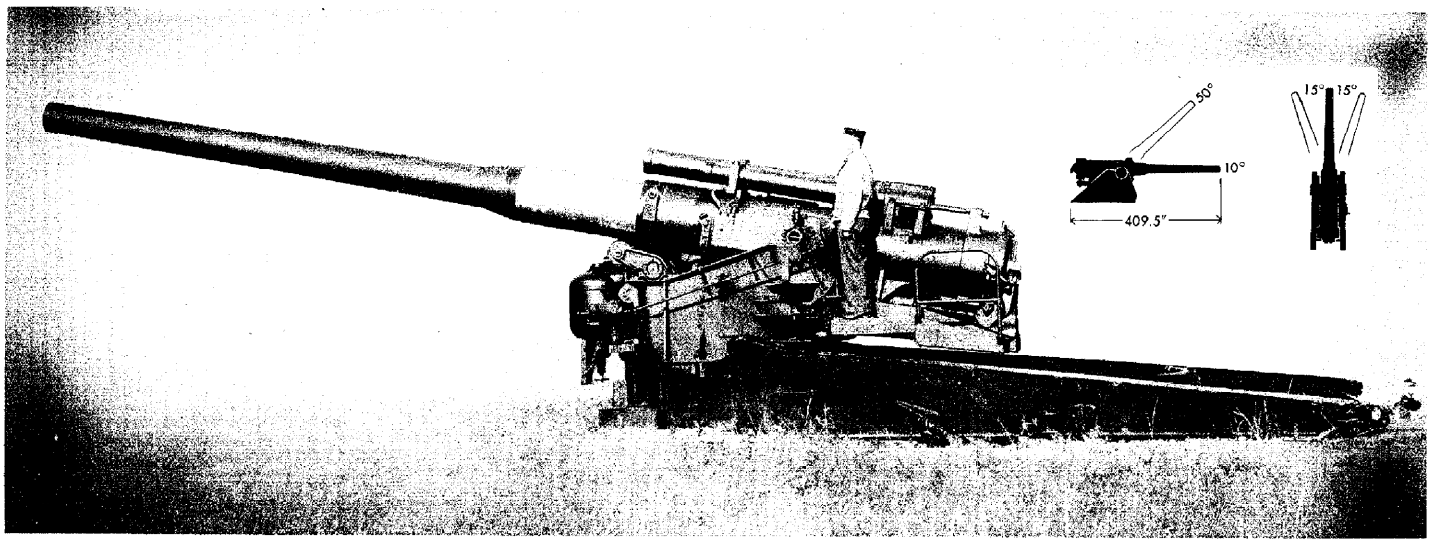
The 37 mm Gun, M1916, on Subcaliber Mount, M10, is used for practice in laying and firing the 8″ Howitzer, M1.

REFERENCES—TM 9-2005, v.3; TM 9-335; TM 9-1335; FM 21-6.



8 INCH HOWITZER, M1, ON CARRIAGE, M1, IN TRAVELING POSITION

8 INCH GUN M1—CARRIAGE M2—STANDARD



8 INCH GUN, M1, CARRIAGE, M2, IN FIRING POSITION, AT 10° ELEVATION

The 8″ Gun, M1, on the Carriage, M2, was designed for use as a G.H.Q. reserve artillery weapon. The Caliber Board report of 5 May 1919, recommended the construction of an 8″ field gun, but all development work on this matériel was suspended by O.C.M. 4110, dated 8 September 1924. The project was formally resumed in 1939. O.C.M. 15791, dated 9 May 1940, approved the military characteristics of the 8″ Gun, T2, and the 8″ Gun Carriage, T2, and O.C.M. 17053, dated 31 July 1941, approved the design of the pilot matériel. O.C.M. 17241, dated 18 September 1941, approved the nomenclature of the 8″ gun matériel, when eventually standardized, as 8″ Gun, M1, 8″ Gun Carriage, M2, Recoil Mechanism, M7, Cannon Transport Wagon, M1, and Carriage Transport Wagon, M3.

8 INCH GUN, M1—The gun consists of a cold-worked tube with a shrunk-on jacket. The jacket contains a keyway to guide it in the recoil mechanism. The breech mechanism, with an interrupted step thread, rotating drop type breechblock, is interchangeable with that of the 240 mm Howitzer, M1.

CARRIAGE, M2—The carriage is similar to that for the 240 mm Howitzer, M1, with the exception that it has a minimum elevation of 10° and a maximum elevation of 50°, and such other modifications as are necessary to adapt it to the longer, heavier 8″ gun. The Recoil Mechanism, M7, is of the hydropneumatic type, the recoil and counter-recoil rod and the recoil control rod being longer than those in the 240 mm howitzer recoil system. The gun is dismounted from the carriage for transport and loaded on the Cannon Transport Wagon, M1. The carriage is transported on the Carriage Transport Wagon, M3. Dismounting and assembling of the gun and carriage are accomplished by the Truck Mounted Crane, M2, or by winches and cables on the tractors.

CANNON TRANSPORT WAGON, M1—This is a 6 wheel wagon with a steel chassis, designed to transport the 8″ M1 gun and recoil mechanism. It is equipped

PRINCIPAL CHARACTERISTICS

GUN

Weight	29,800 lb.
Overall length	409.5 ins.
Length of bore	50 calibers
Muzzle velocity	2,950 f./s.
Volume of chamber	5,156 cu. ins.
Travel of projectile in bore	338.58 ins.
Maximum powder pressure	38,000 lb./sq. in.
Type of block mechanism	Rotating drop type breechblock
Rate of fire	1 rd./min.
Range—maximum (approx.)	35,000 yds.
Range—minimum (approx.)	22,000 yds.

RECOIL MECHANISM, M7 (Including Cradle)

Type	Hydropneumatic
Weight	7,021 lb.
Recoil	50 ins. at 50° 47 ins. at 10°

CARRIAGE

Weight without gun	39,300 lb.
Trail spread (included angle)	45°
Elevation (maximum)	50°
Elevation (minimum)	10°
Traverse (maximum, right)	15°
Traverse (maximum, left)	15°
Total weight of gun, mechanism and carriage	69,300 lb.

CANNON TRANSPORT WAGON, M1

Weight (loaded)	49,200 lb.
Weight under front tires (loaded)	15,200 lb.
Weight under rear tires (loaded)	34,000 lb.
Overall length (loaded)	501 ins.
Overall height (loaded)	84 ins.
Overall width	111½ ins.
Wheel tread	92 ins.
Wheel base	192 ins.

CARRIAGE TRANSPORT WAGON, M3

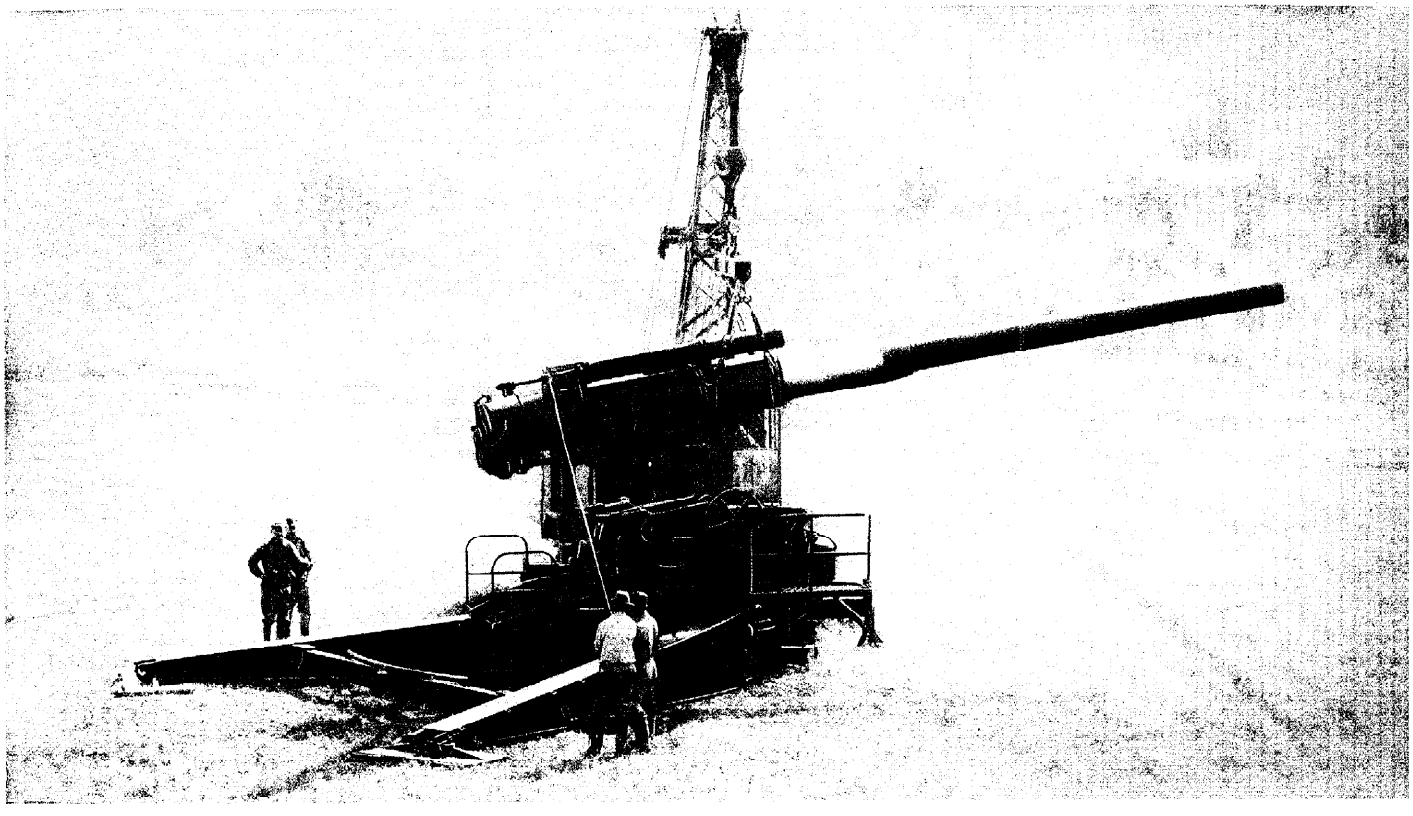
Weight (loaded)	46,900 lb.
Weight under front tires (loaded)	14,360 lb.
Weight under rear tires (loaded)	32,540 lb.
Overall length (loaded)	429½ ins.
Overall height (loaded)	128¼ ins.
Overall width	111½ ins.
Wheel tread	92 ins.
Wheel base	264 ins.

TRUCK MOUNTED CRANE, M2

Gross weight	53,000 lb.
Wheel base	168½ ins.
Overall length (without boom)	298½ ins.
Overall height	130½ ins.
Overall width	108 ins.

AMMUNITION

Type of shell	H.E., M103
Weight of complete round	347.24 lb.
Weight of shell as fired	240.37 lb.
Weight of charge, propelling, NH powder	106.77 lb.
Weight of charge, bursting, TNT	20.90 lb.
Weight of primer, percussion, electric, Navy, Mk. XIM1	10 lb.



8 INCH GUN, M1, CARRIAGE, M2. GUN AND RECOIL MECHANISM SUPPORTED IN AIR BY CRANE, M2

with wheels having divided rims and combat tires and tubes. Air brakes are supplied for control of the vehicle.

CARRIAGE TRANSPORT WAGON, M3—This wagon is of the same general type as the Cannon Transport Wagon, M1, with such modifications as are required for securing and transporting the 8″ Carriage, M2.

TRUCK MOUNTED CRANE, M2—This vehicle comprises a steel boom, rigging, and crane-operating cab and machinery mounted on a 6 wheel motor truck.

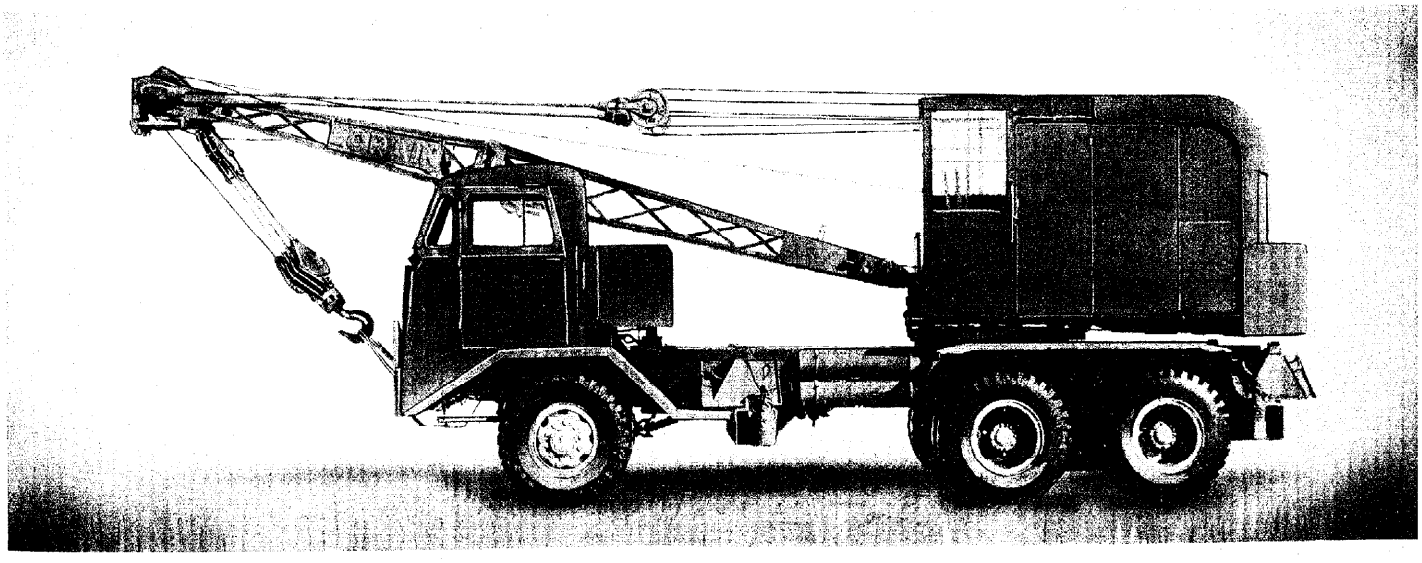
Ammunition

Ammunition for the 8″ Gun, M1, is of the separate-loading type. It consists of H.E. shell, M103, weighing 240 lb., with P.D. fuze, M51A1.

Sighting and Fire Control Equipment

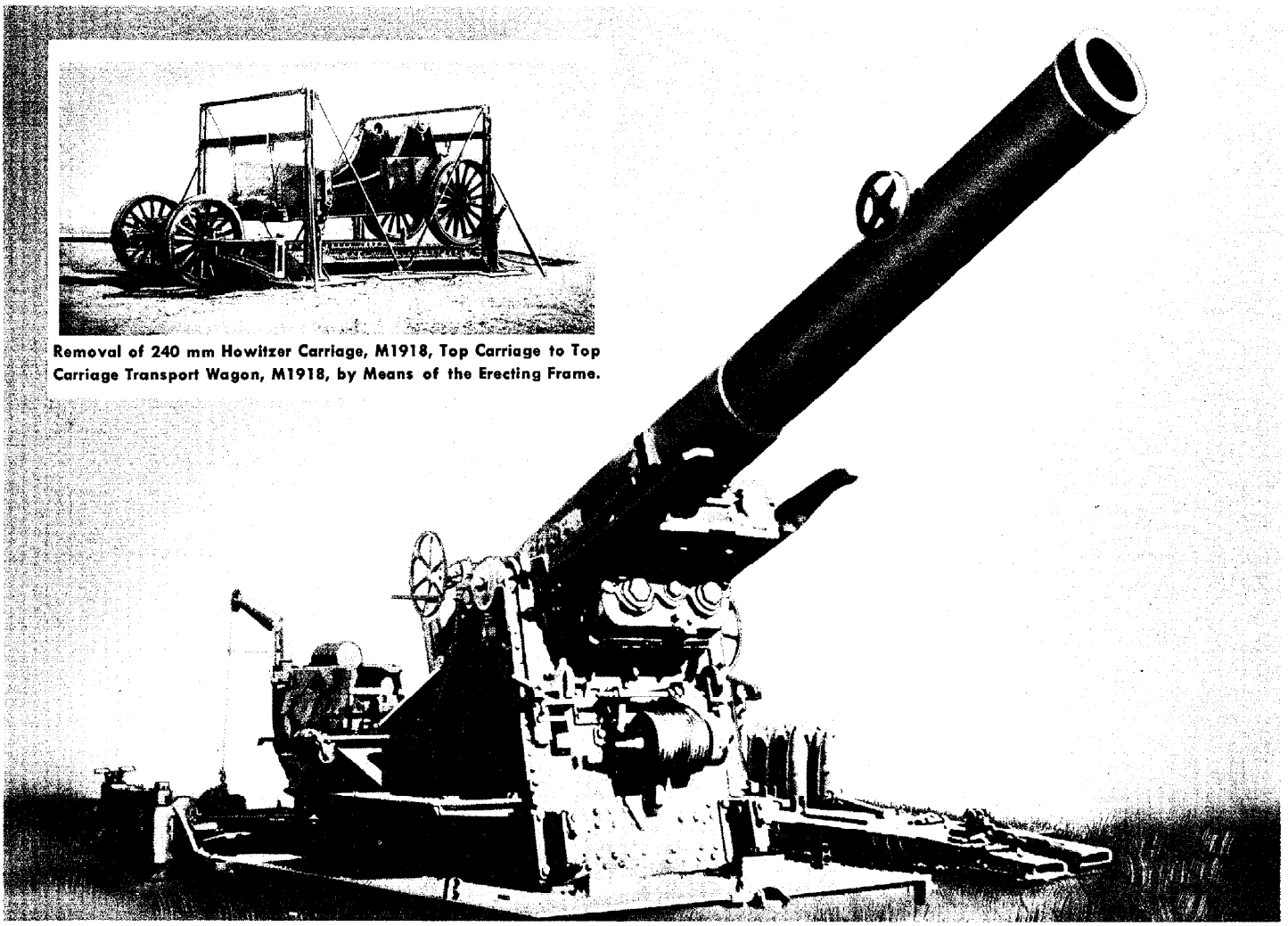
On Carriage Equipment
Panoramic Telescope, M12
Telescope Mount, M30
Elevation Quadrant, M1
Quadrant Adapter, M10

Off Carriage Equipment
B.C. Telescope, M1915A1, or M65
Aiming Circle, M1
Graphical Firing Table, M22



LORAIN TRUCK MOUNTED CRANE, M2

240 MM HOWITZER M1918M1A1—CARRIAGE M1918A2 LIMITED STANDARD



Removal of 240 mm Howitzer Carriage, M1918, Top Carriage to Top Carriage Transport Wagon, M1918, by Means of the Erecting Frame.

240 MM HOWITZER, M1918M1A1, ON CARRIAGE, M1918, IN FIRING POSITION

PRINCIPAL CHARACTERISTICS

Total weight of howitzer and carriage in firing position	41,296 lb.
Weight of howitzer	10,790 lb.
Weight of projectile	345 lb.
Weight of powder charge	36 lb.
Length of howitzer	199.6 ins.
Travel of projectile	164 ins.
Length of recoil, normal	44.83 ins.
Diameter of bore	9.45 ins.
Maximum elevation	60°
Maximum depression	1°
Loading angle	15°
Maximum traverse, left or right	10°
Number of grooves	84
Maximum range, approximate	16,400 yds.
Muzzle velocity	1,700 f./s.
Maximum pressure	33,000 lb./sq. in.
Maximum rate of fire	1 round in 2 minutes
Sustained rate of fire	1 round in 5 minutes

The 240 mm howitzer is a heavy weapon for army artillery. Although the A.E.F. did not possess such matériel, its desirability was apparent, resulting in the American manufacture of 330 of the French designed howitzers and carriages.

240 mm HOWITZER, M1918—A total of 182 of these weapons were fabricated at the Watervliet Arsenal. All 240 mm howitzers are of built-up construction. They consist of a tube, a jacket and a hoop with front and rear rollers for mounting. The breechblock is of the interrupted-screw type, hand operated by a lever which swings with the block and its carrier. As the howitzer uses separate-loading ammunition, a De Bange type obturator with a plastic gas-check pad is employed. The screw type firing mechanism is similar to that on the 155 mm Howitzer, M1918; the 155 mm Gun, M1918M1, and the 8″ Howitzers, Mks. VI and VIII-½. The 240 mm Howitzer, M1918, is classified as Limited Standard.

240 mm HOWITZER, M1918A1—This howitzer is identical with the M1918 except for a change in the rifling. It is classified as Limited Standard.

240 mm HOWITZER, M1918M1—These howitzers, numbered 183 to 330 inclusive, were also built at Watervliet. They differ from the M1918 only in having a greater exterior diameter in the tapered portion of the barrel forward of the hoop. This necessitates the use of different front roller spindles and front roller fastening screws. The 240 mm Howitzer, M1918M1, is classified as Limited Standard.

240 mm HOWITZER, M1918M1A1—The M1918M1 takes the designation

M1918M1A1 when rifled in the same manner as the M1918A1. It is classified as Limited Standard.

240 mm HOWITZER CARRIAGE, M1918—The main components of the carriage are the platform, top carriage, cradle and sleigh. A hydropneumatic recoil system housed in the sleigh interlocks with the howitzer when in firing position. The recoil and counter-recoil piston rods are fastened to the front of the cradle. The cradle also carries the elevating mechanism, a firing rod and a trunnion band which supports the cradle in the trunnion bearings in the top carriage. Since the weapon must be elevated to an angle of 9.25° for loading, a quick-return mechanism is located on the cradle.

The top carriage is formed by two steel flasks united by cross transoms and end plates. At the rear end are brackets which support the loading platform and crane.

Because of their great weight, the howitzer and carriage cannot be transported as a unit, but must be disassembled and divided into four loads consisting of the howitzer, the cradle with sleigh attached, the top carriage and the platform. Each load requires its own transport wagon and limber which are equipped with hand brakes and solid rubber tires. An erecting frame of structural steel is used for mounting and dismounting the platform and top carriage, while the cradle and howitzer are drawn into place by a cable attached to a tractor, or by a windlass fastened to the forward part of the top carriage. An ammunition attachment fitted to the erecting frame is used for lifting and placing projectiles on the shot trucks which run back and forth on tracks between the ammunition supply point and the howitzer. Each truck carries two projectiles. Carriage, M1918, is classified as Limited Standard.

240 mm HOWITZER CARRIAGE, M1918A2—Conversion of all matériel for high-speed transport resulted in the development of a new Carriage, M1918A2, for the 240 mm Howitzers, M1918, M1918A1, M1918M1 and M1918M1A1. This new carriage differs from earlier models in that it has a loading angle of 15° and can be loaded by hand instead of by a rammer. It is broken down into two loads instead of four, a truck-mounted crane being employed to manipulate the parts, thus eliminating the erecting frame, loading crane and loading platform formerly needed. This carriage is classified as Limited Standard.

CANNON TRANSPORT WAGON, M4—This wagon, developed by the Bucyrus-Erie Co., is used for carrying the howitzer section of the 240 mm howitzer when mounted on Carriage, M1918A2. It has air brakes and heavy-duty 13 x 24 bus and truck tires with self-sealing, bullet-proof tubes. Together with its load, it can be towed at a speed of 35 miles an hour. It is classified as Substitute Standard.

CARRIAGE TRANSPORT WAGON, M5—This wagon is used to transport the 240 mm Howitzer Carriage, M1918A2. Its brakes, tires and towing speed are the same as those of the Cannon Transport Wagon, M4. This carriage is classified as Substitute Standard.

Sighting and Fire Control Equipment

On Carriage Equipment

Quadrant Sight, M1918A1
Panoramic Telescope, M6

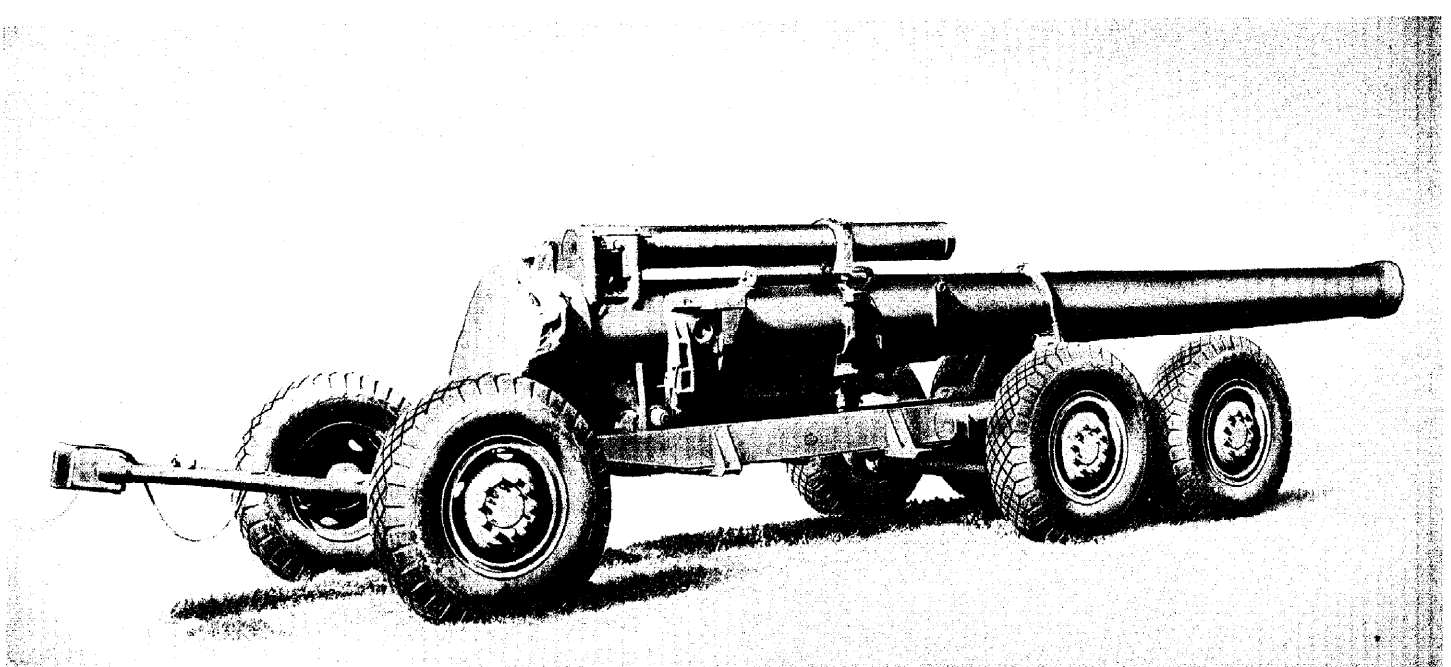
Off Carriage Equipment

Aiming Post, M1
Gunner's Quadrant, M1
Bore Sight
Aiming Circle, M1
B. C. Telescope, M65 or M1915A1
Hand Fuze Setter, M21
Graphical Firing Tables, M14 (short range) and M18 (long range)

Ammunition

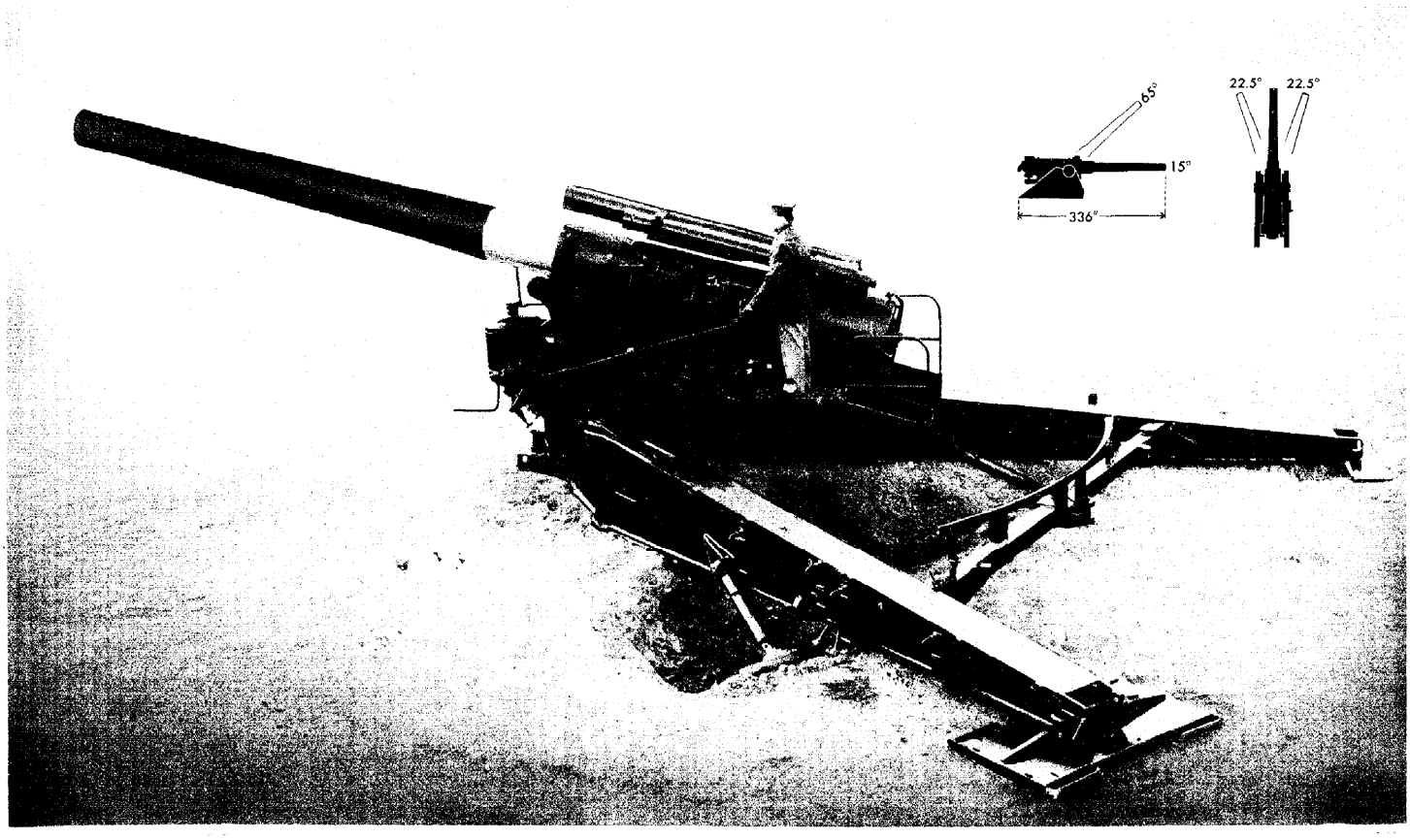
Ammunition is in the form of separate-loading rounds, the propelling charge being assembled to provide six zones of fire. The projectile is H.E. shell, Mk. IIIA1, with either P.D. fuze, M51A1, or M.T. fuze, M67.

REFERENCES—TM 9-2005, v.3; TM 9-340; TM 9-1340.



CANNON TRANSPORT WAGON, M4, WITH BARREL OF EXPERIMENTAL 240 MM HOWITZER, M1

240 MM HOWITZER M1—CARRIAGE M1—STANDARD



240 mm HOWITZER, M1, ON CARRIAGE, M1, IN FIRING POSITION AT MAXIMUM LEFT TRAVERSE AND 15° ELEVATION

PRINCIPAL CHARACTERISTICS

HOWITZER, M1

Weight	25,100 lb.
Overall length	336 ins.
Length of bore	34 calibers
Muzzle velocity	2,300 f./s.
Volume of chamber	4,430 cu. ins.
Travel of projectile in bore	268.16 ins.
Maximum powder pressure	36,000 lb./sq. in.
Type of block mechanism	Interrupted step thread
Rate of fire	1 rd./min.
Range (maximum)	25,255 yds.
Range (minimum)	12,000 yds.

RECOIL MECHANISM, M8

Type	Hydropneumatic
Weight (including cradle)	6,980 lb.
Recoil	60 ins.

CARRIAGE, M1

Total weight without howitzer (including cradle and recoil mechanism)	39,425 lb.
Trail spread (included angle)	45°
Elevation (maximum)	65°
Elevation (minimum)	15°
Traverse (maximum)	22½°
Traverse (minimum)	22½°
Total weight—howitzer, mechanism and carriage	64,525 lb.

HOWITZER TRANSPORT WAGON, M2

Weight under front tires (loaded)	18,595 lb.
Weight under rear tires (loaded)	21,100 lb.
Overall length (loaded)	398 ins.
Overall height (loaded)	84 ins.
Overall width	107⅝ ins.
Wheel tread	80 ins.
Wheel base	192 ins.

CARRIAGE TRANSPORT WAGON, M3

Weight under front tires (loaded)	16,740 lb.
Weight under rear tires (loaded)	25,440 lb.
Overall length (loaded)	370 ins.
Overall height (loaded)	120 ins.
Overall width (loaded)	114 ins.
Wheel tread	80 ins.
Wheel base	240 ins.

AMMUNITION

Weight of projectile (H.E. shell, M114)	360 lb.
Weight of projectile explosive charge	54 lb.
Type of loading	Separate
Weight of propellant powder	78 lb., 8 oz.
Weight of complete round	438 lb., 8 oz.

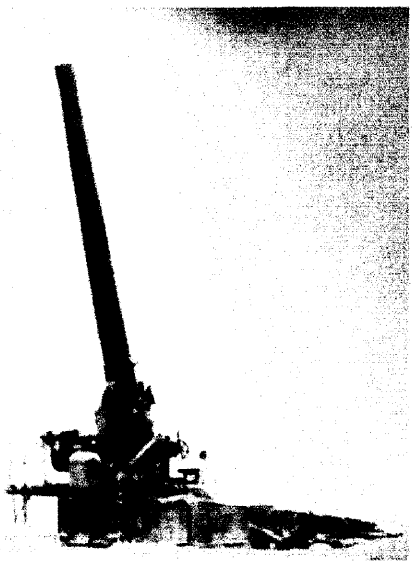
In 1919 the Caliber Board recommended the development of a new 240 mm howitzer for the Field Army. This howitzer was to be more powerful than the 240 mm Howitzer, M1918, and have a maximum range of 25,000 yards. Preliminary studies were made in 1920 and 1921, but the project was suspended in 1924, being held in abeyance until it was formally resumed by the Ordnance Department in December, 1939.

O.C.M. 15791, dated 9 May 1940, approved the military characteristics of the Howitzer, T1, Carriage, T1, Heavy Carriage Limber, T4, and Howitzer Transport Wagon, T2. O.C.M. 16362, dated 27 December 1940, approved the design of the pilot matériel. O.C.M. 17240, dated 18 September 1941, approved the nomenclature of these items, for future standardization, as 240 mm Howitzer, M1, with Recoil Mechanism, M8; 240 mm Howitzer Carriage, M1; Cannon Transport Wagon, M2, and Carriage Transport Wagon, M3. It also approved the Panoramic Telescope, M12, the Telescope Mount, M30, and the Elevation Quad-

rant, M1, as standard sighting equipment for the weapon. This matériel was recommended for approval as required types, as adopted types, and as standard articles, by O.C.M. 20328, dated 3 May 1943.

240 mm HOWITZER, M1—The Howitzer, M1, consists of a built-up tube and a breech mechanism equipped with an interrupted step thread, rotating drop type breechblock. The recoil mechanism is below the howitzer, and the counter-recoil mechanism, of the hydropneumatic type, is housed in two cylinders mounted on the top of the cradle.

CARRIAGE, M1—The M1 carriage, together with the Transport Wagons, M2 and M3, designed and manufactured by the Bucyrus-Erie Company in collaboration with the Ordnance Department, can be used interchangeably with either the 240 mm Howitzer, M1, or the 8 inch Gun, M1. The carriage, which has split trails, consists of a cradle supporting the howitzer and recoil and recuperator cylinders; the top carriage, in which the cradle is trunnioned; the bottom carriage, and the trails. The elevating mechanism consists of spur gears that are locked by a large friction brake. The traversing mechanism is locked by a worm mechanism. Both mechanisms are hand operated. Each trail has "spades" near the center, and floats at the rear end, to stabilize the carriage during firing. It is necessary to excavate a pit to clear the recoiling parts at high angles. For transport the matériel



240 mm HOWITZER, M1, IN FIRING POSITION AT 64° ELEVATION

is divided into two loads, carried on transport wagons. One load consists of the howitzer and recoil mechanism assembly. The other load is composed of the remainder of the carriage and trails. Mounting and dismounting of the howitzer and carriage and the placing of the loads on the transport wagons is accomplished by means of the Truck Mounted Crane, M2, or by means of winches on the tractors.

CANNON TRANSPORT WAGON, M2—This wagon is a steel frame chassis with 6 divided rim wheels equipped with combat tires and tubes, and air brakes. The front is pivoted for steering. It can be towed at speeds up to 25 miles an hour when loaded. Manually operated parking brakes are also provided.

CARRIAGE TRANSPORT WAGON, M3—This wagon is of the same general type as the Transport Wagon, M2, with such structural modifications as are required for securing and transporting the 240 mm howitzer carriage and spades, floats, etc.

Both transport wagons were approved as required types, adopted types, substitute standard articles, by O.C.M. 20328, dated 6 May 1943.

Sighting and Fire Control Equipment

On Carriage Equipment

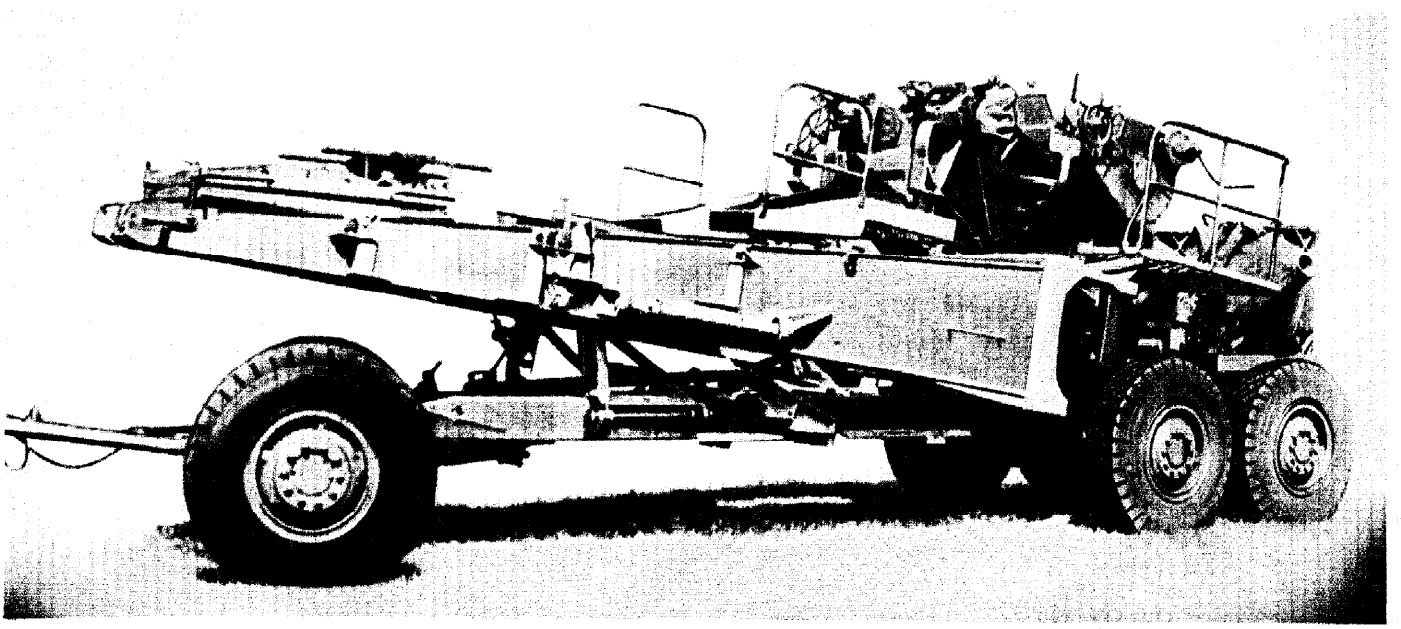
Panoramic Telescope, M12
Telescope Mount, M30
Elevation Quadrant, M1
Quadrant Adapter, M10

Off Carriage Equipment

B.C. Telescope, M1915A1, or M65
Aiming Circle, M1
Graphical Firing Tables, M9 (short range) and M19 (long range)
Hand-fuze Setter, M21

Ammunition

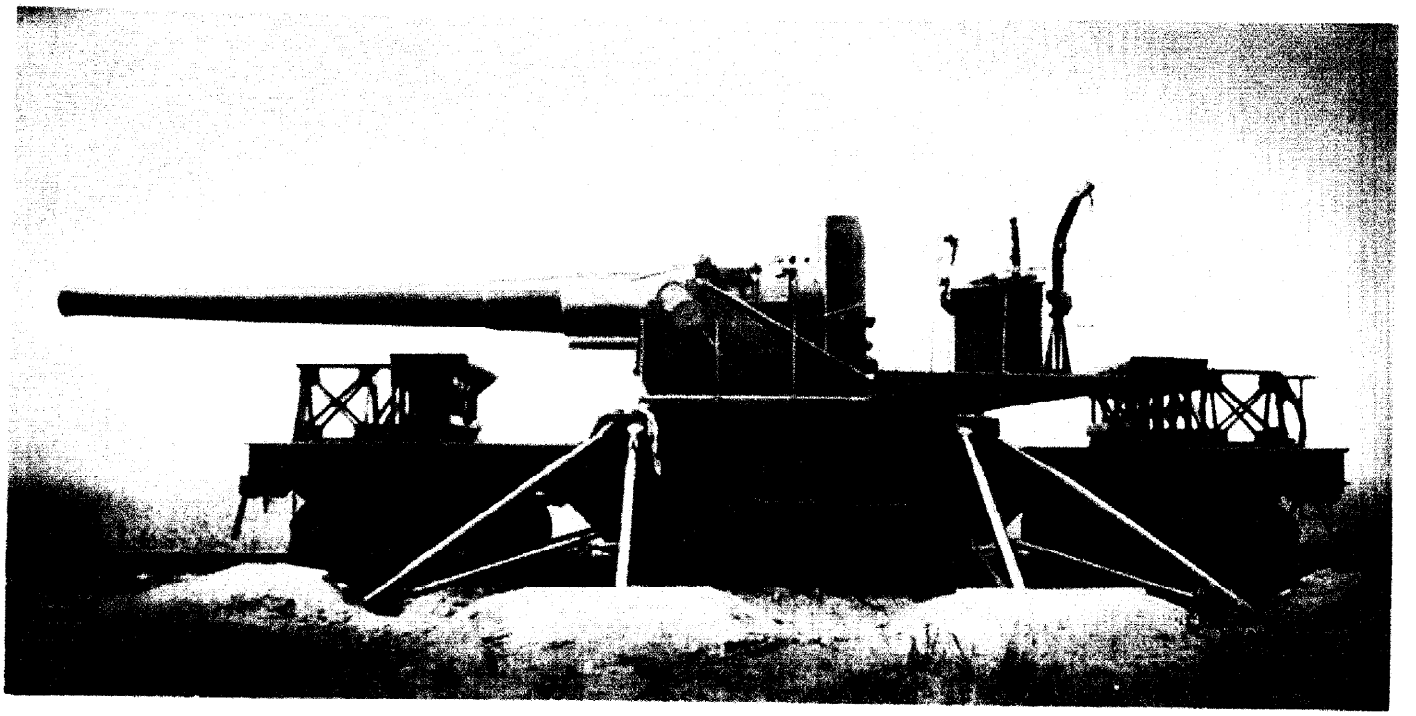
Ammunition for the 240 mm Howitzer, M1, is in the form of separate-loading rounds. It consists of H.E. Shell M114, weighing 360 pounds, with P.D. fuze, M51A3, or M.T. fuze, M67A2. The powder charges provide four zones, with muzzle velocities of 1,500, 1,740, 2,020 and 2,300 feet per second. The maximum range is 25,275 yards.



CARRIAGE TRANSPORT WAGON, M3, LOADED WITH 240 mm HOWITZER CARRIAGE, M1

RAILWAY AND SEACOAST ARTILLERY

8 INCH GUN MK. VI, MOD. 3A2—RAILWAY MOUNT M1A1—STANDARD



Left View of 8 INCH GUN, MK. VI, M3A2, ON RAILWAY MOUNT, M1, with Gun at 0° Elevation and Outriggers in Place

PRINCIPAL CHARACTERISTICS

Depth of rifling	.07 in.
Length of bore	45 calibers
Length of rifling	288.79 ins.
Type of breechblock	Interrupted screw
Type of firing mechanism	Electrical and percussion
Type of rifling	Right hand, uniform twist, one turn in 25 calibers
Weight of gun with breech mechanism	42,000 lb.
Maximum range (260 lb. shell)	32,000 yds. (approx.)
Maximum service powder pressure	38,000 lb./sq. in.
Muzzle energy (A.P., 260 lb. shell)	15,300 ft.-tons
Muzzle velocity	
A.P., 260 lb., Mk. XX (Normal charge)	2,100 f./s.
(Super charge)	2,750 f./s.
H.E., 240 lb., M103 (Normal charge)	2,150 f./s.
(Super charge)	2,840 f./s.
Weight of powder charge (Normal)	75 lb., 12 oz.
Weight of powder charge (Super)	108 lb., 8 oz.
Mount, 8 inch Gun, Railway, M1A1	
Brakes, type	Mechanical, air operated
Maximum elevation	45°
Maximum firing elevation	45°
Minimum elevation	−5°
Minimum firing elevation	0°
Overall weight (carriage and gun)	230,000 lb.

RECOIL MECHANISM

Final air pressure in recuperator	2,683 lb./sq. in.
Final liquid pressure in intensifier	3,065 lb./sq. in.
Initial air pressure in recuperator	1,600 lb./sq. in.
Initial liquid pressure in intensifier	1,828 lb./sq. in.
Normal recoil	27 ins.

TRAVELING DIMENSIONS

Height	13 ft., 10 ins.
Length overall	49 ft., 4 ins.
Width	10 ft., 3 ins.
Traverse	360° (continuous)

During the first World War, railway artillery played an increasingly important part in major operations. Mortars and guns removed from seacoast fortifications, together with certain naval guns, were mounted on improvised railway mounts for service in France. Most of these mounts were expedients lacking wide traverse, high elevation and ease of emplacement. Many of them were of the rolling or sliding types no longer utilized because of the time needed for emplacement and the return of the gun to battery after firing.

Efforts to improve the design of railway mounts continued after the war, culminating in the 8" Railway Mount, M1A1, for the 8" Gun, Mk. VI, Mod. 3A2. This combination comprises the most modern railway matériel possessed by the U. S. Army. It is intended for employment by either a field army or the coast defense forces.

8 INCH GUN, MK. VI, MOD. 3A2—The barrel is of built-up construction with a liner, tube, jacket and hoops of nickel steel. A nickel steel locking ring holds the liner in position. The breech mechanism is a modified Navy design, Mk. V, with an obturator; a breechblock of the tray-supported Welin stepped thread type; a breech operating crank and gears, and a firing lock using a combination electric and percussion primer. This gun is classified as Standard.

8 INCH RAILWAY MOUNT, M1A1—The mount consists of a top carriage rotating on a drop frame car body of cast and structural steel riding upon two six-wheeled standard gauge 70-ton trucks. It is equipped with air brakes and hand brakes and standard couplers. The base ring is an integral part of the car. The gun rests in a cradle which serves as a slide for the gun and carries the recoil and recuperator mechanisms. The cradle is supported in the side frames of the mount by its trunnions. A main platform of structural steel rotates with the top carriage,

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and a steel plate breech platform extends rearward from the breech end of the cradle. The traversing and elevating mechanisms are of the regular barbette type design, employing worm and spur gears operated by handwheels. The recoil mechanism is of the hydraulic type, while the recuperator is of the pneumatic variety.

A heavy counterweight at the breech end enables the gun to be mounted well toward the front, making the use of equilibrators unnecessary. Projectiles and powder are transferred from the ammunition car to the mount car by means of an overhead trolley and hoist. Two cranes at the rear corners of the main platform then lift the projectiles to a loading trough with an angle of –5° down which they are slid by hand into the breech of the gun.

Eight tubular steel outriggers with floats act as supports to prevent the mount from tipping or sliding when fired. Four lifting jacks in the corners of the base plate raise the mount for insertion of eight firing pedestals under the base plate. The weapon may be emplaced for all-round fire within a few hours of reaching its destination. The 8″ Gun Railway Mount, M1A1, is classified as Standard.

The 8″ railway matériel is accompanied by a modified commercial steel box car for ammunition, a Fire Control Car, M2, and a Machine Shop Car, M1, equipped for making necessary repairs to the gun and mount in the field. These cars are all classified as Standard. When traveling a gondola or flat car is required at the front end of the mount.

Sighting and Fire Control Equipment

On Carriage Equipment

Telescope Mount, M20
Elevation Quadrant, M1
Panoramic Telescope, M8

Off Carriage Sighting Equipment

Clinometer, M1912A1
Gunner's Quadrant, M1
Bore Sight

Equipment in Fire Control Car

Fire Adjustment Board, M1
Range Correction Board, M1A1
Deflection Board, M1
Data Transmission System, M9, of which Azimuth Indicator, M5, and Elevation Indicator, M5, are on carriage. The other elements are in the Fire Control Car.
Plotting and Relocating Board, M1
Spotting Board, M3
Percentage Corrector, M1
Set-forward Rule, Type B
Prediction Scale, M1
Generating Unit, M1

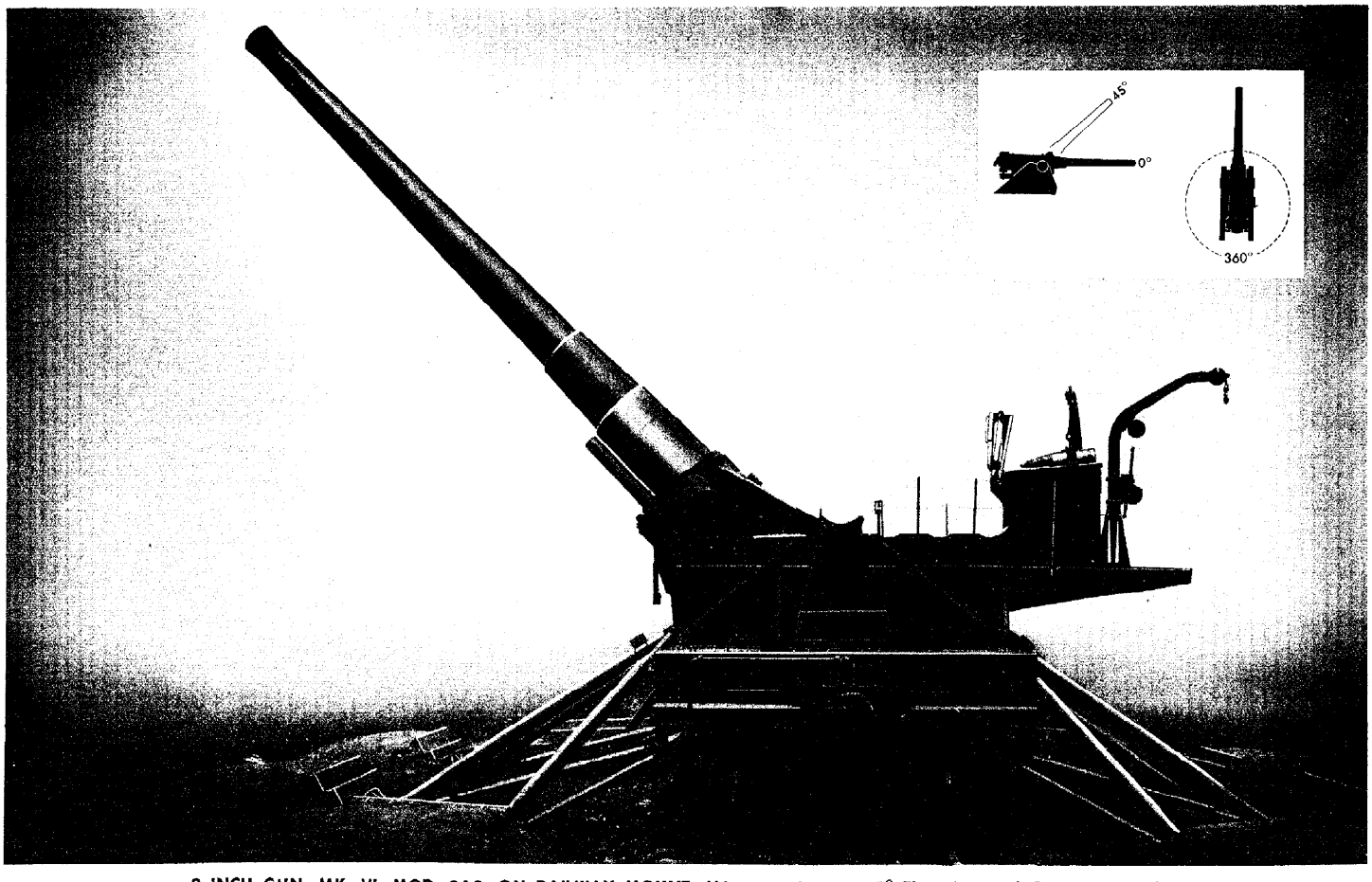
Ammunition

Ammunition is in the form of separate loading rounds. The standard service projectiles are A.P. shell, 260 lb. (Navy), Mk. XX, with B.D. fuze, Mk. X, and H.E. shell, 240 lb., M103, with P.D. fuze, M51A1, Model 1, with booster, M21A1.

Subcaliber Gun

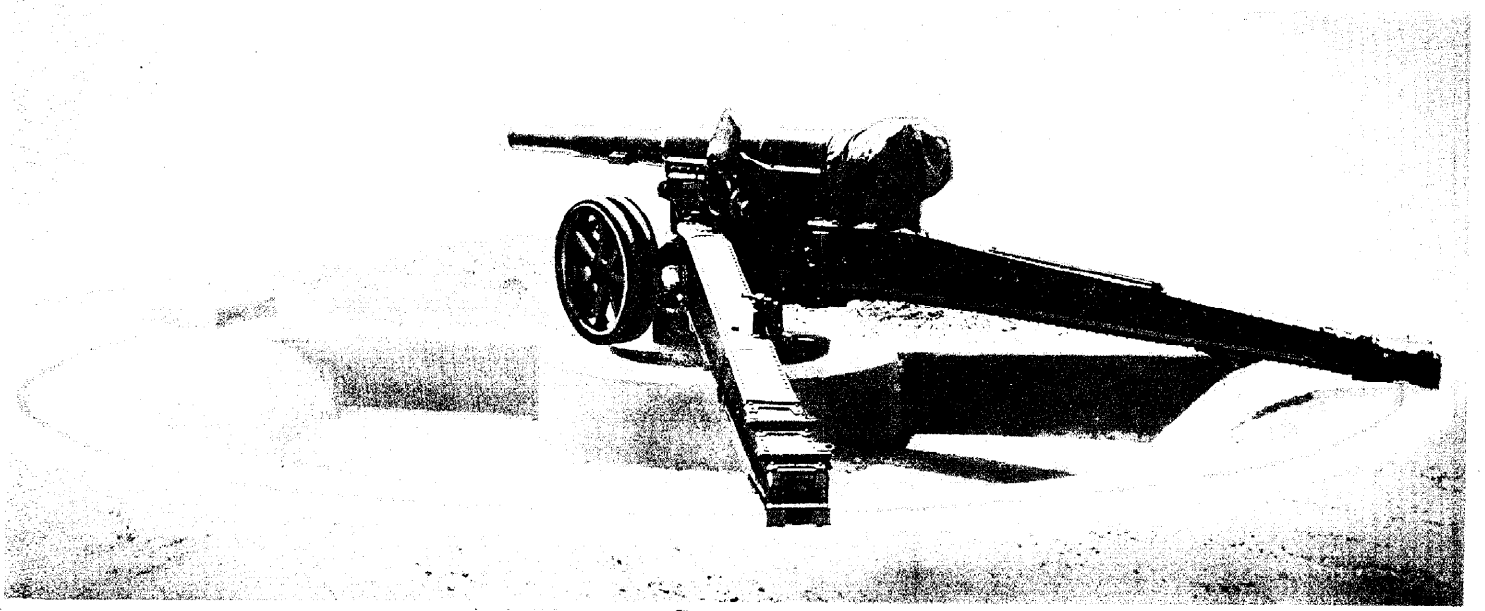
For practice in laying and firing the 8″ gun a 75 mm subcaliber gun is mounted in the bore of the larger gun.

REFERENCES—TM 9-2005, v.4; TM 9–463; TM 4–210.



8 INCH GUN, MK. VI, MOD. 3A2, ON RAILWAY MOUNT, M1, with Gun at 45° Elevation and Outriggers in Place

SEACOAST EMPLACEMENT FOR 155 MM MOBILE GUNS—PANAMA MOUNT



PANAMA MOUNT FOR SEACOAST EMPLACEMENT OF 155 mm MOBILE GUNS, WITH 155 mm GUN, M1918M1, ON GUN CARRIAGE, M1918

The 155 mm field guns are the only mobile weapons regularly used as seacoast artillery. Since the 60° traverse of the 155 mm gun is insufficient for harbor defense, the gun is mounted on a concrete emplacement designed by the Corps of Engineers. The emplacement, known as the "Panama Mount," consists of a centrally located, round base, raised above a semicircular rim. The gun carriage rests on the base, the altitude of which provides a recoil pit and allows the gun to be fired at a greater elevation than would be possible otherwise. The spade plates are removed from the ends of the trails and are replaced by plates which fit a curved rail embedded in the semicircular rim of the emplacement. This permits the carriage to be rotated 180°. The additional 60° traverse of the gun thus makes a 240° field of fire practicable.

Sighting and Fire Control Equipment

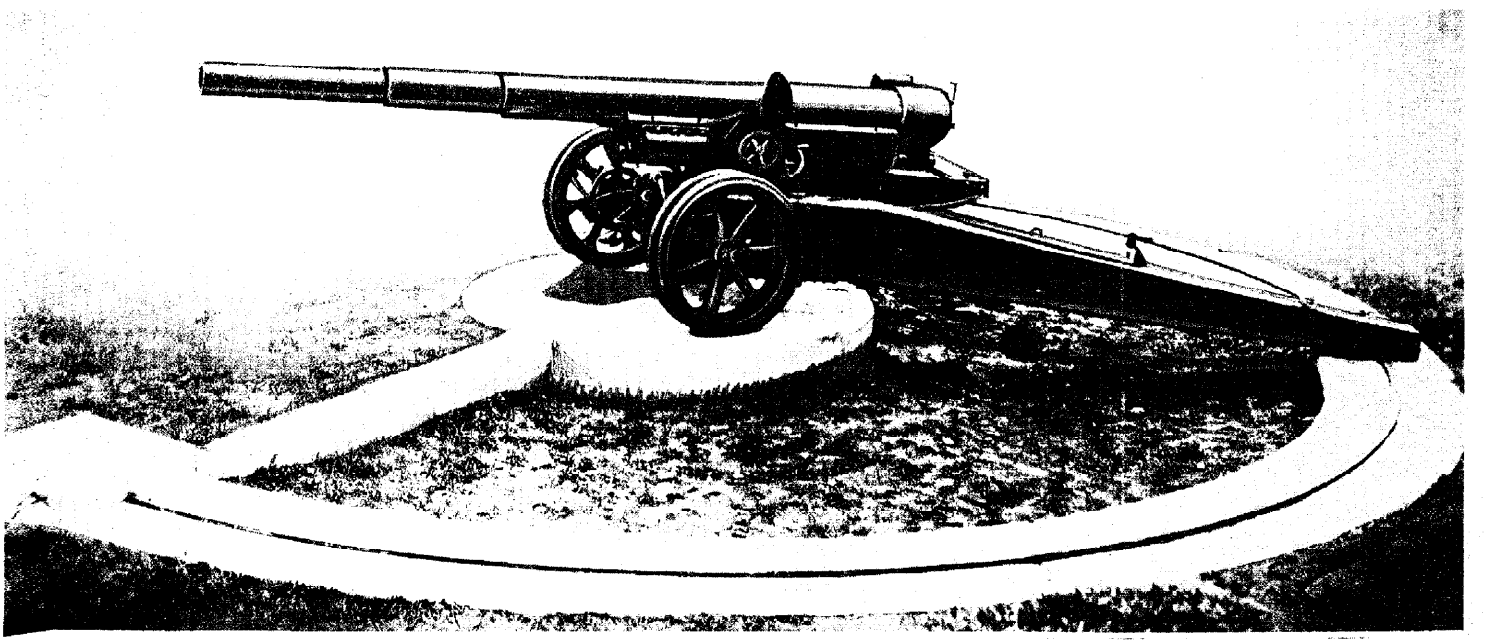
When the 155 mm gun is used as coast artillery matériel, the following sighting and fire control equipment is employed.

In Panama
Telescope Mount, M4
Panoramic Telescope, M3A1
Telescope, M1909A1

Outside Panama
Telescope Mount, M6
Panoramic Telescope, M4
Telescope, M1909A1

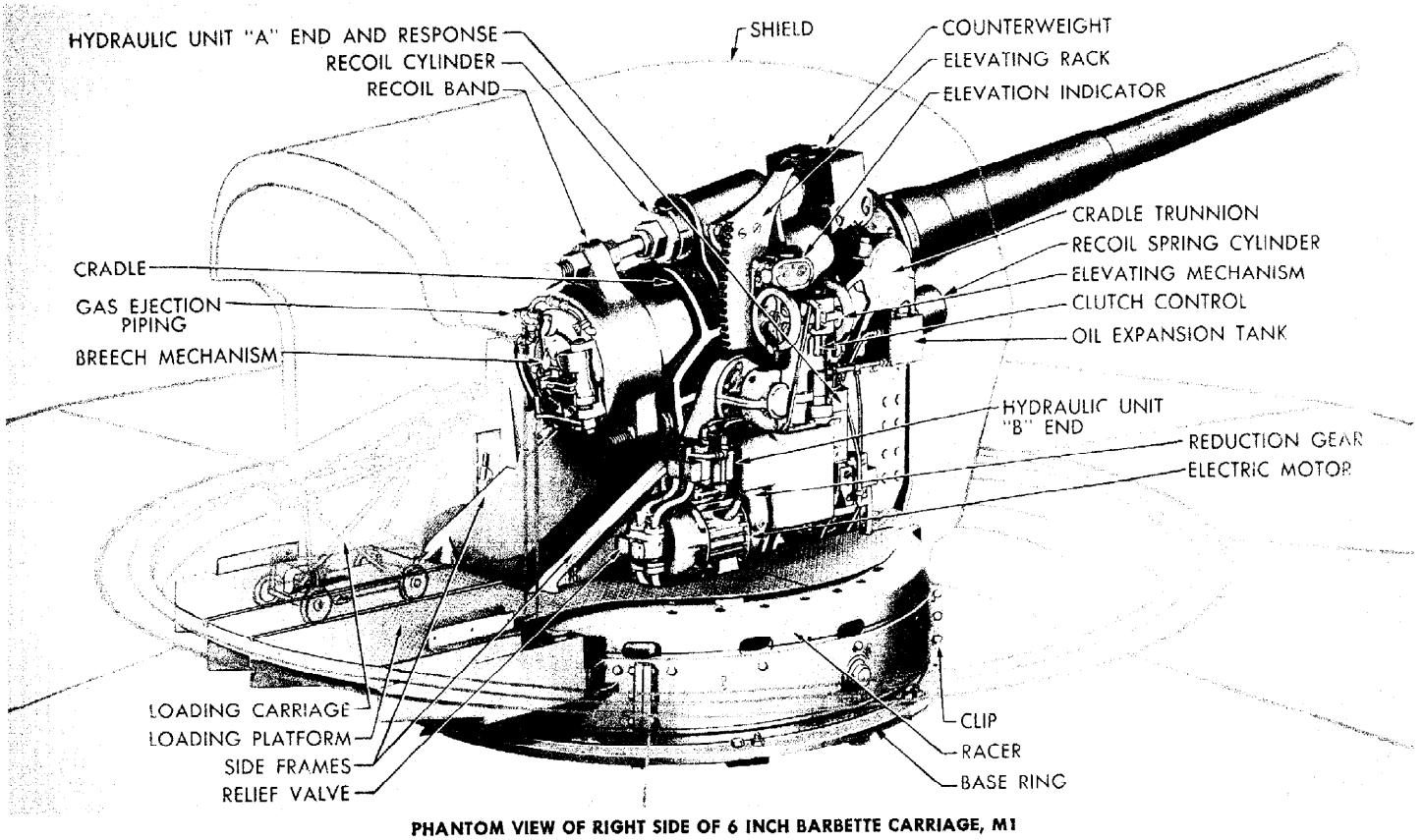
Future Installations
Telescope Mount, M6A1
Panoramic Telescope, M8

REFERENCES—TM 4-210; TM 9-2005, v.4.



PANAMA MOUNT WITHOUT RECOIL PIT OR ELEVATION PLATFORM

6 INCH BARBETTE CARRIAGE M1—STANDARD



PHANTOM VIEW OF RIGHT SIDE OF 6 INCH BARBETTE CARRIAGE, M1

The 6″ Barbette Carriage, M1, is a modernization of earlier types of seacoast weapons. It was instituted for the purpose of supplying the United States with coast defense guns and carriages capable of protecting bases and harbors against cruisers and destroyers. Military characteristics of the carriage were approved in O.C.M. 15930, dated 5 July 1940, and standardization was approved in O.C.M. 17748 of 5 February 1942.

The Barbette Carriage, M1, was designed to utilize 6″ Guns, M1903 and M1905, on hand in considerable numbers. Since either gun can be fired at the rate of six rounds a minute, it has the speed of service possessed by a light gun in combination with a destructive power approaching that of the larger calibers. It may be used effectively against ships moving at 27 knots within 3,000 yards of the emplacement, or at a maximum range of 25,000 yards.

GUN, M1903—The gun is of built-up construction without a replaceable liner. When it is no longer accurate, a similar new gun of monobloc construction can be substituted for it. A breechblock of the interrupted thread variety is supplied with a firing mechanism for both percussion and electric primers.

GUN, M1905—The main difference between this gun and the M1903 is in the location of the center of gravity. This is compensated for by adjustable stops on the cradles.

BARBETTE CARRIAGE, M1—The carriage is designed for 360° traverse at a rate of not less than 1½° a second. A hydrospring recoil mechanism is employed. Elevation is accomplished by hydraulic power drive. In order to afford protection to the crew and carriage from bombing and shell fire, a deep shield of 6″ armor plate is placed overhead, in front and on both sides. The shield is open in the rear to permit service of the piece.

Sighting and Fire Control Equipment

Sighting equipment consisting of the Telescope, M31, and Mount, M35, is provided for Case II pointing. On carriage data receivers are provided for Case III pointing. Off carriage equipment varies with different gun batteries.

PRINCIPAL CHARACTERISTICS OF 6 INCH BARBETTE CARRIAGE, M1, WITH GUN, M1905

Weight of gun, carriage, shield, and base ring	176,000 lb.
Weight of gun	22,000 lb.
Length of bore	50 cals.
Number of grooves in barrel	76
Twist, one turn in	25 cals.
Weight of A. P. projectile	105 lb.
Muzzle velocity	2,800 f./s.
Maximum range	27,500 yds.
Maximum powder pressure	38,000 lb./sq. in.
Maximum elevation	47°
Minimum elevation	−5°
Traverse	360°
Normal recoil	19 ins.
Type of breechblock	interrupted screw
Type of recoil mechanism	hydrospring

Ammunition

Ammunition is in the form of separate loading rounds. It consists of A.P. Shell, Mk. XXXIII, and A.P. Shell, M1911, both furnished with B.D. fuze, M60; H.E. Shell, M1911, with B.D. fuze, M60, and H.E. Shell, Mk. II, with P.D. fuze, M47.

8 INCH GUN MK. VI, MOD. 3A2—BARBETTE CARRIAGE M1—STANDARD

The 8″ Gun, M1888, on Barbette Carriage, M1892, was the only 8″ matériel emplaced on fixed mounts until the adoption of the 8″ Gun, Mk. VI, Mod. 3A2, mounted on Barbette Carriage, M1. This latter combination of gun and carriage permits fire at a maximum range more than twice that of the earlier weapon.

8 INCH GUN, MK. VI, MOD. 3A2—This is the same gun used with the 8″ Railway Mount, M1A1.

8 INCH BARBETTE CARRIAGE, M1—The barbette carriage consists of a base ring bolted to a concrete emplacement, a traversing roller system, and a gun-supporting structure.

A tubular cradle containing the recoil and recuperator cylinders, the elevating rack, a liquid pump, air-pressure gage, air-charging and maneuvering valve and the breech platform is supported by trunnions in the side frames of the top carriage. The cradle serves to guide the gun in recoil and counter recoil.

The top carriage consists of the racer, the side frames, the front and rear transoms, the main platforms for securing the piece, dust guards and the racer clips.

The hydraulic recoil system is composed of a long and a short recoil cylinder. The recuperator system is pneumatically operated and consists of a cylinder and a plunger. An intensifier and air-charging mechanism is used to maintain pressure on the liquid seal in the stuffing box around the recuperator plunger and facilitates charging the recuperator.

The elevating mechanism is mounted on the right side frame of the top carriage. Emergency elevation and depression stops are provided.

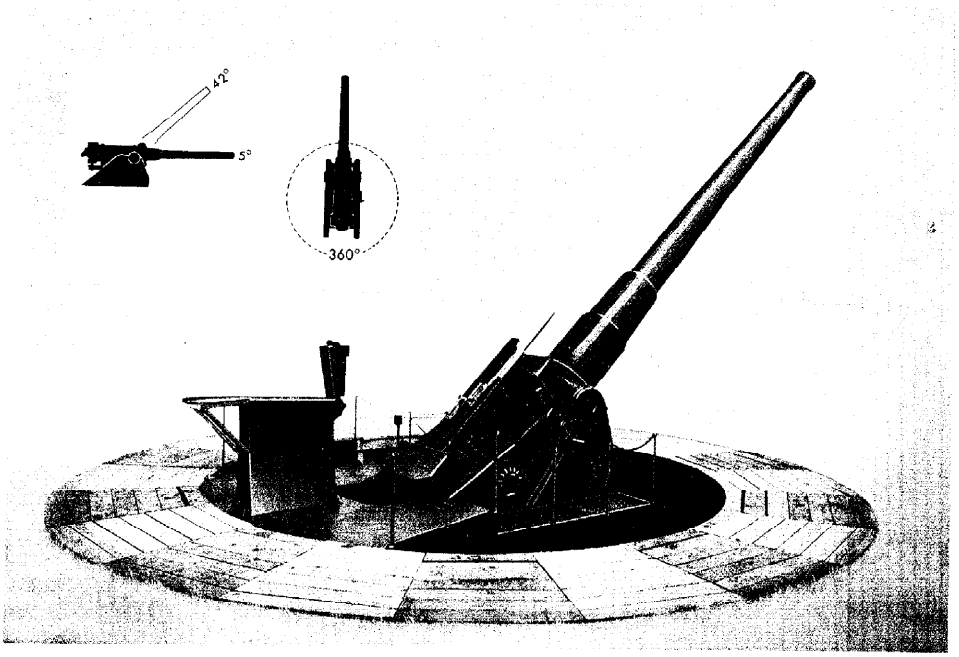
The traversing mechanism is placed on the right side of the mount. An azimuth indicator drive mechanism pinion meshes with the data receiver drive rack on the base ring. An azimuth index plate graduated in tenths and fifteenths of a degree is mounted on the main platform.

A loading stand and trough facilitate loading of the gun and the ramming of projectiles.

The gun may be fired electrically by a firing pistol used in conjunction with a gun commander's push button. The gun cannot be fired until a complete circuit has been established. Current for the firing circuit is furnished by a storage battery.

Certain M1 carriages (Nos. 1 to 4 inclusive) are fitted with a counterweight on top of the cradle over the trunnions, carriages Nos. 5 and upward do not have this counterweight, the trunnions being placed lower on the cradle than is the case with the lower numbered carriages.

Carriages Nos. 1 to 4 inclusive have a simple elevation disk for showing elevation of the gun, and a similar azimuth disk. On carriage No. 5 and upward, the finished surface of a lug on the upper right side of the cradle is not level and is not intended as a seat for the gunner's quadrant.



THREE-QUARTER REAR VIEW OF 8 INCH GUN, MK. VI, MOD. 3A2, ON BARBETTE CARRIAGE, M1

PRINCIPAL CHARACTERISTICS

Total weight of gun and carriage	103,000 lb.
Weight of gun and band	55,000 lb.
Weight of carriage	103,000 lb.
Overall length of gun	369 ins.
Length of barrel	45 cals.
Number of grooves in barrel	64
Rifling, uniform R.H., one turn in	25 cals.
Muzzle velocity (260 lb. shell)	2,750 f./s.
Total traverse	360°
Depression, maximum (loading angle)	−5°
Elevation, maximum	45°
Maximum range, A.P. 260 lb. projectile	32,980 yds.
Maximum range, H.E. 240 lb. projectile	35,635 yds.
Muzzle energy (A.P. 260 lb. shell)	15,300 ft.-tons
Rate of fire, approximate	2 rds./min.
Construction of gun	Built-up

RECOIL

Distance	27 ins.
Mechanism type	Hydraulic
Number of cylinders	2

COUNTER RECOIL

Mechanism type	Pneumatic
Number of cylinders	1

Subcaliber Gun

For practice in laying and firing the 8″ gun a 75 mm gun is mounted in the bore of the larger gun.

Sighting and Fire Control Equipment

On Carriage Equipment

Telescope Mount, M35; Telescope, M31

Off Carriage Equipment

Off carriage fire control equipment is of the usual seacoast artillery type, the instruments for the individual position being determined by the local coast-defense commander according to the nature of the fire control system used in that area.

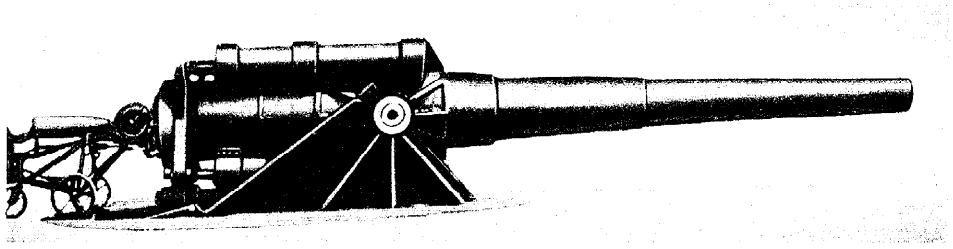
Ammunition

Ammunition is in the form of separate loading rounds. The standard service projectiles are A.P. shell, 260 lb. (Navy), Mk. XX, with B.D. fuze, Mk. X, and H.E. shell, 240 lb., M103, with P.D. fuze, M51A1, Model 1, with Booster, M21A1.

REFERENCES—TM 9-2005, v.4; TM 4-210.

12 INCH GUNS M1895A2, M1895A3, M1895M1A2, M1895M1A3 BARBETTE CARRIAGE M1917—SUBSTITUTE STANDARD

The 12″ Guns, M1895A2, M1895A3, M1895M1A2 and M1895M1A3, on Barbette Carriage, M1917, are classified as Substitute Standard. There is no Standard 12″ weapon in service, although a new model barbette carriage to meet modern requirements is under development. All older models are classified as Limited Standard.



12 INCH GUN, M1895, ON BARBETTE CARRIAGE, M1917

12 INCH GUNS OF 1895 TYPE—These guns are of built-up construction, with variable rifling. The breechblock is of the Stockett, three-cycle, tray-supported type, consisting of a cylindrical, single-thread, slotted block operated by hand. A seacoast firing mechanism, M1903, is housed in a seat on the rear end of the obturator spindle, and is designed for firing primers electrically.

12 INCH BARBETTE CARRIAGE, M1917—The Barbette Carriage, M1917, was developed from 1917 to 1922 without parapets or shields. Casemates are now being built over all carriages. The mount is constructed in the usual manner for a barbette carriage. The gun is carried in a cradle which contains the recoil and counter-recoil system. The hydraulic recoil mechanism permits a 30 inch recoil. Counter recoil is accomplished by a 4 cylinder, spring-type recuperator assembly. Return of the gun to battery is eased by a plug-type counter-recoil buffer.

The elevating mechanism, of the screw type, is motor driven, but in case of power failure the gun can be elevated by hand. Traversing is by handpower only, the mechanism consisting of a spur gear meshing with a circular rack inside and concentric with the base ring. The top carriage is bolted to a racer which rides on rollers between it and the base ring and rotates with the racer when the traversing handwheel is turned to operate the spur gear.

An azimuth circle and index are employed in laying the piece for direction. The azimuth and elevation setters work below the ground level.

Ammunition is served to the gun on shot trucks and powder trays operating on the surface of the ground. Loading is by hand, but experiments are under way to develop a suitable electric rammer for this weapon.

PRINCIPAL CHARACTERISTICS

Total weight of gun and carriage	406,700 lb.
Weight of gun and band	118,200 lb.
Overall length of barrel	36.9 ft.
Length of barrel	35 cals.
Rifling	twist 1–50 to 1–25
Number of grooves	72
Muzzle velocity (1,070 lb. proj.)	2,250 f./s.
Total traverse in casemate	145°
Depression, maximum	0°
Elevation, maximum	35°
Maximum range, 1,070 lb. projectile	27,600 yds.
Maximum range, 975 lb. projectile	30,100 yds.
Maximum range, 900 lb. projectile	29,200 yds.
Volume of powder chamber	12,403 cu. ins.
Maximum powder pressure	38,000 lb./sq. in.
Life (full charge)	350 rounds
Rate of fire	1⅓ rds./min.
Construction of gun	Built-up
Muzzle energy	36,754 ft. long tons

Breechblock

Type	Stockett
Single or step cut	Single
Operating handles	1
Operation	Hand only
Firing mechanism	Seacoast, M1903

Recoil

Distance	30 ins.
Mechanism type	Hydraulic (grooves)
Number of cylinders	1

Counter recoil

Mechanism type	Spring
Number of cylinders	4
Buffer type	Hydraulic plug type
Primers	Combination electric and friction

Sighting and Fire Control Equipment

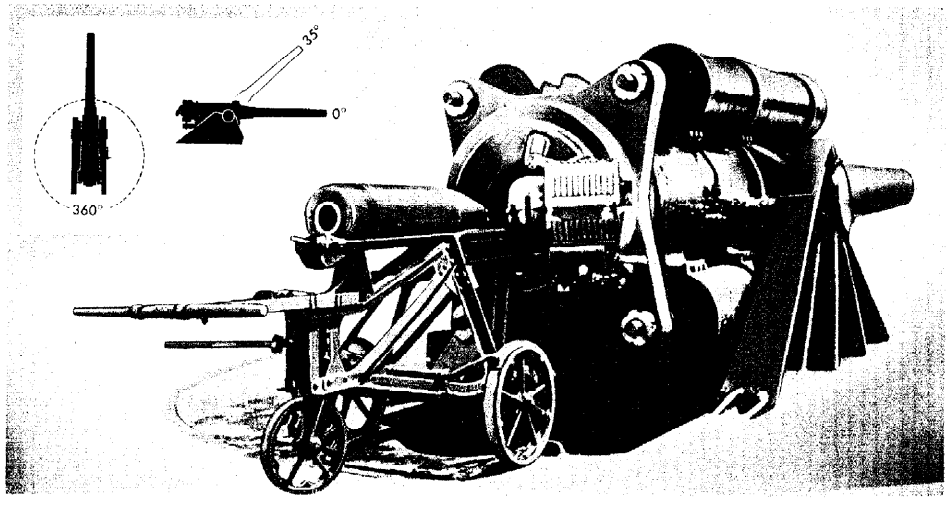
On Carriage Equipment

Telescope Mount, M1912M1, 3″
Telescope, M1912, 3″

Six carriages have T11 Data receivers. Receivers for M10 Data Transmission System to be applied to other carriages.

Off Carriage Equipment

Off carriage fire control equipment is of the usual seacoast artillery type, the instruments for the individual position being determined by the local coast defense commander according to the nature of the fire control system used in that area.



REAR VIEW OF 12 INCH GUN, M1895, ON BARBETTE CARRIAGE, M1917

Subcaliber Gun

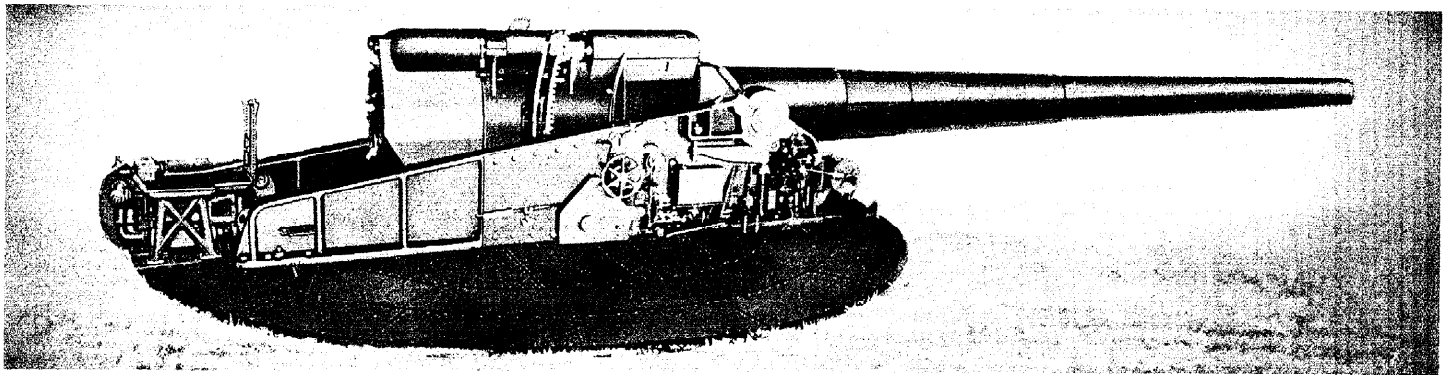
Subcaliber equipment for these 12″ Guns comprises the 75 mm Gun, which is mounted in the bore of the larger weapon.

Ammunition

Service ammunition for the 12″ Gun, M1895M1, is in the form of separate loading rounds. It consists of A.P. Shell, Mk. VI, with B.D. Fuze, Mk. X, and H.E. Shell, Mk. X, with P.D. Fuzes, M46 and M47.

REFERENCES—TM 9–2005, v.4; TM 9–2400; FM 4–60.

16 INCH GUN MK. II, MOD. 1—BARBETTE CARRIAGE M5—STANDARD



16 INCH GUN, MK. II, MOD. 1, ON CARRIAGE, M5

The 16 inch gun is the largest and most powerful American coast defense weapon. The Mk. II, Mod. 1, gun with its recoil mechanism and cradle, is of Navy design. The Barbette Carriage, M4, was designed by the Army as a modification of the earlier 16 inch Barbette Carriage, M1919. The gun is mounted in a casemate type of emplacement.

16 INCH GUN, MK. II, MOD. 1—This gun is of built-up construction. It consists of a tube, liner, jacket, hoops, rings, recoil band and a breech mechanism with closing cylinders and gas-ejector systems. Rotation of the gun during recoil and counter recoil is prevented by a stake-in key. Automatic elevating stops confine elevation or depression within prescribed limits.

The breechblock is of interrupted-thread design, dropping on hydraulic buffers when opened. It is opened by hand, but is closed by a piston actuated by compressed air. The Firing Lock, Mk. I, resembles the firing lock on all Navy cannon employing separate-loading ammunition. It uses a combination electric-percussion primer which may be fired by electricity or by lanyard.

After each round, the bore of the gun is blown free of gases by a jet of compressed air.

BARBETTE CARRIAGE, M4—The main structure of the carriage consists of two side frames which support the tipping parts and provide trunnion bearings for the cradle; a front transom tying together the side frames; floor beams to support the floor of the mount and stiffen the racer; a cast-steel racer bolted to the side frames and riding on conical rollers rest-

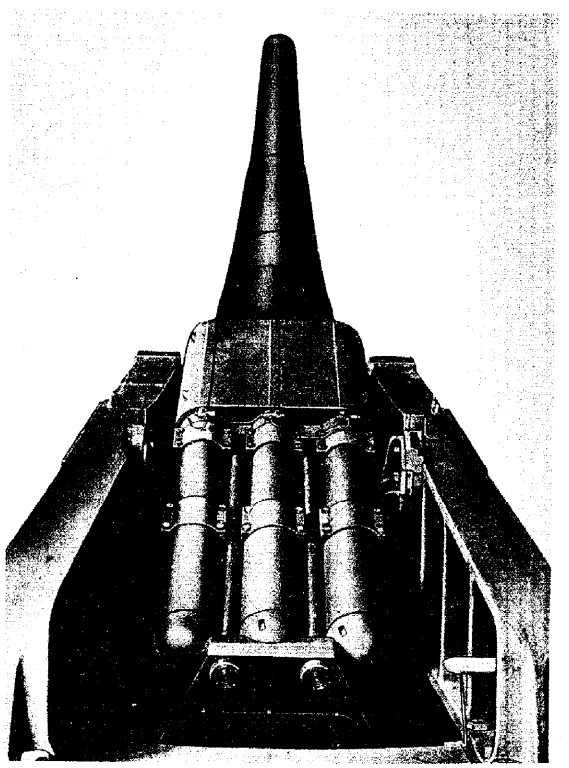
PRINCIPAL CHARACTERISTICS

16 INCH GUN, MK. II, MODEL 1

Weight of gun with band	307,185 lb.
Weight of gun without band	287,050 lb.
Caliber	16 ins.
Length of bore	50 cals.
Length (muzzle to rear face of breech ring)	821 ins.
Weight of projectile { Mk. XII, A.P.	2,240 lb.
Weight of projectile { Mk. II, M2, A.P.	2,100 lb.
Weight of powder charge (for both Mk. XII and Mk. II, M2, full charge)	672 lb.
Chamber pressure	38,000 lb./sq. in.
Muzzle velocity { Mk. XII projectile	2,650 f./s.
Muzzle velocity { Mk. II, M2 projectile	2,750 f./s.
Range (46° elevation) { Mk. XII projectile	45,100 yds.
Range (46° elevation) { Mk. II, M2 projectile	44,670 yds.
Travel of projectile in barrel	681.68 ins.
Capacity of powder chamber	30,000 cu. ins.
Rifling:	
Length	675.992 ins.
Number of grooves	96
Twist	Right-hand uniform, 1 turn in 32 cals.

16 INCH BARBETTE CARRIAGE, M4

Weight of carriage without shield, gun and band	665,315 lb.
Total dead load on emplacement including shield	1,172,500 lb.
Weight of recoiling parts including gun and band	316,853 lb.
Weight of tipping parts including gun and band	385,377 lb.
Weight of tipping parts not including gun and band	78,192 lb.
Weight of base ring and stationary parts	186,426 lb.
Weight of traversing parts including shield	986,074 lb.
Weight of air compressor	4,200 lb.
Traverse	145°
Maximum elevation	46°
Maximum depression	Depends on location
Normal recoil	48 ins.
Maximum recoil	49 ins.



REAR VIEW OF 16 INCH GUN, MK. II, MOD. 1 WITH GUN ELEVATED, SHOWING RECUPERATOR CYLINDERS

UNCLASSIFIED

ing on the upper surface of the base ring; a base ring of four sections bolted together and anchored in a concrete foundation, and a traversing rack bolted to the outside of the base ring.

The gun is supported in a cradle of gridiron design with trunnions so located in relation to the center of gravity of the tipping parts that there is a slight breech preponderance when the gun is loaded and a muzzle preponderance when it is unloaded. This feature, together with antifriction bearings at the trunnions, permits the gun, after it is fired, to be dropped smoothly to loading position by a spin of the handwheel.

The recoil mechanism consists of a single recoil cylinder and three recuperator cylinders. The recoil cylinder is located on the under side of the cradle, while the recuperator cylinders are assembled at the top. Recoil is controlled hydraulically, but recuperation is accomplished by the hydropneumatic method. Buffer action for counter recoil is obtained by means of a buffer plunger functioning in a cavity in the recoil cylinder head.

The elevating mechanism comprises two spur-gear racks mounted on either side of the cradle, the anti-friction mechanism incorporated in the trunnion bearings, a Waterbury hydraulic speed gear, shafts, trains of gears leading to the handwheel and the elevating motor. A buffer in each side frame stops the gun at either extreme of elevation without serious jarring. Friction handbrakes are included in the mechanism. Elevation is normally effected by electric motor through the speed gear, but there are handcranks for manual operation in case of power failure.

An elevation data receiver, part of the Data Transmission System, M5, gives the correct elevation for the gun and makes unnecessary the range disk used in earlier 16 inch barbette carriages.

The carriage can be traversed either by hand through a train of bevel and spur gears leading from the slow- and high-speed handwheels to the traversing rack on the base ring, or by an electric motor through a Waterbury speed gear.

An azimuth data indicator is located near the left traversing handwheel for tracking in azimuth with off carriage fire control equipment which transmits azimuths mechanically to one of the dials of the indicator.

The carriage is mounted in a circular pit so that all mechanism is below the ground level. Additional protection is afforded by an armored shield 4 inches thick with side walls 12 feet high.

Ammunition trucks are loaded at the magazines, pushed to the carriage by hand and unloaded onto parking tables in rear of the mount whence it is rolled onto the rammer. A power rammer operated by an electric motor through a hydraulic speed gear is utilized to increase rapidity of fire and to insure uniform seating of the heavy projectile. In case of power failure, manual loading may be accomplished by two handcranks each manned by four men.

Electric power for operating the various mechanisms of the carriage is produced by a Diesel engine generator located in the emplacement. An overhead trolley is provided as an alternate means of transporting projectiles. The M4 Carriage is now Substitute Standard.

BARBETTE CARRIAGE, M5—The chief differences between Carriages, M4 and M5, are that in the M5 roller bearings replace the trunnion anti-friction device of the M4; the air compressor, compressor motor, and air tanks are removed from the carriage; a redesigned traversing mechanism with a motor of greater horsepower raises the traversing rate to 3.5° per second, and a new type of hydraulic speed gear is employed. Increased power of the rammer motor is also a factor in faster operating speed of the Carriage, M5.

Compressed air for scavenging and for closing the breechblock of the M5 is brought through piping from the power room to the carriage.

Sighting and Fire Control Equipment

On Carriage Equipment

Telescope Mount, M35
Telescope, M31

Off Carriage Equipment

This may vary depending upon the system of position finding and the type of plotting room equipment used.

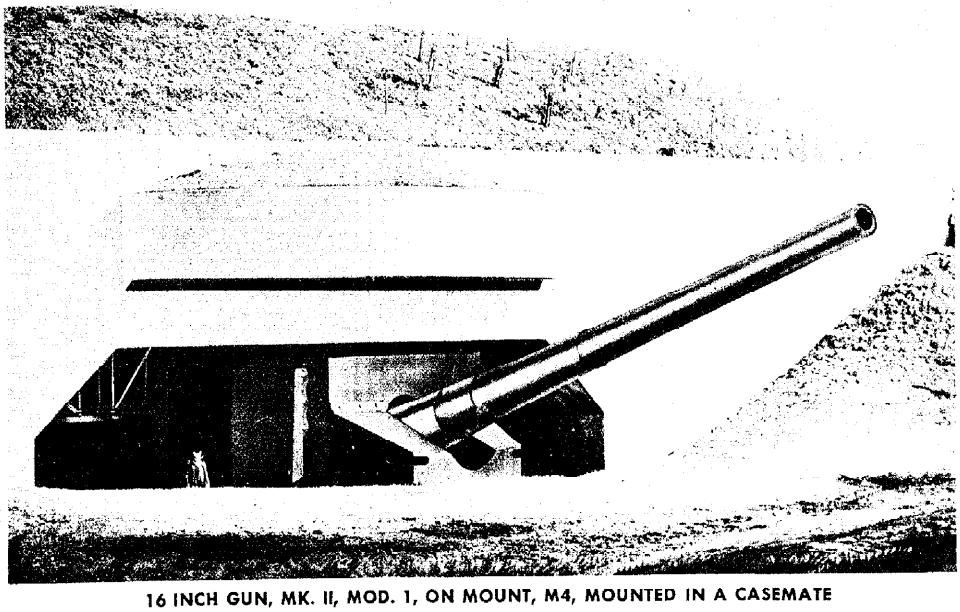
Ammunition

Ammunition for the 16 inch gun, Mk. II, M1, is in the form of separate loading rounds. It consists of A. P. shell, Mk. XII, with B.D. fuze, Mk. X, and A. P. shell, Mk. II, M2, with B.D. fuze, Mk. X.

Subcaliber Gun

Subcaliber equipment for the 16 inch Gun, Mk. II, M1, consists of a 75 mm gun for mounting in the bore of the larger gun.

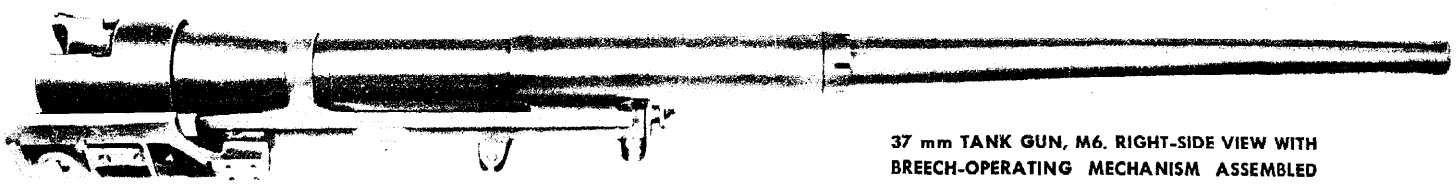
REFERENCES—TM 9-2005, v.4; TM 9-471.



16 INCH GUN, MK. II, MOD. 1, ON MOUNT, M4, MOUNTED IN A CASEMATE

TANK ARMAMENT

37 MM GUN M6—STANDARD FOR TANKS



37 mm TANK GUN, M6. RIGHT-SIDE VIEW WITH BREECH-OPERATING MECHANISM ASSEMBLED

The 37 mm tank guns were developed from the 37 mm Antitank Gun, M3, the first model being the 37 mm Tank Gun, M5. Addition of an automatically opened breechblock changed the designation to the M6, standardized by O.C.M. 16279 dated 14 Nov. 1940. The M5 barrel is shorter by about 5 inches than the barrels of the other guns.

The 37 mm Gun, M6, is standard for use on Light Tanks, M3A1, M3A3, M5 and M5A1; on Medium Tank, M3, and its variations, and on the 37 mm Light Armored Car, M8. The gun is carried on the M23, M24 or M44 Mount.

The barrel is a one-piece forging or casting with a rifled bore, threaded to screw into the breech ring. Two bearings support the barrel and align it in the yoke of the sleigh. Keys are employed to prevent rotation of the barrel.

The breech ring is broached to receive the drop-type breechblock. A breech-operating mechanism is bolted to the recoil cylinder. Recoil of the gun automatically opens the breechblock, extracts the empty cartridge case, locks the breech in an open position and cocks the gun. Rounds are inserted into the breech manually.

The recoil cylinder is assembled with the trunnion pins mounted in the trunnions of the yoke. It is provided with rails to guide the sleigh and contains a recoil mechanism of the hydrospring type, the counter-recoil spring, and a buffer mechanism.

In tanks with power traverse the gun is fired by a solenoid-firing device connected with the trigger. In other cases the hand-operated trigger actuator causes the firing process to start.

The gun may be elevated by a hand-wheel, but a throw-out lever permits free movement of the weapon.

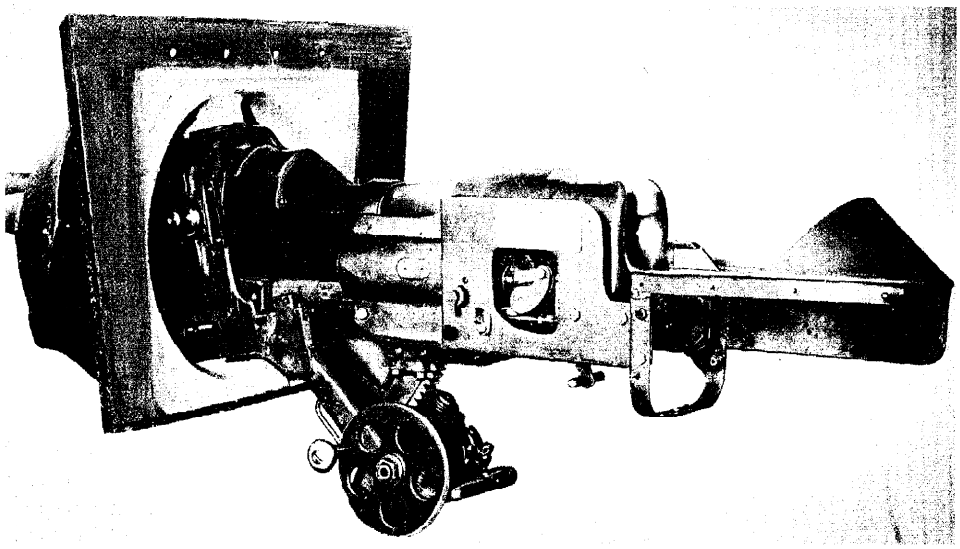
Traverse of guns mounted in tanks with power-traversing mechanisms is obtained by power-drive rotation of the turret. In tanks equipped with manually operated turrets only, the gun can be traversed 10° right or left by means of a traversing knob. When greater traverse is necessary the turret must be rotated or the tank turned in direction.

A shield is attached to the yoke and recoil cylinder by bolts, or, in some tanks, direct to the turret.

PRINCIPAL CHARACTERISTICS

Weight of gun	190 lb.
Total weight of gun and mount	700 lb.
Length of barrel	78 ins.
Overall length of gun	82.5 ins.
Diameter of bore	1.457 ins.
Rifling, uniform R.H.	1 turn in 25 cals.
Weight of powder charge	8 oz. (approx.)
Volume of powder chamber	19.92 cu. ins.
Maximum powder pressure (Rated for A.P.C. Shot, M51B2)	50,000 lb./sq. in.
Maximum rate of fire	30 rds./min.
Maximum rate of fire, aimed	15–20 rds./min.
Muzzle vel., A.P.C. Shot, M51B2	2,900 f./s.
Muzzle vel., H.E. Shell, MK. II	2,750 f./s.
Muzzle vel., H.E. Shell, M63	2,600 f./s.
Maximum range (M51B2)	12,850 yds.
Weight of H.E. projectile	1.61 lb.
Weight of A.P.C. Shot, M51B2	1.92 lb.
Weight of recoil mechanism	77.5 lb.
Length of recoil	6–8 ins.
Maximum elevation	+20°
Minimum elevation	−10°
Maximum traverse (manually operated turret)	10° in each direction

ARMOR PENETRATION AT 20°	Homo. Plate 500 yards	Homo. Plate 1,000 yards	Face-Hard. Plate 500 yards	Face-Hard. Plate 1,000 yards
A.P.C. Shot, M51B2, Supercharge	2.4 ins.	2.1 ins.	2.1 ins.	1.8 ins.



37 mm GUN, M6, MOUNTED IN COMBINATION MOUNT, M23, IN TURRET OF LIGHT TANK, M5

A traveling lock inside the turret is utilized to prevent undue wear on the elevating mechanism.

A spent-case deflector is bolted to the recoil cylinder and has suspended from it a bag to receive the ejected cartridge cases.

Ammunition

Ammunition is in the form of fixed rounds. It consists of a Canister, M2, H. E. Shell, M63, with B.D. Fuze, M58; H. E. Shell, Mk. II, with B. D. Fuze, M38A1, and A.P.C. Shot, M51B2, with tracer.

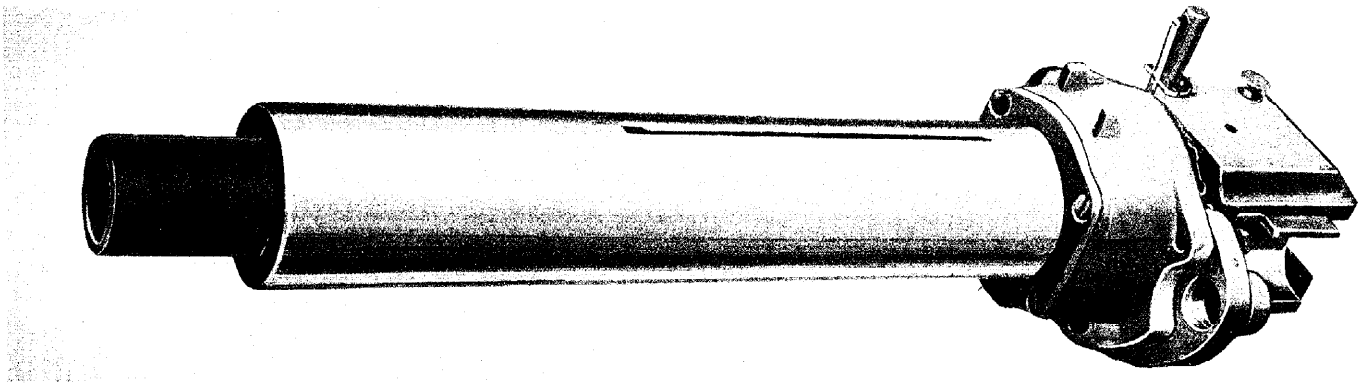
Sighting Equipment

Sighting equipment varies with the tank in which the gun is mounted. The following table designates the sighting equipment used with each tank.

Tank	Telescope	Periscope
Light Armored Car, M8	M70D	——
Light Tanks, M3A1, M3A2	M40A2	M4A1
Light Tanks, M3A3, M5A1	M70D, M40A2	M4A1
Light Tank, M5	M40A2	M4A1
Medium Tank, M3, and variations	M19A1	M2
Heavy Tanks, M6, M6A1*	M15, M39A2	M8A1

*O.C.M. 19199 specifies that all 37 mm guns shall be removed from heavy tanks.

75 MM HOWITZER M3—MOUNT M7—STANDARD



75 mm HOWITZER, M3

The decision to adapt the Pack Howitzer, M1 or M1A1, for use in the Howitzer Motor Carriage, M8, necessitated spot welding and keying a tube mounting support in place over the howitzer tube. This mounting support increased the outside diameter of the tube to fit the central bore of the cradle. Pack howitzer tubes modified in this manner were designated Howitzers, M2. They are now classified as Substitute Standard.

Since there were insufficient M2 tubes to supply the required number of howitzer motor carriages, new tubes were made with the howitzer mounting support integral with the tube. These tubes were given the designation of 75 mm Howitzer, M3, and classified as Standard.

Howitzers, M2 and M3, are manually loaded weapons fired electrically by means of a solenoid, or manually by a hand firing mechanism handle. The tube assembly differs from that of the M1 or M1A1 Howitzers only in the hoop at the rear end of the mounting support on the M2 and in the flash detector which is integral with the howitzer shield in both the M2 and M3 models.

The tube is screwed into a breech ring containing a breechblock of the horizontal sliding wedge type. A recoil tube retainer, which provides the means of attaching the two recoil cylinder assemblies to the tube assembly, is bolted to a breech yoke support on the tube.

The tube assembly is supported and alined in a cradle which is a part of the mount assembly. The tube mounting support, which is finish-ground, rides in liners inside the cradle.

The Firing Lock, M13, fits into an axial hole in the breechblock. It is of the continuous-pull, self-cocking type, and is retained in position by sector lugs on its exterior which engage with lugs in the breechblock.

The hydrospring recoil mechanism consists of two recoil cylinders, one on each side of the howitzer, which are held and located in the cradle. A counter-recoil buffer is attached to the front cover of each cylinder.

Howitzers, M2 and M3, are mounted in 75 mm Howitzer Mount, M7, which rests on trunnions in the turret of the Howitzer Motor Carriage, M8. The mount assembly is composed of a cradle with two recoil cylinders, a firing mechanism, and a recoil guard. The shield is attached to the forward end of the cradle and is elevated and depressed with it. Rotation of the howitzer is prevented by a key in the cradle which rides in a groove in the howitzer tube mounting support.

The firing mechanism is mounted on the rear end of the recoil guard. An electrical system is provided for primary use, with current supplied by the vehicle battery. The system operates electrically from a firing button, activating the electro-magnetic solenoid, and then through a mechanical series of linkages to a trigger chain hooked directly to the trigger. A hand firing system, which may be employed in case of failure of the elevation system, is operated by the hand firing mechanism handle and utilizes the mechanical linkage of the electrical firing system.

A recoil guard of tubular framework with right and left shields surrounds the breech. It is attached to the cradle and acts as a support for the electrical firing mechanism.

Elevation is accomplished by means of an elevating mechanism mounted on the right rear wall of the turret. A train of gears inside the elevating mechanism case connects with a pinion that meshes with the elevating quadrant rack on the howitzer cradle. The elevating mechanism is operated by a handwheel which may be engaged with or disengaged from the gear train by means of a shifter lever and a sliding gear.

Traverse is obtained by rotating the turret. A handwheel operates a gear train and a pinion meshed with the traversing rack bolted to the under side of the turret roof. A traversing lock is provided to lock the turret in traveling position.

Sighting and Fire Control Equipment

Telescope, M70C
Telescope Mount, M44, with Panoramic Telescope, M12A5
Gunner's Quadrant, M1

Ammunition

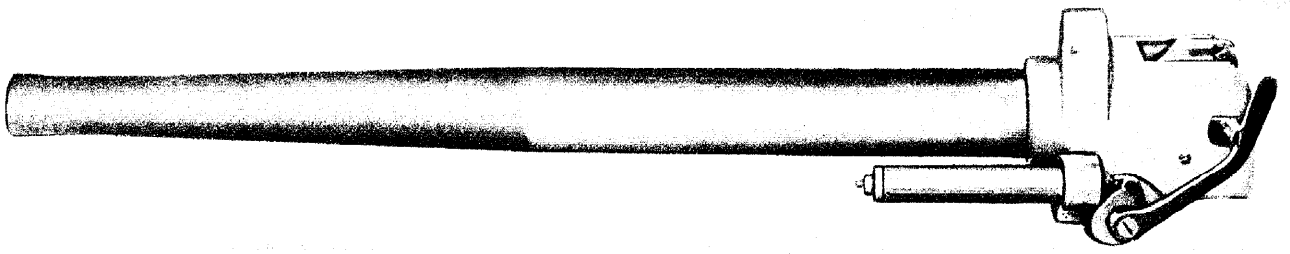
Ammunition is in the form of fuzed, fixed and semifixed complete rounds. It consists of Shell, fixed, H.E., A.T., M66, with Fuze, B.D., M62; Shell, fixed, H.E., A.T., M66, steel case, with Fuze, B.D., M62; Shell, semifixed, H.E., M41A1, with Fuze, P.D., M48, M48A1, or M48A2; Shell, semifixed, H.E., M41A1, with Fuze, P.D., M54; Shell, semifixed, H.E., M48, with Fuze, P.D., M48, M48A1, M48A2 or M54; Shell, semifixed, H.E., M48, steel case, with Fuze, P.D., M48, M48A1, M48A2, or M54; Shell, semifixed, gas, persistent, H, M64, with Fuze, P.D., M57; Shell, semifixed, gas, persistent, H, M64, steel case, with Fuze, P.D., M57; Shell, semifixed, smoke, FS, M64, with Fuze, P.D., M57; Shell, semifixed, smoke, phosphorous, WP, M64, with Fuze, P.D., M57; Shell, semifixed, smoke, phosphorous, WP, M64, Steel case, with Fuze, P.D., M57.

REFERENCES—OCM 21025; OCM 21293; TM 9-318.

CHARACTERISTICS

Weight of 75 mm Howitzer, M2	318 lb.
Weight of 75 mm Howitzer, M3	421 lb.
Length of bore	35.91 ins.
Length overall	54.18 ins.
Rifling	
Length	35.91 ins.
Twist	Uniform, right; one turn in 20 cals.
Number of grooves	28
Depth of grooves	0.03 in.
Width of grooves	0.1866 in.
Width of lands	0.14439 in.
Type of breechblock	Horizontal sliding
Maximum powder pressure	20,600 lb.
Muzzle velocity	700, 810, 950, 1,250 f./s.
Maximum range (Shell, H.E., M41)	9,760 yds.
Maximum elevation	40°
Maximum depression	−20°
Traverse of turret (with howitzer)	360°
Normal recoil	11.62 ins.
Type of recoil mechanism	Hydrospring

75 MM GUN M3—STANDARD FOR TANKS



75 mm GUN, M3, SHOWING TUBE, BREECH RING, COCKING LEVER, CLOSING SPRING CYLINDER AND OPERATING HANDLE

The 75 mm Gun, M3, a development from the Tank Gun, M2, was standardized by O.C.M. 17018, dated 24 July 1941. The M2 gun is now designated as Limited Standard.

The M3 gun is a single-shot, flat-trajectory weapon differing from the M2 only in having the tube lengthened by 26.6″, with a higher muzzle velocity and greater range as a result. It is equipped with a drop-type breechblock automatically opened. This weapon is mounted in Medium Tanks, M4, M4A1, M4A2, M4A3, M4A4, and in Medium Tank, M7, using Mounts, M34, M34A1 and M47.

The alloy steel tube screws into the breech ring, where it is locked into position with a key. The breech ring contains the vertical sliding breechblock assembly and the principal operating parts of the gun. The breech mechanism is composed of the breechblock assembly, firing mechanism, extractors, spline shaft, breechblock crank, operating crank, closing mechanism and related parts. A hole bored through the center of the breechblock houses the percussion mechanism. The breech may be opened by means of an operating handle secured to the spline shaft.

Manual loading of each round automatically closes the block. The gun can be fired either manually or by means of a solenoid. During counterrecoil after firing, the gun is cocked, the block is opened, the cartridge case is extracted and the breechblock is locked in an open position for insertion of the next round.

The gun recoils in the mount, which consists of a horizontal rotor upon which is mounted the elevating mechanism and traversing mechanism; the hydraulic recoil mechanism, supported by trunnions which rotate in the trunnion seats of the horizontal rotor; an elevating shield, bolted to the trunnions of the recoil mechanism and projecting through an opening in the rotor; two recoil cylinders, held by the cradle and trunnion assembly upon which are mounted the solenoid, firing lever link, and firing lever of the firing mechanism; and a shoulder guard, bolted to the cradle, covering the firing mechanism and extending beyond the rear face of the breech.

CHARACTERISTICS

Weight of gun, recoil mechanism and elevating shield at trunnion	1,763 lb.
Weight of gun	910 lb.
Length of gun	118.38 ins.
Muzzle velocity, A.P. shell (weight 14.92 lb.)	2,030 f./s.
Muzzle velocity, H.E. shell (weight 14.60 lb.)	1,515 f./s.
Maximum powder pressure	38,000 lb./sq. in.
Rate of fire	20 rds./min.
Maximum range, A.P. shell	14,000 yds.
Maximum elevation	19°12′
Maximum depression	7°48′
Traverse, left	14°
Traverse, right	14°

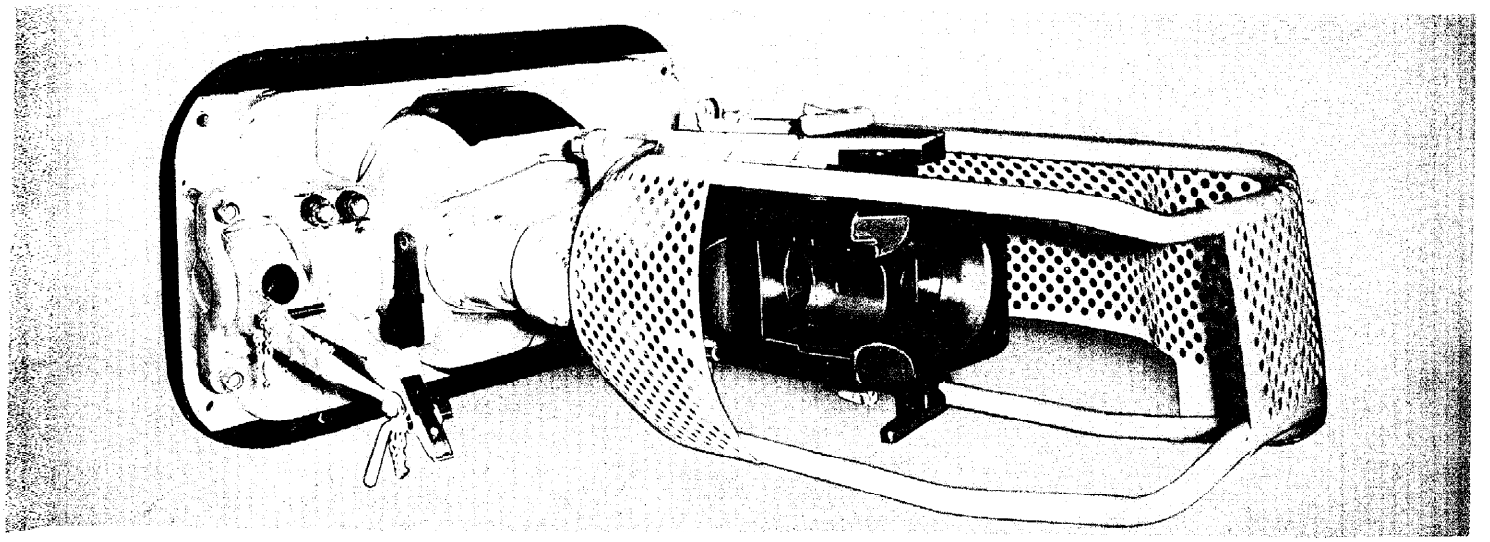
Sighting Equipment

Periscope, M10, or M4A1
Telescope, M38A1
Azimuth Indicator, M19

Ammunition

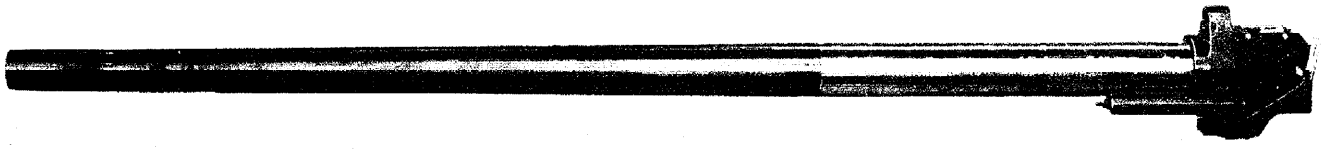
Ammunition is in the form of complete, fixed rounds. It consists of A.P.C. shell, M61, with tracer, and B.D. fuze, M66A1; H.E. shell, M48, normal charge, with P.D. fuze, M48.

References—FM 23-95; TM 9-307; TM 9-2005, v.5; Oldsmobile Training Manual, 75 mm, M3, Tank Gun.



BREECH END OF 75 mm GUN, M3, WITH RECOIL MECHANISM AND SHOULDER GUARD

76 MM TANK GUN M1A2—STANDARD



76 MM TANK GUN, M1A1. THE M1A2 DIFFERS FROM THE M1A1 ONLY IN HAVING THE MUZZLE END THREADED FOR ATTACHMENT OF A MUZZLE BRAKE

The 76 mm Gun, M1A2, is a modification of the M1 Gun of the same caliber. The original 76 mm Gun, M1, was designed to provide tank weapons of greater power and armor penetration than were possible with 75 mm armament.

