GENERAL LEE'S FAMOUS RAILWAY MONITOR.

Ordnance Department Document No. 2034

RAILWAY ARTILLERY

A REPORT ON THE CHARACTERISTICS, SCOPE OF UTILITY, ETC. OF RAILWAY ARTILLERY

IN TWO VOLUMES

VOLUME I

WASHINGTON
GOVERNMENT PRINTING OFFICE
1921

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
March 16, 1920.

This work on Railway Artillery is a Report on the Characteristics, Scope of Utility, etc., of Railway Artillery, presented by H. W. Miller, lieutenant colonel of Ordnance. It has likewise been prepared for publication by Lieut. Col. Miller. This report is approved for publication.

C. C. WILLIAMS,
Major General, United States Army, Chief of Ordnance.

CONTENTS.

PREFACE.

The following treatise on railway artillery was originally submitted as a part of the final report of the Railway Artillery Unit, Artillery Section, Engineering Division, Office of the Chief Ordnance Officer, American Expeditionary Forces in France. This report was made up at the close of the World War of 1914–1918, and was a revision of a similar report prepared by the undersigned in April, 1918. The second report was finished and submitted in August, 1919, and covered, as fully as available information would permit, all railway artillery completely or partially designed by ourselves, our allies, and our enemies in that war.

In preparing this revised report, two factors were kept particularly in mind with reference to the change in railway artillery requirements of the United States Army, which had taken place since the completion of the first report.

The first factor is the time available for the construction of the artillery, throughout the period of active warfare. The aim was to mount, in the shortest possible time, the greatest possible number of available heavy guns on any type of mount that had been found satisfactory for land warfare in France. Only limited machine facilities were available and speed was the essence of every problem. Now that the war is ended conditions are vastly different; we are not in so great a hurry as we were a year ago, and we may assume that any, or all, machine facilities that might be required for any type of carriage are available.

The second factor is the characteristics required of the mount. During the active period of the war, as noted above, any mount which had been found satisfactory for land warfare would serve; now only such mounts as are adaptable also to coast defense should be considered for new design and construction.

It is the object, therefore, of this revised report: First, to embody in available form as much as possible of the information concerning railway artillery acquired through experience in the war just ended; and second, to indicate the application of this information and the lessons learned to the present and future problems of the Ordnance Department, the formation of a new program of construction for railway artillery.

The recommendations contained herein should not be considered official, since they have not been so approved by any regularly constituted board of the Ordnance Department. They are the final conclusions of the writer based upon over two years close association with engineering work on railway artillery both in Europe and America.

The material contained herein has been obtained from a large number of sources which may be summarized as follows:

(*a*) Examination of French railway artillery in French artillery parks, heavy artillery proving grounds, shops, and on the front.

(*b*) Examination and study of designs of railway mounts of all types, and conference with designing engineers of the Ordnance companies in France and England who have been responsible for the greater number of the railway artillery designs.

(*c*) Examination of captured German matériel and study of captured documents.

(*d*) Consultation and cooperation with Staff of American Railway Artillery Reserve and Heavy Artillery School in France.

(*e*) Study of all bulletins and regulations issued by the French and English services for railway artillery.

(*f*) Observation of French and English Railway Artillery in action and conference with Railway Artillery personnel of French, English, and American Armies.

(*g*) Eighteen months cooperation with the French services directing the design, manufacture, maintenance, and field service of railway artillery.

Particular reference is made throughout the text to specific publications, etc., listed under the bibliography, from which data has been secured, or in which additional information may be found.

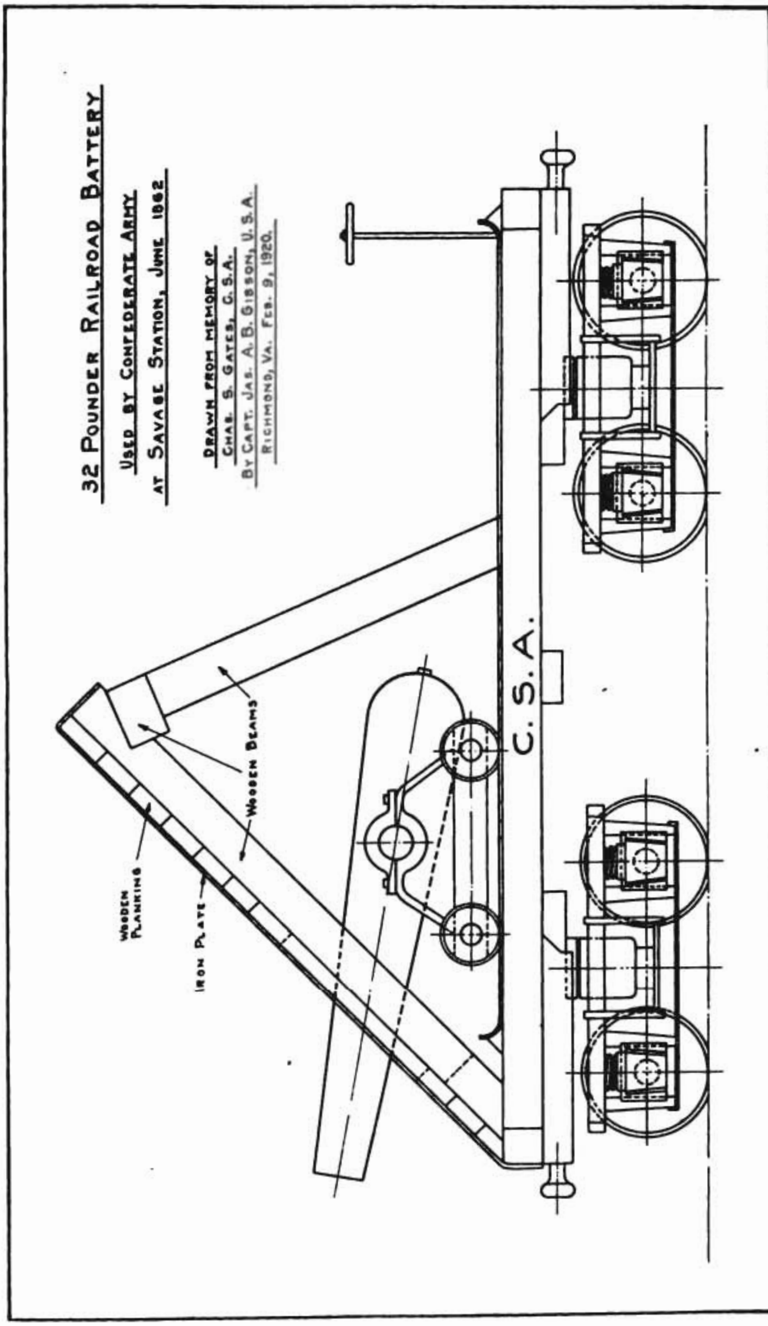
Much of the material given in the descriptions of the mounts belonging to our allies in the European war as well as the tabulated data on weights, ballistics, etc., is considered by these allies as being confidential and, at their request, is printed and issued to our service as such. For this reason the report has been divided and is published in two parts. The one part contains all information of a general character, as well as the descriptions and tabular data on the American and German mounts. The other volume contains descriptions and tabular data on all of the French, British, and Italian mounts and is issued as a confidential publication and is not for general distribution; it is available only for official Army use. This, of course, includes its use as a reference work in regularly constituted Army schools.

The description of the German long-range gun and of the bombardment of Paris given under the heading of Appendix I is considered as going properly in this work, because the guns instrumental in the bombardment were mounted on a railway carriage. The "Study of the relative efficiency of different calibers" given under the heading of Appendix II is included because it has an important bearing in the discussion given on the "Scope of Utility of Railway Artillery," and on the conclusions with reference to the types of guns recommended for future construction. The description of the coast defenses installed by the Germans in Belgium is given, under the heading of Appendix III, because these defenses included railway artillery and because the future problem of America with reference to railway artillery is so intimately connected with the plans on coast artillery.

The undersigned desires to acknowledge his indebtedness to Capt. W. F. Dietrichsen, who has assisted in the collection of all data and preparation of the original report, and to Maj. Hugh Pastoriza, who has assisted so effectively in preparing this revision. Appendix II on the "Relative efficiency of the different calibers" was prepared by Maj. Hugh Pastoriza and Capt. R. H. Kent.

H. W. Miller,
Lieutenant-Colonel, Ordnance Department, United States Army.

PLATE 1


32 POUNDER RAILROAD BATTERY
USED BY CONFEDERATE ARMY
AT SAVAGE STATION, JUNE 1862
DRAWN FROM MEMORY OF
CHAS. S. GATES, C.S.A.
BY CAPT. JAS. A. B. GIBSON, U.S.A.
RICHMOND, VA. FEB. 9, 1920.
WOODEN PLANKING
IRON PLATE
WOODEN BEAMS
C. S. A.

CHARACTERISTICS, SCOPE OF UTILITY, ETC., OF RAILWAY ARTILLERY.

HISTORICAL INTRODUCTION.

1. Railway Artillery seems not to have been recognized as an important and separate subdivision of Artillery before the outbreak of the World War, 1914-1918. For this reason the idea and the material are thought of as new developments, whereas in fact both appeared almost simultaneously with the widespread adoption of railway transportation.

2. The earliest railway artillery of which the writer has been able to find any record was employed in the Confederate Army under Maj. Gen. J. Bankhead Magruder, on June 29 and 30, 1862, at Savage Station, on the Richmond & York River Railway, about 10 miles east of Richmond, in one of the "Seven Days' Battles." A sketch of this mount according to the best data available is given in plate 1. Apparently the credit for the conception of the idea for the construction of such a battery should be given to Gen. Robert E. Lee. Following is a copy of the correspondence between Gen. Lee and the authorities in Richmond responsible for the construction of the mount:

[A.—Official records of the War of the Rebellion, Volume XI, part 2, page 574 (1).]

HEADQUARTERS, *June 5th, 1862.*

Col. J. GORGAS,

Chief of Ordnance Dept.

COLONEL: Is there a possibility of constructing an iron-plated battery, mounting a heavy gun on trucks, the whole covered with iron, to move along the York River Railroad? Please see what can be done. See the Navy Department and officers. If a proper one can be got up at once, it will be of immense advantage to us. Have you got any mortars that we could put at some point on the railroad?

Very respectfully,

R. E. LEE, *General.*

[B.—Same reference, pages 575-576 (1).]

HEADQUARTERS, *Near Richmond, Va., June 5th, 1862.*

Capt. GEORGE MINOR,

Chief of Ordnance and Hydrography:

The Armstrong gun, if mounted on a field carriage with its supply of projectiles, will be of immense importance to us. Can we not have it in the morning? The smaller gun (Parrott) I think we have enough at present. I am very anxious to have a railroad battery. I wrote to Colonel Gorgas on the subject this morning and asked him to get you and Brooke to aid him. Till something better could be accomplished

I propose a Dahlgren or columbiad, on a ship's carriage, on a railroad flat, and one of your Navy iron aprons adjusted to it to protect gun and men. If I could get it in position by daylight tomorrow, I could astonish our neighbors. The enemy cannot get up his heavy guns except by railroad. We must block his progress.

Very respectfully and truly,

R. E. LEE, *General.*

[C.—Same reference, page 610 (1).]

HEADQUARTERS, *Dubb's House, Va., June 21, 1862.*

Hon. S. R. MALLORY,

Secretary of the Navy, Richmond, Va.

SIR: I have been informed by Colonel Gorgas that the railroad battery will be ready for service tomorrow. Inasmuch as this battery has been constructed by the Navy, I would be pleased if you would assign an officer and a requisite number of men to take charge of and operate it. If you desire to do so, I request that you will designate the officer at once, as I wish to place the battery in position tomorrow. I am very much obliged to you for your kindness as well as promptness in its construction.

I am, very respectfully, your obedient servant,

R. E. LEE.

[D.—Same reference, page 615 (1).]

OFFICE OF ORDNANCE & HYDROGRAPHY,
Richmond, Va., June 24, 1862.

General R. E. LEE,

Comdg., &c., near Richmond, Va.

GENERAL: The railroad iron-plated battery designed by Lieut. John M. Brooke, C. S. Navy, has been completed. The gun, a rifled and banded 32-pounder of 57 cwt., has been mounted and equipped by Lieut. R. D. Minor, C. S. Navy, and with 200 rounds of ammunition, including 15-inch solid bolt shot, is now ready to be transfered to the Army. I have the honor to be,

Very respectfully, your obedient servant.

GEORGE MINOR,
Commander, in Charge.

Numerous records are available of the service of this mount in the battle mentioned. Following are extracts from some of these records and references to others:

[E.—Official records of the War of the Rebellion, volume XI, part 2, page 664.(1)]

EXTRACT FROM REPORT OF MAJ. GEN. J. BANKHEAD MAGRUDER, C. S. A., OPERATIONS JUNE 29–30, 1862, AT SAVAGE STATION.

Taking my position on the railroad bridge, which commanded a good view of the fight and the enemy's line of battle, I directed the railroad battery, commanded most efficiently by Lieutenant Barry, to advance to the front, so as to clear in some degree, the deep cut over which the bridge was thrown, and to open fire upon the enemy's masses below. which was done with terrible effect. The enemy soon brought the fire of his artillery and infantry to bear upon the railroad battery and bridge while he advanced a heavy line of infantry to support the troops already engaged to capture our artillery and turn our right flank.

[F.—Same reference, pages 717-718.(1)]

EXTRACT FROM REPORT OF MAJ. GEN. LAFAYETTE M'LAWS, C. S. A., DATED JULY 20, 1862.

Lieutenant Barry of the artillery had been for some days previous placed in charge of a 32-pound rifled gun, mounted on a rail car and protected from cannon shot by a sloping roof in front, through which a porthole had been pierced, and from rifle shots on the sides by thick walls of wood lined with iron. His battery moved down the road, keeping pace with the advance of the troops, and by his fire annoyed the enemy whenever the range would allow.

[Battles and leaders of the Civil War, volume 2, page 373.(2)]

(Here will be found a report made by Maj. Gen. Wm. B. Franklin, United States Army, describing the approach of the railway battery used at Savage Station.)

[Same reference, page 374.(2)]

(Here will be found a sketch showing the opposing forces at Savage Station and the marked location of the railway battery.)

Gen. Joseph L. Brent of the Confederate Army mentions in his book "Mobilizable fortifications" (3), first published in 1865, and republished in 1916 by Williams & Wilkins Co., Baltimore, that a 32-pounder gun was mounted on a standard flat car and operated at a point called Savage Station on the Richmond and York River Railway. To quote, he says:

However, it was my fortune to witness perhaps the first fire that was ever delivered in actual combat from an armored railway wagon.

During the American Civil War, in 1862, the Confederate authorities prepared in Richmond a railway battery armored with railroad iron and carrying a 32-pounder gun in front of the engine. The iron shield only covered the front of the battery, and was pierced by an embrasure, but the sides and rear were unprotected.

When, in June, 1862, Lee made his flank movement against McClellan, one of the Seven Days' Battles was delivered on the line of the Richmond and York River Railway, at a point called Savage Station.

The iron railway battery was sent out on this road from Richmond, and Maj. Gen. MacGruder, commanding the Confederates at Savage Station, ordered this battery to advance and fire on the enemy.

It moved, propelled by steam, down the track, and passed into a deep cut, and from this cut opened with its 32-pound gun, and burst its shell beyond the first line of the Federals, and over the heads of their reserves, forcing them to shift their position.

About the same time the skirmishers of the opposing forces became engaged and the lines of battle were deployed, resting on the right side of the railway.

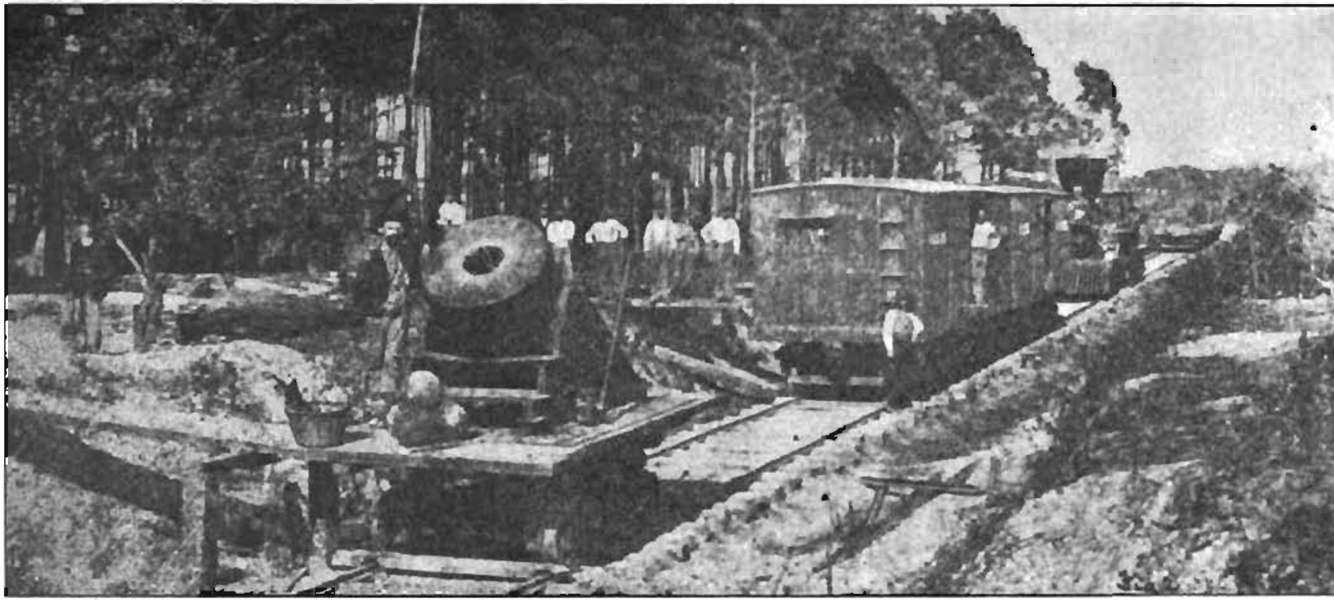
The Union line was a little beyond the cut from which the railway battery fired, and at right angles to it. If the battery had advanced it would have completely enfiladed the Union line at short range, and must have broken it; but owing to the fact that the sides and rear of the battery were open and exposed to the fire of the skirmishers, and to the further fact that the field of fire of the gun was limited by its embrasures, the battery could not advance; and as the skirmish fire approached, it withdrew. If guns had been mounted "en barbette" and the gunners and machinery protected by only bullet-proof armor, and if there had been half a dozen such batteries, they could have easily broken the Federal line of battle and have cut off their reserves, large numbers of which were stationed on the left of the track.

Particular attention is invited to Gen. Brent's book. During the Civil War he had been particularly impressed with the effectiveness of the Union gun boats operating on the larger rivers and in the bayous at the mouths of the smaller rivers, especially in Louisiana, Alabama, etc. He was thoroughly convinced of the futility of fortifying inland cities against siege by means of masonry forts, etc., and was much impressed by the effectiveness of the Union gunboats just noted, with the possibilities of fortifying and protecting any large railway center by means of artillery of all calibers mounted on railway carriages. Some time before 1870, while in France, a discussion that he had with reference to this scheme of fortifying inland cities came to the ears of Napoleon III, who called Gen. Brent into a conference with reference to the practicability of his scheme in fortifying Paris. Napolean was so much impressed with its possibilities that he detailed several officers to conduct Gen. Brent on a tour of inspection of the fortifications of Paris. These officers were likewise impressed with the possibilities of the scheme and submitted to Napoleon a report recommending its adoption. This report was forwarded by Napoleon to his army staff and was quite unfavorably received; as a consequence the plan was rejected. Gen. Brent discusses the Franco-Prussian War of 1870, commenting particularly on the sieges of Metz and Paris.

3. William P. Brady's Civil War Pictures contain several excellent photographs of two designs of artillery that were used by the Union Army in their siege of Petersburg in 1864. One of these guns, plates 2 and 2A, was a 13-inch muzzle-loading mortar, 2.7 calibers in length. This mortar weighed 17,000 pounds, used a spherical shell weighing 220 pounds, and a powder charge of 20 pounds. The records available indicate that this mortar had a range between 3 and 4 miles and did effective work in the siege. It will be noted in plate 2 that the car on which the mortar is mounted seems to be made up of two standard trucks on which an improvised platform has been placed. It is understood that this carriage failed after the mortar had been fired several times and that thereafter the practice was to transfer the mortar and its platform, as shown on plate 2A, from the railway car to a more solid foundation. This railway mount was called "The Dictator" and "Petersburg Express." On plate 3 is shown another mount photographed by Brady which in his records is also described as having been used in the siege of Petersburg.

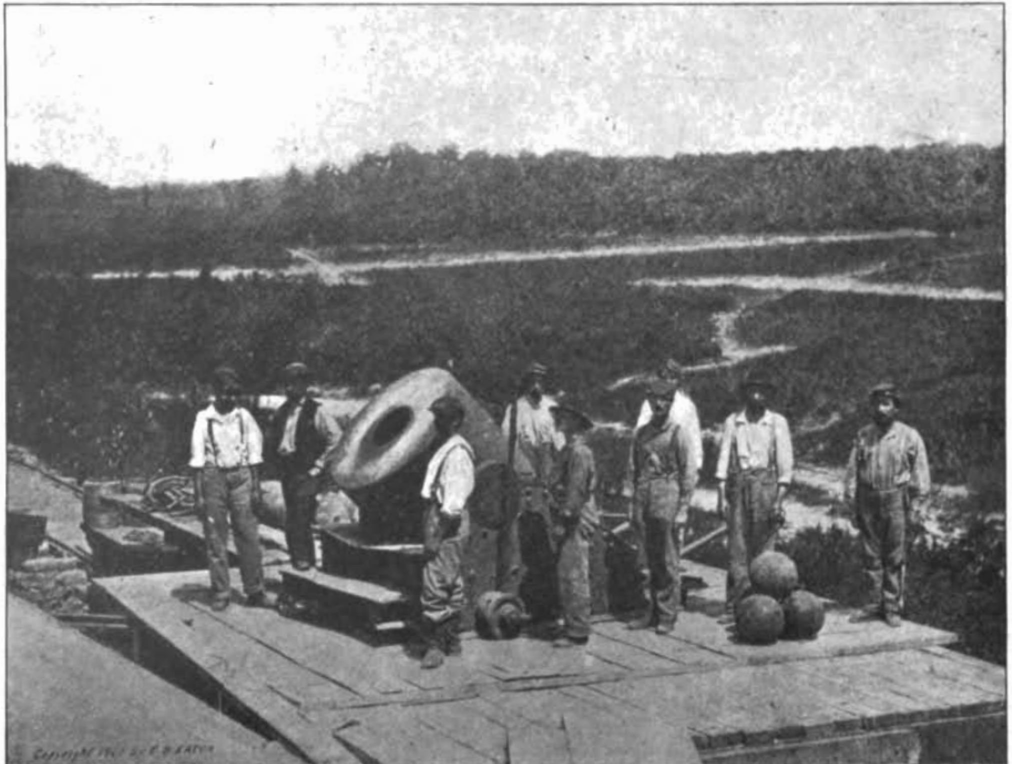
4. Another reference to what was likely though not certainly the 13-inch mortar discussed before is given in Professional Papers, Corps of Engineers, No. 14, Siege Artillery in the Campaign Against Richmond, by Bvt. Brig. Gen. Henry L. Abbott, United States Army, 1868 (5). The following is quoted from page 23, referring to the campaign of 1864:

> The great weight of the 13-inch mortar (17,000 pounds) renders it difficult to move and some satisfactory experiments were made with a novel platform. An *ordinary railroad platform car* (eight wheels) was strengthened by additional beams tied strongly by iron rods and was plated on top with iron.



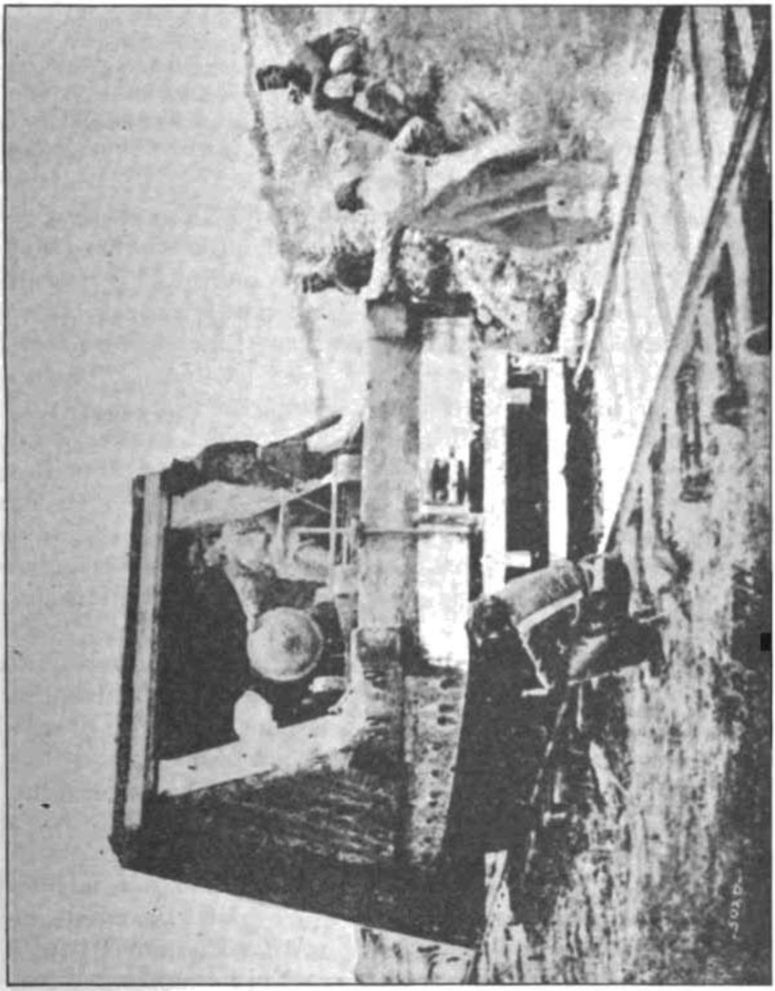
THIRTEEN-INCH MORTAR (DICTATOR OR PETERSBURG EXPRESS) (FIRING FROM TRACK).

PLATE 2A



THIRTEEN-INCH MORTAR THROWING SHELLS INTO PETERSBURG IN 1864 (FIRING NORMAL TO TRACK).

PLATE 3



RAILWAY BATTERY USED IN SEIGE OF PETERSBURG.

181768—21——2

The mortar was placed upon this car (top of mortar 9 feet above track), and run down on the City Point Railroad to a point near our lines where a curve in the track afforded facilities for changing the plane of fire by advancing the car or drawing it back. The mortar fired with 14 pounds of powder, recoiled less than 2 feet on the car, which moved 10 or 12 feet on the track. The effect of the charge was taken up without damage to the axles, even when the full allowance of 20 pounds of powder was used. This mortar, whose shell would crush and explode any ordinary field magazine, excited dread among the Confederate gunners, and was effective in inducing their enfilading batteries on Chesterfield Heights to discontinue fire upon the right of our line. Its practice was excellent. At the Battle of the Mine, as reported by three different observers stationed at different points, the explosion of one of its shells blew a Confederate field gun and carriage above the parapet at a range of about 3.600 yards.

Of course with this platform the plane of the fire must be nearly parallel to the track or the mortar will be dismounted, but by placing the car on a curve a very considerable traverse can be secured without difficulty.

The fact that Gen. Abbott mentions that this mortar which operated against Richmond was mounted on a standard flat car seems to indicate that it is not the same mortar that was photographed by Brady at Petersburg. The mortar carriage shown in plate 2 is apparently improvised, the two trucks being practically together.

5. In the "Revue d' Artillerie," volume 7, 1876, page 8, (6) a railway mount used by the British service for proof work is described. This carriage consisted of a rigid body of steel mounted on two six-wheel trucks; there was no recoil mechanism. The following data is given with reference to weights and dimensions: Weight of truck with gun carriage, 38 tons; weight of powder charge, 108.9 kilograms; muzzle velocity, 472.4 meters per second; recoil length, 11.63 meters up a 2.5 per cent grade.

6. Mention is made of a proof mount employed by the British for a 26-ton gun in the proceedings of the Institute of Civil Engineers, November 22, 1881, (7) under the discussion of the effect of recoil on field carriages. This mount consisted of an ordinary coast type of gun lift carriage mounted on two four-wheel trucks and is similar in many respects to some of the Schneider mounts, improvised from coast defense guns and used in the European War. Apparently this mount was used as a rolling recoil mount and was not anchored to the track. In the discussion, it is mentioned that the total recoil of the gun on the carriage was 3 feet and that the movement of the railway car began when the gun had reached its maximum velocity, i. e., after a recoil of about 6 inches.

7. In the minutes of the proceedings of the Royal Artillery Institute, volume 15 of 1888, (8) there is an article dealing with experiments made at Delhi, India, January, 1886, with a 40-pounder breech-loading gun on a wooden naval carriage. The railway cars on which this carriage was successively mounted were of 1 meter

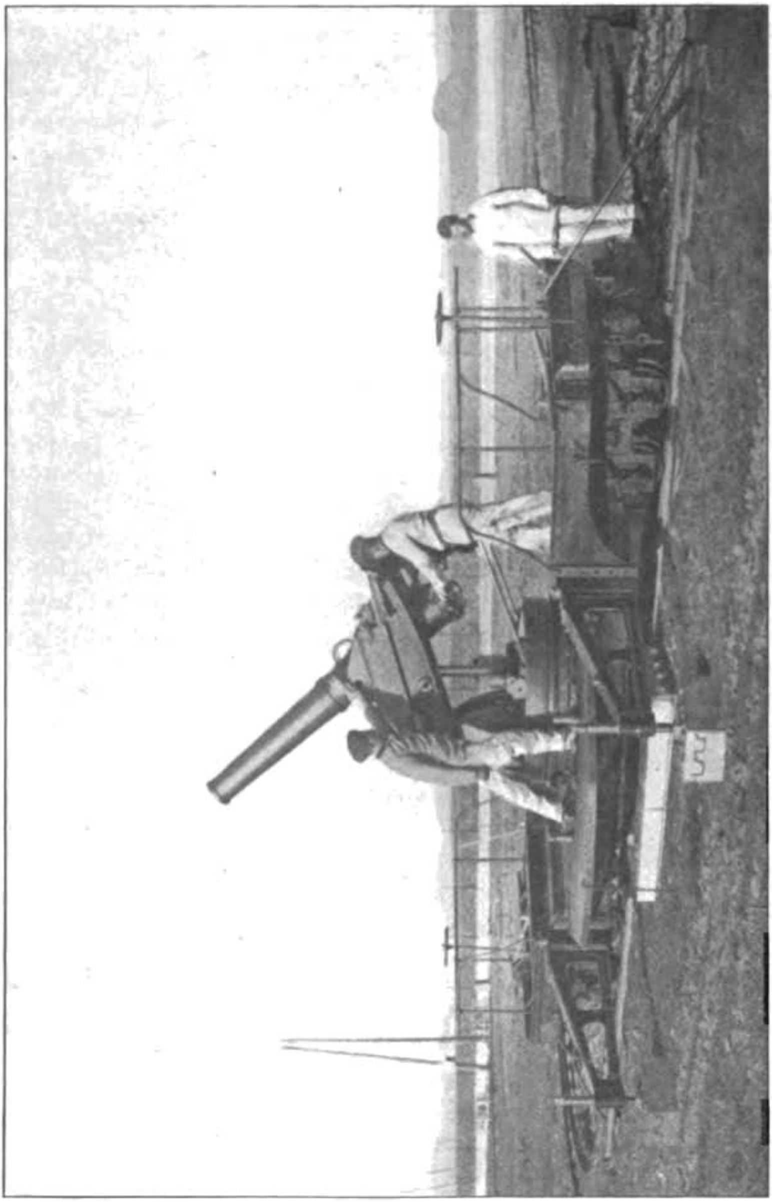
gauge. The naval carriage mentioned above, carried the gun directly with no recoil mechanism. Two types of cars were employed; the first was a light four-wheel car, 6.5 by 13.5 feet, and provided with a wrought-iron underframe. The weight of the car, light, was 2.87 tons and with the gun, 9 tons; the second was an eight-wheel car 7 by 25 feet and was constructed entirely of wrought iron. The weight of this gun was 5.4 tons. Wood wedges were put under the car against the sleepers and props were also employed. The guns were fired at right angles to the track. Firing proved both of these arrangements to be unstable, although the eight-wheel car jumped much less than the four-wheel car. In subsequent experiments the car was loaded with rails to a total weight of 19 tons, and the gun was placed over the forward truck with its center line 7 feet 0.5 inches above the rail. This appeared to give satisfactory results with the eight-wheel car. The truck springs were deflected 0.437 inches, but the wheels were not lifted from the track. The conclusion stated in this article is that the scheme is suggested as satisfactory, although much would probably be gained by clamping the mount to the rails. It is mentioned that the oscillation of the car is so great that a man could probably not stand on it during firing.

8. A description is given of experiments made by the British in 1896 in the "Revue d' Artillerie," volume 50, page 34, of 1894, (9). These experiments were made on the railroad between Brighton and New Haven with a train of armored cars on which field guns were mounted. It was possible to fire these guns in all directions. The cars were solidly fixed to the rails by special brakes and remained stationary even when the guns were fired in the direction of the track. In certain French publications, (10) mention was found of the fact that both the Krupp and Skoda works conducted experiments between 1890 and 1900 on the use of the light field guns mounted on railway carriages.

9. The first concrete results of the interest of the French Technical Service in railway artillery appeared in the eighties when Gen. (then Col.) Peigne became its advocate. The first papers appeared in about 1883, and his work culminated in experiments carried on with the 155-millimeter Howitzer in 1888, and the construction of material developed from these experiments for the coast defenses of Denmark, plates 4 to 7. About the same time the St. Chamond Co. developed a disappearing carriage on railway wheels for the defense of fortifications and coasts. Carriages of this type mounting 120-millimeter guns, plate 8, were furnished the Swiss Government for the defense of the Rhone Valley.

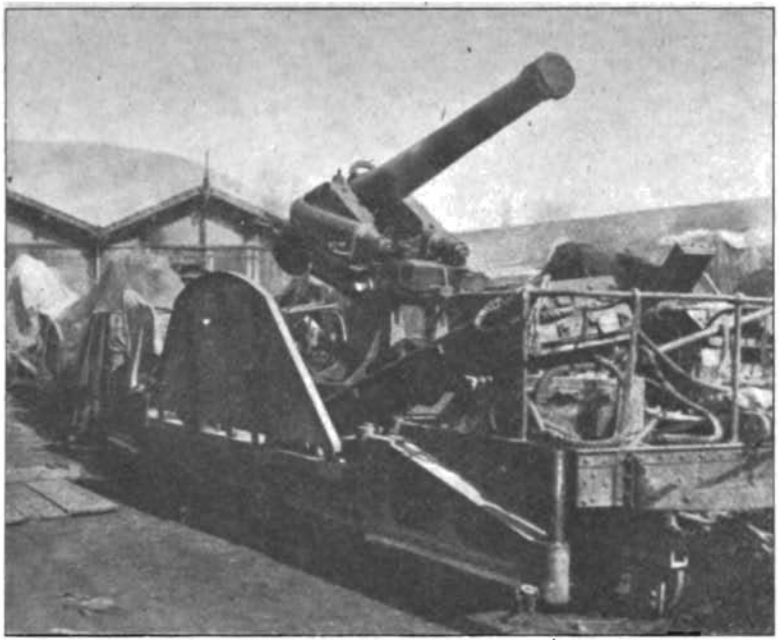
10. The second actual employment of railway artillery in warfare, of which record is available, was by the British in the South African

PLATE 4



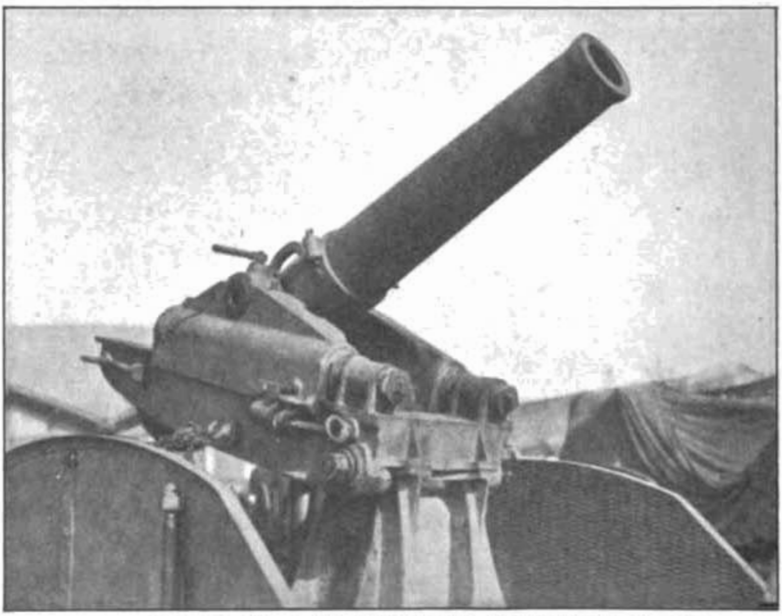
RAILWAY CARRIAGE FOR 155 MM. HOWITZER AND 120 MM. GUN. CARRIAGE DESIGNED BY PEIGNE-CANET IN 1888.

PLATE 5



PEIGNE-CANET CARRIAGE MOUNTING 120 MM. GUN. (THIS CARRIAGE WAS USED BY AMERICAN FORCES IN THE PRESENT WAR.)

PLATE 6



GUN CARRIAGE OF 155 MM. HOWITZER ON RAILWAY MOUNT.

PLATE 7

GUN CARRIAGE OF THE 120 MM. RIFLE ON RAILWAY MOUNT.

120 MM. GUN (DISAPPEARING CARRIAGE), ON RAILWAY MOUNT USED BY THE SWISS GOVERNMENT FOR THE DEFENSE OF THE RHONE VALLEY.

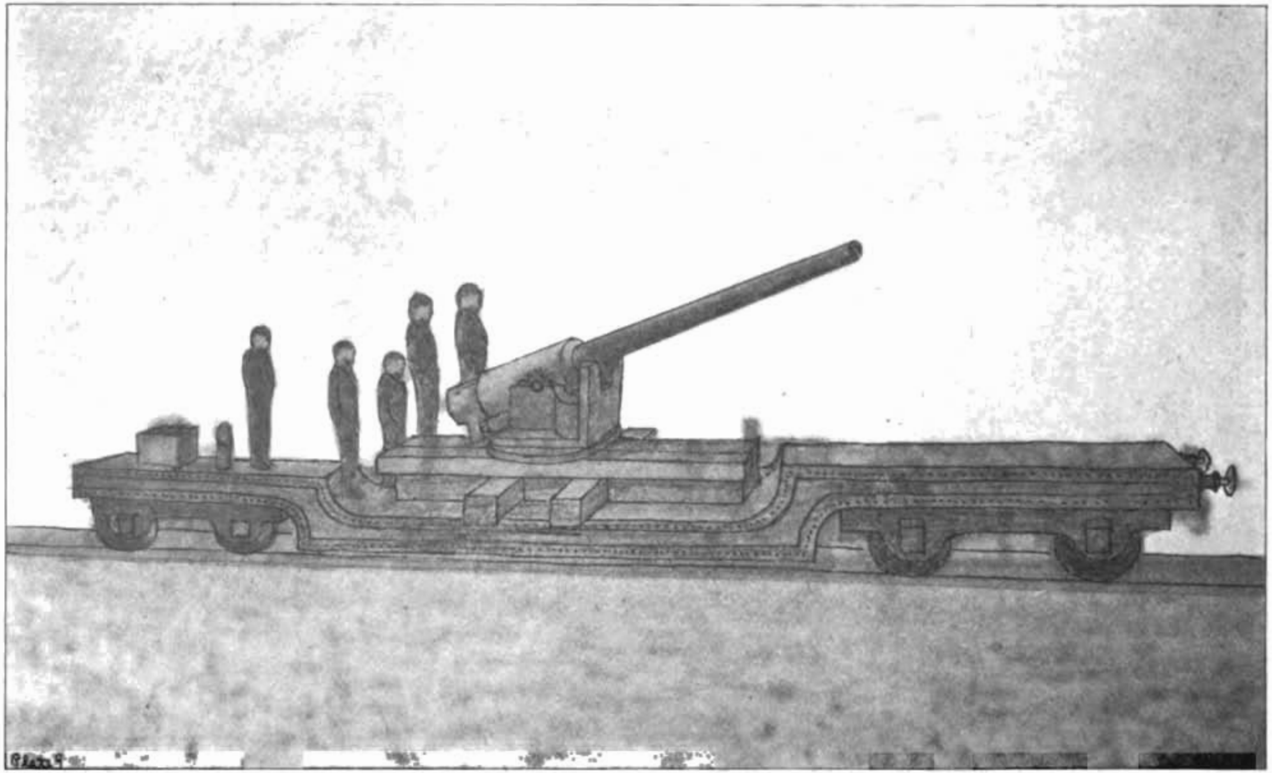
War in 1899-1900. One reference to the guns used in this war is found in the lecture given by Capts. Percy Scott and H. A. Limpus in Hongkong, and published by the Hongkong Daily Press on June 13, 1900, (11). In this lecture mention was first made of the 4.7-inch gun mounted on a railway carriage and used at Ladysmith. The mounting for this gun consisted of four pieces of timber 14 feet long by 12 inches square, plate 9, placed in the form of a cross. The ordinary ship mounting was arranged on the center of this and held in place by bolts passing through to a steel plate underneath. The gun carriage was set over the spindle of this mounting and screwed down by its clip plate. The railway car on which this cross of heavy wood beams was placed was an eight-wheel drop frame flat car. The lecture further mentioned that while the army was operating in the Spion Kop direction, Gen. Barton who was active at Chievely wanted a 4.7-inch gun mounted on a railway carriage to shell a new position that had been occupied by the Boers. There was no time to make a new mounting, so one of the platform mountings similar to those sent to Ladysmith was placed on a low truck and secured down with chains. The ends of the transverse timber were cut off to allow the carriage to pass through the tunnels. Very little recoil was transmitted to the track and the gun could be fired across the track satisfactorily. The mount was arranged for removal from the car and installation on the ground by the use of supplementary beams, replacing those partially cut off. Three more mounts like this were made up and used against the Boers in the attack at Pieters Hill.

11. The limit of development of this type of artillery prior to 1914 appears to have been the 200-millimeter howitzer mounts, plate 10, constructed by the Schneider Co. for the Peruvian Government in 1910. These represented really very little advance over the ideas of Gen. Peigne as worked out by Canet over 20 years previously.

12. The invasion of Belgium in 1914 gave the first intimation of the great German 42-centimeter mortars. There is evidence to indicate that some of these were mounted on railway carriages. Others were mounted on wheeled carriages. A little later the French improvised a mount for their 305-millimeter gun.

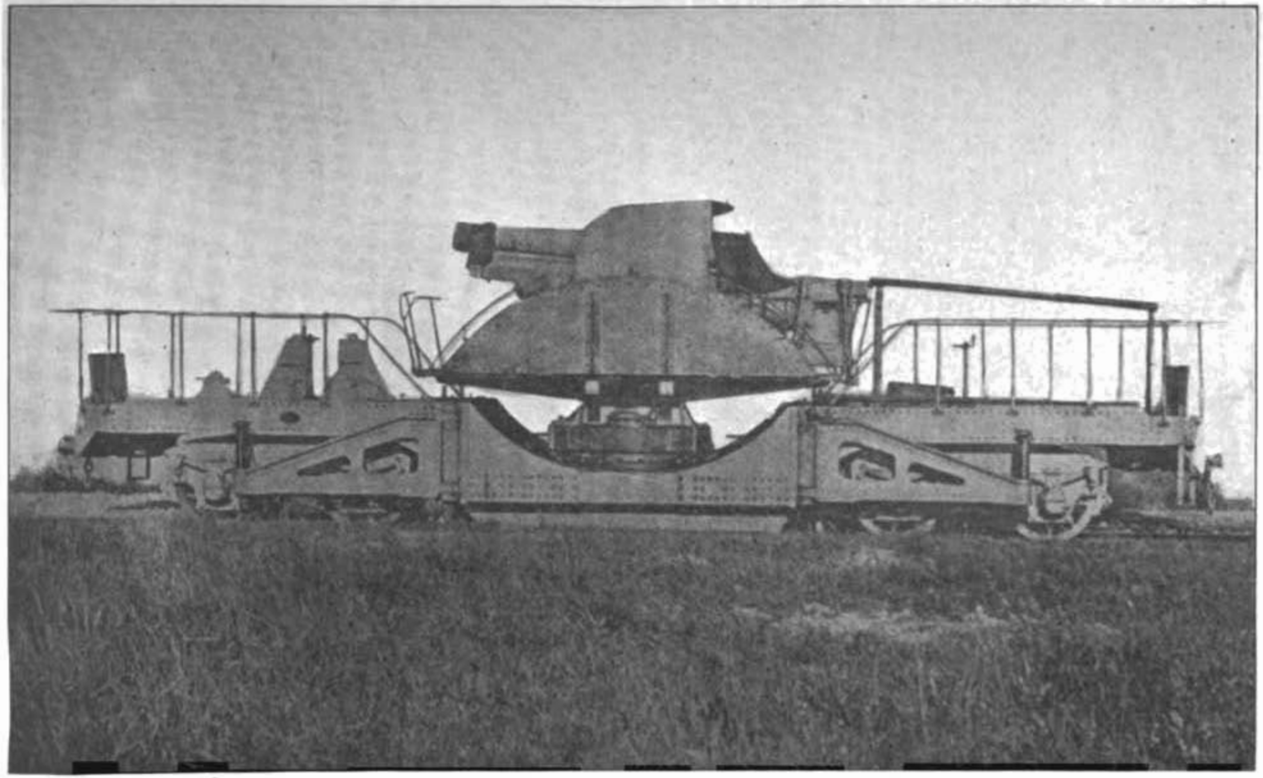
13. In the Engineer for September 3, 1915, 12 photographs are given showing 4.7 and 6 inch guns, mounted on platform cars and with shields over them. A photograph is given also of a 12-pounder mounted on the car. These mounts were manufactured and used in South Africa. All of them were improvised from available guns and locomotive and tender trucks, except in the case of the 12-pounder mount, for which a standard two-truck car was employed. These mounts were provided with swinging arms and jack screws extending

PLATE 9



4.7-INCH BRITISH NAVAL GUN MOUNTED ON RAILWAY CARRIAGE AND USED IN THE SOUTH AFRICAN WAR AT LADYSMITH.
(Artist's sketch.)

PLATE 10



200-MM. HOWITZER ON RAILWAY MOUNT, CONSTRUCTED BY SCHNEIDER CO. FOR THE PERUVIAN GOVERNMENT IN 1910.

PLATE 10A

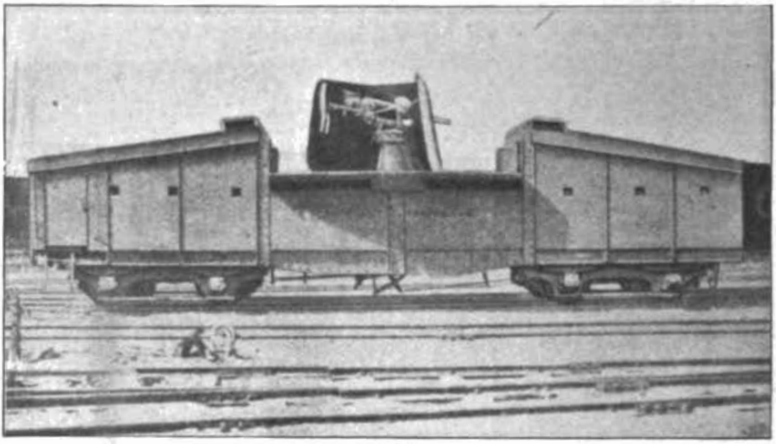


FIG. 1.

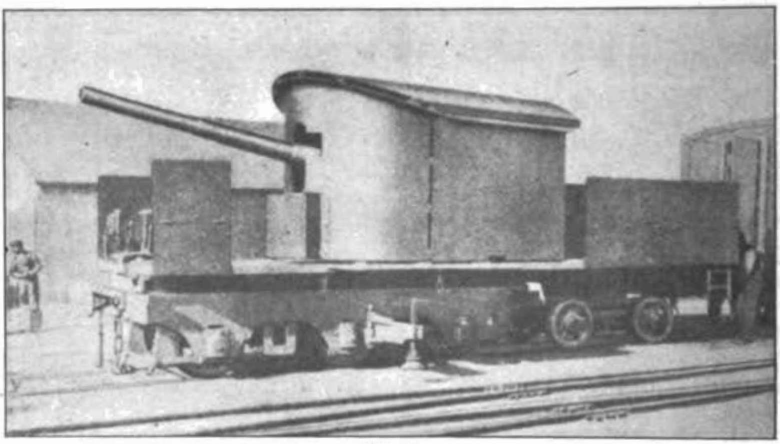


FIG. 2.

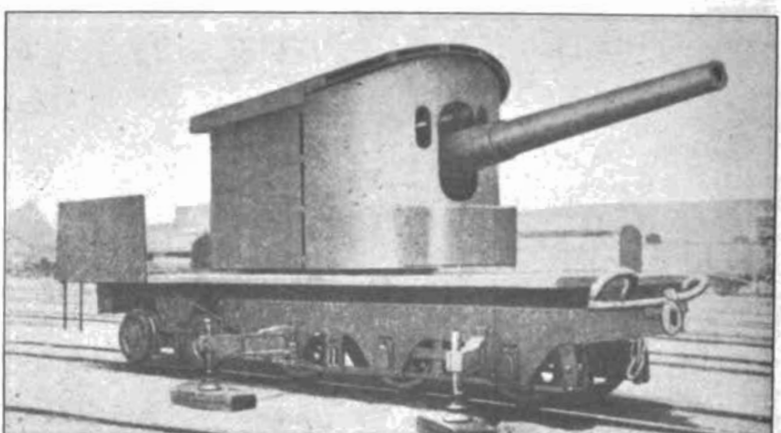


FIG. 3.

from the arms, similar to the Schneider 200-millimeter howitzer and the American original model 1918 8-inch mount.

14. The character of development of railway artillery is perhaps best illustrated by the following table of mounts already mentioned, as well as of mounts developed during the European war.

No.	Caliber.	Type.	Make.	Date.	Approximate muzzle energy.
					Tons-meters.
1	13-inch	Mortar	Improvised, Civil War	1864	300
2	155-mm	Howitzer	Schneider-Canet	1887-1890	270
3	120-mm	Gun	St. Chamond	1889	368
4	200-mm	Howitzer	Schneider	1910	920
5	420-mm	Mortar	Krupp	1914	4,900
6	305-mm	Gun	St. Chamond	1915	11,200
7	520-mm	Howitzer	Schneider	1917	17,860
8	14-inch	Rifle	United States Navy	1918	19,600
9	16-inch	do	United States Army (design only)	1918	37,600

15. A comparison of the fourth, fifth, and sixth items above shows the enormous increase in power of railway artillery which took place at the beginning of the war. The seventh and eighth show the heaviest pieces actually constructed and used and the last is the heaviest mount on which design had been perfected. Thus the period of the war has seen a forty-fold development in the power of railway artillery. It is the high points of this development which will be traced in the succeeding sections.

SECTION 1.

CLASSIFICATION OF TYPES OF RAILWAY ARTILLERY.

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16. The various types of railway artillery may be classified to advantage by the characteristics of three chief factors in design—traverse, recoil, and anchorage.

17. Before going into the details of these classifications it should be emphasized that a very large number of the mounts described in Volume II and used for illustrations below were designed and constructed under the greatest possible pressure, so far as time was concerned, and from whatever materials happened to be available. In consequence, many features found in them were the result of this pressure, and in many cases were inherently undesirable. In the following, an attempt is made to point out, as clearly as possible, these features which were the result of such forced improvisation.

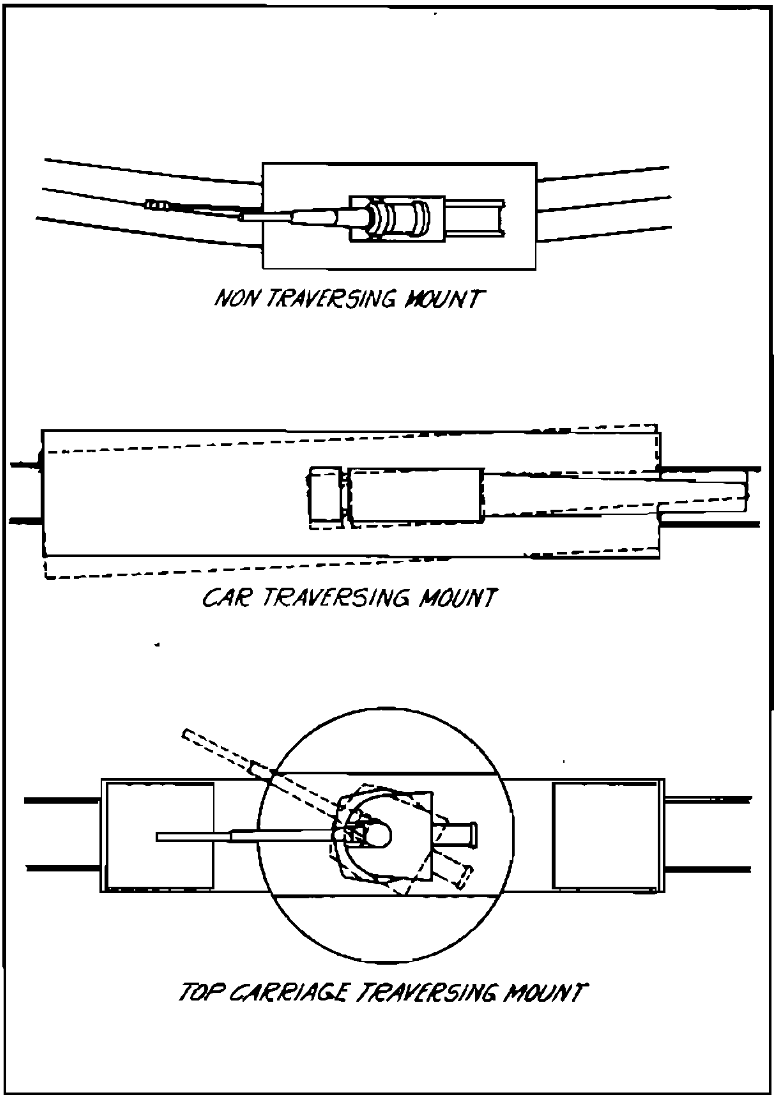
CLASSIFICATION ACCORDING TO METHOD OF TRAVERSE.

18. Traverse is obtained in railway mounts by one of three methods. These are: (1) By moving the mount along a curved track or epi (nontraversing mount); (2) by rotating the railway carriage about a real or imaginary vertical axis (car traverse); and (3) by rotating a top carriage rotable with respect to the car (top carriage traverse). For illustrations of these methods see plate 11.

19. Nontraversing Mount.—On this type of mount no provision is made either on the gun carriage or the railway car body for traversing the gun; it can be pointed in azimuth only by moving the entire mount along a curved track.

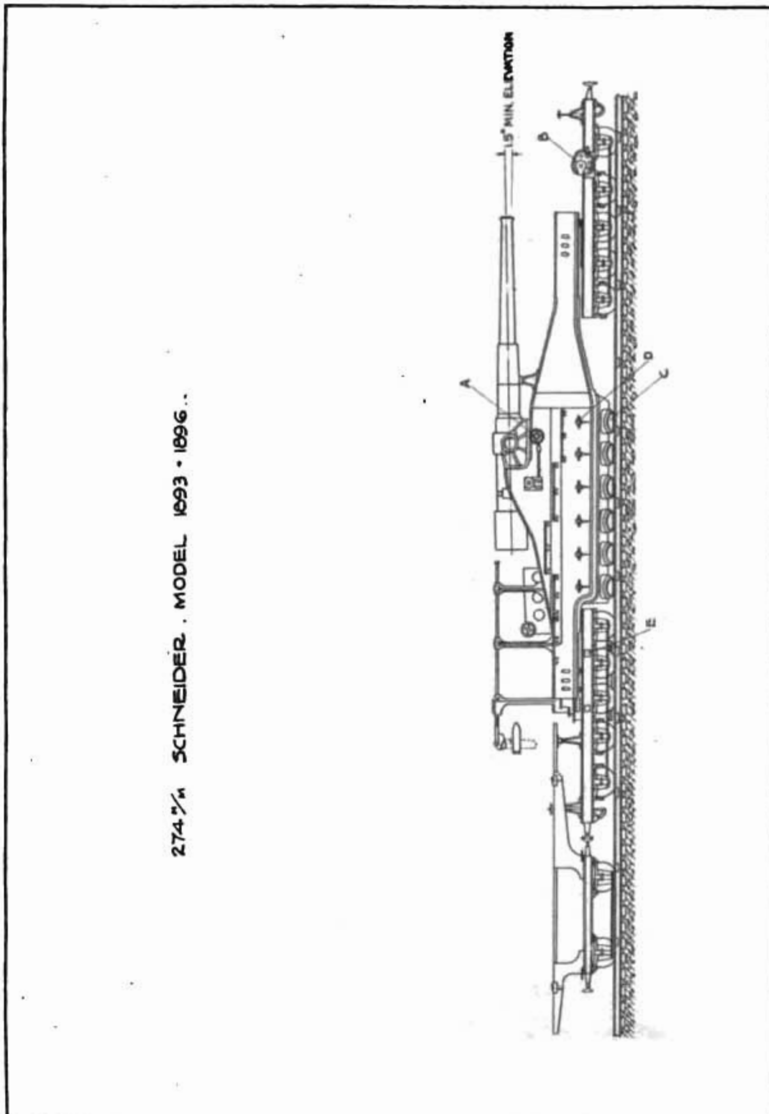
20. The most striking examples of this type are the so-called Schneider mounts on which the gun is either supported on the side girders of the car or on a gun carriage that is capable of linear motion only, and that in a direction parallel to the side girders. The first arrangement (gun supported directly on side girders) is illustrated on plates 12, 13, 14, and 15, and the second (gun on recoiling top carriage) on plates 16, 17, 18, and 19.

PLATE 11



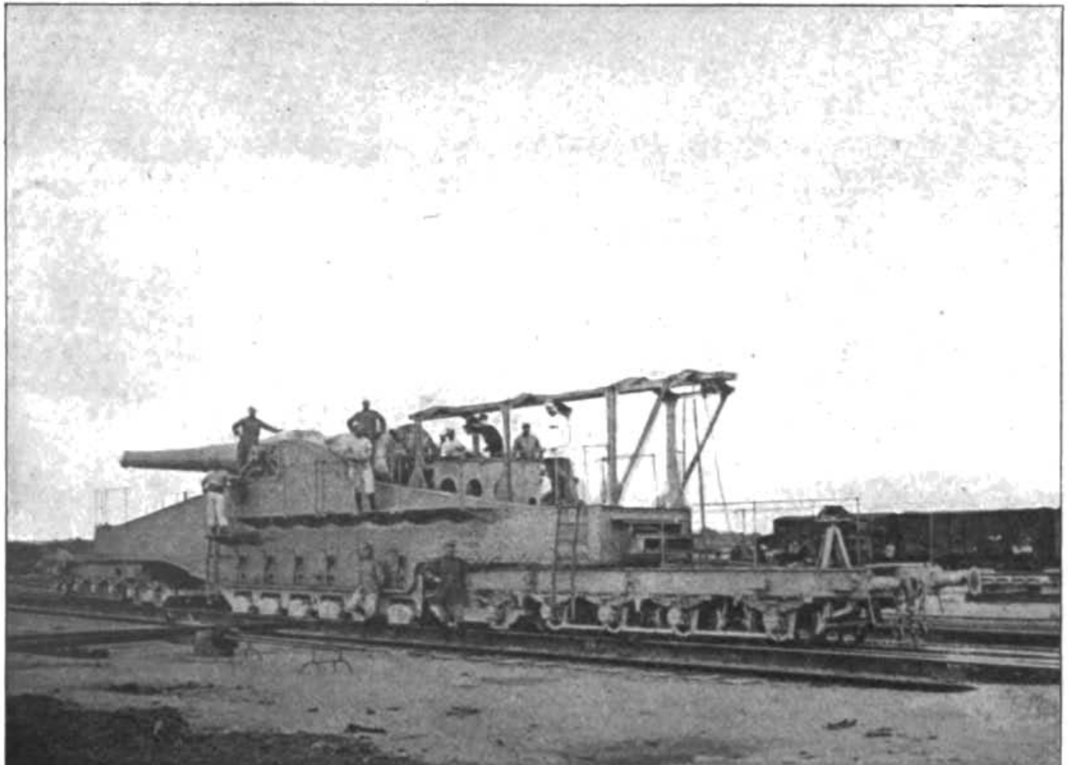
CLASSIFICATION OF RAILWAY ARTILLERY ACCORDING TO METHODS OF TRAVERSE.

PLATE 12



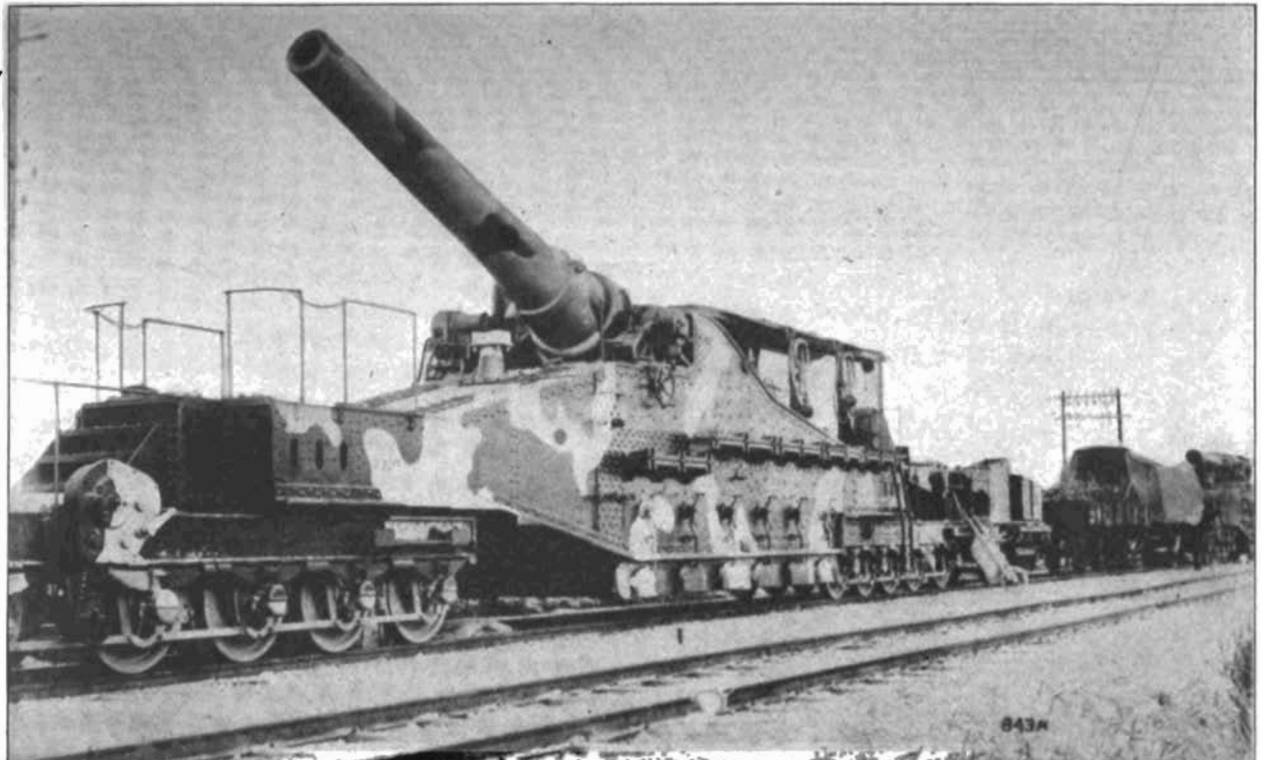
SLIDING TYPE MOUNT FOR FRENCH 274-MM. GUN.

PLATE 13



SLIDING TYPE MOUNT FOR FRENCH 305-MM. GUN (MOUNT SET FOR FIRING).

PLATE 14



SLIDING TYPE RAILWAY MOUNT FOR FRENCH 320-MM. HOWITZER.

PLATE 15

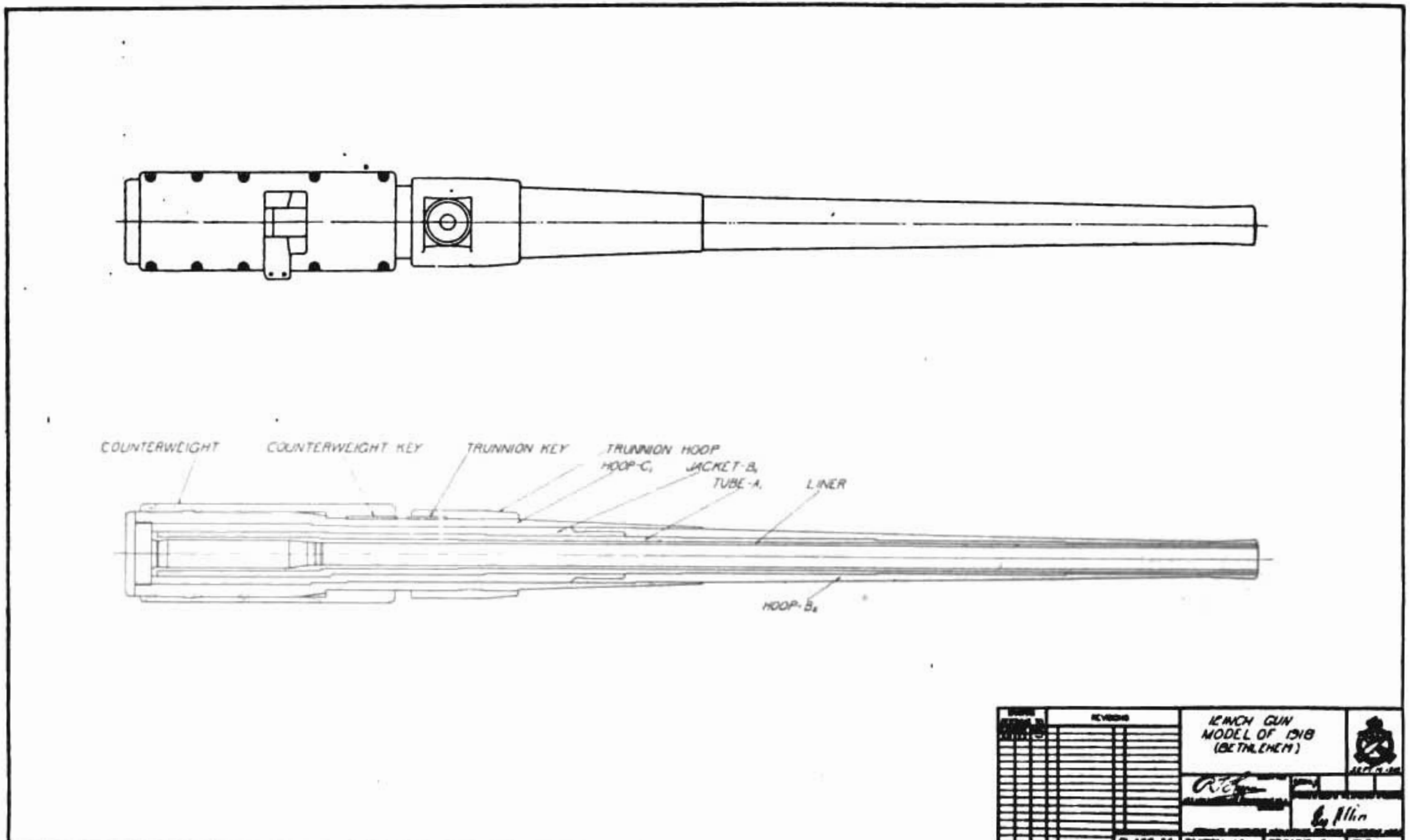
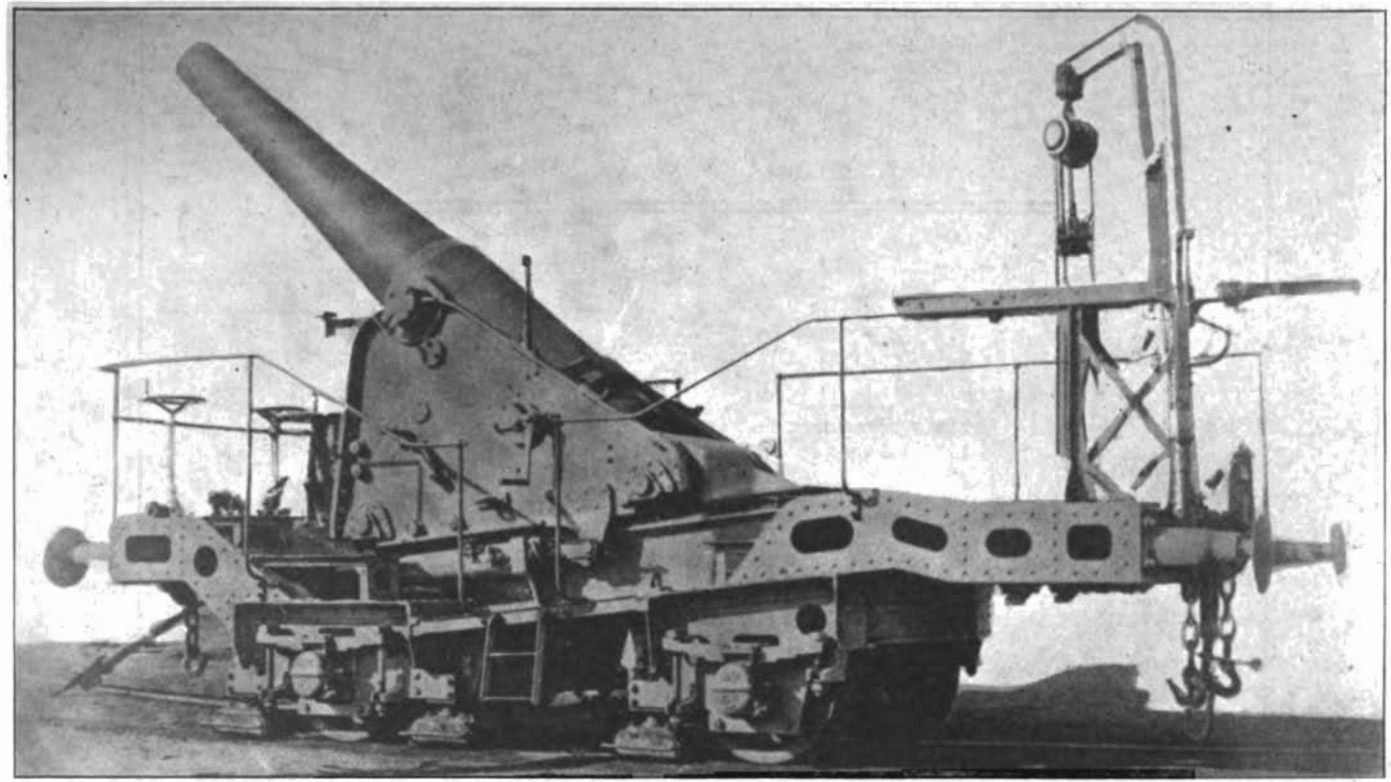
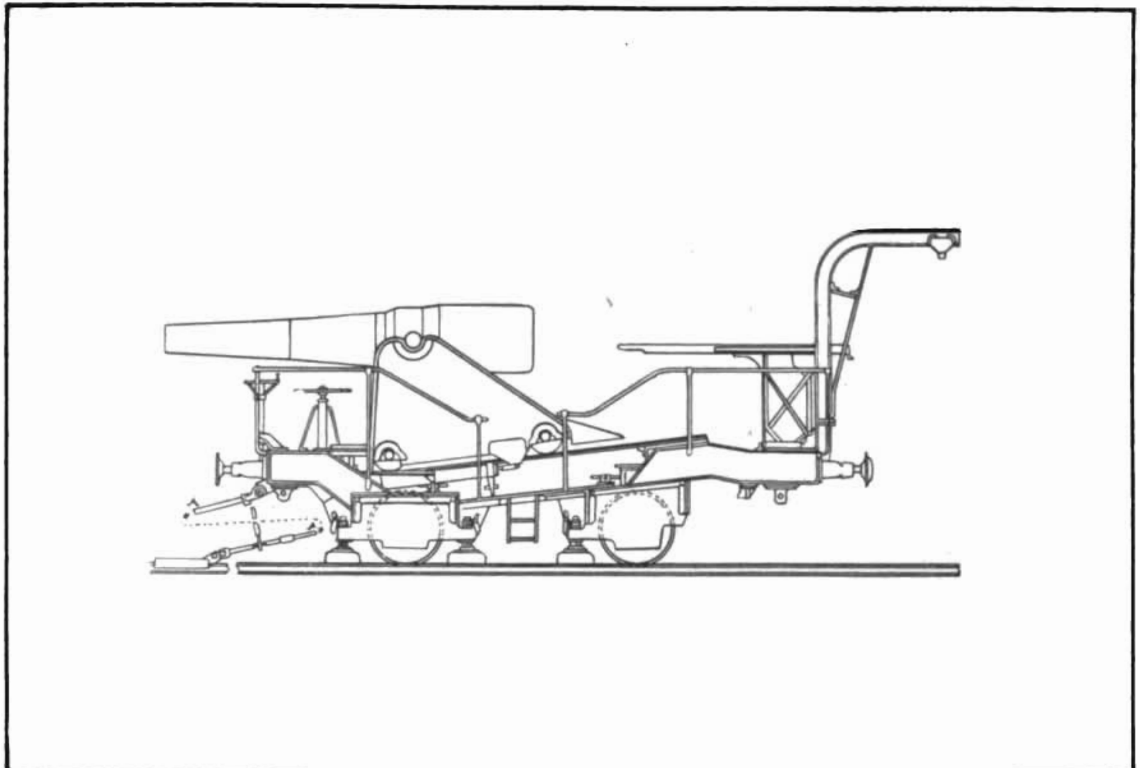

COUNTERWEIGHT
COUNTERWEIGHT KEY
TRUNNION KEY
TRUNNION HOOP
HOOP-C,
JACKET-B,
TUBE-A,
LINER
HOOP-B
12 INCH GUN
MODEL OF 1918
(BETHLEHEM)
CLASS 26
DIVISION 10
DRAWING 51
FILE

PLATE 16



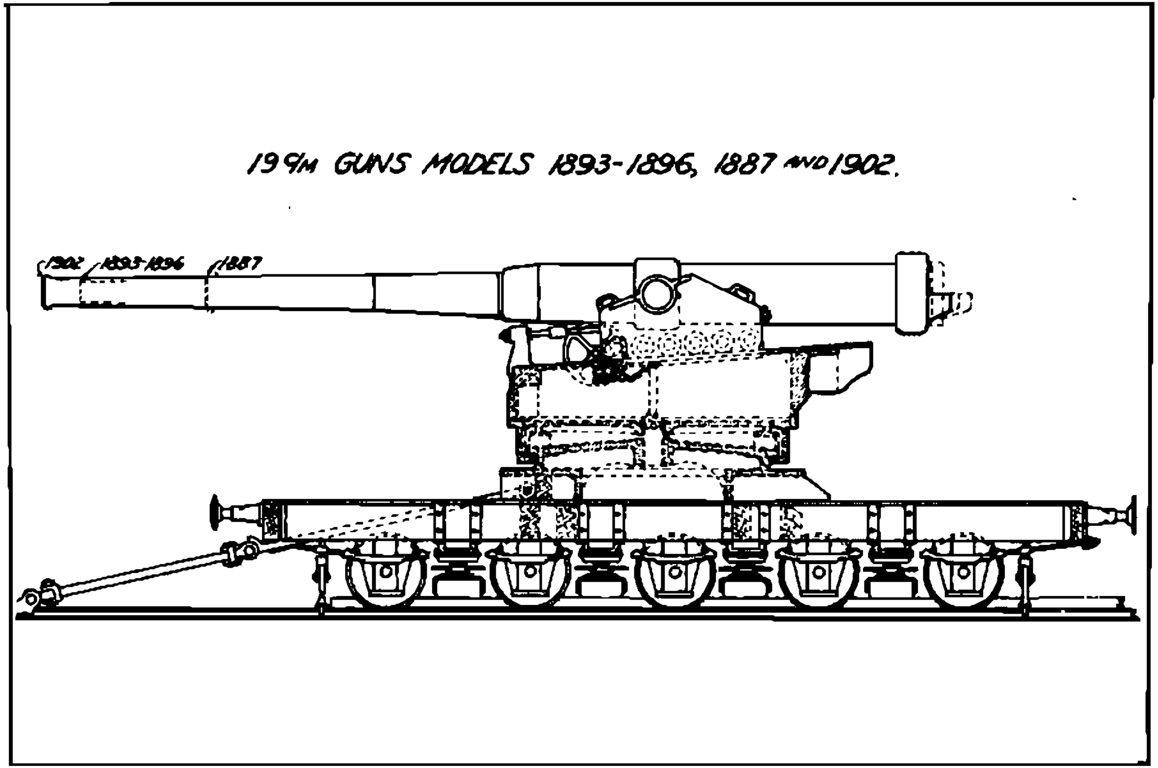
IMPROVISED RAILWAY MOUNT FOR 190-MM. FRENCH HOWITZER AND ITS SEACOAST CARRIAGE.

