

~~RESTRICTED~~

AIRC
COPY

TM 9-2005
Vol. 3

WAR DEPARTMENT

TECHNICAL MANUAL

(TENTATIVE)

AUTHORITY HISTORICAL FILE

ORDNANCE MATERIEL - GENERAL

VOLUME 3

INFANTRY - AND CAVALRY - ACCOMPANYING WEAPONS
FIELD ARTILLERY

REGRADED UNCLASSIFIED BY
AUTHORITY OF DOD DIR. 5200. 1 R
BY KAKEZS ON 040504

AUTHORITY HISTORICAL FILE

PREPARED BY
THE ORDNANCE SCHOOL
ABERDEEN PROVING GROUND, MARYLAND

SECOND EDITION
DECEMBER 1942

NOTE

This publication is a temporary expedient pending the incorporation of the information contained herein in an approved War Department Manual.

THE ORDNANCE DEPARTMENT

TENTATIVE
TECHNICAL MANUAL

ORDNANCE MATERIEL - GENERAL

Vol. 3

Infantry- and Cavalry-Accompanying Weapons

Field Artillery

Prepared under the direction of
the Chief of Ordnance

Second Edition, December 1942
Supersedes TM 9-2005 dated January 1942

~~RESTRICTED~~

Reproduction Plant
The Ordnance School
Aberdeen Proving Ground, Maryland

ORDNANCE MATERIEL - GENERAL

VOLUMES

- VOLUME 1. Rifles, shotguns, bayonets, pistols, revolvers, and signal projectors.
2. Automatic rifles, machine guns, and mounts.
3. Infantry- and cavalry-accompanying weapons.
Field Artillery.
4. Railway and seacoast artillery.
5. Sighting and fire-control equipment - general.
Aircraft cannon.
6. Antiaircraft artillery.
Antiaircraft fire-control equipment.
7. Automotive materiel.

ORDNANCE MATERIEL - GENERAL

VOLUME 3

INFANTRY- AND CAVALRY-ACCOMPANYING WEAPONS

FIELD ARTILLERY

Prepared under the direction of
the Chief of Ordnance

	Paragraphs
CHAPTER 1. Infantry- and Cavalry-Accompanying Weapons	
Section I. General -----	1
II. Gun, 37-mm, M1916 -----	2-4
III. Gun, 37-mm, M3A1 -----	5-7
IV. Subcaliber equipment for 37-mm guns ----	8-10
V. Mortars, trench, 3", Mk. I and Mk. IA2 ---	11-13
VI. Mortar, 81-mm, M1 -----	14-16
VII. Mortars, 60-mm, M1 and M2 -----	17-19
CHAPTER 2. Field Artillery	
Section I. General -----	20-21
II. Gun, 75-mm, M1897, and modifications`---	22-24
III. Gun, 75-mm, M1916, and modifications ---	25-27
IV. Gun, 75-mm, M1917, and modifications ---	28-30
V. Gun, 3", M5, (antitank) -----	31-32
VI. Howitzer, pack, 75-mm, M1 and M1A1 ---	33-35
VII. Howitzers, 105-mm, M2 and M2A1 -----	36-38
VIII. Gun, 4.5", M1 -----	39-41
IX. Guns, 155-mm, M1917, M1918MI, M1, and M1A1 -----	42-44
X. Howitzers, 155-mm, M1917, M1917A1, M1918, and M1 -----	45-47
XI. Howitzers, 8", Mk. VI, VII, and VIII-1/2 --	48-50
XII. Howitzer, 8", M1 -----	51-53
XIII. Howitzer, 240-mm, M1918, and modi- fications -----	54-56
XIV. Subcaliber equipment for field artillery --	57-59
INDEX for Volume 3 -----	Pages

ORDNANCE DEPARTMENT

LIST OF ILLUSTRATIONS

Figure No.		Page
1	Gun, 37-mm, M1916, on carriage, M1916 -----	6
2	Gun, 37-mm, M1916, and carriage, M1916A1 -----	7
3	Gun, 37-mm, M1916, on tripod, M1916 -----	8
4	Gun, 37-mm, M1916, on carriage, M1916A2 -----	9
5	Gun, 37-mm, M3, on carriage, M4 (left side) -----	13
6	Gun, 37-mm, M3, on carriage, M4 (right side) -----	14
7	Rifle, subcaliber, cal..30, M1903A2 -----	15
8	Mortar, trench, 3", Mk. I -----	18
9	Mortar, 81-mm, M1, on mount, M1 -----	21
10	Mortar, 81-mm, M1, in action -----	22
11	Mortar, 60-mm, M1, on mount, M1 -----	26
12	Mortar, 60-mm, M2, on mount, M2 -----	27
13	Gun, 75-mm, M1897, on carriage, M1897 -----	32
14	Gun, 75-mm, M1897, on carriage, M1897A4 -----	33
15	Gun, 75-mm, M1897A4, on carriage, M2A3 -----	34
16	Gun, 75-mm, M1897A2, on carriage, M2A2 -----	37
17	Gun, 75-mm, M1916, on carriage, M1916A1 -----	41
18	Gun, 75-mm, M1917, on carriage, M1917A1 -----	44
19	Gun, 3", M5, on carriage, M1 (side view) -----	47
20	Gun, 3", M5, on carriage, M1 (3/4 right rear view) --	48
21	Howitzer, pack, 75-mm, M1A1, on carriage, M1 ----	52
22	Howitzer, pack, 75-mm, M1A1, on carriage, M3 ----	53
23	Howitzer, 105-mm, M2A1, and carriage, M2 -----	56
24	Gun, 4.5", M1, and carriage, M1, in firing position --	60
25	Gun, 4.5", M1, and carriage, M1, limbered to prime mover -----	61
26	Gun, 155-mm, M1918MI, on carriage, M1918 -----	64
27	Gun, 155-mm, M1, on carriage, M1 -----	66
28	Gun, 155-mm, M1, on carriage, M1, and limber, M2, in traveling position -----	67
29	Howitzer, 155-mm, M1, and carriage, M1, limbered to prime mover -----	72
30	Howitzer, 155-mm, M1918, on carriage, M1918A1 ---	74
31	Howitzer, 155-mm, M1917, on carriage, M1917 -----	75
32	Howitzer, 8", Mk. VI, on carriage, Mk. VI -----	81
33	Howitzer, 8", M1, on carriage, M1 -----	84
34	Howitzer, 240-mm, M1918A1, on carriage, M1918 ---	88
35	Gun, 37-mm, M1916, on subcaliber mount -----	90

CHAPTER 1

INFANTRY- AND CAVALRY-ACCOMPANYING WEAPONS

	Paragraphs
SECTION I. General -----	1
II. Gun, 37-mm, M1916 -----	2-4
III. Gun, 37-mm, M3A1 -----	5-7
IV. Subcaliber equipment for 37-mm guns -----	8-10
V. Mortars, trench, 3", Mk. I and Mk. IA2 -----	11-13
VI. Mortar, 81-mm, M1 -----	14-16
VII. Mortars, 60-mm, M1 and M2 -----	17-19

SECTION I

GENERAL

	Paragraph
Scope -----	1

1. SCOPE. - a. This chapter deals with mortars, minor-caliber cannon, and antitank materiel. These are the weapons which are provided to augment the fire of rifles and machine guns.

b. The principal weapons in this class are the 37-mm gun and the trench mortar. The 37-mm guns are the smallest weapons of the field-gun type used in the U. S. Army. As they are intended to follow the infantry over any kind of ground, construction is designed to give great mobility. The original 37-mm gun, M1916, is of French design; the M3 antitank gun is a further development. The Stokes, 3", trench mortar is of British design, and the 81-mm trench mortar is of French design.

c. This chapter also covers the subcaliber equipment used with the 37-mm guns.

SECTION II

GUN, 37-MM, M1916

	Paragraph
Data -----	2
Description -----	3
Operation -----	4

2. DATA. - The weights, measurements, and ballistic data for the 37-mm gun, M1916, and carriage, M1916, are as follows:

Weight of gun and carriage, M1916, complete -----	pounds	342.00
Weight of barrel and breech mechanism -----	pounds	56.00
Weight of cradle -----	pounds	32.00
Weight of trails, complete tripod mount -----	pounds	86.00
Weight of wheels and axle -----	pounds	167.00
Weight of ammunition chest, with 16 rounds H.E. shell -	pounds	33.20
Weight of ammunition chest, empty, approximate -----	pounds	8.00
Weight of projectile, H.E. shell -----	pounds	1.23
Over-all length of vehicle -----	inches	75
Over-all width of vehicle, trails spread -----	inches	57
Over-all width of vehicle, trails closed -----	inches	39.25
Height of gun on tripod mount -----	inches	22.5
Length of barrel, (19.94 calibers) -----	inches	29.13
Diameter of bore -----	inches	1.457
Length of recoil -----	inches	7 to 10
Maximum angle of elevation -----	degrees	22
Maximum angle of depression -----	degrees	0
Maximum traverse, right -----	degrees	22
Maximum traverse, left -----	degrees	16
Rifling, uniform L.H., one turn in 30 calibers -----	inches	43.582
Oil capacity of recoil mechanism -----	pints	2.75
Maximum range -----	yards	4,900
Maximum range, effective -----	yards	1,800
Muzzle velocity, H.E. shell -----	ft./sec.	1,342
Weight of powder charge (bursting) -----	grains	500
Volume of powder charge -----	cu. in.	3.70
Maximum powder pressure -----	lb./sq. in.	18,500
Maximum rate of fire (short bursts) -----	rds./min.	35
Maximum rate of fire, (prolonged fire) -----	rds./min.	30

3. DESCRIPTION. - The 37-mm gun, M1916, is a flat trajectory weapon of the field gun type which fires high-explosive shell that weigh slightly more than 1 pound. This weapon is classified as "Limited Standard" and is used with the 37-mm gun carriages, M1916, M1916A1, and M1916A2, which are also "Limited Standard." (See figs. 1, 2, 3, and 4.) Although it is "Limited Standard" as far as manufacture is concerned, the M1916 gun is "Standard" for issue, with its cradle, as subcaliber equipment, with the 37-mm subcaliber mounts, M1, M4, M5, M7, M8, M9, M10, and M12, on all field artillery weapons including the 155-mm guns. (See fig. 35.) It is not issued for combatant use.

a. This weapon was used by advancing infantry chiefly for destroying machine-gun emplacements, outposts, and other points of resistance. Its mission was to prepare and support the attack, to break any resistance which developed in the course of the advance and to cooperate in the defense of the captured position. Inasmuch as this gun was designed to follow infantry over any kind of ground, its construction was

designed to give great mobility.

b. Each gun unit is composed essentially of two elements:

(1) The gun on a tripod mount which is capable of being set on wheels.

(2) A light cart serving as a limber and carrying ammunition, spare parts, and accessories. The gun and limber, when joined, are normally hauled by one horse or mule, but near the enemy, they are separated and moved by manpower.

c. Five general methods of transporting the weapons are:

(1) Gun and cart attached, drawn by horse or mule.

(2) Gun and carriage unlimbered, drawn on wheels by the gun squad.

(3) Gun disassembled into three loads consisting of gun and cradle, tripod, and wheels and axle; the first two loads being carried, and the wheels and axle being pushed.

(4) Gun and carriage unlimbered and carried in a truck.

(5) Gun and carriage broken down for pack transport.

d. Gun group. - (1) The gun is made up of an alloy gun-steel barrel, a bronze front clip, and an aluminum jacket. The front clip and the jacket serve as guides and supports for the barrel. The breech housing is a steelforging into which is screwed the rear end of the barrel.

(2) The breechblock is of the Nordenfeld type and, with the exception of size, is practically the same as that used on the French 75-mm field gun. It screws into the breech housing and is opened and closed by being rotated 156° about its axis, which movement is limited in each direction by a stop.

(3) This gun is equipped with a recoil mechanism, consisting of a cylinder containing a piston, a piston rod; a piston valve; a counterrecoil spring in three sections; and a counterrecoil buffer. This buffer is screwed into the front cap of the cylinder and eases the movement of the gun into battery, thus preventing excessive shock.

(4) The gun is provided with a telescopic sight for use in direct fire and with a quadrant sight for indirect fire. Either sight is mounted in a bracket on the left side of the gun. The quadrant sight is equipped

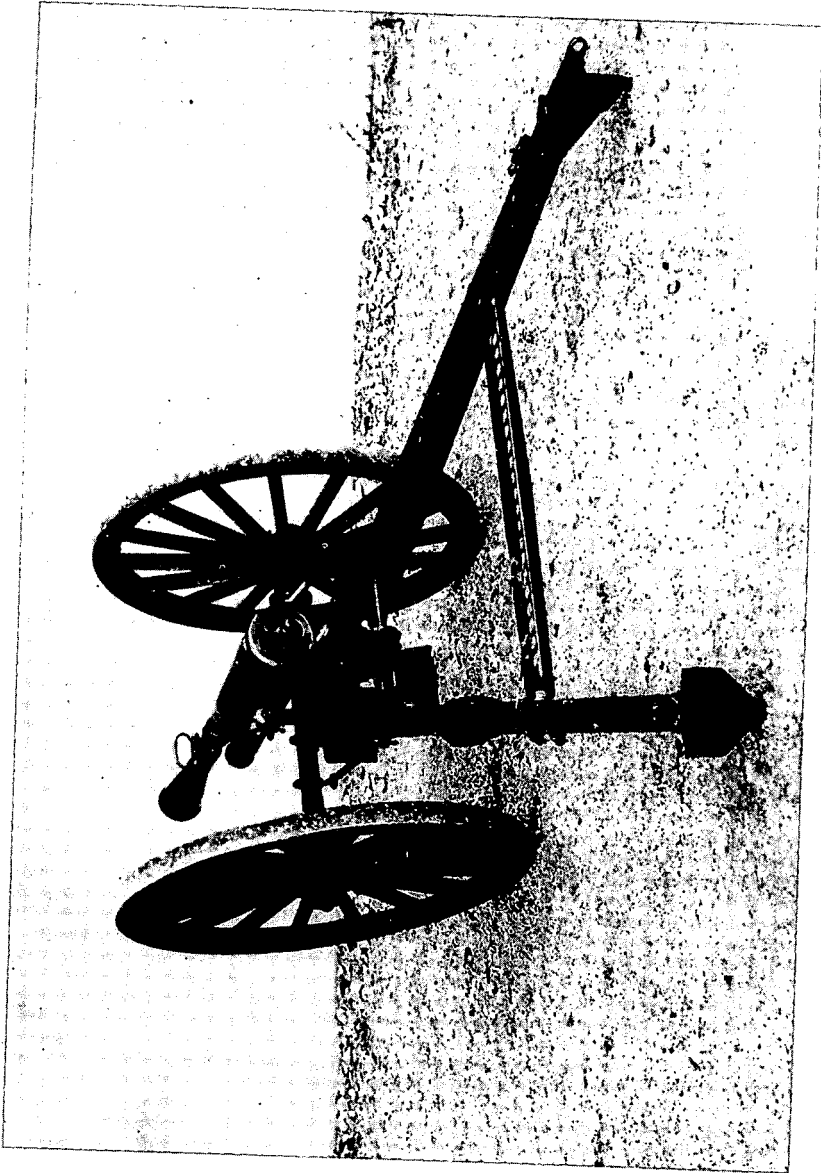


FIGURE 1. - GUN, 37-MM, M1916, ON CARRIAGE, M1916.

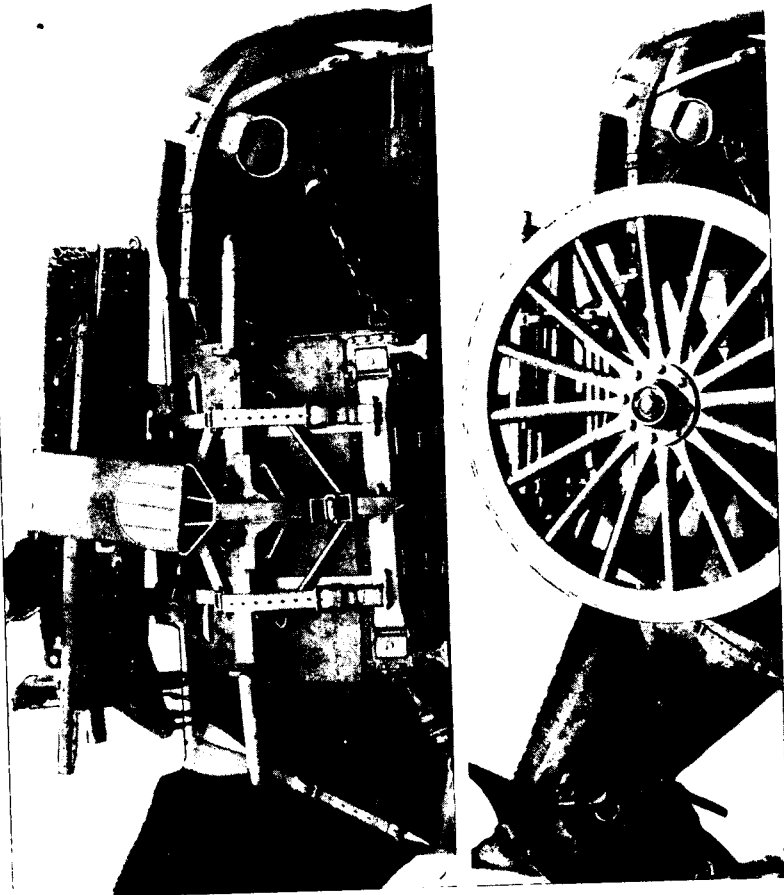


FIGURE 2. - GUN, 37-MM, M1916, AND CARRIAGE, M1916A1.

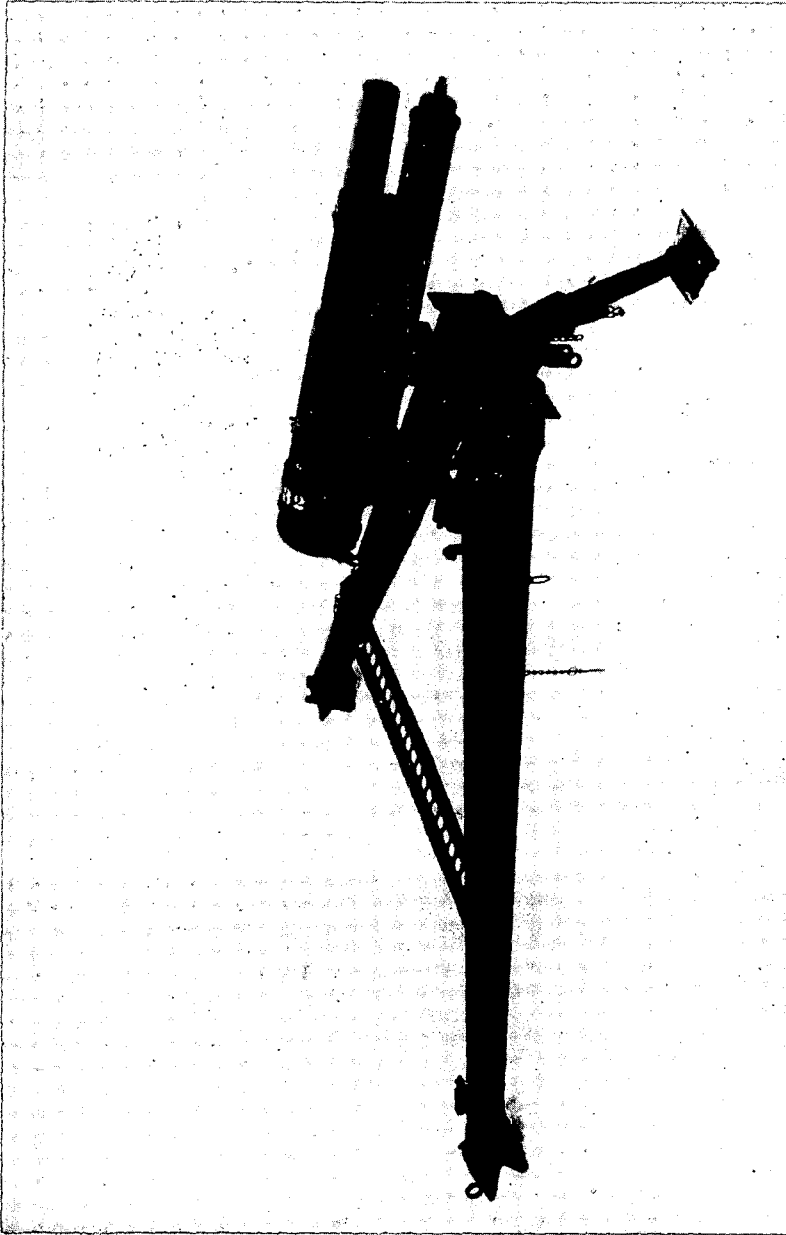


FIGURE 3. - GUN, 37-MM, M1916, ON TRIPOD, M1916.

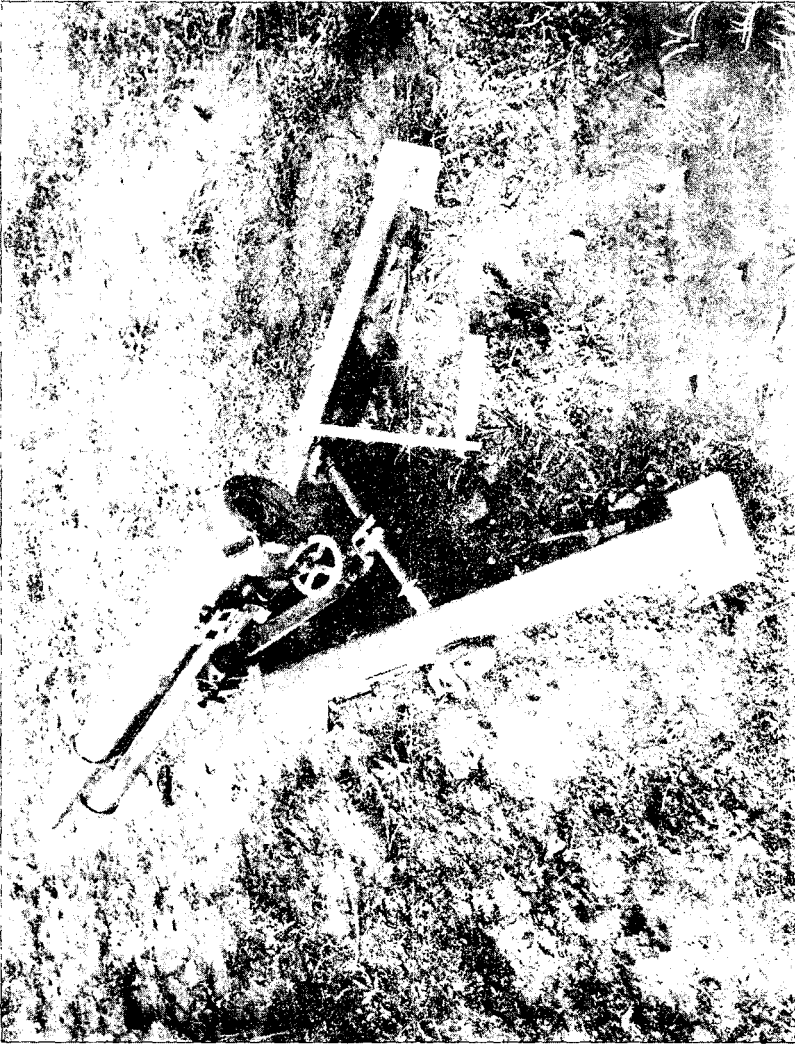


FIGURE 4. - GUN, 37-MM, M1916, ON CARRIAGE, M1916A2.

with scales for the setting range, deflection and angle of sight.

e. Carriages. - (1) The carriage, M1916A1, is essentially the same as the M1916 carriage, except that the trail is hinged for packing. It is divided into two pack loads. Load No. 1 weighs 175 pounds and consists of the gun, recoil mechanism, and hangers; load No. 2 weighs 225 pounds and consists of the trail, axle, and hangers.

