TECHNICAL REGULATIONS
No. 1305-A

WAR DEPARTMENT,
WASHINGTON, *February 1, 1933.*

FIELD ARTILLERY

SPECIAL FIELD ARTILLERY VEHICLES

Prepared under direction of the Chief of Ordnance

SECTION I

GENERAL

1. Purpose and scope.—*a.* These regulations are published for the information and guidance of all concerned and contain descriptive

*This pamphlet supersedes the following:
War Department Form No. 1062, Battery Reel, Model of 1917.
War Department Form No. 1110, Artillery Cart, Model of 1918, and Artillery Reel, Model of 1909MI.
† War Department Form No. 1035, 75-mm Gun Matériel, Model of 1916.
† Ordnance Department Form No. 1815, 75-mm Gun Matériel, Model of 1917 (British).
† Ordnance Department Form No. 1817, 75-mm Gun Matériel, Model of 1897MI (French).
† Those sections which refer to—
75-mm gun carriage limber, Model of 1918.
75-mm gun caisson limber, Model of 1918.
75-mm gun caisson, Model of 1918.
Forge limber, Model of 1902MI.
Store limber, Model of 1902MI.
Battery and store wagons, Model of 1917.

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matter, illustrations, reference lists, and instructions necessary for the proper care and maintenance of the matériel.

b. The battery personnel will do only such disassembling and assembling as prescribed herein and only in the manner prescribed, the work being done under the supervision of an officer or the chief mechanic.

c. Difficulties which can not be remedied by the prescribed method will be referred to an ordnance maintenance company.

2. References.—Nomenclature, list of spare parts and equipment, and basic spare parts for the 75-mm gun caisson, M1918, gun caisson limber, and gun carriage limber are contained in Standard Nomenclature List No. C–5; battery and store wagon, M1917, forge limber, M1902MI, and store limber, M1902MI, in Standard Nomenclature List No. C–8; battery reel, M1917, in Standard Nomenclature List No. C–10; artillery cart, M1918, and artillery reel, M1909MI, in Standard Nomenclature List No. C–11; instructions covering the characteristics, purpose, handling, etc., of cleaning and preserving materials, tools, and materials for use therewith, and special oils, greases, and cutting oils issued by the Ordnance Department in TR 1395–A.

3. General information.—*a.* The following vehicles are common to the 75-mm gun matériel, M1897MI (French), M1916 (American), and M1917 (British).

(1) 75-mm gun carriage limber, M1918.
(2) 75-mm gun caisson limber, M1918.
(3) 75-mm gun caisson, M1918.
(4) Battery and store wagon, M1917.
(5) Forge limber, M1902MI.
(6) Store limber, M1902MI.
(7) Battery reel, M1917.
(8) Artillery reel, M1909MI.
(9) Artillery cart, M1918.

b. The 75-mm gun carriage limber, M1918, battery and store wagon, M1917, forge limber, M1902MI, and the battery reel, M1917, are used exclusively by horse and horse-drawn light field artillery organizations. The 75-mm gun carriage limber, M1918, is being replaced by the 75-mm gun caisson limber, M1918, as fast as circumstances permit; quite a number of the former, however, are still in use.

c. The 75-mm gun caisson limber, M1918, and the 75-mm gun caisson, M1918, in addition to being issued to the above organizations are issued to light field artillery, tractor-drawn organizations.

d. The artillery reel, M1909MI, and the artillery cart, M1918, are issued to battalion, regimental, and brigade headquarters of light field

artillery, horse drawn; to gun batteries and to battalion, regimental, and brigade headquarters of light field artillery, tractor drawn, and of medium and heavy field artillery; and to brigade headquarters of portee artillery. The artillery reel without the cart is also issued to observation battalions and batteries.

e. The store limber, M1902MI, and the battery and store wagon, M1917, formerly assigned as store wagon, are at present not included in the authorized equipment of field artillery organizations.

SECTION II

PARTS COMMON TO SEVERAL VEHICLES

4. Wheels.—*a.* All of the vehicles mentioned herein are equipped with the standard 56-inch diameter, 3-inch steel-tired wheels. These wheels are a modification of the Archibald pattern and consist of—

(1) A hub box having a heavy inner flange and fitted with a hub liner.

(2) A hub ring which slips over the outer end of the hub box.

(3) Eight carriage bolts which draw the hub box and the hub ring together, clamping the spokes.

(4) A lock washer located between the hub ring and the hub band.

(5) A hub band screwed onto the hub box and provided with 12 holes to engage the hub latch plunger.

(6) A hub-cap assembly screwed onto the hub box and held in place by the hub latch plunger which engages 1 of the 12 holes in the hub band. The cap is fitted with a wheel oil valve which projects into the bore of the axle arm. This provides means of lubricating the wheel without removal.

(7) Sixteen spokes and four bent felloe sections. In older models, the felloe sections are aligned with joint clamps and steel dowels. In the present wheel, the joints are embraced by spoke shoes. At

the felloe end, the spokes bear against steel plates in the spoke shoes. The spoke-shoe rivets prevent splitting of the felloes.

(8) A steel tire shrunk on and bolted to the felloes.

b. When a brake drum, driving ring, or driving gear is attached to the wheel hub, four regular hub-box carriage bolts are replaced by longer bolts.

5. Wheel fastenings.—The wheel fastenings are yokes which fit in slots in the outer ends of the axle arms. They are retained by small contained-spring plungers and enclosed by the hub caps of the wheels.

6. Dust guards.—Two dust guards made of sheepskin (with the wool on) are strapped about the axle arms just inside of the wheel hubs. They prevent the entrance of grit into the bearing surfaces of the liner and axle arm and also conserve the lubricant. The dust guards are classed as accessories to the vehicles on which they are used.

7. Poles and pole pins.—*a. Animal-drawn limbers.*—Movement of the limbers is guided and retarded by the poles. The poles, formerly made of wood, are now made of tapered steel tubes, strengthened by a reinforce at the butt, and by a neck-yoke chafing plate near the front. The front end is closed by a plug riveted in place. The pullback of the neck yoke is resisted by the neck-yoke stop which is riveted to the pole body. Just forward of the neck-yoke stop, the neck-yoke counterstop swings downward in a slot cut in the underside of the pole body and is held in an out position by the counterstop spring. This allows the passage of the ring of the neck yoke when being placed on the pole, but resists its disengagement until the counterstop is raised by compressing it with the hand. A pole-pin bushing is welded in place in the butt reinforce. A round pole pin passes through the pole and socket, maintaining the pole in its seat and keeping it from turning. Neither the tractive nor holdback forces are taken by the pole pin. The tractive force is through the doubletree and doubletree pin and the holdback force is taken at the butt end of the pole.

b. Tractor-drawn limbers.—The limbers, or vehicles functioning as limbers, have the pole replaced by a short, heavy drawbar. A lunette is fitted in the front end of the drawbar, a hole near the rear end taking the pole pin.

The same pole pin is used as is used for the horse-drawn limbers. The tractive force is through the pole pin, while the holdback force is taken at the butt end of the drawbar.

8. Doubletree.—*a.* The tractive force of the horses is transmitted to the limber frame through the doubletree and the doubletree bolt. The doubletree is a U-sectioned beam, stiffened by a reinforce piece

and a nipple separator in the middle and by the separators of the rivets which hold the parts together. The bearing for the doubletree bolt (the nipple separator) is replaceable. It passes through the doubletree from the underside and is fastened by the nipple nut. Each end of the doubletree body is fitted with a double hook. The rear hooks engage the doubletree ropes which limit the swinging movement of the doubletree while the front hooks take the singletrees. The doubletree ropes are usually connected directly to brackets on the axle. The doubletree hooks are attached by bolts and are replaceable. The doubletree bolt wears more or less rapidly and is now made as a separate piece, inserted by passing upward from the interior of the pole socket. Generally, its upper end is braced back to the framework by a metal strap. A nut is screwed on the upper end above the doubletree strap to hold the bolt in place.

b. The doubletrees and doubletree bolts are interchangeable. The doubletree bolt and strap are generally retained on motorized vehicles so that horses may be used in an emergency.

9. Singletrees.—The singletree body is a U-sectioned beam with an eye riveted at the center which engages the front hook of the double hook on the doubletree. Swinging hooks at each end engage the trace chains of the harness. To engage a trace chain link to a singletree hook, it is necessary to swing the hook to the back side of the singletree to secure the necessary clearance. This prevents the accidental unhitching of the trace.

10. Neck yokes.—*a.* Neck yokes, formerly made of wood, are now made of a tubular steel body with a reinforce (center eye sleeve) for the eye which engages the pole, and rings at the ends for the neck yoke straps of the harness. The disengagement of the neck yoke from the pole is prevented by the neck-yoke counterstop of the pole. The ends of the neck yoke are closed by the end eye sleeves which hold the eye rings and eye ring loops. Near the end eye sleeves are the martingale staples which are riveted through the neck-yoke body.

b. Neck yokes and singletrees, formerly regarded as accessories, are now considered as parts of the vehicle. As they are detachable, their presence should be noted at every transfer of a vehicle to another organization.

11. Lunettes.—The ring in the trail of a gun carriage or rails of a battery and store wagon, caisson, or cart, by which it is attached to the limber, is called the lunette. The lunette has a stout shank which passes through the lunette bracket and is secured by a nut and a lock washer. The hook of the limber with which the lunette engages is called the pintle. Provision must be made for one of these to turn in its seat. The American practice is to have the lunette fixed and the pintle free to rotate. The lunettes used for the horse-

drawn batteries have a small eye with a ledge in the rear part to suit the pole supporting device of the limbers. For the motorized batteries, tractors replace the limbers and a different type of lunette is used. This lunette has a larger eye and no provision is made for an automatic pole support. Therefore, while all the lunettes are interchangeable, care should be taken that the proper type is used.

12. Pintles and pintle latches.—*a.* The lunette is retained upon the pintle hook by a pintle latch which pivots on a pin in the end of the pintle horn, and is held in either the open or closed position by the pintle latch spring. The latch is opened either by hand or by the entering lunette, but must be closed by hand. The pintle latch spring is seated in a transverse slot on the pintle horn and has two projections which engage V-shaped notches in the latch. The pintles revolve 360° in bearings and while the pintle hooks and latches are similar on the various vehicles, the shanks and bearings vary somewhat to suit the conditions of the pole-supporting devices.

b. Pintles in bearings without pole-supporting devices are used on the caisson to couple several caissons together.

13. Padlocks, bolt snaps, and chains.—*a.* The padlocks furnished for each separate vehicle, other than those having ammunition chests, are alike and are supplied with two keys each. Each padlock and the keys belonging to it are stamped with a serial number.

b. Limber and caisson ammunition chests are furnished with a padlock marked "Ammunition" which is supplied with one key only. All ammunition keys are interchangeable.

c. Padlocks are chained to the vehicle to prevent their loss.

d. For temporary security and to avoid the trouble of opening a padlock, bolt snaps are commonly provided, especially for doors not fitted with shot bolts, or doors having more than one hasp and staple.

14. Name plates.—A name plate giving the name, number, and model of the vehicle, name of manufacturer, year of completion, and initials of the inspector is attached to each vehicle. All reports and correspondence concerning a particular vehicle must always refer to it by the name, model, and serial number given on the name plate. The location of the name plates on the various vehicles will be found in the description of the particular vehicles.

15. Disassembling and assembling.—*a. To dismount a wheel from the axle.*—(1) Jack up the vehicle until the wheel is clear of the ground.

(2) Pull out on the ring of the plunger of the hub cap to disengage the plunger from the hub ring and unscrew the hub cap, using the hub-cap spanner wrench if necessary. The old-type hasp cap is removed by lifting up the hub latch to disengage the plunger from the hub ring and unscrewing the hub cap.

(3) Disengage the spring plunger of the wheel fastening by inserting a screw-driver blade or similar tool under the exposed portion of the plunger and force up and remove the wheel fastening.

(4) Remove the wheel. The weight of the wheel is from 210 to 240 pounds.

b. To assemble a wheel on the axle.—(1) Proceed in the reverse order to that outlined in *a* above.

(2) Make sure that the axle arm and the inside of the hub are clean and that fresh lubricant is applied to the axle arm before slipping the wheel on.

(3) Note and report any cutting of the axle arm or wheel fastenings.

(4) Be sure that the plunger of the hub cap is in its locked position.

c. To dismount a pole.—(1) Loosen the pole-clamp bolt nut.

(2) Withdraw the cotter pin of the pole pin and drive out the pole pin.

(3) Withdraw the pole. The pole weighs approximately 58 pounds.

(4) The same procedure is followed in the removal of a drawbar. Drawbars weigh from 90 to 100 pounds.

d. To assemble a pole.—(1) Proceed in the reverse order to that outlined in *c* above.

(2) Make sure that the pole, pole pin, and the pole socket are clean and free from dirt.

(3) The pole should be straight and tightly clamped in the bracket.

e. To dismount a doubletree.—(1) Remove the pole as outlined in *c* above.

(2) Unscrew the nut of the doubletree bolt and drop the bolt into the pole socket.

(3) Lift off the doubletree.

f. To mount a doubletree.—(1) Proceed in the reverse order to that outlined in *e* above.

(2) In reassembling the doubletree bolt, note that the dowel which prevents the turning of the bolt when the nut is screwed on is in its proper position in its guide. Failure to do so may result in damage to the pin. Also note that the doubletree strap does not rest on the shoulder of the doubletree bolt.

g. To dismount a neck yoke.—Raise the neck yoke counterstop and slip off the neck yoke.

h. To mount a neck yoke.—Slip the center ring of the neck yoke over the end of the pole. The ring will raise the counterstop of the pole as it goes over the pole.

i. To replace a neck yoke counterstop and spring.—(1) Cut off the riveted head of the neck yoke counterstop pin and drive out the pin.

(2) Replace the stop or spring and assemble in position using a new counterstop pin.

(3) Rivet over the ends of the counterstop pin.

j. To dismount a lunette (horse-drawn or motorized vehicle).—(1) Remove the lunette nut and lock washer.

(2) Drive out the lunette.

k. To replace a lunette (horse-drawn or motorized vehicles).—(1) Proceed in the reverse order to that outlined in *j* above.

(2) Care should be taken in replacing the lunette to see that the broad lug which prevents the lunette from turning is on top.

l. To dismount a lunette (drawbar).—(1) Remove the cotter pins from the two lunette pins.

(2) Drive out the lunette pins and then drive off the lunette.

m. To replace the lunette (drawbar).—(1) Proceed in the reverse order to that outlined in *l* above.

(2) In replacing the lunette pins, be sure that the pin with the button on the head is to the front.

n. To dismount the pintle.—(1) In removing the unmodified pintle (AB10A), Figure 3, it will be necessary to remove the automatic pole support assembly from the middle rail by taking out two ⅜-inch fillister head cap screws and removing the lock plates after which the two pintle trunnion bolts (AB13F) and two pintle bearing bolts (AB12F) can be removed.

(2) Remove the ¾ and 1 inch diameter bolts which pass through the pintle bearing guide. For replacement purposes and in new equipment, standard cap screws ¾-10-NC x 5¼ and 1-8-NC x 6¼ with regular hexagon nuts and lock washers will be used in place of these two bolts.

(3) Remove the guide bolt (AB13H), Figure 3, and withdraw the pintle and automatic pole support from the middle rail.

(4) Remove the cotter pin and spring rod pin (AB12E), Figure 3, disconnecting the pintle from the automatic pole support.

(5) Place the pintle in a vise or pass a bar through the mouth of the pintle in such a manner that it will not turn and unscrew the pintle nut.

o. To replace a pintle.—Proceed in the reverse order to that outlined in *n* above.

p. To dismount a pintle latch.—(1) Place the pintle latch in the open position.

(2) Remove one of the cotter pins from the pintle latch pin and drive out the pin.

(3) Pull the pintle latch off toward the front.

(4) Care should be taken not to damage the spring.

q. To replace a pintle latch.—Proceed in the reverse order to that outlined in *p* above.

r. To replace a pintle latch spring.—(1) Remove the pintle latch as outlined in *p* above.

(2) Drive out the old spring with a punch and replace.

(3) Care should be taken in driving in a new spring to use a copper hammer or to interpose a block of wood to prevent damage to the spring.

s. To remove a padlock or bolt snap from its chain.—(1) It is necessary to take out the padlock clevis or to cut the chain ring.

(2) The chain assembly, as formerly made up and issued for repairs, included a bolt snap, two chain rings, and a chain rivet. Replacement contemplated the taking out of the old chain rivet. Later chain repair assemblies substitute S hooks for the chain rings. S hooks may be opened sufficiently by twisting slightly and are easily closed after assembling.

16. Care and maintenance.—*a.* The vehicles can not be kept in serviceable condition unless proper attention is given to cleaning, lubrication, and to loose and broken parts. The subject of lubrication is taken up in detail in Section X.

b. All bearing surfaces, screw threads, and exterior parts must be kept as clean and free from dirt as possible. Special attention should be given to bearing surfaces. When disassembling and assembling operations are being carried on, extra precautions must be taken to prevent the entrance of foreign matter into working parts.

c. Maintenance of wheels and wheel fastenings.—(1) The wheels and wheel fastenings should be dismounted periodically and the fastenings, hub boxes, axle arms, and axle bores cleaned and examined. All roughness due to cutting or scoring should be removed. When the wheel fastening wears $\frac{1}{16}$ inch it should be turned around. When both sides have worn $\frac{1}{16}$ inch it should no longer be used.

(2) The dust guards should be examined to see that they are in serviceable condition. If the wool is matted with grease and dirt it should be washed with gasoline.

(3) Nuts on the hub bolts should be tightened monthly during the first year of service and twice a year thereafter. The ends of the bolts should be slightly peened over to prevent the nuts from unscrewing.

(4) When the hub bolts are tightened, the hub band should be screwed up as tightly as possible against the lock washer.

(5) Although the spokes and felloes of the wheels are made of thoroughly seasoned wood, it will be found that tires and spokes become loose due to shrinkage. A wheel with a loose tire or spokes will be made unserviceable rapidly if the trouble is not remedied. If the hub bolts are kept tight at all times much of this trouble will be eliminated.

(6) The soaking of wheels in water to tighten spokes and felloes is forbidden.

(7) Wheels should be kept well painted at all times; this prevents moisture from rotting the wood, and also prevents water from getting into the wood and swelling it.

(8) All other repair work on wheels should be referred to an ordnance maintenance company.

d. Maintenance of poles.—Keep poles tight in the pole sockets. The maintenance of the poles by the battery will be limited to the replacement of the counterstop or counterstop spring, cleaning, and painting. A badly kinked or bent pole should be sent to an ordnance maintenance company for repair. The maintenance of the drawbars is limited to the replacing of lunettes and painting. All other work should be referred to an ordnance maintenance company.

e. Maintenance of the doubletrees.—The maintenance of the doubletrees consists of cleaning, painting, and the replacement of a doubletree bolt or nut, doubletree hook, or a nipple separator when necessary.

f. Maintenance of singletrees and neck yokes.—The maintenance of the singletrees and neck yokes consists of replacing a singletree hook, cleaning, and painting. It may sometimes be necessary to straighten a singletree or neck yoke, but in doing so neither should be heated.

g. Maintenance of lunettes.—It may sometimes be necessary to replace a damaged or worn lunette, otherwise the maintenance of lunettes will consist of seeing that the lunette is tight in its seat and free from rust.

h. Maintenance of pintles and pintle latches.—The pintles and pintle latches should be kept clean and free from dirt. The pintle should revolve freely in the pintle bearing 360°. The pintle latch should function without undue force being required. The parts most liable to damage are the pintle latch and the pintle latch spring.

i. Maintenance of padlocks.—No oil should be used on padlocks as it will gather dirt. If they do not unlock freely they should be washed with gasoline.

SECTION III

75-MM GUN CARRIAGE AND GUN CAISSON LIMBERS, M1918

17. Weights, dimensions, etc.—The following list gives the principal weights, dimensions, etc., for the 75-mm gun carriage and gun caisson limbers, M1918:

75-mm gun carriage limber, M1918:

Weight without ammunition or equipment	pounds	1,038
Weight of equipment, oil cans filled	do	108
Maximum capacity of ammunition chest	rounds	21
Normal load of ammunition chest	do	18
Oil cans		3

75-mm gun caisson limber, M1918:

Weight without ammunition or equipment	pounds	1,071
Weight of equipment, oil cans filled	do	108
Weight of one round of shrapnel, fuzed, approximately	do	20
Weight of one round of shell, unfuzed, approximately	do	16
Maximum capacity of ammunition chest	rounds	39
Normal load of ammunition chest	do	36
Oil cans		3
Wheel base, either limber with—		
75-mm gun carriage, M1897MI (French)	inches	131.65
75-mm gun carriage, M1916	do	148.25
75-mm gun carriage, M1917 (British)	do	126
Wheel base, caisson limber with caisson	do	117.25
Road clearance under limber	do	24

18. Description of the 75-mm gun carriage and gun caisson limbers, M1918.—*a.* The gun caisson limber (fig. 2) is substantially the same as the carriage limber, except that the chest is larger.

b. The limber is made of metal throughout, excepting the spokes and felloes of the wheels. The principal parts are the wheels, axle, frame, ammunition chest, pole, doubletree, singletrees, and neck yoke.

c. The wheels, wheel fastenings, dust guards, pole, pole pin, doubletree, singletrees, neck yoke, pintle, pintle latch, padlocks, and bolt snaps are described in Section II.

d. The axle (PB1D), Figure 2, is a round, hollow, one-piece forging. It is removable, being clamped and keyed in position. The axle keys may be integral or separate keys of a special "Woodruff" type.

e. The frame consists of a middle and two side rails. The middle rail is in the form of a split cylinder, one half passing below and the other half above the axle. The two halves are united in front to form a pole socket and in the rear to form a seat for the pintle bearing guide. Holes in the front end of the middle rail sections form a seat for the pole pin.

f. The side rails are of channel shape, fitting down over the axle brackets (AB23G), Figure 2, and riveted thereto. The rear ends project slightly behind the chest to form steps for use of the cannoneers in mounting. The front ends are bent upward to support the foot rest (EB68A). The middle portions are riveted to the chest which they support and of which they form a part of the bottom.

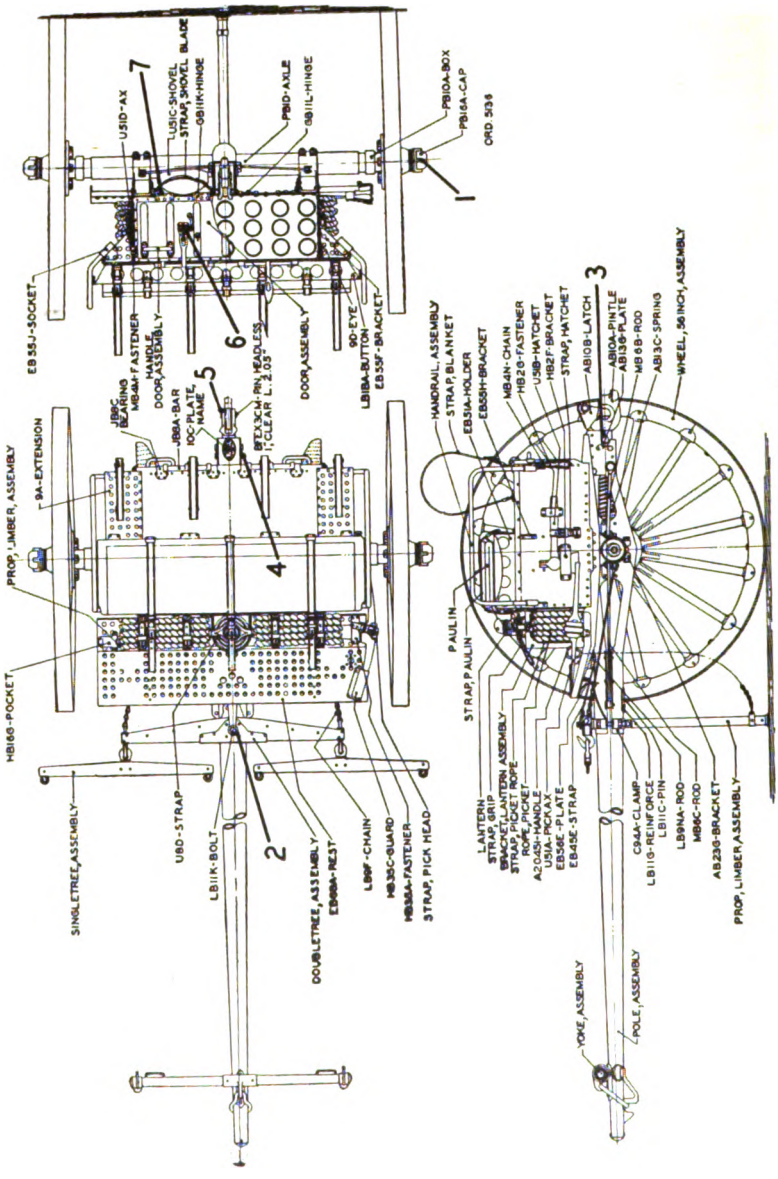

FIGURE 1.—75-mm gun carriage limber, M1918, assembled views

Reference	Item
U51D	Ax.
PB1D	Axle.
JB8A	Bar, lock.
JB8C	Bearing, lock bar, left.
LB11K	Bolt, doubletree.
PB10A	Box, hub.
AB23G	Bracket, axle.
EB55H	Bracket, chest top extension, left.
EB55F	Bracket, handrail, left.
HB2F	Bracket, hatchet blade, right.
	Bracket, lantern, assembly.
LB1BA	Button, prop chain.
PB16A	Cap, hub.
MB4N	Chain, door.
LB9F	Chain, doubletree.
C94A	Clamp, pole.
	Door assembly.
	Doubletree assembly.
9D	Eye, door chain, left.
9A	Extension, chest top, right.
MB4M	Fastener, door chain.
HB2G	Fastener, hatchet handle.
HB35A	Fastener, pick head.
HB35C	Guard, pick mattock point.
	Handle, door, assembly.
A20451	Handle, prop chain.
	Handrail assembly.
U51B	Hatchet.
GB11L	Hinge, door, female.
GB11K	Hinge, door, male.
EB51A	Holder, bucket.
	Lantern.
ABI0B	Latch, pintle.
	Paulin.
BFEX3CM	Pin, hdls., 1, clear L. 2.050.
LB11C	Pin, pole.
AB10A	Pintle.
U51A	Pickax.
EB56E	Plate, foot rest.
AB13G	Plate, lock (for pintle bolts).
10C	Plate, name.
HB16G	Pocket, pole prop.
	Pole assembly.
	Prop, limber, assembly.
LB11G	Reinforce, pole pin.
EB68A	Rest, foot.
LB9NA	Rod, doubletree.
MB6C	Rod, tie, front.
MB6B	Rod, tie, rear, left.
	Rope, picket.
U51C	Shovel, pointed, D handle.
	Singletree assembly.
EB55J	Socket, handrail.
AB13C	Spring, pole supporting.
EB45E	Strap, doubletree.
	Strap, grip.
	Strap, hatchet.
U8D	Strap, lantern.
	Strap, blanket.
	Strap, paulin.
	Strap, pick head.
	Strap, picket rope.
	Strap, shovel blade.
	Wheel, 56-inch, assembly.
	Yoke, neck, assembly.

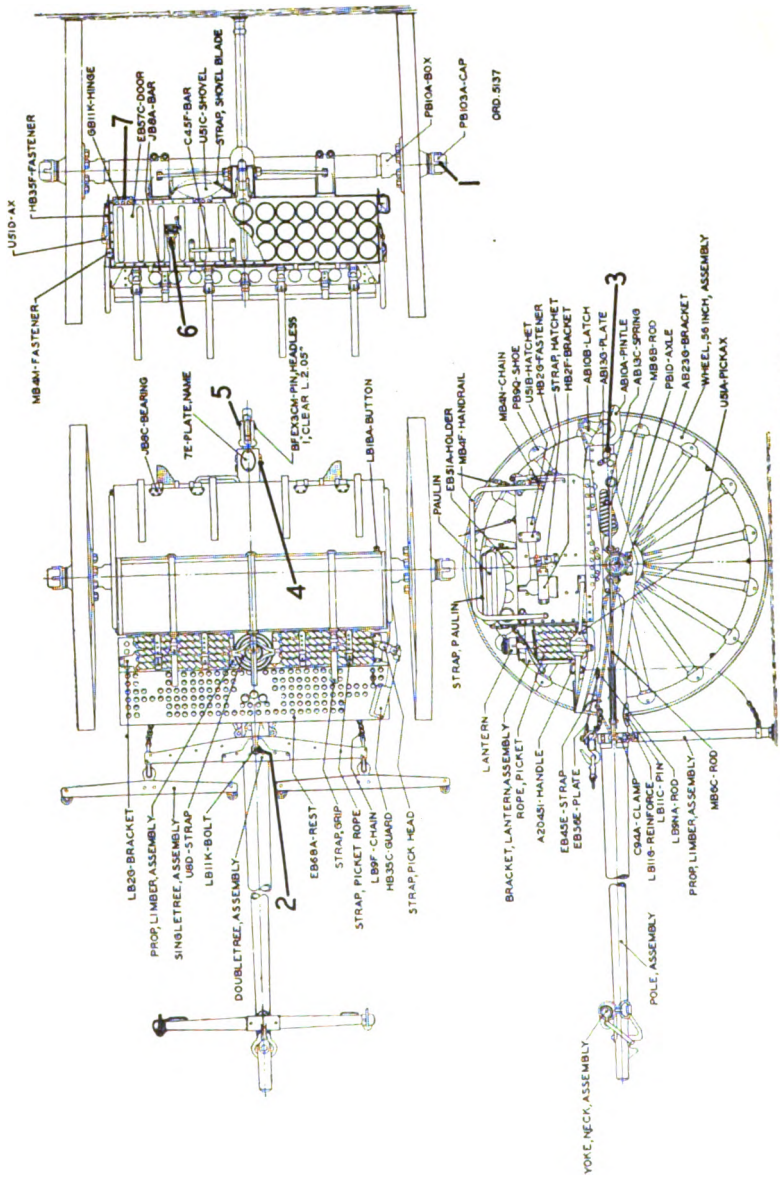

FIGURE 2.—75-mm gun caisson limber, M1918, assembled views

Reference	Item	Reference	Item
U51D	Ax.	U51A	Pickax.
PB1D	Axle.	LB11C	Pin, pole.
C45F	Bar, door handle.	AB10A	Pintle.
JB8A	Bar, lock.	BFEX3CM	Pin, hdls., 1, clear L. 2.050.
JB8C	Bearing, lock bar, left.	AB13G	Plate, lock (for pintle bolts).
LB11K	Bolt, doubletree.	EB56E	Plate, foot rest.
PB10A	Box, hub.	7E	Plate, name.
AB23G	Bracket, axle.		Pole, limber, assembly.
	Bracket, lantern, assembly.		Prop, limber, assembly.
HB2F	Bracket, hatchet blade, right.	LB11G	Reinforce, pole pin.
LB2G	Bracket, prop.	EB68A	Rest, foot.
LB1BA	Button, prop chain.	LB9NA	Rod, doubletree.
PB103A	Cap, hub.	MB6C	Rod, tie, front.
MB4N	Chain, door.	MB6B	Rod, tie, rear, left.
LB9F	Chain, doubletree.		Rope, picket.
C94A	Clamp, pole.	PB9Q	Shoe, spoke.
EB57C	Door.	U51C	Shovel, pointed, D handle.
	Doubletree assembly.		Singletree assembly.
HB35F	Fastener, ax head.	AB13C	Spring, pole, supporting.
MB4M	Fastener, door chain.	EB45E	Strap, doubletree.
HB2G	Fastener, hatchet handle.		Strap, grip.
HB35C	Guard, pick mattock point.		Strap, hatchet.
A20451	Handle, prop chain.	U8D	Strap, lantern.
MB4F	Handrail.		Strap, picket rope.
U51B	Hatchet.		Strap, pick head.
GB11K	Hinge, door, male.		Strap, paulin.
EB51A	Holder, bucket.		Strap, shovel blade.
	Lantern.		Wheel, 56-inch, assembly.
AB10B	Latch, pintle.		Yoke, neck, assembly.
	Paulin.		

g. The axle brackets (AB23G), two in number, are clamped about the axle near the axle arms with two bolts each, and are provided with lugs, front and rear. For replacement purposes and in new equipment, standard cap screws ⅝–11–NC x 4 with regular hexagon nuts and lock washers will be used in place of these bolts. Tie-rods (MB6B), Figure 2, pinned to these lugs are attached to the middle rail, in front and rear of the axle, thus bracing the pole assembly and pintle seats rigidly with the axle.

h. The pole clamp (C94A), Figure 2, is riveted to the front end of the middle rail. It consists of a collar, split on one side and provided with a clamping bolt for drawing the two halves of the middle rail firmly about the pole. A seat for the doubletree assembly is formed on top of the pole clamp. The doubletree bolt (LB11K) projects up through this seat and through the doubletree assembly. Its upper end is threaded for a nut and is braced back to the middle rail by the doubletree strap (EB45E). The prop bracket (LB2G) to which the limber prop assembly is connected is riveted to the underside of the pole clamp (C94A).

i. The limber prop assembly (fig. 2) attached to the prop bracket (LB2G) by means of the prop eye maintains the vehicle in its normal road position when the horses are unhitched. When not in motion, it is also used to relieve the wheel horses of the weight of the limber pole when the attached vehicle has been unlimbered. When not in use, it is swung up under the frame by means of a chain attached to the lower end of the prop which passes through an opening in the foot rest (EB68A). A handle on the prop chain hooks over a prop chain button (LB1BA), riveted to the left rear side of the bucket holder (EB51A).

j. Two doubletree rope assemblies (fig. 2) reach from the ends of the doubletree to tie-rod clamps on the axle to which they are clamped.

k. The automatic pole support is shown in Figure 3. When limbered with another vehicle the pintle (AB10A) and pintle bearing (AB12A) of this limber function to relieve part of the weight on the neck yoke assembly (fig. 2). The hook part of the pintle has a lug formed on its lower side which projects backward and bears against the under side of the lunette (AB9B), Figure 3, on the drawn vehicle, thus preventing the vertical rotation of the pintle (AB10A). The pintle bearing guide (AB12B) is a yoke fixed in the rear end of the middle rail. The pintle bearing (AB12A) is pivoted to the guide by two trunnion bolts (AB13F). It is bored out to receive the shank of the pintle and is counterbored in front for the pintle bearing spring (AB13B). The latter, assembled about a pintle sleeve (AB12G) fitting over the pintle shank, is compressed between a pintle nut

(AB13D) and the pintle bearing (AB12A), and absorbs the shock of starting. The pintle sleeve (AB12G) checks the movement of the pintle nut (AB13D) before the spring (AB13B) is compressed solid. On top of the pintle bearing (AB12A) is formed a lug to which is pinned one end of a spring rod (AB13A), the other end of which is threaded for a spring rod nut (AB13E) and slotted to receive a guide bolt (AB13H), that passes through the middle rail near the axle. This spring rod (AB13A), guided in the rear by a vertical wall of the pintle bearing guide (AB12B) and in the front by the guide bolt (AB13H) through the slot, is drawn backward by the relative action of the pintle (AB10A) bearing on its trunnion compressing the pole supporting spring (AB13C) between the spring rod nut (AB13E) and the vertical wall of the pintle bearing guide (AB12B). When the limber pole assembly (fig. 2) is dropped the pintle (AB10A) tends to rise. Being held down, however, by the lunette in it, the pintle bearing (AB12A), Figure 3, is forced to swing on its trunnion bolts and draws the spring rod (AB13A) backward, thus compressing the pole supporting spring (AB13C) until the reaction of the spring is sufficient to support the pole assembly (fig. 2).

l. The gun-carriage limber chest is a rectangular box built up of plates riveted together. The front plate is flanged all around and is riveted through the flanges to the top plate which forms the top, sides, and part of the bottom of the chest. The remainder of the bottom is formed by two bottom plates and the side rails. The door is made of plate and is riveted to a frame. The door assembly (fig. 1) is hinged at the bottom and swings downward and to the rear to an approximately horizontal position, where it is held by two door chains (MB4N) attached to the handrail brackets (EB55F) by eyes (9D) and to the door by door chain fasteners (MB4M). The front plate and the door are strengthened by vertical corrugations pressed into the metal. Those in the chest door serve as shields for the primers of the cartridge cases. The door is held in the closed position by two lock bars (JB8A), each hinged in two lock bar bearings (JB8C), riveted to the top of the chest. The door fastenings are similar to those on the caisson. Inside the chest the ammunition is supported by three vertical diaphragms, flanged all around and riveted to the body of the chest. Each diaphragm is perforated with 21 flanged holes. Between the diaphragms, riveted to and supporting them, are six vertical plates called transoms, the lower ends of which are riveted to the middle rail. Corresponding holes in the intermediate and rear diaphragms are connected by means of connecting pieces which form supports for the cartridge cases. The chest carries 18 rounds of ammunition and 3 tubular oil cans.

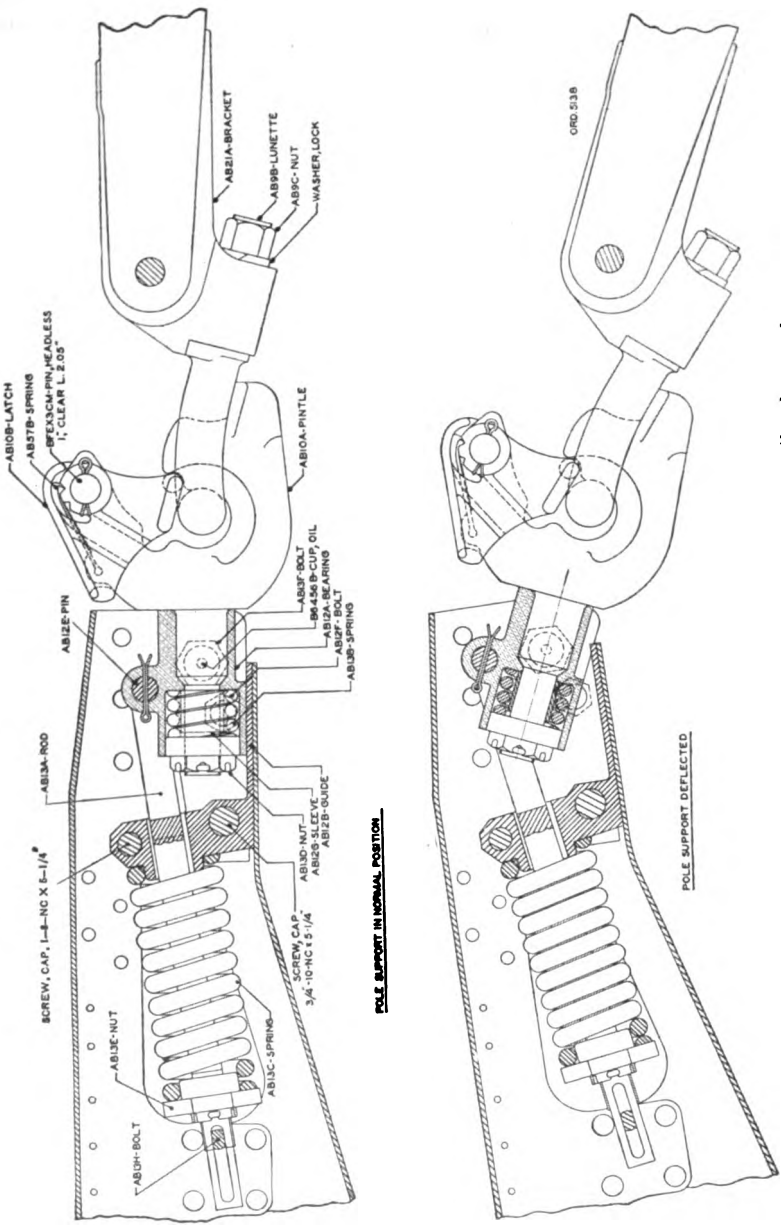

FIGURE 3.—75-mm gun caisson limber, M1918, automatic pole support

Reference	Item	Reference	Item
AB12A	Bearing, pintle.	AB12E	Pin, spring rod.
AB13H	Bolt, guide.	BFEX3CM	Pin, hdls., 1, clear L. 2.050.
AB12F	Bolt, pintle bearing.	AB10A	Pintle.
AB13F	Bolt, pintle trunnion.	AB13A	Rod, pole supporting spring.
AB21A	Bracket, lunette (caisson part).		Screw, cap, hex. hd., 1-8-NC x 6¼.
B6456B	Cup, oil, size 2 (¾") (trunnion bolt)		Screw, cap, hex. hd., ¾-10-NC x 5¼.
AB12B	Guide, pintle bearing.	AB12G	Sleeve, pintle.
AB10B	Latch, pintle.	AB13B	Spring, pintle bearing.
AB9B	Lunette (caisson part).	AB57B	Spring, pintle latch.
AB9C	Nut, lunette (caisson part).	AB13C	Spring, pole supporting.
AB13D	Nut, pintle.		Washer, lock (caisson part).
AB13E	Nut, spring rod.		

m. The gun caisson limber chest is substantially the same as that of the gun carriage limber except that the chest is larger and carries more ammunition. Each chest diaphragm is perforated with 39 flanged holes. Between the diaphragms, riveted to and supporting them, are 10 vertical transoms, the lower ends of which are riveted to the middle and side rails. The chest carries 36 rounds of ammunition and 3 tubular oil cans. (See par. 3*b*.)

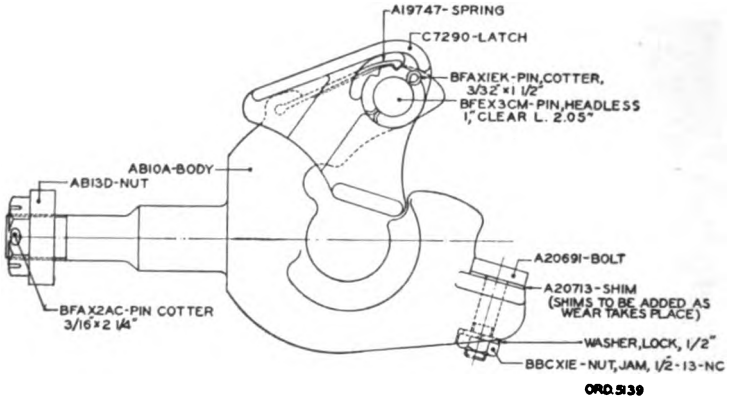

FIGURE 4.—Pintle, M4A1

Reference	Item	Reference	Item
AB10A	Body, pintle.	BFAX1EK	Pin, cotter, 3/32 x 1½.
A20691	Bolt, adjusting.	BFEX3CM	Pin, hdls., 1, clear L. 2.050.
C7290	Latch, pintle.	A20713	Shim, adjusting bolt.
BBCX1E	Nut, jam, s.-fin., ½-13-NC-2.	A19747	Spring, pintle latch.
AB13D	Nut, pintle.		Washer, lock, bolt, ½.
BFAX2AC	Pin, cotter, 3/16 x 2¼.		

n. The bucket holder (EB51A), Figure 2, on top of the chest, forms a seat for the cannoneers. Since the carriage limber chest is not as wide as that of the caisson limber chest, the handrails (MB4F) are bent in at the bottom and the handrail brackets are utilized to brace the overhanging ends of the bucket holder.

o. The foot rest (EB68A), Figure 2, is a perforated plate formed to shape and riveted to the side rails.

p. A name plate is attached to the top of the middle rail of each limber above the pintle bearing.

q. Implement fastenings, attached to the chest and foot rest, are provided for carrying the various accessories. The accessories are held in position in the fastenings by means of straps which are attached to the vehicle by strap fasteners.

19. Disassembling and assembling.—*a. To dismount the automatic pole support* (fig. 3).—(1) Remove the guide bolt (AB13H).

(2) Remove the two bolts which pass through the pintle bearing guide. For replacement purposes and in new equipment, standard cap screws ¾–10–NC x 5¼ and 1–8–NC x 6¼ with regular hexagon nuts and lock washers will be used in place of these two bolts.

(3) Remove the two pintle trunnion bolts (AB13F).

(4) Pull the mechanism out to the rear.

(5) Remove the spring rod nut (AB13E) and spring (AB13C).

(6) Remove the pintle nut (AB13D) and spring (AB13B), and withdraw the pintle (AB10A).

b. To mount the automatic pole support.—(1) Proceed in the reverse order to that outlined in *a* above.

(2) There is sufficient thread on the spring rod so that the spring rod nut will engage when the pole supporting spring is free.

(3) The expansion of the pintle bearing spring is not so great as to interfere with the reassembling of the pintle nut.

(4) See that all oil passages are clean and that the pintle and spring rod nut cotter pins are in position.

(5) Grease the pole supporting spring (AB13C) and pintle bearing spring (AB13B) and the spring rod (AB13A). Oil all moving parts.

(6) Assemble all the through bolts from the left side.

c. To adjust the automatic pole support.—(1) As manufactured, the automatic pole support (fig. 3) holds the pole assembly (fig. 2) constantly at a height of 29.25 inches without support from the harness, the limber and caisson props being in the traveling position. When inspection shows that the pole assembly (fig. 2) is not supported at the proper height the cause should be determined and the necessary corrections made. One or both of the following causes will probably be found:

(*a*) Pole loose in pole socket, or pole bent.

(*b*) Automatic pole support spring not properly adjusted.

(2) In adjusting the automatic pole support, proceed as follows:

(*a*) Clamp the pole assembly (fig. 2) properly in the pole socket.

(*b*) Clean and lubricate all parts and see that they move freely.

(*c*) Adjust the compression of the pole-supporting spring (AB13C), Figure 3, sufficiently to support a 20-pound weight suspended from the pole assembly (fig. 2) at the neck yoke stop.

(*d*) The pole supporting spring (AB13C), Figure 3, is compressed by tightening the spring rod nut (AB13E). To do this, it is necessary to dismount the automatic pole support as outlined in *a* above.

(3) If the pole assembly (fig. 2) still droops, the lug of the pintle (AB10A), Figure 3, or the bottom of the lunette (AB9B), or both, are

worn. If this be the case, place sufficient shims between the lug of the pintle (AB10A) and the lunette (AB9B), to bring the pole assembly (fig. 2) to the desired height. Take a piece of steel about 1¼ inches wide, the thickness of the shims, and long enough to forge around the lug and down and over the main part of the pintle proper. When the steel cools it will shrink on the pintle and make a close fit without the necessity of rivets or pins. In an emergency, a piece of horseshoe can be used successfully for this purpose.

d. The method of adjusting the automatic pole support when the vehicle is equipped with the modified pintle M4A1 (fig. 4) is to adjust the height of the pole to approximately 29½ inches by adding shims (A20713) (three of which are furnished with each modified pintle), if necessary, under the head of bolt (A20691), measuring from a level floor to the center of the pole when the vehicle is limbered with another vehicle. It will be noted that the square head of the adjusting bolt (A20691) may be turned to a fresh wearing surface, and full service should thus be obtained before replacing the bolt.

e. Instructions on the disassembling and assembling of wheels, wheel fastenings, pole, doubletree, singletrees, neck yoke, pintle latch and spring, padlocks and bolt snaps are contained in paragraph 15.

20. Care and maintenance.—*a.* Maintenance of the limber chests consists mainly in oiling the hinges and locking devices and cleaning. Occasionally a handrail is bent or an implement strap is broken, the replacement of which is so simple that specific instructions are unnecessary.

b. Care and maintenance of the wheels, wheel fastenings, pole, doubletree, singletrees, neck yoke, pintle and pintle latch, and padlocks and bolt snaps are contained in paragraph 16.

c. Lubricating instructions are contained in Section X.

d. General instructions on care and maintenance such as painting, cleaning, etc., are contained in Section XI.

SECTION IV

75-MM GUN CAISSON, M1918

21. Weights, dimensions, etc.—The following list gives the principal weights, dimensions, etc., for the 75-mm gun caisson, M1918:

Weight without ammunition or equipment	pounds	1,425
Weight of equipment	do	62
Weight of one round of shrapnel, fuzed, approximate	do	20
Weight of one round of shell, unfuzed, approximate	do	16
Maximum capacity of ammunition chest	rounds	70
Capacity of one fuze chest, p. d. fuzes	fuzes	36
Capacity of fuze chest receptacle	chests	6
Road clearance under caisson	inches	21

22. Description of the 75-mm gun caisson, M1918.—*a.* The caisson (fig. 5) is made of metal throughout, excepting the spokes and felloes of the wheels. The principal parts are the wheels, axle, frame, carrying springs, brakes, ammunition chest, and apron.

b. The wheels, wheel fastenings, dust guards, pintle and pintle latch, lunette, and padlocks and bolt snaps are described in Section II.

c. The axle (PB19A), Figure 5, is a round, hollow, one-piece forging. It is removable, being clamped and keyed in position. The axle keys may be integral or separate keys of a special "Woodruff" type.

d. The frame consists principally of two side rails and a middle rail, braced by two tie-rods (AB31B), Figure 5, and also by the ammunition chest, to which the side rails are riveted, forming parts of the chest bottom. The ends of the tie-rods (AB31B) are bolted to the middle rail and also to the side rails just over the axle. The middle rail is made up of two channels connected by the middle rail top plate (14A) with the flanges overlapping in the rear to form a pintle bearing seat, the front ends being riveted to a lunette bracket in which the lunette (AB9B) is retained by the lunette nut (AB9C). Near the lunette bracket two frame handles (MB6G) and two wheel guards are attached to the sides of the middle rail. At the wheel guards the middle rail is braced and stiffened inside by a middle rail transom.

e. The caisson prop formed of two tubes and a foot is hinged on a prop fastening pin (LB16B) which passes through the middle rail and the lunette bracket. When not in use, the prop is swung up against the middle rail and held by means of chains (C171B) which lead from the prop legs through guides on the sides of the middle rail terminating in a hook which engages a button (LB16E) attached to the top cover plate.

f. The pintle bearing (AB26F) is bored out to take the pintle shank and is held in place by two bolts (AB26G and AB26H) which pass through the middle rail. The pintle has a swiveling motion of 360° upon its shank but is held in its normal position by the pintle spring, a small coiled spring in the pintle bearing which presses a spring plunger against a flattened seat on the pintle shank. The pintle (AB26A) is retained in the pintle bearing (AB26F) by means of the pintle nut on the end of the pintle shank.

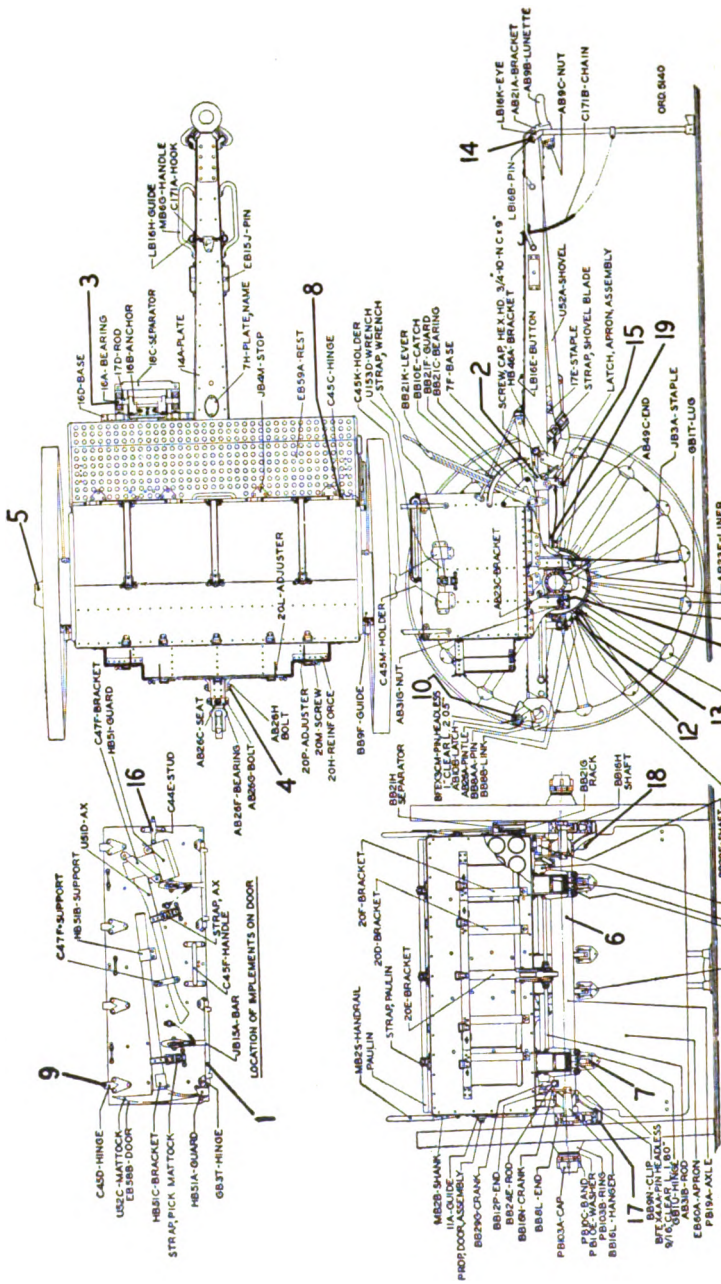

FIGURE 5.—75-mm gun caisson, M1918, assembled views

Reference	Item
20P	Adjuster, large (for fuze box receptacle).
20L	Adjuster, small (for fuze box receptacle).
16B	Anchor, fuze setter.
EB60A	Apron.
U51D	Ax.
PB19A	Axle.
PB10C	Band, hub.
JB15A	Bar, lock.
7F	Base, apron latch, right.
16D	Base, fuze setter latch, left.
BB21A	Bearing, brake crank shaft, left.
BB21C	Bearing, brake lever shaft.
16A	Bearing, fuze setter anchor rod.
AB26F	Bearing, pintle.
AB26G	Bolt, pintle bearing.
AB26H	Bolt, pintle bearing.
C47E	Bracket, ax head.
AB23C	Bracket, axle.
20F	Bracket, fuze box receptacle, end, right.
20D	Bracket, fuze box receptacle, intermediate.
20E	Bracket, fuze box receptacle, center.
AB21A	Bracket, lunette.
HB51C	Bracket, pick mattock head.
HB46A	Bracket, shovel blade.
LB16F	Button, prop chain.
PB103A	Cap, hub.
BB10E	Catch, brake lever.
C171B	Chain, prop.
BB9N	Clip, brake band.
BB29G	Crank, brake (front).
BB16N	Crank, brake, outer (rear).
EB58B	Door.
BB8A	Drum, brake.
BB8L	End, brake band.
BB12P	End, brake rod.
AB49C	End, fuze setter bracket arm, right.
LB16K	Eye, prop, right.
HB51D	Guard, ax.
BB21F	Guard, brake segment.
HB51A	Guard, pick mattock.
BB9F	Guide, brake band.
11A	Guide, door prop.
LB16H	Guide, prop chain.
C45F	Handle, door.
MB6G	Handle, frame, left.
MB2S	Handrail.
BB16L	Hanger, brake, left.
GB1U	Hinge, apron.
C45C	Hinge, door, female.
C45D	Hinge, door, male.
GB3T	Hinge, lock bar.
C45K	Holder, wrench (front, right).
C45M	Holder, wrench (rear, right).
C171A	Hook, prop.
	Latch, apron, assembly.
AB10B	Latch, pintle.
BB21K	Lever, brake.
AB23E	Liner, side rail, right.
BB8B	Link, brake adjusting.
EB61A	Lug, apron hinge, center.
GB1T	Lug, apron hinge, end.
AB9B	Lunette.
U52C	Mattock, pick.
BB8F	Nut, brake adjusting.
AB9C	Nut, lunette.
AB31G	Nut, spring bolt.
	Paulin.
BB8AA	Pin, brake band, for adjusting link.
BB8BA	Pin, brake band, for brake band.
EB15J	Pin, chain guide.
LB16B	Pin, prop fastening.
BFEX4AA	Pin, hdls., 9/16, clear L. 1.80.
BFEX3CM	Pin, hdls., 1, clear L. 2.050.
AB26A	Pintle.
14A	Plate, middle rail top.
7H	Plate, name.
	Prop, door, assembly.
BB21G	Rack, brake segment.
20H	Reinforce, fuze box receptacle, right.
EB59A	Rest, foot.
PB103B	Ring, hub.
BB21E	Rod, brake.
17D	Rod, fuze setter anchor.
AB31B	Rod, tie.
20M	Screw, adjuster.
	Screw, cap, hex. hd., 3/4-10-NC x 9 (for front tie-rod).
AB26C	Seat, pintle spring.
BB21H	Separator, brake segment rack.
18C	Separator, fuze setter bracket.
BB16H	Shaft, brake.
BB29F	Shaft, brake lever.
MB2B	Shank, handrail.
PB9Q	Shoe, spoke.
U52A	Shovel, pointed, long handled.
AB21B	Spring, Belleville.
AB21C	Spring, carrying.
JB3A	Staple, apron latch.
17E	Staple, fuze setter bracket latch.
JB4M	Stop, lock bar.
	Strap, ax.
	Strap, paulin.
	Strap, pick mattock.
	Strap, shovel blade.
	Strap, wrench.
C44E	Stud, door prop.
C47F	Support, ax handle.
HB51B	Support, pick mattock handle.
PB10E	Washer, hub lock.
	Wrench, Eng., dbl. hd., 1-1/16 and 1-1/4 openings.

g. The side rails are steel castings which extend the length of the chest. Each has two pairs of vertical guides that straddle the axle, fitted with liners in which the axle brackets slide. Above and between these liners, the side rails are bored out and tapped for the spring rods and counterbored for the caisson carrying springs.

h. Clamped to the axle (PB19A), Figure 5, at each side rail are axle brackets (AB23C), upon each of which are formed two lugs bored out for the spring rods and counterbored for the caisson carrying springs (AB21C). These lugs slide up and down between the side rail liners and hold the chest from lateral and horizontal motion with respect to the axle.

i. The four caisson carrying springs (AB21C), Figure 5, assembled on the spring rods are compressed between the lugs on the axle brackets (AB23C), the side rails thus supporting the chest on the axle and allowing a movement of 0.75 inch. Each spring rod is screwed up into a threaded socket in the side rail and is secured by one of the rivets used in fastening the bottom plates to the side rails. The spring rod lower end extends below the axle bracket lug through a column of four Belleville springs (AB21B) which are held in place by a nut on the spring rods. When the caisson is traveling over rough ground the rebound of the chest from the caisson carrying springs (AB21C) is met by the action of the Belleville springs (AB21B) which are compressed between the spring rod nuts and the axle bracket lugs.

j. The nuts on the two front spring rods are formed with lugs to which are pinned the two apron end hinges. An apron hinge lug, center (EB61A), Figure 5, riveted to the middle rail, supports the two inner hinges by which the apron (EB60A) is hung.

k. The apron (EB60A), Figure 5, is made of armor plate and extends to within 4.5 inches of the ground when lowered. When traveling, the apron is swung up to the front and held by two apron latches.

l. Each apron-latch assembly (fig. 5) consists principally of a latch body, handle, plunger, and spring. The apron-latch body is pinned to an apron latch base (7F), riveted to the foot rest (EB59A). The lower end of the latch body terminates in a hook which engages an apron-latch staple (JB3A) riveted to the apron and holds the latter in the traveling position. To retain the staple in the hook the opening of the hook is closed by a plunger seated in the latch body and pressed outward into action by a coiled spring. By pressing the apron latch handle down with the hand, the plunger is first withdrawn from the hook and then the hook is pushed backward, disengaging it from the apron-latch staple (JB3A).

m. The brake mechanism (fig. 6) is of the external contracting-band brake type, operated from the seat by means of a brake lever (BB21K), Figure 5, located at the right side of the ammunition chest. The brake drums (BB8A) are bolted to the wheels and revolve with them. Brake bands, lined with commercial brake lining, are assembled around drums and held in place by brake band guides (BB9F), riveted to the brake bands. Lateral movement of the guides (BB9F) is prevented by brake-band clips (BB9N), consisting of brackets riveted to the brake hangers, which fit over the guides (BB9F) on the brake bands. The brake-band clips (BB9N) also support the brake bands and prevent them from dragging on the brake drums (BB8A) when the brakes are in the released position. The brake hangers (BB16K and BB16L) are clamped and keyed on the axle (PB19A). The brake bands are provided with forked ends (BB8L), the lower ends being attached to the lower arms of the brake shafts by adjusting nuts and links; the upper ends being attached directly to the upper arms of the brake shafts. The brake shafts are supported in bearings formed in the brake hangers. The outer rear cranks (BB16N) are assembled on the inner ends of the brake shafts (BB16H) and are connected to the brake cranks on the brake-lever shaft (BB29F) by the brake rods (BB24E). The right brake crank is integral with the brake-lever shaft while the left brake crank is a separate piece, pinned in position. The brake rods (BB24E) are provided with adjustable brake-rod ends. The brake-lever shaft (BB29F), Figure 6, is supported in the brake-lever shaft bearing (BB21C), attached to the right side of the ammunition chest and the foot rest, and in bearings attached to the side rails beneath the front edge of the ammunition chest. The brake lever (BB21K) is pinned in position on the right end of the brake-lever shaft (BB29F), and is provided with a catch which engages with the teeth on the segment rack. One end of the segment rack, with guide, is attached to the ammunition chest, the other end to the foot rest. When the brake lever (BB21K) is pulled up, the brake-lever shaft (BB29F) turns in a counterclockwise direction, moving the brake cranks forward. This motion is transmitted through the brake rods (BB24E), outer cranks, and brake shafts (BB16H), to the brake-band ends (BB8L), compressing them and thereby tightening the brake bands about the drums (BB8A).

n. The caisson ammunition chest is a rectangular box built up of plates riveted together with provision for 70 rounds of ammunition arranged in 5 horizontal rows of 14 rounds each. The top plate forms the top and sides of the chest and the bottom is made up of the side rails, middle rail, two inner bottom plates, and two outer bottom plates. The back is made of armor plate. An angle is riveted to the

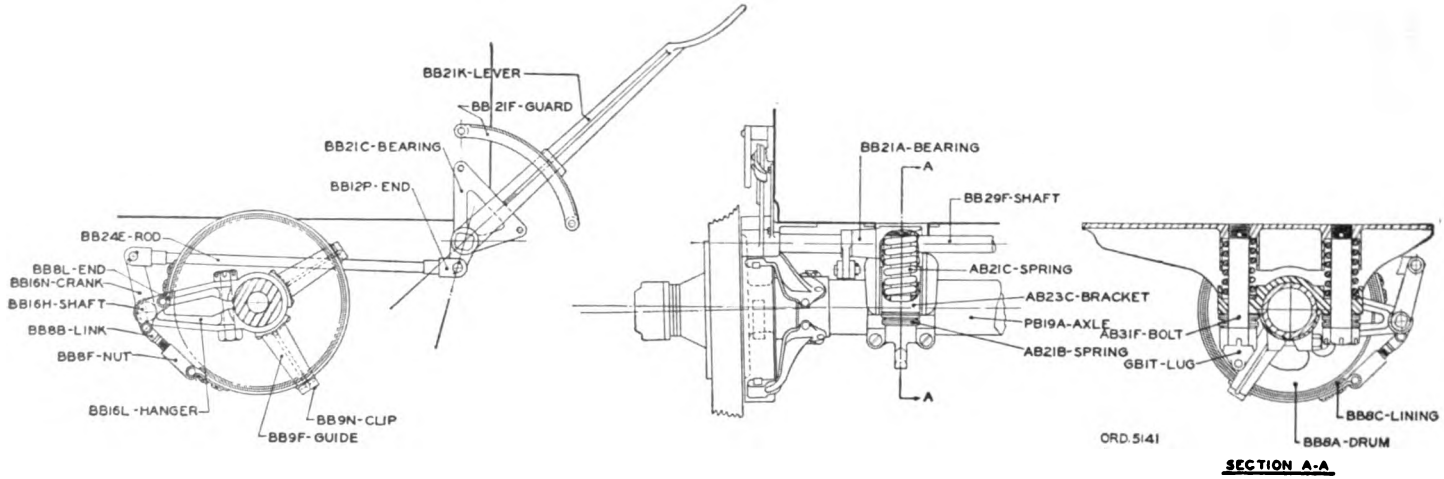

FIGURE 6.—75-mm gun caisson, M1918, band brake and caisson carrying springs

Reference	Item	Reference	Item
PB19A	Axle.	BB16L	Hanger, brake, left.
BB21C	Bearing, brake lever shaft.	BB21K	Lever, brake.
BB21A	Bearing, brake crank shaft, left.	BB8B	Link, brake adjusting.
AB31F	Bolt, spring.	BB8C	Lining, brake band.
AB23C	Bracket, axle.	GB1T	Lug, apron hinge, end.
BB9N	Clip, brake band.	BB8F	Nut, brake adjusting.
BB16N	Crank, brake, outer.	BB24E	Rod, brake.
BB8A	Drum, brake.	BB16H	Shaft, brake.
BB8L	End, brake band.	BB29F	Shaft, brake lever.
BB12P	End, brake rod.	AB21B	Spring, Belleville.
BB21F	Guard, brake segment.	AB21C	Spring, carrying.
BB9F	Guide, brake band.		

armor plate all around its edge, and the projecting leg of this angle is riveted to the body of the chest. Inside the chest the ammunition is supported by three vertical diaphragms, flanged all around and riveted to the body of the chest. Corresponding holes in the front and middle diaphragms are connected by means of connecting pieces. The diaphragms are rigidly braced to each other and to the caisson frame by 12 transoms riveted to the diaphragms, the middle and side rails, and also to the chest back, which they serve to stiffen. Riveted to the bottom of the rear and middle diaphragms and to the top of the side rails are four diaphragm reinforces which help to transmit the load from the diaphragms to the side rails.

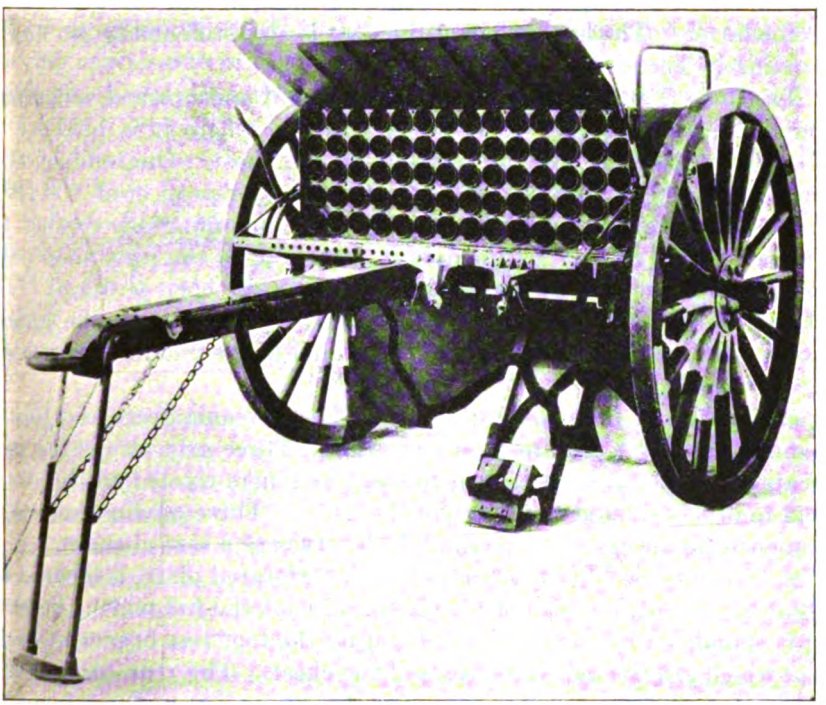

FIGURE 7.—75-mm gun caisson, M1918, front view

The chest door (EB58B), Figure 5, is made of armor plate. It is hinged to the body of the chest at the top by four hinges (C45D), at each of which inside the chest is a hinge reinforce riveted to the chest top and middle and front diaphragms. The door (EB58B) is held closed by two lock bars (JB15A) hinged to the bottom of the door. A hasp and two eccentric lugs are formed upon each of these bars. In locking the door these lugs bear against lock bar stops (JB4M), riveted to the foot rest (EB59A), thus pressing the door shut, while

the hasp engages a turnbuckle on the door. The right lock bar may be locked in position either by a spring padlock or by a bolt snap, both of which are fastened by a chain to the door near the turnbuckle and engage in the eye of the latter. The left lock bar is provided with a bolt snap.

Tees are riveted to the inner face of the door. These tees are spaced so that, with the door closed, the vertical leg of the tee falls between each alternate row of ammunition and the horizontal legs press against the base of the cartridge cases. The rims of the cartridge cases are thus firmly held between the front diaphragm and the door tees, which, in addition to forming stiffeners for the door, provide clearances between the door plate and the primers, for the protection of the latter. The lower edge of the door is also stiffened by an angle running its entire length.

The door (EB58B), Figure 5, opens forward and upward, swinging through an arc of 120° to its open position, where it is held by a door-prop assembly, on the left side of the chest. One end of the prop assembly is secured with a nut on a door-prop stud (C44E), riveted to the door; the other end runs in a door-prop guide riveted to the side of the chest. As the door is thrown open the prop assembly catches in a notch in the guide and holds it in the open position. To close the door the prop must be released by hand from the guide notch. A door handle bar (C45F) is riveted to the middle of the door at its lower edge.

o. The top of the chest forms a seat for the cannoneers and has a handrail (MB2S), Figure 5, at each side. Three grip straps for use of the cannoneers are attached to strap fasteners riveted to the door and to others riveted to the top of the chest. Three paulin straps are attached for securing the paulin which serves as a seat cushion.

p. The foot rest (EB59A), Figure 5, a perforated plate, is located in front of the bottom edge of the chest and runs the full width thereof. It is supported by the middle rail and by the foot rest braces at each end which are riveted to the sides of the chest. The rear corners are strengthened on the right side by the brake lever shaft bearing (BB21C), Figure 6, and on the left side by a foot rest corner brace.

q. The fuze-box receptacle, a built-up framework for carrying the fuze chests is riveted to the back of the chest. The receptacle is provided with adjusters to suit the different types of fuze boxes.

r. The fuze-setter bracket, located beneath the foot rest (EB59A), Figure 5, on the left side of the caisson, is a built-up framework which supports the bracket fuze setter. It is hinged to two brackets, one attached to the middle rail and the other to the side rail. The anchor bracket, to which the fuze setter is bolted, is riveted to the

anchor which in turn fits on the anchor rod (17D), located in bearings attached to the arms of the fuze-setter bracket. The anchor rod (17D) rotates in its bearings (16A), so that when the anchor bracket is swung up into traveling position the fuze setter rests on the fuze-setter carrier. When in use, the anchor bracket swings down with its front end on the ground, the fuze setter being inclined about 45°. The assembly, consisting of fuze setter, anchor bracket, and anchor, when revolved, can be disengaged from the anchor rod. Two fuze-setter latches (identical with the apron latches) hinge in fuze-setter latch bases (16D), riveted to the front of the foot rest. They engage with staples riveted to the fuze-setter arms and hold the fuze-setter bracket in the traveling position. When the fuze-setter bracket is in traveling position, the fuze-setter bracket separator serves as a step for the cannoneers in mounting. The anchor bracket is fitted with a stop which contacts with the foot rest when the fuze-setter bracket

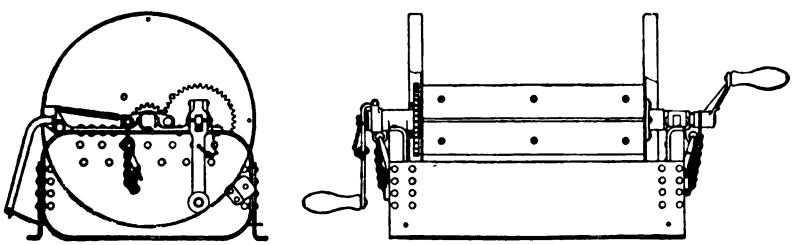

FIGURE 8.—Hand reel, M1917

is in traveling position. If the bracket fuze setter is not attached to the anchor bracket, the bracket must be folded in before the latches are engaged to prevent movement and possible loss of the anchor bracket assembly.

s. A name plate (7H), Figure 5, is attached to the middle rail top cover plate just in front of the foot rest.

t. Implement fastenings, attached to the chest and frame, are provided for carrying the various accessories. The accessories are held in position in the fastenings by means of straps which are attached to the vehicles by strap fasteners.

23. Description and operation of the hand reel, M1917.—*a.* The hand reel, M1917 (fig. 8), is a hand-operated reel for the transportation and handling of telephone wire. The reel is bolted to the top of the caisson ammunition chest. Two caissons in each gun battery are so equipped. For replacement purposes and in new equipment, standard cap screws ¼-20-NC x ¾ with hexagon nuts and lock washers will be used in place of the bolts formerly utilized.

b. The frame is built up of two flanged ends, two bearings with hinged caps, and two sides, riveted together and reinforced by four corner angle irons

c. The spool consists of two spool flanges and a spool hub, held together by four tie-rods, and a spool-flange hub riveted to the left spool flange. The spool is so mounted on the squared portion of a shaft, held in bearings riveted to the ends of the frame, that it can be readily removed and replaced by another spool.

d. A removable crank is mounted on the left end of the shaft. When removed it is held by a clip riveted to the end of the frame. A chain, one end of which is attached to the crank and the other to a chain rivet in the end of the frame, prevents its loss.

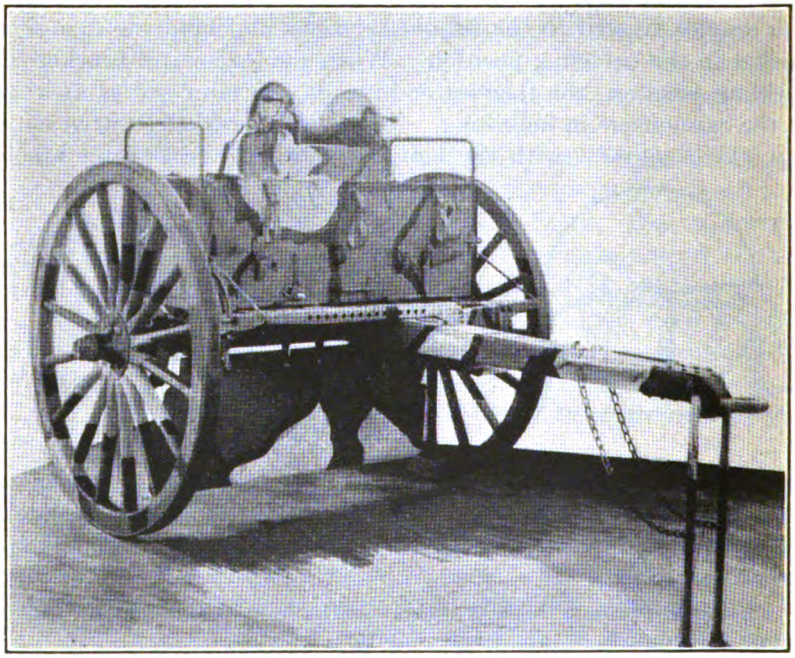

FIGURE 9.—75-mm gun caisson, M1918, with hand reel, M1917

e. On the right side, an 18-toothed pinion is mounted on the squared portion of the shaft. It meshes with a 40-toothed driving gear seated in the bearing riveted to the right side of the frame. A hinged crank, mounted on the end of the driving gear, is so designed that it may be folded compactly against the frame. When folded back, the crank is disengaged from the driving gear and does not revolve when the wire is paid out.

f. A brake is provided for controlling the speed of the spool. It acts on the inner rim of the right spool flange. The brake-lever pivots on the brake-lever pin of the right shaft bearing. It is held out of engagement with the spool flange by the brake release spring. A thong or cord long enough to reach to the seat of the limber, if

desired, may be reeved through the lower end of the brake lever to operate the brake mechanism.

g. In laying out wire, the left crank is removed and placed in the clips on the left end of the frame, the cotter pin is removed from the end of the driving gear and the right crank is folded back and placed on the crank rest. The drum is then free to revolve. The speed of the drum in paying out the wire is controlled by the action of the brake.

h. In recovering the wire, place the right and left cranks in position. Revolving the left crank operates the driving gear, the right crank being connected directly to the shaft on which the spool is mounted.

24. Disassembling and assembling.—*a. To dismount a brake band.*—(1) Remove the wheel.

(2) Remove the cotter pins of the brake-band end pins and the rear brake-rod end pin.

(3) Drift out the brake-rod end pin and lower the brake-band end pin.

(4) Swing the outer crank (BB16N), Figure 6, to the rear, raising the upper brake-band end pin.

(5) Drift out the upper brake-band end pin.

(6) In the first brakes of this model the adjusting nuts were attached to the brake-band end by a straight pin held by a cotter pin in the adjusting link which engaged a notch in the pin. The straight pin is now replaced by a bolt with a thin head and nut. The head is assembled on the outside and just clears the spokes.

b. To assemble a brake band or a newly relined brake bana.—(1) Proceed in the reverse order to that outlined in *a* above.

(2) In assembling a newly relined brake band, loosen the adjusting link (BB8B), Figure 6, and note that the adjusting nut (BB8F) is assembled to the proper end of the band so that when the adjusting link (BB8B) is assembled to the lower arm of the brake shaft (BB16H), the brake-band guides (BB9F) enter the clips (BB9N).

(3) Smooth all burrs and roughness off the brake drum (BB8A), Figure 6, but do not put oil or grease on it or the lining.

c. To dismount a brake shaft.—(1) Remove the wheel.

(2) Remove the cotter pins from the rear brake-rod end pin, outer crank (BB16N), Figure 6, and brake-rod end pins.

(3) Drive out the brake-rod end pin and the brake-band end pins.

(4) Remove the outer crank (BB16N), Figure 6.

(5) Drive out the brake shaft (BB16H), Figure 6.

(6) It is possible to remove the brake crank (BB16N), Figure 6, and the brake band as a unit, without removing the brake-band end pins. Revolve the brake crank, moving the brake band so that the brake-

band guides (BB9F), Figure 6, clear the clips (BB9N). Pull out the unit.

d. To assemble a brake shaft.—(1) Proceed in the reverse order to that outlined in *c* above.

(2) Clean all bearing surfaces and lubricate parts before assembling.

e. To dismount the pintle.—(1) Remove the pintle bearing bolts (AB26H and AB26G), Figure 5, and withdraw the pintle (AB26A) and bearing (AB26F) to the rear.

(2) Unscrew the pintle spring seat (AB26C), Figure 5 (located in the top of the pintle bearing), and take out the small spring and plunger.

(3) Remove the pintle nut and withdraw the pintle from the bearing.

f. To replace the pintle.—Proceed in the reverse order to that outlined in *e* above.

g. To replace a carrying spring (AB21C), Figure 5.—(1) Remove the apron (EB60A), Figure 5, by withdrawing the apron hinge pins.

(2) Disconnect the brake rods (BB24E), Figure 5.

(3) Remove the cotter pins and nuts from the lower ends of the spring bolts. The Belleville springs (AB21B), Figure 5, come off with the nuts.

(4) Raise the chest and frame from the axle sufficiently to remove the broken spring and insert a new one.

(5) Examine all the springs, also the axle brackets (AB23C), Figure 6, and the liners of the side-rail guides, for scoring and wear of the contact surfaces. Smooth off any roughness or burrs.

(6) Clean the springs and slush with lubricating graphite grease.

(7) Lightly coat the axle brackets (AB23C), Figure 6, and the liners of the side-rail guides with lubricating graphite grease, and follow by a light oiling with Class A lubricating oil.

(8) Reassemble the Belleville springs (AB21B), Figure 5, and the spring-bolt nuts. The Belleville springs are to have the convex side next to the axle brackets (AB23C), Figure 6, and the spring-bolt nuts. Screw on the nuts until flush with the ends of the spring bolts. Insert the cotter pins.

(9) If the weight of the chest without ammunition is insufficient to compress the carrying springs, so that the spring bolt nuts can be started on the thread, have a number of men sit on the chest to weight it down or use any convenient weight. Replace the cotter pins.

(10) Replace the apron (EB60A), Figure 5, and connect the brake rods (BB24E), Figure 6.

h. Instructions on the disassembling and assembling of the wheels, wheel fastenings, pintle latch and springs, lunette, and padlocks and bolt snaps are contained in paragraph 15.

25. Care and maintenance.—*a. The maintenance of the caissons* consists mainly in lubrication and cleaning. Occasionally, a handrail is bent or an implement fastening or strap is broken, the replacement of which is so simple that specific instructions are unnecessary. Due to a difference in radii of ogives of the Mk. I and Mk. IV shells, the nose of the Mk. IV shell does not bear in the rear diaphragm. This results in a tendency of the projectiles to rattle and occasionally to break loose from their cartridge cases. In the event of a projectile of any kind becoming stuck in the caisson, the cartridge case having pulled loose from it, the removal of same should be referred to an ordnance maintenance company.

b. Maintenance of the hand reel, M1917.—The bolts or cap screws, whichever may be in use, attaching the reel to the caisson may become loose or sheared off; tighten them or insert new cap screws. It is not necessary to take out any of the ammunition-chest connecting pieces to do this. The chains of the bearing pins and cranks are sometimes broken off. Spare chains may be attached by attaching the replacement to the chain rivet.

c. Maintenance of the brake mechanism.—Brake levers (BB21K), Figure 6, must not be released by a kick or blow. When brake bands slip and fail to lock the wheels, they may be worn or merely greasy. Wash the lining surfaces thoroughly with gasoline and adjust. No dressing of any kind is to be put on the linings. When linings (BB8C), Figure 6, are worn beyond further service, which will be when no further adjustment is practicable or when the copper rivets attaching them to the bands become loose, the band must be relined. This work is done by an ordnance maintenance company. Refer any other brake-mechanism trouble to the maintenance company for correction.

d. To adjust the brake bands.—The braking effect should be the same for both wheels. It should be possible to skid the wheels and to secure proper release of the brake bands when the brake lever is operated. When the linings become badly worn, jack up the axle to raise one wheel, disconnect the adjusting nut (BB8F), Figure 6, from the brake-band end and tighten the nut on the adjusting link (BB8B) a definite number of turns. Reconnect the adjusting link to the band and set the brake. It should hold the wheel when a man of ordinary weight stands on the outer end of one of the horizontal spokes. Then throw the brake lever (BB21K) to the extreme released position and see if the brake band drags when the wheel is turned. If it does, the band is too tight and must be readjusted. The brake lever (BB21K) should not come to the last notch in the segment when the brake is set. Leave a little movement in reserve

for wear of the lining. Follow the same procedure with the other wheel.

e. Care and maintenance of the wheels, wheel fastenings, pintle and pintle latch, lunette, and padlocks and bolt snaps are contained in paragraph 16.

f. Lubricating instructions are contained in Section X.

g. General instructions on care and maintenance such as painting, cleaning, etc., are contained in Section XI.

SECTION V

BATTERY AND STORE WAGON. M1917

26. Weights, dimensions, etc.—The following list gives the principal weights, dimensions, etc., for the battery and store wagon, M1917:

Weight of battery wagon, empty	pounds	1, 705
Weight of battery wagon, completely equipped and loaded, approximate	pounds	3, 325
Weight of store wagon, empty	do	1, 705
Weight of store wagon, completely equipped and loaded. (See par. 3*e*).		
Road clearance under wagons	inches	24. 5
Weight at lunette of either wagon, loaded, approximate	pounds	112

27. Description of the battery and store wagon, M1917.—*a.* The battery spare parts, cleaning and preserving materials, and repair tools necessary in the upkeep of an animal-drawn battery are transported in the battery and store wagon. Previously, two vehicles were assigned each gun battery and, according to their loads, were designated as battery wagon and store wagon. At present, only one wagon is used, with its attendant forge limber.

b. The battery and store wagons are identical, except for the equipment that is carried in the compartments of each vehicle. Each vehicle is given a serial number.

c. The wagons are made of metal throughout, excepting the spokes and felloes of the wheels and the packing. The principal parts are the wheels, axle, frame, carrying springs, chest, and brakes.

d. The wheels, wheel fastenings, dust guards, lunette, padlocks, and bolt snaps are described in Section II.

e. The frame consists of two side rails and one rear cross channel with intermediate bracing channels. The side rails, parallel under the chest, are bent in near the front and meet to form a housing for

the lunette bracket (AB21A), Figure 10. Wheel guards (10C) are attached to the sides of the side rails forward of the foot rest. Frame handles (7E), Figure 10, for maneuvering purposes are attached to the side rails at the lunette bracket (AB21A).

f. The lunette (AB9B), Figure 10, and lunette bracket (AB21A) are similar to those used on the 75-mm gun caisson, M1918.

g. The prop assembly (fig. 10), attached to the side rails at the lunette bracket (AB21A), is similar in design but slightly shorter than that used on the 75-mm gun caisson, M1918.

h. The axle is a tubular one-piece forging.

i. Carrying springs (AB21C), Figure 10, similar to those on the 75-mm gun caisson, M1918, are used to carry the chest.

j. An oil-can compartment, located in the space between the side rails in rear of the axle, is fitted to carry three rectangular 5-gallon cans for recoil oil, lubricating oil, and gasoline. A bar and padlock are provided to prevent the unauthorized use of the contents of the oil cans.

k. The chest, built up of plates and angles, is divided into seven compartments which are used to carry various articles of the battery equipment and tools. The top compartments are provided with vertical-opening hinged doors, the front and rear doors having lid props (MB4S), Figure 10, and lock bar (JB4C). The lower compartments are provided with vertical swing doors in front and rear of the chest. All of the compartments are provided with lock bars or bolts and padlocks. The top of the chest is used as a seat, cushioned by the paulin. Handrails (C135A), grip straps, and foot rest (18A) are provided.

l. Fastenings for carrying one spare 56-inch wheel on each side of the chest are provided. The spare-wheel fastenings are not intended to support the weight of the wheel. The wheel should always rest on the carrying spring bracket (25D), Figure 10. When used with the 75-mm gun matériel, M1897MI (French), the spare-wheel fastening on the right side of both the battery and store wagon chests is modified to carry a 1,334-mm wheel instead of the 56-inch wheel. See Field Service Modification Work Order C8–W2.

m. The brakes are similar in operation but differ somewhat in design from those used on the 75-mm gun caisson, M1918.

n. A spare limber pole is carried bolted through the pole pin hole to brackets on the wheel-guard cross brace (10B) Figure 10, and extends back through an opening in the chest.

o. The battery wagon carries a blacksmith's vise attached to the frame near the lunette and a crowbar under the right side rail.

p. A name plate is attached to the front of the chest.

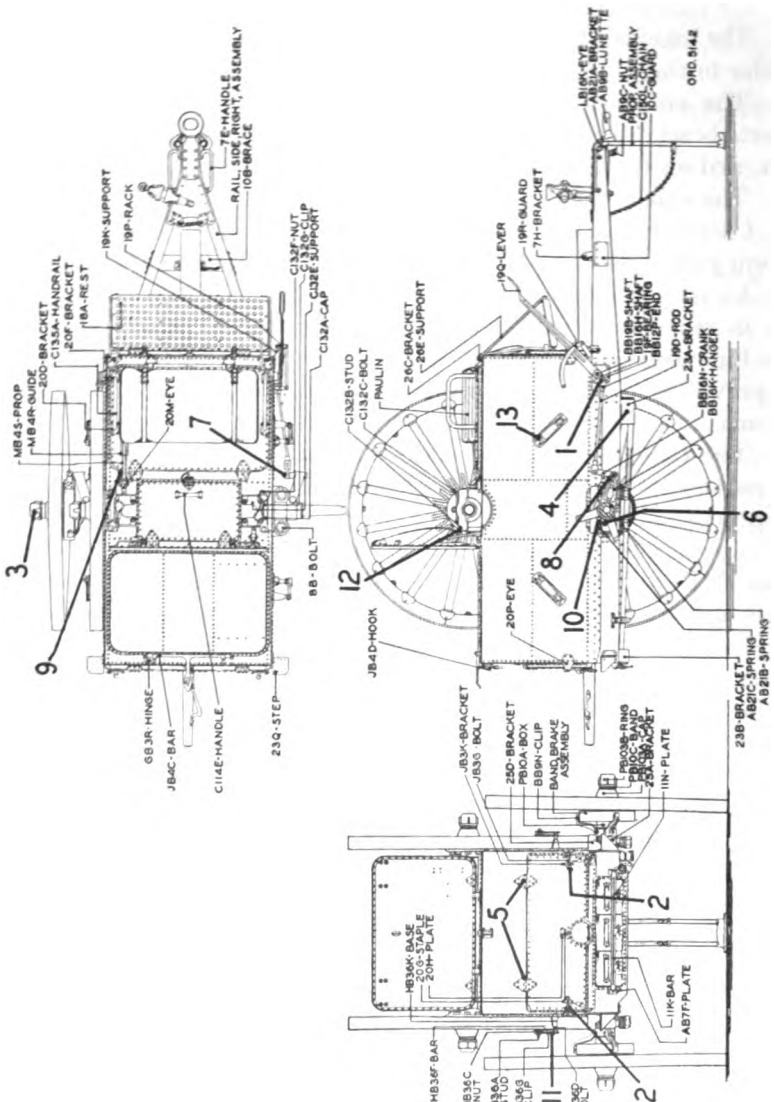

FIGURE 10.—Battery and store wagon, M1917, assembled views

Reference	Item
	Band, brake, assembly.
PB10C	Band, hub.
JB4C	Bar, lock.
11K	Bar, oil-can.
HB36F	Bar, spare-wheel fastening.
HB36K	Base, spare-wheel fastening.
19P	Bearing, brake crank shaft, right.
JB3G	Bolt, shot, left.
C132C	Bolt, spare-wheel support swing.
HB38D	Bolt, spare-wheel fastening swing.
8B	Bolt, spring.
PB10A	Box, hub.
10B	Brace, wheel-guard cross.
25A	Bracket, axle.
25D	Bracket, carrying spring.
23A	Bracket, crowbar, front.
23B	Bracket, crowbar, rear.
26C	Bracket, foot-rest support, right.
20D	Bracket, handrail, rear.
20F	Bracket, handrail, front, left.
AB21A	Bracket, lunette.
JB3K	Bracket, shot bolt, right.
7H	Bracket, spare pole, right.
PB103A	Cap, hub.
C132A	Cap, spare-wheel support.
C150L	Chain, prop.
BB9N	Clip, brake band.
HB36G	Clip, spare-wheel fastening.
C132G	Clip, spare-wheel support.
BB16N	Crank, brake, outer (rear).
BB12P	End, brake rod.
20M	Eye, lid prop.
LB16K	Eye, prop, right.
20P	Eye, shot bolt.
19R	Guard, brake segment.
10C	Guard, wheel.
MB4R	Guide, lid prop.
C114E	Handle, door.
7E	Handle, frame, right.
C135A	Handrail.
BB16K	Hanger, brake, right.
GB3R	Hinge, lock bar, top.
JB4D	Hook, door.
19Q	Lever, brake.
AB9B	Lunette.
AB9C	Nut, lunette.
HB36C	Nut, spare-wheel fastening.
C132F	Nut, spare-wheel support.
	Paulin.
20H	Plate, door staple.
AB7F	Plate, oil-can bar staple.
11N	Plate, oil-can locking.
	Prop assembly.
MB4S	Prop, lid.
19P	Rack, brake segment.
	Rail, side, right, assembly.
18A	Rest, foot.
PB103B	Ring, hub.
19D	Rod, brake.
BB16H	Shaft, brake.
BB19B	Shaft, brake lever.
AB21B	Spring, Belleville.
20G	Staple, door.
AB21C	Spring, carrying.
23Q	Step, right.
HB36A	Stud, spare-wheel fastening.
C132B	Stud, spare-wheel support.
19K	Support, brake segment.
26E	Support, foot rest, right.
C132E	Support, spare wheel.

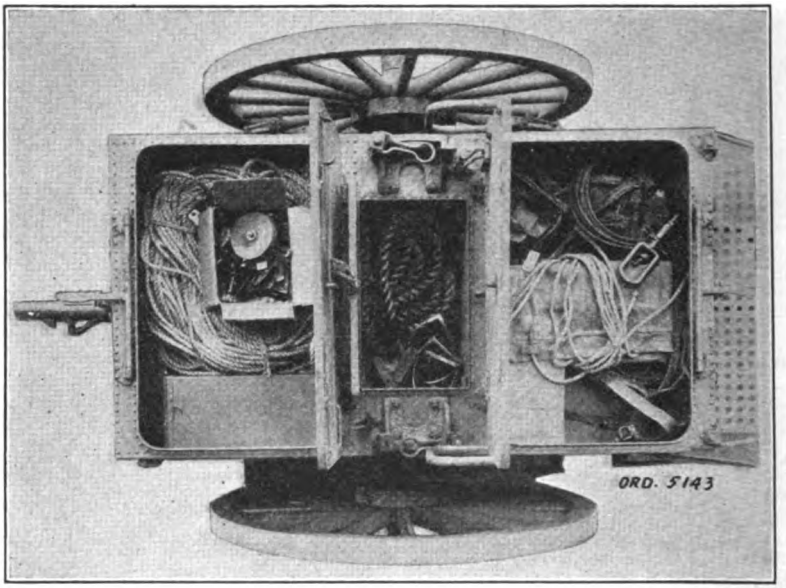

FIGURE 11.—Battery wagon, M1917, upper compartments partially packed

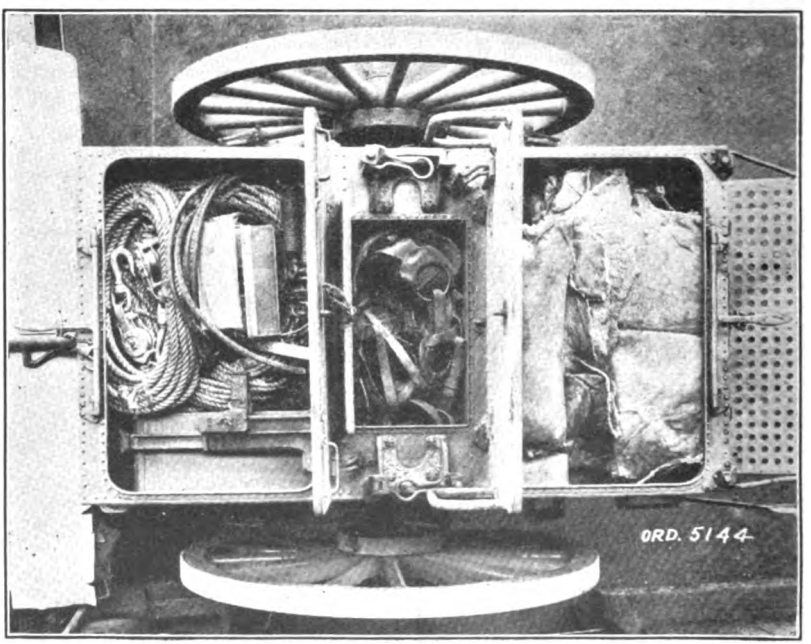

FIGURE 12.—Battery wagon, M1917, upper compartments completely packed

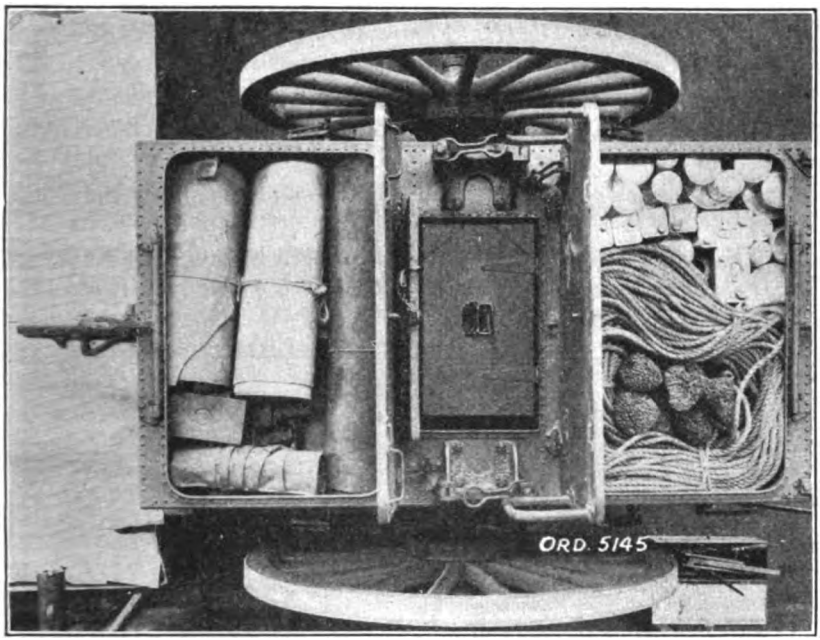

FIGURE 13.—Store wagon, M1917, upper compartments packed

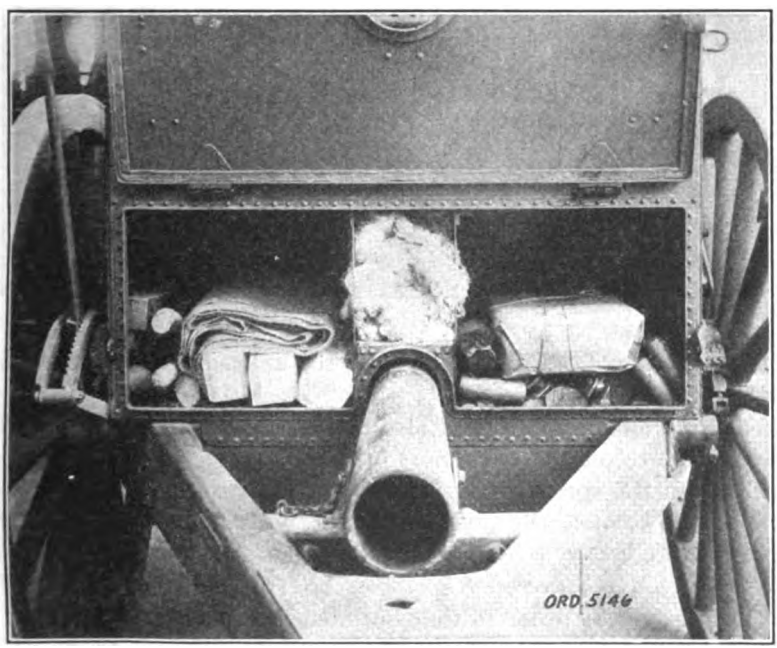

FIGURE 14.—Store wagon, M1917, front compartments packed

28. Disassembling and assembling.—*a. To dismount or replace the carrying springs (AB21C), Figure 10.*—(1) Disconnect the brake rods (19D), Figure 10.

(2) Remove the cotter pins and nuts from the lower ends of the spring bolts (8B), Figure 10. The Belleville springs (AB21B) come off with the nuts.

(3) Remove the cotter pins from the heads of the spring bolts (8B), Figure 10.

(4) Drop a hexagon nut (one of the brake hanger bolt nuts) into the recess in the spring-bolt head and apply a wrench to it, removing the spring bolt (8B), Figure 10.

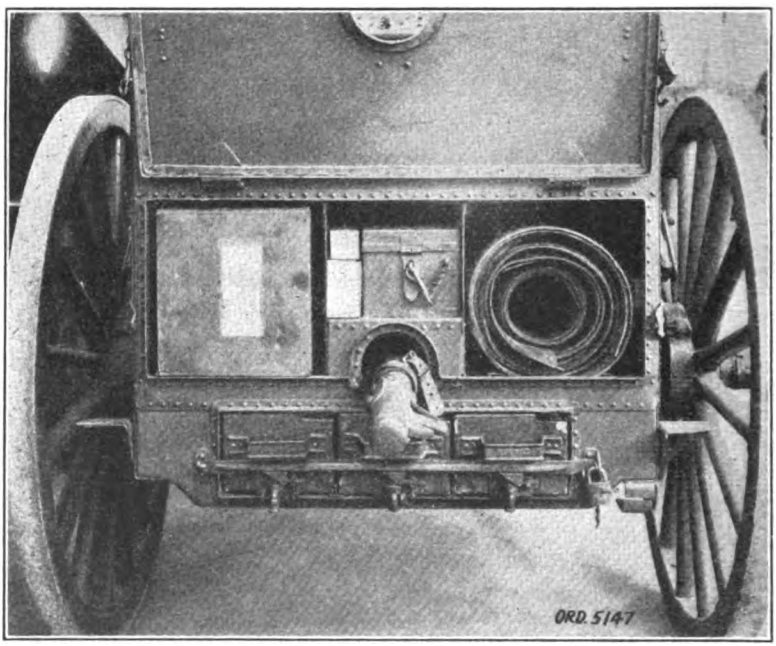

FIGURE 15.—Store wagon, M1917, rear compartments packed

(5) Raise the chest and frame from the axle sufficiently to remove the springs.

(6) Examine all the springs, also the axle brackets, for scoring and wear. Smooth off any roughness or burrs.

(7) Clean the springs and slush with lubricating graphite grease.

(8) Lightly coat the axle brackets with lubricating graphite grease, and follow by a light oiling with Class A lubricating oil.

b. To mount the carrying springs (AB21C), Figure 10.—(1) Proceed in the reverse order to that outlined in *a* above.

(2) The Belleville springs (AB21B), Figure 10, are to have the convex side next to the axle brackets and the spring-bolt nuts. Screw

on the nuts until flush with the end of the spring bolts (8B). Insert the cotter pins.

(3) If the weight of the chest is insufficient to compress the carrying springs so that the spring-bolt nuts can be started on the threads, have a number of men sit on the chest to weight it down or use any convenient weight.

c. Assembling and disassembling operations pertaining to the brake mechanism are similar to those outlined for the 75-mm gun caisson, M1918, in paragraph 24 *a*, *b*, *c*, and *d*.

29. Care and maintenance.—*a.* The maintenance of the battery and store wagons consists mainly in lubrication and cleaning. Occasionally a handrail is bent or a strap, strap fastener, or padlock chain is broken, the replacement of which is so simple that specific instructions are unnecessary.

b. The maintenance of the brake mechanism is similar to that outlined for the 75-mm gun caisson, M1918, in paragraph 25 *c* and *d*.

c. Care and maintenance of the wheels, wheel fastenings, lunette, padlocks, and bolt snaps are contained in paragraph 16.

d. Lubricating instructions are contained in Section X.

e. General instructions on care and maintenance such as painting, cleaning, etc., are contained in Section XI.

SECTION VI

FORGE AND STORE LIMBERS, M1902MI

30. Weights, dimensions, etc.—The following list gives the principal weights, dimensions, etc., for the forge and store limbers, M1902MI:

Weight of forge limber, empty	pounds	975
Weight of accessories carried on forge limber	do	94
Weight of blacksmith's tools carried, including 200 pounds of horseshoes and 50 pounds of horseshoe nails, approximate	pounds	508
Weight of forge limber, completely equipped and loaded, approximate	pounds	1,577
Weight of store limber, empty	do	972
Road clearance under limbers	inches	26.5

31. Description of the forge and store limbers, M1902MI.—*a.* The forge and store limbers (figs. 16, 17, and 18) with the exception of

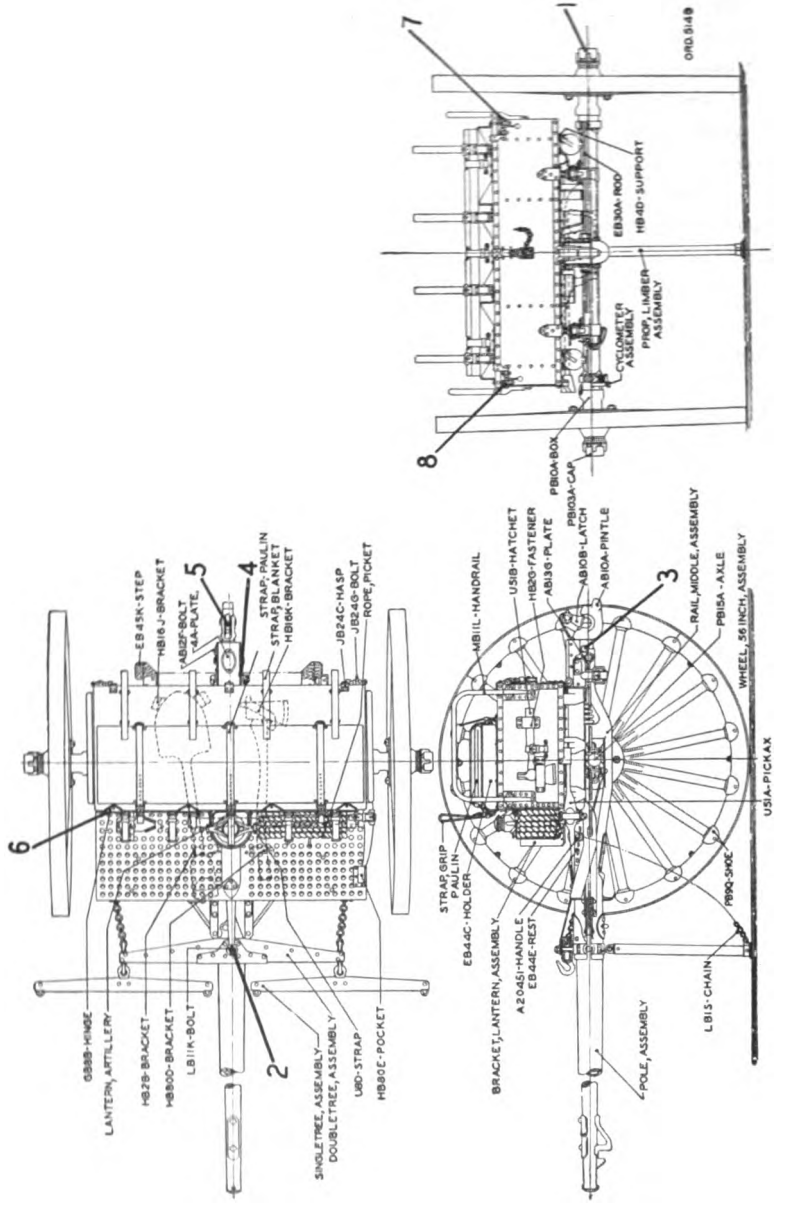

FIGURE 16.—Forge limber, M1902MI, assembled views

Reference	Item	Reference	Item
PB15A	Axle.	AB10B	Latch, pintle.
LB11K	Bolt, doubletree.		Paulin.
AB12F	Bolt, pintle bearing.	U51A	Pickax.
JB24G	Bolt, shot, left.	AB10A	Pintle.
PB10A	Box, hub.	AB13G	Plate, lock (for pintle bolts).
HB80D	Bracket, ax handle.	4A	Plate, name.
HB16K	Bracket, ax head.	HB80E	Pocket, pick-needle end.
	Bracket, lantern, assembly.		Pole assembly.
HB16J	Bracket, shovel blade.		Prop, limber, assembly.
HB2B	Bracket, shovel handle.		Rail, middle, assembly.
PB103A	Cap, hub.	EB44E	Rest, foot.
LB1S	Chain, prop.	EB30A	Rod, tie, rear, right.
	Cyclometer assembly.		Rope, picket.
	Doubletree assembly.	PB9Q	Shoe, spoke.
HB2G	Fastener, hatchet handle.		Singletree assembly.
A20451	Handle, prop chain.	EB45K	Step.
MB11L	Handrail.		Strap, grip.
JB24C	Hasp, shot bolt, left.	U8D	Strap, lantern.
U51B	Hatchet, 4-inch cut, plain face 1¼ inches.		Strap, blanket.
			Strap, paulin.
GB8B	Hinge, lid, female.	HB4D	Support, oil can, rear.
EB44C	Holder, bucket.		Wheel, 56-inch, assembly.
	Lantern, artillery, M1.		

the interior fittings of the chests are identical. Each vehicle is given a serial number.

b. The limbers are made of metal throughout, excepting the spokes and felloes of the wheels and the chest packings. The principal parts are the wheels, axle, frame, chest, pole, doubletree, singletrees, and neck yoke.

c. The wheels, wheel fastenings, dust guards, pole, pole pin, doubletree, singletrees, neck yoke, pintle and pintle latch, padlocks, and bolt snaps are described in Section II.

d. The frame differs only from that of the 75-mm gun carriage and gun caisson limbers, M1918, in that the chest is entirely self-contained and may be dismounted, and the axle (PB15A), Figure 16, square in section, has projecting lugs to which the side and middle rails are riveted.

e. The axle end of the tie-rod (EB30A), Figure 16, and doubletree ropes are pinned in lugs on the tie-rod clamps which are fitted to the axle (PB15A) just inside the wheel hubs.

f. The chest is a built-up box of plates and angles riveted together with a top lid. The lid is hinged to the chest front and fastened in the closed position by a shot bolt (JB24G), Figure 16, at each rear corner and a hasp and turnbuckle in the middle. A padlock, chained to the chest of the body, engages with the turnbuckle to lock the chest. When open, the lid is supported by an inside lid prop. The chest is stiffened near each end on the bottom by a T-shaped chest rail from which two connection lugs project downward into the side rails. Four connection pins secure the connection lugs to the side rails.

g. The top of the chest is used as a seat, cushioned by the paulin. Handrails (MB11L), grip straps, and a foot rest (EB44E), Figure 16, are provided.

h. Implement fastenings, attached to the chest and foot rest, are provided for carrying the various accessories. The accessories are held in position by straps which are attached to the vehicle by strap fasteners.

i. Brackets under each end of the chest carry tubular oil cans similar to those carried in the ammunition compartments in the 75-mm gun caisson limber, M1918. The oil cans are retained in place by a cover on the rear bracket. The cover is hinged at the bottom and held in the closed position by a spring latch.

j. A name plate is attached to the top of the middle rail of each forge and store limber over the pintle bearing.

k. The interior of the forge limber chest is divided by steel partitions into seven compartments. The end compartments for carrying the blacksmith's tools are comparatively narrow and are fitted with

fastenings so arranged that each tool can be taken out without disturbing the others. The compartments adjacent to the tool compartments are wider and are subdivided by lateral partitions, forming two compartments for horseshoes and two for horseshoe nails, with a total capacity for 300 pounds of shoes and 50 pounds of nails. The shoes are carried loose in the compartments, which are wood lined; the nails may be carried loose, though the nail compartments are of the proper size to take the 25-pound box of nails as issued. The middle compartment is fitted to take the field forge in front, the anvil in the rear, and several small tools in brackets on the walls. The

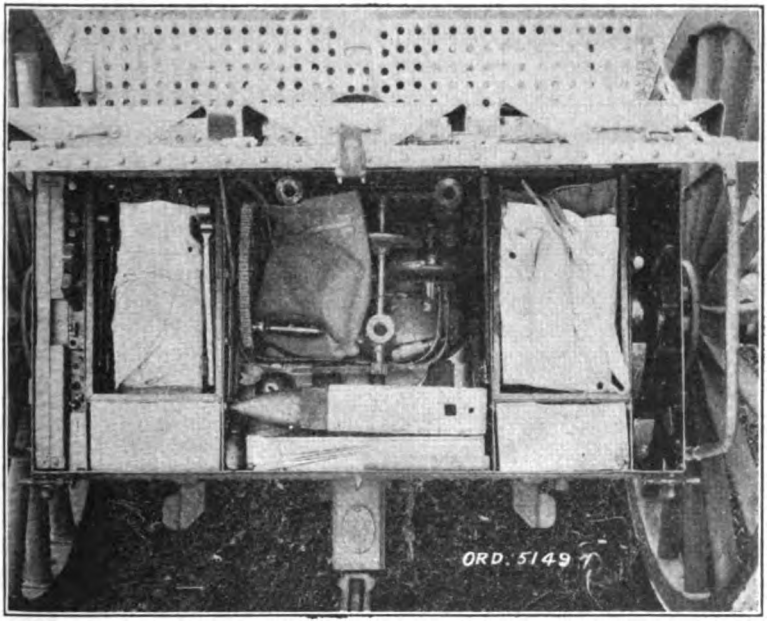

FIGURE 17.—Forge limber, M1902MI, interior of chest with tools

anvil is bedded in a wooden seat in the bottom of the chest, and with the forge is held in place by cleats on the chest lid. No special brackets are provided for hoof-branding irons.

l. The store limber chest has one large wood-lined compartment which is fitted with adjustable partitions which may, if necessary, be moved to adapt the various compartments to changes in the fire-control equipment carried. Some of the compartments which carry the more delicate instruments are provided with supporting springs and pads.

32. Description of the cyclometer.—*a.* Each forge and store limber is fitted with a cyclometer assembly (fig. 16) which registers the number of miles traveled. This instrument is mounted on the left tie-rod clamp in the rear of the axle.

b. The cyclometer consists of a star wheel (tally shaft) which actuates a gear train carrying numbered drums. The range of the cyclometer is from 0.1 to 9,999.9 miles.

c. A tally pin, attached to the hub of the wheel, strikes the star wheel and moves it one tooth at each revolution of the wheel.

d. In the cover of the star wheel there is a flat stop, actuated by a coil spring, which functions to hold the star wheel from turning too far when struck by the tally pin.

e. The attachment of the tally pin to the wheel hub requires two rivet holes in the hub. Such attachment is easily accomplished by the battery mechanic or by the personnel of an ordnance maintenance company. Special wheels with the hubs drilled for the tally pin are not issued.

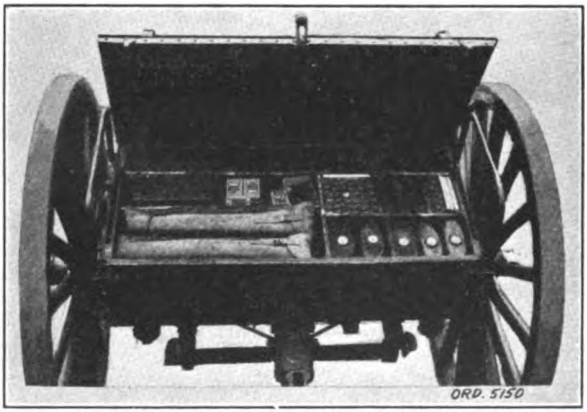

FIGURE 18.—Store limber, M1902MI, interior of chest with instruments

f. Where a cyclometer is issued for a vehicle not previously equipped a proper tie-rod clamp is issued with it. In such case all parts replaced should be returned to the arsenal of issue.

g. Dust guards when used on wheels fitted with the cyclometers should be carefully fitted and adjusted.

33. Disassembling and assembling.—*a.* Instructions for disassembling the wheels, wheel fastenings, pole, doubletree, singletrees, neck yoke, pintle latch and spring, padlocks, and bolt snaps are contained in paragraph 15.

b. Instructions for dismounting and mounting the automatic pole support are contained in paragraph 19.

c. Dismounting and mounting the cyclometer.—(1) If the counter is damaged, a new one may readily be assembled by taking out the case screws and replacing the counter.

(2) Set the metal of the case into the slots of the screws to retain them.

(3) Set the new counter at zero.

(4) Note, for report, the mileage record of the old counter.

d. Dismounting and mounting the chest.—(1) Remove the cotter pins from the connection pins and drive them out.

(2) Lift off the chest.

(3) In replacing, proceed in the reverse order.

34. Care and maintenance.—*a.* Maintenance of the forge and store limbers consists mainly in lubrication and cleaning. Occasionally, handrails are bent or straps, strap fasteners, or padlock chains are broken. The replacement of these parts is so simple that specific instructions are unnecessary.

b. Care and maintenance of the wheels, wheel fastenings, pintle and pintle latch, pole, doubletree, singletrees, neck yoke, and padlocks and bolt snaps are contained in paragraph 16.

c. Maintenance of the cyclometer consists mainly in cleaning and oiling. Occasionally, the cyclometer is damaged by brush or wire entangling the star wheel and tally pin.

d. Care must also be taken to prevent the flat stop in the cover of the star wheel from sticking, either from dirt or by gummy oil. Keep all oil holes in the cyclometer clean.

e. The circumference of the wheel used with the cyclometer should, for accuracy, be as close to π (3.1416) $\times$ 56 inches = 175.93 inches, as possible.

f. Lubricating instructions are contained in Section X.

g. General instructions on care and maintenance such as painting, cleaning, etc., are contained in Section XI.

SECTION VII

BATTERY REEL, M1917

35. Weights, dimensions, etc.—The following list gives the principal weights, dimensions, etc., for the battery reel, M1917:

Weight of battery reel, empty	pounds	1, 385
Weight of accessories carried	do	62
Weight of communication equipment carried (includes 1.7 miles of wire, twisted pair pounds per mile)	pounds	331. 5
Weight of fire-control equipment carried, approximate	do	112
Weight of topographical equipment carried, approximate	do	22
Weight of battery reel, completely equipped and loaded, approximate	pounds	2, 252
Road clearance under reel	inches	19
Number of revolutions of drum to one of wheel		4. 6225

The battery reel, M1917, is replaced by the artillery reel, M1909MI, and the artillery cart, M1918, in battalion, regimental, and brigade headquarters of light field artillery, horse drawn; in gun batteries and in battalion, regimental, and brigade headquarters of light field artillery, tractor drawn, and of medium and heavy field artillery; and in brigade headquarters of portee artillery; also in observation battalions and batteries the artillery reel without the cart is used.

36. Description of the battery reel, M1917.—*a.* The reel (fig. 19) is a single, 2-wheeled vehicle, drawn by four horses. It is designed to carry, lay, and recover 1.7 miles of double insulated wire and to transport certain other communication, fire-control, and topographical equipment. With the exception of the spokes and felloes of the wheels and the chest packings, the reel is made of metal throughout. The principal parts are the frame, drum, operating gear, front chest, rear chest, plotting-board case, seat, wheels, pole, doubletree, singletrees, and neck yoke.

b. The wheels, wheel fastenings, pole, pole pin, doubletree, singletrees, neck yoke, padlocks, and bolt snaps are described in Section II.

c. Standard 56-inch wheels are used with the reel. The driving gear (20A), Figure 19, is bolted to the left wheel hub, 8–0.75 x 4.75-inch carriage bolts replacing the standard hub bolts. The driving gear is concentric with the axis of the hub liner. Originally, the wheels used were special. They were 56 inches in diameter and the tires, 2.5 inches wide and 0.4 inch thick, with the spokes and felloes to suit. The hub used was that standard for the 56-inch wheel.

d. The frame consists principally of two side rails, the forward ends of which converge and are riveted to the front end of the pole socket. The rear ends are connected by a cross brace. The side rails are of channel section and taper in depth from rear to front. They are braced by a front end, a front and an intermediate cross brace. The rear end of the pole socket is riveted to the front end of the cross brace. A diagonal brace runs from the center of the rear cross brace to each side rail and a front diagonal brace runs from the junction of each side rail with the intermediate cross rail forward to the pole socket. About midway between the front and rear ends of the side rails and riveted thereto are the right and left axle brackets (10A and 11A), Figure 19, on which the wheels are mounted. In the rear of these, two brackets which support the rear chest are riveted to each side rail.

e. The drum upon which the wire is wound is built up of a perforated drum body (16E), Figure 20, one foot in diameter, braced on the interior and closed on each end by a drumhead (17D), the whole revolving on a hollow drum shaft (18A). A flanged plate (16A)

about twice the diameter of the drum is riveted to each drumhead forming the ends of the spool. Each of the wires of the double wire is attached to a separate terminal secured to the right drum end plate (16B), so that connection with the wire remaining on the drum may be made readily through these terminals.

The drum shaft (18A), Figure 20, is supported in bearings in the axle brackets (10A and 11A), designed to prevent rotation of the shaft. The method of mounting the shaft is such that the left end of the drum is lower than the right. This is necessary in order to maintain the parallelism of the gear axes, as the axle arms having the usual set, the left wheel and the driving gear are inclined to the vertical.

Each drumhead is provided with a ball bearing (fig. 20), so that the drum may revolve freely upon the shaft. A conical clutch surface is machined in the exterior end of each drumhead. Two leather-faced sliding cones engage these surfaces, forming a driving clutch on the left drumhead and a braking clutch on the right drumhead. The brake cone (19B) is keyed to the drum shaft (18A) on which it slides in or out of engagement with the drumhead. The driving cone is secured to a bushed sleeve having a pinion (20E) on its outer end. It is free to revolve on the shaft. The pinion (20E) is engaged or disengaged from the gear train by a hand lever (B5619) at the will of the operator.

f. The drum (16E), Figure 20, is revolved by means of a train of gears operated by a driving gear (20A), Figure 21, attached directly to the hub of the left wheel. The intermediate pinion (20B) and gear are mounted on a shaft supported in a bushed bearing in the left axle bracket (10A), Figure 20, the intermediate gear (20F), Figure 21, meshing with the driving clutch pinion (20E), Figure 20, on the drum shaft (18A). The gears are entirely enclosed by covers.

On the top surface of the left axle bracket (10A), Figure 20, is bolted the hand-lever bracket (22A), and on the right axle bracket (11A) is bolted the brake-lever bracket (22D). In each bracket are mounted a pair of lever arms (22F). The upper ends of the pair in the left bracket are bolted to the hand lever; the upper ends of those in the right bracket to the brake lever (22H). The lower ends of each pair of lever arms form a fork which controls a clutch yoke (19D). These yokes engage circular grooves on the shanks of the driving clutch and brake clutch cones. The brake lever is connected to the hand lever by a connecting rod running between the two above the drum.

The operation of the gear is as follows: When the hand lever (B5619) is thrust to the left, out from the seat, the lower end moves

FIGURE 19.—Battery reel, M1917, assembled views

Reference	Item
18B	Arm, axle.
22F	Arm, lever.
42B	Bar, wire guide.
HB14A	Base, implement fastening.
LB5D	Body, doubletree.
LB3F	Body, pole.
10A	Bracket, axle, left.
11A	Bracket, axle, right.
22D	Bracket, brake lever.
21G	Bracket, gear guard, rear.
22A	Bracket, hand lever.
23C	Bracket, hand-lever rack.
12E	Bracket, handrail, front.
12F	Bracket, handrail, rear.
HB2F	Bracket, hatchet blade, right.
	Bracket, lantern, assembly.
LB2K	Bracket, prop, half.
LB1BA	Button, prop chain.
21B	Case, gear, lower half.
21A	Case, gear, upper half.
HB43A	Catch, spring, implement fastening.
LB9X	Chain, doubletree.
LB1HA	Chain, prop.
12D	Channel, seat.
31G	Eye, fastening, doubletree chain.
LB1B	Eye, prop.
LB1N	Fastening, prop chain.
HB44H	Filler, spring, implement fastening.
LB1A	Foot, prop.
20A	Gear, driving.
20F	Gear, intermediate.
42A	Guard, foot.
42C	Guide, wire.
A20451	Handle, prop chain.

Reference	Item
C115E	Handrail.
43C	Hinge, front chest door, male.
LB5H	Hook, double, left.
23D	Jaw, connecting rod.
22H	Lever, brake.
B5619	Lever, hand.
HB17D	Lever, implement fastening.
LB9Y	Link, doubletree chain end.
22C	Pin, hand lever.
LB12D	Pin, neck-yoke counterstop.
20B	Pinion, intermediate.
LB3A	Plate, chafing, neck yoke.
LB12E	Plug, pole.
12C	Plate, name.
14A	Plate, seat.
23A	Rack, hand lever.
23F	Rod, connecting.
BCAX1CC	Screw, cap, hexagon head, ⅜-16-NC-2 x 1 (for wire guide bar).
BCAX1ED	Screw, cap, hexagon head, ½-13-NC-2 x 1¼.
BCAX1EE	Screw, cap, hexagon head, ½-13-NC-2 x 1½ (for gear case and lever arm).
BCAX1EQ	Screw, cap, hexagon head, ½-13-NC-2 x 3¾.
23G	Slide, hand lever.
HB44C	Spring, implement fastening.
LB12B	Stop, counter, neck yoke.
LB12A	Stop, neck yoke.
13A	Support, seat, front, left.
13D	Support, seat, rear, left.
13C	Support, seat, rear, right.
LB1GA	Tube, prop.

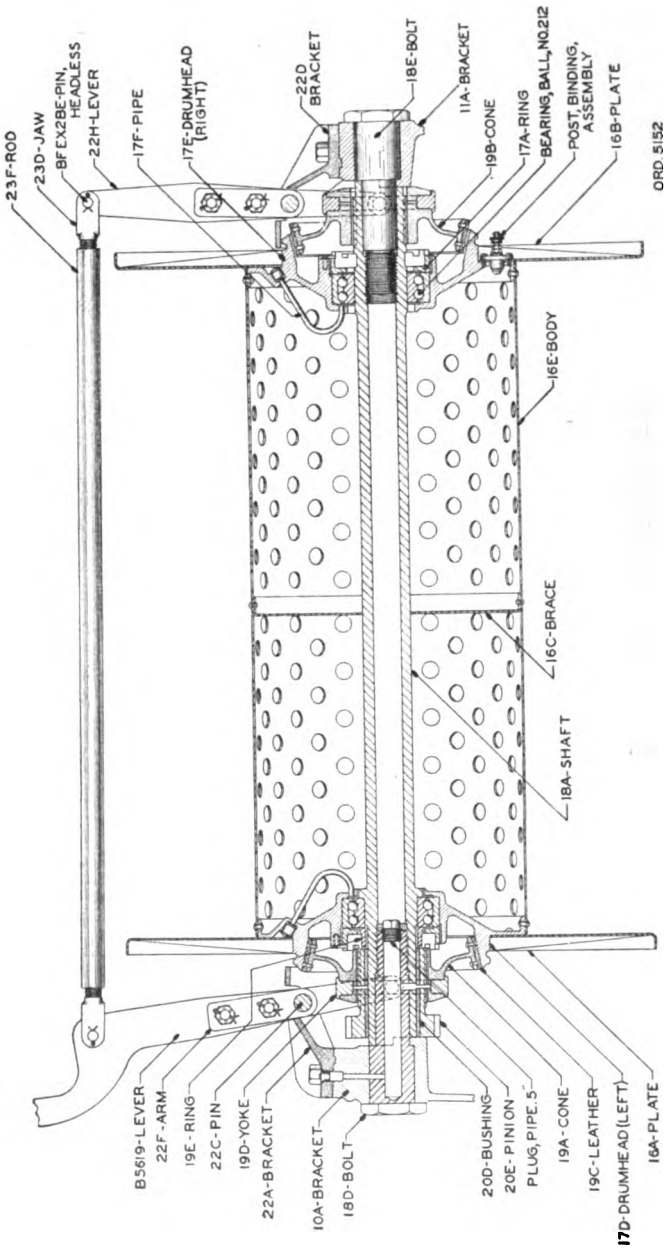

FIGURE 20.—Battery reel, M1917, section through drum and clutches

Reference	Item	Reference	Item
22F	Arm, lever.	22H	Lever, brake.
	Bearing, ball, No. 212.	B5619	Lever, hand.
16E	Body, drum.	BFEX2BE	Pin, hdls., 1/4, clear L. 1.300 (connecting rod).
18D	Bolt, drum shaft, left.		
18E	Bolt, drum shaft, right.	16A	Plate, drum end (left).
16C	Brace, drum.	16B	Plate, drum end (right).
10A	Bracket, axle, left.	22C	Pin, hand lever.
11A	Bracket, axle, right.	20E	Pinion, clutch.
22D	Bracket, brake lever.	17F	Pipe, copper.
22A	Bracket, hand lever.		Plug, pipe, 0.5.
20D	Bushing, clutch pinion.		Post, binding, assembly.
19B	Cone, brake.	17A	Ring, drum bearing retaining.
19A	Cone, clutch.	19E	Ring, shaft bearing retaining.
17D	Drumhead (left).	23F	Rod, connecting.
17E	Drumhead (right).	18A	Shaft, drum.
23D	Jaw, connecting rod.	19D	Yoke, clutch.
19C	Leather, cone.		

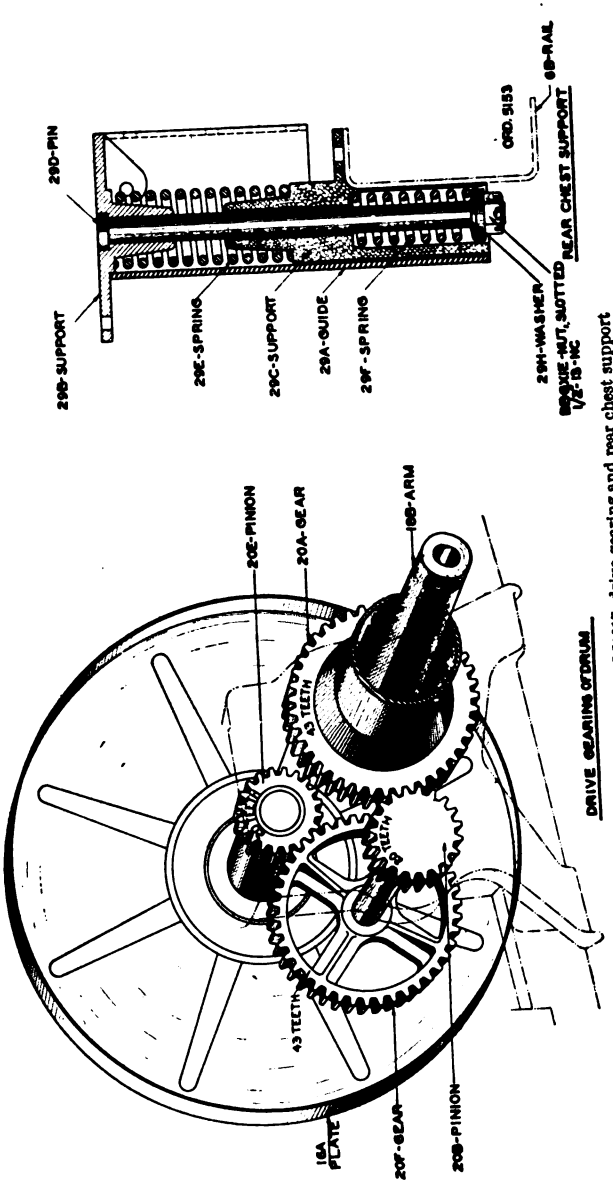

FIGURE 21.—Battery reel, M1917, drive gearing and rear chest support

Reference	Item	Reference	Item
	DRIVE GEARING OF DRUM		REAR CHEST SUPPORT
18B	Arm, axle.	29A	Guide, rear chest support.
20A	Gear, driving.	BBGX1F	Nut, slotted, s.-fin., 1/2-13-NC-2.
20F	Gear, intermediate.	29D	Pin, rear chest support.
20E	Pinion, clutch.	6B	Rail, side, left.
20B	Pinion, intermediate.	29F	Spring, carrying, lower.
16A	Plate, drum end, left.	29E	Spring, carrying, upper.
		29C	Support, rear chest, lower.
		29B	Support, rear chest, upper.
		29H	Washer, rear chest support pin.

to the right with the driving clutch yoke (19D), bringing the driving clutch cone (19A) into engagement with the conical surface in the drumhead (17D). As the driving clutch cone (19A) is directly connected to the pinion (20E) this movement causes the pinion (20E) to mesh with the gear train simultaneously, causing the drum to be revolved in the same direction as the wheel. At the same time, the movement of the hand lever pulls the connecting rod (23F) and brake lever (22H) to the left, thereby throwing the lower end of the brake lever (22H) to the right and the brake-clutch cone (19B) away from the drumhead (17E). On drawing the hand lever (B5619) to the

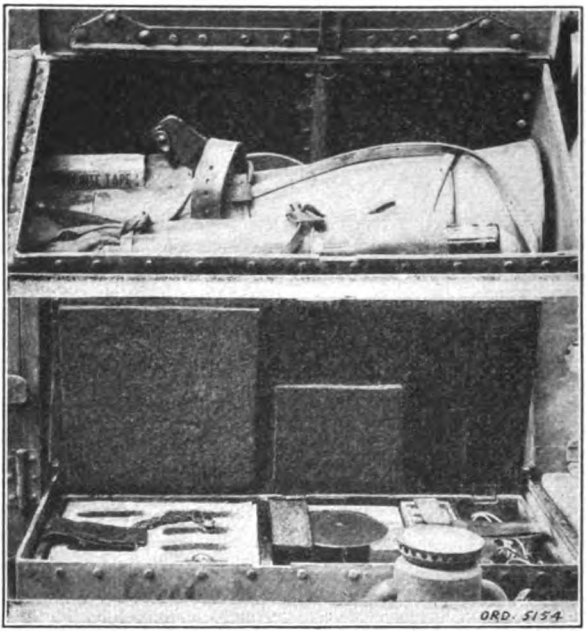

FIGURE 22.—Battery reel, M1917, front chests with contents

right, the opposite effect is produced; the driving-clutch cone (19A) and pinion (20E) are disengaged from the drumhead (17D) and gear train, respectively, and the brake clutch cone (19B) is brought into engagement with the right drumhead (17E), holding the drum stationary. A rack (23A), Figure 19, on the side of the seat support and a catch on the hand lever (B5619), Figure 20, hold the hand lever in the latter position.

g. The front chest is built up of plates and angles. It is secured to the side rails and lower front flanges of the seat supports. The chest is divided into two separate compartments by a steel partition, each compartment having a separate cover. The covers are each hinged

to the lower end of the seat plate and are secured by hasps and turnbuckles. A bolt snap and padlock are also provided for each cover. The top surfaces of the covers, which are roughened to prevent slipping, serve as foot rests for the operators. A foot guard is riveted to the left end of the left cover. The interior of the chest is divided by wooden partitions into various compartments for the accommodation of the instruments and small stores carried therein.

h. The rear chest is built up of plates and angles. It is larger than the front chest. The chest is designed to carry the large fire-control instruments as well as some of the smaller ones. The interior is divided into compartments by wooden partitions and packing. The cover has three hinges and three hasps, the latter being secured by turnbuckles on the body of the chest. Bolt snaps and a padlock for locking are also provided. A roller over which the insulated wire is guided is supported in brackets at the rear of the cover. A foot guard is riveted to the right of the cover.

The upper half of the chest, which projects out on either side, has spring supports riveted to the horizontal under surfaces thus formed. Lower spring supports are riveted to the frame. Four spring columns, resting in the spring supports, support the chest, preventing too great a jar either upon impact or rebound when traveling over rough ground.

i. A flat case attached to the seat support on the right side of the vehicle carries the plane table. It has a small door, hinged to open to the front, provided with two hasps and turnbuckles.

j. Riveted to the upper surface of each rail, and to the axle brackets (10A and 11A), Figure 19, attached to the rail, is a seat support composed of two pieces riveted together in the form of an inverted U. The two supports are connected by a channel at the upper rear end. A perforated plate is riveted across the tops of the supports to form a seat. It extends down the sloping front edges of the support to the top of the front chest, preventing the operator from coming in contact with the revolving drum body (16E), Figure 20.

The seat plate is reinforced on the underside; rails are riveted to each end of the seat. The seat channel has a guide bar (42B), Figure 19, attached to it, which runs the length of the drum, and on which the wire guide (42C) slides. The wire guide (42C) has a handle at the upper end and a twisted ring at the lower end, through which the wire passes. By means of this guide (42C), the cable can be evenly distributed when being wound on the drum. The hand-lever rack bracket (23C), through which the drum-operating hand lever projects upward, is secured on the upper side of the left seat support.

k. The limber prop, attached to a prop bracket bolted to the pole socket, maintains the vehicle in its normal road position when the

horses are unhitched. It is also used to relieve the horses by supporting the pole when standing for any length of time. When not in use it is swung up under the frame by means of a chain which is attached to the lower end of the prop and which passes up through an opening in the flange of the pole socket. A handle on the free end of the prop chain hooks over a prop-chain button attached to the front end of the front chest.

l. Implement fastenings attached to the chests and frame are provided for carrying the various accessories. The accessories are held in position by fasteners or by straps which are attached to the vehicle by strap fasteners.

FIGURE 23.—Battery reel, M1917, rear chest and contents

m. A name plate is attached to the seat channel in the rear of the seat.

37. Operation.—The following instructions govern the laying and recovering of the wire:

a. To lay the wire.—Loosen the free end of the wire and pass it back between the roller and the roller cross brace on the rear chest. Tie it to a tree or any other convenient anchor. Make sure that the hand lever (B5619), Figure 20, is in the neutral position and drive the vehicle over the route desired.

b. To recover the wire.—In the initial winding of the wire, the end to go on first is passed between the roller and roller cross brace and through

the helix of the wire guide (42C), Figure 19, thence through a hole in the right-drum end plate where the twin wires are separated and the ends attached to the two insulated binding posts provided. Revolving the drum winds on the wire. By moving the wire guide (42C) back and forth along the guide bar (42B), the wire is evenly distributed on the drum.

38. Disassembling and assembling.—*a. To dismount the rear chest.*—(1) Remove the contents of the chest to reduce the weight and to facilitate handling.

(2) Remove the cotter pins, nuts, and washers from the rear chest-support pins. The lower carrying springs will drop out.

(3) Lift the chest vertically until the rear chest-support pins clear the upper carrying springs which are seated on the lower rear chest supports.

b. To remount the rear chest.—(1) Clean the springs, support pins, and spring chambers in the upper and lower rear chest supports and examine for scoring or excessive wear.

(2) Clean the springs and spring chambers and slush with lubricating graphite grease.

(3) Place the upper carrying springs in position in their seats on the upper rear chest supports.

(4) Lubricate the support pins and their bearings in the lower rear chest supports with Class A lubricating oil.

(5) Lower the chest in position, care being taken to properly line up the support pins with their bearings in the lower rear chest supports.

(6) Assemble the lower carrying springs, support pin washers, nuts and cotter pins in position. It may be necessary to have several men sit on the chest to compress the upper carrying springs so as to lower the support pins sufficiently to replace the nuts.

c. To dismount the wheels.—(1) The left wheel is restrained by the driving-gear case. Remove the four tap bolts and lock washers holding the case. For replacement purposes and in new equipment, standard cap screws ½ x 3¾ with lock washers will be used in place of these tap bolts.

(2) Remove the wheels as outlined in paragraph 15*a*.

d. To replace the wheels.—(1) Clean and slush the teeth of the driving gear attached to the left wheel hub with lubricating graphite grease.

(2) Replace the wheels as outlined in paragraph 15*b*.

e. To dismount the drum.—(1) Remove the rear chest as outlined in *a* above.

(2) Remove the four bolts holding the wire guide bar. On the earlier vehicles this bar was riveted in place. Cut out the rivets and

when reassembling, use standard cap screws ⅜ x 1 with regular plain nuts and lock washers. Also, where found to be bolted on, cap screws will be used in making replacements and in new equipment.

(3) Remove the clutch yokes (19D), Figure 20, from the cones. The hand lever bracket (22A) and brake lever bracket (22D) are fastened by 2–0.5 x 1.375-inch bolts each. Take these out and raise the whole cone shifter mechanism up and out of the way. For replacement purposes and in new equipment, standard cap screws of the dimensions given will be used in the hand and brake lever brackets.

(4) Take out the two drum shaft bolts (18D and 18E), Figure 20. To do this, it is necessary to take off the wheels as outlined in paragraph 38*c*. The hexagon head of each drum-shaft bolt is locked with a fillister head screw. See that each bolt is marked so that it will be reassembled in the same axle bracket. Put a plank or two (plank to be approximately 8 feet in length) under the drum and over the rear cross brace and use as a lever to prevent the drum from dropping when the drum-shaft bolts come out. The cones may then be slipped off the drum shaft (18A).

(5) An empty drum with the shaft and two cones weighs approximately 165 pounds; one with 1.7 miles of wire wound on, approximately 500 pounds.

f. To remount the drum.—(1) Clean the cone-clutch leather faces (19C), Figure 20, and lightly oil them with neat's-foot oil. Clean the clutch seats in the drum heads (17D and 17E) and the bearings of the drum shaft (18A).

(2) If the intermediate gear (20F) and intermediate pinion (20B), Figure 21, have been taken out, do all the work of reassembling them before replacing the drum.

(3) If the planks used to support the drum when inserting the drum-shaft bolts overhang four or five feet to the rear, the resulting leverage will materially assist in getting the drum back into position.

Put the drum-shaft bolts (18D and 18E), Figure 20, back into the same sides from which removed. When tight, they will come right for the fillister head locking screws. Set the metal of the bolts or of the screws with a punch to secure the screws.

(4) Slush the teeth of the drum shaft pinion with lubricating graphite grease.

(5) Replace the clutch yokes (19D), Figure 20, wire guide (42C), Figure 19, and bar (42B), rear chest, and the wheels.

g. Instructions for the assembling and disassembling of the wheels, wheel fastenings, pole, doubletree, singletrees, neck yoke, and padlocks and bolt snaps are contained in paragraph 15.

39. Care and maintenance.—*a.* Maintenance of the battery reel consists mainly in lubrication and cleaning. Occasionally, handrails

are bent, straps, strap fasteners, or padlock chains are broken. It is necessary at times to replace a pole socket bolt, a drum key, clutch cones, cone leathers, or rear chest carrying springs. The replacement of these parts is so simple that specific instructions other than those outlined for disassembling and assembling in paragraph 38 are unnecessary.

b. The leather of the cones should be inspected at least once in every three months. Apply neat's-foot oil to the leather to soften and preserve it.

c. Tighten loose bolts or cap screws.

d. Care and maintenance of the wheels, wheel fastenings, pole, doubletree, singletrees, neck yoke, and padlocks and bolt snaps are contained in paragraph 16.

e. Lubricating instructions are contained in Section X.

f. General instructions on care and maintenance such as painting, cleaning, etc., are contained in Section XI.

SECTION VIII

ARTILLERY REEL, M1909MI

40. Weights, dimensions, etc.—The following list gives the principal weights, dimensions, etc., for the artillery reel, M1909MI:

Weight of reel without load	pounds	1,402
Weight of reel completely equipped and loaded	do	1,855
Road clearance, approximate	inches	19
Length of wire carried	miles	4

The battery reel, M1917, is replaced by the artillery reel, M1909MI, and the artillery cart, M1918, in battalion, regimental, and brigade headquarters of light field artillery, horse drawn; in gun batteries and in battalion, regimental, and brigade headquarters of light field artillery, tractor drawn, and of medium and heavy field artillery; and in brigade headquarters of portee artillery. The artillery reel without the cart is also issued to observation battalions and batteries.

41. Description of the artillery reel, M1909MI.—*a.* The reel (fig. 24) used as a limber for the cart, M1918, is a 2-wheeled vehicle designed to carry, lay, and recover 4 miles of 11-strand insulated wire. It has interchangeable pole connections which enable it to be adapted to either horse or motor traction. The cable constitutes the principal load, although various accessories are carried in the tool

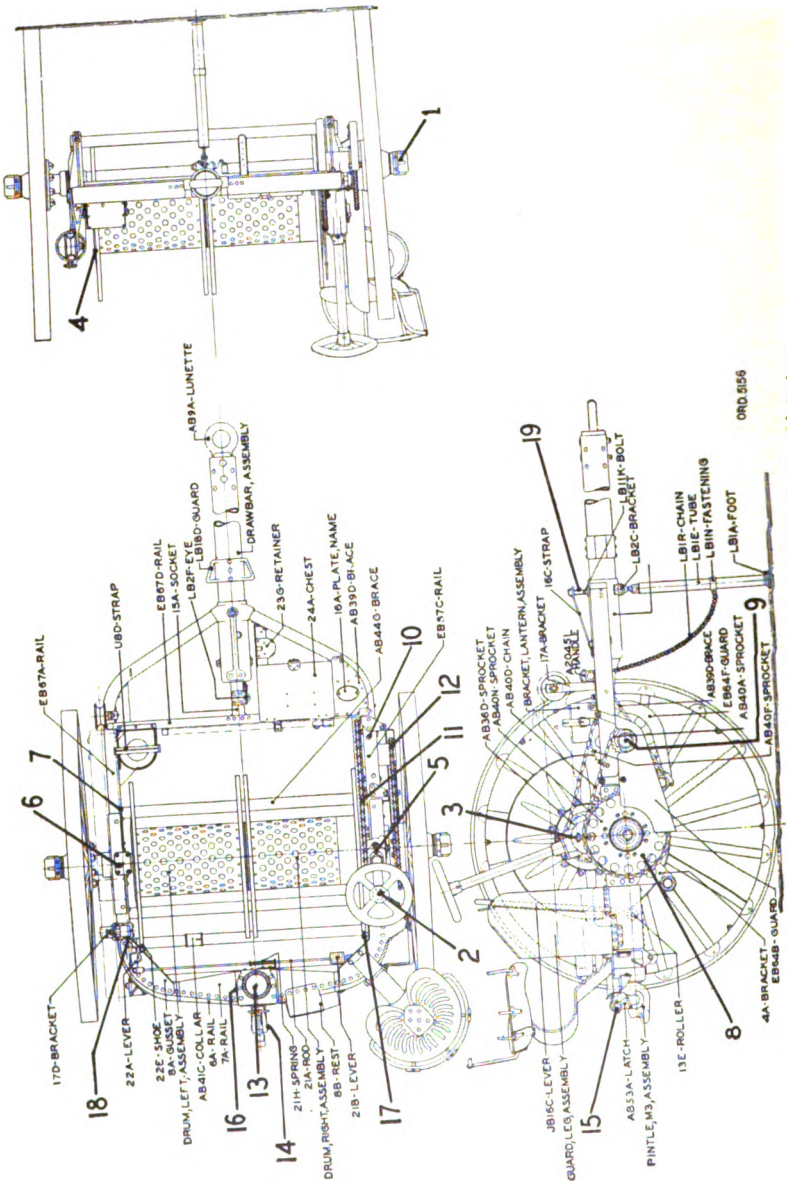

FIGURE 24.—Artillery reel, M1909MI, assembled views

Reference	Item	Reference	Item
LB11K	Bolt, doubletree.	21B	Lever, foot.
AB44G	Brace, cross, front.	AB53A	Latch, pintle.
AB39D	Brace, frame, right.	AB9A	Lunette.
4A	Bracket, axle, right.		Pintle, M3, assembly (motorized artillery).
17A	Bracket, drawbar, front.		
17D	Bracket, drawbar, rear.	16A	Plate, name.
	Bracket, lantern assembly.	EB67D	Rail, cross, front.
LB2C	Bracket, prop, half.	7A	Rail, cross, inner.
LB1R	Chain, prop.	6A	Rail, cross, outer.
AB40D	Chain, roller, jackshaft sprocket.	EB67A	Rail, side, front, left.
24A	Chest, tool.	8B	Rest, foot.
AB41C	Collar.	23G	Retainer, oiler.
	Drawbar, assembly.	21A	Rod, brake.
	Drum, left, assembly.	13B	Roller, front.
	Drum, right, assembly.	13E	Roller, rear.
LB2F	Eye, prop chain.	22E	Shoe, foot brake.
LB1N	Fastening, prop chain.	15A	Socket pole.
LB1A	Foot, prop.	AB40N	Sprocket, axle.
EB64F	Guard, chain, inner.	AB36D	Sprocket, drum.
EB64B	Guard, chain, outer.	AB40F	Sprocket, jackshaft, inner.
	Guard, leg, assembly.	AB40A	Sprocket, jackshaft, outer.
LB18D	Guard, wheel.	21H	Spring, brake rod.
8A	Gusset, cross rail, left.	16C	Strap, doubletree.
A20451	Handle, prop chain.	U8D	Strap, lantern.
22A	Lever, brake.	LB1E	Tube, prop.
JB16C	Lever, drum latch.		

box or in fastenings attached to the vehicle. With the exception of the spokes and felloes of the wheels, the chest packing, and the rollers, the reel is made of metal throughout. The principal parts are the frame, drums, drum clutch, drum driving mechanism, drum brake, seat, wheels, drawbar or pole, doubletree, singletrees, and neck yoke.

b. The wheels, wheel fastenings, pole, pole pin, doubletree, singletrees, neck yoke, drawbar, padlocks, and bolt snaps are described in Section II.

c. Standard 56-inch wheels are used with the reel. The driving ring is bolted to the right wheel hub, longer carriage bolts replacing the standard hub bolts.

d. The frame is composed of members which are riveted together to form a front and a rear frame, these frames being joined by the axle brackets. The left and right front side rails (EB67A and EB67C), Figure 24, are riveted in seats in the axle brackets and are parallel up to a point in front of the jackshaft, where they are connected by the front cross rail (EB67D). Beyond this point the side rails converge and are assembled to a pole socket (15A) which forms the front end of the frame. Three parallel tubes connect the axle brackets, the top tube being used as a shaft for the drums. The attachment of the front cross rails (EB67D) to the side rails is braced by reinforce pieces and by the lantern bracket assembly. The axle arms are pressed into the axle brackets and are fastened by riveting over the ends and also by pins. The axle arms are placed at an angle to the frame so as to bring the lowest spoke of each wheel vertical.

The rear portion of the frame consists of two U-shaped members riveted together to form a hollow flask of rectangular section. This assembled piece is rigidly secured to the axle brackets. It is reinforced by gusset plates on the corners. At the rear center is located the pintle (fig. 24). On the right side at the rear is located the operator's seat and leg-guard assembly. Two drawbar brackets (17D and 17A) for carrying the drawbar assembly when not in use are riveted to the frame, one at the front and one at the rear on the left side.

e. The pole socket (15A), Figure 24, is tightened about the drawbar assembly by a pole clamp bolt which is located underneath the socket (15A). On this bolt is placed the prop bracket (LB2C) which is connected to the prop (LB1E), a tube provided with a foot (LB1A), by the prop eye. When not in use, this prop is swung up under the frame by a chain (LB1R) attached to the lower end of the tube and passing up through the chain eye on the rear end of the pole socket (15A), where it terminates in a prop-chain handle (A20451). It is held in the raised position by hooking the handle over a prop-chain button on the left side of the frame near the front drawbar bracket (17A).

f. Brackets and a strap are provided on the rear of the front cross rail (EB67D), Figure 24, so that the prop (LB1E) used under the front end of the horse pole can be carried when not in use.

g. The pintle, M3 (fig. 24), is of standard design with a semiautomatic latch (AB53A); it is assembled in a bearing supported in a bracket at the rear midpoint of the rear cross rail (6A). When limbered with another vehicle, the pintle acts as an automatic pole support. The pintle hook has a lug formed on its lower side which projects backward and bears against the underside of the lunette on the drawn vehicle, thus preventing rotation of the reel about its wheel axle, which would lower the pole or drawbar. The pintle body (AB10A), Figure 26, has been or will be modified to provide an adjusting bolt for adjusting the height of the pole when horse drawn. See Field Service Modification Work Order No. C11–W7. This modified pintle assembly is designated as M4A2.

h. The pintle bearing (11B), Figure 25, is fitted with trunnion bolts (10C), which retain it in place but permit it and the attached pintle to rotate vertically through an angle of approximately 45°. This movement is controlled by a pole supporting spring (AB13C), which is vertically mounted on the shank of a pole supporting spring yoke (11A). The prongs of the yoke (11A) are held in recesses in the pintle bearing (11B) by the compression of the spring (AB13C), which is held in place by the pole supporting spring cap (10A). When the pole is dropped, the pintle tends to rise. Being held down, however, by the lunette, the pintle bearing (11B), Figure 25, is forced to swing on its trunnion bolts (10C), and forces the spring yoke (11A) upward, thus compressing the pole supporting spring (AB13C), until the reaction of the spring is sufficient to support the pole.

The pintle bearing (11B), Figure 25, is bored to receive the shank of the pintle body and is counterbored in front for the pintle-bearing spring. The latter, assembled about a sleeve fitting over the pintle shank, is compressed between a pintle nut (AB13D), Figure 25, and the pintle bearing (11B) and absorbs the shock of starting. The sleeve checks the movement of the pintle nut (AB13D) before the spring becomes compressed solid.

i. A tool chest with a lid opening on the top is assembled in the space on the right side of the pole socket (15A), Figure 24, between the side rail and the front cross rail.

j. A wooden roller to protect the wire when it is being laid or recovered is suspended from brackets beneath the rear cross rail and a similar but smaller roller is supported in brackets attached to the rear cross rail immediately in front of and above the rear roller.

k. Midway between the automatic pole support and gusset plates on the inner rear cross rail (7A), Figure 24, two handholes have been

cut to allow access to the trunnion bolts (10C), Figure 25, holding the pintle bearing (11B) in position. These holes are closed by covers secured by screws.

l. The assembled drum is composed of two subassemblies, left drum assembly and right drum assembly (fig. 24). Each consists of a cylindrical body of perforated plate in the ends of which are riveted the drumheads. To each of the latter is riveted a circular corrugated end

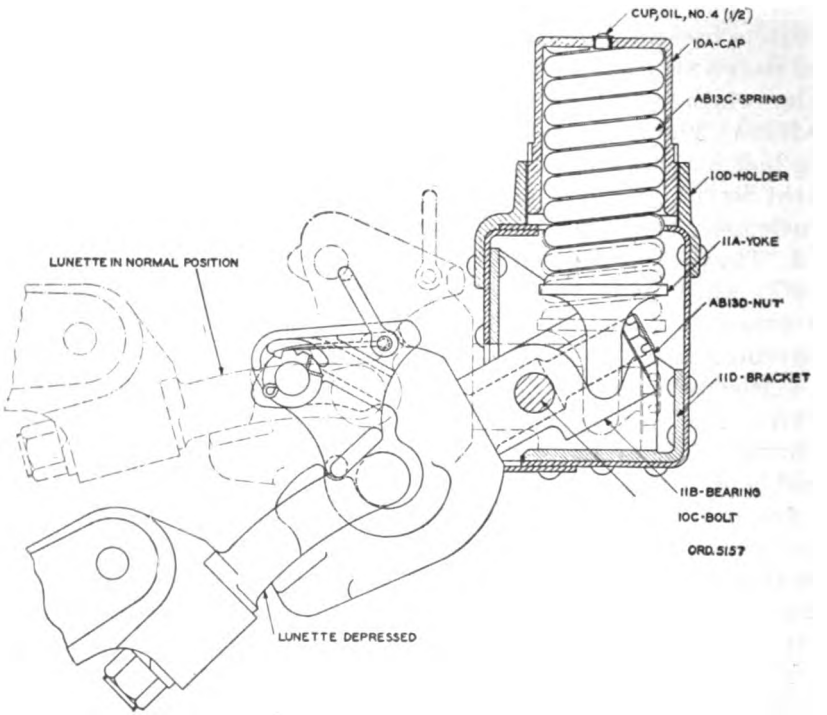

FIGURE 25.—Artillery reel, M1909MI, automatic pole support

Reference	Item	Reference	Item
11B	Bearing, pintle.	10D	Holder, pole-supporting spring cap.
10C	Bolt, pintle bearing, trunnion.	AB13D	Nut, pintle.
11D	Bracket, pintle bearing.	AB13C	Spring, pole-supporting.
10A	Cap, pole-supporting spring. Cup, oil, plain, No. 4 (1/2).	11A	Yoke, pole-supporting spring.

plate which extends perpendicularly from the axis of the axle and the body of the drum. For greater strength in riveting, the thin metal of the drum end plates and the drum bodies is countersunk for the rivets by stamping into depressions in the drumheads. As this operation is performed in assembling, the drumhead, the drum end plates, and the drum body are to be collectively considered as one interchangeable piece.

m. The top tube of the three parallel tubes connecting the axle bracket serves also as an axle for the drums. The left end is closed with a stopper; the right is finished to receive within it parts of the clutch. Four spaces for roller bearings, which fit in the drumheads and upon which the drums rotate, are finished upon the drum axle.

n. On the right end of the drum axle between the right axle bracket (4A), Figure 24, and the right end of the right drum assembly is assembled the drum sprocket ring (AB36A), Figure 27, which rotates upon the drum axle (3C). A sprocket (AB36D) secured to this ring (AB36A) is driven by a roller chain from a sprocket on the jackshaft, which, in turn, is driven by a second roller chain carried on the

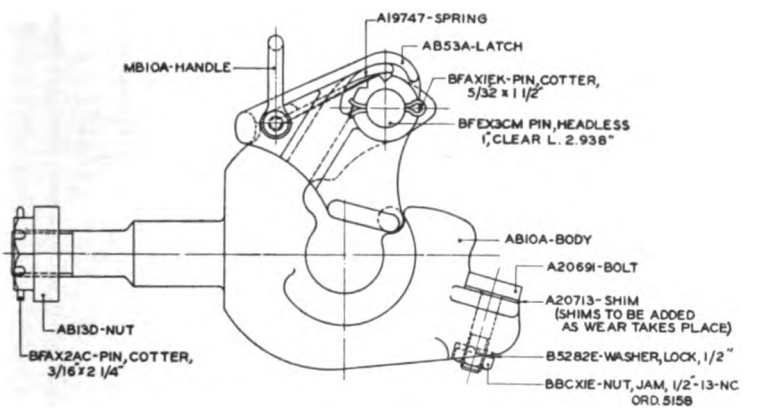

FIGURE 26.—Pintle M4A2 (horse-drawn artillery)

Reference	Item	Reference	Item
AB10A	Body, pintle.	BFAX1EK	Pin, cotter, 5/32 x 1½.
A20691	Bolt, adjusting.	BFAX2AC	Pin, cotter, 3/16 x 2¼.
MB10A	Handle, latch.	BFEX3CM	Pin, hdls., P, clear L. 2.938.
AB53A	Latch, pintle.	A20713	Shim, adjusting bolt.
BBCX1E	Nut, jam, s.-fin., ½-13-NC-2.	A19747	Spring, pintle latch.
AB13D	Nut, pintle.	B5282E	Washer, lock, ½ inch.

sprocket on the jackshaft and a sprocket on the right axle arm. This axle sprocket (AB40N), Figure 24, is driven by a driving ring bolted to the hub of the right wheel. Four pins fitted in the driving ring assemble in corresponding holes in the axle sprocket (AB40N) and thus drive it. Owing to the angularity of the axes of the wheel and axle sprocket (AB40N), the driving pins work in and out of the sprocket holes as the wheel revolves.

The jackshaft frame is bolted in the right front side rail. The location of the bolt holes and finish of the jackshaft frame permit the frame to have a sliding movement of ¼ inch as an adjustment for tension of the roller chains.

o. The clutch connecting the drum driving gear and the right drum is located in a recess in the right drumhead behind the revolving sprocket ring. This ring is assembled between an adjusting ring (AB36L), Figure 27, threaded into the end of the recessed drumhead, and a drum friction disk (AB36F), arranged with a slight axial movement along the drum axle. Movement of the drum friction disk (AB36F) against the drum sprocket ring (AB36A) clamps the drum sprocket ring (AB36A) between the drum friction disk (AB36F) and the drum clutch-adjusting ring (AB36L), and thus connects the driving mechanism to the drum. Movement of three toggle links (AB36P), Figure 27, pivoted to the drum friction disk (AB36F), and the right drumhead and a sliding drum clutch spider (AB36N), applies or releases the clutch, according to the action of the drum clutch spider (AB36N). The latter is moved along the drum axle by a drum clutch shifter (AB39A) sliding in the interior of the drum axle and connected to the drum clutch spider (AB36N) by two keys working through slots in the axle wall. The shifter (AB39A) is threaded on its outer end and is actuated by a thread formed in the drum clutch-shifter bevel gear (AB37L) meshing with a handwheel-shaft bevel pinion (AB37K) on the lower end of the handwheel shaft (AB37H) mounted on the right axle bracket (4A).

p. The drums may be revolved either singly or both at the same time. This is brought about by the drum clutch, consisting of drum clutch rod, spring, and handle. The rod passes through both drumheads of the left drum and into the intermediate head of the right drum when engaged. Stops are provided on the rod to regulate its travel.

q. The drum latch lever (JB16C), Figure 24, on the right side near the seat operates a drum latch for locking the right drum. Movement of the drum latch lever engages or disengages a spring plunger with a projection piece riveted to the right drum end plate. The lever is held in position to lock or free the drum by means of a drum latch pawl which engages notches in a segment riveted to a flange of the leg guard gusset. A leather-faced brake shoe attached to the drum latch lever may be brought against the flanged rim of the end plate to act as a brake. A brake shoe which engages a flange of the left drum end plate is controlled by a foot lever (21B), Figure 24, near the operator's seat.

r. The end of the cable passes through a hole in the drum body at the left end of the left drum and is secured with a cable clamp. A connection is fastened to the ends of the wires and by means of the plugs in the connection blocks provides a suitable method for connecting the telephones. Clips riveted on the ends of the drum plates are used to hold loose ends of cables.

s. A name plate is attached to the lid of the tool box.

42. Operation of the reel and adjustment of the driving clutch.—*a.* For the initial assembly of wire on the left drum, the end of the cable is carried down through a hole in the outer drumhead to the telephone connections. The end of the wire of the right drum may be threaded through the perforations of the drum body and tied. Jack up the right wheel, couple the drums, engage the clutch, and revolve the wheel in the direction in which it runs when the vehicle is moving forward.

b. To pay out the wire.—Release the drum latch and disconnect the left drum from the right so that either drum revolves freely. Pass the free end of the wire over the forward roller and under the rear roller. Unwind sufficient wire to allow tying to a tree or other suitable anchor.

c. To adjust the driving clutch.—When the clutch handwheel is turned in a counterclockwise direction its rotary motion turns the drum shaft shifter bevel gear which acts as a nut engaging the threads of the drum clutch shifter (AB39A), Figure 27. The drum clutch shifter (AB39A) is drawn to the right carrying with it the sliding keys (A6589) and spider (AB36N) of the clutch. The radial links (AB36W) which are attached to the spider (AB36N) force the inner toggle links (AB36P) to straighten into line forcing the friction disk against the sprocket ring and the latter against the adjusting ring. The adjusting ring may be screwed into the drumhead to vary the distance between it and the toggle brackets, which distance must be carefully adjusted so as not to allow the forcing of the toggles beyond the dead center, while at the same time the friction between the disks must be sufficient to positively drive the drum. The adjusting ring has 12 threads per inch and 12 notches for the small blocks which lock it to the drumhead. It may be moved, therefore, distances which are multiples of one one-hundred-and-forty-fourths of an inch.

If the clutch habitually slips:

(1) Take out the drum clutch adjusting ring lock screw (AB36U), Figure 27, and the adjusting locks (AB36T).

(2) Turn the clutch handwheel counterclockwise as far as it will go to position of full engagement of the clutch.

(3) Using the large spanner, engage the notches of the adjusting ring (AB36L), Figure 27, and turn it into the drumhead until the adjusting ring locks (AB36T) can be mounted in the next set of notches. Then revolve the handwheel to free position, again bring it to engaged position, test the drag of the clutch. When satisfactory, reassemble the adjusting ring locks (AB36T), and set the metal of the locks into the slots of the screws (AB36U) to prevent their coming loose.

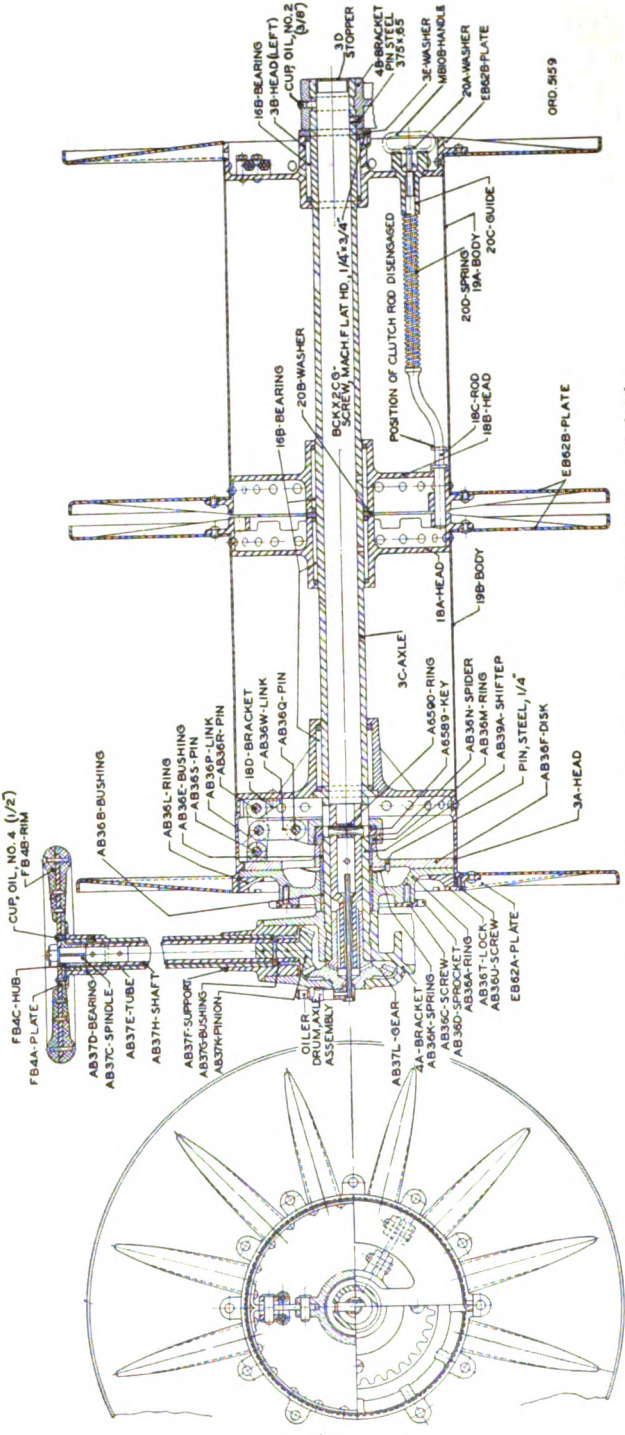

FIGURE 27.—Artillery reel, M1909M1, sections through drums and clutch

Reference	Item	Reference	Item
3C	Axle, drum.	AB37K	Pinion, handwheel shaft bevel.
AB37D	Bearing, handwheel hub.	EB62A	Plate, drum end.
16B	Bearing, roller.	EB62B	Plate, drum end.
19A	Body, drum, left.	FB4A	Plate, handwheel.
19B	Body, drum, right.	FB4B	Rim, handwheel.
AB36E	Bushing, drum friction disk.	AB36L	Ring, drum clutch adjusting.
AB36B	Bushing, drum sprocket ring.	A6590	Ring, drum clutch shifter.
AB37G	Bushing, handwheel standard support.	AB36A	Ring, drum sprocket.
		AB36M	Ring, drum clutch spider filler.
4B	Bracket, axle, left.	18C	Rod, drum clutch.
4A	Bracket, axle, right.	AB36U	Screw, drum clutch adjusting ring lock.
18D	Bracket, toggle.		
	Cup, oil, plain No. 4 (½).	AB36C	Screw, drum sprocket.
	Cup, oil, plain No. 2 (⅜).	BCKX2CG	Screw, mach., flat hd., S., ¼-20-NC-2 x ¾.
AB36F	Disk, friction, drum.		
AB37L	Gear, drum clutch shifter bevel.	AB37H	Shaft, handwheel.
20C	Guide, drum clutch rod.	AB39A	Shifter, drum clutch.
MB10B	Handle, drum clutch rod.	AB36N	Spider, drum clutch.
18B	Head, drum, intermediate, left.	AB37C	Spindle, handwheel.
18A	Head, drum, intermediate, right.	AB36K	Spring, drum clutch relief.
3B	Head, drum, left.	20D	Spring, drum clutch rod.
3A	Head, drum, right.	AB36D	Sprocket, drum.
FB4C	Hub, handwheel.	31D	Stopper, drum axle.
A6589	Key, sliding.	AB37F	Support, handwheel standard.
AB36W	Link, radial.	AB37E	Tube, standard.
AB36P	Link, toggle.	20A	Washer, drum clutch rod.
AB36T	Lock, drum clutch adjusting ring.	20B	Washer, drum, intermediate.
	Oiler, drum axle, assembly.	3E	Washer, thrust, drum.
AB36Q	Pin, drum clutch link.		
AB36R	Pin, drum clutch link.		
AB36S	Pin, drum clutch link.		
	Pin, S., 0.375 x 0.65.		
	Pin, ¼ x ⅝.		

o. The clutch connecting the drum driving gear and the right drum is located in a recess in the right drumhead behind the revolving sprocket ring. This ring is assembled between an adjusting ring (AB36L), Figure 27, threaded into the end of the recessed drumhead, and a drum friction disk (AB36F), arranged with a slight axial movement along the drum axle. Movement of the drum friction disk (AB36F) against the drum sprocket ring (AB36A) clamps the drum sprocket ring (AB36A) between the drum friction disk (AB36F) and the drum clutch-adjusting ring (AB36L), and thus connects the driving mechanism to the drum. Movement of three toggle links (AB36P), Figure 27, pivoted to the drum friction disk (AB36F), and the right drumhead and a sliding drum clutch spider (AB36N), applies or releases the clutch, according to the action of the drum clutch spider (AB36N). The latter is moved along the drum axle by a drum clutch shifter (AB39A) sliding in the interior of the drum axle and connected to the drum clutch spider (AB36N) by two keys working through slots in the axle wall. The shifter (AB39A) is threaded on its outer end and is actuated by a thread formed in the drum clutch-shifter bevel gear (AB37L) meshing with a handwheel-shaft bevel pinion (AB37K) on the lower end of the handwheel shaft (AB37H) mounted on the right axle bracket (4A).

p. The drums may be revolved either singly or both at the same time. This is brought about by the drum clutch, consisting of drum clutch rod, spring, and handle. The rod passes through both drumheads of the left drum and into the intermediate head of the right drum when engaged. Stops are provided on the rod to regulate its travel.

q. The drum latch lever (JB16C), Figure 24, on the right side near the seat operates a drum latch for locking the right drum. Movement of the drum latch lever engages or disengages a spring plunger with a projection piece riveted to the right drum end plate. The lever is held in position to lock or free the drum by means of a drum latch pawl which engages notches in a segment riveted to a flange of the leg guard gusset. A leather-faced brake shoe attached to the drum latch lever may be brought against the flanged rim of the end plate to act as a brake. A brake shoe which engages a flange of the left drum end plate is controlled by a foot lever (21B), Figure 24, near the operator's seat.

r. The end of the cable passes through a hole in the drum body at the left end of the left drum and is secured with a cable clamp. A connection is fastened to the ends of the wires and by means of the plugs in the connection blocks provides a suitable method for connecting the telephones. Clips riveted on the ends of the drum plates are used to hold loose ends of cables.

s. A name plate is attached to the lid of the tool box.

42. Operation of the reel and adjustment of the driving clutch.—*a.* For the initial assembly of wire on the left drum, the end of the cable is carried down through a hole in the outer drumhead to the telephone connections. The end of the wire of the right drum may be threaded through the perforations of the drum body and tied. Jack up the right wheel, couple the drums, engage the clutch, and revolve the wheel in the direction in which it runs when the vehicle is moving forward.

b. To pay out the wire.—Release the drum latch and disconnect the left drum from the right so that either drum revolves freely. Pass the free end of the wire over the forward roller and under the rear roller. Unwind sufficient wire to allow tying to a tree or other suitable anchor.

c. To adjust the driving clutch.—When the clutch handwheel is turned in a counterclockwise direction its rotary motion turns the drum shaft shifter bevel gear which acts as a nut engaging the threads of the drum clutch shifter (AB39A), Figure 27. The drum clutch shifter (AB39A) is drawn to the right carrying with it the sliding keys (A6589) and spider (AB36N) of the clutch. The radial links (AB36W) which are attached to the spider (AB36N) force the inner toggle links (AB36P) to straighten into line forcing the friction disk against the sprocket ring and the latter against the adjusting ring. The adjusting ring may be screwed into the drumhead to vary the distance between it and the toggle brackets, which distance must be carefully adjusted so as not to allow the forcing of the toggles beyond the dead center, while at the same time the friction between the disks must be sufficient to positively drive the drum. The adjusting ring has 12 threads per inch and 12 notches for the small blocks which lock it to the drumhead. It may be moved, therefore, distances which are multiples of one one-hundred-and-forty-fourths of an inch.

If the clutch habitually slips:

(1) Take out the drum clutch adjusting ring lock screw (AB36U), Figure 27, and the adjusting locks (AB36T).

(2) Turn the clutch handwheel counterclockwise as far as it will go to position of full engagement of the clutch.

(3) Using the large spanner, engage the notches of the adjusting ring (AB36L), Figure 27, and turn it into the drumhead until the adjusting ring locks (AB36T) can be mounted in the next set of notches. Then revolve the handwheel to free position, again bring it to engaged position, test the drag of the clutch. When satisfactory, reassemble the adjusting ring locks (AB36T), and set the metal of the locks into the slots of the screws (AB36U) to prevent their coming loose.

43. Disassembling and assembling.—*a. To dismount and replace the outer chain guard (EB64B), Figure 24.*—(1) Remove the right wheel.

(2) Remove the four bolts holding the chain guard (EB64B). The guard is secured by two bolts to the supports on the side rail, by one bolt to the bottom flange of the axle bracket (4A), and by one bolt to the forward web of the axle bracket. In a number of reels, this latter bolt has been assembled with the nut inside the axle bracket which is very awkward because of the limited space in which to manipulate the cotter pin. In replacing this bolt, put the nut outside of the axle bracket and the other bolts nut down. See that the guard properly clears the chain. If it rubs, loosen all the bolts, adjust the guard, and, if necessary, bend the supports to obtain clearance. Oil the threads before putting on the nuts and replace the cotter pins.

NOTE.—The bolts in original outer chain guard are $\frac{3}{8}$ x $2\frac{7}{16}$ (1) and $\frac{1}{2}$ x $1\frac{3}{16}$ (2) with crown nuts and cotter pins. For replacement and in new equipment, standard cap screws $\frac{3}{8}$ x $2\frac{1}{2}$ (1) and $\frac{1}{2}$ x $\frac{3}{4}$ (2) with regular plain nuts and lock washers will be used.

b. To dismount the inner chain guard (EB64F), Figure 24.—(1) The guard is attached by two bolts and by an eyebolt passing through the cross brace.

NOTE.—The bolts in original inner chain guard are $\frac{1}{2}$ x $1\frac{3}{16}$ (1) and $\frac{1}{2}$ x $2\frac{7}{16}$ (1) with crown nuts and cotter pins. For replacement and in new equipment, standard cap screws $\frac{1}{2}$ x $\frac{3}{4}$ (1) and $\frac{1}{2}$ x $2\frac{1}{2}$ (1) with regular plain nuts and lock washers will be used.

(2) Remove the front bolt or cap screw and the nut of the eyebolt and work the guard forward, pulling the eyebolt out of the cross brace.

c. To dismount the roller chains.—(1) Several types and makes of chains are in use. In the plain roller chain with side links, all the links are riveted except one assembling link in which the pins on one side of one outer side plate are secured by cotter pins.

(2) Remove the cotter pins and disengage the link and the chain will come off.

(3) Before reassembling, clean the chain by washing with gasoline then immerse it in a hot solution of lubricating graphite grease. Leave it in this solution until it becomes as hot as the solution, otherwise it will not penetrate to the interior parts where it is most needed. After removing the chain from the solution lay it on a level surface and push the links together so as to take up all the stretch, thus permitting the lubricant to become settled in the bearings.

(4) When the chain is cold, wipe it off well on the outside before placing it in service to prevent gathering dust and grit. Replace the

chain so that it runs in the same direction and with the same side out as it did originally.

d. To adjust the tension of the driving chains.—(1) The roller chains must be neither too tight nor too loose. The ideal tension may be taken as that which allows about ½-inch sag in the upper line of the chain when the bottom line is drawn tight. Chains tighten up when they become dirty.

(2) To tighten, loosen the nuts of the four jackshaft frame bolts and the lock nuts of the chain tightener. Unscrew the chain tightener. This forces the jackshaft forward. Continue until there is ½-inch sag in the loose line of the tighter chain.

NOTE.—The bolts in original jackshaft frames are ½ x 2 $^{13}/_{16}$ (2) and ½ x 3 $^{25}/_{32}$ (2) with crown nuts and cotter pins. For replacement and in new equipment, standard cap screws ½ x 2¾ (2) and ½ x 3¾ (2) with regular plain nuts and lock washers will be used.

(3) Then set up the chain-tightener lock nut. Tighten up the nuts of the jackshaft frame bolts or cap screws, and replace the cotter pins if in use. For convenience, the two upper jackshaft bolts or screws may be assembled with the nuts on top.

e. To remove a link of the roller chain.—(1) When the chains wear until they are loose after all possible tightening movement of the jackshaft has been accomplished, one-half link may be taken out of each chain. Note that by reason of the lapping of the side plates, the unit of a roller chain includes two rollers. Thus, if the chain is to have an odd number of rollers, the ends must be joined by an offset connecting link; that is, one in which the side plates outside one roller are offset to become the inside side plates for the next roller.

(2) When new, the longer inner chain is fitted with an offset connecting link. When the chains are to be shortened, this link must be transferred to the outer chain in place of one common link (two inner side plates with rollers) and one pair of outer side plates with pins.

(3) The chain repair block is used for removing a riveted link of the chain and consists of the base, anvil, and set. In using the chain repair block, the base is placed on a solid foundation and the anvil inserted through the chain opposite the side plate which is to be removed. Place the anvil and the chain over the groove in the base, support the ends of the chain and anvil flush with the top of the base to secure even and full contact. Using a small hammer, strike the top of each rivet in the side plate sharp but not heavy blows, driving the rivet back into the side plate. This shears off the riveted end of the rivet, which may then be punched out with the small pin in the set. Before reassembling, straighten the side plate if it is bent. Rerivet, using the base as an anvil, first driving the side plate down upon the shoulder of the rivet with a light blow on the set.

f. To dismount the drums.—(1) Dismount the inner driving chain.

(2) Remove the spare drawbar.

(3) Unscrew the four left-axle bracket-cap bolts and remove the cap.

(4) Remove the two machine screws from the oiler clip on the right-axle bracket cap and allow the oiler to swing out of the way.

(5) Take out the four right-axle bracket-cap bolts and remove the cap, handwheel, and standard.

(6) Lift out the drums and shaft. A rope sling around each drum outside the intermediate drum end plates with a tackle block overhead, so arranged that a lift of at least 20 inches is secured, is suggested for this operation.

g. To remount the drums and drum axle.—(1) Clean the seats in the axle brackets and ends of the drum axle.

(2) Note the close-fitting pins in the axle brackets which enter holes in the drum axle, lower the drums carefully onto these pins and make sure that there is no clamping action tending to bend the drum axle when the cap bolts are drawn tight.

h. To disassemble the friction clutch (right drum).—(1) This operation is not to be undertaken by the battery personnel except under the direction of some one familiar with the clutch and the methods of reassembling.

(2) The drums being dismounted, remove the three drum clutch adjusting ring lock screws (AB36U), Figure 27, and locks (AB36T) and unscrew the adjusting ring (AB36L). A large spanner is provided for this purpose. If force is required, be careful in clamping or holding the drum by the end plate so as not to deform it.

(3) Remove the drum clutch shifter bevel gear (AB37L) (unscrew it from the shifter (AB39A)) and slide off the drum sprocket ring (AB36A) and relief spring (AB36K).

(4) Reach through the openings exposed in the drum friction disk (AB36F) and withdraw one cotter pin from each pin connecting the friction disk (AB36F) to the toggle links (AB36P), take out these toggle link pins (AB36R) and remove the friction disk (AB36F).

(5) Take out the locking screw of the clutch spider filler ring (AB36M) (preserving it against loss) and unscrew the ring from the spider (AB36N). Use a small drift or punch to turn the filler ring (AB36M), and do not batter up the threads. Pull the shifter (AB39A) toward the end of the axle as far as it will go by reassembling the drum clutch shifter bevel gear (AB37L), then push the spider (AB36N) back uncovering the sliding keys (A6589). Work the keys out by inserting a thin piece of metal between the ends of the semicircles. Note that they are assembled with a small rectangular projection toward the *outer* end of the slot.

(6) Pull out the shifter (AB39A) and the gear (AB37L). Note the small ring inside the shifter into which the fingers of the sliding keys fit and preserve it if loose.

i. The driving clutch being dismounted, the drum axle may be pulled out from the drums to the right. Whenever the friction clutch is dismounted the opportunity to examine, clean, and slush the roller bearings should be taken advantage of. Note the loose ring between the drums so that it is not forgotten in assembling.

j. To assemble the friction clutch.—(1) The drums will be properly assembled on the drum axle and all parts of the clutch thoroughly cleaned and lightly oiled.

(2) Assemble the toggle links (AB36P), Figure 27, to the toggle brackets (18D) and radial links (AB36W). Slip the drum clutch spider (AB36N) on the drum axle (3C) and connect it to the radial links (AB36W).

(3) Place the ring to receive the fingers of the sliding keys (A6589) in the drum clutch shifter (AB39A), and the shifter in the axle. Slip the keys (A6589) in place with the rectangular projection on each key toward the outer end of the axle slot. New keys should not drive too tight as in that case there will be trouble in removing them later on. Slip the spider (AB36N) over the keys and see that it turns freely. Oil the keys, assemble the drum clutch spider filler ring (AB36M) and drum clutch spider filler ring screw, and set the metal of the ring into the notches of the screw to lock it.

(4) Put one cotter pin in each of the pins which are to connect the outer toggle links (AB36P) to the drum friction disk (AB36F), and put the pins into the links so that they hang from the outer ends of the radial links (AB36W). Oil all of the pins. Put on the friction disk (AB36F) and, reaching through the openings with the fingers of one hand, manipulate the toggle link pin to make the connection while the fingers of the other hand guide the links. Insert and properly open the cotter pins in the toggle link pins.

(5) Complete the assembling by putting in the drum clutch relief spring (AB36K), Figure 27, drum sprocket ring (AB36A) and the drum clutch adjusting ring (AB36L). Adjust the tension of the driving chains as described in *d* above.

k. To dismount the left drum clutch.—(1) It is not necessary to dismount the drums.

(2) The drum clutch rod guide (20C), Figure 27, is screwed into the left drumhead and locked with a driven pin in the threads. Drive or drill out the pin and unscrew the clutch rod guide (20C). The drum-clutch rod assembly will come out through the opening.

l. To dismount the jackshaft.—(1) Take off the inner and outer chain guards (EB64F and EB64B), Figure 24, and outer chain as described in *a*, *b*, and *c* above.

(2) Unscrew the jackshaft nut. The metal of the shaft has been set with a punch into the four notches in the end of the thread. It may be necessary to clip this out. The inner chain will assist in holding the jackshaft while the nut is being unscrewed. The outer jackshaft sprocket (AB40A) will probably be tight on its tapered seat.

Put a hardwood block against the outer end of the jackshaft and strike a sharp blow to loosen it. Do not lose the round-bottomed (Woodruff type) key. If the key sticks in the shaft, rock it out by driving down the outer end with a bronze drift.

(3) Take off the inner roller chain, loosen the bolts in the jackshaft frame, and the chain tightener, and pull the jackshaft frame to the rear as far as possible. The jackshaft and sprocket can then be worked out.

NOTE.—The bolts in original jackshaft frames are ½ x $2\frac{13}{16}$ (2) and ½ x $3\frac{25}{32}$ (2) with crown nuts and cotter pins. For replacements and in new equipment, standard cap screws ½ x 2¾ (2) and ½ x 3¾ (2) with regular plain nuts and lock washers will be used.

Clean out all the oil passages before reassembling. Do not attempt to dismount the jackshaft frame from the side rails.

m. To disassemble the automatic pole supporting spring.—(1) The pole supporting spring cap (10A), Figure 25, is screwed into the pole supporting spring cap holder (10D) and locked with a headless screw. The pole supporting spring (AB13C) at assembled height is loaded at 2,060 pounds, but the length of thread of the cap (10A) is such that the spring is free, or nearly so, before the threads are disengaged.

(2) Unscrew the cap (10A), Figure 25, using the wheel hub-cap wrench, and the spring (AB13C) and yoke (11A) may be lifted out. The spring should be well slushed with lubricating graphite grease before reassembling.

n. To adjust the automatic pole support.—(1) When in proper adjustment, the automatic pole support holds the pole constantly at a height of 29.25 inches without support from the harness; the reel and cart props being in the traveling position. When inspection shows that the pole is not supported at the proper height the cause should be determined and the necessary corrections made. One or both of the following causes will probably be found:

(*a*) Pole loose in pole socket or bent.

(*b*) Automatic pole support not properly adjusted.

(2) In adjusting the automatic pole support, proceed as follows:

(*a*) Clamp the pole properly in the pole socket.

(*b*) Clean and lubricate all parts and see that they move freely.

(*c*) Adjust the compression of the pole supporting spring (AB13C), Figure 25, sufficiently to support a 20-pound weight suspended from the pole at the neck yoke stop.

(*d*) The pole supporting spring (AB13C), Figure 25, is compressed by moving the locking screw and, using the wheel hub-cap wrench, screwing down the pole supporting spring cap (10A).

(3) If the pole still droops it is very likely that the lug of the pintle or the bottom of the lunette, or both, are worn. If this is the case, place sufficient shims between the lug of the pintle and the lunette to bring the pole to the desired height. Take a piece of steel about 1¼ inches wide, the thickness of the shims, and long enough to forge around the lug and down and over the main part of the pintle proper. When the steel cools it will shrink on the pintle and make a close fit without the necessity of rivets or pins. In an emergency a piece of horseshoe can be used successfully for this purpose.

(4) The method of adjusting the automatic pole support when the vehicle is equipped with the modified pintle (see Field Service Modification Work Order No. C11–W7) is to adjust the height of the pole to approximately 29½ inches by adding shims (three of which are furnished with each modified pintle), if necessary, under the head of the adjusting bolt, measuring from a level floor to the center of the pole when the vehicle is limbered with another vehicle.

o. To dismount the pintle.—(1) Disassemble the pole supporting spring (AB13C), Figure 25, and spring yoke (11A). The front end of the pintle shank will rise, exposing the pintle nut (AB13D) and cotter pin. Pull out the cotter pin.

(2) Tip the pintle shank horizontal again and put the small end of the wheel hub-cap wrench between the flats of the pintle nut (AB13D), and the sides of the pintle bearing seat and turn the pintle to unscrew the nut. When free the pintle will come out to the rear, the pintle nut (AB13D), pintle bearing spring, and sleeve to the front.

(3) Slush the pintle bearing spring with lubricating graphite grease before reassembling.

p. To dismount the pintle bearing.—(1) Disassemble the pole supporting spring (AB13C), Figure 25, and spring yoke (11A).

(2) Disconnect the foot lever (21B), Figure 24, from its bracket and the left end of the brake rod (21A) to get the rod out of the way and take off the rear cross rail (handhole) covers. Working through the opening for the pole supporting spring, find and extract the cotter pins of the pintle bearing trunnion bolts (10C), Figure 25.

(3) Using the 1¼-inch opening of the engineers' wrench as a socket wrench, work through the handholes to start the pintle bearing trunnion bolts. Once started, they may probably be unscrewed by hand. Replace the cotter pins in reassembling. These cotter pins need not be crimped open but merely spread a little before assembling.

q. To dismount the axle sprocket.—(1) The holes for the pins of the driving ring in the axle sprocket (AB40N), Figure 24, are covered on the inside with thin plates secured by bolts.

(2) Remove a bolt from one end of one axle-sprocket hub cover plate and swing the plate around so that the axle-sprocket retainer bolts may be removed through the hole for the driving-ring pin.

(3) Remove the six axle-sprocket retainer bolts and pull the sprocket from its seat.

(4) A space between the axle-sprocket hub and its bushing is used for oil storage. Before assembling, clean all oil holes and smooth any roughness of bushing, sprocket retainer, or seat on the axle sprocket.

r. Instructions for the assembling and disassembling of the wheels, wheel fastenings, pole, doubletree, singletrees, neck yoke, and padlocks and bolt snaps are contained in paragraph 15.

44. Care and maintenance.—*a.* Maintenance of the artillery reel consists mainly in minor adjustments, lubrication, and cleaning.

b. The roller chains should be dismounted once a month and thoroughly cleaned, washed in gasoline, then dipped in a hot solution of lubricating graphite grease, making certain that the lubricant penetrates every bearing.

c. The drum and sprocket bearings should be cleaned and flushed out with gasoline monthly. Block up the axle so that it is horizontal and the right wheel clear of the ground. Fill all the oil holes and passages with gasoline, turn the right wheel and refill until the gasoline flushes through the bearings. Give the wheel several turns, allow to drain and then lubricate as indicated in the lubricating chart, paragraph 49.

d. Serious deformation of the frame, braces, drums, clutch, clutch standard, driving chains, and loose or broken rivets should be referred to an ordnance maintenance company for correction.

e. Tighten loose bolts and cap screws.

f. Care and maintenance of the wheels, wheel fastenings, pole, doubletree, singletrees, neck yoke, drawbar padlocks, and bolt snaps are contained in paragraph 16.

g. Lubricating instructions are contained in Section X.

h. General instructions on care and maintenance such as painting, cleaning, etc., are contained in Section XI.

SECTION IX

ARTILLERY CART, M1918

45. Weights, dimensions, etc.—The following list gives the principal weights, dimensions, etc., of the artillery cart, M1918:

Weight of the cart, without load	pounds	1,499
Weight of the cart, completely equipped and loaded, approximate	do	2,018
Road clearance, approximate	inches	26

The battery reel, M1917, is replaced by the artillery reel, M1909MI, and the artillery cart, M1918, in battalion, regimental, and brigade headquarters of light field artillery, horse-drawn; in gun batteries and in battalion, regimental, and brigade headquarters of light field artillery, tractor-drawn, and of medium and heavy field artillery; and in brigade headquarters of portee artillery. Also in observation battalions and batteries, the artillery reel without the cart is used.