76 mm GUN, M1—This gun was designed to use the 3″ H.E. Shell or A.P.C. Projectile with a different cartridge case. The gun tube and extractors were constructed to accommodate the redesigned cartridge, but the breech ring and breech mechanism were similar to those used on the 75 mm Gun, M3. This 76 mm Gun, M1, is now Limited Standard.

76 mm GUN, M1A1—In order to better adapt the M1 Gun to use with various tanks and gun motor carriages, the contour of the tube was changed, and the recoil slide surface on the tube was lengthened 12 inches, thus permitting the trunnion position to be set farther forward to obtain better balance. The M1 gun with these modifications was designated 76 mm Gun, M1A1, and is classified as Limited Standard.

76 mm GUN, M1A2—In the 76 mm Gun, M1A2, the rifling twist is one turn in 32 calibers instead of one turn in 40 calibers as in the M1 and M1A1 Guns. All tubes are threaded at the muzzle to allow assembly of a muzzle brake, and a ring is provided to cover the threaded portion of the tube when the muzzle brake is not in place. This gun is classified as Standard.

Sighting Equipment

Telescope, M47A2
Periscope, M4A1

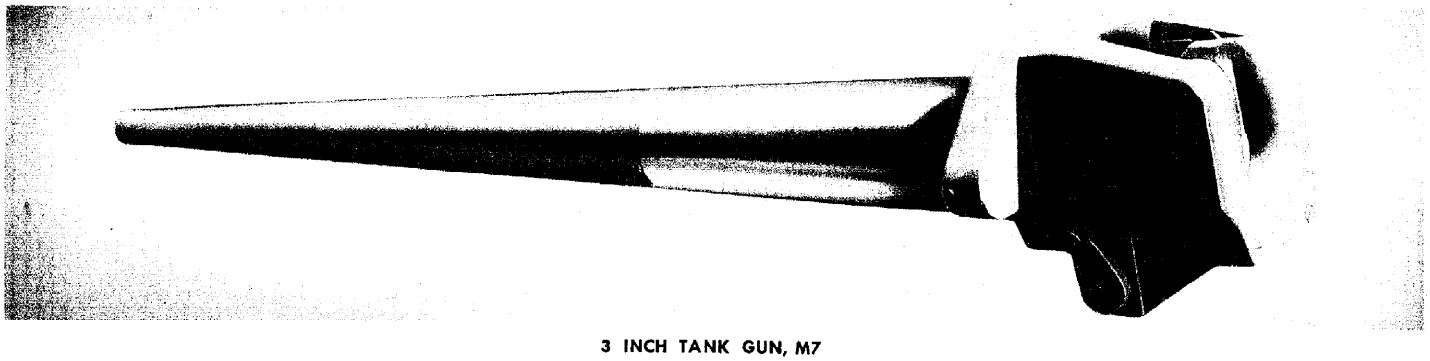
Ammunition

Ammunition is in the form of complete fixed rounds. It consists of Shell, H.E., 3 Inch, M42A1, with Fuze, P.D., M48A1; Projectile, 76 mm, A.P.C., M62, with Fuze, B.D., M66A1, and Shell, Smoke, M88.

CHARACTERISTICS

Diameter of bore	76.2 mm (3 ins.)
Length of bore	52 cals.
Overall length of gun	167.75 ins.
Weight of gun	1,204 lb.
Weight of tube	940 lb.
Capacity of chamber	142.6 cu. ins.
Muzzle velocity (H.E. Shell, M42A1)	2,800 f./s.
Rated maximum powder pressure	43,000 p.s.i.
Maximum range (H.E. Shell, M42A1)	14,780 yds.
Type of breechblock	Semi-automatic, vertical drop

3 INCH TANK GUN M7—STANDARD



3 INCH TANK GUN, M7

The 3″ Gun, M7, was designed for use in Heavy Tanks, M6 and M6A1. It was also adopted as standard armament for the 3″ Gun Motor Carriage, M10. Ammunition for this weapon is the same as that for the 3″ antitank and antiaircraft guns.

O.C.M. 16200, dated 24 October 1940, initiated the development of a 3″ gun similar to 3″ Gun, T9, for the Heavy Tank, T1. It was designated 3″ Gun, T12, with interior dimensions and ballistics practically identical with those of the 3″ Antiaircraft Gun, M3, and the 3″ Antitank Gun, M5. After firing tests, the T12 was standardized as 3″ Gun, M7, by O.C.M. 18467, dated 9 July 1942.

The 3″ Gun, M7, is a high-velocity, manually loaded weapon employing a semi-automatic breech mechanism with a vertical drop-type breechblock. The general functioning of the gun is very similar to that of the 75 mm Gun, M3. A solenoid-actuated mechanism is used for firing the gun. The recoil mechanism and mount for this gun are supplied along with the vehicle.

Ammunition

Ammunition is in the form of complete fixed rounds. It consists of A.P.C. projectile, M62, with B.D. fuze, M66A1; A.P. shot, M79, and H.E. shell, M42A1, with M.T. fuze, M43.

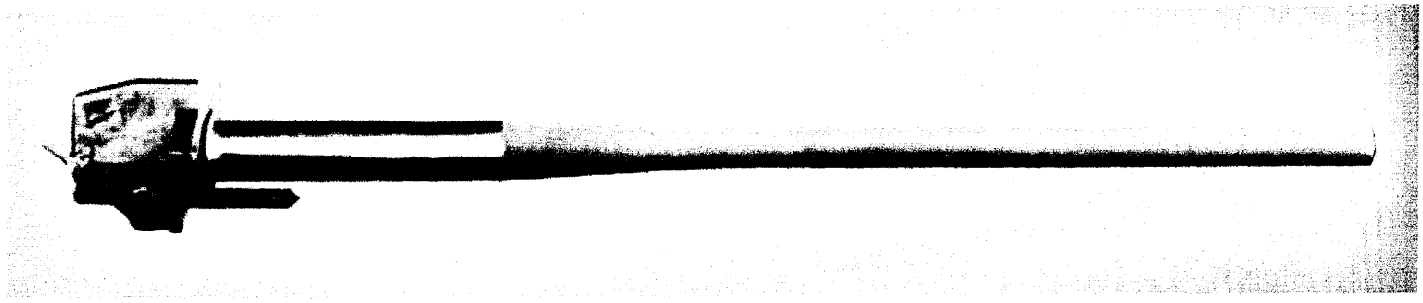
CHARACTERISTICS

Diameter of bore	3 ins.
Length of bore	50 cals.
Overall length of gun	158.1 ins.
Travel of projectile	128.49 ins.
Weight of gun only	1,990 lb.
Capacity of chamber (with A.P.C., M62)	205.58 cu. ins.
Maximum powder pressure	38,000 lb./sq. in.
Muzzle velocity (A.P.C., M62)	2,600 f./s.
(H.E., M42A1)	2,800 f./s.
Maximum range (A.P.C., M62)	16,100 yds.
Breech mechanism	semi-automatic drop block
Recoil mechanism	hydraulic

SIGHTING EQUIPMENT—Sighting equipment for the 3″ Gun, M7, varies according to the type of vehicle in which the gun is installed.

Tank or Armored Car	Telescope	Telescope Mount	Panoramic Telescope	Azimuth Indicator	Periscope
M10, M10A1	M70G	M30	M12A4	M18	M6
M6, M6A1	M39A1	—	—	—	M8A1

90 MM GUN M3—STANDARD



90 mm TANK GUN, M3

Battle experience in North Africa indicated the desirability of a weapon which would materially increase the firepower of tanks and gun motor carriages. The high velocity, range, and relatively flat trajectory of the 90 mm Gun, M1, were thought to make it particularly suitable for this use. Weight was also given to the availability of all types of ammunition for the M1 gun, including armor-piercing projectiles. A project was therefore initiated to investigate the feasibility of installing this gun in the 3 Inch Gun Motor Carriage, M10, in place of the 3 Inch Gun, M7. Experiments were conducted which indicated the necessity of modifying the gun before it could be successfully utilized for this purpose. Upon completion of the modifications required to adapt the M1 gun to the Mount, M7, of the 3 Inch Gun Motor Carriage, the weapon was standardized as 90 mm Gun, M3.

The 90 mm Gun, M3, has the same exterior and interior ballistics as the M1, and uses the same ammunition. A new breech ring was provided with a lug on each side for attaching the piston rods of the 3 inch recoil mechanism. In the M3, the breech-operating handle is mounted directly on the breech mechanism assembly. The breech mechanism is semi-automatic in operation and required changes in the breech-operating cam of the M1 gun. It also was essential to alter the trigger mechanism to enable the M3 gun to be fired when mounted in tanks or gun motor carriages.

A longitudinal key-way and a cylindrical recoil surface directly on the exterior of the M3 tube, added to permit the weapon to fit the 3 Inch Mount, M7, resulted in a decreased exterior diameter of the tube and thinner powder chamber walls than those of the Gun, M1.

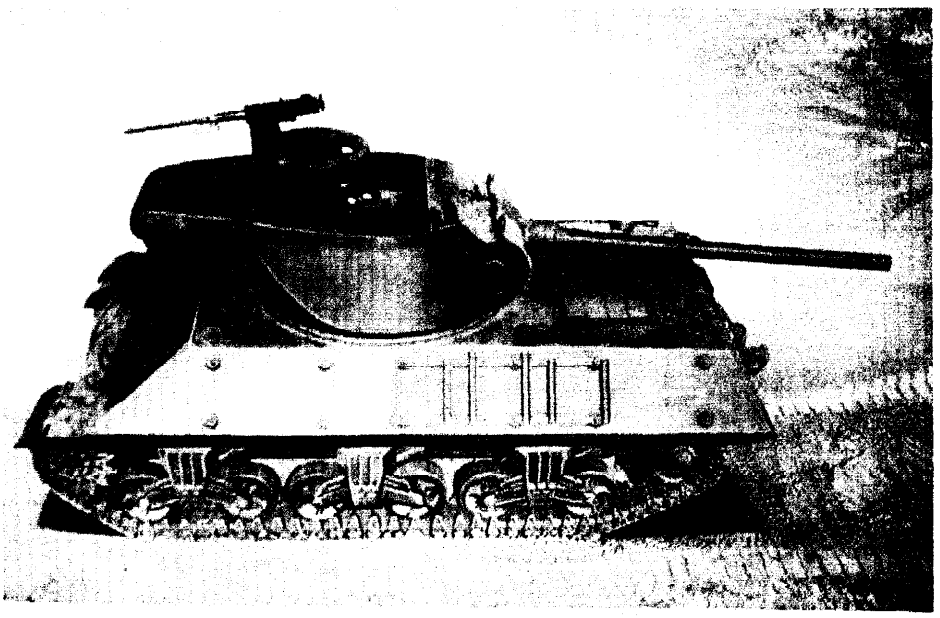
In order to secure the desired throttling action for the Gun, M3, it was necessary to substitute new sleeves in the 3 inch recoil mechanism. The 90 mm Gun, M3, is now mounted on the 90 mm Gun Motor Carriage, T71, which is a modification of the 3 Inch Gun Motor Carriage, M10A1.

Ammunition

Ammunition is in the form of fuzed, complete, fixed rounds. It consists of Shell, H.E., M58, with Fuze, time, mechanical, M43; Shell, H.E. (Ammonal), M58, with Fuze, time, mechanical, M43; Shell, H.E., M71, with Fuze, time, mechanical, M43; Shell, H.E., M71, with Fuze, time, mechanical, M43; Shell, H.E., M71, with Fuze, P.D., M48; Shell, H.E., M71, with Fuze, P.D., M48A1; Projectile, A.P.C., M82, with Fuze, B.D., M68, and Tracer; Shot, A.P., M77, with Tracer; Ammunition, Blank, 90 mm Gun, M1, and Cartridge, drill, M12, with Fuze, dummy, M44A2.

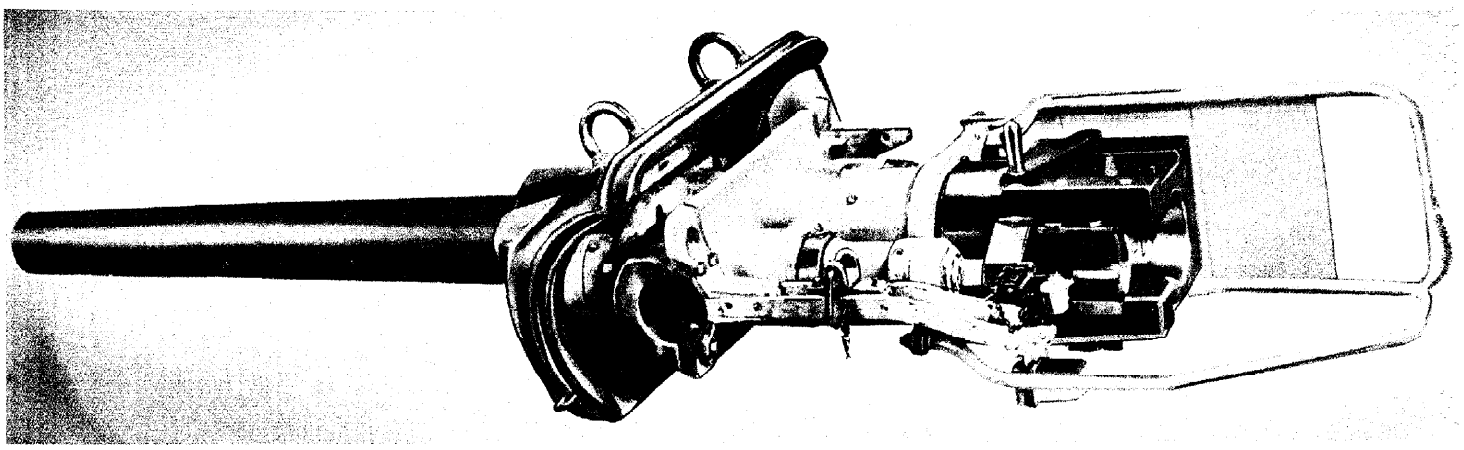
PRINCIPAL CHARACTERISTICS

Caliber	90 mm
Weight, complete	2,260 lb.
Length overall	186.15 ins.
Length of bore	50 cals.
Length of rifling	152.4 ins.
Grooves, number	32
width	.1978 in.
depth	.04 in.
Width of lands	.15 in.
Twist, uniform, R.H.	1 turn in 32 cals.
Travel of projectile	156.4 ins.
Chamber capacity	300 cu. ins.
Maximum powder pressure	38,000 lb./sq. in.
Muzzle velocity	
H.E., M71 (23.4 lb.)	2,700 f./s.
A.P., M77 (23.4 lb.)	2,700 f./s.
A.P.C., M82 (24.06 lb.)	2,680 f./s.
Range at 20° elevation (computed)	
H.E., M71	13,000 yds.
A.P., M77	10,200 yds.
A.P.C. M82	14,800 yds.
Breech mechanism	Drop block, semi-auto.
Recoil	12⅜ ins.
Elevation	−10° to +20°
Traverse	360°



90 mm GUN, M3, MOUNTED ON 90 mm GUN MOTOR CARRIAGE, T71

105 MM HOWITZER M4—COMBINATION GUN MOUNT M52—STANDARD



105 mm HOWITZER, M4, AND COMBINATION GUN MOUNT, M52

The 105 mm Howitzer, M4, was developed following reports from battle fronts which indicated that there was definite need for a 105 mm howitzer mounted in a medium tank. In the Medium Tanks, M4 and M4A3, the howitzer can now be carried in the most forward combat areas with less danger of being neutralized by small arms and light cannon fire than the lightly armored 105 mm Howitzer Motor Carriage, M7.

The M4 Howitzer consists of a tube screwed into a breech ring, where it is locked in place by a locking screw. Rotation of the tube in the mount is prevented by engagement of a key in the bottom of the breech ring with a groove in the cradle.

The breech mechanism is of the horizontal sliding wedge type, manually operated. A percussion firing mechanism in the breechblock is actuated either electrically or manually. A separate firing mechanism located on the under side of the cradle yoke provides a means of releasing the percussion mechanism that fires the howitzer. It is operated by a firing pedal connected to a solenoid with a plunger that pushes the firing trigger plunger and results in release of the percussion firing mechanism.

The M4 Howitzer is mounted in the Combination Gun Mount, M52. This mount is fastened to the turret of the tank by trunnions around which the howitzer and mount are elevated and depressed. The mount consists of a cradle, two recoil cylinders, an elevating mechanism, a firing mechanism, a coaxial machine-gun mount, and a shield.

The howitzer is supported in a central longitudinal hole in the cradle, with the two recoil cylinders in smaller holes on each side of the howitzer tube. Bronze liners in the howitzer hole provide a bearing surface for the tube. A yoke welded to the front end of the cradle extends rearward from the bottom of the cradle. A groove machined in the top surface of the yoke engages a key on the bottom of the breech ring and guides the howitzer during recoil and counterrecoil.

The recoil mechanism is of the hydrospring type. Counterrecoil is controlled by two large counterrecoil springs. A counterrecoil buffer is located in the front of each recoil cylinder.

Elevation is accomplished by means of an elevating mechanism located under the telescope mount on the right side of the turret and fastened directly to the right trunnion. The elevating rack is secured to the right side of the cradle beneath the trunnion. The elevating mechanism is operated by a handwheel connected to a system of gears which moves the elevating rack pinion up or down and transmits this movement to the cradle.

The coaxial machine-gun mount is fastened to the left trunnion cap. It is formed by two side rails separated and secured to a pintle support and pintle bearing. A freely revolving pintle to which the machine gun is fastened by a fastening pin enables the gun to be elevated or depressed around the pin and to traverse with the pintle. An elevation clamp is fastened between the mount sides on the rear end. Elevation and depression of the machine gun are caused by an elevation screw, and traverse is accomplished by means of a traversing screw and wedge.

The shield is a large rectangular steel piece curved to close the opening in the front of the turret. It is pierced for the howitzer, machine gun, and sighting telescope.

Sighting and Fire Control

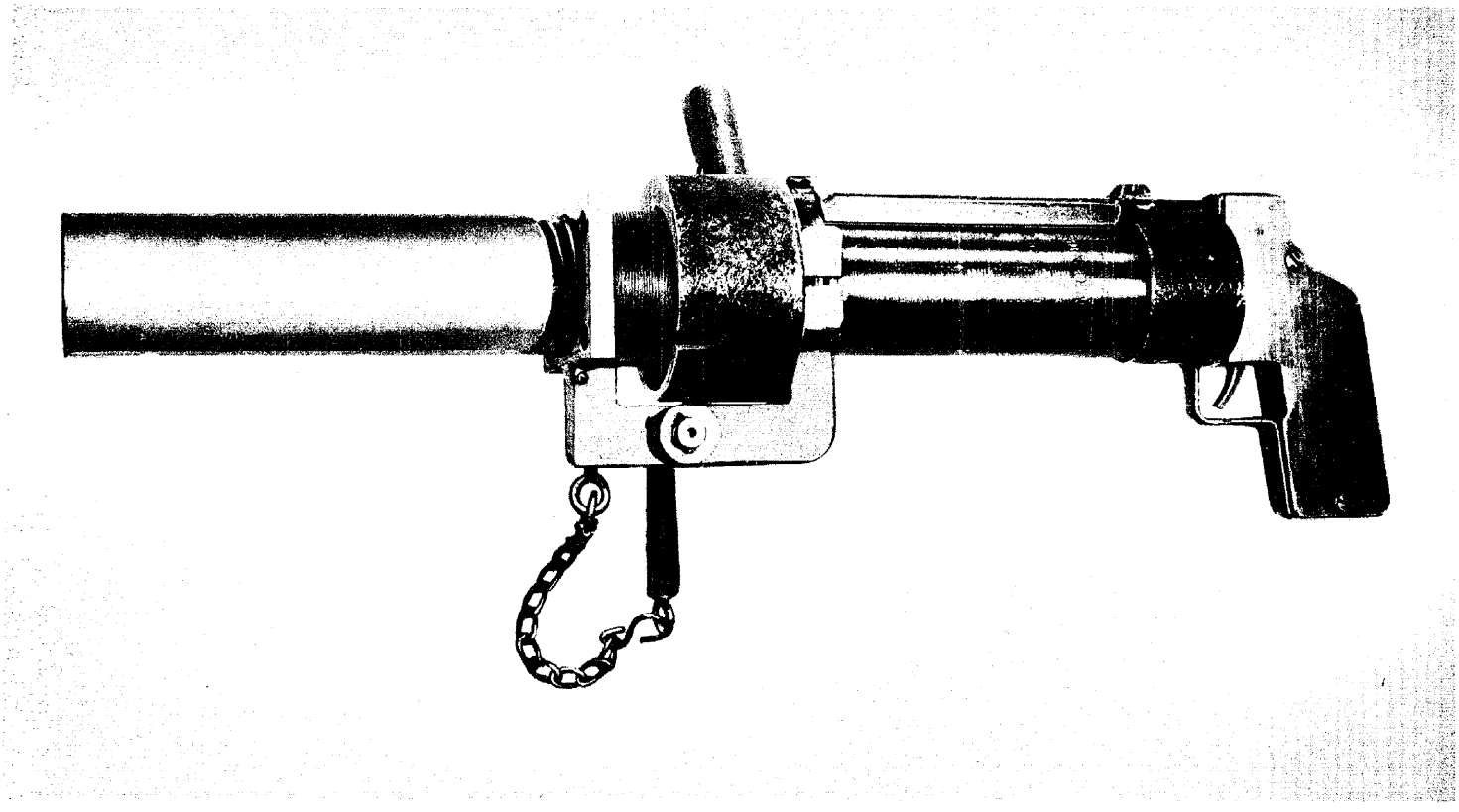
ON CARRIAGE EQUIPMENT

Telescope, T92E2
Telescope Mount, M56, and headrest
Instrument Light, M33
Azimuth Indicator, M19
Elevation Quadrant, M9
Instrument Light, M30
Periscope, M6
Periscope, M8, with telescope

PRINCIPAL CHARACTERISTICS

Length of bore	22.5 cals.
Muzzle velocity	1,550 f./s.
Twist of rifling	1 turn in 20 cals.
Volume of chamber	153 cu. ins.
Weight of projectile	
H.E.	33 lb.
H.E., A.T.	29.22 lb.
Weight of charge	
H.E.	3.04 lb.
H.E., A.T.	1.60 lb.
Weight of complete round	
H.E.	42.07 lb.
H.E., A.T.	36.85 lb.
Travel of projectile in tube	81.67 ins.
Maximum powder pressure	28,000 lb./sq. in.
Muzzle energy	549.6 ft.-tons
Type of recoil mechanism	Hydrospring
Recoil length	12⅞ ins.
Maximum elevation	+35°
Maximum depression	−10°
Traverse	360° cont., hand or power operated

2 INCH MORTAR M3 (BRITISH BOMB THROWER, 2 INCH, MK. I)—STANDARD



2 INCH MORTAR, M3

The Mortar, 2 Inch, M3, is identical with the British Bomb Thrower, 2 Inch, Mk. I, and is used for projecting smoke bombs from tanks. By this means retreating tanks can form protective smoke screens concealing their movements. Mounted on the tank turret at a fixed elevation, the mortar can be traversed through 360° by rotation of the turret.

It is very effective in throwing smoke bombs at ranges of 35, 75 and 150 yards. The variation in range is obtained by the use of a gas regulator on the mortar which governs the escape of the propellant gases. The Smoke bomb, Mk. I/L, fired from the M3 Mortar, begins to produce smoke while in flight and ejects an effective screen in from five to eight seconds after it strikes the ground. This screen will last approximately 70 seconds in an eight mile per hour wind. As a result of its superiority over the Hand Grenade, Smoke, M15, and its ability to throw bombs without the necessity of opening the tank hatch, the Mortar, 2 Inch, M3, was standardized 2 September 1943.

The chief components of the Mortar, 2 Inch, M3, are the barrel, barrel clamp, clamp carrier, breech tube, gas regulator and trigger housing. When the barrel clamp is unlocked, the mortar can be opened and pivoted on the locking pin, enabling the operator to load a bomb through the opening in the barrel clamp.

The bomb is chambered in the breech tube, which is locked to the trigger housing by a screw. This screw prevents vibrations from loosening the tube.

The gas regulator, which adjusts the range of the mortar by controlling the escape of propellant gases, may be mounted either on the left or right side of the breech tube. Similarly, the gas regulator nut can be attached either to the top or bottom end of the gas regulator body. This is determined by the type of installation.

The firing mechanism, of the continuous hull type, is contained in the trigger housing. The mechanism of the safety rod, safety crank and safety link, is so designed that the trigger will not operate when the mortar is open.

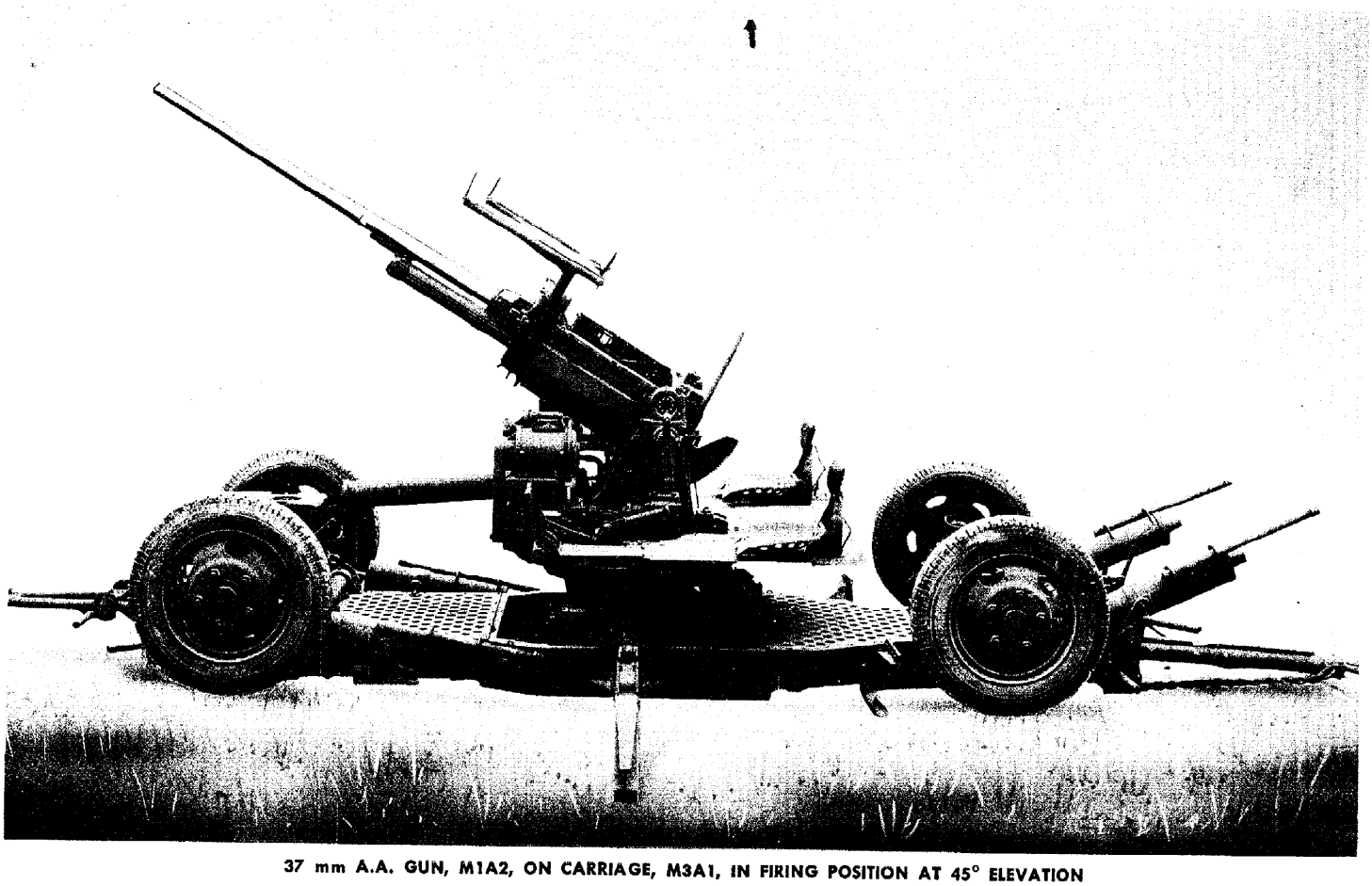
When the bomb is fired, the propellant gases tend to escape through the gas regulator body, which contains the valve. When most of these gases escape, the range will be very short. As the valve is rotated clockwise, and holes in the valve no longer are aligned with the escape hole, the rate of gas escape is reduced and consequently the range is increased.

CHARACTERISTICS

Weight of mortar	18 lb.
Weight of bomb	2.1 lb.
Controllable ranges	
Short	35 yds. (approx.)
Medium	75 yds. (approx.)
Long	150 yds. (approx.)

ANTI - AIRCRAFT ARTILLERY

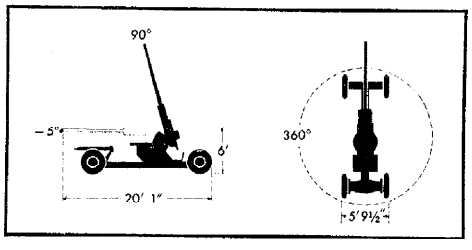
37 MM ANTIAIRCRAFT GUN M1A2—CARRIAGE M3A1—SUBSTITUTE STANDARD



37 mm A.A. GUN, M1A2, ON CARRIAGE, M3A1, IN FIRING POSITION AT 45° ELEVATION

PRINCIPAL CHARACTERISTICS

Weight of gun and carriage, complete	6,124 lb.
Weight of carriage, w/o gun and tube	5,759 lb.
Weight of gun, complete	365 lb.
Weight of tube	119 lb.
Type of breechblock	Vertical sliding
Recoil mechanism	Hydrospring
Weight of complete round of H.E. ammunition, M54	2.62 lb.
Weight of projectile, H.E.	1.34 lb.
Weight of powder charge	6.00 oz.
Overall length of vehicle in traveling position	241 ins.
Overall height of gun in traveling position	72 ins.
Overall width of vehicle in traveling position	69.5 ins.
Length of tube	78.2 ins.
Diameter of bore	1.457 ins.
Maximum length of recoil at elevation 0°–85°	10.75 ins.
Length of rifling, approximate	68.35 ins.
Number of grooves in barrel	12
Maximum elevation	90°
Minimum elevation	−5°
Traverse	360°
Maximum vertical range (H.E. shell)	6,200 yds.
Maximum horizontal range (H.E. shell)	8,875 yds.
Muzzle velocity	2,600 f./s.
Rated maximum powder pressure	30,000 lb./sq. in.
Volume of powder chamber for M54 shell	17.80 cu. ins.
Maximum rate of fire	120 rds./min.



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The 37 mm Antiaircraft Gun, M1A2, is a fully automatic, air-cooled weapon which may be employed against both airplanes and tanks. It fires high-explosive and armor-piercing shells at a cyclic rate of 120 rounds per minute. When mounted on the Carriage, M3A1, it can be towed at the speed of 50 miles an hour on good roads.

37 mm GUN, M1A2—The tube for this gun is one-piece forging or casting, threaded at its breech end to screw into the tube extension. The tube extension houses the breechblock with firing pin, cartridge extractor, carrier cam and front bracket supports for the driving spring tubes. It is fitted with bronze bearing strips which slide between the top and bottom sides of the gun casing. The recuperator piston rod is attached to the bottom side of the tube extension.

The gun casing is attached to the trunnion block which also supports the recu-

perator cylinder. The feed box is fastened to the top flange of the side plates at a point just to the rear of the breech end of the tube. Ammunition is fed to the gun from feeders or clips holding 10 rounds each. The recuperator mechanism is of the hydrospring type.

CARRIAGE, M3A1—The carriage is of the two-axle trailer type, with wheels mounted on spindles offset from the longitudinal axis of the axles. A leveling mechanism permits tilting of the carriage through a range of 10°.

The trunnion block, containing the gun and recuperator cylinder, slides in a cradle of frame construction with top, bottom and front removable covers. The cradle is supported in the top carriage by trunnions, the top carriage in turn rotating on a pintle, integral with the bottom carriage. Twin spring action counterpoise assemblies are contained in cylinders at either end of both axles to allow the carriage to be lowered to firing position without undue force and to enable it to be lifted to traveling position by one man at each wheel. Rotation of the axles lowers the chassis into firing position on the ground, the wheels being lifted from the ground at the same time.

A single spring equilibrator is utilized to counterbalance the muzzle preponderance of the gun. It is attached to the cradle by means of a rod and a chain.

Hand- and power-operated traversing and elevating mechanisms are attached to the carriage.

Two outriggers, pivoted about brackets, are attached to the side members of the chassis; when rotated to the ground they give stability to the carriage when it is in firing position. They are rotated to and secured in a vertical position for traveling.

Adjustment is provided for semi-automatic or automatic firing; firing is controlled by a lever and cable arrangement operated by two foot pedals.

Disk and lever type electric brakes operated from the prime mover are on all 4 wheels. Handbrakes are also installed on the rear wheels.

Sighting and Fire Control Equipment

On Carriage Equipment

Remote Control System, M9
Sighting System, M5
Telescope, M7 (azimuth), M64 (elevation)

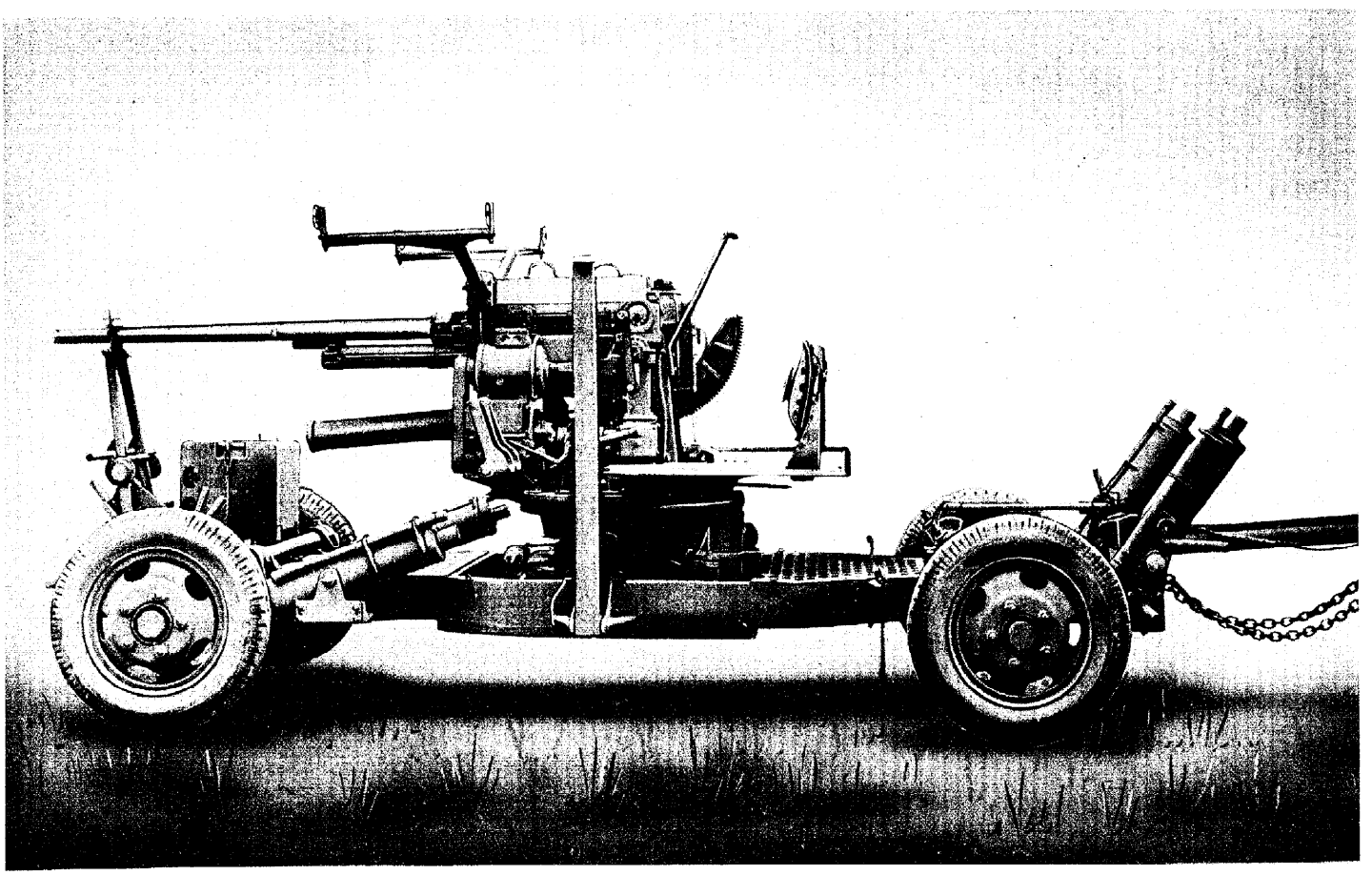
Off Carriage Equipment

Cable System, M8
Director, M5
Generating Unit, M17
Gunner's Quadrant, M1

Ammunition

Ammunition is in the form of complete fixed rounds. It consists of A.P. Shot, M74, with tracer; A.P.C. Shot, M59, with tracer; H.E. Shell, M54, with SD tracer and P.D. Fuze, M56, and Practice Shell, M55A1, with tracer and Dummy Fuze, M50.

REFERENCES—TM 9-2005, v.6; TM 9-235; TM 9-1235; FM 4-140.

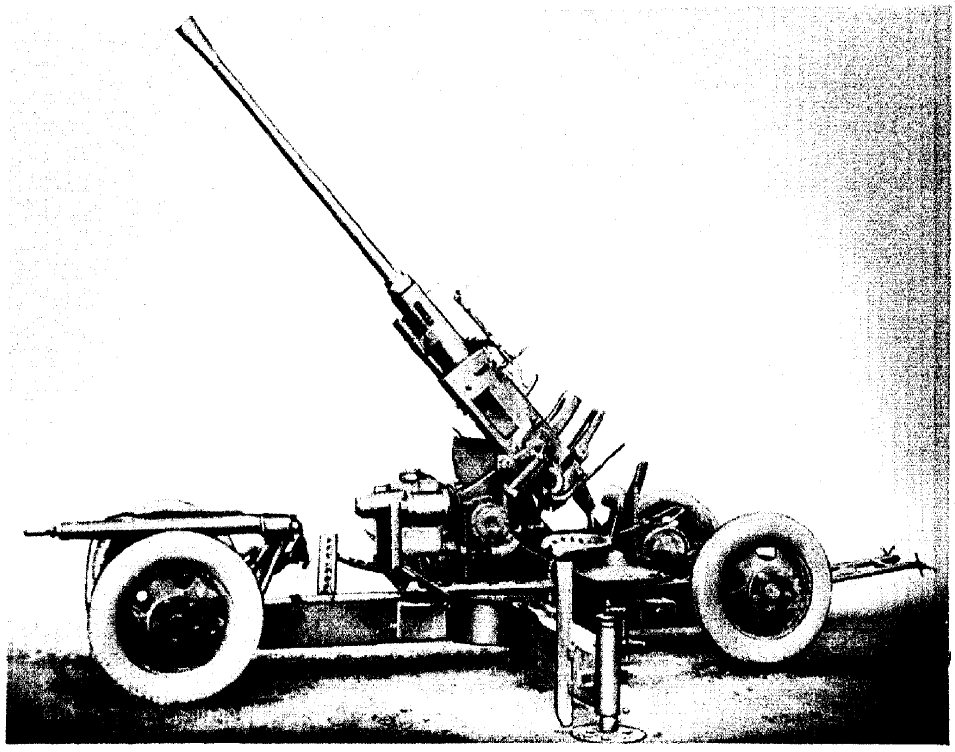


37 mm A.A. GUN, M1A2, ON CARRIAGE, M3A1, IN TRAVELING POSITION

40 MM AUTOMATIC ANTIAIRCRAFT GUN M1—CARRIAGE M2A1—STANDARD

This weapon was originally designed by the Aktiebolaget Bofors, a Swedish firm, and is used by a number of the nations now at war. It was first brought to the United States in November, 1940, and was standardized, together with the Carriage, M1, by O.C.M. 16787, dated 29 May 1941. O.C.M. 17499, dated 4 Dec. 1941, standardized the Carriage, M2, and designated the Carriage, M1, as Substitute Standard.

The Bofors gun can fire a 1.96 pound shell to a vertical range of 4.3 miles. Aiming can be accomplished with great rapidity, fire usually being in bursts of four or five rounds. Since the cyclic rate is 120–140 rounds per minute, the barrel may overheat. In this event it can be removed and replaced by a new barrel in approximately two minutes. Mobility of the carriage is such that it can be towed at speeds up to 50 miles per hour. It can be transferred from traveling position to firing position in 25 seconds.



40 mm AUTOMATIC A.A. GUN, M1, ON CARRIAGE, M2, IN FIRING POSITION. CARRIAGE, M2A1, DIFFERS ONLY IN OUTRIGGER BRACKETS.

GUN, M1—The complete gun consists of the barrel assembly, the recoil cylinder, the breech casing, the breech ring, the breech mechanism and the automatic loading assembly. The tube, of forged alloy steel, is threaded at its muzzle for attachment of the flash hider. The rectangular breech casing forms a chamber for the breech ring, breechblock and loading mechanism. It is supported in the carriage mounting by means of flanged trunnions at the sides of the casing. A breechblock of the vertical sliding type, concave on its upper surface so as to form a loading trough when open, is seated in a slot in the breech ring. The breechblock closes automatically when a round is inserted in the bore and opens automatically during recoil, at which time the empty cartridge case is ejected.

A recuperator spring is assembled near and around the breech end of the tube. The hydrospring recoil system is housed in a cylinder underneath the recuperator spring and is held in position by a supporting bracket secured to the breech casing.

The automatic loading mechanism feeds cartridges one by one into a loading tray from which they are pushed into the chamber by a mechanically operated rammer. A hand-operating device is used for setting the mechanism for loading the first round or for removing a cartridge.

CARRIAGE, M2—The frame or chassis consists of a central circular-shaped structure with front and rear longitudinal girders and two transverse outriggers hinged midway of their length. The top carriage, which rotates on a large ball bearing about a vertical axis, carries the loading platform with its operating equipment. When in traveling position the gun is held rigidly in place by a tubular frame known as the gun stay. The front and rear axle trees are capable of being rotated up and down. When going into firing position the outriggers are swung out and the carriage is lowered to the ground by rotating the axle trees. Axle balancing mechanisms assist in raising and lowering the front and rear axles and wheels. On uneven ground the cross-bed

PRINCIPAL CHARACTERISTICS

Weight of carriage	4,498 lb.
Weight of tipping parts	1,051 lb.
Weight of gun and carriage	5,549 lb.
Weight of barrel assembly	295.81 lb.
Length of bore	88.58 ins.
Muzzle velocity	2,870 f./s.
Volume of chamber (A.P., M81)	30.73 cu. ins.
Weight of projectile (A.P., M81)	1.96 lb.
Maximum pressure	40,000 lb./sq. in.
Time of flight at 1,500 yds.	2.0 sec.
Maximum elevation	90°
Maximum depression, carriage level	-6°
with jacks	-11°
Traverse	360°
Maximum recoil, permissible	8.3 ins.
Range (maximum effective—limited by director)	3,000 yds.
Wheelbase	126 ins.
Wheel tread	55⅜ ins.
Overall length (traveling)	18 ft., 9½ ins.
Overall width (traveling)	6 ft.
Overall height (traveling)	6 ft., 7½ ins.
Road clearance	14½ ins.

is leveled by the use of four adjustable leveling jacks attached to the ends of the outriggers and longitudinal girders. Four anchoring posts are also provided. Spring suspension is arranged according to the Bofors parallelogram system, permitting the wheels to spring independently of each other.

The steel disk wheels are equipped with truck transport type pneumatic tires containing bullet-resisting inner tubes. Electric brakes, operated from the prime mover, are furnished on all wheels. A switch applies these brakes independently in the event of accidental separation of the carriage from the prime mover. Handbrakes on the rear wheels are also provided for use when the gun is not connected with the prime mover. During travel the carriage is secured to the prime mover by a tubular drawbar with end fittings for fastening to the steering linkage of the carriage and to the prime mover.

Two spring-type equilibrators are housed in tubular casings held in a trunnion. They are located under the gun and between the gun trunnion frames.

The elevation and traversing mechanisms are provided with individual electro-oil drives operated by 6 hp. electric motors. In the event of failure of the remote control system, power plant or director, the direct sighting system is used. Manual elevation and traverse is then effected by means of double-handled cranks, the motor switches having first been cut off and the oil-drive clutches disengaged.

The firing mechanism can be operated either by front or rear footpedals interconnected and linked to the firing lever.

It can be placed on safety, or can be adjusted for single shot or automatic fire by means of a lever.

CARRIAGE, M2A1—This carriage is a modification of the M2 carriage designed to increase the tracking rate. New gears with a higher gear ratio allow the carriage to be rotated through 17.1° by one turn of the hand crank. The increased rate of traverse facilitates fire at a high-speed target approaching from an unexpected direction at short range.

Angle type outrigger brackets have also been added to the carriage to hold the lateral outrigger in an intermediate position. This permits 360° traverse without interference by the outrigger jacks when the carriage is in traveling position.

The forward area sights originally provided with Carriage, M2, have been superseded by sights of the "cartwheel" type with the diameter of the forward ring increased to provide for leading a 300 m.p.h. target at 1,000 yards range. The inner ring is used for targets with speeds of 100 m.p.h. and 200 m.p.h. A ring with a hole ⅛ inch in diameter replaces the cross wires in the rear frame of the sight formerly used.

40 mm AUTOMATIC A.A. GUN, M1, ON CARRIAGE, M2A1, IN TRAVELING POSITION

Sighting and Fire Control Equipment

On Carriage Equipment

Direct Fire Sights, Bofors
Computing Sight, M7
Remote Control System, M10

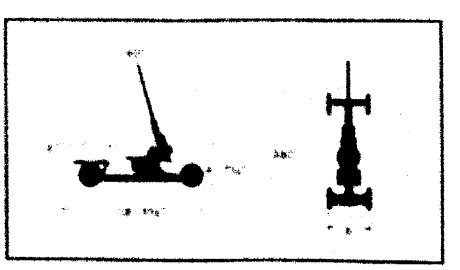
Off Carriage Equipment

Director, M5A2
Cable System, M8
Generating Unit, M17
Gunner's Quadrant, M1 or M1918

Ammunition

Ammunition is in the form of fixed rounds. It consists of A.P. Shot, M81, with tracer, H.E. Shell, Mk. II, Q.F., H.E., with Percussion Fuze, D.A. No. 251, Mk. I.L., and H.E. Shell, Mk. II, T.L., Q.F., H.E., with P.D. Fuze, Navy, Mk. 27, or P.D. Fuze, M71.

REFERENCES—TM 9-252, TM 9-2005, v. 6.



40 MM GUN CARRIAGE M5 (AIRBORNE)—STANDARD

The need for an automatic antiaircraft gun and mount that could be transported by air for use as an antitank or antiaircraft battalion weapon within the Airborne Division resulted in the development of the 40 mm Gun Mount, M5.

A 40 mm Gun, M1, and the Carriage, M5, comprise a mobile unit designed for delivery to its destination by Transport Planes C46, C46A, C47 or C54. It can be unloaded from the plane and moved by manpower for short distances, or be towed by any prime mover. Care must be taken that speeds on rough roads do not exceed five miles per hour in order to avoid tire and wheel failures. Three men can emplace the carriage in approximately five minutes and raise it from firing position to traveling position in approximately eight minutes.

The top carriage of the Carriage, M5, is similar to that of the 40 mm Gun Carriage, M2A1, except for minor modifications to the platform and foot rests which reduce the width of the mount sufficiently to permit its passage through the doorway of the plane.

The chassis consists of a center base with one permanently attached outrigger and three removable outriggers which may be fastened to the mount by brackets and tapered wedges. Each outrigger has a leveling jack. In traveling position the side outriggers are removed and hung by steel straps to the rear outrigger or are carried separately. Individual right and left wheel assemblies for maneuvering the mount are attached to each side of the base in place of the outriggers.

The wheels are of the airplane type with 7.25 x 11.50 plain tread airplane tires inflated to 50 pounds pressure. No system of spring suspension is utilized. Airplane type mechanical brakes operated by a lever and cable are fitted to each wheel.

Before loading the carriage into a plane it is necessary to remove the gun barrel and the detachable outriggers. When the carriage is to be transported in C47 or C54 airplanes the automatic loader and the Computing Sight, M7, must also be taken off the mount.

Power operation of the carriage, identical to that of the 40 mm Gun Carriage, M2A1, is effected by means of the Remote Control System, M5, and Director, M5A1E1.

Sighting and Fire Control Equipment

Director, M5A1E1
Remote Control System, M5
Generating Unit, M5
Computing Sight, M7

REFERENCES—OCM 18883, 20 August 1942; OCM 21099, 20 June 1943; OCM 21280, 9 August 1943; OCM 21516, 9 September 1943.

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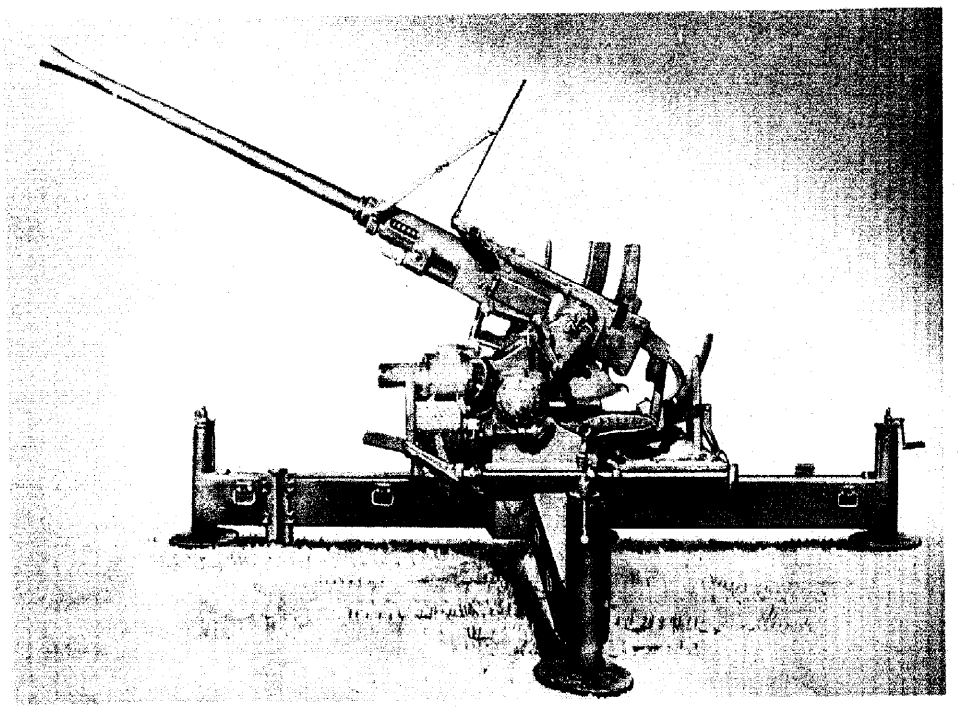
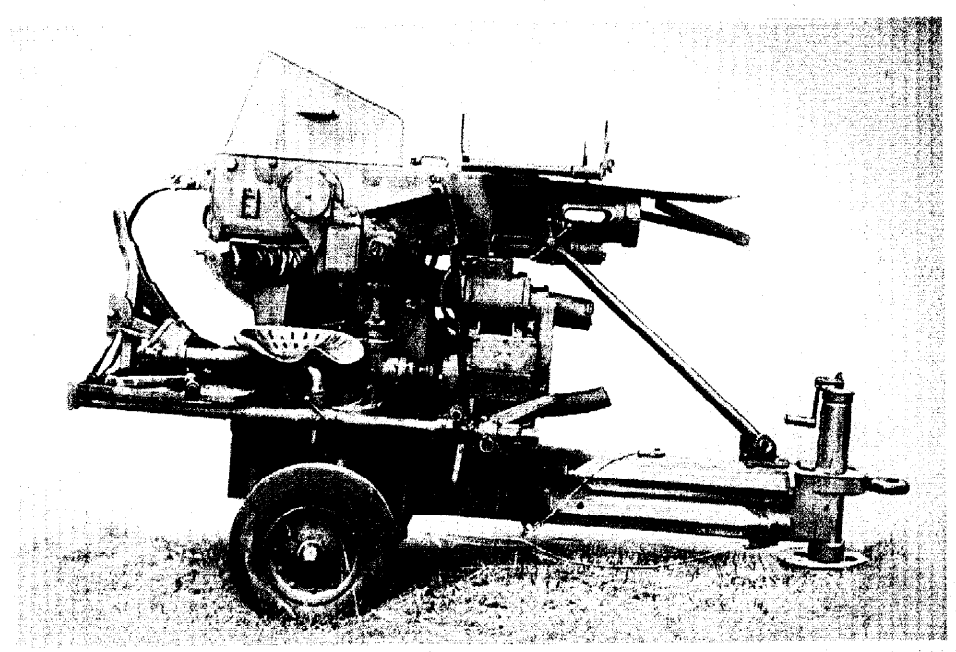


40 mm GUN CARRIAGE, M5, IN FIRING POSITION

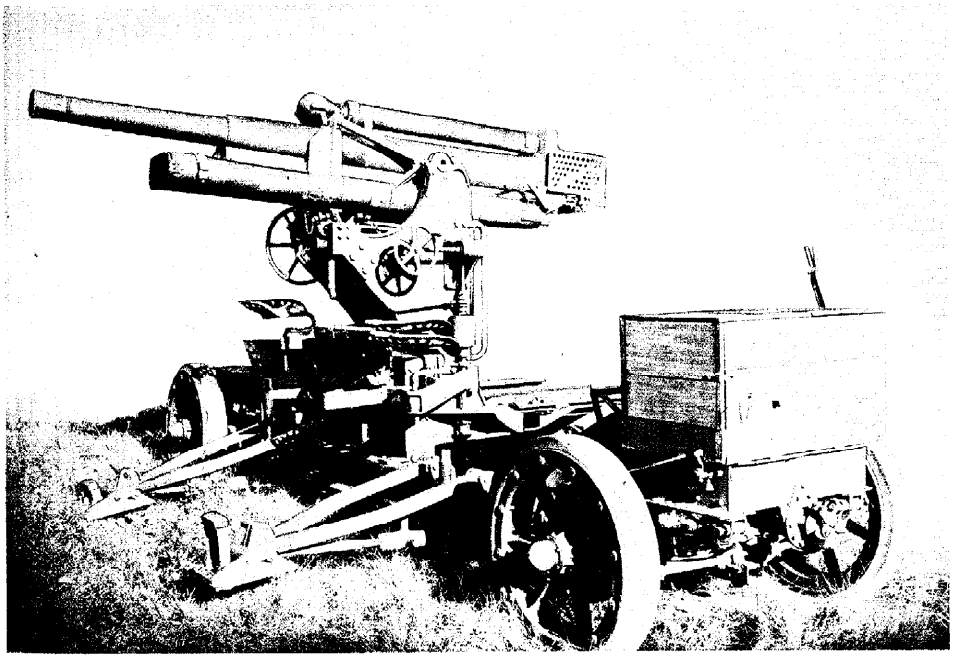
CHARACTERISTICS

Weight overall, maneuvering position	4,495 lb.
Weight overall, traveling position (detachable outriggers and barrel removed)	3,480 lb.
Weight overall, traveling position, tube installed	3,375 lb.
Overall length, maneuvering position	194½ ins.
Overall length, traveling position	117¾ ins.
Overall width, maneuvering position	68¾ ins.
Overall width, traveling position	56 ins.
Overall height, maneuvering position	75¾ ins.
Overall height, traveling position	75¾ ins.
Turning radius when towed by 1½-ton truck	202 ins.
Elevation	−5° to +90°
Traverse	360°



40 mm GUN CARRIAGE, M5, IN TRAVELING POSITION, WITH GUN AND OUTRIGGERS REMOVED FOR LOADING IN AN AIRPLANE OR TOWING WITH A LIGHT VEHICLE

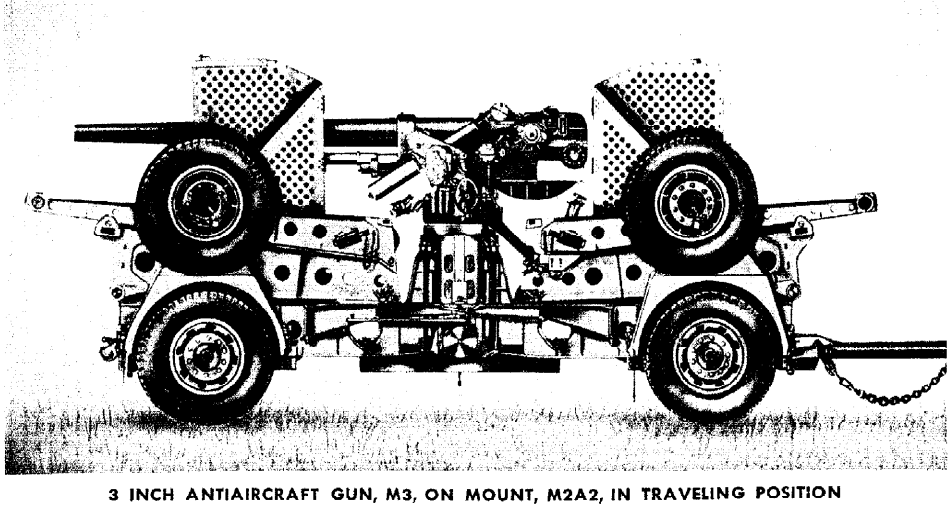
3 INCH ANTIAIRCRAFT GUN M3—MOUNT M2A2—STANDARD



3 INCH ANTIAIRCRAFT GUN AND MOUNT, M1918

CHARACTERISTICS OF 3 INCH A.A. GUNS, M1, M3, AND MOUNTS, M1A1, M1A2, M2A1, M2A2

Weight of gun, M3, and mount, M2A2, total	16,800 lb.
Weight of gun, complete	2,302 lb.
Weight of liner	538 lb.
Weight of complete round of ammunition (M42A1, H.E.)	24.6 lb.
Weight of projectile (M42A1, H.E.)	12.8 lb.
Overall length of vehicle	300 ins.
Overall height of vehicle, with gun in traveling position	113 ins.
Overall width of vehicle	83 ins.
Overall length of gun, muzzle to rear face of breech ring	158.2 ins.
Caliber of bore	3 ins.
Length of bore	50 cals.
Maximum length of recoil at 85° elevation	32 ins.
Maximum length of recoil at 0° elevation	23.5 ins.
Length of rifling	125.83 ins.
Number of grooves in barrel	28
Rifling, uniform R.H., one turn in	40 cals.
Travel of projectile in bore of gun (M42A1, H.E.)	127.73 ins.
Maximum elevation	80°
Maximum depression	−1°
Traverse	360°
Maximum range, at 85° elevation	10,400 yds.
Maximum range, at 45° elevation (M42A1, H.E.)	14,780 yds.
Muzzle velocity (M42A1, H.E.)	2,800 f./s.
Maximum powder pressure (M42A1, H.E.)	36,000 lb./sq. in.
(M62, A.P.C.)	38,000 lb./sq. in.
Volume of powder chamber (M42A1, H.E.)	2,035 cu. ins.
Maximum rate of fire	25 to 30 rds./min.



3 INCH ANTIAIRCRAFT GUN, M3, ON MOUNT, M2A2, IN TRAVELING POSITION

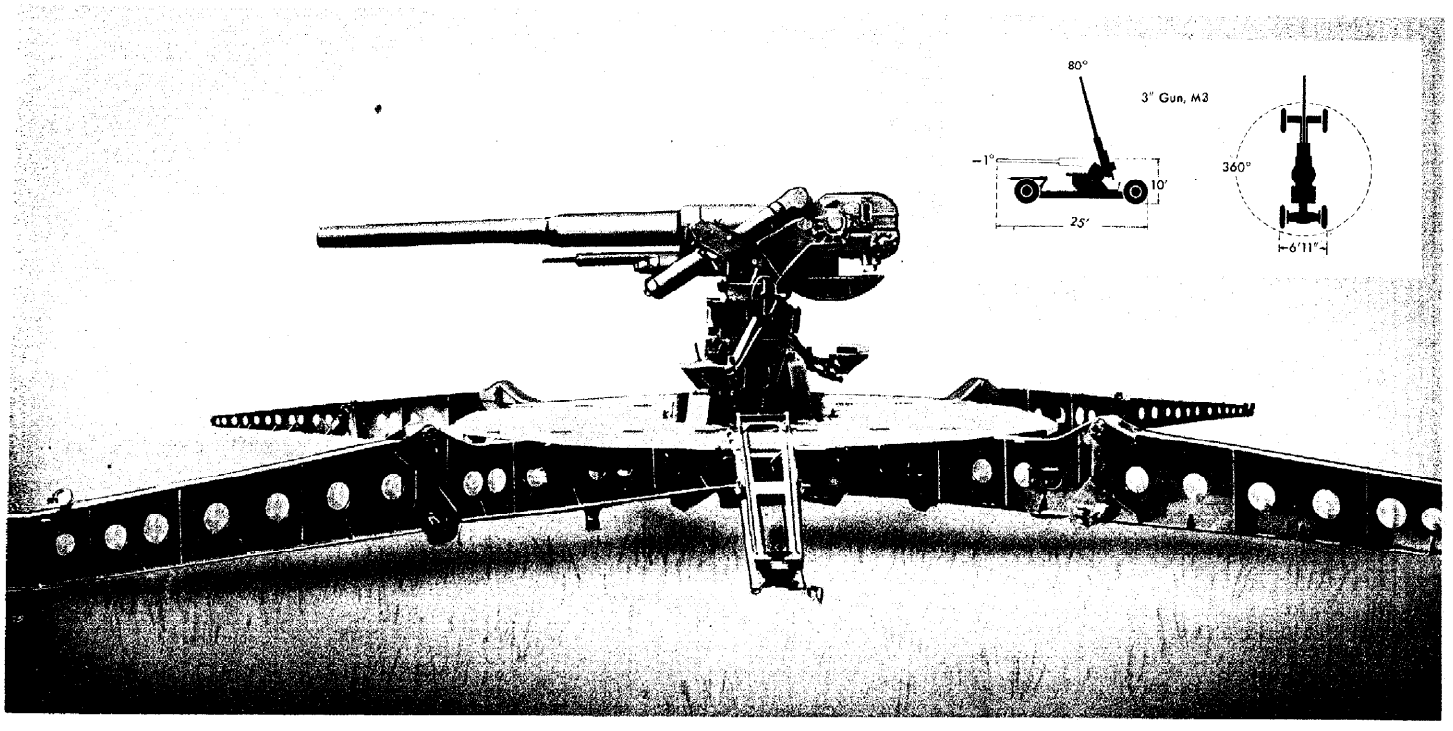
The development of medium caliber mobile antiaircraft artillery for the U. S. Army was initiated when a 75 mm Gun, M1916, was placed on a Truck Mount, M1917, during the First World War. Shortly thereafter, the caliber of antiaircraft guns was fixed at 3 inches, the cartridge case then employed in the 3″ (15 pdr.) Gun, M1898, being adopted as standard for antiaircraft use.

The first mobile antiaircraft gun and mount of 3″ caliber to be designed and manufactured in the United States was the 3″ Gun, M1918, and the Mount, M1918. This mount was standard for issue until replaced by the Mount, M2. Postwar development continued in an endeavor to increase muzzle energy and rate of fire for antiaircraft guns, to improve road performance and stability of carriages and to produce more efficient fire control systems. A 3″ pilot mount, T1, was built and tested in 1927. Tests continued throughout 1928 and 1929 on the Mounts, M1 and M2, the latter being standardized to replace the Mount, M1918. Development of mounts progressed thereafter until the present 3″ Mount, M2A2, was standardized in O.C.M. 14339, dated 24 Feb. 1938. While this mount is still standard, further procurement will be made only upon specific authority of the Secretary of War.

A new 3″ Gun, M1, with removable liner and ballistic qualities superior to those of the M1918, was the first gun in a series that culminated in the 3″ Gun, M3, classified as Standard by O.C.M. 7186, dated 30 August 1928.

GUNS, M1918, M1918M1—The construction of these guns was similar to that of the M1917 series antiaircraft guns designed for use on fixed mounts for harbor defense. The only difference in these guns is in the greater length of the breech ring of the M1918M1 gun. The gun is built up of alloy steel, with the tube shrunk in place in the jacket. The breech end of the jacket is threaded to receive the breech ring which is screwed and shrunk on the jacket and held by a lock screw. The breech mechanism is of the hand-operated drop block type. Originally, rifling for this weapon had an increasing twist, from 1 turn in 50 to 1 turn in 25 calibers.

GUNS, M1918A1, M1918M1A1—Guns with rifling having a uniform twist of 1 in 25 were designated as M1918A1 and M1918M1A1.



3 INCH ANTIAIRCRAFT GUN, M3, ON MOUNT, M2A2, IN FIRING POSITION

GUN, M3—This gun is similar to the M1 except that the diameter of the removable liner for the M3 is greater than that of the M1. The autofrettage method is used for the manufacture of the liner, the interior of the tube being taper bored for the removable liner. The exterior of the tube is threaded at the breech end for attachment of the breech ring. The rectangular breechblock, of the vertical sliding type, moves up and down in its recess in the breech ring. It may be operated either semi-automatically or manually. In semi-automatic operation the breechblock is opened, as the gun returns to battery, by means of a cam mounted on the cradle. Upon insertion of a round in the chamber the extractors are tripped by the rim of the cartridge case and the breechblock closes automatically. A breech-operating handle is used for manual opening of the breechblock and for closing it when firing is discontinued. A Firing Lock, M14, of the continuous pull type is housed in the breechblock. The gun is fired by means of a lanyard attached to the trigger shaft.

MOUNT, M2A2—This mount differs from the Mounts, M2A1, M1A2, M1A1, T1A2 and T1A1, primarily in the commercial brake system, the fabricated parts and method of carrying the spare tires. These models derive from the T1.

The Mount, M2A2, is of the trailer type, possessing a mobility that permits it to be drawn at high speeds over good roads and at medium speed over irregular terrain. It is of the variety familiarly known as a spider mount, with folding perforated platforms and four folding outriggers fastened to the undercarriage. These outriggers, when folded, form the chassis. For transport the chassis rests on the front and rear pneumatic-tired bogies, secured in place by clamp screws and equipped with four-wheel electric brakes operated from the prime mover. The gun is mounted in a cradle which is supported on its trunnions in antifriction bearings on the arms of the pivot yoke in the top carriage. The top carriage, which supports the cradle, elevating and traversing mechanisms and the recoil mechanism, is in turn mounted on the undercarriage. The top carriage is supported on a spherical bearing; at the lower end is the leveling mechanism mounted in the pedestal. The leveling mechanism permits adjustment of the axis of the top carriage to a vertical position when the ground on which the mount is placed is not level. Two level vials, set at right angles to each other, are attached to the top carriage for the guidance of the operator in leveling the mount.

Sighting and Fire Control Equipment for 3 Inch A.A. Gun, M3, on Mount, M2A2

On Carriage Equipment

- Elbow Telescope, M24, M25
- Telescope Mount, M26, M27
- Bore Sight

Off Carriage Equipment

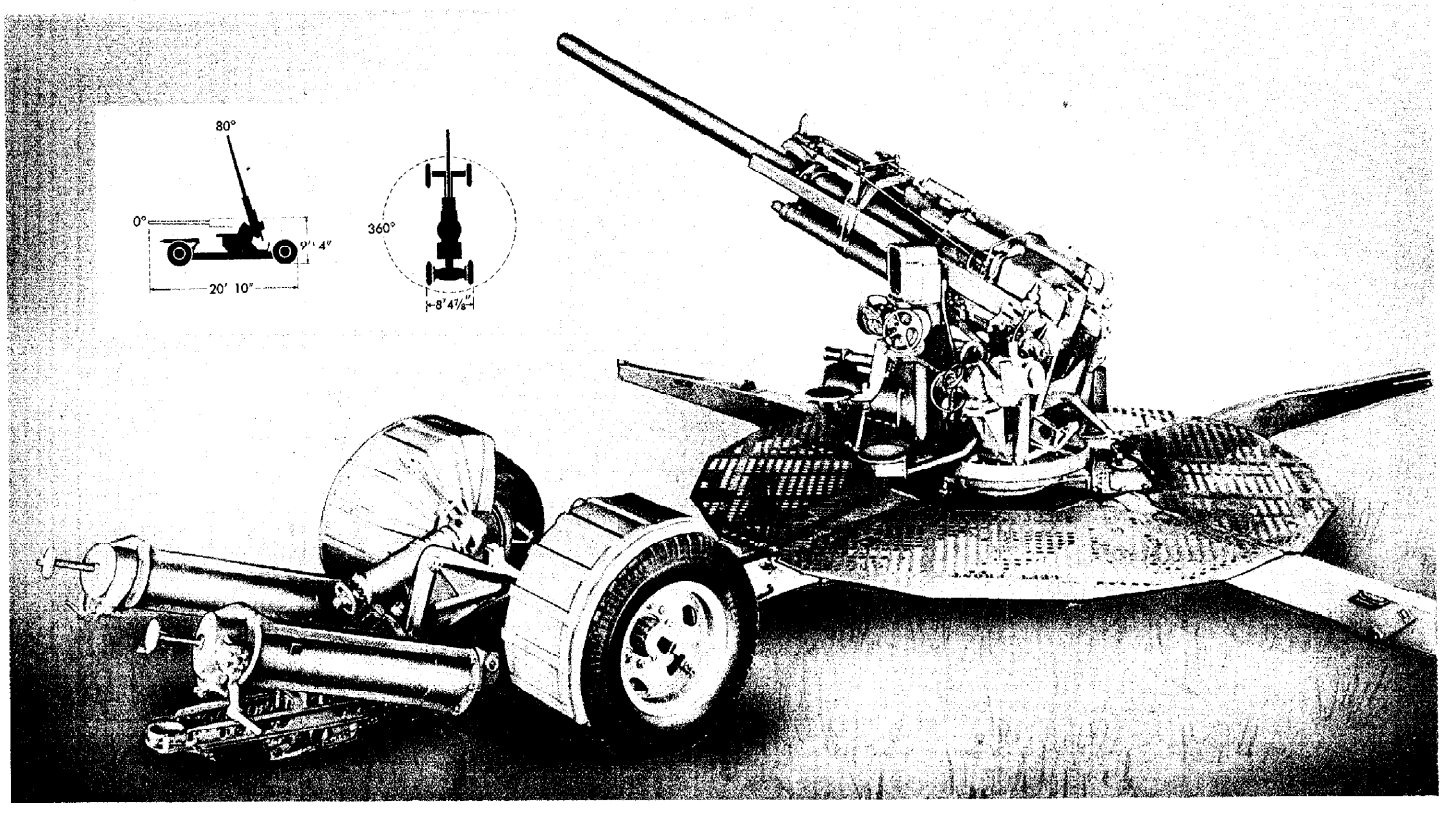
- Height Finder, M1A1 or M2A1
- Director, M7 (Standard), or M1, M1A1, M2, M3, M4A1B6, M4A1B2, M7A1, or M7A1B2
- B.C. Observation Instrument (A.A.), M1
- Data Transmission System, M4
- Gunner's Quadrant, M1918
- Generating Unit, M6 (Standard) or M4 (Limited Standard)
- Slide Rule, M1
- Fuze Setter, M8
- Flank Spotting Instrument, M1

Ammunition

Ammunition is in the form of complete fixed rounds. It consists of A.P. Projectile, M79; H.E. Shell, Mk. IX, with M.T. Fuze, M43, and modifications; H.E. Shell, M42A1, with M.T. Fuze, M43, and modifications, or P.D. Fuze, M48, and modifications; and A.P.C., Projectile, M62, with B.D. Fuze, M66A1.

REFERENCES—TM 9-2005, v.6; TM 9-360; TM 9-1360; FM 4-125.

90 MM GUNS M1, M1A1—ANTIAIRCRAFT MOUNT M1A1—SUBSTITUTE STANDARD



90 MM ANTIAIRCRAFT GUN, M1A1, ON MOUNT, M1A1, IN FIRING POSITION

Aviation progress, especially in the field of high-altitude bombing, demanded reconsideration of requirements for mobile antiaircraft artillery. In order to cope with rapidly maneuvering bombers flying at modern speeds at extreme heights, it was essential to have guns with longer range, greater muzzle velocity, and a larger effective shell-burst area than those previously considered satisfactory. The desired increase in firepower which could be obtained from guns of larger calibers than 3 inch dictated the adoption of a 90 mm antiaircraft weapon by the U. S. Army.

Development of 90 mm antiaircraft matériel was instituted by O.C.M. 14531, dated 9 June 1938, for the 90 mm Gun, T2, and O.C.M. 14633, dated 18 August 1938, for the 90 mm Mount, T1, approving military characteristics of the gun and mount.

O.C.M. 15688, dated 21 March 1940, recorded standardization of the T2 gun as 90 mm Gun, M1, the T1 mount as 90 mm Gun Mount, M1, and the recoil mechanism for the mount as 90 mm Recoil Mechanism, M1.

O.C.M. 16755, dated 22 May 1941, approved standardization of the 90 mm Gun Mount, M1A1, and reclassification of 90 mm Gun Mount, M1, as Limited Standard.

O.C.M. 19946, dated 15 January 1943, approved model designations of components of 90 mm A.A. Gun Mount, M1A1, as 90 mm Gun, M1A1, Recoil Mechanism, M1A1, Spring Rammer, M8, and Fuze Setter, M13.

PRINCIPAL CHARACTERISTICS

Gun, M1, M1A1

Total weight of gun and mount, M1A1	19,000 lb.
Weight of gun, complete	2,445 lb.
Weight of gun tube	1,465 lb.
Weight of recoil mechanism	1,740 lb.
Length of bore	50 cals.
Length (muzzle to rear face of breech ring)	186.51 ins.
Muzzle velocity (M71 H.E., M77 A.P.)	2,700 f./s.
Weight of complete round (M71 H.E., M77 A.P.)	42.04 lb.
Weight of projectile (M71 H.E., M77 A.P.)	23.4 lb.
Chamber capacity (cartridge case) (M71 H.E.)	298.04 cu. ins.
Maximum powder pressure	38,000 lb./sq. in.
Length overall in traveling position	250 ins.
Height overall in traveling position	112 ins.
Width overall in traveling position	100 7/8 ins.
Weight of rammer	500 lb. (approx.)
Elevation	
Maximum	80°
Minimum (without depression stops)	0°
Minimum (with depression stops)	22 1/2°
Traverse	360° cont.
Maximum slope on which mount can be leveled	4°
Diameter of circle of emplacement	35 ft.
Distance from center to center of outside wheel treads	87 7/8 ins.
Tire size and type	10.00 x 22, combat or bus balloon
Type of brakes	Electric

GUN, M1—The tube for this gun is of monobloc construction and cold worked. The tube, which screws into the breech ring, is readily removed for replacement or repair. A locking key prevents rotation of the tube in the breech ring. The tube and breech mechanism are supported and guided in recoil and counter-recoil by recoil slide rails fastened to the breech ring and front tube supports. A cam in the right side rail prevents opening the breech by hand when the gun is out of battery.

The breech mechanism employs a vertical sliding breechblock that may be opened either manually or automatically. It is closed automatically when a cartridge is rammed in the chamber. Extraction is automatic or by hand.

The firing mechanism is automatically cocked upon opening the breech.

GUN, M1A1—This is the 90 mm Gun, M1, modified by adding a hook on the front tube support and by changing the design of the cocking lever, in order to accommodate the Spring Rammer, M8, which is utilized to facilitate loading.

90 mm A.A. GUN MOUNT, M1A1—The mount, M1A1, is a self-contained mobile unit provided with a single-axle, dual-wheeled bogie and drawn by the trail. It is adapted for use with the Remote Control System, M2, as well as for manual operation.

The mount consists basically of bogie, trail, outriggers, pedestal, leveling mechanisms, top carriage, elevating and indicator drive mechanisms, equilibrator, cradle, recoil mechanism and rammer.

The top carriage rests on and pivots about the leveling socket which, together with the other components of the leveling mechanism, rests in turn on the pedestal. The trails and outriggers are hinged to the pedestal.

The cradle is suspended from the top carriage on its trunnions, which rest in trunnion bearings at the top rear of the top carriage. The cradle houses the three cylinders of the hydropneumatic recoil system. A spring type equilibrator provided for neutralizing the unbalanced weight of the gun and cradle is located on the lower left front of the top carriage.

The elevating and indicator drive mechanism is located on the right side of the top carriage and the traversing and indicator drive mechanism on the left side. Elevation and traverse are accomplished either mechanically by remote control or manually by handwheels.

The Rammer, M8, operates from the gun recoil, the springs in the rammer cylinder being compressed by the rearward movement of the barrel. After the round is placed in position, pulling back on the rammer trip lever frees the springs which then move the rammer plunger and rammer arm forward, the latter pushing the cartridge into the breech.

The bogie is equipped with disk and rim wheels, combat tires and tubes, and electric brakes operated from the prime mover. For parking, or when the electric brakes are not functioning, each brake can be operated independently by means of a hand lever.

When in firing position, the outriggers are spread, the bogie is removed, and the mount is lowered to the ground until it rests on the pedestal base. The mount is then leveled and the firing platform is unfolded and fastened to the outriggers and trails.

Sighting and Fire Control Equipment

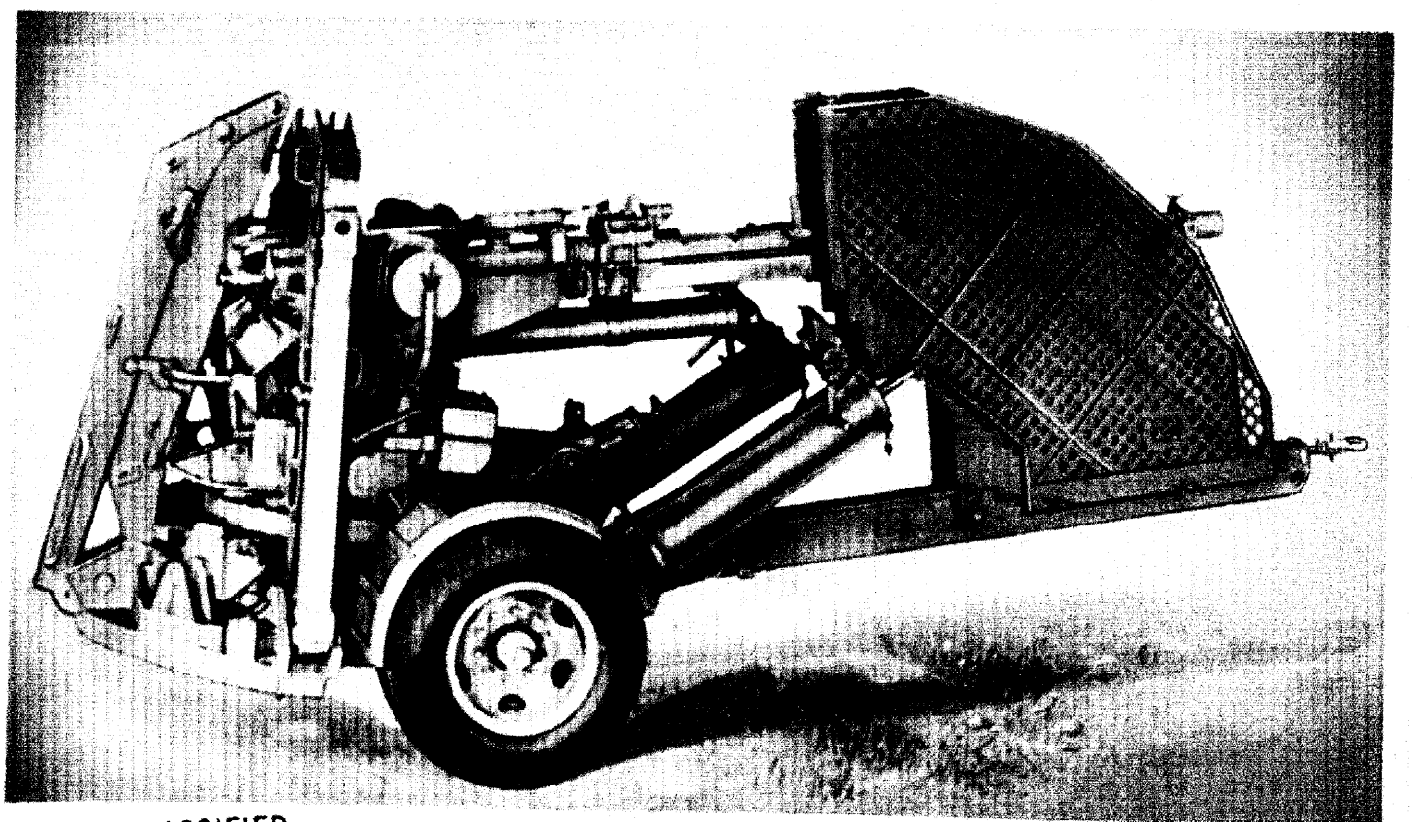
On Carriage Equipment
- Elbow Telescope, M24, M26
- Telescope Mount, M28, M54
- Remote Control System, M2

Off Carriage Equipment
- Bore Sight
- Director, M7A1B1, M7A1B2, M9A1
- Height Finder, 13½-foot, M1A1, or M2A1
- Antiaircraft B.C. Observation Instrument, M1
- Gunner's Quadrant, M1, M1918
- Slide Rule, M1
- Fuze Setter, M13
- Generating Unit, M18
- Cable System, M1

Ammunition

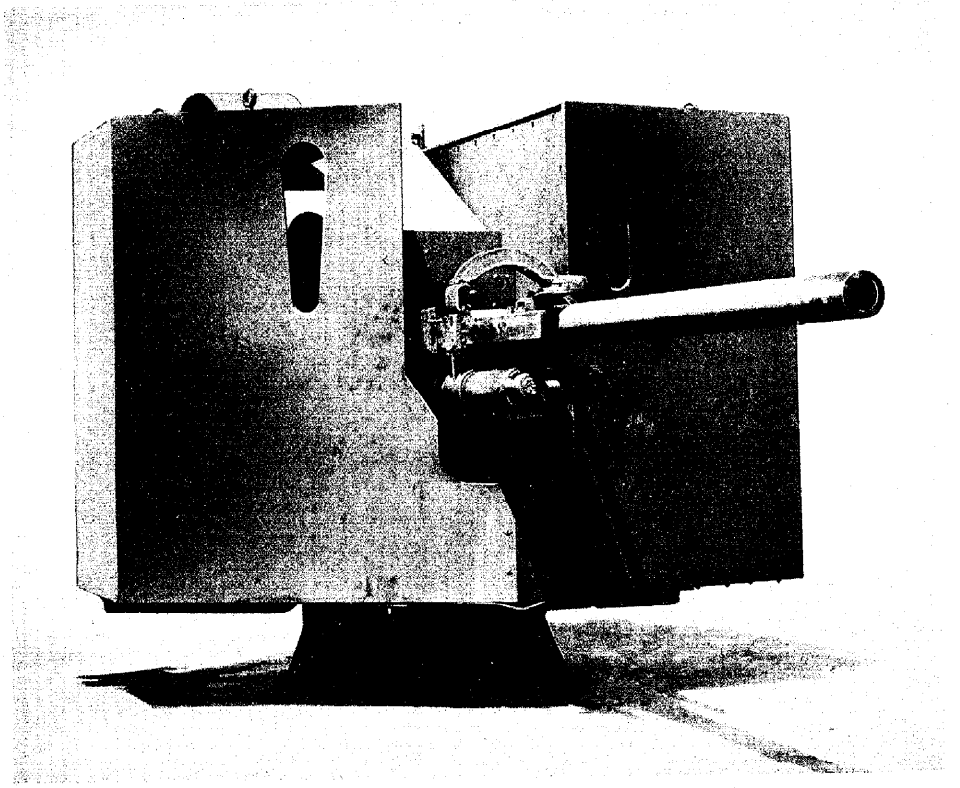
Ammunition is in the form of fuzed complete fixed rounds. It consists of H.E. Shell, M58, with M.T. fuze, M43A4; H.E. Shell, M71, with M.T. fuze, M43A4; A.P. Shot, M77, with tracer, and A.P.C. Shot, M82, with B.D. fuze, M68.

REFERENCES—TM 9-2005, v.6; TM 9-370; TM 9-371; TM 9-1370A; TM 9-1370B; FM 4-126.



UNCLASSIFIED 90 MM ANTIAIRCRAFT GUN, M1A1, ON MOUNT, M1A1, IN TRAVELING POSITION

90 MM GUN M1—MOUNT M3 (ANTI-MOTOR-TORPEDO-BOAT)—STANDARD



90 mm GUN MOUNT, M3 (ANTI-MOTOR-TORPEDO-BOAT)

In 1941 it was decided to construct a fixed mount for the 90 mm, M1, Gun that would permit it to be used effectively as an anti-motor-torpedo-boat weapon.

The resultant Mount, M3, permits direct fire against water, land, and air targets. It may be controlled either manually or automatically through the medium of a remote control system. A gun depression of −8° allows fire against enemy boats, while the elevation of +80° makes it practicable for antiaircraft use.

The principal components of the 90 mm Gun Mount, M3, are the pedestal, base ring, top carriage, traversing mechanism, elevating mechanism, equilibrator, cradle, recoil mechanism, and shield and platform assembly.

The cradle, in which the gun is mounted, is composed of a body, yoke, two trunnions, and a hydropneumatic recoil mechanism consisting of a recoil cylinder, a floating piston cylinder, and a gas cylinder. The recoil piston rod screws into a threaded hole in the front under surface of the breech ring. A counterrecoil buffer on top of the cradle eases the gun back into battery during the last 7 inches of counterrecoil.

A spring type equilibrator is mounted on the left front of the top carriage and connected to the cradle equilibrator arm by a chain.

Gears which can be operated manually by handwheels or automatically by remote control comprise the elevating mechanism located on the right side of the top carriage. A transfer valve enables the operator to change from remote control to manual operation.

The traversing mechanism is also capable of operation by hand or by remote control. The traversing mechanism is located on the left side of the top carriage.

The top carriage supports the gun and all parts of the mount above the base ring, including the shield assembly and platform. The cradle trunnions are seated in bearings on the top of the top carriage side frames. The circular base of the top carriage traverses through 360° on the bearing surface of the base ring. The shield assembly encloses the gun except in the rear, where an opening permits entrance of the crew and the passing of ammunition. The shield is in two main sections, with an opening between them that enables the gun to be elevated and depressed. The shield provides full overhead protection and includes a sliding shield which moves on rollers as the gun is elevated or depressed.

The base ring is a steel casting with machined top and bottom surfaces. While the top surface supports the top carriage, the bottom surface rests on the top surface of the pedestal.

The cast steel pedestal, to which the base ring is secured, is fastened by anchor bolts to a prepoured concrete base which incorporates an ammunition storage place below the ground level. A manhole gives accessibility to the stored ammunition.

Sighting and Fire Control Equipment

On Carriage

- Elbow Telescope, M6A1 / Telescope Mount, M52C } Case II Firing
- Elbow Telescope, M24A1 / Telescope Mount, M47 / Elbow Telescope, M26A1 / Telescope Mount, M46 } Direct Firing
- Remote Control System, M13

Off Carriage

- Cable System, M10
- Director, M7A1B1, M9, or M9A1
- Height Finder, M1A1, or M2A1
- Antiaircraft B.C. Observation Instrument, M1
- Gunner's Quadrant, M1, M1918
- Slide Rule, M1
- Fuze Setter, M13

Ammunition

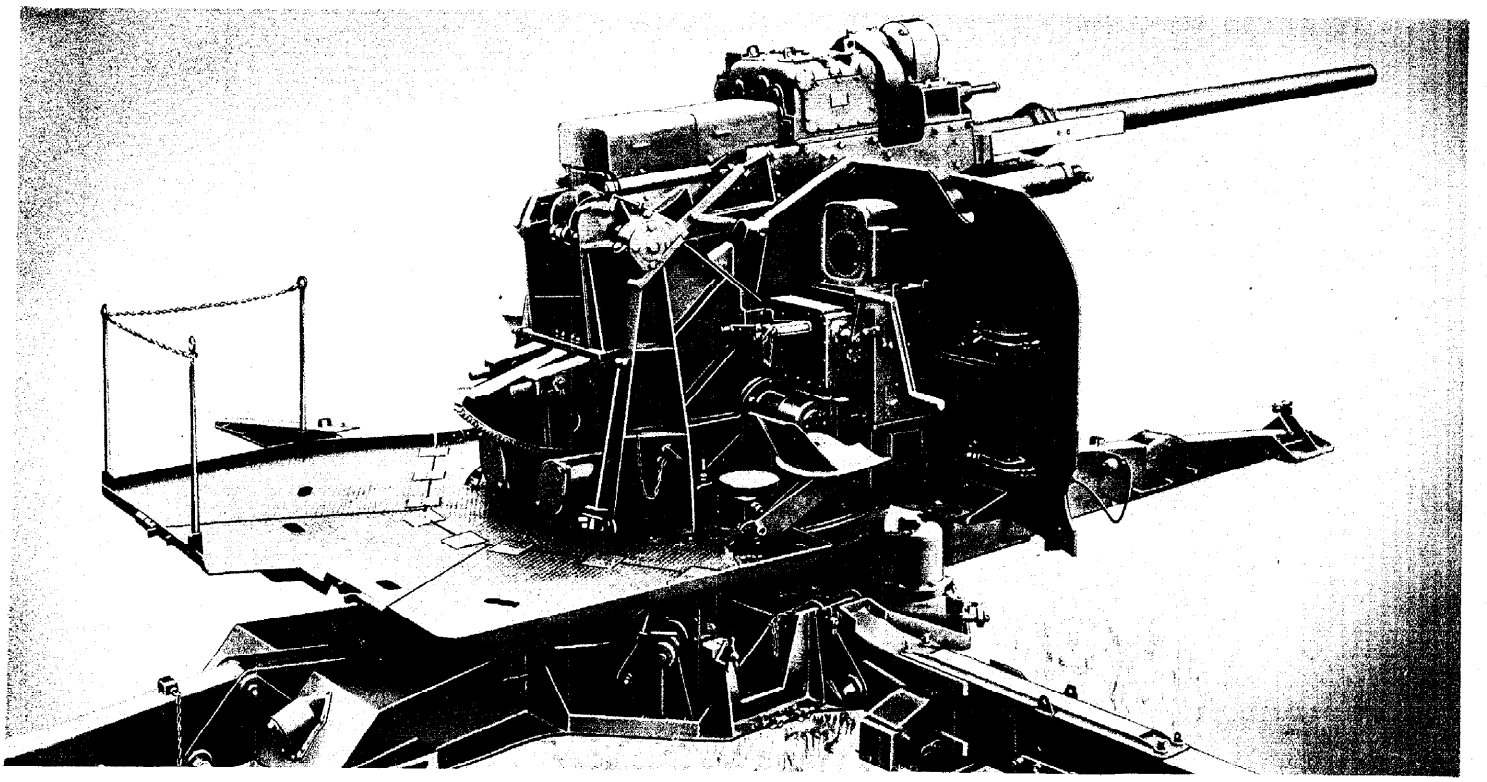
Ammunition is in the form of fuzed, complete, fixed rounds. It consists of Shell, H.E., M58, with Fuze, time, mechanical, M43; Shell, H.E. (Ammonal), M58, with Fuze, time, mechanical, M43; Shell, H.E., M71, with Fuze, time, mechanical, M43; Shell, H.E., M71, with Fuze, time, mechanical, M43; Shell, H.E., M71, with Fuze, P.D., M48; Shell, H.E., M71, with Fuze, P.D., M48A1; Projectile, A.P.C., M82, with Fuze, B.D., M68, and Tracer; Shot, A.P., M77, with Tracer; Ammunition, Blank, 90 mm Gun, M1, and Cartridge, drill, M12, with Fuze, dummy, M44A2.

PRINCIPAL CHARACTERISTICS

Caliber	90 mm
Length of bore	50 cals
Length of gun tube	186.15 ins
Weight	1,465 lb
Maximum powder pressure	38,000 lb./sq. in
Muzzle velocity	2,700 f./s
Maximum range (vertical)	13,170 yds
Maximum range (horizontal)	18,960 yds
Recoil mechanism	Hydropneumatic
Elevation	−8° to +80°
Traverse	360°
Weight of recoil mechanism and cradle	1,740 lb
Weight of base ring	1,109 lb
Weight of pedestal	1,250 lb
Height (base of pedestal to top of shield)	103 ins

REFERENCES — OCM 15688; OCM 17537; OCM 17609; OCM 18632; OCM 20674; OCM 21065; OCM 22029; TM 9-373.

90 MM ANTIAIRCRAFT GUN M2—MOUNT M2—STANDARD



90 mm ANTIAIRCRAFT GUN, M2, ON MOUNT, M2, EMPLACED FOR FIRING

In July, 1941, it was decided that all mobile antiaircraft guns should be dual-purpose weapons that could be fired against both aerial and ground targets when the mount was on wheels. This was impossible with the M1A1 mount, since it was necessary to remove the wheeled bogie and emplace the mount on its pedestal base with outriggers extended before opening fire. It was also desired that the 90 mm gun should be capable of use against motor torpedo boats and other small craft, a function that required a greater depression than the 0° which was the minimum of the Mount, M1A1.

In order to fill the need for a 90 mm dual-purpose gun, a project to design and manufacture such a weapon and its mount was initiated on 11 September 1941. On 13 May 1943 the gun was standardized as M2, the Mount as M2, the recoil mechanism as M17, and the combination fuze setter-rammer as M20.

GUN, M2—The gun assembly of the M2 consists of the gun tube, recoil slide rails, breech mechanism, and firing mechanism. The tube, manufactured by the autofrettage method, is in one piece. It is attached to the breech ring by interrupted threads. Rotation of the tube in the breech ring is prevented by a locking key. A tube support fastened to the recoil slide rails supports the muzzle end of the tube.

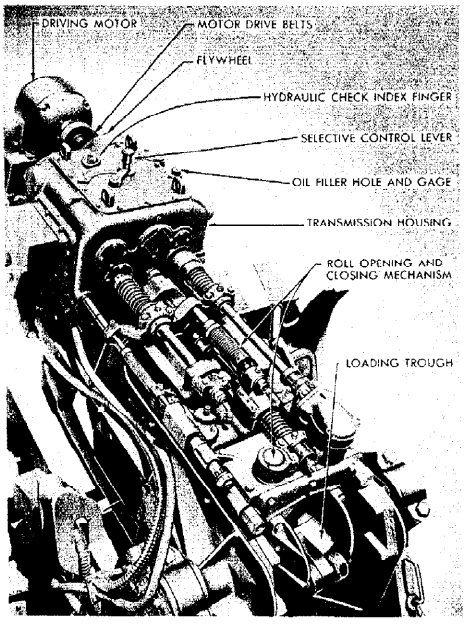
The breech mechanism uses a vertical sliding block which opens and closes automatically when a round is fired and a cartridge is rammed home in the chamber of the gun. The breech must be opened manually for insertion of the initial round. Downward movement of the breechblock cocks the percussion firing mechanism through the medium of the automatic cocking lever. In case of a misfire, the percussion mechanism can be recocked with the breech closed by depressing the hand cocking lever handle.

COMBINATION FUZE SETTER-RAMMER, M20—The purpose of the combination fuze setter-rammer, which is operated automatically and is controlled by a director through remote control, is to shorten and hold constant the time interval between setting a time fuze and firing the round, and to facilitate loading cartridges into the gun. The fuze setter is normally used only with time-fuzed ammunition for antiaircraft fire. A selective control lever makes the fuze setter inoperative when armor-piercing, point-detonating, or base-detonating ammunition is employed against mechanized targets. The power rammer is used in both instances.

In the event of power failure, malfunctioning of the fuze setter-rammer, or for emergency firing from the wheels of the mount, the gun can be loaded manually and fuzes set by means of the manual Fuze Setter, M13.

The nonrecoiling parts of the fuze setter-rammer are mounted on the recoil mechanism cradle, while the recoiling parts are attached to the gun breech ring. The complete unit consists of a 3 hp., 110-volt, 3-phase, 60-cycle induction motor for driving the fuze setter-rammer; a transmission which transmits power to the ramming and fuze setting mechanisms; a ramming mechanism which drives and opens and closes the rubber ramming rolls; a fuze setter mechanism which rotates the fuze setter jaws for setting the fuze and provides a means of opening and closing the jaws, and a fuze setter torque amplifier servo mechanism which receives the fuze setter time signal from the remote control director and converts it into power for setting the fuze setting mechanism.

In operating the fuze setter a round of ammunition is loaded into the slowly rotating ramming rolls which draw the round into the fuze setter jaws, where it is stopped and held stationary. The jaws



COMBINATION FUZE SETTER-RAMMER, M20

then rotate the fuze to the position signaled by the remotely located director, following which the jaws open and the round is rammed by the ramming rolls into the open breech. The breech closes and the round is fired. As the gun recoils, the fuze setter jaws and the ramming rolls open to allow ejection of the cartridge case, and the ramming roll rotational speed is changed from high to low. During counterrecoil the breech is opened automatically, the ramming rolls and fuze setter jaws are closed, and the fuze setter-rammer is ready for loading the next round.

When the fuze setter is inoperative the fuze setter jaws are open, the ramming rolls are driven at high speed, and the round is rammed without interruption.

RECOIL MECHANISM, M17—This recoil mechanism is of the hydropneumatic type, with variable recoil to compensate for change in weight transfer of the gun when it is fired at different elevations. Shortening the recoil at higher elevations permits the use of a lower, more compact top carriage and prevents the possibility of the gun assembly striking the operator's platform. Longer recoil at near-horizontal elevations enables greater shock absorption to be employed. Movement of the gun assembly in recoil and counterrecoil is utilized to change operating speeds of the fuze setter-rammer and to open the breech after firing.

The recoil cylinder, containing a recoil piston connected to the breech ring, is between the floating piston cylinder on its left and the gas cylinder on its right. The three cylinders, mounted under the gun, are held in place by cylinder supports. The recoil and floating piston cylinders are screwed into the cradle yoke which contains the stuffing box for the recoil piston rod and valves for controlling the recoil of the gun. The floating piston cylinder contains both recoil oil and nitrogen under a normal operating pressure of 1,000 pounds. The gas and oil are separated by the floating piston. A gas bypass connection provides a passage for gas between the floating piston cylinder and the gas cylinder. In effect, the gas cylinder is an extension of the floating piston cylinder. It contains only gas under pressure.

The yoke not only provides support for the recoil cylinders, but also serves as a crosstie for the cradle side frames. It contains the oil filling valve, throttling valve, counterrecoil valve, and passages for recoil oil between the floating piston cylinder and recoil cylinder.

After firing, the gun is eased back into battery by the action of a hydraulic counterrecoil buffer located on the front end of the cradle. The buffer in recoil and counterrecoil also changes the operating speeds of the rammer rolls of the fuze setter-rammer.

MOUNT, M2—The mount is composed of the cradle; equilibrators; elevating, traversing, and leveling mechanism; top carriage; pedestal, and outriggers. It is supported in the traveling position by two unsprung two-wheeled bogies equipped with 14 x 24 inch balloon tires. In the theaters of operations combat balloon tires with bullet-resisting inner tubes are used.

The cradle, which is mounted on antifriction bearings on the top carriage, contains all the tipping parts of the gun, the combination fuze setter-rammer, the recoil mechanism, and the counterrecoil buffer.

The top carriage carries all the traversing parts of the mount, the cradle, the equilibrator mechanism, the elevating, traversing, and leveling mechanisms, and the on-carriage elements of the remote control system. The elevating mechanism and elevation indicator-regulator and power unit of the remote control system are mounted on the right side of the gun, while the traversing mechanism, azimuth indicator, and the azimuth power unit are on the left side. The firing platform sections, held in the raised traveling position by swiveled rods, are also mounted on the top carriage. Chains attached to the side frames hold the platforms in the slightly raised position necessary when the gun is fired from the wheels. A signal light for manual firing indicates to the gunner that the gun is on the target. Folding shields, with sight openings and covers to provide access to the remote control power units, are secured to each side of the top carriage.

Two spring-type equilibrators are mounted horizontally between the side frames of the top carriage. Chains from the equilibrator spring piston rods pass over chain wheels at the front end of the top carriage and are attached to arms on the under side of the cradle.

PRINCIPAL CHARACTERISTICS

Caliber	90 mm
Length of bore	50 cals.
Length of tube	186.15 ins.
Weight of tube	1,465 lb.
Maximum powder pressure	38,000 lb./sq. in.
Muzzle velocity (H.E., M71)	2,700 f./s.
Maximum range (vertical) (H.E., M71)	13,170 yds.
Maximum range (horizontal) (H.E., M71)	19,500 yds.
Weight of projectile (H.E., M71)	23.40 lb.
Weight of fuze setter-rammer	975 lb.
Aver. firing cycle—max. fuze setting	2.6 secs.
Aver. firing cycle—min. fuze setting	2.1 secs.
Aver. firing cycle—selective control lever set	2.0 secs.
Recoil mechanism	Hydropneumatic
Recoil length	Variable
Normal recoil at 0° elevation	44 to 46 ins.
Normal recoil at 80° elevation	28 to 31 ins.
Traverse, continuous	360°
Elevation	−10° to +80°
Equilibrators	Spring, adjustable
Wheel base	164 ins.
Length (lunette to gun muzzle)	355.15 ins.
Max. height (traveling position)	121 ins.
Weight of complete gun and mount (approx.)	32,300 lb.
Weight of front bogie	3,250 lb.
Tread, front bogie	72 ins.
Tires, regular or combat	14 x 24 ins.
Turning angle	35°
Weight of rear bogie	3,200 lb.
Brakes, electric, compound	16 x 5 ins.
Length across side outriggers, gun emplaced	380 ins.
Rated capacity of hydraulic jacks	10 tons each
Prime mover	Medium Tractor, M4
Towing speed	Moderate speed on good roads; approx. 20 m.p.h. on sec. roads

The elevating mechanism may be operated either manually or by remote control. The traversing mechanism comprises upper and lower housing units, the remote control power unit, and the azimuth indicator. The carriage is rotated by a series of spur and bevel gears on vertical shafts which drives a pinion meshed with the traversing gear rack fixed to the stationary leveling socket.

A leveling mechanism, consisting of the leveling socket and bearing and four locking screws, enables the top carriage to be leveled when the gun is to be fired from the ground. Spirit level vials are mounted near each of the leveling screws.

The gun, cradle, top carriage and all mechanisms are supported on the pedestal. The pedestal forms the base of the mount and functions as a chassis for the bogies when the gun and mount are in traveling position. A front, rear, and two side outriggers attached to the pedestal are extended and rigidly locked by means of wedge keys when the gun is fired from the ground. The folders and locked outriggers are fastened to the side frames for traveling.

The pedestal lower base plate, prevented from slipping when in firing position by vertical spade plates welded to the bottom, forms the ground base of the mount. Two hydraulic jacks are used for raising and lowering the mount so that the bogies may be removed or placed in traveling position.

When traveling, the mount rests on front and rear bogies. The front bogie is connected by a draft spindle pin to a draft spindle at the front of the pedestal chassis, while the rear bogie is attached to a groove in the rear of the pedestal.

The front bogie is equipped with single wheels which, with the electric brakes mechanism, are mounted on the spindles of a box-section axle. The drawbar is a three-member pipe section hinged to the bogie when traveling and keyed to the bogie so that it may be used for maneuvering when detached from the pedestal. A standard M1 lunette is provided for coupling the bogie to the Medium Tractor, M4, which is used as a prime mover. The turning angle of the bogie is limited to 35°. A break-away switch sets the electric brakes in the event that the mount becomes accidentally separated from the prime mover.

The rear bogie is similar in construction to the front bogie. It has a box section axle to which a maneuvering bar is rigidly fixed for ease of handling when the bogie is detached from the mount. The electric brakes are energized from the prime mover, and a hand-operated parking brake is provided for each wheel.

REFERENCES — OCM 17213; OCM 20401; TM 9–372.

Sighting and Fire Control Equipment

On Carriage

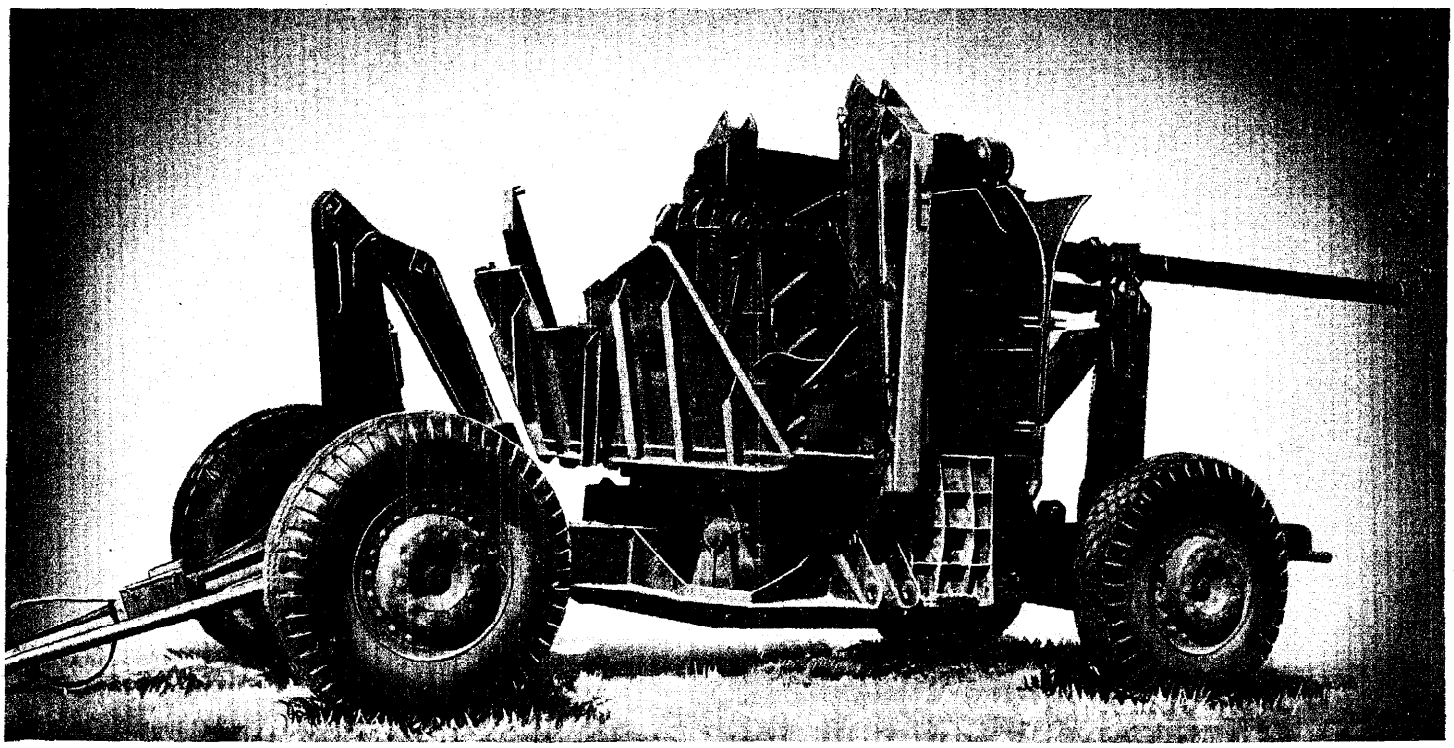
Sighting System, M7
Torque Amplifier, M1 or T5
Cable System, M1
Bore Sight

Off Carriage

Director, M7A1B1, M9 or M9A1
Remote Control System, M12
Height Finder, M1A1 or M2A1
Generating Unit, M18
Fuze Setter, M13
Antiaircraft B.C. Observation Instrument, M1
Gunner's Quadrant, M1
Slide Rule, M1

Ammunition

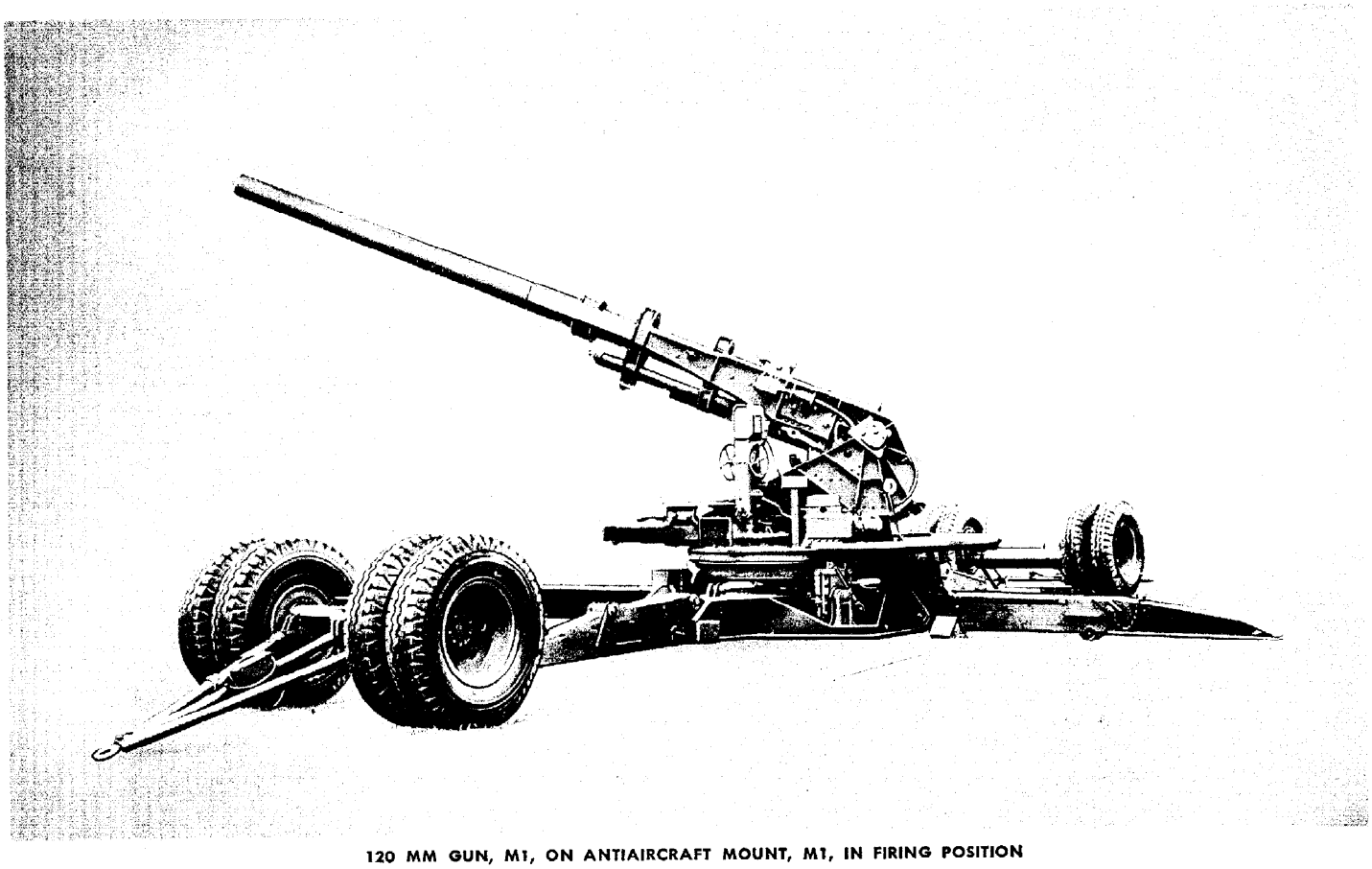
Shell, fixed, H.E., M58, with Fuze, M.T., M43 (all modifications); Shell, fixed, H.E. (ammonal), M58, with Fuze, M.T., M43 (all modifications); Shell, fixed, H.E., M71, with Fuze, M.T., M43 (all modifications); Shell, fixed, H.E., M71, with Fuze, P.D., M48A1; Shell, fixed, M71, with Fuze, P.D., M48A1; Projectile, fixed, A.P.C., M82, with Fuze, B.D., M68, and Tracer; Shot, fixed, A.P., M77, with Tracer; Shell, fixed, Practice, inert loaded, M71, with Fuze, inert or dummy; Ammunition, Blank; Cartridge, Drill, M12, with Fuze, Dummy, M44A2.



UNCLASSIFIED

90 mm GUN, M2, ON MOUNT, M2, IN TRAVELING POSITION

120 MM GUN M1—120 MM ANTIAIRCRAFT MOUNT M1—STANDARD



120 MM GUN, M1, ON ANTIAIRCRAFT MOUNT, M1, IN FIRING POSITION

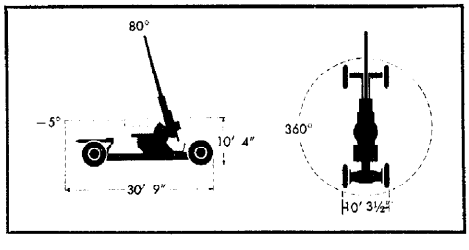
PRINCIPAL CHARACTERISTICS

GUN, M1

Weight (complete)	10,675 lb.
Weight of projectile	50 lb.
Weight of powder charge	24 lb.
Dimensions	
Length of bore	60 cals.
Length (Muzzle to rear face of breech ring)	291 ins.
Caliber	4.7 ins.
Travel of projectile in barrel	248.35 ins.
Chamber capacity	1,046 cu. ins.
Muzzle velocity	3,100 f./s.
Maximum powder pressure	38,000 lb./sq. in.
Rate of firing	10 rds./min.
Type of breechblock	Vertical sliding
Type of recoil mechanism	Hydropneumatic with variable recoil

MOUNT, M1

Type	2 bogie, 8 wheel trailer, portable in one load
Weight (Gun and mount complete, traveling position)	61,500 lb.
Rear bogie	4,100 lb.
Front bogie	3,850 lb.
Mount in firing position	48,800 lb.
Dimensions of Mount, Traveling	
Overall length lunette to rear muzzle	369 ins.
Maximum height	124 ins.
Maximum width	123.5 ins.
Wheelbase	186 ins.
Center road clearance under spade	15 ins.
Size of tires (duals)	13 x 24 ins.
Dimensions of Mount, Emplaced	
Height of trunnions above ground	79 ins.
Height of platform above ground	36 ins.
Diagonal of spread outriggers	33 ft. (approx.)
Maneuvering Data	
Maximum elevation	+80°
Maximum depression	−5°
Leveling adjustment (each way)	4°
Traverse	360°
Capacity of hydraulic jacks	15 tons each



Development of 120 mm antiaircraft matériel for the U.S. Army began with the 120 mm Antiaircraft Gun, M1918, designed and built at the request of General Pershing for an antiaircraft weapon more powerful than those in service during the first World War. The pilot model, tested in October, 1918, was found unsatisfactory. Development work on this gun was under way until 1921, when the project was discontinued.

The fact that bombing altitudes had increased to over 30,000 feet, and the need for a heavy antiaircraft gun for the defense of large area targets, resulted in the approval of military characteristics and the development of a 120 mm antiaircraft gun and mount by O.C.M. 15059, dated 1 June 1939, and supplemented by O.C.M. 15126, dated 22 June 1939; O.C.M. 15725, dated 8 April 1940; and O.C.M. 16220, dated 10 Oct. 1940.