(2) The carriage, M1916A2, is similar to the M1916 model. The trails are shortened and telescoped; the wheels and axle are omitted. It is carried as one pack load and weighs 146.5 pounds.

(3) The elevating and traversing mechanisms are essential parts of the tripod.

f. The on-carriage sighting equipment consists of a quadrant sight, M1916, and a telescopic sight, M1916. See volume 5 of this manual.

g. The ammunition is of the fixed type. The steel projectile contains high explosive which is detonated by a base percussion fuze.

h. In action, this single-shot gun is operated by two men, one keeping it on the aiming point and the other loading and firing. The gun must be cocked by hand in order to load for the first round. Thereafter, the counterrecoil of the barrel cocks the piece, and it is only necessary to open the breechblock which ejects the case, insert a new cartridge, close the breech, and fire.

i. This gun has a number of desirable characteristics, including fairly light weight, accuracy, and convenient traverse. The split trail, pintle traverse, and hydrospring recoil are main features, and the gun can be fired either from wheels or from a tripod arrangement composed of the trails and the front leg.

j. The disadvantage of the M1916 gun are, mainly, lack of power and vulnerability to enemy artillery; its flat trajectory precludes placement behind hillocks or concealed rising ground.

4. OPERATION. - The details regarding the functioning of the 37-mm gun, M1916, are given in FM 23-75.

SECTION III

GUN, 37-MM, M3A1

	Paragraph
Data -----	5
Description -----	6
Operation -----	7

5. DATA. - The weights, measurements, and ballistic data for the 37-mm gun, M3A1, and carriage, M4A1, are as follows:

Weight of M3A1 gun and M4A1 carriage, total -----	pounds	912.00
Weight of gun -----	pounds	191.00
Weight of recoil mechanism -----	pounds	77.5
Weight of complete round, AP -----	pounds	3.41
Weight of complete round, H.E. -----	pounds	2.72
Weight of projectile, AP -----	pounds	1.92
Weight of projectile, H.E. -----	pounds	1.23
Over-all length of vehicle -----	inches	154.5
Over-all width of vehicle, over hub caps -----	inches	63.5
Over-all width of vehicle, trails spread -----	inches	117.0
Over-all height of vehicle, traveling -----	inches	37.9
Length of barrel, (53.5 calibers) -----	inches	78
Over-all length of gun -----	inches	82.5
Diameter of bore -----	inches	1.457
Maximum length of recoil -----	inches	20.5
Normal length of recoil -----	inches	20.0
Maximum angle of elevation -----	degrees	15.0
Maximum angle of depression -----	degrees	10.0
Maximum traverse, right -----	degrees	30.0
Maximum traverse, left -----	degrees	30.0
Rifling, uniform R.H. one turn in -----	calibers	25
Oil capacity of recoil mechanism -----	pints	5
Maximum range, AP, approximate -----	yards	7,500
Maximum range, H.E., approximate -----	yards	5,300
Muzzle velocity, AP shell -----	ft./sec.	2,600
Muzzle velocity, H.E. shell -----	ft./sec.	2,750
Weight of powder charge -----	ounces	8
Volume of powder chamber -----	cu. in.	19.92
Maximum powder pressure -----	lbs./sq. in.	36,000
Maximum rate of fire (short bursts) -----	rds./min.	25
Maximum rate of fire, aimed (prolonged fire) -----	rds./min.	15 - 20

6. DESCRIPTION. - The 37-mm antitank gun, M3A1, which is mounted on the M4A1 carriage, is a flat trajectory weapon of the field type which fires either armor-piercing or high-explosive shell. The M3A1 and M4A1 are modifications of the M3 and M4, gun and carriage

respectively. The modifications consists of a modified shoulder guard and firing mechanism, to permit free traverse. They do not adversely affect the small lateral movements through the traverse mechanism that are necessary when firing at a stationary target. The gun, M3A1 and carriage, M4A1, are classified as "Standard" and the gun, M3 and carriage, M4, are classified as "Limited Standard." (See figs. 5 and 6.)

a. Gun group. - (1) The barrel is a one-piece forging with rifle bore and is threaded to screw into the breech ring. A bearing near the breech end and one at midlength support the barrel and aline it in the yokes of the sleigh.

(2) The breech ring has lugs for attachment of the recoil piston rod and is recessed for a vertically sliding drop block which is operated manually.

(3) The recoil system is of the hydrospring type. It includes the recoil mechanism which absorbs the recoiling energy of the gun after it is fired; the counterrecoil mechanism which returns the gun to battery; and the buffer mechanism which absorbs the last portion of the counter-recoil action, to prevent damage to the weapon due to sudden stopping of the recoiling parts.

b. Mount. - (1) The gun is mounted on the carriage, M4A1, which is of the split-trail type with pneumatic tires. The complete unit is designed for towing behind its prime mover on roads and across country, and by men.

(2) The elevating and traversing mechanisms are attached to the mount. Adjustment of the gun in elevation is transmitted from the elevating knob to the barrel by a system of shafts and gears. Adjustment of the gun in traverse is transmitted from the traversing handwheel and flexible joint shaft to the traversing arc on the support. For quick adjustment of the gun in traverse, the worm gear drive is equipped with a release mechanism which disengages the gear drive and permits free movement of the gun in traverse.

c. The telescope, M6, is held in position by the telescope mount, M19, which is attached to the gun carriage by means of a bracket. Therefore, the sight will move with the gun when traversed. A parallelogram linkage between the gun trunnion and the telescope mount transmits the elevating motion to the telescope as the gun is elevated or depressed.

d. The carriage, M4A1, is designed for one-man control of aiming, elevating, traversing, and firing. The gun squad consists of six men: a squad leader, one gunner, one assistant gunner, two ammunition carriers, and a chauffeur.

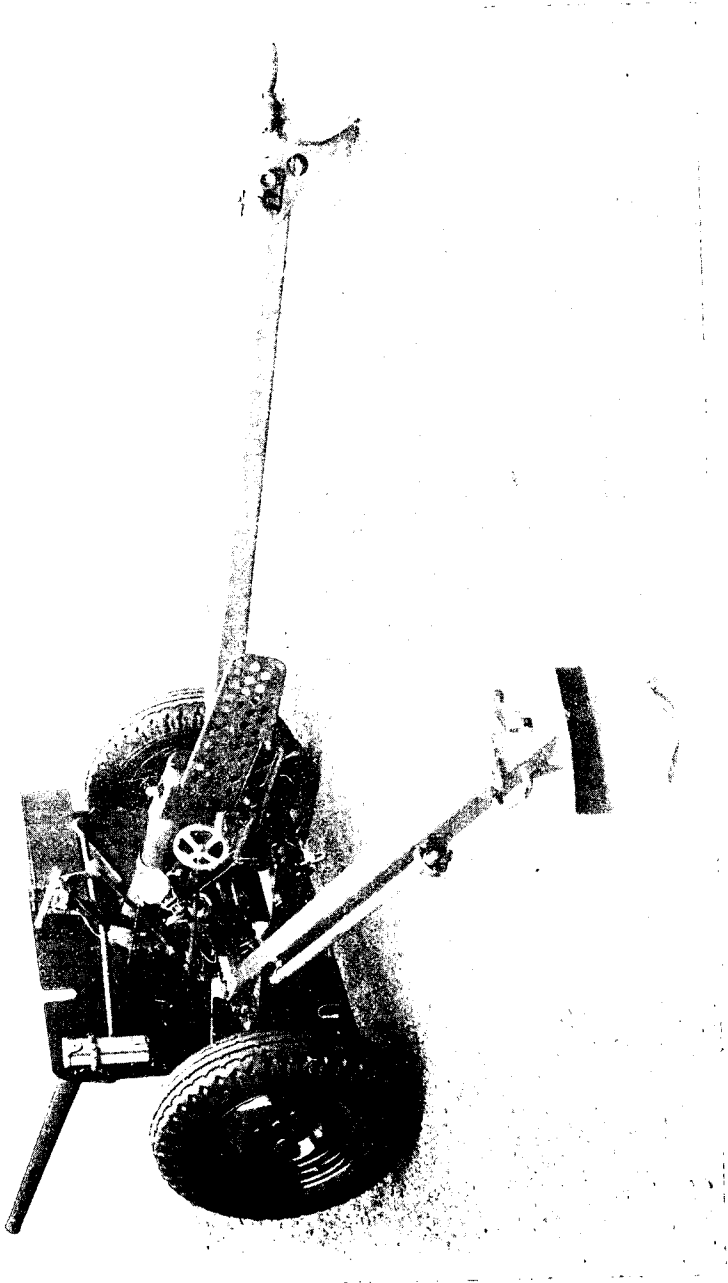


FIGURE 5. - GUN, 37-MM, M3, ON CARRIAGE, M4 (LEFT SIDE).



FIGURE 6. - GUN, 37-MM, M3, ON CARRIAGE, M4 (RIGHT SIDE).

e. Ammunition. - The ammunition for the 37-mm gun, M3A1, is issued as fixed complete rounds. The following types of service ammunition are used.

- (1) Shot, fixed, APC, M51B1, 37-mm guns, M3, M5, and M6.
- (2) Shell, fixed, H.E., M63, with BDF, M58, 37-mm guns, M3, M5, and M6.
- (3) Cannister, M2, 37-mm guns, M3, M5, and M6.

7. OPERATION. - The mechanical functioning of the 37-mm gun, M3, is described in FM 23-70.

SECTION IV

SUBCALIBER EQUIPMENT FOR 37-MM GUNS

	Paragraph
Rifle, subcaliber, cal..22, M2A1 -----	8
Rifle, subcaliber, cal..30, M1903A2 -----	9
Mount, subcaliber, cal..22 - .30, M6 -----	10

8. RIFLE, SUBCALIBER, CAL..22, M2A1. - This weapon is the cal..22, U. S., rifle, M2, minus the stock and the front and rear sights. The front end of the rifle barrel is fitted with a bronze bushing which has a diameter equal to the bore of the gun in which the subcaliber rifle is mounted. The ballistic data are the same as that for the U. S. rifle, cal..22, M2.

a. The M2A1 rifle is classified as "Standard" for use, along with the subcaliber mount, M6, in the 37-mm gun, M3.

9. RIFLE, SUBCALIBER, CAL..30, M1903A2. - This weapon is the cal..30, U. S. rifle, M1903, minus the stock and front and rear sights. (See fig. 7.) The front end of the rifle barrel is fitted with a bronze

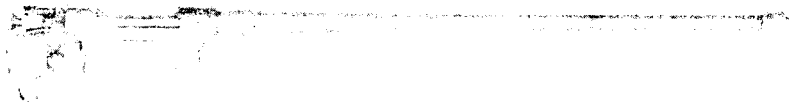


FIGURE 7. - RIFLE, SUBCALIBER, CAL..30, M1903A2.

bushing which has a diameter equal to the bore of the gun in which the subcaliber rifle is mounted. This rifle is 32" long and weighs 4-7/8

pounds. The ballistic data are the same as that for the M1903 rifle.

a. The subcaliber rifle, M1903A2, is classified as "Standard" for use, along with the subcaliber mount, M6, in the 37-mm gun, M3.

10. MOUNT, SUBCALIBER, CAL..22 - .30, M6. - a. This is a subcaliber mount for use in the interior of the bore of the 37-mm gun, M3. It is classified as "Standard" and mounts either the cal..22 rifle, M2A1, or the cal..30 rifle, M1903A2. The mount consists of the three main assemblies described below.

(1) Rifle-tube assembly. - This assembly extends the entire length of the 37-mm gun tube and projects out of both ends. The rear end has a flange, to prevent further entry into the chamber, and a short portion shaped to the inner contour of the chamber. From this, a cylindrical tube extends through and out of the 37-mm gun tube. The extreme forward end of this tube is threaded to receive a nut. A leather washer fits over the rifle tube to prevent this nut from coming in direct contact with the 37-mm gun.

(2) Firing-support assembly. - The firing support is fastened to the rear end of the rifle tube by screws and pins, and supports the entire receiver of the rifle and the firing-mechanism assembly. It has a vertical opening to receive the magazine of the rifle and has supports for both the recoil lug and the tang of the receiver. This positions the subcaliber rifle, and it is held by two screws that take the place and position of the guard screws on the conventional rifle.

(3) Firing-mechanism assembly. - The firing mechanism is fastened to the left side of the firing support. It houses a spring and plunger. The plunger is attached on one end to a trigger trip and on the other to a cable. This cable has, at its free end, an attachment to connect it to the firing-mechanism plunger on the 37-mm gun carriage.

b. Operation. - Operation of the firing mechanism causes the cable to pull the plunger forward, which compresses the plunger spring, draws the plunger forward, and draws one end of the trip forward. This trip is pivoted near its center, with its free end entered into the trigger guard in front of the trigger. Thus, as one end is moved forward, the other end moves to the rear and fires the piece. Cocking is accomplished by hand operation of the bolt.

SECTION V

MORTARS, TRENCH, 3", MK. I AND MK. IA2

	Paragraph
Data -----	11
Description -----	12
Operation -----	13

11. DATA. - The weights, measurements, and ballistic data for the 3" trench mortar, Mk. IA2, are as follows:

Weight of mortar and mount, Mk. I, complete -----	pounds	114.64
Weight of mortar -----	pounds	45.47
Weight of mount -----	pounds	69.17
Weight of bipod -----	pounds	37.00
Weight of base plate -----	pounds	30.00
Over-all length of mortar -----	inches	50.5
Diameter of bore -----	inches	3.2
Maximum elevation -----	degrees	75
Minimum elevation -----	degrees	40
Maximum traverse, right, approximate -----	degrees	6
Maximum traverse, left, approximate -----	degrees	6
Number of zones -----		4
Maximum ranges of various shells used:		
Shell H.E., Mk. I; and Shell, Practice, Mk. I -----	yards	750
Shell, H.E., M43, 81-mm; Shell, Practice, M44, 81-mm -	yards	2,550
Shell, H.E., M45, 81-mm -----	yards	1,300
Shell, H.E., M56 -----	yards	2,650
Shell, Chemical, M57 (WP) -----	yards	2,470
Minimum range of Mk. I shells -----	yards	150
Rate of fire, maximum -----	rds./min.	30
Rate of fire, normal -----	rds./min.	10

12. DESCRIPTION. - The 3" trench mortar is a smooth-bore, muzzle-loading weapon for high angles of fire. During World War I, the U. S. Army adopted the British, 3", Stokes trench mortar, Mk. I, to meet the infantry's requirement for a weapon to be used in indirect fire. Although it is called a 3" mortar, its bore is actually 3.2" or 81-mm. (See fig. 8.)

a. The mortar is assembled into a single unit, known as the barrel, while the mount, Mk. I, consists of two parts: the bipod and the base plate. Each of these three components forms a load light enough to be carried by one man.

(1) Barrel. - The barrel is demountable from the bipod and has no mechanical connection with the base plate. It is a seamless drawn-

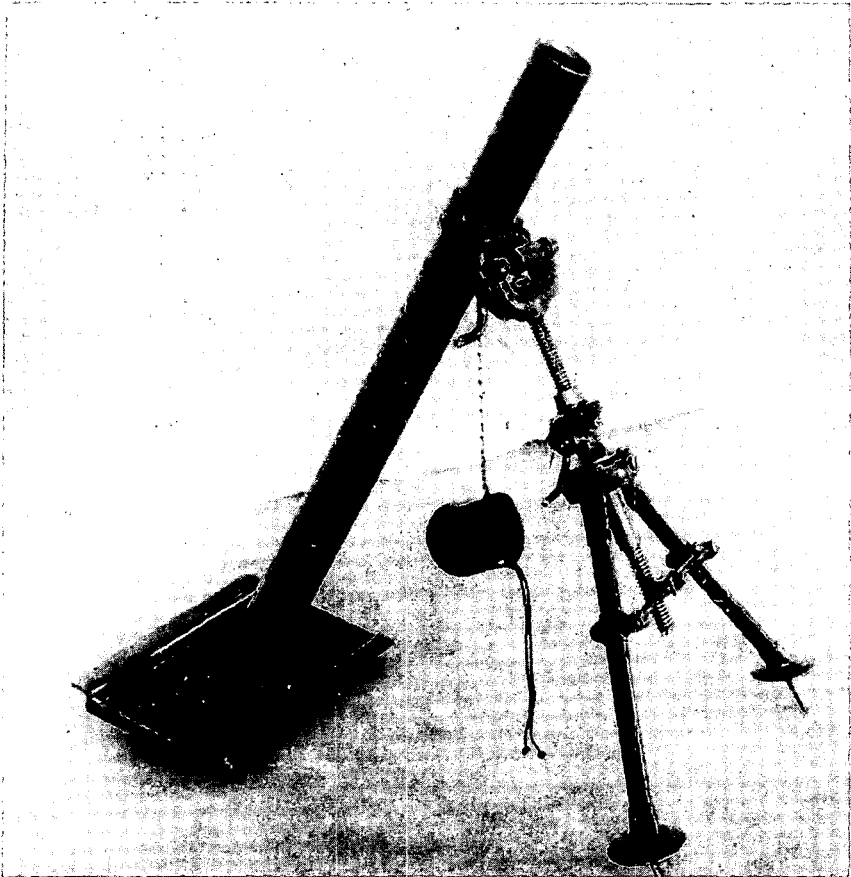


FIGURE 8. - MORTAR, TRENCH, 3", MK. I.

steel tube necked down at the breech or base end. To the breech end is fitted a base cap, within which is secured a firing pin protruding into the barrel.

(2) Bipod. - The barrel is supported near the muzzle end by a bipod which is made of tubular steel and consists of two legs attached to a center trunnion by means of a compass joint. These legs are held apart by a cross stay which is arranged to spring just past the dead center in such a manner as to insure rigidity.

(a) The trunnion standard is fitted with a pair of bevel gears operated by a handle with which the elevating screw can be rapidly raised

or lowered.

(b) The upper end of the elevating screw is fitted with a yoke to support the traversing-screw shaft which, together with a traversing handle and a dog clutch, forms a bolt held in position by a locking pin. A traversing screw, carried by the traversing-screw shaft and driven by the dog clutch, forms the means of traversing the mortar by engaging a nut fixed to the barrel.

(c) The barrel can be quickly disconnected from the mounting by lifting the locking pin and withdrawing the traversing bolt. The barrel may then be lifted out of position.

(3) Base plate. - The reaction of the barrel is taken up by the base plate against which the base cap of the barrel rests. The base plate has three depressions. The shape of the base cap permits the lower end of the barrel to rest in any of these depressions, and, by shifting the barrel from one to another, a change of 3° in direction of line of fire can be made on either side of the center position.

b. The 12-pound, high-explosive shell used with the mortar, Mk. I, is very effective but has a short range and wide dispersion. See section VI for a discussion of mortar ammunition. It has been found that modification of the firing pin will allow the use of the 81-mm mortar shell which has less dispersion and much greater range. When so modified, the weapon is known as mortar, trench, 3", Mk. IA2. All mortars, Mk. I, will eventually be so modified.

c. The sighting equipment includes a clinometer, Mk. I.

d. The trench mortars, Mk. I and Mk. IA2, and the trench-mortar mount, Mk. I, are classified as "Limited Standard."

13. OPERATION. - a. Placement of weapon. - In firing position, the base plate is imbedded in the ground at an angle of approximately 45° . The lower end of the barrel is placed in that indentation of the base plate which gives the direction desired. The upper end of the barrel is supported by the tripod. Minor adjustment for direction is secured by means of the traversing screw. The barrel is then given the elevation corresponding to the desired range by operating the elevating screw. The range quadrant, or clinometer, is set for the desired range and indicates when the barrel has the proper elevation.

b. Firing. - The shell is dropped, cartridge end first, into the muzzle of the mortar. As it slides down the barrel, the primer of the cartridge is fired on impact with the firing pin. Ignition of the propelling charges on the shell is accomplished by the flash through the ports of the

cartridge case. The shell, carrying the cartridge case with it, is projected from the barrel. The mortar is now ready for another shell.

SECTION VI

MORTAR, 81-MM, M1

	Paragraph
Data-----	14
Description-----	15
Operation-----	16

14. DATA. - The weights, measurements, and ballistic data for the 81-mm mortar, M1, are as follows:

Weight of mortar and mount, M1, complete -----	pounds	136.0
Weight of mortar -----	pounds	44.5
Weight of mount -----	pounds	91.5
Weight of bipod -----	pounds	46.5
Weight of base plate -----	pounds	45.0
Over-all length of mortar -----	inches	49.5
Diameter of bore -----	inches	3.2
Elevations, approximate -----	degrees	40 to 85
Mortar clamp position A -----	degrees	40 to 70
Mortar clamp position B -----	degrees	50 to 80
Mortar clamp position C -----	degrees	55 to 85
Maximum traverse, right -----	mils	90
Maximum traverse, left -----	mils	90
Ranges, approximate:		
H.E. shell:		
6.87 pounds -----	yards	100 to 3,290
10.75 pounds -----	yards	300 to 2,655
15.05 pounds -----	yards	100 to 1,275
Chemical shell:		
11.4 pounds -----	yards	300 to 2,470
Smoke shell:		
11.86 pounds -----	yards	100 to 2,470
Rate of fire, maximum -----	rds./min.	30 to 35
Rate of fire, normal (prolonged) -----	rds./min.	18

15. DESCRIPTION. - a. General. - (1) In 1920, work was started on a design for a satisfactory mortar for use by the infantry and on a design for a 75-mm mortar with a wheeled mount. Both of those projects were subsequently abandoned, and efforts were concentrated on improvements for the bomb vanes which had been found so effective in increasing the accuracy of trench-mortar projectiles.

(2) While those tests were going on in this country, the Edgar

Brandt Establishment in France attained what was actually desired by our War Department. That firm refined the design of the Stokes, 3", trench mortar, Mk. I, along with the design of the mortar ammunition. The improvement in the ammunition was the more important. As a result, quantities of the Stokes-Brandt mortars and M1930 mounts were procured in 1931 and tested by the Ordnance Department and by the Infantry, Field Artillery, and Cavalry Corps. The results were highly satisfactory, and the manufacturing rights were purchased from the Brandt Company.

(3) The refinements in the design of the 3" trench mortar, Mk. I, consist of a heavier barrel, a cross-leveling device on the bipod, level vials, a collimator sight, and a heavier base plate of new design. The new weapon is known as mortar, 81-mm, M1. (See figs. 9 and 10.)



FIGURE 9. - MORTAR, 81-MM, M1, ON MOUNT, M1.



FIGURE 10. - MORTAR, 81-MM, M1, IN ACTION.

b. Mortar, 81-mm, M1. - This is a smooth-bore, muzzle-loading weapon for high angles of fire. The mortar is assembled into a single unit, while the mount, M1, consists of two units: the tripod and the base plate. These units form separate loads, each of which is light enough to be carried by one man. The 81-mm mortar, M1, is classified as "Standard." The 81-mm mortar mount, M1, is also classified as "Standard."

(1) Design. - As mentioned above, the construction of this mortar is similar to that of the Mk. I mortar, with the following refinements in design.

(a) The barrel is made heavier to withstand the higher pressures, and it is machined more accurately.