46. Description of the artillery cart, M1918.—*a.* The cart, which limbers to the artillery reel, M1909MI, is a 2-wheeled vehicle designed to carry part of the fire-control, communication, and topographical equipment of the organization to which it is issued. With the exception of the spokes and felloes of the wheels and the chest packing, the cart is made of metal throughout. The principal parts are the frame, carrying springs, chest, brakes, and wheels.

b. The wheels, wheel fastenings, pintle and pintle latch, lunette, and padlocks and bolt snaps are described in Section II.

c. The frame is similar in many respects to that of the 75-mm gun caisson, M1918, described in Section IV. The axle, carrying springs, axle brackets, lunette, prop, pintle, pintle bearing, brake bands, brake hangers, brake shafts, and a number of the other minor brake parts are interchangeable. The middle and side rails are similar in design but longer than those used on the caisson.

d. The cart chest is a rectangular box built up of plates and angles riveted together. It is securely fastened to the side rails by rivets. The side rails transmit the weight of the chest and load to the axle through the carrying springs.

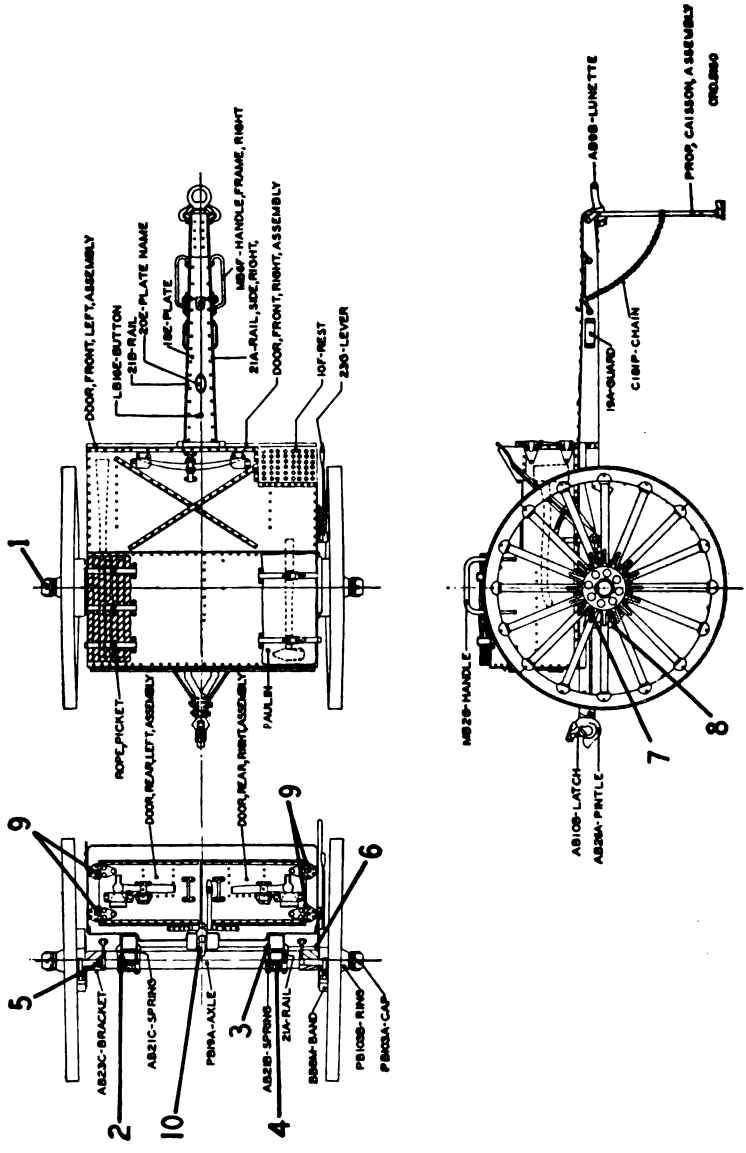

FIGURE 28.—Artillery cart, M1918, assembled views

Reference	Item	Reference	Item
PB19A	Axle.	23G	Lever, brake.
BB8M	Band, brake.	AB9B	Lunette.
AB23C	Bracket, axle.		Paulin.
LB16E	Button, prop chain.	AB26A	Pintle.
PB103A	Cap, hub.	20E	Plate, name.
C181P	Chain, prop.	18E	Plate, top, middle rail.
	Door, front, left, assembly.		Prop, caisson, assembly.
	Door, front, right, assembly.	21B	Rail, side, left.
	Door, rear, left, assembly.	21A	Rail, side, right.
	Door, rear, right, assembly.	10F	Rest, foot.
19A	Guard, wheel.	PB103B	Ring, hub.
MB6F	Handle, frame, right.		Rope, picket.
MB2G	Handrail.	AB21B	Spring, Belleville.
AB10B	Latch, pintle.	AB21C	Spring, carrying.

The rear half of the chest is higher than the front half. Doors which open outward in both the front and rear allow access to the interior of the chest which is divided into 17 compartments. The doors are held firmly closed against the chest by lock bars. Bolt snaps and padlocks are furnished for securing the lock bars.

The compartments of the chest contain drawers for carrying the fire-control instruments and material. The drawers and supports for the optical instruments are padded with felt pads and, in addition, are supported by conical helical springs which absorb the shocks and vibrations when traveling.

For reference purposes, the compartments entered from the rear of the chest may be numbered from the left to the right, Nos. 1 to 12,

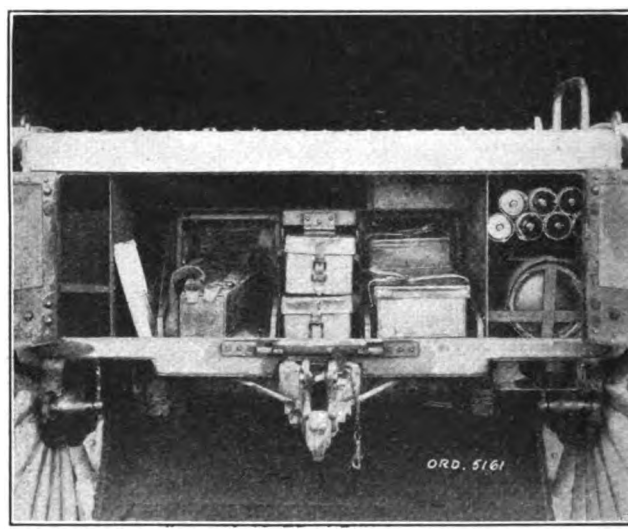

FIGURE 29.—Artillery cart, M1918, rear view, doors open

inclusive, and those entered from the front from right of the vehicle to the left, Nos. 12 to 17, inclusive. (See fig. 30.)

e. Fastenings for carrying the various accessories are attached to the exterior of the chest and to the frame.

f. A name plate is attached to the top of the middle rail top plate, just in front of the chest.

47. Disassembling and assembling.—*a.* Disassembling operations for the brake mechanism, carrying springs, and pintle are similar to those outlined in the assembling and disassembling instructions for the 75-mm gun caisson, M1918, in paragraph 24.

b. Instructions on the disassembling and assembling of the wheels, wheel fastenings, pintle latch and spring, lunette, and padlocks and bolt snaps are contained in paragraph 15

48. Care and maintenance.—*a.* The maintenance of the cart consists mainly in lubrication, cleaning, and care of the packing in the interior of the chest. Occasionally, handrails are bent or straps or

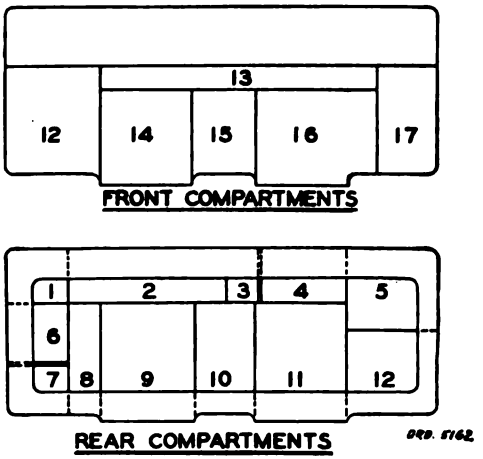

FIGURE 30.—Artillery cart, M1918, diagrams of compartment numbers

fasteners are broken, the replacements of which are so simple that specific instructions are unnecessary.

b. The pads, cushions, and spring supports for the delicate instruments carried in the chest should be inspected frequently. They should be kept in a serviceable condition at all times.

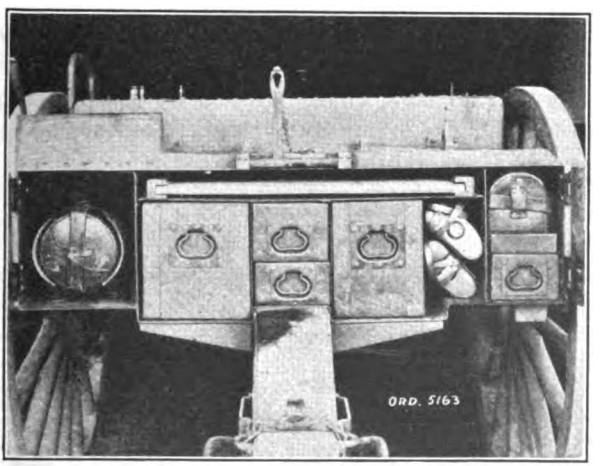

FIGURE 31.—Artillery cart, M1918, front view, doors open

c. Maintenance of the brake mechanism and adjustment thereof are discussed in paragraph 25 *c* and *d*.

d. Care and maintenance of the wheels, wheel fastenings, pintle and pintle latch, lunette, padlocks, and bolt snaps are discussed in paragraph 16.

e. Lubrication instructions are contained in Section X.

f. General instructions on care and maintenance such as painting, cleaning, etc., are contained in Section XI.

SECTION X

LUBRICATING INSTRUCTIONS

49. Lubricating instructions.—*a.* The life of the vehicles depends to a great extent on proper lubrication. Particular attention should be given to the sliding and bearing surfaces. Oil cups, oil holes, openings, or exposed surfaces provide means for lubricating the various bearing parts.

b. Care should be taken when cleaning oil and grease compartments to insure the complete removal of all residue and sediment. Be certain that no dirt or other foreign matter drops into any of the lubricating passages or on the bearing surfaces.

c. Oil passages which become clogged should be cleaned with a piece of wire; wood should never be used for this purpose as splinters are apt to break off and clog the passages.

d. Should an oiler valve stick in its seat and prevent the passage of oil, it can be loosened by means of a piece of wire pushed through the hole, care being taken not to damage the valve.

e. No lubricants will be used other than those issued or other than in the manner prescribed.

f. The oiling and greasing chart is based on the probable lubrication required for vehicles in continual service, as on the march. It should be used as a general guide only as the requirements will vary according to conditions.

LUBRICATION CHART

75-mm gun caisson and carriage limbers, M1918

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
1	1 and 2	Hub cap	Oiler (2)	Oil, lub., cl. A	⅛ pint per day or every 25 miles.
2	1 and 2	Doubletree bolt	On bearing surfaces.	do	Few drops. Once per day.
3	1 and 2	Trunnion bolts	Oil cup in each trunnion bolt (2).	do	Few drops. Once per week.
4	1 and 2	Pintle	Fill pintle spring chamber.	Grease, lub., cup No. 3.	When assembling.
5	1 and 2	Pin, headless, 1 x 2 15/16 clear L. 2.05 (for pintle latch).	On bearing surfaces.	Oil, lub., cl. A	Few drops. Once per week.
6	1 and 2	Lock bar	At hinge joints (2).	do	Do.
7	1 and 2	Door hinge, male Door hinge, female	At hinge joints (4)	do	Do.

75-mm gun caisson, M1918

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
1	5	Lock bar	At hinge joints (2)	Oil, lub., cl. A	Few drops. Once per week.
2	5	Apron latch base, left	At contact surfaces.	do	Do.
		Apron latch base, right			
3	5	Fuze setter anchor rod bearing.	At contact surfaces (2).	do	Do.
4	5	Pintle bearing	Oil cup	do	Do.
5	5	Hub cap	Oiler (2)	do	½ pint per day or every 25 miles.
6	5	Brake lever shaft	Bearing surface of shaft.	do	Few drops. Once per week.
7	5	Apron hinge	At hinge joints (4)	do	Do.
8	5	Door hinge, female	do	do	Do.
9	5	Door hinge, male	do	do	Do.
10	5	Pintle latch	Bearing surface at pintle latch pin.	do	Do.
11	5	Side rail liner, right	At contact surfaces (4).	do	Do.
12	5	Brake band pin for adjusting link.	Bearing surface of pin (2).	do	Do.
13	5	Brake band pin for brake band.	Bearing surface of pin (4).	do	Do.
14	5	Prop fastening pin	Bearing surface of pin.	do	Do.
15	5	Apron latch plunger	Bearing surface of plunger (4).	do	Do.
16	5	Door prop stud	Bearing surface of stud.	do	Do.
17	5	Brake hanger, left	Oil cup	do	Do.
18	5	Brake hanger, right	do	do	Do.
19	5	Brake rod	Bearing surface of pin (2).	do	Do.

Battery and store wagon, M1917

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
1	10	Brake crank shaft bearing, right.	Oil cup	Oil, lub., cl. A	Few drops. Once per week.
2	10	Shot bolt, left	Sliding surface (2)	do	Do.
3	10	Hub cap	Oiler (2)	do	½ pint per day or every 25 miles.
4	10	Brake hanger, right	Oil cup	do	Few drops. Once per week.
5	10	Door hinge, female	At hinge joints (16)	do	Do.
		Door hinge, male	At hinge joints (4)	do	Do.
6	10	Side rail, liner, left	At contact surfaces (2) each.	do	Few drops. Once per day.
		Side rail liner, right			
7	10	Brake band pin for adjusting link.	Bearing surface of pin (2).	do	Few drops. Once per week.
8	10	Brake band pin for brake band.	Bearing surface of pin (4).	do	Do.
9	10	Lid prop	Sliding surface (2)	do	Do.
10	10	Carrying spring	Slush (4)	Grease, graph., lub., medium.	When assembling.
11	10	Spare-wheel fastening stud.	On contact surface (4).	Oil, lub., cl. A	Few drops as required.
12	10	Spare-wheel support stud.	On contact surface (2).	do	Do.
13	10	Spare-wheel support	At hinge joints (2)	do	Do.

Forge and store limber, M1902MI

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
1	16	Hub cap	Oiler (2)	Oil, lub., cl. A	⅛ pint per day or every 25 miles.
2	16	Doubletree bolt	On bearing surfaces.	do	Few drops. Once per week.
3	16	Trunnion bolt	Oil cup (2)	do	Do.
4	16	Pintle	Fill pintle spring chamber.	Grease, lub., cup, medium.	When assembling.
5	16	Pin, headless, 1 x 2 15/16, clear L. 2.05 (for pintle latch).	On bearing surfaces.	Oil, lub., cl. A	Few drops. Once per week.
6	16	Lid hinge, female Lid hinge, male	At hinge joints (4) each.	do	Do.
7	16	Shot bolt, left	On sliding surface	do	Do.
8	16	Shot bolt, right	do	do	Do.

Battery reel, M1917

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
1	19	Hub cap	Oiler (2)	Oil, lub., cl. A	⅛ pint per day or every 25 miles.
2	19	Axle bracket, right	Oil cup	do	Few drops. Once per day.
3	19	Axle bracket, left	do	do	Do.
4	19	Hand lever bracket	do	do	Do.
5	19	Clutch yoke	At contact surfaces (2).	do	Do.
6	19	Drumhead, left	Oil cup	do	Few drops. Once per month.
7	19	Drumhead, right	do	do	Do.
8	19	Hand-lever pin	On bearing surfaces (2).	do	Few drops. Once per week.
9	19	Roller stud	Oil cup (2)	do	Do.
10	19	Carrying spring, lower Carrying spring, upper	Slush (4) each	Grease, graph., lub., medium.	When assembling.
11	19	Hasp, for rear chest	At hinge joints (3)	Oil, lub., cl. A	Few drops. Once per week.
12	19	Hasp, for front chest	At hinge joints (2)	do	Do.
13	19	Front chest door hinge, female. Front chest door hinge, male.	At hinge joints (4) each.	do	Do.
14	19	Lid hinge, female	At hinge joints (3) each.	do	Do.
15	19	Doubletree bolt	On bearing surfaces.	do	Do.

Artillery reel, M1909MI

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
1	24	Hub cap	Oiler (2)	Oil, lub., cl. A	⅛ pint per day or every 25 miles.
2	24	Handwheel assembly	Oil cup	do	Fill. Once per day.
3	24	Drum axle oiler assembly	Oiler	do	Do.
4	24	Drumhead, left	Oil cup	do	Few drops. Once per day.
5	24	Axle bracket cap, right	Oiler (2)	Oil, lub., cl. A	Fill. Once per day.
6	24	Axle bracket cap, left	do	do	Do.
7	24	Drum clutch rod	On sliding surface	do	Few drops. Once per week.
8	24	Axle sprocket	Oil hole	do	Few drops, every 5 miles.
9	24	Jackshaft	Oil plug	Grease, lub., cup medium.	Fill. Once per day or every 25 miles.
10	24	Jackshaft frame	Oil cup	Oil, lub., cl. A	Few drops, every 5 miles.
11	24	Roller chain, ¾ pitch, ⅜ wide, 69¾ long.	Clean with brush and lubricate.	Grease, graph., lub., medium.	As required.
12	24	Roller chain, ¾ pitch, ⅜ wide, 67½ long.	do	do	Do.
13	24	Pole-supporting spring cap.	Oil cup	Oil, lub., cl. A	Few drops. Once per day or every 25 miles.
14	24	Pintle bearing	do	do	Do.
15	24	Pin, headless, 1 x 2 1 5/16, clear L. 2.05 (for pintle latch).	On bearing surfaces.	do	Few drops, once per week.
16	24	Pintle bearing spring	Slush	Grease, graph., lub., medium.	When assembling.
16	24	Pole supporting spring	do	do	Do.
17	24	Rear roller bracket, right	Oil holes	Oil, lub., cl. A	Few drops. Once per week.
18	24	Rear roller bracket, left	do	do	Do.
19	24	Doubletree bolt, assembly (when horse-drawn).	On bearing surfaces.	do	Few drops. Once per day.
		Tool chest hinge, female Tool chest hinge, male	At hinge joints (2) each.	do	Few drops. Once per week.

Artillery cart, M1918

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
1	28	Hub cap	Oiler (2)	Oil, lub., cl. A	⅛ pint per day or every 25 miles.
2	28	Side rail liner, left	At contact surfaces (4).	do	Few drops. Once per day or every 25 miles.
3	28	Side rail liner, right	do	do	Do.
4	28	Carrying spring	Slush (4)	Grease, graph., lub., medium.	When assembling.
5	28	Brake hanger, left	Oil cup	Oil, lub., cl. A	Few drops. Once per week.
6	28	Brake hanger, right	do	do	Do.
7	28	Brake band pin for brake band.	At contact surfaces (4).	do	Do.
8	28	Brake band pin for adjusting link.	At contact surfaces (2).	do	Do.
9	28	Shield hinge, female Shield hinge, male	At hinge joints (4) each.	do	Do.
10	28	Lock bar A, rear	At hinge joints	do	Do.

SECTION XI

GENERAL CARE AND PRESERVATION

50. General instructions and information.—*a.* Various instructions on the care and maintenance of the vehicles appear in the sections pertaining to the individual vehicles. Some of the more important are here condensed for more convenient reference.

(1) The vehicles should be kept clean and lubricated at all times.

(2) Battery commanders should frequently make detailed inspections of all the vehicles.

(3) If necessary, lash parts with copper wire to prevent unscrewing or loss.

(4) Keep hub bolts properly tightened.

(5) Replace and open cotter pins after replacing crown nuts.

(6) Do not strike a metal part directly with a steel hammer; interpose a block of wood or a piece of copper.

(7) In all requisitions and correspondence, the correct name and the piece mark referred to should be given. This may be obtained from the Standard Nomenclature Lists. If the name of the part is unknown, submit a sketch showing the location, shape, material, etc., sufficient to establish definitely the identity of the part in question.

b. In cases where vehicles are to be stored or not used for an appreciable length of time, all bright and unpainted surfaces should be thoroughly cleaned with gasoline so as to be free from rust, water, lubricating oil, and grease and then coated with rust-preventive compound.

51. Inspection.—*a.* Daily inspection should be made to discover any parts which need attention or adjustment.

(1) See that the vehicles are clean and properly lubricated.

(2) Operate and examine the brake mechanisms to see that they function properly.

(3) Examine hinges, straps, fasteners, chest packings, etc., to see that they are in serviceable condition.

(4) Check the accessories to see that they are in their proper place and that none are missing.

b. At least once a month the vehicles should be thoroughly inspected by the battery mechanics under the direction of the commanding

officer. The instructions given for daily inspection should be followed out and in addition:

(1) Operate all moving parts to see that they work freely and function properly.

(2) Examine all nuts and bolts to see that they are tight and that cotter pins are in place in crown nuts. In making replacements, when practicable use cap screws with plain nuts and lock washers

(3) Examine for loose and broken rivets.

(4) See that there is no excessive end play of the wheels on the axles.

(5) Examine the condition of the paint.

52. Cleaning.—*a.* The vehicles should be thoroughly cleaned and lubricated at intervals not exceeding one month. Care should be taken to keep all parts free from rust as it is the starting point of serious injury. All bearing surfaces must be kept clean at all times. Only those cleaning materials issued should be used.

b. In cleaning disassembled parts, wash with water or gasoline and dry thoroughly, then oil lightly.

c. To clean off rust-preventive compound, the greater part should be scraped off, the balance removed by using rags or cotton waste dipped in gasoline. A hot solution of lye and water will also loosen the compound and render it easy to remove.

d. Gasoline will be found useful in cutting and loosening any oil which has become dry and gummy.

e. Rust may be softened by using gasoline and scraping with a piece of wood.

f. Oil holes which have become clogged should be opened up with a piece of wire. Wood should never be used for this purpose, as splinters are likely to break off and clog the passages.

53. Paint.—*a.* See TR 1395-A.

b. All nonbearing parts should be painted. Where the metal is exposed red lead should be used as a base coat.

c. All parts to be painted should be free from rust, dirt, oil, and grease.

d. When the matériel is in fair condition and only marred in spots the marred places should be primed with olive-drab paint, second coat, and permitted to dry. Then the whole surface should be sandpapered with No. 1½ flint paper and a finishing coat applied and allowed to dry thoroughly before using.

e. Where paint on the matériel is in bad condition all parts should be thoroughly sandpapered with No. 2½ flint paper, given a coat of paint and permitted to dry for at least 24 hours. Then sandpaper with No. 00 flint paper and apply a finishing coat, permitting the parts to dry thoroughly before use.

f. In general, two coats of paint a year will be sufficient to keep the matériel in good condition. After repeated painting the paint may become so thick as to scale off or become unsightly. A vehicle in this condition should have all the old paint removed as described in TR 1395-A. Rusted places should be sandpapered until they present a bright appearance and then the whole vehicle given a coat of red lead. After allowing a sufficient time for drying (from 12 to 24 hours) apply a coat of paint allowing at least 24 hours for drying. Then apply a finishing coat of paint and permit all parts of the vehicle to dry thoroughly before using.

54. Painting of grease cups, oil hole covers, and oil holes.—As an aid to ready identification, grease cups and oil hole covers are painted red. Oil holes have a red ring painted around the hole.

55. Protection, cleaning, etc., of matériel affected by gas.—*a. Protection against phosgene, chlorine, etc.*—Matériel which is in constant danger of gas attacks, whether from gas clouds or gas shells, must be protected. Care should be taken to keep all bright parts of the vehicles, mountings, and accessories well coated with oil.

(1) All instruments should also be covered with oil and protected with covers when not in actual use, care being taken that the oil does not come in contact with any glass or find its way into the interior of the instruments.

(2) Cartridge cases of ammunition and all uncapped fuzes or fuzes which have been removed from their cylinders should be wiped over with oil as soon as possible and protected with a cover.

b. Protection against mustard gas.—It must not be forgotten that practically all fabrics and materials, such as wool, cotton, rubber, and oilcloth, can be penetrated by mustard gas if sufficient time is given. The mustard gas actually dissolves in these materials and penetrates them by a slow process of diffusion. In general, it may be said that the greater the length of time allowed for penetration the greater the danger in wearing these articles after they have been exposed for some time to mustard gas. For instance, rubber boots which have been worn in an area shelled heavily with mustard gas may be a grave danger to men who wear them several days after the bombardment. Fabrics thoroughly impregnated with boiled linseed oil will resist penetration by mustard gas for over an hour, but after this time these articles are dangerous because the mustard gas dissolves in the linseed oil and they must be destroyed.

c. All bright parts of vehicles together with all accessories and spare parts exposed to the gas must be cleaned and wiped dry as soon as possible after the attack, and in any case within 24 hours, after which

they should be thoroughly coated afresh with oil. The same applies to ammunition which for any reason has not been oiled. It is desirable to expend such ammunition as soon as possible.

d. Disinfection of material.—The following measures should be used for the removal of mustard gas from various materials and equipment which have come in contact with mustard gas. For all of the operations indicated below, the gas mask and protective clothing, including protective shoes and gloves, must be worn.

(1) Commence by freeing the objects of dirt, lumps of earth, and liquids with wooden spatulas, rags, etc., which will be buried immediately after this operation. They must never be burned.

(2) Sprinkle a continuous layer of calcium hypochlorite, which is preferred if available, or else dry chloride of lime over the parts that lend themselves to this treatment. In the statements hereafter calcium hypochlorite is specified but dry chloride of lime may be substituted in the event that calcium hypochlorite is not available. After two hours, or better after six hours, if practicable, wash off the layer of calcium hypochlorite and rinse thoroughly. It is imperative that all the calcium hypochlorite be removed in order to prevent the deterioration resulting from the prolonged action of the calcium hypochlorite. In the case of ammunition it is imperative to prevent particles of calcium hypochlorite from being introduced into the bore of the piece.

(3) Whitewash soiled parts which do not lend themselves to sprinkling with dry powder with a thick paste of calcium hypochlorite made from three volumes of calcium hypochlorite and one volume of water. After two hours, or preferably six hours, wash off the calcium hypochlorite.

(4) Delicate instruments such as the fire-control instruments which would be injured by calcium hypochlorite should be cleaned by dry polishing with rags. After this operation the rags should be buried.

(5) If there are large quantities of water on hand, in place of calcium hypochlorite, use water. The water should be warm, but never boiling, and large quantities should be used. This can not be done in the case of greasy articles, where only calcium hypochlorite should be used.

(6) When it is not necessary to immediately use contaminated matériel, or when one has not the above means at his disposal, it may be considered that the handling of the matériel or apparatus is not dangerous after six or eight days.

e. Transportation of matériel affected by gas.—The removal will be effected by automotive units whenever possible. If horse transportation must be used, the route will be carefully reconnoitered in order to avoid infected ground. The matériel will be disinfected as thoroughly as possible before its removal.

[A. G. 062.12 (5-16-32).]

BY ORDER OF THE SECRETARY OF WAR:

DOUGLAS MACARTHUR,
General,
Chief of Staff.

OFFICIAL:

C. H. BRIDGES,
Major General,
The Adjutant General.

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TECHNICAL REGULATIONS
No. 1305–75B

WAR DEPARTMENT,
WASHINGTON, *January 2, 1940.*

MOBILE ARTILLERY MATÉRIEL

GUN AND CARRIAGE, 75-MM, M1916A1 AND M1916MIA1

Prepared under direction of the
Chief of Ordnance

SECTION I

GENERAL

1. Purpose.—These regulations are published for the information and guidance of the using arms, Reserve Officers' Training Corps students, Reserve officers, and all personnel charged with the maintenance of this matériel.

2. Scope.—*a.* In addition to description and figures, these regulations contain instructions for the operation, inspection, disassembly and assembly, repair, and care and preservation of the matériel.

b. Disassembly and assembly and such repairs as may be handled by the battery personnel will be undertaken only under the supervision of an officer or the chief mechanic.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope of the battery personnel, the corps area or department ordnance officer upon request will provide trained men to perform the work.

*This pamphlet supersedes W. D. Doc. 1035 (Handbook of the 75-mm Gun Matériel, Model of 1916—With Instructions for its Care).

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3. References.

Nomenclature, list of spare parts and equipment, and basic spare parts for gun and carriage, SNL C–30, or ordnance drawings.

Description and information on sighting and fire-control equipment, TR 1320–A and 1320–C (now TR 310–20).

Ammunition, TR 1350–A.

Drill ammunition, TR 1370–D.

Targets and accessories therefor, TR 1340–C.

Instructions covering the characteristics, purpose, handling, etc., of cleaning and preserving materials, tools, and equipment for use therewith, and special oils, greases, and cutting oils issued by the Ordnance Department, TR 1395–A.

Ammunition for subcaliber guns, TR 1370–C.

Instructions for service of the piece, pertinent FM 6-series.

SECTION II

DESCRIPTION AND OPERATION

4. Description of 75-mm gun, M1916, and modifications.—*a.* The 75-mm gun, M1916, is the basic weapon of its type. However, eight modifications have been applied to the original gun so that at present the 75-mm guns, M1916, M1916MI, M1916MIA1, M1916MII, M1916MII½, M1916MIII, M1916MIIIA1, M1916MIII½, and M1916MIII½A1 are the models in existence.

b. The M1916, M1916MI, M1916MII, M1916MII½, M1916MIII, and M1916MIII½ guns may be mounted on either the 75-mm gun carriage, M1916 or M1916A1, while the M1916MIA1, M1916MIIIA1, and M1916MIII½A1 guns are mounted on 75-mm gun carriage, M1916MI or M1916MIA1. The latter two carriages are equipped with hydropneumatic recoil mechanisms of the St. Chamond type.

c. 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.

d. 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, and which is operated manually in opening but auto-

matically closes when a round of ammunition is inserted in the breech chamber.

e. 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.

5. Operation of breech mechanism (fig. 4).—*a.* The operating handle (6C) is grasped around the grip, and pressure of the fingers is applied which releases the latch (9K). The handle is rotated to the rear and down approximately 90°, lowering the breechblock. During the downward movement of the breechblock the inclined grooves on its sides force the outer extractor trunnions forward and rotate the lips on the extractor away from the end of the tube, thus forcing the cartridge case out of the breech. When the breechblock reaches the limit of its downward movement, the inner extractor trunnions are forced over the horizontal shoulders at the top of the lugs by the extractor plunger (8S), and lock the breechblock in the open position.

b. To close the breech, a round of ammunition is inserted *smartly* into the chamber which causes the flange on the cartridge case to catch on the lips of the extractors (7C and 7B), thereby rotating them so that the trunnions are forced to the rear and off the locking shoulders. As the breechblock is released from its locked position it is subjected to the pull of the closing spring (9C), causing the operating handle (6C) to rotate upward where it is locked in the closed position by the operating handle latch (9K).

6. Operation of firing mechanism (fig. 4).—*a.* When the trigger shaft (7D) is forced to the rear either by operating the firing shaft (KB67A) on the cradle or pulling the lanyard, it causes the firing spring shoe (8E) to move forward, compressing the firing spring (8F) until the projecting shoulder on the firing arm (8N) engages a corresponding shoulder on the sear (8L) which disengages the latter from the firing pin (8D). The firing pin (8D) is thrown forward under the compression of the firing spring (8F), firing the piece. After the firing pin (8D) has gone forward the firing spring (8F) is still under its initial compression. The pressure of the firing spring is conveyed to the front side of the firing arm (8N) by the firing spring shoe (8E), and the same pressure is conveyed to the rear of the firing arm by the rear edge of the slot in the pin through which the firing arm projects.

b. These two pressures are equal and opposite and would ordinarily tend to rotate the firing arm about a point halfway between their

points of application, but the firing arm is pivoted on the trigger shaft and can rotate about the center of the shaft only. Therefore, as the pressure applied by the firing spring shoe has the greater arm surface, the firing arm is rotated about the center of the trigger shaft and carries the firing pin back until the sear engages in its slot and the mechanism is ready to be fired again.

7. Description of 75-mm gun carriage, M1916A1 and M1916-MIA1.—*a.* The 75-mm gun carriages, M1916A1 and M1916MIA1, are modified M1916 and M1916MI carriages. This modification consists of the removal of the brake mechanism, axle seat, foot rest, and steel tired wheels, and the application of new parts to provide for high speed transport.

b. These carriages are of the split trail type, which permits high elevation and wide traverse without changing the positions of the trails.

c. The recoil mechanism of the 75-mm gun carriage, M1916A1, is of the hydrospring, variable recoil type, automatically adjusted to different elevations. In counterrecoil the gun is controlled by springs housed within the spring cylinders and a counterrecoil buffer housed in the recoil cylinder.

d. The recoil mechanism of the 75-mm gun carriage, M1916MIA1, is hydropneumatic, known as the St. Chamond type. This mechanism consists of three cylinders. The middle one is the recoil cylinder. The right has an air reservoir at the forward end and an oil reservoir at the rear end. The left cylinder is the recuperator cylinder, having at its forward end an air space and at its rear end a regulator for controlling the length of recoil. The floating piston in this cylinder separates the air from the oil.

8. Operation of 75-mm gun carriage, M1916A1 and M1916-MIA1.—*a. Elevating mechanism.*—The elevating mechanism is designed to allow elevation of the gun to 42° independent of the angle of site mechanism. The mechanism is operated by the elevating handwheel on the right side of the carriage, which is turned in a clockwise direction for elevating and counterclockwise for depressing.

b. Angle of site mechanism.—The angle of site handwheel is located on the left side of the carriage. The movement of this handwheel transmits power through the rocker to the elevating arc. The angle of site mechanism thus operates the elevating mechanism, gun, cradle, rocker, and sights.

c. Traversing mechanism.—The total traverse of the gun on carriage is 800 mils, 400 mils each left and right of center. The traversing handwheel is located on the left side of the carriage and turns in a

clockwise direction for left traverse and counterclockwise for right traverse.

d. Brakes.— The brakes of the carriage are of the internal expanding type (Ford). They are operated by hand brake levers, one on each side of the carriage to the rear of the shield. The hand brakes are not for use in traveling but only for immobilizing the carriage in firing.

9. Tabulated data.

a. Gun.

Weight of gun with breech mechanism	pounds	749
Caliber	inches	2. 95
Muzzle velocity (see FT 75–E–2).		
Length of bore	inches	84
Length of gun	do	90. 9
Twist of rifling, right hand, one turn in 119 calibers at beginning of rifling to one turn in 25.4 calibers at 9.72 inches from muzzle, thence uniform.		
Weight of shell, HE, Mk. IV	pounds	13. 44
Weight of shrapnel, Mk. I	do	15. 95
Weight of charge	do	1. 50

b. Carriage.

Weight of carriage, complete	do	2. 461
Weight of gun and carriage, complete	do	3, 210
Diameter of wheels	inches	40
Width of tread	do	66
Length of recoil on 75-mm gun carriage, M1916A1 (at 0°)	do	46
Length of recoil on 75-mm gun carriage, M1916MIA1 (at 0°)	do	46
Height of axis of gun	do	41⅝
Height of panoramic telescope	do	52
Maximum angle of elevation	degrees	53
Maximum angle of depression	do	−7
Traverse of gun on carriage	mils	800

SECTION III

DESCRIPTION OF GROUPS

10. Gun.—*a.* The variations in these models of guns are such that recognition is difficult from their outside appearance, except in the cases of the M1916MIA1, M1916MIIIA1, and M1916MIII½A1, which have the top portion of the breech ring cut away and a steel casting, known as the saddle, on the upper surface for use with the St. Chamond recuperator.

b. Except for the differences outlined in *a* above, the guns have the same characteristics.

(1) The tube extends from the muzzle of the gun to the rear end of the powder chamber, and two recesses are cut in its rear face to form seats for the lips on the extractor.

(2) The jacket is assembled over the breech end of the tube. The jacket carries two flanges on its lower side which form guides for the gun in the slide ways of the cradle of the carriage. A lug on top of the jacket of all guns, except the M1916MIA1, M1916MIIIA1, and M1916MIII½A1, contains a T-slot for the recoil cylinder of the 75-mm gun carriage, M1916A1.

(3) The breech ring is threaded internally at its forward end and screws on to the rear of the jacket.

(4) Where applicable, the upper hole in the breech ring is for the recoil cylinder, and the two holes in the bottom of the breech ring are for the attachment of the counterrecoil spring piston rods.

(5) The breech ring of the guns modified for mounting on the St. Chamond recuperator does not have the upper hole, and the lower portion has only one hole for the recoil rod.

(6) The rear part of the breech ring is cut away to form the breech recess. A vertical rectangular slot extending through the rectangular section of the breech ring forms a seat for the sliding breechblock. The upper part of the breech ring in rear of this slot is cut away, having a U-shaped opening which permits the passage of the cartridge case. Recesses cut in both of the side faces of the breech recess form seats for trunnions on the two extractors. Holes bored into these recesses from the rear face form seats for the extractor plungers, springs, and plugs.

(7) The clip is shrunk on the tube near the muzzle. Two lugs on the underside of the clip form the muzzle guide of the gun. The rear ends of the guides on the jacket are extended to the face of the recoil lugs by short extensions riveted in place to prevent entrance of dust between the surface of the guides and their bearing surfaces on the cradle. For the same purpose, the forward ends of the guides on the jacket are connected by steel plate dust guards with the rear ends of the guides on the clip.

11. Breech mechanism (fig. 4).—*a. Breechblock.*— (1) The breechblock is rectangular, of forged steel, and has two flanges on either side which engage with corresponding grooves in the breech recess. These flanges and grooves are inclined at a slight angle to the vertical so that the breechblock moves forward slightly in closing and forces the cartridge case into its seat. The upper part of the breechblock is

so cut as to form a semicircular opening to permit the passage of the cartridge case when the breech is open. The front of this opening is beveled so that when the breechblock is closed this beveled portion will strike the edge of the case and push it home. A slot inclined at an angle to the front face of the breechblock and having a T-shaped cross section is contained in the lower part of the breechblock. Slots in the side faces of the breechblock form guides for the inside trunnions of the extractors. The lower parts of these slots are inclined slightly forward and the upper parts curve sharply to the front, thus increasing the speed of the extractors during the final part of the downward motion of the breechblock. The lugs at the front of these slots are cut away at their upper ends to form horizontal shoulders, the inner trunnions of the extractors being forced over these shoulders by the extractor plungers so as to lock the breechblock in its open position.

(2) The breechblock under the action of the operating arm (6A), slides up and down in the breech recess. The operating arm is pivoted to the operating shaft (6B) and acts as an oscillating crank in opening and closing the breechblock. The operating shaft (6B) which rotates the operating arm (6A) is operated by the operating handle (6C). The operating handle (6C) is provided with a latch to keep it in closed position, and is connected by a chain (9A), spring piston (9F), and spring piston rod (9B) to the closing spring (9C), which is housed in the closing spring case (6D) attached to the right side of the jacket by means of the spring case key (A12732). The closing spring (9C) is under compression and tends to keep the breechblock closed, or to close the breechblock when released from its locked open position.

b. Operating arm.—The operating arm (6A) carries a cylindrical hub at one end which is fitted to the operating shaft (6B)and at the other end a T-shaped head which operates in the corresponding slot of the breechblock. The operating arm oscillates about the axis of the operating shaft and acts as a crank in raising and lowering the breechblock.

c. Operating shaft.—The operating shaft (6B) is seated in a cylindrical recess in the upper part of the lower lug of the breech ring. The center of the shaft supports the hub on the operating arm (6A) and the right end supports the operating handle into which it fits.

d. Operating handle.—The operating handle (6C) carries a grip at the upper end. Fitted into this grip is the lever of the handle latch which is pivoted at the bottom of the grip by the operating handle latch pivot (9P). The operating handle latch spring (9L) is located at the upper end of the slot in the grip and keeps the latch lever

projecting beyond the surface of the grip. When the handle is grasped the lever is forced into the slot in the grip, rotating the latch and releasing the handle.

e. Extractor.—(1) The extractors (7C and 7B) are flat oblong steel forgings, each having three projections as follows:

(*a*) Lips at the front parts of the upper ends of the extractors fit into the recesses in the tube and bear against the front face of the rim on the cartridge case.

(*b*) Trunnions on the outside of the lower portions of the extractors move in recesses in the wall of the breech recess and against which the extractor plungers bear. These plungers, which together with the plunger springs and plunger plugs are housed in cylindrical holes in the breech ring, tend to push the lower parts of the extractors forward, and have for their principal purpose the forcing of the inside trunnions on the extractors over the horizontal shoulders on the breechblock, in order to lock the breechblock in the open position.

(*c*) Trunnions on the inside of the lower portions of the extractors operate in the cam slots in the side face of the breechblock and impart the rolling motion to the extractors which extract the cartridge case. Flat surfaces are cut on these trunnions to engage with the corresponding horizontal shoulders on the breechblock in locking the breechblock when open.

(2) The front surfaces of the extractors are curved in vertical directions, and as the breechblock is opened the lower ends of the extractors are forced forward by the trunnions which fit in the inclined grooves in the breechblock. The extractors roll on the surfaces which bear against the vertical surface on the gun at the rear of the tube.

f. Closing spring case.—The closing spring case (6D) is a cylindrical, hollow steel casting with a lug on one side. This lug contains a dovetailed slot to fit over a corresponding lug on the right side of the gun. A rectangular slot at right angles to the dovetail, passing through the case and lug in the gun, is provided for the insertion of a rectangular key (A12732) having a taper on one side, the insertion of which forces the case into position and locks it there. The case incloses the closing spring (9C). A shoulder is left at the rear end of the case against which one end of the closing spring bears.

g. Spring piston rod.—The spring piston rod (9B) passes through the center of the closing spring (9C) and through the spring piston (9F) and closing spring case (6D). The spring piston rod nut (9D) is held in place by a lock nut (9H) and cotter pin. Attached to the

opposite end of the rod is the chain (9A) which is also attached to the operating handle (6C) and operates in closing the breechblock.

h. Closing spring.—The closing spring (9C) is a spiral spring. It is normally compressed to a height of 14 inches when the breechblock is in the closed position. This pressure may be increased by *screwing* up on the spring piston rod nut (9D) the necessary amount to allow the breechblock to close without excessive shock which might cause the operating handle to become battered.

12. Firing mechanism (fig. 4). —*a. Firing pin.*—The firing pin (8D) is a hollow cylinder terminating into a smaller solid conical point which protrudes through the front face of the breechblock when firing the gun.

b. Firing spring shoe.—The shoe (8E) is a hollow cylinder which fits over the rear of the firing spring (8F) and slides inside the firing pin (8D).

c. Firing arm.—The arm (8N) is a steel forging consisting of a cylindrical hub with a square shoulder for engaging the sear (8L) and a projecting arm carrying a small knob at its outer end. The hub is provided with a square hole which fits over a corresponding square on the trigger shaft.

d. Sear.—The sear (8L) is a small steel cylinder open at one end to receive the sear spring. It carries a projecting shoulder which engages in a notch in the firing pin and a second shoulder on which the shoulder of the firing arm (8N) operates in releasing the sear.

e. Trigger shaft.—The trigger shaft (7D) is cylindrical in form with a square on one end which fits into the firing arm (8N) and a flat arm projecting at right angles from the other end. The latter serves as a lever to rotate the shaft. It is held in position in the breechblock by the trigger shaft detent (7F).

f. Return catch.—The return catch (A12727) is pivoted on the left side of the breech end of the gun, and when the gun is out of battery it is held down by its weight and the action of the catch spring (A12728) which bears against the underside of the return catch stop (A12731). When the return catch is in the downward position, the hook on its end is in line with a notch in the end of the firing shaft (KB67A) on the carriage. If the firing shaft is moved to the rear when the gun is out of battery, it will be caught by this catch which prevents firing of the piece. When the gun is in battery, the hook on the catch is lifted out of line with the notch in the firing shaft by a cam mounted on the firing shaft bracket.

13. Gun Carriage, M1916A1.—*a. General.*—(1) The carriage is of the split trail, variable long recoil type. The length of recoil is regu-

197169°—40——2

lated automatically so that the breech of the gun will not strike the ground on recoil when elevated at an angle of less than 47°. At elevations greater than 47°, a hole must be dug for the breech in recoil.

(2) The gun is mounted in slides on the cradle. The slides are attached to the spring cylinder. The spring cylinder is suspended by trunnions mounted in bearings on the top carriage. The top carriage (fig. 17) is supported by the pintle bearing (KB31A, fig. 7). Axle arms are attached to the pintle bearing. On each axle arm a wheel spindle bracket is mounted to which the wheels and braking mechanism are assembled.

(3) The carriage has an independent line of site through the angle of site mechanism by means of which maximum depression of −7° and elevation of +11° may be obtained. Additional elevation is obtained through the elevating mechanism.

b. Principal parts.—The principal parts of the carriage are the trail, cradle, recoil mechanism, top carriage, pintle bearing, equalizing gear, angle of site mechanism, elevating mechanism, traversing mechanism, firing mechanism, shield, brake mechanism, shoulder guards, and wheels.

(1) *Trail.*—(*a*) The trails, left and right, are hinged to the left and right equalizing pinions. Stops are provided to control maximum trail spread. A trail lock is provided to secure the trails in travel position and is composed of a ball on the left trail seated in a cup on the right trail. This seat is locked by a toggle joint actuated by a handle which in turn is secured in travel position by a strap.

(*b*) To the right trail is welded a drawbar (C64458, fig. 6) which forms a bearing for the drawbar (D31532). The latter is held in place by the drawbar key (A158911). The lunette is secured to the drawbar by a nut and cotter pin.

(*c*) Floats consisting of flanged steel plates are attached to the bottom of both trails at their rear for the purpose of increasing area of the trails on soft ground.

(*d*) Spade bearings are riveted on the rear of the trails for the removable spades. The removable spades (KB85E, figs. 5 and 7) are secured in position by the spade latch plungers. When in position the spades are driven into the ground at which time the spade latch plungers are forced into notches in the spades by means of the spade latch spring. The slopes on the faces of the plungers allow downward movement of the spades but prevent upward movement. To release a spade, the foot pedal on the spade latch handle is pressed

down. This disengages the plunger from the spade and allows the spade to be removed.

(*e*) A trail handle is riveted to the outside of each trail for lifting purposes. Trail guards are riveted to the top of the trails to prevent battering by sledges used for driving the spades.

(*f*) Sponge staff fastenings are riveted to the top of each trail. Sponge staffs are inserted in upper rings of staff fastenings and the lower ends are clamped in place. The smaller section of the sponge staffs fits in the sponge fastening.

(*g*) Sledge fastenings are similar to sponge staff fastenings and are riveted to the outside of each trail.

(*h*) Trail seats are made of formed plates and are riveted to the top of the trails near the breech of gun. The oiler support with springs is under the right-hand trail seat. The oiler rests on this support and is held in place by springs.

(*i*) The traveling lock bar (KB48A, fig. 5) consists of a steel bar pinned to the lock bar bearing on the left trail. It is made to swing across the trails in traveling position and along the left trail in firing position. In traveling position the socket in the middle of the lock bar engages with the traveling lock stud in the bottom of the cradle. The right end of the lock bar is held in the lock bar clip on the right trail by the traveling lock bar latch plunger. To disengage the latch plunger for firing, the latch lever is lifted and the traveling lock bar swung to fastening in the left trail where it is secured by the traveling lock bar latch plunger.

(2) *Cradle.*—The cradle of the 75-mm gun carriage, M1916A1, is in the form of two cylinders joined at the center with axes in the same horizontal plane. Above the cylinders are the gun ways parallel with the cylinders and opening toward the center line of the cylinders. The traveling lock stud is bolted through a lug at the rear and below the cylinders. The firing shaft bracket is riveted to the left side, and the range scale bracket to the right side of the cylinders at their rear end. Shoulder guards are pinned in sockets in both the firing shaft and range scale brackets to prevent contact of the cannoneers with the gun during recoil. Trunnions are riveted and keyed to the cylinders near the center. The elevating arc is bolted to lugs on the bottom of the cylinders at the trunnions. The piston rod bracket is riveted to projections on the cylinders above the gun slides and near the front end. The cylinder cover is pinned to the cylinder clips which are riveted to the front of the spring cylinders.

(3) *Recoil mechanism.*—(*a*) *General.*

1. The recoil mechanism of the 75-mm gun carriage, M1916A1, is of the hydrospring type, with the recoil cylinder mounted above the gun and the counterrecoil cylinders and springs in the cradle below the gun.

2. The recoil cylinder is held by a slot machined in the gun jacket at the front and rests in a cylindrical opening in the lug at the top of the breech ring. It is held in place by the recoil cylinder retainer, which screws into the rear cylinder head and bears against the lug of the breech ring. Three lands are formed inside of the recoil cylinder parallel to the center line.

3. The recoil valve is a cylinder with a collar at the front end and three lands inside and parallel to the bore. Three rows of holes are bored at the lands. The recoil valve fits inside of the recoil cylinder, resting on the lands of the latter. It is held in place by a collar bearing against the edge of a counterbore in the cylinder at the front, while the rear end of the valve bears against the inside rear end of the recoil cylinder.

4. The recoil piston rod assembly is composed of a piston which is screwed and pinned to the piston rod. The piston is of bronze and is slotted to fit the lands of the recoil valve. The piston rod is hollow for almost its entire length. The front end passes through the gland in the cylinder head and piston rod sleeve in the piston rod bracket. The valve turning gear fits over the front end of the piston rod, the rod being held by the piston rod nut, which causes the shoulder on the rod to bear against the piston rod sleeve. The front end of recoil cylinder is closed by means of a gasket and the front cylinder head, the latter being screwed in place. A bronze gland and four rings of $\frac{5}{16}$-inch Garlock hydraulic packing prevent leakage around the piston rod.

5. The counterrecoil buffer assembly consists of a buffer rod (66B, fig. 8) screwed into the buffer rod nut at the rear end of the recoil cylinder, and extends through the buffer bushing into the interior of the piston rod. A buffer head is screwed and pinned to the front end of the buffer rod. The buffer head is of two diameters connected by a short cone. The rear end is the smaller diameter which is threaded inside to screw over the buffer rod. The

coned surface contains slots leading to a hollow chamber in front. The front end of the head is faced and provided with a central bearing for the valve stem. The bearing is supported by webs in the main body of the guide. The valve stem at its rear end acts as a stop. To the threaded portion of the stem a valve is screwed and pinned.

6. The counterrecoil springs (KB28X and W, fig. 8) are assembled around spring rods in the spring cylinders. The spring rods are attached to the lower portion of the breech ring and are retained by taper keys driven diagonally through the lug of the breech ring and spring rods. Three coils of inner counterrecoil springs are assembled over the spring rods, surrounded by three coils of outer springs. The inner and outer springs are coiled in opposite directions to prevent nesting. The sets of coils are separated by bronze separators. The rear ends of the spring cylinders are bushed for the spring rods.

(*b*) *Operation of the recoil and counterrecoil system.*

1. When the gun is fired it moves back in slides on the cradle, carrying with it the spring rods, buffer rod, recoil cylinder, and recoil valve. The recoil piston rod assembly and the spring cylinders remain stationary, being fixed to the carriage.

2. The recoil cylinder being full of oil, the oil is forced by the piston through holes in the recoil valve in front of the piston up into an annular space between the valve and cylinder and into space behind which has been vacated by the piston. The hydraulic resistance caused by forcing the oil through the holes in the valve absorbs most of the recoil energy of the gun, and the remaining energy is taken up by compression of the counterrecoil springs and friction.

3. When the gun reaches the end of recoil all of the recoil energy has been absorbed, and the counterrecoil springs acting against the spring rod pistons force the gun back to battery position. The purpose of the counterrecoil buffer is to overcome the tendency of the gun to return to battery too rapidly, although at the same time allowing sufficient speed of counterrecoil to permit maximum rapidity of fire. Buffer action is necessary, as the strength of the counterrecoil springs required to return the gun to battery at high elevation is greater than is required at lower elevations.

4. As the buffer rod moves backward in the recoil piston rod, the valve in the buffer rod head is opened by the pressure of oil in back of the valve and the vacuum in front, which forces oil into the buffer chamber in front of the buffer rod head. At full recoil the buffer chamber is full of oil and the buffer rod head is inside the rear end of the recoil piston rod. When the counterrecoil springs force the gun back in counterrecoil, the buffer rod moves forward, compressing oil in the buffer chamber and forcing the counterrecoil buffer valve closed. This prevents escape of oil through the counterrecoil buffer valve and forces oil to throttle between the outside surface of buffer rod head and the inside surface of the recoil piston rod, offering resistance to the counterrecoil spring action. The inside bore of the recoil piston rod is tapered at the front end to increase resistance and obtain desired decrease in counterrecoil velocity.

(*c*) *Variable recoil mechanism.*—Variable recoil is obtained by varying areas of effective throttling holes in the recoil valve. An arm on the trunnion cap is connected by means of a valve turning connecting rod, valve turning arm, valve turning gear, and piston rod gear to the recoil piston rod. As the gun is elevated the relation of the cylinder to the trunnions changes, causing the recoil piston rod to turn by means of the valve turning mechanism. Slots in the recoil piston engage lands in the recoil valve, causing the recoil valve to turn with the recoil piston. As the recoil cylinder remains stationary the location of the lands inside of the recoil cylinder changes with relation to the three rows of holes in the recoil valve, and these rows of holes are covered to produce variations in length of recoil. At long recoil all rows of holes are uncovered, at intermediate recoil one row is covered, and at short recoil two rows are covered. The setting of the recoil valve in degrees elevation is shown by a scale on the piston rod sleeve and index mark on the edge of the piston rod bracket bushing at the top of the piston rod.

(4) *Top carriage.*—The top carriage carries the trunnions of the cradle and rests on the pintle bearing. It bears on circular bronze slides in the upper part of the pintle bearing and is centered on a bronze pintle collar of the pintle bearing.

(5) *Pintle bearing.*—The pintle bearing supports the top carriage, equalizing pinions and equalizing gears, and axle arms, the latter being shrunk and pinned to the pintle bearing.

(6) *Equalizing gear.*—(*a*) The object of the equalizing gear (KB76B, figs. 8 and 9) is to increase the stability of the carriage on the wheels in firing at different elevations. The equalization gear is an H-section with a bevel-toothed sector on each end and a bronze bushed bearing in the center.

(*b*) It bears over the vertical journal below the pintle bearing and is held in place by the equalizing gear support (KB32K) screwed inside the journal.

(*c*) Vertical deflection is prevented by the equalizing gear studs (KB32B, fig. 9) which are fixed to the pintle bearing by hexagon shoulders and nuts passing through slots in the equalizing gear. The gear is supported on the shoulders of the studs.

(*d*) Equalizing pinions (KB32D, figs. 8 and 9) are bevel pinion sectors, bronze bushed, bearing over arms of the pintle bearing. They have lugs for trail connection bolts. The pinions are held in place by locking rings screwed over the axle arms and are free to revolve about the pintle bearing arms. The equalizing pinions mesh with the equalizing gear.

(*e*) When the carriage is laid at a cant it is more unstable than when the wheels are level. If fired under this condition, the force of recoil tends to overturn the carriage. The function of the equalizing gear is to overcome this tendency. In firing, stresses are transmitted to the trails, and the side on which the lesser stress is exerted tends to rise. This motion is transmitted through the equalizing pinion and equalizing gear to the equalizing pinion on the other side, applying downward force on this trail and preserving the stability of the carriage.

(7) (*a*) *Angle of site mechanism.*

1. The angle of site mechanism is designed to give the gun a maximum depression of about −7° and a maximum elevation of +11°, independent of the elevating mechanism. The mechanism is operated by two handwheels, one on either side of the carriage.

2. The handwheel on the right side operates through the bevel gear on the handwheel shaft and an intermediate shaft, both mounted in the angle of site bracket, right, and angle of site cross shaft, right, mounted in bronze bushings in the top carriage. The handwheel on the left side operates through bevel gears on handwheel shaft mounted in angle of site bracket, left, and angle of site cross shaft, left, mounted in bronze bushings in the top carriage. Bevel gears on ends of both angle of site cross shafts mesh

with bevel gears on angle of site worm, which is mounted in bushings in top carriage and held in place by angle of site worm caps. This worm meshes with teeth cut in the rocker.

3. The rocker (KB34D, figs. 9, 15, and 16) is a U-shaped piece with bearings at the top of both arms and teeth cut in bottom of U. The bearings bear over and are free to revolve about trunnions on the cradle independent of the trunnion bearing in the top carriage. The top half of the right bearing is formed by the right rocker arm which extends back and carries the angle of site scale (EA30H, fig. 16), range scale pointer (KB80C), rocker arm range scale pointer rack (EA4R), and level, and forms a bearing for the elevating handwheel shaft (KB81A, figs. 15 and 16). Rear of the right rocker arm (KB79A) is the rocker arm brace which is attached to the rocker arm and rocker (KB34D). The top half of the left bearing is formed by the left rocker arm, a diagonal arm extending upward to the rear to form a support for the sight. Movement of the angle of site mechanism is limited in elevation by the rocker stop bolt to the side of the rocker and in depression by a screw in the arc.

(*b*) *Elevating mechanism.*

1. The elevating mechanism (fig. 15) is designed to allow an elevation of the gun 42° independent of the angle of site mechanism. The mechanism is operated by one handwheel on the right side of carriage which is turned in a clockwise direction to elevate the gun.

2. The elevating mechanism is operated through bevel gears on the elevating handwheel shaft (KB81A, figs. 15 and 16) mounted on the right rocker arm (KB79A), elevating intermediate handwheel shaft (KB81C) inside the rocker arm brace, elevating cross shaft (KB81B) mounted in the elevating cross shaft bearing (KB61C, figs. 8, 15, and 16) bolted to the rocker, and the elevating worm (KB50A, figs. 7, 15, and 16) which meshes with the elevating arc bolted to the bottom of the cradle.

(*c*) *Operation of angle of site and elevating mechanisms.*

1. Angle of site mechanism (fig. 14) is operated by turning the handwheel, the movement of which is transmitted through shafts and gears to the angle of site worm (KB90F, figs. 7, 14, and 17) meshing with the rocker (KB34D, figs. 9,

15, and 16). Movement of the rocker is transmitted directly through the elevating worm (KB50A, figs. 7, 15, and 16), elevating arc (57A) and cradle to the gun, and through rocker arms to the elevating mechanism and sight support. The angle of site mechanism thus moves the elevating mechanism rocker, cradle, gun, and sights.

2. The elevating mechanism through movement of the handwheel moves only the gun and cradle, shaft, and elevating worm inside the rocker which meshes with the elevating arc.

3. The angle of site scale (EA30H, fig. 16) is graduated in mils from 170 to 500. The range scale is graduated in meters. The zero setting of the gun is with 0 on the range scale opposite 300 on the angle of site scale and level bubble on the right rocker arm. This allows the maximum depression of −7° (about 130 mils) or maximum elevation of +11° (about 200 mils) of angle of site mechanism to be read on angle of site scale against zero on the range scale.

4. The sight, M1916, which acts as a support for the panoramic telescope, is attached to the left rocker arm.

5. In direct fire the axis of the bore is brought on the line of site by operating the angle of site handwheel until the cross hairs of the panoramic telescope are on the target, and the range is laid off independently by bringing the desired range graduation opposite 300 on the angle of site scale. The line of site may be set independently of range as there are two angle of site handwheels.

6. In indirect fire the angle of site in mils is laid off on the angle of site scale with the pointer, and the desired range graduation brought opposite the pointer by means of the elevating handwheel.

(8) *Traversing mechanism.*—(*a*) The total traverse of the gun on the carriage is 800 mils, or 400 mils each side of center. The traversing handwheel is located on left side of the carriage and turns in a clockwise direction for left traverse or in the opposite direction for right traverse.

(*b*) The traversing handwheel shaft (KB36H, fig. 18) is mounted in the angle of site shaft left bracket (KB46D, figs. 14, 17, and 18) and angle of site bracket left cover (KB46A, figs. 17 and 18). A bevel pinion on the upper end of the shaft meshes with a bevel gear on the traversing intermediate shaft (KB36B, figs. 9, 17, and 18) which

bears in the angle of site cross shaft gear left cover and intermediate traversing shaft bearing (KB38A) bolted to the top carriage. A bevel pinion at the lower end of the traversing intermediate shaft (KB36B) meshes with the bevel gear on the end of the traversing worm shaft (KB36D, figs. 9 and 18) which is mounted in the bearing in the top carriage. The traversing worm (KB36A, figs. 9, 17, and 18) meshes with the traversing rack which is screwed to the pintle bearing. Traversing and elevating stops (KB37E, fig. 18) which are fillister-head screws between the end teeth of the traversing rack limit movement of the worm meshed in the rack.

(*c*) The movement of the handwheel is transmitted through shafts and bevel gears to the worm and rack. The rack is mounted in the pintle bearing which remains stationary, and the top carriage revolves about its bearing in the center of the pintle bearing and bronze-lined slides around the outside of pintle bearing. The azimuth scale (KB37B, fig. 18) is screwed to the pintle bearing above the rack, and the pointer is formed on the traversing worm shaft bearing.

(9) *Brake mechanism* (fig. 10).—(*a*) The brakes are of the internal expanding type. The brake shoes (B145080) are connected to cam shafts and are actuated by the hand brake levers.

(*b*) The movement of the brake levers is controlled by the brake lever catch engaging the teeth of the brake segment rack assembled to the wheel spindle bracket.

(*c*) The brake shoe is a flanged segment, the outer diameter of which is covered with a brake lining secured by rivets. When the brake shoes are secured to the brake housing plate assembly by the brake cam roller pin (B144962) and brake shoe link pin (B144975), and connected with the brake shoe adjusting wedge (B144959) by the brake shoe links (B144960) and brake cam roller (B144955), they are held in contact with the brake cam (B144968) by the three brake shoe retracting springs. The assembly is designated as the brake.

(*d*) When engaging the brake the movement of the hand brake levers rotates the brake cam, causing the brake cam rollers (B144955) to ride toward the high point of the brake cam, and thereby forces the brake shoe against the brake drum secured to the hub of the wheel.

(*e*) When the hand brake levers are released, the tension on the brake shoe retracting spring is likewise released. This action forces the brake cam rollers to the low point of the brake cams and thereby releases the pressure of the brake shoes against the brake drums.

(10) *Disk and rim wheel.*—The wheel assembly consists of a 24 by 6 automobile disk and rim wheel, with locking ring, mounting a 7.50–24

truck and bus balloon type B pneumatic automobile tire, with a puncture sealing truck and bus balloon compression type 1, 7.50–24 automobile inner tube. The tire is secured to the rim by the tire locking ring. The rated capacity of the tire as given in Federal Specification No. ZZ–T–381a is 2,400 pounds tire load at 55 pounds air pressure. As used on these carriages the tire load is approximately 1,500 pounds but is all unsprung weight. Therefore, for carriage stability and to reduce wear and tear in the carriage, the air pressure is fixed at 35 pounds cold pressure. The air pressure should be checked and recorded at each inspection.

(11) *High-speed adapter.*—(*a*) The high-speed adapter consists of the left- and right-wheel spindle bracket assembly, disk and rim wheel group assembly, brake mechanism assembly, hand brake lever, and ratchet racks.

(*b*) The left- and right-wheel spindle brackets are mounted on the axle arms attached to the pintle bearing and are clamped to the axle arm by cap screws and bolts.

(12) *Shoulder guards.*—Shoulder guards are small shields pinned into sockets in the firing shaft bracket and the range scale bracket to protect cannoneers from the recoiling gun.

(13) *Shields.*—(*a*) Shields are designed to provide protection for the cannoneers when under fire.

(*b*) The main shield is divided into two parts which are attached to shield brackets bolted to the pintle bearing.

(*c*) The top shield is hinged to the top of the main shield and may be raised or lowered as required.

(*d*) An apron is hinged to the bottom of the main shield and may be lowered when in firing position or raised when traveling.

(14) *Exterior firing mechanism.*—(*a*) The exterior firing mechanism is secured to the left side of the cradle by the firing shaft bracket.

(*b*) When the firing handle is pulled the motion is transmitted through the firing link to the firing shaft, which moves to the rear, and the firing shaft pawl engages the trigger shaft (7D, fig. 4) so that a slight additional pull fires the gun. When the gun is more than an inch out of battery the sloping face of the return catch (A12727) is not engaged with the slope on the firing shaft bracket, but is forced down by its spring and engages the undercut groove in the end of the firing shaft and stops further movement of the firing shaft in that direction.

14. Gun carriage, M1916MIA1.—*a.* As the gun carriage, M1916MIA1, is similar to the carriage, M1916A1, their main differences

being in the type of recoil and counterrecoil systems, description only of the recoil mechanism is given below.

b. (1) The recoil mechanism is hydropneumatic, known as the St. Chamond type. The use of small forgings was made possible by introducing high pressure in the recuperator and recoil cylinders.

(2) The mechanism consists of three cylinders. The middle one is the recoil cylinder. The right cylinder has an air reservoir at its forward end and an oil reservoir at its rear end. The left cylinder is the recuperator cylinder, having at its forward end an air space and at its rear end a regulator for controlling the length of recoil. A floating piston in this cylinder separates the air from the oil.

(3) In recoil the gun moves to the rear, carrying with it the recoil piston. The recoiling parts are held in battery by the reaction of the air on the floating piston which is transmitted through the liquid against the leak-tight recoil piston. The energy of recoil is absorbed by the throttling of the oil through a spring-controlled orifice in the regulator valve.

(4) An opening is provided between the recoil and the recuperator cylinders to house the regulator valve. During recoil the pressure in the recoil cylinder opens the regulator valve, the movement of which is controlled by a helical spring and a number of Belleville springs. The oil passing through the orifice controlled by this valve moves the floating piston forward against the air pressure, thereby storing up energy to return the gun from the recoiled position to its position in battery. The valve in the counterrecoil orifice remains closed during recoil.

(5) Throttling during recoil is controlled by the regulator valve consisting of an upper and lower valve stem. The lower valve stem is sealed in a circular seat at the entrance channel to the valve. As the valve lifts, the throttling area becomes the vertical circumferential area between the valve and its seat. In long recoil the movement of the valve is controlled by a spiral spring which rests on the lower valve stem. The upper stem rests in a valve housing and has Belleville springs reacting on the stem only. To move the upper valve stem, the whole housing is lowered automatically by a cam operated when elevating the cradle. At short recoil the upper stem of the regulator is brought down by the cam until its lower surface is in contact with the top surface of the lower valve stem, thus controlling the throttling of the valve.

(6) The regulator valve is closed during the counterrecoil movement, except for a very small constant opening. During counterrecoil there is also a second path for the flow of oil through a small

channel beginning at the inside of the buffer chamber in the recuperator cylinder, and finally emptying into the recoil cylinder through a bypass around the regulator valve. Near the end of counterrecoil the tapering buffer rod on the floating piston in the recuperator controls the flow through the second path by causing additional throttling through the small annular area between the buffer chamber and buffer rod, thus bringing the recoil parts to rest without any great amount of shock.

SECTION IV

DISASSEMBLING AND ASSEMBLING

15. Firing mechanism (fig. 4).—*a. Disassembling.*—(1) This may be done either when the breechblock is mounted or dismounted. Remove the trigger shaft detent (7F) and trigger shaft (7D), unscrew the breechblock face plate (8P) with the teat wrench provided and pull the firing mechanism out with the fingers. Remove the firing arm (8N), insert the flat end of the trigger shaft (7D) in the slot in the firing spring shoe (8E), push down and turn clockwise to disengage the pin on the shoe from the shoulder in the slot in the firing pin (8D). This releases the shoe from the firing pin and the shoe and firing spring may be removed. The sear and sear spring are removed from their recess.

(2) In order to facilitate assembly and disassembly a small hole has been drilled and tapped in the sear and firing spring shoe into which the end of the trigger shaft detent may be screwed when difficulty is experienced in assembling or disassembling these parts.

b. Assembling.—Place the firing spring (8F) in the firing pin (8D). Place the firing spring shoe (8E) over the end of the firing spring, engage the flat end of the trigger shaft (7D) in slot in the firing spring shoe and turn so that the pin on the shoe is opposite the rear end of the slot in the firing pin. Push down on the firing spring shoe until the pin on the shoe is opposite the shoulder in the slot in the firing pin. Turn the firing spring shoe counterclockwise until the pin engages the forward end of the shoulder in the slot, and lock the parts together. Insert the end of the firing arm (8N) through the slot in the firing pin. Place the sear spring (A12222) in the sear and put the sear (8L) and spring in place either by removing the sear spring seat (7E) which closes the left end of the sear hole or by using a knife or small pair of

pliers and inserting from the firing pin hole. Insert the assembled firing mechanism in the recess in the breechblock and assemble the breechblock face plate by screwing it home. This completes assembly of the firing mechanism with the exception of the trigger shaft which must be assembled when the breechblock is mounted in the breech recess.

16. Breech mechanism (fig. 4).—*a. Dismounting and disassembling.*—Remove the trigger shaft detent cotter pin and trigger shaft. Remove the operating shaft detent (A12726) by pulling its upper end to the right until the small pin is released from its seat, then rotate it to the rear until it comes clear of the operating shaft (6B). Remove the tension from the closing spring (9C) by unscrewing the lock and spring piston rod nut (9D). Disconnect the closing spring by removing the small connecting pin. Place a block of wood under the breechblock to hold it in position. Remove the operating handle (6C) from the operating shaft (6B). Pull the operating shaft out to the left. Push up on the breechblock until it is ¼ inch above its closed position and remove the operating arm. Allow the breechblock to slide downward until it clears the breech recess and remove the breechblock. Withdraw the taper key (A12732) from the closing spring case (6D) and push the case to the front and off its seat. The closing spring piston rod (9B), spring piston (9F), and chain (9A) can be withdrawn from the closing spring case. The extractor plungers (8S) and springs (8Q) are removed by unscrewing the two extractor plunger plugs (8R) from the breechblock. Care must be used to prevent these plugs from being thrown to the rear when they are removed.

b. Assembling and mounting.—The firing mechanism having been assembled in the breechblock, place the trunnions of the extractors (7C and 7B) in their respective recesses, insert the extractor plungers (8S) and plunger springs (8Q) and place the plunger plugs (8R) in the ends of the plunger springs (8Q) in the breechblock. Compress the plunger springs and screw the plunger plugs home. Place the outer end of the operating arm in the slot in the breechblock, insert the breechblock in breech recess from the bottom, and push up until ¼ inch above the closed position, then push the operating arm (6A) into its seat in the breech recess. Insert the operating shaft (6B). Assemble the operating handle (6C) on the end of the operating shaft (6B). Place the fork of the operating shaft detent (A12726) in the groove in the operating shaft and rotate the detent until it locks in place. Assemble the closing spring (9C), spring piston rod (9B), and chain (9A) within the closing spring case (6D), and assemble the spring

piston rod nut (9D) and lock nut (9H) to the spring piston rod. Assemble the closing spring case in position on its dovetail seat and insert the spring case key. Connect the closing spring chain to the operating handle. Screw up on the spring piston rod nut until the spring is compressed to about 14 pounds pressure. Place the trigger shaft in its hole in the breechblock and into the square hole in the firing arm and then push the trigger shaft detent home.

17. Counterrecoil springs.—*a. Removal.*—Close and lock the trails together. Set brakes and drive one spade into the ground to secure the carriage.

(1) (*a*) Remove the breechblock (see par. 16).

(*b*) Attach the spring compressor to the right spring rod by screwing the stud into the spring rod.

(*c*) Secure the single sheave tackle block issued with battery accessories to a fixed point such as a "dead man" or tree. The holding power of this point must be greater than the power of the compressed counterrecoil springs. The block should be on a plane with the center of the spring rod.

(*d*) Sufficient slack of rope must be allowed to permit the spring compressor to travel the full length of the spring cylinder and be detached from the spring rod at the front end.

(*e*) Open the spring cylinder cover.

(*f*) Retract the spring rod about 6 inches, remove the cotter pin from the spring rod key, and drive out the key with a bronze drift.

(*g*) Slack off on the pull rope until the counterrecoil springs are no longer under compression. Draw the spring rod out of the front end of the spring cylinder, detach the spring compressor, and remove the counterrecoil springs.

(2) Attach the spring compressor to the left spring rod and proceed as with the right.

b. Assembling.—In assembling the counterrecoil springs proceed in the reverse order of removal. The following precautions must be observed:

(1) If the tension of the spring compressor should bring the spring rod up solid against the spring cylinder bushing in rear of spring cylinder, ease off on the pull rope slightly and pry up the rod with bronze drift until the rod will enter the bushing.

(2) Before the key slot enters the breech lug see that keyways in spring rods and keyway in breech lug are in line. If not, turn the spring rod by means of a drift until keyways are in line.

SECTION V

INSPECTION AND ADJUSTMENT

18. Gun.—The following instructions with reference to the inspection of the gun carriage and recoil mechanism should be observed scrupulously by all concerned:

Parts to be inspected in order of inspection	Points to observe
a. The gun as a unit.	*a.* Note general appearance; smoothness of operation of the breech mechanism in opening and closing. Note the action of the operating handle latch when pressed by the fingers. Test the action of the firing mechanism with the lanyard. Disassemble the breech mechanism and thoroughly clean it. Notice the condition of the bore for copper deposits on the lands and in the grooves; erosion at rifling. Examine the breech recess and note whether there are scores or burs on the bearing surfaces.
b. Breechblock.	*b.* Note whether there are scores or bruises on bearing surfaces and that the vent hole is clear.
c. Firing mechanism.	*c.* Disassemble the firing mechanism and see that it is thoroughly clean and lubricated and that all parts are free of burs.

19. Carriage.

Parts to be inspected in order of inspection	Points to observe
a. The carriage as a unit.	*a.* Note the general appearance, whether the carriage is painted in accordance with regulations, including grease and oil cups, oil plugs and oil hole covers, and that all moving parts are properly lubricated.
b. Elevating mechanism.	*b.* Elevate and depress the gun through the full extent of its travel. Note

	whether the mechanism operates without binding or undue backlash.
c. Traversing mechanism.	*c.* Traverse the carriage through the full extent of its travel. Note whether the mechanism operates without binding or undue backlash.
d. Brake mechanism.	*d.* Test the brakes by placing the carriage in firing position, the wheels clear of the ground. Set the hand brake levers. Note position of plunger latch on brake segment rack. If plunger latch is in last tooth of rack the brake shoe should be adjusted. Release the hand brake lever to its off position. Note whether wheel revolves freely without drag.
e. Disk and rim wheels.	*e.* (1) Examine the disk and rim wheel nuts. Note condition, and whether they are set up tight. Note whether the rim of the wheel is deformed. (2) Examine the tire. Note whether the crown of the tire is taking the wear. If worn on either side of the crown, test alinement of wheels.

20. Recoil mechanism, M1916A1.

Parts to be inspected in order of inspection	Points to observe
a. Valve turning mechanism.	*a.* (1) Elevate the gun. Note whether the piston rod turns. (2) Note if oil is leaking at the piston rod gland; if so, tighten slightly on the gland. (3) Note whether oil cup is functioning properly, and whether the bearing surfaces of the piston rod and piston rod sleeve are being lubricated.
b. Recoil oil.	*b.* Elevate the gun to zero elevation, remove the two filling plugs on top of recoil cylinder. Note whether oil is level with top of cylinder. If not, add recoil oil to the mechanism.

21. Recoil mechanism, M1916MIA1 (St. Chamond).—Points to observe during firing:

a. Watch the length of recoil. The normal recoil at 0° elevation is 45.67 inches, and at 53° elevation, 22 inches. The time of recoil and return to battery under normal conditions is 3 to 5 seconds.

b. Note the action of gun in recoil to see that its movement is uniform. Should the gun jump or jerk in returning to battery, it probably indicates the presence of air in the oil in the recoil and recuperator cylinders.

c. Note the action of the variable recoil mechanism and see that the lug operating in the camshaft slot functions properly.

d. If the gun returns to battery with a decided shock it indicates that there is too much reserve oil and the reserve should be drained gradually until the action is smooth. Continued firing will cause the oil to expand. This condition will have to be taken care of by draining off the excess oil. When firing ceases and the mechanism has cooled, a new reserve of recoil oil must be pumped into the mechanism until the oil gage rack is flush with the face of the oil gage follower.

e. After firing, inspect to see that no clear oil is leaking from the rear end of the recoil or recuperator cylinders. Open the recoil cylinder front head. See if there is clear oil at this point. If clear oil is found at either place notify the ordnance maintenance company.

22. Verification and adjustment of the sights.—*a. General.*—(1) Battery mechanics are forbidden to disassemble any part of the panoramic telescope and will make only such adjustments as are hereinafter prescribed. Adjustments are to be made only with tools provided by the Ordnance Department for that purpose and in the presence of a commissioned officer. Any difficulties which cannot be corrected by the methods herein described should be reported to the ordnance maintenance company.

(2) When out of adjustment the panoramic telescope will cause inaccurate firing and therefore should be verified and adjusted frequently. A testing target is provided for verifying the telescope.

b. Verification.—The procedure of verification is as follows:

(1) Place the carriage in firing position.

(2) Level the carriage transversely with the aid of the gunner's quadrant. With the gunner's quadrant on the leveling plates level the gun in a horizontal plane.

(3) Set the cross level bubble of the M1916 sight.

(4) Open the breech and insert the bore sight. Place the black cord in the horizontal and vertical lines on the muzzle face, and strap in position.

(5) Place the testing target at a distance of 54 yards in a plane perpendicular to the bore of the gun and at a height where the axis of the bore passes through the center of the target marked "bore". The target should be checked by means of a plumb bob. The target is moved vertically until the vertical line through the target and the vertical cord on the muzzle of the gun coincide.

c. Adjustment.— (1) With the panoramic telescope mounted in the socket of the M1916 sight, set the azimuth scale and elevation micrometer of the panoramic telescope at zero. With the telescope thus arranged, the line of sight should pass through the center line of the target.

(2) If the line of sight pierces the target above or below the horizontal center line, it indicates that the elevating knob of the panoramic telescope is out of adjustment. Operate the elevating knob until the line of sight pierces the target on the horizontal center line. Loosen the elevating knob locking screw and turn the elevating knob without turning the elevating worm until the index on the rotating head points to zero. Tighten the locking screw.

(3) If the line of sight pierces the target to either the right or left of the vertical center line of the target, and the azimuth micrometer index reads zero, elevate and depress the gun, noting the angular differences. Loosen the micrometer locking screw, and with the teat wrench provided for the purpose turn the index one-half the difference of the angular errors, at the same time holding the scale to prevent it from turning. Tighten locking screw.

(4) After the panoramic telescope is adjusted it should be submitted to the following test for accuracy at extreme elevation and azimuth:

(*a*) With the carriage level and the gun and panoramic telescope at zero elevation and deflection, see that the line of sight and axis of the bore prolonged strike the target at the proper point.

(*b*) Elevate the gun to its maximum elevation without altering the elevation of sight. As the elevation of the gun is altered, the line of sight should follow the vertical line of the testing target.

(*c*) With conditions as in (*a*) above, traverse the gun to its extreme position in azimuth. As the deflection is altered the line of sight should follow the horizontal line of the testing target.

SECTION VI

FUNCTIONING

23. General.—The functioning of the matériel as a whole and of the groups is so closely allied with description and operation and description of groups that it has been included in sections II and III and is not repeated hereunder.

24. Malfunctions of gun.—Abnormal conditions and their correction.

Malfunction	Cause	Correction
a. Fails to fire.	*a.* (1) Broken or weak firing spring.	*a.* (1) Remove firing mechanism and disassemble, wash parts in dry cleaning solvent, remove all burs with an oilstone or smooth file. Replace broken or damaged parts.
	(2) Broken or deformed point on firing pin.	(2) Replace firing pin.
b. Failure to extract cartridge case.	*b.* (1) Broken extractors.	*b.* (1) Ram the cartridge case gently from the muzzle. Examine edge of chamber for deformation. Disassemble mechanism and replace broken extractors.
	(2) Broken or weakened extractor plunger springs.	(2) Unscrew plunger plugs and replace defective springs.
c. Breechblock fails to rise when extractors are pushed forward.	*c.* Broken closing spring, chain, or stud link pins.	*c.* Unscrew piston rod lock nut and piston rod nut and remove spring piston rod and replace broken parts.

Malfunction	Cause	Correction
d. Breechblock fails to rise to the fully closed position.	*d.* (1) Lack of compression of closing spring.	*d.* (1) Loosen piston rod lock nut and increase the compression of the closing spring by screwing up on the piston rod nut. Set up on piston rod lock nut.
	(2) Weakened closing spring.	(2) Replace closing spring.
	(3) Lack of lubrication on sides of breechblock.	(3) Clean and lubricate breech recess and breechblock.
	(4) Burs or roughened surfaces on sides of breechblock, breech recess, operating shaft, or operating cam.	(4) Do not operate mechanism. Notify ordnance maintenance company.
e. Operating handle latch fails to operate.	*e.* Broken latch spring, broken operating latch, or bent or broken latch pivot.	*e.* Remove latch pivot and latch and replace broken parts.

25. Malfunctions of carriage, M1916A1.

Malfunction	Cause	Correction
a. Gun fails to return completely into battery.	*a.* (1) Weak or broken counterrecoil springs.	*a.* (1) Disassemble spring cylinder and replace broken springs.
	(2) Expansion of recoil oil.	(2) Open the filling plug and allow excess oil to escape.
	(3) Lack of lubrication on gun slides and cradle ways.	(3) Lubricate all exposed bearing surfaces.
	(4) Piston rod gland too tight.	(4) Loosen piston rod gland.

26. Malfunctions of carriage, M1916MIA1.

Malfunction	Cause	Correction
a. Oil leaking into front of recoil cylinder.	*a.* Failure of piston packing, or wear of cylinder wall.	*a.* Notify the ordnance maintenance company.
b. Oil leaking around oil index.	*b.* Failure of packing.	*b.* Notify the ordnance maintenance company.

Malfunction	Cause	Correction
c. Oil gage rack not functioning.	*c.* Index stuck.	*c.* Drain off about one-half pint of reserve oil, then pump sufficient oil into the mechanism to move the oil gage rack. If rack does not move notify the ordnance maintenance company.
d. Failure of gun to return to battery.	*d.* Insufficient oil reserve.	*d.* Drain reserve oil until oil gage rack moves to the bottom of its recess, then pump sufficient oil to bring the oil gage rack flush with the face of the oil gage follower.
e. Failure of gun to return into battery (oil gage rack showing sufficient reserve oil).	*e.* (1) Low nitrogen pressure.	*e.* (1) Notify the ordnance maintenance company.
	(2) Excessive friction.	(2) Notify the ordnance maintenance company.
f. Return of gun to battery with a shock.	*f.* Too much reserve oil.	*f.* Drain off reserve oil until oil gage rack moves to the bottom of its recess, then pump sufficient oil into the reservoir to bring the oil gage rack flush with the face of the oil gage follower.

SECTION VII

CARE AND PRESERVATION

27. Gun.—*a. General.*—(1) Whenever the rate of fire permits, it is important that the cannoneer look through the bore before loading to ascertain that no particles of the cartridge case, wadding, or unburnt powder remain in the bore. The presence of such particles causes imprints in the bore and sometimes premature explosions. During night firing the sponge should be used between rounds.

(2) When shells burst near the gun, make sure before firing that neither the exterior nor the muzzle face of the bore have been struck by the fragments. Any injuries affecting the bore of the gun are likely to cause the tube to split if the gun is fired. Bulges at any part of the gun or any unusual condition which appears should be reported at once to the ordnance inspector of artillery.

(3) In cleaning after firing, wash the bore with a solution made by dissolving ½ pound of soda ash or 1 pound of sal soda in 1 gallon of water, using the sponge for swabbing purposes. Wipe perfectly dry, using the sponge covered with burlap, and then swab the bore with a light coating of rust preventive compound, applying it with the slush brush.

(4) The surface of the leveling plates should be protected from injury. Do not lay tools or other articles upon their surfaces. In case of injury, repairs must be made by the personnel of the ordnance maintenance company.

(5) If the matériel is to be left unused for any considerable length of time, the bore of the gun, breech mechanism, and all bright and unpainted surfaces should be cleaned thoroughly with dry cleaning solvent so as to be free from rust, water, and lubricating oil before coating the surfaces with rust preventive compound. The various covers must also be placed in position.

(6) Lubrication instructions for the various parts of the gun are given in paragraph 31.

b. Breech mechanism.—(1) The breech mechanism should be kept clean and the parts well lubricated at all times. The mechanism should be disassembled periodically when not in use to discover if any rust is forming. When in use it should be disassembled at frequent intervals, cleaned, and oiled, and should always be so cared for immediately after each firing period.

(2) Do not use a steel hammer directly on any part of the breech mechanism. A copper drift or hardwood block should be interposed or a copper hammer used to prevent deforming the parts.

(3) Vigilance must be exercised to detect any cuts or abrasions forming on the bearing surface of the breech recess and breechblock. If the breechblock does not operate smoothly it should be examined

and scoring or bruises should be removed by the ordnance maintenance company.

c. Firing mechanism.—(1) The firing mechanism parts require the same careful attention as the breech mechanism, and should be disassembled frequently from the breechblock for cleaning and oiling.

(2) Wear in the firing mechanism is almost negligible except for deformation of the firing pin. Such deformation may become so great as to prevent the firing pin striking the primer. If the firing pin is examined after each firing period it can be anticipated when replacement is necessary.

(3) To remove rust preventive compound from matériel taken from temporary storage, the greater part should be scraped off and the balance removed with a rag or cotton waste dipped in dry cleaning solvent.

28. Carriage.—*a.* The carriage cannot be kept in serviceable condition unless proper attention is given to cleaning, lubrication, and loose or broken parts. The subject of lubrication, together with the method and frequency of application, is covered in detail in paragraph 31.

b. All bearing surfaces, revolving parts, springs, gear teeth, and brake mechanisms must be kept clean and as free from dirt as possible. Special attention should be given to the elevating arc to see that it is clean and free of grit and oil as this condition forms an abrasive causing the teeth to wear and thereby creating excessive backlash.

c. Brake mechanism.—(1) The proper functioning of the brake is of vital importance. A freely operating brake insures a long period of operation before readjustment becomes necessary.

(2) Brake adjustment is accomplished by rotating the brake shoe adjusting wedge (B144959, fig. 10) which extends to the outside of the brake housing plate. The exposed end of the adjusting wedge is machined with a square for turning with a wrench in the direction desired.

(3) The correct procedure for adjusting the brake is as follows:

(*a*) Set the hand brake lever at its full released position.

(*b*) Jack up the wheel.

(*c*) Adjust the brake adjusting wedge until a drag is felt on the wheel. Then back off just enough so that the brake does not drag. Brake must be cold when making this adjustment.

(*d*) The position of the hand brake lever can be adjusted by removing the cotter pin (BFAX1CG) and nut (BBFX1C) on screw (BCBX7CF) in the end (B150585) of the lever (C64752, fig. 5).

d. Wheel bearings should be adjusted to prevent brake drag due to loose bearings.

e. The brake camshaft is lubricated through a buttonhead fitting. Lubrication must be held to the correct amount to avoid the brake lining becoming saturated with oil or grease. This condition will demand heavy brake handle pressure and the premature replacement of brake linings.

29. Recoil mechanism, M1916A1.—*a. Before and during firing.*—(1) Before firing, the recoil mechanism should be examined for leakage of oil, proper amount of recoil oil (U. S. A. spec. 2–96) in the recoil cylinder, and to see that the valve turning mechanism is performing its function.

(2) During firing, the action of the recoil mechanism should be noted and the following conditions checked:

(*a*) That gun recoils its prescribed distances at all elevations.

(*b*) That gun returns to battery without excessive shock.

(*c*) Leakage of oil from the filling plugs, drain hole, and piston rod gland.

b. Draining.—Elevate the gun to about 5° and remove the forward filling plug. Remove the drain plug and allow the oil in the cylinder to drain into a clean receptacle. Replace drain plug.

c. Filling with recoil oil.—(1) Elevate the gun to about 5°. Remove both filling plugs. Pour in recoil oil slowly with the aid of a funnel until it appears at the rear filling hole. Replace rear filling plug, and continue to fill the cylinder slowly until the oil appears at the top filling hole. Depress gun to zero elevation. Remove the rear filling plug and continue to fill the cylinder, shaking the carriage gently until air ceases to come out of the cylinder. When the oil is level with both filling plug holes replace the filling plugs.

(2) Depress the gun to about −5° and remove the valve turning gear cover. Remove rear filling plug. Loosen filling plug in the end of the piston rod sufficiently to allow oil to drop out. As soon as the oil starts to drip, tighten filling plug. Again level the gun and rock the carriage to permit air to escape and replace rear filling plug. Remove the front plug and add recoil oil if required. Again rock the carriage until all air in the cylinder has escaped. Replace the front filling plug.

(3) Elevate the gun to 5° elevation and allow to stand in this position for about 5 minutes. Remove the front filling plug and again refill the cylinder with recoil oil. Loosen the drain plug and drain out about ¼ gill of oil. Tighten drain plug and replace front filling plug.

(4) About 4 quarts of recoil oil are required to fill the recoil cylinder.

30. Recoil mechanism, M1916MIA1 (St. Chamond) (fig. 13).—Before firing, the recoil mechanism should be examined for leakage of oil, for proper amount of oil reserve, and for leakage of air past the floating piston.

a. Oil reserve.—The oil gage rack (17B) indicates the "oil reserve," or the amount of reserve oil which keeps the floating piston apart from the regulator.

(1) The movement of the oil gage rack (17B) is at right angles to the floating piston. When the oil gage rack is flush with the end or slightly beyond the face of the cylinder, a full reserve is indicated. Reserve oil must be added when the oil gage rack is ¼ inch below the face of the oil gage follower (18E).

(2) To add reserve oil to the system unlock the handle extension of the pump with wrench (DP33A). Make sure there is sufficient oil in the oil reservoir by removing the oil index head assembly and note the height of oil on the index. If the oil in the reservoir registers less than half full, add recoil oil in order to be sure to cover the intake valve of the pump. Start stroking the pump. Should it require priming, open the air valve located in the end of the pump piston by pressing on the air valve button, while operating the pump handle, until oil flows from the end of the pump piston. Pump oil into the system until the oil gage rack is flush with or slightly beyond the face of the oil gage follower.

(3) When in doubt as to the amount of reserve oil in the system, always draw off the existing reserve by inserting the drain valve release in the drain plug hole on the left rear side of cradle.

NOTE.—The leather gasket should remain in the recess of the drain hole.

(4) The condition of the oil should be noted. Emulsified oil indicates a defective floating piston.

b. To exercise the floating piston.—(1) Draw off the reserve oil with drain valve release. Close the drain valve by unscrewing the drain valve release.

(2) Move the floating piston forward by pumping excess reserve oil into the mechanism. This will require approximately 150 full strokes of the pump handle.

(3) Drain off the oil. Repeat the operation three times.

(4) Reestablish the proper reserve.

NOTE.—The gun need not be disconnected.

31. Lubrication instructions.—*a. Gun and carriage.*—The life of the matériel depends to a great extent on proper lubrication. Particular attention should be given to the lubrication of sliding surfaces of the breech mechanism and other sliding surfaces that may not contain oil holes, oil cups, or fittings.

(1) Grit must be kept out of lubricating openings and the lubricant. In cleaning oil cups and open oil holes the necessary wiping should be done with a piece of firm cloth, and no lint should be allowed to remain in any orifice. Open oil holes which have become clogged with congealed oil should be cleaned with a piece of wire.

(2) Oil and grease should be applied while the parts are being maneuvered to insure distribution of lubricant to all moving parts.

(3) The teeth of the elevating and traversing arc should be cleaned with dry cleaning solvent before new grease is applied.

(4) Wheel hubs are packed with grease at assembly and should be cleaned and repacked every 6 months of continuous use.

(5) The various lubricants and cleaning and preserving materials issued by the Ordnance Department and their uses are described in TR 1395–A.

b. Chart.—The following chart gives the location, lubricant, amount, frequency, and method of application of lubricants.

c. For oiling gun slides, breechblocks, elevating and traversing mechanisms, etc., when the temperature is 50° F. or above, oil, lubricating, class D, SAE 50, will be used, and SAE 20 when the temperature is below 50° F.

LUBRICATION CHART

Fig.	Location	Type of oiler	Lubricant	How applied	Remarks
4	Breech mechanism (bearing surfaces).	Brush	Oil, lubr., cl. D, SAE 50 or SAE 20.	Brush	Daily and after firing.
4	Operating handle latch	do	do	Drops on pin	Weekly.
—	Piston rod bracket	Oil cup	do	Oiler	Do.
14	Angle of site worm	do	do	do	Do.
15	Rocker arm brace end, upper	do	do	do	Do.
9, 14	Angle of site bracket, right	do	do	do	Do.
9, 14, 18	Angle of site bracket, left	do	do	do	Do.
9, 14, 18	Angle of site bracket cover, left	do	do	do	Do.
8, 15, 16	Elevating cross shaft bearing	do	do	do	Do.
7, 15, 16	Elevating worm cap	do	do	do	Do.
17	Trunnion cap, right	do	do	do	Do.
17	Trunnion cap, left	do	do	do	Do.
15	Rocker arm cap	do	do	do	Do.
9, 17	Intermediate traversing shaft bearing.	do	do	do	Do.
9, 14, 17, 18	Top carriage	do	do	do	Do.
9, 15, 16	Rocker	do	do	do	Do.
7, 18	Pintle bearing	do	do	do	Do.
8, 9	Equalizing pinion, right	do	do	do	Do.
8, 9	Equalizing pinion, left	do	do	do	Do.
10	Brake cam shaft	B-hd. fitting	Grease, lubricating mineral, medium grade.	Grease gun	Do.
10, 11	Wheel hub (Remove wheel)	Hand pack	Wheel bearing grease	Pack	Every 6 months.

32. Paint.—For detailed information regarding the removal of old paint, cleaning and preparation for painting, preparing new paint, application and kind of paint for different surfaces, brushes, slushing oils, abrasives, burlap, etc., see TR 1395–A.

33. Protection and cleaning of matériel affected by gas.—*a. Protection against phosgene, chlorine, etc.*—(1) For matériel which is in constant danger of gas attacks, whether from gas clouds or gas shells, care will be taken to keep all bright parts of the guns, carriages, mountings, and accessories well coated with oil.

(2) Sights and all instruments also will be covered with oil and protected with covers when not in actual use, care being taken that the oil does not come in contact with any glass or find its way into the interior of the instruments.

(3) All uncapped fuzes or fuzes which have been removed from their containers will be wiped over with oil as soon as possible and protected with a cover.

b. Protection against mustard gas.—It must be remembered that practically all fabrics and materials such as wool, cotton, rubber, and oilcloth can be penetrated by mustard gas if exposed to it a sufficient length of time. The mustard gas is absorbed by these materials and penetrates them by a slow process of diffusion. In general, it may be said that the greater the length of time allowed for penetration the greater the danger in wearing these articles. For instance, rubber boots which have been worn in an area shelled heavily with mustard gas may be a grave danger to men who wear them several days after the bombardment. Fabrics thoroughly impregnated with boiled linseed oil will resist penetration by mustard gas for over an hour, but after this time these articles are dangerous because the mustard gas dissolves in the linseed oil and they must be destroyed.

c. Cleaning.—All bright parts of gun and carriages, together with all accessories and spare parts exposed to the gas, will be cleaned and wiped dry as soon as possible after the attack, and in any case within 24 hours, after which they will be thoroughly coated afresh with oil. The same applies to the whole of the ammunition still in the battery position. Ammunition which for any reason has not been oiled will be cleaned and oiled. It is desirable to expend it as soon as possible.

d. Disinfection of matériel of all kinds affected with mustard gas.—The following measures will be taken for the removal of mustard gas

from various materials and equipment (guns, projectiles, cases, wood, metals, rope, etc.) which have come in contact with mustard gas. For all of the operations indicated below, the gas mask and protective clothing, including protective shoes and gloves, must be worn.

(1) Commence by freeing the objects of dirt, lumps of earth, and liquid with wooden spatulas, rags, etc., which will be buried immediately after this operation. They must never be burned.

(2) Sprinkle a continuous layer of calcium hypochlorite, which is preferred if available, or else dry chloride of lime over the parts that lend themselves to this treatment. In the statements hereafter calcium hypochlorite is specified, but dry chloride of lime may be substituted in the event that calcium hypochlorite is not available. After 2 hours, or better after 6 hours, if practicable, wash off the layer of calcium hypochlorite and rinse thoroughly. It is imperative that all the calcium hypochlorite be removed in order to prevent the deterioration resulting from the prolonged action of the calcium hypochlorite. In the case of ammunition it is imperative to prevent particles of calcium hypochlorite from being introduced into the bore of the piece.

(3) Whitewash soiled parts which do not lend themselves to sprinkling with dry powder with a thick paste of calcium hypochlorite made from three volumes of calcium hypochlorite and one volume of water. After 2 hours, or preferably 6 hours, wash off the calcium hypochlorite.

(4) The delicate parts of the apparatus, such as breech mechanism, sighting apparatus, glasses, etc., which would be injured by calcium hypochlorite will be cleaned by dry polishing with rags. After this operation the rags will be buried.

(5) If there are large quantities of water at hand, in the place of calcium hypochlorite use water. The water should be warm, but not boiling, and large quantities should be used. This cannot be done in the case of greasy articles where only calcium hypochlorite should be used.

(6) When it is not necessary to use contaminated matériel immediately, or when one has not the above means at his disposal, it may be considered that the handling of the matériel or apparatus is not dangerous after 6 or 8 days.

e. Transportation of matériel affected by gas.—Removal will be effected by automotive units whenever possible. If horse transport must be used, the route will be reconnoitered carefully in order to avoid infected ground. The matériel will be disinfected as thoroughly as possible before removal.

SECTION VIII

ACCESSORIES

34. General.—There are a number of accessories provided with this matériel, such as cold chisels, bronze drifts, files, file handles, machinists' hammers, pliers, steel punches, screwdrivers, wrenches, gun, and sponge covers, the names or general characteristics of which plainly indicate their use and application. Therefore, no detailed description nor method of use is outlined herein. However, the special accessories being of a different nature, their description, purpose, and method of use are outlined below.

35. Book, artillery gun.—The artillery gun book (O. O. Form No. 5825) is issued for the purpose of keeping an accurate record of the matériel. It must always remain with the gun regardless of where the gun may be sent (to the repair shop, to another battery, etc.). The book is divided as follows: Record of assignment of the gun to the various batteries, battery commander's daily gun record, inspector's record of examinations, and forms to be filled out in the case of premature explosions.

36. Compressor, spring, No. 5.—The spring compressor is used when assembling or disassembling the counterrecoil springs from the cradle of the 75-mm gun carriage, M1916A1. In using this compressor a tackle block is also required. The latter is staked to some fixed object of sufficient strength to stand the pressure of the compressed counterrecoil springs.

37. Gage, tire, balloon.—The balloon tire gage is for measuring the air pressure within the tire.

38. Gun, lubricating, screw type, 8-ounce.—With the handle unscrewed to its maximum out position and the screw cover removed, the lubricating gun is filled with grease by hand. The gun holds 8 ounces of grease. The cover is screwed on to the cylinder, and the movement of screwing in on the handle forces the grease through the hose and into the grease receptacles.

39. Hose, heavy duty, 15-inch, buttonhead fitting.—The steel hose is equipped with an adapter which is screwed into the nozzle of the lubricating gun. The other end of the hose is fitted with a pull-on coupling which fits over the head of the buttonhead type fitting on the carriage.

40. Release, drain valve.—The drain valve release is used to drain the reserve oil from the recoil mechanism of the 75-mm gun carriage, M1916MIA1.

41. Sights, bore.—The breech bore sight is a brass disk which fits into the shell chamber. It has four finger holes for use in inserting and withdrawing it from the chamber, and one small hole in the exact center for sighting. The muzzle bore sight consists of a black cord, which is placed across the muzzle in the bore sight lines cut in the face of the gun, and a web belt for holding the cord in place.

42. Target, testing.—The testing target is used in the verification and adjustment of sights.

Section IX

SUBCALIBER EQUIPMENT

43. General.—*a.* The purpose of the subcaliber equipment is to provide for a greater amount of target practice than could be obtained by the use of the regular 75-mm ammunition. Except for the firing of other than the regular ammunition, the handling and loading of which differ, as well as the range, the training is with the 75-mm gun carriage, M1916A1.

b. Subcaliber firing is accomplished by the use of the 37-mm gun, M1916, and recoil mechanism, mounted on the top of the 75-mm gun by means of a specially constructed mount.

44. Description and operation of the mount (fig. 19).—*a.* The 37-mm subcaliber mount, T15, mounted on the 75-mm gun carriage, M1916A1, is composed of a bracket (D33282) to which is bolted a bracket (B19138). The trunnions of the brackets are provided with cap screws and jam nuts which retain the tank cradle in position and provide a means of adjustment for deflection. The front end of bracket (D33282) is equipped with three ⅜-inch cap screws and jam

nuts, their purpose being that of retaining and providing a means of adjusting the 37-mm subcaliber gun when bore sighting on a testing target.

b. Two supports (B154355 and B154356) attached to the cradle (11A) and the cylinder retainer (B154686) welded to the recoil cylinder retainer (KB51H) provide a seat for the subcaliber mount, T15, which is retained at the front by two cap screws (BCBX2BD) and at the rear by cap screws (BCBX4BB).

45. Disassembling and assembling (fig. 19).—*a.* Clean the seats for bracket (D33282) and mount the bracket, retaining it in position by means of its cap screws, nuts, and lock washers.

b. Remove bracket (B19138) from bracket (D33282) by removing the three cap screws (BCBX1CD), nuts, and lock washers, retaining it in position. Lift the 37-mm gun and recoil mechanism on top of the 75-mm recoil mechanism and insert the front end of the 37-mm gun recoil mechanism through the band on the front end of bracket (D33282) placing the trunnion of the recoil mechanism in the trunnion bearing of bracket (D33282). Assemble bracket (B19138) over the recoil mechanism trunnion and bolt in place. Tighten the cap screws in the trunnion bearing and those at the front end of bracket (D33282) just sufficiently to retain the 37-mm gun in position.

46. Bore sighting.—*a.* As the subcaliber gun is to be laid with the regular sighting and maneuvering mechanism of the 75-mm gun, the bores of the gun and 37-mm subcaliber gun should be parallel. To secure the proper alinement when the 75-mm gun carriage is in firing position, bore sights are set in the subcaliber gun.

b. Verification of the sights having been accomplished as described in paragraph 22, the following procedure should be observed in bore sighting the 37-mm gun:

(1) Make a testing target by wrapping two pieces of black tape of equal width around the aiming post with the lower edge exactly $16\frac{49}{64}$ inches apart. By the use of the aiming post as a testing target, it will not be necessary to level the 75-mm gun carriage, as the aiming post can be canted to conform to the angle of the carriage so that the vertical line of the bore of the 75-mm gun will coincide with the side of the aiming post. Place the target some distance from the gun.

(2) Use the bore sights to line up the bore of the 75-mm gun with the lower edge of the lower tape on the aiming post.

(3) Use the bore sights of the 37-mm subcaliber gun and bore sight it on the testing target. The bore of this gun should be lined up with the lower edge of the upper tape on the aiming post.

(4) The adjustment of the 37-mm subcaliber gun upon the target is made by the three cap screws in the front of bracket (D33282 fig. 19). When tightening these cap screws great care must be taken not to place a strain upon the recoil cylinder as it will become distorted and may not function properly.

47. Care and preservation.—Repairs to this mount will be minor in nature and will involve only the removal of burs when necessary and the replacement of nuts and cap screws. When the subcaliber mount is dismounted from the 75-mm gun all parts should be assembled in their proper place.

48. Accessories and spare parts.—Accessories and spare parts for the subcaliber equipment are shown in Standard Nomenclature List No. C–30.

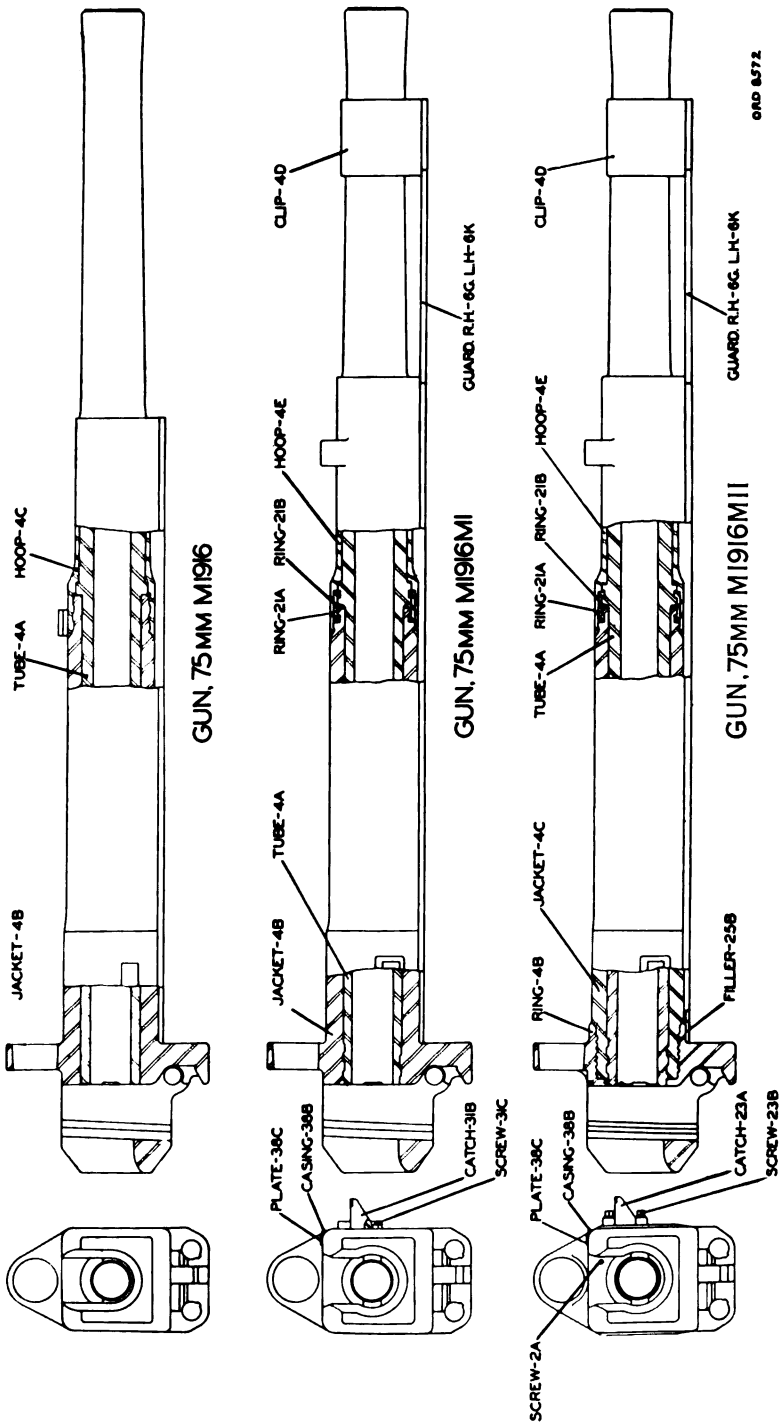


FIGURE 1.—75-mm gun, M1916, M1916MI, and M1916MII (sectioned views).

Reference	Item
38B	Casing, leveling plate (for M1916MI and M1916MII).
31B	Catch, latch (for M1916MI).
23A	Catch, latch (for M1916MII).
4D	Clip (for M1916MI and M1916MII).
25B	Filler (for M1916MII).
6K	Guard, L. H. (for M1916MI and M1916MII).
6G	Guard, R. H. (for M1916MI and M1916MII).
4E	Hoop, locking (for M1916MI and M1916MII).
4B	Jacket (for M1916 and M1916MI).
4C	Jacket (for M1916MII).
38C	Plate, leveling (for M1916MI and M1916MII).
4B	Ring, breech (for M1916MII).
21B	Ring, filling (for M1916MI and M1916MII).
21A	Ring, locking (for M1916MI and M1916MII).
31C	Screw, latch catch (for M1916MI).
23B	Screw, latch catch (for M1916MII).
2A	Screw, securing (for M1916MII).
4A	Tube (for M1916, M1916MI, and M1916MII).

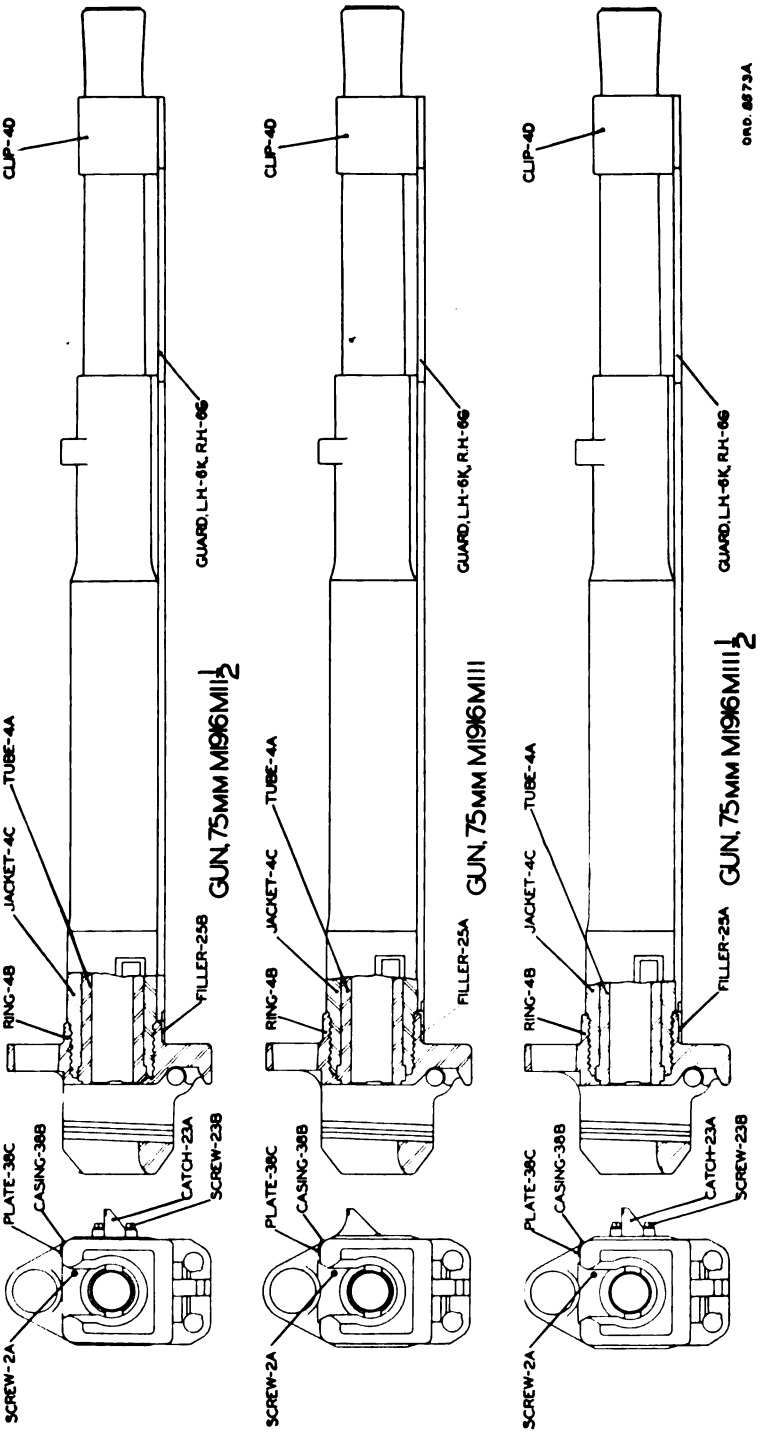


FIGURE 2.—75-mm gun, M1916MIII½, M1916MIII, and M1916MIII½ (sectioned views).

Reference	Item	Reference	Item
38B	Casing, leveling plate (for M1916MII½, M1916MIII, and M1916MIII½).	4C	Jacket (for M1916MII½, M1916MIII, and M1916MIII½).
23A	Catch, latch (for M1916MII½ and M1916MIII½).	38C	Plate, leveling (for M1916MII½, M1916MIII, and M1916MIII½).
4D	Clip (for M1916MII½, M1916MIII, and M1916MIII½).	4B	Ring, breech (for M1916MII½, M1916MIII, and M1916MIII½).
25B	Filler (for M1916MII½).	23B	Screw, latch catch (for M1916MII½ and M1916MIII½).
25A	Filler (for M1916MIII and M1916MIII½).	2A	Screw, securing (for M1916MII½), M1916MIII, and M1916MIII½).
6K	Guard, L. H. (for M1916MII½, M1916MIII, and M1916MIII½).	4A	Tube (for M1916MII½, M1916MIII, and M1916MIII½).
6G	Guard, R. H. (for M1916MII½), M1916MIII, and M1916MIII½).		

FIGURE 3.—75-mm gun, M1916M1IIA1 (sectioned view).

Reference	Item	Reference	Item
42C	Filler, front.	BFDX5BT	Pin, stght., S., ⅜ by 4½.
42B	Filler, middle.		Pin, stght., S., ⅜ by 4¾.
42A	Filler, rear.	4B	Ring, breech.
41B	Hoop, left half.	40A	Saddle.
41A	Hoop, right half.	42E	Screw, filler, middle and front.
4C	Jacket.	42D	Screw, filler, rear.
42F	Key, hoop.	42G	Screw, hoop key.
	Pin, stght., S., ⅜ by 3¼.	40B	Screw, saddle, front.
BFDX5AU	Pin, stght., S., ⅜ by 3¾.	40C	Screw, saddle, rear.
BFDX5AW	Pin, stght., S., ⅜ by 4¼.		

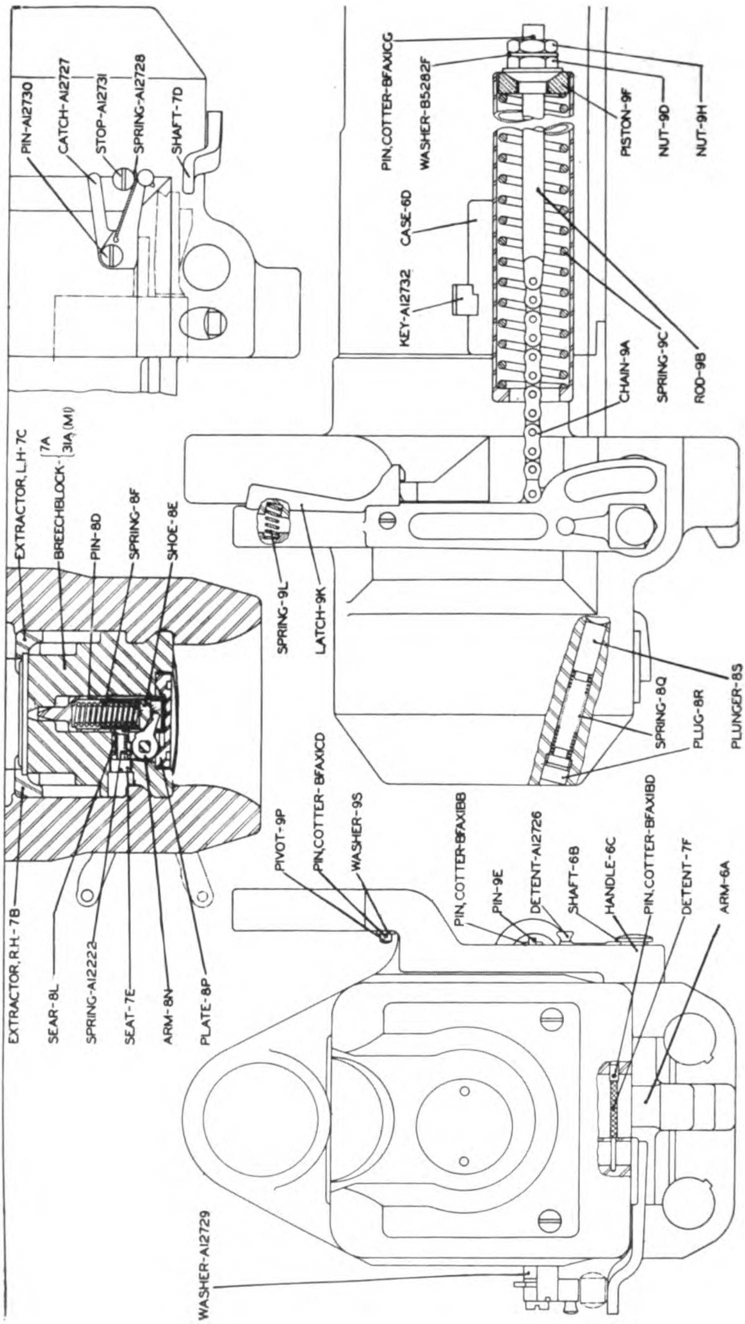


FIGURE 4.—75-mm gun, M1916MIII, breech mechanism (sectioned view).

Reference	Item	Reference	Item
8N	Arm, firing.	9E	Pin, stud link.
6A	Arm, operating.	9F	Piston, spring.
31A	Breechblock (for M1916M1).	9P	Pivot, operating handle latch.
7A	Breechblock (for M1916M1, M1916MIII½, M1916MIII, and M1916MIII½).	8P	Plate, face, breechblock.
		8R	Plug, plunger.
6D	Case, closing spring.	8S	Plunger, extractor.
A12727	Catch, return.	9B	Rod, spring piston.
9A	Chain.	8L	Sear.
A12726	Detent, operating shaft, assembly.	7E	Seat, sear spring.
7F	Detent, trigger shaft.	6B	Shaft, operating.
7C	Extractor, L. H.	7D	Shaft, trigger.
7B	Extractor, R. H.	8E	Shoe, firing spring.
6C	Handle, operating.	A12728	Spring, catch.
A12732	Key, spring case.	9C	Spring, closing.
9K	Latch, operating handle.	8Q	Spring, extractor plunger.
9H	Nut, lock.	8F	Spring, firing.
9D	Nut, spring piston rod.	9L	Spring, operating handle latch.
A12730	Pin, catch.	A12222	Spring, sear.
BFAX1BB	Pin, cotter, split, S., 1/16 by 7/16.	A12731	Stop, return catch.
BFAX1BD	Pin, cotter, split, S., 1/16 by 5/8.	A12729	Washer, catch pin.
BFAX1CD	Pin, cotter, split, S., 3/32 by 5/8.	BECX1P	Washer, lock, reg., 5/8 by 13/64 by 5/32
BFAX1CG	Pin, cotter, split, S., 3/32 by 1.	9S	Washer, operating handle latch pivot.
8D	Pin, firing.		

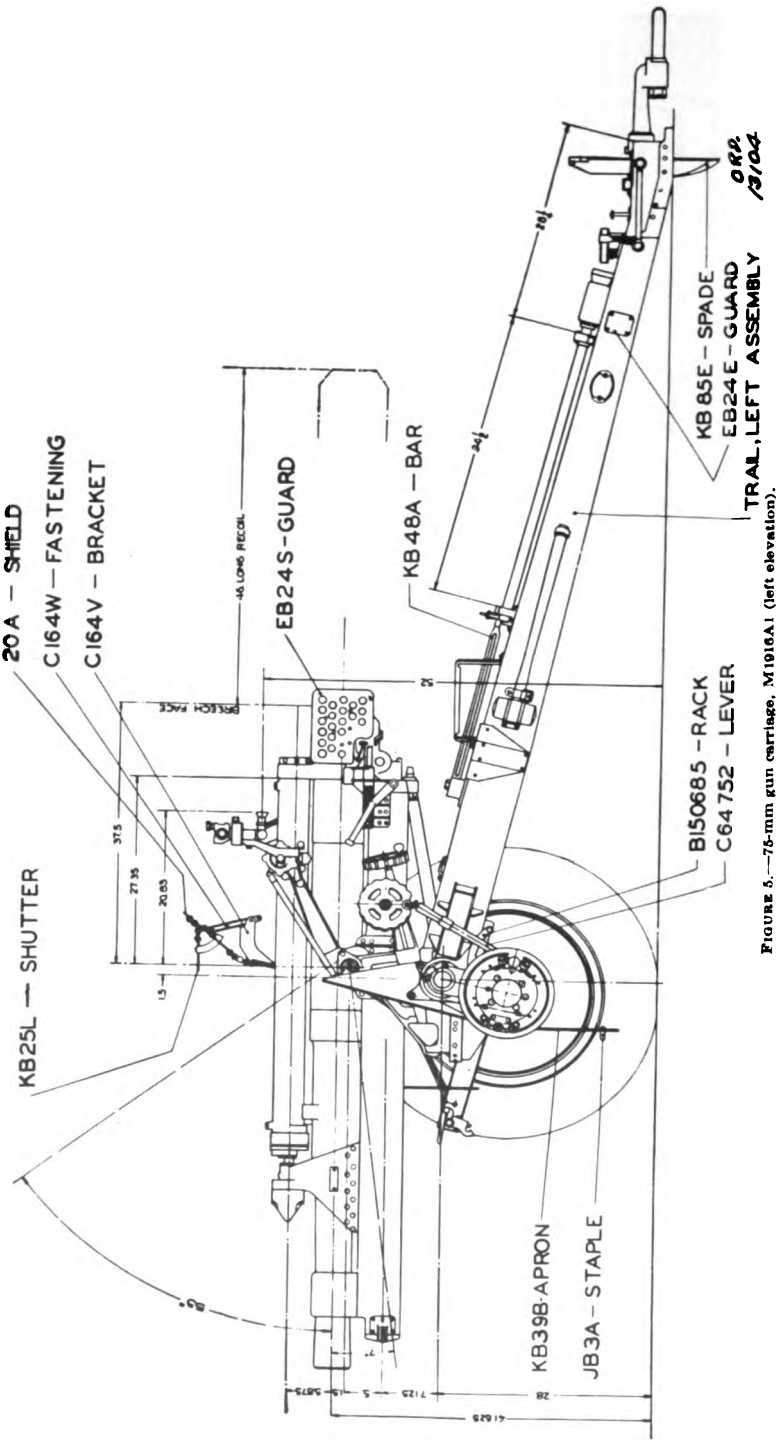


FIGURE 5.—75-mm gun carriage, M1916A1 (left elevation).

Reference	Item	Reference	Item
KB39B	Apron.	B150685	Rack, brake ratchet.
KB48A	Bar, traveling lock.	20A	Shield, top.
C164V	Bracket, top shield.	KB25L	Shutter, telescope port.
C164W	Fastening, top shield.	KB85E	Spade.
EB24S	Guard, shoulder, left.	JB3A	Staple, apron latch.
EB24E	Guard, wheel, rear.		Trail, left, assembly.
C64752	Lever, hand brake, assembly.		

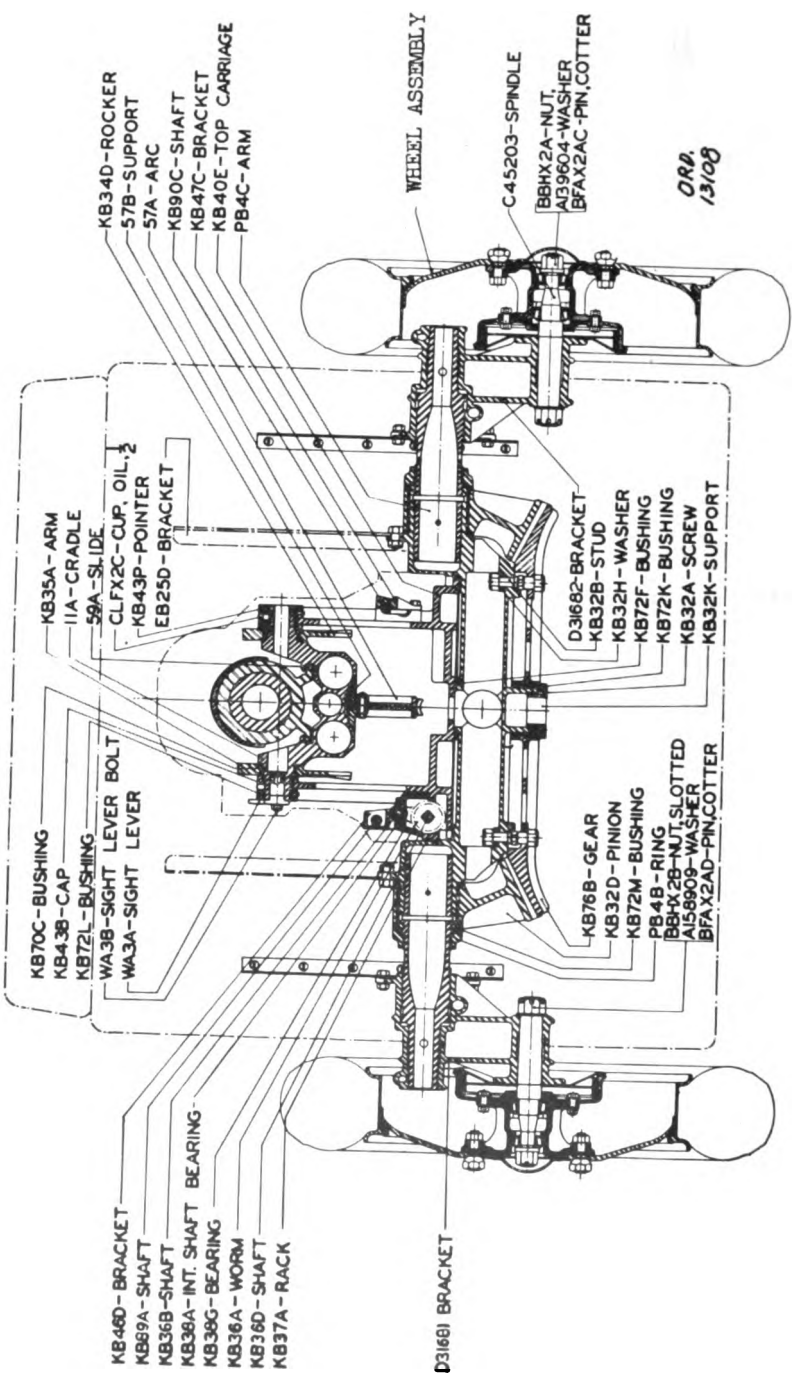


FIGURE 6.—75-mm gun carriage, M1916A1 (plan view).

Reference	Item	Reference	Item
B150380	Bracket.	BFAX2AD	Pin, cotter, split, S., 3/16 by 2½.
C64470	Bracket.	A157134	Pin, hdls., S., .560 diam. by 2 3/16 clear.
C64439	Bracket, ball.		
C64458	Bracket, drawbar.	A157132	Pin, rod end, .560.
C64438	Bracket, socket.	A157133	Pin, stght., S., .560 by 2 7/16.
A158910	Connection, trail lock.	BFCX1DE	Pin, taper, No. 2 (.193) by 1½.
D31532	Drawbar.	EB81B	Seat, trail, left.
C62484	Handle, trail lock.	EB81D	Seat, trail, right.
B144410	Hook, trail connection.	C62990	Stop, trail, right, assembly.
A158911	Key, drawbar.	QBDX1BB	Strap, lea., type B, 13 in.
B144409	Loop, trail connection.		Support, apron latch base, right, assembly.
C45804	Lunette, M6.		
BBDX2C	Nut, jam, hex., s-fin., ¾-16NF-2.		Trail, left, assembly.
BBGX3B	Nut, slotted, s-fin., 1¼-7NC-2.		Trail, right, assembly.
BFAX1DF	Pin, cotter, split, S., ⅛ by ⅞.		Wheel, assembly.
BFAX1EH	Pin, cotter, split, S., 5/32 by 1¼.		

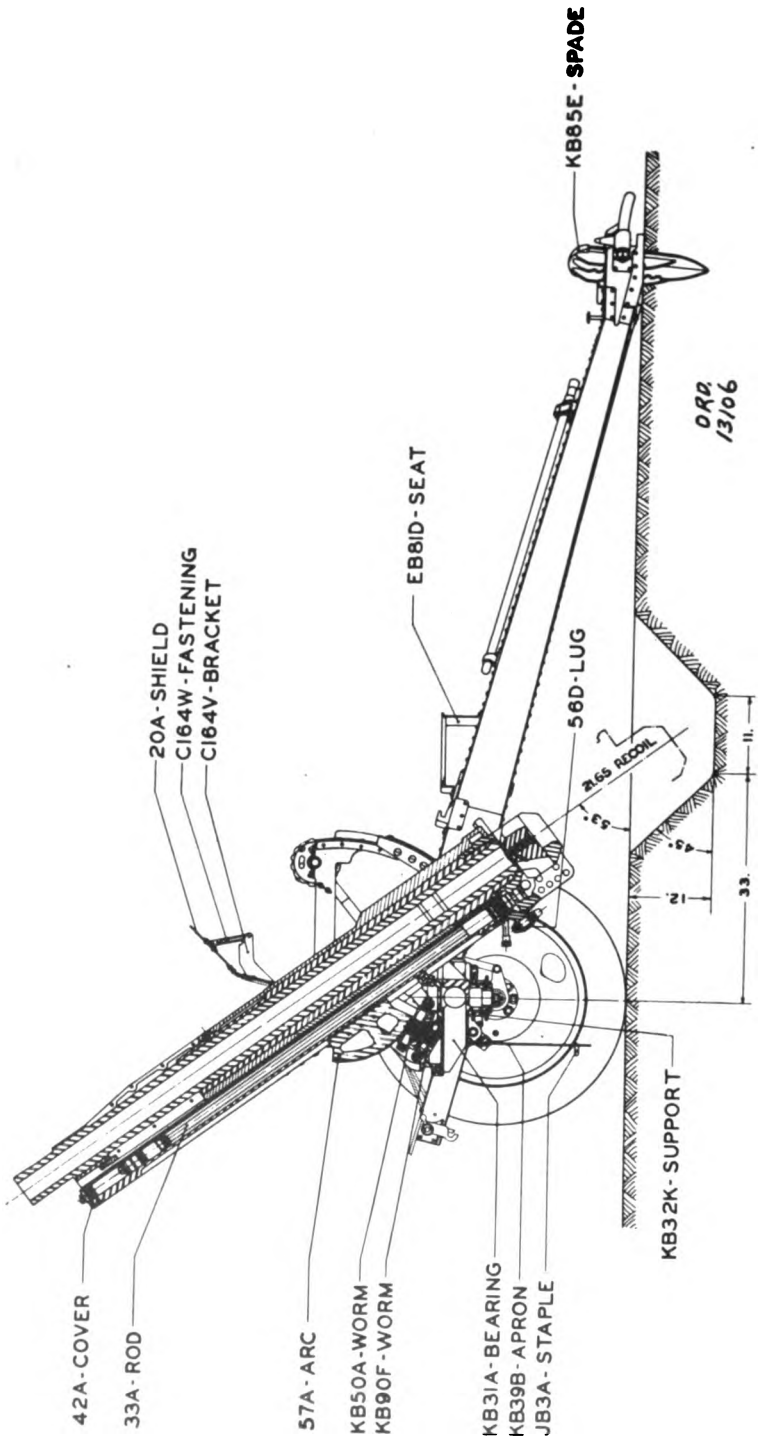


FIGURE 7. -75-mm gun carriage, M1916M1A1 (longitudinal section)

Reference	Item	Reference	Item
KB39B	Apron.	EB81D	Seat, trail, right.
57A	Arc, elevating.	20A	Shield, top.
KB31A	Bearing, pintle.	KB85E	Spade.
C164V	Bracket, top shield.	JB3A	Staple, apron latch.
42A	Cover, cradle, front.	KB32K	Support, equalizing gear.
C164W	Fastening, top shield.	KB90F	Worm, angle of site.
56D	Lug, traveling lock.	KB50A	Worm, elevating.
33A	Rod, recoil.		

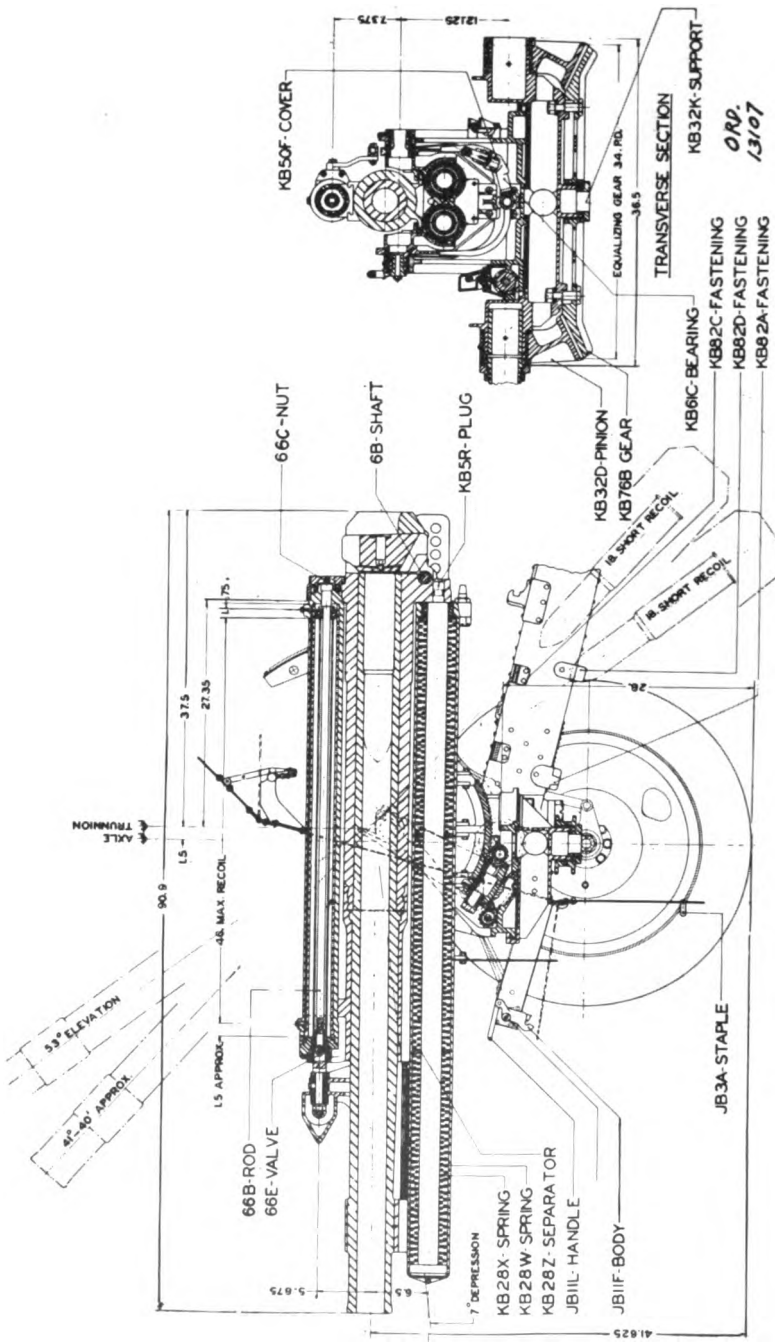


FIGURE 8.—75-mm gun carriage, M1916A1 (longitudinal section).

Reference	Item	Reference	Item
KB61C	Bearing, elevating cross shaft.	KB32D	Pinion, equalizing, left.
JB11F	Body, apron latch.	KB5R	Plug, spring rod.
KB50F	Cover, elevating cross shaft gear.	66B	Rod, counterrecoil buffer.
KB82A	Fastening, spade, lower, front, right.	KB28Z	Separator, counterrecoil spring.
KB82D	Fastening, spade, lower, rear.	6B	Shaft.
KB82C	Fastening, spade, upper.	KB28X	Spring, counterrecoil, inner.
KB76B	Gear, equalizing.	KB28W	Spring, counterrecoil, outer.
JB11L	Handle, apron latch.	JB3A	Staple, apron latch.
66C	Nut, counterrecoil buffer rod.	KB32K	Support, equalizing gear.
		66E	Valve, counterrecoil buffer.

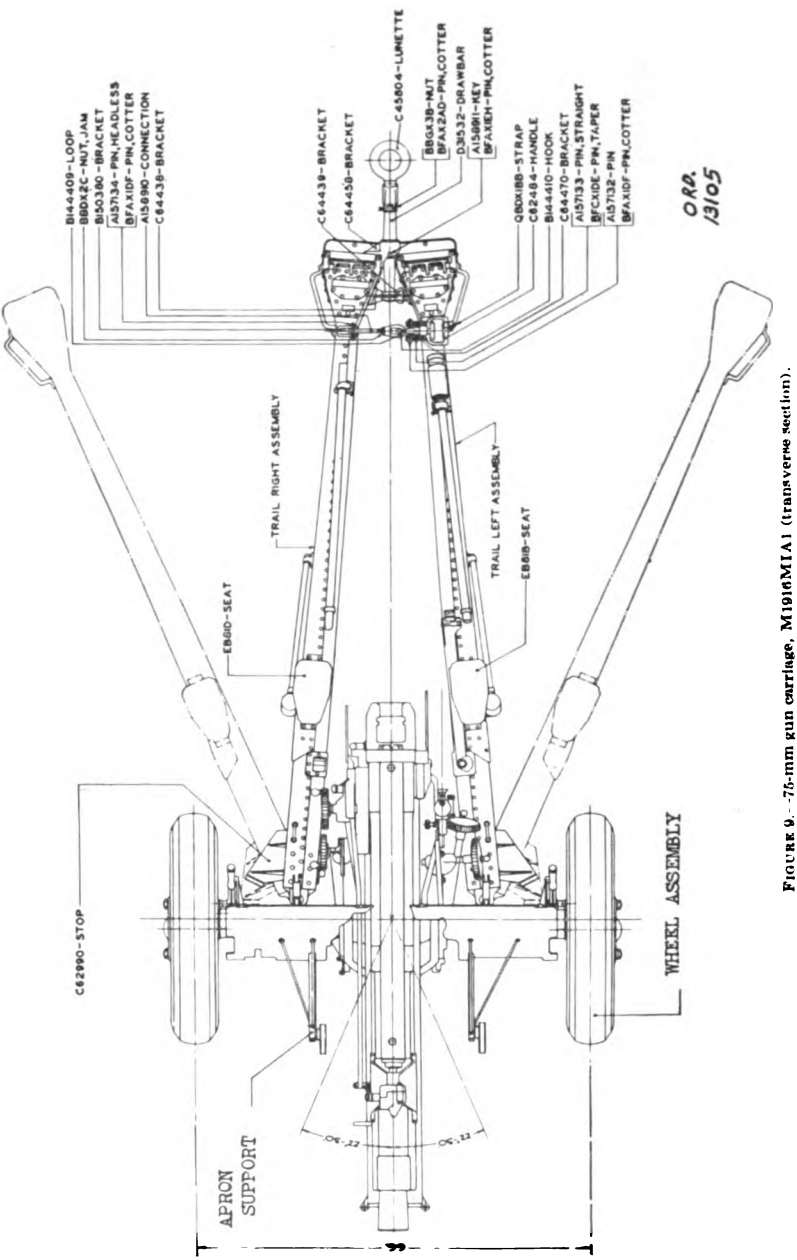


FIGURE 9.—75-mm gun carriage, M1916M1A1 (transverse section).

Reference	Item	Reference	Item
57A	Arc, elevating.	BFAX2AD	Pin, cotter, split, S., 3/16 by 2½.
PB4C	Arm, axle, right.	KB32D	Pinion, equalizing, left.
KB35A	Arm, rocker, left.	KB43P	Pointer, traveling lock.
KB38A	Bearing, intermediate traversing shaft.	KB37A	Rack, traversing.
		PB4B	Ring, axle arm locking.
KB38G	Bearing, traversing worm shaft.	KB31D	Rocker.
WA3B	Bolt, sight lever.	KB32A	Screw, equalizing gear support locking.
D31681	Bracket, left.		
D31682	Bracket, right.	KB89A	Shaft, angle of site handwheel, w/bevel pinion.
KB46D	Bracket, angle of site, left.		
KB47C	Bracket, angle of site, right.	KB90C	Shaft, angle of site intermediate.
EB25D	Bracket, shield, inner, right.	KB36B	Shaft, traversing intermediate, w/bevel pinion.
KB72K	Bushing, equalizing gear.		
KB72M	Bushing, equalizing pinion.	KB36D	Shaft, traversing worm.
KB72L	Bushing, half, left trunnion cap.	59A	Slide, gun, left.
KB70C	Bushing, half, rocker trunnion.	C45203	Spindle, wheel.
KB72F	Bushing, top carriage pintle.	KB32B	Stud, equalizing gear.
KB43B	Cap, trunnion, left.	57B	Support, elevating arc.
KB40E	Carriage, top.	KB32K	Support, equalizing gear.
11A	Cradle.	A158909	Washer, disk and rim wheel spindle, inner.
CLFX2C	Cup, oil, drive type, ½ in. diam.		
KB76B	Gear, equalizing.	A139604	Washer, disk and rim wheel spindle, outer.
WA3A	Lever, sight.		
BBHX2A	Nut, slotted, s-fin., 1⅛–12NF–2.	KB32H	Washer, equalizing gear stud.
BBHX2B	Nut, slotted, s-fin., 1¼–12NF–2.		Wheel, assembly.
BFAX2AC	Pin, cotter, split, S., 3/16 by 2¼.	KB36A	Worm, traversing.

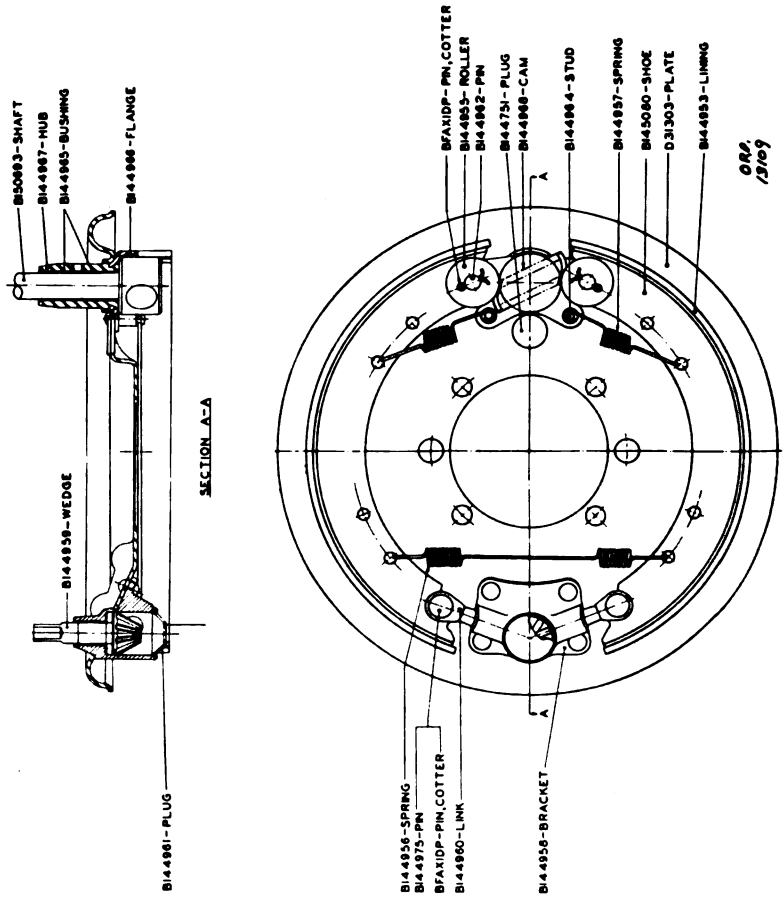


FIGURE 10.—Brake, left hand (sectioned view).

Reference	Item	Reference	Item
B144958	Bracket, brake adjusting wedge.	B144751	Plug, brake housing plate.
B144965	Bushing, brake cam hub.	B144961	Plug, brake shoe adjusting wedge.
B144968	Cam, brake.	B111955	Roller, brake cam.
B144966	Flange, brake cam hub.	B150093	Shaft, brake cam.
B144967	Hub.	B145080	Shoe.
B144953	Lining, brake shoe.	B144956	Spring, retracting, brake shoe, long.
B111960	Link, brake shoe.	B144957	Spring, retracting, brake shoe, short.
B111962	Pin, brake cam roller.		
B144975	Pin, brake shoe link.	B144964	Stud, brake shoe retracting spring.
BFAX1DP	Pin, cotter, split, S., ⅛ by ¾.	B144959	Wedge, brake shoe adjusting.
D31303	Plate.		

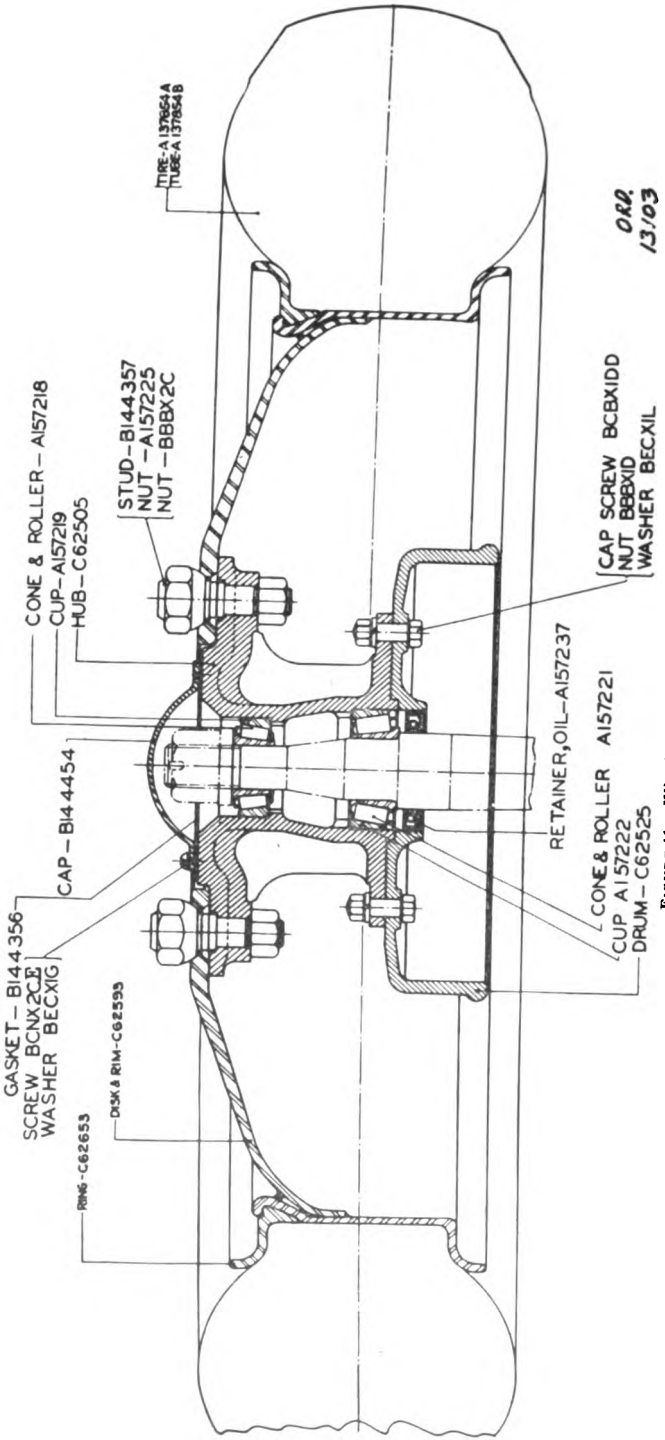


FIGURE 11.– Wheel and hub (sectioned view).

Reference	Item	Reference	Item
B144454	Cap, hub.	C62653	Ring, locking, tire.
A157218	Cone and roller, taper roller bearing, 1.1562 I. D. by 1.0013 width.	BCBX1DD	Screw, cap, hex-hd., 7/16-20NF-2 by 1¼.
A157221	Cone and roller, taper roller bearing, 1.6250 I. D. by 1.1965 width.	BCNX2CE	Screw, mach., rd-hd., S., ¼-20NC-2 by ½.
A157219	Cup, taper roller bearing, 2.615 O. D. by .750 width.	B144357	Stud, disk and rim wheel.
A157222	Cup, taper roller bearing, 3.1562 O. D. by .9375 width.	A137854A	Tire, automobile, pneumatic, truck and bus balloon, 7.50–24 (type B).
C62525	Drum, brake.	A137854B	Tube, inner, automobile, puncture sealing, 7.50–24, assembly.
B144356	Gasket, hub cap.	BECX1G	Washer, lock, reg., ¼ by 9/32 by 1/16.
C62505	Hub.	BECX1L	Washer, lock, reg., 7/16 by 9/32 by ⅜.
A157225	Nut, disk and rim wheel, 1⅛-16NS-2.	C62593	Wheel, automobile, disk and rim, assembly.
BBBX1D	Nut, reg., hex., s-fin., 7/16-20NF-2.		
BBBX2C	Nut, reg., hex., s-fin., ¾-16NF-2.		
A157237	Retainer, oil.		

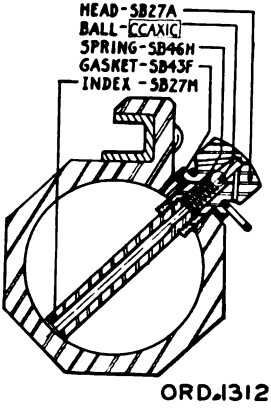
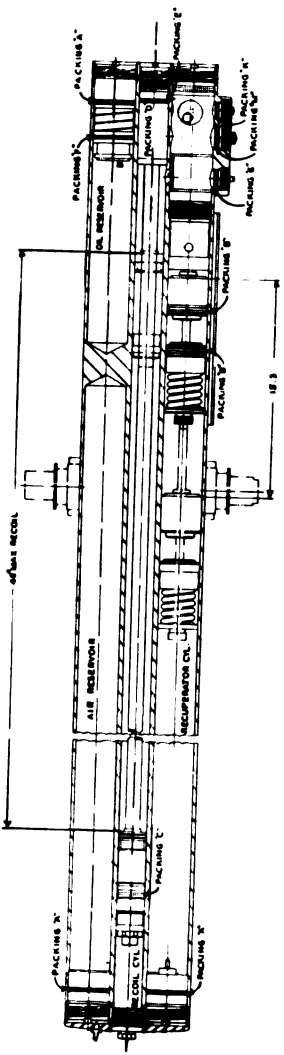


FIGURE 12.—Oil index head, assembly (sectioned view).

Reference	Item	Reference	Item
CCAX1C	Ball, chr-alloy-S., grade 2, ¼ in.	SB27M	Index, oil.
SB43F	Gasket, oil index head.	SB46H	Spring, oil index.
SB27A	Head.		



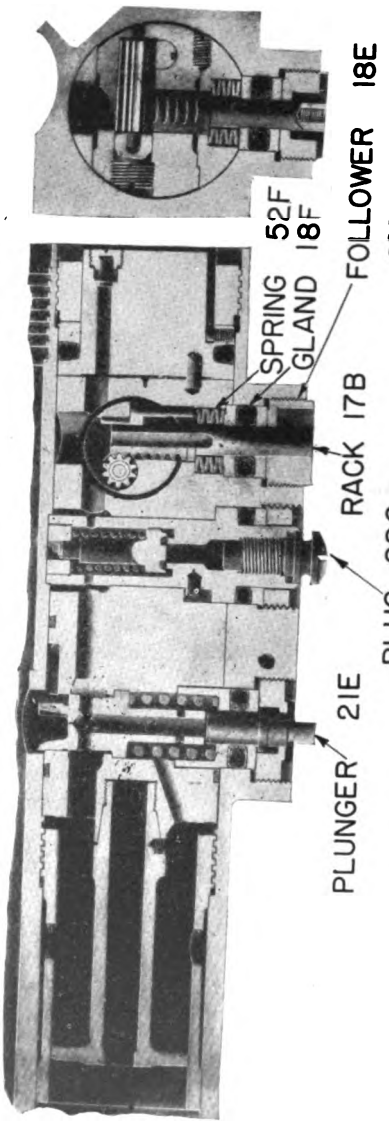


FIGURE 13.—Recoil mechanism (schematic view) and oil gage rack (sectioned view).

Reference	Item	Reference	Item
18E	Follower, oil gage.	17B	Rack, oil gage.
18F	Gland, oil gage.	52F	Spring, Belleville, oil gage packing compression.
22C	Plug, recuperator cylinder head.		
21E	Plunger, throttling valve control.		

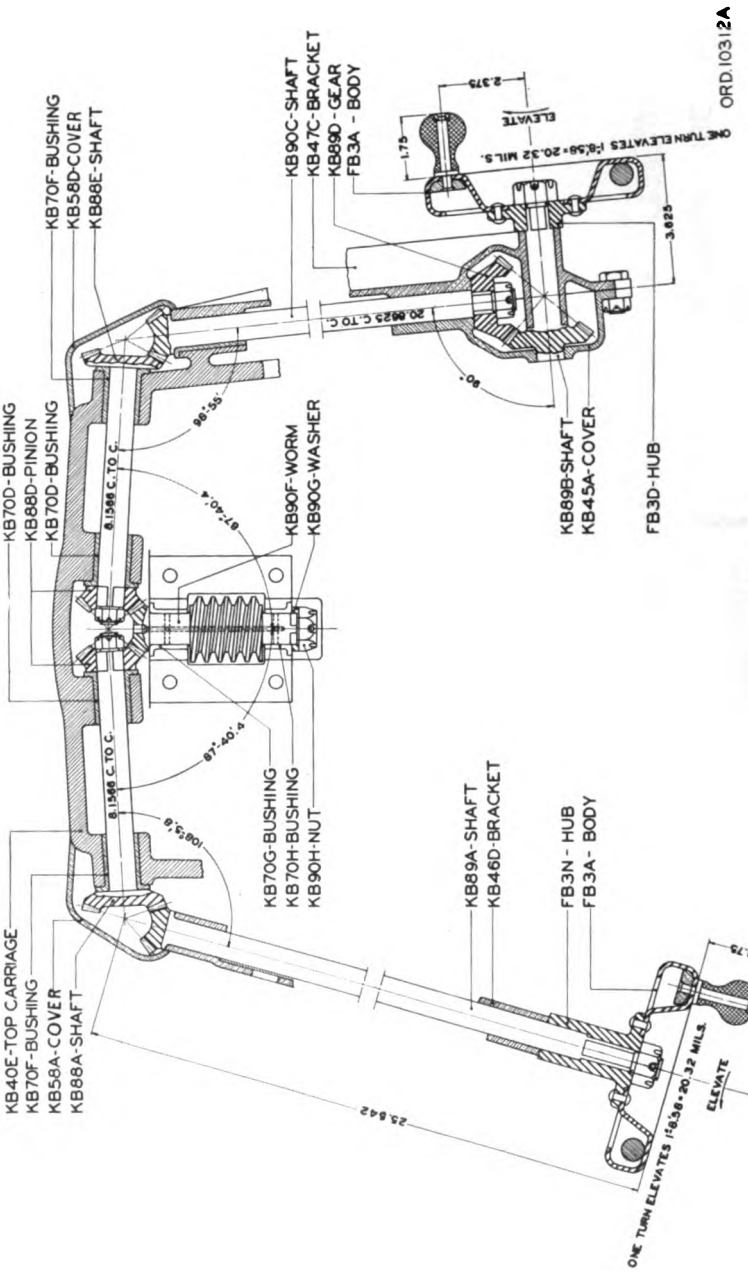


FIGURE 14. Angle of site mechanism, assembly.

Reference	Item
FB3A	Body, handwheel, 6 inch.
KB46D	Bracket, angle of site, left.
KB47C	Bracket, angle of site, right.
KB70D	Bushing, angle of site cross shaft, inner.
KB70F	Bushing, angle of site cross shaft, outer.
KB70G	Bushing, half, angle of site worm, front.
KB70H	Bushing, half, elevating worm, rear.
KB40E	Carriage, top.
KB45A	Cover, angle of site bracket, right.
KB58A	Cover, angle of site cross shaft gear, left.
KB58D	Cover, angle of site cross shaft gear, right.
KB89D	Gear, angle of site intermediate shaft.
FB3D	Hub.
FB3N	Hub.
KB90H	Nut, angle of site worm.
KB88D	Pinion, angle of site cross shaft.
KB88A	Shaft, angle of site cross, left.
KB88E	Shaft, angle of site cross, right.
KB89A	Shaft, angle of site handwheel, w/bevel pinion, left.
KB89B	Shaft, angle of site handwheel, w/bevel pinion, right.
KB90C	Shaft, angle of site intermediate.
KB90G	Washer, angle of site worm.
KB90F	Worm, angle of site.

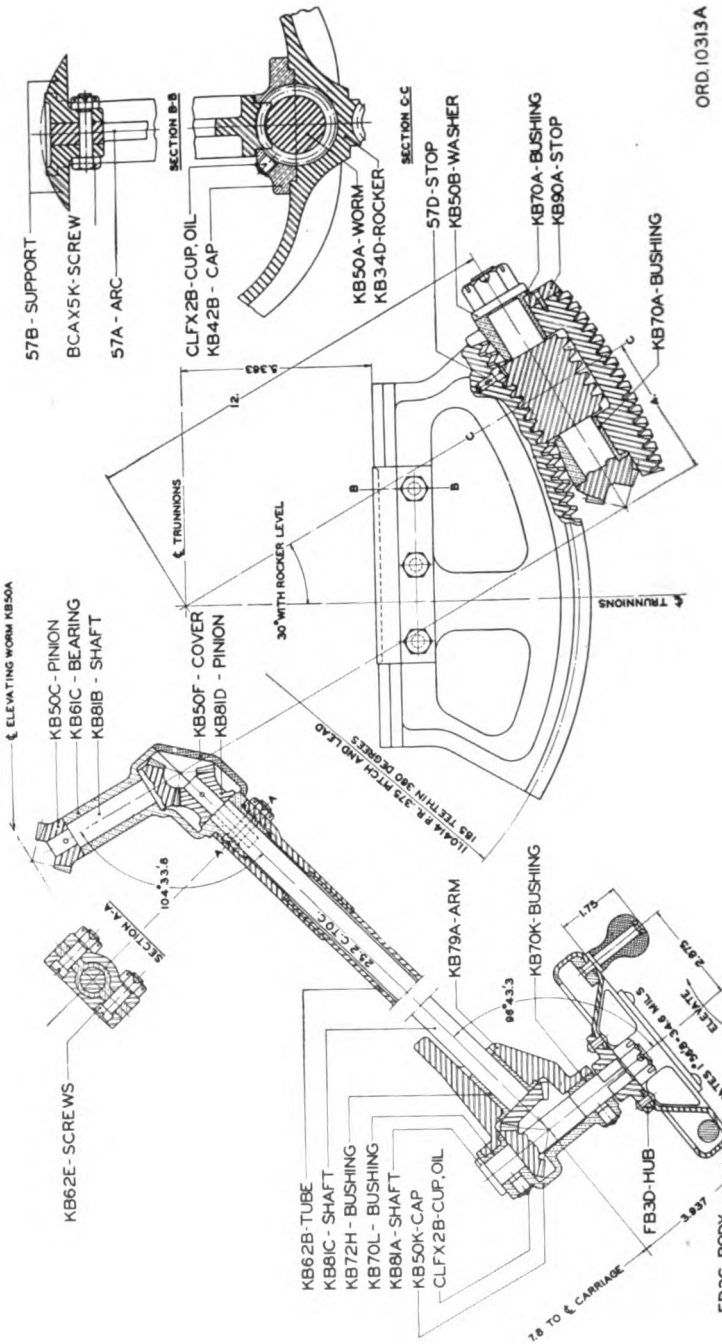


FIGURE 16.—Elevating mechanism, assembly.

Reference	Item	Reference	Item
57A	Arc, elevating.	KB50C	Pinion, elevating cross shaft.
KB79A	Arm, rocker, right.	KB81D	Pinion, elevating intermediate shaft.
KB61C	Bearing, elevating cross shaft.	KB34D	Rocker.
FB3C	Body, handwheel, 7 inch.	BCAX5K	Screw, cap, hex-hd., ⅝–16NC–2 by 1¾.
KB70A	Bushing, half, elevating worm.	KB62E	Screw, rocker arm brace lower end.
KB70L	Bushing, half, right rocker arm, top, left.	KB81B	Shaft, elevating cross.
KB70K	Bushing, half, right rocker arm, top, right.	KB81A	Shaft, elevating handwheel.
KB72H	Bushing, rocker arm angle of site intermediate shaft.	KB81C	Shaft, elevating intermediate handwheel.
KB42B	Cap, elevating worm.	KB90A	Stop, angle of site worm.
KB50K	Cap, rocker arm.	57D	Stop, depression.
KB50F	Cover, elevating cross shaft gear.	57B	Support, elevating arc.
CLFX2B	Cup, oil, drive type, ⅛ inch diameter.	KB62B	Tube, rocker arm brace.
FB3D	Hub.	KB50B	Washer, elevating worm.
		KB50A	Worm, elevating.

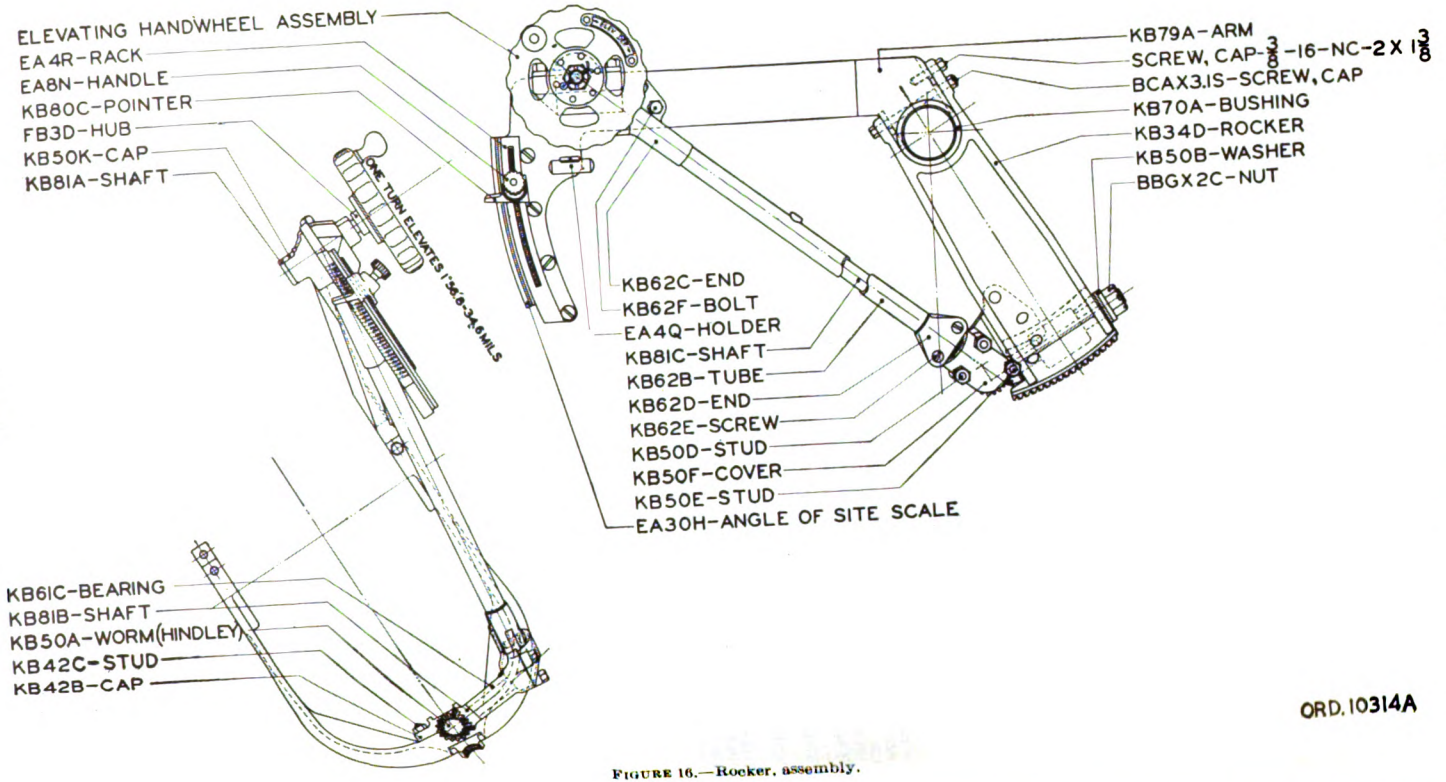


FIGURE 16.—Rocker, assembly.

Reference	Item
KB79A	Arm, rocker, right.
KB61C	Bearing, elevating cross shaft.
KB62F	Bolt, rocker arm brace end, upper.
KB70A	Bushing, half, elevating worm.
KB42B	Cap, elevating worm.
KB50K	Cap, rocker arm.
KB50F	Cover, elevating cross shaft gear.
KB62D	End, rocker arm brace, lower.
KB62C	End, rocker arm brace, upper.
EA8N	Handle, scroll gear.
	Handwheel, elevating, assembly.
EA4Q	Holder, level.
FB3D	Hub.
BBGX2C	Nut, slotted, s-fin., ¾–10NC–2.
KB80C	Pointer, range scale.
EA4R	Rack, rocker arm range scale pointer.
KB34D	Rocker.
EA30H	Scale, angle of site.
	Screw, cap, hex-hd., ⅜–16NC–2 by 1⅜.
BCAX3.18	Screw, cap, hex-hd., ⅜–16NC–2 by 4¼.
KB62E	Screw, rocker arm brace lower end.
KB81B	Shaft, elevating cross.
KB81A	Shaft, elevating handwheel.
KB81C	Shaft, elevating intermediate handwheel.
KB50E	Stud, elevating cross shaft gear cover.
KB50D	Stud, elevating cross shaft gear cover, long.
KB42C	Stud, elevating worm cap.
KB62B	Tube, rocker arm brace.
KB50B	Washer, elevating worm.
KB50A	Worm, elevating.

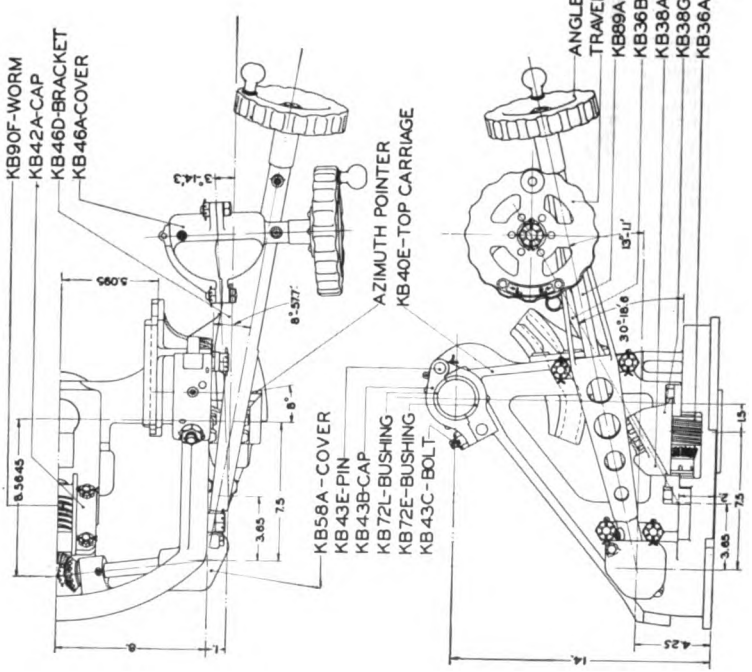


FIGURE 17.—Top carriage, assembly.

Reference	Item	Reference	Item
KB38A	Bearing, intermediate traversing shaft.	KB58A	Cover, angle of site cross shaft gear, left.
KB38G	Bearing, traversing worm shaft.		Handwheel, angle of site, assembly.
KB43C	Bolt, trunnion cap swing.		Handwheel, traversing, assembly.
KB46D	Bracket, angle of site, left.	KB43E	Pin, trunnion cap and swing bolt.
KB72L	Bushing, half, left trunnion cap.	KB89A	Shaft, angle of site handwheel w/bevel pinion, left.
KB72E	Bushing, half, trunnion, left.		
KB42A	Cap, angle of site worm.	KB36B	Shaft, traversing intermediate, w/bevel pinion.
KB43B	Cap, trunnion.		
KB40E	Carriage, top.	KB90F	Worm, angle of site.
KB46A	Cover, angle of site bracket, left.	KB36A	Worm, traversing (Hindley).

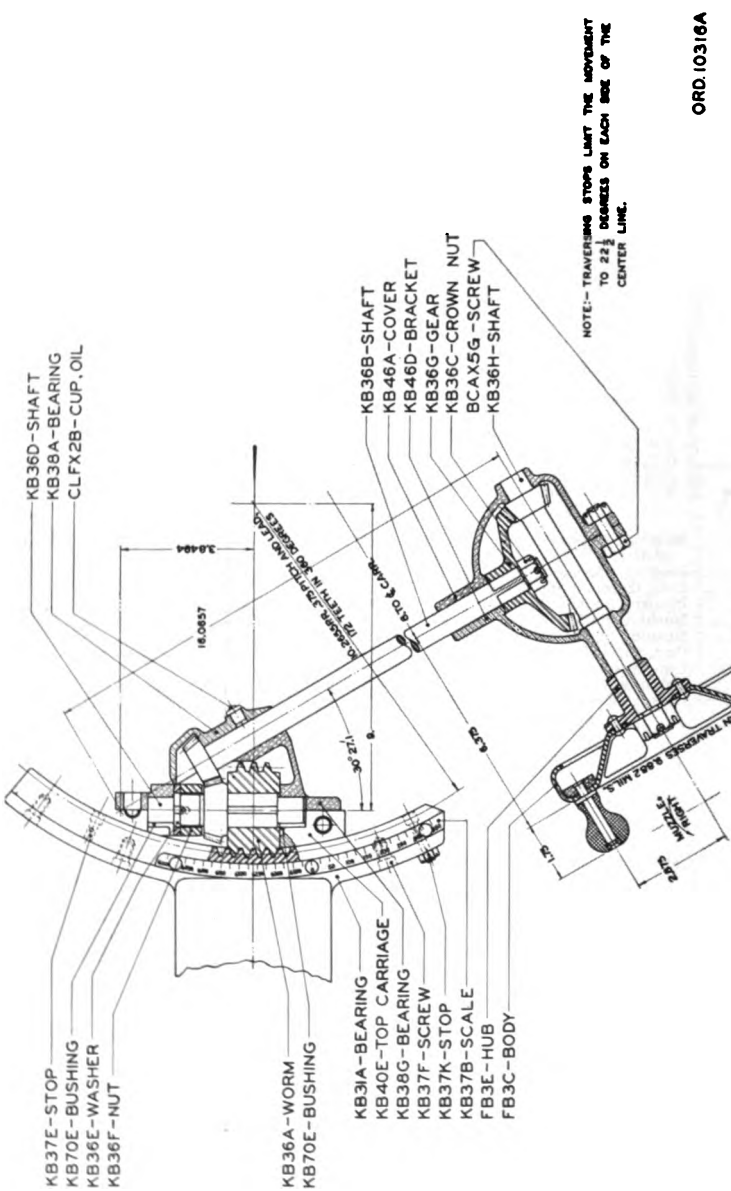


FIGURE 18.—Traversing mechanism, assembly.

Reference	Item	Reference	Item
KB38A	Bearing, intermediate traversing shaft.	KB36F	Nut, traversing worm shaft adjusting.
KB31A	Bearing, pintle.	KB37B	Scale, azimuth.
KB38G	Bearing, traversing worm shaft.	KB37F	Screw, azimuth scale.
FB3C	Body, handwheel, 7 in.	BCAX5G	Screw, cap, hex-hd., ⅝–16NC–2 by 1¼ (dld. f/c–pin.).
KB46D	Bracket, angle of site, left.	KB36H	Shaft, traversing handwheel, w/bevel pinion.
KB70E	Bushing, half, traversing worm.	KB36B	Shaft, traversing intermediate, w/bevel pinion.
KB40E	Carriage, top.	KB36D	Shaft, traversing worm.
KB46A	Cover, angle of site bracket, left.	KB37E	Stop, traversing and elevating.
CLFX2B	Cup, oil, drive type, ⅜ in. diam.	KB37K	Stop, traversing, rear.
KB36G	Gear traversing intermediate shaft.	KB36E	Washer, traversing worm shaft adjusting nut.
FB3E	Hub.	KB36A	Worm, traversing (Hindley).
KB36C	Nut, angle of site intermediate shaft, right and traversing intermediate shaft.		

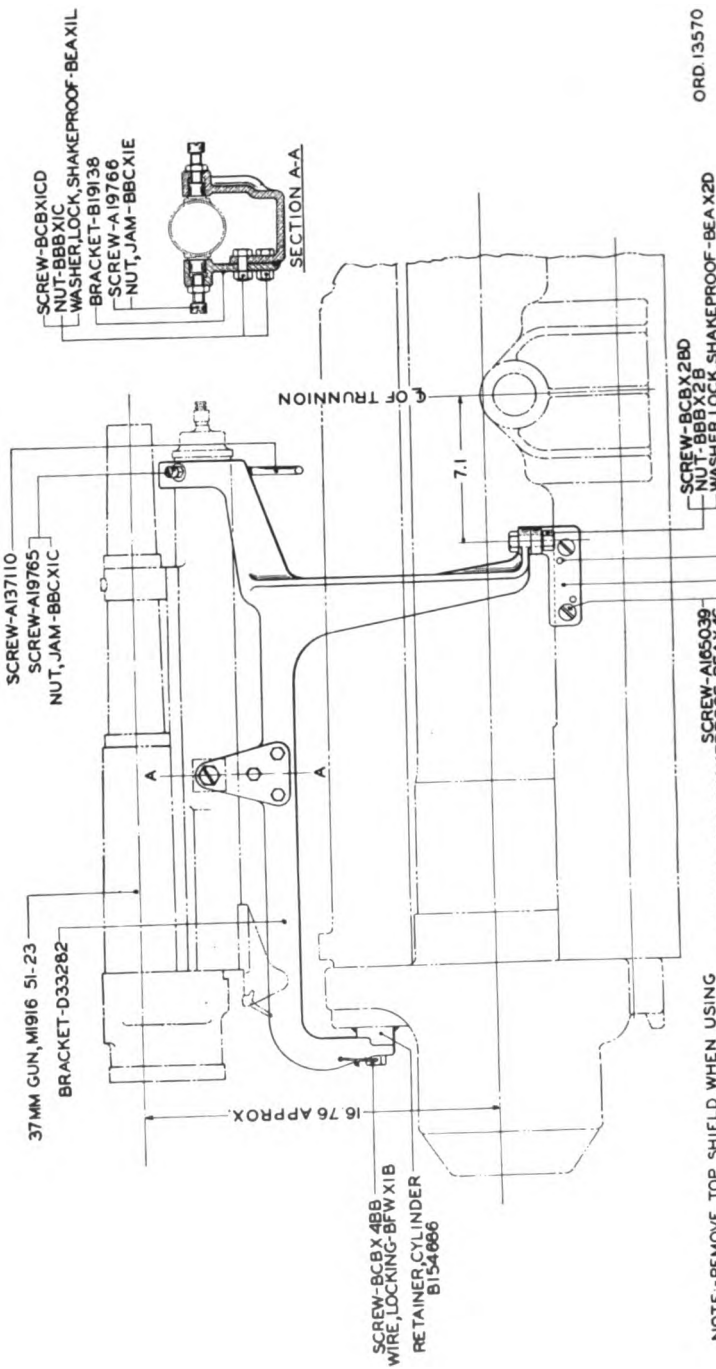


FIGURE 19.—Mount, subcaliber, 37-mm, T15.

Reference	Item	Reference	Item
D33282	Bracket, cradle mounting.	BCBX4BB	Screw, cap, hex-hd., 5/16–18NF–2 by 1¼ (dld. f/lkg-wire).
B19138	Bracket, cradle trunnion.	BCBX2BD	Screw, cap, hex-hd., 5/16–18NF–2 by 1¾.
BBCX1C	Nut, jam, s-fin., 5/8–16NC–2.	A165039	Screw, subcaliber support.
BBCX1E	Nut, jam, s-fin., 1½–13NC–2.	B154356	Support, subcaliber, L. H. (attached to cradle).
BBBX1C	Nut, reg., hex., s-fin., 3/8–24NF–2.	B154355	Support, subcaliber, R. H. (attached to cradle).
BBBX2B	Nut, reg., hex., s-fin., 5/8–11NC–2.	BEAX1L	Washer, lock, "Shakeproof No. 12 type", 3/4 in.
BFDX2AA	Pin, stght., S., ¼ by ¾.	BEAX2D	Washer, lock, "Shakeproof No. 12 type", 5/8 in.
B154686	Retainer, cylinder (welded to KB51H).	BEAX4G	Washer, lock, "Shakeproof No. 15 type", 5/8 in.
A137110	Screw, adjusting.	BFWX1B	Wire, S., low carbon, bright annealed, .0625 in. diam. lb.
A19765	Screw, cap, fl-fil-hd., S., 5/8–16NC–2 by 1¼.		
A19766	Screw, cap, fl-fil-hd., S., 1½–13NC–2 by 1½.		
BCBX1CD	Screw, cap, hex-hd., 5/16–24NF–2 by 1¼.		

[A.G.062.12 (10-31-39).]

By order of the Secretary of War:

G. C. MARSHALL,
Chief of Staff.

Official:

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Major General,
The Adjutant General.

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TECHNICAL REGULATIONS
No. 1305-75E

WAR DEPARTMENT,
WASHINGTON, *May 23, 1935.*

MOBILE ARTILLERY MATÉRIEL

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Prepared under direction of the Chief of Ordnance

SECTION I

GENERAL

1. Purpose.—These regulations are published for the information and guidance of the using arms, Reserve Officers' Training Corps students, Reserve officers, and all personnel charged with the maintenance of this matériel.

2. Scope.—*a.* In addition to description and figures, there are contained herein instructions for the operation, inspection, assembly and disassembly, repair, and care and preservation of the matériel.

b. Disassembly, assembly, and such repairs as may be handled by the battery personnel will be undertaken only under the supervision of an officer or the chief mechanic.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope of the battery personnel, the corps area or department ordnance officer will, upon request, provide trained men to perform the work.

109945°—35——1

3. References.—Nomenclature, list of spare parts and equipment, including pack equipment, and basic spare parts for the howitzer and carriage are contained in Standard Nomenclature List No. C–20; description and information on sighting and fire-control equipment in TR 1320–A and TR 1320–C; ammunition in TR 1350–A; drill ammunition in TR 1370–D; targets and accessories therefor in TR 1340–C; instructions covering the characteristics, purpose, handling, etc., of cleaning and preserving materials, tools and equipment for use therewith, and special oils, greases, and cutting oils issued by the Ordnance Department in TR 1395–A; subcaliber gun ammunition in TR 1370–C; and instructions for service of the piece in the pertinent Training Regulations.

SECTION II

DESCRIPTION AND OPERATION

4. General.—*a.* (1) The 75-mm pack howitzer matériel 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 obsoleted. Towing applies to the matériel furnished the Navy Department and Marine Corps only, and the assembly of the howitzer and carriage for this purpose, together with the special accessories, is described herein for their benefit. The howitzers, recoil mechanisms, and carriages, M1923E2, serial numbers 3 and 4, differ from like assemblies, M1, in some details but they function identically and are interchangeable as assemblies. The howitzer to be manufactured in the future will be somewhat different from the M1 howitzer and will be designated as M1A1. These slight differences are in the breech ring and breechblock, and these components will not be interchangeable for the two models. The original extractor has been redesigned and those in service have been replaced or modified accordingly. The descriptions in these regulations refer to the M1 matériel. The following are the serial numbers of the 75-mm pack howitzers, M1, with carriages and recoil mechanisms, which are in the hands of the Navy and Marine Corps:

75-mm pack howitzers, M1	Recoil mechanisms	75-mm pack howitzer carriages, M1	Branch of service
16	16	16	Navy.
17	17	17	Do.
18	18	18	Do.
19	19	19	Do.
20	20	20	Do.
21	24	24	Do.
24	47	41	Marine Corps.
29	46	46	Do
38	29	29	Navy.
39	32	32	Do.
40	34	34	Do.
41	36	36	Do.
42	48	42	Marine Corps.
43	49	43	Do.
44	44	44	Do.
45	45	45	Do.

(2) In general, the pack loads consist of the howitzer tube (figs. 23 and 24); breech mechanism and wheels (figs. 25 and 26); cradle and top sleigh (figs. 27 and 28); recoil mechanism, including the bottom sleigh (figs. 29 and 30); front trail (figs. 31 and 32); rear trail and axle (figs. 33 and 34); ammunition (fig. 35); fire-control instruments (figs. 36 and 37); pioneer antiaircraft pack load (figs. 38 and 39); forge load (fig. 40); command post pack load (fig. 41); wire pack no. 2 (fig. 42); and radio pack no. 2 (fig. 43). The details of the ordnance equipment carried, as well as the pack equipment required for the various loads, are shown in Standard Nomenclature List No. C–20.

(3) This matériel was designed for transport on the Phillips cargo-type pack saddle, but may, with minor changes in pack load accessories, be transported on the aparejo. For details of equipment in either case see Standard Nomenclature List No. C–20. The figures in these regulations show the equipment of the Phillips cargo-type pack saddle.

b. The 75-mm pack howitzer matériel arranged for towing is shown in figure 3.

c. (1) General views of the howitzer mounted are shown in figures 1 and 2.

(2) The far-forward position of the howitzer and recoil mechanism should be noted. The muzzle preponderance, resulting from the rocker trunnions being located so far to the rear of the center of gravity of the tipping parts, is overcome in great measure by the use of spring equilibrators set between the inner and outer front trail flasks so as to push against the rockers from the rear. The object of this arrangement is high elevation without the necessity of a split trail and the digging of a pit to accommodate the howitzer in recoil.

5. Description of howitzer.—*a.* The howitzer is separated into two main groups, the tube assembly and breech mechanism. This division is principally for purposes of pack transportation as outlined in paragraph 4. 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.

b. The breech mechanism is of the horizontal sliding breechblock type and is hand operated by means of a lever pivoted to the breech ring.

c. The firing mechanism is of the design for side sliding breechblocks and is known as firing lock, M13.

d. The name of the piece and manufacturer, year of manufacture, serial number, and weight are stamped on the breech hoop and the breech ring.

6. Operation of breech mechanism.—*a.* To open the breech grasp the handle of the operating lever and press the latch in against the latch spring which unlatches the lever. Swing the lever to the right and around to the rear until it strikes the breech ring.

b. The operating lever rotates around the axis of the operating lever pivot, during which movement the inner arm of the lever moves the breechblock to the right through the action of the crosshead sliding in the groove across the top of the breechblock. As the breechblock moves to the open position it actuates the extractor which ejects the cartridge case.

c. In opening the breech rapidly the operator should retain his hold on the lever to prevent rebound of the breechblock.

7. Operation of firing mechanism.—*a.* Firing is accomplished by a sharp pull on the lanyard which is attached to the trigger (A12136), figure 5.

b. As the arm of the trigger is drawn to the rear the trigger shaft rotates in the opposite direction through the action of the spur gears on the trigger (A12136) and trigger shaft (A12138), figure 5. The trigger fork (A12132), figure 6, rotates with the trigger shaft and forces the firing pin holder sleeve (A12133) forward, which compresses the firing spring (A12134). When the spring is compressed the desired amount the front end of the sleeve comes into contact with the sloping portion of the sear (B8031) and forces the sear down against its spring (A12135) and out of contact with the firing-pin holder (B8187). The firing-pin holder on being released is propelled forward under pressure of the firing spring and causes the firing pin (A12755) to strike the primer.

c. The firing-pin holder with the firing pin returns automatically to the cocked position when the lanyard is slackened.

8. Description of carriage.—*a.* The 75-mm pack howitzer carriage, like the howitzer, is separated into several main groups for ease of transportation on pack animals. The subdivisions consist mainly of the recoil mechanism, including the bottom sleigh (figs. 29 and 30); cradle and top sleigh (figs. 27 and 28); front trail (figs. 31 and 32); rear trail (figs. 33 and 34); and the wheels which are carried on the same pack load as the breech mechanism (figs. 25 and 26).

b. 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.

c. The piston rod is secured to the cradle by means of the piston-rod latch. Therefore, in recoil and counterrecoil the two cylinders and bottom sleigh move with the howitzer while the cradle remains stationary. On each side of the bottom sleigh there are bearing strips or slides which engage the slideways of the cradle.

d. The carriage is constructed so that the howitzer may be elevated and depressed between — 5° and + 45°, and traversed 3° from the middle position to the right and 3° to the left.

e. The trail is divided into two groups, the front trail and rear trail. The two are joined by fittings sufficiently heavy to withstand the firing stresses.

f. The elevating mechanism, rockers, and equilibrators are assembled to the front trail and are carried with it in pack. Likewise, the axle bearings, into which the detachable axle and traversing mechanism are assembled, are built into the front trail for two positions of the axle. In the first or firing position the axle is well forward, where the weight of the axle and wheels is advantageously placed to increase the firing stability of the carriage. The second position is that arranged for towing, when the weight of the entire matériel is nearly balanced over the axle. In the second position the axle rests in rear axle bearings. With the obsoletion of the draft equipment, these bearings are no longer required on matériel used by the Army and will probably be removed.

g. (1) In the arrangement for towing, the axle is moved from its bearings in the front of the front trail to others underneath and slightly in rear of the trunnion bearings of the rockers. The rear trail is disconnected and a towing pole attached in its place.

(2) The cradle, sleigh, and howitzer are lifted from the rockers and set back until the rear trunnions lie in brackets just forward of the trail locking device. The front of the cradle rests on suitably shaped reinforces to the forward trail transoms. The rear trail is placed above the top sleigh, spade end toward the towing pole, and a cincha passed about the whole combination to hold it together.

h. During Army troop movements by rail, water, or truck, the matériel should be arranged as provided in *g* (2) above, and lashed together. This arrangement takes the weight off the elevating mechanism and reduces the possibility of damage.

9. Operation in dismounting the matériel for pack.—At least 4 men with 2 lifting bars are required. The carriage must be in firing position, without telescope mount, the cradle level, and the elevating handwheel knob turned into the trail lightening hole.

a. To disengage the top sleigh, pull the top sleigh clamping latch pin (A3872), figure 7, from the top sleigh clamping latch (A18873), and apply the socket of the handspike to the top sleigh clamping latch and turn it one-quarter of a turn. Move the top sleigh to the rear and lift it off, disengaging it from the hooks or lugs on the bottom sleigh. Lay the top sleigh to one side until the bottom sleigh is dismounted.

b. Insert a lifting bar in the forward lifting eye of the howitzer tube, turn the howitzer until the eye is vertical, and pass the lifting bar through the lifting eye. Two men, grasping the bar, force the tube forward free of the breech. When free, pass a second lifting bar through the eyebolt on the rear and place the tube on the pack. Put on and adjust the tube and muzzle covers.

c. Insert a lifting bar through the eyebolt on the breech ring. The breech ring is lifted off. The breech-ring cover is put on and the breech ring placed on the pack.

d. Disengage the piston-rod latch (B17569), figure 7, and start the bottom sleigh to the rear, passing a lifting bar through the rear bar holes. When the forward lifting-bar opening passes the wheels, insert a lifting bar. Slide the bottom sleigh out, turn it upside down, and place it on the pack. Place the top sleigh (D4821), figure 7, upside down in the cradle.

e. The trunnion hooks, right and left (B103545 and B5568), figure 10, are disengaged. Insert the front lifting bar. Lift the front end of the cradle (D3850), figure 7, until the rear lifting bar can be inserted. Remove the cradle and top sleigh and assemble the combination to the pack.

f. To dismount the trail.—(1) The trail is supported on both sides while the trail connecting mechanism is disengaged. The joint is broken and the trails allowed to rest on the ground. The rear trail is turned upside down and placed on the pack.

(2) The axle sleeve lock (A3363), figure 12, is disengaged and the axle sleeve (C5784) revolved to the position of disengagement. The front end of the front trail is supported while the wheels and axle are run out. The front trail is mounted on the pack.

g. The axle is supported and the wheels removed. The wheels are mounted on the pack carrying the breech ring and the axle on the rear trail pack.

h. To mount the matériel for firing, reverse the order of procedure as outlined for the operation in dismounting the matériel for pack when assembling for firing.