120 mm GUN, M1—This gun consists of a 1-piece cold-worked tube screwed into the rectangular breech ring. It is supported and aligned in the cradle by gun

rails attached to the breech ring at the rear and the tube support in front. A locking key prevents rotation of the tube in the breech ring. The breech mechanism employs a vertical sliding type breechblock opened automatically during counterrecoil and closed automatically by insertion of the cartridge.

A percussion type firing mechanism is contained in the breechblock. The gun is fired by means of a firing lever located on the cradle.

MOUNT, M1—The mount is of the spider type, supported on two dual-wheel bogies when in the traveling position. It consists basically of the cradle supporting the gun, hydropneumatic recoil mechanism, and the power rammer; the top carriage, trunnioning the cradle and forming a structure for the attachment of the elevating and traversing mechanisms, remote-control power apparatus, equilibrator cylinders and pressure tank, working platforms and data receivers, and the pedestal, which serves as the base of the mount and functions as a chassis to which the bogies are connected when the mount is prepared for travel. Four outriggers are attached to the pedestal. The two side outriggers house hydraulic jacks which are used when lowering and raising the mount for firing and traveling positions. Spade plates on the bottom of the pedestal dig into the ground and give additional stability to the emplaced matériel.

Elevation and traverse are accomplished either mechanically by means of hydraulic force supplied by electric motor driven pumps and controlled by the remote control system, or by manually operated handwheels.

The Power Rammer, M9, is a cam-driven, arm type rammer, bolted to the rammer mounting pads on the left side of the cradle. It is supplied with a tray hinged above and to the left of the breech which carries both projectile and cartridge case. An automatic fuze setter is geared to the rammer; both are operated by an electric motor.

The bogies have dual wheels equipped with standard 13 x 24 bus balloon tires, and are furnished with Warner-electric brakes operated from the prime mover. A handbrake lever for parking or emergency use is provided on each of the rear bogie brakes. The electric brakes are automatically applied in the event that the mount becomes separated from the prime mover during transport.

Sighting and Fire Control Equipment

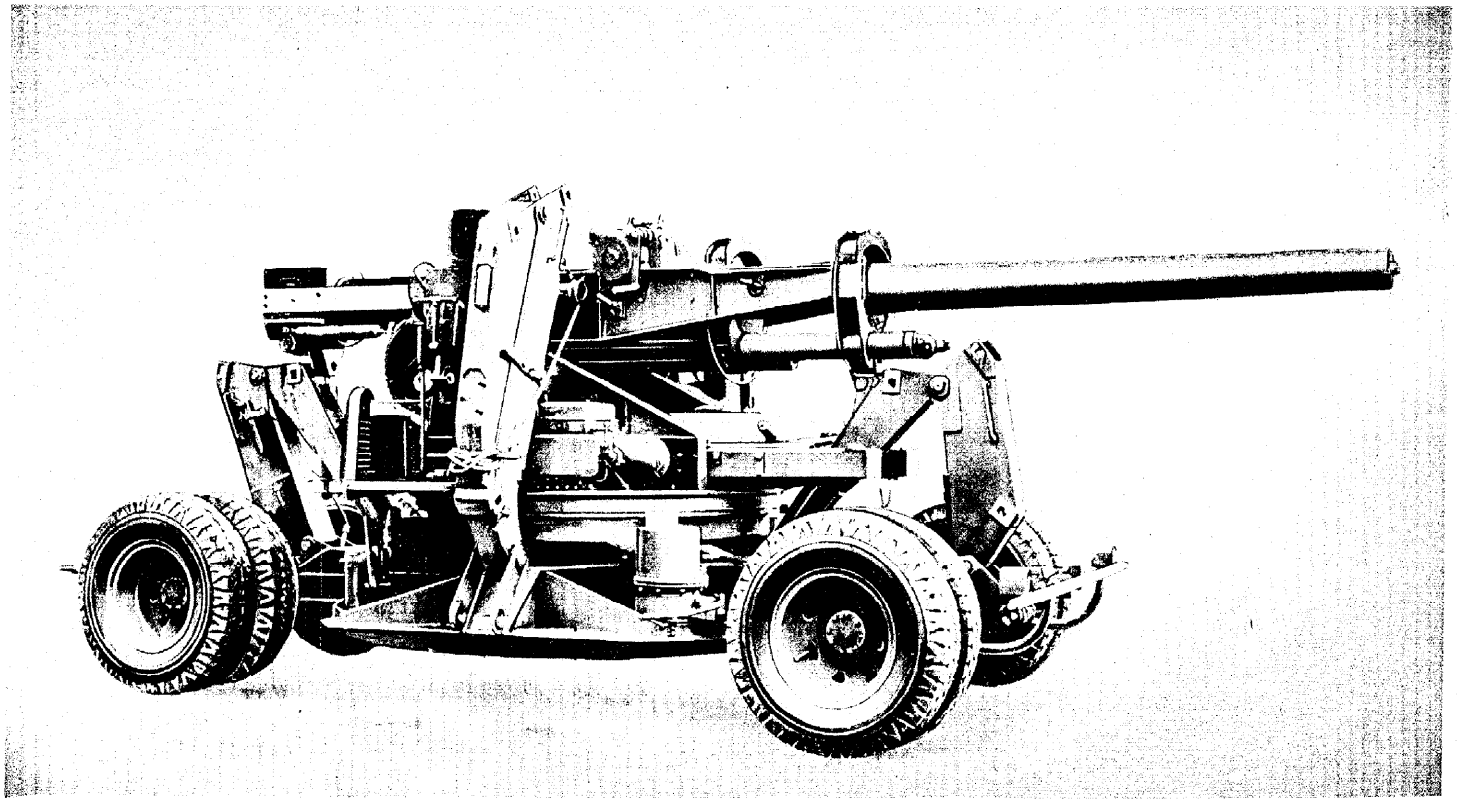
On Carriage Equipment
Remote Control System, M6

Off Carriage Equipment
Cable System, M3
Director, M10
Height Finder, M1A1 or M2A1
A.A. Battery Commander's Observation Instrument, M1
Gunner's Quadrant, M1
Generating Unit, M18
Slide Rule, M1
Graphical Firing Table, M2
Powder Temperature Indicators, M12, M3

Ammunition

The ammunition is of the separate-loading type and consists of a projectile and a brass cartridge case containing the propelling charge. A Palmatex plug serves as a cushion between the cartridge case and the projectile and as a seal to keep the charge in the case. The projectile is designated as H.E. Shell, M73, with M.T. Fuze, M61, and the cartridge case is designated as M24.

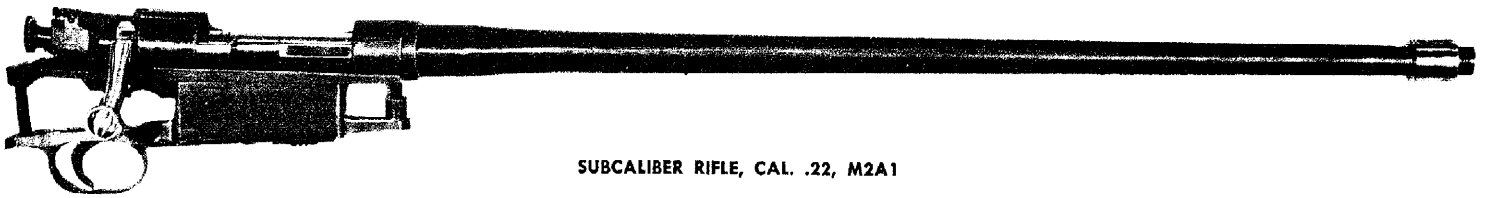
REFERENCES—TM 9–2005, v.6; TM 9–380.



UNCLASSIFIED 120 MM ANTIAIRCRAFT GUN, M1, ON MOUNT, M1, IN TRAVELING POSITION

SUBCALIBER GUNS

SUBCALIBER RIFLE, CAL. .22, M2A1—STANDARD

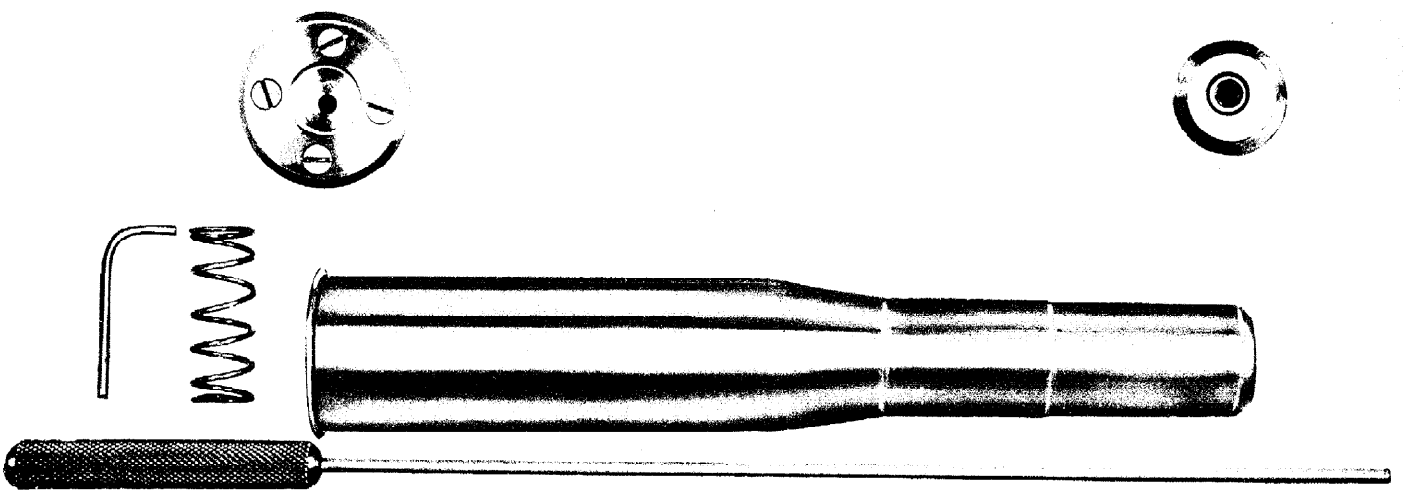


SUBCALIBER RIFLE, CAL. .22, M2A1

The Subcaliber Rifle, cal. .22, M2A1, is standard subcaliber equipment for mounting in the 37 mm Antitank Gun, M3A1. The interior mount used with the rifle is the Subcaliber Mount, cal. .22–.30, M6.

This rifle is the cal. .22 U. S. Rifle, M2, with the stock and the sights removed. A bronze bushing, designed to fit readily into the mount, is fitted on the front end of the barrel.

SUBCALIBER RIFLE, CAL. .22, M5—STANDARD

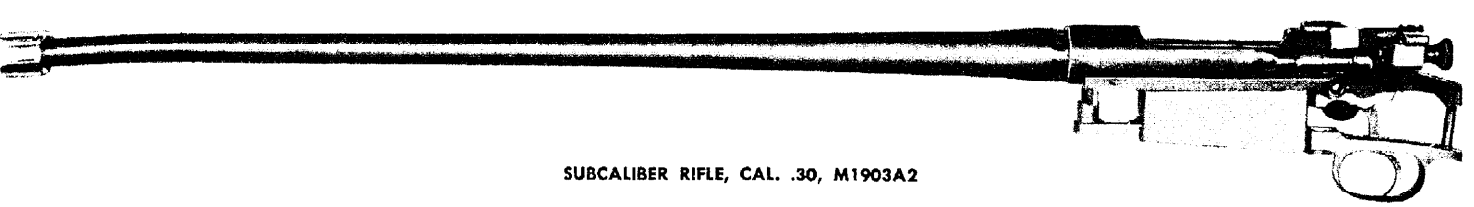


SUBCALIBER RIFLE, CAL. .22, M5

This weapon supersedes the cal. 22 Subcaliber Rifle, M2A1, the cal. .30 Subcaliber Rifle, M1903A2, and the subcaliber mount, cal. .22–.30, M6, for use in the 37 mm Tank Guns, M5 and M6. It was standardized by O.C.M. 18169, dated 5 May 1942.

The Subcaliber Rifle, M5, comprises a short commercial type, cal. .22, M2, rifle barrel mounted in a bronze casting similar in form to a 37 mm complete round in such a way that, when inserted in the chamber of the 37 mm gun, the center firing pin of the cannon can strike the rim of the cal. .22 cartridge. The casting has a steel flange which engages the extractors of the tank gun. The M5 rifle is loaded before insertion in the barrel of the 37 mm weapon. After firing, the breech mechanism of the larger gun is opened, extracting the subcaliber rifle. The empty cal. .22 cartridge is then removed by the use of a rod or a hand extractor.

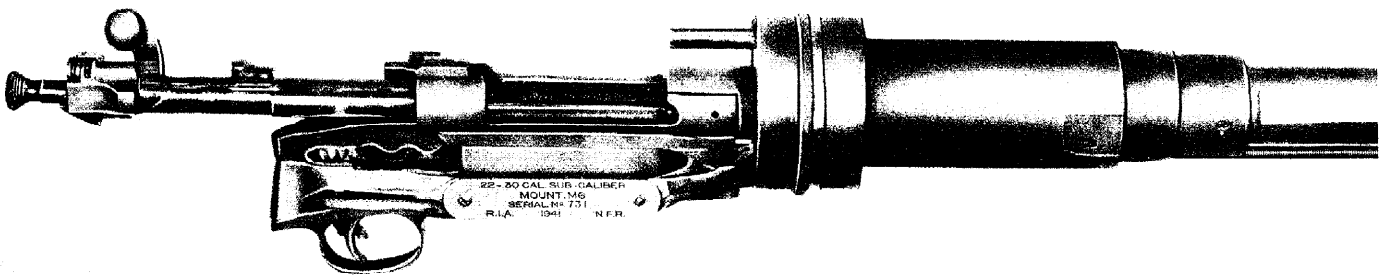
SUBCALIBER RIFLE, CAL. .30, M1903A2—STANDARD



SUBCALIBER RIFLE, CAL. .30, M1903A2

This weapon is the cal. .30 U. S. Rifle, M1903, from which the stock and front sight have been removed. The front end of the rifle is fitted with a bronze bushing which has a diameter equal to the bore of the gun in which the subcaliber rifle is to be mounted. The rifle is 32 inches long and weighs 4⅞ pounds. It may be used interchangeably with the Subcaliber Rifle, cal. .22, M2A1, in the Subcaliber Mount, cal. .22–.30, M6, which fits in the bore of the 37 mm Antitank Guns, M3 and M3A1. The standard cartridge, Tracer, cal. .30, M1, is used for training.

SUBCALIBER MOUNT, CAL. .22-.30, M6—STANDARD
SUBCALIBER MOUNT, CAL. .22-.30, M14—STANDARD

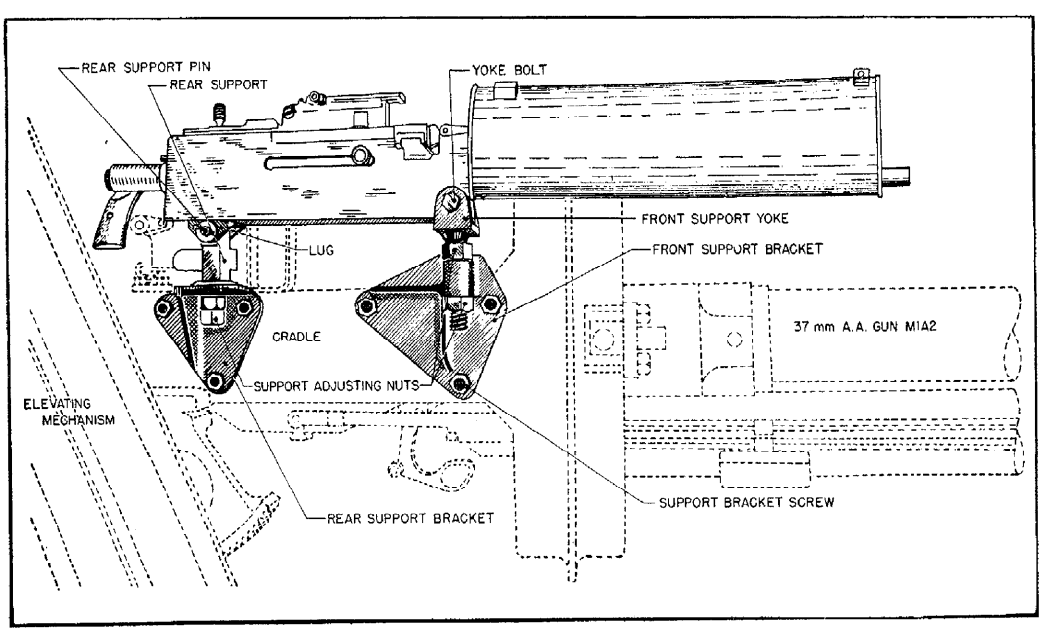


SUBCALIBER MOUNT, CAL. .22-.30, M6

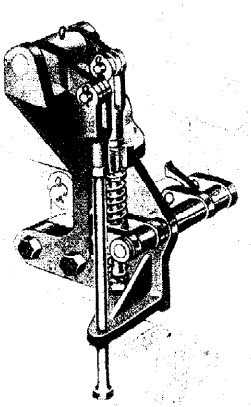
The Mount, M6, consists of a rifle tube extending the length of the 37 mm gun tube, a firing-support assembly fastened to the rear end of the rifle for the support of the receiver and firing mechanism of the rifle, and a firing mechanism assembly fastened to the left side of the firing support and connected with the firing mechanism of the 37 mm gun. Cocking of the rifle must be done by hand. It is used with Subcaliber Rifle, cal. 22, M2A1, and Subcaliber Rifle, cal. .30, M1903A2.

The Mount, M14, is the Mount, M6, modified to fit the 57 mm Gun.

SUBCALIBER MOUNT, CAL. .30, M8—STANDARD



SUBCALIBER MOUNT, CAL. .30, M8



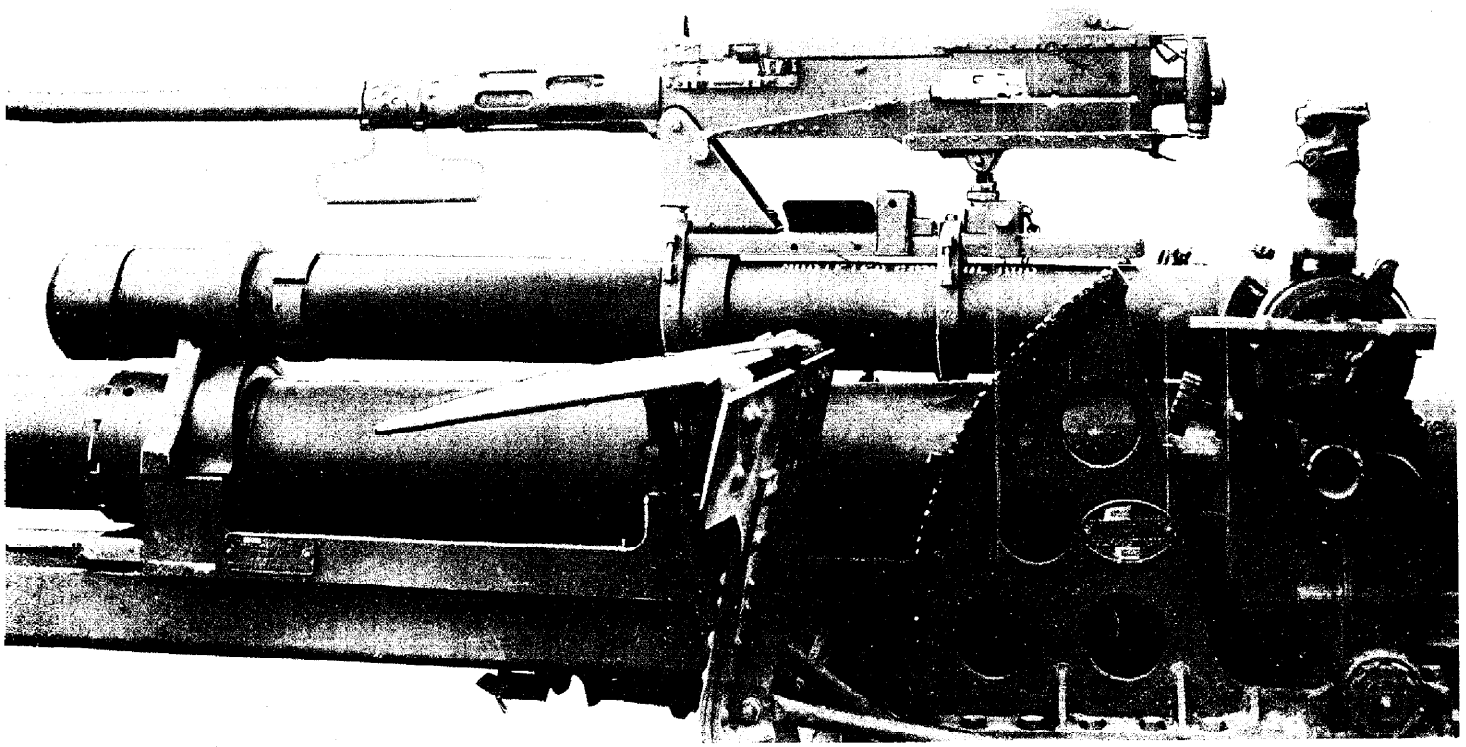
SUBCALIBER FIRING MECHANISM, MOUNT, M8

This Mount is for use with the Browning Subcaliber Machine Gun, cal. .30, M1917A1, on the 37 mm Gun, M1A2, on the Carriage, M3. It was standardized by O.C.M. 16696, dated 8 May 1941.

The mount, which is bolted to the right side of the 37 mm gun cradle, consists of front and rear supports. The front support is a triangular bracket holding the U-shaped yoke which surrounds a portion of the subcaliber gun. Adjusting nuts which secure the yoke to the bracket may be tightened or loosened to effect slight changes in elevation of the subcaliber weapon. The rear bracket holds the rear support consisting of a T-shaped rectangular block with its projection toward the center of the carriage. This bracket contains a slot in which the support slides horizontally for adjustments in azimuth. In making such adjustments the nut on the front support serves as a pivot. During adjustments in elevation, the rear end of the gun pivots vertically in the rear support pin.

REFERENCE—TM 9-235.

SUBCALIBER MOUNTS, CAL. .50, M9, M10, M12—STANDARD



CALIBER .50 SUBCALIBER MOUNT, M12, ON 3" GUN CARRIAGE, M1, WITH BROWNING MACHINE GUN, CAL. .50, HB, M2

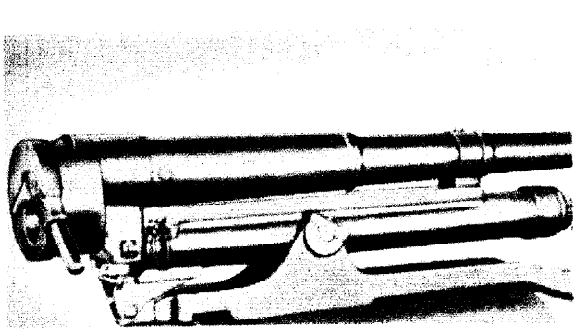
Subcaliber Mounts, Cal. .50, M9, M10, and M12, were developed in order to provide subcaliber training equipment for tank destroyer guns where range facilities are not available for firing service ammunition. They are to be used in training gunners in firing at moving targets.

The mounts are designed to support the Browning Machine Gun, Cal. .50, HB (flex.), M2, and to fit all guns assigned to the Tank Destroyer Battalion. The mount and top bracket are universal, and the steel securing straps vary for each type of gun for which the mount is intended. These straps are so constructed that they are removable, permitting them to be stowed in the smallest possible space.

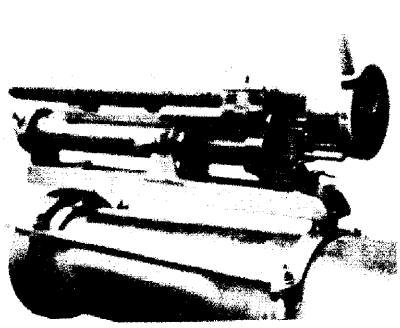
The proper firing solenoid is furnished for attachment to the Browning Machine Gun, Cal. .50, together with sufficient electric cable to connect the solenoid with the solenoid switch in the motor carriage. When it is desired to fire the cal. .50 machine gun as a single-shot weapon, using a lanyard, it is necessary to install a trigger motor on the machine gun casing, together with a rocker arm to reverse the direction of pull and a cable fastened to the firing mechanism of the major caliber weapon.

REFERENCES—OCM 21024; OCM 21244.

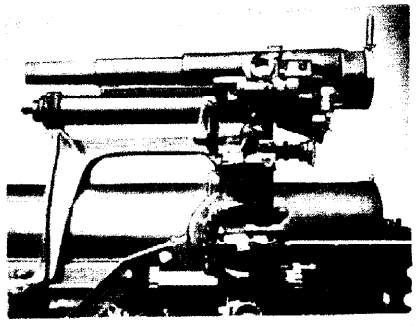
37 MM SUBCALIBER GUN M1916 STANDARD—SUBCALIBER MOUNTS M1, M4, M7, M8, M9, M10 STANDARD



37 MM GUN, M1916—SUBCALIBER MOUNT, M1



37 MM GUN, M1916—SUBCALIBER MOUNT, M4



37 MM GUN, M1916—SUBCALIBER MOUNT, M7

The 37 mm Subcaliber Gun, M1916, is standard for subcaliber use with various mobile artillery weapons. It consists of the 37 mm Gun, M1916, and its cradle. In all cases it is mounted on the larger gun by means of a mount adopted as standard for that matériel.

CHARACTERISTICS

Weight of gun unit	104 lb.
Weight of gun	57 lb.
Length of barrel	29.13 ins., 19.94 cals.
Diameter of bore	1.457 ins.
Length of recoil	7–10 ins.
Rifling, uniform L.H., one turn in	43.582 ins.
Maximum effective range	1,800 yds.
Maximum rate of fire, aimed	25 rds./min.
Ammunition	Subcaliber ammunition consists of fixed round, designated as 37 mm Practice Shell, Mk. II, with Practice Fuze, M38.

The different subcaliber mounts used with the gun, M1916, are constructed on the same general principles, differing only in details necessary for use with different weapons. Each mount consists of a mounting bracket which, when in position, lies between the barrels of the two guns and is parallel to them. Either forming a part of the bracket, or firmly attached to it, are the supports which hold the mount on the larger weapon to keep the subcaliber gun in place. The lower supports are firmly attached to the main gun, in some cases by a U-bolt which encircles a portion of the barrel. The upper supports are adjustable at the trunnion, and at the front end of the cradle, which permits adjustment of the 37 mm weapon to parallelism with the main weapon.

37 mm SUBCALIBER MOUNT, M1—This mount is used on the 155 mm Guns, M1917 and M1918M1.

37 mm SUBCALIBER MOUNT, M4—This mount is used on the 155 mm Howitzers, M1917 and M1918.

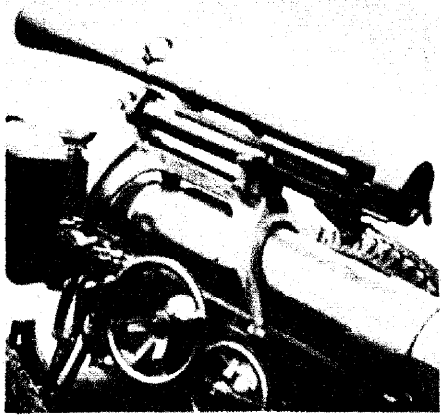
37 mm SUBCALIBER MOUNT, M7—This mount is used on the 75 mm Guns, M1897, M1897A1, M1897A2, M1897A3 and M1897A4, on 75 mm Carriages, M1897M1 and M1897A4.

37 mm SUBCALIBER MOUNT, M8—This mount is used on the 75 mm Gun Carriages, M1897M1 and M1897A4.

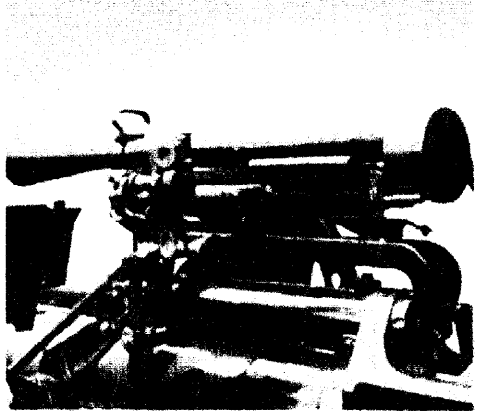
37 mm SUBCALIBER MOUNT, M9—This mount is used on the 75 mm Gun Carriage, M1916A1.

37 mm SUBCALIBER MOUNT, M10—This mount is used on the 155 mm Gun Carriage, M1, and 8″ Howitzer Carriage, M1.

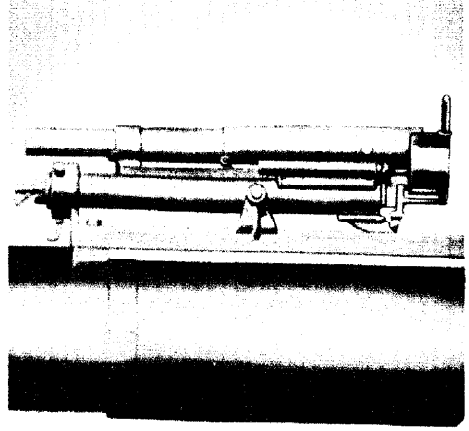
REFERENCES—TM 9-2005, v.3; III, TM 9-320; TM 9-335; TM 9-345; TM 9-350.



37 MM GUN, M1916—SUBCALIBER MOUNT, M8

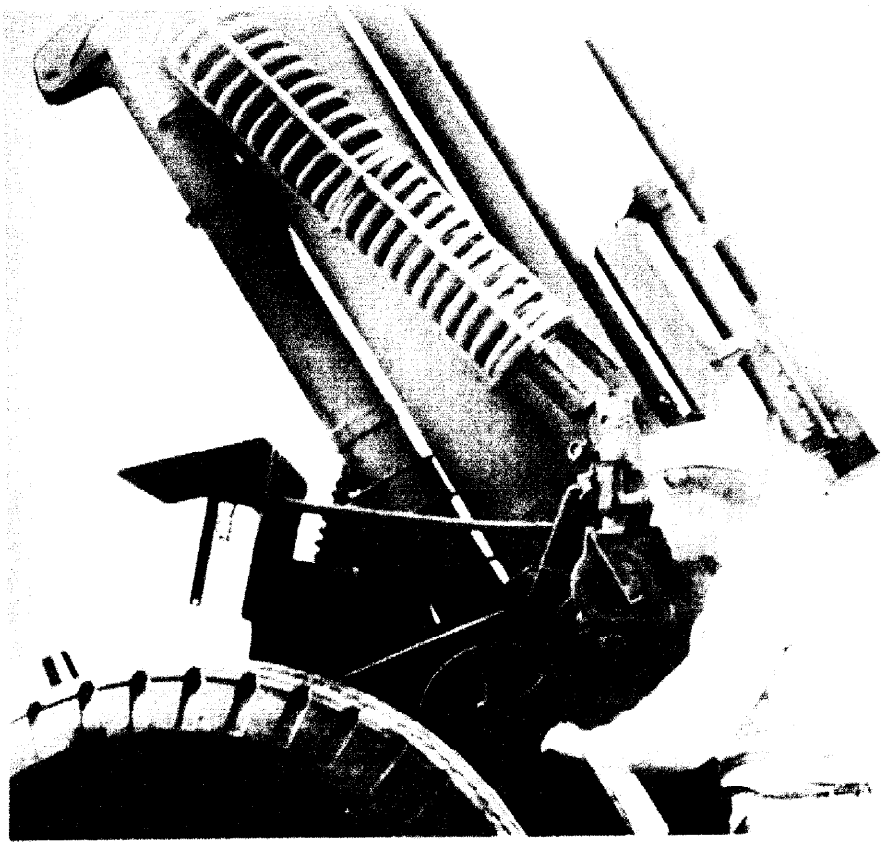


37 MM GUN, M1916—SUBCALIBER MOUNT, M9



37 MM GUN, M1916—SUBCALIBER MOUNT, M10

37 MM SUBCALIBER MOUNT M13A1—FLASH HIDER TAC-4—STANDARD



37 mm SUBCALIBER MOUNT, M13A1, ON 4.5 INCH GUN CARRIAGE, M1

The 37 mm Subcaliber Mount, M13A1, is used on the 4.5 Inch Gun Carriage, M1, and the 155 mm Howitzer Carriage, M1.

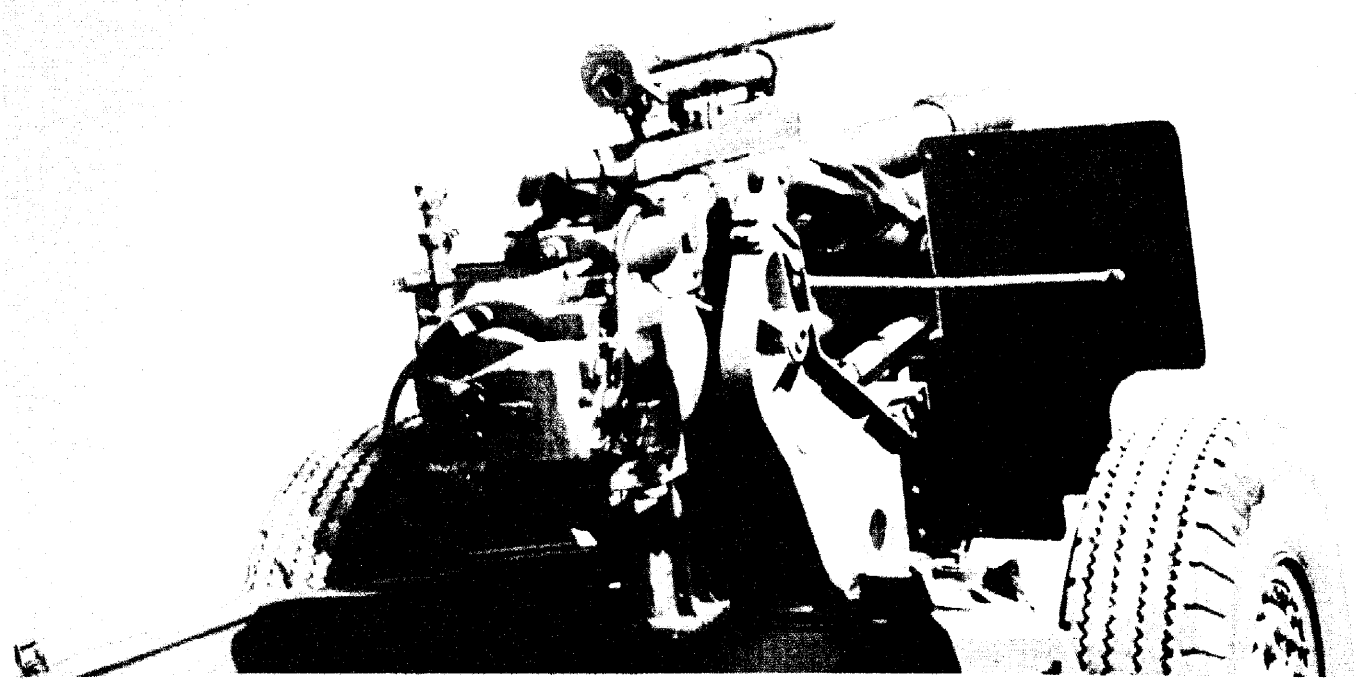
Due to accidents caused by premature bursts of the Mk. II projectile, the 37 mm gun and recoil system were relocated to place the muzzle of the subcaliber weapon 17½ inches farther forward on the 4.5 inch gun and 155 mm howitzer carriages, thus reducing the hazard to men serving the piece. Further protection from fragments of a premature burst at or within a few inches of the muzzle was provided by Flash Hider, TAC-4. The flash hider also tends to reduce blast effect on the gunner.

Tests indicated that Flash Hider, TAC-4, increased the average muzzle velocity of the practice round from 1,232 feet per second to 1,256 feet per second.

The Flash Hider, TAC-4, is locked securely to the barrel of the 37 mm gun by means of a clamping bolt that engages a notch near the muzzle of the weapon. It may be used on the 37 mm Gun, M1916, mounted on 37 mm Subcaliber Mounts, M1, M5, M10, M13A1, and M16.

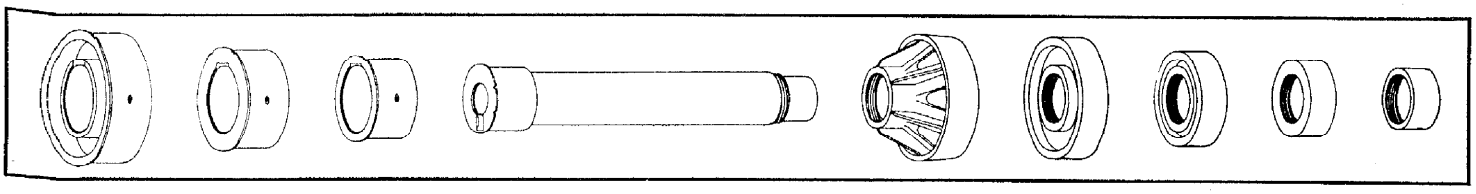
CHARACTERISTICS OF FLASH HIDER, TAC-4

Length	15 ins.
Diameter	2.5 ins.
Wall thickness	.95 in.



SUBCALIBER MOUNT, M13A1, ON 155 mm HOWITZER CARRIAGE, M1

1-POUNDER SUBCALIBER GUN—STANDARD



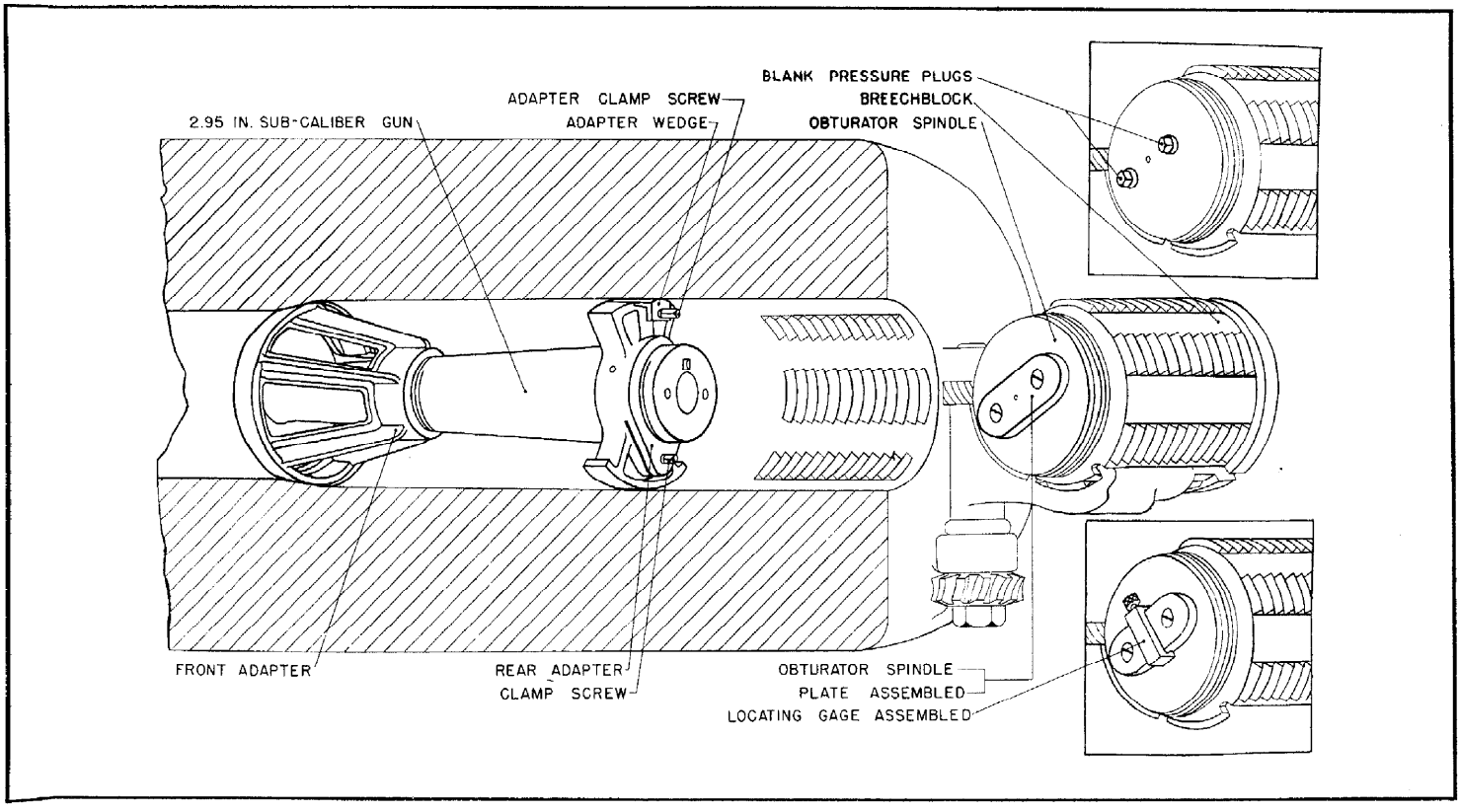
1-POUNDER (1.457 INCH) SUBCALIBER GUN, WITH FRONT AND REAR ADAPTERS FOR WEAPONS OF VARYING CALIBER

The 1-pounder subcaliber gun is used with the 6 inch guns, M1897M1, M1900, M1903, M1905, M1908, M1908M1, M1908M2; 8 inch guns, M1888 and modifications; 10 inch guns, M1888, M1895, M1900, and modifications, and with 14 inch guns, M1907, M1907M1, and M1909.

The 1-pounder subcaliber gun is inserted in the chamber of the larger cannon where it is held in place by means of adapters screwed over the muzzle and breech of the smaller weapon. When the subcaliber gun is inserted the adapters are expanded to hold it firmly in position. A center support screws on threads near the middle of the 1-pounder tube in order to insure rigidity of the gun.

The round is fired by the firing mechanism of the major weapon, and the supply cartridge case is removed by means of a hand extractor.

2.95 INCH SUBCALIBER GUN—STANDARD



2.95 INCH SUBCALIBER GUN, WITH ADAPTERS

The 2.95″ subcaliber gun is used in conjunction with all models of 12″ seacoast mortars. The gun is supplied with rear and front adapters screwed over the subcaliber tube at the breech and muzzle. These adapters permit the subcaliber gun to be inserted in the bore of the mortar, where the rear adapter is expanded until it is wedged against the walls of the chamber. The round is fired by the mortar firing mechanism, and the empty cartridge case is extracted by means of a hand extractor.

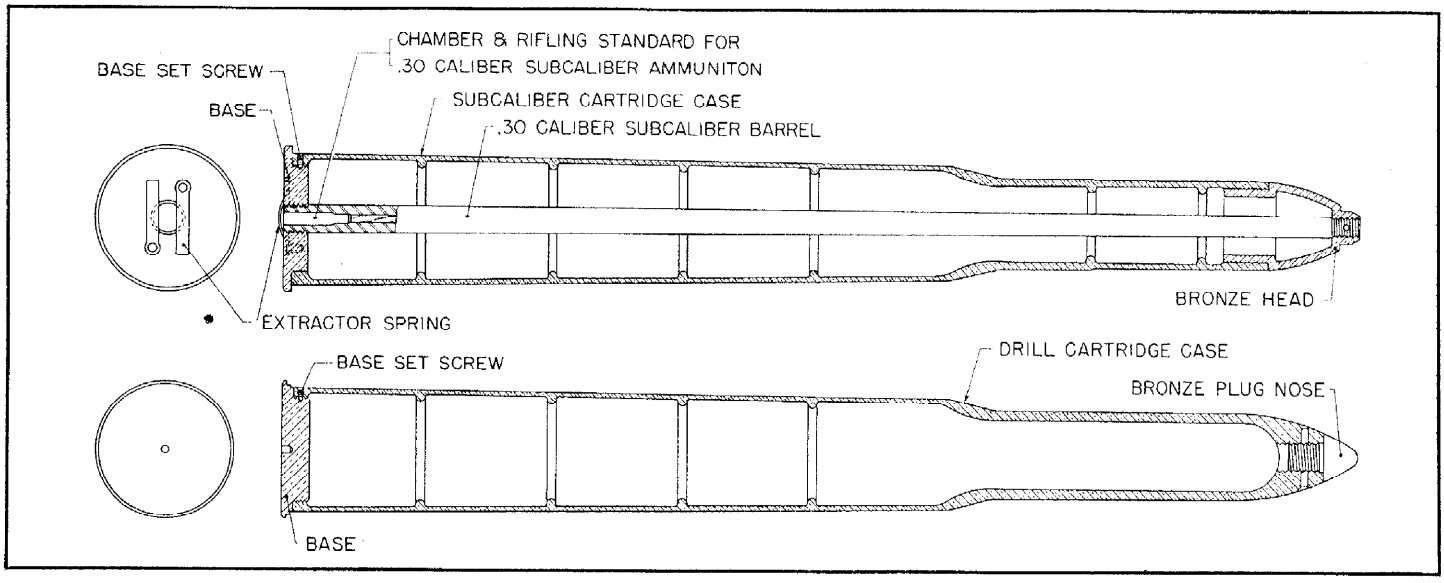
Ammunition for the 2.95″ subcaliber gun is in the form of a complete fixed round with a solid steel or cast-iron projectile weighing 18 pounds. Three distinct rounds are furnished with a different propelling charge in each round to provide for zone 1, 2 and 3 firing. Muzzle velocity for zone 1 is 550 feet per second; for zone 2, 625 feet per second, and for zone 3, 700 feet per second.

REFERENCES—TM 9-456; TM 9-457; TM 9-458.

CHARACTERISTICS

Weight of subcaliber tube	224 lb.
Caliber	2.953 ins.
Length of bore, including chamber	31.6 ins.
Length of rifled portion of bore	24.33 ins.
Rifling, uniform R.H. twist	1 turn in 25 cals.
Rifling, number of grooves	30
Capacity of powder chamber	34.9 cu. ins.
Weight of projectile	18 lb.
Weight of cartridge case	1.45 lb.
Muzzle velocity— three zones	550, 625, 700 f./s.
Maximum chamber pressure	18,000 lb./sq. in.
Maximum range	4,142 yds.
Minimum range	1,975 yds.

SUBCALIBER KITS AND DRILL CARTRIDGES FOR 3 INCH (15 PDR.) GUNS M1902, M1903—STANDARD



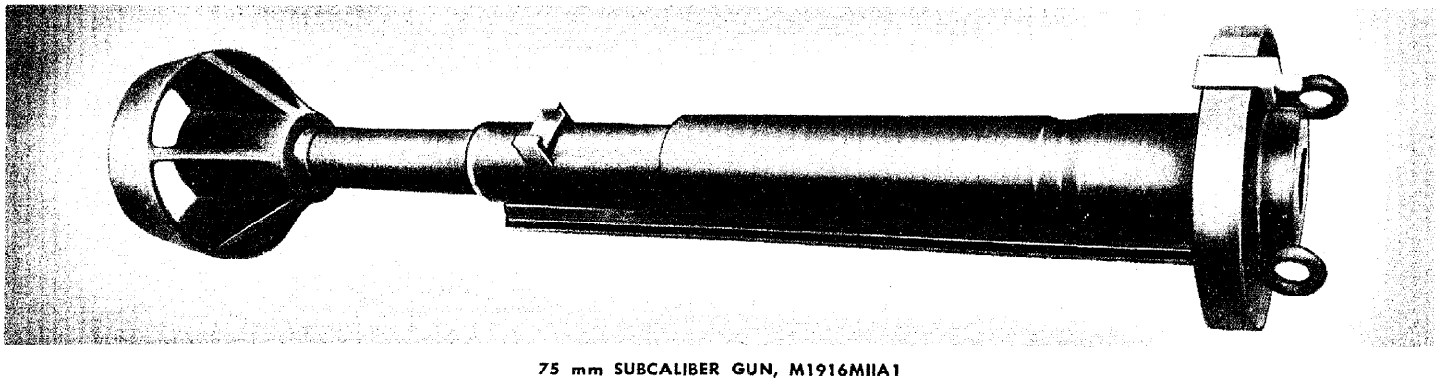
SUBCALIBER AND DRILL CARTRIDGES FOR 3 INCH (15 PDR.) GUNS, M1902, M1903

Subcaliber equipment for the 3 inch (15 pdr.) Guns, M1902 and M1903, is stored in a subcaliber and drill cartridge kit which contains: 1 cleaning brush, 3 drill cartridges, 1 subcaliber cartridge, 1 extension piece, 1 cleaning rod, 2 flathead special screws, 1 slotted tip, 1 extra base and 1 storage chest.

DRILL CARTRIDGE—This is a dummy cartridge for use in drilling cannoneers in the service and loading of the gun. It is a bronze casting of the shape and dimensions of the service round of fixed ammunition.

SUBCALIBER CARTRIDGE—The subcaliber cartridge consists of a cal. .30 rifle barrel mounted axially in a bronze subcaliber cartridge case, and is of the same weight and exterior dimensions as the cartridge case for the service ammunition. The breech end of the rifle screws into the base of the subcaliber cartridge, while the muzzle end is threaded to take the ogival-shaped bronze head, which accurately fits the bore of the 3 inch gun at the front end of the subcaliber case, and is capable of longitudinal motion to allow for expansion of the barrel when it becomes heated. Two extractor springs are provided for extracting the subcaliber ammunition from the cal. .30 barrel. They are secured to the base of the 3 inch subcaliber cartridge by two flathead special screws so that the springs catch the rim of the cal. .30 subcaliber cartridge as it is inserted into the cal. .30 barrel.

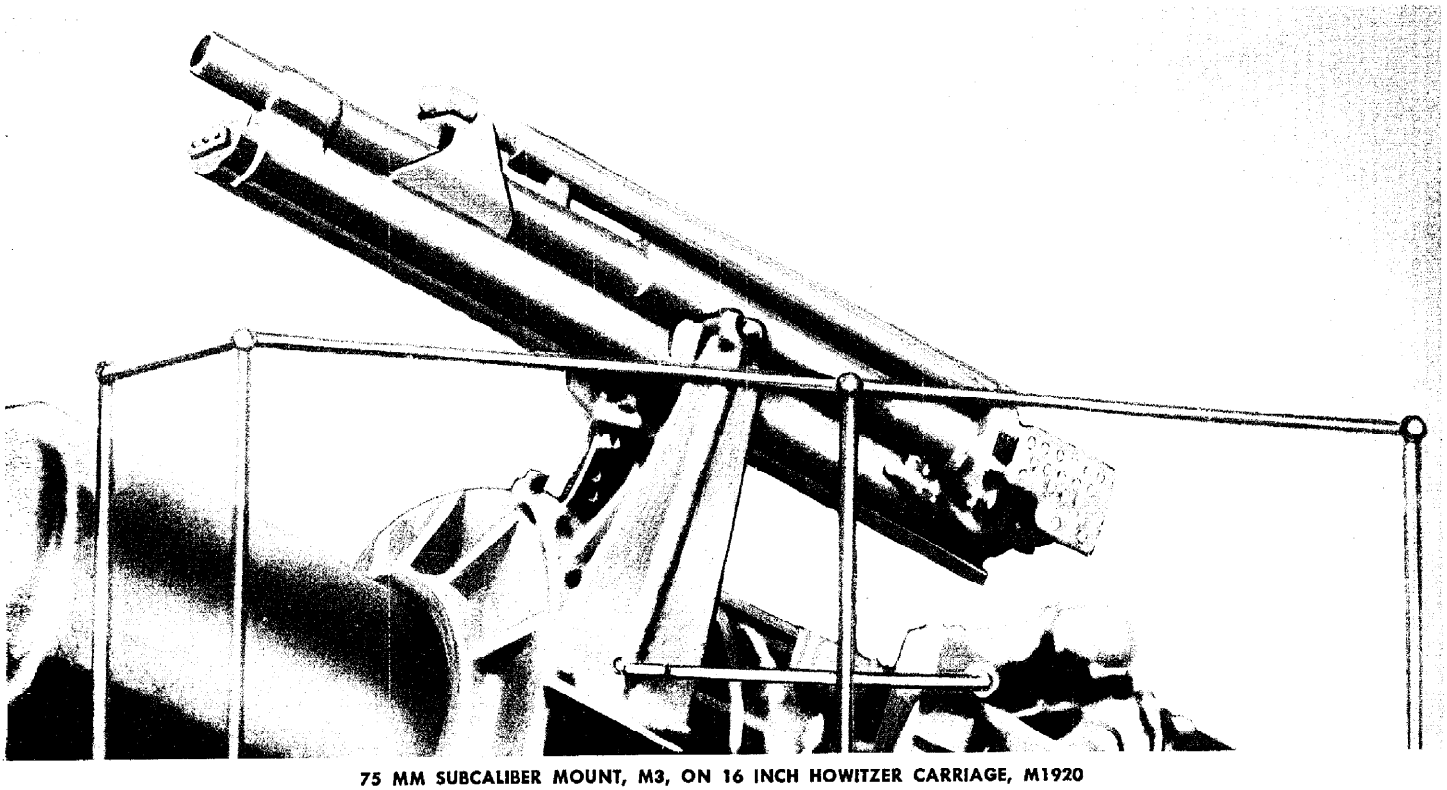
75 MM SUBCALIBER GUN M1916MIIA1—STANDARD



75 mm SUBCALIBER GUN, M1916MIIA1

The 75 mm Subcaliber Gun, M1916MIIA1, is used as subcaliber matériel with the 14 Inch Gun, M1910M1, on 14 Inch Disappearing Carriage, M1906M1. No mount is used with this gun, the tube being fitted with front and rear adapters which permit it to be inserted in the chamber of the 14 inch weapon.

75 MM GUN M1916—MOUNTS M1, M2, M3, M4—STANDARD



75 MM SUBCALIBER MOUNT, M3, ON 16 INCH HOWITZER CARRIAGE, M1920

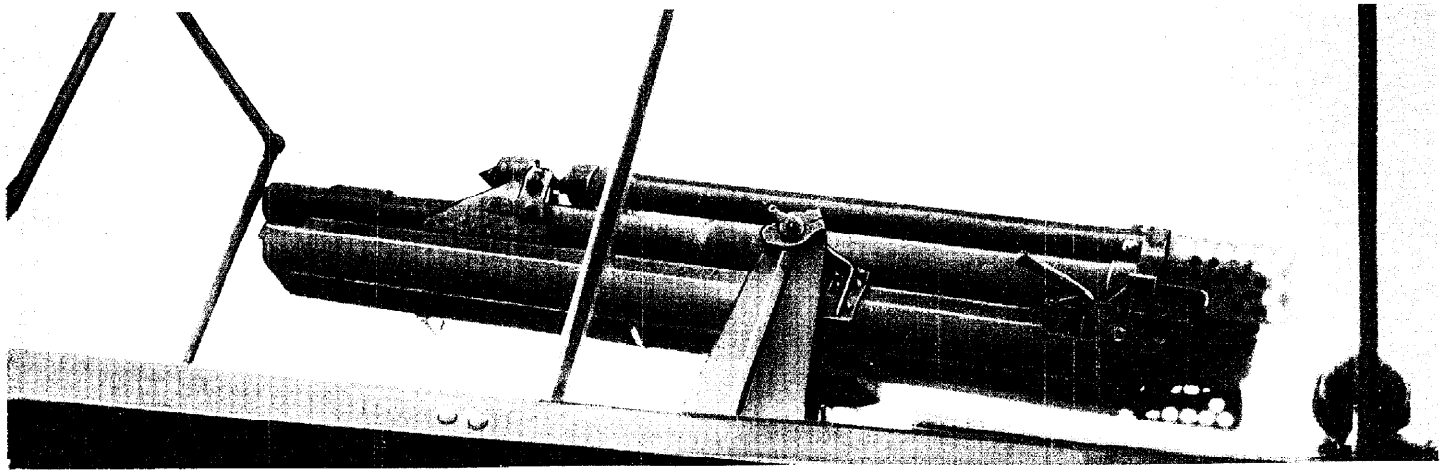
The 75 mm Gun, M1916, is used as subcaliber equipment with 75 mm Subcaliber Mount, M1, for the 12 inch Barbette Carriage, M1917; with Mount, M2, for 16 inch Barbette Carriage, M1919; with Mount, M3, for 16 inch Howitzer Carriage, M1920; and with Mount, M4, for 16 inch Barbette Carriage, M1919.

The 75 mm Gun, M1916, is a built-up weapon of alloy-steel forgings. It consists of a tube, jacket breech hoop and clip. The clip has two lugs on the under side to guide the gun in the carriage. The breech mechanism is of the semi-automatic drop-block type, closing automatically when a round is inserted in the chamber. Manual opening of the breechblock extracts the empty cartridge case. The firing mechanism is of the continuous pull type. The recoil mechanism is of the hydrospring design.

The Mounts, M1, M2, M3, and M4, vary only in minor details. They are attached to the cradle of the major caliber weapon and support the 75 mm Gun, M1916, together with its recoil mechanism.

CHARACTERISTICS

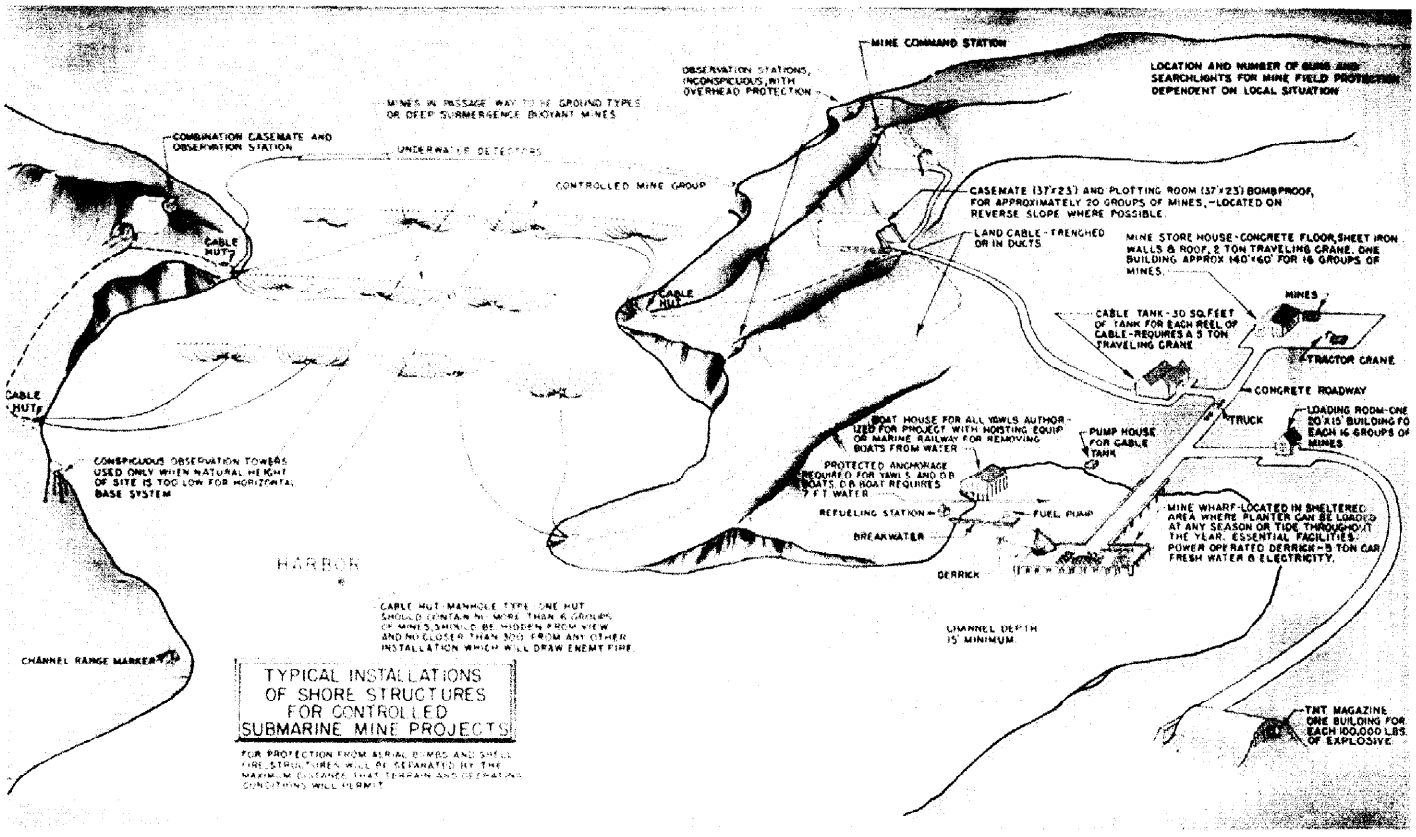
Total weight of gun	749 lb.
Overall length	90.9 ins.
Length of bore	28.4 cals.
Muzzle velocity	1,780 f./s.
Maximum range (with H.E. Shell, Mk. I)	8,780 yds.
Type of breech mechanism	semi-automatic vertical sliding wedge block
Firing mechanism	continuous pull
Recoil mechanism	hydrospring, variable recoil



75 MM SUBCALIBER MOUNT, M2, ON 16 INCH BARBETTE CARRIAGE, M1919

SUBMARINE MINES

HARBOR DEFENSE BY CONTROLLED MINES



Controlled submarine mines are utilized in conjunction with other defense measures employed for the protection of important harbors. The tactical operation of all controlled submarine mine equipment is a function of the Coast Artillery Corps.

Controlled mine fields are planted to effect the destruction or damage of hostile vessels attempting to enter such portions of harbor entrances as lead to channels used by friendly shipping. The fields are normally limited to distances of 10,000 yards from shore and to water not over 300 feet deep.

A mine field consists of from two to four parallel lines of mines. Individual lines are composed of groups, each of which contains nineteen buoyant mines or thirteen ground mines. This arrangement insures the probability of a vessel passing over at least one mine and probably several other mines. Mines within a group are separated by 100 foot intervals in the case of buoyant mines and by 150 foot intervals in the case of ground mines.

The approach of a hostile vessel to the mine field may be detected by visual observation, by an audio reception system or by a signal light on the mine control panel which flashes on when a ship strikes a buoyant mine or comes within actuating distance of an influence-operated ground mine.

Observation and command stations are located in specially protected shore installations. Observers in the shore stations communicate to the casemate plotting room the azimuth, speed and course of an approaching enemy vessel which they can see. These data enable the plotting board operators to determine the mine which should be fired in order to destroy or put the hostile vessel out of action. Commands are communicated to the casemate electrician to fire the mine by closing the proper group firing switch.

The shore installations for controlled mine harbor defense consist of the mine casemate, housing the power and control equipment; a mine storehouse; a loading room; a cable tank for storage of cable; a mine wharf and derricks; trackage or roads to connect the various structures; a mine group commander's station; base end stations; a plotting room, and cable terminal huts. There are also boathouses and anchorages for the mine yawls and DB boats.

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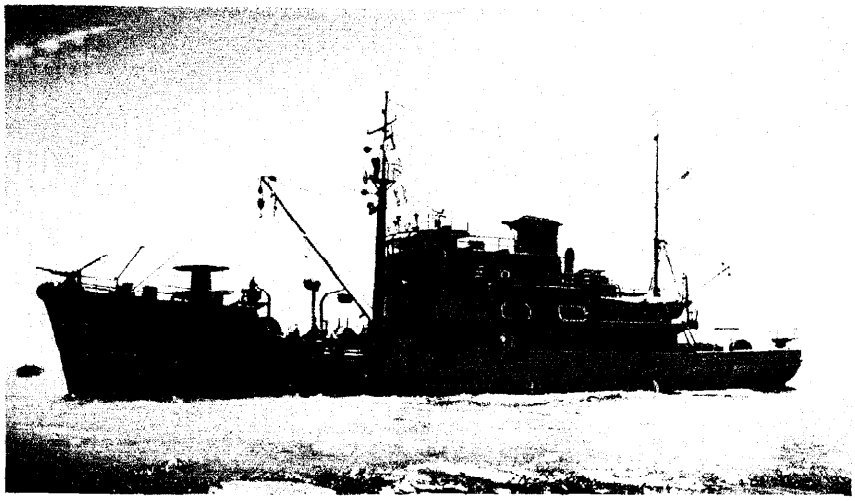
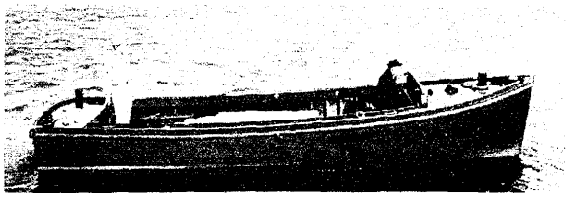
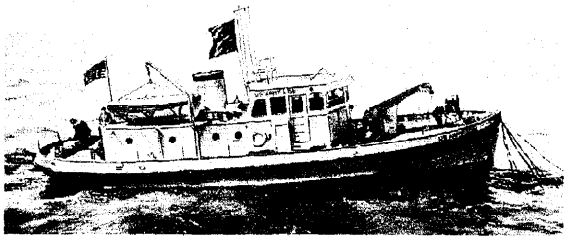
SUBMARINE MINE FLOTILLA



U. S. ARMY MINE PLANTER *MAYBACK*, USED FOR LOCATING, PLANTING, REPAIRING AND CLEARING MINE FIELDS

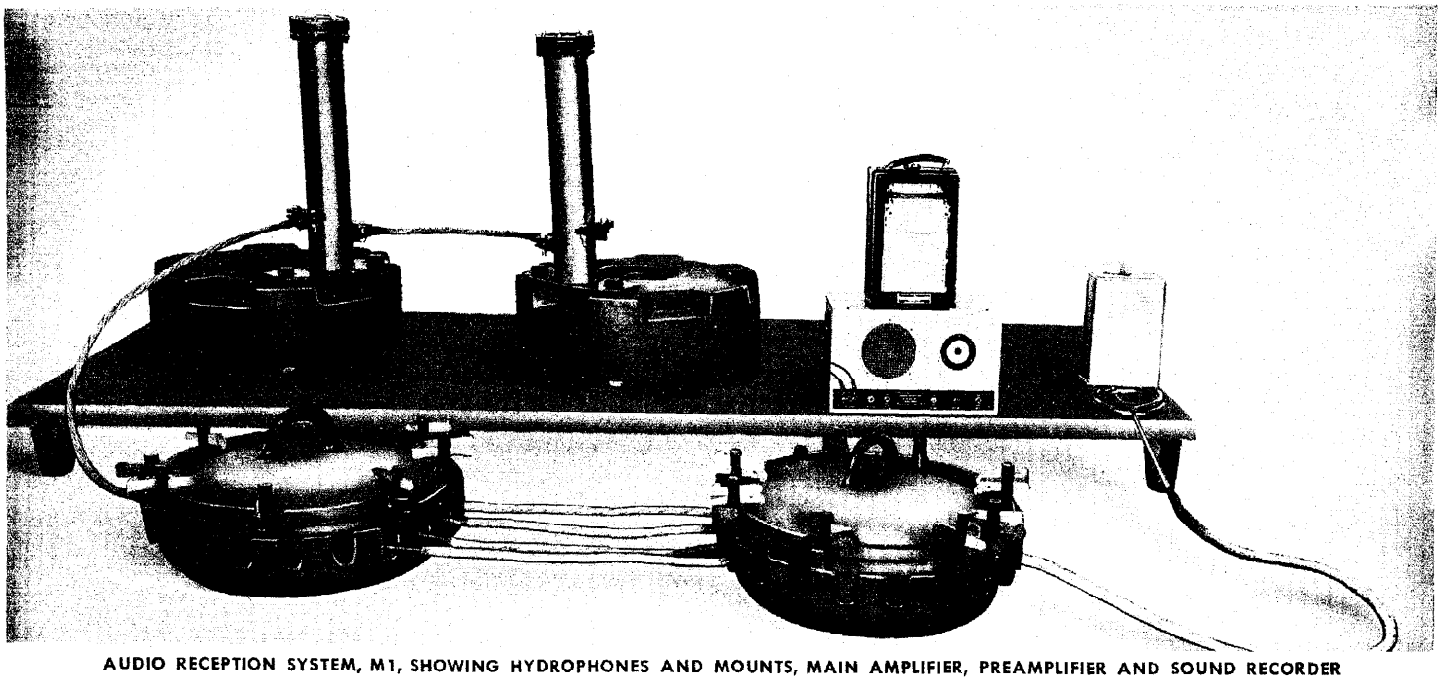


MINE YAWL, USED TO ASSIST MINE PLANTERS AND DB-BOATS, TO ACT AS A SAFETY BOAT, AND AS A UTILITY AND MESSAGE DELIVERY BOAT



DISTRIBUTION BOX BOAT, USED TO ASSIST THE OPERATIONS OF THE MINE PLANTER AND AS A PATROL BOAT

AUDIO RECEPTION SYSTEM M1—STANDARD



AUDIO RECEPTION SYSTEM, M1, SHOWING HYDROPHONES AND MOUNTS, MAIN AMPLIFIER, PREAMPLIFIER AND SOUND RECORDER

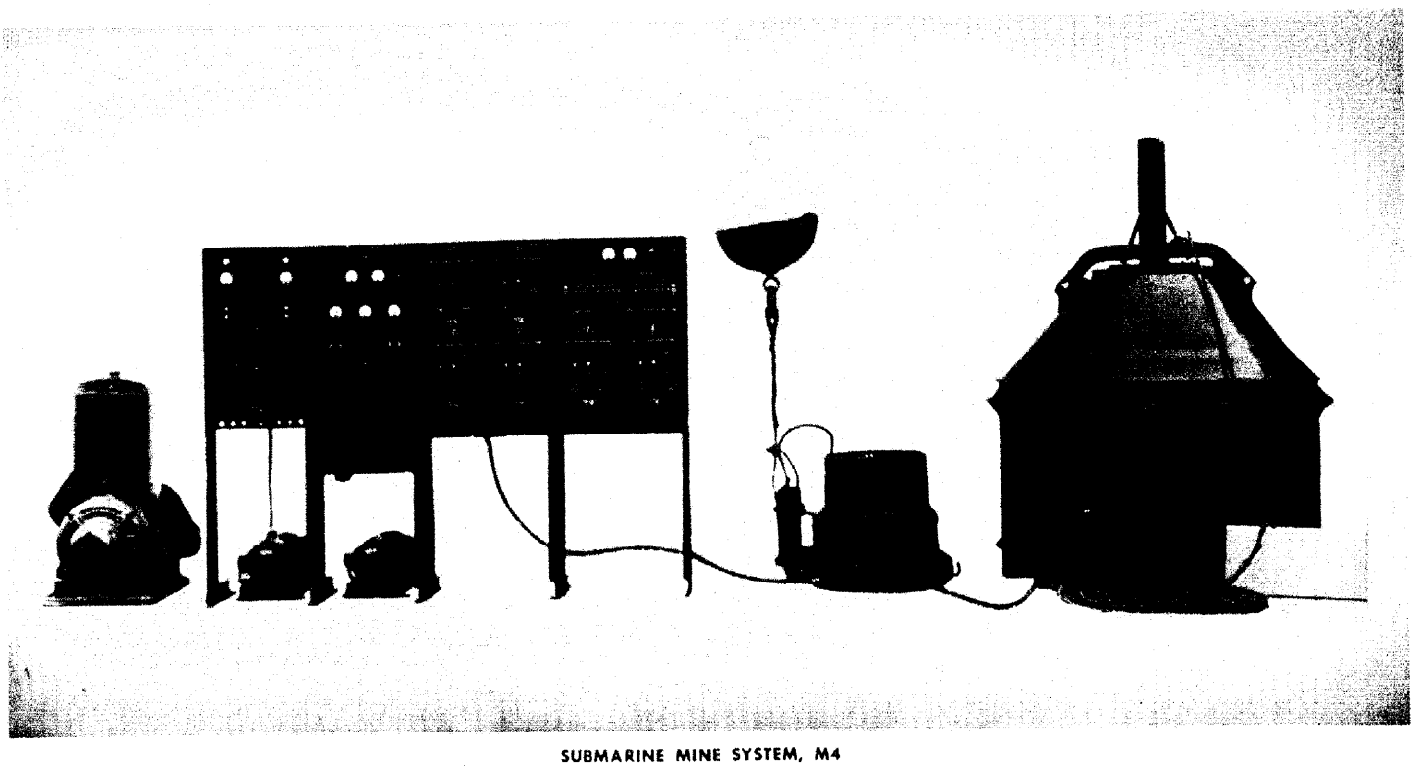
The Audio Reception System, M1, was developed as a result of a request from the Commanding Officer of Fort Mills, Corregidor, P.I., for some method of determining the difference between bomb or shell bursts and an approaching hostile vessel when mines in a defense field were armed. As designed, the system will distinguish between mines being armed by the explosion of depth bombs, aerial bombs, and shells, by wave action, and by the approach of a vessel.

The distinctive sounds of an approaching vessel are audible at distances of from 500 to 3,500 yards, depending on hydrographic conditions. The audible sounds are picked up and translated to a visual signal as the vessel comes closer to the hydrophones. Experienced operators can often identify the nature of a vessel as it passes over the line by the character of its signature and sound output.

The audio reception system is composed of underwater and shore equipment. The underwater components consist of two hydrophones connected together and to the shore equipment by single-conductor submarine mine cable. The shore equipment comprises a preamplifier installed in an M1 selector box buried in the beach where the cable comes ashore; a main amplifier, including a loud speaker, which is connected to the preamplifier; and a sound recorder which is a standard 5 milliampere, direct current, recording milliammeter. The sound recorder graphically translates sound reception in a series of lines varying in length and character according to the nature and volume of the originating sounds.

REFERENCE—Coast Artillery Training Bulletin, Vol. I, No. 14, "Audio Reception System, M-1."

ARMY CONTROLLED SUBMARINE MINES



SUBMARINE MINE SYSTEM, M4

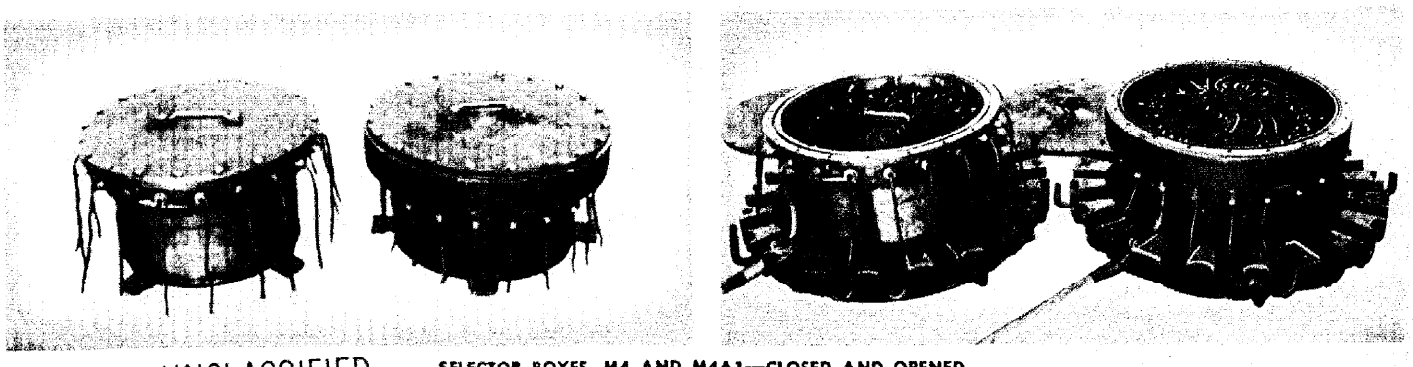
SUBMARINE MINE SYSTEM, M3 (BUOYANT)

The Submarine Mine System, M3, is composed of underwater and shore units. The underwater equipment consists of loaded mines, distribution boxes containing selector boxes and selector assemblies, mine cables, mooring and raising ropes, anchors, and buoys. The shore equipment comprises electric power plants and control panels situated in the casemate for electrically controlling the mines, and land cables for electrically connecting the control panels to the groups of mines. Specifically, the land cables establish electrical connection between the casemate and the terminal huts near the water's edge.

CASEMATE CONTROL SYSTEM, M3—This system is composed of a series of panels from which all planted mines are fired, cleared, or tested. Each group of underwater equipment is connected to the shore equipment by a single-conductor submarine cable which extends from the selector assembly to the shore cable. The shore control equipment requires a permanent casemate installation.

SELECTOR ASSEMBLY, M3—The selector assembly in the planted distribution box provides a means for electrically selecting, testing, or firing any mine in the group which it controls.

SELECTOR BOXES, M4 AND M4A1—The Selector Boxes, M4 and M4A1, provide watertight, shockproof containers for the selector assembly and a means for connecting the shore cable and mine cables to their corresponding leads in the selector assembly.



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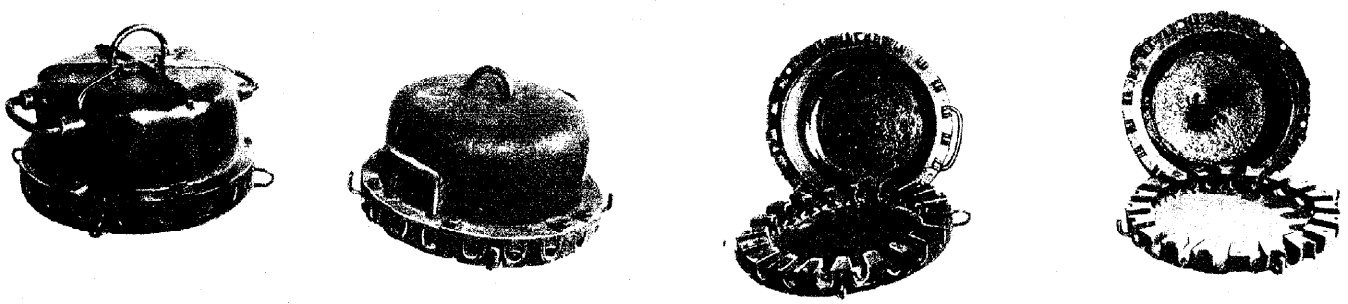
SELECTOR BOXES, M4 AND M4A1—CLOSED AND OPENED



DISTRIBUTION BOXES, M2B1 AND M2—CLOSED AND OPENED

DISTRIBUTION BOXES, M2 AND M2B1—the Distribution Boxes, M2 and M2B1, provide a rigid clamp for holding the ends of the shore and the mine cables to give mechanical protection to the selector box.

MINE CABLE, M4—This cable has a 7-strand, soft-drawn, annealed copper conductor, covered by a $\frac{3}{32}$ inch layer of insulating compound containing 50% crude rubber or Buna S by weight. Number 12 galvanized steel armor wire provides a protective cover for the insulation.

BUOYANT MINE CASE, M2—The Mine Case, M2, has a cylindrical center section with flanged, curved end sections. It contains a firing device, M4A1, which is actuated by impact of a vessel. It is loaded with from 300 to 500 pounds of granulated TNT depending on hydrographic conditions. In the M3 system the mines may be fired by manual control from shore, in conjunction with observation fire, or automatically when the mine is struck by a vessel. The mine will not fire when struck unless the firing power switch is closed.

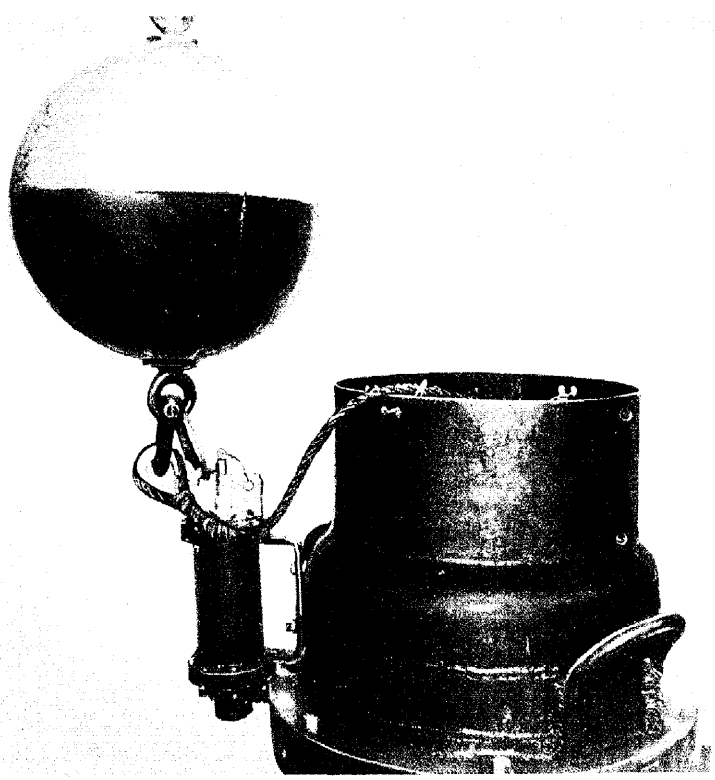
CAST-IRON MINE ANCHORS—Anchors of 1,000, 2,000, or 3,000 pounds are supplied, the size depending upon the weight necessary to hold the buoyant mine case at the proper submergence and in its proper location under all conditions of weather, tide, and firing of adjacent mines.

MINE BUOY, WOODEN BLOCK TYPE—These buoys are used to mark the positions of mines during planting operations.

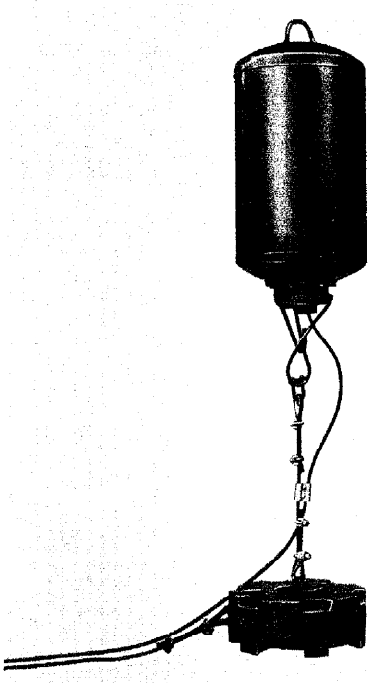
STEEL MARKING BUOYS—These buoys are used to mark the position of the distribution box and the line of mines prior to and during planting.

SUBMARINE MINE SYSTEM, M4 (GROUND)

This system differs from the M3 in that the mine employed rests on the floor of the ocean and is influence operated. It is, therefore, spoken of as a ground mine. The magnetic field of an approaching



DISTRIBUTION BOX RELEASE BUOY



BUOYANT MINE CASE, M2, ATTACHED TO A CAST-IRON ANCHOR. THIS MINE CASE IS USED WITH SUBMARINE MINE SYSTEM, M3

vessel induces a minute current in the windings of a coil rod. This current then causes a series of relays to operate resulting in the mine control system selecting the mine. Ground mines may be set for fire automatically when influenced, or for manual firing upon receipt of a signal in the casemate. Observation firing may be employed from data transmitted from the shore stations to the plotting room. The ground mine will not fire unless the firing power switch is closed.

GROUND MINE CASES, M3 AND M3A1—The Ground Mine Cases, M3 and M3A1, are similar except for the manner in which they are reinforced and a provision on the case, M3A1, for lead or iron loading to give additional weight where hydrographic conditions so necessitate. Both cases are welded steel containers designed to hold 3,000 pounds of granular TNT. The base of either case is flat to permit resting on the bottom of the sea. The firing device, M5, is located in the lower part of the case. The booster charge, electrically connected to the firing device, is approximately in the center of the mine, close to the bottom. The loaded case weighs approximately 5,800 pounds.

EMERGENCY MINE CONTROL, M4—The Emergency Mine Control, M4, is a compact and readily portable unit for the control of 10 groups of buoyant or ground mines. It is designed for either independent or parallel operation with the standard Mine Control, M3. For carrying, it is broken down into three components: the operating panel—19″ high, 25½″ wide, and 20″ deep, weighing 75 pounds; a power pack—16″ high, 25½″ wide, and 19″ deep, weighing 104 pounds; and the power plant composed of a generator rated at 2½ KVA, 130 volts, 60 cycle AC, driven by a 6.5 hp. single cylinder, 4-cycle gasoline engine, Signal Corps type PE-75, weighing 324 pounds.

The M4 control may be installed and operated in submarine mine casemates, on L-boats, mine planters, or in any emergency shelter as required by the tactical situation.

Two power plants are provided for each 10-group control so that plants can be serviced without interruption of mine protection.

Any power source capable of supplying at least 2½ KVA of 110-volt, 60-cycle electric power may be used instead of the gasoline driven plant where installation does not require portability.

PORTABLE CABLE REELER, M1—The portable cable reeler is a mechanical unit designed to reel and unreel submarine mine cable. The use of mechanical power to rotate the reels cuts to a minimum the time and manpower required. The cable reeler can be used for all types of cable reeling work such as rereeling, repairing cable, unreeling for figure eights, and measuring cable lengths.

The crew required to reel cable from one reel to another after setting up the equipment is three men instead of the eight men needed formerly. 10,000 feet of cable can be rewound in 2½ hours' operation. Use of the M1 reeler also tends to eliminate hand injuries which are frequent when cables are reeled manually.

The variable speeds of the machine allow the operator to select the most practical speed to make smooth and uniform lays.

More cable will be reeled per hour with steady operation at medium speeds than with intermittent operation at high speeds.

The power unit of the portable cable reeler is a 6.5 hp. single cylinder, 4-cycle, air-cooled gasoline engine running at 2,700 r.p.m. This engine is identical with the engine used in Power Unit, PE-75-5, procured by the Signal Corps, U. S. Army. The power is taken off by a quadruple "V" belt driving an expanding type clutch.

The operation of the clutch is accomplished by remote control through the medium of a vacuum cylinder controlled by a solenoid that derives its power from a 6-volt battery. Functioning of the solenoid is effected by a foot pedal. Hand operation of the clutch is provided for in case of failure of the vacuum control system.

Selection of three forward speeds of 4, 8, and 15 r.p.m. and one reverse speed of 3 r.p.m. is by an automobile truck transmission.

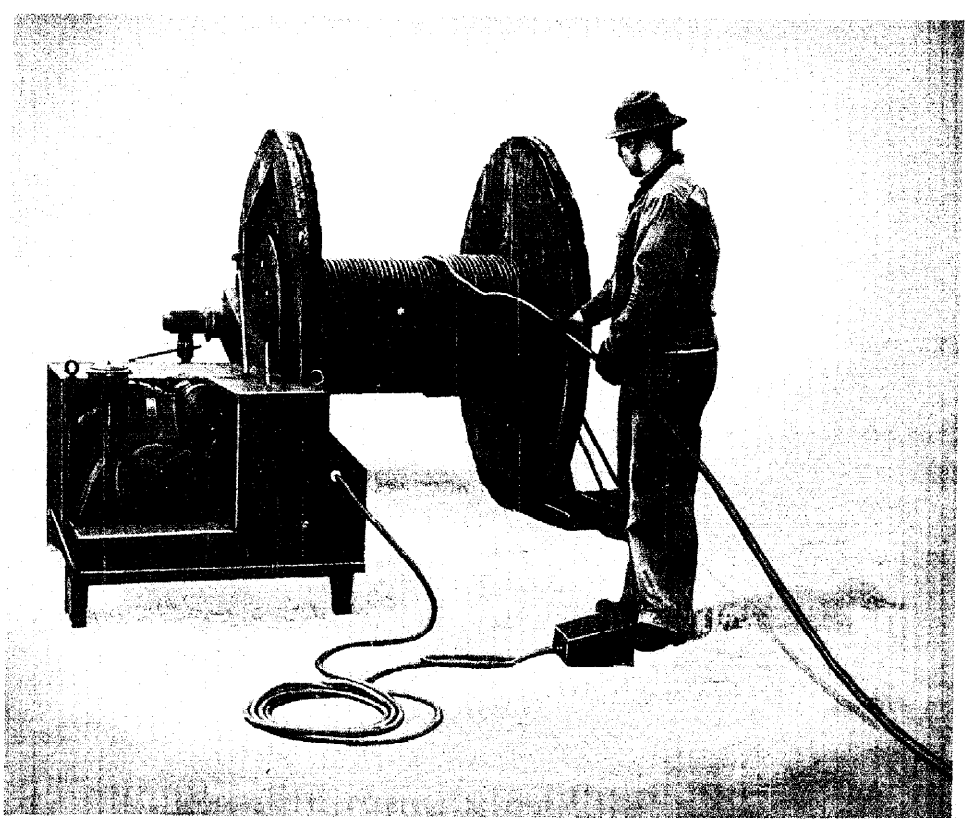
Reduction of output of the transmission to three forward and one reverse speeds is by a 32 to 1 worm gear speed reducer.

The battery is kept in fully charged condition by a generator connected to the transmission drive shaft. Charging rate is controlled automatically by a voltage regulator.

Reels weighing not more than 6 tons can be used on this cable reeling machine by properly connecting the output end of the driving arm to the driven reel.

The cable reeler is built on a four leg platform and can be moved about by means of a Mechanical Lift Truck, Submarine Mine Depot, No. 5395.

REFERENCES — OCM 21657; OCM 22015.



PORTABLE CABLE REELER, M1

FIRE CONTROL
MOBILE ARTILLERY

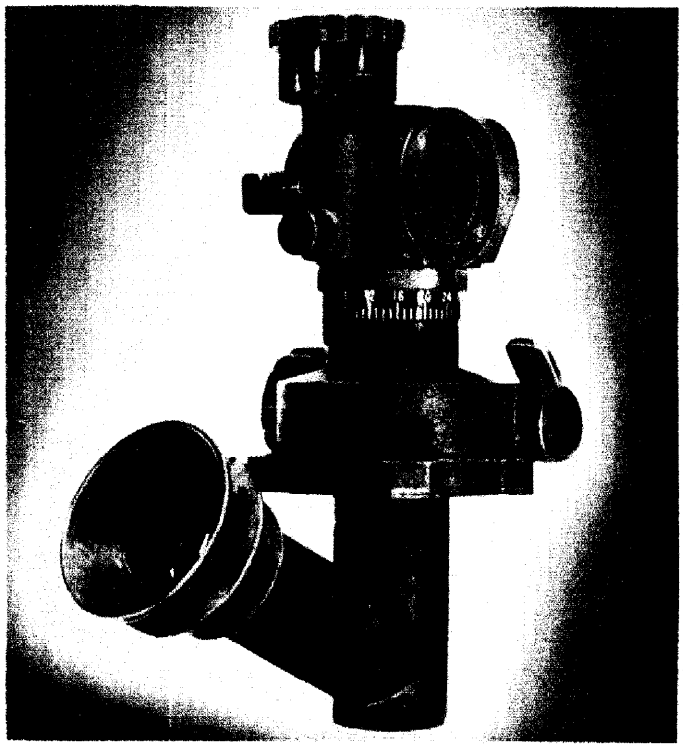
PANORAMIC TELESCOPES FOR USE WITH MOBILE ARTILLERY

A panoramic telescope provides a means for sighting a gun or howitzer and for laying it in azimuth. Reticle markings in some of these instruments allow the use of the telescope for laying the weapon in elevation in direct fire. The telescope is attached to the left side of the carriage by means of a mount, some models of which contain certain indicating elements.

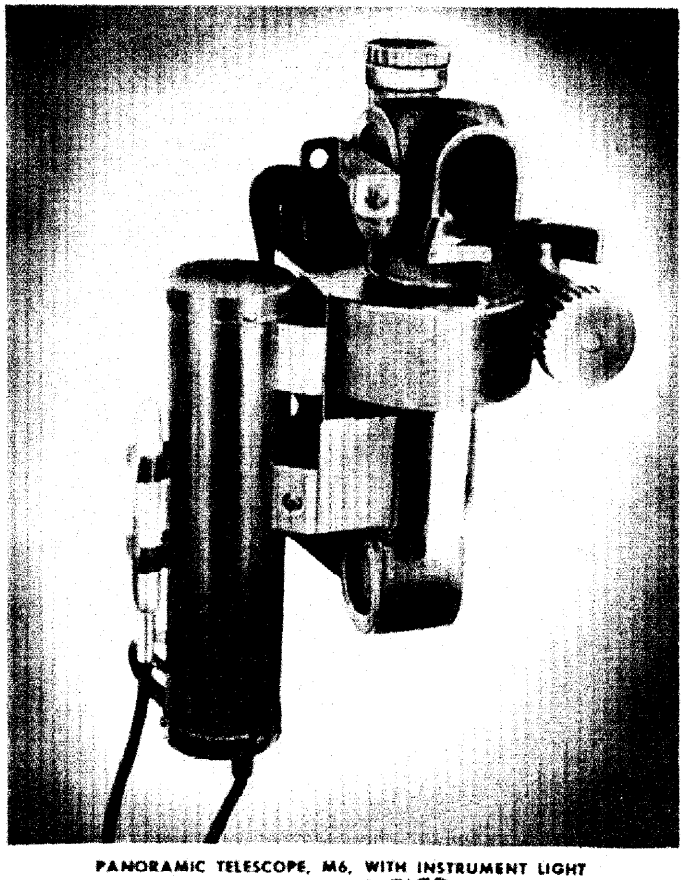
The panoramic telescope is a fixed-focus, erect-image, vertical telescope of the periscope type, with an optical system composed of various prisms and lenses, and a reticle to facilitate aiming. The objective prism can be elevated and depressed to bring the target into view. It can also be rotated through a complete circle, thereby enabling the target to be kept constantly in view while the observer remains in the same position. Rotating prisms in the rotating head and housing insure accurate and erect images at all azimuths. The rotation of the elevating prism and the dove prism is accomplished by a worm mechanism with a throwout device for rapid changes in azimuth.

At present, there are several standard panoramic telescopes. All contain basically the same parts and have the same general appearance. They differ chiefly in optical characteristics, in the markings of the reticle, in the relation of the head to the eyepiece, and in minor matters affecting only the appearance of the instrument.

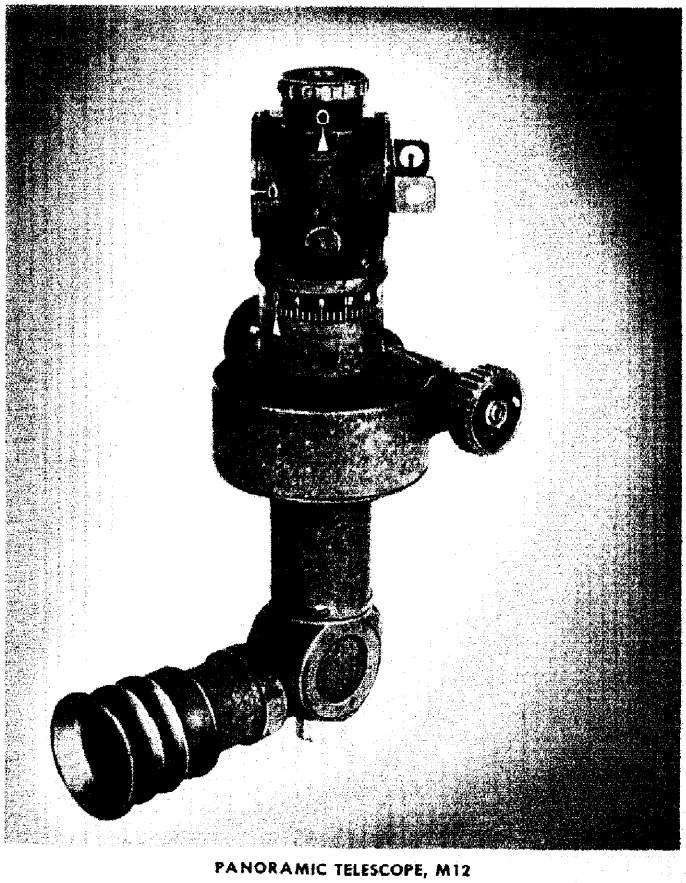
At the top of the panoramic telescope is an elevation knob by which the instrument is elevated or depressed to give the proper



PANORAMIC TELESCOPE, M1



PANORAMIC TELESCOPE, M6, WITH INSTRUMENT LIGHT



PANORAMIC TELESCOPE, M12

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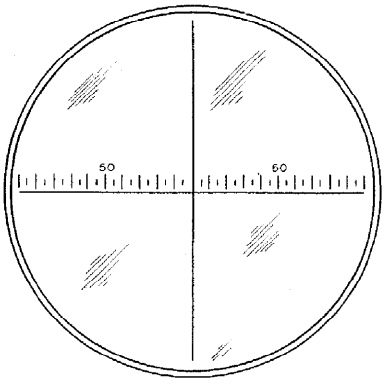
line of sight. Zero graduations and accompanying indexes on the elevation knob and on the rotating head below are matched to set the instrument for a horizontal line of sight.

The azimuth scale is graduated in 100-mil intervals from 0 to 32 and from 32 back to 0. An azimuth micrometer covers 100 mils at 1-mil intervals. Open sights are provided on each telescope.

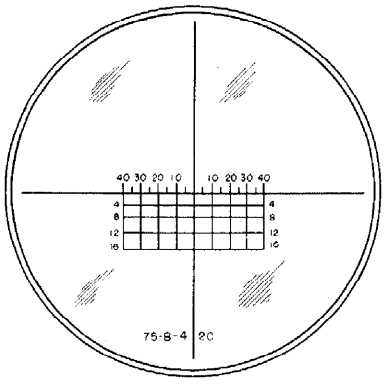
Reticles and scales of panoramic telescopes are illuminated by self-contained instrument lights.

Optical Characteristics of Panoramic Telescope, M1

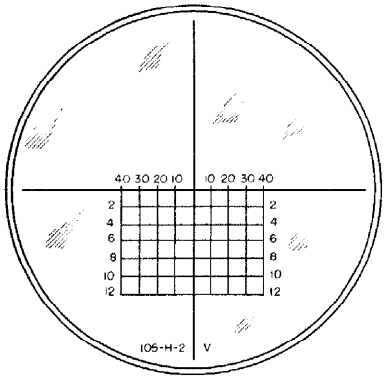
Magnification	3 power
Field of view	12° 12′
Diameter of exit pupil	0.15″
Effective focal length of objective	2.362″
Effective focal length of eyepiece	0.784″



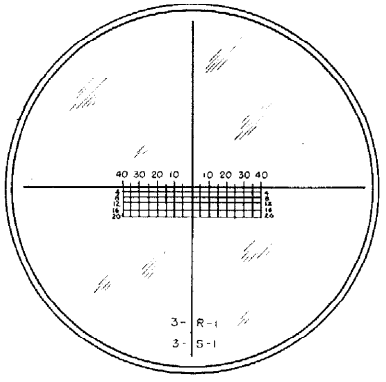
M12



M12A1



M12A2



M12A3

RETICLE PATTERNS FOR THE M12 SERIES OF PANORAMIC TELESCOPES

PANORAMIC TELESCOPE, M1

Panoramic Telescope	Telescope Mount	Instrument Light	Gun Carriage	Status of Carriage	Additional on-carriage equipment for this matériel
M1	M3A1C	M13	75 mm Pack Howitzer Carriages, M1, M8	Standard	None
M1	M16A1	M20	75 mm Howitzer Carriages, M3A2, M3A3	Standard	Range Quadrant, M3 Instrument Light, M18 Elbow Telescope, M5
M1	M16A1	M20	75 mm Howitzer Carriages, M2A1, M3, M3A1	Limited Standard	Range Quadrant, M3 Instrument Light, M18 Elbow Telescope, M5
M1	M16A1	M20	105 mm Howitzer Carriage, M3A1	Standard	Range Quadrant, M8 Elbow Telescope, M61
M1	M16	M20	105 mm Howitzer Carriage, M3A1	Standard	Range Quadrant, M8 Elbow Telescope, M61

A distinguishing point of this telescope is that the eyepiece slants upward at an angle of 25°; in other standard panoramic telescopes, the eyepiece is horizontal.

Where Panoramic Telescope, M1, is not available, Elbow Telescope, M62, and Telescope Adapter, M9, with a 1-inch filler, can be used as a substitute for the panoramic telescope.

TELESCOPE MOUNT, M3—This mount supports the Panoramic Telescope, M1, on the cradle of the 75 mm pack howitzer. It is mounted on a socket which is supported on a central pivot. The latter is aligned to the bore of the weapon. It automatically applies to the azimuth and the angle of elevation any necessary correction for trunnion cant.

This mount completes the sighting equipment for the 75 mm pack howitzer, containing within itself leveling, cross-leveling, angle-of-site, and elevation mechanisms.

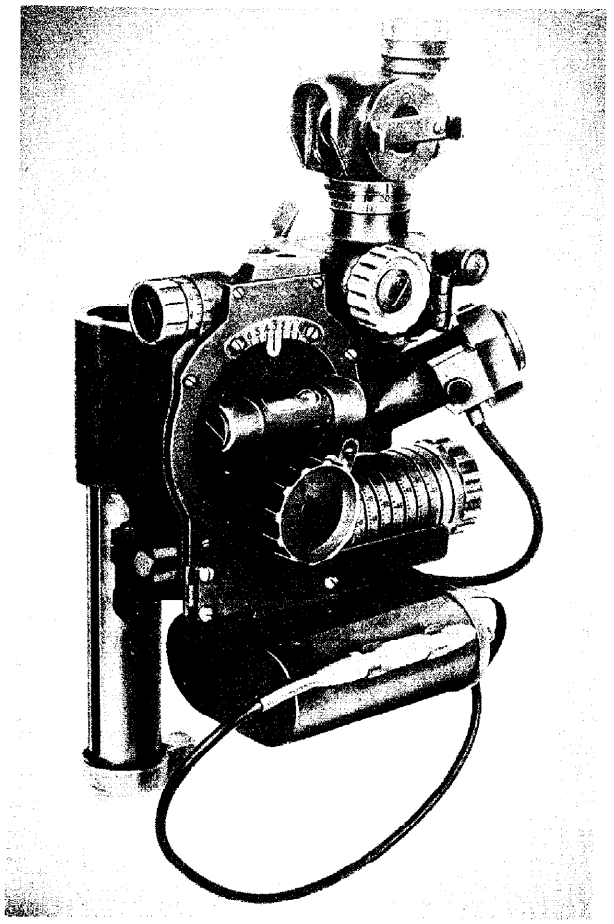
An elevating knob operates an elevation scale which is graduated in 100-mil intervals and an elevation micrometer which is graduated in 1-mil intervals. The elevating knob is attached to a range drum which is scaled in yards.

The angle-of-site mechanism consists of an angle-of-site level vial and a 600-mil scale and associated micrometer scale, operated by the angle-of-site micrometer knob.

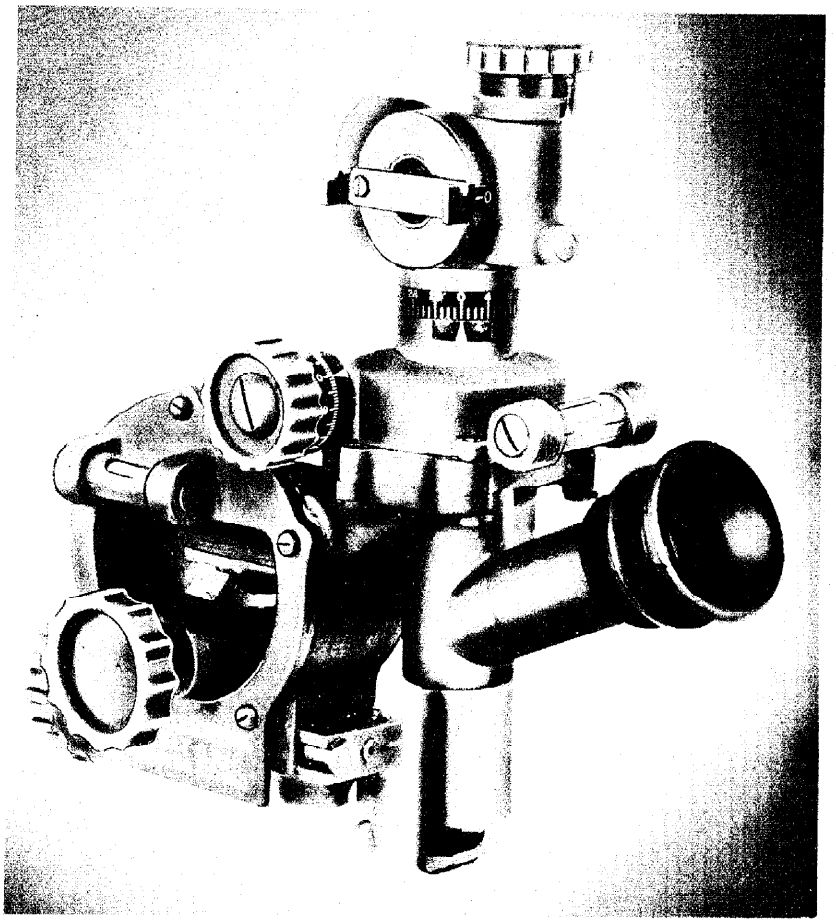
Telescope Mount, M3 has been reclassified as Limited Standard. All mounts are to be modified to M3A1C status.

TELESCOPE MOUNT, M3A1C—This telescope mount, now standard in place of the M3, consists of Telescope Mount, M3, modified to permit its use at elevations up to 65°. Telescope Mount, M3, can indicate a maximum elevation of only 45°.

TELESCOPE MOUNT, M16—This mount supports the Panoramic Telescope, M1, on the 75 mm field howitzer carriage. It contains leveling and cross-leveling mechanisms. The gun is laid in elevation by means of the range quadrant which is mounted on the right side of the carriage.



TELESCOPE MOUNT, M3, WITH INSTRUMENT LIGHT, M13



TELESCOPE MOUNT, M16, WITH PANORAMIC TELESCOPE, M1

TELESCOPE MOUNT, M16 has been reclassified as Limited Standard. All mounts are to be modified to M16A1 status.

TELESCOPE MOUNT, M16A1—This telescope mount is standard for use on 75 mm howitzer carriages in place of the M16. It is an M16 telescope mount modified to permit its use at elevations up to 65°.

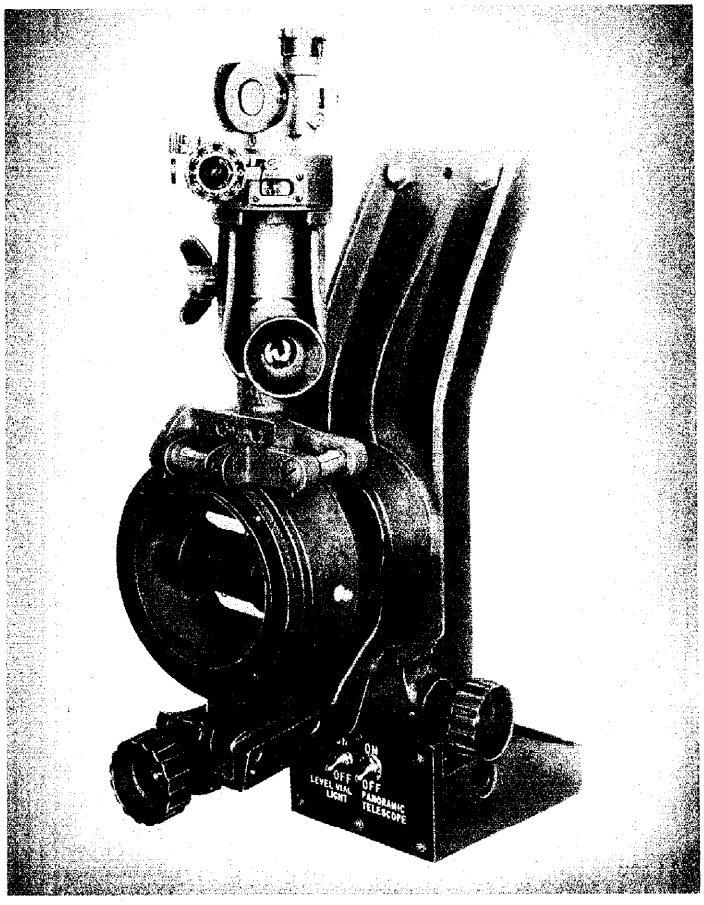
Optical Characteristics of Panoramic Telescope, M6

Power	4
Field of view	10°
Diameter of exit pupil	1.66″
Effective focal length of objective	3.135″
Effective focal length of eyepiece	0.788″

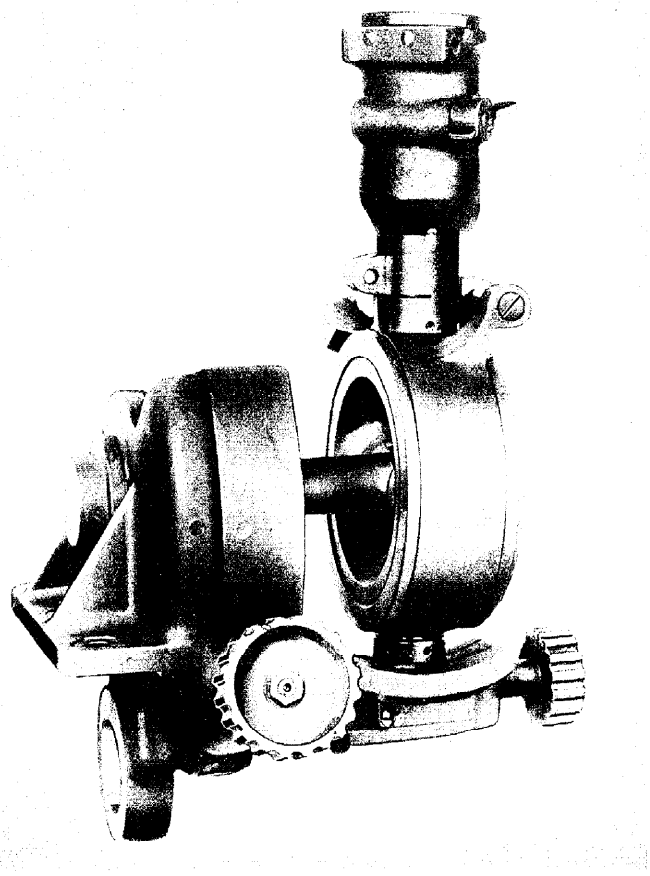
This instrument, itself standard, is used only on certain limited standard and substitute standard matériel. It has a reticle with a vertical and a horizontal crossline. The latter is graduated in mils to indicate deviations from the central position. An open sight on the side of the rotating head permits rapid approximate aiming.

PANORAMIC TELESCOPE, M6

Panoramic Telescope	Instrument Light	Gun Carriage	Status of Carriage	Additional on-carriage equipment for this matériel
M6	M9	75 mm Gun Carriages, M1916, M1916A1, M1916M1, M1916M1A1	Limited Standard	Sight, M1916 (L.S.)
M6	M9	75 mm Gun Carriages M1917, M1917A1	Limited Standard	Rocking Bar Sight (L.S.)
M6	M9	2.95″ V.M. Gun Carriage	Limited Standard	Sight, M1912 (L.S.)
M6	M9	155 mm Gun Carriage, M3	Substitute Standard	Quadrant Sight, M1918A1
M6	M9	155 mm Gun Carriages, M1917, M1917A1, M1918, M1918A1, M2	Limited Standard	Quadrant Sight, M1918A1 & M1918 (L.S.)
M6	M9	155 mm Howitzer Carriages, M1918A1	Substitute Standard	Quadrant Sight, M1918A1
M6	M9	155 mm Howitzer Carriages M1917, M1918, M1917A3	Limited Standard	Quadrant Sight, M1918 (L.S.)
M6	M9	8″ Howitzer Carriage, M1917, U.S.	Limited Standard	Rocking Bar Sight, Type A (L.S.)
M6	M9	8″ Howitzer Carriage, M1918, U.S.	Limited Standard	Rocking Bar Sight, Type B (L.S.)
M6	M9	240 mm Howitzer Carriage, M1918A2	Substitute Standard	Quadrant Sight, M1918A1
M6	M9	155 mm Gun Motor Carriage, M12	Standard	Quadrant Sight, M1918 (L.S.) Telescope, M53A1 Telescope Mount, M40



TELESCOPE MOUNT, M18A1
(WITH SUBSTITUTE STANDARD PANORAMIC TELESCOPE, M5A5)



TELESCOPE MOUNT, M21A1

PANORAMIC TELESCOPES, M12 SERIES

Panoramic Telescope	Telescope Mount	Instrument Light	Gun Carriage	Status of Carriage	Other sighting equipment used with this materiel
M12	M18A1	M19	155 mm Gun Carriage, M1	Standard	Quadrant Mount, M1 Instrument Light, M12
M12	M18A1	M19	8″ Howitzer Carriage, M1	Standard	Quadrant Mount, M1 Instrument Light, M12
M12	M30	M22 M35	240 mm Howitzer Carriage, M1, and 8″ Gun Carriage, M2	Standard	Elevation Quadrant, M1 Quadrant Adapter, M10
M12	M25	M34	4.5″ Gun Carriage, M1	Standard	———
M12	M25	M34	155 mm Howitzer Carriage, M1	Standard	———
M12A1	M22	M19	75 mm Gun Carriage, M2A3	Standard	Elbow Telescope, M14A1* Range Quadrant, M5 Telescope Mount, M23
M12A2	M21A1	M19	105 mm Howitzer Carriage, M2 series	Standard	Range Quadrant, M4 Telescope Mount, M23 Elbow Telescope, M16A1D*
M12A2	M21A1	M19	105 mm Howitzer Motor Carriage, M7, M7B1	Standard	Range Quadrant, M4 Telescope Mount, M42 Elbow Telescope, M16A1C*
M12A3	M21A1(S.) or M41A2 (L.S.)	M19	3″ A.T. Gun Carriage, M6 3″ A.T. Gun Carriage, M1A1	Standard Substitute Standard	Range Quadrant, M10C Telescope Mount, M23 Elbow Telescope, M29A1* Telescope Mount, M61A1 Telescope, M79C Instrument Light, M33

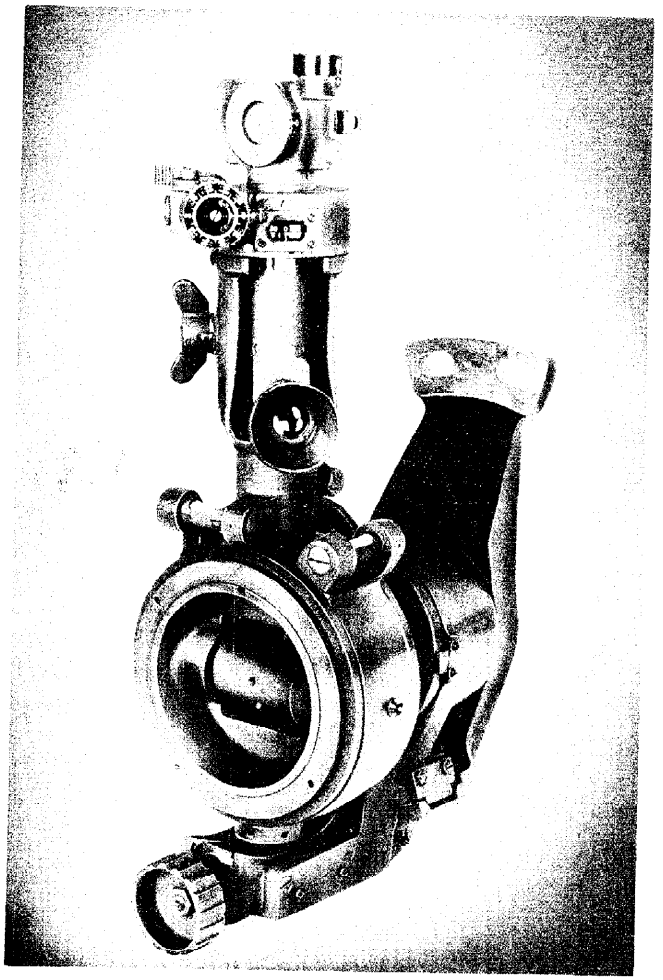
*Uses Instrument Light, M36.