(b) The left leg of the tripod carries a cross-leveling mechanism which consists of a sliding bracket connected with the guide tube by a connecting rod.

(c) The mortar clamp, by means of which the barrel is clamped to the bipod, is in two sections. It can be easily adjusted to positions A, B, and C on the barrel.

(d) Each 81-mm mortar is provided with a sight which includes a collimator, elevating and lateral deflection mechanisms, and longitudinal and cross levels. The sight mechanism is supported by a bracket with a dovetailed base which fits in a slot in the mortar yoke and latches in place. It provides accurate laying for elevation and deflection.

(e) The base plate consists of a pressed-steel body to which are welded a series of ribs and braces, a front flange, three loops, two handle plates, and the socket. The socket has three seats for the spherical end of the base cap of the mortar.

(2) Sighting equipment. - The sight, M4, and the aiming posts, M4, M5, and M6, are standard equipment for the 81-mm mortar, M1. The mortars of early manufacture had either the M2A3, M2A1, or M2 sight. See volume 5 of this manual.

(3) Transportation. - (a) The 81-mm mortar can be carried by two men, or can be transported on a hand cart similar to those, used for machine guns, described in volume 2. The hand cart, M6A1, is "Standard"; the hand cart, M6, is "Limited Standard."

(b) This mortar is part of the armament of the half-track, 81-mm mortar carrier, M4. See volume 7 of this manual.

(4) Ammunition. - (a) 81-mm trench mortar. - Because of its

stabilizing fins, this ammunition, even though fired from a smooth-bore mortar, is stable in flight and strikes nose end first. In fact, the success of the 81-mm mortar is due to no small part to the design of this ammunition. A point-detonating, impact type fuze is fitted to the nose of the shell. The propelling charge, consisting of an ignition cartridge and propellant increments, is attached to the base end of the projectile. When fired, the projectile carries the fired ignition-cartridge case with it. The following types of ammunition are used in the 81-mm trench mortar:

- Shell, gas, persistent, HS, M57.
- Shell, H.E., M43A1.
- Shell, H.E., M45.
- Shell, H.E., M45B1.
- Shell, H.E., M56.
- Shell, practice, M43.
- Shell, practice, M43A1.
- Shell, practice, M44.
- Shell, smoke, FS, M57.
- Shell, smoke, phosphorus, WP, M57.
- Shell, training, M68.

(b) 3-inch trench mortar. - The 81-mm mortar ammunition is adapted for use in the mortar, trench, 3", Mk. IA2, by reducing the outer zone propelling charge for the M43A1 and M44 shell, from 6 to 4 increments; for the M56 and M57, from 4 to 3 increments; for the M45 and M45B1 shell, the full charge of 4 increments may be used. The 81-mm mortar ammunition will not be used in the mortar, trench, 3", Mk. I or Mk. IA1.

16. OPERATION. - The details regarding the operation of the 81-mm mortar, M1, are given in FM 23-90.

SECTION VII

MORTARS, 60-MM, M1 AND M2

	Paragraph
Data -----	17
Description -----	18
Operation -----	19

17. DATA. - The weights, measurements, and ballistic data for the 60-mm mortar, M2, are as follows:

Weight of mortar, M2, and mount, M2 -----	pounds	42.0
Weight of mortar -----	pounds	12.8
Weight of mount -----	pounds	29.2
Weight of bipod -----	pounds	16.4

ORDNANCE MATERIEL - GENERAL

17-18

Weight of base plate -----	pounds	12.8
Over-all length of mortar -----	inches	28.6
Diameter of bore -----	inches	2.36
Elevations, approximate -----	degrees	40 to 85
Mortar clamp position A -----	degrees	40 to 65
Mortar clamp position B -----	degrees	45 to 70
Mortar clamp position C -----	degrees	50 to 85
Maximum traverse, right -----	mils	70
Maximum traverse, left -----	mils	70
Range, approximate, Shell, H.E., M49A2 -----	yards	100 to 1,935
Rate of fire, maximum (short bursts) -----	rds./min.	30 to 35
Rate of fire, normal (prolonged) -----	rds./min.	18

18. DESCRIPTION. - a. General. - For missions immediately beyond the ranges of usefulness of hand grenades, the Ordnance Department initiated the development of a light 42-mm mortar to fire small vaned projectiles and ground pyrotechnic signals. Before a pilot 42-mm mortar could be made, the Edgar Brandt Establishment of France furnished a 47-mm mortar for demonstration purposes, which was favorably considered as being suitable for use in the Infantry. However, the Cavalry expressed a desire for a mortar lighter than the 81-mm mortar for attacking machine guns, but with greater maximum range than was possible with the 47-mm type. Consequently, a 60-mm mortar and some ammunition were produced from the Edgar Brandt Company. The Infantry Board and the Cavalry Board tested both of these light mortars. In February 1938, action was taken to recommend adoption of the 60-mm mortar and to reject the 47-mm mortar.

b. Mortar, 60-mm, M1. - This model number is used on the eight mortars and mounts purchased from Edgar Brandt. The collimating sight originally furnished was replaced by one graduated in mils. The M1 mortar and M1 mount are classified as "Limited Standard." (See fig. 11.)

c. Mortar, 60-mm, M2. - This is a smooth-bore, muzzle-loading weapon for high angles of fire, similar in design to the 81-mm mortar, M1, described in section VI of this chapter. The mortar is assembled into a single unit, while the mount, M2, consists of two units; the bipod and the base plate. The 60-mm mortar, M2, is classified as "Standard." and is the American-manufactured counterpart of the M1 model. (See fig. 12.)

(1) The sight, M4, is used with this mortar. It is described in volume 5 of this manual.

(2) The 60-mm mortar ammunition for this weapon is similar in design to that which is used in the 81-mm mortar, M1.

(3) This mortar is used with the mount, M2, which is classified as "Standard."



FIGURE 11. - MORTAR, 60-MM, M1, ON MOUNT, M1.

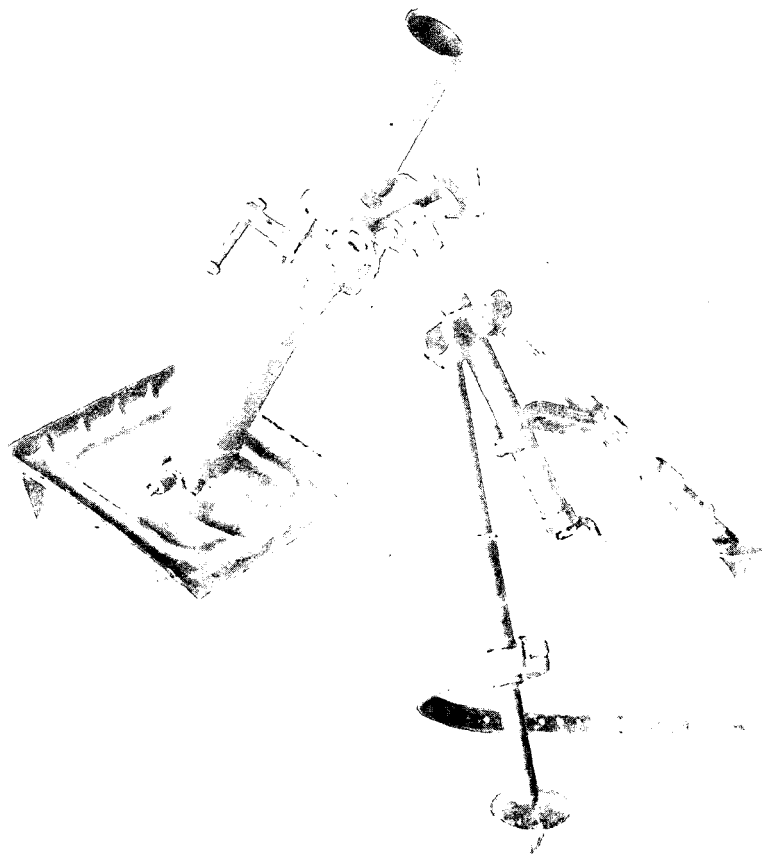


FIGURE 12. - MORTAR, 60-MM, M2, ON MOUNT, M2.

19. OPERATION. - The details regarding the operation of the 60-mm mortar, M2, are given in FM 23-85.

ORDNANCE DEPARTMENT

CHAPTER 2

FIELD ARTILLERY

	Paragraphs
SECTION I. General -----	20-21
II. Gun, 75-mm, M1897, and modifications -----	22-24
III. Gun, 75-mm, M1916, and modifications -----	25-27
IV. Gun, 75-mm, M1917, and modifications -----	28-30
V. Gun, 3", M5 (antitank) -----	31-32
VI. Howitzers, pack, 75-mm, M1 and M1A1 -----	33-35
VII. Howitzers, 105-mm, M2 and M2A1 -----	36-38
VIII. Gun, 4.5", M1 -----	39-41
IX. Guns, 155-mm, M1917, M1918M1, M1, and M1A1 -----	42-44
X. Howitzers, 155-mm, M1917, M1917A1, M1918, and M1 -----	45-47
XI. Howitzers, 8", Mk. VI, VII, and VIII-1/2 -----	48-50
XII. Howitzer, 8", M1 -----	51-53
XIII. Howitzer, 240-mm, M1918, and modifications --	54-56
XIV. Subcaliber equipment for field artillery -----	57-59

SECTION I

GENERAL

	Paragraph
General -----	20
Classifications of field artillery -----	21

20. GENERAL. - a. The term "Field Artillery" is applied to all large-bore ordnance used in the field of maneuver, with the exception of antiaircraft and railway artillery.

b. Unlike small arms which commonly fire nonexplosive missiles, artillery fires projectiles machined from steel and hollowed out to provide a recess for high explosives or chemical agents. Such projectiles are nose-fuzed and have a copper rotating band fastened near the base of the shell to engage in the lands of the gun tube. Like the small-bore missile, the projectile rotates in flight and follows a course, toward the target, called the trajectory. Somewhere along this trajectory, the shell may be exploded at a predetermined point by setting of the fuze, or the shell may be detonated on impact at the target. In either case, the object of the projectile is to destroy enemy troops and weapons by release of stored explosive energy, or to produce harassing effect through the release of chemical agents. "Fire power" is the term used to describe the volume, accuracy, and effective destroying ability of projectiles fired for destructive or harassing purposes.

21. CLASSIFICATIONS OF FIELD ARTILLERY. - a. Field artillery consists of guns and howitzers. The guns fire artillery projectiles at high velocity, with a flat trajectory and a small angle of fall between the projectile and the target. The howitzers fire artillery projectiles at lower velocity, with more curved trajectories and with a larger angle of fall between the projectile and the target. The purpose of gunfire is to obtain great striking power with a short time of flight of the projectiles. Howitzers are able to search out concealed targets on reverse slopes and destroy buried objectives, like dugouts, by plunging fire, due to the high angle of fall of the projectiles. Formerly, guns fired up to elevations of 20°; howitzers fired at higher elevations. Modern ordnance, however, has provided carriages for gun fire up to 65° in elevation. At long ranges, gun fire becomes plunging like howitzer fire, the angle of fall of the projectile increasing with the elevation of the piece.

b. Fire power is supplied by ordnance. The amount of fire power depends on the tactics of the troops employed and the artillery and ammunition available. Artillery is, therefore, classified according to its application by troops whose job in warfare is defined within certain limits.

c. Field artillery, in its broad sense, is all artillery that accompanies the army in the field. This implies that such artillery must have the same mobility as the troops which it accompanies. The limiting factor, speed of transport, is determined by the weight of the gun, its parts and by the emplacement problems of setting the piece. The classification of field artillery is therefore made along tactical lines in addition to its classification by weight and caliber.

d. Field artillery may be classified according to:

(1) Tactical employment of weapons:

(a) Divisional, Corps, Army, and GHQ Reserve artillery.

(2) Weight or caliber of weapons:

(a) Light artillery (75-mm guns and howitzers and 105-mm howitzers.)

(b) Medium artillery (4.5" guns and 155-mm howitzers.)

(c) Heavy artillery (155-mm guns and all guns and howitzers of larger caliber.)

(3) Method of transport:

(a) Horse-drawn, truck- and tractor-drawn artillery, horse artillery and pack artillery.

SECTION II

GUN, 75-MM, M1897, AND MODIFICATIONS

General data -----	Paragraph 22
Description -----	23
Operation -----	24

22. GENERAL DATA. - a. Table of guns, recoil mechanisms, and carriages. - The table below gives the guns and recoil mechanisms (columns 1 and 2) which are mounted on any carriage (column 3). Reading across, any of the guns or recoil mechanisms listed in any one section may be mounted on any of the carriages in the same section.

Gun	Recoil Mechanism	Mounted on 75-mm gun carriage
M1897 (LS)	M1897A3	M1897 (LS)
M1897A1 (LS)	M1897A6	M1897A2 (LS)
M1897A2 (S)		M1897MI (LS)
M1897A3 (LS)		M1897MIA2 (LS)
M1897A4 (S)		M1897A4 (LS)
M1897A2 (S)	M1897A5	M2A1 (LS)
M1897A4 (S)	M2 (Mod.)	M2A2 (LS)
M1897A2 (S)	M1897A7	M2A3 (S)
M1897A4 (S)	M2	

Note: (LS) - "Limited Standard"
 (S) - "Standard"

b. General data pertaining to gun carriages. -

75-mm Gun Carriage M1897 M1897MIA2 M1897A4 M2A1 M2A2 M2A3

Weight of gun and carriage complete (without accessories) in firing position -----pounds	2,660	2,660	3,010	3,800	3,800	3,460
Length of recoil - inches	44.9	44.9	44.9	41.5- 46.0	41.5- 46.0	44.9
Height of axis above ground ----- inches	40.4	40.4	44.4	47.65	47.65	47.65
Maximum elevation ----- degrees	19	19	19	46	46	45
Maximum depression ----- degrees	10	10	10	10	10	10
Maximum traverse right ----- degrees	3	3	3	45	45	30
Maximum traverse left ----- degrees	3	3	3	40	40	30

23. DESCRIPTION. - a. Gun group. - (1) Gun, 75-mm, M1897. - This gun is the basic weapon of its type and is of French design. It is of built-up construction, consisting mainly of a steel tube reinforced at the breech with a breech hoop and covered in the central position with a bronze jacket. (See figs. 13 and 14.) The breechblock is of the Nordenfeld eccentric-screw type, cylindrical in shape and threaded on the outside to fit the breech recess. It has a large diameter compared with the caliber of the gun, due to the fact that its axis is below that of the bore of the gun. The block is opened by rotating it 156° around its axis. Rotation of the breechblock to the loading position automatically ejects the empty cartridge case. The gun weighs 1,015 pounds.

(a) A number of these weapons were purchased by the United States, while similar guns were manufactured in this country. The parts of the American- and French-manufactured guns are identical and therefore interchangeable.

(b) On the American-made guns, the name and model are stamped on the left side of the breech hoop. The name of manufacturer, year of manufacture, serial number, and weight including breech mechanism, are stamped on the muzzle. The data on guns bought from France will be found on top of the breech end.

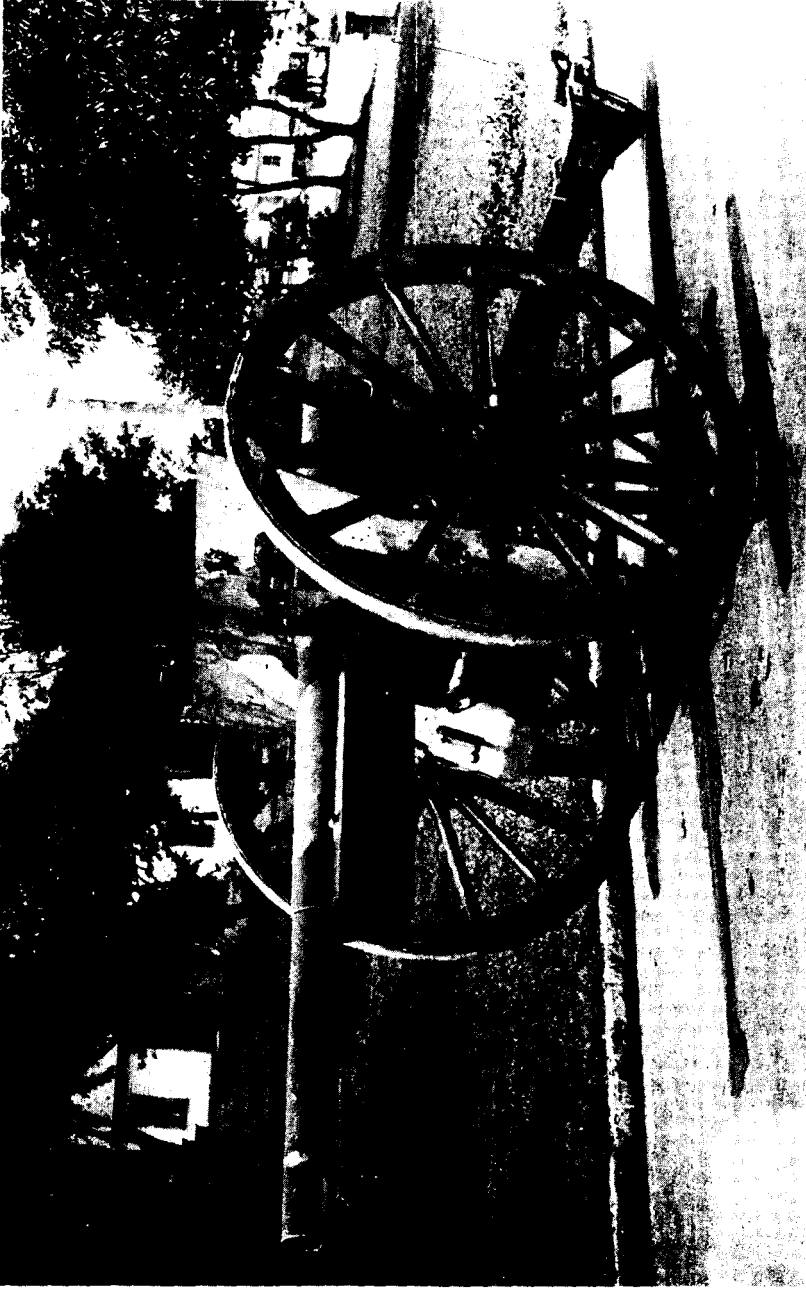


FIGURE 13. - GUN, 75-MM, M1897, ON CARRIAGE, M1897.

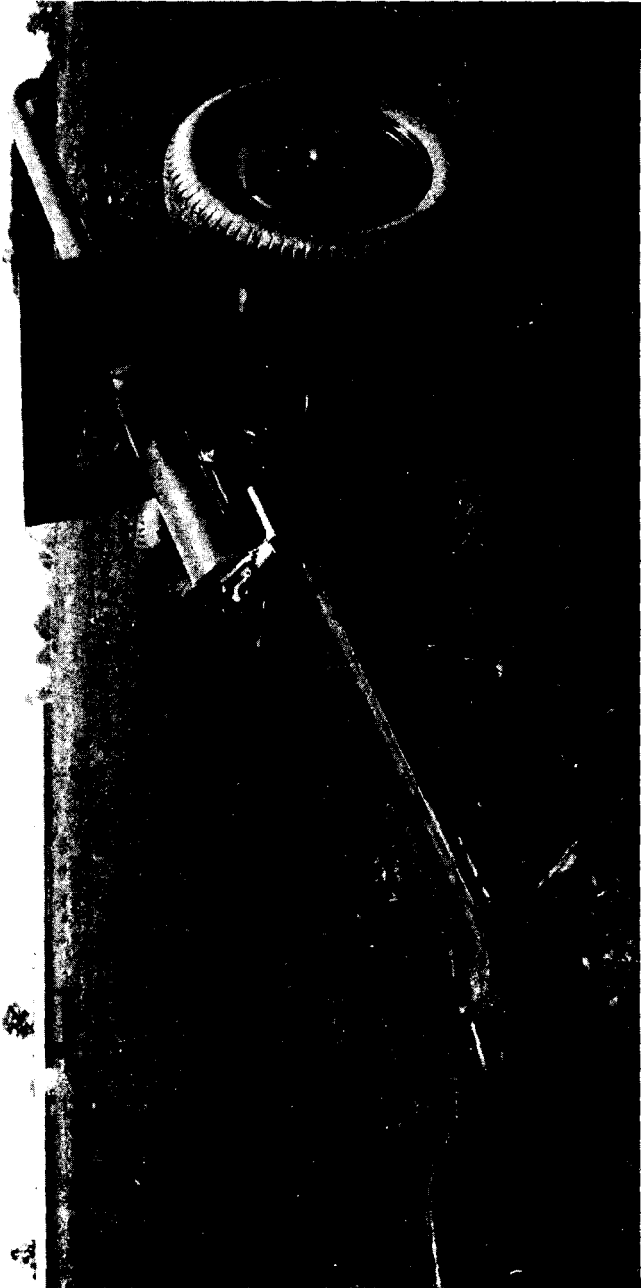


FIGURE 14. - GUN, 75-MM, M1897, ON CARRIAGE, M1897A4.

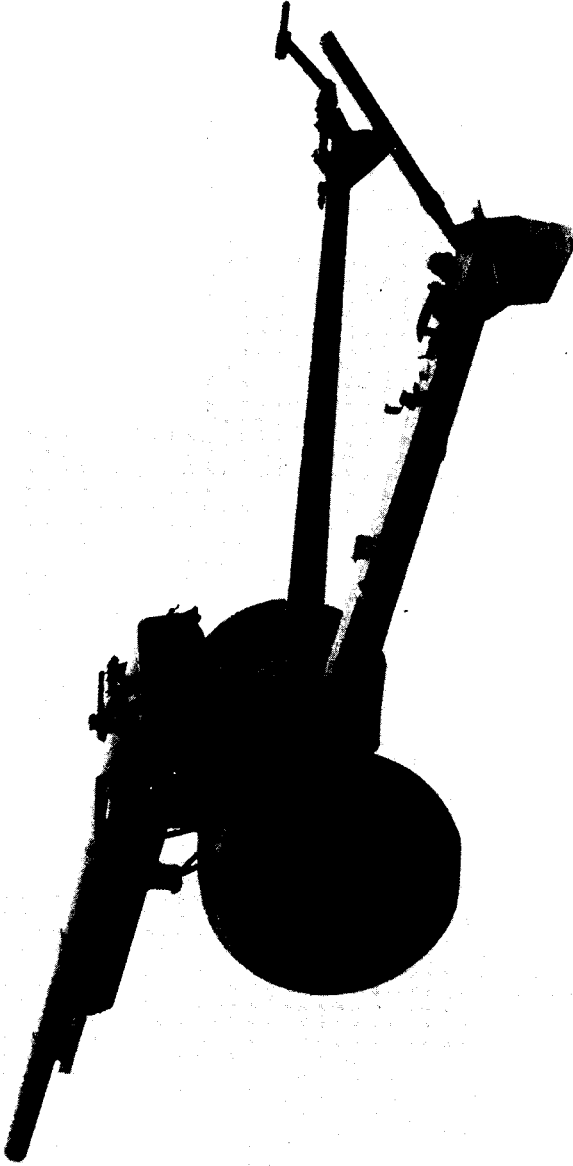


FIGURE 15. - GUN, 75-MM, M1897A4, ON CARRIAGE M2A3.

(2) Gun, 75-mm, M1897A4. - This gun is a modification of the M1897 and is standard for conversion of the M1897 gun. (See fig. 15.) The modification consists of the removal of rollers and sweeper plates with felt pads, and a portion of the jacket of the gun; these parts are replaced by steel rails and bronze strips attached to supports on the gun. The gun weighs 1,035 pounds.