10. Changing from firing position to arrangement for towing.—(Applicable to Navy Department and Marine Corps only.)

a. Place the cradle at 0 elevation. Remove the top sleigh, howitzer, and bottom sleigh from the carriage as described in paragraph 9. Disconnect the rear trail. Lift up on the front trail and unlock the axle from the axle bearings. Roll the wheels and axle to the rear under the rear axle bearings. Lower the front trail on the axle. Mount the bottom sleigh, howitzer, and top sleigh in their traveling positions.

b. Place the rear trail on the top sleigh with the small clips of the forward transom centering at the front end of the top sleigh. Wrap the lifting bars and handspike in a manta and lay the package between the oil cans on top. Put the tool and accessory chests on either side with their hanger straps inside the rear trail and pass the cincha (strap end up) over the rear trail and under the front trail in front of the axle (fig. 3), and cinch tight.

c. To cinch, pass the end of the cincha strap through the open ring from the carriage side, through the upper ring from the outside, and again through the open ring. It will be found that the strap then functions as a tackle with the rings for pulleys, and that by pulling up on the strap end the cincha can be brought very tight. Pass the last loop of strap through the traversing handwheel. Secure by passing the strap end through the upper ring from the outside, then bring it around in front from right to left and through the ring from the inside, then down through the loop made by passing in front. The appearance of the knot (fig. 3) is something like a four-in-hand scarf tie.

NOTE.—When arranged for towing, the center of gravity is high enough to overturn the vehicle backward if the pole is raised above level. Also, the weight will lurch forward if the towing pole is dropped below level and will fall with sufficient force to damage it.

SECTION III

DESCRIPTION OF GROUPS

11. Tube assembly.—*a.* The tube assembly is composed of the tube, breech hoop, breech hoop pin, muzzle hoop, muzzle hoop pins, an eyebolt, lifting eye, lifting eye pin, two studs which act as guides, and muzzle hoop tangential pins.

b. Tube.—(1) The tube is a cold-worked forging or casting. It is threaded on the breech end to screw into the breech ring. The threads on the tube and those in the breech ring are interrupted so that in assembly the tube is pushed into the breech ring and screwed home by rotating it one-eighth of a turn.

(2) A collar is formed on the tube in front of the threads in which are seated the two studs which guide the tube in and out of the breech ring to prevent jamming the threads.

(3) The breech hoop fits over the tube in front of the collar. It is locked against rotation on the tube by two dovetailed lugs which seat in the collar on the tube. These lugs also act as stops for the barrel when screwing the barrel into the breech ring.

(4) The breech hoop is secured from longitudinal movement on the tube by the breech hoop pin which passes tangentially through the hoop and tube.

(5) The lifting eye is pivoted to the top of the hoop between two lugs and serves in connection with the front eyebolt as a means of lifting the tube. The lifting eye folds down against the tube when the latter is assembled on the carriage.

(6) The muzzle hoop is shrunk over the muzzle end of the tube and is locked by 2 keys on the breech end of the hoop fitting into keyways in the tube and by the 2 muzzle hoop tangential pins.

(7) The eyebolt (front) screws into the top of the hoop and is locked by a steel pin. The eyebolt serves as a lifting eye and is also utilized in connection with the lifting bar to screw the tube into the breech ring.

12. Breech mechanism.—*a.* The breech mechanism is composed of the breech ring assembly, breechblock assembly, operating lever assembly, trigger assembly, firing lock, gear cover, extractor, operating lever pivot, and trigger shaft.

b. (1) The breech ring assembly is composed of the breech ring (C7967), figure 5; eyebolt (A9195); leveling plates (A12121); operating lever latch catch (A12122); operating lever latch catch screw (A12123); and a headless screw (A12834) for locking the eyebolt.

(2) The breech ring (C7967), figure 5, is threaded in the front end to receive the tube. These threads are interrupted for rapid assembly and disassembly. Two lugs project from the front face which carry cam grooves to guide the two studs on the tube when assembling the barrel to the breech ring.

(3) The rear half of the breech ring is hollowed out to form the rectangular-shaped breech recess. The bottom face of the breech recess contains a curved groove which forms a guide for the lower trunnion of the extractor (B8027), figure 5. The upper wall of the breech recess is recessed to clear the operating lever (B8028) and operating lever latch catch (A12122).

(4) Two lugs, one on each side of the forward cylindrical portion, serve to lock the breech ring to the recoil mechanism.

(5) Two leveling plates (A12121) are inlaid in the top face to form seats for the gunner's quadrant.

(6) The eyebolt (A9195) is screwed in the top face at the center of gravity and locked by a screw (A12834).

c. (1) The breechblock assembly is composed of the breechblock (D1430), breechblock bushing (A21299), and a headless screw (A12130).

(2) The breechblock (D1430), figure 5, is rectangular except for a slight taper to the rear face made to produce a wedge action against the cartridge case as the block moves to the closed position. The left end is U-shaped to guide the cartridge case and is beveled on the front edge to force the case into the chamber.

(3) The top face contains a transverse groove which serves as a pathway for the crosshead (A12124). The bottom face contains a cam-shaped groove which engages the upper trunnion of the extractor (B8027) and actuates the extractor when the breech is opened.

(4) The breechblock is bored axially to take the firing case. This hole is threaded at the front end to take the breechblock bushing. The right end of the breechblock has two parallel holes which take the trigger and trigger shaft.

(5) The wide T-slot in the right end receives the gear cover (A12131), figure 5, which retains the trigger (A12136) and trigger shaft (A12138)

in the block. A vent hole leads from the firing case hole to the right end of the block.

d. (1) The operating lever assembly is composed of the operating lever (B8028); crosshead (A12124); crosshead pin (A12126); operating lever latch (A12125); operating lever latch pivot (A12127); and operating lever latch spring (A12128).

(2) The operating lever is pivoted to the upper right, rear portion of the breech ring. A short arm of the lever projecting from the pivot end swings into the breech recess. This arm carries a stud at the end on which is assembled the crosshead. The crosshead is secured on the stud by the crosshead pin which enters an annular groove in the stud.

(3) The long arm of the operating lever carries a handle which projects upward in the form of a hand grip. The handle is slotted vertically on one side to take the latch. The latch is retained in the handle by the operating lever latch pivot (A12127) and is actuated by the hand in gripping the handle and by the latch spring seated in the upper part of the handle.

e. (1) The trigger assembly is composed of the trigger (A12136), figure 5, and the trigger knob (A12137).

(2) The trigger journals in a hole in the end of the breechblock parallel to the hole for the trigger shaft. It contains a partial spur gear which meshes with the gear on the trigger shaft. The outer end contains a lever arm with a hole in the end to take the trigger knob.

(3) The trigger knob is pressed into the hole in the trigger lever arm and is secured by riveting. The knob provides the means of attaching the lanyard to the trigger.

f. (1) The firing lock, M13, consists of the firing case (C3537), figure 6; firing pin holder (B8187); firing pin (A12755); firing pin bushing (A12579); cotter pin; firing pin holder sleeve (A12133); firing spring (A12134); trigger fork (A12132); sear (B8031); and sear spring (A12135).

(2) The firing case fits the axial hole in the breechblock and is retained therein by the 3 sectors on the exterior engaging the 3 sectors in the breechblock. The interior of the firing case houses the remaining parts of the firing lock.

(3) The firing pin holder (B8187), figure 6, has a cylindrical head which fits the interior of the firing case (C3537). To the rear of the head the holder is reduced in diameter to pass through the firing spring (A12134), and flattened on two sides to pass through the firing pin holder sleeve (A12133), and between the prongs of the trigger fork (A12132).

(4) The head of the firing pin holder (B8187) is bored and threaded axially to take the firing pin bushing (A12579). It contains a number of flutes to reduce air resistance in front of the holder.

(5) The firing pin bushing (A12579) is bored to take the firing pin (A12755). The rear half is threaded on the exterior to screw into the firing pin holder. The forward half is flattened on two sides for a wrench. An annular groove in the threads receives the cotter pin which passes tangentially through the holder and the groove to prevent the bushing from unscrewing.

(6) The firing pin (A12755) is cylindrical with a flange on the rear end and a rounded point on the front end. The pin fits the hole in the bushing (A12579) and is held by the latter in axial alinement with the firing pin holder (B8187).

(7) The firing pin holder sleeve (A12133) fits the bore of the firing case (C3537). The interior is hollowed out to take the firing spring (A12134) and the rear end of the firing pin holder (B8187). The rear end is partly closed, and the rear face is beveled on the lower half to clear the trigger fork (A12132). The sleeve, in connection with the trigger fork, centers the rear end of the firing pin holder in the case.

(8) The trigger fork (A12132) has a square hole through its hub which fits the square on the trigger shaft (A12138), figure 5. In position the fork straddles the firing pin holder (B8187), figure 6, and supports the rear end of the holder in the firing pin holder sleeve (A12133). The ends of the fork arms bear against the rear end of the sleeve.

(9) The sear (B8031) rests in a slot in the interior of the firing case (C3537). It is held in the case by the trigger shaft which passes through the yoke-shaped rear end. The sear (B8031) is supported at the middle by the sear spring (A12135). The front end contains a notch which engages the front end of the firing pin holder to retain the latter in cocked position. To the rear of the notch the top slopes downward to clear the firing pin holder sleeve. This slope is acted upon by the sleeve to depress the sear out of engagement with the firing pin holder to fire the piece.

(10) The gear cover (A12131), figure 5, is a flat plate forced to slide in the wide T-slot in the right end of the breechblock. It serves to cover and retain the trigger (A12136) and trigger shaft (A12138) in the breechblock (D1430).

(11) The trigger shaft journals in the right end of the breechblock. It is fitted with a partial spur gear which meshes with the gear on the trigger. A square is formed near the inner end which fits the square hole in the trigger fork. The trigger shaft extends into the

firing case and through the trigger fork and sear, and holds the firing case from rotating in the breechblock.

(12) The extractor (B8027), figure 5, is an irregular flat-shaped piece with two opposed trunnions at one end, by which it is actuated, and a toe on the other end which engages the rim of the cartridge case. The trunnion on the bottom face rides in the curved groove in the bottom of the breech recess, while the upper trunnion fits into the extractor groove in the bottom of the breechblock. The front edge of the extractor is curved and rolls against the front face of the breech recess in extracting the case. (See par. 4.)

(13) The operating lever pivot (B8029) is a cylindrical pin with an integral key which fits the keyway in the lever (B8028), causing the pivot to rotate with the lever. A knob on the end serves as a handle.

13. Top sleigh.—*a.* The top sleigh assembly is composed of the top sleigh (D4821), figure 7; top sleigh clamping cam (B104254); top sleigh clamping latch (A18873); top sleigh clamping latch pin (A3872); cam bushing (A3580); and a leather thong (A17950) for retaining the latch pin. The latch and cam are secured together by a steel pin. Two headless screws suitably placed form stops on either side of the cam.

b. The top sleigh is weighted with a lead counterweight of approximately 20 pounds to bring the center of gravity of the recoiling parts to the desired position.

c. The top sleigh retains the howitzer in the bottom sleigh and also forms a covering piece for it. Four hooks on the top sleigh engage with lugs formed on the bottom sleigh. The cam, which is hand operated by means of the socket of the handspike, bears against the front of the breech ring and forces the top sleigh forward when turned to the locked position. By inserting the top sleigh clamping latch pin the two sleighs are solidly locked together and retained in that position.

14. Bottom sleigh.—*a.* The bottom sleigh (D3762), figure 7, is a U-shaped steel casting having two slides riveted on the outside which engage the ways of the cradle. Two narrow ledges inside form the seat for the howitzer and maintain the alinement of the tube and breech ring when assembled.

b. The recoil indicator bracket (B104820), which carries the recoil indicator (A19262) with its spring (A1344) and handle (A1343) for recording the length of recoil, is bolted to the right side of the bottom sleigh near the front.

c. The recoil indicator is a spring plunger arrangement, and may be so set that its point will trace a path in grease or similar substance

smeared on the top of the cradle. The length of recoil may be read on a scale cut in the cradle.

d. When not in use, the recoil indicator is raised and retained out of contact with the cradle by its handle resting in a notch in the wall of the bracket.

15. Cradle.—*a.* The cradle (D3850), figure 7, is a trough-shaped piece with ways extending its entire length to embrace the slides on the bottom sleigh. The trough is closed at the front except for openings necessary for the latching of the piston rod.

b. The piston rod latch (B17569) slides vertically in closely fitted ways in the front end of the cradle. When dropped behind the piston rod nut it secures the piston rod to the cradle; and with the bottom sleigh and howitzer in the cradle it cannot be disengaged, as interference with the howitzer tube prevents its rising. An automatic plunger latch is provided for holding the piston rod latch in either open or locked position.

c. Four horizontal lugs or trunnions near the rear end are machined to rest in notches in the rockers where they are retained by covering hooks which firmly lock the cradle to the rockers.

d. The sight bracket is bolted to the left rear side of the cradle. It is fitted with a flattened sight retaining shaft (A37140) which automatically returns to the locked position by the sight retaining shaft torsion spring (A37142), and with the sight socket plunger (A37304) and spring (A37302) holds a lug of the telescope mount against a headless stop screw (A37305) which is adjustable by means of a jam nut. By this means the accuracy of alinement of sight in azimuth is maintained, and at the same time quick removal of the telescope mount is provided for.

e. The cradle is also provided on the bottom with four feet which fit into the arches for pack transportation.

16. Axle, traversing mechanism, and wheels.—*a. Axle.*—(1) The axle (C1654), figure 12, is a round steel bar, bored out at each end and fitted with right and left axle arms (C6586 and C1695). The left arm is pinned to the axle while the right arm is attached with a screw for disassembling purposes, although the screw is peened over at assembly.

(2) A keyway is cut in the axle for the insertion of a key which prevents the axle from revolving when the carriage is traversed. Also, the axle is threaded, or grooved, on the left end for a distance of 13⅜ inches. These grooves form the inner race for the steel balls which act as threads in traversing.

(3) The axle passes through an enveloping sleeve by means of which it is retained in the bearings of the trail. The cylindrical bearings are flattened to pass restricted openings in the trail axle bearings. When inserted the sleeve is given a one-quarter turn. Its full diameter cannot then pass the openings and the sleeve is positively retained in the bearings. The lock for fixing the sleeve in proper angular position is made in the form of a hinged handle, which, in released position, becomes a lever by which the sleeve may be turned. When swung against the sleeve the heel of the sleeve lock (A3363) enters a groove in the right axle bearing and prevents rotation of the sleeve.

(4) The body of the axle is graduated in mils traverse, the right end of the sleeve forming the index of the graduations.

b. (1) The traversing mechanism is composed of the traversing nut (C8018), figure 12, which is locked to the handwheel (C8019) by machine screw (BCKX2CG); ball bearing (A15809); ball bearing cap (B13968); ball bearing nut (A15810); and seventy-one 5/16-inch steel balls (CCAX1D).

(2) A collapsible or bellows-like dust cover (C1666), attached to the axle arm and handwheel by means of clips (A15729 and A9222) and screws, is provided to prevent the entry of dust or other foreign matter into the traversing mechanism and for the like protection of the grooved portion of the axle not covered by the axle sleeve and traversing mechanism.

(3) The traversing nut is grooved on the inside to correspond with the axle and therefore serves as an outer race. The steel balls are enclosed within the grooves of the axle and traversing nut and form a thread over which the latter moves on turning the handwheel. This operation of the handwheel, in conjunction with the traversing nut, forces the axle sleeve over the axle and traverses the piece to the desired azimuth.

(4) The traversing nut is fixed in the hub of the traversing handwheel beside a ball bearing which greatly relieves the friction between the sleeve and axle. The ball bearing is fitted to the axle sleeve just outside the seat for the left axle bearing on the front trail.

(5) When the matériel is transported on its wheels the handwheel is lashed to the trail to prevent it from turning and running the axle off center.

c. (1) The wheel (fig. 22) is 29 inches in diameter with a steel tire 3/8 inch thick and 1 7/8 inches wide. It has 12 spokes (C6594), imbedded in 6 sections of wooden felly (C6595). The felly sections are secured on the inside by felly clamps (A18220) which are fastened by tire

bolts (BAMX1D). Six carriage bolts (BADX3AH) clamp the spokes between the hub ring (B17679) and the flange of the hub box (B12251). Steel dowels (A18219) are used to aline the felly segments.

(2) The hub liner (B128014) of the wheel does not revolve upon the axle arm but is keyed to it. The wheel turns upon the liner and is retained on it by the bronze hub ring (B17679) on the outer end of the liner. Therefore, the liner remains in the wheel when it is dismounted. The wheel is held on the axle arm by the linchpin secured by a thong.

(3) A drag link (B17678) is retained on the outer end of the hub ring by the wheel nut (A20809).

17. Front trail.—*a.* (1) The front trail (fig. 8) is composed of 2 side members consisting of 2 trail flasks each (D5059, D5060, D5061, and D5066), welded together to form 2 box-like sections. These sections are connected by transoms that tend to strengthen the trail to withstand the firing stresses. Openings are provided at the front of each side member which house the rockers which pivot on trunnion pins (A3486), figure 10, through the rockers and trunnion bearings.

(2) At the front and between the side members of the trail the upper elevating gear case (D3848), figure 8, rocker pinion shaft tube (B13506), and rocker pinion shaft tube bearing are assembled. The elevating worm (A16), figure 11, and elevating worm wheel (A15) are enclosed within the gear case and the rocker pinion shaft within the tube.

(3) Axle bearings, left and right (C5786 and C5785), figure 8, are provided at the front end of the trail which retain the axle when the piece is in firing position. At the bottom and to the rear of the trunnion bearings two additional axle bearings (B104369 and B104370), figure 8, are fitted for retaining the axle when the matériel is transported by towing. These additional axle bearings now apply to Navy Department and Marine Corps matériel only.

(4) Two bearings (B9699), figure 8, are assembled toward the rear of the front trail in which the rear ends of the equilibrators rest, the front ends being supported in bearing surfaces in the rockers.

(5) Two brackets (B13971) on the top toward the rear support the cradle when arranged for towing or shipment.

(6) Trail hinges (C5796 and C6591), figure 8, are attached to the rear end of the trail. These hinges engage with other hinges on the rear trail for assembling the matériel in firing position. The trail fulcrum plungers (B6832), housed within the trail connecting mechanism housing (C5797), pass through the eyes of the hinges.

(7) The trail fulcrum plungers are moved in and out by means of the trail fulcrum (B6833) and two trail fulcrum links (A8690). By the use of a lifting bar through the eye of the fulcrum it may be turned 90° which engages or disengages the plungers with the hinges.

(8) The trail connecting mechanism is also utilized when attaching the towing pole.

b. Rockers.—The rockers (fig. 10) are segments of internal gears of 152 teeth to the complete circle. There is a rocker on either side of the cradle in the space between the inner and outer flasks of the front trail side segments. The internal gears center in the axis of pins assembled through the rockers and trunnion bearings of the trail. The rocker teeth mesh with 15-tooth pinions on the rocker pinion shaft (B5570), figure 11. A worm wheel (A15), figure 11, of 22 teeth on the rocker pinion shaft is revolved by a single-threaded right-hand worm (A16) on the elevating worm shaft. Motion is transmitted from the elevating crank shaft to the worm by a pair of bevel gears with 15 teeth on the crank shaft and 18 teeth on the worm shaft.

c. Equilibrators.—(1) Two equilibrators (fig. 13) are provided to overcome the preponderance of weight resulting from the position of the rocker trunnions being so far to the rear of the center of gravity of the tipping parts. The equilibrators are set between the inner and outer front trail flasks so as to push against the rockers from the rear.

(2) The equilibrator is composed of the barrel (B19613); stem (B19614); equilibrator pin (A21724); equilibrator helical spring (A21723); equilibrator stem plug (A21725); equilibrator pin lock (A3552); and machine screw (BCNX2AA) which fastens the lock in place.

(3) The equilibrator pressure is adjustable within limits to secure the lightest and most uniform resistance to elevation and depression. The rear end of the barrel and the plug are adapted to receive the equilibrator locking tool to hold the equilibrator compressed while inserting it, and in dismounting it from the trail. The load on the spring when the locking tool is inserted is approximately 1,400 pounds.

18. Rear trail.—*a.* The rear trail (fig. 9) is somewhat similar to the front trail in that it is composed of two side members consisting of flanged flasks joined by welding into box-like sections. The side sections are joined and supported by transoms (C5820 and C5818), supports (B103001, B103006, B104407, and B104408), and angles (B103005 and A15937) to strengthen the trail.

b. The spade (fig. 9), consisting of the spade plate (C8287), spade braces (C6588, C8288, C8289, and C6589), and spade points (B17438 and B103550), and the handspike socket (C5824), is assembled to the

rear end of the trail. Its purpose is to prevent backward movement of the matériel when the howitzer is fired.

c. Trail hinges, left and right (C5823 and C6587), are riveted to the front end for connection with the front trail.

d. The handspike socket is for the purpose of maneuvering the matériel by the use of the handspike.

e. The sponge staves are transported on the inside of the rear trail and are held secure by fastening plate (A18222), figure 9, supported by the strap plate filler (A18221) and a web strap (QADX1BA).

f. The axle and traversing mechanism assembly is carried inside the trail with the right end of the axle in the bore of the handspike socket and the left end over the rear trail front transom. The axle sleeve is adjusted by turning the handwheel until the lug, in which the sleeve lock handle locks, engages the trail fastening pin (A18983) of the rear trail fastening (B104391) riveted to the transom (C5818).

19. Recoil mechanism.—*a.* (1) When the howitzer is fired, the force which propels the projectile forward reacts upon the howitzer and drives it to the rear. It is necessary to check this force in a gradual manner so as not to cause displacement of the carriage. Also, the howitzer must be brought back into battery position before it can be fired again. These objects are accomplished by the recoil mechanism (fig. 14) which is of the hydropneumatic type and combines the recoil and counterrecoil systems housed within separate cylinders.

(2) The two cylinders, known respectively as the recoil cylinder (C5825), figure 21, and the recuperator cylinder (C5806), are fixed underneath the bottom sleigh and are screwed into the yoke (D3859). The piston rod is attached to the cradle when the matériel is mounted. The yoke and cylinders move with the bottom sleigh and howitzer while the piston rod remains stationary.

(3) The piston rod and piston are contained in the right or recoil cylinder, the rod passing out through the stuffing box in the yoke. The recoil cylinder is closed at the front and rear by the recoil cylinder front head (B103501), figure 16, and the recoil cylinder rear head (B17563), figure 14.

(4) In the left or recuperator cylinder is the regulator (fig. 14), floating piston, and the chamber for compressed gas. The rear end of the recuperator cylinder is closed by the recuperator cylinder rear head (B17669), containing the air filling valve (B104103), figure 15, through which the gas is introduced.

(5) All space in the yoke and cylinders not occupied by the metal parts, floating piston grease, or the compressed gas is filled with recoil

oil. A communicating passage in the yoke allows the oil to freely pass from one cylinder to the other. The original design required medium recoil oil, but action is being taken to replace it with heavy recoil oil in future manufacture and in recoil mechanisms in service.

b. Action of the recoil mechanism.—(1) When the howitzer is fired, the howitzer and sleighs move to the rear. The yoke and cylinders of the recoil mechanism move with the bottom sleigh, while the piston rod is stationary. This action forces the recoil oil in front of the piston through the communicating passage in the yoke into the recuperator cylinder through the regulator (fig. 19), and moves the floating piston (fig. 14) to the rear, still further compressing the nitrogen housed within the recuperator cylinder. As the oil passes the regulator it is obliged to pass through a very small opening offering considerable resistance to its passage. This resistance, plus the frictions of the cradle guides, stuffing box, and pistons, added to the energy absorbed in the further compression of the nitrogen, finally exhausts the energy of recoil and the howitzer stops. Immediately the compressed nitrogen (fig. 14) expands, moving the floating piston forward, forcing the recoil oil against the recoil piston, thereby moving the howitzer into firing position.

(2) The regulator valve (B19670), figure 19, is closed by a spring (A20803) when recoil ceases, so the recoil oil returns to the recoil cylinder through the grooves of varying depth in the central bore of the regulator. By varying the depth of these grooves the desired resistance to the passage of oil in counterrecoil is secured.

(3) The recuperator cylinder is closed at the front by the recuperator cylinder front head (C5803), figure 19, and is retained in position by a follower (B17675) which bears against a gland (B17676) that compresses the recuperator cylinder front head packing filler (B17674)

(4) The inner end of the recuperator cylinder front head is fitted with the oil index pinion housing (C4825), figure 19, into which the oil index mechanism is assembled. The function of the oil index is to show the amount of oil separating the floating piston and regulator. Should the howitzer be fired with the oil index (A15893) indicating a loss of oil in the system, considerable additional stress may occur in the recoil mechanism and cause great damage. It is, therefore, necessary to force in enough oil to move the oil index (A15893) until it is flush with the extension on the oil index follower assembled in the recuperator cylinder front head (C5803). This reserve oil moves the floating piston about one-half inch away from the regulator.

c. (1) The recoil cylinder (fig. 14) contains the recoil piston and rod, recoil cylinder stuffing box (B103501), and the recoil cylinder rear head.

(2) The recoil piston rod (B102669), figure 18, is machined to close dimensions and finished with a high polish. The front end is turned to a slightly smaller diameter and threaded to receive the piston rod nut (A15848) and stop collar (A15850). To the latter is assembled a fiber ring stop (A15849) which limits counterrecoil of the bottom sleigh. The space between the piston rod nut and the stop collar embraces the piston rod latch of the cradle.

(3) The construction of the recoil piston is illustrated in figure 17. The column of saucer-shaped (Belleville) springs (A15877) exerts a pressure against the plastic rubber filler (B102672) and expands it radially against a leather ring packing (B102671) and flanges of adjacent silver rings (B102670). The pressure of the Belleville springs is assisted by the oil, resulting in a tight seal which becomes tighter as the oil pressure is increased in recoil. The recoil piston packing filler seals the joints around the rod as well as that between the piston and cylinder. The leather wiper (A15870) cleans the cylinder in counterrecoil of any grit that may have entered through the recoil cylinder rear head relief opening.

(4) The recoil cylinder stuffing box (fig. 16) makes use of exactly the same principle as the recoil piston to assure a tight joint around the piston rod. The Belleville springs, assisted by the oil pressure, squeeze the stuffing box packing filler which closes in on the rod. A wiper (A15853) between the front recoil cylinder head and follower cleans the rod in counterrecoil.

(5) The filling valve (B103503), figure 21, is contained in the filling valve housing (B13659) which is screwed tightly into the yoke against a soft copper gasket (A6370). This valve is opened by means of the oil screw filler when it is necessary in replenishing recoil oil that may have leaked through the recoil piston stuffing box or the oil index packings or to replace oil which may have been withdrawn from the system due to expansion of the oil caused by rapid firing.

(6) The recoil cylinder is closed at the rear by the recoil cylinder rear head (fig. 14). As this head is not on the pressure side of the piston, elaborate packing is not required. In order to relieve the accumulation of oil that may pass the piston, a relief opening is provided in the recoil cylinder rear head through which the oil is ejected. A small vent screw closes the relief opening, and prevents dirt from being sucked into the cylinder.

SECTION IV

ASSEMBLY AND DISASSEMBLY

20. General.—*a.* Incidents of wear, breakage, cleaning, and inspecting make necessary the occasional disassembly of various parts of the howitzer and carriage. This work comes under two headings—that which can be performed by the battery personnel with the equipment furnished, and that which must be performed by trained ordnance personnel.

b. The battery personnel may, in general, do such dismounting as is required for the assembly of such parts as are indicated in Standard Nomenclature List No. C–20 for battery use. Such work should be done in the manner prescribed. Any difficulty which cannot be overcome by the prescribed methods must be brought to the attention of ordnance personnel.

c. The battery personnel will not attempt to disassemble any part of the recoil mechanism not authorized in these regulations, nor do any filing on the sights or howitzer parts other than as outlined in Training Regulations, and only by order of the battery commander on any carriage part.

d. The use of wrenches which do not fit snugly on the parts should be avoided. They will not only fail to tighten the parts properly but will damage the corners of nuts and bolt heads and there is danger of spreading the wrenches and rendering them useless.

21. Tube assembly.—The tube is so constructed that disassembly of any parts should not be attempted. The breech hoop, muzzle hoop, and studs are permanently assembled. Likewise the eyebolt and lifting eye are locked in place by riveting which necessitates chipping or drilling before removal.

22. Disassembly of breech mechanism.—*a.* (1) Open the breech to the point where the assembling line on the top of the operating lever is parallel with the side of the breech ring and lift out the operating lever pivot (B8029), figure 5.

(2) Slide the breechblock to the right far enough to clear the crosshead (A12124), and lift off the operating lever.

(3) Take the breechblock (D1430) out to the right. This will leave the extractor (B8027) free, and it may be removed.

(4) The breechblock bushing (A21299) will not be removed.

(5) Lay the breechblock on its rear face.

(6) Slide out the gear cover (A12131), pull out the trigger (A12136), start the trigger shaft by engaging a screw driver or the knob on the trigger in the partial annular slot in the trigger shaft gear, and pull out the trigger shaft (A12138).

(7) Turn the breechblock up. Rotate the firing case 60° in either direction and pull it out of the block.

b. Firing lock.—(1) Pry the trigger fork (A12132), figure 6, out of the firing case with a screw driver, first through the trigger shaft hole, then from the outside of the case.

(2) Insert the trigger shaft to engage one of the yoke ends of the sear. Press the front end of the sear out of engagement with the firing pin holder (B8187), insert a screw driver in rear of the firing pin holder sleeve (A12133), and pry the sleeve and holder forward until they can be grasped by the fingers and pulled from the case.

(3) Remove the trigger shaft and draw out the sear (B8031) and sear spring (A12135).

(4) Hold the front end of the firing pin holder (B8187) in one hand and place the rear end of the sleeve against the edge of a bench or some convenient part of the carriage. Push against the front end of the firing pin holder to compress the spring and press the rear end of the holder down to unhook it from the rear end of the sleeve; allow the holder to recede out of the sleeve, freeing the spring.

(5) Remove the cotter pin, unscrew the firing pin bushing (A12579), and push the firing pin (A12755) out of the bushing.

c. Operating lever.—Press the operating lever latch (A12125), figure 5, into the operating lever until they are parallel. This alines the keyways in the two pieces. Push the operating lever latch pivot (A12127) out and remove the latch and spring (A12128). Drive out the crosshead pin (A12126) and remove the crosshead (A12124).

23. Assembly of breech mechanism.—*a. Operating lever.*—Assemble the crosshead (A12124), figure 5, on the stud of the operating lever and drive in the crosshead pin. Place the latch spring in the handle of the lever. Put the latch in position with the stud on the latch into the spring and press in on the latch to the point where the pivot holes and keyways are in alinement and insert the pivot.

b. Firing lock.—(1) Insert the firing pin (A12755), figure 6, into the firing pin bushing and screw the bushing into the firing pin holder. Put in the cotter pin and spread the ends so that they will not rub the firing case.

(2) Assemble the firing spring over the firing pin holder and the firing pin holder sleeve over the spring and holder. Force the sleeve against the spring, compressing the spring to allow the beveled surfaces on the sleeve and holder to hook together. This can be accomplished by grasping the holder with one hand and guiding the sleeve with the other while pushing the rear end of the sleeve against the edge of a bench or convenient part of the carriage to compress the spring.

(3) Insert the sear spring into its seat in the bottom of the firing case, using a screw driver between two coils of the spring for the purpose. Assemble the sear into the case, locating the stud into the sear spring. Press the sear down against the spring with the fingers and insert the trigger shaft temporarily into the firing case and through the sear.

(4) Using a small screw driver press the sear down and enter the firing pin holder sleeve into the case. Withdraw the screw driver and push the holder fully home.

(5) Remove the trigger shaft and insert the trigger fork into the opening in the bottom of the case with the part marked "muzzle face" toward the front, in which position the rounded ends of the fork bear against the rear face of the firing pin holder sleeve. Push the trigger fork in until it snaps into position.

c. Breech mechanism.—The breech mechanism may be assembled with the breech ring mounted or dismounted.

(1) Place the extractor (B8027), figure 5, in the breech recess with its lower trunnion resting at the forward end of the curved groove in the breech ring.

(2) Slide the breechblock part way into the breech recess from the right side. Leave the groove across the top of the block exposed for entry of the crosshead attached to the operating lever.

(3) Hold the operating lever about parallel with the side of the breech ring and place the crosshead in the groove in the breechblock; push the breechblock into the breech recess far enough to aline the operating lever pivot holes in the breech ring and lever. Move the lever to aline the keyways and insert the pivot.

(4) Close the breech. Assemble the firing lock (fig. 6) into the breechblock by pushing it in until the sectors on the case strike those in the breechblock. Push gently on the case and at the same time rotate it in either direction until the sectors on the case match the spaces between the sectors in the breechblock, when the case will go forward until the head strikes the block. Rotate the case until the lines on the case and the breechblock marked "TOP" coincide

(5) Insert the trigger shaft into the breechblock and through the firing case. The assembly line on the gear of the trigger shaft must match the line on the breechblock to enter the square on the trigger shaft through the hole in the trigger fork.

(6) Assemble the trigger into the breechblock, matching the assembly line with a similar line on the trigger shaft.

(7) Push the gear cover down in the breechblock to retain the trigger shaft and trigger.

24. Carriage.—*a.* In general, no disassembling of the carriage will be undertaken by the battery personnel other than into the various pack loads. Certain complete assemblies and minor individual parts may be removed and replaced if necessary. These are all indicated in Standard Nomenclature List No. C-20.

b. The recoil mechanism is complex and unsuited for successful disassembling except at an arsenal or shop equipped for the work. The high pressure present in the system at all times makes it extremely dangerous to attempt unauthorized disassembly. It is, therefore, forbidden to perform any disassembling of the inside parts of the recoil mechanism.

SECTION V

INSPECTION AND ADJUSTMENT

25. Inspection.—The following instructions with reference to the inspection of the howitzer and carriage should be scrupulously observed by all concerned:

Parts to be inspected in order of inspection	Points to observe
a. The howitzer as a unit.	*a.* General appearance; smoothness of operation of the breech mechanism in both opening and closing; the bore for copper deposits on the lands and grooves; erosion at the origin of rifling; condition of threads on the exterior of the tube and interior of the breech ring.
b. Breech ring.	*b.* Condition of the eyebolt; burrs or roughness on the leveling plates.

Parts to be inspected in order of inspection	Points to observe
c. Breechblock.	*c.* Indication of burrs, roughness, or scoring.
d. Firing lock, M13.	*d.* Condition of all parts; weak or broken springs; cracked or broken sear.
e. Adjustment.	*e.* The howitzer is so designed that it requires no adjustment. If any of the parts show excessive wear they are to be replaced.
f. The carriage as a unit.	*f.* General appearance. Whether the oil plugs are painted red and a red ring has been painted around all oil holes, and the carriage is painted in accordance with regulations.
g. Recoil mechanism.	*g.* That the proper amount of oil is in the system. Whether the oil index functions correctly. When the howitzer is fired, note whether the oil relief opening in the recoil cylinder rear head is functioning properly and allows the oil and air which may be trapped in the cylinder between the piston head and rear head to escape.
h. Elevating mechanism.	*h.* Whether operation is smooth and the mechanism is properly lubricated. Elevate and depress and see that the movement of the rockers and equilibrators is smooth and whether the elevating crank functions properly.
i. Traversing mechanism.	*i.* Whether operation is smooth and the parts are properly lubricated. Condition of dust cover and axle sleeve lock.
j. Front trail.	*j.* Condition of axle bearings. Whether the operation of the trail connecting mechanism is

Parts to be inspected in order of inspection	Points to observe
	smooth and parts properly lubricated. Condition of the hinges.
k. Rear trail.	*k.* Condition of the hinges, spade, and spade points. That all straps and fastenings are in place and in good condition.

26. Verification and adjustment of the sight.—*a.* (1) The panoramic telescope, M1, and the telescope mount, M3, are in adjustment when, at zero elevation, with the carriage axle and telescope leveled and all scale settings normal, the line of sight is parallel to the bore of the howitzer.

(2) Battery mechanics are forbidden to disassemble any part of the panoramic telescope and telescope mount and will make only such adjustments as are hereinafter prescribed. Adjustments are only to be made with equipment provided by the Ordnance Department for that purpose and in the presence of a commissioned officer. Any difficulties which cannot be corrected by the methods herein prescribed should be reported to the ordnance maintenance company.

(3) When out of adjustment the telescope and mount will cause inaccurate firing and should, therefore, be frequently verified, and adjusted when necessary. A testing target (fig. 46) is provided for such verification.

b. The procedure under the above conditions is as follows: Level the carriage transversely with the aid of the gunner's quadrant on the exposed finished end of the axle. Suspend the testing target in a plane perpendicular to the bore of the howitzer and at a distance of about 50 yards. Place the muzzle and breech bore sights in the howitzer. Train the howitzer in the direction of the testing target and level the howitzer with the gunner's quadrant resting on the leveling plates of the breech ring. Raise or lower the testing target and bring the center line of the bore, as determined by the bore sights, on the center of the lower cross, keeping the vertical lines of the target plumb. The verticality of the target should be verified by a plumb line.

c. (1) With the telescope in its high position on the mount, the mount indices at zero settings, and both mount level bubbles in the centers of their runs, the line of sight should pierce the center of the cross at the left of the testing target.

(2) If the line of sight falls on one side of the cross, turn the azimuth worm of the telescope mount to bring the line of sight on its mark;

loosen the azimuth micrometer clamp screw; rotate the micrometer without turning the worm until its index registers zero, then tighten the clamp screw to hold the micrometer head in correct position.

(3) If not more than several mils lateral adjustment is necessary, the adjustment can also be effected by setting the micrometer and azimuth scale to zero, then by means of the adjusting screw in the socket on the cradle make the necessary adjustment. This adjustment is provided primarily to parallel the axis of the pivot (cross level) with the axis of the bore and should not be resorted to for making large collimation adjustments when the collimation of the panoramic telescope has been disturbed more than is usually encountered due to wear of parts and effect of temperature.

(4) With the angle of site index at "300", if the angle of site micrometer or range drum indices are not at zero the angle of site micrometer clamp nut or range drum screws may be similarly loosened, the micrometer knobs turned to bring the reading correct, and the clamp nut or range drum screws securely retightened. The horizontal crossline of the panoramic telescope should be parallel to the horizontal line of the testing target when the bubble of the cross level is central with respect to the guide lines cut in the level vial.

(5) If the cross level requires adjustment, remove the plug which exposes the adjusting screws and after making the necessary adjustment be sure that all of the adjusting screws are tight. Then replace the plug.

SECTION VI

FUNCTIONING

27. General.—The functioning of the matériel as a whole, and of the groups, is so closely allied with description and operation, and description of groups, that it has been included in sections II and III and is not repeated hereunder.

28. Malfunction of howitzer.—Malfunction, cause, and correction.

Malfunction	Cause	Correction
a. Fails to fire; no percussion on primer.	*a.* Broken firing spring. Broken or deformed firing pin.	*a.* Disassemble firing lock and replace broken or deformed part.

Malfunction	Cause	Correction
b. Fails to fire until after several percussions on primer.	*b.* (1) Firing mechanism parts not working freely.	*b.* (1) Disassemble firing lock and examine carefully for burrs and rough spots. Remove burrs or rough spots with crocus cloth or an oilstone. Wash parts with gasoline to remove gummy oil; dry thoroughly and lubricate with light class A lubricating oil before reassembly.
	(2) Weak firing spring.	(2) If correction (1) above does not remedy condition, it may be inferred that the firing spring is weak. Replace spring.
c. Fails to fire when proper percussion on primer is obtained.	*c.* Defective primer.	*c.* Insert another round of ammunition.
d. Fails to extract empty case.	*d.* Broken extractor.	*d.* Ram the case out gently from the muzzle. Examine the edge of the chamber for burrs which might cause difficult extraction. Remove burrs, if any, with crocus cloth or an oilstone. Replace extractor.

29. Malfunction of carriage.—Malfunction, cause, and correction.

Malfunction	Cause	Correction
a. Oil index projects less than the required distance.	*a.* (1) Loss of reserve oil.	*a.* (1) Drain the remainder of the reserve oil and refill.
	(2) Loss of gas pressure, either through	(2) Gas escaping by the floating piston is

Malfunction	Cause	Correction
	the cylinder rear head or past the floating piston.	indicated by an emulsified condition of the reserve oil drained off. If, when proceeding to fill the recoil mechanism with oil, the oil index does not move out and the oil screw filler works easily, the gas pressure probably has been lost. Substantiate this by an attempt to drain the mechanism. Oil will not spurt from a mechanism without at least some pressure.
b. Oil index remains stationary when the reserve is pumped in against evident pressure.	*b.* The packing is too tight or the index is broken or locked by some foreign substance.	*b.* Drain off all reserve oil and refill. While injecting the oil, tap the oil index gently with each turn of the screw filler. If the oil index fails to move after employing the screw filler, refer the matter to the ordnance maintenance company.
c. Howitzer returns to battery with too great a shock.	*c.* Excess reserve caused by expansion of oil due to rapid firing. If rapid fire is started with a full oil reserve, the heat will cause the oil to expand and become less viscous. Expansion of the oil means further initial and final com-	*c.* Assemble the oil release and withdraw oil until the index is half way in. When the mechanism is cooled off refill to normal.

Malfunction	Cause	Correction
	pression of the nitrogen gas. A decreased viscosity means slightly less resistance in the tortuous passage through which the oil must flow. Each of these conditions tends to cause the recoiling parts to counterrecoil too fast and strike the stop with an audible shock.	
d. Howitzer fails to return to battery.	*d.* Insufficient reserve or dry or scored bottom sleigh gun slide or piston rod; excessive friction or loss of nitrogen pressure.	*d.* Establish a full reserve. If the howitzer fails to return to battery, examine the bottom sleigh gun slides and piston rod. Loosen the screw in the recoil cylinder rear head or have the ordnance maintenance company determine whether oil has clogged between the recoil piston and recoil cylinder rear head, and test the gas pressure and friction of the recoil mechanism.

SECTION VII

CARE AND PRESERVATION

30. Howitzer.—*a.* (1) In cleaning after firing, wash the bore with a solution made by dissolving one-half pound of soda ash or 1 pound of sal soda in 1 gallon of water using the sponge for swabbing purposes. Wipe perfectly dry, using the sponge covered with burlap, and then oil the bore with a light coat of rust-preventive compound.

(2) The breech and firing mechanism should be kept clean and well lubricated. The mechanisms should be disassembled periodically when not in use, thoroughly cleaned, and coated with rust-preventive compound, as it is difficult to stop the action of rust when once started.

(3) If the breechblock does not slide smoothly examine it for burrs or scoring. Remove the burrs and coat the breechblock with light class A lubricating oil. If the breechblock is scored report the condition to the ordnance maintenance company.

(4) Disassemble the firing lock and examine the firing mechanism. If any of the parts are cracked or the springs have become weak replace the damaged parts.

b. To remove the rust-preventive compound, the greater part should be scraped off, and the balance removed with a rag or cotton waste dipped in gasoline.

c. Do not strike any metal part with a steel hammer. Use a buffer of wood or copper between the part and the hammer.

31. Carriage.—*a.* Maintenance of the carriage in service requires proper cleaning, strict observance of the lubrication program, and proper adjustment of the axle sleeve lock, equilibrator, and trail connecting mechanism, as well as in correction of loose or broken parts.

(1) All bearing surfaces, screw threads, and exterior parts must be clean and as free from dirt as possible. Special attention should be given those bearing surfaces which are exposed. When disassembly operations are being carried on, extra precautions must be taken to prevent the entrance of foreign matter into the working parts.

(2) Clean and lubricate the seats for the equilibrator pins and smooth all roughness from the rounded portion of the barrel. Lubricate the socket of the bearing. Adjustment of the equilibrator should be made by the ordnance maintenance company.

(3) Lubricate all parts of the trail connecting mechanism thoroughly.

b. Recoil mechanism.—(1) Before firing, the recoil mechanism should be examined for leakage of oil and to assure that the proper amount of reserve oil is in the system and that the sleigh slides are well lubricated.

(2) In draining the reserve oil from the recoil mechanism, provide a clean receptacle of at least 1-pint capacity. Unscrew the filling plug, using the ratchet wrench and the ½-inch socket. Assemble the oil release into the filling hole. The reserve oil will spurt out in a stream and suddenly drop at right angle to the flow. At this point the flow of oil should be stopped by unscrewing the filling and drain valve release. It will be noted that the oil index has moved in and is no longer flush with the extension on the oil index follower. If the oil index has not moved, tap it gently with a small piece of wood as it may be bound by the index packing.

c. To establish a new oil reserve.—(1) Fill the body of the oil screw filler with recoil oil. Hold the filler nozzle up, give the screw a turn or two until a small amount of oil runs out in order to expel all air from the filler. Screw the nozzle of the oil screw filler into the filling hole, give the handle of the filler another turn to force out any air in the filling hole, then tighten the oil screw filler. Operate the oil screw filler, using both hands to avoid forcing it to one side and breaking off the threaded nozzle.

(2) When the oil index has reached its extreme outward position, which is indicated by the oil index being flush with the extension on the oil index follower, a full oil reserve is present in the mechanism.

(3) If the oil index does not move out as prescribed in (2) above during the process of forcing oil into the cylinder, the ordnance maintenance company should be notified to repair the oil index.

(4) In emergency if the oil index fails to register, the reserve oil in the system should be drained. The flow and sudden stoppage of the oil will prove that the mechanism is serviceable. Refill the mechanism with one oil screw filler of oil and proceed to fire the piece.

(5) Remove the oil screw filler and replace the filling plug.

32. Lubricating instructions.—*a.* The life of the matériel depends to a great extent on proper lubrication. Particular attention should be given to the lubrication of the sliding surfaces of the breech mechanism, sleigh slides, elevating and traversing mechanisms, and wheel hub liners.

b. Grit must be kept out of lubricating openings and open bearings. This may be accomplished by wiping off the lubricant which seeps from the moving parts to prevent the accumulation of dirt and grit.

c. Oil should be applied while the parts are being maneuvered to insure distribution of lubricant to all moving parts.

d. The various lubricants and cleaning and preserving materials issued by the Ordnance Department are described and their use prescribed in TR 1395–A.

33. Lubrication of the howitzer.—*a.* The howitzer mechanisms are not provided with oil holes and many of the bearing surfaces may be oiled only after disassembly. The following places are to be cleaned and lubricated immediately after each firing period:

(1) Bore and breech ring.
(2) Operating lever assembly.
(3) Firing lock.
(4) Breechblock.

b. The parts should be lubricated with light class A lubricating oil.

34. Lubrication of the carriage.—*a.* Drops of light class A lubricating oil should be placed once a week during active service and while the bearings are being operated at the following points of the carriage:

(1) Cradle trunnions.
(2) Hooks and hook latches on rockers.
(3) Elevating pinion shaft bearings.
(4) Equilibrator pins.
(5) Elevating cranks and left crank shaft bearing.
(6) Threads and body of axle.
(7) Trail connection links and plungers.
(8) At the oil fittings and at the sides of the cross level worm segment of the sight mount.

b. Medium graphite lubricating grease is specified for the rocker teeth (exposed to weather) as this grease is not so easily washed away by rain as are soap greases. An application twice per month should be sufficient.

35. Paint.—For detailed information regarding the removal of old paint, cleaning and preparation for painting, preparing new paint, application and kind of paint for different surfaces; brushes, slushing oils, abrasives, burlap, etc., see TR 1395-A.

36. Protection and cleaning of material affected by gas.—*a. Protection against phosgene, chlorine, etc.*—(1) For material which is in constant danger of gas attacks, whether from gas clouds or gas shells, care should be taken to keep all bright parts of the guns, carriages, mountings, and accessories well coated with oil.

(2) Sights and all instruments should also be covered with oil and protected with covers when not in actual use, care being taken that the oil does not come in contact with any glass or find its way into the interior of the instruments.

(3) All uncapped fuzes or fuzes which have been removed from their containers should be wiped over with oil as soon as possible and protected with a cover.

b. Protection against mustard gas.—It must be remembered that practically all fabrics and materials such as wool, cotton, rubber, and oilcloth can be penetrated by mustard gas if exposed to it a sufficient length of time. The mustard gas is absorbed by these materials and penetrates them by a slow process of diffusion. In general, it may be said that the greater the length of time allowed for penetration the greater the danger in wearing these articles. For instance, rubber boots which have been worn in an area shelled heavily with mustard gas may be a grave danger to men who wear them several days after the bombardment. Fabrics thoroughly impregnated with boiled linseed oil will resist penetration by mustard gas for over an hour, but after this time these articles are dangerous because the mustard gas dissolves in the linseed oil and they must be destroyed.

c. Cleaning.—All bright parts of howitzers and carriages, together with all accessories and spare parts exposed to the gas, must be cleaned and wiped dry as soon as possible after the attack, and in any case within 24 hours, after which they should be thoroughly coated afresh with oil. The same applies to the whole of the ammunition still in the battery position. Ammunition which for any reason has not been oiled must be cleaned and oiled. It is desirable to expend it as soon as possible.

d. Disinfection of matériel of all kinds affected with mustard gas.—The following measures should be taken for the removal of mustard gas from various materials and equipment (guns, projectiles, cases, wood, metals, rope, etc.) which have come in contact with mustard gas. For all of the operations indicated below, the gas mask and protective clothing, including protective shoes and gloves, must be worn.

(1) Commence by freeing the objects of dirt, lumps of earth, and liquid with wooden spatulas, rags, etc., which will be buried immediately after this operation. They must never be burned.

(2) Sprinkle a continuous layer of calcium hypochlorite, which is preferred if available, or else dry chloride of lime over the parts that lend themselves to this treatment. In the statements hereafter calcium hypochlorite is specified, but dry chloride of lime may be substituted in the event that calcium hypochlorite is not available. After 2 hours, or better after 6 hours if practicable, wash off the layer of calcium hypochlorite and rinse thoroughly. It is imperative that all the calcium hypochlorite be removed in order to prevent the deterioration resulting from the prolonged action of the calcium hypochlorite. In the case of ammunition it is imperative to prevent particles of calcium hypochlorite from being introduced into the bore of the piece.

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(3) Whitewash soiled parts which do not lend themselves to sprinkling with dry powder with a thick paste of calcium hypochlorite made from 3 volumes of calcium hypochlorite and 1 volume of water. After 2 hours, or preferably 6 hours, wash off the calcium hypochlorite.

(4) The delicate parts of the apparatus, such as breech mechanism, sighting apparatus, glasses, etc., which would be injured by calcium hypochlorite should be cleaned by dry polishing with rags. After this operation the rags should be buried.

(5) If there are large quantities of water at hand, in the place of calcium hypochlorite use water. The water should be warm, but not boiling, and large quantities should be used. This cannot be done in the case of greasy articles, where only calcium hypochlorite should be used.

(6) When it is not necessary to immediately use contaminated material, or when one has not the above means at his disposal, it may be considered that the handling of the material or apparatus is not dangerous after 6 or 8 days.

e. Transportation of material affected by gas.—The removal will be effected by automotive units whenever possible. If horse transport must be used, the route will be carefully reconnoitered in order to avoid infected ground. The material will be disinfected as thoroughly as possible before its removal.

SECTION VIII

ACCESSORIES

37. General.—*a.* The accessories for use with this matériel are of three general classes, viz, howitzer and carriage accessories, pack load accessories, and towing equipment (Navy Department and Marine Corps only). For complete lists of all accessories see Standard Nomenclature List No. C-20. There are a number of howitzer and carriage accessories provided, such as covers, screw drivers, wrenches, etc., the name or general characteristics of which plainly indicate their use and application. Therefore, no detailed description or method of use is outlined herein. The special accessories, however, being of a different nature, description, purpose, and method of use, are outlined herein.

b. The pack load accessories are included in the standard nomenclature list in groups for each load to be packed. They are also shown for use with both the Phillips cargo-type pack saddle and the aparejo.

38. Bar, lifting, M2.—The lifting bar, M2, is composed of a pipe body with two collars spaced an equal distance from the center of the bar. Each end of the bar is closed with a steel end. The purpose of the bar is lifting the various loads when dismounting for pack or draft travel and when mounting the equipment for action.

39. Book, artillery gun.—The artillery gun book (O. O. Form 5825) is issued for the purpose of keeping an accurate record of the howitzer. It must always remain with the howitzer regardless of where the howitzer may be sent. The book is divided as follows: Record of assignments of the howitzer to the various batteries; battery commander's daily howitzer record; inspector's record of examination; and forms to be filled out in case of premature explosions.

40. Carrier, oil can, M1.—The oil-can carrier is composed of two leather tubes with covers. Straps are interposed between the tubes to hold them in alinement. The purpose of the carrier is to house the oil cans, M4, for pack transport.

41. Chest, accessory, M1.—The accessory chest is a metal box 10¼ inches high, 7 inches wide, and 12½ inches long, with a hinged lid. Hasps on either side of the lid embrace hasp staples riveted to the body of the chest. By this means the lid is locked in position by bolt snaps which are fastened to the chest by means of chains riveted to the chest. Two hangers are riveted to the cover, the purpose of which is to suspend the chest on the pack saddle. The interior of the chest is provided with packing blocks and a locking lever to retain the panoramic telescope, telescope mount, and the sponge in rigid positions.

42. Chest, tool, M3.—The tool chest is practically the same as the accessory chest, the difference being in the packings for the interior of the chest. It is suspended in the same manner on the pack saddle.

43. Filler, oil screw, M3, with adapter.—*a.* (1) The oil-screw filler is a high-pressure hand pump and is only used to replenish the recoil mechanism with recoil oil.

(2) It is composed of a hollow cylindrical body in which the oil is placed, and the piston is manipulated in forcing the oil into the recoil mechanism. The piston and its allied parts are attached to a long screw which is recessed at its outward end to take the handle by means of which the screw is turned. The screw is retained in position by, and rotated through, the threaded filler head. The filler head is screwed on the cylinder and locked by a screw. The handle is detachable and may be used either in its regular position in the screw or through the adapter. It is prevented from slipping out without the use of force by two steel balls held rigidly in place by a spring.

b. The adapter is fitted over the hexagon portion of the filler and is retained in position by means of a headless screw. The purpose of the adapter is for screwing the filler in and out of the filling hole.

44. Handspike, M3.—The handspike is a steel tube with a socket welded 7 inches from the small end. The other end is closed by an aluminum knob riveted to the tube. The purpose of the handspike is to traverse the howitzer by moving the trail to any desired firing position. By means of the socket it is also used in turning the cam latch in engaging and disengaging the top sleigh from or to the bottom sleigh.

45. Lanyard, M8.—The lanyard is composed of a piece of sash cord 39½ inches long, one end of which is passed through a wood handle and knotted. The handle is recessed to receive the knot. The other end is passed around a steel thimble and wound with brown linen shoe thread. Assembled through the eye of the thimble is a hook, the purpose of which is to engage the firing trigger shaft.

46. Lanyard, M9.—This lanyard consists of practically the same parts as the lanyard, M8, the difference being in the length of the sash cord which is 187½ inches long and a pulley with a hook which is assembled between the handle and thimble. The lanyard is used when it is necessary to take cover when firing the howitzer. The pulley is hooked to the trail and forms a support for the lanyard to prevent it sagging and becoming entangled with some foreign matter. A leather thong is used for binding to the trail.

47. Roll, tool, M4.—The tool roll carries tools as listed in Standard Nomenclature List No. C-20. It is 30 by 26 inches when opened. It

is made of cotton duck and has 20 pockets. When rolled it is tied by two latigo leather thongs stitched at one end of the roll.

48. Sponge and staff, M1.—*a.* The sponge and staff is composed of the sponge assembly, sponge head assembly, and the end staff and middle staff assemblies. The sponge is a piece of carpet 6½ by 7 inches which fits around the sponge tube and is supported at the ends by two sponge tube supports to which the carpet is sewed. The sponge assembly fits over the sponge head and is supported by the sponge collar held in place by a taper and cotter pin. The sponge head is threaded to receive the coupling on the staff. The middle staff is a round wood body to which are riveted male and female couplings. The end staff is similar but with only a male coupling.

b. The sponge head at the front end is so shaped and hollowed as to fit over the fuze of the shell or shrapnel when it is used as a rammer in dislodging them from their seat in the howitzer.

49. Thong, leather, 5/16 by 12 inches.—This thong is a narrow strip of latigo leather, 5/16 by 12 inches. The purpose is to bind the lanyard pulley to the trail.

50. Thong, leather, 3/8 by 36 inches.—This thong is a narrow strip of latigo leather, 3/8 by 36 inches, used for general purposes.

51. Wrenches.—The reversible ratchet wrench is used in conjunction with the hexagon wrench sockets for removing nuts or plugs assembled in positions where it is impossible to use an ordinary open or adjustable screw wrench.

52. Pack load accessories.—*a. General.*—The details of the use, method of loading, balancing, etc., of the pack load accessories and pack loads, as well as the cinching and securing of the loads, are covered in Training Regulations. Therefore only a short, concise description of the accessories and their care and preservation will be given in these regulations.

b. Adapters.—(1) For adapting the howitzer tube to the pack arch, M2, two adapters are necessary owing to the taper of the tube.

(2) The tube is loaded on the animal muzzle to the rear. Therefore, the radius of the front adapter is greater than the rear adapter, 3.2 inches as opposed to 2.5 inches. The two adapters are practically the same otherwise, being malleable iron castings, the lugs of which fit into cut-outs in the arches. The adapters are held in position by headless pins secured by cotter pins. The tube is held in place by means of front and rear wire-rope assemblies.

c. Ammunition bars are used with the aparejo only. They are 1-inch steel bars with lugs in the inclined corners, the long flats of which rest on the flat top of the arch.

d. Ammunition box hanger, M4.—(1) This is composed of a U-bolt which fits around the ammunition box, the hook which goes on to the U-bolt over the top, two wing nuts, and lock washers. Two hangers are required for each box. When assembled around the box, the outside of the hooks should measure 13⅝ inches apart on the Phillips cargo-type pack saddle and 16½ inches for the aparejo.

(2) When ammunition boxes are packed on the aparejo, for animals with prominent hip bones, it is necessary to use canvas pads stuffed with hay under the boxes. The hay pad is not used with the Phillips cargo-type pack saddle.

e. Arch, pack, M2.—(1) The pack arch, M2, is a malleable iron casting with a flat top. When used with the Phillips cargo-type pack saddle they are bolted directly to the saddle framework.

(2) When used with the aparejo they are connected by the hinged pack frame sides and are detachably stapled to the aparejo itself.

(3) Adapters are used where necessary to fit the load to the arches.

(4) When the configuration of a particular animal brings the load too low, fillers may be placed between the arch and the load. A number of fillers, thick and thin, are issued for this purpose.

(5) The pack arch, M2, is used for the following loads:

Howitzer tube Cradle and top sleigh Bottom sleigh and recoil mechanism Front trail Rear trail and axle Fire-control instruments Pioneer pack load Wire pack load	On both Phillips cargo-type pack saddle and aparejo.
Ammunition—on aparejo only.	

f. Arch, front trail, rear.—This is composed of the pack arch, M2, and an adapter fastened together with two headless pins and cotter pins. The pack arch, M2, is described in *e* above. The adapter is somewhat similar to the others except that it is larger and is flat on top. The pack arch, M2, is used for the front of the trail. The front trail rear arch is used on both the Phillips cargo-type pack saddle and the aparejo.

g. Bracket.—Two brackets with curved hooks are used on each of the howitzer tube, cradle and top sleigh, bottom sleigh and recoil mechanism, and front trail loads into which the lifting bars fit. They are shaped to fit over the ribs of the pack saddle. They are used with the Phillips cargo-type pack saddle only.

h. Cincha, M2.—The body of this cincha is made of olive-drab cotton duck cut 22 inches wide and folded in such manner as to form a 10-inch band. The end pieces are leather to which are riveted steel bars. The cincha is 85½ inches long. A long leather strap is attached to one of the bars which passes underneath the animal and ties to the bar on the other end of the cincha. It is used with the aparejo on the howitzer tube load.

i. Cincha, M3.—A duplicate of cincha, M2, except it is 91 inches long. It is used with the aparejo on the cradle and top sleigh, and bottom sleigh and recoil mechanism loads.

j. Cincha, M4.—Exactly like the M2 and M3 cinchas, but 101½ inches long. Used with aparejo on front trail and rear trail loads.

k. Cincha, M6.—Made of olive-drab cotton duck 11 inches wide, folded to 4½ inches to form the body. Leather facings at the ends retain D-rings. The cincha is 30 inches long and is used with the aparejo on ammunition, wheel and breechblock, and wire pack loads.

l. Cincha, M7.—(1) The body is made of olive-drab cotton duck 18 by 60 inches. The width is folded three times and stitched with linen thread. At one end the cincha is adjustable by means of a two-bar loop, around one of the bars of which the body is passed and doubled over the other, drawn back and stitched to a leather keeper. The other end is also attached to a steel loop by means of a leather facing stitched with linen thread. Leather straps are attached at either end which are secured by thongs. The straps are for securing the cincha to prevent the load from slipping.

(2) The cincha, M7, is used for the following loads:

Ammunition	On Phillips cargo-type pack saddle.
Cradle and top sleigh	
Bottom sleigh and recoil mechanism	
Front trail	
Rear trail and axle	
Forge load	
Command post pack load	
Supply and forage chests pack load	

Ammunition—on aparejo only.

m. Cover, breech, M1.—The breech cover is made of leather with a sheepskin pad. It is held in place over the breech ring by two leather thongs. It is used when the howitzer is disassembled for pack transportation.

n. Cover, tube, M1.—The tube cover is used over the breech end of the tube when disassembled for pack transportation. It is made of

leather and also has a sheepskin pad. It has two chapes and billets which are buckled together to hold the cover in place.

o. Frame, breech mechanism, M1.—The frame is a malleable iron casting designed to transport the complete breech mechanism including the breech ring. The mechanism is held in position on the frame by means of a wire rope which has threaded fittings on each end. One end of the rope passes through a hole in the frame and is held by means of two nuts. The other end is assembled with a loop attached to a hook. The hook is assembled to a lever hinged to the frame. To release the strain on the rope the lever is pulled out and up. In this position the hook may be disengaged from the loop. The breech mechanism frame is used on both the Phillips cargo-type pack saddle and the aparejo.

p. Frame, instrument, T1E1.—This frame is composed of the frame proper and various braces and supports for carrying either the 18- by 24- or the 24- by 31-inch plane table and accessories in case, plus the B. C. telescope in its case. Adjustable stops are provided for carrying either size plane table. The 18- by 24-inch plane table is for the howitzer battery. The 24- by 31-inch plane table is for the light battalion headquarters battery.

q. Frame, pack, M1912.—This frame was designed for aparejo transport of the forge, command post, supply chests, etc., pack loads of the 2.95-inch mountain gun, and can be used with these loads for the 75-mm pack howitzer matériel "as is" on the aparejo, until the eyes on the chests, etc., are replaced by hooks, designed for transport of the chests, etc., on the Phillips cargo-type pack saddle. The frame is made up of 2 pack frame sides, exact duplicates of the pack frame side, M1, assembled by pack frame pins to 2 arches (Z101A). Strap loop clevises are attached by the same pins through the arches. Four leather straps are used in connection with this frame. When chests designed or adapted for transport on the Phillips cargo-type pack saddle must be transported on the aparejo, the sides of this frame should be used in conjunction with the ammunition bar and pack arches, M2. See *u* below.

r. Hangers, instrument, T1 and T2.—Two instrument hangers are provided and hang from the sides of the instrument frame, T1E1. They have not been adopted as standard equipment but are under test.

(1) The instrument hanger, T1, fits on the off side. It carries the two aiming circles in their carrying cases, plus the range finder in its case.

(2) The instrument hanger, T2, carries the B. C. telescope tripod and its carrying case, the plane-table tripod and its case, and the range-finder tripod and its case.

s. Hangers, wheel, Phillips cargo-type pack saddle.—These wheel hangers are designed for use with the Phillips cargo-type pack saddle only and are for carrying the wheels of the carriage.

t. Hangers, wheel, aparejo.—These hangers are designed for use with the aparejo only and are for carrying the wheels of the carriage.

u. Side, pack frame, M1.—When packing by the aparejo two pack frame sides, M1, are necessary on certain of the loads, viz, ammunition, howitzer tube, cradle and top sleigh, bottom sleigh and recoil mechanism, front trail, rear trail and axle, wheel and breechblock, fire-control instruments, pioneer pack load, and wire pack load. This pack frame side consists of two crossbars with wood blocks attached, supported and braced by upright braces. Hinge hooks are attached to the tops of the braces by means of which, with arch pins, the pack-frame sides are suspended between the rear and front arches. See *q* above.

v. Pack, combination, pioneer, antiaircraft.—Certain material issued by the Quartermaster Corps and items issued by the Ordnance Department are carried on this pack. (See Standard Nomenclature List No. C–20.) The ordnance issues are as follows: Automatic rifle in its leather case, the accessories and spare-parts case which carries a set of spare parts for the automatic rifle, the chamber cleaning brush, brush and thong, two fabric envelops, ruptured cartridge extractor, an oval oiler, gas cylinder cleaning tool, and combination tool. In addition thereto, 1,200 caliber .30 cartridges are carried, while the loads assigned to the howitzer sections each include two lantern masks, M1. Description of cases, chests, etc., follows:

(1) *Machine-rifle ammunition chest, M1.*—The ammunition chest (fig. 39), which is made of pressed steel, is divided into 3 compartments, each compartment holding 100 rounds in 5 magazines. The magazines are placed in compartments with cartridge opening downward and magazines staggered. The chest is carried above the rifle, top of chest upward and lid-fastening device outward. The chest is held in the hanger by straps equipped with a quick-release device.

(2) *Accessories and spare-parts case, M1918.*—The accessories and spare-parts case is a leather box. The top flap, which is part of the body, is retained in the closed position by means of a billet being passed through a metal loop. The case is carried on the off side.

(3) The *automatic-rifle carrying case* is constructed of leather and is designed to fit the general contour of the automatic rifle. The case is carried as shown in figure 39.

w. The *miscellaneous supply chest no. 1* will be used for storing the padded box containing the spare panoramic telescope and telescope mount; also the spare gunner's quadrant, bore sight complete, testing target, and bags containing the spare parts for the howitzer and carriage and the spare parts of the pack-load accessories.

x. When shipping an unserviceable panoramic telescope and telescope mount the padded box mentioned in *w* above will be used.

53. Towing equipment.—*a.* The cincha, M5, is composed of a body of olive-drab cotton duck cut 22 inches wide and folded to a width of 10 inches. A leather facing is stitched to the body. Leather ends reinforce the body through which a bar made of ½-inch pipe flattened at each end is inserted and riveted in position. A long leather strap is attached to one of the bars. The purpose of the cincha, M5, is to retain the load in position when the howitzer and carriage are placed in towing position. The cincha is 75 inches long.

b. The towing pole (C58154), figure 3, consists of a bracket which is attached to the front trail by means of the trail-connecting mechanism, a steel-tubing body approximately 4 feet long, a lunette, and a crossbar of iron pipe approximately 44 inches long.

c. This towing equipment is provided with matériel furnished the Navy Department and Marine Corps only.

SECTION IX

DATA

54. Characteristics of the matériel:

Length of bore	calibers	15.93
Length of rifling	inches	11.24
Number of grooves		28
Depth of grooves	inch	0.03
Width of grooves	do	0.1866
Width of lands	do	0.14439
Rifling—uniform, right-hand twist, 1 turn in 20 calibers.		
Muzzle velocity	foot-seconds	1,250
Volume of chamber	cubic inches	57.3
Density of loading (approximate)		0.4589
Travel of projectile	inches	39.2894
Weight of projectile	pounds	15
Weight of charge (approximate)	do	0.95
Maximum powder pressure permitted	pounds per square inch	26,000
Maximum range	yards	9,000
Center of gravity—distance from breech end of howitzer	inches	19.72
Range of elevating mechanism	degrees	−5 to +45

		Paragraph
Traverse, right	degrees	3
Traverse, left	do	3
Expected recoil	inches	32
Maximum permissible recoil	do	33. 5
Weight of tube assembly	pounds	221
Weight of breech mechanism assembly	do	121
Weight of top sleigh	do	121
Weight of bottom sleigh and recoil mechanism	do	203
Weight of cradle	do	100
Weight of front trail, including rockers	do	235. 5
Weight of rear trail	do	95
Weight of axle and traversing mechanism	do	65. 5
Weight of wheels (2)	do	96. 5
Weight of panoramic telescope, M1, and telescope mount, M3	do	10. 5
Weight of howitzer and carriage, complete, with telescope in firing position	pounds	1, 269
Weight of howitzer and carriage assembled for towing (approximate)	pounds	1, 290
Center to center of wheels on ground	inches	38
Clearance under axle sleeve, towing assembly	do	10. 5
Height of telescope above ground (upper position on mount) at zero elevation	inches	37. 107

SECTION X

SUBCALIBER EQUIPMENT

55. General.—*a.* The purpose of the subcaliber equipment is to provide for a greater amount of target practice than could be obtained by the use of regular 75-mm ammunition. Save for the firing of other than the regular ammunition, the handling and loading of which differ, as well as the range, the training is with the 75-mm pack howitzer matériel.

b. Subcaliber firing is accomplished by the use of the 37-mm gun and recoil mechanism, M1916, mounted on the top of the 75-mm pack howitzer by means of a specially constructed mount designated as 37-mm subcaliber mount, M5. See figure 45.

56. Description and operation of the mount.—The 37-mm subcaliber mount, M5, is composed of a number of steel angles and plates, welded into a frame. This frame is retained upon the howitzer by four hooks formed to slide under the lugs of the bottom sleigh.

a. The rear end of the frame is equipped with a cam, the purpose of which is to force the frame forward to the full engagement of the hooks and lock it in this position.

b. At the front an adjusting screw is provided for the purpose of raising the front end of the frame until the hooks are in full contact with the lugs of the bottom sleigh.

c. Trunnion brackets are bolted to each side of the frame which support the trunnions of the 37-mm gun cradle.

d. The collar welded on the upright pieces at the front of the frame encircles the recoil cylinder of the 37-mm gun cradle. Three adjusting screws are provided in the collar to hold the cradle in position and to facilitate the adjustment for parallelism of the bore of the 37-mm gun with that of the pack howitzer.

57. Assembly and disassembly.—*a.* To assemble the 37-mm subcaliber mount to the 75-mm pack howitzer it is necessary to remove the top sleigh from the howitzer.

b. Place the 37-mm subcaliber mount on top of the howitzer, guiding the hooks of the frame under the lugs of the bottom sleigh.

(1) Turn the locking cam clockwise 90°, forcing the frame into the full locked position. Raise the frame at the front by the adjusting screw until the hooks of the frame come to a bearing on the lugs of the bottom sleigh.

(2) Remove the trunnion brackets from the frame and place them on the trunnions of the 37-mm gun cradle.

(3) Lift the 37-mm gun and cradle on to the mount guiding the recoil cylinder through the collar at the front of the frame. Bolt the trunnion brackets in place.

(4) Center the recoil cylinder in the collar by the three adjusting screws. In making this adjustment no strain should be exerted on the adjusting screws. Tighten the adjusting screws in the trunnion centering the cradle in the frame.

58. Bore sighting.—*a.* As the 37-mm gun is to be laid with the regular sighting and maneuvering mechanism of the 75-mm pack howitzer, the bore of the guns should be parallel. To secure proper alinement when the 75-mm pack howitzer carriage is in firing position bore sights are set in the subcaliber gun as well as in the pack howitzer.

b. Verification of the sights having been accomplished as described in paragraph 26, the following procedure should be observed in bore sighting the 37-mm gun:

(1) Place the bore sights in the 37-mm gun and bore-sight on the testing target.

(2) All adjustments of the 37-mm gun upon the testing target are made by the three adjusting screws in the collar that encircles the recoil cylinder and those in the trunnion brackets.

(3) When the proper adjustments have been made set the jam nuts up tight. Ordnance Field Service Modification Work Order No. A7–W5 provides for modification of the cylinder of the recoil mechanism when used for subcaliber purposes. A steel band is to be applied. Without this the pressure of the screws is liable to distort the cylinder, in which case the gun fails to return to the full battery position.

59. Care and preservation.—Repairs to the 37-mm subcaliber mount, M5, will be minor in nature and will involve only the removal of burrs when necessary and the replacement of parts. When the subcaliber mounts are disassembled all screws, nuts, and lock washers should be assembled in their proper places.

60. Accessories and spare parts.—Accessories and spare parts for the subcaliber equipment are shown in Standard Nomenclature List No. C–20.

[A. G. 062.12 (10-31-34).]

BY ORDER OF THE SECRETARY OF WAR:

DOUGLAS MACARTHUR,
General,
Chief of Staff.

OFFICIAL:

JAMES F. McKINLEY,
Major General,
The Adjutant General.

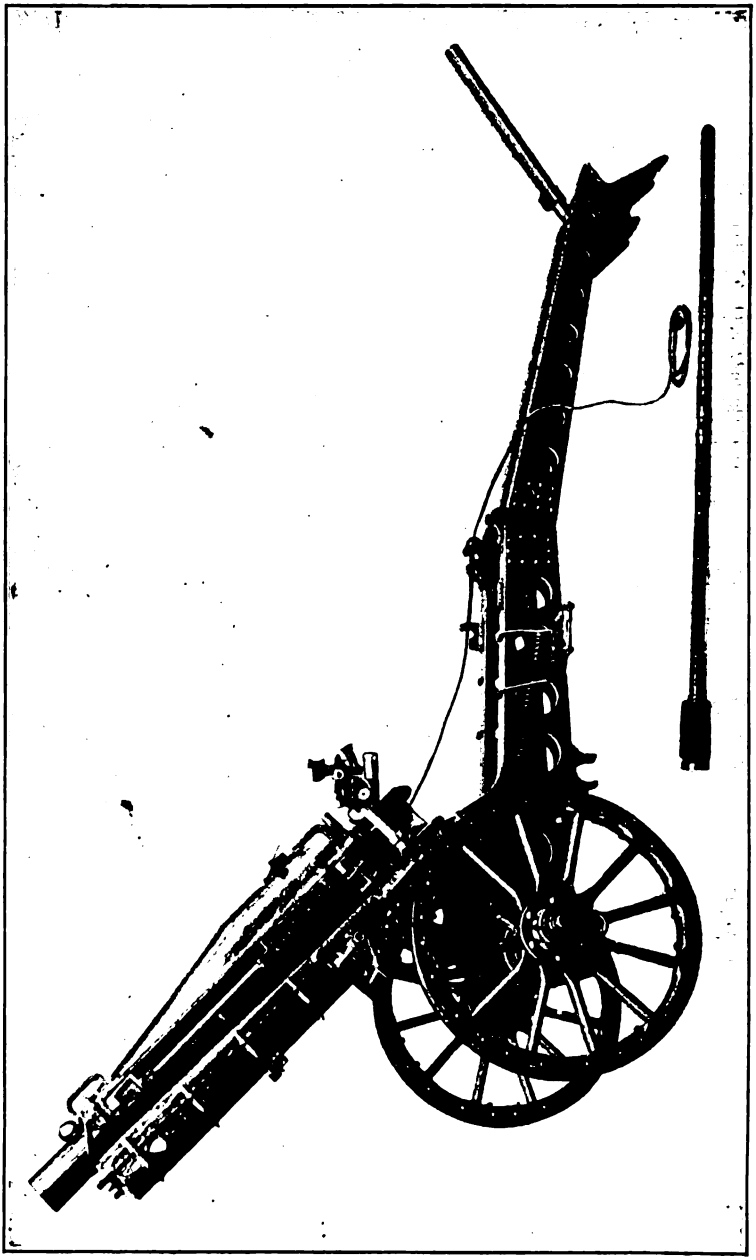

FIGURE 1.—75-mm pack howitzer and carriage, M1, left side view.

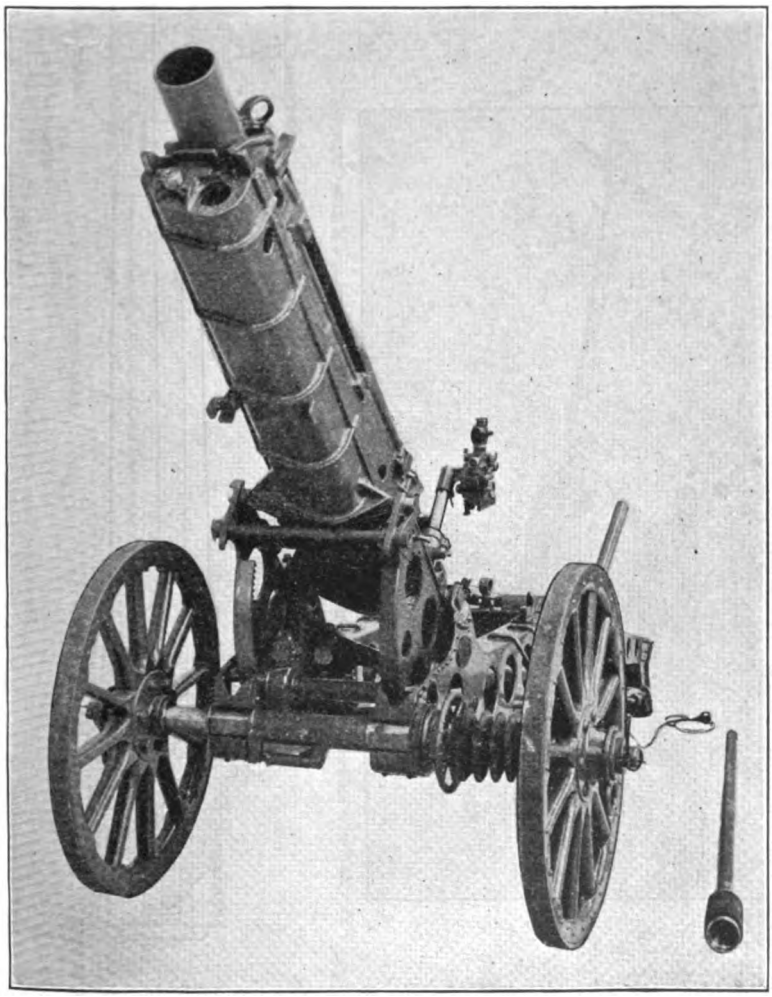

FIGURE 2.—75-mm pack howitzer carriage, front view.

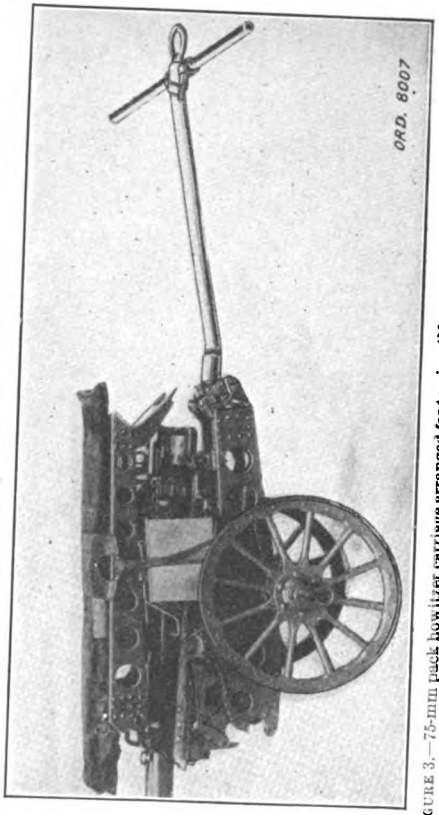

FIGURE 3.—75-mm pack howitzer carriage arranged for towing (Navy Department and Marine Corps only)

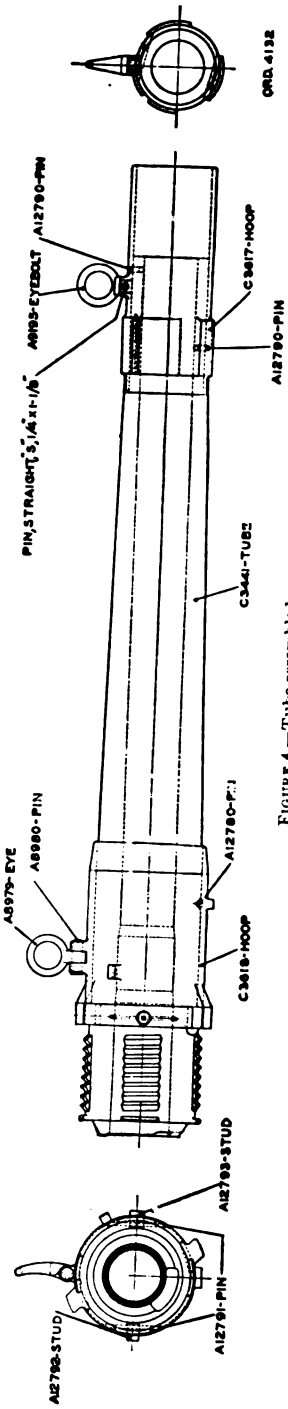

FIGURE 4.—Tube assembled.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item	Reference	Item
A8979	Eye, lifting.	A8980	Pin, lifting eye.
A9195	Eyebolt.	A12790	Pin, muzzle hoop.
C3618	Hoop, breech.	BFDX2AD	Pin, stght., S., ¼ by 1⅛.
C3617	Hoop, muzzle.	A12792	Stud, ⅝ diameter.
A12789	Pin, breech hoop.	A12793	Stud, ¾ diameter.
A12791	Pin, drill rod, 3/16 by 3¾.	C3441	Tube.

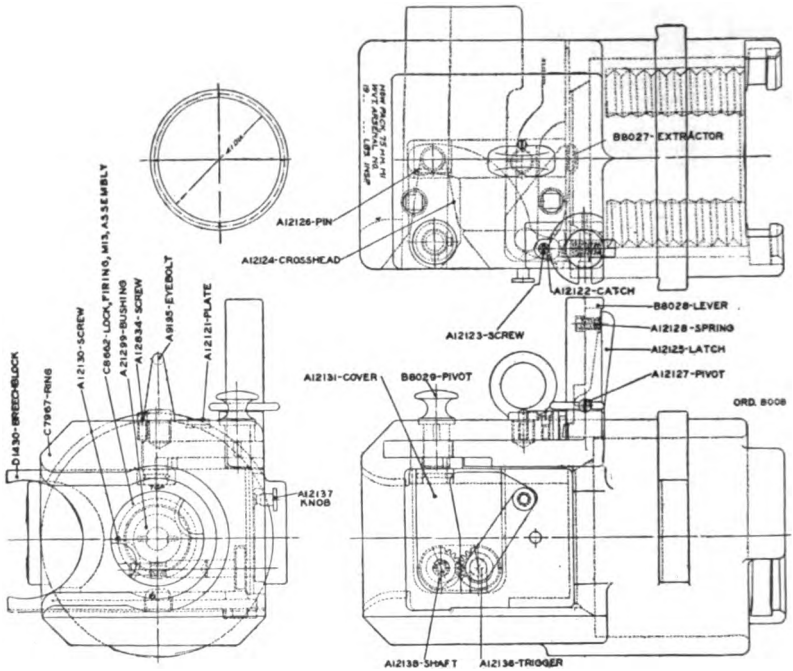

FIGURE 5.—Breech mechanism assembled.

Reference	Item	Reference	Item
D1430	Breechblock.	B8029	Pivot, operating lever.
A21299	Bushing, breechblock.	A12127	Pivot, operating lever latch.
A12122	Catch, operating lever latch.	A12121	Plate, leveling.
A12131	Cover, gear.	C7967	Ring, breech.
A12124	Crosshead.	A12130	Screw, hdls., S., 0.190–32–NF–3 by 0.40.
B8027	Extractor.	A12834	Screw, hdls., S., 5/16–24–NF–3 by 0.965.
A9195	Eyebolt.	A12123	Screw, operating lever latch catch.
A12137	Knob, trigger.	A12138	Shaft, trigger.
A12125	Latch, operating lever.	A12128	Spring, operating lever latch.
B8028	Lever, operating.	A12136	Trigger.
C8662	Lock, firing, M13, group assembly.		
A12126	Pin, crosshead.		

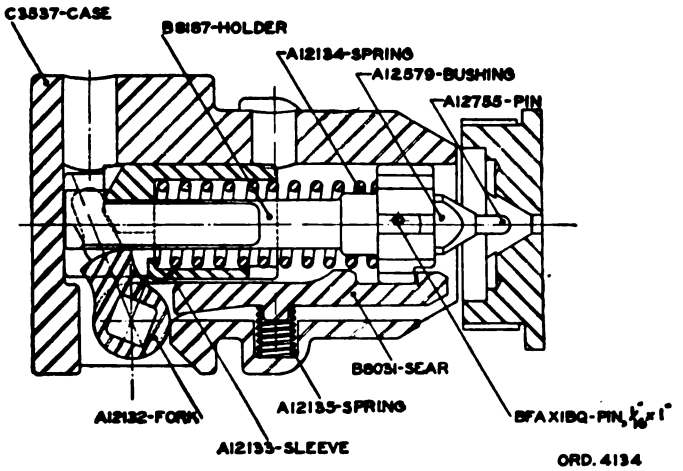

FIGURE 6.—Firing lock assembled, sectioned view.

Reference	Item	Reference	Item
A12579	Bushing, firing pin.	A12755	Pin, firing.
C3537	Case, firing.	B8031	Sear.
A12132	Fork, trigger.	A12133	Sleeve, firing pin holder.
B8187	Holder, firing pin.	A12134	Spring, firing.
C8662	Lock, firing, M13, group assembly.	A12135	Spring, sear.
BFAX1BQ	Pin, cotter, S., $\frac{1}{16}$ by 1.		

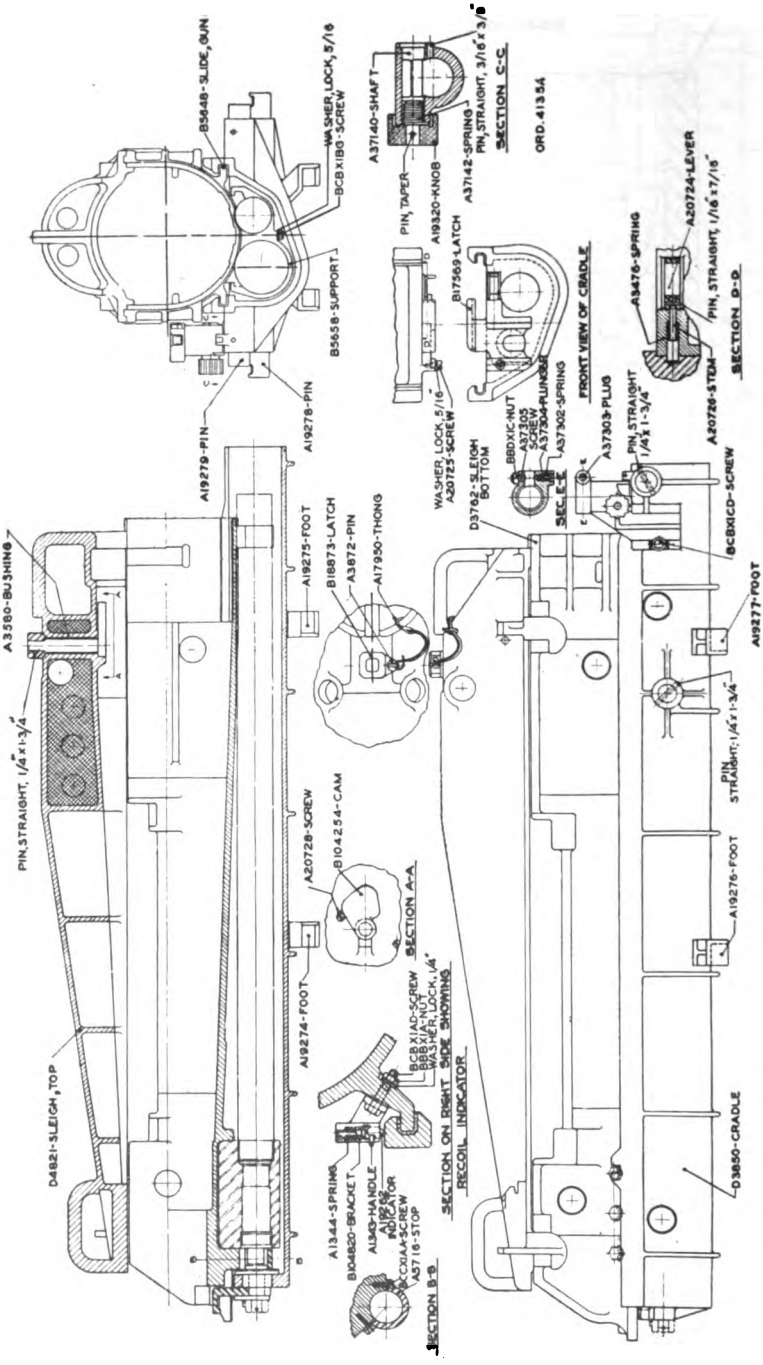

FIGURE 7.—Cradle and sleigh assembled.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item
B104820	Bracket, recoil indicator.
A3580	Bushing, cam.
B104254	Cam, top sleigh clamping.
D3850	Cradle.
A19274	Foot.
A19275	Do.
A19276	Do.
A19277	Do.
A1343	Handle, recoil indicator.
A19262	Indicator, recoil.
A19320	Knob, sight retaining shaft.
A18873	Latch, clamping, top sleigh.
B17569	Latch, piston rod.
A20724	Lever, piston rod latch.
BBDX1C	Nut, jam, hex., s-fin., S., $\frac{3}{8}$-24-NF-2.
BBBX1A	Nut, reg., hex., s-fin., S., $\frac{1}{4}$-28-NF-2.
A19278	Pin, cradle locking, front.
A19279	Pin, cradle locking, rear.
BFDX1AF	Pin, stght., S., $\frac{1}{16}$ by $\frac{7}{16}$.
BFDX4AL	Pin, stght., S., $\frac{3}{16}$ by $\frac{3}{8}$.
BFDX2AK	Pin, stght., S., $\frac{1}{4}$ by $1\frac{3}{4}$.
BFCX1BD	Pin, taper, S., 0.156 by $1\frac{1}{4}$.
A3872	Pin, top sleigh clamping latch.
A37303	Plug, sight socket.
A37304	Plunger, sight socket.
BCCX1AA	Screw, cap, fil-hd., S., $\frac{1}{4}$-20-NC-2 by $\frac{3}{4}$.
BCBX1AD	Screw, cap, hex-hd., S., $\frac{1}{4}$-28-NF-2 by $1\frac{1}{4}$.
BCBX1BG	Screw, cap, hex-hd., S., $\frac{5}{16}$-24-NF-2 by 2.
A20728	Screw, hdls., fl-pt., S., $\frac{3}{8}$-24-NF-2 by $\frac{3}{4}$.
A37305	Screw, hdls., rd-pt., S., $\frac{3}{8}$-24-NF-2 by $\frac{3}{4}$.
A20725	Screw, piston rod latch.
A37140	Shaft, retaining, sight.
D3762	Sleigh, bottom.
D4821	Sleigh, top.
B5648	Slide, gun.
A3476	Spring, compression, 0.031 diam. stock, 0.292 O. D., 12 coils.
A1344	Spring, compression, 0.035 diam. stock, 0.260 O. D., 8 coils.
A37302	Spring, compression, 0.093 diam. stock, 0.375 O. D., 6 coils.
A37142	Spring, torsion, sight retaining shaft
A20726	Stem, piston rod latch.
A5716	Stop, recoil cylinder.
B5658	Support, cylinder.
A17950	Thong, leather, $\frac{1}{8}$ by $\frac{5}{16}$ by 9, both ends slit.
	Washer, lock, S., $\frac{1}{4}$.
	Washer, lock, S., $\frac{5}{16}$.

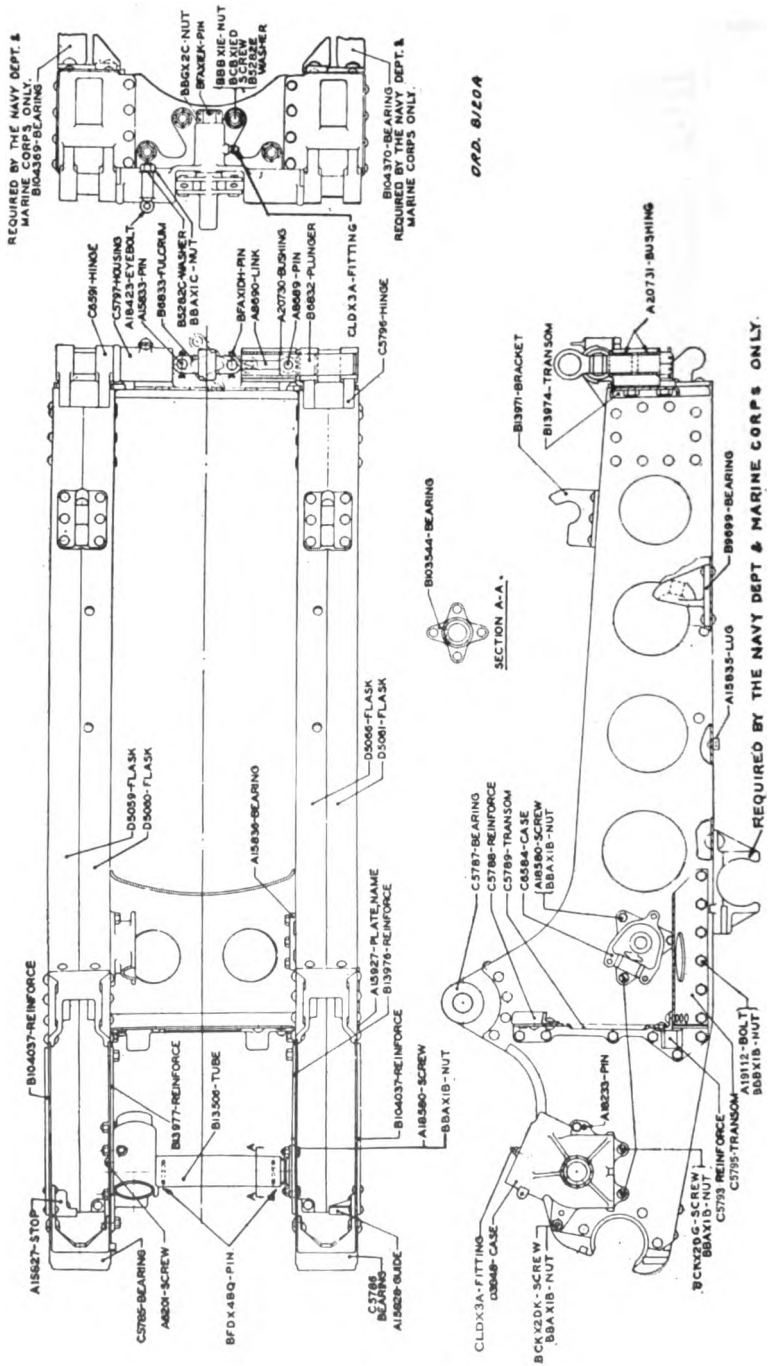

FIGURE 8.—Front trail assembled.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item
B9699	Bearing.
C5796	Bearing, axle, left.
C5785	Bearing, axle, right.
A15836	Bearing, elevating crank shaft.
B103544	Bearing, rocker pinion shaft tube.
B104370	Bearing, axle, rear, left. (For Navy Department and Marine Corps only.)
B104369	Bearing, axle, rear, right. (For Navy Department and Marine Corps only.)
C5787	Bearing, trunnion.
A19112	Bolt, hex-hd., S., 5/16-24-NF-2 by 9/16.
B13971	Bracket, front trail.
A20730	Bushing, trail connecting mechanism housing.
A20731	Bushing, trail fulcrum.
C6584	Case, gear, elevating, lower.
D3848	Case, gear, elevating, upper.
A18423	Eyebolt, trail connecting mechanism housing.
CLDX3A	Fitting, push-type, stght., 1/4", male, short.
D5059	Flask, trail.
D5060	Do.
D5061	Do.
D5066	Do.
B6833	Fulcrum, trail.
A15828	Guide, front trail.
C5796	Hinge, trail.
C6591	Do.
C5797	Housing.
A8090	Link, trail fulcrum.
A15835	Lug.
BBAX1B	Nut, reg., hex., s-fin., S., 5/16-18-NC-2.
BBBX1B	Nut, reg., hex., s-fin., S., 5/16-24-NF-2.
BBAX1C	Nut, reg., hex., s-fin., S., 3/8-16-NC-2.
BBBX1E	Nut, reg., hex., s-fin., S., 1/2-20-NF-2.
BBGX2C	Nut, slotted, s-fin., S., 3/4-10-NC-2.
BFAX1DH	Pin, cotter, S., 1/8 by 1 1/4.
BFAX1EK	Pin, cotter, S., 5/32 by 1 1/2.
BFDX4BQ	Pin, stght., S., 0.120 by 1 3/8.
BFDX5.1K	Pin, stght., S., 1/4 by 3/4.
A15833	Pin, trail fulcrum.
A8689	Pin, trail fulcrum link.
A15927	Plate, name.
B6832	Plunger, trail fulcrum.
B13976	Reinforce.
B13977	Do.
C5793	Do.
C5788	Do.
B104037	Do.
A6201	Screw, b-hd., S., 5/16-24-NF-3 by 3/8.
A18580	Screw, cap, hex-hd., S., 5/16-18-NC-2 by 3/4.
BCBX1ED	Screw, cap, hex-hd., S., 1/2-20-NF-2 by 1 1/4.
BCKX2DG	Screw, mach., fl-hd., S., 5/16-18-NC-2 by 3/4.
BCKX2DK	Screw, mach., fl-hd., S., 5/16-18-NC-2 by 1.
A15827	Stop, front trail.
C5795	Transom, trail.
B13974	Do.
B5789	Do.
B13506	Tube, rocker pinion shaft.
	Washer, lock, S., 3/8.
	Washer, lock, S., 1/2.

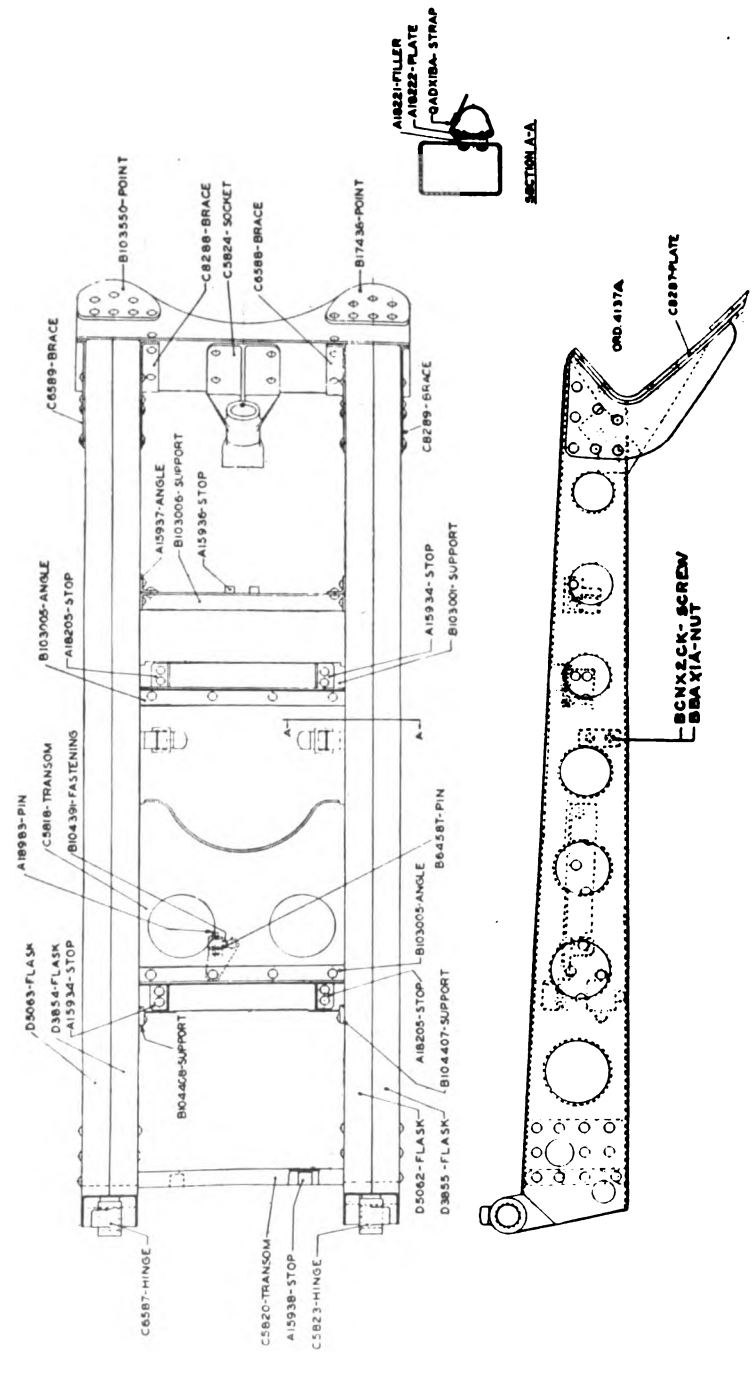

FIGURE 9.—Rear trail assembled.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item
B103005	Angle.
A15937	Angle, trail support.
C6588	Brace, spade, inner, left.
C8288	Brace, spade, inner, right.
C8289	Brace, spade, outer, left.
C6589	Brace, spade, outer, right.
B104391	Fastening.
A18221	Filler, strap plate.
D3062	Flask, rear trail, inner, left.
D3854	Flask, rear trail, inner, right.
D3855	Flask, rear trail, outer, left.
D3063	Flask, rear trail, outer, right.
C5823	Hinge, trail, left.
C6587	Hinge, trail, right.
BBAX1A	Nut, reg., hex., s-fin., S., ¼–20–NC–2.
	Pin, sleht., S., 0.120 by ⅞.
A18983	Pin, trail fastening.
A18222	Plate, strap fastening.
C8287	Plate, spade.
B17438	Point, spade, left.
B103550	Point, spade, right.
BCNX2CK	Screw, mach., rd-hd., S., ¼–20–NC–2 by 1.
C5824	Socket, handspike.
A15934	Stop.
A18205	Do.
A15936	Do.
A15938	Do.
QADX1BA	Strap, web, 1 by 10, assembly.
B103001	Support.
B103006	Do.
B104407	Support, left.
B104408	Support, right.
C5818	Transom, trail.
C5820	Transom, trail, front.

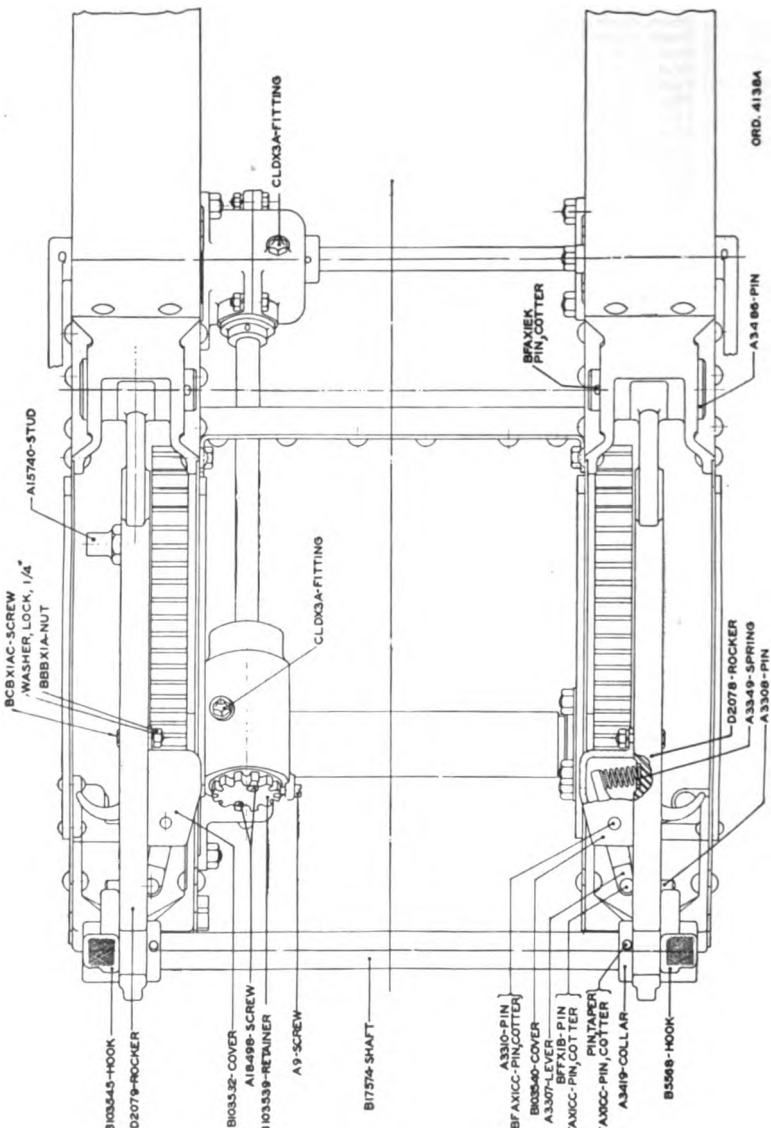

FIGURE 10.—Elevating mechanism assembled.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item	Reference	Item
A3419	Collar, rocker connecting shaft.	A3308	Pin, trunnion hook latch.
B103540	Cover, trunnion hook latch, left.	A3310	Pin, trunnion hook latch lever.
B103532	Cover, trunnion hook latch, right.	B103539	Retainer, bearing.
CLDX3A	Fitting, push-type, stght., ¼, male, short.	D2079	Rocker.
		D2078	Do.
B5568	Hook, trunnion, left.	BCBX1AC	Screw, cap, hex-hd., S., ¼-28-NF-2 by 1.
B103545	Hook, trunnion, right.		
A3307	Lever, trunnion hook latch.	A18498	Screw, hdls., S., 5/16-24-NF-2 by 5/16.
BBBX1A	Nut, reg., hex., s-fin., S., ¼-28-NF-2.	A9	Screw, lock, bearing retainer.
		B17574	Shaft, connecting, rocker.
BFAX1CC	Pin, cotter, S., 3/32 by ½.	A3349	Spring, helical, trunnion hook latch.
BFAX1EK	Pin, cotter, S., 5/32 by 1½.	A15740	Stud, rocker.
BFFX1B	Pin, rod end, ¼ by 0.636.		Washer, lock, S., ¼.
BFCX1FG	Pin, taper, S., 0.25 by 2.		
A3486	Pin, trunnion.		

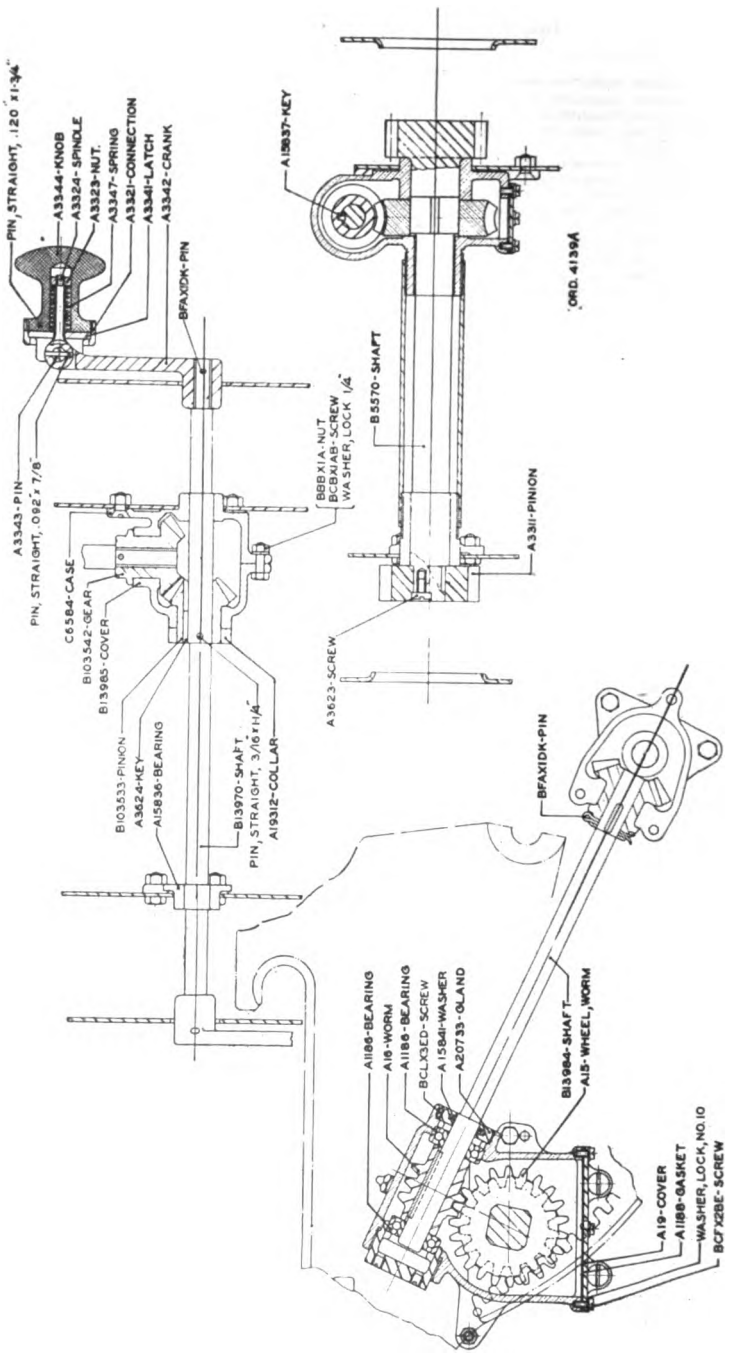

FIGURE 11.—Elevating mechanism—sections.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item
A1186	Bearing, ball, single row, angular contact, light series, 0.6693 bore, 1.5748 O. D., 0.4724 width.
A1187	Collar, elevating crank shaft.
A3321	Connection, crank knob.
B13985	Cover, elevating gear case, lower.
A19	Cover, elevating gear case, upper.
A3342	Crank, elevating.
A1188	Gasket, elevating lower gear case cover.
B103542	Gear, bevel, elevating.
A20733	Gland.
A3624	Key, elevating crank shaft.
A15837	Key, elevating worm shaft.
A3344	Knob, elevating crank.
A3341	Latch, elevating crank knob.
A3323	Nut, crank spindle.
BBBX1A	Nut, reg., hex., s-fin., S., ¼-28-NF-2.
BFAX1DK	Pin, cotter, S., ⅛ by 1½.
A3343	Pin, crank spindle.
B6458H	Pin, stght., S., 0.092 by ⅞.
B6458UA	Pin, stght., S., 3/16 by 1¼.
B103533	Pinion, elevating.
A3311	Pinion, rocker.
BCBX1AB	Screw, cap, hex.-hd., S., ¼-28-NF-2 by ⅞.
BCFX2BE	Screw, mach., fil.-hd., S., 0.190-24-NC-2 by 7/16.
BCLX3ED	Screw, mach., fl.-hd., S., 0.164-36-NF-3 by ¼.
A3623	Screw, rocker pinion.
B13970	Shaft.
B13984	Do.
B5570	Shaft, rocker pinion.
A3324	Spindle, crank.
A3347	Spring, helical, crank spindle.
A15841	Washer, elevating worm ball bearing gland.
	Washer, lock, S., 0.190.
	Washer, lock, S., ¼.
A15	Wheel, elevating worm.
A16	Worm, elevating.

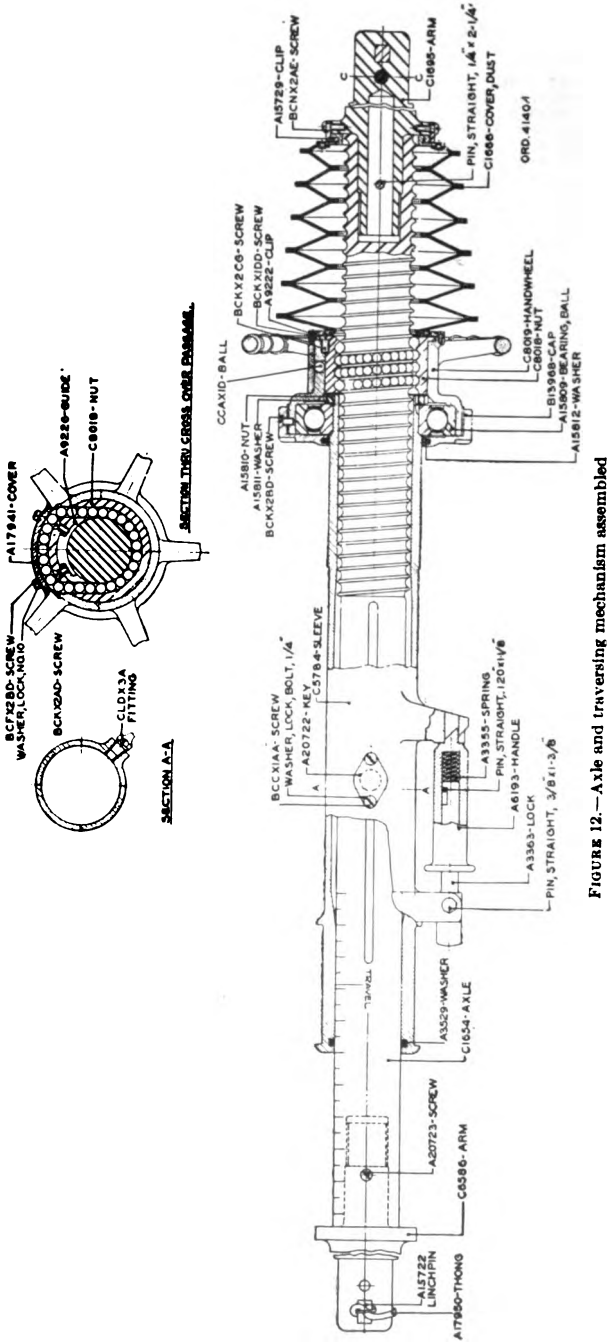

FIGURE 12.—Axle and traversing mechanism assembled

HOWITZER AND CARRIAGE, PACK, 75-MM M1

Reference	Item
C1695	Arm, axle, left.
C6586	Arm, axle, right.
C1654	Axle.
CCAX1D	Ball, bearing, S., chromium-alloy, 5/16.
A15809	Bearing, ball, single row, radial, light series, 2.5591 bore, 4.7244 O. D., 0.9055 width.
B13968	Cap, ball bearing.
A9222	Clip, dust cover, inner.
A15729	Clip, dust cover, outer.
A17941	Cover, ball.
C1666	Cover, dust, assembly.
CLDX3A	Fitting, push-type, stght., 1/8, male, short.
A9226	Guide, traversing.
A6193	Handle, sleeve lock.
C8019	Handwheel.
A20722	Key, axle.
A15722	Linchpin.
A3363	Lock, sleeve.
A15810	Nut, ball bearing.
C8018	Nut, traversing.
	Pin, stght., S., 0.120 by 1 1/8.
	Pin, stght., S., 1/4 by 2 1/4.
BFDX2CF	Pin, stght., S., 3/8 by 1 3/8.
A2680	Plug, axle arm.
A15725	Plunger axle arm.
A20723	Screw, axle arm.
BCCX1AA	Screw, cap, fil.-hd., S., 1/4-20-NC-2 by 3/4.
BCFX2BD	Screw, mach., fil.-hd., S., 0.190-24-NC-2 by 3/8.
BCKX2CG	Screw, mach., fl-hd., S., 1/4-20-NC-2 by 3/4.
BCKX1DD	Screw, mach., fl.-hd., S., 1/8-40-NC-2 by 9/16.
BCKX2AD	Screw, mach., fl.-hd., S., 0.190-24-NC-2 by 7/16.
BCKX2BD	Screw, mach., fl.-hd., S., 0.216-24-NC-2 by 7/16.
BCNX2AE	Screw, mach., rd.-hd., S., 0.190-24-NC-2 by 1/2.
C5784	Sleeve.
A5686	Spring, helical, axle arm plunger.
A3355	Spring, helical, sleeve lock.
A17950	Thong, leather, 1/8 by 3/16 by 9, both ends slit.
A3529	Washer, axle sleeve.
A15812	Washer, ball bearing cap.
	Washer, lock., S., 0.190.
	Washer, lock, S., 1/4.
A15811	Washer, lock, ball bearing nut.

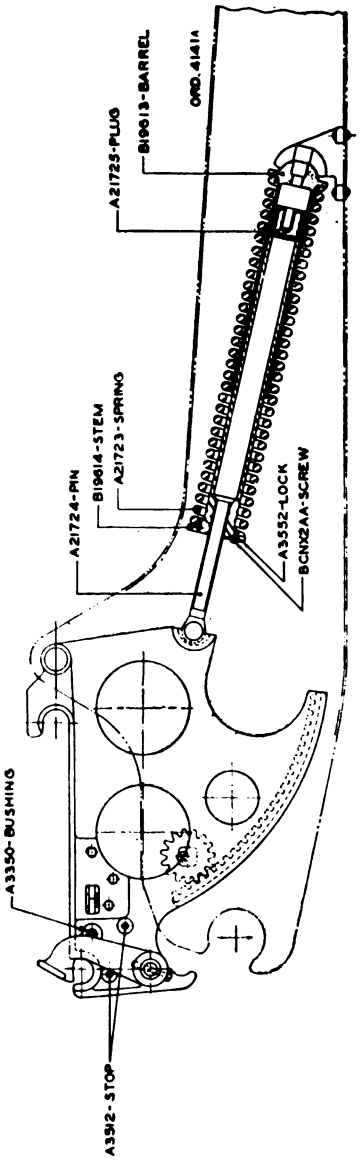

FIGURE 13.—Equilibrator assembled.

Reference	Item	Reference	Item
B19613	Barrel, equilibrator.	BCNX2AA	Screw, mach., rd-hd., S., 0.190–24–NC–2 by ¼.
A3350	Bushing, rocker.	A21723	Spring, helical, equilibrator.
A3552	Lock, equilibrator pin.	B19614	Stem, equilibrator.
A21724	Pin, equilibrator.	A3512	Stop, trunnion hook.
A21725	Plug, equilibrator stem.		

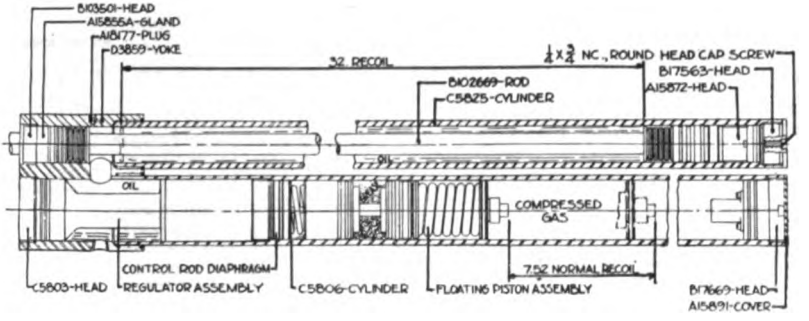

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FIGURE 14.—Diagram of recoil mechanism.

Reference	Item	Reference	Item
A15891	Cover, recuperator cylinder.	B17563	Head, recoil cylinder, rear.
C5825	Cylinder, recoil.	C5803	Head, recuperator cylinder, front.
C5806	Cylinder, recuperator.	B17669	Head, recuperator cylinder, rear.
A15855A	Gland, recoil cylinder stuffing box, outer.	A18177	Plug, purge.
A15872	Head, piston.	B102669	Rod, piston.
B103501	Head, recoil cylinder, front.	D3859	Yoke.

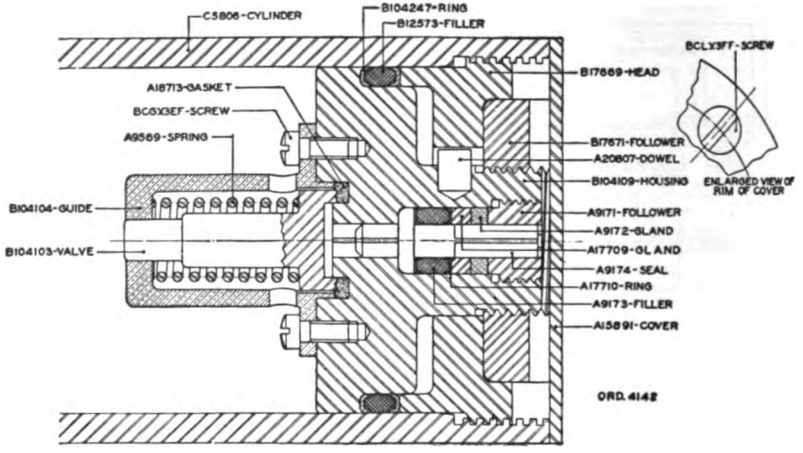

FIGURE 15.—Recuperator cylinder rear head assembled, sectioned view.

Reference	Item	Reference	Item
A15891	Cover, recuperator cylinder.	B17669	Head, recuperator cylinder, rear.
C5806	Cylinder, recuperator.	B104109	Housing.
A20807	Dowel.	A17710	Ring, air seal filler cup.
B12573	Filler, air filling valve housing packing.	B104247	Ring, air filling valve housing packing cup.
A9173	Filler, air seal.	BCGX3EF	Screw, mach., fil.-hd., S., 0.164-36-NF-3 by 3/16.
A9171	Follower, air seal.	BCLX3FF	Screw, mach., fl.-hd., S., 0.190-32-NF-3 by 3/16.
B17671	Follower, recuperator cylinder rear head.	A9174	Seal, air.
A18713	Gasket, air filling valve.	A9569	Spring, recuperator cylinder filling valve.
A9172	Gland, air seal, bronze.	B104103	Valve, air filling.
A17709	Gland, air seal, steel.		
B104104	Guide, air valve.		

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

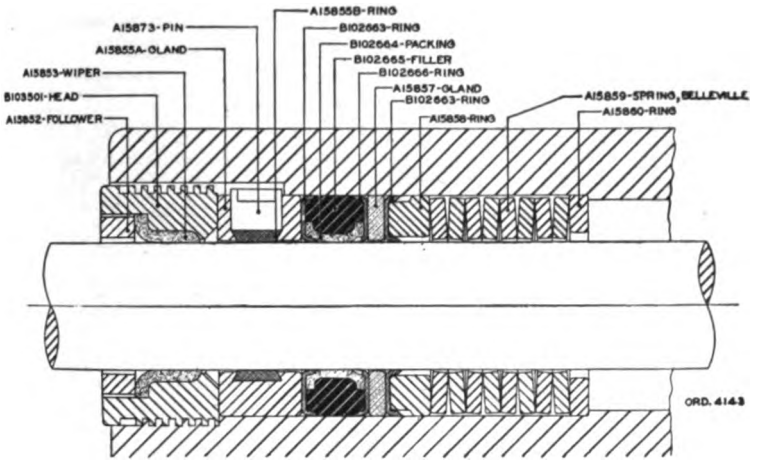

FIGURE 16.—Recoil stuffing box assembled, sectioned view.

Reference	Item	Reference	Item
B102665	Filler, recoil stuffing box packing.	B102663	Ring, recoil stuffing box cup.
A15852	Follower, recoil cylinder head.	B102666	Do.
A15855A	Gland.	A15858	Ring, recoil stuffing box packing.
A15857	Gland, recoil cylinder stuffing box.	A15860	Ring, recoil stuffing box spring retaining.
B103501	Head, recoil cylinder, front.	A15859	Spring, Belleville, recoil stuffing box.
B102664	Packing, recoil stuffing box.	A15853	Wiper, piston rod.
A15873	Pin.		
A15855B	Ring.		

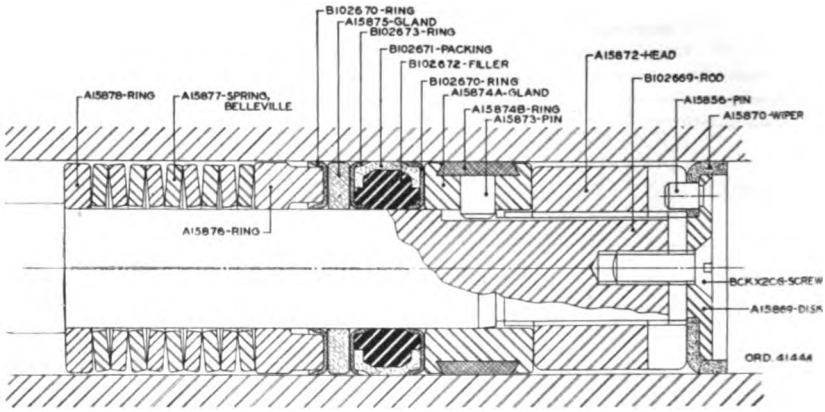

FIGURE 17.—Recoil piston assembled—sectioned view.

Reference	Item	Reference	Item
A15869	Disk.	A15876	Ring, recoil piston.
B102672	Filler, recoil piston packing.	B102670	Ring, recoil piston packing cup.
A15874A	Gland.	B102673	Ring, recoil piston packing cup.
A15875	Gland, recoil piston, inner.	A15878	Ring, recoil piston spring retaining.
A15872	Head, piston.	B102669	Rod, piston.
B102671	Packing, recoil piston.	BCKX2CG	Screw, mach., fl.-hd., S., ¼–20–NC–2 by ¾.
A15873	Pin.	A15877	Spring, Belleville, recoil piston.
A15856	Pin, recoil piston disk.	A15870	Wiper, recoil cylinder.
A15874B	Ring.		

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

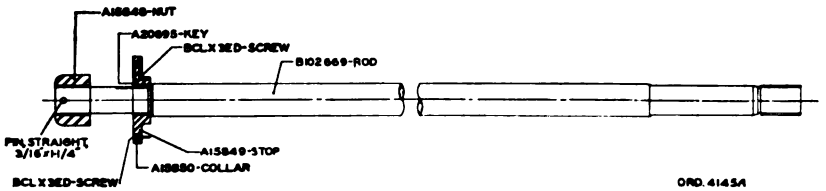

FIGURE 18.—Piston rod.

Reference	Item	Reference	Item
A15850	Collar.	B102669	Rod, piston.
A20695	Key, piston rod collar.	BCLX3ED	Screw, mach., fl.-hd., S., 0.164–36–NF–3 by ¼.
A15848	Nut, piston rod.		
BFDX1ET	Pin, stght., S., 3/16 by 1¼.	A15849	Stop, piston rod.

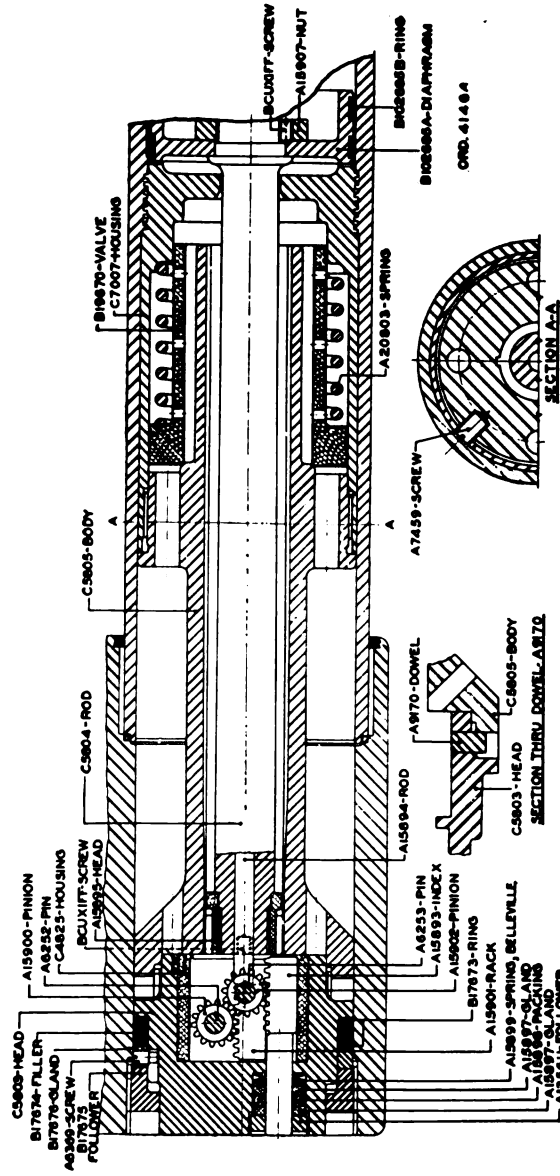

FIGURE 19.—Regulator assembled—sectioned view.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item	Reference	Item
C5805	Body, regulator.	A6252	Pin, oil index rack pinion.
B102685A	Diaphragm.	A15902	Pinion, oil index.
A9170	Dowel.	A15900	Pinion, oil index rack.
B17674	Filler, recuperator cylinder front head packing.	A15901	Rack, oil index.
		B102685B	Ring.
A135611	Follower, oil index.	B17673	Ring, recuperator cylinder front head packing cup.
B17675	Follower, recuperator cylinder front head.	C5804	Rod, control.
		A15894	Rod, oil index.
A15897	Gland, oil index.	BCUX1FF	Screw, hdls., fl.-pt., S., 0.190-32-NF-3 by ¼.
B17676	Gland, recuperator cylinder front head packing.	A7459	Screw, hdls., fl.-pt., S., ¼-28-NF-3 by ½.
C5803	Head.	A6369	Screw, hdls., fl.-pivot-pt., S., 0.190-32-NF-3 by 0.3.
A15895	Head, control rod.		
C4825	Housing, oil index pinion.		
C7007	Housing, regulator valve.	A15899	Spring, Belleville, oil index packing.
A15893	Index, oil.	A20803	Spring, helical, regulator valve.
A15907	Nut, control rod.	B19670	Valve, regulator.
A15898	Packing, oil index.		
A6253	Pin, oil index pinion.		

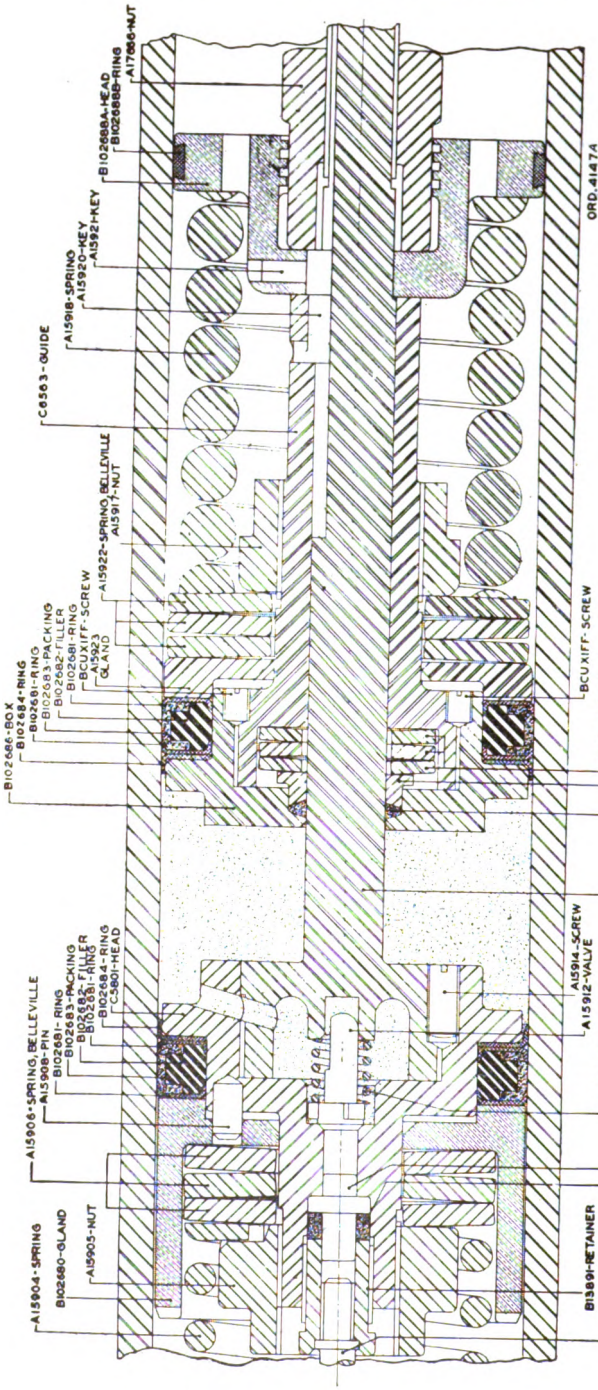

FIGURE 20.—Floating piston assembled—sectioned view.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item
B102686	Box, floating piston stuffing.
B102682	Filler, floating piston packing.
A9578	Gasket, grease seal retainer.
B102680	Gland, floating piston packing, front.
A15923	Gland, floating piston packing, rear.
A15915	Gland, floating piston stem packing.
C6563	Guide, floating piston stem.
B102688A	Head.
C5801	Head, piston.
A15921	Key.
A15920	Key, floating piston stem guide.
A15905	Nut, floating piston front head.
A15917	Nut, floating piston packing.
A17666	Nut, floating piston spring compression.
B102683	Packing, floating piston.
A15924	Packing, floating piston stem.
A15908	Pin.
B13891	Retainer, grease seal.
B102688B	Ring.
B102684	Ring, floating piston packing cup.
B102681	Do.
A15894	Rod, oil index.
BCUX1FF	Screw, hdls., fl.-pt., S., 0.190-32-NF-3 by ¼.
A15914	Screw, hdls., rd.-pt., S., ¼-28-NF-3 by ½.
A15687	Seal, grease.
A15906	Spring, Belleville, floating piston front packing gland.
A15922	Spring, Belleville, floating piston rear packing gland.
A15916	Spring, Belleville, floating piston stem packing gland.
A15904	Spring, helical, floating piston, front.
A15918	Spring, helical, floating piston, rear.
A15909	Spring, helical, grease valve.
B102689	Stem, floating piston.
A15912	Valve, grease.

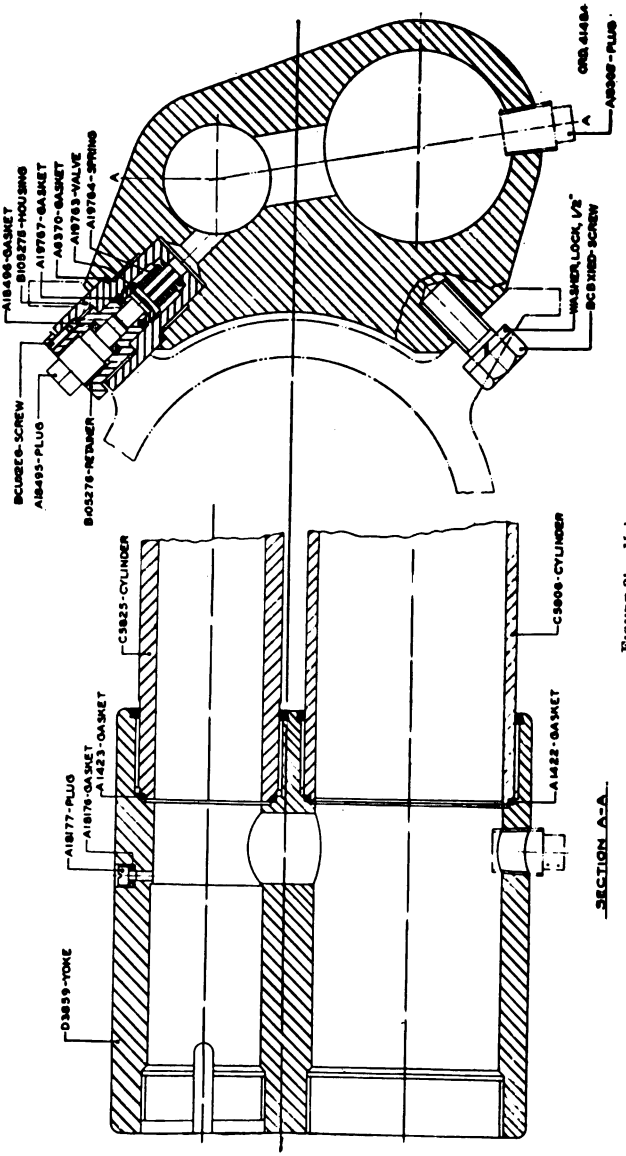

FIGURE 21.—Yoke.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item
C5825	Cylinder, recoil.
C5806	Cylinder, recuperator.
A18176	Gasket, purge plug.
A1423	Gasket, recoil cylinder.
A18496	Gasket, recoil cylinder filling plug.
A19767	Gasket, recoil cylinder filling valve.
A6370	Gasket, recoil cylinder filling valve housing.
A1422	Gasket, recuperator cylinder.
B105275	Housing, recoil cylinder filling valve.
A18305	Plug.
A18495	Plug, filling, recoil cylinder.
A18177	Plug, purge.
BCBX1ED	Screw, cap, hex.-hd., S., ¼–20–NF–2 by 1¼.
A19764	Spring, helical, recoil cylinder filling valve.
A19763	Valve, filling, recoil cylinder.
	Washer, lock, S., ½.
D3859	Yoke.

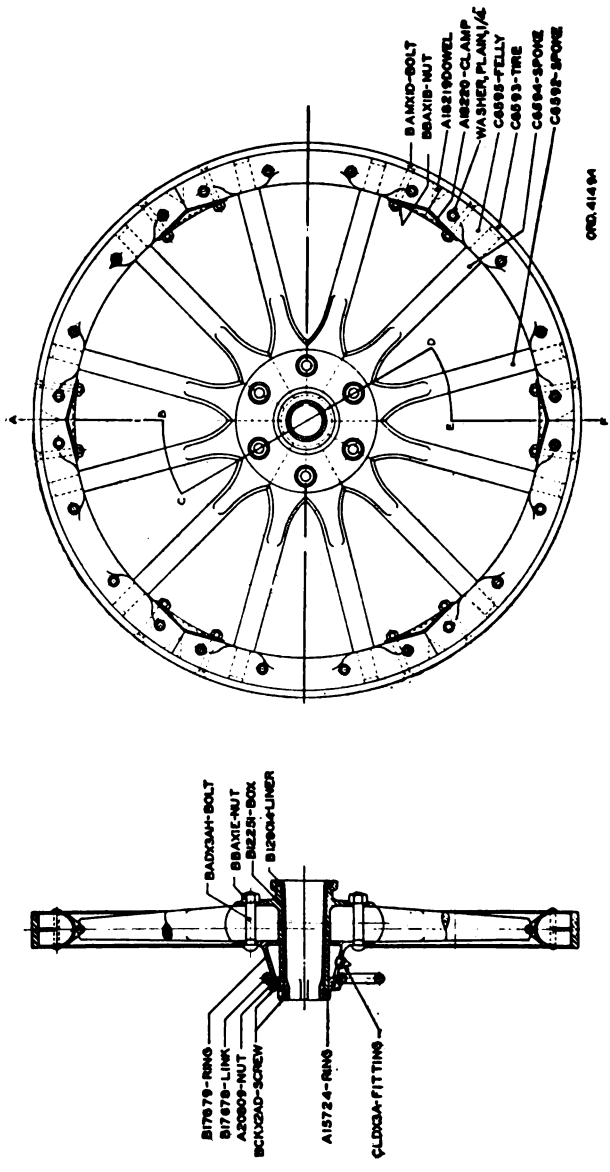

FIGURE 22.—Wheel, 29-inch, M4, assembly.

HOWITZER AND CARRIAGE, PACK, 75-MM, M1

Reference	Item
BADX3AH	Bolt, car., rd.-hd., sq.-nk., ½–13–NC–2 by 2¾.
BAMX1D	Bolt, tire, 5/16–18–NC 2 by 2¾.
B12251	Box, hub.
A18220	Clamp, felly.
A18219	Dowel, felly.
C6595	Felly.
B128014	Liner, hub.
B17678	Link, drag.
BBAX1B	Nut, reg., hex., s.-fin., S., 5/16–18–NC–2.
BBAX1E	Nut, reg., hex., s.-fin., S., ½–13–NC–2.
A20809	Nut, wheel.
B17679	Ring, hub.
A15724	Ring, wheel.
BCKX2AD	Screw, mach., fl.-hd., S., 0.190–24–NC–2 by 7/16.
C6592	Spoke, left.
C6594	Spoke, right.
C6593	Tire.
	Washer, plain, S., ¼.
D3820	Wheel, 29-inch, M4, assembly.

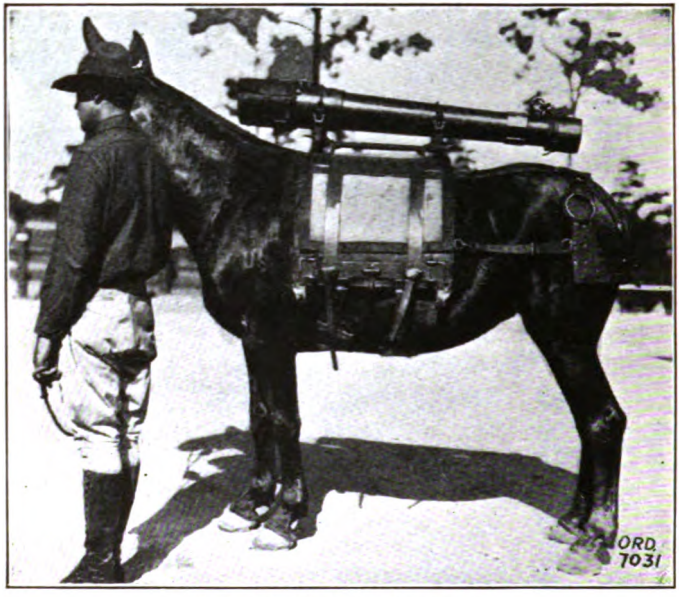

FIGURE 23.—Howitzer tube on pack.

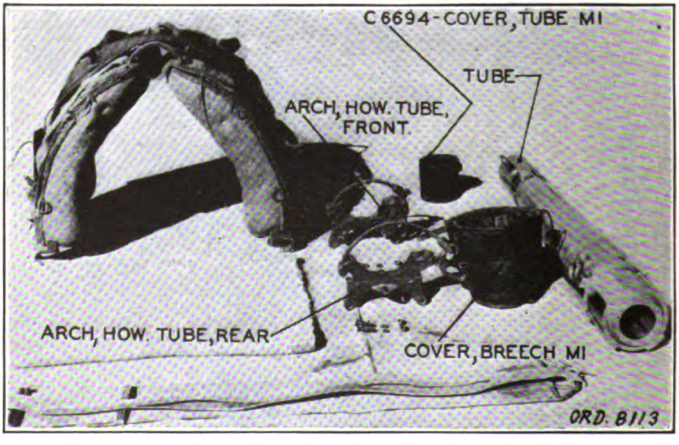

FIGURE 24.—Howitzer tube, Phillips cargo-type pack saddle and pack load accessories.

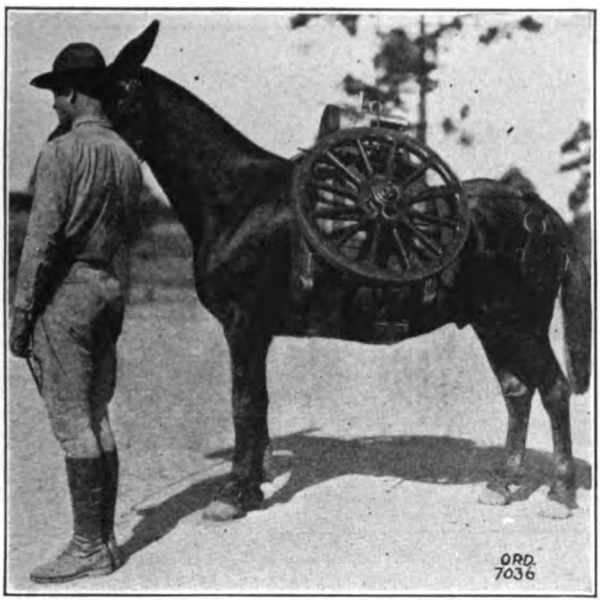

FIGURE 25.—Breech and wheels on pack.

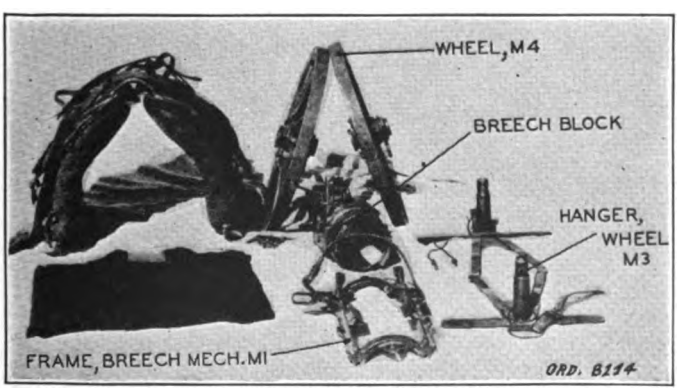

FIGURE 26.—Breech and wheels unpacked.

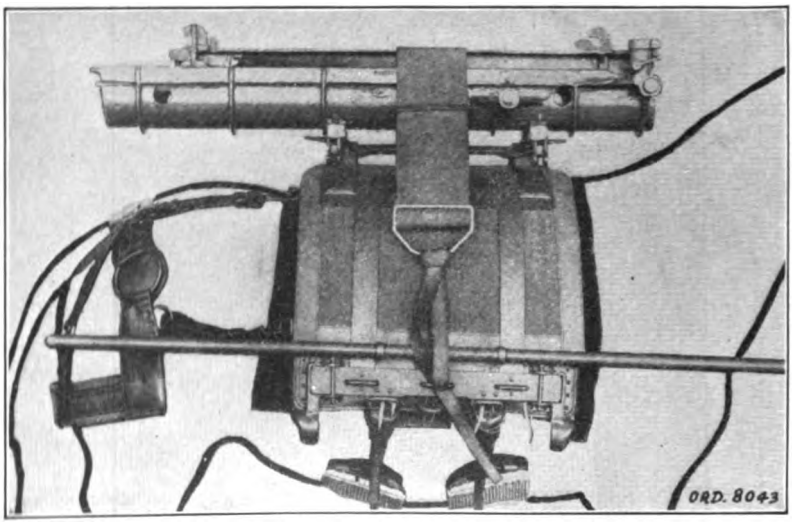

FIGURE 27.—Cradle and top sleigh on pack.

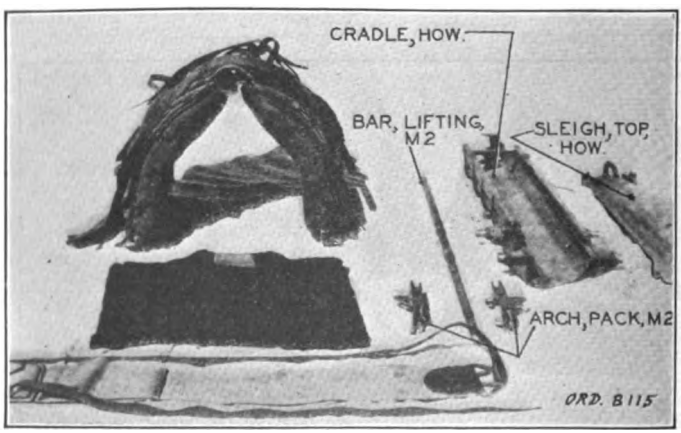

FIGURE 28.—Cradle, Phillips cargo-type pack saddle and pack load accessories.

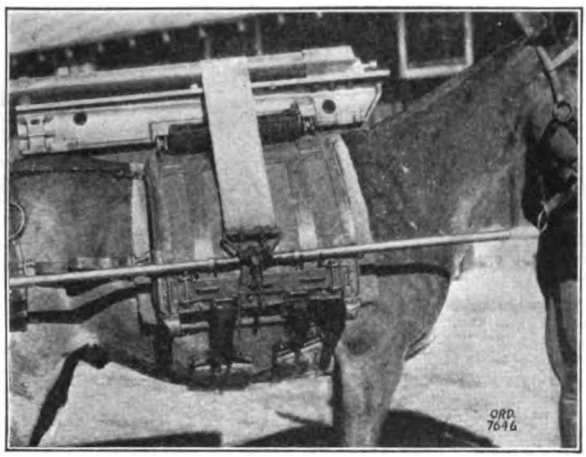

FIGURE 29.—Bottom sleigh on pack.

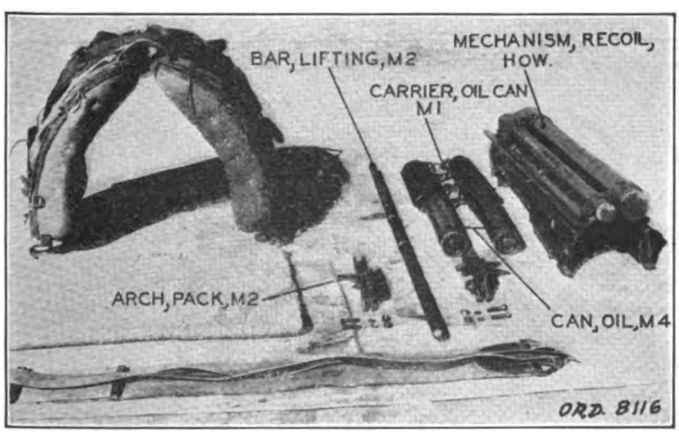

FIGURE 30.—Bottom sleigh, Phillips cargo-type pack saddle and pack load accessories.

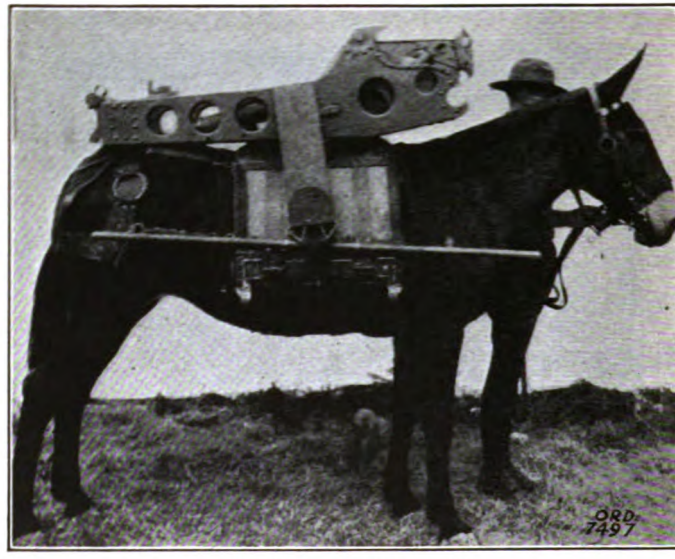

FIGURE 31.—Front trail on pack.

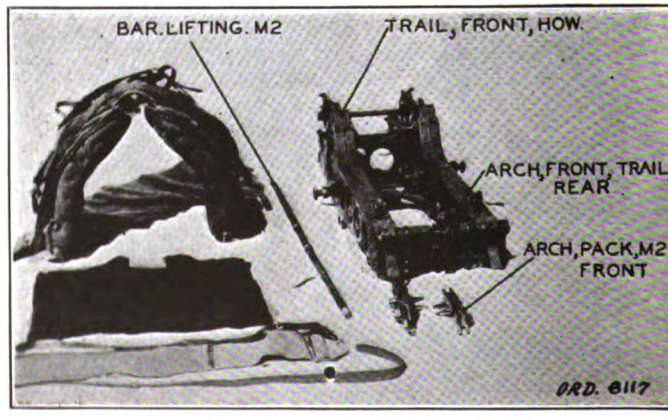

FIGURE 32.—Front trail load unpacked.

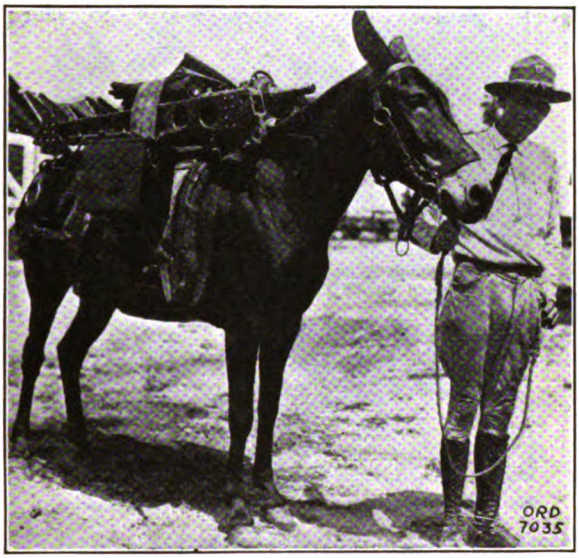

FIGURE 33.—Rear trail and axle on pack.

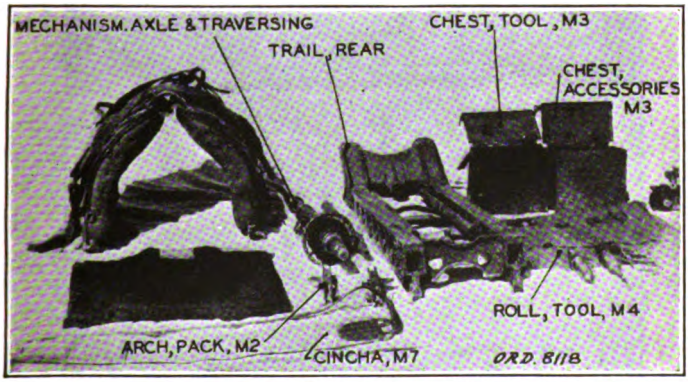

FIGURE 34.—Rear trail load unpacked.

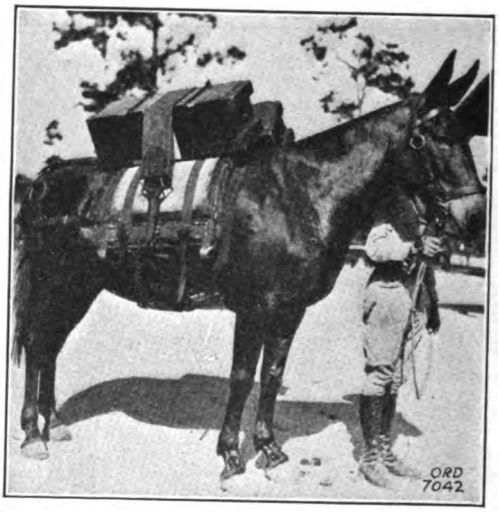

FIGURE 35.—Ammunition on Phillips cargo-type pack saddle.

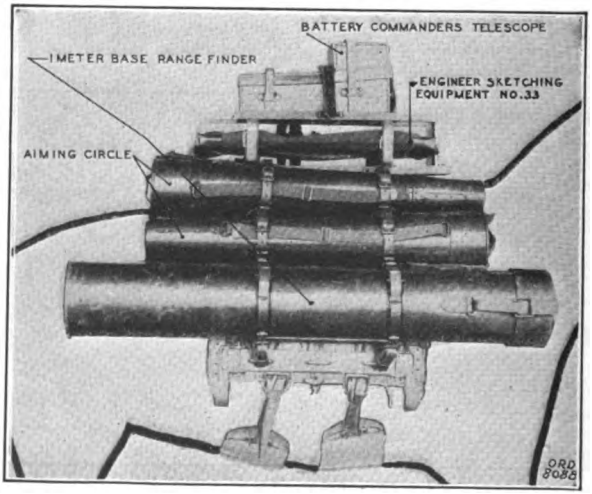

FIGURE 36.—Fire-control instruments on pack

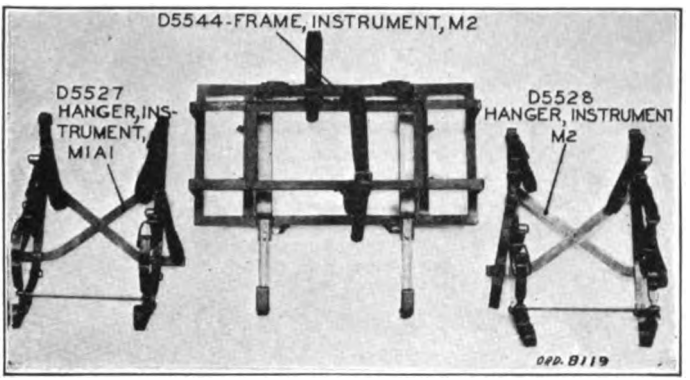

FIGURE 37.—Fire-control instrument pack accessories.

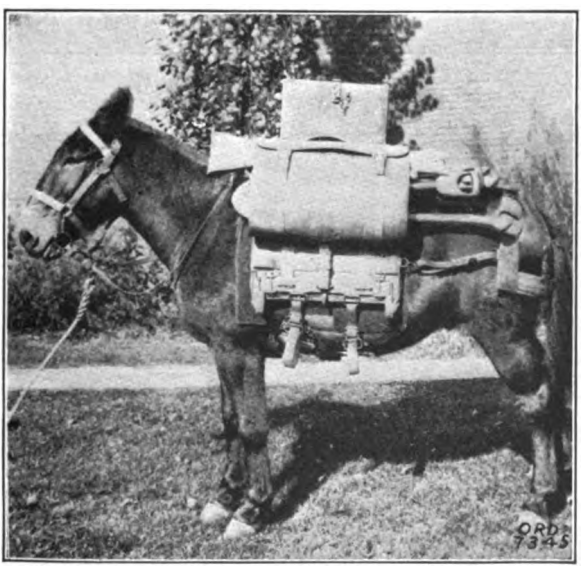

FIGURE 38.—Pioneer antiaircraft pack load, near side.

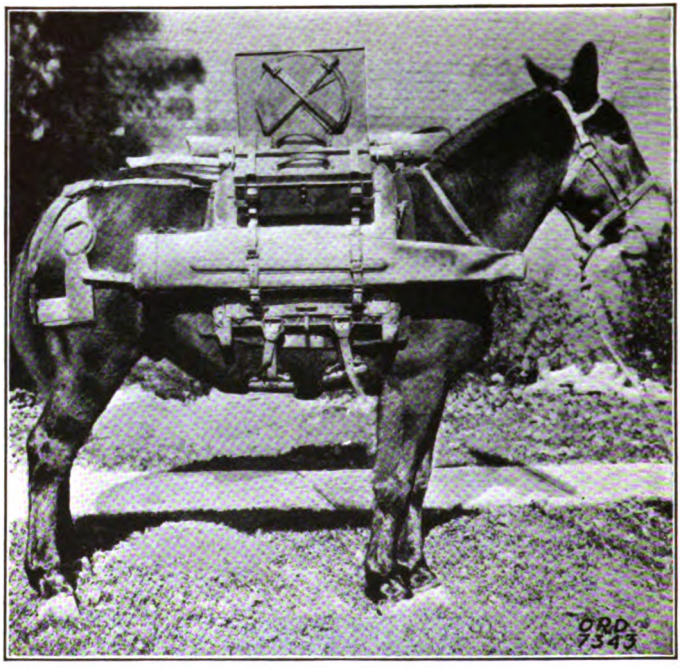

FIGURE 39.—Pioneer antiaircraft pack load, off side.

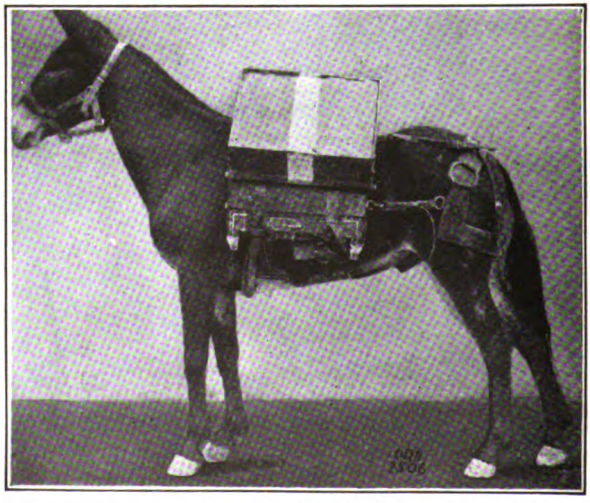

FIGURE 40.—Forge load.

FIGURE 41.—Command post pack load.

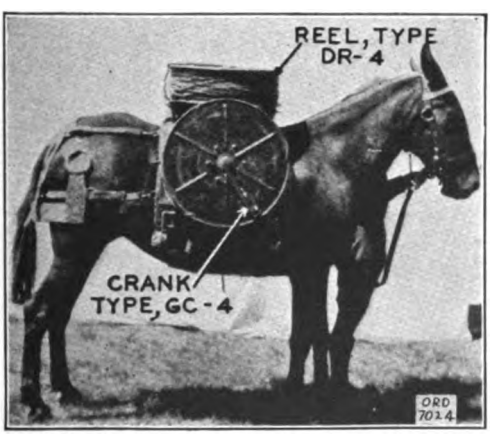

FIGURE 42.—Wire pack no. 2.

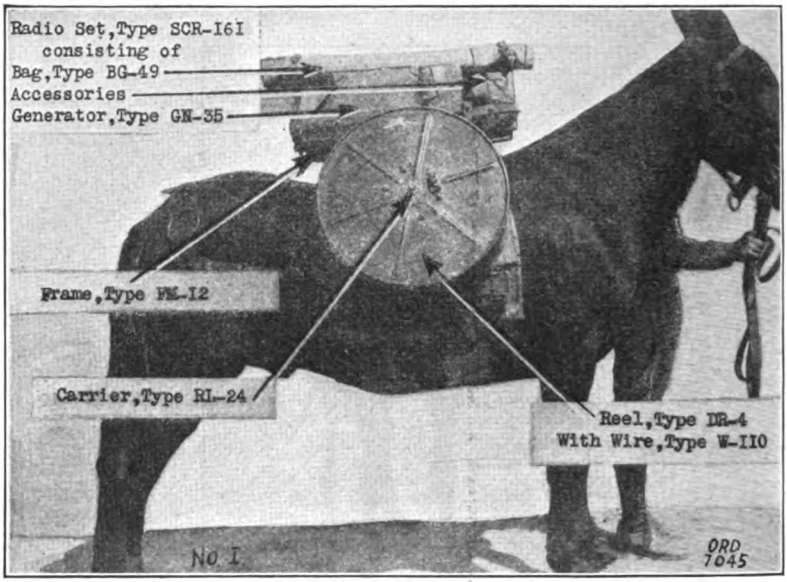

FIGURE 43.—Radio pack no. 2.

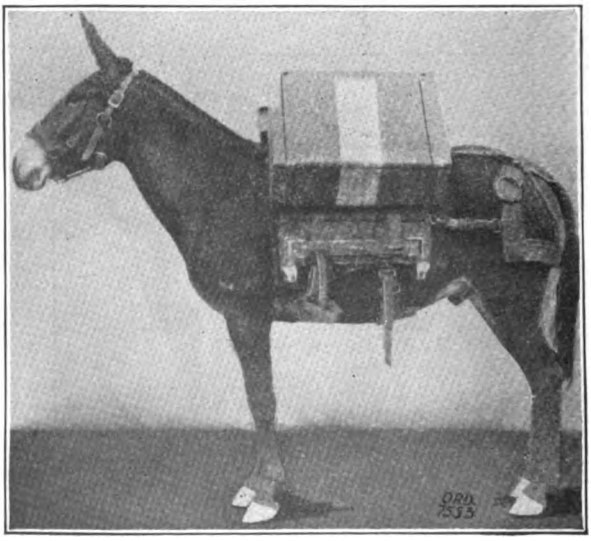

FIGURE 44.—Supply and forage chests pack load.

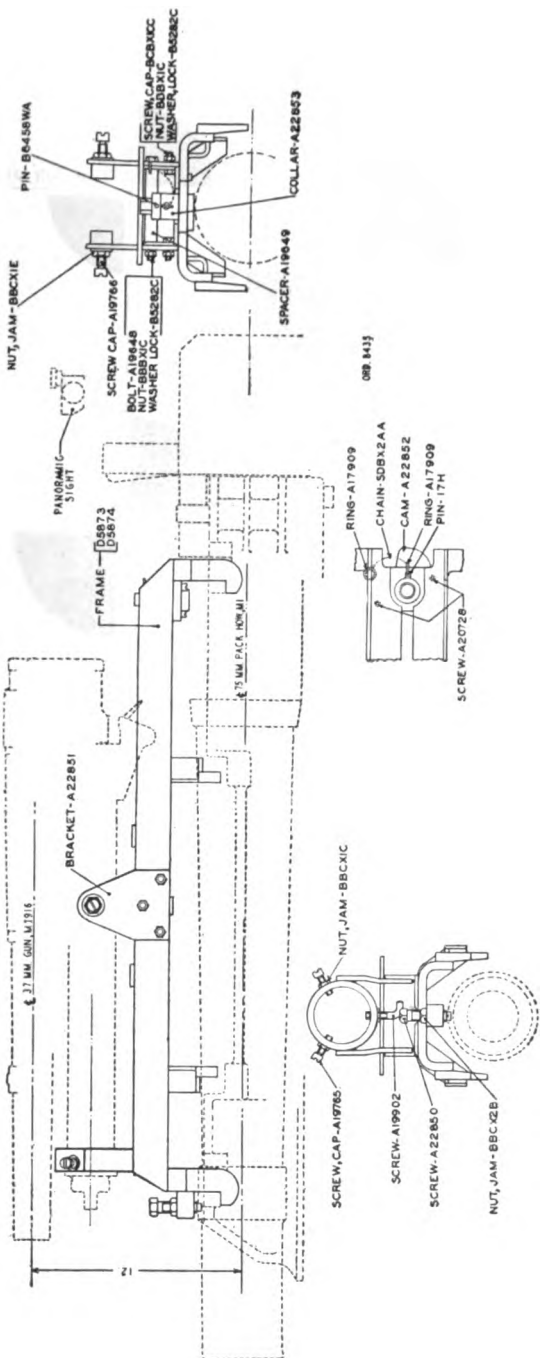

FIGURE 45.—37-mm subcaliber mount, M6.

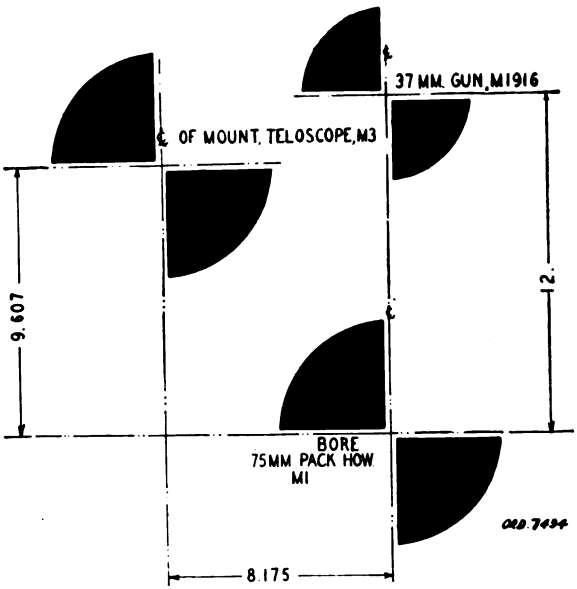

FIGURE 46.—Testing target.

U. S. GOVERNMENT PRINTING OFFICE: 1935

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - Price 10 cents

TECHNICAL REGULATIONS
No. 1305–155A

WAR DEPARTMENT,
WASHINGTON, October 1, 1931.

MOBILE ARTILLERY MATÉRIEL

155-MM. HOWITZER MATÉRIEL, M1917 AND M1918

Prepared under direction of the
Chief of Ordnance

SECTION I

GENERAL

1. Purpose.—These regulations are published for the information and guidance of the using arms, Reserve Officers' Training Corps students, Reserve officers, and all personnel charged with the maintenance of this matériel.

2. Scope.—*a.* In addition to description and figures, there are contained herein instructions for the operation, inspection, assembly and disassembly, repair, and care and preservation of the matériel.

b. Disassembly, assembly, and such repairs as may be handled by the battery personnel will be undertaken only under the supervision of an officer or the chief mechanic.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope of the battery personnel, the corps area or department ordnance officer will, upon request, provide trained men to perform the work.

3. References.—Nomenclature, list of spare parts and equipment, and basic spare parts for the howitzer and carriage, M1918, are contained in Standard Nomenclature List No. C–3; for the howitzer and carriage, M1917, in Standard Nomenclature List No. C–17; and for the limber and caisson in Standard Nomenclature List No. C–7; description and information on sighting and fire-control equipment in TR 1320–A and TR 1320–C; ammunition in TR 1355–155A; drill ammunition in TR 1370–D; targets and accessories therefor in TR 1340–C; instructions covering the characteristics, purpose, handling, etc., of cleaning and preserving materials, tools and materials for use therewith, and special oils, greases and cutting oils issued by the Ordnance Department in TR 1395–A; subcaliber gun ammunition in TR 1370–C; and instructions for service of the piece in TR 430–65.

SECTION II

DESCRIPTION AND OPERATION

4. Description of 155-mm. howitzer, M1918.—*a.* The 155-mm. howitzer, M1918 (fig. 1), is of American manufacture. It is a short, stocky cannon of the built-up type. The name and model of the howitzer are stamped on the left side of the jacket just below the counterweight. The name of the manufacturer, year of manufacture, serial number, and weight including the breech mechanism are stamped on the muzzle.

b. The breech mechanism is of the interrupted screw type and consists mainly of the gas check pad, breechblock, breechblock carrier, and a percussion type firing mechanism. The gas check pad is of the plastic type. The breechblock rotates on the pintle of the breechblock carrier and is locked in position in the breech recess by

threaded sectors. The mechanism is operated by an operating lever which, in conjunction with the rack, rotates the breechblock and swings the breechblock carrier to the open or closed position. The breechblock carrier is hinged to swing on the right side of the howitzer.

c. The firing mechanism (fig. 4) is of the screw type. This firing mechanism is common to the 155-mm. gun, M1918 MI; the 8-inch howitzer, M1917 (Mk. VI and Mk. VIII½); and the 240-mm. howitzer. The firing mechanism block latch assembly (fig. 4) is provided as a safety measure for use in connection therewith.

d. A maximum rate of fire of four or five rounds per minute may be attained but can not 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 two rounds per minute. The howitzer may be loaded at any attainable angle of elevation, the limits of elevation being from zero to 42° 20′. The approximate life of the howitzer before relining becomes necessary is 7,500 rounds.

e. Firing is accomplished either from the rear by pulling the lanyard attached to the percussion hammer (24A), Figure 2, or from the right side of the carriage by movement of the firing hammer operating shaft striker (130G), Figure 11, which strikes the arm on the end of the percussion hammer operating shaft (22A), Figure 2.

5. Description of 155-mm. howitzer, M1917.—The 155-mm. howitzer, M1917, is of French manufacture and is similar to the 155-mm. howitzer, M1918, with regard to build, weight, dimensions, and ballistics. The differences are—

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

b. Certain parts of the breech mechanism are interchangeable with those of the M1918. Such parts are indicated by note symbol "#" in Standard Nomenclature List No. C–3. They are not repeated in Standard Nomenclature List No. C–17.

c. 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. Another raised surface extends about one-twelfth of a turn on the breech face. This surface is directly in front of the opening in the breechblock carrier through which the spur on the percussion hammer passes. The travel of the percussion hammer is limited by this surface except

where a recess is cut through the raised surface for the spur to enter when the breechblock is locked in the firing position.

d. 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. The mushroom spindle nut is screwed on to the spindle of the mushroom head and is secured by the mushroom spindle nut key assembly.

e. The percussion hammer is slightly different.

f. Although some howitzers, M1917, are in service they are equipped with breechblocks, M1918, and it is expected that this change will be made in all cases prior to issue to the service.

6. Operation of breech mechanism, M1918.—*a. To open the breech.*—(1) Raise the firing mechanism block latch (48A), Figure 2, and unscrew the firing mechanism assembly (fig. 4) by turning to the left. The breech mechanism can not be opened without first removing the firing mechanism. Any attempt to do so will result in jamming the firing mechanism safety plunger (50K), Figure 4. Press down on the operating lever handle sleeve (16B), Figure 2, to disengage it from the breechblock carrier lever catch (13D), Figure 3, and pull the operating lever (15A), Figure 2, to the rear and around to the right. In the first part of this movement the operating lever turns on the pintle of the lever and the lug on the underside operates the breechblock rack (23A), Figure 2, which rotates the breechblock, disengaging its threads from the threads in the breech recess. When the breechblock is fully unlocked further rotation is prevented by a lug on the breechblock rack coming in contact with the breechblock rack lock (23C), Figure 2, preventing further movement of the operating lever independent of the breechblock carrier (13C), Figure 3. Further pull on the operating lever draws the breechblock carrier away from the breech face of the howitzer.

(2) As the breechblock carrier (13C), Figure 3, moves away from the breech face, the breechblock rack lock (23C), Figure 2, moves up in its seat in the front face of the carrier under pressure of the breechblock rack lock spring (23B), and engages a slot in the rack, locking the rack from movement and the breechblock from rotation in either direction.

(3) As the breechblock carrier moves away from the howitzer the percussion hammer shaft plunger (22L), Figure 2, is forced up by the percussion hammer shaft plunger spring (22K) into a recess in the percussion hammer operating shaft (22A) and locks

the shaft against rotation. This is a safety feature to prevent possible injury to the percussion hammer.

(4) When the operating lever (15A), Figure 3, reaches the full-opened position the right end of the operating lever latch (16L) engages the operating lever catch (16F), and locks the mechanism in the open position.

b. To close the breech.—(1) Press down on the operating lever handle sleeve (16B), Figure 2, to disengage the handle from the operating lever catch (16F), and pull to the left and forward.

(2) As the breechblock carrier (13C), Figure 3, comes in contact with the breech face of the howitzer, the breechblock rack lock (23C), Figure 2, is pushed down into its seat which unlocks the breechblock rack. Further movement of the operating lever (15A), Figure 3, from this point moves the breechblock rack to the left and screws the breechblock home. The breechblock rotation advances the block slightly due to the lead of the threads which further presses the gas check pad (20A), Figure 3, between the obturator spindle (53A) and the breechblock. The expansion of the gas check pad provides initial sealing of the breech which is made final and complete by the backward movement of the obturator spindle as a result of chamber pressure in firing.

(3) As the breechblock carrier reaches the breech face of the howitzer in the closing movement, the bevel on the underside of the breechblock carrier forces the percussion hammer shaft plunger (22L), Figure 2, down and frees the percussion hammer operating shaft (22A). When the mechanism is fully closed, the operating lever handle (16A), Figure 3, engages the breechblock carrier lever catch (13D) locking the mechanism.

(4) Screw in the firing mechanism (fig. 4) until its handle (A12255) passes as far beyond the firing mechanism block latch (48A), Figure 2, as it will go. The firing mechanism can not be screwed in until the breech mechanism is closed and locked, this being a safety feature.

7. Operation of firing mechanism, M1918.—The firing mechanism (fig. 4) is held in the hand and loaded with a primer by sliding the rim of the primer under the primer holder (B8058), Figure 4. The primer is held in place by means of the U-shaped opening in the holder. This locates the cap in the primer directly in front of the firing pin (A12258). The firing mechanism is then screwed into the firing mechanism housing (50B), seating the primer in the obturator spindle plug (B241) as the firing mechanism block

handle (A12255) passes the firing mechanism block latch (48A), and is locked in position.

8. Operation of breech mechanism, M1917.—*a. To open the breech.*—Press down on the operating lever handle to disengage it from the breechblock carrier lever catch, pull the lever to the rear and around to the right. As the breechblock starts to rotate to the unlocked position the cam surface on its breech face engages the nose on the front face of the firing mechanism slide and raises the slide in its housing, carrying the firing pin above the primer and prevents any possibility of firing until the breech is again fully locked. In all other respects the operation of opening is similar to the operation of opening the mechanism for the M1918.

b. To close the breech.—(1) Press down on the operating lever handle to disengage the operating lever latch from the operating lever catch, and move the operating lever to the left and forward.

(2) When the mechanism is fully closed and latched the firing mechanism slide is left in a partially raised position, ready for the insertion of a primer, after which the slide is forced down by hand until the plunger latches it in the firing position.

9. Operation of firing mechanism, M1917.—The firing mechanism of the M1917 howitzer is of the vertical sliding type. It operates in conjunction with the primer extractor and the obturator spindle nut.

10. Description of carriage, M1918.—The carriage, M1918, 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 millimeters 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.

11. Description of carriage, M1917.—This carriage is of French manufacture. It has a curved shield, but no panoramic sight case attached; steel tired wheels; the trail has no safety chain ring for limiting the swing of the limber; the tool box packings are differently arranged from those of the M1918; there are

small differences in the accessories furnished. With these exceptions, the design of the carriage is similar to that of the carriage, M1918.

12. Operation of carriage, M1918.—*a. Elevating and depressing.*—Located on the left side of the carriage is the elevating handwheel (104A), Figure 8, which is unlatched by pressing down on the elevating handwheel knob (104B), thereby unlocking it from the elevating handwheel latch plate (104E). By moving the elevating handwheel in a clockwise direction it elevates the howitzer to the various firing angles from zero to 42°. Moving the elevated handwheel in the opposite direction will depress the piece.

b. Traversing.—The traversing handwheels (94G) and (94B), Figure 10, are located on the left and right sides of the carriage. When turned they transmit motion to the traversing screw (89C), which slides the carriage upon the axle (152A), Figure 14, the trail pivoting on the spade. The movement of traverse each side of the center of the axle is 3°, or a total of 105 mils.

c. Axle traveling lock.—The axle traveling lock (99G), Figure 14, is to relieve the traversing screw from road stresses. This arrangement is for locking the carriage to the axle. Care must be taken when about to travel, to see that the carriage has been traversed to the center of the axle and that the axle traveling lock is in the position marked "To Travel," and that the carriage can no longer be moved by the traversing handwheels.

d. Road brake.—The brake handle (162A), Figure 5, is located on the right side of the carriage just in front of the right shield. When the brake is applied, brake shoes (162C), Figure 9, bear directly on the rubber tires (C6981) of the wheels. When traveling, the brake should be operated, when necessary, by a dismounted man.

13. Operation of carriage, M1917.—The carriage, M1917, is operated in the same manner as described for the M1918 carriage.

14. Description of carriage limber, M1918.—*a.* The 155-mm. howitzer carriage limber, M1918 (fig. 18), is a 2-wheeled vehicle for supporting the trail of the carriage when traveling.

b. It is composed of a frame section to which are attached the bucket holder, grease-box holder, picket rope hooks, and picket rope support; an axle, attached to which are two axle brackets; two wheels; drawbar and connecting plates, bolts, etc.; and a limber prop. The name plate giving the serial number of the limber, model, name of manufacturer, year of completion and initials of inspector is located on the middle rail top plate near the front end.

c. The safety chain is attached by the safety chain loop, secured across the frame with two riveted clamps. The safety-chain hook is hooked through the safety chain ring of the carriage trail after limbering. The chain then prevents damage to the limber tires by contact with the carriage trail in making short turns.

d. A limber prop to support the frame when not in transport is attached by the prop-carrying ring. When traveling the limber prop is drawn up under the left front rail and there held by the prop chain.

15. Description of carriage limber, M1917.—The M1917 limber was originally designed for animal draft and had a draft pole and springs, doubletree chain eyes and picket rope hooks permanently attached to the side rails, steel-tired wheels, and a bracket for electric lighting equipment. It was not equipped with a bucket holder nor safety chain. However, a little less than half of these limbers are now equipped with drawbars and connecting pieces for motor traction. The remainder have had the horse draft poles removed, but have not as yet been equipped with drawbars and connecting pieces.

16. Description of caisson, M1918.—*a.* The 155-mm. caisson, M1918 (fig. 20), is a 2-wheeled, spring supported vehicle for the transportation of ammunition. It is normally a motorized vehicle, but is so designed that it may be converted into horse draft. Two caissons limbered together form a train drawn by a medium tractor. The caisson carries 14 complete rounds of ammunition and two extra powder charges.

b. A name plate giving name of vehicle, model, name of manufacturer, date of completion, initials of inspector and serial number is riveted to the rear plate.

c. The wheels have steel tires, and dust guards are buckled about the base of the axle spindle. Attached to the chest are a lantern bracket, bucket holder, and strap and implement fastenings for securing the various accessories furnished with the caisson.

Section III

DESCRIPTION OF GROUPS

17. Description of howitzer groups.—*a. Barrel assembly.*— The barrel of the M1918 howitzer consists of a tube which extends the entire length (fig. 1); a jacket (10C) which is screwed and shrunk on; a bridle (35B); a counterweight (32B); holding down band (36A), Figure 6; and breech key (35C), Figure 1. On the underside of the breech end of the jacket the bridle is attached by four howitzer bridle fastening screws. The counterweight is fastened to the upper side of the breech end of the jacket by six counterweight screws. The holding-down band encircles the front end of the jacket and is secured by three holding-down band screws. Leveling plates (30A), Figure 1, which form seats for the gunner's quadrant are set into the counterweight. Three lifting eyes (32C) are also attached to the counterweight. These lifting eyes are also used for attaching the tackle block for returning the howitzer to battery from traveling position. The breech key passes through the bridle and sleigh and locks the howitzer and recoil mechanism together when mounted.

b. The greater part of the percussion mechanism is also attached to the barrel assembly. These parts consist of the percussion hammer (24A), Figure 2, percussion hammer operating shaft (22A), percussion hammer operating shaft collar (22H), percussion hammer operating shaft housing (22E), percussion hammer operating shaft housing control screws, percussion hammer operating shaft nut, percussion hammer shaft plunger (22L), percussion hammer shaft plunger spring (22K), and in addition thereto the regulating plate (11B) and regulating plate nut.

c. The percussion hammer fires the howitzer by striking the firing pin. It is assembled on the percussion hammer operating shaft, the latter being journaled in the percussion hammer operating shaft housing. The percussion hammer may be rigidly locked by the percussion hammer lock bolt (A12217), Figure 2. A lug is formed and drilled on the percussion hammer for the attachment of the lanyard.

d. The percussion hammer operating shaft housing (22E), Figure 2, is dovetailed into a projection on the breech end of the howitzer. There is a projection to the left center of the percussion hammer operating shaft housing which is drilled to receive the percussion hammer shaft plunger (22L) and spring (22K). The plunger locks the shaft against rotation when the breech mechanism is open.

e. The regulating plate is attached to the lower hinge lug of the howitzer. A projection on its underside acts as a bushing in the

hole of the hinge lug. The lower end is threaded for the regulating plate nut which holds it in place.

f. Breech mechanism, M1918.—(1) The breechblock (28A), Figures 2 and 3, is of the cylindrical interrupted screw type. The outer diameter is divided into eight sectors, the threads being removed from four sectors. This permits the threads of the breechblock to engage with those in the breech recess. The breechblock is locked by a one-eighth turn. It is threaded to screw into the breechblock carrier. A portion of these threads is cut away and gear teeth are cut in this space for the purpose of rotating the breechblock when it is brought into engagement with a horizontally disposed rack mounted in the breechblock carrier and moved by operation of the operating lever. The center of the breechblock is bored to receive the obturator spindle, and at the rear end so that it will slide over the pintle of the breechblock carrier. An assembling stud is screwed into the breech face of the breechblock to form a stop for locating it in position for assembling the breechblock rack.

(2) The breechblock carrier (13C), Figures 2 and 3, swings from two lugs on the right side of the jacket, and is hinged thereto by the pintle of the operating lever (15A), Figure 3, which passes through the two lugs of the jacket and the lug of the carrier (fig. 3). The dead weight of the carrier and parts assembled thereto is carried on the breechblock carrier hinge bearing plate (13A), Figure 2, which is fastened to the underside of the carrier lug by three breechblock carrier hinge bearing plate screws. The carrier is threaded to receive the breechblock. The pintle of the carrier houses the firing mechanism housing, obturator spindle spring and obturator spindle spring front and rear seats (50C and 50D), Figure 3. The hole extending from the right side into the interior of the carrier houses the breechblock rack (23A), Figure 2, which engages the spur teeth on the breechblock. The inclined pocket in the front face of the carrier receives the breechblock rack lock spring (23B) and breechblock rack lock (23C). The breechblock rack lock is actuated by the breechblock rack lock spring which tends to force the lock upward, causing it to protrude beyond the front face of the breechblock carrier when the latter moves away from the breech face of the howitzer. This allows the breechblock rack lock to engage with a slot in the breechblock rack and prevents further movement of the rack and rotation of the breechblock until the breechblock carrier again bears against the breech face of the howitzer. A breechblock carrier assembling stud is driven and riveted into the front face of the carrier. This stud forms a stop for a similar stud on the breech-

block when the breechblock is screwed into the carrier. The breech face is drilled and tapped at the top to receive the firing mechanism block latch holder (48D), Figure 4, and at the bottom for the percussion hammer lock housing (22N), Figure 2. The upper left side of the carrier has a dovetail seat into which the breechblock carrier lever catch (13D), Figure 3, is assembled.

(3) The obturator spindle (53A), Figure 3, passes through the breechblock and the pintle of the breechblock carrier. It is retained in position by screwing it into the firing mechanism housing (50B), Figures 2 and 3, which is assembled in the bore of the breechblock carrier. The rear end of the obturator spindle contains the obturator spindle plug (B241), Figures 3 and 4, and obturator spindle plug gasket (A325), Figure 4. The front end contains the obturator spindle vent bushing (A362), Figure 3. A vent hole is bored through the obturator spindle from end to end to conduct the flame of the primer to the chamber of the howitzer.

(4) The gas check pad (20A), Figure 3, is assembled on the obturator spindle between the obturator spindle head and the filling-in disk (20B) and bears against the front of the breechblock. It supports the front and rear split rings (20C) and (20D) and seals the powder chamber so that gases can not escape. The gas check pad is composed of three parts asbestos and one part nonfluid oil pressed in a mold under hydraulic pressure, covered with cotton duck and again pressed.

(5) The filling-in disk (20B), Figure 3, is a thin disk acting as a washer between the gas check pad and the breechblock. The gas check pad and the split rings may be made to seat more tightly in the gas check seat by adding additional disks. One disk must always be assembled behind the gas check pad.

(6) The front and rear split rings (20C) and (20D), Figure 3, are of triangular cross section, and are conical on the exterior to fit the gas check seat in the howitzer.

(7) The firing mechanism housing (50B), Figures 2, 3, and 4, is threaded in the forward end to receive the obturator spindle (53A), Figure 3. It is threaded in the rear end to receive the firing mechanism (fig. 3). A projection on the top of the firing mechanism housing is drilled to receive the firing mechanism safety plunger (50K), Figure 4, and the firing mechanism safety plunger spring (50M). The firing mechanism safety plunger is retained in the firing mechanism housing by the firing mechanism housing screw (50A), Figure 2. A keyway in the lower side of the firing mechanism housing forms a path for the firing mechanism housing

key (50F), Figure 4, which is for the purpose of locking the obturator spindle in the firing mechanism housing. A small hole in the bottom of the keyway receives the stud of the firing mechanism housing key spring which retains the firing mechanism housing key assembly in position.

(8) The firing mechanism, M1918, is an assembly composed of the firing mechanism block (C3554), Figure 4; firing mechanism block handle (A12255), Figure 2; firing mechanism block handle collar (A12254), Figure 4; firing pin (A12258), Figure 3; firing pin guide (A12256); firing pin housing (A12257); firing pin spring (A12261); primer holder (B8058), Figure 4; firing mechanism shoe and two safety set screws (A12260). The exterior of the firing mechanism block is threaded and screws into the firing mechanism housing. The interior is threaded to receive the primer holder. The firing pin is retained by the firing pin housing screwed into the rear end of the firing mechanism block. The set screws secure the primer holder and the firing pin housing. The primer holder has a U-shaped slot which is for the purpose of engaging the rim of the primer. The primer is retained in position by the pressure of the firing pin spring bearing against the firing pin guide. The firing pin spring also holds the firing pin in position and prevents it from coming in contact with the primer until struck by the percussion hammer (24A), Figure 2. On the rear of the firing mechanism block a projecting rim is formed, a portion of which is removed to allow the percussion hammer to pass and make contact with the firing pin. This rim is a protective feature against firing until the firing mechanism has been screwed all the way into the firing mechanism housing and locked by the firing mechanism block latch (48A), Figure 2.

(9) The operating lever (15A), Figure 2, is for the purpose of controlling the movement of opening and closing the breech mechanism. The operating lever pivots on its pintle, which passes through the hinge lugs of the jacket and the hinge lug of the breechblock carrier. It is retained in position by the operating lever collar (16C), Figure 2, and the operating lever collar detent (16K). The operating lever is hollow and houses the operating lever latch (16L). Figure 3, which pivots at its center. The end opposite the pintle contains a stud or pivot which holds and guides the operating lever handle (16A). A round projection on the underside near the pintle engages and actuates the breechblock rack (23A). The operating lever handle is assembled over the stud on the end of the operating lever and is actuated by the operating lever handle spring (16H).