PLATE 17



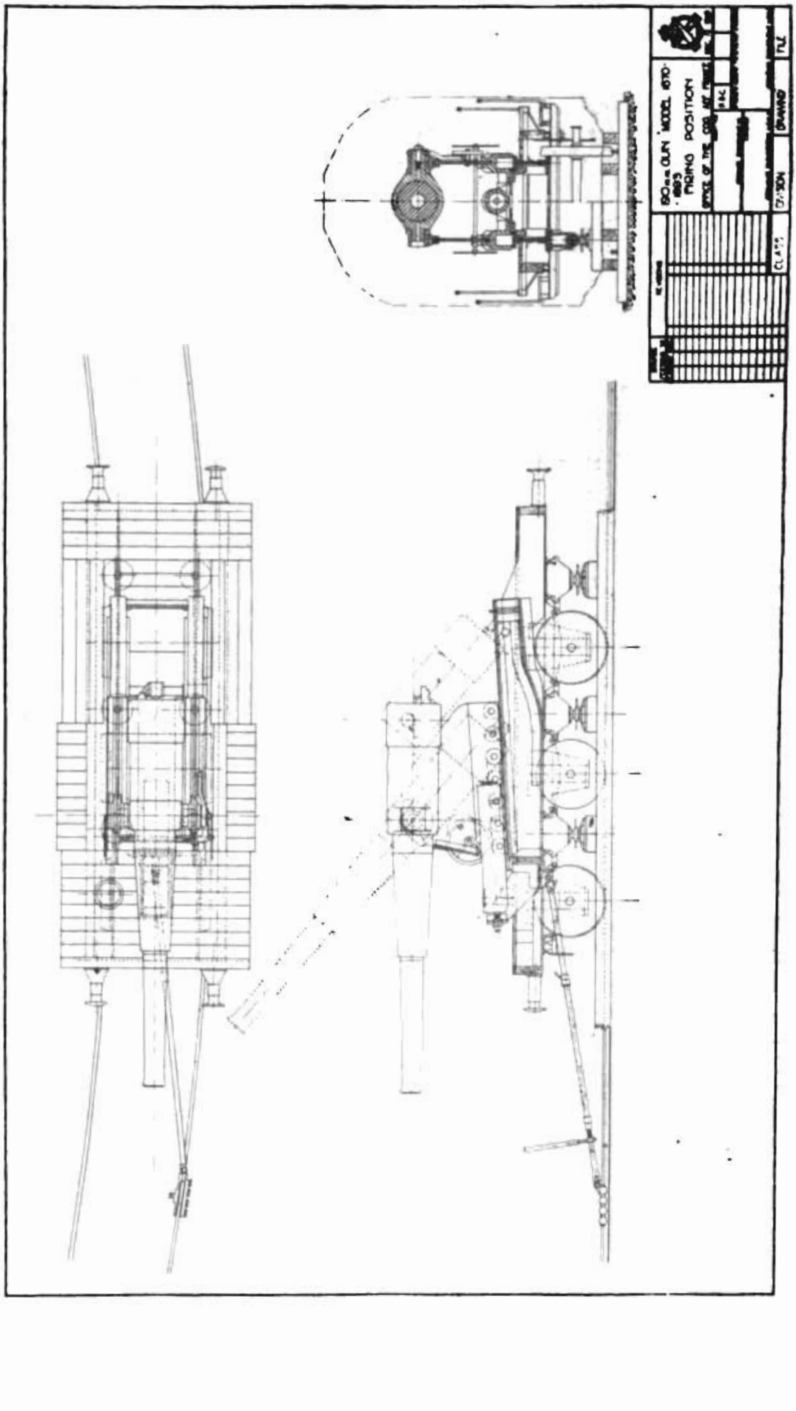
IMPROVISED RAILWAY MOUNT FOR 190-MM. HOWITZER AND ITS SEACOAST CARRIAGE.

PLATE 18



RAILWAY MOUNT FOR 19-MM. GUN AND ITS SEACOAST CARRIAGE.

PLATE 19


GUN MODEL 1870-1893
FIRING POSITION
OFFICE OF THE
DIVISION
DRAWING
FILE

21. CAR-TRAVERSING MOUNT.—The distinctive feature of this type is the provision which is made for traversing the entire car body. The gun is supported in the car body, either directly on rigid trunnions, or through a cradle or top carriage without traverse, and it can be moved in azimuth only to the extent that it is possible to traverse the car body. As a rule this traverse is obtained by a slight movement of the car body on the trucks, giving a few degrees on each side of the center line. Other mounts of this type, however, are provided with an elaborate center plate with traversing rollers and are capable of large traverse or even of all round fire. The latter type, and sometimes the former as well, require an elaborate foundation and are generally provided with a large center pin which takes the horizontal component of the shock of recoil. Car-traversing mounts affording limited fire are illustrated on plates 20, 21, 22 and 23, and one allowing large traverse or all round fire is illustrated on plate 24.

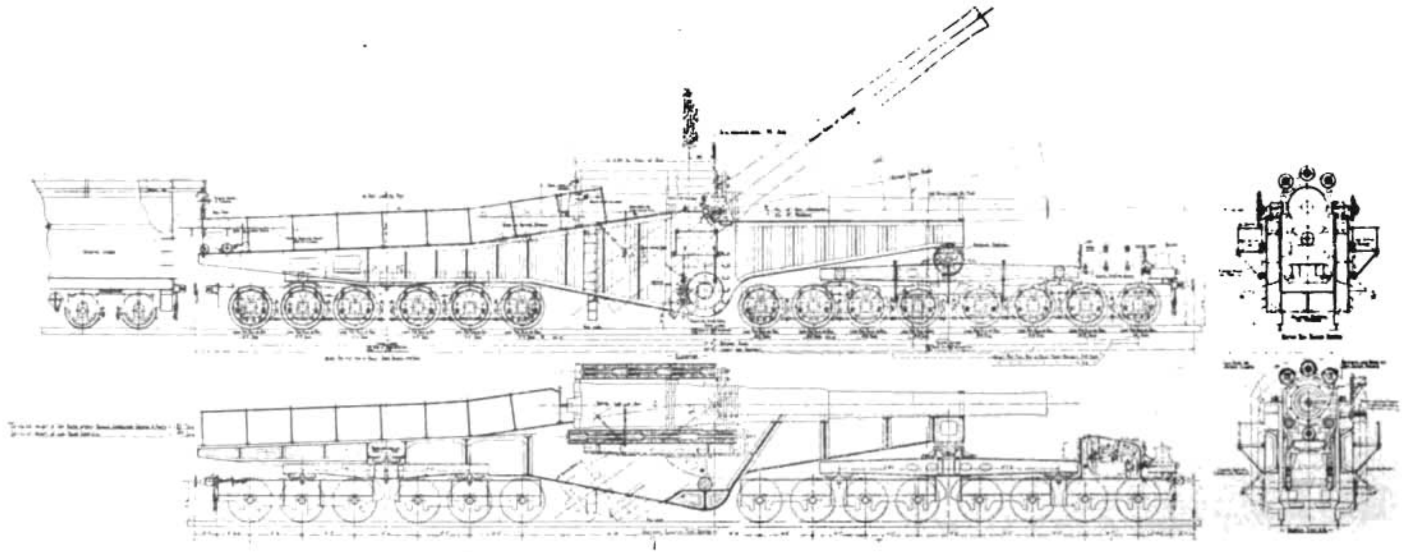
22. TOP CARRIAGE TRAVERSING MOUNTS.—The distinctive feature of this type is the provision of a top carriage rotable with respect to the car body. The amount of traverse varies on the different designs in use from 10 to 360 degrees. In each of these designs, with the single exception of the American 16-inch howitzer, model 1918 MI, either a more or less elaborate firing platform or some arrangement of outriggers is required. Top carriage traversing mounts affording limited fire are illustrated on plates 25 and 26, and those affording all round fire are shown on plates 27, 28, 29, 30, and 31.

23. DISCUSSION.—The nontraversing mounts are all, to a certain extent, improvisations. The French term them "affuts de circonstance." It is the concensus of opinion that, where time and facilities permit, a small amount of traverse at least should be given, so that the gun may be trained closely in azimuth. The distinction between the other two types seems to be more essentially on the basis of caliber and muzzle energy. The top carriage type traverse is easily applied with the smaller guns while the car-body traverse is reserved for the heavier and higher powered ones.

CLASSIFICATION ACCORDING TO RECOIL SYSTEM.

24. Recoil is taken up on railway artillery by allowing the displacement of the mount or some portion thereof and retarding this motion. Characteristic provisions are made for bringing the moving part back to its original position. Such artillery may be classified in accordance with the extent of this recoiling portion into the following well-marked systems: (1) Cradle recoil, top carriage recoil, sliding mount recoil, and rolling mount recoil. See plate 32 for illustrations of these types. The means of retardation and of return to battery

PLATE 20



RAILWAY MOUNT FOR BRITISH 12-INCH GUN.

PLATE 21

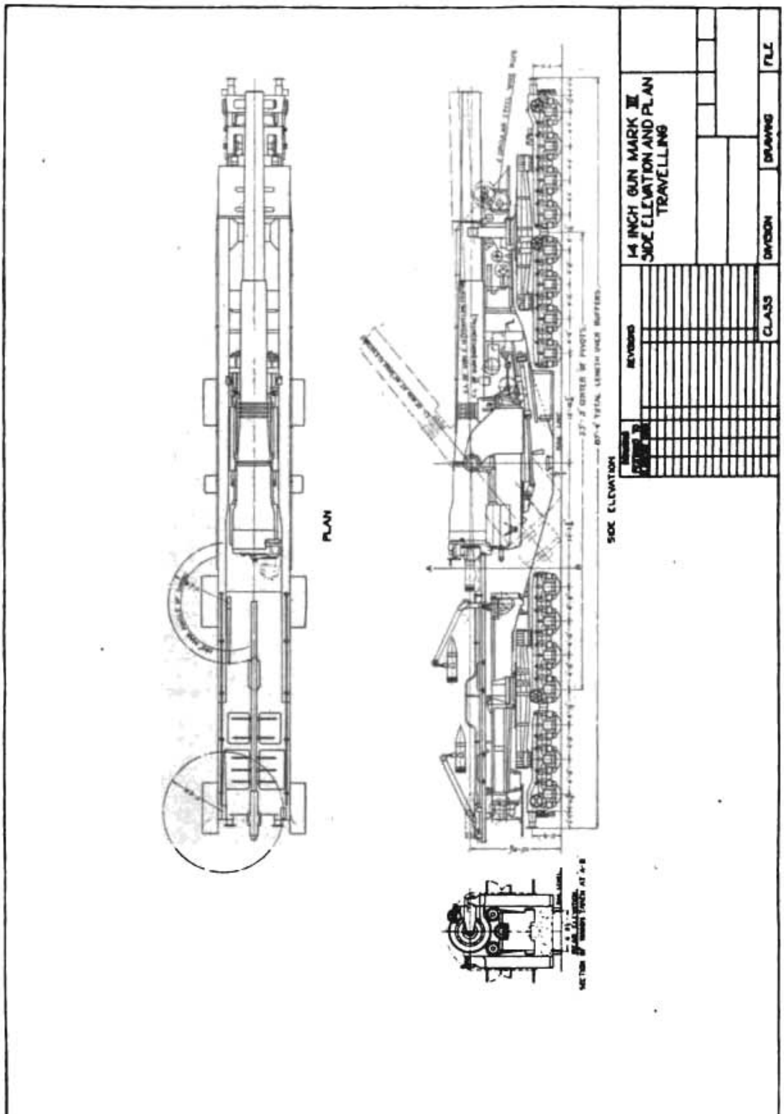

14 INCH GUN MARK II
SIDE ELEVATION AND PLAN
TRAVELLING
PLAN
SIDE ELEVATION
REVISIONS
CLASS
DIVISION
DRAWING
FILE

PLATE 22

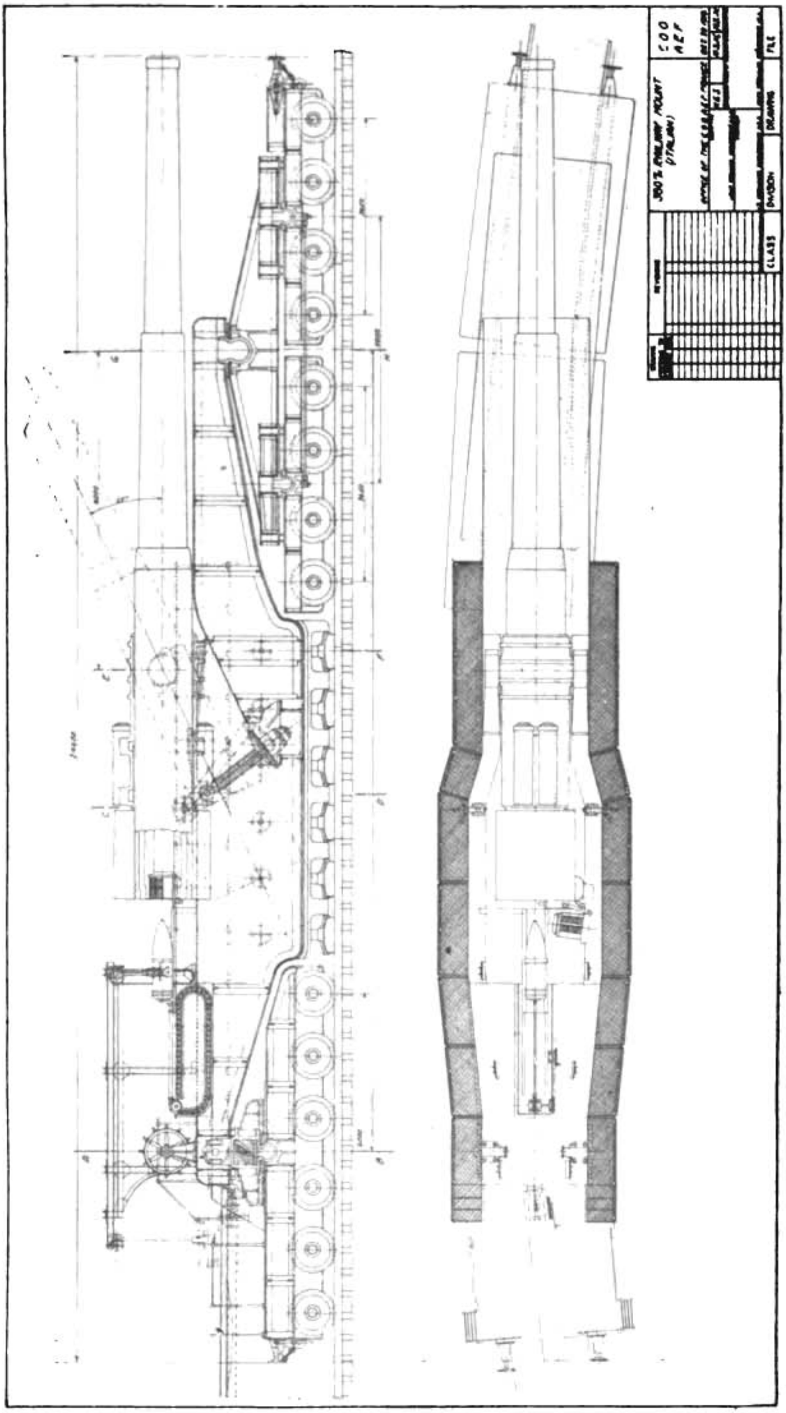


PLATE 23

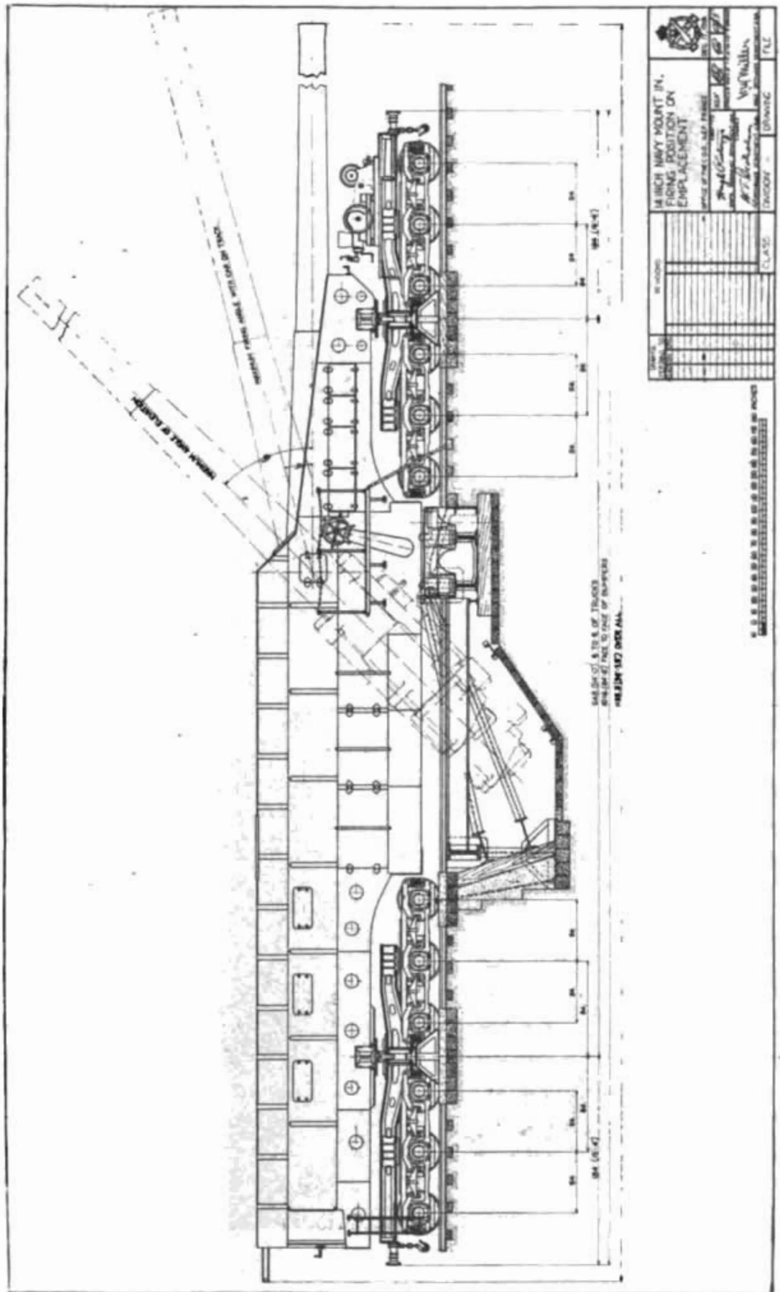
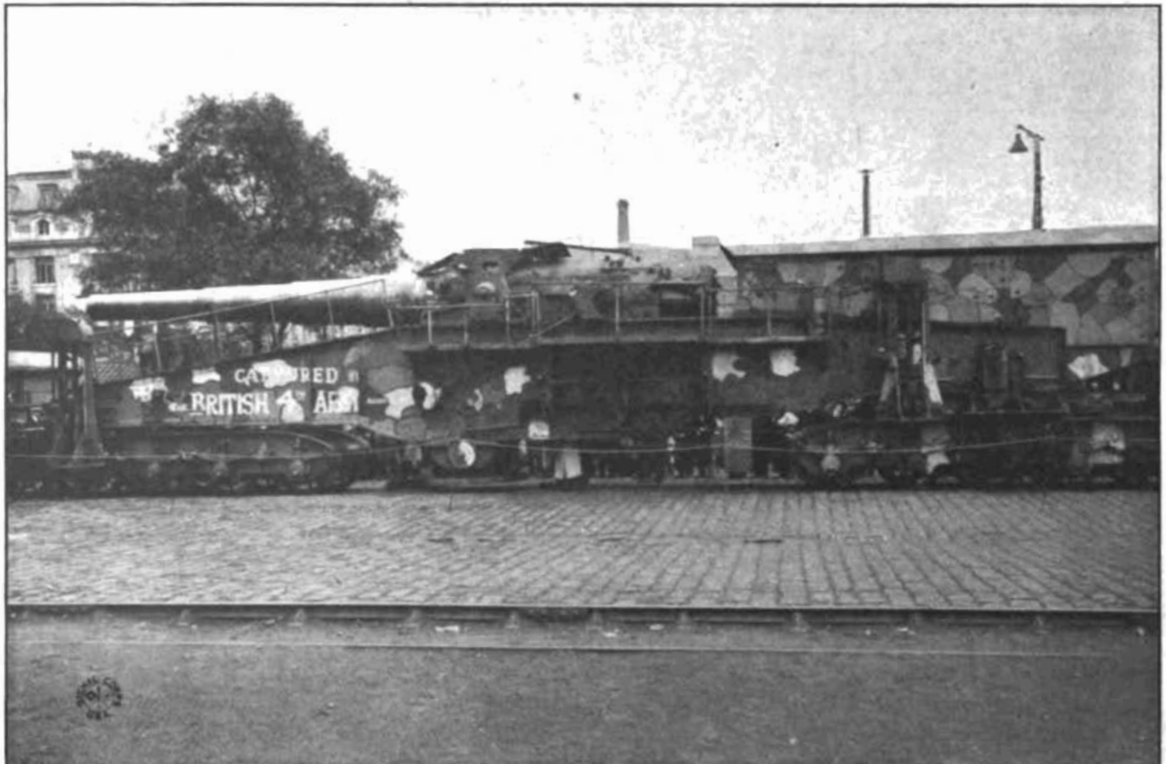
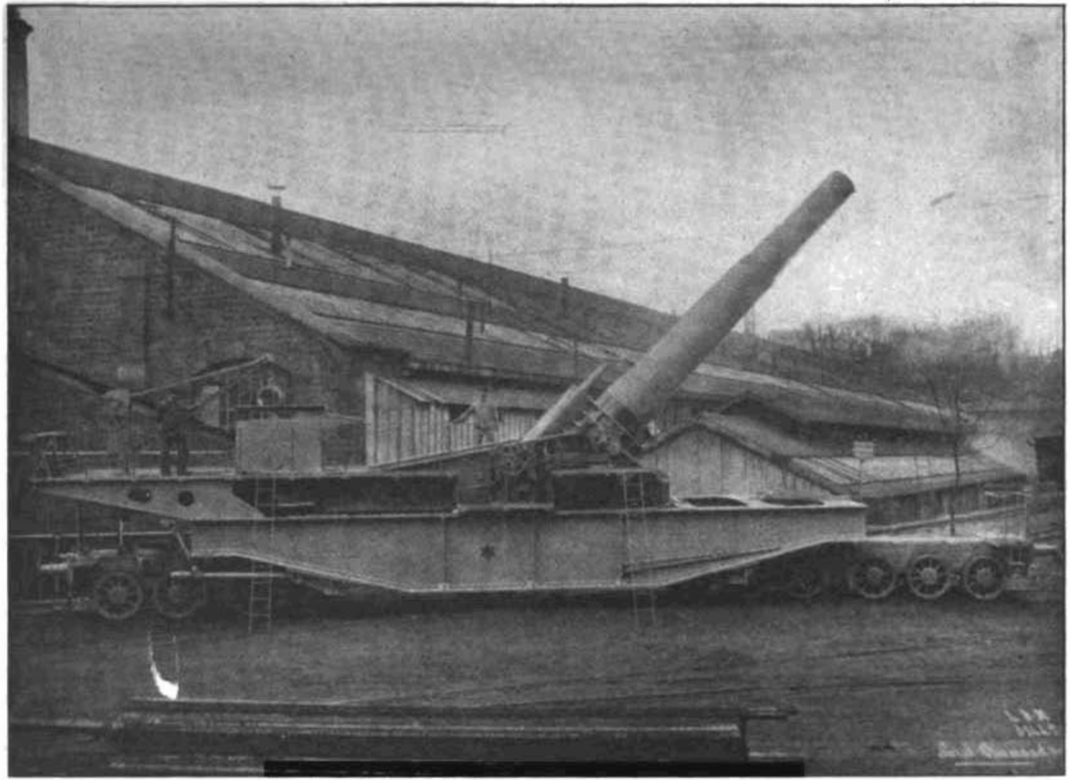

14 INCH NAVY MOUNT IN FIRING POSITION ON EMPLACEMENT
DIVISION
DRAWING
CLASS
FILE

PLATE 24



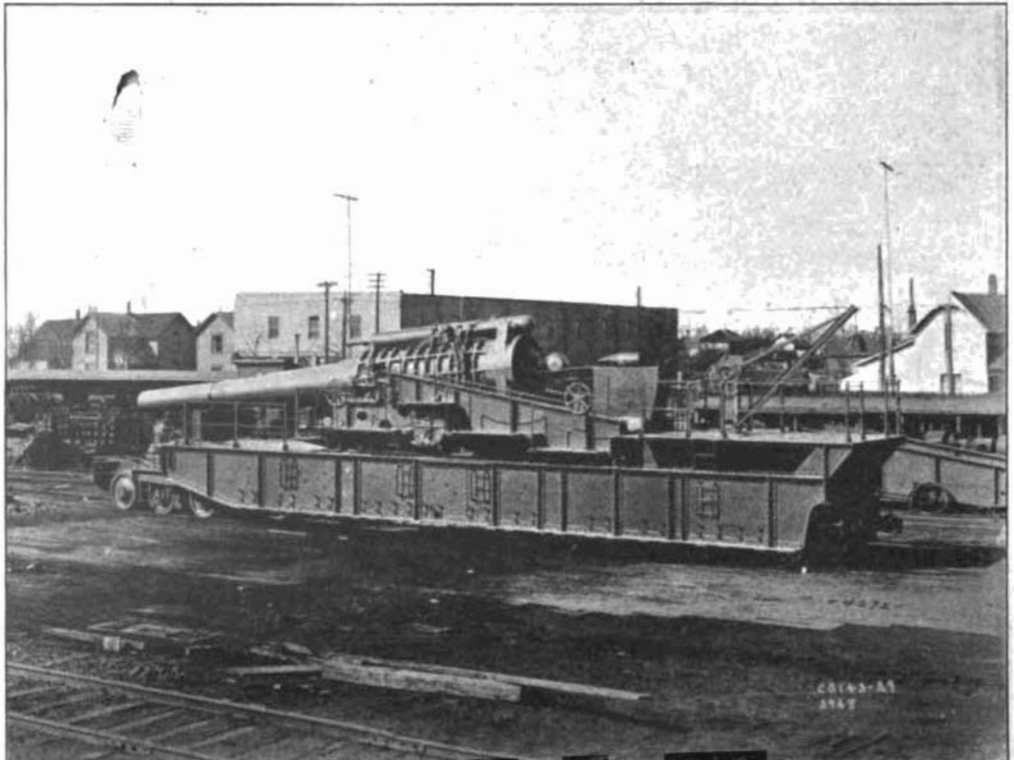
RAILWAY, MOUNT FOR GERMAN 280-MM. GUN.

PLATE 25



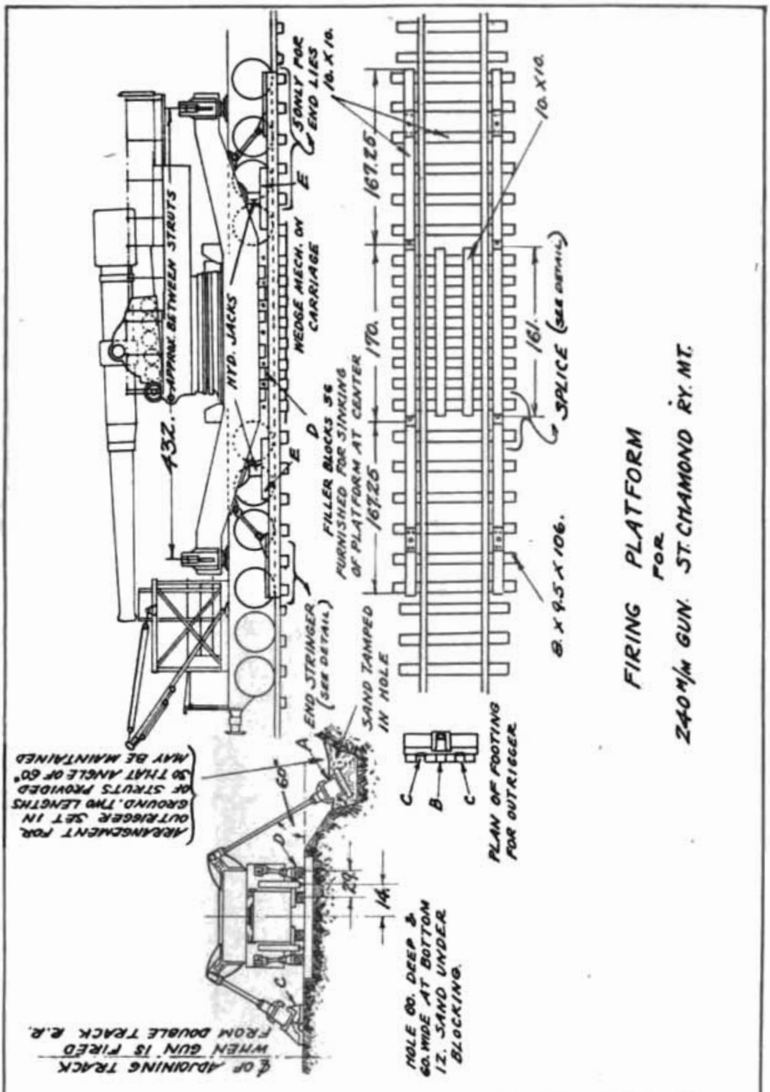
RAILWAY MOUNT FOR 400-MM. FRENCH HOWITZER.

PLATE 26



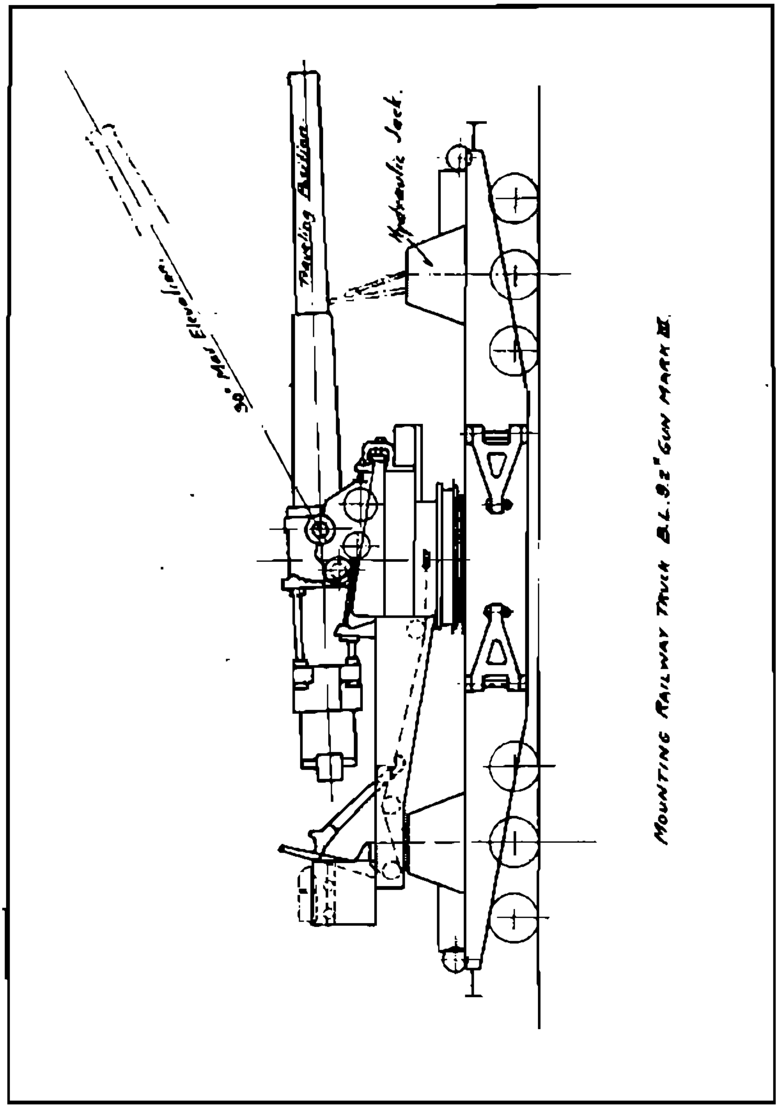
BATEGNOLLES RAILWAY MOUNT FOR AMERICAN 12-INCH, 35-CALIBER GUN.

PLATE 27



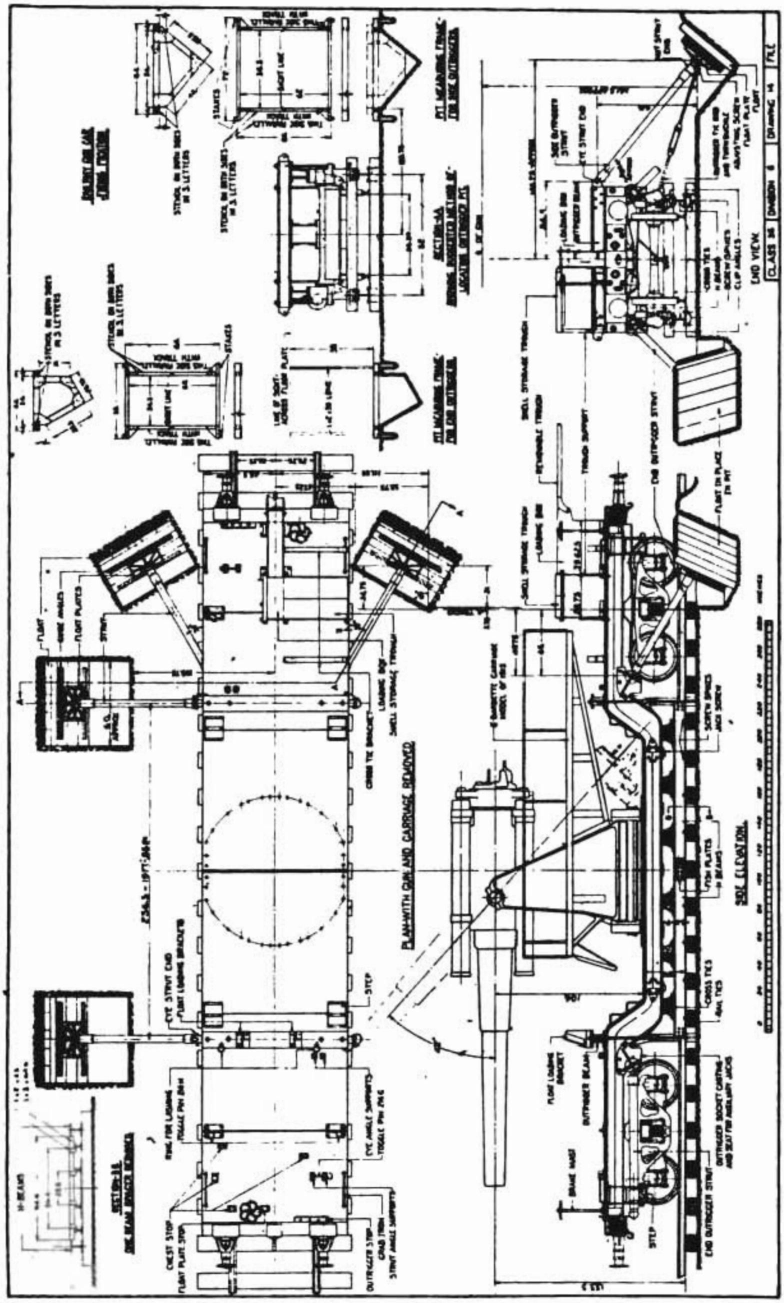
FIRING PLATFORM FOR 240 M/M GUN. ST. CHAMOND RY. MT.

PLATE 28



MOUNTING RAILWAY TRUCK B.L. 9.2" GUN MARK III

PLATE 30



RAILWAY MOUNT FOR AMERICAN 8-INCH GUN, 32-CALIBER.

PLATE 31

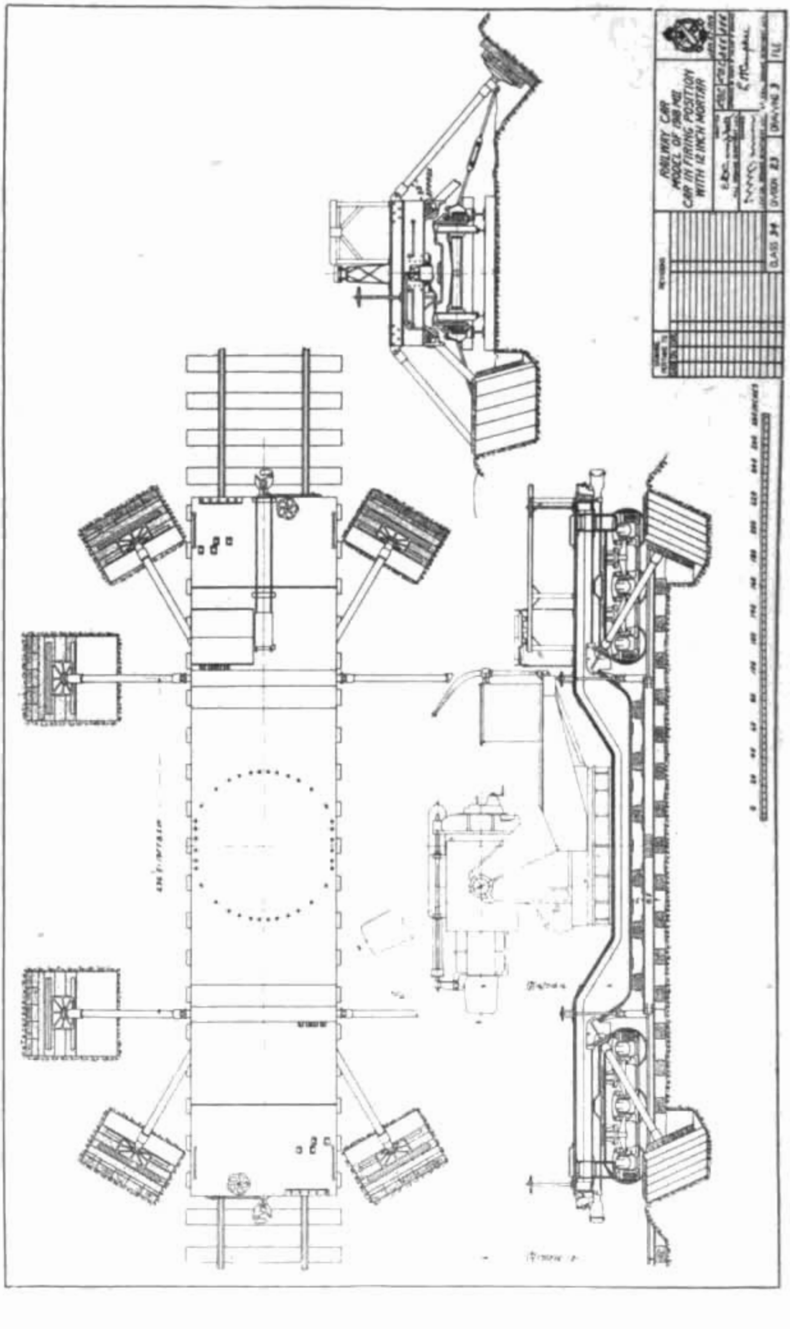
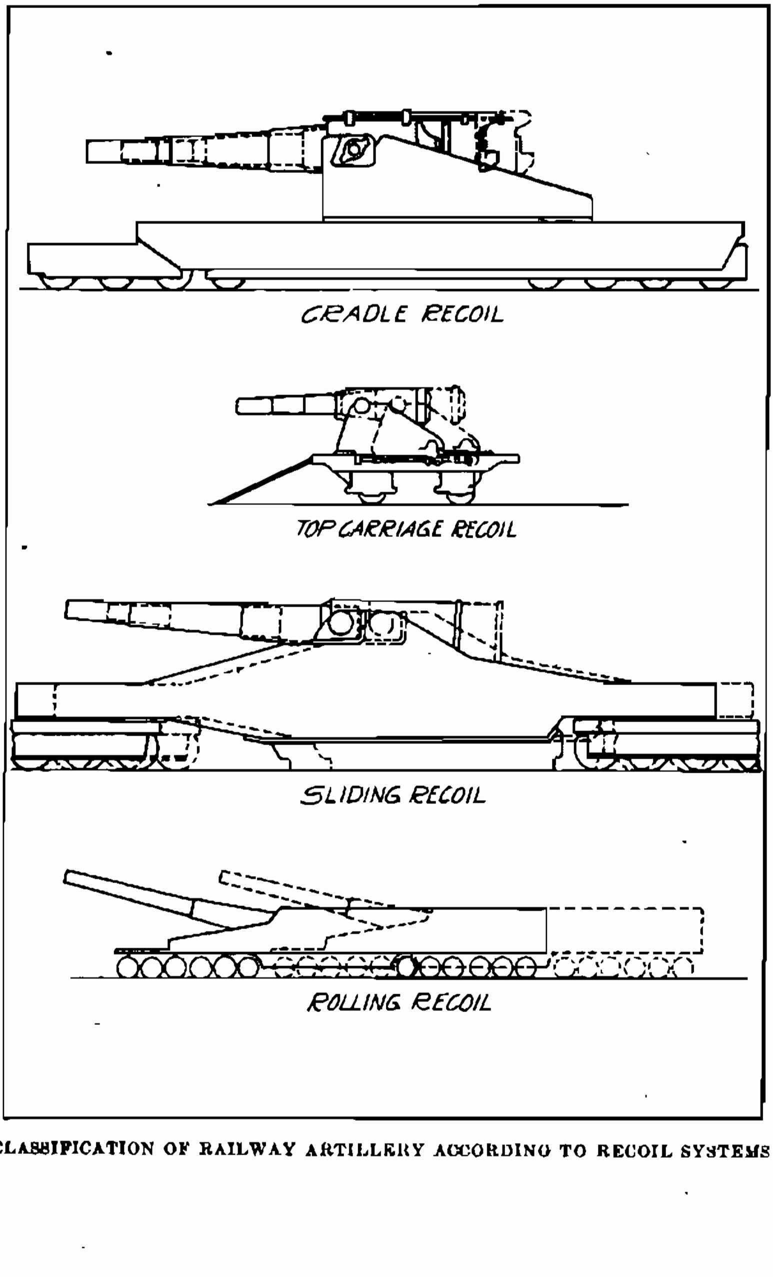

RAILWAY CAR
MODEL OF 1918 MI.
CAR IN FIRING POSITION
WITH 12 INCH MORTAR
CLASS 34
DIVISION 23
DRAWING 3
FILE

PLATE 32



CLASSIFICATION OF RAILWAY ARTILLERY ACCORDING TO RECOIL SYSTEMS.

are various but each is more or less characteristic of one of the above types and they will be described in detail under the appropriate heads.

25. CRADLE RECOIL.—The characteristic of this type is that the gun only recoils, moving backward along the line of fire, in a sleeve or cradle. The gun is retarded and brought to rest by means of hydraulic buffers, or dashpots, attached to the cradle, and with pistons which are rigidly attached to the gun. Return to battery is obtained by helical steel springs, or by the pressure of air in a pneumatic recuperator cylinder, in which increased compression is produced by the recoil. The cradle is provided with trunnions and the cradle and gun are swung in the trunnion bearings of the carriage. For examples of this type of recoil system see plates 33, 34, 35 (spring counterrecoil) and plates 36, 37, and 38 (pneumatic counterrecoil).

26. TOP-CARRIAGE RECOIL.—The characteristic of this type is that the gun is carried in a top carriage, supported by wheels on fixed rails. The gun and carriage recoil together in a fixed direction along these rails. Recoil is restrained by hydraulic buffers and return to battery is obtained either by gravity, through the use of inclined rails, up which the gun recoils, by springs, or on some improvised mounts, by rubber bands. An air recuperator might equally well be used, but no example of such a combination is known. Examples of this type with gravity counterrecoil are shown on plates 16 and 39, and with springs or rubber bands on plates 40 and 41.

27. SLIDING RECOIL.—The characteristics of this type are that the gun, car body, and trucks recoil together, the car body sliding on a special set of girders incorporated in the track. The car body is provided with wooden crossbeams or "sleepers" which are jacked down on the track girders in such a way that about one-half the weight of the mount is transferred to them from the truck. The resulting friction thus created absorbs the energy of recoil and brings the mount to rest. This recoil varies from 1 to 2 meters. All of these mounts, with two exceptions—the American Army 14-inch design and Italian 381-millimeter—are of the nontraversing type and must be fired from a previously prepared curved firing track or epi. Counter-recoil, or the return of the gun to firing position, is obtained by jacking up the sleepers, thus returning all of the weight to the trucks and rolling the entire mount forward by the amount of the recoil. This is usually accomplished by gear trains and handwheels, through which two or more pairs of wheels may be driven and exact adjustment of the mount on the track obtained. In the heavier mounts an electric motor drive is employed, and in other cases a gasoline winch has been used with success. Even with the heaviest guns ordinary car pushers, applied in sufficient number, have served as an emergency method of moving the gun back into battery. Examples of this type of mount may be found in a wide variety of calibers on plates 12, 13, 42, 43, and 44.

PLATE 63

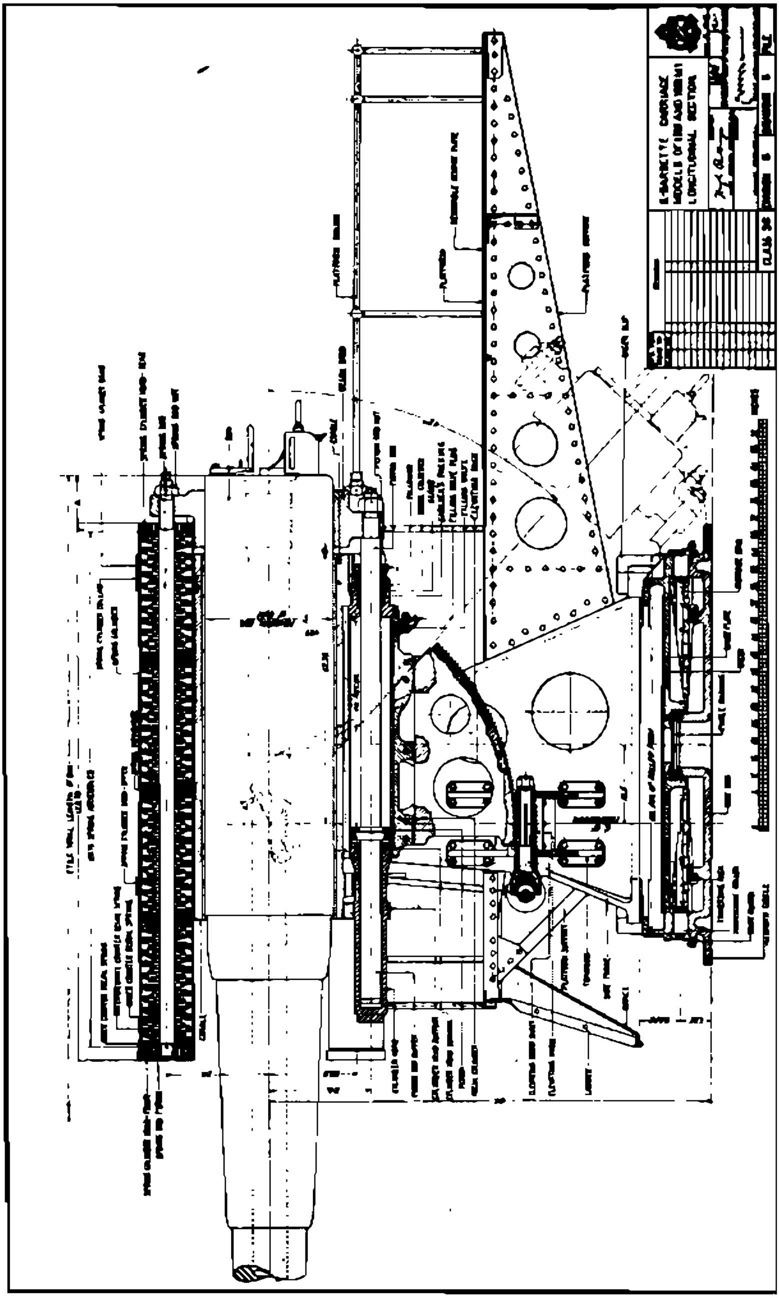


PLATE 34

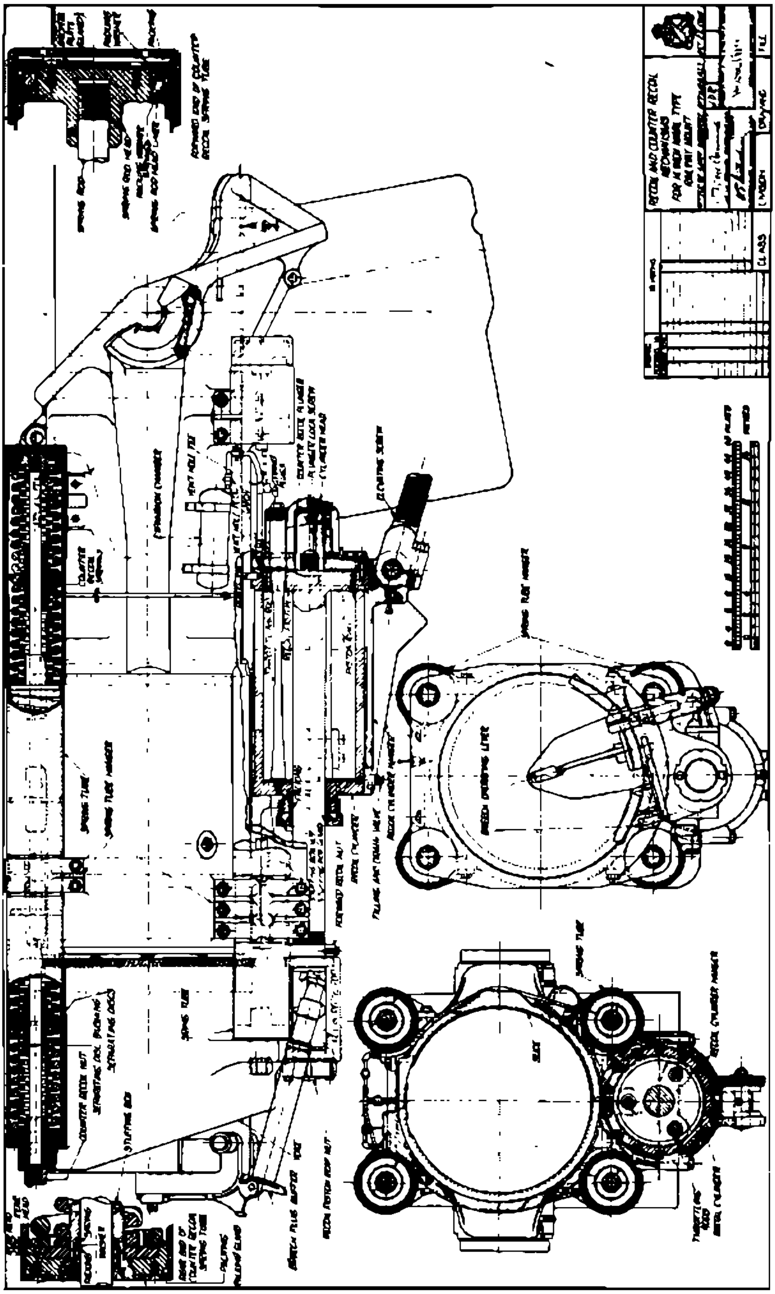


PLATE 35

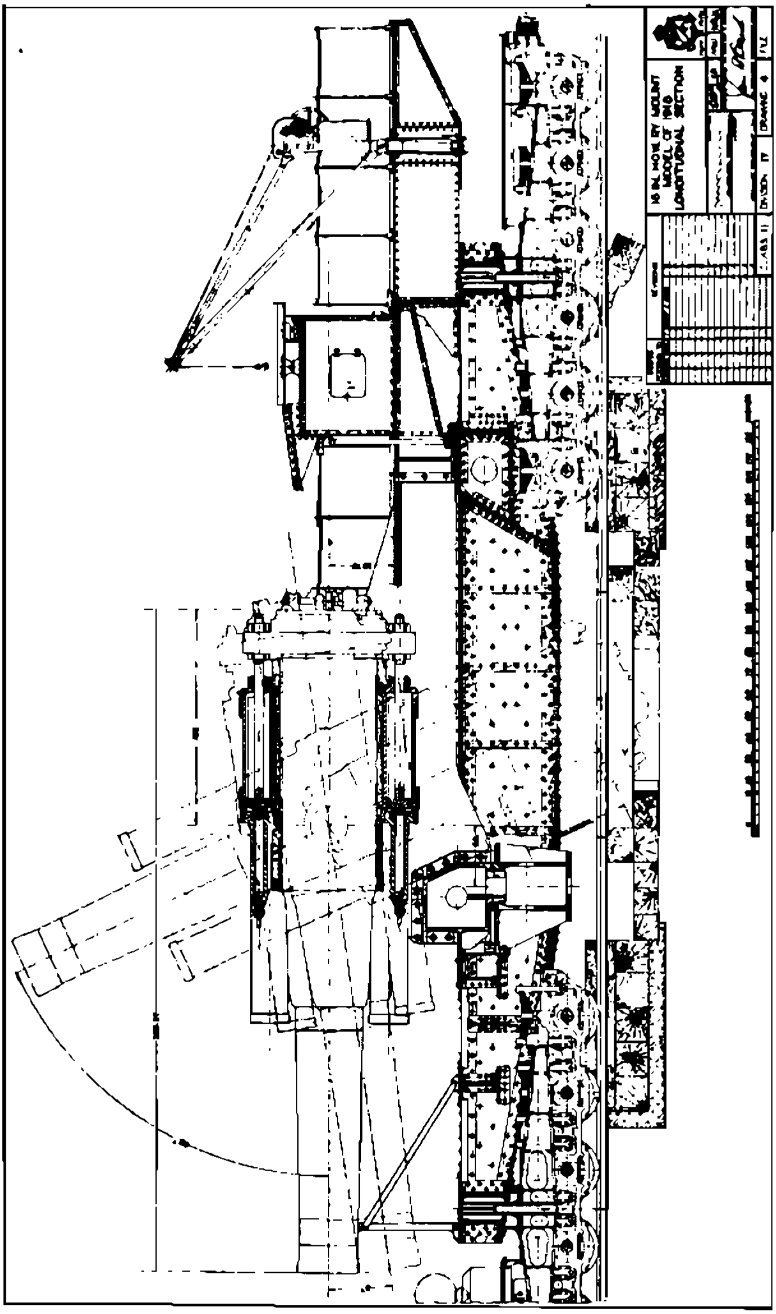
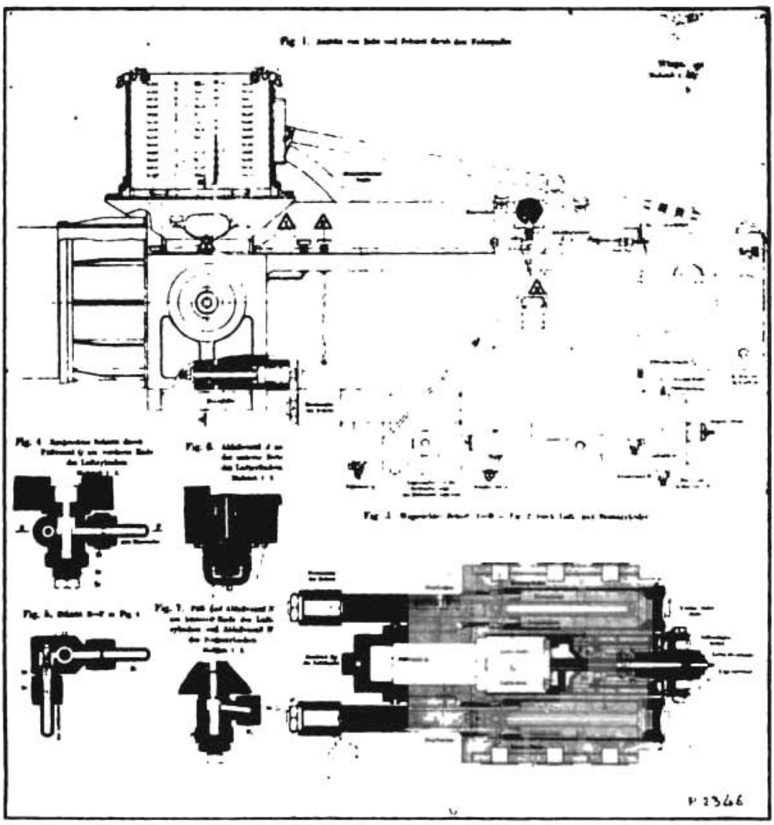


PLATE 36



CRADLE RECOIL (HYDRO-PNEUMATIC) SYSTEM OF THE GERMAN 280-MM. GUN.

PLATE 37

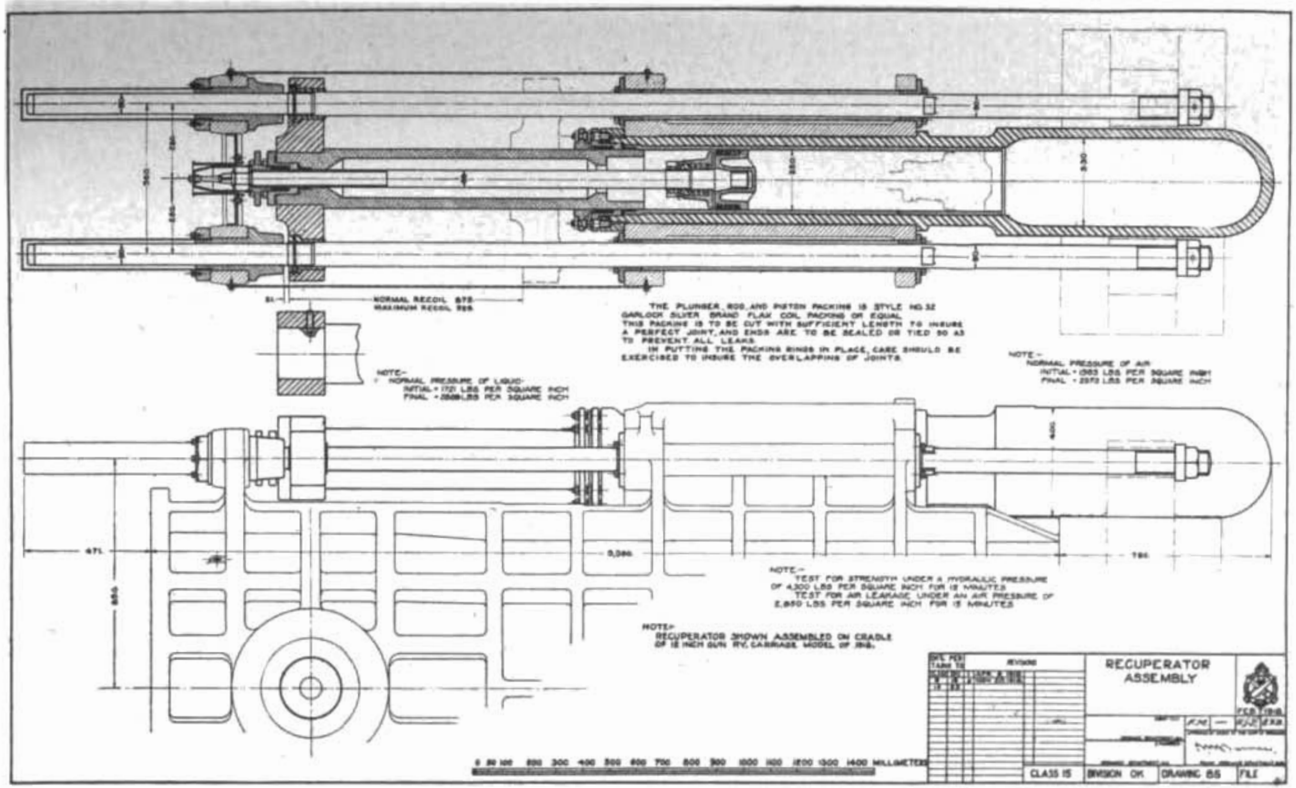

NORMAL RECOIL
MAXIMUM RECOIL
THE PLUNGER, ROD, AND PISTON PACKING IS STYLE NO. 32 GARLOCK SILVER BRAND FLAX COIL PACKING OR EQUAL.
THIS PACKING IS TO BE CUT WITH SUFFICIENT LENGTH TO INSURE A PERFECT JOINT, AND ENDS ARE TO BE SEALED OR TIED SO AS TO PREVENT ALL LEAKS.
IN PUTTING THE PACKING RINGS IN PLACE, CARE SHOULD BE EXERCISED TO INSURE THE OVERLAPPING OF JOINTS.
NOTE-
NORMAL PRESSURE OF LIQUID-
INITIAL - 1721 LBS PER SQUARE INCH
FINAL - 2808 LBS PER SQUARE INCH
NOTE-
NORMAL PRESSURE OF AIR
INITIAL - LBS PER SQUARE INCH
FINAL - LBS PER SQUARE INCH
NOTE-
TEST FOR STRENGTH UNDER A HYDRAULIC PRESSURE OF 4,300 LBS PER SQUARE INCH FOR 15 MINUTES
TEST FOR AIR LEAKAGE UNDER AN AIR PRESSURE OF 2,850 LBS PER SQUARE INCH FOR 15 MINUTES
NOTE-
RECUPERATOR SHOWN ASSEMBLED ON CRADLE OF 12 INCH GUN RY. CARRIAGE MODEL OF 1918.
RECUPERATOR ASSEMBLY
CLASS 15
DIVISION OK
DRAWING 85
FILE
0 50 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 MILLIMETERS

PLATE 38

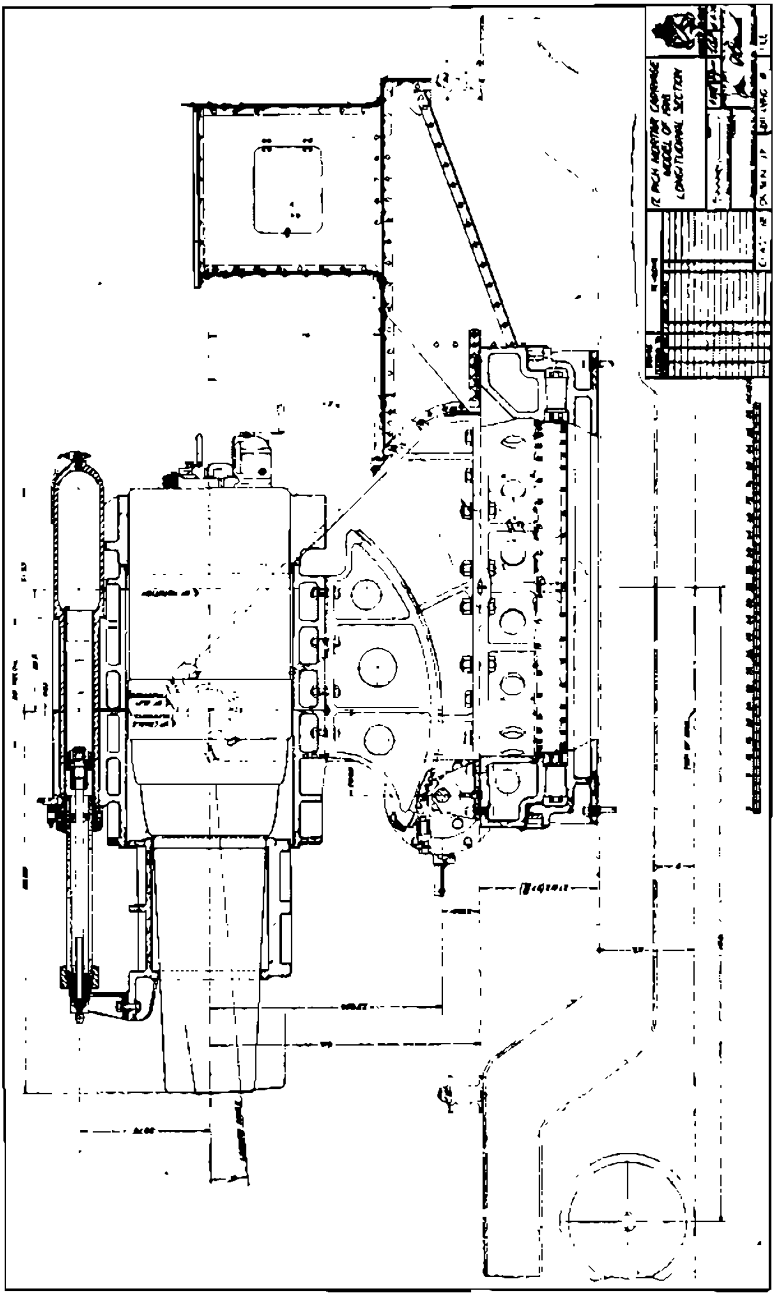
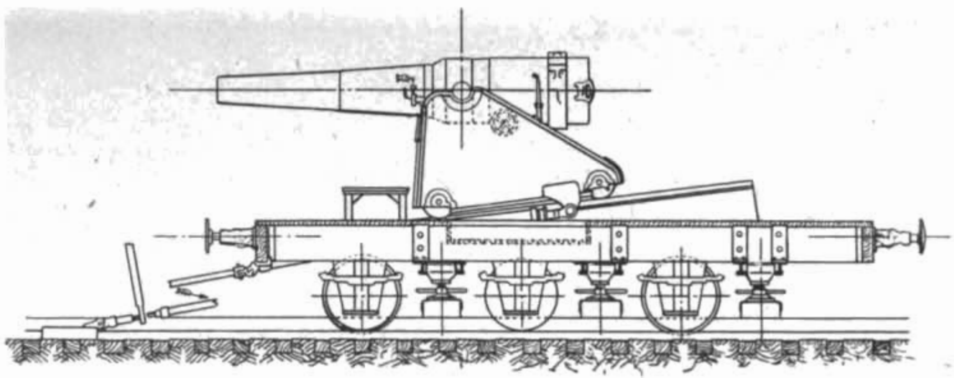
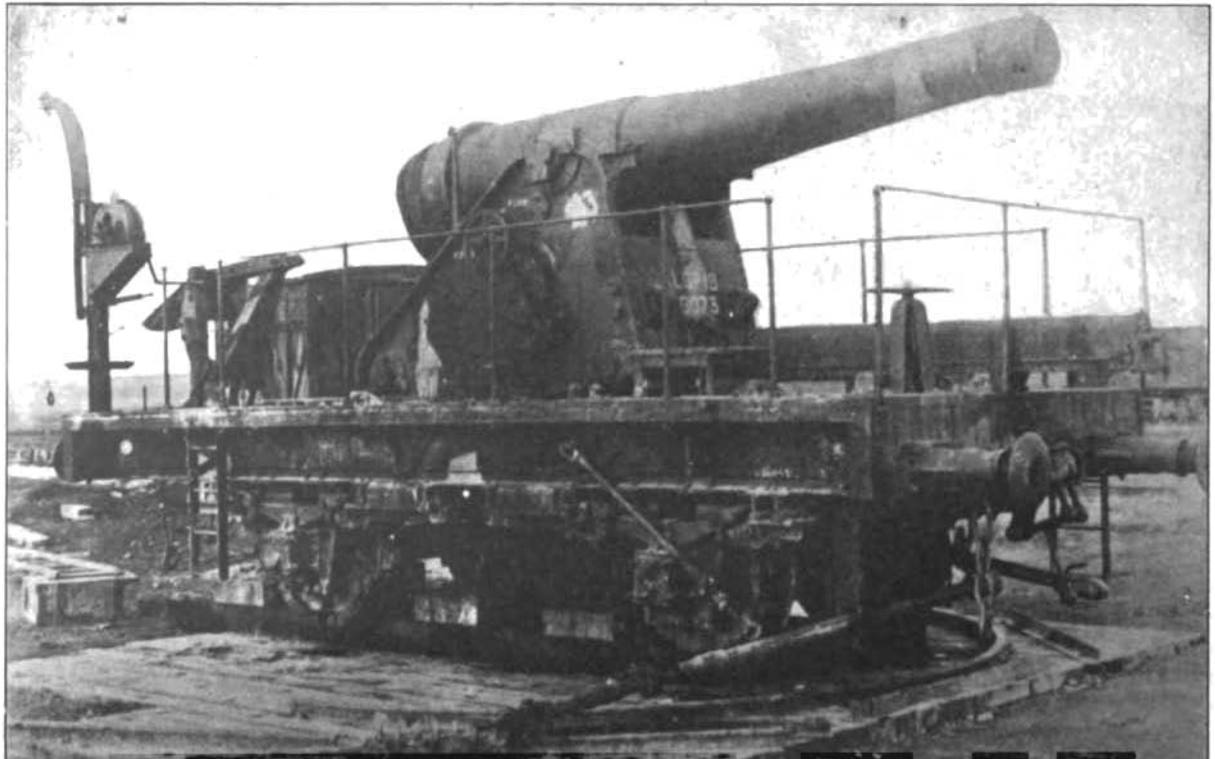


PLATE 39



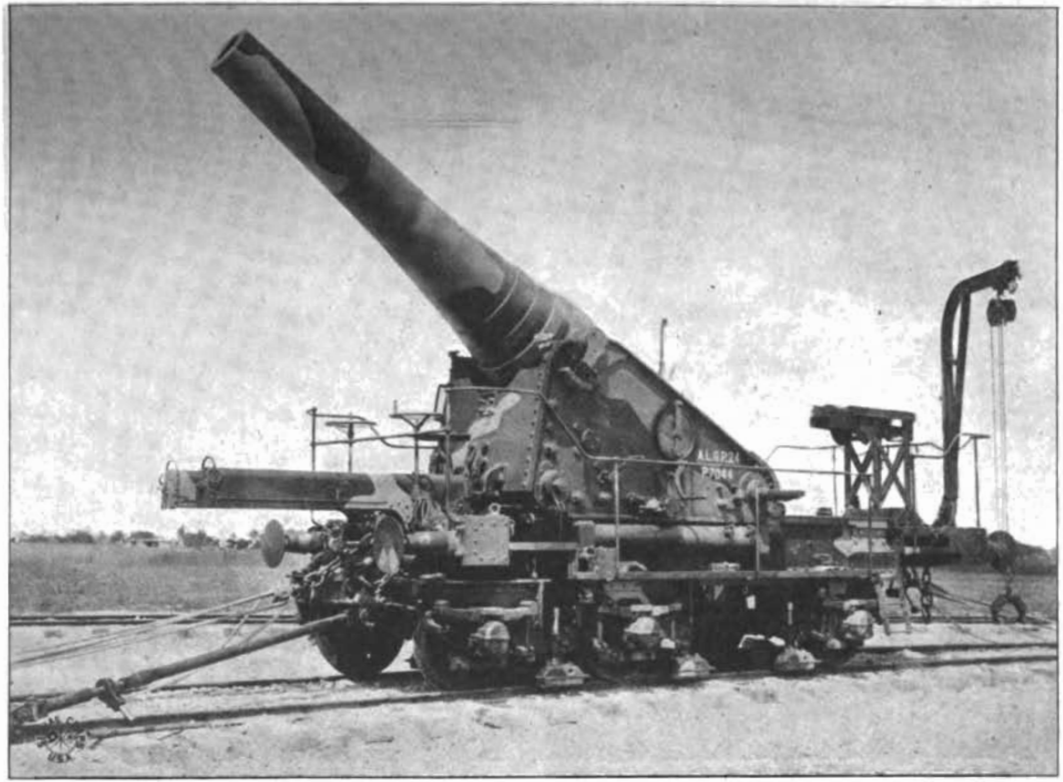
TOP CARRIAGE RECOIL (HYDRO-GRAVITY) SYSTEM OF THE 190-MM. FRENCH HOWITZER.

PLATE 40



TOP CARRIAGE RECOIL (RUBBER BAND RECUPERATORS) SYSTEM OF THE 190-MM. FRENCH HOWITZER.

PLATE 41



TOP CARRIAGE RECOIL (RUBBER BAND RECUPERATOR) OF THE FRENCH 240-MM. HOWITZER.

PLATE 42

SLIDING TYPE MOUNT FOR FRENCH 320-MM. HOWITZER.

PLATE 43

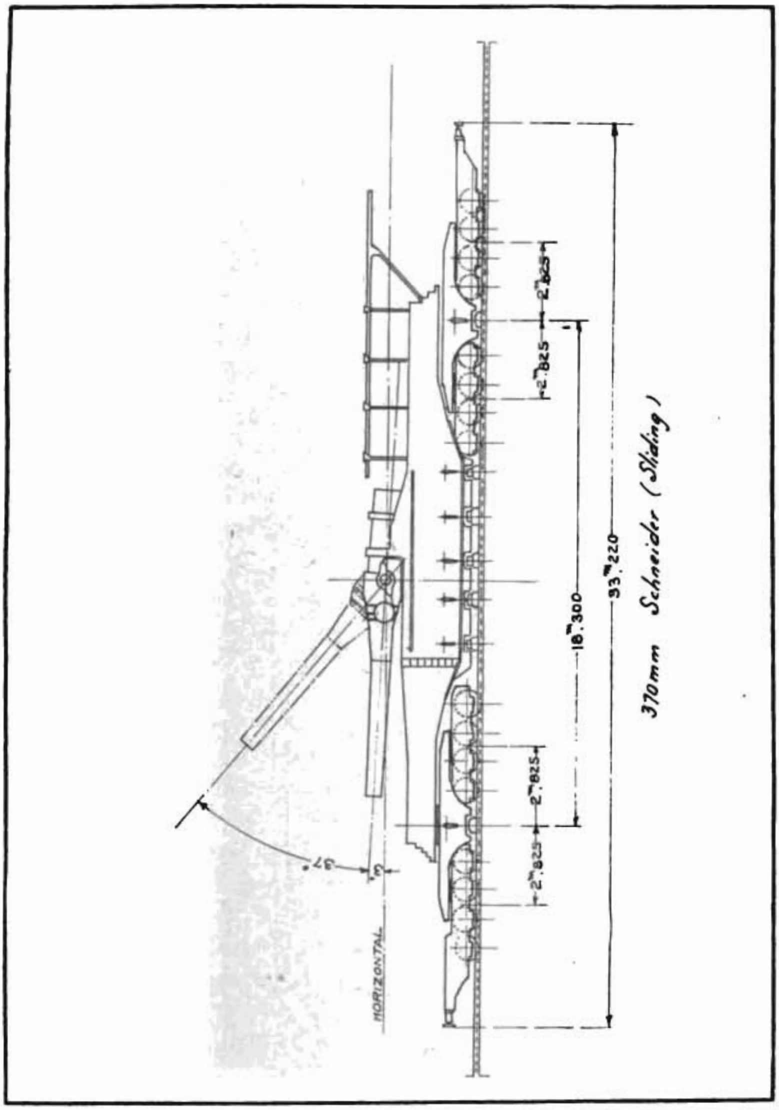
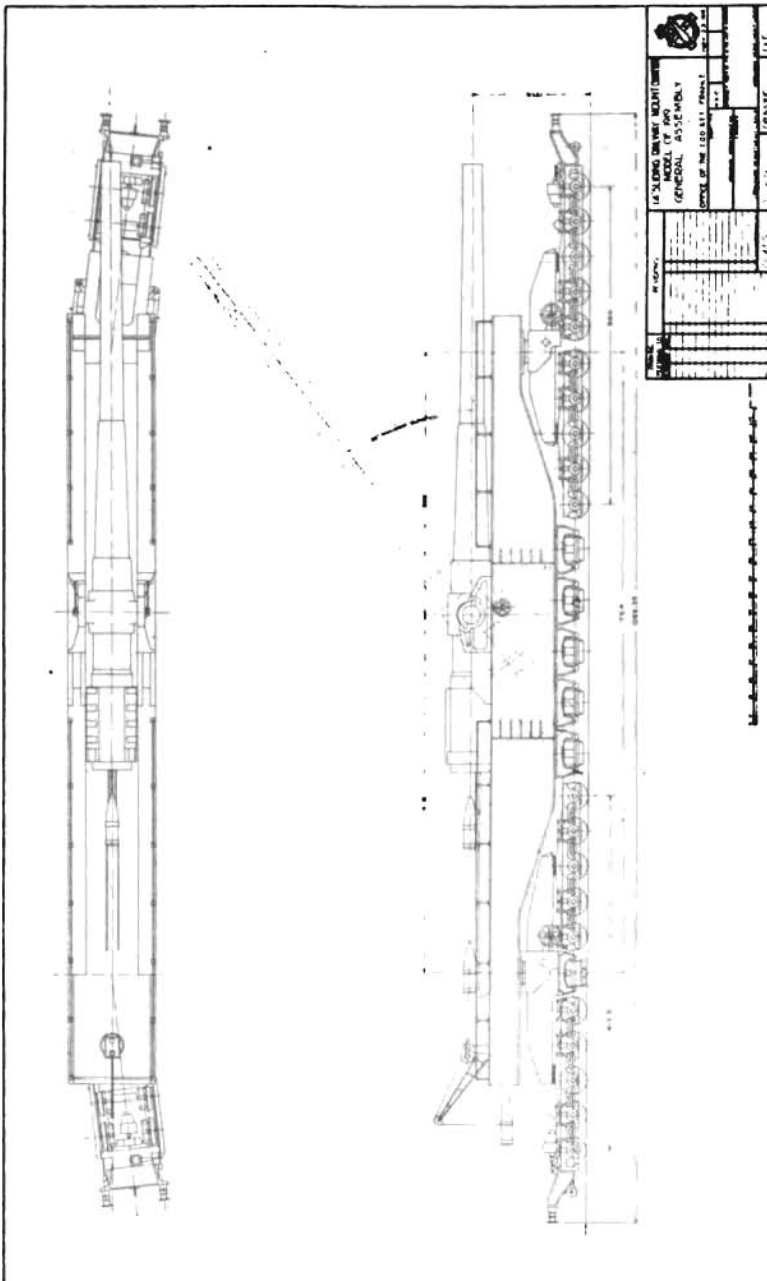

370mm Schneider (Sliding)
33m.220
18m.300
2m.825
2m.825
2m.825
2m.825
37°
HORIZONTAL

PLATE 44



28. Rolling Recoil.—The characteristics of this type are that the gun, car body, and trucks recoil together, rolling backward on standard track, the brakes being set to bring the mount to rest. Return to battery is obtained by a winch mounted on the forward truck; the cable is attached to the track some distance ahead. Mounts of this type recoil a distance of from 30 to 50 feet. The use of this type of recoil alone is not practicable, as the vertical component of the force of recoil would be too great for the truck springs to stand. In all existing types the gun is mounted in a cradle, thereby giving a double recoil system. This type of mount is usually provided with car traverse, giving a small amount of movement in azimuth, and must, of course, be fired from a curved track to get a greater movement. Plates 20, 21, and 45 show examples of this type of recoil system in combination with a cradle as noted above.