(3) Gun, 75-mm, M1897A2. - This gun is standard for new manufacture of a complete gun and is similar in design to the M1897A4. It weighs 1,035 pounds. See figure 16.

b. Carriage group. - (1) Carriage, M1897. - This type was manufactured in France. It varies from the M1897MI (American manufacture) in wheels, lunette, wheel guards, shields, spares and accessories. See figure 13. The recuperator mechanism has a front plug in this type, and a respirator assembly in the American type. The parts of these carriages are not entirely interchangeable with each other or with American-manufactured types. About 2,800 of these carriages were purchased from France, and they have been issued and stored without distinction as to their source. When repairs are to be made, the source of the particular carriage must be indicated to insure obtaining the proper parts. The characteristics are the same as for the carriage, M1897MI, and are listed under that type.

(2) Carriage, M1897A2. - The M1897 takes the model designation of M1897A2 when equipped with the handspike.

(3) Carriage, M1897MI. - This carriage is the American manufacture of the M1897, the specifications being obtained by translating the French drawings into American units. It has hydropneumatic (Puteaux) recoil mechanism with constant-length recoil, independent line of sight, single trail, axle traverse, shoe brakes, and fixed spade. The gun slides on the cradle which is trunnioned on a rocker; and the rocker is trunnioned on the trail supported by the axle housing. It has a combination road brake and firing support.

(a) Data for 75-mm gun, M1897, on carriage, M1897MI. -

Weight of gun and carriage, complete (firing position)-- pounds	2,660
Weight of gun ----- pounds	1,015
Weight of recoil mechanism ----- pounds	283
Weight of complete round H.E. ----- pounds	19.3
Weight of projectile H.E. ----- pounds	14.6
Over-all length of vehicle ----- inches	180
Over-all length of barrel and breech mechanism ----- inches	110.6
Length of recoil ----- inches	44.9
Diameter of bore ----- inches	2.95
Maximum angle of elevation ----- degrees	19
Maximum angle of depression ----- degrees	10

Maximum traverse, left -----	degrees	3
Maximum traverse, right -----	degrees	3
Rifling, uniform R.H., one turn in -----	calibers	25.59
Maximum range, normal -----	yards	6,930
Maximum range, trail buried -----	yards	13,600
Muzzle velocity -----	ft./sec.	1,955
Weight of powder charge (propelling) -----	pounds	.56 - 2.0
Volume of powder chamber -----	cu.in.	85.5
Maximum powder pressure -----	lbs./sq.in.	36,000
Rate of fire, maximum (short bursts) -----	rds./min.	6
Rate of fire, (prolonged) -----	rds./min.	3

(4) Carriage, M1897MIA2. - The 75-mm gun carriages, M1897MI, when equipped with the handspike, take the model designation of M1897-MIA2.

(5) Carriage, M1897A4. - When the M1897, M1897A2, M1897MI, and M1897MIA2 carriages are equipped with high-speed adapters, their model designation is changed to M1897A4. (See fig. 14.) This modification consists of the removal of seats, seat supports, shaft brackets, steel- or rubber-tired wheels, brake-worm support bolts and washers, brake crank pin and brake crank, and equipping the carriage with a high-speed adapter, pneumatic tires mounted on disk and rim wheels, and an internal-expanding brake mechanism.

(a) With the 75-mm gun, M1897A4, the over-all length of the vehicle is 184". The total weight of the gun and carriage is 3,007 pounds.

(6) Carriages, M2A1 and M2A2. - In 1934, while the modifications of the M1897 carriage were still in progress, the first of a series of completely new carriages was designed to mount the M1897 gun and recoil mechanism. The high-speed carriages finally evolved the M1897A4 which solved the problem of mobility, but made no progress toward the improvement of limited elevation and traverse of the M1897 carriage. The M2, M2A1, and M2A2 carriages were finally designed to overcome these difficulties. These carriages are of the split-trail type built for high-speed transport, and equipped with pneumatic-tired disk and rim wheels with internal-expanding brakes. (See fig. 16.) Equilibrators neutralize unbalanced weight of the gun and recoil mechanism. This gun carriage elevates the gun to 45° and traverses 85°, thus utilizing fully the power of the gun. When the carriage is emplaced with the trails spread, an adjustable firing jack may be used to support the carriage weight. This forms a three-point support, consisting of the jack and the spades. However, on level ground the piece may be fired safely from the wheels, with the trails in either of the spread positions.

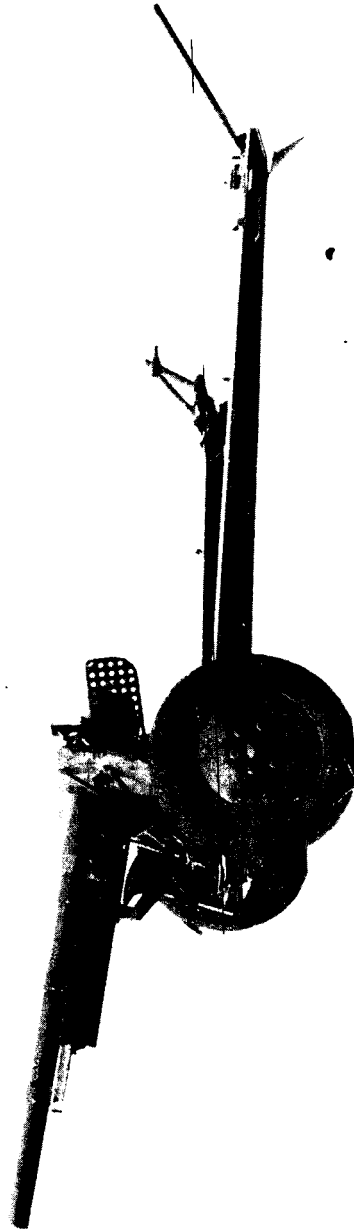


FIGURE 16. - GUN, 75-MM, M1897A2, ON CARRIAGE, M2A2.

(a) Data for 75-mm gun, M1897A4, on carriage, M2A2. -

Weight of gun and carriage, complete (firing position)--	pounds	3,800
Weight of gun -----	pounds	1,035
Weight of recoil mechanism -----	pounds	283
Weight of complete round H.E. -----	pounds	19.3
Weight of projectile H.E. -----	pounds	14.6
Weight of powder charge -----	pounds	.56 to 2.0
Over-all length of vehicle -----	inches	239
Over-all length of barrel -----	inches	110.6
Diameter of bore -----	inches	2.95
Length of recoil -----	inches	41.5 to 46
Maximum angle of elevation -----	degrees	46
Maximum angle of depression -----	degrees	10
Maximum traverse, left -----	degrees	40
Maximum traverse, right -----	degrees	45
Maximum range -----	yards	13,600
Muzzle velocity -----	ft./sec.	1,955
Volume of powder chamber -----	cu. in.	85.5
Rate of fire, maximum (short bursts) -----	rds./min.	6
Rifling, uniform, R.H., one turn in -----	calibers	25.59
Maximum powder pressure -----	lbs./sq.in.	36,000

(7) Carriage, M2A3. - The carriage, M2A3, is another modification of the 75-mm gun carriage, M2. (See fig. 15.) The firing jack is replaced by segments, and the carriage is equipped with a pivoted axle which automatically adjusts itself to permit laying the piece with the wheels at an angle up to 10° to the horizontal. The top-carriage modification consists of removing and relocating various pads, brackets, and bosses, and adding other parts to the mounting and elevating mechanism handwheel on the left hand side of the carriage, and provisions for cradle and traveling locks. The lower part of the top carriage is modified to provide clearance for the pivoted axle. The trails and spades are modified by reducing the length 19". The drawbar is designed for use with a motorized unit. The recoil mechanism, M2, combines the cradle, recoil, and recuperator (counterrecoil) cylinders. Its function is to check movement of the recoiling mass, in recoil and counterrecoil, in a gradual manner so as not to cause displacement of the carriage. Other characteristics are the same as those of the carriages, M2A1 and M2A2.

c. Sighting and fire-control equipment. - (1) Carriages, M1897, M1897M1, and M1897A4. - The on-carriage equipment consists of the sight, M1901. The off-carriage equipment includes the aiming post, M1; gunner's quadrant, M1; bore sight; aiming circle, M1; prismatic compass, M1918; 1-meter-base range finder, M1916; and the B. C. telescope, M1915.

(2) Carriages, M2, M2A1, and M2A2. - The on-carriage equip-

ORDNANCE MATERIEL - GENERAL

ment includes the panoramic telescope, M12A1, on the telescope mount, M15A1; an elbow telescope, M14, on telescope mount, M23; and a range quadrant, M1. The off-carriage equipment is the same as that mentioned in (1) above.

(3) Carriage, M2A3. - The equipment is the same as that in (2) above, except that the panoramic telescope, M12A1, is on the telescope mount, M22; and the range quadrant, M5, is used.

d. Ammunition. - Ammunition for the 75-mm guns, M1897, M1897-A2, and M1897A4, is issued in the form of fixed rounds, either unfuzed or as fuzed complete rounds. A complete round includes all of the ammunition components, used in a cannon, to fire one round. In fixed ammunition, the cartridge case, which contains the propelling charge and the primer, is crimped rigidly to the projectile.

(1) The 75-mm guns, M1897, M1897A2, and M1897A4, being chambered alike, fire the same ammunition. A wide variety of shell, shrapnel, and armor-piercing projectiles are authorized for use therein. A list of ammunition is given in TM 9-305.

24. OPERATION. - The operation of the 75-mm gun materiel, M1897 and modifications, is explained in TM 9-305 and TM 9-1305.

SECTION III

GUN, 75-MM, M1916, AND MODIFICATIONS

	Paragraph
Data -----	25
Description -----	26
Operation -----	27

25. DATA. - a. The following table gives the guns (column 1) which are mounted on any carriage (column 2). Reading across, any of the guns listed in any one section may be mounted on any of the carriages in the same section. All of these guns and carriages are classified as "Limited Standard."

Gun	Mounted on 75-mm gun carriage
M1916	M1916
M1916MI	M1916A1
M1916MII	
M1916MII-1/2	
M1916MIII	
M1916MIII-1/2	
M1916MIA1	M1916MI*
M1916MIIIA1	M1916MIA1*
M1916MIII-1/2A1	

*Equipped with hydropneumatic recoil mechanism of the St. Chamond type.

b. Data for 75-mm gun, M1916, on carriage, M1916A1. -

Weight of gun and carriage, complete -----	pounds	3,240
Weight of gun -----	pounds	749
Weight of recoil mechanism, approximate -----	pounds	400
Weight of complete round H.E. -----	pounds	19.3
Weight of projectile H.E. -----	pounds	14.6
Weight of powder charge (propelling) -----	pounds	.56 to 2
Over-all length of vehicle -----	inches	191
Over-all length of barrel -----	inches	90.9
Maximum length of recoil -----	inches	46
Maximum length of recoil, variable type -----	inches	18 to 46
Diameter of bore -----	inches	2.950
Maximum angle of elevation -----	degrees	53
Maximum angle of depression -----	degrees	7
Maximum traverse, right -----	degrees	22.5
Maximum traverse, left -----	degrees	22.5
Maximum range at 45° elevation -----	yards	13,300
Muzzle velocity -----	ft./sec.	1,900
Volume of powder chamber -----	cu. in.	85.5
Rate of fire, maximum (short bursts) -----	rds./min.	6
Rifling, right-hand twist, one turn in 119 calibers at beginning of rifling to one turn in 25.4 calibers at 9.72 inches from the muzzle, thence uniform.		
Maximum powder pressure -----	lbs./sq.in.	36,000

26. DESCRIPTION. - a. Gun, 75-mm, M1916. - The 75-mm gun, M1916, is the basic weapon of its type. (See fig. 17.) However, eight modifications have been applied to the original gun so that at present the 75-mm guns, M1916, M1916MI, M1916MIA1, M1916MII, M1916MII-1/2, M1916MIII, M1916MIIIA1, M1916MIII-1/2, and M1916MIII-1/2A1 are the



FIGURE 17. - GUN, 75-MM, M1916, ON CARRIAGE, M1916A1.

models in existence. The guns are of the built-up type of alloy-steel forgings, consisting of a tube, jacket, breech ring, and clip. All of the parts are assembled by shrinkage.

(1) The breech mechanism is of the vertical-sliding type having a rectangular breechblock which slides up and down in its recess in the breech ring. It is opened manually; it closes automatically, when a round of ammunition is inserted in the breech chamber.

(2) The firing mechanism housed within the breechblock is of the continuous-pull type. It is cocked and the gun fired by one continuous motion of the trigger shaft. The mechanism is designed to function either by the firing shaft and handle on the cradle of the carriage, or by means of a lanyard.

b. Carriages. - (1) M1916A1 and M1916MIA1. - The 75-mm gun carriages, M1916A1 and M1916MIA1, are modified M1916 and M1916MI carriages. (See fig. 17.) This modification consists of the removal of the brake mechanism, axle seat, footrest, and steel-tired wheel, and the application of new parts to provide for high-speed transport. These carriages are of the split-trail type, which permit high elevation and wide traverse without changing the position of the trails.

c. Sighting and fire-control equipment. - The on-carriage equipment consists of the panoramic telescope, M6, and the sight, M1916. The off-carriage equipment included an aiming post, M1; a gunner's quadrant, M1; a bore sight; aiming circle, M1; prismatic compass, M1918; 1-meter-base range finder, M1916; bracket fuze setter, M1916; hand fuze setter, M1912; and B. C. telescope, M1915. These instruments are described in volume 5 of this manual.

d. Ammunition. - These guns use the same ammunition as is authorized for the M1897 models.

27. OPERATION. - The operation of the 75-mm gun materiel, M1916, and modifications, may be found in TM 9-310 (TR 1305-75B).

SECTION IV

GUN, 75-MM, M1917, AND MODIFICATIONS

	Paragraph
Data -----	28
Description -----	29
Operation -----	30

28. DATA. - a. The gun and carriages. - The 75-mm gun, M1917, is mounted on carriage, M1917 or M1917A1. The latter type has pneu-

matic tires. This gun and its carriages are classified as "Limited Standard."

b. General data pertaining to gun carriages. -

	M1917	M1917A1
Weight of gun and carriage complete --- pounds	2,945	2,990
Length of recoil ----- inches	41* (49)	41* (49)
Maximum angle of elevation- degrees	16	16
Maximum angle of depression --- degrees	5	5
Traverse of gun on carriage -- mils	144	144

*Normal length of recoil. Figure in parentheses indicates maximum length of recoil.

c. Data for 75-mm gun, M1917, on carriage, M1917A1. -

Weight of gun and carriage, complete -----	pounds	2,990
Weight of gun -----	pounds	995
Weight of recoil mechanism -----	pounds	325
Weight of complete round H.E. -----	pounds	19.3
Weight of projectile H.E. -----	pounds	14.6
Weight of powder charge (propelling) -----	pounds	.56 to 2.0
Over-all length of vehicle -----	inches	180
Over-all length of barrel -----	inches	88.21
Diameter of bore -----	inches	2.950
Maximum length of recoil -----	inches	49.0
Maximum angle of elevation on carriage -----	degrees	16.0
Maximum angle of depression -----	degrees	5.0
Maximum traverse, right -----	degrees	4.0
Maximum traverse, left -----	degrees	4.0
Maximum range, at 45° elevation -----	yards	13,300
Maximum range, normal -----	yards	8,150
Muzzle velocity -----	ft./sec.	1,900
Volume of powder chamber -----	cu. in.	85.5
Rate of fire, maximum (short bursts) -----	rds./min.	6
Rifling, right-hand twist, zero turns at origin to one turn in 25.4 calibers at 9.72 inches from muzzle, thence uniform.		
Maximum powder pressure -----	lbs./sq.in.	36,000

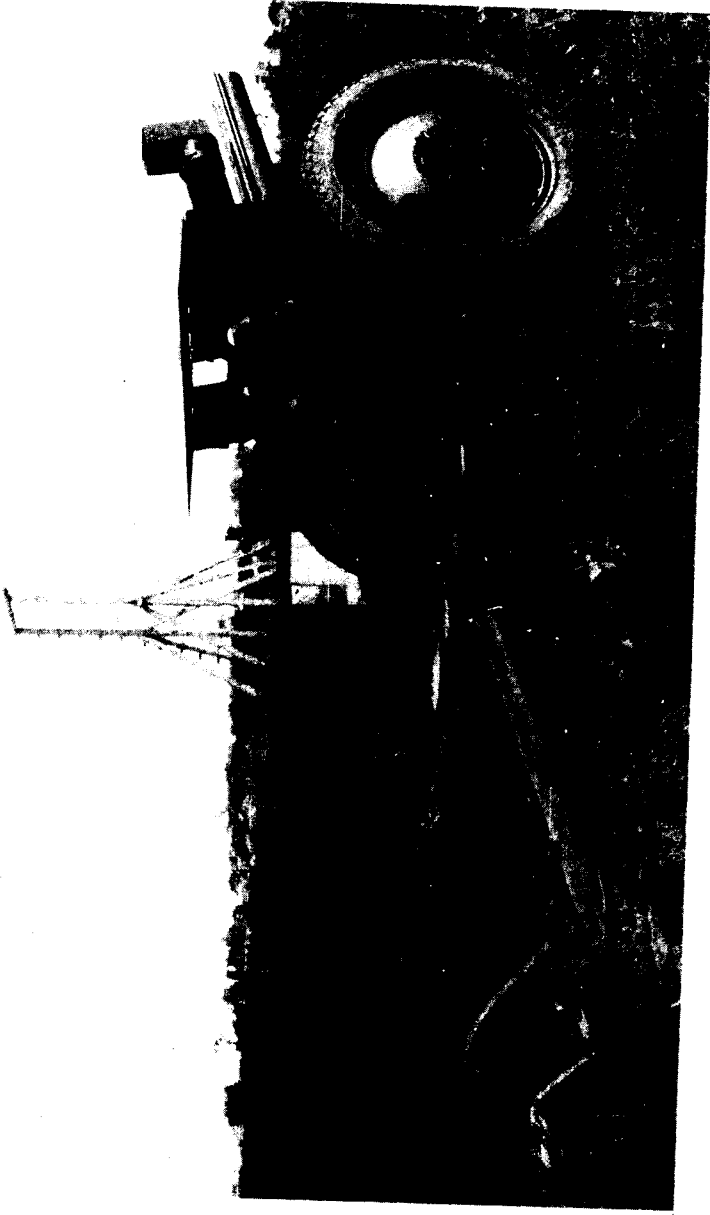


FIGURE 18. - GUN, 75-MM, M1917, ON CARRIAGE, M1917A1.

29. DESCRIPTION. - a. Gun, 75-mm, M1917. - This gun is the British, 18-pdr. (3.3") Mk. I, modified to a 75-mm gun. (See fig. 18.) It is of the built-up type, consisting of a tube, a series of layers of steel wire, and a jacket. The breech ring is screwed to the tube.

(1) The breechblock is of the interrupted-screw type. It has two threaded and two flat sectors, in rear of which is a cylindrical section on which is threaded the breechblock carrier. The breechblock carrier is hinged on the right side of the breech recess by the carrier-hinge bolt.

(2) The firing mechanism is of the continuous-pull type and is so arranged that the gun cannot be fired until the breechblock is in its fully closed position and the hand lever locked.

(3) The extractor is hinged to the right side of the breech ring. The yoke portion of the extractor bears against the inner rim face of the cartridge case and ejects the case from the chamber, when the breech is opened.

b. Carriages. - (1) M1917. - This is the British 18-pdr. (3.3") carriage, Mk. I, modified to 75-mm. It has a single tubular trail, hydro-spring recoil mechanism, and independent line of sight. Traveling brakes are provided.

(2) M1917A1. - The M1917A1 gun carriage is a modified 75-mm gun carriage, M1917 (British). (See fig. 18.) This modification consists of removing the running gear and the application of new parts to provide for high speed transport. The design was modified to use as many parts from the M1897A4 carriage as practicable including wheels, tires and brake mechanism. The tread was cut to 70" and the height of trunnions was made the same as on the original M1917 carriage. The original sight and shields were maintained and a new lunette provided.

c. Sighting and fire-control equipment. - The on-carriage equipment consists of the panoramic telescope, M6, and the rocking bar sight, type F. The off-carriage equipment is the same as that for the 75-mm gun, M1916.

d. Ammunition. - This gun uses the same ammunition as is authorized for the M1897 models.

30. OPERATION. - The operation of the 75-mm gun materiel, M1917, and modifications, may be found in TM 9-315.

ORDNANCE DEPARTMENT

SECTION V

GUN, 3", M5, (ANTITANK)

Data-----	Paragraph
Description-----	31
	32

31. DATA. - The weights, measurements, and ballistic data for the 3" gun, M5, on carriage, M1, are as follows:

Weight of gun and carriage, M1-----	pounds	4,646.00
Weight of gun-----	pounds	1,475.00
Over-all length-----	inches	158.40
Length of bore-----	calibers	50.00
Maximum range (H.E. projectile)-----	yards	14,200.00
Muzzle velocity:		
A.P., 15-lb. projectile-----	ft./sec.	2,600.00
H.E., 12.7-lb. projectile-----	ft./sec.	2,800.00
Volume of chamber-----	cu.in.	200.00
Travel of projectile-----	inches	127.30
Maximum powder pressure-----	lbs./sq.in.	34,000.00
Rate of fire-----	rds./min.	12.00
Weight of recoil mechanism-----	pounds	463.00
Normal recoil:		
At 0°-----	inches	30.50
At 30°-----	inches	34.50
Maximum recoil-----	inches	44.00
Total weight of carriage without gun-----	pounds	3,171.00
Height of lunette (limbered position)-----	inches	29.00
Length of carriage (muzzle to lunette)-----	inches	23.00
Over-all width-----	inches	82.00
Tread, center to center-----	inches	70.00
Height of lunette (limbered position)-----	inches	60.00
Maximum elevation-----	degrees	30.00
Minimum elevation-----	degrees	-5.00
Total weight, gun, mechanism, and carriage-----	pounds	4,875.00
Total traverse-----	degrees	44.00

32. DESCRIPTION. - a. The 3" gun, M5, and its carriage, M1, are classified as "Standard." (See fig. 19.)

b. The 3" gun, M5, is a truck-drawn weapon which supplements the 37-mm antitank gun, M3, and the 75-mm antitank gun, M1897A2 and M1897A4, for attacking tanks having armor protection that is greater than those weapons can penetrate. It is mounted on a split-trail carriage that is capable of high-speed travel.



FIGURE 19. - GUN, 3", M5, ON CARRIAGE, M1 (SIDE VIEW).



FIGURE 20. - GUN, 3", M5, ON CARRIAGE, M1 (3/4 RIGHT REAR VIEW).

c. When the need for this weapon became apparent, the gun and mount were designed by adopting units of other weapons. Thus, the gun consists of a modified breech ring and breech mechanism pertaining to the 105-mm howitzer, M3A1, a tube of the 3" gun, M6, the 105-mm howitzer recoil mechanism, M2, and a 105-mm howitzer carriage, M2, with minor modifications.

d. The standard ammunition for this gun consists of the following types of fixed ammunition:

- (1) Shell, H.E., M42A1, w/fuze, point detonating, M48.
- (2) Projectile, A.P.C., M62, w/tracer.
- (3) Shot, A.P., M79, w/tracer.
- (4) Shell, smoke, M88 (B.E.).
- (5) Shot, target practice, M85.
- (6) Shell, practice, M42B2.