The main distinguishing point of this instrument is in its method of mounting, no separate mount being required. Instead, there is a T-lug on the telescope shank which fits into a corresponding T-shank which is in most cases located on the second item of sighting equipment.

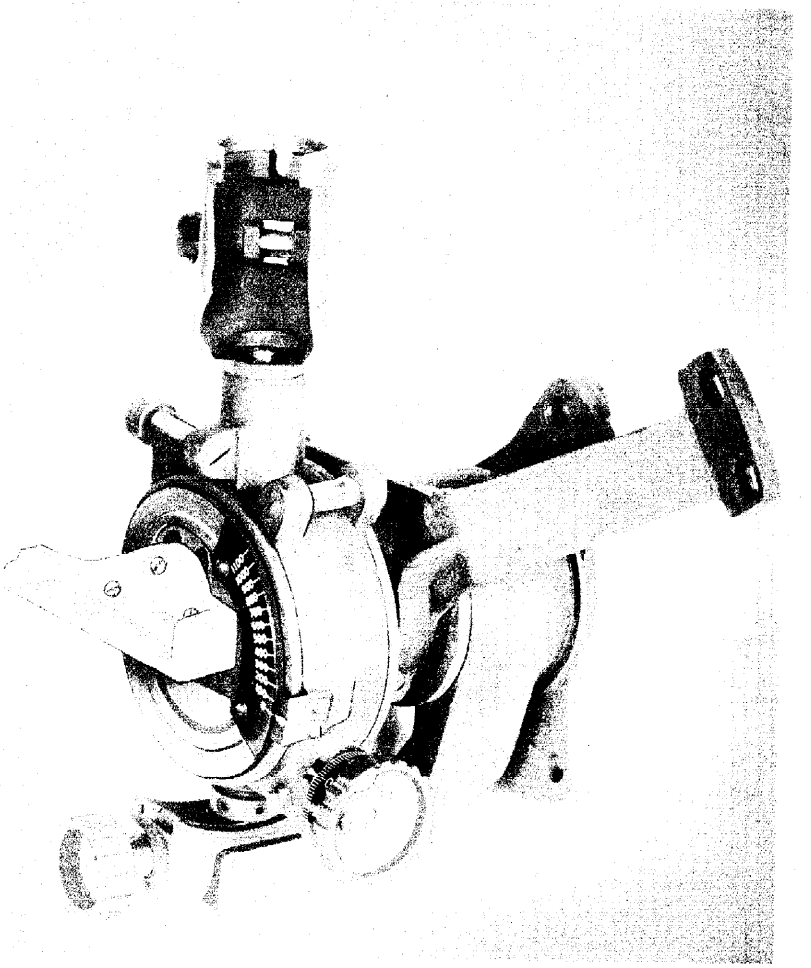
Optical Characteristics of Panoramic Telescope, M12

Power	4
Field of view	10°
Diameter of exit pupil	0.165″
Effective focal length of objective	4.004″
Effective focal length of eyepiece	1″

The four standard panoramic telescopes of the M12 series are identical except for the patterns of the reticles. In appearance and optical characteristics, they are similar to the M6.



TELESCOPE MOUNT, M22
(WITH SUBSTITUTE STANDARD PANORAMIC TELESCOPE, M5A4)



TELESCOPE MOUNT, M25—LEFT REAR VIEW

PANORAMIC TELESCOPE, M12—The reticle has a horizontal and a vertical line intersecting at right angles. The horizontal line is graduated at 5-mil intervals, indicating 100 mils to the right and to the left of the center.

PANORAMIC TELESCOPES, M12A1, M12A2, M12A3—In addition to the central vertical and horizontal crosslines, the reticles of these telescopes have parallel horizontal and vertical lines below the central horizontal crossline to indicate the elevations for various ranges. The lines are spaced differently in each of the four models in order to apply to a specific weapon and ammunition. The number of the firing table from which the range-elevation data for graduating the reticle was taken is engraved at the bottom of each reticle.

Direct laying of these guns in both azimuth and elevation is therefore possible with the use of the panoramic telescope and mount only. Whenever possible, however, the panoramic telescope is used only for indirect laying of the gun in direction.

MOUNTS FOR PANORAMIC TELESCOPES, M12 SERIES—These mounts differ in the way in which they are affixed to the gun carriage. All of them have leveling, cross-leveling, and azimuth-compensating mechanisms, and a socket into which the panoramic telescope is inserted and firmly held in place.

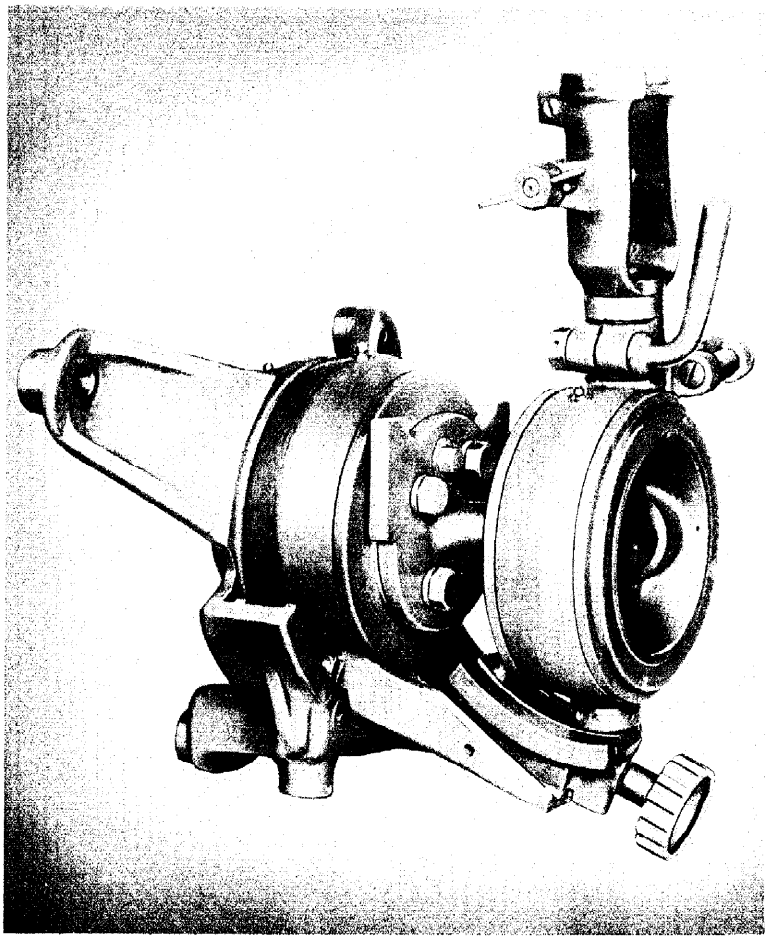
TELESCOPE MOUNT, M18A1—This mount has a housing which is firmly bolted to the left side of the carriage. The mount does not elevate with the gun.

TELESCOPE MOUNT, M21—This mount has a bracket which fits over the left cradle trunnion, being attached to the cradle. The mount elevates with the gun.

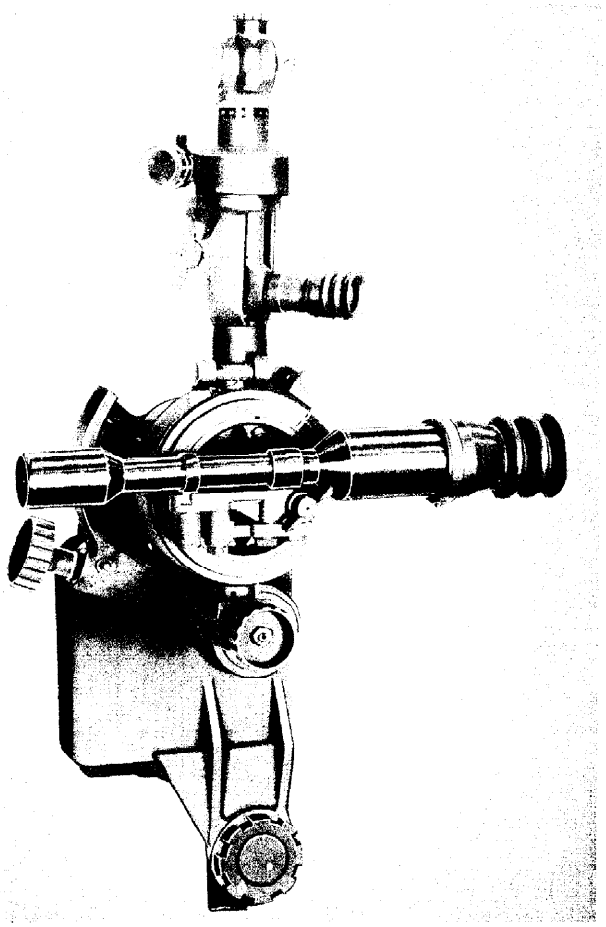
TELESCOPE MOUNT, M21A1—This consists of Telescope Mount, M21, with a locking device added to the fore and aft leveling worms. It is standard for use on 3 inch matériel and on the 105 mm Howitzer Carriage, M2, and the 105 mm Howitzer Motor Carriage, M7.

TELESCOPE MOUNT, M22—This mount is bracketed to the upper cross-arm on the gun cradle and is centered on a prolongation of the left trunnion extending into the actuating arm of the mount. It therefore rotates in elevation with the gun.

TELESCOPE MOUNT, M25—This mount, with the Panoramic Telescope, M12, constitutes the complete sighting equipment for the 4.5″ Gun Carriage, M1, and the 155 mm Howitzer Carriage, M1. In addition to forming the support for the panoramic telescope, the mount has



TELESCOPE MOUNT, M30



TELESCOPE MOUNT, M41A1, WITH PANORAMIC TELESCOPE, M12A3, AND DIRECT SIGHTING TELESCOPE

incorporated into it mechanisms for laying the weapon in elevation.

Attached to the mount are an actuating arm bracket and another bracket which is attached to the gun carriage. Both brackets are bolted to a third bracket which is, in turn, bolted to the end of the left trunnion.

The actuating arm bracket supports the pivot for the cross-leveling mechanism. The actuating arm itself acts as a pivot for elevating the longitudinal leveling mechanism.

The elevating mechanism is actuated by the elevating worm which causes the body assembly and the rocker to rotate about the actuating arm. The elevation scale is graduated at 100-mil intervals, from 0 to 1,100 mils with the 0 graduation indicating normal. An elevation micrometer covers 100 mils at 1-mil intervals.

TELESCOPE MOUNT, M30 — This mount follows the general pattern of mounts for the M12 series panoramic telescopes, and since it is never used for laying the gun in elevation, it is mounted so that it does not elevate with the gun.

TELESCOPE MOUNTS, M41A1 and M41A2 — LIMITED STANDARD — Telescope Mount, M41A1, was formerly standard for use on 3-inch antitank guns. It was designed to mount both a M12A3 panoramic telescope and a straight Telescope, M41. The latter was used for direct laying in a one-man, one-sight system. This mount was originally developed by modifying Telescope Mount, M21, by the addition of an 8 inch filler piece and a new actuating arm which had an extension and bracket on the outer end to support the straight telescope.

With the standardization of Telescope, M79C, and Telescope Mount, M61A1, in place of Telescope, M41, there was no longer any requirement for a panoramic telescope mount with additional facilities for the mounting of a straight telescope. Telescope Mount, M41A1, has therefore been reduced to limited standard, and the M21A1 is standard. All M41A1 mounts are to be made similar to the standard mount, M21A1, by modification to M41A2 status. This requires the removal of the 8 inch filler piece and the straight telescope holder and the addition of a locking device to the fore and aft leveling worms.

REFERENCES—OS 9-16; TM 9-305; TM 9-1545; TM 9-1548; TM 9-1551; TM 9-1552; TM 9-1553; TM 9-1583; TM 9-1584; TM 9-2005, v.5; TM 9-2674.

RANGE QUADRANTS M3A1C, M4, M5, M8, M10C STANDARD—M3 LIMITED STANDARD

STANDARD RANGE QUADRANTS

Range Quadrant	Gun Carriage
M3, M3A1C	75 mm Howitzer Carriages, M2A1, M3, M3A1, M3A2, M3A3
M4	105 mm Howitzer Carriages, M2, M2A1, M2A2
M5	75 mm Gun Carriage, M2A3
M8	105 mm Howitzer Carriage, M3A1
M10C	3 inch Gun Carriages, M1A1 and M6

A range quadrant is used for laying a gun or howitzer in elevation, for indirect fire. It is mounted on the right-hand side of the carriage so that any movement of the gun in elevation is imparted to the instrument.

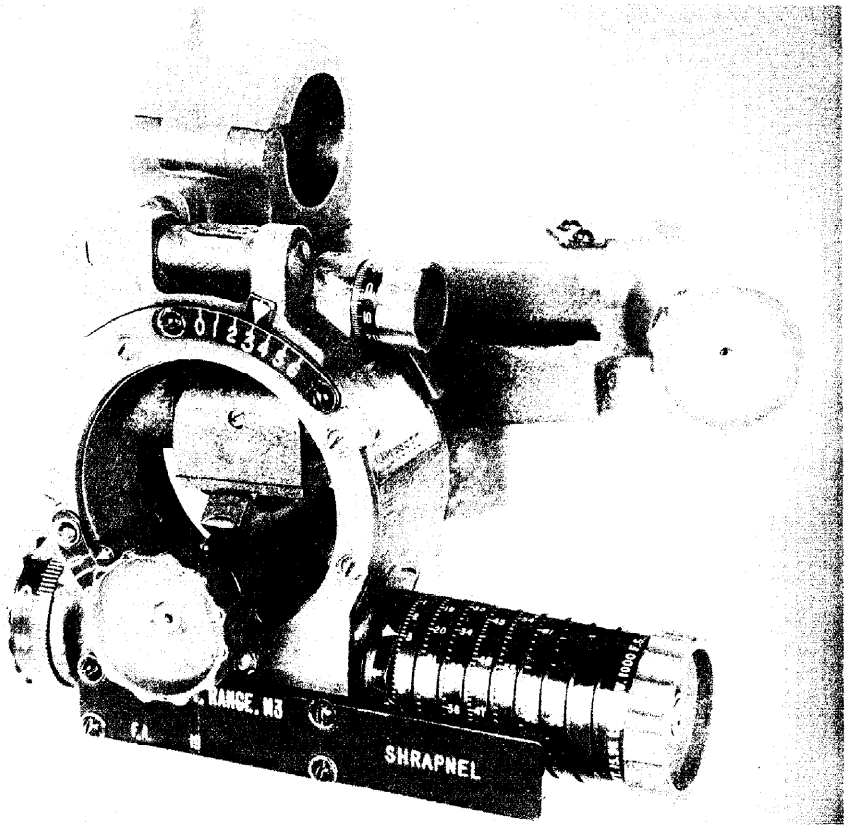
The five standard models of range quadrants are essentially the same, having the same general appearance, and performing the same functions. Each instrument has a cross-leveling mechanism, and a range-elevation mechanism which contains range and elevation scales. In addition, it has an angle-of-site level vial.

An elevation mechanism, which is contained in the elevating-worm housing, consists of an elevating-worm knob and accompanying mechanism, an elevation scale graduated into 100-mil intervals, an elevation micrometer covering 100 mils at 1-mil intervals, and a range drum.

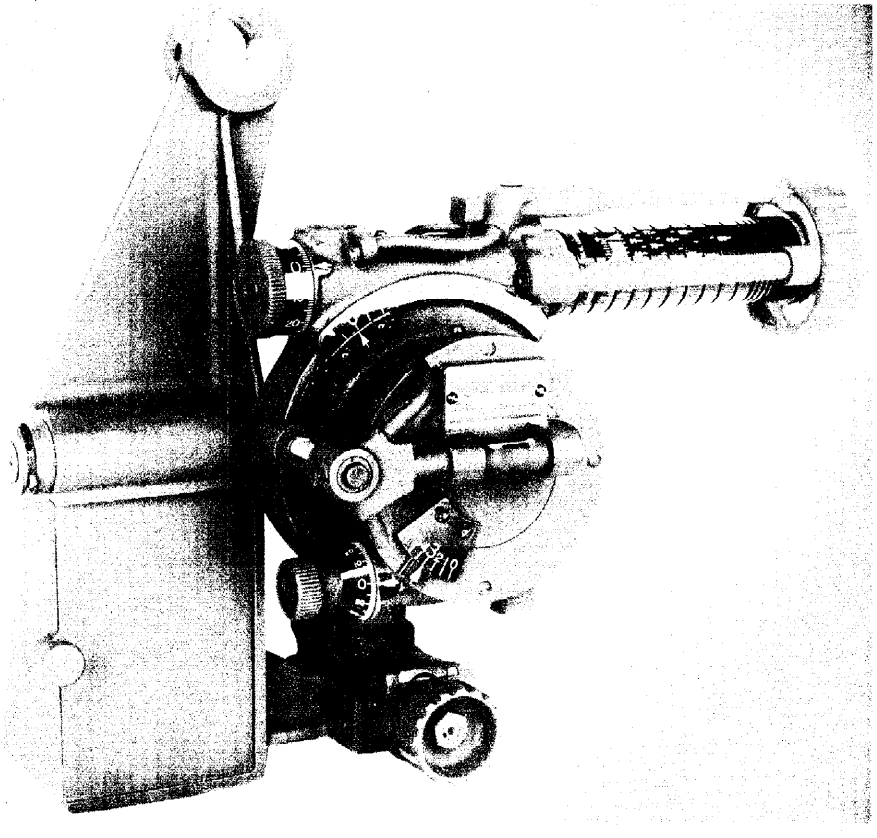
The angle-of-site scale, graduated in increments of 100 mils, represents a total of 600 mils. The normal angle of site is represented by the graduation "3." The angle-of-site micrometer is graduated into 100 equal spaces, each representing 1 mil. The centering of the longitudinal level vial indicates that the gun has been elevated to an angle equal to the angles shown on the scales. The angle-of-site mechanism is geared to the elevation mechanism, so that the angle of site and the angle of elevation are mechanically added together.

Each range drum is scaled for a specific weapon and a particular type of ammunition and powder charge. The drum is revolved until the index, which moves in a helical groove, is positioned at the desired range. At this time the correct elevation will be indicated by the elevation scale and micrometer.

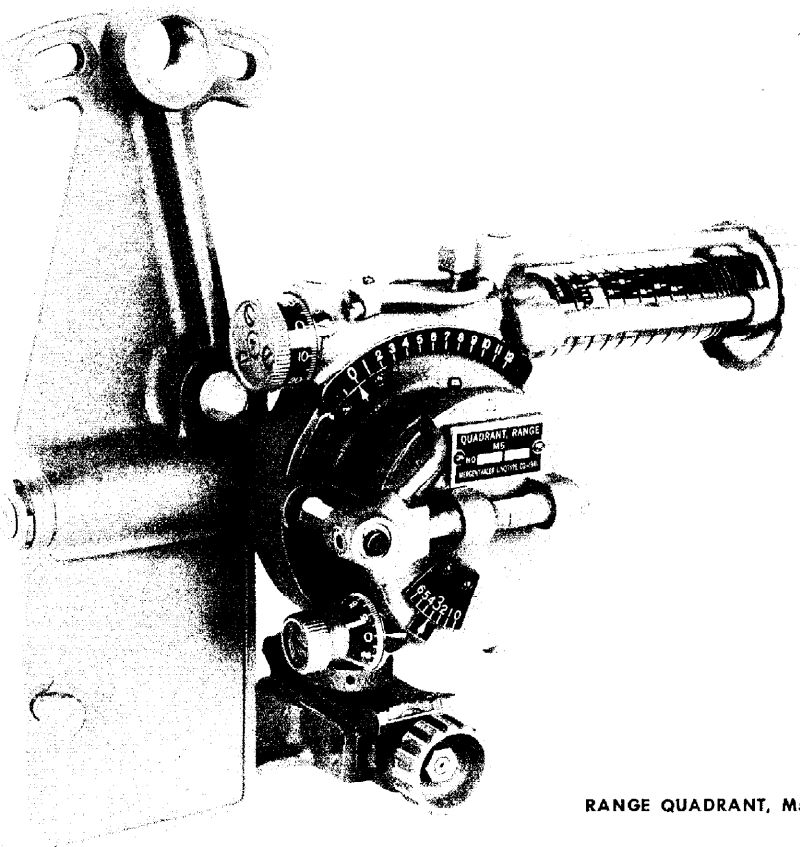
RANGE QUADRANT, M3—This instrument is inserted in a socket in the sight bracket on the right side of the cradle. The Elbow Telescope, M5, is clamped into a socket in the upper part of the range quadrant. The range quadrant has a lateral deflection mechanism for use with this telescope in direct fire only.



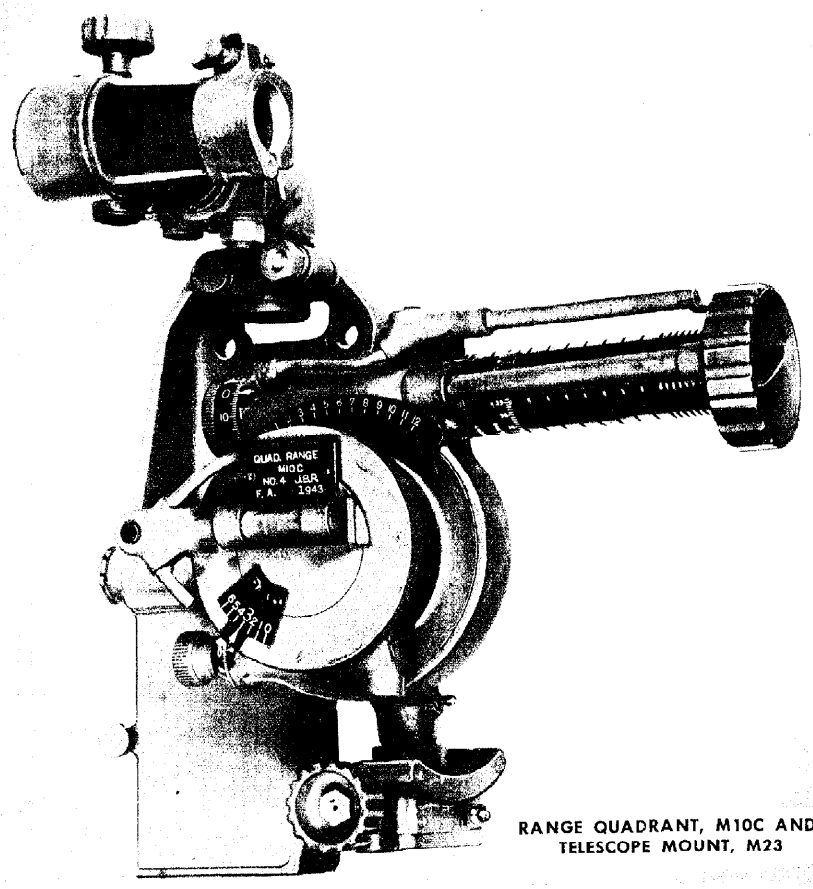
RANGE QUADRANT, M3 (M8 is similar except for change of range scales)



RANGE QUADRANT, M4



RANGE QUADRANT, M5



RANGE QUADRANT, M10C AND TELESCOPE MOUNT, M23

Illumination for the scales, levels and range drum is provided by means of Instrument Light, M18.

Range Quadrant, M3, has been reduced in classification to Limited Standard. All instruments will be modified to M3A1C status.

RANGE QUADRANT, M3A1C—Range Quadrant, M3A1C, consists of Range Quadrant, M3, modified to permit its use with the howitzer elevated up to 65°.

RANGE QUADRANT, M4—This range quadrant is mounted on a pad on the right side of the howitzer cradle. On a bracket in the upper part of this instrument are mounted the Telescope Mount, M23, and the Elbow Telescope, M16A1. Three range drums are provided, bearing range graduations for high-explosive shell for zones of fire III, V and VII.

A built-in lighting system with power supplied by four flashlight cells provides illumination for the elevation and angle-of-site scales and micrometers, the range drum, and the levels. The cells are contained in a battery box on the mounting bracket.

RANGE QUADRANT, M5—The mounting bracket of this instrument is supported on an extension of the right trunnion of the gun and on the guard of the gun cradle. The Telescope Mount, M23, which supports the Elbow Telescope, M14A1, is fastened to an extension on the upper part of this range quadrant. Four range drums are provided for use with four different kinds of ammunition. This instrument has a built-in lighting system similar to that used in the M4.

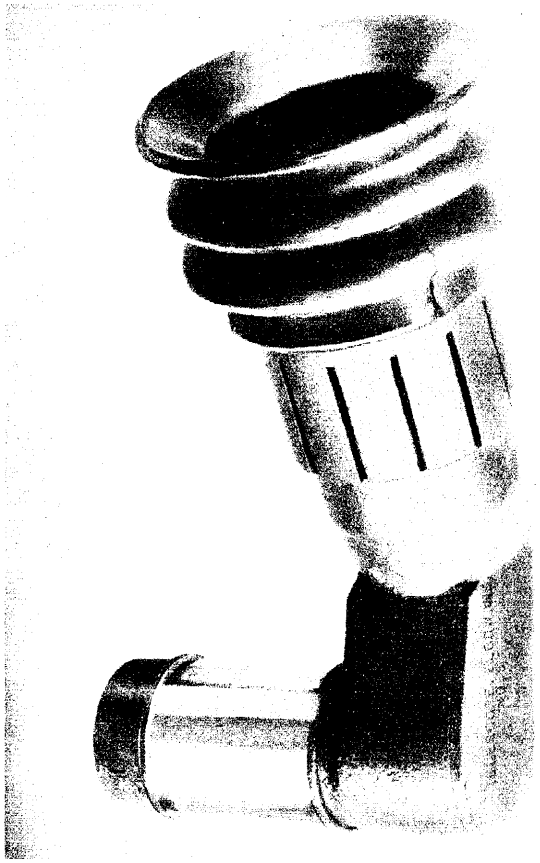
RANGE QUADRANT, M8—This range quadrant is mounted on a support on the right side of the howitzer cradle. The Elbow Telescope, M61, fits into a clamp in the upper part of the range quadrant. Only one range drum is provided. It is graduated in terms of the semifixed H.E. Shell, M1, with P.D. Fuze, M48, for zone IV. This range quadrant makes use of Instrument Light, M18.

RANGE QUADRANT, M10C—This range quadrant is similar to the M4 and M5 range quadrants, except that it has a range drum for the 3 inch H.E. Shell, M42, with Fuze, P.D., M48, muzzle velocity 2,800 feet per second, and mounts by four bolts without a trunnion pin support.

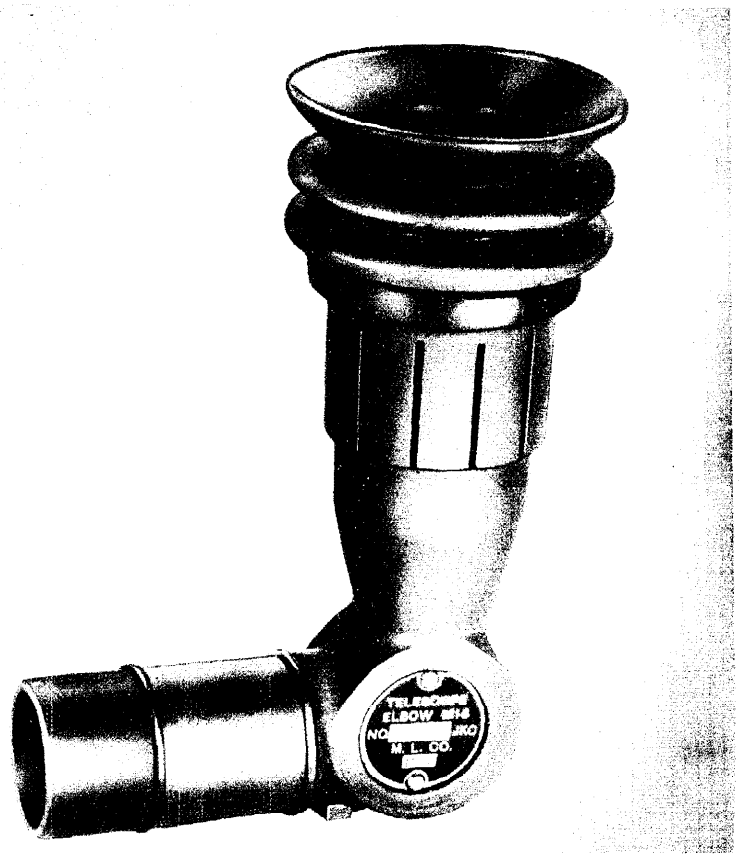
REFERENCES—TM 9-236; TM 9-1547; TM 9-1551; TM 9-1552; TM 9-2005, v. 5.

UNCLASSIFIED

ELBOW TELESCOPES M5, M14A1, M16A1C, M16A1D, M29A1, M61 STANDARD—M14, M16, M29 LIMITED STANDARD TELESCOPE MOUNTS M23, M42, M50 STANDARD



ELBOW TELESCOPE, M5



ELBOW TELESCOPE, M14, M16, OR M29. THESE MODELS ARE IDENTICAL EXCEPT FOR DIFFERENCES IN THE RETICLES

These elbow telescopes are mounted on the right side of a gun or howitzer carriage and are used for laying the gun in elevation in direct fire. They are 3-power, fixed-focus, prism-erecting instruments, with line of sight always parallel to the axis of the bore of the gun. There is a 90° elbow, thus permitting the observer to face the side of the carriage while observing. Each telescope has a reticle etched with range lines applicable to the ammunition used. Telescopes, M14A1, M16A1C, M16A1D, and M29A1, are each to be provided with a window for illumination of the reticle by means of Instrument Light, M36.

ELBOW TELESCOPE, M5—On either side of the vertical axis, the reticle is etched with a series of long and short horizontal lines, numbered to represent ranges from 400 to 3,000 yards. A letter "N" represents the normal line of sight.

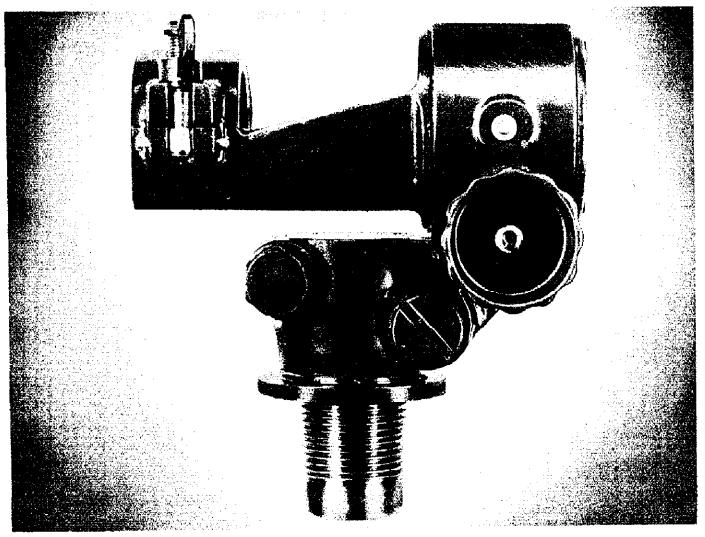
This telescope has no separate mount, but is clamped into the upper part of the Range Quadrant, M3. The Range Quadrant has an azimuth worm knob, and when large lateral deflections are being applied, it may be used in order to bring the target within the field of view.

ELBOW TELESCOPE, M61—This instrument fits into a clamp in the Range Quadrant, M8. The reticle pattern has a normal point near the top and a series of

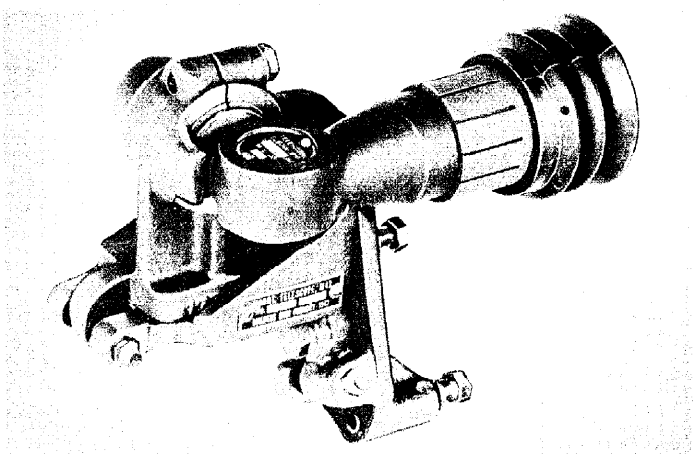
Elbow Telescope	Telescope Mount	Gun Carriage
M5	None	75 mm Howitzer Carriage, M3A1
M5	None	75 mm Howitzer Carriages, M2A1, M3
M14, M14A1	M23	75 mm Gun Carriage, M2A3
M14, M14A1	M23	75 mm Gun Carriages, M2, M2A1, M2A2
M16, M16A1D	M23	105 mm Howitzer Carriages, M2, M2A1, M2A2
M16, M16A1C	M42	105 mm Howitzer Motor Carriage, M7
M29	M23	3" Anti-tank Gun Carriage, M6, M1A1
M61	None	105 mm Howitzer Carriage, M3

interrupted horizontal parallel lines denoting elevations for ranges of from 400 to 2,800 yards. These ranges are applicable to the semifixed, high-explosive antitank shell, M67. The telescope is used primarily for direct aiming at moving targets.

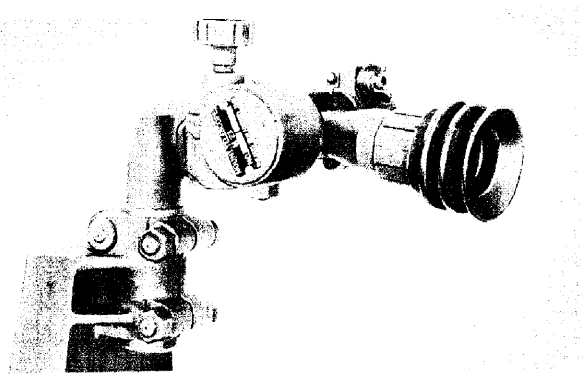
ELBOW TELESCOPES, M14, M14A1—The reticle of this type telescope is marked with nine range lines, representing ranges of from 0 to 1,600 yards at 200 yard intervals. The 0 graduation passes through the optical center of the telescope, and the remaining lines are below the center.



TELESCOPE MOUNT, M23



TELESCOPE MOUNT, M42



TELESCOPE MOUNT, M50

ELBOW TELESCOPE, M16—The reticle of this type telescope is also graduated for the 105 mm H.E. Shell, M1 Charge V at ranges of from 0 to 1,600 yards at 200 yard intervals, with the 0 graduation passing through the optical center of the telescope. All of these telescopes are to be modified to M16A1C or M16A1D status.

ELBOW TELESCOPE, M16A1C—This elbow telescope has a two-purpose reticle, with graduations arranged according to the antitank pattern. The range graduations on the right-hand side of the reticle are applicable to the 105 mm H.E. Shell, M1, and those on the left-hand side to the 105 mm H.E., A.T. Shell, M67.

ELBOW TELESCOPE, M16A1D—The reticle of this telescope is graduated for the 105 mm H.E., A.T. Shell, M67. It can also be used with the H.E. Shell, M1, Charge VI, which has approximately the same range elevation relation as the M67 up to about 2,500 yards.

ELBOW TELESCOPES, M29, M29A1—The reticle of this type telescope is graduated for 3 inch A.P. shot, M62, as used in the 3 inch Antitank Gun, M5.

TELESCOPE MOUNT, M23—This mount has a threaded support which is inserted and secured in the mounting bracket of the range quadrant. The support is thus perpendicular to the bore. The housing, attached to the support, holds a rotating bracket in which the objective arm of the telescope is fastened, perpendicular to the housing, and parallel to the axis of the bore.

By means of an elevating worm, the housing may be rotated on the support in a vertical plane, thus enabling the telescope to be adjusted in elevation with respect to the bore of the gun. The rotation of the telescope in the rotating bracket enables the range lines to be made parallel to the horizontal axis of the bore.

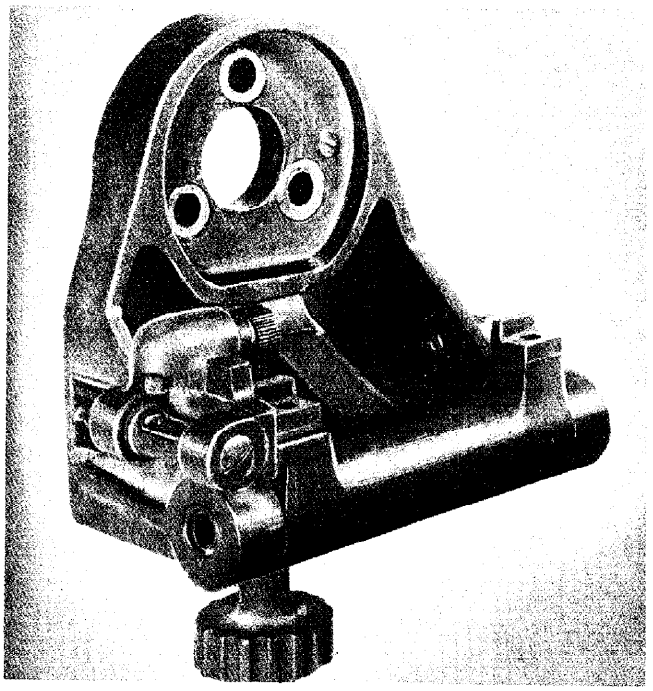
TELESCOPE MOUNT, M42—This telescope mount replaces Telescope Mount, M23, for use on the 105 mm Howitzer Motor Carriage, M7. The use of this mount makes it possible to position the telescope between the range quadrant and the howitzer instead of outside the range quadrant. This change is necessary in the howitzer motor carriage because, with the telescope mounted as in the field howitzer, the antiaircraft machine gun mount interferes with the line of sight.

TELESCOPE MOUNT, M50—This is the Telescope Mount, M23, with a modified bracket which enables it to be mounted directly on the carriage without use of a range quadrant. It was formerly required on 3 inch antitank guns, but since a new group of sighting equipment, including a range quadrant, has been standardized the M50 will no longer be required.

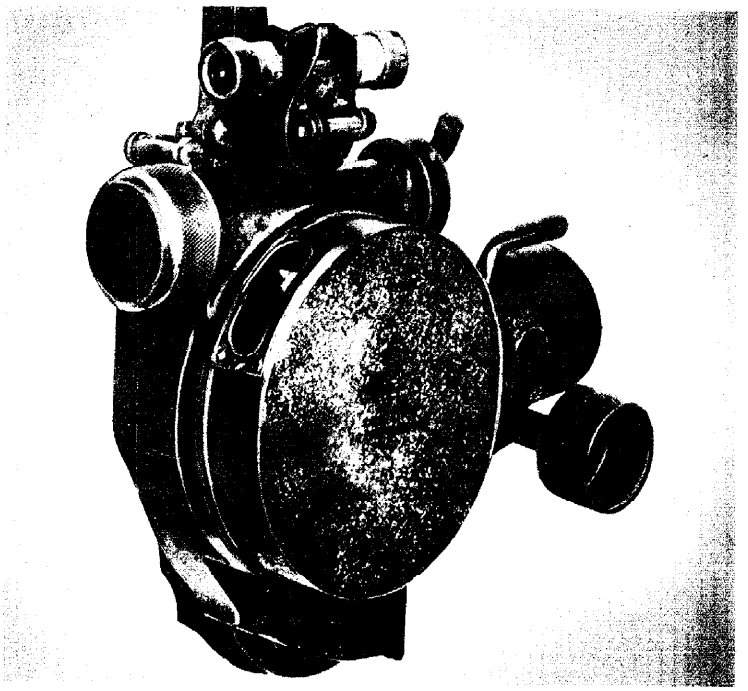
REFERENCES—TM 9-1547; TM 9-1551; TM 9-1552; TM 9-2005, v. 5.

QUADRANT MOUNT M1—STANDARD

QUADRANT SIGHT M1918A1—STANDARD



QUADRANT MOUNT, M1



QUADRANT SIGHT, M1918A1

QUADRANT MOUNT, M1—This mount is standard on-carriage equipment for the 155 mm gun and 8″ howitzer carriage, M1. It provides a support for the gunner's quadrant which is used for laying the guns in elevation.

The bracket of the quadrant mount is firmly attached to the right-hand trunnion. The leveling feet of the gunner's quadrant are placed on the level shoes of the quadrant mount.

The quadrant mount also contains a cross-leveling mechanism actuated by the cross-level knob which is located at the bottom of the mount. The cross level is illuminated by Instrument Light, M12, and power for the latter is secured from a dry cell which is lodged in a tube below the cross level. The light is clipped on to the cross level.

REFERENCES—TM 9–1553; TM 9–335; TM 9–2005, v. 5.

QUADRANT SIGHT, M1918A1—STANDARD

Gun Carriage	Status of Carriage	Quadrant Sight Bracket	Additional Sighting Equipment
155 mm Gun Carriage, M3 (Field Artillery)	Substitute Standard	QF4A1, D45816	Panoramic Telescope, M6
155 mm Gun Carriage M3 (Coast Artillery)	Substitute Standard	QF4A1, D45816	Panoramic Telescope, M8 Telescope Mount, M6A1
155 mm Gun Carriage, M1917, M1917A1, M1918, M1918A1, M2 (Field Artillery)	Limited Standard	QF4A1, D45816	Panoramic Telescope, M6
155 mm Gun Carriages, M1917, M1917A1, M1918, M1918A1, M2 (Coast Artillery)	Limited Standard	QF4A1, D45816	Panoramic Telescope, M2A1 (mils)
155 mm Howitzer, M1918A1	Substitute Standard	QF301, D74340	Panoramic Telescope, M6
155 mm Howitzer Carriages, M1917, M1918, M1917A3	Limited Standard	QF3C1, D74340	Panoramic Telescope, M6
240 mm Howitzer Carriage, M1918A2	Substitute Standard	QF5A2, D43840	Panoramic Telescope, M6
240 mm Howitzer Carriage, M1918	Limited Standard	QF5A2, D43840	Panoramic Telescope, M6

UNCLASSIFIED

QUADRANT SIGHT, M1918A1—The quadrant sight, in conjunction with a panoramic telescope, is used for aiming a weapon in direction and for aiming or laying it in elevation and site. The quadrant sight is mounted on a quadrant sight bracket which is bolted to the left trunnion of the cradle. On the upper part of the quadrant sight is a sight shank which supports the panoramic telescope. The latter is secured by a ratchet. If necessary, a 14″ extension is used so that the panoramic telescope clears the shield or other obstacles on the carriage. The extension is removed during travel or when the weapon is fired.

This instrument consists of three sighting elements, each operated by means of a worm gear. These include the cross-leveling mechanism, the angle-of-site mechanism, and the elevation mechanism.

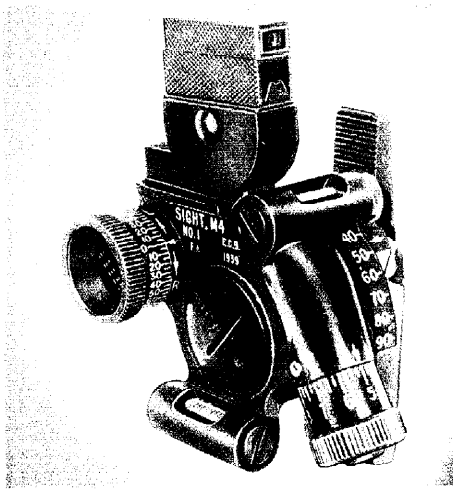
The angle-of-site and elevation mechanisms operate in such a way that their data are added together. The angle-of-site mechanism has a level, a scale and a micrometer. The scale covers 600 mils at 100-mil intervals, with 300 representing a zero angle of site. The micrometer covers 100 mils at 1-mil intervals.

The elevation scale contains two rows of graduations, the outer covering elevations from 0 to 800 mils and the inner covering elevations from 800 to 1,160 mils. By means of a throwout lever, rapid elevation is possible.

QUADRANT SIGHT BRACKETS—Bracket QF3C or D74340 is attached to the carriage by a bolt and taper pin. Bracket AF5A2 or D43840 has a shank and mounting feet which are attached to the elevating arm bearing cap of the howitzer carriage and an arm extension which fits onto the auxiliary trunnion of the howitzer carriage. Bracket QF4A1 or D45816 is attached to the gun carriage by three flat-head screws.

REFERENCES—TM 9–330; TM 9–345; TM 9–1555; TM 9–2005, v. 5.

SIGHT M4—STANDARD



SIGHT, M4

This instrument is used for laying the 60 mm Mortar, M2, and the 81 mm Mortar, M1, in elevation and azimuth. The sight is mounted on the left side of the mortar with the dovetailed portion of its bracket fitting into a yoke on the mortar.

By means of a knob, the elevation of the mortar required for the desired range is set off on the elevation scale which is graduated from 40° to 90° at 10° intervals. The elevation micrometer covers 10° at ¼° steps.

The deflection to the left or right is set off on the deflection micrometer which is graduated for 150 mils in either direction, at 5-mil intervals with the proper direction indicated by the letters L and R, and arrows near the index. When the index is set at 0, it indicates a normal setting.

The instrument also contains cross-leveling and longitudinal-leveling mechanisms and an open and a collimating sight. These sights have vertical reference lines. They may be elevated independently of the elevation mechanisms to bring the target into view.

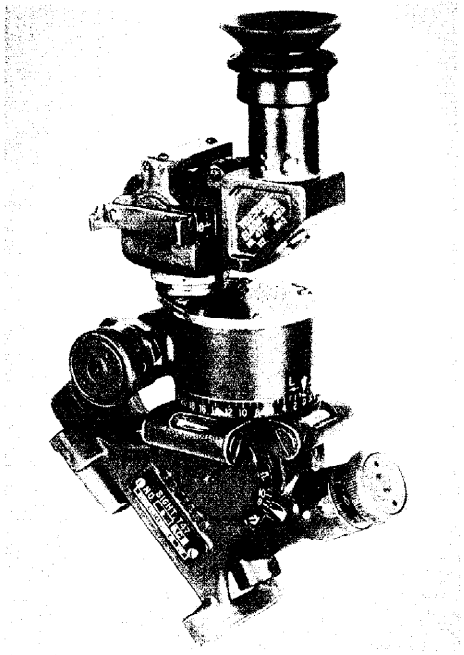
When not in use, the sight is removed from the weapon and kept in a Carrying Case, M14.

Instrument Light, M36, provides illumination for the sight.

REFERENCES—TM 9-1535; TM 9-2005, v. 5.

ELBOW TELESCOPE M62—STANDARD
TELESCOPE MOUNT M59—STANDARD

Elbow Telescope, M62, and Telescope Mount, M59, comprise the complete equipment for laying the 4.2 inch Chemical Mortar, M2, in indirect fire. This weapon is a standard Chemical Warfare Service item, but its sighting equipment has been developed and standardized by the Ordnance Department. The telescope mount is a modification of Sight, M6, which is essentially Sight, M4, with a 6,400-mil azimuth circle substituted for the 300-mil deflection mechanism. Instead of the collimator mounted on the top of Sights, M4 and M6, Telescope Mount, M59, mounts an adapter into which is clamped Elbow Telescope, M62.



ELBOW TELESCOPE, M62, AND TELESCOPE MOUNT, M59

Telescope Mount, M59, which consists essentially of a supporting bracket assembly, an elevation mechanism, a deflection mechanism, and a telescope holder assembly, fits on the upper end of the barrel of the mortar, thus moving with the mortar in elevation and traverse. The instrument is removed from the mortar during firing.

The supporting bracket assembly consists of a supporting bracket, a clamp, and a holding spring. The supporting bracket is shaped to fit the outer surface of the mortar tube, and the clamp fits the inner surface. The holding spring connects the two parts and permits the clamp to be pulled outward for inserting and removing the mount, yet to hold the mount firmly in place in all positions of the mortar tube.

The elevating mechanism permits the weapon to be laid in elevation from +600 to +1,100 mils. The elevation scale, attached to the supporting bracket, is graduated at 100-mil intervals and the micrometer, located on the elevation worm, covers 100 mils. It is graduated at 1-mil intervals and numbered at 10-mil intervals. Attached to the elevation gear housing are a cross level and an elevation level. The elevation level is used for determining when the gun is elevated to the amount indicated on the elevation scale and micrometer.

Deflections are set off by turning a micrometer located on the deflection worm. This serves to rotate the upper part of the telescope mount, thus causing the line of sight of Elbow Telescope, M62, to be moved to the left or right of normal position. The micrometer is graduated at 1-mil intervals and numbered at 10-mil intervals. One complete turn of the micrometer causes the azimuth index to register 100-mils deflection in the same direction on the azimuth scale. The scale covers 6,400 mils at 100-mil intervals. It is numbered at 200-mil intervals from 0 to 32 and from 0 to 32 again. A throw-out mechanism disengages the deflection worm from its mating gear to permit rapid movement in azimuth to an approximate setting.

Elbow Telescope, M62, is a 3-power, fixed-focus instrument with a field of view of 12° 12′ and a reticle pattern consisting of a horizontal and a vertical crossline. It is supported on the mount so that it moves in azimuth only with the rotating part of the telescope mount and with the gun. An independent movement in the vertical plane between −300 mils and +300 mils is permitted to keep the aiming point within the field of view. After the deflection is set in, the mortar is traversed until the crosshairs of the reticle are on the aiming point.

An open sight is located beside the telescope.

REFERENCES—Notes on Matériel—Frankford Arsenal, FCDD-40-Sight, T47.

DIRECT-SIGHTING TELESCOPES AND MOUNTS FOR ANTITANK GUNS

Antitank guns require sighting equipment by which the weapon may be aimed quickly in direct fire by one man. This includes a telescope, mounted so that the line of sight may be made parallel to the bore of the gun. Most of these instruments are mounted so that they move with the gun in elevation and traverse. For some weapons, such a telescope and mount comprise the complete sighting equipment. Other guns are provided with additional equipment for two-man laying in direct or indirect fire.

Telescope	Telescope Mount	Magnification	Field of View	Instrument Light	Status of Telescope and Mount	Weapon
M6	M19	1 x	11°	None	Standard	37 mm Antitank Gun Carriages, M4 and M4A1
M69C	M63	3 x	10° 27′	M33	Standard	57 mm Gun Carriages, M1A3 and M2
M18	M24 or M24A1	1 x	10° 52′	None	Limited Standard	57 mm Gun Carriage, M1A2
M79C	M61A1 or M61	3 x	10° 27′	M33	Standard except Telescope Mount, M61—Substitute Standard	3 inch Antitank Gun Carriages, M1A1 and M6*

*Additional Sighting Equipment: Panoramic Telescope, M12A3 (S) or M5A6 (SS); Telescope Mount, M21A1; Instrument Light, M19 or M5, all mounted on left side of gun; Elbow Telescope, M29A1; Telescope Mount, M23; Instrument Light, M36; Range Quadrant, M10C; all mounted on right side of gun.

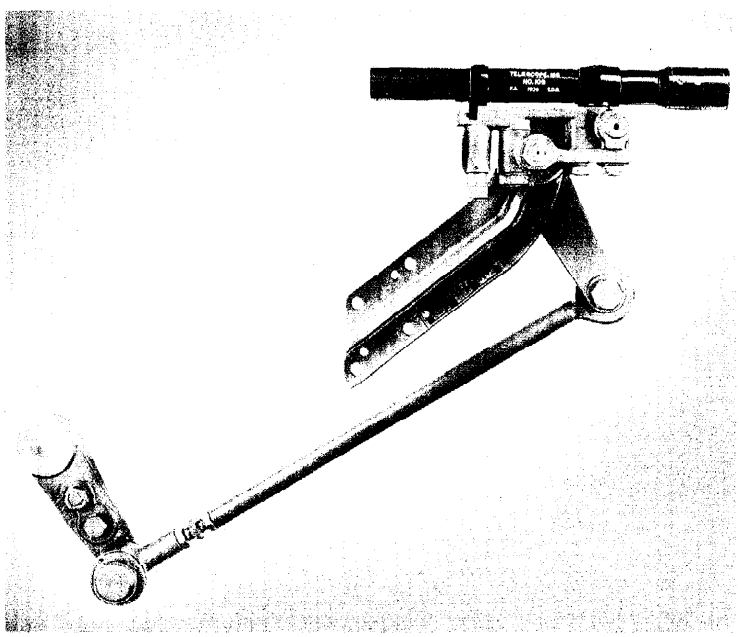
TELESCOPE, M6, AND TELESCOPE MOUNT, M19—STANDARD—This telescope has a reticle etched with dots, lines, and a circle used as reference points with different ranges and leads. The reticle is illuminated by a flashlight-type lamp which is connected to two standard flashlight cells in the tool case. The exit pupil has a diameter of 0.6 inch and the eye distance is 4.384 inches.

The mount is assembled to the left side of the top carriage behind and slightly above the cradle trunnions. It is in the form of a hinged bracket, which constantly assumes the shape of a parallelogram, thus keeping the telescope parallel to the bore of the gun.

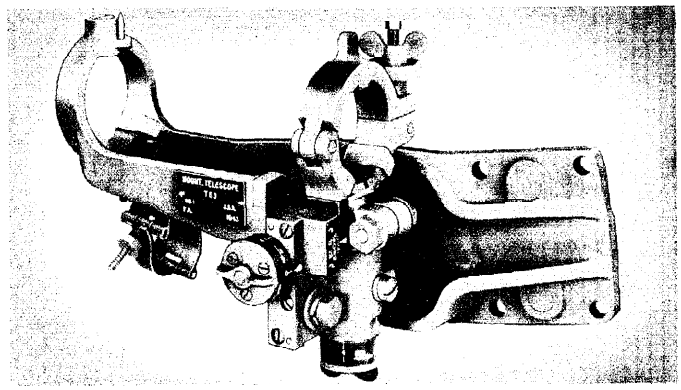
TELESCOPE, M69C, AND TELESCOPE MOUNT, M63—STANDARD—Telescope, M69C, is a straight, lens-erecting telescope. Because of its shape, it is often referred to as a "dumb-bell" or "potato masher" telescope. The instrument has red, amber, and neutral filters, and is fitted with a reticle designed according to the standard antitank pattern, and graduated for the 57 mm Gun, M1, firing the A.P.C. M86 projectile at a muzzle velocity of 2,700 feet per second. The reticle is illuminated by Instrument Light, M33, consisting of a battery case which fits into a spring clamp on the telescope mount, and a reticle lamp attached to the case by a cord. The reticle lamp assembly fits onto the body of the telescope. In addition to two dry cells, the battery case contains a rheostat for controlling the amount of illumination.

Telescope Mount, M63, consists of a bracket (fastened to the gun carriage by studs and bolts), mounting rings for holding the telescope, boresighting adjustment mechanisms, a clamp for holding the instrument light, and an open sight.

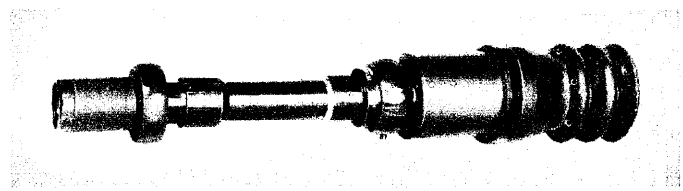
Two mounting rings serve to support the telescope firmly. The rear ring is split and hinged to facilitate installation and removal of the telescope, and is itself movable both horizontally and vertically for collimating the telescope with the bore. Mil-graduated scales and micrometers, each with matching indexes, are located to the left of and below the rear ring. These are used for making approximate measurements when boresighting. When alinement is completed, the telescope is locked in position. On the mounting rings is an open sight, consisting



TELESCOPE, M6, AND TELESCOPE MOUNT, M19



TELESCOPE MOUNT, M63



TELESCOPE, M69C

of a V-notch on the rear ring and a post on the front ring.

TELESCOPE, M18, AND TELESCOPE MOUNTS, M24 AND M24A1—This telescope and mount were formerly standard equipment with all 57 mm guns, but have been reduced to limited standard with the standardization of Telescope, M69C, and Telescope Mount, M63. This limited standard sighting equipment will continue to be supplied for the 57 mm Gun Carriage, M1A2. This weapon is used chiefly by British troops who prefer the older type of sighting equipment.

Telescope, M18, a straight telescope of simple construction, is a 1-power fixed-focus instrument. The reticle pattern consists of a horizontal and a vertical crossline, with a deflection scale along the horizontal line. The deflection scale measures a total deflection of 1½° to the right and 1½° to the left, graduated at ½° intervals. A carrying case, with sunshade and protective end caps, is provided for this telescope.

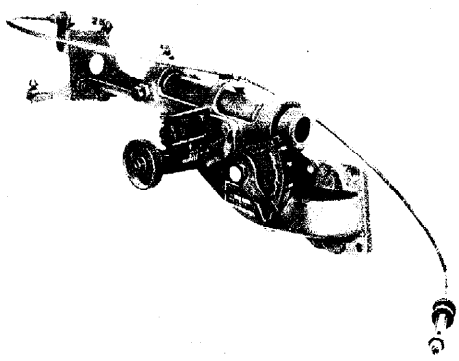
The telescope is set in elevation by means of the elevation mechanism on the mount. The telescope and mount move with the gun in traverse and in elevation. In addition, an independent movement of the telescope in elevation allows the instrument to be set for the proper range by means of the elevation mechanism of the telescope mount. Then the gun is elevated and traversed until the crosslines of the telescope reticle or the horizontal line and the applicable deflection line are on the target.

TELESCOPE MOUNT, M24—This consists of a bracket assembly, cradle, telescope holder, elevation eccentric, elevation quadrant segment, rear open sight assembly, and shutter assembly.

The bracket assembly is attached to the elevating gear of the gun which is itself fastened to the left trunnion of the gun cradle. The cradle of the mount, pivoted so that it may move in elevation, forms a support for the telescope holder. By loosening the adjusting screws which hold the telescope holder on the cradle, the telescope may be moved for boresighting. When properly oriented, the screws are tightened to hold the telescope firmly in place.

Movement of the cradle in elevation is controlled by the elevation eccentric, or range lever, which is attached to the elevation quadrant assembly. The latter supports the range scale which is graduated and numbered at 0, 300, 500, 700, and 900 yards. Zero is the setting for boresighting.

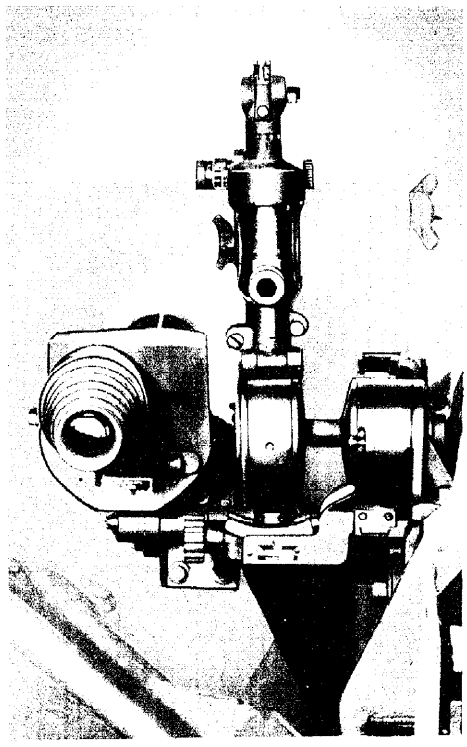
The rear open sight assembly consists of a rectangular open sight with horizontal and vertical crosswires and an index. It is attached to the cradle of the mount and moves with it in elevation and traverse. In addition, there is a deflection screw which moves the crosswires and the index along a deflection scale corresponding to that on the telescope reticle.



TELESCOPE, M18, AND TELESCOPE MOUNT, M24

The shutter assembly is screwed to the front of the cradle and consists of a bracket containing a diaphragm opening, a shutter plate, and a flexible shaft which automatically pulls the shutter over the opening where the gun is fired, thus keeping the flash out of the gun pointer's eye. The front open sight is supported on a lug attached to the left side of the shutter assembly.

TELESCOPE MOUNT, M24A1—This is the designation for the M24-type mount of most recent manufacture. It consists of the M24, without the shutter assembly and modified to permit its use in laying the weapon for ranges up to 2,500 yards.



TELESCOPE, M79C, AND TELESCOPE MOUNT, M61, (WITH PANORAMIC TELESCOPE AND MOUNT)

The range scale is graduated and numbered at T (the setting for boresighting), 300, 500, 700, 900, 1,100, and 1,300 yards, and thereafter up to 2,500 yards at 100-yard intervals.

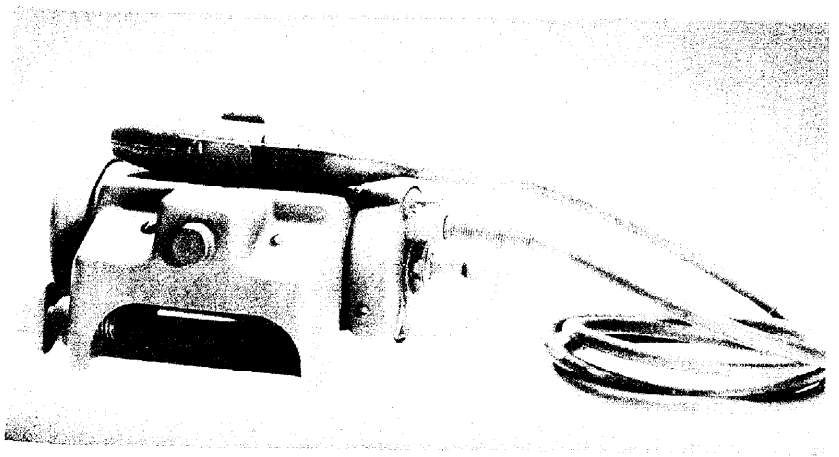
TELESCOPE, M79C, AND TELESCOPE MOUNTS, M61 AND M61A1—Telescope, M79C is a 3-power instrument with a reticle of the standard antitank pattern graduated for the 3 inch Gun, M5, firing the APC Projectile, M62, muzzle velocity 2,600 feet per second, in accordance with Firing Table FT 3-R-2. C 2. The instrument has an Abbé mirror-erecting system which results in reducing its length below that of a comparable straight telescope and produces a characteristic offset. The significant feature of this type of telescope is its large 1" exit pupil and its long 6" eye distance which greatly improve the gunner's ability to track a moving target. The telescope has a protective rubber eyeshield. A sighting vane is mounted on the top of the instrument for aiding the gunner in alining the telescope on the target. The reticle of Telescope, M79C, is illuminated by Instrument Light, M33, which is clamped to the mounting bracket of the telescope mount.

TELESCOPE MOUNT, M61—SUBSTITUTE STANDARD—This consists of a mounting bracket and an adapter assembly. The mounting bracket is bolted at the left-hand side of the gun carriage so that telescope and mount move with the gun in elevation and traverse. The adapter assembly consists of a body which holds the telescope, and a longitudinal shaft about which the body rotates to level the telescope. At one end of the shaft is a spherical collar which is held in the mounting bracket by a lateral spring-held adjustment mechanism. At the other end of the shaft is a "T" or "hitching post" which is held in the bracket by a hinge clamp mechanism. The latter mechanism, of which the throw is from left to right, serves to secure the hitching post against turning. The telescope mount has knobs for moving the telescope up and down and to the left and right for making boresighting adjustments. Mil-graduated scales and matching indexes, as well as micrometers on each of the knobs, are used in making measurements when boresighting.

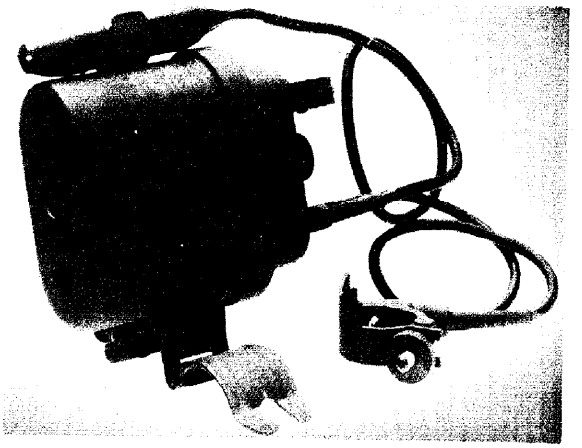
TELESCOPE MOUNT, M61A1—STANDARD—This is identical to Telescope Mount, M61, except that direction of throw of the hinge clamp is from right to left instead of from left to right. This arrangement makes the hinge clamp-locking wing nut more accessible to the gunner and facilitates the seating and removal of the telescope.

REFERENCES—TM 9-303; TM 9-1578; TM 9-2005, v.5.

INSTRUMENT LIGHTS M12, M13, M16, M18, M19, M20—STANDARD



INSTRUMENT LIGHT, M12

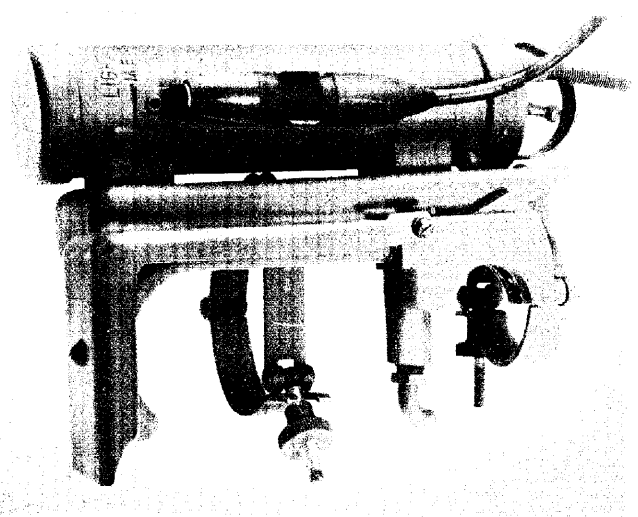


INSTRUMENT LIGHT, M13

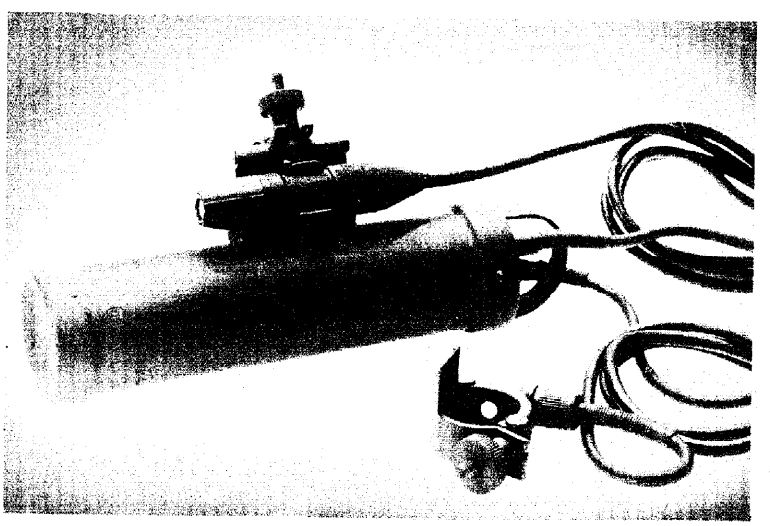
These are self-contained instrument lights, with power supplied by dry-cell batteries. They are mounted on weapons not connected to a main source of power and are used to illuminate scales, indexes, reticles, and level vials of fire-control instruments. The various models are similarly constructed and operated. The models vary in order to meet the lighting requirements of the particular instruments with which they are used.

An instrument light consists of a case for holding the dry cells, clamps for mounting the light, a control switch, and one or more lamps. In some models light is conducted through plastic tubes from a lamp to reticles or scales. Finger lamps, which the operator may direct on various parts of the instrument, are also provided with certain instrument lights.

Instrument Light	Instrument	Gun Carriage
M12	Quadrant Mount, M1	155 mm Gun—8″ Howitzer Carriage, M1
M13	Panoramic Telescope, M1 Telescope Mount, M3	75 mm Pack Howitzer Carriage, M1
M16	Panoramic Telescope, M12 Telescope Mount, M18A1	155 mm Gun Carriage, M1
	Panoramic Telescope, M5A5 Telescope Mount, M25	4.5″ Gun—155 mm Howitzer Carriage, M1
M18	Range Quadrant, M3	75 mm Howitzer Carriage, M3A1
M19	Range Quadrant, M1 Telescope Mount, M15A1	75 mm Gun Carriages, M2, M2A1, M2A2
	Panoramic Telescope, M12 Telescope Mount, M18A1	8″ Howitzer Carriage, M1
	Panoramic Telescope, M12A3 Telescope Mount, M21A1	3″ Gun Carriage, M1A1, M6
	Panoramic Telescope, M12A2 Telescope Mount, M21A1	105 mm Howitzer Carriage, M2
	Panoramic Telescope, M12A1 Telescope Mount, M22	75 mm Gun Carriage, M2A3
M20	Panoramic Telescope, M1 Telescope Mount, M16	75 mm Howitzer Carriage, M3A1



INSTRUMENT LIGHT, M16



INSTRUMENT LIGHT, M20

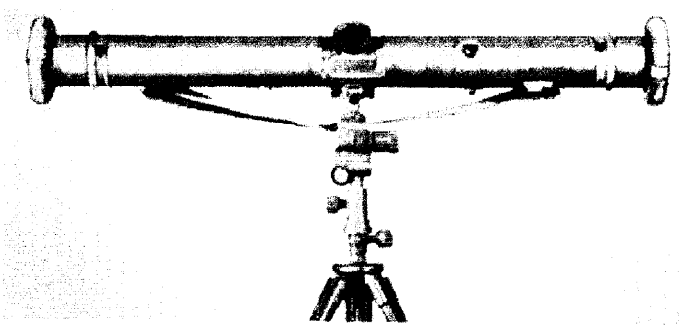
80-CM-BASE RANGE FINDER M1914M1—LIMITED STANDARD
1-METER-BASE RANGE FINDERS M7 STANDARD—M1916, M9 LIMITED STANDARD—M9A1 SUBSTITUTE STANDARD

A range finder is an instrument which calculates the range of the target by triangulation. It consists of a range finder proper and a tripod. A carrying case and a special adjusting lath designed for the individual instrument are also provided.

The range finder proper is primarily two telescopes laid horizontally to each other so that their objective windows are a definite distance apart, but with one common eyepiece at the center of the tube. It contains a range mechanism by means of which the measuring wedge can be moved in order to bring the inverted image of the target into coincidence with the erect image. The correct range is then indicated on the range drum.

80-CM-BASE RANGE FINDER, M1914M1—This was the standard infantry and cavalry range finder. It can measure ranges from 400 yards to 10,000 yards. It has 10-power magnification and a 4.5° field of view. There is a ray filter containing an amber filter to moderate strong sunlight and a smoked filter to permit observance into the direct glare of a searchlight.

1-METER-BASE RANGE FINDER, M1916—This was for many years the standard field artillery range finder. It was standard for use with 75 mm gun and howitzers, 105 mm howitzers, 4.5 inch guns, and 155 mm howitzers. It calculates ranges of from 400 yards to 20,000 yards. It can also be used for measuring azimuths and angles of site. It has 15-power magnification and a 3° 10′ field of view. Amber and smoked filters are also provided.



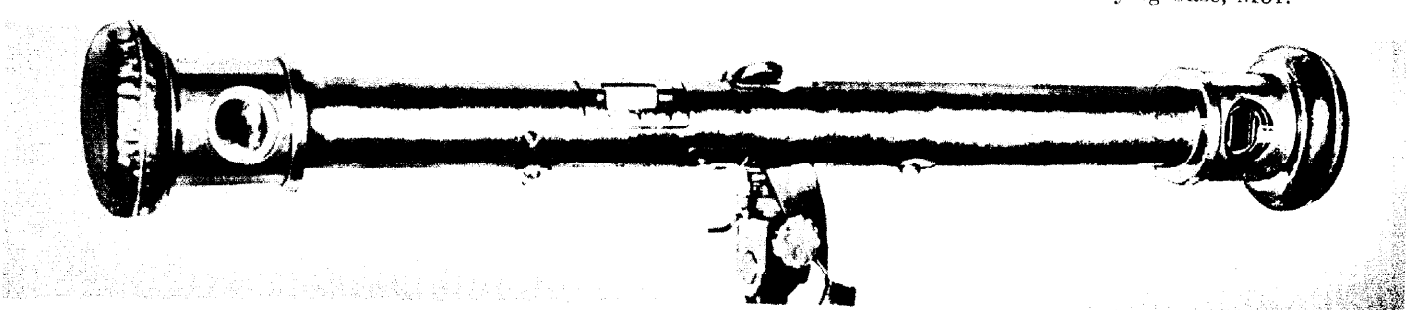
80-CM-BASE RANGE FINDER, M1914M1

1-METER-BASE RANGE FINDER, M7—This standard range finder is a 11-power instrument with a range of from 500 to 20,000 yards. It is more accurate, lighter in weight, and more easily handled than the M1916. The instrument has mounting rings which enable it to be mounted in tanks or gun motor carriages, making use of the special Mount, M58, instead of the tripod mount used by the Field Artillery. This mount is positioned in the existing well provided in combat vehicles for the M4-type periscope.

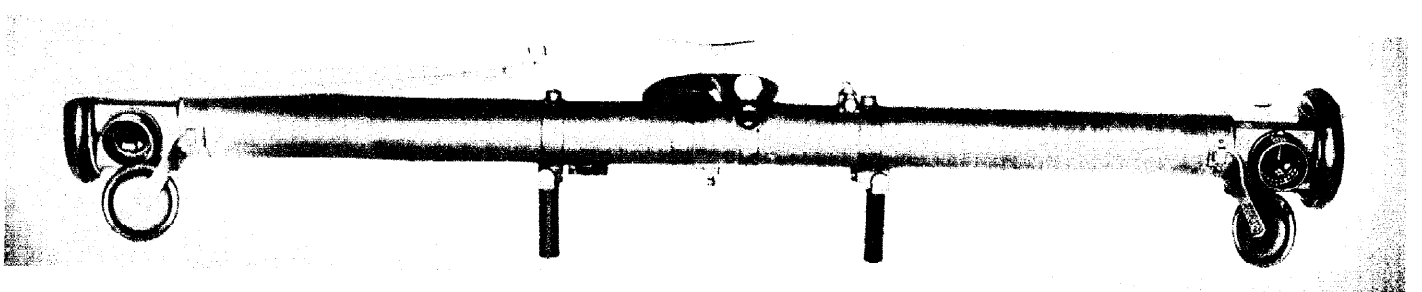
1-METER-BASE RANGE FINDERS, M9 and M9A1—This is similar to Range Finder, M7, but it has British standard threads instead of the American type incorporated in the M7. The M9A1 type instrument was developed in Canada and modified as M7. In the interest of speedy procurement, the M9A1 was standardized. When M7 models were produced in sufficient quantity, it was reduced to substitute standard to simplify procurement. The limited standard Range Finder, M9, lacks the mounting rings provided in the M9 and M9A1.

The designations, Range Finders, M7 and M9, refer only to the range finder tube and its interior optical parts. To facilitate procurement, issue, maintenance, and storage, the additional components are arranged in groups, known as equipment sets. Each equipment set contains all equipment used by a given using arm. Their designations and contents are as follows:

1. Set, equip., 1st Ech., Field Artillery, for Range Finders, M7 and M9A1—Cradle, M3; Carrying Case, M49; Range Finder Mount, M62; Cover, M436; Tripod, M18; Adjusting Lath, M2; Carrying Case, M50.
2. Set, equip., 1st Ech., Infantry, for Range Finders, M7, M9A1, and M9—Carrying Case, M51.
3. Set, equip., 1st Ech., Armored Command, for Range Finders, M7 and M9A1—Cradle, M3; Carrying Case, M49; Range Finder Mount, M58.
4. Set, equip., 1st Ech., Cavalry, for Range Finders, M7, M9A1, and M9—Carrying Case, M51.
5. Set, equip., 1st Ech., Tank Destroyer Command, for Range Finders, M9A1 or M7—Carrying Case, M51.



1-METER-BASE RANGE FINDER, M1916



1-METER-BASE RANGE FINDER, T16, WHICH HAS BEEN MODIFIED TO BECOME M7 AND M9A1

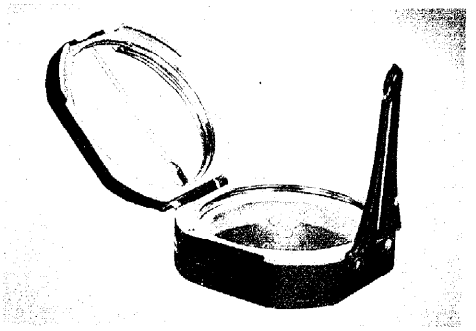
COMPASS M2—STANDARD

The Compass, M2, is used for obtaining clinometer, angle-of-site, and azimuth readings. It is designed for use as a reconnaissance instrument for the Field Artillery.

The apparatus is contained in a compact case and is protected by a glass window which keeps dust, wind, and moisture from the interior of the instrument and protects the internal part. On the inside of the hinged cover is a mirror with a black line engraved across the center. A small oval window in the mirror coincides with a hole in the cover. When the cover is fully opened, an escutcheon pin serves to place the cover assembly in line with the instrument case.

Hinged front and rear sights are attached to cover and case. These may be opened out when in use. Levels are provided for use when the base is held either horizontally or vertically.

The angle-of-site mechanism is actuated by a lever which is clamped to the index by means of an adapter which protrudes through the base of the instrument.



COMPASS, M2, IN POSITION FOR ALTERNATE METHOD OF TAKING AZIMUTH

Any movement of the lever moves the index along the angle-of-site scale. The latter is engraved on the base of the compass.

In the center of the magnetic needle is a jewel housing pivoted on a needle point which is attached to an adapter in the center of the base. The points of the compass are engraved on the base with the E and W reversed so that courses may be read directly from the face of the compass. When the cover is closed, the magnetic needle is automatically lifted from its pivot and held firmly against the glass window of the compass.

Contained on a movable rim is the azimuth scale which is divided into 320 equally spaced graduations, each representing 20 mils. The graduations are numbered at 200-mil intervals from 0 to 6,200 mils. By loosening the azimuth scale adjuster, the scale may be rotated approximately 1,800 mils. Teeth cut in the under side of the scale engage with the pin teeth of the adjuster, thus affixing the scale firmly on each position.

The leather Carrying Case, M19, is designed to hold the closed compass when not in use. The case may be suspended from the user's belt by means of a leather loop.

REFERENCES—TM 9-1596; TM 9-2596.

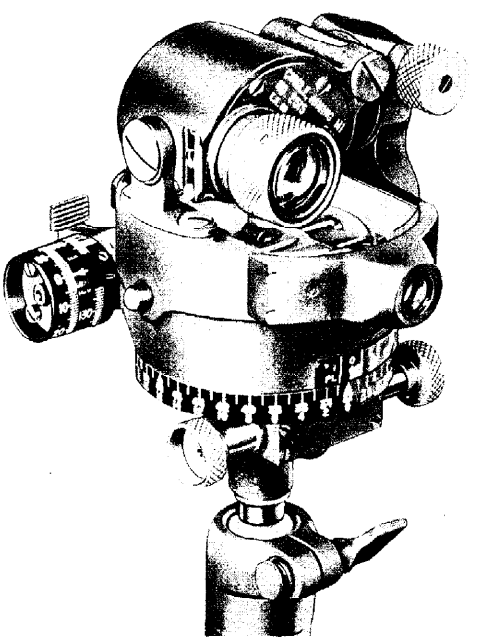
AIMING CIRCLE M1—STANDARD

This instrument is designed principally for measuring angles in azimuth, but small angles of elevation may also be measured by it, and simple survey work carried out. The instrument is equipped with the Tripod, M5, Instrument Light, M2, and Carrying Case, M6A1.

The aiming circle proper includes a 4-power telescope pivoted above a compass box. Leveling devices insure accurate laying of the telescope on the horizontal. The instrument may be elevated and depressed about 85 mils above and below the horizontal, and it may be rotated through a complete circle either slowly by turning of the azimuth worm knob or rapidly by use of a throwout device.

The reticle of the telescope is engraved with a horizontal and a vertical line. Along each line is a mil scale, marked at 5-mil intervals, measuring 85 mils at each side of the central point. This scale provides the only means for measuring vertical angles and it is also used for determining small horizontal angles.

In general the azimuths are measured on the azimuth scale which measures a complete circle in 100-mil intervals, with every even hundred mils marked from 0 to 64. An additional scale is graduated from 0 to 32 with 0 at the 32 mark on the main scale. It is used in reciprocal laying of guns which have panoramic telescopes graduated in two 3,200-mil scales. Still another scale is the upper or plateau scale which measures a quadrant divided into 200-mil spaces. It is used only in conjunction with the French collimator sight, M1901. On this scale, each space is divided into two sections, one plain, the other cross-hatched. At each quadrant on the main scale, there is an index for the plateau scale. On the worm knob are two micrometers, the azimuth micrometer and the plateau azimuth micrometer. Each micrometer measures 100 mils at 1-mil intervals. When using the plateau scale, the plateau azimuth micrometer is used when the index points into a cross-hatched space. If not, the regular azimuth micrometer is used.



AIMING CIRCLE, M1

The compass is used in orienting the zero point on the azimuth scale to magnetic north. It may also be used in finding the declination of arbitrary grid lines from magnetic compass directions. In such cases the 0 is often oriented to the Y grid line.

REFERENCES—FM 6-40; OS 9-19; TM 9-305; TM 9-1530; TM 9-2005, v. 3; TM 9-2005, v. 5.

OPTICAL CHARACTERISTICS OF TELESCOPE

Field of view	10°
Power	4
Diameter of exit pupil	0.156 in.
Aperture of objective	0.625 in.
Effective focal length of objective	3.125 ins.

MATÉRIEL WITH WHICH AIMING CIRCLE, M1, IS USED

All 75 mm field artillery guns
105 mm Howitzers, M2A1 and M2
4.5" Gun, M1
All 155 mm howitzers
155 mm Guns, M1 and M1A1
All 8" howitzers
All 240 mm howitzers

OBSERVATION TOWER M1—STANDARD

Observation Tower, M1, is used for the observation of field artillery fire in certain types of terrain, such as desert or level bushy territory where the use of forward observers is limited and adequate observation from airplanes is lacking. Two towers are issued to each Battalion Headquarters Battery that has a definite need for the equipment.

The Observation Tower, M1, is a metal ladder made in three uniform sections with a total height of about 72 feet. A fourth section is provided for increased height if necessary. There is a base plate at the foot of the tower and further support is provided by means of guy ropes which connect the tower with stakes which are driven into the ground. Attached to the top of the tower is a revolving seat for the observer. There is a foot rest, and a table which has a compartment about 2 inches deep for the storage of maps and papers.

OBSERVATION TOWER, M1

OBSERVATION TELESCOPES M48, M49—STANDARD

These 19.6 power telescopes are used for observation purposes by cavalry and infantry organizations. They are straight monocular telescopes, each mounted on a tripod which supports the instrument about 1 foot above the ground. Each telescope is secured to the cradle of the all-metal tripod by means of a web strap.

A ball and socket arrangement at the top of the support permits pivoting, elevating and depressing. The tripod itself may be raised and lowered.

This type telescope was originally standardized as the M4. It was manufactured by Bausch and Lomb and International Industries. The construction details vary so that the parts are not interchangeable. For this reason, the telescope, carrying cases, and tripod, as manufactured by the two companies, were given different model designations. The nameplates of the instruments already in the field are being changed as rapidly as possible so that each instrument will bear the new model designation.

The lenses of the telescope may be brought into focus by rotation of a knurled nut. Screwed to the objective end is a sliding sunshade. To protect the lenses when the instrument is not in use, an objective cap and an eyepiece cap are provided which are screwed over the ends of the telescope.

When not in use, the telescope is kept in a cylindrical leather carrying case. A canvas carrying case, reinforced with leather, is provided for the tripod.

REFERENCE—TM 9-575.

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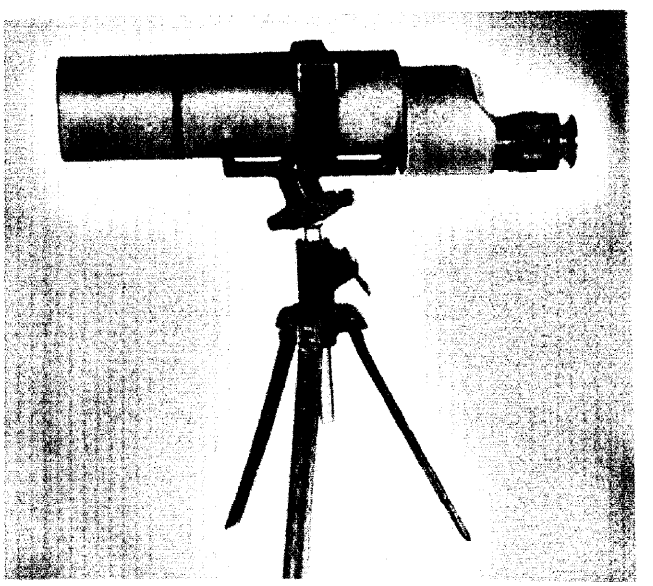


OBSERVATION TELESCOPE, M48

	OBSERVATION TELESCOPE, M48	OBSERVATION TELESCOPE, M49
Manufacturers	Bausch & Lomb	International Industries, Inc.
Observation Telescope, M4 Serial Numbers	1-1791	1792—4845
Tripod	M14	M15
Telescope Carrying Case	M26	M27
Tripod Carrying Case	M31	M32

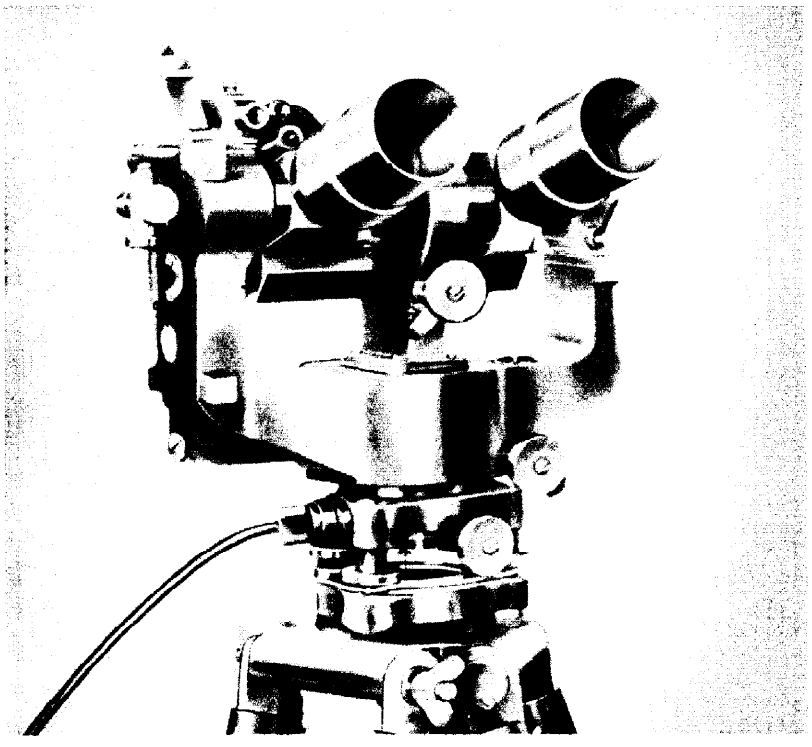
SPOTTING INSTRUMENT M2—STANDARD
AZIMUTH INSTRUMENT M1—SUBSTITUTE STANDARD
AZIMUTH INSTRUMENT M1918A2—LIMITED STANDARD

SPOTTING INSTRUMENT, M2—This observation instrument is used primarily by Field Artillery observers in flash spotting and in the measurement of horizontal and vertical angles. It consists essentially of two telescopes, a mount, and a tripod. The telescopes, identical, fixed-focus, 8-power instruments with a field of view of 7.5 degrees, are positioned to permit binocular vision. Adjustment for interpupillary distances of from 57 mm to 73 mm is permitted. The reticle has a vertical and a lateral spotting scale, each covering 3 degrees on each side of zero, graduated at 10-minute intervals and numbered at 1-degree intervals.

The mount serves as a support for the telescopes and provides a means for rotating them in elevation and azimuth. The amount of movement in elevation and azimuth is measured and read against illuminated scales in the field of view of a separate optical system which acts as a microscope.

There is also a reflecting compass by which the instrument may be aligned in direction. In addition there is a collimator sight and leveling devices.

Spotting Instrument, M2, is an adaptation of a British instrument. Those instruments to be manufactured for American use are to be scaled in mils instead of degrees.

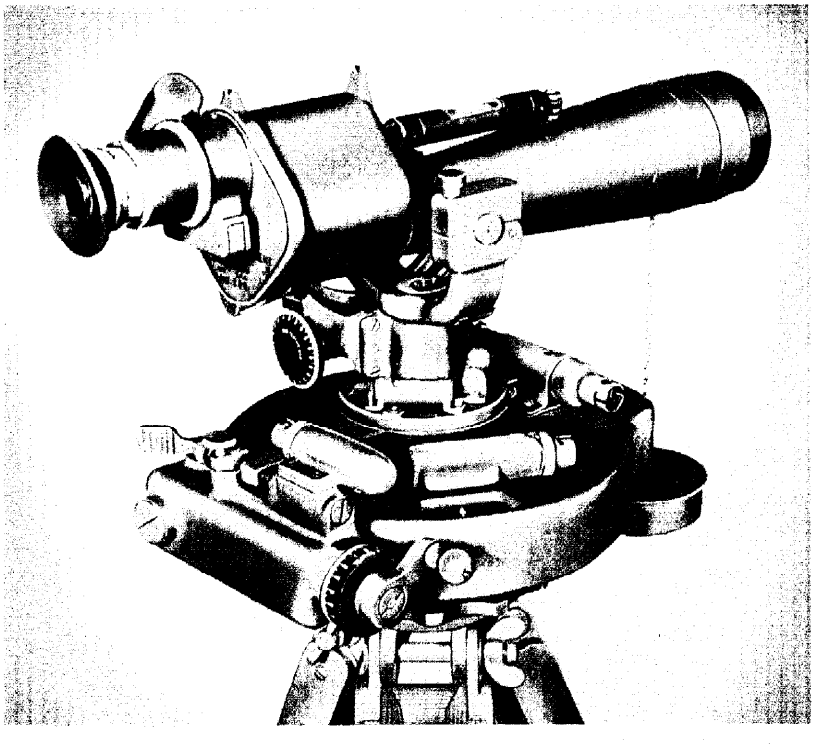


SPOTTING INSTRUMENT, M2

AZIMUTH INSTRUMENT, M1—This spotting and observing instrument is substitute standard for Spotting Instrument, M2. It consists of Telescope, M23, a mount, and Tripod, M19. Instrument Light, M10, provides illumination for the scales.

Telescope, M23, a 10-power instrument with a field of view of 4 degrees, is provided with an amber filter and a reticle with a vertical and a lateral spotting scale covering 30 mils on each side of zero. Diopter adjustments totaling plus and minus two diopters may be made.

The mount serves as a support for the telescope, and contains the mechanisms by which the instrument may be rotated through 6,400 mils of azimuth and may be elevated and depressed between −300 mils and 500 mils. It also has leveling devices, an elevation scale, and an azimuth scale and micrometer.



AZIMUTH INSTRUMENT, M1918A2 OR M1

AZIMUTH INSTRUMENT, M1918A2—This instrument is similar to Azimuth Instrument, M1, but was manufactured by modifying Azimuth Instrument, M1918. Azimuth Instrument, M1, is of original manufacture.

REFERENCE—TM 9-2300.

UNCLASSIFIED

BATTERY COMMANDER'S TELESCOPES M1915A1 LIMITED STANDARD—M65 STANDARD

Optical Characteristics	M1915A1	M65
Power	10×	10×
Field of View	4° 10′	6°
Diameter of Exit Pupil	0.18″	.177″
Clear Aperture of Objective	1.78″	1.77″
Effective Focal Length of Objective	11.55″	10.75″

A battery commander's telescope is a binocular observing instrument equipped with mechanisms for the measurement of horizontal angles and angles of site. It is used with practically all field artillery weapons. It is chiefly designed for spotting and observing the effect of fire, but it is often used for position and range finding as well. The instrument consists of a telescope, a mount, and a tripod.

BATTERY COMMANDER'S TELESCOPE, M1915A1—The telescope proper is made up of two prismatic telescopes of the same optical characteristics. The telescopes are mounted on a common pivot by which they can be moved to a horizontal or a vertical position. When the telescopes are vertical, the objective prisms are about 12 inches above the eyepieces. Thus, concealment of the observer is facilitated. When in horizontal position, the telescopes are spread outward so that the objective prisms are about 10 times as far apart as the eyepieces. This brings the objects viewed into strong stereoscopic relief. When so used it is possible to judge comparative distances of very distant objects.

Interpupillary distances can be adjusted, and a diopter scale on each eyepiece provides for independent focusing of each telescope. Sunshades for the objective lenses and ray filters for the eyepieces are provided.

The telescope for the right eye has a reticle marked with horizontal and vertical lines. These lines are chiefly used in measuring lateral and vertical deflection of shots. A reticle-adjusting telescope ring provides a means for rotating the reticle so that the lines remain horizontal and vertical, no matter what the position of the telescopes. By means of an Instrument Light, M1, the reticle may be illuminated.

The angle-of-sight mechanism is connected with the right telescope. It consists of a worm and wheel mechanism, a scale and micrometer, and a level vial. By means of this mechanism, elevation or depression of the target can be measured through 300 mils in either direction.

The mount contains a lower vertical spindle by which the mount is fastened in the tripod and an upper vertical spindle which holds the telescope on the mount. A circular level vial indicates the level position of the instrument. The mechanisms for moving the telescope in azimuth through a complete circle and the scales and micrometers by which the azimuth is measured in 1-mil intervals are also contained in the mount. There is also an orienting mechanism by which the instrument may be moved in azimuth without changing the readings on the scale and micrometer.

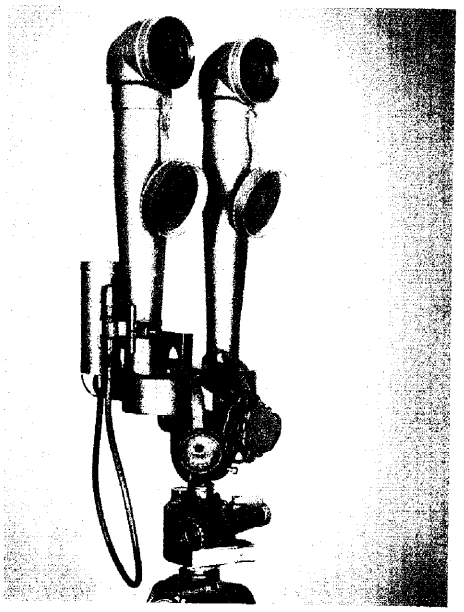
The tripod, Type G, consists of three extensible legs which are hinged to the tripod head so that they may be opened out and clamped at any desired angle. The head is bored to hold the lower vertical spindle. A key in the tripod head is used for locating or positioning the mount.

Provision has also been made for the use of this telescope while the observer is lying in a prone position. For such use, Tripod, M10, and Telescope Adapter, M12, are used. The adapter is a cylindrical casting which is screwed into the head of the tripod. The upper part of the adapter is in the form of a collar with a split projection which is drilled and stamped to receive the clamping screw. Attached to the outer end of the clamping screw is the lever by which the collar is released or tightened.

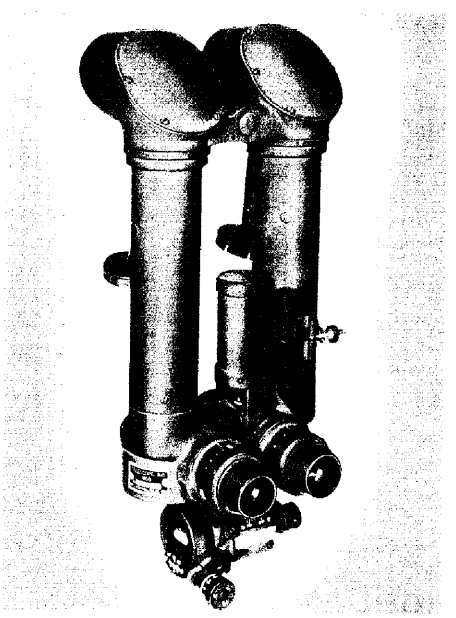
Two leather carrying cases are provided for this instrument when used on Tripod, Type G. One holds the telescope and certain auxiliary equipment. The other is used for the tripod and the mount. A special wooden carrying case is provided for the telescope, the Tripod, M10, the telescope mount, and the telescope adapter.

BATTERY COMMANDER'S TELESCOPE, M65—This telescope consists of the Telescope, M65, the Tripod, M17, and the Telescope Mount, M48. The instrument, generally like the M1915A1, has a fixed vertical telescope which cannot be extended horizontally. The optical system has a greater field of view than the M1915A1, and minor changes have been made in the mechanisms of the telescope and mount to insure more accurate readings and to facilitate the operation. Instrument Light, M28, is a standard component of this telescope.

To adapt Battery Commander's Telescope, M65, for use with Tripod, M10,

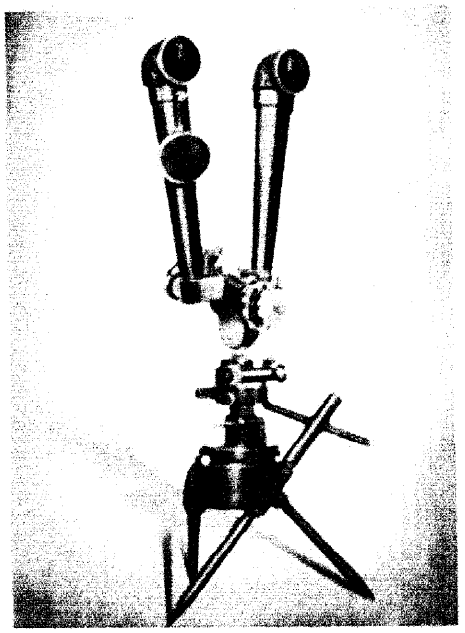


BATTERY COMMANDER'S TELESCOPE, M1915A1



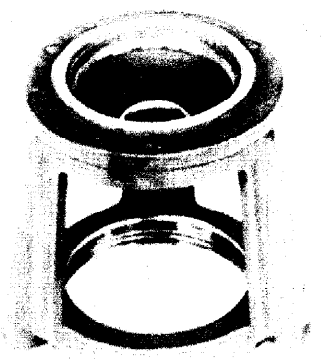
BATTERY COMMANDER'S TELESCOPE, M65

BATTERY COMMANDER'S TELESCOPES M1915A1, M65 (Continued)



BATTERY COMMANDER'S TELESCOPE, M1915A1, ON TRIPOD, M10

Telescope Adapter, M14, has been provided. This adapter is a cylindrical hollow casting with three openings in the sides to facilitate adjustment of the wing nuts in leveling the telescopes. The inside of the lower part of the adapter is threaded to permit screwing the device into the tripod.



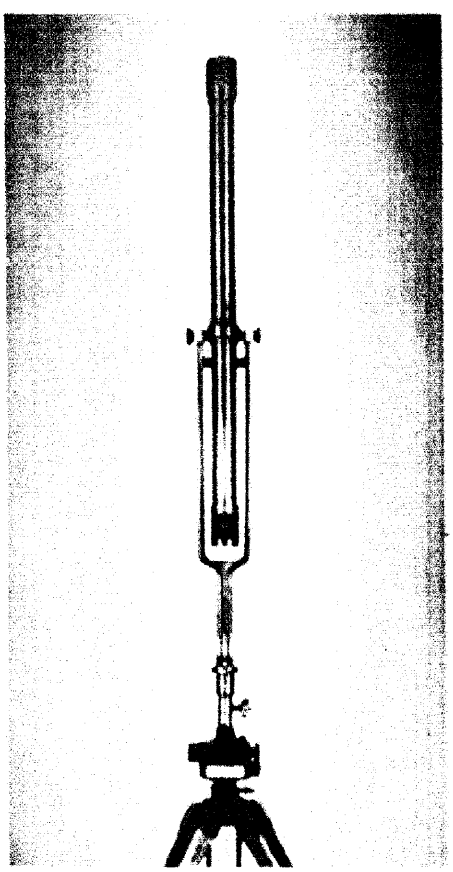
TELESCOPE ADAPTER, M14

The top of the adapter has a machined surface with tapped holes to secure the head permanently in place. The head is a saucer-like casting with a circular hole in the center to receive the spindle of the telescope mount. The inside of the head is shaped to conform to the lower surface of the upper clamp on the telescope mount and the outside of the head fits the upper surface of the lower clamp. A coprene strip on the upper inside surface of the head prevents metal contact between the telescope mount and the adapter head. It also serves to keep dust and grit out of the ball and socket joint and lubricants in.

Carrying Case, M45, is also designed for use with this telescope, tripod, mount, and adapter.

REFERENCES—OS 9-8; TM 9-1580.

BATTERY COMMANDER'S PERISCOPE M1918—STANDARD



BATTERY COMMANDER'S PERISCOPE, M1918

The battery commander's periscope, originally designed for trench use, is used by the field artillery for making observations and measuring azimuths when enemy fire makes the use of other instruments inadvisable. It consists of a periscopic monocular 6-power telescope, with a 6° field of view. The instrument is pivoted on the upper end of a Y-shaped metal bracket. The main support of the bracket is inserted into a socket at the top of a wooden tripod.

The bracket and the periscope can be concurrently moved in azimuth through 360° by turning a worm knob. An azimuth scale, graduated at 100-mil intervals, and a micrometer, covering 100 mils at 1-mil intervals, serve to indicate the correct azimuth, if the instrument has been properly oriented.

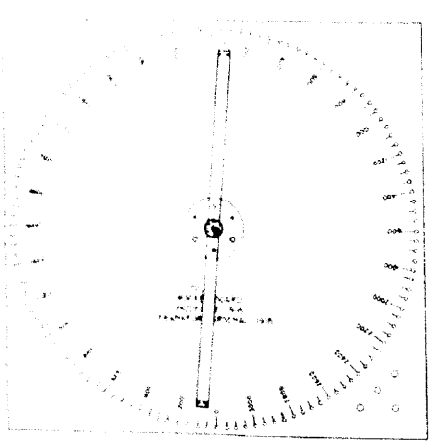
Although no scale is provided, a small movement in elevation is permitted in order to bring the target into view.

A circular level vial is contained on the mount in order to provide a means of leveling the instrument.

ROCKET BOARD M1918—STANDARD

The rocket board is used for marking, in proper relationship to each other and to the observation post, the locations from which flares or smoke signals are to be released by friendly troops. The board is 24 inches square and contains a sighting bar pivoted about the center. At equal distances from the center and spaced at 50-mil intervals are holes in which pegs may be inserted to mark the locations of the expected bursts. The board is graduated from 0 to 3,200 on each half, instead of from 0 to 6,400.

The rocket board was at first issued only to troops in the field in time of war. At present it is also used for training purposes.

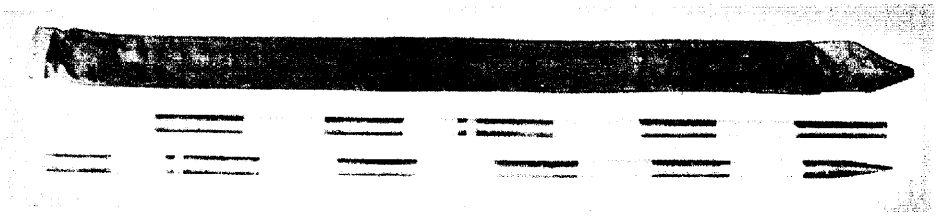


ROCKET BOARD, M1918

UNCLASSIFIED

AIMING POSTS, M1, M4, M6, M10, M12—STANDARD
AIMING POSTS, M7, M8, M9—LIMITED STANDARD

AIMING POST, M1—This post is standard for use with indirect fire weapons of smaller caliber than 4.2 inches. It is made in two sections of tubular steel each approximately 4½ feet long, and is painted in alternating bands of red and white. A canvas cover is provided. Aiming Post Light, M14, is standard equipment for this post. The lamp is a 3-volt aircraft instrument panel lamp. The light has a metal hood and red and green filters. Modified with a clamp to fit a square aiming post, this light is designated M43, and is standard for issue with the square Chemical Warfare Service aiming post.



AIMING POST, M1, WITH CASE

AIMING POSTS, M4, M6, M7, M8 AND M9—The aluminum posts, M4 and M6, along with the M5, were adopted in 1939 as standard equipment for 81 mm mortars. Due to the shortage of aluminum, it was decided not to manufacture the aluminum posts, but to adopt as substitute standard wooden aiming posts of similar dimensions and characteristics. The M5 has recently been declared obsolete because it was never manufactured and this type of post is being supplanted by the M10. In addition, the wooden Aiming Posts, M7, M8 and M9 have been reclassified as limited standard, since the aluminum aiming posts are now to be manufactured and issued to the field. Aiming Post, M4 and its wooden counterpart, the M9, are 46 inches long and are used when the mortar is carried by pack. They are jointed for convenience in pack transport. Aiming Posts, M5 and M7, were 24 inches tall, and designed for use under any condition of transport. Aiming Posts, M6 and M8, are 6 feet high. Since the latter two types of post are not designed for pack transport, a carrying strap is riveted to each post.

AIMING POST, M10—This aiming post is for use with 60 mm and 81 mm mortars. This post is a combination aiming post and alidade. Constructed of steel, Aiming Post, M10, is 28.75 inches long and of the same diameter as Aiming Post, M1. A section of the stake is cut away and pivoted by a bolt, so that it may be positioned at right angles to the post, to serve as an alidade. A mil scale on the alidade is used in reading deflections. The post is supported in hard ground by a replaceable metal spike. A replaceable cap prevents damage to the pivoted part.

AIMING POST, M12—This aiming post is standard with the 4.2 inch Chemical Mortar, all Field Artillery and self-propelled artillery weapons of 4.5 inches and above, and with the 155 mm gun in seacoast installations. By means of this post it is possible to compensate for the lateral displacement of the sight from the center of rotation of the gun. It consists of the M1 aiming post to which is welded an emplacing bracket which aids in emplacing the post and prevents the wind from turning the post when emplaced. Also supplied is a steel crossbar 26 inches long, $\frac{1}{16}$ inch thick and $2\frac{5}{8}$ inches wide. This is fastened to the aiming post by means of another bracket. The crossbar is painted black, and is marked with evenly spaced white geometric figures. Two posts are supplied with each weapon. Corrections for sight displacement are made by sighting on the identical figures on the two crossbars which are in line.

LIGHTING EQUIPMENT—Standard for use with Aiming Posts M4, M6, M7, M8, M9, and M10 are Instrument Light, M37, and Aiming Post Light, M41. The instrument light consists of a battery case which is attached to one of the bipod legs of the mortar; a single cell, 1½ volt battery; a collimator light, and a hand light, both attached to the battery case by flexible cables; and a rheostat for controlling the illumination of the collimator. The rheostat is built into the battery case.

The Aiming Post Light, M41, is clamped to the top of the aiming post and is a single unit, consisting of a flashlight battery case, a hooded light bulb, and a switch. Red and green filters are provided. Aiming Post Light, M14, is limited standard for use with mortars.

REFERENCES—TM 9-305; TM 9-2005, v. 5.

GUNNER'S QUADRANT M1—STANDARD

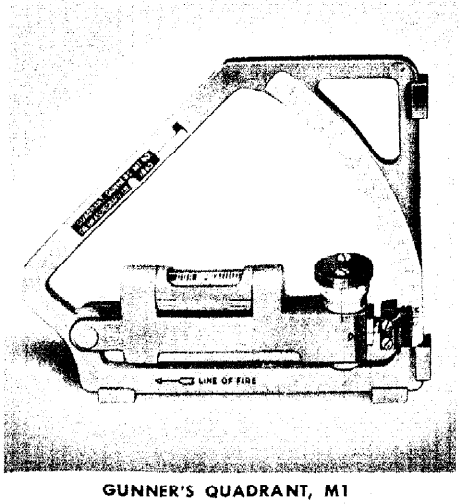
Guns and howitzers are supplied with a gunner's quadrant which is used for laying the weapon in elevation or for checking on the elevation of a weapon which has been laid by other means.

This instrument consists of a frame mounting an elevating arc, scaled on one side for elevations from 0 to 800 mils and on the other from 800 to 1,600 mils. A quadrant arm, pivoted at one end of the frame, may be moved along the elevating arc and set on the elevation scale at any of the 10-mil divisions. The level holder and a micrometer drum are attached to the quadrant arm. The micrometer drum is used for setting the instrument at closer intervals, as small as 2 mils.

When the quadrant scale has been set at the proper angle, the instrument is placed on the quadrant seat of the gun. If the setting is more than 800 mils, the leveling feet on the side of the frame containing the scale are used. Otherwise the leveling feet on the side perpendicular to that are used. The gun is then elevated or depressed until the level bubble is centered.

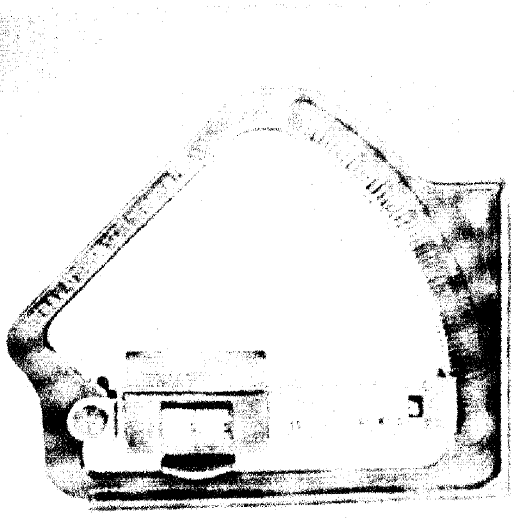
The gunner's quadrant has no cross-leveling device. Therefore, the trunnions of the cradle must be level before the elevation of the gun can be checked correctly from this instrument.

REFERENCES—TM 9-1527; TM 9-2005, v. 5.



GUNNER'S QUADRANT, M1

MACHINE-GUN CLINOMETER M1917—STANDARD



MACHINE-GUN CLINOMETER, M1917

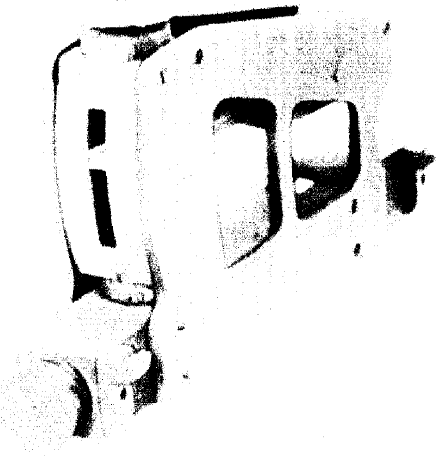
This instrument is used in laying a machine gun in elevation or for determining whether the weapon has been elevated to the correct angle. The clinometer consists of a sector-shaped frame to which is pivoted a radial arm.

The lower and rear edges of the frame are accurately machined to form a right angle. Along the sector-shaped arc are graduations measuring 840 mils of elevation and 160 mils of depression at 20-mil intervals. The radial arm can be clamped into position along the arc at the nearest 20-mil interval below the desired elevation. The radial arm serves as a micrometer, being graduated from 0 to 20 mils at 1-mil intervals. Settings on the micrometer are made by sliding the level holder along the radial arm until the index marks the desired reading.

When the instrument has been properly set, it is placed on the gun parallel to the bore of the gun. The level will be centered when the weapon has been elevated or depressed as indicated on the clinometer.

REFERENCE—TM 9-2005, v. 5.

ANGLE-OF-SITE INSTRUMENT M1917—STANDARD



ANGLE-OF-SITE INSTRUMENT, M1917

The angle-of-site instrument is primarily used for measuring angles of site. It can also serve as a clinometer for laying machine guns in elevation or for checking on the elevation of machine guns.

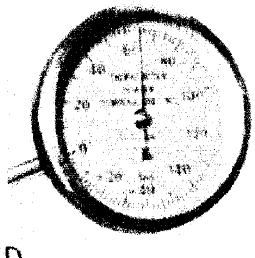
The frame of this instrument consists of two side plates and a base tube. Pivoted on a screw which is fastened to the right side plate is the leveling arm. By means of an elevating knob, the leveling arm can be elevated or depressed 180 mils from the horizontal. An angle-of-site scale is located on the vertical plate between the two side plates. Micrometers for the more exact measurement of angles of site and depression are on the elevating knob and screw respectively. A level assembly attached to the leveling arm indicates the horizontal position.

At the inner end of the base tube is an eyepiece which is used in sighting the target. While the observer is sighting the target, he can also see a mirror on which is engraved a horizontal line representing the line of sight and in which is reflected the image of the level vial.

REFERENCES—TM 9-1525; TM 9-2005, v. 5.

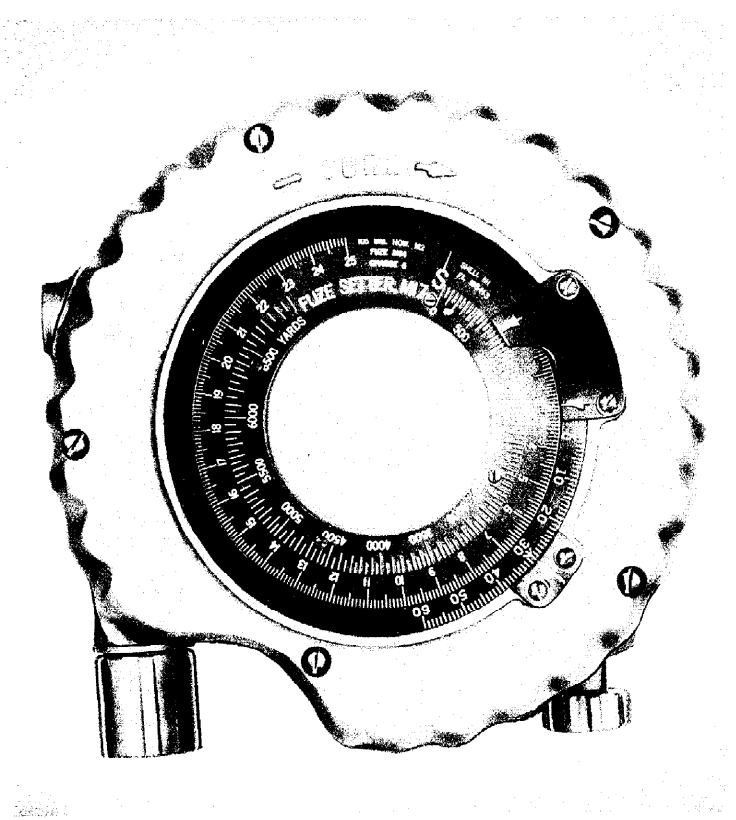
POWDER TEMPERATURE THERMOMETER M1—STANDARD

This instrument is used to ascertain the temperature of the powder in semi-fixed or separate-loading ammunition in order that the proper change in muzzle velocity caused by a change in powder temperature may be applied. It consists of a dial-type, Weston thermometer, registering from −40° to +160° F. There is a spike stem with pointed end. The rear plate of the disk is reinforced. A metal padded box is provided for carrying the instrument. This thermometer and container are supplied to all batteries using semi-fixed or separate-loading ammunition.