29. Combinations.—These various systems are found in several combinations, also, in existing mounts.

Cradle-sliding recoil is found in the Schneider 520-millimeter howitzer, plate 46.

Cradle-rolling recoil is found in the British 12 and 14 inch rifle mounts and the United States Navy 14-inch mount, Mark II, plate 45.

Top-carriage-sliding recoil is found in the Schneider 270-millimeter howitzer as shown on plate 47.

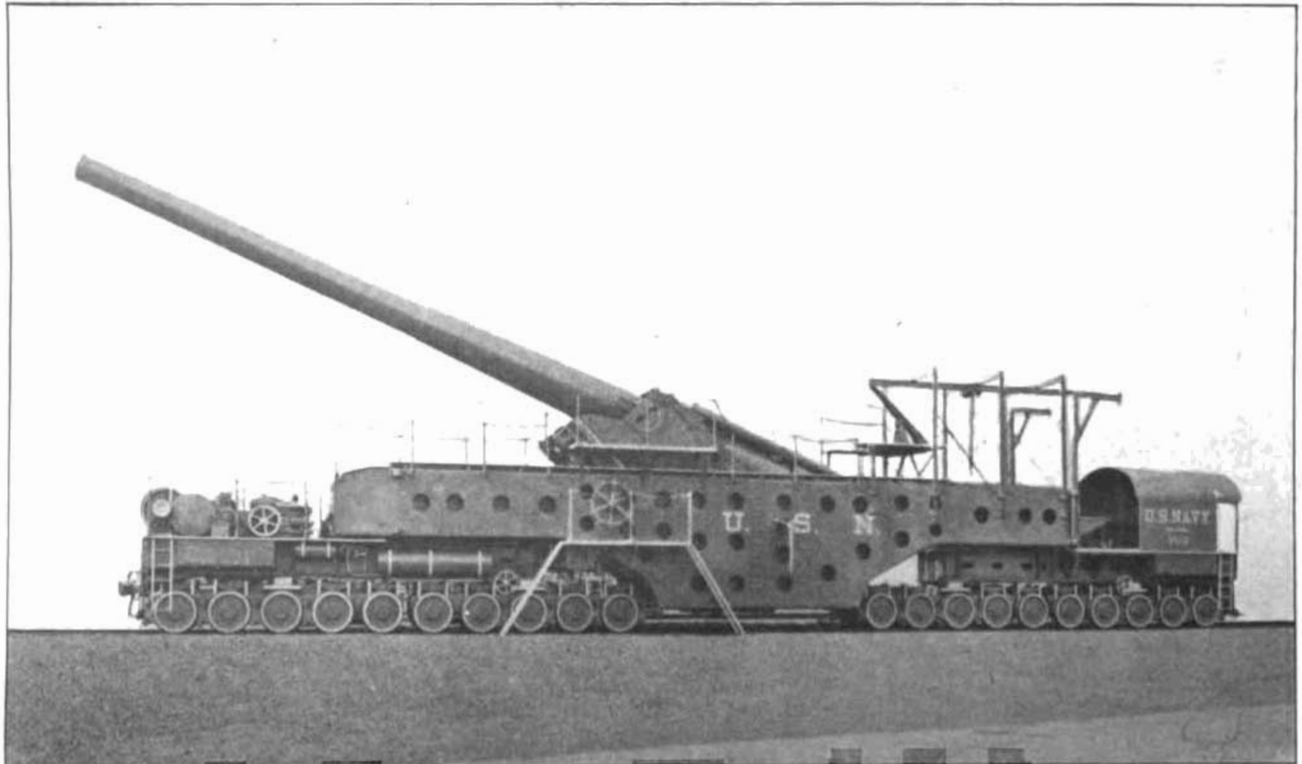
30. Discussion.—Cradle recoil with air recuperation is probably the highest development in recoil systems.

31. Top-carriage recoil was devised 40 or more years ago for coast defense guns operated at low angles of elevation. It is not well suited to firing at high elevations. This system is found only on railroad mounts which have been improvised from available coast defense matériel, and there seems no great reason why it should be considered for new design.

32. The sliding recoil system is worthy of considerable consideration. Improvised originally to provide for heavy guns, a mount which could be manufactured in a minimum of time, it has shown a ruggedness and convenience in service that have recommended it very highly. There are certain limitations on the use of this type of mount. Time of operation and lack of traverse make it unsuited to small guns. The enormous trunnion forces which must be taken care of likewise make it unsuited for the very largest howitzers firing at high angles.

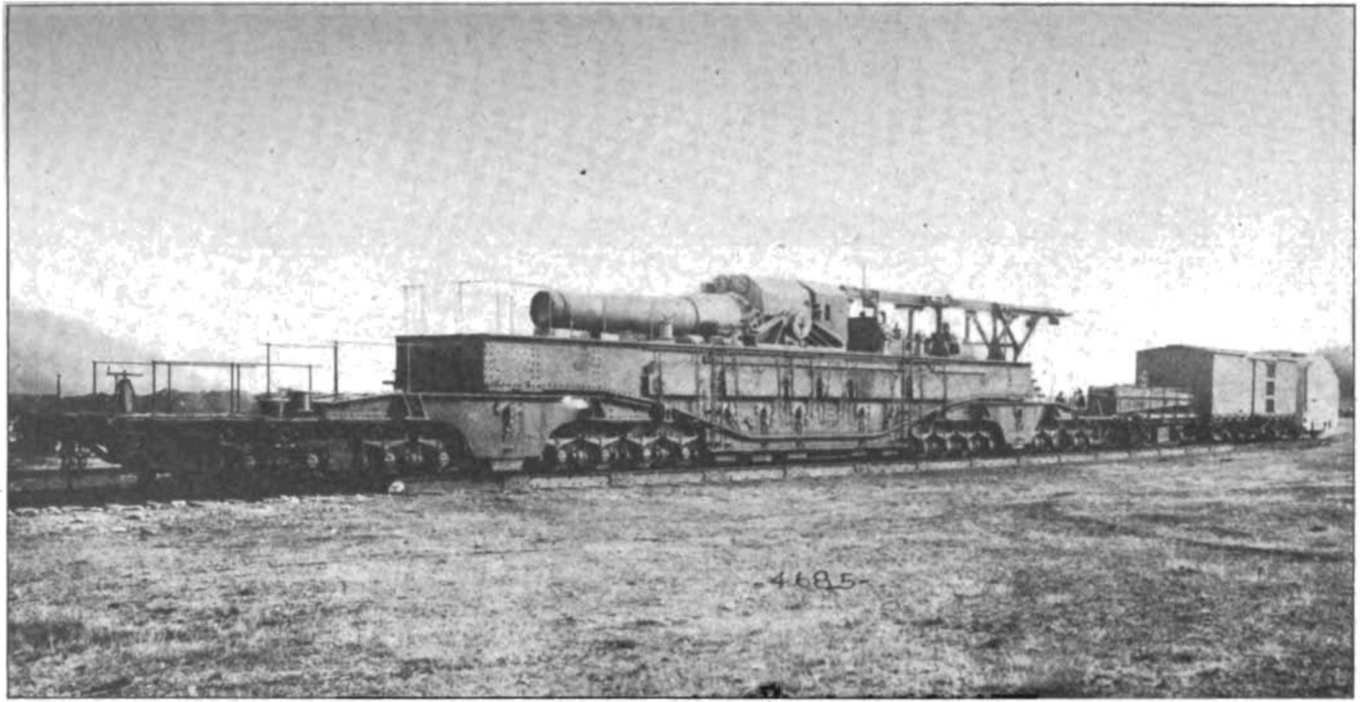
33. The cradle-rolling recoil combination is, like the sliding system, unsuited to small guns, because of the lack of traverse and time of operation, but it represents a very satisfactory system for the heaviest type of guns.

PLATE 45



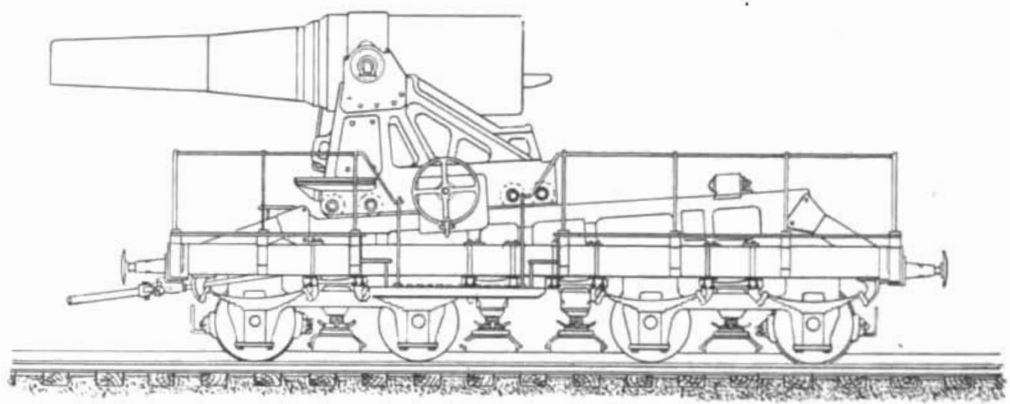
ROLLING RECOIL MOUNT, MARK II, FOR AMERICAN NAVY, 14-INCH, 50-CALIBER GUN.

PLATE 46



CRADLE SLIDING RECOIL MOUNT FOR FRENCH 520-MM. HOWITZER.

PLATE 47



TOP CARRIAGE SLIDING MOUNT FOR FRENCH 274-MM. HOWITZER.

CLASSIFICATION ACCORDING TO METHOD OF ANCHORAGE.

34. Railway mounts may be classified according to the character of the structure required to transmit the force of recoil from the gun to the earth, as follows:

1. Mounts requiring no structure whatever.
2. Mounts requiring a track platform; i. e., a structure built above and more or less without disturbing the track.
3. Mounts requiring a ground platform; i. e., a structure fitting into and under the track.

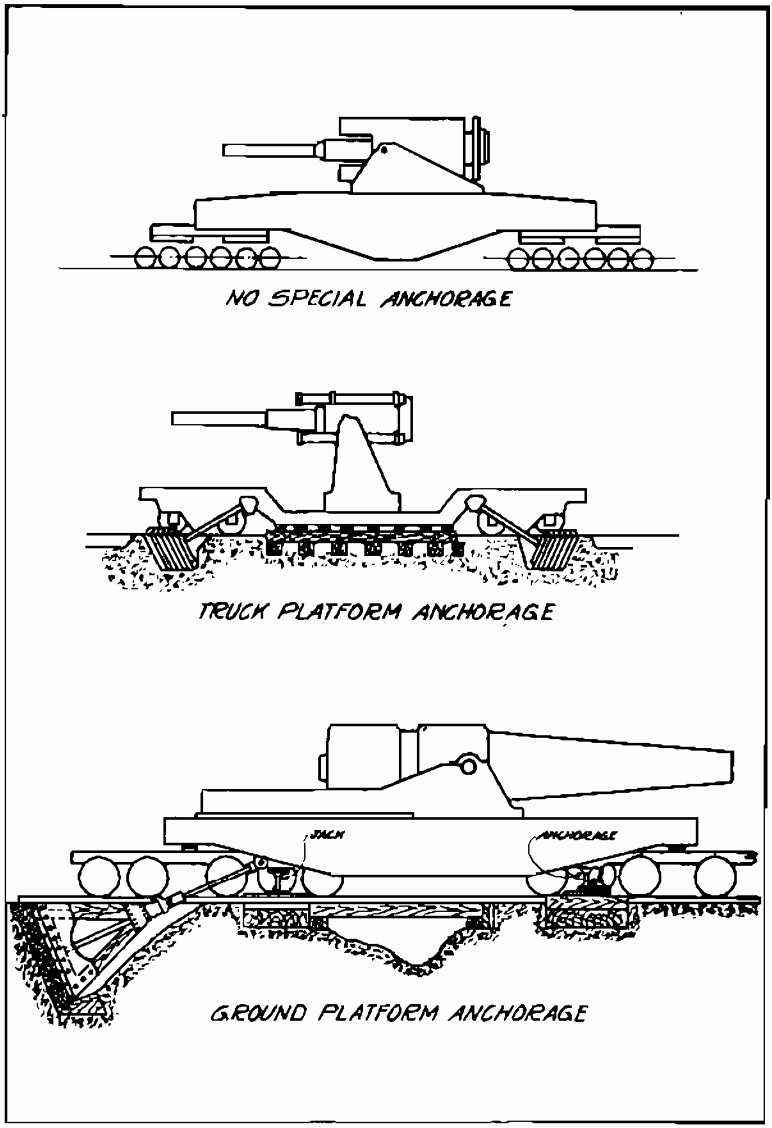
These schemes of anchorage are illustrated on plate 48.

35. Mounts Requiring no Structure.—The only mounts of this type are those with the combination of cradle and rolling recoil mechanism, which fire directly from standard track. They are provided with car-body traverse, giving a small movement in azimuth, and must be fired from a curved track or epi to get greater traverse. The British 12-inch and 14-inch rifle mounts, the American 14-inch naval mount, Mark I (for firing at angles under 15 degrees) and Mark II (for elevations as great as 40 degrees), the 16-inch howitzer, model 1918 MI (American), and German 38-centimeter are examples. These are shown on plates 20, 21, 45, and 364.

36. Mounts Requiring a Track Platform.—In mounts of this type a part of the vertical component of the force of recoil is taken by girders, pads, or floats placed on the ground or on top of the ties, and the horizontal component either by friction, or through rail clamps, guys, or struts. The Schneider sliding mounts are examples of the type in which the horizontal component is absorbed by friction. This type can have only very limited car traverse (a maximum of 5 degrees), since a greater traverse will result in an abnormal displacement of the track. They are shown on plates 12, 13, 42, 43, and 46. The 194 and 240 millimeter Schneider mounts and the British 12-inch howitzers and 9.2-inch guns belong to the class employing rail clamps or guys. They have top-carriage or cradle recoil and in some cases afford all-round fire. These are shown on plates 16, 41, 49, and 50. The American 8-inch gun, plate 30, and French 240-millimeter gun, plate 27, belong to the class using struts as well as track platforms and both permit of all-round fire.

37. Mounts Requiring a Ground Platform.—The characteristics of this type is that an extensive anchorage, the installation of which involves tearing up the track, must be constructed before firing can take place. This foundation may consist simply of very heavy timber pads and floats, as with the St. Chamond 340 and 400 millimeter and the American 16-inch mounts, or it may be a very elaborate and specially constructed steel or concrete base, as with the Batignolles, and the German 280 and 380 millimeter mounts.

PLATE 48



CLASSIFICATION OF RAILWAY ARTILLERY ACCORDING TO METHOD OF ANCHORAGE.

PLATE 49

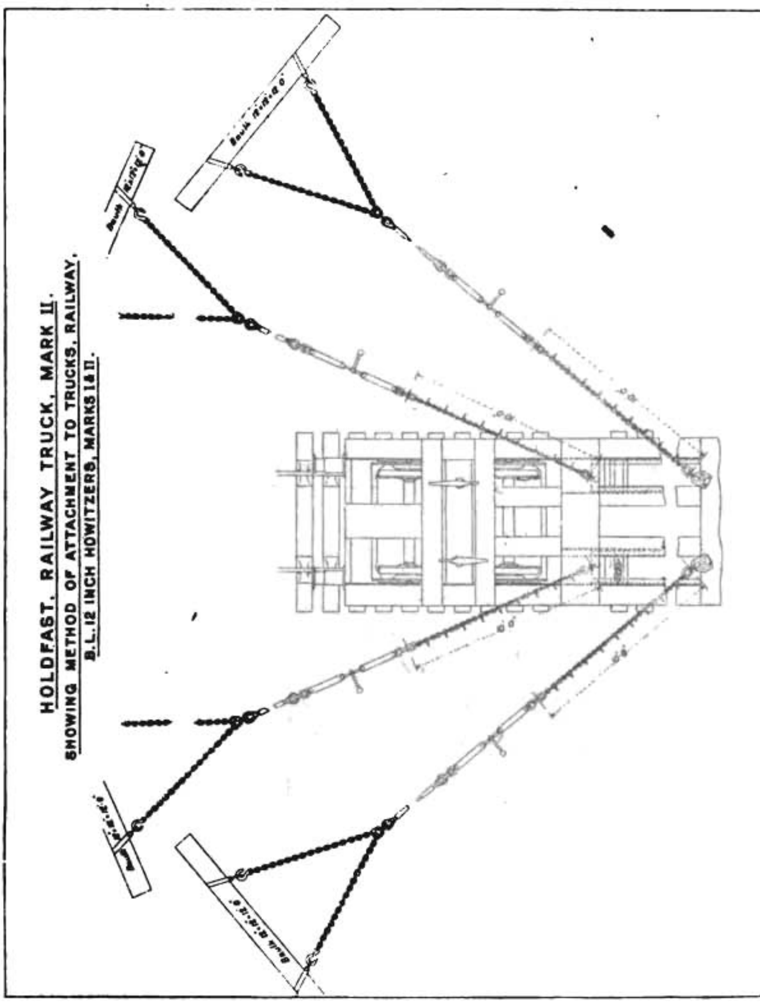
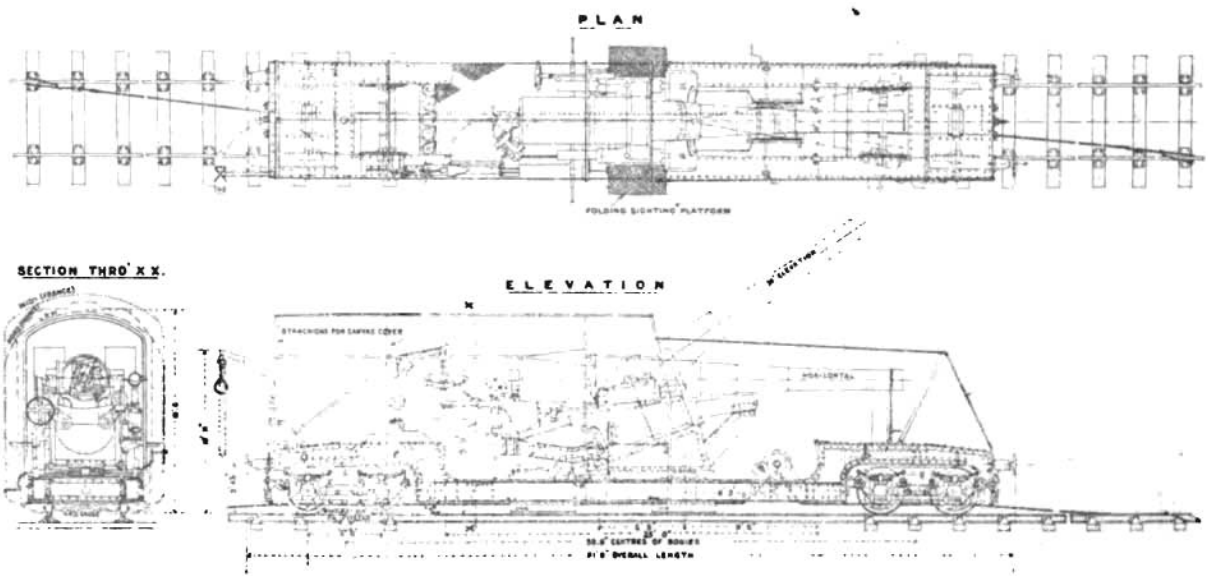

HOLDFAST, RAILWAY TRUCK, MARK II.
SHOWING METHOD OF ATTACHMENT TO TRUCKS, RAILWAY,
B.L. 12 INCH HOWITZERS, MARKS I & II.

PLATE 50

MOUNTING, RAILWAY TRUCK, B.L. 9·2-INCH, MARKS III* TO VIC* GUNS, MARK II.

ON MARK IA. RAILWAY TRUCK.

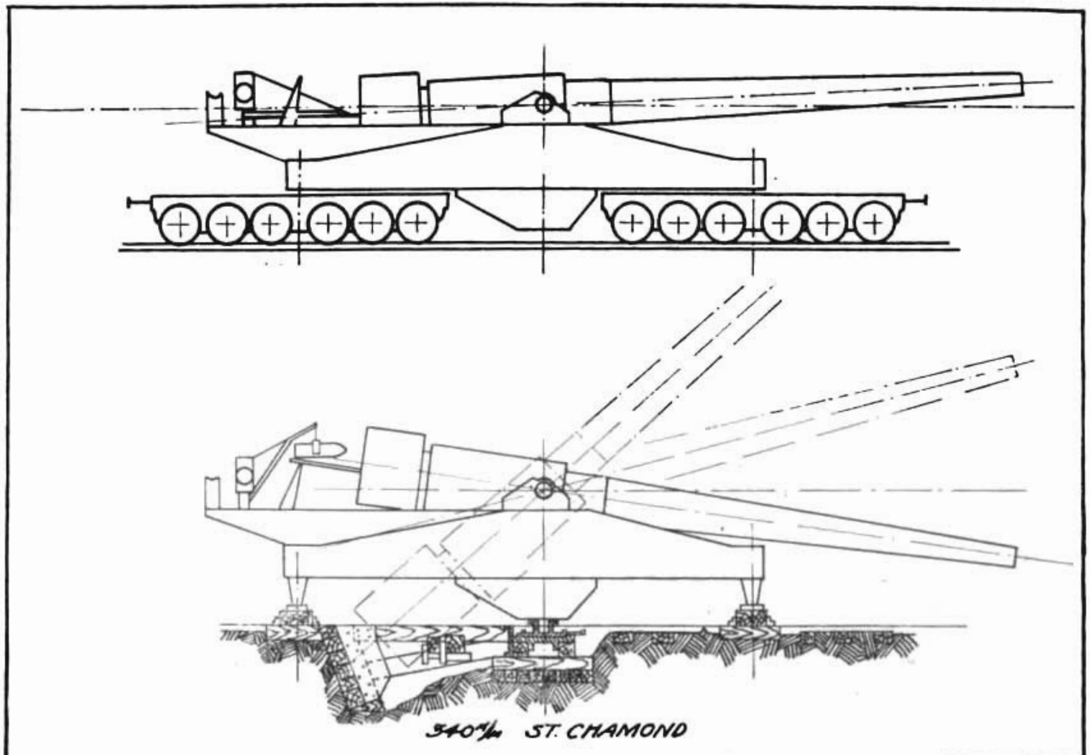
GENERAL ARRANGEMENT



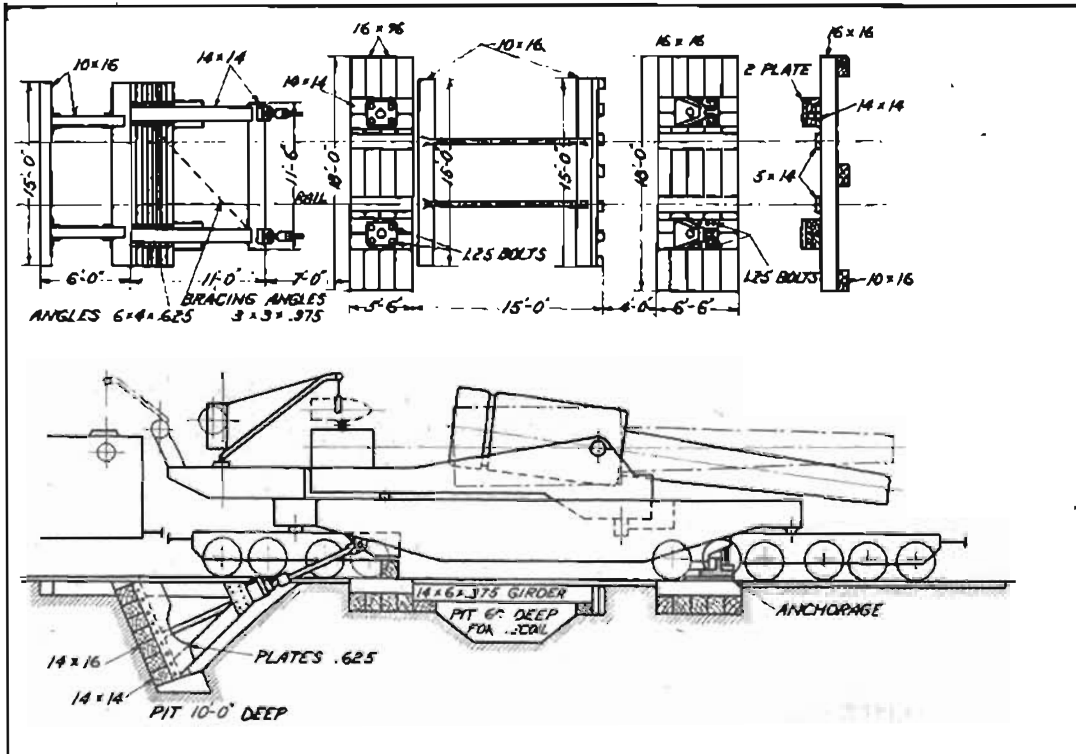
In almost all cases only a very limited traverse is possible. The German guns give all-round fire. The above noted mounts are illustrated on plates 51, 52, 53, 209, 54, 24, 55, 56, and 57.

38. Discussion.—Two points are intimately connected with the type of anchorage employed, viz: (1) The time necessary to get into action and withdraw the mount from position, and (2) the amount of traverse allowed. The former is important in effecting a surprise and in withdrawing to avoid enemy counterfire. It varies from almost nothing on the first type, after the epi is constructed, to perhaps an hour on the best of the second type, and then up to three or four days on the very elaborate mounts of the ground platform type. As to traverse, the first type permits any desired amount, limited only by the extent of the curve, and is suited to the largest calibers; the second likewise permits of a traverse limited only by the extent of the curve for heavy guns with sliding recoil and all-round fire for the lighter and medium guns. The third type usually permits of only limited traverse (10 to 15 degrees) for the heaviest guns and all-round fire for medium calibers. It might be added that rail clamps and guys are devices adopted with the lighter guns and are to be considered improvisations; struts have proved more efficient.

PLATE 51



METHOD OF ANCHORING 340-MM. FRENCH GUN RAILWAY MOUNT.



METHOD OF ANCHORING 400-MM. FRENCH HOWITZER RAILWAY MOUNT.

PLATE 53

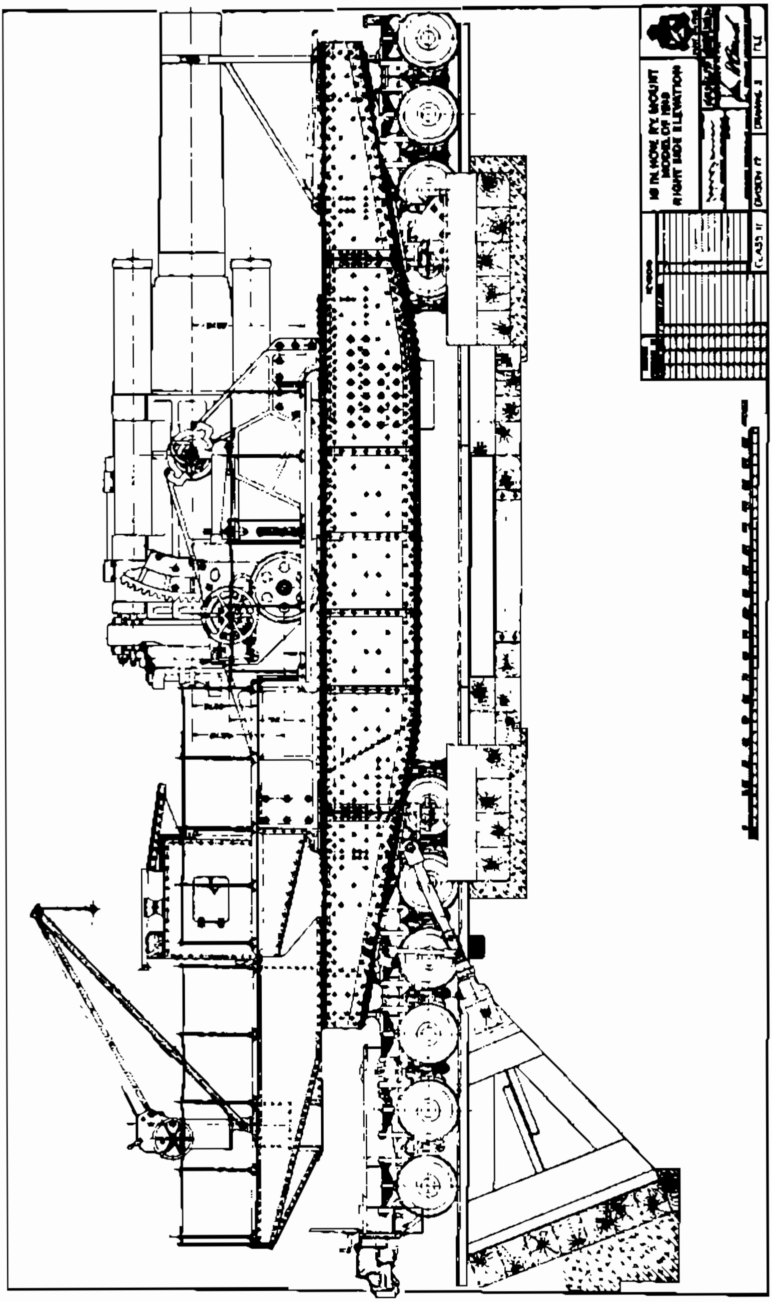


PLATE 54

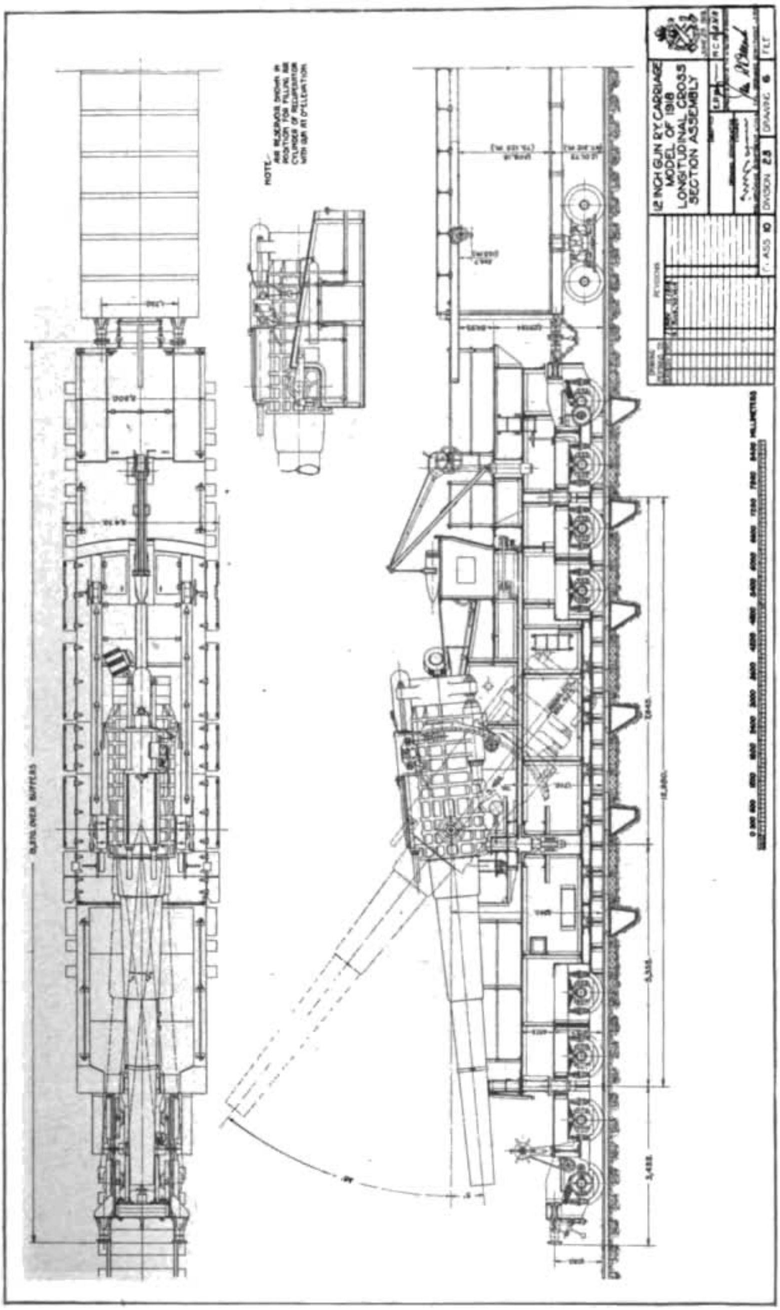
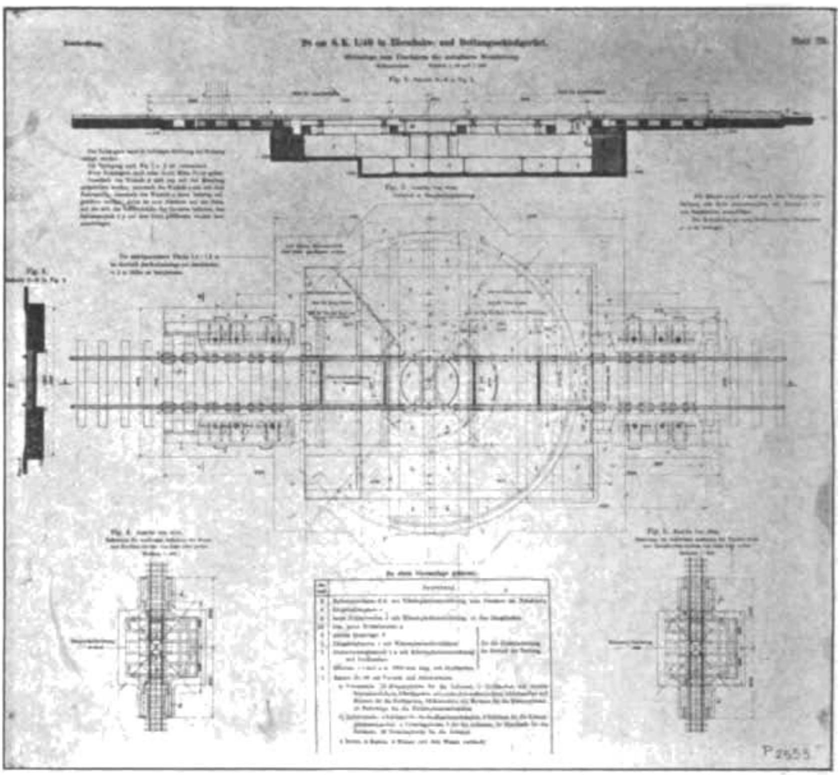
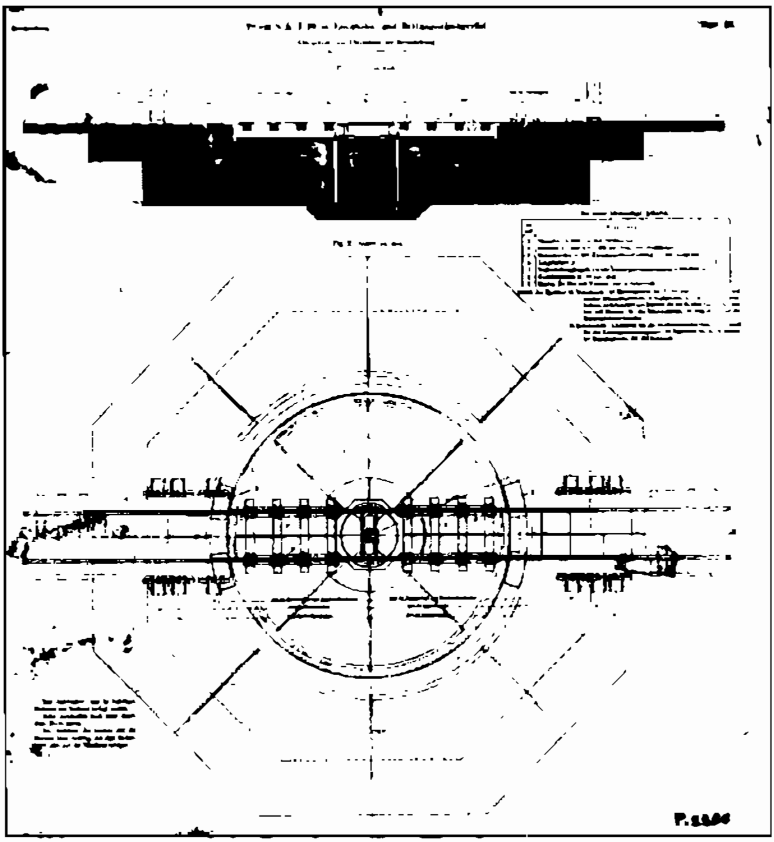

12 INCH GUN RY. CARRIAGE
MODEL OF 1918
LONGITUDINAL CROSS
SECTION ASSEMBLY

PLATE 55



STRUCTURAL STEEL EMPLACEMENT FOR 280-MM. GUN.

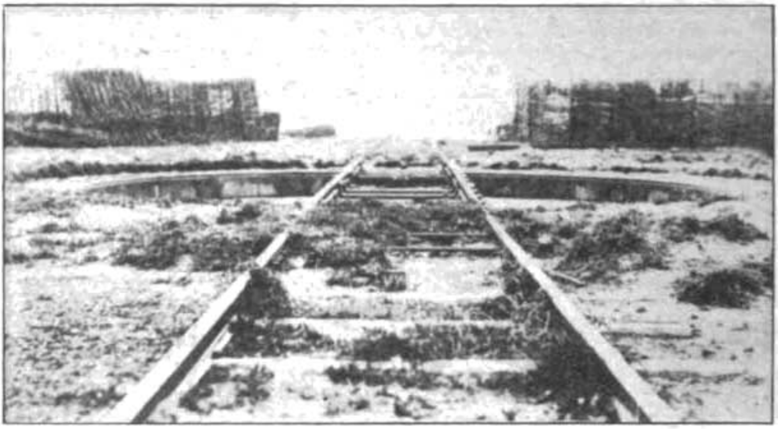
PLATE 56

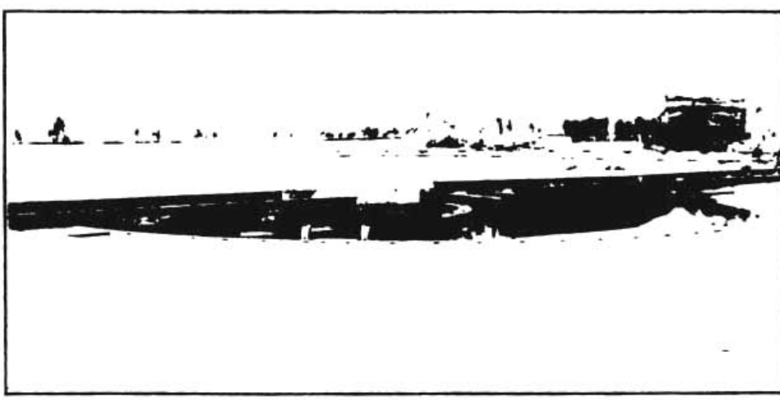


CONCRETE EMPLACEMENT FOR GERMAN 280-MM. GUN.

181768—21——6

PLATE 57





CONCRETE EMPLACEMENTS FOR GERMAN 280-MM. GUN RAILWAY MOUNTS ON THE COAST OF BELGIUM.

SECTION 2.

SCOPE OF UTILITY OF RAILWAY ARTILLERY.

39. Experience with railway artillery in the present war has been almost entirely in land warfare, so that the following is written primarily to cover that field. A final paragraph is added, however, covering its use for coast defense.

40. In considering the scope of utility of railway artillery in land warfare, several general limitations should be borne in mind. It is the heaviest, most powerful, and most costly of all artillery and for this reason, it should be exposed to a minimum of danger of destruction and capture, and should be used only when heavy mobile artillery will not suffice. It is hence used only for offensive operations and special service, being organized as a separate reserve and not attached to any one army. Except in sectors of a front, which have been quiet for a long while, standard gauge railway lines can not easily be maintained closer than from 5 to 10 kilometers to the line, hence heavy railway artillery can not be operated closer to the line. Further, experience has taught that it should be kept out of the range of the field guns and smaller caliber heavy guns. In some cases, as in the American St. Mihiel offensive of September, 1918, the railway artillery was run up to within 3 kilometers of the front lines. This point is discussed more fully in section 7.

41. Within the limitations noted above, railway artillery is utilized for the following purposes:

Destruction.
Counter-battery work.
Interdiction.
Distant bombardment for moral effect.

42. Destruction.—Fire of destruction as executed by railway artillery has for objectives in general order of range:

(*a*) Permanently fortified works, as concrete turrets, observation posts, sentry towers or observation posts, concrete rampart shelters, concrete cantonment shelters, gun casemates, flanking casemates, and flank trenches, concrete communication galleries, troop shelters, machine gun and antitank forts.

(*b*) Bridges, culverts, cuts, and fills.

(*c*) Balloons and towers used for observation and located at long range.

(*d*) Centers of supply and distribution, as railroad yards, supply depots, ammunition dumps, industrial centers, etc.

Except in the case of (*c*) above, it is obvious that, for the purpose of destruction the maximum plunging fire is desirable and that the pieces that should be used are howitzers and mortars, so long as the necessary range can be obtained with them. Objectives of class (*d*) are ordinarily located at such ranges that guns must be used, It is evident that relatively large explosive charges and perhaps numerous shots will be required for this purpose and, except in the last case, very high accuracy of fire is essential.

43. COUNTER-BATTERY WORK.—Under the heading of counter-battery work is ordinarily included the destruction of only such enemy batteries as are so distant as to be beyond the range, or so well protected as to be beyond the destructive power of the army artillery. Occasionally it may be imperative that certain batteries be put out of action in much less time than would be possible with army artillery that must be moved up from some other locality. In these cases, obviously, railway artillery capable of all-round fire should be used.

44. Circumstances demand ordinarily cannon of long range and medium caliber for this work and mounts provided with facilities for the most rapid and universal service. This would include mounts whose firing platform requires a very small time for installation, and mounts provided with traverse for all-round or nearly all-round fire.

45. INTERDICTION.—The objectives of fire of interdiction are lines of communication, roads, railroads, telegraph, and telephone lines, etc. It may be very desirable to keep a section of a certain railway line out of commission. It may be desirable likewise to shell certain sections of very important roads over which supplies and men must be moved. At night a few shells per hour may be sufficient to seriously interrupt traffic. During the day when observation is possible more active shelling may be carried out. Guns of long range, medium caliber, and large traverse are preferred for this work. The practice has been to carry out fire of interdiction only when it will be most effective, i. e., immediately before, during, or immediately after, an attack.

46. DISTANT BOMBARDMENT FOR MORAL EFFECT.—The objectives of bombardment for moral effect are large centers of population long distances behind the lines. The aim is to destroy any sense of security which the distance from the front lines may give the civilian, to undermine the spirit of the army by weakening the morale of the civil population, and to interfere to the maximum with the administration of the war.

47. The characteristic of first importance for this kind of fire is extremely long range, 100 to 120 kilometers or so. Difficulties of construction seem to limit the caliber of these long guns to about 240 millimeters. Little or no traverse is required. At least one shot per

hour is considered necessary to produce the desired effect, and absolute regularity in the bombardment is necessary for the maximum effect on morale.

48. The single example of action from a gun of this sort was the bombardment of Paris. The writer was in Paris for several days at a time on four occasions during the bombardment by the long-range gun. On some days projectiles arrived every 15 minutes from about 8 a. m. to 5 p. m. On other days the bombardment would begin promptly at 12.40 noon. On the first day of the bombardment, on March 23, 1918, there was considerable confusion, more because the people thought they were being bombed by airplanes from a great height than from any other apparent reason. From then on the effect could not be determined with any certainty. There seemed to be as many people on the streets during the days of most active bombardment as on quiet days. When a projectile would burst the people in that vicinity would appear startled but not frightened and always some would hurry in the direction of the explosion to see the damage. All of the trains going west or south from Paris were crowded in those days, but there was no evidence that the departure of those people who lived in Paris was not caused by the steady approach of the Germans and the possibility of the capture of Paris rather than through panic or fear of the bombardment.

49. The damage done by the long-range projectiles was never very great. If one burst in a building its effect was not always evident outside. One shell hole seen in the Gardens of the Tuilleries was about 4 feet deep and from 10 to 12 feet in diameter. Further, the dispersion of the guns was so great that two projectiles would land within a kilometer of each other only by chance. Judging from the small extent of damage and the doubtful effect produced on the civil population, it would seem extremely doubtful if such bombardment as this is nearly as effective either from the standpoint of material damage or effect on morale, as an equal investment in bombing planes and bombs. A published statement of the work of aeroplanes and of the long-range guns is given as an appendix to this report.

50. Assignment of Mounts to Various Duties.—The following rules govern the assignment of types of railway artillery to the various duties detailed above.

(*a*) Calibers of pieces are assigned according to the resistance of the targets.

(*b*) Types of pieces (mortar, howitzer, rifle) are assigned according to range (see later discussion).

(*c*) Types of mounts (as regards provision for traverse, anchorage, etc.) are assigned according to the number of different targets to be fired upon and the time available for preparation and change of position.

Following is a discussion of the significance of each of the above rules.

51. Assignment of Calibers According to Resistance of Targets.—Railway artillery is far too difficult to manufacture and too valuable to be used except at the nearest possible approach to a 100 per cent efficiency basis. It would be most unwise to undertake to destroy certain heavy concrete fortifications with 194-millimeter howitzers, involving the expenditure of a great amount of ammunition and considerable wear of the guns and perhaps, after all, not accomplishing satisfactory results, when a few shells from a 320-millimeter howitzer would accomplish the desired results. Further, it would be criminal to use 320-millimeter howitzers on machine-gun forts, sentry towers, etc., if smaller howitzers were available.

52. In the region northeast of Soissons the Germans were using in 1917 some old quarries very similar to a series of mine galleries, some 90 feet or more under ground, as troop shelters. The French were aware of this fact, and in preparing for their offensive in this region, decided to attempt the destruction of these shelters. 400-millimeter howitzers were assigned to the work, and with their great weight of projectile, high angle of fire, and consequent nearly vertical drop of projectile, accomplished very satisfactory results. The shells penetrated the overlying earth and chalk to a depth of about 50 feet and on bursting caused great sections of the roofs of the galleries to drop, imprisoning or killing the Germans.

53. Assignment of Types According to Range.—As with resistance of target so with range, no more powerful gun should be employed than is absolutely necessary. Wear, first cost, and time of manufacture are all much less on the shorter and less powerful guns. The following table, which is taken from French experience, shows clearly the relative rates of wear at the various ranges. It is evident that to use a 300-round gun on objectives that could be destroyed as effectively by from 2,000 to 4,000 round howitzers would be nothing short of criminal.

Gun.	Caliber length.	Range.	Life, rounds.
280-millimeter howitzer	15	11,400	4,000
24-G howitzer	20	13,700	3,000
240-millimeter T. R. 1903	27	16,800	2,400
240-millimeter model 1893-6	40	23,200	500
305-millimeter model 1893-6	40	27,000	300

In regard to the other two points, cost and time of manufacture, only about half the time is required to manufacture a howitzer as to make a gun of the same caliber, lighter machinery may be employed, and the cost is even less than half.

54. Relative Wear of Guns.—The accuracy life of any gun is greatly increased if it is fired with reduced charges and consequently reduced muzzle velocities. The following British table of equivalent charges illustrates this point:

Equivalent charges, showing relative wear of guns with various charges.

[Full charge taken as 100 per cent wear.]

No. of parts of charge.	15-inch howitzer.	12-inch howitzer, I and II.	9.2-inch howitzer.	8-inch howitzer.	6-inch 26 cwt.	6-inch 30 cwt.	4.5-inch howitzer.
6	1.000	1.00	....	....	....	....	....
5	.62	.48	....	....	....	....	1.00
4	.38	.27	1.00	1.00	1.00	1.00	.22
3	.27	.14	.30	.14	.15	.24	.08
2	.17	.09	.17	.07	.07	.06	.05
1	.13	.06	.07	.04	.03	.03	.04

55. In view of these facts it would seem best to use the shortest gun and the lowest charge and muzzle velocity possible. The closest point at which it is possible safely to locate the piece determines, of course, the range. Ideal practice, therefore, would be to use the shortest piece of the required caliber, which at its most favorable elevation can realize this range. If the nearest piece to the ideal which is available has a range materially greater than that required, then it should be fired with as much of a reduced charge as possible.

56. In this connection it is, of course, understood that the designer and builder and the users of the gun will probably never agree on the question of their proper use. A prime and proper desire always in the mind of the user is for greater and greater range. The designer and builder dislikes to see his machine abused and wishes to keep the muzzle velocity as low as possible.

57. Assignment of Types of Mounts According to Time Available for Emplacement.—It is to be assumed, of course, that the caliber and type of gun required has first been determined in accordance with the resistance and range of the target. With any given type and caliber of gun there will ordinarily be found a series of mounts, some of which afford no traverse, others limited traverse, and still others all-round traverse. Some mounts require no anchorage, others require a simple arrangement which may be put in place in an hour or less, while others use very elaborate emplacements, requiring from two to five days to install. The principle upon which mounts having various characteristics as to traverse and extent of anchorage will be selected, is that the least valuable gun and mount that can be made to satisfactorily accomplish the desired results shall be used. This will permit the most valuable mounts and guns to be saved for that special and emergency work for which only they are adapted.

58. Ordinarily, arrangements for the use of railway artillery may be made very deliberately. If there is plenty of time, the necessity for the use of a cumbersome firing platform may not be a handicap. There is no objection to having the men do the manual labor of putting down a platform since, ordinarily, the battery commander may be hard put to find enough work to keep his men busy and contented. This should not be considered an argument for building such artillery, however, and indeed no battery or group commander with whom the writer has talked would select 340 or 400 millimeter St. Chamond mounts if he had the choice between these and 305 or 370 millimeter Schneider mounts. However, if the Army possesses such mounts and if time is available sufficient to construct the number of emplacements required to cover all the objectives, then there is no objection to the use of mounts having small traverse and elaborate firing platforms.

59. For counter-battery work it is ordinarily necessary to move the guns up and prepare them for action in a minimum of time, this minimum being counted in hours (six or less). It is desirable, likewise, that it be possible to remove these mounts within a half hour or less. In such cases, which are really those emergency cases noted in the previous paragraph, the mounts affording wide traverse or all-round fire and requiring not more than an hour for emplacement will be chosen.

TABULAR CLASSIFICATION OF RAILWAY ARTILLERY.

60. For convenient reference, tables classifying railway artillery in accordance with the preceding are given below. The examples here given are from practice.

Railway artillery classified according to use.

Destruction.	Interdiction.	Counter-battery work.	Distant bombardment.
16-inch Howitzer, American.	14-inch gun, American Navy.	6-inch howitzer, American.	210-millimeter gun of 100 caliber, French.
12-inch mortar, American.	12-inch gun, American.	8-inch gun, American.	8-inch gun, British.
12-inch howitzer, American.	12-inch gun Batlg., American.	320-millimeter howitzer, American.	
12-inch gun, American.	340-millimeter gun, French.	240-millimeter gun A. R. F., French.	
10-inch gun, American.	305-millimeter gun, French.	190-millimeter gun A. R. F., French.	
520-millimeter howitzer, French.	274-millimeter gun, French.	170-millimeter gun, German.	
400-millimeter howitzer, French.	240-millimeter gun, French.		
370-millimeter howitzer, French.	14-inch gun, British.		
240-millimeter howitzer, French.	12-inch gun, British.		
200-millimeter howitzer, French.	9.2-inch gun, British.		
12-inch howitzer, British.	380-millimeter gun, Italian.		
240-millimeter howitzer, German.	210-millimeter gun, German.		
420-millimeter mortar, German.	280-millimeter gun, German.		
	380-millimeter gun, German.		

Railway artillery classified according to range.

Short range.		Medium range.				Long range.	
Gun.	Range.	Gun.	Range.	Gun.	Range.	Gun.	Range.
	Km.		*Km.*		*Km.*		*Km.*
12-inch mortar, American	10.0	16-inch howitzer, American	20.0	12-inch gun, American	25.0	14-inch gun, American	38.0
520-millimeter howitzer, French	18.0	12-inch howitzer, American	20.0	10-inch gun, American	24.0	12-inch gun, American	32.0
400-millimeter howitzer, French	15.0	8-inch gun, American	19.0	305-millimeter gun, French	27.0	16-inch gun,[1] American	55.0
370-millimeter howitzer, French	16.4	340-millimeter howitzer, French	20.0	280-millimeter gun, French	31.0	210-millimeter gun, French, 100 caliber.	120.0
320-millimeter howitzer, French	16.3	320-millimeter howitzer, French	21.6	274-millimeter gun, French	27.0	340-millimeter gun, French	37.0
293-millimeter mortar, French	10.7	305-millimeter gun, French	20.0	12-inch gun, British	28.0	14-inch gun, British	32.0
270-millimeter howitzer, French	14.0	285-millimeter gun, French	21.9	9.2-inch gun, British	24.0	8-inch gun, British	110.0
240-millimeter howitzer, French	13.0	274-millimeter gun, French	20.5	280-millimeter gun, German	33.0	380-millimeter gun, Italian	55.0
200-millimeter howitzer, French	11.0	240-millimeter gun, French	22.0	210-millimeter gun, German	26.0	380-millimeter gun, German	56.0
194-millimeter howitzer, French	13.9	194-millimeter gun, French	16.5	170-millimeter gun, German	24.0		
12-inch howitzer, British	13.0	164-millimeter gun, French	18.0				
420-millimeter mortar, German	18.0	240-millimeter howitzer, German	18.0				

[1] American mount projected only.

Railway artillery classified according to traverse.

Nontraversing.	Railway car traversing.		Top-carriage traversing.	
	Limited fire.	All round fire.	Limited fire.	All round fire.
12-inch gun, American.	14-inch gun, American.	380-millimeter gun, German.	16-inch howitzer, American.	12-inch mortar, American.
10-inch gun, American.	340-millimeter gun, French.	280-millimeter gun, German.	12-inch gun, American.	12-inch howitzer, American.
520-millimeter howitzer, French.	285-millimeter gun, French.	240-millimeter howitzer, German.	400-millimeter howitzer, French.	8-inch gun, American.
370-millimeter howitzer, French.	274-millimeter gun, French.	210-millimeter gun, German.	370-millimeter howitzer, French.	7-inch gun, American Navy.
340-millimeter gun, French.	14-inch gun, British.		305-millimeter gun, French.	240-millimeter gun, French.
340-millimeter howitzer, French.	12-inch gun, British.		274-millimeter gun, French.	200-millimeter howitzer, French.
320-millimeter howitzer, French.			12-inch howitzer, British.	194-millimeter gun, French.
305-millimeter gun, French.			9.2-inch gun, British.	164-millimeter gun, French.
274-millimeter gun, French.			170-millimeter gun, German.	155-millimeter howitzer, French.
240-millimeter howitzer, French.				
194-millimeter howitzer, French.				
380-millimeter gun, Italian.				

Railway artillery classified according to anchorage.

No anchorage.	Track platform.		Ground platform.	
	Mount.	Time to build.	Mount.	Time to build.
14-inch gun, American Navy.	12-inch howitzer, American	30 minutes.	16-inch howitzer, American	2–5 days.
16-inch howitzer, American.	12-inch gun, American	2 hours.	14-inch gun, American Navy	1–2 days.
14-inch gun, British.	12-inch mortar, American	30 minutes.	12-inch gun, Batignolles, American	2–3 hours.
12-inch gun, British.	10-inch gun, American	2 hours.	400-millimeter howitzer, French	2–5 days.
9.2-inch gun, British.	8-inch gun, American	30 minutes.	370-millimeter howitzer, Batignolles, French	2–3 hours.
380-millimeter gun, German.	520-millimeter howitzer, French	2 hours.	340-millimeter gun, St. Chamond, French	2–5 days.
280-millimeter gun, German.	370-millimeter howitzer, sliding, French	2 hours.	305-millimeter howitzer, Batignolles, French	2–3 hours.
240-millimeter howitzer, German.	340-millimeter gun, sliding, French	2 hours.	293-millimeter mortar, 1903, French	1 hour.
210-millimeter gun, German.	340-millimeter howitzer, sliding, French	2 hours.	240-millimeter gun, 1903, French	1 hour.
170-millimeter gun, German.	320-millimeter howitzer, sliding, French	2 hours.	305-millimeter gun, St. Chamond, French	5–6 hours.
	305-millimeter gun, sliding, French	2 hours.	380-millimeter gun, German	8 weeks.
	274-millimeter gun, sliding, French	2 hours.	280-millimeter gun, German	1 week.
	270-millimeter gun, French	15 minutes.	240-millimeter gun, German	1 week.
	270-millimeter howitzer, French		210-millimeter gun, German	1 week.
	240-millimeter gun, French, St. Chamond	12 hours.		
	240-millimeter howitzer, French	30 minutes.		
	200-millimeter howitzer, French	10 minutes.		
	194-millimeter gun, French	30 minutes.		
	194-millimeter howitzer, French	30 minutes.		
	12-inch howitzer, British	6 hours.		
	380-millimeter gun, Italian	3 hours.		

The platforms for the sliding and French and American Batignolles mounts can be installed beforehand, and the gun can be run up, fired, and brought back in a very short time. In the case of the sliding type, the platform amounts simply to additional girder rails laid on the ties. Successful experiments have been conducted in which the girder rails were attached to the sleepers of the mount and slid on the ties. In such cases the operation of the sliding mounts becomes almost as rapid as that of mounts firing without preparation.

RELATION OF RAILWAY ARTILLERY TO OTHER TYPES.

61. A consideration of the scope of utility of railway artillery would be incomplete without a presentation of the relation between this and the less powerful types—field and heavy wheeled artillery.

62. If a set of rectangular coordinates be set up, with ordinates representing calibers and abscissæ representing ranges, then any possible objective of artillery fire can be located in the field of these coordinates, its position relative to the nearest available battery location giving the range, and the character and resistance fixing the caliber, plate 58.

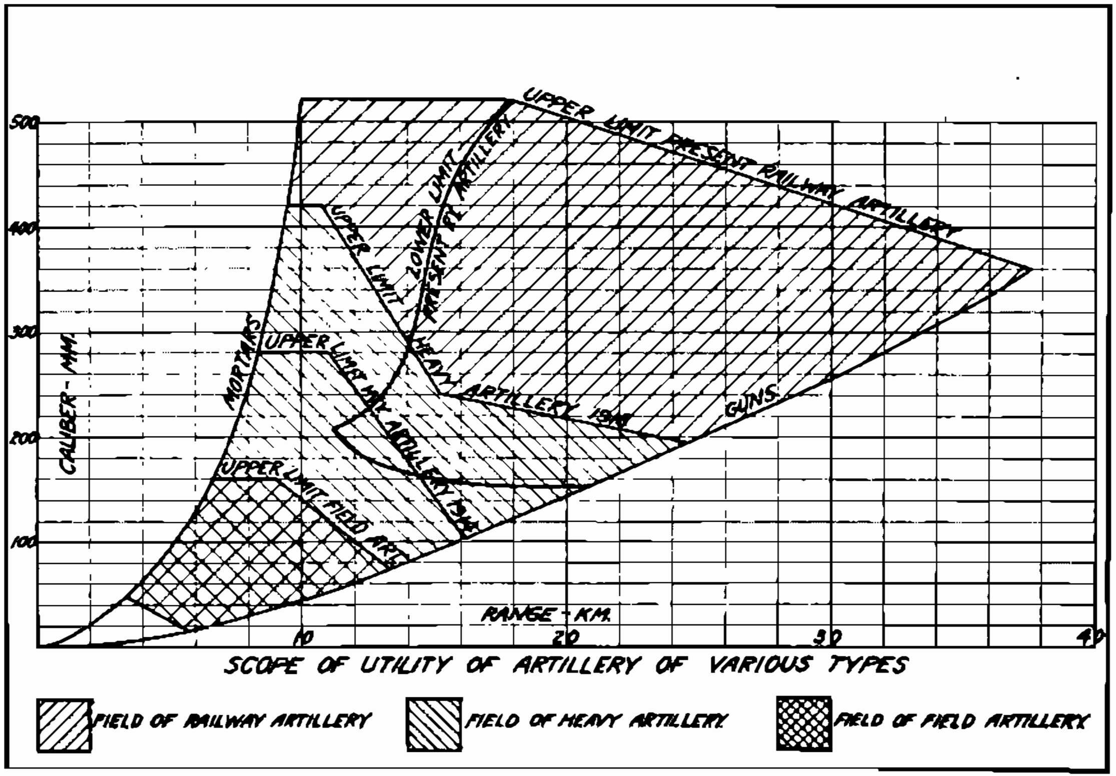
63. A given type of gun may be represented on the above-noted ordinates by a line joining the points representing the objectives it can reach. Mortars, for example, with a characteristic muzzle velocity of approximately 300 meters per second, would be represented by the line to the left on the diagram, joining all points representing a range and caliber requiring 300 meters per second velocity to realize them. In the same way the line at the bottom represents long guns (muzzle velocity about 850 meters per second). Thus the entire field of artillery (except trench artillery and long-range guns) is included between the two exterior lines.

64. A given type such as field or heavy artillery is represented by an area including all the points representing objectives for which the various guns of this type of artillery are suitable. On the diagram, plate 58, a line has been drawn, joining the points representing the heaviest field artillery guns, howitzers, and mortars. Thus the area below this line and between the two limiting lines represents the province of field artillery.

65. A second similar line has been drawn representing the upper limit of heavy artillery at the beginning of the war in 1914. The area between it and the previous line therefore represents the domain of heavy artillery. And, by consequence, the area above and to the right of this line is the domain of railway artillery.

66. For comparison, a line has been drawn through points representing the lightest railway artillery employed by the French. As will be noted, it intersects the heavy artillery line, indicating that railway howitzers were being used where heavy artillery matériel would have served equally well.

PLATE 38



SCOPE OF UTILITY OF ARTILLERY OF VARIOUS TYPES.

67. Developments during the war have, however, considerably changed conditions. All along the line it has become possible to mount heavier artillery on mobile carriages and therefore the line marking the upper limit of heavy artillery has advanced to the position shown by the new curve marked 1918. This, of course, restricts the field of railway artillery and means that still others of the French railway mounts (240 and 270 millimeter howitzers) could be replaced by mobile matériel.

68. The upper limit of the field of railway artillery is not yet marked, as in other arms, by the limitations of the type of mount. Any gun yet constructed can be mounted on a railway mount. The limitation comes in a vertical direction from the resistance of the most difficult objective to be destroyed. Certainly no objective has yet been encountered which the 520-millimeter howitzer or even the 400-millimeter howitzer could not reduce. The opinion gained from a general familiarity with the subject is that, in land warfare, only very exceptional targets will require such calibers and 300 to 350 millimeters is ample for all ordinary purposes.

69. The upper limit of railway artillery in respect to range is also fixed by economic rather than by physical limitations. Guns of extreme range used in distance bombardment for moral effect can perfectly well be mounted on railway carriages, but, as previously pointed out, their utility as compared with bombing planes is a mooted question. Indeed it may be questioned if such planes will not supplant artillery even at shorter ranges.

70. The dispersion of the long-range gun firing on Paris at the range of 110 kilometers was such that 183 of the 303 shots fell inside Paris (area about 90 square kilometers). The shell contained not over 10 kilograms of explosive and the gun had a life of perhaps 50 rounds. Thus the gun could place during its life about 500 kilograms of explosive somewhere within an area of 100 square kilometers.

71. The same results could be secured through the use of light bombing planes operating at a height safe from anti aircraft guns in daylight, and it is probable that dispersion would be considerably less than that noted above (30 bombs were dropped on a single railway shop in Paris). Three light bombing planes could carry the 500 kilograms of explosive just noted and release it on a single raid and even if all the planes were lost, which is not probable, the cost of so delivering the explosive would be considerably less than if it were delivered by the long range gun.

72. The dispersion of the United States 14-inch, 50-caliber gun at the extreme range of about 40 kilometers is about 4 kilometers. It fires a shell carrying about 40 kilograms of explosive and has a life of perhaps 300 rounds. This gives a total of 12,000 kilograms of explo-

sive placed somewhere in an area of 16 square kilometers during the life of the gun.

73. Twenty-five heavy bombing planes could drop this amount of explosive in a single raid, and, even at night, ought to be able to put it inside an area so large as 16 square kilometers.

74. On the other hand, there might be objectives at this range which drop bombs could not destroy because of lack of penetrative power. Further, for interdiction, it frequently is necessary to send over some shells on very short notice and often at times when a plane can not be used at all.

75. The conclusion of the writer is that at extreme ranges, that is, 70 to 120 kilometers, where the firing is for moral effect alone, this service should not ordinarily be considered as a proper one for railway artillery, the use of drop bombs being much more effective.

76. At shorter ranges, approximating 40 kilometers, many cases would seem to exist in fire for destruction and interdiction where drop bombs might be used to better advantage than railway artillery. Some targets would probably be found, however, for which drop bombs are ineffective, therefore railway artillery has a perfectly proper field at these ranges. Further, artillery capable of these ranges is required for accurate fire of destruction at shorter ranges, hence it is available for the longer range work if required.

77. The experiences of the war seem to indicate that the field of usefulness of railway artillery lies between the line on the diagram for heavy artillery, marked 1918, and the line above, joining the heaviest of the present railway guns. In other words, many of the smaller of the present railway guns should not be considered in any new program and there would seem to be little or no advantage in trying to exceed the largest of the present guns. This confines the field of railway artillery to calibers between 200 and 520 millimeters (preferably 250 to 400 millimeters, since there is little need for a caliber greater than 400 millimeters and the 200-millimeter gun can probably be mounted on a caterpillar), and ranges between 10 and 40, or possibly 50 kilometers.

UTILITY IN COAST DEFENSE.

78. Railway artillery has been exploited chiefly in the past as a means of coast defense. The outstanding advantage claimed for it is great mobility, permitting concentration of a large number of guns at any threatened point, and the effective defense of many places which would not justify permanent works, as well as enabling the guns to deliver their fire and retreat before effective counter-battery fire from the sea can be commenced.

79. For this service the work would be primarily the same as that demanded of the present coast-defense guns, i. e., the destruction of

battleships, destroyers, and lighter craft. This service calls for extreme accuracy and rapid fire, in some for long-range direct fire, and in others for medium-range plunging fire. These requirements are quite similar to some of those for land warfare. The essential differences, however, are that while in land warfare, the targets are fixed, in coast defense they are moving, and provisions must be made for following such a moving target; volley firing is often necessary.

80. Specifically the requirements of a mount for coast defense are:

(*a*) Wide traverse (60–180 degrees).

(*b*) Rapid fire.

(*c*) Quick emplacement.

(*d*) Sighting, elevating, and traversing mechanisms which can be operated until the moment the gun is fired, and simultaneously for all guns of a battery.

SECTION 3.

CHARACTERISTICS OF EXISTING TYPES OF RAILWAY ARTILLERY.

81. Railway mounts have been constructed and used to our certain knowledge by the French, British, Italian, German, and American Governments. Information on mounts constructed by all of these nations has been collected and tabulated for each type of which anything could be learned. At the request of the technical services of the French and British Governments all descriptions and tabular data on their mounts are omitted from this volume, which is intended for general distribution, and are placed in a separate volume for confidential use only. The tabular data on American and German mounts is given in section 10 of this volume. The descriptions and tabular data of the French, British, and Italian mounts are given in continuations of articles 3 and 10 in Volume II. All of the American and German mounts will be described in detail in this volume, each mount being designated by the number it bears in the table. In Volume II all other mounts will be mentioned, but only those on which special information is available will be dealt with in detail.

82. The various designs described herein are criticized chiefly under the head of "Difficulties involved in service." Most of the mounts are criticized under this head on a basis of the type of firing platform used and the time required for its installation.

83. There are in existence at the present time six types of mounts, according to the characteristic design or nature of their firing platform. These are: (1) Mounts of the type of the American 8-inch, plate 30, or French 200-millimeter, plate 10, using some simple type of outrigger; (2) mounts of the sliding and rolling type, similar to the French 320-millimeter, plate 42, or the American 10-inch, plate 111, and the British 12 and 14-inch rolling mounts, plates 20 and 21, or the American Navy 14-inch mount, plate 23, requiring a curved track of very heavy construction to permit of traversing the mount and to stand the exceedingly heavy service brought upon it in firing; (3) semipermanent emplacement mounts of the type of the American

12-inch Batignolles, plate 54, requiring a firing platform made up of easily handled sections which are carried in a special platform car provided with the necessary equipment for installing them; (4) semipermanent emplacement mounts of the type of the French 340-millimeter gun mount, plate 51, the 400-millimeter howitzer mount, plate 52, and American 16-inch howitzer mount, plate 53, and American 14-inch naval mount, Mark I, plate 23, requiring an elaborate subtrack platform of timber and steel construction which ordinarily can not be installed in less than from two to five days and affords only limited traverse of 10 degrees or less; (5) semipermanent emplacement mounts of the type of the American 14-inch model E mount, plate 249, requiring a heavy base ring of comparatively simple design, but which necessitates the use of a locomotive crane of 150 tons or more capacity; (6) semipermanent emplacement mounts of the type of the German 21, 24, and 28-centimeter mounts, plate 24, requiring a firing platform of structural steel, plate 55, which is cumbersome to transport and requiring crane facilities for installation, or a reenforced concrete emplacement, plate 56, which requires few facilities but considerable time for its installation.

84. So far, the use of the outriggers which are characteristic of class 1, have been limited to guns of smaller caliber and, of course, in criticizing the emplacements for larger guns, they are not being compared with the outrigger scheme of emplacement of these smaller mounts. In comparing the last five classes of mounts where one has a choice of: (*a*) A new curved track of heavy construction, (*b*) a special platform carried in a special car, (*c*) a heavy timber platform requiring days for installation, (*d*) a simple steel base ring requiring unusual facilities in the shape of a locomotive crane for installation, or (*e*) a structural steel platform difficult to transport and requiring days for installation, or a substitute therefor, in the shape of a reenforced concrete platform, apparently any one type has a questionable advantage over another and the various designs described in this section are not criticized on a basis of a preference for any of the types so far mentioned. After careful examination and consideration of all the types of railway mounts in existence, it seems possible to combine in a mount for heavy guns, modifications of emplacement schemes of the above types in such a way as to render the mount almost universally serviceable. On plates 59 and 60 is a suggestion for a design of a carriage for 10-inch, 50-caliber guns. Computation of the necessary data indicates that this type of emplacement can be installed almost as quickly and as easily as the simple outrigger emplacement. It gives all round traverse if desired and will stand the strains brought upon it by a 50-caliber, 10-inch gun.

PLATE 59

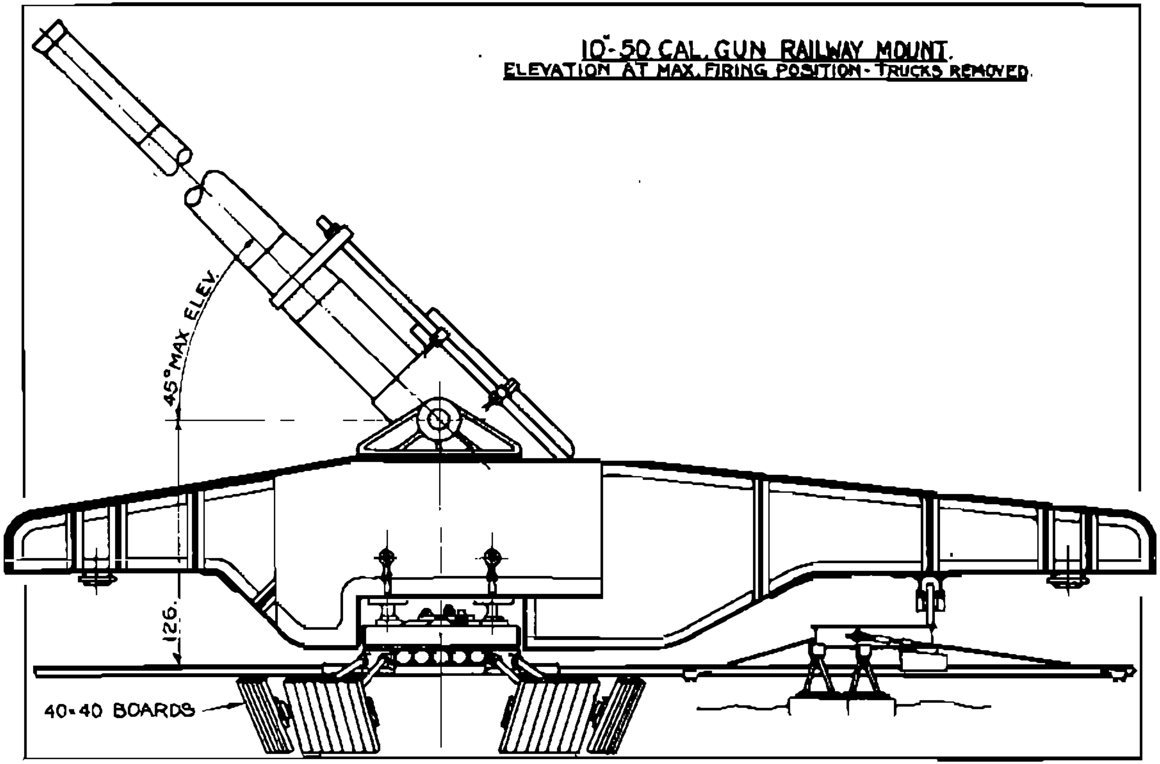
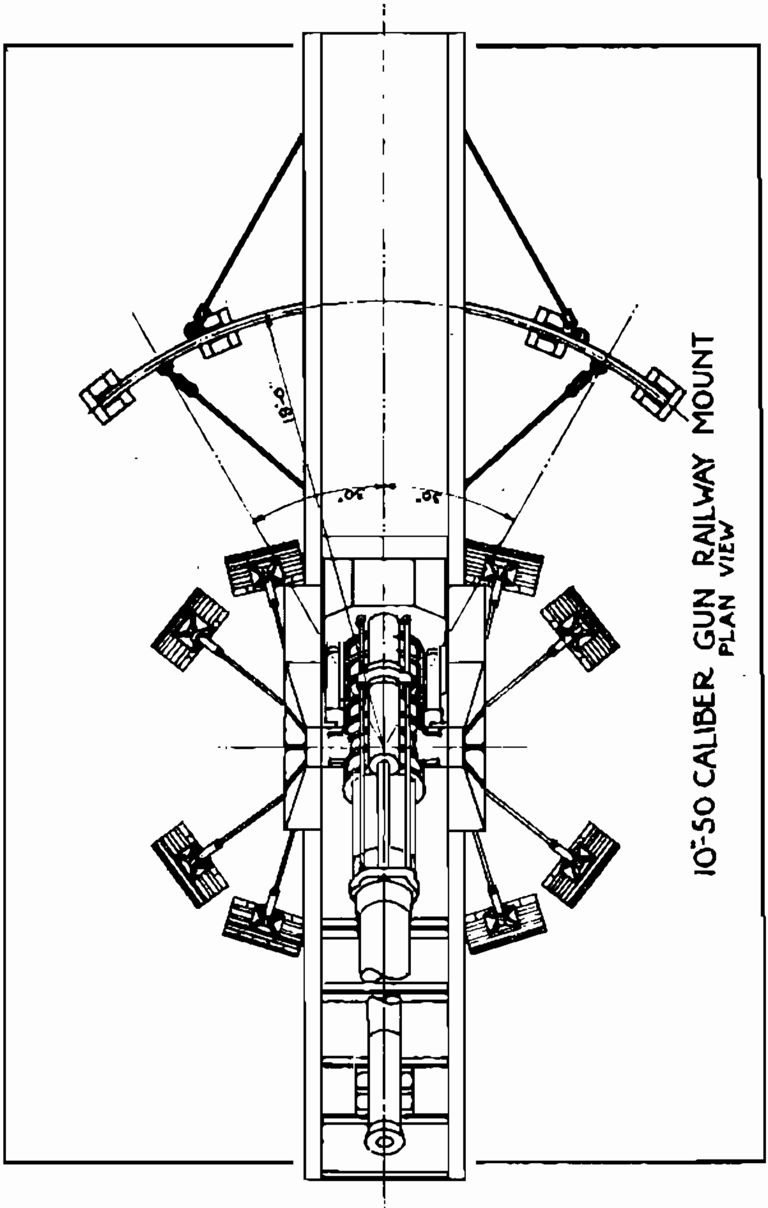

10"-50 CAL. GUN RAILWAY MOUNT.
ELEVATION AT MAX. FIRING POSITION - TRUCKS REMOVED.
45° MAX ELEV.
126.
40-40 BOARDS

PLATE 60



10"-50 CALIBER GUN RAILWAY MOUNT
PLAN VIEW

85. Going a step further, it seems entirely feasible to design a mount which will embody the features of the sliding type mount in the shape of steel shoes similar to those used on the 14-inch model E mount and the features of the mounts of classes 1 and 6 in the shape of a center pivot and traversing rollers attached to the car body to secure the necessary traverse, and outriggers on the rear of the car body to take a large part of the horizontal component of the force of recoil. In addition, it seems possible to incorporate other features of the 14-inch model E mount, in the shape of a simple base ring which will be set on the concrete and on which the mount can be operated for seacoast service. These simple base rings would be inexpensive and could be installed in great numbers along our coast at comparatively little cost. This type of mount would then service perfectly as a coast defense mount, and for land warfare could be used as a combined sliding and rolling mount with any desired traverse, or as a simply and quickly emplaced mount requiring very few extra facilities and having any desired traverse.