SECTION VI

HOWITZERS, PACK, 75-MM, M1 AND M1A1

	Paragraph
Data -----	33
Description -----	34
Operation -----	35

33. DATA. - a. Table of howitzers and carriages. - The table below gives the howitzers (column 1) which are mounted on any carriage (column 2). Reading across, any of the howitzers listed in any one section may be mounted on any of the carriages in the same section.

Howitzers	Carriages
M1A1 (S)	M1 (S) M3A2 (S) M2A1 (LS) M3A1 (LS) M3A3 (S)
M1 (LS)	M1 (S)

Note: (LS) - "Limited Standard"
(S) - "Standard"

b. Data for 75-mm pack howitzer, M1A1, on mount, M1. -

Weight of howitzer, M1A1, and carriage, M1, complete - pounds	1,269
Pay weight of pack loads (less tools and accessories):	
Tube assembly ----- pounds	221
Breech mechanism assembly and wheels ----- pounds	217.5
Top sleigh and cradle ----- pounds	221
Bottom sleigh and recoil mechanism ----- pounds	203
Front trail ----- pounds	235.5
Rear trail and axle assembly ----- pounds	160.5
Weight of complete round H.E. ----- pounds	18.25
Weight of projectile H.E. ----- pounds	14.6
Weight of powder charge ----- pounds	1.04
Over-all length of vehicle ----- inches	145
Over-all length of barrel and breech mechanism ----- inches	59.1
Diameter of bore ----- inches	2.95
Maximum length of recoil ----- inches	35.5
Normal length of recoil ----- inches	32
Maximum angle of elevation ----- degrees	45.0
Maximum angle of depression ----- degrees	5.0
Maximum traverse, right ----- degrees	2.5
Maximum traverse, left ----- degrees	2.5
Maximum range at 45° elevation ----- yards	9,489
Muzzle velocity ----- ft./sec.	1,270
Volume of powder chamber ----- cu. in.	57.3
Rate of fire, maximum (short bursts) ----- rds./min.	6
Rifling, uniform R.H., one turn in ----- calibers	20
Maximum powder pressure ----- lbs./sq.in.	26,000

34. DESCRIPTION. - a. General. - The 75-mm pack howitzer materiel was designed primarily for pack transport, and secondarily for animal draft, and low-speed towing, manual or otherwise. Its use in animal draft has been discontinued and the special accessories made obsolete. This type of howitzer is now used as cannon for pack artillery and for cavalry division artillery.

(1) The development of this 75-mm pack howitzer began in 1920. Several different models were developed, including the M1920, M1922 type A and type B, M1923 type B, M1923E1, and M1923E2. The M1923E2, with several minor changes, was standardized as the M1.

b. Howitzer, pack, 75-mm, M1. - This howitzer is separated into two main groups; the tube assembly and the breech mechanism. This division is principally for purposes of pack transportation as mentioned above. The tube and breech mechanism are joined together by interrupted threads, those in the breech ring mating with those on the breech end of the tube, one-eighth of a turn being required. The interrupted threads enable rapid assembly and disassembly.

ORDNANCE MATERIEL - GENERAL

(1) The breech mechanism is of the horizontal-sliding type and is hand-operated by means of a lever pivoted to the breech ring.

(2) The firing mechanism is of the design for horizontal sliding wedge breechblocks and is known as firing lock, M13. It is of the continuous-pull type.

c. Howitzer, pack, 75-mm, M1A1. - The M1 howitzer was modified and the new model is known as the M1A1. (See figs. 21 and 22.) The slight differences are in the breech ring and the breechblock, and these components are not interchangeable for the two methods.

d. Carriage, pack howitzer, M1. - This carriage, like the howitzer, is separated into several main groups for ease of transportation on pack animals. (See fig. 21.)

(1) The recoil mechanism is of the hydropneumatic type. It is housed within two cylinders: the recoil cylinder and the recuperator cylinder. The two cylinders are connected with the bottom sleigh at the front by means of a yoke suitably formed and secured by six bolts. At the rear they are fastened to the bottom sleigh by the cylinder support which is also bolted thereto.

(2) The piston rod is connected to the cradle by means of the piston-rod latch. Therefore, during recoil and counterrecoil the two cylinders and bottom sleigh move with the howitzer, while the cradle remains stationary.

(3) The trail is divided into two groups: the front trail and the rear trail. The two are joined by fittings sufficiently heavy to withstand the firing stresses. The elevating mechanism, rockers, and equilibrators are assembled to the front trail and are carried with it in the pack.

(4) Greater mobility of the weapon was desired and experimental models as listed below developed into what we now know as the "Field Howitzer."

e. Carriage, M2A1. - Four experimental pack howitzer carriages, T2, T2E1, T1E2, T2E3, were overhauled and modified to become M2A1. Modifications consist of: new wheel carriers which eliminate the carrying springs, provision for fastening new sighting-equipment chest on the trails, and provision for securing aiming post with covers on the trail flasks.

f. Carriage, M3. - This is the recommended nomenclature of the T2E2 carriage. It has a modified firing-base latch. The bearing plate, wheel latches, trail, trail stops, and sighting equipment are improved.



FIGURE 21. - HOWITZER, PACK, 75-MM, M1A1, ON CARRIAGE, M1.

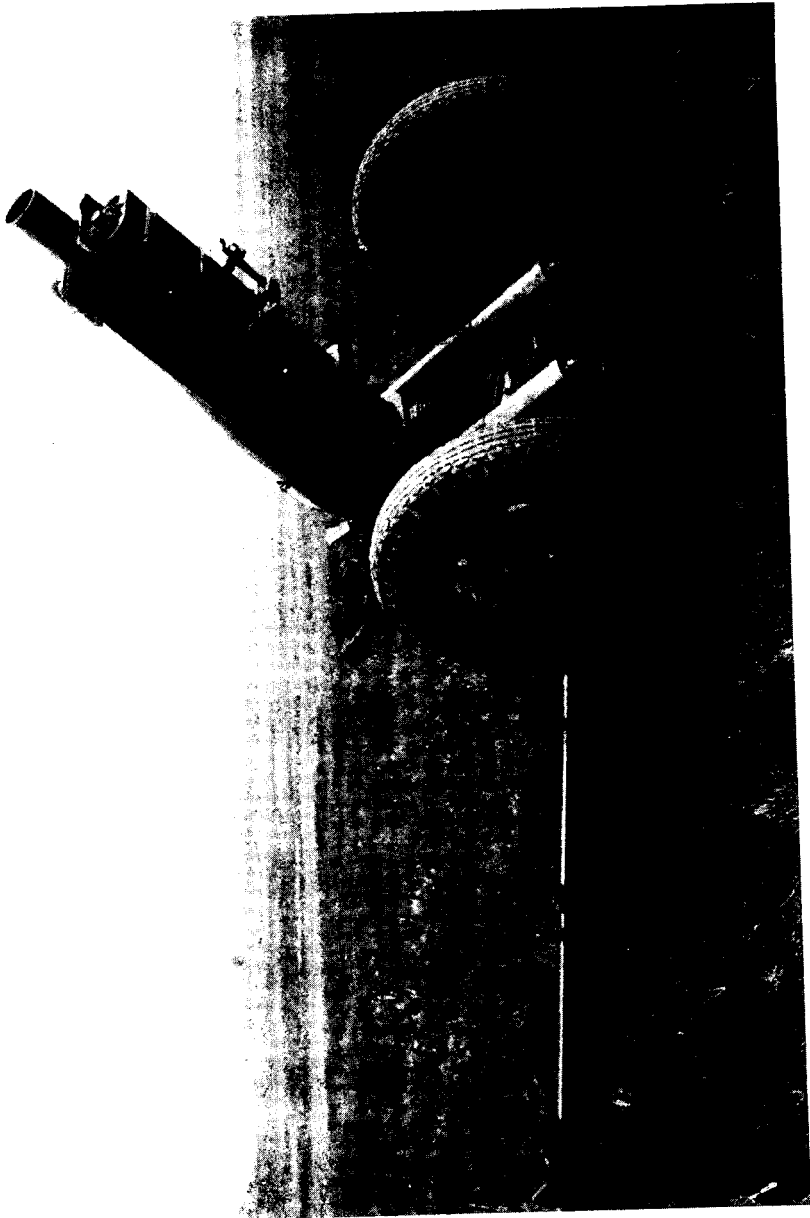


FIGURE 22. - HOWITZER, PACK, 75-MM, M1A1, ON CARRIAGE, M3.

g. Carriage, M3A1. - The M3A1 carriage is an adaptation of the M1 carriage with its recoil mechanism, top and bottom sleighs, and cradle, to a split-trail, high-speed carriage. (See fig. 22.) The wheels have pneumatic tires and are mounted on wheel carriers which can be rotated so as to permit the carriage to rest on a firing base and the trails. In this three-point suspension position, the carriage is very stable. The following differences exist between the M1 and the M3A1 carriages.

(1) The total weight of the M3A1 carriage and the 75-mm howitzer, M1A1, is 2,089 pounds. The howitzer weighs 342 pounds, and the recoil mechanism weighs 203 pounds.

(2) The over-all length of the vehicle is 152.5 inches.

(3) The carriage is constructed so that the howitzer may be elevated $49^{\circ} 30'$ and depressed 9° ; traverse is $22^{\circ} 30'$ either right or left.

h. Carriages, M3A2 and M3A3. - The carriages, M3A2 and M3A3 are modifications of the carriage, M3A1. The M3A1 becomes the M3A2 when shields are added and the M3A1 becomes the M3A3 due to the addition of 7.50 x 16 combat tires and wheels with 16 x 6.50 CS divided rims.

i. Sighting and fire-control equipment. - (1) Carriage, M1. - The on-carriage equipment consists of the panoramic telescope, M1, on the telescope mount, M3. The off-carriage equipment includes the gunner's quadrant, M1; bore sight; aiming circle, M1; prismatic compass, M1918; 1-meter-base range finder, M1916; and the B. C. telescope, M1915A1.

(2) Carriages, M2A1, M3, and M3A1 (Field Howitzer). - The on-carriage equipment consists of the panoramic telescope, M1; the telescope mount, M16; range quadrant, M3 and the elbow telescope, M5. The off-carriage equipment is the same as that used with the carriage, M1.

j. Ammunition. - The 75-mm pack howitzer uses either fixed or semi-fixed ammunition. Semi-fixed ammunition differs from the fixed type in that while the projectile and the cartridge case are issued assembled and are loaded into the gun as a unit, the cartridge case is not permanently attached to the projectile, but may be removed for the purpose of varying the propelling charge. This type of ammunition is used for howitzer firing where different zones, corresponding to different ranges, require different weights of powder charge.

(1) Shrapnel ammunition is "Limited Standard" for issue for use in the 75-mm pack howitzer. Shell, H.E., M41A1, w/fuze, time and superquick, M54, or PDF M45 are "Substitute Standard." The following service ammunition is "Standard" both for issue and for manufacture.

(a) Shell, H.E., M48, w/fuze, point detonating, M48, 75-mm pack howitzer, M1A1.

(b) Shell, H.E., M48, w/fuze, time and superquick, M54, or PDF M48, 75-mm pack howitzer, M1A1.

(c) Shell, H.E., A.T., M66, w/BDF, M62.

(d) Shell, chemical, M64 w/fuze, point detonating, M57.

35. OPERATION. - The operation of the 75-mm pack howitzer materiel is described in TM 9-320 (TR 1305-75 E).

SECTION VII

HOWITZERS, 105-MM, M2 AND M2A1

	Paragraph
Data-----	36
Description -----	37
Operation -----	38

36. DATA. - The weights, measurements, and ballistic data for the 105-mm howitzer, M2A1, on carriage, M2, are as follows:

Weight of howitzer and carriage complete -----	pounds	4,250
Weight of howitzer -----	pounds	1,064
Weight of recoil mechanism -----	pounds	457
Weight of complete round H.E. -----	pounds	41.6
Weight of projectile H.E. -----	pounds	32.7
Weight of powder charge -----	pounds	2.8
Over-all length of vehicle -----	inches	238
Diameter of bore -----	inches	4.134
Maximum length of recoil -----	inches	44
Normal length of recoil -----	inches	42
Maximum angle of elevation -----	degrees	65° 50'
Maximum angle of depression -----	degrees	5.00
Maximum traverse, right -----	degrees	22.5
Maximum traverse, left -----	degrees	22.5
Maximum range at 45° elevation -----	yards	12,146
Muzzle velocity -----	ft./sec.	1,550
Rifling, uniform R.H., one turn in -----	calibers	20
Volume of powder chamber -----	cu. in.	153
Maximum powder pressure -----	lbs./sq.in.	28,000
Maximum rate of fire, (short bursts) -----	rds./min.	4

37. DESCRIPTION. - a. Howitzers, 105-mm, M2 and M2A1. - These light field howitzers are interchangeable and have the same general characteristics. (See fig. 23.) The M2 is classified as "Limited Standard," and the M2A1 is "Standard."

ORDNANCE DEPARTMENT

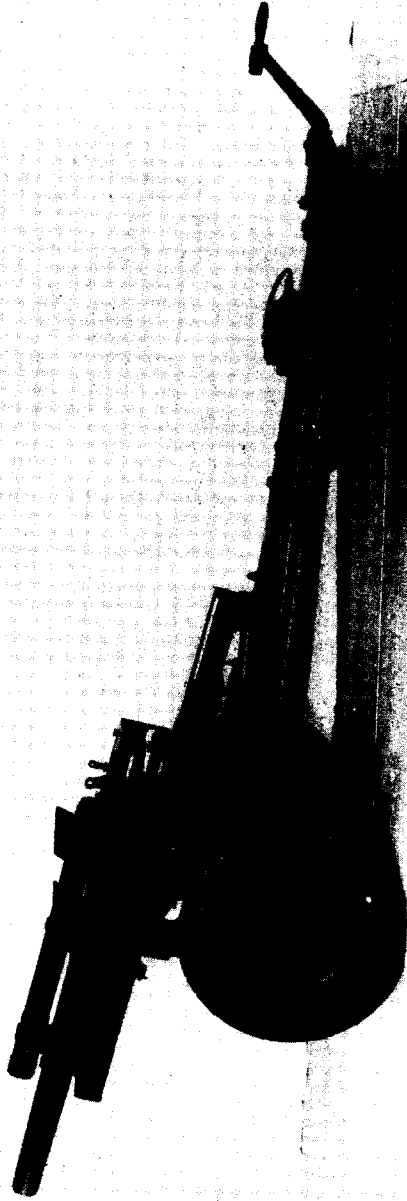


FIGURE 23. - HOWITZER, 105-MM, M2A1, AND CARRIAGE, M2.

(1) The only difference between the two models is in the design of their breech rings. The breech ring of the M2A1 howitzer is equipped with two bronze bearing strips which fit into dovetail slots cut in the bottom of the breech ring and are retained in position by four flat-head screws. In each model, the breech ring is screwed on to the end of the tube.

(2) The breech mechanisms of the howitzers have a rectangular, sliding wedge breechblock which moves in horizontal grooves cut in the sidewalls of the breech-ring recess. The movement of the breechblock is controlled by the breechblock operating lever.

(3) Firing of the howitzer is controlled by the action of the firing lock, M13, housed within the firing lock recess of the breechblock. When the howitzer is mounted on carriage, M1A1, it is fired by means of a lanyard attached to the trigger shaft; when mounted on carriage, M2, it is fired by a firing mechanism attached to the cradle. The construction of this mechanism permits firing when the howitzer is no more than 3/4" out of battery. It is operated by pulling the lanyard handle to the rear.

b. Carriages. - (1) These are of the split-trail type and are designed for towing behind prime movers.

(a) A single-unit, spring-type equilibrator is centrally located and connects the top carriage and the cradle. The equilibrator is provided to neutralize the unbalanced weight due to the fact that the tube is trunnioned to the rear of its center of gravity and to reduce the manual effort required to elevate and depress the weapon.

(b) The recoil mechanism is of the constant-length type and consists of a recoil cylinder and a recuperator cylinder. The howitzer and the recoil mechanism are attached to a sleigh. The piston rod is attached to the cradle and remains stationary during recoil and counterrecoil.

(c) The carriage is provided with an equalizing support which compensates for irregularities in the terrain when the carriage is in the firing position.

(d) Both the M1A1 and M2 carriages are equipped with electric brakes and are capable of being towed by a prime mover at speeds up to 35 m.p.h. on improved roads. The braking mechanism is controlled from the driver's seat of the prime mover. Hand brakes are provided for parking the carriage. The brakes are applied automatically in the event of an accidental separation of the carriage and the prime mover.

(2) Carriages, M1 and M1A1. - The M1A1 is a modification of the M1 carriage, which consisted of the replacement of the 56-inch

wheels, the brake mechanism, and other parts pertaining to horse draft artillery. Fourteen M1 carriages were manufactured, thirteen of which were modified and designated as carriage, M1A1. All are equipped with 7.50 x 24 pneumatic tires mounted on disk and rim wheels. They are classified as "Limited Standard."

(3) Carriage, M2. - This carriage embodies the successful features of the M1A1 model, along with improvements thereon. (See fig. 22.) The elevating mechanism on the cradle has been redesigned so as to allow operation from either side of the carriage. The elevating arcs on the M2 serves also as a seat for the trunnions of the cradle. The axle and the support provide an improved means of compensation for irregularities of terrain, with the howitzer in firing position. The carriage, M2, is classified as "Standard."

c. Sighting and fire-control equipment. - (1) Carriage, M2. - The on-carriage equipment consists of the panoramic telescope, M12A2; telescope mount, M21; range quadrant, M4; telescope mount, M23; and elbow telescope, M16. The off-carriage equipment includes the aiming circle, M1; the prismatic compass, M1918; the 1-meter-base range finder, M1916; and a B. C. telescope, M1915A1. A fuze setter for this materiel is under development.

(2) Carriage, M1. - The on-carriage equipment consists of the panoramic telescope, M5A2, on the telescope mount, M7. The off-carriage equipment is the same as that for the carriage, M2.

(3) The above instruments are described in volume 5 of this manual.

d. Ammunition. - Ammunition for the 105-mm howitzers, M2 and M2A1, is issued fuzed in the form of semifixed complete rounds. The following types of service ammunition are "Standard" for issue and manufacture.

(1) Shell, H.E., M1, w/fuze, point detonating, M48, 105-mm howitzers, M2 and M2A1

(2) Shell, H.E., M1, w/fuze, time and superquick, M54, 105-mm howitzers, M2 and M2A1.

(3) Shell, gas, M60, w/fuze, point detonating, M57, 105-mm howitzers, M2 and M2A1.

(4) Shell, smoke, M84, 105-mm howitzers, M2 and M2A1.

(5) Shell, H.E.,A.T., M67.

38. OPERATION. - The operation of the 105-mm howitzers, M2 and M2A1, is described in TM 9-325.

SECTION VIII

GUN, 4.5", M1

	Paragraph
Data -----	39
Description -----	40
Operation -----	41

39. DATA. - The weights, measurements, and ballistic data for the 4.5" gun, M1, and carriage, M1, are as follows:

Weight of gun and carriage, M1-----	pounds	12,466.00
Weight of gun and breech mechanism -----	pounds	4,200.00
Caliber of gun -----	inches	4.50
Over-all length of gun and breech mechanism -----	inches	187.6
Length of bore -----	calibers	41.00
Maximum range:		
Normal charge -----	yards	16,300.00
Super charge -----	yards	20,500.00
Muzzle velocity:		
Normal charge -----	ft./sec.	1,820.00
Super charge -----	ft./sec.	2,275.00
Maximum powder pressure, approximate -----	lbs./sq.in.	40,000.00
Volume of chamber -----	cu.in.	531.00
Travel of projectile -----	inches	162.16
Rate of fire (prolonged fire) -----	rd./min.	1
Normal recoil:		
At 0° -----	inches	45.00
At 65° -----	inches	29.00
Maximum recoil -----	inches	48.00
Maximum piston rod pull -----	pounds	61,320.00
Weight of carriage -----	pounds	8,266.00
Length of carriage (muzzle to lunette) -----	inches	321.00
Over-all width -----	inches	95.50
Tread, center to center -----	inches	81.50
Height of lunette (limbered position) -----	inches	29.00
Over-all height -----	inches	83.50
Trail spread (including angles) -----	degrees	60.00
Maximum elevation -----	degrees	65.00
Minimum elevation -----	degrees	0.00
Total traverse -----	degrees	53.00

40. DESCRIPTION. - a. The 4.5" gun and its carriage, M1, are classified as "Standard." (See figs. 24 and 25.)

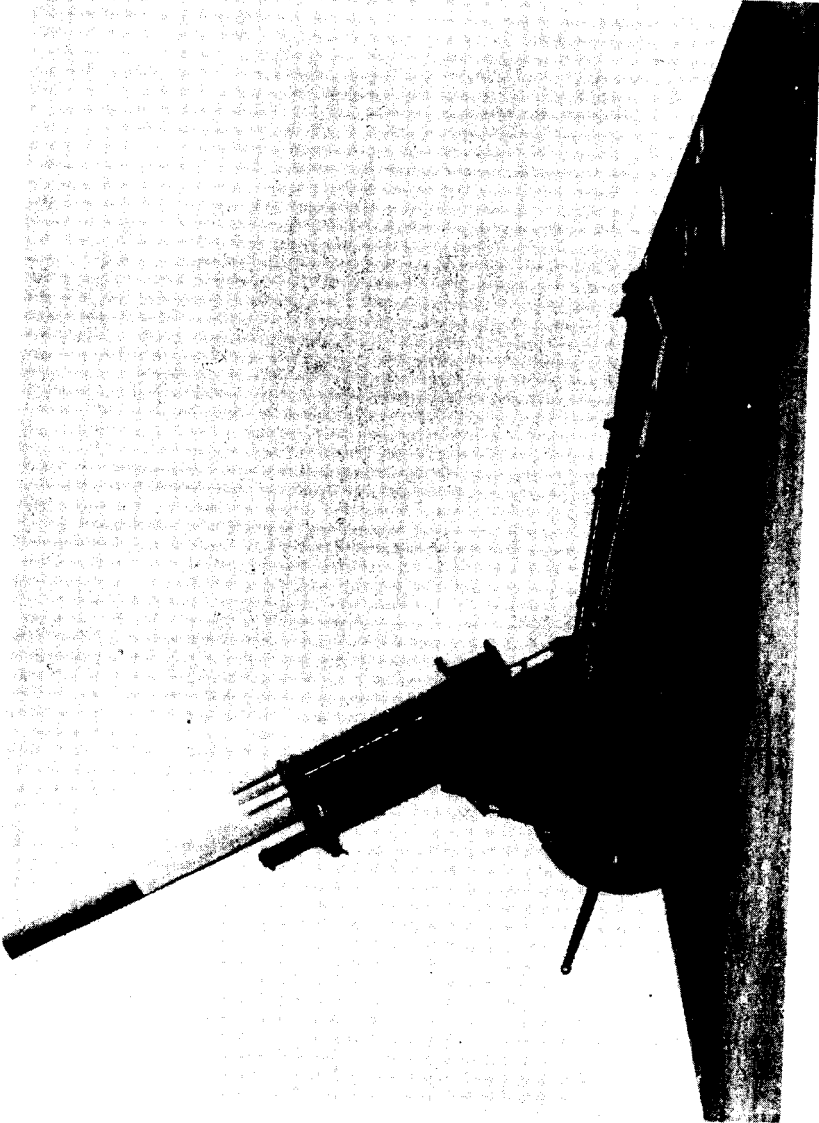


FIGURE 24. - GUN, 4.5", M1, AND CARRIAGE, M1, IN FIRING POSITION.