The operating lever handle is retained on the stud by the operating lever handle key (16M) which slides in a slot milled in the stud. This allows the operating lever handle to slide up and down freely. The lower end of the operating lever handle is formed to engage the end of the operating lever latch (16L). It also engages the breechblock carrier lever catch (13D). The operating lever handle spring (16H) is a coil spring with the wire projecting at one end parallel with the axis of the coil. It is assembled into the operating lever handle with the projecting end passing through a small hole in the upper end of the operating lever handle and acts as a detent for the operating lever handle nut (16G). The operating lever handle sleeve (16B) is assembled over the operating lever handle (16A) and forms the grip for the operating lever. It is retained thereon by the operating lever handle nut.

g. Breech mechanism, M1917.—The description of the breech mechanism for the M1918 howitzer is applicable to the M1917 with the following exceptions:

(1) *Breechblock.*—A cam surface on the breech face of the breechblock of the M1917 raises the firing mechanism slide upward when the breechblock is rotated to the unlocked position. Another raised surface extends about one-twelfth of a turn on the breech face. This surface is directly in front of the opening in the breechblock carrier through which the spur on the percussion hammer passes. The travel of the percussion hammer is limited by this surface except where a recess is cut through the raised surface for the spur to enter when the breechblock is locked in the firing position.

(2) *Breechblock carrier.*—Due to the different type of firing mechanism, the carrier for the M1917 requires no firing mechanism block latch nor percussion hammer lock housing. The opening for the assembly of the firing mechanism is different and the breechblock carrier is, therefore, not interchangeable with the breechblock carrier for the M1918.

(3) *Firing mechanism, M1917.*

(*a*) This firing mechanism consists of the firing leaf assembly, firing pin, striker guide, striker spring, striker seat, striker seat pin, firing leaf latch plunger, firing leaf latch spring, and primer extractor.

(*b*) The firing leaf assembly with the parts assembled thereto moves vertically between guides. Its upward movement is limited by the plunger, actuated by its spring engaging a projection in the side of its pathway. The plunger also latches the mechanism tightly in the closed position.

(*c*) The lower portion of the leaf is threaded to receive in its front face the striker seat and in its rear face the striker guide. When assembled the firing pin and its spring are inclosed between the seat and guide. The latter are secured by the striker seat pin inserted through the side of the leaf. A beveled surface on the lower front of the seat and leaf forces the primer into its seat in the spindle of the mushroom head when the leaf is forced downward.

(*d*) The extractor fulcrums in a recess in the mushroom spindle nut and is actuated suddenly when the leaf is raised by an inclined surface on the leaf coming in contact with the short lever portion of the extractor. Thus tripped, the forked or lower portion of the extractor which straddles the head of the primer moves outward violently and ejects the primer.

(4) *Percussion mechanism.*—The percussion mechanism functions the same in the M1917 as in the M1918. The percussion hammer is slightly different in form and is locked in traveling position at a different angle, dispensing with a percussion hammer lock housing on the carrier. The spur on the hammer passes through the carrier and contacts with a raised surface on the breechblock when the breechblock is in any but the locked position. This is a safety feature.

18. Description of carriage groups.—*a. Sleigh.*—(1) The sleigh forms a support for the howitzer and is secured to it by the breech key (35C), Figure 1, and by the holding-down band (36A), Figure 6. Longitudinal thrust of the howitzer against the sleigh is resisted by seven projections or keys of the howitzer jacket which fit into mating keyways in the top of the sleigh. The holding-down band is secured to the front band clips, right and left, of the sleigh by the tapered front band keys.

(2) Grooves cut underneath the upper edges of the sleigh are fitted with bronze liners known as the sleigh slides (132B and 132F), Figure 5. These liners slide over the cradle clips (117A and 117B), Figure 6, and guide the sleigh as it recoils with the howitzer.

(3) There are five longitudinal chambers or cylinders in the sleigh (fig. 13). The two upper chambers run about one-third the length of the sleigh and are in effect an extension of the recuperator cylinder to secure a large volume of gas under compression. They are constructed as separate chambers simply to avoid a longer or more

bulky recuperator cylinder. These chambers are closed at the forward ends by the air-tank heads which are secured by air-tank head followers.

(4) The two lower cylinders (fig. 13) extend the full length of the sleigh. The left is the recoil cylinder which contains the recoil piston rod and the counterrecoil buffer rod, while the right contains the counterrecoil rod. The recoil piston rod and counterrecoil rod extend forward of their cylinders through stuffing boxes and are, in battery position, attached to the cradle.

(5) A fifth chamber, small and short, in the center of the sleigh is closed at the front end by the filling-valve body (148M), Figure 13, through which gas or liquid is introduced into the systems. The fifth chamber and both upper chambers are connected with the interior of the counterrecoil cylinders by openings in front of the counterrecoil piston, and therefore the pressure in these cylinders is always equal. The counterrecoil cylinder is closed at the rear end by the counterrecoil cylinder head (134H), Figure 12.

(6) The recoil piston rod (135A), Figure 12, is hollow and houses the tapered counterrecoil buffer rod (138A), the rear end of which is secured to the recoil cylinder head (134E). The counterrecoil buffer rod (138A) therefore moves with the sleigh (131A), Figure 6, in recoil and counterrecoil, and its tapered portion is drawn through the counterrecoil throttling ring (135E), Figure 12, inserted in the recoil piston to which is attached the recoil piston liner (135B). Orifices in the front face of the recoil piston open into the annular clearance between the throttling ring and the buffer rod.

(7) Each recoil mechanism is given a serial number which appears on the small name plate screwed to the sloping rear end, left side, of the sleigh. As this plate is read with difficulty when the piece is in firing position, the serial number is also stamped on the vertical outer face of the flange over the right sleigh slide where it may be found (on most sleighs, howitzer in battery) between the recoil indicator and the firing handle. This serial number of the recoil mechanism is not necessarily the same as that assigned to the recoil rod which is given on a second plate fixed on the *right* side of the rear end of the sleigh for purposes of recording the exact diameter of the counterrecoil valve.

b. Recoil mechanism (fig. 12).—(1) When the howitzer is fired the force which propels the projectile forward reacts upon the howitzer and drives it to the rear. It is necessary to check this force in a gradual manner so as not to cause displacement of the carriage. Also, the howitzer must be brought back into battery position before

it can be fired again. These objects are accomplished by the recoil mechanism which is of the hydropneumatic type and combines the recoil and counterrecoil systems, both being housed within the several cylinders of the sleigh.

(2) *Recoil system.*—Action of the recoil system when the howitzer is fired:

(*a*) In recoil the recoil piston rod is stationary, being attached to the cradle, while the sleigh (fig. 12) moves to the rear with the howitzer. Some of the liquid with which the recoil cylinder is filled is forced through the piston orifices and throttling ring clearance. The friction and inertia of this liquid, in rapidly passing from one side of the piston to the other, resist the movement and assist in checking the recoil. As the recoil proceeds and its velocity decreases, the tapered counterrecoil buffer rod (138A), Figure 12, takes up more and more of the clearance in the counterrecoil throttling ring (135E), so that the resistance of the liquid is kept nearly uniform throughout recoil.

(*b*) At the same time another portion of the liquid passes forward around the counterrecoil buffer rod and through the counterrecoil valve (138B), Figure 12, on the front end of the counterrecoil buffer rod into the space in the recoil piston rod (135A) left by the withdrawal of the counterrecoil buffer. As the sleigh returns to battery, the movement being much slower than that of recoil, the liquid returning from the rear of the recoil piston to the front of it through the throttling ring has such comparatively low velocity as to offer very little resistance, but the *counterrecoil valve closes*, forcing the liquid trapped in the forward part of the recoil rod through the very small clearance around the valve, and developing a resistance which absorbs the energy of counterrecoil so that the sleigh returns to battery without shock.

(3) *Action of the counterrecoil system.*

(*a*) The counterrecoil and fifth cylinders are entirely, and the upper chambers or gas tanks partially, filled with liquid, while the remaining space in the gas tanks is occupied by nitrogen gas under pressure. When the piece is fired and the sleigh recoils, the liquid in front of the counterrecoil piston is forced through the com-

municating channels into the gas tanks, reducing the volume of gas and increasing the pressure.

(*b*) The compressing of the gas absorbs a part of the energy of recoil, the remainder of the energy of recoil being taken up in the recoil system as explained above.

(*c*) When the movement of recoil is ended, the force stored in the gas tanks expands, driving the liquid back into the counterrecoil cylinder and returning the howitzer to battery.

(*d*) The amount of liquid in the recoil cylinder is practically fixed in the original assembly. The recoil cylinder is first completely filled, then 100 cubic centimeters (6.1 cubic inches or approximately one-fourth pint) of the liquid extracted, leaving space into which the liquid may expand as the absorbed energy of recoil is turned into heat and raises the temperature of the liquid. Should the liquid get too hot, the expansion may prevent the sleigh from returning completely to battery. The remedy is to open the filling plug in the recoil cylinder head and allow the excess liquid to escape. When the mechanism cools, the liquid so drained out should be replaced. An insufficient amount of liquid in the recoil cylinder has the effect of increasing the pressure at the beginning of recoil, causing excessive stress in the cylinder walls. A large void in this cylinder may result in the breaking of piston rods and the howitzer being put out of action.

(*e*) The amount of liquid in the counterrecoil side may be measured by the gauge cock which is assembled into the left air tank head. When the cradle is level (both horizontally and transversely) the liquid should exactly half fill the upper chambers or gas tanks. The gauge-cock body is provided with an orifice in the side, opposite the pointer, which dips below or raises above the liquid level as the gauge-cock body is rotated. The gauge-cock valve inside the gauge-cock body prevents the liquid from blowing through unless the valve is intentionally opened. When the valve is opened either liquid or the compressed nitrogen will blow through and the gauge-cock pointer will show the position of the gauge-cock body orifices when the blow-off changes from nitrogen to liquid and hence indicates the level and

amount of liquid in the tank. A device consisting of the pressure gauge adapter including a pressure gauge for measuring the pressure in the system is attached to the gauge-cock body by means of the pressure gauge adapter union.

(*f*) An insufficient pressure or quantity of liquid in the counterrecoil system has the effect of not completely returning the howitzer to battery.

(4) Packings of the stuffing boxes and counterrecoil piston consist of dermatine gaskets and rubber pads, the edges of which are protected by bronze cup rings. These packings are forced against the piston rods and walls of the cylinders by a heavy coiled spring housed in a sliding spring case. The inner spring case bears against the end of the coiled spring, the opposite end of the case being compressed by the packing spring compressor, which is screwed into the forward end of the stuffing box. The outer spring case also bears against the coiled spring and its opposite end comes in contact with a gasket, forcing the rubber follower to compress the rubber packing against a packing seat, thereby pressing the dermatine gasket against the piston rods.

(5) A hole in the counterrecoil cylinder head (134H), Figure 12, is provided as a vent through which the liquid which has passed the counterrecoil piston may escape. This vent prevents the forming of a vacuum in the counterrecoil cylinder and is also used as an oil hole to lubricate the counterrecoil piston lubricator (144H).

(6) The piston rods are lubricated by surrounding them with lubricators which are ring-shaped pieces of lamp wicking housed in the forward ends of the stuffing boxes. The oil passage to the lubricator of the counterrecoil rod is through the front end of the rod and may be seen in Figure 12. The recoil piston rod lubricator oil hole is reached through the opening in the bottom of the cradle.

c. Cradle.—(1) The cradle (fig. 7) is a trough-shaped steel plate, stiffened by the cradle transom (119A), Figure 12, the cradle front head (118B), Figure 13, the trunnion bracket (185A), Figure 9, the elevating segment brackets (121B), Figure 7, and (121C), Figure 8, and the cradle band (122A), Figure 5. Cradle clips (117A and 117B), Figure 6, left and right, are riveted to the upper edges of the cradle plate. The sleigh which houses the recoil mechanism is guided in recoil and counterrecoil by bronze slides. attached to the sleigh, which embrace the cradle clips. The trunnions of the cradle extend through the trunnion bearings in the

trail (72B and 72A), Figures 8 and 9, and the left trunnion at its outer end is fitted for the attachment of the quadrant sight.

(2) The cradle band (122A), Figure 5, is a heavy steel casting near the rear end of the cradle. It has lugs projecting downward which rest on the cradle traveling locks (71K), Figure 5, and (71H), Figure 6, which support the cradle when in traveling position. The cradle band also fits snugly between the sides of the trail, thus maintaining alignment at high angles of fire.

(3) The cradle traveling locks are heavy pins mounted in bearings on the trail and arranged so as to project inward to support the cradle. There are two sleigh traveling lock bearings, right and left, which are attached to the rear end of the cradle plate for the purpose of housing the sleigh traveling locks, right and left, which project into seats in the sleigh. The functions of these locks are to prevent the retraction of the howitzer from the sleigh and to maintain the sleigh in a retracted traveling position. A shoulder guard (126A), Figure 7, is located on the left side of the cradle to protect the gunner from the recoiling parts.

(4) The nuts of the recoil and counterrecoil piston rods project through holes in the cradle transom and forward of a sliding plate called the piston rod lock (123A), Figures 12 and 13. The piston rod lock (123A), Figure 12, has openings so shaped as to fit into the recesses cut in these nuts and prevents the movement either way of the piston rods. The piston rod lock is operated by the piston rod lock lever (123B), Figure 13, attached to the cradle transom. The right end of the piston rod lock embraces the cranked end of the firing safety shaft (129M), Figures 11 and 13, which extends rearward to the cradle firing mechanism. As the piston rod lock lever is swung downward to release the piston rod nuts, the piston rod lock moves to the right and causes rotation of the firing safety shaft (129M), and consequent movement of a lever on its rear end which raises the firing safety latch (128K), Figure 11, and locks the firing handle shaft (130C), Figure 11. This prevents firing by the cradle firing mechanism except when the piston rods are properly attached.

(5) The piston rod lock is protected by the cradle front cover (124G), Figures 12 and 13, hinged underneath the cradle. It swings upward to close the cradle opening. This cover is held in the closed position by the cradle front cover locking pin which engages the cradle front cover hasp. The cover supports the piston rod lock lever (123B), Figure 13, in the locked or firing position when closed. It will be noted that when the cradle front cover is dropped the piston rod lock may, by its own weight, fall and release the piston

rods; therefore, arrangement for latching the piston rod lock lever to the piston rod nut by means of copper wire, as directed in Field Service Modification Work Order No. C3–W2, was provided for. In spite of this precaution, however, great care should be exercised not to open the cradle front cover with the howitzer at any elevation, as the wire lashing may have been omitted, and the piston rod lock will automatically open and allow the howitzer to slide down the cradle and strike the sleigh traveling locks with sufficient force to spread the rear end of the cradle. Frequent inspections should be made to insure that the cradle front cover locking pin is in proper condition.

(6) The cradle firing mechanism (fig. 11) is on the right side of the cradle. The firing handle shaft (130C), Figure 11, slidably mounted in bearings of the firing handle return spring housing (129E) carries at its rear end the firing hammer operating shaft striker (130G) and the firing handle (129L). When the firing handle shaft is pulled to the rear by the firing handle or by the lanyard, the firing hammer operating shaft striker engages the arm of the percussion hammer operating shaft (22A), Figure 2, and fires the piece. As soon as the lanyard or firing handle is released by the operator, the firing handle return spring (129F), Figure 11, moves the striker forward to its "ready to fire" position. The lanyard is carried on pulleys (128C and 128D).

(7) The recoil indicator (124B), Figure 11, is a flat spring attached to the cradle near the firing mechanism. It may be adjusted by means of the recoil indicator adjusting stud, nut, and collar to bring the point on its upper end in contact with the scale engraved on the sleigh. If grease, chalk, or other substance is rubbed on the scale, the indicator will trace the length of recoil.

(8) The filling valve body (148M), Figure 13, underneath the sleigh is accessible through a hole in the bottom of the cradle in rear of the cradle transom. This opening is closed by the cradle bottom cover which is hinged to the cradle. The pump bracket (125A), Figure 7, is fixed to the left side of the cradle near the front. The cradle head cap (118C), Figure 5, closes an opening in the cradle head through which tests may be made to determine the pressure and amount of liquid contained in the counterrecoil cylinders. To the cap is attached a bronze correction pressure plate for convenient reference in determining the correct pressures in the cylinders under varying temperatures.

d. Trail and spades (fig. 7).

(1) (*a*) The trail forms the framework of the carriage. It is composed of two flasks connected and braced by the axle housing and traversing screw housings (86A), Figure 14, and (87A), Figure 10, several transoms, and the top and bottom plates. Above the axle the flasks are extended upward and are fitted with trunnion bearings to receive the cradle.

(*b*) The forward part of the trail is open to clear the cradle and howitzer during recoil. At its middle, the plates form the trail box, a convenient place for carrying tools and small spare parts. The extreme rear end is fitted with a float (75A), Figure 5, which by its bearing upon the ground resists the tendency of the trail to sink into the ground when the howitzer is fired.

(2) The fixed spade is riveted underneath, bracing the turned-down flange of the float. The movable spade is mounted on the spade shaft (79A), Figure 7, which passes through bearings in the fixed spade. It is held in either of two firing positions by means of the spade latch shaft (80B) which engages either of two half bearings on the ends of the spade braces (77B). With the spade latch shaft in the lower spade brace half bearing, the spade is rigidly held at an angle of 20° with the vertical, a position suitable for firing in soft ground. In the second position the spade angle with the vertical is 40°, considered more practical for hard ground. When traveling, the spade is swung forward and up to near contact with the underside of the trail and there secured by the engagement of the spade latches (80C), Figure 5, in spade traveling hooks (76C) attached to the front of the spade plate reinforce.

(3) The lunette (81B), Figure 7, is riveted to the underside of the float and forms a pintle bearing when the carriage is limbered.

(4) The handspike assembly (fig. 5) is mounted on the handspike base (82C), Figure 7, which is located on top of the extreme rear end of the trail. In firing position the handspike is held rigid by turning the handspike fulcrum (84B) which forces the handspike foot (83A) under the handspike pin (84C). In traveling position the handspike is turned back on the trail and held in position by the fulcrum which forces the top end of the handspike under the handspike hook (83B) provided for that purpose.

(5) The safety chain ring attached to the safety chain ring eye for the safety chain of the limber, the lunette chain fastening, loading-barrow supports, name plate, loading-barrow clip, handspike

hook, trail-box cover, loading-barrow fastenings and the loading-rammer fastenings are other details placed on top of the trail.

(6) The name plate gives the serial number of the carriage, model, name of the manufacturer, year of completion, and initials of the inspector. All of this information, except the initials, should be given in identifying the carriage in reports and correspondence.

(7) The axle housing (86A), Figure 14, is lined with a bronze bushing at each end through which the axle passes. An adjacent traversing screw housing (87A), Figure 10, paralleling the axle housing, incloses the traversing screw (89C).

(8) The following minor parts are attached to the trail in the order given, beginning at the front:

Right side: Rammer staff fastening, front; rammer staff fastening, rear.

Left side: Sponge staff fastening, front; sponge staff fastening, rear.

On bottom: Draft hooks, right and left; wheel mat brackets; wheel guards; bottom plate reinforce; fixed spade; lunette; fifth wheel.

e. Elevating mechanism (fig. 8).—(1) By means of the elevating mechanism the cradle, sleigh, and howitzer are elevated or depressed to the various firing angles from zero to 42°.

(2) The elevating segments (101A and 101B), Figure 6, attached to the cradle are sections of an internal gear of 266 teeth. These segments are actuated by pinions of 11 teeth on the elevating pinion shaft (102B), Figure 6, which operates in bearings secured to the trail. On the left end of the elevating pinion shaft is fixed the 66-toothed elevating worm wheel (103A), Figure 8, meshing with the right-hand, single-thread elevating worm (103B). On the upper end of the elevating worm shaft (103G) is fitted the elevating handwheel (104A), Figures 5 and 8, which is provided with a knob of a spring locking type. A downward pressure on the elevating handwheel knob (104B), Figure 8, unlocks it from the elevating handwheel latch plate (104E) and allows the handwheel to be turned. Unless the handwheel is thus deliberately unlatched, the elevating mechanism is locked against all movement in traveling and undesired movements due to the shock of firing.

(3) One revolution of the elevating handwheel in a clockwise direction is transmitted through the worm, worm wheel, elevating pinions and elevating segments, and elevates the cradle $\frac{1}{1396}$ of a revolution about the trunnions, or through an angle of 13.53′, or approximately 4 mils.

(4) The elevating stop under the cradle comes in contact with the elevating pinion shaft (102B), Figure 6, to limit elevation. The depression stop on the trail angle, front (56A), Figure 8, comes in contact with the bottom of the cradle and limits depression.

f. Traversing mechanism.—(1) Traverse of the howitzer is obtained by the carriage sliding on the axle, the trail pivoting about the spade. The amount of movement from the position of midtraverse is indicated by the index of the azimuth scale imbedded in the left end of the axle.

(2) The traversing screw (89C), Figure 10, lays in the traversing screw housing (87A) which is parallel to and opens into the axle housing chamber. The bronze traversing nut (89A) is pinned into the traversing nut support (153B) set in the middle of the axle. The traversing nut support slides in the opening between the chambers of the axle housing and traversing screw housing and prevents rotation of the axle in the trail.

(3) The traversing screw (89C), Figure 10, is supported at the ends by traversing screw bearings (90A and 90B), adjustable longitudinally to insure proper meshing of the gears. Each end carries a beveled traversing gear (93N) having 16 teeth, which meshes with a 10-tooth pinion on the lower end of the traversing intermediate shaft (111B and 111C). The traversing handwheel shaft pinions (93Q) have 10 teeth each and mesh with traversing intermediate gears (93K) having 16 teeth each on the upper ends of the intermediate shafts. The left handwheel sleeve (94D) describes a circle of 942.48-mm. circumference; the right, 1,143.54-mm. circumference. As the lead of the traversing screw is 4 mm., the movement along the axle for one revolution of either handwheel is one-sixteenth of an inch and the ratio of movement of the left handwheel sleeve to movement on axle is as 603 to 1.

(4) By turning the left handwheel in a clockwise direction, the muzzle of the howitzer moves to the left; anticlockwise, to the right.

(5) *The traversing rollers.*—On the outside of each trail flask above the axle is a traversing roller box which houses a roller or small wheel with a rim curved to suit the axle. These rollers are straddled by traversing roller forks which carry the weight of the traversing parts through a column of Belleville springs, and thus relieve the friction on the axle when the carriage is traversed. Under firing load these springs compress and the excess weight is assumed by the axle housing bushings.

(6) *The axle traveling lock* (99G), Figure 14.—To relieve the traversing screw from road stresses an arrangement for solidly lock-

ing the axle in midtraverse to the trail is provided. The axle traveling lock slides in a direction at right angles to the axle in the axle traveling lock box (99A) fixed to the axle housing. A helical spring tends to push the lock toward the axle and engage the rack teeth of the lock in the 5-tooth spaces cut in the axle. A cam on the axle traveling lock shaft (100A), Figure 14, operated by a lever outside the left trail flask, withdraws the lock from engagement, or allows the spring to force the lock inward according to the position of the axle traveling lock lever (99K). It should be noted that while the lever may be swung at any time from the axle traveling lock catch marked "To fire" to that marked "To travel," the lock is not necessarily engaged thereby until the axle is traversed to the midposition and the rack teeth of the lock can enter. The engagement should, therefore, be proved by attempt to traverse the carriage before beginning a march.

g. Axle.—(1) The axle (152A), Figure 14, is a round, solid bar of steel with the tapered spindles or wheel bearings given a set downwards to bring the underside horizontal when the carriage is limbered and thus avoid a component of force tending to make the wheel rub hard against the outer fastening (axle cap) as well as to bring the lower spokes of the dished wheel into the vertical plane. The axle spindles are chambered out to form storage spaces for grease which reaches the contact surfaces of the wheel through two small holes in the bottom of the axle. The shallow keyways at the bases of the axle spindles are for keys which prevent rotation of the axle collars.

(2) An azimuth scale inlaid in the top of the axle and graduated in mils to show movement either way from midposition is read from the left side of the trail.

h. Wheels.—(1) The carriage wheels are 1,350 by 150 millimeters. They are of solid-rubber tire construction; have 14 wooden spokes (PB49A), Figure 6, each joined to wooden felloes (PB49B and PB49C) by spoke shoes (PB48A); a steel felloe band is bolted to the felloes. The tire (C6981), Figure 9, is mounted on a steel base, which is forced over the felloe band. The flanges of the hub box and hub ring embrace the spokes and are drawn tightly about them by 14 carriage bolts. The inner and outer hub liners are forced into the hub box and form the bearing surfaces for the axle.

(2) The wheels are held in place by the axle caps, which are put over the ends of the axle and secured by linch pins. Leather axle washers are placed between the axle caps and the hub box and between the hubs and the axle collars. Adjustment of end play of the wheels on the axle is accomplished by varying the thickness of the

leather washers. The axle caps are provided with holes through which drag ropes may be passed if needed. The linch pins are secured by linch-pin latches hinged to the upper ends of the linch pins and tied below with leather thongs.

i. Shield.—(1) For the protection of the gunners, the carriage is equipped with a shield of armor plate 4 millimeters thick (fig. 5).

(2) The right and left shields, suitably tied together by riveted stiffeners, butt straps, and a hood, are bolted to shield brackets (154E), Figure 7, secured to the trail at the trunnion bearings and near the bottom bolted to the brake-shaft bearing supports (155E), Figure 6, and (155F), Figure 7. The left shield plate is provided with a sight port with a hinged sight port shutter, which is held in the closed position by a spring latch and in the open position by a wing nut, both accessible from behind the shield.

(3) The panoramic sight case (fig. 5) is supported by helical springs in its bracket bolted to the rear of the left shield. It is for the protection of the panoramic sight when not in use.

j. Brake.—(1) In front of the axle a framework of flat bars is attached to the trail extending forward to support the brake shaft and shields. Brake-shaft arms (161B and 161C), Figure 9, keyed to the ends of the brake shaft (161A), Figure 6, are fitted with brake heads, to which brake shoes (162C), Figure 9, are riveted. The brake screw (163A), Figure 6, mounted in bearings attached to the brake-shaft bearing supports (155C and 155E), Figure 6, and (155D and 155F), Figure 7, extends forward through a hole in the shield and terminates in the brake handle (162A), Figure 5. The brake-screw nut (163F), Figure 9, is trunnioned in the brake-shaft lever (162B), Figure 6, keyed to the brake shaft.

(2) The brake screw has a left-hand thread, and a few turns in a clockwise direction of the brake handle force the brake shoes against the tires.

19. Description of limber groups.—*a.* The frame (fig. 18) is built of two flanged steel middle rails riveted to the top and bottom plates which form a box section. The axle brackets are riveted on each side through which the axle passes. A shoulder on the axle is placed against the left axle bracket and is retained in that position by the axle nut which is screwed on the threaded portion of the axle and tightened against the right axle bracket thereby preventing movement of the axle endwise. Four steel pins pass through the axle brackets and the axle, preventing rotation. The pintle (12A), Figure 18, is riveted to the extreme rear end of the frame and serves as a bearing for the lunette of the carriage when limbered.

b. (1) To strengthen the forward ends of the middle rail top and bottom plates (fig. 18), these parts are surrounded by a middle rail collar (21A), Figure 19, which is riveted to the top and bottom plates by eight rivets. Against the front of the collar is placed a middle rail collar disk (21D), held in place by four collar disk bolts (22E), having special tapered stud heads.

(2) The drawbar hinge plate (LB22B), Figure 18, is held against the middle rail collar disk by the drawbar supporting-spring bolt (21B), Figure 19, and its allied parts.

(3) The drawbar is attached to the drawbar hinge plate (LB22B) by the hinge pin (LB21B), Figure 18, which is passed through the drawbar hinge plates and the drawbar hinge and retained in place by the hinge pin nut (LB21C) and cotter pin.

(4) The mechanism is so designed as to allow limited rocking of the drawbar with reference to the hinge plate through a vertical angle of 35°. There is a further rocking motion possible between the hinge plate and the collar disk in any direction whenever the pressure against the lunette is sufficient to overcome the tension of the drawbar supporting spring.

c. Side rails (11B and 11A), Figure 18, attached to the axle just inside the wheel hubs extend forward to join the front rails which are at their inner ends riveted to the middle rails forming a frame for carrying the lighting equipment.

d. The bucket holder (10E) is riveted to the right front rail and a grease box holder in the angle between the left front rail and middle rail. Picket rope hooks (16C and 16B) are riveted to the side rails and the picket rope support is riveted to the frame directly under the pintle.

e. (1) The wheels have wooden spokes and felloes, steel felloe bands, and rubber tires. The spokes in each wheel are clamped between the flanges of the hub box and the hub ring by seven carriage bolts. Bronze liners in the hub box bear on the axle spindle.

(2) The wheel fastenings which hold the wheels in position on the axle consist of axle collars, surrounded by dust collars, fitted with leather axle washers, and keyed to the axle at the inner ends of the hubs, and the axle caps fitted with leather washers and held in position by linch pins.

(3) The axle is a single solid piece of steel with tapered axle spindles given a downward set in order that the wheel thrust will be toward the center of the axle.

20. Description of caisson groups.—The principal groups are the chest body, which is divided into upper and lower compartments;

upper and lower loose diaphragms; apron; axle and spring supporting mechanism; brake mechanism; wheels; pintle; and the drawbar and drawbar socket. (See figs. 20 and 21.)

a. (1) The inclosure of the chest is made up of the lower chest body, upper chest body, rear plate, and upper and lower chest doors. It is divided horizontally into three compartments by the upper and lower intermediate plates. A compartment between the intermediate plates provides space for the axle, drawbar socket, pintle bracket, fuze chest, and oil can.

(2) The upper compartment is arranged for the transportation of 8 projectiles and 16 powder charges. The front and rear diaphragms are riveted to the chest body and perforated with 16 holes arranged in three horizontal rows. The top row and three center holes of the middle row of each diaphragm are connected by carrier tubes which are rolled in place, each providing space for one powder container. Powder is served to the caissons in fiber containers, each containing two powder charges. The container is fitted with a metal cover and base, the cover being pressed in, thereby procuring an air-tight joint. The middle diaphragm of the upper compartment is riveted in place between the front and rear diaphragms and perforated with eight holes. These holes are connected with the lower row and the two end holes of the middle row of the front diaphragm by projectile tubes which are rolled in place, each providing space for one projectile. The diaphragms are stiffened and kept in proper alignment by seven bolts which pass through gas-pipe diaphragm stiffeners.

(3) The lower compartment is arranged for the transportation of six projectiles. The front, middle, and rear diaphragms are riveted to the body and each perforated with six holes. The holes in the middle and front diaphragms are connected by projectile tubes which are rolled in place, each providing space for one projectile.

(4) Both compartments are provided with loose diaphragms by the use of which the caisson can be made available for transporting any of the following types of shells: High explosive, Mk. I; high explosive, Mk. IV (obus allonge or French long shell); high explosive, Mk. XVII; gas shell, Mk. II; and shrapnel, Mk. I. However, only one type of shell can be carried in the same compartment at one time. When carrying either high explosive, gas, or shrapnel the loose diaphragms are placed in position after the projectiles are inserted in the projectile tube. When the doors are closed, carrying either high explosives or gas shells, the door stiffeners bear against the bases of the projectiles, holding them in place. With shrapnel,

the edges of the flanged holes in the loose diaphragm bear against the rotating bands of the projectiles and prevent them from moving. When the caisson is being used to transport high explosive, Mk. IV, the loose diaphragms are placed inside the body of the caisson next to the front diaphragms. When the doors are closed the door stiffeners bear against the bases of the projectiles, holding them firmly against the loose diaphragms. The door stiffeners also bear against the powder containers, holding them in place.

(5) *Armor.*—The rear plate, the upper and lower doors, and a short apron hinged to the lower door are made of armor plate for the protection of the cannoneers. The upper chest door is hinged at its upper edge and swings upward to open. It is held up by the door props, one on each side of the chest. When closed the doors are secured by lock bars fastened with a padlock. The apron is then doubled back against the lower door and latched in place.

(6) Two foot rests, two handrails, and three grip straps are provided on the chest for the convenience of the cannoneers. They use the folded 12 foot by 12 foot paulin as a seat cushion. Straps and fastenings for the various accessories issued are disposed about the chest as was found convenient.

(7) A name plate giving the name of the vehicle, model, name of manufacturer, date of completion, initials of the inspector, and serial number is riveted to the rear plate. In reports, correspondence, etc., the vehicles will be designated by name, model, and serial number.

b. Axle and spring supporting mechanism.—(1) The axle passes through the chest between the intermediate plates. Between it and the chest is interposed a system of helical springs which carry the weight of the chest and contents. Axle brackets fixed on the axle fit into front and rear guide brackets riveted to the sides of the chest.

(2) The upward thrust of the carrying springs which rest on the xle brackets is assumed by washers and the heads of the spring bolts. Each spring bolt passes with a free fit downward through its carrying spring (AB21C), Figure 20, axle bracket, a short column of Belleville springs (AB21B) or saucer-shaped springs the purpose of which is to check rebound, the outstanding flange of the guide bracket and the spring bolt nut. The weight of the chest is, therefore, suspended from the top of the carrying springs.

(3) The heads of the spring bolts (17G) are prevented from unscrewing and the bolts maintained in alignment by the spring bolt head locks (AB50A).

(4) Lateral motion of the chest is restricted by guide bolts fixed in the ends of the guide brackets and slidably passing through bronze bushings in the ends of the axle brackets.

(5) The downward movement of the chest when the carrying springs are compressed is limited by chest stops riveted to the chest just above the axle brackets.

c. Brake mechanism.—(1) The caisson is equipped with band brakes operated by a brake lever (BB20E) which draws the brake bands tightly about brake drums bolted to the wheel hubs. Brake hanger brackets are bolted to the underside of the axle brackets with long screws which also clamp the axle bracket tightly about the axle. Brake hanger bracket braces link the hanger brackets to brake shaft brackets attached to the lower forward corners of the chest.

(2) The brake bands are lined with commercial brake band linings and are pinned at one end to the brake hangers. The free ends of the brake bands are pinned to the brake rod levers (BB25D), Figure 20, which are pivoted to the brake hangers. The brake bands are prevented from dragging on the drums by brake band guides (BB28D) riveted to the upper sides of the bands and anchored in the band clips which are pinned into the axle brackets.

(3) The lower ends of the brake rod levers are attached through the brake rods to the brake shaft levers, adjustment being provided for by means of brake rod ends (BB31G), which are screwed to the brake rods (BB31C). One brake shaft lever is made integral with the brake shaft, the other being mounted on the square cut on the left end of the brake shaft and is held in place with a cotter pin.

(4) The brake hand lever is riveted into the brake lever bearing and the latter is mounted on the brake lever pin. The pin is forced and pinned in the brake lever bracket which is riveted to the chest body. The brake lever rod (BB31E) is pinned at lower end to the crank on the brake shaft and at the upper end to the brake lever bearing (BB30A). The upper end of the brake lever rod is screwed into a brake rod end, allowing for adjustment in the length of the rod.

(5) A segment rack (BB28F) is mounted on the segment rack bracket. A brake lever catch (BB10H) mounted on the lever engages this rack and holds the lever in any desired position.

d. Wheels.—(1) The wheels have steel tires, 60 inches in diameter by 5 inches in width, wood felloes and spokes and steel hubs with bronze hub liners. Each wheel has 16 spokes clamped at the hub end between the flanges of the hub box and hub ring by eight carriage bolts. The outer ends of the spokes fit into metal spoke shoes riveted to a felloe made up of four sections. The tire is shrunk on and held with tire bolts passing through the felloe.

(2) A wheel hook bushing is mounted on each hub box between the hub ring and the hub band. The wheel hooks fit over and revolve on these bushings. The hub band is screwed on the hub box with a lock washer between it and the wheel hook bushing.

(3) A hub cap is screwed on the outer end of the hub and locked to the hub band by a hub cap latch. The hub cap covers the wheel fastening and prevents its disengagement from deep notches in the axle spindle. Wheel oil valves are mounted in the hub caps through which the oil for lubricating the axle is introduced. The oil valves are held closed by springs.

e. Pintle and pintle bearing.—A standard ordnance pintle is mounted in a divided bearing bolted between the upper and lower pintle bearing supports which project to the rear from the chest intermediate plates. The pintle swivels 360° in the bearing under stress, but ordinarily is supported in an upright position by the pressure of the pintle spring against a flat on the enlarged end of the pintle shank. The pintle is equipped with a semiautomatic pintle latch.

f. Drawbar and drawbar socket.—(1) The drawbar socket is riveted into the front of the chest between the upper and lower intermediate plates. The drawbar fits into the drawbar socket and is held in place by the drawbar pin and the drawbar key. The lunette bearing is riveted into the front end of the drawbar. A wheel guard is riveted to the drawbar near the rear end.

(2) The caisson prop is pinned to the caisson prop connection and consists of two prop tubes into the upper ends of which prop eyes are riveted, the lower ends being fitted with a prop foot. When down, the prop serves to support the front end of the caisson. In traveling it is swung up and held by the prop chain.

SECTION IV

ASSEMBLY AND DISASSEMBLY

21. General.—When disassembled it is desirable to complete the subassemblies before attempting the assembly of the larger mechanisms. In all assembling, the bearings, sliding surfaces, threads, etc., should be cleaned and lubricated with class A oil.

22. Disassembly of the firing mechanism, M1918.—Remove the firing mechanism assembly (fig. 4) and take out the safety set screw that retains the firing pin housing. Take out the firing pin housing (A12257), Figures 3 and 4, with the firing mechanism wrench and remove the firing pin (A12258), Figures 3 and 4. Remove the safety set screw and primer holder (B8058), Figure 4, and slip out the firing pin guide (A12256), Figures 3 and 4. Remove the firing pin spring (A12261), Figures 3 and 4.

23. Assembly of the firing mechanism, M1918.—Place the firing pin spring (A12261), Figures 3 and 4, in the muzzle end of the firing mechanism block (C3554), Figures 3 and 4; insert the firing pin guide (A12256), Figures 3 and 4, and assemble the primer holder (B8058), Figure 4. Insert the firing pin (A12258), Figures 3 and 4, in the breech end of the firing mechanism and assemble the firing pin housing (A12257), Figures 3 and 4. Assemble the set screws in position to retain the firing pin housing and the primer holder.

24. Disassembly of the firing mechanism block latch, M1918.—From the face of the breechblock carrier (13C), Figures 2 and 3, remove the four firing mechanism block latch holder screws

(48E), Figure 4, and remove the firing mechanism block latch (48A), Figures 2 and 4.

25. Assembly of the firing mechanism block latch, M1918.—Assemble the firing mechanism block latch (48A), Figures 2 and 4, to the breechblock carrier (13C), Figures 2 and 3, with the four firing mechanism block latch holder screws (48E), Figure 4.

26. Disassembly of the obturator spindle, M1918.—Remove the firing mechanism housing key by pressing down on the firing mechanism housing key spring (50G), Figure 4, and with a screw driver acting as a pry against the key and the face of the breechblock move the key to the rear as far as it will go. Open the breechblock and with the obturator spindle wrench remove the obturator spindle (53A), Figure 3, care being taken not to drop the split rings or the gas check pad.

27. Assembly of the obturator spindle, M1918.—Place the obturator spindle (53A), Figure 3, on end with the mushroom head down and place over it the front split ring, gas check pad, rear split ring, inner ring, and the filling-in disk. Assemble the obturator spindle through the breechblock and screw it into the firing mechanism housing until it can be locked by the firing mechanism housing key.

28. Disassembly of the percussion mechanism, M1918.—With the breech closed, remove the percussion hammer operating shaft nut and collar (22H), Figure 2, and pull the percussion hammer operating shaft (22A) out of its bearing to the right, holding the percussion hammer (24A) in the left hand. Open the breech and remove the percussion hammer shaft plunger and spring (22L and 22K).

29. Assembly of the percussion mechanism, M1918.—With the breech opened, replace the percussion hammer shaft plunger spring and plunger (22K and 22L), Figure 2. Close the breech and slide the percussion hammer operating shaft (22A) into its bearings from the right, passing it through the percussion hammer. Replace the percussion hammer operating shaft collar and nut.

30. Disassembly of the percussion hammer lock bolt, M1918.—Remove the screw from the bolt, meanwhile holding the percussion hammer lock bolt spring to the bolt. Disassemble the spring from the bolt.

31. Assembly of the percussion hammer lock bolt, M1918.—Set the percussion hammer lock bolt spring into the percussion hammer lock bolt, with the small knob on the spring

away from the bolt, and secure it with the percussion hammer lock bolt spring screw.

32. Disassembly of breech mechanism, M1918.—*a.* Raise the firing mechanism block latch (48A), Figure 2, and unscrew the firing mechanism.

b. Remove the percussion hammer operating shaft nut and collar (22B and 22H), Figure 2, from the end of the percussion hammer operating shaft (22A) and withdraw the shaft.

c. Open the breech and remove the percussion hammer shaft plunger and spring.

d. Press down on the firing mechanism housing key spring and push the key to the rear as far as it will go.

e. Unscrew the obturator spindle with the wrench provided and pull the spindle out of the breechblock. Support the split rings from falling out of place.

f. Withdraw the firing mechanism housing assembly and firing mechanism housing key assembly from the breechblock carrier.

g. Draw out the operating lever collar detent (16K), Figure 2, and remove the collar from the pintle of the operating lever and raise the lever out of engagement with the rack.

h. Depress the breechblock rack lock (23C), Figure 2, and turn the breechblock to the left until the assembling studs strike. Draw out the breechblock rack lock and the breechblock rack lock spring.

i. Unscrew the breechblock from the breechblock carrier and remove it from the pintle of the carrier. Remove the obturator spindle spring front seat from the interior of the breechblock, and the obturator spindle spring (50E), Figure 3, and rear seat (50D) from the interior of the breechblock carrier.

j. Remove the operating lever by lifting it out of the hinge lugs, and remove the breechblock carrier.

33. Assembly of breech mechanism, M1918.—*a.* Set the lug of the breechblock carrier (13C), Figures 2 and 3, between the hinge lugs on the jacket and align the hinge hole. Pass the pintle of the operating lever (15A), Figure 3, part way down through the upper hinge lug and the carrier. Turn the carrier so that its breech face is parallel to the side of the howitzer and swing the operating lever to the closed position against the breech face of the howitzer. Insert the breechblock rack lock (23C), Figure 2, and breechblock rack lock spring (23B) into the recess in the front face of the breechblock carrier. Place the obturator spindle spring rear seat (50D), Figure 3, in the hub of the breechblock carrier from the front with the rounded edge of the seat to the rear, and insert the obturator spindle spring

(50E) against the rear seat. Clean thoroughly and oil the threads and spindle of the breechblock carrier and the threads and interior of the breechblock. Insert the obturator spindle spring front seat (50C) in the bore of the breechblock. Lift the breechblock in horizontal position and slide it carefully over the pintle of the breechblock carrier, rotating back and forth slightly to prevent binding. Screw the breechblock into the breechblock carrier by turning to the left. When screwed in about one and one-half turns it will be necessary to reach in the muzzle end of the breechblock and center the obturator spindle spring front seat (50C) so that it will enter the bore of the carrier. This can easily be done with a piece of hardwood, after which screw the breechblock in until the assembling studs strike. Push the breechblock rack lock down into its seat in the breechblock carrier and slide the breechblock rack (23A), Figures 2 and 3, into the breechblock carrier until the assembling line on the top of the breechblock rack is flush with the end of the covered portion of the rack hole. Hold the breechblock rack lock (23C), Figure 2, completely depressed and rotate the breechblock to the right. This causes the teeth of the breechblock to draw in the breechblock rack. Release the breechblock rack lock and turn the breechblock to the left until the breechblock rack lock engages the breechblock rack and stops the movement. This locates the breechblock correctly for entering the breech recess. Raise the operating lever (15A), Figures 2 and 3, sufficiently to clear the breechblock rack and swing the breechblock lever around until the lug on the bottom is directly over the driving slot in the breechblock rack and press the breechblock lever fully down into engagement. Assemble the operating lever collar (16C), Figure 2, and detent (16K) to the lower end of the pintle of the operating lever.

b. Assemble the obturator assembly as follows: Swing the carrier to the fully open position (fig. 3), depress the rack lock (23C), Figure 2, to the bottom of recess, and swing the operating lever to the fully closed position against the carrier. This rotates the breechblock to the locked position and permits the assembly of the firing mechanism housing (50B), Figures 2, 3, and 4, without depressing the firing mechanism safety plunger (50K), Figure 4. (Care must be exercised not to swing the carrier while the breechblock is in this position.)

c. Place the firing mechanism housing key assembly into the firing mechanism housing (50B), Figures 2, 3, and 4, in such a position that the stud in the spring will bear against the rear face of the housing, and then insert the firing mechanism housing (50B),

Figures 2, 3, and 4, into the breechblock carrier. Insert the obturator spindle (53A), Figure 3, into the breechblock, carefully supporting the split rings from falling, and press firmly against the breechblock, at the same time screw the obturator spindle into the firing mechanism housing (50B), Figures 2, 3, and 4, using the wrench provided, until the firing mechanism housing is drawn into the breechblock carrier approximately flush with its rear face. At this point depress the firing mechanism housing key spring, and push the key into the keyway in the obturator spindle. It may be necessary to rotate the obturator spindle one way or the other slightly to align the keyway. When the key is fully entered, the stud on the key spring enters the small hole in the bottom of the firing mechanism housing, which retains the key in position.

d. Swing the operating lever (15A), Figure 3, to the fully open position where the breechblock rack lock (23C), Figure 2, will move up into its seat in the breechblock rack (23A), which locates the breechblock in the proper position for closing into the breech recess. Insert the percussion hammer shaft plunger spring (22K) and plunger (22L) into the percussion hammer operating shaft housing (22E). Hold the percussion hammer (24A) in the pocket in the percussion hammer operating shaft housing (22E) and pass the percussion hammer operating shaft (22A) through the housing (22E), hammer (24A), and plunger (22L) from the right side. Assemble the percussion hammer operating shaft collar (22H) and nut to the left end of the percussion hammer operating shaft.

e. Close the breech and screw the firing mechanism block (C3554), Figures 2 and 3, into the firing mechanism housing (50B), Figures 2, 3, and 4, until the handle passes the firing mechanism block latch (48A), Figures 2 and 4. This completes the assembly.

34. Disassembly of breech mechanism, M1917.—The disassembling of the mechanism for the M1917 does not differ from the M1918 with the exception of the mushroom head, the mushroom spindle nut, and the firing leaf.

a. Remove the firing leaf by pressing the firing leaf latch plunger inward, after which the firing leaf should be raised until it can be removed through the opening at the rear. Remove the primer extractor. Pull the mushroom spindle nut key assembly out of its seat and unscrew the mushroom head from the mushroom spindle nut.

b. Remove the striker seat pin which retains the striker guide and the striker seat in position. Unscrew the striker guide and remove the firing pin and striker spring. Unscrew the striker seat.

c. Lift the operating lever out of its hinge lug and remove the breechblock carrier.

35. Assembly of breech mechanism, M1917.—The instructions for assembly of the following parts apply only to the M1917 due to the difference in construction from the M1918.

a. The firing pin is placed into the striker guide and the striker guide is screwed into the front face of the leaf. The striker spring fits over the firing pin and the striker seat is screwed into the leaf. The striker seat pin is then driven in.

b. Insert the mushroom spindle nut into the breechblock carrier. Screw the mushroom spindle into the mushroom spindle nut until the mushroom spindle nut is drawn into the breechblock carrier to a point where the rear face of the mushroom spindle nut projects about ⅛-inch out of the carrier. Insert the mushroom spindle nut key into the key slot of the mushroom spindle. The key is retained in position by the spring entering a hole in the mushroom spindle nut. Insert the primer extractor into its slot in the mushroom spindle nut. Assemble the firing leaf into the guides in the breechblock carrier. The primer extractor should be raised slightly to engage the short arm with the slide when pushing the slide fully in. Press down on the firing leaf until it is locked in position by the firing leaf latch plunger.

36. Disassembly and assembly of carriage.—*a. General.*—(1) Cleaning, inspection, and replacements made necessary by wear or breakage necessitate the disassembling and assembling of various parts of the carriage. The work comes under two headings: That which can be performed by the battery personnel with the tools furnished and that which should go to the ordnance maintenance company which has more elaborate equipment. In general, the battery organization may do such dismounting as is required to replace any of the spare parts issued to the organization as listed in Standard Nomenclature List No. C–3. The battery mechanics will not, however, remove the cylinder heads of the recoil mechanism under any circumstances notwithstanding the issue of a spare counterrecoil-buffer valve.

(2) All work must be done in accordance with instructions given and any difficulties which can not be remedied should be referred to the ordnance maintenance company.

(3) Cleanliness is of prime importance in assembling operations. When gear cases are opened for inspection or partial disassembling if there is any doubt as to whether grit has gotten into the grease, all the grease should be cleaned out and fresh substituted.

(4) Bolts in vertical positions are, in general, assembled with their heads up as they are less liable to be lost should the nut come off.

(5) Dismounting of the howitzer, sleigh or cradle will not be done by the using arms. The reason for prohibiting disassembling is the difficulties usually attending the removal of the breech key, and danger from improper support of the weights of the parts. Occasions seldom arise when these parts have to be removed from the carriage.

(6) Battery mechanics will not do any filing on the sights or howitzer parts other than as outlined in TR 430–65, and only by order of the battery commander on any carriage part. Nor will they be allowed to disassemble or assemble any part of the recoil mechanism. Disassembly or assembly of the mechanism is a function of the ordnance maintenance company.

(7) *Set screws.*—Most parts which might otherwise unscrew or slip from vibration are locked in some way. Paint is apt to hide small set screws and pins provided for such locking of parts, so that they are overlooked and often sheared in disassembling. Careful examination of nuts, caps, washers, sleeves, etc., before applying force to them will save trouble later.

(8) Avoid the use of wrenches which do not fit snugly on the parts, as they will damage the corners of the nut and the wrench is apt to be spread. The proper way to apply an adjustable screw wrench to tighten a nut or bolt is to have the strain upon the solid jaw as near the back of the wrench as practicable.

b. Removal of a carriage wheel.—Traverse the carriage as far as possible away from the wheel to be removed. Place a jack under the axle as near as possible to the wheel, placing a substantial piece of wood between the head of the jack and the axle to prevent bruising. Disengage the linch pin thong, pull the free end of the linch pin latch away from the axle cap and pull the linch pin out. Remove the axle cap with wheel oil valve attached to it. Prevent the outer axle leather washer from dropping and pull the wheel off. (Weight of rubber tired wheel is approximately 539 pounds.)

c. Assembly of wheel.—Clean the axle washers, inside of wheel hub, liners and axle spindles and carefully smooth any scoring that may have occurred. If any metal chips have gotten into the grease, clean out all the grease in the axle and run a piece of cloth through the two small grease holes under the axle spindle. Fill with fresh cup grease. Put on the inner axle leather washer, the wheel, the outer axle washer, the axle cap, and linch pin, and try the end play

of the wheel. If there is considerable end play, put in new axle washers. Do not forget to finally secure the linch pin latch with the thong through its lower end.

d. To disassemble traversing rollers.—With the axle traveling lock in traveling position, remove the cotter pins from the Belleville spring compressors, and lift off the traversing roller box covers. Unscrew and remove the spring compressors. Remove the cotter pins and nuts from the traversing roller forks; lift out the fork thrust collars and Belleville springs. Lift out the forks with the traversing rollers mounted in them. Slip the traversing roller shafts out and drop the rollers out of the forks.

e. To assemble the traversing rollers.—Clean and lubricate the parts with cup grease. With the axle traveling lock (fig. 14) in traveling position, place the traversing rollers and traversing roller shafts in the traversing roller forks and slip the assembled units in place in the traversing roller boxes. Replace the Belleville springs, four springs to each roller, arranged as follows: Bottom spring, convex side down; second spring, convex side up; third spring, convex side down; top spring, convex side up. Replace the fork thrust collars, fork nuts and cotter pins. Screw in the Belleville spring compressors until they seat in the traversing roller boxes. Stuff the box with cup grease. Replace the roller box covers and cotter pins which hold them in place.

f. To disassamble the traversing mechanism and axle.—(1) Place the howitzer in the center of its traverse, and put the axle traveling lock (fig. 14) in traveling position. Place a timber chipped to fit the profile of the trail flasks across the underside of the trail just back of the draft hooks (65B), Figure 6. With a jack bearing against the timber, lift the carriage until both wheels clear the ground. Block up under the timber to hold the trail rigid, remove the jack, and remove both wheels and both axle collars, and dismount the traversing rollers. Release the axle traveling lock (fig. 14).

(2) Remove the cotter pins and traversing handwheel shaft nuts (111E), Figure 10, and pull the traversing handwheel shafts out; restore each nut and cotter pin to its proper shaft. Open the gear case covers and take out the handwheel shaft pinions, laying them aside with the shafts to which they belong.

(3) Take out the traversing intermediate shaft dust cover cotter pins (fig. 10), unscrew the traversing intermediate shaft bearings and lift the shafts out. Block or tie them up out of the way of dismounting the traversing screw, or unbolt and remove the gear cases.

(4) Remove the cotter pins and thrust bearing adjuster locks (90E), Figure 10, which also secure the gasket rings on the ends of the axle housing (86A), Figure 14. Loosen the gasket ring set screws, unscrew and remove the gasket rings and leather gaskets. Remove the housing cover screw and lift off the left traversing screw housing covers. Unscrew and remove the left traversing screw bearing.

(5) Pull the axle (152A), Figure 14, out to the left. It will carry with it the traversing nut support (153B), Figure 10, traversing nut (89A) and traversing screw (89C), with traversing gears (93N) in place. Be sure the right gear has remained on the screw. The axle may be withdrawn from either side in the manner specified. It is preferable to remove it from the left to avoid possible damage to the azimuth scale. The disassembling of the right intermediate shaft (111B) is not essential to removal of the axle to the left but it is better because of the danger, in reassembling, that the right traversing gear may be jammed. Frequently water is found in the axle housing (86A), Figure 14, having apparently condensed from air. The axle should be taken out at frequent intervals, cleaned, and thoroughly covered with grease.

(6) To remove the traversing screw (89C), Figure 10, from the traversing nut (89A), drive out the traversing screw stop collar rivet and take off the traversing gear (93N) and stop collar (89B). Turn the traversing screw out of the nut.

(7) To remove the traversing nut (89A), Figure 10, from the traversing nut support (153B), drive out the taper pin from below. The traversing nut support will not be removed from the axle in the field.

g. To disassemble the traversing screw without removing the axle.—(1) Engage the axle traveling lock (99G), Figure 14, in the "To travel" position. Perform the disassembling described in *f* (2), (3), and (4) above, removing both traversing screw bearings.

(2) Turn the traversing screw (89C), Figure 10, until the stop collar is outside the right end of the traversing screw housing. Drive out the stop collar pin and take off the collar. Turn the traversing screw in the opposite direction until it comes out of the traversing nut to the left

h. To assemble the axle and the traversing mechanism (the carriage should be on blocks as described for dismounting).—(1) Clean all the parts thoroughly and examine particularly the threads of the traversing screw (89C), Figure 10, for wear or bruises and smooth all scored places. Put a little lubricating oil in the travers-

ing nut and put the nut on the screw. Screw on the traversing screw stop collar and pin it in place, riveting the end of the pin cold. Center the traversing nut between the shoulder on the left end of the screw and the stop collar.

(2) Place the traversing nut (89A), Figure 10, in the traversing nut support. Replace the traversing nut taper pin and drive it home. When the above parts are thus assembled, be sure that the traversing screw stop collar is on the opposite end from the azimuth scale on the axle, and that the portion of the traversing nut which is cut away to form a grease cup, and the azimuth scale on the axle, are both on the upper side of the assembled unit.

(3) Wipe out the axle and traversing screw housings (87A), Figure 10, and put in plenty of medium lubricating graphite grease. Cover every thread of the screw as a protection against rust as well as to lubricate it. Slide the unit into the axle and traversing screw housings from the left side of the carriage, that end entering first which carries the traversing screw stop collar. Center the axle longitudinally in the axle housing and put the axle traveling lock in traveling position and reassemble the traversing rollers.

(4) Replace the two traversing gears (93N), Figure 10. Examine the thrust bearings in the traversing screw bearings without changing the original adjustment and tentatively screw the traversing bearings into the traversing screw housing.

(5) Pass the intermediate shafts (111B and 111C), Figure 10, through the intermediate shaft bearings (having first cleaned the oil passages), the dust cover gaskets, the dust covers, and into the traversing gear cases. Replace the filler plates and traversing gear cases on the trail, allowing the lower ends of the shafts to enter the holes in the traversing gear housing, the bevel pinions meshing with the traversing gears. Replace the gear case dowels and all gear case bolts, pulling the nuts up tight and replacing the cotter pins.

(6) Test the adjustment of the thrust bearings (fig. 10) of the traversing screw by trying the mesh of the intermediate shaft pinions and the traversing gears. Back out the thrust bearing adjusters slightly, if necessary, to avoid binding when screwing the intermediate shaft bearings in place. Replace the cotter pins over the dust covers. Replace the traversing screw housing covers and housing cover screws. Replace the leather gaskets and gasket rings on the ends of the axle housing. Tighten the thrust bearing adjusters until the traversing screw revolves smoothly without end

play. Replace the traversing screw thrust bearing adjuster locks to secure the traversing screw thrust bearing adjusters.

(7) Replace the traversing intermediate gears (93K), Figure 10, and the intermediate shaft nuts and pins, then the handwheel shaft pinions. Pass the handwheel shafts through the gear boxes and pinions and put on the shaft nuts and cotter pins. Pack the gear case with cup grease and close the gear case covers.

(8) With the axle traveling lock in firing position, traverse to the fullest extent in either direction and see that the lost motion is reduced to the minimum. If the lost motion exceeds two-thirds of a revolution of either traversing handwheel before movement along the axle begins, notify the ordnance maintenance company.

i. To disassemble the axle traveling lock (99G), Figure 14.—Remove the cotter pin which bears against the axle traveling lock bushing and unscrew the bushing. Remove the cotter pins and nuts from the bolts which hold the axle traveling lock bearing in place. Remove the lever shaft bushing and bearing as a unit. To disassemble the axle traveling lock shaft, remove the cotter pin and axle traveling lock shaft nut, and slip the axle traveling lock lever bearing and bushing off the small end of the shaft. Unscrew the axle traveling lock box cover and remove the axle traveling lock spring and axle traveling lock. To remove the axle traveling lock box, take out the cotter pins and remove the nuts from the two bolts which hold the latter in place and lift off the box.

j. To assemble the axle traveling lock (99G), Figure 14.—Place the axle traveling lock box in position with the side opening toward the left trail flasks and replace the nuts and cotter pins to the bolts which hold it in place. Place the axle traveling lock in the box with the edge which is cut away on the underside. Traverse the carriage, if necessary, until the teeth on the axle traveling lock mesh with the grooves cut in the axle. Slip the small end of the shaft through the axle traveling lock bushing and bearing, and pass the cam end of the axle traveling lock shaft through the opening in the trail and the axle traveling lock box, being sure that the point of the cam is toward the front of the carriage. Replace the bolts, nuts, and cotter pins which hold the axle traveling lock bearing in position and replace the axle traveling lock lever in such a manner that the outer end will lie between the two axle traveling lock lever stops when the point of the cam is toward the front of the carriage. Replace the axle traveling lock spring, and screw the axle traveling lock box cover on tight. Back off the axle traveling lock box cover until the notch on the under edge of the rim is in line

with the bushing opening in the side of the axle traveling lock box. Screw in the axle traveling lock bushing and replace the cotter pin. Operate the axle traveling lock to see that it locks the carriage in the center of its traverse when the axle traveling lock catch is in traveling position and does not engage when the axle traveling lock catch is in firing position.

k. To disassemble the elevating mechanism.—(1) It is important that the howitzer should be either in traveling position with the cradle rear band bearing firmly on the cradle traveling locks, or in firing position, depressed until the cradle bears firmly on the depression stop with the rear end of the cradle blocked up to prevent it from tipping, before dismounting any part of the elevating mechanism.

(2) Remove the cotter pin and handwheel retainer (111D), Figure 8, and lift off the handwheel (104A), Figures 5 and 8. Remove the two set screws which hold the handwheel latch plate (104E), Figure 8, and unscrew the latter.

(3) Remove the cotter pin, worm shaft nut, and washer from the lower end of the elevating worm shaft (103G), Figure 8. Remove the cotter pin which holds the dust collar in place and lift the shaft up through the bracket. Remove the elevating worm wheel case cover (106A), Figure 9, lift out the elevating worm (103B), Figure 8, and elevating worm shaft ball thrust bearing (103F), Figure 8. Remove the cotter pin and pinion shaft nut. Pull the elevating worm wheel (103A), Figure 8, from its seat on the elevating pinion shaft (102B), Figure 6. Remove the cotter pins and nuts from the pinion shaft bracket bolts and pull out the elevating pinion shaft bracket. The elevating pinion shaft (102B), Figure 6, can then be pulled out, passing it between the spokes of the right wheel. Clean all the parts.

l. To assemble the elevating mechanism.—Have all the parts well cleaned. With the howitzer in position as described in *k* above pass the elevating pinion shaft (102B), Figure 6, between the spokes of the right wheel and through the opening in the right trail flask, pushing the shaft home. Insert the elevating pinion shaft bracket, pinion shaft bracket bolts, nuts, and cotter pins. Replace the elevating worm wheel (103A), Figure 8, pinion shaft nut and cotter pin. Place the ball thrust bearing (103F) in its seat in the elevating worm wheel case (105F) and place the elevating worm (103B) in position, being sure that the square section of the bore is down. Pass the elevating worm shaft (103G) down through the elevating worm shaft bracket (107A), slip the dust collar and dust

collar gasket on the shaft, and lower the shaft through the elevating worm wheel case (105F) and elevating worm (103B) until the lower end projects below the case. Replace the cotter pin which holds the dust collar in place. Replace the worm shaft washer, nut, and cotter pin. Cover the elevating worm (103B) and elevating worm wheel (103A) thickly with cup grease. Replace the elevating worm wheel case cover (106A), Figure 9, cover bolts, washers, nuts, and cotter pins. Replace the elevating handwheel latch plate (104E), Figure 8, and lock it in position with the two set screws; replace the handwheel, handwheel retainer (111D), and cotter pin. After the material is assembled elevate and depress the howitzer through the full extent of its travel and see that the mechanism functions easily and properly. If lost motion exceeds one-fifth of a revolution of the handwheel, notify the ordnance maintenance company.

m. To disassemble the movable spade assembly and spade latches (80C), Figure 5.—(1) With the spade in traveling position and the trail blocked up so that the spade clears the ground in all positions, drive out the pin which holds the spade shaft nut in place and unscrew the nut. Pull the spade shaft out to the left side of the carriage, driving it, if necessary, with a copper hammer or sledge, using a block of wood to receive the blows.

(2) To remove the spade latch shaft (80B), Figure 7, drive the pin out of the right spade latch shaft nut, unscrew the nut, and remove the right spade latch. Drive the pin which holds the shaft in place out of the right bearing of the fixed spade. Turn the spade latch handle to the vertical position and pull the shaft out to the left, driving it if necessary. Drive the pin out of the left spade latch shaft nut, unscrew the nut, and remove the left spade latch.

n. To assemble the movable spade and spade latches.—(1) Have the parts well cleaned and all oil passages cleared. With the trail blocked up as described above, put the left spade latch on the left end of the spade latch shaft, the handle pointing in a direction almost perpendicular to the flat surfaces on the ends of the shaft. Replace the left spade latch shaft nut and drive the pin in place. Reaching through the opening in the underside of the fixed spade, press the spade latch spring up and slip the spade latch shaft into its bearings, entering it from the left side and keeping the latch handle vertical. Release the spring and turn the handle forward and down until the spring engages the flattened spaces in the center of the shaft. Replace the right spade latch and nut and drive the pin in place. Drive the pin which holds the spade latch shaft in place into the right bearing of the fixed spade.

(2) Put the spade in place and oil and slip the spade shaft into position from the left side, turning it until the dowel engages the notch in the left spade brace. Replace the spade shaft nut and drive the pin into place.

o. To disassemble the brake mechanism.—(1) Remove the cotter pins, shaft arm nuts, and brake shoe stops. Slip the brake heads with the brake shoes (162C), Figure 9, riveted to them off the ends of the brake shaft arms (161B and 161C). Remove the cotter pins and drive the brake shaft keys out through the holes in the shield provided for that purpose. Pull out the brake shaft arms (161B and 161C), using a bar as a pry through brake shaft keyholes if necessary.

(2) Remove the cotter pin, nut, and washer from the lower end of the brake screw (163A), Figure 6. Pull the screw out of the brake screw supporting bushing and take the bushing out of the brake screw bracket (164F). Take out the cotter pin and screw off the brake screw supporting nut. Turn the brake screw in a clockwise direction until it comes completely out of the brake screw nut (163F), Figure 9, pulling the screw through the hole in the shield. Remove the cotter pins and nuts from the bolts which hold the brake screw bracket (164F), Figure 6, in place and remove the bracket.

(3) Remove the brake shaft lever and brake shaft bushing and pull the brake shaft (161A), Figure 6, out of its bearings. It may be necessary to traverse the howitzer to the end of its travel in order to clear the wheel. The brake screw nut (163F), Figure 9, should not be removed from the lever in the field.

(4) To disassemble the brake screw remove the cotter pin and take off the brake handle (162A), Figure 5. Remove the cotter pin and screw the brake screw stop off the brake screw.

p. To assemble the brake mechanism.—(1) Clean all parts thoroughly and examine particularly the threads of the brake screw for scoring, carefully smoothing all bruised places in the thread. Put a little lubricating oil in the brake screw nut.

(2) With the howitzer traversed to the end of its travel if necessary to clear the wheel, place the brake shaft (161A), Figure 6, in its bearings, large end of the keyholes toward the shield. Replace the brake shaft lever and bushing. Place the brake shaft arms (161B and 161C), Figure 9, in the ends of the shaft, curved portion up, replace the brake shaft keys, passing them through the holes in the shield, and replace the cotter pins. Replace the brake screw bracket (164F), Figure 6, bolts, nuts, and cotter pins.

(3) Put the brake handle (162A), Figure 5, on the screw and replace cotter pin. Replace the brake screw stop and cotter pin. Pass the screw through the hole in the shield and screw it into the brake screw nut (163F), Figure 9, until it projects several inches beyond the nut. Replace the brake screw supporting nut and cotter pin. Slip the brake screw bushing into the bracket and pass the end of the screw through it. Replace the brake screw washer, nut, and cotter pin. Put on the brake heads with shoes attached with the longer or oil hole side toward the howitzer and replace the brake shoe stops, nuts, and cotter pins.

q. Cradle firing mechanism (fig. 11).—(1) *To replace a firing handle return spring* (129F), Figure 11.—With cradle level and with the piston rod lock (123A), Figure 12, in firing position, take out the cotter pin of the firing handle shaft nut (130D), Figure 11, and unscrew the nut; as the nut comes off the spring will push the firing handle shaft piston (130L) out against it. Hold the piston back while unscrewing the last thread or two of the nut, then take the piston away and allow the spring to expand. There will not be much pressure upon it. Notice that the piston is cut to allow the passage of the firing safety latch. This cut must be on the inside or toward the howitzer when assembled. If the firing handle return spring (129F), Figure 11, is broken be sure to get all the pieces out of the housing. Slush the new spring with lubricating graphite grease and put it in place, compressing it so that the piston can be slipped in and held by opening the piston rod lock (123A), Figure 12. This proves the correct assembly of the piston. Assemble the nut and cotter pin.

(2) *To dismount the firing handle shaft* (130C), Figure 11.—Retract the howitzer to traveling position, leaving the piston rod lock (123A), Figure 12, open, take out the three lanyard pulley bracket screws and slip the lanyard pulley bracket (128E), Figure 11, out of the firing shaft guide. Take off the firing handle shaft nut (130D) and pull the shaft out to the rear. The firing safety latch (128K) will hold the piston (130L) and retain the return spring (129F). Clean and oil the parts before assembling.

(3) *To disassemble the firing safety shaft* (129M), Figure 11.—Put the howitzer in traveling position, and with the cradle front open take out the safety catch screw and slide the safety catch forward to clear the arm of the firing safety shaft. Unscrew the piston rod lock stop screw from the bottom of the cradle front transom sufficiently to allow additional movement of the piston rod lock (123A), Figure 12, to the left to clear the firing safety shaft (129M), Figure 11. Open the firing safety latch cover (129A) and support the firing

safety latch (128K) and the firing safety shaft lever (128H) as the shaft is pulled forward out of its bearings. The latch and lever are then free. Clean all the parts and oil passages.

(4) *To assemble the firing safety shaft* (129M), Figure 11.—Oil all the parts. Slip the firing safety shaft lever (128H) into the square hole in the firing safety latch (128K) and slide the latch up into its guide (130B) with its rounded lower corner outward. The arm on the front end of the shaft will stand at right angles to the firing safety shaft lever (128H). Work the shaft back to position and continue the assembling by reversal of the operations of dismounting. Then prove correct assemblage by pulling the firing handle (129L), Figure 11, with piston rod lock (123A), Figure 12, in open and closed positions.

37. Disassembly and assembly of limber.—*a. To disassemble the limber wheel*, allow the drawbar to rest on the ground. Place a jack under the collar of the side frame surrounding the axle on the side of the wheel to be removed and raise the wheel clear. Do not attempt to jack up a wheel with the front end supported on the limber prop. Remove the linch pin and axle cap and pull the wheel off. One limber wheel weighs about 325 pounds.

b. To assemble a limber wheel, see that the axle spindle and axle washers are clean and that the axle dust washers are in place, and examine both axle and interior of hub for evidences of scoring. When the surfaces are satisfactory, apply grease plentifully on the axle spindle and on both sides of the inner axle washer. Slip the wheel on and spin it around a turn or two to crowd out excess grease, replace the outer axle washer, axle cap, and linch pin. With the axle cap set to take up all possible end play, close the linch pin latch and tie the linch pin thong.

c. To disassemble the drawbar supporting spring.—Take off the nuts of the four middle rail collar disk bolts and pull the collar disk and spring assembly out of the middle rail. It is then an easy matter to take off the drawbar supporting spring bolt nut and release the spring. There will probably be little or no tension on the spring by the time the nut is ready to leave the thread, hence no special spring compressor is necessary. Take off the sleeve and front spring plate and disconnect the drawbar hinge by removing the hinge pin. Clean all the parts.

d. To assemble the drawbar supporting spring, make sure that all the parts are clean, then slush the inside of the drawbar supporting bolt head with a little medium lubricating graphite grease, and put the bolt (21B), Figure 19, through the hinge plate. Set the

four collar disk bolts in the collar disk. Cover the contact surfaces of the collar disk and hinge plate with lubricating oil well spread to protect the surfaces from rust and set the disk and hinge plate together with the spring bolt projecting to the rear of the disk. Put on the front spring plate. Slush the bolt and the spring with slushing oil, put on the sleeve, the spring, the rear spring plate, and the spring bolt nut. The hinge plate may be held in a vise while the drawbar bolt is run down to where the cotter pin may be inserted. Spread the cotter pin to prevent its coming out. Clean and oil the surface of the middle rail collar and the collar disk and insert the spring into the frame, entering the collar disk bolts so as to bring the yoke of the drawbar hinge plate in the vertical plane. Assemble and tighten the collar disk bolt nuts and put in and spread the cotter pins. Assemble the drawbar with heads of lunette pins uppermost. Put the hinge pin in place and restore its nut and cotter pin.

38. Disassembly and assembly of caisson.—*a. To disassemble a caisson wheel.*—With the caisson prop down and the brake released, place a jack under the chest on the side near the wheel to be removed. It is advisable to place a timber between the bottom of the chest and the head of the jack. It is important that the center of the jack should be slightly to the rear of the center line of the axle, otherwise the caisson may tip over backwards. Pull out the hub latch and with the spanner wrench remove the hub cap. Raise the plunger of the wheel fastenings, lift the wheel fastening from its seat on the end of the axle and pull off the wheel. Care should be taken not to damage the brake band in removing the wheel. The weight of one wheel is about 456 pounds.

b. To assemble a caisson wheel, clean and examine the axle spindle for evidence of scoring. All roughness should be smoothed off. Note the presence of the dust guard and that it is in serviceable condition. Clean and examine the hub liner. Put oil on the axle spindle. With the caisson jacked up as outlined in *a* above, place the wheel on the axle, being careful to slip the brake drum into the band without damaging the latter. Replace the wheel fastening and, holding the hub latch out, screw on the hub cap with the spanner wrench until it comes up tight. Then back off the hub cap until the hub latch seats in the hole in the hub band.

c. To disassemble the drawbar, loosen the drawbar socket bolt. Place a jack or blocking under the front end of the drawbar socket and under the rear of the chest, remove the cotter pin from the drawbar, and remove the drawbar key, driving it out if necessary.

Remove the cotter pin from the drawbar pin, remove the drawbar pin, and pull the drawbar from the socket. Clean all the parts and temporarily put the cotter pins back in the key, drawbar pin, and drawbar socket bolt to prevent loss. Remember the loss of the weight of the drawbar will affect the balance of the vehicle and do not take chances by neglecting the blocking.

d. To assemble the drawbar, have the drawbar and drawbar socket clean and lightly oil the latter and assemble by reversing the operation of removal.

e. To dissassemble the pintle, remove the cotter pins, nuts, and bolts which hold the pintle bearing in place. Pull the pintle and bearing out of the pintle bearing supports and separate the halves of the bearing. Clean the half bearings and pintle shank and smooth off any scoring. The pintle spring may then be disassembled by taking out the tap bolts of the pintle spring guide.

f. To assemble the pintle, thoroughly lubricate the pintle shank, place the two halves of the pintle bearing about it, compress the pintle spring with a stick or bar, and slide the unit between bearing supports. Replace the bolts, heads up, screw on the nuts, and put in the cotter pins.

g. To disassemble the brake mechanism.—(1) *To take off a brake band*, remove the wheel, detach the pins which secure the band to the brake hanger, brake rod lever, and brake band clip, and lift the band out.

(2) *To disassemble the brake shaft*, disconnect the brake rods and brake lever rod for withdrawing the pins. Take out the cotter pin securing the detachable brake shaft lever to the right end of the shaft. Slide the lever off and note the relation of the longer brake shaft crank inside of the square of the shaft. Mark both pieces to insure correct assembly. Pull the shaft out to the left.

(3) *To assemble the brake shaft.*—Clean the brake shaft bearings and oil passages and smooth off any roughness in them or on the shaft. Oil the bearings, put the shaft through from the left side, assemble the brake shaft crank so the marks made before dismounting agree. Put on the brake shaft lever, hub to the inside, in line with the fixed crank on left end of shaft and put in and spread the cotter pins. Connect the brake lever rod to the longer crank on the right end. Attach the brake rods and make sure that there is a cotter pin, suitably opened, in each end of each brake rod pin. Lubricate all the joints. In case the assembling marks for the brake shaft crank are lost, the correct position of the brake shaft crank is

at an angle of 64° below the fixed crank of the shaft. The longer side of the hub of the brake shaft crank is outside.

(4) *To assemble the brake band*, the wheel being removed, smooth any roughness of the brake drum, but do not put oil on it or the brake band lining. The end of the brake band having the larger loop and wider slot goes to the rear for assembling to the brake hanger. Slip the brake band guide up into the brake band clip and tie the band to the clip with cord or wire to support it while the pins are assembled. Attach the band to the brake hanger with pin and cotter pin, and to the brake rod lever with pin and cotter pin, and then remove the lashing of the band to the clip.

(5) *To adjust the brake bands.*—When the wheels do not lock with the brake lever pulled clear back, adjustment of the tension of the bands is necessary. Jack up the left side of the caisson as if to remove a wheel and release the brake. Take out the pin attaching the brake lever rod end to the brake lever bearing and screw the rod end onto the rod, shortening the center distance so that when the hand lever is pulled back from two-thirds to four-fifths of its total travel the wheel remains locked with a man standing on the outer end of one of the spokes. Then shove the brake lever to its fully released position and turn the wheel to see if the brake band drags. If it does, lengthen the brake lever rod a trifle and try again. After getting a satisfactory adjustment for the left side, check the presence of all necessary cotter pins and transfer the jack to the right side of the vehicle. Adjust this brake band if necessary by varying the length of the short brake rod until the wheel locks with a man standing on the spoke and the band does not drag when the brake lever is released. If such adjustment is not possible owing to worn linings, have the ordnance maintenance company reline the bands.

h. To replace a pintle latch spring, dismount the pintle latch by withdrawing the pintle latch pin and pulling the pintle latch off the horn of the pintle. Drive the pintle latch spring out, put a little oil or grease on the new spring and drive it in, being careful to get it started straight. Replace the pintle latch and try the action, putting a little lubricant on the spring points.

Disassembling of the carrying springs and axle will not be undertaken by the battery personnel.

SECTION V

INSPECTION AND ADJUSTMENT

39. Howitzer.—The following instructions with reference to inspections should be scrupulously observed by all concerned:

Parts to be inspected in order of inspection	Points to observe
a. The howitzer as a unit.	*a.* Note the general appearance; smoothness of operation of the breech mechanism in opening and closing. Note the action of the operating lever, operating lever latch in connection with the catches, also the action of the rack. Test the action of the firing mechanism by firing several primers. Disassemble the breech mechanism and thoroughly clean it and the barrel. Note the condition of the bore for copper deposits on the lands and grooves; erosion at origin of rifling; bruised or rusted gas check seat. Examine the breech recess for scored and bruised threads. Examine the leveling plates for burrs or bruises.
b. Breech mechanism.	*b.* Examine the breechblock sectors for scored or bruised threads.
(1) Obturator spindle assembly.	(1) Note the condition of the obturator spindle vent bushing and spindle plug.
(2) Gas check pad.	(2) Note whether the covering of the gas check pad is torn or badly worn.
(3) Obturator spindle spring.	(3) Examine the spring to see if it is cracked or broken.
(4) Breechblock carrier.	(4) Note the condition of threads and bearing surfaces. Examine for loose breechblock carrier assembling stud.
(5) Firing mechanism.	(5) Note the condition of the firing pin, firing-pin spring, plunger and plunger spring.

Parts to be inspected in order of inspection	Points to observe
(6) Firing mechanism housing key assembly.	(6) Inspect for broken spring.
(7) Percussion hammer operating shaft and hammer.	(7) Note whether bent or broken, or if the nut is loose on shaft.
(8) Percussion hammer lock bolt.	(8) Examine for broken spring.
(9) Operating lever assembly.	(9) Note the condition of the operating lever handle, plug, spring, sleeve and nut.
(10) Rack.	(10) Examine for broken or worn teeth.

40. Carriage and limber.

Parts to be inspected in order of inspection	Points to observe
a. The carriage.	*a.* Note the general appearance, whether the oil plugs are painted red, the carriage painted in accordance with regulations, and that all moving parts are properly lubricated.
(1) Gas pressure and volume of liquid.	(1) Test the gas pressure in the recuperator, using the figures and temperature readings as shown on correction pressure plate. Test volume of liquid as outlined in Section VII.
(2) Elevating mechanism.	(2) Elevate and depress the howitzer through the full extent of its travel. Note whether the mechanism operates without binding or undue backlash.
(3) Traversing mechanism.	(3) Traverse the carriage throughout its movement of 6°. Note smoothness of operation without binding or undue backlash.
(4) Cradle traveling locks.	(4) Operate the cradle traveling locks. Note that they move freely.
(5) Road brake.	(5) Test the road brake for ease of operation. Note whether the brake shoes bear properly on the tire when set. Examine the brake screw to see that it is not battered or scored.

Parts to be inspected in order of inspection	Points to observe
(6) Cradle.	(6) Examine the cradle clip for burrs or indentations. Inspect the piston rod lock lever to see that it is in position and properly lashed. Examine the sleigh traveling locks to see that they function properly. Open the cradle head cap. Note whether the gauge cock pointer points between plus 4 and minus 5.
(7) Trail.	(7) Test all bolts, nuts, and screws for looseness and broken fastenings or other damaged parts.
(8) Axle.	(8) Examine the axle for scored surfaces, lack of lubrication, or defects in the metal.
(9) Wheels.	(9) Remove both wheels and examine the axle spindles and hub liners. See that all hub bolts are tight and that spokes are not separating at the hub. Note the condition of the rubber tires.
(10) Shield.	(10) Examine the shield for missing rivets, etc., open and close the sight port shutter and adjust the shutter latch and wing nut. Open and close the panoramic sight case and examine the padlock and hinges.
b. The limber and wheels.	*b.* Have the carriage limbered and note the condition of the safety chain, lunette chain, spade latch, handspike, and canvas covers. Inspect the limber drawbar hinge plate for deformation of the plate. Try the action of the drawbar supporting spring. Note the condition of the lunette. Inspect the limber frame for loose rivets and pins. The inspection as outlined in *a* (9) above applies to the limber wheels.

41. Caisson.

Parts to be inspected in order of inspection	Points to observe
a. The caisson as a unit.	*a.* Note the general appearance, and that it is painted in accordance with regulations.

Parts to be inspected in order of inspection	Points to observe
b. Chest.	*b.* Note that the padlock and bolt snap are present and in serviceable condition. Open the doors and remove all ammunition. Examine the connecting tubes. Note whether the loose diaphragms are present and in good condition. Examine the hand rails and their brackets, all strap fastenings, oil can, and fuze-box carrier for missing rivets or broken parts. Examine the doors, apron hinges, and turnbuckles, and see that the door props are serviceable.
c. Brake.	*c.* Jack up the caisson until both wheels are clear. Apply the brake and stand on a spoke. Neither wheel should revolve under the weight of a 150-pound man. Release the brake lever and revolve the wheel by hand to determine whether either brake band is dragging.
d. Wheel.	*d.* Try the tightness of the tires by tapping them lightly with a hammer. See that all hub bolts are tight. With the caisson jacked up, spin the wheel on the axle, noting the wobble. If the tire should be loose or the spokes loose in their sockets immediate replacement should be made. Report to the ordnance maintenance company each wheel showing evidence of rubbing the axle. Note the condition of the brake lining and the brake drum.
e. Pintle.	*e.* Open and close the pintle latch and revolve the pintle in its bearing.
f. Carrying spring.	*f.* Examine for broken or weak springs and for evidence of poor lubrication of the guide bolts. See that all spring bolt head locks are in place.

42. Verification and adjustment of the sights (the quadrant sight, M1918, with panoramic sight, M1917).—*a.* Battery mechanics are forbidden to disassemble any part of the quadrant or panoramic sights and will make only such adjustments as are hereinafter prescribed. Adjustments are only to be made with tools provided by

the Ordnance Department for that purpose and in the presence of a commissioned officer. Any difficulties which can not be corrected by the methods herein prescribed should be reported to the ordnance maintenance company.

b. When out of adjustment the sights will cause inaccurate firing and should, therefore, be frequently verified and adjusted when necessary. A testing target is provided for verifying the sights. Verification of the sights is of such importance that battery commanders may find it advantageous to make permanent arrangements for such verification when occupying a position for an extended period.

c. The procedure under the above conditions is as follows: Place the carriage on a level foundation and with the aid of the gunner's quadrant see that the center line of the trunnions lays in a horizontal plane. Level the sight transversely, set the angle of site pointer at 300 mils, and the elevating scale at zero degrees elevation, and elevate or depress the howitzer until the center line of the bore is horizontal as determined by the gunner's quadrant. The bubble in the elevation level should be centered between the reference marks on the level vial. If the bubble is not centered, operate the angle of site worm until the vial is level. Loosen the set screw which holds the rear micrometer clamp in place and unscrew the clamp. Turn the rear micrometer drum without turning the worm until the index on the angle of site housing points to zero. Tighten the rear micrometer clamp and set screw.

d. Suspend the testing target in a plane perpendicular to the bore of the howitzer and at a distance of about 50 yards. Place the front and rear bore sights in the howitzer and move the testing target until the center line of the bore, as determined by the bore sights, pierces the target at the center of the lower circle of the target. The verticality of the target should be verified by a plumb line. With the panoramic sight mounted in the shank of the quadrant sight set the azimuth scale and elevation micrometer of the panoramic sight at zero. With the sights thus arranged, the line of sight should pass through the upper circle on the target.

e. If the line of sight pierces the target above or below the upper circle, it indicates that the elevation knob of the panoramic sight is out of adjustment. Operate the elevation knob until the line of sight pierces the target on the horizontal center line. Loosen the elevating knob locking screw and turn the elevating knob without turning the elevating worm until the index on the rotating head points to zero. Tighten the locking screw.

f. If the line of sight pierces the target to either right or left of the upper circle, it indicates that either the cross level of the quadrant or the azimuth micrometer index of the panoramic sight, or both, are out of adjustment. Traverse the panoramic sight until the line of sight pierces the target at the proper point and elevate the howitzer to maximum elevation, at the same time elevating the quadrant sight. If the point where the line of sight pierces the target appears to move either to the right or left, it indicates that the cross level of the quadrant sight is out of adjustment. Cross level the quadrant sight by turning the leveling worm handwheel until the howitzer can be elevated or depressed to the full extent of its travel without moving the point where the line of sight pierces the target to either the right or left. With the wrench provided for the purpose loosen the cross level holder set screw and carefully move the cross level holder until the bubble in the level vial is centered between the reference marks, and tighten the set screw.

g. If the azimuth micrometer index does not read zero with the howitzer returned to zero elevation, it indicates that the azimuth micrometer index is also out of adjustment. Loosen the micrometer locking screw and with the teat wrench provided for the purpose turn the index until the arrow points to zero on the azimuth micrometer scale, at the same time holding the latter to prevent it from turning. Tighten the locking screw.

h. After the sights are adjusted they should be submitted to the following test to assure their accuracy at extreme elevation and azimuth:

(1) With the carriage level and the gun and sights at zero elevation and deflection, see that the line of sight and axis of the bore prolonged strike the target at the proper points.

(2) Elevate the howitzer to its maximum elevation without altering the elevation of the sight. As the elevation of the howitzer is altered, the line of sight should follow the vertical line through the upper circle on the target.

(3) With conditions as in (1) above, traverse the howitzer to its extreme position in azimuth. As the deflection is altered the line of sight should follow the horizontal line through the upper circle.

(4) By construction and assembly the sights, if properly adjusted, should fill the above conditions with substantial accuracy. If in error, a report of the facts of the case, with cause, if known, should be made to the ordnance officer charged with repair of the material for his information and action.

i. In the field or when a suitable foundation for the carriage is not available, the sights may be verified and adjusted in the following manner, neglecting the angle of parallax: Jack up one wheel of the carriage until the center line of the trunnions is horizontal, as determined with the aid of the gunner's quadrant. Elevate or depress the howitzer until the center line of the bore is horizontal, as determined with the aid of the gunner's quadrant, and set the elevation scale of the quadrant sight at zero. Cross level the quadrant sight, verify and adjust the elevation level, as directed above. With the aid of the bore sights, train the howitzer on some distant aiming point (2,000 or 3,000 yard range). Proceed as above to adjust the panoramic and quadrant sights so that the line of sight and the center line of the bore will intersect at the aiming point.

SECTION VI

FUNCTIONING

43. General.—The functioning of the matériel as a whole, and of the groups, is so closely allied with description and operation, and description of groups, that it has been included in Sections II and III and is not repeated hereunder.

44. Malfunctions of howitzer.

Malfunction	Cause	Correction
a. Fails to fire until after several percussions on primer.	*a.* (1) Firing mechanism block not screwed home.	*a.* (1) Screw the block as far beyond the latch as it will go.
	(2) Fouled firing pin.	(2) Remove firing mechanism, or slide of the M1917, as the case may be, and disassemble. Wash all parts free of dirt or gummed oil with gasoline. Dry thoroughly and lubricate with light class A oil.
	(3) Deformed point on firing pin.	(3) Remove firing mechanism, or slide of the M1917, disassemble and replace firing pin.

Malfunction	Cause	Correction
	(4) Weak pull on the lanyard.	(4) Pull lanyard with considerable snap.
b. Fails to fire when proper percussion on primer is obtained.	*b.* Defective primer.	*b.* After three percussions wait at least two minutes before replacing primer.
c. Fails to fire after the primer has discharged.	*c.* (1) Damp or fouled vent hole through obturator spindle.	*c.* (1) Wait at least 10 minutes and remove primer and clean vent hole with vent cleaning bit.
	(2) Damp charge.	(2) Wait at least 10 minutes before opening the breech to remove the charge.
d. Mechanism does not operate freely.	*d.* (1) Lack of lubrication between rack and breechblock carrier.	*d.* (1) Remove the rack as follows: Open the breech, remove the operating lever collar detent and collar, raise the operating lever to clear the rack. Depress the rack lock and rotate the breechblock to the left and remove the rack. Clean and lubricate.
	(2) Lack of lubrication and the formation of scores in the threads of the breechblock carrier or in the breech recess.	(2) Disassemble the breechblock and thoroughly clean. If the threads are scored, repair must be made by the personnel of an ordnance maintenance company.
e. Percussion hammer not working freely.	*e.* Lack of lubrication and roughness on shaft and shaft bearings.	*e.* Disassemble, clean, and remove roughness.

45. Malfunctions of carriage.

Malfunction	Cause	Correction
a. Howitzer fails to return completely into battery.	*a.* (1) Expansion of liquid.	*a.* (1) Open the filling plug in the recoil cylinder head and allow the excess liquid to escape.
	(2) Insufficient pressure or quantity of liquid.	(2) Test the nitrogen pressure and level of the liquids, and replenish if necessary.
	(3) Vent in counterrecoil cylinder head stopped up.	(3) Clean vent hole in counterrecoil cylinder head.
b. Howitzer returns to battery with too great a shock.	*b.* (1) Insufficient liquid in recoil system.	*b.* (1) Add liquid to the recoil system.
	(2) Excess liquid in counterrecoil system.	(2) Drain liquid from counterrecoil system.
c. Howitzer slow to return to battery.	*c.* (1) Insufficient gas pressure.	*c.* (1) Add pressure by means of air pump.
	(2) Too much friction on packings.	(2) Report to ordnance maintenance company.
d. Howitzer recoils more than maximum distance allowed.	*d.* (1) Insufficient liquid in recoil mechanism.	*d.* (1) Refill system to normal.
	(2) Insufficient gas pressure in counterrecoil cylinders.	(2) Add air pressure by air pump.
e. Hard traverse.	*e.* (1) Lack of lubrication.	*e.* (1) Grease and oil all bearings.
	(2) Scored axle.	(2) Report to ordnance maintenance company.

Malfunction	Cause	Correction
f. Cradle spread.	*f.* Shock upon sleigh traveling locks.	*f.* Report to ordnance maintenance company.
g. Hub box of wheel hot.	*g.* (1) Lack of lubrication.	*g.* (1) Disassemble and pack with grease.
	(2) Scored liners.	(2) Report to ordnance maintenance company.

46. Safety precautions.—*a. Misfires.*—(1) Should the primer fail, no report will be heard. Failure may be due either to a defect of the primer or because its center has not been struck. An elapse of two minutes should be allowed, after which it should be ascertained that the firing mechanism is fully screwed home, using caution to keep as far to one side of the howitzer as possible. Several attempts should then be made to fire the primer; and if it still misses, an elapse of two minutes must be allowed, after which the firing mechanism should be removed and a new primer inserted. Before insertion of a new primer, however, the firing mechanism should be examined to determine whether the firing pin or firing pin spring is broken or whether the firing pin housing or primer seat plug has become loosened.

(2) Any primer removed after an attempt to fire should be handled with great care due to the possibility of a primer hangfire.

b. Missing of the charge.—(1) Should the primer explode without affecting the charge, only the explosion of the primer is heard. This may be caused by a damp or dirty channel in the obturator, because the base of the charge does not bear against the head of the obturator, or because the charge is very damp itself.

(2) Should a charge fail to explode, it is necessary to wait at least 10 minutes before approaching the piece to avoid accident. Remove the firing mechanism and, without opening the mechanism, run the vent cleaning bit through the channel in the obturator spindle and insert a new primer in the firing mechanism. If the howitzer does not fire on the second attempt, an interval of at least 10 minutes should elapse before the breech is opened and the charge removed.

SECTION VII

CARE AND PRESERVATION

47. Howitzer.—*a.* (1) Cannon become less copper fouled if properly cared for. The wear of the cannon does not depend entirely on the number of rounds fired but rather upon the care given the bore in cleaning, greasing, and the allowing of sufficient time for cooling between rounds.

(2) The accuracy life of cannon usually depends on erosion at the rear of the forcing cone or at the beginning of the rifling, which is most likely to be produced by a fast rate of firing, together with the excessive heating induced.

(3) Each projectile should be cleaned and a small amount of grease placed on the front edge of the rotating band before the projectile is inserted into the bore.

(4) When shells, etc., burst near the muzzle of the piece, make sure before firing that neither the exterior nor the muzzle face of the tube has been indented by the fragments. Any indentations affecting the bore of the tube are likely to cause it to split if the piece be fired. Bulges at any part of the piece or unusual conditions which may appear should be reported at once to the ordnance inspector of artillery.

(5) After firing periods it is important that the bore of the piece should be cleaned to remove the residue of powder and then thoroughly oiled. In cleaning, use the sponge and wash the bore with a solution of soda ash and water or sal soda and water, in the proportion of one-half pound of soda ash, or 1 pound of sal soda, to a gallon of water. After washing with the soda solution wipe perfectly dry, using the sponge covered with burlap, and then oil the bore with a thin coat of light slushing oil, applying it with the slush brush.

(6) The surfaces of the leveling plates should be protected from injury. Do not lay tools or other articles upon the surfaces. In case of accidental injury repair must be made by the personnel of the ordnance maintenance company.

(7) The various screws in the howitzer should be examined frequently and kept tight.

(8) Extreme care must be taken to prevent injury to the gas check seat. Bruises in the gas check seat affect the seating of the split rings and are likely to cause leakage of gas and burning of the pad. If such a leakage actually occurs, serious erosion may result. Rusting of the gas check seat is likely to occur, due to the pads being susceptible to moisture. The seat and rings, therefore, should be well protected with rust-preventive compound at all times when the howitzer is not in use, and the entire canvas surface of the pad, in contact with the seat, split rings, obturator spindle, and filling-in disk should be kept coated with a graphite lubricant at all times.

(9) When the howitzer is not in use the various covers provided for protection must be placed in position.

b. The breech mechanism.—(1) The breech mechanism should be kept clean and the parts well lubricated at all times. When not in use the mechanism should be disassembled periodically to make sure no rust is forming. When in use the mechanism should be disassembled at intervals, cleaned, and oiled. This is especially important, as no provision is made for oiling by means of oilers or oil channels. The cleaning and oiling should always be done after each firing period.

(2) It is important that any cutting or abrasion on the threads of the breechblock or in the breech recess should be corrected as soon as detected, no matter how slight, because if neglected serious and permanent injury is certain to follow. If the breechblock does not rotate smoothly or the mechanism requires a greater effort than usual to operate, it should be considered sufficient warning to warrant disassembly for examination.

(3) Scored or indented threads should be reported at once to the ordnance maintenance company.

(4) In case the mechanism should be left unused for any considerable length of time, all bright or unpainted surfaces should be protected with a coat of rust-preventive compound. Before applying the rust-preventive compound the surface should be thoroughly cleaned and freed from rust, water, or lubricating oil. Rust-preventive compound may be readily removed with gasoline.

(5) In assembly or disassembly do not use a steel hammer directly on any part. A copper drift should be interposed or a copper hammer used to prevent deforming the parts.

c. The firing mechanism.—(1) The firing mechanism parts require careful attention and should be disassembled frequently for the purpose of cleaning and oiling. The parts should be washed with gasoline to remove any gummy oil, after which wipe dry and oil with light lubricating oil.

(2) Fouling of the firing pin, or the use of heavier than light class A lubricating oil may result in misfires. This is especially true in cold weather, as the oil may congeal and become gummy.

(3) The primer seat and the vent hole in the obturator spindle should be kept clean by frequent use of the vent cleaning tool. The slightest accumulation of fouling in the primer seat will cause the primer to enter with difficulty and trouble in extraction.

48. Carriage.—*a.* (1) The carriage can not be kept in serviceable condition unless proper attention is given to cleaning, lubrication, and repair of loose or broken parts. All bearing surfaces, screw threads, and exterior parts must be kept as clean as possible. When disassembling and assembling operations are being carried on, extra precautions must be taken to prevent the entrance of foreign matter into the working parts. Gasoline is issued by the Ordnance Department for cleaning purposes.

(2) In case the carriage is to be stored or to remain unused for any considerable length of time, all bright and unpainted surfaces should be protected with a coat of rust-preventive compound.

(3) The axle should be dismounted at least every six months to remove any water which may have condensed in the housing.

b. Wheels.—(1) The wheels should be removed periodically and the axle arms, axle collars, caps and washers, linch pins and hub liners cleaned and examined. All roughness, due to scoring or cutting, should be smoothed off.

(2) The nuts on the hub bolts should be tightened frequently during the first year of service and twice a year thereafter. Strict compliance with this regulation is necessary. The ends of the bolts should be lightly riveted over to prevent the nuts from unscrewing. The wooden parts of the wheels are made of seasoned material and the hub bolts are properly tightened when the material is issued but the wood dries out and shrinks, and the spokes become loose. If the wheel is used in this condition it will rapidly become unfit for service and may be damaged beyond repair. No attempt should be made to tighten the wooden parts by soaking in water. The water quickly dries out and the wood is left in worse condition than before. Keep water out by painting frequently.

(3) A sufficient thickness of leather axle washers should be maintained between the hub, the axle collars and axle cap so that after the linch pin is in place the wheel has only a slight longitudinal play upon the axle while still turning freely. This end play helps to conserve the lubricant. There must always be at least one leather washer at each end of the hub.

(4) The traveling locks and especially the axle traveling lock must be kept in good condition and used whenever the carriage is moved.

c. Whenever the carriage is placed in firing position the chiefs of gun sections will satisfy themselves that the piston rod locks are properly engaged, the piston rod locking levers wired to the recoil piston rod nuts and the cradle front covers closed and locked.

49. Recoil mechanism.—*a. To add liquid to the recoil cylinder*, place the howitzer an inch or two out of battery by means of the tractor and block it, disconnect the tractor and bring the howitzer to the position of maximum depression. With the filling plug wrench, remove the filling plug. Assemble the funnel and filling pipe into the filling hole, cover the funnel with a clean cloth. Fill the 1-liter measure with about a half pint of liquid and pour it into the funnel until the recoil cylinder is full. Replace the filling plug tightly. Again elevate the piece, connect the tractor, remove the blocking, and allow the howitzer to return to battery. It will probably not go clear in. Depress again and loosen the filling plug. The excess liquid will be forced out. The original 100 cubic centimeters of the air will have been so trapped in front of the piston that it can not get out; therefore, no more liquid need be extracted. Tighten the filling plug.

b. Length of recoil.—(1) When the howitzer is in action, the length of recoil should be constantly checked by means of the recoil indicator (124B), Figure 11.

(2) To measure the length of recoil place chalk, grease, or other substance on the edge of the sleigh and screw up the adjusting nut of the indicator until the pointer touches the sleigh and measure the length of the line traced when the howitzer has returned to battery. The following table gives the proper length of recoil at various elevations:

Powder charge

Angle of elevation	7		6		5		4		3		2		1	
	Meters	Inches	Meters	Inches	Meters	Inches	Meters	Inches	Meters	Inches	Meters	Inches	Meters	Inches
10°	1. 26	49. 6	1. 22	48. 0	1. 00	43. 3	1. 01	39. 8	0. 94	37. 0	0. 85	33. 5	0. 77	30. 3
20°	1. 28	50. 4	1. 24	48. 8	1. 14	44. 9	1. 05	41. 3	. 97	38. 2	. 89	35. 0	. 81	31. 9
40°	1. 30	51. 2	1. 25	49. 2	1. 17	46. 1	1. 10	43. 3	1. 02	40. 1	. 95	37. 4	. 87	34. 2

Correction pressure plate

Temperature		Maximum pressure		Minimum pressure	
		Kilograms per square centimeter	Pounds per square inch	Kilograms per square centimeter	Pounds per square inch
°C.	°F.				
50	122	37. 0	526. 3	35. 8	509. 2
45	113	36. 4	517. 7	35. 3	502. 1
40	104	35. 8	509. 2	34. 7	493. 5
35	95	35. 3	502. 1	34. 2	486. 4
30	86	34. 7	493. 5	33. 6	477. 9
25	77	34. 1	485. 0	33. 1	470. 8
20	68	33. 6	477. 9	32. 6	463. 7
15	59	33. 0	469. 4	32. 0	455. 1
10	50	32. 4	460. 8	31. 4	446. 6
5	41	31. 9	453. 7	30. 9	439. 5
0	32	31. 3	445. 2	30. 3	431. 0
−5	23	30. 7	436. 7	29. 8	423. 9
−10	14	30. 1	428. 1	29. 2	415. 3
−15	5	29. 5	419. 6	28. 7	408. 2

(3) If the howitzer overrecoils or does not return to battery after retraction tests have indicated the recoil cylinder as containing the proper amount of liquid, the pressure and amount of liquid in the counterrecoil system should be measured. Pressure and liquid level are usually measured together as described in *c* below, but in an emergency the pressure only may be taken (without the necessity of leveling the cradle) and, if less than the normal value as shown on the correction pressure plate indicated above, it should be re-established by the addition of compressed nitrogen. The recoil will then usually be within the limits fixed by the table. If recoil is still too great, the services of the ordnance maintenance company should be called for. At the same time have the pressure gauges examined and tested. When the howitzer is not in action the volume of liquid in the two cylinders and the pressure in the counterrecoil cylinder should be periodically checked, and checked before each

firing period. The outside of the recoil cylinders should be kept well painted to prevent rusting. They should be inspected periodically and any rust immediately removed.

(4) Pressure tests are not very reliable if made while the mechanism is heated from long or rapid firing. If the temperatures of the atmosphere and the liquid are not practically the same error will result.

(5) When the volume of liquid is to be tested the mechanism should be allowed to remain idle some minutes previously to allow the liquid to settle.

c. To measure the pressure and liquid in the counterrecoil system.—(1) The howitzer must be in battery and the carriage perfectly level. Use the gunner's quadrant to determine whether the axle is level. If necessary jack up a wheel until the bubble of the quadrant remains at the center.

(2) Open the cradle head cap (118C), Figure 5. Remove the gauge cock body head. Screw the pressure gauge into the adapter. Be sure that the pressure gauge adapter is clean and screw the pressure gauge into it. See that the adapter valve stem is fully drawn back so that it will not prematurely unseat the gauge cock valve, and check the presence of the adapter gasket; then assemble the adapter and tighten the pressure gauge adapter union.

(3) Using the special gauge cock and filling pipe coupling wrench turn the gauge cock body until the pointer stands at the lowest (1) graduation on its scale. Do not attempt to do this with an adjustable screw wrench on the pointer hexagon as the setting of the pointer may be destroyed.

(4) The adapter stem (U313A), Figure 15, should be screwed in slowly, opening the gauge cock valve (147B). Read the pressure directly from the gauge (U314L). Then note the temperature and compare the gauge reading with that given on the correction pressure plate (166D) (on the cradle head cap) for that temperature. Defer correction of the pressure until after correction of liquid level.

(5) *To test the level of the liquid.*—Close the adapter needle valve (U313C), Figure 15, but leave the gauge cock valve (147B) open and by means of the gauge cock wrench turn the gauge cock body (146A) in a counterclockwise direction by small angular movements, and at each stop momentarily open the adapter needle valve (U313C). When liquid begins to flow through the port on the bottom of the adapter, stop turning the gauge cock and close both valves. If the pointer now stands between 0.5 above and 0.5 below

the zero line on the scale the liquid may be considered as at the proper level. If the pointer is outside of these limits, pump in or drain off as directed on the scale.

(6) After securing a satisfactory liquid level, turn the gauge cock body (146A), Figure 15, until the pointer (147F) stands at "1," and again observe the pressure. If the gauge reading is high, open the adapter needle valve (U313C), allowing nitrogen to escape until the desired pressure is reached. If the gauge reading is low, reestablish the normal pressure by adding nitrogen. Then dismount the adapter by unscrewing the pressure gauge union (U314A), screw on the gauge cock body head (146G) tightly, and close the cradle head cap (118C).

d. To add liquid to the counterrecoil system.—(1) The pressure gauge and adapter will be attached to the gauge cock body as above.

(2) Open the cradle bottom cover (124F), Figure 16. Remove the filling valve cap and the filling needle valve cap (148F), using the filling valve cap wrench. Assemble the long swivel of the filling tube, marked "sleigh," on the filling valve body (148M) (use the filling pipe swivel nut and filling needle valve follower). Mount the liquid pump on the cradle pump bracket and connect it to the filling pipe (U320A) (use the same wrench on the filling pipe union). Pump a little liquid through the filling pipe before attaching it to the long swivel to insure a good seal in the pump before opening the filling needle valve (148A). Open the filling needle valve (148A) with the filling needle valve wrench. Turn the gauge cock body (146A), Figure 15, until the pointer (147F) stands at zero and pump in liquid until by trial openings of the adapter needle valve (U313C) the issuance of liquid from the adapter port shows that the proper level is reached.

(3) In assembling the filling needle valve caps (148F), Figure 16, note that the diameter of thread (20-mm.) in the first or forward cap is smaller than the diameter (22-mm.) of the second.

e. To add nitrogen to the counterrecoil mechanism.—(1) The pressure gauge adapter will be mounted as for the introduction of liquid.

(2) Open the cradle bottom cover (124F), Figure 16, remove the filling valve and filling needle valve caps (148F), and screw on the long swivel nut (U312A) as before.

(3) Attach the longer coupling of the filling pipe (U320A) (for reservoir, approximately 7 feet long) marked "Sleigh" to the long swivel, since it contains a check valve which will not work if reversed.

Attach the other coupling of the filling pipe to the cylinder of compressed nitrogen.

(4) Open the gauge cock valve (147B), Figure 15, by screwing in the pressure gauge adapter stem (U313A). Be sure the gauge is registering the pressure before opening the valves in the filling line so that the gauge will show the rise in pressure. Then open the filling needle valve (148A), Figure 16, of the sleigh fully, and *slowly* turn the handwheel of the compressed gas cylinder valve, *very gradually* opening that valve until the desired pressure is shown on the pressure gauge (U314L), Figure 15. Then close the valve of the compressed gas cylinder tightly.

(5) Check the pressure gauge (U314L), Figure 15, reading, and if it is too high see that the gauge cock pointer (147F) stands at "1" and open the adapter needle valve (U313C). Get the pressure in exact accord with the correction pressure plate (166D), Figure 15, then close the filling needle valve (148A), Figure 16, and gauge cock valve (147B), Figure 15, and restore the tools to their proper chests. Put on the gauge cock body head (146G), Figure 15, the filling valve and filling needle valve caps (148F), Figure 16, and close the cradle bottom cover (124F), Figure 13.

(6) There will be no use in connecting a gas cylinder in which the pressure has been reduced below 525 pounds per square inch (47 kg. per sq. cm.). A separate pressure gauge is issued for testing the pressure in these compressed gas cylinders.

50. Limber.—*a. General.*—Attention to lubrication is the principal requirement in the maintenance of the limber. Instructions for lubrication will be found in paragraph 52 *e.*

b. Wheels.—(1) Hub bolts should be tightened frequently and the bolt lightly riveted over the nut to prevent unscrewing.

(2) Wheels should be removed periodically and the liners as well as the axle arms cleaned and examined for scoring. All roughness should be smoothed off.

(3) Enough leather washers should be maintained between the outer end of the hub and the axle cap so that after the linch pin is in place the wheel has only a slight longitudinal play on the axle though still turning freely. Make sure that there is a washer between the hub and the axle collar. In adjusting for end play, effort should be made to get practically no end play with the linch pin in the deepest notches of the axle collar. It will then be possible as the washer wears to obtain new adjustment by turning the axle cap before it is again necessary to add more leather washers.

(4) When the hub liners have worn to such an extent that the hub rides hard in the overhanging flange of the axle dust collar a report should be made to the ordnance maintenance company for replacement.

(5) Bent connecting hinge plates should be reported to the ordnance maintenance company.

51. Caisson.—*a.* Maintenance of the caisson by the battery will consist principally in proper cleaning and lubrication, and such minor replacements as frequent inspections show to be necessary.

b. Nuts must be kept properly tightened and all missing cotter pins replaced.

c. Frequent tightening of the wheel hub bolts is as essential as with the carriage and limber wheels and should be followed by a tightening of the hub bands on caisson wheels, using the hub cap spanner wrench for the purpose.

d. Exposed unpainted metal parts should be well slushed with rust-preventive compound.

e. Frayed and weak implement straps should be replaced before the implements are lost.

f. Have the oil can repaired at the first sign of a leak in it.

g. Maintain the cleanliness and adjustment of the brakes. When brake band linings become glazed or slippery with grease so that they do not take hold properly, they should be scrubbed with gasoline. Take the wheel off to do this. Brake band linings do not need any sort of lubrication, and oil must be kept away from them, which is another reason for frequent inspection of the wheel dust guards.

52. Lubrication instructions.—*a. General.*—(1) The life of the material depends to a great extent on proper lubrication. Particular attention should be given to the sliding surfaces of the cradle clips and of the breech mechanism and to lubrication of the wheel hub liners.

(2) Oil holes and grease nozzles are provided on the vehicles by means of which the various parts are lubricated. Such openings on the carriage have been given reference numbers as indicated in Figure 22.

(3) All oil and grease nozzles and oil hole spring covers on the material are painted red. Oil holes have a red ring around the hole.

(4) All open oil holes and oil holes which may have become clogged with congealed oil should be cleaned with a piece of wire and wiped clean with hard cloth. Wood should never be used for this purpose as splinters are likely to break off and clog the oil

passage. Lint from the cloth must not be allowed to remain in the oil hole.

(5) Oil should be applied to the orifices of the carriage, shown in Figure 22, with the oil gun or oiler while the parts are being maneuvered to insure good lubrication. The nose of the oil gun is tapered to fit the openings of the nozzles and must not be damaged in any way that will spoil this fit.

b. Lubricants.—(1) The various lubricants and cleaning and preserving materials issued by the Ordnance Department are described in TR 1395–A.

(2) No lubricants will be used other than those authorized, nor will any lubricant be used in a manner other than as prescribed.

c. Lubrication of the 155-mm. howitzer, M1918.—The howitzer mechanisms are not provided with oil holes and many of the bearings may be oiled only after disassembling.

d. Lubrication of the 155-mm. howitzer carriage and recoil mechanism, M1918.—In Figure 22 are shown the openings for lubricants. They are referred to by numbers.

NOTE.—M1917 carriages vary in the means provided for oiling bearings. Use whatever is provided.

(1) In addition to the numbered places in which oil is used as a lubricant, the hasp and hinge pins of the trail box cover and the panoramic sight case, the loading barrow fastening pins, rammer and sponge staff fastening pins, lanyard pulley hubs, and bolt snaps must occasionally have a drop or two of oil on the contact surfaces.

(2) The teeth of the elevating pinion and elevating segments and the contact surfaces of the segments with the thrust bracket plates should be periodically slushed with lubricating graphite grease.

e. Lubrication of the limber.—(1) The axle spindles should be greased twice a month or after each 50 miles of travel. There are no grease chambers in the ends of the axle. Therefore the wheels must be removed for greasing.

(2) The lunette shaft and base and the top of the trail rest should be slushed with lubricating graphite grease before limbering.

(3) The drawbar supporting spring bolt head should be given a few drops of class A oil at the joint between it and the hinge plate and the drawbar forced down and up a few times to work the oil into the bearing. The spring, bolt, and sleeve should be well slushed with lubricating graphite grease in assembling. The middle rail collar disk bolt heads should be given a few drops of class A oil every day of travel, and the hinge pin (oil cup in drawbar hinge) oiled weekly.

f. Lubrication of caisson.—(1) Axle spindles of the caisson are hollow and serve as reservoirs for lubricant. Oil works better in the 1-piece, grooveless hub liners than grease and also flows better from the interior of the axle to the ends. Light class A lubricating oil is, therefore, to be used. It is inserted by pulling out the wheel oil valve of the hub cap, turning it until the opening is uppermost, and pouring about one-sixth pint of oil in each hub. With serviceable wheel dust guards and until the hub liner becomes badly worn this amount should be sufficient for 50 to 60 miles travel with full load.

(2) The axle bracket bushings and carrying spring bolts should be lubricated every day by placing a little class A oil in the oil cup in the top of each guide bolt and on the spring bolts reaching through the coils of the springs above the axle brackets.

(3) As oil is applied the various parts should be operated to thoroughly spread the lubricant.

g. Lubrication chart.—The following chart gives the location, lubricant, amount, frequency, and method of application for the various lubricating points of the 155-mm. howitzer, carriage, limber, and caisson when in active service:

OILING AND GREASING CHART

155-mm. howitzer, carriage, limber, and caisson, M1918

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
----------	-----	Quadrant sight	At bearing surfaces	Oil, neutral	Twice per week smear the oil well over the segment.
----------	-----	Breech threads and breech recess	Spread oil on threads	Oil, lub., cl. A	Twice per week or after firing.
----------	-----	Firing mechanism threads and firing pin.	do	do	Do.
----------	-----	Breechblock rack and rack lock	At contact surfaces	do	Do.
8A	22	Firing handle shaft	Bearing surfaces	do	Drops at each end of shaft.
----------	-----	Breechblock carrier pintle	At contact surfaces	do	Twice per week or after firing.
		Operating lever, and handle Firing mechanism block Firing mechanism block latch Firing mechanism safety plunger			
----------	-----	Breechblock carrier hinge bearing plate Regulating plate Percussion hammer operating shaft Percussion hammer lock bolt	do	do	Twice per week or as required to prevent rust
----------	-----	Obturator spindle spring Firing pin spring Firing mechanism safety plunger	Slush	Grease, graph., lub., medium.	In assembling.
18 19 20 21	22	Sleigh and cradle clips	Oilers	Oil, lub., cl. A	Twice per week, ¼ teaspoonful at each oiler. Note cradle clips are cleaned and slushed with lubricating graphite grease monthly or as required.
----------	-----	Axle	Exposed unpainted surfaces.	do	Spread the oil with the fingers.
1	22	Handspike fulcrum	Oil cups (2)	do	Drops, operate the unit weekly.

Oiling and greasing chart—Continued

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
1A	22	Handspike fulcrum	Bearing surfaces	Oil, lub., cl. A	Drops, operate the unit weekly.
1B	22	Handspike foot	Oil cup	do	Do.
2, 3	22	Cradle traveling locks	Oil holes with spring covers.	do	Do.
2A	22	do	Bearing surfaces	do	Do.
3A	22	Cradle traveling lock sleeves and plungers.	do	do	Do.
4, 5	22	Sleigh traveling locks	Oil cups	do	Do.
4A, 5A	22	Sleigh traveling lock sleeves and plungers.	Bearing surfaces	Oil, lub., cl. A	Drops, operate the unit weekly.
6, 7, 8	22	Firing safety shaft, right wall of cradle	Oil holes (3)	do	Do.
9, 10	22	Traversing intermediate shaft bearings	Oil holes	do	Do.
9A, 10A	22	Traversing screw bearings	Oil cups	do	Ten drops each, weekly.
11A, 12A	22	Traversing handwheel sleeves and spindles, right and left.	Bearing surfaces	do	Weekly, drops, operate the unit.
13	22	Traversing nut	Oiler in traversing screw housing.	do	Weekly. Teaspoonful. Have axle traveling lock engaged. Traversing screw slushed with cup grease in assembling.
13A	22	Axle traveling lock bearing	Contact surfaces	do	Weekly. Drops, operate the unit.
13B	22	Axle traveling lock lever sleeve	do	do	Do.
14, 15	22	Traversing roller boxes (axle housing bushing).	Oilers	do	Weekly. 10 drops. Rollers are slushed with cup grease in assembling.
16, 17	22	Trunnion caps	do	do	Drops, weekly.
22, 23	22	Brake shaft bearings	Oil holes with spring covers.	Oil, lub., cl. A	Drops, weekly. Operate the unit.
22B	22	Brake screw	Contact surfaces	Grease, graph., lub., medium.	Cover the surfaces weekly.

24, 25	22	Brake shoe heads	Oil holes with spring covers.	Oil, lub., cl. A	Drops, weekly. Swing the brake shoe heads.
26	22	Elevating pinion shaft bracket	Oil cup	do	Drops, weekly. Operate the unit.
27	22	Elevating worm wheel case inner hub	do	do	Drops, weekly. The worm and worm wheel are slushed with cup grease in assembling
28	22	Elevating worm shaft bracket bushing	Oil hole with spring cover	do	Drops, weekly. Operate the unit.
28A	22	Elevating handwheel knob plunger	Contact surfaces	do	Do.
29	22	Elevating worm shaft bushing upper	Oiler	do	One-half teaspoonful weekly. Force.
31A	22	Piston rod lock	Contact surfaces of lock, lock lever and crank of firing safety shaft.	do	Drops, weekly. Operate the unit. Have cradle horizontal.
11, 12	22	Traversing handwheel shafts right and left.	Oil holes (4) inside gear cases.	do	Monthly, or as required. Gear cases are packed with cup grease in assembling.
22A	22	Brake screw nut trunnions	At contact surfaces	Oil, lub., cl. A	Monthly or as required. Drops.
22C	22	Brake screw supporting bushing	At upper end of bushing	do	Monthly or as required. Drops, operate the unit.
30	22	Recoil stuffing box	Oil hole plug	Oil, castor	Monthly or as required. ¼ teaspoonful, force. Open cradle bottom cover to get at plug.
31	22	Counterrecoil stuffing box	Oil hole in front end of counterrecoil rod.	do	Monthly or as required. ¼ teaspoonful, force.
32, 33	22	Spade shaft bearings	Oil cups	Oil, lub., cl. A	Monthly or as required. Until oil oozes out.
34, 35	22	Spade latch shaft bearings	do	do	Do.
	-----	Axle spindles	Grease cavity	Grease, lub., cup, Nos. 3 and 5.	Monthly or as required. Fill the cavity in winter with No. 3 and in summer with No. 5.

Oiling and greasing chart—Continued

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
	-----	Elevating segment and pinion	Gear teeth and surfaces in contact with thrust bracket plates.	Grease, graph., lub., medium.	Monthly or as required. Slush all surfaces.
	-----	Lunette and fifth wheel	Contact surfaces	Grease, lub., cup, No. 3.	When limbering.
	-----	Panoramic sight case hinges and hasp pins and turnbuckle pin. Cradle front cover hinge and locking pins. Trail box cover hinge pin Loading barrow fastening pins Trunnion cap latch pins Trunnion cap hinge pins Lanyard pulley bolts Sight port shutter hinge and turnbuckle pin.	At contact surfaces	Oil, lub., cl. A	Monthly, or as required.

53. Paint.—For detailed information regarding the removal of old paint, cleaning and preparation for painting, preparing new paint, application and kinds of paints to different surfaces, brushes, slushing oils, abrasives, burlap, etc., see TR 1395–A.

54. Protection and cleaning of material affected by gas.—*a. Protection against phosgene, chlorine, etc.*—(1) For material which is in constant danger of gas attacks, whether from gas clouds or gas shells, care should be taken to keep all bright parts of the guns, carriages, mountings, and accessories well coated with oil.

(2) It must not be forgotten that practically all fabrics and materials such as wool, cotton, rubber, and oilcloth can be penetrated by mustard gas if sufficient time is given. The mustard gas is absorbed by these materials and penetrates them by a slow process of diffusion. In general, it may be said that the greater the length of time allowed for penetration the greater the danger in wearing these articles. For instance, rubber boots which have been worn in an area shelled heavily with mustard gas may be a grave danger to men who wear them several days after the bombardment. Fabrics thoroughly impregnated with boiled linseed oil will resist penetration by mustard gas for over an hour, but after this time these articles are dangerous because the mustard gas dissolves in the linseed oil and they must be destroyed.

(3) Sights and all instruments should also be covered with oil and protected with covers when not in actual use, care being taken that the oil does not come in contact with any glass or find its way into the interior of the instruments.

(4) All uncapped fuzes or fuzes which have been removed from their containers should be wiped over with oil as soon as possible and protected with a cover.

b. Cleaning.—All bright parts of guns and carriages, together with all accessories and spare parts exposed to the gas, must be cleaned and wiped dry as soon as possible after the attack, and in any case within 24 hours, after which they should be thoroughly coated afresh with oil. The same applies to the whole of the ammunition still in the battery position. Ammunition which for any reason has not been oiled must be cleaned and oiled. It is desirable to expend it as soon as possible.

c. Disinfection of material.—The following measures should be taken for the removal of mustard gas from various materials and equipment (guns, projectiles, cases, wood, metals, rope, etc.) which have come in contact with mustard gas. For all of the operations

indicated below the gas mask and protective clothing, including protective shoes and gloves, must be worn.

(1) Commence by freeing the objects of dirt, lumps of earth, and liquid with wooden spatulas, rags, etc., which will be buried immediately after this operation. They must never be burned.

(2) Sprinkle a continuous layer of calcium hypochlorite, which is preferred if available, or else dry chloride of lime over the parts that lend themselves to this treatment. In the statements hereafter calcium hypochlorite is specified but dry chloride of lime may be substituted in the event that calcium hypochlorite is not available. After two hours, or better after six hours if practicable, wash off the layer of calcium hypochlorite and rinse thoroughly. It is imperative that all the calcium hypochlorite be removed in order to prevent the deterioration resulting from the prolonged action of the calcium hypochlorite. In the case of ammunition it is imperative to prevent particles of calcium hypochlorite from being introduced into the bore of the piece.

(3) Whitewash soiled parts which do not lend themselves to sprinkling with dry powder with a thick paste of calcium hypochlorite made from three volumes of calcium hypochlorite and one volume of water. After two hours, or preferably six hours, wash off the calcium hypochlorite.

(4) The delicate parts of the apparatus, such as breech mechanism, sighting apparatus, glasses, etc., which would be injured by calcium hypochlorite should be cleaned by dry polishing with rags. After this operation the rags should be buried.

(5) If there are large quantities of water at hand, in place of calcium hypochlorite use water. The water should be warm, but not boiling, and large quantities should be used. This can not be done in the case of greasy articles, where only calcium hypochlorite should be used.

(6) When it is not necessary to immediately use contaminated material, or when one has not the above means at his disposal, it may be considered that the handling of the material or apparatus is not dangerous after six or eight days.

d. Transportation of matériel affected by gas.—The removal will be effected by automotive units whenever possible. If horse transport must be used, the route will be carefully reconnoitered in order to avoid infected ground. The matériel will be disinfected as thoroughly as possible before its removal.

SECTION VIII

ACCESSORIES

55. Accessories, general.—There are a number of accessories provided with this matériel, such as cold chisels; breech, cradle, muzzle, and sponge covers; bronze drifts; files and file handles; machinist hammers; copper hammers; pliers; steel punches and screw drivers, the names or general characteristics of which plainly indicate their use and application. Therefore, no detailed description nor method of use is outlined herein. The special accessories, however, being of a different nature, description, purpose, and method of use are outlined in paragraphs following.

56. Adapter, pressure gauge.—The pressure gauge adapter (see fig. 15) is composed of a bronze body designed to receive the parts that control and register the pressures of the counterrecoil

mechanism. The pressure gauge adapter is attached to the gauge cock body housed in the left air tank head by means of a pressure gauge adapter union. The pressure gauge adapter with the pressure gauge is for measuring the liquid or gas pressure or for drawing liquid or gas from the mechanism when expansion has become so great that it affects smooth operation of the counterrecoil mechanism.

57. Bag, flannel, hydrometer.—This bag is for the protection of the hydrometer.

58. Barrow, loading.—The loading barrow consists of a short concave metal tray. The tray is provided with two handles on either side. When the gun is to be loaded the shell is laid on the tray, the handles grasped by two men, the nose of the tray inserted into the breech of the howitzer, and the projectile rammed home by the loading rammer. When traveling the loading barrow is attached to the trail.

59. Bit, vent cleaning.—The vent cleaning bit is 18½ inches long with a loop for handling. The other end is fluted 4 inches in length. It is for the purpose of cleaning the obturator spindle vent.

60. Book, artillery gun.—The artillery gun book (O. O. Form 5825) is issued for the purpose of keeping an accurate record of the howitzer. It must always remain with the howitzer regardless of where the howitzer may be sent. The book is divided as follows: Record of assignments of the howitzer to the various batteries, battery commander's daily howitzer record, inspector's record of examination, and forms to be filled out in case of premature explosions.

61. Brush, slush, M1.—The slush brush, M1, is a round segment of wood partially covered on one end with carpet. The brush is used to coat the rifling of the howitzer with slushing oil.

62. Can, oil, 2-gallon.—Twelve rectangular oil cans 4 7/16 by 8 by 14.7 inches, capacity 2 gallons, are provided per firing battery. Six of these cans are for carrying spare glycerin, three for lubricating oil and three for gasoline. They are carried in compartments provided in the caissons. The cans will be painted distinctive colors and labeled according to contents. See Field Service Modification Work Order No. M3–W2.

63. Case, carrying, hydrometer.—This case is a cylinder of wood drilled to receive the hydrometer.

64. Chest, pump.—This chest is a substantial, metal-bound wooden chest 19 by 22 by 10¾ inches deep and is partitioned to receive the air and liquid pumps and accessories connected with the operation of the pumps, pressure gauges, and fittings for the compressed-gas cylinder, and certain wrenches are also carried in this

chest, as shown in Standard Nomenclature List No. C–3. The weight of the chest with contents is 144 pounds.

65. Cylinder, compressed gas, 2,000 pounds, M1.—The compressed-gas cylinder is 9 inches in diameter and 56 $\frac{7}{16}$ inches over all and is equipped with adapter valve and cap. It is charged with nitrogen at a pressure of 2,000 pounds per square inch and no more. The nitrogen is used in the counterrecoil system. Capacity of cylinder, 2,661 cubic inches. Approximate weight, 125 pounds. It is tested and marked in accordance with Interstate Commerce Commission regulations.

66. Funnel, with pipe.—The funnel is made of copper with a soldered screen of brass wire gauze, 34 mesh per inch. It is for the purpose of filling the recoil cylinder with liquid and should not be used for any other purpose. The funnel fits into the upper end of the funnel pipe, the lower end of which is inserted into the filling hole of the cylinder. The pipe is of copper and is bent in two places to a radius of 20 inches.

67. Gauge, pressure, 60-kg.—This gauge is calibrated from 0 to 60 kilograms per square centimeter and is screwed into the pressure gauge adapter and used to test the pressure in the counterrecoil system.

68. Gauge, pressure, 150-kg.—This gauge is calibrated from 0 to 150 kilograms per square centimeter. It is used to ascertain the pressure of nitrogen in the compressed gas cylinder. It is assembled to the cylinder by means of a swivel attached to the pressure gauge.

69. Gun, oil, ¼-pound, M1.—The oil gun is used to insert oil into bearings by force so that the lubricant may be sure of reaching the desired bearing points. The nose of the gun is intended to fit tightly in the tapered opening of the grease cup plugs (see F. S. M. W. O. No. C3–W8) so that none of the pressure generated in the gun is lost at the oil hole. The oil gun is of the plunger type, filled by plunging the nose in oil during the backstroke.

70. Hydrometer, 6-inch, 10° to 30°.—The hydrometer is a glass tube which is graduated in half degrees between 10° and 30° Baumé scale. Its purpose is for testing the density of liquid in the recoil mechanism.

71. Mat, wheel, 750 by 1,500 mm. (30 by 60 inches).—The wheel mat is of woven rattan and is reinforced with steel end plates and wire. The mats are used under the wheels of the carriage when maneuvering on soft or swampy ground.

72. Measure, 1 liter (graduated in half deciliters).—This measure is cylindrical and is graduated in half deciliters. It is made of galvanized iron. Its purpose is to measure the liquid when filling the recoil mechanism.

73. Opener, container.—The container opener (1), Figure 23, is a hook-shaped tool made of steel. It is used for opening the gas check pad zinc containers to prevent cutting the pads.

74. Paper, litmus (vial).—This paper is for testing the acidity of the liquid of the recoil mechanism (for added information see TR 1395–A).

75. Pipe, filling.—The filling pipe consists of a copper tube of small diameter, to each end of which are brazed brass couplings. A check valve is provided in one coupling which is attached to the filling valve body on the sleigh by means of a long swivel. The filling pipe is designed for a working pressure of 2,000 pounds per square inch, but care must be taken not to put sharp bends in it as this may cause it to leak. The connections at the ends should never be removed from the pipe; however, the nipple may be unscrewed from the short swivel nut to permit inspection of the check valve. The coupling marked "sleigh" is assembled to the filling valve body and the coupling marked "reservoir" is attached to either of the pumps or to the compressed gas cylinder.

76. Pump, air.—The air pump is for maintaining the necessary pressure in the counterrecoil system when the need is urgent and nitrogen under pressure is not available. The pump will operate against a pressure of 600 pounds per square inch. Power is applied by means of a hand lever connected by parallel links and a link pin to the upper end of the piston operating through a gland in the top of the cylinder. The piston is fitted with a special packing at its lower end and operates in a cylinder larger in diameter than the body of the piston. The action of the pump is as follows: As the piston moves up, air is drawn through the intake valve filling the space below the piston. As the piston moves down the intake valve closes and the air is forced through the piston valve into the space around the piston and above the shoulder. This constitutes the first stage of compression. On the up stroke of the piston the air is forced out through the check valve into the counterrecoil system, constituting the second stage of compression. At the same time more air is taken through the intake valve. The filling pipe connection should be covered with the connection cap provided when the pump is not in use. The pump should be kept free from dust and grit and all parts should be well oiled. Loss of compression

may be caused by small particles of dust on the valve seat preventing the valve from closing. When operating the air pump for a long period a few drops of oil should be squirted in from time to time through the intake valve by turning the pump upside down. If the pump becomes too hot it will undoubtedly burn the piston packing and score the cylinder.

77. Pump, liquid.—The liquid pump is furnished for the purpose of replenishing losses of liquid from the counterrecoil system. It is mounted on the same bracket as is used for the air pump and is operated in the same manner. On the downward stroke of the piston, liquid is drawn into the cylinder through a check valve from a reservoir containing a fine mesh screen located on the top of the pump. On the up stroke it is discharged through a check valve through the filling pipe thence to the counterrecoil cylinders. On the suction stroke the check valve closes by action of the valve spring and the pressure of the counterrecoil system. Thus it is a single-acting force pump and will operate against a pressure of 600 pounds per square inch. The pump should at all times be kept free from dust and grit and all parts well oiled. Loss of compression may be caused by small particles of dust on the valve seats preventing the valve from closing.

78. Rammer, loading.—The loading rammer is a short staff of ash fitted with a bronze head and a tubular crossbar handle. It is used to ram the projectile into its seat in loading. Another rammer head is supplied to be screwed on the sponge staff and used for removing a projectile from the bore when for any reason it is desired not to fire the howitzer. Since this rammer head must engage the fuzed end of the projectile, it is chambered out to clear the fuze. Nevertheless it is advisable to use care and start the projectile by gentle pressure, or light taps, from its seat.

79. Reamer, primer seat cleaning (bronze).—This is composed of the reamer attached and pinned to a wooden handle. It is 7 inches over all. The reamer is fluted and is for the purpose of removing powder fouling from the primer seat. Being made of bronze it does not remove any metal.

80. Roll, spare-parts.—The spare-parts roll is for the purpose of carrying certain small delicate parts to protect them against damage. It is 16¼ by 21½ inches when open. It is made of cotton duck and has 10 pockets numbered.

81. Roll, tool, M1915.—The tool roll carries tools as listed in Standard Nomenclature List No. C–3. It is 25½ by 46 inches when open. It is made of cotton duck and has 17 pockets numbered.

82. Rope, drag.—The drag rope is a ¾-inch manila rope approximately 117 inches long with a hook and thimble spliced at one end. A sliding leather sleeve is provided to protect the rope from chafing on sharp edges of the wheels or trail. The other end of the rope is stitched to a cotton webbing loop, enabling man power to be used when required.

83. Sights, bore.—The bore sights consist of a breech bore sight and a muzzle bore sight. They are steel disks and fit into the rear end of the powder chamber and muzzle of the howitzer, respectively. The breech bore sight has four holes for use in inserting and withdrawing it and a very small hole in the center for sighting. The muzzle bore sight has two cut-out portions, one at the bottom D-shaped and one at the top fan-shaped. There are vertical and horizontal grooves cut into the muzzle face of the M1918 howitzer for the purpose of holding strings when using same for bore sighting.

84. Target, testing.—The testing target is used in the verification and adjustment of the sights.

85. Wrenches.—*a. Filling needle valve.*—This wrench (2), Figure 23, is used to open and close the filling needle valve assembled in the filling valve body (148M), Figure 13.

b. Filling valve cap.—This wrench (3), Figure 23, is used to remove the cap from the filling valve body (148M), Figure 13.

c. Filling pipe swivel nut and filling needle valve follower.—This wrench (4), Figure 23, is for disassembly and assembly of the connection caps of the pumps, on some of the hexagons of the filling pipe, and in repacking the filling needle valve. It is also used on the gauge cock valve.

d. Filling plug.—This wrench (5), Figure 23, is for disassembly and assembly of the filling plugs in the recoil cylinder rear head.

e. Gauge cock and filling pipe coupling.—This wrench (7), Figure 23, is used for the assembly of the filling pipe coupling to the sleigh and to adjust the gauge cock body when tests are being made of the liquid and nitrogen pressure of the counterrecoil system.

f. Obturator spindle.—This wrench (9), Figure 23, is used in disassembling and assembling the obturator spindle.

g. Percussion hammer operating shaft nut and operating lever handle nut.—This wrench (10), Figure 23, is used in disassembling and assembling the percussion hammer operating shaft nut and the operating lever handle nut.

h. Piston rod nut.—This wrench (12), Figure 23, is for disassembling and assembling the piston rod nuts and the counterrecoil cylinder head.

i. Wrench, fuze, M1.—This wrench (11), Figure 23, is used for tightening the fuze in the projectile before firing.

j. Safety set screw.—This wrench (18), Figure 23, is used on the hollow safety set screws in the firing mechanism.

k. Firing mechanism.—This wrench (6), Figure 23, is a face spanner with offset screw driver end and is used in disassembling and assembling the firing mechanism.

SECTION IX

DATA

86. Weights, dimensions, and ballistics of 155-mm. howitzer, M1918.

Length of barrel (breech face to muzzle face)	91.8108 inches.
Length of bore in calibers	13.64.
Weight of projectile	95 pounds.
Weight of charge	7.70 pounds.
Travel of projectile	69.8817 inches.
Volume of chamber	425 cubic inches.
Density of loading	.501.
Maximum pressure	26,500 pounds per square inch.
Muzzle velocity and muzzle energy at given elevations for different types of ammunition will be found in firing tables.	
Weight of howitzer	2,740 pounds.
Rifling, uniform right-hand twist, one turn in 25.586 calibers, number of grooves	48.

87. General data pertaining to the carriage.

Weight of sleigh and recoil mechanism complete	863 pounds.
Weight of cradle with elevating segments and attached parts	753 pounds.
Weight of trail with elevating, traversing, and wheel-brake mechanisms, and axle traveling lock	1,914 pounds.
Weight of axle and wheel fastenings	258 pounds.
Weight of movable spade	230 pounds.
Weight of armor	236 pounds.
Weight of two 1,350 mm. (about 53 inches) by 150 mm. (5.9 inches) rubber-tired wheels	1,078 pounds.
Weight of quadrant sight	48 pounds.
Total weight, howitzer and carriage, completely equipped, firing position	8,262 pounds.
Weight of accessories carried on carriage and limber (traveling position)	252 pounds.

Reaction under each wheel, firing position, 0° elevation	3,773 pounds.
Reaction under spade, firing position, 0° elevation	716 pounds.
Reaction under each carriage wheel, carriage limbered and completely equipped. (NOTE.—Wheel mats and canvas covers are added to firing-position weights)	3,241 pounds.
Reaction under each limber wheel. (NOTE.—Wheel mats and canvas covers are added to firing-position weights)	1,530 pounds.
Reaction under lunette of limber drawbar	54 pounds.
Total weight, material in traveling position, complete	9,596 pounds.
Height above ground of center line of howitzer at 0° elevation, 1,443 mm	56.81 inches.
Height above ground of cradle trunnions, 1,378 mm	54.25 inches.
Height above ground of line of panoramic sight, 1,632.4 mm	64.267 inches.
Sight extension raises sight, 355.6 mm	14 inches.
Height above ground, highest point, top of shield, 1,965 mm	77.36 inches.
Range of elevation from 0° to 42° 20′.	
Traverse to right or left	52.5 mils.

SECTION X

SUBCALIBER EQUIPMENT

88. General.—*a.* The purpose of the subcaliber equipment is to provide for a greater amount of target practice than could be obtained by the use of the regular 155-mm. ammunition. Save for the firing of other than regular ammunition, the handling and loading of which differs, as well as the range, the training is with the 155-mm. howitzer matériel.

b. Subcaliber firing is accomplished by the use of the 37-mm. gun, M1916, and recoil mechanism, mounted on the top of the 155-mm. howitzer by means of a specially constructed mount, designated as mount, subcaliber, 37-mm., M4.

89. Description and operation of the mount.—*a.* The 37-mm. subcaliber mount is composed of a bracket (C8698), Figure 24, to

which is bolted bracket (B19138). The trunnion bearing of bracket (C8698) and bracket (B19138) are provided with cap screws and jam nuts which retain the tank cradle in position and provide a means of adjustment for deflection. The front end of bracket (C8698) is equipped with three 3/8-inch cap screws and jam nuts, their purpose being that of retaining and providing a means of adjusting the 37-mm. subcaliber gun when bore sighting on a testing target.

b. Two brackets (B19608 and B19609) with clamps (B19610 and B19611) and two braces (B19607) provide a seat for bracket (C8698) on the muzzle end of the 155-mm. howitzer and is retained in position by bolts (A21718).

90. Assembly and disassembly.—*a.* Mount bracket (B19609) directly in rear of the muzzle bell, set bracket (B19608) approximately 21 1/8 inches in rear of bracket (B19609). Assemble braces (B19607), one on each side of the howitzer, with the cut-out part embracing the muzzle bell and the braces resting on the flange of brackets (B19608 and B19609). Place the clamp (B19611) around the howitzer from underneath and up through the holes in bracket (B19609) and brace (B19607) and secure it with lock washers and the 5/8-inch–11–NC nuts. Assemble clamp (B19610) in the same manner. Place the 37-mm. subcaliber mount on the seat provided by brackets (B19608 and B19609) and assemble bolt (A21718) to retain it in a rigid position.

b. Remove bracket (B19138) from bracket (C8698) by removing the three bolts retaining it in position. Lift the 37-mm. gun and recoil mechanism on top of the howitzer and insert the front end of the recoil cylinder through the band on the front end of bracket (C8698), placing the trunnion of the recoil mechanism in the trunnion bearing of bracket (C8698). Assemble bracket (B19138) over the recoil mechanism trunnion and bolt in place. Tighten the cap screws in the trunnion bearing and those at the front end of bracket (C8698) just sufficient to retain the 37-mm. gun in position.

91. Bore sighting.—*a.* As the subcaliber gun is to be laid with the regular sighting and maneuvering mechanism of the 155-mm. howitzer, the bores of the howitzer and 37-mm. subcaliber gun should be parallel. To secure the proper alignment when the 155-mm. howitzer carriage is in firing position bore sights are set in the subcaliber gun.

b. Verification of the sights having been accomplished as described in paragraph 42, the following procedure should be observed in bore sighting the 37-mm. subcaliber gun:

(1) Make a testing target by wrapping two pieces of black tape of equal width around the aiming post with the lower edges exactly $8\frac{9}{32}$ inches apart. By the use of the aiming post as a testing target it will not be necessary to level the 155-mm. howitzer, as the aiming post can be canted to conform to the angle of the howitzer so that the vertical line of the bore of the 155-mm. howitzer will coincide with the side of the aiming post. Place the testing target some distance from the howitzer.

(2) Use the bore sights to line up the bore of the 155-mm. howitzer with the lower edge of the lower tape on the aiming post.

(3) Use the bore sights for the 37-mm. subcaliber gun and bore sight it on the testing target. The bore of this gun should be lined up with the lower edge of the upper tape on the aiming post.

(4) The adjustment of the 37-mm. subcaliber gun upon the testing target is made by the three cap screws in the front of bracket (C8698), Figure 24. When tightening these cap screws great care must be taken not to place a strain upon the recoil cylinder as it will become distorted and may not function properly.

(5) In order that the initial assembly of the 37-mm. subcaliber mount on the 155-mm. howitzer may serve as a guide in proper alignment for all future mountings of the same nature, the following should be carefully noted and executed:

When the bore sighting of the 155-mm. howitzer and the 37-mm. subcaliber gun is completed, assembly or witness lines must be placed upon brackets (B19608 and B19609), and upon the barrel of the 155-mm. howitzer. These lines are to be scribed sufficiently heavy in order that they may be easily located and lined up in future mountings.

92. Counterbalancing the 155-mm. howitzer.—With the 37-mm. subcaliber gun, recoil mechanism and subcaliber mount in place, the increased force required to elevate the 155-mm. howitzer without counterbalance is negligible.

93. Operation.—The normal position for operating the subcaliber equipment is from the right side.

94. Safety precautions.—No safety precautions out of the ordinary are necessary when firing. The only need for precaution is on the first round when the gunner is compelled to reach across the

gun to cock the firing mechanism. Subsequent firing automatically cocks it.

95. Care and preservation.—Repairs to this mount will be minor in nature, and will involve only the removal of burrs when necessary and the replacement of nuts and cap screws. When the subcaliber mount is dismounted from the 155-mm. howitzer all parts should be assembled in their proper places.

96. Accessories and spare parts.—Accessories and spare parts for the subcaliber equipment are shown in Standard Nomenclature List No. C–3.

[A. G. 062.12 (5–2–31).]

BY ORDER OF THE SECRETARY OF WAR:

GEO. VAN HORN MOSELEY,
Major General.
Acting Chief of Staff.

OFFICIAL:

C. H. BRIDGES,
Major General,
The Adjutant General.

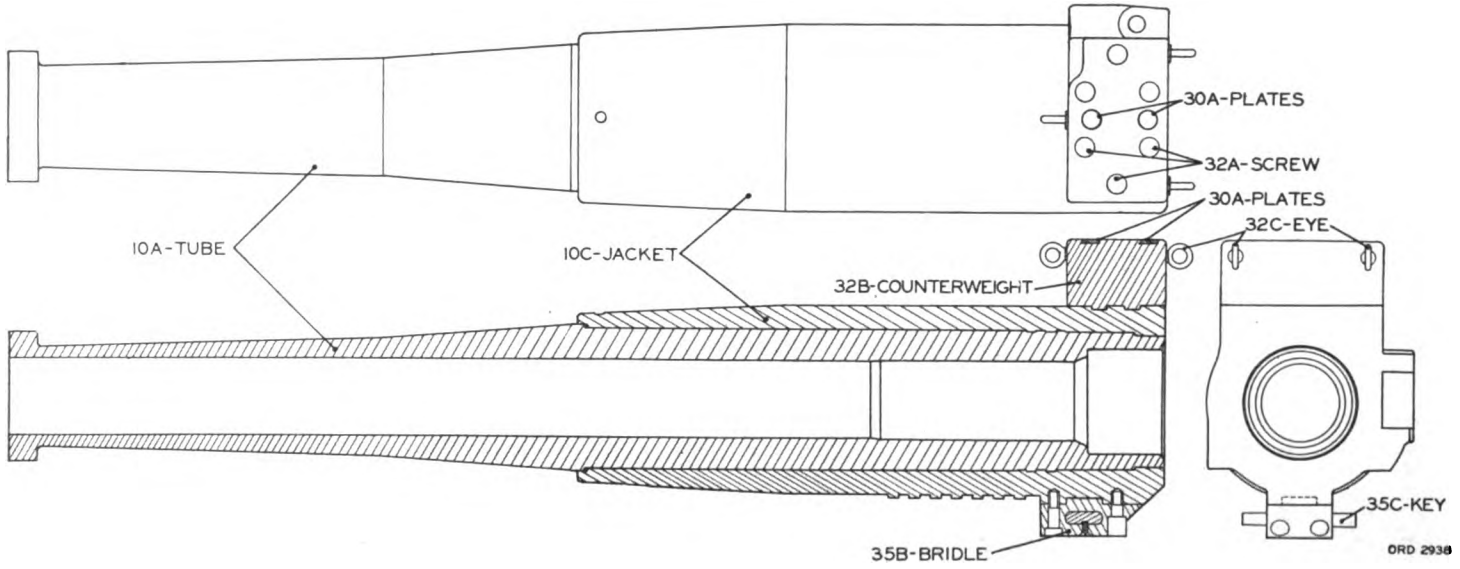

FIGURE 1.—155-m. howitzer, M1918—sectioned view

FIGURE 1.—155-mm. howitzer, M1918—sectioned view

Reference	Item	Reference	Item
35B	Bridle, howitzer.	35C	Key, breech.
32B	Counterweight.	30A	Plate, leveling.
32C	Eye, lifting.	32A	Screw, counterweight (long).
10C	Jacket.	10A	Tube.

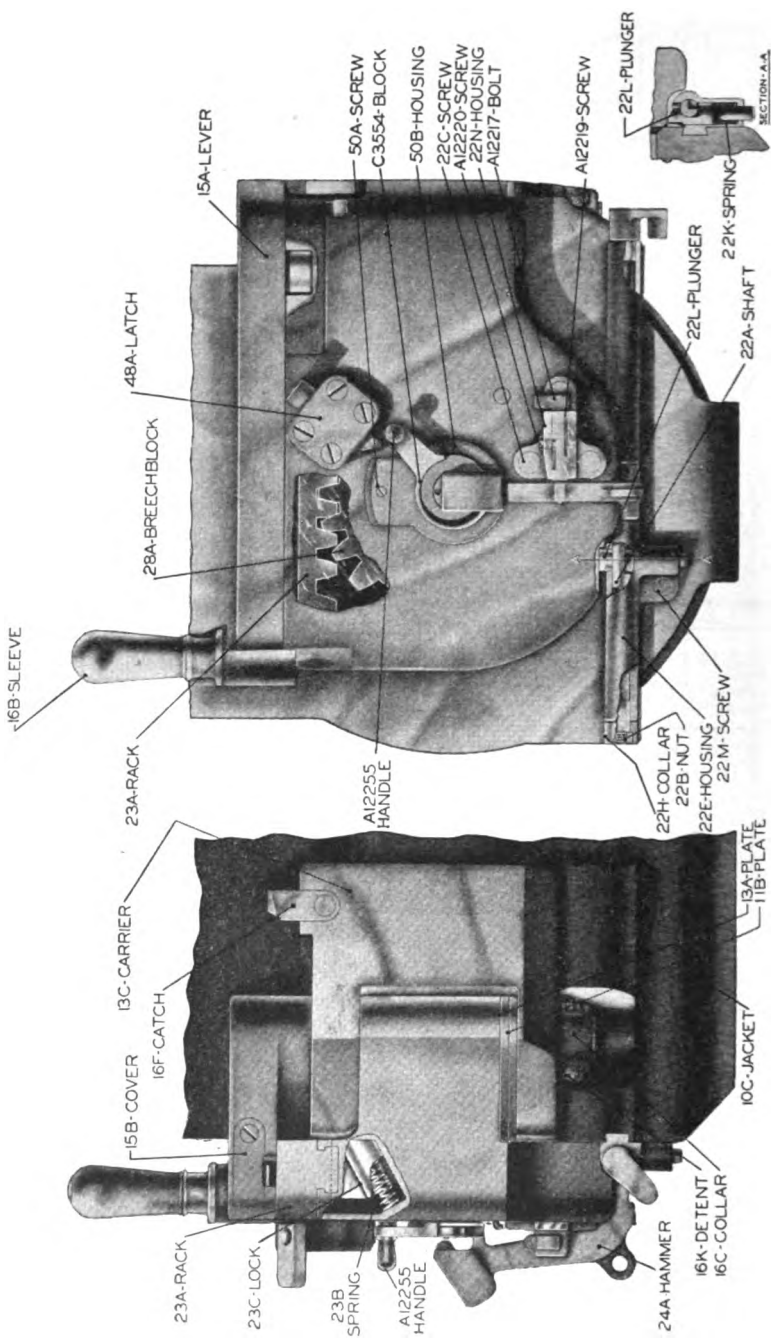

FIGURE 2.—Breech mechanism—assembled views

FIGURE 2.—Breech mechanism—assembled views

Reference	Item	Reference	Item
C3554	Block, firing mechanism.	23C	Lock, breechblock rack.
A12217	Bolt, percussion hammer lock.	22B	Nut, percussion hammer operating shaft.
28A	Breechblock.	13A	Plate, breechblock carrier hinge bearing.
13C	Carrier, breechblock.	11B	Plate, regulating.
16F	Catch, operating lever.	22L	Plunger, percussion hammer shaft.
16C	Collar, operating lever.	23A	Rack, breechblock.
22H	Collar, percussion hammer operating shaft.	50A	Screw, firing mechanism housing.
15B	Cover, operating lever latch slot.	A12219	Screw, percussion hammer lock bolt spring.
16K	Detent, operating lever collar.	A12220	Screw, percussion hammer lock bolt stop.
24A	Hammer, percussion.	22C	Screw, percussion hammer lock housing.
A12255	Handle, firing mechanism block.	22M	Screw, percussion hammer operating shaft housing control.
50B	Housing, firing mechanism.	22A	Shaft, percussion hammer operating.
22N	Housing, percussion hammer lock.	16B	Sleeve, operating lever handle.
22E	Housing, percussion hammer operating shaft.	23B	Spring, breechblock rack lock.
10C	Jacket.	22K	Spring, percussion hammer shaft plunger.
48A	Latch, firing mechanism block.		
15A	Lever, operating.		

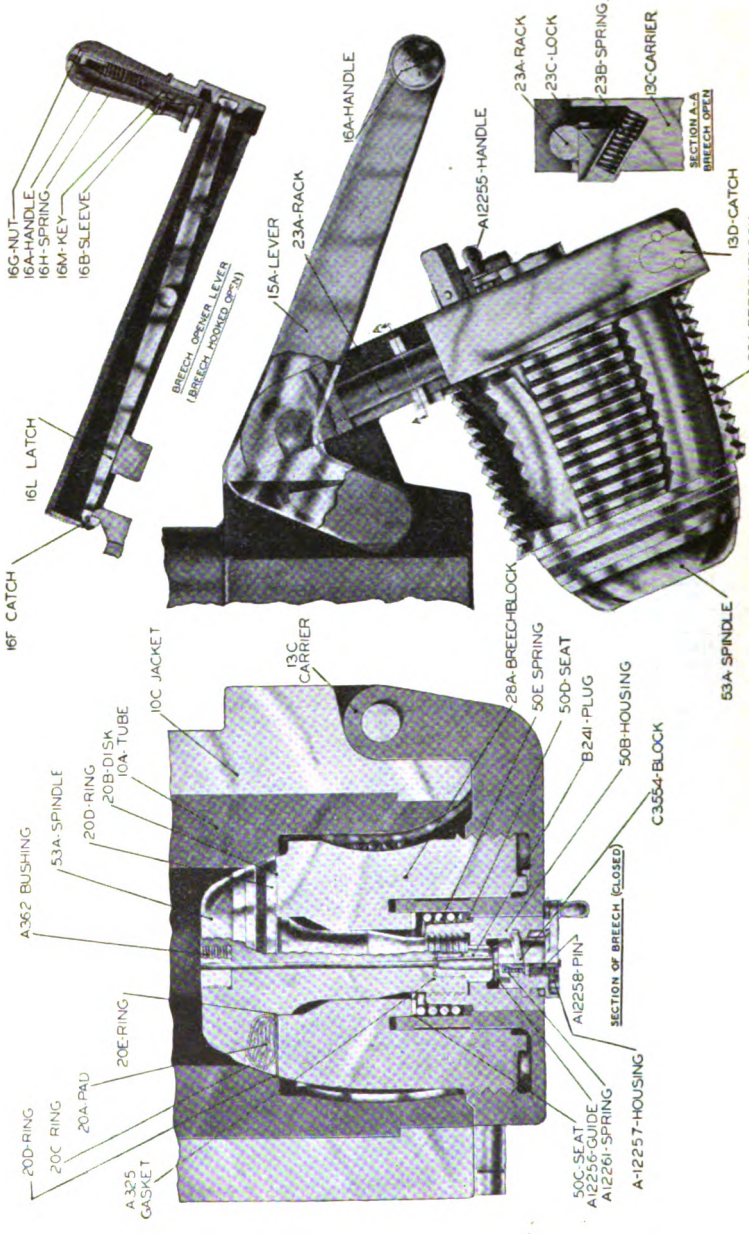

FIGURE 3.—Breech mechanism—sectioned views

FIGURE 3.—Breech mechanism—sectioned views

Reference	Item	Reference	Item
C3554	Block, firing mechanism.	16G	Nut, operating lever handle.
28A	Breechblock.	20A	Pad, gas check.
A362	Bushing, obturator spindle vent.	A12258	Pin, firing.
13C	Carrier, breechblock.	B241	Plug, obturator spindle.
13D	Catch, breechblock carrier lever.	23A	Rack, breechblock.
16F	Catch, operating lever.	20E	Ring, inner (obturator).
20B	Disk, filling-in (obturator).	20C	Ring, split, front (obturator).
A325	Gasket, obturator spindle plug.	20D	Ring, split, rear (obturator).
A12256	Guide, firing pin.	50C	Seat, obturator spindle spring, front.
A12255	Handle, firing mechanism block.	50D	Seat, obturator spindle spring, rear.
16A	Handle, operating lever.	16B	Sleeve, operating lever handle.
70B	Housing, firing mechanism.	53A	Spindle, obturator.
A12267	Housing, firing pin.	23B	Spring, breechblock rack lock.
10C	Jacket.	A12261	Spring, firing pin.
16M	Key, operating lever handle.	50E	Spring, obturator spindle.
16L	Latch, operating lever.	16H	Spring, operating lever handle.
15A	Lever, operating.	10A	Tube.
23C	Lock, breechblock rack.		

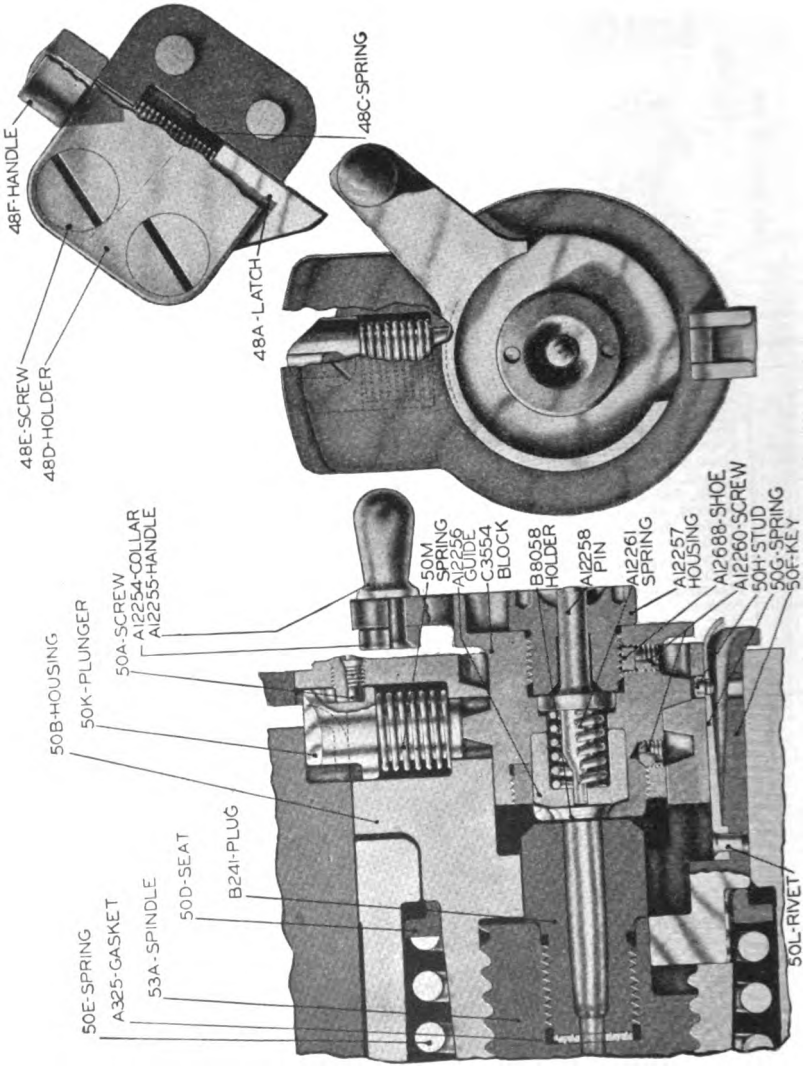

Figure 4.—Firing mechanism, M1918—sectioned views

FIGURE 4.—Firing mechanism, M1918—sectioned views

Reference	Item	Reference	Item
C3554	Block, firing mechanism.	48E	Screw, firing mechanism block latch holder.
A12254	Collar, firing mechanism block handle.	50A	Screw, firing mechanism housing.
A325	Gasket, obturator spindle plug.	A12260	Screw, safety set.
A12256	Guide, firing pin.	50D	Seat, obturator spindle spring, rear.
A12255	Handle, firing mechanism block.	A12688	Shoe, firing mechanism.
48F	Handle, firing mechanism block latch.	53A	Spindle, obturator.
48D	Holder, firing mechanism block latch.	48C	Spring, firing mechanism block latch.
B8058	Holder, primer.	50G	Spring, firing mechanism housing key.
50B	Housing, firing mechanism.	50M	Spring, firing mechanism safety plunger.
A12257	Housing, firing pin.	A12261	Spring, firing pin.
50F	Key, firing mechanism housing.	50E	Spring, obturator spindle.
48A	Latch, firing mechanism block.	50H	Stud, firing mechanism housing key spring.
A12258	Pin, firing.		
B241	Plug, obturator spindle.		
50K	Plunger, firing mechanism safety.		
50L	Rivet, firing mechanism housing key spring.		

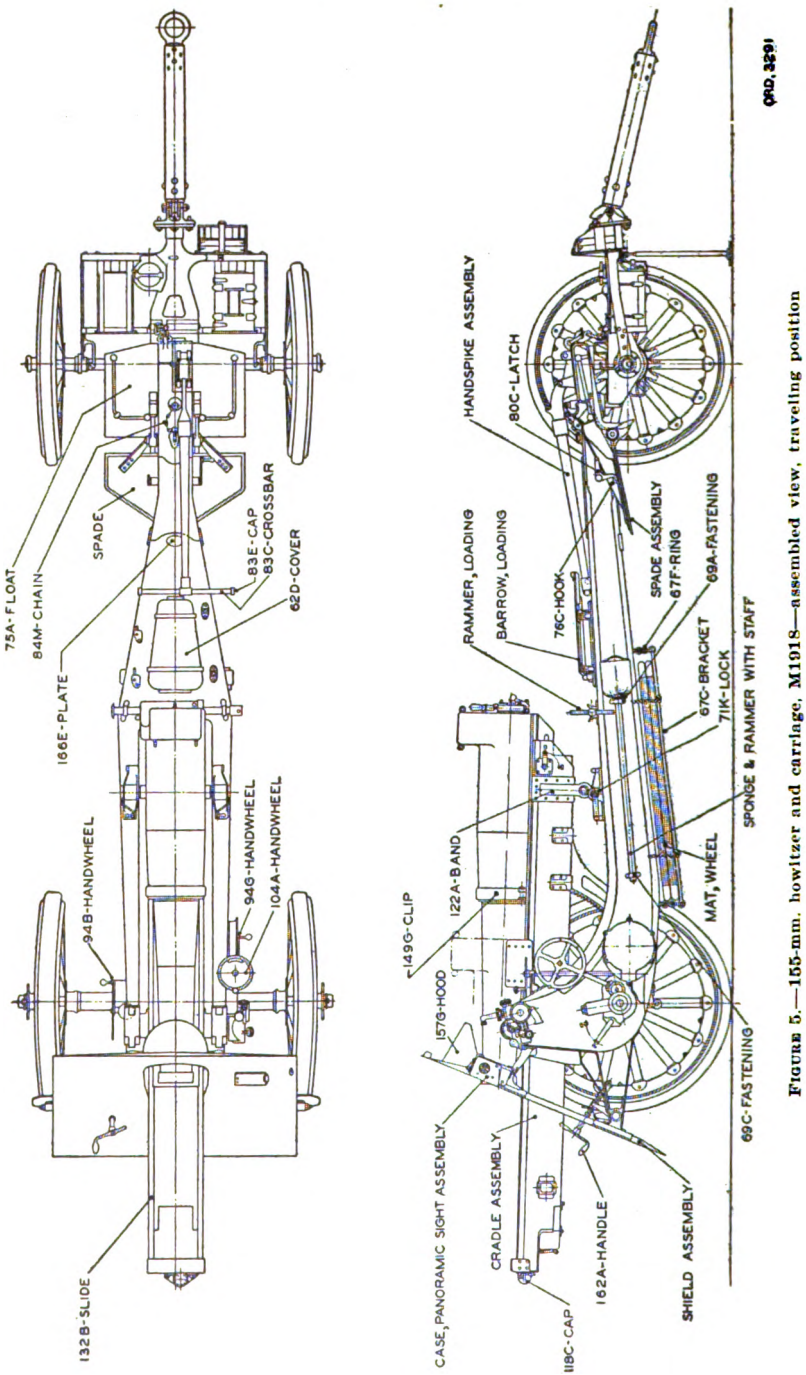

FIGURE 5.—155-mm. howitzer and carriage, M1918—assembled view, traveling position

FIGURE 5.—155-mm. howitzer and carriage, M1918—assembled view, traveling position

Reference	Item	Reference	Item
122A	Band, cradle, rear.	104A	Handwheel, elevating.
	Barrow, loading.	94G	Handwheel, traversing, left.
67C	Bracket, wheel mat.	94B	Handwheel, traversing, right.
118C	Cap, cradle head.	157G	Hood, shield.
83E	Cap, handspike crossbar.	76C	Hook, spade traveling.
	Case, panoramic sight, assembly.	80C	Latch, spade, left.
84M	Chain, lunette.	71K	Lock, cradle traveling, left.
149G	Clip, front, band, left.		Mat, wheel, 750 by 1,500 mm. (approximately 30 by 60 inches.)
62D	Cover, trail box.		
	Cradle, assembly.	166E	Plate, name, carriage.
83C	Crossbar, handspike.		Rammer, loading.
69C	Fastening, sponge staff, front.	67F	Ring, wheel mat bracket.
69A	Fastening, sponge staff, rear.		Shield, assembly.
75A	Float.	132B	Slide, sleigh, front, right.
162A	Handle, brake.		Spade, assembly.
	Handspike, assembly.		Sponge and rammer, with staff.

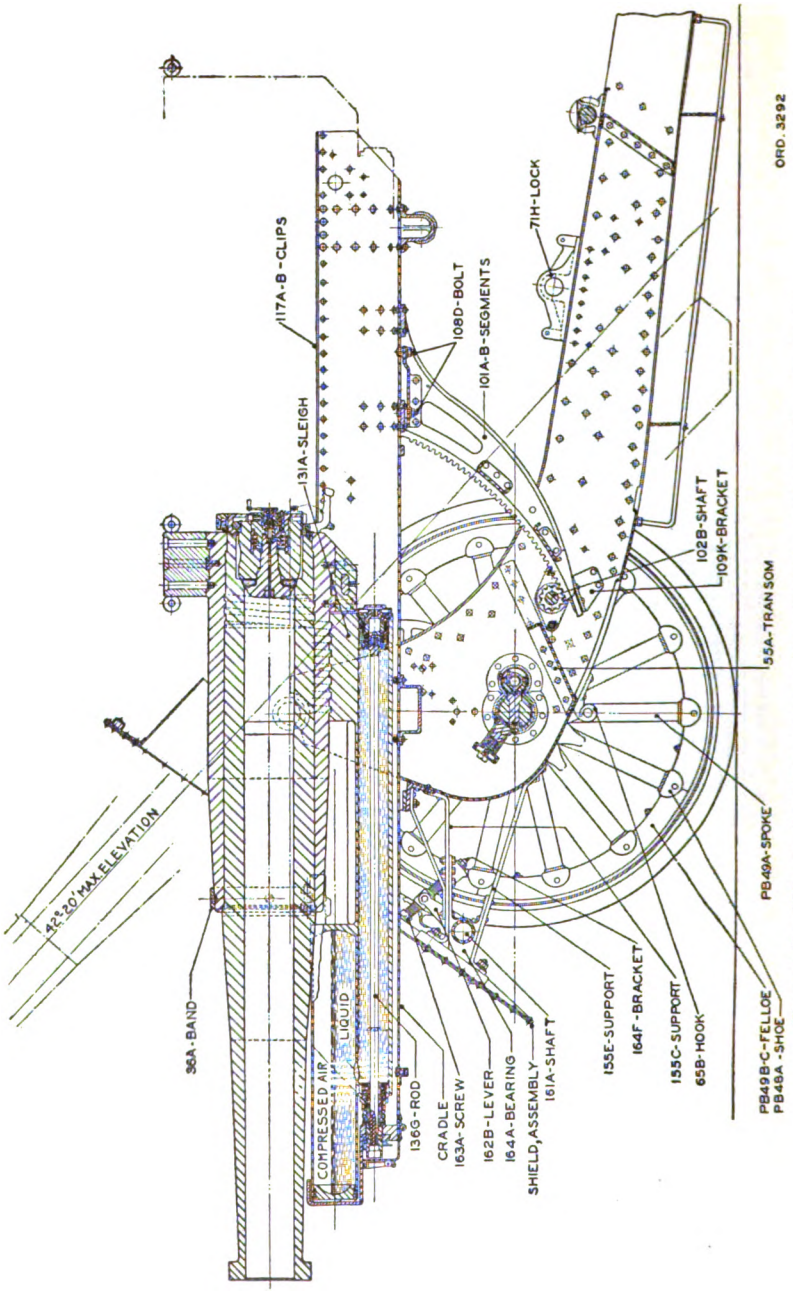

FIGURE 6.—155-mm. howitzer and carriage, M1918—sectioned view, in battery

FIGURE 6.—155-mm. howitzer and carriage, M1918—sectioned view, in battery

Reference	Item	Reference	Item
36A	Band, holding down.	136G	Rod, counterrecoil.
164A	Bearing, brake shaft, right.	163A	Screw, brake.
108D	Bolt, elevating segment transom.	101A & B	Segments, elevating.
164F	Bracket, brake screw.	161A	Shaft, brake.
109K	Bracket, elevating segment thrust, lower right.	102B	Shaft, elevating pinion.
117B	Clip, cradle, left.		Shield, assembly.
117A	Clip, cradle, right.	PB48A	Shoe, spoke.
	Cradle.	131A	Sleigh.
PB49B	Felloe, long.	PB49A	Spoke.
PB49C	Felloe, short.	155E	Support, brake shaft bearing, lower, right.
65B	Hook, draft, right.	155C	Support, brake shaft bearing, upper, right.
162B	Lever, brake shaft.	55A	Transom, trail, front.
71H	Lock, cradle traveling, right.		

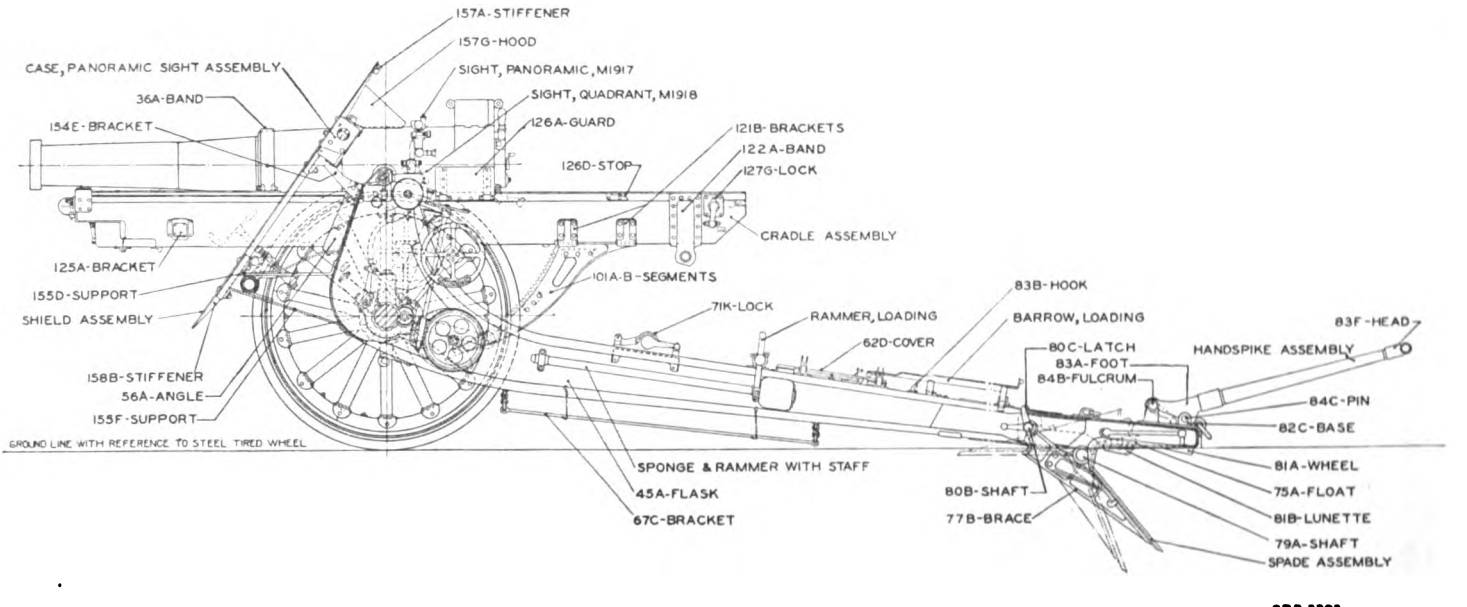

FIGURE 7.—155-mm. howitzer and carriage, M1918—left side elevation, in battery

FIGURE 7.—155-mm. howitzer and carriage, M1918—left side elevation, in battery

Reference	Item	Reference	Item
56A	Angle, trail, front.	80C	Latch, spade, left.
122A	Band, cradle, rear.	71K	Lock, cradle traveling, left.
36A	Band, holding down.	127G	Lock, sleigh traveling, left.
	Barrow, loading.	81B	Lunette.
82C	Base, handspike.	84C	Pin, handspike.
77B	Brace, spade, left.		Rammer, loading.
121B	Bracket, elevating segment, front.	101B	Segment, elevating, left.
125A	Bracket, pump.	101A	Segment, elevating, right.
154E	Bracket, shield, left.	79A	Shaft, spade.
67C	Bracket, wheel mat.	80B	Shaft, spade latch.
	Case, panoramic sight, assembly.		Shield, assembly.
62D	Cover, trail box.		Sight, panoramic, M1917.
	Cradle, assembly.		Sight, quadrant, M1918.
45A	Flask, trail, left.		Spade, assembly.
75A	Float.		Sponge and rammer, with staff.
83A	Foot, handspike.	158B	Stiffener, shield, left.
84B	Fulcrum, handspike.	157A	Stiffener, shield, upper.
126A	Guard, shoulder.	126D	Stop, loading barrow, left.
	Handspike, assembly.	155F	Support, brake shaft bearing, lower, left.
83F	Head, handspike.	155D	Support, brake shaft bearing, upper, left.
83B	Hook, handspike.	81A	Wheel, fifth.
157G	Hood, shield.		

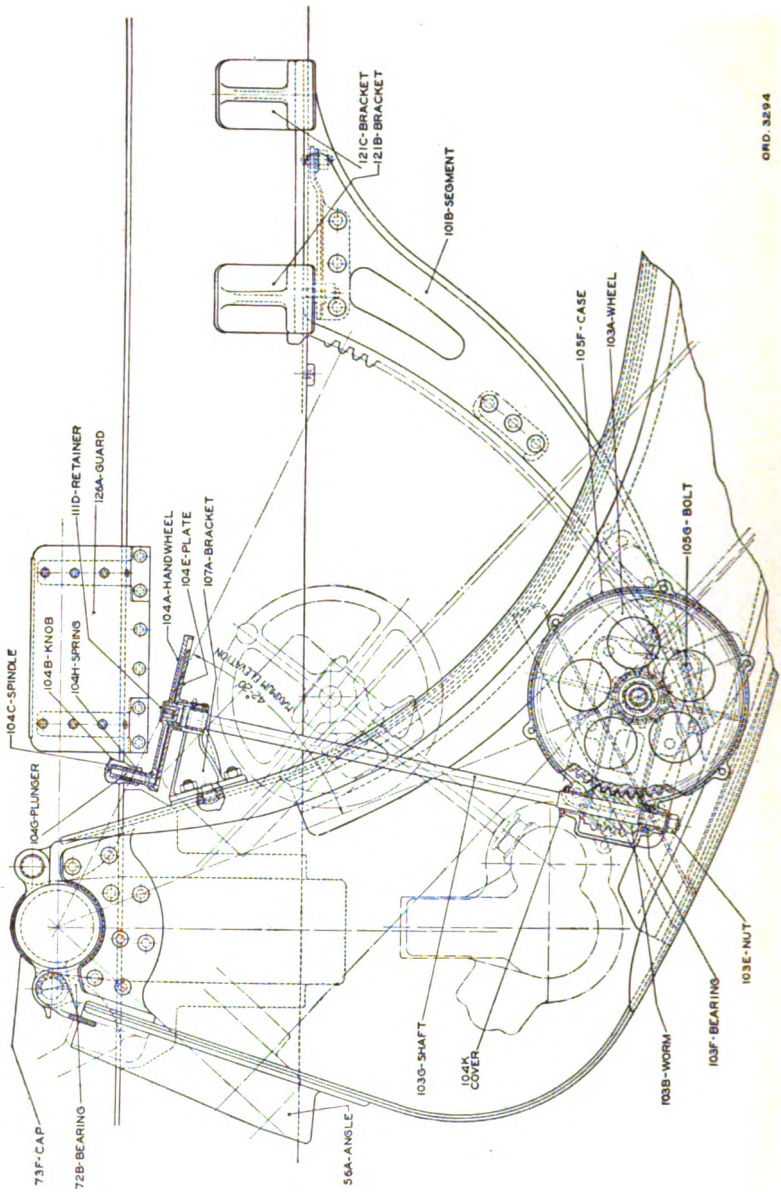

FIGURE 8.—Elevating mechanism—sectioned view

FIGURE 8.—Elevating mechanism—sectioned view

Reference	Item	Reference	Item
56A	Angle, trail, front.	104B	Knob, elevating handwheel.
103F	Bearing, thrust, elevating worm shaft ball.	103E	Nut, elevating worm shaft.
72B	Bearing, trunnion, left.	104E	Plate, elevating handwheel latch.
105G	Bolt, elevating worm wheel case.	104G	Plunger, elevating handwheel knob.
121B	Bracket, elevating segment, front.	111D	Retainer, handwheel.
121C	Bracket, elevating segment, rear.	101B	Segment, elevating, left.
107A	Bracket, elevating worm shaft.	103G	Shaft, elevating worm.
73F	Cap, trunnion.	104C	Spindle, elevating handwheel.
105F	Case, elevating worm wheel.	104H	Spring, elevating handwheel knob plunger.
104K	Cover, elevating worm shaft dust.	103A	Wheel, worm, elevating.
126A	Guard, shoulder.	103B	Worm, elevating.
104A	Handwheel, elevating.		

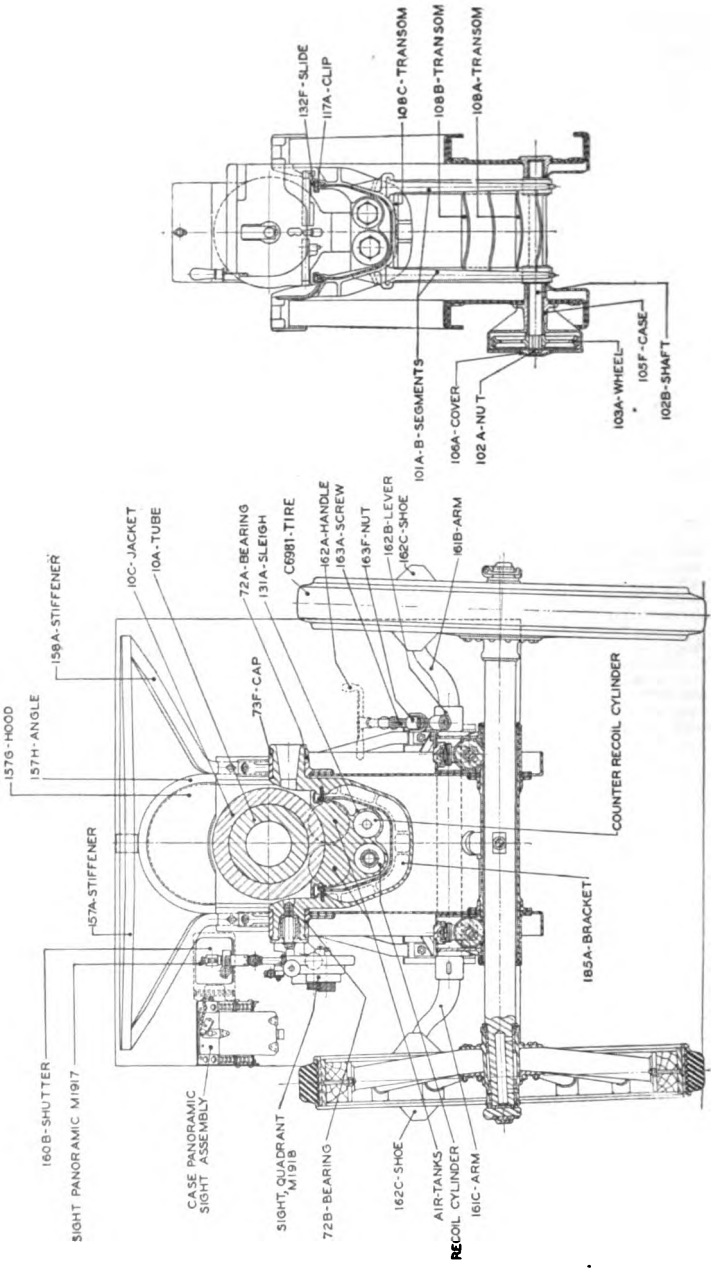

FIGURE 9.—155-mm. howitzer and carriage, M1918—transverse section

FIGURE 9.—155-mm. howitzer and carriage, M1918—transverse section

Reference	Item	Reference	Item
157H	Angle, shield hood.	163A	Screw, brake.
161C	Arm, brake shaft, left.	101B & A	Segment, elevating, left and right.
161B	Arm, brake shaft, right.	102B	Shaft, elevating pinion.
72B	Bearing, trunnion, left.	162C	Shoe, brake.
72A	Bearing, trunnion, right.	160B	Shutter, sight port.
185A	Bracket, trunnion.		Sight, panoramic, M1917.
73F	Cap, trunnion.		Sight, quandrant, M1918.
105F	Case, elevating worm wheel.	131A	Sleigh.
	Case, panoramic sight, assembly.	132F	Slide, sleigh, rear, right.
117A	Clip, cradle, right.	158A	Stiffener, shield, right.
106A	Cover, elevating worm wheel case.	157A	Stiffener, shield, upper.
162A	Handle, brake.	C6981	Tire, rubber.
157G	Hood, shield.	108A	Transom, elevating segment, lower.
10C	Jacket.	108B	Transom, elevating segment, middle.
162B	Lever, brake shaft.	108C	Transom, elevating segment, upper.
163F	Nut, brake screw.	10A	Tube.
102A	Nut, elevating pinion shaft.	103A	Wheel, worm, elevating.

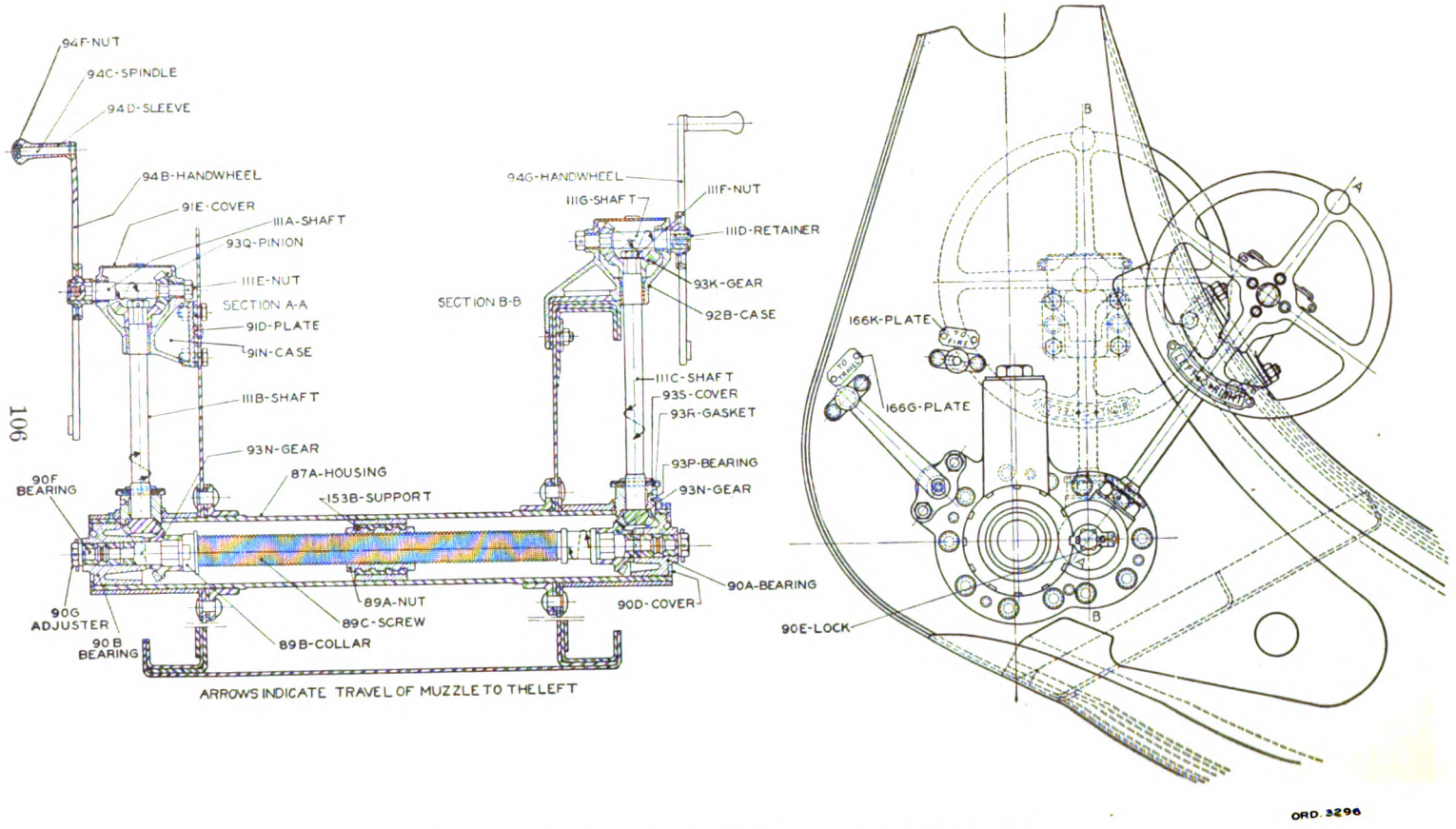

FIGURE 10—Traversing mechanism—assembled and sectioned views

FIGURE 10.—Traversing mechanism—assembled and sectioned views

Reference	Item	Reference	Item
90G	Adjuster, traversing screw thrust bearing.	90E	Lock, traversing screw thrust bearing adjuster.
90F	Bearing, thrust, traversing screw.	89A	Nut, traversing.
93P	Bearing, traversing intermediate shaft.	111E	Nut, traversing handwheel shaft.
90A	Bearing, traversing screw, left.	94F	Nut, traversing handwheel spindle.
90B	Bearing, traversing screw, right.	111F	Nut, traversing intermediate shaft.
92B	Case, traversing gear, left.	93Q	Pinion, traversing handwheel shaft.
91N	Case, traversing gear, right.	166K	Plate, instruction "To Fire."
89B	Collar, traversing screw stop.	166G	Plate, instruction "To Travel."
93S	Cover, dust, traversing shaft.	91D	Plate, right traversing gear case filler.
91E	Cover, traversing gear case.	111D	Retainer, handwheel.
90D	Cover, traversing screw housing.	89C	Screw, traversing.
93R	Gasket, traversing shaft dust cover.	111G	Shaft, traversing handwheel, left.
93N	Gear, traversing.	111A	Shaft, traversing handwheel, right.
93K	Gear, traversing intermediate.	111C	Shaft, traversing intermediate, left.
94G	Handwheel, traversing, left.	111B	Shaft, traversing intermediate, right.
94B	Handwheel, traversing, right.	94D	Sleeve, traversing handwheel.
87A	Housing, traversing screw.	94C	Spindle, traversing handwheel sleeve.
		153B	Support, traversing nut.

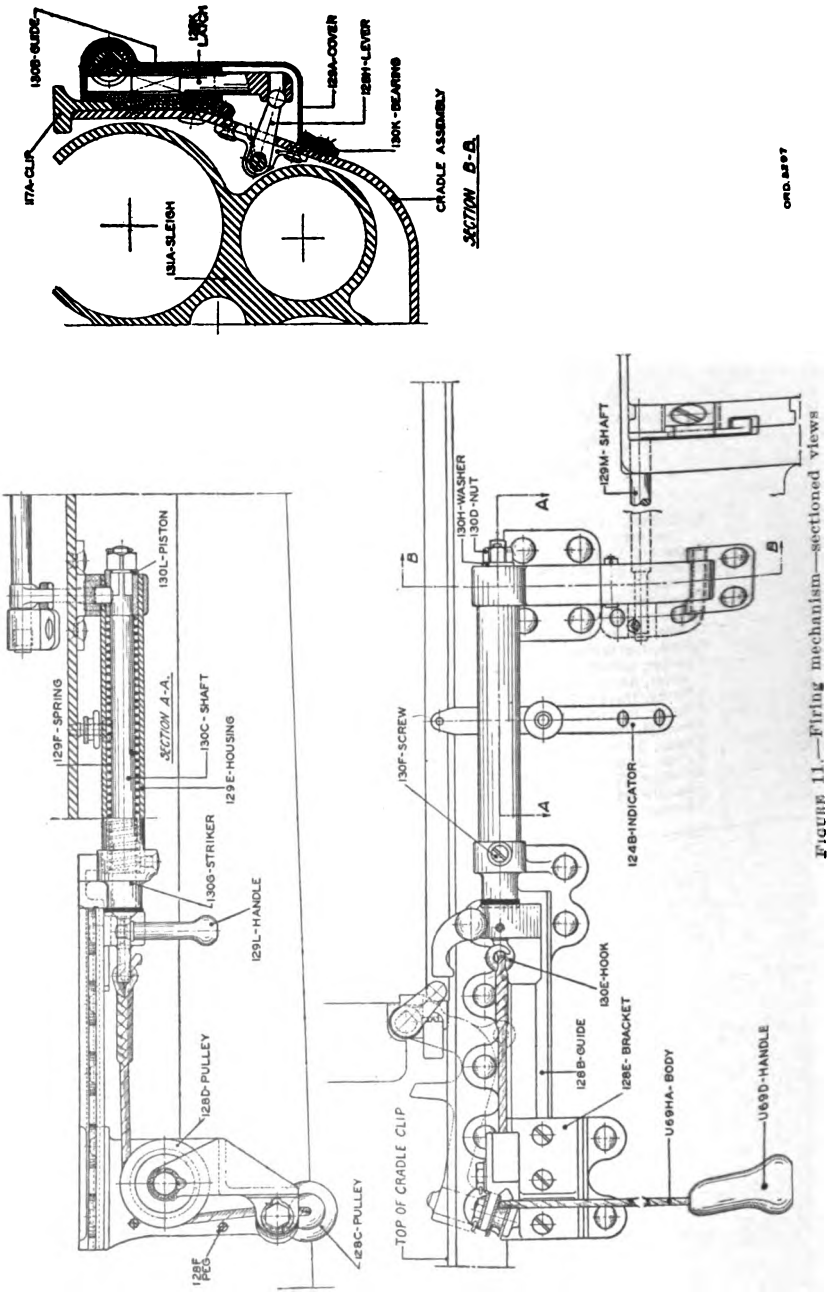

FIGURE 11.—Firing mechanism—sectioned views

FIGURE 11.—Firing mechanism—sectioned views

Reference	Item	Reference	Item
130K	Bearing, firing safety shaft, intermediate or first.	128H	Lever, firing safety shaft.
U69HA	Body, lanyard.	130D	Nut, firing handle shaft.
128E	Bracket, lanyard pulley.	128F	Peg, lanyard pulley bracket.
117A	Clip, cradle, right.	130L	Piston, firing handle shaft.
129A	Cover, firing safety latch.	128D	Pulley, lanyard, large.
130B	Cradle, assembly.	128C	Pulley, lanyard, small.
128B	Guide, firing safety latch.	130F	Screw, firing handle return spring housing.
129L	Guide, firing shaft.	130C	Shaft, firing handle.
U69D	Handle, firing.	129M	Shaft, firing safety.
130E	Handle, lanyard.	131A	Sleigh.
129E	Hook, lanyard.	129F	Spring, firing handle return.
124B	Housing, firing handle return spring.	130G	Striker, firing hammer operating shaft.
128K	Indicator, recoil.	130H	Washer, firing handle shaft.
	Latch, firing safety.		