86. The writer has these two types in mind in criticizing the various mounts throughout this section, from the standpoint of time, and difficulties involved, and facilities necessary in placing, removing, and maintaining their platforms.

1.—4.7 HOWITZER ON RAILWAY MOUNT. (13)

87. This mount, which is model of 1917, was designed as an alternate mounting for the pivot yoke and other rotating parts of the 4.7-howitzer pedestal mount, model 1915. The railway carriage resembles very closely the design made up by Col. Peigne for the 155-millimeter French howitzer, 1890. This can be seen by comparison of plates 62 and 65 with plate 4. Four of these mounts were completed for service at Panama, and have functioned satisfactorily.

88. Guns.—The gun that is used with this mount is a 4.7 howitzer, model 1913. It is a wire-wound gun of 22.5 caliber length, plate 66, and is provided with the standard American type interrupted thread breechblock, which is fitted with a mechanical firing mechanism, plate 67. The tube is rifled with 42 grooves, the twist of which is to the right and at a pitch increasing from 1 turn in 40 calibers to 1 turn in 20 calibers. As mentioned before, this same model of gun is used on the pedestal mounting, model 1915.

89. Recoil Mechanism.—The recoil mechanism is of the hydro-spring type and as with the light field pieces, the entire recoil mechanism is combined in one cylinder, plate 68. It will be noted on this plate that the hydraulic cylinder recoils with the gun while the piston remains stationary. The counterrecoil buffer is not a part

of the piston rod as in the usual railway design, but is attached to the cylinder. The hydraulic cylinder head serves as a piston head for the recuperator spring column. The length of recoil is 12 inches.

90. ELEVATING MECHANISM.—It is possible to elevate the gun from minus 10 degrees, the loading angle, to plus 40 degrees, by means of the screw hinged to the bottom of the cradle at its forward end, plate 69. This screw is driven by the bronze nut in the oscillating central bearing. This bearing is supported on the cross shafts as trunnions. Elevating handwheels are provided on both sides of the carriage.

91. TRAVERSING MECHANISM.—The gun can be traversed through 360 degrees. The traversing mechanism comprises the handwheel shaft and bevel gears shown on plate 70, with the worm shaft, worm and bronze wormwheel shown on plate 69. The lower portion of this bronze wormwheel serves as a drum for the two halves of the friction band which are hinged on the stud bolt, passing through the boss in the rear of the pedestal. The two halves of this friction band are joined at the front by a bolt.

92. TOP CARRIAGE.—The top carriage comprises the cradle carrying the hydrospring recoil mechanism and the pivot yoke with the elevating and traversing mechanisms, plate 69. On this plate the gun is shown on the pedestal for which it was originally designed. On the railway mount the pedestal is part of the car body, but its design, as well as the dimensions of its machined surface are identical. Any gun of this design with its pivot yoke can be transferred from the separate pedestal to the railway mount. The weight of the gun, cradle, and pivot yoke is carried on ball thrust bearings at the bottom of the pedestal. The separate pedestal is provided with an azimuth circle which is not provided on the pedestal of the railway mount. Front and rear views of the top carriage are shown on plate 71, and a right-hand side view on plate 72.

93. RAILWAY CAR BODY.—The railway car body proper, plate 73, comprises a central steel casting, of which the pedestal is an integral part, and the two structural steel ends riveted to this casting. On each side of the car body two side arm castings are riveted, both to the cast steel center section and the structural steel ends. On each end of the car body are hinged three pieces of 0.5-inch armor, the side pieces having two copper lined loop holes for machine guns, and the end pieces one copper lined loop hole each. These plates of armor can be let down to a horizontal position to serve as working platforms. Two other plates which serve likewise as working platforms are hinged to the central cast steel section of the car body.

94. ANCHORAGE.—The mount is let down and clamped to the track for firing. Additional provision is made for stabilizing the mount when the gun is fired at any considerable angle to the direction

of the track. Side arms are attached to the car body on each side by means of the side arm castings shown on plate 73. A jack screw passes through the end of each of these side arms and cast steel foot plates of simple design are provided on which the screws bear. These foot plates are placed on well tamped earth, rock ballast or timber. When firing at a wide angle to the track, it is necessary to put out the side arms on both sides of the car, since the return of the gun to battery has a tendency to tip it in the direction of fire.

95. In the four corners of the central section of the car body there are openings into which rail hook casings are fitted and bolted by four bolts, plate 74. These casings, which may be taken out and turned through 180 degrees, and replaced, are so designed that one arrangement spaces the hooks for the 60-inch gauge track, and the other for the 56.6-inch gauge. Inside of this casing there is a sleeve, two parts of which project above the top of the casing and are fitted with handles as shown on figure 3, plate 74. By means of these handles the sleeves can be raised or lowered. A 0.875-inch pin across the bottom of this sleeve, figure 3, passes between the rail hooks and spreads them when the sleeve is raised, thereby freeing the hooks from the rails. The two rail hooks are hinged to the bottom of the clamping screw, which is operated by the two-handled nut shown at the top of the casing, figure 2. The sleeve and rail hooks are carried normally at their highest position. When it is desired to clamp the car body to the rails, the hooks are lowered as far as they will go As they are lowered, the pin in the sleeve spreads them and the lugs on the hooks strike the top of the rail when they are in the proper position. The sleeve is then lowered by its handles, and as it descends the opening pin permits the hooks to swing together and close over the rail. The bottom of the sleeve encircles the rail hooks and when in its lowest position binds them to the rails. On the under side of the center section of the car body there are six pads which rest on the rails when the mount is lowered to the firing position. These are of sufficient width to be adapted to the 60-inch or the 56.5-inch gauge. Each is provided with a pair of rail stops, one on each side of the rail, which serve to prevent the mount from sliding across the rails and take the strain off the truck pintles. One stop is longer than the other and they are interchangeable. For the 56.5-inch tracks the long stops are placed outside the rails and for the 60-inch tracks they are placed on the inside.

96. In the center of each of the structural steel ends of the car body there is installed a screw lifting jack used in lowering the mount on to the track for firing and in raising it to the traveling position. These jacks are shown in figures 1 and 3, plate 74. This lifting jack comprises a cast-steel pintle guide rivetted into the car body, a bronze pintle, a jack screw, bevel gears, spur gears, and two handles,

figure 1, plate 74. A roller thrust bearing is provided between the top of the jack screw and the top of the pintle guide. The bottom of the pintle rests on the center plate of the truck. Into the two sides of the pintle are machined racks, which mesh with one of the four pinions. The fourth pinion meshes with a rack in the side of the moveable side bearing. As the pintle moves up or down, the side bearing moves in the same direction at the same rate. The first two railway mounts of this type manufactured were also equipped with an alternate method of operating the jack screw. The upper end of the jack screw was slotted and a capstan head provided to fit into it. Four maneuvering levers were provided for the operation of this capstan. The crank handles used to operate the lifting jack may be replaced by ratchet levers. The additional leverage obtained through the use of these ratchets reduces considerably the effort required for raising and lowering the car. When ratchet wrenches are used with a lever arm of 32 inches, the force necessary on each ratchet lever, one being used at a time on each end of the car, is 65 pounds to raise, and 50 pounds to lower. The time necessary to raise the car, using ratchet wrenches, eight men working in reliefs of four, is 5.5 minutes, and to lower ready to fire, approximately 5 minutes. When capstans are used the pull necessary at the end of one lever to turn the capstan at one end of the car is 150 pounds to raise and 100 pounds to lower. When four maneuvering levers are used with one man at each lever, eight men in all, the car can be lowered in 1 minute and raised in 1.25 minutes. When crank handles are used the force necessary on each of the four handles is 85 pounds to raise the car, and 50 pounds to lower. The time necessary to raise the car with crank handles, four men at each end of the car, is 1.5 minutes, and to lower, 2 minutes.

97. Armor.—Each end of the car is fitted with three shields of 0.5-inch armor plate hinged to the floor so that they can be swung down to a horizontal position, plate 73. When raised, the side shields are locked to the end shield by angle iron clips and a locking pin. The two pieces of angle iron are rivetted to the side shield and straddle the end shield when vertical. A single pin locks a side shield to the end. The outsides of the shields are fitted with shield props which slide through guides on the car body. Collars on these props limit the movement of the shields. The upper end of the props extend through the shields and provide an attachment for handle rods on the inside. Three of these handle rods can be seen at the right end of the car, plate 73, the shield on the near side in this case being cut away to show the opposite side. Men standing on the car and clasping hands can let down the side shields by means of these handles without undue difficulty.

98. Trucks.—The trucks are commercial four-wheel trucks of 50,000 pounds capacity. The brake mechanism has been modified slightly to take a special brake bracket in order that the brake handwheel might be located in the free space beside the lifting jack toward the center of the car.

99. Ammunition Supply System.—No special provisions have been made for supplying ammunition for this caliber of gun. All the ammunition components are of such weight as to enable them to be handled entirely by hand.

Plate 61

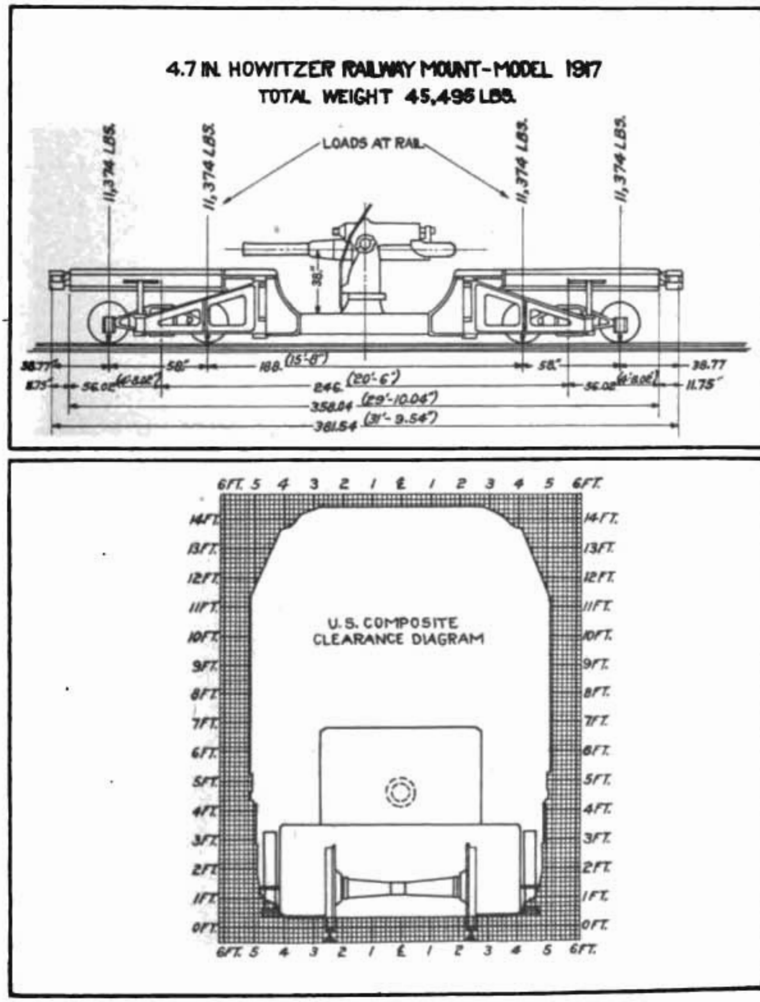
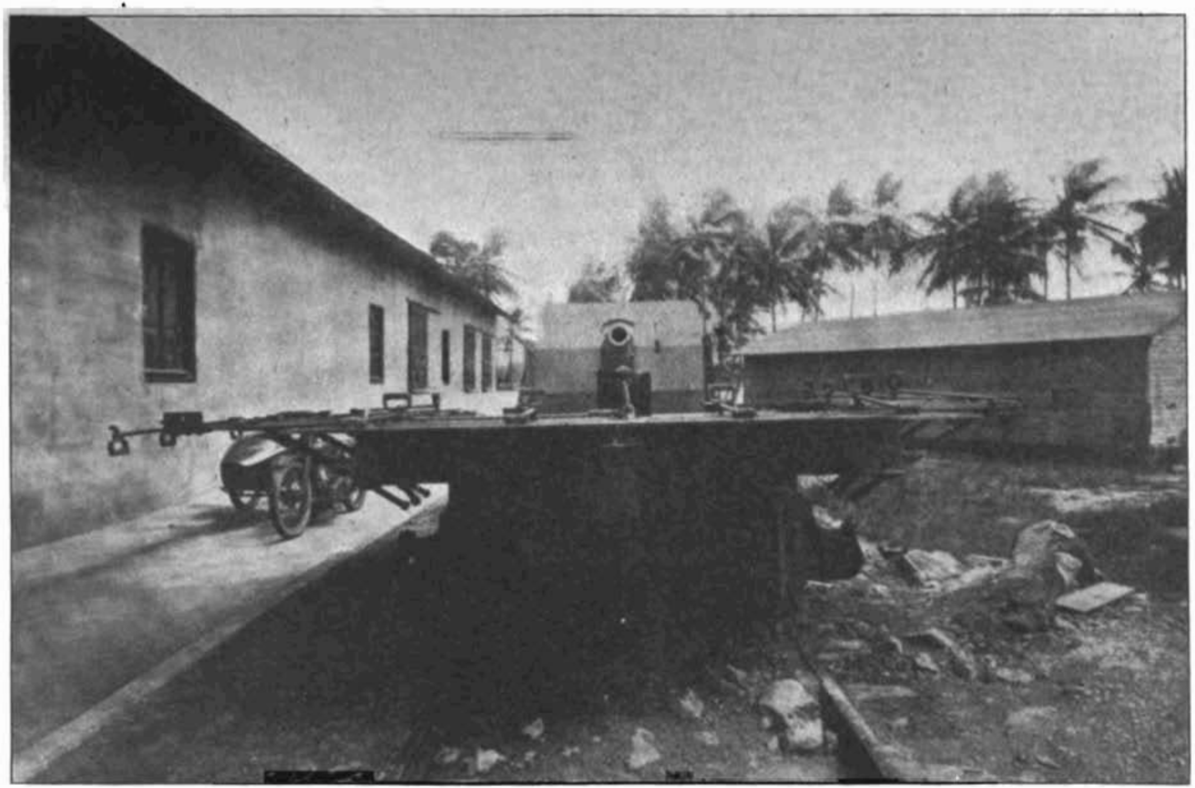


PLATE 62

4.7-INCH AMERICAN HOWITZER ON RAILWAY MOUNT (SIDE VIEW).

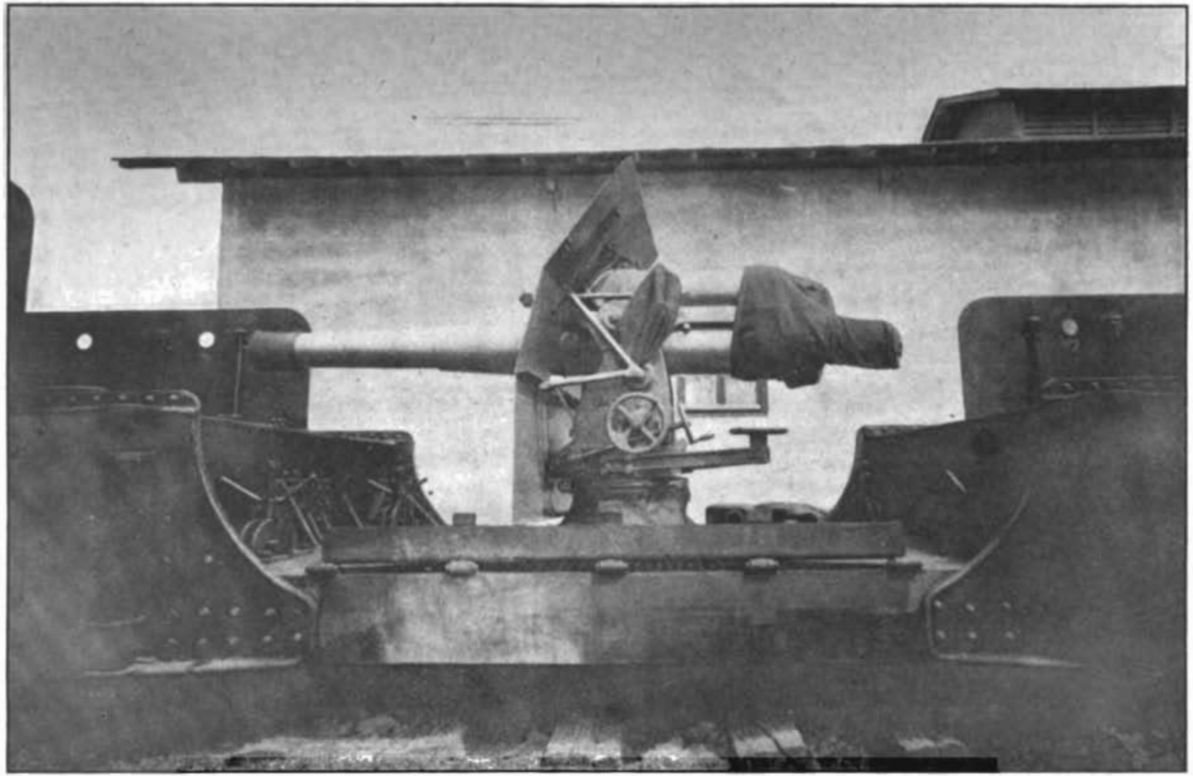
PLATE 68



4.7-INCH AMERICAN HOWITZER ON RAILWAY MOUNT (FRONT END VIEW).

PLATE 64

4.7-INCH AMERICAN HOWITZER ON RAILWAY MOUNT (REAR END VIEW).



4.7-INCH AMERICAN HOWITZER ON RAILWAY MOUNT (SIDE VIEW ASSEMBLY).

PLATE 66

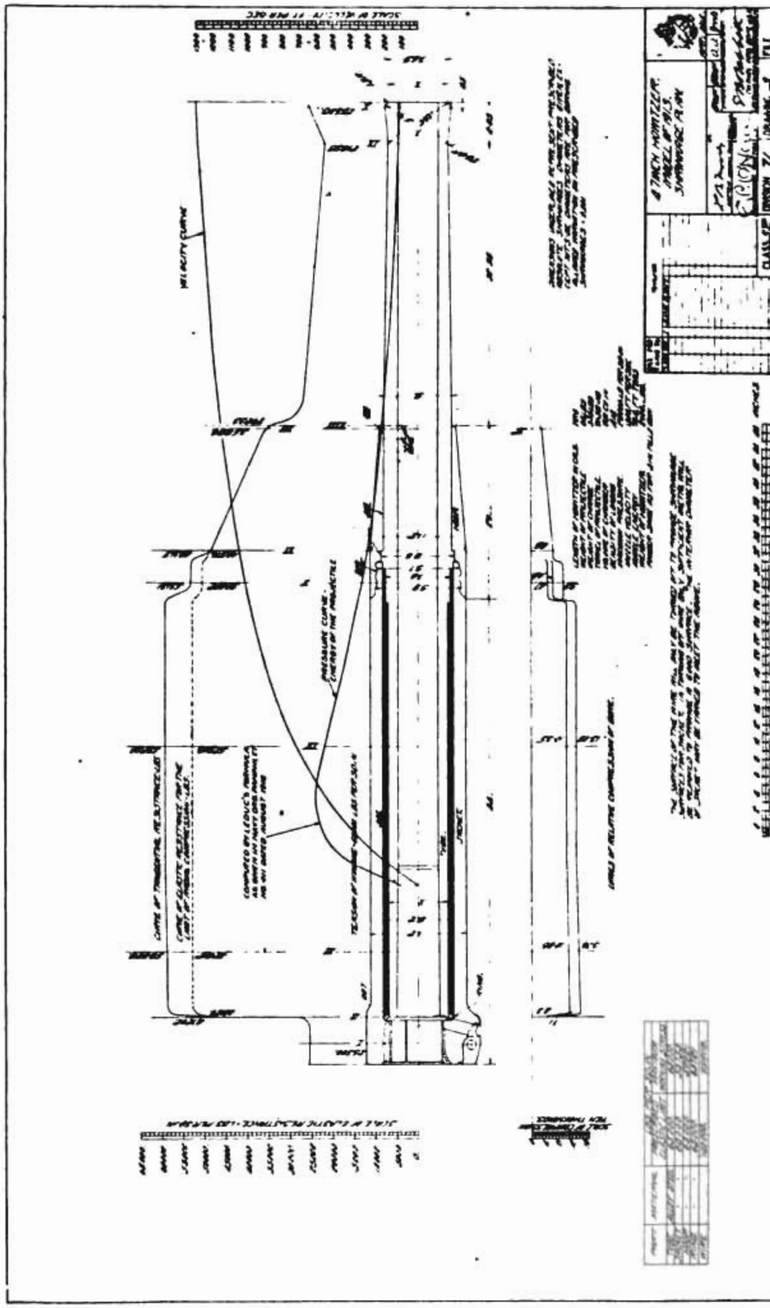


PLATE 67

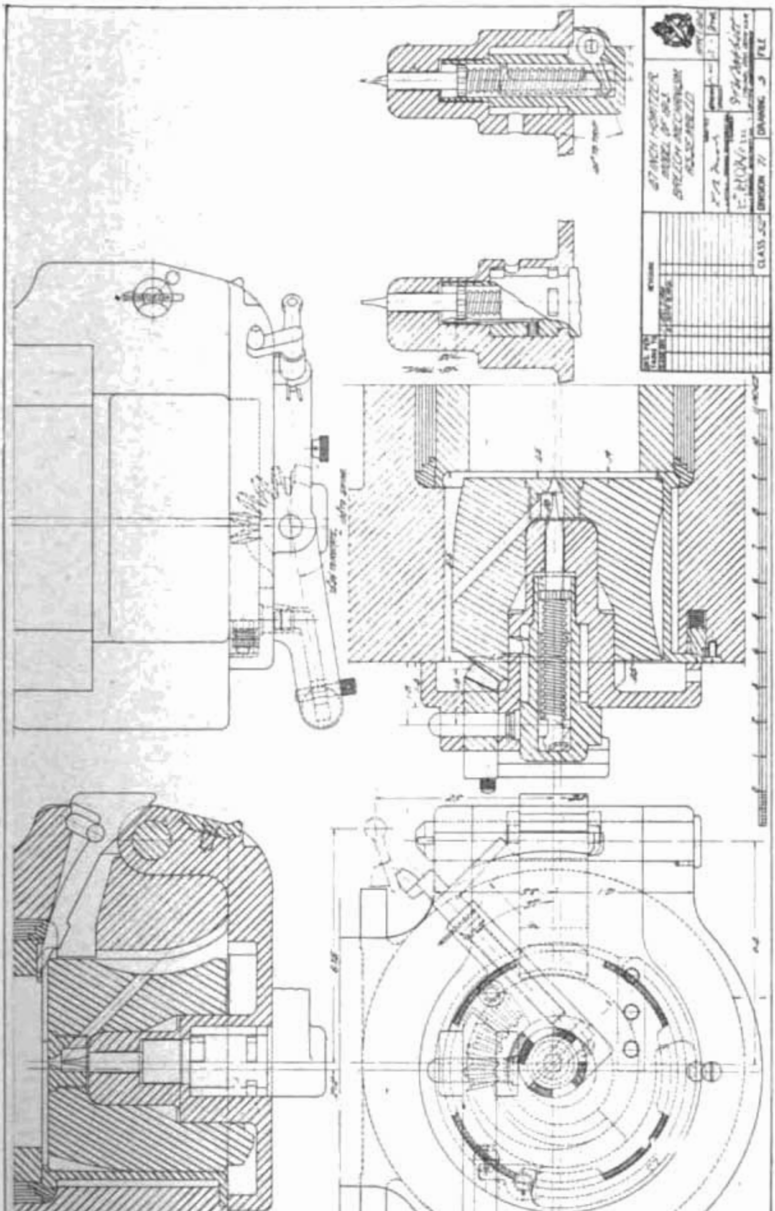


PLATE 68

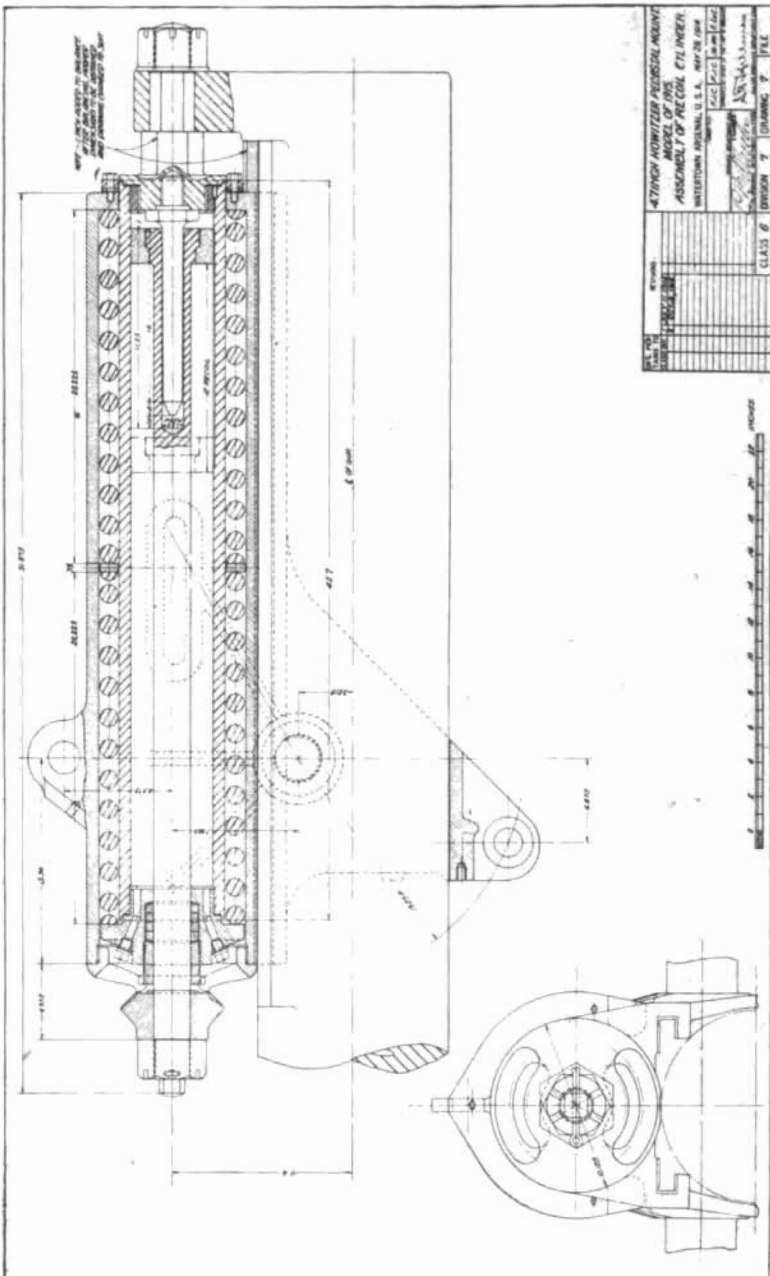

4.7 INCH HOWITZER PEDESTAL MOUNT
MODEL OF 1915
ASSEMBLY OF RECOIL CYLINDER
WATERTOWN ARSENAL, U.S.A. MAY 28 1914
CLASS 6
DIVISION 7
DRAWING 7
FILE

PLATE 69

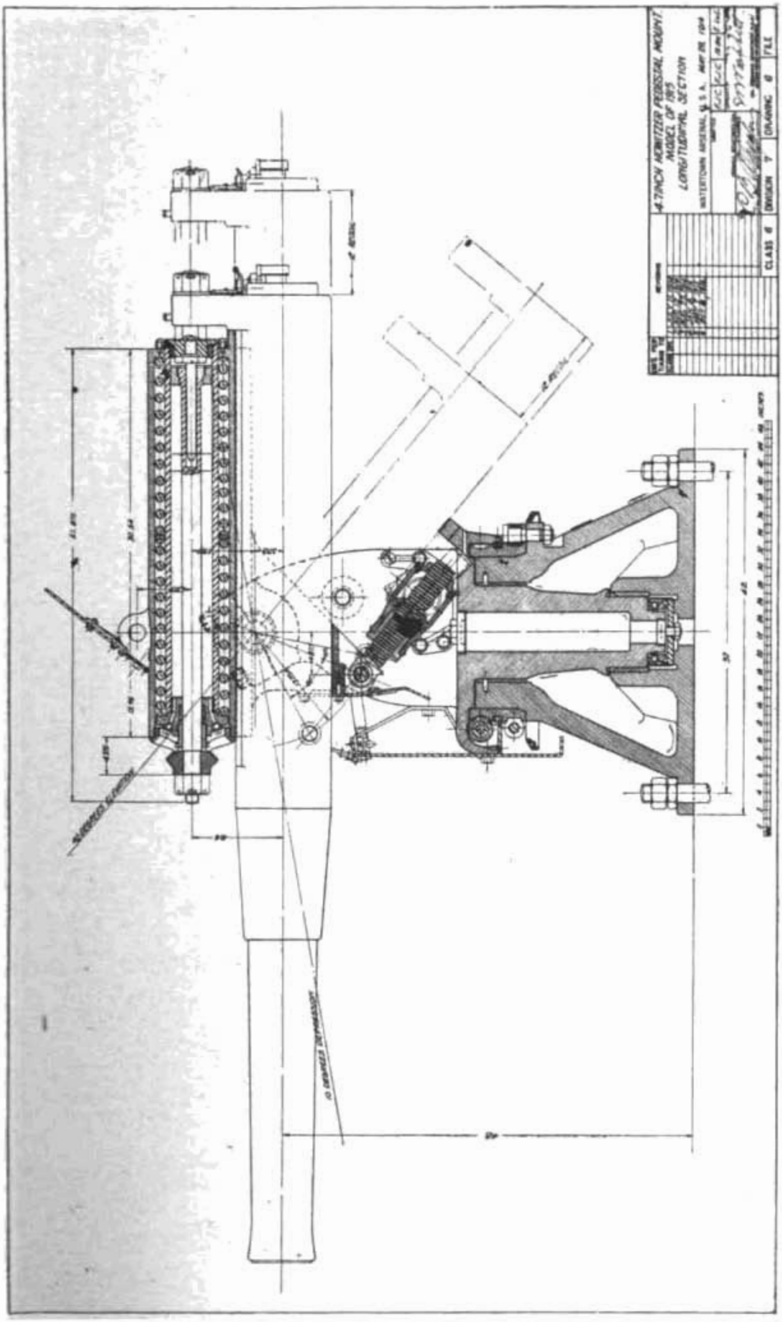

4.7-INCH HOWITZER PEDESTAL MOUNT.
MODEL OF 1915
LONGITUDINAL SECTION
WATERTOWN ARSENAL, U.S.A.
CLASS 6
DIVISION 7
DRAWING 6
FILE

PLATE 70

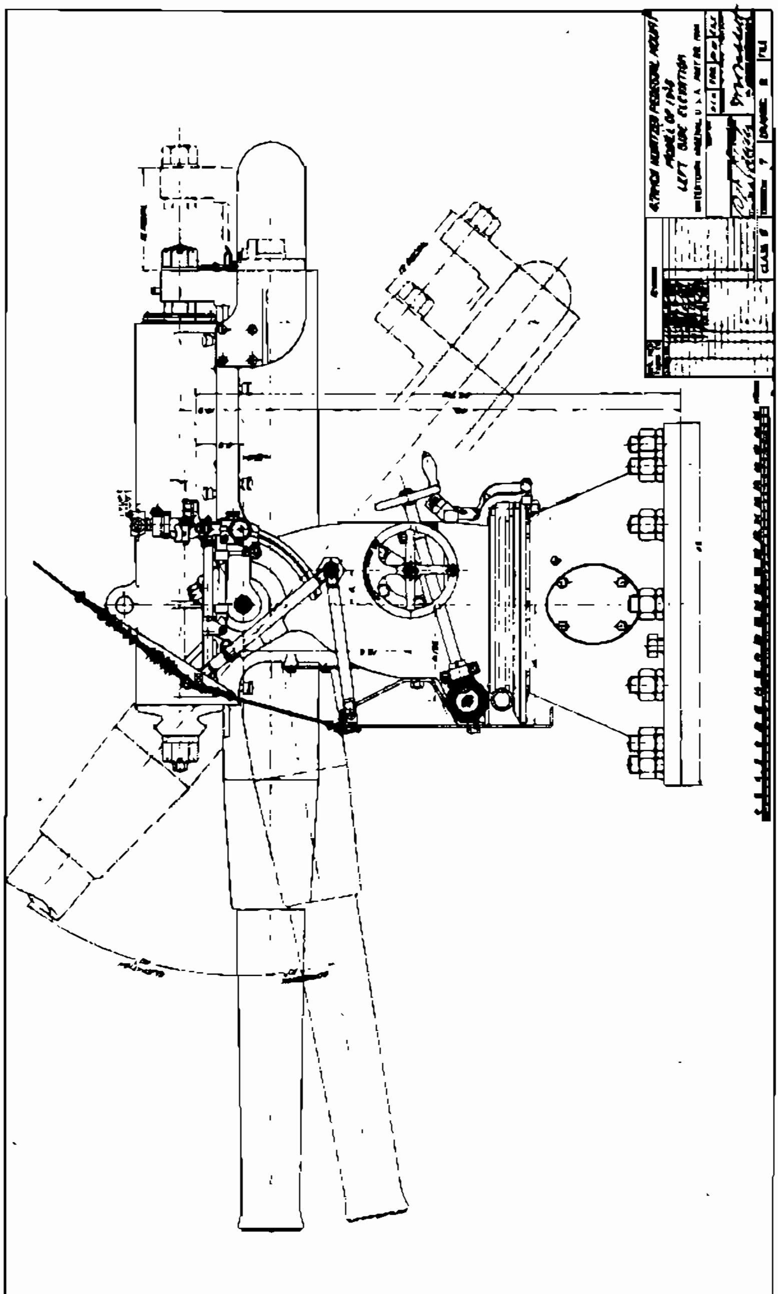


PLATE 71

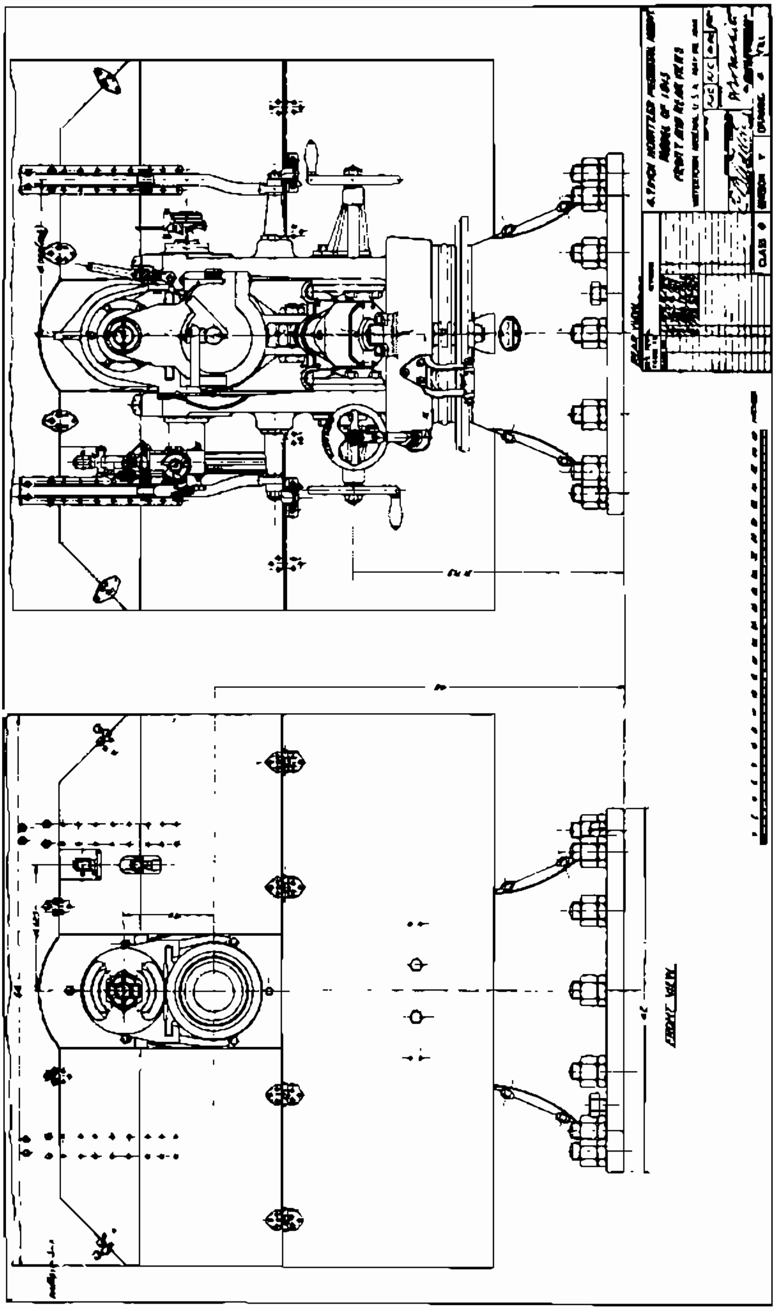


PLATE 72

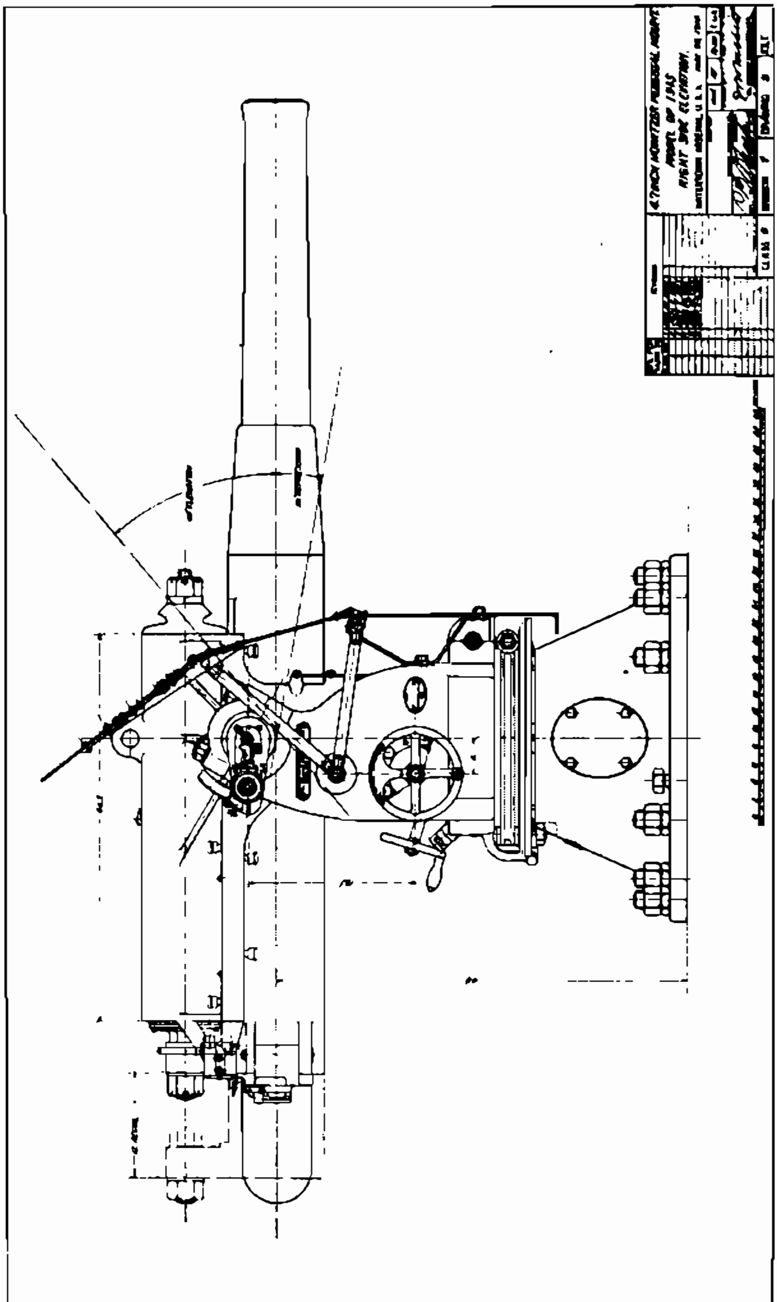


PLATE 78

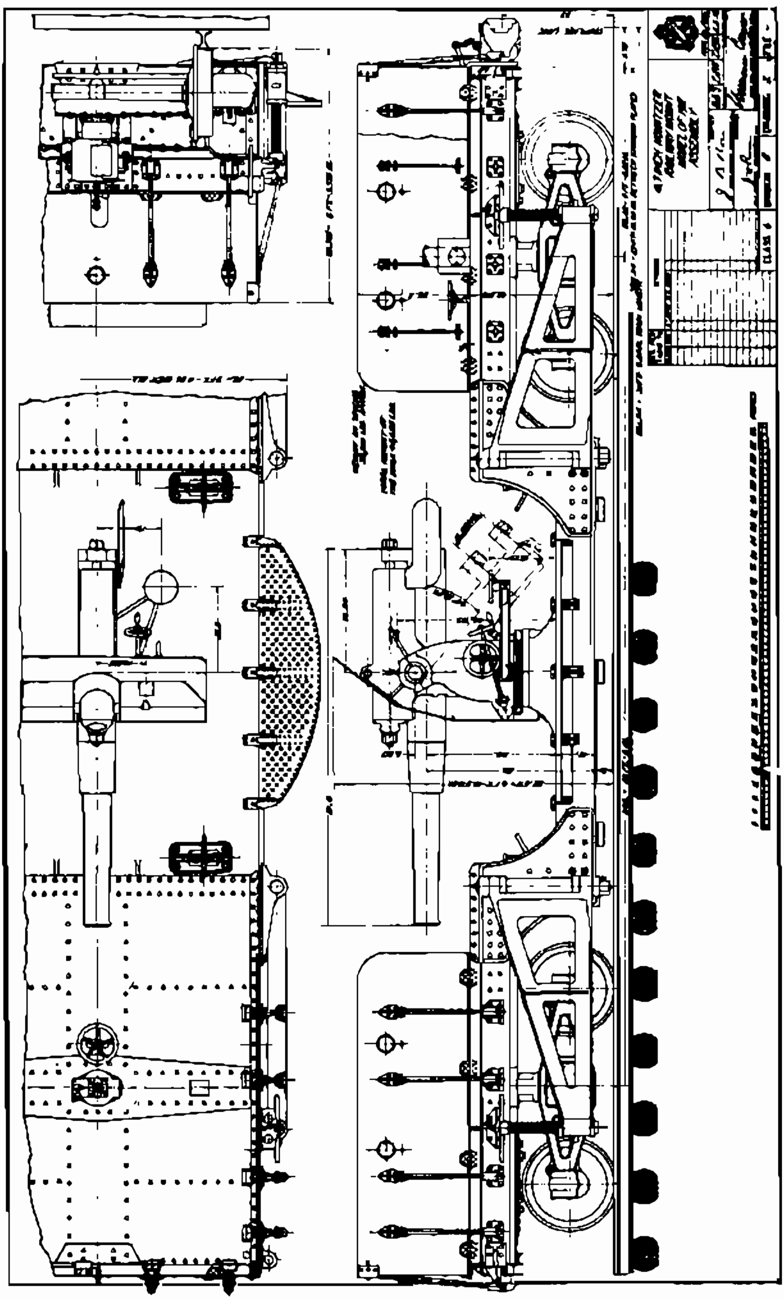


PLATE 74

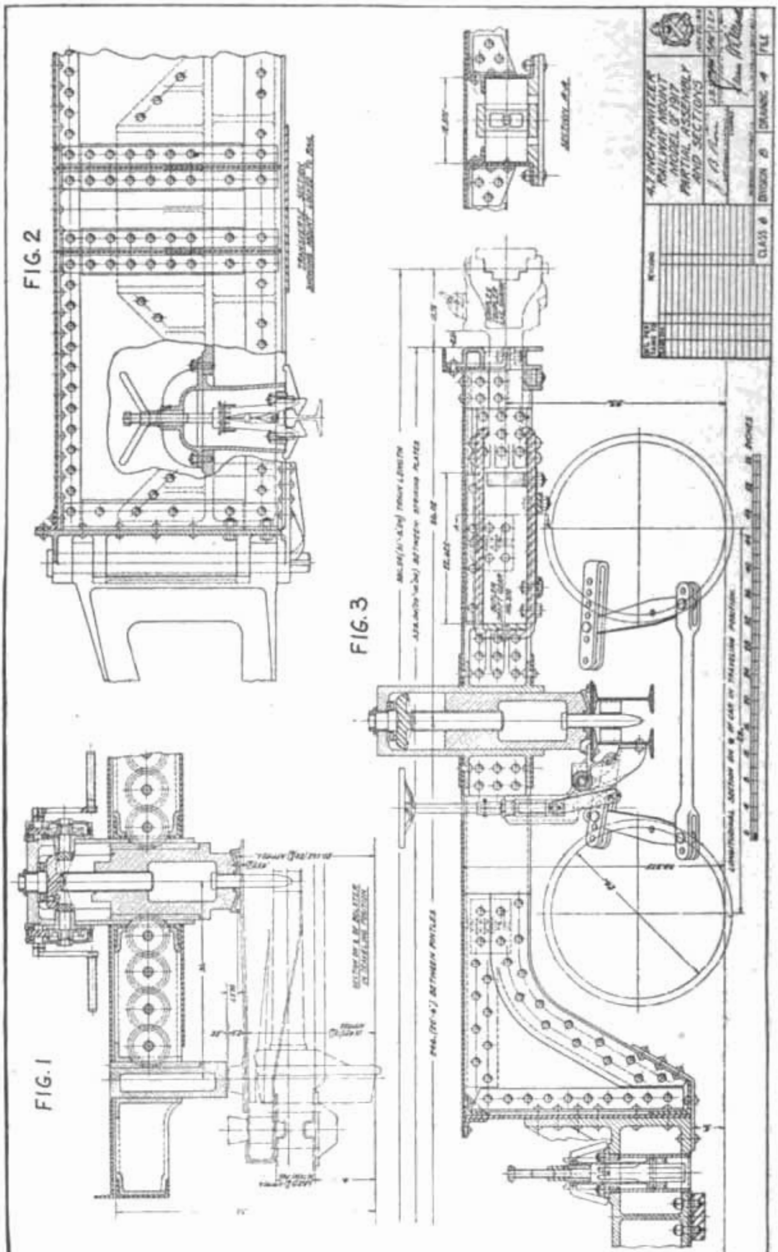


FIG. 1
FIG. 2
FIG. 3
4.7 INCH HOWITZER RAILWAY MOUNT MODEL OF 1917 PARTIAL ASSEMBLY AND SECTIONS
CLASS
DIVISION
DRAWING
FILE

2.—7-INCH GUN ON RAILWAY MOUNT. (14)

100. This combination of Navy gun on Army design of drop-platform car was made up toward the end of the active period of the war, in 1918. The railway cars, model 1918, were designed for 6 and 8 inch seacoast guns, as will be explained later, being modeled to a certain extent after the design already completed for 4.7-inch howitzers. Twelve of these cars were available, and since they were equipped with hydraulic jacks over each of the trucks, it was decided in 1918 to mount Navy 7-inch guns on them for service against submarines along our coast. A few especially designed pieces of equipment were added as will be described later.

101. GUNS.—The guns that are used on these mounts are 7-inch, Mark II Navy guns, of 45 caliber length. They are provided with an interrupted thread breechblock which is fitted with a mechanical firing mechanism.

102. RECOIL MECHANISM.—The recoil mechanism is of the hydro-spring type and comprises one hydraulic recoil cylinder attached to the cradle, in the center of the bottom, and two spring recuperator cylinders likewise attached to the bottom of the cradle, and on either side of the hydraulic cylinder. The hydraulic recoil cylinder is shown in detail on plate 78 and the general arrangement of cylinders on the bottom of the cradle, on plate 79. The length of recoil is 21 inches. The spring columns, which are double, are divided by spacing plates into five sections, plate 80.

103. ELEVATING MECHANISM.—The elevating mechanism comprises a rack attached to the left side of the cradle, plate 80, which is connected with the handwheel through a pinion, shaft, slip friction device, wormwheel, worm, bevel and miter gears, plates 81 and 82, sections ZZ and YY. The gun can be elevated from minus 5 degrees to plus 15 degrees. The cradle trunnions are provided with a very simple type of friction-reducing mechanism, as shown on plate 81.

104. TRAVERSING MECHANISM.—The gun can be traversed through 360 degrees. The traverse wormwheel is attached to the pedestal, as shown on plate 77, and is connected with the handwheel on the right side of the carriage through a worm, two sets of miter gears, sections XX and VV, plate 82. The pivot yoke is supported on the pedestal by means of conical rollers, plate 83.

105. GUN CARRIAGE.—The top or gun carriage comprises the cradle, with recoil, elevating and traversing mechanisms, pivot yoke and pedestal, plates 81, 79, 84, and 85. It will be observed on plates 76 and 77 that the original deck mounting of this gun is so low that it was necessary to provide an additional cast steel base to elevate the gun sufficiently to permit it to be fired at its maximum elevation of 15 degrees when firing in the direction of the track. This cast steel base has been bolted to the floor of the car and additional

cast steel brackets have been added to the side of the car to accomodate the additional width of the base over the width of the car.

106. Car Body.—At the beginning of this discussion it was mentioned that this car body was originally designed for 6 and 8 inch seacoast guns. It was found impossible to use them because the bottom outside angles in the well of the car extended beyond the clearances permissible on European railways. Attention should be called to two other modifications that were made in the car body, model 1918, Mark I. It will be observed on plate 769, that the outrigger struts are attached to the car body by means of cast steel hinges, and from the bottom of the hinge to the end of the strut there is a torsion rod for the purpose of counteracting certain tendencies of the car to jump when gun is fired at low elevations. On the modified design, plate 88, one set of four struts is attached to the car by means of ball joints. Four more struts are attached in such a way as to swing only in one vertical plane, as shown on plate 98. The car under discussion is likewise provided with hydraulic jacks over the truck center plates and with adjustable side bearings, plate 86. The pumps for these jacks are installed on the sides of the car, as shown on plate 76, and connect with the inside of the hydraulic cylinder through the small hole in the piston. Two racks meshing with pinions which in turn mesh with racks cut in the side of the adjustable side bearings are machined into the side of the cylinder which also serves as a body center plate. As the car is raised or lowered the side bearing clearance between truck and body is held constant, due to the action of this compensating device. In the modified design, these jacks and adjustable side bearings were omitted and four jackscrews were placed at the four corners of the lowest part of the flat car.

107. Anchorage.—The mount is emplaced for firing by first injecting sufficient pressure in the hydraulic cylinders to remove the safety locking pins. It is then dropped to the rails by releasing the pressure in the cylinders. No special emplacement is required. The outriggers and floats are placed, as shown on plates 76 and 77, for firing in any direction. It is necessary to put out four outriggers since the car whips to such an extent as to loosen the outriggers if only two are used.

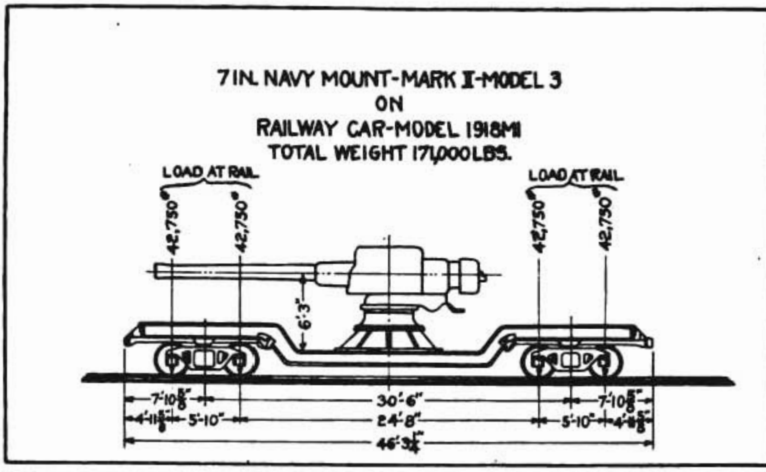
108. Trucks.—The trucks used are of standard M. C. B. design with cast steel side frames. They are provided with both hand and air brakes.

109. Ammunition Supply System.—Projectiles are supplied directly from the ammunition car on to the ammunition table, shown on the end of the car body in plate 77. On the side of this ammunition table are two working platforms which are let down to a horizontal position. The projectiles are transferred from the table into the gun

over the removable tray which can be seen on the top of the table on plate 77. This ammunition table is light in design and is merely bolted to the car; it can be transferred to the other end of the car without difficulty whenever desired. The ammunition cars used with this mount are standard 8-inch ammunition cars.

110. Maintenance, Merits, Demerits.—It is believed that there is no point in discussing the 7-inch mount under these headings, since they are purely emergency mounts and it is believed that they do not represent a type that would receive consideration for future construction.

Plate 75



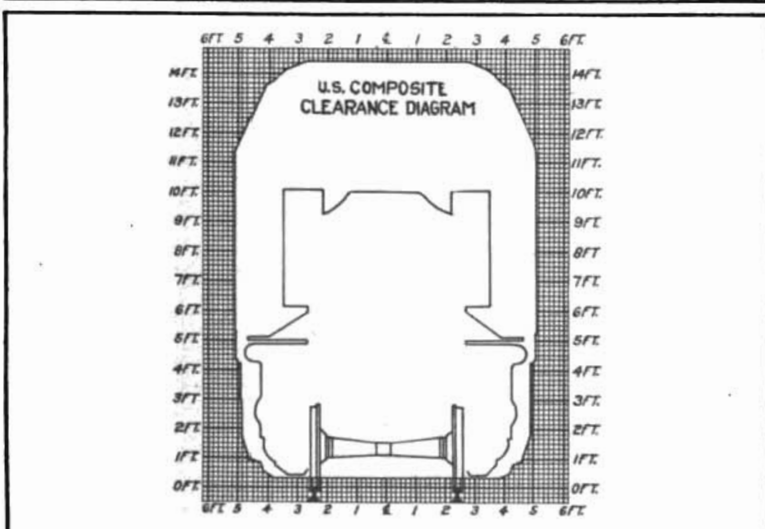


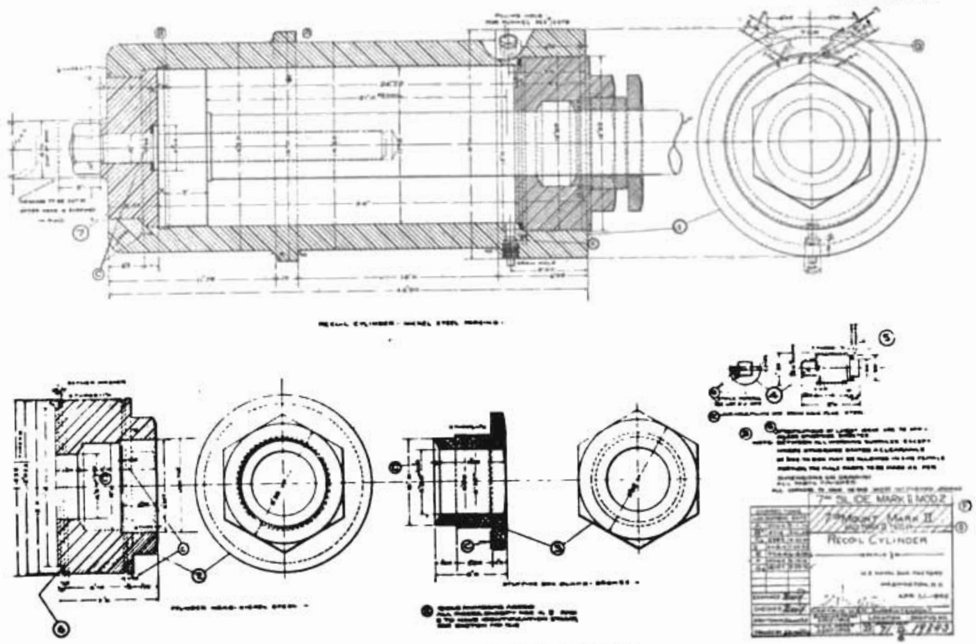
PLATE 76

7-INCH AMERICAN NAVAL GUN AND DECK MOUNTING ON 8-INCH RAILWAY CAR BODY, MODEL OF 1918, MARK I.

PLATE 77

7-INCH NAVAL GUN AND DECK MOUNTING ON 8-INCH RAILWAY CAR BODY, MODEL OF 1918, MARK I.

PLATE 78



RECOIL CYLINDER OF THE 7-INCH AMERICAN NAVAL GUN.

PLATE 79

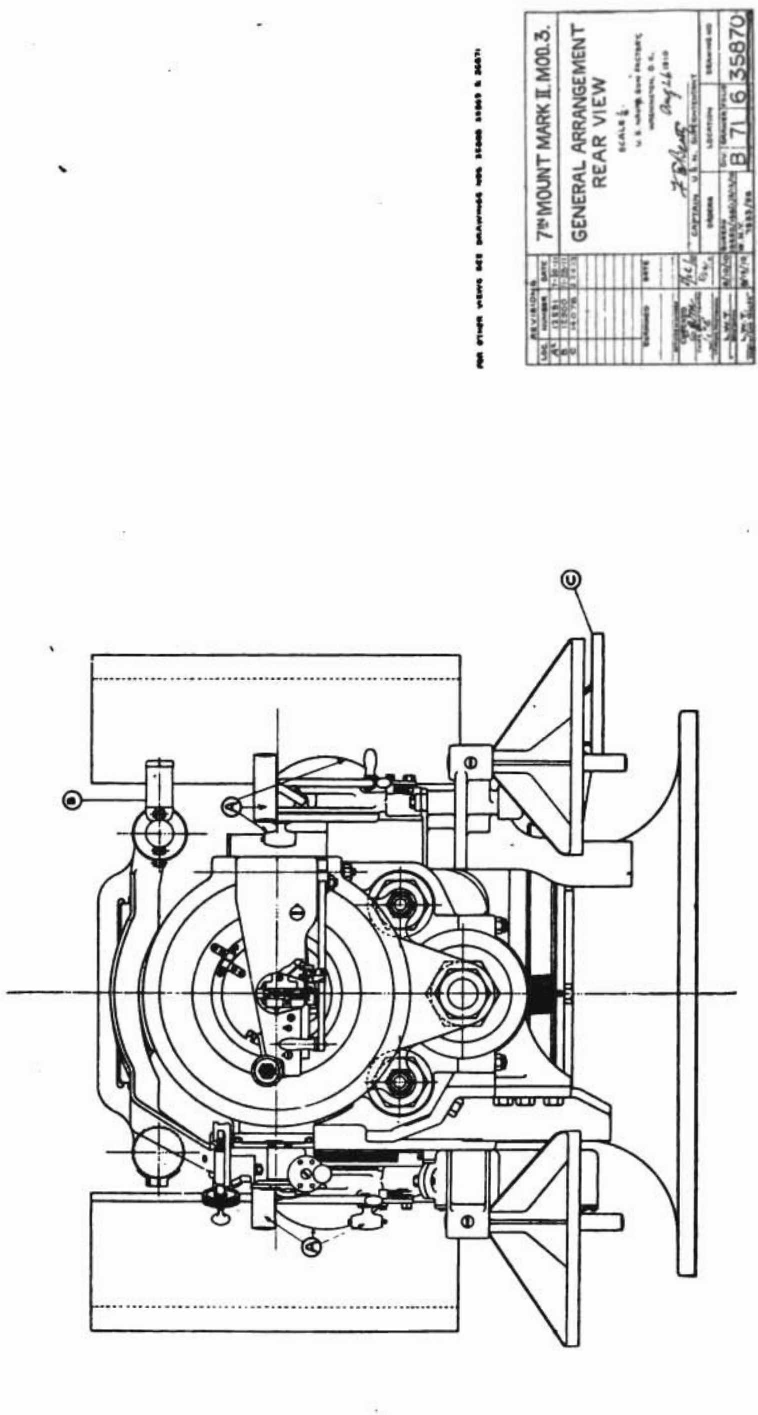

7 IN MOUNT MARK II. MOD. 3.
GENERAL ARRANGEMENT
REAR VIEW
REVISIONS
B 71 6 35870

Plate 80

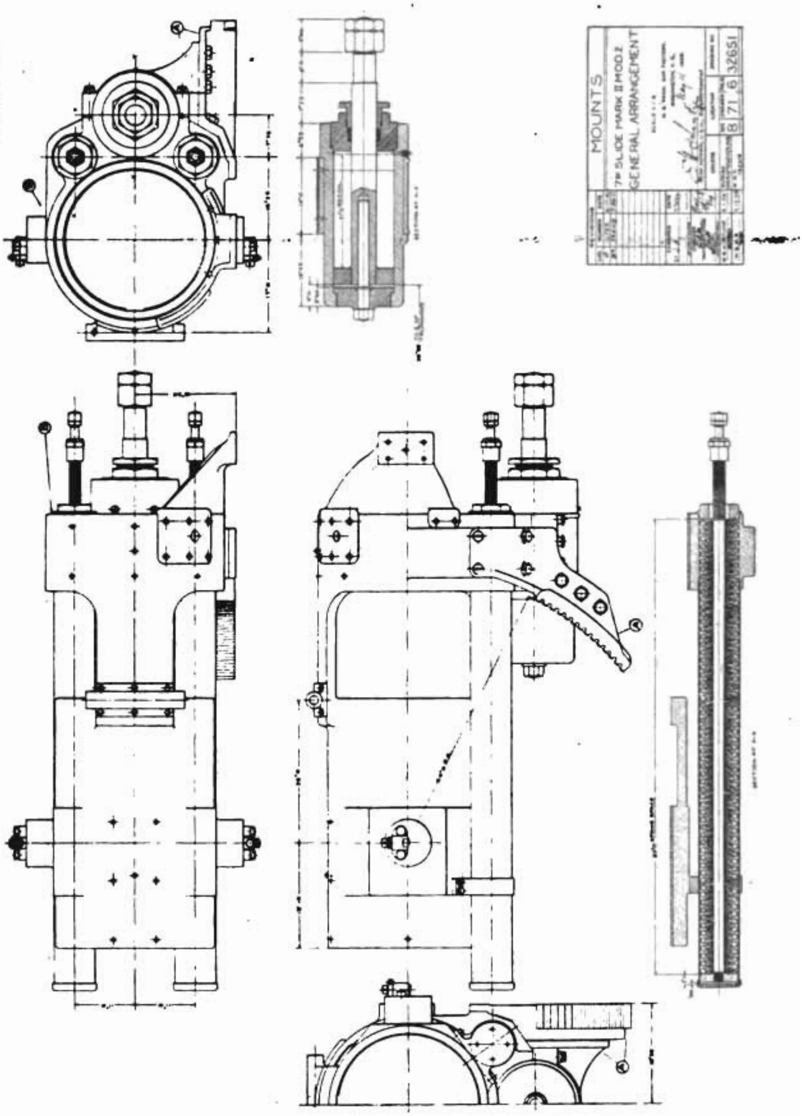


Plate 81

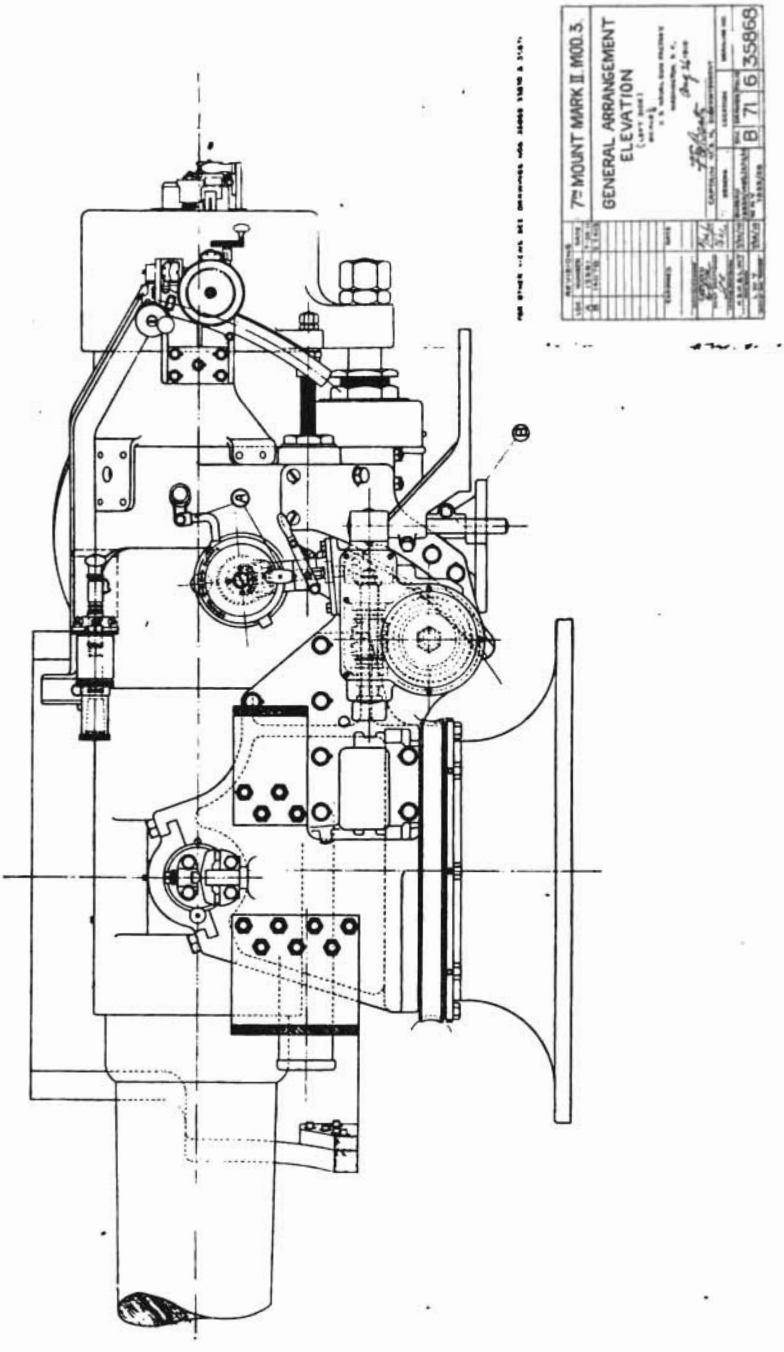

7" MOUNT MARK II. MOD.3.
GENERAL ARRANGEMENT
ELEVATION
B 71 6 35868

PLATE 82

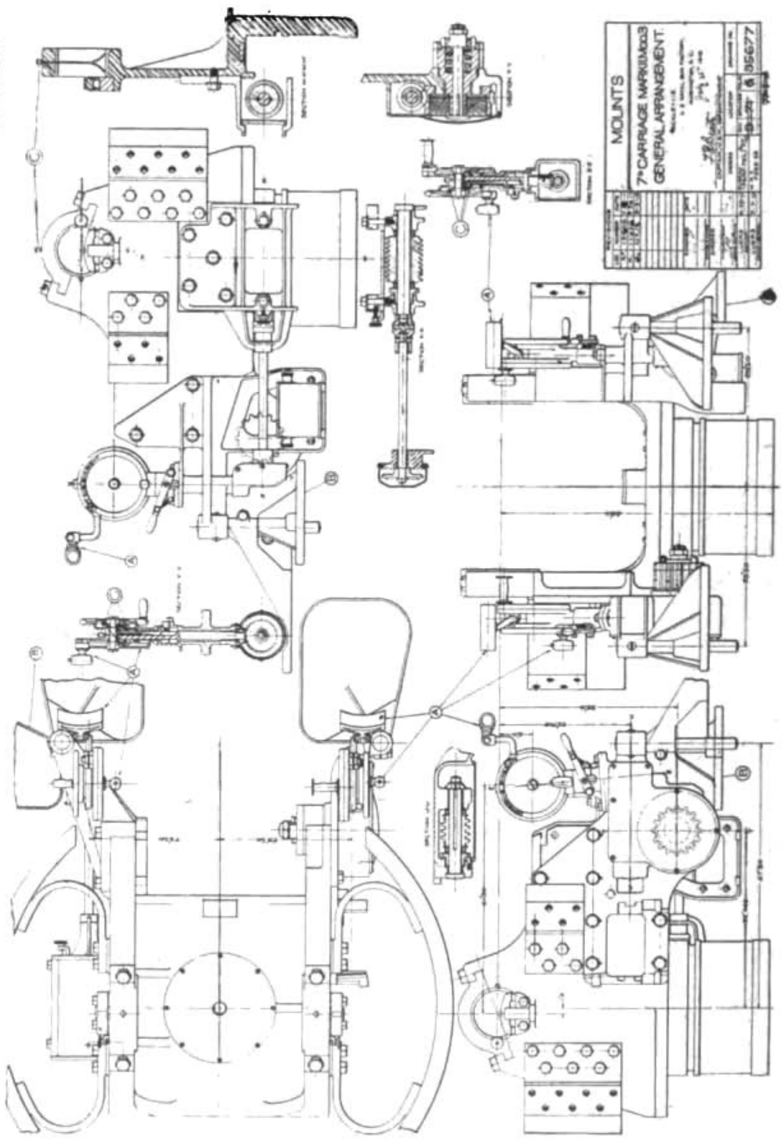
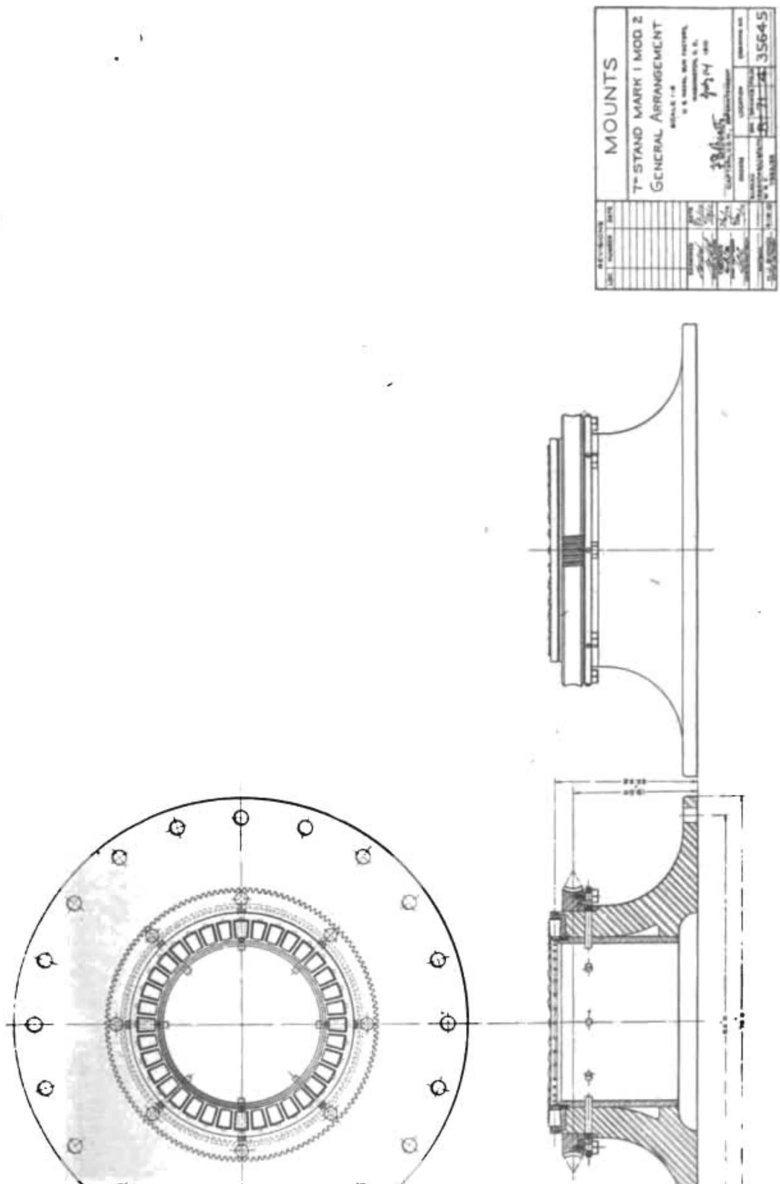


PLATE 83



181768—21——9

PLATE 84

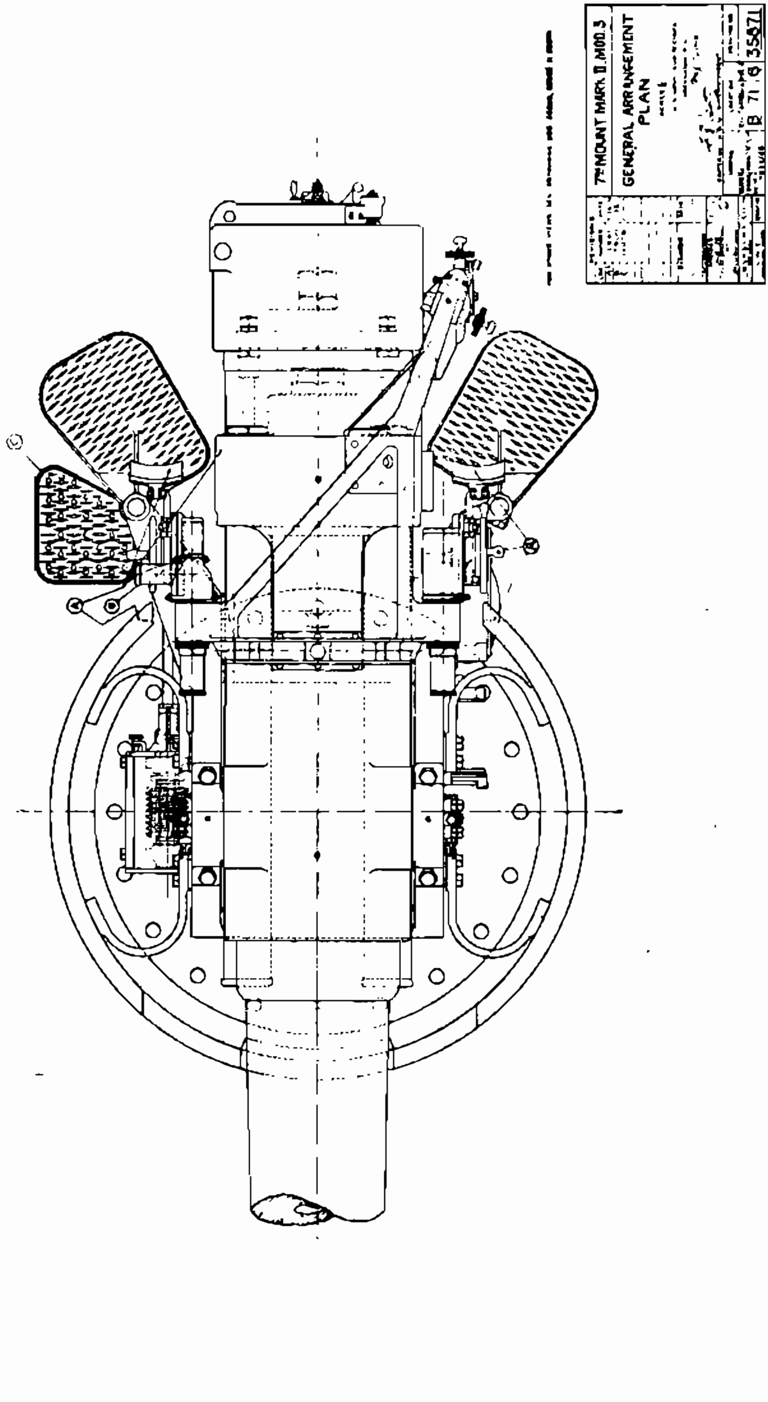


PLATE 85

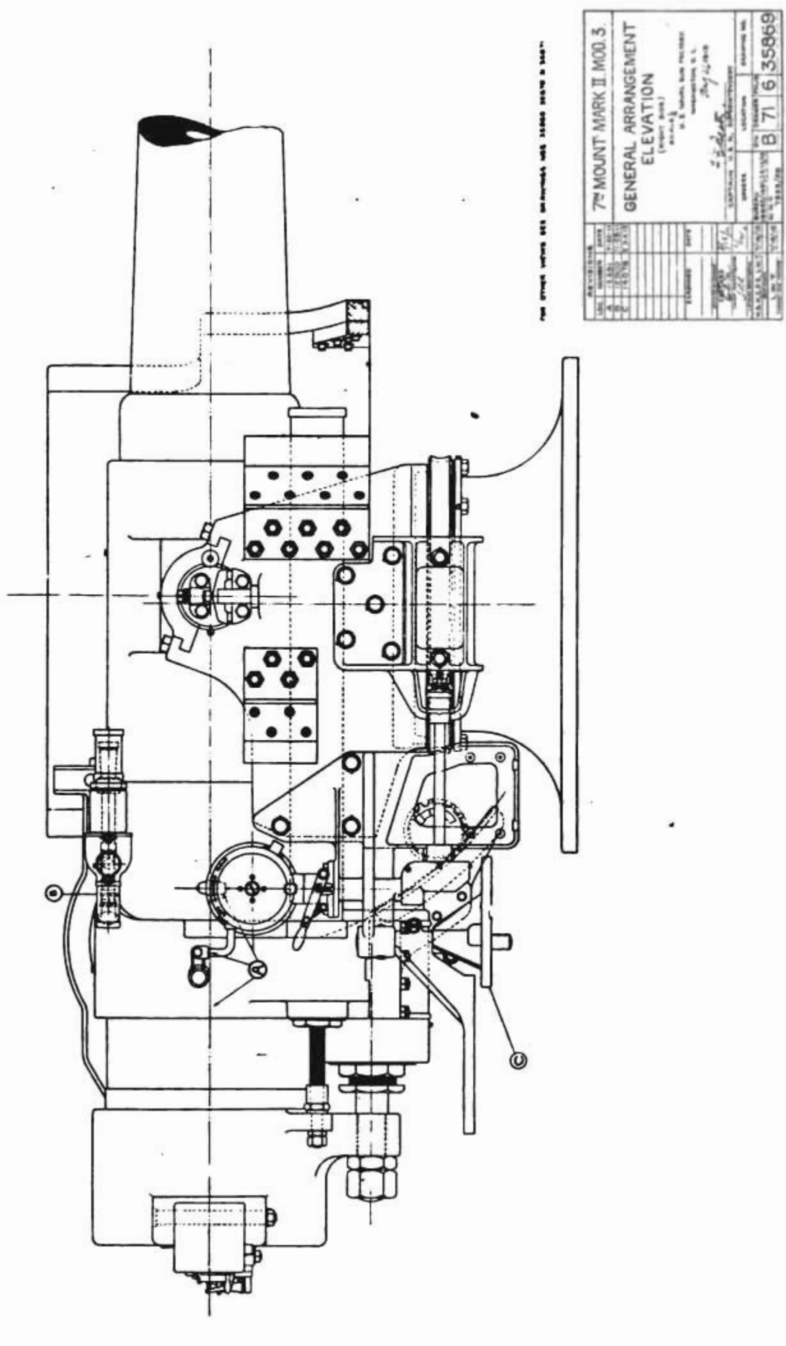
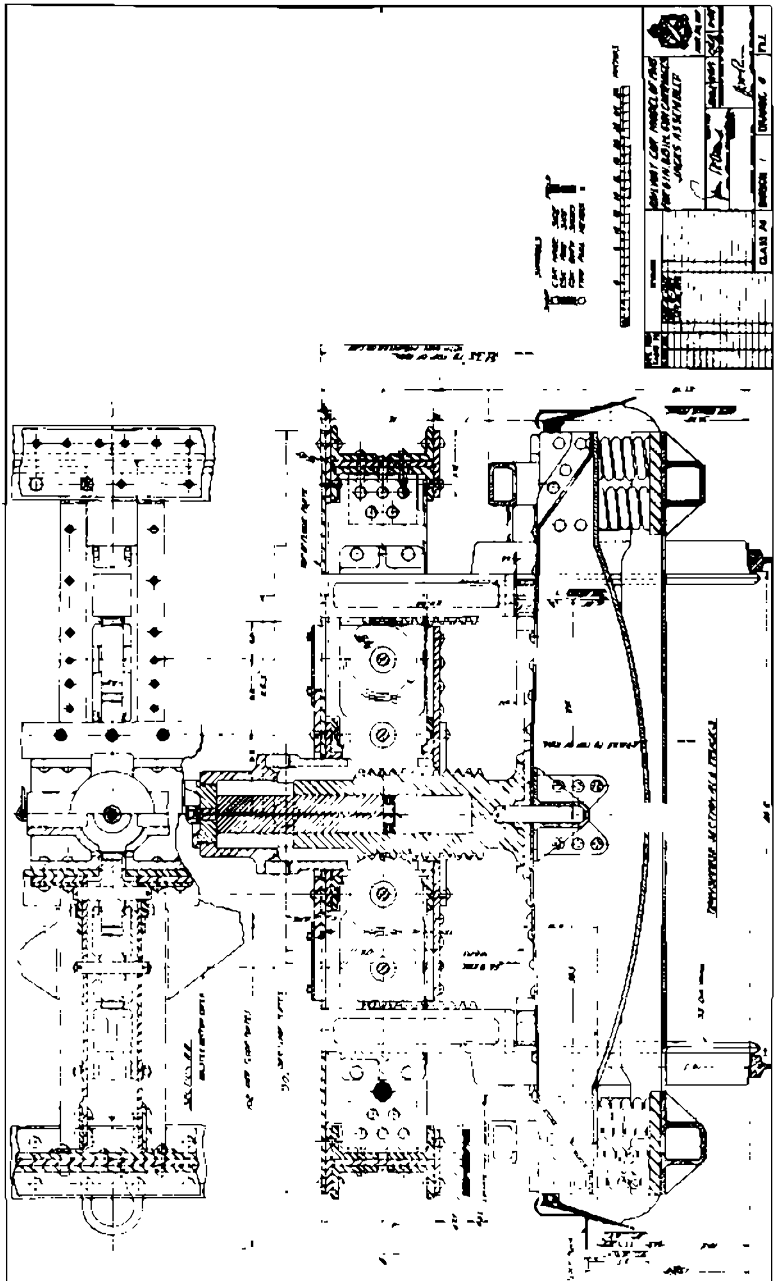

7" MOUNT MARK II MOD. 3.
GENERAL ARRANGEMENT
ELEVATION
B
71
6
35869

PLATE 88



3.—AMERICAN 8-INCH GUN ON RAILWAY MOUNT. MODEL 1918, M. I. (15)

111. This is a combination of seacoast defense gun and barbette carriage on a special railway car. The mount is shown on plates 88 to 93.