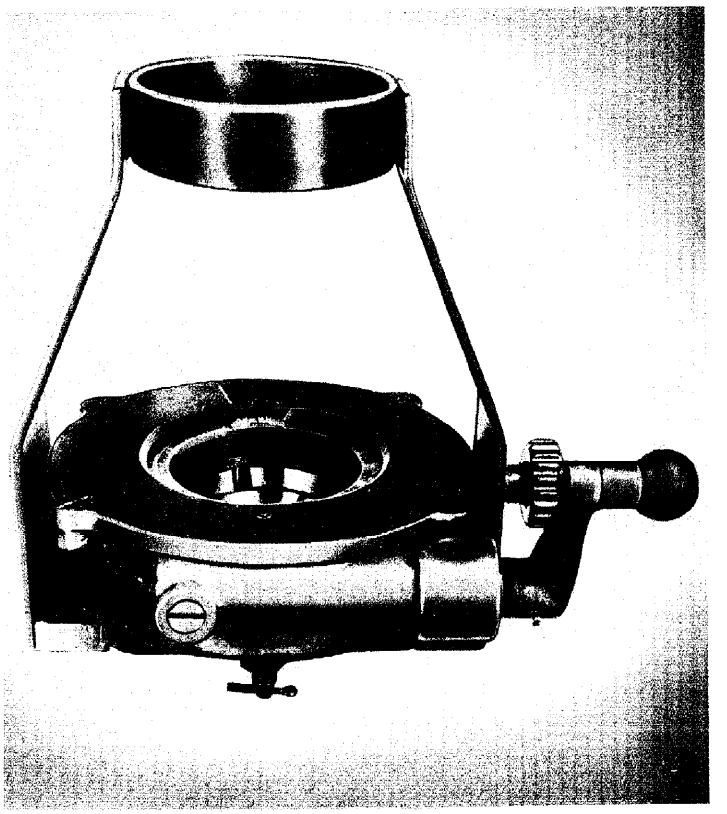


POWDER TEMPERATURE THERMOMETER, M1

BRACKET FUZE SETTERS M1916, M1916A2—LIMITED STANDARD
HAND FUZE SETTER M1912A4—LIMITED STANDARD
FUZE SETTERS M15, M17 LIMITED STANDARD—M22, M23 STANDARD



FUZE SETTER, M17, SHOWING SCALES



BRACKET FUZE SETTER, M1916A2

A fuze setter is a mechanical device for setting a time fuze so that the projectile will detonate at a definite time after being fired or at a definite distance from the muzzle of the gun.

This instrument contains two rings which are sloped to fit the contour of the fuze. One ring, known as the range or worm ring, is used for setting the range. It carries a scale graduated in yards. The second ring, called the corrector scale, is used for setting in corrections in the height at which the projectile is to burst. These are usually scaled from 0 to 60 with 30 representing normal. Each fuze setter has rings scaled to correspond to the fuze, ammunition and weapon with which it is used. Some models may be used interchangeably with different ammunition, fuzes or matériel, by merely substituting a different range ring.

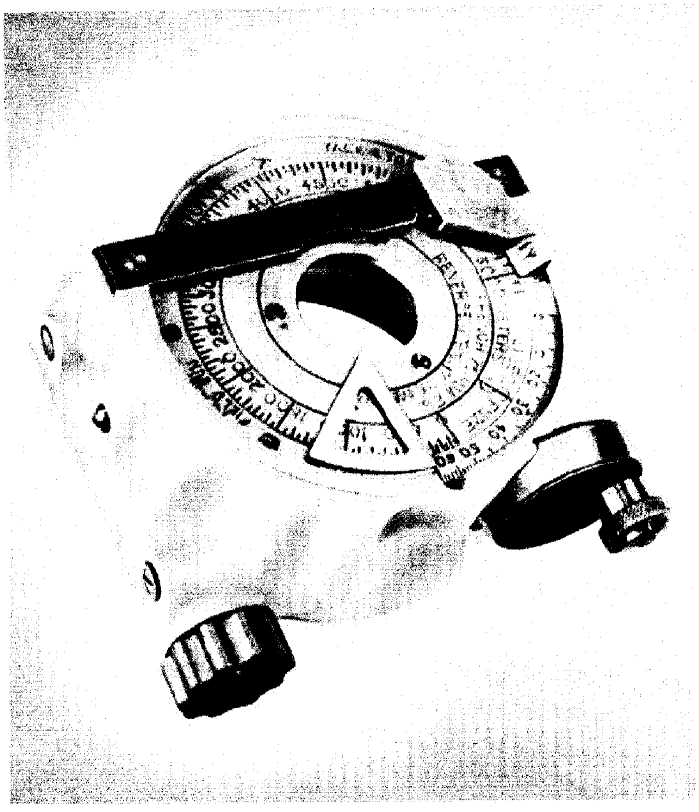
A fuze setter is operated by turning the range ring by means of a worm mechanism until the index is opposite the desired range. If a correction is necessary, the corrector scale is likewise turned until the proper correction is opposite the index. Otherwise the corrector scale is set at normal. These settings serve to position a stop and a notch in the fuze setter in angular relation corresponding to the desired setting. When the fuze is inserted in the fuze setter it can be rotated until the stop in the fuze setter encounters a fixed pin on the fuze body. During the rotation the movable time-train ring of the fuze is revolved so that the final setting of the fuze corresponds to that on the fuze setter scales.

BRACKET FUZE SETTER, M1916—This fuze setter is used with 75 mm guns, M1897, M1916 and modifications, and M1917. It operates upon the regular service ammunition for these weapons, as equipped with the 21-second combination fuze, M1907. It is mounted on the anchor, 16B, which is carried on the fuze setter anchor rod of the caisson. The range ring, with a scale graduated from 0 to 6,600 yards, is operated by turning a crank on the side of the instrument. The corrector scale is set by turning a knurled knob. A canvas cover is provided to protect the fuze setter when not in use.

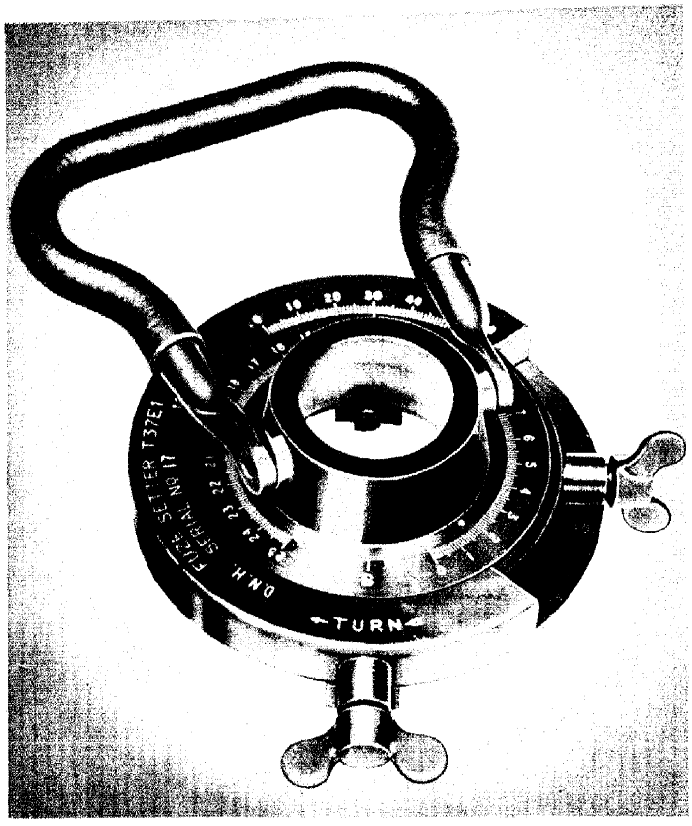
BRACKET FUZE SETTER, M1916A2—This is the M1916 fuze setter as modified for use with drill cartridges with the 75 mm howitzer carriages, M2A1, M3 and M3A1. It differs from the M1916 in the range scale, which is graduated from 0 to 5,600 yards, and in the mount. The M1916A2 is mounted on the anchor, B141845. The latter is placed on the ground instead of on the caisson.

BRACKET FUZE SETTERS M1916, M1916A2
HAND FUZE SETTER M1912A4
FUZE SETTERS M15, M17, M22, M23

(Continued)



HAND FUZE SETTER, M1912 SERIES



FUZE SETTER, M22

HAND FUZE SETTER, M1912A4 This is a typical hand fuze setter, one which has no mount. During operation, it is held in the hand. There is no crank, and both scales are turned by means of knobs. This instrument is standard for use with the shrapnel, M37, and the 21-second combination fuze, M1907, ammunition for the 75 mm pack howitzers, M1 and M1A1. The range scale is graduated from 0 to 5,500 yards.

FUZE SETTER, M15 Basically this hand fuze setter has a typical corrector scale and combined time and range ring. The time ring is graduated in tenths of seconds from 0 to 25 seconds. The range scale is graduated in hundreds of yards for the H.E. shell, M48, fuze, M54, charge 3, for 75 mm howitzer matériel.

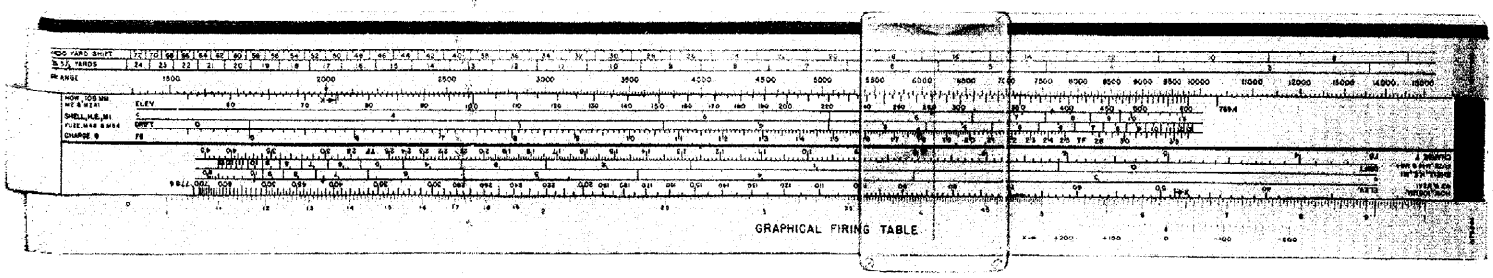
FUZE SETTER, M17 This is the same as the M15 fuze setter but has the range scale graduated for use with the H.E. shell, M1, fuze, M54, charge 5, for the 105 mm howitzer, M2, matériel.

FUZE SETTER, M22 This fuze setter is standard for use with all shells incorporating the 25-second Time Fuze, M54 or M55. It is a simply constructed but accurate instrument, eliminating the worm gear construction. Its principal parts are in three concentric rings. The outer ring has a conventional corrector scale which is set against an index on the intermediate ring. The scale may be turned only when the corrector knob is loosened. When the scale is at the desired setting, the knob is tightened. The intermediate ring has a time scale graduated at 0.1-second intervals from 0 to 25 and numbered at 1-second intervals. It is set by loosening the time knob and turning the handle connected to the inner ring until the index on the inner ring is opposite the desired setting. Attached to the inner portion of the fuze setter is the pawl which engages a slot in the setting ring of the fuze when the fuze setter is forced down over the nose of the fuze. On the base of the fuze setter is another pawl which engages a depression in the body of the fuze to stop all motion when the fuze setting is complete.

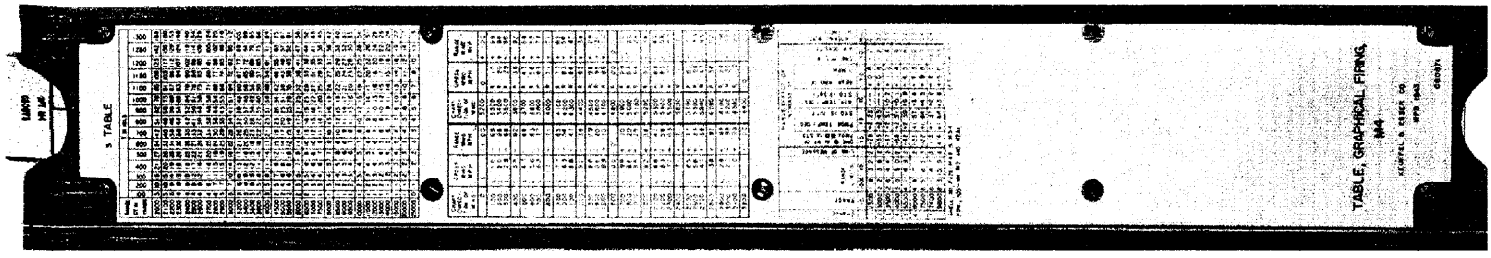
FUZE SETTER, M23—This is standard for setting the 75-second Time Fuze, M67, as used in various high-explosive shells for 4.5 inch guns, 155 mm guns and howitzers, 8 inch howitzers, and 240 mm howitzers. It is similar to the M22 fuze setter but the range scale covers 75 seconds at 0.2-second intervals. It is numbered at 1-second intervals.

REFERENCES—TM9-1590; TM9-2005, v.5; Matériel Data Sheet on Fuze Setter, T37E2 (M23).

GRAPHICAL FIRING TABLES



GRAPHICAL FIRING TABLE, M4



GRAPHICAL FIRING TABLE, M4, REVERSE SIDE

A graphical firing table is a device by means of which corrected firing data for a particular weapon and charge of ammunition can be determined quickly without lengthy calculations. It can be used in numerous ways to obtain required information. One of its advantages is that when corrections are ascertained, further corrections due to changes in meteorological message or other conditions and factors can be determined with little difficulty. Once a correction has been obtained and set in on the graphical firing table, corrected data can be read as easily as can uncorrected data from an ordinary firing table. Two types of graphical firing tables have been adopted for use. The 12-inch tables are standard, and the 18-inch tables are substitute standard.

12-INCH GRAPHICAL FIRING TABLES—Each of these tables is constructed for use with a particular weapon and consists of from one to three rules and two indicators, all of which are supplied in a canvas carrying case, M57, which is treated to be water- and fungus-proof. The rule is 11½ inches long, 2 inches wide, and ¼ inch thick and contains on each side a range scale (plotted logarithmically, as are the other scales) and a scale giving the deflection shift in mils necessary to move the center of the sheaf 100 yards at each range. There is also a mark for converting range readings from yards to meters. On each side of the rule are two additional sets of scales, each set containing data for a different powder charge and specific ammunition. If the rule is designed to determine firing data for low angle fire, the scales are elevation, "c" (change in elevation for 100 yards change in range), "f"-fork (change in elevation necessary to move the center of impact four probable errors), drift, and fuze setting or time of flight. For high angle fire, the remaining scales include: elevation, drift, time of flight and 10 m SI (change in quadrant elevation for a 10-mil change in site). The transparent indicator, which slides over the rule slightly above the surface of the rule, is 2½ inches wide and each of its two faces is 0.04 inch thick. At the center of each face is a hair line to serve as an index. Each face is slightly frosted to permit its being marked with pencil. Furnished with each table is a card 11½ inches by 2 inches made of a transparent plastic material. Printed on this card are jump corrections, and shift and deviation tables for use in the conduct of observed fire.

18-INCH GRAPHICAL FIRING TABLES—The 18-inch graphical firing tables are Mannheim-type slide rules. Each table consists of a stock, a ballistic slide, a mathematical or transit slide, and an indicator. The stock is uniformly marked for the long range or the short range graphical firing table. The slide contains the individual data for a particular gun with various charges. The indicator is a transparent window which may be slid along the rule without disturbing the relative position of stock and slide. It has a vertical line which serves as an index. Carrying Case, M23, holds a stock and three slides.

On the front of the stock just above the slide is a range scale, plotted logarithmically. The long range tables contain ranges from 10,000 yards to 26,000 yards and the short range tables are graduated from 1,000 yards to 15,000 yards.

Along the upper edge of the stock is a scale giving the deflection shift in mils necessary to move the center of the sheaf 100 yards at each range. Between this scale and the range scale is a scale giving the amount for each range by which a 100-yard sheaf must be opened to form a 200-yard sheaf. It also indicates the increment to add to the site in time fire to secure the correct height of burst.

On the front of the stock below the slide are two more scales. On one of the scales may be read the "K" or range correction for each 1,000 yards. The second scale is used with a special mathematical or transit slide in making arithmetical and trigonometrical calculations.

The back of the stock contains a deviation table, or a shift table, a wind component table, and a weather effects table. Short range tables contain a shift table, while long range tables have a deviation table. The wind component tables are identical on each short range rule and vary on each long range table. The weather effects tables differ in each short range rule and the weather effects table of each long range rule is identical to that of the corresponding short range rule.

Some older models of graphical firing tables contained only a shift table, a deviation table, and a chart to be filled in by the user of the table. This chart was designed to show at a glance the most suitable charge to use for a given range and various pertinent data for each charge.

Each ballistic slide has scales for four charges. There are two scales on each side of the slide. To eliminate all chance of confusion and to insure that the scale to be used is placed against the fixed range scale, the slide is marked so that the scale not being used on each side of the slide is turned end-over-end. When it

is desired to use the second scale, the slide is removed from the stock and replaced in an inverted position.

The scale for each charge contains four lines as follows: elevations in mils; the change in elevation to the nearest mil; for a 100-yard change in range; drift; and time of flight or fuze setting. For ammunition which is not time fuzed this line of the scale gives time of flight in seconds. For time-fuzed ammunition, the fuze setting in seconds is shown instead. This figure differs only slightly from time of flight.

A mathematical slide is provided with each short range table. This has no connection with the ballistic functions of the table, but is used with the second scale on the lower part of the stock in solving various problems. A similar slide, graduated in degrees and minutes instead of in mils, and designated Slide, M1, is also supplied for use with the 18-inch graphical firing table. It is often referred to as a transit slide.

REFERENCES—FM 6–40; TM 9–526.

18-INCH GRAPHICAL FIRING TABLES—SUBSTITUTE STANDARD

Graphical Firing Table	Weapon	Range
M4	105 mm Howitzer, M2 to M2A2	Short range
M5	105 mm Howitzer, M1917, M1918, and modifications	Short range
M6	155 mm Gun, GPF	Short range
M7	155 mm Gun, M1	Short range
M8	8 inch Howitzer, M1	Short range
M9	240 mm Howitzer, M1	Short range
M10	75 mm howitzers (pack and field)	Short range
M12	155 mm Howitzer, M1	Short range
M13	4.5 inch Gun, M1	Short range
M15	155 mm Gun, GPF	Long range
M16	155 mm Gun, M1	Long range
M17	8 inch Howitzer (Schneider)	Long range
M19	240 mm Howitzer, M1	Long range
M20	4.5 inch Gun, M1	Long range
M22	8 inch Gun, M1	Long range

12-INCH GRAPHICAL FIRING TABLES—STANDARD

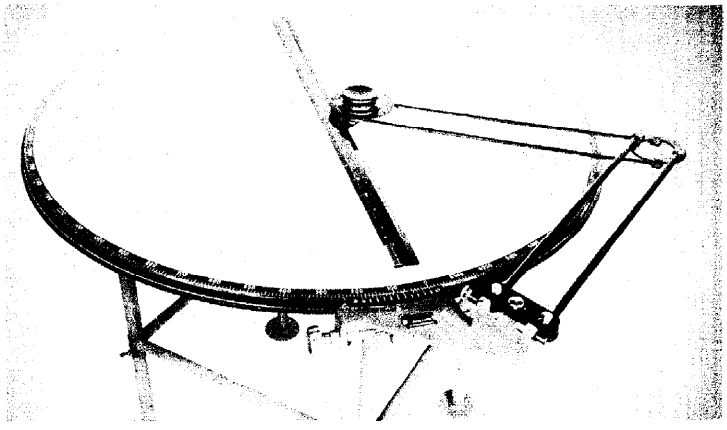
Graphical Firing Table	Number of Rules	Weapon	Shell	Charge	Maximum Range in yards
M23	2	105 mm Howitzer	M1	1 and 3	5,500
				High angle	13,000
				4 and 5	8,500
				6 and 7	14,000
M24	3	75 mm Howitzer	M48	1 and 2	5,500
				3 and 4	12,000
			M41A1	1 and 2	5,500
				3 and 4	12,000
			M48	High angle	12,000
			M41A1	High angle	12,000
M25	(data not available)	76 mm gun	(data not available)		
M26	(data not available)	90 mm gun	(data not available)		
M27	1	4.5 inch gun	M65	Normal and super	17,500
				Super and high angle	25,000
M28	2	155 mm howitzer	M107	1 and 3	7,000
				High angle	20,000
			M107	4 and 5	11,000
				6 and 7	18,000
M29	(data not available)	3 inch gun	(data not available)		
M30	(data not available)	75 mm tank gun	(data not available)		
M31	1	155 mm Gun, M1	M101	Normal and super	18,000
				Super and high angle	28,000
M32	2	240 mm Howitzer, M1	M114	1 and 2	18,000
				3 and 4	27,000
			M114	High angle reverse side blank	25,500
M33	2	8 inch Howitzer	M106	1 and 3	9,000
				High angle	20,000
			M106	4 and 5	13,000
				6 and 7	20,000
M34	(data not available)	120 mm gun	M73	(data not available)	
M35	(data not available)	8 inch gun	(data not available)		
M36	(data not available)	240 mm Howitzer, M1918	(data not available)		

PLOTTING BOARD M5—STANDARD

This instrument, formerly known as the Flash Ranging Plotting Board M5, is used for locating hostile batteries by plotting the azimuth of the flashes or smoke from enemy guns as reported from two or more observation posts. The center of impact of friendly fire may also be determined.

The board consists essentially of a rotating circular table mounted on a circular base supported by four braced legs. A grid is engraved on one side of a disk fastened to the table. The disk can be reversed and special grids or maps drawn on the clear side. Around the edge of the table is an azimuth scale graduated at 10-mil intervals. A drafting machine is fastened to the edge of the base by means of a bracket. Attached to the top of the bracket is a vernier graduated at ½-mil intervals to provide for the reading and setting of the azimuth to the nearest ½ mil. Also contained within the bracket is a braking mechanism which keeps the table from rotating while the plotting is being done.

A straightedge, with graduations corresponding to the markings of the grid, is attached to the drafting machine. For orientation, the straightedge is made to coincide with the north-south grid line. When the grid has been properly oriented, the locations of the observation stations are plotted in the proper positions. The straightedge may be moved across the board only parallel to its original position. When the azimuth of a flash is reported from an observation station, the board is rotated until that azimuth is indicated by the scale and vernier. With the board set in that position, the straightedge is moved to touch the station location, and a line is drawn along the straightedge from the station. The location of the flash or burst is represented by the intersection point of the lines from all the observation posts.



PLOTTING BOARD M5

REFERENCES—TM 9-1569, TM 9-2683.

SOUND RANGING PLOTTING BOARD M1—STANDARD

This board is used for locating the approximate position of enemy fire by plotting certain data derived from the differences in the time when the sound of gunfire reaches each of several microphone stations situated at uniform distances along either a straight line or an arc. By plotting data relating to the sounds of bursts, this instrument can also be used for adjustments of fire of gun and howitzer batteries.

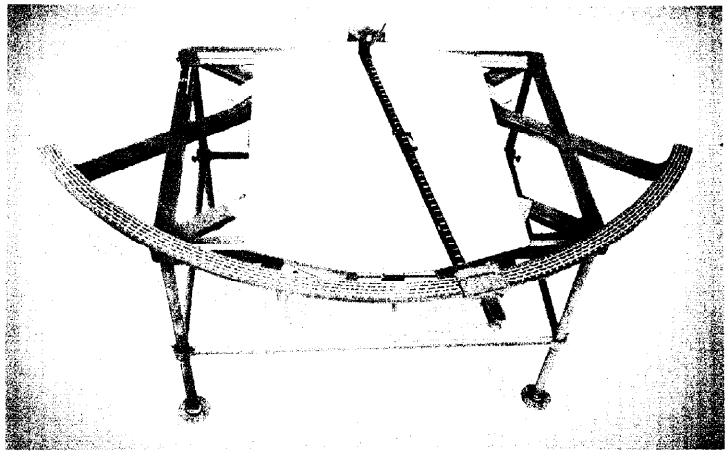
The functioning of this instrument is based on the fact that, if the time is known when a sound is heard at three known locations, a circle can be drawn with its center at the point of origin of the sound. Since constructing this circle is impractical, the principle of the hyperbola is used instead. These curves represent all points located so that the difference of the distance from two stations is constant. The point of intersection of all hyperbolae marks the approximate location of the point of origin of the sound.

For further simplification hyperbolae are not actually drawn. Instead, two straight lines, called asymptotes, are associated with the hyperbolae. They intersect at the midpoint of the straight line joining the two foci and become tangent to the hyperbolae at infinity. By means of an asymptote correction chart, values secured from the use of asymptotes are expressed in terms of the corresponding hyperbolae.

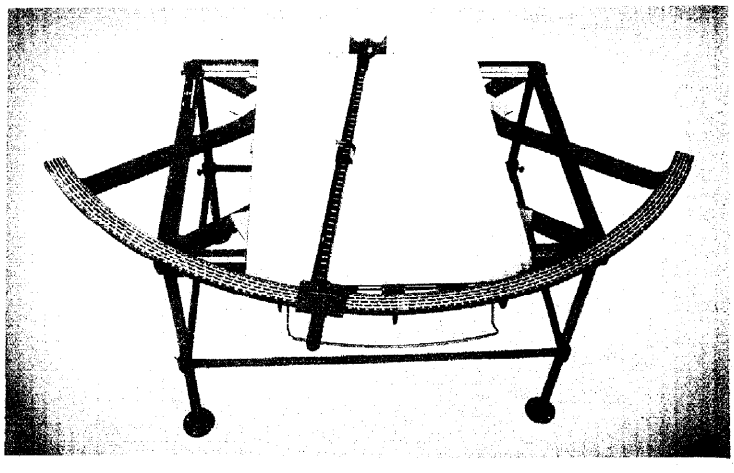
This instrument consists basically of a frame supported on four legs. Two carriages are provided, one for straight-base stations, and the other for curved-base stations. When the board is in use, a grid is drawn on the plotting surface or on a piece of vellum. A straight or curved-base platen, with holes representing the location of the midpoints of each pair of microphone stations, is affixed to the rear of the frame.

In order to set the plunger in the locating mechanism in the holes representing the midpoints of the successive stations, the straight-base carriage is moved across the frame on rollers and the curved-base carriage is rotated about a spindle mounted in the frame.

A straightedge, graduated from 1,000 to 20,000 yards at 50-yard intervals to a scale of 1:200,000, is known as the asymptote range arm. It is pivoted at the rear of the frame and rides in an arc-shaped rail which has four time-difference scales graduated



SOUND RANGING PLOTTING BOARD M1 WITH CURVED BASE



SOUND RANGING PLOTTING BOARD M1 WITH STRAIGHT BASE

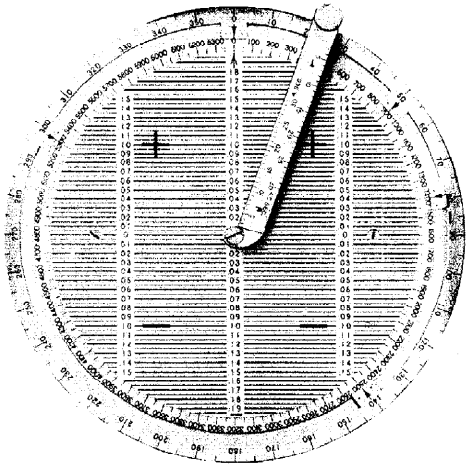
in hundredths of a second and one graduated in degrees attached to it. With the locating mechanism properly set, the asymptote for each pair of microphone stations is drawn with the index of the asymptote range arm set at the difference between the time of hearing of the sound at the two stations, along the proper time-difference scale. The difference is given as plus when the time is greater for the second of two microphone stations. Otherwise it is minus.

The intersection of the asymptotes indicates the plotted position of the sound source. When asymptote, wind, and temperature corrections are applied to this plot, the correct location of the battery or burst can be ascertained.

AUXILIARY INSTRUMENTS—Sound Ranging Wind Corrector M1.

REFERENCES—TM 9-1569; TM 9-2005, vol. 5; TM 9-2684.

SOUND RANGING WIND CORRECTOR M1—STANDARD



SOUND RANGING WIND CORRECTOR M1

This instrument is used with the Sound Ranging Plotting Board M1, to determine the changes in time differences due to the direction and velocity of the wind. It gives the time-difference corrections in both value and sign, with plus and minus having the same significance as on the Sound Ranging Plotting Board.

The components of the instrument consist of a circular rotating correction disk surrounded by an inner and an outer azimuth scale. Pivoted at the center of the disk is the wind arm which is scaled according to wind velocity, with a different scale for each sub-base length.

The correction disk is marked with time corrections graduated to .005 second, every .010 second graduation being numbered. The proper sign is indicated in each quadrant. The inner azimuth scale is used for marking the azimuths of the microphone stations as directed from the second station to the first, by means of sub-base markers. The outer scale indicates the wind azimuth, with the wind arm used as a marker. An index on the correction disk is placed opposite the index of the proper sub-base marker.

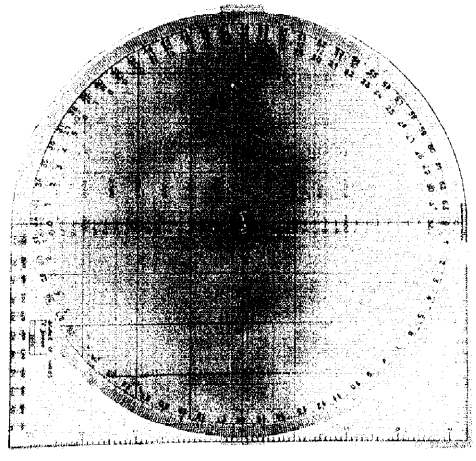
With the wind arm marking the wind azimuth, the sub-base markers indicating the azimuths of the sub-base, and the correction disk index pointing to the index of the sub-base marker, the wind correction for that sub-base will be found opposite the wind velocity on the wind arm.

REFERENCES—TM 9-1569; TM 9-2005, vol. 5; TM 9-2684.

PLOTTING BOARD M10—STANDARD

Plotting Board M10 is used with heavy infantry weapons in determining quickly the azimuth and range from gun to target when the azimuths and ranges from observer to target and from observer to gun are known.

The board consists of a translucent plastic disk eight inches in diameter pivoted at the center to a flat base of water-repellent material. The base is of essentially the same size and shape as the disk, except that half of it is squared off to furnish a grip for the left hand. In addition, there are short extensions on the movable disks, projecting over the circular edge of the base, to aid in pivoting the movable disk. The disk is prepared so that it can receive pencil marks. The periphery of the disk is graduated in a clockwise direction at 10-mil intervals from zero to 6,400. On the left half of the disk are additional scales, one reading counterclockwise from zero to 3,200, marked in red, and the other clockwise with 0 at the 3,200 graduation and 3,200 at the 6,400 graduation, marked in black. The first additional scale is for use with machine guns, and the second with infantry artillery.



PLOTTING BOARD M10

Along one diameter of the base is a red index line with an arrow at one end close to the edge. Beyond the arrow is a vernier scale covering 10 mils of azimuth at 1-mil intervals, permitting closer reading of azimuths than by the main azimuth scale alone. The index line is marked off into one-fifth of an inch graduations, each representing a distance of 100 yards. Parallel to this line is a supplementary double value scale for use in situations involving longer ranges. The zero point, at the center of the board, represents the observation point.

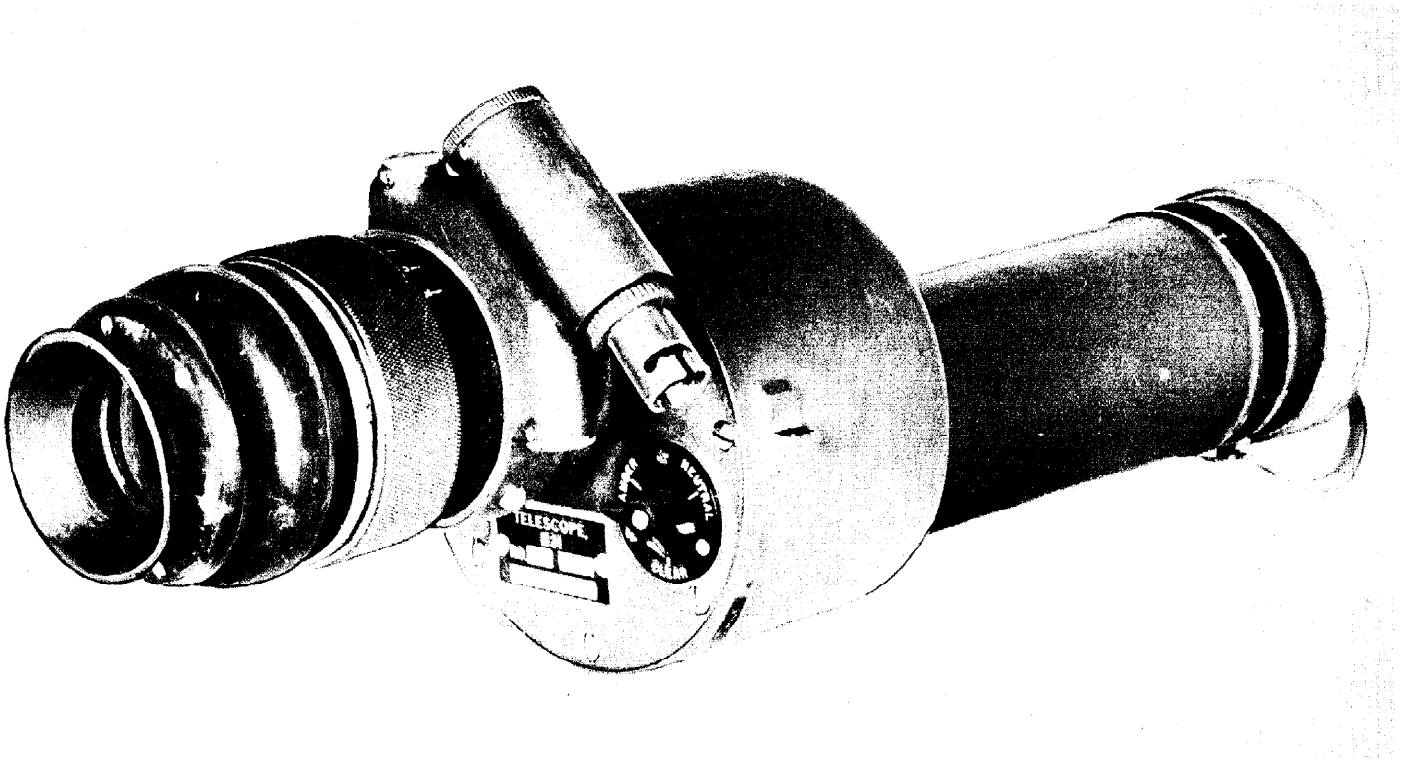
For convenience in using this plotting board for finding vertical angles of site, plus and minus signs are placed on the right and left sides respectively of the zero line of the movable disk.

Perpendicular to the index line are other graduations, half as far apart, representing 50-yard intervals. These graduations are joined by perpendicular and parallel lines to form a grid.

The operator plots in turn the position of gun and target, with respect to the observing station, by rotating the disk until the proper azimuth is opposite the index and then marking the range from the observing station along the index line. The disk is rotated until the two plotted points are parallel to the index line. Then the azimuth from gun to target can be read opposite the index, and the range from gun to target can be determined by counting the number of squares between the two points.

FIRE CONTROL - RAILWAY AND SEACOAST ARTILLERY

TELESCOPES M1912 SUBSTITUTE STANDARD—M31 STANDARD
TELESCOPE MOUNTS M1912M1, M1918, M35—STANDARD



TELESCOPE, M31

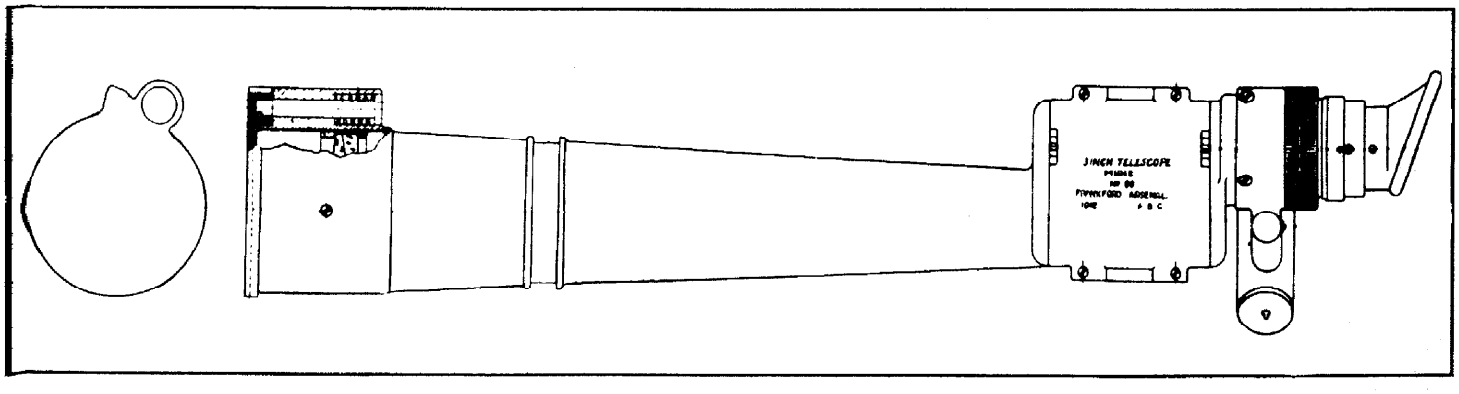
These straight telescopes, mounted on the side of a barbette carriage, are used in direct fire for aiming the gun, laying it in azimuth, and making lateral adjustments of fire. The telescopes are similar, but vary in size and power. Each telescope has crosswires or a clover-leaf design for centering the target. A protective cover is provided for the objective end.

Telescope	Mount	Barbette Carriages	Status of Carriages
M31	M35	6″ Barbette Carriage, M1	Standard
M31	M35	8″ Barbette Carriage, M1	Standard
M1912, 3″	M1912M1, 3″	12″ Barbette Carriage, M1917	Standard
M31	M35	16″ Barbette Carriage, M4	Standard
M1912, 3″	M1918	16″ Barbette Carriages M1919, M1919M1, M2, M3	Limited Standard

The mounts are in the form of a cradle supported on a bracket which is attached to a trunnion bearing of the carriage. The mounts support the telescopes so that they can be moved vertically in order to keep the target sighted. The telescopes move horizontally as the weapons are traversed. The mounts also contain the mechanisms for limited horizontal motion in both directions in order that deflections may be set in. The deflection scales, scaled in degrees, and the micrometer in hundredths of a degree, are located on the mounts.

All these mounts have open sights.

Illumination of the crosswires, micrometer and index is provided from the main power source on the mount.



TELESCOPE, M1912

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TELESCOPES M1912, M31
TELESCOPE MOUNTS M1912M1, M1918, M35
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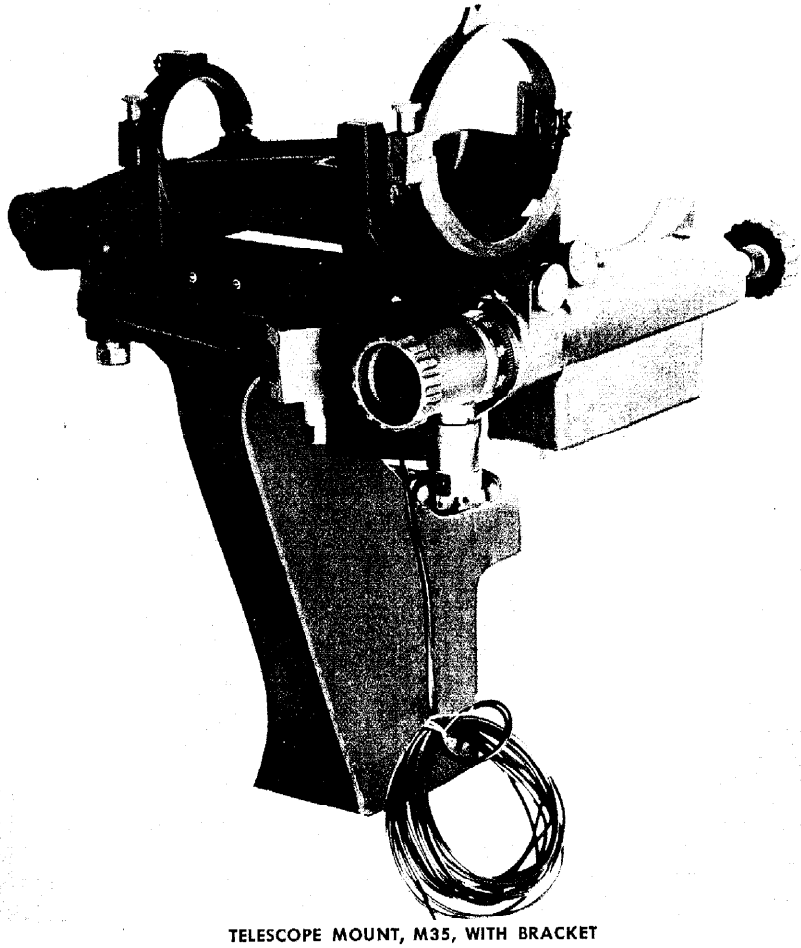


TELESCOPE MOUNT, M35, WITH BRACKET

OPTICAL CHARACTERISTICS

	Telescope, M1912	Telescope, M31
Power	15	8
Field of view	3° 20′	8° 45′
Diameter of exit pupil	.3″	.276″

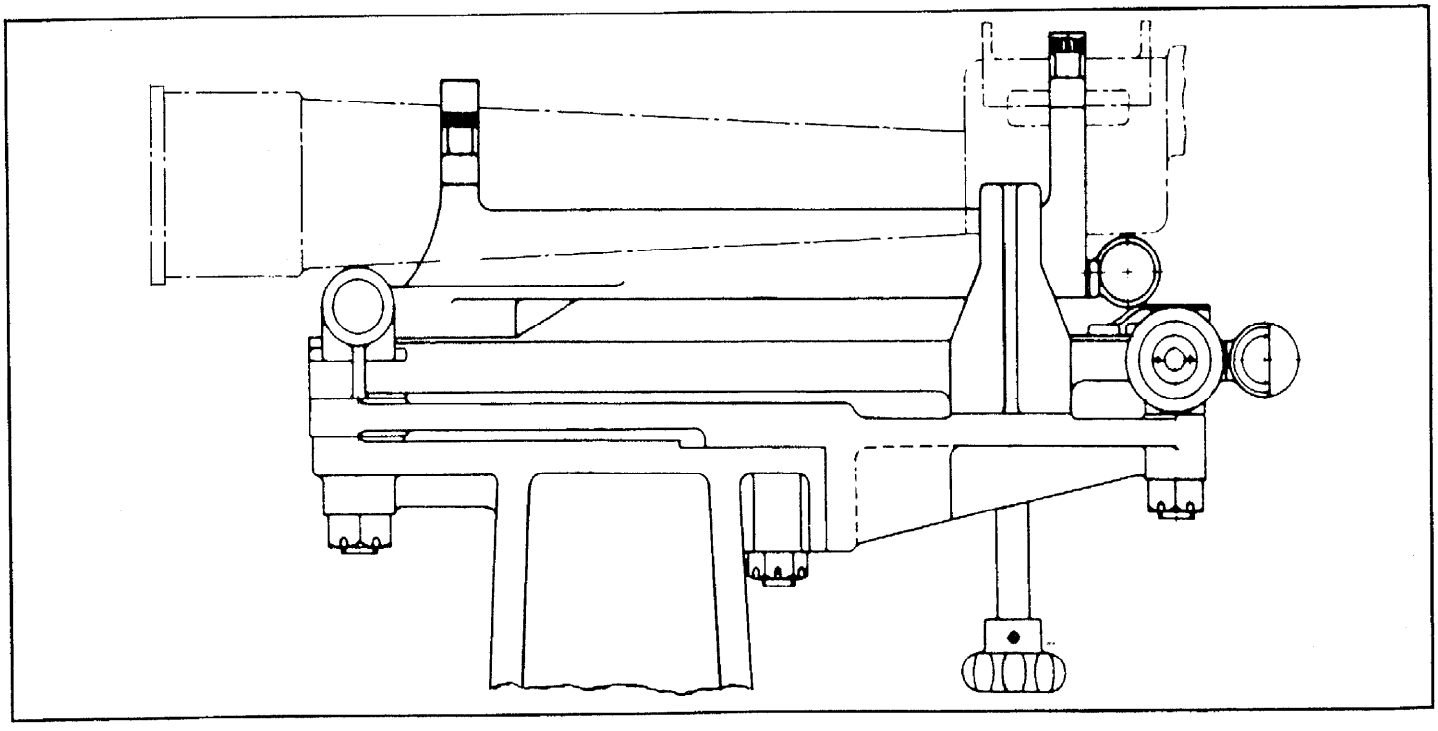
TELESCOPE, M1912, is approximately 25.75″ long; it has a clover leaf pattern on the reticle.

TELESCOPE, M31, is about 16″ long and the reticle pattern consists of a horizontal and a vertical crosswire. The telescope is provided with amber and neutral filters.

TELESCOPE MOUNTS, M1912M1, M1918—These mounts follow the general pattern of mounts for direct-sighting seacoast telescopes, differing from each other only in minor details. The M1912M1 allows a total deflection of 12°, with the normal setting marked by the 6° graduation. The M1918 permits 20° deflection, with the 10° setting representing the normal.

TELESCOPE MOUNT, M35—This resembles the earlier mounts and is designed to replace the corresponding elements of Mounts, M1912M1 and M1918. A total deflection movement of 20° is possible, with 10° as the normal setting.

REFERENCE—TM 9-2005, v. 5.



TELESCOPE MOUNT, M1912M1

UNCLASSIFIED

ELEVATION QUADRANT M1—STANDARD
QUADRANT ADAPTERS M8, M10—STANDARD

The Elevation Quadrant, M1, is used for laying various weapons in elevation. It is standard on-carriage equipment for 8″ railway mounts and certain barbette carriages. With the Quadrant Adapter, M8, it is used on the 155 mm Gun Carriage, M1. Its only application outside the realm of seacoast artillery is on the 240 mm Howitzer Carriage, M1, and the 8″ Gun Carriage, M2.

The elevation quadrant is a metal casting containing an elevating mechanism, a cross-leveling mechanism, and a lighting system. It is pivoted to a mounting bracket by which it is attached to the right gun trunnion.

Elevations are indicated on an elevation scale which is graduated in 100-mil increments from a depression angle of 200 mils to an elevation of 1,200 mils. The elevation micrometer is graduated in 1-mil increments. A longitudinal level indicates when the actual elevation of the gun is the same as that shown on scale and micrometer.

The cross-leveling mechanism is actuated by means of a cross-leveling knob. The centering of a cross-level bubble indicates a level position.

The levels, scales, and indexes on the quadrant may be lighted electrically by lamps which are controlled by a toggle switch on the right underside of the quadrant body. Electric power is drawn from the main power source on the gun mount.

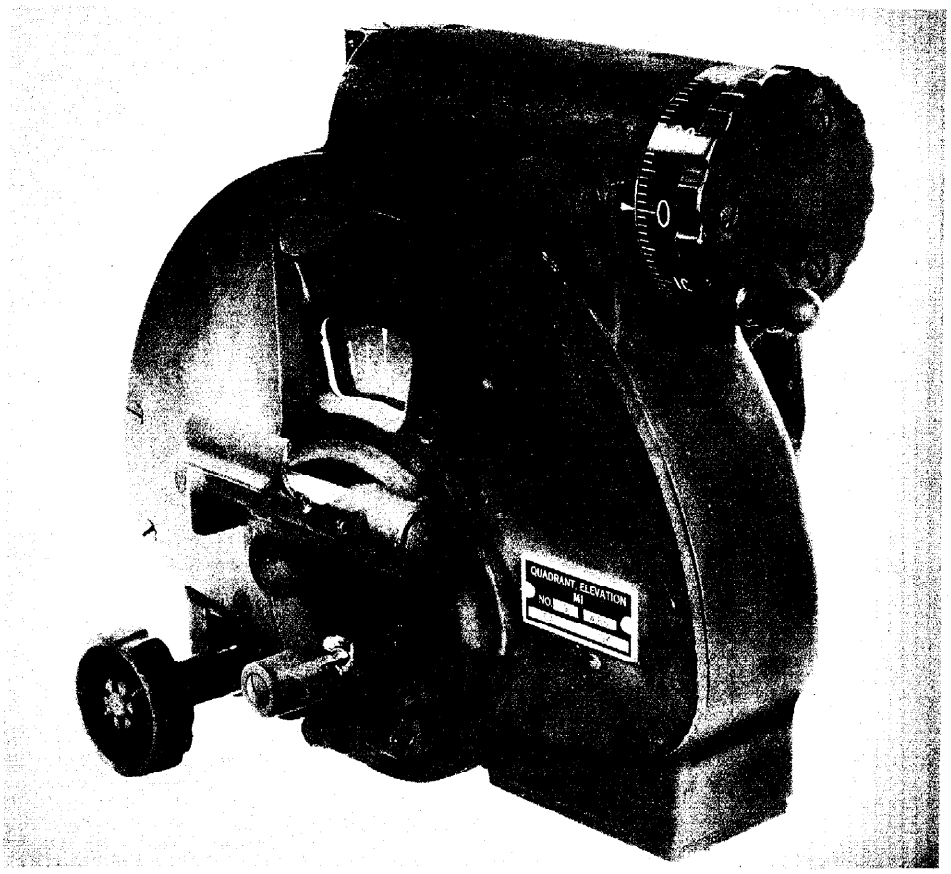
The Elevation Quadrant, M1, is standard on-carriage equipment for the following railway and seacoast matériel:

8″ Gun Railway Mount, M1A1 (S.)
155 mm Gun Carriage, M1 (with Quadrant Adapter, M8) (S.)
8″ Gun Railway Mount, M1 (L.S.)
8″ Barbette Carriage, M1 (L.S.)
8″ Barbette Carriages, M1918, M1918M1 (L.S.)
16″ Barbette Carriages, M1919, M1919M1 (L.S.)
16″ Barbette Carriage, M2 (L.S.)
16″ Barbette Carriage, M3 (L.S.)

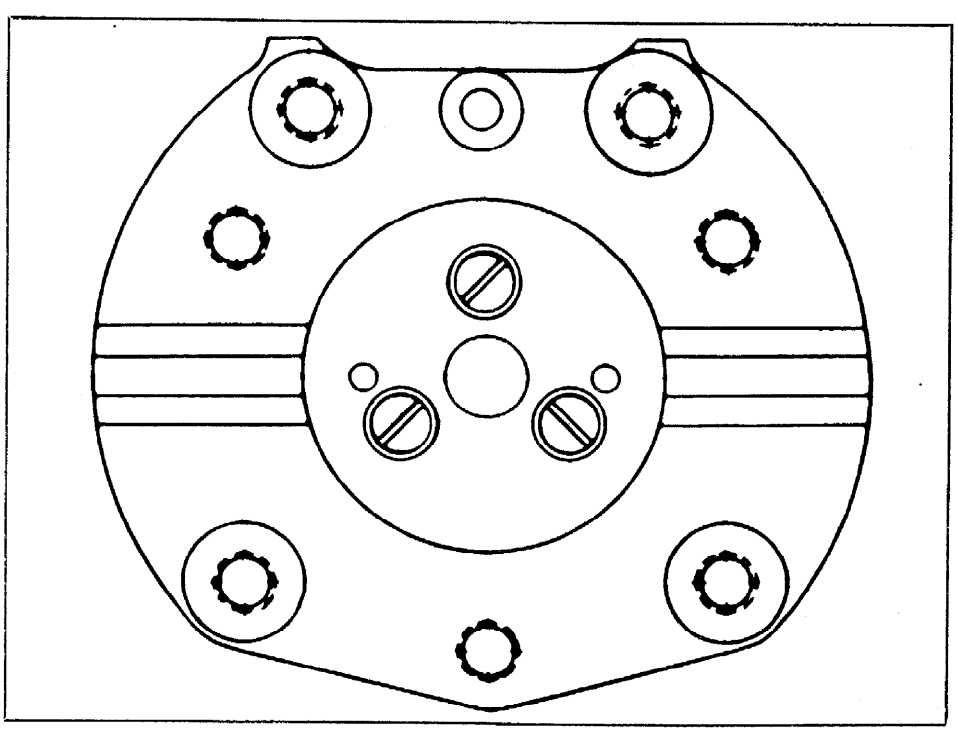
QUADRANT ADAPTER, M8—This is a device which is used to enable the Elevation Quadrant, M1, to be mounted on the 155 mm Gun Carriage, M1, when used as a seacoast weapon.

QUADRANT ADAPTER, M10—This is a bracket which serves as a support for Elevation Quadrant, M1, when used on the 240 mm Howitzer Carriage, M1, or the 8″ Gun Carriage, M2.

REFERENCES—TM9-1557; TM9-2674; TM 9-2005, v. 5.

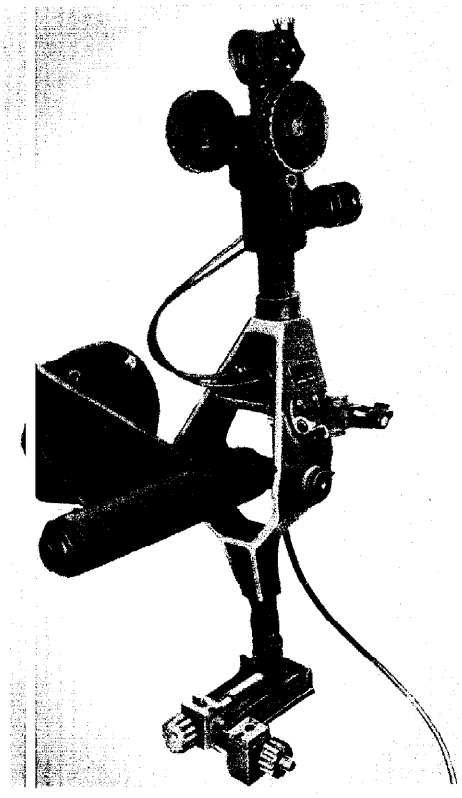


ELEVATION QUADRANT, M1

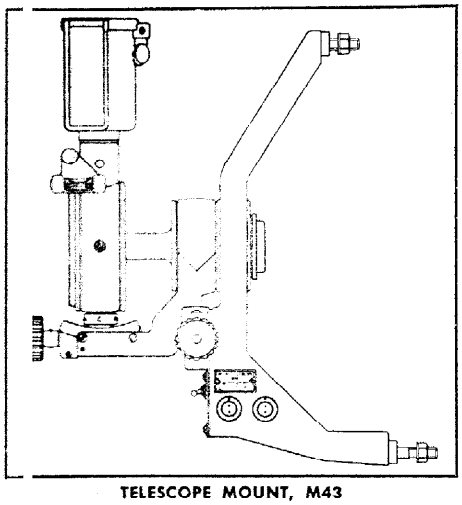


QUADRANT ADAPTER, M8

PANORAMIC TELESCOPE M8—STANDARD
TELESCOPE MOUNTS M20, M43—STANDARD



PANORAMIC TELESCOPE, M8, ON TELESCOPE MOUNT, M20



TELESCOPE MOUNT, M43

The Panoramic Telescope, M8, standard for use with certain seacoast guns, is generally similar to the panoramic telescopes used with field artillery. Its main differences are that it has greater power, is much larger, and its scales are graduated in degrees rather than mils.

Instead of the dove-reflecting prisms usually used in panoramic telescopes, there are a 90° rotating-head prism and two erecting prisms in the lower horizontal leg of the telescope. This telescope contains an amber and a neutral filter. There are also a diopter mechanism and scale for adjusting the eyepiece. The reticle pattern consists of a horizontal and a vertical crossline intersecting at right angles at the center of the reticle.

The elevation indicators consist of a scale and a micrometer, both actuated by the elevation knob. The only marking on the scale and micrometer is an index which matches with another index on the head to indicate normal elevation. Stop rings in the elevating-worm knob limit the range of elevation and depression.

The azimuth scale is graduated from 0° to 360° in 10° intervals. Another distinguishing point of this instrument is the fact that there are two large micrometer knobs, each covering 10° of azimuth, graduated at intervals of .05° and numbered at intervals of .5°. The micrometer on the left side of the scale is used for case III pointing and that on the right side is used for case II pointing. The former is numbered from 0 to 9 with 0 as normal, and the latter from 5 to 14 with 10 as normal. A correction scale is etched on the worm shoe opposite the left micrometer. It is graduated at .05° intervals and allows as much as 1° correction on each side of normal.

When used on the 155 mm gun carriage, the telescope is slightly modified to permit the setting of the azimuth index at 0 when the telescope is mounted with the eyepiece at an angle of 45° with the axis of the bore. The M8 telescopes already in service are being modified in the field.

TELESCOPE MOUNT, M20—This mount is secured to the left trunnion of the gun and the left side of the top carriage. It contains leveling, cross-leveling, and azimuth-compensating mechanisms.

TELESCOPE MOUNT, M43—This is a modification of the Telescope Mount, M18A1, which mounts the Panoramic Telescope, M12, on the 155 mm Gun Carriage, M1, for field artillery use. When the 155 mm gun is used as a coast defense weapon, the Mount, M18A1, is given a new socket to accommodate the Panoramic Telescope, M8.

ILLUMINATION—Electric power to illuminate the scales, levels, and reticle of the telescope and mount is drawn from the main power source on the fixed gun mount and controlled by a switch on the upper part of the support. Self-contained instrument lights are under development for use on the 155 mm gun carriage.

REFERENCES—TM 9-1582; TM 9-1674; TM 9-2005, v. 5; TM 9-2684.

OPTICAL CHARACTERISTICS OF PANORAMIC TELESCOPE, M8

Power	6
Field of view	6°40′
Diameter of exit pupil	0.20″
Effective focal length of objective	7.58″
Effective focal length of eyepiece	1.263″

Panoramic Telescope	Telescope Mount	Gun Carriage	Status of Carriage	Additional Sighting Equipment
M8	M20	8″ Gun Railway Mount, M1A1	Standard	Elevation Quadrant, M1
M8	M20	8″ Gun Railway Mount, M1	Limited Standard	Elevation Quadrant, M1
M8	M43	155 mm Gun Carriage, M1	Standard	Elevation Quadrant, M1 Quadrant Adapter, M8
M8	M6A1 (Substitute Standard)	155 mm Gun Carriage, M3	Substitute Standard	Quadrant Sight, M1918A1

LOTTING BOARDS M1915, M1918, M3, M4—STANDARD

A plotting board is a small-scale representation of the field of fire. On it ay be plotted the present and predicted urse of a moving target.

The board is generally sector shaped. ie center of the circle, known as the ecting point, represents the location of e directing gun. The gun arm, scaled to licate distances from the directing int, pivots about the directing point.

A metal plate, known as the station ate, has its center at the directing point. this plate, properly located as to disace and direction from the directing int, are placed sleeves representing the rious stations. Pivoted on two of these eves are the two station arms which e scaled with ranges from the respective tions. At the end of each station arm pivoted a coupler equal in length to the led distance of that station from the ecting point. Each coupler is attached an index box which rides in a groove ng the arc-shaped edge of the board to licate on the azimuth circle the azith of the target from the observation tion. The use of the couplers and index xes enables the azimuth circle, with its ter at the directing point, to be utilized show the correct azimuths from other ters.

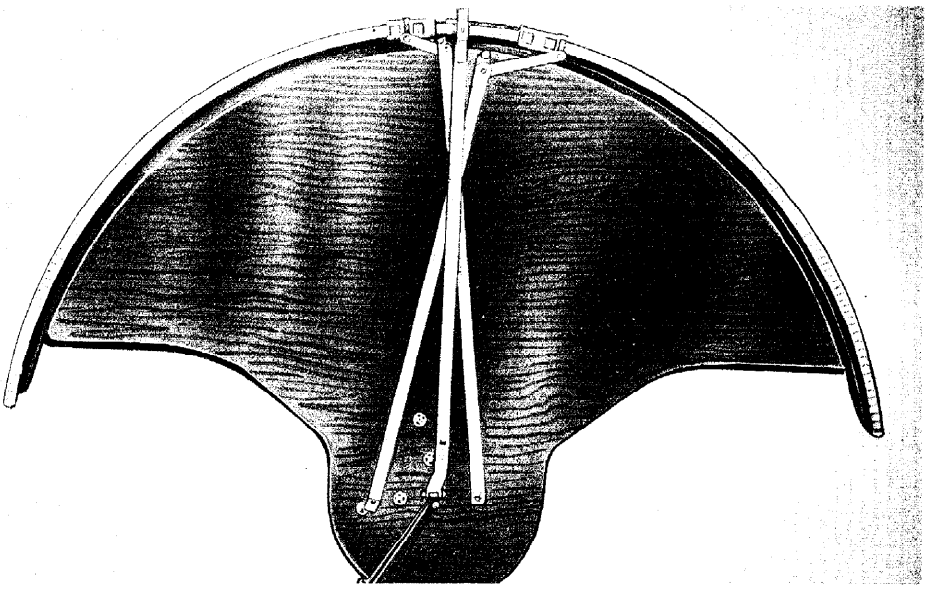
With the correct azimuths indicated the index boxes, the location of the get can be located at the intersection int of the two scaled edges of the stan arms. The range and azimuth from gun are determined by setting the gun ns so that it passes through the point.

By plotting the position of the target regular intervals its course can be pped out, and its regular rate of travel certained. Then, by means of the prection scale and the set forward rule, the ge and azimuth of the target at the e when the projectile will strike are termined.

Plotting boards are used with all types fixed coast artillery cannon. The four ndard models are all operated in the ne manner, but differ in certain details. ch board of the M3 and M4 classes is igned for a particular battery and ries in certain details.

LOTTING BOARD, M1915—This ard represents a 110° arc, but 360° of muth can be covered due to the fact t there are four sets of azimuth scales ng the azimuth circle, each represent- a different quadrant. Gun and station ns are graduated to 20,500 yards.

LOTTING BOARD, M1918—This is M1915 as adapted for use with newer, ger-range cannons. It can represent a ge of 30,000 yards.



PLOTTING BOARD, M1915

PLOTTING BOARD, M3—This board provides for continuous plotting through a field of from 200° to 260°. There is a plotting radius of 58⅓ inches, with scales of 400, 500 or 600 yards to the inch. The arms are graduated from 2,000 to 35,000 yards.

The M3 is equipped with optical as well as mechanical station arms. An optical station arm is used to represent any station at a great distance from the directing point. It is used to avoid the use of very long and unwieldy couplers. An azimuth indicator takes the place of the index box. It is installed at the junction of the base line and the azimuth circle on the station side of the directing point. The indicator is connected mechanically with a mirror. When the dials of the indicator are set at the desired azimuth, the mirror is positioned accordingly.

The Elbow Telescope, M10, is placed near the end of the optical station arm. The station arm is correctly positioned when a vertical black line in the telescope reticle appears in the mirror to be superimposed upon the reflected image of a broad white line on a strip in front of the objective lens.

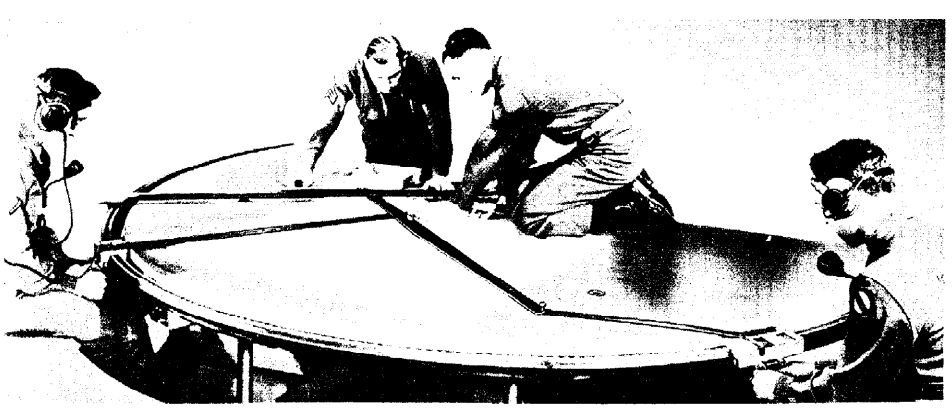
When a station is located in front of the directing point, a special optical arm and a special elbow telescope, the M10A1, are used.

PLOTTING BOARD, M4—This is like the M3 except in size. It is designed for longer ranges, having a plotting radius of 67½ inches scaled at 800 yards per inch and arms graduated from 4,000 to 54,000 yards.

Auxiliary Equipment

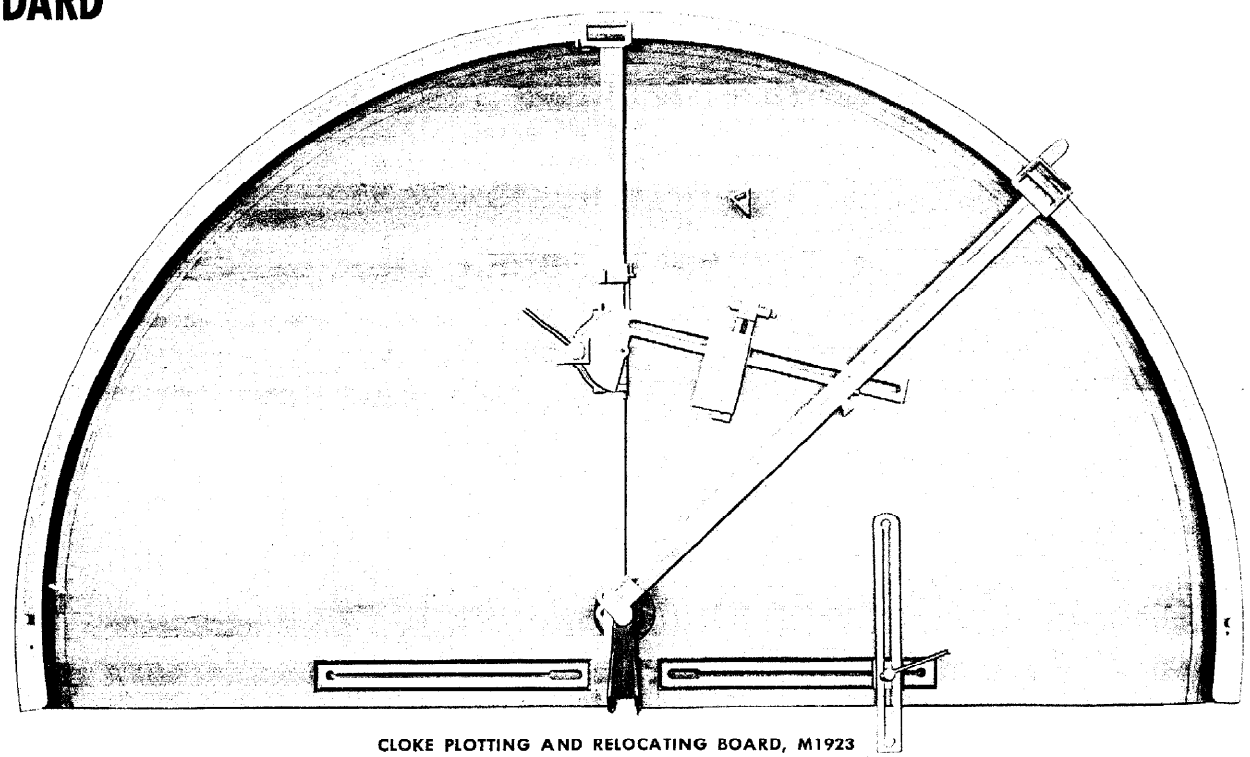
Prediction Scale, M1;
Set Forward Rule, Type B.

REFERENCES—FM 4-15; TM 9-1570; TM 9-2005, v. 5; TM 9-2681.



PLOTTING BOARD, M3

PLOTTING AND RELOCATING BOARDS—CLOKE M1923, AND M1—STANDARD



CLOKE PLOTTING AND RELOCATING BOARD, M1923

A plotting and relocating board is a plotting board modified for use with mobile coast artillery. On the board, the target is represented as a fixed point and the positions of observation stations and guns in relation to the target change after each observation. The board can be used in either one- or two-station position finding.

These boards have two arms, known as the plotting arm and the relocating arm. They are pivoted around the point which represents the target. By the insertion of interchangeable scales in these arms, the board may accommodate long or short ranges. Since both arms rotate around the same center, no couplers or index boxes are needed. At the outer end of each arm is a vernier for accurate setting of the azimuth. Along the azimuth circle is a slot into which may be fitted the azimuth scale.

The base line is represented by the platen, a movable metal plate pivoted to a slide which fits over the plotting arm. Push buttons at each end of the platen are used to indicate each station every time the observation is made.

Moving along the platen is the gun slide which is used to locate the directing point and the relative positions of the guns. The directing point is represented by the gun push button.

CLOKE PLOTTING AND RELOCATING BOARD, M1923—This board is standard for use with 12″ railway mortar batteries and with all other railway matériel and mobile coast artillery gun batteries except 8″ (45 calibers), 12″ and 14″. It is scaled for ranges of 300, 600, 750, 900 and 1,200 yards to the inch. It can represent a range of 47,000 yards on the plotting arm and 51,400 yards on the relocating arm. The azimuth scales are marked in mils or degrees.

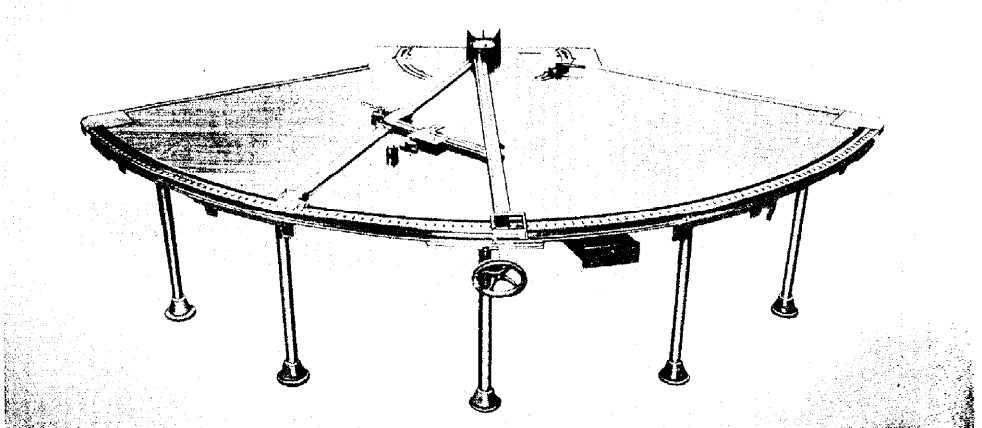
PLOTTING AND RELOCATING BOARD, M1—This board is standard for use with 8″ (45 calibers), 12″ and 14″ railway guns. It is scaled for 200, 400, 800 and 1,000 yards to the inch. It may represent a maximum range of 64,000 yards. The azimuth scale is marked in degrees only. It is like an endless chain, representing a total of 360°, and may be moved until the most suitable range of degrees is visible.

The M1 also possesses a base line stop. This keeps the base line in orientation while the plotting and relocating arms are being set.

Auxiliary Equipment

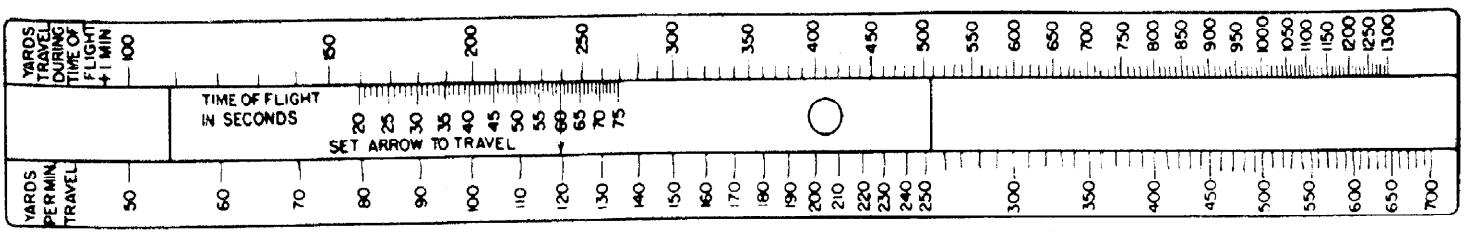
Prediction Scale, M1;
Set Forward Rule, Type B.

REFERENCES—FM 4-15; TM 9-1570; TM 9-2005, v. 5.



PLOTTING AND RELOCATING BOARD, M1

SET FORWARD RULE, TYPE B—STANDARD



SET FORWARD RULE, TYPE B

The set forward rule is used in conjunction with a prediction scale and a plotting board to indicate rapidly the distance traveled by a moving target during the time required for firing the gun plus the time of flight of the projectile.

The rule is constructed like a slide rule. The stationary scale on the left side of the rule is gaged for from 50 to 700 yards per minute travel by the target. The sliding central scale is gaged for a projectile flight time of from 20 to 75 seconds. The right-hand stationary scale indicates the yards traveled during the time of flight plus 1 minute. All scales are gaged logarithmically.

This scale can be used only when the "dead time" equals one minute. A scale may be constructed, however, for other times of firing.

The set forward rule is used in conjunction with the following instruments:

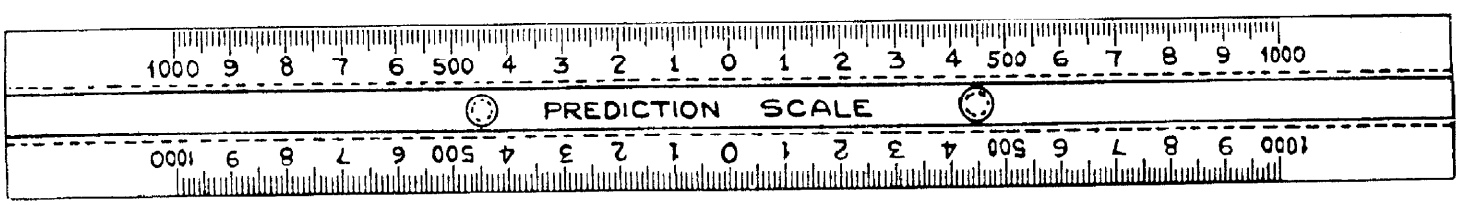
Plotting Board, M1915, M1918, M3, or M4, or

Plotting and Relocating Board, Cloke, M1923 or M1

Prediction Scale, M1

REFERENCES—FM 4–15; TM 9–1570.

PREDICTION SCALE M1—STANDARD

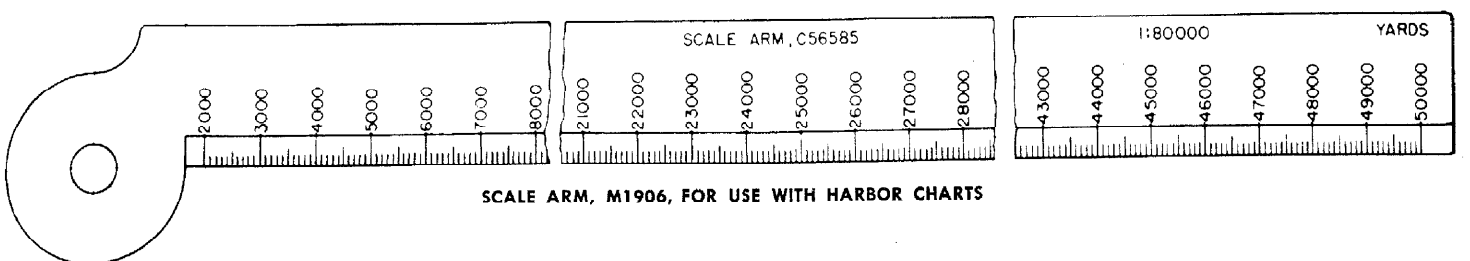


PREDICTION SCALE, M1

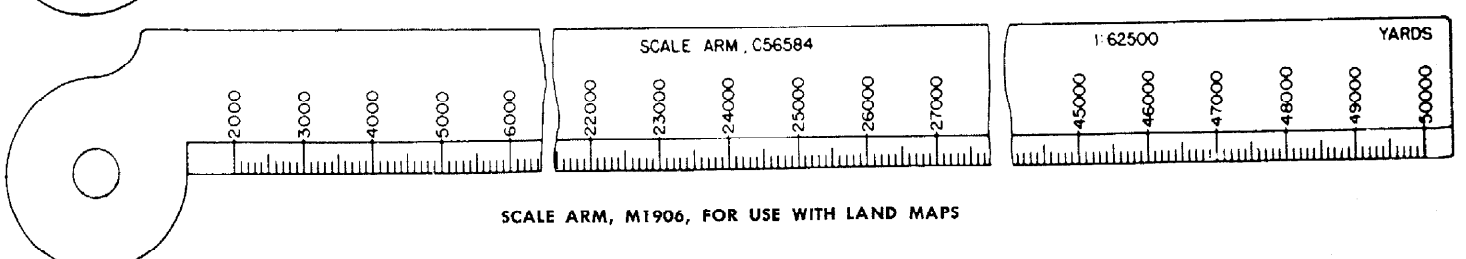
The prediction scale, a straight piece of metal resembling an ordinary ruler, is used in conjunction with a set forward rule, to locate on a plotting board the point which a moving target is expected to reach at the time when the projectile will arrive at this same point.

REFERENCES—FM 4–15; TM 9–1570.

SCALE ARMS M1906—STANDARD



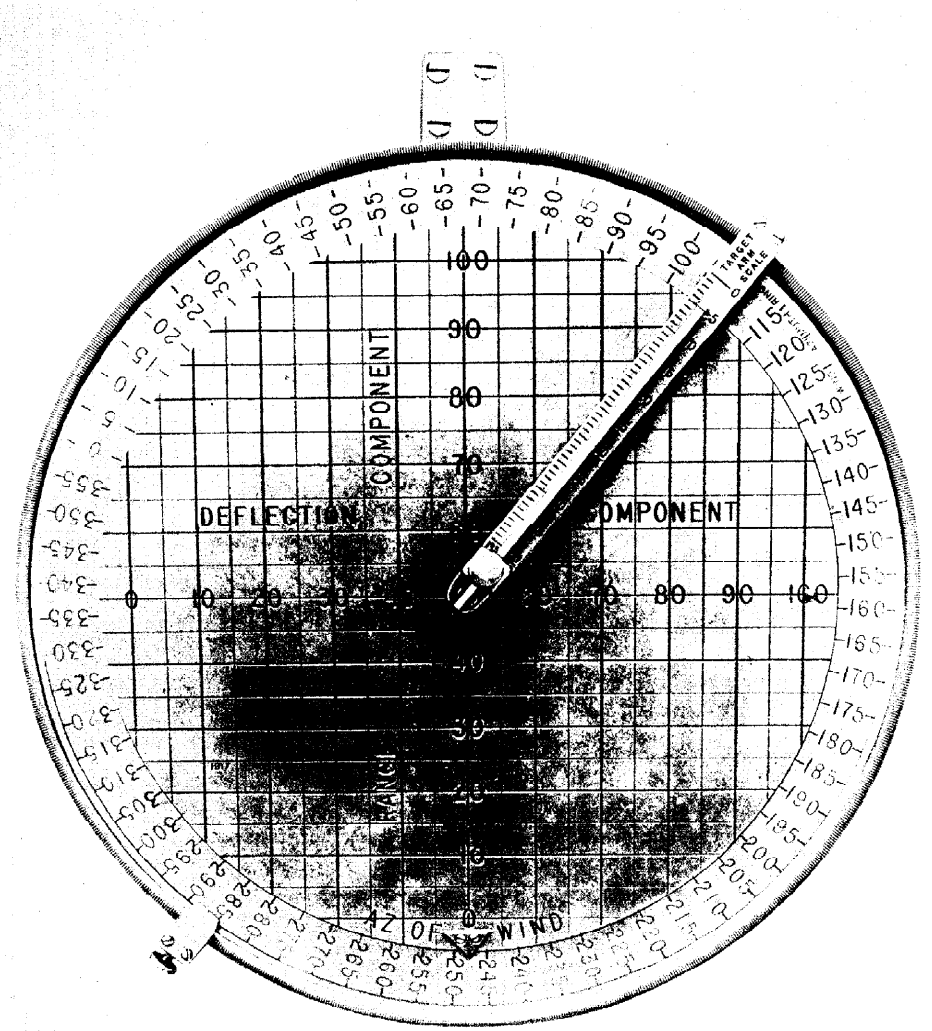
SCALE ARM, M1906, FOR USE WITH HARBOR CHARTS



SCALE ARM, M1906, FOR USE WITH LAND MAPS

Scale arms are for use as arms for improvised plotting boards and, in conjunction with harbor charts and land maps, for making approximations of distances. One scale arm center is furnished for each scale arm. The scale arms for use with harbor charts are furnished with a scale of 1:80,000. Those for use with land maps have a scale of 1:62,500.

WIND COMPONENT INDICATOR M1—STANDARD



WIND COMPONENT INDICATOR, M1

The wind component indicator aids in determining the adjustments necessary in the elevation and traverse of a weapon in order to compensate for the effects of the wind. It is used on all seacoast batteries not provided with the Deflection Board, M1, which has its own wind component indicator.

This instrument, which is 13½ inches in diameter, consists of a circular plate on which are engraved cross-section lines, marked with reference numbers. These lines represent wind mileage, with the vertical scale representing the component of influencing the range. The center of the circle represents a "normal and ballistic wind." On the vertical scale the figures on the upper half of the circle represent tail winds, while the lower half represents head winds. The horizontal scale represents winds from the right and from the left. At the base of the vertical scale is an index used to set wind azimuth.

Surrounding the plate is an azimuth circle, marked in mils and degrees. Pivoted at the center of the circle is the target arm marked with velocity of wind. A pointer slides along the target arm and may be set with one end at any point along the arm, to represent the wind velocity. The reading is made at the opposite end of the pointer.

Instruments used in conjunction with Wind Component Indicator, M1:

Prediction Scale, M1
Set Forward Rule, Type B
Plotting Board, M1915, M1918, M3 or M4
Range Correction Board, M1A1
Mortar Deflection Board, M1906

REFERENCE—FM 4-15.

DEFLECTION BOARDS M1906, M1—STANDARD

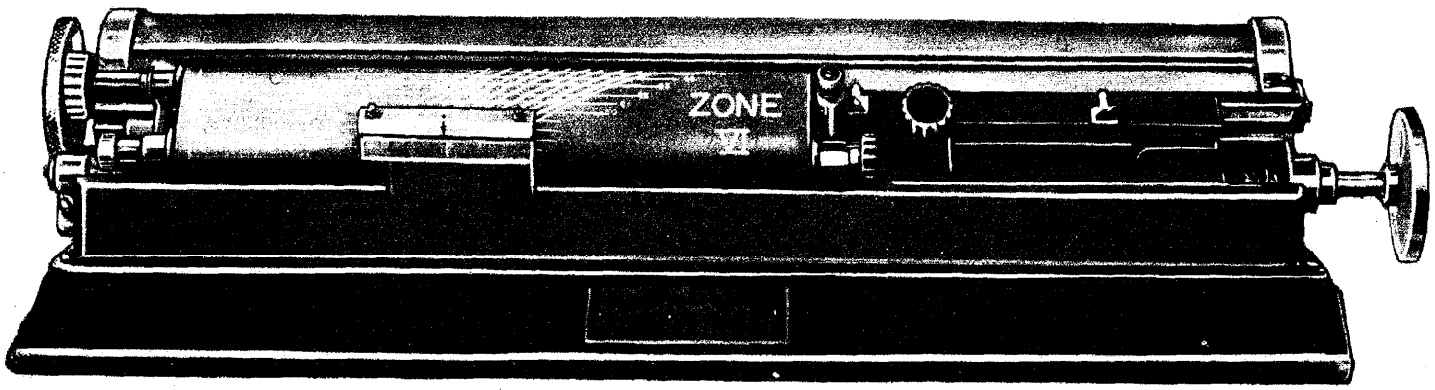
A deflection board provides a means for computing and adding algebraically the corrections in azimuth due to wind, drift, angular travel and other factors. Thus it gives the corrected azimuth to be used in traversing the weapon. It is comparable to the range correction board and the percentage corrector which indicate similar corrections in range.

At present there are two standard deflection boards, quite different in appearance and method of operation. The principles of operation, however, are the same. Each instrument is designed with several auxiliary charts and scales, the movement or setting of which affects the main recording device which is originally set at the uncorrected azimuth. When all the auxiliary charts have been properly operated, the main scale will show the corrected azimuth.

MORTAR DEFLECTION BOARD, M1906—This instrument is used for case III pointing with any type of cannon for which wind and drift charts are available. It was originally designed only for use with mortars. It applies the corrections due to wind, drift, and adjustment to the uncorrected azimuth of the set forward point. It can indicate a total correction of about 20° of azimuth.

The main parts of this instrument are a cylinder, a carriage, a slide, a fixed pointer to indicate the uncorrected azimuth, and a second pointer which moves from the position of the set pointer as each correction is recorded. When all corrections are applied, the second pointer, known as the read pointer, will indicate the corrected azimuth.

DEFLECTION BOARD, M1—This is a newer instrument than the M1906 and computes the corrections in azimuth due to travel, wind, drift, and rotation of the earth. These various corrections and any adjustment corrections are added alge-



MORTAR DEFLECTION BOARD, M1906

braically. It can be used with either case II or case III pointing for any type of weapon for which the proper charts have been prepared. It can cover about 40° of azimuth and can be adjusted to operate in either degrees or mils. When operating in degrees, it can correct the firing data for parallax due to displacement.

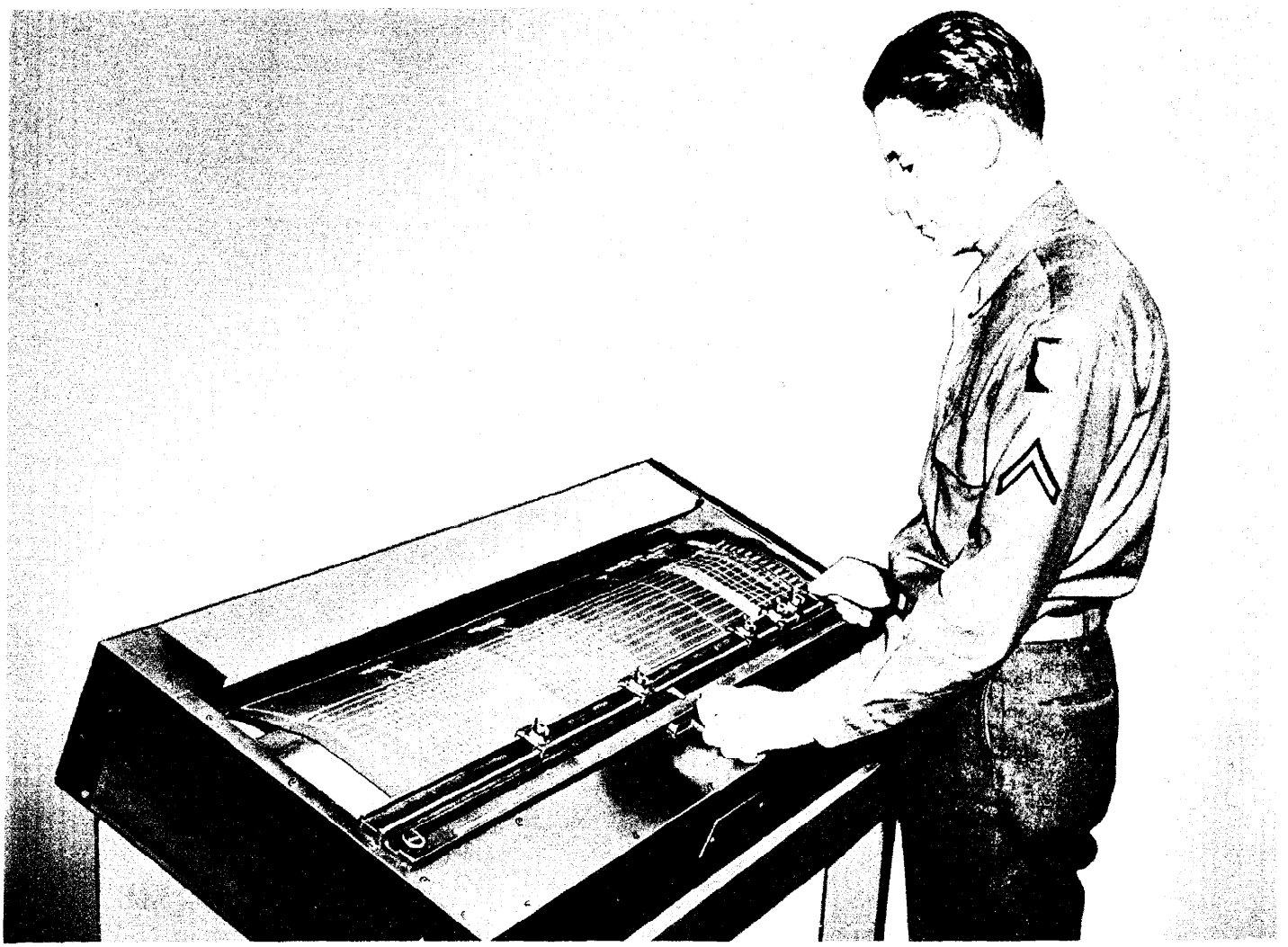
This instrument consists chiefly of the azimuth-indicating mechanism, wind-resolving mechanism (which is practically like the wind component indicator), wind and drift computing mechanism, and angular travel computing mechanism. The main azimuth scale rotates on a pintle and, by 9 to 1 gearing, its movements are imparted to auxiliary scales which indicate tenths and hundredths of degrees. The uncorrected azimuth is set on the auxiliary scale which forms the base plate of the wind-resolving mechanism, while the corrected azimuth is set on the second auxiliary scale. The latter scale forms a base plate for the displacement correction.

REFERENCES—FM 4-15; TM 9-1570; TM 9-2005, v. 5.

UNCLASSIFIED

DEFLECTION BOARD, M1

RANGE CORRECTION BOARD M1A1—STANDARD



RANGE CORRECTION BOARD, M1A1

The range correction board is a device by which corrections in percentage of range due to variations in muzzle velocity, atmospheric density, height of the site or the tide, ballistic wind, weight of the projectile, elasticity, and rotation of the earth are added algebraically. As a result the percentage of correction to be applied to the uncorrected range is ascertained. This instrument can be used with any seacoast artillery.

This instrument consists of a chart bearing curves for individual corrections, a ruler that makes the algebraic additions, and a scale which indicates the ballistic corrections, all mounted in a metal case. Each chart represents one particular combination of gun, powder charge, and projectile. By means of the rollers, the correct chart for the conditions at hand can be placed in position.

Each chart contains seven sets of curves, each set representing one of the seven factors under consideration. Increasingly curving lines to the right represent conditions increasing the velocity of the projectile, while similar lines to the left represent conditions slowing the projectile. Horizontal lines, uniform on all curves, represent the distance from the directing point to the set forward point. The chart is set with all curves at the proper range by the first operation of the rollers.

The correction ruler is a strip of metal with two raised bars extending along its whole length. The lower bar may be slid to the left or to the right. An index is attached to the movable bar. Fixed to the ruler below the index is the correction scale. It is graduated in reference numbers according to percentage of range with 300 as normal. Numbers denoting conditions below normal are on the right side of the scale and those denoting conditions above normal are on the left.

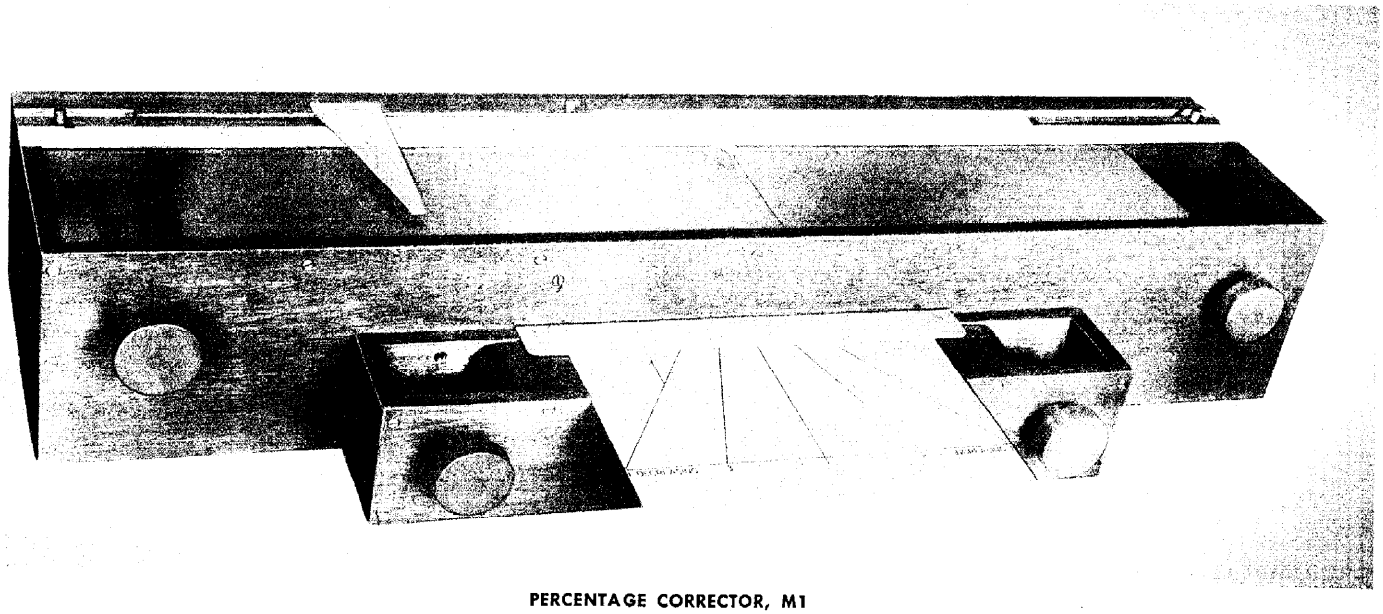
Below each of the seven curves is a knob mounted on a rectangular metal slide. At the top of the slide is a pointer. The slide is mounted over the correction ruler, and by turning the knob the slide may be clamped to either the fixed bar or the movable bar. With the index originally set at normal, each of the slides in turn is clamped to the movable bar and the pointer set at the proper curve. This causes the movable bar with its index to move along the percentage scale until the percentage of elevation for the situation represented by the curve is shown. When all seven slides have been moved in turn, the result, as shown by the index, will be the algebraic sum of percentage of range deviation due to all seven factors.

Auxiliary Instruments

Wind Component Indicator
Percentage Corrector

REFERENCES—FM 4-15; TM 9-1570

PERCENTAGE CORRECTOR M1—STANDARD



PERCENTAGE CORRECTOR, M1

Through operation of the range correction board, the ballistic correction in percentage is obtained. This is the correction for range given in percentages of the uncorrected range to the set forward point. The percentage corrector multiplies the uncorrected range by these percentages, thus giving the corrected range in yards.

The percentage corrector consists of a box containing two rollers upon which are mounted the proper one of three scales, a transparent window engraved with a fixed index line, a ballistic correction scale, an adjustment correction scale with the ballistic pointer attached to it, and a read pointer attached to a slide.

The index line on the window is used for setting the uncorrected range and also coincides with the normal on the fixed ballistic correction scale which is located on the top of the box. The index of the ballistic pointer coincides with the normal on the adjustment correction scale which can be slid up and down to set in the ballistic correction. The long or read pointer is used to set in adjustment corrections. The corrected range will always be indicated by the read pointer because if no adjustment corrections are made the read pointer will be set to normal on the adjustment correction scale and thereby coincide with the ballistic pointer.

Additional scales, operating concurrently with the main scale, are provided. They give the corrected range in terms of the corresponding elevation of the gun or in terms of any other type of unit with which the gun pointing device is marked. There is also an interpolator for use when the firing interval is less than the interval between predictions on the plotting board.

REFERENCES—FM 4–15; TM 9–2005, v. 5.

SPOTTING BOARDS M3, M7—STANDARD

A spotting board determines corrections for range deviations in percentage of range and corrections for lateral deviations in angular units, both read in reference numbers. It is a rectangular base casting on which are mounted the various mechanisms, the entire device being supported on a 4-legged pipe stand.

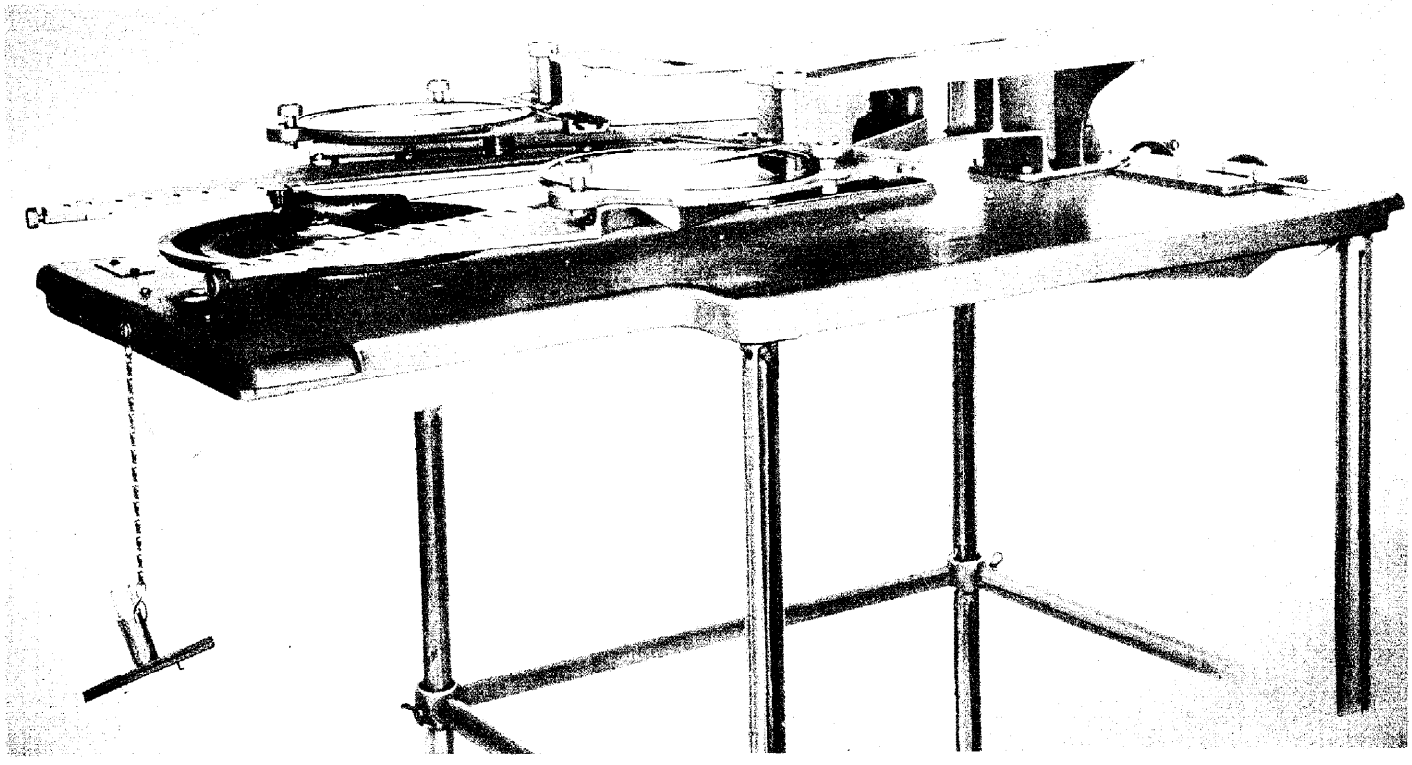
On one end is mounted a rectangular deviation grid with the central point representing the target. The grid is marked with cross-section lines, one set of parallel lines indicating range corrections and the second set, perpendicular to the first, showing lateral corrections. These lines are graduated respectively for lateral corrections from 0 to 600 and for range corrections from 240 to 360. In both cases, 300 represents the normal.

At the other end of the board is the station arm plate with its center, directly in line with the target position, representing the directing point. The station arm plate is moved along the gun target line to indicate on the proper scale, the range to the target or set forward point.

Two station arms, with attached targs representing the spotting stations, are locked in guides which are pivoted about the center of the disk. These are oriented in azimuth by rotation of the guides to the proper azimuth reading on the scale of the station arm plate. The targs then indicate on the integral scale of the spotting arms the ranges from the spotting stations.

Attached to each spotting arm is a deviation arm and a deviation disk. The latter has a movable inner plate marked along the outside with a logarithmic range scale with an index for setting the distance from spotting station to target. Surrounding the inner disk is an outer range disk for setting the range from gun to target.

In the center of each deviation disk is a series of curves representing deviations. Deviations are set off by means of pointers attached to the deviation arms. The movement of these pointers moves the deviation arms laterally across the spotting arms. Their point of intersection on the grid represents the location of the splash instead of the target. Corrections for range and azimuth deviations can be read from the grid at that point.



SPOTTING BOARD, M3

SPOTTING BOARD, M3—This board is designed for use when bilateral observation is possible, and may be used when both spotting stations are on the same side of the directing point. Earlier spotting boards did not possess this latter feature.

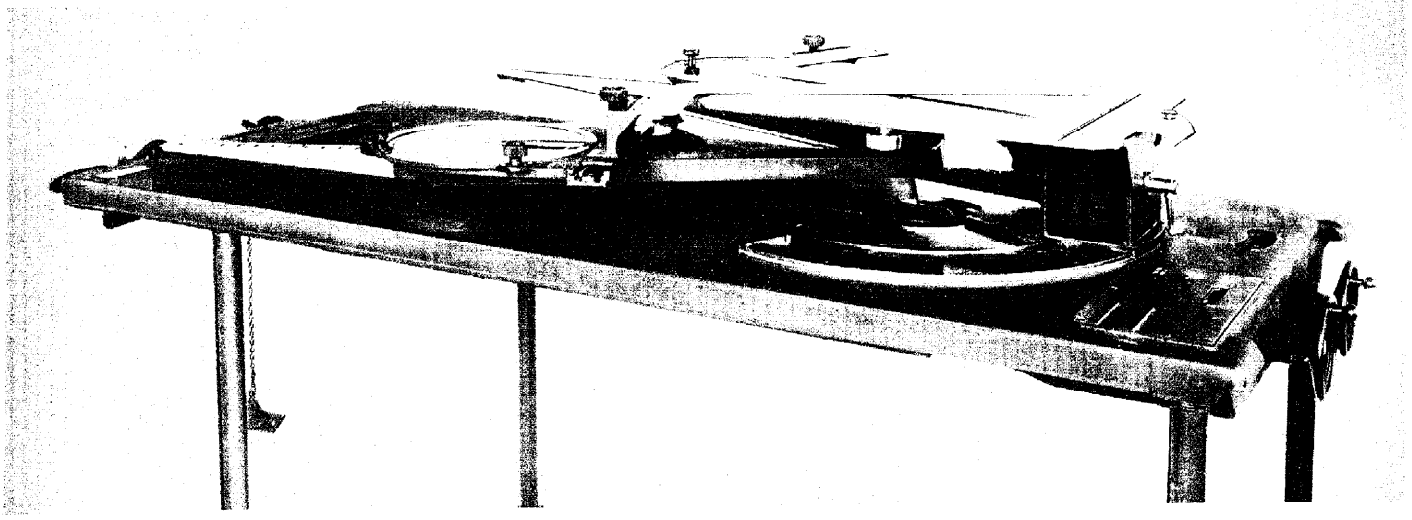
SPOTTING BOARD, M7—This instrument was developed for use in certain situations where the M3 could not be used, chiefly where the angle of intersection between the spotting arm and the line between the gun and target exceeds 116°. This board may also be used when the target is between the directing point and the spotting baseline. It is required for use by long-range fixed seacoast batteries above 6 inches in caliber, with spotting stations 20,000 yards or more from the directing point.

The M7 is a longer board with hand wheels and scales for setting range and azimuth at both ends of the board. The bracket which supports the grid is mounted so that it can be revolved through 180°.

Auxiliary Instruments

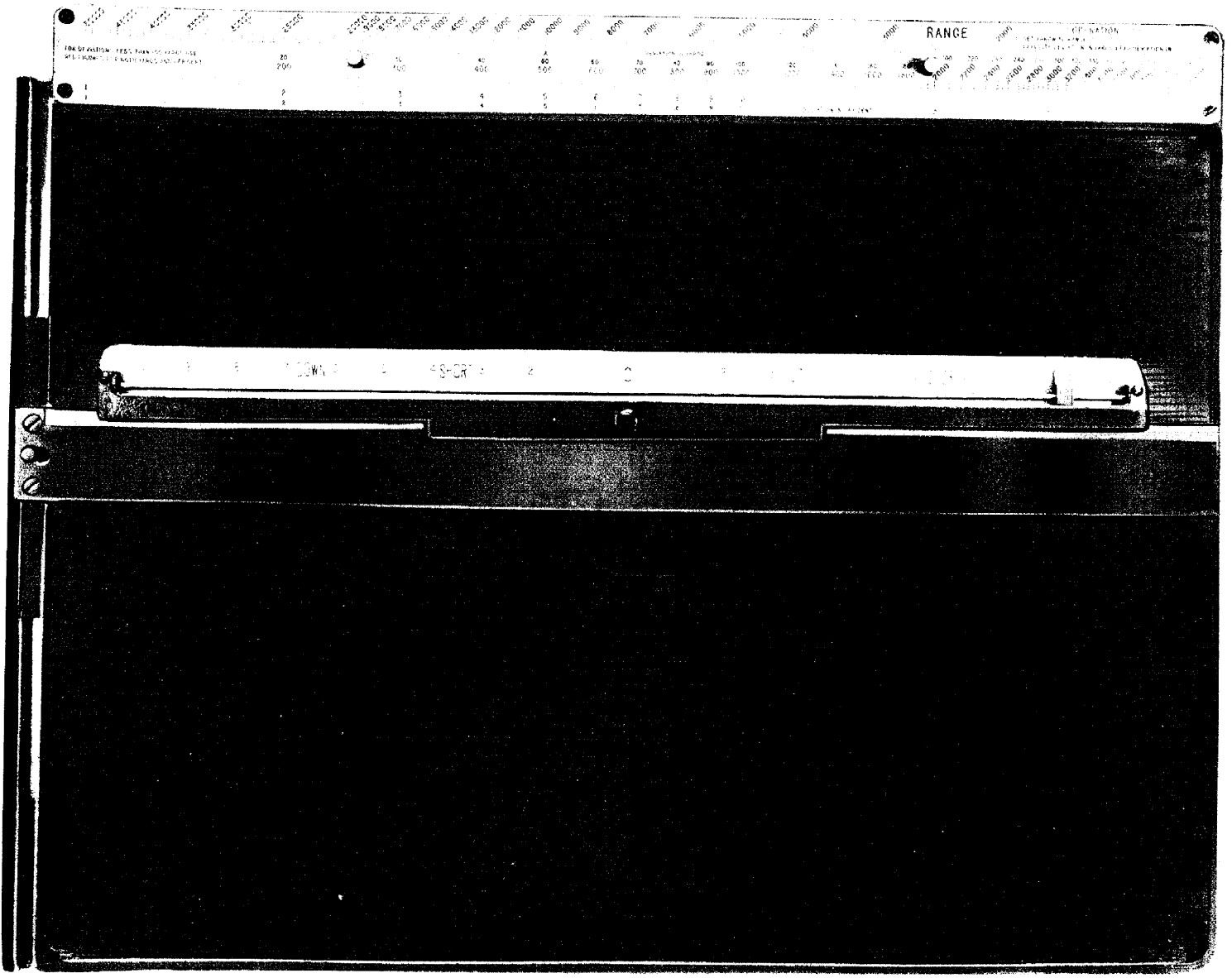
Azimuth Instrument, M1910A1
Plotting Board, M1915, M1918, M3 or M4 or Plotting and Relocating Board, M1923 (Cloke) or M1

REFERENCES—FM 4-15; TM 9-1570; TM 9-2005, v. 5; TM 9-2682.



SPOTTING BOARD, M7

FIRE ADJUSTMENT BOARD M1—STANDARD



FIRE ADJUSTMENT BOARD, M1

The fire adjustment board provides a means for representing graphically the deviations of shots even when these shots have been made with different adjustment corrections, thus solving graphically the proper adjustment correction to be applied. It also forms a record of adjustment corrections.

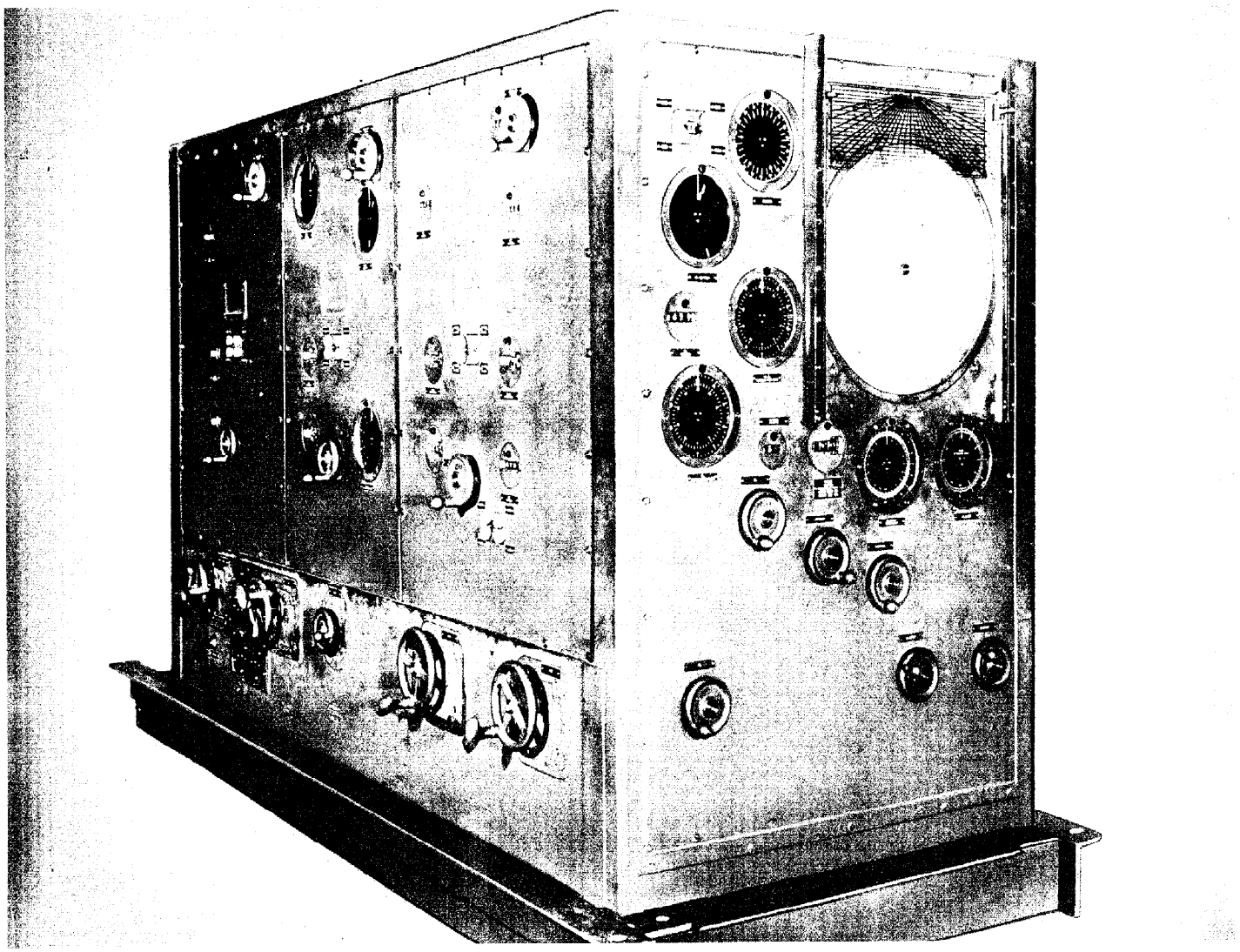
The board consists of a wooden drawing board mounted in a metal frame. At the top of the board is a fixed logarithmic range scale, representing ranges from 1,000 to 50,000 yards. In conjunction with this, there is a sliding deviation scale, graduated from 10 yards to 5,000 yards, and two additional scales by which the deviation in range is transformed to a deviation reference number. When the deviation scale is moved so that its pointer is set at the correct range, the deviation reference number appears opposite the deviation in yards.

Riding along a groove in the left side of the fire adjustment board is a T-square with a horizontal metal slide, which is scaled in reference numbers representing percentages of range. A piece of cross-section paper, upon which a group of shots is to be plotted along a horizontal line, is inserted on the board with horizontal lines parallel to the metal slide. The slide can be moved to the left and right, and whenever corrections are applied, the normal point on this scale is moved to the center of impact of the shots upon which corrections are based.

By using a different set of scales at the top of the board, this device can be used to plot angular deviations of shots as well as deviations in range. This is less frequently done, however.

REFERENCES—FM 4-15; TM 9-1570; TM 9-2005, v. 5.

GUN DATA COMPUTERS M1, M8 SERIES—STANDARD



GUN DATA COMPUTER, M1—Front and Right End View, Showing Triangle Solver Panels and Target Position Generator Panel

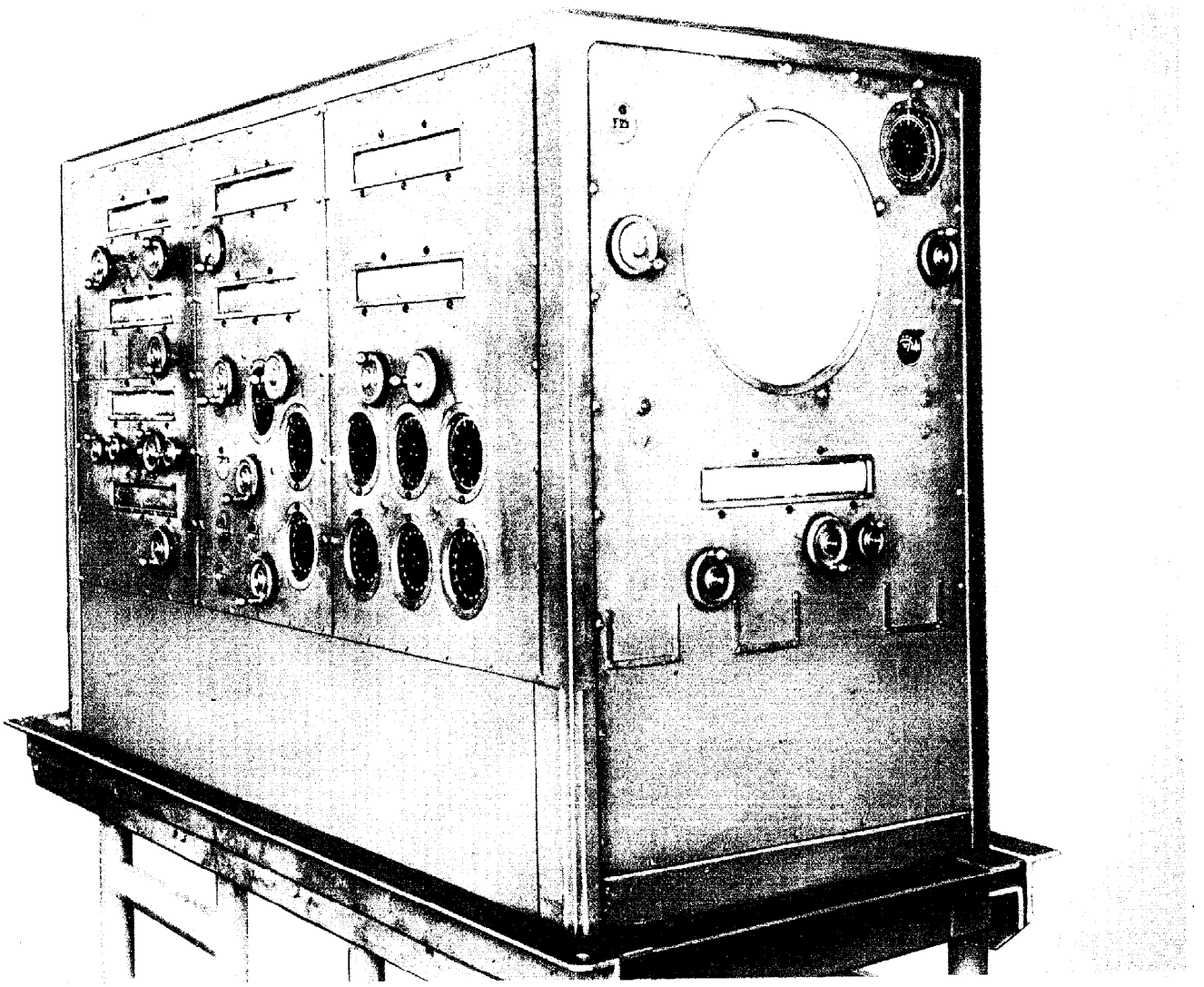
These instruments compute continuously the firing data for a two- or four-gun seacoast battery. By means of a data transmission system, the applicable resultant firing azimuth and elevation are transmitted electrically from the plotting room to one or more guns and received there on azimuth and elevation indicators. An independent electric source supplies the 115-volt, 60-cycle electric power by which the gun data computer is operated.