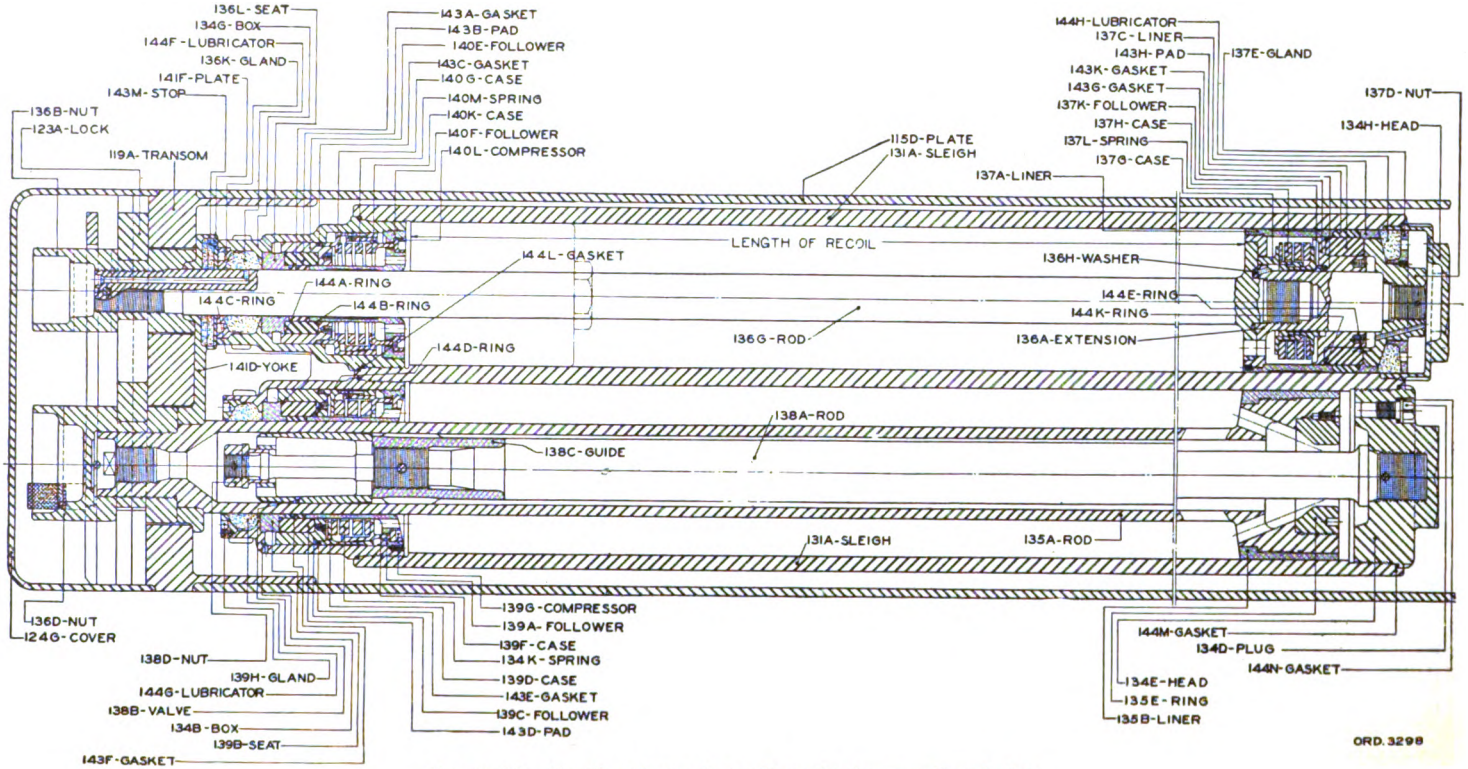

FIGURE 12.—Recoil and counterrecoil mechanism—sectioned view

FIGURE 12.—Recoil and counterrecoil mechanism—sectioned view

Reference	Item	Reference	Item
134G	Box, stuffing, counterrecoil.	144F	Lubricator, counterrecoil rod.
134B	Box, stuffing, recoil.	144G	Lubricator, recoil piston rod.
137H	Case, counterrecoil piston spring, inner.	138D	Nut, counterrecoil buffer rod.
137G	Case, counterrecoil piston spring, outer.	137D	Nut, counterrecoil piston.
140K	Case, counterrecoil rod spring, inner.	136B	Nut, counterrecoil rod.
140G	Case, counterrecoil rod spring, outer.	136D	Nut, recoil piston rod.
139F	Case, recoil piston rod spring, inner.	143H	Pad, counterrecoil piston rubber.
139D	Case, recoil piston rod spring, outer.	143B	Pad, counterrecoil rod rubber.
140L	Compressor, counterrecoil rod packing spring.	143D	Pad, recoil piston rod rubber.
139G	Compressor, recoil piston rod packing spring.	141F	Plate, counterrecoil stop.
124G	Cover, cradle, front.	115D	Plate, cradle.
136A	Extension, counterrecoil rod.	134D	Plug, filling.
137K	Follower, counterrecoil piston rubber.	144E	Ring, counterrecoil piston rubber pad cup, inner.
140F	Follower, counterrecoil rod gasket.	144K	Ring, counterrecoil piston rubber pad cup, outer.
140E	Follower, counterrecoil rod rubber.	144B	Ring, counterrecoil rod rubber pad cup, inner.
139A	Follower, recoil piston rod gasket.	144A	Ring, counterrecoil rod rubber pad cup, outer.
139C	Follower, recoil piston rod rubber.	135E	Ring, counterrecoil throttling.
143A	Gasket, No. 1.	144D	Ring, recoil piston rod rubber pad cup, inner.
143C	Gasket, No. 2.	144C	Ring, recoil piston rod rubber pad cup, outer.
143G	Gasket, No. 3.	138A	Rod, buffer, counterrecoil.
143K	Gasket, No. 4.	136G	Rod, counterrecoil.
143E	Gasket, No. 5.	135A	Rod, recoil piston.
143F	Gasket, No. 6.	136L	Seat, counterrecoil rod packing.
144L	Gasket, 96 by 100 by 2 mm.	139B	Seat, recoil piston rod packing.
144M	Gasket, 114 by 118 by 2 mm.	131A	Sleigh.
144N	Gasket, filling plug.	137L	Spring, counterrecoil piston packing.
137E	Gland, counterrecoil piston lubricator.	140M	Spring, counterrecoil rod packing.
136K	Gland, counterrecoil rod lubricator.	134K	Spring, recoil piston packing.
139H	Gland, recoil piston rod lubricator.	143M	Stop, counterrecoil.
138C	Guide, counterrecoil buffer.	119A	Transom, cradle.
134H	Head, counterrecoil cylinder.	138B	Valve, counterrecoil.
134E	Head, recoil cylinder.	136H	Washer, counterrecoil rod extension lock.
137A	Liner, counterrecoil piston.	141D	Yoke, piston rod.
137C	Liner, counterrecoil piston nut.		
135B	Liner, recoil piston.		
123A	Lock, piston rod.		
144H	Lubricator, counterrecoil piston.		

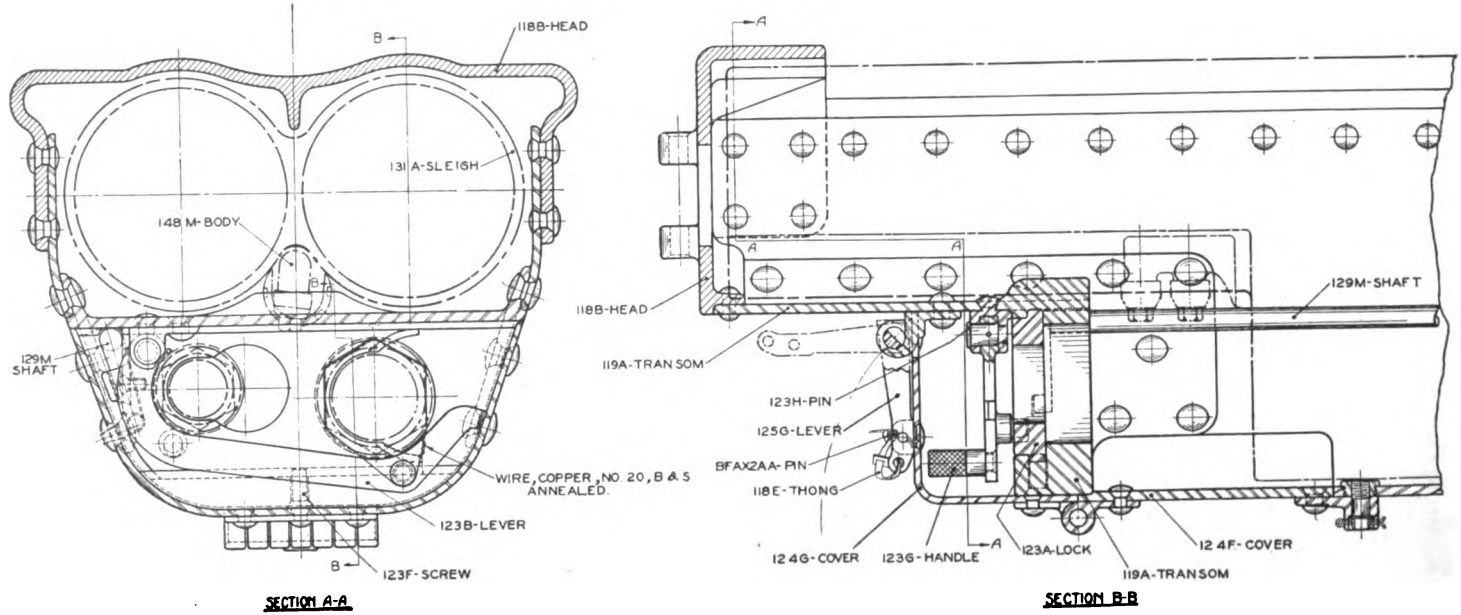

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FIGURE 13.—Piston rod lock mechanism—assembled view

FIGURE 13.—Piston rod lock mechanism—assembled view

Reference	Item	Reference	Item
148M	Body, filling valve.	123H	Pin, piston rod lock lever.
124F	Cover, cradle, bottom.	123F	Screw, piston rod lock stop.
124G	Cover, cradle, front.	131A	Sleigh.
123G	Handle, piston rod lock lever.	129M	Shaft, firing safety.
118B	Head, cradle, front.	118E	Thong, leather.
125G	Lever, cradle front cover locking pin.	119A	Transom, cradle.
123B	Lever, piston rod lock.		Wire, copper, No. 20, B. & S. gauge, annealed.
123A	Lock, piston rod.		
BFAX2AA	Pin, cotter, 3/16 by 1.75 inch.		

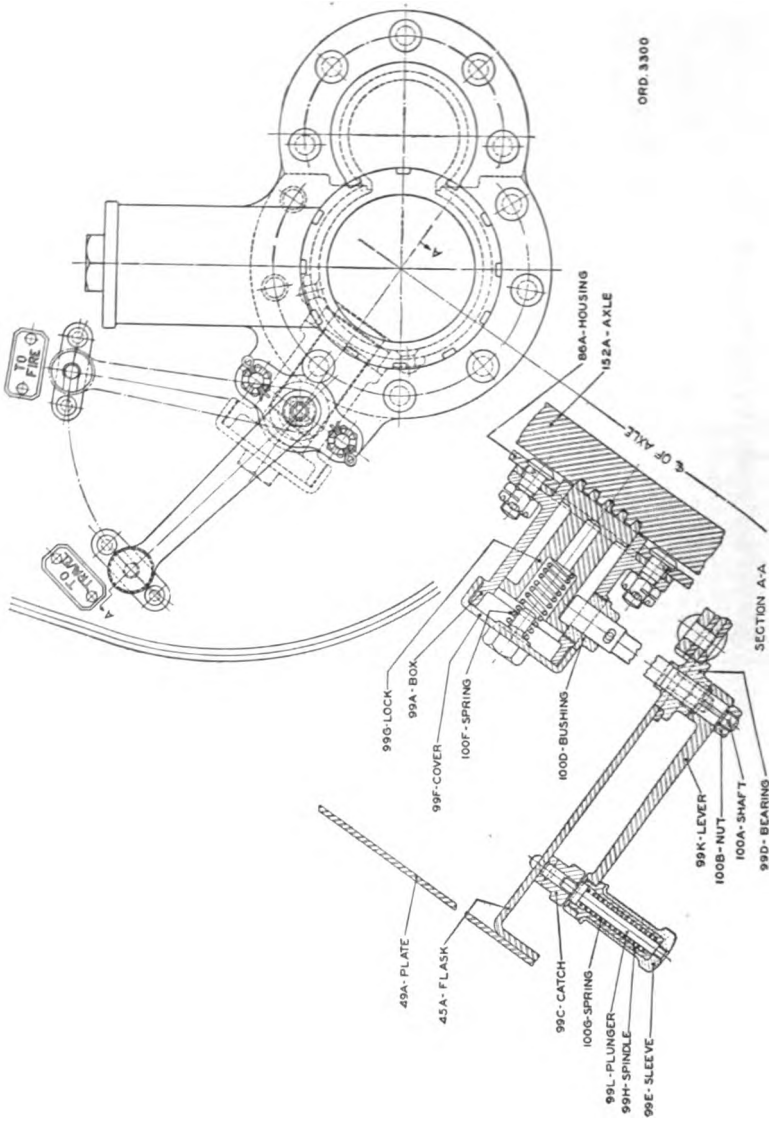

Figure 14.—Axle traveling lock—sectional view

FIGURE 14.—Axle traveling lock—sectioned view

Reference	Item	Reference	Item
152A	Axle.	100B	Nut, axle traveling lock shaft.
99D	Bearing, axle traveling lock.	4JA	Plate, trail, top.
99A	Box, axle traveling lock.	99L	Plunger, axle traveling lock lever.
100D	Bushing, axle traveling lock.	100A	Shaft, axle traveling lock.
99C	Catch, axle traveling lock, left.	99E	Sleeve, axle traveling lock lever.
99F	Cover, axle traveling lock box.	99H	Spindle, axle traveling lock lever.
45A	Flask, trail, left.	100F	Spring, axle traveling lock.
86A	Housing, axle.	100G	Spring, axle traveling lock lever plunger.
99K	Lever, axle traveling lock.		
99G	Lock, axle traveling.		

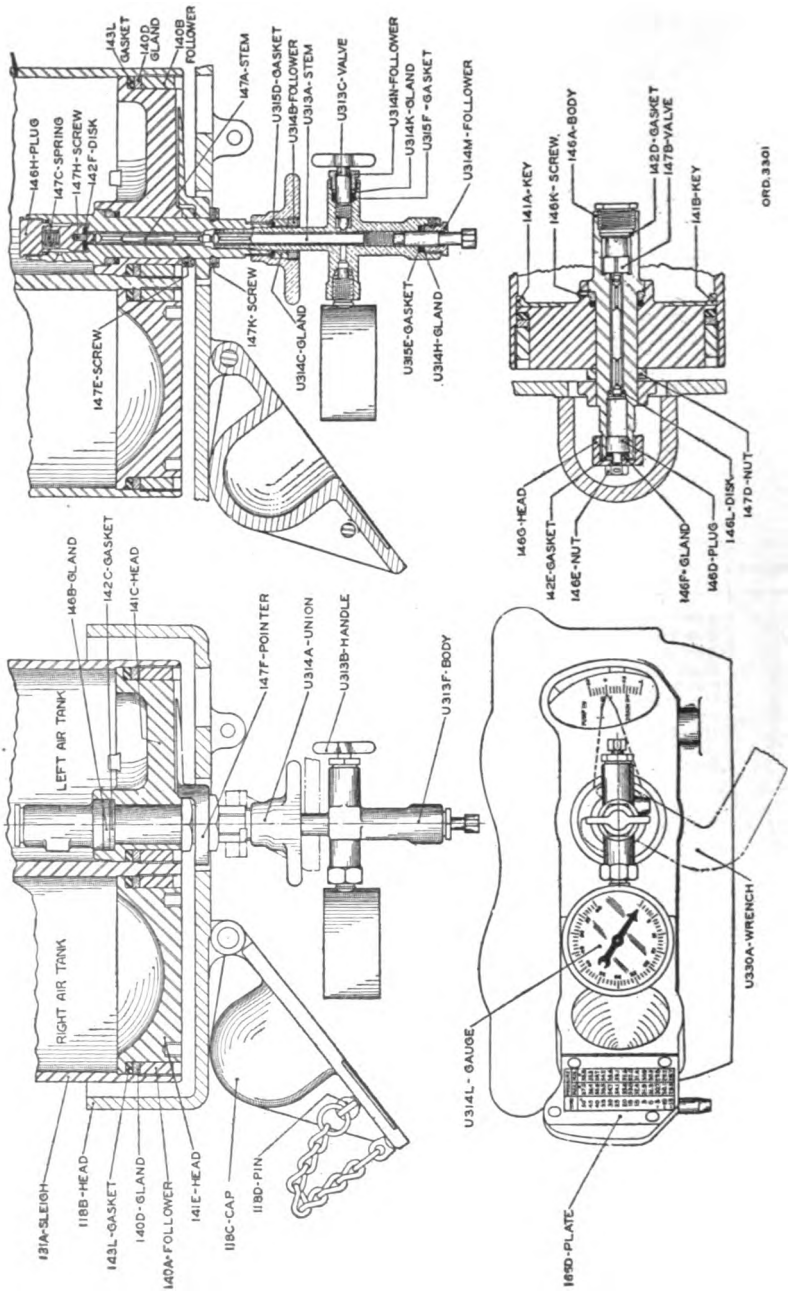

Figure 15.—Gauge cock with pressure gauge and adapter

FIGURE 15.—Gauge cock with pressure gauge and adapter

Reference	Item	Reference	Item
146A	Body, gauge cock.	141C	Head, air tank, left.
U313F	Body, pressure gauge adapter.	141E	Head, air tank, right.
118C	Cap, cradle head.	118B	Head, cradle, front.
146L	Disk, gauge cock body (not used on some gauge cock bodies).	146G	Head, gauge cock body.
		141B	Key, air tank head, lower, left head.
142F	Disk, gauge cock valve.	141A	Key, air tank head, upper, left head.
U314N	Follower, adapter needle valve.	147D	Nut, gauge cock body.
U314M	Follower, adapter stem.	146E	Nut, gauge cock body plug.
140B	Follower, air tank head, left.	118D	Pin, cradle head latch.
140A	Follower, air tank head, right.	166D	Plate, correction pressure.
U314B	Follower, union gland.	146D	Plug, gauge cock body, front.
U315D	Gasket, adapter, No. 1.	146H	Plug, gauge cock body, rear.
U315E	Gasket, adapter, No. 2.	147F	Pointer, gauge cock.
U315F	Gasket, adapter, No. 4.	147E	Screw, gauge cock body nut.
143L	Gasket, No. 7.	147K	Screw, gauge cock pointer.
142C	Gasket, No. 8.	147H	Screw, gauge cock valve.
142D	Gasket, No. 9.	146K	Screw, gland locking.
142E	Gasket, No. 10.	131A	Sleigh.
U314L	Gauge, pressure.	147C	Spring, gauge cock valve.
U314C	Gland, adapter (for union).	U313A	Stem, adapter.
U314K	Gland, adapter needle valve.	147A	Stem, gauge cock valve.
U314H	Gland, adapter stem.	U314A	Union, pressure gauge adapter.
140D	Gland, air tank head.	U313C	Valve, adapter needle.
146B	Gland, gasket, No. 8 (gauge cock body).	147B	Valve, gauge cock.
		U330A	Wrench, for gauge cock and filling pipe coupling.
146F	Gland, gauge cock body plug.		
U313B	Handle, needle valve adapter.		

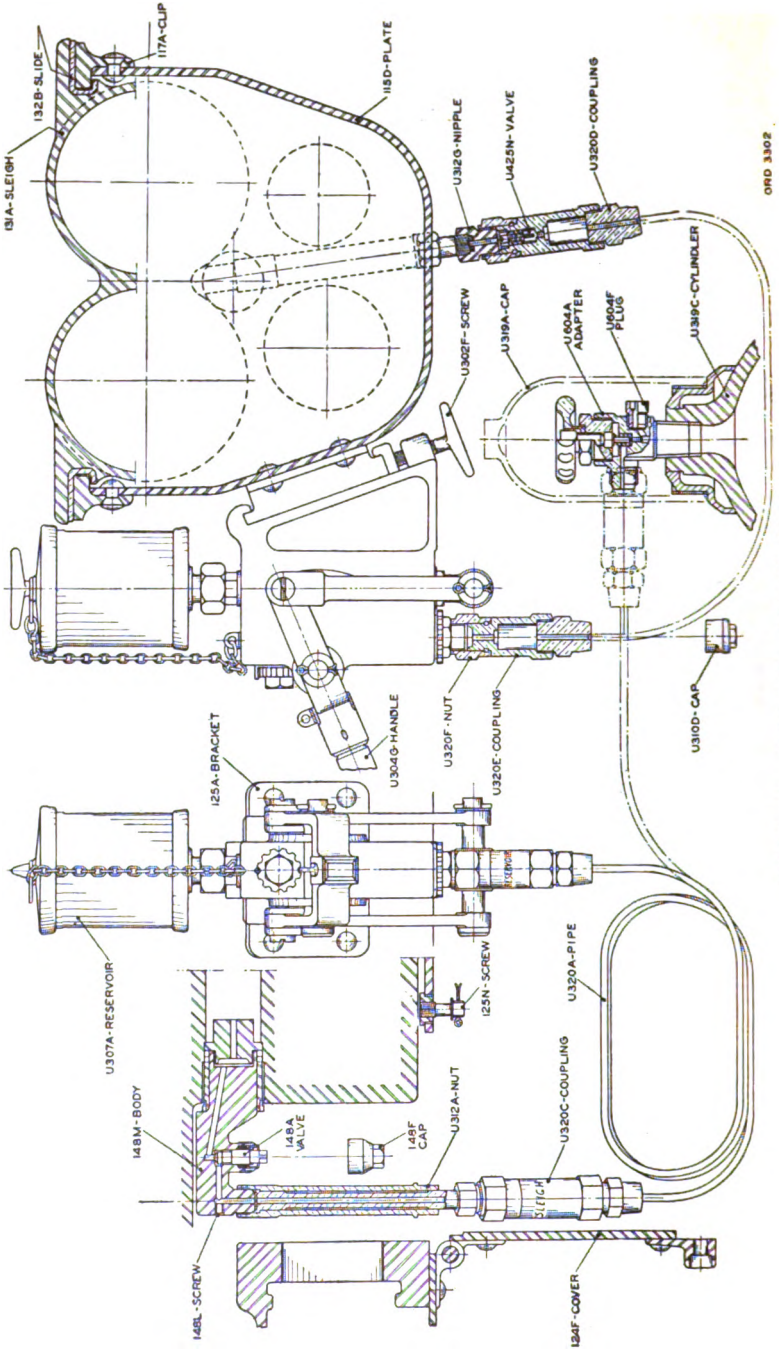

Figure 16.—Attachment of the liquid pump

FIGURE 16.—Attachment of the liquid pump

Reference	Item	Reference	Item
U604A	Adapter.	U312A	Nut, swivel, long.
148M	Body, filling valve.	U320F	Nut, swivel, short.
125A	Bracket, pump.	U320A	Pipe, filling.
U319A	Cap, compressed gas cylinder.	115D	Plate, cradle.
U310D	Cap, connection.	U604F	Plug, safety.
148F	Cap, filling needle valve.	U307A	Reservoir.
117A	Clip, cradle, right.	U302F	Screw, bracket grip.
U320D	Coupling, hose, inner.	125N	Screw, cradle bottom cover fastening.
U320E	Coupling, hose, outer, "reservoir."	148L	Screw, filling valve body (closing).
U320C	Coupling, hose, outer, "sleigh."	131A	Sleigh.
124F	Cover, cradle, bottom.	132B	Slide, sleigh, front, right.
U319C	Cylinder, compressed gas.	U425N	Valve, check.
U304G	Handle, lever.	148A	Valve, filling needle.
U312G	Nipple.		

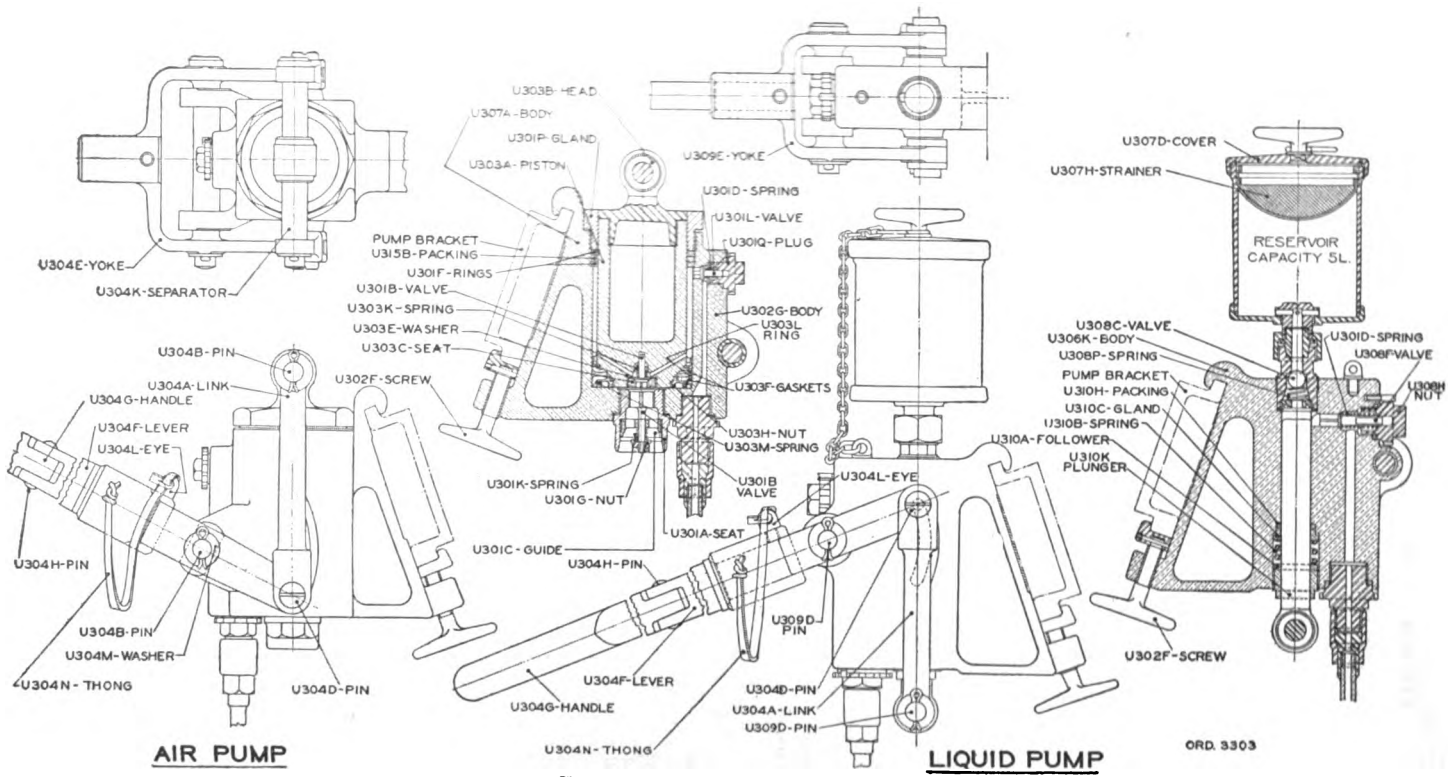

FIGURE 17.—Air and liquid pumps

FIGURE 17.—Air and liquid pumps

Reference	Item	Reference	Item
U302G...	Body.	U310K...	Plunger.
U306K...	Body, pump.	U301Q...	Plug, check valve.
U307A...	Body, reservoir.	U303L...	Ring, piston gasket.
U307D...	Cover, reservoir.	U301F...	Ring, piston packing.
U304L...	Eye, screw.	U302F...	Screw, bracket grip.
U310A...	Follower, plunger packing gland spring.	U301A...	Seat, intake valve.
U303F...	Gasket, piston.	U303C...	Seat, piston valve.
U301P...	Gland, piston.	U304K...	Separator, link.
U310C...	Gland, plunger packing.	U301D...	Spring, check valve.
U301C...	Guide, intake valve.	U308P...	Spring, inlet valve.
U304G...	Handle, lever.	U301K...	Spring, intake valve.
U303B...	Head, piston.	U303M...	Spring, piston packing.
U304F...	Lever.	U303K...	Spring, piston valve.
U304A...	Link.	U310B...	Spring, plunger packing gland.
U301G...	Nut, intake valve stem.	U307H...	Strainer.
U308H...	Nut, check valve.	U304N...	Thong, leather.
U303H...	Nut, piston gasket.	U308C...	Valve, ball, inlet.
U315B...	Packing, piston.	U308F...	Valve, check.
U310H...	Packing, plunger.	U301B...	Valve, intake.
U304H...	Pin, lever.	U301L...	Valve, piston and check.
U304D...	Pin, link.	U303E...	Washer, valve seat.
U304B...	Pin, yoke.	U304M...	Washer, yoke pin.
U309D...	Pin, yoke.	U309E...	Yoke.
U303A...	Piston.	U304E...	Yoke.

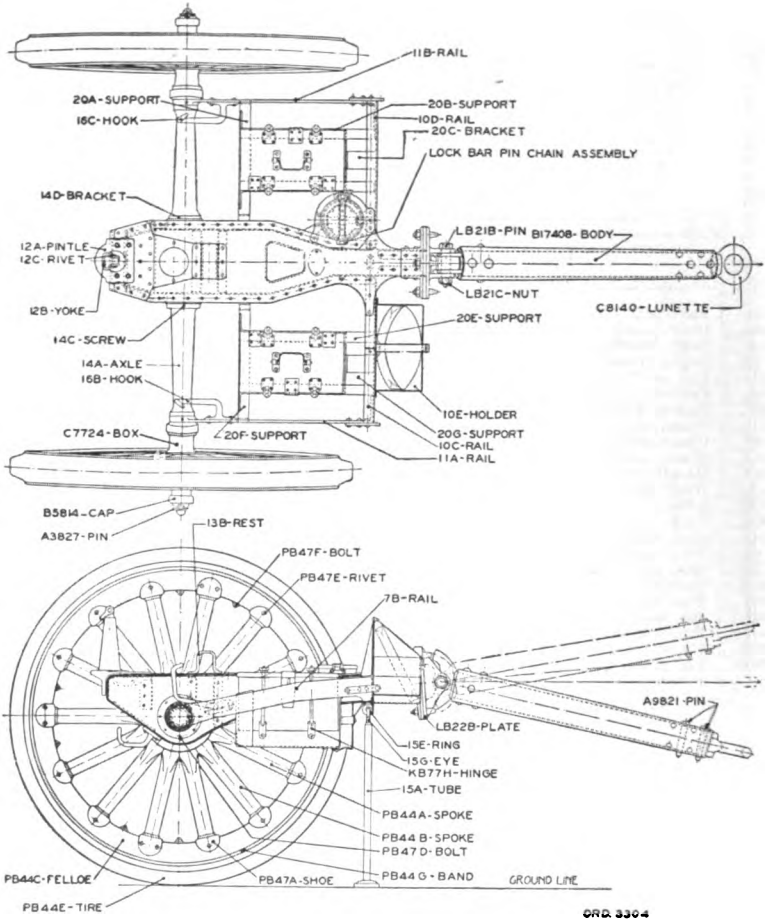

FIGURE 18.—155-mm. howitzer carriage limber, M1918—general views

FIGURE 18.—155-mm. howitzer carriage limber, M1918—general views

Reference	Item	Reference	Item
14A	Axle.	LB22B	Plate, drawbar hinge.
PB44G	Band, felloe.	10D	Rail, front, left.
B17408	Body, drawbar.	10C	Rail, front, right.
PB47D	Bolt, carriage, round head, square-neck, 1 9/16 by 4 inch.	7B	Rail, middle, left.
		11B	Rail, side, left.
PB47F	Bolt, tire, 9.52 by 98 mm.	11A	Rail, side, right.
C7724	Box, hub.	13B	Rest, trail.
14D	Bracket, axle.	15E	Ring, prop carrying.
20C	Bracket, case support auxiliary.	12C	Rivet, pintle yoke.
B5814	Cap, axle.	PB47E	Rivet, spoke shoe.
	Chain, lock bar pin, assembly.	14C	Screw, axle nut lock.
15G	Eye, prop.	PB47A	Shoe, spoke.
PB44C	Felloe, long.	PB44B	Spoke, left.
KB77H	Hinge, swing bolt.	PB44A	Spoke, right.
10E	Holder, bucket.	20E	Support, case longitudinal, inner, left.
16C	Hook, picket rope, left.	20G	Support, case longitudinal, inner, right.
16B	Hook, picket rope, right.	20B	Support, case longitudinal, outer.
C8140	Lunette (motorized).	20A	Support, case transverse, left.
LB21C	Nut, drawbar hinge pin.	20F	Support, case transverse, right.
LB21B	Pin, drawbar hinge.	PB44E	Tire, rubber, 100 by 1,110 mm.
A3827	Pin, linch.	15A	Tube.
A9821	Pin, lunette, rear.	12B	Yoke, pintle.
12A	Pintle.		

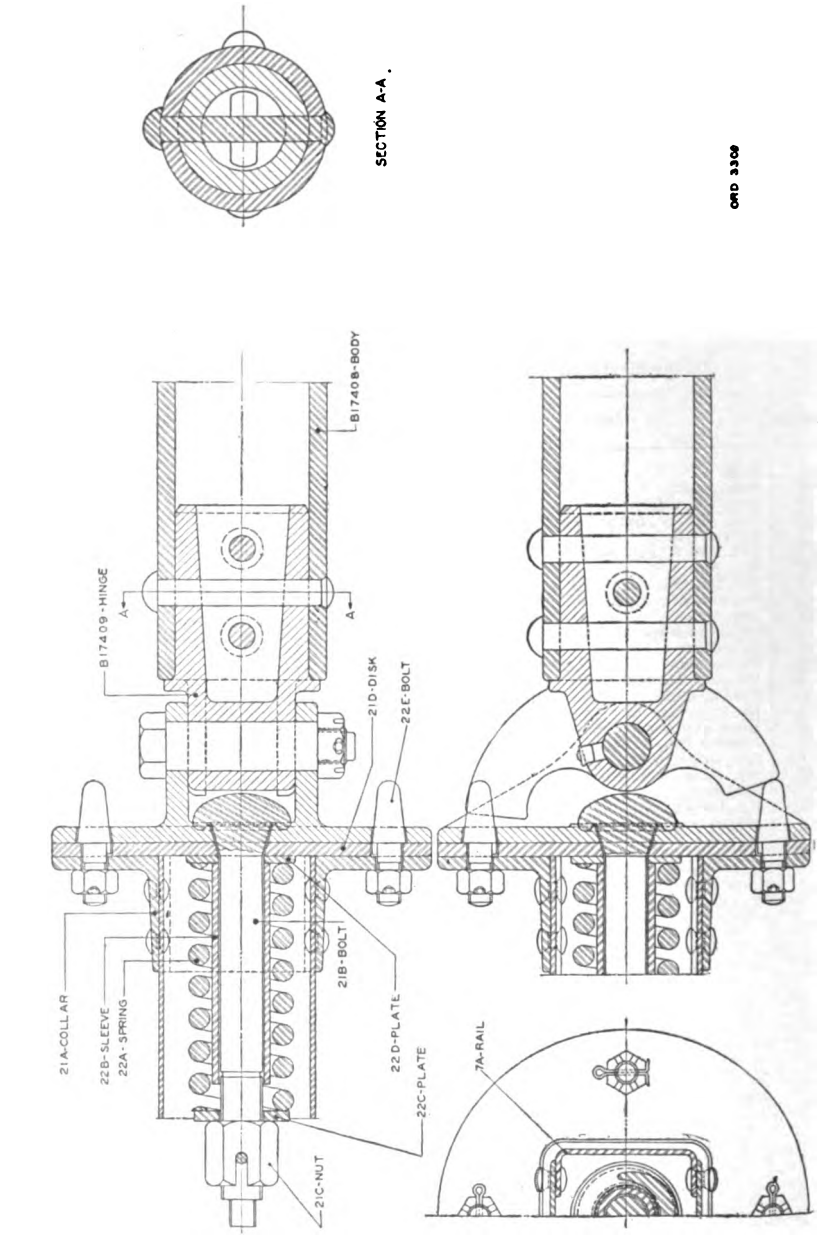

Figure 19.—Drawbar support—assembled

FIGURE 19.—Drawbar support—assembled

Reference	Item	Reference	Item
B17408	Body, drawbar.	21C	Nut, drawbar supporting spring bolt.
21B	Bolt, drawbar supporting spring.	22D	Plate, spring, front.
22E	Bolt, middle, rail collar disk.	22C	Plate, spring, rear.
21A	Collar, middle rail.	7A	Rail, middle, right.
21D	Disk, middle rail collar.	22B	Sleeve, spring bolt.
B17409	Hinge, drawbar.	22A	Spring, drawbar supporting.

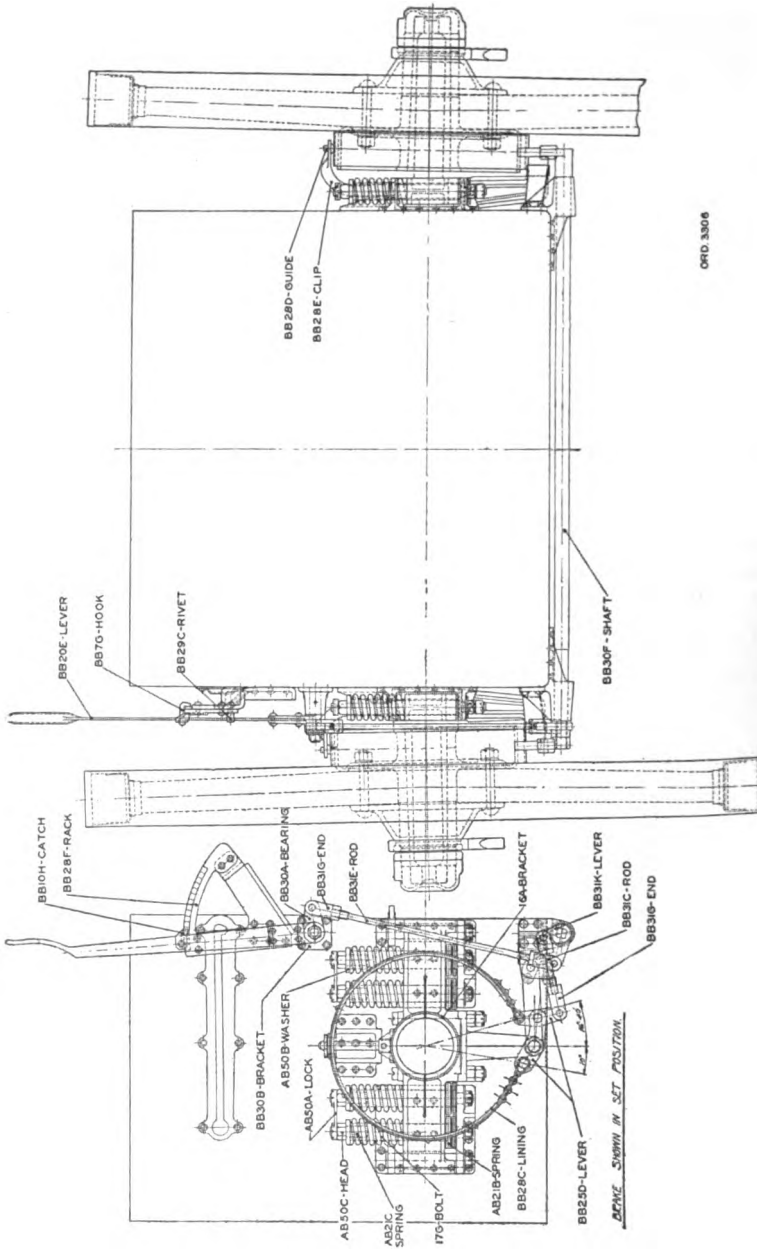

Figure 20.—155-mm. howitzer caisson, M1918, spring support and brake—assembled views

FIGURE 20.—155-mm. howitzer caisson, M1918, spring support and brake—assembled views

Reference	Item	Reference	Item
BB30A	Bearing, brake lever.	BB31K	Lever, brake shaft.
17G	Bolt, spring.	BB28C	Lining, brake band.
16A	Bracket, axle.	AB50A	Lock, spring bolt head.
BB30B	Bracket, brake lever.	BB28F	Rack, segment.
BB10H	Catch, brake lever.	BB29C	Rivet, brake lever stop.
BB28E	Clip, brake band.	BB31C	Rod, brake.
BB31G	End, brake rod.	BB31E	Rod, brake lever.
BB28D	Guide, brake band.	BB30F	Shaft, brake.
AB50C	Head, spring bolt.	AB21B	Spring, Belleville.
BB7G	Hook, brake lever.	AB21C	Spring, carrying.
BB20E	Lever, brake.	AB50B	Washer, spring bolt.
BB25D	Lever, brake rod.		

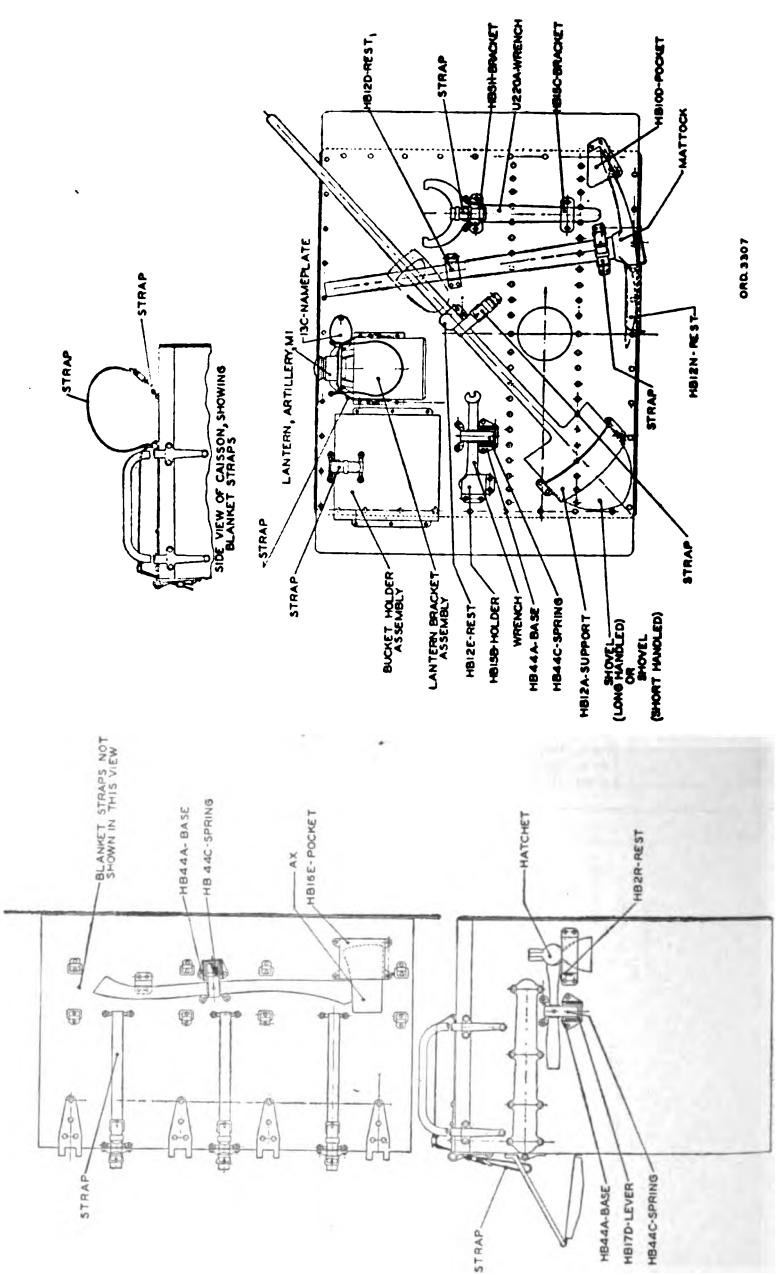

FIGURE 21.—155-mm. howitzer caisson, M1918—location of implements

FIGURE 21.—155-mm. howitzer caisson, M1918—location of implements

Reference	Item
U51D	Ax, 5-pound (with handle).
HB44A	Base, implement fastening (ax).
	Base, implement fastening (hatchet).
	Base, implement fastening (wrench).
	Bracket, lantern, assembly.
HB5H	Bracket, spanner, front.
HB15C	Bracket, spanner, rear.
U51B	Hatchet, 2-pound (with handle).
	Holder, bucket, assembly.
HB15B	Holder, wrench, left.
	Lantern, artillery, M1.
HB17D	Lever, implement fastening.
U52C	Mattock, pick (with handle).
13C	Plate, name.
HB16E	Pocket, ax.
HB10D	Pocket, pick needle end.
HB2R	Rest, hatchet handle, left.
HB12N	Rest, pick.
HB12D	Rest, pick handle.
HB12E	Rest, shovel handle.
U52A	Shovel, long handled.
U51C	Shovel, short handled.
HB44C	Spring, implement fastening (ax).
	Spring, implement fastening (hatchet).
	Spring, implement fastening (wrench).
	Strap, leather, 1¼ inches wide, 14 inches long, with two fixed keepers (for hub cap wrench).
	Strap, leather, 1¼ inches wide, 16 inches long, with two fixed keepers (for shovel handle).
	Strap, leather, 1¼ inches wide, 24 inches long, with two fixed keepers (for bucket and grips).
	Strap, leather, 1¼ inches wide, 42 inches long, with two fixed keepers (for paulin).
	Strap, leather, 1¼ inches wide, 14 inches long, with one fixed keeper and two loose keepers (for pick handle).
	Strap, leather, 1¼ inches wide, 8 inches long, with two fixed keepers (for blankets).
	Strap, leather, 1¼ inches wide, 40 inches long, with one fixed keeper (for blankets).
	Strap, leather, 1¼ inches wide, 19¼ inches long (for lantern).
HB12A	Support, shovel.
U153D	Wrench, open, 1 1/16 inches by 1¼ inches (for ⅝ inch and ¾ inch nuts).
U220A	Wrench, 60-inch wheel hub cap.

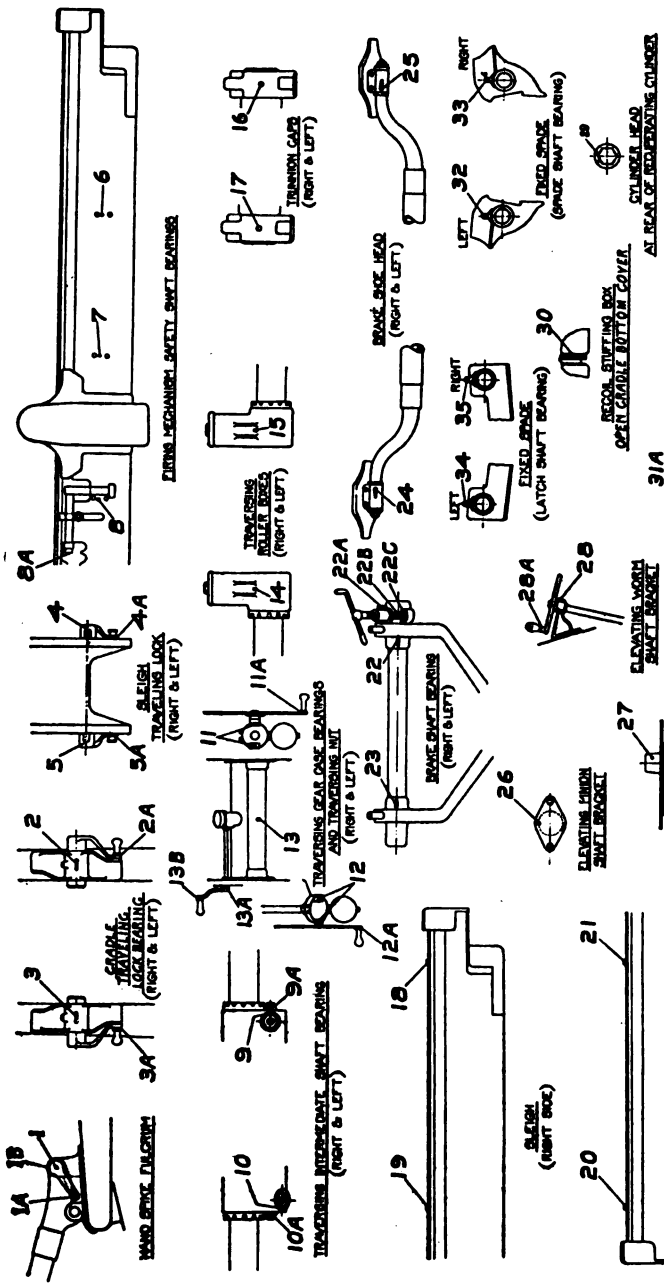

FIGURE 22.—Location of oil holes in carriage

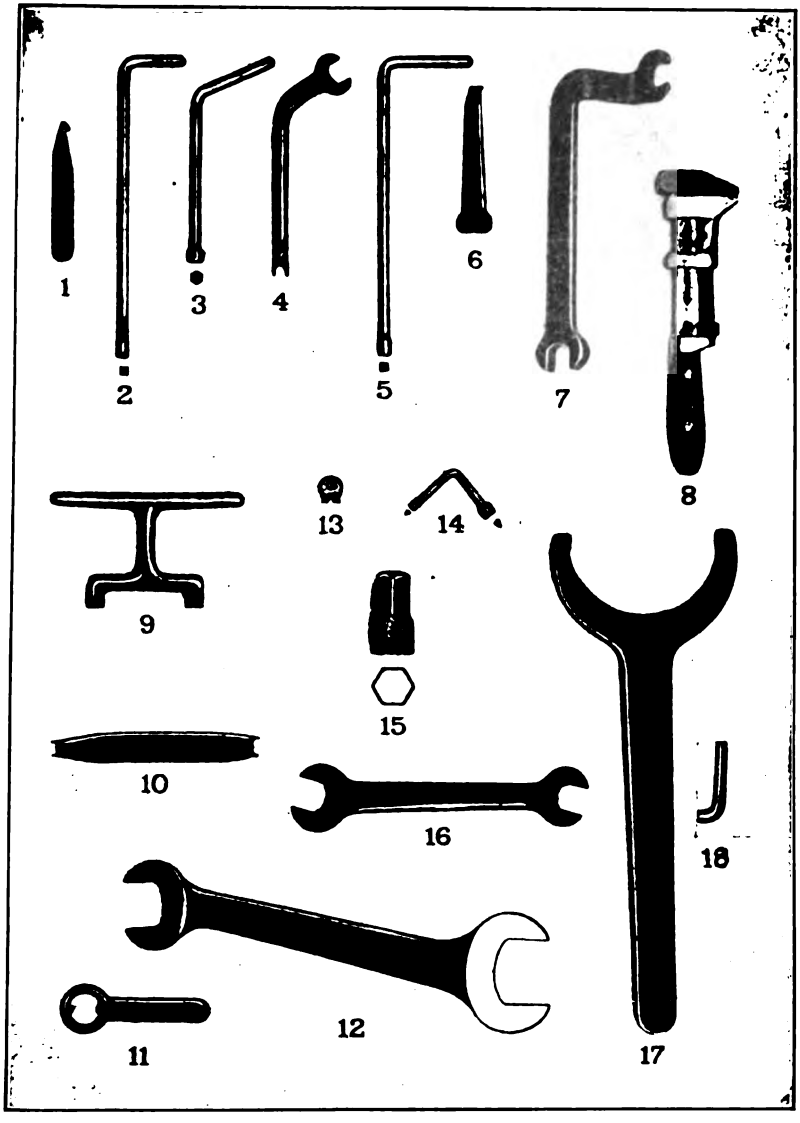

FIGURE 23.—Wrenches

Reference	Item	Reference	Item
1. U67Q	Opener, container.	10. U336F	Wrench, percussion hammer operating shaft nut and operating lever handle nut.
2. U329E	Wrench, filling needle valve.	11. B17538	Wrench, fuze, M1.
3. U329B	Wrench, filling valve cap.	12. U328B	Wrench, piston rod nut.
4. U329C	Wrench, filling pipe swivel nut and filling needle valve follower.	13. A31973	Wrench, teat, wing (for panoramic sight).
5. U329A	Wrench, filling plug.	14. U329D	Wrench, socket (quadrant sight).
6. U332B	Wrench, firing mechanism, M1918.	15. U345C	Wrench, socket (quadrant sight bracket bolt).
7. U330A	Wrench, gauge cock and filling pipe coupling.	16. B7023J	Wrench, open, 1 1/16 by 1 1/4 inch.
8. TKAX1C	Wrench, screw, adjustable, knife handle, 12-inch.	17. U220A	Wrench, 60-inch wheel hub cap.
9. U332L	Wrench, obturator spindle.	18. B8144A	Wrench, safety set screw, 1/4-inch, for 1/4-inch screw.

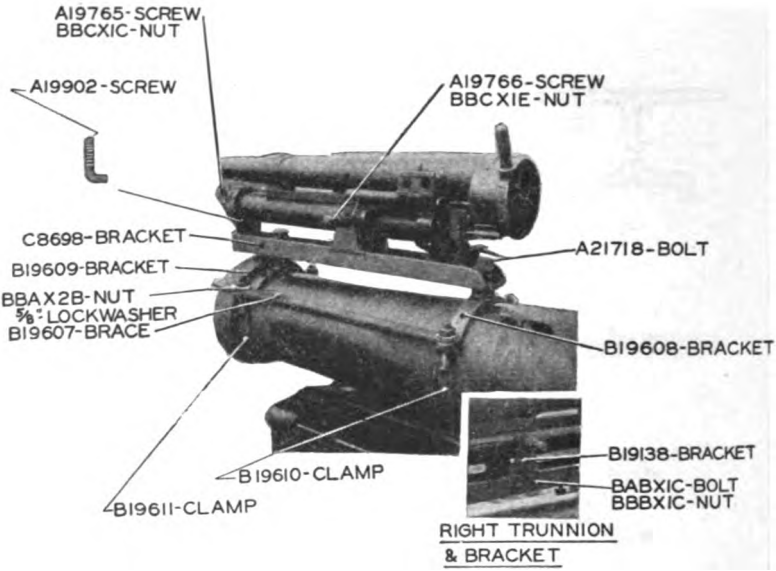

FIGURE 24.—37-mm. gun, M1916, on mount, subcaliber, 37-mm., M4

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TECHNICAL REGULATIONS
No. 1305–155C

WAR DEPARTMENT,
WASHINGTON, *March 10, 1931.*

MOBILE ARTILLERY MATÉRIEL

155-MM. GUN MATÉRIEL, M1918

Prepared under direction of the
Chief of Ordnance

SECTION I

GENERAL

1. Purpose.—These regulations are published for the information and guidance of the using arms, Reserve Officers' Training Corps students, Reserve officers, and all personnel charged with the maintenance of this matériel.

2. Scope.—*a.* In addition to description and figures, there are contained herein instructions for the operation, inspection, assembly and disassembly, repair, and care and preservation of the matériel.

b. Disassembly and assembly, and such repairs as may be handled by the battery personnel will be undertaken only under the supervision of an officer or the chief mechanic.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope of the enlisted personnel, the corps

area or department ordnance officer will, upon request, provide trained men to perform the work.

3. References.—Nomenclature, list of spare parts and equipment, and basic spare parts are contained in Standard Nomenclature List No. D–11 or on ordnance drawings; description and information on sighting and fire-control equipment in TR 1320–C; ammunition in TR 1355–155B; targets and accessories therefor in TR 1340–C; description of the 37-mm. gun and tank cradle, M1916, as well as care and maintenance thereof in TR 1300–37B; instructions covering the characteristics, purpose, handling, etc., of cleaning and preserving materials, tools and materials for use therewith, and special oils, greases, and cutting oils issued by the Ordnance Department in TR 1395–A; subcaliber gun ammunition in TR 1370–C; Coast Artillery Corps, service of the piece in TR 435–184; and Field Artillery, service of the piece in TR 430–30.

Section II

DESCRIPTION AND OPERATION

4. Description of gun.—*a.* The 155-mm. gun, M1917, is of French manufacture. A number of these weapons was 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 by the United States.

b. The breech mechanisms of the M1917 and M1918 MI guns as complete units are interchangeable. The parts common to each mechanism are the rack lock spring (16C), Figure 4, hinge pin (21D), hinge pin driving washer (21C), hinge pin collar (21B), counterbalance regulating screw (32C), counterbalance regulating screw nut (32G), counterbalance tension rod shim (32B), operating lever latch (19A), Figure 2, operating lever latch trunnion screw (19E), rack (16A), rear split ring (29D), Figure 3, front split ring (29C), inner ring, filling-in disk (29B), gas check pad (29A), obturator spindle spring front seat (28B), obturator spindle spring supporting washer (28D), obturator spindle spring (28A), Figure 5,

counterbalance assembly (fig. 4), operating lever handle (19B), Figure 2, operating lever handle sleeve (19C), Figure 4, operating lever handle nut (19D), operating lever handle spring (19F), and operating lever (18C), Figure 2.

NOTE.—The gas check pad originally assembled in the obturator mechanism of the M1917 was covered with a wire mesh cloth and the split rings were made of bronze. These differences in materials do not affect their interchangeability.

c. There are in service both M1917 and M1918 MI guns with their respective breech mechanisms. Modification of the M1917 breech mechanisms to make all parts interchangeable with the M1918 MI is contemplated. This would necessitate the removal of the M1917 mechanisms in service and their transfer to Watervliet Arsenal for eventual modification and the replacement by M1918 MI mechanisms when actually required on guns in service. The modification will consist of inserting a ring at the rear end of the breechblock and modifying the carrier to permit use of the M1918 firing mechanism housing. The only change necessary to the obturator spindle is the retapping of the vent plug hole.

d. Beginning at the breech end, the chamber is conical for a distance of 1.575 inches, forming the gas check seat; cylindrical for 38.464 inches; conical for 4.921 inches, forming a surface to center the projectile and providing a seat for the rotating band. From this point to the muzzle (180.433 inches), the bore is rifled with 48 grooves, having a uniform right-hand twist of one turn in 29.89 calibers. The gun uses separate loading ammunition and throws a projectile of 95 pounds at a muzzle velocity of about 2,410 feet per second a maximum distance of approximately 18.000 yards.

5. Operation of the breech mechanism.—*a.* To open the breech mechanism, M1918, raise the firing mechanism block latch (48A), Figure 5, and remove the firing mechanism by unscrewing it to the left. Grasp the operating lever handle (19B), Figure 2, and press it down in order to disengage it from the breechblock carrier lever catch (24C). At the same time pull on the operating lever handle (19B). In the first part of this movement, the operating lever (18C), Figure 2, turns freely on the hinge pin (21D), Figure 4, and its lug operates the rack (16A), Figure 2, which turns the breechblock (15A), disengaging its threads from those in the breech ring (13A), Figure 1. When the breeckblock is completely unlocked, further rotation of it to the right is prevented by a lug on the rack (16A), Figure 2, coming in contact with the rack lock (16B), Figure 4, and preventing further movement of the operating lever independent of the breechblock carrier (14A), Figure 2. Further pull

on the operating lever handle draws the breechblock carrier away from the gun and permits the rack lock (16B), Figure 4, to be forced into its seat in the rack (16A), Figure 2, by the action of the rack lock spring (16C), Figure 4, thus locking the breechblock (15A), Figure 2, in the open position. The hinge pin (21D), Figure 4, is locked to the breechblock carrier (14A), by the hinge pin driving washer (21C), and so is forced to turn the breechblock carrier. The rotary motion thus developed in the hinge pin creates a pull on the counterbalance tension rod (31C), through the lever arm on the hinge pin and compresses the counterbalance spring (31K), to a greater or lesser degree, according to the position of the counterbalance regulating nut (32A), which must be adjusted so as to properly counterbalance the mechanism at the given elevation. When the breechblock carrier strikes the operating lever catch bracket (22A), the operating lever latch (19A), Figure 2, on the operating lever catches on the operating lever catch (24A), Figure 4, and locks the breech mechanism in its open position.

b. To close the breech mechanism, as when opening the breech mechanism, grasp the operating lever handle (19B), Figure 2, and press it down to disengage the operating lever latch (19A), from the operating lever catch (24A), Figure 4. At the same time pull on the operating lever handle (19B), Figure 2. This movement will cause the breechblock carrier (14A) to come against the rear face of the gun, the counterbalance facilitating the closing if the counterbalance regulating nut (32A), Figure 4, is set in the proper position. The rack lock (16B), Figure 4, the forward end of which projects from the front face of the breechblock carrier (14A), strikes the breech ring and is pushed back into its seat freeing the rack (16A), Figure 2. The operating lever continues to rotate about the axis of the hinge pin (21D), Figure 4, and moves the rack (16A), Figure 2, to the left, screwing the breechblock home. The operating lever comes to rest when the operating lever latch (19A), Figure 2, engages the operating lever catch (24A), Figure 4, on the breechblock carrier (14A).

c. The firing mechanism is held in the hand and loaded by inserting a primer into the primer holder (B8058), Figure 5. This locates the cap in the primer directly in front of the firing pin. The firing mechanism is then screwed into the firing mechanism housing (50B), Figure 5, and when the firing mechanism has passed the firing mechanism block latch (48A), it has seated the primer in the obturator spindle plug (27D).

d. Firing of the M1918 MI gun is accomplished by giving a quick pull on the lanyard which is hooked to the arm on the left end of the percussion hammer operating shaft (B8060), Figure 2. The operator stands to the right rear of the gun when firing.

e. The breechblock of the M1918 MI gun can not be opened after the insertion of the firing mechanism until the firing mechanism is removed, due to the fact that the firing mechanism safety plunger (50K), Figure 5, can not move while the firing mechanism is assembled in the firing mechanism housing.

f. The breechblock will not accidentally open or close, because of the operation of the operating lever latch.

6. Description of carriage.—*a.* The gun carriage is patterned after the French design "Grande Puissance Filloux" (G. P. F.), which means a gun and carriage of great power, and the name of the inventor. 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 to which the gun is secured is the hydropneumatic variable recoil type and is housed in a cradle (fig. 9). The cradle is suspended by its trunnions resting in the trunnion bearings of the top carriage (fig. 10).

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 3-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 (22A), Figure 9, which houses the recoil mechanism; top carriage (fig. 10) with elevating and traversing mechanisms; bottom carriage (fig. 12); gun axle; gun axle springs; wheels; trails; spades; and road brake. These groups are described under Section III.

7. Operation to emplace weapon in firing position.—When the carriage is limbered, the gun retracted and secured by the traveling lock (fig. 21), the axle pivot pin (87B), Figure 12, withdrawn, the weight of the carriage is borne by the gun axle springs (fig. 13).

The assembly of wheel shoes (fig. 16) will depend upon ground conditions.

a. Remove the breech, muzzle, and piston rod covers. Thoroughly clean the piston rod ends and the piston rod nuts. Lubricate the threads of each piston rod nut with Class A oil. Clean and lubricate the translating racks, cradle, and gun slides.

b. Unscrew the traveling bar clip locking screw releasing the traveling lock beam (fig. 21).

c. Assemble the ratchet wrenches to the traveling lock pinions (fig. 21) located at each end of the traveling lock beam. It is essential that the mechanic in charge station himself in such position that he can watch the progress of the traveling lock beam and control the movement of either pinion so as to keep the traveling lock beam square across the trail and avoid jamming and breaking the teeth in the pinions and translating racks when moving the gun to or from battery position.

d. Assemble the recoil and counterrecoil piston rod nuts, which are housed in the breech ring of the gun, to the recoil and counterrecoil piston rods.

e. Release the traveling lock locking screw (fig. 21), located near the mid-point of the traveling lock beam, until the traveling lock locking screw nut moves freely in the T-shaped slot of the breech ring. Move the traveling lock beam to the rear to clear the gun and lift it off the trails.

f. Unlash the spades and remove them.

g. Place the jack beam across and under the trails and place the jacks beneath its ends. Pin the jack beam fulcrum to the rear lug of the bottom carriage. The jacks require blocking underneath to secure sufficient lift as well as to provide a perfectly solid foundation. The 4 by 12 by 42 inch blocks issued as maneuvering material are generally satisfactory (see fig. 19). For heavy lifting the jacks must rest squarely on a good foundation.

h. Disconnect the brake cables at the ball connections.

i. Loosen the trail clamping bolt nuts seven or eight turns, or until the clamping bolt eye may be disengaged from the trail clamping bolt pins (24E), Figure 18, then remove the limber seat (33A) and clamping trail transom (23A), Figure 17. Place blocking beneath the trails back of the limber to support the trails in case of failure of the jacks.

j. Lift with the jacks until the limber (fig. 18) can be pulled out from under the trails.

k. Lower with the jacks, removing the blocking as the trails descend, until the trails are just clear of the ground. Remove the pin which holds the two trails together.

l. Clean the openings of the trail which encircle the trail locking bolts and trail connecting pins (95C), Figure 12. Unscrew the trail locking bolt nuts (90C), Figure 12, to give plenty of clearance when the trails are moved in position.

m. Man the ends of the trails and spread them until the trail locking bolts prevent further movement. Mark the ground at the rear end of each trail, also lines about 4 feet long each side of the trails, then swing the trails back toward the center of the carriage sufficiently to allow plenty of working space to dig a trench for the spade. Measure 26 inches forward from the marks placed at the rear end of the trails. Lay out a rectangle, measuring 8 inches wide, 50 inches long at right angles to the 4-foot lines placed each side of the trail. Dig a trench within the rectangle 2 feet deep, cut necessary space to clear spade braces. Sink the spades in the trench giving plenty of clearance in rear of the points of the spades.

n. Lay the spade clamp bolts down pointing away from the center of spade. Clean all dirt from the top of the spade and underside of the trails. Swing the trails into position and tighten the trail locking bolt nuts (90C), Figure 12. Lower the trails onto the spades; swing the spade clamp bolts into engagement with the spade clamping transom. Maneuver the spades with crowbars, if necessary, to get proper relation between trail and spade, and tighten the spade clamp bolts.

o. Remove the jacks and jack beam.

p. Unshackle the gun axle spring. (Fig. 13.) Place the jacks on large blocks beneath the two jack lugs on the front of the bottom carriage and raise the bottom carriage until there is clearance between the bottom carriage and the gun axle spring. Release the shackle adjusting bolt safety clips (122B), Figure 14, by pressing in on the shackle adjusting bolt safety clip lock (122F), and pull down on the shackle adjusting bolt safety clip (122B). Pull the shackle adjusting bolt pin (122C) out, releasing the shackle adjusting bolt (122A), Figure 13. Swing the shackle adjusting bolts down and replace the shackle adjusting bolt pins in the brake brackets. Release the spring eye pin safety clips (123G), Figure 14, by pressing in on the safety clip locks (123E). Pull the spring eye pin safety clip down and draw the assembly as far out as it will come.

q. Open the axle pivot pin cap (86C), Figure 12. Lower the jacks until the gun centering pins (85B), Figure 12, rest on the gun axle

(120A), Figure 13. Wipe and lubricate the axle pivot pin housing, clean and lubricate the axle pivot pin (87B), Figure 12, and shove it into place. Close the axle pivot pin cap.

r. Pit for gun clearance. Set the gun at 20° elevation. Place a straight edged board on top of the gun, one end bearing on the ground. Traverse the gun through its arc allowing the board to scribe a line. Elevate the gun to its maximum elevation, place the board under the recoil mechanism, traverse and mark the ground in the same manner as above. Dig a pit within the scribed lines 32 inches deep and shaped as shown in Figure 16.

s. Equipment required for firing:

Panoramic sight, M1917.
Quadrant sight, M1918.
Quadrant sight bracket, M1918.
Sighting platform.
Loading tray.
Sponge and rammer, with staff.

(1) The panoramic sight is attached to an upright arm of the quadrant sight which has a T-shaped slot milled at its upper end to receive the T-shaped lug of the panoramic sight. The panoramic sight is held rigid in the slot by a clamp.

(2) The quadrant sight, M1918, is mounted on the quadrant sight bracket which is bolted to the left trunnion of the cradle. Figure 6 shows the bolt and dowel pinholes used in securing the brackets to the trunnion.

(3) The sighting platform is bolted to the ledge projecting from the bottom of the bottom carriage just inside the left trail. The sighting platform can be attached only when the trails are in the firing position and must be dismounted before the trails are closed for traveling.

8. Elevating.—The elevating handwheel (FB6A), Figure 10, is located on the left side of the top carriage and when turned a complete revolution it elevates the muzzle of the gun 28.72 minutes or 8½ mils.

9. Traversing.—The traversing handwheel (FB6A), Figure 10, is located on the left side of the top carriage and is set at right angles to the elevating handwheel. When rotated in a clockwise direction it traverses the muzzle of the gun to the right; counterclockwise, to the left. Traverse is to be limited within the lines scribed on the top and bottom carriages.

10. Description of limber.—*a.* The gun carriage limber, M1918 (fig. 17), is a 2-wheeled vehicle composed of two sections, (1) a

chassis designed to support and secure the trails and to provide a coupling for the tractor, and (2) a seat for the operator of the road brake. The principal parts of the chassis are the wheels, axle, steering mechanism, frame, and springs.

b. The wheels and wheel fastenings are interchangeable with those of the carriage, but no brake drums are assembled to the wheels.

c. When the trails, coupled together, are raised for limbering, the limber is backed under until the rear spring hangers contact with the limber stops attached to the undersides of the trails. The trails are then lowered until they rest upon the limber forward transom (10A), Figure 17. The clamping trail transom (23A), Figure 17, is laid across the trails behind the trail clamping transom stops and drawn down and forward by the inclined trail clamping bolts, one on either side of the trail. The result is a very rigid connection between the trail and the limber. The trail clamping bolts have eye heads easily detached from the fixed trail clamping bolt pins, when the clamping bolt nuts are loose.

SECTION III

DESCRIPTION OF GROUPS

11. Barrel assembly.—*a.* The barrel of the 155-mm. gun, M1918 MI, is built of six alloy steel forgings. The tube (3A), Figure 1, is enveloped by the jacket (2A) and hoops (4A) and (5A) 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 (13A), which is screwed (cold) onto the jacket. The clip hoop (5B) is shrunk on hoop (5A). A jacket screw (1B) is halved into the jacket and tube to insure the tube from rotating within its enveloping members, the latter in turn being prevented from rotating with relation to each other by dowel pins. The jacket (2A), hoops (4A) and (5A), and the clip hoop (5B) have symmetrical projections fitted with bronze clips on which the gun slides in the cradle when fired.

b. The interior diameter of the breech ring (13A), Figure 1, abutting the breech face of the tube (3A), is threaded and sectored to

receive the breechblock (15A), Figure 2. An extension on the underside forms a recoil lug by means of which the gun is connected to the recoil mechanism. Two lugs on the right side form a hinge for the breechblock carrier (14A), Figure 4. Slightly in front of the hinge the operating lever catch bracket (22A) is fastened. This forms a stop and also serves to hold the breech mechanism in the open position as its operating lever catch (24A) engages the operating lever latch (19A), Figure 2, on the operating lever (18C). Two leveling plates (A12215), Figure 1, of German silver are inlaid in the top of the breech ring. They parallel the axis of the bore of the gun and are used as seats for the gunner's quadrant when laying the gun.

12. Breech mechanism.—*a.* The breechblock (15A), Figure 2, is of the cylindrical interrupted screw type with a 12-mm. (.47244-inch) left-hand buttress thread flattened at the top and bottom on nearly its entire length. The outer diameter is divided into eight sectors, the threads being removed from four sectors. This permits the threads of the breechblock to engage with those in the breech ring by a one-eighth revolution of the breechblock in the breech recess in closing. At the rear end and just in rear of the breech threads, the periphery of the breechblock is threaded to screw into the breechblock carrier. A portion of these threads is cut away and gear teeth are cut in this space for the purpose of rotating the breechblock when it is brought into engagement with a horizontally disposed rack mounted in the breechblock carrier and moved by operation of the operating lever. The breechblock is bored to receive the obturator spindle and hub of the breechblock carrier.

b. The breechblock carrier (14A), Figure 2, is hinged to the lugs on the breech ring (13A), Figure 1, by the hinge pin (21D), Figure 4, and is secured to the latter by the hinge pin driving washer (21C). It is threaded internally to receive the breechblock and has a hub on which the breechblock circles when rotated. The rack lock (16B), Figure 4, and rack lock spring (16C), are in its front side. The hollow hub of the carrier (14A), Figure 4, incloses the firing mechanism housing (50B), Figure 5, obturator spindle (27A) and its allied parts. The breechblock carrier lever catch (24C), Figure 2, locks the operating lever in the closed position. The rack (16A) slides in the breechblock carrier and its teeth mesh with those on the breechblock. The lug which operates the rack is on the underside of the operating lever. Sockets for the rack lock (16B), Figure 4, and the lug of the operating lever are cut in the rack.

c. The operating lever (18C), Figure 2, performs the function of first rotating the breechblock (15A) in the breechblock carrier (14A), until the threads are disengaged and then swinging the mechanism as a whole about the hinge pin (21D), Figure 4, until it is in an open, locked position. For approximately the first 30° of movement of the operating lever (18C), Figure 2, in opening, and the last 30° in closing, the breechblock carrier (14A), Figure 2, is seated. Within the operating lever handle (19B), Figure 2, is an operating lever handle spring (19F), Figure 4, which keeps the operating lever handle (19B), Figure 2, in a raised position and prevents unlocking of the mechanism until pressure is brought to bear on the handle. An operating lever latch (19A), Figure 2, running through the operating lever (18C), locks the breech mechanism in the open position.

d. The obturator mechanism consists of the obturator spindle (27A), Figure 3, front and rear split rings (29C) and (29D), inner ring, gas check pad (29A), filling in disk (29B), obturator spindle spring (28A), Figure 5, and obturator spindle spring supporting washer (28D), Figure 3. The gas check pad is made of one part nonfluid oil and three parts asbestos in a canvas or copper wire screen. Into the head of the obturator spindle (27A), Figure 3, is screwed the obturator spindle vent bushing (A362). The obturator spindle plug (27D), Figure 5, which is screwed into the rear end of the obturator spindle forms the seat for the primer. A copper washer is inserted in front of the obturator spindle plug to make a gas-tight joint. The obturator spindle (27A), Figure 3, passes through the breechblock (15A) and the breechblock carrier (14A). The firing mechanism housing (50B), Figure 5, is inserted into the breechblock carrier and over the rear end of the obturator spindle (27A), Figure 3, which compresses the obturator spindle spring (28A), Figure 5, thereby drawing the gas check pad (29A), Figure 3, and its allied parts to a firm bearing on the muzzle face of the breechblock.

e. The firing mechanism is of the French screw type and is screwed into the firing mechanism housing. It is also common to—

155-mm. howitzer, M1918.
8-inch howitzers, M1917, Mks. VI and VIII½.
240-mm. howitzer, M1918 and M1918 MI.

f. The firing mechanism is composed of a firing mechanism block (C3554), Figure 5, which contains the firing pin (A12258), firing pin spring (A12261), firing pin guide (A12256), firing pin housing (A12257), primer holder (B8058) and two safety set screws

(A12260). The primer holder (B8058) has a slot to receive the head of the primer and is screwed into the forward end of the firing mechanism block (C3554), holding the firing pin guide (A12256) in place. The firing pin housing (A12257) is screwed into the rear end of the firing mechanism block (C3554) and, as its name implies, houses the firing pin (A12258) and firing pin spring (A12261). Safety set screws prevent the unscrewing of the primer holder (B8058) and the firing pin housing (A12257).

g. The firing mechanism block (C3554), Figure 5, is provided with a handle for screwing the firing mechanism into the firing mechanism housing. It can be completely screwed into the housing only when the breech mechanism is closed as the firing mechanism safety plunger (50K) prevents complete assembly at any other time. The firing mechanism block (C3554) has a rim on which the lug on the percussion hammer (B8061), Figure 2, strikes and thus prevents firing unless the firing mechanism is screwed fully home, at which time the lug on the percussion hammer drops into a recess in the rim. Each battery is provided with a gauge to determine when the lug on the percussion hammer is worn beyond the safety limit. When this gauge will pass over the lug, the percussion hammer should be replaced.

h. The firing mechanism safety plunger (50K), Figure 5, and firing mechanism safety plunger spring (50M) are located in the lug in the upper element of the firing mechanism housing (50B). The plunger has a cam surface which bears against an arc cam surface on the inside of a circular boss on the breechblock (15A), Figure 2, when the breech mechanism is not fully closed. This forces the firing mechanism safety plunger (50K), Figure 5, to protrude through and into the space occupied by the firing mechanism, thereby preventing the seating of the firing mechanism. It is possible, however, to partially insert the firing mechanism before closing the breechblock. This practice is strictly prohibited.

i. The firing mechanism block latch (48A), Figure 5, is attached to the breechblock carrier (14A), Figure 2, at the right and a little above the firing mechanism housing (50B), Figure 5. Its function is to prevent the firing mechanism from unscrewing during firing.

j. The percussion mechanism is attached to the rear face of the breechblock carrier (14A), Figure 2, below the firing mechanism housing. The percussion hammer (B8061), Figure 2, is attached to the percussion hammer operating shaft (B8060), which is held in place by the percussion hammer operating shaft collar (A12264), Figure 2, and percussion hammer operating shaft collar detent.

A percussion hammer lock bolt with a knurled finger grip is incased in the percussion hammer operating shaft housing, its function being to hold the percussion hammer stationary when the gun is in traveling position. In firing, as a safety precaution, the percussion hammer lock bolt will be locked immediately the breech is opened, and this bolt will not be unlocked until after the breechblock has been fully rotated and locked in the closed position and the gun is ready to be fired.

13. Counterbalance mechanism.—The counterbalance mechanism overcomes the effect of gravity on the operation of the breech mechanism, making it easier to open and close. It consists of a counterbalance cylinder (31A), Figure 4, attached to the gun by the counterbalance bracket (33A), in which a counterbalance tension rod (31C) slides. Attached to one end of the counterbalance tension rod is a counterbalance piston (31B) acting upon the counterbalance spring (31K) and on the other end is a socket which fits around the counterbalance regulating nut (32A). This nut is fitted to a counterbalance regulating screw (32C) seated in a slotted arm which is a projection of the hinge pin (21D). By rotating the counterbalance regulating screw (32C) the counterbalance regulating nut (32A) is moved in such a manner that the tension of the counterbalance spring (31K) will either be increased or decreased as desired, according to the angle of fire.

14. Cradle.—*a.* The cradle (22A), Figure 9, is a steel forging which rocks on its trunnions in the bearings of the top carriage, Figure 11. The gun slides in recoil and counterrecoil in guiding slots formed on top of the cradle. The largest of the three bores of the cradle contains the recoil mechanism, while the other two house the parts of the counterrecoil system. Bolted firmly to the underside of the cradle is a segment of a worm gear having 94 teeth to the complete circle which forms the elevating sector (62A), Figure 9. The replenisher cylinder (47A) or automatic filler is bolted to the left front side of the cradle.

b. The recoil system is for the purpose of controlling the force created by firing and to check the movement of the recoiling mass in a gradual manner so as not to cause displacement of the carriage. The counterrecoil mechanism is for the purpose of returning the recoiling mass into battery in order that the gun may be fired again.

c. The recoil pointer is attached to the right side of the gun. It is for the purpose of indicating the length of recoil. Previous to firing, by placing grease, chalk, or other substance on the cradle the pointer will trace a record of the length of recoil.

d. The piston rods of the recoil and counterrecoil mechanisms are connected to the lug of the breech ring of the gun. The recoil rod (27C), Figure 8, is hollow and houses the control rod (29A) which does not recoil, being rotatably attached at its front end to the cylinder head. Ports are cut in the recoil piston (28C) leading from the rear of the piston into the interior which connect with grooves cut in the control rod (29A). All space in the recoil cylinder not otherwise occupied is filled with oil, and the oil in rear of the recoil piston (28C) must, in recoil, pass through the ports and control rod grooves. These grooves are so arranged that rotation of the control rod varies the area of the orifices through which the oil must pass. The rotation of the control rod (29A) is accomplished by geared segments linked to the top carriage in such a manner that the position of the rod is automatically controlled by the elevation of the cradle. As the angle of elevation increases the length of recoil is shortened.

e. The replenisher cylinder, or automatic filler, is a device which communicates with the recoil cylinder and assures a sufficient supply of oil at all times. It also serves as a reservoir to permit the escape from the recoil cylinder of excess oil which is due to expansion on account of heat developed during firing, or hot weather.

f. The replenisher cylinder contains a piston which is driven forward by a heavy coiled spring (41B), Figure 7. Should there be no oil in the replenisher the spring will force the piston until it stops against the front end of the chamber.

g. The replenisher piston is prolonged to the rear, the extension serving as a guide to hold the piston in line, as well as acting as a gauge which makes it possible to ascertain at any time the quantity of recoil oil contained in the replenisher. A graduated scale is used for measuring the distance from the rear face of the replenisher to the rear end of the piston extension. The normal working position, indicative of the correct amount of recoil oil, is 150 mm. (5.9 inches) in from the rear face of the replenisher.

h. When it is necessary to add oil to the recoil system to compensate for leakage, it is done through the recoil filling valve in the front of the replenisher housing. A drain plug is set in the front of the cradle for the removal of oil and air from the recoil system.

i. The recuperator cylinder houses the floating piston (fig. 8) which separates the compressed nitrogen in the forward end of the cylinder from the oil in rear of the floating piston. A smaller cylinder which has direct communication with the recuperator cylinder houses the counterrecoil rod (50A), the rear end of which is attached

to the breech ring of the gun. In recoil the oil in rear of the counterrecoil piston is forced through a communicating orifice into the recuperator cylinder, where it forces the floating piston forward and builds up a sufficient pressure in the nitrogen to return the gun to battery. The expansion of the compressed nitrogen forces the floating piston to the rear. It in turn drives the oil against the regulator valve (58B), which closes, leaving two small holes for the passage of the oil to escape into the counterrecoil cylinder. In the latter cylinder the oil forces the counterrecoil rod (50A) forward, forcing the gun into battery.

j. The purpose of the small holes in the regulator valve (58B), Figure 8, is to throttle the oil and reduce the speed of counterrecoil. The effect of such throttling, at the regular valve and at the rear end of the counterrecoil rod. is to ease the gun into battery without shock.

k. The small amount of oil which separates the floating piston from the regulator is known as the counterrecoil reserve oil, and should this oil be reduced through leakage the floating piston would bear against the regulator valve and damage to the mechanism would occur if fired in this position. There is an oil index in the recuperator cylinder rear head which indicates by its position whether or not such reserve oil is present. If there is a full reserve the oil index will project 5 mm. (0.19 inch). If there is no reserve the oil index will disappear into the cylinder head and the system must be filled before firing. Such filling is accomplished with the battery pump or the oil screw filler through the filling valve set in the right side of the cradle about 160 mm. (6.3 inches) from the rear end. A filling and drain plug (46D), Figure 9, is provided in the recuperator rear cylinder head.

15. Top carriage.—*a.* The top carriage (fig. 10) is a heavy steel casting having two upright arms which form a yoke. The upper ends of these arms are machined to receive the trunnions of the cradle. In order to completely encircle the trunnions, trunnion bearing caps (63A), Figure 10, are provided and are assembled into recesses machined in the upright arms. The bottom part of the carriage has a machined surface, elliptical in shape, which bears on a corresponding surface of the bottom carriage when the gun is fired. The top carriage is secured to the bottom carriage (fig. 12) by a wide embracing lug on the latter. In order to facilitate traversing, however, the weight of the top carriage, tipping parts and gun is borne on a small steel pivot and not on the elliptical bearing surface of the top and bottom carriages. The pivot supports the weight through a column of eight Belleville springs (150G), assem-

bled in the elastic suspension housing (83K) bolted beneath the bottom carriage. The force of recoil compresses these springs, permitting contact of the elliptical bearing surfaces as stated above. By changing the position of the spring suspension adjusting nut (83L), the space between these bearing surfaces may be varied within limits. The maximum clearance allowable is 0.012 inch. The clearance between these elliptical surfaces should be only sufficient to make traversing possible with a minimum effort at the traversing handwheel.

b. The handwheels, driving gears and shafting of the elevating and traversing mechanisms are mounted on the top carriage and are operated from the left side. The gearing is inclosed in the sighting gear casing (67A), Figure 10, which sets in a depression in the top carriage casting and is provided with a sighting gear casing cover (69A).

16. Bottom carriage and axle.—*a.* The bottom carriage supports the top carriage and provides hinge connections for the trails. The forward portion of the bottom carriage forms a transverse chamber through which the gun axle passes and in which the axle moves vertically according to the deflection and return of the gun axle spring under road shocks. The front and rear walls of the axle chamber form guiding and bearing surfaces for the axle to control its movement and resist horizontal thrust.

b. The connections with the gun axle differ in traveling arrangement from that in the firing position. In the traveling arrangement the bottom carriage (fig. 13) rests directly on the gun axle spring, to which it is rigidly connected by four spring plate bolts (124C). The gun axle spring (fig. 13) is suspended from the axle (120A) by means of lower spring shackles (121C). When the gun is placed in firing position the lower spring shackles (121C) are disconnected and the weight of the carriage is borne on the gun axle. The two lugs that project from the front of the bottom carriage are provided for applying the lifting jacks by means of which the carriage is lowered until the two gun centering pins (85B), Figure 12, rest on the gun axle, or for raising the carriage to place it in traveling position. The contact of the gun centering pins with the rounded surface of the axle brings a hole in the axle in line with mating holes in the bottom carriage. The round axle pivot pin (87B) is inserted in these openings to lock the axle and bottom carriage together. The bottom carriage is permitted a rocking movement on the axle pivot pin, which thus forms an equalizing device

compensating for differences in level between the top surfaces of the spades and the plane on which the wheels rest.

c. The sides of the bottom carriage are extended as wings to the right and left rear, and each wing is bored to receive the trail hinge pin, which acts as a pivot about which the trail swings in passing from the closed to the spread position.

17. Trails.—*a.* The two trails are composed of steel plates and trail ends, riveted together forming a box beam which is hinged to the wings of the bottom carriage by the trail hinge pins. When spread each trail forms an angle of 30° with the center of the carriage. The outward swing of the trails is limited by the trail ends, which come in contact with and encircle the trail locking bolts. The trail locking bolt nuts (90C), Figure 12, of the trail locking bolts are screwed down into counterbored seats and lock the trails in the spread position.

b. At the rear end of the trails spade seat plates are riveted which form bearing surfaces for the spades. On the inner side of the trails at the rear end are trail connecting pieces. A trail connecting pin inserted through the trail connecting pieces holds the trails in the closed position. Other pieces riveted to the top and bottom near the rear ends are for aligning, supporting, and retaining the trails on the spades or the limber. Translating racks screwed to the top of the trails are for use in moving the gun to and from traveling position. Attached to each trail about midway are traveling bar clips. These clips lock the traveling lock (fig. 21) to the trails when it is fastened to the gun in traveling position.

c. There are two pairs of spades provided—one for use in ordinary or soft ground and the other in hard ground. Both types are built of plates and function both as spades and floats. Each spade is equipped with swing bolts for securing it to the spade clamping transoms.

In traveling, the spades for soft ground are lashed to the tops of the trails, one in front and one in back of the brakeman's seat. (Fig. 17.) The spades for hard ground are carried on an accompanying vehicle.

18. Limber.—*a.* The axle (14A), Figure 17, is a steel forging, I-section in form, similar to the ordinary automobile front axle. The ends are forked and vertically bored to seat the steering knuckle spindles. The steering knuckles (15A), Figure 18, are hinged by the steering knuckle spindle (16A) and are designed to swing in unison by an arrangement of steering arms, steering tie rods (18D), Figure 17, and drawbar tie (20C).

b. Two pads on the axle form seats for the springs and are drilled to receive the ends of the limber spring clips (13D), Figures 17 and 18.

c. The frame is an assembly of two channel-shaped side rails with forward and rear spring hangers (11A), Figure 18, riveted to them, joined by the main steel casting known as the forward transom (10A), Figure 17, and by the flange steel rear transom. It is attached to the axle by two semielliptic, multiple leaf springs which extend beneath the side rails.

d. The forward transom (10A), Figure 17, is bored in the center of the frame for the vertical pintle bolt (19G) of the drawbar tie and is so shaped that it limits the swing of the drawbar tie and consequently the turning angle of the vehicle. The drawbar is hinged on a horizontal pin in the front end of the drawbar tie.

e. The rear end of the drawbar tie is connected by steering rods and their universal joint couplings to steering arms rigidly fixed in the steering knuckles. As the drawbar is swung to either side the steering knuckles are swung in the same direction so that the wheels follow the movement of the drawbar.

f. When the limber is detached from the carriage and drawn as a single vehicle it is necessary to lock the drawbar tie to the forward transom, and this is accomplished by inserting the drawbar key (22C), Figure 17, downward through the transom and drawbar tie. It is also necessary to fix the drawbar to the drawbar tie, and a second drawbar key is inserted through the rear ends of the yoke of the drawbar and a hole in the drawbar tie. The drawbar keys are chained to the drawbar tie to prevent their loss.

g. The leaves of the limber springs are maintained in proper relation by a flattened limber spring centering bolt having a circular head which passes through a hole in the bronze lower spring plate and fits a counterbore in the axle. An upper spring plate is assembled over the spring centering bolt washer above the spring, and holds the spring clips which clamp the spring to the axle in correct position.

h. The springs are bushed at each end and are attached to the forward spring hanger of the frame by the spring eye pins, and to the rear spring hangers through the limber spring shackles.

i. The limber seat support is of box form, built up of plates and angles and bolted to the trail clamping transom. Upon this is secured a support for the cushioned seat back, which support also forms seat arms. The opening at the top of the seat support is

closed by a cover plate surmounted by a padded spring seat which is retained in a flange formed by the top angle of the seat support.

j. The brake lever shaft bearing (25A), Figure 18, and the brake lever yoke bearing are two brackets bolted to the clamping trail transom (23A) to the left and right respectively of the seat support. In these is supported a tubular shaft with a cable rocker on each end. The cable passes from one detachable ball connection with the brake cable of one trail, over the cable rocker on that side, then through the bore of the brake lever shaft and out over the other brake rocker to the other brake rope ball connection. When the brake lever is unlatched and pulled to the rear, the cable winds up on the brake rockers and puts tension on the carriage brake cables. If this tension is unequal the cable slips through the shaft and equalizes the stress. The brake lever latch pawl automatically engages the brake quadrant bolted to the yoke of the brake lever yoke bearing to hold the brake in the tightened position.

SECTION IV

ASSEMBLY AND DISASSEMBLY

19. General (subassemblies of the M1918 MI gun).—It is desirable to complete the subassembling before attempting the assembly of mechanisms to the gun. In all assembling the bearings, sliding surfaces, threads, etc., should be clean and lubricated with class A oil.

20. Disassembly of the operating lever.—Remove the operating lever latch guide screws (18B), Figure 4, the operating lever latch guide (18A), and the operating lever latch trunnion screw

(19E), Figure 2. Withdraw the operating lever latch (19A). Remove the operating lever handle nut (19D), Figure 4. Lift off the operating lever handle sleeve (19C), Figure 4, the operating lever handle (19B), Figure 2, and remove the operating lever handle spring (19F), Figure 4.

21. Assembly of the operating lever.—Pass the operating lever handle over the spindle on the operating lever. Slip the operating lever handle sleeve over the operating lever handle. Drop the operating lever handle spring into its seat in the top of the spindle on the operating lever and screw the operating lever handle nut into the operating lever handle as far as it will go. Insert the operating lever latch into the operating lever (the end with the knob which functions in a round hole in the operating lever handle should enter first with the recessed side of the other end toward the bottom) and depress the latch to permit assembly. Pass the operating lever latch trunnion screw through the operating lever and latch and screw home. The last piece to be assembled is the operating lever latch guide which is held in place by two screws.

22. Disassembly of the percussion mechanism.—The percussion hammer operating shaft housing is permanently assembled to the breechblock carrier (14A), Figure 2, by four percussion hammer operating shaft housing securing screws which can not be removed without special equipment. Remove the percussion hammer operating shaft collar detent, slide the percussion hammer operating shaft collar (A12264) from the percussion hammer operating shaft. Grasp the percussion hammer (B8061) in the right hand, then withdraw the percussion hammer operating shaft (B8060) from the percussion hammer operating shaft housing. Remove the percussion hammer lock bolt spring screw and withdraw the percussion hammer lock bolt (A12217) and percussion hammer lock bolt spring.

23. Assembly of the percussion mechanism.—To assemble the percussion hammer set its hub in the pocket of the percussion hammer operating shaft housing and pass the percussion hammer operating shaft through the housing and the hammer. Assemble the percussion hammer operating shaft collar and its detent. Set the percussion hammer lock bolt spring in the percussion hammer lock bolt and secure by the percussion hammer lock bolt spring screw. Pass the percussion hammer lock bolt into the rectangular shaped hole in the percussion hammer operating shaft housing, taking care to keep the percussion hammer lock bolt spring facing downward. The last piece to be assembled is the percussion ham-

mer lock bolt screw which should be screwed into its seat on top of the percussion hammer operating shaft housing.

24. Disassembly of the firing mechanism.—The firing mechanism block handle and collar are permanently riveted to the firing mechanism block. Remove the safety set screw from the primer holder and unscrew the primer holder (B8058), Figure 5. Remove the firing pin guide (A12256), the firing pin spring (A12261), and the firing pin (A12258). Remove the safety set screw (A12260) and unscrew the firing pin housing (A12257) with the wrench provided.

25. Assembly of the firing mechanism.—Place the firing pin guide in its seat in the block and screw the primer holder in its seat, which will hold the guide in position. Lock the primer holder with the safety set screw. Place the firing pin spring into the firing pin guide and the firing pin into the spring. Screw the firing pin housing into the rear end of the firing mechanism block and assemble the safety set screw.

26. Disassembly of the counterbalance regulating screw.—Withdraw the cotter pin from the end of the counterbalance regulating screw (32C), Figure 4. Remove the counterbalance regulating screw nut (32G) and unscrew the counterbalance regulating screw (32C) from the counterbalance regulating nut (32A).

27. Assembly of the counterbalance regulating screw.—Set the counterbalance regulating nut in the top of the hinge pin. Pass the counterbalance regulating screw through its bushing and into the counterbalance regulating nut until the flange on the screw abuts the one on the bushing. Assemble successively to the other end of the screw the counterbalance regulating screw washer, nut and cotter pin.

28. Disassembly of the counterbalance.—Remove the counterbalance cylinder head screws and unscrew the counterbalance cylinder head (31G), Figure 4. Withdraw the counterbalance tension rod (31C), counterbalance spring (31K), counterbalance piston (31B), and the counterbalance cylinder head (31G) from the counterbalance cylinder (31A). Unscrew the counterbalance cylinder head (pivoted) (31F) from the counterbalance cylinder.

29. Assembly of the counterbalance.—Screw the counterbalance cylinder head (pivoted) (31F), Figure 4, to the counterbalance cylinder (31A). Assemble in the order named the following parts over the counterbalance tension rod (31C): Counterbalance cylinder head (31G), counterbalance spring (31K), counterbalance piston (31B), and the counterbalance tension rod nut.

Place this assembly within the counterbalance cylinder (31A) and assemble the counterbalance cylinder head to the counterbalance cylinder.

30. Disassembly of the operating lever catch bracket.—Take out the two screws which hold the operating lever catch (24A), Figure 4, to the operating lever catch bracket (22A), and remove the operating lever catch and the operating lever catch bracket screws (24F) from the operating lever catch bracket and breechblock carrier (14A). Remove the four block carrier stop screws which hold the block carrier stop to the operating lever catch bracket.

31. Assembly of the operating lever catch bracket.—Place the block carrier stop on the operating lever catch bracket and secure with the four block carrier stop screws. The operating lever catch bracket assembly is secured to the gun by four operating lever catch bracket screws. The two upper screw holes in the gun and in the bracket (bottom side) are counterbored to receive the operating lever catch bracket shims which locate the bracket and keep it from shifting.

32. Disassembly of the breech mechanism.—*a.* Remove the firing mechanism block latch assembly from the breechblock carrier by the removal of its four firing mechanism block latch holder screws (48E), Figure 5. Remove the firing mechanism by rotating it to the left. Drive the hinge pin collar detent (21A), Figure 4, from the hinge pin (21D) and take off the hinge pin collar (21B). Drive out the detent which holds the counterbalance bracket collar to the counterbalance bracket pivot. Remove the counterbalance bracket collar (33B). Open the breech mechanism and insert the counterbalance tension rod spacer between the shoulders of the counterbalance tension rod (31C) and the rear end of the counterbalance cylinder. Then slowly close the breech mechanism and lift off the counterbalance assembly when the counterbalance regulating nut (32A) is at the large opening of the tension rod eye.

b. Raise the hinge pin (21D), Figure 4, about 2½ inches and hold it while opening the breech (the weight of the breech mechanism, when open, will hold the hinge pin up), depress the rack lock (16B) and move the operating handle to the closed position while holding the breechblock open.

c. Depress the firing mechanism housing key spring (50G), Figure 5, and draw the firing mechanism key to the rear as far as possible. It will not come out entirely. Unscrew and remove the obturator spindle (27A), using wrench (U490A), by turning to the

left. Take care not to injure the gas check pad (29A), Figure 3, split rings (29D) and filling-in disk (29B), which are assembled on the obturator spindle (27A).

d. Draw the firing mechanism housing (50B), Figure 5, from the breechblock carrier (14A), Figure 2, with which will come the firing mechanism housing key (50F), Figure 5, and the firing mechanism safety plunger (50K), the latter part being assembled to the housing.

e. Raise the operating lever (18C), Figure 2, on the hinge pin (21D), Figure 4, disengaging the rack (16A), Figure 2, and swing forward as far as possible. With the left hand press the rack lock (16B), Figure 4, down as far as possible and with the right hand turn the breechblock (15A), Figure 2, to the left and withdraw the rack (16A) from the breechblock carrier. Lift out the rack lock (16B), Figure 4, and rack lock spring (16C).

f. Turn the breechblock (15A), Figure 3, to the right approximately four revolutions and slip it from the hub of the breechblock carrier. Remove the obturator spindle spring front seat (28B) and the obturator spindle spring supporting washer (28D) from the bore of the breechblock. Remove the obturator spindle spring rear seat (28C) and the obturator spindle spring (28A), Figure 5, from the breechblock carrier. Lift out the hinge pin (21D), Figure 4, raising the breechblock carrier (14A) slightly to overcome sag, and remove the operating lever (18C), Figure 2, and draw the breechblock carrier (14A), Figure 4, and the hinge pin driving washer (21C) from the lugs of the breech ring.

33. Assembly of the breech mechanism.—*a.* To assemble the breech mechanism to the barrel, place the hinge pin driving washer on the bottom face of the breechblock carrier lug and, while holding it in position, set the breechblock carrier lug between the hinge lugs on the breech ring. Set the operating lever on the upper lug on the breech ring and on the breechblock carrier which should be about 45° from the breech face of the gun. Pass the hinge pin assembly through the operating lever and the hinge lugs of the gun and breechblock carrier. Leave the hinge pin projecting about 2½ inches and swing the operating lever as far forward as possible.

b. Assemble the rack lock and rack lock spring to the breechblock carrier. Set the breechblock on its muzzle face and place in it, in the order named, the obturator spindle spring front seat (with flange down) and obturator spindle spring supporting washer. In the breechblock carrier hub place the obturator spindle spring rear seat (with flange facing muzzle) and the obturator spindle spring.

Place the breechblock on the breechblock carrier hub. Pass a stick through the bore of the breechblock, holding it against the upper side so as to keep the obturator spindle spring, etc., in position. Turn the breechblock to the left, screwing it into the breechblock carrier as far as possible, and then back it off slightly until the assembly line on one of the slotted sectors aligns with the line on the breechblock.

c. Depress the rack lock and push the rack, with the teeth down, into the recess in the breechblock carrier until the line on the rack is about one-fourth inch in advance of the line on the breechblock carrier. With the breechblock and rack set in this position, depress the rack lock and rotate the breechblock to the right as far as possible. This causes the gear teeth on the breechblock to engage in the teeth on the rack, drawing it into the breechblock carrier. Release the rack lock and turn the breechblock to the left until the rack lock engages the rack. Swing the operating lever to the rear until the lug on its bottom side is over the slot in the rack, then lower the operating lever and allow the lug on it to engage the slot in the rack. At this time it will be possible to swing the breechblock into the gun, which should be done slowly the first time so as not to damage the breechblock if not properly assembled.

d. With the mechanism in the open position, depress the rack lock and rotate the operating lever to the locked position to facilitate assembly of the firing mechanism housing and obturating mechanism.

e. Assemble the front split ring, gas check pad, rear split ring, inner ring and filling-in disk to the obturator spindle in the order named.

f. The obturator spindle should then be passed through the bore of the breechblock. Insert the firing mechanism housing key into the notch in the firing mechanism housing so that the lug on the firing mechanism housing key spring abuts against the breech face of the firing mechanism housing. Hold the key in this position and insert the firing mechanism housing into the breechblock carrier. Rotate the obturator spindle to the right so that the threads on it will engage those in the firing mechanism housing and draw the housing into position. When the housing is almost in, depress the firing mechanism housing key spring and at the same time press in on the key until it enters the slot in the end of the obturator spindle as the spindle reaches its final position. This locks the obturator spindle and prevents it from rotating. Close the mechanism to take the weight off the hinge pin.

g. Screw the counterbalance regulating nut to a position about three-fourths inch from its neutral position over the center of the hinge pin to allow the counterbalance cylinder to be placed in position without putting tension on the counterbalance spring. Place the counterbalance tension rod shim on the counterbalance regulating nut. Point the lever arm of the hinge pin toward the muzzle and to the left so that it will just clear the counterbalance cylinder when the cylinder is held in line between the counterbalance regulating nut and the pivot on the counterbalance bracket. Take the counterbalance cylinder, with its allied parts assembled, and pass the elongated hole in the counterbalance tension rod (flat side down) over the counterbalance regulating nut, and at the same time, assemble the other end to its pivot on the counterbalance bracket. Screw the counterbalance regulating nut to its neutral position. Turn the lever arm of the hinge pin so that it points toward the handle of the operating lever (still closed). Tap the hinge pin into position. Assemble the hinge pin collar and detent to the hinge pin, and the counterbalance bracket collar and detent to the pivot on the counterbalance bracket. Note that when the hinge pin is properly assembled the counterbalance holds the breech mechanism open as well as tending to assist in closing.

h. Assemble the firing mechanism block safety latch assembly to the face of the breechblock carrier by means of the four screws.

i. Screw the firing mechanism into the firing mechanism housing as far as it will go. This completes the assembly.

34. Disassembly and assembly of carriage.—*a.* (1) Incidents of wear, breakage, cleaning, and inspecting make necessary the occasional disassembly and assembly of various parts of the carriage. This work comes under two headings—that which can be performed by the battery personnel with the equipment furnished, and that which must be performed by an ordnance maintenance company.

(2) The battery personnel may, in general, do such dismounting as is required for the assembling of the spare parts carried by the battery, and such work should be done in the manner prescribed. Any difficulty which can not be remedied by the prescribed methods will be brought to the attention of the ordnance maintenance company. Battery personnel will not attempt to dismount the gun from the cradle or the cradle from the carriage due to the impracticability of furnishing the organization with necessary equipment for the performance of this work.

(3) Battery personnel will do no filing on the sights; only such filing on the gun parts as is outlined in TR 435–184, and only by order of the battery commander on any carriage part.

(4) The use of wrenches which do not fit snugly on the parts should be avoided, as they will not only fail to tighten the parts properly but will damage the corners of nuts and there is danger of spreading the wrenches and rendering them useless.

b. (1) To remove a carriage wheel, release the brake and take out one of the type A pins of the brake link (133A), Figure 15, and the brake band adjusting bolt spindle (133D), nut, and brake band adjusting bolt spindle washer (133C), thus disconnecting the brake band assembly so that it may come off with the wheel.

(2) Place a jack under the forward lug of the bottom carriage and lift the wheel clear of the ground.

(3) Remove the hub cap, cotter pin, and wheel fastening nut lock collar and slide the wheel off. Weight of wheel and brake parts is about 1,020 pounds. Take off the fiber journal gasket for examination. Preserve all of the nuts and cotter pins for assembling.

(4) Clean all of the parts of the hub and axle spindle and examine for scoring. Smooth off all roughness. Pay particular attention to cleaning the passage for lubricant in the lock collar and lock nut. Special attention should be given to the underside of the axle spindle.

(5) To assemble a carriage wheel to the carriage, the hub liner and axle spindle being clean and smooth and the carriage on the jack as for disassembling, put on the journal gasket, grease the axle spindle, and slip the wheel in place. Follow with the lock collar, wheel fastening nut, cotter pin and hub cap, in the order named, and connect the brake band.

c. (1) The elevating oblique spindle (73B) and traversing oblique spindle (73C), Figure 11, at their upper ends fit elongated sockets which permit of their being raised longitudinally to disengage their lower ends, after which the lower end is swung to one side and the oblique spindle lowered until free at the upper end. A bronze plunger in each upper squared socket is forced downward by a coiled spring and bears against the top of each oblique spindle to hold it down on the connection below. The ends of the socket springs are expanded so that the pressure of the end coils will support the spring sockets when the oblique spindles are removed. The oblique spindle spring sockets (73E), Figure 11, can be pulled out without difficulty with a pair of pliers. These parts must not be omitted in assembling as the oblique spindle may become lost on the road. Clean and

lightly oil the bearing surfaces before assembling. Removal of the oblique spindles exposes oil holes in the heads of the parts below.

(2) To remove a handwheel, elevating or traversing, take out the cotter pin and pull the handwheel off the spindle. Do not lose the small semicircular key. Handwheel handles are easily dismounted for replacement by unscrewing the spindle nut about half its length, holding some solid block against the face of the handwheel and giving the spindle nut a sharp tap with a hammer to loosen the spindle from its tapered seat.

(3) No further dismounting of the elevating and traversing mechanism should be performed by the battery personnel.

d. (1) To dismount the elastic suspension housing raise the rear end of the trail on to the limber, or higher if necessary, to obtain sufficient room to work under the bottom carriage. Remove the adjusting nut locking strap and with wrench (U357D) unscrew the spring suspension adjusting nut (83L), Figure 12, until the top carriage rests on the bottom carriage. Support the elastic suspension housing (83K) by blocking underneath, remove the three elastic suspension housing bolt nuts, and lower the elastic suspension housing (83K), with its contained parts, out of the elastic suspension housing cover. The weight of the housing and contents is about 40 pounds. With the housing dismounted, all contained parts are easily disassembled and replaced without specific instructions. It should be noted, however, that the eight Belleville springs (150G) are assembled in pairs, with the concaved surfaces facing each other. When assembled each pair will rest on the convexed surface of the other pair, as shown in Figure 12.

(2) The upper pivot (83D), Figure 12, may remain suspended in the pivot bolt (83A) by suction. It will not need to be replaced unless badly worn, in which case the ordnance maintenance company will be notified, and will drill a small hole through the center of the pivot (83D) to relieve the partial vacuum behind it.

(3) Before assembling a new upper pivot scribe a deep scratch from top to bottom to relieve the air pressure, and clean and lightly oil the seat in the pivot bolt (83A).

(4) To assemble the elastic suspension housing to the bottom carriage place the upper pivot (83D) in the pivot bolt (83A), using a light clean grease, if necessary, to secure sufficient suction to hold it up. Spring the upper end of the elastic suspension housing cover into the grooves of the pivot bolt.

(5) Having cleaned and lubricated all parts, put the lower pivot assembly with the Belleville springs, nut down, in the housing and

place the stop (83G) on the lower pivot. Pack the housing full of clean lubricating graphite grease. Raise the housing into place, guiding it onto the elastic suspension housing bolts (83M), and screw on the three elastic suspension housing bolt nuts and assemble the cotter pins.

(6) Screw in the spring suspension adjusting nut (83L), Figure 12, and raise the top carriage just enough to traverse the carriage with very little effort applied to the traversing handwheel. Check the clearance between the bottom and top carriages. This clearance must not exceed 0.012 of an inch. Secure the adjusting nut locking strap.

(7) Spring the elastic suspension housing cover down over the head of the housing (83K).

SECTION V

INSPECTION AND ADJUSTMENT

35. Inspection.—The following instructions with reference to the inspection of guns, carriages, and limbers should be scrupulously observed by all concerned:

Parts to be inspected in order of inspection	Points to observe
a. The gun as a unit.	*a.* Note the general appearance; smoothness of operation of the breech mechanism in both opening and closing. Test the firing mechanism by firing two primers. Disassemble the breech mechanism and see that it is thoroughly clean. Note the condition of the bore for copper deposits on the lands and in the grooves; erosion at the origin of rifling; bruises in the gas check seat; burrs or roughness on the leveling plates.
b. Breech recess and breech threads.	*b.* Note if there are scores or bruises in the threads of breech recess and on breechblock.
c. Breechblock carrier assembly and its allied parts.	*c.* Note roughened or scored condition of pintle, firing mechanism housing, hinge pin, rack, rack lock, etc.

d. Percussion hammer.	*d.* Note if the safety lug has been worn so as to allow the snap gauge, A115225, to go over it. If it goes, replace the percussion hammer.
e. Obturator spindle.	*e.* Note if there is erosion of the vent hole and primer chamber; condition of obturator spindle plug, threads on end of spindle; bruised split ring; torn gas check pad; broken or weakened obturator spindle spring. Try several primers in the obturator spindle plug. The primers should extend more than one-eighth of an inch when pressed in hard with the thumb or finger.
f. Counterbalance.	*f.* Test the mechanism and see that it functions properly at different degrees of elevation.
g. Recoil indicator.	*g.* Note whether it is in place and in good condition.
h. The carriage as a unit.	*h.* General appearances. Note whether the oil plugs are painted red and that a ring has been painted around all oil holes, and that the carriage is painted in accordance with regulations.
i. Recoil mechanism.	*i.* See that the proper amount of oil is in both recoil and recuperator cylinders. Note whether the oil index and the replenisher piston function correctly. See that the recoil and recuperator piston rod nuts are screwed tight. When the gun is fired, see that the relief valve in the counterrecoil cylinder front head is functioning properly and allowing the air trapped in the cylinder to escape. See that air is escaping from the replenisher piston guide assembled in the rear end of the replenisher. (See par. 38 *a* (4).)
j. Elevating mechanism.	*j.* Note whether operation is smooth and whether properly lubricated. Elevate and depress. Note the movement of the connecing rod and that it functions properly. Note whether the nut which retains the handwheel is in place.

k. Traversing mechanism.	*k.* Note whether operation is smooth. Note whether there is excessive backlash, and that parts are properly lubricated. Test clearance between the top and bottom carriages using a piece of tin or heavy paper measuring 0.012 inch. This clearance not to exceed 0.012 inch.
l. Trails.	*l.* Note the condition of the translating racks; that the teeth are not burred or broken. Move the trail hinge pin up and down, and see that it is properly lubricated. Test the trail locking bolt nuts for ease of operation, also the traveling bar clip clamping screw.
m. Spade.	*m.* Note condition of swing bolt nuts, and that they move freely on the bolts. General condition of the spades.
n. Bottom carriage.	*n.* Note condition of spring shackles and spring shackle pins and that they are not scored or stuck tight. Open and close the axle pivot pin cap; see that it latches properly.
o. Gun axle.	*o.* Note condition of axle where it bears in the axle housing.
p. Brakes.	*p.* Note condition of brake lining, and that all parts of the brake mechanism function properly, and that all nuts and pins are in place.
q. Wheel.	*q.* Note condition of the rubber; that all torn strips and embedded stones have been removed. Remove the hub cap and see that the gun axle is properly lubricated. Note that all nuts of the brake drum bolts are in place and held by cotter pins.
r. The limber as a unit.	*r.* Note general appearance. Note condition of limber springs; that steering mechanism moves freely; that the seat is in good condition; that trail clamping bolts and nuts are in good condition; that all oil cups are in place and moving parts receiving lubrication.

36. Verification and adjustment of the sights (the quadrant sight, M1918, with panoramic sight, M1917).—*a.* Battery mechanics are forbidden to disassemble any parts of the quadrant or panoramic sights and will make only such adjustments as are hereinafter prescribed. Adjustments are only to be made with tools provided

by the Ordnance Department for the purpose and in the presence of a commissioned officer. Any difficulties which can not be corrected by the methods herein prescribed should be reported to the ordnance maintenance company.

b. When out of adjustment the sights will cause inaccurate firing and should, therefore, be frequently verified, and adjusted when necessary. A testing target (D864), Figure 24, is provided for verifying the sights. Verification of the sights is of such importance that battery commanders may find it advantageous to make permanent arrangements for such verification when occupying a position for an extended period.

c. The procedure under the above conditions is as follows: Place the carriage on a level foundation and with the aid of the gunner's quadrant see that the center line of the trunnions lies in a horizontal plane. Level the sight transversely, set the angle of site pointer at 300 mils, and the elevating scale at 0° elevation, and elevate or depress the gun until the center line of the bore is horizontal as determined by the gunner's quadrant. The bubble in the elevation level should be centered between the reference marks on the level vial. If the bubble is not centered, operate the angle of site worm until the vial is level. Loosen the set screw which holds the rear micrometer clamp in place and unscrew the clamp. Turn the rear micrometer drum without turning the worm until the index on the angle of site housing points to zero. Tighten the rear micrometer clamp and set screw.

d. Suspend the testing target in a plane perpendicular to the bore of the gun and at a distance of about 50 yards. Place the front and rear bore sights in the gun and move the testing target until the center line of the bore, as determined by the bore sights, pierces the target at the center of the lower circle of the target. The verticality of the target should be verified by a plumb line. With the panoramic sight mounted in the shank of the quadrant sight set the azimuth scale and elevation micrometer of the panoramic sight at 0. With the sights thus arranged, the line of sight should pass through the upper circle on the target.

e. If the line of sight pierces the target above or below the upper circle, it indicates that the elevation knob of the panoramic sight is out of adjustment. Operate the elevation knob until the line of sight pierces the target on the horizontal center line. Loosen the elevating knob locking screw and turn the elevating knob without turning the elevating worm until the index on the rotating head points to zero. Tighten the locking screw.

f. If the line of sight pierces the target to either right or left of the upper circle, it indicates that either the cross level of the quadrant or the azimuth micrometer index of the panoramic sight, or both, are out of adjustment. Traverse the panoramic sight until the line of sight pierces the target at the proper point and elevate the gun to maximum elevation, at the same time elevating the quadrant sight. If the point where the line of sight pierces the target appears to move either to the right or left, it indicates that the cross level of the quadrant sight is out of adjustment. Cross level the quadrant sight by turning the leveling worm handwheel until the gun can be elevated or depressed to the full extent of its travel without moving the point where the line of sight pierces the target to either the right or left. With the wrench provided for the purpose loosen the cross level holder set screw and carefully move the cross level holder until the bubble in the level vial is centered between the reference marks, and tighten the set screw.

g. If the azimuth micrometer index does not read zero with the gun returned to 0 elevation it indicates that the azimuth micrometer index is also out of adjustment. Loosen the micrometer locking screw and with the teat wrench provided for the purpose turn the index until the arrow points to 0 on the azimuth micrometer scale, at the same time holding the latter to prevent it from turning. Tighten the locking screw.

h. After the sights are adjusted they should be submitted to the following test to assure their accuracy at extreme elevation and azimuth.

(1) With the carriage level and the gun and sights at zero elevation and deflection, see that the lines of sight and axis of the bore prolonged strike the target at the proper points.

(2) Elevate the gun to its maximum elevation without altering the elevation of the sight. As the elevation of the gun is altered the line of sight should follow the vertical line through the upper circle on the target.

(3) With conditions as in (1) above, traverse the gun to its extreme position in azimuth; as the deflection is altered the line of sight should follow the horizontal line through the upper circle.

(4) By construction and assembly, the sights, if properly adjusted, should fill the above conditions with substantial accuracy. If in error a report of the facts of the case with cause, if known, should be made to the ordnance officer charged with the repair of the matériel, for his information and action.

i. Verification and adjustment of the sights in the field.—In the field, or when a suitable foundation for the carriage is not available, the sights may be verified and adjusted in the following manner, neglecting the angle of parallax: Jack up one wheel of the carriage until the center line of the trunnions is horizontal, as determined with the aid of the gunner's quadrant. Elevate or depress the gun until the center line of the bore is horizontal, as determined with the aid of the gunner's quadrant, and set the elevation scale of the quadrant sight at zero. Cross level the quadrant sight, verify and adjust the elevation level, as directed above. With the aid of the bore sights train the gun on some distant aiming point (2,000 or 3,000 yard range). Proceed as above to adjust the panoramic and quadrant sights so that the line of sight and the center line of the bore will intersect at the aiming point.

SECTION VI

FUNCTIONING

37. Malfunctions of gun.—*Malfunction, cause and correction.*

Malfunction	Cause	Correction
a. Fails to fire.	*a.* (1) Firing mechanism not screwed home.	*a.* (1) Screw the firing mechanism as far beyond the latch as it will go.
	(2) Fouled firing pin.	(2) Remove firing mechanism and disassemble. Wash all parts free of dirt or gummed oil with gasoline. Dry thoroughly and lubricate with light class A oil.
	(3) Deformed point on firing pin.	(3) Remove firing mechanism, disassemble and replace firing pin.
	(4) Weak pull on the lanyard.	(4) Pull lanyard with considerable snap.
b. Fails to fire when proper percussion on primer is obtained.	*b.* Defective primer.	*b.* After three percussions, wait at least 2 minutes and then replace primer.

c. Fails to fire after the primer has discharged.	*c.* (1) Damp or fouled vent hole through obturator spindle.	*c.* (1) Wait at least 10 minutes, remove primer, and clean vent hole.
	(2) Damp charge.	(2) Wait at least 10 minutes and replace the charge.
d. Breech mechanism does not operate freely.	*d.* (1) Lack of lubrication between rack and breechblock carrier.	*d.* (1) Remove the rack. Clean and lubricate.
	(2) Lack of lubrication and the formation of scores in the threads of the breechblock carrier or in the breech recess.	(2) Disassemble the breechblock and thoroughly clean. If the threads are scored, repair must be made by the personnel of an ordnance maintenance company.
e. Percussion hammer not working freely.	*e.* Lack of lubrication and roughness on shaft and shaft bearings.	*e.* Disassemble, clean and remove roughness.

38. Malfunctions of carriage.—*Abnormal conditions and their correction.*

Malfunction	Cause	Correction
a. Replenisher piston less than 100 mm. (3.93 inches) from rear face of replenisher.	*a.* (1) Expansion of oil due to warm weather or continued firing.	*a.* (1) Drain the recoil cylinder until the piston of the replenisher is 150 mm. (5.9 inches) from the rear face of the replenisher.
	(2) Accumulation of air in the recoil system. When the accumulation of air occurs to any great extent after the system has been drained and filled it is	(2) Refer to ordnance maintenance company.

	an indication that the replenisher piston packing is defective or that the cylinder wall is leaking.	
b. Replenisher piston 200 mm. (7.87 inches) from rear face.	*b.* Too little reserve oil.	*b.* Fill the mechanism until the piston is 150 mm. (5.9 inches) from the rear face of the replenisher.
c. Oil leaks from rear of replenisher.	*c.* Whether or not a serious leak exists must be determined by the position of the replenisher piston and the frequency of refilling required in the recoil system.	*c.* There is no cause for alarm should the oil drip rapidly or even run in a stream from the rear of the replenisher when the gun is elevated, provided the cradle has been at zero elevation for some time previously. This condition might exist on a normal replenisher. A leak at any packing that does not exceed three drops per minute is not considered serious.
d. Position of replenisher piston does not change during firing.	*d.* Replenisher piston stuck.	*d.* Insert a block of hardwood in the rear of the replenisher against the piston end and tap with a hammer. It has been found that where the replenisher has not been exercised from time to time the piston rod may become rusted in the replenisher piston guide. The replenisher may be exercised by draining as much of the oil as possible (through the filling and drain valve release) and then pumping in oil until the rear end of the piston rod projects to the rear of the replenisher and any visible rust polished off. Enough oil should then be withdrawn to bring the piston back to normal

		position. The replenishers of all 155-mm. gun carriages in the hands of troops which are not being used for firing should be exercised in the manner prescribed above *at least once a month*. There are two 2-mm. holes in the replenisher piston guide (67D), Figure 7, and one 3-mm. hole in the replenisher cylinder, which are provided for the purpose of draining the cylinder of accumulated water and oil that has passed the replenisher piston, and to provide for the circulation of air through the replenisher. The 2-mm. holes are in the center of the teat wrench holes. The 3-mm. hole is in the underside of the replenisher about 1¼ inches from the rear end. It is very important that these holes be kept open. The walls of a replenisher should never be struck with a hammer or any other article. If the replenisher cylinder becomes dented in any way, report the fact to the ordnance maintenance company.
e. Oil index projects less than 5 mm. (0.19 inch).	*e.* (1) Loss of reserve oil.	*e.* (1) Drain the remainder of the reserve and refill.
	(2) Loss of gas pressure either through the recuperator cylinder front head or past the floating piston.	(2) Gas escaping by the floating piston is indicated by an emulsified condition of reserve oil drained off. If, when proceeding to fill the counterrecoil system in the ordinary manner, the oil index does not move out and the pump works easily, the gas pressure has probably been lost. Substantiate this by an attempt

		to drain the counterrecoil system; oil will not spurt from a mechanism without at least some pressure.
f. Oil index remains stationary when the reserve is pumped in against evident pressure.	*f.* The packing is too tight, or the index is broken or locked by some foreign substance.	*f.* Drain off all reserve oil and refill. While injecting the oil, tap the oil index gently with each stroke of the pump or each turn of the oil screw filler. If the oil index fails to move after 30 strokes of the pump or one and one-half charges with the oil screw filler, refer the matter to the ordnance maintenance company.
g. Oil drips from counterrecoil rod, recoil rod, or control rod stuffing boxes in excess of three drops per minute.	*g.* (1) Broken springs.	*g.* (1) Report to ordnance maintenance company.
	(2) More compression required on springs.	(2) Report to ordnance maintenance company.
	(3) Damaged packing.	(3) Report to ordnance maintenance company.
h. Oil leaks from forward end of counterrecoil cylinder.	*h.* Black oil appearing in front of the counterrecoil piston is a normal condition due to lubrication. Clear oil is an indication of a leak due to broken packing springs or lack of compression on the springs.	*h.* Report a leak of clear oil to the ordnance maintenance company.

i. Excessive leaks from recuperator and recoil filling and drain plugs.	*i.* Sticking of valve or defective packing.	*i.* Remove the plug and insert a piece of ¼-inch drill rod into the hole against the end of the valve stem and tap it lightly with a hammer. If this does not stop the leak, report it to the ordnance maintenance company.
j. Gun will not return to battery.	*j.* (1) Too much oil in the recoil system.	*j.* (1) Drain the recoil reserve oil, purge and refill.
	(2) Insufficient oil in the counterrecoil system.	(2) Drain off the reserve oil and refill.
	(3) Insufficient air pressure.	(3) Report to ordnance maintenance company for investigation.
k. Gun returns to battery with too great a shock.	*k.* (1) Insufficient oil in recoil system.	*k.* (1) Refill recoil system to normal.
	(2) Excess oil in counterrecoil system.	(2) Drain counterrecoil reserve and refill to normal.
	(3) Change of viscosity of oil (due to rapid firing).	(3) Allow mechanism to cool.
	(4) Frictions of various packings too low.	(4) Report to the ordnance maintenance company.
l. Gun slow to return to battery (when oil gauge is normal).	*l.* (1) Insufficient air pressure.	*l.* (1) Report to the ordnance maintenance company.
	(2) Too much friction on packing.	(2) Report to the ordnance maintenance company.
m. Uneven and jerky counterrecoil.	*m.* (1) Too close fit of bearing surfaces such as the re-	*m.* (1) Report to ordnance maintenance company.

	coil rod piston liner and anti-friction ring bearings.	
	(2) Scoring of various bearings.	(2) Report to ordnance maintenance company.
	(3) Foreign substances in the oil.	(3) Report to ordnance maintenance company.
n. Gun in counterrecoil does not cause a hissing sound like air escaping.	*n.* Air vents are stopped up.	*n.* Clean the vents in the replenisher piston guide, using a small wire. If air is not escaping from the counterrecoil cylinder front head notify the ordnance maintenance company who will remove counterrecoil cylinder head and try the relief valve. Disassemble and clean if necessary.
o. Gun recoils more than the maximum distance allowed.	*o.* (1) Insufficient oil in recoil mechanism.	*o.* (1) Refill recoil system to normal.
	(2) Insufficient gas pressure in recoil mechanism.	(2) Report to ordnance maintenance company.
	(3) Insufficient frictions.	(3) Report to ordnance maintemance company.
	(4) Malfunction of control rod.	(4) Report to ordnance maintenance company.
p. Gun does not recoil full distance.	*p.* (1) Low viscosity of oil due to low temperature.	*p.* (1) Warm the recoil mechanism by firing warming rounds or otherwise.
	(2) Scoring of various bearing surfaces.	(2) Report to the ordnance maintenance company.

	(3) Increased friction on all packings.	(3) Report to the ordnance maintenance company.
	(4) Malfunction of control rod.	(4) Report to the ordnance maintenance company.
		((2), (3), and (4) require complete disassembling.)
q. Gun will not elevate to full 35° (when carriage is set on level ground).	*q.* (1) Replenisher cylinder or actuating mechanism jammed.	*q.* (1) Examine the mechanisms and determine what interference exists. Report trouble with the replenisher or any interference not easily removed to the ordnance maintenance company.
	(2) Interference between the elevating sector and elevating worm or top carriage.	(2) Report trouble to the ordnance maintenance company.
	(3) Interference between cradle and top carriage.	(3) Report trouble to the ordnance maintenance company.
	(4) Malfunction of the elevating mechanism.	(4) Report trouble to the ordnance maintenance company.

SECTION VII

CARE AND PRESERVATION

39. Gun.—*a. General.*—(1) Cannon become less copper fouled when properly cared for, and it is known that the wear of cannon does not depend entirely upon the number of rounds fired but very much upon the care given the bore in cleaning, greasing, and cooling between rounds.

(2) The accuracy life of cannon usually depends on the amount of erosion of the bore at the front of the forcing cone or beginning of the rifling. This condition is produced by a fast rate of fire and its attendant excessive heating, therefore it is essential that after 10 rounds have been fired that the piece be washed and oiled and allowed to cool. Each projectile should be cleaned and a slight amount of grease placed on the edge of the rotating band before it enters the bore of the gun.

(3) In cleaning after firing, wash the bore with a solution made by dissolving one-half pound of soda ash or 1 pound of sal soda in 1 gallon of water, using the sponge for swabbing purposes. Wipe perfectly dry, using the sponge covered with burlap, and then oil the bore with a light coating of rust-preventive compound, applying it with the bore slush brush.

(4) The breech should be kept covered to prevent dust and grit getting into the recesses of the mechanism and impeding their easy operation.

(5) Extreme care must be taken to prevent injury to the gas-check seat. Bruises in the gas check seat affect the seating of the split ring and are likely to cause leakage of gas and burning of the gas-check pad. If such a leak should occur, serious erosion may result. Rusting of the gas check seat is likely to occur, due to the gas-check pad being susceptible to moisture. The seat and rings therefore should be well protected by rust-preventive compound when the gun is not in use.

(6) The surface of the leveling plates should be protected from injury. In case of accidental injury repair should be made by the personnel of the ordnance maintenance company.

(7) The breech mechanism should be kept clean and well lubricated. It should be disassembled periodically when not in use and lubricated to prevent rusting.

(8) When in use the mechanism should be disassembled at intervals, and after each firing period cleaned and oiled. This is extremely important as no provision is made to oil by means of the oiler or oil channels.

(9) It is important that any cutting or abrasion on the threads of the breechblock or in the breech recess be reported to the ordnance maintenance company for correction.

(10) If the breechblock does not rotate smoothly or the mechanism requires a greater effort than usual to operate, it should be considered sufficient warning to warrant disassembly and determination of the cause.

(11) In assembly or disassembly do not use a steel hammer directly on any part. A copper drift should be interposed or a copper hammer used to prevent deforming the part.

b. Firing mechanism.—(1) The firing mechanism parts require careful attention and should be disassembled frequently for the purpose of cleaning and oiling. The parts should be washed with gasoline to remove any gummy oil, after which they should be wiped dry and lubricated with class A oil.

(2) Fouling of the firing pin or the use of heavier oil than light class A lubricating oil may result in misfire. This is especially true in cold weather, as the oil may congeal and become gummy.

(3) The primer seat and the vent hole in the obturator spindle should be kept clean by frequent use of the vent cleaning tool. The slightest accumulation of fouling in the primer seat will cause the primer to enter with difficulty and cause trouble in extraction.

c. Misfires.—(1) *Missing of the primer.*—Should the primer fail, no report will be heard. Failure may be due either to a defective primer or because its center has not been struck. An elapse of two minutes should be allowed after which it should be ascertained that the firing mechanism is fully screwed home, using caution to keep as far to one side of the gun as possible. Several attempts should then be made to fire the primer and, if it still misses, an elapse of two minutes must be allowed after which the firing mechanism should be removed and a new primer inserted. Before insertion of a new primer, however, the firing mechanism should be examined to determine whether the firing pin or firing-pin spring is broken or whether the firing-pin housing or primer holder has become loosened.

(2) Any primer removed after an attempt has been made to fire it should be handled with great care due to the possibility of hangfires.

d. Missing of the charge.—Should the primer explode without firing the charge, only the explosion of the primer is heard. This may be caused by a damp or dirty channel in the obturator spindle or because the base of the charge does not bear against the head of the obturator spindle or because the charge is damp. In such cases it is necessary to wait 10 minutes before approaching the piece to avoid accident. Remove the firing mechanism and without opening the breech mechanism run the vent cleaning bit through the channel in the obturator spindle and insert a new primer in the firing mechanism. If the gun does not fire on the second attempt, an interval of 10 minutes must elapse before the breech is opened and the charge removed.

40. Care and preservation of carriage and limber.—*a. General.*—(1) Maintenance of the carriage and limber in service requires proper cleaning, strict observance of the lubrication program, and proper attention to the adjustments of the traveling lock, axle pivot pin, canvas covers, trail clamping bolts and wheel brakes when traveling, as well as in correction of loose or broken parts.

(2) All bearing surfaces, screw threads, and exterior parts must be clean and as free from dirt as possible. Special attention should be given those bearing surfaces which are exposed. When disassembly and assembly operations are being carried on, extra precautions must be taken to prevent the entrance of foreign matter into the working parts.

b. Care of the wheels.—(1) Remove, by means of a screw driver or small bar, any small stones or other foreign substance which may have become lodged in the rubber of the tires.

(2) If a strip of the rubber is cut or torn on the edges of the tires cut off the loose portion to prevent the strip from tearing further.

(3) Keep tires free from oil and grease as much as possible, as these have a deteriorating effect upon the rubber.

(4) Caterpillar band segments should be kept clean and the segment pins well lubricated. Examine the fastening pins frequently and renew those showing evidence of wear or breakage before the segment pin is bent by coming partially out of its seat.

(5) Before traveling, remove the wheels, clean the hub liners and bearings on the axle arms, smooth off any roughness and thoroughly lubricate before replacement. Pack the hub caps with lubricating graphite grease.

c. To adjust the road brake.—(1) As the brake band linings wear, it becomes necessary to tighten them. The carriage being limbered, place lifting jacks under the lugs of the bottom carriage and raise both wheels from the ground. Set the limber hand brake lever at two-thirds of its full travel on the brake quadrant and have a man stand on one of the horizontal spokes of each wheel. (The men should be of equal weight.) Tighten the brake bands equally by screwing down the lower nuts of the brake band adjusting bolts until neither wheel revolves under the weight of the man on the spoke. Release the brake and see if each wheel is free. Set the brake again and repeat the test. The remaining one-third travel of the brake quadrant will allow for some wear of the brake band linings before it becomes necessary to again adjust the brake. When satisfactory action is secured, set the upper nuts of the brake band

adjusting bolts down hard against the lower nuts to secure them from turning.

(2) All adjustments of the brake band for wear should be made through the brake band adjusting bolt (133E), Figure 15, and not by taking up slack in the longitudinal or transverse cables. Stretching of the cables or slipping of the clamps may be taken care of by readjusting and tightening the clamps.

(3) Keep oil and grease from the brake linings. If they become glazed or greasy, clean them with gasoline.

d. Maintenance of the trail and spades.—(1) Clean the notches for the locking bolts in the upper and lower trail ends.

(2) Clean the teeth and upper portion of the translating racks.

(3) Clean and oil the threads and points of the traveling bar clip screws.

(4) Clean that portion of the spade clamping transoms that the spade bolt lock nuts bear upon.

(5) Clean the spades, especially those surfaces which come in contact with the trails; oil the spade clamp bolt threads and the spade clamp bolt lock nuts.

(6) Before fastening the trail to the limber, clean the top and the rear spring hangers of the limber, as well as the limber stops of the trails.

e. Drain holes.—(1) The top carriage should be provided with a drain hole in each pocket. See that these holes are not closed with dirt.

(2) Keep the drain hole in the bottom carriage which leads into the axle housing clean of all obstructions.

f. Recoil mechanism.—(1) Before firing, the recoil and counterrecoil mechanisms should be examined for leakage of oil; that proper amount of reserve oil is in the counterrecoil system and in the replenisher; and to see that the gun slides are well lubricated and that piston rod nuts are properly tightened.

(2) During firing the action of the mechanism should be watched to see that the gun returns to battery smoothly and without shock, and that there is no leakage of oil.

(3) When replenishing the reserve oil it should be carefully filtered through a piece of clean cloth, as well as through the wire strainer of the filling funnel. Every precaution must be taken to prevent the introduction of grit into the mechanism, either in the oil or through failure to clean the filling pipe or connections thoroughly.

(4) To remove and replace a filling or drain plug remove the filling or drain plug with the screw driver (B183). Be careful that the gasket beneath the plug is not lost. Examine the threads of the plug and if in good condition replace and screw the plug upon the gasket tightly, but do not force it excessively.

g. Filling of recoil cylinder.—(1) The position of the replenisher piston (67A), Figure 7, governs the filling of the recoil cylinder. The normal position of the replenisher piston is 150 mm. (5.9 inches) measured from the rear face of the replenisher cylinder (47A). This position indicates a full cylinder and sufficient reserve in the replenisher.

(2) When the replenisher piston is at a point 100 mm. (3.93 inches) or less from the rear face of the replenisher, oil should be removed from the recoil cylinder before firing is continued.

(3) When the replenisher piston has moved in to a point 200 mm. (7.87 inches) or more from the rear face of the replenisher, oil should be added.

(4) Before filling the recoil cylinder with oil test the operation of the replenisher piston by inserting a scale through the opening of the replenisher piston guide (67D), Figure 7, and against the replenisher piston, then releasing oil from the recoil cylinder by means of the filling and drain valve release screwed into the recoil cylinder drain hole (fig. 7). If movement of the replenisher piston takes place proceed with the filling of the recoil cylinder as follows: Unscrew the plug (46D) of the recoil cylinder filling hole (fig. 7) (on left side of the replenisher), and screw the union of the pump coil into the filling hole loosely and pump a little oil through until all air is excluded. The union should be set up without the use of a wrench, except for the final tightening. Extreme care must be taken to prevent any injury to the threads of the filling hole, as any damage may put the entire cradle out of commission. As the filling and drain valve release is already in place, work the pump and force oil through until it flows from the filling and drain valve release free from air bubbles; then remove the filling and drain valve release and continue to work the pump until the rear end of the replenisher piston is 150 mm. (5.9 inches) from the rear face of the replenisher. Remove the filling pipe union and replace the filling and drain plugs.

(5) The oil screw filler may also be used in filling the recoil cylinder with oil. The oil screw filler requires careful handling in order to avoid breaking it off in the filling hole by the operator failing to properly balance the effort required to turn the handle.

Only an experienced man should be allowed to use the oil screw filler and it should only be used when no pump is available.

(6) In filling the recoil cylinder with the oil screw filler remove the filling plug from the replenisher. Before screwing the oil screw filler into the filling hole it must be filled with oil as follows: Unscrew the screw assembly of the filler as far as the threads permit. Unscrew the screw nut from the body and remove the nut and screw. Hold the filler vertically, close the opening at the nozzle with a finger and pour the filler three-fourths full of perfectly clean recoil oil. Replace the filler screw and screw on the screw nut, invert the filler and give the screw a turn or more to remove all air contained in the filler.

(7) Screw the filler into the recoil cylinder filling hole (fig. 7) of the replenisher with great care to avoid damage to the threads. While still loose, give a few turns to the screw to force any air out which may be in the filling hole; then tighten against the gasket. Turn the screw with both hands on the handle, balancing the effort so that there will be no tendency to push the filler to one side. Screw the piston in as far as it will go. Continue the above operation until the replenisher piston (67A), Figure 7, is 150 mm. (5.9 inches) from the rear face of the replenisher. Unscrew the oil screw filler and replace the filling plug.

h. Filling the counterrecoil or recuperator cylinder.—(1) The position of the oil index which is directly below the filling and drain plug (46D), Figure 9, governs all filling and draining of the system. The normal position of the oil index is 5 mm. out from the rear face of the cradle.

(2) When the counterrecoil of the gun or the position of the oil index indicates that there is too small a quantity of oil in the recuperator it will be necessary to drain off the reserve oil before refilling. This is accomplished by inserting the filling and drain valve release into the drain hole in the recuperator rear cylinder head. The reserve oil will spurt out in a stream and suddenly drop at right angle to the flow. At this point the flow of oil should be stopped by unscrewing the filling and drain valve release. It will be noted that the oil index has moved out of sight before all of the reserve oil has been released. If the oil index has not moved tap it gently with a small piece of wood as it may be frozen. The amount of reserve oil which will escape will be close to a quart.

(3) To fill the recuperator system remove the plug from the filling hole located on the right side of the cradle (22A), Figure 9. Clamp the pump chest to the right trail, purge the pump, clean the

union, and screw the union into the filling hole loosely. Work the pump a few strokes to clear the pipe and connection of air, and screw the union firmly against the gasket in the filling hole. Give the pump a few more strokes and screw in the filling and drain valve release. Note whether air bubbles appear in the escaping oil. If free from air bubbles remove the filling and drain valve release. Give the pump exactly 100 strokes which will fill the cylinder with the required amount of oil. It will be noted that 30 full strokes of the pump lever (fig. 22) will cause the oil index to move out to its maximum projection from 5 mm. to 6 mm. beyond the rear face of the cradle, but 70 more strokes of the lever are required to introduce the necessary reserve oil. Detach the pump and replace both plugs.

(4) Filling the recuperator cylinder can also be accomplished by the use of the oil screw filler. The same procedure will be followed in the release of the reserve oil as outlined for filling the system by means of the pump. After the oil screw filler has been filled with recoil oil as outlined in the preceding subparagraph it will be screwed into the filling hole located on the right side of the cradle. The oil screw filler will be filled five times and the contents forced into the recuperator cylinder. Remove the oil screw filler and replace the filling plug.

i. Replacing, adjusting, and assembling a carriage brake rocker spring.—(1) To replace and adjust a carriage brake rocker spring (135A), Figure 15, release the brake, take off the brake shaft nut, unhook the ends of the spring, and remove the brake rocker and the spring. Clean and oil the clutch face.

(2) To assemble, put on the new spring and the brake rocker, hook the ends of the spring and screw the brake shaft nut on one or two turns. Draw the brake band tightly about the drum with any convenient clamp over the brake band ends. Set the limber brake lever at two-thirds of its full movement on the brake quadrant and draw the brake cable tight. The rear end of the brake cable will indicate the position of the upper end of the brake rocker, which may then be set in correct relation to the brake shaft and the brake shaft nut tightened. The length of the brake cables should be such that in the position of brake set as described above, the brake rocker is inclined about 10° forward of the vertical.

j. To change a limber spring (fig. 17) (carriage limbered).—(1) When the limber spring is free the upper leaf may arc so much as to bring the eyes too close together to readily assemble the spring eye pins. For this reason a hardwood block about 4 inches thick should

be wedged between the upper leaf and the limber side rail just forward of the limber spring shackle (13A), to relieve the pressure on the pin before dismounting. The upper part of the limber and trails are then raised by jacks, and the limber spring clips (13D) taken off to free the spring. The same wedges and blocks may then be placed on the replacement spring and the weight on the trails allowed to compress the spring until the lower spring eye pin can be assembled. The spring eye pins should be cleaned of all rust and well slushed with lubricating graphite grease before assembly.

(2) The limber spring leaves are maintained in correct relation by a flat center bolt and side clips. All springs should be thoroughly greased with lubricating graphite grease, as required. The height of the limber spring, when free, is at least 160 mm. (6.3 inches) from top of the axle to center of the eye, deflecting to a height of 110 mm. (4.33 inches) under a load of 4,400 pounds.

k. To replace a limber steering knuckle.—(1) Loosen the steering knuckle spindle lock nuts so that the nuts are together and the bottom of the lower nut flush with or a little below the lower end of the steering knuckle spindle (16A), Figure 18. Set a jack under the spindle with a piece of sheet copper, lead, or other soft metal between the lock nut and jack, and lift that end of the axle. Strike a light blow or two on the top of the yoke of the axle with a piece of timber, if necessary, to start the steering knuckle spindle from its tapered seat in the axle. After starting the spindle transfer the jack to the axle inside the spindle and raise and remove the limber wheel (PB24A), disconnect the steering tie rod (18D), Figure 17, take off the lock nuts and raise the spindle out. The steering knuckle is then free. If it is necessary to change the steering arm, back its nut off a thread or two and turn the steering knuckle down on some solid support which does not interfere with movement of the steering arm. Put a hardwood block on the steering arm nut and strike it with a sledge to start the steering arm out of its tapered seat. Striking on the nut in this manner is less apt to batter the parts than to take the nuts off and strike against the threaded end of the arm or spindle. If the joint between the steering arm and knuckle, which has been solidly set, proves stubborn, soak it with penetrating oil for an hour or so and try again.

(2) The steering knuckle spindle (16A), Figure 18, should fit well in the steering knuckle bushings (16C). If the bushings become worn and permit appreciable side play, they should be replaced. Turning the steering knuckle spindle around one-quarter

of a revolution may tighten the joint so as to make immediate replacement unnecessary. Clean the oil passage in the spindle before assembling and make sure that there is not the slightest particle of grit in or on the tapered portions of the spindle or steering arm to spoil the fit, which must be set up solid.

41. Lubricating instructions.—*a.* The life of the matériel depends to a great extent on proper lubrication. Particular attention should be given to the lubrication of the sliding surfaces of the breech mechanism and cradle gun slides, the elevating and traversing worms, and wheel hub liners.

b. The oil holes of the carriage, recoil mechanism, and limber are generally provided with a special self-closing and telescoping oil cup having a plunger head which is lifted to expose the opening for the lubricant. These oil cups and other locations on the matériel where lubrication is required are painted red.

c. Grit must be kept out of lubricating openings and from the lubricant. In cleaning oil cups and open oil holes the necessary wiping should be done with a piece of firm cloth and no lint should be allowed to remain in any orifice. Open oil holes which have become clogged with congealed oil should be cleaned with a piece of wire.

d. Oil should be applied while the parts are being maneuvered, to insure distribution of lubricant to all moving parts.

e. The various lubricants, and cleaning and preserving materials issued by the Ordnance Department are described and their use prescribed in TR 1395–A.

42. Lubrication of the 155-mm. gun, M1918 MI.—*a.* The gun mechanisms are not provided with oil holes and many of the bearing surfaces may be oiled only after disassembly. The following places are to be cleaned and lubricated immediately after each firing period.

(1) Bore and powder chamber.

(2) Obturator spindle head, split rings, and gas check pad seat.

(3) Gas check pad. Cover entire canvas surface with lubricating graphite grease.

(4) Firing mechanism parts. Wash with gasoline and wipe dry before lubricating.

b. The bearings, such as the operating lever latch, percussion hammer operating shaft, percussion hammer lock bolt, breechblock carrier hinge pin, hinge pin driving washer, counterbalance bracket and tension rod, rack lock and firing mechanism block latch, are to be lubricated with class A oil as often as required to forestall the slightest tendency to rust.

43. Lubrication of the 155-mm. gun carriage and limber, M1918.—In heavy mobile artillery it is hardly practical to fix lubrication periods by regulations because the conditions change with the nature of the service. If the matériel occupies a more or less fixed position, the bearings which move in traveling will need lubrication for the purpose of preventing rust only; if the organization is on the march, the breech, firing, elevating, and traversing mechanisms will require but very little lubrication. It is unquestionably better to over lubricate rather than under lubricate, but this does not justify needless waste of lubricants.

a. The following points requiring lubrication are more or less obscure and apt to be overlooked in oiling the matériel.

(1) Oil cups in the left end of the traversing bevel pinion housing. Oil introduced here lubricates the bevel pinion teeth and works through a channel in the center of the traversing worm pinion (77A), Figure 10, to the bearings on either side of the traversing worm. It can not be seen except when in firing position and when the top carriage is traversed to the left.

(2) The open oil holes in tops of the traversing spindle pinion arbor (77D), Figure 10, and the elevating spindle bevel pinion (73D), which serve the supporting bearings of those parts, are exposed when the piece is fully elevated and the oblique spindles are removed.

(3) The oil cup near the front end of the elevating worm shaft in the elevating bevel pinion housing cover may be reached with the cradle fully elevated. This oil cup serves the bearings of the elevating worm shaft bevel pinion (73A), Figure 10, only. The main bearings of the elevating worm shaft are served by the oil cup in the rear stop (74E), Figure 11, through an oil passage in the center of the worm shaft.

(4) Two oil cups in the floor of the top carriage, one on either side and outside of the elevating worm compartment, lead oil to the surface between the top carriage and bottom carriage. They are accessible when the cradle is elevated.

(5) The great weight carried by the gun axle spring bushings forces out the lubricant and, therefore, the spring eye pins should be frequently withdrawn, rubbed with lubricating graphite grease, then lightly oiled and reinserted. Oil the spring plungers in the forward end of the spring eye pins and shackle adjusting bolt pins, at the same time working the plungers in and out to be sure of proper action. Take this opportunity to work a little oil into the upper

bearings of the lower spring shackle. The limber spring eye pins, especially the rear pins, should also be frequently lubricated.

(6) The front and rear surfaces of the axle in the axle chamber of the bottom carriage, as well as the guides for the limber drawbar, should be well coated with lubricating graphite grease frequently while on the march.

(7) The trail locking bolts should be given a few drops of oil at the top of each bearing in the bottom carriage before the trails are spread and each bolt raised and lowered in the bearings several times to thoroughly distribute the oil. Use lubricating graphite grease and oil on the threads and in the openings in the trail ends. Oil the trail locking bolt nut handle where it slides through the nut. The spade clamping bolt and trail clamping bolt of the limber should receive the same lubrication as the trail locking bolts.

(8) The trail hinge pins should receive sufficient lubrication. Oil should be placed around the head and both upper and lower bearing surfaces between the trail ends and the bottom carriage and the trail swung in and out, or the pin turned by means of a wrench on the trail pin nut to work the oil downward into the bearings. Trail pins of late design have an oil hole closed by a flathead screw marked "oil" in the center of the head. Report a seized trail hinge pin to the ordnance maintenance company.

(9) The axle pivot pin should be cleaned and lubricated each time it is inserted or withdrawn from the bottom carriage.

b. To clean and lubricate the traversing sector.—(1) The top carriage should be traversed to the left until the worm leaves the traversing sector (84A), Figure 12. It may be necessary to withdraw the axle pivot pin and jack up the carriage to obtain clearance between the cradle and wheel. Wipe the traversing sector clean and coat with lubricating graphite grease.

(2) While the gun is at extreme traverse, clean and wipe the top carriage retaining lug and wipe clean the clip on the bottom carriage beneath which the lug moves.

(3) Bring the traversing worm back into mesh very carefully to prevent injury to the teeth of the worm or sector.

c. The elevating sector (62A), Figure 9, should be wiped clean and slushed with lubricating graphite grease and the cradle depressed and elevated through the whole range of elevation. Make sure the elevating worm is covered with a film of grease.

d. Cradle.—(1) Clean and oil all accessible parts of the gun slides while moving the gun from battery to traveling position or vice versa.

(2) Clean and grease the ends of the recoil and counterrecoil piston rods and piston rod nuts with the gun in traveling position.

(3) Clean and oil the valve-turning rod and connecting rod (43A), Figure 7, of the recoil mechanism while elevating and depressing the cradle. Put a few drops of oil in the oil cup at the front end of the replenisher.

e. Top carriage.—(1) In the sighting gear casing cover 4 oil cups are provided, 2 serving the handwheel shafts and 2 the elevating and traversing gear spindles which drive the oblique spindles. About one teaspoonful of oil should be placed in each of the oil cups of the cover at each oiling.

(2) The handwheel handles should be given an occasional drop of oil at each end while the handles are turning on their spindles.

f. Lubrication of the wheels.—By removing the hub caps, filling them with graphite lubricating grease and screwing the hub caps back on, the grease is forced through the space between the hub liner and the top of the axle and will appear on the inside of the hub. This operation is performed in the manner often used in lubricating the front wheels of an automobile, and is considered the approved method of lubrication except when it is deemed advisable to remove the wheels from the axle for inspection of the bearing surfaces.

g. Brake.—The brake cables should be lubricated with lubricating graphite grease where they pass through the cable rocker bushings and rear cable guides on the trail. The ball connections should be oiled occasionally while stretched to maximum length and gymnasticated to work the lubricant into the spring chambers. Drops of oil should be placed at the joints of the links and in the oil cups of the carriage brake brackets and limber shaft bearings. Oil the sides of the slot in the brake lever for the brake quadrant and the joints of the brake lever latch and handle.

h. The ratchet wrenches and the traveling lock pinions should be oiled each time before using.

i. When repairs are beyond the scope prescribed for the using arms, the matériel should be taken to the ordnance maintenance company, who will issue a receipt therefor. When notification of the completion of such repairs has been received from the ordnance maintenance company, the organization will send for the matériel, returning the receipt previously received.

j. Lubricating chart.—The following chart gives the location, lubricant, amount, frequency, and method of application for the various lubricating points of the 155-mm. gun, carriage, and limber when in active service.

OILING AND GREASING CHART

155-mm. gun, carriage, and limber, M1918

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
1	20	Breech threads and breech recess	Spread oil on threads	Oil, lub., cl. A	Twice per week or after firing.
2	20	Firing mechanism threads and firing pin	do	do	Do.
3	20	Breechblock rack and rack lock	At contact surfaces	do	Do.
4	20	Breechblock carrier pintle	do	do	Do.
5	20	Operating lever handle; Firing mechanism block; Firing mechanism block latch; Firing mechanism safety plunger; Hinge pin; Percussion hammer operating shaft; Percussion hammer lock bolt; Counterbalance tension rod; Counterbalance cylinder head (pivoted)	do	do	Twice per week or as required to prevent rust.
	20	Obturator spindle spring; Firing pin spring; Counterbalance spring; Firing mechanism safety plunger	Slush	Grease, graph., lub., medium.	In assembling.
	20	Counterbalance regulating screw	On threads and at ends of bearings.	Oil, lub., cl. A	Twice per week.
		Quadrant sight (not shown in figure)	At bearing surfaces	Oil, neutral	Twice per week. Smear the oil well over the segment.
8	20	Cradle clips	Four special oil cups on each side.	Oil, lub., cl. A	Before firing, retracting, or returning gun from traveling position.
9	20	Trunnion bearing caps	One oil cup on each side	do	Once per week.
10	20	Oil cups (in floor of top carriage)	do	do	Once per week. These cups lubricate the bearing of top carriage on chassis.
11	20	Elevating bevel pinion housing cover	Oil cup	do	Once per week.
12	20	Rear stop	do	do	Do.

OILING AND GREASING CHART—Continued

155-mm. gun, carriage, and limber, M1918—Continued

Ref. No.	Fig. No.	Part	Method	Kind	Remarks
13	20	Elevating worm and elevating sector	At contact surfaces	Grease, graph., lub., medium.	Once per week.
14	20	Elevating spindle bevel pinion	Oil hole in top	Oil, lub., cl. A	Once per week. Remove elevating oblique spindle to uncover oil hole.
15	20	Traversing spindle pinion arbor	do	do	Once per week. Remove traversing oblique spindle to uncover oil hole.
16	20	Traversing bevel pinion housing	Oil cup	do	Once per week.
17	20	Traversing worm and traversing sector	Spread	Grease, graph., lub., medium.	Do.
18	20	Sighting gear casing bearing	Two oil cups in upper rear quadrant.	Oil, lub., cl. A	Do.
19	20	do	Two remaining oil cups	do	Do.
20	20	Handwheel handles	At contact surfaces	do	Once per week at both ends of each handle.
21	20	Connecting rod pins	do	do	Once per week.
22	20	Replenisher cylinder	Oil cup in front end of replenisher.	do	Do.
23	20	Wheels (of carriage and limber)	At hub cap	Grease, graph., lub., medium.	At start of march and after every 50 miles of travel.
24	20	Brake brackets, left and right	Oil cups (2) in brake brackets, and at contact surfaces.	Oil, lub., cl. A	Once per day.
25	20	Gun axle	At guide surfaces in chassis.	Grease, graph., lub., medium.	Twice per week, at front and rear of axle.
26	20	Spring eye pin and shackle	At contact surfaces	Oil, lub., cl. A	Once per week.
27	20	Limber steering knuckle spindle	Oil cups (2)	do	Twice per week.
28	20	Steering tie rod Universal joints	Oil cups (6)	do	Do.
29	20	Pintle bolt	Oil cup (1)	do	Do.

30	20	Drawbar pin	At contact surfaces	do	Do.
31	20	Limber spring eye pin	do	do	Do.
32	20	Drawbar guides	do	Grease, graph., lub., medium.	Once per week.
33	20	Brake lever shaft and brake lever shaft bearings.	Oil cups (2)	Oil, lub., cl. A	Twice per week.
34	20	Brake lever latch and handle Brake lever slots for quadrant Brake cable connections	At contact surfaces	do	Do.
35	20	Trail clamping bolts	On threads	Grease, graph., lub., medium.	Work the nuts over the grease.
		Spade clamping bolts	At sliding handles	Oil, lub., cl. A	Until handles slide freely.
36	20	Trail locking bolts	At top of each bearing	do	Before spreading trails.
37	20	Trail hinge pins	At oil hole in top around the head, and at top of lower bearing.	do	Do.
----	20	Recoil rod and counterrecoil rod	Ends exposed in traveling position.	Grease, lub., cup, No. 5 or compound, rust-preventive, grade B.	When gun is placed in traveling position, and whenever necessary to prevent rust.

44. Paint.—For detailed information regarding the removal of old paint, cleaning and preparation for painting, preparing new paint, application and kinds of paint for different surfaces; brushes, slushing oils, abrasives, burlap, etc., see TR 1395–A.

a. Protection and cleaning of material affected by gas.— (1) Protection against phosgene, chlorine, etc. For material which is in constant danger of gas attacks, whether from gas clouds or gas shells, care should be taken to keep all bright parts of the guns, carriages, mountings, and accessories well coated with oil.

(2) Sights and all instruments should also be covered with oil and protected with covers when not in actual use, care being taken that the oil does not come in contact with any glass or find its way into the interior of the instrument.

(3) All uncapped fuzes or fuzes which have been removed from their containers should be wiped over with oil as soon as possible and protected with a cover.

b. Protection against mustard gas.—It must be remembered that practically all fabrics and materials such as wool, cotton, rubber, and oilcloth can be penetrated by mustard gas if exposed to it a sufficient length of time. The mustard gas actually dissolves in these materials and penetrates them by a slow process of diffusion. In general, it may be said that the greater the length of time required for penetration the greater the danger in wearing these articles after they have been exposed for some time to mustard gas. Attention is called to the fact that rubber boots which have been worn in an area shelled heavily with mustard gas may be a grave danger to the men who wear them several days after the bombardment. Fabrics thoroughly impregnated with boiled linseed oil will resist penetration by mustard gas for over an hour, but it must not be forgotten that after this time these articles are dangerous, because of the mustard gas they contain, which is dissolved in the linseed oil, and they must either be destroyed or the oil renewed.

c. Cleaning.—All bright parts of guns and carriages, together with all accessories and spare parts exposed to the gas, must be cleaned and wiped dry as soon as possible after the attack, and in any case within 24 hours, after which they should be thoroughly coated afresh with oil. The same applies to the whole of the ammunition still in the battery position. Ammunition which for any reason has not been oiled must be cleaned and oiled. It is desirable to expend it as soon as possible.

d. Disinfection of matériel of all kinds affected by mustard gas.— The following measures should be taken for the removal of mustard

gas from various materials and equipment (guns, projectiles, cases, wood, metals, rope, etc.) which have come in contact with mustard gas. For all of the operations indicated below the respirator and special gloves must be worn:

(1) Commence by freeing the objects of dirt, lumps of earth, and liquid with wooden spatulas, rags, etc., which will be buried immediately after this operation. They must never be burned.

(2) Sprinkle a layer of dry chloride of lime over the parts of the equipment that lend themselves to this treatment. After two hours wash off the layer of chloride of lime and rinse thoroughly. It is imperative that all of the chloride of lime be removed in order to prevent the deterioration resulting from its prolonged action. In the case of ammunition it is imperative that no particles of chloride of lime be introduced into the bore of the gun.

(3) Whitewash the parts which do not lend themselves to sprinkling with a thick paste made from three volumes of chloride of lime and one volume of water. After two hours wash off the paste.

(4) The delicate parts of the apparatus, such as breech mechanism, sighting apparatus, glasses, etc., which would be injured by chloride of lime, should be cleaned by dry polishing with rags. After this operation the rags should be buried.

(5) If there are large quantities of water at hand, in the place of chloride of lime use water. The water should be warm, but not boiling, and large quantities should be used. This can not be done in the case of greasy articles, where only chloride of lime should be used.

(6) When it is not necessary to immediately use contaminated matériel, or when one has not the above means at his disposal, it may be considered that the handling of the matériel or apparatus is not dangerous after 6 or 8 days.

e. Transportation of matériel affected by gas.—The removal will be effected by automotive units whenever possible; if horse transport must be used, the route will be carefully reconnoitered in order to avoid infected ground. The matériel will be disinfected as thoroughly as possible before its removal.

SECTION VIII

ACCESSORIES

45. Accessories—general.—There are a number of accessories provided with this matériel, such as crowbar, pinch bar, water bucket, covers, wrenches, etc., the names or general characteristics of which plainly indicate their use and application. Therefore, no detailed description nor method of use is outlined herein. The special accessories, however, being of a different nature, description, purpose, and method of use are outlined in paragraphs following.

46. Artillery gun book.—The artillery gun book (O. O. Form 5825) is issued for the purpose of keeping an accurate record of the gun. It must always remain with the gun, regardless of where the gun may be sent. The book is divided as follows: Record of assignments of the gun to the various batteries, battery commander's daily gun record, inspector's record of examination, and forms to be filled out in case of premature explosions.

47. Caterpillar band.—The caterpillar band is for the purpose of providing more bearing surface under the wheels in both traveling and firing positions as shown in Figures 6 and 10. The caterpillar band is assembled over the rubber tires of the gun carriage and limber wheels. Each band consists of a chain of 12 segments to which are hinged 12 caterpillar band shoes. They are held in relation to each other by 12 caterpillar band segment pins. The latter are secured by fastening pins, 2 to each segment pin.

a. When the tires and caterpillar bands are new, each band consists of 1 caterpillar band segment type B, which is 14.76 inches

long between pin centers, and 11 caterpillar band segments type A, 12.79 inches long. After the tires wear to a smaller diameter and the segment pins wear their bearing surfaces, the type B segment is replaced by a type A segment.

b. To facilitate handling, the caterpillar band is divided into two half sections. The weight of one half section is 267 pounds.

c. Lubrication of caterpillar band segment pins is accomplished by rubbing the segment pin at assembly with lubricating graphite grease until a graphite surface is established, then oiling with class A oil.

d. The caterpillar band bearing and pins should not be oiled when traveling through sand or loose dry earth, as these materials mix with the oil and form a cutting compound.

48. Jack beam.—The purpose of the jack beam is to facilitate the maneuvering of the trails to the traveling or firing position. The jack beam is an I-beam and at each end is fitted an end piece. In the center of the beam there is a fulcrum member which is riveted to the top side. A fin of the fulcrum fits within a slot in the maneuvering lug at the rear of the bottom carriage which is held in position by a pin. The complete beam is 2.660 mm. (102¾ inches) long and weighs 364 pounds.

49. Jack, 15-ton.—The jack is of the lever-action type having a lifting capacity of 15 tons and a lift of 17 inches. The weight of the jack is approximately 100 pounds. Until lever jacks are available some batteries will be equipped with hydraulic jacks. Repairs to these jacks will be made by the ordnance maintenance company.

50. Loading tray.—The loading tray is used to support the projectile and to protect the breech threads when the gun is loaded. The loading tray is a concaved metal trough, having one end closed by an end piece. Handles are attached to the sides for lifting, and at the nose of the tray two lateral guides are assembled which slide into the spaces cut in the breech sectors. A bronze stop on the bottom of the tray engages a socket in the breech ring and retains the tray in position.

51. Pump.—*a.* A special plunger pump (fig. 22) is provided for filling the recoil and counterrecoil systems with oil. This pump is housed in a wooden chest. Clamps are provided under the chest to secure it when in use to the right trail of the gun carriage.

b. The horizontal plunger or piston of the pump is driven by a vertical lever which is fulcrumed in a bracket by a pin. In the bracket are two holes which may be utilized if it is desired to increase or decrease the leverage to suit the back pressure of the pump.

This is accomplished by moving the fulcrum pin into the upper or lower hole of the bracket. The lower position gives the plunger or piston a shorter stroke and greater ease in operating the pump, and is usually used. Attached to the pump outlet valve is a copper coil which may be attached to the filling valve of either the recoil or counterrecoil cylinder.

c. When filling the reservoir of the pump the oil must be strained through a clean cloth in order that no foreign matter may enter the reservoir. The capacity of the reservoir is 6 quarts. If the pump should get out of order the ordnance maintenance company should be notified.

52. Oil screw filler.—The oil screw filler is a high-pressure hand pump, and is only used to replenish the recoil and counterrecoil systems with oil when the pump is out of commission.

53. Filling and drain valve release.—The filling and drain valve release is used to drain the reserve oil from the recoil and counterrecoil cylinders.

54. Other items in pump chest.—In addition to the above items the pump chest contains a funnel (with strainer), a 25-cm. steel rule which is used in measuring the position of the replenisher piston, and a flat wrench (U378E) having openings 21.3 and 35.3 mm., fitting the pump copper coil unions and stuffing box. The 35.3-mm. opening of the wrench fits the sighting gear casing bolt sleeve nut.

55. Tool chest.—With each carriage is issued a metal bound wooden chest for the several small tools and wrenches. Including the top and bottom cleats and clearance for the lock and rope handles, the tool chest occupies a space of $18\frac{5}{16}$ by $36\frac{13}{16}$ by $20\frac{7}{8}$ inches, or 8.14 cubic feet. Its weight with contents is approximately 270 pounds.

56. Chest for sighting equipment.—The sighting equipment chest is provided with each carriage for the transporting of the quadrant sight, panoramic sight, gunner's quadrant, panoramic sight extensions, and the accompanying wrenches and covers. This chest is of wood, occupies a space, including clearances for lock and hinges, of 18 inches wide by $47\frac{3}{8}$ inches long by $12\frac{5}{8}$ inches high, and weighs, without contents, about 73 pounds.

57. Contents of spare sight chest.—One spare set of sights is carried by the battery. The muzzle and breech bore sights and testing target used in verification of the sights are carried in the spare sight chest.

58. 2-ton duplex chain block.—The 2-ton duplex chain block is carried in a steel chest 15.9 by $22\frac{3}{16}$ by 5.5 inches in size. Weight of the chain block, chest, and oak packing block is 162 pounds.

59. Sponge and rammer, with staff.—*a.* The sponge is for the purpose of swabbing and cleaning the bore of the gun, and is composed of a block of wood cylindrical in shape and covered with carpet. Assembled to the rear of the wood block is a sponge head coupling sleeve which is to receive the staff.

b. The rammer is used for the purpose of ramming projectiles into the bore, or for removing projectiles from the bore. The rammer consists of an aluminum head which is deeply recessed in order to clear the longest fuze assembled in a projectile. The rear end is threaded to receive the rammer staff.

c. The staff is composed of three sections of steel pipe, one having a male and female coupling, the other a male coupling and a staff end button. The third and shorter section is equipped with a male coupling and a staff end button. From the front face of the rammer head to the white line of the short staff is the distance that each projectile should be seated in the bore of the gun.

60. Traveling lock.—*a.* The traveling lock (fig. 21) is for the purpose of supporting and providing a means of retracting the gun to its traveling position or moving the gun into its firing position.

b. The traveling lock is attached to the gun by a locking screw nut which fits into a T-shaped slot in the breech lug, and when the locking screw is tightened the traveling lock is firmly secured to the gun.

c. Two pinions, housed one in each end of the traveling lock, engage the translating racks on the trails and may be revolved by their ratchet wrenches when the piston rod nuts have been removed from the recoil and counterrecoil piston rods, thereby retracting the gun either to or from traveling position.

d. When the gun has been retracted and further movement stopped by the traveling bar clips it is locked in position by the traveling bar clip locking screw.

61. Snap gauge, A115225.—Snap gauges, A115225, have been issued for checking the length of the safety lug on the percussion hammer. A smooth surface has been made on the back of the percussion hammer opposite the safety lug, for use as a reference in determining the wear on the safety lug. If this gauge will go over the hammer, with one face of the gauge over the safety lug and the other face over the reference plane on the back of the hammer, the safety lug is too short and the percussion hammer is unsafe for further use.

SECTION IX

DATA

62. Weights, dimensions, and ballistics.—The following weight, measurement, and ballistic data are included herein for the information of all concerned:

Weight of 155-mm. gun, M1918 MI, complete	8,715 pounds.
Caliber, 155-mm. or	6.102 inches.
Length (muzzle to rear face of breech ring)	232.87 inches.
Chamber:	
Diameter	6.693 inches.
Length, breech closed to base of projectile	37.087 inches.
Capacity	1,329 cubic inches.
Rifling:	
Number of grooves	48.
Twist, right-hand, uniform, 1 turn in 29.89 calibers (inclination 6°).	
Travel of projectile in bore	185 inches.
Weight of projectile	95 pounds.
Weight of full powder charge	25¼ pounds.
Maximum powder pressure per square inch	31,500 pounds.
Range with full charge	18,000 yards.
Rate of fire (with supercharge):	
4 rounds per minute for not to exceed 40 rounds.	

63. General data pertaining to the 155-mm. gun carriage, M1918, and 155-mm. gun carriage limber, M1918.

Weight:	
Weight of recoil mechanism with elevation sector and piston-rod nuts	3,114 pounds.
Weight of sights and bracket, panoramic sight 5 pounds, quadrant sight and bracket 41 pounds	46 pounds.
Weight of 2 large spades	1,220 pounds.
Weight of accessories carried on carriage and limber (including axle pivot pin 27½ pounds)	35 pounds.
Weight of limber chassis	3,600 pounds.
Weight of limber seat and trail clamping transom	245 pounds.
Weight of remainder of the carriage	10,970 pounds.
Total weight, gun (8,715 pounds), carriage and limber, road position, without caterpillar band	27,800 pounds.

Weight—Continued.	
Reaction at each carriage wheel (road position)	8,300 pounds.
Reaction at each limber wheel (road position)	5,600 pounds.
Weight of caterpillar band for one wheel	534 pounds.
Weight of one 1,160-mm. dual rubber-tired wheel (average without 35-pound brake drum)	985 pounds.
Dimensions:	
Width of track, center to center of wheels	88.58 inches (2.250 mm.).
Greatest width (over hub caps)	105.28 inches (2,674 mm.).
Height of center line of bore from ground (at zero degree elevation without caterpillar bands)	54.17 inches (1,376 mm.).
Caterpillar bands raise the gun approximately	2 inches (51 mm.).
Height of line of sight above ground	69.81 inches.
Height of cradle trunnions above ground	52 inches.
Wheel base, carriage, and limber	14 feet 9 inches.
Width of space required for half-turn	52 feet 6 inches.
Length over all, traveling position, gun, carriage, and limber	28 feet 8 inches.
With 10-ton artillery tractor (approximately)	42 feet 8 inches.
Road clearance (without caterpillar bands), at middle of gun axle spring	11 inches.
At ends of gun axle spring	8½ inches.
Maneuvers:	
Range movement in elevation from 0° to 35°	(622.2 mils).
Movement in elevation for one turn of the handwheel	0° 28′ 72″ (8½ mils).
Traverse to right or left from mid-position	30° (533½ mils).
Movement in azimuth for one turn of traversing handwheel	0° 43′ 2″ (12.8 mils).

155-mm. gun emplacement.—When the 155-mm. gun is used on the 180° emplacement, the spade seat is removed and one of different design applied. Instructions covering this change will be published by the Ordnance Department. If these guns are later required for use in a field emplacement, no change will be necessary as the spade may be used with the new spade seat plate.

SECTION X

SUBCALIBER EQUIPMENT

64. General.—*a.* The purpose of the subcaliber equipment is to provide for a greater amount of target practice than could be obtained by the use of the regular 155-mm. ammunition. This is accomplished by the conversion of the value of the allowance thereof into 37-mm. ammunition. Save for the firing of other than the regular ammunition, the handling and loading of which differs, as well as the range, the training is with the 155-mm. gun matériel.

b. Subcaliber firing is accomplished by the use of the 37-mm. gun and tank cradle, M1916, mounted on the top of the 155-mm. gun by means of the 37-mm. subcaliber mount, M1.

65. Description and operation of the mount.—The 37-mm. subcaliber mount, M1, is composed of the mounting bracket (C6270), Figure 23, to which are riveted the band (B102747), 2 trunnion caps, a U-bolt, with nuts and lock washers, 4 cap screws and 2 set screws. The mounting bracket fits on top of the 155-mm. gun as shown in Figure 23. The front end of the mounting bracket is drilled for the U-bolt while the rear end has a milled slot which engages the elevating screw latch catch of the 37-mm. gun tank cradle.

66. Assembly and disassembly.—*a.* Place the mounting bracket (C6270), Figure 23, on top of the 155-mm. gun with its front edge approximately 117½ inches from the muzzle or just in front of the reduction in diameter of hoop (4A), Figure 1. Place the U-bolt (B102748), Figure 23, around the gun from underneath and up through the holes in the bracket and secure it with the lock washers (B5282F) and nuts (A17395). Tighten the set screws (Q84A) of the band (B102747). This will force the lower ends of the band against the cradle flanges and thereby draw the rear end of the bracket firmly to the gun.

b. Remove the trunnion caps (A17940) from the bracket (C6270). Lift the 37-mm. gun and cradle and assemble the elevating screw latch catch in the milled slot of the bracket; then lower the gun and cradle into the trunnion bearings of the bracket and replace the trunnion caps.

c. As the trunnion caps (A17940) are not interchangeable it is essential that they be assembled to the side to which they pertain.

67. Bore sighting.—*a.* As the subcaliber gun is to be laid with the regular sighting and maneuvering mechanisms of the 155-mm. gun, the bores of the guns should be parallel. To secure proper alignment when the 155-mm. gun carriage is in firing position bore sights are set in the subcaliber gun.

b. Verification of the sights having been accomplished as described in paragraph 36 the following procedure should be followed in bore sighting the 37-mm. subcaliber gun.

(1) Make a testing target by wrapping two pieces of black tape of equal width around the aiming post with the lower edges exactly 13.72 inches apart. By the use of the aiming post as a testing target it will not be necessary to level the 155-mm. gun as the aiming post can be canted to conform to the angle of the gun so that the vertical line of the bore of the 155-mm. gun will coincide with the side of the aiming post. Place the testing target some distance from the gun.

(2) Use the bore sights to line up the bore of the 155-mm. gun with the lower edge of the lower tape on the aiming post.

(3) Use the bore sights for the 37-mm. gun and bore sight it on the testing target. The bore of this gun should be lined up with the lower edge of the upper tape on the aiming post.

(4) The adjustment of the 37-mm. gun upon the testing target is made by placing shims upon the mounting bracket to bring the 37-mm. bore sight on the lower edge of the upper tape on the aiming post.

(5) In order that the initial assembly of the 37-mm. subcaliber mount on the 155-mm. gun may serve as a guide in proper alignment for all future mountings of the same nature, the following should be carefully noted and executed:

When the bore sighting of the 155-mm. gun and the 37-mm. subcaliber gun is completed, assembly or witness lines must be placed upon the front and rear ends of the mounting bracket and the barrel of the 155-mm. gun. These lines are to be scribed sufficiently heavy in order that they may be easily located and lined up in future mountings. Weld shims to mounting bracket.

68. Care and preservation.—Repairs to this mount will be minor in nature, and will involve only the removal of burrs when necessary and the replacement of nuts, lock washers, and set screws. When the subcaliber mount is dismounted the U-bolts with lock washers and nuts should be assembled in their proper places.

69. Accessories and spare parts.—Accessories and spare parts for the subcaliber equipment are shown in Standard Nomenclature List No. D–11.

[A. G. 062.12 (8–22–30).]

BY ORDER OF THE SECRETARY OF WAR:

DOUGLAS MacARTHUR,
General,
Chief of Staff.

OFFICIAL:

C. H. BRIDGES,
Major General,
The Adjutant General.

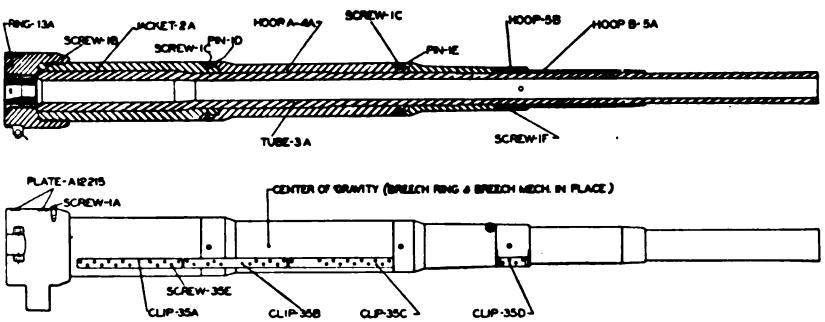


FIGURE 1.—155-mm. gun, M1918—assembled views

Reference	Item	Reference	Item
35C	Clip, front, right.	1E	Pin, hoop B.
35D	Clip, hoop, right.	A12215	Plate, leveling.
35B	Clip, intermediate, right.	13A	Ring, breech.
35A	Clip, rear, right.	1A	Screw, breech ring.
4A	Hoop, A.	35E	Screw, clip.
5A	Hoop, B.	1F	Screw, clip hoop.
5B	Hoop, clip.	1C	Screw, hoop.
2A	Jacket.	1B	Screw, jacket.
1D	Pin, hoop A.	3A	Tube.

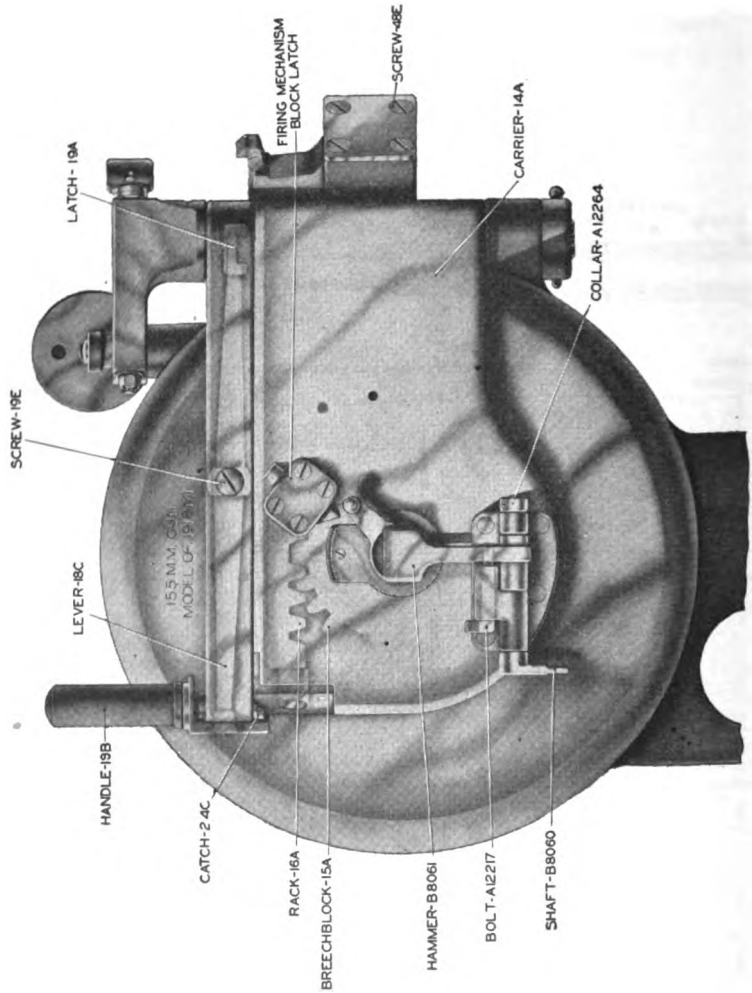


FIGURE 2.—Breech mechanism—assembled and sectioned views

Reference	Item	Reference	Item
A12217	Bolt, percussion hammer lock.	19A	Latch, operating lever.
15A	Breechblock.	18C	Lever, operating.
14A	Carrier, breechblock.	16A	Rack.
24C	Catch, breechblock carrier lever.	48E	Screw, firing mechanism block latch holder.
A12264	Collar, percussion hammer operating shaft.	19E	Screw, operating lever latch trunnion.
B8061	Hammer, percussion.	B8060	Shaft, operating, percussion hammer.
19B	Handle, operating lever.		

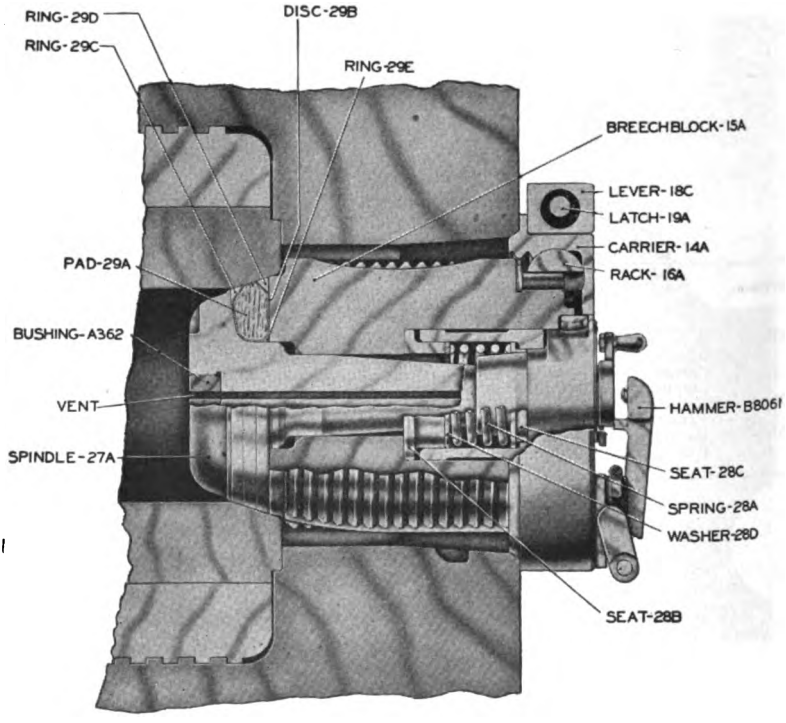


FIGURE 3.—Breech mechanism—assembled and sectioned views

Reference	Item	Reference	Item
15A	Breechblock.	29E	Ring, inner (obturator).
A362	Bushing, obturator spindle vent.	29C	Ring, split, front (obturator).
14A	Carrier, breechblock.	29D	Ring, split, rear (obturator).
29B	Disk, filling-in (obturator).	28B	Seat, obturator spindle spring, front.
B8061	Hammer, percussion.	28C	Seat, obturator spindle spring, rear.
19A	Latch, operating lever.	27A	Spindle, obturator.
18C	Lever, operating.	28A	Spring, obturator spindle.
29A	Pad, gas check.	28D	Washer, supporting, obturator spindle spring.
16A	Rack.		

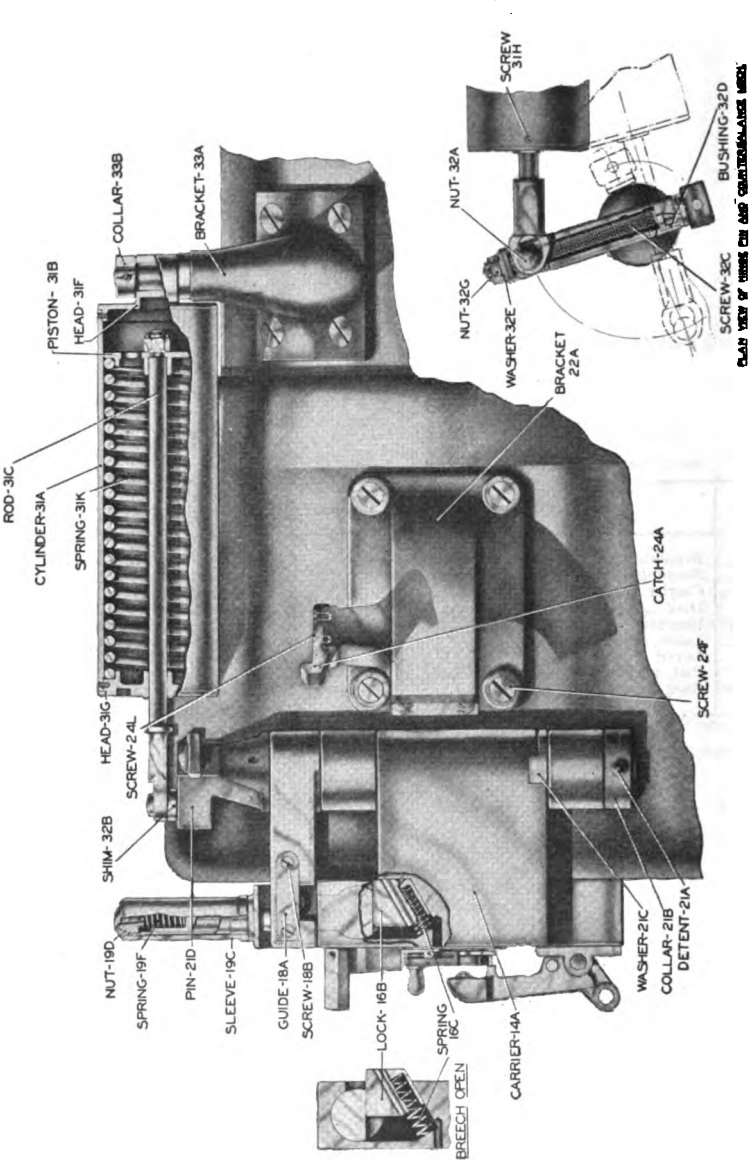


FIGURE 4.—Breech mechanism and counterbalance cylinder—assembled and sectioned views

Reference	Item	Reference	Item
33A	Bracket, counterbalance.	32A	Nut, regulating, counterbalance.
22A	Bracket, operating lever catch.	21D	Pin, hinge.
32D	Bushing, counterbalance regulating screw.	31B	Piston, counterbalance.
		31C	Rod, counterbalance tension.
14A	Carrier, breechblock.	31H	Screw, counterbalance cylinder head.
24A	Catch, operating lever.	32C	Screw, counterbalance regulating.
33B	Collar, counterbalance bracket.	24L	Screw, operating lever catch.
21B	Collar, hinge pin.	24F	Screw, operating lever catch bracket.
31A	Cylinder, counterbalance.	18B	Screw, operating lever latch guide.
21A	Detent, hinge pin collar.	32B	Shim, counterbalance tension rod.
18A	Guide, operating lever latch.	19C	Sleeve, operating lever handle.
31G	Head, counterbalance cylinder.	31K	Spring, counterbalance.
31F	Head, counterbalance cylinder (pivoted).	19F	Spring, operating lever handle.
		16C	Spring, rack lock.
16B	Lock, rack.	32E	Washer, counterbalance regulating screw.
32G	Nut, counterbalance regulating screw.	21C	Washer, driving, hinge pin.
19D	Nut, operating lever handle.		

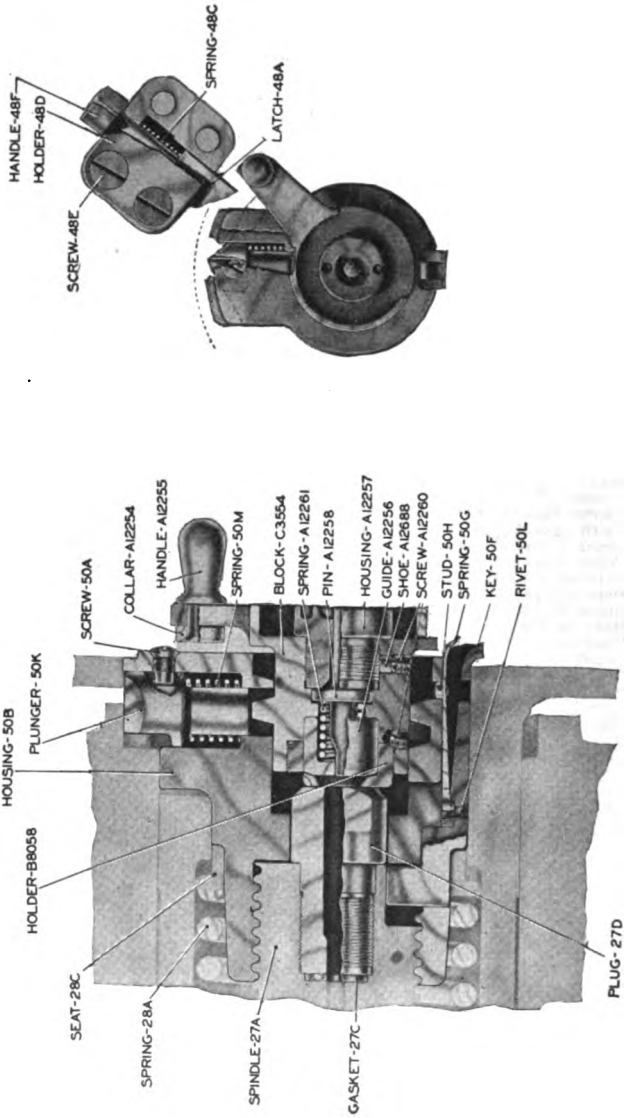


FIGURE 5.—Firing mechanism—assembled and sectioned views

Reference	Item	Reference	Item
C3554	Block, firing mechanism.	50L	Rivet, firing mechanism housing key.
A12254	Collar, firing mechanism block handle.	48E	Screw, firing mechanism block latch holder.
27C	Gasket, obturator spindle plug.	50A	Screw, firing mechanism housing.
A12256	Guide, firing pin.	A12260	Screw, set, safety.
A12255	Handle, firing mechanism block.	28C	Seat, obturator spindle spring, rear.
48F	Handle, firing mechanism block latch.	A12688	Shoe, firing mechanism.
48D	Holder, firing mechanism block latch.	27A	Spindle, obturator.
B8058	Holder, primer.	48C	Spring, firing mechanism block latch.
50B	Housing, firing mechanism.	50G	Spring, firing mechanism housing key.
A12257	Housing, firing pin.	50M	Spring, firing mechanism safety plunger.
50F	Key, firing mechanism housing.	A12261	Spring, firing pin.
48A	Latch, firing mechanism block.	28A	Spring, obturator spindle.
A12258	Pin, firing.	50H	Stud, firing mechanism housing key spring.
27D	Plug, obturator spindle.		
50K	Plunger, safety, firing mechanism.		