112. GUN.—Seven different types of Army and Navy guns may be used on this mount:

Army guns: Models of 1888, 1888 M.I., 1888 M.II.

Navy guns: Marks I, II, III, IV, (16).

The Army guns are all 32 caliber in length, are equipped with uniform type of breech mechanism and are mounted on model 1918 barbette carriages, having a standard type of cradle with hydraulic recoil and spring return system. The Navy guns vary from 30 to 40 calibers in length, are equipped with four different types of breech mechanism and are mounted in barbette carriages model 1918, M.I. of the same general type as model 1918.

113. RECOIL MECHANISM.—The recoil mechanism as noted above is of the hydro-spring type with one recoil and four spring cylinders arranged symmetrically about the outside of the cradle. Details of this mechanism are shown on plate 94.

114. ELEVATING MECHANISM.—Elevation from zero to 42 degrees is secured through a segmental circular rack attached to the bottom of the cradle. A Hindley worm meshes with this rack. Three sets of bevel gears on as many shafts lead to the handwheel, plate 94. Any thrust due to fire is taken by the worm and transmitted from it to the side frames through the heavy transom casting in which it is mounted. One turn of the handwheel moves the gun through approximately 0.333 degrees in elevation. Details of this mechanism are shown on plate 93.

115. TRAVERSING MECHANISM.—The traversing mechanism provides for a total movement of 360 degrees. The gun and cradle are carried in side frames on a racer casting which is supported by conical traversing rollers. A complete circular rack is mounted on the base ring into which meshes a pinion of the traversing mechanism mounted upon the racer. This pinion connects, through a slip-friction device, a wormwheel and worm and two bevel gears, with the handwheel. The slip friction serves to relieve the gearing from any undue strain from pressure of projectile against lands of the gun in firing. An azimuth circle with pointer is provided for reading changes in azimuth. One turn of the handwheel moves the gun through a little more than 1 degree in azimuth. Details of this mechanism are shown on plate 94.

116. GUN CARRIAGE.—The gun carriage, plate 33, includes the cradle, carrying the recoil and spring cylinders, the elevating and traversing mechanisms, described above, and the cast-steel side

frames, racer and base ring to which these mechanisms are assembled. An operating platform of structural steel is attached to the rear of the side frames and rotates with the gun in azimuth.

117. Railway Car Body.—The railway car body is of structural steel, drop center type construction, with the barbette carriage mounted in the well, plate 92. The body is provided with jack transoms at each end of the well, which mount the four screw jacks used for lifting the body, carriage, and gun for emplacing. French couplers, buffers, etc., were originally provided for service in France, but have since been replaced by the standard M. C. B. type. All of this is shown in detail in plate 92. Air-brake equipment is likewise supplied. French, English, and German railway mounts are not provided with air brakes.

118. Anchorage.—For firing, the car body, carriage, and gun rest upon a firing platform which takes the vertical component of the shock of fire, while the horizontal component is taken by outriggers, plates 88, 89, 30, 95, and 96. The firing platform consists of two lines of H-beams placed under the car, along the railroad ties outside the rails, and of six wooden crossties. The car body is raised by means of the jacks; crossties are then put in place across the top of the H-beams and under the car body and the car is lowered upon them. The outriggers consist of wooden floats about 5 feet square, cast-steel float plates resting against these and serving as sockets for the ball ends of the struts, and struts made of pipe and extending from these plates to suitable attachments on the car body. These attachments are located, four on each side of the car, in such a way that the car can be braced in all directions. The eight floats are placed in as many holes dug in the adjacent ground and the struts are tightened up between them and the car. These floats are located as shown to brace the car horizontally in every direction; details of this arrangement are shown in plate 30. A speed test by a trained crew showed that the car could be emplaced and prepared for firing in 45 minutes and that the emplacement could be taken up and all material loaded on the car in 25 minutes.

119. Trucks.—The trucks are standard 70-ton M. C. B. type having 6 by 11 inch journals and crown cast-steel side frames. The wheels are 33 inches in diameter and are of rolled steel. Both hand and air brakes are provided. Details are shown in plate 97.

120. In addition to the above trucks, a complete set of equipment is furnished for hauling this material over 60-centimeter gauge track. This equipment consists of a gun transport car, plate 98, with loading and unloading rig, a pair of 12-wheel trucks which are substituted for the 70-ton M. C. B. trucks and carry the car body and gun carriage, and narrow gauge shell cars for the ammunition,

plates 99 to 105. Powder, spare parts, tools, etc., are carried on narrow-gauge flat cars.

121. Ammunition Supply System.—A standard-gauge, steel box car with special racks for holding ammunition is provided. This is shown on plate 106. The car has an I-beam trolley, the track of which can be pushed out beyond the end of the car when desired. The ammunition car is located directly back of the gun car, ammunition is run out on its trolley and is dropped on to a loading box located on the after end of the gun car. From there, it is picked up by a small jib crane located on the rear end of the gun operating platform, transferred directly to a second jib crane and by means of the latter swung to the breech of the gun. This method of operation can be employed for angles of fire of 35 degrees or less on either side of the center line of the car. Beyond that, it is necessary to transfer the ammunition to the ground at one side of the car so that it can be picked up by the jib crane. The entire operation of this arrangement is well illustrated on plate 108.

122. Maintenance.—Neither carriage nor car involve any new or uncertain features which might be expected to require extraordinary maintenance. It is perhaps to be anticipated that the car body may, after repeated use in trains, develop a permanent set or sag which would be large enough to necessitate correction. Inasmuch, however, as the mount would probably not be subjected to service either as continuous or as severe as the standard flat car, it is not felt that this should introduce a serious difficulty.

123. Difficulties Involved in Service.—Several minor criticisms in regard to the operation of this mount have developed in connection with experiments made upon it in the United States. Some of these criticisms no longer apply to the mount as it exists now, the design having been modified to correct them, and they are mentioned only to point out what difficulties might have occurred from previously used designs, and to show the development that has taken place.

124. When the car is first fired, the floats yield more or less according to the nature of the ground, and it is necessary to tighten them up or repack the earth behind them. This should not be a serious matter when a large number of shots are fired from the same emplacement in approximately the same direction.

125. The elevating mechanism, before the addition of the antifriction device, was comparatively slow in operation. Somewhat over a minute was required to move the gun through the full arc in elevation or depression, even under the best conditions. This no longer applies, since the antifriction mechanisms have so much reduced the effort required to elevate and depress the gun as to

permit of the use of a gear ratio approximately three times as great as the original.

126. A by-pass pipe is provided from the rear end of the recoil cylinder to the forward end of the recoil buffer. A check valve in this pipe is exposed to severe and sudden pressures on the counter-recoil, and on one occasion during proof it failed to function properly. On investigation, it appeared that this failure to function was due to unsatisfactory machine work, and on paying more attention to the fine machine work of these valves no such difficulty has been experienced on any other mounts.

127. It is difficult to swing the shell away from the breech when carrying it to loading position on the second jib crane. The operation is entirely possible, however.

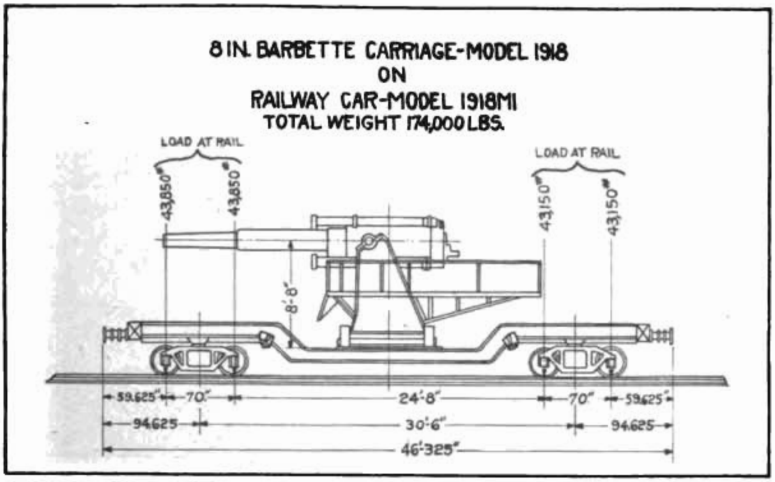
128. The speed test of this mount made by a trained Coast Artillery crew gave a record of four shots in 10 minutes. This is rather slow for the caliber. Since this time, an improved elevating mechanism has been installed, so that it is felt that this record could be bettered.

129. Merits.—The one feature which makes this mount conspicuous among railway carriages of all armies and which likely would have made it of very great value in the present war is its system of anchorage. There is no other mount in any of the allied armies which has an anchorage system that compares with this in effectiveness, nor which can be prepared for action in so short a time. The system is self-contained, if this term may be used to state the fact that the anchorage system is a traveling part of the carriage and it is of such a type as to permit the gun to be fired without any difficulty in any direction. To realize the full effectiveness of the efficiency of this anchorage system it should be compared with the anchorage used with the several types of 9.2-inch British guns on railway mounts, the 19 and 24-G French howitzers on improvised all-round traverse platforms, and the 240-millimeter French gun on the railway carriage known as the Colonies type, plate 27.

130. Demerits.—The characteristics of the carriage which appear to those who have observed the operation of allied railway artillery as demerits, are as follows: The elevating system includes a rack bolted to the bottom of the carriage meshing with a Hindley worm. It seems certain that under the working conditions that prevailed in the present war considerable difficulty would have been experienced in maintaining this rack and worm in proper working order. Second, a worm of the type of the Hindley worm can not easily be secured in the field, and inasmuch as such a worm must be worn in with the rack, it is possible that some difficulty might have been experienced in the maintenance.

131. A second point which applies perhaps entirely to the mount as originally designed is the lack of rigidity of the underframe. The whip of the car body was so great as to make it impossible for the personnel to remain upon it when the gun was fired. The car body as at present designed, however, has proved satisfactorily sturdy and rigid, and it is probable that there is not sufficient vibration either to injure the barbette carriage, even after long service, or to injure the personnel if they desire to remain on the mount while it is in action.

PLATE 87



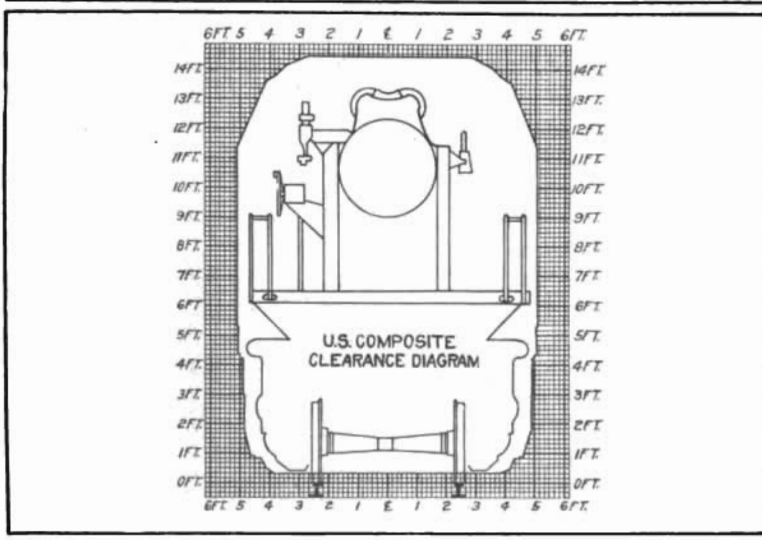
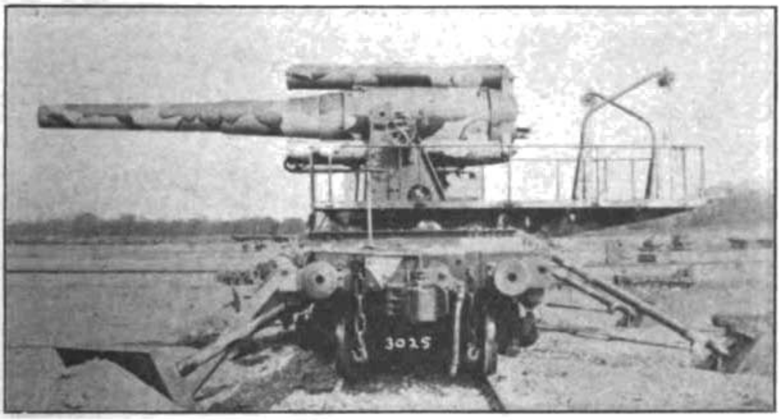
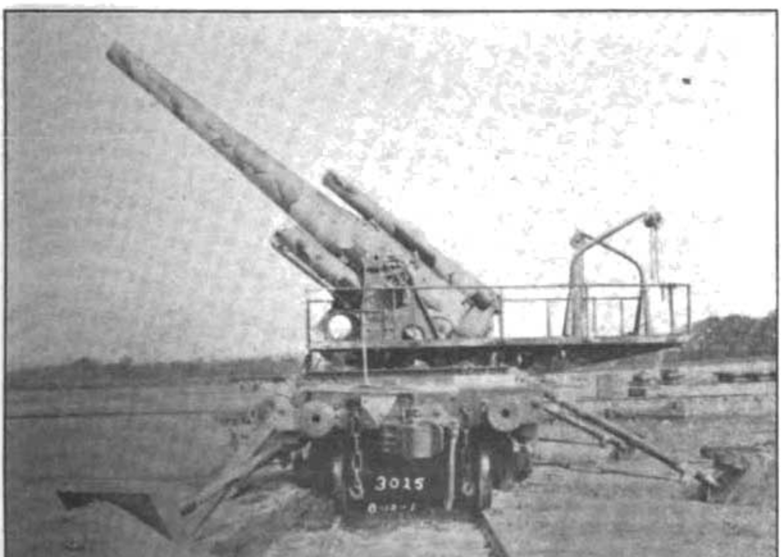


PLATE 88

8-INCH AMERICAN GUN ON RAILWAY MOUNT AND STANDARD AMMUNITION CAR.

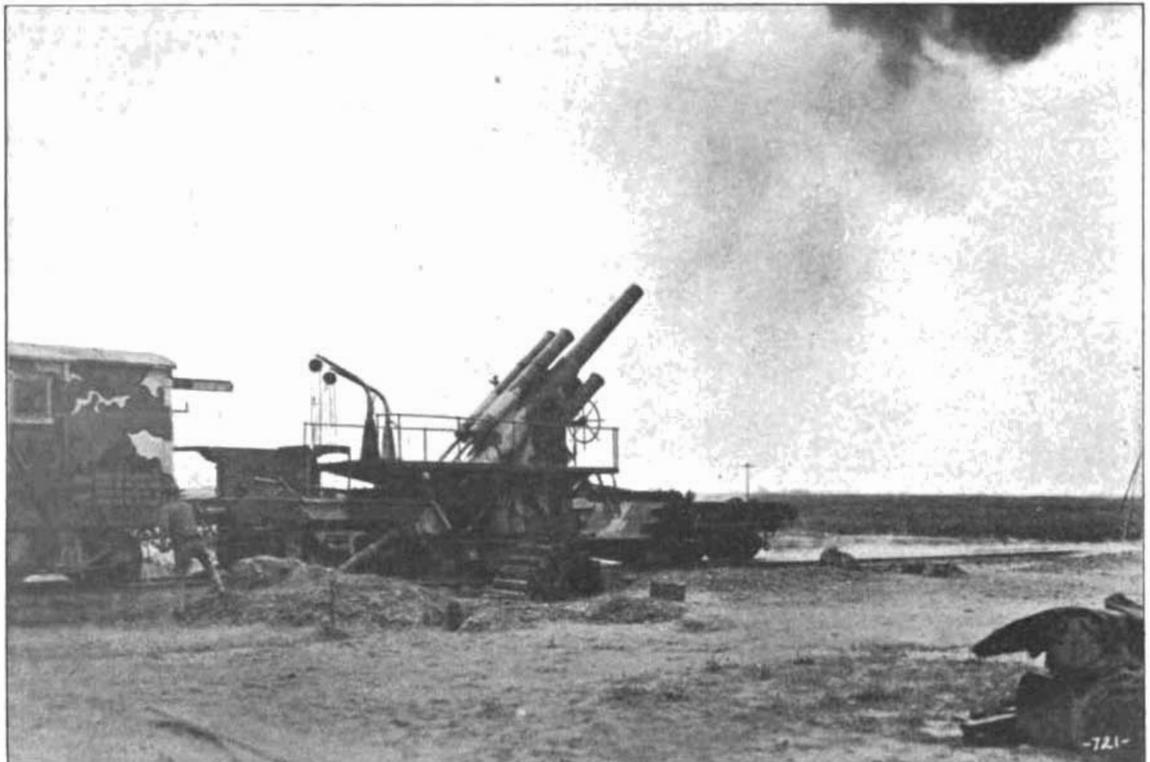
PLATE 89





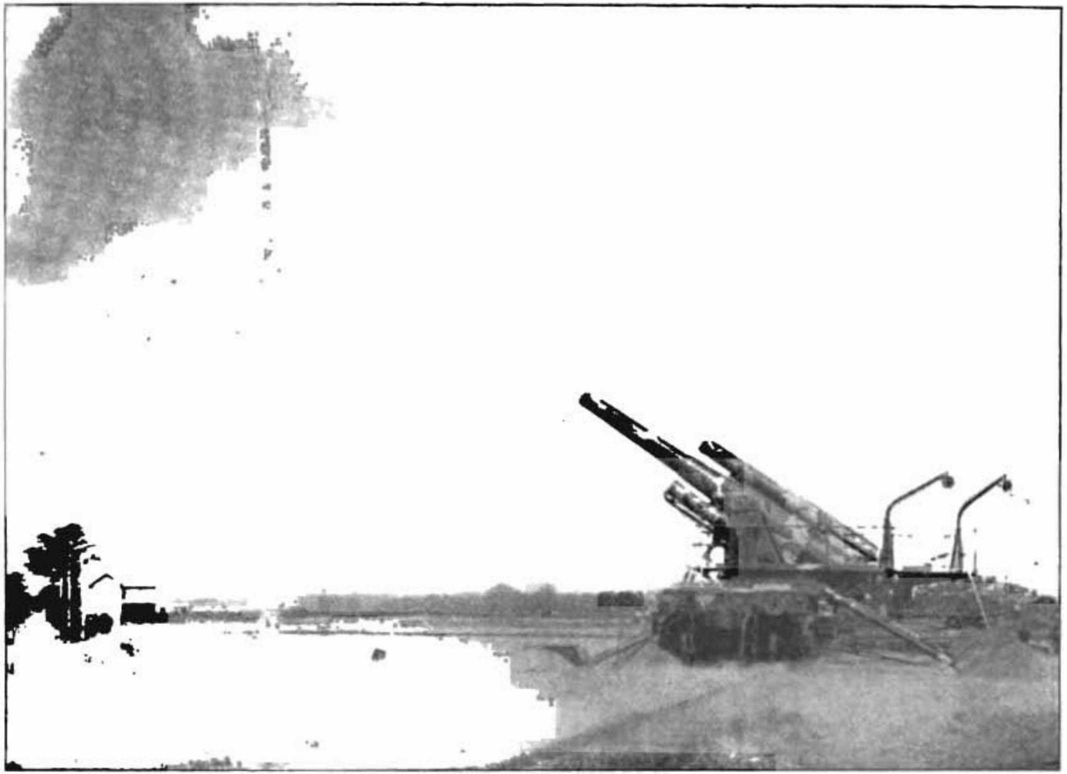
8-INCH AMERICAN GUN ON RAILWAY MOUNT.

PLATE 90



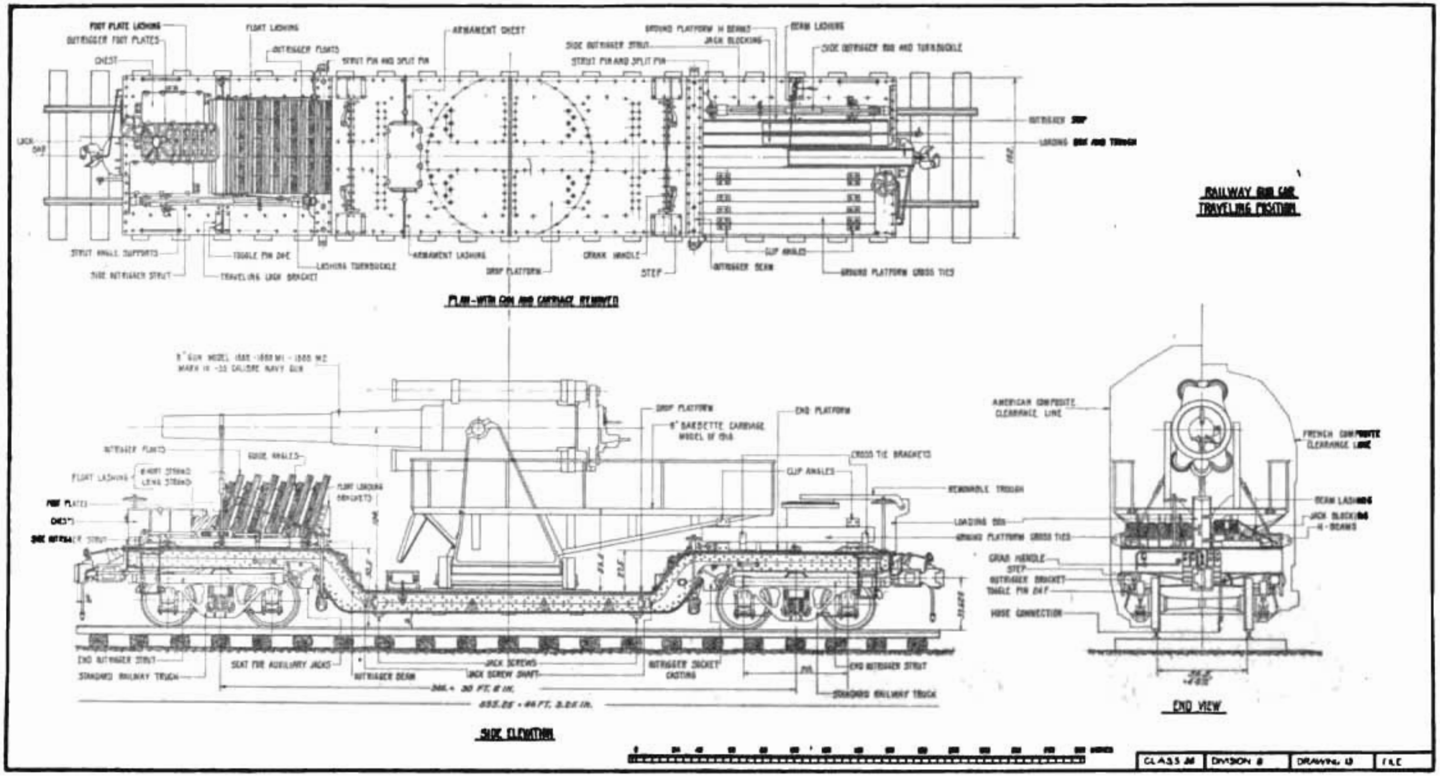
8-INCH AMERICAN GUN ON RAILWAY MOUNT.

PLATE 91



8-INCH AMERICAN GUN ON RAILWAY MOUNT.

PLATE 92



8-INCH AMERICAN GUN ON RAILWAY MOUNT.

PLATE 93

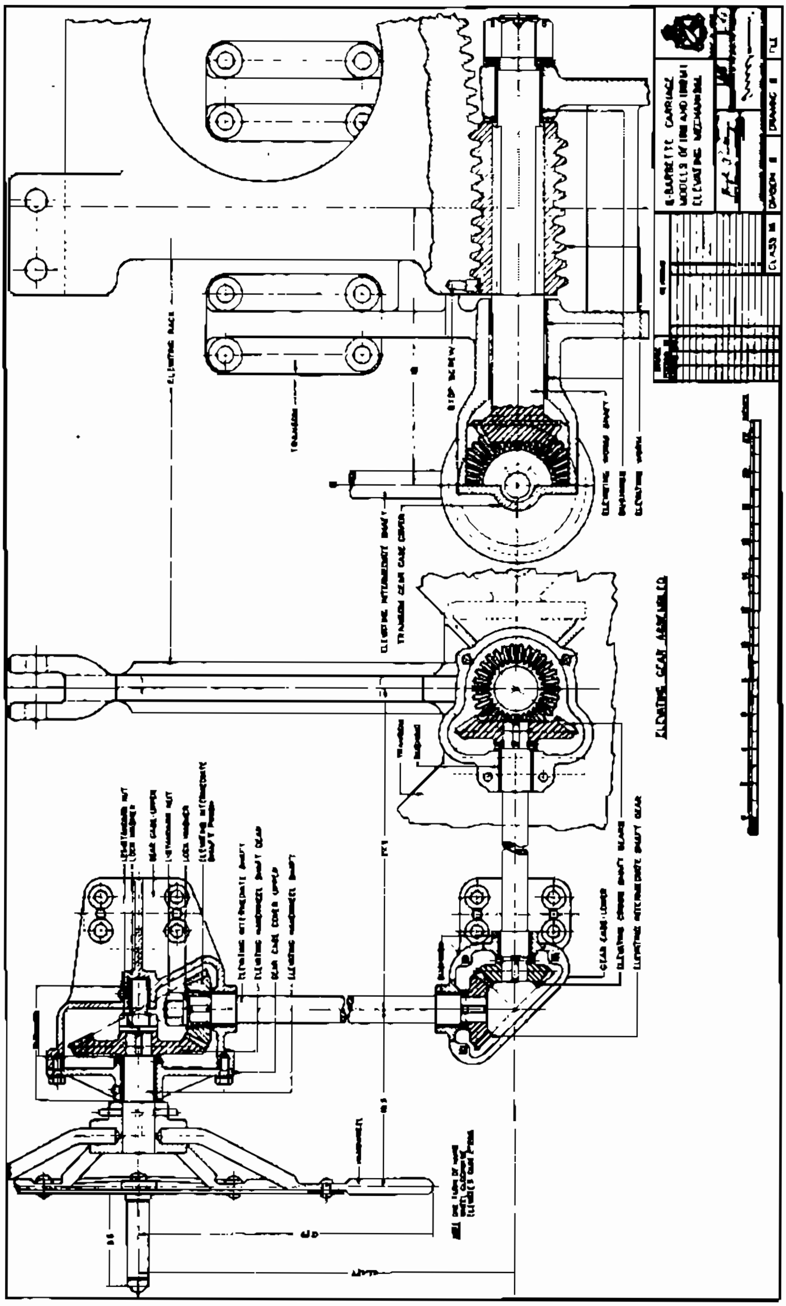
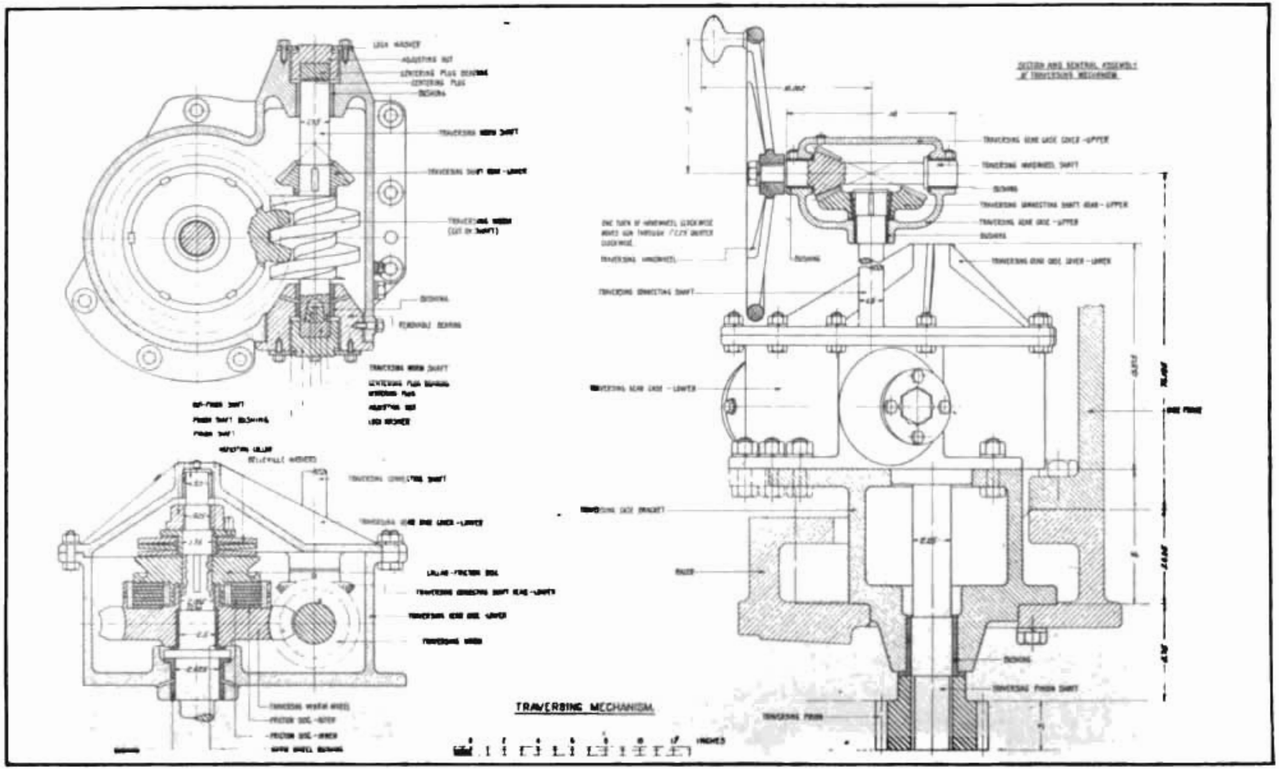
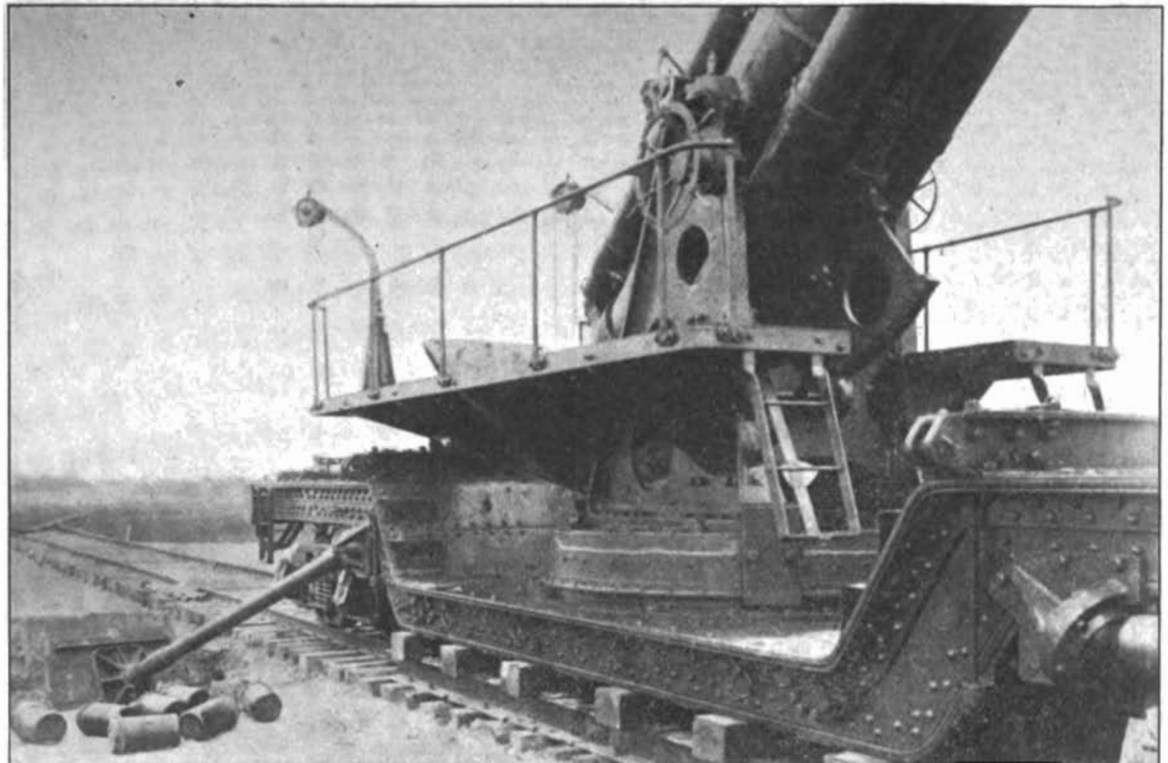


PLATE 94



TRAVERSING MECHANISM OF THE 8-INCH AMERICAN GUN.

PLATE 95



METHOD OF ANCHORING 8-INCH RAILWAY MOUNT FOR FIRING IN DIRECTION OF TRACK.

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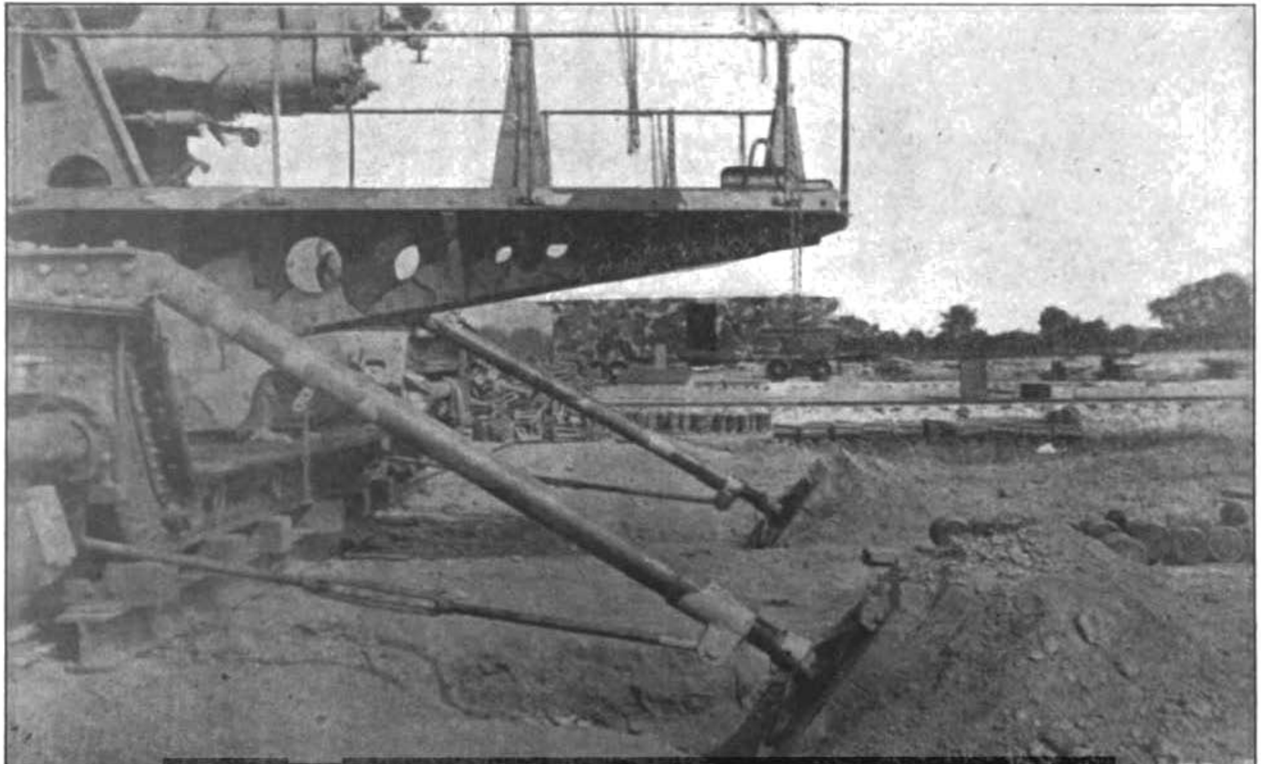
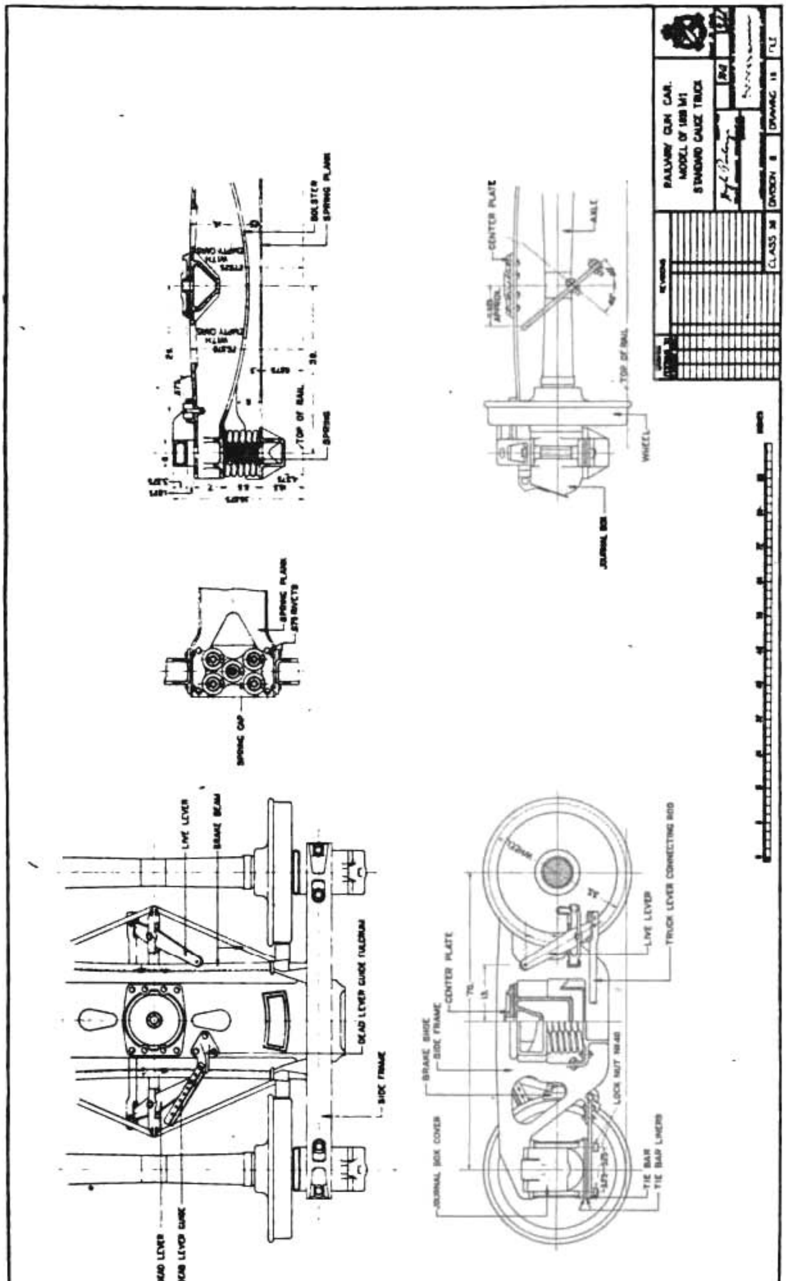
PLATE 96



METHOD OF ANCHORING 8-INCH AMERICAN RAILWAY MOUNT FOR FIRING ACROSS TRACK.

PLATE 97



RAILWAY GUN CAR.
STANDARD GAUGE TRUCK
DEAD LEVER
DEAD LEVER GUIDE
LIVE LEVER
BRAKE BEAM
DEAD LEVER GUIDE FULCRUM
SIDE FRAME
SPRING CAP
SPRING PLANK
BOLSTER
TOP OF RAIL
SPRING
CENTER PLATE
AXLE
WHEEL
JOURNAL BOX
JOURNAL BOX COVER
BRAKE SHOE
CENTER PLATE
TRUCK LEVER CONNECTING ROD
TIE BAR
TIE BAR LINERS
CLASS
DIVISION
DRAWING

PLATE 98

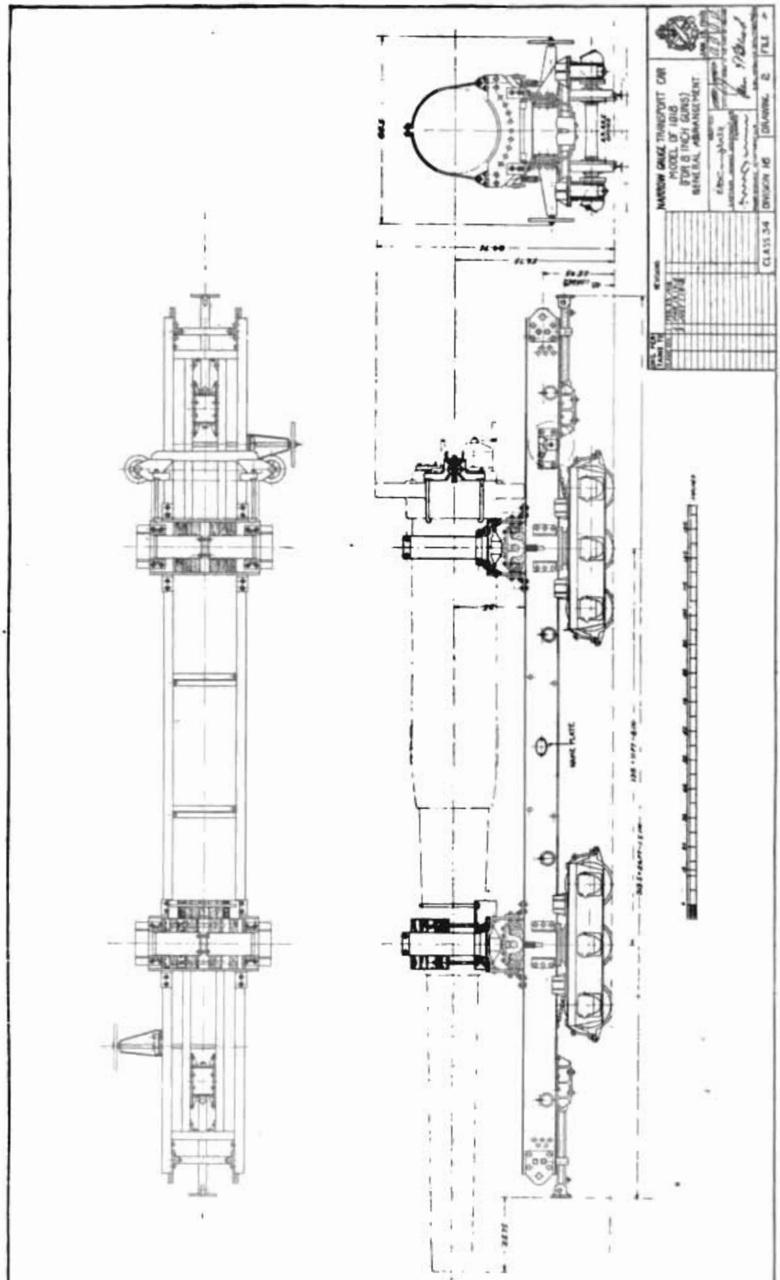

NARROW GAUGE TRANSPORT CAR
MODEL OF 1918
(FOR 8 INCH GUNS)
GENERAL ARRANGEMENT
NAME PLATE
CLASS 34
DIVISION 16
DRAWING 2
FILE

PLATE 99

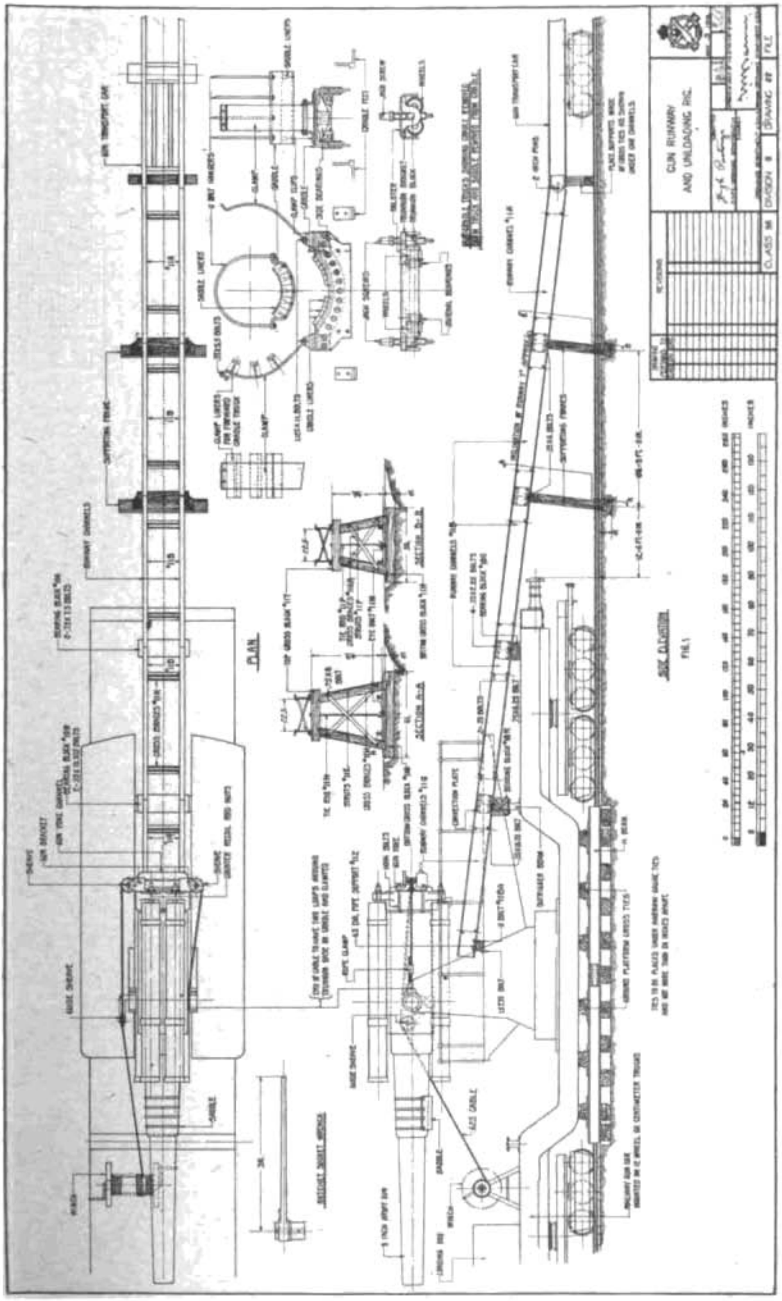


PLATE 100

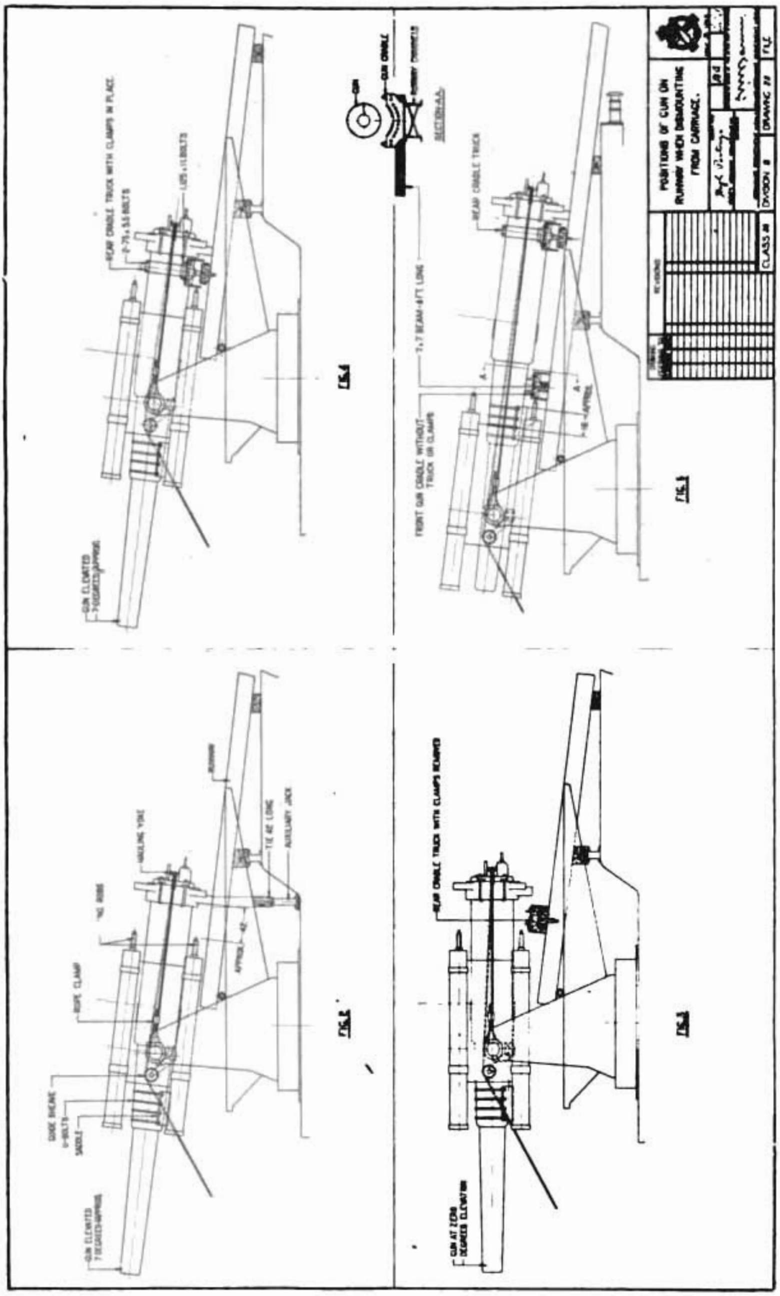

GUN ELEVATED 7 DEGREES APPROX.
REAR CRADLE TRUCK WITH CLAMPS IN PLACE
REAR CRADLE TRUCK
FRONT GUN CRADLE WITHOUT TRUCK OR CLAMPS
SECTION A-A
GUN
GUN CRADLE
HAULING YOKE
ROPE CLAMP
GUIDE SHEAVE
U-BOLTS
SADDLE
RUNWAY
AUXILIARY JACK
REAR CRADLE TRUCK WITH CLAMPS REMOVED
GUN AT ZERO DEGREES ELEVATION
POSITIONS OF GUN ON RUNWAY WHEN DISMOUNTING FROM CARRIAGE.

PLATE 101

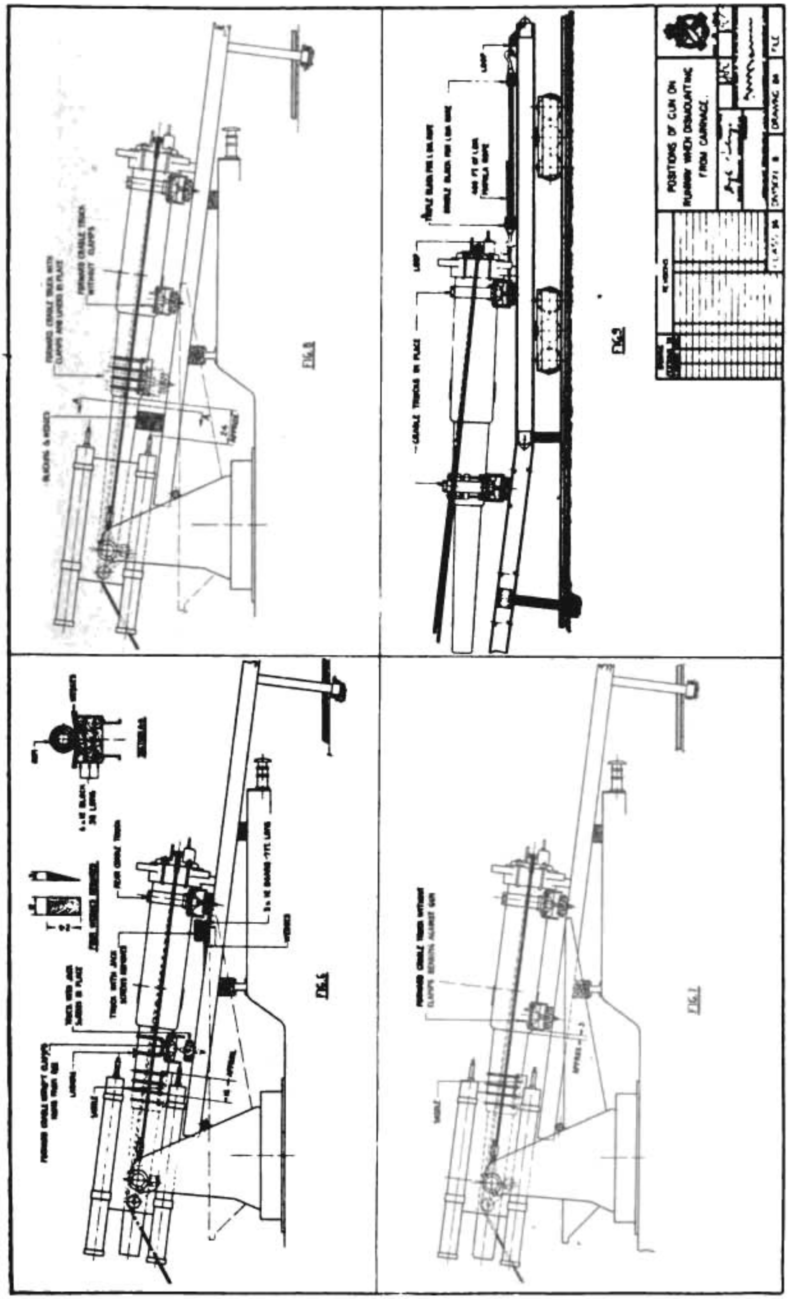


PLATE 102

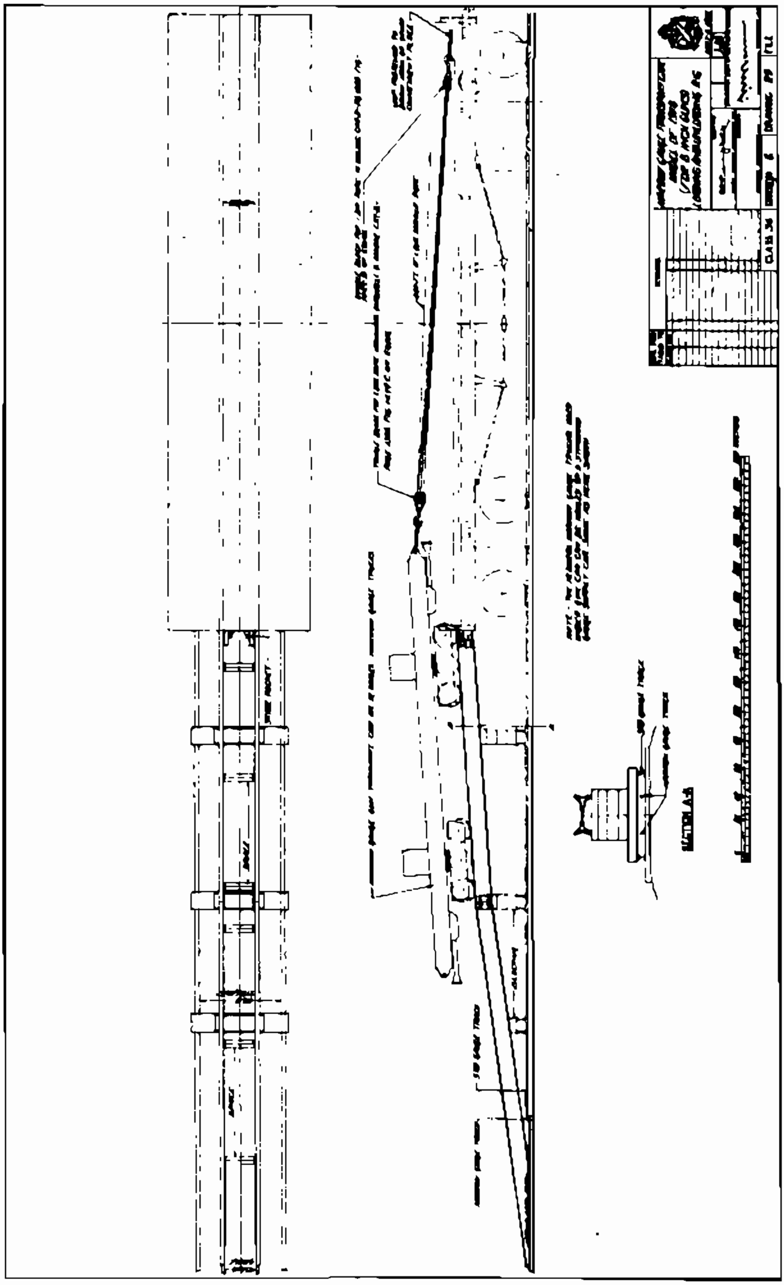


PLATE 103

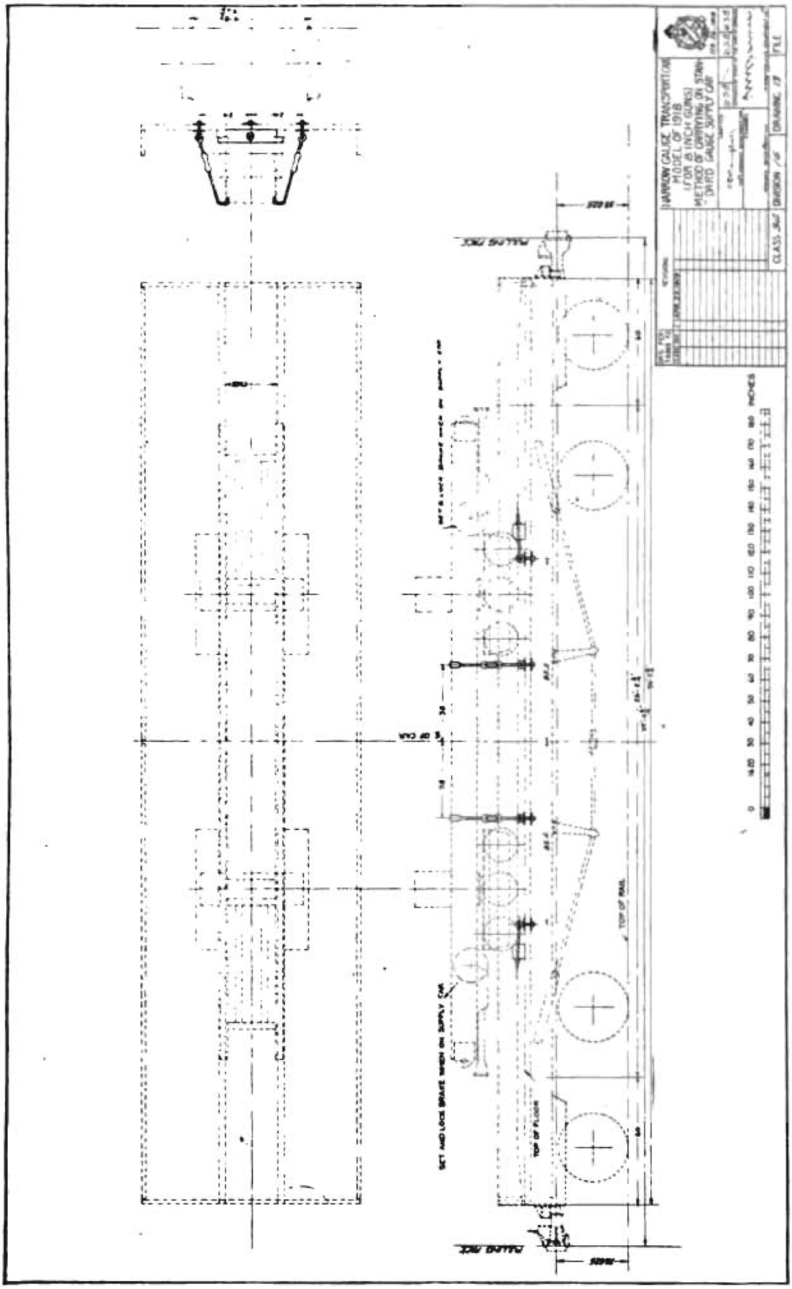

NARROW GAUGE TRANSPORTATION
MODEL OF 1918
(FOR 8 INCH GUNS)
METHOD OF CARRYING ON STANDARD GAUGE SUPPLY CAR
PULLING FACE
TOP OF FLOOR
TOP OF RAIL
SET AND LOCK BRAKE WHEN ON SUPPLY CAR
INCHES

PLATE 104

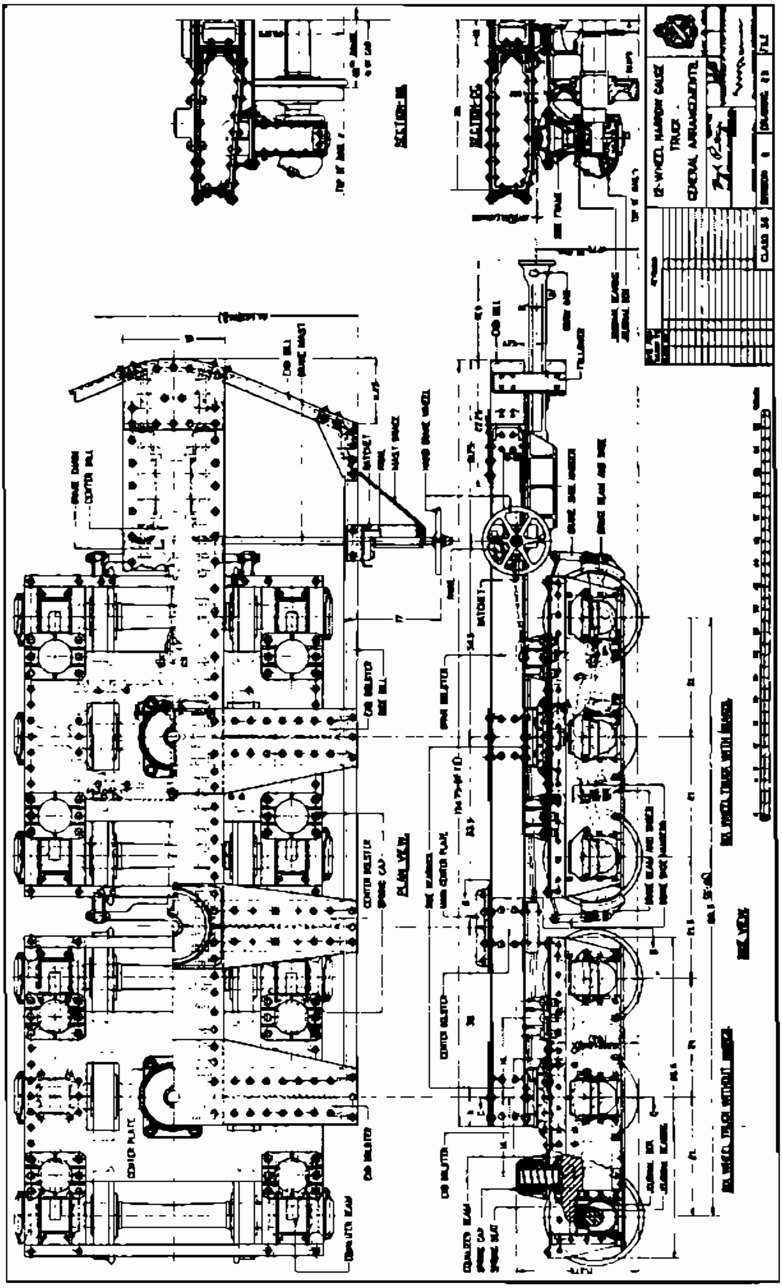

12-WHEEL NARROW GAUGE
TRUCK
GENERAL ARRANGEMENT
PLAN VIEW
SIDE VIEW

PLATE 105

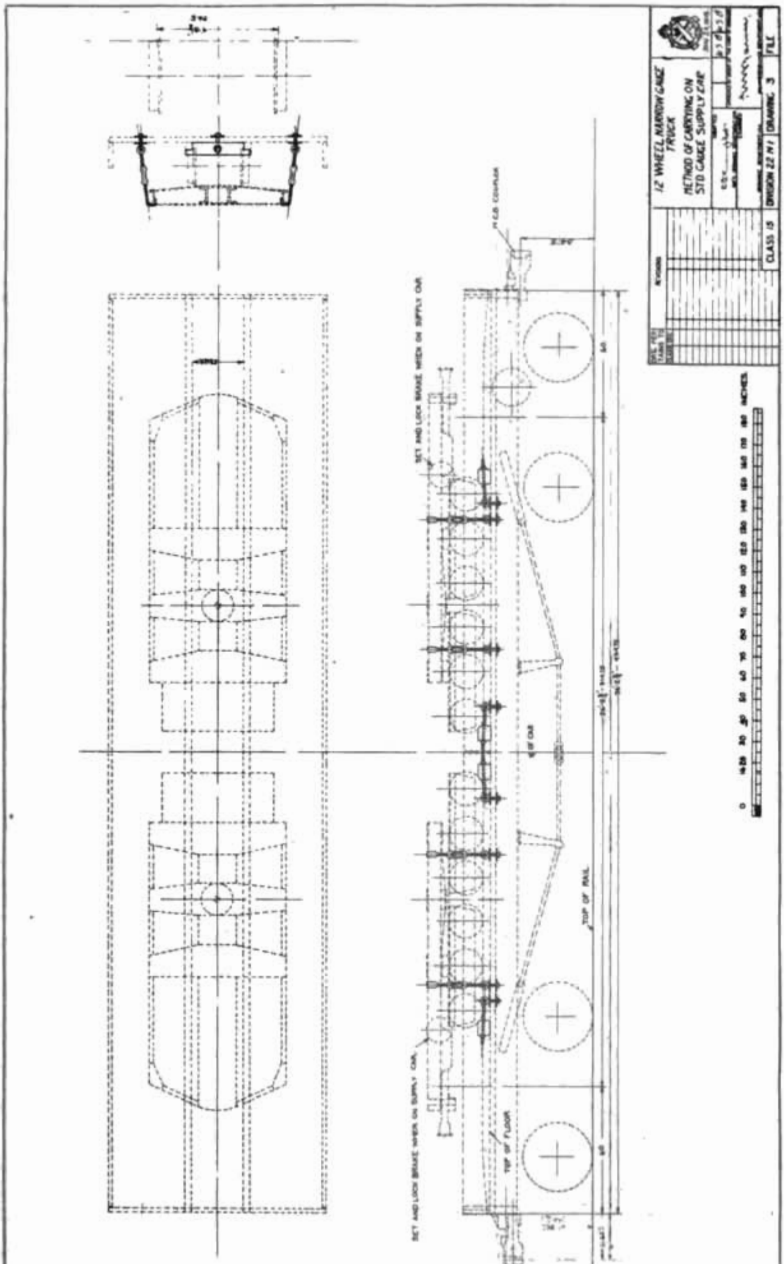

12 WHEEL NARROW GAUGE TRUCK
METHOD OF CARRYING ON STD GAUGE SUPPLY CAR
SET AND LOCK BRAKE WHEN ON SUPPLY CAR.
TOP OF RAIL
TOP OF FLOOR
INCHES
CLASS 15
DIVISION 22 H1
DRAWING 3
FILE

PLATE 106

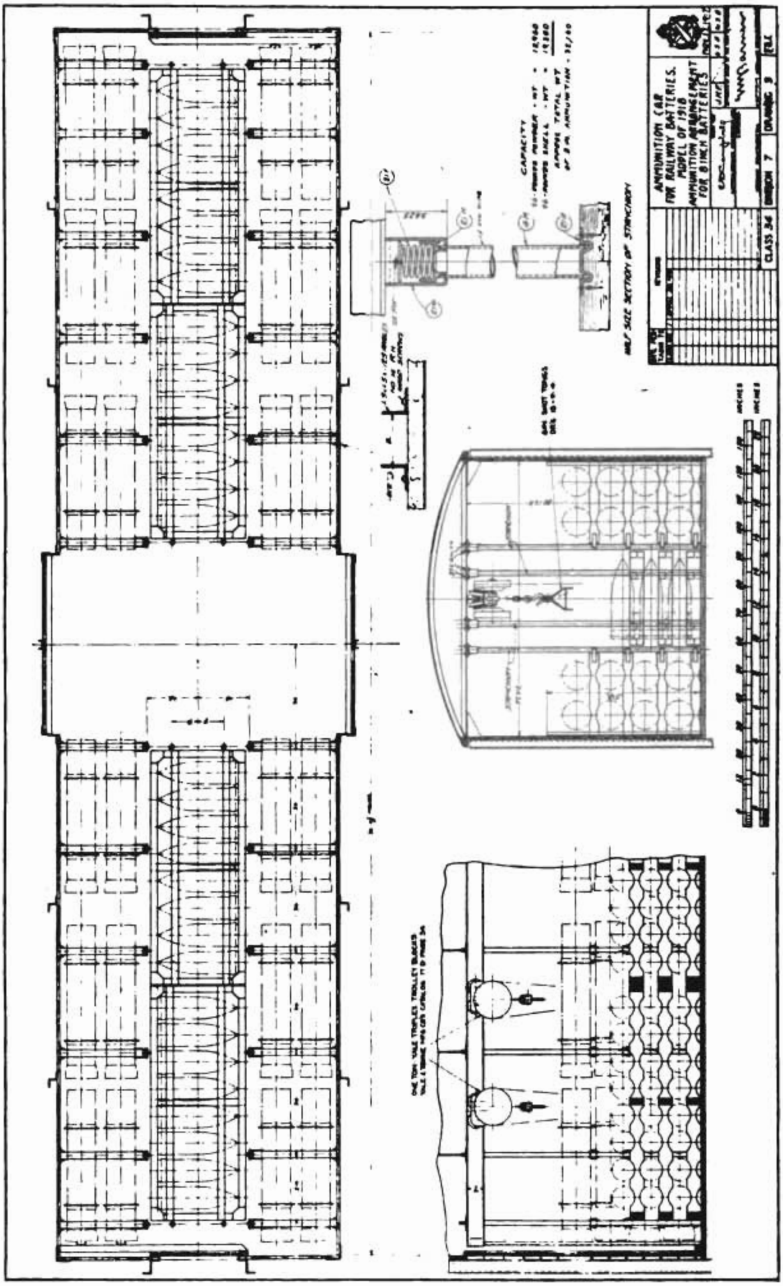
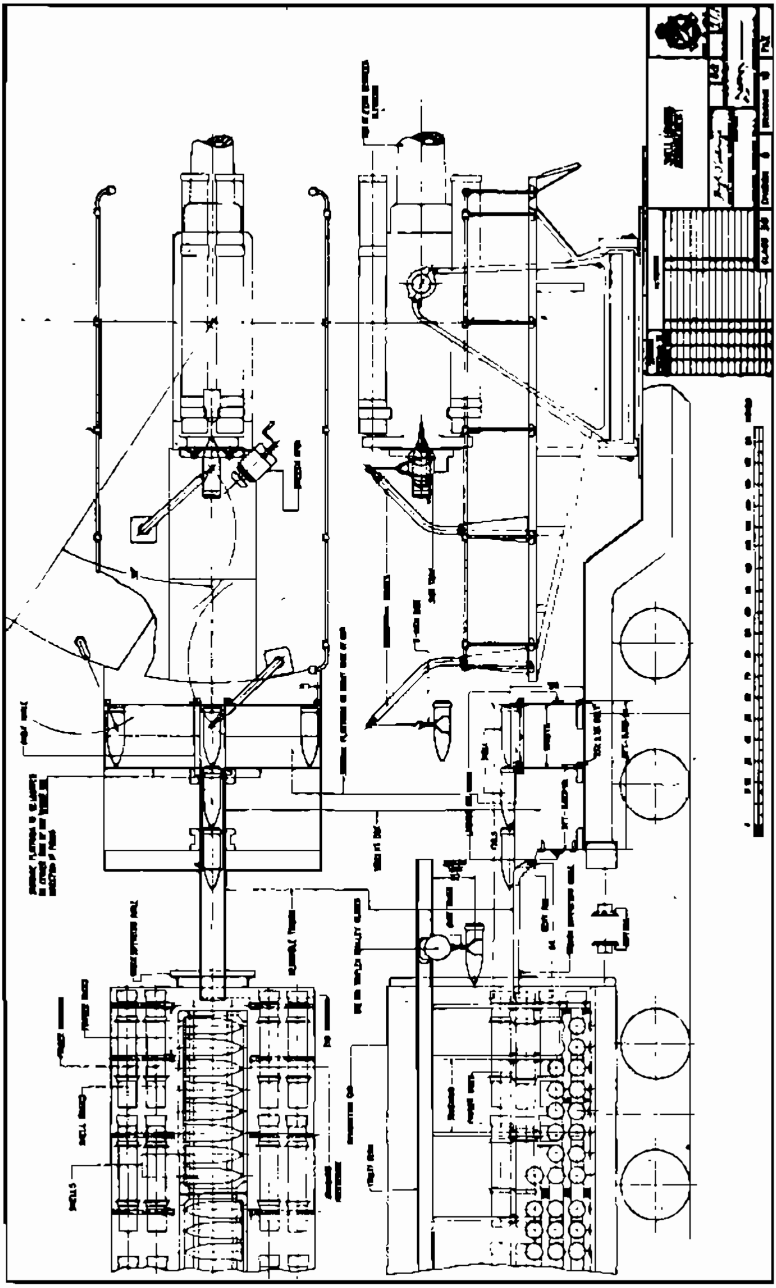

CAPACITY
APPROX TOTAL WT
HALF SIZE SECTION OF STANCHION
AMMUNITION CAR
FOR RAILWAY BATTERIES.
MODEL OF 1918
AMMUNITION ARRANGEMENT
FOR 8 INCH BATTERIES
CLASS 34
DIVISION 7
DRAWING 3
FILE

Plate 107



4.—AMERICAN 10-INCH GUN ON SLIDING RAILWAY MOUNT.(17)

132. Those guns are mounted on what are termed "sliding mounts" in the American and English Armies, and "glissement mounts" in the French Army. The gun is swung directly by means of its trunnions, in bearings mounted rigidly on the side girders of the car body, and the gun and mount slide back together along the track in recoil. The mount is stopped by the friction between the special jacking beams or sleepers in the bottom of the mount and special firing beams or I-beam stringers attached to the ties of the track. Most mounts of this type have no internal means of traversing the gun with respect to the car body or the trucks, and they must be operated on curved tracks to train the gun in azimuth. This is the first modern mount of this type to be described and it may be of interest to mention some points with reference to its development. It will be recalled that in the "Historical introduction," mention was made of the 13-inch mortar mount constructed and operated by the Union Army, in which case the gun carriage slid on rails on top of the car and the car rolled back on the track when the gun was fired.