Data regarding the present azimuth or the present range of the target are transmitted to the computer from one or two base-end stations by means of a data transmission system or by telephone. These data, as well as corrections for certain variable factors, are introduced into the input section of the computer. By means of carefully constructed and positioned mechanisms or by the operation of electrical devices, the firing data are computed.

GUN DATA COMPUTER, M1—The computer furnishes firing data for two identical major caliber guns, situated up to 1,000 feet apart. The instrument is of the mechanical type, making use of such mechanisms as gears, cams, differentials, and variable speed drives, as well as accurately constructed charts, the positioning of the pointers of which causes the deflection, to the correct degree, of other mechanisms of the computer.

This is a rectangular instrument about 7 feet long, 3 feet wide, and 4½ feet high, mounted on a stand at convenient operating height. The mechanism is contained in the interior, and the controls, dials, counters, and warning lights are on the sides and ends of the instrument.

The gun data computer makes use of uniform orientation data giving distances and azimuth relationships between observation stations and gun emplacements. In addition there are incorporated into the instrument various charts designed only for the particular gun and battery. These charts cover possible variations due to wind and drift, rotation of the earth, elasticity, time of flight, dead time, atmospheric conditions, and influences causing variation of muzzle velocity from



GUN DATA COMPUTER, M1—Rear, and Left Face, Showing Ballistic Chart Panel, Range Elevation Converter Panel, Parallax Panel and Wind Component Indicator Panel

standard. The final group of data used by this machine consists of information relating to the position of target and splash as sent by observation stations and an observation airplane.

The computing and indicating elements consist of the A, B, and C triangle solvers, located in the front of the instrument, the target position generator on the right end, the wind component indicator on the left end, and the ballistic chart, range-elevation converter, and parallax unit in the rear.

The predictor is located behind the A triangle solver. It is wholly within the machine with no indicators or controls on the side.

The A triangle solver receives various orientation data, including the azimuth of the target from observation stations A and B. It computes the distance from each station to the target. This distance is automatically entered on a counter on the A triangle solver and on a corresponding match dial on the B triangle solver.

The B triangle solver also receives the azimuth and length of the base line from observation station B to the first gun. It computes the azimuth of the target from the gun by triangulation. The value of the angle is changed until the value of its opposite side matches that on the match dial. The range from gun to target is computed at the same time.

The C triangle solver is only used if there is a third observation station, and permits a rapid change to an adjacent baseline. It does the same work as does the A triangle solver, but computes data relating to B and C stations and the target.

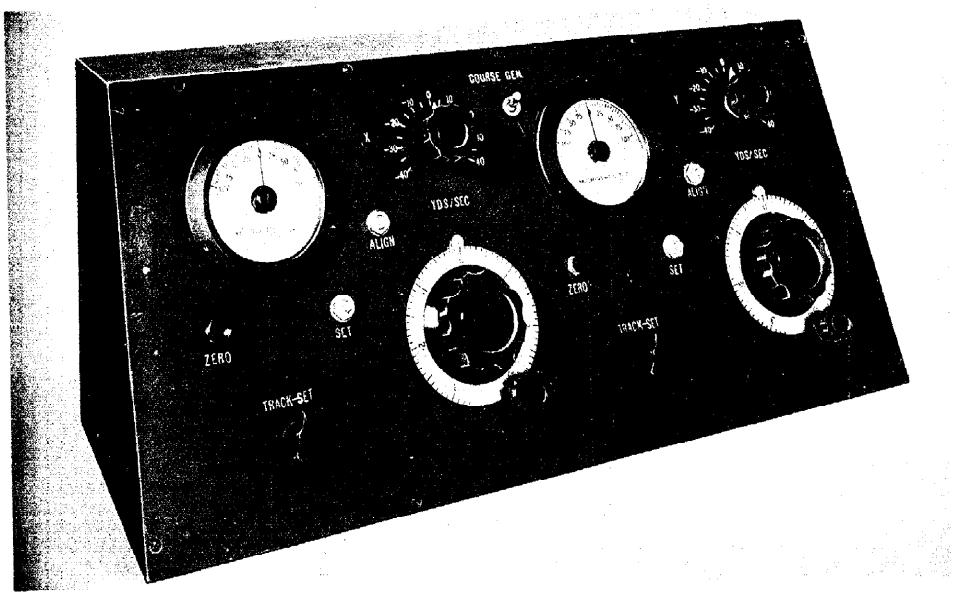
The azimuth and range of gun and target are automatically sent to the target position generator. The latter computes the rate of change of range and the linear rate of change of azimuth. The rates of changes and the present range and azimuth go to the predictor where the corrected future range and azimuth are computed. Meteorological and ballistic corrections are introduced on the various charts on the wind component indicator and ballistic chart panels. Adjustment corrections as reported from an airplane

are applied by means of a spotting board located on the target position generator. Adjustment corrections as reported from observation stations are applied by use of an external spotting board. All these corrections are added to the future range and azimuth within the predictor.

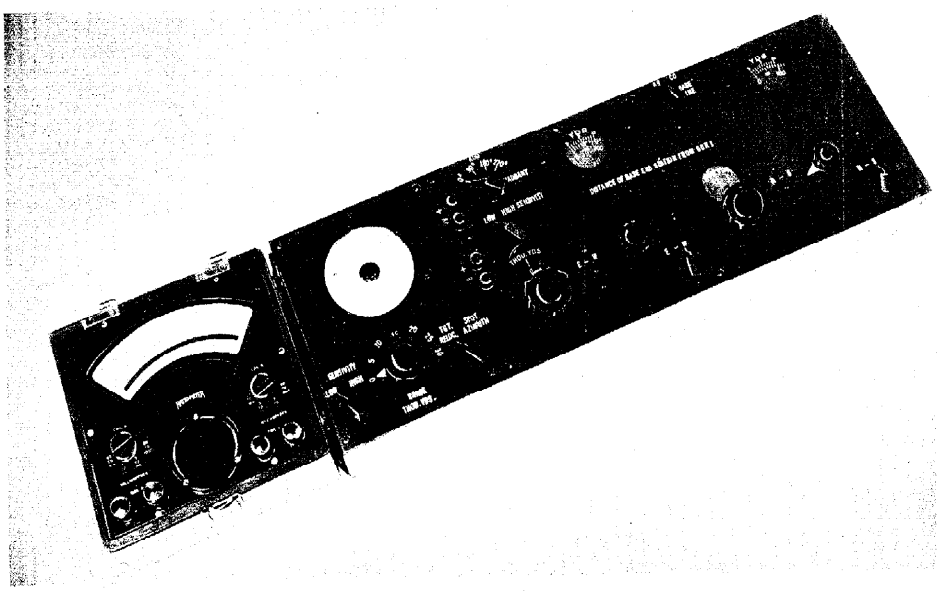
The range is converted to quadrant elevation in the range-elevation converter. The final azimuth and elevation are sent to the first gun for firing and to the parallax unit where the azimuth and elevation for the second gun are computed and transmitted.

Among other components of this instrument is a 115-volt, 1-phase transformer located on the mounting plate on the underside of the base, between the A-solver and the parallax corrector. It reduces voltage for the various lamps which illuminate each of the counters, dials, and charts. There are also warning lights on the triangle solvers and on the target position generator panel. These light automatically when a solution is incorrect and indicate whether the correct solution is higher or lower than the incorrect one.

In addition, there are two heater elements which protect the mechanisms of the gun data computer in cold or damp weather. Also, there is a protective canvas cover for the instrument when not in use.



GUN DATA COMPUTER, T12—POSITION GENERATOR



GUN DATA COMPUTER, T12—TARGET RELOCATER

GUN DATA COMPUTER, M8 SERIES—These instruments, based on Gun Data Computer, T12, are designed for use with two guns, situated no more than 450 feet apart. These gun data computers use electrical rather than mechanical computing elements. Many of the principles and elements used are those of the electrical directors. Input data can be received not only from the transmitter of the azimuth instrument or depression position finder, but also from a radio range finder located at one base-end station.

Each instrument consists of five separate units: power unit, line balancer, one or more triangle solvers, position generator, and predictor. The Power Unit, M8, is used in all the computers of the M8 series. It converts the 115-volt alternating current to the various forms in which it is used.

Line Balancer, M1, is the base-end terminating unit. Changes of base line

Gun Data Computer	Predictor	Predictor Has Ballistic Units for the Following Guns	Ammunition
M8C	M2C	6″ Guns, M1903A2 and T2, on 6″ Barbette Carriage, M1 type	(a) 105 lb. A.P. Projectile, Mk. XXXIII (b) 90 lb. H.E. Projectile, Mk. IIA1 (c) Subcaliber—75 mm Shell, H.E., M48
M8F	M2F	8″ Guns, Mk. VI, Mod. 3A2, on 8″ Barbette Carriage, M1 type mounts and 8″ Railway Mount, M1A1	(a) 260 lb. Projectile, A.P. 8″, Mk. XX, supercharge (b) 240 lb. Projectile, M103 supercharge (c) 75 mm Shell, H.E., M48, normal charge
M8N	M2N	155 mm Guns, M1 and M1A1	(a) Shell, H.E., M101, supercharge (b) Projectile, A.P. M112 (c) Shell, H.E., M48, 75 mm subcaliber, normal charge
M8P	M2N	155 mm Guns, M1 and M1A1	(a) Shell, H.E., M101, supercharge (b) Projectile, A.P., M112 (c) Shell, H.E., M48, 75 mm subcaliber, normal charge

and changes from horizontal to vertical base line can be made without delay. It is possible to change from one target to another within the field of fire of a given base line or vertical base observing station with a delay of no more than 45 seconds.

The triangle solvers compute the present position of the target from the base-end data. Gun Data Computers, M8C and M8F, are each supplied with two Triangle Solvers, M1C. Gun Data Computer, M8N, has one Triangle Solver, M1D which differs from the M1C in that it is supplied with legs for mounting in a trailer. Gun Data Computer, M8P, makes use of Triangle Solver, M2, which is constructed to receive data from a Navy radar set, while the M1C receives data from Radar Set AN/MPG-1. This triangle solver is also provided with legs for trailer mounting.

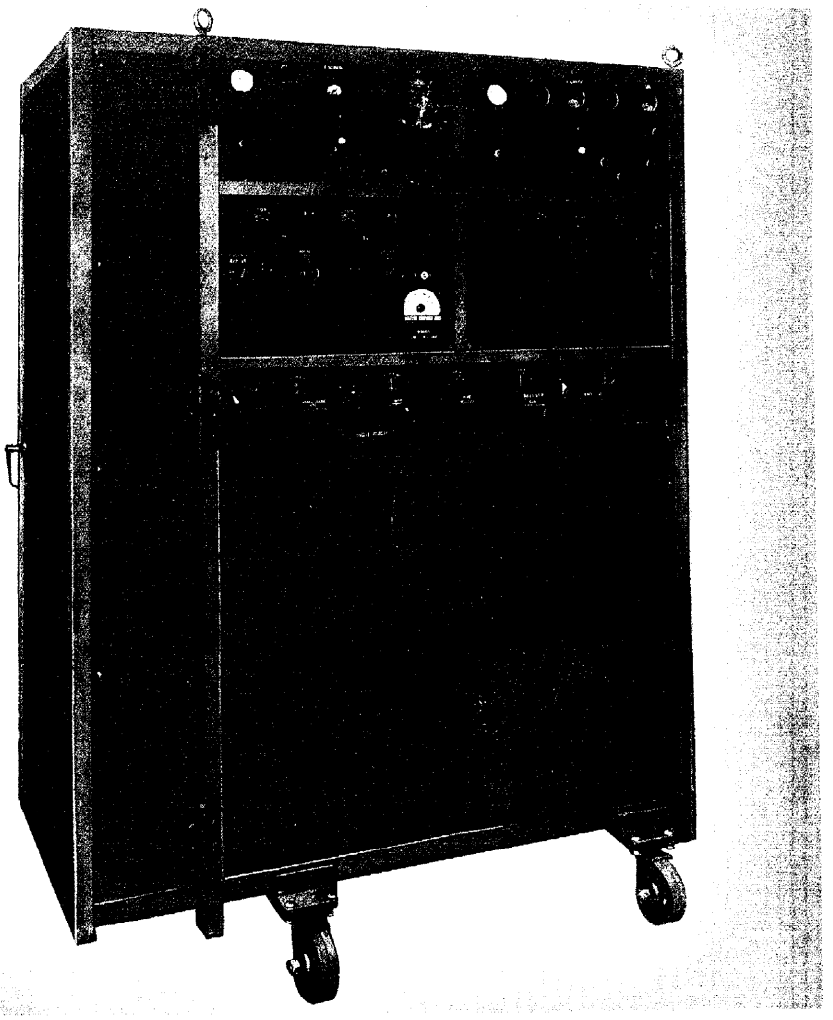
The Position Generator, M5C or M5D, furnishes present position while the target is temporarily invisible from the observation station by assuming constant course and speed. The M5C is supplied with Gun Data Computers, M8C and M8F. The M5D, provided with legs, is a Component of Gun Data Computers, M8N and M8P.

Predictors of the M2 series are used with these computers. Except for predictor, M2N, which is used with both Gun Data Computers, M8N and M8P, each predictor bears as a suffix the same letter as does the computer with which it is used.

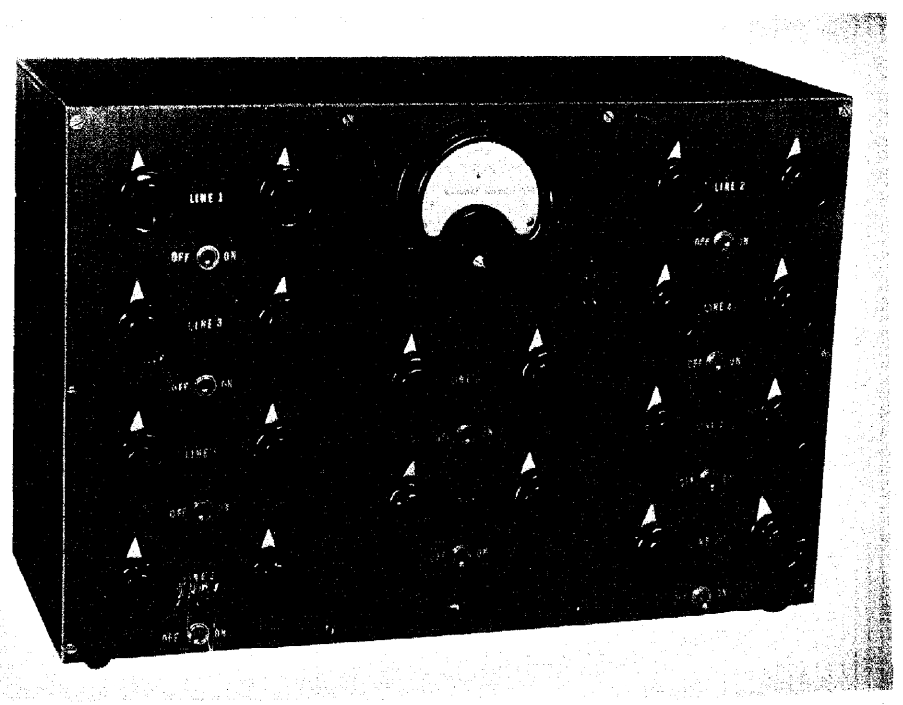
The predictor contains present position and target relocator dials. The use of the latter insures that with a change in base line, the same target is being tracked. In addition, the predictor has ballistic elements which make provisions for corrections for wind, drift, rotation of the earth, muzzle velocity, air density, and height of site. Ballistic corrections are made automatically, once the original data are introduced, but ballistic corrections obtained from external sources can be made without delay. Other elements of the predictor include the triangle solver switch and meter, spot controls, zero set panels, and output dials. The instrument also has elements for computing the azimuth of the target from any base-end station when its present position in respect to any other base-end station is known.

By a change of the ballistic units in the predictor, this gun data computer can be adapted for use with different models of guns. Each ballistic unit makes provision for three types of ammunition. The instrument can be used at any battery equipped with the applicable model of gun.

REFERENCES—FM 4-15; TM 9-2646.

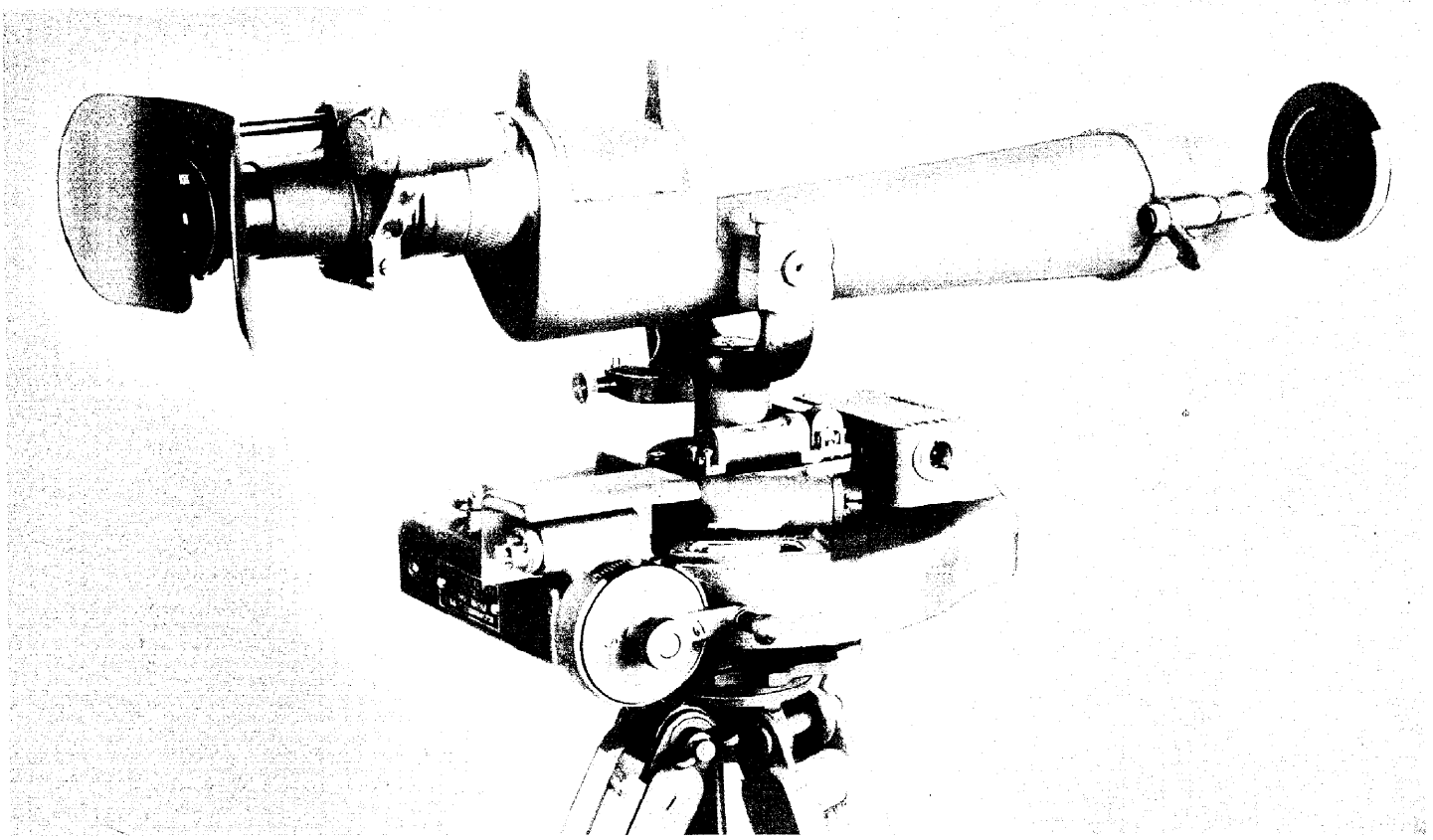


GUN DATA COMPUTER, T12—A.C. SIDE

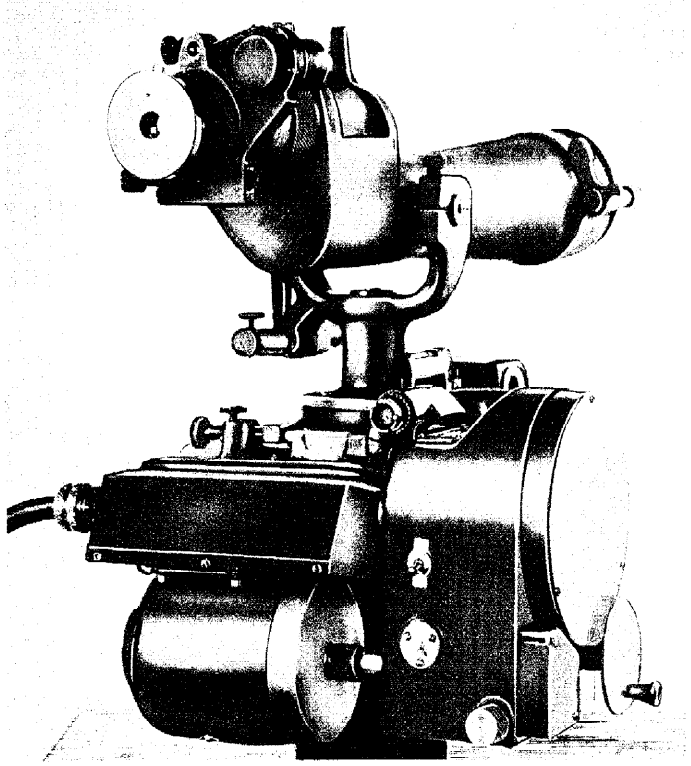


GUN DATA COMPUTER, T12—LINE BALANCER

AZIMUTH INSTRUMENTS M1910A1, M2A1 STANDARD—M2 LIMITED STANDARD



AZIMUTH INSTRUMENT, M1910A1



AZIMUTH INSTRUMENT, M2

The azimuth instrument is used with seacoast artillery both for measuring the azimuth of the target and for indicating the angular deviation of a splash from the target. The instrument consists of the Telescope, M1910A1, the base (or mount), and the tripod Type A. A pier mount similar to the tripod is also provided. This mount is secured in concrete or steel supports when the instrument is used in permanent base-end stations of fixed seacoast artillery.

AZIMUTH INSTRUMENT, M1910A1—The Telescope, M1910A1, has two interchangeable eyepieces, with 10-power and 15-power magnification. There is a reticle with a vertical crossline and a horizontal deflection scale. The telescope is mounted on the base which contains leveling devices, an azimuth circle and micrometer for measuring azimuths, and the mechanisms which provide for a vertical movement of approximately 40° and a traverse of 360°.

AZIMUTH INSTRUMENT, M2—This consists of Azimuth Instrument, M1910A1, equipped with Azimuth Transmitter, M7, by which the azimuth is automatically and continually transmitted to the gun data computer. It has been reduced in classification to limited standard and all instruments of future manufacture designed for use with a gun data computer will be of the M2A1 type.

AZIMUTH INSTRUMENT, M2A1—This azimuth instrument, standard for new manufacture for use with the gun data computer, consists of the M1910A1 instrument equipped with the Azimuth Transmitter, M18. The M18 transmitter permits higher and more uniform rate in traversing. Unlike the M7, the transmitter proper does not rotate about a vertical axis during slewing, but remains fixed with respect to the azimuth instrument.

REFERENCES—FM 4-15; TM 9-2005, v. 5.

DEPRESSION POSITION FINDERS M1, M2A1 STANDARD—M2 LIMITED STANDARD

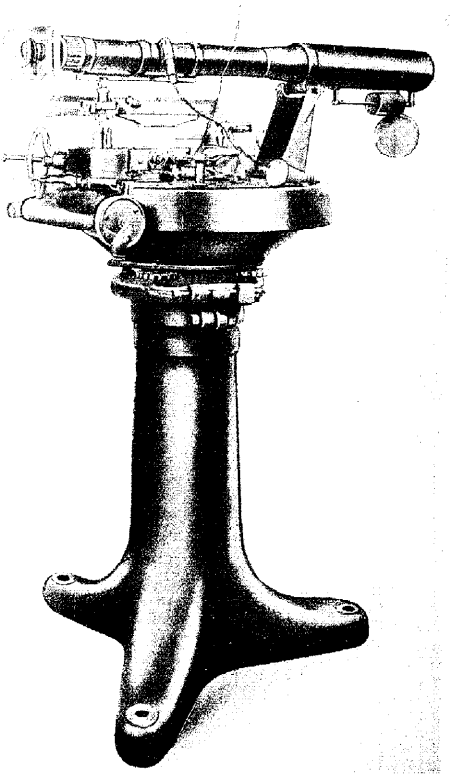
The depression position finder, consisting essentially of a telescope, mount, and pedestal, is used in vertical-base position-finding systems for measuring range by means of the depression angle. It determines the horizontal range of the target by triangulation. The instrument is adjusted for the effects of refraction and the curvature of the earth. Adjustment can be made to compensate for tidal changes.

DEPRESSION POSITION FINDER, M1—This instrument is issued in 10 classes, covering all heights of instrument from 74 to 1,395 feet, and another class, known as class 12, which covers heights of from 2,250 feet to 4,100 feet. It is mounted on a base of heavy cast metal and contains a Telescope, M1. This instrument has an eyepiece which can be set for any desired power from 10 to 30. This telescope performs the same functions as does that on the azimuth instrument, being connected with an azimuth scale and a subscale for more exact measurement. In addition, however, it is connected with a range scale which indicates the range of the object being sighted. Unlike the azimuth instrument, this instrument has no splash scale. It can be used as an azimuth instrument when tracking is done by the horizontal-base system.

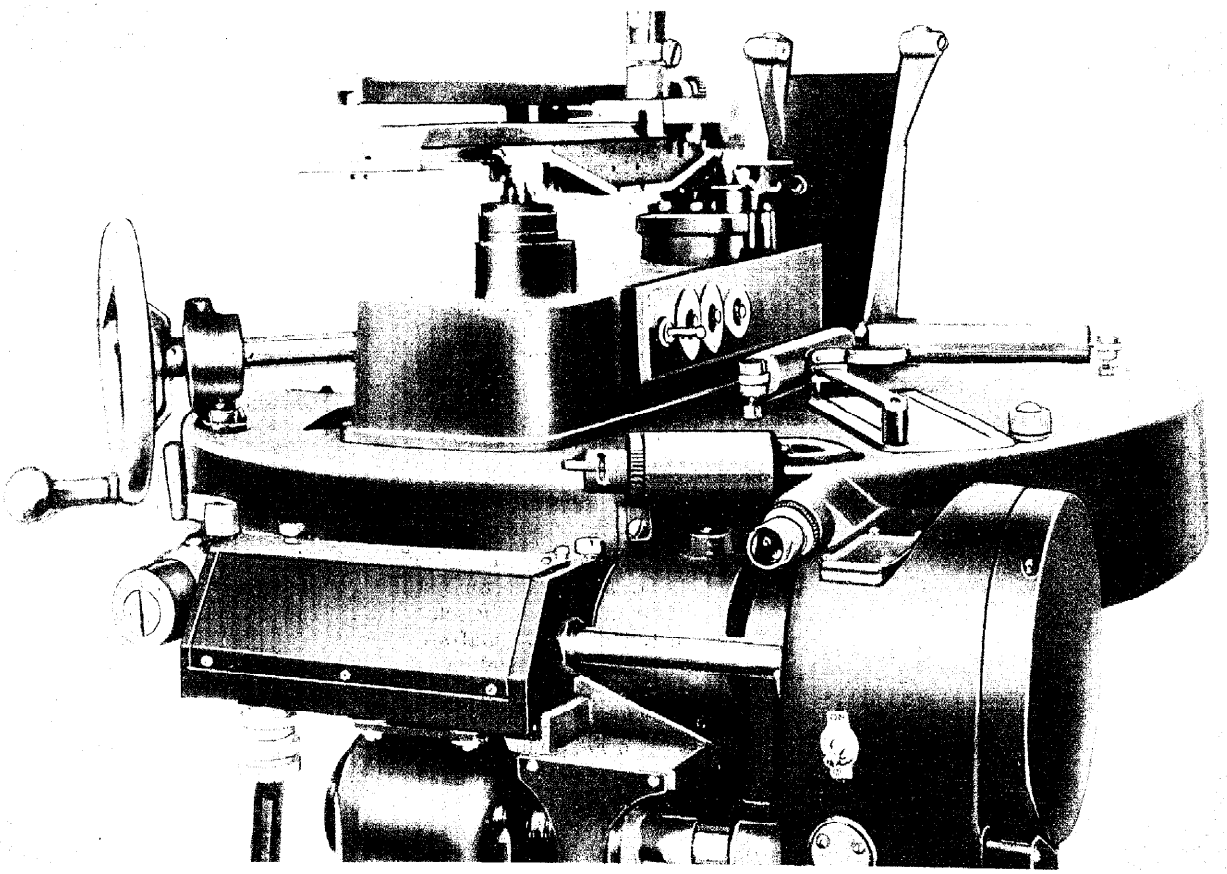
DEPRESSION POSITION FINDER, M2—This instrument is limited standard for all batteries with gun data computers. It is a Depression Position Finder, M1, with an Azimuth Transmitter, M8, installed on the side. The transmitter automatically and continuously transmits the azimuth to the gun data computer.

DEPRESSION POSITION FINDER, M2A1—This instrument will supplant the M2 in future manufacture. It consists of an M1 depression position finder, with an improved azimuth transmitter, the M19. Azimuth Transmitter, M19, is like the M18, used on the Azimuth Instrument, M1910A1, but has different mounting brackets to fit the depression position finder.

REFERENCES—FM 4-210; TM 9-2005, v. 5.



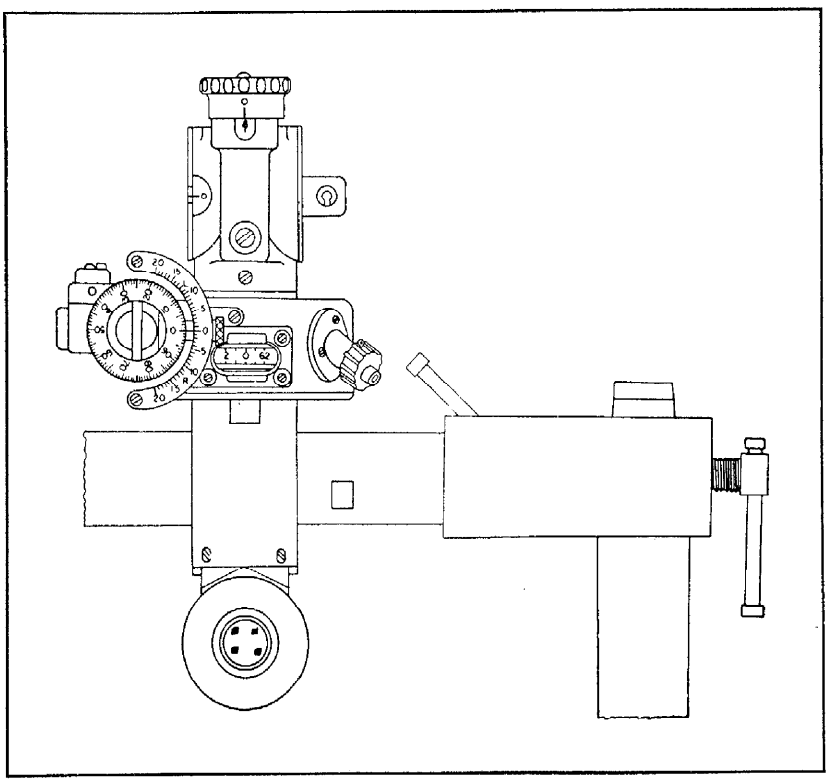
DEPRESSION POSITION FINDER, M1



DEPRESSION POSITION FINDER, M2

UNCLASSIFIED

AIMING RULE M1918—STANDARD



AIMING RULE, M1918

The aiming rule is a device which serves as an aiming point for the indirect pointing of mobile seacoast artillery. It consists of two vertical steel stakes and a horizontal connecting bar. A panoramic telescope is mounted on an adapter which is connected to the bar in such a manner that it can be slid along its path without rotating about it.

The panoramic telescope on the cannon is oriented so that it reads the correct azimuth for the bore of the cannon. The aiming rule is set up at any convenient distance from the cannon within visible range so that it is approximately perpendicular to the line of sight of the cannon telescope. The aiming rule telescope is then adjusted so that its line of sight passes through the cannon telescope.

With the change in the azimuth of the bore of the cannon, the successive lines of sight of the cannon telescope will be parallel to each other. To operate the aiming rule, its telescope remains set at the azimuth used when adjusting. As the telescope on the cannon is moved, the aiming rule telescope is slid along the rule so that the cannon telescope is always kept in the line of sight.

REFERENCE—FM 4-15.

DATA TRANSMISSION SYSTEMS M5, M7, M8, M9, M10, M13, M14, M15, M17—STANDARD

These data transmission systems, each designed for a coast artillery battery of two guns, are used for the electrical transmission of elevations and azimuths from the auxiliary plotting room instruments or the gun data computer to match-the-pointer indicators on the gun mounts. One system, the M5, was originally standardized for use with all barbette carriages of 8″ caliber or above except for the 8″ Barbette Carriages, M1918 and M1918M1. Since certain modifications were necessary in order to adapt the equipment to all mounts, different model designations have been given to the modified systems. At present, the standard models include the M5, M7, M8, M9, M10, M13, M14, M15 and M17.

ELEVATION AND AZIMUTH TRANSMITTERS—These instruments are located in the plotting room and transmit azimuths and elevations computed by the auxiliary plotting room instruments. The azimuths and elevations to be transmitted are set into the transmitters by means of the knobs and handwheels. By internal gearing these values are indicated on the coarse and fine dials fastened to the shafts of synchronous transmitters which in turn are connected electrically to the synchronous repeaters of the indicators on the gun. The only differences between the elevations and azimuth transmitters are the gearing ratio and the engraving on the dials. The dials of the azimuth transmitter are graduated in degrees and the dials of the elevation transmitter are graduated in mils. The transmitters are used only upon failure of the computer.

AZIMUTH AND ELEVATION INDICATORS—These instruments are mounted on the gun. On the face of the indicators are coarse and fine dials known as the electrical dials, graduated the same as their respective transmitters. The electrical dials are fastened to the shafts of synchronous repeaters. Also a mechanical dial encircles each coarse and fine dial. The mechanical dials are geared to the elevation and azimuth handwheels of the gun. When the electrical system is energized, the electrical dials assume the same position as the dials of the transmitters or gun data computer. The gun crew traverses and elevates the gun until the indexes of the mechanical dials match the indexes of the electrical dials at which time the gun is positioned for firing.

ARRANGEMENT OF BOXES AND CABLES—Multi-conductor cables connect the power source and the transmitters or gun data computer to the main junction box in the plotting room. From the main junction box, multi-conductor cables distribute electrical data to the guns of the battery, either to an emplacement box or to a gun extension box. From there the connections follow to the gun junction box. The gun junction box contains step-down transformers which provide a 6-volt circuit for the trouble lamp and the lights of the indicators. By means of single-conductor wires in a conduit, a switch box is also connected to the gun junction box. The switch box provides a means of turning the lights of the indicators off and on and also an outlet for a trouble lamp. Single conductor wires through conduits and elbow assemblies carry the electrical data to the indicators. The elbow assemblies are used to facilitate the wiring of the carriages.

On-Carriage Parts (one per gun)

Azimuth indicator
Elevation indicator
On-carriage wiring and conduits
Gun junction box
Switch box

Elbow assemblies

Outlet boxes (where necessary)
Contact ring assembly (where necessary)

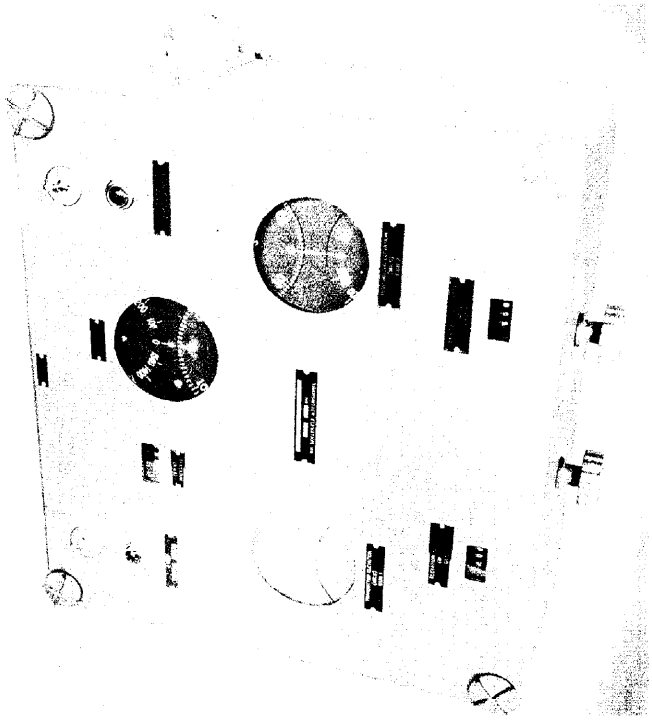
Off-Carriage Parts (one per battery)

Azimuth transmitter
Elevation transmitter
Connecting cables
Main junction box
Emplacement junction box (where necessary)
Gun extension box (where necessary)

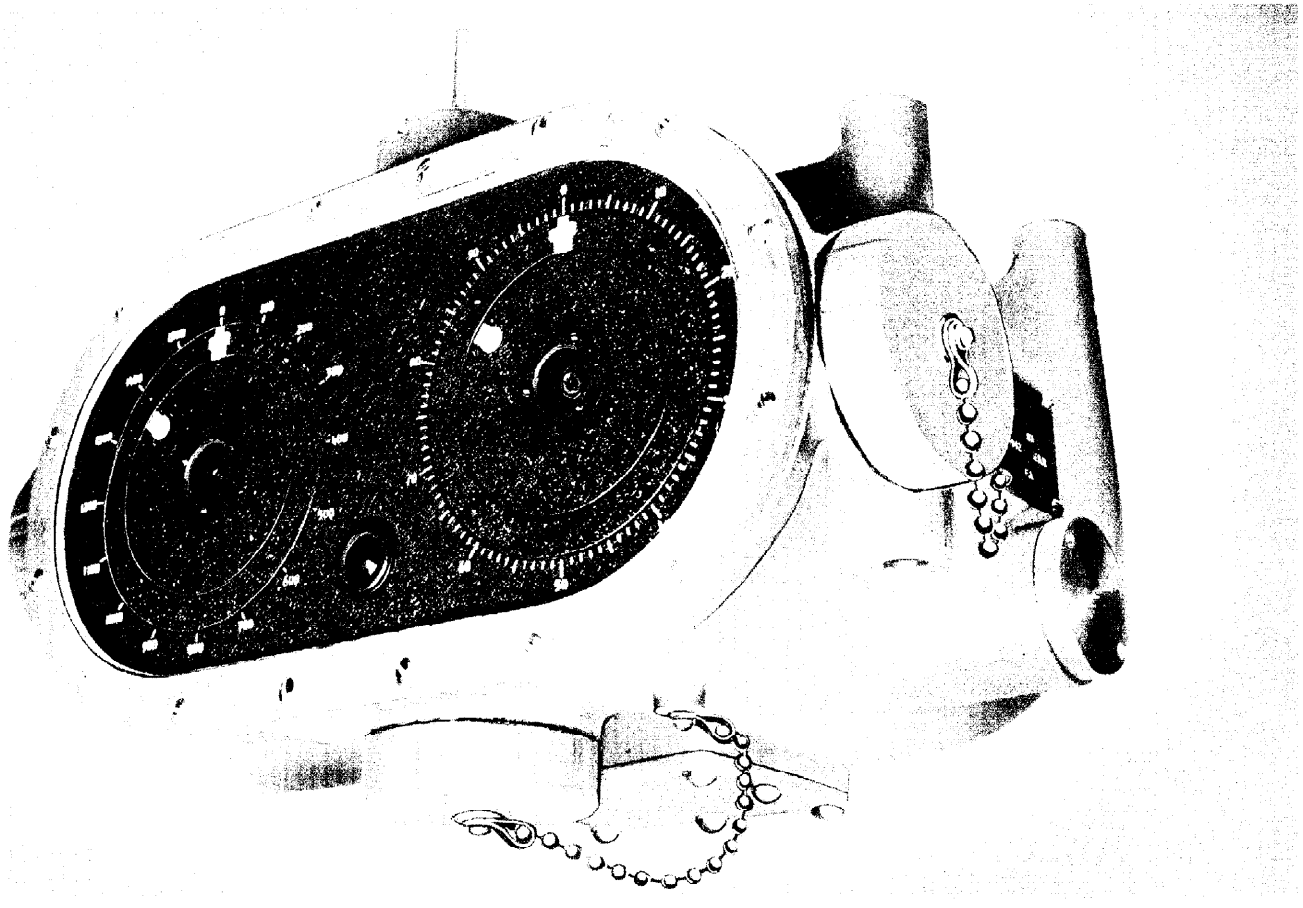
Indicating Devices

Data Transmission System	Carriage	Azimuth Indicator	Elevation Indicator	Azimuth Transmitter	Elevation Transmitter
M5	16″ Barbette carriages M2 & M3, M1919M1, M4 (1 plotting room)	M6	M5	M5	M6
M5	16″ Barbette carriage, M1919 (1 plotting room)	M5	M10	M5	M6
M7	6″ Barbette carriage, M1 (Hydraulic)	M3	M8	M5	M6
M8	8″ Barbette carriage, M1 (Casemated)	M5	M5	M5	M6
M9	8″ Railway mount, M1A1	M5	M5	M5	M6
M10	12″ Barbette Carriage, M1917 (2 plotting rooms)	M6	M10	M5	M6
M13	16″ Howitzer carriage, M1920	M16	M8	M5	M6
M14	16″ Barbette carriage, M1919 (2 plotting rooms)	M6	M10	M5	M6
M15	6″ Barbette carriages, M1900, M1910	(Type not determined)		M5	M6
M17	12″ Barbette carriage, M1917 (1 plotting room)	M6	M10	M5	M6

REFERENCES—FM 4-15; TM 9-2005, v. 5.



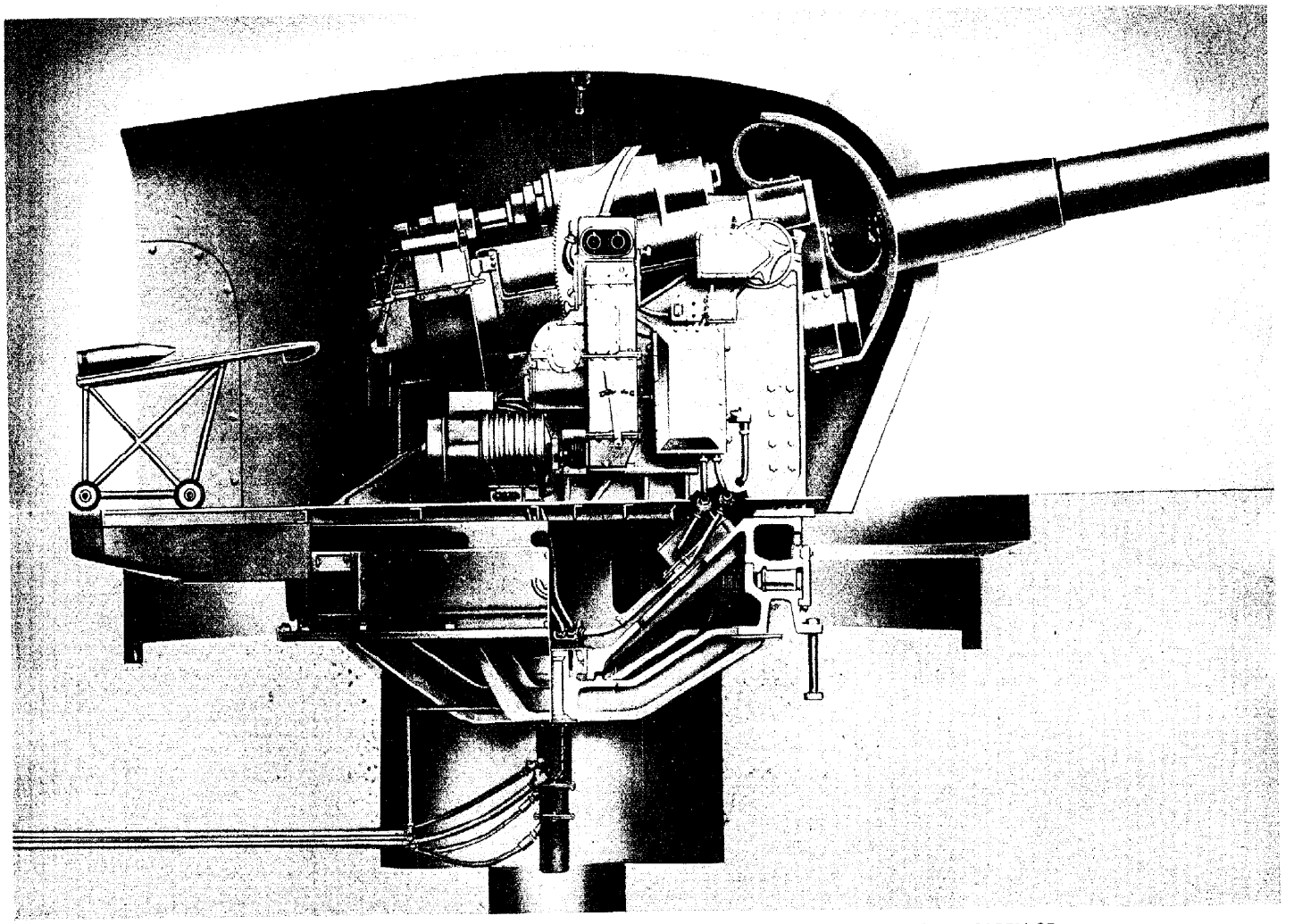
ELEVATION TRANSMITTER, M6



ELEVATION INDICATOR, M5

UNCLASSIFIED

REMOTE CONTROL SYSTEM M14—STANDARD
CABLE SYSTEM M12—STANDARD



REMOTE CONTROL SYSTEM, M14—SHOWING ARRANGEMENT OF PARTS ON BARBETTE CARRIAGE

Remote Control System, M14, used with Cable System, M12, receives and applies elevation data to the 6-inch Barbette Carriages, M2 and M4. In addition, it receives azimuth data at the carriage where it is indicated by the movement of the electrical pointer of the Azimuth Indicator, M9. A member of the gun crew keeps the gun constantly positioned at the proper azimuth by turning the azimuth handwheel of the gun carriage so that the position of the mechanical pointer on the azimuth indicator coincides with that of the electrical pointer. If great speed of operation is not essential, this type of semi-automatic operation may also be used in laying the gun in elevation.

Unlike the remote control systems used with antiaircraft matériel and the Waterbury speed gears which it replaces, the M14 system is completely electrical, with no hydraulically operated units. It provides for the automatic positioning of the gun at the loading elevation and the firing elevation. It decreases the average dead time of loading the gun by about two seconds per round.

The cable system, which requires a source of 110-volt, single-phase power, consists of the cables through which the correct firing elevation and azimuth are transmitted instantaneously from the plotting room to the indicator system, an element of the remote control system which is located on the gun carriage. When data are obtained by use of a plotting board and related instruments, the cable system also includes an Azimuth Transmitter, M5, and an Elevation Transmitter, M6, which are located in the plotting room. The correct azimuth and elevation are set in the respective transmitters by members of the plotting room staff. When the Gun Data Computer, M8, is employed, the cable system is connected directly to the computer which has its own transmitting elements.

The Remote Control System, M14, essentially a controlled variable voltage system, consists of the Indicator System, M7; Motor Generator Set, M1; Amplifier, M2; and Power Control, M6. The Indicator System includes an Indicator Regulator, M2, on which elevation data are received, and an Azimuth Indicator, M9, on which azimuth data are received, as well as certain on-carriage cables and

REMOTE CONTROL SYSTEM M14
CABLE SYSTEM M12

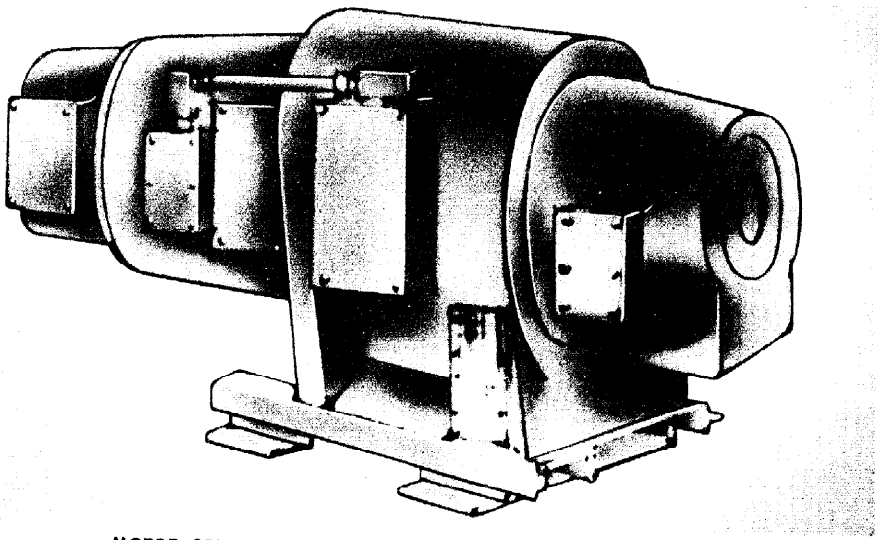
(Continued)

other electrical components. In laying the gun in azimuth no further components are employed.

Indicator-Regulator, M2, is mounted on the right side of the carriage above the elevating mechanism. It consists of a coarse and a fine synchronous repeater, each of which has an electrical and a mechanical index. The electrical index is positioned electrically from the elevation transmitter. The mechanical index is connected to the elevating mechanism and is brought into alignment either by turning the elevation handwheel in semi-automatic control or by the operation of the elevation driving motor. When the first method is used, the shifter lever on the side of the indicator-regulator is in "hand" position, and when the second method is employed, it is in "automatic" position. When the semi-automatic method is used, the operator must stop turning the handwheel when the position of the electrical pointer is matched. When the automatic method is used, the contacts in the indicator-regulator are actuated by coarse and fine repeaters and when synchronism is reached power to the elevation drive is shut off with the gun at the proper elevation.

The amplifier, power control, motor generator, and associate cables and electrical components are used only in elevating the gun electrically and automatically. The motor generator, located in a separate room, is connected to a 440-volt, 3-phase, A.C. generator, and is started and stopped by a starter switch. It consists of an A.C. motor, which drives the Motor Generator Set, and a constant voltage exciter, which furnishes direct current for the generator field excitation, driving motor field, motor brake, relay coils, and pilot lights in the cut-out switch. In addition, the Motor Generator Set includes a direct current generator which produces a variable voltage by means of controlled generator field excitation, thus controlling the speed of the driving motor. The amplifier, located in the motor generator room, serves to supply a flow of current for smooth and uniform control of the gun.

Power Control, M6, consists of the on-carriage components by which the movement of the weapon in elevation is effected and controlled. Its major components are the power contact ring, the driving motor, the elevating mechanism, the relay box, the limit switch, the transfer switch, the resistor box, the breech interlock, and various connecting elements.



MOTOR GENERATOR UNIT OF REMOTE CONTROL SYSTEM, M14

The power-contact ring connects the off-carriage equipment to the on-carriage equipment in such a way, that although there are a number of separate cables leading between different components, 360° rotation of the carriage is permitted without snarling the cables.

The driving motor is used to drive the elevating mechanism when automatic or semi-automatic control is used. The direction and speed in which the motor drives the elevating mechanism depends on the voltage which is supplied by the generator.

The elevating mechanism consists of gearing which connects the driving motor on the handwheel to the rack on the gun cradle. To connect the elevating mechanism to the driving motor for automatic or semi-automatic control the shifter lever on the front of the elevating mechanism is set at the "power" position. For hand operation, the elevating gears are connected to the handwheel by moving the lever to the "hand" position.

The relay box contains the nine relays which control the direction and speed of elevation of the gun. They are connected with the elements of the motor generator by which the proper direction and speed of gun travel are determined. Two of the relays, one for each direction, are controlled from the contacts operated by the coarse repeater. They control the advance into high speed when on automatic control. The operating coils of the various relays are themselves controlled by contacts in the indicator-regulator, the loading position switch, the limit switch, and the transfer switch.

The limit switch, contained within the elevating mechanism, prevents the driving motor from moving the gun beyond the upper and lower limits of elevation for which the weapon is constructed. Thus there is no danger of injuring the mechanisms of the gun.

The transfer switch has two positions, "automatic" and "load." When in the first position the relays of the relay control are connected with the contacts of the indicator-regulator and the gun is then moved to the position of the electrical pointer on the indicator-regulator. In the second position, the relays of the relay control are connected to the contacts of the loading position switch by which the gun is brought to the loading position.

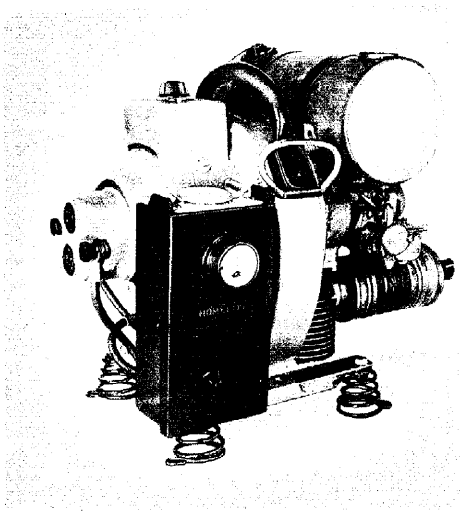
The interlock is used to prevent automatic movement of the gun in elevation when the breechblock is open. It is automatically operated by the opening and closing of the breech.

REFERENCE—TM 9-428.

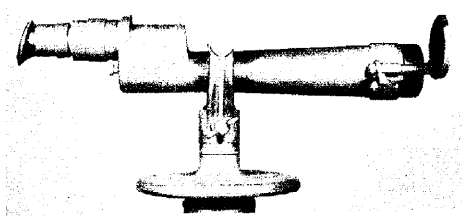
GENERATING UNIT M1—STANDARD

This portable, gasoline-driven generating unit is used to furnish light and power to plotting rooms and the battery commander's station or command post of mobile seacoast batteries. It contains all the equipment necessary to supply the current for a lighting system which consists of six 3-candlepower incandescent lamps, eight 21-candlepower incandescent lamps and two 3-candlepower illuminating lamps.

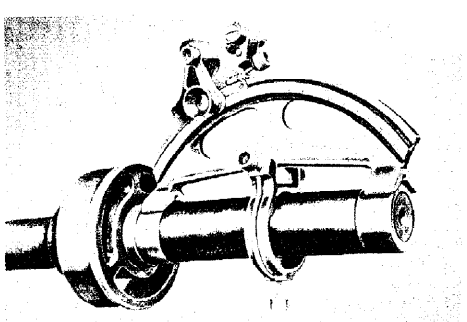
GENERATOR—This weatherproof unit is a 650-watt, 12-volt direct-current generator with a field rheostat mounted on the yoke. It is equipped with a two-pole receptacle and cover as well as a switch box with an ammeter, a cut-out switch and a 250-volt, 60-ampere fuse.



GENERATING UNIT, M1



OBSERVATION TELESCOPE, M1908



CLINOMETER, M1912A1

CHARGING PANEL—This instrument which is connected to the generator by a 50-foot, two-conductor cable and plug assembly, is installed in a steel cabinet. Its equipment consists of a single-pole, 50-ampere toggle type generator switch and an auxiliary charging switch, either of which can act as a circuit breaker to open the circuit if overcharged. A series rheostat is connected to the auxiliary charging switch. In addition, there are a 30-volt voltmeter, a 50-ampere ammeter, three .4-ohm resistors, a dash or pilot lamp to illuminate the panel and to indicate the presence of voltage, and six two-pole receptacles with two binding posts for each.

STORAGE BATTERIES—There are three 6-volt, 120-ampere-hour storage batteries connected in parallel and wired to the charging panel. In the switch box of the generator there is a switch which prevents the batteries from discharging through the generator when the unit is for any reason not operating.

SOCKET PANEL—This is contained in a steel cabinet and is connected to the charging panel by means of a 25-foot, two-conductor cable and plug arrangement. In addition, there are 14 sockets for extension cords, a voltmeter, ammeter, a dash or pilot lamp, and a single-pole, 50-ampere light switch to disconnect all lamp circuits when the batteries are being charged. This serves as a circuit breaker.

ADDITIONAL EQUIPMENT—Twenty-eight lamps are included with this unit, half of which serve as spares. There are also fourteen extension cords, each 15 feet long, and a hydrometer for testing the batteries.

REFERENCES—TM 9-2005, v. 5; TM 9-2615.

MOTOR GENERATOR M2—STANDARD

Motor-Generator, M2, is a commercially procured generator which serves as an auxiliary power source for the operation of gun data computers at seacoast batteries where the main power supply is direct current. This 110-120 volt generator supplies 3 kilowatts at 80% power factor, and generates 125 volts at 60 cycles when running at 1800 r. p. m. It delivers single phase power.

OBSERVATION TELESCOPE M1908—STANDARD

This straight telescope is used for general observation purposes by the seacoast artillery. Two eyepieces are furnished, one 12 and the other 24 power. The eyepiece can be focused by turning a knurled knob.

The telescope is supported on a cradle-type fixed-pedestal mount which permits vertical movement of the instrument.

A packing chest for the telescope, one for the mount, and a protective leather cover are also provided.

Horizontal movement through a complete circle is also possible. The instrument is positioned horizontally and vertically by the tightening of nuts.

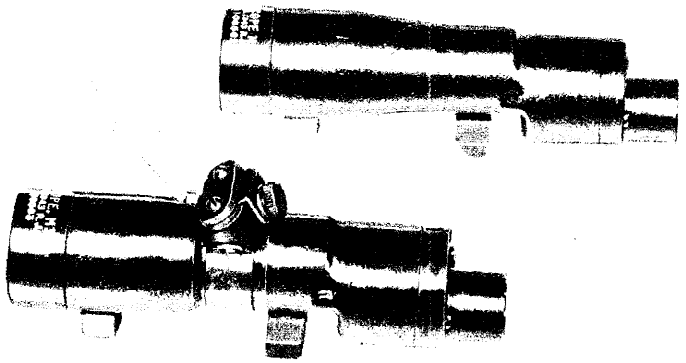
CLINOMETER M1912A1—STANDARD

The clinometer is a measuring device for vertical angles and is used to determine whether a cannon has been elevated to the proper angle. The standard clinometer is scaled in mils, being a modification of the M1912, which is scaled in degrees. It is put into position by means of a clinometer rest, which is a metal plug, fitting firmly into the muzzle of the cannon, and has a projecting axis coinciding with the axis of the bore. The clinometer may be rotated on this axis for cross leveling. When the clinometer has been set at the desired angle of elevation, the gun is raised or lowered until the leveling bubbles are centered. When this occurs the gun is at the correct elevation.

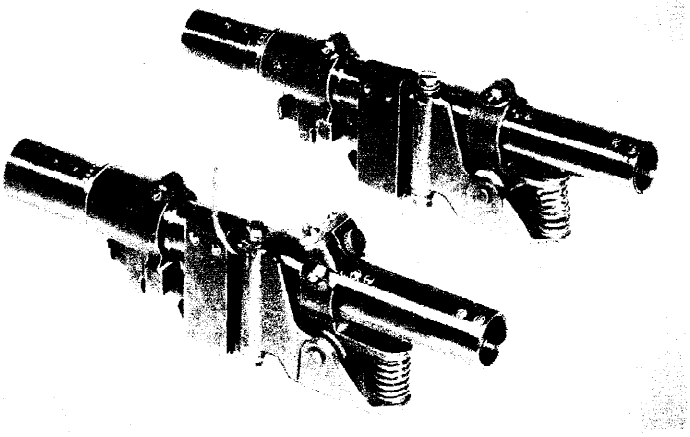
REFERENCES—TM 4-215; TM 9-2005.

FIRE CONTROL
TANK ARMAMENT

PERISCOPES M2, M4A1, M6, M8A1, M9, M10—STANDARD
TELESCOPES M38A2, M39A2, M40A2, M46A2, M47A2—STANDARD
TELESCOPE M19A1—LIMITED STANDARD



ABOVE—TELESCOPE, M38, M40, OR M47; BELOW—TELESCOPE, M38A2, M40A2, OR M47A2



ABOVE—TELESCOPE, M39 OR M46, ASSEMBLED TO MOUNT; BELOW—TELESCOPE, M39A2 OR M46A2, ASSEMBLED TO MOUNT

A periscope is designed to permit members of the tank crew, from concealed positions inside a tank, to observe the field and sight upon a target. Gun sighting periscopes are designed so that a telescope may be fitted into the right side. The periscope is positioned, through parallel gun sighting linkage with the gun mount, so that its line of sight moves with the gun.

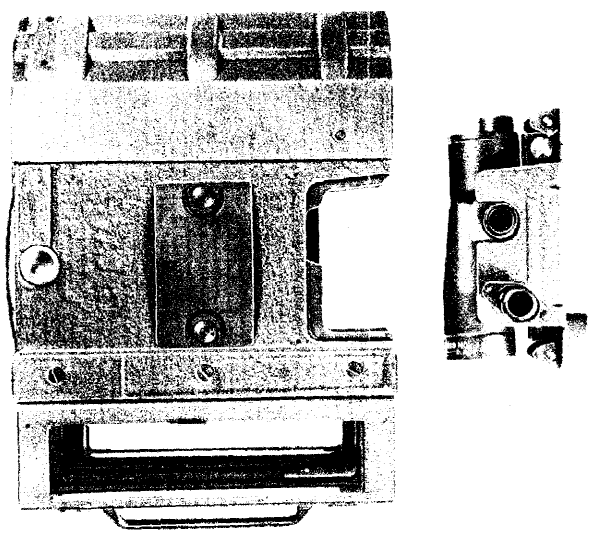
A periscope is approximately parallelepiped in shape. Its main components are: body, head, and lower elbow housing.

The body is the framework of the periscope. On the front are springs for holding the periscope in place in the periscope holder. The telescope holder in Periscope, M2, like the bracket in the old type observation periscopes, fits into an opening in the right side of the body. In Periscopes, M4A1 and M8A1, the telescope holder is attached to the right inside wall of the periscope.

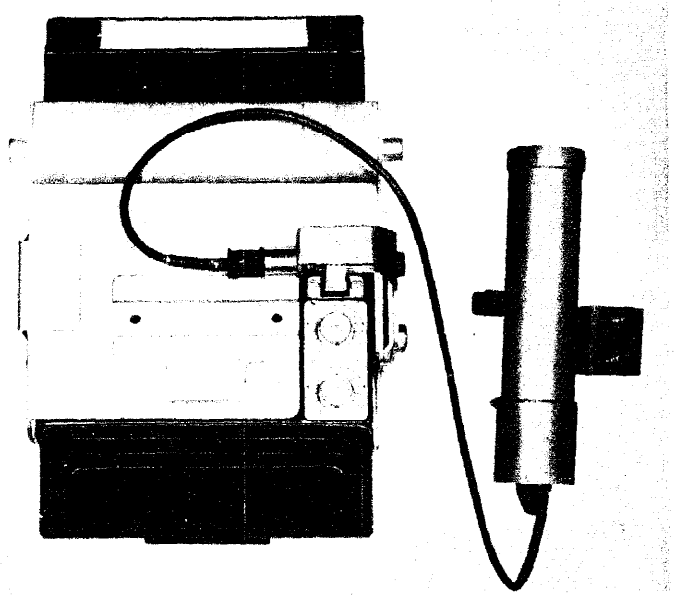
The head is attached to the body by pins or clamps. The old type head consists of a vertical window through which light enters from the outside, a mirror, and a horizontal window. Periscopes now in production use a solid prism in the head instead of a mirror. This solid prism has been adopted because of its better light-transmitting powers and generally improved optical qualities.

The elbow housing, attached to the lower part of the body, contains the same sighting elements as does the head, and prisms are now being substituted for mirrors. The vertical glass surface is in this case used for observing. A handle for removing the periscope from the holder is attached to the lower part of the elbow housing.

Each periscope has a removable head, made of a light plastic material, which, in case of a direct hit, will shatter rather



PERISCOPE, M2, AND TELESCOPE, M19A1



PERISCOPE, M4A1

PERISCOPES M2, M4A1, M6, M8A1, M9, M10
TELESCOPES M38A2, M39A2, M40A2, M46A2, M47A2
TELESCOPE M19A1

(Continued)

than become wedged in the mount. Several spare heads are furnished with each periscope. The heads for Periscopes, M4, M4A1, M6, M8, M8A1, and M9, are interchangeable and identical.

PERISCOPE, M2—Fitting into the right side of the body is the telescope holder adapter assembly which holds the telescope in position in the periscope. Provision is made for longitudinal and lateral adjustment of the telescope by the rotation of two knobs attached to the lower part of the adapter.

The horizontal windows of instruments of late manufacture are etched with crosslines for rough sighting. Periscopes of early manufacture are equipped with an Instrument Light, M15.

PERISCOPE, M4A1—This periscope is mounted in place in the tank by a holder which is assembled in the turret and is linked to the gun. It moves with the gun in elevation and direction. The head and elbow assembly are attached to the body by means of clamps which engage with latches on the body. The latter are actuated by means of eccentric assemblies on the body. A label, for recording data, such as elevation and deflection settings, is attached to the rear of the head.

In the sighting control assembly of the periscope body are mechanisms, actuated by adjusting knobs, for lateral deflection and elevation adjustment of the telescope. For each type of adjustment, a total range of about 70 mils is possible. Scales, graduated in mils, surround the knobs.

For use in night firing, provision has been made for illumination of the telescope reticle by means of Instrument Light, M30. To adapt the periscope for use with the instrument light, it has been provided with electrical contacts and an opening for the contact. In addition, the glass surfaces of the telescope are coated with a film to reduce reflection. This periscope replaces the M4 periscope which has no provision for illumination.

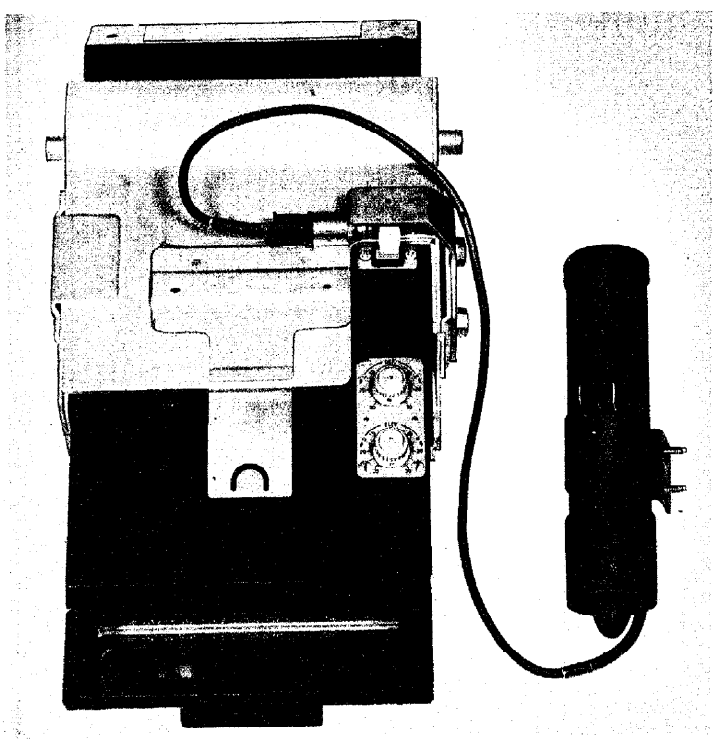
PERISCOPE, M6—This periscope is mounted in place in a holder which fits into a mount. The periscope is not linked to the gun, and both mount and periscope can be rotated completely and tilted manually over a wide field. It is like the M4A1, but since it is used for observation only, it has no telescope, holder, control assembly, and electrical contacts.

PERISCOPE, M8A1—In appearance and construction, this periscope resembles the M4A1. It is different only in dimensions and the addition of a few mechanical devices. It replaces Periscope, M8, which has no provision for illumination.

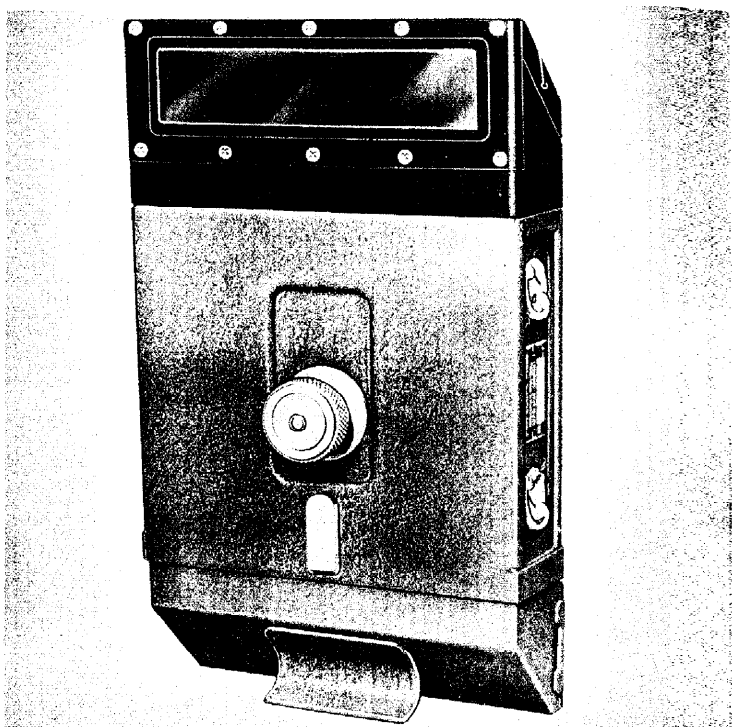
PERISCOPE, M9—This periscope differs from the M8A1 in that it lacks a telescope and the elements connected with it, including the electrical contacts.

PERISCOPE, M10—This periscope is constructed on principles entirely different from those previously considered, for it is really two self-contained telescopes in one body which is linked with the gun. There is a 1-power optical system which is used for firing at near targets and a 6-power system for firing at distant or indistinct targets. The 6-power telescope has a true field of view of 11° 20', a 7 mm exit pupil, and eye relief of 29 mm. The 1-power instrument has a vertical field of view of 8° 10', a horizontal field of view of 42° 10', and unrestricted eye relief. The 1-power telescope has an infinity reticle and the 6-power instrument has the standard antitank type reticle, graduated for use with the tank gun.

STANDARD TELESCOPES—The seven telescopes standard for use in periscopes are tubular instruments producing an erect image. The magnification of these telescopes is low so that the movement of the telescopes will keep the movement of the field of view to a minimum, yet there is enough magnification to permit the reticle to be seen easily. Each telescope except the limited standard, M19A1, has an opening for illumination of the reticle



PERISCOPE, M8A1



PERISCOPE, M4 OR M6

PERISCOPES M2, M4A1, M6, M8A1, M9, M10
TELESCOPES M38A2, M39A2, M40A2, M46A2, M47A2
TELESCOPE M19A1

(Continued)

by means of the instrument light. The optical surfaces are coated with nonreflecting film.

Within each group listed, the telescopes differ from each other only in reticle pattern. All reticle patterns, except the M19A1, however, adhere to the recently adopted antitank reticle pattern.

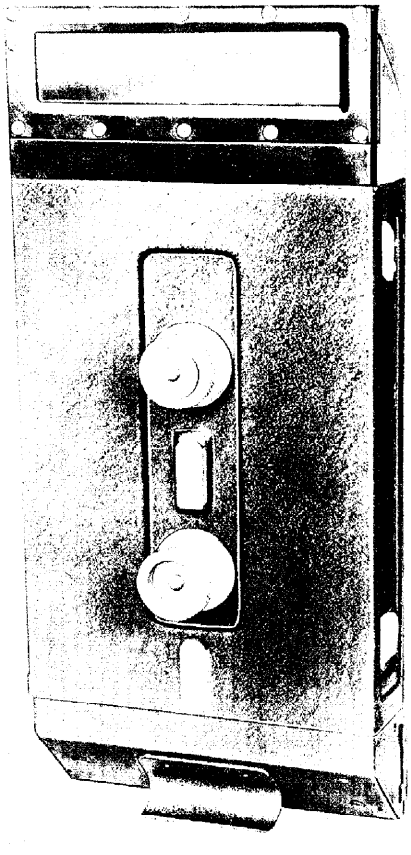
REFERENCE—TM 9-1608.

TABLE "A"

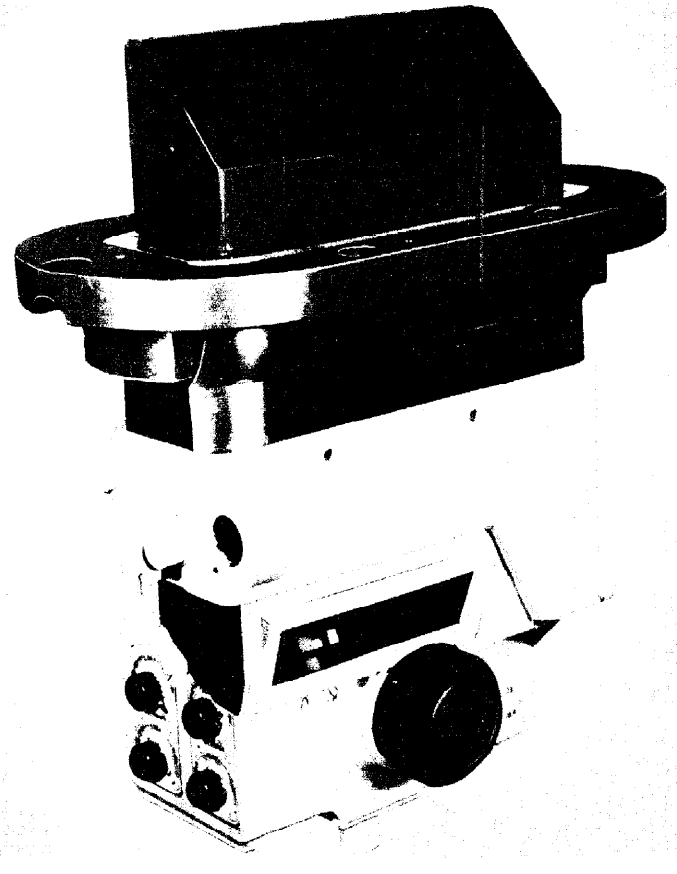
	Telescopes, M39A2, M46A2	Telescope, M19A1	Telescopes, M38A2, M40A2, M47A2
Length of tube	8 7/8 ins.	4 15/16 ins.	5 17/64 ins.
Diameter of objective end	1 1/16 ins.	1 1/4 ins.	1 1/4 ins.
Diameter of eyepiece end	0.875 in.	0.64 in.	0.75 in.
Diameter of exit pupil	0.33 in.	0.28 in.	0.272 in.
Effective focal length of objective	1.918 ins.	2.193 ins.	3.156 ins.
Effective focal length of eyepiece	1.918 ins.	2.193 ins.	2.193 ins.
Field of view	6°	11°	9°
Power	1.8X	1X	1.44X

STANDARD PERISCOPES AND TELESCOPES

Periscope	Dimensions	Used With	Used In	Used For
M2	8 1/2 x 6 1/2 x 1 3/4 ins.	Telescope, M19A1	Medium Tank, M3	Gun sighting and observation
M4A1 (Substitute Standard in Medium Tanks, M4 series)	11 1/16 x 6 1/2 x 1 3/4 ins.	Telescope, M38A2 Telescope, M40A2 Telescope, M47A2	Medium Tanks, M4 series Light Tanks, M3A1, M3A3, M5, M5A1; 76 mm Gun Motor Carriage, T70; M18; Medium Tank M4 series (76 mm)	Gun sighting and observation
M6	11 1/16 x 6 1/2 x 1 3/4 ins.		Light Tanks, M3A1, M3A3, M5, M5A1 Medium Tanks, M4 series and M4 series (76 mm); Heavy Tanks, M6, M6A1; 3" Gun Motor Carriages, M10, M10A1; 76 mm Gun Motor Carriage, M18; 90 mm Gun Motor Carriage, M36	Observation
M8A1	14 3/4 x 6 1/2 x 1 3/4 ins.	Telescope, M39A2 Telescope, M46A2	Heavy Tanks, M6, M6A1 Light Tanks, T9, T9E1	Gun sighting and observation
M9	14 3/4 x 6 1/2 x 1 3/4 ins.		75 mm Howitzer Motor Carriage, M8	Observation
M10		Self-Contained Telescopes	Medium Tanks, M4 series	Gun sighting and observation



PERISCOPE, M9



PERISCOPE, M10

UNCLASSIFIED

DIRECT-SIGHTING TELESCOPES FOR ARMORED VEHICLES

These telescopes are used for the direct aiming of some of the weapons on certain tanks, gun motor carriages, and armored cars. The telescopes are secured to the respective gun mounts in such a way that they move with the gun in elevation and traverse. Therefore the target can be correctly sighted in reference to markings on the reticle of the telescope.

Telescope, M53A1, and Telescope Mount, M40

Optical Characteristics, Telescope, M53A1

Power	3 X
Field of view	10° 27′
Diameter of exit pupil	0.300 in
Effective focal length of objective	3.447 ins.
Effective focal length of eyepiece	2.250 ins.

Telescope, M53A1, is an adaptation of Elbow Telescope, M6, to a straight, lens-erecting telescope. It has a characteristic "potato masher" or "dumb-bell" shape. The reticle is of the recently adopted antitank pattern in which corrections for drift have been incorporated. The reticle is graduated for use with the 155 mm H. E. Shell, M101, supercharge, MV 2,410 feet per second. The telescope has an adjustable sunshade and an eyeshield which insures the maintenance of the eye distance at the point where the maximum field of view is obtained. Red, amber, and neutral filters are provided.

Telescope Mount, M40, is a metal bracket which places the telescope in the most convenient position for sighting and which is firmly fastened to the left trunnion of the gun so that the telescope moves with the gun in elevation and in traverse. The mount contains provisions for making bore-sighting adjustments of the telescope.

Telescope, M71D, and Telescope Mount, M57

Optical Characteristics, Telescope, M71D

Power	5 X
Field of view	13°
Diameter of exit pupil	6.7 mm.
Effective focal length of objective	5.525 ins.
Effective focal length of eyepiece	1.625 ins.

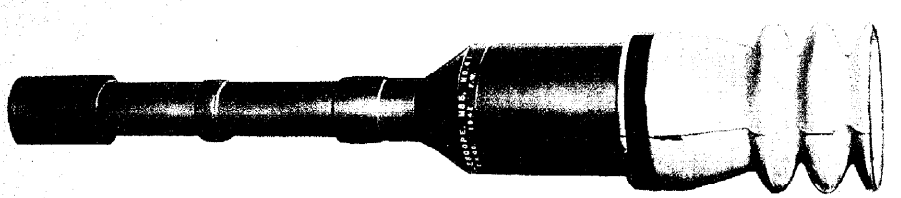
Telescope, M71D, is a straight, lens-erecting telescope with provisions for diopter adjustments in accordance with a scale reading from −2 to +2. The telescope contains a reticle of the standard antitank pattern applicable to 76 mm A.P. Shot, M62. Two spherical collars, one near the front of the telescope, and the other at the rear, fit the locating surfaces on the telescope mount. A locating pin in the rear collar serves to position the telescope correctly in the mount. There is a window to allow illumination of the reticle. A soft rubber eyeshield is mounted over the end of the eyepiece assembly.

Telescope Mount, M57, which consists essentially of a mounting bracket and a support mechanism, is bolted to the right-hand side of the gun cradle. The mounting bracket is a casting 14 inches long and about 9½ inches wide. It contains a surface for supporting the telescope tube, a clamp for the battery case of Instrument Light, M33, and a holder which surrounds the front mounting collar of the telescope. The holder includes two locating pads for positioning the front end of the telescope and a spring-loaded plunger to hold the telescope firmly against the pads. In the rear part of the mounting bracket is a lateral slide which fits into a slot in the support mechanism.

The support mechanism consists of an adapter, a lateral adjusting mechanism, and a vertical adjusting mechanism. The adapter serves to mount the rear telescope holder and the other components of the support mechanism. The lateral adjusting mechanism is actuated by a screw which is turned by a micrometer on the left-hand side of the adapter. This mechanism serves to slide the adapter to the left and right. The amount of movement can be read on a scale on the rear of the mounting bracket. The scale is graduated in reference numbers closely approximating mils and covers 20 units to the left and 20 units to the right of the zero point. The vertical adjusting mechanism, operated by a micrometer at the bottom of the adapter, provides a means for raising and lowering the telescope through about 20 mils of elevation and 20 mils of depression as indicated on a scale on the rear of the adapter. This telescope mount is provided with a headrest.

TELESCOPE M76C AND TELESCOPE MOUNT M55. Telescope, M76C, is similar to Telescope, M71D, in construction and appearance. Its magnification is 3 power and the field of view is accordingly increased to 21°30′. It has some decided improvements in optical qualities and, like all recent telescopes, has coated optics. The body is slightly larger and heavier than the M71D Telescope, but the mounting rings are identical in size of bearing surface. Like Telescope, M71D, the M76C has a reticle of the standard antitank pattern graduated for the 76 mm APC projectile.

Telescope Mount, M55, is similar to Telescope Mount, M57. It is about an inch longer than the M57. The mounting bracket has been modified to permit bolting the mount to the left hand side of the gun mount rather than the right side, as is the case with Telescope Mount, M57.



TELESCOPE, M53A1

TELESCOPE, M70 TYPE

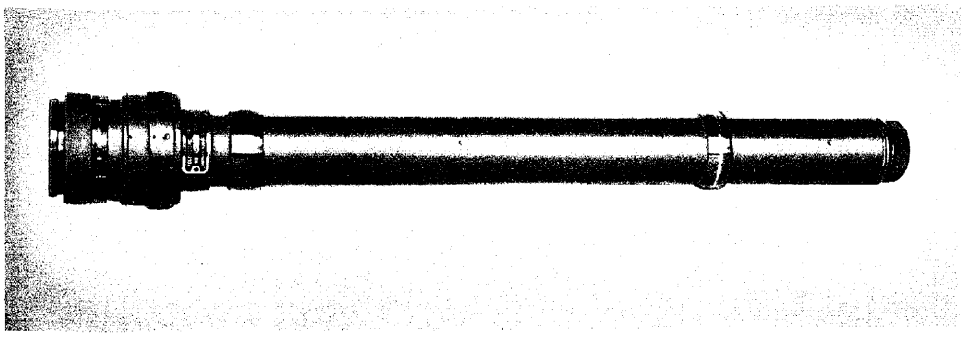
M70 Series Telescopes

Optical Characteristics

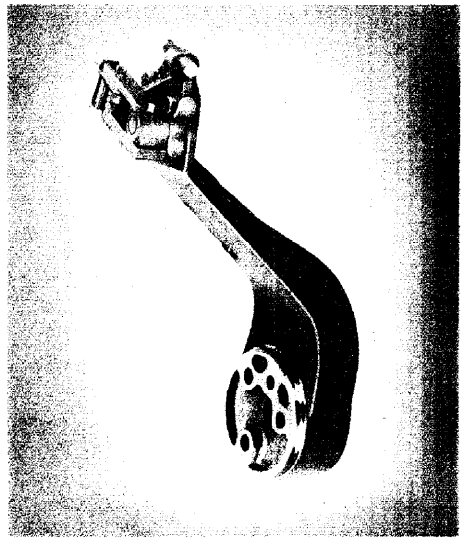
Power	3 X
Field of view	12° 19′
Diameter of exit pupil	0.217 in.
Effective focal length of objective	3.75 ins.
Effective focal length of eyepiece	1.25 ins.

The lens-erecting telescopes of the M70 series are identical except for the reticle patterns, each of which is marked with ranges and deflections applicable to a different type of ammunition.

Each of these instruments consists essentially of a tube and a sleeve. A



TELESCOPE, M71D



TELESCOPE MOUNT, M40

collar, attached to the tube, provides a mounting surface. Except for the M70H, P and Q each telescope of the M70 series is about 24 inches long. The length of the M70H has been increased to permit mounting the instrument on Telescope Mount M55 or M57. The increase in length is achieved by the use of an adapter set which attaches to the telescope tube between the erector lenses where the light rays are parallel. Thus there is no effect on the optical characteristics of the telescope.

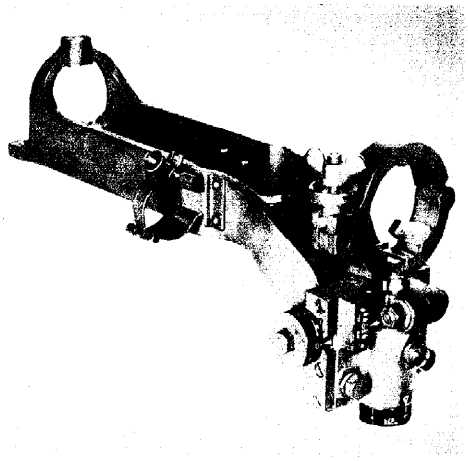
The objective end of the M70 type of telescope is made as small as possible so that only a small hole is needed in the armor plate. A rubber shield is fitted on the eyepiece end. All these instruments are provided with red, amber, and neutral filters.

The M70 series of telescopes consists of the M51 type of telescope, utilizing improved types of glass, and with reticles of the recently adopted antitank pattern in place of the Armored Force type reticles used in the telescopes which have been reduced to Limited Standard classification.

Instrument lights are provided for all these telescopes. Instrument Light, M32, is used with the M70 type of telescope having the binocular eyeshield, and Instrument Light, M39C, is used with such telescopes equipped with the monocular type of eyeshield.

TELESCOPES, M51, M54, M55, M56A1—In appearance, these telescopes resemble those of the M70 series. They contain the Armored Force Reticle instead of the recently adopted antitank reticle. Telescopes, M51, M55, and M56A1, are identical with the M70 type except in the type of reticle and optical glass. Telescope, M54, possesses slightly different optical characteristics. All these telescopes are to be replaced by M70 type instruments whenever they are turned over to Ordnance personnel for adjustment.

REFERENCES: FCDD–35, Notes on Materiel—Telescopes T92, T92E1, and T92E2; FCDD–43, Notes on Materiel-Telescope Mount, T85; FCDD–47, Notes on Materiel-Telescope Mount, T82.



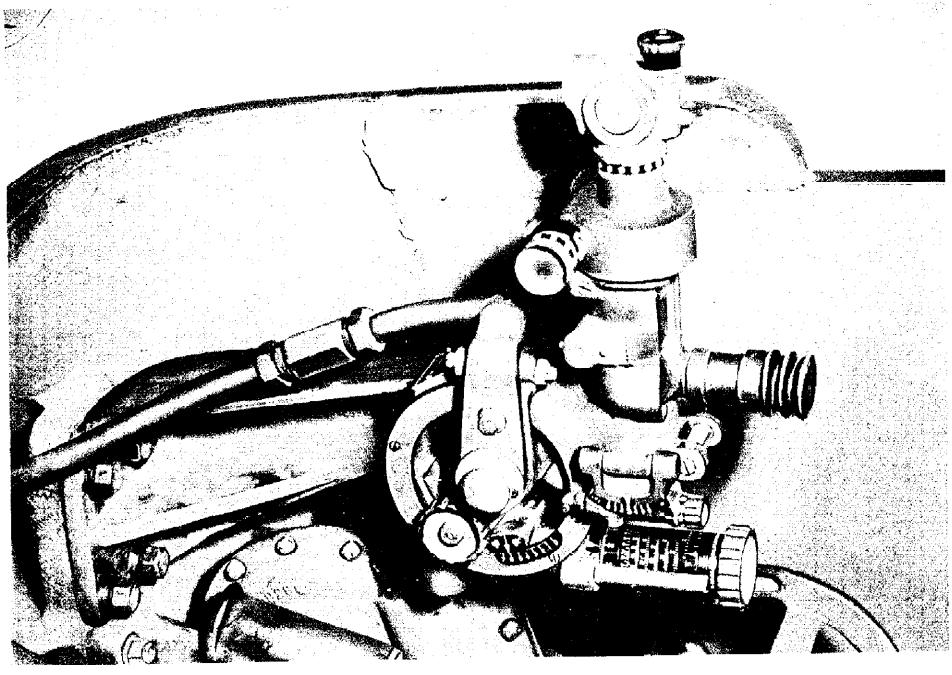
TELESCOPE MOUNT, M55

Telescope	Telescope Mount	Reticle Illuminated By Instrument Light	Used In	Used With
M53A1-S	M40-S	M17	155 mm Gun Motor Carriage, M12	155 mm Gun, M1918A1; 155 mm H.E. shell, M101, supercharge, MV 2,410 f/s
M70C-S M56A1-LS	Component of vehicle	M32 or M39C	75 mm Howitzer Motor Carriage, M8	75 mm Howitzer, M1A1, 75 mm H.E. shell, M48, charge IV, MV 1,250 f/s
M70D-S M54-LS	Component of vehicle	M32 or M39C	Light Tanks M3A3 and M5A1, Light Armored Car, M8	37 mm Gun, M6; 37 mm A.P. Shot, M51
M70F-S M55L-S	Component of vehicle	M32 or M39C	Medium Tanks, M4 series	75 mm Gun, M3; 75 mm A.P. Shot, M61
M70G-S	Component of vehicle	M32 or M39C	3" Gun Motor Carriages, M10 and M10A1	3" Gun, M7; 3" A.P. Shot, M62
M51-LS	Component of vehicle	M29	3" Gun Motor Carriages, M10 and M10A1	3" Gun, M7; 3" A.P. Shot, M62
M71D (S)	M57	M33	Medium Tanks, M4 series, 76 mm	76 mm Gun, M1; 76 mm APC Projectile, M62, (1 mil jump)
M70H (LS)	M51	M32	Medium Tanks, M4 series, 76 mm	76 mm Gun, M1; 76 mm APC Projectile, M62
M76C (S)	M55	M33	76 mm Gun Motor Carriage, M18	76 mm Gun, M1; 76 mm APC Projectile, M62
M70H (LS)	M55	M32	76 mm Gun Motor Carriage, M18	76 mm Gun, M1; 76 mm APC Projectile, M62

PANORAMIC TELESCOPE M12A5—STANDARD
TELESCOPE MOUNT M44—STANDARD

Gun and howitzer motor carriages are self-propelled artillery, and therefore their sighting and fire control requirements in some cases resemble more closely those of Field Artillery weapons than those of tanks. The 75 mm Howitzer Motor Carriage, M8, is provided with an observation periscope, a direct-sighting telescope of the M70 series, and, for laying the gun in both elevation and traverse in indirect fire, a Panoramic Telescope, M12A5, and Telescope Mount, M44.

PANORAMIC TELESCOPE, M12A5—This differs from the other panoramic telescopes of the M12 series in that it has a special reticle for the 75 mm H.E. shell, M48, as used in the howitzer motor carriage. It is a grid-type reticle, graduated for ranges up to 1,600 yards and for deflections of 40 mils to the left and to the right.

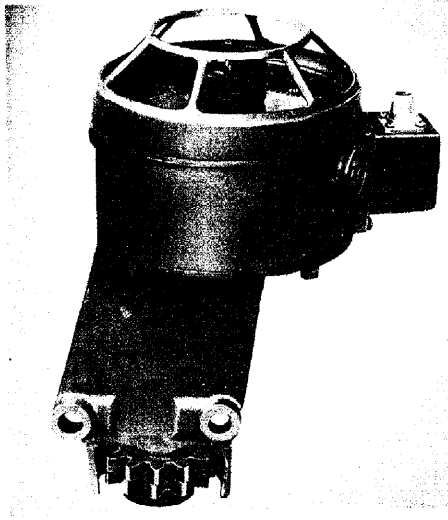


PANORAMIC TELESCOPE, M12A5 AND TELESCOPE MOUNT, M44

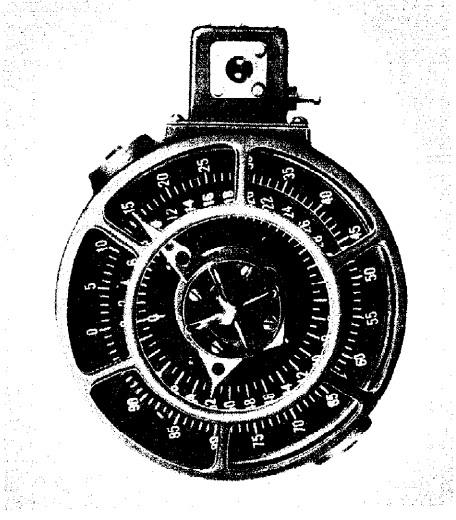
TELESCOPE MOUNT, M44—This mount, which is located on the right-hand side of the gun mount, serves to position the telescope so that the eyepiece is parallel to the bore of the gun. To secure parallel movement of the telescope mount with the gun in traverse, the mount is bolted to the right side of the gun mount above and behind the trunnions. The telescope possesses no azimuth-compensating elements, to permit accurate firing with the trunnions out of level, because there is no space on the mount for these elements. Cross-leveling of the gun partially solves this problem.

In order that the howitzer may also be laid in elevation by means of the panoramic telescope, there is an elevation linkage which is bolted to the right-hand side of the cradle. Through this linkage, movement of the gun in elevation from −175 mils to +750 mils is transmitted to the telescope mount and indicated on an elevation scale. There is also an attached range drum scaled in yards.

AZIMUTH INDICATOR M20—STANDARD



AZIMUTH INDICATOR, M18



AZIMUTH INDICATOR, M19—TOP VIEW

AZIMUTH INDICATOR, M20—STANDARD—This instrument is used for indirect laying of tank guns in azimuth. It is standard equipment for the Gun Motor Carriages, M10, M10A1, M18, and T71; Light Tank, T24; Medium Tanks, M4 series; including those with the 76 mm gun; and Medium Tanks, T23E3, T25E1, and T26E1. It consists of a mounting bracket, a circular azimuth scale and a micrometer, pointers to indicate the readings of the scale and micrometer, and a lighting system.

The mounting bracket serves as a support for the instrument and contains the mechanism by which the pointers are geared to the turret ring. The azimuth scale is graduated in mils at 100-mil

AZIMUTH INDICATOR M20 (Continued)

intervals from 0 to 32 in two consecutive semicircles. Around the edge of the azimuth scale is the micrometer scale graduated at 1-mil intervals from 0 to 100. Both scales are read in counterclockwise direction. The third pointer beneath the azimuth pointers indicates 0 when the gun on the vehicle is pointing straight ahead. As the turret is rotated, the pointers move concurrently to indicate the azimuth of the gun.

Azimuth Indicator, M20, is standard for production, superseding the M18 and M19. Originally the Azimuth Indicator, M18, was designed for use with Gun Motor Carriages, while the M19 was designed for tank use. The Azimuth Indicator, M20, has been designed as an improvement over the M18 and M19 and is to be used with both gun motor carriages and tanks. Its improvements over the M18 and M19 include a dust and moisture seal, new pointers for micrometer and scale, a new raised dial reading counterclockwise instead of clockwise, and a gunner's aid. This is an additional dial which permits the gunner to apply azimuth corrections directly to the indicator, thereby obtaining a "new zero."

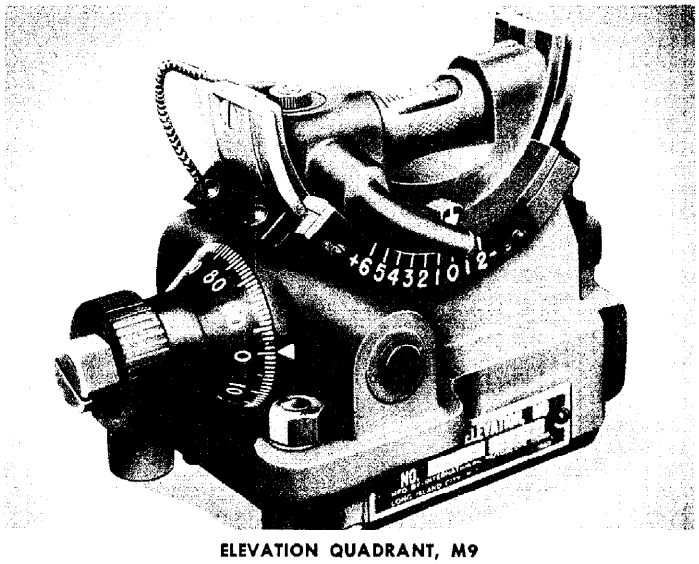
Azimuth Indicator, M18, differs from the M19 chiefly in the graduations of the azimuth scale. The M18 is graduated in a clockwise direction from 0 to 3,200 in two semicircles, while the M19 is graduated from 0 to 6,400. There is also a slight difference in the mounting arrangements of the two instruments.

ELEVATION QUADRANT M9—STANDARD

Elevation Quadrant, M9, is used for the indirect laying of tank guns in elevation. It is standard fire control equipment for Light Tank, T24, Medium Tanks, M4, including those with a 76 mm gun, and Medium Tanks T23E3, T25, and T26. Heavy Tanks, M6 and M6A1, and Gun Motor Carriages, M10, M10A1, M18, and T71. The adoption of this instrument has eliminated the necessity for the gunner's quadrant, which is inconvenient for use in a tank.

The instrument, contained in a metal casting, has an elevation mechanism, scale, and micrometer. The unit is screwed firmly to a mounting bracket shaped to fit the mounting surface of the tank gun mount. It is installed on the gunner's side of the mount, in a position convenient for use by him.

The elevation quadrant proper contains a level vial and an index and is driven by a worm mechanism. The worm knob contains a micrometer scale which measures 100 mils at 1-mil intervals. As the worm knob is turned, it moves the quadrant and the index along a scale measuring from 200 mils depression to 600 mils elevation until the desired elevation or depression has been set to the correct 100-mil indication. By turning the micrometer scale further, the exact elevation or depression in mils may be set in. When the actual elevation or depression of the gun corresponds with the setting indicated on the scale and micrometer, the level bubble is centered.



ELEVATION QUADRANT, M9

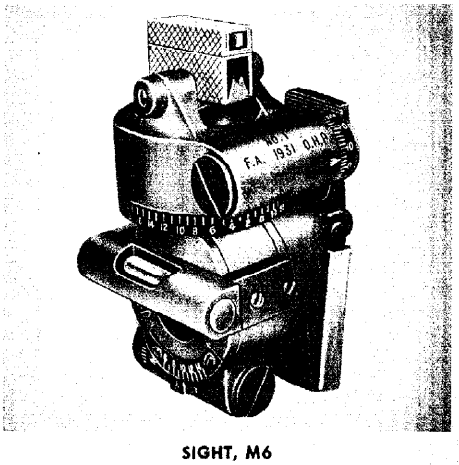
Instrument Light, M30, is provided for illumination of the scales at night.

SIGHT M6—STANDARD

Sight, M6, is the complete sighting equipment for the Half Track 81 mm Mortar Carriers, M4 and M21, and is used for laying the mortar in elevation and in traverse. The instrument is a modification of Sight, M4. The major difference between Sights, M4 and M6, is that, for the 300-mil deflection mechanism of the M4, there has been substituted a 6,400-mil azimuth circle, thus permitting full utilization of the wider traverse of the mortar when mounted in the mortar carrier. With the aim of expediting production, a certain amount of ease of operation has been sacrificed by the omission of an azimuth worm throwout device from the instrument.

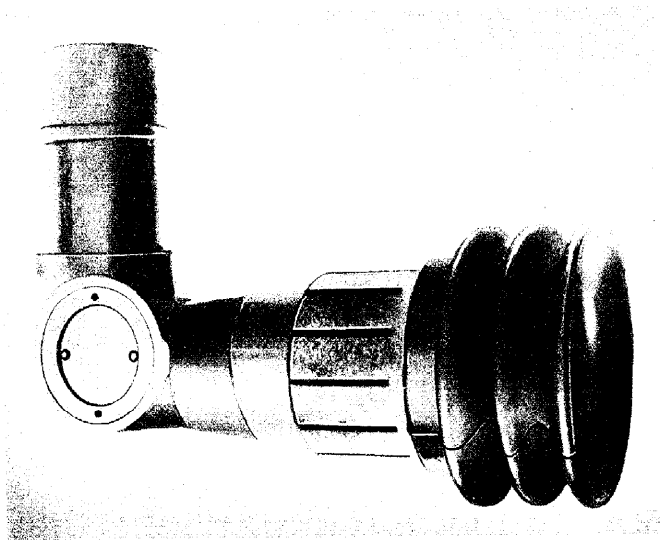
The cross level incorporated in the M4 sight has been eliminated from the M6 because there is a satisfactory level on the yoke of the bipod which supports the mortar. The vertical crosshair on the reticle of the collimator sight is also eliminated.

Carrying Case, M46, is provided for this sight.

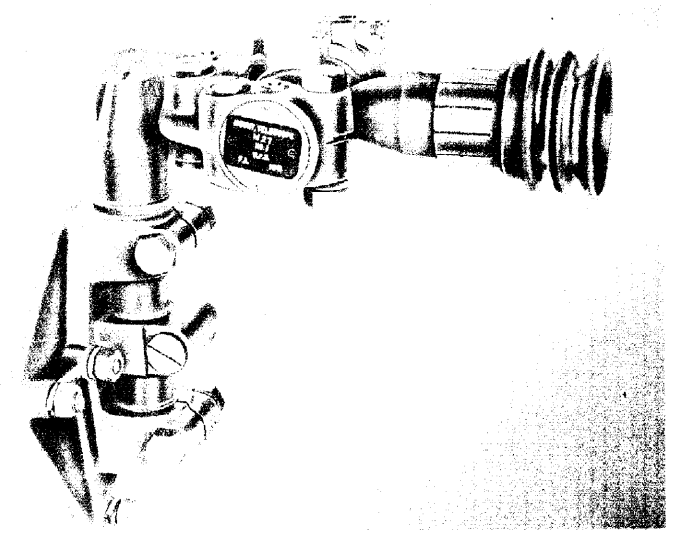

SIGHT, M6

FIRE CONTROL
ANTI - AIRCRAFT ARTILLERY

ELBOW TELESCOPES M24A1, M25A1, M26A1—STANDARD
TELESCOPE MOUNTS M26, M27, M28, M54—STANDARD
M46, M47—SUBSTITUTE STANDARD



ELBOW TELESCOPE, M24 (M24A1 HAS LIGHTING WINDOW)



ELBOW TELESCOPE, M25, AND TELESCOPE MOUNT, M27

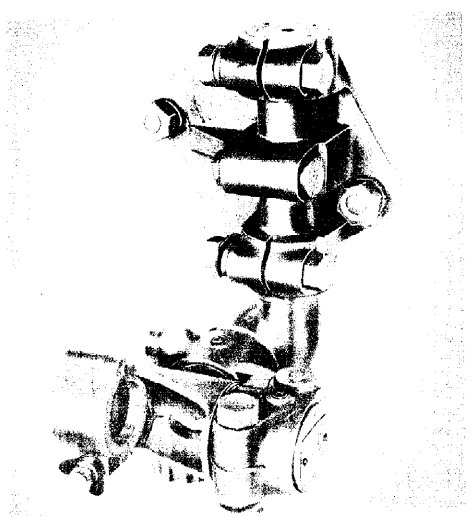
These elbow telescopes and mounts are standard on-carriage equipment for 3 inch and 90 mm antiaircraft gun carriages for direct fire sighting against mechanized land or sea targets. They are operated by the azimuth and elevation trackers of the gun crew independently of the regular antiaircraft fire control system.

Elbow Telescope	Telescope Mount	Gun Mount	Position of Instrument on Gun	Purpose
M24A1	M26	3″ AA Gun Mount, M2A2.	Left side	Azimuth
M25A1	M27	3″ AA Gun Mount, M2A2.	Right side	Elevation
M24A1	M28	90 mm AA Gun Mount, M1A1	Left side	Azimuth
M26A1	M54	90 mm AA Gun Mount, M1A1	Right side	Elevation
M24A1	M47 (S. S.)	90 mm AA Gun Mount, M3	Left side	Azimuth
M26A1	M46 (S. S.)	90 mm AA Gun Mount, M3	Right side	Elevation

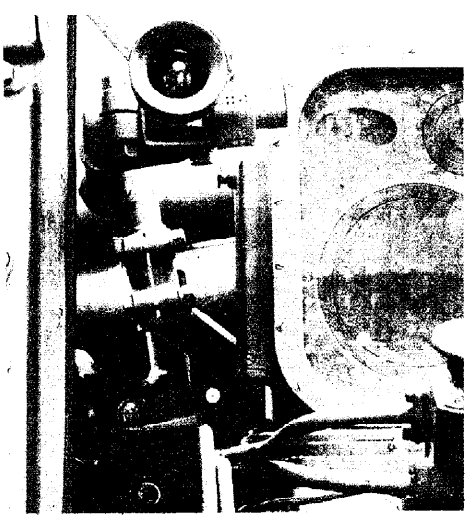
The three telescopes are identical in construction and optical characteristics, being 3-power, erect-image instruments with a field of view of 13° 20′. Their only differences are in the reticle patterns. Since the M24A1 is designed for aiming in azimuth, it has a horizontal reticle scale graduated in mils lead. The M25A1 and M26A1, being used for aiming in elevation, have reticles marked to indicate ranges in yards for specific ammunition. They have a series of horizontal range lines with the normal line on the horizontal axis of the reticle.

Each telescope has a lighting window, so that the reticle may be illuminated by means of Instrument Light, M36.

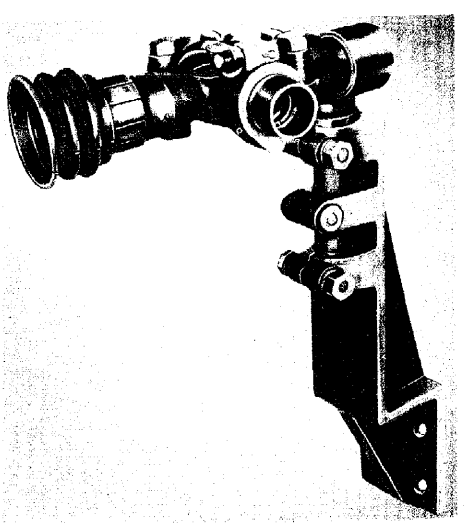
The Telescope Mounts, M26 and M28,



TELESCOPE MOUNT, M26



ELBOW TELESCOPE, M26, AND TELESCOPE MOUNT, M54, INSTALLED ON GUN CARRIAGE



ELBOW TELESCOPE, M26, AND TELESCOPE MOUNT, M46

ELBOW TELESCOPES M24A1, M25A1, M26A1

TELESCOPE MOUNTS M26, M27, M28, M54—M46, M47 (Continued)

are attached to the left side of the top carriage above the azimuth handwheels and they rotate only in azimuth with the respective guns. The mounting brackets of the two mounts are differently shaped in order to fit the mounting surfaces of the particular gun.

Telescope Mount, M27, is mounted on the right-hand side of the gun cradle in front of the right trunnion, thus rotating with the gun in elevation as well as in azimuth. It is similar to the M26 and M28 mount except that the bracket is fastened to the right side of the gun with the spindle in an inverted position and the elevation adjustment is made by screwdriver instead of by means of an elevation worm knob.

Telescope Mount, M54, is mounted on the right-hand side of the gun cradle at the rear of the elevation indicator. It performs the same functions as does the Mount, M27, but differs in constructional details so that it can be mounted on a different weapon in a different location. It supersedes the now obsolete Mount, M29, which was found to be unsatisfactory because, when the gun was elevated, the eyepiece soon went beyond the gunner's reach.

The substitute standard Telescope Mounts, M46 and M47, are similar to the standard mounts, with only such modifications as are necessary for use on different matériel.

REFERENCES—TM 9-370; TM 9-1600.

ELBOW TELESCOPE M6A1—STANDARD

TELESCOPE MOUNTS M52C, M52D—STANDARD

Elbow Telescope, M6A1, and the Telescope Mounts, M52C and M52D, comprise the azimuth sighting equipment for Case II pointing of the guns of a fixed anti-motor-torpedo-boat battery, consisting of four 90 mm Guns, M1, two on Mounts, M1A1, and two on Mounts, M3.

ELBOW TELESCOPE, M6A1—This is an 8-power instrument with a field of view of 8° 45′. The reticle pattern consists of a single vertical line through the center. The telescope has facilities for diopter-setting adjustments, and has clear, red, neutral, and amber filters, any one of which may be inserted in place by the turning of a filter selection knob. A socket in front of the eyeshield provides connection for a lamp which illuminates the reticle.

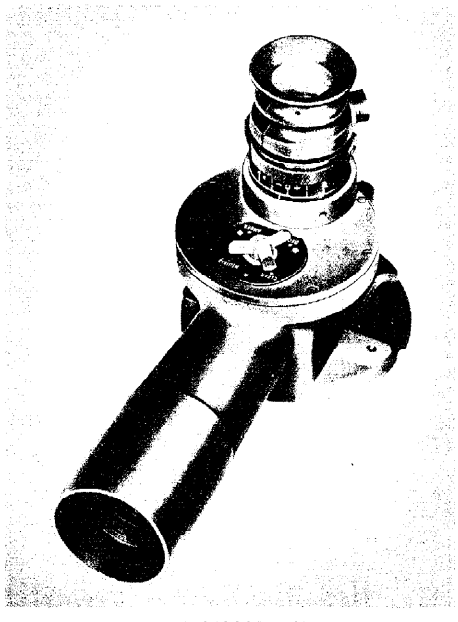
TELESCOPE MOUNTS, M52C AND M52D—Telescope Mount, M52C, is used on each of the two 90 mm Gun Mounts, M3, and Telescope Mount, M52D, is used on each of the two 90 mm Gun Mounts, M1A1. The mounts are identical except in having slightly different types of braces to fit the mounting surface of different matériel.

The mount is fastened to the left side of the gun carriage so that telescope and mount move with the weapon in traverse. The telescope is secured to the upper part of the mount which can be moved to the left and right for a setting of plus or minus 7° deflection with 10° as normal. Deflections are set in by turning a micrometer knob, which is located opposite the micrometer drum on the worm gear. The deflection scale is graduated in degrees, from 3° to 17°, and the micrometer drum in hundredths of a degree. A knob in front of the micrometer knob is provided for moving the telescope in elevation, independently of the movement of the gun, thus permitting the making of adjustments.

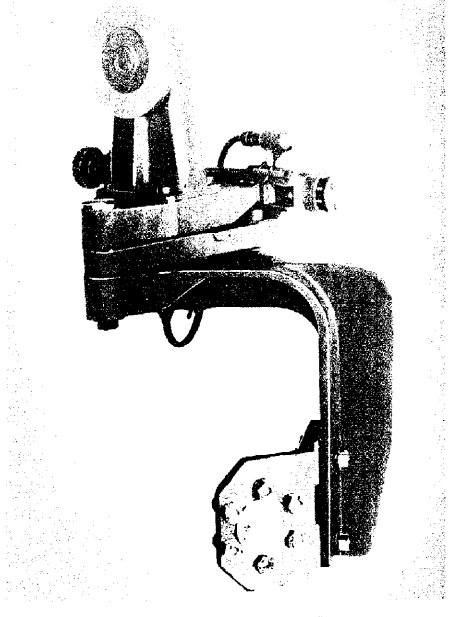
Indexes are provided on the deflection scale and the micrometer drum. By movement of these indexes, the instrument can be aligned correctly.

Illumination of the telescope reticle and the deflection scale and micrometer drum is provided by means of a 6–8 volt source brought to the mount from the trouble light outlet on the gun junction box.

To insure that the mount holds the telescope firmly in place when the gun is fired, two braces have been installed. One attaches the pivot point of the telescope mount to the azimuth indicator bracket and the other connects the left rear bolt of the telescope mount to the gun junction box.

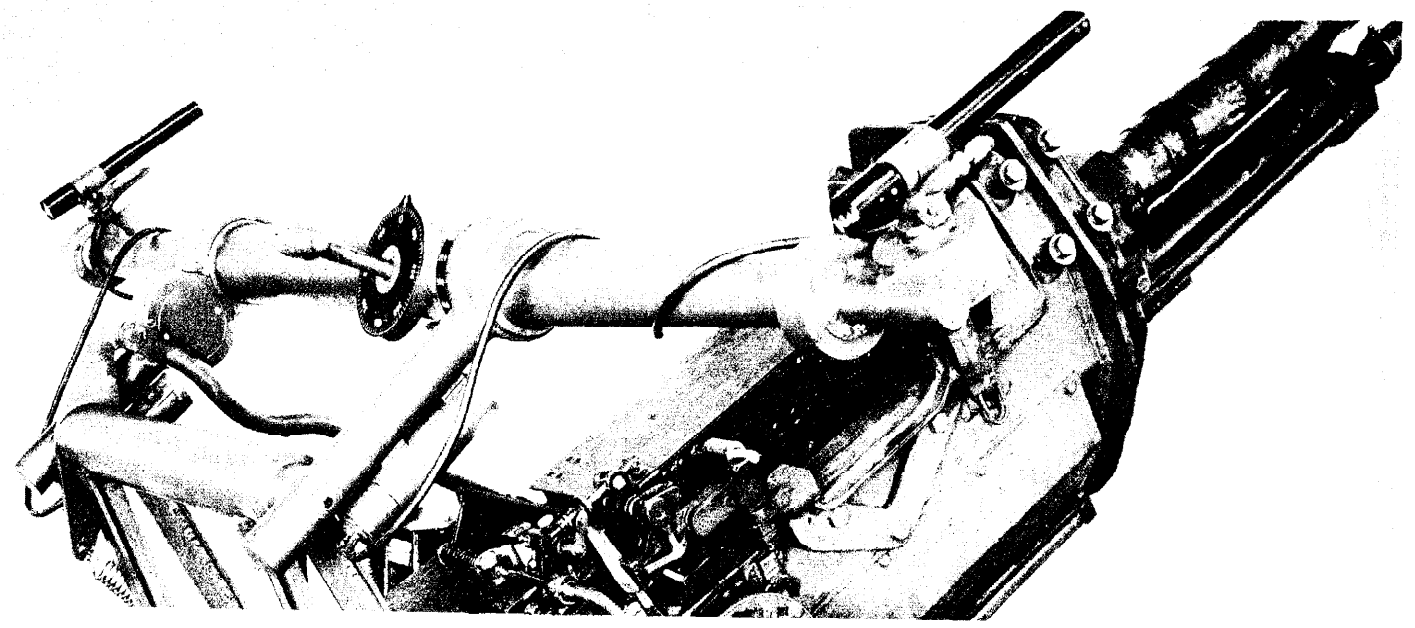


ELBOW TELESCOPE, M6A1



TELESCOPE MOUNT, M52—WITHOUT BRACES

SIGHTING SYSTEMS M5, M6, M7—STANDARD



SIGHTING SYSTEM, M5, ON 37 mm CARRIAGE, M3A1

These sighting systems are mounted on antiaircraft gun carriages to provide for direct sighting of the guns against ground or naval targets or against aerial targets under emergency conditions when the remote control system is not in operation.