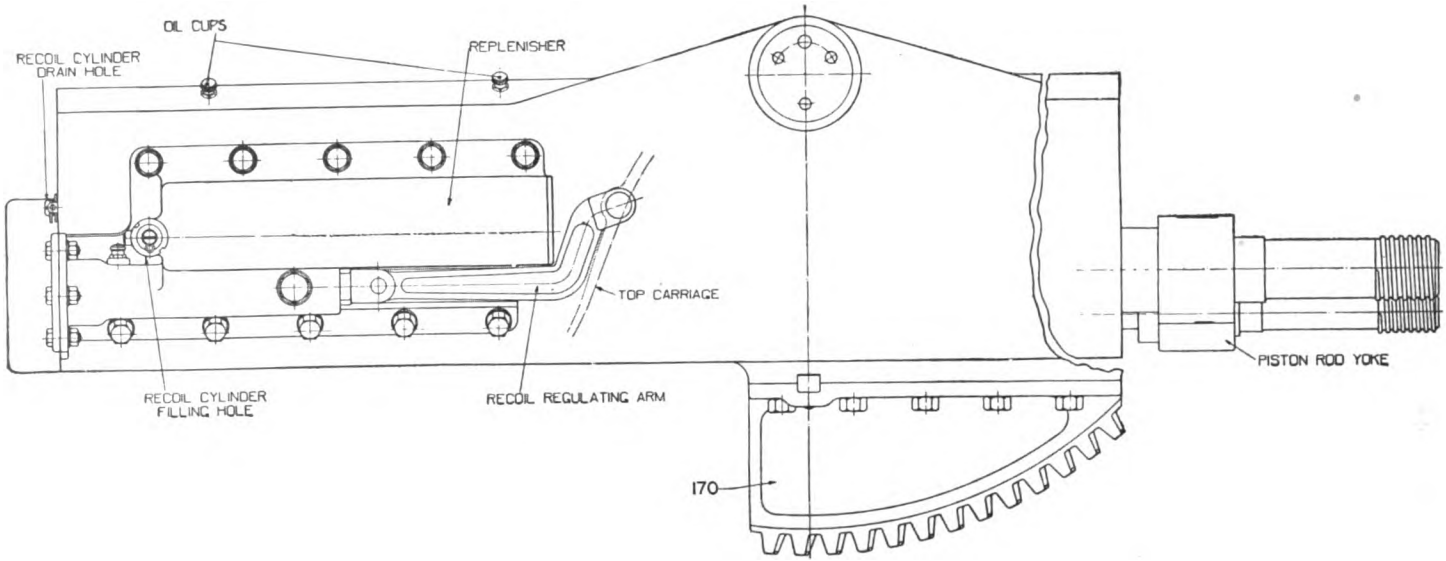


FIGURE 6.—Recoil mechanism—side view

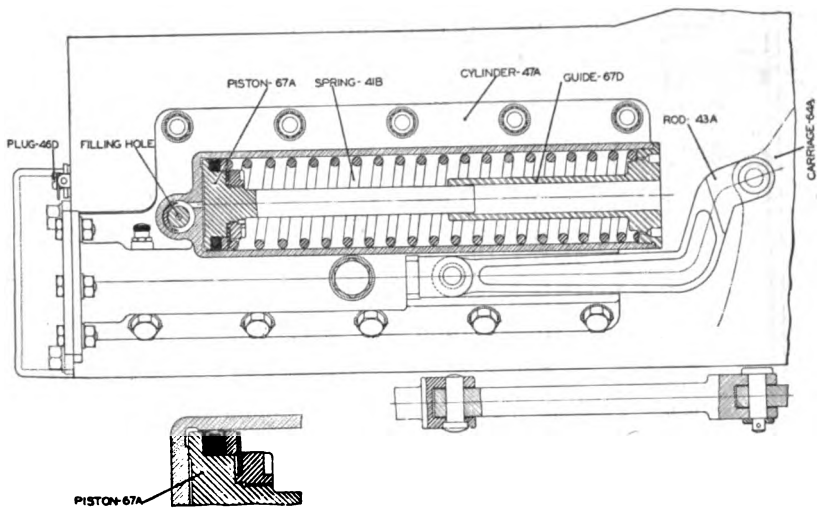


FIGURE 7.—Replenisher, assembled views

Reference	Item	Reference	Item
64A	Carriage, top.	67A	Piston, replenisher.
47A	Cylinder, replenisher.	46D	Plug, recoil cylinder drain.
67D	Guide, replenisher piston.	43A	Rod, connecting.
----------	Hole, recoil cylinder filling.	41B	Spring, replenisher piston.

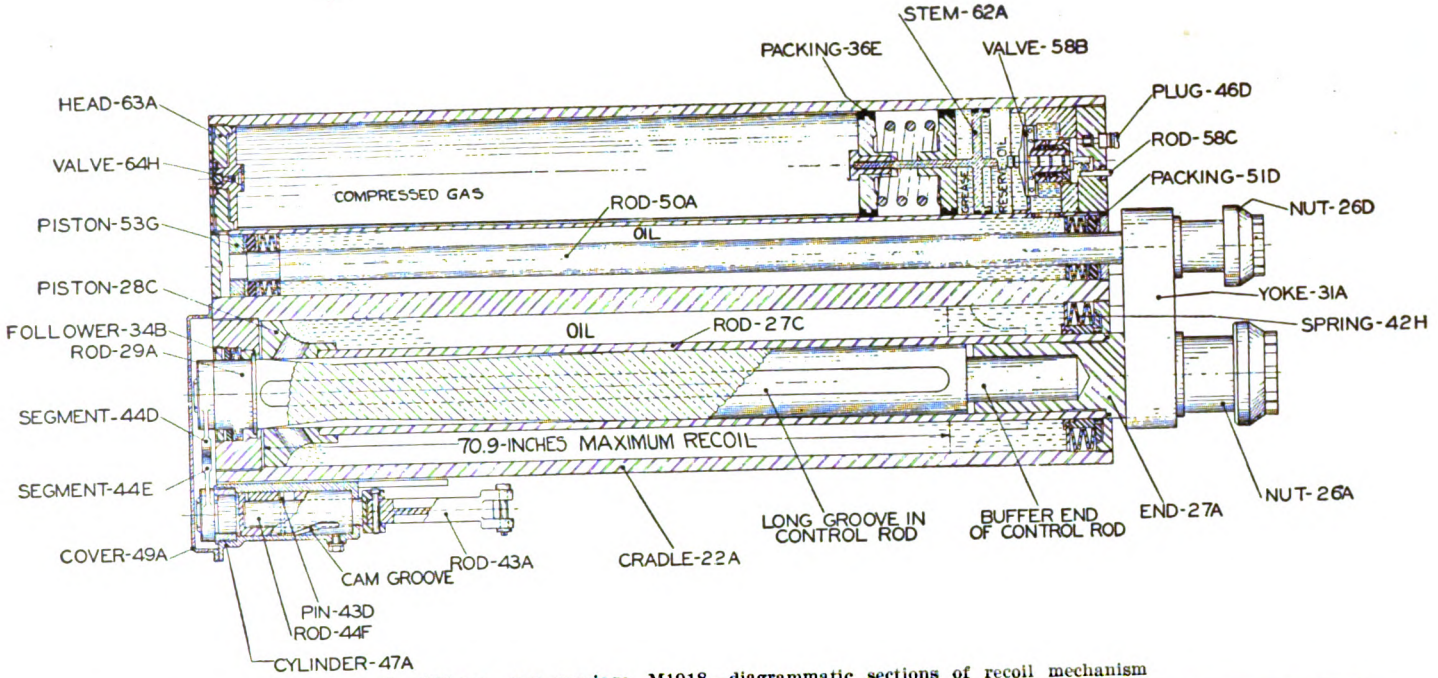


FIGURE 8.—155-mm. gun carriage, M1918—diagrammatic sections of recoil mechanism

Reference	Item	Reference	Item	Reference	Item
----------	Buffer end of control rod.	26A	Nut, recoil piston rod.	58C	Rod, oil index.
----------	Cam groove in actuating cam.	51D	Packing, ccunterrecoil rod.	27C	Rod, recoil.
49A	Cover, valve turning gear.	36E	Packing, floating piston.	44F	Rod, valve turning.
22A	Cradle.	43D	Pin, valve turning cam.	44D	Segment, control rod (of spur gear).
47A	Cylinder, replenisher.	53G	Piston, counterrecoil.	44E	Segment, valve turning gear.
27A	End, recoil rod.	28C	Piston, recoil.	42H	Spring, Belleville, recoil rod.
34B	Follower, control rod.	46D	Plug, filling and drain.	62A	Stem, floating piston.
63A	Head, recuperator cylinder, front.	43A	Rod, connecting.	64H	Valve, air.
----------	Long groove in control rod.	29A	Rod, control.	58B	Valve, regulator.
26D	Nut, counterrecoil piston rod.	50A	Rod, counterrecoil.	31A	Yoke, piston rod.

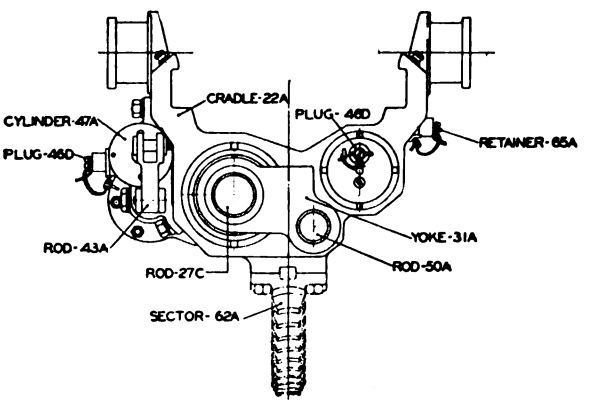


FIGURE 9.—Recoil mechanism—rear view

Reference	Item	Reference	Item
22A	Cradle.	50A	Rod, counterrecoil.
47A	Cylinder, replenisher.	27C	Rod, recoil.
46D	Plug, filling and drain.	62A	Sector, elevating.
65A	Retainer, recuperator filling valve.	31A	Yoke, piston rod.
43A	Rod, connecting.		

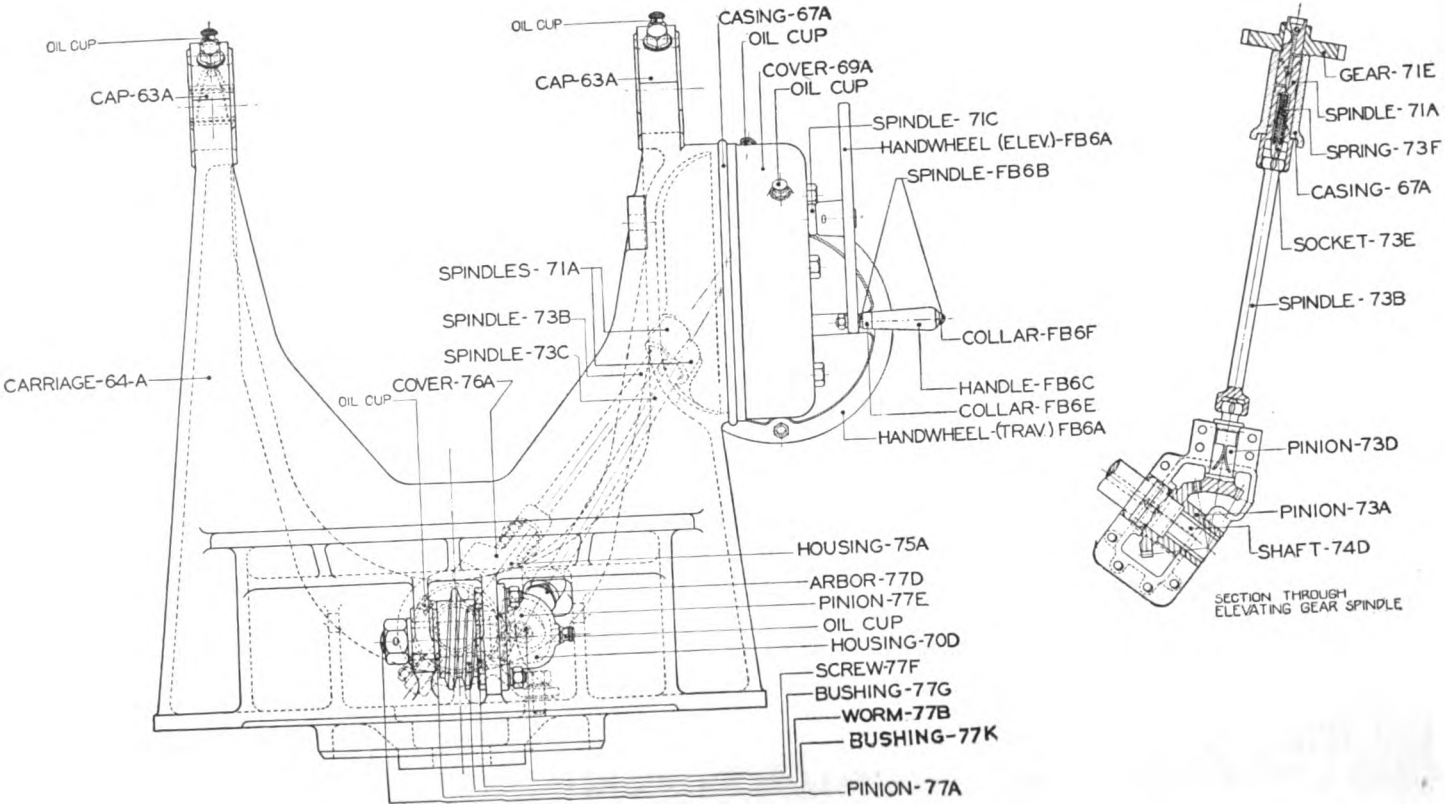


FIGURE 10.—Top carriage—front view

Reference	Item	Reference	Item
77D	Arbor, traversing spindle pinion.	75A	Housing, elevating bevel pinion.
77G	Bushing, traversing worm pinion, left.	70D	Housing, traversing bevel pinion.
		73D	Pinion, bevel, elevating spindle.
77K	Bushing.	73A	Pinion bevel, elevating worm shaft.
64A	Carriage, top.	77E	Pinion, traversing spindle.
67A	Casing, sighting gear.	77A	Pinion, traversing worm.
FB6E	Collar, handwheel handle spindle.	77F	Screw, traversing spindle pinion.
FB6F	Collar, handwheel handle spindle riveting.	74D	Shaft, elevating worm.
		73E	Socket, oblique spindle spring.
76A	Cover, elevating bevel pinion housing.	FB6B	Spindle, handwheel handle.
		71C	Spindle, helical, elevating pinion.
69A	Cover, sighting gear casing.	73B	Spindle, oblique, elevating.
	Cup, oil, special.	73C	Spindle, oblique, traversing.
71E	Gear, elevating.	71A	Spindle, traversing and elevating worm gear.
FB6C	Handle, handwheel.		
FB6A	Handwheel, elevating.	73F	Spring, oblique spindle.
FB6A	Handwheel, traversing.	77B	Worm, traversing, L. H.

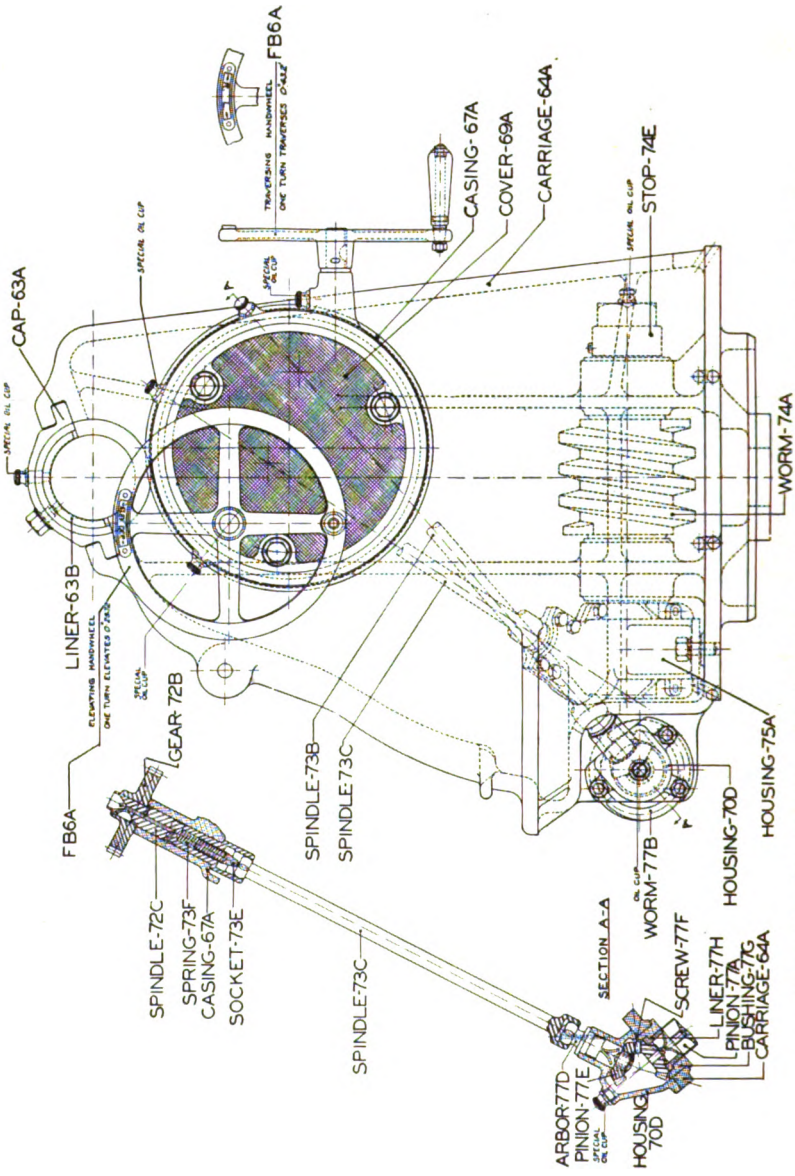


FIGURE 11.—Top carriage—left side view showing elevating and traversing mechanism

Reference	Item	Reference	Item
77D	Arbor, travesring, spindle pinion.	63B	Liner, trunnion bearing cap.
77G	Bushing, traversing worm pinion, left.	77E	Pinion, traversing spindle.
63A	Cap, trunnion bearing.	77A	Pinion, traversing worm.
64A	Carriage top.	77F	Screw, traversing spindle pinion.
67A	Casing, sighting gear.	73E	Socket, oblique spindle spring.
69A	Cover, sighting gear casing.	72C	Spindle, helical traversing pinion.
	Cup, oil, special.	73B	Spindle, oblique, elevating.
72B	Gear, helical, traversing.	73C	Spindle, oblique, traversing.
FB6A	Handwheel, elevating.	73F	Spring, oblique spindle.
FB6A	Handwheel, traversing.	74E	Stop, rear.
75A	Housing, elevating bevel pinion.	74A	Worm, elevating, L. H.
70D	Housing, traversing bevel pinion.	77B	Worm, traversing, L. H.
77H	Liner, half, traversing worm pinion left bushing.		

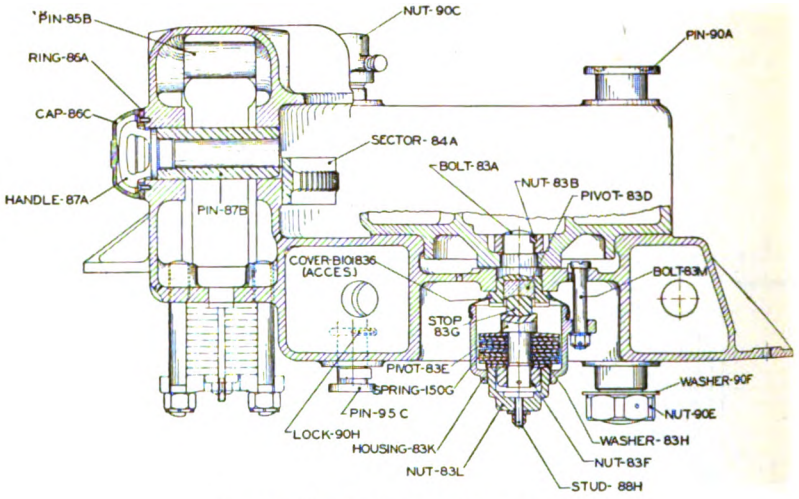


FIGURE 12.—Bottom carriage assembled

Reference	Item	Reference	Item
83M	Bolt, elastic suspension housing.	87B	Pin, axle pivot.
83A	Bolt, pivot.	85B	Pin, gun centering.
86C	Cap, axle pivot pin.	95C	Pin, trail connecting.
B101836	Cover, elastic suspension housing (accessory).	90A	Pin, trail hinge.
87A	Handle, axle pivot pin.	83E	Pivot, lower.
83K	Housing, suspension, elastic.	83D	Pivot, upper.
90H	Lock, trail locking bolt stop.	86A	Ring, hinge, pivot pin cap.
83L	Nut, spring suspension adjusting.	84A	Sector, traversing.
83F	Nut, lower pivot.	150G	Spring, Belleville (for lower pivot).
83B	Nut, pivot bolt.	83G	Stop.
90E	Nut, trail hinge pin.	88H	Stud, spring suspension adjusting nut.
90C	Nut, trail locking bolt.	83H	Washer, Belleville spring support.
		90F	Washer, trail hinge pin.

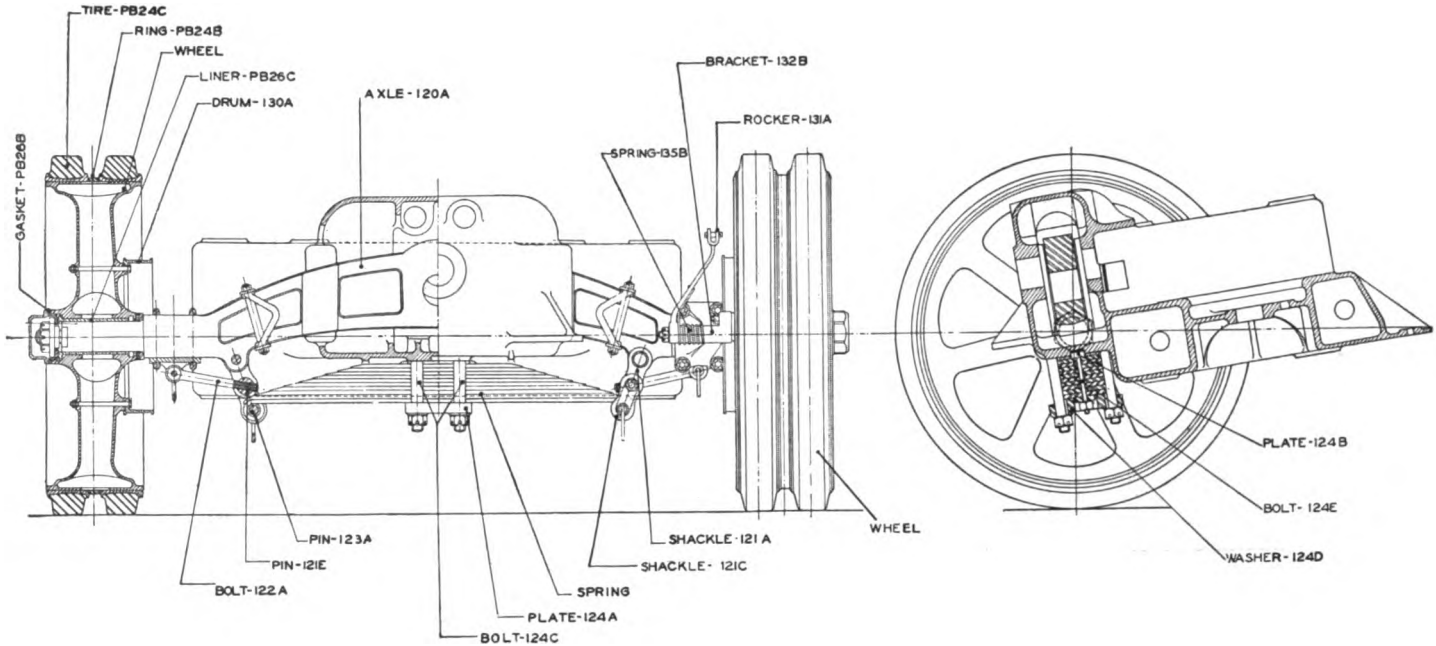
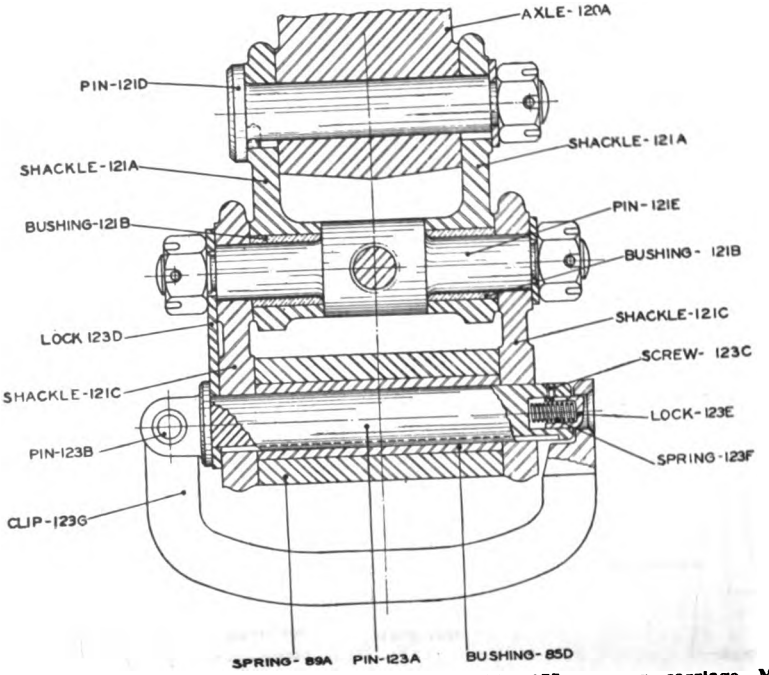


FIGURE 13.—Axle and wheel assembled

Reference	Item	Reference	Item	Reference	Item
120A	Axle, gun.	121E	Pin, lower shackle hinge.	135B	Spring, brake rocker, left.
122A	Bolt, adjusting, shackle.	123A	Pin, spring eye.	----------	Spring, gun axle.
124E	Bolt, centering, spring.	124A	Plate, bottom spring.	PB24C	Tire.
124C	Bolt, spring plate.	124B	Plate, top spring.	124D	Washer, spring centering bolt.
132B	Bracket, brake, left.	PB24B	Ring, tire separator.	----------	Wheel, with brake drum.
130A	Drum, brake.	131A	Rocker, brake.	----------	Wheel, without brake drum.
PB26B	Gasket, hub cap.	121C	Shackle, lower spring.		
PB26C	Liner, hub.	121A	Shackle, upper spring.		



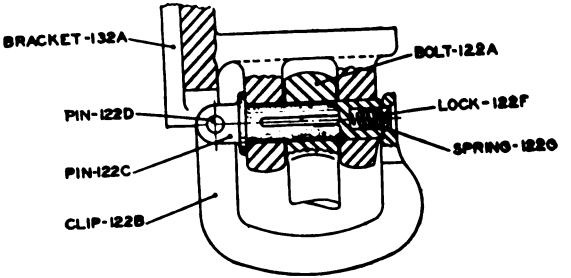


FIGURE 14.—155-mm. gun carriage, M1918—spring shackle sections

Reference	Item	Reference	Item
120A	Axle, gun.	122C	Pin, shackle adjusting bolt.
122A	Bolt, shackle adjusting.	123A	Pin, spring eye.
132A	Bracket, brake, right.	121D	Pin, upper shackle hinge.
85D	Bushing, gun axle spring.	122D	Pin, 10 by 30 mm.
121B	Bushing, upper spring shackle.	123B	Pin, steel, 14 by 42 mm.
122B	Clip, shackle adjusting bolt safety.	123C	Screw, locking, 4 by 10 mm.
123G	Clip, spring eye pin safety.	121C	Shackle, lower spring.
123E	Lock, safety clip.	121A	Shackle, upper spring.
122F	Lock, shackle adjusting bolt safety clip.	89A	Spring, gun axle.
123D	Lock, spring eye pin.	122G	Spring, shackle adjusting bolt safety clip.
121E	Pin, lower shackle hinge.	123F	Spring, spring eye pin safety clip.

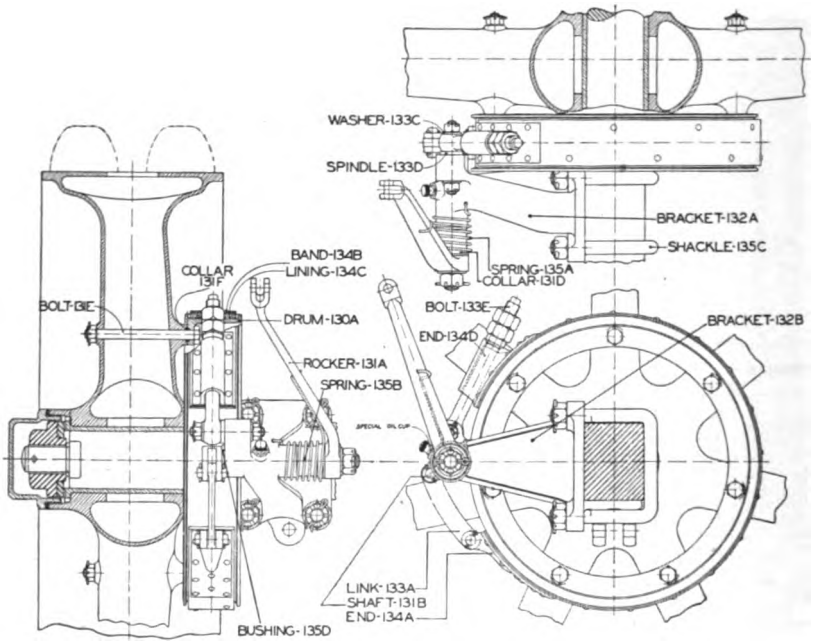


FIGURE 15.—Brake assembled

Reference	Item	Reference	Item
134B	Band, brake.	134D	End, upper brake band.
133E	Bolt, brake band adjusting.	134C	Lining, brake band.
131E	Bolt, brake drum.	133A	Link, brake.
132B	Bracket, brake, left.	131A	Rocker, brake.
132A	Bracket, brake, right.	135C	Shackle, brake bracket.
135D	Bushing, brake bracket.	131B	Shaft, brake.
131D	Collar, adjusting, brake rocker.	133D	Spindle, brake band adjusting bolt.
131F	Collar, shear, brake drum bolt. Cup, oil, special.	135A	Spring, brake rocker, right.
130A	Drum, brake.	135B	Spring, brake rocker, left.
134A	End, lower brake band.	133C	Washer, brake band adjusting bolt spindle.

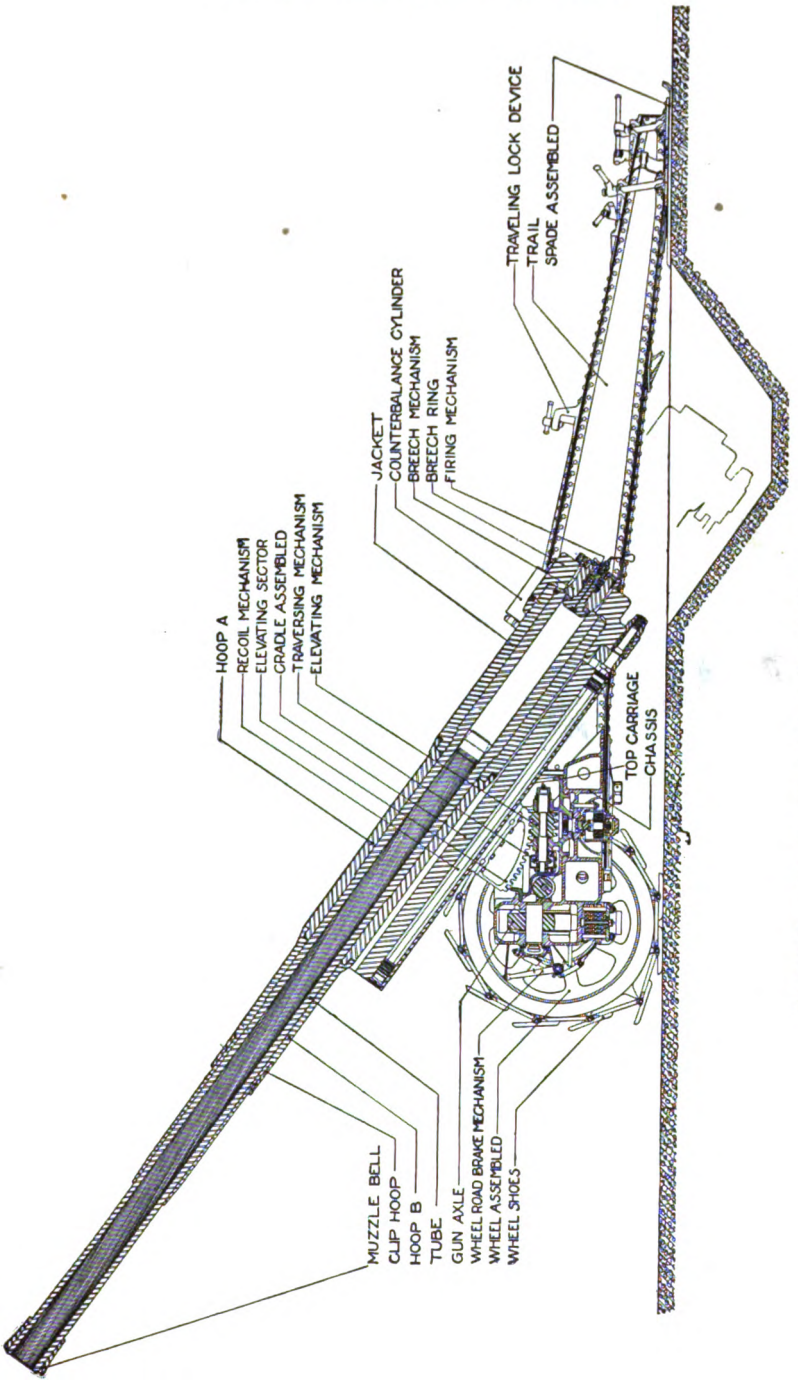


FIGURE 16.—155-mm. gun carriage—longitudinal section in battery

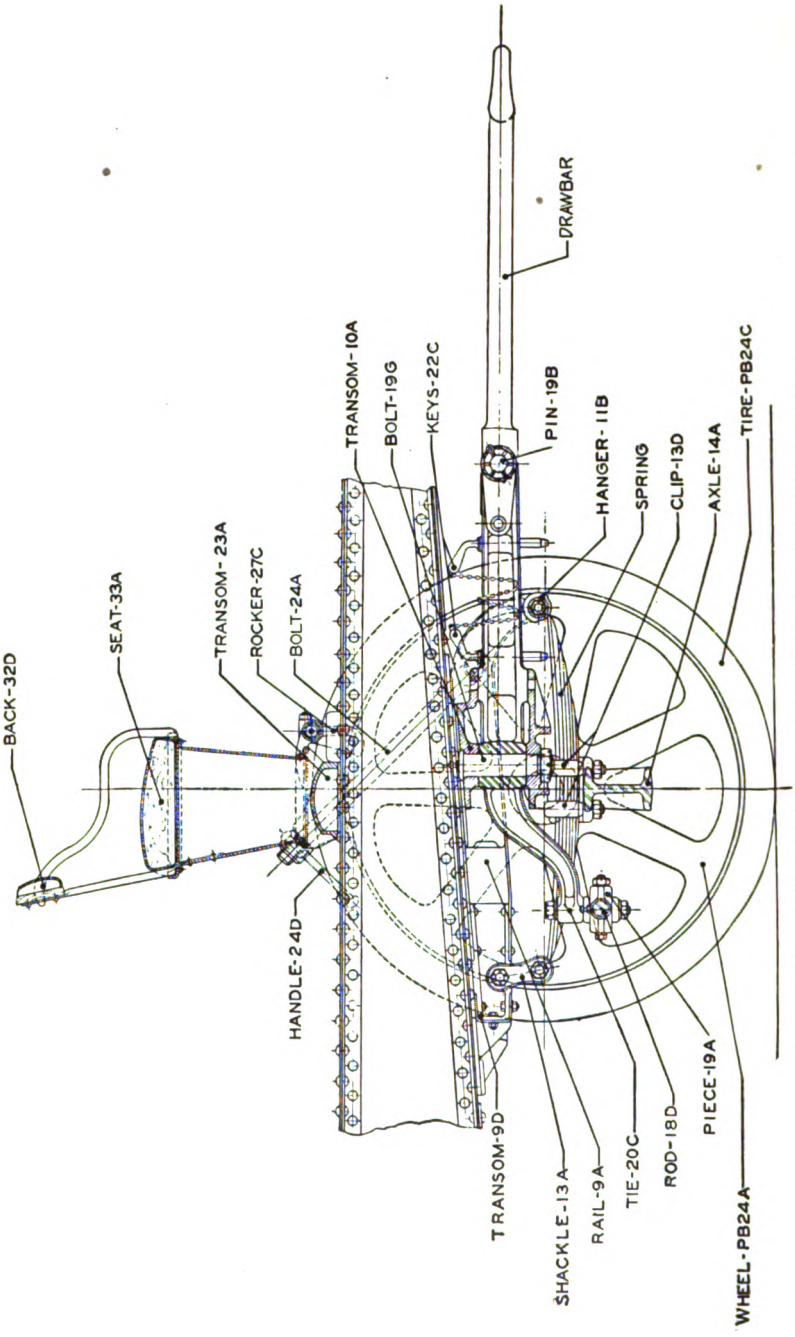


FIGURE 17.—155-mm. gun carriage limber—longitudinal section

Reference	Item	Reference	Item
14A	Axle.	27C	Rocker, cable, right.
32D	Back, limber seat, assembly.	18D	Rod, steering tie.
24A	Bolt, clamping, trail.	33A	Seat, limber, assembly.
19G	Bolt, pintle.	13A	Shackle, limber spring.
13D	Clip, limber spring.		Spring, limber.
	Drawbar assembly.	20C	Tie, drawbar.
24D	Handle, trail clamping bolt nut.	PB24C	Tire, 1,160 by 125 mm.
11B	Hanger, spring, forward, left.	23A	Transom, clamping trail.
22C	Key, drawbar.	10A	Transom, forward.
19A	Piece, outer universal joint, male.	9D	Transom, rear.
19B	Pin, drawbar.	PB24A	Wheel.
9A	Rail, side, right.		

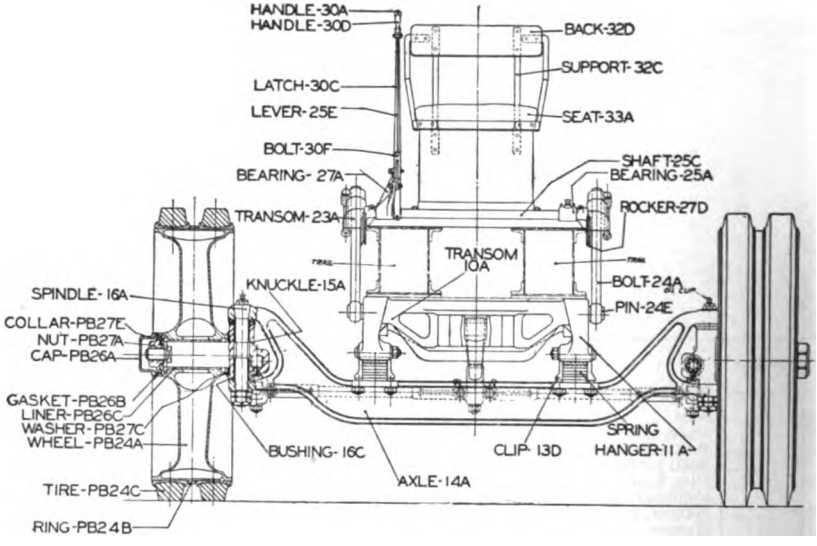


FIGURE 18.—155-mm. gun carriage limber—front view

Reference	Item	Reference	Item
14A	Axle.	30C	Latch, brake lever.
32D	Back, limber seat.	25E	Lever, brake.
25A	Bearing, brake lever shaft, left.	PB26C	Liner, hub.
27A	Bearing, brake lever shaft, right.	PB27A	Nut, lock, wheel.
30F	Bolt, brake lever latch.	24E	Pin, trail clamping bolt.
24A	Bolt, clamping, trail.	PB24B	Ring, separator, tire.
16C	Bushing, steering knuckle, lower.	27D	Rocker, cable, left.
PB26A	Cap, hub.	33A	Seat, limber, assembly.
13D	Clip, limber spring.	25C	Shaft, brake lever.
PB27E	Collar, lock, wheel.	16A	Spindle, steering knuckle.
	Cup, oil, special.		Spring, limber, assembly.
PB26B	Gasket, hub cap.	32C	Support, limber seat frame back.
30A	Handle, brake lever.	PB24C	Tire, 1,160 by 125 mm.
30D	Handle, brake lever latch.	23A	Transom, clamping, trail.
11A	Hanger, spring, forward.	10A	Transom, forward.
15A	Knuckle, steering, right.	PB27C	Washer, journal, fiber.
		PB24A	Wheel.

FIGURE 19.—Limbering position

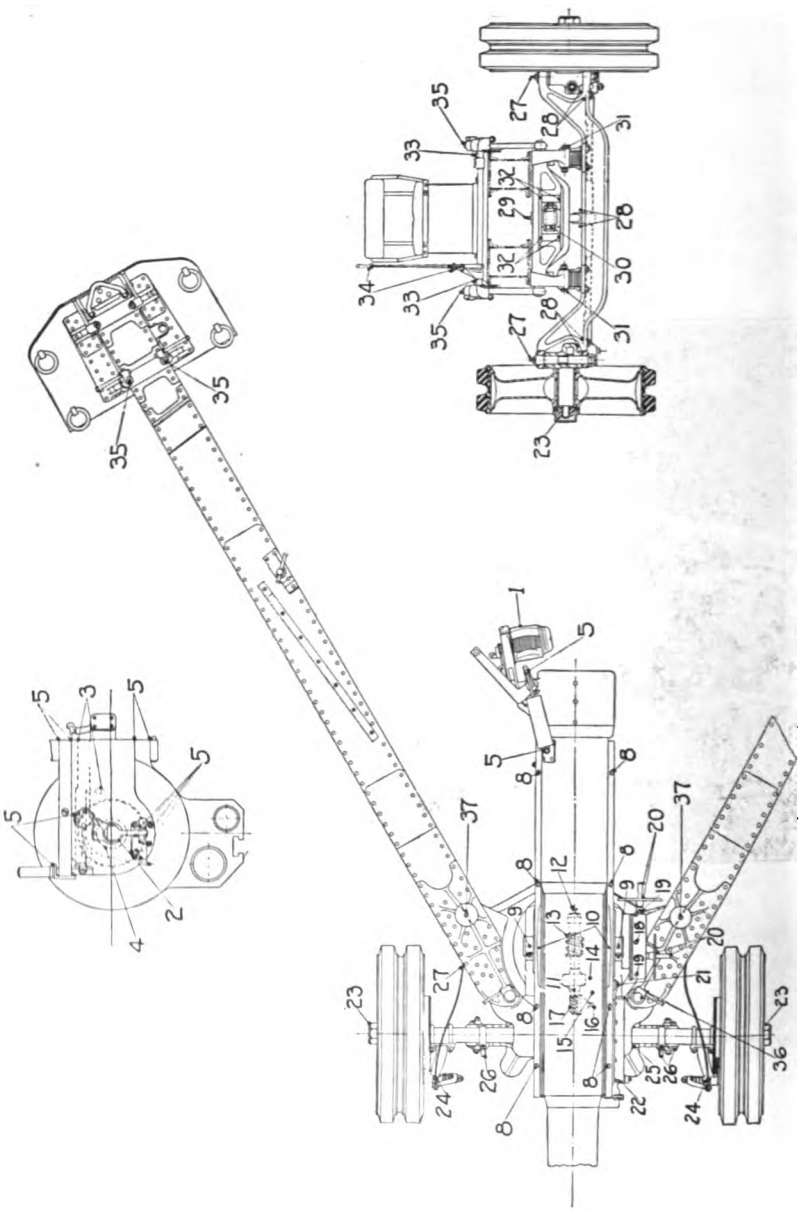


FIGURE 20.—Lubricating chart

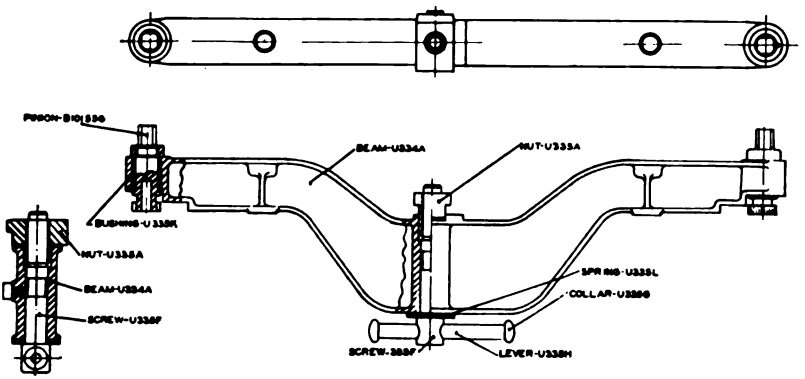


FIGURE 21.—Traveling lock—assembled view

Reference	Item	Reference	Item
U334A	Beam, traveling lock.	U335A	Nut, traveling lock locking screw.
U335K	Bushing, traveling lock beam.	B101556	Pinion, traveling lock.
U335G	Collar, lever.	U335F	Screw, locking, traveling lock.
U335H	Lever, traveling lock locking screw.	U335L	Spring, Belleville.

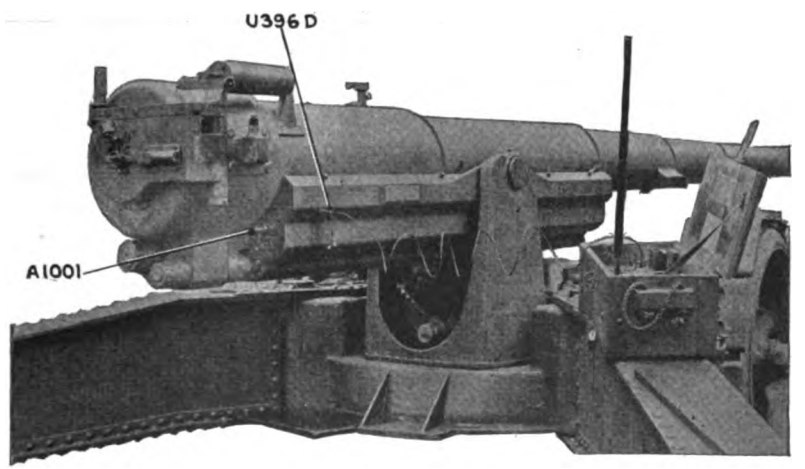


FIGURE 22.—Pump attached to recoil mechanism

Reference	Item	Reference	Item
----------	Chest, oil pump.	A1001	Release, filling and drain valve.
----------	Lever, pump.	U396D	Union.

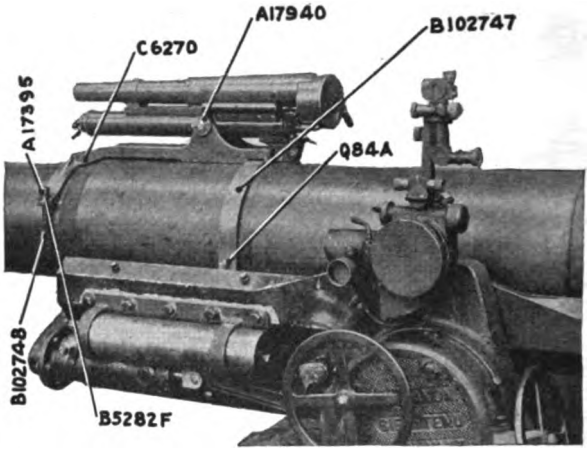


FIGURE 23.—37-mm. subcaliber mount, M1 on 155-mm. gun, M1918

Reference	Item	Reference	Item
B102747	Band.	Q84A	Screw, set.
C6270	Bracket, mounting.	B102748	U-bolt.
A17940	Cap, trunnion.	B5282F	Washer, lock.
A17395	Nut.		

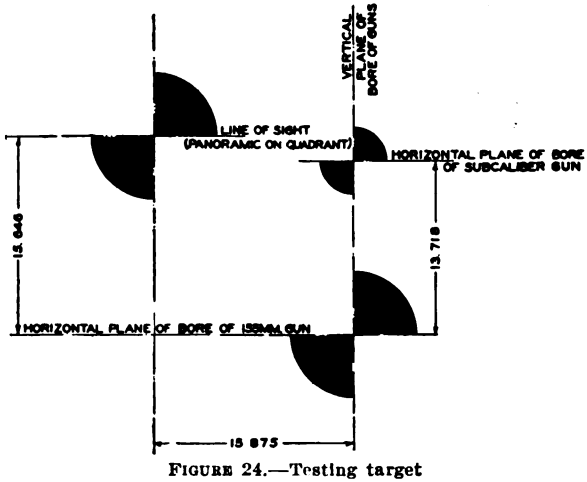


FIGURE 24.—Testing target

U. S. GOVERNMENT PRINTING OFFICE: 1931

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - Price 20 cents

MOBILE ARTILLERY MATÉRIEL

155-MM GUN MATÉRIEL, M1918

CHANGES No. 2

WAR DEPARTMENT,
WASHINGTON, *January 2, 1934.*

TR 1305–155C, March 10, 1931, is changed as follows:

Title of section IX is changed to Data (including harbor-defense emplacement).

Paragraph 5 *c*, line 5, change (50B) to (C3674). (1933.)

Paragraph 5 *e*, line 4, change (50K) to (B19693). (1933.)

Paragraph 12 *b*, line 8, change (50B) to (C3674). (1933.)

Paragraph 12 *d*, line 14, change (50B) to (C3674). (1933.)

Paragraph 12 *g*, line 5, change (50K) to (B19693) and line 7, change (B8061) to (B19694). (1933.)

Paragraph 12 *h*, line 1, change (50K) to (B19693), line 2, change (50M) to (A12922), line 3, change (50B) to (C3674), and line 7, change (50K) to (B19693). (1933.)

Paragraph 12 *i*, line 3, change (50B) to (C3674). (1933.)

Paragraph 12 *j*, line 3, change (B8061) to (B19694). (1933.)

Paragraph 22, line 8, change (B8061) to (B19694). (1933.)

Paragraph 32 *d*, line 1, change (50B) to (C3674), and line 4, change (50K) to (B19693). (1933.)

63. General data pertaining to the 155-mm gun carriage, M1918, and 155-mm gun carriage limber, M1918.

* * * * * * *

155-mm gun emplacement.—a. **To provide for the wider field of fire required of 155-mm guns when used against naval targets, reinforced concrete emplacements providing for such field of fire are designed and constructed in harbor defenses.**

b. **These emplacements are designed to cover desired fields of fire up to 360° and are constructed by the Corps of Engineers. Embedded in the concrete at 17 feet 7¾ inches from the center of rotation is a 70-pound A.S.C.E. steel rail on which the spade seat plates slide during large changes in azimuth settings. The rail also takes the vertical and horizontal trail loads during firing. Embedded around the center of rotation is a 6-foot 2¾-inch diameter curb band which restrains the carriage from lateral displacement during action.**

c. **Slight modifications to the gun carriage are necessary for use on the harbor-defense emplacement. The modifications consist of elimination of the spades, and the removal of original spade seat plates from the trails and substitution**

plates of similar form, although of 1.5 inches thick-
stead of 0.5 inch, and with a circular groove 4 inches
id 1 inch deep therein to fit over the rail embedded in
placement. The original spade seat plates are fas-
y rivets while the modified plates are assembled with
l cap screws, nuts, and lock washers. Modification of
ls is a function of the Ordnance Department.

order to decrease friction, the bearing surface for the
on the center pedestal of the emplacement is given a
ment finish.

facilitate traversing, the bearing surfaces of the rail
:b are well greased with heavy grease. The traversing
nplished by manual labor of the troops.

hen the piece is not in use, in order to relieve the
of the weight of the gun and carriage the matériel
:d and rests on a wood block.

ıould the matériel later be transferred for field use, no
s will be necessary as the spades can be used with the
seat plates required for harbor-defense emplacements.
.G. 062.12 (10–30–33).] (1933.)

68, figure 2, change B8061 to B19694. (1933.)

69, first column, change B8061 to B19694. (1933.)

70, figure 3, change B8061 to B19694. (1933.)

71, first column, change B8061 to B19694. (1933.)

74, figure 5, change 50B to C3674, 50F to B8298, 50K to
, 50L to A12923, 50A to A12918, 50G to A12924, 50H to
, and 50M to A12922. (1933.)

75, first column, change 50B to C3674, 50F to B8298, and
› B19693. Third column, change 50L to A12923, 50A to
, 50G to A12924, 50M to A12922, and 50H to A12925. (1933.)

84, figure 12, delete Pin–95C and substitute Bolt–90B.
ınd fourth columns delete 95C Pin, trail connecting, and sub-
90B Bolt, trail locking. (1933.)
.G. 062.12 (10–30–33).] (1933.)

RDER OF THE SECRETARY OF WAR:

DOUGLAS MacARTHUR,
General,
Chief of Staff.

CIAL:

JAMES F. McKINLEY,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1934

MOBILE ARTILLERY MATÉRIEL

155-MM GUN MATÉRIEL, M1918

ANGES
O. 3

WAR DEPARTMENT,
WASHINGTON, *January 2, 1936.*

TR 1305–155C, March 10, 1931, is changed as follows:

14. Cradle.

* * * * * * *

. The replenisher cylinder, or automatic filler, is a device which nmunicates with the recoil cylinder and assures a sufficient supply oil at all times. It also serves as a reservoir to permit the escape om the recoil cylinder of excess oil which is due to expansion on count of heat developed during firing, or hot weather **(see par. *g* (2)).**

* * * * * * *

g. The replenisher piston is prolonged to the rear, the extension rving as a guide to hold the piston in line, as well as acting as a ge which makes it possible to ascertain at any time the quantity of coil oil contained in the replenisher. A graduated scale is used for easuring the distance from the rear face of the replenisher to the ar end of the piston extension. The normal working position, indicative of the correct amount of recoil oil, is 150 mm (5.9 inches) from the rear face of the replenisher **(see par. 40*g* (1)).**

* * * * * * *

38. Malfunctions of carriage.—*Abnormal conditions and their rrection.*

Malfunction	Cause	Correction
a. Replenisher pis- n less than **50** mm **1.97** inches) from ear face of replen- her **(see par. 40*g* 2)).**	*a.* (1) Expansion of oil due to warm weather or continued firing.	*a.* (1) Drain the recoil cylinder until the piston of the replenisher is 150 mm (5.9 inches) from the rear face of the replenisher **(see par. 40*g* (1)).**
	(2) Accumulation of air in the recoil system. When the accumulation of air occurs	(2) Refer to ordnance maintenance company.

88925°—36

	to any great extent after the system has been drained and filled, it is an indication that the replenisher piston packing is defective or that the cylinder wall is leaking.	
b. Replenisher piston 200 mm (7.87 inches) from rear face.	*b.* Too little reserve oil.	*b.* Fill the mechanism until the piston is 150 mm (5.9 inches) from the rear face of the replenisher **(see par. 40*g* (2)).**

40. Care and preservation of carriage and limber.

* * * * * * *

g. Filling of recoil cylinder.—(1) The position of the replenisher piston (67A), Figure 7, governs the filling of the recoil cylinder. The normal position of the replenisher piston is 150 mm (5.9 inches) measured from the rear face of the replenisher cylinder (47A). This position indicates a full cylinder and sufficient reserve in the replenisher.

NOTE.—When it is known that rapid fire is to take place the replenisher should be drained until the reading of the replenisher piston is 200 mm (7.87 inches) measured from the rear face of the replenisher cylinder.

(2) When the replenisher piston is at a point 100 mm (3.93 inches) from the rear face of the replenisher, oil should be removed from the recoil cylinder before firing is continued.

NOTE.—When, in an emergency, it is necessary to continue firing without interruption, firing may be permitted until the reading is down to 50 mm.

[A. G. 062.12 (10–10–35).]

BY ORDER OF THE SECRETARY OF WAR:

MALIN CRAIG,
Chief of Staff.

OFFICIAL:
E. T. CONLEY,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1936

TECHNICAL REGULATIONS
No. 1305-240A

WAR DEPARTMENT,
WASHINGTON, *January 15, 1933.*

MOBILE ARTILLERY MATÉRIEL

240-MM HOWITZER MATÉRIEL, M1918 AND M1918A1

Prepared under direction of the
Chief of Ordnance

SECTION I

GENERAL

1. Purpose.—These regulations are published for the information and guidance of the using arms, Reserve Officers' Training Corps students, Reserve officers, and all personnel charged with the maintenance of this matériel.

2. Scope.—*a.* In addition to description and figures, there are contained herein instructions for the operation, inspection, assembly and disassembly, repair, and care and preservation of the matériel.

b. Disassembly and assembly, and such repairs as may be handled by the battery personnel will be undertaken only under the supervision of an officer or the chief mechanic.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope of the battery personnel, the services of the ordnance maintenance company should be enlisted.

130926°—33——1

3. References.—Nomenclature, lists of spare parts and equipment, and basic spare parts are contained in Standard Nomenclature List No. D–4 or in ordnance drawings; description and information on sighting and fire-control equipment in TR 1320–A and 1320–C; ammunition in TR 1370–E; drill ammunition in TR 1370–D; targets and accessories therefor in TR 1340–C; instructions covering the characteristics, purpose, handling, etc., of cleaning and preserving materials, tools and materials for use therewith, and special oils, greases, and cutting oils issued by the Ordnance Department in TR 1395–A; and instructions for service of the piece in TR 430–60.

Section II

DESCRIPTION AND OPERATION

4. Description of howitzers.—*a.* There are four models of these howitzers, M1918, M1918A1, M1918MI, and M1918MIA1. They are of the built-up type, the principal parts being the tube, jacket, and hoop, with front and rear rollers for mounting. 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. The M1918 howitzers are numbered from 1 to 182, inclusive, and the M1918MI from 183 to 330, inclusive, and are of Watervliet Arsenal manufacture. When modified these howitzers will become M1918A1 and M1918MIA1, respectively.

c. The howitzers are marked on the muzzle face with the caliber and model, name of manufacturer, year of manufacture, weight of howitzer, and initials of inspector. The breech face is marked with the caliber and model, name of manufacturer, year of manufacture, and the name of manufacturer of the forgings. Horizontal and vertical center lines are scribed on the breech and muzzle faces for bore-sight-

ing purposes, and the center of gravity is marked on the left side of the hoop. Axis lines are also marked on the left side of the breech and muzzle.

d. (1) The breech mechanism is of the type having a breechblock with interrupted screw threads, which rotates on the pintle of the breechblock carrier in the breech recess in opening and closing, the carrier being hinged to swing on the right side of the howitzer. The mechanism is hand operated by means of an operating lever. The lever swings with the mechanism. The mechanism, designed for separate loading ammunition, forms an obturating mechanism.

(2) The firing mechanism is of the screw type. The firing mechanism is common to 155-mm howitzer, M1918; 155-mm gun, M1918MI; and 8-inch howitzers, M1917, Mks. VI and VIII½

e. The howitzers, M1918 and M1918MI, briefly described above, are rifled alike. A different form of rifling, however, has been adopted, and when applied to the present howitzers, they will be known as M1918A1 and M1918MIA1, respectively. The details of rifling are as follows: All howitzers are rifled with a right-hand twist, one turn in 40 calibers at origin, increasing to one turn in 20 calibers at 24.369 inches from muzzle, and uniform thereafter.

		M1918 and M1918MI	M1918A1 and M1918MIA1
Number of grooves		84	84
Width of grooves	Inch	.21343	.23339
Width of lands	do	.14	.12
Depth of grooves	do	.06	.06

5. Description of carriage, M1918 and M1918A1.—*a.* The 240-mm howitzer carriages, M1918 and M1918A1, are of the same design except that the M1918A1 carriage is equipped with a quick release traversing mechanism and does not utilize the platform in its firing position as the top carriage rests on a concrete emplacement where it may be traversed through 360° of azimuth. (See figs. 82 and 83.) The quick release traversing mechanism is for the purpose of allowing the carriage to be moved quickly to the approximate azimuth independent of the traversing mechanism operated by the traversing handwheel. These carriages are of the hydropneumatic long recoil type. The M1918 carriage consists of the platform, top carriage, cradle, and sleigh. The length of recoil is sufficient to insure stability at low degrees of elevation.

b. In firing position the howitzer interlocks with the sleigh which houses the recoil mechanism. The latter embodies both the recoil and counterrecoil systems. A mixture of glycerin and water is used

in the recoil and recuperator cylinders. The sleigh has two bronze lined slide-ways which engage the clips on the cradle so that the sleigh slides upon the cradle during recoil and counterrecoil. Attached to the front of the cradle is a cast-steel beam to which the recoil and counterrecoil piston rods are fastened. The cradle also carries the elevating segments, firing rod, quick-loading mechanism, and trunnion band which supports the cradle in the trunnion bearings in the top carriage. 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. The top carriage is pivoted at the front by the pintle head seat supported by Belleville springs in the pintle socket in the platform. This facilitates traversing the top carriage to its limits of 10° either side of the center line.

c. The howitzer is served by shot trucks which carry two projectiles each. They run on tracks to and from the ammunition supply point. The projectiles are lifted from the shot truck and placed on the rammer car by shot tongs and a cable operated by a hand crane, all of which are supported by the loading platform at the rear of the top carriage. The rammer car, operated by hand cranks, moves along a track into the cradle, registering and locking with the breech of the howitzer, after which the projectile is pushed into the breech of the howitzer by a semiflexible rammer chain.

d. In mounting and dismounting the carriage an erecting frame made 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 the windlass which is attached to the forward part of the top carriage.

e. The erecting frame with ammunition attachment is also used for lifting and placing projectiles on the shot trucks.

f. For transporting, the complete unit is divided into four loads: Howitzer, cradle with sleigh attached, top carriage, and platform. Each load requires a limber and its respective transport wagon.

6. Mounting of howitzer and carriage.—As the organizations to be equipped with the 240-mm howitzer matériel will receive the howitzer and the carriage dismounted, together with a number of the groups disassembled therefrom as required for transport purposes, the first consideration should be the mounting in order that the personnel may become familiar with the operation. They are mounted in the following order: First, the platform, after the pit is dug; then the top carriage; next the cradle with sleigh attached; and lastly the howitzer. Then follows the attachment of the loading platform, the crane, and the rammer car in order. The details are as follows:

a. Preparation of pit.—Select a piece of level ground and dig the pit for the platform trunk, using the angle, depth, and plan templates shown in Figure 68 for laying it out. Template No. 1 is for laying out the plan of the pit. Templates Nos. 2 and 3 are used to determine when the pit has been dug to the proper depth and shape. By referring to Figure 34 a general idea will be gained of how the pit should be dug. To facilitate maneuvering a space about 16 by 23 feet should be made approximately level by using a straight board and testing level. The pit is dug in the center of this space. For ease in moving the vehicles to and from the emplacement, the ground for a distance of 12 feet on each side of the pit should be cleared of all obstacles. This cleared area should extend about 20 feet in front and 30 feet in the rear of the pit.

b. Emplacement of platform.—(1) Place the wheel tracks without the inclined planes (fig. 54) over the pit. The wheel tracks should be parallel with and an equal distance from the center line of the pit and connected by the tie-rods. The rear end of the tracks should be about 2½ feet from the rear edge of the pit.

(2) Run the platform transport wagon (fig. 67) over the pit, centering the platform trunk with the pit, and block the wheels.

(3) Unhook the brake connecting rope (BB54K), Figure 45, and remove the brake lever (BB70L). Unlock the axle (RS14A). Remove the draft hook.

(4) Set up the erecting frame. (Figs. 55 and 56.) The base plates of the erecting frame must set parallel to the platform with the straight side nearest the platform and about 6 inches from it. The columns must be parallel to each other and perpendicular to the base so as not to jam the suspension beams when jacking up the platform and top carriage.

(5) Place the front and rear suspension beams in position and connect the straps to the front and rear suspension eyes on the platform by means of the supporting pins. The rear suspension beams are those with the long links.

(6) Place the jack rods and jacks in position and raise the platform. The proper location of the right and left hand jacks is shown in Figure 55. The four jacks must be kept in step, the strokes being regular and slow enough to permit the valves to function properly. The platform may be secured to the erecting frame independently of the jacks by inserting the support pins through the columns under the suspension beams. The hydraulic jacks will eventually be replaced by mechanical jacks.

(7) Unlock the false trail. Remove the limber and transport wagon. They may then be connected to form the platform transport wagon, close coupled. (Fig. 63.)

(8) Remove the wheel tracks (fig. 56) and lower the platform into the pit (fig. 69), care being taken to lower all four jacks at uniform speed. Remove the floats (fig. 32) from within the platform. The ground should be tamped down firmly around the platform spade and under the platform. In soft soil the platform should be slightly inclined to the rear as the greatest weight and reaction from firing come on the forward end.

c. Mounting of top carriage.—(1) Remove the rear crossbeam and slide the rear suspension beam through the left-hand column. (Fig. 70.)

(2) Place the wheel tracks on the platform with the inclined planes at the rear. The tie-rods are folded against the sides of the wheel tracks so as to leave space for the top carriage.

(3) Remove the pintle head nut (LS331G), Figure 23, and pintle cover (fig. 67), and slip the pintle head cover (fig. 70) over the threads in order to protect them as the top carriage is lowered.

(4) Remove the brake lever rope (BB56Q), Figure 43, from the pulleys and the breech operator's footboard from the front end of the top carriage.

(5) Put in position the small wheel blocks, run the top carriage transport wagon onto the platform (fig. 70), and block the rear wheels. The small wheel blocks are located in the proper position by dropping the retaining levers into the forward notches in the tracks.

(6) Replace the rear crossbeam and rear suspension beam and attach the front and rear suspension links to the outboard brackets, respectively, on the top carriage. (Figs. 70 and 55.)

(7) Raise the top carriage slightly and unlock and remove the transport wagon. The limber and transport wagon may then be connected to form the top carriage transport wagon, close coupled. (Fig. 63.)

(8) Lower the top carriage onto the platform. (Fig. 71.) Before lowering clean and lubricate the pintle liner (LS330C), Figure 23, the bearing surfaces on each side of the pintle, and the holding-down sector (LS487B), Figure 26, and see that the rear clips (LS336A) are unlocked. Also clean and lubricate the traversing rack (LS416A), Figure 25, and the traversing pinion (LS416F), Figure 14, under the top carriage. It may be necessary to move the traversing handwheel (KB146A), Figure 14, to make the pinion (LS416F), Figure 14, mesh with the rack (LS416A), Figure 25, when lowering the top carriage.

(9) Take down the erecting frame and remove the footboards. The erecting frame may be set up again with the addition of the overhead trolley to be used for handling ammunition as shown in Figure 57.

(10) Remove the rammer car, loading platform, and crane from within the top carriage. (Fig. 58.) Take out the support beams. The rammer car is disengaged from the loading platform by pressing on the loading platform lock treadle (LS749A), Figure 29, to lower the swinging tracks (LS723G and LS723F), and pushing the car forward. Two lifting bars are inserted in the holes in the rammer car and the car is lifted out. Before removing the loading platform the loading crane bracket with the loading crane is unlocked and removed from the loading platform by giving the lock shaft a half turn. A wooden lifting bar is put through the loop at the rear of the loading platform to facilitate maneuvering.

(11) Remove the pintle head cover (fig. 70), and replace the pintle head nut (LS331G), Figure 23, and lock with the cotter pin. Lock the rear clips (LS336A), Figure 26, in engagement with the holding-down sector (LS487B).

d. Mounting of cradle.—(1) Remove the elevating and traversing handwheels (KB146B and KB146A), Figure 14. The elevating handwheel (KB146B) is removed by pressing together the latch springs in the hub. The traversing handwheel (KB146A) with its shaft is removed by pressing up on the latch under the shaft and unscrewing the collar.

(2) Unlock and turn back the trunnion bearing caps. (Fig. 72.) Remove the cradle lock. (Fig. 8.)

(3) Remove the cradle draft hook. (Fig. 41.) Attach the windlass cable to the hook under the trunnion band. (Fig. 72.) Attach the assembling pulley. (Fig. 73.) By pulling out and turning the clutch handle (fig. 72), the cable drum is free to rotate so that the cable may be rapidly unwound.

(4) Insert the windlass crank shaft assemblies and draw the cradle transport vehicle over the top carriage by means of the windlass until the lugs on the roller brackets can engage the projections on the ends of the forward roller paths. (Fig. 72.) The roller brackets are slid up along the forward edges of the top carriage for this purpose. Block the limber wheels.

(5) Place two jacks, one right-hand and one left-hand, on the jack foot blocks with their caps under the roller brackets. (Fig. 73.) The windlass crank shaft assemblies must be removed in order to put the jacks in position. The jacks should be so placed as to bring their operating levers on the outside away from the cradle.

(6) Raise the rear wheels of the transport wagon off the tracks by means of the jacks ①, Figure 73, and remove the rear wheels from the axle. Preserve the axle washer for reassembling.

(7) Slip off the assembled brake shoe mechanism by unlocking the two levers (PS13B), Figure 38.

(8) Unlock the axle from the cradle. The axle-lifting levers are inserted in the holes in the axle ends and are used for lifting out the axle.

(9) Continue to draw the cradle forward, at the same time raising the jacks so that the trunnions of the cradle will clear the top carriage ②, Figure 73. The limber wheels should be followed up with the large wheel blocks to prevent accident in case the cable should break.

(10) Lower the jacks until the trunnions of the cradle rest in their bearings and lock the bearing caps. (Fig. 72.) Replace the elevating handwheel (KB146B), Figure 14, and move the elevating pinion shaft slightly, if necessary, to make the teeth mesh.

(11) Unhook the cable from the cradle, pass it around the pulley, and fasten the end to the platform hook ②, Figure 73. By tightening up on the windlass the weight of the cradle is taken off the limber.

(12) Unlock the false trail (fig. 42) and remove with the limber. The rear wheels and brake mechanism should then be assembled on the rear axle and the transport wagon and limber connected to form the cradle transport wagon, close coupled. (Fig. 61.)

e. Mounting of howitzer.—(1) Place the cradle in mounting position (about 11° elevation). See that the guide cover rails are in place (fig. 74), that the locking wedges (RB249A and RB249B), Figure 7, are moved in toward the center, and that the firing rod arm (KB129D), Figure 8, is swung back to clear the rollers. Unscrew the firing gear screw collar (KB128D), Figure 13, at the rear of the firing gear and push the firing rod arm forward to permit it to turn.

(2) Remove the end of the windlass cable from the platform hook and attach it to the hook under the howitzer through the slot in the rear axle ①, Figure 74.

(3) Draw the howitzer transport wagon (fig. 64) forward until the rear axle reaches the end of the cradle ②, Figure 74, and the rear wheels have been raised clear of the tracks.

(4) Remove the rear wheels and unlock the axle. The axle lifting levers are used to lift the axle out from under the howitzer.

(5) Continue to draw the howitzer up until the breech reaches the cradle (fig. 75, dot and dash lines). Remove the right-hand guide cover rail.

(6) Complete the drawing up of the howitzer and tighten the locking wedges (RB249A and RB249B), Figure 7, firmly. The T-shaped sliding clip on the front end of the hoop seats in the slot at the front end of the sleigh. To facilitate this, the rear rollers are adjustable up or down by means of a socket wrench (1), Figure 47.

(7) Remove the left-hand guide cover rail, unlock the false trail and remove it with the limber. The rear wheels should then be

assembled on the rear axle and the transport wagon and limber connected to form the howitzer transport wagon, close coupled. (Fig. 60.)

(8) Unhook the windlass cable from the howitzer and remove the wheel tracks. Unlock the elevating arcs from the cradle. (Fig. 65.) The cable is rewound upon the windlass drum and the crank shaft assemblies removed.

f. Mounting of miscellaneous equipment.—(1) Hook on the loading platform and loading crane (fig. 29) and set the rammer car in place and replace the cradle locking bolt slide assembly (fig. 18). The loading crane, loading crane bracket, and loading platform may be separated from each other for ease in handling. Wooden lifting bars are provided for insertion through the holes in the rammer car and loading platform for lifting.

(2) Release the lock screw (fig. 30) so that the lifting arm will swivel and attach the shell tongs to the hoisting cable (NC84A).

(3) Replace the elevating and traversing handwheels (KB146B and KB146A), Figure 14, and attach all footboards.

(4) Unlock the percussion hammer and swing down the firing rod arm (KB129D), Figure 8, to engage the percussion hammer operating shaft (20D), Figure 2.

(5) Place the floats (fig. 32) under the swinging arms and screw down the swinging arm screws. The screws should be kept tight against the floats when firing, but no attempt should be made to use them as jacks for leveling purposes.

NOTE.—The floats are so designed as to increase the length of the platform and thus diminish the tendency of the front part of the platform to lift when firing at low elevations. They should ordinarily be placed parallel to the axis of the platform as shown in Figure 76. When, however, the axis of the howitzer is very oblique to the platform the float on the side toward which the breech points may be moved so as to be parallel to the axis of the top carriage.

(6) Attach the quadrant sight to the left-hand elevating arm bearing cap, the sight bracket slipping over the auxiliary trunnion.

7. Preparation for action.—After the carriage and howitzer have been properly mounted and before firing, a special inspection will be made to determine whether the following conditions exist:

a. Inside of howitzer is clean and dry, and breech mechanism is clean and well oiled.

b. The percussion hammer is unlocked from the traveling position.

c. The obturator vent is clean.

d. The howitzer is properly locked in the sleigh. (Fig. 7.)

e. All parts of the carriage are well lubricated according to the oiling and greasing chart. (Fig. 79.)

f. The recoil slide guides on the cradle are clean and oiled (KB102B and KB102A). (Fig. 8.)

g. The proper amount of liquid is in both recoil and recuperator systems.

h. The pressure in the recuperator system is as prescribed and the sleigh is in full firing position.

i. The recoil and recuperator piston rod nuts are screwed up tight, and the piston rod beam is firmly locked to the cradle. (Fig. 9.)

j. The sight is securely attached and properly adjusted.

k. The elevating lock lever for the elevating arms is unlocked and secured in its position. (Fig. 21.)

l. The firing mechanism functions properly.

m. The trunnion bearing caps are properly locked. (Fig. 27.)

n. The cradle trunnions are floating on the roller bearings resting on the Belleville springs. (Fig. 27.)

o. The elevating pinions and arcs are clean and well lubricated and the elevating and quick loading mechanisms work easily. (Figs. 20, 21, and 24.)

p. The friction clutch in the elevating worm wheel is properly adjusted. (Fig. 19).

q. The pintle head nut (LS331G), Figure 23, is screwed down and the spring pin is in place.

r. The loading platform, loading crane bracket, loading crane, and rammer car are attached and working properly.

s. The traversing gearing is working properly, and the pinion and rack are free from dirt or gravel. (Figs. 14 and 25.)

t. The path of the traversing rollers is free from dirt or gravel. (Fig. 26.)

u. The rear clips are in place and properly locked (LS336A), Figure 26.

v. The screws in the swinging arms are down in the sockets of the floats. (Fig. 32.)

w. The floats are set on level ground. (Fig. 32.)

x. The platform is firmly set and the gravel or dirt well tamped under it.

y. The track for the shot truck is laid close enough to the carriage to bring the shot truck directly under the loading crane. (Fig. 30.)

z. All the footboards are down and securely fastened.

8. Elevating and depressing.—Elevating and depressing the howitzer are accomplished by rotating the handwheel (KB146B). Figure 14, on the left side of the top carriage.

9. Quick-loading mechanism.—Elevating for quick loading is accomplished by disengaging the cradle locking bolt slide (fig. 18), then disengaging the elevating lock lever (KB112A), Figure 21, located just below the bottom of the cradle and attached to the quick-loading arc connecting plate. To operate this lock pull on the knob (U616G), Figure 21, and move the elevating lock lever down and to the left as far as it will go, then pull the quick-loading gear operating lever (KB168A), Figures 21 and 24, toward the handwheel, at the same time turning the quick-loading handwheel (KB167A), Figure 24.

10. Traversing.—Traversing is accomplished by turning the traversing handwheel (KB146A), Figure 14, located on the left side of the top carriage.

11. Method of dismounting the matériel.—Complete instructions for assembling the carriage in the field have been given. These operations are reversed for dismounting, the following points being noted:

a. See that the quadrant sight is removed before starting to dismount the howitzer.

b. See that the windlass rope (fig. 75) is hooked to the howitzer and that the rear rollers are bearing on the rails before opening the locking wedges (fig. 7). The locking wedges can not be opened before the locking bolt (RB249C) is pulled back. The left-hand guide cover rail (KB123B), Figures 5 and 10, must be in place on the rear of the cradle and the firing-rod arm (KB129D), Figures 8 and 13, turned back. The right-hand guide cover rail (KB123A), Figures 5 and 10, is put in place as soon as the breech has cleared the cradle.

c. Have the limbers and false trails in readiness behind the howitzer and the transport rear axles and wheels in front.

d. See that all the trail and axle locks and trail dovetails are wiped free of mud and grit.

e. Before jacking up the cradle, secure the elevating arms by the elevating lock plunger (KB112H), Figure 21, and remove the cradle locking bolt slide (fig. 18) from the top carriage. Before attempting to jack up the top carriage, see that the rear clips (LS336A), Figure 26, are loose, the pintle head nut (LS331G), Figure 23, removed and that the bronze pintle head cover (fig. 70) is slipped over the threads.

f. The rammer car, loading platform, and loading crane should be assembled in the top carriage before starting to jack it up. (Fig. 58.)

g. The floats should be placed in the interior of the platform for transportation.

12. Instructions before traveling.—After the carriage has been dismounted and assembled on the proper transport wagons, a special

inspection will be made to determine whether the following conditions exist:

a. All false trails and rear axles are properly locked and handles holding them have their locking pins (U616D), Figure 44, properly inserted in their holes.

b. All wheels have their linchpins (PB65A), Figure 38, in and properly latched, and the hub boxes filled with grease.

c. The brake riggings are properly assembled and all bolts and nuts in place and tight.

d. Apply all brakes and examine to see that no sand or gravel is between the brake linings and drums.

e. All connecting cables are properly tied and are free for operation from the tractor.

f. The safety chains (fig. 36) and limit chains on the limbers are properly attached.

g. The breech mechanism of the howitzer is closed and the percussion hammer locked in traveling position by the lock bolt.

h. The breech, muzzle, howitzer, cradle, and trunnion covers are in place and properly strapped.

i. The guide cover rails (KB123B and KB123A), Figures 5 and 10, are in place on the recoil slide guides on the rear of the cradle and properly locked. (Fig. 10.)

j. The elevating lock plunger (KB112H), Figure 21, in the connecting plate of the elevating arms is inserted in the socket on the cradle plate and the handle properly locked.

k. All footboards on the top carriage are turned up and locked and the breech operator's footboard is securely fastened in front. (Figs. 15, 16, and 17.)

l. The loading platform, loading crane bracket, and loading crane are set properly inside the top carriage and the rammer car strapped to the loading platform. (Fig. 58.)

m. The trunnion-bearing caps are turned back in position and locked. (Fig. 27.)

n. The swinging arms on the platform are swung up to the sides and the screws turned down into the sockets provided. (Fig. 67.)

o. The pintle cover is in place, the nut screwed down, and the spring pin inserted. (Fig. 67.)

p. The brake lever rope (BB56Q), Figure 45, on the platform is hooked to the rod (BB54N), and the clevis (BB54H) adjusted to take up the slack.

q. All brake pawls are turned back from the ratchets so that they will not engage.

r. The axle brace rods and trail supports are properly folded back onto the trail in position for transport.

s. The loading crane lifting arm is locked in central position. (Figs. 31 and 58.)

t. The cradle and platform draft hooks (figs. 41 and 45) are properly attached.

u. All other parts are in good condition and not fractured or broken.

v. A report of any repairs needed must be made immediately to the officer in charge of the matériel or to the commanding officer of the ordnance maintenance company.

13. Breech mechanism.—*a*. To open the breech, release the percussion hammer by moving the percussion hammer lock bolt to the left.

b. Raise the firing mechanism block latch and unscrew the firing mechanism by turning it to the left.

c. Grasp the operating lever at the grip portion, depress the operating lever trigger and pull the lever to the rear and around until the operating lever handle engages with the operating lever latch bracket. The instant the block carrier moves away from the breech face of the howitzer, the rack lock under the action of its spring slides upward in its inclined seat and protrudes from the muzzle face of the carrier. This allows the lock to engage in the groove in the rack and locks it, thereby preventing the breechblock from turning while outside of the breech recess.

NOTE.—To avoid accident, the breech should never be opened when the howitzer is at an elevation greater than that for loading, 9° 30′.

d. To close the breech, grasp the vertical grip of the operating lever in such a manner as to depress the operating lever trigger into the grip, and release the operating lever handle from the operating lever latch bracket.

e. Swing the operating lever with the breech mechanism around until the block carrier strikes the breech face of the howitzer and the operating lever handle engages with the operating lever latch plate.

f. Screw the firing mechanism into the firing mechanism housing until its handle passes the firing mechanism block latch.

g. To operate the firing mechanism, hold the firing mechanism in the hand and load with a primer by sliding the rim of the primer into the slot of the primer holder. This locates the cap in the primer directly in front of the firing pin. The firing mechanism is then screwed into the firing mechanism housing, seating the primer in the chamber of the obturator spindle as the handle of the firing mechanism passes the firing mechanism block latch. Firing is effected from the

side of the carriage by movement of the firing rod, or from the rear by pulling the lanyard attached to the outer end of the percussion hammer operating shaft. This causes the hammer to swing upward, striking the rear end of the firing pin, driving it forward against the cap in the primer which explodes it.

14. Permanent emplacement.—*a.* The emplacement for the 240-mm howitzer carriage, M1918A1, is of concrete and is arranged for a field of fire of 360°. (See fig. 84.) Anchor bolts for the roller path and pintle base plate are set in the concrete during construction of the emplacement by the Corps of Engineers.

b. The traversing rack is made integral with the roller path, which is furnished in four sections. The roller path, pintle base plate, and base ring are furnished, set and leveled by the Ordnance Department. The anchor bolts for the roller path and pintle base plate, as well as the pintle and wheel track support rods, are also supplied by the Ordnance Department.

c. When the 240-mm howitzer carriage is mounted on this emplacement, the platform is not used.

d. The pintle rests within the pintle socket of the pintle base plate, and is permanently installed after the emplacement is constructed. An additional pintle is furnished with each carriage for use with the matériel other than on the permanent emplacement. The traversing rollers of the top carriage rest upon the roller path when the carriage is mounted on the emplacement.

e. In mounting the 240-mm howitzer matériel, M1918A1, the following equipment is required, provided wheel-track support rods are previously installed as shown in Figure 84:

1 ax, single-bit, 5-lb. (w/handle).
2 bars, lifting, wood, 43″.
9 blocks, wood, 6″ x 12″ x 24″ (blocking).
2 blocks, wood, 12″ x 12″ x 24″ (jack foot).
1 block, wheel, large, left.
1 block, wheel, large, right.
2 blocks, wheel, small.
1 cover, pintle head.
1 crowbar, pinch point, 18-lb. (60″).
2 crowbars, wooden, steel pt., 102 1/16″.
2 handspikes, wood, 82 3/4″.
2 jacks, hydraulic, L. H., w/operating lever.
2 jacks, hydraulic, R. H., w/operating lever.
or
4 jacks, 15-ton, M1, w/lever.
2 levers, lifting, axle.
2 mats, wheel.

1 rod, iron, 2¾″ x 6′ 3″ (false axle).
2 planks, 3″ x 12″ x 8′ 10″, 17° chamfer at one end.
2 planks, 3″ x 12″ x 12′ (wheel track support).
1 rope, Manila, 2″ x 60′.
1 sledge, steel, double-face, 10-lb. (w/handle).
1 tractor, Ordnance "Caterpillar" 60, M1, or substitute.
1 track, wheel, complete.
(Composed of—
2 planes, incline, removable.
1 track, wheel, left.
1 track, wheel, right.)
1 wrench, locking wedge.
1 wrench, pintle.
1 wrench, socket, gun roller.

If the four wheel track support rods are not already in position, and the concrete base has not been altered to take them, the following additional equipment should be provided:

2 chisels, cold, ¾″.
2 hammers, ball peen, 20 oz.
4 rods, iron 2¾″ x 6′ 3″ (wheel track support rods)

f. Mounting top carriage.—(1) Remove the pintle head nut and slip the pintle head cover over the threads of the pintle head.

(2) If not already there, place the wheel track support rods in position as shown in Figure 84, and wheel track support planks, Figures 85 and 86.

(3) Place wheel tracks, with inner edges resting directly over outer edges of the base ring. This gives proper distance between tracks. (Figs. 85 and 86.)

(4) Remove all footboards, platforms, rammer car, crane, and loading platform supports from the top carriage.

(5) Put the small wheel blocks in position. The correct position can be determined by dropping the retaining levers into the forward notches in the tracks. Run the top carriage transport wagon onto the tracks and block the rear wheels. Place the jack foot blocks in position as shown in Figure 86.

(6) (*a*) Place the front jacks on the jack foot blocks, and the rear jacks as shown in Figure 87, using a jack foot plank. With the rear jacks raise the top carriage slightly, unlock and remove the false trail and rear axle. Place blocking as shown in Figure 87 and lower the load onto this blocking. Remove the incline planes and attach them to the front end of tracks. (Fig. 87.) Jack up the carriage until the front wheels clear the tracks. Unlock the front axle and clear axle locks.

Lower the carriage onto the front blocking. (Fig. 87.) Take strain on rear jacks. Roll the front axle and wheels away. (Fig. 87.) Remove one piece of blocking at a time and jack down alternately front and rear until front jacks near their lower limit.

(*b*) Change front and rear jacks and place the false axle (iron rod) as shown in Figures 88 and 89. Lower as previously. Check position of pintle as the carriage is lowered. When it comes to rest remove the pintle head cover and replace the pintle head nut and cotter pin.

g. Mounting the cradle.—(1) Remove the elevating and traversing handwheels.

(2) Place a piece of 2-inch plank on each wheel track as shown in Figure 90. These planks raise the cradle sufficiently to obviate the necessity of removing the brake-operating lever and brake shaft.

(3) Unlock and turn back the trunnion bearing caps and draw the cradle transport vehicle forward until the lugs on the roller brackets can engage the projections on the ends of the forward roller path.

(4) Place two jacks on the jack foot planks with their caps under the roller brackets. (Fig. 90.) The jack foot planks must engage the raised lip of the roller path as shown in Figure 91 to prevent sliding from under jacks. Another method to hold these planks in place would be to place one tractor track over the ends. As an additional safety precaution to prevent the jacks from sliding out on the planks, the windlass cranks may be inserted in their sockets as shown in Figure 90.

(5) Place wheel mats as shown in Figure 90, if not already placed The wheel mats serve as platforms for the detail handling the wheels to stand and walk on.

(6) Raise the front wheels off the tracks by means of the jacks. Move the tracks out to position shown in Figure 90, and remove the front wheels from the axle and roll them back along the tracks.

(7) Unlock the axle from the cradle and remove axle by means of the axle lifting levers.

(8) Continue to draw the cradle forward, at the same time raising the jacks so that the trunnions will clear the top carriage. The limber wheels should be followed up with the large wheel blocks to prevent accident in case the cable should break.

(9) Replace the elevating handwheel and move the elevating pinion slightly if necessary to make the teeth mesh while lowering the jacks until the trunnions rest in the bearings. Lock the bearing caps.

(10) Due to the preponderance of weight at the rear of the cradle, it is necessary to place a bar or timber under the breech to assist in

elevating or depressing the cradle with the handwheel. This is usually necessary in order to remove the front axle and wheels.

h. Mounting the howitzer.—See paragraph 6*e*.

i. Mounting of miscellaneous equipment.—See paragraph 6*f*, as far as applicable to this matériel.

j. The blocking should be used and placed as shown in Figure 87. By jacking one end at a time and by placing blocking as shown, the tendencies of the carriage to move forward or backward or to roll are overcome.

k. Tie-rods for the wheel tracks are not essential in the mounting operations, but may be used in spacing the tracks prior to mounting the carriage. If the tracks are laid as described herein, and as shown in Figure 85, no spacing difficulty will be encountered. The tie-rods have to be removed before the top carriage is lowered and can not be used on any succeeding operations.

l. Dismounting the matériel is accomplished in the reverse order of mounting. See paragraph 12 for the instructions before traveling.

m. The foregoing contemplates use of the windlass for drawing the different loads into position. This may be accomplished by use of a tractor.

n. The following equipment is required for handling ammunition at the emplacement:

1 barrow, shot.
1 frame, erecting, with ammunition attachment.
1 track, shot truck, complete.
(Composed of:
6 switches, left, 131¼″, assembly.
6 switches, right, 131¼″, assembly.
28 tracks, curved, 123¾″, assembly.
4 tracks, curved, 85⅜″, assembly.
4 tracks, curved, 38½″, assembly.
12 tracks, straight, 39⅜″, assembly.
12 tracks, straight, 71″, assembly.
12 tracks, straight, 86⅝″, assembly.
60 tracks, straight, 197″, assembly.)
2 trucks, shot.

SECTION III

DESCRIPTION OF GROUPS

15. Barrel assembly.—*a.* The barrel is of the built-up type, consisting of the tube, hoop, and jacket. The hoop and jacket are expanded by heat and then screwed upon the tube and are held rigid by shrinkage. The tube extends the entire length of the barrel. The interior of the breech end forms the threaded and plain sectors. This gives half of the circumference as bearing surfaces for the threads of the breechblock. Suitable clearance cuts on the breechblock, which with the breechblock carrier swings from the hinge lugs of the jacket, permit the block to swing into the breech recess without interference.

b. The howitzer is provided with front and rear rollers on either side for mounting and dismounting. The front roller spindles fit into dovetailed seats and are held by four fastening screws. The rollers are secured by nuts and washers. The rear roller spindles fit into hollow boxlike projections and are held by one screw each, while the rollers are also secured by nuts and washers.

c. The hoop has a T-shaped lug on its bottom side which acts as a holding down clip for the muzzle end of the howitzer. It also acts as a sliding surface when the howitzer is being mounted. The hole through the lug takes the hook used in mounting and dismounting the howitzer.

d. Lugs on the bottom side of the jacket, near the breech end, are provided between which the locking wedges are forced. This secures the howitzer from longitudinal movement in the sleigh. The dovetailed seat in the bottom side of the breech end receives the false trail of the transport wagon, and the locking eye in the breech face of the jacket engages the lock of the false trail, thus securing the breech end of the howitzer to its transport vehicle.

e. A lug is formed on the right side of the jacket for hinging the breechblock carrier. The operating lever latch plate fits into the breech face at the upper left and latches the breech mechanism in the

closed position. The mechanism is held in the open position by the operating lever latch bracket fastened to the exterior of the jacket at the upper right.

f. Jacket dust covers are attached to the right and left sides with six machine screws each to protect the interior of the sleigh.

g. Two leveling plates are inlaid at the top center line of the jacket and form a level surface in alignment with the bore of the howitzer for applying the gunner's quadrant.

16. Breech mechanism.—*a. Breechblock carrier.*—(1) The breechblock carrier which carries the breech mechanism swings on the hinge lug of the jacket, and is secured thereto by means of the hinge pin passing through the lug and the two lugs of the carrier. The operating lever shaft passes through the hole to the rear of that for the hinge pin and is secured by the operating lever shaft nut and cotter pin.

(2) The hole in the upper lug of the breechblock carrier contains the hinge pin bushing which is securely held in position by the hinge pin bushing nut. The lower portion of the bushing rests upon the regulating plate and bears the weight of the breech mechanism.

(3) A threaded recess is contained in the muzzle face of the breechblock carrier. The breechblock screws into this recess. A pintle is formed in the center of the recess and projects into the breechblock. The breechblock turns upon this pintle through its arc of rotation. The pintle is bored through the center and receives the obturator spindle spring and its allied parts at the front, while at the rear it takes the firing mechanism housing.

(4) The breechblock carrier assembling stud is assembled in the threaded recess and forms a stop against which a similar stud on the breechblock abuts, locating the breechblock in correct assembled position when it is screwed into the carrier.

(5) The hole which extends from the right side into the interior of the breechblock carrier carries the rack which engages the gear teeth on the breechblock. The inclined pocket in the muzzle face carries the rack lock spring and rack lock which engages in a slot in the rack and locks the breechblock to prevent it from turning when the latter is outside of the breech recess.

(6) On the breech face of the carrier, toward the bottom, the operating shaft housing is secured. Toward the upper right the firing mechanism block latch is fastened.

b. Breechblock.—(1) The breechblock is of the interrupted screw type, having four threaded and four plain sectors located 90° apart. Suitable clearance cuts are made on the block as well as in the breech recess to permit the block to enter the recess without interferences.

The portion of the exterior threads at the rear, which screws into the carrier, is left continuous, except at that point where the gear teeth have been formed for rotating the breechblock by means of the rack.

(2) The interior is bored at the forward end to receive the obturator spindle. The rear is fitted to slide over the pintle of the breechblock carrier. At the edge of this bore, a depression is formed into a cam surface to operate the firing mechanism safety plunger upon rotation of the breechblock.

(3) In the breech face of the breechblock the breechblock assembling stud is located and forms a stop to locate the block in position for assembling the rack.

c. Rack.—The rack slides into its seat from the right side of the breechblock carrier. Its inner end is provided with teeth which engage the gear teeth of the breechblock and rotate the latter. The outer end is also provided with teeth for engagement with the gear teeth of the rack segment.

d. Rack segment.—The rack segment slides over the hub of the operating lever. A key is formed on the underside and the segment thus turns with the lever. The four gear teeth in its circumference provide the means of actuating the rack.

e. Rack lock.—The rack lock is assembled in the front face of the breechblock carrier in an inclined pocket. It is actuated by the rack lock spring which tends to force the lock upward, causing it to protrude beyond the front face of the carrier when the latter moves away from contact with the breech face of the howitzer. This allows the lock, in raising upward, to engage with a slot in the underside of the rack which locks the latter from movement until the carrier again swings against the breech face.

f. Operating lever.—(1) The operating lever receives the end of the operating lever shaft through the hole in the center of the hub. The hole is formed with three keys which provide the means of driving the shaft with the lever. The exterior of the hub receives the rack segment, and is formed with a key to fit the interior of the segment, providing the means of driving the segment with the lever.

(2) The outer end of the lever has both a horizontal and a vertical grip which provide for grasping and rotating the lever. The vertical grip is hollow and contains the operating lever handle, spring, and the operating lever handle spring plug, the latter screwing on the end of the handle and retaining the parts within the grip. The top of the grip is closed by the operating lever handle nut. An opening in the side of the grip and two projecting lugs are for the operating lever trigger, which pivots between the lugs on the operating lever trigger screw. The short arm of the trigger projects into the opening in the

side of the operating lever handle spring plug, and operates the handle when the trigger is pressed, thus freeing the operating lever from the operating lever latch plate.

g. Operating lever shaft.—The operating lever shaft passes through the hole in the breechblock carrier just to the rear of the hinge pin hole. The lower end of the shaft is provided with four gear teeth which engage with corresponding spaces in the hinge pin to draw the carrier away from the breech face of the howitzer. The upper end of the shaft is formed with three spaces in its exterior to fit corresponding keys in the lever. One space slightly wider than the others compels assembly of the lever in correct relation to the gear teeth on the bottom end of the shaft. A washer, nut, and cotter pin, fitting the upper end, are provided for securing the operating lever to the shaft.

h. Hinge pin.—The hinge pin forms the pivot on which the breechblock carrier swings. It is inserted through the hinge lugs of the carrier and jacket, and is prevented from turning by the hinge pin screw. The lower end is formed with four gear tooth spaces with which the gear teeth of the operating lever shaft mesh in opening and closing the breech mechanism.

i. Obturator.—(1) *Obturator spindle.*—The obturator spindle passes through the breechblock, breechblock carrier, and interior parts thereof. The spindle is retained by screwing it into the firing mechanism housing which is assembled in the breechblock carrier. Slots are cut in the head of the spindle for use of a wrench in assembling and disassembling.

(2) The breech end of the spindle contains the obturator spindle plug gasket and obturator spindle plug. The latter is screwed in against the gasket. The front end, or head of the spindle, contains the obturator spindle vent bushing which is screwed in very tightly. The vent hole which conducts the flame from the primer passes through the center of the bushing and the spindle, and connects with the chamber in the obturator spindle plug. The exterior of the breech end of the spindle is threaded and screws into the firing mechanism housing. It has a short keyway in which the firing mechanism housing key engages to prevent unscrewing.

(3) *Gas check pad.*—The gas check pad is composed of three parts asbestos and one part nonfluid oil, inclosed in canvas or wire screen. It is subjected to great pressure in forming. The pad is protected by the front split ring, rear split ring, inner ring, and filling-in disk. The pad is assembled on the obturator spindle between the mushroom-shaped head of the spindle and the filling-in disk, against the muzzle face of the breechblock.

(4) *Filling-in disk.*—The filling-in disk acts as a washer between the moving parts and protects the pad from abrasion by the block and the block from abrasion by the rear split ring. The pad may be made to seat more tightly, if necessary, by adding an additional disk. The one disk provided must never be omitted.

(5) *Split rings, front and rear.*—The split rings are of triangular cross section and are coned on the outer diameter to correspond to the angle of the gas check seat in the chamber of the howitzer. They are made slightly larger in diameter than the point at which they are designed to seat, and, being split, they conform to the smaller diameter under some compression. The rings protect the outer diameter of the pad at the front and rear edges, especially the front edge where the pad would otherwise be burned by the hot gasses.

(6) *Inner ring.*—The inner ring is similar to the front and rear rings, except that it is not split. It protects the gas check pad at the rear edge of its inner diameter.

(7) *Obturator spindle spring.*—The obturator spindle spring is helical, and is assembled in the bore of the breechblock carrier between the obturator spindle spring front and rear seats. It furnishes the necessary force to hold the gas check pad, ring, and disk firmly between the mushroom head of the obturator spindle and the muzzle face of the breechblock.

(8) *Obturator spindle spring front seat and collar.*—The obturator spindle spring front seat acts as a washer between the obturator spindle spring and the obturator spindle spring front seat collar. The latter fills the space between the front seat and the breechblock, thus obtaining the required compression of the spring when the parts are in the assembled position.

(9) *Obturator spindle spring rear seat.*—The obturator spindle spring rear seat is formed to fill the space at the rear of the obturator spindle spring to obtain a seating against the firing mechanism and to provide a seat for the spring.

j. Firing mechanism housing.—The firing mechanism housing is threaded in both its forward and rear ends. The obturator spindle screws into the former and the firing mechanism in the latter. A projection on the top is bored out to contain the firing mechanism safety plunger and spring. The safety plunger is retained in position by the firing mechanism housing screw. A keyway in the exterior of the housing on the lower side forms a path for the firing mechanism housing key to be moved in and out of engagement with the obturator spindle. A small hole in the bottom of the keyway receives the stud in the firing mechanism housing key spring which retains the key in position.

k. Firing mechanism housing key.—The firing mechanism housing key slides a short distance in the keyway in the firing mechanism housing to engage or disengage with the keyway in the end of the obturator spindle. The key contains the firing mechanism housing key spring which is riveted thereto, and the spring has riveted to it the firing mechanism housing key spring stud. A slot in the rear end of the key forms a point for prying with the extractor when withdrawing the key.

l. Firing mechanism.—(1) The firing mechanism is composed of the firing mechanism block assembly, which is made up of the block, handle and collar; firing mechanism shoe; firing pin; firing pin guide; firing pin housing; firing pin spring; primer holder; and two safety set screws which lock the primer holder and the firing pin housing.

(2) The firing mechanism block is threaded and screws into the firing mechanism housing to a point where its handle passes the firing mechanism block latch. It houses the firing pin guide which is retained by the primer seat plug screwed in from the front end, and the firing pin and firing pin spring which are secured by the firing pin housing screwed in the rear end. The latter is secured by the firing mechanism housing screw inserted from the exterior.

(3) The primer holder is provided with an opening through which the rim of the primer is inserted. The firing pin guide, forced by the firing pin spring, provides sufficient friction against the head of the primer to retain it in position. This spring also forces the firing pin to the rear and prevents protrusion of the pin except by action of the percussion hammer.

(4) On the rear face of the firing mechanism block a projecting rim is formed with a portion removed. This slot allows the spur on the percussion hammer to pass beyond the projecting rim and the percussion hammer to come in contact with the firing pin, when the firing mechanism is screwed fully into the housing. At all other positions of the firing mechanism the full travel of the percussion hammer is prevented by the spur on the hammer striking the rim on the block. Therefore, firing can not take place until the handle of the firing mechanism has been turned past the block latch.

m. Firing mechanism block latch.—The firing mechanism block latch is assembled to the firing mechanism block latch holder, together with its spring and handle. The assembly is secured to the upper right breech face of the breechblock carrier with four screws. The latch is beveled on one side, and, as the firing mechanism is screwed into the housing, the handle strikes the bevel, depressing the latch against its spring and allowing the handle to pass. This locates and

locks the firing mechanism in proper position so that the percussion hammer can properly function to fire the howitzer.

17. Percussion mechanism.—The percussion mechanism consists of the percussion hammer, percussion-hammer operating shaft, percussion-hammer operating shaft housing, and the percussion-hammer lock bolt.

a. Percussion hammer.—The percussion hammer swings through an angle of 66° on the percussion-hammer operating shaft. A hole is formed through its hub with 3 squared sides and 1 rounded side to insure the assembly of the shaft in 1 position only. The hammer portion is formed on the outer end of its swinging arm. A projection or spur on the inner face of the arm provides a safety feature in connection with the rim on the rear face of the firing mechanism block. The round hole through the side is engaged by the end of the percussion-hammer lock bolt, which locks the hammer in the traveling position.

b. Percussion-hammer operating shaft.—The percussion-hammer operating shaft passes through the percussion hammer and the percussion-hammer operating shaft housing, which is located on the breech face of the breechblock carrier. It is retained in the housing by the percussion-hammer operating shaft collar and its detent. A projecting arm at right angles to the shaft contains a hole for attaching the lanyard, and a round projection from the side of the arm contacts with the firing-rod arm of the top carriage in firing from the side of the carriage.

c. Percussion-hammer lock bolt.—The percussion-hammer lock bolt operates in the square hole in the percussion-hammer lock bolt housing. It contains the percussion-hammer lock bolt spring which is secured by a screw in the recess in the bottom of the bolt. The spring recedes into the recess as the bolt is pressed into its seat in the housing. A round projection on the spring is provided to offer a slight resistance to the movement of the bolt by engaging into depressions in the bolt seat and holds the bolt in the engaged or disengaged positions. The slot in the upper side of the bolt receives the end of the percussion-hammer lock bolt stop screw by which it is retained in the housing.

18. Sleigh.—*a.* The sleigh (figs. 6 and 7) is made from a forged steel block and serves as a support for the howitzer. Grooves are cut underneath the top edges of the sleigh, which are lined with bronze liners known as the sleigh liners. These liners slide on the recoil slide guides, fastened to the cradle, and guide the sleigh during recoil. There are five longitudinal cylinders bored in the sleigh. The two upper cylinders, running about one-half the length of the sleigh, form

gas reservoirs and are closed at the front end by the reservoir caps. The left reservoir cap is provided with an opening in which the valve used in connection with the pressure gauge and adapter for taking pressures is assembled. The three lower cylinders, extending the full length of the sleigh, form a housing for the recoil and the recuperator mechanisms, the two outside cylinders being the recoil cylinders and the center the recuperator cylinder. The recoil cylinders are closed at the rear with the recoil cylinder rear plugs (RB251B), Figure 11, and at the front end with the recoil packing boxes, through which the recoil piston rods operate. The recuperator cylinder is closed at the rear end with the recuperator rear cylinder head and at the front with the recuperator rod packing box (RB255A) through which the recuperator piston rod moves.

b. The sleigh is bored to receive the wedge screws which operate the locking wedges that are inserted into milled recesses of the sleigh.

c. The locking wedges, left and right (RB249A and RB249B), Figure 7, lock the howitzer to the sleigh and prevent any horizontal movement of the howitzer in relation to the sleigh. Access to the wedge screws when the sleigh is mounted in the cradle is gained through the locking wedge key door (KB120A), Figure 8. When the locking wedges are unlocked or are in position to remove or mount the howitzer, the wedges are brought together on the center line of the carriage in which position the howitzer is free to slide on or off the sleigh. After the howitzer is assembled on the sleigh the wedge screws, left and right hand (RB264A and RB264B), Figure 7, which are engaged through the medium of clutch teeth cut in the ends, are rotated by a wrench engaging with the left-hand screw releasing ring (RB264C) which in turn engages the end of the left-hand wedge screw (RB264A). Rotation of the locking wedge wrench clockwise locks the howitzer to the sleigh and when the locking wedges are fully engaged a locking bolt (RB249C) slides forward automatically into a hole in the left-hand locking wedge and prevents any movement of the wedges until the locking bolt is pulled out and held until the hole in the wedge has passed the end of the bolt.

d. In case the locking bolt (RB249C), Figure 7, does not automatically enter the hole in the left-hand wedge, a safety buffer (KE18B), Figure 52, mounted on the rammer car, will not engage with the end of the locking bolt handle (RB264L), Figure 7, and will prevent the rammer car locking with the breech of the howitzer.

e. An additional safety device in the form of a wedge screw brake (RB264H), Figure 7, is provided, which, when the wrench is withdrawn, engages with the left-hand screw releasing ring (RB264C) and

the releasing ring abutment plug (RB249E), thereby preventing the rotation of the screws without the use of the wrench. The wedge screw brake is operated and held in place by a small spring. The right-hand wedge screw (RB264B) is supported by the wedge screw abutment plug (RB249F), which is screwed into the sleigh and locked by the spring plunger (RB264F) and plunger spring (RB264K). The end thrust is taken up by the wedge screw abutment block (RB264E).

19. Recoil mechanism.—The recoil system is for the purpose of controlling the force created by firing and to check the movement of the recoiling mass in a gradual manner so as not to cause displacement of the carriage. The counterrecoil mechanism is for the purpose of returning the recoiling mass into battery in order that the howitzer may be fired again.

a. Figure 78 shows by diagram the action of the recoil mechanism, but does not show actual details of the various parts. For details see Figure 11.

b. When fired, the howitzer and sleigh recoil, carrying with them the throttling rods which are attached to the cylinder rear plugs, while the piston rods which are attached to the front of the cradle do not move. The liquid which is in front of the recoil pistons is then forced through six diagonal holes drilled in each piston, two of which are shown in Figure 78, into the interior of the piston and then out through the variable aperture formed by the throttling rod and the hole in the rear of the recoil piston rod throttling ring (RB252D), Figure 11, to the rear of the piston.

c. The liquid is also forced through the return valve (RB253C), Figure 11, which is forced from its seat by the pressure of the liquid, thereby allowing the interior of the recoil piston rod (RB252A) to fill as the recoil throttling rod (RB253A) and return valve move to the rear.

d. The resistance of the flow of liquid through the rear of the recoil piston rod throttling ring (RB252D), Figure 11, is regulated by the variable diameter of the throttling rod which passes through it at recoil, continually changing the area of the aperture through the throttling ring through which the liquid is forced. This resistance is such as to control and limit the recoil to its normal amount.

e. At counterrecoil or return of the howitzer and sleigh (fig. 78) to the firing position, the recoiling mass is forced to the front by the energy stored up by action of recoil which has compressed the nitrogen stored in the reservoir of the sleigh. The energy thus stored is sufficient to return the howitzer and sleigh to the firing position when the howitzer is elevated to the maximum elevation. There will be an

excessive amount of energy at low elevation. The apertures which form in the throttling rings by the throttling rods will offer sufficient resistance to the flow of liquid to control the howitzer and sleigh in recoil, but will not offer sufficient resistance to the flow of liquid at counterrecoil. An auxiliary braking resistance is therefore necessary, which is provided by the return valve (RB253C), Figure 11, attached to the front end of the throttling rods. At counterrecoil the pressure of the liquid in the interior of the recoil piston causes the return valve to seat. The liquid in counterrecoil is thus forced to pass through the clearance space between the outside diameter of the return valve (RB253C), Figure 11, and the interior wall of the recoil piston rod (RB252A). A resistance effort against the counterrecoiling mass is thus produced and as the diameter of the piston rod traversed by the return valve is varied, the braking resistance will at all times be of such proportions as to allow the howitzer and cradle to return smoothly into battery. At the end of counterrecoil the clearance between the outside diameter of the return valve and the interior diameter of the piston rod is diminished to such an extent that the return valve functions as a hydraulic buffer, thereby preventing shock.

f. The cylinder rear plugs (RB251B), Figure 11, which close the rear ends of the recoil cylinders are held in place by the rear plug retainers (RB269B) which are screwed into the recoil cylinders and brought to a bearing upon the rear plug washers (RB251E and RB251F) which pack the joints and prevent any liquid being forced out through the plugs. This packing in turn bears upon projecting rings integral with the rear plugs, transmitting the pressure due to screwing in the rear plug retaining nuts to the cylinder rear plugs which in turn bear upon projections in the recoil cylinders. The rear plug retainers (RB269B) are provided with eight slots in the rear ends for application of a wrench when assembling or disassembling. The filling plugs (RB269D) seating on filling plug washers (RB269F) are also screwed into the cylinder rear plugs.

g. The recoil throttling rods (RB253A), Figure 11, are screwed into the cylinder rear plugs and are locked by the throttling rod securing screws (RB251G). Two flats are machined on this end of the recoil throttling rods to hold them when assembling the cylinder rear plugs. At the front end of the recoil throttling rods the valve seats (RB253D) are fitted and screwed on and serve as seats for the return valves. They also support the front ends of the recoil throttling rods which slide upon four fins slightly larger in diameter than the return valves (RB253C) which are supported by the front ends of the recoil throttling rods and by the throttling rod valve stops (RB253B).

The return valves have seven equally spaced holes, through which the liquid flows during the recoil. They have a sliding fit upon the recoil throttling rods and recoil throttling rod valve stops and are, therefore, free to move upon application of the pressure of the liquid during recoil and counterrecoil. The recoil throttling rod valve stops (RB253B) are screwed on to the recoil throttling rods and limit the forward movement of the return valves (RB253C).

h. These parts are attached to the sleigh through the medium of the recoil cylinder rear plugs (RB251B), Figure 11.

i. The recoil piston rods (RB252A), Figure 11, are attached to the piston rod beam (KB114A) by the recoil piston rod lock nuts (RB252G) and recoil piston rod nuts (RB252F). The recoil piston rod nuts are locked by the spring plungers (RB264F) and plunger springs (RB264K). The recoil piston rod lock nuts (RB252G) are locked by the recoil piston rod lock nut set screws (RB252B).

j. The rear end of the recoil piston rods (RB252A), Figure 11, are enlarged and form the pistons. These pistons have six holes through which the liquid flows. Recoil piston rod sleeves (RB252E) are screwed on to the outside of the pistons and are locked in place by the lock screws (RB252C) which also lock the recoil piston rod throttling rings (RB252D) screwed into the pistons.

k. The front ends of the recoil cylinders are closed by packing boxes, consisting of the recoil packing box body (RB251A), Figure 11, and recoil packing box retainer (RB269A) which are screwed into the ends of the recoil cylinders and bear upon the recoil packing box washers (RB251D and RB251C). Recoil packing box packing glands (RB269C) are screwed into the front ends of the recoil packing box bodies and are locked by the lock screws (RB250M). These packing glands are provided with an oil hole through which the recoil piston rod lubricating packings (RB269E) are oiled.

l. In the rear of and into the recoil packing box bodies (RB251A), Figure 11, recoil packing box sleeves (RB250H) are screwed, which are locked by the lock screws (RB250M). Into the recoil packing box sleeves, recoil packing box pressure rings (RB250G) are screwed and locked in place by lock screws (RB250M). The recoil packing box pressure rings (RB250G) transmit pressure through the short pins integral with the recoil packing box spring retainers (RB250C) to the recoil packing box packing springs (RB250F) which in turn transmit pressure to the recoil stuffing box spring housings (RB250B), recoil packing box packing rings (RB240C), recoil packing box cushion housings (RB250A), recoil stuffing box cushion shoes (RB240D), recoil stuffing box cushions (RB240A), and inner recoil packing box glands (RB250D). Between the inner recoil packing box glands

(RB250D) and recoil packing box sleeves (RB250H), the inner recoil packing box packing rings (RB240B) are located.

m. The recuperator reservoirs are closed by reservoir caps (RB259D and RB259A), Figure 48, which are seated on a slight projection on the interior of the cylinder and are held in place by the reservoir cap securing follower (RB259B). They bear upon the recuperator packing box packing ring (RB256M), and reservoir cap packing rings (RB259E). The parts for both reservoirs are identical except that provision is made in the left reservoir cap (RB259D) for inserting the pressure gauge by means of an adapter screwed into the valve body contained therein.

n. The recuperator cylinder houses the recuperator piston rod (RB257E), Figure 11, which is attached to the piston rod beam (KB114A) by the recuperator piston rod nut (RB256A) and recuperator piston rod lock nut(RB256B) which is locked in position by the recuperator rod securing screw (RB256H). The recuperator piston rod nut (RB256A) is locked by a spring plunger (RB264F) and plunger spring (RB264K). The front end of the recuperator piston rod is packed in a similar manner to the recoil piston rods. In addition, six recuperator buffer rings (RB256K) and the recuperator buffer washer are provided which limit the forward movement of the recoiling parts as they return to the firing position. The piston head is provided with a recuperator piston ring (RB257F), recuperator piston spindle (RB257A), and recuperator piston nut (RB257G) which retain the packing. This packing is similar to that of the front end and that in the recoil cylinders. The rear end of the recuperator cylinder is closed by the recuperator cylinder rear head (RB256D). The recuperator cylinder rear head is provided with an oil cup and an air vent hole. The latter is covered by the vent hole cover (RB256E), attached by screws and limited in outward movement by the vent hole cover stop (RB256F), as the air is forced out of the cylinder at counterrecoil. To prevent a vacuum behind the piston head the air vent hole provides a means of allowing the air to be drawn into the rear of the cylinder during recoil.

20. Cradle.—*a.* The cradle is a U-shaped plate (KB100A), Figures 8 and 10, along the edges of which the recoil slide guides (KB102B and KB102A), Figures 8 and 10, are riveted. The sleigh slides on these guides during recoil and counterrecoil.

b. Axletree band.—The axletree band (KB106A), Figure 8, is riveted to the lower front end of the cradle for the attachment of the transport wagon axle.

c. Trunnion band.—The trunnions, which transmit the firing stresses to the top carriage, are formed on the trunnion band

(KB110A), Figure 8, which also materially stiffens the cradle. Auxiliary trunnions, which support the tipping parts except in firing, are fitted into bores concentric with the main trunnions. The auxiliary trunnions with their roller bearings and trunnion end plates remain with the cradle assembly. The action at the trunnions is explained further in paragraph 21 *b*. The cable hook (KB116A), used when hauling the cradle into position when mounting, is riveted to the lower front end of the trunnion band.

d. Intermediate cradle band.—To the rear of the trunnions, the cradle bottom plate (KB100A), Figure 8, is stiffened by the intermediate cradle band (KB105A). To this band are attached the firing rod bracket (KB128A) and the locking wedge key door (KB120A). The band is also provided with a beveled surface on each side to bear on the upper ends of the elevating arcs. It is through contact at these surfaces with the elevating arcs that the reaction, due to firing, is transmitted through the elevating gearing to the friction clutch.

e. Rear cradle band.—The rear end of the cradle bottom plate (KB100A), Figure 8, is stiffened by the rear cradle band (KB104A). The rear band is provided with guides on the bottom and a coupling hook (PS11A) which are used to attach the false trail of the transport wagon to the cradle. To balance the tipping parts the rear cradle band contains about 300 pounds of lead. When mounting a 240-mm howitzer, M1918MI (Nos. 183 to 330, inclusive) or M1918MIA1, counterweights, one right hand and one left hand, are attached to the rear end of the cradle and rear cradle band. These two counterweights weigh approximately 580 pounds, and are provided with cavities into which lead may be poured to increase the weight for properly balancing the tipping parts. If occasion should arise whereby it becomes necessary to mount a 240-mm howitzer, M1918 (Nos. 1 to 182, inclusive) or M1918A1, in tipping parts to which these counterweights are applied, the counterweights will be removed as these models can be properly balanced without them.

f. Cradle elevating stop.—The cradle elevation stop (KB107A), Figure 8, is riveted to the underside of the cradle bottom plate (KB100A) a little forward of the rear band, and is used to limit the elevation of the howitzer 60°, at which time the stop engages with the cradle elevating stop (LS502A), Figure 34, in the trunk portion of the platform.

g. Piston-rod beam.—The piston-rod beam (KB114A), Figures 11 and 12, is attached to the front lower part of the cradle bottom plate (KB100A), Figure 8, and is held by two locking bolts (KB115B), Figure 9, on the upper side and by an operating screw (KB115A) operated by the operating screw crank (KB115L) engaged in the

operating screw nut (KB115E) on the lower side. The piston-rod beam is thus detachable in order to give access to the recoil packing box bodies (RB251A), Figure 11, and recuperator rod packing box (RB255A), Figure 11. Piston-rod beam slides (KB107D and KB107E), Figure 8, are provided to guide the piston-rod beam into place. The lock bolt (KB115B), Figure 9, when in place is locked by the spring plunger (RB264F). As the recoil and recuperator piston rods are fastened to the piston-rod beam, all the stress due to firing comes on this member and it is, therefore, very important that it be properly attached to the cradle.

h. Forward roller paths.—The forward roller paths (KB108B and KB108A), Figure 8, on which the cradle runs during mounting and dismounting, are attached to each side of the cradle in front.

i. Front transom.—The front transom (KB109A), Figure 8, located at the front end of the cradle, is riveted to the cradle and the forward roller paths (KB108B and KB108A) by means of screw rivets. The front transom is used to stiffen the front end of the cradle and the forward roller paths (KB108B and KB108A). Attached to the front transom is the indicator and gauge cap (KB117A).

j. Firing gear.—The firing gear (fig. 13) is located on the left side of the cradle and is attached to the intermediate cradle band (KB105A). It is operated by pulling the firing handle (KB129F) sharply toward the rear, which causes the firing rod arm (KB129D) to hit the percussion hammer shaft attached to the breech of the howitzer. The shaft throws the percussion hammer against the firing pin, exploding the primer.

(1) The firing gear consists of a firing-rod bracket (KB128A), Figure 13, attached to the intermediate cradle band (KB105A), and a firing handle (KB129F) attached to the firing rod (KB129C), Figure 13. To the other end of the firing rod the firing-rod arm (KB129D) is attached.

(2) The forward end of the firing rod (KB129C), Figure 13, is supported by and slides in the firing-rod handle guide (KB128B) which is riveted to the firing-rod bracket (KB128A). The rear end of the firing rod is supported by and slides in the firing-rod housing (KB128K) and the clutch bushing (KB128G).

(3) When the firing handle is pulled sharply to the rear, the firing-rod spring (KB128E), Figure 13, is compressed and serves to return the firing gear to its original position.

(4) The firing-gear locking lever (KB130A), Figures 8 and 13, is located on the left side of the carriage and is provided to prevent premature firing when the intermediate cradle band (KB105A), Figure 8, does not rest on the elevating arcs (KB154A and KB153A),

Figures 21 and 20. It is operated by the left quick-loading mechanism lock rod (KB170A), Figure 13, which causes the upper end to move in toward the cradle in such a way as to prevent the firing rod (KB129C) from being pulled backwards.

(5) The lanyard consists of a cord attached to the percussion hammer operating shaft at the breech running through the firing mechanism bracket sheaves (KB131B), Figure 14, which are attached to the left side of the top carriage. It is used for firing the first shots to determine whether the carriage is working properly, and also when the firing gear is out of order. As the lanyard is not interlocked with the elevating mechanism, precaution must be taken to see that the cradle is properly locked before firing.

21. Top carriage.—*a.* The top carriage (figs. 14, 15, 16, and 17) is a unit composed of two top carriage flasks (LS321A), Figure 14, and (LS323A), Figure 15, top plate, bottom plate, and front plate, with necessary connecting and stiffening angles and plates.

b. Trunnion bearings.—The trunnion bearings (LS325A and LS325B), Figures 14 and 15, riveted to the top carriage flasks and caps (KB136A and KB136B), Figures 15 and 27, embrace the trunnions of the cradle, auxiliary trunnion roller bearings, and the trunnion bearing half covers (KB139M), Figures 14 and 27. On the outer end of the auxiliary trunnions the trunnion end plates (KB110G), Figure 27, for retaining the roller bearings in position, are screwed and locked in position by lock screws (KB110F), Figure 27. The roller bearings are inclosed within the roller races (KB135A), the latter being supported by the trunnion bearing spring center pin shoes (KB136L) which in turn are supported by the trunnion bearing springs (KB136N), held in place by the trunnion bearing spring center pins (KB136K). With the trunnion bearing springs (KB136N) properly assembled, and compressed by the roller race adjusting screws (KB136H) which are locked after properly adjusting by the cap screws (BCCXIEB), the trunnion bearing spring center pin shoes (KB136L) are forced upward against the roller races (KB135A) thereby floating the cradle trunnions, and bringing the entire load of the tipping parts upon the auxiliary trunnions and roller bearings. This reduces to a minimum the effort required to elevate or depress the tipping parts. When the howitzer is fired the trunnion bearing springs (KB136N) are compressed and the cradle trunnions, previously floated, are forced downward and come in contact with the solid bearing surfaces of the top carriage flasks which receive the full force of recoil. After the firing has taken place the tipping parts again resume their floating position with the load upon the auxiliary trunnions and roller bearings.

c. Pintle.—The pintle crown (LS330A), Figure 23, is built into the lower front part of the top carriage. It provides a means of supporting the top carriage upon the pintle mechanism of the platform. The load of the top carriage is transmitted through the pintle crown to the pintle crown filler ring (LS330B) and then to the pintle head (LS331A) which is locked to the pintle crown filler ring by the pintle head nut (LS331G), at which point the top carriage load is transmitted to the platform through the platform pintle mechanism.

d. Traversing roller assembly.—(1) The rear end of the top carriage is supported on two traversing roller mechanisms as shown in Figure 26, which consist of mount roller brackets, left and right hand, (LS334B and LS334A) attached to the top carriage flasks. A traversing roller spring retainer (LS334C) is screwed into the top of each bracket, through which the load coming on the rear end of the top carriage is transmitted to the traversing roller spring retainer bushings (LS334D), the traversing roller disk springs (LS335K), the wheel carriers (LS334F), the traversing roller wheel spindles (LS335G), the traversing roller wheels (LS335A), and then to the rear holding-down sector attached to the platform.

(2) This mechanism when properly assembled and adjusted by the wheel carrier nuts (LS334E), Figure 26, should have 0.08-inch clearance between the top carriage and the holding-down sector, thereby bringing the load at the rear end of the top carriage upon the two wheels. When the howitzer is fired, the traversing roller disk springs are compressed, thus bringing the top carriage down to a bearing on the rear holding-down sector (LS487B), which relieves the traversing roller mechanism of the firing load.

e. Cradle locking bolt slide.—The cradle locking bolt slide (fig. 18) is located on the right side of the carriage. It automatically locks the cradle as the howitzer is brought to the loading position. The slide assembly consists of the cradle locking bolt slide (KB138A), cradle locking bolt (KB139A), and cradle locking bolt spring (KB139G). To unlock the cradle to permit of elevation simply step on the locking device pedal (KB139H). To depress the howitzer below the loading angle, the cradle locking bolt slide (KB138A) with its mechanism guided by the cradle locking device bracket (KB138B) is withdrawn to the position shown by dotted lines. This is accomplished by unlatching the locking lever handle and cradle locking lever (KB138C) which releases the slide and permits its partial withdrawal and locking. When assembling the cradle to the top carriage the cradle locking bolt slide is removed entirely from the cradle locking device bracket (KB138B).

f. Footboards.—Five footboards (figs. 14 and 15) are provided for the personnel maneuvering the carriage. Two of these, the gunner's

movable footboards (LS342E), Figure 14, and the rear detachable footboards, left (LS344B), are located on the left side, while the three on the right side are known as the forward movable footboard, right (LS342C), Figure 15, the breech operator's footboard (LS351A), and the rear detachable footboard, right (LS343E).

g. Roller bracket guides, left and right hand, T-shaped pieces (LS520C and LS520B), Figure 16, are riveted to the front of the top carriage, as guides for brackets, left-hand (LS662E) and right-hand (LS662D), of the rollers which support the cradle in mounting and dismounting.

h. Miscellaneous brackets.—(1) The outboard brackets, left-hand (LS655D) and right-hand (LS655C), on the front of the top carriage, and the suspension bracket (LS356B), Figure 14, on the rear ends of the flasks, are for the attachment of the erecting frame suspension beam links in mounting and dismounting.

(2) A draft hook (LS677A), Figure 16, the windlass frame (LS652A), Figure 28, and two axle brackets (LS615A), Figure 14, are attached to the front plate.

(3) The adapter (LS356A), Figure 14, under the rear end at middle and the false trail bracket (LS550A) just above the adapter are for housing and retaining the false trail of the transport wagon.

(4) The rear clip brackets, left-hand (LS336F) and right-hand (LS336E), Figures 17 and 26, secure the rear end of the top carriage to the platform.

(5) The rammer car lock support brackets (LS744A), upper, and (LS744B), lower, Figure 17, are connections which engage the loading platform.

(6) Bracket (KB140A), Figure 14, on the left flask is for attachment of either the air or liquid pump.

(7) The firing mechanism bracket (KB131A), Figure 14, inside the left flask near the lower traversing gear case supports two sheaves by which the direction of a lanyard attached to the arm of the percussion hammer operating shaft is so changed that the lanyard comes through a slot in the flask and may be pulled from the outside.

i. Elevating mechanism.—The elevating mechanism (figs. 14, 22, and 25) is located on the left side of the top carriage. It permits of 1° depression and 60° elevation, this movement being limited by stops on the cradle and corresponding stops on the top carriage and platform. Approximately one and one-half turns of the handwheel elevate or depress the howitzer, including the other tipping parts, 1°. The elevating handwheel (KB146B), Figure 14, is attached to the elevating handwheel shaft and bevel gear (KB145H), Figure 25, this gear meshing with the elevating shaft and bevel gear (vertical)

(KB145A) which is coupled to the elevating worm shaft (KB145E), Figures 19 and 21, by the vertical shaft sleeve (KB145D), Figure 14. The elevating worm (KB150B), Figures 19, 21, and 25, keyed to the elevating worm shaft (KB145E), Figures 19 and 21, meshes with the elevating worm wheel (KB150A), Figures 19 and 22, assembled on the worm wheel support (KB159A), Figure 19, which is keyed to the elevating arc pinion and shaft (KB153D), Figure 25. It is retained in place by the friction disk (KB159E) and friction clutch spring (KB160A). The elevating pinions, one on each side of the carriage, are integral parts of the elevating arc pinion and shaft (KB153D). They mesh with the elevating arcs, also on either side of the carriage (KB154A and KB153A) attached to the elevating arms (KB156A and KB155A), Figures 21 and 22. When the carriage is in transit the elevating arcs are locked to the cradle by the mechanism shown in sections in Figure 21, this mechanism being located on a plate connecting the elevating arcs. The elevating lock plunger (KB112H) which engages with the elevating lock plunger socket (KB111C) is attached to and located on the center line of the cradle. The elevating arms (KB156A and KB155A), Figures 21 and 22, are pivoted in bronze bushings on the cradle trunnions and are connected across underneath the cradle by a connecting plate (fig. 22). The left-hand bearing is designed to permit attachment of the sight, the sight being supported on the left-hand auxiliary trunnion. The elevating arcs bear against lugs on the intermediate cradle band (KB105A), Figure 8, and when the howitzer is fired the tendency to rotate is transmitted directly from these lugs to the ends of the elevating arcs and thence to the meshing teeth of the arcs and pinions and from the pinions through the pinion shafts to the friction clutch.

j. Friction clutch.—To relieve the stress on the elevating gearing during maneuvering and firing, the elevating worm wheel (KB150A), Figure 19, is provided with a friction clutch composed of bronze and steel disks held together by a tension screw (KB160B), friction clutch spring (KB160A), and tension screw nut (KB160E). The elevating worm (KB150B), elevating worm wheel (KB150A), and friction clutch are inclosed within the elevating worm gear case (KB147A) which also provides the bearings for the worm and worm wheel. The case is provided with a gear-case cover (KB148A); also a handhole cover (KB147B).

k. Traversing mechanism.—(1) *Description.*—The traversing mechanism (figs. 14 and 25) is located on the left side of the carriage. It permits of 10° traverse, either side of the center line of the platform. Approximately 13½ turns of the handwheel traverse the carriage through 1° in azimuth. The traversing mechanism consists of a

traversing handwheel (KB146A), Figure 14, attached to the traversing handwheel shaft (LS415B), Figure 25, on the other end of which is the handwheel shaft traversing gear (LS430A), meshing with the vertical traversing gear (LS430B), located on the upper traversing shaft (LS426A). On the lower end of the shaft the intermediate traversing pinion (KB145L) is located and meshes with the intermediate traversing gear (KB145G) attached to the upper end of the lower traversing shaft (forward end) (LS426K), Figure 14. This shaft is connected to the lower traversing shaft (rear end) (LS426P), Figure 25, by the lower traversing shaft sleeve (LS426F). To the end of the lower traversing shaft (rear end) (LS426P) is attached the lower traversing gear pinion (KB145K), meshing with the lower traversing gear (KB145F), attached to the traversing worm shaft extension (outer end) (LS426N), this extension being connected to the traversing worm (LS415C) by keys. The traversing worm engages with the traversing worm wheel (LS415A) which is keyed to the traversing pinion (LS416F), Figure 14, and meshes with the traversing rack (LS416A), Figure 25, attached to the platform. The traversing mechanism of the M1918A1 carriage is the same as that of the M1918 carriage except that the mechanism assembled within the worm wheel housing (LS413A), Figure 14, is replaced by the quick release mechanism shown in Figure 83.

(2) *Housings.*—The traversing mechanism is supported in housings provided with bearings; at the handwheel by the elevating and traversing gear case (KB144A), and traversing gear case (upper) (LS420A), Figure 14; at the intermediate gears by the traversing gear housing (middle) (LS421A), Figure 25; at the lower traversing gears by the traversing gear case (lower) (LS424A), all of which are attached to the left side flask. The traversing worm (LS415C) and traversing worm wheel (LS415A) are inclosed by the worm and worm wheel housing (LS413A), Figure 14, which is supported by the top carriage bottom plate (fig. 15).

l. Windlass.—The windlass (fig. 28) is used for mounting and dismounting the howitzer and the cradle. The windlass is composed of a rope drum (LS656A), keyed to the drum shaft (LS650G) on the left end of which is attached the windlass worm wheel (LS654A) which is driven by the windlass worm (LS653B). Keyed to the worm shaft which is integral with the worm is the windlass worm shaft miter gear (LS653D), driven by a similar gear keyed to the windlass horizontal gear shaft (LS654N), on the right end of which the windlass horizontal ratchet gear (LS653E), engaging with the windlass ratchet pawl (LS653H), is located. Provision is made on the right end for attaching the crank. Provision is also made for dis-

connecting the gearing just described from the drum shaft (LS650G) by withdrawing the drum shaft clutch (LS650B) by the drum shaft clutch handle (LS650D). The drum may then be revolved by attaching the crank to the drum shaft extension (LS650C) in which position, with clutch out and no load, the cable may be wound on the drum quickly. A cable hook (LS653G) attached to the windlass horizontal gear shaft (LS654N) is provided for attaching the free end of the cable when not in use.

m. Quick-loading mechanism.—The quick-loading mechanism (figs. 20, 21, 22, and 24) is provided for rapid elevation and depression. Four and two-tenths turns of the handwheel elevate or depress the howitzer 45°. The quick-loading mechanism is attached to and moves with the right elevating arm (KB155A), Figure 21, and consists of the quick-loading handwheel (KB167A), Figure 24, attached to the quick-loading gear handwheel shaft (KB165B) on which the quick-loading gear handwheel shaft sprocket (KB166C) is keyed, this sprocket being connected with the lower quick-loading gear sprocket (KB166A) by means of a roller chain (KB166L). The lower quick-loading gear sprocket (KB166A) is integral with its shaft, on which the quick-loading gear sprocket hub pinion (KB166B) is keyed. This pinion meshes with the quick-loading arc (KB166H), Figure 20, attached to the right side of the cradle.

n. Locking device.—The elevating arm also carries the operating lever (KB168A), Figure 24, and quick-loading gear vertical shaft (KB165A) which operates the left quick-loading mechanism lock rod (KB170A), Figure 22. This lock rod engages the quick-loading mechanism locking lug (KB169A), Figure 21, on the left side of the cradle plate, locking the left and right elevating arcs (KB154A and KB153A), Figures 21 and 20, against the lugs on the intermediate cradle band (KB105A), Figure 8. To the middle of the operating lever shaft the quick-loading gear sector locking pawl (KB164C), Figure 24, is fastened. This pawl bears against the face of the quick-loading arc (KB166H), Figure 20. Its purpose is to prevent the quick-loading gear vertical shaft spring (KB164D), Figure 24, and quick-loading gear lock spring (KB169F), Figure 22, from moving the left lock rod (KB170A) to the right before the cradle rests on the left and right elevating arcs (KB154A and KB153A), Figures 20 and 21. When this position is reached, the quick-loading gear sector locking pawl (KB164C), Figure 24, drops into a slot in the upper end of the quick-loading arc and releases the operating lever (KB168A). The left and right elevating arcs (KB154A and KB153A), Figures 20 and 21, are then locked to the cradle by the left lock rod (KB170A), Figure 22. This lock rod also operates the firing gear locking lever (KB130A), Figure 8.

22. Platform.—*a.* The platform (figs. 34 and 76) is made up of a top and bottom plate, each of which is provided with an opening for the cradle to tip into at high elevations. A pintle socket (LS470A), Figure 23, which contains the pintle parts about which the top carriage pivots, is riveted to the platform near the front. At the rear end of the platform the traversing rack (LS416A), Figure 25, the rear holding-down sector (LS487B), Figure 26, and the locking bracket (LS488D), Figure 46, are attached.

b. The trunk section (fig. 34) made up of structural steel plates and angles is riveted to the base of the platform. It is so provided in order that the cradle and howitzer, when elevated and recoiling, may tip into it. Being embedded in the ground it serves as a spade and thus prevents movement of the platform during firing. The cradle elevating stop (LS502A), Figure 34, limiting elevation to 60°, is attached to the inside of the front plate of the trunk. The transport rear axle brackets and left and right hand brake fulcrum sockets (LS500B and LS500A), Figure 33, are attached to the outside of the front and side plates of the trunk.

c. The parts of the main pintle (fig. 23) assembled to the platform consist of the pintle socket (LS470A), riveted in place, which contains the pintle springs (LS331D). The springs rest on the bottom pintle spring supporting disk (LS331C), and are limited to a fixed height by the upper pintle spring retainer (LS331B), pintle spring retaining bolt (LS331L), and pintle spring retaining bolt nut (LS331K). Due to clearance provided between the top carriage and the platform, the greater portion of the weight of the top carriage and howitzer is supported by the main pintle mechanism, the weight being transmitted by the pintle crown filler ring (LS330B) to the pintle head (LS331A), from the pintle head to the pintle head thrust block (LS331Q), from the pintle head thrust block to the pintle head seat (LS331F), and then through the upper pintle spring retainer to the pintle springs (LS331D). The pintle head (LS331A) is held in place by the pintle head retaining ring (LS330D) and the pintle head nut (LS331G). The pintle socket (LS470A) is provided with a pintle liner (LS330C). Upon firing, the pintle springs (LS331D) are compressed by the downward thrust on the mount until the top carriage bottom plate is in contact with the outer raised surfaces of the pintle socket plate (LS490A) which is riveted to the top plate of the platform. This prevents further compression of the pintle springs (LS331D). The clearance provided between the top carriage and the platform is 0.08 inch. To obtain this clearance remove the cotter pin from the pintle head nut (LS331G) and loosen the nut. Then screw the pintle crown filler ring (LS330B) in or out until it is possible to insert the 0.08-inch thickness gauge

between the top carriage and platform. The springs then return the top carriage to its original position. Figure 23 shows the position of the pintle springs (LS331D), compressed to the maximum during firing, the top carriage bottom plate and pintle socket plate (LS490A) being in contact.

d. The outriggers (fig. 32) are for the purpose of giving stability to the mount and are particularly necessary at extreme positions of traverse during firing. They are attached to the rear end of the platform. The outriggers (fig. 32) consist of outrigger arms (LS468A) swinging on swinging arm hinge pins (LS509D), inserted in the swinging arm brackets, left and right hand (LS486B and LS486A), attached to the platform. Swinging arm screws (LS509B) engaging in outrigger bushings (LS468B) are contained in the outrigger arms. At the lower ends bearings are provided in the yokes (LS496A). The latter are riveted to the floats and provide means for adjustment on uneven ground or when by the force of firing the floats are forced into the ground.

23. Loading platform.—*a.* The loading platform (fig. 17) is made up of structural steel and is attached to the upper and lower rammer car lock support brackets (LS744B and LS744A), Figure 17, of the top carriage. It is locked in position by means of the loading platform locking shaft (LS742A), Figure 29. Two handles (fig. 29) are provided on each side. Also the shot hoist bracket locking shaft at the rear is used for lifting the loading platform in place. This platform is detachable to facilitate transportation. At the front end of the platform the swinging tracks (LS723G and LS723F) are provided to span the opening between the loading platform and the cradle for the purpose of running the rammer car to the breech of the howitzer for loading. The track when not in use is locked in a raised position by the track-locking lever (LS737C), Figure 29, engaging with the loading platform lock bolt (LS748D) on the right side of the platform, the loading platform lock bolt (LS748D) being held in its up position by the loading platform lock spring (LS748H), which is encased in the loading platform lock frame (LS748C) and releases the track-locking lever (LS737C) by a downward pressure upon the loading platform lock treadle (LS749A).

b. In releasing the rammer car from the cradle the front axle bracket (KE16B), Figure 51, strikes against the connecting link pin connected to the swinging track operating lever (LS737B), Figure 29, which transmits motion through the track operating link (LS747C) and swinging track link lever (LS737A) to the track shaft (LS747B) to which the swinging tracks, left and right hand (LS723G and LS723F), are attached, thereby automatically raising the tracks as the rammer

car is rolling onto the platform. Motion is also transmitted through the swinging track operating lever (LS737B) to the track-locking shaft (LS747A) to which the track-locking lever (LS737C) is attached, and engages this lever with the loading platform lock bolt (LS748D), as the rammer car is brought to a stop and locked to the two buffers. When the rammer car is in this position the track-locking lever (LS737C) is engaged with the loading platform lock bolt (LS748D), and the front axle bracket (KE16B), Figure 51, extends downward between the swinging track operating lever stud (LS737H), Figure 29, and the connecting link pin, thereby preventing any forward movement of the rammer car until the loading platform lock treadle is pushed down.

c. Loading-crane bracket.—The loading-crane bracket (figs. 29 and 33) is made of structural steel and is detachable from the loading platform, it being held in place at the top by loading platform top and shot hoist bracket top hinges (LS770B and NC88A) and shot hoist bracket locking shaft (NC88C), and at the bottom by locking platform bottom and shot hoist bracket bottom hinges (LS770A and NC88B), and shot hoist bracket bottom hinge pin (NC88G).

d. Loading crane.—(1) The loading crane (figs. 30 and 31) consists of a loading mechanism lifting arm (NC79D), Figure 30, with lifting arm pulley (NC77K), and front pulley wheel guard (NC79E) attached to the outer end. On the column portion a similar wheel and guard are attached; also a loading mechanism cable hook (NC77A) to which the hoisting cable (NC84A) is connected when not in use. The lifting arm sets into the loading mechanism rear support (NC83A) upon ball bearings. (Fig. 31.) It is also provided at the bottom with ball bearings. The loading mechanism rear support (NC83A), Figure 30, is assembled to the loading mechanism support (NC80A) by lowering into guide clips on the support (NC80A) which is riveted to the loading crane bracket. (Fig. 33.) A lifting arm lock screw (NC80B), Figure 31, operated by a locking handle, which, when fully unscrewed, allows the lifting arm to swivel in the loading mechanism rear support, is also used for locking the crane in traveling position.

(2) When the lifting arm lock screw is in the "IN" position, it enters a hole in the upper ball bearing cover retaining crown (NC76G), Figure 31, which is keyed to the loading mechanism lifting arm (NC79D), thereby preventing the latter from swinging when in transit In transit the loading mechanism lifting arm must point forward to be locked.

(3) The latch stop (NC80G), Figures 29 and 31, contains holes in two positions for locking pins (U616D), Figure 31, one when locking the loading mechanism lifting arm for transit and one when in operation.

(4) The lifting mechanism is operated by the shot hoist handle (fig. 30), attached to the shot hoist ratchet shaft (NC87B) which is supported by the gear case (NC78A), attached to the loading bracket. This shaft carries a miter gear (NC87F) which engages a similar gear carried by the intermediate shaft (NC87D), the latter carrying the cable drum gear meshing pinion (NC81C) which engages with the cable drum gear (NC81B), Figure 31, which is riveted to the shot hoist cable drum (NC81A). The shot hoist cable drum rotates on the cable drum spindle (NC82A) which is secured to the left and right cable drum supports (NC82E and NC82F) attached to the platform bracket. A shot hoist ratchet (NC87G), Figure 30, and shot hoist ratchet pawl (NC87H) are provided to prevent the projectile from lowering if the crank is released. To lower a shell upon the shell car the shot hoist ratchet pawl is tripped and the shell lowered by means of the crank. Maneuvering of the crane is performed by the loading mechanism maneuvering arm (NC77C).

24. Transport vehicles.—*a.* To transport the howitzer and carriage four transport wagons and four limbers are provided. They are known as the howitzer carriage limber (fig. 36), the howitzer transport wagon (fig. 64), cradle transport wagon (fig. 65), top carriage transport wagon (fig. 66), and platform transport wagon (fig. 67).

(1) *Howitzer carriage limber.*—This vehicle consists of two wheels, an axle, drawbar and turning arc, with side plates to which the axle brackets are attached, and which form a connection for the drawbar. The drawbar and side plates are joined with a flexible spring coupling. This coupling consists of a draft spring (MS7C), tension rods (MS7D), and drawbar hinge (MS6F), Figure 36. This provides for a movement of the drawbar about 15 inches to make up for any difference in height between the limber and the vehicles to which it may be coupled. This spring coupling also relieves the vehicles of any sudden shocks during transportation. The limber is provided with a pintle (MS13B) over which the lunette (AB62A), Figure 40, of the false trails of the transport wagons fits. A limit chain is provided which secures the false trail to the limber pintle (MS13B), Figure 36. The turning arc (MS11A) is attached to the axle and the false trail bears on it as it rotates around the pintle.

(2) *Howitzer transport wagon.*—This vehicle (fig. 64) consists of the two wheels, an axle (NS10A), Figures 39 and 40, to which the axle bracket is attached, gun false trail body (NS8A), Figure 40, and necessary locking and braking mechanisms. When transporting the howitzer, the false trail (fig. 40) becomes separated from the axle and wheels and is attached to the breech end of the howitzer and to the limber while the remainder of the transport wagon is attached toward

the muzzle end of the howitzer. The false trail slides into guides on the howitzer and is locked in place by a locking device as shown in Figure 40, which consists of the locking pin (U616D), locking pin knob (U616G), lock pin spring (U616F), locking pin bushing (U616E), locking lever (NS12B), Figure 40, and locking shaft (NS12A) which locks the false trail to the locking eye of the howitzer. The rear axle is attached to the howitzer by placing the muzzle end in the U-shaped part of the axle (NS10A), Figure 39, in which position it is locked to the axle by left and right hand gun lock levers (NS10E and NS10D) which prevent either horizontal or vertical movement on the axle. The brake mechanism is operated from the tractor hauling the howitzer by means of a brake lever rope (BB56Q), attached to the howitzer operating lever (BB56A).

(3) *Cradle transport wagon.*—This vehicle (fig. 65), less the false trail, is attached to the front of the cradle and the false trail and limber to the rear. Its construction is similar to that of the howitzer transport wagon, differing only as the load to be transported differs. The axle has its U-shaped part which is larger than that of the howitzer transport wagon to accommodate the width of the cradle. The false trail slides into guides which are integral with the rear cradle band and is locked in position by the locking mechanism (fig. 42), consisting of the locking pin (U616D), locking pin knob (U616G), lock pin spring (U616F), locking pin bushing (U616E), lock handle (PS11B), and the false trail lock pin (PS11F). The rear axle fits into a groove in the axletree band (fig. 41), and is locked in place by two locking devices, one on each side, consisting of locking pins, left and right hand, cradle lock levers (PS17E and PS17D), locking pin knob (U616G), lock pin spring (U616F), and locking pin bushing (U616E). The brake mechanism is attached to the transport wagon. The brake lever rope (BB56Q) is attached to the cradle operating lever (fig. 41), and leads to the tractor hauling the cradle from which it is operated.

(4) *Top carriage transport wagon.*—This vehicle (fig. 66) transports the top carriage, including the footboards, loading platform and loading crane, all of which are securely locked in position. The false trail is detached from the transport wagon and slid into an adapter riveted to the top carriage and over the pintle of the limber. It is locked to the top carriage by means of the locking mechanism as shown in Figure 44. This mechanism consists of the locking pin (U616D), locking pin knob (U616G), lock pin spring (U616F), locking pin bushing (U616E), lock cam (QS14B), and lock cam lever (QS14A). The rear axle and wheels, which carry the brake mechanism, are attached to the front of the top carriage by means of two axle brackets bolted to the top carriage and locked in position. Connected

to the hand operating lever (BB57E), Figure 43, is the brake lever rope (BB56Q), which leads to the tractor hauling the top carriage from which the brake mechanism is operated.

(5) *Platform transport wagon.*—This vehicle (fig. 67) transports the platform, including the swinging arms. The latter are locked by inserting the swinging arm screws into the outrigger screw sockets on the sides of the platform. This wagon consists principally of the wheels, axle, and false trail. The false trail (fig. 46) is detached from the transport wagon and attached to the rear of the platform and over the pintle of the limber. It is locked to the platform as shown in Figure 46. The rear axle and wheels are connected to the platform by two transport rear axle brackets riveted to the front of the platform trunk section, the axle being locked to these brackets by locking devices similar to that at the front (fig. 45). The rear axle carries the brake mechanism. The brake lever rope is attached to the brake lever. It leads to the tractor hauling the platform from which point the brake mechanism is operated.

b. False trails.—False trails, shown in Figures 40, 42, 44, and 46, are provided for each transport wagon. They are similar in most respects, especially the front end which contains the lunette. The false trail provides the connection between the limber and the unit to be transported, and consists of a cast unit with a pocket in the front end (fig. 40) containing the lunette. An end limit chain eye (AB63A) is attached to the front, a limit chain eye (AB63G) to the underside, and a cable eye (AB63H) to the top flange. The false trail also carries the brace rods (AB60C) and mechanism for bracing the rear wheels and trail when close coupled. The transport limber and rear wheels when close coupled form a short 4-wheeled vehicle which may be drawn away. (See figs. 61, 60, 63, and 62.)

c. False trail locks.—The false trail locks are of the same general design for the four transport wagons, although differing in some details. Only the howitzer transport wagon false trail lock, as shown in Figure 40, will be described. This lock consists of a locking pin knob (U616G), lock pin spring (U616F), locking pin bushing (U616E), locking lever (NS12B), locking shaft nut (NS12D), locking shaft washer (NS12E), and a locking shaft (NS12A), which has a full diameter where it bears in the false trail; but only a half diameter on that portion bearing in the locking eye. It also has a cam on one end corresponding to a similar cam on the locking lever (NS12B). In the position shown, the false trail is locked to the howitzer. To unlock, the locking pin knob (U616G) is pulled outward, withdrawing the locking pin (U616D). The locking lever is then rotated anticlockwise 180°, bringing the bearing of the locking shaft (NS12A) in

the locking eye at the bottom, from which position the gun false trail body (NS8A) may be removed. When rotating the locking lever (NS12B) the cams on the lever and on the locking shaft (NS12A) are brought to bear against the howitzer, forcing the false trail outward sufficiently to loosen the gun false trail body (NS8A) in the guides integral with the howitzer.

d. Brake mechanisms.—The transport wagon brakes (figs. 38, 39, 41, 43, and 45) are of the same general design on the four vehicles, but they are not interchangeable. The two brakes on any one vehicle are connected across by a connecting lever shaft, except the cradle transport vehicle (see fig. 41) on which the brakes are operated from two separate cradle operating levers (BB56H). All brakes are operated by brake operating lever ropes extending from the brake levers to the hauling tractors. As the brakes are set, they are retained by a ratchet and pawl, making it necessary to trip the pawl by hand to release the brakes on each vehicle on which the brakes have been applied, there being provided a small finger integral with each pawl to facilitate this operation. The brake proper (fig. 38) is of the internal drum type, and is applied by rotating the right-hand brake cam (BB53F), forcing the brake shoe (BB59A) carrying the brake band lining (BB59C) to expand and come in contact with the surface of the brake drum (BB59B). When the brake is released it is held in the off position by the brake release spring (BB53H).

SECTION IV

ASSEMBLY AND DISASSEMBLY

25. General.—*a.* When assembling or disassembling the breech-block carrier, it will be necessary to unlock the howitzer from the sleigh, and slide the howitzer to the rear until the hinge pin and the operating lever shaft clear the rear end of the cradle.

b. When disassembled it is desirable to complete the subassemblies before attempting the assembly of the larger mechanisms. In all assembling the bearings, sliding surfaces, threads, etc., will be cleaned and lubricated.

26. Disassembly and assembly of breech mechanism.—Lift the firing mechanism block latch and remove the firing mechanism by unscrewing it to the left. Open the breech mechanism by grasping

the operating lever handle and trigger and move the lever to the rear and right until it latches to the jacket, then press down on the firing mechanism housing key spring (24M), Figure 4, and pull the key out as far as it will come. Unscrew the obturator spindle from the firing mechanism housing and remove it, together with the gas check pad and split rings. Unscrew the firing mechanism housing and remove the firing mechanism housing key assembly from the breechblock carrier. Remove the cotter pin, nut (22B), Figure 2, and the operating lever shaft collar (22C) from the operating lever shaft (22D). Remove the operating lever (17A), then remove the rack segment (22F). Remove the operating lever shaft. Press down on the rack lock (23C), until it assumes its position when the breech is closed. Remove the rack (23A) by rotating the breechblock by hand until the teeth of the breechblock and rack are completely disengaged. Remove the rack lock (23C). Pass a supporting bar, preferably of wood, through the bore of the breechblock and unscrew the breechblock from the breechblock carrier (10A). Remove the obturator spindle spring front seat (24B), obturator spindle spring (24E), and obturator spindle spring rear seat (24C), from the breechblock carrier. Support the breechblock carrier and remove the hinge pin bushing nut (22K). Remove the hinge pin screw (22E). Remove the hinge pin (22A). Remove the breechblock carrier from the jacket lug. When removing the carrier be careful that the hinge pin bushing and regulating plate (22H) are not injured. To assemble the breech mechanism reverse the order of procedure.

27. Disassembly and assembly of firing mechanism.—Take out the firing mechanism by turning it to the left and remove it from the firing mechanism housing (24F), Figures 2 and 4. Remove the safety set screws from the primer holder (B8058) and firing pin housing (A12257), Figure 4. Remove the primer holder (B8058) with the spanner wrench provided for this purpose by turning the primer seat plug to the right. Remove the firing pin guide (A12256) and firing pin spring (A12261). Remove the firing pin housing (A12257), using the same wrench as used in removing the primer holder. Remove the firing pin (A12258) from the firing mechanism block. To assemble the firing mechanism reverse the order of procedure.

28. Disassembly and assembly of percussion mechanism.—Remove the percussion hammer lock bolt (A12217), Figure 2. Remove the operating shaft collar detent (A12263), and collar (A12264). Remove the operating shaft (20D). Remove the percussion hammer (B19694). To assemble the percussion mechanism, reverse the order of procedure.

29. Disassembly and assembly of lifting arm.—To disassemble the lifting arm (NC79D), Figure 30, from the support (NC83A), it will be necessary to remove the retaining screw (NC76L), Figure 31, from the retaining nut (NC76H). Screw out on the lifting arm lock screw (NC80B), by means of the locking pin knob (U616G). Lift up on the lifting arm (NC79D), Figure 30, until it is clear of the support (NC83A). Care must be taken in removing the lifting arms that the ball bearings are not injured. Reverse the order for assembling.

SECTION V

INSPECTION AND ADJUSTMENT

30. Inspection of the matériel.—The following instructions with reference to inspections of the matériel will be scrupulously observed by all concerned:

Parts to be inspected in order of inspection	Points to observe
a. The howitzer as a unit.	*a.* General appearance. Smoothness of operation of breech mechanism in both opening and closing. Test the firing mechanism by firing several primers. Note the condition of the bore for copper deposits on the lands and in the grooves; erosion at origin of rifling; bruises in the gas check seat and burrs or roughness on the leveling plates.
b. Breechblock carrier.	*b.* Examine the pintle of the carrier for burrs or bruises; the rack lock and spring for rust or gummy deposits; the rack teeth for burrs or indentations. Examine the operating lever; see that all parts are free from rust and that they function properly. Examine the hinge pin and the hinge pin bushing for wear.
c. Breechblock.	*c.* Examine all threaded sectors for burrs or indentations, also the geared teeth which engage with the rack. Examine the bore of the block for rust or other defects.
d. Obturator.	*d.* Examine the obturator spindle for burrs on its threaded portion, and see that the bore of the spindle is free of powder fouling, rust,

	or other defects. Examine the mushroom head for burrs and rust.
e. Split rings.	*e*. Examine all split rings and filling-in disks for burrs or other defects.
f. Firing mechanism.	*f*. Examine the threaded portion of the block for burrs or bruised threads. Inspect the firing pin and spring for proper functioning.
g. Gas check pad.	*g*. Examine the gas check pad for bruises or torn covering. See that the pad has not become soft.
h. The carriage as a unit.	*h*. General appearance. Note whether the oil plugs and grease cups are painted red and whether the oil holes have a red circle painted around them. See that the carriage is painted in accordance with regulations.
i. Cradle.	*i*. Examine the sliding surfaces of the cradle for burrs or indentations.
j. Elevating and depressing.	*j*. Test the effort required to elevate and depress the howitzer. Note the slippage of the elevating friction clutch. Time required to elevate and depress the howitzer when unloaded. Time required to elevate and depress the howitzer when loaded.
k. Loading crane.	*k*. Test the crane for freedom of movement and examine all parts exposed to view for defects.
l. Locking wedges.	*l*. Test the movement of the locking wedges for ease of operation. An inspection should always be made when the left-hand screw releasing ring has been removed from the sleigh to see that it is assembled properly and that it does not extend into the cradle.
m. Main pintle.	*m*. Test the clearance between the top carriage and the platform with the thickness gauge. A clearance space of 0.08 of an inch should always be maintained between these parts.
n. Movable platforms.	*n*. Examine all locking levers; see that they are in working order.
o. Quick loading gear.	*o*. Test the elevating lock lever and the quick-loading gear operating lever for proper functioning.

p. Rammer car.	*p.* Test the ramming mechanism locking device. See that all parts function properly.
q. Recoil and counterrecoil systems.	*q.* Test the air pressure; also the amount of liquid in the recoil and the recuperator cylinders. (See par. 47.)
r. Traversing rollers.	*r.* Test the clearance between the top carriage and the holding-down sector. A clearance space of 0.08 of an inch should be maintained at all times between these parts.
s. Transport wagons.	*s.* Examine all false trail connections, together with the locking pins and levers. See that they are free from burrs and function properly. Examine the brake mechanisms. See that all brake bands are in good condition, and that all other parts pertaining to the transport wagons are free from rust, burrs and other defects; that the rubber of the wheels is in good condition. Examine the axles for scored bearing surfaces, and note whether all moving parts are receiving the required amount of lubrication.
t. Accessories.	*t.* Inspection should be made embracing all the accessories pertaining to the mounting and dismounting of the carriage. All parts of the accessories should be given a rigid inspection in order to be sure of their serviceability, especially the erecting frame. All locking parts of the erecting frame should be examined and tested for proper functioning. All parts which are subject to strain should be examined for defects of matériel.

31. Verification and adjustment of the sights (the quadrant sight, M1918, with panoramic sight, M1917).—*a.* The battery personnel is forbidden to disassemble any parts of the quadrant or panoramic sights and will make only such adjustments as are hereinafter prescribed. Adjustments are to be made only with tools provided by the Ordnance Department for the purpose and in the presence of a commissioned officer. Any difficulties which can not be corrected by the methods herein described will be reported to the ordnance maintenance company.

b. When out of adjustment the sights will cause inaccurate firing and should, therefore, be frequently verified and adjusted when necessary. A testing target (39-9-2) is provided for verifying the sights.

c. The condition under which the sights will be verified is as follows: Level the carriage with the aid of the gunner's quadrant placed on the leveling plates of the howitzer. Reverse the quadrant on the leveling plates to test its accuracy; if out of adjustment have it repaired by the ordnance maintenance company. See that the center line of the trunnions lies in a horizontal plane throughout the traverse of the carriage. Level the sight transversely, set the angle-of-site pointer at 300 mils, and the elevating scale at 0° elevation, and elevate or depress the howitzer until the center line of the bore is horizontal as determined by the gunner's quadrant placed on the leveling plates on the howitzer jacket. The bubble in the elevation level should be centered between the reference marks on the level vial. If the bubble is not centered, operate the angle-of-site worm until the vial is level. Loosen the set screw which holds the rear micrometer clamp in place and unscrew the clamp. Turn the rear micrometer drum without turning the worm until the index on the angle-of-site housing points to zero. Tighten the rear micrometer clamp and set screw.

d. Sight on some distant object or suspend the testing target in a plane perpendicular to the bore of the howitzer and at a distance of not less than 38 yards. Place the front and rear bore sights in the howitzer and move the testing target until the center line of the bore, as determined by the bore sights, pierces the target at the center of the circle marked "bore." The verticality of the target should be verified by a plumb line. With the panoramic sight mounted in the shank of the quadrant sight set the azimuth scale at zero and the elevating scale of the panoramic sight at 3. With the sights thus arranged, the line of sight should pass through the point on the target marked "Panoramic sight."

e. If the line of sight pierces the target above or below the point marked "Panoramic sight," it indicates that the elevation knob of the panoramic sight is out of adjustment. Operate the elevation knob until the line of sight pierces the target on the horizontal center line marked "Panoramic sight." Loosen the elevation knob locking screw and turn the elevation knob without turning the elevating worm until the index on the rotating head points to zero. Tighten the locking screw.

f. If the line of sight pierces the target to either right or left of the point marked "Panoramic sight," it indicates that either the cross level of the quadrant or the azimuth micrometer index of the panoramic sight, or both, are out of adjustment. Traverse the panoramic sight until the line of sight pierces the target at the proper point and elevate the howitzer to maximum elevation, and at the same time elevate the quadrant sight. If the point where the line of sight pierces the

target appears to move either to the right or left, it indicates that the cross level of the quadrant sight is out of adjustment. Cross level the quadrant sight by turning the leveling worm handwheel until the howitzer can be elevated or depressed to the full extent of its travel without moving the point where the line of sight pierces the target to either the right or left. With the wrench provided for the purpose loosen the cross level holder set screw and carefully move the cross level holder until the bubble in the level vial is centered between the reference marks, and tighten the set screw.

g. If the azimuth micrometer index does not read zero with the howitzer returned to 0 elevation it indicates that the azimuth micrometer index is also out of adjustment. Loosen the micrometer locking screw and with the teat wrench provided for the purpose turn the index until the arrow points to 0 on the azimuth micrometer scale, at the same time holding the latter to prevent it from turning. Tighten the locking screw.

h. After the sights are adjusted they should be submitted to the following test to assure their accuracy at extreme elevation and azimuth:

(1) With the carriage level and the howitzer and sights at zero elevation and deflection, see that the line of sight and axis of the bore prolonged strike the target at the proper points.

(2) Elevate the howitzer to its maximum elevation without altering the elevation of the sight. As the elevation of the howitzer is altered the line of sight should follow the vertical lines of the target.

(3) With condition as in (1) above traverse the howitzer to its extreme position in azimuth; as the sight deflections are now altered, the line of sight should follow the horizontal line on the target.

(4) By construction and assembly, the sights if properly adjusted should fill the above conditions with substantial accuracy. If in error a report of the facts of the case, if known, should be made to the ordnance officer charged with the repair of the matériel, for his information and action.

SECTION VI

FUNCTIONING

32. General.—The functioning of the matériel as a whole and of the groups is so closely allied with description and operation and

description of groups that it has been included in Sections II and III and is not repeated hereunder.

33. Malfunctions of howitzer.—*Malfunction, cause, and correction.*

Malfunction	Cause	Correction
a. Fails to fire until after several percussions on primer.	*a.* (1) Firing mechanism not screwed home.	*a.* (1) Screw the mechanism as far beyond the latch as it will go.
	(2) Fouled firing pin.	(2) Remove firing mechanism and disassemble. Wash all parts free of dirt or gummed oil with gasoline. Dry thoroughly and lubricate with light class A oil.
	(3) Point of firing pin deformed.	(3) Remove firing mechanism, disassemble and replace firing pin.
	(4) Weak pull on the lanyard or insufficient force on the firing gear.	(4) Pull lanyard with considerable snap, or sharply pull the firing gear to the rear.
b. Fails to fire when proper percussion on primer is obtained.	*b.* Defective primer.	*b.* After three percussions wait at least two minutes before replacing primer.
c. Fails to fire after the primer has discharged.	*c.* (1) Damp or fouled vent hole through obturator spindle.	*c.* (1) Wait at least 10 minutes and remove the primer and clean vent hole with vent cleaning bit.
	(2) Damp charge.	(2) Wait at least 10 minutes before opening the breech to remove the charge.
d. Fails to fire, no percussion on primer.	*d.* Firing mechanism not screwed fully in.	*d.* Screw the firing mechanism in until its handle passes the firing mechanism block latch.
e. Breech mechanism does not operate freely.	*e.* (1) Lack of lubrication between rack and breechblock carrier.	*e.* (1) Remove the rack, clean and lubricate with class A oil, and replace the rack.
	(2) Lack of lubrication and the formation of scores in the	(2) Disassemble the breech mechanism and thoroughly clean. If the threads are scored, repair must be made by the

	threads of the breechblock carrier or in the breech recess.	personnel of an ordnance maintenance company.
f. Percussion hammer not working freely.	*f.* Lack of lubrication and roughness on shaft and shaft bearings.	*f.* Disassemble, clean, and remove roughness.

34. Malfunctions of carriage.—*Malfunction, cause, and correction.*

Malfunction	Cause	Correction
a. Howitzer fails to return completely into battery.	*a.* (1) Expansion of liquid in the recoil cylinders.	*a.* (1) Draw off a small quantity of liquid from each cylinder. The two recoil cylinders are adjusted separately, the method being identical for each. Depress the cradle to horizontal position and unscrew filling plug on side of sleigh. Clean filling hole and outside of funnel tube. Use the funnel and pour in the filtered recoil liquid. Agitate funnel slightly to assist escape of air. Stop filling when the liquid overflows. Then remove filling plugs on rear end of recoil cylinders and draw off 0.67 pint (0.32 liter) which should leave proper void for expansion of liquid. Replace filling plugs, screwing them down tight. If sleigh is warm from prolonged firing, do not adjust recoil cylinders until it has thoroughly cooled. If much liquid is to be added, elevate the howitzer 1° or 2° and remove all three filling plugs. Entrapped air will then be driven forward and out through the hole in the piston rod. Replace the front and rear plugs as soon as liquid over-

		flows through the front and rear holes. Wait a few minutes to allow all the air to escape before drawing off to leave the void.
	(2) Insufficient pressure or quantity of liquid.	(2) Add liquid or air pressure by means of the air and liquid pumps.
	(3) Vent in counterrecoil cylinder rear head stopped up.	(3) Clean vent hole.
	(4) Ungreased recoil slides.	(4) Keep recoil slides perfectly clean and oil recoil slide guides through oil cups in the sleigh.
b. Too short a recoil and howitzer returns to battery with too great a shock.	*b.* (1) Too much pressure in recuperator.	*b.* (1) Pressure should be reduced.
	(2) Ungreased recoil slides.	(2) Keep recoil slides perfectly clean and oil recoil slide guides through oil cups in the sleigh.
c. Howitzer slow to return to battery.	*c.* (1) Insufficient gas pressure.	*c.* (1) Add pressure by means of air pump.
	(2) Too much friction on packings.	(2) Report to ordnance maintenance company.
d. Howitzer recoils more than maximum distance.	*d.* (1) Insufficient liquid in recoil mechanism.	*d.* (1) Refill system to normal.
	(2) Insufficient gas pressure in counterrecoil cylinders.	(2) Add air pressure by means of air pump.
e. Excessive end play in traversing shafts.	*e.* Wear, or loosening of the thrust screws.	*e.* Tighten the thrust screws, taking care that the shafts and gears still turn easily.

f. Excessive end play in windlass shafts.	*f.* Wear, or loosening of the thrust screws.	*f.* Tighten the thrust screws, taking care that the shafts and gears still turn easily.

35. Malfunctions of transport vehicles.—*Malfunction, cause, and correction.*

Malfunction	Cause	Correction
Hub box of wheel hot.	*a.* Lack of lubrication.	*a.* Remove wheel and pack with grease.
	b. Scored liners.	*b.* Report to ordnance maintenance company.

36. Safety precautions.—*a. Misfires.*—(1) *Missing of the primer.*—Should the primer fail, no report will be heard. Failure may be due either to a defective primer or because its center has not been struck. In such case an elapse of two minutes should be allowed, after which it will be ascertained whether or not the firing mechanism is fully screwed home, using caution to keep as far to one side of the howitzer as possible. Several attempts should then be made to fire the primer. If it still misses, an elapse of two minutes must be allowed, after which the firing mechanism should be removed and a new primer inserted. Before insertion of the new primer, however, the firing mechanism should be examined to determine whether the firing pin or firing-pin spring is broken or whether the firing-pin housing or primer seat has become loosened.

(2) Any primer removed after an attempt to fire should be handled with great care due to the possibility of a hangfire.

b. Missing of the charge.—(1) Should the primer explode without affecting the charge, only the explosion of the primer is heard. This may be caused by a damp or dirty channel in the obturator, because the base of the charge does not bear against the head of the obturator, or because the charge itself is damp.

(2) Should the charge fail to explode, it is necessary to wait at least 10 minutes before approaching the piece to avoid accident. Remove the firing mechanism and, without opening the breech mechanism, run the vent-cleaning bit through the channel in the obturator spindle and insert a new primer in the firing mechanism. If the howitzer does not fire on the second attempt, an interval of at least 10 minutes will be allowed to elapse before the breech mechanism is opened and the charge removed.

SECTION VII

CARE AND PRESERVATION

37. Adjustment of Belleville springs at trunnion bearings.—The Belleville springs at the trunnion bearings (fig. 27) should be adjusted, if necessary, by the adjusting screws (KB136H) in order to support the cradle entirely on the roller bearings. The trunnions should only touch the main bearings when the piece is fired. When the springs are properly adjusted the elevation or depression of the howitzer should be easily accomplished by turning the quick-loading handwheel with one hand.

38. Adjustment of bevel gearing.—The thrust screws on the ends of the bevel-gear cases for the traversing mechanism (fig. 25) and windlass (fig. 28) are adjusted when manufactured and should not require attention for a long time. If excessive end play develops in the shafts due to wear or loosening of the thrust screws, it should be taken up by tightening these screws, care being taken that the shafts and gears still turn easily.

39. Adjustment of friction clutch.—*a.* The friction clutch (fig. 19) on the elevating worm wheel (KB150A) should be carefully tested from time to time to ascertain whether it is properly set. Sufficient slippage should be left so as to take the strain off the elevating arc, and the disks should be so adjusted that the howitzer will not elevate more than 4° during firing. For preliminary setting bring the cradle to either the elevation or depression stop and then compress the Belleville springs until the efforts of a strong man on the elevating handwheel will just cause the disks to slip. The howitzer should be elevated and depressed rapidly and suddenly stopped at some point. No shifting should occur. The friction disks are coated with light class A oil when assembled and should not require lubrication for a long time.

b. Caution.—(1) The oscillating mass is only in balance when the howitzer and sleigh are in battery position. Moreover, the oscillating mass is not perfectly balanced at all elevations but is held by the elevating mechanism and friction clutch. Care must be taken to see that the latter is tight enough to prevent the cradle from tipping of its own weight.

(2) Before removing the piston-rod nuts the cradle must be blocked in the horizontal position and one or both guide-cover rails attached so that the sleigh can not slide back off the guides. It is not necessary to block the cradle during the regular mounting and dismounting operations as the windlass cable, reacting on the assembly pulley, prevents the cradle from tipping even though the friction clutch should give. However, before loosening the sleigh-locking wedges, see that the windlass cable is hooked to the howitzer and the cable is taut.

(3) To prevent serious accidents, no one should be allowed in the platform trunk or at the rear of the cradle when assembling or disassembling any of the oscillating parts. Never step upon the rear of the cradle as this may unbalance the oscillating mass to such an extent as to cause the friction clutch to give and let the cradle tip suddenly into the trunk.

(4) Before running the rammer car onto the cradle make sure that the cradle is locked by the cradle lock.

(5) If the howitzer has stood idle for a considerable length of time, verify the pressure in the recuperator system before elevating. If the gas pressure is much reduced by leakage, the howitzer and sleigh will slide down into the recoil position, due to their own weight. This will unbalance the cradle to such an extent as to cause it to tip up suddenly unless the friction clutch is screwed up tight.

(6) When using the quick-loading gear the cradle is unlocked from the elevating arcs and the friction clutch has no effect upon the oscillating mass. Any material change in the center of gravity of the oscillating mass will cause the quick-loading handwheel to spin and get beyond control of the operator. Therefore, when the elevating arcs are unlocked and the quick-loading gear is being used, especial care must be taken to insure that the howitzer remains in full battery position and that no outside weight is placed upon any part of the howitzer or cradle.

40. Adjustment of roller chain.—Slack in the roller chain on the quick-loading mechanism (fig. 24) may be taken up by removing the quick-loading gear shaft bracket bushing securing key (KB164G) and the nut from the quick-loading gear handwheel shaft. Tap the end of the shaft (KB165B) with a wood block until the shoulder is a

sufficient distance away from the face of the bushing (KB164E) to remove it from its slots. Turn the bushing until nearly all slack is removed from the chain and insert it into new slots, care being taken that some slack remains in the chain to permit ease of operation.

41. Adjustment of traversing rollers.—The rear traversing rollers (fig. 26) should be adjusted so that clearance under the rear of the top carriage is within the same limits as the front. Adjustment at the rear is obtained by revolving the traversing roller spring retainer (LS334C) in the top of the bracket.

NOTE.—Except when the piece is fired the entire weight of the top carriage, cradle, and howitzer is supported at three points; namely, the bearing blocks in the pintle and the two traversing rollers. When the piece is fired the top carriage is forced downward so that it bears on the pintle socket plate in front and on the holding down sector at the rear and is thus firmly supported by the platform.

42. Howitzer.—*a.* Cannon become less copper fouled when properly cared for. The wear of the cannon does not depend entirely on the number of rounds fired, but rather upon the care given the bore in cleaning, greasing, and allowing sufficient time for cooling between rounds.

b. The accuracy life of cannon usually depends on erosion at the rear of the forcing cone, or at the beginning of the rifling, which is most likely to be produced by a fast rate of fire, together with the excessive heating induced. Therefore, the howitzer should be allowed to cool between rounds whenever possible.

c. The ideal manner of using cannon is to wash and oil the bore after each shot and to clean the projectile before inserting it into the chamber. The procedure of washing and oiling the above will not always be possible, but the ideal should constantly be kept in mind.

d. It is of importance, whenever the rate of fire permits, to have the cannoneer look through the bore before each loading to determine whether any particles of powder bags or unburned powder remain in the bore. The presence of such particles causes imprints in the bore and sometimes premature explosions. During night firing, the sponge should be used between rounds.

e. When shells, etc., burst near the muzzle of the piece, make sure before firing that neither the exterior nor the muzzle face of the tube has been indented by the fragments. Any indentations affecting the bore of the tube are likely to cause it to split when fired. Bulges at any part of the piece or any unusual conditions which appear should be reported at once to the ordnance inspector of artillery.

f. After firing periods, it is important that the bore of the piece be cleaned to remove the residue of powder and then thoroughly oiled. In cleaning, use the sponge, and wash the bore with a solution of soda ash or sal soda and water, in the proportion of one-half pound of soda ash or 1 pound of sal soda, to a gallon of water. After washing with the soda solution wipe perfectly dry, using the sponge covered with burlap, and then oil the bore with a thin coat of light slushing oil, applying it with the slush brush.

g. The surfaces of the leveling plates should be protected from injury. Do not lay tools or other articles upon these surfaces. In case of accidental injury, repair must be made by the personnel of the ordnance maintenance company.

h. The various screws in the howitzer should be examined frequently and kept tight.

i. Extreme care must be taken to prevent injury to the gas check seat. Bruises in the gas check seat affect the seating of the split rings and are likely to cause leakage of gas and burning of the pad. If such leakage actually occurs, serious erosion may result. Rusting of the gas check seat is likely to occur due to the pads being susceptible to moisture. The seat and rings, therefore, should be well protected with rust-preventive compound at all times when the howitzer is not in use, and the entire canvas surface of the gas check pad, in contact with the seat, split rings, obturator spindle, and filling-in disk should be kept coated with a graphite lubricant at all times.

j. When the howitzer is not in use the various covers provided for protection must be placed in position.

43. Breech mechanism.—*a.* The breech mechanism should be kept clean and the parts well lubricated at all times with class A oil. The mechanism should be disassembled periodically when not in use to determine whether it is rusting. When in use it should be disassembled at intervals, cleaned and oiled, this being especially necessary as no provision is made to oil by means of oilers or oil channels, and should always be so cared for immediately after each firing period.

b. The primer seat and vent hole in the obturator spindle should receive the same careful attention as the firing mechanism in cleaning, using the vent cleaning tools provided for this purpose. The slightest accumulation of fouling in the primer seat will cause the primer to enter with difficulty, and like difficulty will be experienced in extraction, with the possibility of the breakage of parts. This should be carefully guarded against.

c. Gasoline is issued for cleaning purposes and may be applied with a rag, cotton waste, or brush. It is important, in applying the gaso-

line, not to allow it to touch the gas check pad. Absorption of gasoline by the canvas cover will cause softening of the pad.

d. In case the mechanism is left unused for any considerable length of time all bright or unpainted surfaces should be protected with a coat of light slushing oil. Before applying the slushing oil the surface should be thoroughly cleaned so as to be free from rust, water, or lubricating oil. The slushing oil may readily be removed with gasoline when desired.

e. In assembly or disassembly do not use a steel hammer directly on any part of the mechanism. A copper drift should be interposed or a copper hammer used to prevent deforming the parts.

f. Parts that are likely to be deformed by accidental injury, due to their prominence, are the operating lever, percussion hammer operating shaft with its housing, and the percussion hammer. The parts most likely to become broken in service are the various springs, rack, rack segment, operating lever shaft, hinge pin, and the firing mechanism.

g. Vigilance must be exercised to detect any cutting or abrasions forming on the pressure side of the threads of the breechblock and breech recess, and in the block carrier. If the breechblock does not rotate smoothly, or the mechanism requires a greater effort than usual to operate, it should be considered sufficient warning for disassembly and examination. The removal of such abrasions must be effected at once by the personnel of the ordnance maintenance company.

44. Firing mechanism.—*a.* The firing mechanism parts require the same careful attention as the breech mechanism, and should be disassembled frequently. The parts should be washed when necessary with gasoline to remove any trace of gummy oil, wiped dry and then oiled with class A oil.

b. Fouling of the firing pin and the use of a thicker oil than authorized will cause the mechanism to absorb the blow of the percussion hammer and result in misfire. This is especially true in cold weather when oils are likely to congeal and become gummy.

45. Filling recoil cylinders with liquid.—*a.* The two recoil cylinders are filled separately, the method being identical for each cylinder.

b. Elevate the howitzer 1° or 2°. Open the filling plug opening door (KB119A), Figure 8, of the cradle, remove the filling plug (RB269D), Figure 12, also the filling plug located in the front end of the recoil piston rod (RB252A), Figure 11. Place the tube of the filling funnel through the filling plug opening door (KB119A), Figure 8, into the filling hole of the recoil cylinder and pour the filtered

liquid into the funnel until it flows through the filling hole in the front end of the recoil piston rod. Allow all air to escape from the mechanism and replace the filling plugs. Depress the howitzer until the cradle is level when in the horizontal position. Remove the filling plug (RB269D), from the recoil cylinder rear plug (RB251B), Figure 11, and drain from the cylinder 0.67 pint (0.32 liter) of liquid, and replace the filling plug. This should leave the proper void to take care of the expansion of the liquid.

46. Filling recuperator cylinder with the air pump.—*a.* The air pump (fig. 49) is for the purpose of maintaining the pressure in the recuperator reservoirs. When in operation it is attached to the bracket on the left side of the top carriage. It is connected to the recuperator by the filling pipe (U320A) in the same manner as the liquid pump utilizing the same valves and connections, except when taking the gas pressure. When testing the gas pressure the pressure gauge adapter is assembled to the valve stem body (RB267A), Figure 48. (See par. 47.) The adapter needle valve (U313C), Figure 48, remains closed. Screw in on the adapter handle (U313B) slowly until it comes in contact with and opens the valve in the valve stem body (RB267A). The pressure of gas in the recuperator will be registered by the pressure gauge. Care must be exercised when taking gas pressure to operate the adapter handle (U313B) slowly in order that the pressure gauge will not be strained by the sudden force of gas applied to it. Also tap the gauge with the finger to be sure that the hand of the gauge operates freely.

b. The normal condition of the recuperator system is determined by the initial pressure and by the amount of the liquid contained therein. At 15° C. or 59° F., the initial pressure should be 40 kilograms per square centimeter, or 568 pounds per square inch.

c. Since a temperature variation of 7° C. from normal will cause a variation of 1 kilogram per square centimeter (a change of 1.13 pounds per square inch per degree Fahrenheit) it will be seen that the change in temperature of the gas in the reservoirs caused by a long firing period, or variations in temperature of the outside air, will cause a change in pressure which must be allowed for. A pressure table is fastened to the inside of the cap over the adapter valve, which should be consulted when regulating the pressure in the recuperator reservoirs. The table gives the maximum and minimum pressures and corresponding temperatures in both English and metric units. The proper pressure, however, when firing, is to be determined by the length of recoil. The pressure table and pressure gauge are used as a check in the operation of the recuperator system before firing. The pressure as given in the table must be maintained at all times except when firing.

d. The air pump is to be used only in emergency or when very little air is required to stabilize the pressure in the recuperator.

47. Filling the recuperator system with liquid.—Depress the howitzer until the cradle is level when in the horizontal position. Attach the liquid pump (fig. 49) to the bracket located on the left side of the top carriage. Remove the valve body cap (RB267S), Figure 48, and attach the pressure gauge adapter and pressure gauge to the valve stem body (RB267A), and set the pointer (RB267B) on the zero graduation of the left reservoir cap plate (RB259G). Remove the nozzle connection plugs (RB262H), Figure 12. Attach the filling pipe (U320A), Figure 49, to the liquid pump, and attach the other end of the pipe to the nozzle connection (RB262A), Figure 12. Fill the liquid pump with liquid. Open the filling valve by loosening the filling valve spindle (RB262L) slowly with the wrench provided for this purpose. Pump the liquid into the cylinders with an even stroke. After pumping what is thought to be the required amount of liquid to fill the system to normal close the filling valve by tightening the filling valve spindle (RB262L). Open the valve directly under the pressure gauge, then turn the adapter handle (U313B), Figure 48, until it comes in contact with and opens the valve in the valve stem body (RB267A). This will cause the liquid in the recuperator cylinders to escape past the adapter needle valve (U313C). If the liquid escaping has the consistency of a heavy mist, the recuperator has the required amount of liquid. If nothing but air escapes it indicates that more liquid is required. If only liquid escapes keep the valve open until it has the consistency of a heavy mist.

48. Filling the recuperator system with nitrogen.—When filling the recuperator system with nitrogen the same pipes, valves, and connections are utilized as were used in filling the recuperator with liquid by means of the liquid pump, except that the filling pipe (U320A), Figure 49, is attached to the compressed gas cylinder. In admitting nitrogen or liquid into the recuperator, care must be taken to see that all connections are tight before opening the filling valve. A little grease on the threads of all connections will act as a seal and stop small leaks.

49. To measure length of recoil.—*a.* The length of recoil is measured by a marker point (RB263E), Figure 10, attached to the recoil marker (RB263A). An adjusting marker nut (RB263B) regulates the pressure of the marker point against the sleigh during recoil. The latter traces a line through the grease or other substance placed on the scale which is stamped on the sleigh. The scale is graduated in inches and millimeters. The maximum recoil permissible is 1,187 mm (46.73 inches) and the minimum 1,138 mm (44.83 inches).

b. The time required for the howitzer to return to a point 40 mm (1.574 inches) below full battery position should be from 4 seconds at 0° elevation to 15 seconds at 60° elevation. The time required to travel the last 40 mm will be considerable, due to the fact that the return valve has nearly closed the orifice and the liquid can pass by it very slowly. The total time required for the howitzer to return to full battery position should not exceed 60 seconds regardless of the length of recoil or the elevation.

c. A battery position indicator (RB263G), Figure 10, is located on the right side of the cradle which shows when the howitzer has returned to battery. If the line on the sleigh does not lie between the two lines on the cradle the howitzer must not be fired.

d. If the recoil is too long, after making sure that the recoil cylinders are full, the pressure in the recuperator reservoir should be measured and the liquid level tested.

NOTE.—After firing, the liquid and nitrogen in the recuperator reservoirs become mixed, and it is necessary to wait at least 20 minutes before testing the liquid level to permit the nitrogen to separate from the liquid.

e. If the pressure is less than normal value (40 kg per square centimeter or 568 pounds per square inch) reestablish the pressure.

f. Test the liquid in the recuperator mechanism by placing the howitzer in a perfectly level position lengthwise and crosswise. Turn the depth gauge pointer (RB267B), Figure 48, until liquid emerges from the pressure gauge adapter. The position of the depth gauge pointer on the scale indicates the amount of liquid to be added or withdrawn.

g. If after making the above test the recoil is still too long notify the ordnance maintenance company.

50. Lubrication instructions.—*a. Carriage.*—All bearing parts must be kept oiled and greased according to the oiling charts (fig. 79) which indicate the principal places where lubrication is necessary. In addition all handles, latches, hinges, and similar parts should be oiled occasionally. The elevating arcs and pinions, the quick-loading arc and pinion, and the traversing rack and pinion must be kept free from dirt and grit and greased daily. All gear cases must be kept filled with grease. The rammer chain must be brushed free from dirt and grit and oiled frequently.

(1) Class A lubricating oil will be used exclusively in all oil holes of the matériel and in lubricating such parts as cradle slides, pintle bearings, elevating and traversing mechanisms, brake bearing, hinges and bearing surfaces of the breechblock and breechblock carrier.

(2) Neutral oil should be used on the spindle and all bearings of the sights.

(3) Lubricating cup grease should be used in lubricating gear teeth and bearing surfaces which carry heavy loads; also the axle bearings and turning arcs of the transport wagons. The class of lubricant will depend upon climatic conditions.

b. Transport wagons.—All parts must be kept oiled and greased according to the oiling and greasing charts (figs. 81 and 80) which indicate the principal places where lubrication is necessary. Care should be taken that no sand or dirt gets into the wheel bearings when the wheels are removed for mounting and dismounting the cradle and howitzer. The lunette slide and the spring guides inside the trails should be oiled occasionally. All joints of the brake mechanism should be oiled, care being taken that no oil gets on the brake lining, as this will cause the brake to slip. Keep the rubber tires free from oil or grease as much as possible to prevent deterioration.

51. Paint.—For detailed information regarding the removal of old paint, cleaning and preparation for painting, preparing new paint, application and kinds of paints to different surfaces, brushes, slushing oils, abrasions, burlap, etc., see TR 1395-A.

a. Protection and cleaning of material affected by gas.—(1) *Protection against phosgene, chlorine, etc.*—For material which is in constant danger of gas attacks, whether from gas clouds or gas shells, care should be taken to keep all bright parts of the guns, carriages, mountings, and accessories well coated with oil.

(2) Sights and all instruments should also be covered with oil and protected with covers when not in actual use, care being taken that the oil does not come in contact with any glass or find its way into the interior of the instruments.

(3) All uncapped fuzes or fuzes which have been removed from their containers should be wiped over with oil as soon as possible and protected with a cover.

b. Protection against mustard gas.—It must be remembered that practically all fabrics and materials such as wool, cotton, rubber, and oilcloth can be penetrated by mustard gas if exposed to it a sufficient length of time. The mustard gas is absorbed by these materials and penetrates them by a slow process of diffusion. In general, it may be said that the greater the length of time allowed for penetration the greater the danger in wearing these articles. For instance, rubber boots which have been worn in an area shelled heavily with mustard gas may be a grave danger to men who wear them several days after the bombardment. Fabrics thoroughly impregnated with boiled linseed oil will resist penetration by mustard gas for over an hour, but after this time these articles are dangerous because the mustard gas dissolves in the linseed oil and they must be destroyed.

c. Cleaning.—All bright parts of guns and carriages, together with all accessories and spare parts exposed to the gas, must be cleaned and wiped dry as soon as possible after the attack, and in any case within 24 hours, after which they should be thoroughly coated afresh with oil. The same applies to the whole of the ammunition still in the battery position. Ammunition which for any reason has not been oiled must be cleaned and oiled. It is desirable to expend it as soon as possible.

d. Disinfection of matériel of all kinds affected with mustard gas.—The following measures should be taken for the removal of mustard gas from various materials and equipment (guns, projectiles, cases, wood, metals, rope, etc.) which have come in contact with the mustard gas. For all of the operations indicated below, the gas mask and protective clothing, including protective shoes and gloves, must be worn.

(1) Commence by freeing the objects of dirt, lumps of earth, and liquid with wooden spatulas, rags, etc., which will be buried immediately after this operation. They must never be burned.

(2) Sprinkle a continuous layer of calcium hypochlorite, which is preferred if available, or else dry chloride of lime over the parts that lend themselves to this treatment. In the statements hereafter calcium hypochlorite is specified but dry chloride of lime may be substituted in the event that calcium hypochlorite is not available. After two hours, or better after six hours, if practicable, wash off the layer of calcium hypochlorite and rinse thoroughly. It is imperative that all the calcium hypochlorite be removed in order to prevent the deterioration resulting from the prolonged action of the calcium hypochlorite. In the case of ammunition it is imperative to prevent particles of calcium hypochlorite from being introduced into the bore of the piece.

(3) Whitewash soiled parts, which do not lend themselves to sprinkling with dry powder, with a thick paste of calcium hypochlorite made from 3 volumes of calcium hypochlorite and 1 volume of water. After two hours, or preferably six hours, wash off the calcium hypochlorite.

(4) The delicate parts of the apparatus, such as breech mechanism, sighting apparatus, glasses, etc., which would be injured by calcium hypochlorite should be cleaned by dry polishing with rags. After this operation the rags should be buried.

(5) If there are large quantities of water at hand, in the place of calcium hypochlorite use water. The water should be warm, but not boiling, and large quantities should be used. This can not be done in the case of greasy articles, where only calcium hypochlorite should be used.

(6) When it is not necessary to immediately use contaminated material, or when one has not the above means at his disposal, it may be considered that the handling of the material or apparatus is not dangerous after six or eight days.

e. The material will be disinfected as thoroughly as possible before its removal.

SECTION VIII

ACCESSORIES

52. Accessories, general.—There are a number of accessories provided with this matériel, such as the crowbar, pinch bar, water bucket, various covers and wrenches, etc., the names or general characteristics of which plainly indicate their use and application. Therefore, no detailed description or method of use is outlined herein. The special accessories, however, being of a different nature, description, purpose and method of use are outlined in the paragraphs following.