During the interval between the Civil War and the present war, several proof mounts were constructed by various countries, operating on the same principles, but at the beginning of the present war no nation had constructed for itself any railway mounts on which provision had been made for dissipating the energy of recoil by means of friction between special mechanisms designed as a part of and constructed into the car body and the railway track. The only railway mounts that the French Government possessed at the beginning of the war were some 200-millimeter mounts which the Schneider Ordnance Co., had constructed for the Peruvian Government and which had not been delivered. The designers of the various French ordnance companies were hard put to design carriages on which their heaviest seacoast guns could be mounted and which could be constructed with the facilities available in a satisfactorily short period of time. The scheme of mounting the gun rigidly in the carriage and permitting the mount to slide back on the track in recoil was developed by the Schneider Ordnance Co., late in 1914, and the first carriage mounting a 320-millimeter gun was proved at their heavy artillery camp in February or March, 1915. The designers had considerable misgivings with reference to the performance of this carriage, which had not been developed through any slow process of evolution; but the exhaustive test to which this first carriage was subjected soon proved that although it might appear to be a crude mechanism it nevertheless was unusually sturdy and the gun could be operated as rapidly and as accurately as any other gun provided with the most elaborate of recoil mechanisms and accessory equipment. The French Government then proceeded to mount as rapidly as possible a great number of their large guns on carriages of this type.

133. It is very significant that none of the nations engaged in the present war used any great number of large guns, if any at all, that were finished after their entrance into the war. The writer knows of only two guns finished and mounted by any of our allies, on railway carriages, since 1914. All other guns mounted were either in storage, or were removed from battleships or coast fortifications. On the entrance of America into the war, it was discovered that the supply of guns of some of our allies was running dangerously low and it was proposed that we supply them with some of our heavy guns. Fifteen of the 10-inch guns of the model that are being mounted on these carriages, were sent to France in September or October of 1917, to serve as a reserve and at about the same time, it was decided to have the French Government construct 36 new mounts for more 10-inch guns which would be sent across. Shortly thereafter, the French Government found that its manufacturing facilities would not permit it to supply all of the material for these mounts, as well as to construct them, and plans were made to have the plates, castings and forgings supplied, cut to shape and rough machined in America, and assembled in France in the shops that had been constructing the 320-millimeter sliding mounts.

134. The first four sets of these parts arrived in France several months before the signing of the armistice and were in process of fabrication at the time of the signing of the armistice. It was planned to have most of the mounts finished and ready for service for the big offensive that was planned for the spring of 1919. Several months after the armistice was signed, the four sets of parts that had arrived in France were shipped back and plans were made for completing the mounts in America. Many of the details of design have since been changed and it is probable that only a limited number of the mounts will be constructed. In considering this type of mount from many standpoints, it should be understood that it was originally designed under the stress of the most desperate need and was not chosen because it was the finest possible carriage on which the guns could be mounted. It proved most commendably sturdy and served its purpose well in the type of warfare for which it was designed. General views of the design that will be described are shown on plates 109, 110, and 111.

135. Gun.—The guns to be used with this mount are the 10-inch models of 1888, 1888 M. I., 1888 M. II. and 1895, all of 34 caliber

length, and eight different models of Navy guns from 30 to 34 caliber length. All of these guns are provided with fixed trunnions. All of the Army guns are provided with interrupted thread breech blocks and the Navy guns with stepped thread blocks. All of the breech blocks are fitted with mechanical firing mechanisms. All of the Army guns are rifled with 60 grooves and the twist of the rifling is to the right, progressing in pitch from 1 turn in 50 calibers to 1 turn in 25 calibers.

136. RECOIL MECHANISM.—No recoil mechanism in the ordinary sense of the term, is provided with this type of mount. The gun is fixed to the girders as already noted, and the entire mount slides back along the track as a unit under the shock of recoil. A description of the mechanisms employed to bring the mount to rest, is given under the head of "Anchorage." Counter-recoil is accomplished by the same mechanism that is used in traversing the mount. The length of recoil averages 1 meter.

137. ELEVATING MECHANISM.—Provision is made for elevating the gun from minus 7 degrees, the loading angle, to plus 54 degrees. This provision of so great an elevation, that prior to 1917 would have been considered entirely unwarranted, has come about through our experiences in this war. No one is now certain of what constitutes a proper line of demarkation between a gun and howitzer, and no one can be certain either that within a comparatively short time we may not find it profitable to operate all guns, as well as howitzers, at these extreme elevations. The elevating rack is bolted to the right side of the gun, plates 110 and 111. The pinion meshing with the rack is connected with the handwheels provided on both sides of the carriage through a slip-friction device, plate 113, a worm-wheel, worm and bevel gears. One revolution of the handwheel moves the gun through 1.37 degrees in elevation. To reduce the effort required in elevating and depressing the gun, anti friction devices have been provided on each trunnion. The design of these devices is shown on plate 114. This is a design of antifriction device, that to some extent has been taken from French railway mounts, but has been modified and improved. It has been used already on several other railway mounts and has proved particularly efficient.

138. TRAVERSING MECHANISM.—Since the gun is mounted rigidly in the car body and it is not possible to move the car body with respect to the trucks, it is necessary to move the entire mount along a curved track to train the gun in azimuth. The procedure in preparing these curved tracks has been described in other portions of the report. The mechanism used in moving the mount along the track is

termed a translating mechanism and is incorporated in the front truck. Gear cases and two handles are constructed on both sides of the front truck as shown on plate 109. Sprocket wheels on the cross driving shaft of this mechanism are connected with sprockets on two axles, as shown on plate 117. A clutch is provided by which the mechanism can be thrown out of gear for firing, and for traveling it is necessary to remove the chains. It is possible for four men to move the mount along the track by means of this mechanism at the rate of about a meter per minute. The ratio is 117 turns of the handle for one revolution of the car axle.

139. Gun Carriage.—The gun carriage is incorporated in the car body and will be described in the next paragraph.

140. Car Body.—The car body is made up of two structural steel box girders connected by deck plates and a series of structural steel transoms. The jack screws required for the operation of the jacking beams, the elevating mechanism and the loading mechanism are all incorporated in this structural steel body. The success of this type depends upon the car body being given a rigidity approximating as closely as possible that of a steel casting. As a consequence, it is necessary to have the web plates of all the transoms come into contact with the web plates of the side girders and to have the seats for all of the fittings carefully and accurately machined. The rivetting must likewise be well nigh perfect.

141. Anchorage.—The only anchorage with which this mount is provided, is the friction between the sliding beams and the I-beam stringers or firing beams attached to the ties. The I-beam stringers are placed on the firing track or epis, as shown on plate 118. When the gun has been properly trained in azimuth by moving the mount along the track by means of the translating mechanism already described, the six sleepers shown in their relative position on plate 109, and in detail on plate 119, are forced down on these firing beams as hard as a man on each of the ratchet levers is able to force them. The design of the jackscrew and operating mechanism is shown on plate 117. The men operating these jacks run the sleepers down by means of the handles, first giving the handles one full turn at a time at the call of a sergeant, until the sleepers come into contact with the beams. Then they turn the handles through half revolutions in concert, as long as they are able to turn them. The final tightening is done by means of the ratchet levers and is likewise performed in concert at the call of the sergeant in charge. These jacks normally take about one-half of the entire dead load of the mount and practically all of the firing load. When the gun is fired the entire mount slides back on the stringers, an average distance of one meter. The

jacks are then released, all of the men working in concert as in tightening, and the mount is returned to its firing position by the translating mechanism. In the various actions by this type of artillery that the writer has observed, no cases were seen in which the rate of firing was limited by the time required to return the mount to its firing position and place the jacks. The time required for loading the gun was always the determining factor in the rate of firing.

142. TRUCKS.—These mounts are provided with two special 6-axle trucks with 5.5 by 10 inch journals and 36-inch wheels. The truck frames are of structural steel and the axles are equalized in groups of three. The design of these trucks is shown on plates 120 and 121. Spring-supported conical rollers of a design shown on plate 122 are provided between the trucks and the car body to serve as side bearings.

143. AMMUNITION SUPPLY SYSTEM.—The ammunition car that is to be used with this mount is identical with that provided for the 8-inch railway mount, but with modifications in the fixtures to take the 10-inch ammunition. This car is shown on plate 123. With French mounts it was customary to transfer the ammunition from the ammunition car to the mount by means of a shuttle car known as a transbordeur. No shuttle car is provided with this 10-inch mount; instead, a track is provided on the rear truck with an extension made up of two hinged wings, plate 125, which carries a shot truck onto which the projectile may be laid from the trolley of the ammunition car. Provision is made on the truck just back of the mount, plate 124, for storing four projectiles, two on either side of the track. Two identical jib cranes are provided on the rear of the mount, plate 124, and of a design shown on plates 125 and 126, by means of which projectiles may be picked up from the rear or from the side and placed on the tray of the loading stand. This loading stand is of an entirely new design and is collapsible for traveling. The details of its design are shown on plates 127 and 128. The loading angle is minus 7 degrees and when the projectile is given a start down the greased tray it acquires sufficient velocity to ram itself. In the top view, plate 124, there are four doors in the deck of the mount, between the two crane pedestals. These are doors to four asbestos-lined powder-storage boxes in which sixteen charges of powder can be stored with little probability of change in temperature within a reasonable time or danger of ignition from fire.

144. MAINTENANCE.—The French and American personnel operating these mounts in the field, found them most satisfactory from the standpoint of service. The mounts were exceedingly sturdy and there are few mechanisms requiring much attention. The oiling of

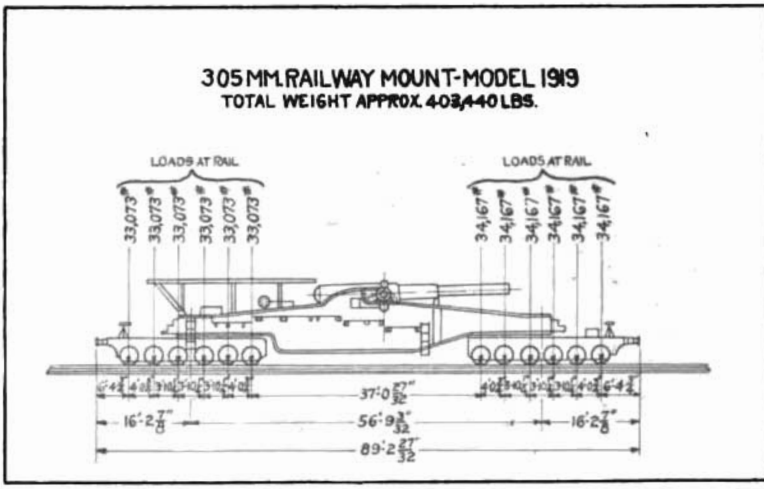
the jacks, truck bearings, trunnion bearings, breech mechanism, etc., is about the only maintenance that this type requires.

145. Difficulties Involved in Service.—The one difficulty that may be laid to this mount in service is the time required for the laying of a new firing track and occasionally the difficulty in finding satisfactory positions for these firing tracks. The time required for the laying of such a track averages from two to three days. The position must be rather well prepared and the track, composed of heavy rails and ties, must be laid on a heavy bed of good ballast. It is necessary to level and tamp the track perfectly. It is well nigh impossible to conceal a curved firing track from the air photographers and the only recourse that the French had was to construct so many curved firing tracks over the front that whenever they desired to commence an action the firing tracks were already in place and the air photographs taken by the enemy did not show any new tracks. It is not impossible to conceal a mount on the track.

146. Merits.—The merits of this mount are its sturdiness, its small maintenance and the speed with which it can be placed on a firing position and removed.

147. Demerits.—The demerit is that it requires a firing track which can not be laid under two days and which can not be concealed from the air photographer. As noted before, it is frequently difficult likewise, to find suitable positions for these firing tracks and under such circumstances an unusual amount of time may be required for its installation. It can not be laid on filled ground and, of course, time is ordinarily not available for excavating a cut if this should seem necessary in a desirable position. From the standpoint of its use at the present time a very serious demerit is that it is exceedingly difficult to use it against a moving target. It probably can be operated on a turntable of exceedingly heavy construction. In this case the sighting apparatus will have to be constructed as a part of the turntable, since the mount must be trained in azimuth until the instant of firing. It will not be impossible to construct a turntable of such strength to permit the mount to slide on it in firing. No trials have ever been made to determine whether the mount is sturdy enough to take the shock of recoil in the event that it is held rigidly to a foundation.

PLATE 108


305 MM. RAILWAY MOUNT-MODEL 1919
TOTAL WEIGHT APPROX. 403,440 LBS.
LOADS AT RAIL
33,073#
33,073#
33,073#
33,073#
33,073#
33,073#
LOADS AT RAIL
34,167#
34,167#
34,167#
34,167#
34,167#
34,167#
37'-0 27/32"
16'-2 7/8"
56'-9 3/32"
16'-2 7/8"
89'-2 27/32"

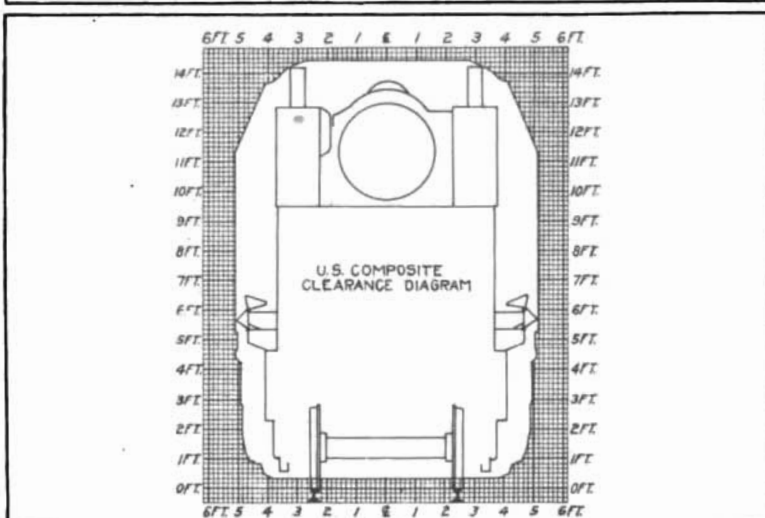

U.S. COMPOSITE
CLEARANCE DIAGRAM
6FT. 5 4 3 2 1 ℄ 1 2 3 4 5 6FT.
14FT.
13FT.
12FT.
11FT.
10FT.
9FT.
8FT.
7FT.
6FT.
5FT.
4FT.
3FT.
2FT.
1FT.
0FT.

PLATE 100

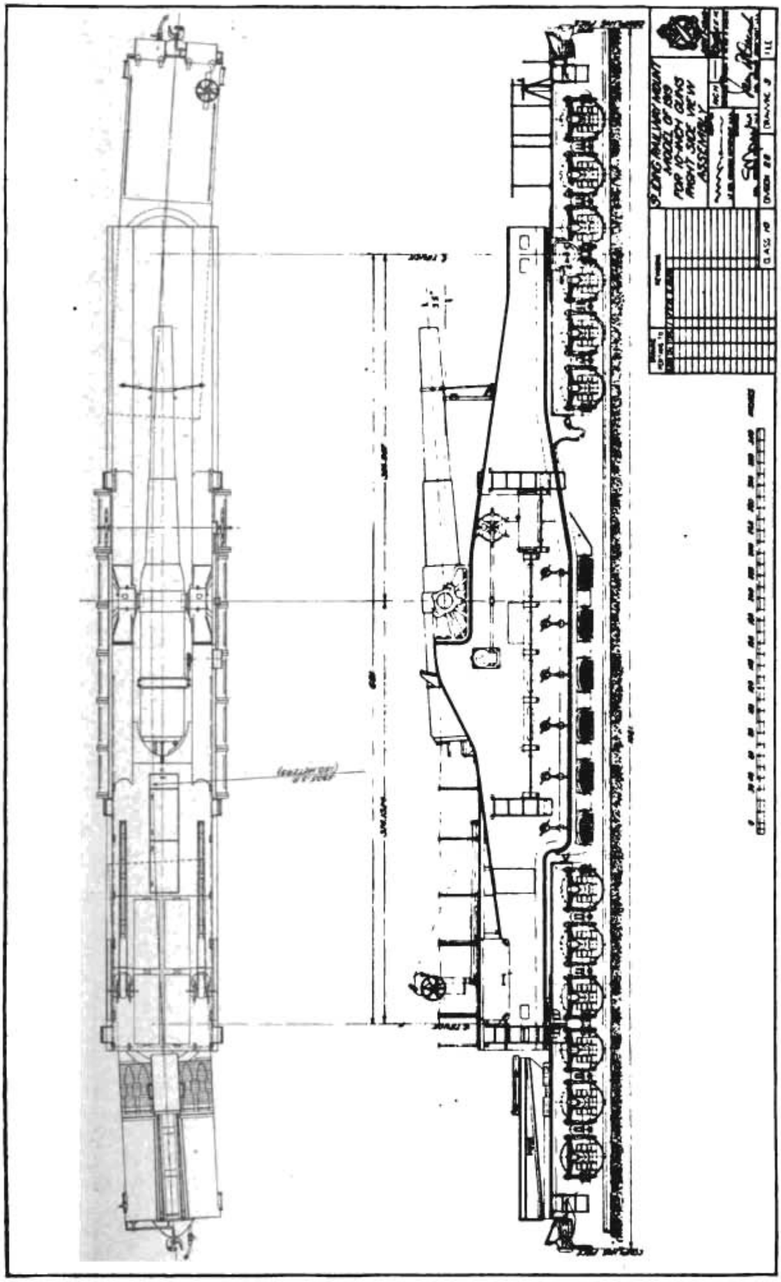


PLATE 110

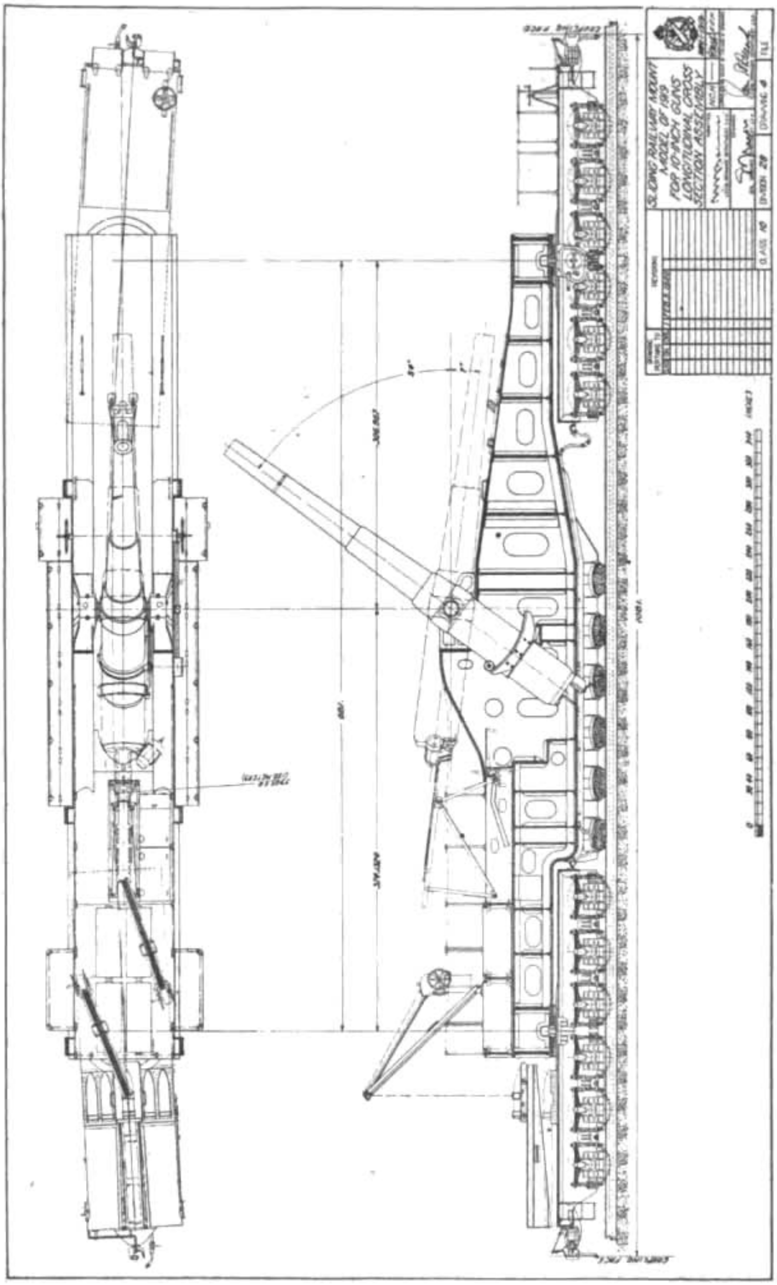

SLIDING RAILWAY MOUNT
MODEL OF 1919
FOR 10-INCH GUNS
LONGITUDINAL CROSS
SECTION ASSEMBLY

PLATE 111

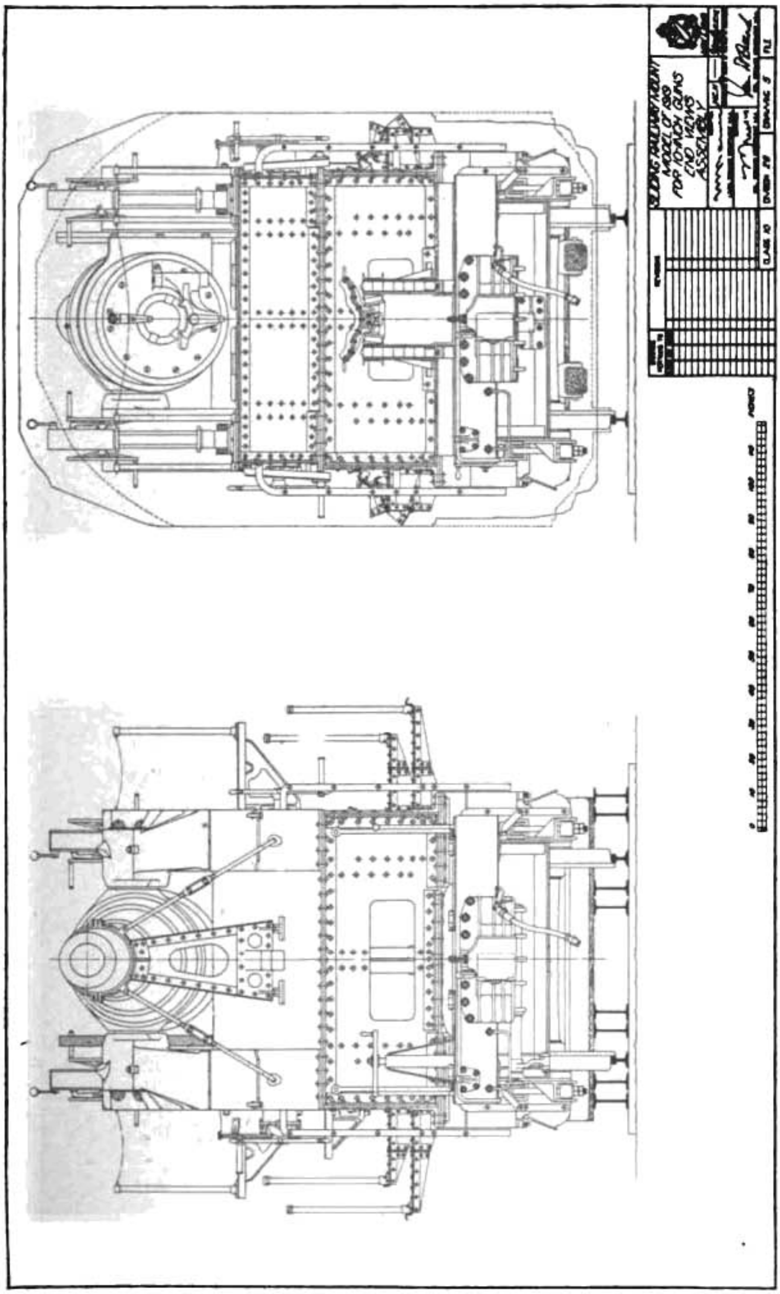


PLATE 112

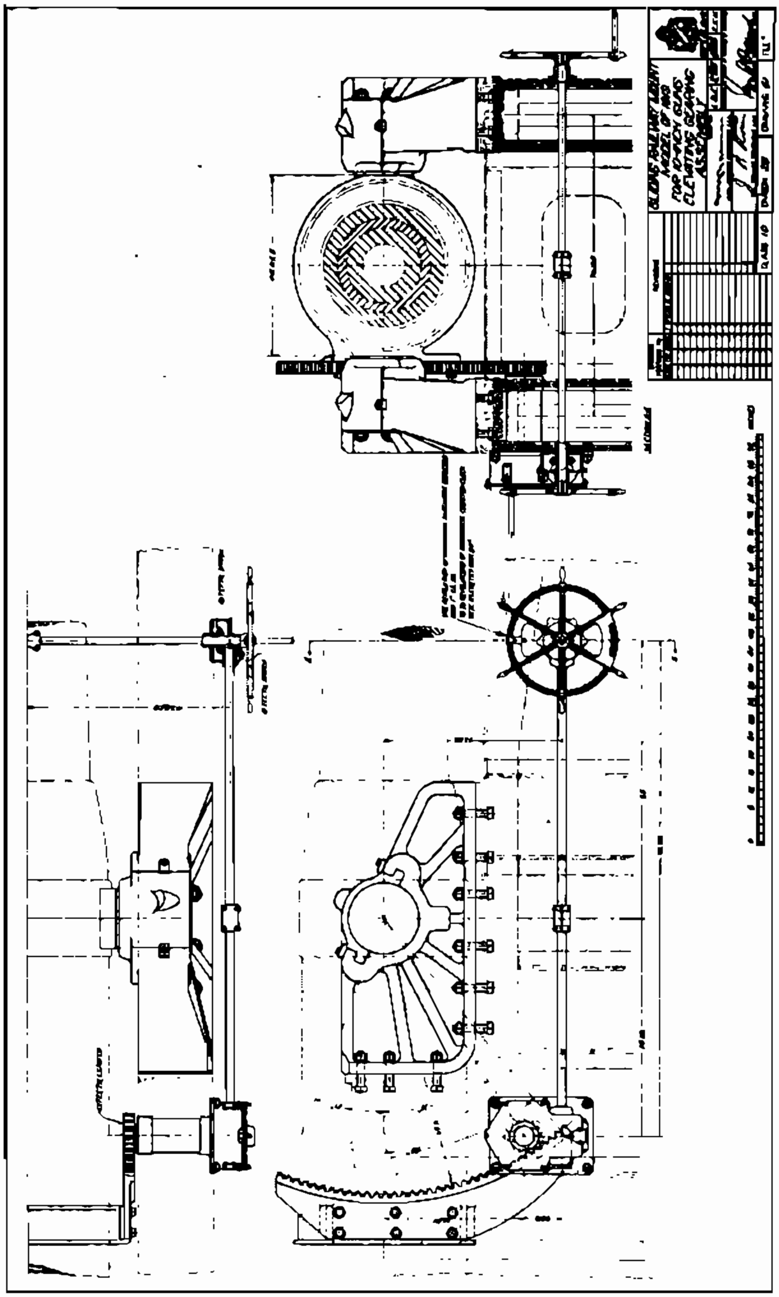


PLATE 118

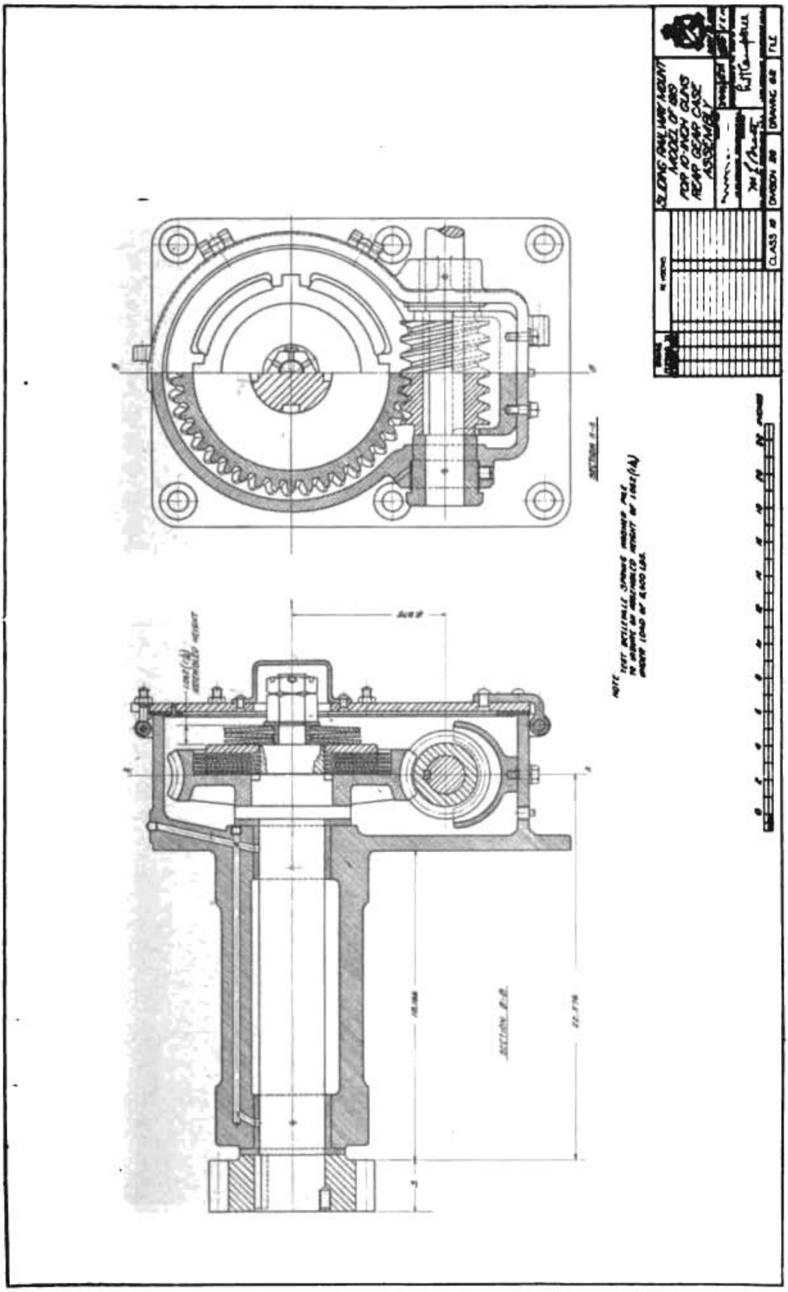

SLIDING RAILWAY MOUNT
FOR 10-INCH GUNS
REAR GEAR CASE
ASSEMBLY

PLATE 114

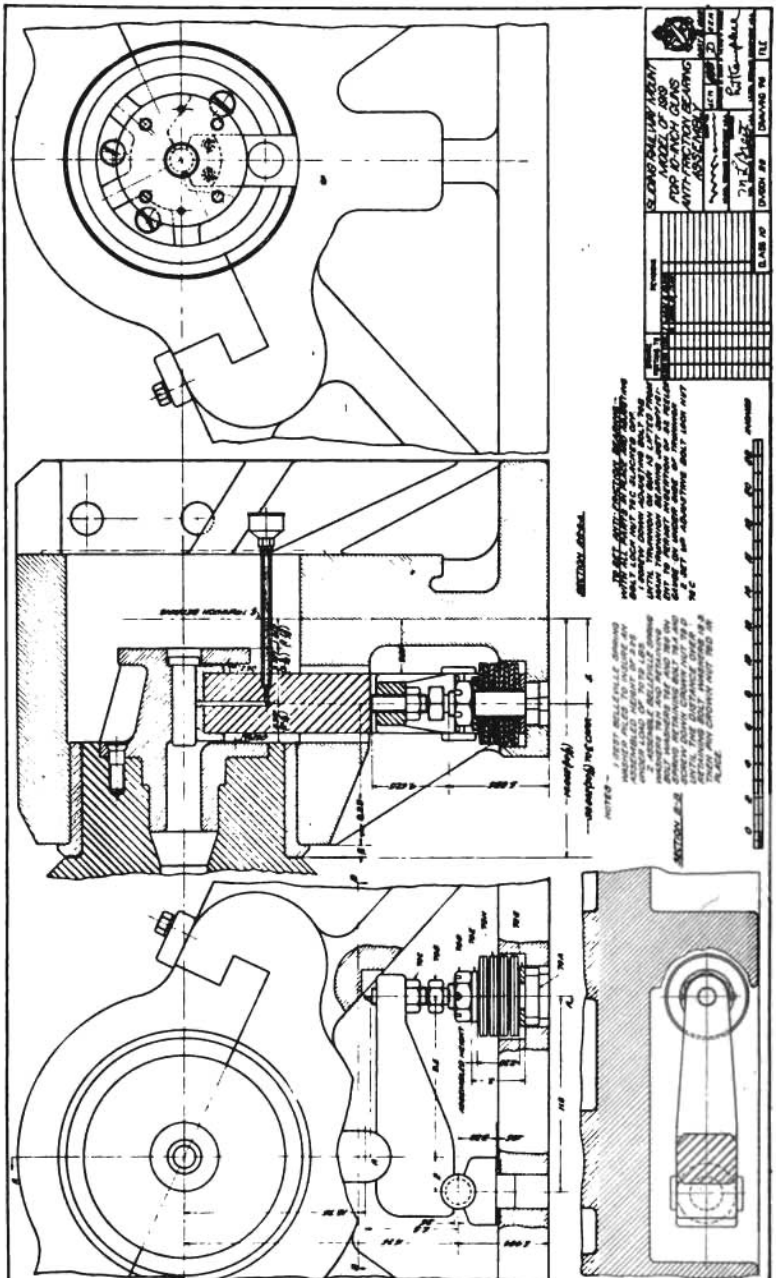

SLIDING RAILWAY MOUNT
MODEL OF 1919
FOR 10-INCH GUNS
ANTI-FRICTION BEARING
ASSEMBLY

PLATE 115

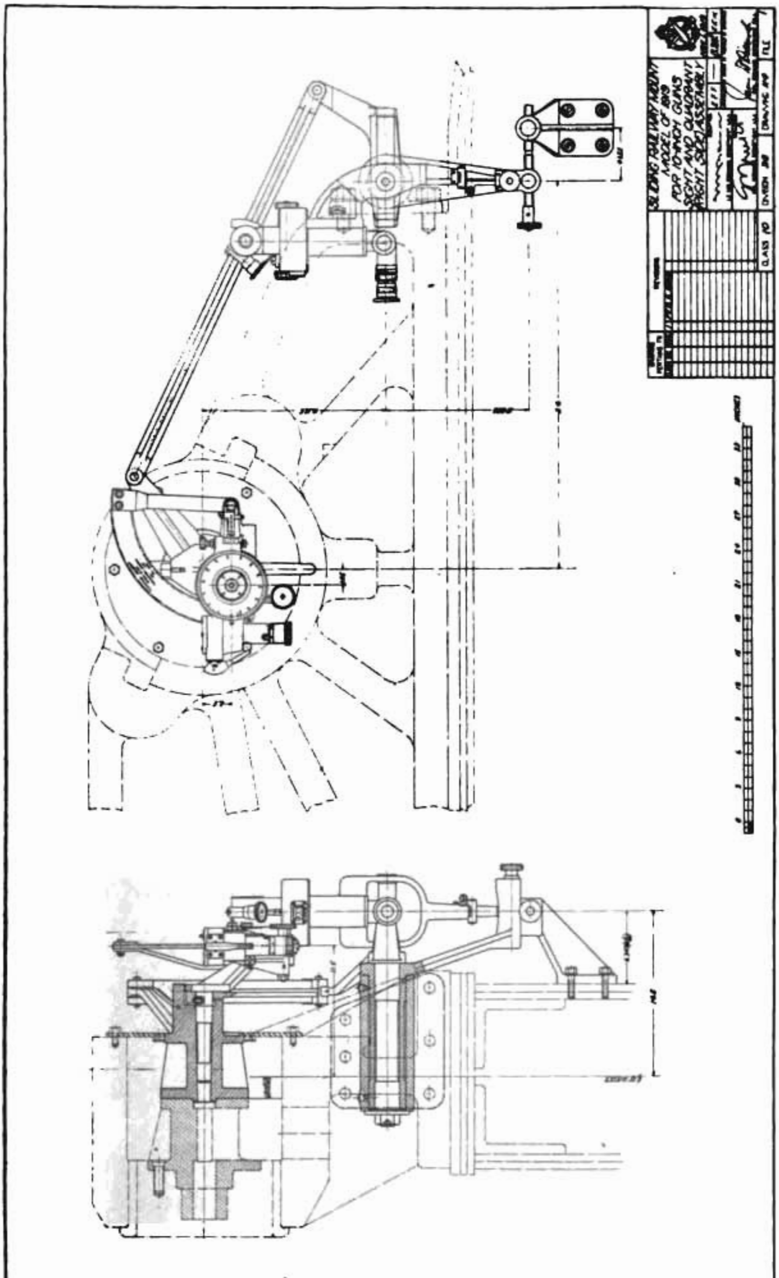

SLIDING RAILWAY MOUNT
MODEL OF 1919
FOR 10-INCH GUNS
SIGHT AND QUADRANT
RIGHT SIDE ASSEMBLY
CLASS 10
DIVISION 39
DRAWING 89
FILE

PLATE 116

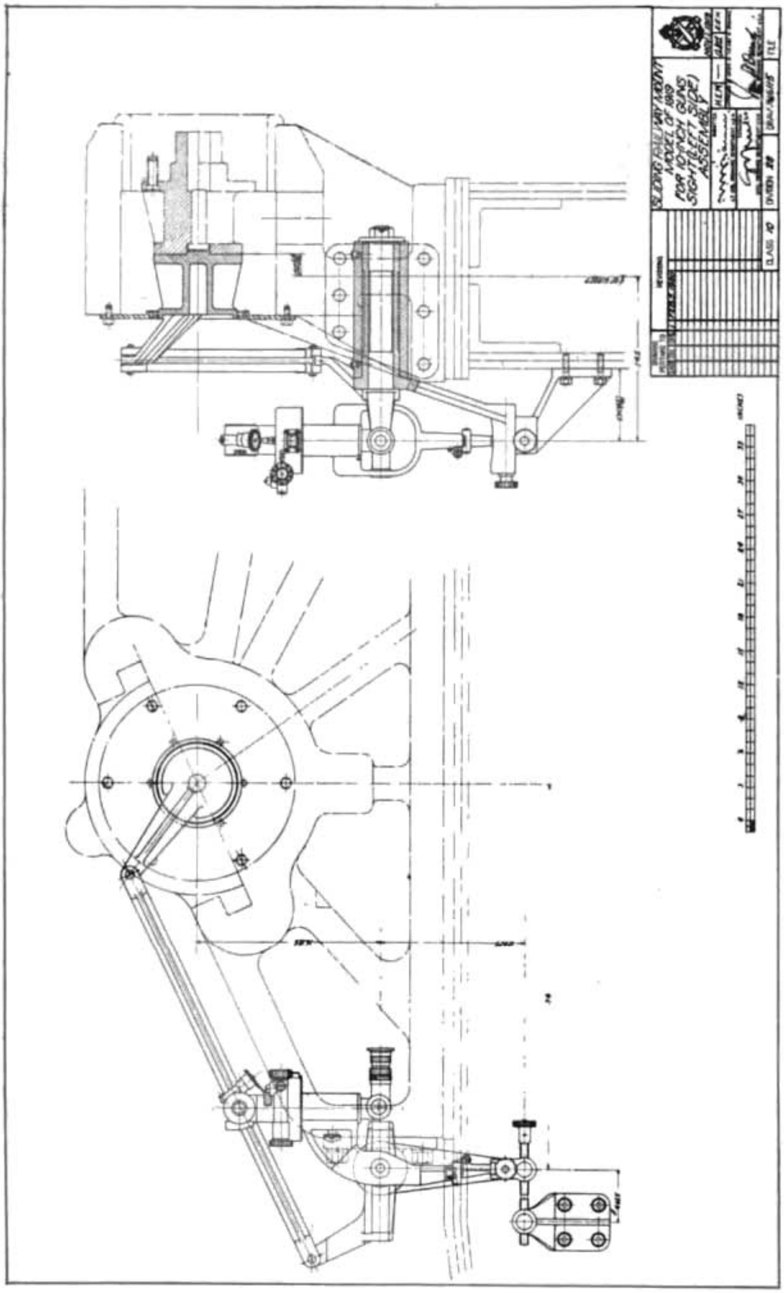

SLIDING RAILWAY MOUNT
MODEL OF 1919
FOR 10 INCH GUNS
SIGHT (LEFT SIDE)
ASSEMBLY
CLASS 10
DIVISION 28
FILE

PLATE 117

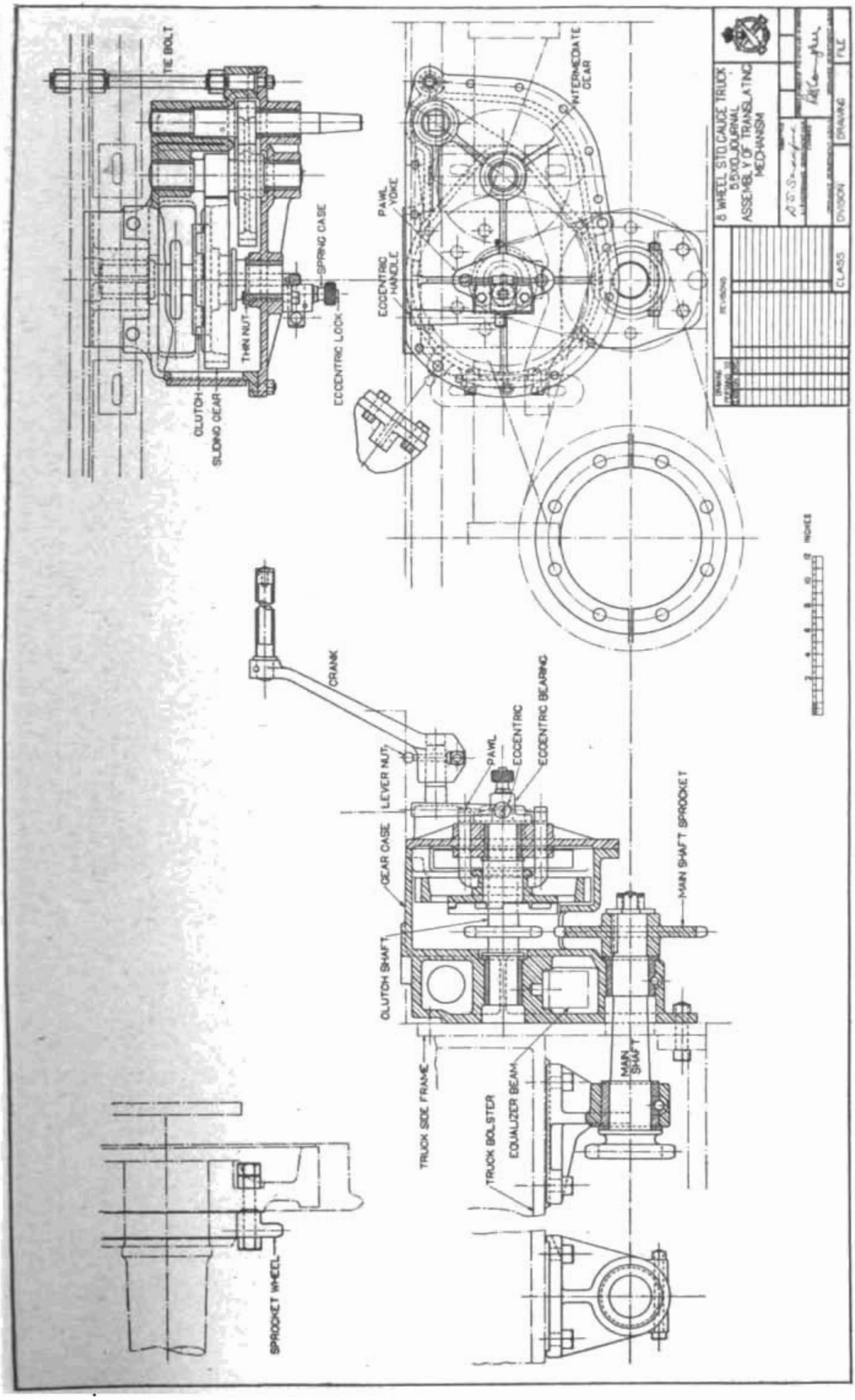

TIE BOLT
SPRING CASE
THIN NUT
ECCENTRIC LOCK
CLUTCH
SLIDING GEAR
PAWL YOKE
ECCENTRIC HANDLE
INTERMEDIATE GEAR
CRANK
LEVER NUT
PAWL
ECCENTRIC
ECCENTRIC BEARING
GEAR CASE
CLUTCH SHAFT
MAIN SHAFT SPROCKET
MAIN SHAFT
TRUCK SIDE FRAME
EQUALIZER BEAM
TRUCK BOLSTER
SPROCKET WHEEL
INCHES
8 WHEEL STD GAUGE TRUCK
5 1/2X10 JOURNAL
ASSEMBLY OF TRANSLATING MECHANISM
REVISIONS
CLASS
DIVISION
DRAWING
FILE

PLATE 118

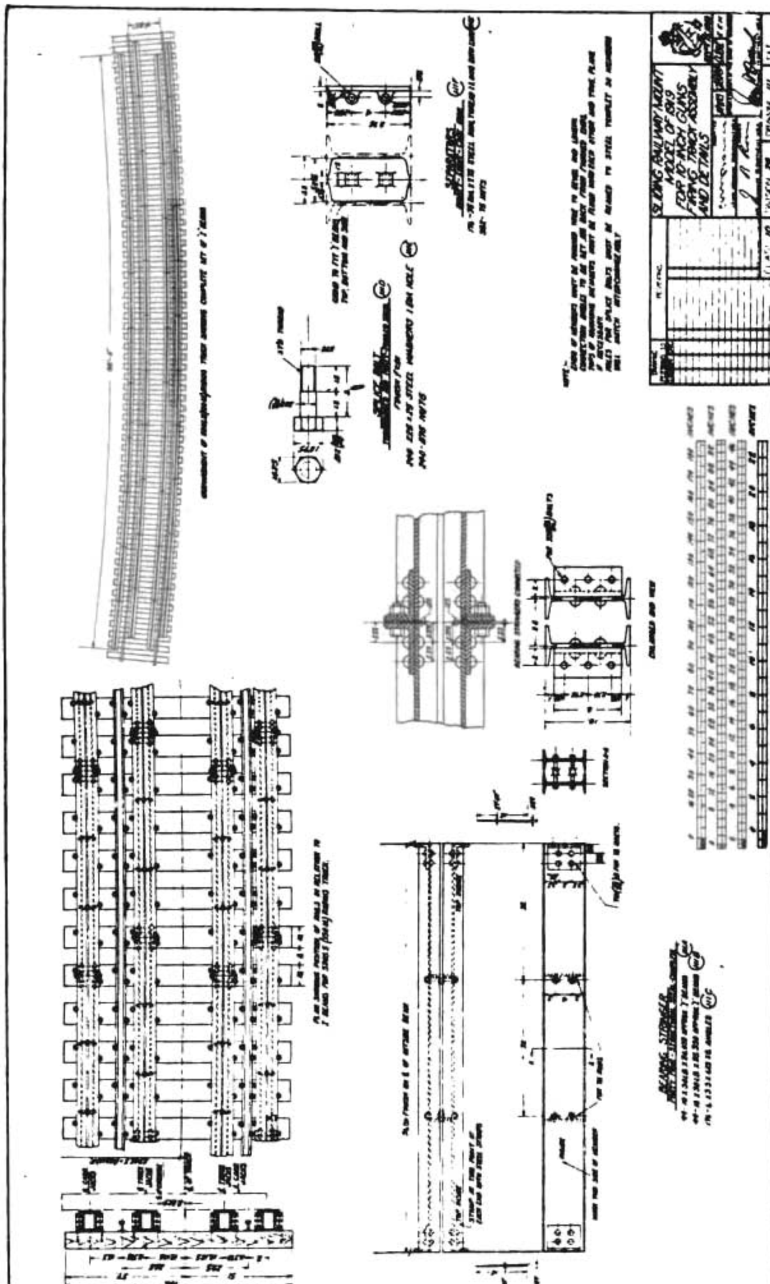
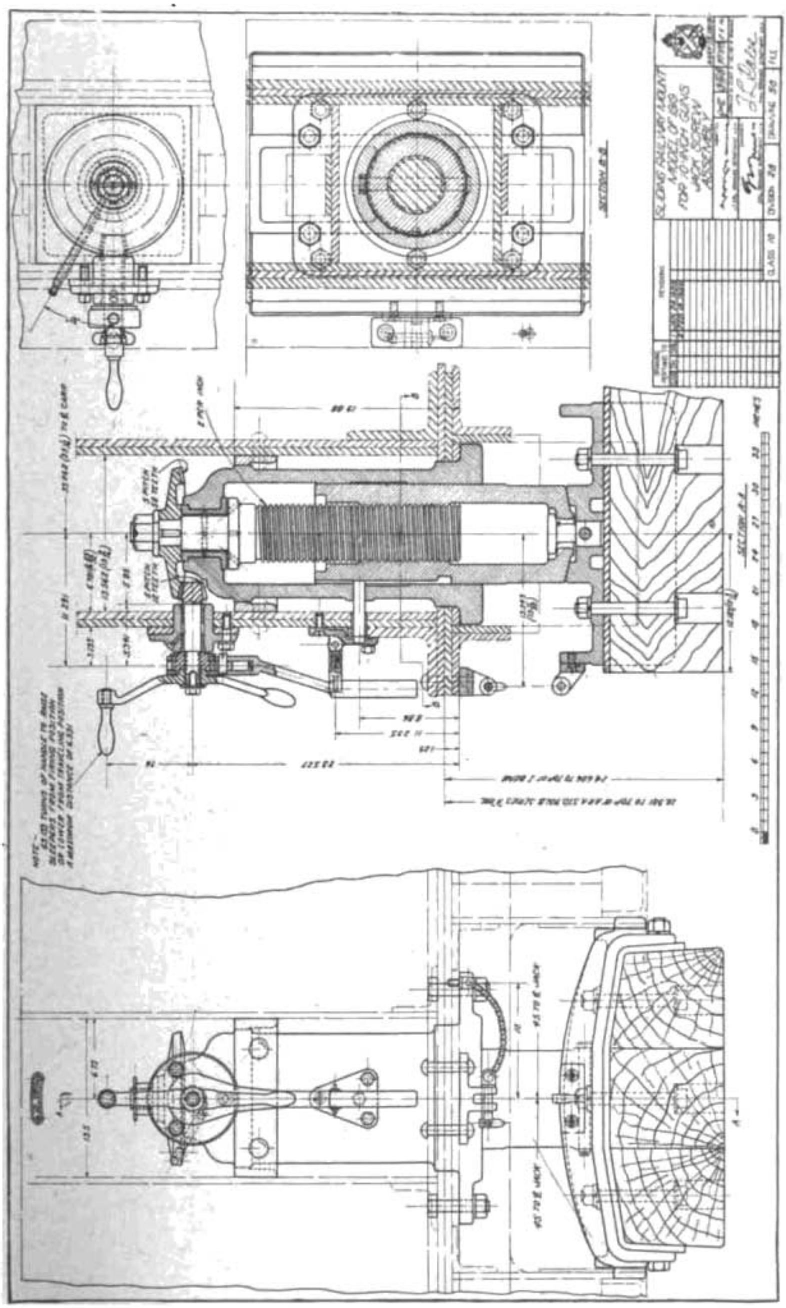

SLIDING RAILWAY MOUNT
MODEL OF 1919
FOR 12-INCH GUNS
FIRING TRACK ASSEMBLY
AND DETAILS

PLATE 119



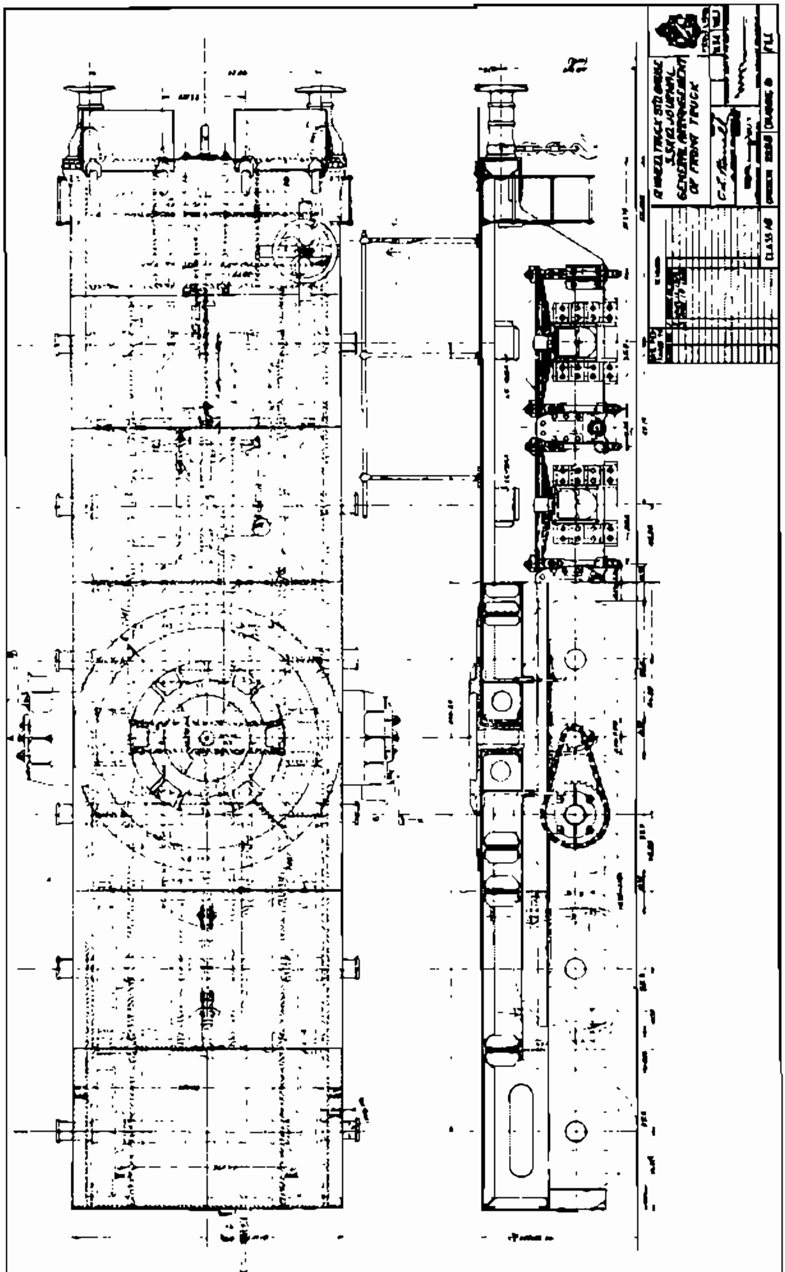


PLATE 120

PLATE 121

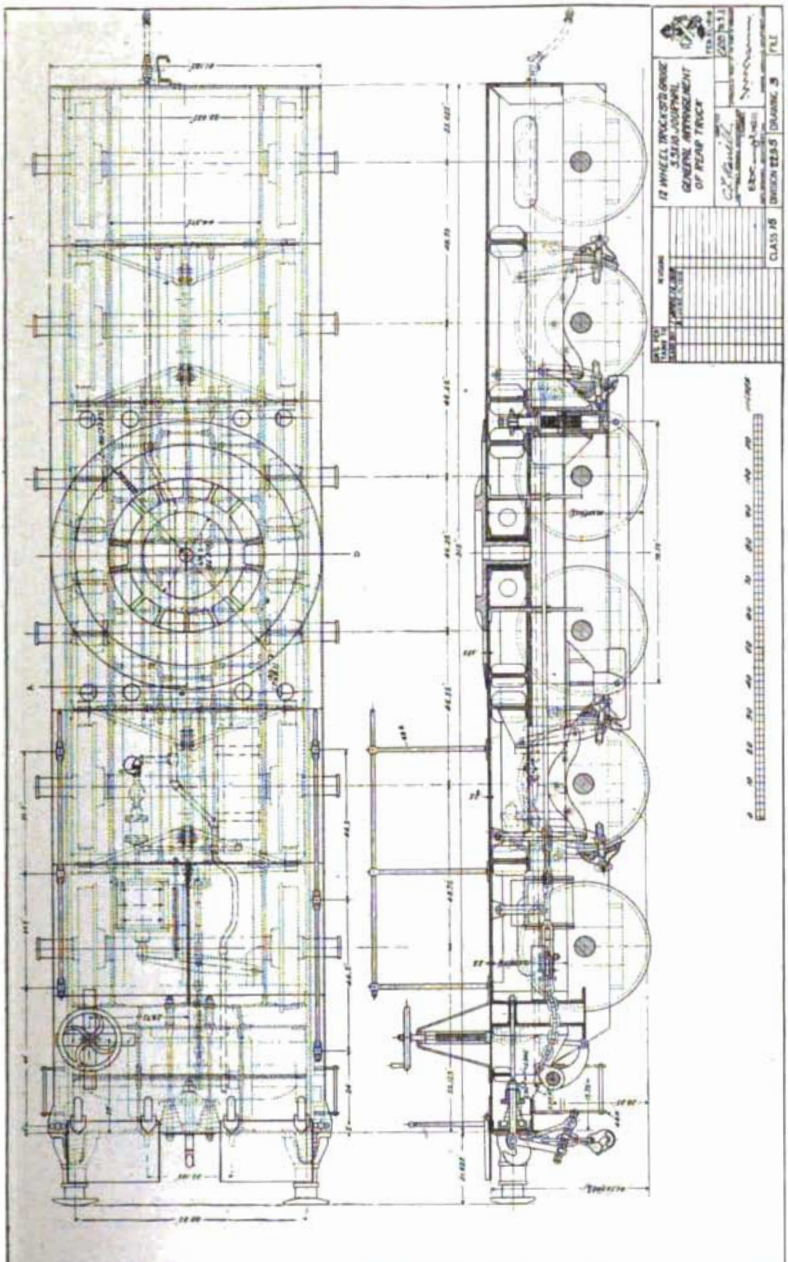

12 WHEEL TRUCK STD GAUGE
5 1/2 X 10 JOURNAL
GENERAL ARRANGEMENT
OF REAR TRUCK
CLASS 15
DRAWING 3
FILE

PLATE 122

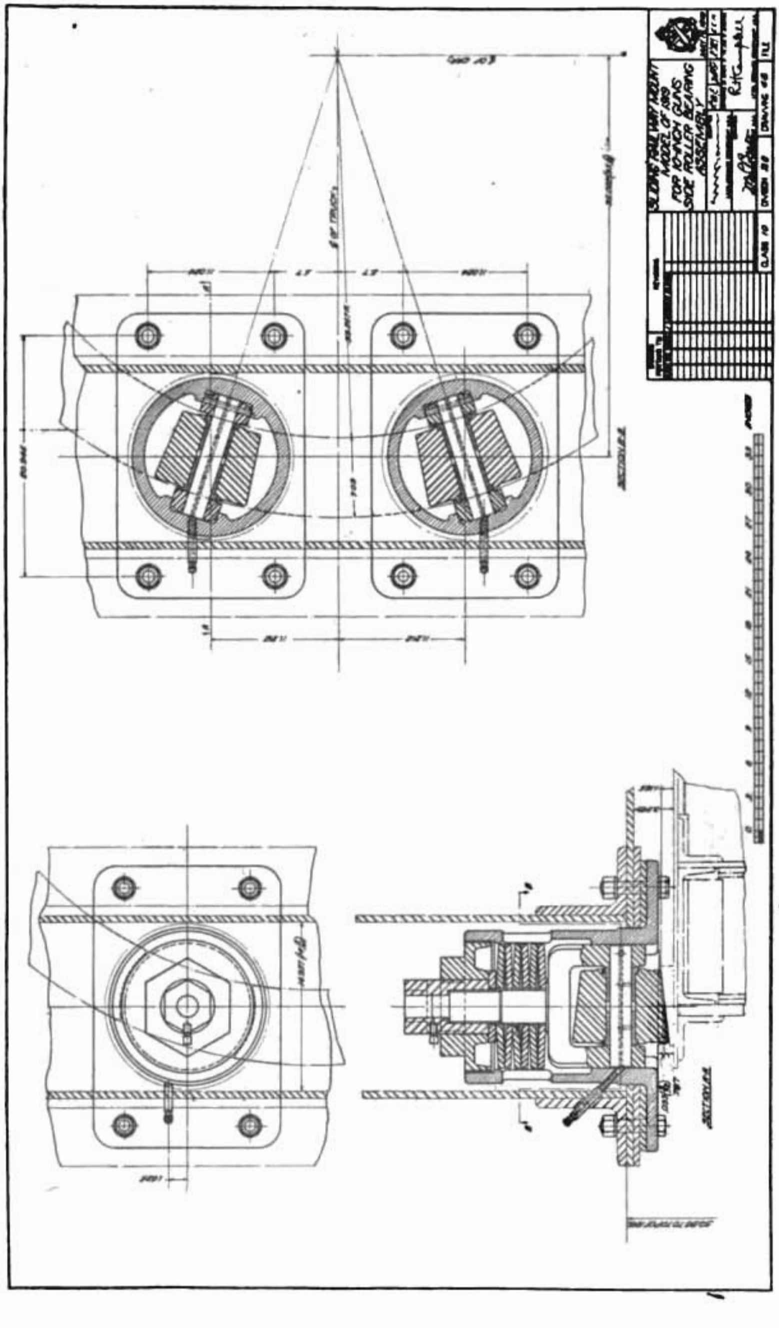


PLATE 128

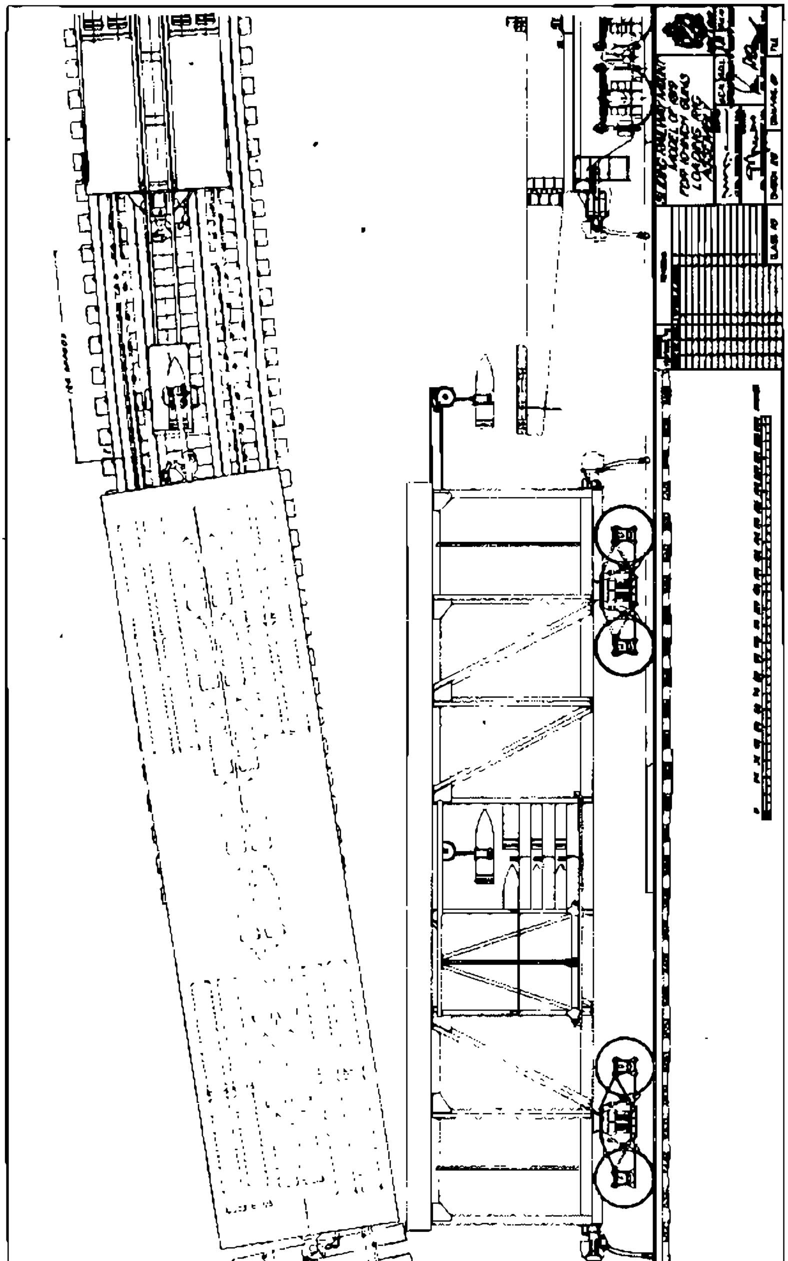


PLATE 124

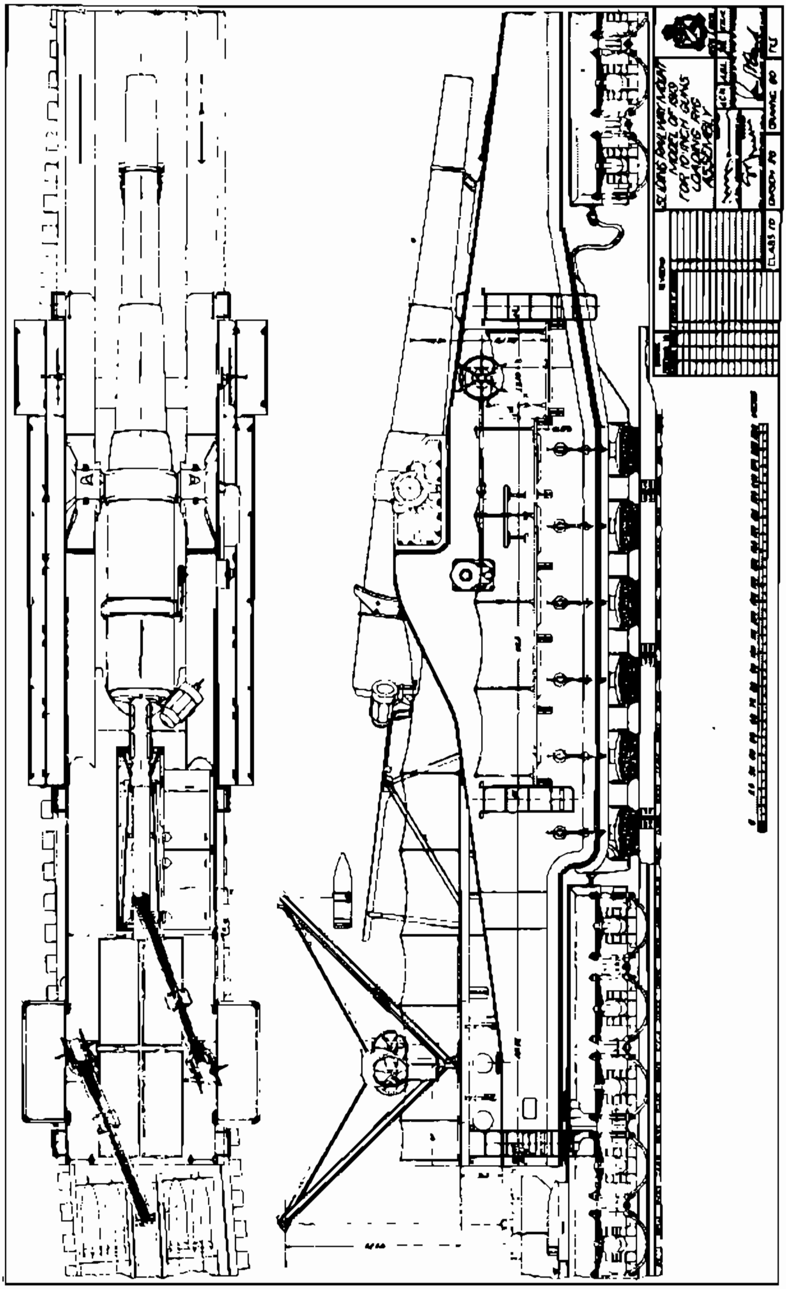


PLATE 125

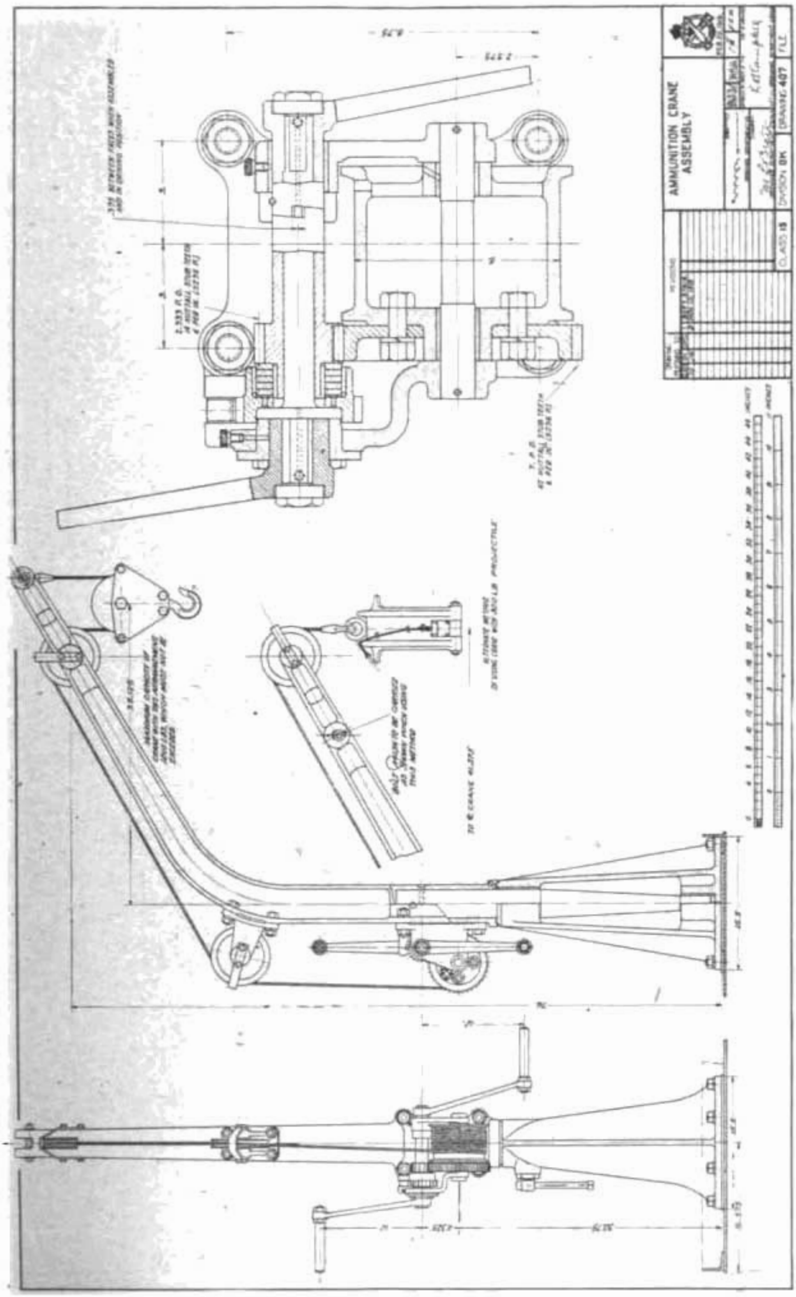


PLATE 128

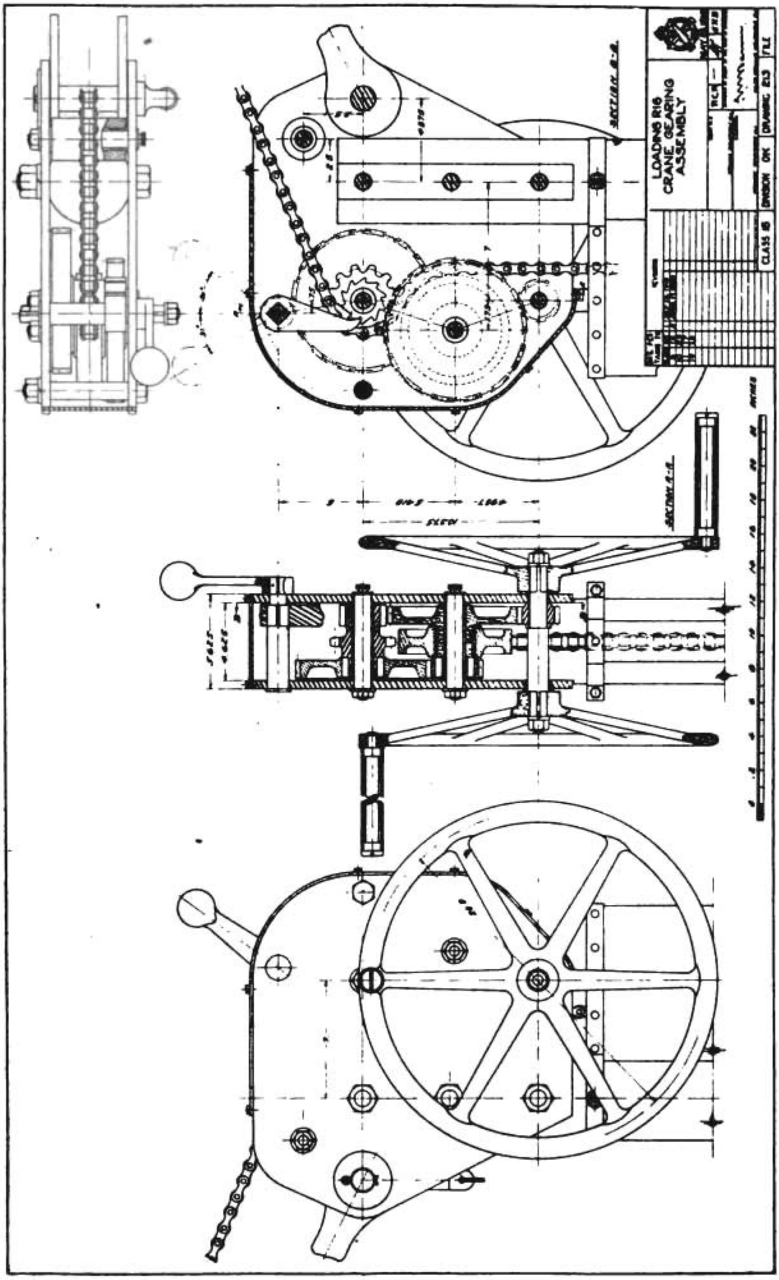


PLATE 127

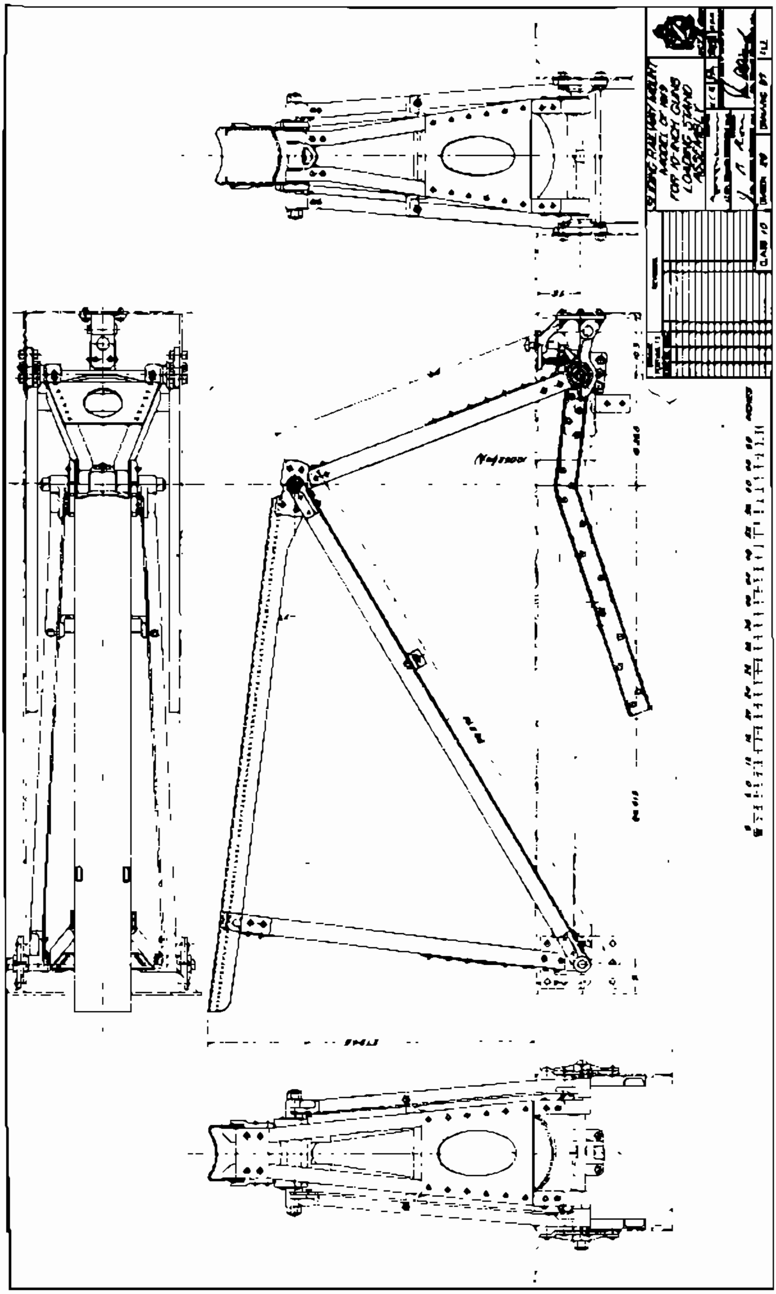
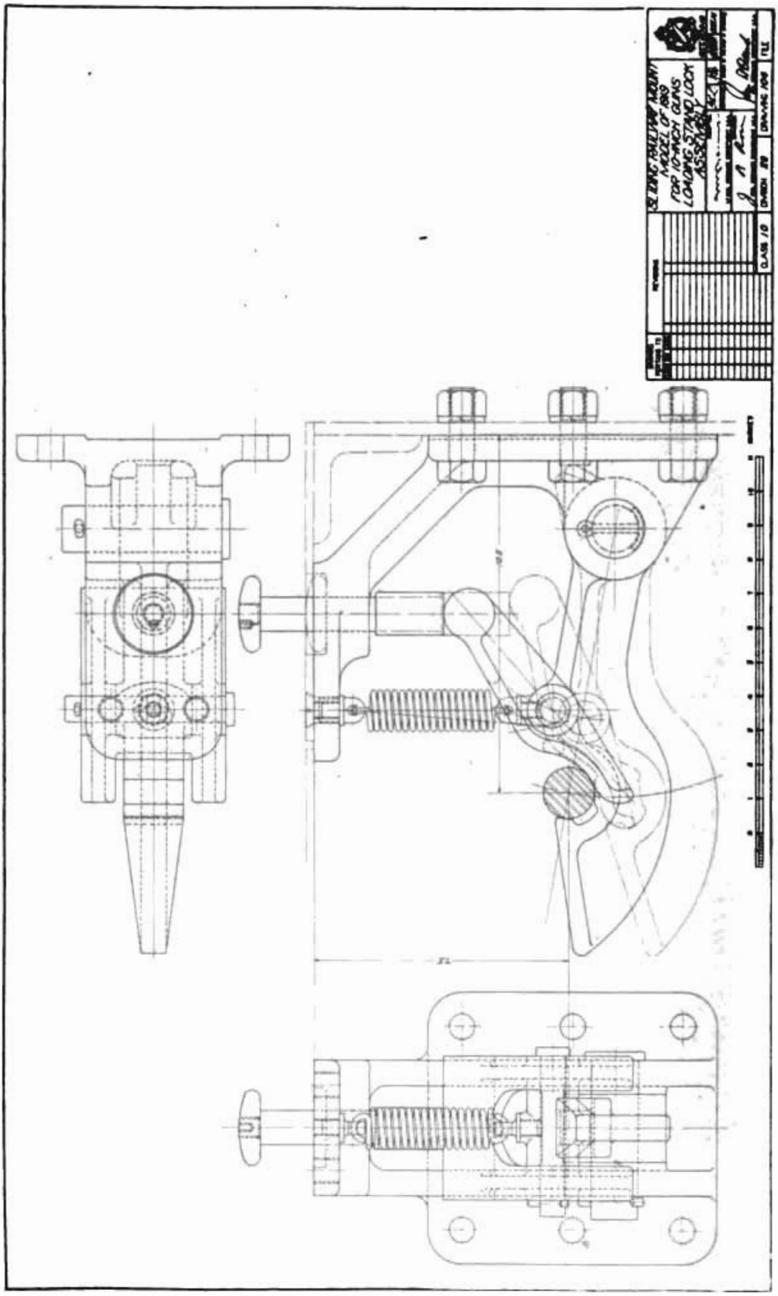


Plate 128


SLIDING RAILWAY MOUNT
MODEL OF 1919
FOR 10-INCH GUNS
LOADING STAND LOCK
ASSEMBLY
CLASS 10
FILE

5.—AMERICAN 12-INCH MORTAR ON RAILWAY MOUNT.(18)

148. This mount is of the cradle recoil top carriage traverse type and is similar in design to the mount for the 8-inch gun. The recoil mechanism is hydropneumatic while that of the 8-inch mount is hydrospring. It is illustrated on plates 130 to 138.