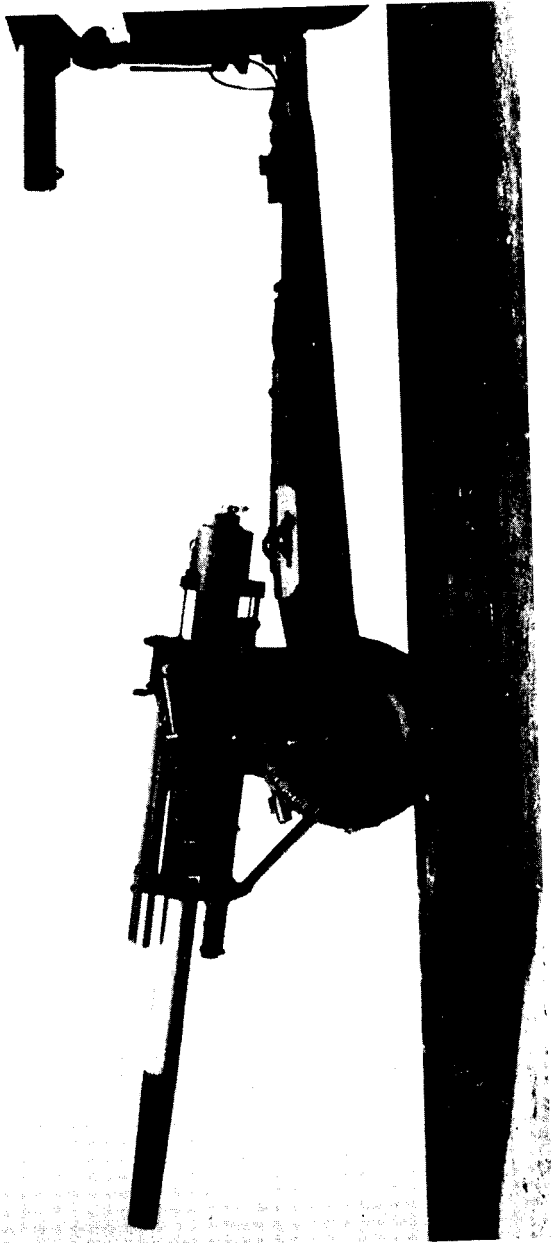


FIGURE 25. - GUN, 4.5", M1, AND CARRIAGE, M1, LIMBERED TO PRIME MOVER.

ORDNANCE DEPARTMENT

- b. The breechblock of the gun is of the interrupted screw type.
- c. The recoil mechanism is of the hydropneumatic (Filloux) type.
- d. Spring-type equilibrators neutralize the unbalanced weight of the gun and the recoil mechanism.
- e. The carriage has pneumatic tires and is of unsprung, ball-bearing design. The weight of the gun and carriage, in firing position, is supported on a firing jack and on the trails.
- f. The on-carriage sighting equipment consists of a panoramic telescope, M12, and a telescope mount, M25. The off-carriage equipment is the same as that for the 105-mm howitzer carriages described in section VII of this chapter.
- g. The standard service ammunition for this gun consists of Shell, H.E., 4.5", M65.

41. OPERATION. - The operation of the 4.5" gun, M1, and the carriage, M1, is described in TM 9-355.

SECTION IX

GUNS, 155-MM, M1917, M1918M1, M1, and M1A1

	Paragraph
Data -----	42
Description -----	43
Operation -----	44

42. DATA. - a. Table of guns and carriages. - The table shown below gives the guns (column 1) which are mounted on any carriage (column 2). Any of the guns listed in any one section may be mounted on any of the carriages in the same section.

Guns	Carriages
M1A1 (S)	M1 (S)
M1 (SS)	
M1918MI (SS)	M3 (SS)
M1917 (LS)	M2 (LS)
	M1917 (LS)
	M1917A1 (LS)
	M1918 (LS)
	M1918A1 (LS)

Note: (S) - "Standard"
(SS) - "Substitute Standard"
(LS) - "Limited Standard"

b. 155-mm gun, M1A1, on carriage, M1. -

Weight of gun and carriage, in firing position -----	pounds	29,900
Load on bogie -----	pounds	19,590
Load on limber -----	pounds	10,310
Weight of gun and breech mechanism -----	pounds	9,595
Weight of recoil mechanism -----	pounds	3,595
Weight of complete round -----	pounds	127.5
Weight of projectile -----	pounds	95
Weight of powder charge (propelling) -----	pounds	32.8
Over-all length of vehicle in traveling position -----	inches	414
Width of tread, center to center -----	inches	95.5
Over-all height -----	inches	103.0
Length of barrel (45 calibers) (including breech mechanism) -----	inches	277.37
Diameter of bore -----	inches	6.102
Maximum length of recoil at 0° elevation -----	inches	71
Maximum length of recoil at 63° elevation, approximate -----	inches	36
Maximum angle of elevation, approximate -----	degrees	63
Maximum angle of depression, approximate -----	degrees	2
Maximum traverse, right -----	degrees	30
Maximum traverse, left -----	degrees	30
Maximum range at 45° elevation -----	yards	26,000
Muzzle velocity -----	ft./sec.	2,800
Rifling, uniform R.H., one turn in -----	calibers	25
Volume of powder chamber -----	cu. in.	1,596
Maximum powder pressure -----	lbs./sq.in.	38,000
Rate of fire, maximum (short bursts) -----	rds./min.	3

43. DESCRIPTION. - a. Guns. - The 155-mm gun represents a French design. The M1917 model is of French manufacture, and a number of these weapons were purchased by the United States. Similar guns were manufactured in this country and designated as 155-mm gun, M1918-MI. The guns of French manufacture differ in but few particulars from those manufactured in the United States.

(1) Gun, 155-mm, M1917 and M1918MI. - (a) The barrel is built of six alloy-steel forgings. (See fig. 26.) The tube is enveloped by a jacket and hoops which are shrunk on. They are locked together by annular grooves and rings and, as a unit, are locked to the tube by the breech ring which is screwed on to the jacket. The gun weighs 8,715 pounds and is 232.87 inches long. The rifling is uniform R.H. with one turn in 29.89 calibers.

(b) The breechblock is of the cylindrical, interrupted-screw type. The circumference is divided into eight sectors, the threads being removed from four of them. This permits the threads of the breechblock to engage those in the breech ring by a one-eighth revolution in closing.

ORDNANCE DEPARTMENT



FIGURE 26. - GUN, 155-MM, M1918M1, ON CARRIAGE, M1918.

The operating lever performs the function of first rotating the breechblock in the breechblock carrier until the threads are disengaged, and then swinging the mechanism as a whole about the hinge pin until the breechblock is in the open position. The breech mechanisms of the M1917 and M1918MI guns are interchangeable as complete units.

(c) The firing mechanism is of the French-screw type. The firing-mechanism housing is inserted in the breechblock carrier and over the rear end of the obturator spindle, which operation compresses the obturator-spindle spring and draws the gas-check pad and its allied parts to a firm bearing on the muzzle face of the breechblock.

(d) The gun uses separate loading ammunition and shoots a 95-pound projectile at a muzzle velocity of about 2,800 ft./sec. a maximum distance of approximately 26,000 yds. The weight of the powder charge is 32.8 lbs., and the volume of the powder chamber is 1,329 cu. in.

(2) Gun, 155-mm, M1. - This gun embodies improvements on the M1918MI design. (See figs. 27 and 28.)

(a) The barrel is longer, and the capacity of the powder chamber is greater. As a result, the M1 gun has a longer range.

(b) The breech mechanism is of the interrupted-screw, carrier-supported, two-cycle type, equipped with a spring-actuated counter-balance mechanism, an improved type of firing mechanism, and a plastic-type obturator mechanism with mushroom head.

(3) Gun, 155-mm, M1A1. - This gun is almost identical to the 155-mm gun, M1. The only difference is that the breech-ring bushing has been eliminated in the M1A1; the breech threads are cut directly in the breech ring. Both guns have the same characteristics.

b. Carriages and limbers. - (1) Carriages, M1917 and M1918. - The M1918 carriage is patterned after the French design, "Grande Puissance Filloux" (M1917). The M1917 has the same characteristics and is identical with the M1918. (See fig. 26.)

(a) The carriage is of the split-trail type and possesses great ruggedness and ease of operation in supporting and controlling the movement of the gun.

(b) The recoil mechanism with elevating sector and piston-rod nuts weighs 3,114 pounds and is of the hydropneumatic, variable-recoil type. It is housed in the cradle. The cradle is suspended by its trunnions resting in the trunnion bearings of the top carriage.

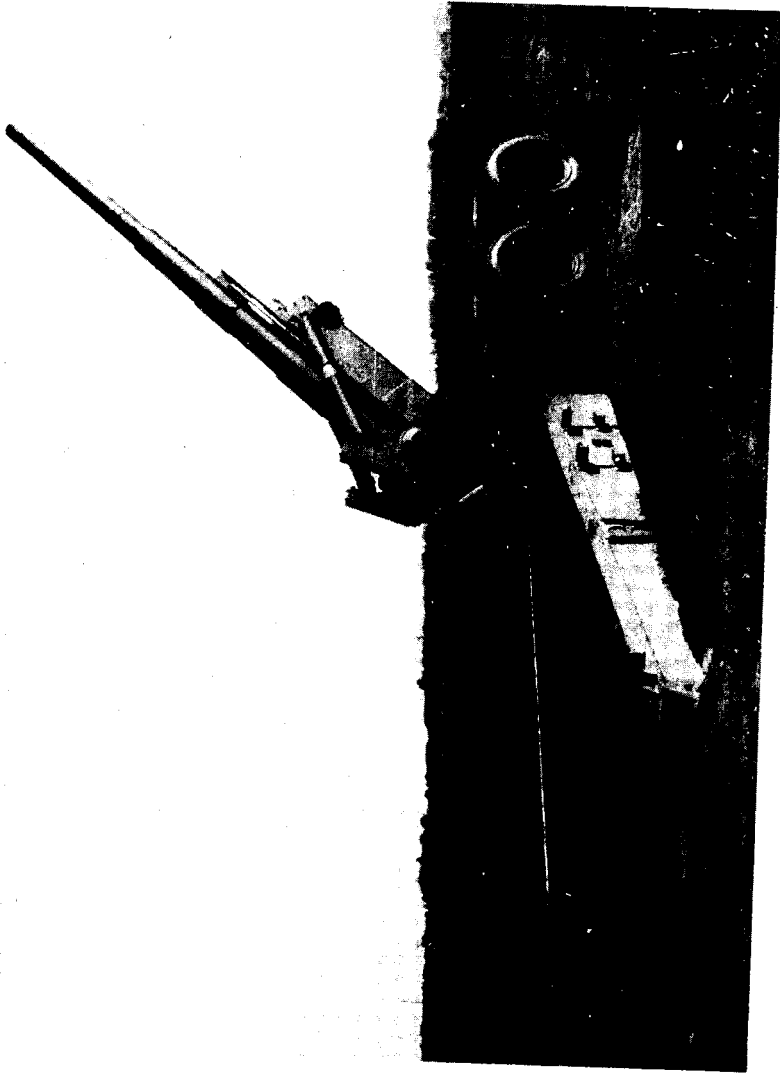


FIGURE 27. - GUN, 155-MM, M1, ON CARRIAGE, M1.

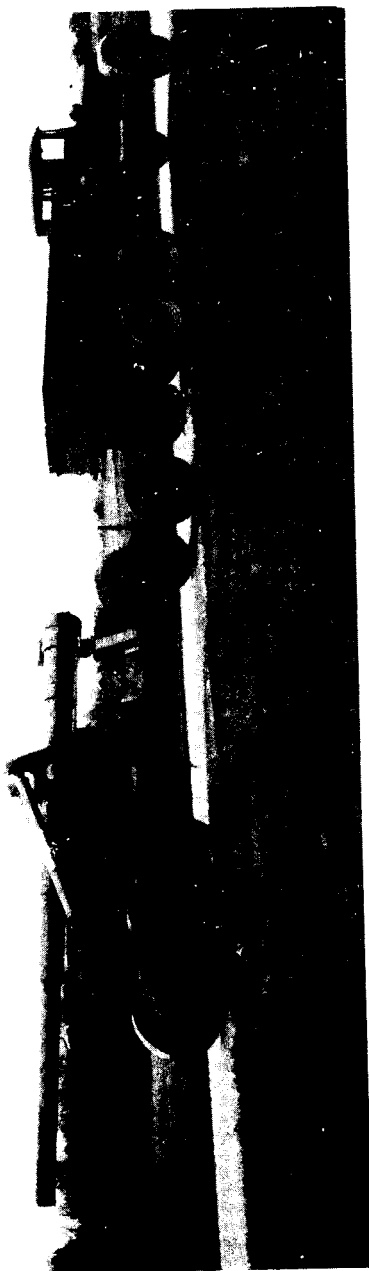


FIGURE 28. - GUN, 155-MM, M1, ON CARRIAGE, M1, AND LIMBER, M2,
IN TRAVELING POSITION.

(c) The top carriage pivots about a vertical axis on the chassis, a part of the bottom-carriage assembly. The bottom carriage is provided with a three-point suspension, the front being suspended from the gun axle, while each of the rear carriers has a trail hinged thereto by a trail-hinge pin. Thus, for firing, the two trails are spread and locked in position by the trail locking bolts.

(d) The firing stresses are transmitted through the trunnions, top carriage, bottom carriage, and trails to the spades which are attached to the rear end of the trails. The spades, being buried in the ground, transmit the reaction back to the trails and prevent movement of the carriage.

(e) The principal parts of the carriage are: the cradle which houses the recoil mechanism, top carriage with elevating and traversing mechanisms; bottom carriage; gun axle; gun axle springs; wheels; trails; spades; and road brake.

(2) Carriage, M1917A1. - For high-speed transport the 155-mm carriage, M1917, was equipped with antifriction bearings, solid rubber tires, and driver-operated power brakes, and standardized as M1917A1. The decision for air or electric brakes has been deferred pending tests. The battery and safety link, for use with electric brakes, originally installed on the limber, were moved to the gun carriage.

(3) Carriage, M1918A1. - The change of designation of the M1918 carriage to M1918A1 followed the modification of the carriage to provide antifriction bearings, solid-rubber tires, and driver-operated power brakes. One carriage, M1918A1, with limber, was equipped with electric brakes for issue to Fort Bragg for testing by towing with truck as well as by tractor. The safety link and battery, originally placed on the limber, were later moved to a position on the carriage.

(4) Carriages, M2 and M3. - When pneumatic tires and air brakes are adopted on the carriage, M1917, it becomes the M2. When similar modifications are made on the carriage, M1918, it becomes the M3.

(5) Limbers, M1917, M1917A1, M1918, M1918A1, and M3. - These limbers are used with their respective carriages. Each one is a two-wheeled vehicle which holds the spade end of the trails, when the gun and carriage are in traveling position.

(6) Carriage, M1. - This carriage is of the split-trail type, ruggedly constructed, and incorporating in its design ease of operation for supporting and controlling the movements of the gun. (See figs. 27 and 28.) It has a hydropneumatic type of recoil mechanism known as 155-mm gun recoil mechanism, M3.

(a) The carriage consists mainly of the bogie, bottom carriage; top carriage; cradle; recoil mechanism; equilibrators; and trails.

(b) The top carriage pivots about a vertical axis on the chassis part of the bottom carriage. The bottom carriage, after the bogie wheels are raised from the ground, provides a three-point suspension; the front, i.e., the bottom carriage, resting on the ground, and the two trails spread, with their spades embedded.

(c) The firing stresses are transmitted through the trunnion, top carriage, bottom carriage, and trails to the spades which are attached to the rear end of the trails.

(d) The cradle is suspended by its trunnions resting in trunnion bearings of the top carriage. Two equilibrators are provided, one on each side of the carriage. The function of the equilibrators is to neutralize unbalanced weight and reduce the manual effort needed to elevate the gun.

(e) Road control of the carriage is by means of a power air-brake system with equalized brakes for each of the four rear bogie wheels, controlled from the driver's seat of the prime mover. In addition, two hand brake levers are provided, which operate the brakes on the two front bogie wheels and are used when parking, or in case of a break between the carriage and prime mover, or in case of malfunctioning of the power-brake system.

(f) All the bogie wheels have pneumatic tires.

(7) Limber, heavy carriage, M2. - This limber is used with the 155-mm gun carriage, M1. It is a two-wheeled, pneumatic-tired vehicle with a limber-lifting mechanism which holds the spade end of the trails, when the gun and carriage are in traveling position. (See fig. 28.) It forms the connection between the carriage and the prime mover. The limber weighs 1,975 pounds, and its wheels are interchangeable with those used on the bogie of the carriage.

c. Sighting and fire-control equipment. - (1) Carriage, M1 (Field Artillery). - The on-carriage equipment consists of a panoramic telescope, M12; quadrant mount, M1; and a telescope mount, M18A1. The off-carriage equipment includes an aiming post, M1; a bore sight gunner's quadrant, M1; aiming circle, M1; and B. C. telescope, M1915A1.

(2) Carriages, M1917, M1917A1, M1918, M1918A1, M2, and M3 (Field Artillery). - The on-carriage equipment consists of a quadrant sight, M1918A1, and a panoramic telescope, M6. The off-carriage equipment is the same as that for the carriage, M1, except that the aiming circle, M1918, and the hand fuze setter, M1913, are used.

(3) Carriages, M1917, M1917A1, M1918, M1918A1; M2, and M3 (Coast Artillery). - The on-carriage equipment consists of the panoramic telescope, M8, and the telescope mount, M6A1. The off-carriage equipment includes the aiming post, M1; gunner's quadrant, M1; bore sight; aiming circle, M1918; adjustment fire board, M1; deflection board, M1; plotting and relocating board, Cloke, M1923; correction range board, M1; percentage corrector, M1; horizontal-base range finder, wind component indicator; azimuth indicator, M1910A1; azimuth instrument, M1918; set-forward rule, type B; prediction scale, M1; hand fuze setter, M1913; B. C. telescope, M1915; and generating unit, M1.

(4) The above equipment is described in volume 5 of this manual.

d. Ammunition. - The 155-mm gun, M1, requires ammunition of the separate-loading type, with either explosive, chemical, or inert projectiles. Each complete round consists of the fuze; the projectile; the propelling charge; and the primer. The projectiles are shipped unfuzed. The ammunition authorized for use in this gun is listed in TM 9-350.

44. OPERATION. - The operation of the 155-mm gun materiel M1917 and M1918MI, is described in TM 9-345. The operation of the 155-mm gun materiel, M1, is described in TM 9-350.

SECTION X

HOWITZERS, 155-MM, M1917, M1917A1, M1918, AND M1

	Paragraph
Data -----	45
Description -----	46
Operation -----	47

45. DATA. - a. The table below gives the howitzers (column 1) which are mounted on any carriage (column 2).

Howitzers	Carriages
M1 (S)	M1 (S)
M1918 (SS)	M1918A3 (SS)
M1917 (LS)	M1917 (LS)
M1917A1 (LS)	M1917A1 (LS)
	M1917A2 (LS)
	M1917A3 (LS)
	M1917A4 (LS)
	M1918 (LS)

Note: (S) - "Standard"
(SS) - "Substitute Standard"
(LS) - "Limited Standard"

b. Data for 155-mm howitzer, M1, on carriage, M1. -

Weight of carriage and howitzer -----	pounds	11,966
Weight of barrel and breech -----	pounds	3,835
Weight of projectile -----	pounds	95
Weight of powder charge (propelling) -----	pounds	13.75
Over-all length, limbered -----	inches	321
Over-all height -----	inches	84
Over-all width -----	inches	95.5
Tread, center to center -----	inches	81.5
Trail spread -----	degrees	60
Length of bore -----	calibers	23
Travel of projectile through bore -----	inches	120.7
Maximum elevation -----	degrees	65
Minimum elevation -----	degrees	0
Total traverse -----	degrees	53
Maximum range -----	yards	16,400
Muzzle velocity -----	ft./sec.	1,850
Maximum powder pressure -----	lbs./sq. in.	32,000
Maximum recoil -----	inches	60
Type of recoil mechanism -----	(variable) hydropneumatic (Filloux)	

c. Data for 155-mm howitzer, M1918, on carriage, M1918A3. -

Weight of howitzer and carriage complete -----	pounds	9,120
Weight of howitzer -----	pounds	2,740
Weight of recoil mechanism and sleigh -----	pounds	863
Weight of complete round H.E. -----	pounds	103
Weight of projectile -----	pounds	95
Weight of powder charge -----	pounds	4 to 8
Over-all length of vehicle -----	inches	257
Over-all length of barrel and breech mechanism -----	inches	95.8
Diameter of bore -----	inches	6.102
Normal length of recoil -----	inches	51.375
Maximum angle of elevation -----	degrees	42
Maximum angle of depression -----	degrees	0
Maximum traverse, right -----	degrees	3
Maximum traverse, left -----	degrees	3
Maximum range at 42° elevation -----	yards	12,500
Muzzle velocity -----	ft./sec.	1,479
Volume of powder chamber -----	cu. in.	425
Rifling, uniform, R.H., one turn in -----	calibers	25.586
Maximum powder pressure -----	lbs./sq. in.	30,000
Rate of fire, maximum (prolonged) -----	rds./min.	1

46. DESCRIPTION. - a. Howitzers. - (1) Howitzer, 155-mm, M1. - This howitzer is the newest type and is shown in figure 29. De-

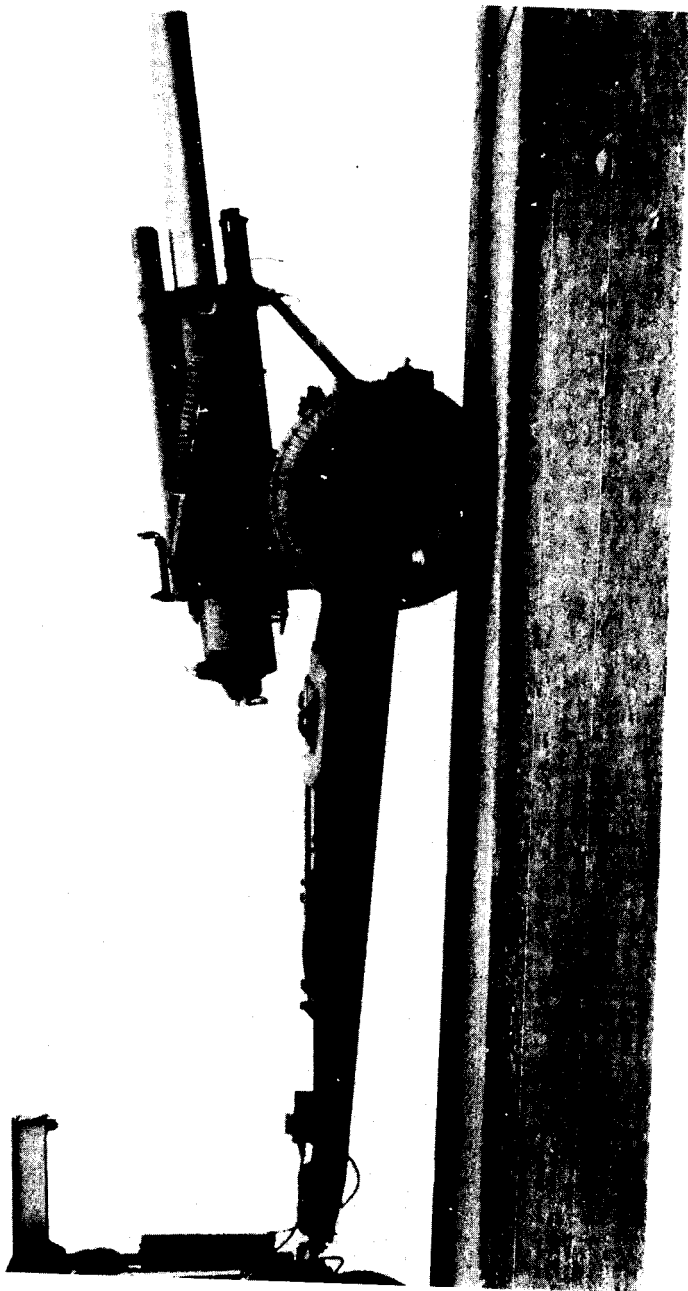


FIGURE 29. - HOWITZER, 155-MM, M1, AND CARRIAGE, M1,
LIMBERED TO PRIME MOVER.

scriptive material, other than that in paragraph 45, is not available for publication in this manual.