SIGHTING SYSTEM, M5—This sighting system is mounted on the 37 mm Antiaircraft Gun Carriage, M3A1. Formerly it was also used with the 37 mm gun on Combination Gun Motor Carriage, M15A1, but the M5 is now obsolete for this installation, having been superseded by Computing Sight, M14. It consists of two 1-power telescopes, the necessary supports, and lighting equipment for illumination of the telescope reticles.

Telescope, M7, mounted on the left side of the carriage, is used for tracking in azimuth, and Telescope, M64, mounted on the right side, is used for tracking in elevation. Each telescope is attached to the top carriage and the cradle so that it moves with the gun in both azimuth and elevation.

The telescopes are identical except for reticle pattern. The M7 has a continuous vertical line and a horizontal crossline broken at the center. The operator of the azimuth handwheel keeps the vertical line on the target.

Telescope, M64, has a broken vertical line and a continuous horizontal line which must be kept constantly on the aerial target. Below the horizontal line are four horizontal range lines for use in sighting land or naval targets.

Ring sights are used as auxiliary sights when the telescopes are not in working order due to fogging of the lenses or clogging of the telescope with sand or dirt. When the mount is rocked by recoil, the target is often kept in view more easily through use of the ring sights.

The azimuth ring sight is clamped over Telescope, M7. It consists of a rear element in the form of an aperture $\frac{3}{8}$ inch in diameter, and a front element made up of a large ring 2 inches in diameter with a wire on its vertical diameter.

The elevation ring sight is used on Telescope, M64, for emergency tracking in elevation. It differs from the azimuth sight only in that the crosswire of the front sight is on the horizontal diameter.

The vertical and lateral deflection dials serve to move the telescopes to account for deflections. Both lateral and vertical deflections are set in by moving the same knob. The deflection knob is rotated for setting lateral deflections and is elevated or depressed for setting in vertical deflections. A lateral and a vertical deflection scale indicate the amount of deflections set in. Each scale can indicate 400 mils deflection in either direction.

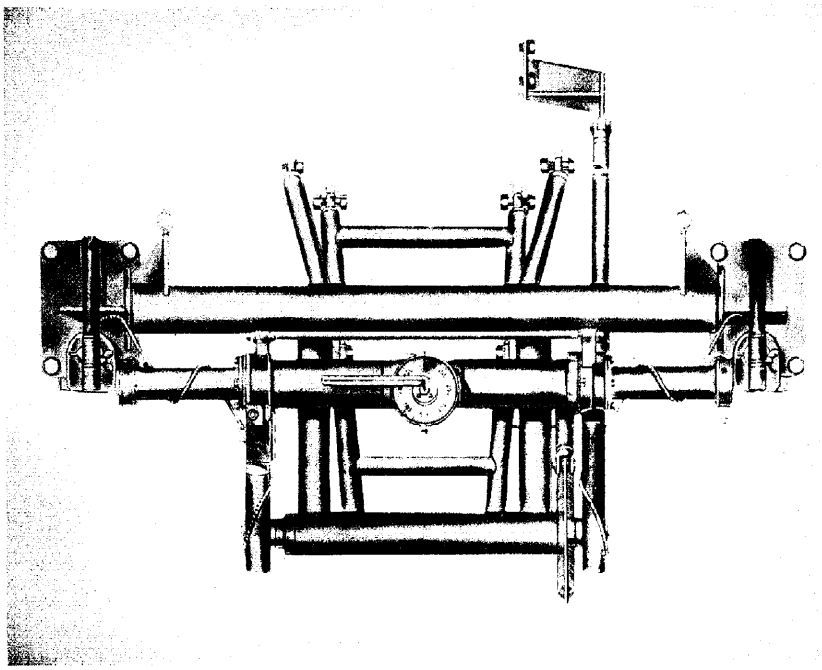
SIGHTING SYSTEM, M6—This is a redesign of Sighting System, M5, to fit the top carriage used on the Multiple Gun Motor Carriage, M15. It consists of the same telescopes—M7 and M64, with the ring sights, vertical and lateral deflection mechanisms operated similarly by rotating or elevating and depressing a single lever, lighting equipment, and a slightly different mounting arrangement.

SIGHTING SYSTEM, M7—This sighting system is mounted on the 90 mm Antiaircraft Gun Carriage, M2, and is used only in direct sighting against mechanized targets. It consists of two 3-power Telescopes, M60, and the necessary supports and linkages.

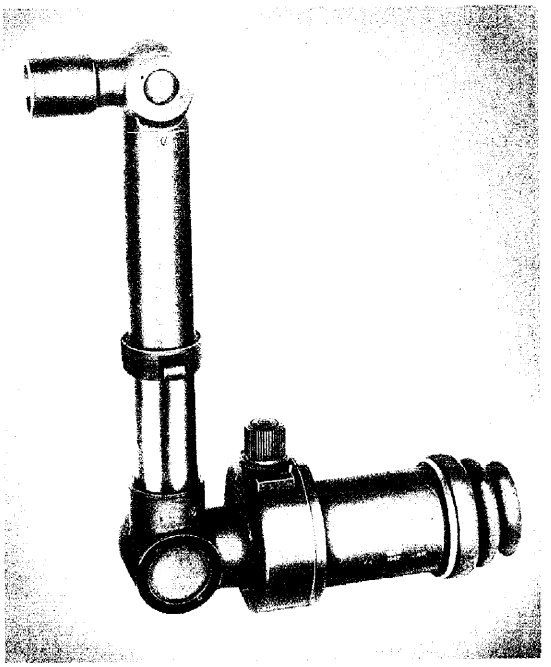
One of the telescopes is mounted on the left-hand side of the gun in front of the trunnion, and the second is similarly located on the right-hand side of the gun. The left-hand telescope is used by the azimuth tracker and the right-hand telescope is used by the elevation tracker.

Both telescopes move with the gun in traverse through 360° and in elevation and depression from −175 mils to +270 mils. When the gun has been elevated to about 15° each telescope is released from elevation linkage by means of a guide and roller mechanism. When the gun has been depressed until it has again reached an elevation of about 15°, the

SIGHTING SYSTEMS M5, M6, M7 (Continued)



SIGHTING SYSTEM, M6



TELESCOPE, M60, USED IN SIGHTING SYSTEM, M7

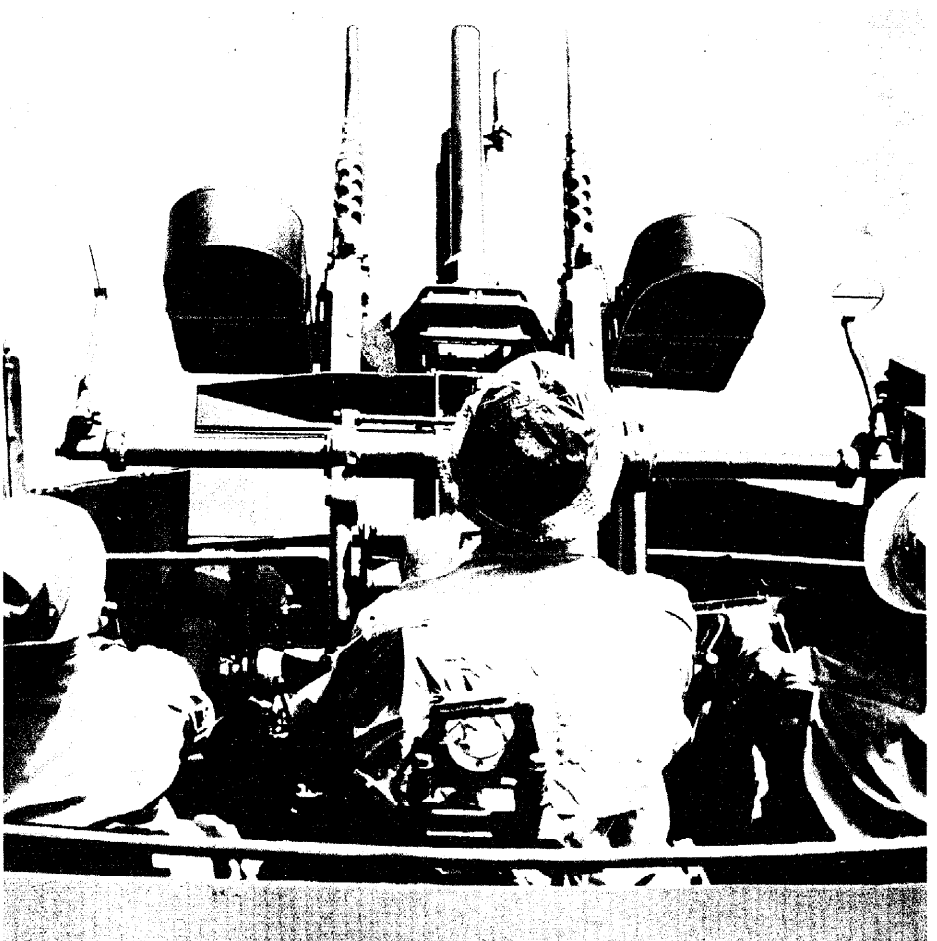
rollers are guided into the groove in the guide and the telescopes again follow the gun in elevation and depression.

Telescope, M60, which has a field of view of 13° 25′, is a periscopic-type instrument with the line of sighting about 12 inches higher than the line of viewing in order that the objective end may clear the top of the shield. The telescope is fitted with two reticles, a fixed reticle marking ranges from 0 to 3,000 yards at 500 yard-intervals, and a movable reticle marking 50 mils of deflection to the left and to the right of the center. By turning the range-setting knob, which is located in front of the eyepiece of the telescope, the deflection scale can be moved opposite the desired range graduation of the fixed reticle.

The telescope is provided with a sunshade and red, amber, and neutral filters, any one of which can be inserted into the end of the eyepiece after unscrewing the knurled eye-shield adapter.

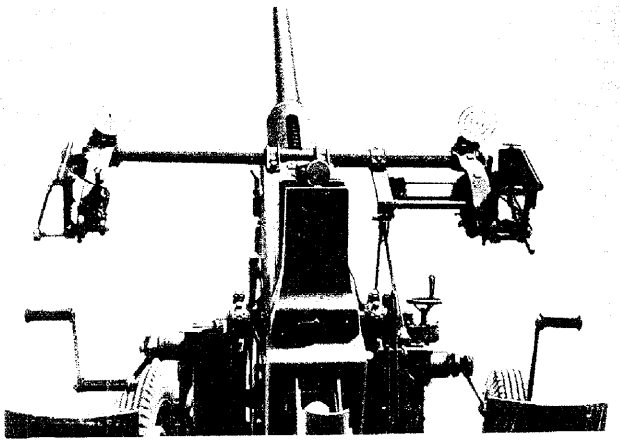
Each telescope is supported on a mount. The mounts differ only in that the azimuth mount has a elevating knob by which the line of sight of the telescope can be elevated or depressed through a limited angle.

REFERENCES—TM 9-708; Notes on Matériel—Frankford Arsenal—Sighting System, M5.

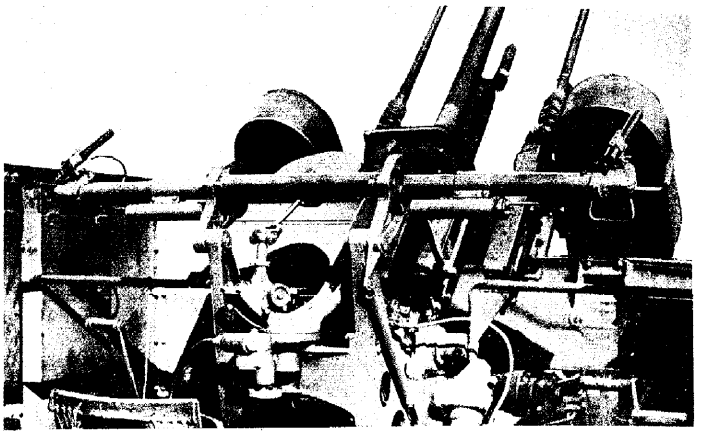


SIGHTING SYSTEM, M6, IN MULTIPLE GUN MOTOR CARRIAGE, M15

COMPUTING SIGHTS M7A2, M14—STANDARD—M7, M7A1—LIMITED STANDARD



COMPUTING SIGHT, M7, HAS BEEN MODIFIED BY THE ADDITION OF 400-MILE SPEED RINGS ON THE FORWARD AREA SIGHTS AND BY THE PROVISION OF SPEED-RING SIGHTS TO BE CLAMPED OVER THE TELESCOPES



COMPUTING SIGHT, M14, HAS BEEN MODIFIED BY THE ADDITION OF FORWARD AREA SIGHTS AND SPEED-RING SIGHTS AS ON THE M7-TYPE COMPUTING SIGHTS

These computing sights are mechanical devices for use in direct pointing of an antiaircraft gun when the director or remote control system is out of order and when it is necessary to open fire so quickly that the automatic fire control instruments cannot be set up. The instrument computes the lateral and vertical leads and displaces the tracking telescopes so that when the trackers are sighting directly on the target, leads are applied. Since the telescopes move with the gun in elevation and traverse, the gun is aimed at the predicted position of the target when the crosshairs of telescope reticles are superimposed on target.

COMPUTING SIGHT, M7A2—This computing sight consists essentially of the computing mechanism, two tracking telescopes connected by parallel linkages and mounted on a support bar, and a flexible shaft which transmits the azimuth to the computing mechanism. Provision for boresighting and dry-cell operated lighting devices for illuminating telescope reticles are also a part of this sight.

The computing mechanism, which is located on the azimuth side of the gun, contains mechanisms by which the direction and the speed of the target are set in. Direction is set in by an arrow which is rotated until it is parallel to the target course and points in the same direction as the target. Speed is set in by turning a handwheel on the computing mechanism. Both of these movements are transmitted to the sights in the form of deflections by means of a linkage. Elevation effect on superelevation is automatically applied by means of another shaft which, as the telescope is elevated or depressed, displaces the telescope in superelevation to the proper degree.

Since the settings in the computing mechanism are based on estimates, they may not be correct as first applied. Adjustment of the estimates is made by the observation of tracers. The direction-of-course setting is adjusted so that tracers pass through the projected course. Speed setting is adjusted so that tracers pass through the target.

The azimuth-tracking telescope, mounted on the right-hand side of the gun, and the elevation-tracking telescope, mounted on the left-hand side of the gun, are identical. They are designated M7 and each contains a crosshair reticle. Formerly Telescope, M7, was used only for azimuth tracking and the M74 was supplied for elevation tracking. The M74 was identical to the M7, except for reticle pattern. In addition to the crosshairs for the tracking of aerial targets, the reticle of Telescope, M74, had horizontal range lines covering ranges up to 1,700 yards. This part of the reticle was used only when the weapon was employed as an antitank gun. In such cases, the telescopes of the computing sights were used without the computing mechanism. Since these range lines were very confusing to aerial trackers, Telescope, M74, was made obsolete and replaced by the M7.

There are circumstances in which Telescopes, M7, do not perform satisfactorily. It has recently been required that the ring sights used in Sighting Systems, M5 and M6, be provided for emergency use on Computing Sights, M7, M7A1, M7A2, and M14. One is clamped to the crossbar adjacent to the azimuth tracking telescope and the other to the crossbar adjacent to elevation tracking telescope.

In addition to the basic elements of Computing Sight, M7, two additional devices are mounted on each side of the gun to provide optional methods for pointing the gun when the straight telescope cannot be used. A collimator type of sight is mounted on each straight telescope. For use when the computing sight is inoperative, removable forward area sights are also provided.

The rear element is a small aperture, and the forward element is a cartwheel type of sight with concentric speed rings for 100, 200, 300, and 400 miles per hour. Between the 100 miles-per-hour and the 400 miles-per-hour speed rings are twelve radial clock hour wires. Within the 100-mile speed ring are horizontal and vertical crosswires only. The vertical crosswire has notches applicable to anti-mechanized targets crossing at a range of 500 yards and at 20 miles per hour.

COMPUTING SIGHT, M7A1—This is a less satisfactory instrument than the M7A2. While the M7A2 has an improved gear box, using a differential, and resulting in the course arrow control handwheel remaining stationary, the M7A1 has a gear box with a slip clutch. Thus the handwheel rotates while the gun mount is traversed. With the M7A1, it is more difficult to adjust the course arrow, and the settings are less accurate.

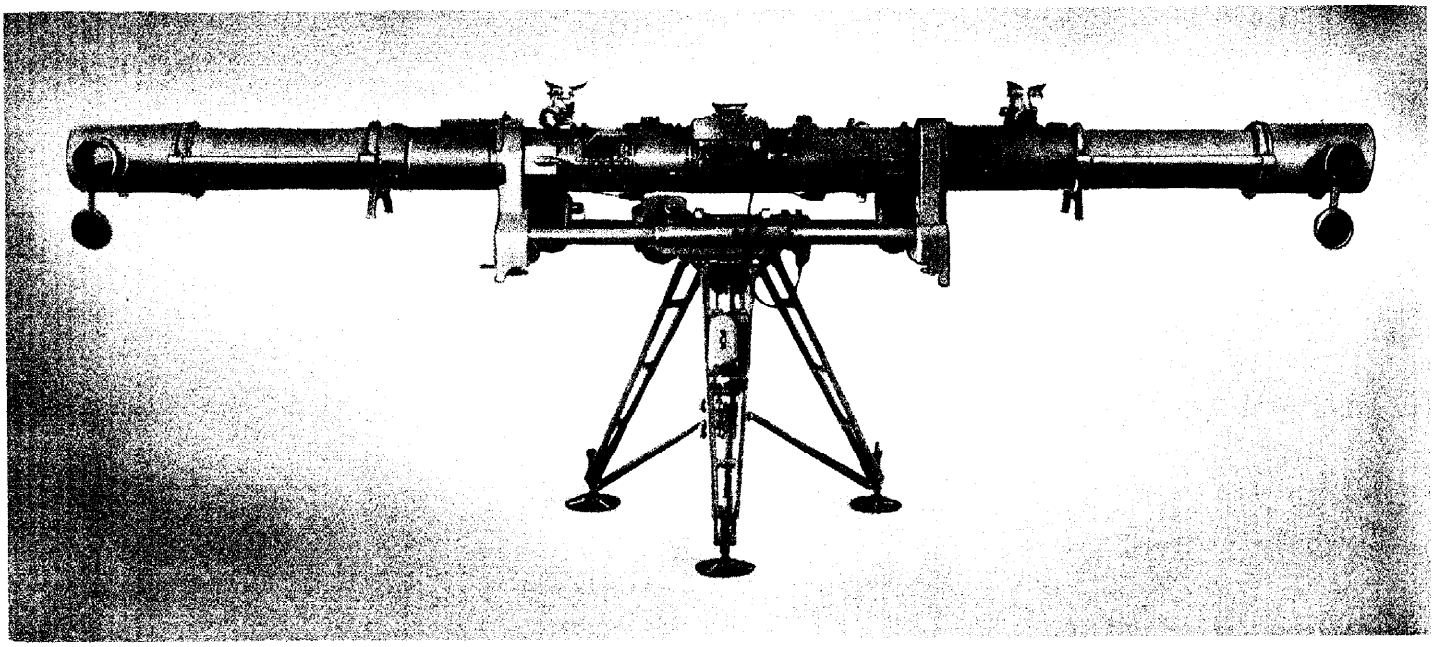
COMPUTING SIGHT, M7—This is an older version of the M7A1. It has a smaller course handwheel and the linkage used to keep the axis of the course arrow vertical is in a different position.

COMPUTING SIGHT, M14 (T55)—This computing sight is standard for use on Multiple Gun Motor Carriage, M15A1, which mounts a 37 mm antiaircraft gun and two cal. .50 machine guns. It performs the same functions as the M7-type computing sights, but has a different type of computing mechanism. The latter is located below the center part of the mounting bracket.

This instrument is also Standard for use with Combination Gun Mount, M54C. The latter is a modification of Combination Gun Mount M54, which is a component of Combination Gun Motor Carriage, M15A1. Combination Gun Mount, M54C, is mounted on railway cars for protection of railway equipment.

REFERENCES—Frankford Arsenal Notes on Matériel, FCDD-55, Computing Sight, T55.

HEIGHT FINDERS M1A2—STANDARD—M1, M2—LIMITED STANDARD

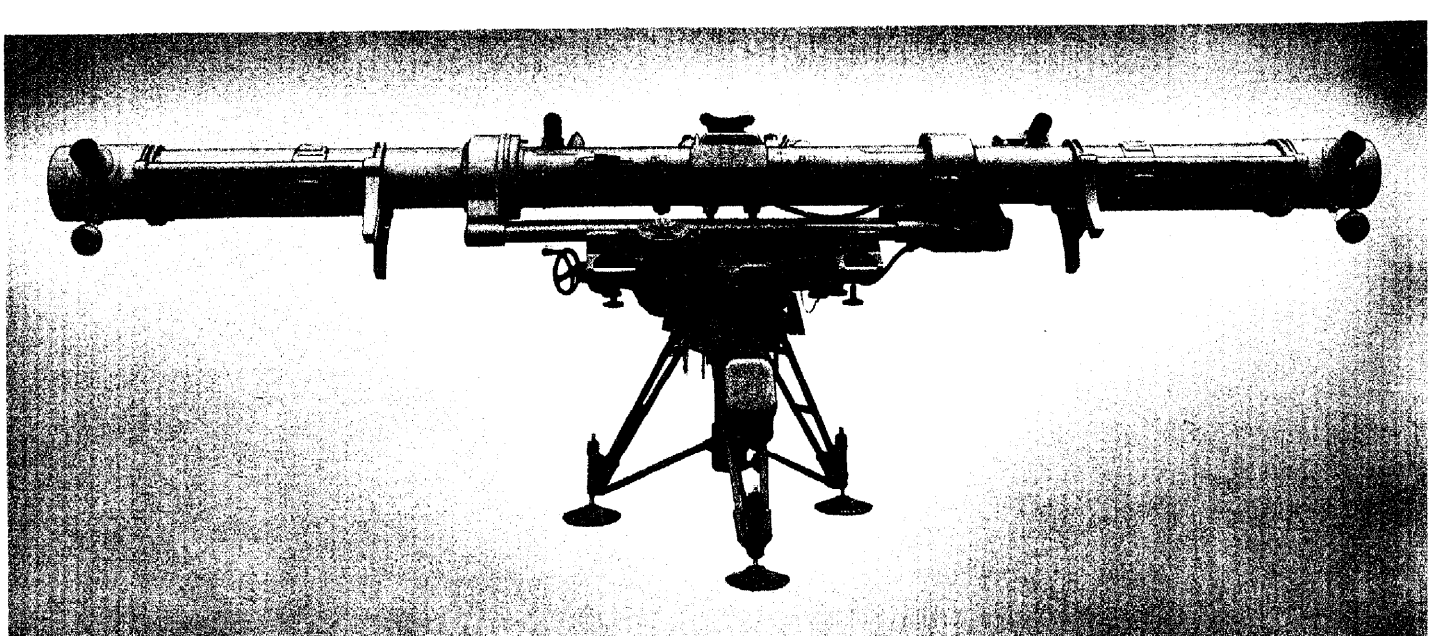


HEIGHT FINDER, M1

A height finder is primarily used to determine the slant range or the altitude of enemy airplanes, and to transmit the resulting data to the director. The instrument may also be used for the spotting of antiaircraft fire. Recently the standard height finder also has been adopted as the standard range finder for use in seacoast artillery batteries. The complete instrument includes the height finder proper, the cradle, and the tripod. Metal carrying cases are provided for each of these components.

The height finder is fundamentally a 13½ foot stereoscopic range finder which converts the slant range to altitude. By means of measuring wedges, the image of the target is moved in space until it appears to have the same stereoscopic relief as the reticle in the instrument. The amount of movement of the wedges necessary to produce this result is related to the range, and range may be read directly from a properly calibrated scale.

The height finder proper consists of two telescopic systems, one for each eye. Each telescope has an objective, erecting lenses, reticle, eyepiece, and other optical components. By changing the position of the erecting lenses, the magnification can be changed from 12 power to 24 power. Diopter settings and interpupillary distance of the eyepiece are adjustable, and



HEIGHT FINDER, M2

various filters are provided for use against haze, glare and camouflaged targets. An internal adjustment mechanism provides an artificial target at a known range against which the instrument may be calibrated.

The objectives, reticles, and erecting lenses are mounted in a rigid tube known as the optical tube. This tube, the measuring wedges, internal adjuster mechanism, and end reflectors are mounted in and protected by a double-walled body tube.

The wedge mechanism for determining range or altitude is contained in the right-hand telescope system. The measuring scale is calibrated from 550 to 50,000 yards, and indicates either range or height according to the position of the range-height lever.

The outer tube is covered with a layer of heat-insulating material and a layer of canvas, to minimize temperature changes. The instrument is tightly sealed and filled with dry helium at approximately 1 pound per square inch pressure, to reduce errors due to unequal heating of the various parts. Since helium has a low index of refraction, its use reduces stratification.

Mounted on the outer tube are two 8-power Elbow Telescopes, M7, one used for tracking the target in azimuth, the other for tracking in elevation.

CRADLE—The cradle supports the height finder proper and contains the mechanisms by which the instrument may be elevated and traversed. On it are mounted the mechanisms for receiving and transmitting azimuth, altitude or height, and elevation data.

Various electrical units are contained in the cradle for power supply, data transmission, and illumination of reticles, scales, and the internal adjustment mechanism.

Level vials are provided on the cradle for leveling the instrument.

TRIPOD—The tripod serves as a firm support for the cradle and the height finder. Leveling is performed by independent adjustment of each tripod leg.

EQUIPMENT—A cylindrical metal carrying case is provided for the height finder proper and includes a shock-proof carriage which facilitates sliding the height finder proper in or out. Both the cradle and tripod have individual packing cases. Spare parts and tools are kept in the cradle and tripod cases.

The instrument is also provided with an electrically heated cover to permit operation at very low temperature, and to maintain an even overall temperature. A canvas sunshade, covering the height finder proper, is provided to keep the instrument from becoming uneven in temperature.

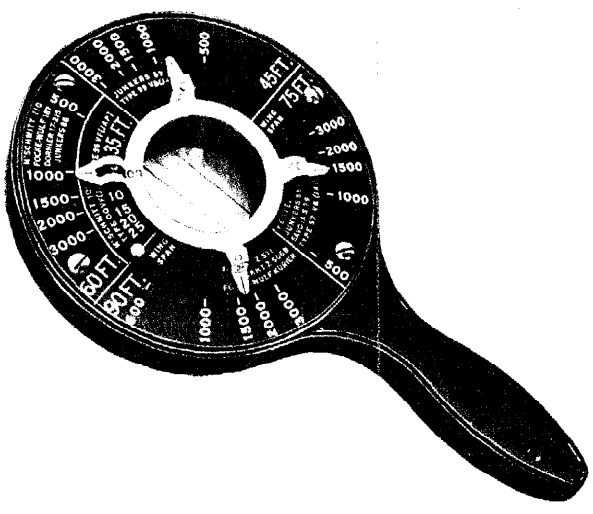
Among other equipment provided with each height finder are end-window diaphragms with slot openings. The use of these diaphragms decreases the number of rays of light entering the instrument and intersecting the reticle plane at different points. Thus the possibility of blurring the target image is lessened and the accuracy of the observer's readings is increased.

HEIGHT FINDER, M1A2—STANDARD—This instrument, is the Height Finder, M1, with a number of modifications designed chiefly for improving the optical parts of the height finder, for strengthening the mechanical construction of the instrument, and for facilitating the operation, adjustment, and transport of the height finder.

HEIGHT FINDER, M1 AND M2—LIMITED STANDARD—All of the height finders which have been procured are either the M1 or M2. The Height Finder, M2 operates on the same principles as the M1, but differs in construction, and weighs 200 pounds more than the M1.

REFERENCES—FM 4-110; TM 9-1623; TM 9-2005 v. 6; TM 9-2623.

RANGE INDICATOR MK. 1—STANDARD



RANGE INDICATOR, MK. 1

Range Indicator, Mk. I, is a simply constructed, but accurate, nonoptical, stadia-type range finder, used to measure quickly the slant range to various enemy aircraft. The instrument has the appearance of a small hand-mirror with a two-inch circular opening in the center. The wide rim is divided into quadrants which are marked off in ranges for designated airplanes with wing spans of 45 feet, 60 feet, 75 feet, and 90 feet respectively. Through the center opening are seen two parallel wires. One is fixed along the diameter of the circle. The position of the second parallel wire may be changed by revolving a narrow circular rim around the edge of the opening. A clockwise movement of the rim serves to shorten the distance between the two parallel wires and a counter-clockwise movement spreads them farther apart.

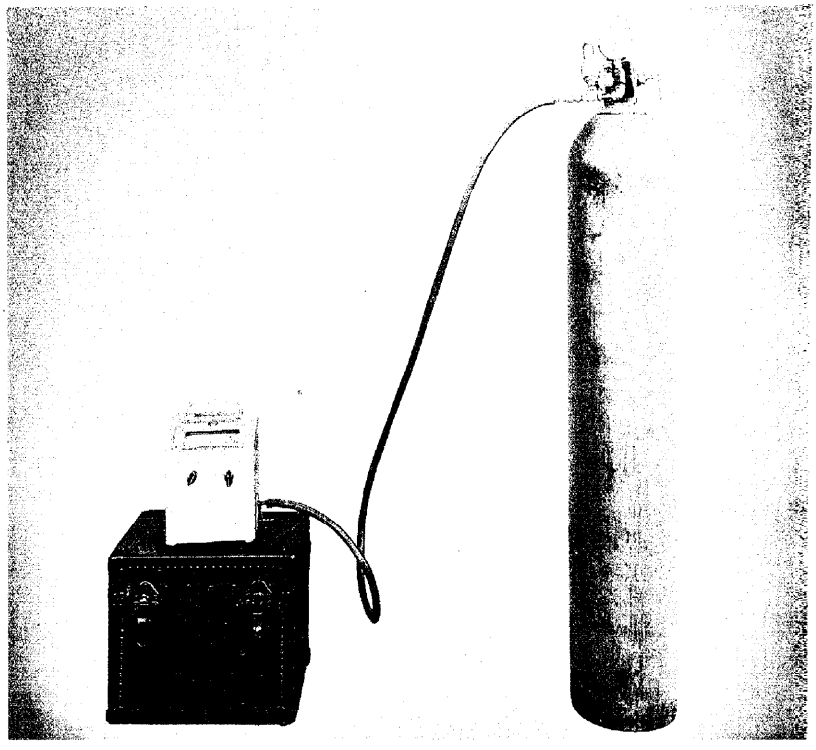
The indicator is suspended around the observer's neck by a lanyard which insures that the instrument is 24 inches from his eyes when held outward and stretched tightly. The wires are adjusted to indicate the maximum range of the gun and ammunition used, and the type of airplane observed. When the wing span of the airplane can be measured between the wires, the gunner may open fire.

HELIUM FILLING KITS M6A1, M8—STANDARD

These kits contain material and equipment necessary for charging a height finder with helium and for checking the purity of the helium filling.

HELIUM FILLING KIT, M6A1—This kit is standard for use by Ordnance personnel. It consists of a helium purity indicator (katharometer), a helium pressure regulator, 3 brass connectors, two 6-foot lengths of 5/16-inch rubber hose, a small screwdriver, a wrench, and printed instructions.

HELIUM FILLING KIT, M8—This kit is used only in filling the height finder and not for checking the helium purity. It is standard for use by antiaircraft personnel who check on the degree of purity of helium by a method not requiring a katharometer. The M8 differs from the M6A1 only in the fact that the helium purity indicator has been eliminated.



HELIUM FILLING KIT, M6A1, SET UP FOR CALIBRATION

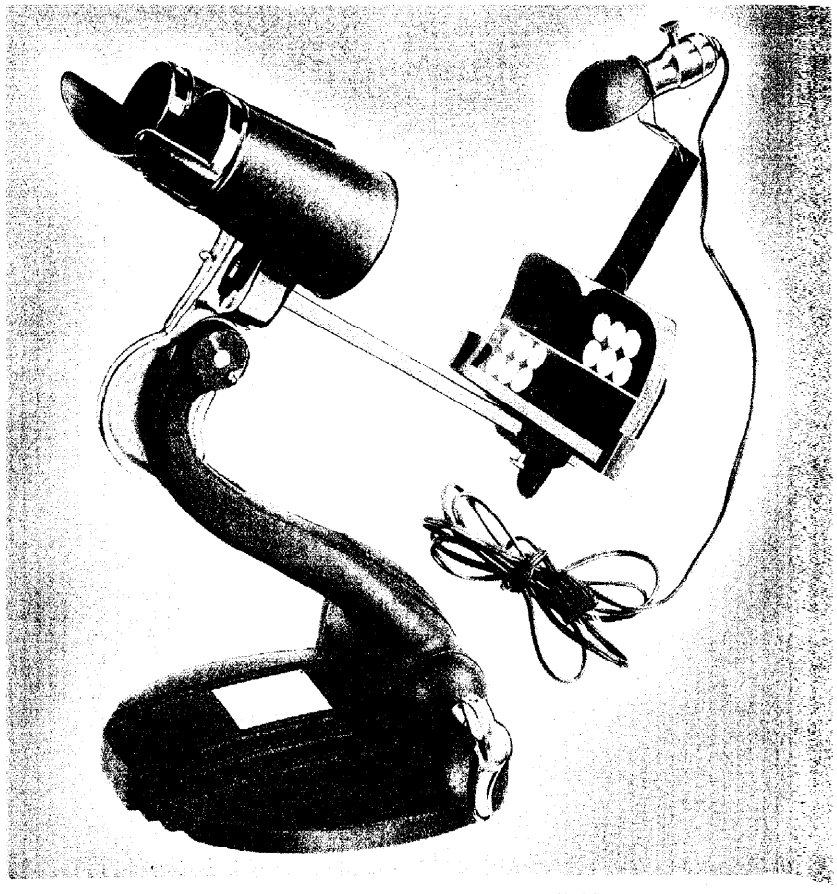
STEREOSCOPIC TESTER M1A1—STANDARD

This instrument is used to test and train stereoscopic vision. Through its use it is possible to determine whether a man's stereoscopic vision is satisfactory enough to fit him for work as a stereoscopic range- or height-finder operator or a spotter. It is also useful for strengthening and exercising the eyes.

The stereoscopic tester is a table model stereoscope with a calibrated shaft, a slide holder and slides with an electric lighting arrangement. There are two series of slides, the first of which, known as the D.B. series, provides a means for testing visual acuity, muscular balance, astigmatism, fusion, color blindness and, to a certain extent, stereo-acuity. The second series of slides, the D.C. series, is usually given only to those who successfully pass the first tests. This series is used for the testing and training of stereo-acuity. The results are measured in percentage of stereopsis.

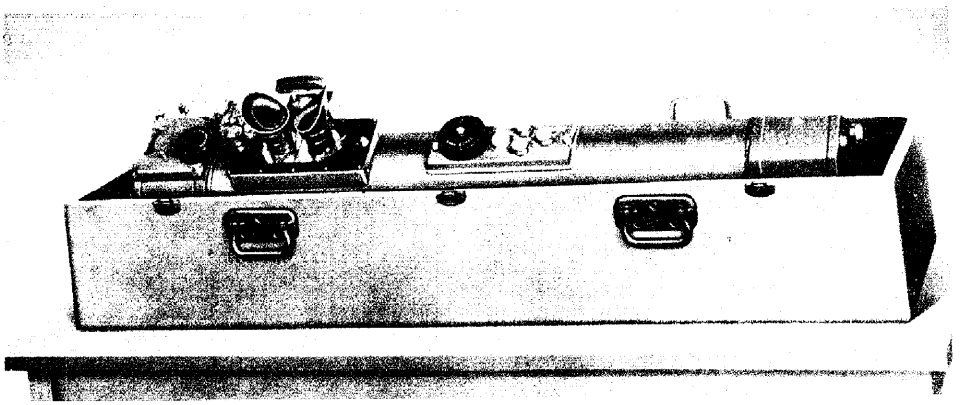
In addition, there is a target slide which demonstrates and tests the making of stereoscopic contact for practice in using stereoscopic range and height finders. It is provided with a reticle which has an image of an airplane, and a slide with a similar image. By turning a knob, the two images can be made to fuse in depth to indicate comparative accuracy of stereoscopic vision.

REFERENCES—TM 9-2005, v. 5; TM 9-2653.



STEREOSCOPIC TESTER, M1A1, WITH SLIDE

STEREOSCOPIC TRAINER M7—STANDARD



STEREOSCOPIC TRAINER, M7

The stereoscopic trainer is an instrument designed principally for training operators of stereoscopic height and range finders in making stereoscopic contact. It can also be used in training operators of coincidence type range finders in bringing target images into coincidence. In addition, the instrument is a valuable means of exercising the eyes and testing vision.

The trainer is a table model stereoscope, of cylindrical shape, with dimensions similar to those of the central portion of the standard height finder. In use, the trainer, in the lower part of its carrying case, is placed on a sturdy table heavy enough to bear its weight, which is more than 100 pounds.

Stereoscopic Trainer, M7, requires two operators—an instructor and a student. The instructor stands at the left-hand end of the trainer and all the parts of the instrument which he must operate are on that end. There is a target turret knob, which is turned to select any one of four target images. A reticle turret knob is used to select either of two reticle patterns or a semihalf-wave plate. The first reticle pattern simulates the standard height finder reticle pattern when viewed at 12× magnification. The second is the same pattern as it appears at 24× magnification. The third choice is a circular plate which covers one half of the image field with a semihalf-wave plate permitting the use of the trainer in split field coincidence training. The instructor can also make use of an elevation and an azimuth tracking cam knob. Either of these may be used in any one of two positions. The first causes the target to move in a steady course. The second simulates lateral movement from the steady course, thus making it necessary for the operator to compensate for errors made by the elevation tracker as often occur in height finder operation. Cams in the interior of the trainer are the mechanisms by which this effect is produced. It is impossible to compensate for azimuth tracking errors, but this gives the student practice in meeting the situations encountered in the use of a height finder.

The student stands at right angles to the operator, and all parts used by him are on the upper surface of the trainer. The knobs and dials used by the student are arranged, spaced, and shaped so that the operation of the trainer is exactly the same as that of the height finder. Toward the left is a binocular eyepiece. Adjustments may be made for interpupillary settings and diopter settings. There is a head rest which has a means for turning on the reticle lamp. On the central control panel, located to the right of the student, is a range knob by which the operator can control the depth position of the target. He aims to keep the target at the same apparent intensity as that of the central line of reticle markings.

When the instrument is used to give coincidence training, the range knob is turned to bring the two target images of the two split half-target images into coincidence. The double-target images are secured when the student turns the polarizing filter levers half way between the ortho-stereoscopic position and the pseudo-stereoscopic position. The split target images are secured by use of the semihalf-wave plate and by correct adjustment of the polaroid filters.

Also mounted on the central control panel are the reticle lamp socket, the knob which controls the illumination of the reticle when a slide is used, which simulates night conditions, and the internal adjuster which is used in making zero adjustments.

To the left of the student, just as in a standard height finder, is an elevation knob. The student turns this knob when necessary to keep the target behind the central line of reticle markings.

The accuracy of the student's operation and his ability to retain stereoscopic contact with the target are recorded automatically by a pencil held over a roll of recording paper which, when set to operate, unrolls for a 100-second period. If the student wishes to note particularly his achievement at a given moment he makes use of the pencil lifter. At this point, a white space is left on the paper.

The simulation of the conditions of binocular vision, as well as the resultant attainment of stereoscopic contact and coincidence of two separate images, is brought about by the optical components of the trainer. In front of the target slide is a fixed Wollaston prism which separates the beam of light from the target image into two components, representing respectively the image as seen by the left eye and the image as seen by the right eye. These images are polarized at right angles to each other. By means of a beam splitter, the component representing the image seen in the left eye is directed into the left telescope and that representing the image seen by the right eye is directed into the right telescope. Because of the action of the polaroid filters, however, the eye appears to see only one target image.

The displacement and convergence of the two images are controlled by means of the range knob which moves longitudinally the second Wollaston prism which is located just after the reticle. This movement causes an apparent movement in depth of the stereoscopically fused image. If the images are superimposed in the plane of the reticle, the target appears to be at the same distance as the reticle. If the left eye image is at the left of the right eye image, the target appears behind the reticle. If the left eye image is at the right of the image it appears in front of the reticle.

The semihalf-wave plate, which is used to provide training in operation of coincidence range finders, consists of a half-wave plate over one half of the image field. It serves to retard the light entering that half of the field so that its plane of polarization is rotated through 90°. When both polarizing filters are in the same position there will be two slightly displaced images of the target. In the upper field, they will be pseudo-stereoscopic, with the image seen by the right eye appearing to the left of that seen by the left eye. Turning the range knob makes the one image appear in front of, behind, or in stereoscopic contact with the other image.

For split-field coincidence type images, the polarizing filter levers are turned to opposing positions. Then there is a split image which can be brought into coincidence by turning the range knob.

REFERENCE—TM 9-654.

MECHANICAL ANTIAIRCRAFT DIRECTORS

These antiaircraft directors compute mechanically and continuously the firing data for the indirect fire of antiaircraft guns. In the case of earlier directors, a data transmission system was used for sending these data automatically to one or more guns from transmitters within the directors. The data were then applied to the guns by manually controlled "match the pointer" indicators. With the most modern directors, the data are applied automatically to the gun by means of a remote control system which has its own cable system for transmitting the elevations and azimuths. Power for the operation of these instruments is secured from a generating unit, located in the vicinity.

The director is enclosed in a metal case, supported at convenient operating height by a tripod. In the interior of the instrument are various interconnected cams, gears, differentials, and other mechanisms, carefully constructed and positioned to represent, calculate, and solve accurately mathematical functions and relationships. By means of these mechanisms known data relating to the present position of the target, such as azimuth, elevation, and range or height are converted mechanically to future position data, representing the position of the target at the instant of shell burst or impact. Thus the correct firing azimuth and quadrant elevation for the gun are determined. For weapons using time fuzes, a fuze time is also calculated and transmitted to the fuze setter.

The operation of the different models of directors is based on various principles of triangulation, the more common being the angular travel method and the plan prediction method. In the first method the rate of travel of the target is derived from the changing angular position of the target. In the second, rates are established along three axes, two at right angles to each other in the horizontal plane.

The present azimuth and the present angular height of the target are introduced into the machine automatically by means of mechanisms geared to tracking telescopes which are kept directed at the target.

In most directors, including the M7 type, the altitude of the target is sent electrically from the height finder. The M5 type, however, is not connected with a height finder. The operator estimates the range, or, as with the Director, M5A2, determines it by means of a special range finder. He sets the range in the director by means of handwheels at the rear of the instrument. Corrections are made by observation of the tracer stream. Except on the M5 series, other handwheels are used for introducing ballistic corrections, spot corrections and parallax corrections.

At present a number of different models of mechanical directors are in use, but only the M5A2 is standard. The older models are considered here, however, because many of them are in general use and because the M7 type director is a modification of many of the older models.

The various models differ in principle of operation, in the number and type of corrections applied, and in the limits of operation. By limits is meant that each model is usually able to register and handle only such data as will be encountered in normal operation of the weapon with which it is used. In addition, some directors work on the assumption that the altitude of the plane is constant. Others can apply corrections to account for gliding or diving targets.

DIRECTOR, M1—LIMITED STANDARD—This director was made in England by Vickers Armstrong, Ltd. It is used with 3″ antiaircraft guns, fixed or mobile. Data are transmitted by a D.C. step-by-step transmission system which is not self-synchronous. The instrument operates on the angular travel system and can apply only constant altitudes. Unlike the later models, many of its computations are solved by matching pointers to curves of charts mounted on drums. The director and tripod weigh 250 pounds and six operators are required.

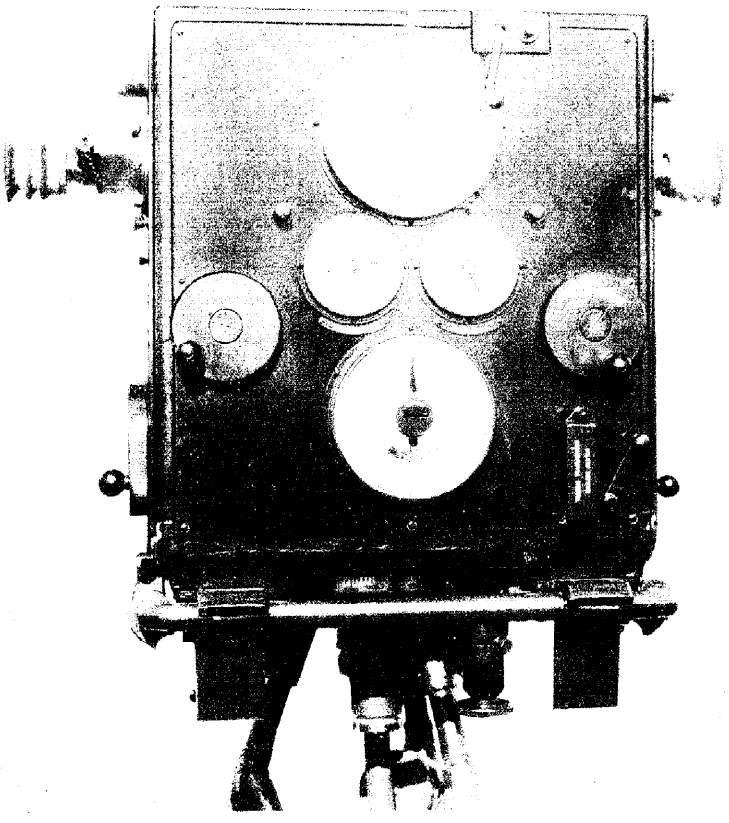
DIRECTOR, M1A1—LIMITED STANDARD—This is the M1 modified to make use of an American data transmission system, the M2. It is larger than the M1, having a total weight of 811 pounds. It is now under further modification for use with the Data Transmission System, M3 or M4.

DIRECTOR, M2—LIMITED STANDARD—This is the first American-made director, being manufactured by Sperry Gyroscope Company. It is used with 3″ fixed or mobile guns and with the M2A1 or M2A2 data transmission system. It is a very complicated and exact instrument, making corrections for wind, drift and time of flight. It is so heavy that it can be transported only on a large trailer, on which it is mounted for operation. The plan prediction method is used, and only constant altitudes are applied. Eight to 12 operators are required.

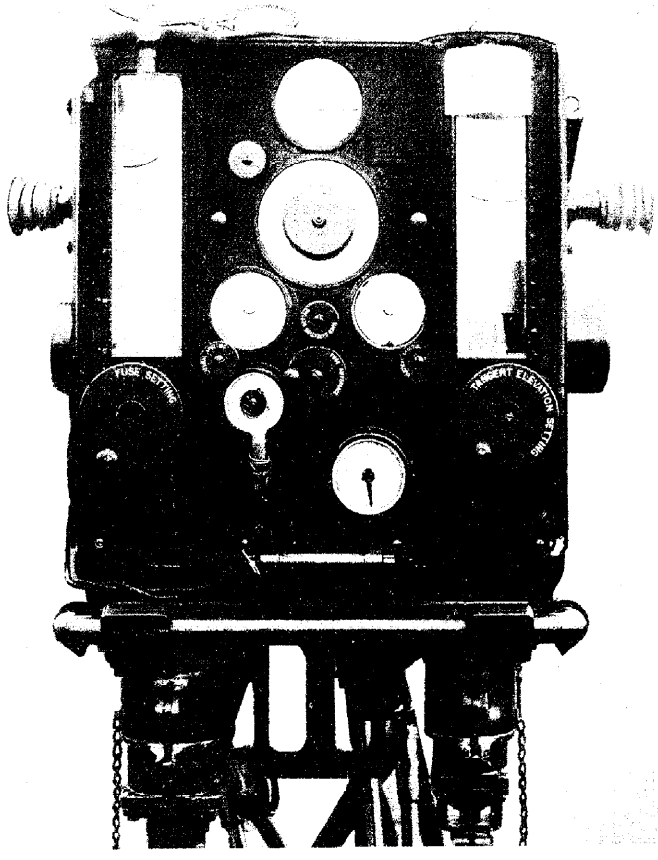
ELBOW TELESCOPES FOR DIRECTORS

Director	Tracking Telescope	Power	Field of View	Reticle	Spotting Telescope	Power	Field of View	Reticle
M2, M3, M3A1	M2	8 X	8° 45′	Plain crosshairs	M1A1	4.2 X	11° 10″	Mils crosshairs
M4 series	M6	8 X	8° 45′	Single hair	M1A1	4.2 X	11° 10″	Mils crosshairs
M5 series	M17 (to be replaced by M75C)	8 X	6°	Interrupted crosshairs	None			
	M58 (parallel procurement with M17)	8 X	6°	Interrupted crosshairs				
	M75C (Standard)	8 X	6°	Crosshair with azimuth scale in mils.				
M7 series	M17 (Standard)	8 X	6°	Interrupted crosshairs	M1A1	4.2 X	11° 10″	Mils crosshairs
	M58 (parallel procurement with M17)	8 X	6°	Interrupted crosshairs				

MECHANICAL ANTIAIRCRAFT DIRECTOR (Continued)



DIRECTOR, M1



DIRECTOR, M1A1

DIRECTOR, T8E3—LIMITED STANDARD—This is a forerunner of the Director, M3, and is designed for use with the Data Transmission System, T8E3. Like all early directors it is used only with 3″ antiaircraft guns. It weighs about 650 pounds.

DIRECTOR, M3—LIMITED STANDARD—This director is a simpler modification of the M2, weighing only 750 pounds and requiring only 5 operators. It is used only with 3″ mobile antiaircraft guns and with the Data Transmission System, M3. Corrections are made for time of flight, wind, drift, quadrant elevation, and fuze settings. Corrections for firing at diving or climbing aircraft and for horizontal firing at land or naval targets are applied.

DIRECTOR, M3A1—LIMITED STANDARD—This is used with 105 mm fixed guns and makes use of Data Transmission System, M3A1 or M4A1. This is the M3 director modified to accommodate the greater range of the 105 mm gun.

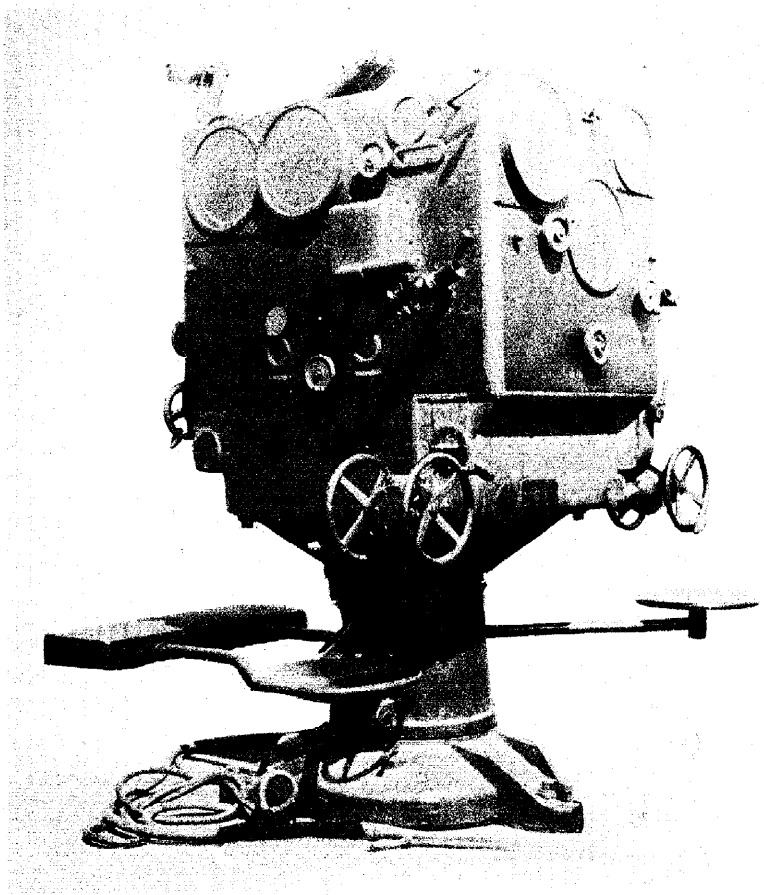
DIRECTOR, M4—LIMITED STANDARD—This director is used with 3 inch or 105 mm antiaircraft guns with Data Transmission System, M3A1 or M4A1. It is a modification of the M3 director, being about 100 pounds heavier. It makes the same corrections as does the M3.

The director can be used with several types of ammunition by making certain substitutions in mechanisms and dials. These spare parts are included in the regular equipment.

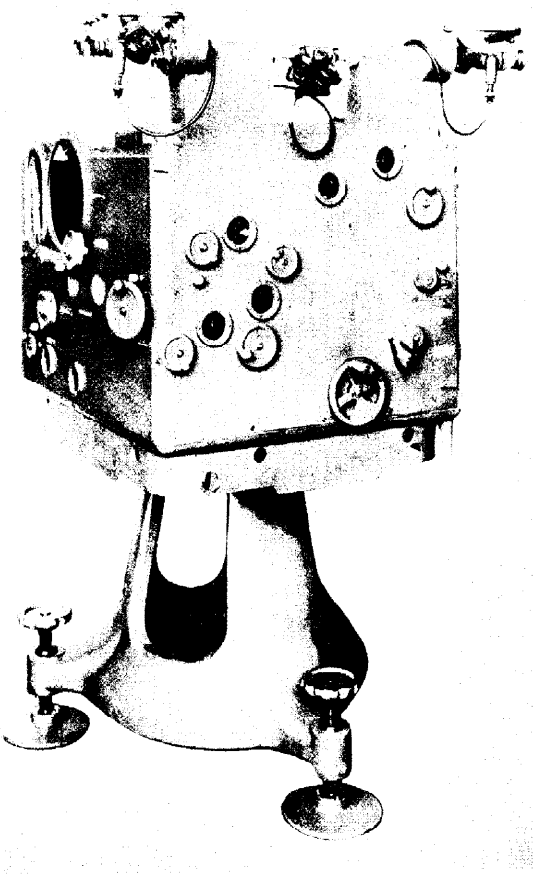
Director, M4, also furnishes the present angular height and the present azimuth of the target to the height finder to insure that both instruments are tracking the same target.

DIRECTOR, M5—LIMITED STANDARD—This director is used with 37 mm and 40 mm antiaircraft matériel in connection with Remote Control System, M1 or M5. It is a comparatively simple mechanism, making no corrections for non-standard ballistic conditions or for parallax and with no fuze data. It is useful against low-flying planes at short range and high angular rates of travel. Three operators are required.

DIRECTOR, M5A1—LIMITED STANDARD—This instrument is the M5 modified by the addition of a synchronous unit which permits complete self-synchronous operation in elevation as well as azimuth. In addition, the torque amplifiers have been removed and various modifications made within the director to make the



DIRECTOR, M2



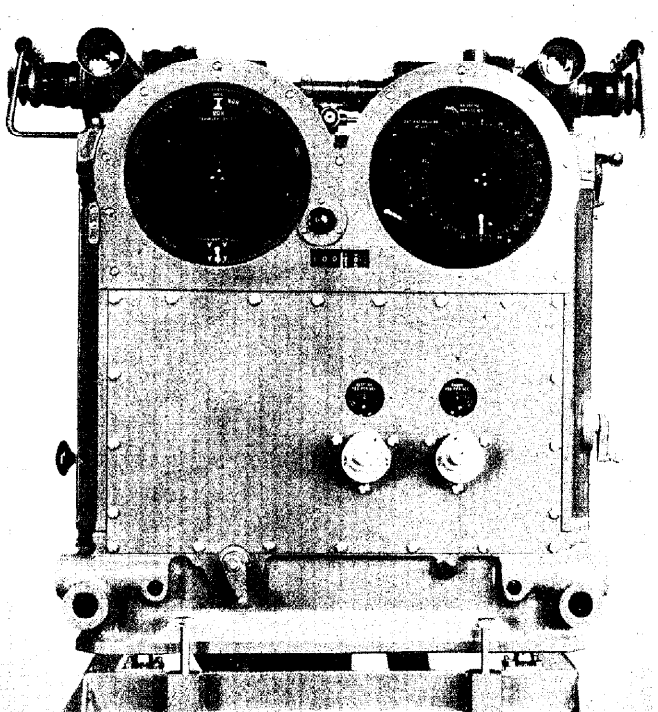
DIRECTOR, M3 OR M3A1

removal possible. This director is used with Remote Control System, M9 or M10.

DIRECTOR, M5A2—STANDARD—This newly standardized M5 type director is made up of Director, M5A1, modified by the addition of the 30-inch-base Range Finder, M10, and provided with an altitude converter and a servo mechanism for setting the slant range into the multiplying mechanism of the director. All M5 type directors in the field are to be modified to M5A2 status as soon as practicable.

Range Finder, M10, is an 8×, coincidence type of instrument, utilizing the principle of color separation of the two images. The image seen through the right window is in one color and that seen through the left window is in the complementary color. When the two images are in coincidence, the colors merge and one image appears in natural colors. This range finder has an additional eyepiece which is used in spotting by the tracer observer to determine how close to the airplane the tracers pass.

DIRECTOR, M7—SUBSTITUTE STANDARD—The M7 director is used with 3 inch, 90 mm, or 105 mm antiaircraft matériel. With 90 mm Gun Mount, M1A1, the Remote Control System, M2, is used.



DIRECTOR, M4

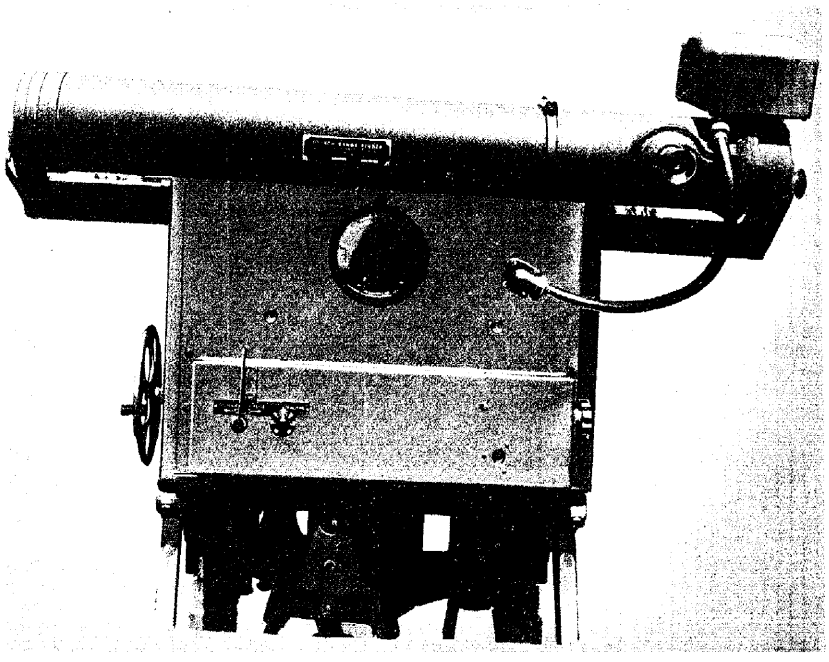
MECHANICAL ANTIAIRCRAFT DIRECTORS (Continued)

The M7 director is like the M4 except that it has increased limits of operation and has some new mechanisms which make its results more nearly accurate. These include a fuze dead time correction mechanism and separation of range and altitude rate knobs from the range and altitude handwheels. All M7 directors are to be modified as soon as possible to M7A1B1 or M7A1B2 status.

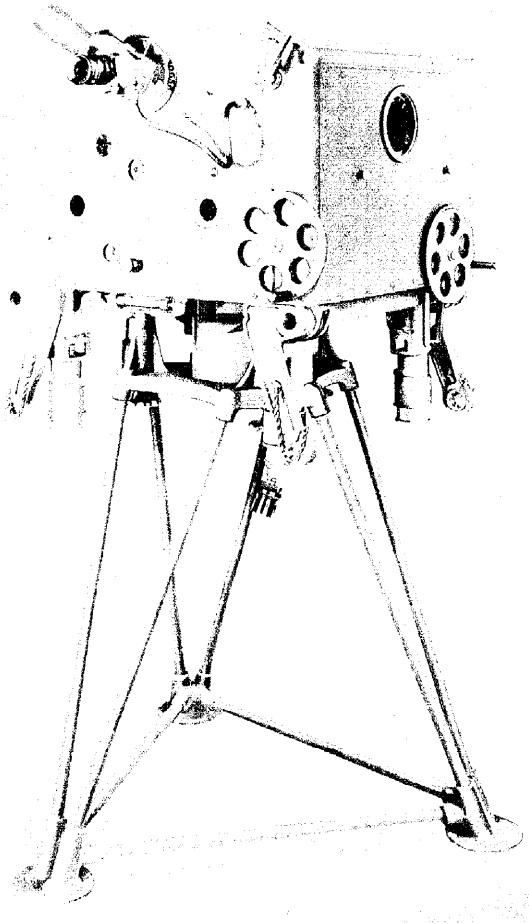
DIRECTOR, M7A1B1—SUBSTITUTE STANDARD—This is Director, M7, modified by the addition of a mechanical smoother. The smoother is used in smoothing the input data of the director, since slight errors in input are often amplified to cause wide errors in output data. It was recently reclassified from standard to substitute standard, leaving only electrical directors standard for major caliber guns.

DIRECTOR, M7A1B2—SUBSTITUTE STANDARD—Director, M7A1B2, consists of Director, M7, modified by the installation of a slightly less satisfactory smoother than that used in Director, M7A1B1.

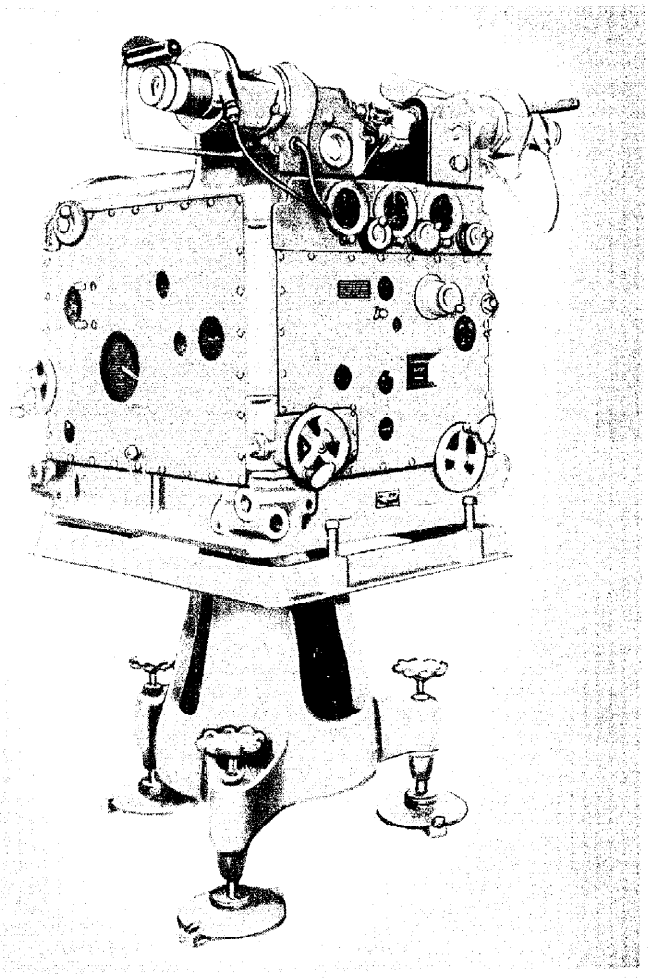
REFERENCES—FM 4-110; FM 4-112; OS 9-58; FM 9-1650; TM 9-1655; TM 9-1658; TM 9-1659; FM 9-2655; TM 9-2658.



DIRECTOR, M5A1E1, WHICH IS MODIFIED AS M5A2

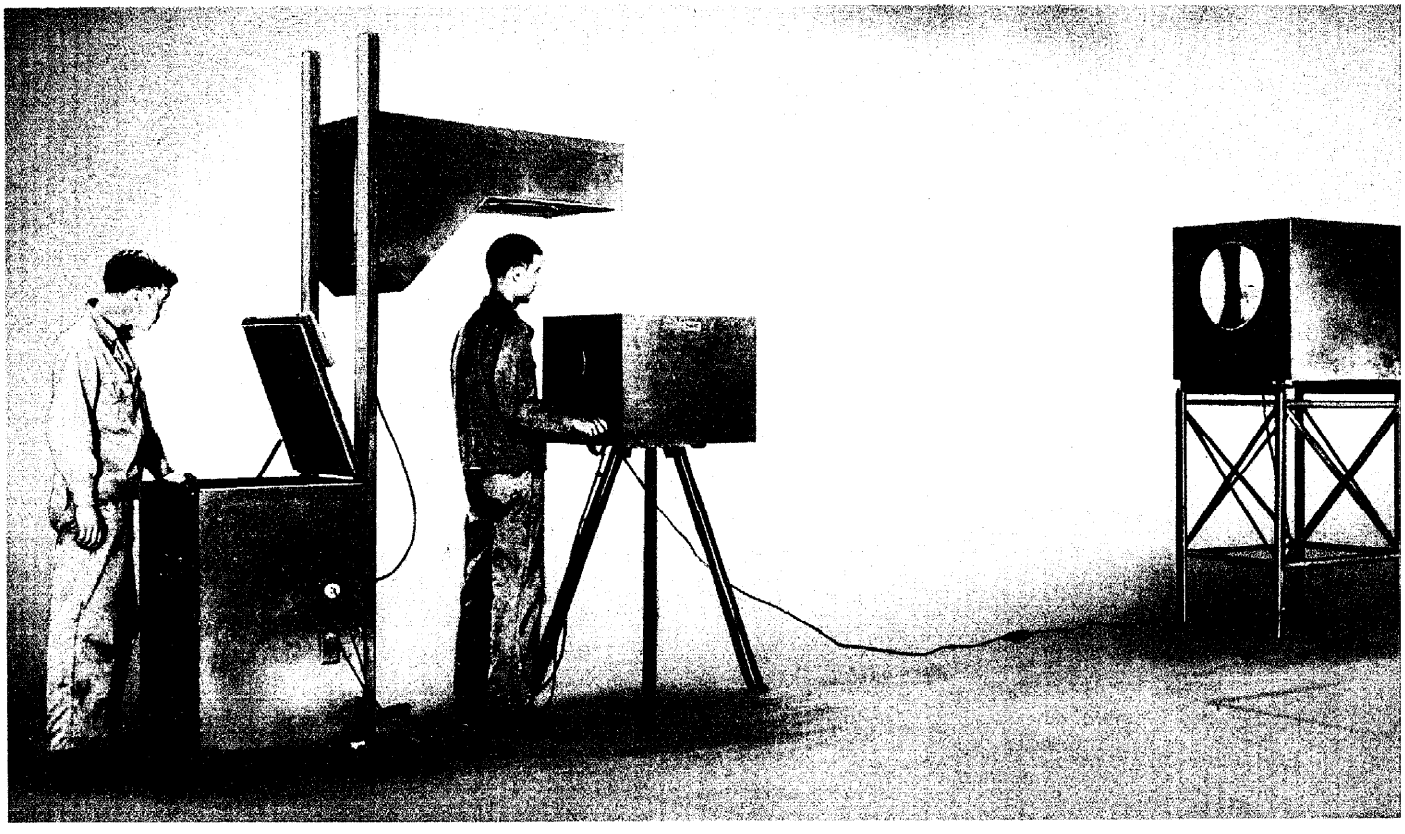


DIRECTOR, M5 OR M5A1



DIRECTOR, M7

DIRECTOR TRAINER M8—STANDARD



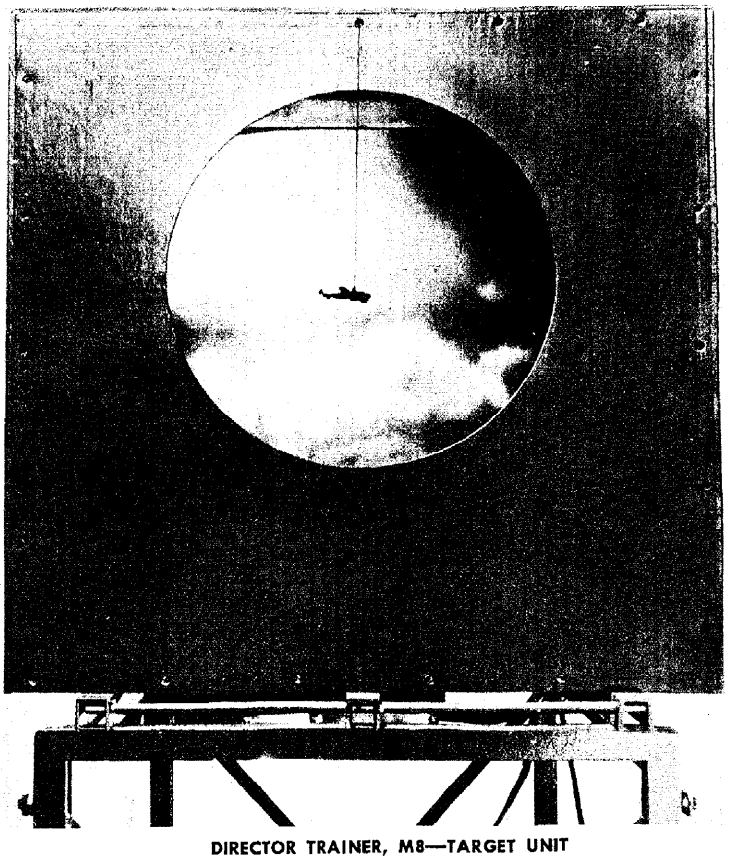
DIRECTOR TRAINER, M8—SET UP FOR OPERATION

The Director Trainer, M8, is an instrument for training the range setter of Director, M5 or M6, used with 37 mm and 40 mm antiaircraft guns.

The trainer contains a director assembly and a target assembly. The director assembly simulates an M5 or M6 director, as far as range handwheel and dial are concerned. It also contains a "canned course" apparatus.

The target assembly contains a miniature airplane which is made to turn on a support, giving the appearance of a hostile plane in various positions of a normal course. Behind the plane is a drum covered with a lithographed sky, which is revolved at a speed representing the plane speed selected by the instructor. The courses of the plane are changed by changing charts in the director.

The trainer is devised so that the instructor, at the control panel, can cause the representation of various representative target courses. The student turns the range input handle as on a real director, making adjustments as indicated by observation of simulated tracers displayed as shorts, hits or overs, depending upon the accuracy of the range value set in. Time delay in the appearance of tracers, corresponding to time of flight of a projectile, is introduced electrically.



DIRECTOR TRAINER, M8—TARGET UNIT

ELECTRICAL ANTIAIRCRAFT DIRECTORS

The electrical antiaircraft directors include the M9 type for use with 90 mm antiaircraft guns, and the M10 for use with 120 mm antiaircraft guns. The M7 type director, however, is retained along with the M9 as the substitute standard director for use with 90 mm antiaircraft matériel.

The M9 series of directors include the M9, the M9A1, and the M9A2, while the M10 series includes the M10 and the M10A1. Director, M9, is designed for use with the 90 mm H.E. Shell, M71, in accordance with Firing Table, 90 AA-B-2. The M9A1 is constructed according to revised and more nearly correct firing data according to Firing Table, 90 AA-B-3. In addition, Director, M9A1, has new spinner motors in the azimuth, elevation, fuze, and time of flight servo motors, a new type of oil pan with improved fittings, and slip rings and a slip ring spring wiper assembly in the azimuth servo, made of a different metal from those in the M9.

Director, M9A2, is the M9A1 with numerous modifications made chiefly to insure smoother input data and more accurate computed data, and to increase the durability and serviceability of the director. Director, M9A2, is standard, and the M9 and M9A1 are limited standard. All directors of this type to be manufactured in the future will conform to specifications for the M9A2. Those actually issued to troops in the field, however, will be given only such changes necessary to conform to M9A1 standards.

All M10 directors are being modified at the factory with new spinner motors in the azimuth, elevation, and fuze servos. Thus modified, the director retains the designation M10, and is classified limited standard. Incorporated in all M10-type directors of new manufacture will be improvements similar to those of the M9A2. These directors will be standard under the designation M10A1.

Electrical directors differ from the generally used mechanical directors in that mathematical calculations are made by electrical devices such as potentiometers, resistances, capacitors, vacuum tubes, and inductances. In the mechanical directors, calculations are performed by means of mechanical devices, such as differentials, cams, gears, and variable speed drives.

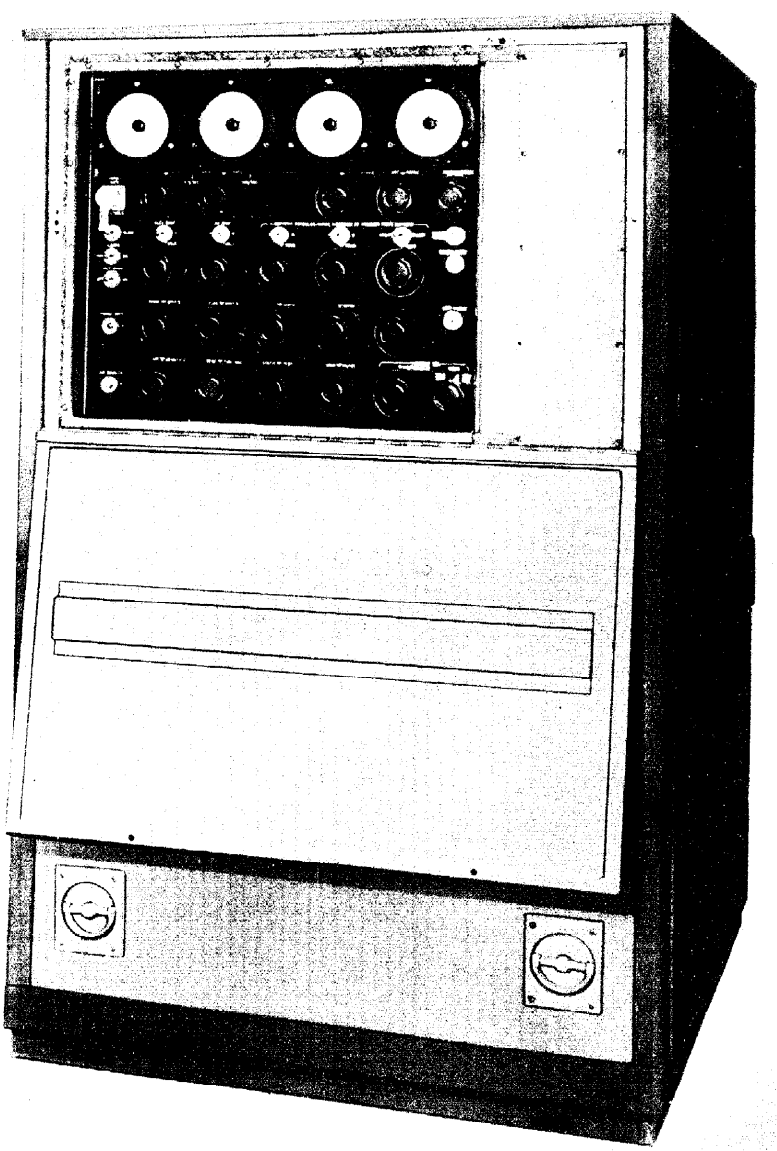
These directors are complicated devices, weighing more than 3,350 pounds. They are installed in Director Trailer, M22, M14, or M13. The major components of an electrical director are a tracker, a computer, a power unit, and an altitude converter, all interconnected by a Cable System, M7.

TRACKER, M2—The tracker consists of a rotating head, mounted on a tripod, carrying two elbow telescopes and two seats for the observers. The two telescopes move together in elevation. The rectangular co-ordinates of the target position, as determined by tracking, are transmitted electrically to the computer. Dials on the tracker indicate continuously the azimuth and elevation. Adjustable illumination is provided for the telescope reticles and the dials. The tracker is used only when the target is visible. When the target is invisible, this director is used with the Radar Systems, SCR–545 and SCR–584, and the tracker is not used.

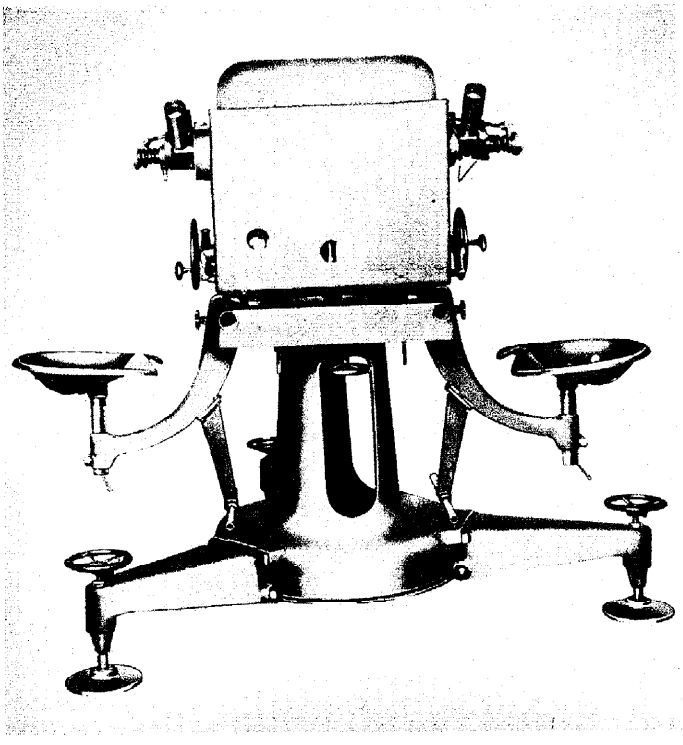
Aided tracking is provided in both azimuth and elevation. It is a combination of manual and motor drive, controlled by the same handwheel. It can be disengaged when desired.

COMPUTER, M3 SERIES—The computer mechanism receives in electrical rectangular coordinate form the present position data supplied by the tracking instrument. It makes continuous automatical electrical computations of firing data and transmits these data continuously to the 90 mm gun. A number of corrections and spots are introduced through these elements. Computer, M3, is used in Director, M9. Computer, M3A1, is the M3 computer, constructed according to the revised ballistics of Firing Table, 90 AA-B-3, for use in Director, M9A1. Computer, M3A2 is used in Director, M9A2.

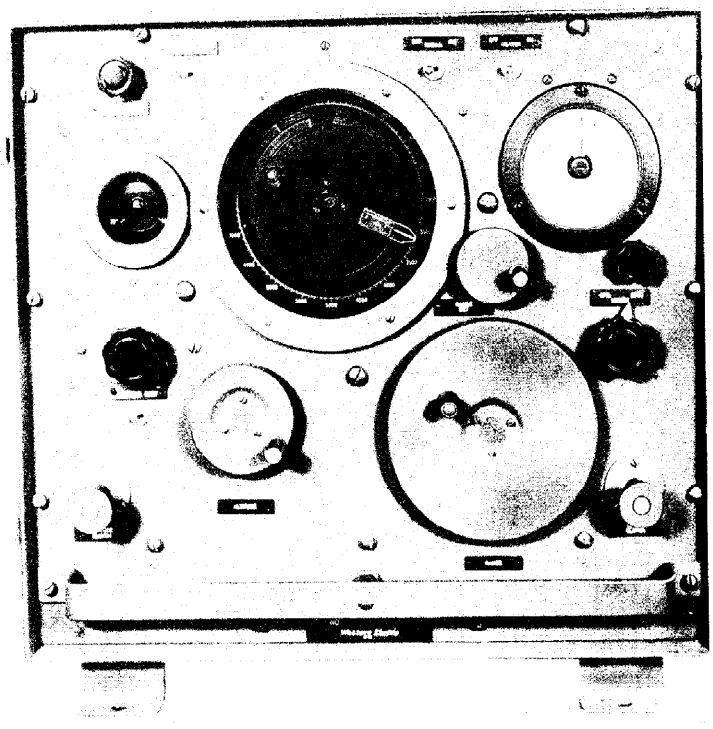
COMPUTER, M4 SERIES—Computer, M4, used with the Director, M10, and Computer, M4A1, with Director, M10A1.



COMPUTER, M3 OR M4 TYPE



TRACKER, M2, WITH TRIPOD, M12



ALTITUDE CONVERTER, M2

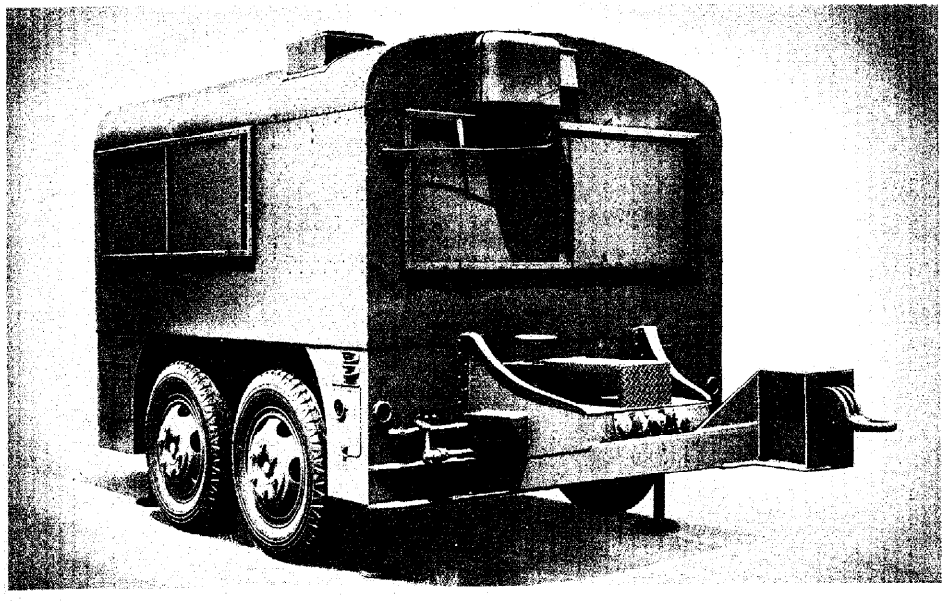
They are like the M3-type computers, but each computer of the M4 type has a ballistic network incorporating data for the firing table used with the 120 mm gun rather than that used with the 90 mm gun.

POWER UNIT, M8—This unit receives 3-phase, 115-volt, 60-cycle power from the primary source, the Generating Unit, M7 or M18. It is converted into direct current of several different highly regulated voltages by means of vacuum tube rectifiers.

ALTITUDE CONVERTER, M2—When ranges or altitudes are transmitted to the director by means of a height finder or the Radar System, SCR-268, an altitude converter is used to convert the data into the electrical form required by this director. When used with Radar Systems, SCR-545, the altitude converter is not used, as data are already supplied in electrical form.

CABLE SYSTEM, M7—The cable system used with this series of directors has recently been modified by the incorporation of a cloud switch into the cable system. The cloud switch enables a quick changeover from visual to radio tracking and vice versa.

DIRECTOR TRAILER, M22—This trailer, a modification of the present substitute standard M14 trailer, has inside dimensions of 9½ feet by 7¾ feet. The M22 also has an insulated wooden ceiling, and dust-, rain-, and gas-proofed doors, windows, and cable outlets. Blackout provisions are also made. All cables are concealed beneath a false floor and in risers. There are a folding workbench and various storage provisions for tools and accessories. A heater is provided. Director Trailer, M13, is limited standard for this purpose.



DIRECTOR TRAILER, M14

ADVANTAGES—The electrical directors have been proved just as accurate as the mechanical directors, and are superior to the mechanical directors in certain respects. The important advantages of the Directors M9 and M10 over the M7 are: aided tracking; complete ballistic solution for nonstandard conditions, such as muzzle velocity, wind, air density, and drift; and the elimination of dynamic errors inherent in the prediction mechanism of the Director, M7.

In addition, the electrical directors have a minimum slant range of 1,200 yards instead of the 3,000 yards of the mechanical directors. With a horizontal range of 28,000 yards, these directors have almost twice the range of a mechanical director of the M7 type.

REFERENCES—TM 9-671; TM 9-1671B.

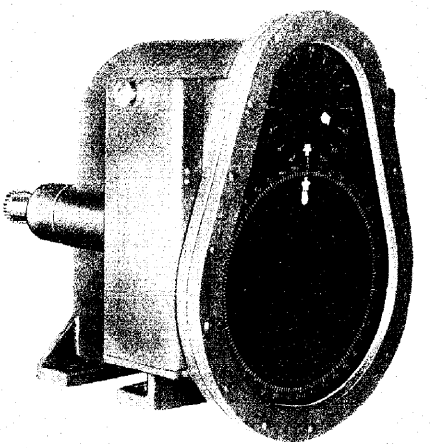
DATA TRANSMISSION SYSTEMS M4, M4A1—STANDARD

These data transmission systems provide a means for the electrical transmission of azimuths and elevations from an antiaircraft director to electrical pointers on an azimuth and an elevation indicator on the gun carriage. Members of the gun crew constantly operate the azimuth and elevation handwheels on the gun carriage so that the indexes of the mechanical and electrical dials of the indicators always match. The weapon is thus elevated and traversed with little dead time elapsing.

Fuze data signals are also sent from the director through the data transmission system to the fuze indicator, and from the height finder to the director. Power for the data transmission system is provided by a generating unit.

A data transmission system consists of: (a) all indicators and associated on-carriage wiring on as many as four guns of a battery; (b) a main junction box; and (c) cables and plugs for interconnecting the guns, junction boxes, height finder, director, and generating unit.

There are two standard antiaircraft data transmission systems, the M4 and the M4A1. They are the same in principles and methods of operation, but they differ in some of the electrical components.



AZIMUTH OR ELEVATION INDICATOR, M4

DATA TRANSMISSION SYSTEM, M4—This system is used with the Antiaircraft Director, M3 or M4, at 3″ mobile Antiaircraft Gun Mounts, M2, M2A1 and M2A2. With some changes, the system can be adapted for use with the Director, M2.

In this system, the cable leads to a receptacle box which is located in front of the top carriage of the gun mount. From the receptacle box, the cable leads to the distribution box where separate cables lead to the elevation indicator on the right side of the carriage and to the gun junction box on the left side. From the gun junction box separate cables lead to the azimuth indicator and the fuze setter. The gun junction box also contains a step-down transformer to provide low-voltage power for illuminating the breech lamp and the fuze setter lamp.

Special equipment furnished includes twelve cable reels, five trouble lamps, an ammeter, a voltmeter and an ohmmeter.

DATA TRANSMISSION SYSTEM, M4A1—This system is used with 3″ fixed Antiaircraft Mounts, M3, M1917M1 and M1917MII, as well as the 105 mm Antiaircraft Gun Mount, M1. It is used where the cable can be buried. The same directors are used as with the M4. It differs from the M4 only in certain details as to arrangement of components, in the addition of an extension junction box and in the substitution of a contact ring assembly for the receptacle box. The use of contact rings prevents the long cable from moving with the carriage, becoming twisted, and interfering with operation.

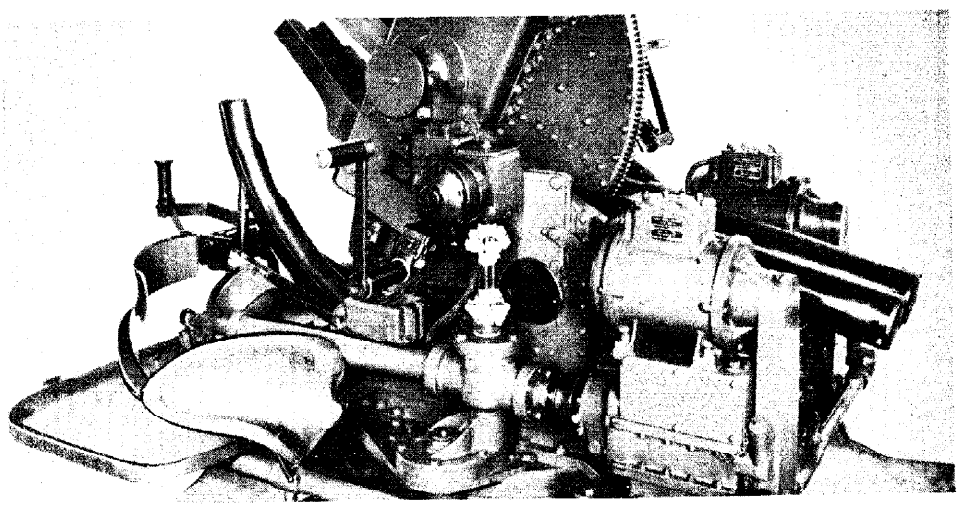
REFERENCES—TM 9-1656, TM 9-2005, v. 5.

REMOTE CONTROL SYSTEM M10 STANDARD—M1, M5 LIMITED STANDARD—M15 SUBSTITUTE STANDARD

These remote control systems provide a means by which an antiaircraft gun is automatically traversed and elevated to the correct angles as transmitted electrically from the director, thus pointing the weapon more accurately and rapidly than is possible by manual operation.

Each remote control system consists of a double set of components, one for receiving and applying azimuths, the other using elevations in the same manner. A single cable system, not a part of the remote control system, is used to connect the M5-type Director electrically with this on-carriage equipment and the generating unit.

Limit switches are provided for the automatic breaking of connections without harm to any mechanism when the weapon has reached its maximum or minimum elevation.



REMOTE CONTROL SYSTEM, M1 or M5, ON 40 MM A.A. GUN CARRIAGE, M2

REMOTE CONTROL SYSTEM, M1—This remote control system provides for continuous automatic tracking of 360° in azimuth and elevations between 0° and 85°. The maximum speed is 20° per second, sufficient to follow practically any target encountered at the present time. The system operates on a 3-phase, 60-cycle, 115-volt current.

The gun is automatically moved in azimuth or elevation by means of an oil motor which receives its oil from an oil pump, itself operated by a separate electric motor. This apparatus, known as the oil gear, is assembled on the weapon and coupled to it.

Each oil gear consists of an oil pump and motor unit assembly and the electrical differential and transmitter assembly. The induction motor drives the oil pump, while the electrical differential and transmitter control the operations of the oil motor in synchronism with the director. In the azimuth oil gear, the oil motor in turn drives the gun carriage through a system of gears causing the upper part of the carriage to revolve in azimuth as the

REMOTE CONTROL SYSTEM M10, M1, M5, M15 (Continued)

target is tracked by the director. The oil motor in the elevation oil gear operates the elevating mechanism of the gun.

The azimuth indicator is connected electrically to the coarse transmitter in the director and mechanically to the azimuth drive of the gun carriage. It is used as a coarse azimuth indicator when synchronizing the gun with the director, after slewing.

The wiring set comprises the rest of the on-carriage equipment and includes the gun junction box, the contact ring, the azimuth indicator, azimuth and elevation switches, and the necessary cables and wiring.

There is no Standard or Substitute Standard remote control system to correspond with the M1 because the 37 mm guns, on which it is used, are being replaced by 40 mm matériel.

REMOTE CONTROL SYSTEM, M5—The M5 is a modification of the M1 system for use with 40 mm matériel. The differences between the two models are as follows. In the M1 the azimuth oil gear is mounted on the left side of the top carriage and the elevation oil gear on the right. The positions are reversed in the M5. The wiring set of the M1 system has no distribution box, while the M5 has a distribution box. The azimuth indicator, switches, gun junction boxes, contact ring, and wiring are somewhat different in construction or arrangement, but not in principles or methods of operation. All M5 Remote Control Systems are to be modified to M15 status.

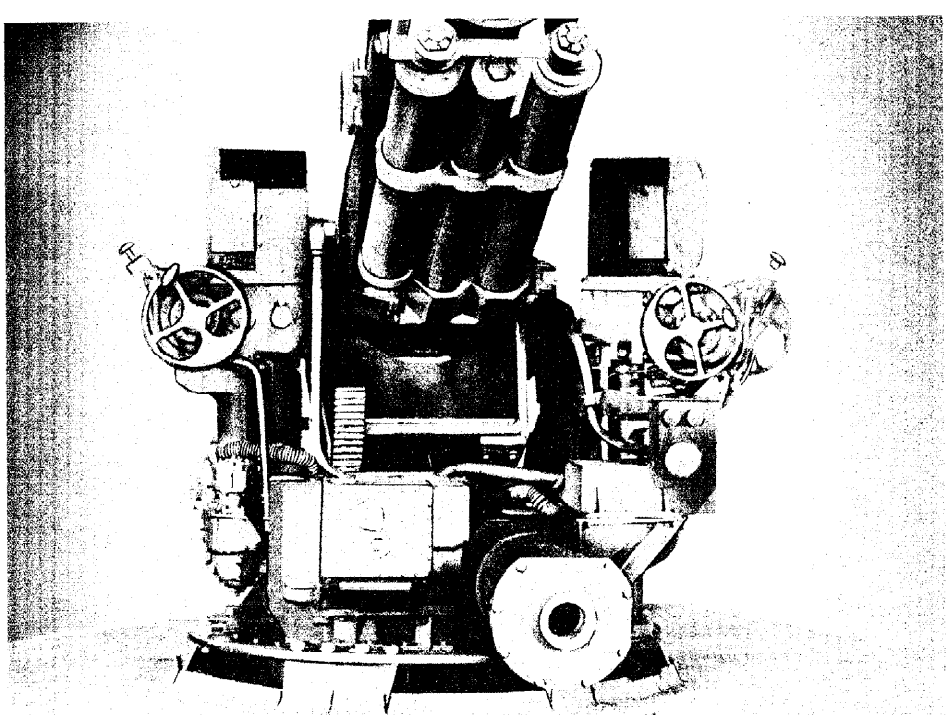
REMOTE CONTROL SYSTEM, M10—This system is a modification of the M1, using an improved oil gear, the M3, which provides a means of eliminating the lag which is inherent in the M1 system. In addition, a coarse receiver in the oil gear takes the place of the azimuth indicator. This coarse receiver makes it possible to slew the gun automatically when used with Directors, M5A1 and M5A2, each of which has coarse transmitters. It has recently been required that Wiring Set, M8, a component of this remote control system, be modified by the incorporation of an elevation linkage extension and power switch for the clutch on elevation oil gears. These additional mechanisms enable the elevation tracker to engage or disengage the clutch without requiring him to lean forward and take his eyes off the target. They also eliminate the risk of injury to the tracker or damage to the oil gear.

Remote Control System	Gun Carriage	Components of System	Cable System Used
M10 (S.)	40 mm A.A. Gun Mounts, M2, M2A1, M5	Oil Gear, M3 (azimuth) Oil Gear, M3 (elevation) Wiring Set, M8	M8
M15 (S.S.)	40 mm A.A. Gun Mounts, M2, M2A1, M5	Oil Gear, M3 (azimuth) Oil Gear, M3 (elevation) Wiring Set, M12	M8
M5 (L.S.)	40 mm A.A. Gun Mounts, M2, M2A1, M5	Oil Gear, M1 (azimuth) Oil Gear, M1 (elevation) Wiring Set, M5	M8
M1 (L.S.)	37 mm A.A. Gun Mount, M3A1	Oil Gear, M1 (azimuth) Oil Gear, M1 (elevation) Wiring Set, M5	M8

REMOTE CONTROL SYSTEM, M15—The designation M15 has been assigned to the modified M1 system, which uses the improved oil gears, M3, as in the M10 system. In addition, the M1 system incorporates the wiring system, M12. This wiring system employs the elevation linkage extension and power switch as in wiring system, M8, used in Remote Control System, M10. Its use of the other improvements of wiring system, M8, over the wiring system, M3, which is used in Remote Control System, M1, is optional, but preferred.

REFERENCES—OS 9-42; TM 9-1643; TM 9-2005, v. 6; TM 9-2643.

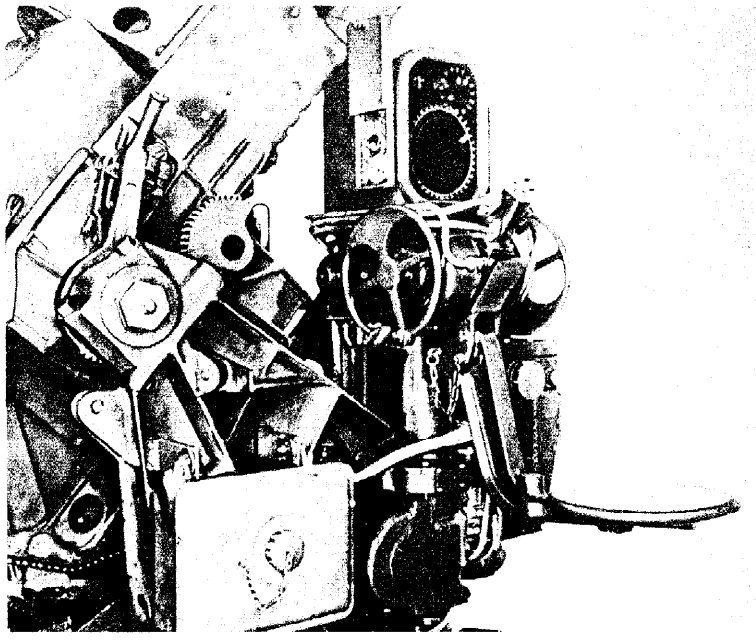
REMOTE CONTROL SYSTEMS M2, M12, M13—STANDARD



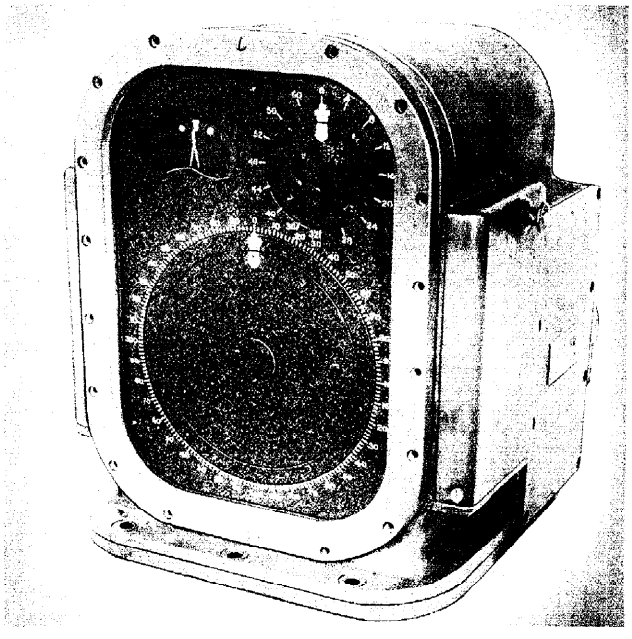
REMOTE CONTROL SYSTEM, M13—SHOWING ARRANGEMENT OF PARTS ON GUN

These remote control systems, designed for use with 90 mm matériel, perform the same functions as the remote control systems used with 37 mm and 40 mm matériel. Each system consists of all the on-carriage equipment required for elevating and traversing the gun by remote control. This includes the indicator system and the power control. Electrical connection between the power source, the M7 or M9 type director, and the remote control system, is made by means of a cable system, not itself a part of the remote control system. One cable system is designed for a battery of four guns.

These three remote control systems are all operated on the same general principles, and contain the same major elements. Differences between the individual systems are mainly to adapt them for use on different weapons with somewhat different requirements. In addition, the M12 and M13 systems, being modifications and subsequent developments of the M2, incorporate certain improvements over the parent system.



REMOTE CONTROL SYSTEM, M2—ELEVATION CONTROL STATION



INDICATOR-REGULATOR, M1

Remote Control Systems	Gun Carriage	Components of Remote Control System	Cable System Used
M2	90 mm AA Gun Mount, M1A1	Indicator System, M4 Power Control, M4	M1
M12	90 mm AA Gun Carriage, M2	Indicator System, M5 Power Control, M3	M1
M13	90 mm AA Gun Carriage, M3	Indicator System, M6 Power Control, M5	M10

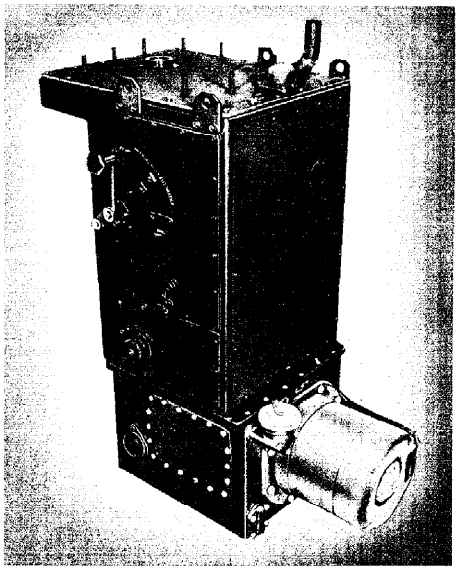
Each system uses 3-phase, 60 cycle, 109–121 volt current. They can traverse the respective guns through 360°. Both the M2 and M12 systems have a maximum rate of traverse at 12° per second. Remote Control System, M2, can elevate or depress the weapon between 0° and 80° elevation at a maximum speed of 12° per second. The M12 can move the gun in elevation between −10° and +80° at a maximum speed of 11° per second. The M13 can elevate or depress the gun between −8° and +80°.

Each indicator system, also known as the signal system, consists of two Indicator Regulators, M1, one for azimuth and one for elevation; various junction and terminal boxes, a contact ring, and the necessary on-carriage cables. The indicator system is actuated by the director system and itself actuates the stroke control system. Each signal system has a synchronizer which brings the gun into exact synchronism. The fine and coarse dials on the face of the indicator-regulator indicate the workings of these two mechanisms during manual operation.

The power control consists of two hydraulic systems and two electric stroke control systems, one of each for azimuth and one for elevation. Each hydraulic system is made up of an oil pump and the oil motor which actually moves the gun in elevation or in azimuth. The stroke control system regulates the speed and direction of the flow of oil pumped by the hydraulic pump. A limit stop valve is provided for the elevation hydraulic system for protection of the gearing at the mechanical limits.

In cases of emergency, the weapon can be pointed mechanically to match the electrical pointer, just as is done when a data transmission system is used. A transfer valve is provided in each hydraulic system in order to bypass the oil flow between the pump and the motor during manual operation. Remote Control System, M13, is so constructed that it can be operated manually on one axis and automatically on the other.

Remote Control Systems, M12 and M13, differ from the M2 chiefly in allowing increased movement of the gun in depression, in modifications to adapt the systems for use on different matériel, in differences of arrangements of components, and various improvements. The latter include: elimination of certain problems of installation and production, increased ease in making adjustments, and reduction of the number of operations for changing from automatic to manual operation from three to one.



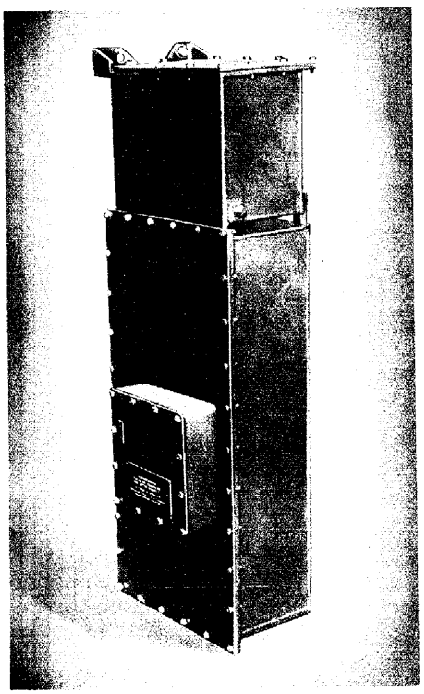
REMOTE CONTROL SYSTEM, M12
POWER CONTROL, M3—ELEVATION UNIT

REFERENCES—TM 9-370; TM 9-372; TM 9-373; TM 9-1642; TM 9-2005 v. 6.

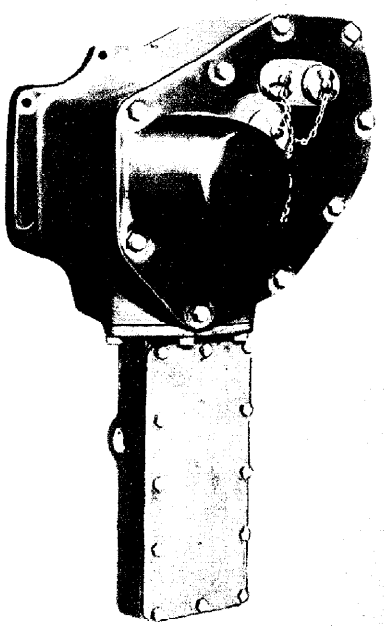
TORQUE AMPLIFIER M1—STANDARD

The Torque Amplifier, M1, is the fire control element of Combination Fuze Setter-Rammer, M20, used with the 90 mm Gun, M2, and the 90 mm Anti-aircraft Gun Mount, M2. It continuously and automatically receives fuze time data from the director, amplifies the data, and uses the amplified data to position the data plunger in the fuze setter-rammer transmission. The position of the data plunger serves to determine the amount of rotation in the fuze setter jaws.

The instrument consists of Motor Drive, M2, and Amplifier, M1 or M1B1.



AMPLIFIER, M1



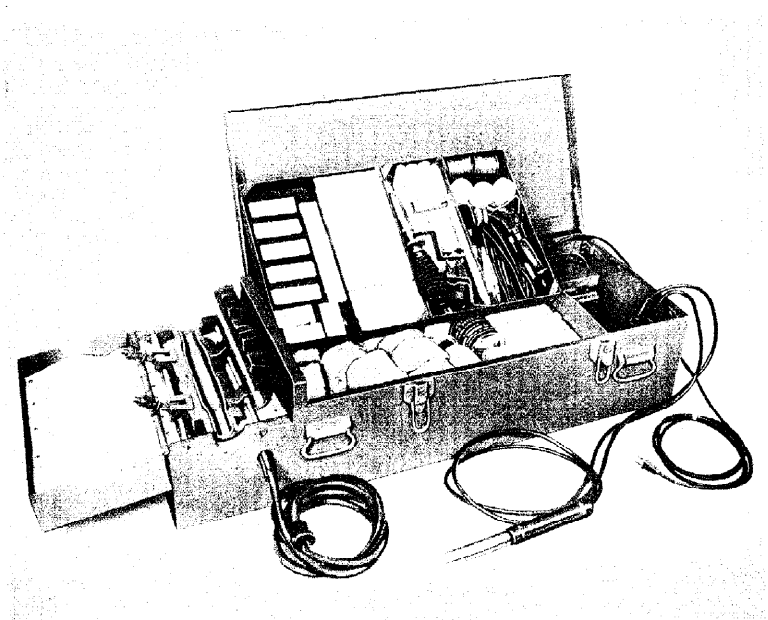
MOTOR DRIVE, M2

The motor drive is located on the side of the fuze setter-rammer transmission, and the amplifier is mounted against the side of the top carriage of the gun mount. The Amplifiers, M1 and M1B1, are similar, but are made by different manufacturers.

The Motor Drive, M2, contains a self-synchronous transformer and an electric driving motor, both of which are geared to the output staff, which itself is connected with the data plunger. The self-synchronous transformer receives from the director the electrical data corresponding to the mechanical position of the fuze dial on the director, and converts the data back to a mechanical position corresponding to that of the fuze dial. Electric voltage built up in the secondary winding of the transformer is led into the amplifier, where it is amplified into a signal strong enough to drive the motor in the motor drive, thus turning the output shaft. When the fuze dial position of the transformer is synchronous with that of the director, the voltage becomes zero and the driving motor ceases to turn the output shaft until the position of the fuze dial of the director is again changed.

REFERENCE—TM 9-372.

CABLE REPAIR KITS M1, M2, M3, M5, STANDARD—M7 (NO CLASSIFICATION)



CABLE REPAIR KIT, M2

A cable repair kit is a portable metal tool-box containing the tools and supplies needed for the making of electrical connections and sheath repairs on antiaircraft data transmission systems and remote control systems. The four standard kits, M1, M2, M3 and M5, are all basically the same. The contents include such items as vulcanizers, soldering iron and solder, diagonal wire-cutting pliers, crimping tools, electric scissors, linoleum knife, wood rasp, paint brush, vulcanizer liners, compression splicing sleeves, insulating sleeves, vulcanizing and insulating tapes, benzol, rubber cement, mould dressing and brush, a 6 inch metal ruler, a carborundum stone, and a prevulcanized spider. The various models differ in the vulcanizing equipment furnished and in certain substitutions in the tools supplied.

Cable Repair Kit	Used With
M1	Data Transmission Systems, M4, M4A1, M6
M2	Remote Control System, M2
M3	Remote Control Systems, M1 and M5
M5	Remote Control System, M6
M7	All data transmission and remote control systems. Used by Ordnance Maintenance Companies only.

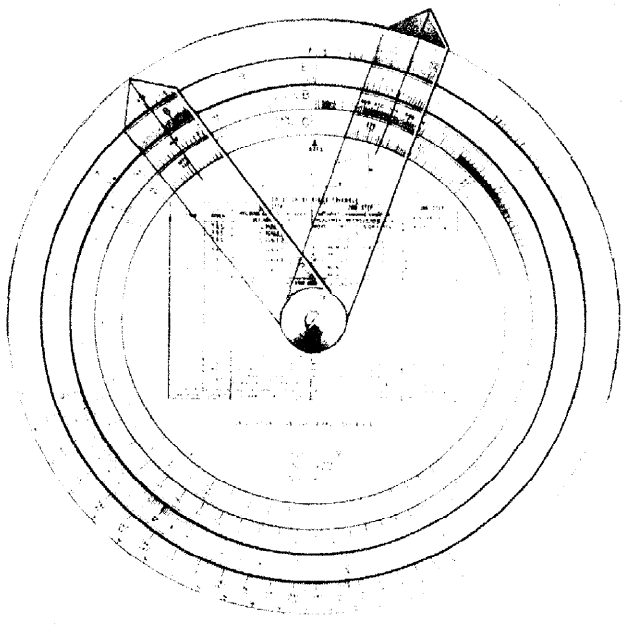
SLIDE RULE M1—STANDARD

The Slide Rule, M1, is an instrument designed primarily for the rapid logarithmic solution of triangles. This device is a flat plastic disk, with four concentric scales engraved on the face, labeled from the outside inwardly, D, E, B and C. Scales D, B and C are used to solve triangles when a particular element of data is missing. Scale E is a logarithmic scale of numbers used to transform into numerical values the logarithmic values obtained by the use of the other scales.

Pivoted from the center are two transparent plastic arms of different lengths. The short arm is usually placed along the index and the long arm is moved along the proper scale until it indicates one of the known acute angles. Then the relative position of the arms represents the unknown logarithmic value.

Instructions and charts showing the various uses and methods of operation of this device are shown on the center of the face and on the reverse side of the slide rule. Also engraved on the reverse side is a grid for the construction of triangles.

REFERENCES—FM 4-110; TM 9-370.



SLIDE RULE, M1

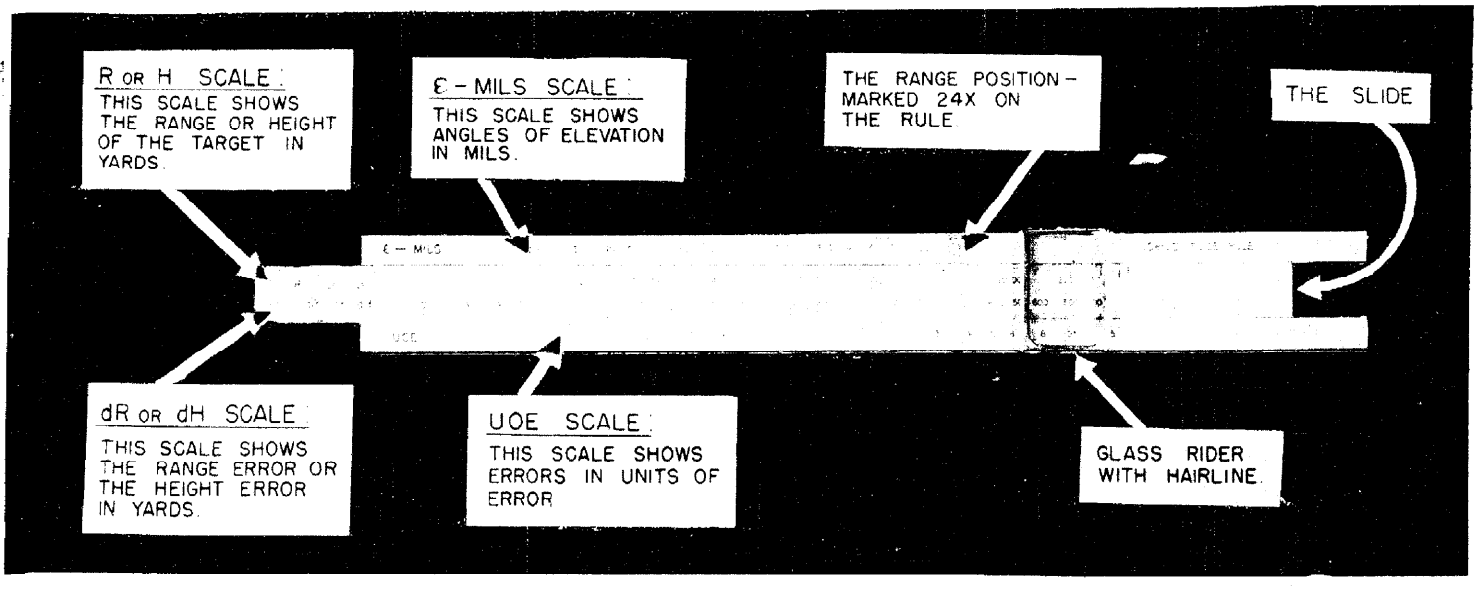
SLIDE RULE M2—STANDARD

Slide Rule, M2, provides a means for determining quickly a height finder observer's unit of error without the necessity of first converting the altitude error into the corresponding error in slant range. Two rules are issued to each height finder. The rule consists of a base, 2 inches wide, and three top sections. The two outside sections each ½ inch wide, are fixed and the center section, an inch wide, is movable.

The lower fixed scale is the unit of error scale and is graduated from 0.1 to 100. Just above it is a sliding scale with ranges or altitudes from 200 yards to 20,000 yards along the upper edge and with the corresponding linear range or altitude errors from 0.1 to 100 along the lower edge. The upper fixed scale contains angular height graduations in mils from 20 to 1,600.