149. GUN.—The piece used with this mount is the 12-inch coast-defense mortar, model 1890, Mark I, of 10-caliber length. It is provided with an interrupted thread breechblock which is fitted with a mechanical firing mechanism. There are 72 grooves, and the twist of the rifling is to the right, the pitch progressing from one turn in 40 calibers to one turn in 20 calibers.

150. RECOIL MECHANISM.—The recoil mechanism is of the hydropneumatic type. Two hydraulic cylinders are mounted on the bottom of the cradle and one pneumatic recuperator cylinder on the top. There is nothing unusual in the design of the hydraulic recoil cylinders. This is the first mount described on which a pneumatic recuperator is used, and it will perhaps be well to describe the recuperator mechanism in detail. It is shown in section on plate 38, and is in general typical of the design of the pneumatic recuperator used on the 12-inch Batignolles mount and the 12-inch 20-caliber howitzer. This recuperator is composed of three main parts, a cylinder which is attached to the cradle, and whose rear end, plate 38, serves as an air reservoir, a hollow piston attached to the gun, and a floating piston, the rod of which can be seen passing through the hollow piston, and the head of which fits in the air cylinder.

151. On plate 134 it can be seen that the cross head on the front end of the hollow recuperator piston is attached by means of two long tension rods to the recoil lug on the rear of the gun. The space in the recuperator to the rear of the floating piston, plate 38, is filled with air at a fixed initial pressure. The floating piston is fitted with a series of U-shaped leathers, which serve in part to retain the air pressure. The space between the floating piston and the hollow piston is filled with a heavy oil or light grease. It can thus be seen that if there is any leakage in this cylinder it is a leakage of the oil which fills the space between the floating and hollow piston, since the air can not escape except by passing both the floating piston and the oil piston. When the gun recoils, the tension rods shown on plate 134 pull the hollow piston back, and the pressure transmitted through the oil or grease forces the floating piston to the rear at the same time. The length of recoil is 30 inches and the position of the floating piston at maximum recoil is shown by dotted lines. As soon as the gun has ceased to recoil the air pressure behind the floating piston forces it forward and in turn pressure is

transmitted through the oil and forces the hollow piston and the gun forward.

152. The front end of the rod of the floating piston projects through the hollow piston and beyond the end of the bracket, which is attached to the gun sleigh. As oil leaks out of the hollow piston the floating piston moves forward under the air pressure. The forward end of the floating piston rod is graduated and when certain of these graduations appear it is an indication that the oil supply must be replenished. As additional oil is forced in the floating piston moves to the rear, again building up the air pressure. The oil pump used in this operation can be seen mounted on the cradle beside the recuperator cylinder. A supply of oil is carried in the pump casing and the pump is operated by means of the long lever shown in the space between the hollow and floating pistons. On plate 134 an air bottle can be seen on the working platform of the mount. This bottle is connected by a small pipe with the rear end of the recuperator cylinder and supplies it with air to increase the pressure whenever necessary.

153. The cradle is noticeably of a clumsy design. The mortars used on these mounts were originally mounted in their seacoast carriage by means of trunnions attached to the gun. To get the required amount of bearing surface for a recoil of desirable length, it was necessary to mount the gun in what is termed a sleigh. This sleigh is composed of two rings and two runners or splines, plates 38 and 134. The forward ring fits over the tapered muzzle of the gun and the rear ring over the breech. They are connected by two runners which fit over the original trunnions of the gun, thereby attaching the entire sleigh rigidly to the gun. This sleigh is in turn mounted in the cradle, which is necessarily very wide to accommodate the large sleigh runners. The cradle is supported in the side frames of the top carriage by its own trunnions.

154. Elevating Mechanism.—Elevation from minus 5 degrees to plus 65 degrees is secured through a segmental circular rack attached to the bottom of the cradle; a pinion meshing with this, a slip-friction device, wormwheel and worm, and a set of bevel gears leading to the handwheel. Any excessive thrust due to fire causes slipping in the friction device and can not impose excessive strain on the gears. One turn of the handwheel moves the mortar through 1.004 degrees in elevation. Details of this mechanism are shown on plate 38.

155. Traversing Mechanism.—The traversing mechanism provides for a total movement of 360 degrees, as with the 8-inch carriage. Gun and carriage are carried in cast steel side frames on a racer casting which is supported by conical traversing rollers, plate 135. A complete circular rack is mounted on the base ring; a pinion of

the traversing mechanism which is mounted on the racer meshes with this rack. This pinion connects through a vertical shaft, worm, and wormwheel with the operating handwheel. Any strain from the pressure of the projectile against the lands of the gun in firing is taken up as thrust on the worm. An azimuth circle with a pointer is provided for reading changes in azimuth. One turn of the handwheel moves the mortar through 0.837 degrees in azimuth.

156. Gun Carriage.—The mortar carriage, plates 38 and 134, is similar in general design to the 8-inch barbette carriage, model of 1918. Certain radical differences have been made in the details, of course. In this carriage the pneumatic recuperator has been substituted for the spring recuperator used in the 8-inch gun. The elevating mechanism comprises a segmental spur-gear rack and a pinion, while the 8-inch mount was provided with a Hindley worm and segmental worm-gear rack. The base ring of the 8-inch mount was provided with a pintle at its center, while in this case the pintle is part of the racer and is of very large diameter, plate 38. On the 8-inch mount the traversing rack is attached to the base ring inside the roller track. On the 12-inch mortar mount the traversing rack is attached to the outside of the roller track. On the rear of the working platform of this mount an ammunition table is provided, since the projectiles are of such weight and size that they can not be handled by the simple method used on the 8-inch mount.

157. Railway Car Body.—The railway car body for a number of these mortars is identical with that of the railway car model 1918, Mark I, plate 133, for the 8-inch gun. The mortar carriage proved sufficiently heavy to cause a deflection of about an inch in the center of the 8-inch design of car body, hence a modified design was made in which the depth of the web plates was increased, especially in the inclined portions of the car body. Four-fifths of the total number of mortar car bodies are of this latter design.

158. Anchorage.—The scheme employed in anchoring this mount is shown on plates 130, 131, and 136. It is identical with that used with the 8-inch mount.

159. Trucks.—The trucks on this car differ from those used with the 8-inch mount due to the heavier load carried. They are 6-wheel type with 5.5 by 10 inch journals and 28-inch wheels. Both hand and air brakes are provided. Details are shown on plate 137. A set of equipment for transporting the mount over narrow-gauge track is provided and is in every way similar to that furnished with the 8-inch mount, plates 99–105.

160. Ammunition Supply System.—The ammunition car is the same as that provided for the 8-inch mount, plate 106. It is located

directly back of the gun car in firing so that the ammunition can be let down directly on the truck mounted on the special track built on the car body. From this truck it is picked up by a jib crane on the rear of the mortar-operating platform and is swung around and lowered to a loading stand on the back of the latter. From here it is slid into the mortar along a loading tray which can be put in place temporarily between this loading stand and the mortar breech. The loading angle is minus 5 degrees. This arrangement is illustrated in detail in plate 138.

161. MAINTENANCE.—The only especially novel feature in this mount, so far as American practice is concerned, is the pneumatic recuperator. Early in proof tests the valves on the pump for recharging the recuperator stuck on one occasion. This difficulty was easily remedied and the recuperator has since operated perfectly. No further difficulty should be experienced in the maintenance of this mechanism. The mortar and carriage are somewhat heavier than the 8-inch gun and carriage and cause a very marked deflection in the 8-inch design of car body used with 17 of these mortars. There is a possibility of the development of a permanent set or sag in these.

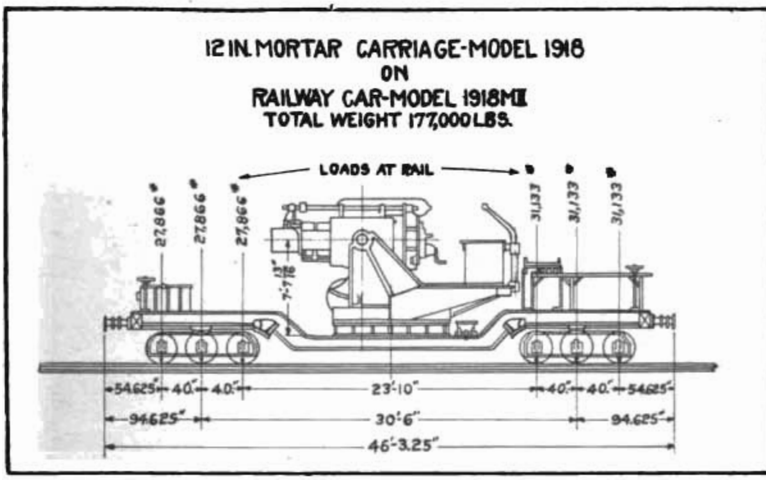
162. DIFFICULTIES INVOLVED IN SERVICE.—Proof of this mount indicates that it operates satisfactorily in every respect at elevations between 35 degrees and 65 degrees. At lower elevations some difficulty has been experienced with the settling of outrigger floats in the ground and particularly with jumping of the car. It appears that at elevations below 25 degrees the mount is dangerously unstable.

163. The heavy deflection of the 8-inch design of car body may cause considerable difficulty in emplacing, as the car must be raised by auxiliary jacks before the standard jacking beams can be inserted. This operates merely to increase the time required for emplacing and removing the mounts and it should not constitute a serious difficulty.

164. MERITS.—One of the merits of this carriage is its system of anchorage, which is identical with that of the 8-inch railway carriage. Attention should also be called to the cradle, which is of excellent design; it is felt that it will give excellent service.

165. DEMERITS.—Some difficulty may be experienced in using a few of these mounts in the field, inasmuch as the deflection of the underframe is so great as to make it impossible to use the jacks provided for lifting the car in order that the firing beams and sleepers may be placed to form the firing platform. It may be necessary to use auxiliary jacks.

PLATE 129


12 IN. MORTAR CARRIAGE-MODEL 1918
ON
RAILWAY CAR-MODEL 1918MII
TOTAL WEIGHT 177,000 LBS.
LOADS AT RAIL
27,866#
27,866#
27,866#
31,133#
31,133#
31,133#
7'-7 13/16"
54.625"
40"
40"
23'-10"
40"
40"
54.625"
94.625"
30'-6"
94.625"
46'-3.25"

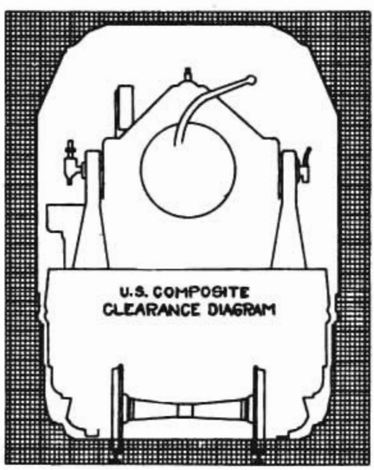
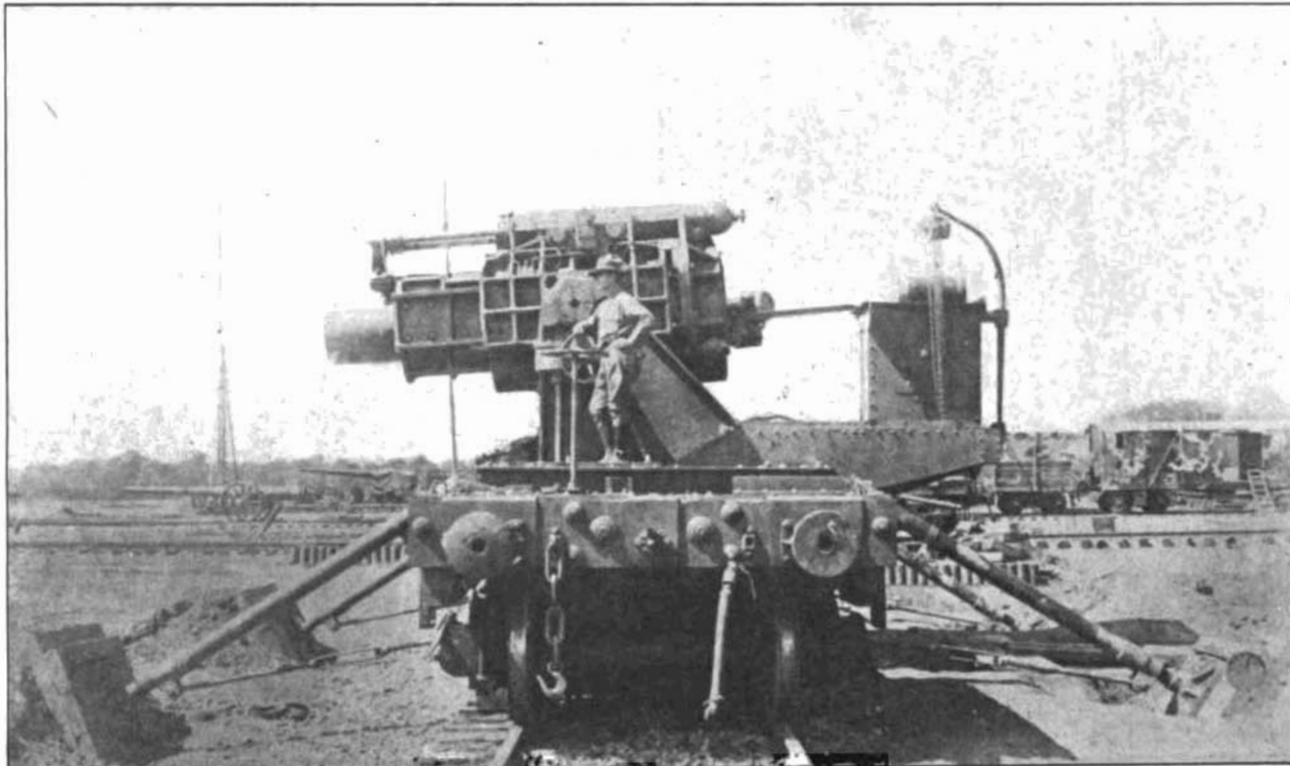
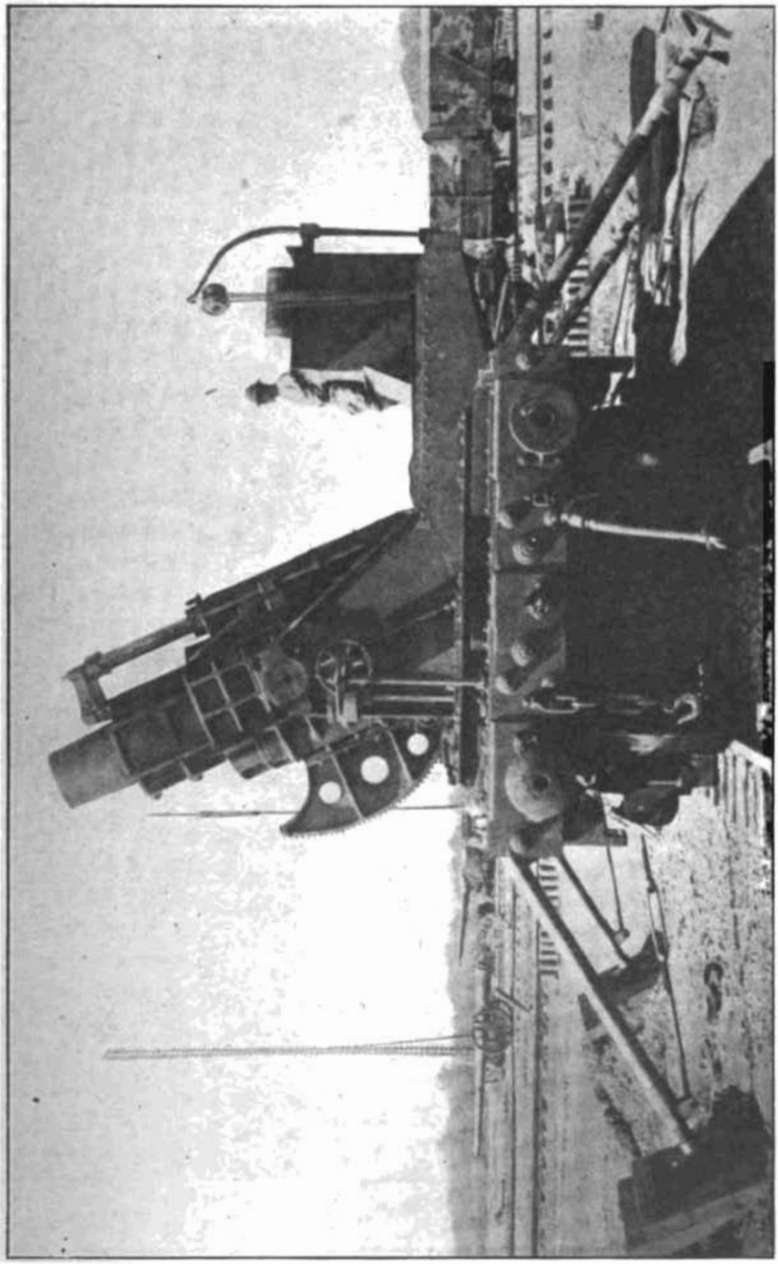

U.S. COMPOSITE
CLEARANCE DIAGRAM

PLATE 130



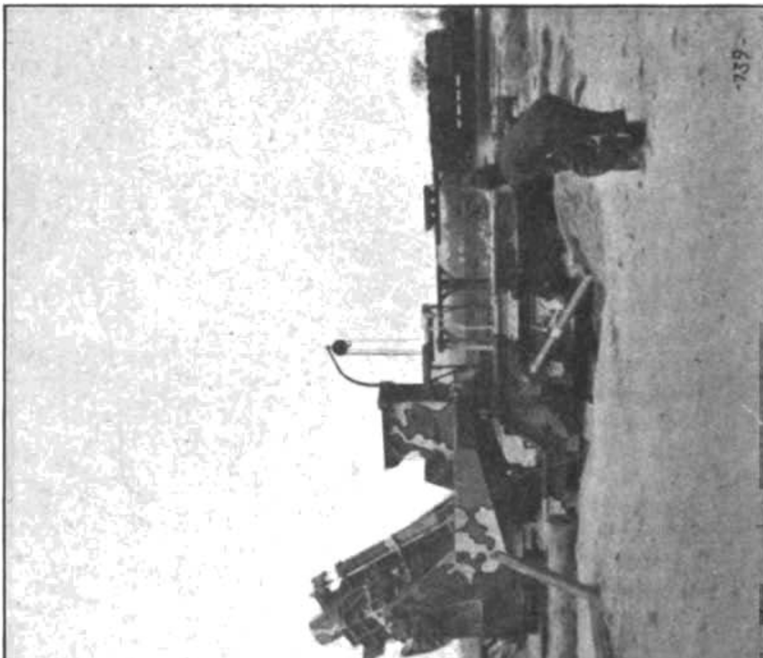
12-INCH AMERICAN MORTAR ON RAILWAY MOUNT.

PLATE 131



12-INCH AMERICAN MORTAR ON RAILWAY MOUNT.

PLATE 132



12-INCH AMERICAN MORTAR ON RAILWAY MOUNT.

PLATE 133

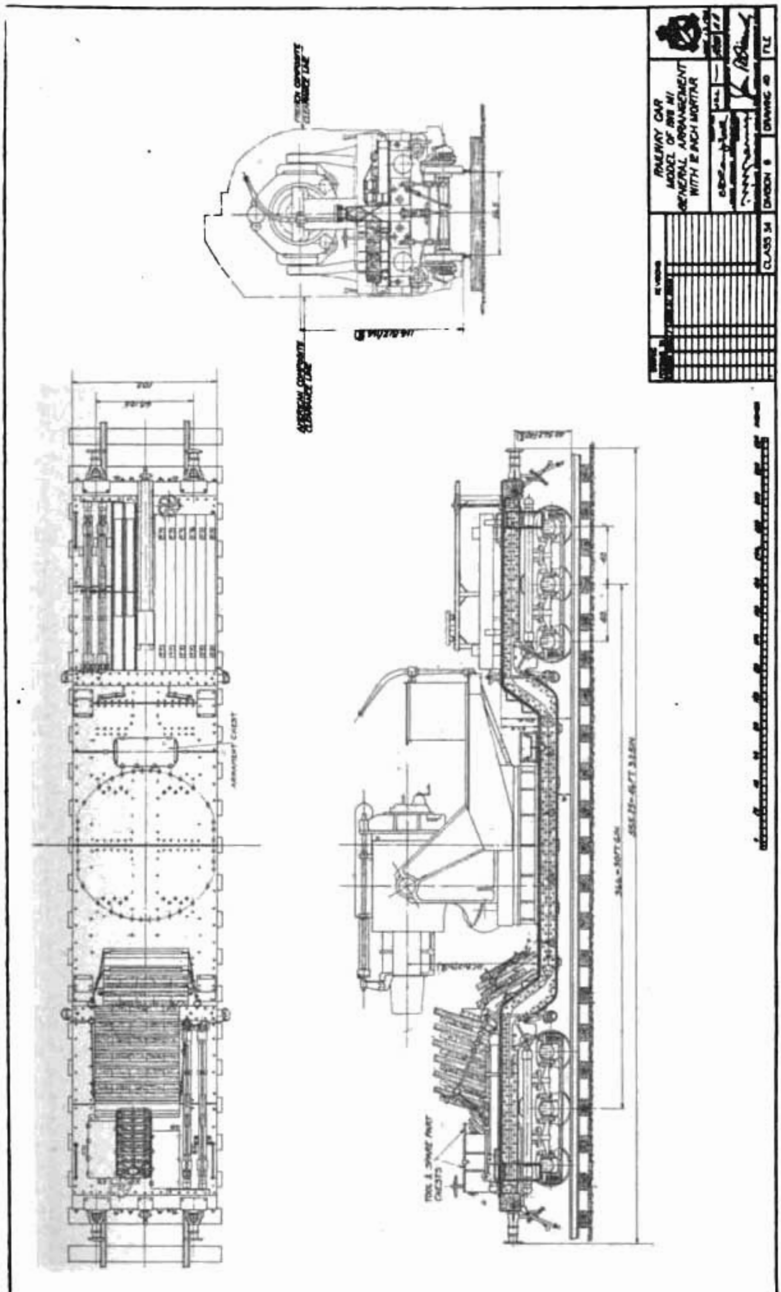

RAILWAY CAR
MODEL OF 1918 MI
GENERAL ARRANGEMENT
WITH 12 INCH MORTAR
CLASS 34
DIVISION 6
DRAWING 40
FILE
ARMAMENT CHEST
TOOL & SPARE PART CHESTS

Plate 184

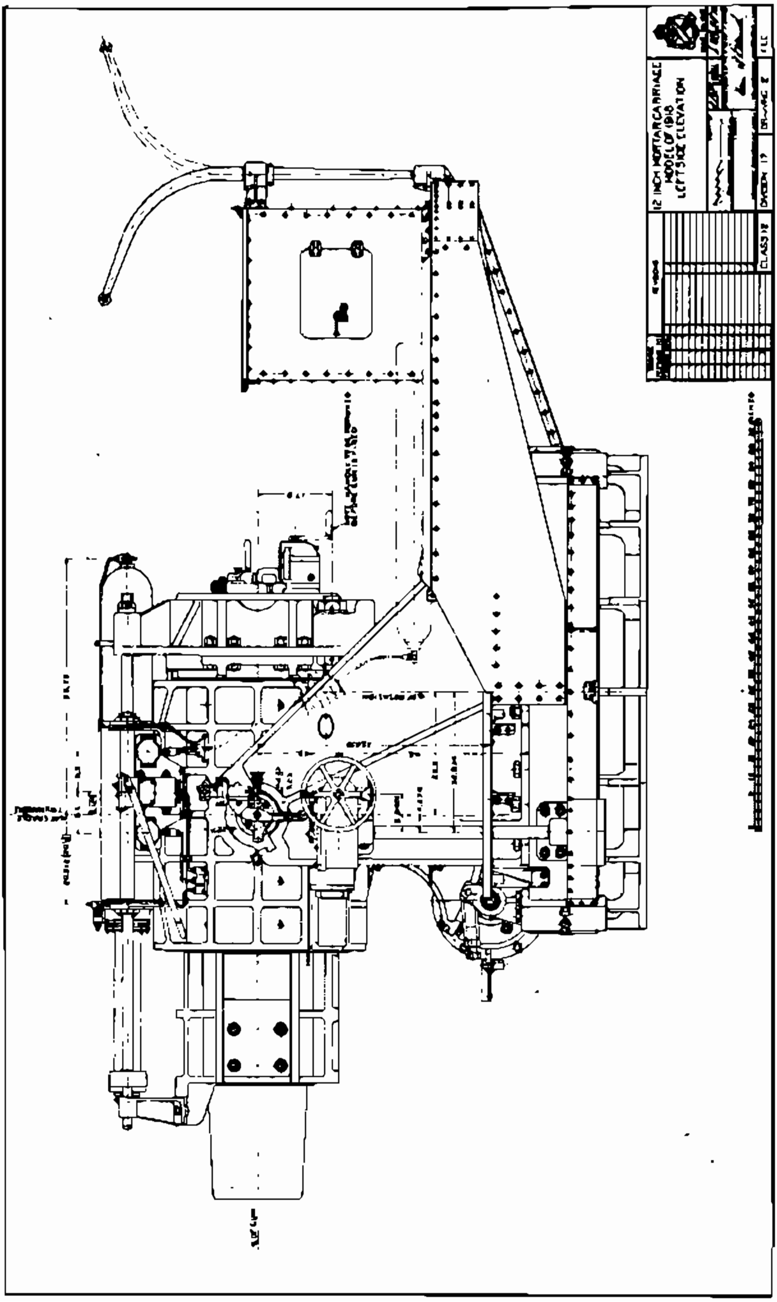


PLATE 135

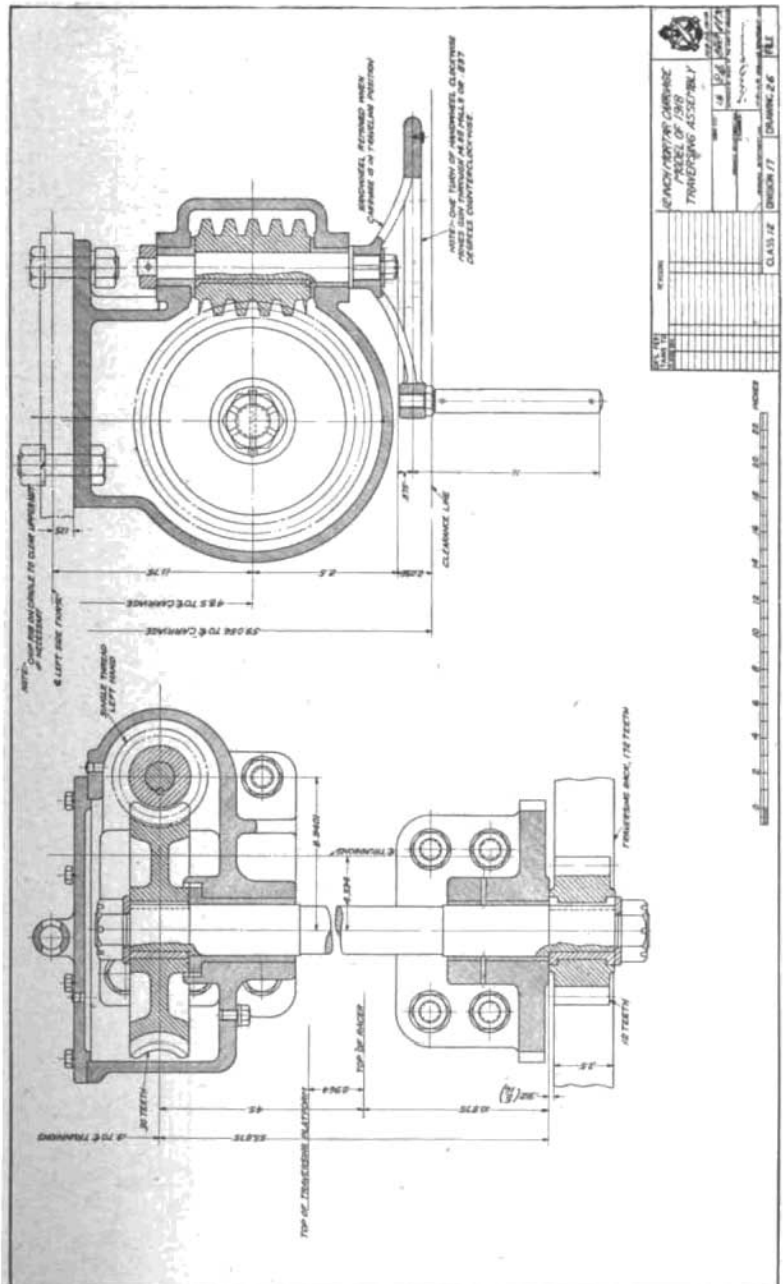

12 INCH MORTAR CARRIAGE
MODEL OF 1918
TRAVERSING ASSEMBLY
CLEARANCE LINE
SINGLE THREAD LEFT HAND
TOP OF TRAVERSING PLATFORM
TOP OF RACKS
TRAVERSING RACK, 170 TEETH
12 TEETH
30 TEETH

PLATE 136

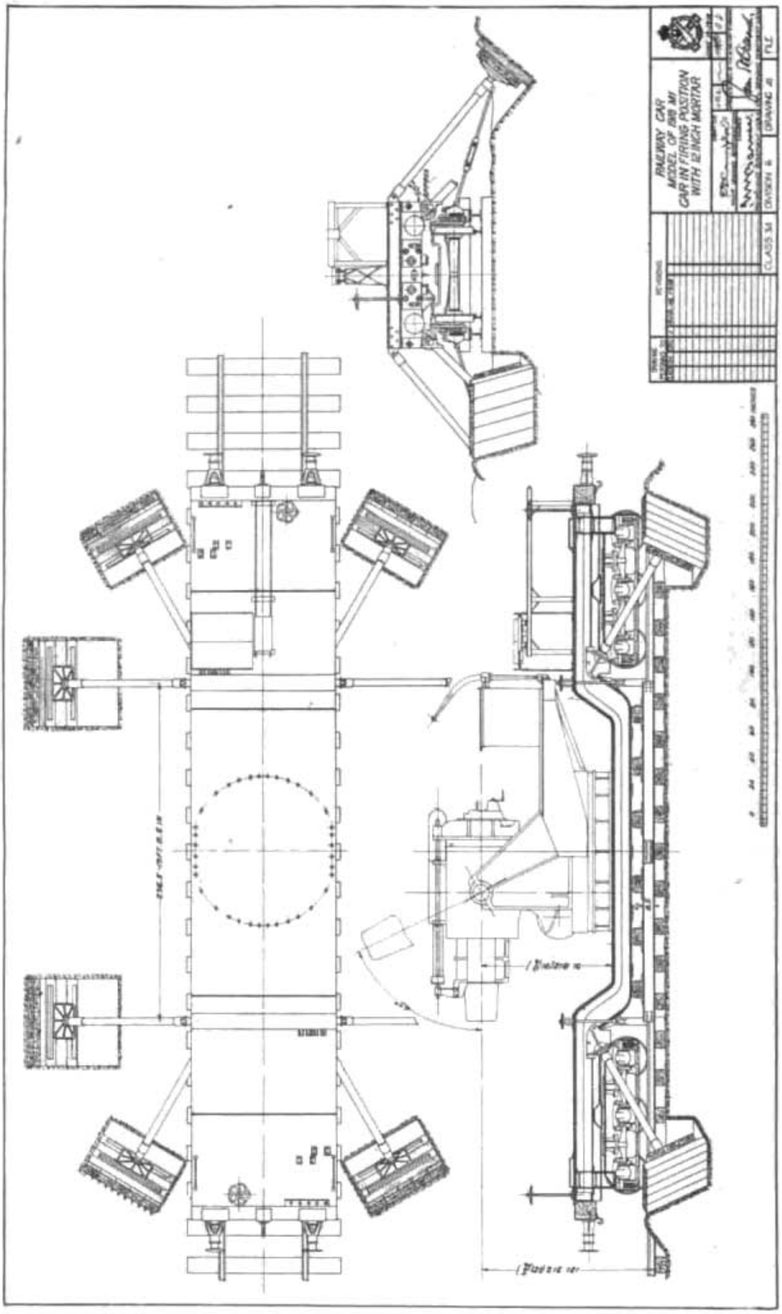

RAILWAY CAR
MODEL OF 1918 M1
CAR IN FIRING POSITION
WITH 12 INCH MORTAR
CLASS 34
DIVISION 6
DRAWING 41
FILE

PLATE 137

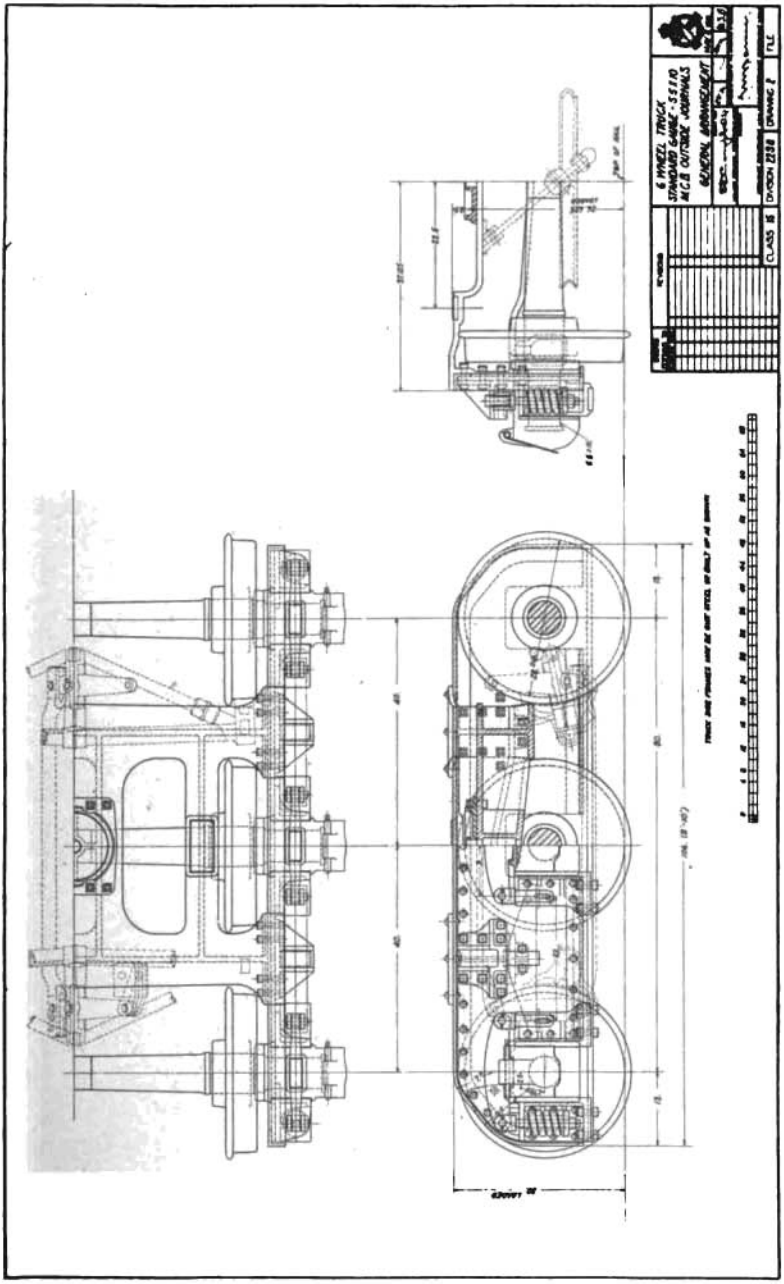
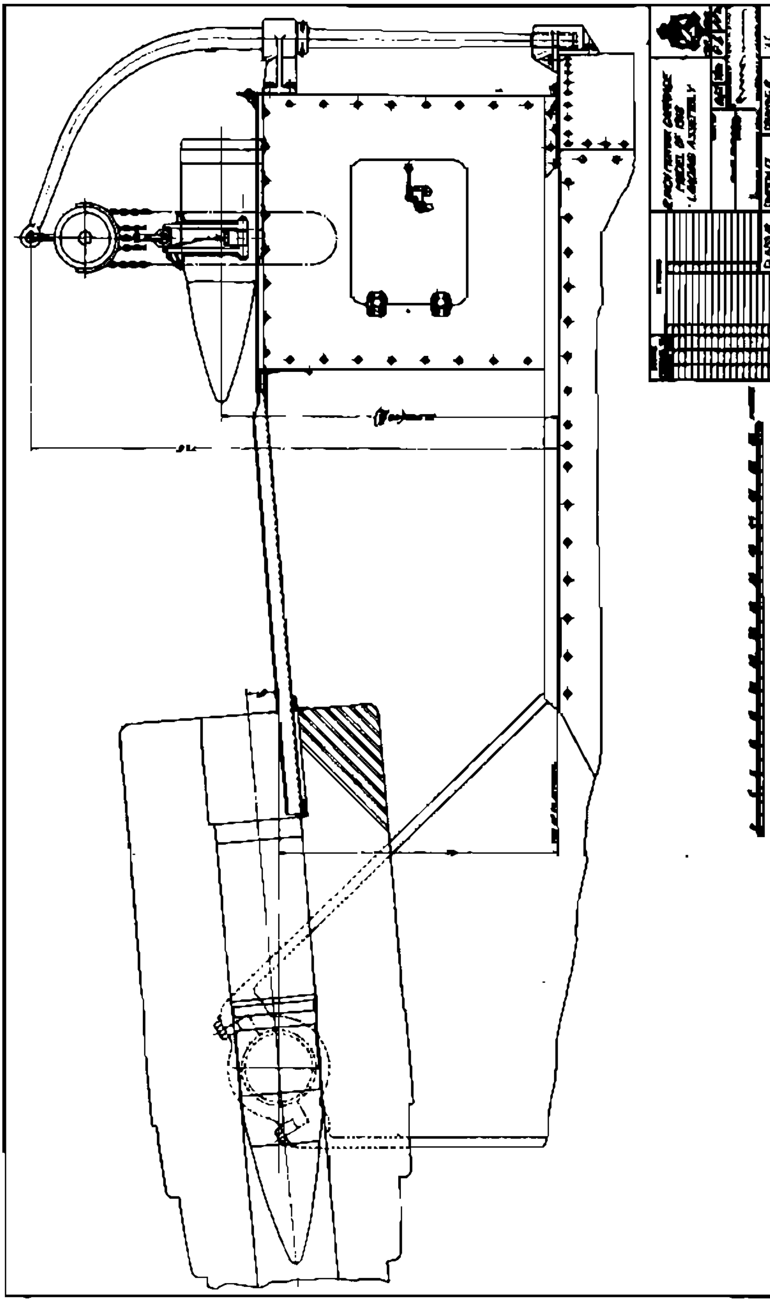

6 WHEEL TRUCK
M.C.B. OUTSIDE JOURNALS
GENERAL ARRANGEMENT
CLASS 16
FILE

Plate 138



6.—AMERICAN 12-INCH GUNS ON BATIGNOLLES TYPE OF RAILWAY MOUNT. (19)

166. This mount is built on a design almost identical with the design of the mounts on which the French have placed 305 and 340 millimeter guns and 370-millimeter howitzers. Modifications were made in the French design to adapt the mount to American manufacture and the American guns. This type of mount, plates 26, 140, and 141 is a development of this war. It was designed by the Société des Batignolles in France, during the latter part of 1914, and the first mount was tested at the Railway Artillery Camp in January or February of 1915. All mounts of this type rendered most excellent service throughout the war, proving definitely the merit of the design. The original American plan was to mount a number of 10-inch 34-caliber guns, models of 1888, 1888 Mark I and 1888 Mark II, on the same design of carriage. This has not and likely will not be done. It can be done at any time without great difficulty simply by providing a new cradle with decreased inside diameter and a slight modification of the throttling grooves and the recoil cylinders.

167. Guns.—The guns that are being used with these mounts are 12-inch, models of 1895 and 1895 Mark I, all of 35-caliber length. These guns are provided with the interrupted thread type of breech block which is fitted with a mechanical firing mechanism. The guns are provided with heavy splines on top and bottom, which not only prevent rotation of the gun on firing, but likewise carry the entire weight of the gun in the cradle; that is, the gun does not touch the cradle except in the spline ways. This is not considered good design, but the French practice was followed in preference to making any radical modifications in their design at a time when it was imperative that the guns be mounted with the least possible delay. Difficulties already experienced in proof firing indicate that unusually fine machine work is required on the splines and spline ways to prevent excessive friction and sticking of the gun before it has returned entirely to battery. The inside construction of the cradle with the spline ways into which the splines fit is shown on plates 142, 143 and 144.

168. Recoil Mechanism.—The recoil system is hydropneumatic and comprises two hydraulic recoil cylinders attached to the bottom of the cradle, and one pneumatic recuperator attached to the top, plates 37, 142, 143, and 144. The length of recoil is about 900 millimeters and no pit is required under the mount for firing at the highest elevation. The air required for the charging of the pneumatic recuperator is furnished in bottles. In field service extra bottles are ordinarily carried on the mount. The design of the pneumatic recoil is

essentially the same as that on the 12-inch mortar which has already been described in detail.

169. Elevating Mechanism.—It is possible to elevate the 12-inch gun from minus 5 degrees to plus 36 degrees. The elevating mechanism is in duplicate with a rack attached to each side of the cradle and pinions connecting through slip friction devices, worm and wormwheels, spur gears, a shaft, miter gears, and chains to the handwheels. This mechanism is shown in detail on plate 145. Antifriction devices of the lever design are included in the mechanism. This can be seen in the view at the right on plate 145. The slip friction devices are a part of the wormwheels shown on plate 154 and in design are practically identical with that used on the 10-inch sliding mount, plate 113. For easy elevating of the gun, the antifriction device is kept so adjusted that a 0.002 thickness gauge can be inserted under the main trunnion. It will be observed on plate 145 that the two mechanisms are rigidly connected by a cross shaft on which the chain sprockets of each are mounted. One turn of the wheel moves the gun through 35 minutes in elevation.

170. Traversing Mechanism.—The gun and cradle are swung between the side frames of the structural steel top carriage which is pivoted on the pintle at its forward end to allow a slight traverse. The extent of this traverse is 5 degrees on each side of the center line. Two handwheels mounted on the sides of the top carriage at the rear connect by chains with a horizontal cross shaft and from this by bevel gears to a horizontal longitudinal shaft which drives the traverse pinion through a worm, wormwheel, and shaft. This mechanism is shown in detail on plate 146. The rack and pinion are shown in detail on plate 147. The location of the handwheel is shown more clearly on plate 148. The greater part of the weight of the gun and top carriage is carried on the pintle, at which point the friction is reduced through the use of a column of Belleville springs, shown on plate 54. No provision is made in the design for the reduction of the friction between the rear of the top carriage and the car body by any special mechanism. The rubbing surfaces are simply kept well oiled. The design of this contact at the rear is shown in the lower right hand view on plate 146.

171. Gun Carriage.—The gun carriage includes the recoil, elevating and traversing mechanisms described above, and two structural steel side frames with their connecting transoms to which these parts are assembled. This carriage is pivoted on the main girder by a heavy pintle which takes the horizontal component of the shock of firing, but normally the weight is supported on a smaller spring-supported pintle to reduce the friction of traversing. The pintle design is shown on plate 54. The general design of the top carriage is shown on plates 144, 147, and 148.

172. CAR BODY.—The car body consists of two plain plate girders of ordinary design connected by suitable transoms and provided with an operating platform at the rear. The exterior car body design is shown on plate 143. The connecting transoms can be seen in the section given on plate 54.

173. ANCHORAGE.—The anchorage consists of a special ground platform made up in six sections and carried on a special ground platform car. Each section consists of a large structural steel spade and three wooden ties across which two running rails and two supporting girders are fastened, plate 150. As noted above, these sections are carried in the special car, plates 151 and 152, which is provided with a special mechanism for placing the sections, and taking them up and loading them. In placing a platform, a section of the railway line of the required length is removed, pits are dug for the spades and lined with sand or fine stone. The platform car is then run up to the end of this space and one section after another is put down, end to end, and bolted together. After one section is placed, the platform car is run on to that section for the placing of the next. On plates 153 and 154 a complete platform is shown installed and ready for the placing of the mount.

174. When the platform has been bolted up and the sand and rock well tamped around and under the ties and spades, the mount is run on and so placed that 12 sets of clips, which can be seen on the bottom of the lower cords on the side girders, plate 26, are just over the similar sets of clips on the supporting girders of the platform, plate 153. The 24 special wedges (12 on each side), which are carried on the hooks which can be seen on the sides of the girders near the lower cord, plate 155, are then placed between the car girders and the platform girder and the mount is well wedged up and later bolted to the platform. The wedges are each composed of three triangular wedge-shaped sections, the middle one of which can be moved with respect to the other two by a screw. The turning of the screw forces the center wedge up and the other two wedges both out and down, thereby lifting a portion of the weight of the mount from the trucks and attaching it rigidly to the platform through the clips. This type of platform is particularly rigid and no displacement whatever can ordinarily be observed even from very heavy firing. It was a French practice to provide each mount with two platforms both of which could be placed near each other in a curved railway line, thereby giving a total traverse of 20 degrees on the two platforms. The writer has seen a platform placed in two hours after the section of track had been opened and pits for the spades had been prepared. Much less time is required for their removal.

175. Trucks.—The trucks, two in number, are eight-wheel locomotive type with inside journals, and the bodies are made up entirely of structural steel. The journals are 6.693 by 12.2 inches and the wheels 36.22 inches in diameter. The trucks are equipped with both hand and air brakes. It will be observed that they are fitted with the French type of buffer, plate 158. This was intended for service in France. These buffers and couplings have since been replaced by the standard M. C. B. type. The original center-pin design, which can be seen on plate 54, was found to be unsatisfactory for service on American roads, since it can not stand the strain of bumping of the average American train. This has been modified to the heavy center-plate design typical of American standard car equipment.

176. Ammunition Supply System.—The ammunition car used with the Batignolles mounts is identical in design to that employed with 8-inch railway mounts, plates 106 and 107. In service, this ammunition car is placed directly behind the mount, plate 54. The ammunition is placed on the operating platform of the mount by means of the ammunition trolley. It is then picked up by the jib crane, the design of which is shown in detail on plate 159, and transferred to a loading stand at the rear of the gun, plate 160, from which it is slid down into the gun on a removable tray. The gun is loaded at 5 degrees depression, the projectile being rammed by hand. The design of the loading apparatus on the working platform of this mount is very radically different from that provided on the French Batignolles mounts, plate 162. On the French mount the projectile is received directly from the ammunition car and drawn up to the tray at the top of the inclined elevator. When this tray, which is shown in an approximately horizontal position, is tipped up at the rear, the projectile slides forward onto the ammunition stand which can be moved back against the elevator. This ammunition stand is then rolled forward by means of two handwheels, one of which can be seen on the right hand side of the stand, bumping the breech of the gun very hard. The projectile starts to slide into the breech of the gun and is rammed by a mechanical rammer, operated by the same two handwheels. It is felt that the simple modified design is decidedly an improvement over the elaborate French design. A closer view of the ammunition stand, breech of the gun, removable tray, projectile tray, and powder bag of the American mount can be seen on plate 161.

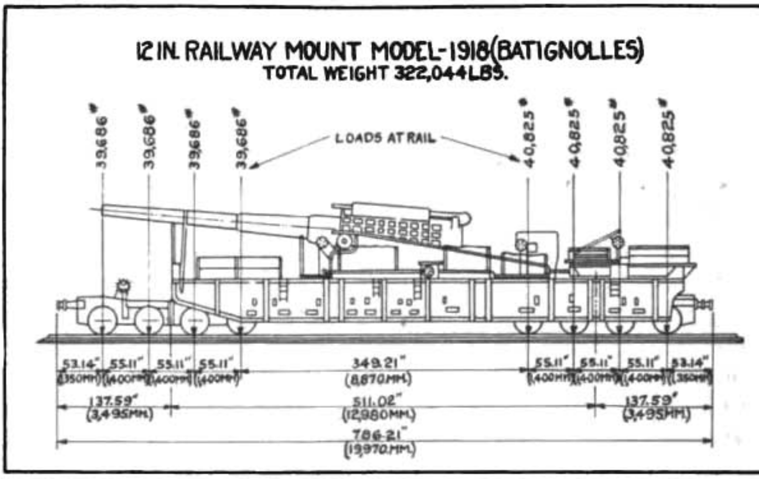
177. Maintenance.—No difficult problems of maintenance presented themselves to the French service on similar mounts, and it is assumed that no serious difficulties will be experienced by the American service. It will likely be necessary to check up occasionally on the adjustment of the anti-friction devices to be certain that the elevating mechanism is working at maximum efficiency.

178. Difficulties Involved in Service.—It can not be said that there are any particular difficulties involved in the service of this design of mount. If the special ground platform car is kept in fine working order the platform sections are not difficult to place, and the time consumed in placing the platforms can not be said to be excessive. One group commander with whom the writer was able to consult a number of times had been in charge of this type of artillery since it had been placed in the field in 1915. He was a naval officer and he was operating his artillery with navy personnel. He was most enthusiastic about the Batignolles design and was positive that he had never experienced any serious difficulties either of maintenance or service. A very striking attitude of commanders who had operated continuously either the Batignolles or the Glisement type mounts was that each had become so thoroughly convinced that the type that he was operating was the only type worth having that he could not conceive of a reason for constructing any other kind. This was especially so of the personnel operating Batignolles mounts. Although they had to admit that the sliding type mounts were giving good service in the field, they could not bring themselves to believe that it was a type of artillery on which construction should continue. The personnel operating sliding artillery held exactly the same point of view regarding their mounts.

179. Merits.—The merit of this design is that it is exceedingly well balanced. It is true that there seems to be an excess of equipment in the ground platforms and platform cars, but with guns of this caliber it is necessary to have a mount that is either provided with a stable foundation or that can be operated on a curved track. The difficulties incident to operating railway mounts on curved tracks are sometimes very great, and it is felt that what might be termed excessive equipment in the platforms and platform cars, is less objectionable than the difficulties involved in the laying of curved tracks. This type of platform can be installed more rapidly than any other existing type of platform for so heavy a gun.

180. Demerit.—The demerit of this mount, if it may be styled such, is the very elaborate ground platform and platform car. It seems quite probable that guns of this caliber might be placed on mounts in which the horizontal component of the force of recoil can be transmitted to the ground by means of struts at the rear, somewhat similar to those used with 8-inch gun and 12-inch mortar mounts. This would likely necessitate the provision of some jacking equipment for lowering the mount, until portions of it were in contact with the service rails or with auxiliary rails, for transmitting the vertical component of the force of recoil into the track by other channels than through the trucks, but this would not be difficult. If such a design can be made, and preliminary investigation indicates that it can, then the Batignolles design is too elaborate.

PLATE 139


12 IN. RAILWAY MOUNT MODEL-1918 (BATIGNOLLES)
TOTAL WEIGHT 322,044 LBS.
39,686#
39,686#
39,686#
39,686#
LOADS AT RAIL
40,825#
40,825#
40,825#
40,825#
53.14" (1350MM)
55.11" (1400MM)
55.11" (1400MM)
55.11" (1400MM)
349.21" (8870MM)
55.11" (1400MM)
55.11" (1400MM)
55.11" (1400MM)
53.14" (1350MM)
137.59" (3,495MM)
511.02" (12,980MM)
137.59" (3,495MM)
786.21" (19,970MM)

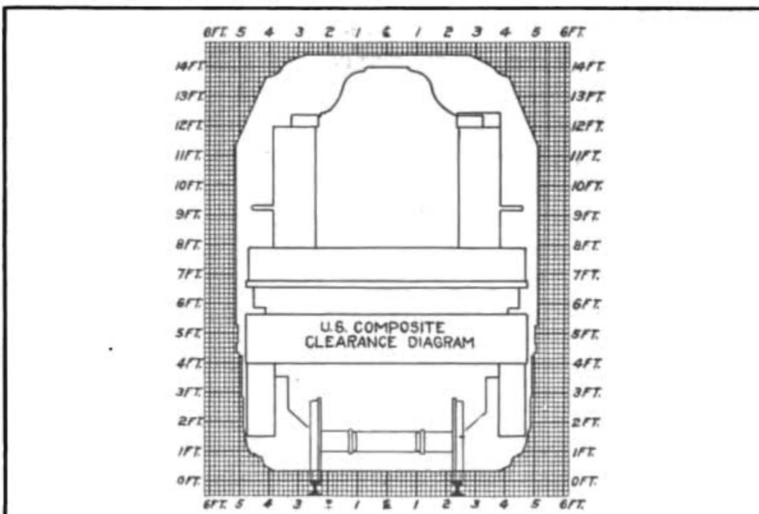
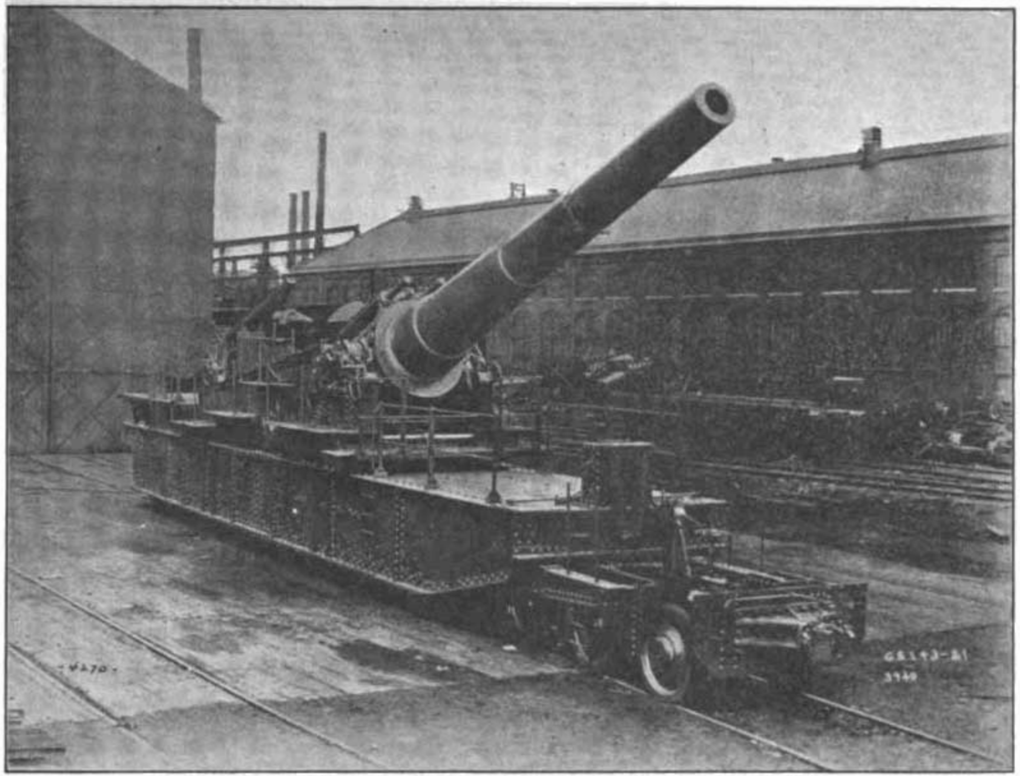
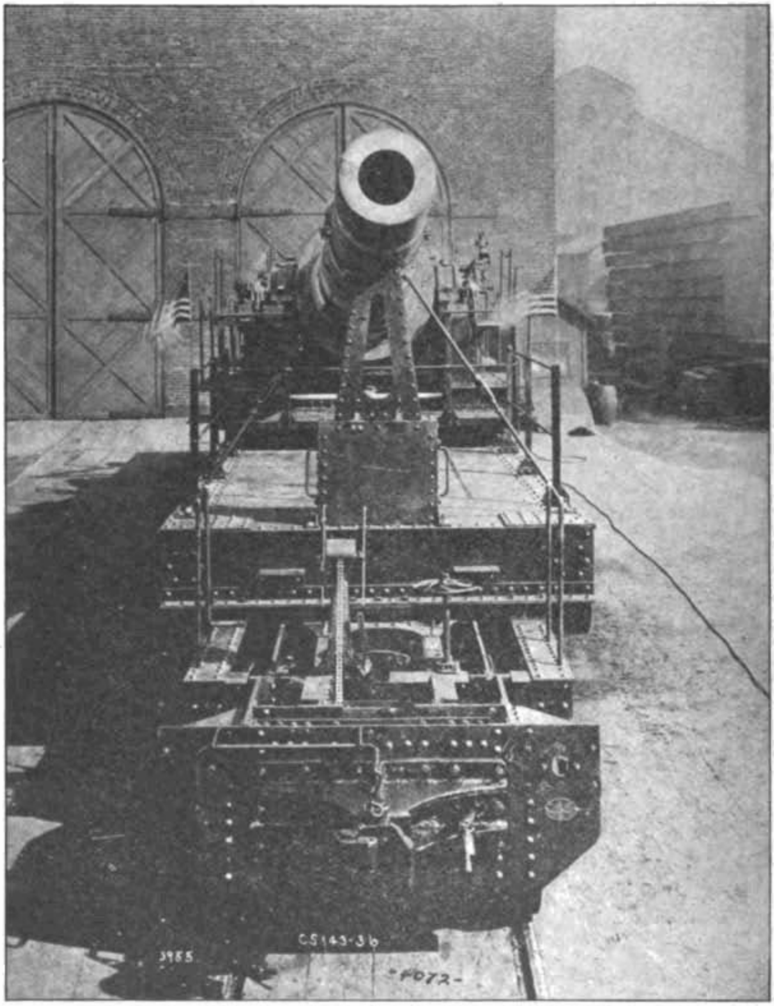

U.S. COMPOSITE
CLEARANCE DIAGRAM
6FT. 5 4 3 2 1 ℄ 1 2 3 4 5 6FT.
14FT.
13FT.
12FT.
11FT.
10FT.
9FT.
8FT.
7FT.
6FT.
5FT.
4FT.
3FT.
2FT.
1FT.
0FT.

PLATE 140

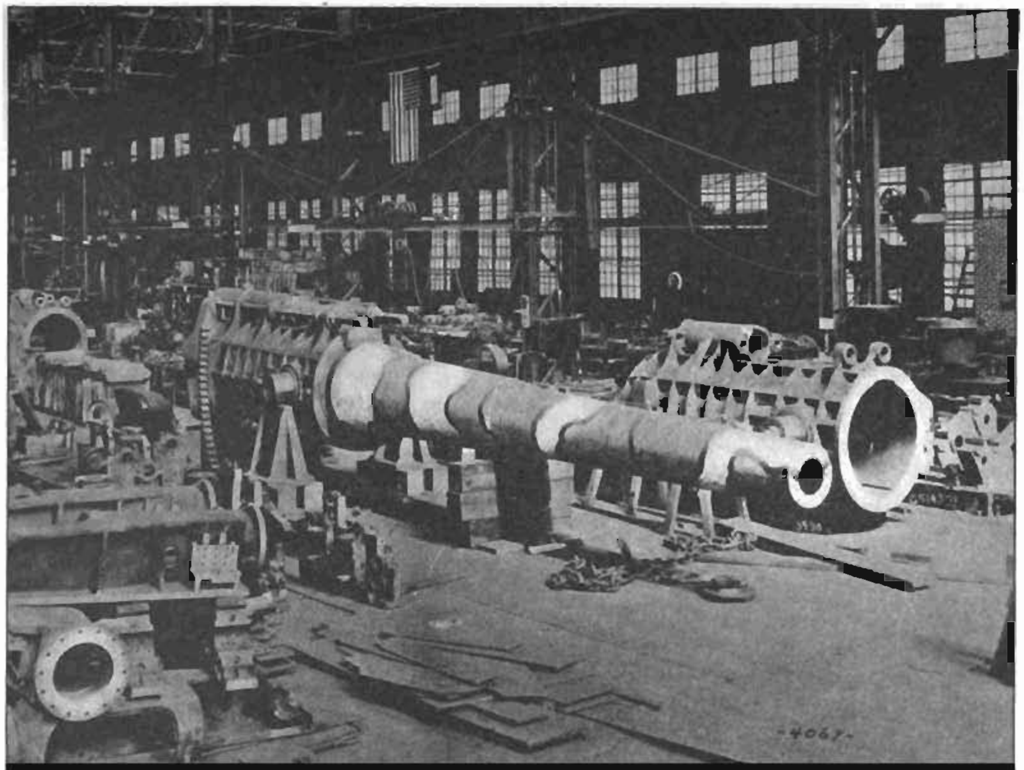


12-INCH, 35-CALIBER GUN ON BATIGNOLLES RAILWAY MOUNT.

PLATE 141

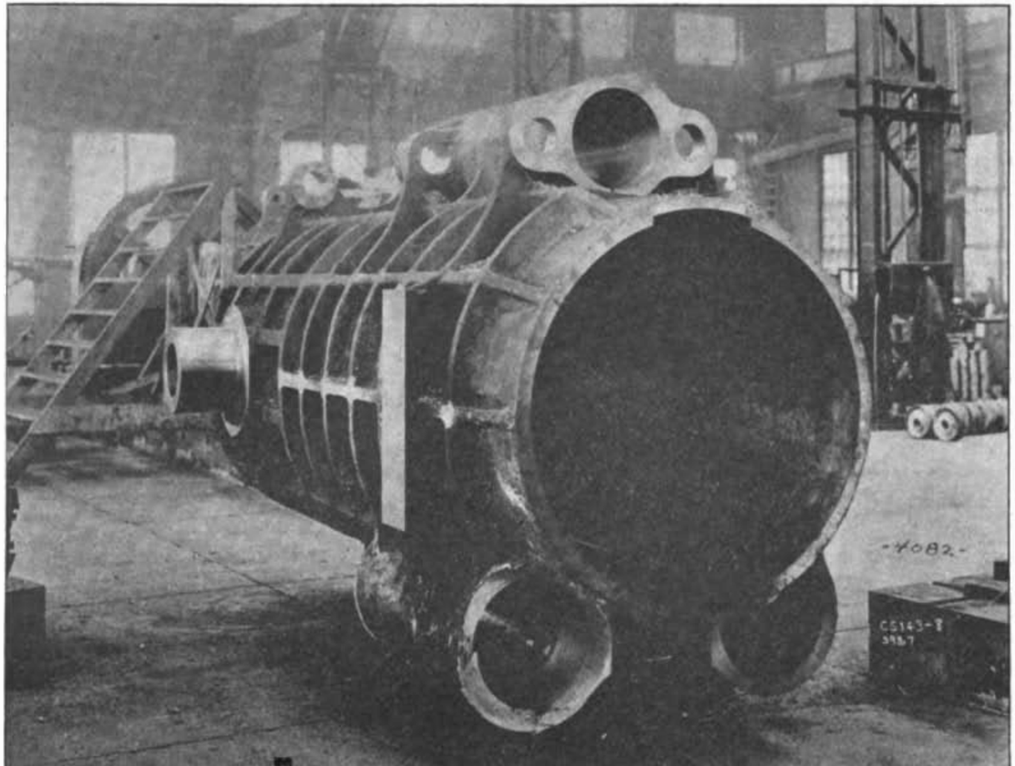


12-INCH, 35-CALIBER AMERICAN GUN ON BATIGNOLLES MOUNT.

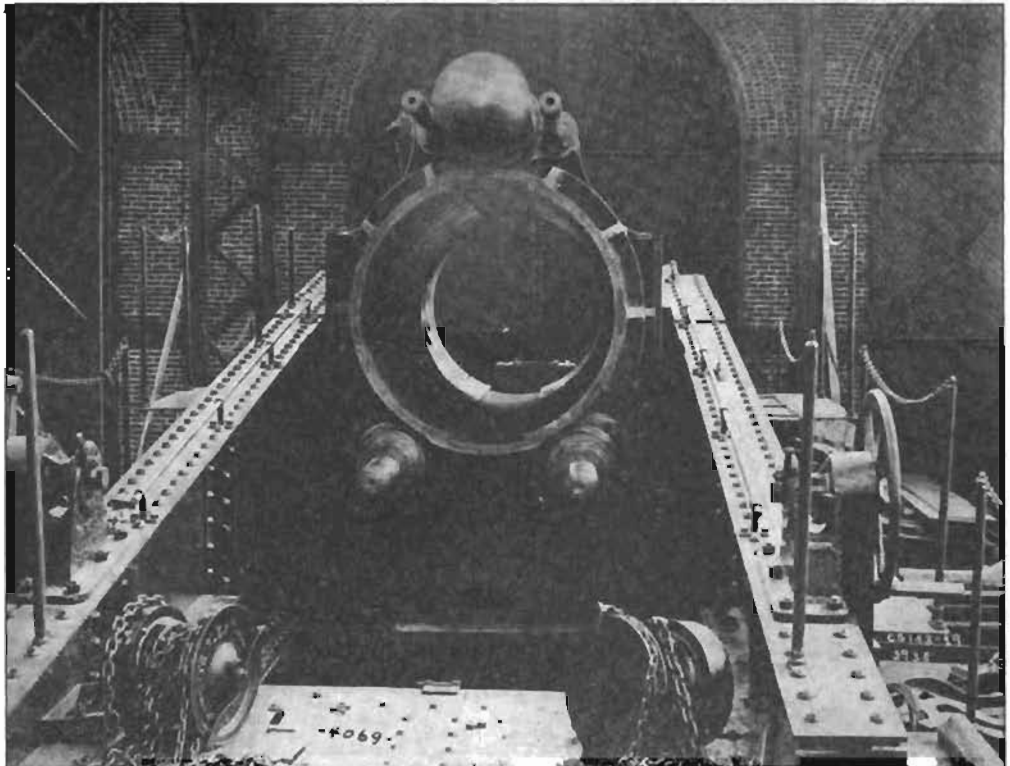


CRADLE RECUPERATOR AND RECOIL MECHANISM OF THE 12-INCH, 38-CALIBER AMERICAN GUN MOUNT.

PLATE 143



CRADLE OF THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.