53. Adapter, pressure gauge.—The pressure gauge adapter (fig. 48) is composed of a bronze body designed to receive the parts that control and register the pressure of the counterrecoil mechanism. The pressure gauge adapter is attached to the valve stem body housed within the left reservoir cap by means of a pressure gauge adapter union. The pressure gauge adapter with the pressure gauge is for measuring the liquid or gas pressure or for drawing liquid or gas from the mechanism when expansion has become so great that it affects smooth operation of the counterrecoil mechanism.

54. Bag, flannel, hydrometer.—This bag is for the protection of the hydrometer.

55. Bar, lifting, wood, 43-inch.—The lifting bars are used when lifting the rammer car on or off the loading platform.

56. Barrow, shot.—The shot barrow is used in conjunction with the shot tongs for lifting shells in emergencies. It is composed of a steel bar with two cross handles which may be removed during transporting.

57. Bit, vent cleaning.—The vent cleaning bit is 18½ inches long with a loop for handling. The other end is fluted 4 inches in length. It is for the purpose of cleaning the vent in the obturator spindle.

58. Blocks, wheel.—The wheel blocks (fig. 70) are used for chocking the wheels of the transport wagons when mounting and dismounting the matériel. The small wheel blocks are used with the

rear wheels and are provided with handles and retaining levers which drop into notches in the edge of the wheel tracks so as to hold the blocks in the proper position. The large wheel blocks have handles but no retaining levers and are used to chock the limber wheels.

59. Book, artillery gun.—The artillery gun book (O. O. Form 5825) is issued for the purpose of keeping an accurate record of the howitzer. It must always remain with the howitzer regardless of where the howitzer may be sent. The book is divided as follows: Record of assignments of the howitzer to the various batteries, battery commander's daily howitzer record, inspector's record of examination, and forms to be filled out in case of premature explosions.

60. Can, glycerin.—The glycerin can is rectangular in shape. Its capacity is 1½ gallons. The can should be painted and labeled in accordance with existing field service modification work orders.

61. Car, rammer.—*a.* The rammer car (figs. 51 and 52) is made of structural steel. It is supported on four car wheels (KE16A) running on left and right hand loading platform tracks and left and right hand swinging tracks (LS723G and LS723F), Figure 29, and in the rear end of the cradle on left and right hand loading apparatus lower rails (KB102F and KB102E), Figure 8. It is used to transport projectiles from the loading crane to the breech and to ram them into the howitzer.

b. The rammer car when in position to receive the projectile from the loading crane as shown in Figure 77 is securely locked to the loading platform by the buffers and swinging track mechanism, and can not be moved until the loading platform lock treadle (LS749A), Figure 29, is operated. The car may then be run into the cradle and locked to the howitzer as shown in Figure 51. The operating shaft cranks (KE10B), one on each side of the car, are then turned, forcing the rammer chain to push the projectile forward into the bore. The powder bags are next pushed in. The car is released by operating the locking handle (KE15S) and rolls down the inclined guide cover rail off the cradle and onto the loading platform, raising the swinging track on its way and automatically locking itself on the platform.

c. The rammer mechanism consists of a rammer chain made up of rollers and links (permitting the chain to bend but one way), and a rammer head (KE12X) attached to the front end of the chain. The chain is operated by a sprocket (KE12T) attached to an operating shaft. The locking device consists of a safety buffer and buffer frame (KE15Q), Figure 51, in which the rammer car lock (KE15K) and lock spring (KE15G) are operated. As the car is pushed forward the rammer car lock (KE15K) is forced down on coming in contact with the locking eye of the howitzer, later springing up into the

depression on the underside of the locking eye. To release the car the locking handle (KE15S) is pulled to the rear, the effort being transmitted through shafting, links, and cranks to the lock rod (KE15Z) thereby depressing and freeing the lock. There are two locking handles (KE15S) one on each side of the car attached to a shaft, which permit the lock to be operated from either side.

d. A buffer (LS748J), Figure 51, backed up by Belleville springs and carrying a buffer block (LS748K) is provided to take up the shock when the car is pushed into the locking position. A safety buffer (KE18B), Figure 52, is provided on the front of the car which strikes the locking bolt handle (RB264L), Figure 7, if the locking wedges are not entirely closed, thus preventing the rammer car from locking to the breech of the howitzer unless the wedges are completely closed.

e. On the underside of the car two stop brackets, one left-hand and one right-hand (KE13E and KE13D), Figure 52, and retaining plugs (KE10D) are provided. On returning the rammer car to the loading platform the stop brackets, left-hand and right-hand (KE13E and KE13D), Figure 51, come in contact with the buffer block (LS748K), Figure 29, and prevent undue shock. The retaining plugs (KE10D), Figure 51, enter holes in lugs integral with the loading platform buffer frames, left-hand and right-hand (LS748B and LS748A), Figure 29. These lugs are provided to prevent any movement of the rammer car during firing which would derail or throw the car from the loading platform.

f. When the rammer car is returned to the loading platform and the swinging track is locked in an upright position the front axle bracket (KE16B), Figure 51, extends down between the connecting link pin and the swinging track operating lever stud (LS737H), Figure 29, and locks the rammer car and prevents any forward movement of the car until the swinging tracks, left and right (LS723G and LS723F), are again released.

62. Case, carrying, hydrometer.—This case is a wooden cylinder for protection of the hydrometer.

63. Chest, glycerin.—The glycerin chest is made of steel and is 13¼ inches wide by 18 inches deep by 49⅝ inches long and is fitted with handles and a padlock. The lid is fastened to the body by four hinges. It is retained in the open position by the lid prop guide. The inside of the chest is fitted with a tray partitioned off to receive the glycerin cans. The approximate weight of the chest without contents is 120 pounds.

64. Cylinder, compressed gas, 2,000 pounds, M1.—The compressed-gas cylinder is 9 inches in diameter and 56$\frac{9}{16}$ inches over all,

and is equipped with an adapter, valve, and cap. It is charged with nitrogen at a pressure of 2,000 pounds per square inch. The nitrogen is used in the counterrecoil system of the howitzer matériel. Capacity of the cylinder is 2,661 cubic inches and approximate weight 125 pounds. It is tested and marked in accordance with Interstate Commerce Commission regulations.

65. Eye, lifting, breechblock.—The breechblock lifting eye (11), Figure 50, is required when assembling and disassembling the breechblock. In shape it resembles an eyebolt, having a 1-inch eye. It is 4 inches over all and its shank is threaded ⅝ inch–11–NC. The breechblock has a threaded hole to receive it.

66. Frame, erecting, with ammunition attachment.—*a.* The erecting frame (figs. 55, 56, and 57) is a structural steel unit composed of four columns resting on two base plates. The columns are held together at the top by crossbeams and are braced on the sides by brace rods. (Fig. 56.) It is operated by hydraulic jacks, four to each erecting frame, and is used for mounting and dismounting the platform and top carriage.

b. After the matériel has been mounted the erecting frame is used for loading the projectiles onto the shot trucks for transport to the loading positions. The ammunition attachment and its arrangement are shown in Figure 57. It consists of the erecting frame as used for mounting the matériel except that the suspension beams (fig. 56) are not utilized. For handling projectiles an overhead trolley track, trolley hanger, ¼-ton triplex chain block and shell tongs, guy ropes, and spikes are provided. Shell racks are shown in Figure 57. These racks are not used in time of peace but may be issued upon demand in time of war, although necessary arrangements in lieu thereof may be improvised. The projectiles are piled on each side of the shot car track as shown in Figure 57. When one pile has been exhausted the track is moved to the other side of the erecting frame. The trolley rail is hung from the crossbeams.

67. Funnel.—The funnel is provided with a curved pipe and is used for filling the recoil cylinders with the recoil liquid. It must not be used for any other purpose and should be cleaned before using.

68. Gauge, pressure, 60-kg.—This gauge is calibrated from 0 to 60 kgs per square centimeter. It is screwed into the pressure gauge adapter for testing the pressure in the counterrecoil system.

69. Gauge, pressure, 150-kg.—This gauge is calibrated from 0 to 150 kgs per square centimeter. It is used to ascertain the pressure of nitrogen in the compressed gas cylinder.

70. Gun, oil, 1/4-pound, M1.—The oil gun (13), Figure 50, is used to insert oil into bearings by force. The nose of the gun is intended to

fit tightly into the tapered openings of oiler nozzles so that none of the pressure generated in the gun is lost at the oil hole. Some of the oil guns in service have a nose of too great a diameter to properly enter the small nozzles. Such noses should be dressed down carefully with a file to secure the desired fit. The oil gun is of the plunger type and is filled by plunging the nose in oil during the back stroke.

71. Handspike.—The handspike is used in maneuvering the 240-mm howitzer matériel when mounting and dismounting. It is made of wood and is 82¾ inches long.

72. Hook, draft, platform.—The platform draft hook is attached to the front end of the platform when placing the platform over the pit.

73. Hydrometer, 6-inch, 10° to 30°.—The hydrometer is a glass tube which is graduated in one-half degrees between 10° and 30° Baume scale. Its purpose is for testing the density of liquid in the recoil mechanism.

74. Jacks, hydraulic.—The hydraulic jacks (fig. 59) are classified as limited standards and will ultimately be replaced by mechanical jacks operated by levers. This is made necessary due to the fact that the hydraulic jacks have not proved entirely satisfactory on account of the type requiring a great deal of care and operating during periods when not in frequent use. Also overhaul and maintenance are extremely difficult when proper facilities are not available. There are a number of these jacks in service and in stock. They will be used until the supply on hand is exhausted or until the mechanical jacks are adopted. The operation of the jacks is as follows: To raise a load either on the head or claw, first open the air valve stem (U678A) which should always be closed when the jack is not in use. Then close the release valve stem (U678C) and move the operating lever up and down. To lower the jack, the release valve is opened, allowing the liquid to flow from the ram cylinder back into the head, which acts as a reservoir. The jacks are filled with liquid the same as that used in the howitzer recoil mechanism. It is introduced by removing the cap from the head. The maximum safe load on the cap is 10,000 pounds, and on the claw 6,000 pounds.

75. Jack, mechanical.—A mechanical jack for the 240-mm howitzer matériel has not yet been adopted. It is expected, however, to replace the hydraulic jacks with mechanical jacks.

76. Lantern, artillery, M1.—The artillery lantern, M1, is used for emergency lighting purposes and is carried on the howitzer carriage limber.

77. Lanyard, steel cable, 60-foot.—The lanyard is used in firing the 240-mm howitzer when it is necessary to resort to safety precautions.

78. Lever, lifting, axle.—The axle lifting levers are of forged steel. One end is shaped into a cross handle while the other carries a lug which fits into the linchpin hole. A stud is also hinged to this end and fits into the hole in the end of the axle. A lever is inserted into each end of the axle to lift it after the wheels have been removed. They are used when mounting and dismounting the cradle and howitzer.

79. Mat, wheel.—The wheel mats are steel plates 10 feet long, provided with lifting handles along each edge. They are laid on the ground to form a track when maneuvering the transport wagons on soft soil.

80. Measure, 1-liter (graduated in half deciliters).—This measure is cylindrical and is graduated in half deciliters. It is made of galvanized iron. Its purpose is to measure the liquid when filling the recoil mechanism.

81. Oiler, M1.—The oiler, M1 (7), Figure 47, is used in distributing lubrication to bearings and sliding surfaces.

82. Opener, container.—The container opener is a hook-shaped tool made of steel. It is used for opening the gas check pad zinc containers to prevent cutting the pads.

83. Paper, litmus (vial).—This paper is for testing the acidity of the liquid of the recoil mechanism. (For additional information see TR 1395-A.)

84. Pipe, filling.—The filling pipe consists of a copper tube of small diameter, to each end of which are brazed brass couplings. A check valve is provided in one coupling which is attached to the filling valve body on the sleigh by means of a long swivel. The filling pipe is designed for a working pressure of 2,000 pounds per square inch, but care must be taken not to put sharp bends in it as this may cause it to leak. The connections at the ends should never be removed from the pipe; however, the nipple may be unscrewed from the short swivel nut to permit inspection of the check valve. The coupling marked "sleigh" is assembled to the filling valve body and the coupling marked "reservoir" is attached to either of the pumps or to the compressed gas cylinder.

85. Pulley, assembly.—The assembly pulley is made up of a bracket, pulley, and pulley shaft. The assembly pulley is attached to the front of the cradle for the purpose of retaining the windlass rope when mounting the 240-mm howitzer.

86. Pump, air.—The air pump is furnished for the purpose of maintaining the correct pressure in the counterrecoil system when only a small amount of air is required. When in operation it is attached to the bracket on the side of the carriage. The pump will

operate against a pressure of 600 pounds per square inch. Power is applied by means of a hand lever which is connected by parallel links and a crossbeam to the piston head which operates through a gland in the top of the cylinder. The piston is fitted with special packing at its lower end and operates in a cylinder larger in diameter than the body of the piston. The action of the pump is as follows: As the piston moves up air is drawn through the intake valve filling the space below the piston. As the piston moves down the intake valve is closed, the piston valve is displaced and the air forced through into the space around the piston and above the shoulder. This constitutes the first stage of compression. On the up stroke of the piston the air is forced out through the check valve into the counterrecoil system, constituting the second stage of compression. At the same time more air is taken in through the intake valve.

87. Pump, liquid.—The liquid pump is furnished for the purpose of replenishing lost liquid from the counterrecoil system. It is provided with a reservoir with a fine mesh strainer, and is mounted on the same bracket as is used for the air pump. It is operated in the same manner as the air pump. On the downward stroke of the piston, liquid is drawn from the reservoir into the cylinder through a ball valve. On the up stroke it is discharged through a check valve and the filling pipe into the counterrecoil cylinders. On the down stroke the check valve closes by action of the valve spring and the pressure of the counterrecoil system. Thus, it is a single acting force pump and will operate against a pressure of 600 pounds per square inch. The pump should at all times be kept free from dust and grit and all parts well oiled. Loss of compression may be caused by small particles of dust on the valve seats preventing the valves from closing.

88. Rack, shell, complete.—The shell rack (fig. 57) is composed of timbers notched to conform to the radius of the shell. This rack will not be issued in time of peace as there is no demand for it, nor in time of war except upon demand. Necessary arrangements in lieu thereof may be improvised.

89. Rail, guide cover.—The guide cover rails (KB123B and KB123A), Figures 5 and 10, are made of steel and are used when mounting the howitzer to protect the recoil slide guide of the cradle.

90. Rammer, hand.—The hand rammer is composed of a round wooden body which is a loose fit in the bore. It is fastened to the end of a wooden handle which may be lengthened by screwing on the same detachable sections used with the sponge. A recess is cut in the front end of the body, which fits over the fuze and nose of the shell. It is used for the following purposes:

a. To force the shell into the breech when the rammer car is not available.

b. To remove the shell from the bore when, for any reason, it is decided not to fire it immediately. To do this, insert the rammer in the muzzle end, and with gentle taps loosen the shell, great care being taken not to arm the fuze.

91. Reamer, cleaning, primer seat (bronze).—This is composed of the reamer (10), Figure 50, attached and pinned to a wooden handle. It is 7 inches over all. The reamer is fluted and is for the purpose of removing powder fouling from the primer seat. Being made of bronze it does not remove any metal.

92. Roll, tool, M1915.—The tool roll carries tools as listed in Standard Nomenclature List No. D-4. It is 25½ by 46 inches when open. It is made of cotton duck and has 17 numbered pockets.

93. Rope, breechblock eye.—The breechblock eye rope is a piece of ¾-inch hemp rope 59 inches long, wound at each end with marline. It is used as a sling when dismounting or mounting the breechblock.

94. Rope, drag.—The drag rope is a 1-inch manila rope approximately 26 feet 3 inches long, with a hook and thimble spliced at one end, and the other end wound with marline. It is used for applying man power when necessary.

95. Sight, bore.—The bore sights consist of a breech bore and a muzzle bore sight. The breech bore sight is of sheet brass 2½ by 9.823 inches by ⅛ inch thick. The muzzle bore sight consists of a canvas strap and two pieces of black silk cord 30 inches long.

96. Sponge.—The sponge has a cylindrical body mounted with pig bristles. It is used to clean the bore of the howitzer.

97. Strap, lantern.—The lantern strap is a leather strap 1¼ inches wide by 19¼ inches long. It is split to fit over the top of the lantern to secure it to the howitzer carriage limber.

98. Strap, transport, rammer car.—The rammer car transport strap is a heavy cotton web strap fitted with chains and S-links, end clip and tongueless bar buckle. This strap is used to secure the rammer car to the loading platform when being transported.

99. Supports, loading platform.—The loading platform front support (fig. 58) is composed of a wood beam reinforced at each end by end pieces, and at each side of the center by a steel support. The loading platform rear support (fig. 58) is composed of a wood crossbeam which is reinforced by top and end plates. Two support socket pieces are assembled through the top plate and are retained in position by ⅞-inch crown nuts. The loading platform supports, when assembled into the support brackets of the top carriage, support the loading platform when in traveling position.

100. Target, testing.—The testing target is used in the verification and adjustment of the sights.

101. Templates.—There are four templates (fig. 68) provided for each carriage, one each, angle, depth, and large and small plan templates, for determining the correct shape and depth of the pit for emplacing the platform. They are provided with hinge rivets, notches, and stops in order that they may be folded for convenience in transportation and when opened come to their correct shape.

102. Tongs, shell.—*a.* The shell tongs (fig. 35) attached to the loading crane are used for handling projectiles from the shot truck to the rammer car. A second set is provided for loading projectiles onto the shot trucks at the dump. They are attached to the erecting frame. The shell tongs have a swivel hook (NC91A) which provides the means of attaching the shell tongs unit to the cable clevis (NC91C). The tongs, when attached, are locked to the clevis pin by the shell tongs swivel hook latch (NC91B). The swivel hook (NC91A) is provided with thirteen ⅜-inch steel balls (CCAX1E), which form a ball bearing and permit easy turning of the tongs.

b. The shell tongs clevis (NC93A) is attached to the swivel hook by a nut seated on the shell tongs bearing washer (NC93Q). This clevis is also assembled with one end of the toggle inner link (NC93C), and toggle outer link (NC93B), by the toggle pin (NC93M), held in position by the toggle pin collar (NC93N). The toggle pin extends into guides cut in the side pieces (NC92B), thereby keeping all parts in correct relation to the others. The side pieces are held together at the top by the spacer pins (NC93D) and near the lower ends by the lower pins (NC93E), about which the shell grips (NC92A) fulcrum. The upper ends of the shell grips are fastened to the toggle inner link and the toggle outer link.

c. When unloaded the inward movement of the shell grips is limited by the upward movement of the toggle pin (NC93M), which keeps them well opened at all times so that when the shell tongs are let down upon a projectile they will automatically open and slip down below the maximum diameter of the shell at the gripping point, after which any upward movement of the cable with the locking handle (NC93K) in place as shown in full lines will cause the shell grips to grip and maintain their position as indicated in Figure 35.

d. After placing the shell upon the rammer car the tongs are released by slacking on the cable and swinging the locking handle into the position shown in dotted lines (fig. 35), after which the tongs may be slipped off the shell.

103. Track, shot truck.—The shot-truck track, upon which the shot trucks run, is composed of light steel rails joined by pressed steel

ties. Straight and curved sections of various lengths are furnished as well as right and left hand switches. The sections are joined by splice plates bolted through the webs of the rails. The switch points are stationary and the front end of the shot truck must be guided onto the switch by hand. The track is 23.62-inch (600 mm) gauge.

104. Track, wheel.—The wheel tracks (fig. 54) are structural steel units, which are used in mounting and dismounting the howitzer and carriage. They are provided with inclined planes at their rear ends, and along the upper edge in the front end are notches for locating the small wheel blocks used to chock the transport wagon wheels.

105. Truck, shot.—*a.* The shot truck (fig. 53) is made up of structural steel and is supported on four wheels (HE12B). The shot truck runs on a track, 23.62-inch (600 mm) gauge, laid in the field from the carriage to the ammunition dump. It holds two projectiles and is used in transporting them from the dump to the howitzer. The truck is provided with two brake shoes (HE6A), one on each side, which are operated independently of each other by the brake levers (HE7B), one on each end of the truck. Pressure on the brake levers causes the brake shoes to be pressed upward against each wheel simultaneously.

b. A locking device is provided for each projectile to prevent its unloading from the shot truck while in transit. This device consists of a rear stop, and rear stop shaft (HE13A), coupled at the center to the front stop shaft coupling (HE13H), which also acts as a locating stop for inserting the left latch bolt (HE13E). A front stop (HE14B) is attached to the front stop shaft. With the two shells in place on the shot truck, the shell stops are lowered, the rear stop bringing up at the base of the shell, while the front stop fits over the nose end. With the stops in position a latch consisting of a latch bolt (HE13E) and operated by a latch bolt handle (HE14D) is inserted in the front stops (HE14B and HE14A), thereby locking the stops in the position shown. Each end of the car is provided with a handle (HE8A) and bumper (HE8D).

106. Wrenches.—*a. Abutment plug.*—The abutment plug wrench (10), Figure 47, is used in assembling and disassembling the releasing ring abutment plug (RB249E), Figure 7, and the wedge screw abutment plug (RB249F), Figure 7.

b. Filling plug.—The filling plug wrench (9), Figure 47, is used in assembling and disassembling the filling plugs (RB269D), Figures 11 and 12, and the filling valve retainer (RB262G), Figure 12.

c. Filling valve.—The filling valve wrench (8), Figure 47, is used in assembling and disassembling the nozzle connection plug (RB262H),

Figure 12, filling valve spindle (RB262L), Figure 12, and the filling port sliding cover securing screw (KB118C), Figure 9.

d. Firing mechanism.—This wrench (4), Figure 47, is a face spanner with offset screw-driver end, and is used in disassembling and assembling the firing mechanism.

e. Friction nut.—The friction nut wrench (3), Figure 47, is for adjusting the tension screw nut (KB160E), Figure 19.

f. Fuze, M1.—This wrench (12), Figure 47, is used for tightening the fuze in the projectile before firing.

g. Gauge cock and filling pipe coupling.—This wrench (4), Figure 50, is used for the assembly of the filling pipe coupling to the sleigh and to adjust the gauge cock body when tests are being made of the liquid and nitrogen pressure of the counterrecoil system.

h. Locking wedge screw.—This wrench (6), Figure 47, is used in assembling and disassembling the left-hand screw releasing ring (RB264C), Figure 7.

i. Obturator spindle and hinge pin bushing nut.—This wrench (5), Figure 50, is used in assembling and disassembling the obturator spindle (15A), Figures 2 and 4, and the hinge pin bushing nut (22K), Figure 2. The wrench is made of a flat steel bar 1⅜ inches wide and 13.779 inches over all, rounded at each end. Four teats are riveted in the bar. Those for the obturator spindle are spaced 5.905 inches between centers while for the hinge pin bushing nut, they are 2.677 inches.

j. Operating lever handle.—This wrench (2), Figure 50, is used in assembling and disassembling the operating lever handle (18A), Figure 3. It consists of a piece of flat steel 1.181 inches wide and 6.102 inches over all. It is tapered at both ends and slotted. Two teats are riveted into the body. The distance between centers is ⅞ inch.

k. Pintle.—The pintle wrench (11), Figure 47, is used for assembling and disassembling the pintle crown filler ring (LS330B), Figure 23, pintle head retaining ring (LS330D) and pintle spring retaining bolt nut (LS331K).

l. Safety set screw.—This wrench (3), Figure 50, is used on the hollow safety set screws in the firing mechanism.

m. Gun roller socket.—The gun roller socket wrench (1), Figure 47, is for making necessary adjustments of the rear detachable roller screw (41E), Figure 5.

n. Spindle plug and hinge pin screw driver.—This wrench (9), Figure 50, is for assembling and disassembling the spindle plug (B241), Figure 4, and the hinge pin screw (22E), Figure 2.

o. Trunnion bearing end plate.—The trunnion bearing end plate wrench (2), Figure 47, is used for assembling and disassembling the trunnion end plate (KB110G), Figure 27.

p. Windlass adjusting nut.—This wrench (5), Figure 47, is used when adjusting the windlass worm shaft bearing lower bushing retainer (LS654F), Figure 28.

SECTION IX

DATA

107. Weights, dimensions, and ballistics of the 240-mm howitzer, M1918.

Weight of 240-mm howitzer	10,790 pounds.
Length of bore (calibers)	19.75.
Total length	199.6 inches.
Powder chamber:	
Diameter	9.82 inches.
Length	21.55 inches.
Capacity	1,740 cubic inches.
Powder charge, kind	Nitrocellulose.
Weight of charge	36 pounds 7 ounces.
Density of loading	0.58.
Projectiles:	
Weight of projectiles	345 pounds.
Travel of projectile	165.06 inches.
Muzzle velocity	1,700 feet per second.
Muzzle energy	6,920 foot-tons.
Maximum pressure	33,000 pounds to the square inch.
Maximum range (approximate)	16,400 yards.

Rifling: For details of rifling of the four models of howitzers see ordnance drawing 53-20-2, revised November 27, 1929.

108. General data pertaining to the 240-mm howitzer, carriage, howitzer carriage limber, and transport wagons.

	Pounds
Cradle (with elevating arms) sleigh and transport wagon	14, 605
Weight of front wheels and axle	1, 185
Weight of rear wheels, axle, and brake	2, 700
Weight on front wheels	3, 530
Weight on rear wheels	11, 075
Howitzer and transport vehicle	15, 220
Weight of front wheels and axle	1, 185
Weight of rear wheels, axle, and brake	2, 750
Weight on front wheels	4, 864
Weight on rear wheels	10, 356

	Pounds
Platform (complete, with pintle springs, swinging arms, and floats)	11,895
Sleigh (complete, filled with liquid and all pistons, packings, caps, etc.)	5,747
Top carriage (with rammer car, loading platform, loading crane) and transport vehicle	12,545
Total weight in firing position (complete, with loading platform, rammer car, loading crane, floats and sights)	41,296

[A. G. 062.12 (7-20-31).]

BY ORDER OF THE SECRETARY OF WAR:

DOUGLAS MacARTHUR,
General,
Chief of Staff.

OFFICIAL:
C. H. BRIDGES,
Major General,
The Adjutant General.

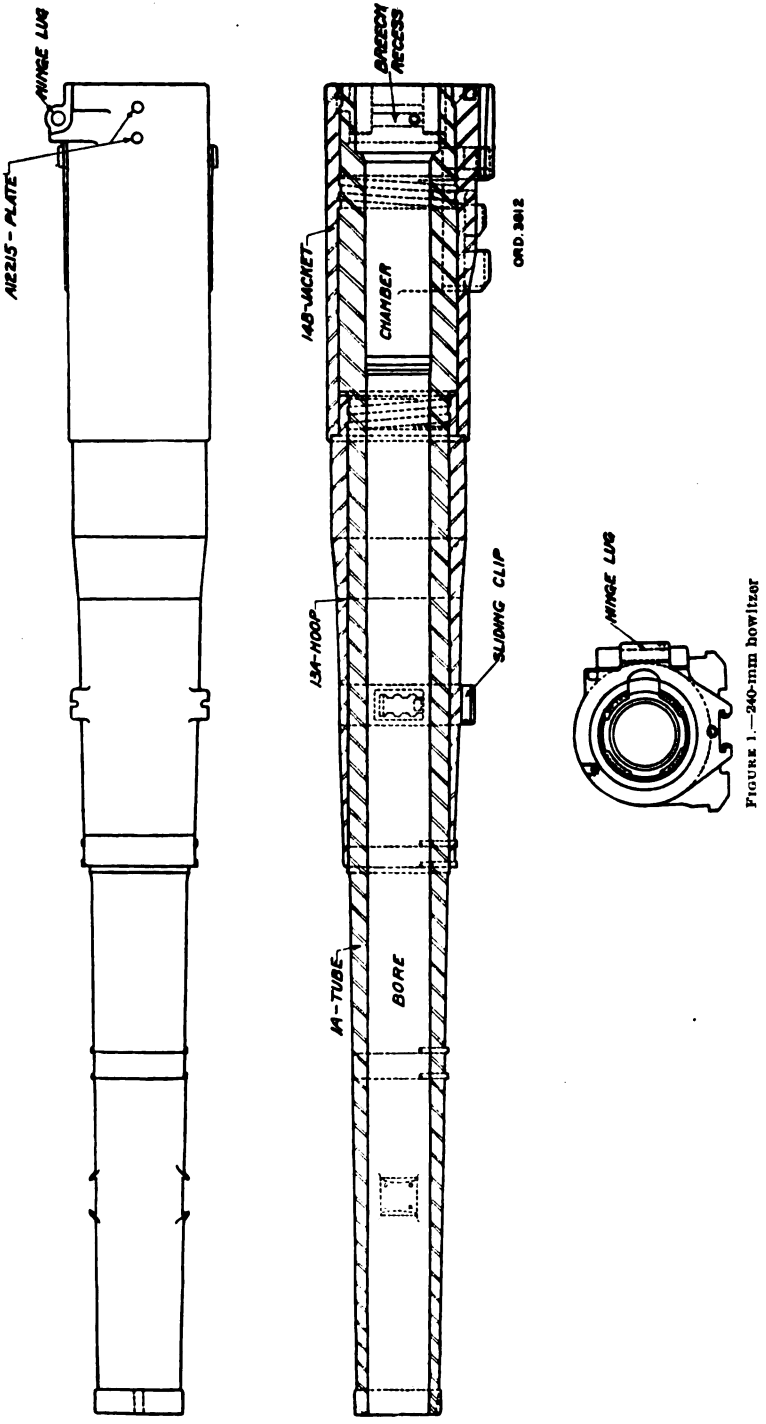


FIGURE 1.—240-mm howitzer

Reference	Item	Reference	Item
13A	Hoop.	A12215	Plate, leveling.
14B	Jacket.	1A	Tube.

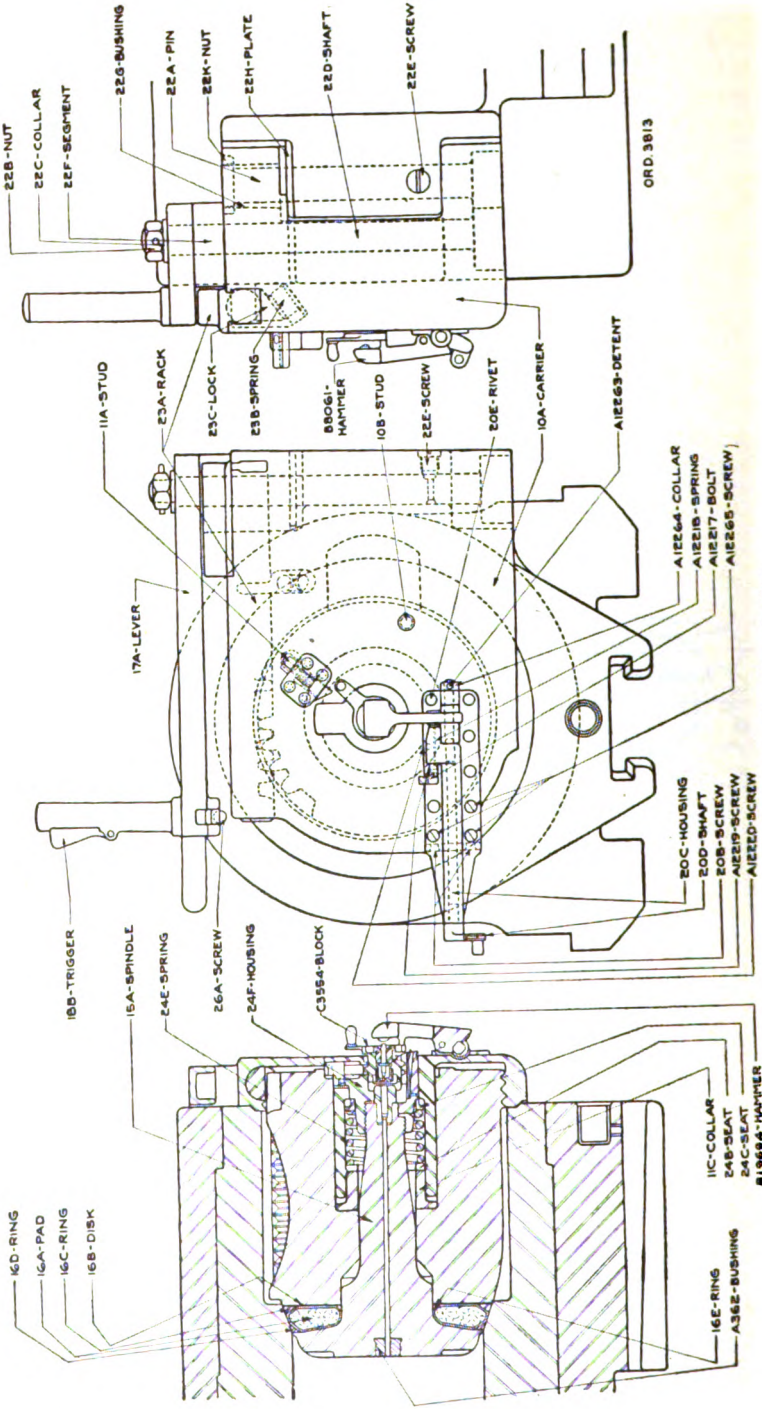


FIGURE 2.—Breech mechanism

Reference	Item	Reference	Item
C3554	Block, firing mechanism.	20E	Rivet, housing securing.
A12217	Bolt, percussion hammer lock.	22E	Screw, hinge pin.
22G	Bushing, hinge pin.	26A	Screw, operating lever latch plate.
A362	Bushing, obturator spindle vent.	A12219	Screw, percussion hammer lock bolt spring.
10A	Carrier, breechblock.	A12265	Screw, securing, operating shaft housing.
11C	Collar, operating spindle spring front seat.	20B	Screw, securing, obturating shaft housing.
22C	Collar, operating lever shaft.	A12220	Screw, stop, percussion hammer lock bolt.
A12264	Collar, percussion hammer operating shaft.	24B	Seat, obturator spindle spring, front.
A12263	Detent, percussion hammer operating shaft collar.	24C	Seat, obturator spindle spring, rear.
16B	Disk, filling-in (obturator).	22F	Segment, rack.
B19694	Hammer, percussion.	22D	Shaft, operating lever.
24F	Housing, firing mechanism.	20D	Shaft, operating, percussion hammer.
20C	Housing, operating shaft.	15A	Spindle, obturator.
17A	Lever, operating.	24E	Spring, obturator spindle.
23C	Lock, rack.	A12218	Spring, percussion hammer lock bolt.
22K	Nut, hinge pin bushing.	23B	Spring, rack lock.
22B	Nut, operating lever shaft.	11A	Stud, assembling, breechblock.
16A	Pad, gas check (obturator).	10B	Stud, assembling, breechblock carrier.
22A	Pin, hinge.	18B	Trigger, operating lever.
22H	Plate, regulating.		
23A	Rack.		
16E	Ring, inner (obturator).		
16D	Ring, split, front (obturator).		
16C	Ring, split, rear (obturator).		

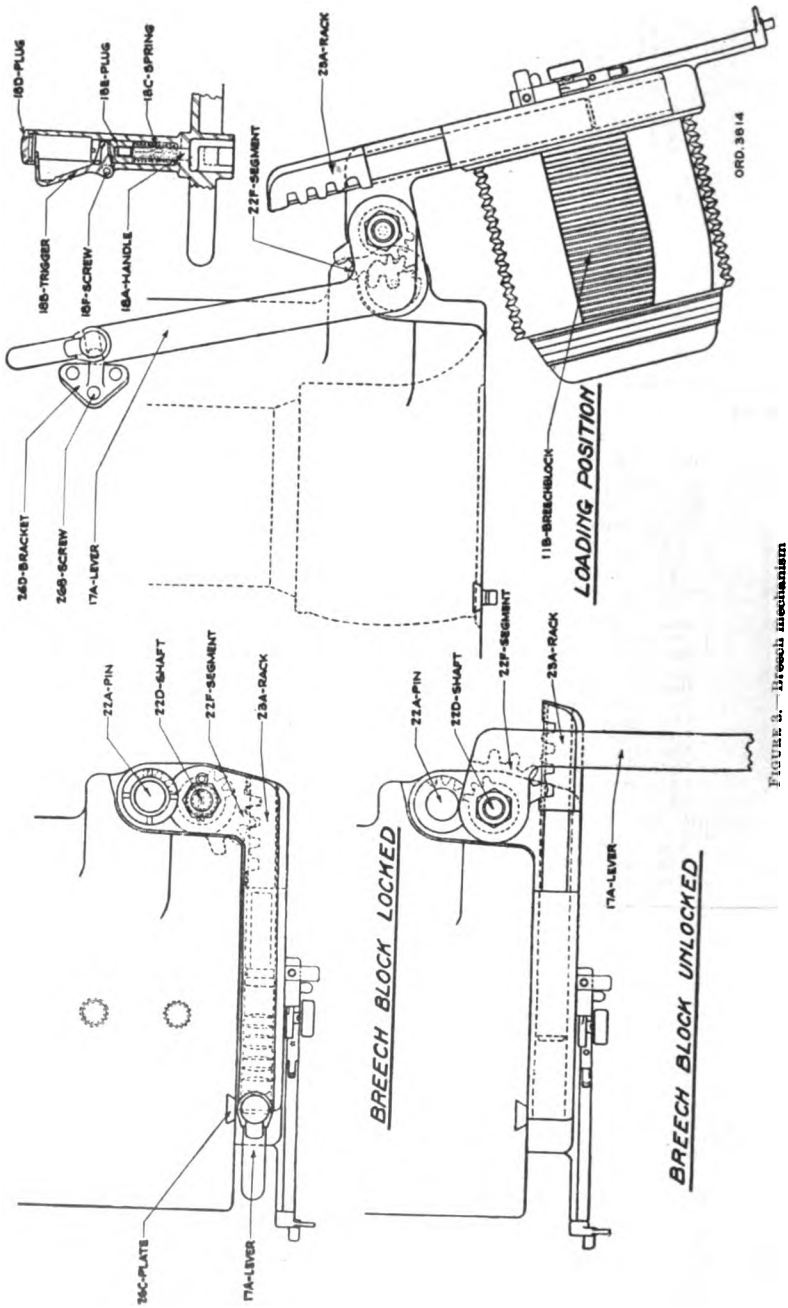


Figure 3. — Breech mechanism

240-MM HOWITZER MATÉRIEL, M1918 AND M1918A1

Reference	Item	Reference	Item
26D	Bracket, operating lever latch.	23A	Rack.
11B	Breechblock.	26B	Screw, operating lever latch bracket.
18A	Handle, operating lever.	18F	Screw, operating lever trigger.
17A	Lever, operating.	22F	Segment, rack.
22A	Pin, hinge.	22D	Shaft, operating lever.
26C	Plate, operating lever latch.	18C	Spring, operating lever handle.
18D	Plug, operating lever handle.	18B	Trigger, operating lever.
18E	Plug, operating lever handle spring.		

FIGURE 4.—Firing mechanism

Reference	Item	Reference	Item
C3554	Block, firing mechanism.	48E	Screw, firing mechanism block latch holder.
A12254	Collar, firing mechanism block handle.	24A	Screw, firing mechanism housing.
A325	Gasket, obturator spindle plug.	A12260	Screw, set, safety, ¼ by 7/32 inch (primer holder and firing pin housing).
A12256	Guide, firing pin.	24C	Seat, obturator spindle spring, rear.
A12255	Handle, firing mechanism block.	A12688	Shoe, firing mechanism.
48F	Handle, firing mechanism block latch.	15A	Spindle, obturator.
48D	Holder, firing mechanism block latch.	48C	Spring, firing mechanism block latch.
B8058	Holder, primer.	24M	Spring, firing mechanism housing key.
24F	Housing, firing mechanism.	24H	Spring, firing mechanism safety plunger.
A12257	Housing, firing pin.	A12261	Spring, firing pin.
24G	Key, firing mechanism housing.	24E	Spring, obturator spindle.
48A	Latch, firing mechanism block.	24L	Stud, firing mechanism housing key spring.
A12258	Pin, firing.		
B241	Plug, obturator spindle.		
24D	Plunger, safety, firing mechanism.		
24K	Rivet, firing mechanism housing key spring.		

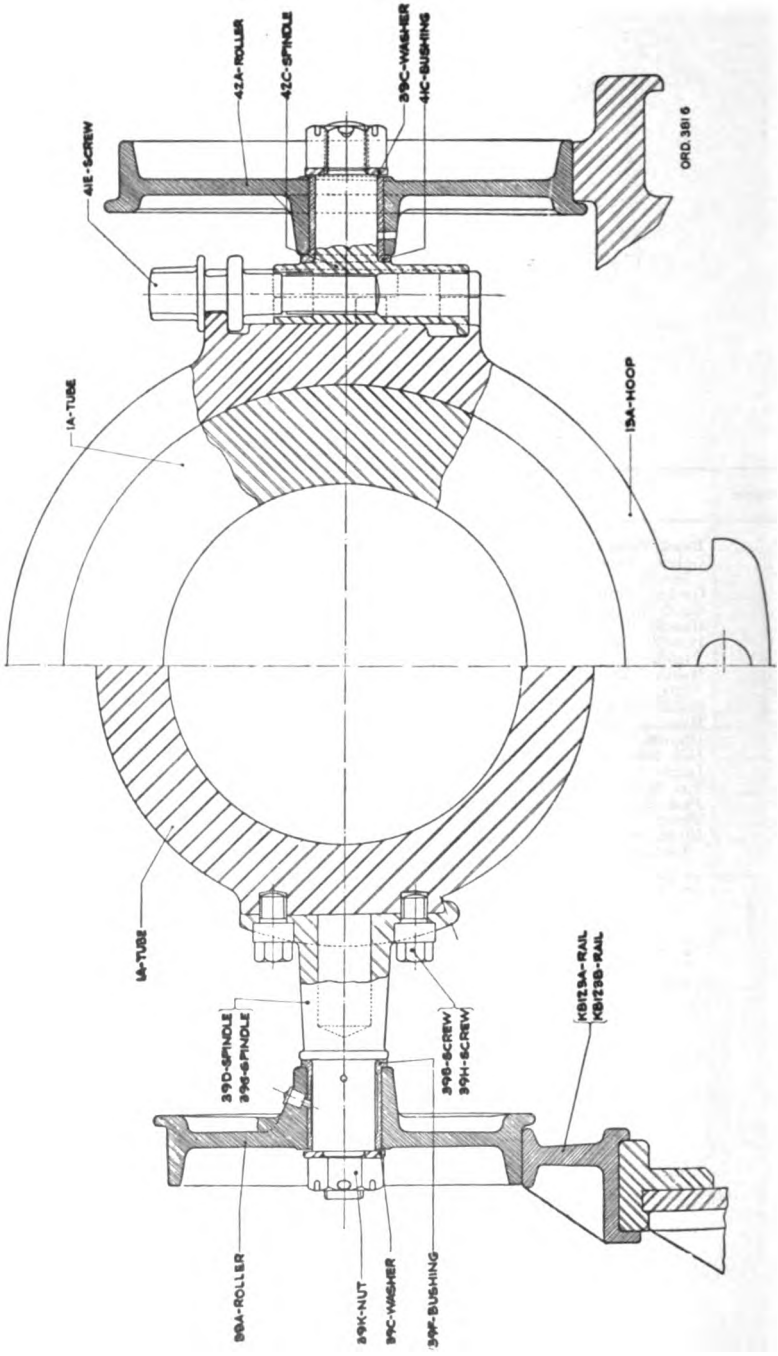


FIGURE 5.—Front and rear rollers

Reference	Item	Reference	Item
39F	Bushing, front roller.	39B	Screw, front roller fastening (1.636 inches over all).
41C	Bushing, rear detachable roller.	41E	Screw, rear detachable roller.
13A	Hoop.	39G	Spindle, front roller (for M1918, Nos. 1 to 182, inclusive).
39K	Nut, front roller.	39D	Spindle, front roller (for M1918MI, Nos. 183 to 330, inclusive).
KB123B	Rail, guide cover, L. H.	42C	Spindle, rear detachable roller.
KB123A	Rail, guide cover, R. H.	1A	Tube.
42A	Roller, detachable, rear.	39C	Washer, roller.
39A	Roller, front.		
39H	Screw, front roller fastening (1¾ inches over all).		

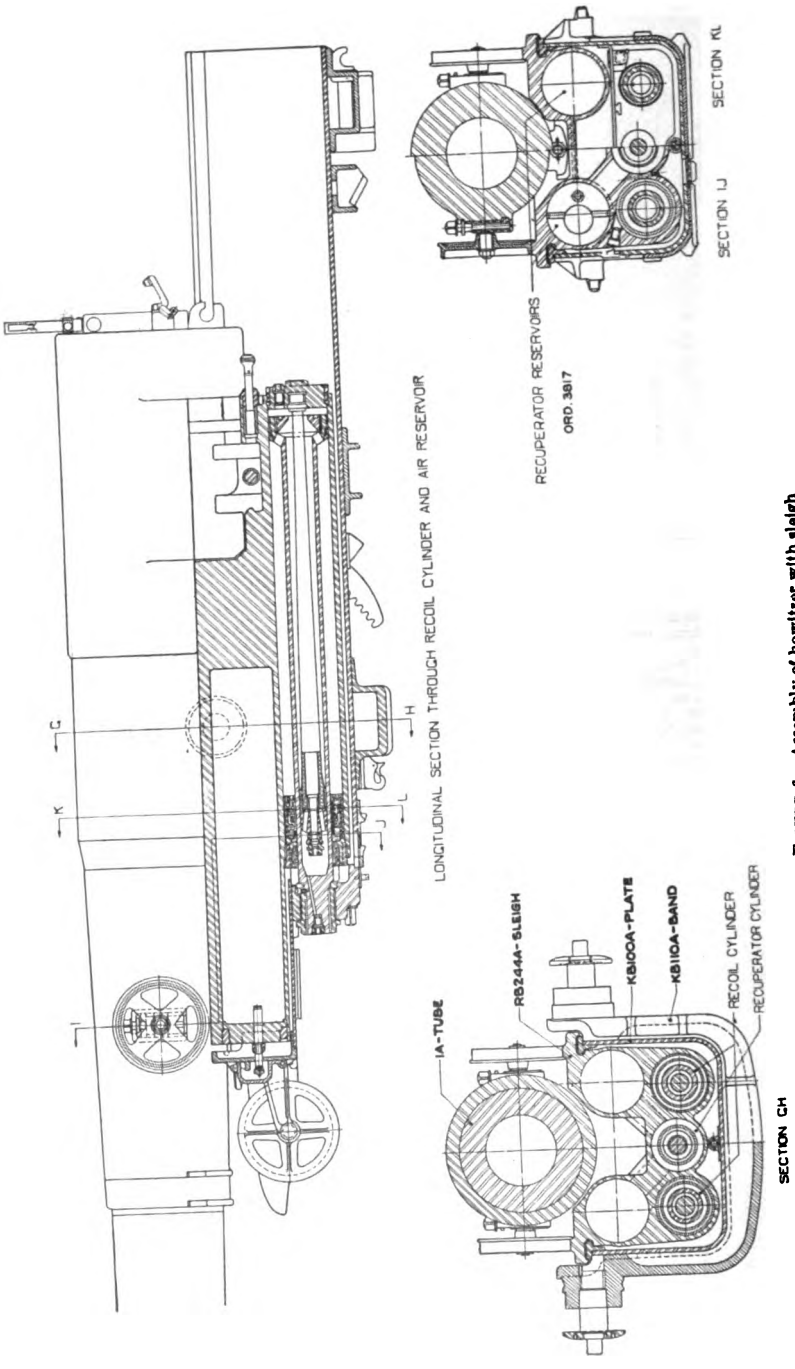


FIGURE 6.—Assembly of howitzer with sleigh

Reference	Item	Reference	Item
KB110A	Band, trunnion.	RB244A	Sleigh, recoil.
KB100A	Plate, cradle bottom.	1A	Tube.

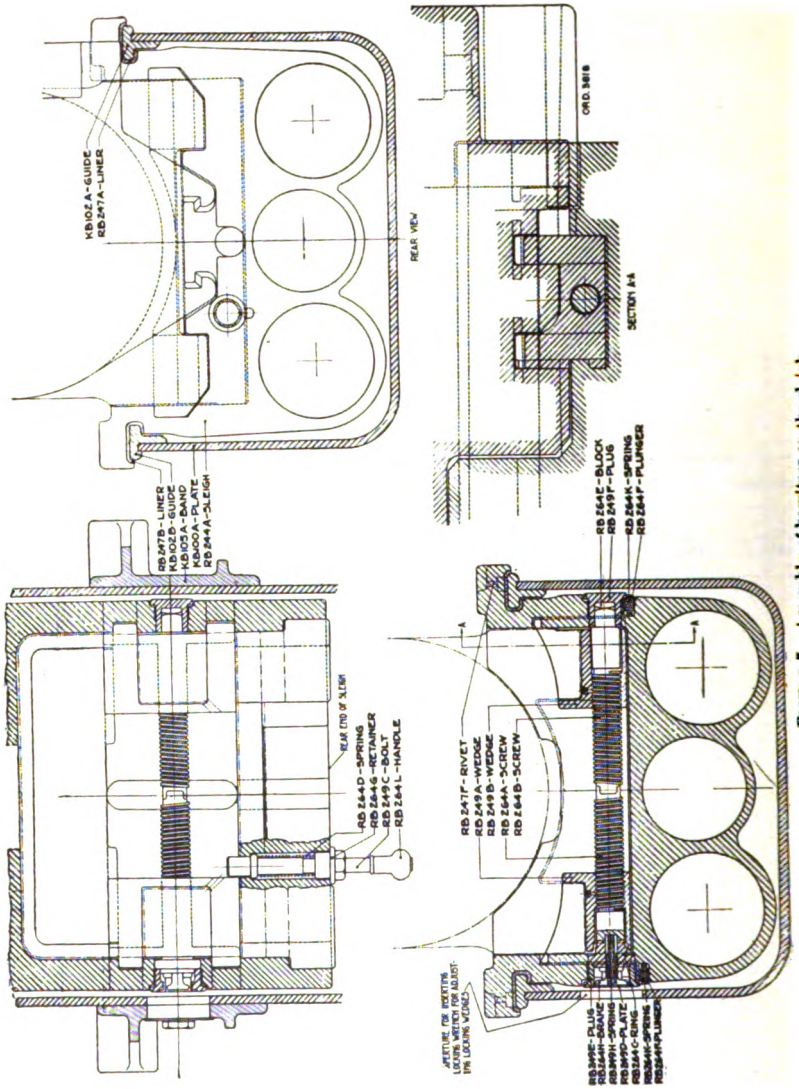


FIGURE 7.—Assembly of howitzer on the sleigh

Reference	Item	Reference	Item
KB105A	Band, intermediate cradle.	RB249F	Plug, abutment, wedge screw.
RB264E	Block, abutment, wedge screw.	RB264F	Plunger, spring.
RB249C	Bolt, locking.	RB264G	Retainer, locking bolt.
RB264H	Brake, wedge screw.	RB264C	Ring, releasing, left-hand screw.
KB102B	Guide, recoil slide, left.	RB247F	Rivet, thrust, sleigh liner.
KB102A	Guide, recoil slide, right.	RB264A	Screw, wedge, L. H.
RB264L	Handle, locking bolt.	RB264B	Screw, wedge, R. H.
RB247B	Liner, sleigh, L. H.	RB244A	Sleigh, recoil.
RB247A	Liner, sleigh, R. H.	RB264D	Spring, locking bolt.
KB100A	Plate, cradle bottom.	RB249H	Spring, locking wedge screw brake.
RB249D	Plate, securing, locking wedge screw brake.	RB264K	Spring, plunger.
		RB249A	Wedge, locking, left.
RB249E	Plug, abutment, releasing ring.	RB249B	Wedge, locking, right.

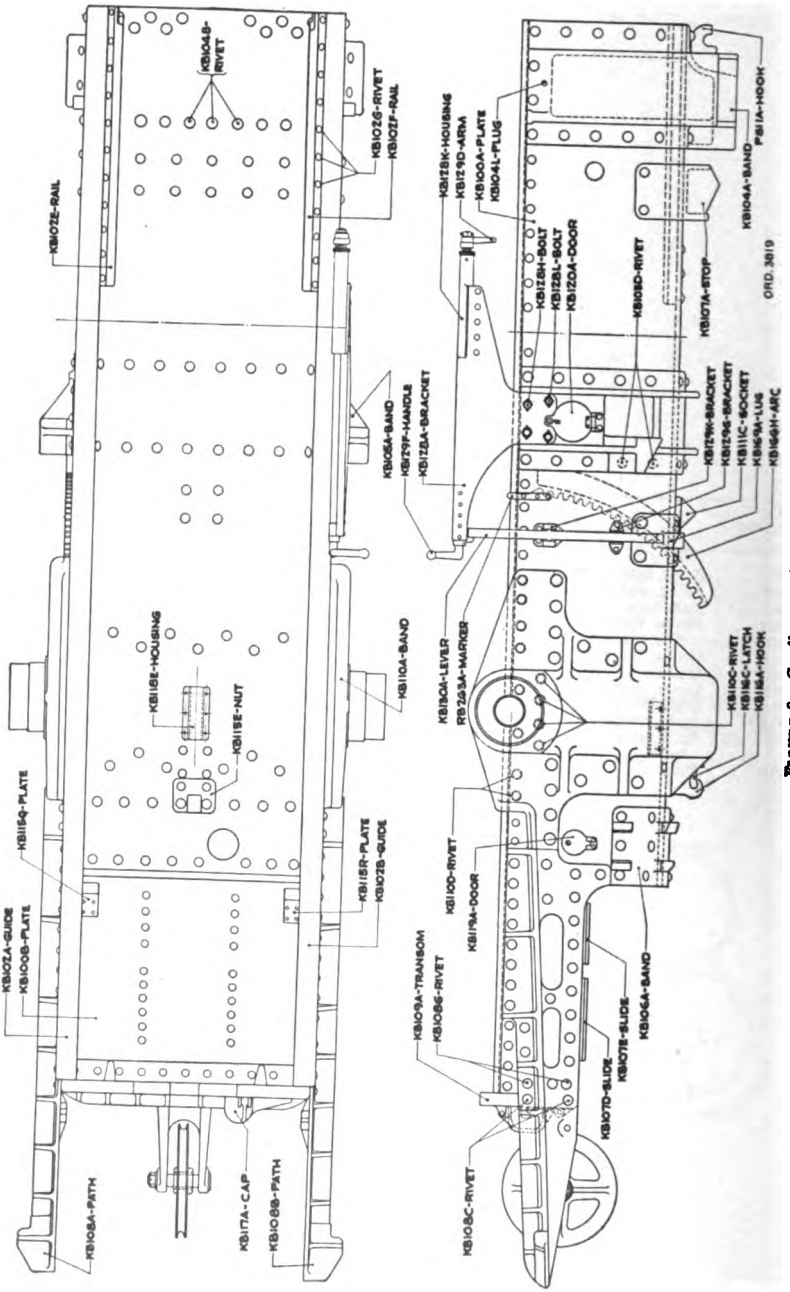


FIGURE 8.—Cradle assembly

Reference	Item	Reference	Item
KB166H	Arc, quick loading.	RB263A	Marker, recoil.
KB129D	Arm, firing rod.	KB115E	Nut, operating screw.
KB110A	Band, trunnion.	KB108B	Path, forward roller, L. H.
KB106A	Band, axletree.	KB108A	Path, forward roller, R. H.
KB105A	Band, intermediate cradle.	KB100A	Plate, cradle bottom.
KB104A	Band, rear cradle.	KB100B	Plate, lower front.
KB128H	Bolt, long, firing rod bracket.	KB115R	Plate, reinforce, lock bolt slot, L. H.
KB128L	Bolt, short, firing rod bracket.	KB115Q	Plate, reinforce, lock bolt slot, R. H
KB129K	Bracket, firing gear locking lever.	KB104L	Plug, cradle screw.
KB129G	Bracket, firing gear locking lever spring plunger.	KB102F	Rail, loading apparatus lower, L. H.
		KB102E	Rail, loading apparatus lower, R. H.
KB128A	Bracket, firing rod.	KB110D	Rivet, slide guide screw.
KB117A	Cap, indicator and gauge.	KB110C	Rivet, trunnion band screw.
KB120A	Door, locking wedge key.	KB105D	Rivet, screw, intermediate band.
KB119A	Door, filling plug opening.	KB102G	Rivet, screw, lower rail.
KB102B	Guide, recoil slide, left.	KB104B	Rivet, screw, rear band.
KB102A	Guide, recoil slide, right.	KB108G	Rivet, screw, roller path, 5/8 by 1.27 inches.
KB129F	Handle, firing.		
KB116A	Hook, cable.	KB108C	Rivet, screw, roller path, 5/8 by 1½ inches.
PS11A	Hook, coupling.		
KB128K	Housing, firing rod.	KB107D	Slide, piston rod beam, long.
KB118E	Housing, operating screw.	KB107E	Slide, piston rod beam, short.
KB116C	Latch, cable hook.	KB111C	Socket, plunger, elevating lock.
KB130A	Lever, locking, firing gear.	KB107A	Stop, cradle elevation.
KB169A	Lug, locking, quick loading mechanism.	KB109A	Transom, front.

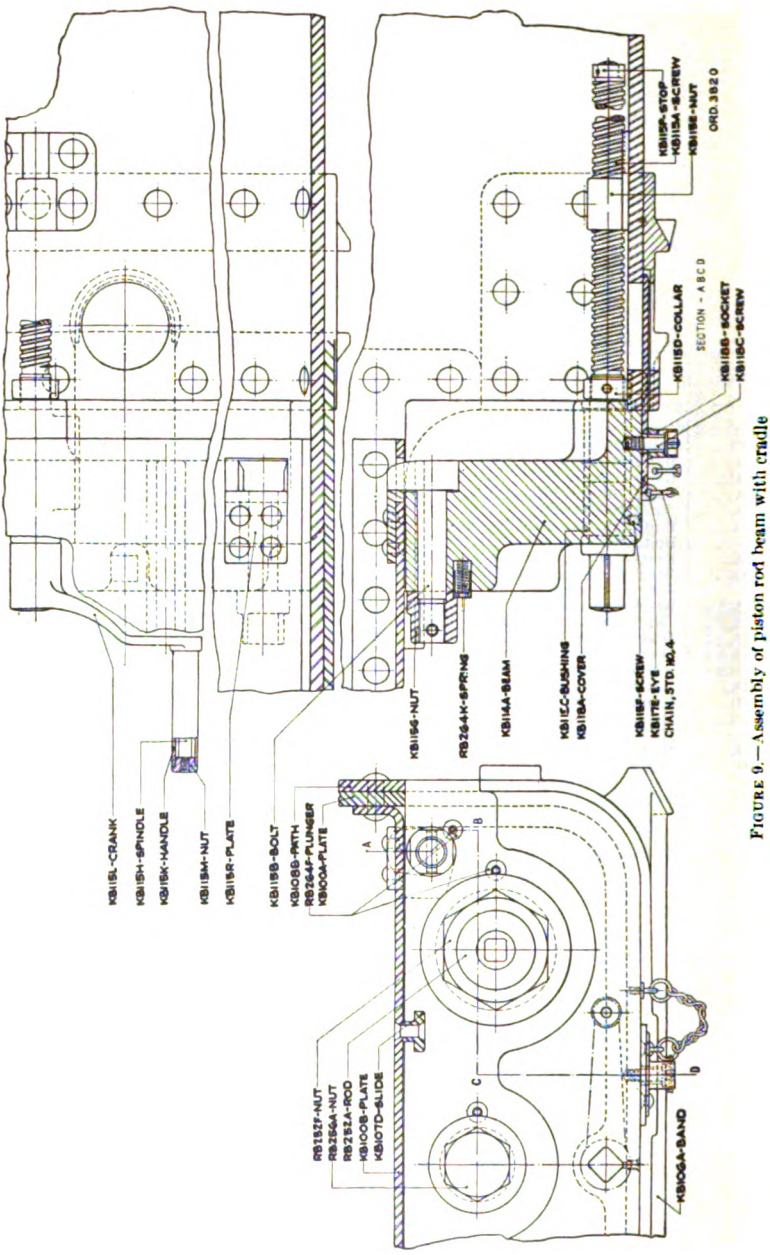


FIGURE 9.—Assembly of piston rod beam with cradle

Reference	Item	Reference	Item
KB106A	Band, axletree.	KB100A	Plate, cradle bottom.
KB114A	Beam, piston rod.	KB100B	Plate, lower front.
KB115B	Bolt, lock, piston rod beam.	KB115R	Plate, reinforce, lock bolt slot, R. H.
KB115C	Bushing, operating screw.	RB264F	Plunger, spring.
	Chain, standard, No. 4, assembly.	RB252A	Rod, recoil piston.
KB115D	Collar, operating screw.	KB115A	Screw, operating.
KB118A	Cover, filling port sliding.	KB115F	Screw, operating screw bushing.
KB115L	Crank, operating screw.	KB118C	Screw, securing, filling port sliding cover.
KB117E	Eye, locking pin chain.		
KB115K	Handle, operating screw crank.	KB107D	Slide, piston rod beam, long.
KB115M	Nut operating screw crank handle.	KB115H	Spindle, operating screw crank handle.
KB115E	Nut, operating screw.		
KB115G	Nut, piston rod beam lock bolt.	RB264K	Spring, plunger.
RB252F	Nut, recoil piston rod.	KB118B	Socket, filling port sliding cover securing screw.
RB256A	Nut, recuperator piston rod.		
KB108B	Path, forward roller, L. H.	KB115P	Stop, operating screw.

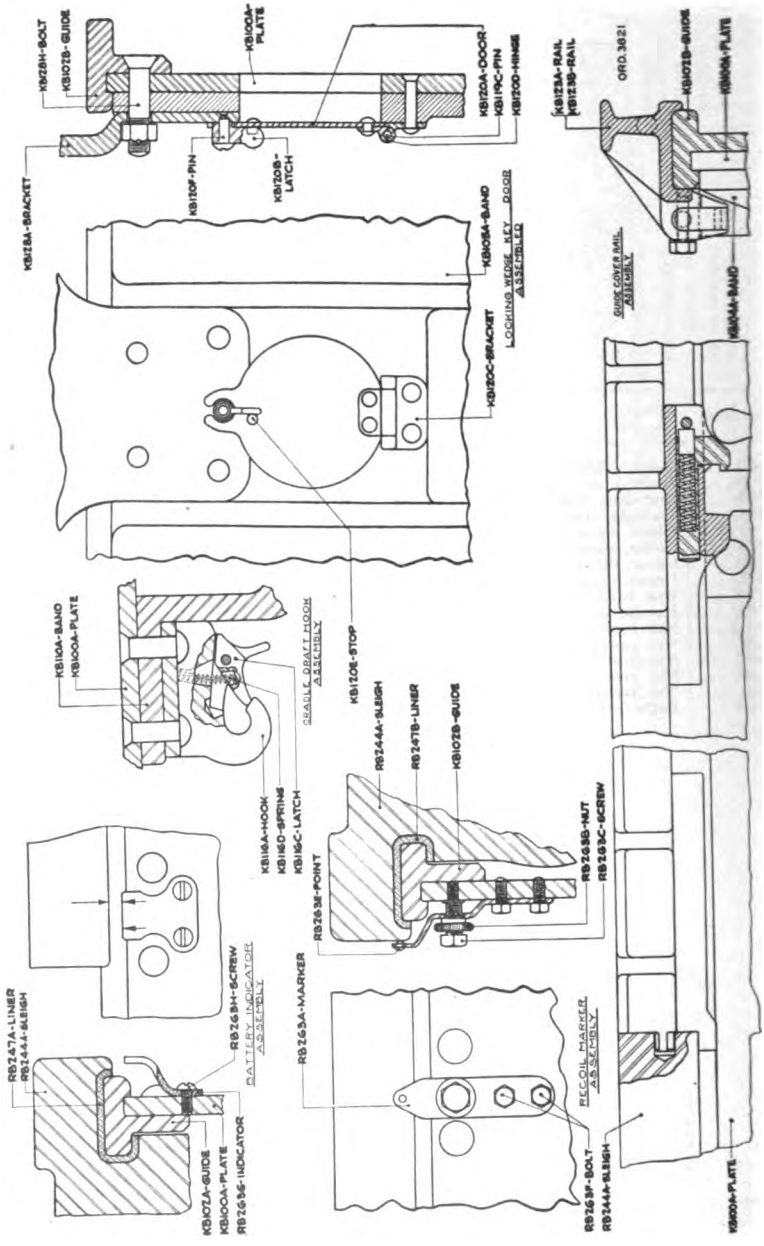


FIGURE 10.—Recoil and cradle sections

Reference	Item	Reference	Item
KB105A	Band, intermediate cradle.	RB247B	Liner, sleigh, L. H.
KB104A	Band, rear cradle.	RB247A	Liner, sleigh, R. H.
KB110A	Band, trunnion.	RB263A	Marker, recoil.
KB128H	Bolt, long, firing rod bracket.	RB263B	Nut, adjusting, marker.
RB263F	Bolt, marker.	KB120F	Pin, door latch.
KB128A	Bracket, firing rod.	KB119C	Pin, filling plug opening door hinge.
KB120C	Bracket, locking wedge key door hinge.	KB100A	Plate, cradle bottom.
		RB263E	Point, marker.
KB120A	Door, locking wedge key.	KB123B	Rail, guide cover, L. H.
KB102B	Guide, recoil slide, left.	KB123A	Rail, guide cover, R. H.
KB102A	Guide, recoil slide, right.	RB263C	Screw, adjusting, marker.
KB120D	Hinge, locking wedge key door.	RB263H	Screw, indicator.
KB116A	Hook, cable.	RB244A	Sleigh, recoil.
RB263G	Indicator, battery position.	KB116D	Spring, cable hook latch.
KB116C	Latch, cable hook.	KB120E	Stop, locking wedge key door latch.
KB120B	Latch, locking wedge key door.		

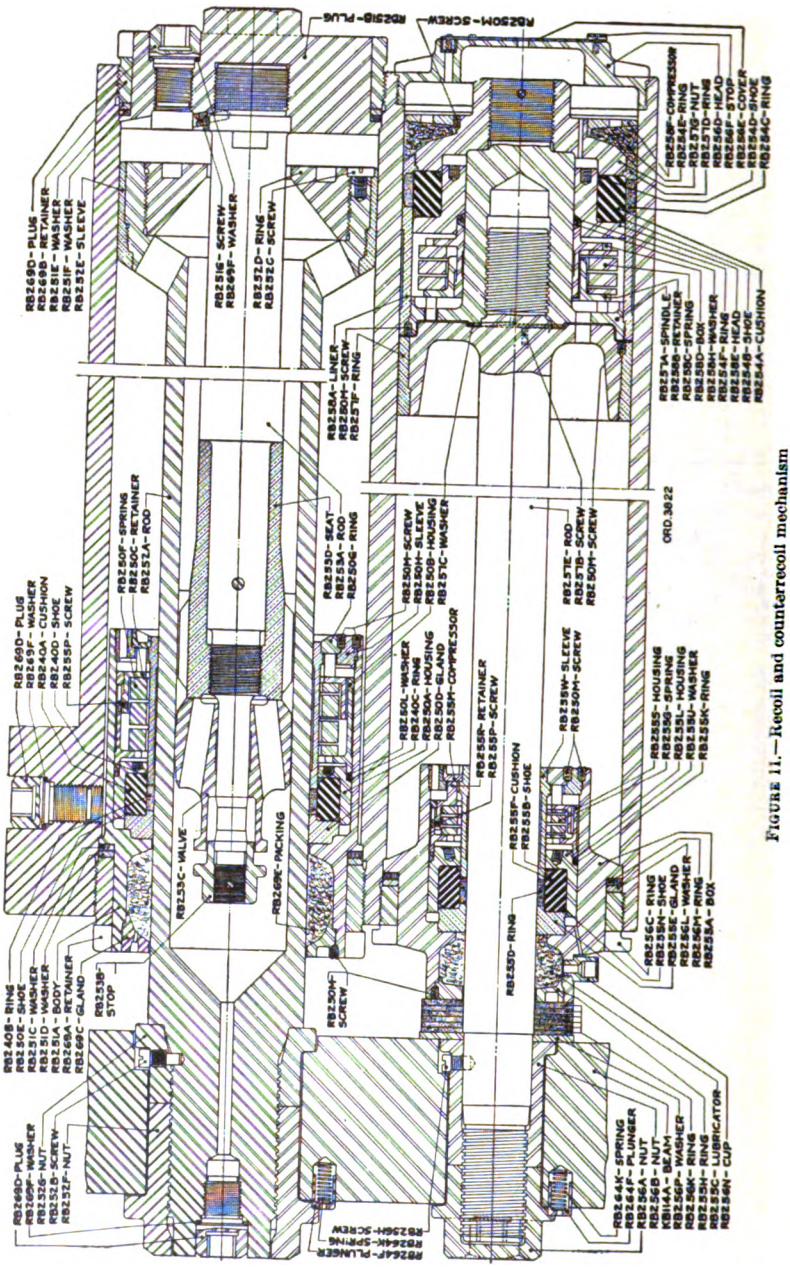


FIGURE 11.—Recoil and counterrecoil mechanism

Reference	Item
KB114A	Beam, piston rod.
RB251A	Body, recoil packing box.
RB255A	Box, packing, recuperator rod.
RB258D	Box, recuperator piston spring.
RB255M	Compressor, recuperator packing box spring.
RB258F	Compressor, recuperator piston spring.
RB256E	Cover, vent hole.
RB256N	Cup, oil.
RB240A	Cushion, recoil stuffing box.
RB255F	Cushion, recuperator packing box.
RB254A	Cushion, recuperator piston.
RB269C	Gland, packing, recoil packing box.
RB250D	Gland, recoil packing box, inner.
RB255E	Gland, recuperator packing box.
RB256D	Head, recuperator cylinder, rear.
RB258E	Head, sliding, recuperator.
RB250A	Housing, recoil packing box cushion.
RB250B	Housing, recoil stuffing box spring.
RB255L	Housing, recuperator packing box.
RB255S	Housing, recuperator packing box spring.
RB258A	Liner, recuperator piston.
RB255C	Lubricator, recuperator piston rod.
RB252G	Nut, lock, recoil piston rod.
RB256B	Nut, lock, recuperator piston rod.
RB252F	Nut, recoil piston rod.
RB257G	Nut, recuperator piston.
RB256A	Nut, recuperator piston rod.
RB269E	Packing, lubricating, recoil piston rod.
RB269D	Plug, filling.
RB251B	Plug, recoil cylinder, rear.
RB264F	Plunger, spring.
RB269B	Retainer, rear plug.
RB269A	Retainer, recoil packing box.
RB250C	Retainer, recoil packing box spring.
RB255R	Retainer, recuperator packing box spring.
RB258B	Retainer, recuperator piston spring.
RB254C	Ring, recuperator piston packing, outer.
RB257D	Ring, recuperator piston nut.
RB254E	Ring, lubricating, recuperator piston.
RB240B	Ring, packing, recoil packing box, inner.
RB240C	Ring, packing, recoil packing box, outer.
RB255D	Ring, packing, recuperator packing box, inner.
RB256M	Ring, packing, recuperator packing box, large.
RB255K	Ring, packing, recuperator packing box, outer.
RB254F	Ring, packing, recuperator piston, inner.
RB250G	Ring, pressure, recoil packing.
RB256K	Ring, recuperator buffer.
RB255H	Ring, recuperator packing box lubricator.
RB257F	Ring, recuperator piston.
RB256C	Ring, retaining, recuperator packing box, front end.
RB252D	Ring, throttling, recoil piston rod.
RB252A	Rod, recoil piston.
RB257E	Rod, recuperator piston.
RB253A	Rod, throttling, recoil.
RB250M	Screw, lock.
RB252C	Screw, lock, recoil piston rod throttling ring.
RB255P	Screw, lock, spring retainer.
RB257B	Screw, recuperator piston.
RB256H	Screw, securing, recuperator rod.
RB251G	Screw, securing, throttling rod.
RB252B	Screw, set, recoil piston rod lock nut.
RB253D	Seat, recoil throttling rod valve.
RB240D	Shoe, recoil stuffing box cushion, inner.
RB250E	Shoe, recoil stuffing box cushion, outer.
RB254D	Shoe, recuperator piston cushion, inner.
RB254B	Shoe, recuperator piston cushion, outer.
RB255B	Shoe, recuperator stuffing box cushion, inner.
RB255N	Shoe, recuperator stuffing box cushion, outer.
RB252E	Sleeve, recoil piston rod.
RB250H	Sleeve, recoil packing box.
RB255W	Sleeve, recuperator packing box, rear.
RB257A	Spindle, recuperator piston.
RB264K	Spring, plunger.
RB250F	Spring, packing, recoil packing box.
RB255G	Spring, packing, recuperator packing box.
RB258C	Spring, recuperator piston.
RB253B	Stop, recoil throttling rod valve.
RB256F	Stop, vent hole cover.
RB253C	Valve, return, recoil throttling rod.
RB269F	Washer, filling plug.
RB257C	Washer, locking, recuperator piston rod.
RB256L	Washer, packing, recuperator packing box, outer.
RB255U	Washer, packing, recuperator stuffing box, inner.
RB251E	Washer, rear plug, bronze.
RB251F	Washer, rear plug, dermatine.
RB251D	Washer, recoil packing box, bronze.
RB251C	Washer, recoil packing box, dermatine.
RB250L	Washer, recoil stuffing box packing.
RB256P	Washer, recuperator buffer.
RB258H	Washer, recuperator piston packing.

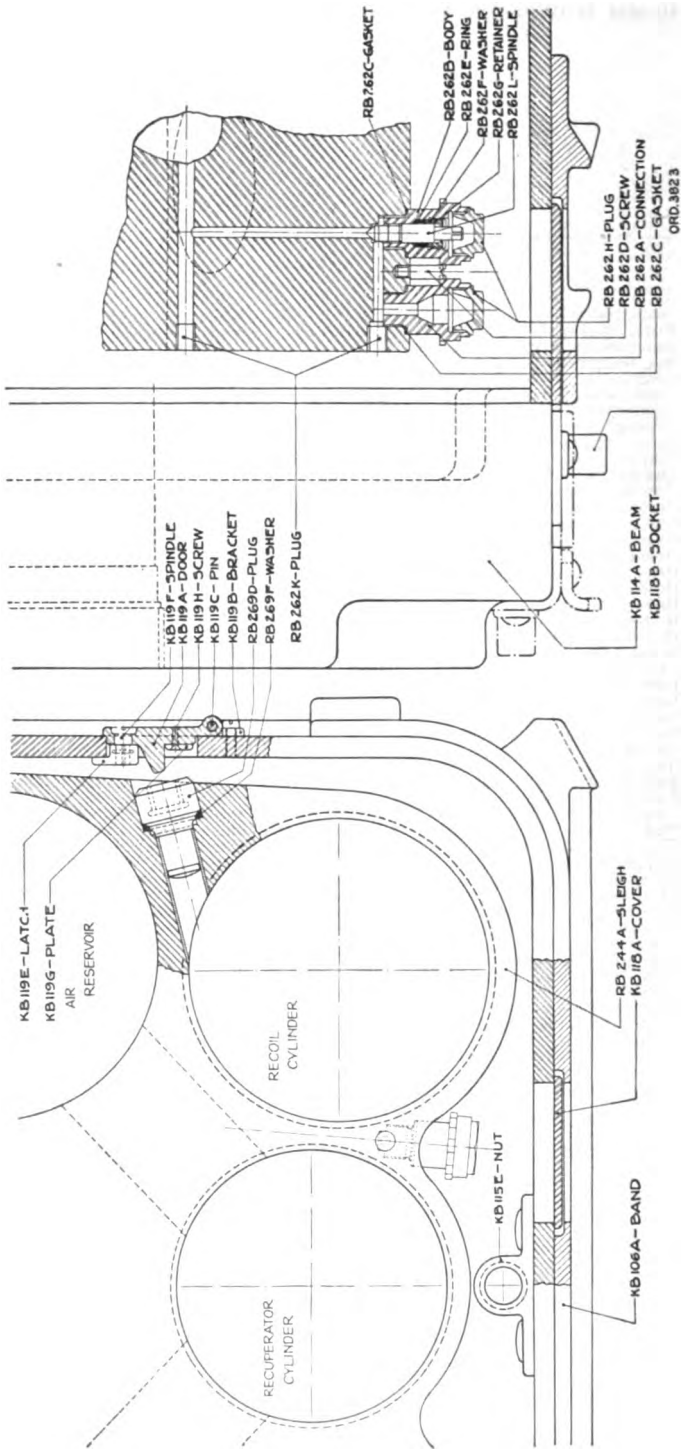


FIGURE 12.—Filling valve and plug

Reference	Item	Reference	Item
KB106A	Band, axletree.	RB269D	Plug, filling.
KB114A	Beam, piston rod.	RB262H	Plug, nozzle connection.
RB262B	Body, valve.	RB262G	Retainer, filling valve.
KB119B	Bracket, filling plug opening door hinge.	RB262E	Ring, packing, filling valve.
RB262A	Connection, nozzle.	RB262D	Screw, lock, filling valve.
KB118A	Cover, filling port sliding.	KB119H	Screw, securing, instruction plate.
KB119A	Door, filling plug opening.	RB244A	Sleigh, recoil.
RB262C	Gasket, filling valve.	KB118B	Socket, filling port sliding cover securing screw.
KB119E	Latch, filling plug opening door.	KB119F	Spindle, filling plug opening door latch.
KB115E	Nut, operating screw.	RB262L	Spindle, filling valve.
KB119C	Pin, filling plug opening door hinge.	RB269F	Washer, filling plug.
KB119G	Plate, instruction (filling plug opening door).	RB262F	Washer, packing, filling valve.
RB262K	Plug, filling hole.		

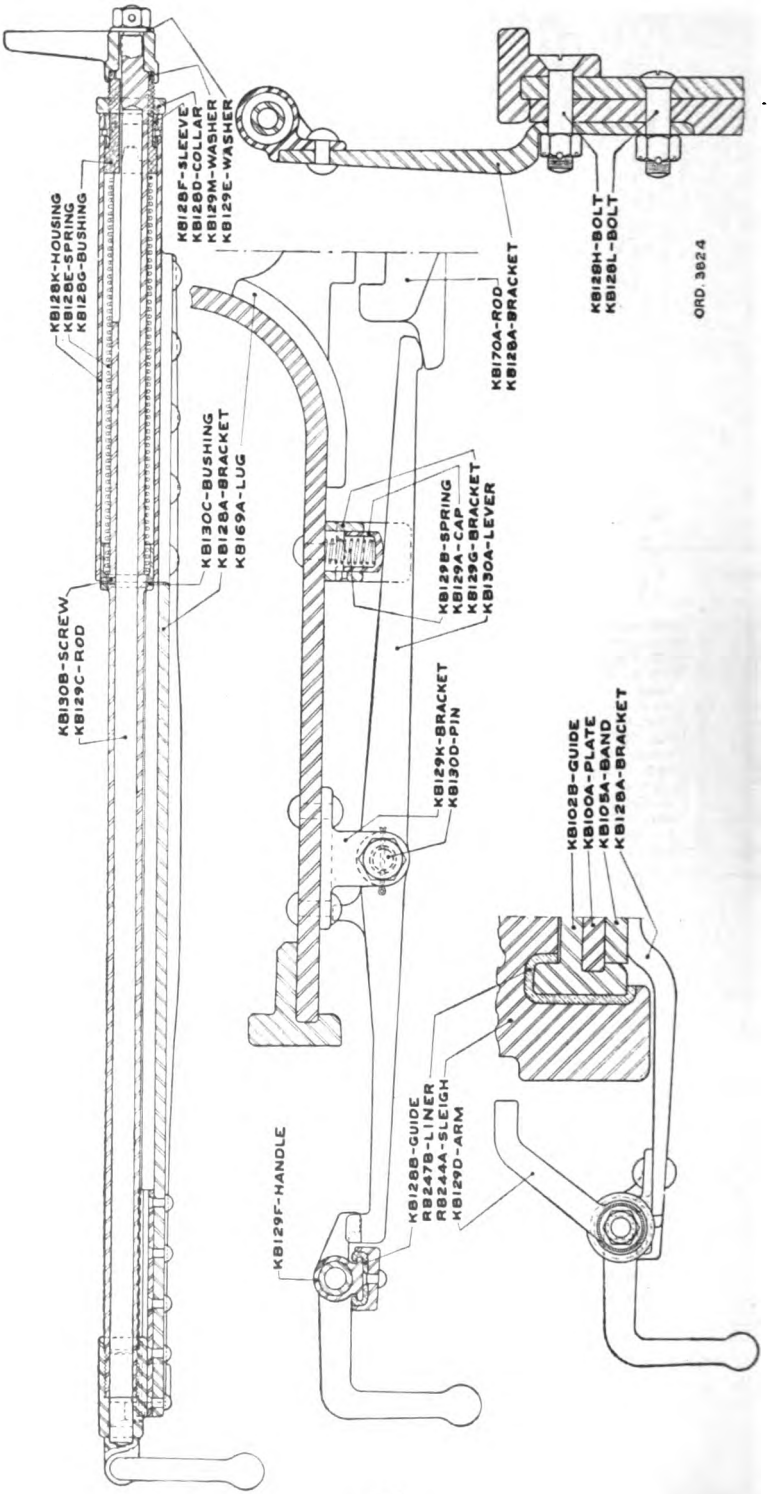


FIGURE 13.—Firing gear assembly

Reference	Item	Reference	Item
KB129D	Arm, firing rod.	KB130A	Lever, locking, firing gear.
KB105A	Band, intermediate cradle.	RB247B	Liner, sleigh, L. H.
KB128H	Bolt, long, firing rod bracket.	KB169A	Lug, locking, quick loading mechanism.
KB128L	Bolt, short, firing rod bracket.	KB130D	Pin, firing gear hinge.
KB129K	Bracket, firing gear locking lever.	KB100A	Plate, cradle bottom.
KB129G	Bracket, firing gear locking spring plunger.	KB129C	Rod, firing.
KB128A	Bracket, firing rod.	KB170A	Rod, lock, left.
KB128G	Bushing, firing gear clutch.	KB130B	Screw, locking, firing rod spring retaining bushing.
KB130C	Bushing, retaining, firing rod spring.	KB128F	Sleeve, clutch, firing gear.
KB129A	Cap, firing gear locking lever plunger.	RB244A	Sleigh, recoil.
KB128D	Collar, screw, firing gear.	KB129B	Spring, firing gear locking lever plunger.
KB102B	Guide, recoil slide, left.	KB128E	Spring, firing rod.
KB128B	Guide, firing rod handle.	KB129E	Washer, firing rod.
KB129F	Handle, firing.	KB129M	Washer, firing rod arm.
KB128K	Housing, firing rod.		

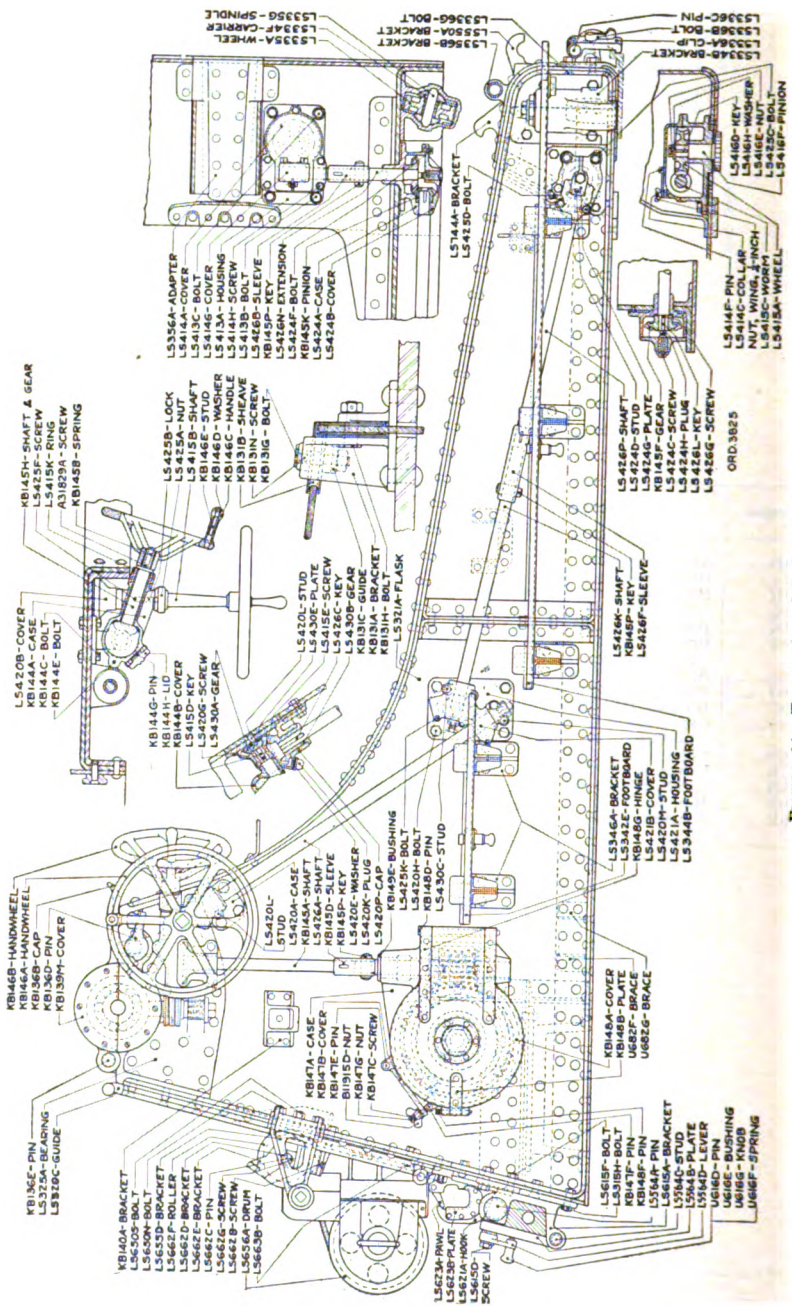


FIGURE 14.—Top carriage, left elevation

240-MM HOWITZER MATÉRIEL, M1918 AND M1918A1

Reference	Item
LS356A	Adapter.
LS325A	Bearing, trunnion, L. H.
LS615F	Bolt, countersunk head.
LS650S	Bolt, outer support bracket, long.
LS650N	Bolt, outer support bracket, short.
KB144C	Bolt, elevating and traversing gear case.
KB131H	Bolt, firing mechanism bracket sheave.
KB131G	Bolt, lanyard guide.
LS336B	Bolt, rear clip locking.
LS425C	Bolt, lower gear case, long.
LS425D	Bolt, lower gear case, short.
LS425K	Bolt, middle traversing gear housing cover.
LS336G	Bolt, rear clip.
LS663B	Bolt, roller bracket guide extension.
KB144E	Bolt, securing, elevating and traversing gear case cover.
LS315H	Bolt, cap, forged steel No. 3, ⅞ by 2¼ inches.
LS424F	Bolt, tap, lower traversing gear case cover.
LS413B	Bolt, traversing worm case.
LS413C	Bolt, traversing worm case.
LS420H	Bolt, upper gear case.
U682F	Brace, shot car support, L. H.
U682G	Brace, shot car support, R. H.
LS334B	Bracket, mount roller, L. H.
LS615A	Bracket, axle.
LS346A	Bracket, detachable footboard hinge.
LS550A	Bracket, false trail lock.
KB131A	Bracket, firing mechanism.
KB140A	Bracket, oil and air pump.
LS655D	Bracket, outboard, L. H.
LS744A	Bracket, rammer car lock support, upper.
LS662E	Bracket, roller, L. H.
LS662D	Bracket, roller, R. H.
LS356B	Bracket, suspension, rear end.
LS662A	Bushing, howitzer carriage mounting roller.
U616E	Bushing, locking pin.
KB149E	Bushing, worm shaft bearing, upper.
LS420P	Cap, case, upper traversing gear.
KB136B	Cap, trunnion bearing, L. H.
LS334F	Carrier, wheel.
KB144A	Case, elevating and traversing gear.
KB147A	Case, elevating worm gear.
LS424A	Case, traversing gear, lower.
LS420A	Case, traversing gear, upper.
LS336A	Clip, rear, R. H.
LS414C	Collar, eyebolt.
LS420B	Cover, bevel gear.
KB148A	Cover, elevating gear case, left side.
KB144B	Cover, elevating and traversing gear case.
KB147B	Cover, handhole.
LS421B	Cover, middle traversing gear housing.
LS424B	Cover, traversing gear case, lower.
LS414A	Cover, traversing worm wheel case.
LS414G	Cover, traversing worm wheel grease hole.
KB139M	Cover, trunnion bearing half.
LS656A	Drum, rope.
LS426N	Extension, traversing worm shaft, outer end.
LS321A	Flask, top carriage, L. H.
LS342E	Footboard, gunners movable.
LS344B	Footboard, rear detachable, left.
LS430A	Gear, handwheel shaft traversing.
KB145F	Gear, traversing (lower).
LS430B	Gear, traversing, vertical.
KB131C	Guide, lanyard.
LS520C	Guide, roller bracket, L. H.
KB146C	Handle.
KB146B	Handwheel, elevating.
KB146A	Handwheel, traversing.
KB148G	Hinge, elevating gear case cover.
LS621A	Hook, draft, on front of mount.
LS421A	Housing, traversing gear, middle.
LS413A	Housing, worm and worm wheel.
LS426L	Key, bevel gear, 12 1/32 inches long.
LS426C	Key, bevel gear, 3 1/16 inches long.
KB145P	Key, sleeve.
LS415D	Key, traversing handwheel shaft upper pinion.
LS416D	Key, traversing pinion.
U616G	Knob, locking pin.
LS564D	Lever, binding stud.
LS425B	Lock, traversing handwheel shaft nut.
KB147G	Nut, lock.
LS416E	Nut, lock, traversing pinion.
LS425A	Nut, traversing handwheel shaft.
	Nut, wing, ¼ inch.
B11915D	Nut, wing, ½ inch.
LS623A	Pawl, draft hook.
LS564A	Pin, binding stud.
KB147F	Pin, handhole cover locking screw.
KB148D	Pin, elevating gear case cover hinge.
KB147E	Pin, hinge, handhole cover.
LS662C	Pin, howitzer carriage mounting roller.
KB148F	Pin, lock elevating gear case cover.
U616D	Pin, locking.
KB136D	Pin, locking, trunnion bearing cap, L. H.
LS336C	Pin, rear clip hinge.
LS414F	Pin, traversing worm wheel case cover hinge.
KB136E	Pin, trunnion bearing cap hinge.
KB145K	Pinion, traversing gear, lower.
LS416F	Pinion, traversing.
KB148B	Plate, lock, elevating gear case cover.
LS564B	Plate, locking, top carriage.
LS424G	Plate, locking, traversing gear thrust screw.
LS623B	Plate, rubbing, draft hook.
LS430E	Plate, thrust, handwheel shaft traversing gear.
LS420K	Plug, grease.
LS424H	Plug, thrust, traversing gear.
LS415K	Ring, clamping, elevating shaft.
LS662F	Roller, howitzer carriage mounting.
LS426G	Screw, bevel gear key.
LS420G	Screw, gear thrust plate.
KB131N	Screw, lanyard guide.
LS662G	Screw, lock, roller pin.
LS615D	Screw, locking.
KB147C	Screw, locking, handhole cover.
LS662B	Screw, roller bracket.
LS425F	Screw, securing, traversing handwheel shaft nut lock.
LS415E	Screw, securing, traversing handwheel shaft upper pinion key.
BCTX1AB	Screw, set, hdls., cup pt., ¼-20-NC-3 by ⅝ inch.
LS424C	Screw, thrust, traversing gear.
LS414H	Screw, traversing worm wheel case cover.
KB145A	Shaft, elevating, and bevel gear (vertical).
KB145H	Shaft, elevating handwheel, and bevel gear.
LS415B	Shaft, traversing handwheel.
LS426K	Shaft, traversing, lower, forward end.
LS426P	Shaft, traversing, lower, rear end.
LS426A	Shaft, traversing, upper.
KB131B	Sheave, firing mechanism bracket.
LS426F	Sleeve, lower traversing shaft.
LS426B	Sleeve, traversing worm shaft extension.
KB145D	Sleeve, vertical shaft.
LS335G	Spindle, traversing roller wheel.
U616F	Spring, lock pin.

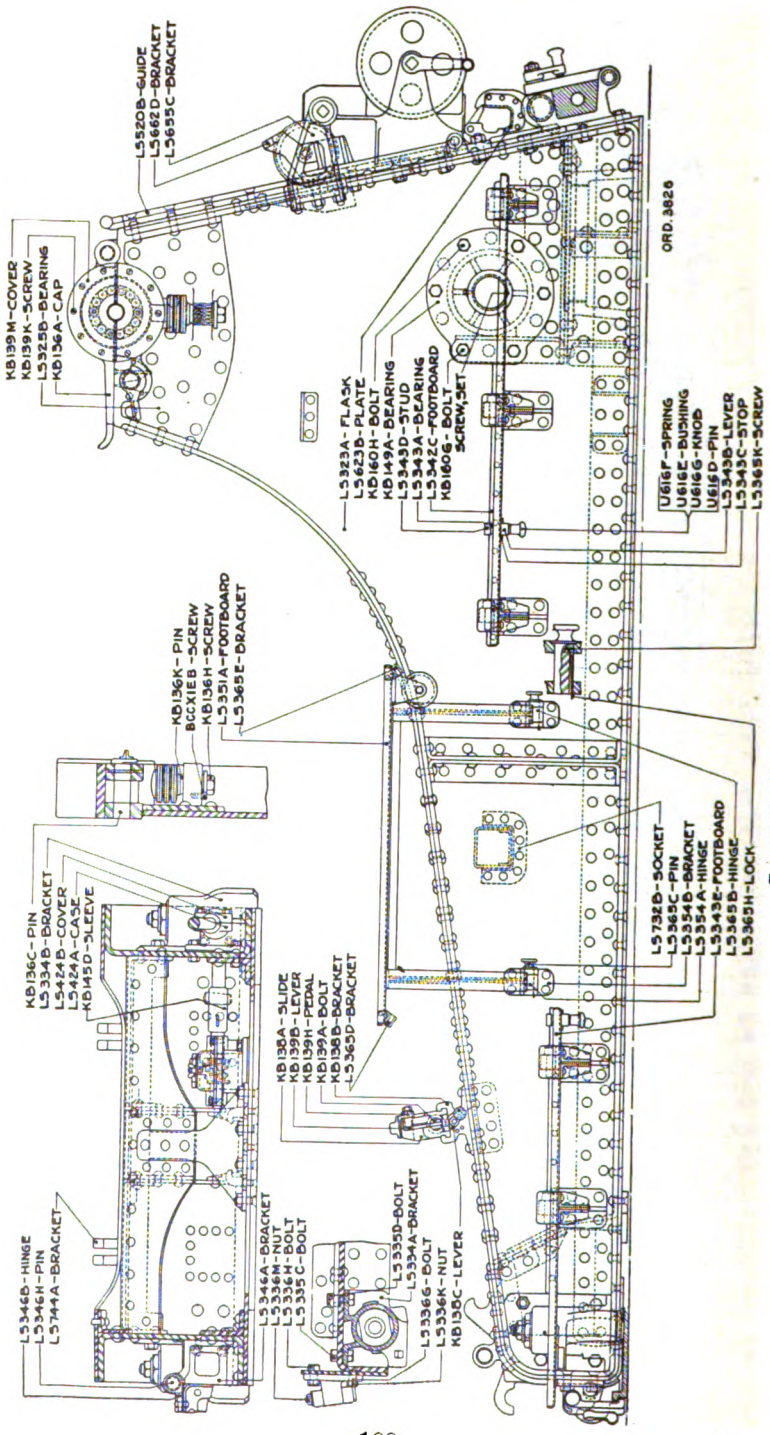


FIGURE 15.—Top carriage, right elevation

FIGURE 14—Continued

Reference	Item	Reference	Item
KB145B	Spring, securing, handwheel.	LS420L	Stud, upper traversing gear case.
KB146E	Stud, handle.	LS420E	Washer, grease plug.
LS564C	Stud, locking plate.	KB146D	Washer, handle stud.
LS420M	Stud, middle traversing gear housing, short.	LS416H	Washer, traversing pinion.
LS430C	Stud, traversing gear.	LS335A	Wheel, traversing roller.
LS424D	Stud, traversing gear thrust screw locking plate.	LS415A	Wheel, worm, traversing.
		LS415C	Worm, traversing.

Reference	Item	Reference	Item
KB149A	Bearing, elevating pinion shaft.	LS354A	Hinge, breech operator's footboard rear support.
LS343A	Bearing, lock stud.	LS346B	Hinge, detachable footboard.
LS325B	Bearing, trunnion, R. H.	U616G	Knob, locking pin.
KB139A	Bolt, cradle locking.	KB138C	Lever, cradle locking.
LS335D	Bolt, mount roller bracket, long.	LS343B	Lever, footboard locking.
LS335C	Bolt, mount roller bracket, short.	KB139B	Lever, cradle locking bolt operating.
LS336G	Bolt, rear clip.	LS365H	Lock, breech operator's footboard hinge pin.
LS336H	Bolt, rear clip bracket.	LS336K	Nut, rear clip bolt.
KB160H	Bolt, worm wheel case, ⅞ by 2 1⅝₁₆ inches.	LS336M	Nut, rear clip hinge pin.
KB160G	Bolt, worm wheel case, ⅞ by 3⅛ inches.	KB139H	Pedal, locking device.
LS365E	Bracket, breech operator's footboard corner, L. H.	LS365C	Pin, breech operator's footboard hinge.
LS365D	Bracket, breech operator's footboard corner, R. H.	KB136K	Pin, center, trunnion bearing spring.
KB138B	Bracket, cradle locking device.	LS346H	Pin, footboard bracket hinge.
LS346A	Bracket, detachable footboard hinge.	U616D	Pin, locking.
LS354B	Bracket, hinge, breech operator's footboard.	KB136C	Pin, locking, trunnion bearing cap, R. H.
LS334B	Bracket, mount roller, L. H.	LS623B	Plate, rubbing, draft hook.
LS334A	Bracket, mount roller, R. H.	KB136H	Screw, adjusting, roller race.
LS655C	Bracket, outboard, R. H.	LS365K	Screw, breech operator's footboard hinge pin lock.
LS744A	Bracket, rammer car lock support, upper.	BCCX1EB	Screw, cap, fil-hd., ½-13-NC-2 by 1 inch.
LS662D	Bracket, roller, R. H.	----------	Screw, set, headless, round point, 5/16 by 7/16 inch.
U616E	Bushing, locking pin.	KB139K	Screw, trunnion bearing half cover (short).
KB136A	Cap, trunnion bearing, R. H.	KB145D	Sleeve, vertical shaft.
LS424A	Case, traversing gear, lower.	KB138A	Slide, cradle locking bolt.
KB139M	Cover, trunnion bearing half.	LS732B	Socket, loading platform rear support.
LS424B	Cover, traversing gear case, lower.	U616F	Spring, lock pin.
LS323A	Flask, top carriage, R. H.	LS343C	Stop, locking lever.
LS351A	Footboard, breech operator's.	LS343D	Stud, locking.
LS342C	Footboard, forward movable, right.		
LS343E	Footboard, rear detachable, right.		
LS520B	Guide, roller bracket, R. H.		
LS365B	Hinge, breech operator's footboard front support.		

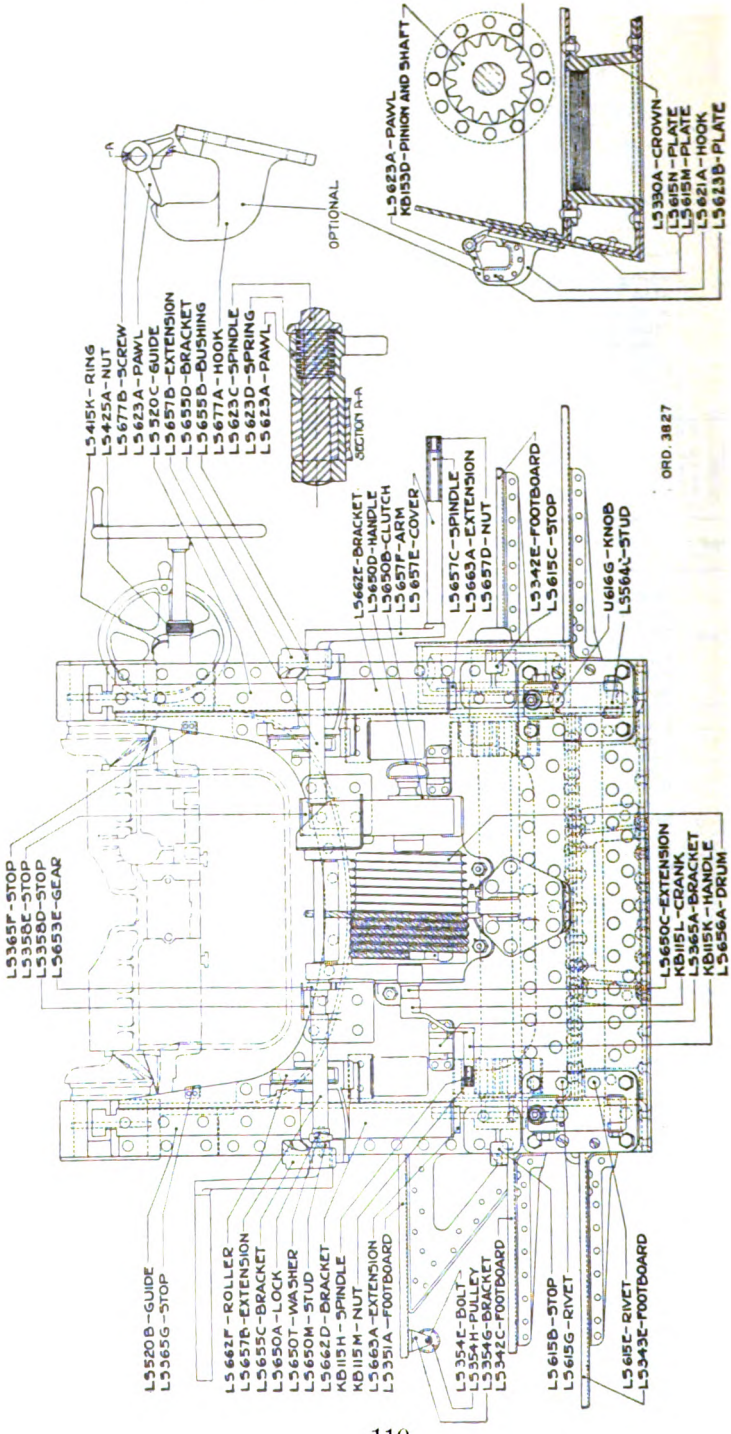


FIGURE 16.—Top carriage, front view

Reference	Item
LS657F	Arm, crank.
LS354E	Bolt, guide pulley bracket.
LS354G	Bracket, guide pulley.
LS365A	Bracket, hinge, on front of mount.
LS655D	Bracket, outboard, L. H.
LS655C	Bracket, outboard, R. H.
LS662E	Bracket, roller, L. H.
LS662D	Bracket, roller, R. H.
LS655B	Bushing, outboard bracket.
LS650B	Clutch, drum shaft.
LS657E	Cover, crank spindle.
LS330A	Crown, pintle.
KB115L	Crank, operating screw.
LS656A	Drum, rope.
LS650C	Extension, drum shaft.
LS657B	Extension, horizontal shaft.
LS663A	Extension, roller bracket drive.
LS351A	Footboard, breech operator's.
LS342C	Footboard, forward movable, right.
LS342E	Footboard, gunner's movable.
LS343E	Footboard, rear detachable, right.
LS653E	Gear, ratchet, horizontal, windlass.
LS520C	Guide, roller bracker, L. H.
LS520B	Guide, roller bracket, R. H.
LS650D	Handle, drum shaft clutch.
KB115K	Handle, operating screw crank.
LS621A	Hook, draft, on front of mount.
LS677A	Hook, draft, on front of mount.
U616G	Knob, locking pin.
LS650A	Lock, windlass shaft.
KB115M	Nut, operating screw crank handle.
LS425A	Nut, traversing handwheel shaft.
LS657D	Nut, crank, spindle.
LS623A	Pawl, draft hook.
KB153D	Pinion and shaft, elevating arc.
LS623B	Plate, rubbing, draft hook.
LS615N	Plate, stiffener, L. H.
LS615M	Plate, stiffener, R. H.
LS354H	Pulley, guide.
LS415K	Ring, clamping, elevating shaft.
LS615G	Rivet, screw, ⅞ by 1 9/16 inches.
LS615E	Rivet, screw, ⅞ by 1 7/8 inches.
LS662F	Roller, howitzer carriage.
LS677B	Screw, draft hook.
LS657C	Spindle, crank.
LS623C	Spindle, draft hook pawl.
KB115H	Spindle, operating screw crank handle.
LS623D	Spring, coil, draft hook.
LS615C	Stop, brake fulcrum, L. H.
LS615B	Stop, brake fulcrum, R. H.
LS358E	Stop, cradle, for 1° depression, L. H.
LS358D	Stop, cradle, for 1° depression, R. H.
LS365G	Stop, footboard, L. H.
LS365F	Stop, footboard, R. H.
LS650M	Stud, windlass crank shaft lock.
LS564C	Stud, locking plate.
LS650T	Washer, windlass crank shaft lock stud.

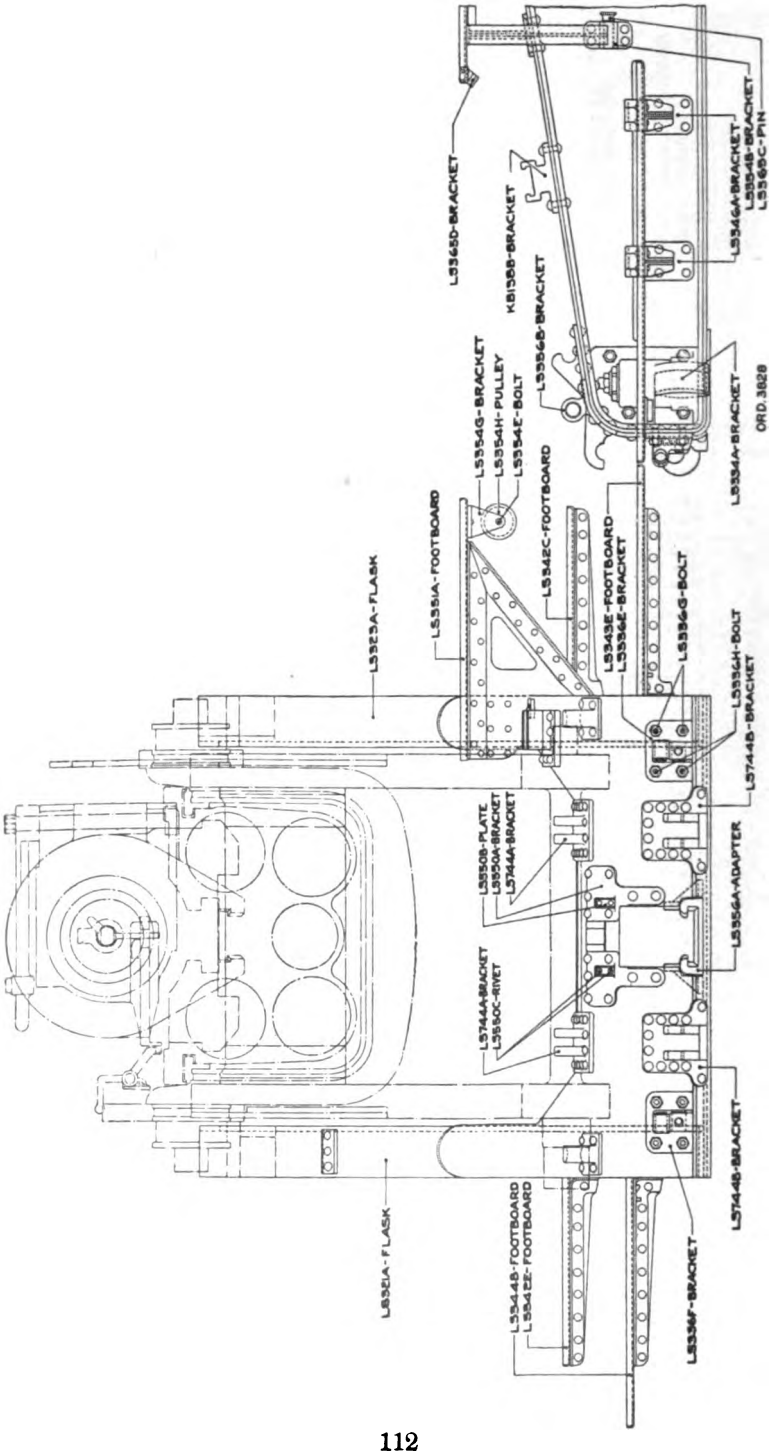


FIGURE 17.—Top carriage, rear view

Reference	Item	Reference	Item
LS356A	Adapter.	LS336F	Bracket, rear clip, L. H.
LS354E	Bolt, guide pulley bracket.	LS336E	Bracket, rear clip, R. H.
LS336G	Bolt, rear clip.	LS356B	Bracket, suspension, rear end.
LS336H	Bolt, rear clip bracket.	LS321A	Flask, top carriage, L. H.
LS365D	Bracket, breech operator's footboard, R. H.	LS323A	Flask, top carriage, R. H.
		LS351A	Footboard, breech operator's.
KB138B	Bracket, cradle locking device.	LS342C	Footboard, forward movable, right.
LS346A	Bracket, detachable footboard hinge.	LS342E	Footboard, gunner's movable.
LS550A	Bracket, false trail lock.	LS344B	Footboard, rear detachable, left.
LS354G	Bracket, guide pulley.	LS343E	Footboard, rear detachable, right.
LS354B	Bracket, hinge, breech operator's footboard.	LS365C	Pin, breech operator's footboard hinge.
LS334A	Bracket, mount roller, R. H.	LS550B	Plate, cam rubbing.
LS744B	Bracket, rammer car lock support, lower.	LS354H	Pulley, guide.
		LS550C	Rivet, screw, rubbing plate.
LS744A	Bracket, rammer car lock support, upper.		

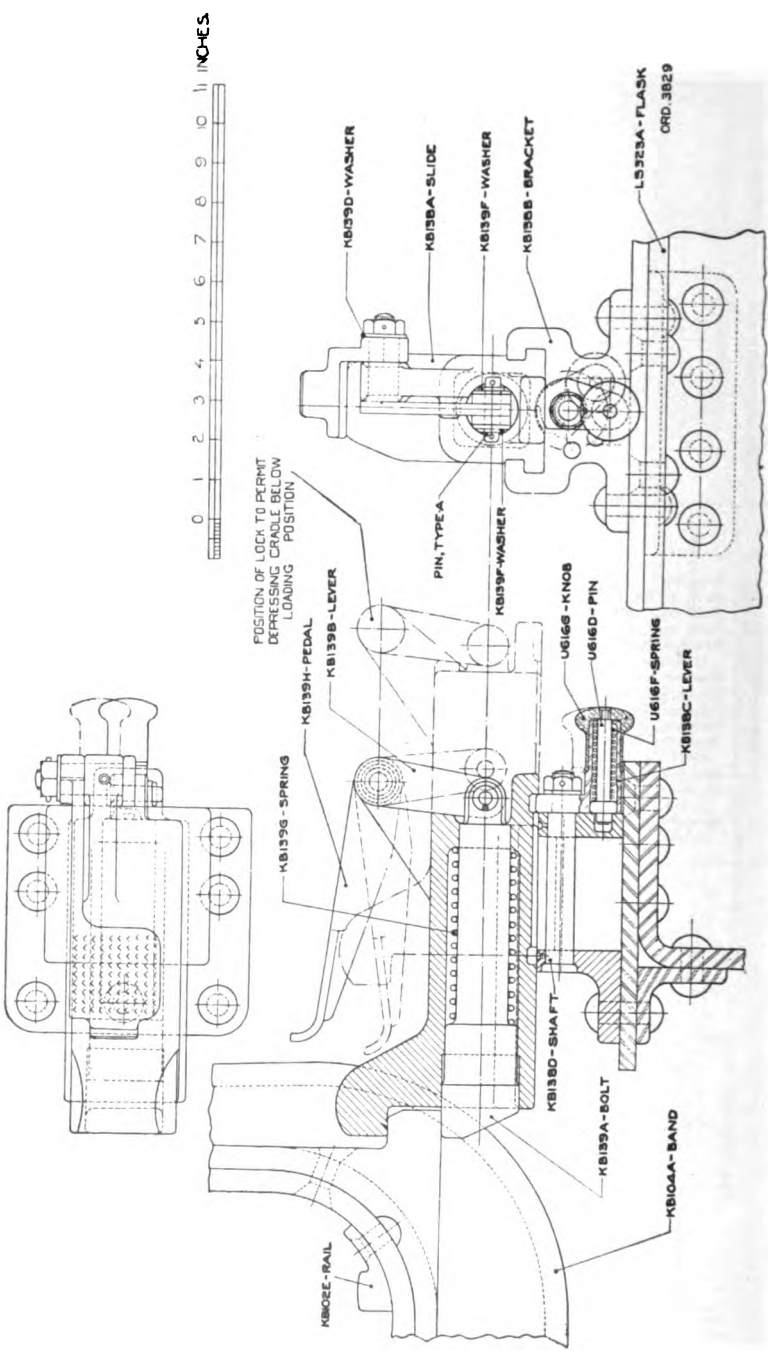


FIGURE 18.—Cradle lock

Reference	Item	Reference	Item
KB104A	Band, rear cradle.	KB102E	Rail, loading apparatus lower, R. H.
KB139A	Bolt, cradle locking.	KB138D	Shaft, cradle locking lever.
KB138B	Bracket, cradle locking device.	KB138A	Slide, cradle locking bolt.
LS323A	Flask, top carriage, R. H.	KB139G	Spring, cradle locking bolt.
U616G	Knob, locking pin.	U616F	Spring, lock pin.
KB138C	Lever, cradle locking.	KB139F	Washer, 3/8 inch inside diameter by 3/4 inch outside diameter by 1/16 inch thick.
KB139B	Lever, cradle locking bolt operating.		
KB139H	Pedal, locking device.		
U616D	Pin, locking.	KB139D	Washer, cradle locking bolt operating lever.
	Pin, type A, 0.368 by 1 19/32 inches (A = 1 3/32 inches).		

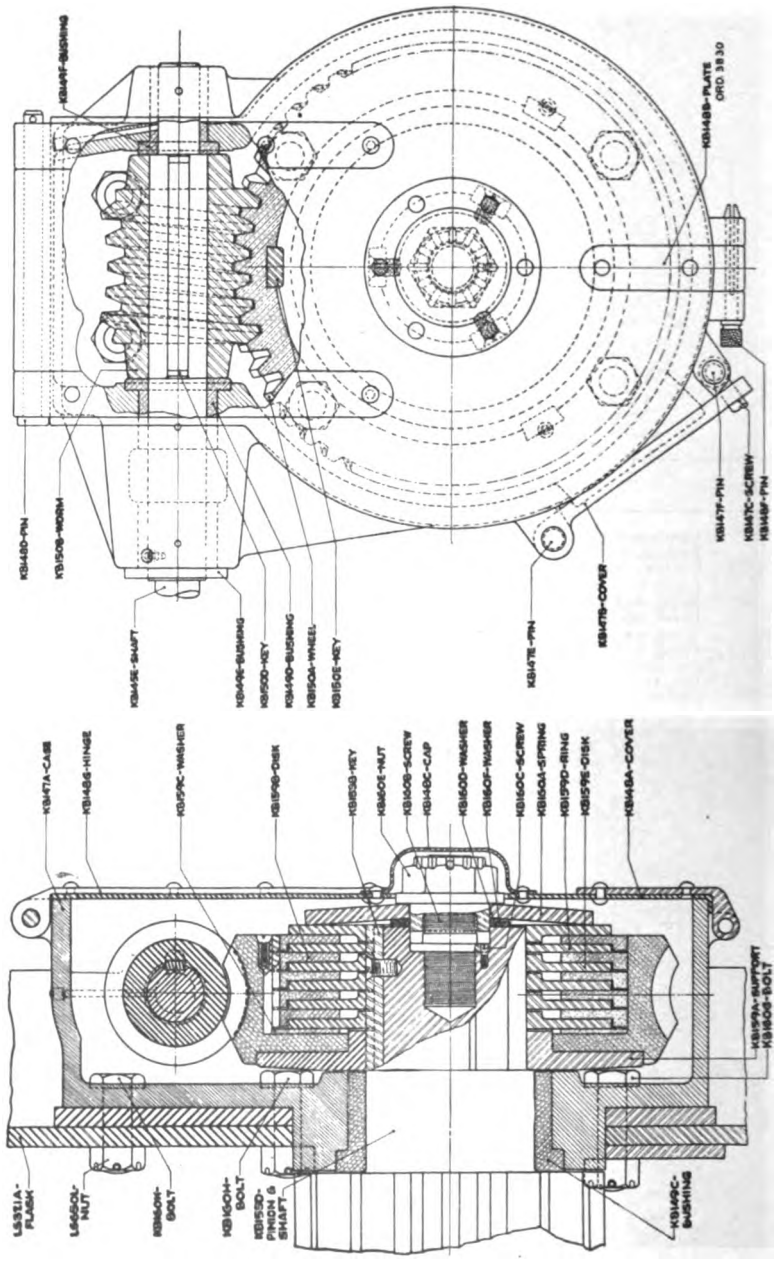


FIGURE 19.—Friction clutch—assembly

Reference	Item	Reference	Item
KB160K	Bolt, worm wheel case, ⅞ by 2 7/16 inches.	KB153B	Key, friction clutch.
KB160H	Bolt, worm wheel case, ⅞ by 2 15/16 inches.	LS650L	Nut, outer support bracket bolt.
KB160G	Bolt, worm wheel case, ⅞ by 3⅛ inches.	KB160E	Nut, tension screw.
KB149C	Bushing, elevating worm gear case.	KB148D	Pin, elevating gear case cover hinge.
KB149D	Bushing, worm shaft bearing, intermediate.	KB147E	Pin, handhole cover hinge.
KB149F	Bushing, worm shaft bearing, lower.	KB147F	Pin, handhole cover locking screw.
KB149E	Bushing, worm shaft bearing, upper.	KB148F	Pin, lock, elevating gear case cover.
KB148C	Cap, elevating gear case cover.	KB153D	Pinion and shaft, elevating arc.
KB147A	Case, elevating worm gear.	KB148B	Plate, lock, elevating gear case cover.
KB148A	Cover, elevating gear case, left side.	KB159D	Ring, center friction.
KB147B	Cover, hand hole.	KB147C	Screw, handhole cover locking.
KB159B	Disk, friction (bronze).	KB160C	Screw, set, tension screw.
KB159E	Disk, friction (steel).	KB160B	Screw, tension.
LS321A	Flask, top carriage, L. H.	KB145E	Shaft, elevating worm.
KB148G	Hinge, elevating gear case cover.	KB160A	Spring, friction clutch.
KB150D	Key, elevating worm.	KB159A	Support, worm wheel.
KB150E	Key, elevating worm wheel.	KB159C	Washer, friction.
		KB160D	Washer, tension screw, thick.
		KB160F	Washer, tension, screw, thin.
		KB150A	Wheel, elevating worm.
		KB150B	Worm, elevating.

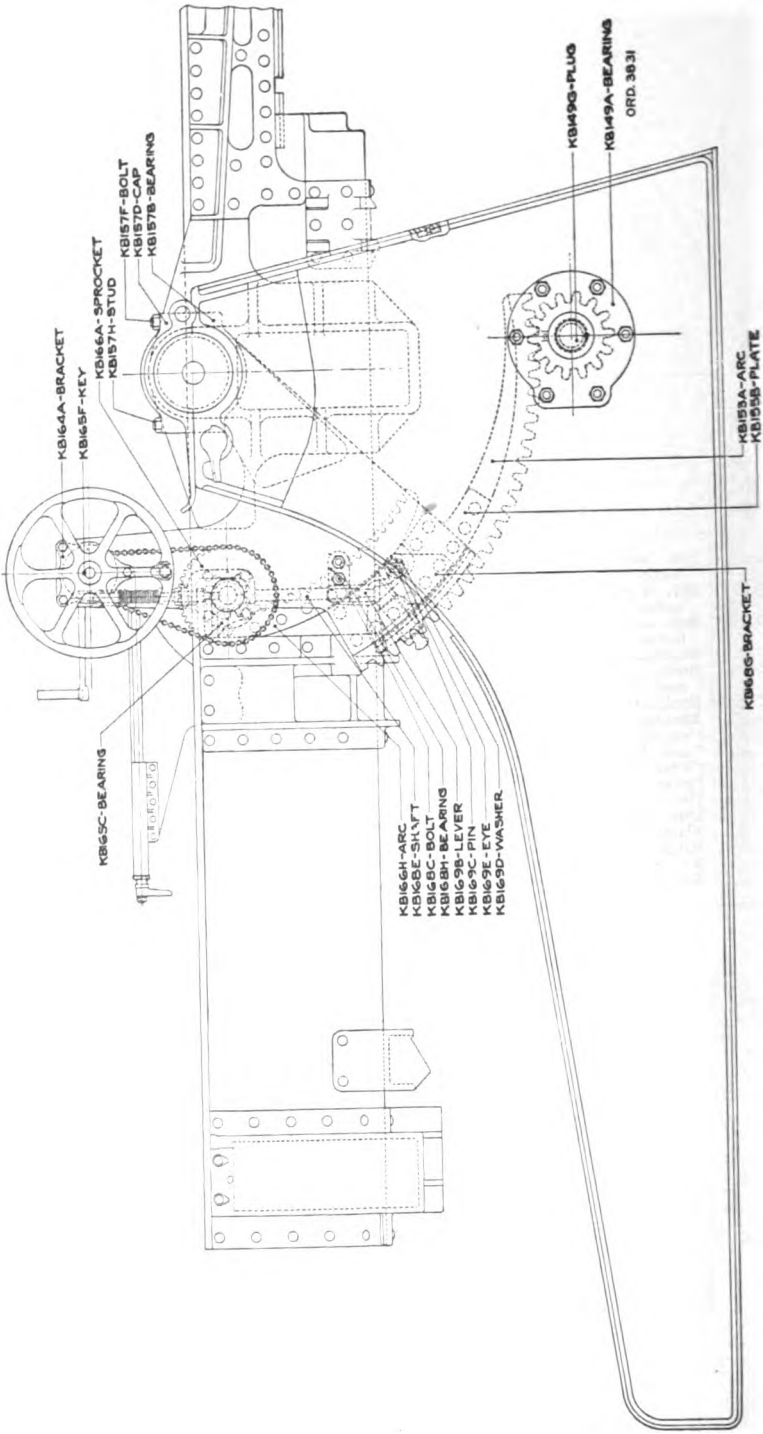


Figure 20.—Elevating and quick loading mechanism (right elevation)

Reference	Item
KB153A	Arc, elevating, right.
KB166H	Arc, quick loading.
KB157B	Bearing, elevating arm, R. H.
KB149A	Bearing, elevating pinion shaft.
KB168H	Bearing, operating shaft, lower.
KB165C	Bearing, quick loading gear lower sprocket shaft.
KB168C	Bolt, lower bearing.
KB157F	Bolt, right elevating arm bearing cap.
KB164A	Bracket, quick loading handwheel shaft.
KB168G	Bracket, right lock rod.
KB157D	Cap, elevating arm bearing, right.
KB169E	Eye, connecting.
KB165F	Key, quick loading gear handwheel shaft (⅜ by 2 inches).
KB169B	Lever, connecting, quick loading mechanism.
KB169C	Pin, connecting lever.
KB155B	Plate, filler.
KB149G	Plug, elevating pinion shaft bearing.
KB168E	Shaft, left and right locking rods operating.
KB166A	Sprocket, quick loading gear, lower.
KB157H	Stud, right elevating arm bearing cap.
KB169D	Washer, quick loading mechanism connecting lever pin.

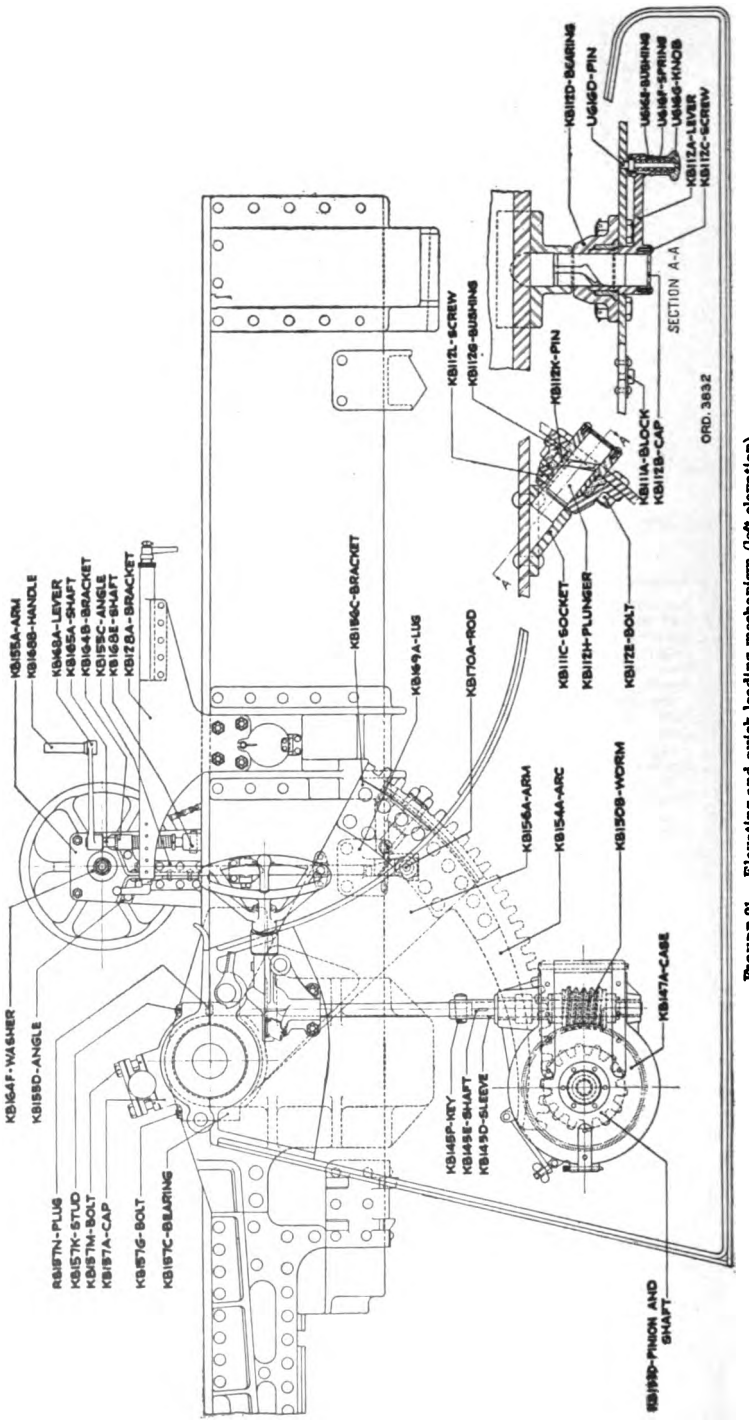


FIGURE 21.—Elevating and quick loading mechanism (left elevation)

Reference	Item	Reference	Item
KB154A	Arc, elevating, left.	U616G	Knob, locking pin.
KB155C	Angle, stiffener, left.	KB112A	Lever, elevating lock.
KB155D	Angle, stiffener, right.	KB168A	Lever, operating.
KB156A	Arm, elevating, left.	KB169A	Lug, locking, quick loading mechanism.
KB155A	Arm, elevating, right.	U616D	Pin, locking.
KB157C	Bearing, elevating arm, L. H.	KB112K	Pin, operating, elevating lock.
KB112D	Bearing, elevating lock.	KB153D	Pinion and shaft, elevating arc.
KB111A	Block, elevating lock stop.	RB157N	Plug, elevating arm bearing.
KB112E	Bolt, elevating lock lever bearing securing.	KB112H	Plunger, elevating lock.
KB157G	Bolt, left elevating arm bearing cap.	KB170A	Rod, lock, left.
KB157M	Bolt, securing, sight bracket.	KB112L	Screw, elevating lock guide.
KB128A	Bracket, firing rod.	KB112C	Screw, elevating lock lever cap.
KB156C	Bracket, lock rod, left.	KB145E	Shaft, elevating worm.
KB164B	Bracket, quick loading gear vertical shaft upper.	KB168E	Shaft, left and right locking rods operating.
KB112G	Bushing, elevating lock plunger.	KB165A	Shaft, quick loading gear vertical.
U616E	Bushing, locking pin.	KB145D	Sleeve, vertical shaft.
KB157A	Cap, elevating arm bearing, left.	KB111C	Socket, plunger, elevating lock.
KB112B	Cap, elevating lock lever.	U616F	Spring, lock pin.
KB147A	Case, elevating worm gear.	KB157K	Stud, left elevating arm bearing cap.
KB168B	Handle, quick loading gear operating lever.	KB164F	Washer, quick loading gear handwheel shaft.
KB145P	Key, sleeve.	KB150B	Worm, elevating.

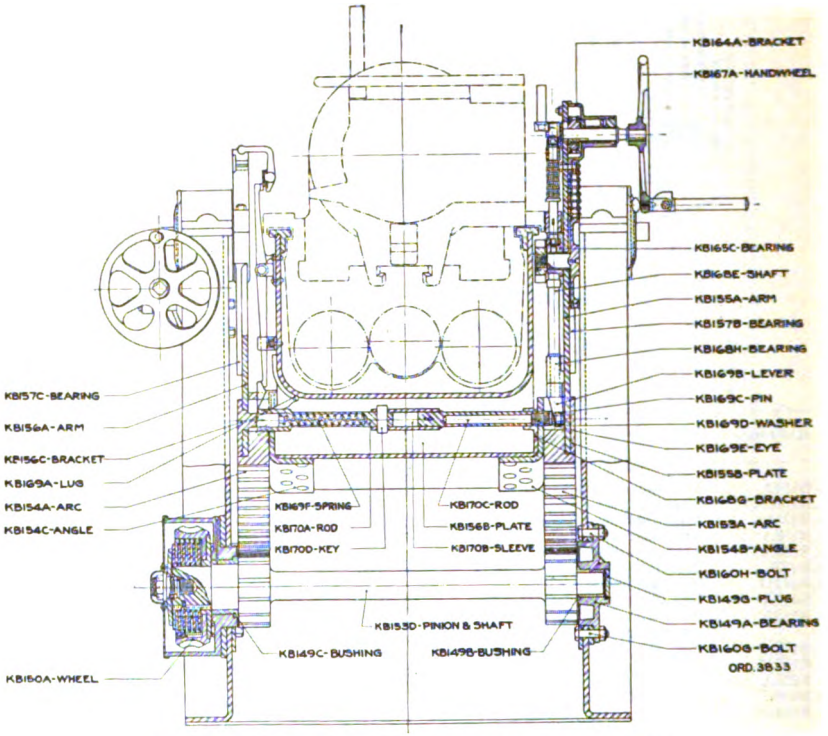


FIGURE 22.- Elevating and quick loading mechanism (rear view)

Reference	Item	Reference	Item
KB154C	Angle, connecting, quick loading arc, left.	KB169E	Eye, connecting.
KB154B	Angle, connecting, quick loading arc, right.	KB167A	Handwheel, quick loading.
KB154A	Arc, elevating, left.	KB170D	Key, quick loading mechanism lock rod sleeve.
KB153A	Arc, elevating, right.	KB169B	Lever, connecting, quick loading mechanism.
KB156A	Arm, elevating, left.	KB169A	Lug, locking, quick loading mechanism.
KB155A	Arm, elevating, right.	KB169C	Pin, connecting lever.
KB157C	Bearing, elevating arm, L. H.	KB153D	Pinion and shaft, elevating arc.
KB157B	Bearing, elevating arm, R. H.	KB156B	Plate, connecting.
KB149A	Bearing, elevating pinion shaft.	KB155B	Plate, filler.
KB168H	Bearing, operating shaft, lower.	KB149G	Plug, elevating pinion shaft bearing.
KB165C	Bearing, quick loading gear lower sprocket shaft.	KB170A	Rod, lock, left.
KB160H	Bolt, worm wheel case, 7/8 by 2 15/16 inches.	KB170C	Rod, lock, quick loading mechanism, right.
KB160G	Bolt, worm wheel case, 7/8 by 3 1/8 inches.	KB168E	Shaft, left and right locking rods operating.
KB156C	Bracket, lock rod, left.	KB170B	Sleeve, quick loading mechanism lock rod.
KB164A	Bracket, quick loading handwheel shaft.	KB169F	Spring, lock, quick loading mechanism.
KB168G	Bracket, right lock rod	KB169D	Washer, quick loading mechanism connecting lever pin.
KB149B	Bushing, elevating pinion shaft bearing.	KB150A	Wheel, elevating worm.
KB149C	Bushing, elevating worm gear case.		

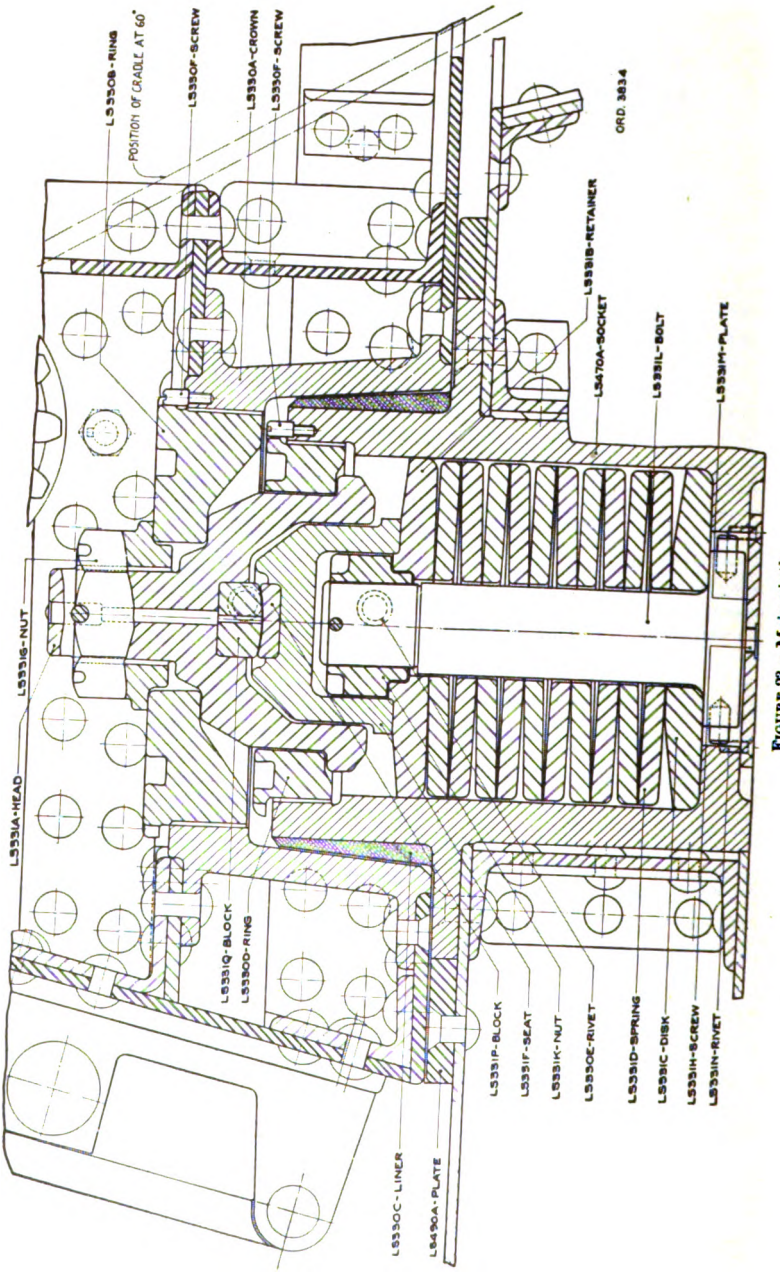


FIGURE 23.—Main pintle

Reference	Item	Reference	Item
LS331Q	Block, thrust, pintle head.	LS331B	Retainer, pintle spring, upper.
LS331P	Block, thrust, pintle head seat.	LS330B	Ring, pintle crown filler.
LS331L	Bolt, pintle spring retaining.	LS330D	Ring, retaining, pintle head.
LS330A	Crown, pintle.	LS330E	Rivet, corner angle screw.
LS331C	Disk, pintle spring supporting, bottom.	LS331N	Rivet, screw, pintle socket bottom plate.
LS331A	Head, pintle.	LS331H	Screw, pintle socket.
LS330C	Liner, pintle.	LS330F	Screw, stop.
LS331G	Nut, pintle head.	LS331F	Seat, pintle head.
LS331K	Nut, pintle spring retaining bolt.	LS470A	Socket, pintle.
LS490A	Plate, pintle socket.	LS331D	Spring, pintle.
LS331M	Plate, pintle socket bottom.		

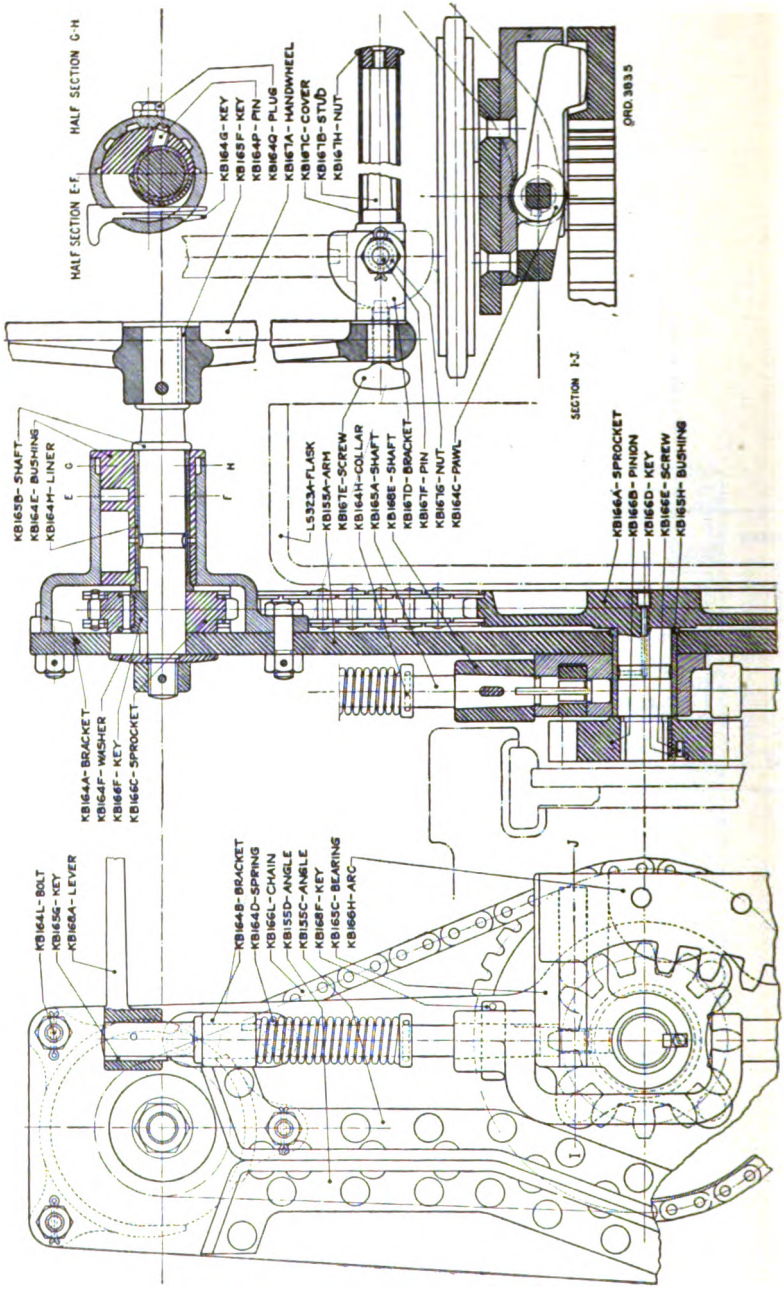


FIGURE 24.—Quick loading gear assembly

Reference	Item
KB155C	Angle, stiffener, left.
KB155D	Angle, stiffener, right.
KB166H	Arc, quick loading.
KB155A	Arm, elevating, right.
KB165C	Bearing, quick loading gear lower sprocket shaft.
KB164L	Bolt, quick loading gear handwheel shaft bracket, ½ by 1¾ inches.
KB164B	Bracket, quick loading gear vertical shaft upper.
KB167D	Bracket, quick loading handwheel handle.
KB164A	Bracket, quick loading handwheel shaft.
KB165H	Bushing, quick loading gear lower sprocket shaft bearing.
KB164E	Bushing, quick loading gear shaft bracket.
KB166L	Chain, roller, ¾-inch pitch, ⅝-inch wide, approximately 55 inches long.
KB164H	Collar, quick loading gear vertical shaft spring.
KB167C	Cover, handle stud.
LS323A	Flask, top carriage, R. H.
KB167A	Handwheel, quick loading.
KB165F	Key, quick loading gear handwheel shaft (¾ by 2 inches).
KB166F	Key, quick loading gear handwheel shaft sprocket.
KB166D	Key, quick loading gear sprocket hub pinion.
KB168F	Key, quick loading gear vertical shaft.
KB165G	Key, quick loading gear vertical shaft lever (5/16 by 1 13/16 inches).
KB164G	Key, securing, quick loading gear shaft bracket bushing.
KB168A	Lever, operating.
KB164M	Liner, quick loading gear shaft bracket bushing.
KB167H	Nut, handle stud.
KB167G	Nut, quick loading handwheel handle stud hinge pin.
KB164C	Pawl, locking, quick loading gear sector.
KB167F	Pin, handle stud hinge.
KB164P	Pin, locking, quick loading gear shaft bracket bushing.
KB166B	Pinion, quick loading gear sprocket hub.
KB164Q	Plug, oil, quick loading gear handwheel shaft.
KB166E	Screw, securing, quick loading gear sprocket hub pinion key.
KB167E	Screw, thumb, quick loading handwheel.
KB168E	Shaft, left and right locking rods operating.
KB165B	Shaft, quick loading gear handwheel.
KB165A	Shaft, quick loading gear vertical.
KB164D	Spring, quick loading gear vertical shaft.
KB166A	Sprocket, quick loading gear, lower.
KB166C	Sprocket, quick loading gear handwheel shaft.
KB167B	Stud, handle.
KB164F	Washer, quick loading gear handwheel shaft.

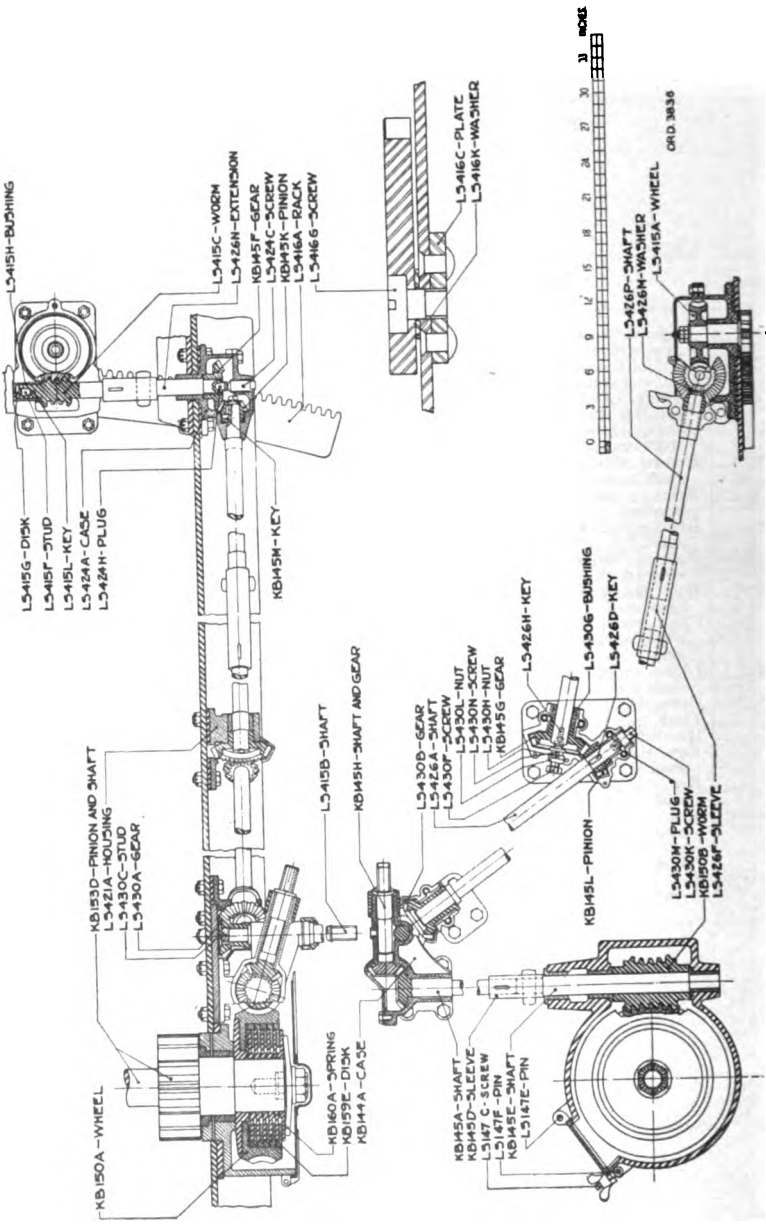


Figure 25.—Traversing and elevating gear mechanism

Reference	Item
LS430G	Bushing, middle traversing gear center bearing.
LS415H	Bushing, traversing worm.
KB144A	Case, elevating and traversing gear.
LS424A	Case, traversing gear, lower.
KB159E	Disk, friction (steel).
LS415G	Disk, thrust, traversing worm.
LS426N	Extension, traversing worm shaft, outer end.
LS430A	Gear, handwheel shaft traversing.
KB145G	Gear, traversing, intermediate.
KB145F	Gear, traversing (lower).
LS430B	Gear, traversing, vertical.
LS421A	Housing, traversing gear, middle.
LS426D	Key, bevel gear, $1\frac{11}{16}$ inches long.
LS426H	Key, bevel gear, $1\frac{17}{32}$ inches long.
KB145M	Key, traversing gear pinion.
LS415L	Key, traversing worm bushing.
LS430H	Nut, intermediate traversing gear thrust screw, large.
LS430L	Nut, intermediate traversing gear thrust screw, small.
KB147E	Pin, handhole cover hinge.
KB147F	Pin, handhole cover locking screw.
KB153D	Pinion and shaft, elevating arc.
KB145L	Pinion, intermediate traversing.
KB145K	Pinion, traversing gear, lower.
LS416C	Plate, securing, rack.
LS424H	Plug, thrust, traversing gear.
LS430M	Plug, thrust, traversing shaft.
LS416A	Rack, traversing.
KB147C	Screw, locking, handhole cover.
LS430N	Screw, locking, intermediate traversing gear thrust screw nut.
LS416G	Screw, rack securing plate.
LS430K	Screw, thrust, intermediate traversing gear, lower.
LS430F	Screw, thrust, intermediate traversing gear, upper.
LS424C	Screw, thrust, traversing gear.
KB145A	Shaft, elevating, and bevel gear (vertical).
KB145H	Shaft, elevating handwheel, and bevel gear.
KB145E	Shaft, elevating worm.
LS415B	Shaft, traversing handwheel.
LS426P	Shaft, traversing, lower, rear end.
LS426A	Shaft, traversing, upper.
LS426F	Sleeve, lower traversing shaft.
KB145D	Sleeve, vertical shaft.
KB160A	Spring, friction clutch.
LS415F	Stud, thrust, traversing worm.
LS430C	Stud, traversing gear.
LS416K	Washer, aligning.
LS426M	Washer, horizontal gear shaft.
KB150A	Wheel, elevating worm.
LS415A	Wheel, worm, traversing.
KB150B	Worm, elevating.
LS415C	Worm, traversing.

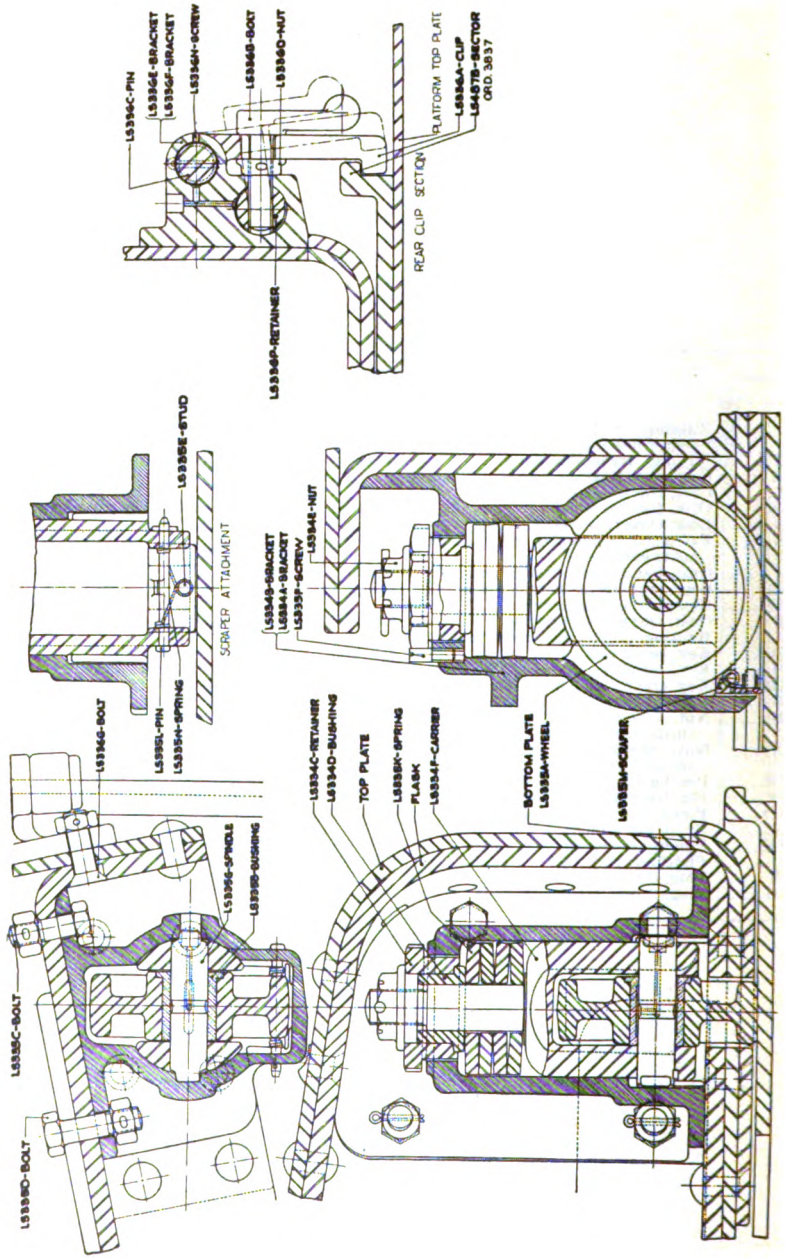


FIGURE 26.—Traversing roller assembly

Reference	Item	Reference	Item
LS335D	Bolt, mount roller bracket, long.	LS336C	Pin, rear clip hinge.
LS335C	Bolt, mount roller bracket, short.	LS335L	Pin, traversing roller scraper spring.
LS336G	Bolt, rear clip.	LS336P	Retainer, rear clip locking bolt.
LS336B	Bolt, rear clip locking.	LS334C	Retainer, traversing roller spring.
LS334B	Bracket, mount roller, L. H.	LS335M	Scraper, traversing roller.
LS334A	Bracket, mount roller, R. H.	LS335F	Screw, locking, traversing roller spring retainer.
LS336F	Bracket, rear clip, L. H.	LS336N	Screw, set, headless, ¼ inch-20-NC by 5/16 inch.
LS336E	Bracket, rear clip, R. H.	LS487B	Sector, holding down, rear.
LS334D	Bushing, traversing roller spring retainer.	LS335G	Spindle, traversing roller wheel.
LS335B	Bushing, traversing roller wheel.	LS335K	Spring, disk, traversing roller.
LS334F	Carrier, wheel.	LS335N	Spring, scraper.
LS336A	Clip, rear.	LS335E	Stud, traversing roller scraper.
LS336D	Nut, rear clip locking bolt.	LS335A	Wheel, traversing roller.
LS334E	Nut, wheel carrier.		

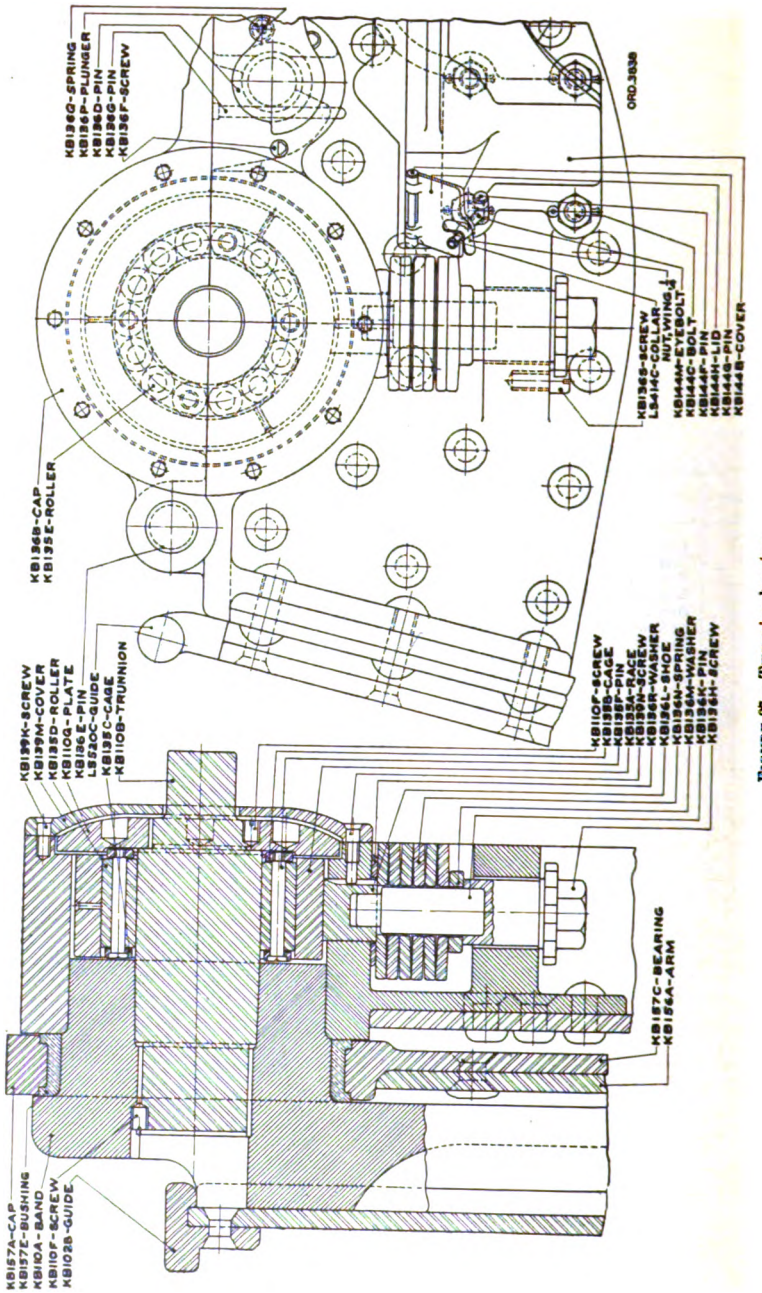


FIGURE 27.—Trunnion bearing

Reference	Item	Reference	Item
KB156A	Arm, elevating, left.	KB110G	Plate, end, trunnion.
KB110A	Band, trunnion.	KB136P	Plunger, trunnion bearing cap locking pin.
KB157C	Bearing, elevating arm, L. H.	KB135A	Race, roller.
KB144C	Bolt, elevating and traversing gear case.		
KB157E	Bushing, trunnion.	KB135D	Roller, trunnion roller bearing (reamed).
KB135C	Cage, roller (reamed and counterbored).	KB135E	Roller, trunnion roller bearing (trunnions integral).
KB135B	Cage, roller (tapped).	KB136H	Screw, adjusting, roller race.
KB157A	Cap, elevating arm bearing, left.	KB110F	Screw, lock.
KB136B	Cap, trunnion bearing, L. H.	KB136S	Screw, lock, adjusting screw.
LS414C	Collar, eyebolt.	KB136F	Screw, stop, cap lock.
KB144B	Cover, elevating and traversing gear case.	KB139N	Screw, trunnion bearing half cover (long).
KB139M	Cover, trunnion bearing half.	KB139K	Screw, trunnion bearing half cover (short).
KB144M	Eyebolt, ¼ inch by 1 13/16 inches.	KB136L	Shoe, trunnion bearing spring center pin.
KB102B	Guide, recoil slide, left.	KB136N	Spring, trunnion bearing.
LS520C	Guide, roller bracket, L. H.	KB136Q	Spring, trunnion bearing cap locking pin plunger.
KB144H	Lid, lubricator.	KB110B	Trunnion, auxiliary.
	Nut, wing, ¼ inch.	KB136M	Washer, supporting, trunnion bearing spring.
KB136K	Pin, center, trunnion bearing spring.	KB136R	Washer, thrust, trunnion bearing spring.
KB144G	Pin, hinge, lubricator lid.		
KB144F	Pin, hinge, swing bolt.		
KB136D	Pin, locking, trunnion bearing cap, L. H.		
KB136G	Pin, retaining, trunnion bearing cap locking pin.		
KB135F	Pin, roller axis.		
KB136E	Pin, trunnion bearing cap hinge.		

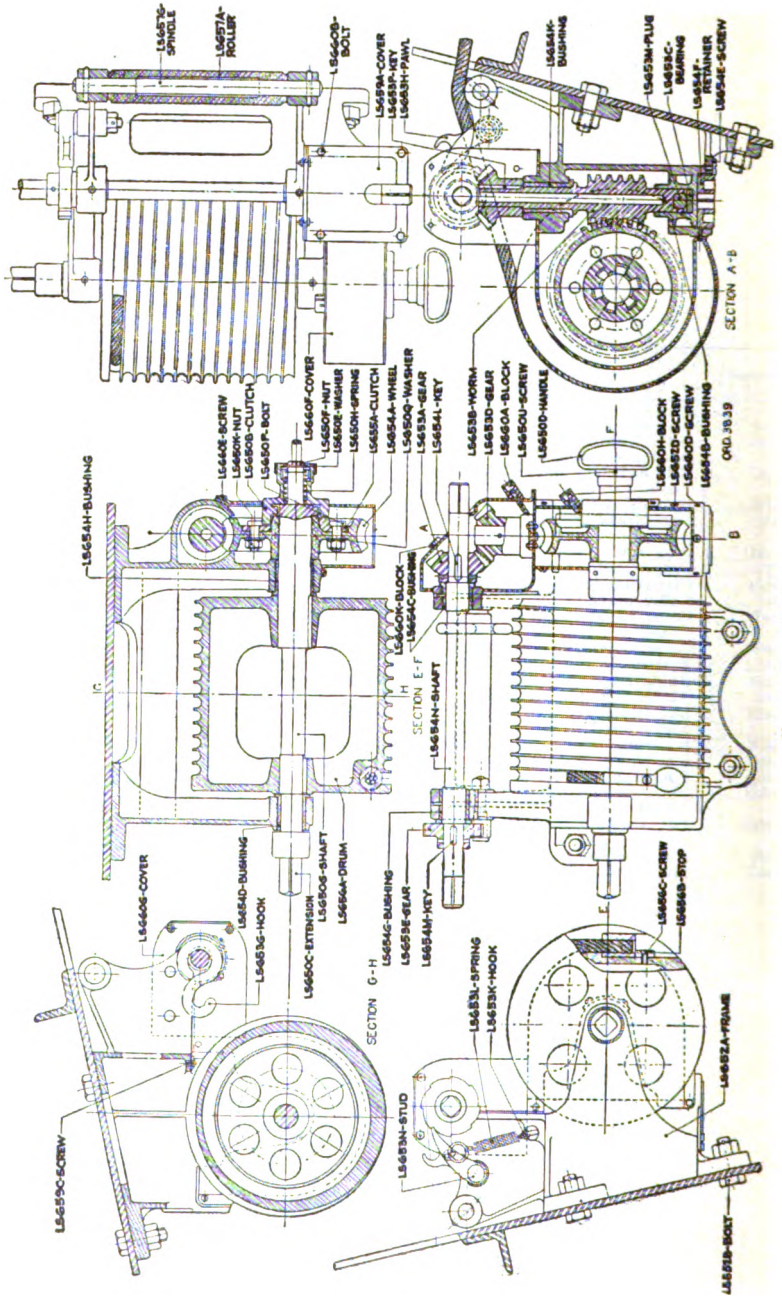


FIGURE 28.— Windlass

Reference	Item
LS653C	Bearing, thrust, windlass, lower.
LS660K	Block, oiler.
	Block, oiler, windlass gear cover, large, long tube, assembly.
	Block, oiler, windlass gear cover, large, short tube, assembly.
LS650P	Bolt, clutch.
LS652B	Bolt, windlass frame.
LS660B	Bolt, windlass gear cover.
LS654H	Bushing, drum shaft bearing, left.
LS654D	Bushing, drum shaft bearing, right.
LS654C	Bushing, windlass upper gear shaft bearing, left.
LS654G	Bushing, windlass upper gear shaft bearing, right.
LS654B	Bushing, windlass worm shaft bearing, lower.
LS654K	Bushing, windlass worm shaft bearing, upper.
KB149F	Bushing, worm shaft bearing, lower.
LS650B	Clutch, drum shaft.
LS655A	Clutch, windlass worm wheel.
LS659A	Cover, windlass bevel gear.
LS660F	Cover, windlass worm gear, large.
LS660G	Cover, windlass worm gear, small.
LS656A	Drum, rope.
LS650C	Extension, drum shaft.
LS652A	Frame, windlass.
LS653A	Gear, miter, windlass horizontal shaft.
LS653D	Gear, miter, windlass worm shaft.
LS653E	Gear, ratchet, horizontal, windlass.
LS650D	Handle, drum shaft clutch.
LS653G	Hook, cable.
LS653K	Hook, spring.
LS654L	Key, miter gear, windlass horizontal gear shaft.
LS653P	Key, miter gear, windlass worm shaft.
LS654M	Key, ratchet gear.
LS650K	Nut, clutch bolt.
LS650F	Nut, drum shaft.
LS653H	Pawl, windlass ratchet.
LS653M	Plug, thrust, windlass worm shaft.
LS654F	Retainer, windlass worm shaft bearing lower bushing.
LS657A	Roller, cable.
LS659C	Screw, cable retaining plate.
LS660D	Screw, cover, windlass gear, ¼ by $1\frac{3}{32}$ inch.
LS660E	Screw, cover, windlass gear, ¼ by ½ inch.
LS650U	Screw, lock, clutch handle.
LS652D	Screw, locking, bushing.
LS654E	Screw, locking, windlass worm shaft bearing lower bushing retainer.
LS656C	Screw, stop.
LS650G	Shaft, drum.
LS654N	Shaft, windlass horizontal gear.
LS657G	Spindle, roller.
LS650H	Spring, clutch.
LS653L	Spring, pawl, windlass ratchet.
LS656B	Stop, rope sleeve drum.
LS653N	Stud, windlass pawl bracket.
LS650Q	Washer, clutch bolt.
LS650E	Washer, clutch spring.
LS654A	Wheel, worm, windlass.
LS653B	Worm, windlass.

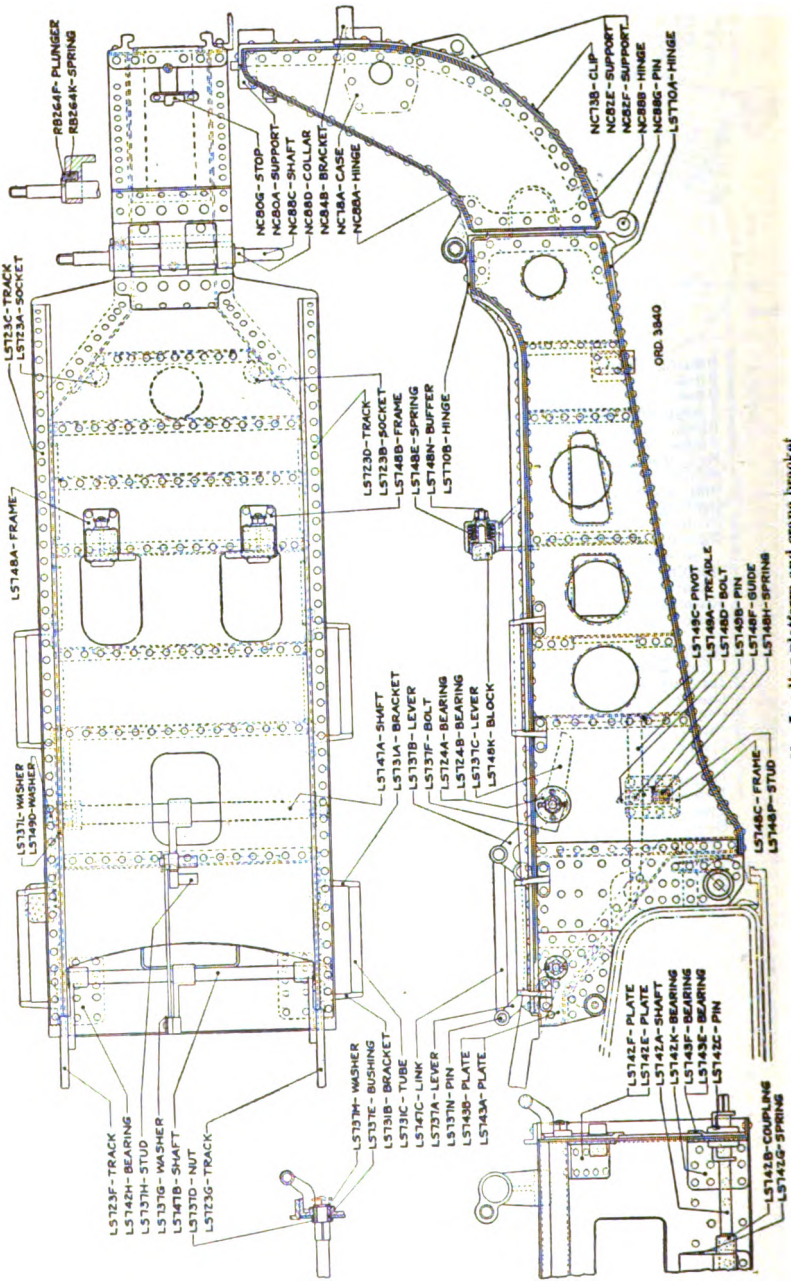


FIGURE 29.—Loading platform and crane bracket

Reference	Item	Reference	Item
LS742K	Bearing, loading platform inside locking shaft, L. H.	LS742C	Pin, limit, loading platform locking shaft.
LS742H	Bearing, loading platform inside locking shaft, R. H.	LS749B	Pin, loading platform lock bolt.
LS743F	Bearing, loading platform outside locking shaft, L. H.	LS737N	Pin, track operating link.
LS743E	Bearing, loading platform outside locking shaft, R. H.	LS749C	Pivot, loading platform treadle.
LS724A	Bearing, track locking shaft, left.	LS742F	Plate, loading platform inside hinge stud, L. H.
LS724B	Bearing, track locking shaft, right.	LS742E	Plate, loading platform inside hinge stud, R. H.
LS748K	Block, buffer.	LS743B	Plate, loading platform outside hinge stud, L. H.
LS748D	Bolt, loading platform lock.	LS743A	Plate, loading platform outside hinge stud, R. H.
LS737F	Bolt, track locking shaft bearing.	RB264F	Plunger, spring.
LS731B	Bracket, loading platform handle, L. H.	LS742A	Shaft, loading platform locking.
LS731A	Bracket, loading platform handle, R. H.	NC88C	Shaft, locking, shot hoist bracket.
NC84B	Bracket, ratchet pawl.	LS747B	Shaft, track.
LS748N	Buffer.	LS747A	Shaft, track locking.
LS737E	Bushing, track shaft.	LS723B	Socket, transport support, loading platform, L. H.
NC78A	Case, gear.	LS723A	Socket, transport support, loading platform, R. H.
NC73B	Clip, hoist casing, female.	LS748E	Spring, buffer, loading platform.
NC88D	Collar, shot hoist bracket locking shaft.	LS748H	Spring, lock, loading platform.
LS742B	Coupling, locking shaft.	LS742G	Spring, locking shaft.
LS748B	Frame, buffer, loading platform, L. H.	RB264K	Spring, plunger.
LS748A	Frame, buffer, loading platform, R. H.	NC80G	Stop, latch.
LS748C	Frame, loading platform lock.	LS748P	Stud, loading platform lock spring.
LS748F	Guide, loading platform lock bolt.	LS737H	Stud, swinging track operating lever.
LS770A	Hinge, loading platform, bottom.	NC82E	Support, cable drum, left.
LS770B	Hinge, loading platform, top.	NC82F	Support, cable drum, right.
NC88B	Hinge, shot hoist bracket bottom.	NC80A	Support, loading mechanism.
NC88A	Hing, shot hoist bracket top.	LS723D	Track, loading platform, L. H.
LS737C	Lever, locking, track.	LS723C	Track, loading platform, R. H.
LS737A	Lever, swinging track link.	LS723G	Track, swinging, L. H.
LS737B	Lever, swinging track operating.	LS723F	Track, swinging, R. H.
LS747C	Link, operating, track.	LS749A	Treadle, lock, loading platform.
LS737D	Nut, track shaft bushing.	LS731C	Tube, loading platform handle.
NC88G	Pin, hinge, shot hoist bracket bottom.	LS737G	Washer, link pin.
		LS749D	Washer, pivot.
		LS737L	Washer, track locking shaft.
		LS737M	Washer, track shaft.

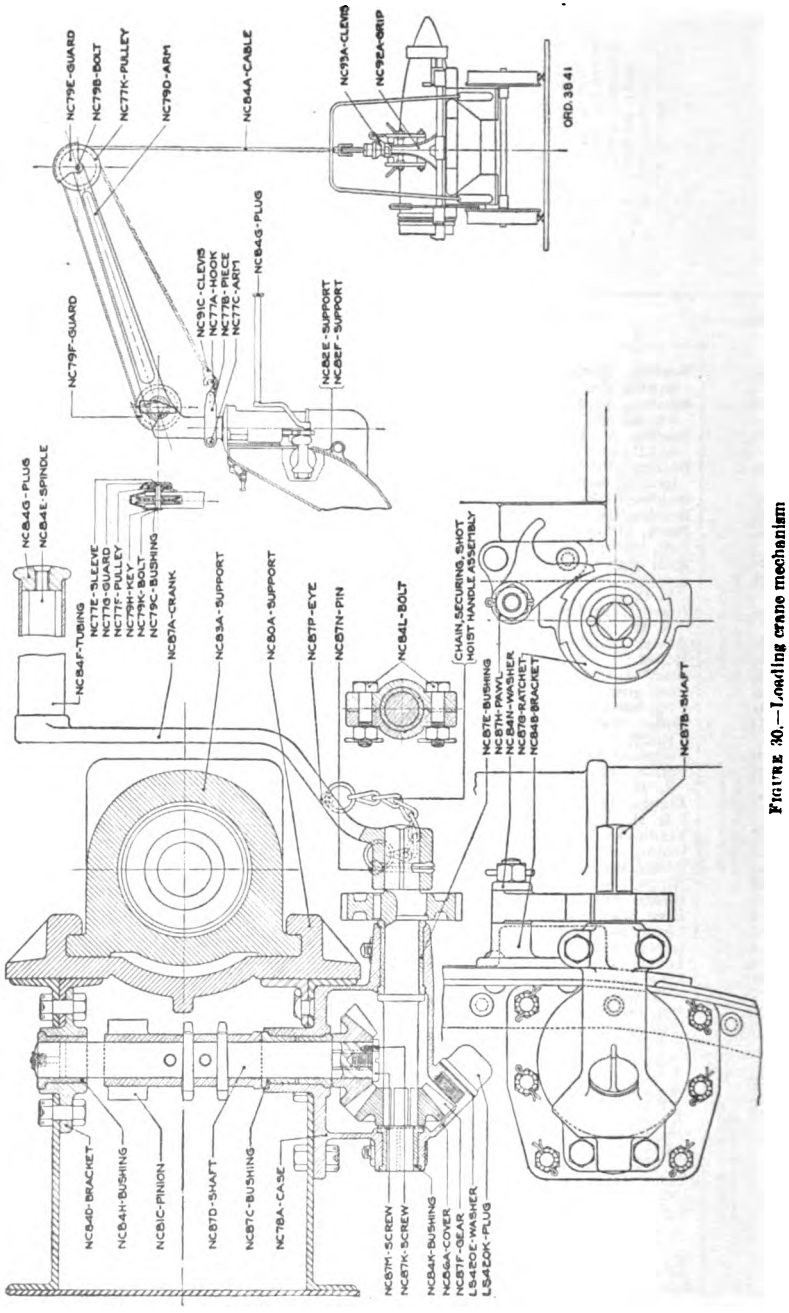


FIGURE 30.—Loading crane mechanism

Reference	Item	Reference	Item
NC79D	Arm, loading mechanism lifting.	NC79F	Guard, pulley wheel, rear.
NC77C	Arm, loading mechanism maneuvering.	NC77A	Hook, loading mechanism cable.
NC84L	Bolt, gear case cover.	NC79H	Key, pulley wheel guard.
NC79B	Bolt, lifting arm.	NC87H	Pawl, shot hoist ratchet.
NC79K	Bolt, wheel guard.	NC77B	Piece, side.
NC84D	Bracket, drum gear meshing pinion shaft.	NC87N	Pin, cotter, shot hoist handle securing chain.
NC84B	Bracket, ratchet pawl.	NC81C	Pinion, meshing, cable drum gear.
NC84H	Bushing, drum gear meshing pinion shaft bracket.	LS420K	Plug, grease.
NC87C	Bushing, gear case.	NC84G	Plug, handle end.
NC79C	Bushing, loading crane pulley.	NC77F	Pulley, guide.
NC87E	Bushing, ratchet shaft (inner).	NC77K	Pulley, lifting arm.
NC84K	Bushing, ratchet shaft (outer).	NC87G	Ratchet, shot hoist.
NC84A	Cable, hoisting.	NC87M	Screw, securing, shot hoist gear intermediate shaft.
NC78A	Case, gear.	NC87K	Screw, stop, shot hoist gear intermediate shaft securing screw.
----------	Chain, securing, shot hoist handle, assembly.	NC87D	Shaft, intermediate.
NC91C	Clevis, cable.	NC87B	Shaft, shot hoist ratchet.
NC93A	Clevis, shell tongs.	NC77E	Sleeve, guide pulley.
NC86A	Cover, gear case.	NC84E	Spindle, handle.
NC87A	Crank.	NC82E	Support, cable drum, left.
NC87P	Eye, shot hoist handle securing chain.	NC82F	Support, cable drum, right.
NC87F	Gear, miter.	NC80A	Support, loading mechanism.
NC92A	Grip, shell.	NC83A	Support, loading mechanism, rear.
NC77G	Guard, guide pulley.	NC84F	Tubing, handle.
NC79E	Guard, pulley wheel, front.	LS420E	Washer, grease plug.
		NC84N	Washer, ratchet pawl bracket.

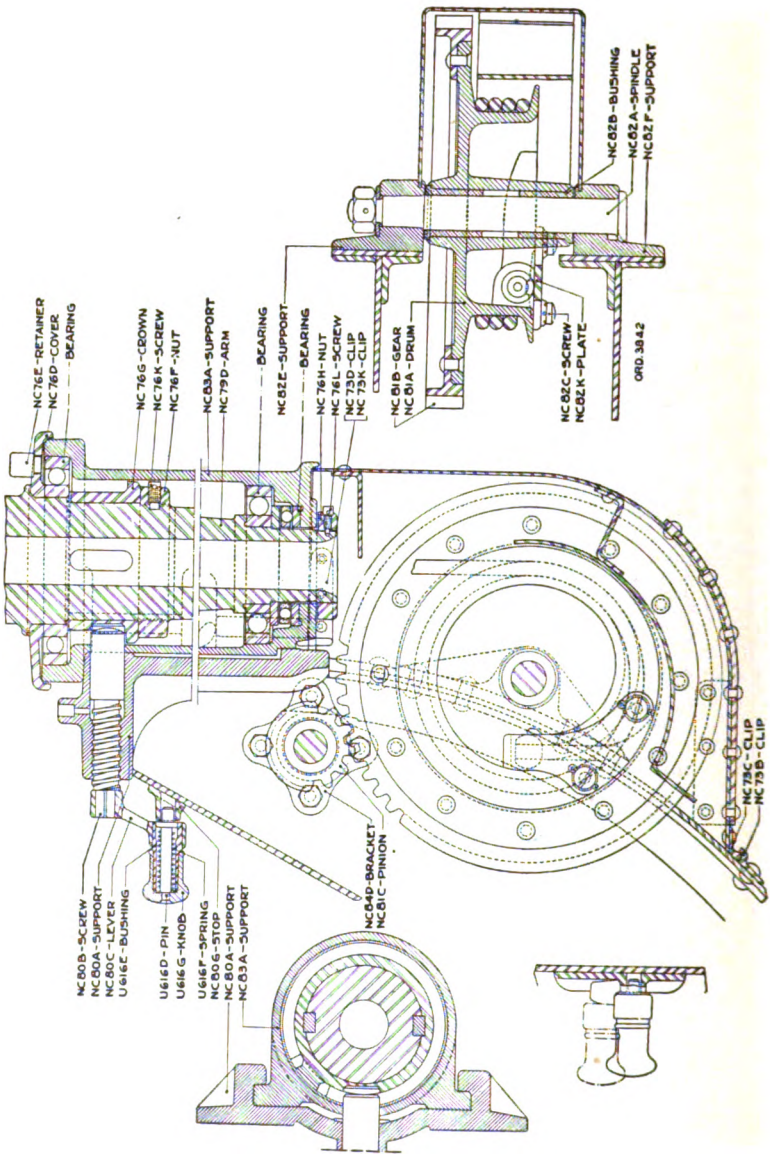


FIGURE 31.—Loading crane mechanism, sections

Reference	Item	Reference	Item
NC79D	Arm, loading mechanism lifting.	U616G	Knob, locking pin.
	Bearing, ball, single row (for shot hoist).	NC80C	Lever, lifting arm latch.
	Bearing, ball, single row (for shot hoist).	NC76F	Nut, retaining, ball bearing.
	Bearing, ball, single thrust (for shot hoist).	NC76H	Nut, retaining, ball bearing cover.
NC84D	Bracket, drum gear meshing pinion shaft.	U616D	Pin, locking.
NC82B	Bushing, cable drum support.	NC81C	Pinion, meshing, cable drum gear.
U616E	Bushing, locking pin.	NC82K	Plate, securing, cable drum.
NC73B	Clip, hoist casing, female.	NC76E	Retainer, oil cup.
NC73C	Clip, hoist casing, male.	NC82C	Screw.
NC73D	Clip, locking, hoist casing, L. H.	NC80B	Screw, lock, lifting arm.
NC73K	Clip, locking, hoist casing, R. H.	NC76K	Screw, retaining.
NC76D	Cover, upper ball bearing.	NC76L	Screw, retaining.
NC76G	Crown, retaining, upper ball bearing cover.	NC82A	Spindle, cable drum.
NC81A	Drum, shot hoist cable.	U616F	Spring, lock pin.
NC81B	Gear, cable drum.	NC80G	Stop, latch.
		NC82E	Support, cable drum, left.
		NC82F	Support, cable drum, right.
		NC80A	Support, loading mechanism.
		NC83A	Support, loading mechanism rear.

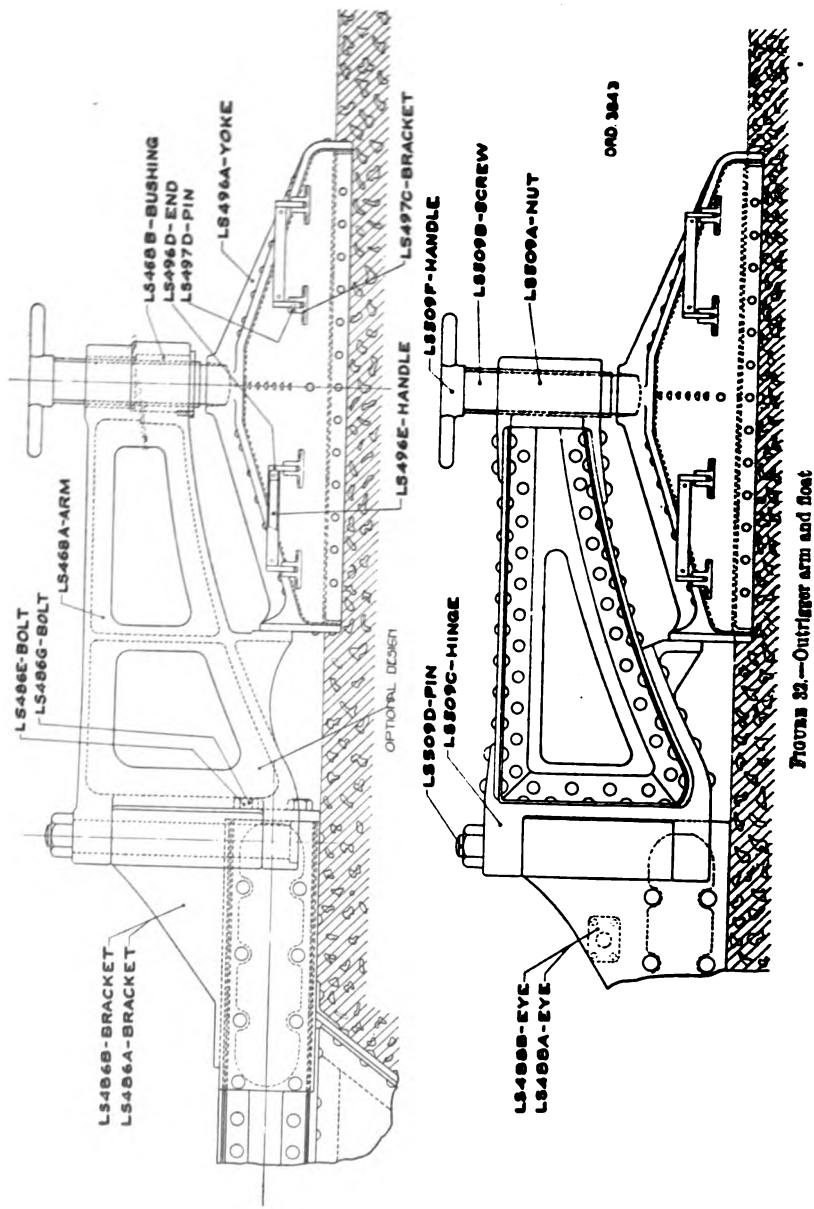


FIGURE 32.—Outrigger arm and float

Reference	Item	Reference	Item
LS468A	Arm, outrigger.	LS488A	Eye, suspension, rear, R. H.
LS486E	Bolt, swinging arm bracket, long.	LS496E	Handle, float.
LS486G	Bolt, swinging arm bracket, short.	LS509F	Handle, leveling screw.
LS497C	Bracket, handle.	LS509C	Hinge, swinging arm.
LS486B	Bracket, swinging arm, L. H.	LS509A	Nut, swinging arm.
LS486A	Bracket, swinging arm, R. H.	LS497D	Pin, float handle bracket.
LS468B	Bushing, outrigger (for optional design swinging arm).	LS509D	Pin, swinging arm hinge.
LS496D	End, for handle.	LS509B	Screw, swinging arm.
LS488B	Eye, suspension, rear, L. H.	LS496A	Yoke.

FIGURE 33.—Right elevation

Reference	Item	Reference	Item
L8488C	Eye, suspension, front.	L8500A	Socket, brake fulcrum, R. H.
L8510A	Hook, platform.	L8507A	Socket, outrigger screw.
L8500B	Socket, brake fulcrum, L. H.		

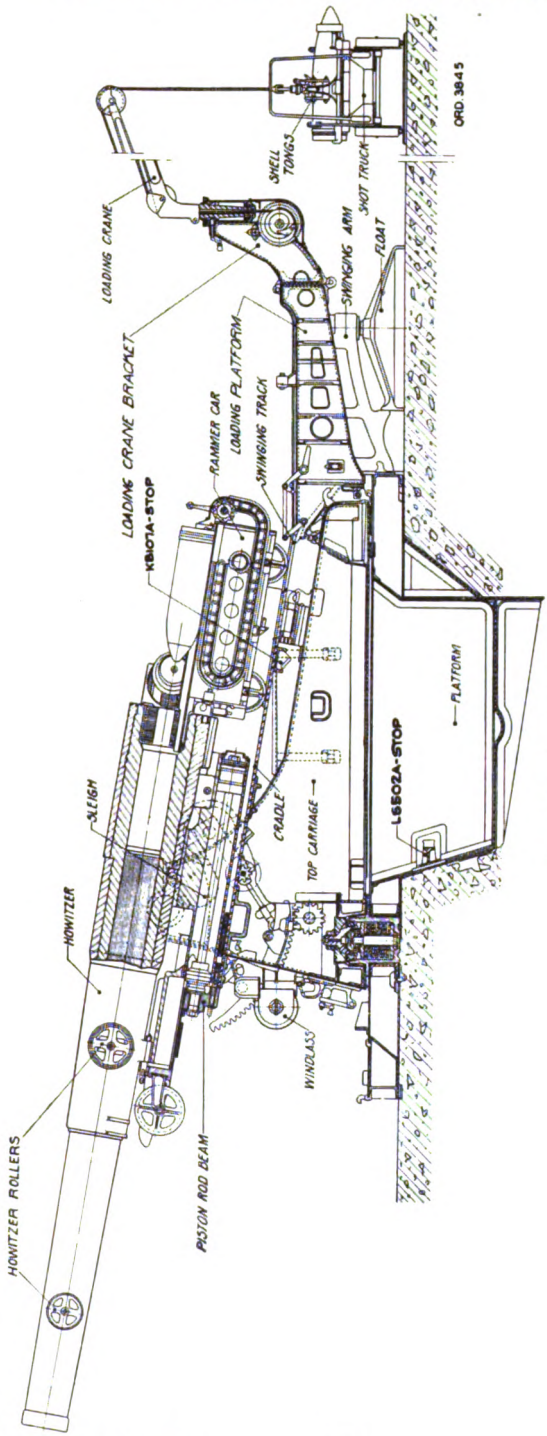


FIGURE 34.—Longitudinal section

Reference	Item	Reference	Item
LS502A	Stop, cradle elevating.	KB107A	Stop, cradle elevation.