(2) Howitzer, 155-mm, M1918. - This howitzer is a short stocky cannon of the built-up type. (See fig. 30.)

(a) The tube extends through the entire length of the barrel. The jacket is screwed and shrunk on the rear half of the tube. A counter-weight is securely fastened to the jacket near the breech.

(b) The breech mechanism consists mainly of the gas-check pad, breechblock, breechblock carrier, and a percussion-type firing mechanism. The breechblock is of the cylindrical, interrupted-screw type. The outer diameter is divided into eight sectors; the threads are removed from four sectors. This permits the breechblock to be inserted in the breech recess and to be locked therein by being turned through 45°. The breechblock is threaded to the breechblock carrier which swings on two lugs on the side of the jacket. The mechanism is operated by an operating lever which, in connection with the rack, rotates the breechblock and swings the breechblock carrier to the open or closed position.

(c) The firing mechanism is of the screw type and is common to the 155-mm gun, M1918MI; to the 8" howitzer, M1917 (Mk. VI, and Mk. VIII-1/2); and to the 240-mm howitzer. The firing mechanism block latch assembly is provided as a safety measure for use in connection therewith.

(d) A maximum rate of fire of 3 rounds per minute may be obtained but cannot be continued for more than a few minutes, due principally to the heating effect and the difficulty of preparing and handling the ammunition. The normal rate is 1 per minute. The howitzer may be loaded at any attainable angle of elevation, the limits of elevation being from 0 to 42° 20'. The approximate life of the howitzer, before replacement of the tube becomes necessary, is 7,500 rounds.

(3) Howitzer, 155-mm, M1917 and M1917A1. - These howitzers are of French manufacture and are similar to the 155-mm howitzer, M1918, with regard to build, weight, dimensions, and ballistics. (See fig. 31.)

(a) The design of the firing mechanism of the M1917 howitzer is of the vertical-sliding type.

(b) The breechblock differs from the M1918 in that a cam surface on the breech face raises the firing mechanism upward when the breechblock is rotated to the unlocked position.

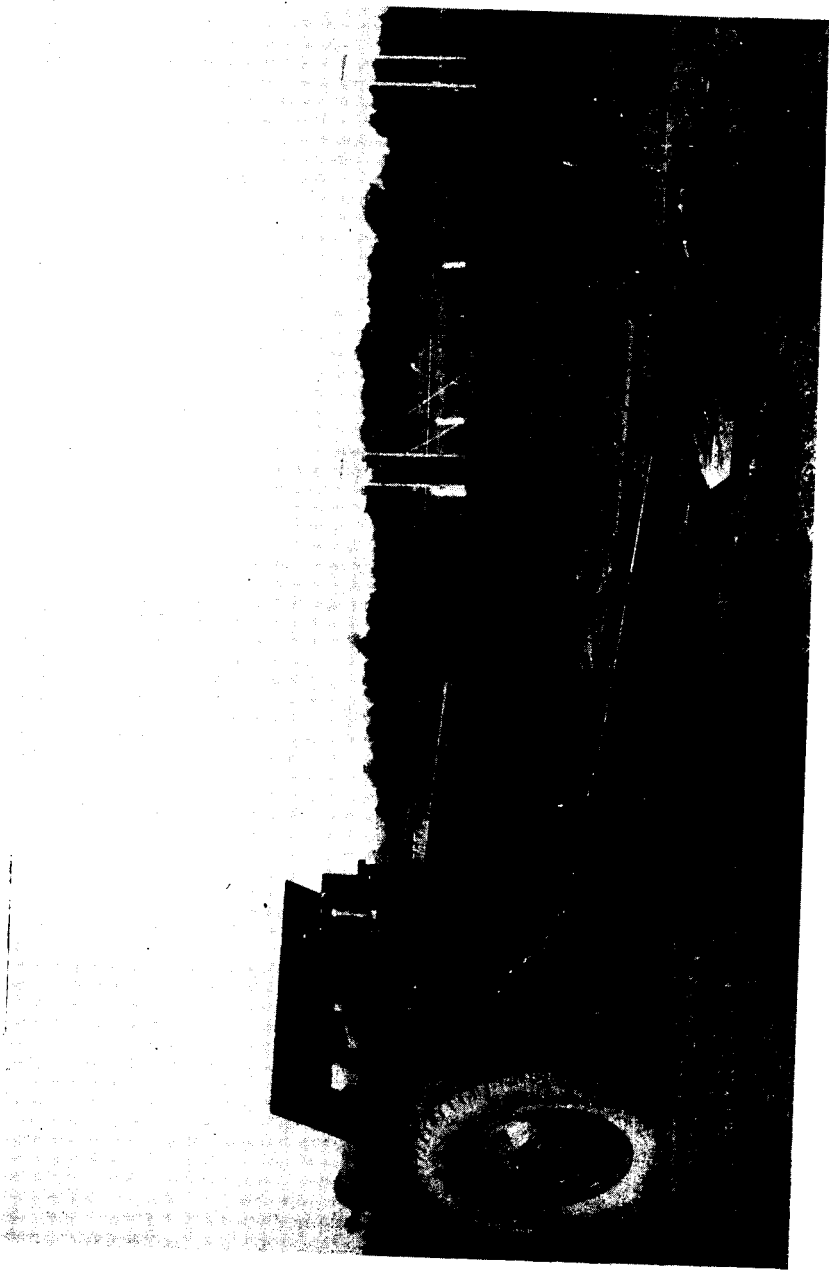


FIGURE 30. - HOWITZER, 155-MM, M1918, ON CARRIAGE, M1918A1.

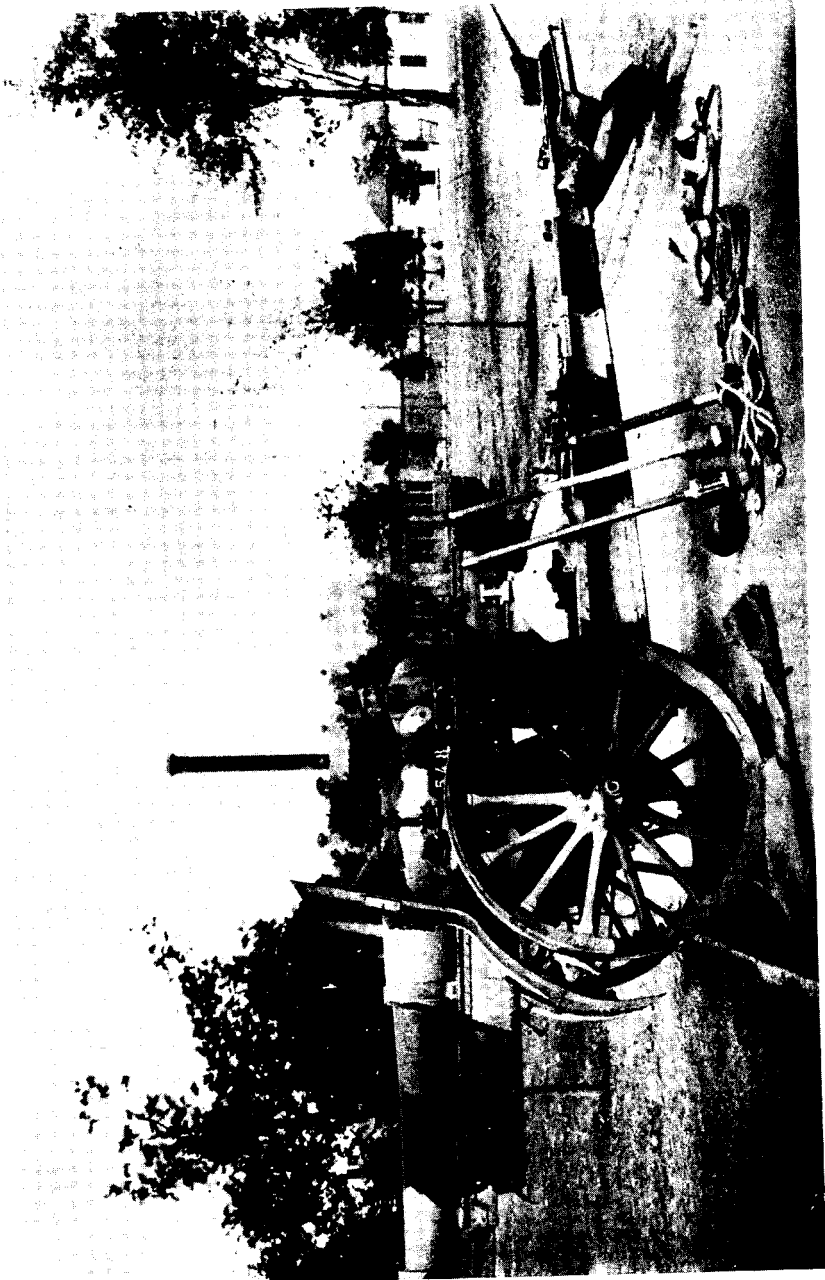


FIGURE 31. - HOWITZER, 155-MM, M1917, ON CARRIAGE, M1917.

(c) The mushroom head (known on other cannon as obturator spindle) extends farther to the rear in the M1917 howitzer. It is, therefore, not interchangeable with the M1918.

(d) The percussion hammer is slightly different.

(e) There are some M1917 howitzers now in service equipped with M1918 breechblocks. It is expected that all M1917 howitzers now in storage will be equipped with M1918 breechblocks prior to issuance to the service.

b. Carriages. - (1) Carriage, M1. - This is the newest type of carriage and is shown in figure 29. Additional details are not available for publication in this manual.

(2) Carriage, M1917. - This carriage is of French manufacture. It has steel-tired wheels and a curved shield, but no panoramic-sight case. The trail has no safety-chain ring for limiting the swing of the limber. The tool box packings are arranged differently than those of the M1918, and there are slight differences in the accessories furnished. With these exceptions, the design is similar to that of the M1918 carriage. The M1917 carriage is shown in figure 31.

(3) Carriage, M1917A1. - The M1917 carriages (French manufacture) in depot storage were modified before issuance to provide for quadrant sight, M1917A1, and panoramic sight, M1917. The shield was made straight and provided with a sight port for the panoramic telescope. The same types of wheels and brake shoes, as employed on the M1918 carriage, and the same tools and accessories are provided.

(4) Carriage, M1917A2. - This is a modification of all M1917A1 carriages in storage and includes installation of the cradle lock and drawbar, used on the M1918A1, for draft by truck or tractor. These changes completely eliminate the need of a limber.

(5) Carriage, M1917A3. - This is the modification of M1917 carriages to include high-speed axle and pneumatic tires with proper wheels, drawbar, and cradle traveling lock.

(6) Carriage, M1917A4. - The addition of torque rods to the 155-mm howitzer carriage, M1917A3, changes it to the M1917A4.

(7) Carriage, M1918. - This carriage is of U. S. manufacture and is of the class in which the howitzer recoils and counterrecoils on a cradle controlled by a hydropneumatic recoil mechanism. It may be used for direct laying on the target, but it is especially designed for high-angle indirect fire. It is made up principally of the sleigh which houses

the recoil mechanism and to which the howitzer is directly connected; the cradle, the trail flasks, right and left, which are fitted with trunnion bearings for seating the cradle trunnions and to which the spade is attached; the axle and the wheels. The wheels are rubber-tired. The carriage is equipped with a shield of armor plate 4-mm thick for protection of the gun crew from rifle and shrapnel fire. The shield is made up of right and left shield plates suitably tied together. The panoramic-sight case is attached to the left shield and supported by helical springs.

(8) Carriage, M1918A1. - In 1933, experiments were started to adapt this materiel to high-speed transport. This program consisted mainly of providing a drawbar to connect the carriage to the prime mover, and altering the wheel bearings to reduce friction. A year later in 1934, the M1918E4 carriage was produced which had pneumatic-tired wheels with lubricant-retaining features in the bearings. These modifications, improved by those exemplified in the M1918E5 carriage, were made standard in 1936 as carriage, M1918A1. (See fig. 30.)

(9) Carriage, M1918A3. - All M1918A1 carriages are to be equipped with the torque rods, and when these additions are completed, the carriages so equipped will be designated M1918A3.

c. Sighting and fire-control equipment. - (1) Carriages M1917, M1917A3, and M1918. - The on-carriage equipment consists of the quadrant sight, M1918, and the panoramic telescope, M6. The off-carriage equipment includes the gunner's quadrant, M1918; bore sight; aiming circle, M1918; 1-meter-base range finder, M1916; hand fuze setter, M1913; and B. C. telescope, M1915.

(2) Carriage, M1918A1. - The on-carriage equipment consists of the quadrant sight, M1918A1, and the panoramic telescope, M6. The off-carriage equipment is the same as that for the carriages in (1), except that the gunner's quadrant, M1, and the aiming circle, M1, are used.

(3) Carriage, M1. - The on-carriage equipment consists of the panoramic telescope, M12, and the telescope mount, M25. The off-carriage equipment is the same as that for the carriage, M1918A1.

(4) The above instruments are described in volume 5 of this manual.

d. Ammunition. - The ammunition for the 155-mm howitzers is of the separate-loading type. It consists of a projectile which is rammed to its seat; a propelling charge, including an igniter, contained in bags tied together and inserted behind the projectile; and a primer which is inserted into the firing mechanism which is, in turn, inserted into the breechblock after closing.

(1) The following types of service ammunition are classified as "Standard" for issue and manufacture for the 155-mm howitzers.

(a) Shell, H.E., M107, w/fuze, M51A1 or M67, 155-mm howitzer, all guns.

(b) Shell, H.E., M102, w/fuze, point detonating, M51A1, 155-mm howitzers, M1917, M1917A1, M1918, and M1.

(c) Shell, H.E., M102, w/fuze, time and superquick, M55A1, 155-mm howitzers, M1917, M1917A1, M1918 and M1.

(d) Shell, chemical, M105, w/fuze, point detonating, M51A1.

(e) Shell, chemical, M110, w/fuze, point detonating, M51A1.

47. OPERATION. - The operation of the 155-mm howitzers, M1917, M1917A1, and M1918, is described in TM 9-330 (TR 1305-155A). The operation of the 155-mm howitzer, M1, is described in TM 9-1331.

SECTION XI

HOWITZERS, 8", MK. VI, VII, AND VIII-1/2

Data -----	Paragraph
Description -----	48
Operation -----	49
	50

48. DATA. - The weights, measurements, and ballistic data for the 8" howitzers, Mk. VI and Mk. VIII-1/2, are as follows:

	Mk. VI Howitzer on Mk. VI Carriage	Mk. VIII-1/2 Howitzer on Mk. VII Carriage
Weight of carriage, limber, and howitzer ----- pounds	21,700	22,650
Weight of howitzer in firing position - pounds	19,100	20,050
Weight of carriage ----- pounds	12,548	12,320
Weight of howitzer, including breech mechanism ----- pounds	6,552	7,730
Weight of howitzer ----- pounds	6,132	7,310
Weight of projectile ----- pounds	200	200
Weight of powder charge ----- pounds	10.75	20.9
Over-all length of carriage, traveling position ----- inches	260	280

ORDNANCE MATERIEL - GENERAL

TM 9-2005
48-49

	Mk. VI Howitzer on Mk. VI Carriage	Mk. VIII-1/2 Howitzer on Mk. VII Carriage
Total length of howitzer ----- inches	127.6	148.3
Length of bore ----- inches	117.7	138.4
Length of rifling ----- inches	102.11	99.52
Number of grooves -----	48	48
Twist, uniform R.H., one turn in ----- calibers	15	25
Length of recoil ----- inches	60-24	52-24
Angle of traverse, right ----- degrees	4	4
Angle of traverse, left----- degrees	4	4
Angle of traverse, with firing platform, right ----- degrees	26	26
Angle of traverse, with firing platform, left ----- degrees	26	26
Maximum elevation ----- degrees	50	45
Range at 15° elevation ----- yards	6,430	7,400
Range at 20° elevation ----- yards	7,810	8,900
Range at 25° elevation ----- yards	8,920	10,500
Range at 30° elevation ----- yards	9,800	11,540
Range at 45° elevation ----- yards	10,710	12,300
Maximum range ----- yards	10,760	12,360
Muzzle velocity ----- ft./sec.	1,300	1,525
Maximum powder pressure ----- lbs./sq.in.	30,250	30,240

49. DESCRIPTION. - a. Howitzers. - (1) General. - The 8" howitzers which were manufactured in the United States, and in England, for the American Expeditionary Forces during the First World War were made in several different types. However, these howitzers have the following points in common.

(a) The breechblock is of the interrupted-screw type. It is operated by a lever on the right-hand side of the breech, which by one motion releases the screw threads and opens the breech. The mushroom-shaped head on the breechblock is equipped with a flexible asbestos ring known as the obturator pad. When the howitzer is fired, this ring is compressed and acts as a gas check to prevent leakage of powder gases back through the breech.

(b) For firing the charge, two separate types of igniters or primers are used. The one known as the T-tube consists of a T-shaped copper tube which fits into a suitable socket in the breech; it is fired by pulling a friction wire out of the tube by means of a lanyard. The other type, the French percussion primer, is very similar in construction to a blank cartridge. It fits a mechanism in the breechblock and is fired by

means of a hammer operated by the lanyard. The two types of firing mechanisms are not interchangeable.

(2) Howitzer, 8", Mk. VI. - This howitzer is of the built-up type and consists of a tube over which is shrunk a jacket. (See fig. 32.) Front and rear guide rings provide means of supporting the howitzer in the cradle. A breech ring is also shrunk on for additional strength and carries a lug for connecting the gun to the recoil mechanism, and a breech bushing is provided for reception of the breechblock. This howitzer is classified as "Limited Standard" and is mounted on the Mk. VI carriage. It has a lower muzzle velocity and, consequently, a shorter range than the Mk. VII.

(3) Howitzer, 8", Mk. VII. - This howitzer is of wire-wound construction and is classified as "Limited Standard." It was superseded by the Mk. VIII-1/2, because it was found necessary to increase the thickness of the powder chamber walls which had cracked during the proof firing.

(4) Howitzer, 8", Mk. VIII-1/2. - This howitzer is also of the built-up type, but differs from the Mk. VI howitzer in that it consists of two tubes, an inner and an outer, over which is shrunk the jacket. The jacket, in this case, supports the howitzer without the use of guide rings. A breech ring is shrunk on over the jacket and carries a lug for connecting the gun to the recoil mechanism. A breech bushing, similar to that on the Mk. VI, is fitted for the breech mechanism. This howitzer is classified as "Limited Standard" and is mounted on the Mk. VII carriage.

b. Platform, howitzer, 8", M1917. - When either the Mk. VI, Mk. VII, or Mk. VIII-1/2 howitzer is set up ready for firing, it rests on, and is braced upon, a firing platform which is transported on a two-wheeled cart. The cart is attached to the howitzer carriage and drawn as part of the unit, with the carriage and limber, by a tractor. On reaching the spot selected for position, the firing platform is buried flush with the surface of the ground and furnishes a steady emplacement from which to fire. The cart and platform are each classified as "Limited Standard."

c. Carriages, Mk. VI and Mk. VII (British). - The carriages are classified as "Limited Standard" and differ but slightly in design. (See fig. 32.) Each is a two-wheeled vehicle with a box-shaped trail, the latter being cut away to provide clearance for the recoil of the howitzer when fired at high angles of elevation. The trails of the Mk. VII type are modified to provide a larger clearance to accommodate the Mk. VIII-1/2 howitzer and are also strengthened to withstand the greater energy of recoil.

(1) The carriage consists of a top carriage, cradle, trail, wheels,

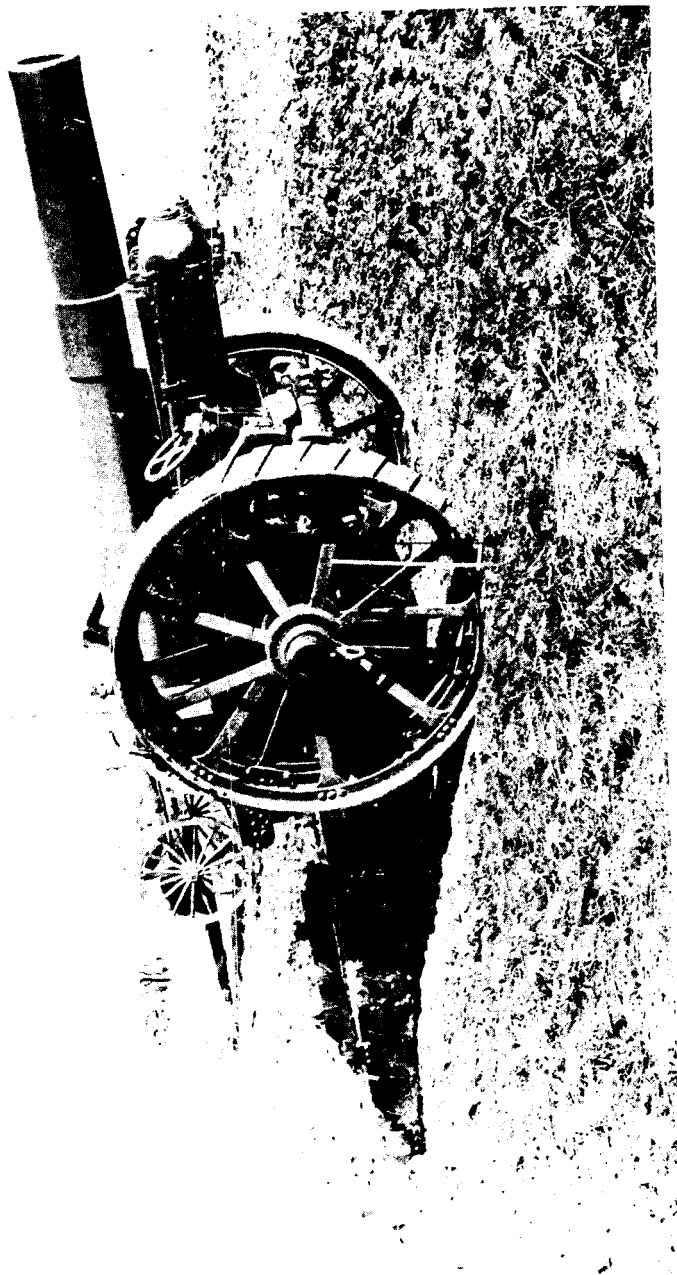


FIGURE 32. - HOWITZER 8", MK. VI, ON CARRIAGE, MK. VI.

axles, and the elevating and traversing gear. The top carriage is built up of nickel-steel plate and carries the trunnion bearings for the cradle. It is pivoted in the front transom of the trail, so as to permit the necessary traverse. The cradle, which carries the recoil mechanism and provides slide ways for the recoil of the howitzer when in action, is supported by the trunnion bearings of the top carriage. The spade is removable, and shoe or bracket may be substituted when firing on scotches or using the firing platform. The elevating and traversing gears are operated by handwheels on the left side of the carriage.