A transparent runner with a hair line is provided, and a fiber or leather case is to be issued with each rule.

REFERENCE—TM 4-250.



DE YOE SLIDE RULE, WHICH IS BEING MODIFIED AS SLIDE RULE, M2

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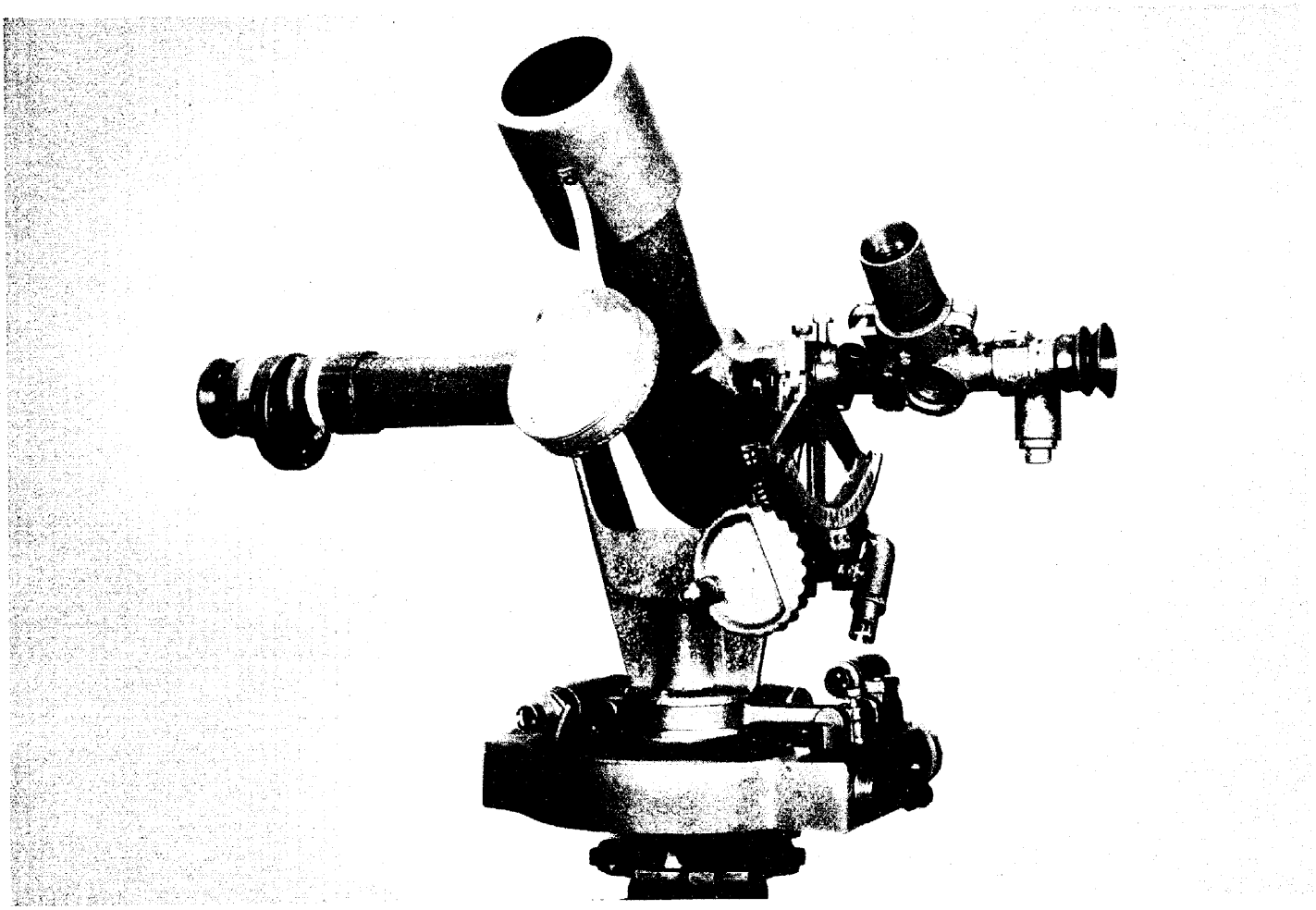
ANTIAIRCRAFT BATTERY COMMANDER'S OBSERVATION INSTRUMENT M1—STANDARD



ANTIAIRCRAFT BATTERY COMMANDER'S OBSERVATION INSTRUMENT, M1

The antiaircraft battery commander's observation instrument is used for observing aerial targets, for measuring azimuths and elevations, and for spotting. The instrument consists of an Elbow Telescope, M35, and an Elbow Telescope, M2, which move concurrently, a mount, a type A tripod, electrical equipment, and the necessary packing chests.

ELBOW TELESCOPE, M35—This instrument is used in order that the battery commander may keep his eyes level and face the observer at the elbow telescope on the opposite side of the mount. The telescope may be set for a magnification of either 10 or 20 power. The eyepiece may be focused in accordance with a diopter scale, but the objective is fixed focus. There are a blue and an amber internal filter. To make use of either filter the special lever for that filter is rotated.

The reticle is marked with a horizontal and a vertical mil scale measuring 50 mils in 1-mil intervals in each direction from the central point. These scales are usually used by the battery commander in spotting for measuring deviations in azimuth and range, while the observer keeps the target tracked with Elbow Telescope, M2.

ELBOW TELESCOPE, M2—This 8-power, fixed-focus instrument is mounted on an adapter which is firmly supported on a shaft extension opposite the eyepiece of the Elbow Telescope, M35. By means of the adapter, the elbow telescope may be adjusted so that the lines of sight of the two telescopes are parallel. This instrument is provided with removable amber and blue filters and with a reticle marked so that the image of the target may be kept at the center.

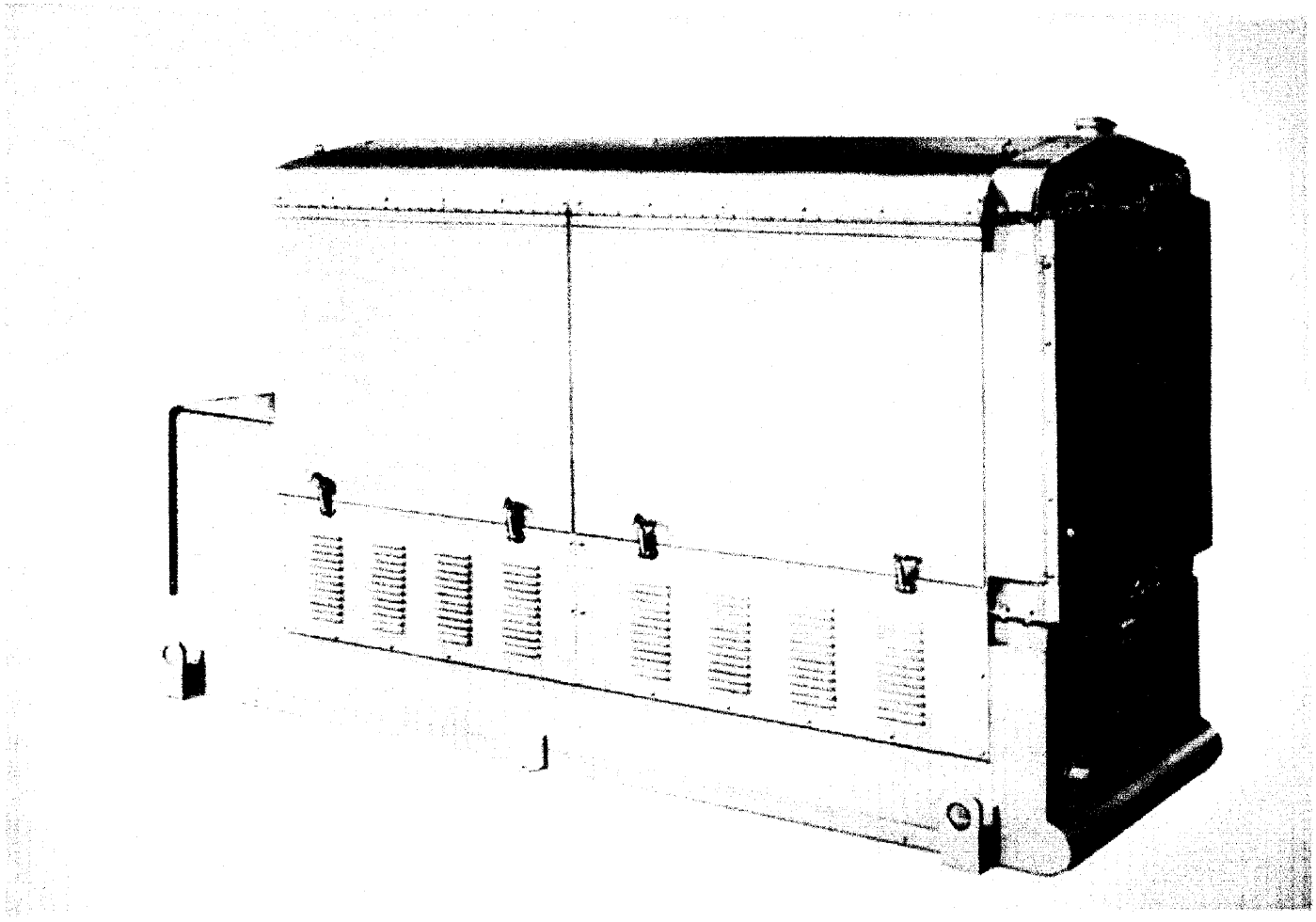
MOUNT—The mount, which is screwed onto the head of the tripod by means of a leveling plate, provides a support for the telescope. In addition, it contains other important mechanisms for leveling and orienting the instrument, and for positioning the telescope in azimuth and elevation. Azimuth and elevation scales and micrometers are also contained in the mount.

TRIPOD, TYPE A—This tripod has a metal head. The extensible wooden legs are provided with adjustable metal braces of the rod and tube type.

ELECTRICAL EQUIPMENT—Illumination for the various reticles and scales is provided by means of a 6-volt alkaline storage battery. A rheostat is provided for adjustment of illumination. Lead wires from each of the lamp brackets and the rheostat are carried to the battery through a central cable.

REFERENCES—TM 9-360; TM 9-2005, v. 6.

GENERATING UNITS M17 (EG 2.5-3G1) AND M18 (EG 30-3G1)—STANDARD



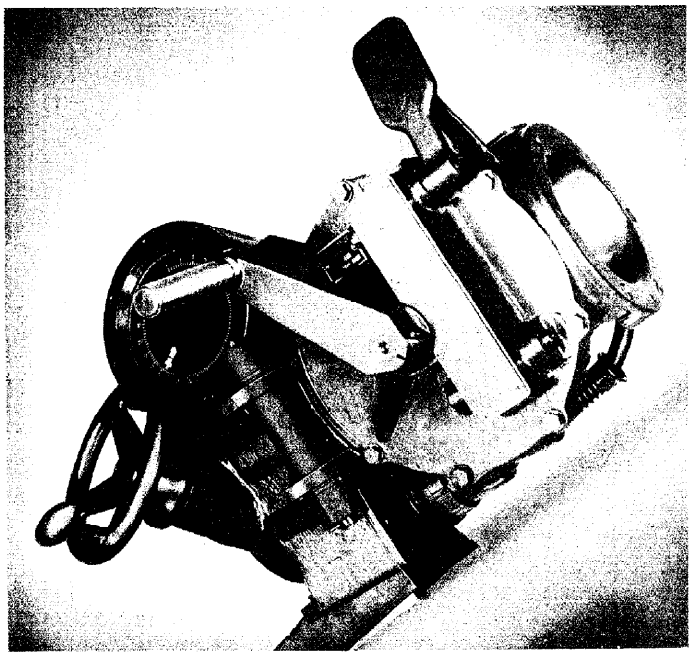
GENERATING UNIT, M18

These two portable, gasoline-driven generating units provide 3-phase A.C. energy for the operation of fire control equipment. Each unit consists of a gasoline engine, an alternator, and various accessory equipment. They are ruggedly constructed for service in conditions varying widely from the tropics to the Arctic. Their design provides for interchangeability of parts, excludes moisture and dust so that the units may be operated in the open without additional protection, and eliminates radio interference. An engine governor maintains close speed regulation to within 4 r.p.m. for any value of load between quarter and full load. Four seconds are allowed for speed stabilization after any sudden large shift in load.

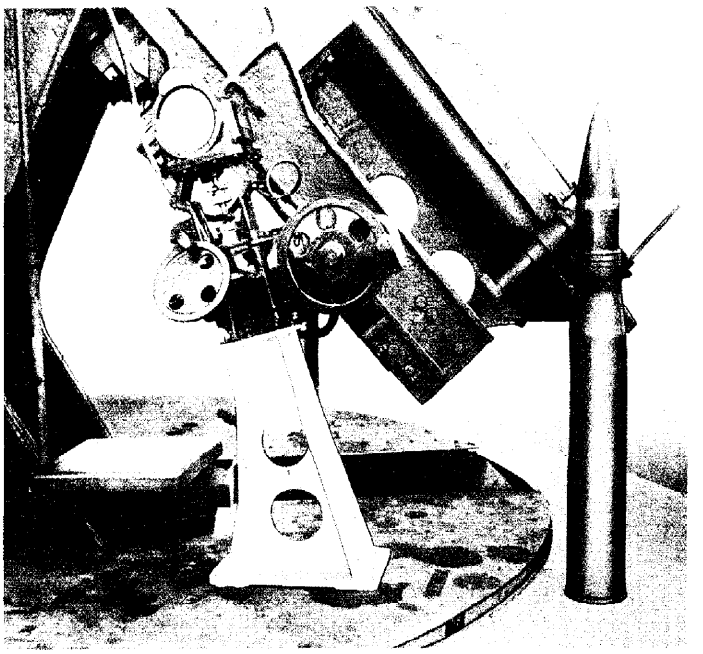
GENERATING UNIT, M17—This unit supplies 2.5 kilowatts at 80% power factor and generates 125 volts at 60 cycles when running 1,200 r.p.m. The unit may also be used as a 1-phase, 60-cycle machine. It weighs 860 pounds, and, when provided with porter bars, may be carried by six or eight men. The complete unit consists of a gasoline engine capable of not less than 8.75 dynamometer horsepower, the self-contained 2.5 kilowatt generator, designated M4; a governor, and an instrument panel containing control equipment. This generating unit supplies power for the M5 type directors and any of the remote control systems used in conjunction with them.

GENERATING UNIT, M18—This unit furnishes 30 kilowatts at 80% power factor, generating 125 or 250 volts at 60 cycles only. It weighs approximately 4,000 pounds and supplies power for the M7 type directors and their associated remote control systems. The unit is operated by a gasoline engine capable of not less than 67 dynamometer horsepower and has additional equipment similar to that of the smaller engine generator. Automatic voltage regulation is provided. The generator used in this unit is designated M3.

FUZE SETTERS M8, M9, M10, M13—STANDARD



FUZE SETTER, M8



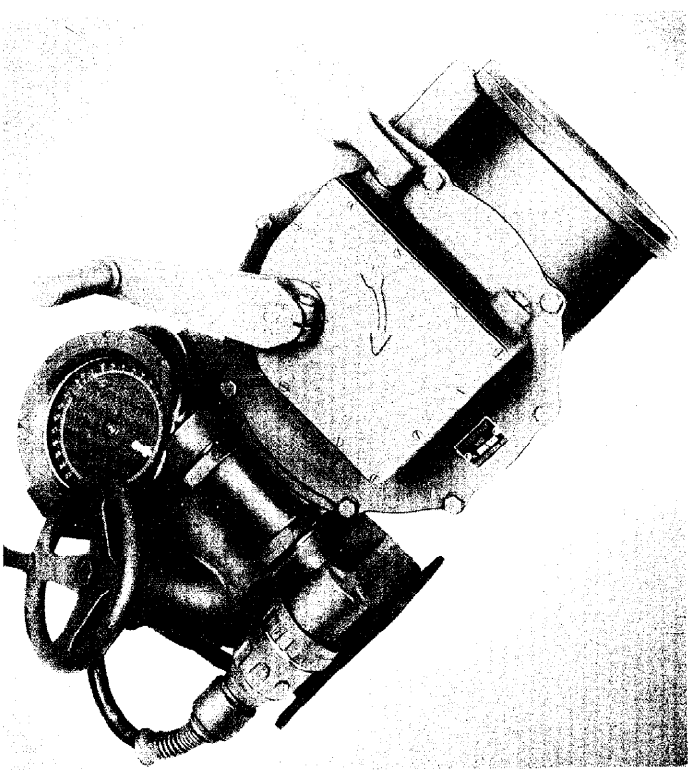
FUZE SETTER, M9

These fuze setters for antiaircraft use are manually operated, but are connected electrically with the director, from which data are automatically transmitted. Each fuze setter is attached to a gun carriage by means of a bracket. The major components include a fuze indicator, adjusting mechanism, and setting mechanism. The round to be set is inserted in a guide connected with the setting mechanism.

The fuze indicator receives electrically and indicates the fuze range (i.e., time of flight in seconds) to the target. A cable leading to the gun junction box serves to connect the indicator with the director. The indicator contains a standard A.C. synchronous repeater with an electrical index mounted on the shaft. The repeater positions the electrical index so that it indicates the range on the fuze setter scale in accordance with the continuously received fuze range data.

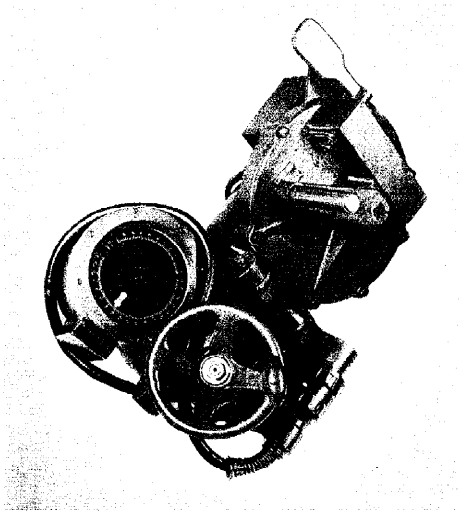
A mechanical index is located between the electrical index and the scale. The adjusting mechanism, driven by an adjusting handwheel, is located below the fuze indicator and is geared to the mechanical index. The adjusting handwheel is turned so that the mechanical index constantly matches the electrical index. If no indicator is used, the mechanical index is merely moved to the desired range. The turning of the adjusting handwheel also rotates the movable or adjusting ring of the fuze to the correct setting for the range. The setting mechanism, operated by the setting crank, completes the work of setting the fuze. When the final position is reached, the fuze setting corresponds to that on the fuze setter scales. Once the fuze has been set, the adjusting mechanism can continue to be operated in accordance with subsequently received data until the round is removed for loading.

Electric lamps are provided to illuminate important parts of the fuze setters where necessary. Power is secured for the lamps by means of a step-down transformer in the gun junction box of the data transmission system.



FUZE SETTER, M10

FUZE SETTER, M8—This device is used with any 3″ antiaircraft ammunition equipped with the 21-second antiaircraft powder-train fuze, Mk. III, or modifications, or with the 30-second mechanical fuze, M43. It may also be used with 3″ dummy ammunition. In order to adapt the fuze setter for use with different fuzes, separate scales, setting rings, and adjusting rings are supplied.



FUZE SETTER, M13

Electric lamps are provided for the guide and the fuze indicator. They are inserted in lamp wells. Luminous paint in the electrical and mechanical fuze indexes also serves to adapt this model for night use.

FUZE SETTER, M9—This fuze setter was developed for setting the M2 time fuze on the fixed H.E. shell, M38, as used in the 105 mm antiaircraft gun. It functions similarly to the M8 fuze setter, but differs in appearance.

This fuze setter has an additional auxiliary scale and index located below the indicator for direct indication of fuze range. The indicator against which this scale is read can be offset to introduce an arbitrary correction.

Fuze Setter, M9, has but one electric lamp for night illumination. It is located above the guide.

FUZE SETTER, M10—This fuze setter is used on 105 mm antiaircraft ammunition fitted with the mechanical time fuze, M43A2. It is an enlargement of the M8, with many of its component parts interchangeable with those of the M8.

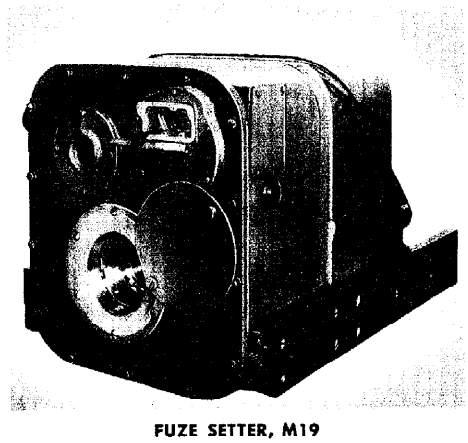
FUZE SETTER, M13—This fuze setter, modeled on the M8, is designed primarily for mounting on the 90 mm Antiaircraft Gun Mount, M1, and is used with 90 mm antiaircraft ammunition fuzed with the 30 second Mechanical Time Fuze, M43, or with dummy drill cartridges fuzed with the Dummy Fuze, M44.

REFERENCES—FM 4–110; TM 9–1635; TM 9–1640; TM 9–1641; TM 9–2005, v. 6.

FUZE SETTER M19—STANDARD

Fuze Setter, M19, is a power-operated mechanism, by which the Mechanical Time Fuze, M61 or M61A1, as used in 120 mm shells, is automatically set to the time setting corresponding to the fuze range data computed by the director. The fuze setter, mounted on rails over the breech ring of the 120 mm mobile Antiaircraft Gun, M1, acts in conjunction with the Power Rammer, M9. The rammer automatically moves the fuze setter back over the nose of the shell which is held in the rammer tray. When the fuze has been set, the mechanisms of the rammer draw the fuze setter forward into the original position, and lower the loading tray so that the shell is in line with the bore of the gun into which it is then rammed.

Essentially, the fuze setter consists of a synchronous repeater, a driving motor, a rotating pawl assembly, and a control unit. The synchronous repeater receives the fuze data from the director, indicating it on a dial. The repeater contains the electrical contacts by which the firing circuit to the control unit is closed when the fuze setting corresponds to that indicated by the position of the repeater.



FUZE SETTER, M19

The driving motor, which is provided with thermal cutout protection to cut off the power when there is danger of burning out the motor, is a ¾-horsepower, 110-volt, 60-cycle, 3-phase, 3,450 r.p.m. induction motor which drives the moving parts of the fuze setter. These include a holding pawl and a setting pawl, which operate at reduced speed through a planetary gear system. The driving motor runs only while the fuze is being set.

The motor is started by the closing of the 2-pole starting switch. This is accomplished by a plunger which is actuated by the end of the fuze as the projectile and fuze enter the fuze setter. At that time, the plunger withdraws the knockout sleeve against spring pressure, and is itself withdrawn from a switch which is closed when there is no projectile in the fuze setter. Another switch, which is wired in series with the opened switch and with the coil of a solenoid on the reciprocating cam control mechanism of the rammer, is closed. Thus no current flows between the two switches, and the fuze setter remains in position.

The planetary gears rotate the setting pawl until it engages the fixed slot in the fuze. This portion of the planetary differential then stops rotating, thus causing the setting pawl to rotate in the reverse direction until the setting pawl engages the fuze setting slot. Rotation continues until the motor comes to rest after the fuze is set. The spur gear differential receives motion from each pawl ring, so that its casing moves in proportion to the angle between the pawls, regardless of orientation. The round may therefore be inserted while in any radial position, without affecting the accuracy of the fuze setting.

When the fuze setting corresponds to that indicated by the repeater, an electrical contact is made which allows the central circuit to fire, thus momentarily energizing the disengaging solenoid. This solenoid releases the knockout sleeve which ejects the setting pawl from the fuze setting slot and opens the motor starting switch. The motor then coasts to a stop and cannot be started until the cycle is repeated.

The movement of the knockout sleeve also closes the switch which was opened when the starting switch was closed. At the same time, the second switch is held in a closed position and thus current flows in the coil of the solenoid which operates the tripping mechanism on the main reciprocating cam. The latter moves the fuze setter from the projectile. As a result of the withdrawal of the fuze nose plunger from the end of the fuze, the current in the solenoid is cut and the reciprocating control of the rammer is reset to normal. With this step, all units of both mechanisms are ready to start the cycle again.

POWDER TEMPERATURE INDICATORS M12, M13, M14, M15—STANDARD

A powder temperature indicator is a device by which the temperature of the powder in fixed rounds can be determined without danger to personnel. The instrument consists of a Powder Temperature Thermometer, M1, a cartridge case for the ammunition being tested, and a metal plug. The cartridge case contains the standard propelling charge, but no igniter. The plug serves as a seal for the cartridge case and contains a hole through which the stem of the thermometer can be inserted to protrude into the powder.

Each indicator is kept in a fiber container similar to those in which the corresponding rounds are shipped. The container is longer than the container for a live round to accommodate the increased length of cartridge case and plug. At the end of the container is an insulated plastic window through which the dial of the thermometer can be read without removing the round from the container.

All standard powder temperature indicators are used with antiaircraft rounds. The four models are identical except for size of cartridge case and amount and type of powder used. The M12 is used with 3″ ammunition, the M13 with 90 mm ammunition, the M14 with 105 mm ammunition and the M15 with 120 mm ammunition.

SCORING REGISTER M1—STANDARD

The Scoring Register, used with automatic antiaircraft weapons firing tracer ammunition, is an instrument which indicates, on dials and on recording tape, the deviations of the tracer stream from the target. The instrument is issued to antiaircraft training centers and to the Antiaircraft Artillery School for use in target practice with rocket targets or towed targets.

The unit consists of two cabinets, one containing the seven dial register and the other containing the tape recorder. In addition, there are cables which connect the spotter's controls and the register. When in use, the scoring register and the tape recorder are placed on a recording desk about 6 feet in length by 3 feet in width.

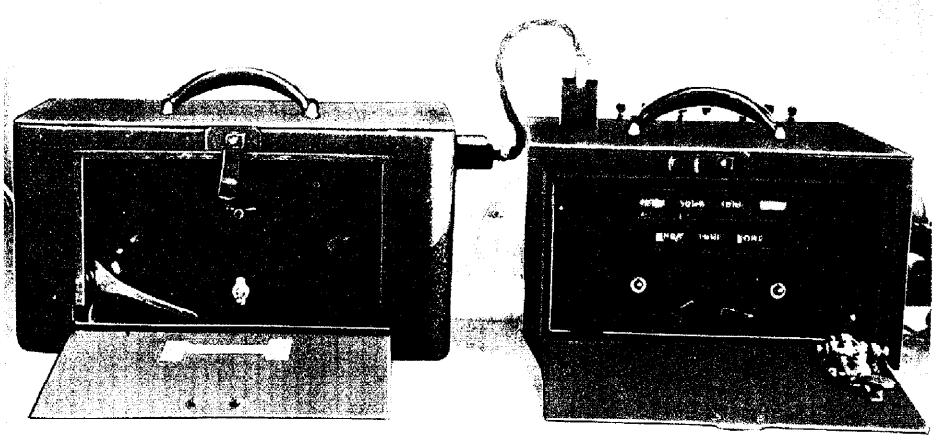
A flank spotter and a front spotter, each situated in a good position for spotting, hold the respective spotting controls. The flank spotter observes the tracers for vertical deflections and the front spotter observes for lateral deflections. In the flank spotter's hand control, there is one button which the spotter presses to indicate overs and another to indicate unders. Similarly, the front spotter presses one button to indicate a shot to the right of the target and another to indicate a shot to the left of the target. If the shot appears to be a hit, the spotter presses both buttons simultaneously.

The seven-dial register automatically registers, in the proper one of the seven dials, the signal sent by each spotter. These data are recorded by two additional operators, the azimuth recorder and the elevation recorder, who occupy positions at the scoring desk. When a hit is spotted, a gong sounds automatically.

Each dial register operates relays which close when the dial actuating armature is pulled back. These relays connect to the tape recorder circuit by a multiple-connector plug and cable. The tape is supplied from a roll and it is driven through the recorder by a spring motor which starts when the first electrical impulse is received. After the last impulse has been received, the motor continues to run only long enough to feed out all tape upon which signals are recorded.

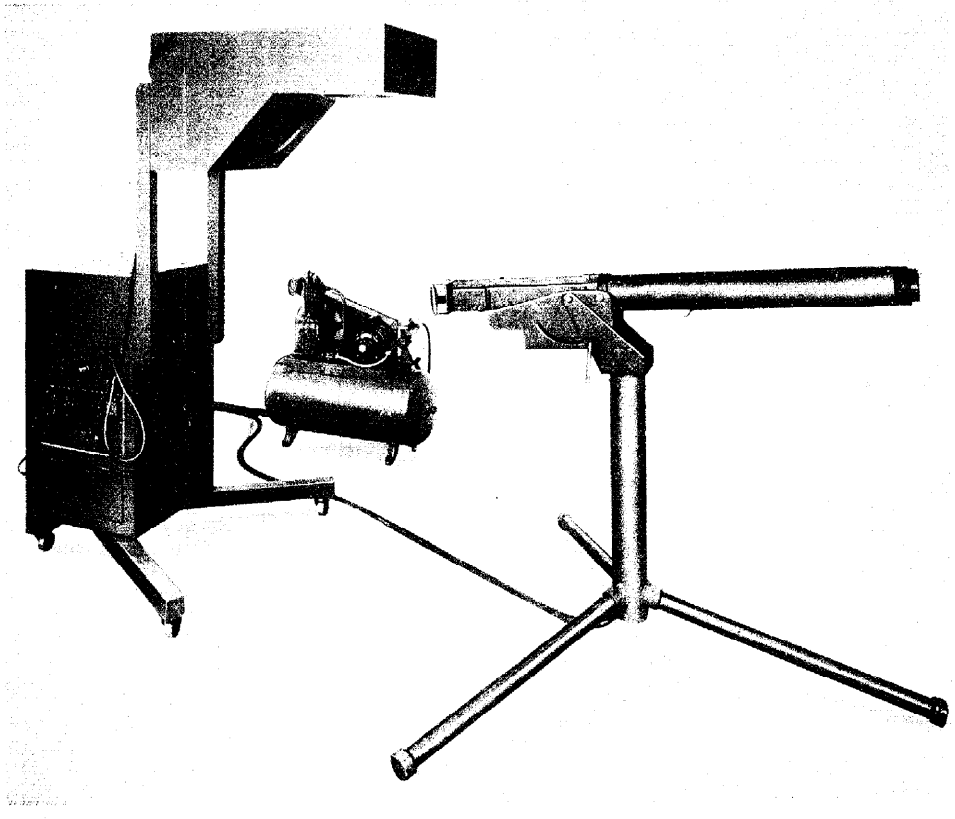
Signals are recorded on the tape by means of two pens, one of which is controlled by each spotting control. When a spotter signals "Right" or "Over," his pen is moved to make a short dash on the recording tape. When a spotter signals "On," his pen will make a long dash. When both spotters signal "On," there will be two long dashes side by side to indicate a hit.

The scoring register is provided with its own self-contained power supply, but auxiliary batteries and an external power supply may be used, if desired.



SCORING REGISTER, M1—LEFT, TAPE RECORDER; RIGHT, SEVEN-DIAL REGISTER

ANTIAIRCRAFT MACHINE GUN TRAINER M9—STANDARD



ANTIAIRCRAFT MACHINE GUN TRAINER, M9

The Antiaircraft Machine Gun Trainer, M9, is used for training gunners in aiming antiaircraft machine guns against aerial targets. It consists of an electrically controlled, pneumatically operated device simulating the appearance of a water-cooled machine gun; a control unit; an air compressor; a target assembly; and an ultraviolet lamp. One advantage of the trainer is that by its use the gunner can obtain experience which would otherwise be attained only in actual combat. In addition, the unit can be set up at any time, indoors or outdoors, and its use eliminates the expenditure of valuable ammunition.

The gun, which is set up in a range scaled at 1:30, releases plastic pellets when the firing mechanism is actuated. The pellets are ejected from the barrel by air pressure at regular intervals corresponding to the intervals between tracers when the cal. .50 machine gun is fired. The gunner elevates and traverses the gun and fires the pellets at a scale-model airplane which may be set to fly a straight course, to climb, or to dive. The time of flight of the pellet to a target at a 50-foot range is approximately the same as that of a cal. .50 projectile to an airplane at a 500-yard range, accurately retaining the 1:30 scale.

In a cabinet contained in the control unit are the electrical units by which the trainer is operated. In addition, the control unit contains a record player with automatic record-changing apparatus, the mechanism for reproducing the sound of muzzle blast, an amplifier, and storage space for records and other equipment. A loudspeaker is mounted on uprights attached to the front of the cabinet. The control cabinet is usually set up about 15 feet behind the gun and 30 feet to the right of the compressor unit.

On the upper part of the right-hand side of the control cabinet is the control panel on which are mounted five electrical switches, a volume control for the record player, a fuze to protect the speaker unit, three electrical outlets, and a pilot light which indicates whether the main switch is on or off. None of the components of the trainer, except the air compressor, can operate unless the main switch is on. The firing switch is turned on to permit the firing mechanism of the gun unit to operate. The recoil switch causes the gun to simulate recoil. In conjunction with the recoil, the gun sound switch is employed to cause the reproduction of the sound of the muzzle blast. The battle sound switch controls the shunt which cuts the recorded battle sounds out of or into the circuit.

Under daylight conditions, white plastic pellets are used, and in darkness fluorescent pellets, painted red for easy identification, are employed. An ultraviolet lamp, located below the water jacket of the gun and controlled by a switch on the gun, makes the fluorescent pellets visible in darkness. The source of power for the ultraviolet lamp is an outlet below the main switch on the control cabinet.

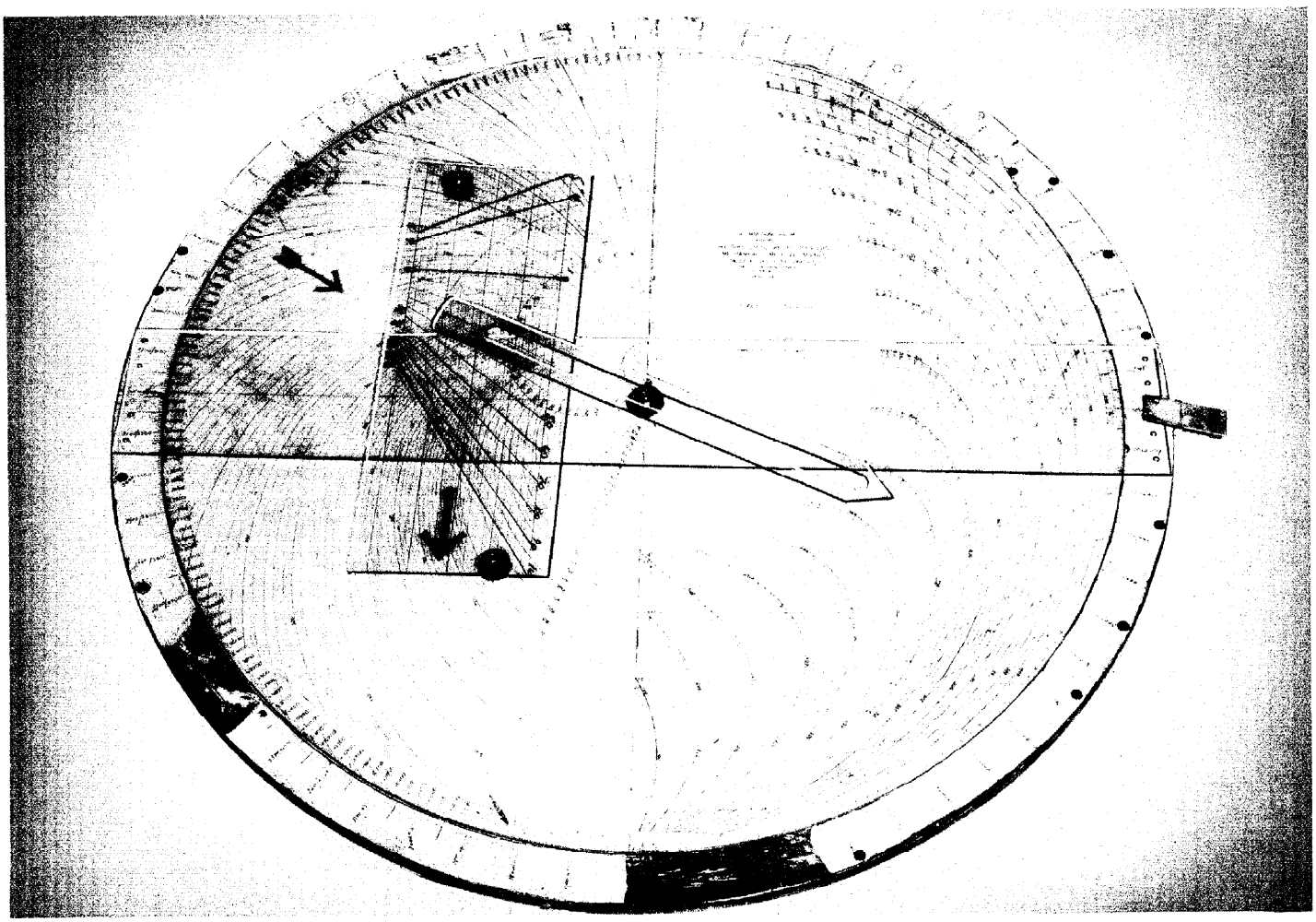
The target assembly is usually set up 50 feet in front of the gun, to reproduce the 1:30 scale. Four metal airplanes serve as targets. Three of them, for daylight use, bear the insignia of the United States, Germany, and Japan respectively. The fourth one has no insignia and is treated with fluorescent paint so that it is visible in darkness by means of the ultraviolet lamp, and with phosphorescent paint so that it is visible when beyond the range of the lamp. In either case, it resembles an airplane in the beam of the searchlight. To provide a permanent record of hits, a paper target with a picture of an airplane is supplied.

In use, the target selected is suspended on one of three trolley wires, strung on a horizontal course, a diving course, and a climbing course. A tow line, controlled by a reel, is attached to the target and operated by the instructor. It is possible to move the target at a speed corresponding to 400 miles per hour. A target towed by an actual airplane cannot ordinarily attain a speed above 150 miles per hour. Thus this device gives training facilities superior to those otherwise obtainable.

For more advanced training, the position of the gun with respect to the target unit can be changed, to give the student experience with targets approaching from various angles. For example, the planes can appear to approach from behind the gunner, or to pass overhead in a climb away from or toward the gunner.

REFERENCE—TM 9-221.

PLOTTING BOARDS M8C AND M8D—STANDARD



PLOTTING BOARD, T9, WHICH IS BEING MODIFIED AS M8C AND M8D

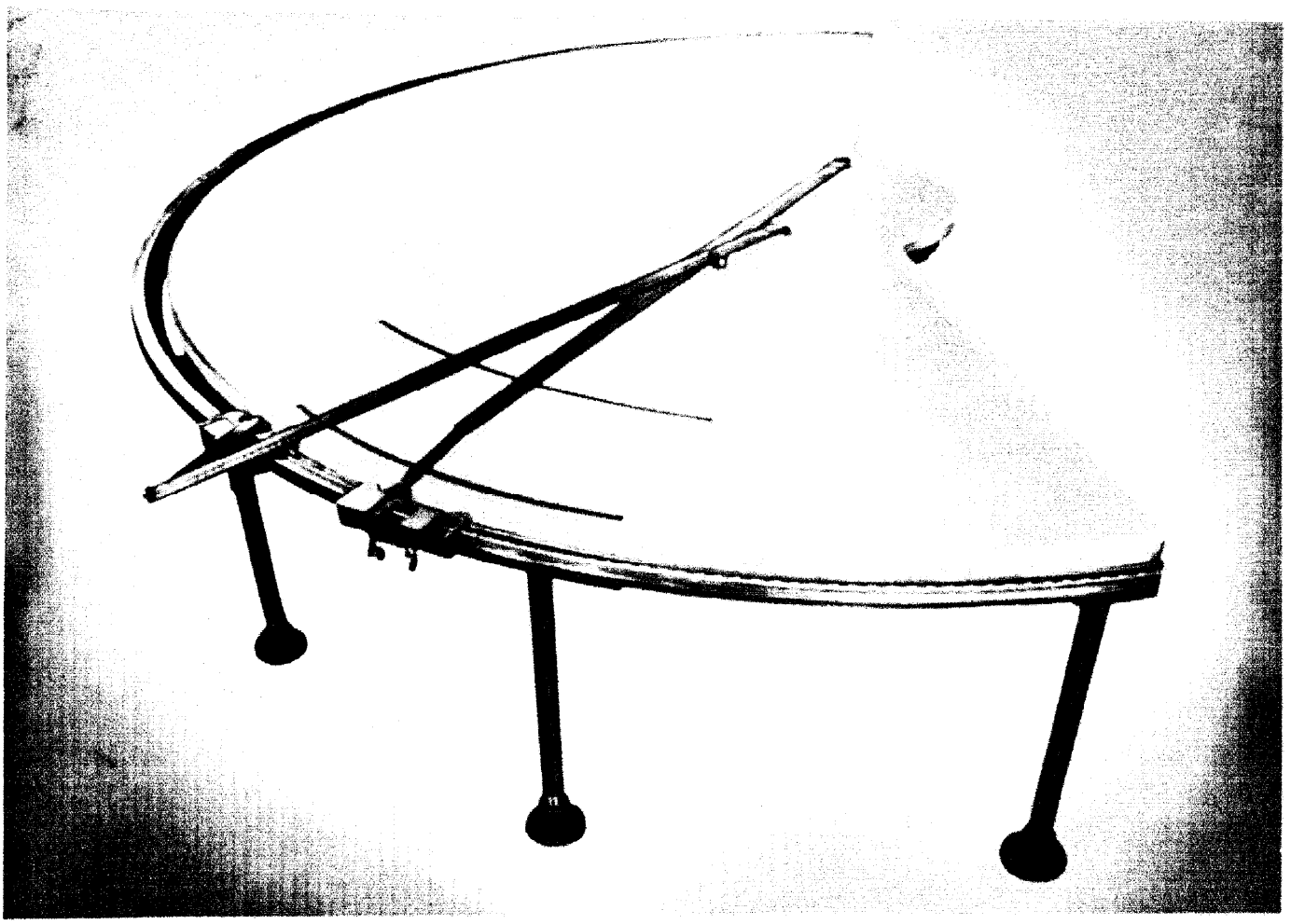
Plotting Boards, M8C, designed for 90 mm ballistics, and M8D, designed for 120 mm ballistics, provide means for plotting the present and future course of an airplane and determining the proper azimuth, quadrant elevation and fuze setting. They are intended only for emergency use in case of failure of the director. These boards, still under design, are being constructed by modification of the T9 Plotting Board.

Plotting Board, T9, is a circular board surrounded by an azimuth circle, and divided in half. Inscribed on the left hand semicircle are angular height curves, while the right hand semicircle contains intersecting quadrant elevation and fuze curves. On the left hand side, just inside the azimuth circle, is an altitude scale graduated at 20-yard intervals and numbered at 100-yard intervals from 0 to 12,800 yards. Revolving on a pivot at the center of the board, and clamped to the azimuth circle, so that the azimuth circle revolves with it, is an azimuth arm with an index inscribed along its entire length. The azimuth arm is used in setting the proper azimuth opposite the altitude of the airplane. At the points where the index coincides with the angular height of the airplane, the successive plotted positions are marked on the plotting surface and connected by a line. The plotting surface is a disc of translucent material on which are inscribed the diameter and parallel chords. It is pivoted about the center of the board over the azimuth arm. Also pivoted about the center, and located above the plotting surface, is a radius arm pointed at one end. The radius arm is also constructed to slide to the left and right along almost its entire length. This plotting board is also provided with a parallax rule and a time speed scale, which are used respectively in correcting for gun displacement and in determining future position. When the radius arm is made to follow the plotted course with the flat end on the predicted point, the pointed end will indicate the proper quadrant elevation and fuze time.

The production models will be modified by increasing the horizontal range to 24,000 yards and in the case of the M8D Plotting Board increasing the altitude range to 16,000 yards, redrafting the present position chart and the ballistic chart, and provision of improved parallax and time-speed rules. In addition, there will be certain mechanical improvements; the parallax lines will be heavier and of a distinctive color; and the plotting surface will be modified to prevent warping and to permit the use of an ordinary pencil.

FIRE CONTROL
MISCELLANEOUS

SUBMARINE MINE PLOTTING BOARDS
M9C, M9D, M9F STANDARD—M1906, M1918A1 LIMITED STANDARD

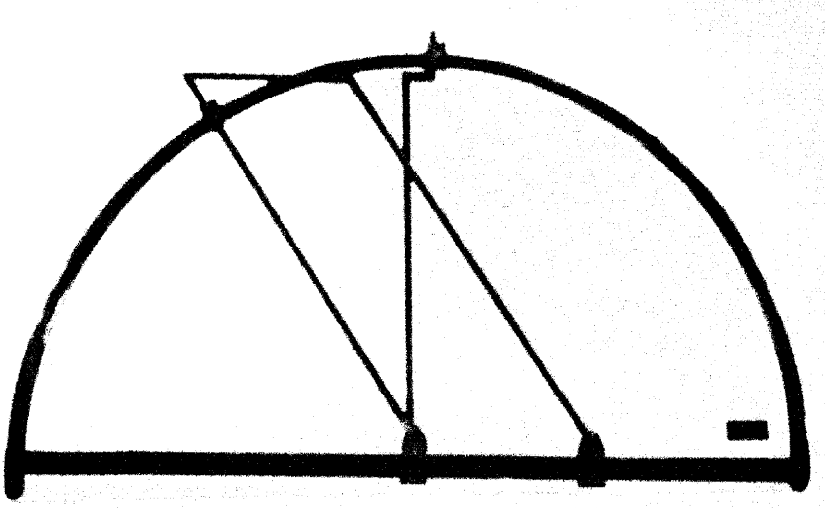


PLOTTING BOARD, M9C

The submarine plotting board is a small scale representation of a mined area and is used for plotting the location of mine fields and the course of a moving target in relation to them.

SUBMARINE MINE PLOTTING BOARD, M1906. This is a semicircular plotting board with a 42-inch plotting radius. Attached to the circular edge is an azimuth circle in which index boxes ride. A base line arm, scaled in ten divisions per inch, which will accommodate itself to the scale of the station arms being used, is placed on the diameter.

The primary arm, representing the primary station, is graduated according to the same scale. It is pivoted from the center of the board, and has an index box



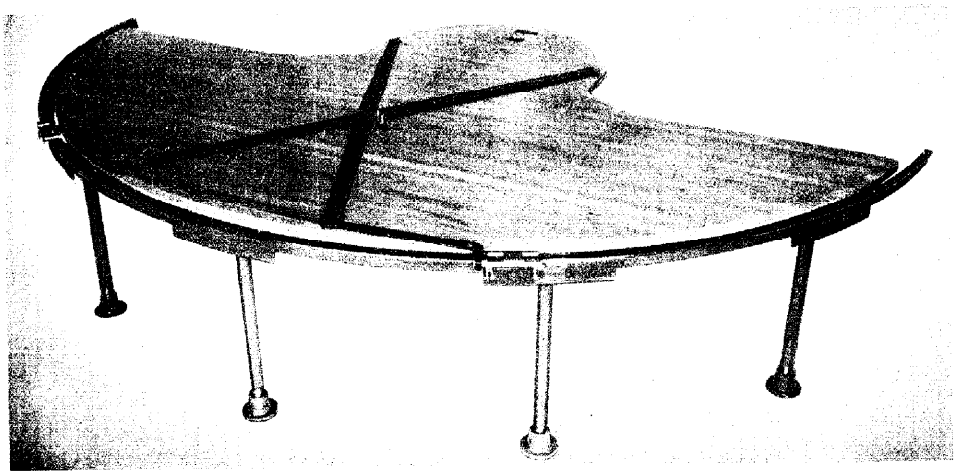
SUBMARINE MINE PLOTTING BOARD, M1906

SUBMARINE MINE PLOTTING BOARDS M9C, M9D, M9F, M1906, M1918A1 (Continued)

on its outer end for indicating the azimuth at which the arm is set.

The secondary arm is pivoted from a sliding block which is set at the point on the base line corresponding to the distance of the secondary station from the primary station. The secondary station index box is attached to the arm by a coupler representing the distance between the two stations. An auxiliary arm is pivoted from the center of the board and is attached to the index box of the secondary arm. It provides a means of keeping the secondary arm parallel to a radius from the center of the board.

SUBMARINE PLOTTING BOARD, M1918A1—This is a larger plotting board with a plotting radius of 75 inches. The board is not a full semicircle, for the azimuth circle covers only about 160°. The base line is not a diameter of a circle, perpendicular to the normal azimuth of the board. The stations are attached permanently to a fixed plate on sleeves correctly positioned in distance and direction from the center of the circle. No auxiliary arm is needed, and the primary and secondary arms are coupled directly to the index boxes. Each coupler is equal in length to the scaled distance between the station represented and the center of the azimuth circle. The index boxes have subscales for reading the azimuths of the station arms to .05°.



SUBMARINE PLOTTING BOARD, M1918A1

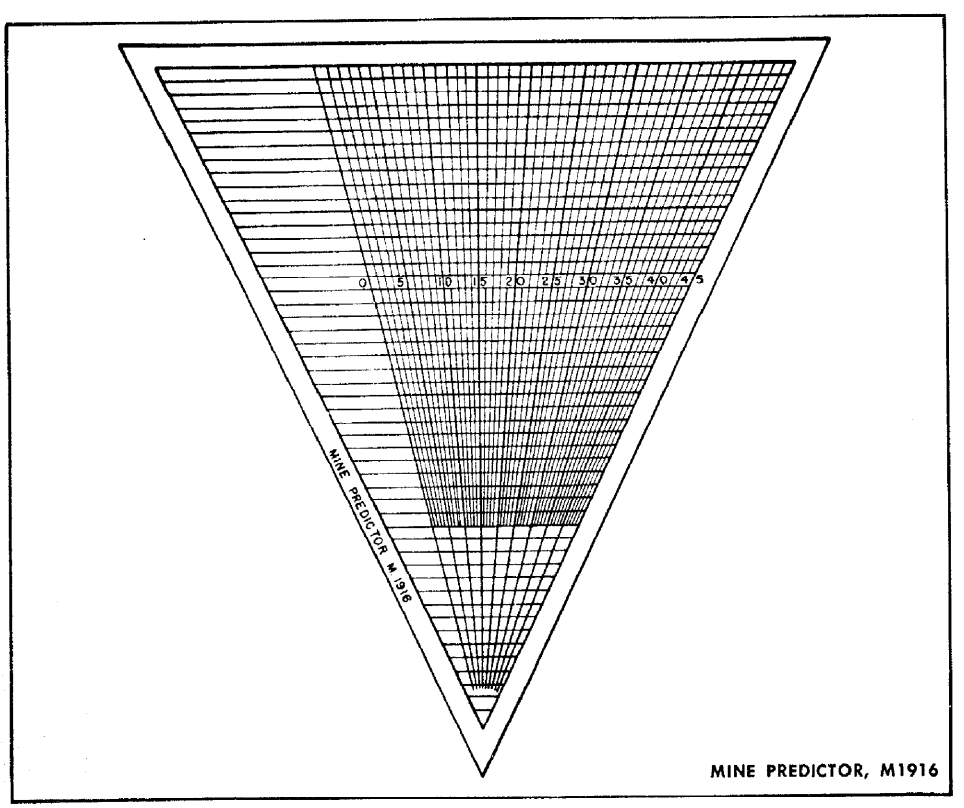
PLOTTING BOARD, M9C—The standard submarine plotting board is an adaptation of Plotting Board, M4, with a plotting radius of 67½ inches and a scale of 150 yards to an inch. It has been standardized in place of the M1906 and the M1918A1 to facilitate production.

PLOTTING BOARD, M9D—This is the M9-type board, scaled at 300 yards per inch.

PLOTTING BOARD, M9F—This is the M9-type board, scaled at 100 yards per inch.

REFERENCES—TM9-1570; TM9-2571.

MINE PREDICTOR M1916—STANDARD



MINE PREDICTOR, M1916

The mine predictor is used in conjunction with the submarine mine plotting board for determining when a moving target will arrive at the location of a mine. The instrument is a triangular piece of xylonite marked into a series of similar triangles. The radial lines represent time at 5-second intervals ranging from 0 on the left to 45 seconds on the right-hand edge. Between the left side of the predictor and the 0-second line is a wider triangle with radial lines representing the travel of the target in 15 seconds.

The course of the target is plotted on the plotting board at 15-second intervals, therefore the distance traveled in 15 seconds can be quickly ascertained. The predictor can be placed on the last plotted position of the target so that the distance between the left-hand edge and the zero graduation is equal to the distance traveled in 15 seconds. The time required for the target to reach the nearest mine can be read on the predictor.

REFERENCE—FM 4-6.

BINOCULARS M2, M13, M15A1, M17—STANDARD
BINOCULARS M3, M7, M8, M9, Mk 21A1—SUBSTITUTE STANDARD
BINOCULARS M6, M15—LIMITED STANDARD

BINOCULAR M2—This instrument is standard to meet all requirements for an 8-power, 56-mm objective binocular. It is designed with a large objective for use as a night glass. At present, it is supplied only to the Engineer Corps for use at searchlight control stations. Binoculars M7 and M15A1 are substitute standard for this requirement.

BINOCULAR M15—This is a 7-power, 50-mm objective binocular, which has been waterproofed to enable it to withstand a 5-minute submersion test. It is limited standard for use by the Engineers and the Air Forces, as well as for other services requiring a large objective binocular.

BINOCULAR M15A1—Binocular M15, modified to permit the use of Filter M1, is standard for issue to the Army Air Forces. It consists of the M15 with the soft rubber eyeshields and the polarized filter and associated mechanism removed. New plain phenolic eyeguards to accommodate Filter M1 are added.

BINOCULAR M13—This is the standard instrument to meet all requirements for a 6-power, 30-mm binocular. It has a field of view of 8° 30′. This instrument was recently adopted as Standard for procurement in lieu of Binoculars M3, M8, and M9, which are now Substitute Standard. The M13 is made to the same specifications as the M3, M8, and M9, except that whereas the latter are subjected to a rain test, the M13 is required to meet a 5-minute submersion test. Another binocular of this group is the limited standard M6 which is similar to the M3, M8, and M9. It was originally procured for the British only and had reticle graduations to meet their needs. Since it has been issued to the U. S. Army Air Forces, it has been given a standard designation.

BINOCULAR M16—This is an unwaterproofed 7 x 50 binocular, with a reticle similar to that of the M13 type of instrument. This binocular is used in limited quantities by cavalry, infantry, and armored units with special requirements for a binocular with a reticle for laying the gun and for spotting. It has better light gathering qualities and higher magnification than the M13 type binocular but is substitute standard for the M17 because it is less waterproof than the latter. This binocular without the reticle is designated M7.

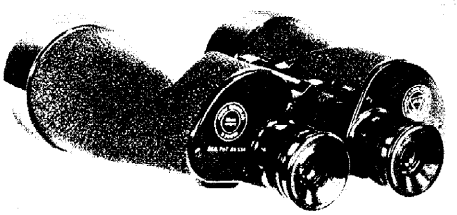
BINOCULAR M17—This consists of Binocular M15, modified by the addition of a reticle. It is standard for issue to those units requiring such an instrument.

BINOCULAR MK. 21A1—This is a 7 x 50 waterproofed Navy binocular. It has been adopted as substitute standard for issue to the Air Forces with case and neck straps but without spare parts.

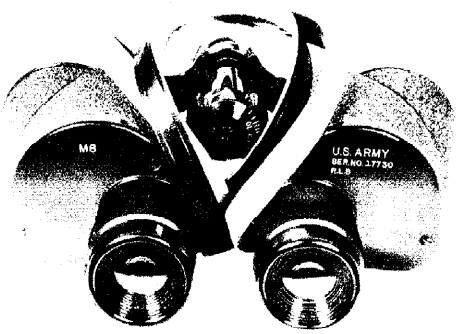
All these instruments have porro-prism erecting systems.

FILTER M1—This variable density filter is to be issued as a standard accessory for every Binocular M3, M6, M7, M8, M9, M13, M15A1, M17, and Mk 21A1. These filters prevent glare and permit observation in conditions of strong light without damage to the eyes. The filter consists of two pairs of polarizing disks, mounted in a frame which can be attached to the eyeguards. Each disk is a sheet of polarizing film between glass. Each pair of disks consists of a fixed disk which serves to neutralize reflection from horizontal surfaces, and a movable disk. The movable disks may be rotated concurrently by means of either of two levers. When in the same axial position as the fixed disk, maximum light transmission is permitted. When rotated 90° from the original position, only a small fraction of the incident light is transmitted. The advantage of this filter is that the light transmission may be varied to suit almost all conditions of visibility.

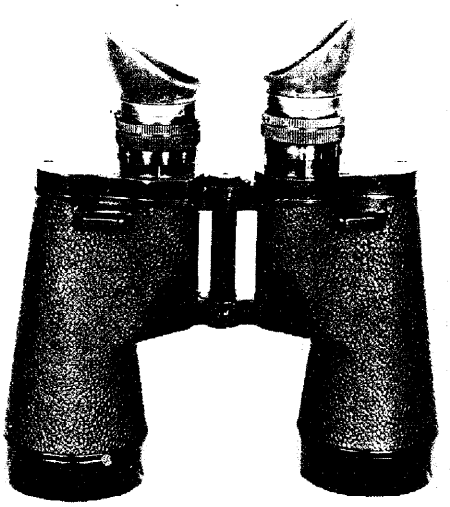
REFERENCES—TM 9-2005, vol. 5; TM 9-575.



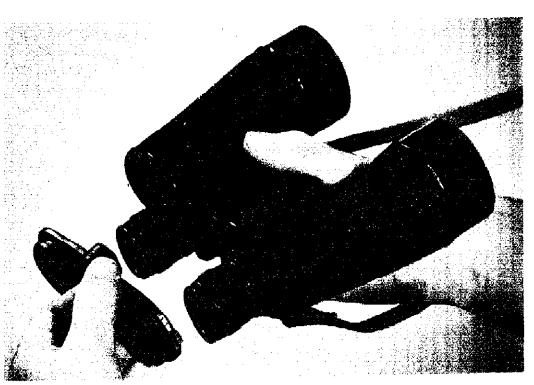
BINOCULAR M2



BINOCULAR M8



BINOCULAR M15

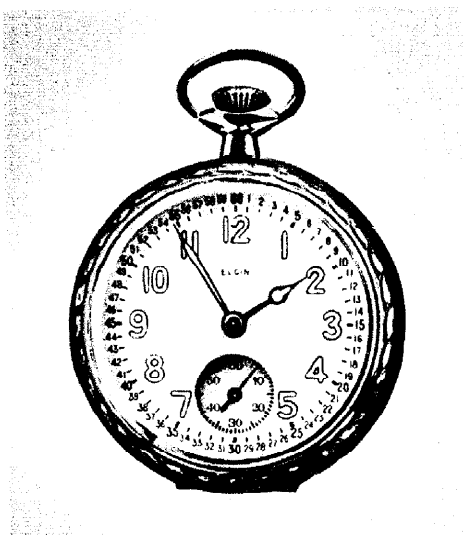


BINOCULAR WITH FILTER M1

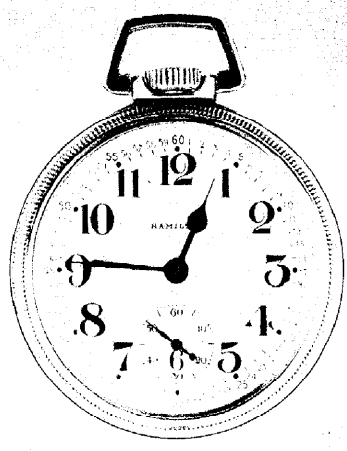
CHARACTERISTICS

	M2	M15A1, M17, Mk 21A1	M3, M6, M8, M9, M13	M7, M16
Magnification	8X	7X	6X	7X
Diameter of entrance pupil	56 mm	50 mm	30 mm	50 mm
Diameter of exit pupil	7 mm	7 mm	7 mm	7 mm
Field of view	100 mils	127 mils	150 mils	127 mils
Weight less strap	50½ oz.	52 oz.	22.25 oz.	41 oz.

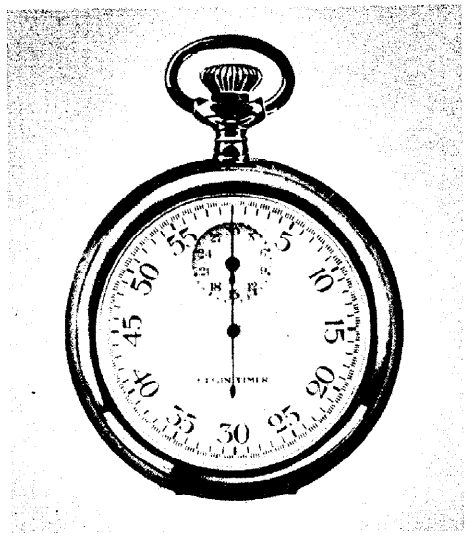
WATCHES—STANDARD



POCKET WATCH, 15 OR MORE JEWELS



POCKET WATCH, RAILROAD GRADE



STOP WATCH, TYPE B, CLASS 15

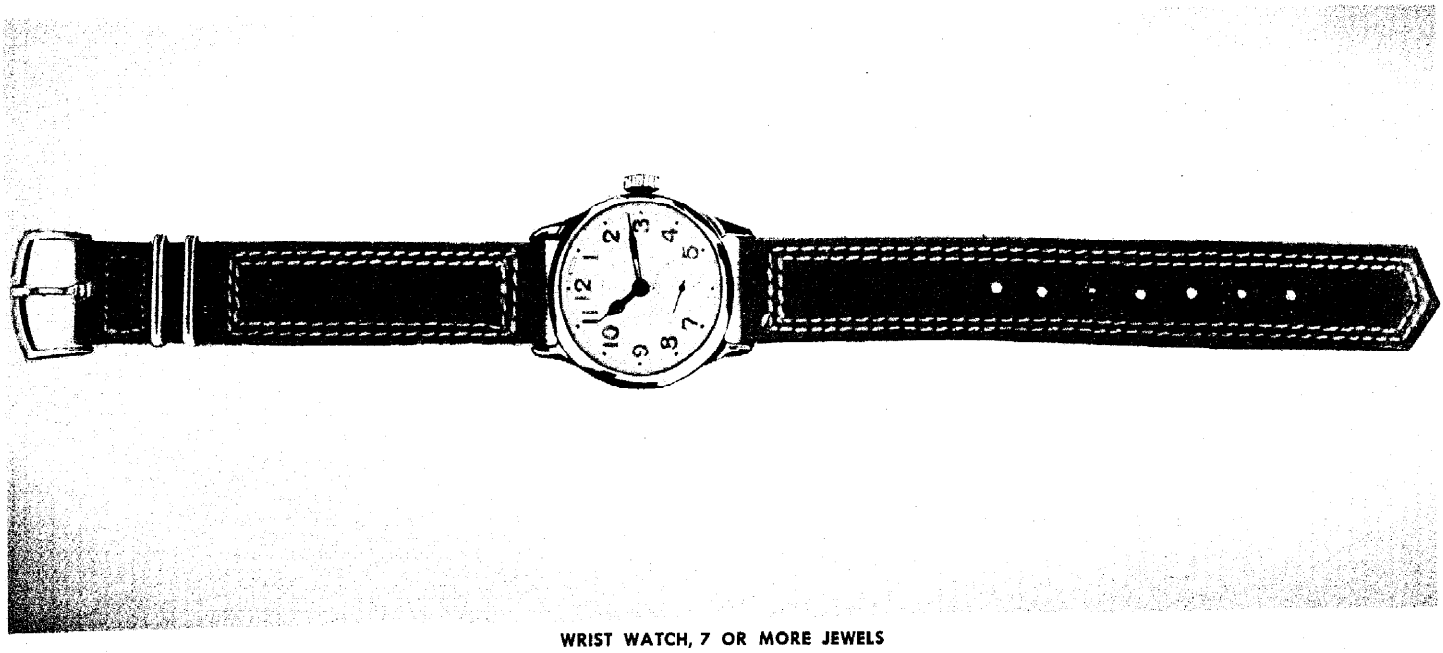
POCKET WATCH, 15 OR MORE JEWELS—This watch has luminous-coated hour and minute hands and a black second hand. It has black minute and second graduations, and small red numerals to indicate 1-minute intervals.

POCKET WATCH, RAILROAD GRADE—This 21-jewel watch is authorized for railway use. It has black numerals and blued-steel hands. The case has a nickel-finish surface.

WRIST WATCH, 7 OR MORE JEWELS—This watch is authorized for issue to all services. The hour and minute hands and hour numerals are luminous-coated for night use. The instrument is somewhat resistant to water and shock. The wrist strap is of water-proof canvas instead of the leather or webbing which was formerly used.

STOP WATCH TYPE B, CLASS 15—This 15-jewel watch has a second dial registering up to 60 seconds in 1/5 second intervals, and a minute dial registering up to 30 minutes in 1-minute intervals. It is controlled by pushing the crown or the pushpiece which extends through the crown.

O.C.M. 19034, 15 Oct. 1942, requires that all watches procured in the future be equipped with a 24-hour face by superimposing figures 13 to 24 in red within the standard 12-hour figures. All watches must successfully pass a test for water resistance.



WRIST WATCH, 7 OR MORE JEWELS

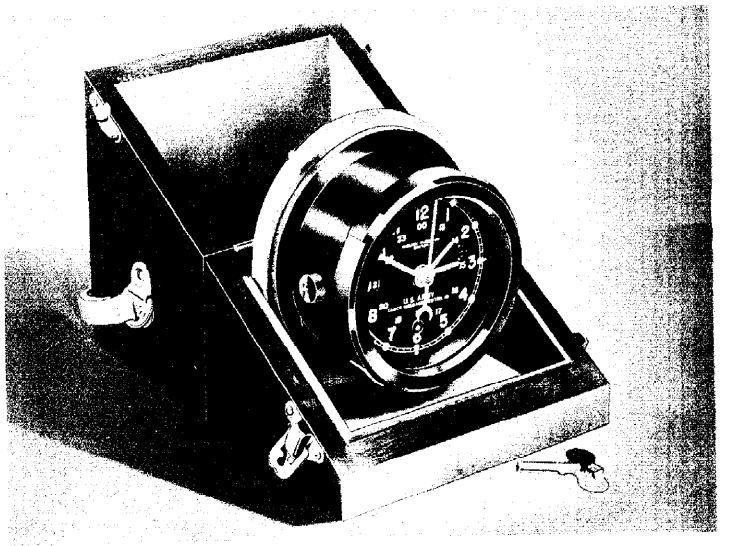
MESSAGE CENTER CLOCKS M2—STANDARD, M1—LIMITED STANDARD

These clocks are timepieces of proven accuracy which are used in message centers. The M1 clock has two adjustable hour hands, one of which is used to indicate the hour in the operation zone and the other to indicate the hour at the point of origin of the message. The timepiece has a black dial and white, radium-inset hands and hour numerals. As in all Ordnance timepieces, there is an inner set of figures from 13 to 00 so that the hours can be read easily according to the 24-hour system. The minute hand is set by an outside stem and the clock has a high-grade, 8-day movement. Accuracy to within 30 seconds in 24 hrs. at temperatures from 0° to 105°F. is one of the specifications of the message center clock.

A carrying case is provided for this clock. It can be opened out to serve as a table support when necessary.

MESSAGE CENTER CLOCK, M2—This clock has a dial 6 inches in diameter. The instrument is moisture resistant, but not completely waterproof and dustproof.

MESSAGE CENTER CLOCK, M1—This timepiece has a dial 4½ inches in diameter and is less moistureproof than the M2.



MESSAGE CENTER CLOCK, M1

BORE SIGHTS—STANDARD

A bore sight is used to determine whether the axis of the bore is properly oriented for direction. Each bore sight consists of a breech element and a muzzle element, designed for one particular model of gun only. In most cases this model number is engraved on the breech element. Several types of bore sights are standard.

For most weapons, the breech element is a disk which fits into the breech end of the gun. There is a small hole in the center for sighting and four large holes used in grasping the disk. The muzzle element for small arms and light Field Artillery consists of black linen cord which is stretched across the muzzle of the gun through notches on the muzzle. A web belt is fastened around the muzzle and holds the cord in place.

For larger weapons the muzzle element is a second metal disk with center clearly indicated by intersecting chords.

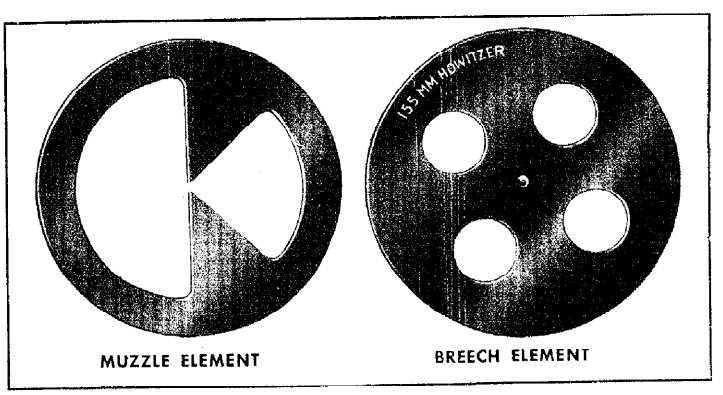
BORE SIGHTS, M10 AND M12—These bore sights are standard for use with 37 mm antiaircraft guns. The M10 is used in the breech and the M12 in the muzzle. The breech bore sight consists of a metal tube which is inserted in the bore and a mirror held at a 45° angle behind the tube. The mirror permits bore sighting by looking down from above the tube extension. It is thus unnecessary to remove the back plate, the driving rod assembly, and the lock frame as must be done when the ordinary type of breech bore sight is used.

The muzzle bore sight consists of a tube which is inserted in the muzzle of the gun. There are two cross wires for use in the actual bore sighting. On the projecting end are three arms which are visible from the rear of the gun. These serve as a warning to the gun crew of the presence of the bore sight.

Procurement of these is being held pending results of tests of Bore Sight Kit, T5.

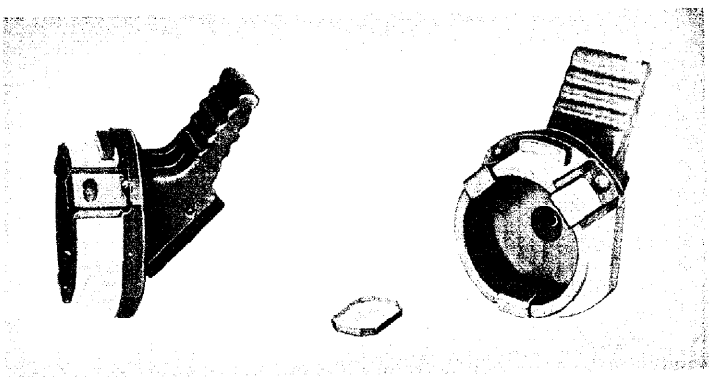
BORE SIGHT, M17—This breech bore sight, standard for the 40 mm Antiaircraft Gun, M1, is used in conjunction with the conventional type of muzzle bore sight. It consists of a disk which fits into the breech of the gun, with a mirror positioned at a 45° angle to permit bore sighting from above without any disassembly of the weapon. The bore sight is correctly positioned by means of a small lug on the forward end which fits into a notch in the barrel. Not only does the lug serve to hold the bore sight in proper vertical alignment, but its upper part interferes with the barrel lock and prevents the closing of the top cover when the bore sight is in the breech.

REFERENCES—FM 4-15; TM 9-2005 vol. V.



MUZZLE ELEMENT BREECH ELEMENT

BORE SIGHTS FOR 155 MM HOWITZER



BORE SIGHT, M17

AIRCRAFT ARMAMENT

BROWNING MACHINE GUN, CAL. .30, M2, AIRCRAFT—STANDARD

BROWNING MACHINE GUN, CAL. .30, M2, AIRCRAFT, ON FLEXIBLE MOUNT

In World War I the .30 caliber machine gun was the predominant aircraft weapon; in World War II it has been reduced to a secondary role by guns of heavier caliber. Its tactical use now is as a supplementary weapon with a high cyclic rate for fire at close ranges.

The Browning Machine Gun, cal. .30, M2, Aircraft, is recoil-operated and air-cooled. It is fed by a metallic link, disintegrating belt in all firing. This gun is designed for both fixed and flexible use and, by replacing some of the component parts, it may be fed from either the left or the right side as desired. The fixed and flexible guns are identical except for the mounting parts.

FIXED GUN—This type is rigidly mounted in the fuselage in front of the gunner or it may be mounted in the wings for firing by remote control. In hand operation an operating slide retracts the breech mechanism for loading, unloading, and clearance of stoppages. A cable may be attached to permit remote control. The fixed gun is normally assembled with a back plate having a horizontal buffer but without spade grips.

The fixed gun, when mounted adjacent to the airplane engine, is fired through the arc of propeller rotation by a synchronizing system which delivers semi-automatic fire timed with the revolutions of the propeller. Fire of wing-mounted guns is controlled by a solenoid and operated by a switch, usually mounted on the pilot's control stick.

FLEXIBLE GUN—This type is installed in the fuselage on a mount which permits free aiming. It has a retracting slide, on the right side of the gun, which connects with the bolt by means of the retracting slide bolt stud. The retracting slide permits retraction of the breech mechanism by hand for loading, unloading, and clearance of stoppages in firing. The flexible gun is provided with a back plate carrying a horizontal buffer, double spade grips, and a hand trigger. It delivers full automatic fire.

REFERENCES—TM 9-205; TM 9-1205; TM 9-2200.

CHARACTERISTICS

Weight of fixed gun	21.5 lb.
Weight of flexible gun	23 lb.
Length, overall	39.8 ins.
Weight of recoiling parts	6.56 lb.
Weight of barrel	3.81 lb.
Length of barrel	23.9 ins.
Length of rifling	70.9 cals.; 21.35 ins.
Rifling	
Number of grooves	4
Right-hand twist: 1 turn in	33.3 cals.; 10 ins.
Depth of grooves	0.0040 in.
Cross-sectional area of bore	0.0740 sq. in.
Rate of fire	1,000–1,350 rds./min.
Firing-pin release	
Pressure applied to sear:	12–17 lb.
Pressure applied to sear holder:	25–35 lb.
Ammunition, types	Ball; A.P.; tracer; incendiary

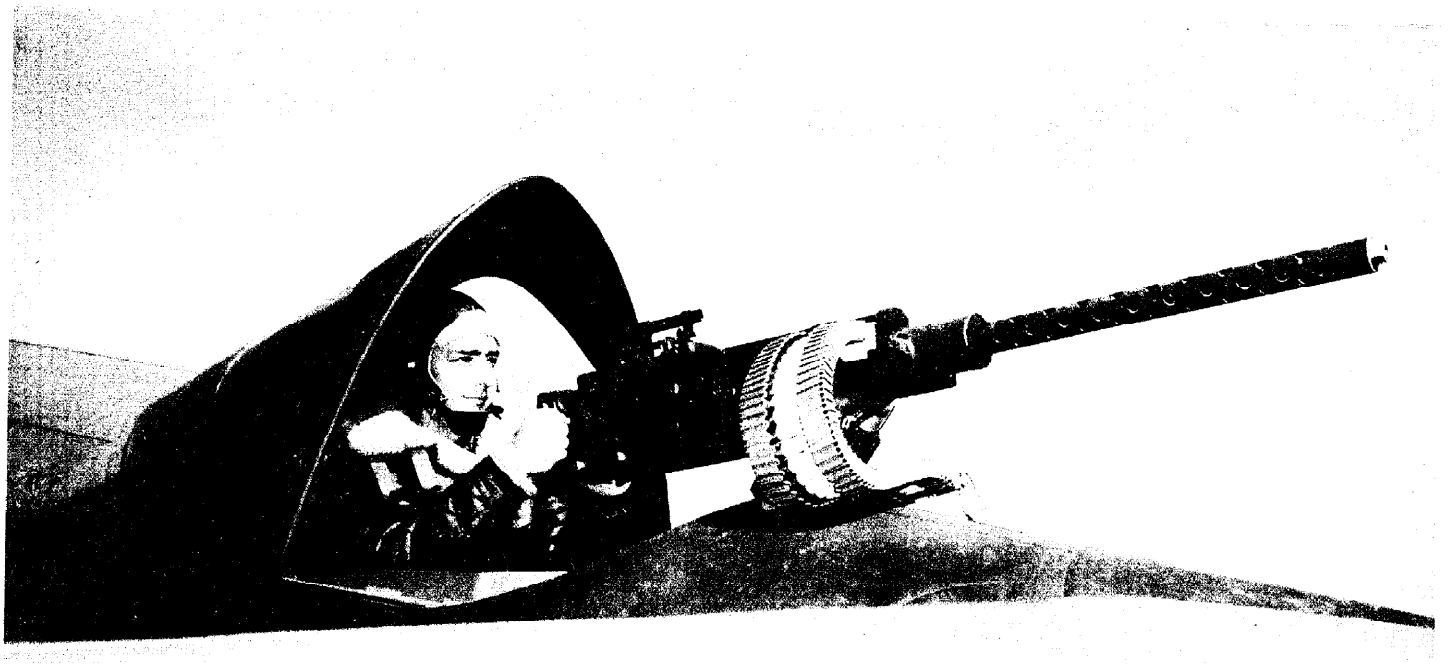
BROWNING MACHINE GUN, CAL. .50, M2, AIRCRAFT—STANDARD

There are three main types of Browning Machine Guns, cal. .50, M2—water-cooled, heavy barrel, and aircraft—and among these the aircraft type was given prime consideration in all phases of design. All these guns may be used in the same mount; and by changing barrels and barrel jackets, and by changing the position of certain minor components, any of the three types may be converted to either of the other two. This interchangeability of the important parts of the gun greatly facilitates mass production with the same tooling setup.

The Browning Machine Gun, cal. .50, M2, Aircraft, is a recoil-operated, belt-fed, air-cooled weapon. The barrel reciprocates in a steel outer jacket drilled to enhance cooling. By repositioning some of the component parts, the gun may be fed from either the right or left side. The disintegrating metallic link belt is used with all installations of the gun.

BASIC GUN—The Browning Machine Gun, cal. .50, M2, Aircraft, is now furnished as a basic gun which may be equipped with either an operating slide group assembly, a retracting slide group assembly, or a retracting slide group assembly and spade grip back plate. The various installations are classified as follows:

WING GUN—This is the basic gun on a fixed mount in the wing of the aircraft. The wing gun may be equipped with a retracting slide assembly, in which case a



BROWNING MACHINE GUN, CAL. .50, M2, AIRCRAFT, MOUNTED IN AN ATTACK BOMBER

charging cable is attached to the slide lever. With either this cable attachment or a hydraulic charger the gun is charged from the cockpit.

Wing-mounted guns are fired by a solenoid attached to the gun receiver and controlled from the cockpit. The solenoid and hydraulic charger are supplied by the Army Air Forces.

SYNCHRONIZED GUN—For synchronized firing, the basic gun is supplied with the operating slide assembly which is provided for retraction of the breech mechanism by hand. The synchronizing mechanism, consisting of an impulse generator attached to the airplane engine, a solenoid, and a trigger motor mounted on the receiver side plate of the gun, is supplied by the Army Air Forces.

FUSELAGE GUN—This type is mounted in the nose, waist, or tail of the plane on a flexible gun mount adapter supplied by the Army Air Forces. The gun mount adapter is equipped with spade grips, back plate trigger, and trigger safety, and is usually provided with a shock-dampening device. The fuselage gun is equipped with the retracting slide assembly, located on either the right-hand or left-hand side of the gun. In some flexible installations, the back plate assembly with spade grips is added. Nose-mounted guns are fired by a solenoid.

TURRET GUN—When installed on a fixed mount in an airplane turret, the basic gun is equipped with a charger and is fired by a solenoid mounted on the back plate, top plate, or side plate. A shock-dampening adapter is usually mounted on the gun. In some turrets the gun is moved both horizontally and vertically by moving the turret as a whole; in others the gun and mount only are moved.

SIGHTS—Sighting equipment for the Browning aircraft machine guns is considered to be plane equipment and is furnished by the Army Air Forces.

ACCESSORIES—Parts added to the gun for firing by trigger motor or solenoid are supplied by the Army Air Forces.

Two devices for accelerating the rate of fire are supplied with the gun as accessories—these are the Flash Hider, cal. .50, M1, and the Aircraft Machine Gun Booster, cal. .50. Either device may be attached to the muzzle end of the barrel jacket and when assembled takes the place of the standard front barrel bearing. The flash hider is usually attached to flexibly installed guns and the booster is used mainly on wing guns or those of fixed installation where muzzle flash is unimportant and where added air resistance would be detrimental. The flash hider boosts the rate of fire approximately 50 rounds per minute and the booster raises it 100 rounds per minute.

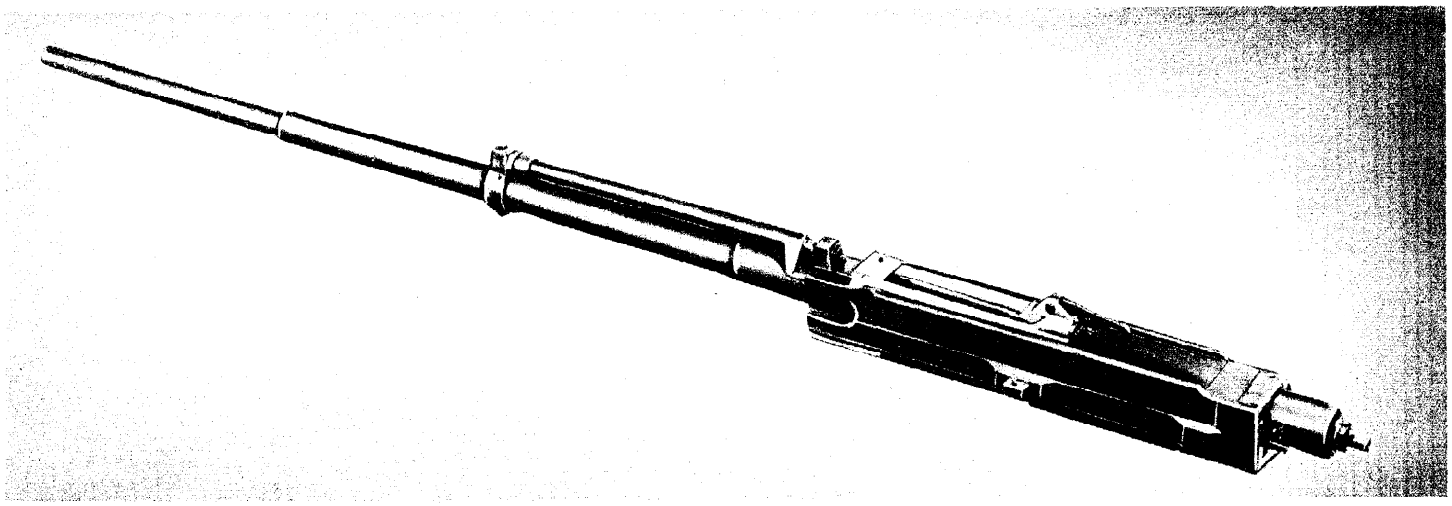
RATE OF FIRE—During training a maximum burst of 75 rounds is permitted from a cool gun. One minute after firing this first burst, firing may be resumed at the rate of one 20-round burst per minute. Combat firing is unrestricted but bursts longer than 75 rounds (5-second bursts) will overheat the barrel and if repeated without pause may cause stoppages or "cooked-off" rounds. Prolonged firing may lead to the scrapping of the barrel, since a new barrel may be ruined by a prolonged burst of about ½ minute duration. After long bursts from synchronized guns the mechanism of the gun must be locked to the rear for 2 minutes to avoid having "cooked-off" rounds strike the propeller blade.

REFERENCES—TM 9–225; TM 9–1225; TM 9–2200.

CHARACTERISTICS

Weight of basic gun	58.32 lb.
Weight of retracting slide group assembly	3.00 lb.
Weight of operating slide group assembly	1.62 lb.
Weight of back plate with horizontal buffer assembly	2.68 lb.
Weight of back plate with spade grips, trigger safety, trigger assembly	4.01 lb.
Weight of side plate trigger assembly	0.44 lb.
Weight of recoiling parts	19.2 lb.
Weight of barrel	9.8 lb.
Length of basic gun, overall	57 ins.
Length of barrel	36 ins.
Length of rifling	63.8 cals.; 31.91 ins.
Rifling	
Number of grooves	8
Right-hand twist: 1 turn in	30 cals.; 15 ins.
Depth of grooves	0.0050 in.
Cross-sectional area of bore	0.2021 sq. in.
Rate of fire	750–850 rds./min.
Firing-pin release	Pressure applied to sear: 10–20 lb. Pressure applied to sear slide: 30–35 lb.
Ammunition, types	Ball; A.P.; tracer; incendiary

20 MM AUTOMATIC GUN AN-M2—STANDARD



BASIC 20 mm AUTOMATIC GUN, AN-M2

The 20 mm Automatic Gun, AN–M2, is a fully automatic aircraft cannon with a muzzle velocity of 2,850 feet per second and a cyclic rate of from 600 to 700 rounds per minute. It is an air-cooled weapon of the gas-unlocking, semi-blow-back type. Designed for fixed mounting in the wing or fuselage of an airplane, the gun may be mounted to fire through the hub of a propeller, and it may also be mounted as a flexible gun in a turret. The gun is seared electrically by remote control but it is not designed for synchronized fire between the blades of a propeller. The 20 mm Gun, AN–M2, was standardized in February, 1941. The 20 mm Automatic Gun, M1, classified as Substitute Standard, is identical with the AN–M2 gun in the tube and working parts, differing only in the dimensions of some of the receiver parts.

The principal components of the basic gun are the receiver, housing most of the working parts, and the tube. The breech end of the tube is screwed into the receiver and secured with a locking pin to prevent its vibrating loose during firing. Mounted on the tube is a gas cylinder and sleeve group, the function of which is to unlock the bolt. In firing, the only parts of the gun that do not recoil are the forward mount ring, the magazine slide assembly, and the magazine.

Changes in the 20 mm Automatic Guns, M1 and AN–M2, made early in February, 1943, included:

(a) The removal of $\frac{1}{16}$ inch from the back of the key slot of the standard firing pin (making it a floating firing pin).

(b) The adoption of a modified extractor spring (Wallace-Barnes strut type).

(c) The strength of the breechblock slide springs was increased.

(d) The chamber was shortened 1 mm.

There are seven gun type designations based on the kind of adapter, sear-actuating mechanism, and charger used with the basic M1 or AN–M2 gun, as follows:

Type A, used by the U. S. Army Air Forces, consists of the basic M1 or AN–M2 gun with AN–M1 adapter, AN–M1 electric trigger, and M2 manual charger.

Type B, used by the U. S. Army Air Forces, consists of the basic M1 or AN–M2 gun with M6 adapter, AN–M1 electric trigger, and M2 manual charger.

Type C, used by the U. S. Army Air Forces, consists of the basic M1 or AN–M2 gun with M7 adapter (with thread protector), AN–M1 electric trigger, and M2 manual charger.

Type D, used by the U. S. Army Air Forces, consists of the basic M1 or AN–M2 gun with M7 adapter (with M1 muzzle brake), AN–M1 electric trigger, and M2 manual charger.

Type E, used by the U. S. Navy, consists of the basic AN–M2 gun with the AN M1 adapter, AN M1 electric trigger, and M1 hydraulic charger.

Type F, used by the British, consists of the basic M1 gun with M7 adapter (with thread protector) and M1 sear mechanism.

Type G, used by the British, consists of the basic AN–M2 gun with M7 adapter (with thread protector) and M1 sear mechanism.

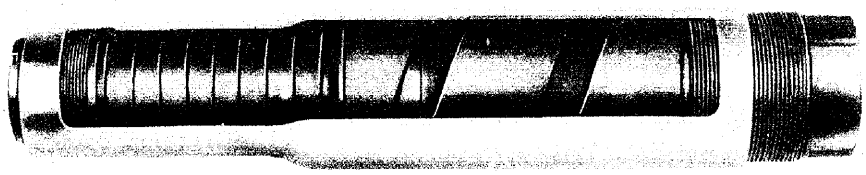
ADAPTERS—The AN–M1 adapter is a self-contained tubular unit consisting of a ring spring in series with a coil spring. Fitted over the tube of the gun, it serves as a front mounting and also controls the recoil of the gun within definite limits (0.875 inch to 1.25 inches) sufficient to operate the feed mechanisms which derive their operating power from the recoil movement of the gun.

CHARACTERISTICS

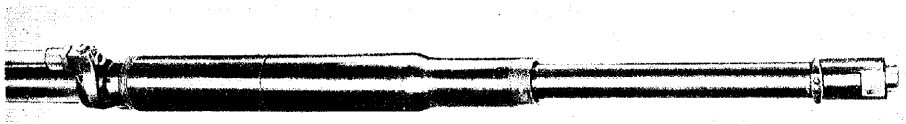
Weight of basic gun, AN-M2 or M1	102 lb.
Length of basic gun overall	94 ins.
Weight of 20 mm Adapter, AN-M1	11.3 lb.
Weight of 20 mm Adapter, M6	14 lb.
Weight of 20 mm Adapter, M7 (with thread protector)	7.5 lb.
Weight of 20 mm Adapter, M7 (with muzzle brake)	10.7 lb.
Weight of Muzzle Brake, M1	4.6 lb.
Weight of Electric Trigger, AN-M1	5 lb.
Weight of Sear Mechanism, M1	1.3 lb.
Weight of Manual Charger, M2	1.5 lb.
Weight of Hydraulic Charger, M1	2.6 lb.
Weight of 20 mm Feed Mechanism, AN-M1A1	18½ lb.
Weight of 20 mm 60-round Magazine, M1A1 (empty)	22 lb.
Weight of projectiles	
H.E.I., Mk. I	0.286 lb.
A.P., M75	0.363 lb.
Ball	0.276 lb.
Muzzle velocity	
H.E.I., Mk. I	2,800 ft./sec.
A.P., M75	2,615 ft./sec.
Ball	2,850 ft./sec.
Maximum powder pressure	48,000 lb./sq. in.
Rate of fire	600-700 rds./min.

Adapter, M6, consists of an AN–M1 adapter with a rear extension body added to increase the overall length of the adapter by $8\frac{1}{16}$ inches in order to meet special Air Force mounting requirements.

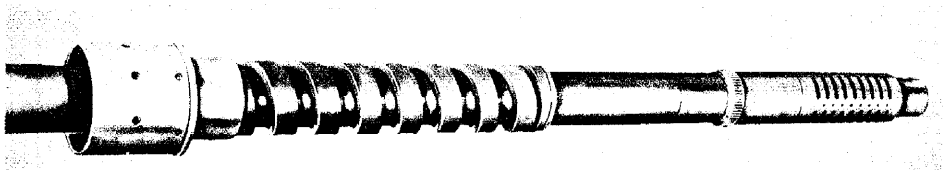
Adapter, M7, consists of a dashpot piston, a recoil spring with a recoil spring filler sleeve, a recoil spring sleeve, and a muzzle brake lock. It reduces the force of recoil on the airplane structure by the resistance of the spring which is compressed against the shoulder in the mounting when the gun recoils. Muzzle Brake, M1, is screwed on the barrel of the gun when the M7 adapter is used in conjunction with the 60-round Magazine, M1-A1, to reduce recoil distance. When the AN–M1A1 feed mechanism and M7 adap-



CUTAWAY VIEW OF 20 mm AN-M1 ADAPTER



20 mm ADAPTER, M6



20 mm ADAPTER, M7, WITH MUZZLE BRAKE, M1

ter are used together, the muzzle brake must be replaced by a thread protector.

SEAR-ACTUATING MECHANISMS—Electric Trigger, AN–M1, is designed to fire the 20 mm guns in airplanes that are equipped with 24-volt electrical systems. It consists essentially of a mounting plate assembly and solenoid body and is attached to the receiver plate of the gun. The solenoid plunger and attached sear shaft are moved magnetically against spring tension by a force of approximately 75 pounds to depress the sear and fire the gun.

Sear Mechanism, M1, uses a bowden cable to move a sear spring plunger against the sear. A groove in the bowden connection shaft accommodates a safety trigger pin operated by a safety lever which is held in two positions, "Safe" and "Fire."

CHARGERS—Hydraulic Charger, M1, is used with Naval installations of the 20 mm AN–M2 gun where it is required that the gun be charged or "safetied" by remote control.

Manual Charger, M2, was previously designated as the B6 charger by the U.S.A.A.F. It consists essentially of a flanged charger slide for engaging and retracting the bolt assembly.

FEED MECHANISMS—The 20 mm Feed Mechanism, AN–M1A1, utilizes the recoil energy of the gun to draw a belt up to the gun, separate the rounds from the disintegrating links, and feed the rounds, one at a time, into the breech of the gun. This feed mechanism is made for both right-hand and left-hand feeding.

In the cylindrical metal case of the AN–M1A1 feed mechanism four sprockets, with hubs keyed on a rotatable central shaft, form an assembly which rotates as a whole. A link-ejector bracket is mounted on the hub of the front sprocket, a front feed lever carrying a last round retainer is mounted on the hub of the center sprocket, and a rear feed lever is mounted on the hub of the rear sprocket. The fourth sprocket was added in the AN–M1A1 mechanism at the forward position of the shaft to aid in supporting the projectile. Riveted to the front sprocket is a driving spring case within which is a spiral driving spring.

The mechanism is operated by the tension of the initially wound driving spring, this tension being maintained by the recoil of the gun which actuates a charging cam assembly. A recoil of approximately $\frac{13}{16}$ inch is required to operate the feed properly. As each round leaves the mouth, the driving spring acts in the driving spring case to rotate the shaft and the feed sprockets, thus feeding another round into the mouth.

Changes distinguishing the AN–M1A1 feed mechanism from the AN–M1 included an increase in the torsional pull of the spring from 180 pounds to 210 pounds, welding of the clutch into one piece, and hardening of the lips of the feed mouth to reduce wear.

The cartridges and disintegrating links can be assembled into a belt by hand or by means of the 20 mm Ammunition Linking Machine, M4.

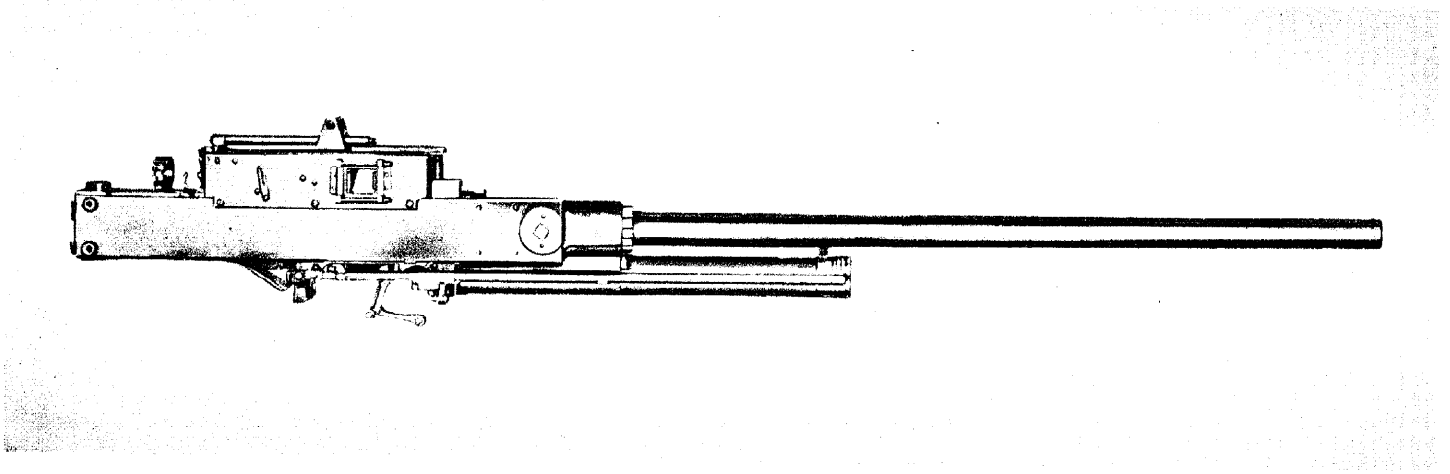
The 20 mm 60-round Magazine, M1A1, is operated by spring tension alone. Initial tension is applied during assembly and further tension is applied progressively in loading. The tensioned spring acts through the tensioning tube, feed arm axis tube, and feed arm to maintain the platform or follower in contact with the last round. Thus a round is always in position in the magazine mouth. The M1A1 magazine differs from its predecessor, the M1, in that the spring was changed to that used with the Oerlikon magazine, the spring case cover was changed from a forging to a stamping, and an improved method of fastening the spring to the case was adopted. A muzzle brake must be used with this magazine as it does not perform the function of the Feed Mechanism, AN–M1A1, in absorbing a portion of energy from the recoil.

FIRING CYCLE—When the sear is depressed, releasing the bolt assembly, the driving spring forces this bolt assembly forward, picking up the round from the mouth of the feed mechanism and forcing it into the chamber. When the round is chambered and the bolt assembly is in the forward position, the bolt lock drops into position and releases the breechblock slide assembly which allows the driving spring and breechblock slides to carry the firing pin forward to strike the primer. As the projectile passes the gas port a pressure is exerted against the gas piston which actuates the bolt-unlocking mechanism. The bolt is then forced backward by the then-existing pressures in the chamber and the force of the piston rods, compressing the driving and buffer springs. Extraction is accomplished by an extractor on the face of the bolt and ejection of the round is done by an ejector attached to the magazine slide upon which the feed mechanism is mounted. For automatic firing the sear is held in a depressed position, allowing the gun to fire continuously until the sear is released to engage the bolt assembly at the rear of the receiver.

AMMUNITION—This is issued in the form of fuzed complete rounds of fixed ammunition, classified as high-explosive-incendiary, armor-piercing, or ball. The M1, AN–M2, and British Hispano-Suiza guns fire the same ammunition. Service ammunition includes cartridge, H.E.I., Mk. I, with fuze, percussion, D.A., no. 253, Mk. III/A/; cartridge, A.P.–T., M75; and cartridge, projectile, ball.

REFERENCES—*Guns, M1 and M2:* O.C.M. 16429, 16530; *Gun, AN–M2:* O.C.M. 18019, 19654; *Adapter, AN-M1:* O.C.M. 17820, 18109; *Adapter, M6:* O.C.M. 20968; *Adapter, M7:* O.C.M. 20853; *Manual Charger, M2:* O.C.M. 21192; *Feed Mechanism, AN–M1A1:* O.C.M. 20746, TM 9–227.

37 MM AUTOMATIC GUN M4—STANDARD



37 MM AUTOMATIC GUN, M4

The 37 mm Automatic Gun, M4, is a plane-to-plane and plane-to-ground weapon with a muzzle velocity of 2,000 feet per second and a cyclic rate of 150 rounds per minute. The armor-piercing projectile, M80, fired from this gun will penetrate 1 inch of homogeneous armor plate at 500 yards. The gun is constructed to fire in any position, all of its parts functioning independently of gravity. It is magazine fed and may be fired manually or by remote control through a solenoid mounted at the rear of the gun. The 37 mm Gun, M4, was standardized from Limited Procurement type, T9, in December, 1939.

Recoil and counter-recoil are controlled hydraulically by means of a piston and spring combination connected to the recoiling parts and operating in an oil-filled recuperator cylinder mounted on the stationary trunnion block assembly. The recoiling parts of the gun include the tube and tube extension, the recuperator piston and piston rod, the lock frame assembly, the driving spring assemblies, and the breechblock assembly. The nonrecoiling parts include the trunnion block group, the feed box and feeding mechanism, the recuperator cylinder and bushing, the back plate group, and the manual charger assembly.

MOUNTS—The gun may be mounted in either a flexible or fixed mount, as provided by the Air Force.

FEEDING MECHANISM—As the gun was originally designed, ammunition could be fed by a 5-round clip, a 15-round link belt, or a nondisintegrating 30-round endless belt (horsecollar) magazine. The 30-round endless belt Magazine, M6, is now used exclusively with this gun. The M4 gun feeds only from left to right. Mounted on the trunnion block assembly is the feed box containing the feed mechanism which draws the belted ammunition from the magazine and feeds it into the gun automatically. The 30-round endless belt Magazine, M6, is an oval-shaped framework providing a track for the endless belt. The articulated link belt contains 33 clips, although only 30 rounds are ordinarily loaded into the magazine. Modified M6 magazines are provided with a loading index, the purpose of which is to provide a lock for the belt when the feed slide is half-way across the full travel and thus reduce double feeding, particularly when the magazine is half empty.

FIRING CYCLE—Initial loading and cocking of the gun are accomplished manually. A safety feature incorporated in the design of the trigger mechanism prevents firing the round until the breechblock assembly is in the battery position.

The breech is locked and unlocked by recoil action which brings the operating lever guide pins against cams to raise and lower the breechblock. The function of the breechblock is to assist in the final chambering of the round, close the breech, and actuate the trigger trip. It also provides a mounting for the firing pin.

The lock frame, during automatic firing, is retracted by recoil action and is forced forward by the driving springs. The major function of the lock frame assembly is to force the cartridge into the chamber, actuate the breechblock, fire the round by means of the hammer striking the firing pin, extract the cartridge case from the chamber, and operate the ejector.

The back plate assembly, by absorbing the energy of the lock frame, reduces the shock against the carrier pin as the lock frame is latched to the rear.

The driving spring assemblies hold the lock frame against the carrier dog until the carrier is released by the carrier catch which is pivoted by the incoming round. The springs then drive the lock frame assembly forward, to operate the ejector, chamber the round, and raise the breechblock.

Initial extraction occurs during recoil. Extraction, ejection, feeding, and loading are accomplished during counter-recoil. If the trigger is held in the firing position, the gun will continue to fire automatically until the magazine is empty.

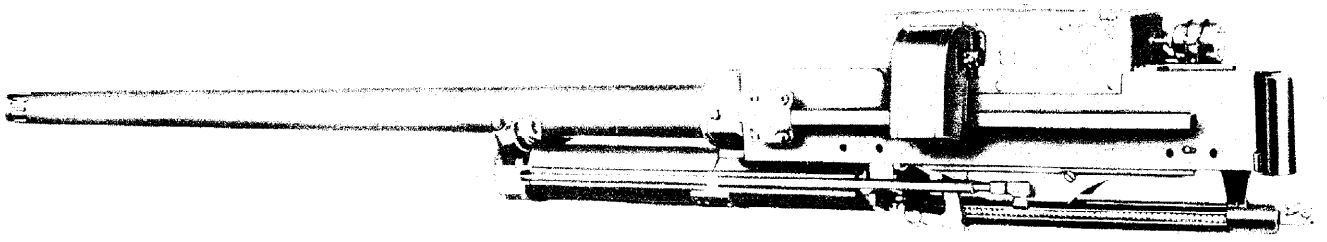
AMMUNITION—Ammunition is issued in the form of fixed rounds, consisting of H.E. shell, M54, with P.D. fuze, M56; practice shell, M55A1, with dummy fuze, M50; and A.P. shot, M80.

REFERENCES—O.C.M. 15542, 15619; TM 9-240.

CHARACTERISTICS

Weight of gun	213 lb.
Weight of 30-round Magazine, M6 (empty)	35.5 lb.
Length of gun overall	89.5 ins.
Weight of projectiles	
H.E., M54	1.34 lb.
Practice, M55A1	1.34 lb.
A.P., M80	1.66 lb.
Muzzle velocity	
H.E., M54	2,000 ft./sec.
Practice, M55A1	2,000 ft./sec.
A.P., M80	1,825 ft./sec.
Maximum powder pressure	23,200 lb./sq. in.
Length of recoil	9⅝ ins.
Rate of fire	150 rds./min.

37 MM AUTOMATIC GUN M9—STANDARD



37 mm AUTOMATIC GUN, M9—RIGHT-HAND FEED GUN—LEFT SIDE VIEW

The 37 mm Gun, M9, is a fully automatic aircraft weapon firing high-explosive and armor-piercing projectiles at a rate of 140 rounds per minute. The muzzle velocity of this gun firing the 1.66-pound A.P. round, M80, is 3,050 feet per second and this shot will penetrate 3.1 inches of homogeneous armor plate at 500 yards. It is therefore an effective plane-to-plane and plane-to-ground weapon. Basically a modification of the 37 mm Antiaircraft Gun, M1A2, the M9 gun was standardized in January, 1943.

The 37 mm Gun, M9, may be mounted in the propeller shaft or in the wings, for which right- and left-hand disintegrating link belt feed mechanisms are provided. It is fired electrically by remote control but it is not designed for synchronized firing between the propeller blades.

The major components of the gun are the trunnion block group, the tube and tube extension, the recuperator group, the lock frame assembly, the breechblock assembly, the back plate group, the driving spring assemblies, and the feeding mechanism. The trunnion block group may be considered as housing the gun, as it provides for mounting the weapon and supports all the operating mechanism. The breech end of the one-piece tube screws into the tube extension, the tube extension in turn being connected to the hydraulic recuperator mechanism by means of the piston rod and nuts. The breechblock is of the vertical drop type, automatically operated.

The gun consists of two distinct groups, recoiling and nonrecoiling. The nonrecoiling unit contains the trunnion block group, the feed box and feed mechanism, the recuperator, the recuperator bushing, the expansion chamber, and the back plate group. The recoiling portion of the gun consists of the tube and tube extension, the recuperator piston and piston rod, the lock frame assembly, the driving spring assemblies, and the breechblock assembly.

MOUNTS—The gun may be mounted on either a fixed or flexible mount as provided by the Air Force.

OPERATION—Initial loading and cocking of the gun are accomplished manually. After the first round has been fired the gun will continue to function automatically while the trigger is held in firing position. Explosion of the propellant forces the recoiling parts of the gun rearward, the breechblock being lowered in the process. Recuperator springs return the tube and tube extension to battery while the lock frame assembly, which moves independently of the tube extension, is carried forward by action of the driving springs and the compressed buffer springs.

When the lock frame assembly separates from the tube extension during recoil an extractor lip engages the rim of the empty cartridge case and partially withdraws it from the chamber. Extraction is completed during the forward movement of the tube extension in counter-recoil, the case being deflected downward out of the gun.

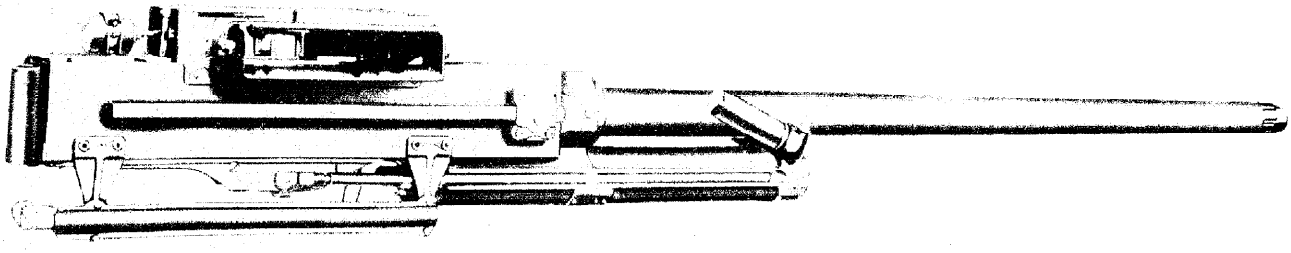
CHARACTERISTICS

Weight of gun	398 lb.
Length of gun overall	104 ins.
Weight of projectiles	
H.E., M54	1.34 lb.
A.P.C., M59	1.91 lb.
A.P., M80	1.66 lb.
Practice, M55A1	1.34 lb.
Muzzle velocity	
H.E., M54	2,600 ft./sec.
A.P.C., M59	2,800 ft./sec.
A.P., M80	3,050 ft./sec.
Practice, M55A1	2,600 ft./sec.
Maximum powder pressure	46,000 lb./sq. in.
Length of recoil	10¾ ins.
Rate of fire	140 rds./min.

Forward movement of the lock frame causes the charger to drive the round into the cartridge chamber, while coincident rotation of the operating lever lifts the breechblock into the closed position, the taper on the upper front side of the block completing the chambering of the round as the breechblock slides past the base of the cartridge. As it moves upward the breechblock raises the front end of the trigger trip, releasing the hammer if the trigger is held in firing position.

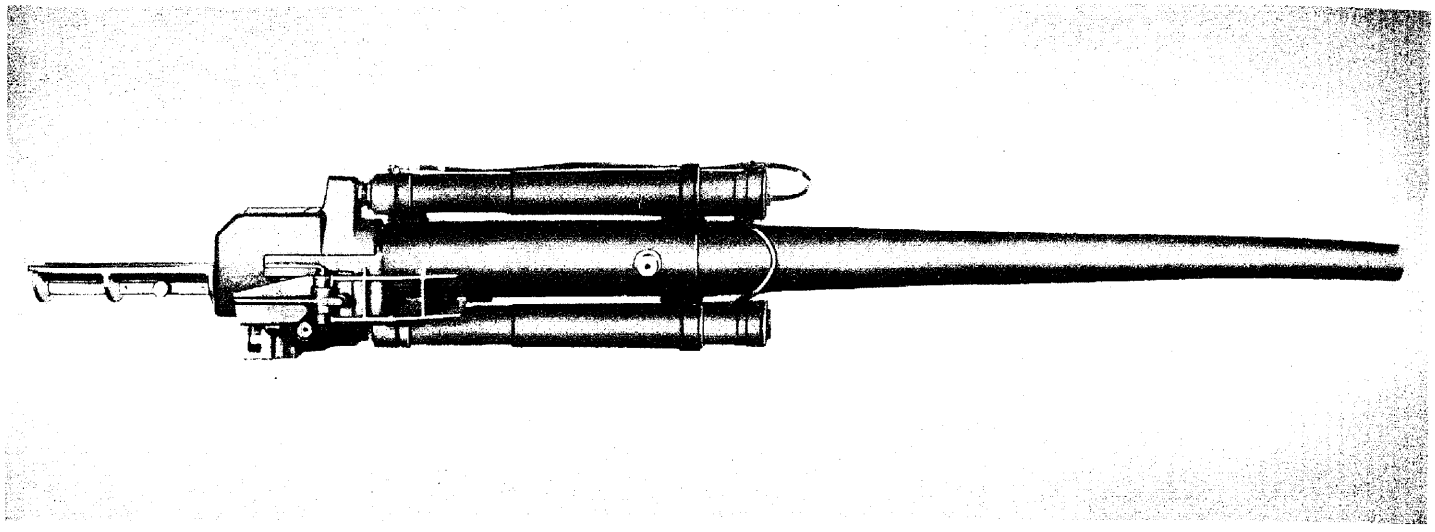
AMMUNITION—Ammunition is issued in the form of fuzed complete rounds of fixed ammunition. It consists of shell, H.E., M54, with fuze, P.D., M56; shot, A.P.C., M59; shot, A.P., M80; and shell, practice, M55A1, with fuze, dummy, M50.

REFERENCES—O. C. M. 19378; TM 9-241.



RIGHT SIDE VIEW

75 MM AIRCRAFT GUN M4—MOUNT M6—STANDARD



75 mm AIRCRAFT GUN, M4—MOUNT, M6

The 75 mm Aircraft Gun, M4, is a modification of the 75 mm Tank Gun, M3, designed for aircraft installation for tactical plane-to-ground use against sea and land targets. The M4 gun is mounted in the airplane on Mount, M6, a development of the Mount, T3E1. Military characteristics for this gun were approved in January, 1937, and Mount, M6, was approved for development in April, 1942. The 75 mm Aircraft Gun, M4, and the Mount, M6, were standardized in October, 1942.

The 75 mm Aircraft Gun, M4, is a single-shot, hand-loaded weapon with a vertical sliding, automatically operated breechlock. A removable, manually operated crank is provided to open the breech in the event of a misfire and for initial loading. A loading tray used with a loading ram is situated in back of the breech.

MOUNT, M6—The cradle of Mount, M6, consists of three tubular sections, mounted one above the other. The center section contains the barrel assembly and provides a mounting for the trunnions; the upper and lower sections carry the two cylinders of the hydrospring recoil mechanism. An electrical firing circuit is mounted on the left rear side of the center section. A cam ejector mechanism is mounted on the right rear side of the center section.

RECOIL MECHANISM—When the gun is fired the breeching, tube, recoil cylinder piston rods, and pistons move rearward as a unit. As each piston moves rearward, the recoil oil behind the piston is forced past the piston through the throttling grooves in the sleeve. Throttling the oil through the orifices thus formed absorbs a part of the recoil energy (part of the recoil energy is stored in the counter-recoil springs). The grooves in the recoil sleeve are tapered toward the rear so that the gun is gradually slowed down and finally stopped when the piston reaches the end of the grooves (21 inches of recoil). When the recoil action ceases, the counterrecoil inner and outer springs force the recoil cylinder pistons, piston rods, breech ring, and tube forward. When the gun is six inches out of battery, a tapered buffer enters a cylindrical buffer chamber in the center of the recoil piston and piston rod. The oil trapped inside this chamber is forced out through an orifice in the center of the buffer, through a spring loaded valve, as well as between the chamber wall and the buffer. When the pressure inside the chamber becomes large enough, it moves the valve which further restricts the oil through the valve and increases the buffing action until the gun comes to rest. By adjusting the compression of the buffer valve spring, the amount of buffing is adjusted.

FIRING MECHANISM—The breech is opened manually. A round is placed in the loading tray and shoved into the breech. The flange on the rear of the case will engage the extractors and pull them forward, thereby releasing the breechblock which is moved upward by the tension of the closing spring to close the breech. The gun is fired electrically by means of a firing solenoid which becomes energized when the firing switch is closed, causing the solenoid plunger to move rearward. The solenoid plunger actuates the firing mechanism which presses the firing plunger, thereby releasing the sear and firing the gun.

EJECTOR MECHANISM—The ejector mechanism functions in conjunction with the semi-automatic operation of the breechblock. During recoil the spring-actuated ejector cam is operated by a boss on the crank, the spring then returning the cam to its original position. As the gun slides forward in counter-recoil the boss strikes the end of the cam, rotating the operating shaft of the breech mechanism, dropping the breechblock and ejecting the empty cartridge case. The boss on the crank then passes under the ejector cam. Insertion of the shell causes the breechblock to return to the closed position.

CHARACTERISTICS

Weight of gun	893 lb.
Weight of gun and mount	1,200 lb.
Length of tube overall	110.575 ins.
Weight of projectiles	
H.E., M48	14.6 lb.
A.P.C., M61	14.96 lb.
Muzzle velocity	
H.E., M48	1,974 ft./sec.
A.P.C., M61	2,024 ft./sec.
Maximum powder pressure	38,000 lb./sq. in.

MUZZLE COVER—An automatically functioning aluminum muzzle cover was formerly provided which opened when the breech was closed and closed when the breech was opened. It consisted of a rear tube surrounding the barrel and secured to the cradle, a collar secured to the gun tube, a retractor in the rear, and a retriever with moveable petals on the front end.

AMMUNITION—This is issued in the form of fuzed complete rounds of fixed ammunition. The rounds include the shell, H.E., M48, with fuze, P.D., M57, and the projectile, A.P.C., M61A1, with fuze, B.D., M66A1. A steel cartridge case is not used for the shell, H.E., M48, in the M4 aircraft gun because of the possibility of poor extraction which would jam the gun.

REFERENCES—O. C. M. 18699; TM 9-311.