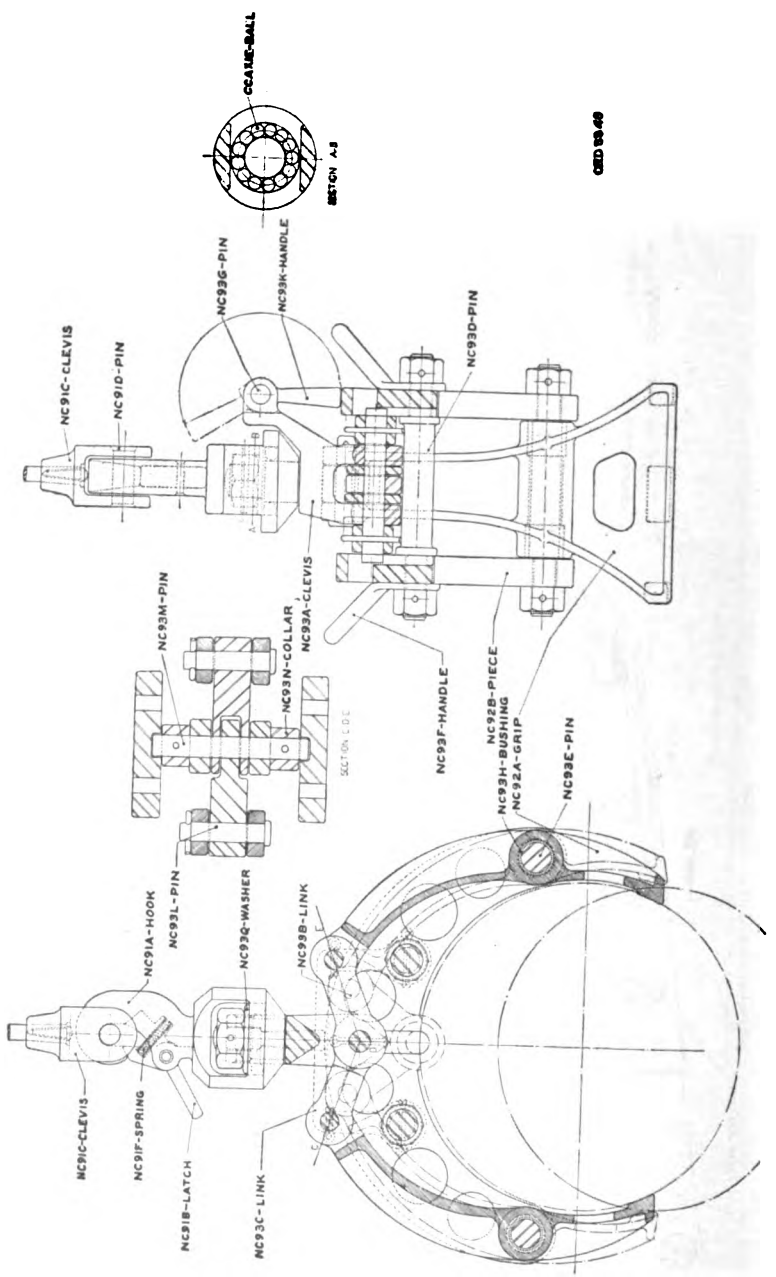


FIGURE 35.—Shell tongs

Reference	Item	Reference	Item
NC93H	Bushing, shell grip pin.	NC92B	Piece, side, shell tongs.
NC91C	Clevis, cable.	NC91D	Pin, cable clevis.
NC93A	Clevis, shell tongs.	NC93E	Pin, shell grip lower.
NC93N	Collar, toggle pin.	NC93L	Pin, shell grip upper.
NC92A	Grip, shell.	NC93D	Pin, shell tongs frame spacer.
NC93K	Handle, locking, shell tongs.	NC93G	Pin, shell tongs lock handle.
NC93F	Handle, shell tongs.	NC93M	Pin, toggle.
NC91A	Hook, swivel.	NC91F	Spring, shell tongs swivel hook latch.
NC91B	Latch, shell tongs swivel hook.	NC93Q	Washer, shell tongs bearing.
NC93C	Link, toggle, inner.		
NC93B	Link, toggle, outer.		

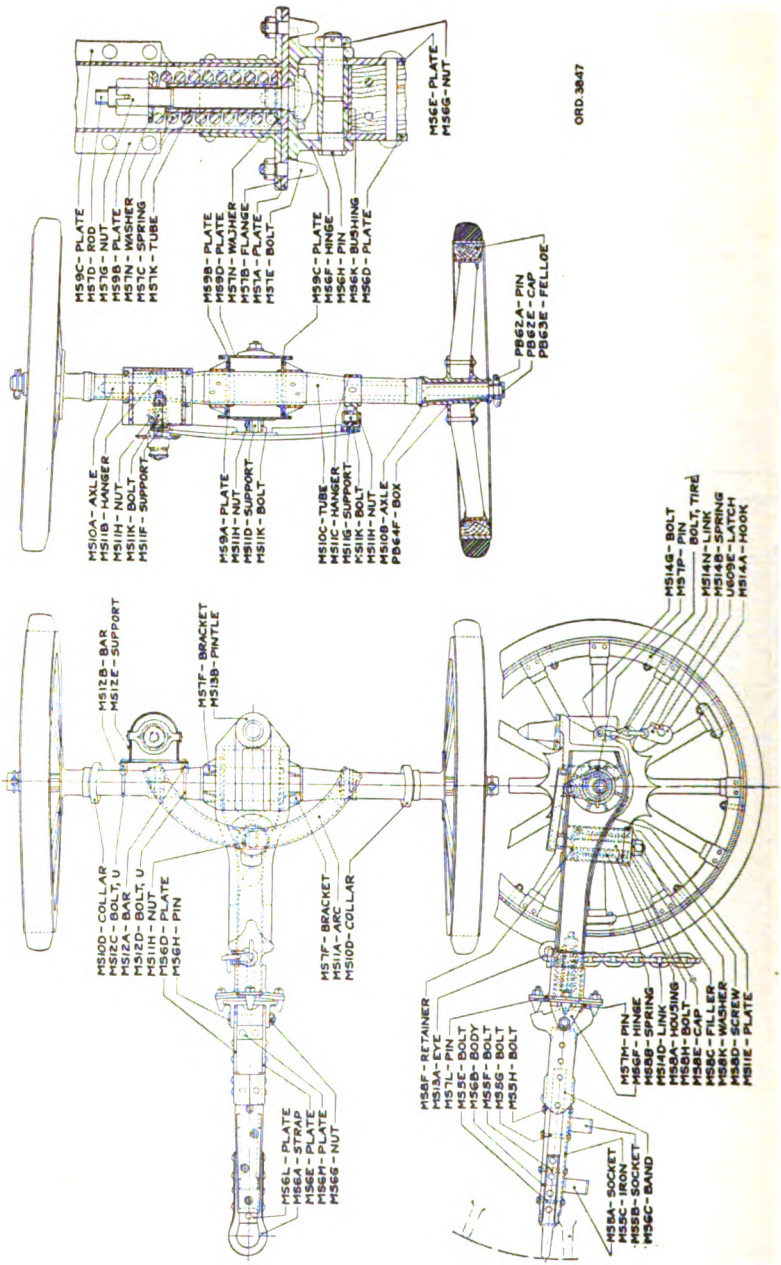


FIGURE 36.—Transport limber

240-MM HOWITZER MATÉRIEL, M1918 AND M1918A1

Reference	Item	Reference	Item
MS11A	Arc, turning.	MS14D	Link, limit chain, small.
MS10B	Axle, L. H.	MS14N	Link, safety chain (twisted).
MS10A	Axle, R. H.	MS11H	Nut, bearing bolt.
MS6C	Band, reinforcing.	MS6G	Nut, drawbar hinge pin.
MS12B	Bar, lantern bracket clamp, 5⅛ inches.	MS7G	Nut, tension rod.
		MS7P	Pin, arc hanger.
MS12A	Bar, lantern bracket clamp, 5¾ inches.	MS6H	Pin, drawbar hinge.
		MS7M	Pin, guide.
MS6B	Body, drawbar.	PB62A	Pin, linch.
MS5E	Bolt, ⅜ by 3⅞ inches.	MS7L	Pin, locating.
MS5F	Bolt, ⅜ by 4⅛ inches.	MS13B	Pintle, limber.
MS5G	Bolt, ⅜ by 4⅞ inches.	MS9D	Plate, bottom.
MS5H	Bolt, ⅜ by 4 1⅛ inches.	MS6L	Plate, drawbar end, front.
MS11K	Bolt, bearing.	MS6M	Plate, drawbar end, rear.
MS7E	Bolt, guide.	MS7A	Plate, drawbar joint.
MS14G	Bolt, saftey chain.	MS6E	Plate, drawbar side, L. H.
MS8H	Bolt, spring.	MS6D	Plate, drawbar side, R. H.
	Bolt, tire, ⅜ by 3 55/64 inches, with square nut and plain washer.	MS11E	Plate, frame reinforcing.
		MS9C	Plate, side, L. H.
MS12D	Bolt, U, lantern bracket, large.	MS9B	Plate, side, R. H.
MS12C	Bolt, U, lantern bracket, small.	MS9A	Plate, top.
PB64F	Box, hub.	MS8F	Retainer, spring.
MS7F	Bracket, axle.	MS7D	Rod, tension.
MS6K	Bushing, hinge pin.	MS8D	Screw, lock, spring housing cap.
PB62E	Cap, axle.	MS5A	Socket, handspike, large.
MS8E	Cap, spring housing.	MS5B	Socket, handspike, small.
MS10D	Collar, axle.	MS7C	Spring, draft.
MS13A	Eye, limit chain.	MS8B	Spring, large.
PB63E	Felloe.	MS14B	Spring, safety chain hook.
MS8C	Filler.	MS6A	Strap, drawbar.
MS7B	Flange, draft.	MS11D	Support, arc, center.
MS11C	Hanger, arc, L. H.	MS11G	Support, arc, end, L. H.
MS11B	Hanger, arc, R. H.	MS11F	Support, arc, end, R. H.
MS6F	Hinge, drawbar.	MS12E	Support, lantern bracket.
MS14A	Hook, safety chain.	MS10C	Tube, axle.
MS8A	Housing, spring.	MS7K	Tube, spring stop.
MS5C	Iron, drawbar bottom.	MS8K	Washer, spring bolt.
U609E	Latch, hook.	MS7N	Washer, tension rod.

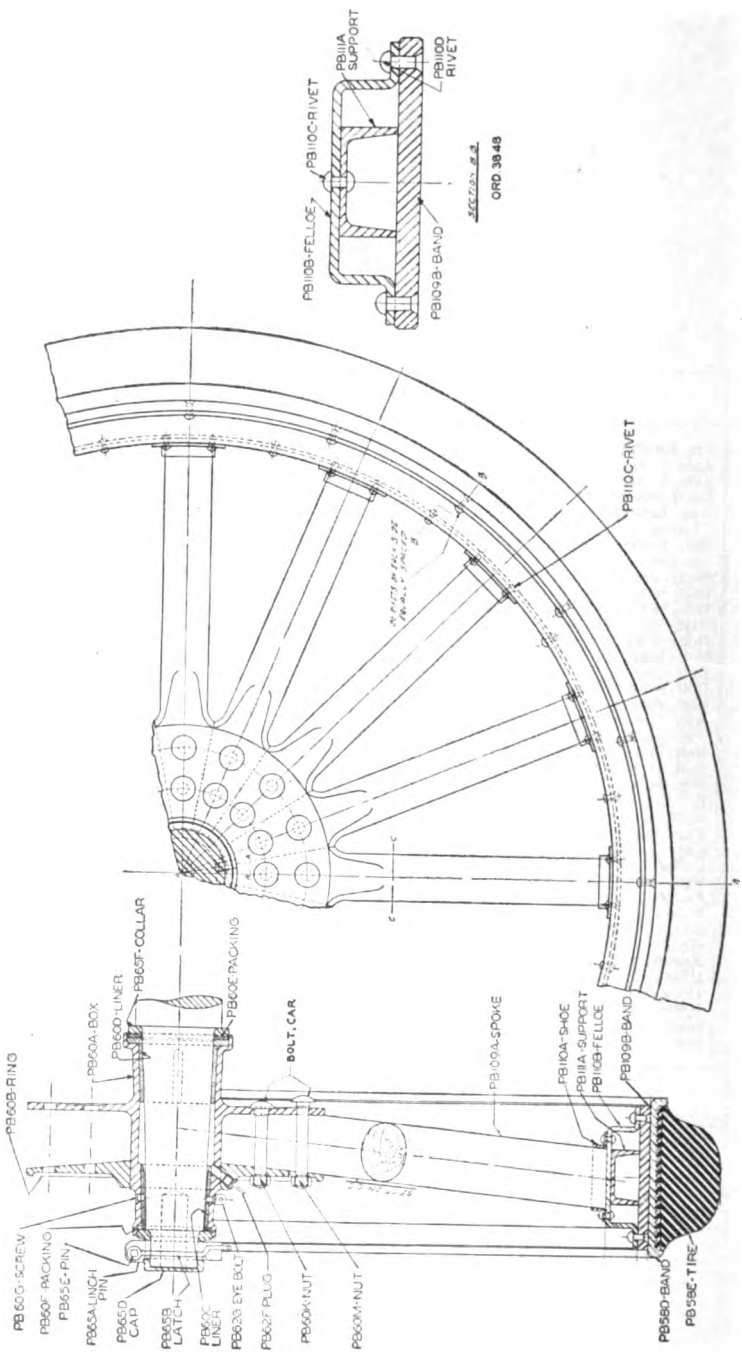


FIGURE 37.—Transport limber and vehicle wheels

Reference	Item	Reference	Item
PB58D	Band, base.	PB60K	Nut, 9/16 inch.
PB109B	Band, felloe.	PB60M	Nut, 5/8 inch.
	Bolt, car., rd.-hd., sq.neck, 9/16 by 4½ inches.	PB60E	Packing, hub liner, inner.
		PB60F	Packing, hub liner, outer.
	Bolt, car., rd.-hd., sq. neck, ⅝ by 5½ inches.	PB65E	Pin, linchpin latch.
		PB62F	Plug, grease.
PB60A	Box, hub.	PB60B	Ring, hub.
PB65D	Cap, axle.	PB110D	Rivet, felloe band.
PB65F	Collar, axle.	PB110C	Rivet, spoke shoe.
PB62G	Eyebolt, grease plug thong.	PB60G	Screw, hub liner.
PB110B	Felloe.	PB110A	Shoe, spoke.
PB65B	Latch, linchpin, L. H.	PB109A	Spoke.
PB65A	Linchpin.	PB111A	Support, felloe.
PB60D	Liner, hub, inner.	PB58E	Tire.
PB60C	Liner, hub, outer.		

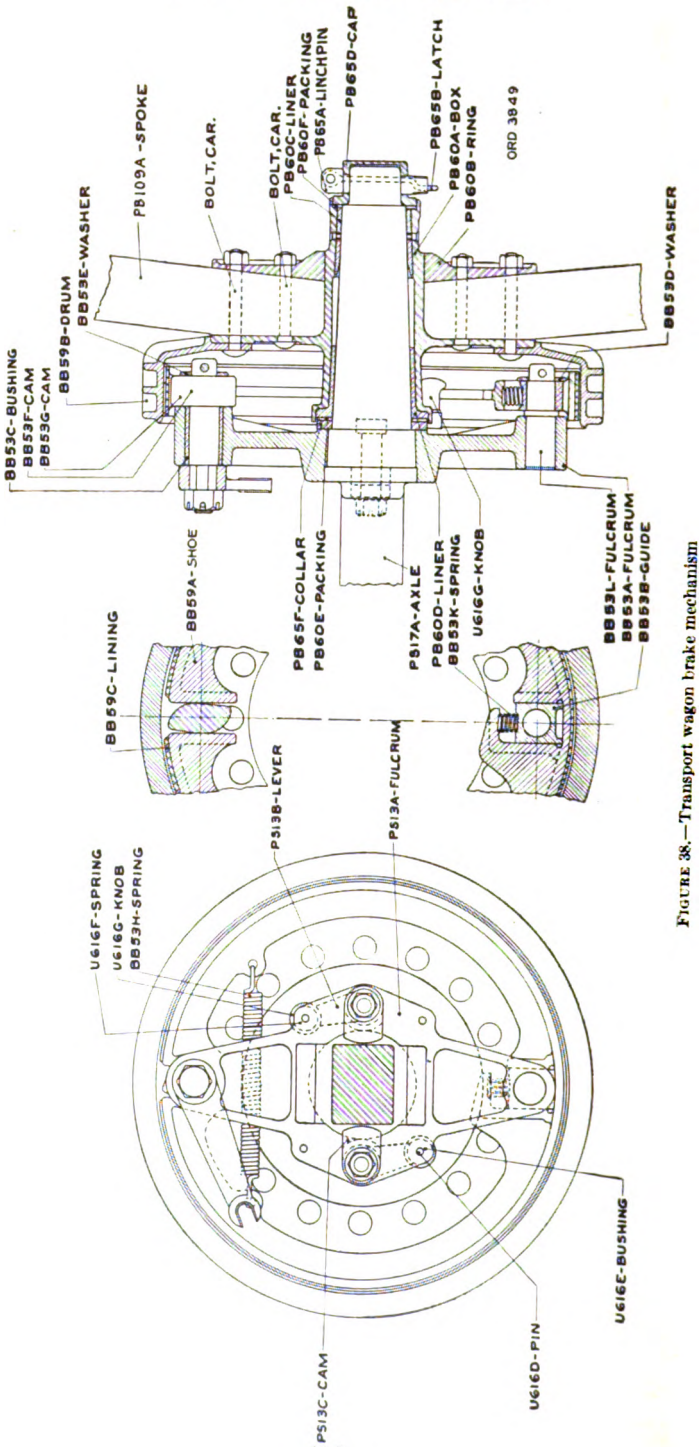


FIGURE 38.—Transport wagon brake mechanism

Reference	Item	Reference	Item
PS17A	Axle.	U616G	Knob, locking pin.
	Bolt, car., rd-head, sq-neck, 9/16 by 4 1/2 inches.	PB65B	Latch, linchpin, L. H.
		PS13B	Lever, cam.
	Bolt, car., rd-hd, sq-neck, 5/8 by 5 5/16 inches.	PB65A	Linchpin.
		PB60D	Liner, hub, inner.
PB60A	Box, hub.	PB60C	Liner, hub, outer.
BB53C	Bushing, brake cam.	BB59C	Lining, brake band.
U616E	Bushing, locking pin.	PB60E	Packing, hub liner, inner.
BB53G	Cam, brake, L. H.	PB60F	Packing, hub liner, outer.
BB53F	Cam, brake, R. H.	U616D	Pin, locking.
PS13C	Cam, locking, brake.	PB60B	Ring, hub.
PB65D	Cap, axle.	BB59A	Shoe, brake.
PB65F	Collar, axle.	PB109A	Spoke.
BB59B	Drum, brake.	BB53H	Spring, brake release.
BB53A	Fulcrum, brake cam.	BB53K	Spring, fulcrum.
PS13A	Fulcrum, brake cam.	U616F	Spring, lock pin.
BB53L	Fulcrum, brake shoe.	BB53E	Washer, brake cam.
BB53B	Guide, brake band.	BB53D	Washer, brake shoe fulcrum.

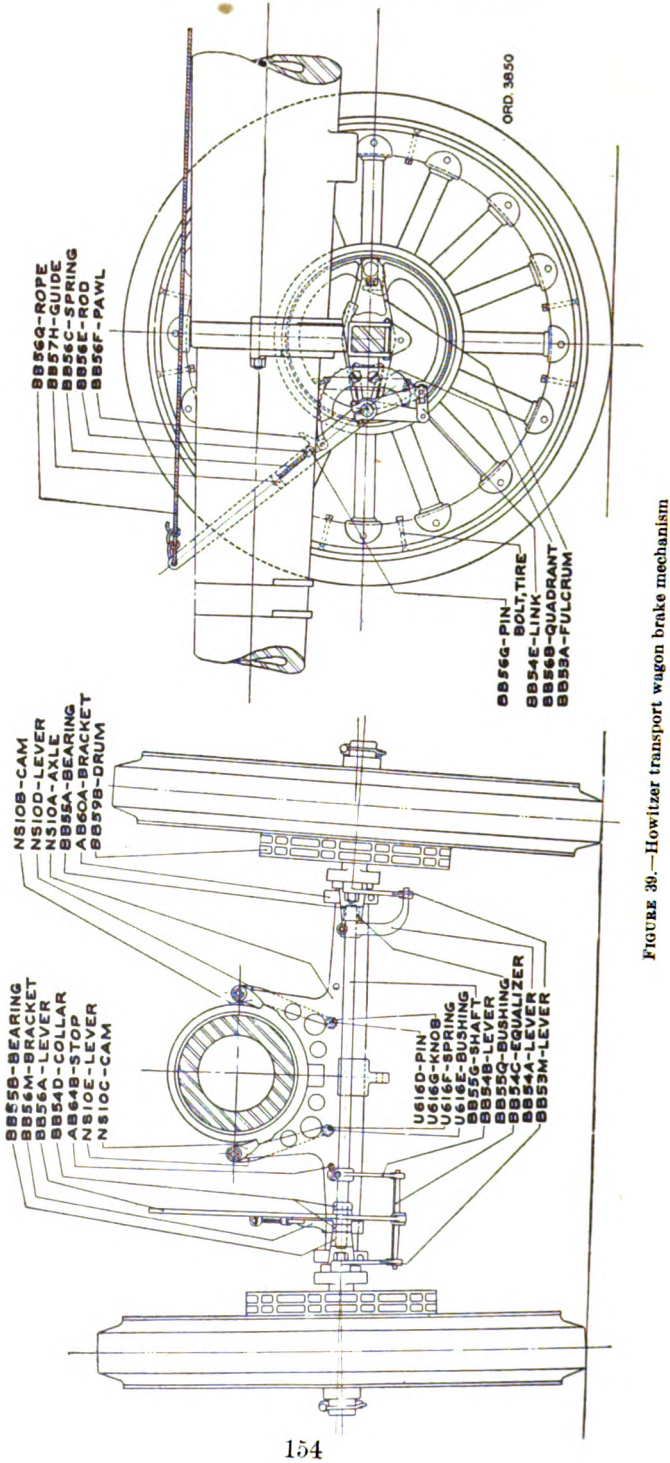


FIGURE 39.—Howitzer transport wagon brake mechanism

Reference	Item	Reference	Item
NS10A	Axle.	BB54B	Lever, equalizer.
BB55B	Bearing, gun brake shaft, L. H.	NS10E	Lever, gun lock, L. H.
BB55A	Bearing, gun brake shaft, R. H.	NS10D	Lever, gun lock, R. H.
	Bolt, tire, ⅜ by 4 7/16 inches, with square nut and plain washer.	BB54A	Lever, operating, brake.
		BB56A	Lever, operating, howitzer.
AB60A	Bracket, brace rod.	BB54E	Link, equalizer.
BB56M	Bracket, howitzer brake quadrant.	BB56F	Pawl, brake.
BB55Q	Bushing, brake shaft bearing.	U616D	Pin, locking.
U616E	Bushing, locking pin.	BB56G	Pin, spring guide.
NS10C	Cam, lock lever, L. H.	BB56B	Quadrant, howitzer brake.
NS10B	Cam, lock lever, R. H.	BB56E	Rod, spring.
BB54D	Collar, brake shaft.	BB56Q	Rope, brake lever.
BB59B	Drum, brake.	BB55G	Shaft, gun brake.
BB54C	Equalizer, brake.	U616F	Spring, lock pin.
BB57H	Guide, spring rod.	BB56C	Spring, pawl.
U616G	Knob, locking pin.	AB64B	Stop, lock lever.
BB53M	Lever, brake cam.	BB56D	Stud, brake pawl.

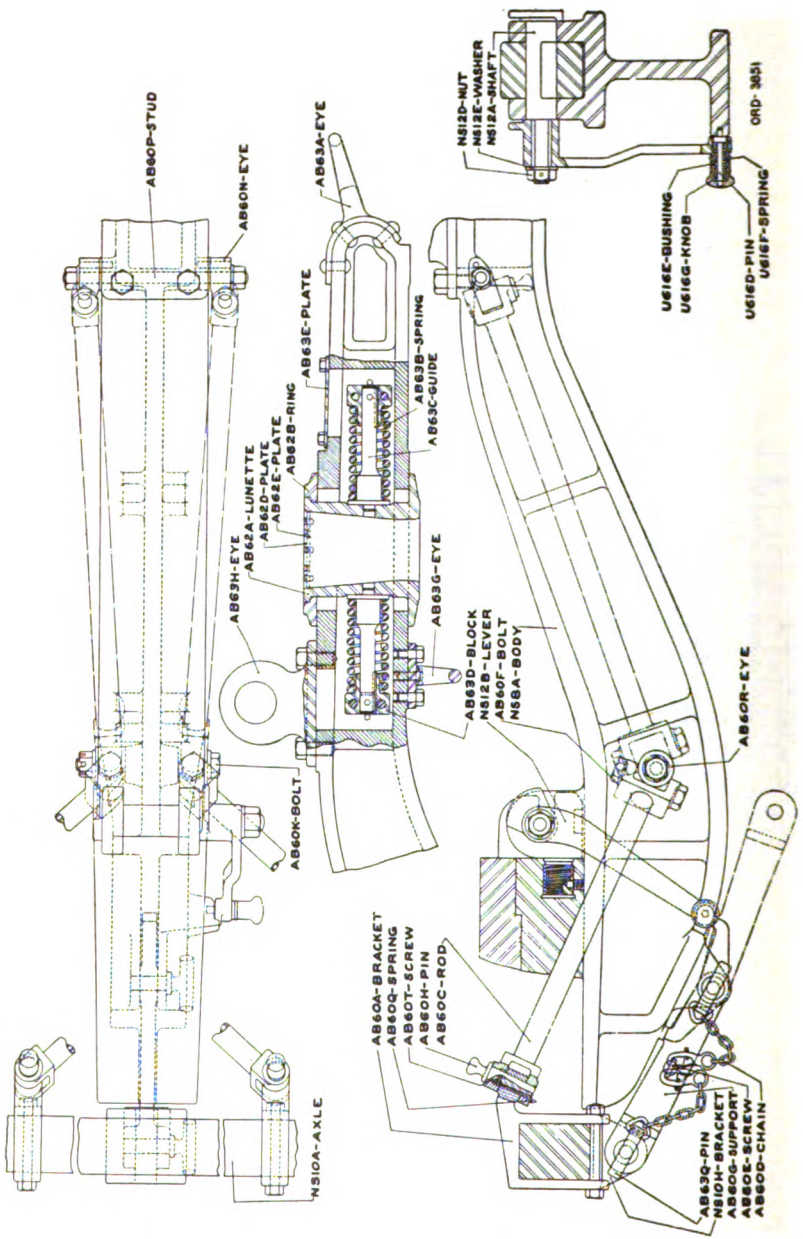


FIGURE 40.—Howitzer transport wagon false trail connections

Reference	Item	Reference	Item
NS10A	Axle.	NS12D	Nut, locking shaft.
AB63D	Block, spring guide.	AB63Q	Pin, connecting.
AB60F	Bolt, brace rod eye, lower.	AB60H	Pin, lock.
AB60K	Bolt, brace rod eye, upper.	U616D	Pin, locking.
NS8A	Body, gun false trail.	AB62E	Plate, butt, lunette, lower.
NS10H	Bracket, axle.	AB62D	Plate, butt, lunette, upper.
AB60A	Bracket, brace rod.	AB63E	Plate, cover.
U616E	Bushing, locking pin.	AB62B	Ring, lunette.
AB60D	Chain.	AB60C	Rod, brace.
AB60R	Eye, brace rod, lower.	AB60E	Screw, eye.
AB60N	Eye, brace rod, upper.	AB60T	Screw, latch spring.
AB63H	Eye, cable.	NS12A	Shaft, locking.
AB63A	Eye, end limit chain.	AB60Q	Spring, latch.
AB63G	Eye, limit chain.	U616F	Spring, lock pin.
AB63C	Guide, spring.	AB63B	Spring, pintle eye.
U616G	Knob, locking pin.	AB60P	Stud, brace rod eye, upper.
NS12B	Lever, locking.	AB60G	Support, false trail.
AB62A	Lunette.	NS12E	Washer, locking shaft.

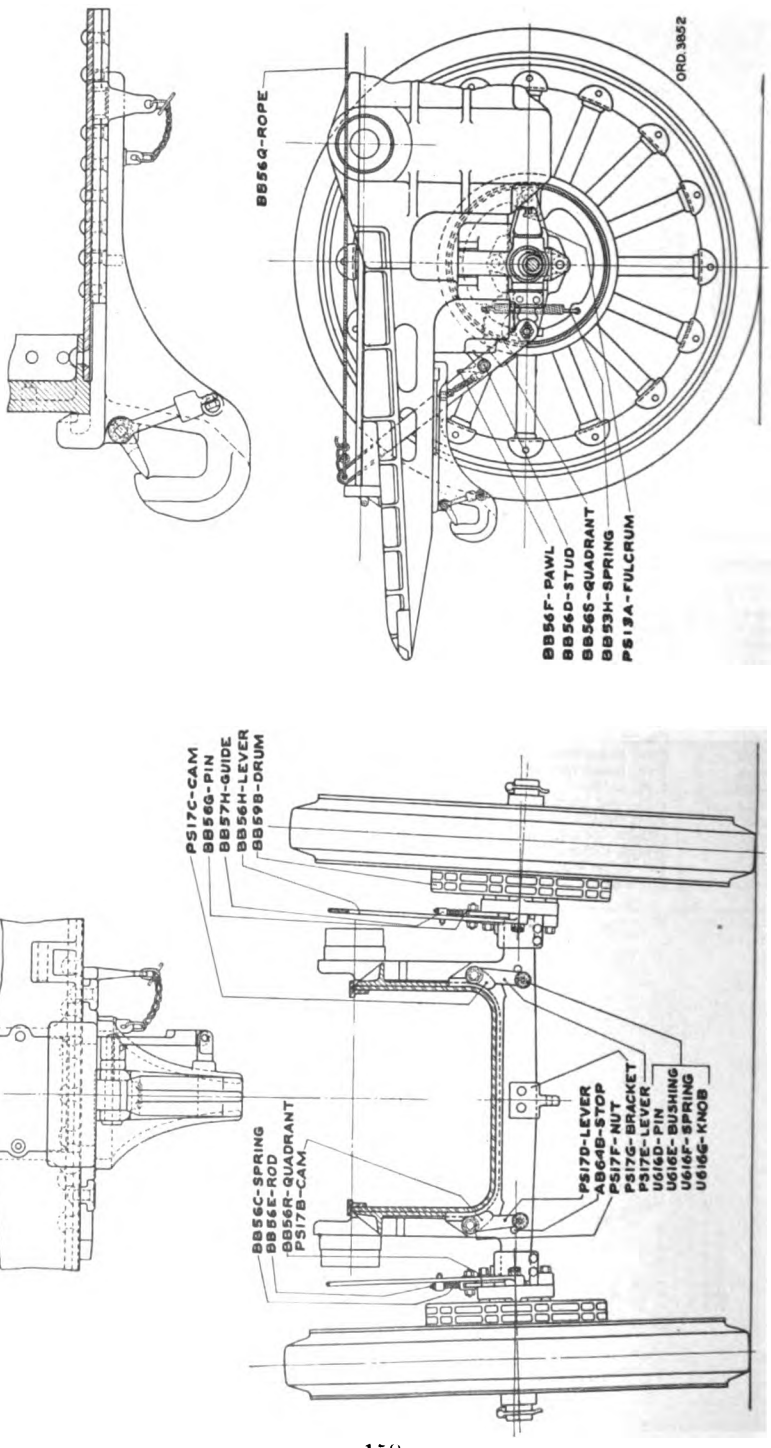


FIGURE 41.—Cradle transport wagon brake mechanism

Reference	Item	Reference	Item
U616E	Bushing, locking pin.	U616D	Pin, locking.
PS17C	Cam, cradle lock lever, L. H.	BB56G	Pin, spring guide.
PS17B	Cam, cradle lock lever, R. H.	BB56S	Quadrant, cradle brake, L. H.
BB59B	Drum, brake.	BB56R	Quadrant, cradle brake, R. H.
PS13A	Fulcrum, brake cam.	BB56E	Rod, spring.
BB57H	Guide, spring rod.	BB56Q	Rope, brake lever.
U616G	Knob, locking pin.	BB53H	Spring, brake release.
PS17E	Lever, cradle lock, L. H.	U616F	Spring, lock pin.
PS17D	Lever, cradle lock, R. H.	BB56C	Spring, pawl.
BB56H	Lever, operating, cradle.	AB64B	Stop, lock lever.
PS17F	Nut, cradle lock lever.	BB56D	Stud, brake pawl.
BB56F	Pawl, brake.		

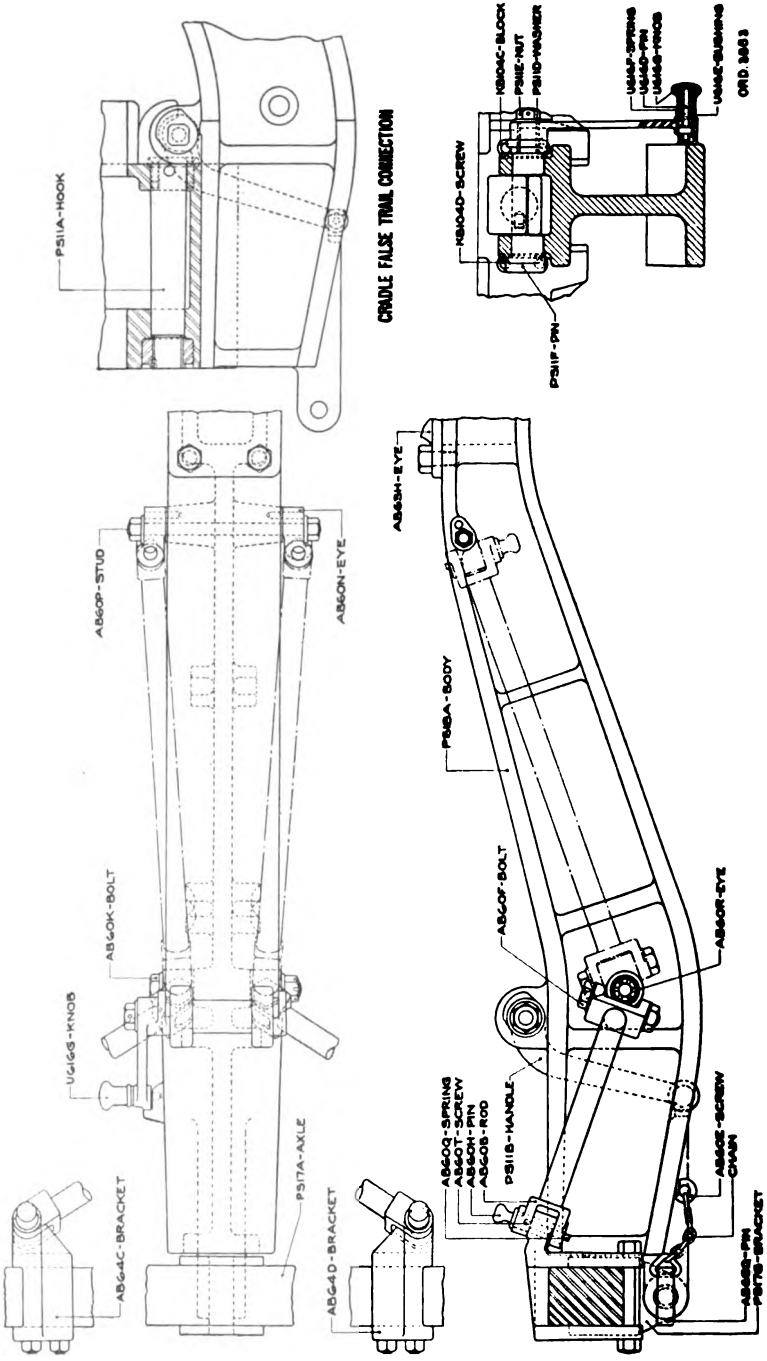


FIGURE 42.—Cradle transport wagon false trail connections

Reference	Item	Reference	Item
PS17A	Axle.	U616G	Knob, locking pin.
KB104C	Block, stop.	PS11E	Nut, false trail lock pin.
PS18A	Body, cradle false trail.	AB63Q	Pin, connecting.
AB60F	Bolt, brace rod eye, lower.	PS11F	Pin, false trail lock.
AB60K	Bolt, brace rod eye, upper.	AB60H	Pin, lock.
PS17G	Bracket, axle.	U616D	Pin, locking.
AB64D	Bracket, cradle brace rod, L. H.	AB60B	Rod, brace.
AB64C	Bracket, cradle brace rod, R. H.	AB60E	Screw, eye.
U616E	Bushing, locking pin.	AB60T	Screw, latch spring.
----------	Chain.	KB104D	Screw, stop block securing.
AB60R	Eye, brace rod, lower.	AB60Q	Spring, latch.
AB60N	Eye, brace rod, upper.	U616F	Spring, lock pin.
AB63H	Eye, cable.	AB60P	Stud, brace rod eye, upper.
PS11B	Handle, lock.	PS11D	Washer, false trail lock pin.
PS11A	Hook, coupling.		

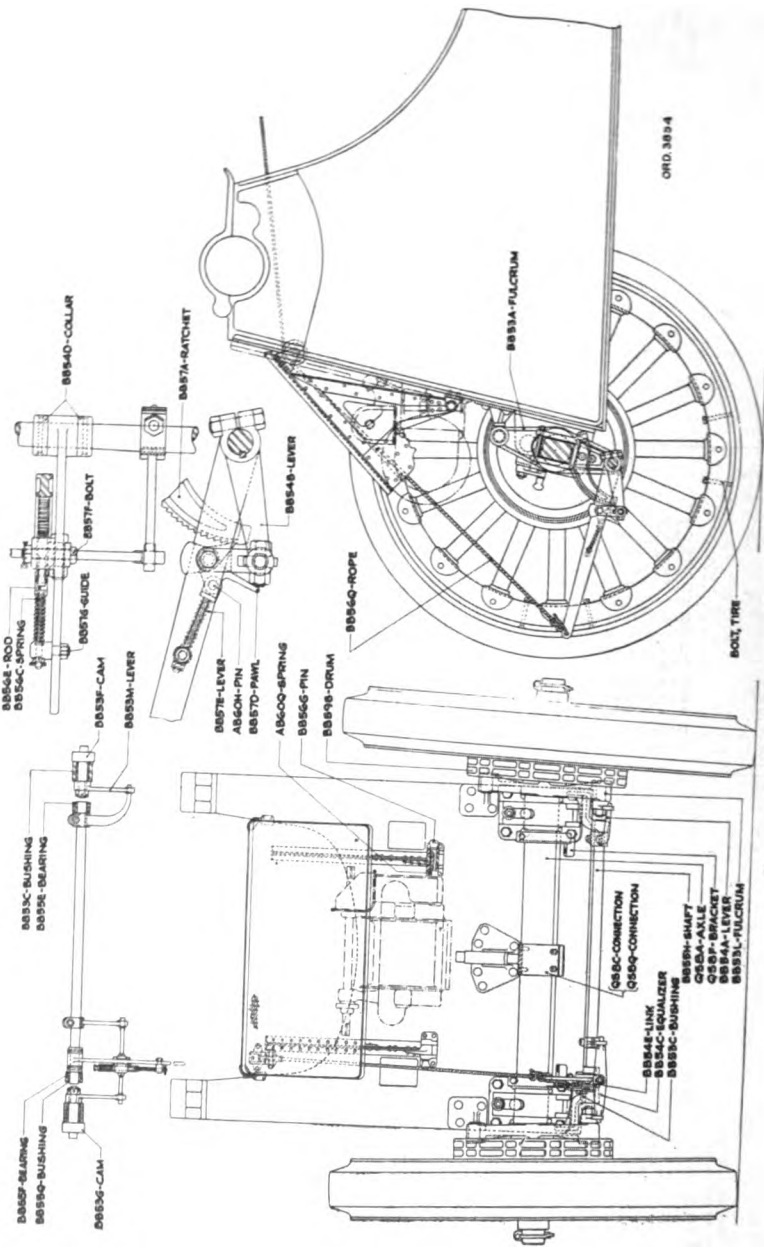


FIGURE 43.—Top carriage transport wagon brake mechanism

Reference	Item	Reference	Item
QS8A	Axle.	BB53A	Fulcrum, brake cam.
BB55F	Bearing, top carriage brake shaft, L. H.	BB53L	Fulcrum, brake shoe.
		BB57G	Guide, spring rod.
BB55E	Bearing, top carriage brake shaft, R. H.	BB53M	Lever, brake cam.
		BB54B	Lever, equalizer.
BB57F	Bolt, brake pawl.	BB54A	Lever, operating, brake.
QS8F	Bracket, brace rod.	BB57E	Lever, operating, hand.
BB53C	Bushing, brake cam.	BB54E	Link, equalizer.
BB55Q	Bushing, brake shaft bearing.	BB57D	Pawl, brake.
BB53G	Cam, brake, L. H.	AB60H	Pin, lock.
BB53F	Cam, brake, R. H.	BB56G	Pin, spring guide.
BB54D	Collar, brake shaft.	BB57A	Ratchet, brake.
QS8C	Connection, false trail (may be of cast steel or forged steel).	BB56E	Rod, spring.
		BB56Q	Rope, brake lever.
QS8Q	Connection, false trail (optional design).	BB55H	Shaft, top carriage brake.
		AB60Q	Spring, latch.
BB59B	Drum, brake.	BB56C	Spring, pawl.
BB54C	Equalizer, brake.		

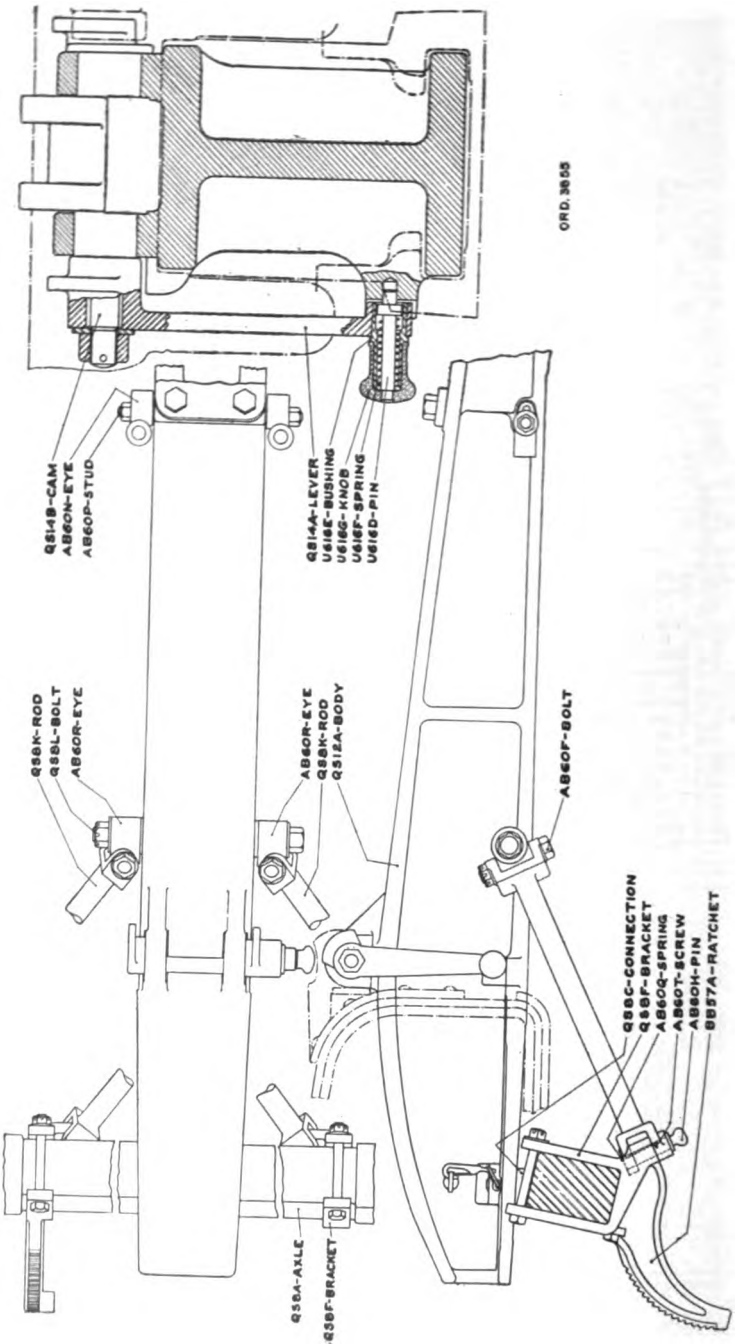


FIGURE 44.—Top carriage transport wagon false trail connections

Reference	Item	Reference	Item
QS8A	Axle.	U616G	Knob, locking pin.
QS12A	Body, top carriage false trail.	QS14A	Lever, lock cam.
AB60F	Bolt, brace rod eye, lower.	AB60H	Pin, lock.
QS8L	Bolt, brace rod eye, upper.	U616D	Pin, locking.
QS8F	Bracket, brace rod.	BB57A	Ratchet, brake.
U616E	Bushing, locking pin.	QS8K	Rod, brace.
QS14B	Cam, lock.	AB60T	Screw, latch spring.
QS8C	Connection, false trail.	AB60Q	Spring, latch.
AB60R	Eye, brace rod, lower.	U616F	Spring, lock pin.
AB60N	Eye, brace rod, upper.	AB60P	Stud, brace rod eye, upper.

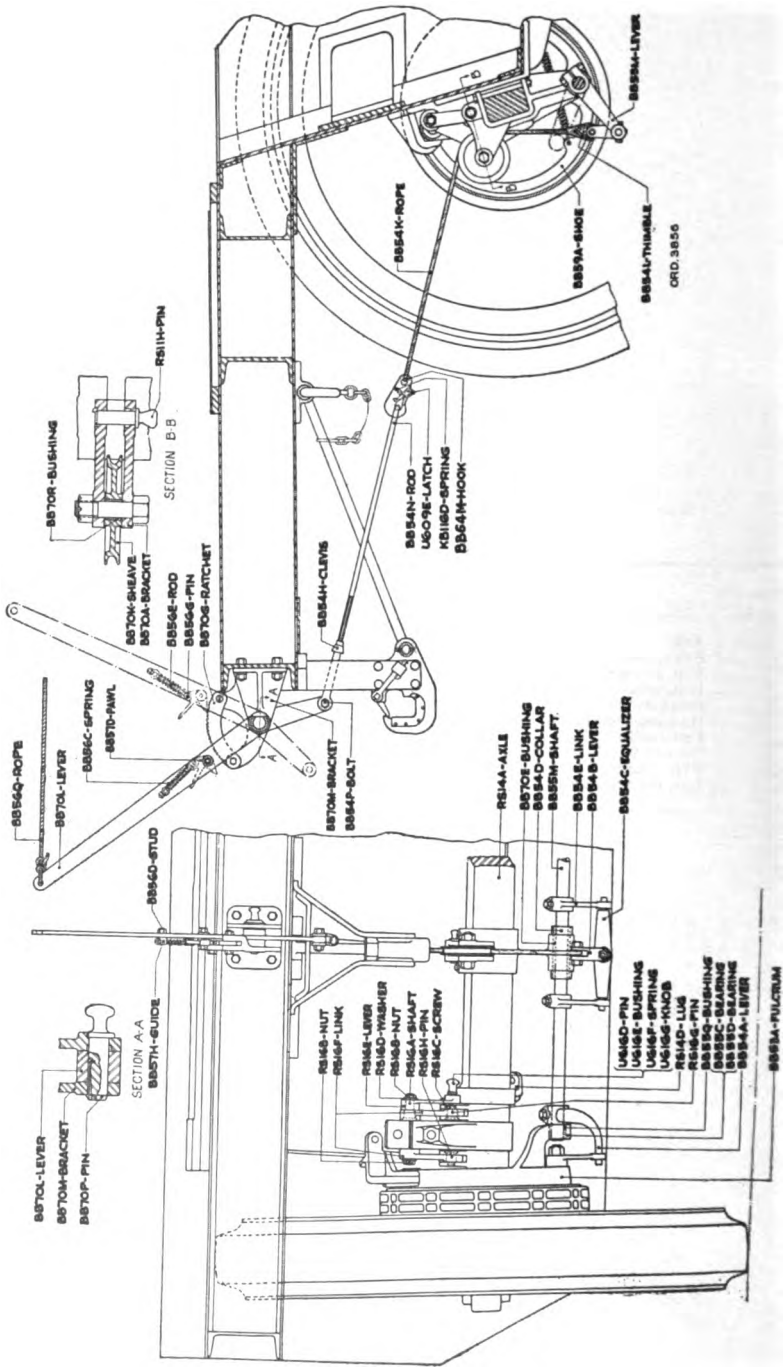


FIGURE 48.—Platform vehicle brake mechanism

Reference	Item	Reference	Item
RS14A	Axle.	RS14D	Lug, brace, R. H.
BB55D	Bearing, platform brake shaft, L. H.	RS16B	Nut, axle locking shaft.
BB55C	Bearing, platform brake shaft, R. H.	BB57D	Pawl, brake.
BB54P	Bolt, brake clevis.	RS11H	Pin, brace rod lock.
BB70M	Bracket, brake.	RS16G	Pin, link, inner.
BB70A	Bracket, brake sheave.	RS16H	Pin, link, outer.
BB55Q	Bushing, brake shaft bearing.	BB70P	Pin, lock.
BB70E	Bushing, brake sheave bracket.	U616D	Pin, locking.
U616E	Bushing, locking pin.	BB56G	Pin, spring guide.
BB70R	Bushing, sheave.	BB70G	Ratchet, brake.
BB54H	Clevis, brake.	BB54N	Rod, brake connecting.
BB54D	Collar, brake shaft.	BB56E	Rod, spring.
BB54C	Equalizer, brake.	BB54K	Rope, brake connecting.
BB53A	Fulcrum, brake cam.	BB56Q	Rope, brake lever.
BB57H	Guide, spring rod.	RS16C	Screw, stop.
BB64M	Hook, snap.	RS16A	Shaft, axle locking.
U616G	Knob, locking pin.	BB55M	Shaft, platform brake.
U609E	Latch, hook.	BB70K	Sheave, brake (bronze or steel).
RS16E	Lever, axle locking.	BB59A	Shoe, brake.
BB70L	Lever, brake.	KB116D	Spring, latch.
BB53M	Lever, brake cam.	U616F	Spring, lock pin.
BB54B	Lever, equalizer.	BB56C	Spring, pawl.
BB54A	Lever, operating, brake.	BB56D	Stud, brake pawl.
RS16F	Link, axle locking shaft.	BB54L	Thimble 7/16 inch.
BB54E	Link, equalizer.	RS16D	Washer, axle locking shaft.

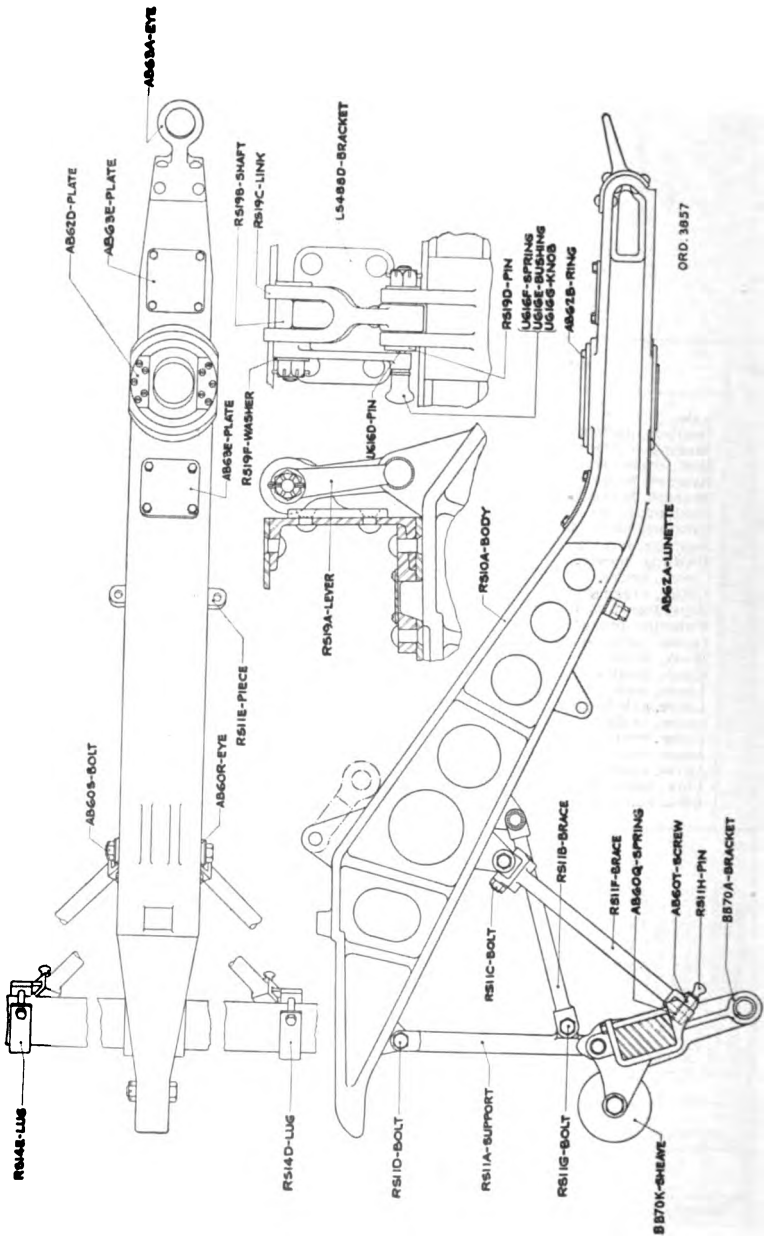


Figure 40.—Platform vehicle false trail connections

Reference	Item	Reference	Item
RS10A	Body, platform false trail.	RS14D	Lug, brace, R. H.
RS11C	Bolt, brace rod eye, lower.	AB62A	Lunette.
AB60S	Bolt, brace rod eye, upper.	RS11E	Piece, axle brace eye.
RS11D	Bolt, trail support.	RS11H	Pin, brace rod lock.
RS11G	Bolt, trail support brace.	RS19D	Pin, connecting link.
RS11F	Brace, axle.	U616D	Pin, locking.
RS11B	Brace, trail support.	AB62D	Plate, butt, lunette, upper.
BB70A	Bracket, brake sheave.	AB63E	Plate, cover.
LS488D	Bracket, locking.	AB62B	Ring, lunette.
U616E	Bushing, locking pin.	AB60T	Screw, latch spring.
AB60R	Eye, brace rod, lower.	RS19B	Shaft, trail body locking.
AB63A	Eye, end limit chain.	BB70K	Sheave, brake (bronze or steel).
U616G	Knob, locking pin.	AB60Q	Spring, latch.
RS19A	Lever, trail body locking.	U616F	Spring, lock pin.
RS19C	Link, connecting.	RS11A	Support, trail.
RS14E	Lug, brace, L. H.	RS19F	Washer, trail body locking shaft.

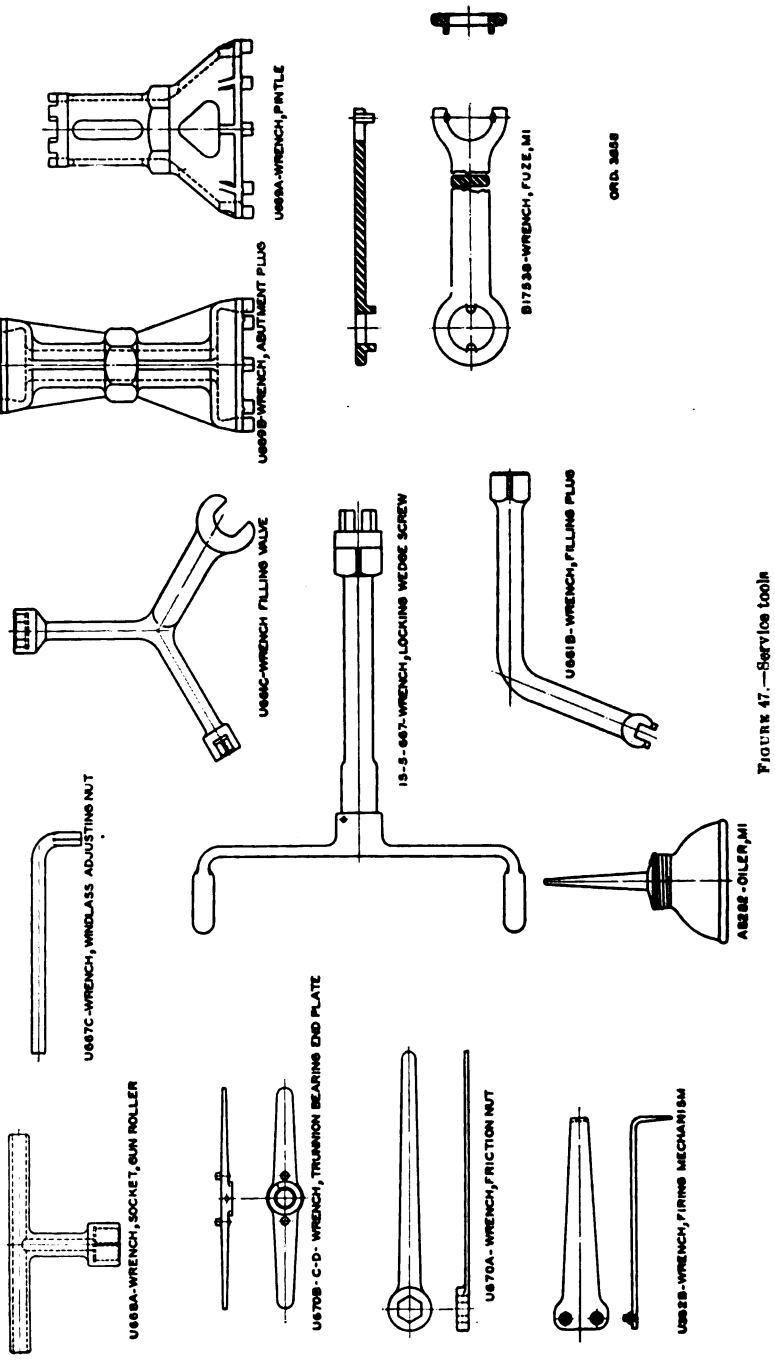


FIGURE 47.—Service tools

Reference	Item	Reference	Item
1. U668A	Wrench, socket, gun roller.	7. A8282	Oiler, M1.
2. 15-5-670	Wrench, trunnion bearing end plate.	8. U661C	Wrench, filling valve.
3. U670A	Wrench, friction nut.	9. U661B	Wrench, filling plug.
4. U332B	Wrench, firing mechanism.	10. U669B	Wrench, abutment plug.
5. U667C	Wrench, windlass adjusting nut.	11. U669A	Wrench, pintle.
6. 15-5-667	Wrench, locking wedge screw.	12. B17538	Wrench, fuze, M1.

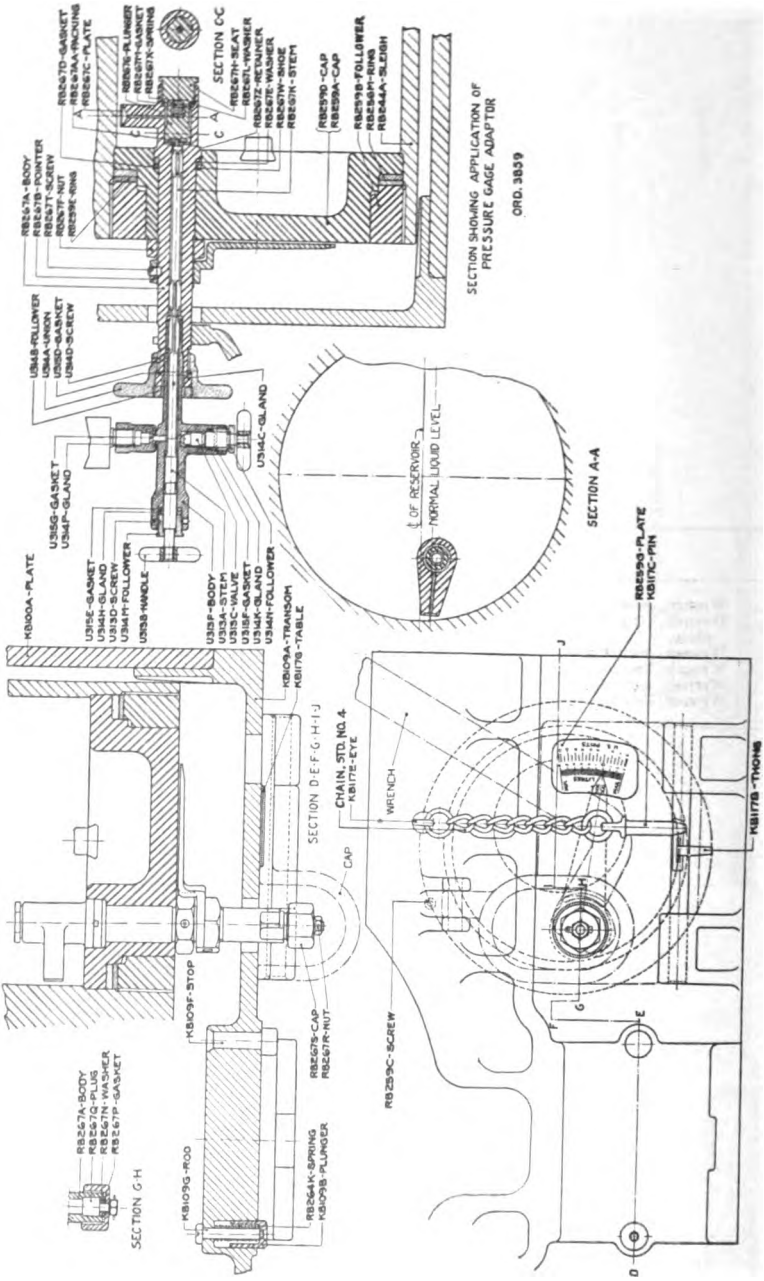


FIGURE 48.—Pressure and liquid gauge assembly

Reference	Item	Reference	Item
U313F	Body.	KB109B	Plunger, assembling pulley bracket spring.
RB267A	Body, valve stem.	RB267G	Plunger, valve.
RB259D	Cap, reservoir, left.	RB267B	Pointer, depth gauge.
RB259A	Cap, reservoir, right.	RB267Z	Retainer, valve plunger packing.
RB267S	Cap, valve body.	RB256M	Ring, packing, recuperator packing box, large.
	Chain, standard, No. 4, assembly.	RB259E	Ring, packing, reservoir cap, bronze.
KB117E	Eye, locking pin chain.	KB109G	Rod, assembling pulley bracket plunger.
U314N	Follower, adapter needle valve.	RB259C	Screw, lock, reservoir cap securing nut.
U314M	Follower, adapter stem.	RB267T	Screw, pointer and nut.
RB259B	Follower, securing, reservoir cap.	U314D	Screw, set, adapter gland.
U314B	Follower, union gland.	U313D	Screw, set, adapter stem follower.
U315D	Gasket, adapter, No. 1.	RB267H	Seat, valve spring.
U315E	Gasket, adapter, No. 2.	RB267W	Shoe, pressure gauge gasket.
U315G	Gasket, adapter, No. 3.	RB244A	Sleigh, recoil.
U315F	Gasket, adapter, No. 4.	RB264K	Spring, oiler plunger.
RB267D	Gasket, pressure gauge.	RB267X	Spring, pressure gauge.
RB267M	Gasket, pressure gauge plug.	U313A	Stem, adapter.
RB267P	Gasket, sealing plug.	RB267K	Stem, valve.
U314C	Gland, adapter.	KB109F	Stop, assembling pulley bracket.
U314K	Gland, adapter needle valve.	KB117G	Table, recuperator pressure.
U314H	Gland, adapter stem.	KB117B	Thong, 6.30-inch.
U314P	Gland, pressure gauge.	KB109A	Transom, front.
U313B	Handle, adapter.	U314A	Union, pressure gauge adapter.
RB267F	Nut, lock pressure gauge.	U313C	Valve, adapter needle.
RB267R	Nut, seal plug.	RB267E	Washer, pressure gauge.
RB267AA	Packing, valve plunger.	RB267L	Washer, pressure gauge plug.
KB117C	Pin, locking, indicator and gauge cap.	RB267N	Washer, sealing plug.
KB100A	Plate, cradle bottom.		
RB259G	Plate, left reservoir cap.		
RB267C	Plate, valve.		
RB267Q	Plug, seal.		

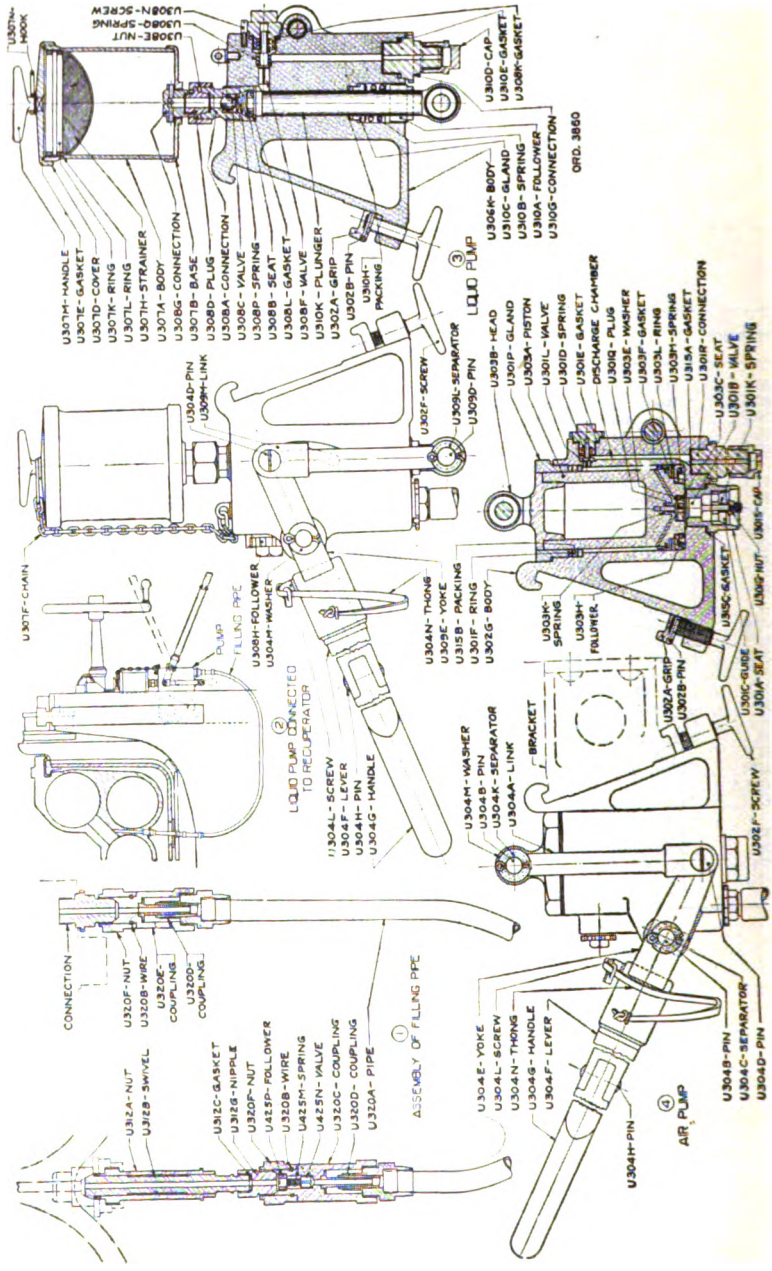


FIGURE 49.—Air pump, liquid pump, filling pipe

Reference	Item	Reference	Item
U307B	Base, reservoir.	U310H	Packing, plunger.
U302G	Body.	U304H	Pin, lever.
U306K	Body, pump.	U304D	Pin, link.
U307A	Body, reservoir.	U302B	Pin, screw, bracket grip.
U301S	Cap, connection.	U309D	Pin, yoke.
U310D	Cap, pipe connection.	U304B	Pin, yoke.
U307F	Chain, reservoir cover.	U320A	Pipe.
U301R	Connection.	U303A	Piston.
U308A	Connection, body.	U301Q	Plug, check valve.
U310G	Connection, pipe.	U308D	Plug, union.
U308G	Connection, reservoir.	U310K	Plunger.
U320D	Coupling, hose, inner.	U303L	Ring, piston gasket.
U320E	Coupling, hose, outer, "reservoir."	U301F	Ring, piston packing.
U320C	Coupling, hose, outer, "sleigh."	U307K	Ring, strainer, inner.
U307D	Cover, reservoir.	U307L	Ring, strainer, outer.
U425P	Follower, check valve.	U302F	Screw, bracket grip.
U310A	Follower, plunger packing gland spring.	U304L	Screw, eye.
U308H	Follower, valve.	U308N	Screw, outlet valve nut.
U308L	Gasket, body connection.	U308B	Seat, inlet valve spring.
U301E	Gasket, check valve plug.	U301A	Seat, intake valve.
U315A	Gasket, connection.	U303C	Seat, piston valve.
U315C	Gasket, intake valve seat.	U304C	Separator, bracket.
U310E	Gasket, pipe connection.	U304K	Separator, link.
U303F	Gasket, piston.	U309L	Separator, link.
U307E	Gasket, reservoir cover.	U301D	Spring, check valve.
U312C	Gasket, union.	U425M	Spring, check valve.
U308K	Gasket, valve nut.	U308Q	Spring, check valve.
U301P	Gland, piston.	U308P	Spring, inlet valve.
U310C	Gland, plunger packing.	U301K	Spring, intake valve.
U302A	Grip, bracket.	U303M	Spring, piston packing.
U301C	Guide, intake valve.	U303K	Spring, piston valve.
U304G	Handle, lever.	U310B	Spring, plunger packing gland.
U307M	Handle, reservoir cover.	U307H	Strainer.
U303B	Head, piston.	U312B	Swivel, long.
U307N	Hook, S, reservoir cover.	U304N	Thong, cotter pin.
U304F	Lever.	U308C	Valve, ball, inlet.
U309M	Link.	U308F	Valve, check.
U304A	Link.	U425N	Valve, check.
U312G	Nipple.	U301B	Valve, intake.
U301G	Nut, intake valve stem.	U301L	Valve, piston and check.
U303H	Follower, piston gasket.	U303E	Washer, piston valve seat.
U312A	Nut, swivel, long.	U304M	Washer, yoke pin.
U320F	Nut, swivel, short.	U320B	Wire, swivel.
U308E	Nut, union.	U304E	Yoke.
U315B	Packing, piston.	U309E	Yoke.

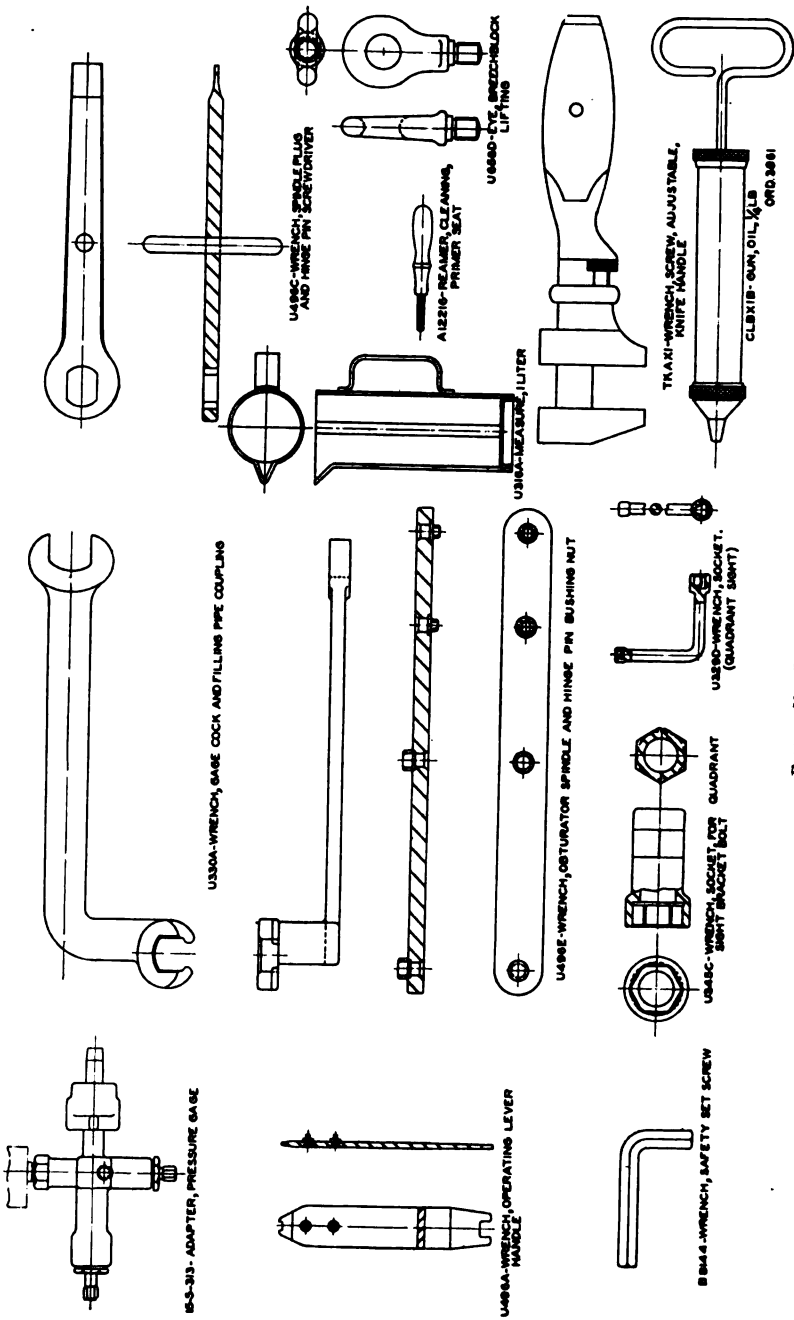


FIGURE 90.—Service tools

Reference	Item	Reference	Item
1. 15-5-313	Adapter, pressure gauge.	7. U329D	Wrench, socket (quadrant sight).
2. U496A	Wrench, operating lever handle.	8. U316A	Measure, 1-liter.
3. B8144A	Wrench, safety set screw.	9. U496C	Wrench, spindle plug and hinge pin screw driver.
4. U330A	Wrench, gauge cock and filling pipe coupling.	10. A12216	Reamer, cleaning, primer seat.
5. U496E	Wrench, obturator spindle and hinge pin bushing nut.	11. U656D	Eye, breechblock lifting.
6. U345C	Wrench, socket, for quadrant sight bracket bolt.	12. TKAX1C	Wrench, screw, adjustable, knife handle, 12 inches.
		13. CLBX1B	Gun, oil, ¼-pound.

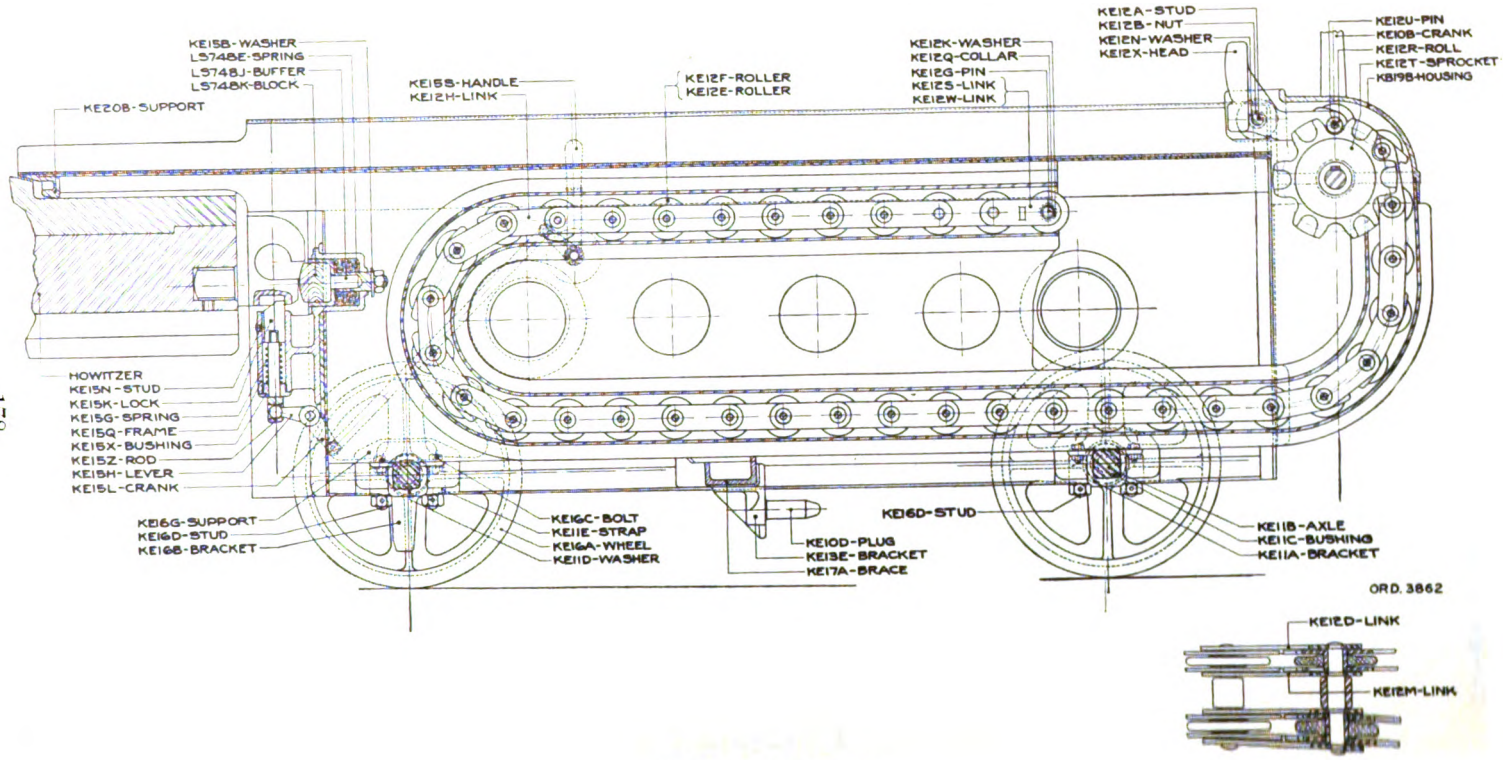


FIGURE 51.—Rammer car

Reference	Item	Reference	Item
KE11B	Axle, car.	KE15K	Lock, rammer car.
LS748K	Block, buffer (wood, 2 by 1.58 inches).	KE12B	Nut, rammer stud.
		KE12G	Pin, end roller.
KE16C	Bolt, axle bracket.	KE12U	Pin, rammer head.
KE17A	Brace, stop.	KE10D	Plug, retaining.
KE16B	Bracket, axle, front.	KE15Z	Rod, lock.
KE11A	Bracket, axle, rear.	KE12R	Roll, rammer head.
KE13E	Bracket, stop, L. H.	KE12F	Roller, with large hole.
LS748J	Buffer.	KE12E	Roller, with small hole.
KE11C	Bushing, car wheel.	LS748E	Spring, buffer.
KE15X	Bushing, lock.	KE15G	Spring, lock.
KE12Q	Collar, stop.	KE12T	Sprocket.
KE15L	Crank, bell.	KE11E	Strap, axle support.
KE10B	Crank, operating shaft.	KE16D	Stud, axle support.
KE15Q	Frame, buffer.	KE15N	Stud, key.
KE15S	Handle, locking.	KE12A	Stud, rammer.
KE12X	Head, rammer.	KE16G	Support, axle.
KE19B	Housing, sprocket wheel, upper.	KE20B	Support, tray.
KE15H	Lever, bell crank.	KE15B	Washer, buffer.
KE12H	Link, bushing.	KE11D	Washer, car axle.
KE12M	Link, inside.	KE12K	Washer, filling.
KE12W	Link, inside end.	KE12N	Washer, retaining.
KE12D	Link, outside.	KE16A	Wheel, car.
KE12S	Link, outside end.		

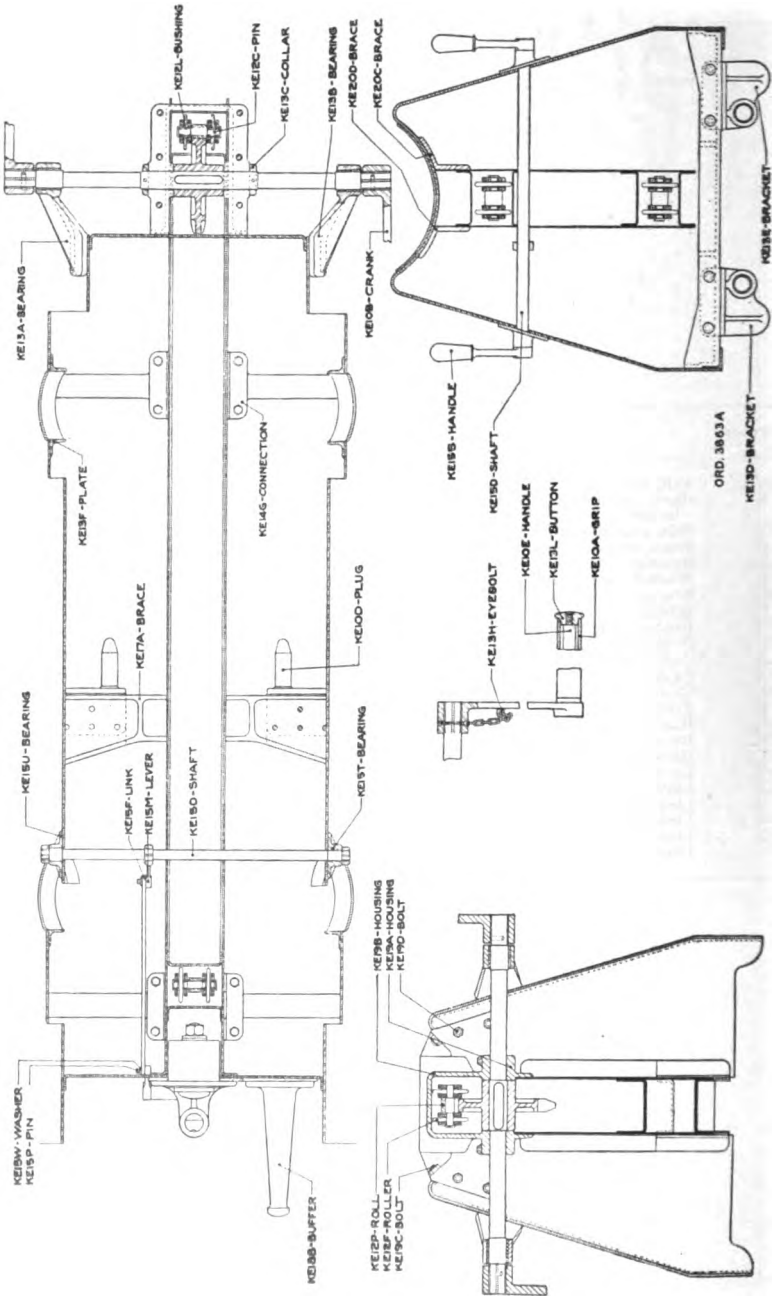


FIGURE 52.—Rammer car sections

Reference	Item
KE15T	Bearing, lock shaft, with $^{19}/_{32}$-inch ream.
KE15U	Bearing, lock shaft, with $^{3}/_{4}$-inch ream.
KE13B	Bearing, operating shaft, L. H.
KE13A	Bearing, operating shaft, R. H.
KE19C	Bolt, housing, long.
KE19D	Bolt, housing, short.
KE20D	Brace, plate, L. H.
KE20C	Brace, plate, R. H.
KE17AE	Brace, stop.
KE13D	Bracket, stop, L. H.
KE13B	Bracket, stop, R. H.
KE182L	Buffer, safety.
KE113L	Bushing, roller.
KEE13C	Button, handle.
KKE14G	Collar, operating shaft.
----------	Connection, axle strap.
KE10B	Crank, operating shaft.
KE13H	Eyebolt, crank handle chain.
KE10A	Grip, handle.
KE10E	Handle, crank.
KE15S	Handle, locking.
KE19A	Housing, sprocket wheel, lower.
KB19B	Housing, sprocket wheel, upper.
KE15M	Lever, lock shaft.
KE15F	Link, connecting.
KE15P	Pin, lever.
KE12C	Pin, roller.
KE13F	Plate, reinforcing.
KE10D	Plug, retaining.
KE12P	Roll.
KE12F	Roller, with large hole.
KE15D	Shaft, lock.
KE15W	Washer, lever pin.

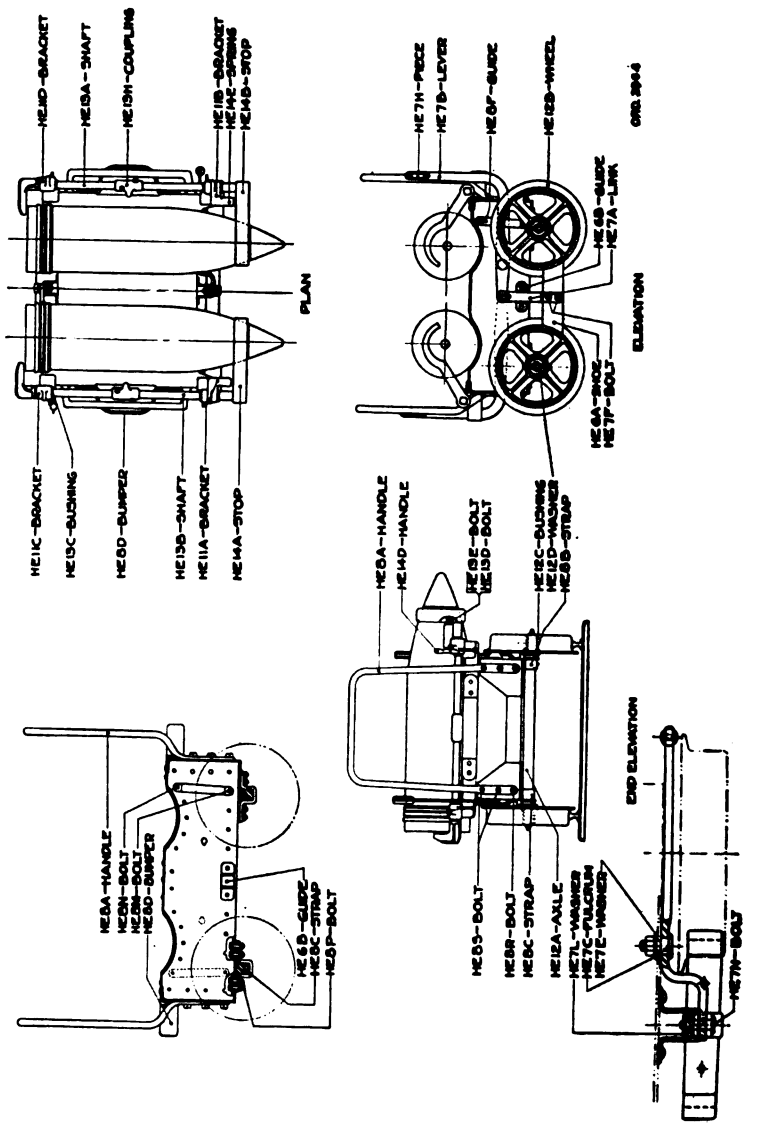


FIGURE 53.—Shot truck

Reference	Item	Reference	Item
HE12A	Axle.	HE6B	Guide.
HE8P	Bolt, axle strap.	HE8F	Guide, brake lever.
HE7N	Bolt, brake lever.	HE8A	Handle.
HE8M	Bolt, brake lever guide, lower.	HE14D	Handle, latch bolt.
HE8N	Bolt, brake lever guide, upper.	HE7B	Lever, brake.
HE7F	Bolt, brake link.	HE7A	Link, brake.
HE8R	Bolt, handle, long.	HE7H	Piece, handle.
HE8S	Bolt, handle, short.	HE13B	Shaft, front stop.
HE13E	Bolt, latch, L. H.	HE13A	Shaft, rear stop.
HE13D	Bolt, latch, R. H.	HE6A	Shoe, brake.
HE11B	Bracket, front stop shaft, L. H.	HE14E	Spring, latch.
HE11A	Bracket, front stop shaft, R. H.	HE14B	Stop, front, L. H.
HE11D	Bracket, rear stop shaft, L. H.	HE14A	Stop, front, R. H.
HE11C	Bracket, rear stop shaft, R. H.	HE8C	Strap, axle, L. H.
HE8D	Bumper.	HE8B	Strap, axle, R. H.
HE13C	Bushing, shaft stop.	HE12D	Washer, axle.
HE12C	Bushing, wheel.	HE7L	Washer, brake lever bolt.
HE13H	Coupling, stop shaft.	HE7E	Washer, brake lever fulcrum.
HE7C	Fulcrum, brake lever.	HE12B	Wheel.

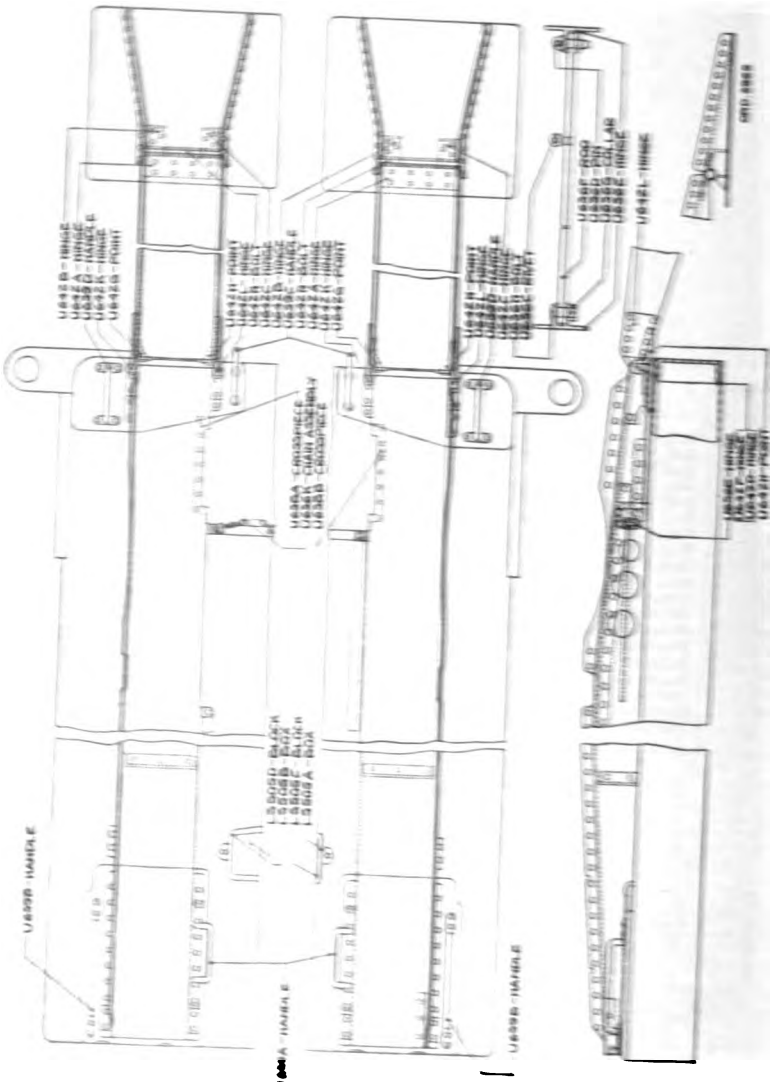


Plate No. 84 Wheel tracks

Reference	Item	Reference	Item
LS505C	Block, jack support, L. H.	U636E	Hinge.
LS505D	Block, jack support, R. H.	U642A	Hinge.
U642N	Bolt, hinge.	U642L	Hinge, L. H.
U636H	Bolt, wheel track.	U642C	Hinge, L. H.
LS505A	Box, jack support, L. H.	U642F	Hinge, L. H.
LS505B	Box, jack support, R. H.	U642K	Hinge, R. H.
U636K	Chain, assembly.	U642B	Hinge, R. H.
U636G	Collar, lock.	U642D	Hinge, R. H.
U638B	Crosspiece, rear, L. H.	U636D	Pin, lock.
U638A	Crosspiece, rear, R. H.	U642H	Point, fork, L. H.
U639A	Handle, inside, front.	U642G	Point, fork, R. H.
U639C	Handle, inside, rear.	U636C	Rivet, eye.
U639B	Handle, outside, front.	U636F	Rod tie.
U639D	Handle, outside, rear.		

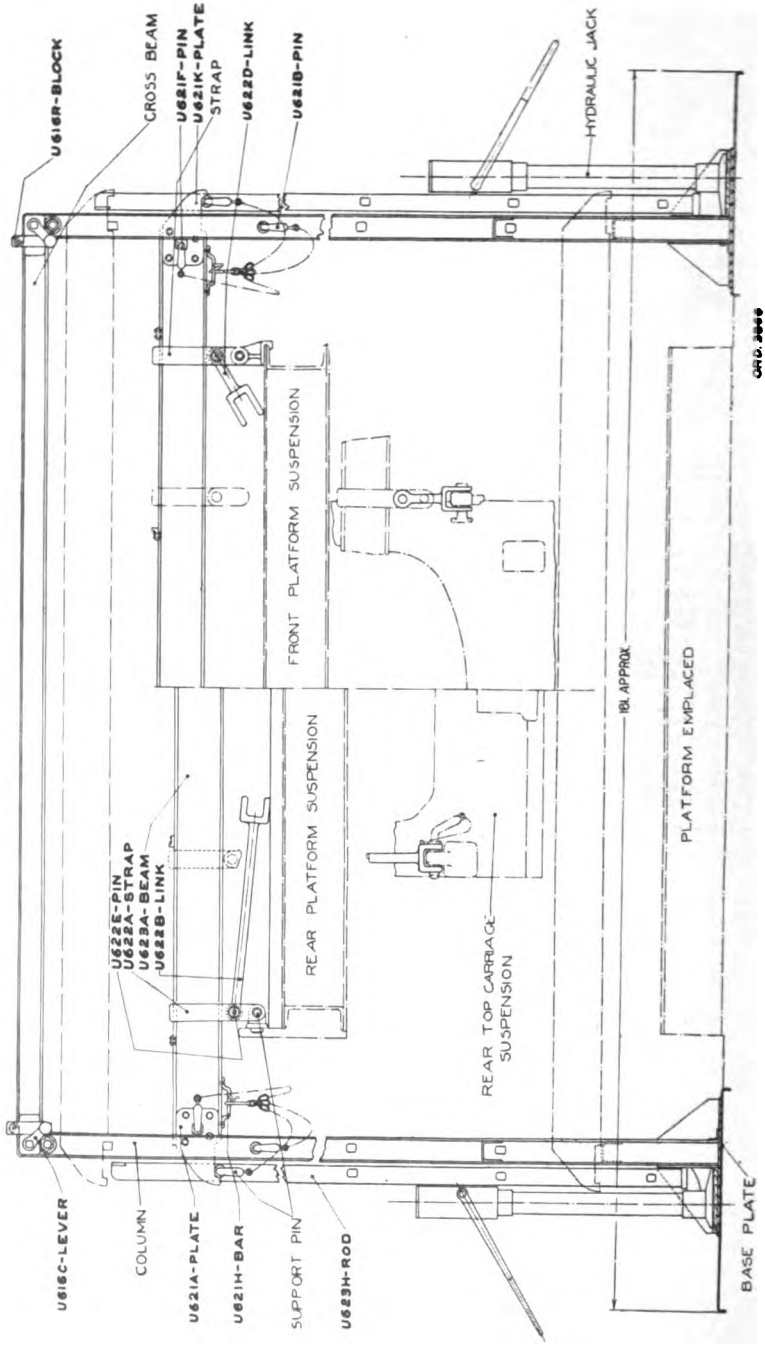


FIGURE 55.—Erecting frame

Reference	Item	Reference	Item
U621H	Bar, chain.	U621F	Pin, stop.
U623A	Beam, suspension.	U621B	Pin, support.
U616R	Block, locking, L. H.	U621K	Plate, end, L. H.
U616C	Lever, locking.	U621A	Plate, end, R. H.
U622B	Link, suspension, long.	U623H	Rod, jack.
U622D	Link, suspension, short.	U622A	Strap, suspension beam.
U622E	Pin.		

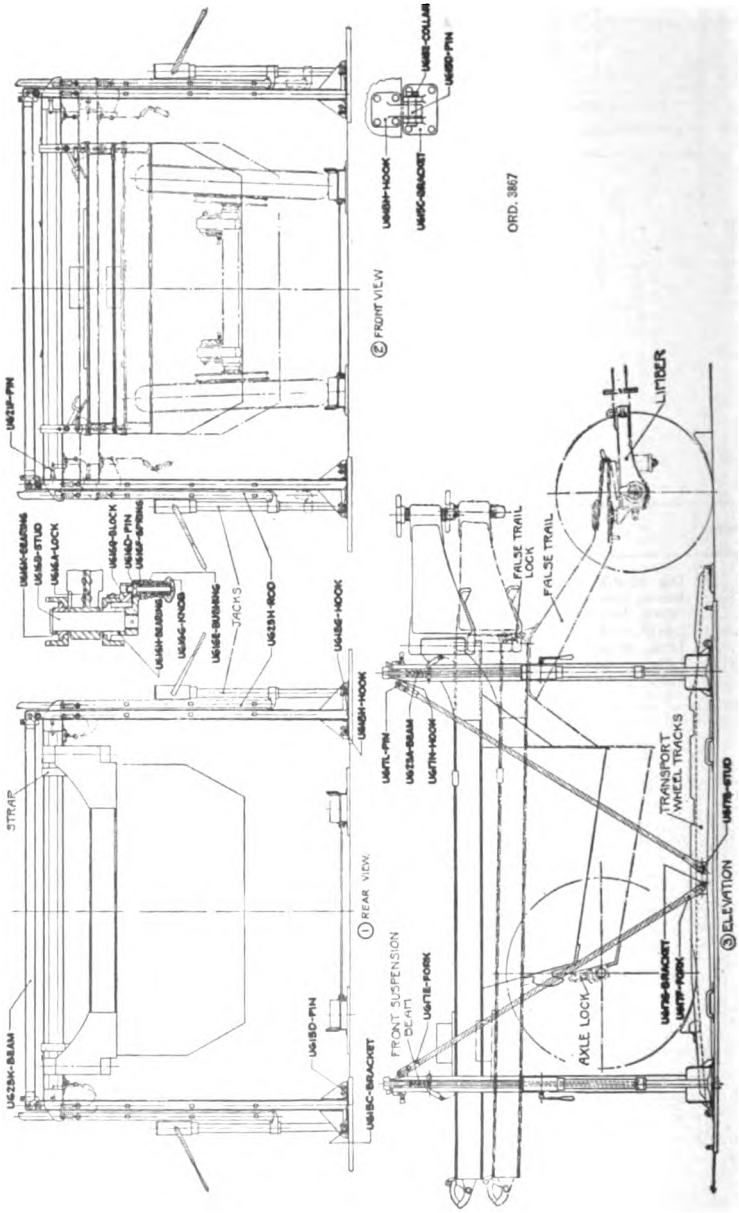


FIGURE 86.—Method of mounting platform

Reference	Item	Reference	Item
U623K	Beam, cross.	U618G	Hook.
U623A	Beam, suspension.	U617N	Hook, locking.
U616H	Bearing, front.	U616G	Knob, locking pin.
U616K	Bearing, rear.	U616A	Lock, brace.
U616Q	Block, locking, R. H.	U615D	Pin, erecting frame bracket.
U617G	Bracket, brace.	U617L	Pin, lock.
U615C	Bracket, erecting frame.	U621F	Pin, stop.
U616E	Bushing, locking pin.	U623H	Rod, jack.
U615E	Collar, erecting frame bracket pin.	U616F	Spring, lock pin.
U617F	Fork, lower.	U616B	Stud, locking.
U617E	Fork, upper.	U617B	Stud, lower fork.
U618H	Hook.		

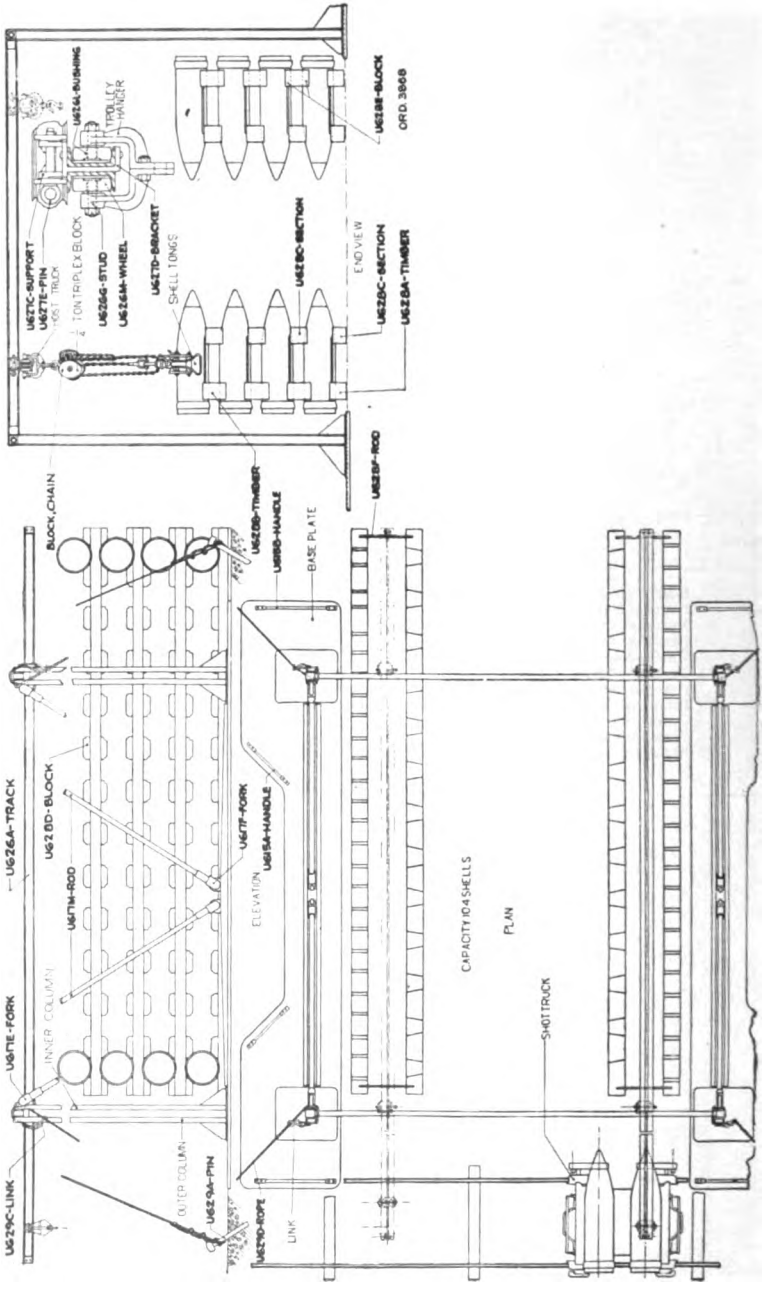


FIGURE 87.—Erecting frame as used for ammunition handling

Reference	Item	Reference	Item
.....	Block, chain, ¼-ton.	U617M.....	Rod, brace.
U628D.....	Block, plain.	U628F.....	Rod, tie.
U628E.....	Block, slotted.	U629D.....	Rope.
U627D.....	Bracket, track.	U628C.....	Section, ogive, shell rack, bottom.
U626L.....	Bushing, trolley wheel.	U628C.....	Section, ogive, shell rack, upper.
U617F.....	Fork, lower.	U626G.....	Stud, trolley wheel.
U617E.....	Fork, upper.	U627C.....	Support, track.
U615B.....	Handle, erecting frame, large.	U628A.....	Timber.
U615A.....	Handle, erecting frame, small.	U628B.....	Timber.
U629C.....	Link.	U626A.....	Track.
U627E.....	Pin, connecting.	U626M.....	Wheel, trolley.
U629A.....	Pin, guy.		

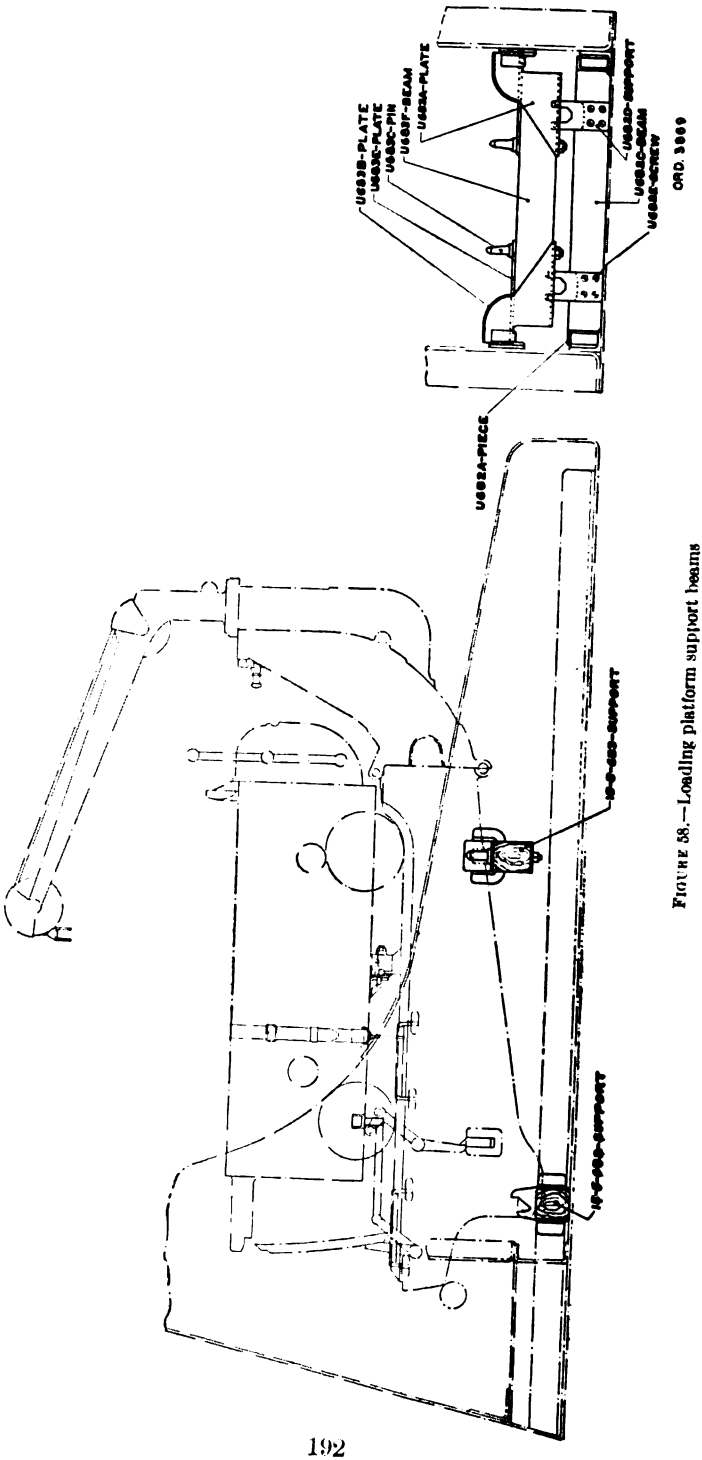


FIGURE 58.—Loading platform support beams

Reference	Item	Reference	Item
U682C	Beam.	U683E	Plate, top.
U683F	Beam, cross.	U682E	Screw, clamping.
U682A	Piece, end.	U682D	Support.
U683C	Pin, support socket.	15-5-682	Support, loading platform, front.
U683B	Plate, cap.	15-5-683	Support, loading platform, rear.
U683A	Plate, end.		

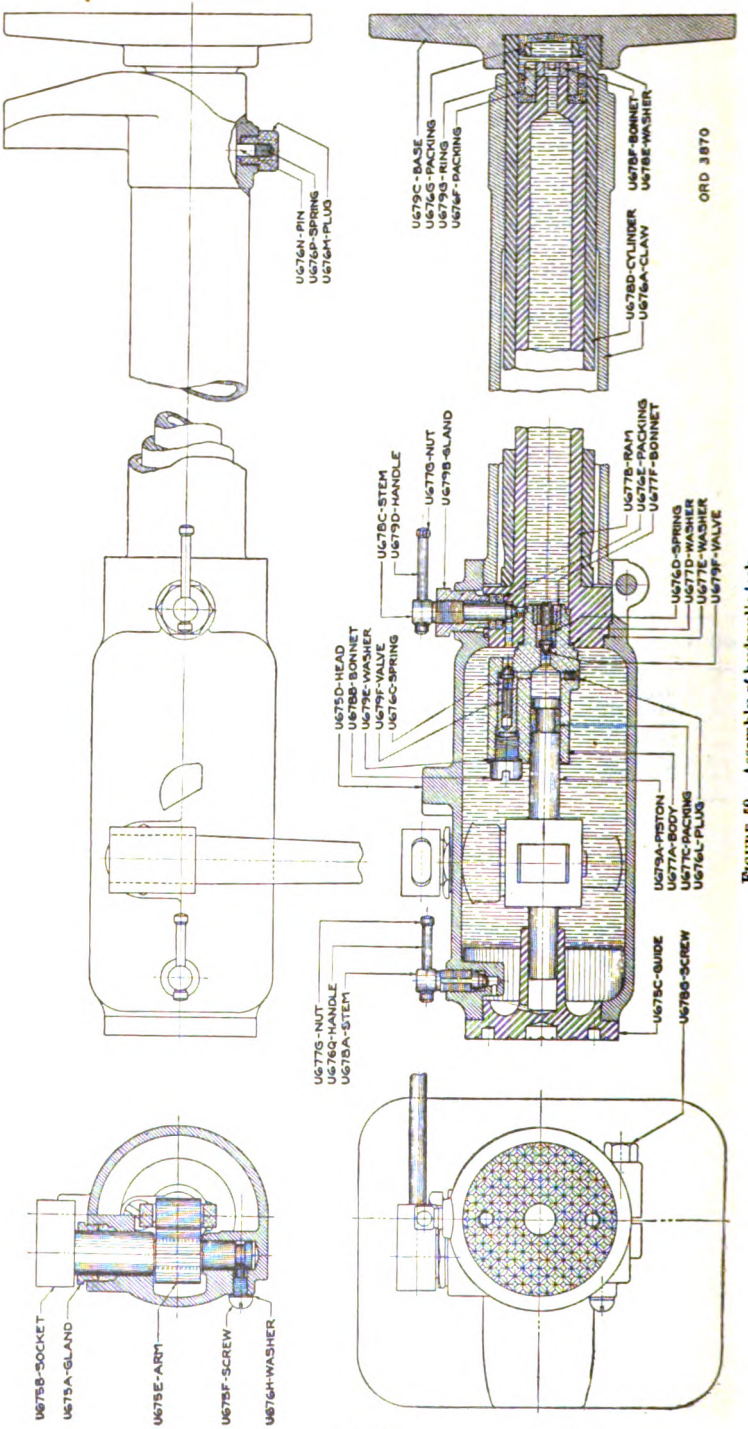


FIGURE 50.—Assembly of hydraulic jack

Reference	Item	Reference	Item
U675E	Arm.	U679A	Piston.
U679C	Base.	U676L	Plug, pump body.
U677A	Body, pump.	U676M	Plug, safety catch.
U677F	Bonnet, pressure valve.	U677B	Ram.
U678F	Bonnet, ram packing ring.	U679G	Ring, packing, ram.
U678B	Bonnet, suction valve.	U678G	Screw, clamp.
U676A	Claw.	U675F	Screw, socket.
U678D	Cylinder.	U675B	Socket.
U679B	Gland, release stem.	U676C	Spring, intake valve.
U675A	Gland, socket.	U676D	Spring, lifting valve.
U675C	Guide, cap and piston.	U676P	Spring, safety catch.
U676Q	Handle, valve stem.	U678A	Stem, air valve.
U679D	Handle, valve stem.	U678C	Stem, release valve.
U675D	Head, L. H.	U679F	Valve, jack.
U677G	Nut, valve stem handle.	U677D	Washer, packing, pump body.
U676G	Packing, cup, ram, lower.	U677E	Washer, packing, ram.
U676F	Packing, cup, ram, upper.	U678E	Washer, packing, ram.
U677C	Packing, piston.	U679E	Washer, packing, suction valve bonnet.
U676E	Packing, release stem gland.		
U676N	Pin, safety catch.	U676H	Washer, socket screw.

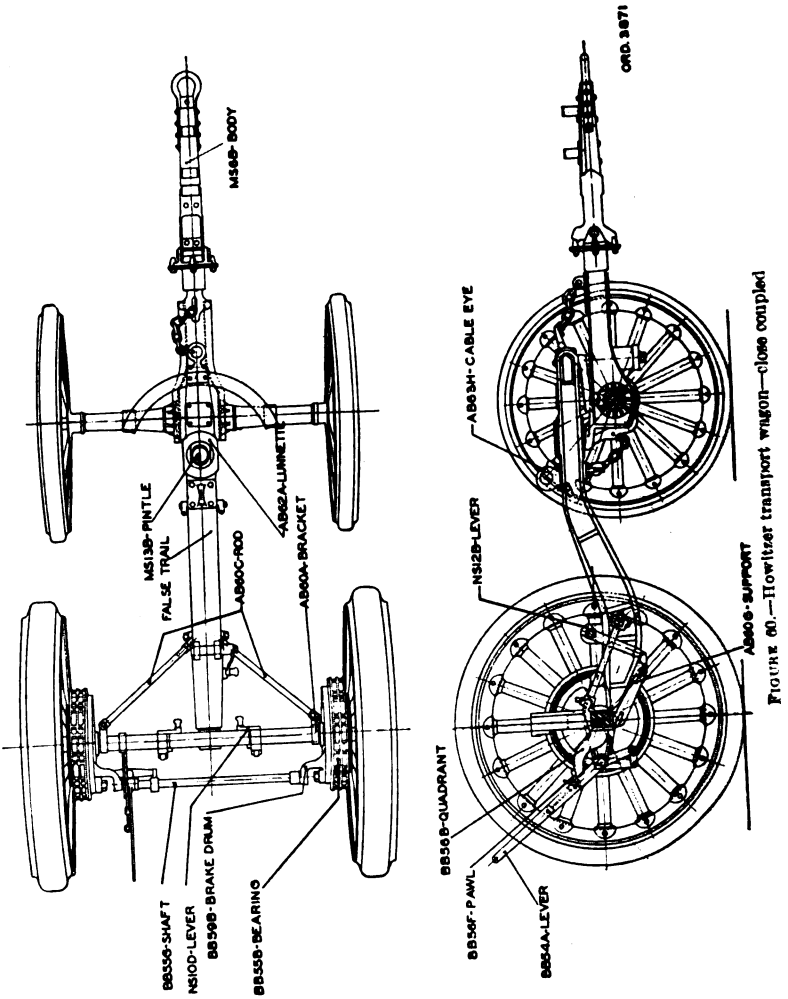
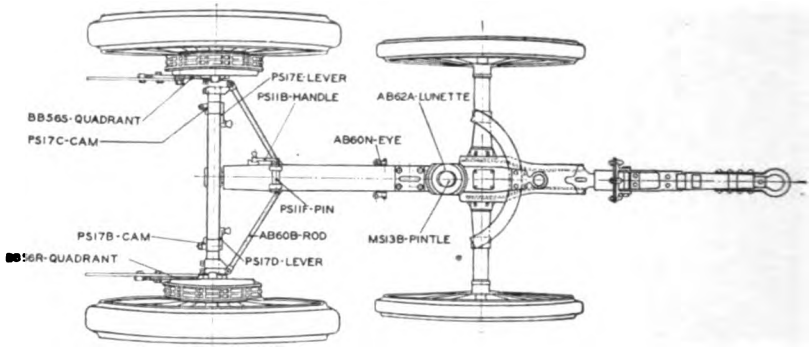


FIGURE 60.—Howitzer transport wagon—close coupled

Reference	Item	Reference	Item
BB55B	Bearing, gun brake shaft, L. H.	AB62A	Lunette.
MS6B	Body, drawbar.	BB56F	Pawl, brake.
AB60A	Bracket, brace rod.	MS13B	Pintle, limber.
BB59B	Drum, brake.	BB56B	Quadrant, howitzer brake.
AB63H	Eye, cable.	AB60C	Rod, brace.
NS12B	Lever, locking.	BB55G	Shaft, gun brake.
BB54A	Lever, operating, brake.	AB60G	Support, false trail.
BB56A	Lever, operating, howitzer.		Trail, false, assembly.



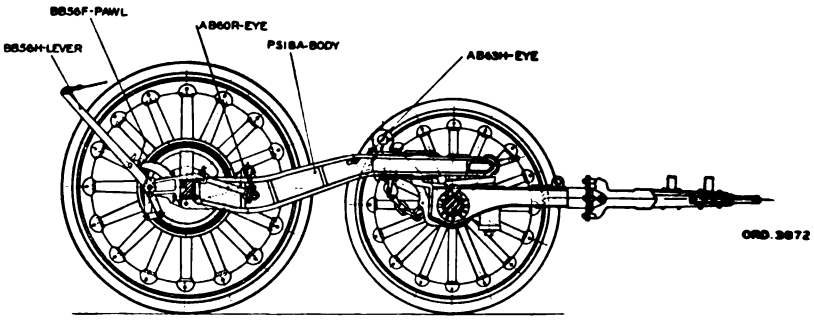


FIGURE 61.—Cradle transport wagon—close coupled

Reference	Item	Reference	Item
PS18A	Body, cradle false trail.	BB56H	Lever, operating, cradle.
PS17C	Cam, cradle lock lever, L. H.	AB62A	Lunette.
PS17B	Cam, cradle lock lever, R. H.	BB56F	Pawl, brake.
AB63H	Eye, cable.	PS11F	Pin, false trail lock.
AB60R	Eye, brace rod, lower.	MS13B	Pintle, limber.
AB60N	Eye, brace rod, upper.	BB56S	Quadrant, cradle brake, L. H.
PS11B	Handle, lock.	BB56R	Quadrant, cradle brake, R. H.
PS17E	Lever, cradle lock, L. H.	AB60B	Rod, brace.
PS17D	Lever, cradle lock, R. H.		

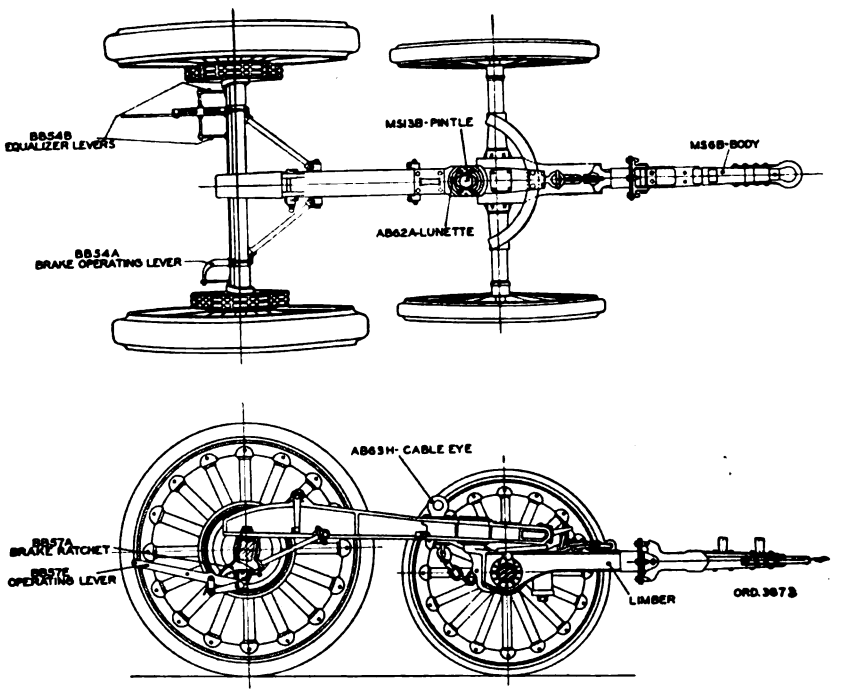


FIGURE 62.—Top carriage transport wagon—close coupled

Reference	Item	Reference	Item
MS6B	Body, drawbar.	BB54B	Lever, equalizer.
AB63H	Eye, cable.	AB62A	Lunette.
BB54A	Lever, operating, brake.	MS13B	Pintle, limber.
BB57E	Lever, operating, hand.	BB57A	Ratchet, brake.

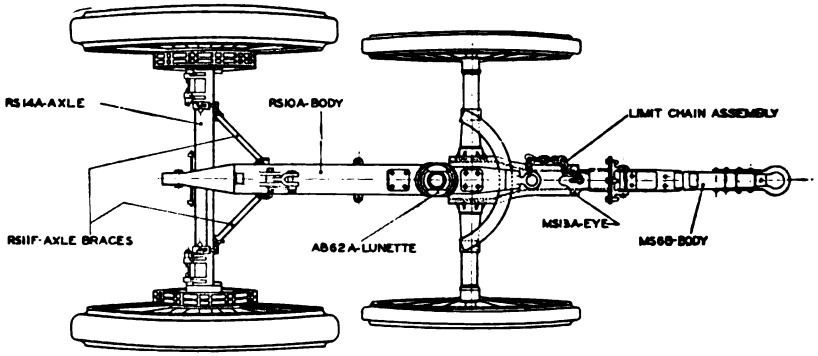


FIGURE 63.—Platform transport wagon—close coupled

Reference	Item	Reference	Item
RS14A	Axle.		Chain, limit, assembly.
MS6B	Body, drawbar.	MS13A	Eye, limit chain.
RS10A	Body, platform false trail.	AB62A	Lunette.
RS11F	Brace, axle.	MS13B	Pintle, limber.
RS11B	Brace, trail support.	RS11A	Support, trail.

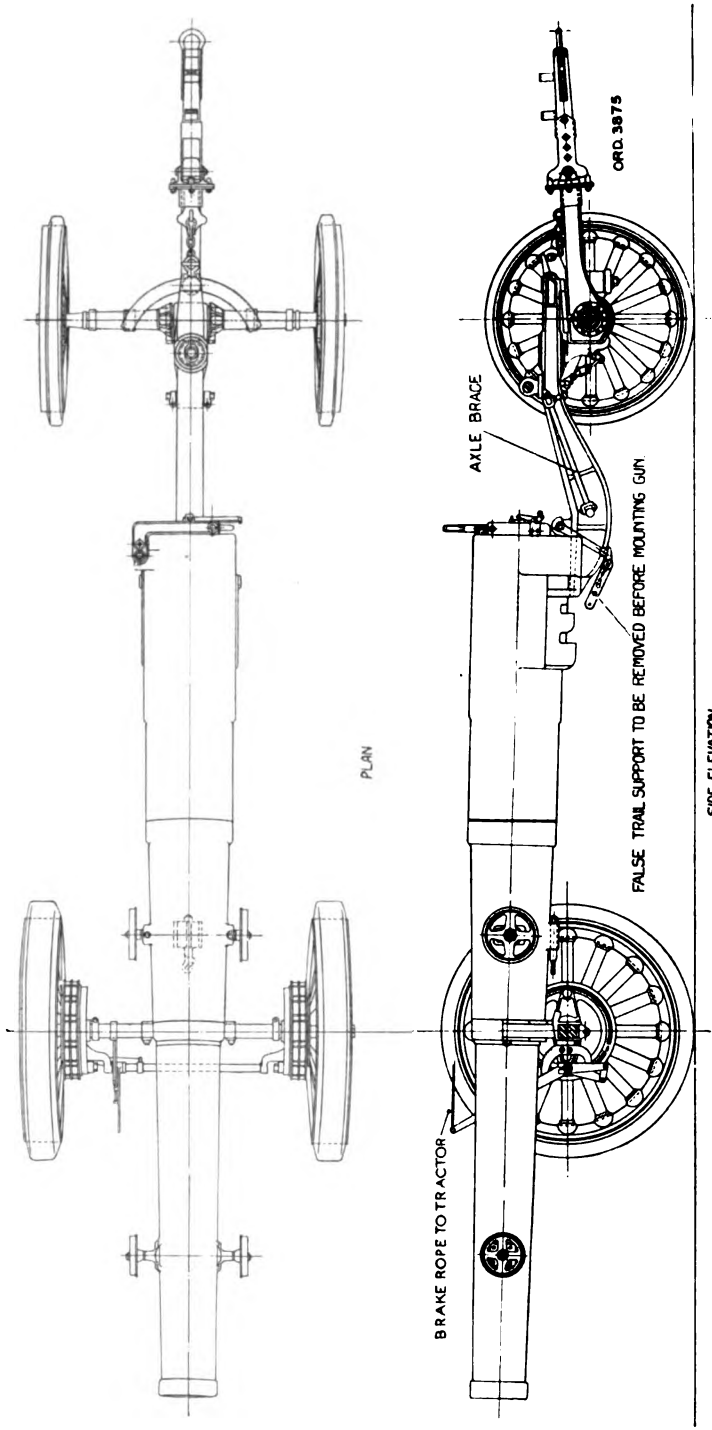


FIGURE 64.—Howitzer transport wagon—with howitzer in place

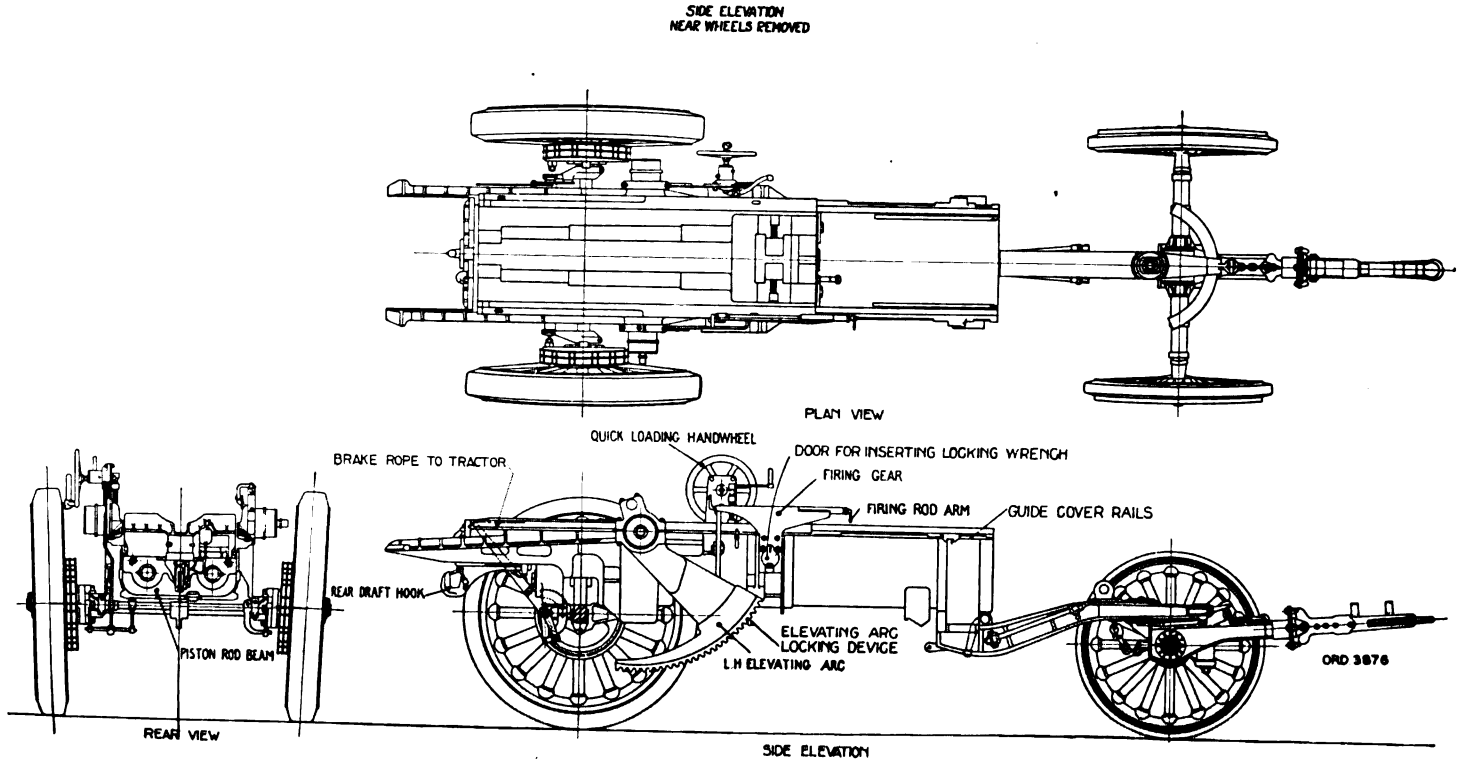


FIGURE 65.—Cradle transport wagon with cradle in place—plan view

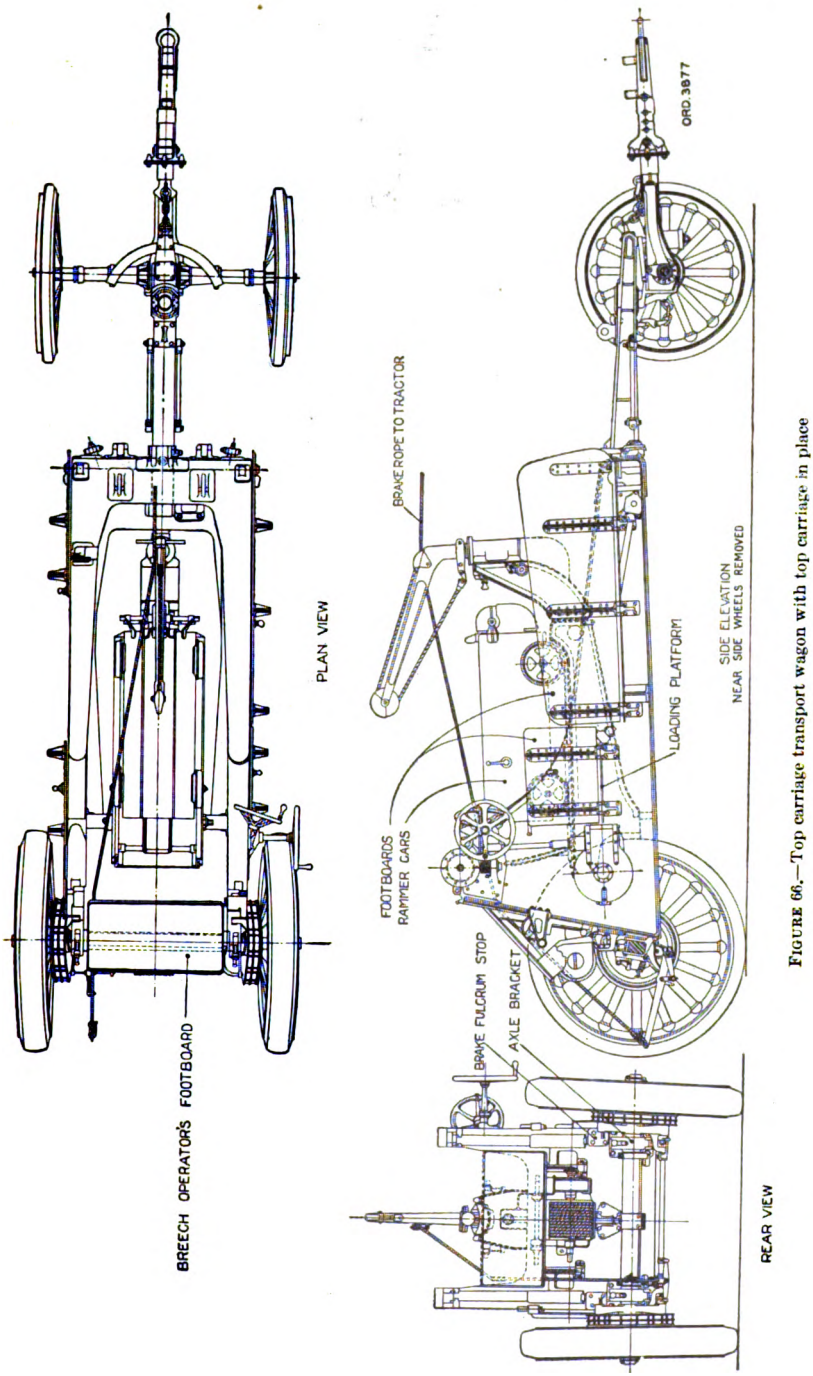


FIGURE 66.—Top carriage transport wagon with top carriage in place

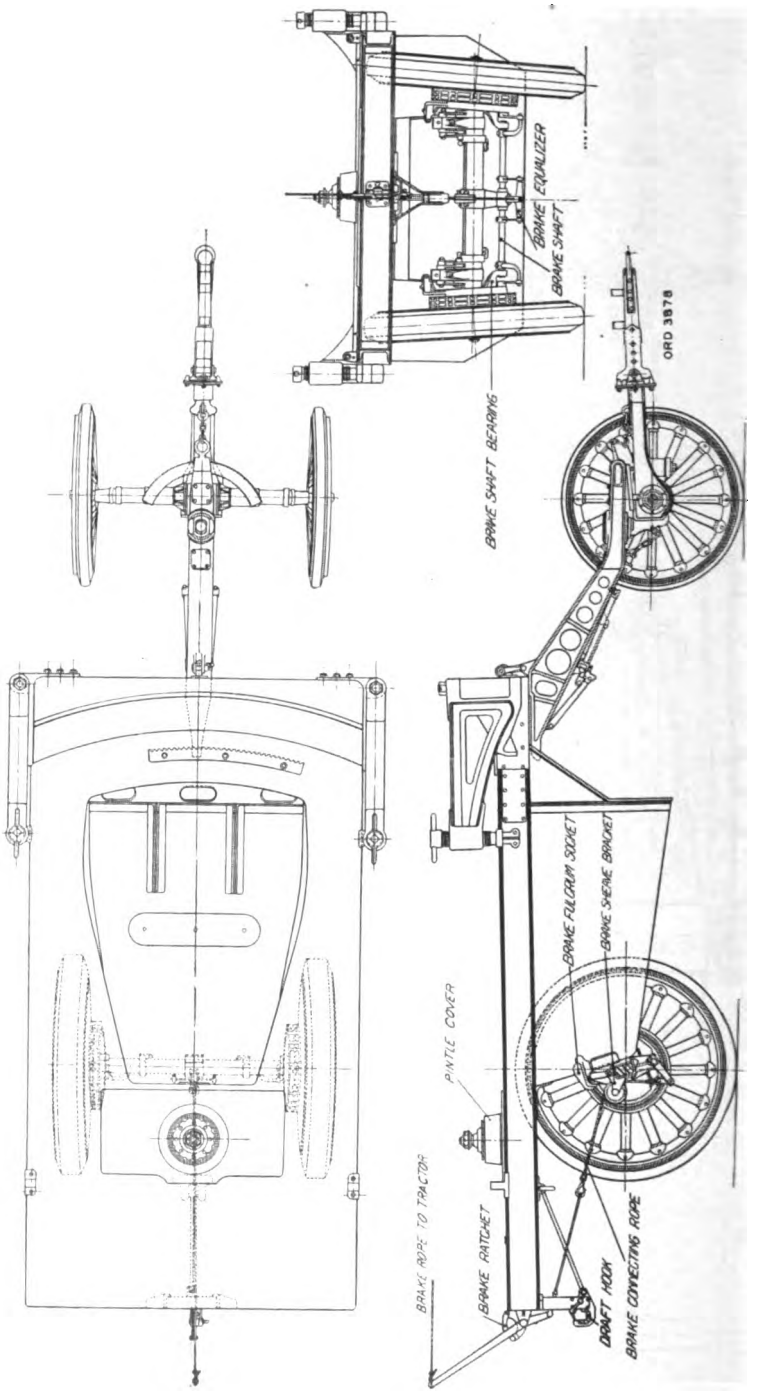


FIGURE 67.—Platform transport wagon—with platform in place

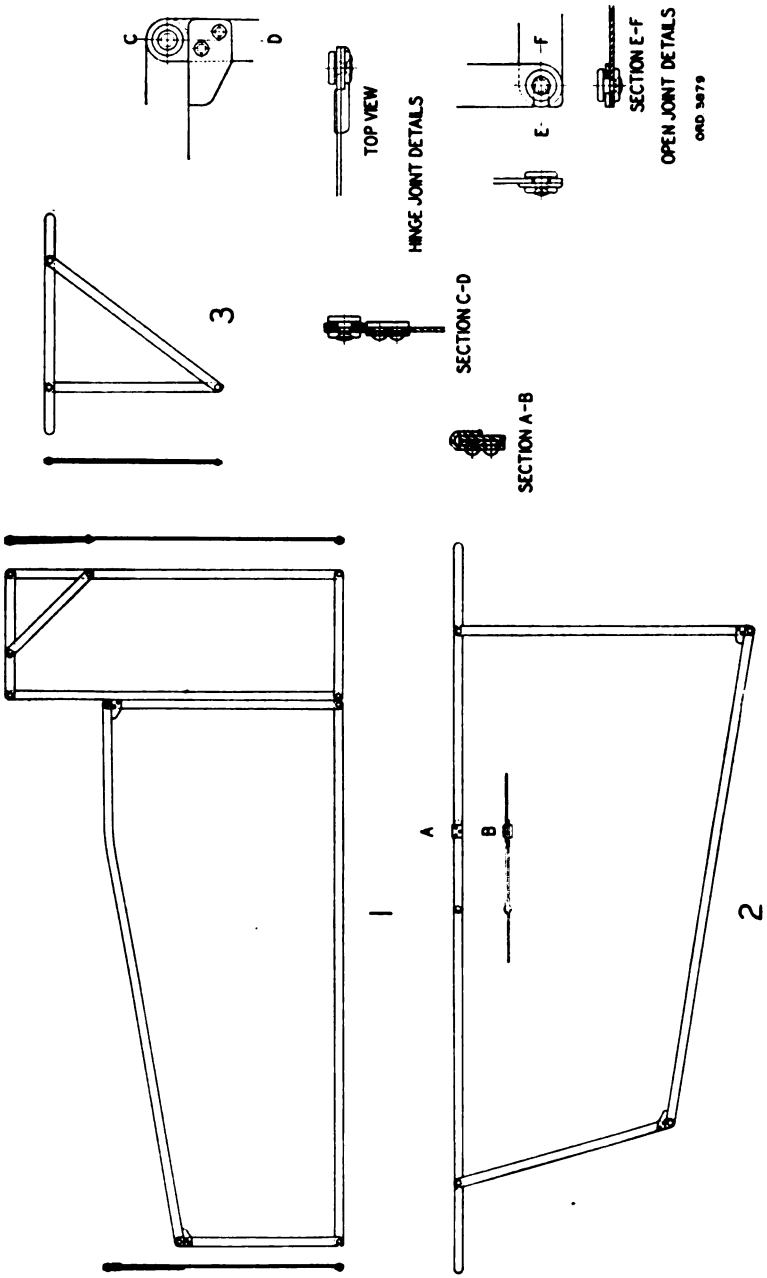


FIGURE 68.—Templates—assembled views

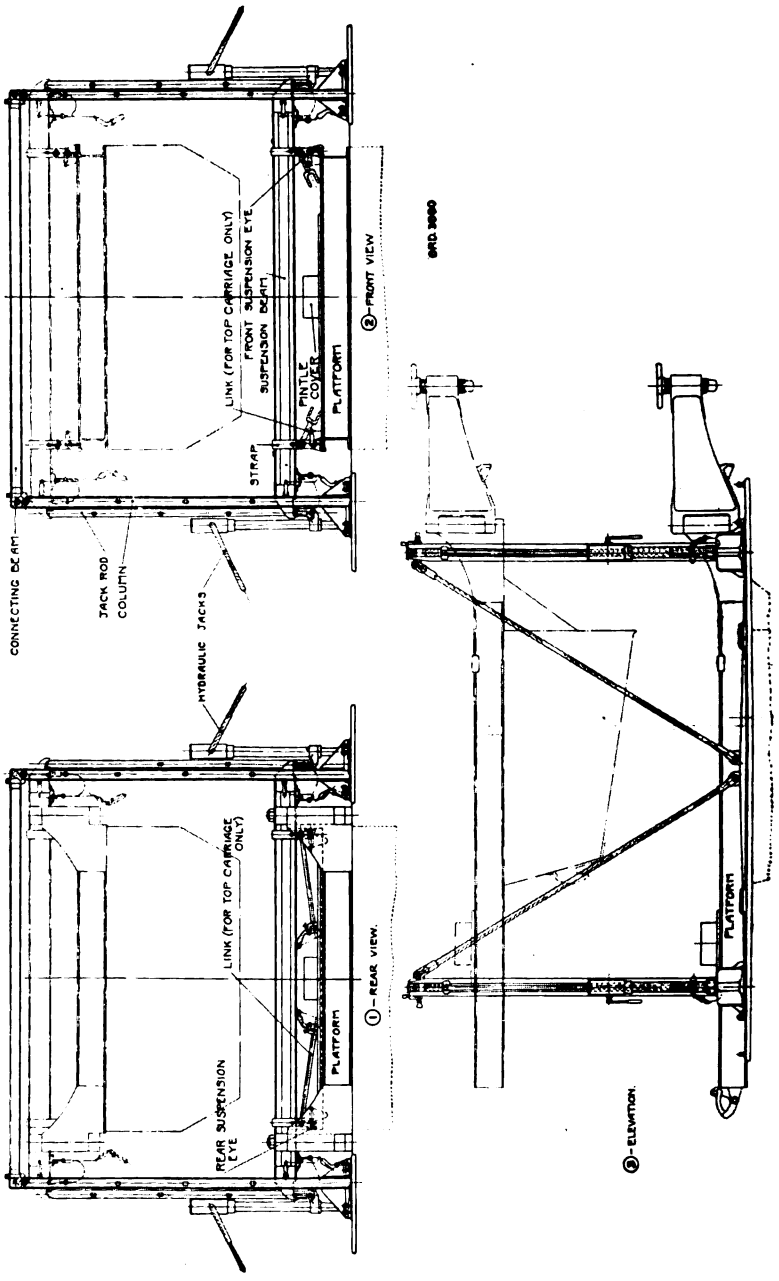


FIGURE 69.—Method of mounting platform

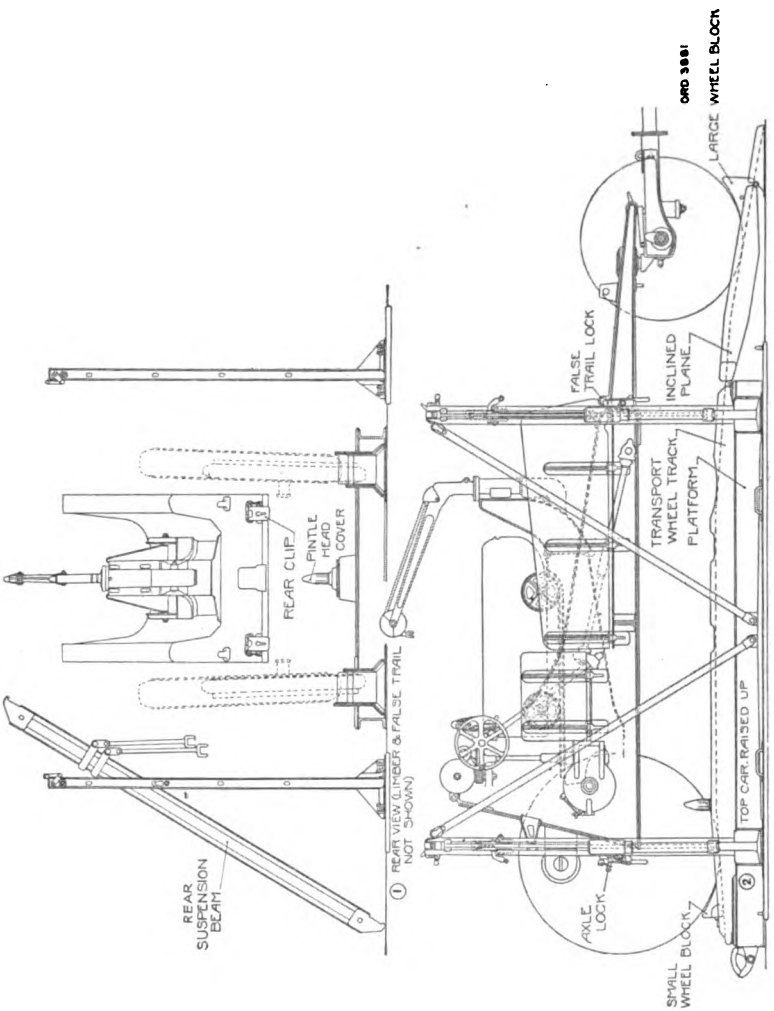


FIGURE 70.—Method of mounting top carriage

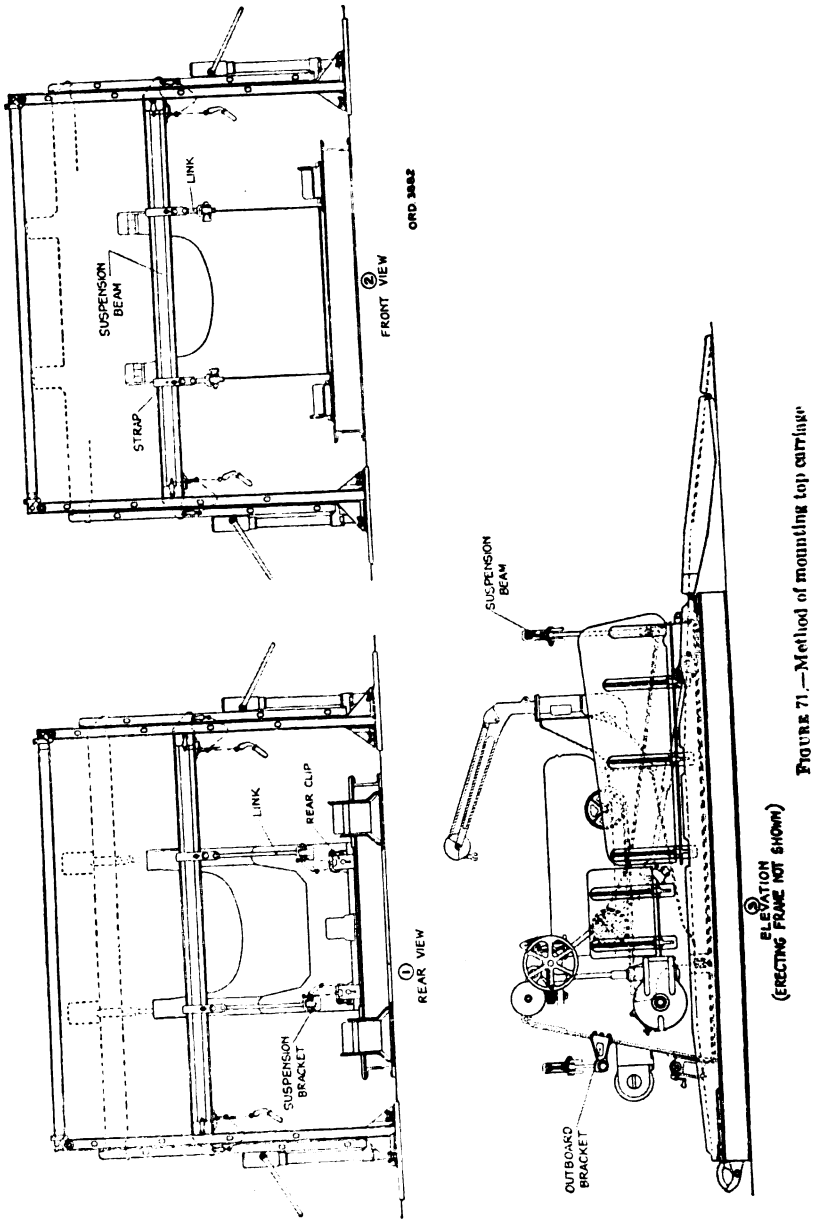


FIGURE 71.—Method of mounting top carriage

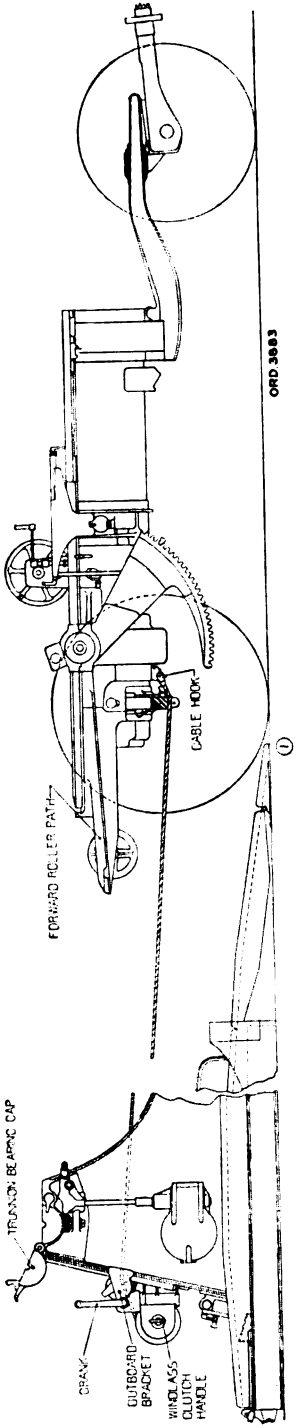


FIGURE 72.—Method of mounting cradle

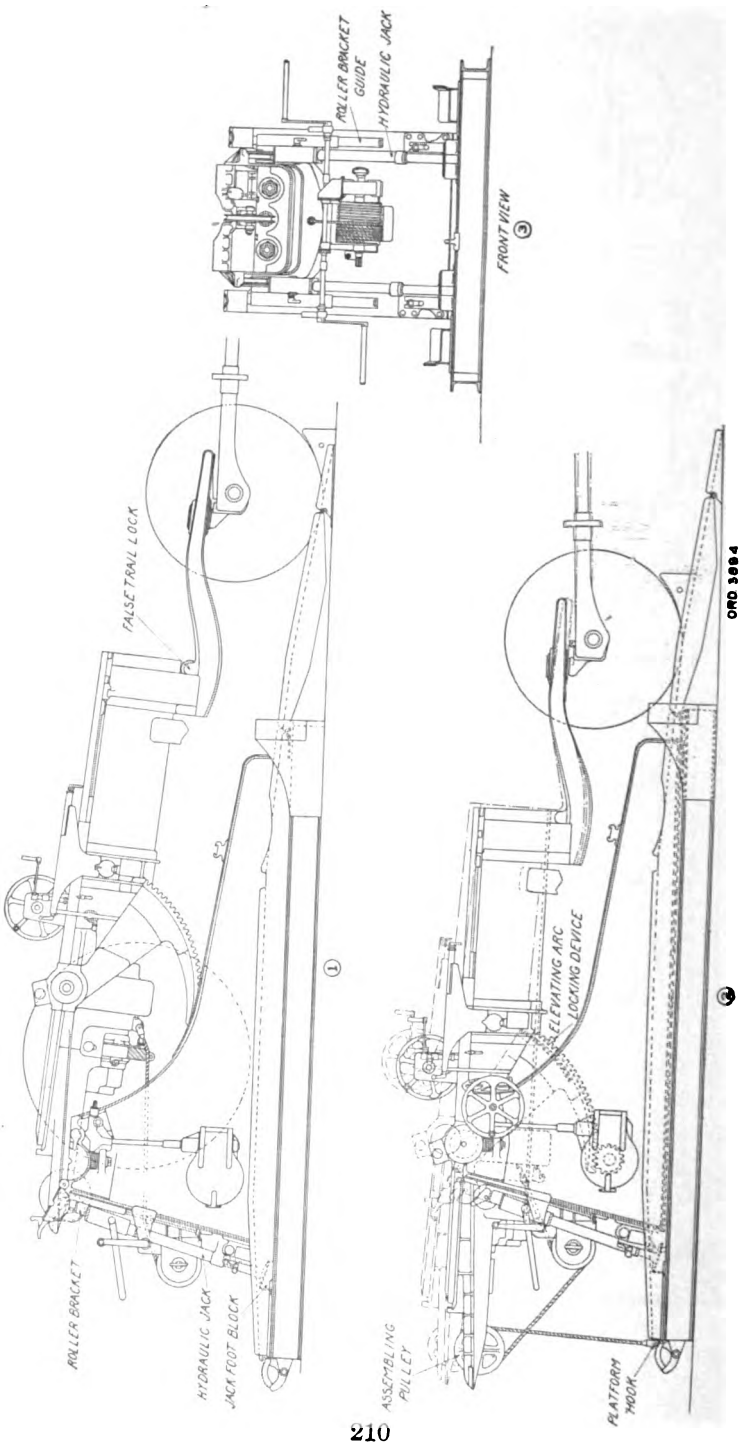


FIGURE 73.—Method of mounting cradle

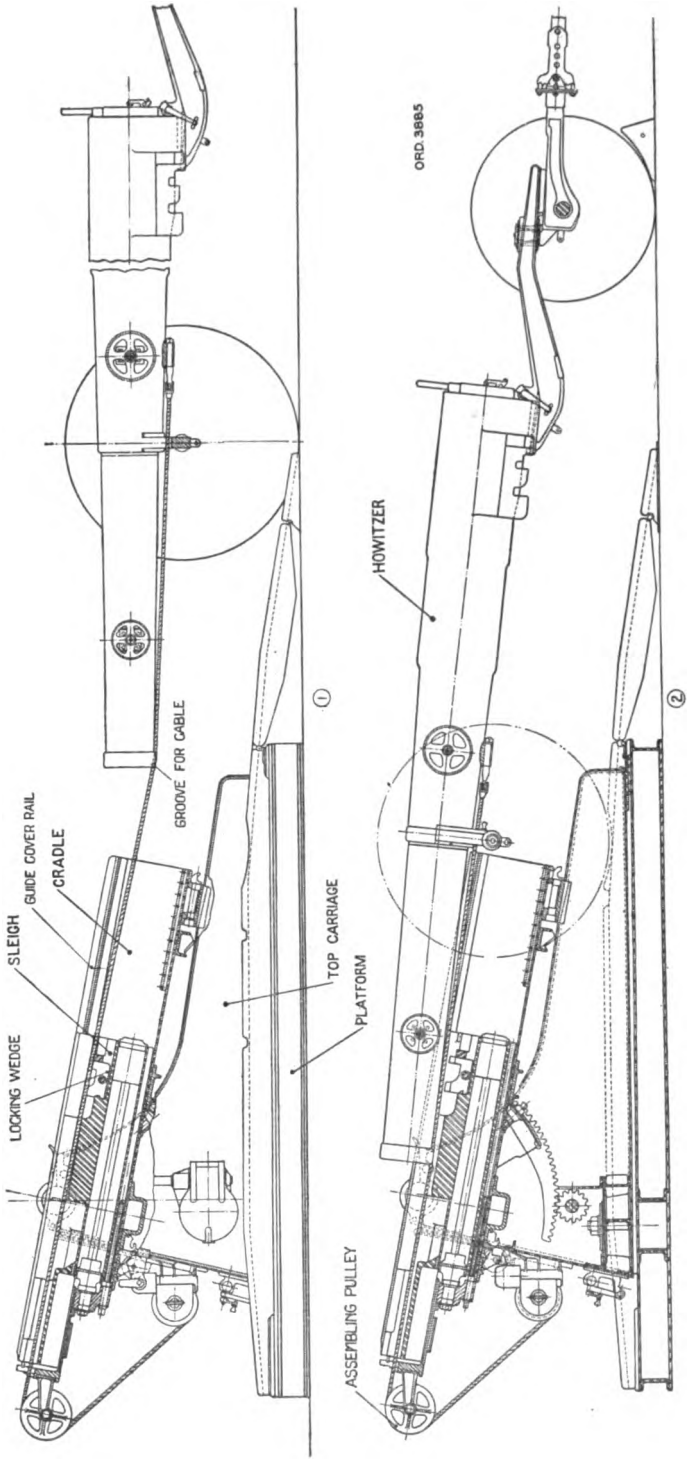


FIGURE 74.—Method of mounting howitzer

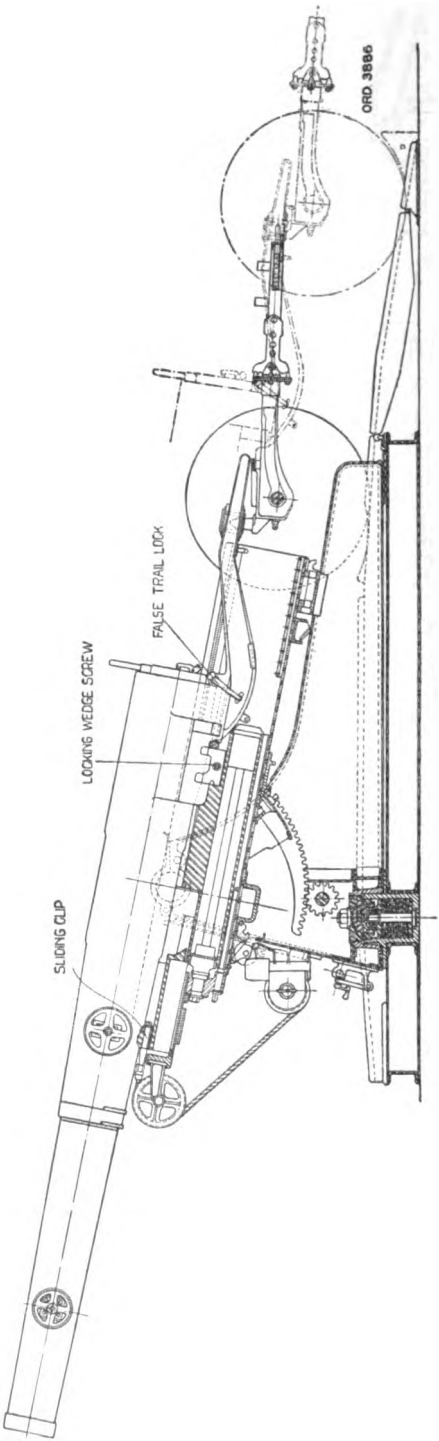


FIGURE 75.—Method of mounting howitzer

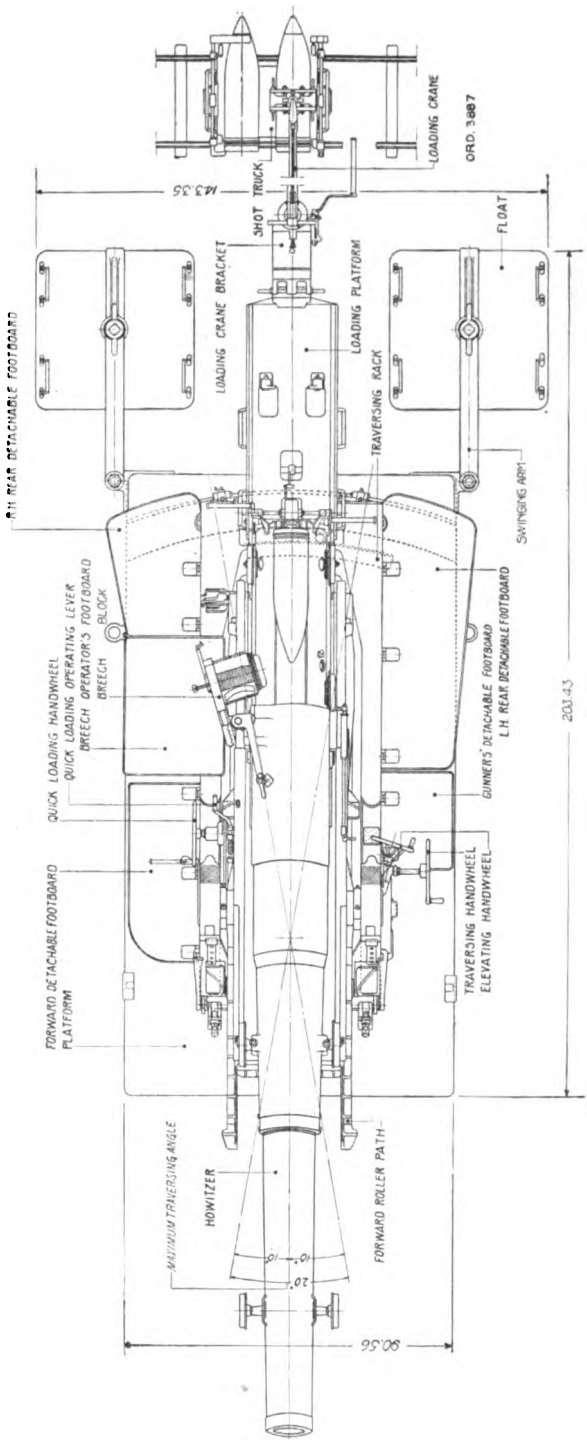


FIGURE 76.—240-mm howitzer—plan

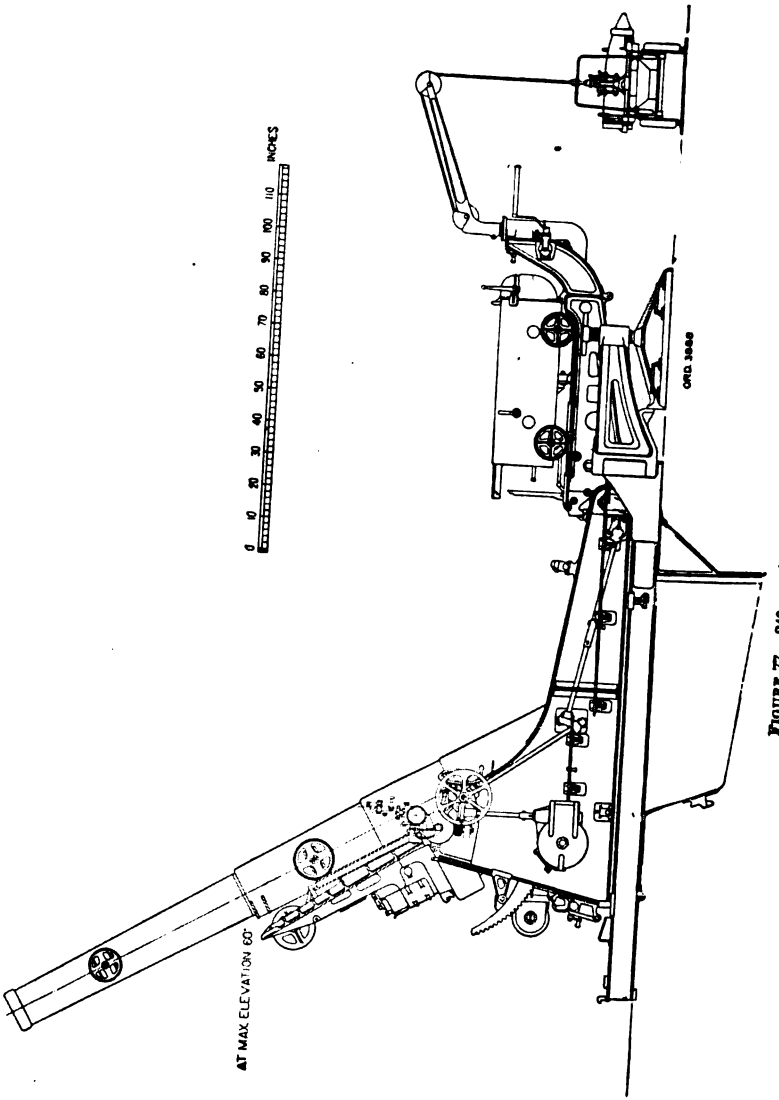


FIGURE 77.—240-mm howitzer—left elevation

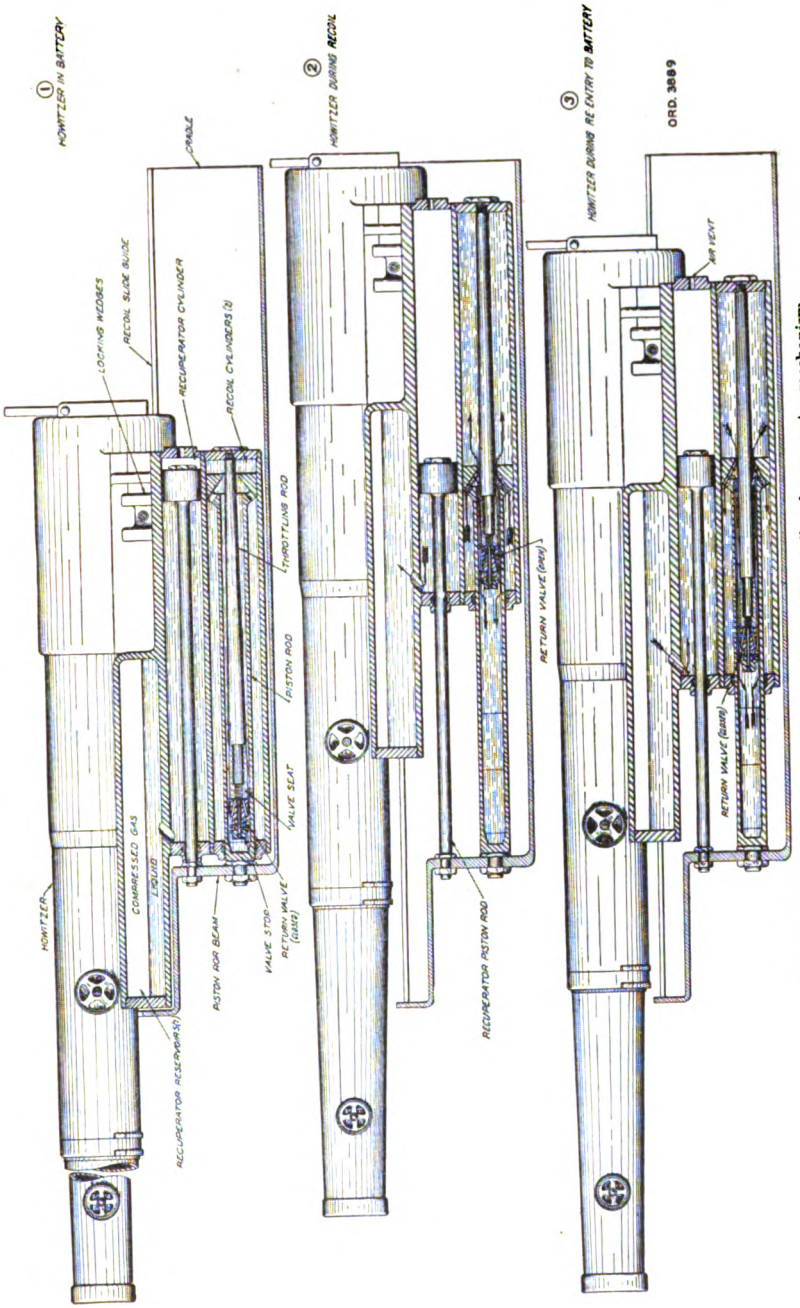


FIGURE 78.—Diagram showing the operation of the recoil and recuperator mechanism

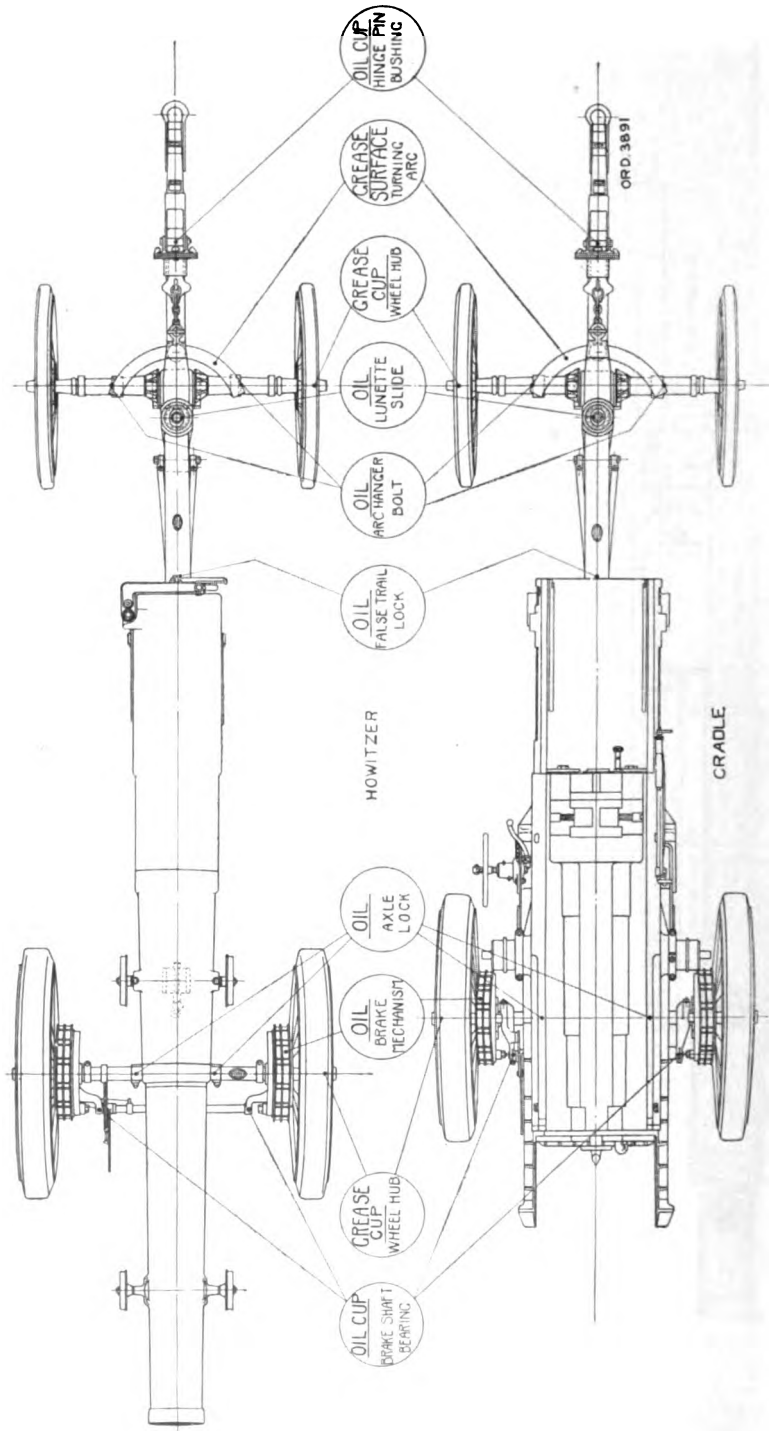
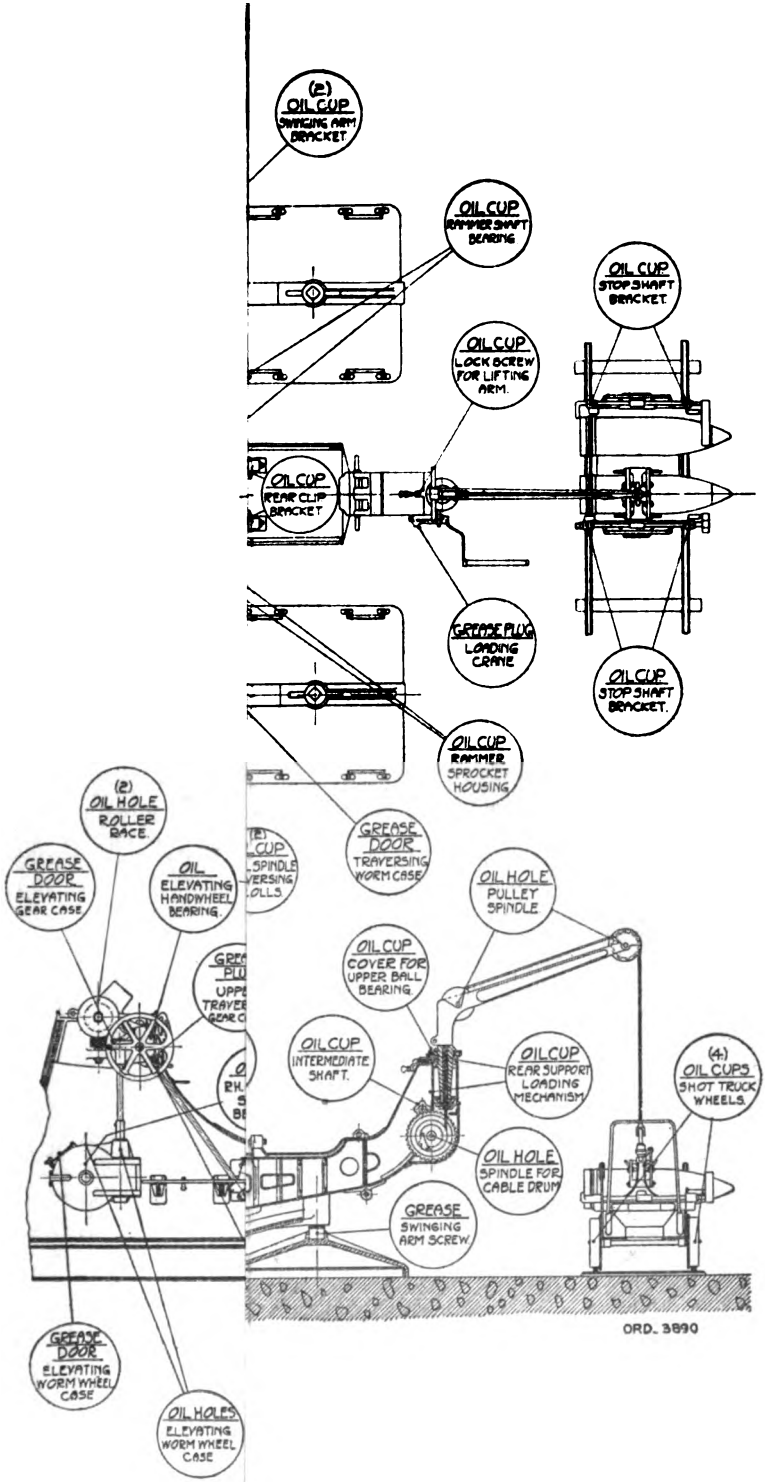


FIGURE 80.—Oiling chart—cradle and howitzer transport wagons



130926°—33. (Face p. 216)

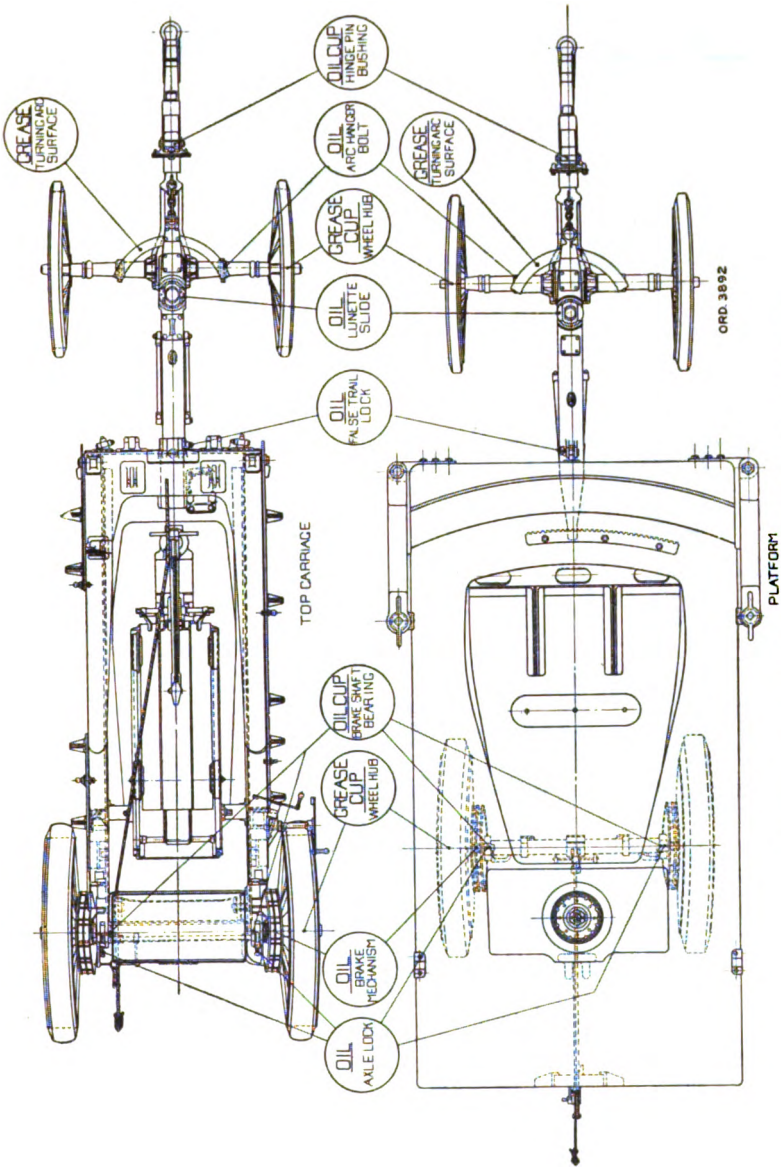


FIGURE 81.—Oiling chart—platform and top carriage transport wagons

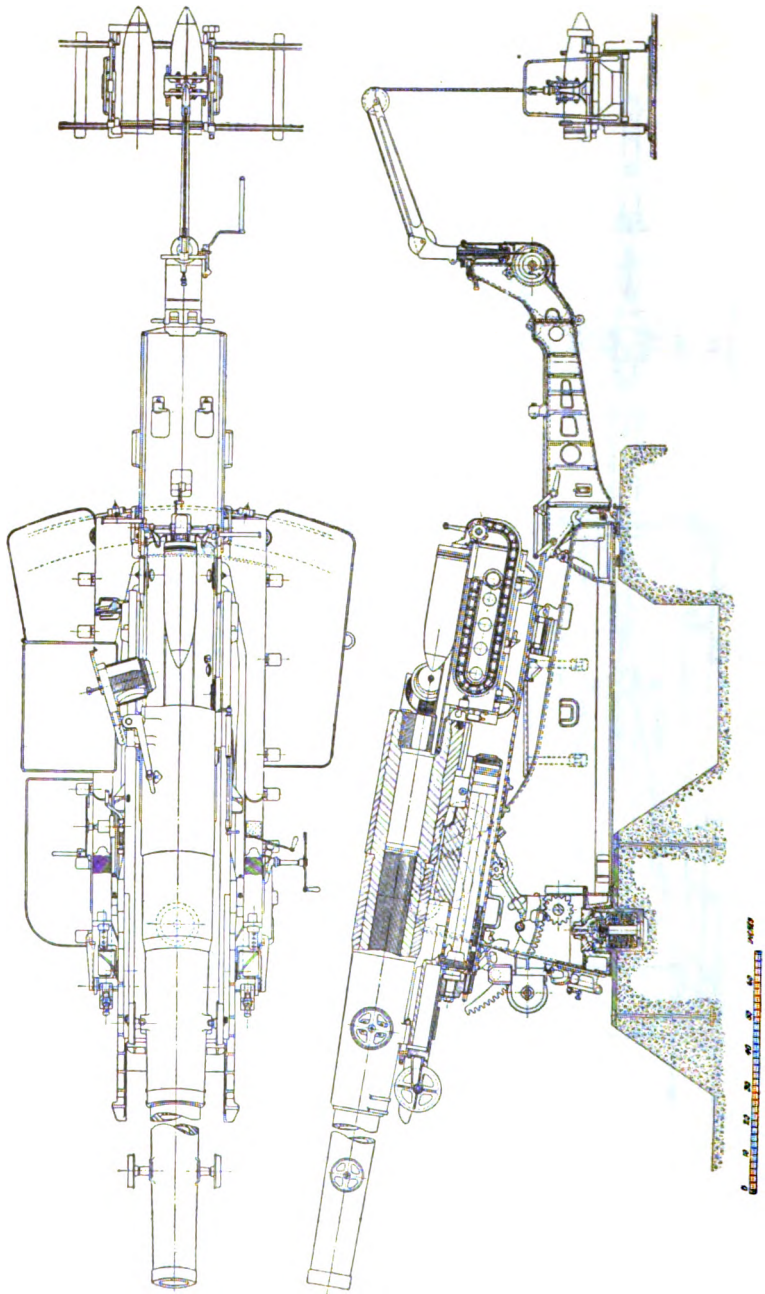


FIGURE 82.—240-mm howitzer carriage, M1918A1

TR

Reference	Item	Reference	Item
413B	Bolt.	BFAX1DT	Pin, cotter.
974	Bracket.	BFAX1DG	Pin, cotter.
8396	Clamp.	BFEX2BG	Pin, headless.
8398	Closure.	A28397	Pipe.
5975	Clutch.	B6976	Plate, clutch.
126190	Cover, traversing worm wheel case.	A28395	Roller, clutch.
8399	Elbow.	A28394	Screw.
413A1	Housing, worm and worm wheel.	BCKX2CG	Screw.
7931	Lever, clutch.	B6977	Shaft, extension.
8377	Nipple.	A9453	Sleeve.
BBX1B	Nut.	A1536	Spring.
BAX1A	Nut.	A26002B	Washer.
BFX2E	Nut.	A28336	Washer.
2L	Oiler.	B5282A	Washer, lock.
6458SA	Pin.	B6978	Wheel, worm.
6458KB	Pin.	B6494	Worm.
8905	Pin, clutch.		

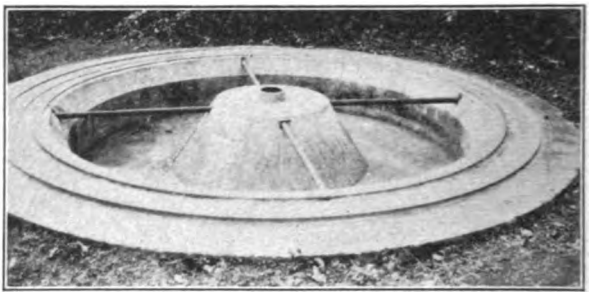


FIGURE 84.—360° emplacement, pintle removed, wheel track support rods in place

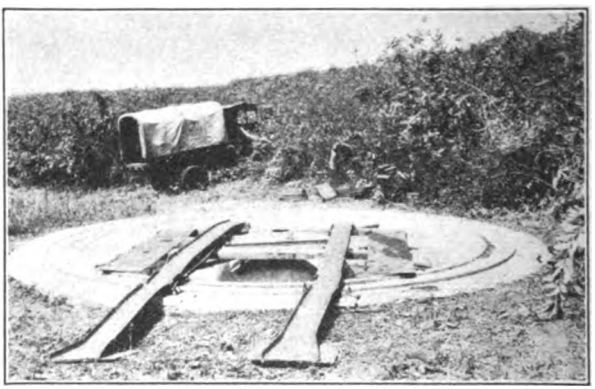


FIGURE 85.—360° emplacement, pintle removed, wheel tracks, incline planes, wheel track support planks and wheel mats in place

FIGURE 86.—360° emplacement with top carriage in position for mounting. Jack foot blocks in position

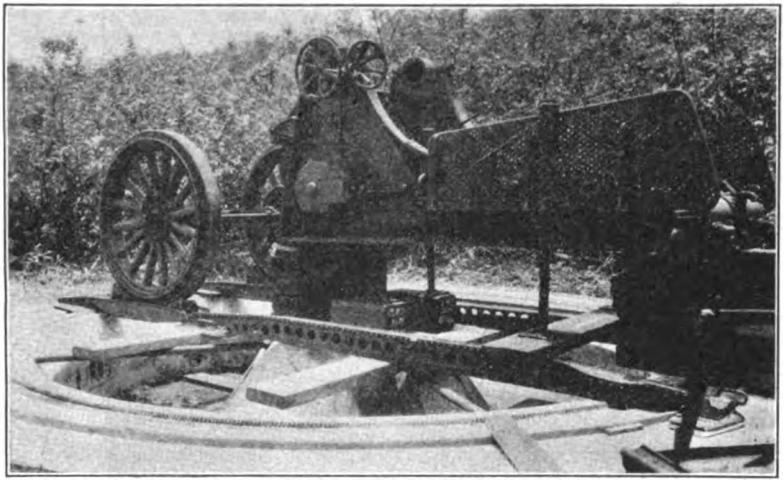


FIGURE 87.—Front axle and wheels cleared from carriage and about to be run off tracks. Jacks in position for jacking down carriage

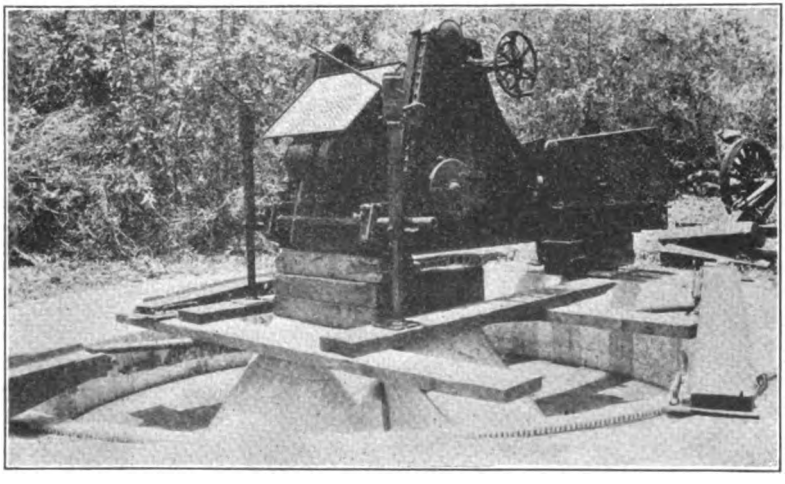


FIGURE 88.—Jacking down carriage. False axle in place supported by jacks, use of wheel track support planks and jack foot planks

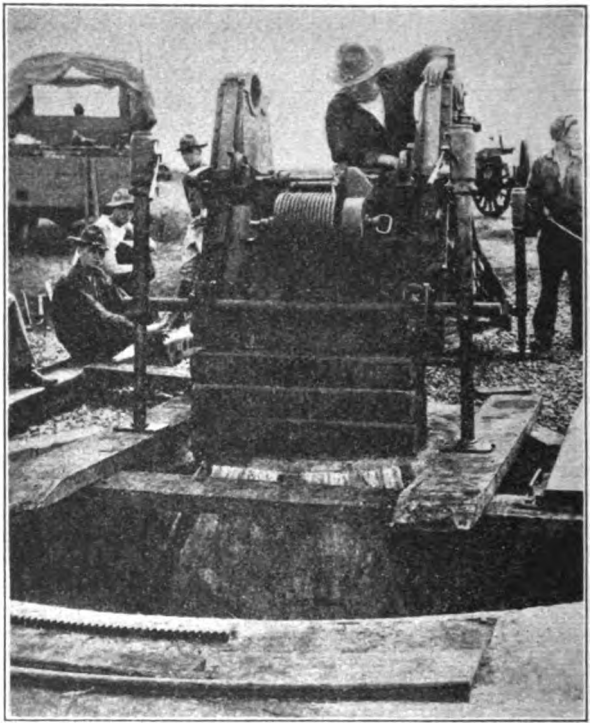


FIGURE 89.—Jacking down carriage. False axle in place supported by jacks, use of wheel track support planks and jack foot planks

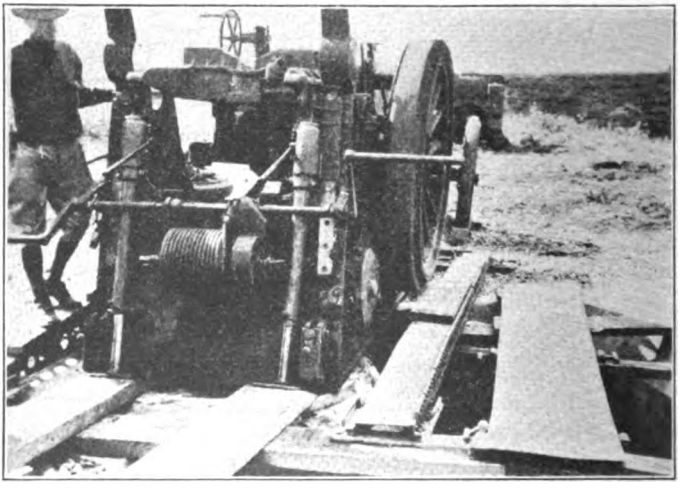


FIGURE 90.—Jacking down cradle. Jacks and jack foot planks in place. Front wheels ready to be removed. Wheel mats in place

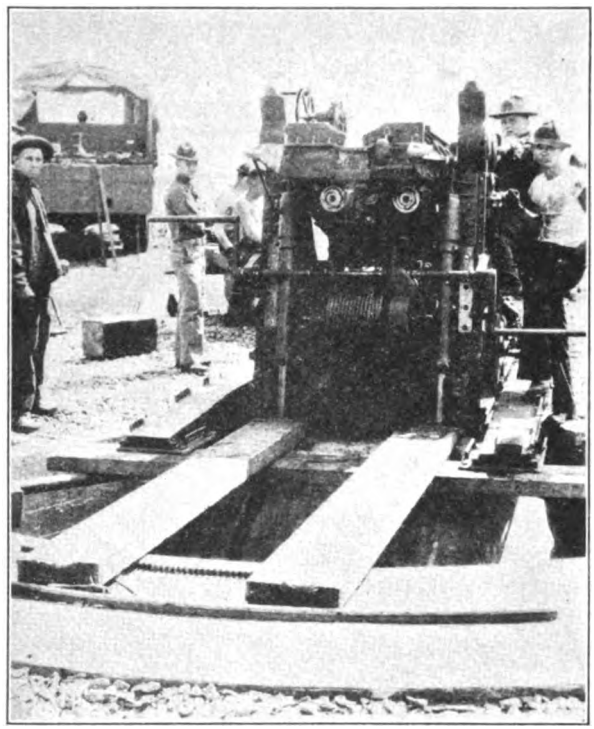


FIGURE 91.—Front axle and wheels removed from cradle, cradle moved forward, trunnions about to be lowered into trunnion bearings. Outer ends of jack foot planks against raised lip of roller path and chamfered ends under jacks

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