(2) The recoil mechanism is of the hydropneumatic long-recoil type and contains both recoil brake and recuperator.

(3) The wheels are of the all-steel, wide-tire type, 66" in diameter with tires 12" wide. They are fitted with brakes which act independently on each wheel.

d. Limber, 8" howitzer carriage. - This limber is of steel construction and carries a chest for tools and spares. It has seats for the personnel, but no ammunition is carried in the limber. It is classified as "Limited Standard."

e. Sighting and fire-control equipment. - (1) Carriage, Mk. VI (British). - The on-carriage equipment consists of the dial sight, No. 1; dial sight, No. 7, Mk. II; rocking bar sight, type C; and the sighting telescope, No. 4, Mk. III. The off-carriage equipment includes a gunner's quadrant, M1; bore sight; aiming post, M1; aiming circle, M1; and a B. C. telescope, M1915A1.

(2) Carriage, Mk. VII (British). - The on-carriage equipment is the same as that for the Mk. VI carriage, except that the rocking bar sight, type D, is used. The off-carriage equipment is the same as that for the carriage, Mk. VI (British), mentioned above.

f. Ammunition. - The service ammunition for the 8" howitzers is of the separate-loading, high-explosive type and consists of:

- (1) Shell, H.E., Mk. I, w/fuze, P.D., M46, 8" howitzer, Mk. VI.
- (2) Shell, H.E., Mk. I, w/fuze, P.D., M47, 8" howitzer, Mk. VI.
- (3) Shell, H.E., Mk. I, w/fuze, P.D., M46, 8" howitzers, Mk. VII and Mk. VIII-1/2.
- (4) Shell, H.E., Mk. I, w/fuze, P.D., M47, 8" howitzers, Mk. VII and Mk. VIII-1/2.

50. OPERATION. - The operation of the 8" howitzer materiel is described in TM 9-335.

SECTION XII

HOWITZER, 8", M1

	Paragraph
Data -----	51
Description -----	52
Operation -----	53

51. DATA. - The weights, measurements, and ballistic data for the 8" howitzer, M1, on the 8" howitzer carriage, M1, are as follows:

Weight of materiel in firing position -----	pounds	28,310
Weight of cannon and breech -----	pounds	9,140
Over-all length of materiel in traveling position -----	inches	403
Over-all width -----	inches	99
Over-all height -----	inches	106
Wheel base -----	inches	232.5
Over-all length of cannon -----	inches	209.59
Length of bore -----	calibers	25
Maximum elevation -----	degrees	65
Minimum elevation -----	degrees	0
Total traverse -----	degrees	60
Length of recoil -----	inches	36-60
Weight of projectile, H.E. -----	pounds	200
Number of zones (H.E.) -----		7
Minimum muzzle velocity -----	ft./sec.	720
Maximum muzzle velocity -----	ft./sec.	1,950
Maximum range -----	yards	18,700
Maximum powder pressure -----	lbs./sq.in.	33,000
Rate of fire -----	rd./min.	1/2
Type of recoil mechanism -----	(variable) hydropneumatic	
Type of breechblock-----	interrupted-screw	

52. DESCRIPTION. - a. The 8" howitzer, M1, and the 8" howitzer carriage, M1, are classified as "Standard." (See fig. 33.)

b. Breech mechanism. - The breech mechanism for the 155-mm gun, M1, was originally developed for the 8" howitzer, M1, and with the exception of the obturator spindle, pads, etc., the breech mechanism parts are interchangeable in these two weapons. See paragraph 43a. (1) (b) in this chapter.

c. Carriage, howitzer, 8", M1. - (1) This carriage is the same as the 155-mm gun carriage, M1. See paragraph 43b. (6) in this chapter. However, due to the greater weight of the howitzer, the nitrogen pressure in the recoil mechanism is greater; this mechanism is known as the 8" howitzer recoil mechanism, M4.

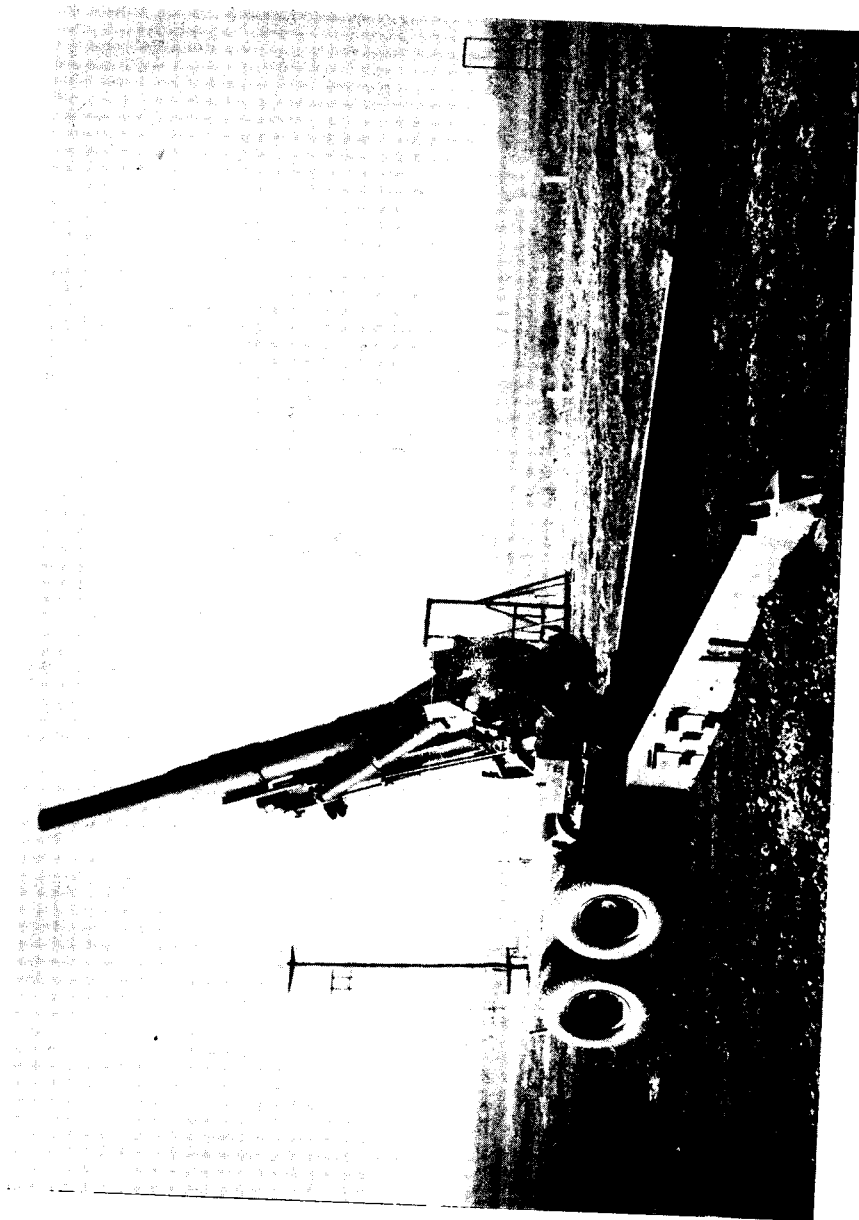


FIGURE 33. - HOWITZER, 8", M1, ON CARRIAGE, M1.

(2) When the howitzer carriage is in traveling position, the howitzer is in battery.

d. Limber, heavy carriage, M2. - This limber is used with either the 155-mm gun carriage, M1, or with the 8" howitzer carriage, M1. See paragraph 43b. (7) in this chapter.

e. Sighting and fire-control equipment. - This equipment is the same as that used with the 155-mm guns, M1 and M1A1.

(1) The on-carriage equipment includes a quadrant mount, M1; a panoramic telescope, M12; and a telescope mount, M18A1.

(2) The off-carriage equipment includes a gunner's quadrant, M1; bore sight for 8" howitzer, M1; an aiming post, M1; an aiming circle, M1, and a B. C. telescope, M1915A1.

(3) These instruments are described in volume 5 of this manual.

f. Ammunition. - The 8" howitzer, M1, fires separate-loading, high-explosive ammunition. The H.E. projectiles weigh 200 pounds each and are propelled by different weights of powder charges chosen so as to give seven zones of fire. The zones of fire overlap sufficiently to reduce, to a minimum, the necessity of changing zones. The service ammunition consists of:

(1) Shell, H.E., M106; w/fuze, P.D., M51, 8" howitzer, M1.

53. OPERATION. - The operation of the 8" howitzer, M1, is described in TM 9-335 and TM 9-1335.

SECTION XIII

HOWITZER, 240-MM, M1918 AND MODIFICATIONS

	Paragraph
Data -----	54
Description -----	55
Operation -----	56

54. DATA. - The weights, measurements, and ballistic data for the 240-mm howitzer, M1918, on carriage, M1918, are as follows:

Total weight of howitzer and carriage in firing position - pounds	41,296
Weight of howitzer ----- pounds	10,790
Weight of howitzer and transport vehicle --- pounds	15,220
Weight of top carriage, with transport vehicle ----- pounds	12,545

Weight of sleigh -----	pounds	5,747
Weight of platform -----	pounds	11,895
Weight of cradle, sleigh, and transport wagon -----	pounds	14,605
Weight of projectile -----	pounds	345
Weight of powder charge -----	pounds	36.5
Length of howitzer -----	inches	199.6
Travel of projectile -----	inches	160.02
Length of recoil, normal -----	inches	46.7
Diameter of bore -----	inches	9.45
Maximum elevation -----	degrees	60
Maximum depression -----	degrees	1
Loading angle -----	degrees	9.25
Maximum traverse, left or right -----	degrees	10
Number of grooves -----		84
Maximum range, approximate -----	yards	16,400
Muzzle velocity -----	ft./sec.	1,700
Maximum pressure -----	lbs./sq.in.	33,000

55. DESCRIPTION. - a. Howitzers. - (1) General. - The 240-mm howitzer is of French design and American manufacture. (See fig. 34.) In 1918, the Army was not equipped with this type of howitzer, but as the type seemed most desirable, it was used to replace the 8" and 9.2" howitzers then in service. Approximately 330 of the howitzers were manufactured. These howitzers are also used as secondary armament in coast defenses. -

(a) Pending development of the 240-mm howitzer materiel, T1, the 240-mm howitzer materiel, M1918, will retain the classifications mentioned in this section, to meet the requirements which are not met by the 8" howitzer materiel, M1.

(b) The 240-mm howitzers are of the built-up type, the principal parts being the tube, the jacket, and the hoop with front and rear rollers for mounting.

(c) The breech mechanism is of the type having a breechblock with interrupted screw threads. In opening and closing, it rotates in the breech recess on the pintle of the breechblock carrier. The carrier is hinged to swing on the right side of the howitzer. The mechanism is hand operated by means of a lever which swings with the mechanism. The mechanism is designed for separate-loading ammunition, and is fitted with a plastic obturator.

(d) The firing mechanism is of the screw type. The firing mechanism is common to 155-mm howitzer, M1918; 155-mm gun, M1918MI; and 8" howitzer, Mks. VI and VIII-1/2.

(2) Howitzers, 240-mm, M1918, M1918MI, M1918A1, and M1918-MIA1. - The M1918 howitzers are numbered from 1 to 182, inclusive, and the M1918MI from 183 to 330, inclusive, and are of Watervliet Arsenal manufacture.

(a) The howitzers, M1918 and M1918MI, are rifled alike. A different form of rifling, however, has been adopted and when applied to the present howitzers, they are known as M1918A1 and M1918MIA1, respectively. The details of rifling are as follows: the above howitzers are rifled with a right-handtwist, one turn in 40 calibers at origin to one turn in 20 calibers at a point 24.369" from muzzle, and uniform thereafter.

(b) The M1918MI howitzer differs from the M1918 only by an increase in the exterior diameter of the tapered portion of the barrel forward of the hoop. This increased diameter necessitates the use of different front roller spindles and front roller fastening screws. In other respects the two howitzers are identical.

b. Carriage, M1918. - The M1918 carriage consists of the platform, top carriage, cradle and sleigh. (See fig. 34.)

(1) In firing position, the howitzer interlocks with the sleigh which houses the hydropneumatic-type recoil mechanism. The latter embodies both the recoil and counterrecoil systems. The length of recoil is sufficient to insure stability at low degrees of elevation.

(2) The recoil and counterrecoil piston rods are fastened to the front of the cradle. The cradle also carries the elevating segments, firing rod, quick-return mechanism for loading, and the trunnion band which supports the cradle in the trunnion bearings in the top carriage.

(3) The top carriage is composed of two steel flasks united by cross transoms and end plates and, at the rear end, carries the brackets which support the loading platform and crane.

(4) The howitzer is served by shot trucks, each of which carry two projectiles. They run on tracks, to and from the ammunition supply point.

(5) In mounting and dismounting the carriage, an erecting frame of structural steel is used for placing the platform and top carriage in position. The cradle and howitzer are drawn into place by a cable attached to a tractor, or by a windlass which is attached to the forward part of the top carriage. The erecting frame, with ammunition attachment, is also used for lifting and placing projectiles on the shot trucks.

(6) For transporting, the complete unit is divided into four loads:

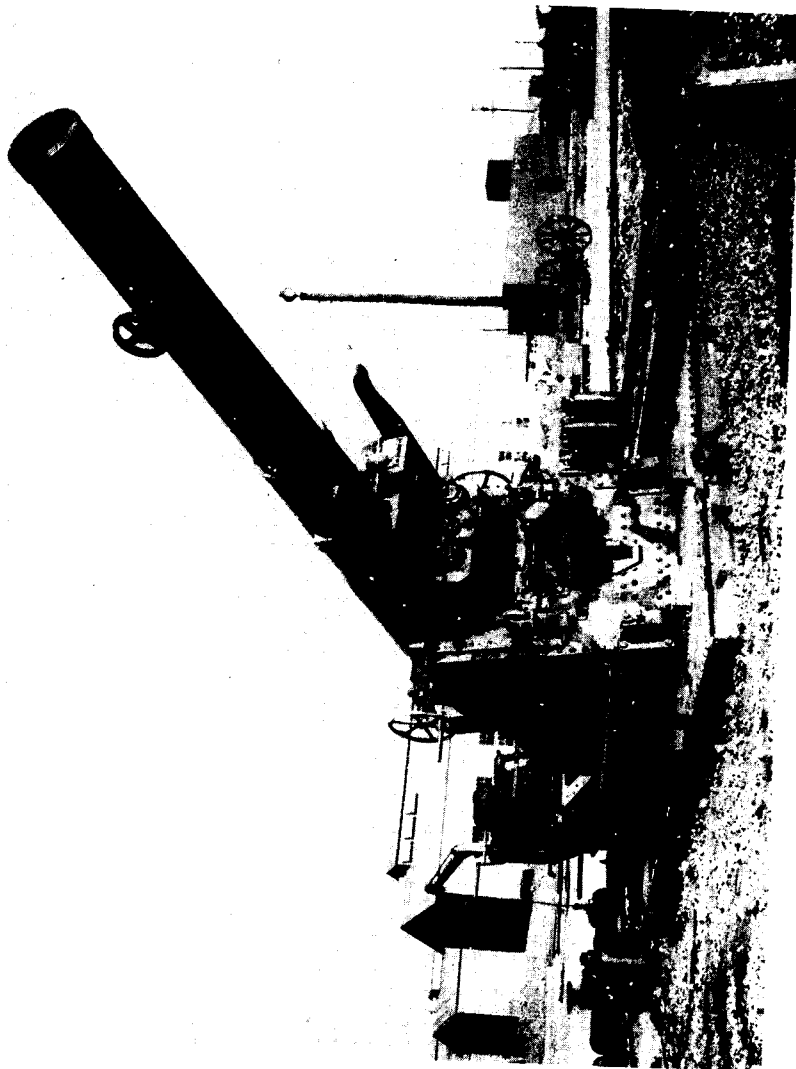


FIGURE 34. - HOWITZER, 240-MM, M1918A1, ON CARRIAGE, M1918.

the howitzer, the cradle with sleigh attached, the top carriage, and the platform. Each load requires a limber and its respective transport wagon.

c. Sighting and fire-control equipment. - The on-carriage equipment consists of the quadrant sight, M1918A1, and the panoramic telescope, M6. The off-carriage equipment includes an aiming post, M1, gunner's quadrant, M1; bore sight; aiming circle, M1918; and B. C. telescope, M1915. These instruments are described in volume 5 of this manual.

d. Ammunition. - The ammunition for the 240-mm howitzers is of the separate-loading type. The service ammunition consists of:

(1) Shell, H.E., Mk. III, w/fuze, P.D., M46, 240-mm howitzer, M1918.

(2) Shell, H.E., Mk. III, w/fuze, P.D., M47, 240-mm howitzer, M1918.

56. OPERATION. - The operation of the 240-mm howitzer, M1918 and modifications, is described in TM 9-340 (TR 1305-240A).

SECTION XIV

SUBCALIBER EQUIPMENT FOR FIELD ARTILLERY

	Paragraph
General -----	57
Guns, subcaliber -----	58
Mounts, subcaliber -----	59

57. GENERAL. - For years, troublesome problems were encountered when interior-mounted subcaliber guns were used with the various types of fieldguns. The principle difficulties were damaged bores and the flare and blowback incident to punctured primers. To eliminate this, a scheme was devised to attach a 37-mm gun on the tube of the field, piece to be used.

58. GUNS, SUBCALIBER. - The following 37-mm guns are classified as "Standard" for use as subcaliber equipment.

a. Gun, 37-mm, M1916. - This gun is described in chapter 1 of this volume. It is used, with its cradle, on subcaliber mounts M1, M4, M5, M7, M8, M9, M10 and M12. (See fig. 35.)

b. Gun, subcaliber, 37-mm, M1916A1. - This gun is used in the 75-mm gun, M1917.



FIGURE 35. - GUN, 37-MM, M1916, ON SUBCALIBER MOUNT.

59. MOUNTS, SUBCALIBER. - The following 37-mm mounts are classified as "Standard" for use as subcaliber equipment.

a. Mount, subcaliber, 37-mm, M1. - This is used on the 155-mm guns, M1917 and M1918MI.

b. Mount, subcaliber, 37-mm, M4. - This is used on the 155-mm howitzers, M1917 and M1918.

c. Mount, subcaliber, 37-mm, M5. - This is for the 75-mm pack howitzers, M1 and M1A1, on 75-mm pack howitzer carriage, M1, and 75-mm howitzer carriages, M2A1, M3, and M3A1.

d. Mount, subcaliber, 37-mm, M7. - This mount is for the 75-mm guns, M1897, M1897A1, M1897A2, M1897A3, and M1897A4, on 75-mm gun carriages, M2, M2A1, and M2A2.

e. Mount, subcaliber, 37-mm, M8. - This is for the 75-mm guns, M1897, M1897A1, M1897A2, M1897A3, and M1897A4, on 75-mm gun carriages, M1897MI, and M1897A4.

f. Mount, subcaliber, 37-mm, M9. - This mount is used on the 75-mm gun carriage, M1916A1.

g. Mount, subcaliber, 37-mm, M10. - This is for the 155-mm gun carriage, M1, and 8" howitzer carriage, M1.

h. Mount, subcaliber, 37-mm, M12. - This is for the 105-mm howitzer carriages, M1A1 and M2.

ORDNANCE DEPARTMENT

INDEX

	Paragraphs	Page
37-mm gun, M1916-----	2-4	3
37-mm subcaliber gun, M1916A1 -----	58	89
37-mm gun, M3A1 -----	5-7	11
60-mm mortars, M1 and M2 -----	17-19	24
75-mm gun, M1897, and modifications -----	22-24	30
75-mm gun, M1916, and modifications-----	25-27	39
75-mm gun, M1917, and modifications -----	28-30	42
75-mm pack howitzer, M1 and M1A1 -----	33-35	49
3" trench mortars, Mk. I and Mk. 1A2-----	11-13	17
81-mm mortar, M1-----	14-16	20
105-mm howitzers, M2 and M2A1-----	36-38	55
4.5" gun, M1-----	39-41	59
3" gun, M5: (Antitank) -----	31-32	46
155-mm guns, M1917, M1918M1, and M1A1 -	42-44	62
155-mm howitzers, M1917, M1917, A1, M1918,		
and M1 -----	45-47	70
8" howitzers, Mk, VI, VII, and VIII ¹ / ₂ -----	48-50	78
8" howitzer, M1-----	51-52	83
240-mm howitzer, M1918, and modifications	54-56	85
Artillery, field:		
Definition of-----	20	28
Classification of -----	21	29
Carriages -		
Gun, for:		
37-mm, M1916 -----	2-4	3
37-mm, M3A1 -----	5-7	11
75-mm, M1897, and modifications ---	22-24	30
75-mm, M1916, and modifications ---	25-27	39
75-mm, M1917, and modifications ---	28-30	42
3", M5, (Antitank)	31-32	46
4.5", M1 -----	39-41	59
155-mm, M1917, M1918M1, and M1A1	42-44	62
Howitzer, for:		
75-mm, pack, M1 and M1A1	33-35	49
105-mm, M2 and M2A1	36-38	55
155-mm, M1917, M1917A1, and M1 --	45-47	70
8", Mk, VI, VII, and VIII ¹ / ₂ -----	48-50	78
8", M1 -----	51-53	83
240-mm, M1918 -----	54-56	85
Cavalry-accompanying weapons, scope of---	1	3
Field artillery:		
Definition of -----	20	28
Classification of -----	21	29

ORDNANCE MATERIEL

	Paragraphs	Page
Guns:		
37-mm, M1916 -----	2-4	3
37-mm, subcaliber, M1916A1 -----	58	89
37-mm, M3A1 -----	5-7	11
75-mm, M1897, and modifications -----	22-24	30
75-mm, M1916, and modifications -----	25-27	39
75-mm, M1917, and modifications -----	28-30	42
3", M5, (Antitank) -----	31-32	46
4.5", M1 -----	39-41	59
155-mm, M1917, M1918M1, M1, and M1A1 -----	42-44	62
Howitzers:		
75-mm, pack, M1 and M1A1 -----	33-35	49
105-mm, M2 and M2A1 -----	36-38	55
155-mm, M1917, M1917A1, M1918, and M1 -----	45-47	70
8", Mk. VI, VII, and VIII $\frac{1}{2}$ -----	48-50	78
8", M1 -----	51-53	83
240-mm, M1918, and modifications -----	54-56	85
Infantry — and cavalry — accompany weapons. Scope of -----	1	3
Mortars:		
60-mm, M1 and M2 -----	17-19	24
3" trench, Mk. I and Mk. IA2 -----	11-13	17
81-mm, M1 -----	14-16	20
Mounts:		
Mortar, for:		
60-mm, M1 and M2 -----	17-19	24
3" trench, Mk. I and Mk. IA2 -----	11-13	17
81-mm, M1 -----	14-16	20
Subcaliber:		
Cal..22-.30, M6 -----	10	16
37-mm, M1, M4, M5, M7, M8, M9, M10 and M12 -----	59	91
Rifles:		
Subcaliber:		
Cal..22, M2A1 -----	8	15
Cal..30, M1903A2 -----	9	15
Subcaliber, equipment for:		
37-mm guns -----	8-10	15
Field artillery -----	57-59	89