CRADLE RECUPERATOR AND RECOIL MECHANISM OF THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

181768—21——14

Plate 145

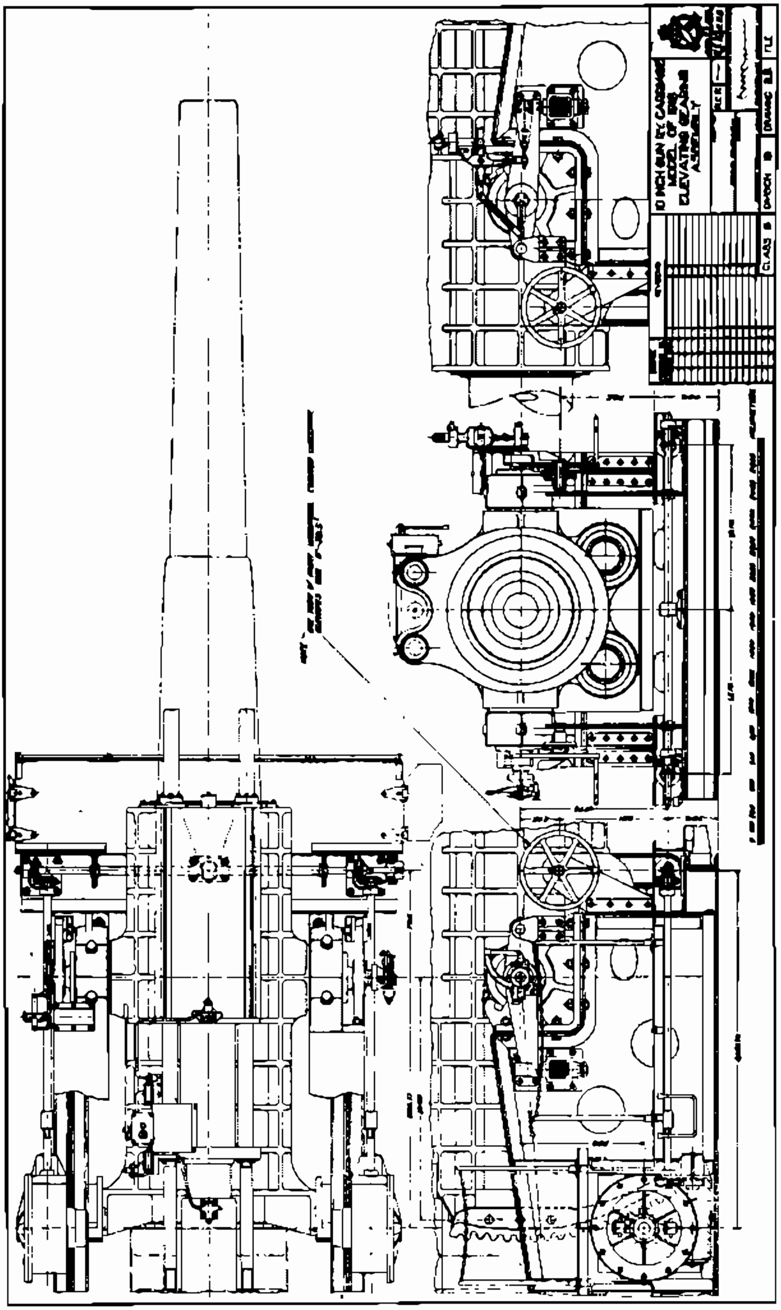
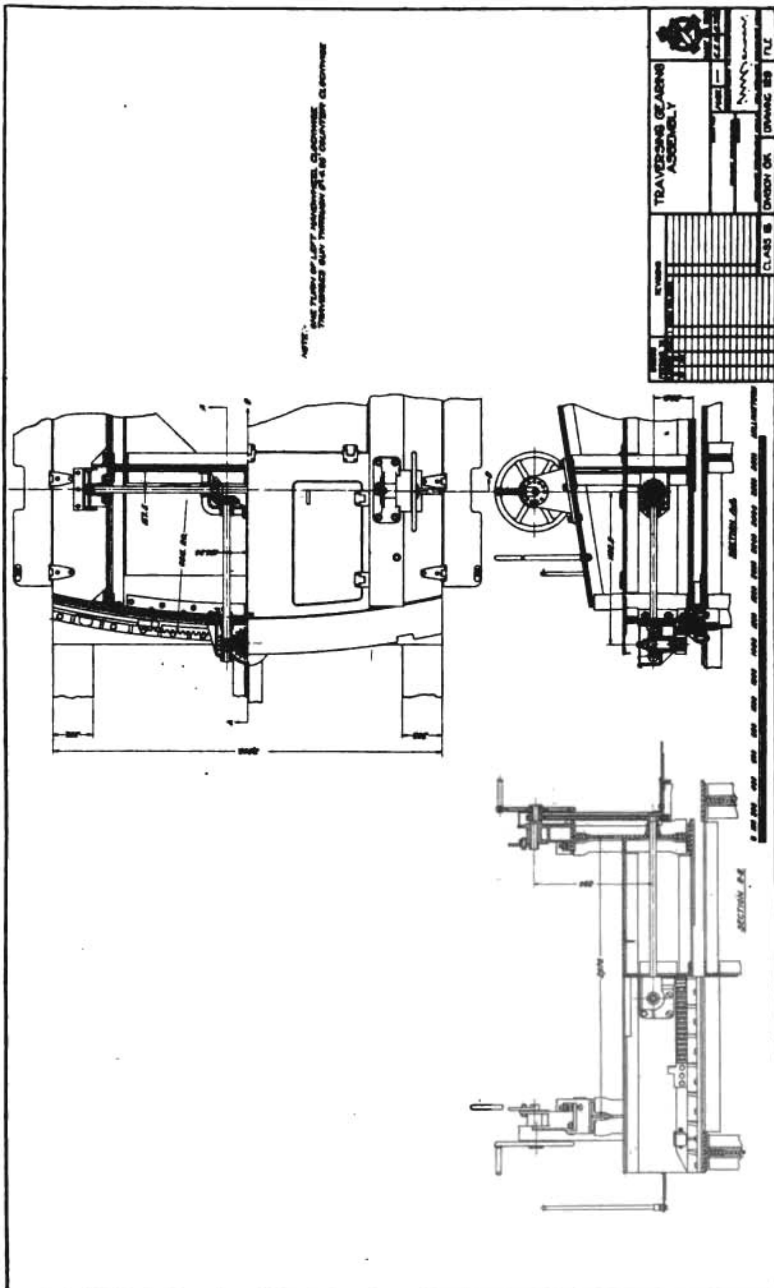
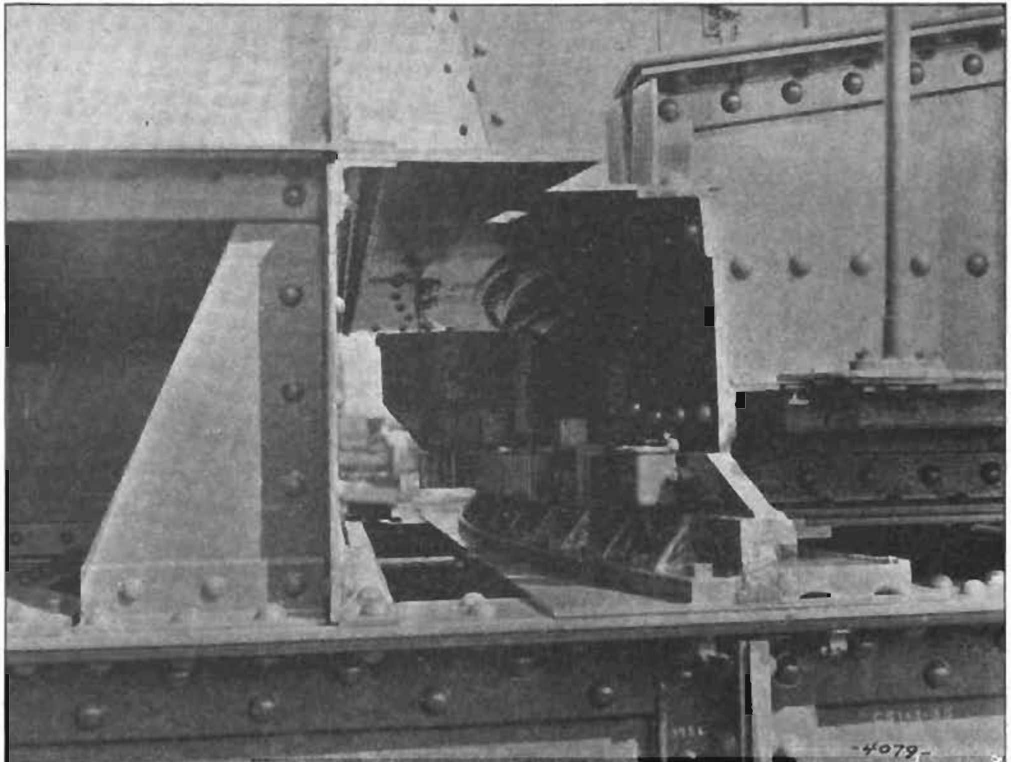


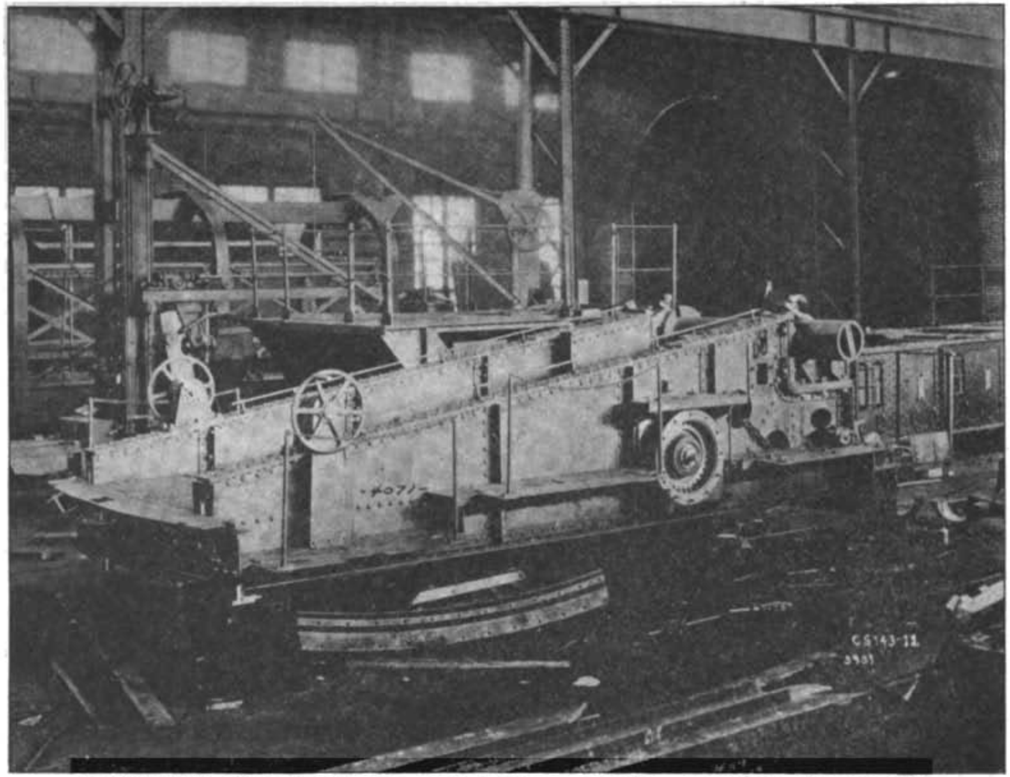
PLATE 146



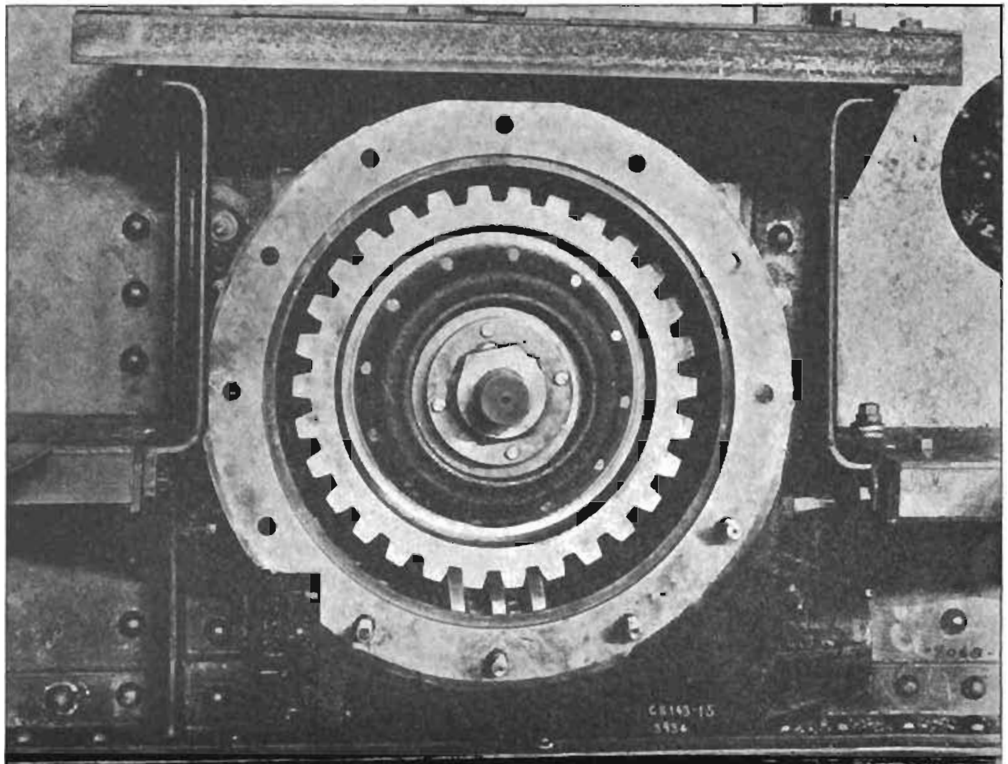


RACK AND PINION OF THE TRAVERSING MECHANISM OF THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

PLATE 148



TRAVERSING HANDWHEELS OF THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.



ELEVATING WORM WHEEL AND SLIP-FRICTION DEVICE OF THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

PLATE 150

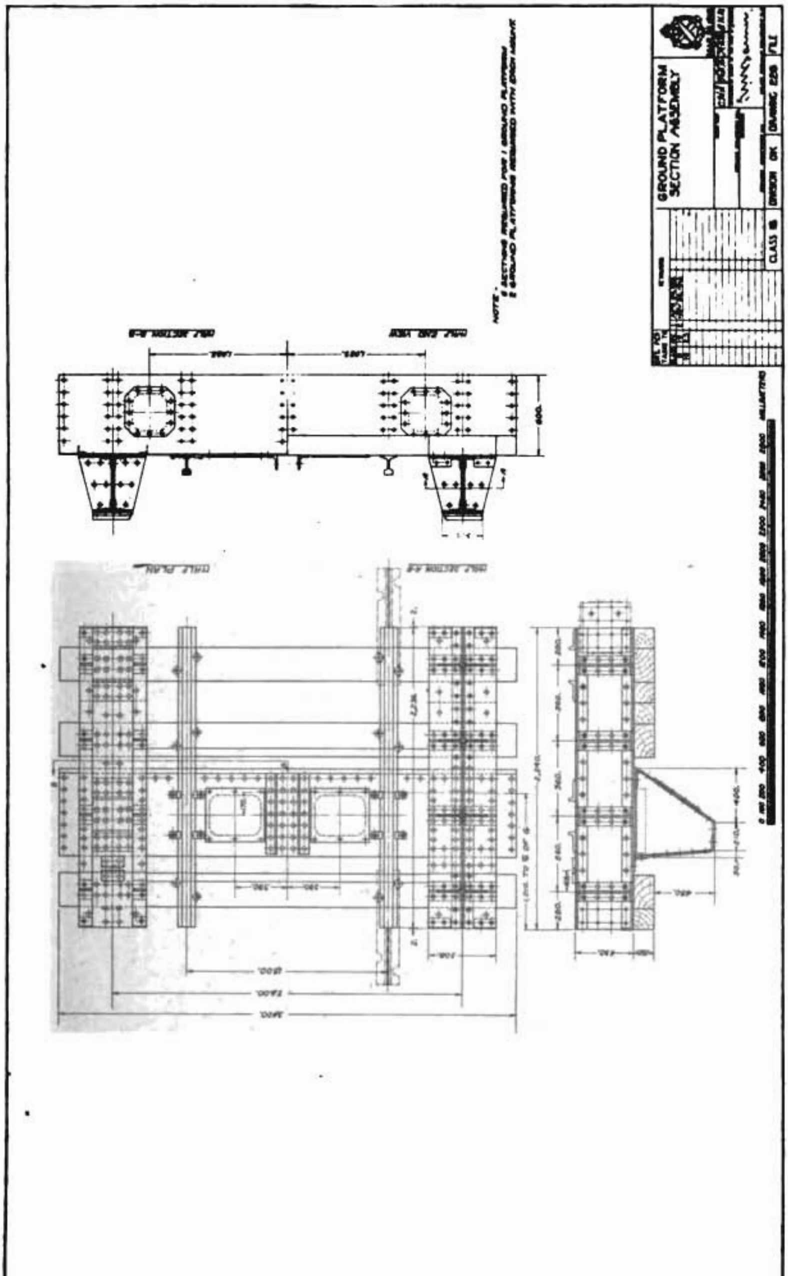
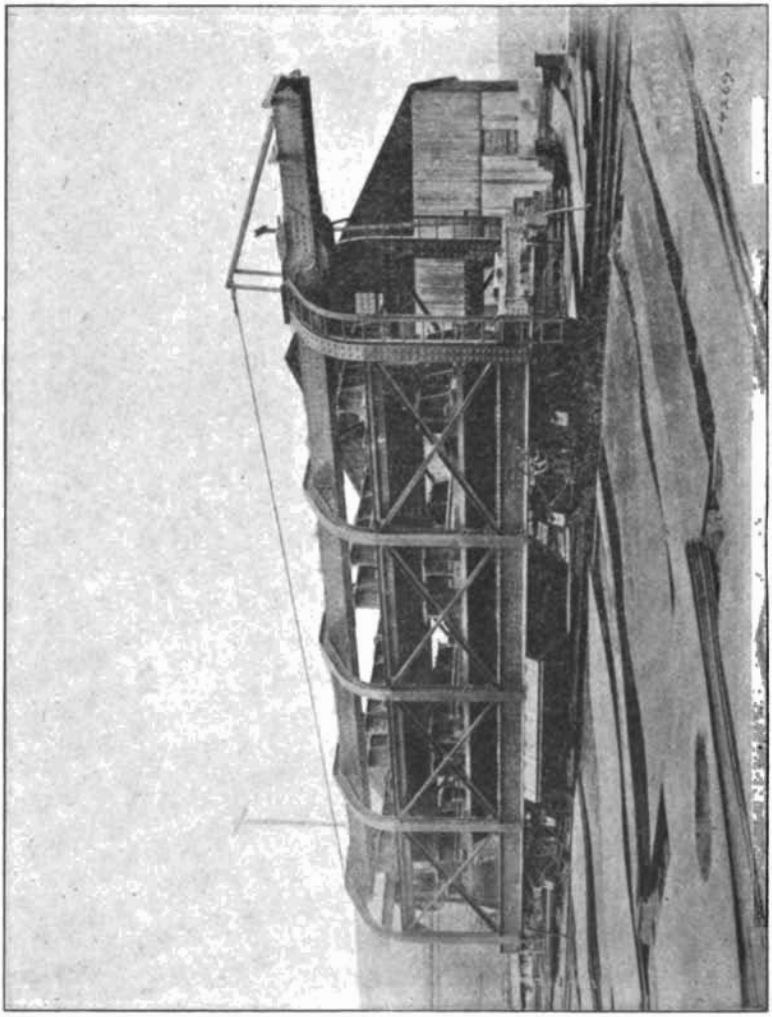
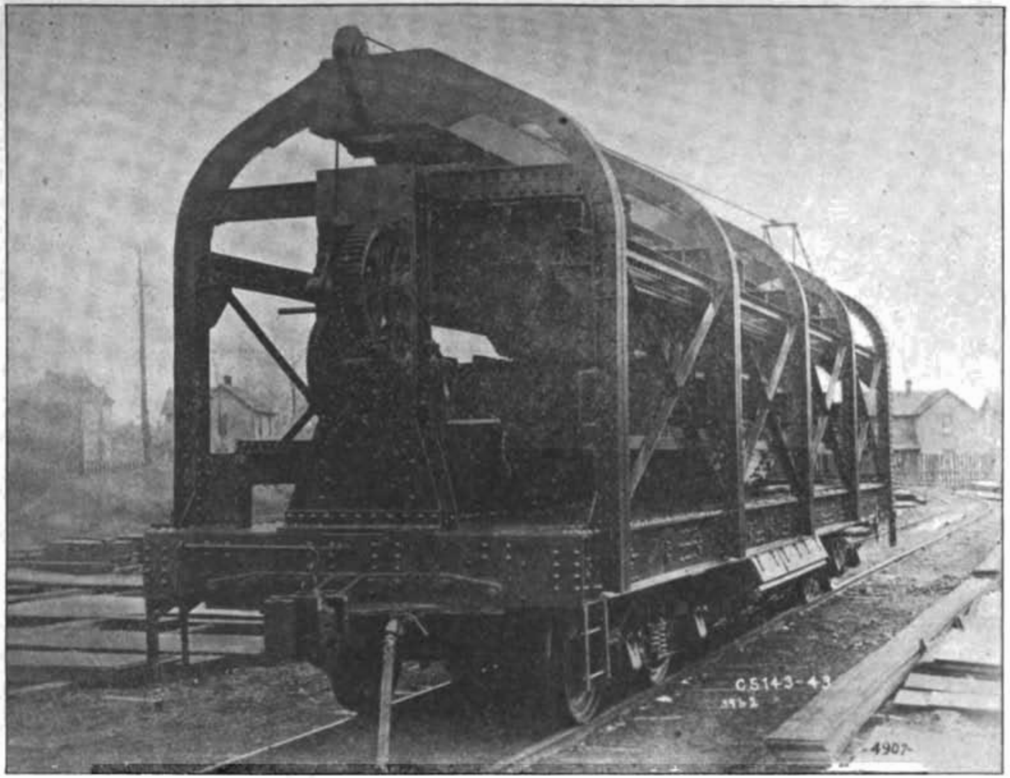


PLATE 151



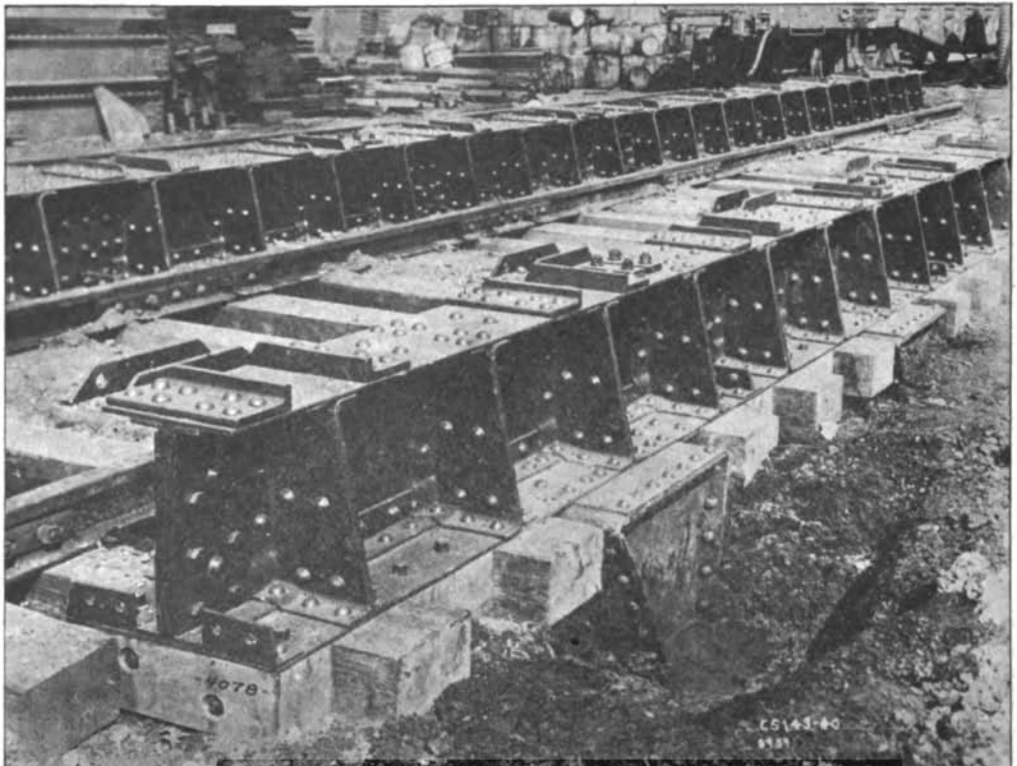
FIRING PLATFORM CAR FOR THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

PLATE 152



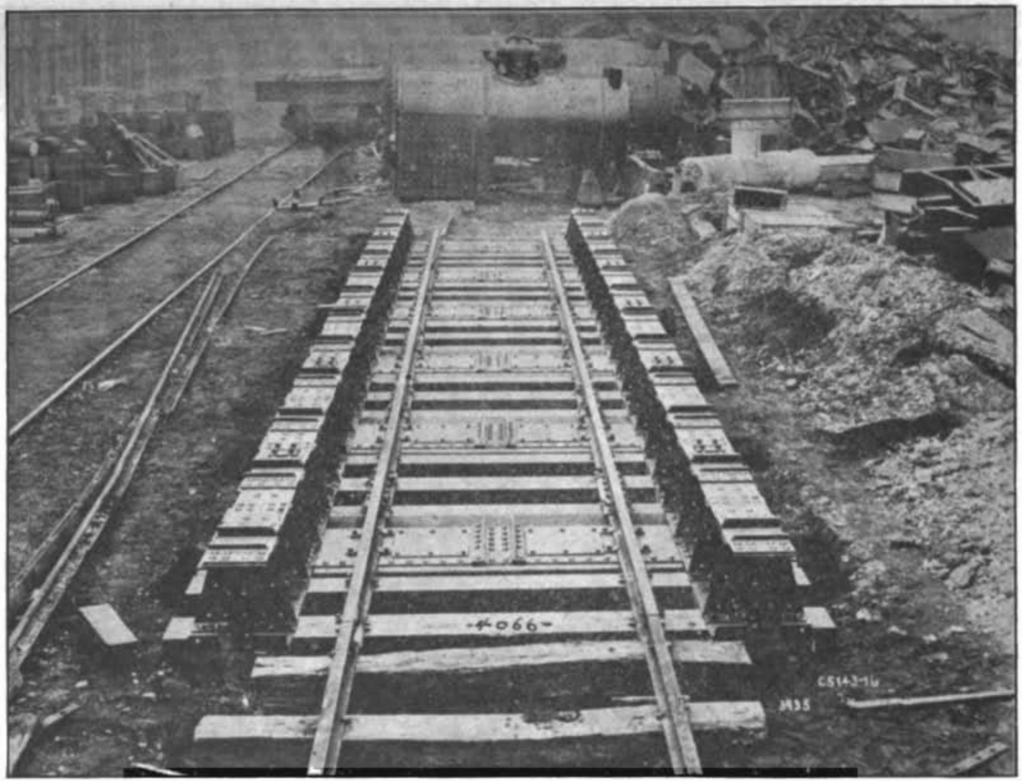
FIRING PLATFORM CAR FOR THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

PLATE 153



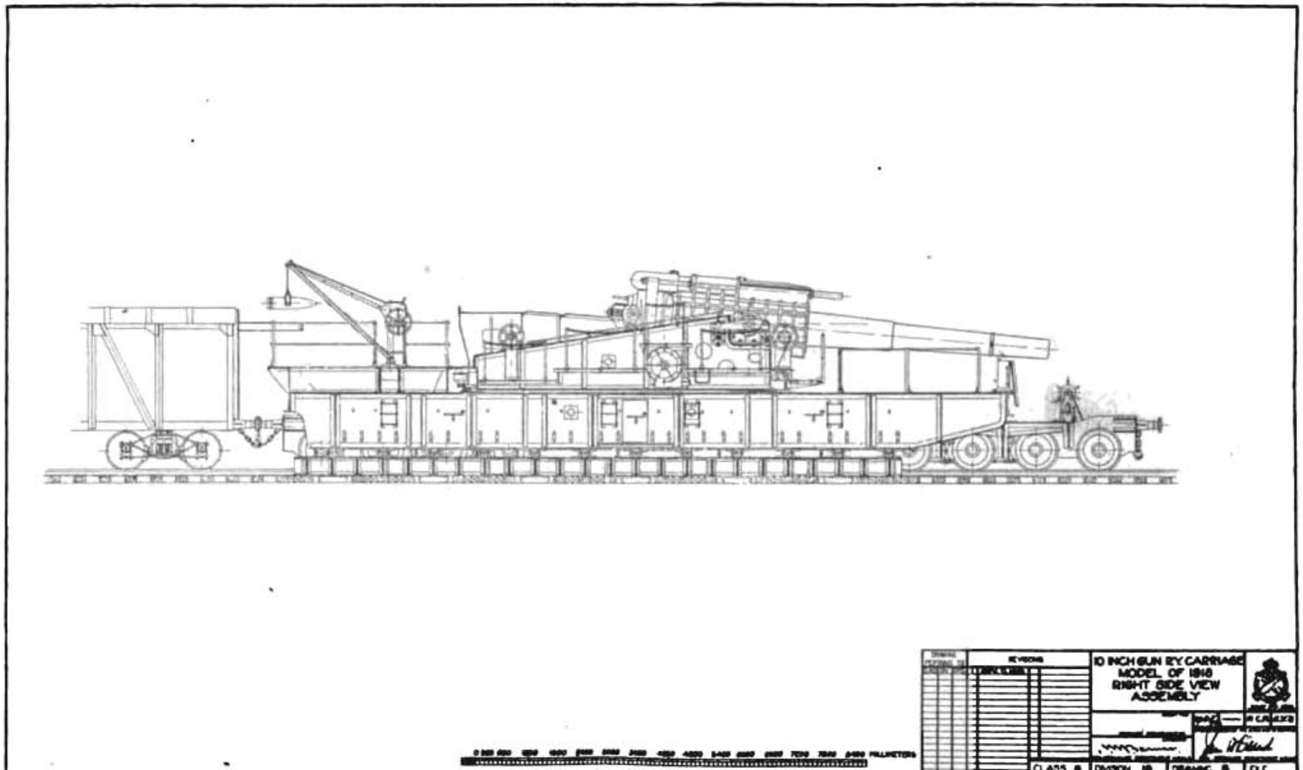
FIRING PLATFORM FOR THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

PLATE 154



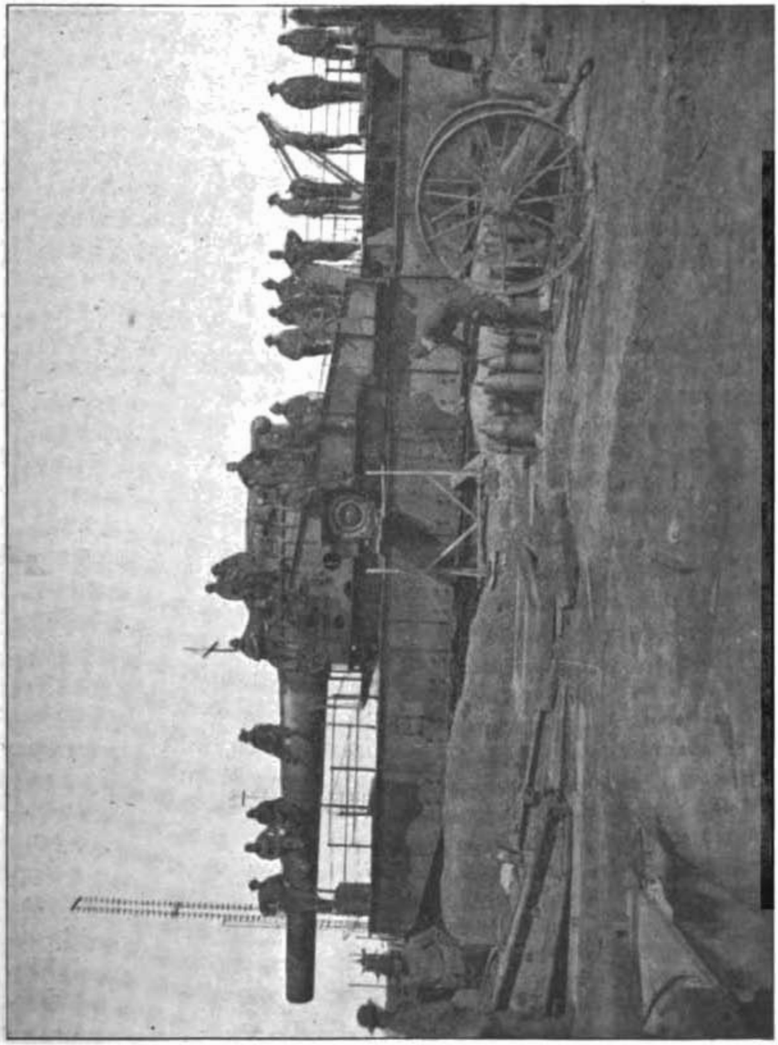
FIRING PLATFORM FOR THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

PLATE 155



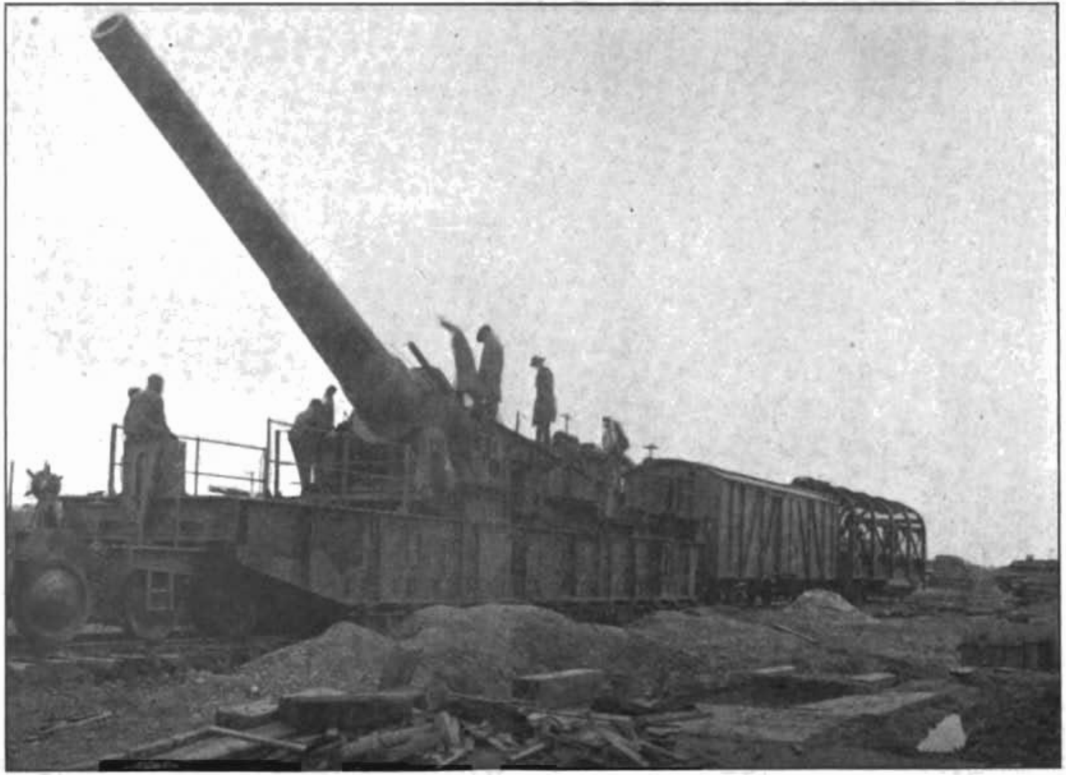
12-INCH, 35-CALIBER AMERICAN GUN MOUNT ON ITS FIRING PLATFORM.

PLATE 156



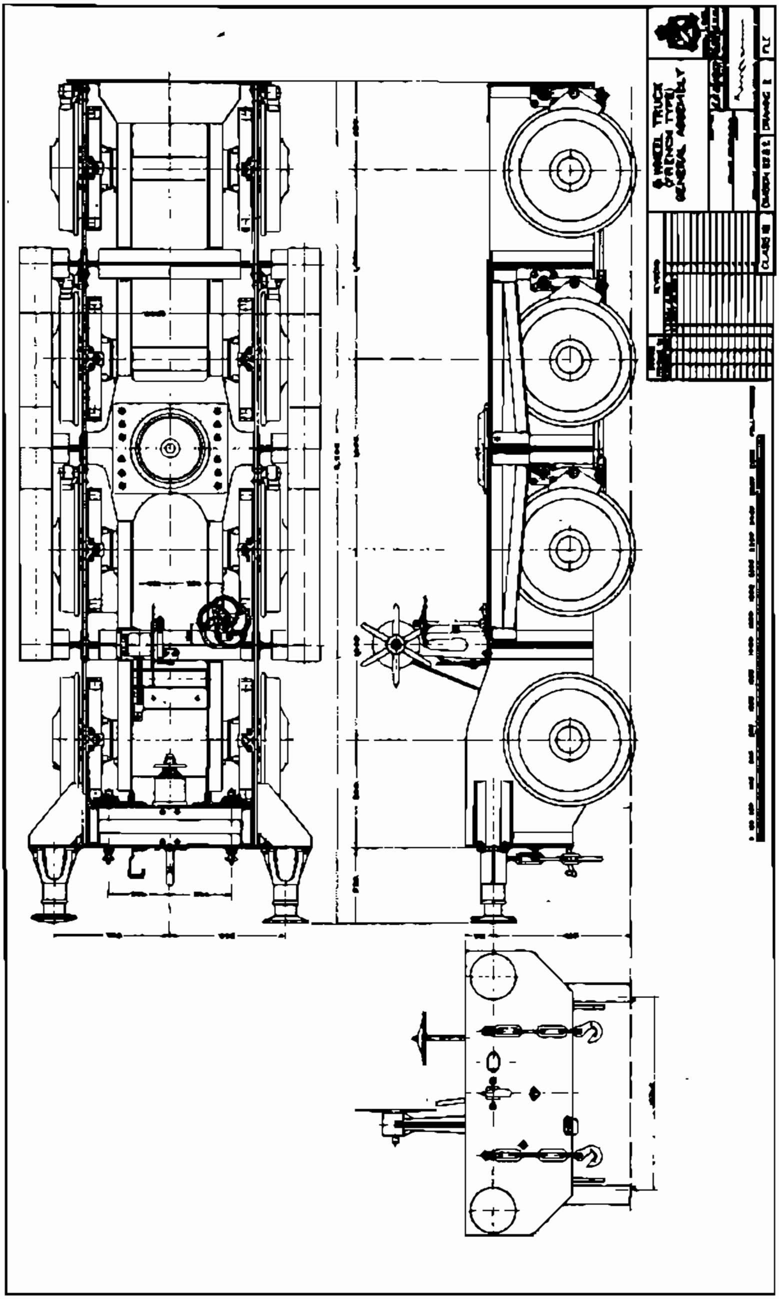
12-INCH, 35-CALIBER AMERICAN GUN MOUNT ON ITS FIRING PLATFORM.

PLATE 157



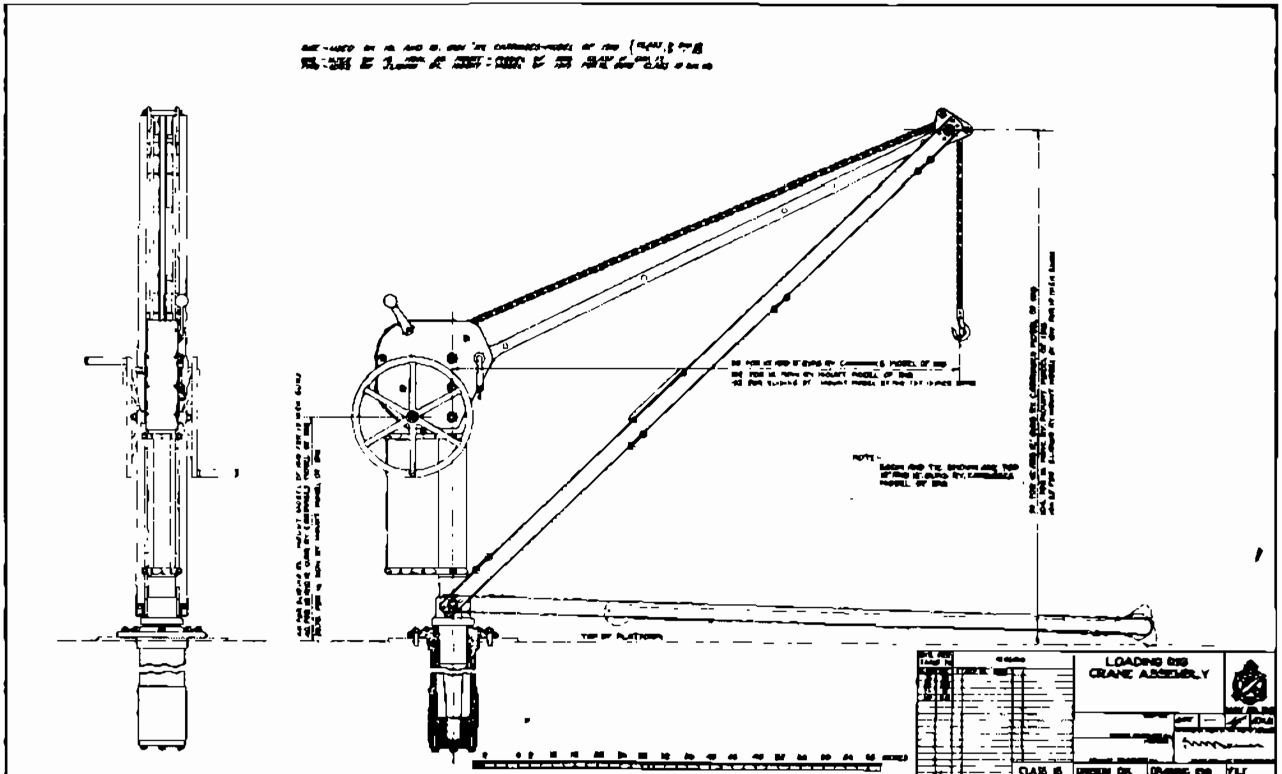
12-INCH, 35-CALIBER AMERICAN GUN MOUNT, AMMUNITION AND PLATFORM CARS.

PLATE 158



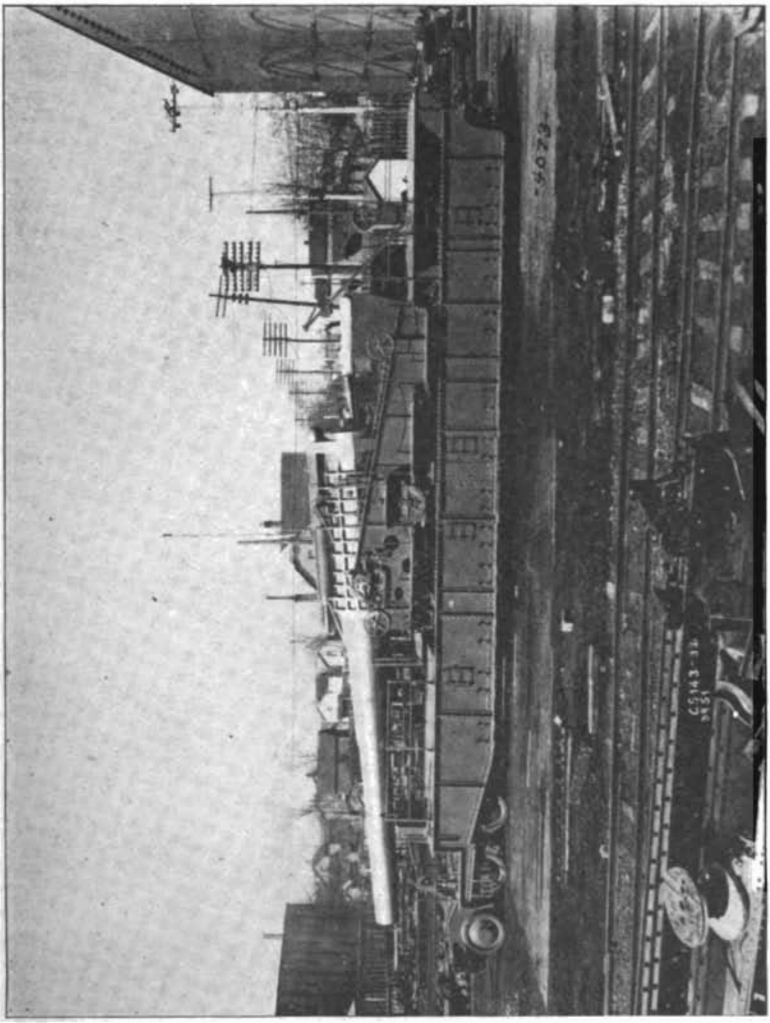
TRUCK FOR THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

PLATE 159



AMMUNITION CRANE OF THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

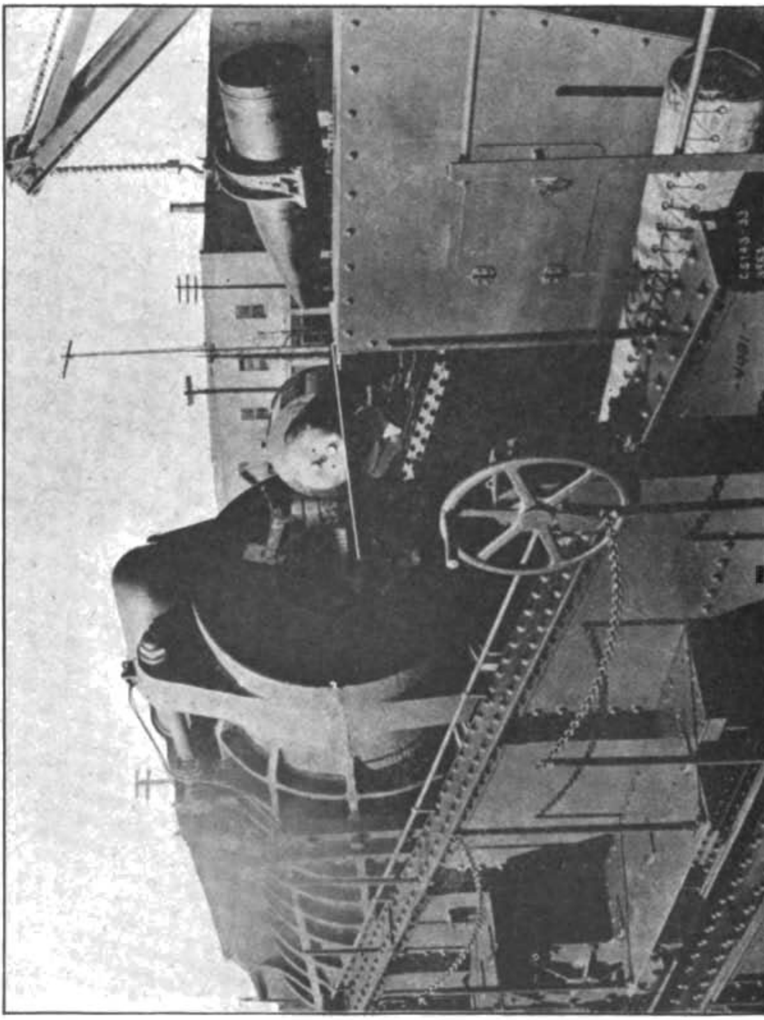
PLATE 160



LOADING TABLE FOR THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

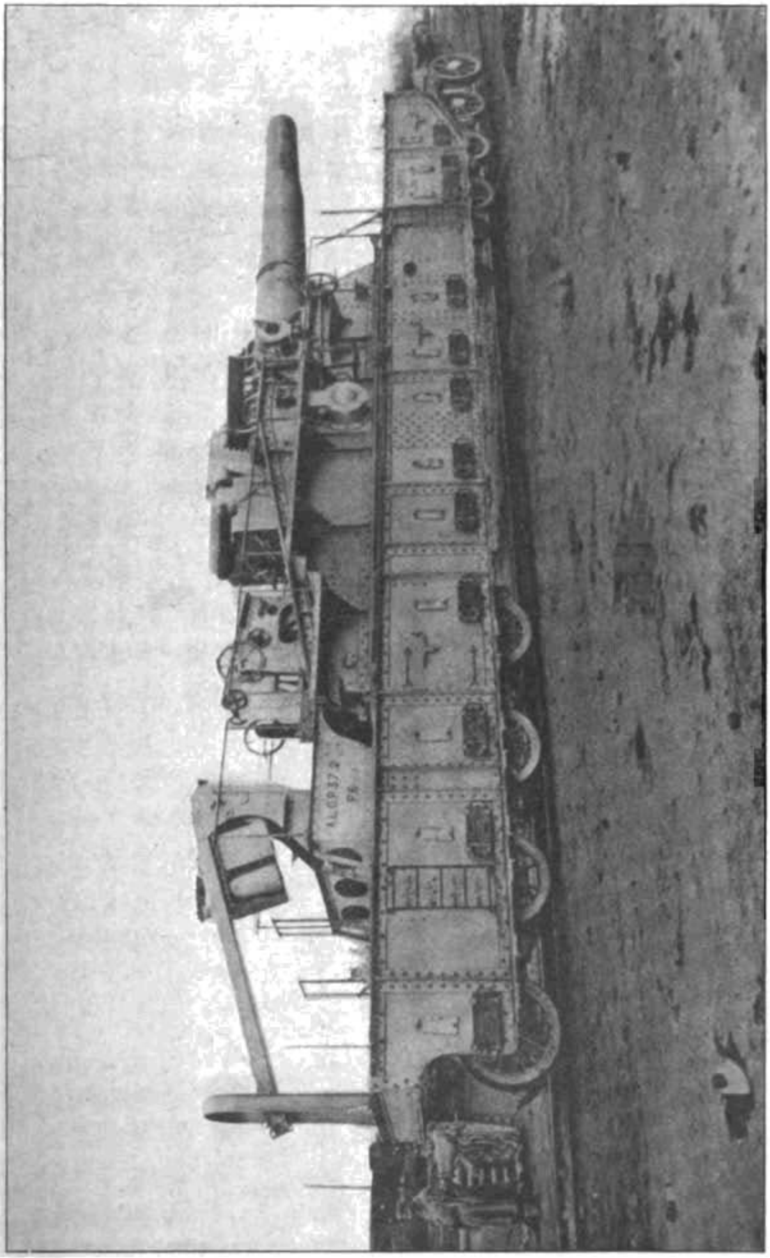
181768—21——15

PLATE 161



LOADING TABLE AND TRAY OF THE 12-INCH, 35-CALIBER AMERICAN GUN MOUNT.

PLATE 162



370-MM. FRENCH HOWITZER ON BATIGNOLLES MOUNT.

7.—AMERICAN 12-INCH 50-CALIBER GUN ON RAILWAY MOUNT. (20)

181. This mount is of the French Glissement or sliding type modified to suit the American war-time manufacturing conditions. The gun rests in trunnion bearings rigidly connected to the main girders of the mount. A general view and details are shown on plates 163 to 184.

182. GUN.—The piece used with this mount is a 12-inch gun, model of 1918, Bethlehem, of 50 calibers length, plate 15. It is equipped with fixed trunnions and counterweight on the breech end, plate 165, to allow mounting the trunnions as near the breech as possible. The breech block is of the Welin or step thread type, plates 169 and 170.

183. RECOIL MECHANISM.—No recoil mechanism, in the ordinary sense of the term, is used with this mount. The gun is fixed to the girders, as noted above, and the entire mount slides back along the track as a unit under the shock of recoil. Description of the arrangement by which this is accomplished is given under "Anchorage." Counter-recoil is accomplished by the same mechanism as traverse.

184. ELEVATING MECHANISM.—Elevation from the loading position, minus 4 degrees to plus 40 degrees, is secured through a segmental circular rack attached to one side of the counterweight on the breech of the gun. The pinion meshing with this rack connects through a slip-friction device, a worm and wormwheel and sets of bevel gears with two handwheels located on top of the two side girders. Any excessive thrust due to fire is taken up by the slip-friction device and no dangerous strain can come on the gear. One turn of the handwheel moves the gun through 0.625 degrees in elevation. Details of this mechanism are shown on plate 172.

185. TRAVERSING MECHANISM.—No provision is made on this mount for traversing the gun; pointing in azimuth is accomplished by translating the entire carriage along the curved firing track. To accomplish this, two translating mechanisms are provided, one on each of the two inner eight-wheeled trucks. Each translating mechanism consists of a train of four gears and two sets of sprockets and chains connecting the operating handwheel with one axle of the truck, plate 117. The total ratio is 100 turns of the handwheel to one turn of the truck wheel and on the shop test of the carriage, four men on each operating handle moved the mount at the rate of about 3 feet per minute. It is probable that this performance will be materially improved as the apparatus is limbered up by use. A clutch is provided between the gear train and the chain so that the gears can be disconnected when the piece is fired. This is necessary in order to avoid excessive speed in them as the car moves backward in recoil. For traveling considerable distances, the chain between truck axle and the rest of the mechanism is removed on all mechanisms.

186. An alternative power translating arrangement is provided on the front span bolster of the mount. This comprises a 50-horsepower gasoline engine and winch which are capable of exerting a pull of about 7,000 pounds; cable and sheaves are provided so that this may be multiplied to the extent necessary to move the mount. It is not possible to readily move the mount backward with this apparatus, but if the mount is pulled somewhat too far forward, it can be run back by the hand translating mechanism. One of the mounts, plate 168, is equipped with electric motors for driving the translating mechanisms; the power is supplied from a 25-kilowatt gasoline generator set mounted on a special recoiling base on the rear of the working platform. It is possible to move the mount either forward or backward by these motors.

187. Gun Carriage.—In this mount the gun carriage and car body are incorporated in a single unit and are described in the next paragraph.

188. Railway Car Body.—The railway car body consists of two large box girders built up of structural steel and connected by transom plates. These girders are carried on span bolsters, plate 164, each of which, in turn, rests upon two trucks. Cast-steel trunnion bearings are mounted on top of the girders and are provided with an antifriction device which supports the gun on small trunnions for elevating or depressing, but allows strains to be transmitted directly to the main trunnion bearings during firing. Operating platforms, loading apparatus, etc., are also provided on the car body. The main girders rest upon span bolsters through a special center plate and king bolt arrangement with removable center and side bearings. A lever is provided on the side of the span bolster, plate 176, by moving which these bearings can be withdrawn, so that a vertical movement of 5 inches between girder and span bolster is possible. This is provided so that any possible sinking of the track and consequent lowering of the main girder can not bring undue strain upon the truck.

189. Anchorage.—As noted above, this carriage is of the sliding type and is not rigidly braced against the ground. It is fired from a specially prepared track laid with extra long ties upon which are set up eight lines of 12-inch, 55-pound steel I beams called bearing stringers, plate 177. The weight of the mount is transferred from the trucks to these stringers by means of 10 sleepers, which are special wooden beams attached crosswise under the main girder. These are attached to the main girder through lifting wedges, which permit them to be lowered, so that they press upon the bearing stringers, or raised, so that they clear and the weight of the mount is taken by the trucks, plate 178. The lifting wedges, one of which is provided at each end of each sleeper, consist of a fixed casting fastened to the underside of the side girder, a movable wedge attached to the sleeper and capable

of vertical movement only, and a second movable wedge between these two, which can be moved horizontally by means of a screw threaded through its center, bevel gears, and operating lever. As the lever is turned, the upper wedge is moved along by the screw and the lower wedge with sleeper is raised or lowered accordingly. Each sleeper consists of a plate steel carrier into which are bolted three heavy wooden beams at each end. While the gun is in action the two ends of the sleeper are supported on the lower wedges of the lifting-wedge mechanism described above. For traveling the sleepers are slid out sideways with the help of sleeper cranes and are loaded separately. For firing the special track with bearing stringers as above described is laid on an 11-degree, 48-minute curve. The mount is pushed approximately to position on this track by means of a locomotive and is adjusted exactly by the translating mechanism. The sleepers are inserted and the weight of the mount is transferred largely to them by the operation of the lifting wedges. The gun is then fired and the mount slides backward along the track for a short distance. The wedges are raised and the mount is run forward to its original position by the translating mechanism, or by the gasoline winch already mentioned. Except for the span bolster center plate arrangement and the character of the wedge mechanism, this anchorage arrangement does not differ materially from that employed in the 10-inch sliding mount.

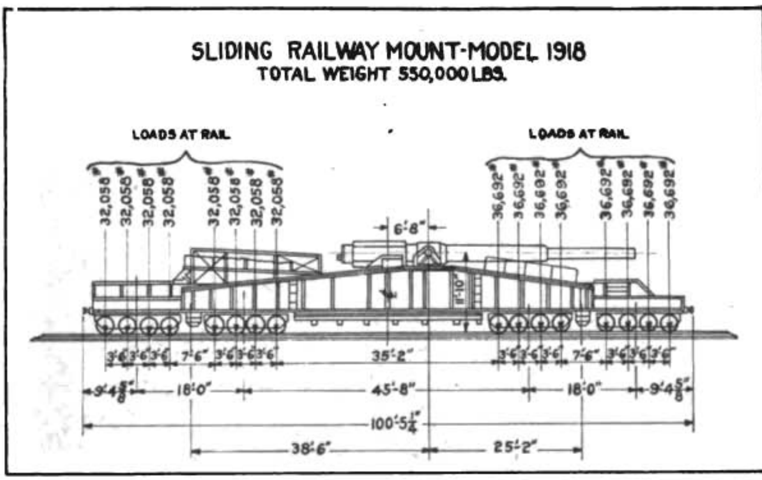
190. Trucks.—Four eight-wheel trucks, plate 179, are provided for this mount. They have structural side frames, cast-steel bolsters, 5.5 by 10 inch journals, and 30-inch wheels. The two outermost trucks are provided with air brakes, plate 180, and the two innermost with translating mechanism, as described under Traversing mechanism. Semi-elliptic springs are provided over each journal box.

191. Ammunition Supply System.—The ammunition car used with this mount, plate 181, is the standard Railway Artillery ammunition car. Special fixtures are provided, however, plate 182, for the 12-inch ammunition. The car is kept down the track at some distance from the mount itself, and a special shuttle car, plate 183, which is pushed by hand, is employed in transferring ammunition from the ammunition car to the mount. In use the shuttle car is run up against the end of the ammunition car and the trolley in the latter is run out over it. Ammunition is picked up from the interior of the car, run out, and let down directly on the shuttle car. The shuttle car is then pushed along the track by hand to the mount. The ammunition is picked up by means of the jib crane mounted on the rear span bolster and is transferred to an ammunition tray which runs on an inclined track from the back end of the main girders to the breach of the gun. This tray is provided with a buffer, so that when it is released it may run down the track and be stopped at the breech of

the gun without undue shock. The projectile slides on and seats itself in the gun. The loading angle is minus 4 degrees. The general arrangements for loading, as described above, are shown on plate 184.

192. MAINTENANCE.—Experience in hauling the mount over the road has shown that there is considerable weaving of the two side girders relative to each other which causes binding of the trunnion bearings. A complete steel plate decking is being added along the top of the girders to eliminate this. A similar weaving in French mounts has resulted in the breaking of trunnion caps. None of the mounts has yet seen sufficient service to develop serious troubles except as just noted. It is probable when these difficulties are remedied that no serious problems of maintenance will present themselves in field service.

PLATE 163



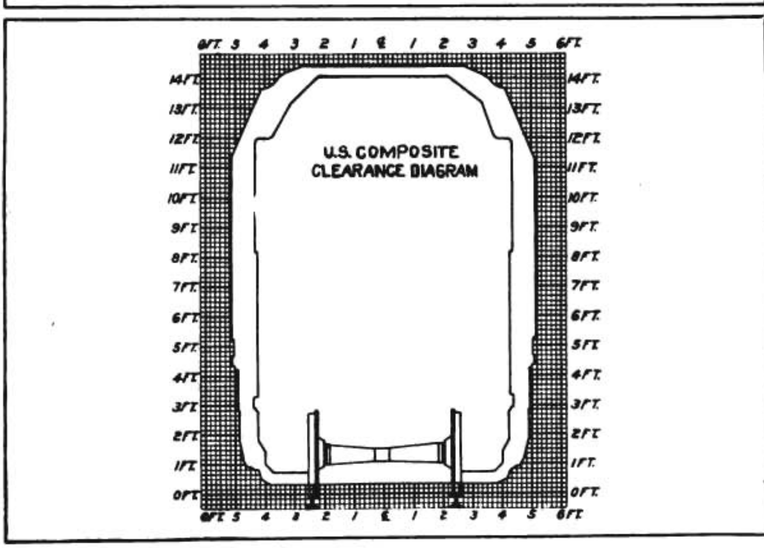


PLATE 164

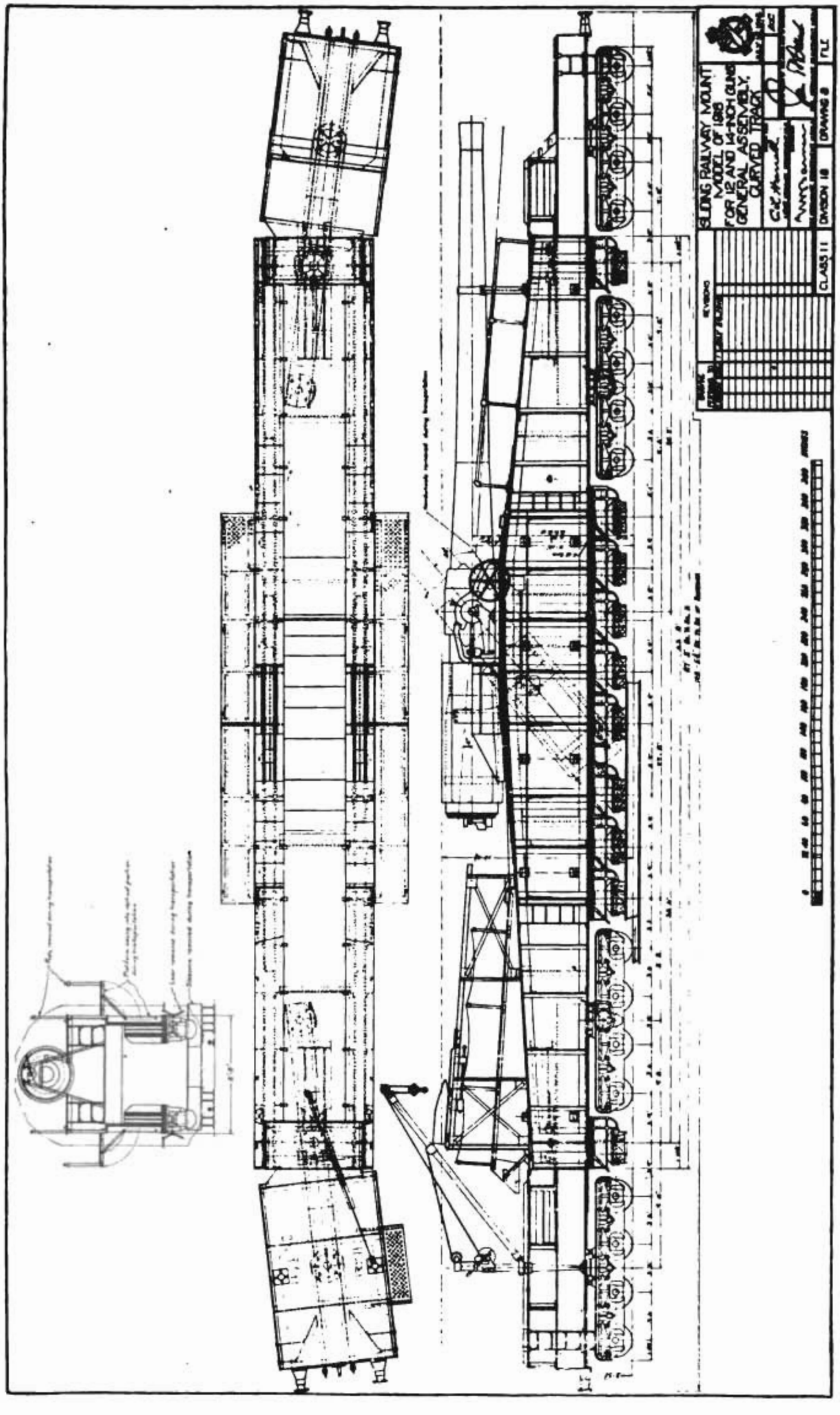
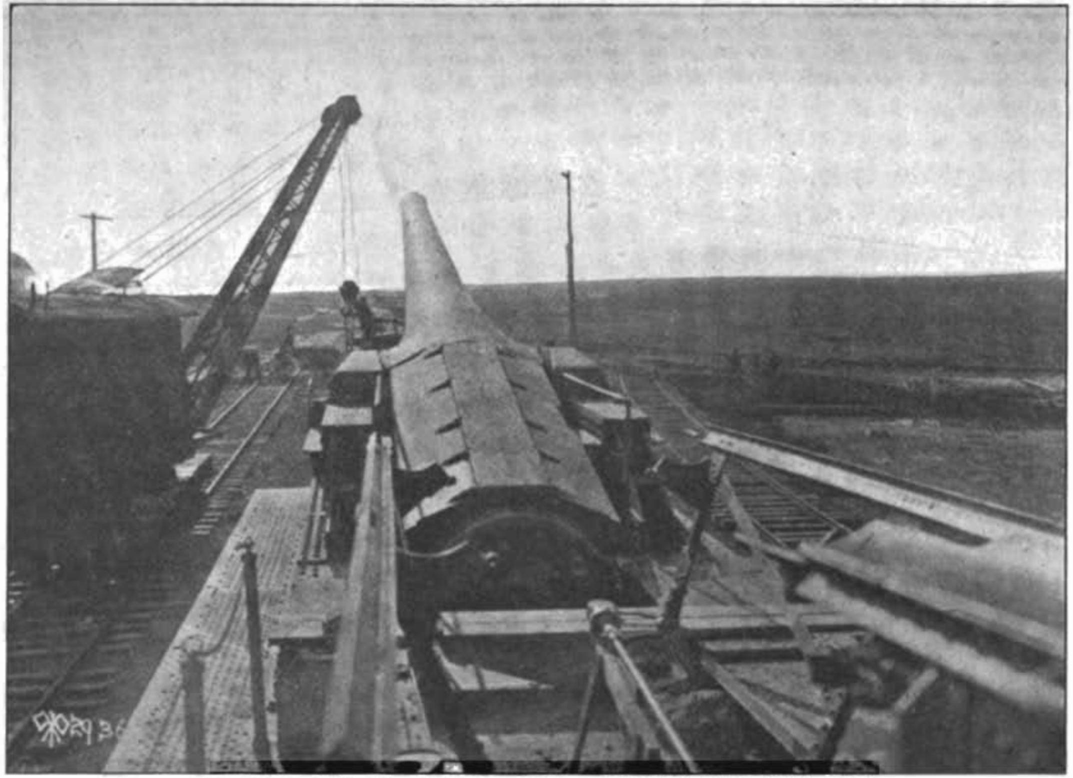
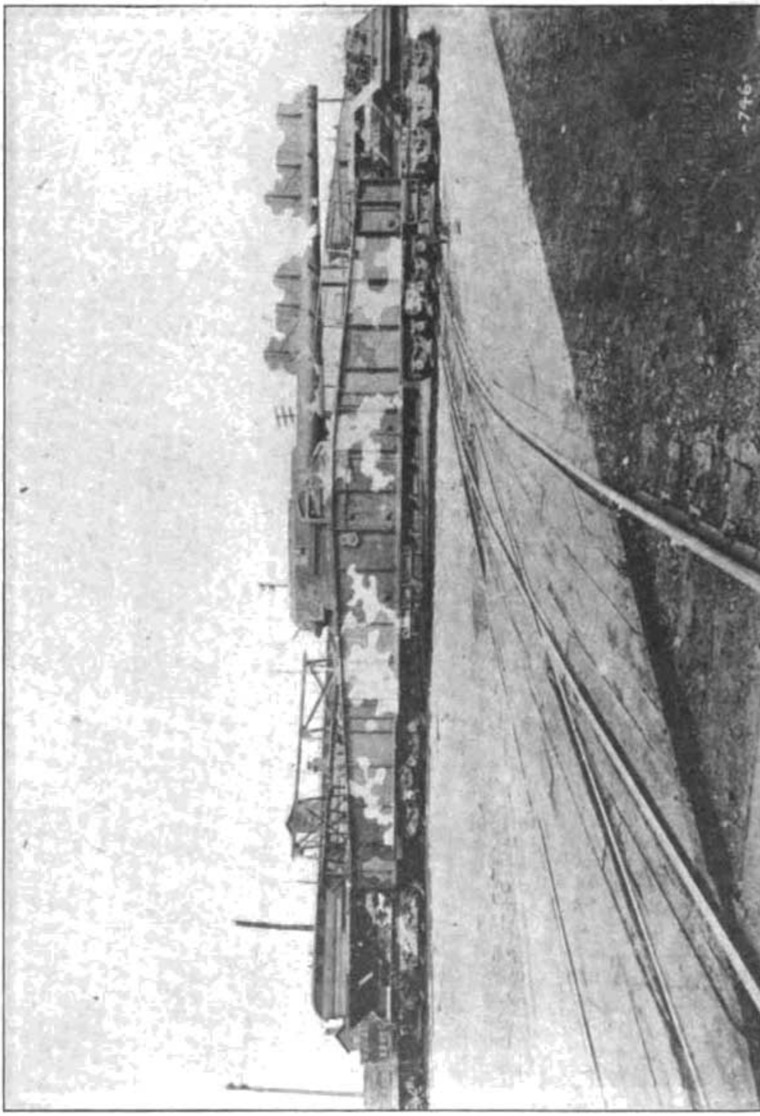

SLIDING RAILWAY MOUNT
MODEL OF 1918
FOR 12 AND 14-INCH GUNS
GENERAL ASSEMBLY,
CURVED TRACK
CLASS 11
DIVISION 18
DRAWING 8

PLATE 165



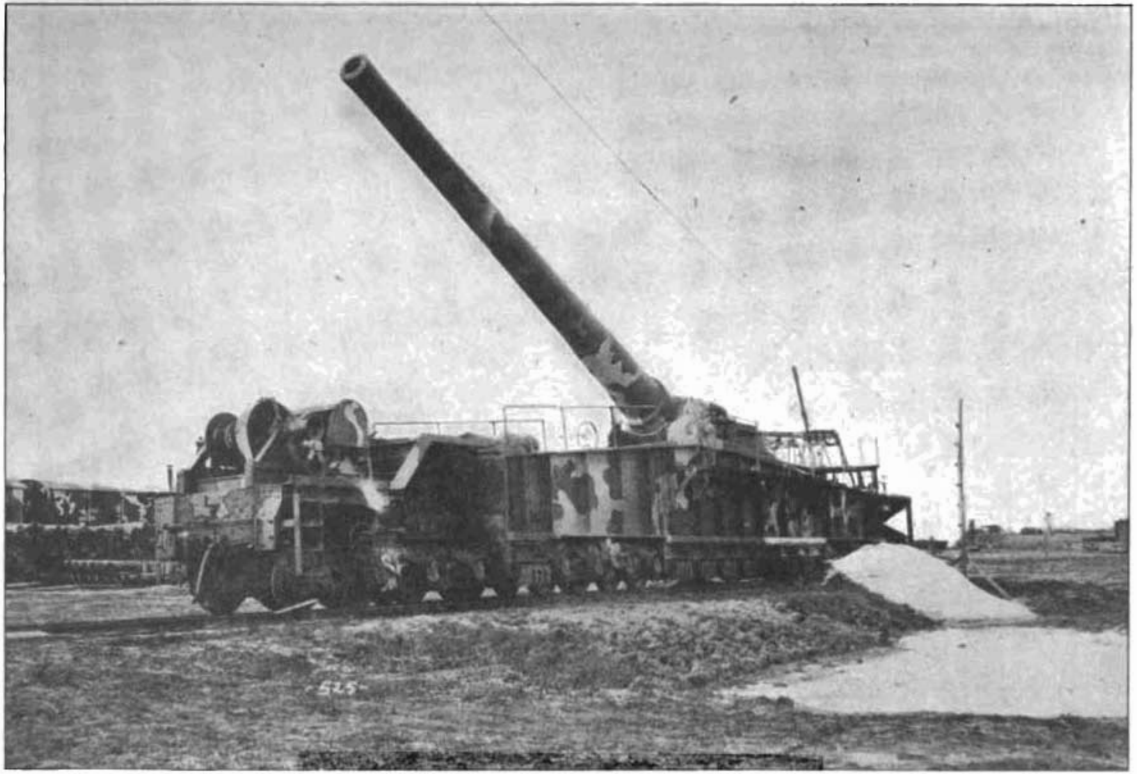
COUNTERWEIGHT OF THE 12-INCH, 50-CALIBER AMERICAN GUN.

PLATE 166



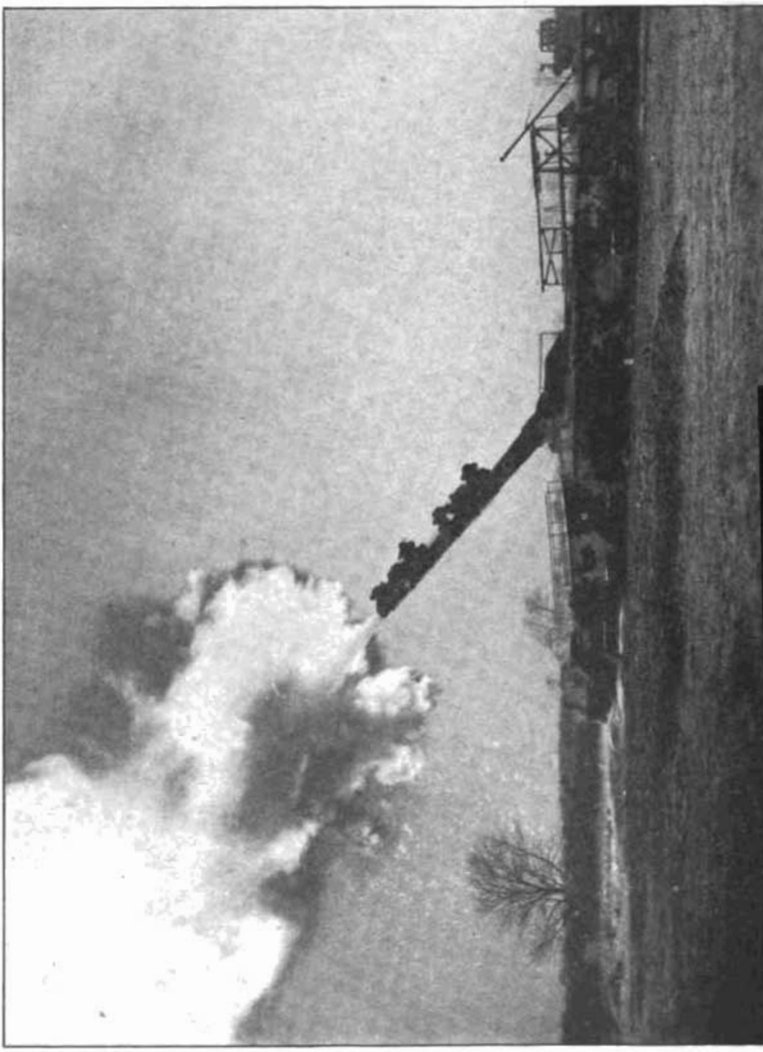
12-INCH, 50-CALIBER AMERICAN GUN AND MOUNT.

PLATE 167

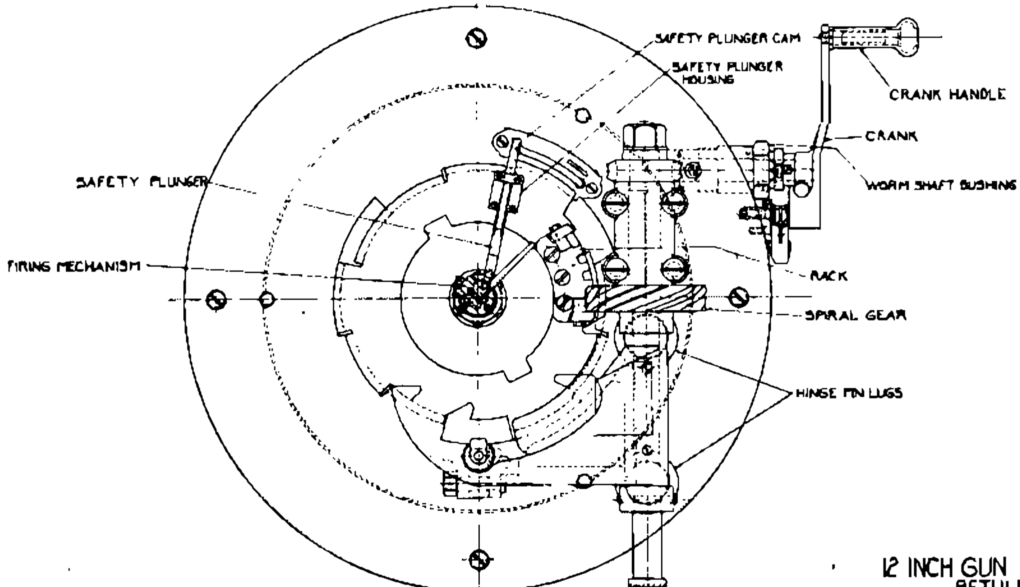


12-INCH, 50-CALIBER AMERICAN GUN AND MOUNT.

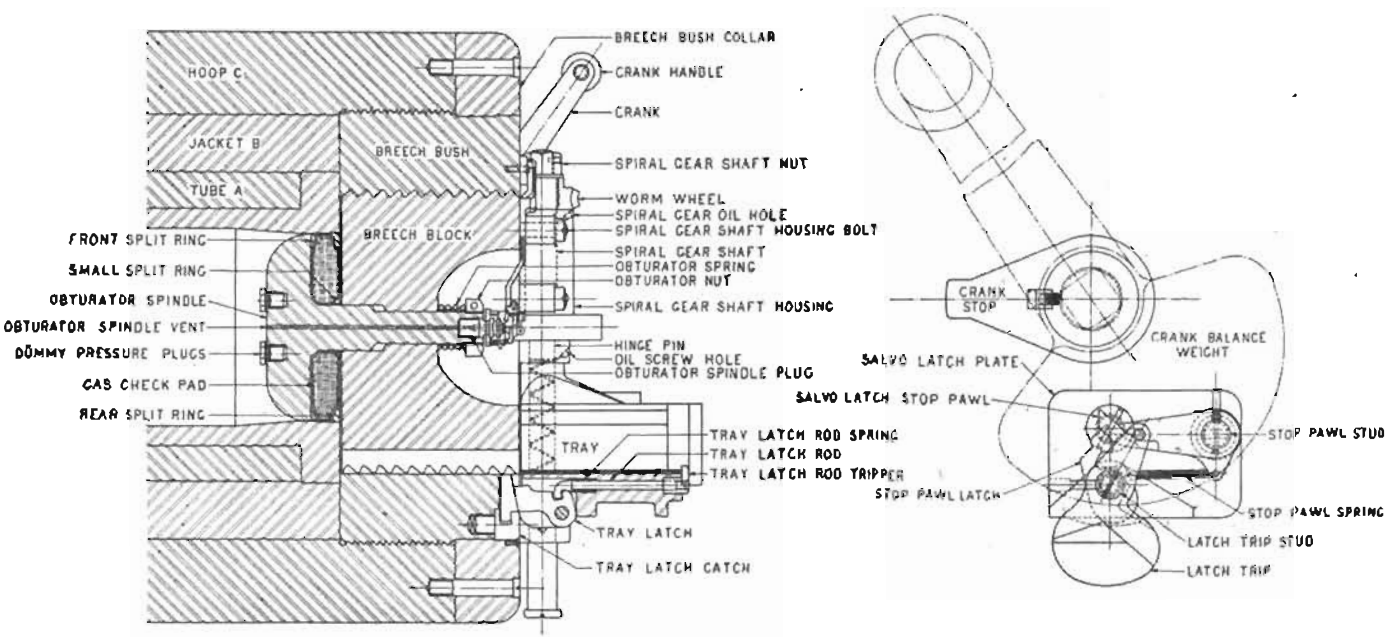
PLATE 168



12-INCH, 50-CALIBER AMERICAN GUN.



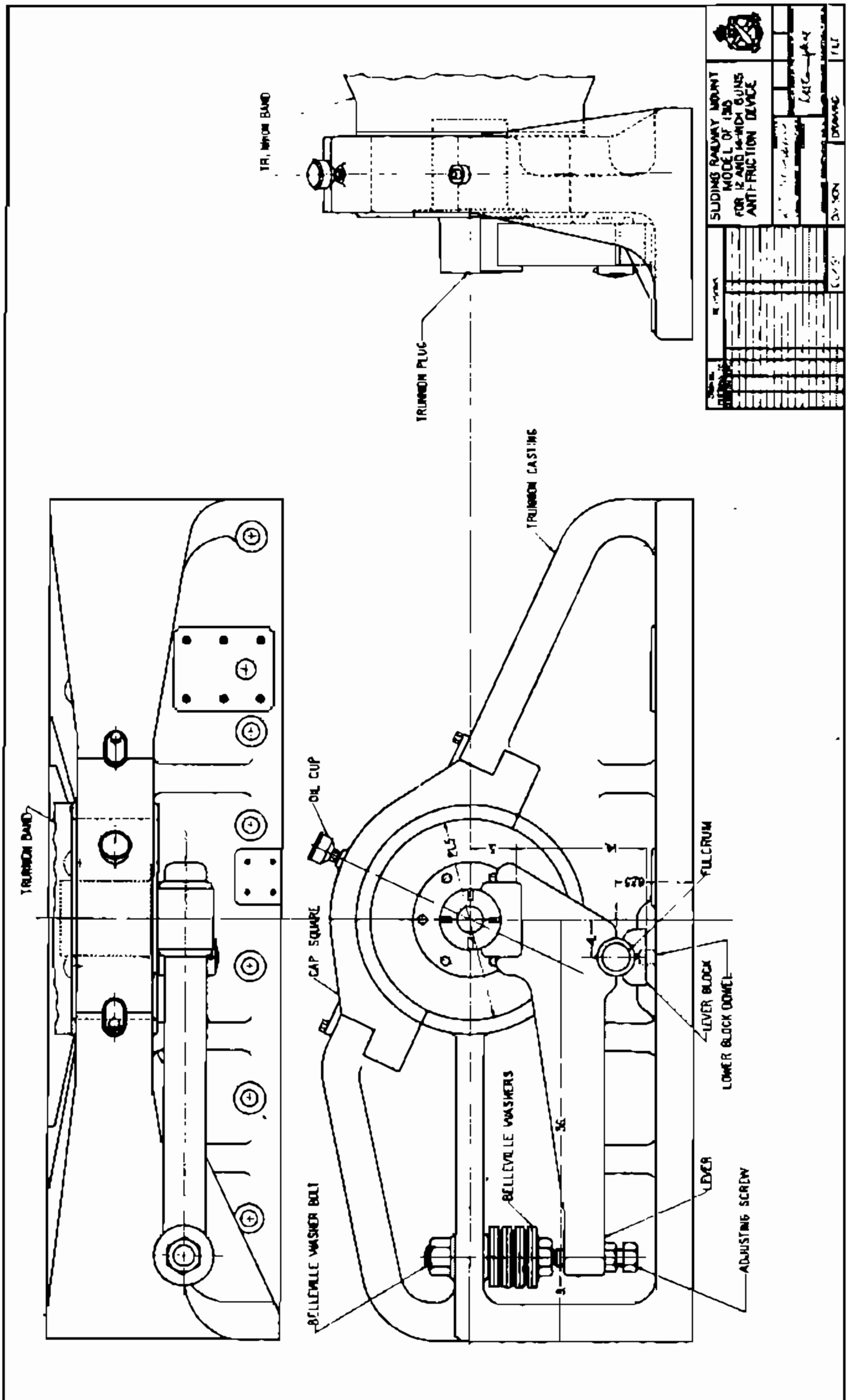
12 INCH GUN MODEL OF 1918
BETHLEHEM
BREECH MECHANISM

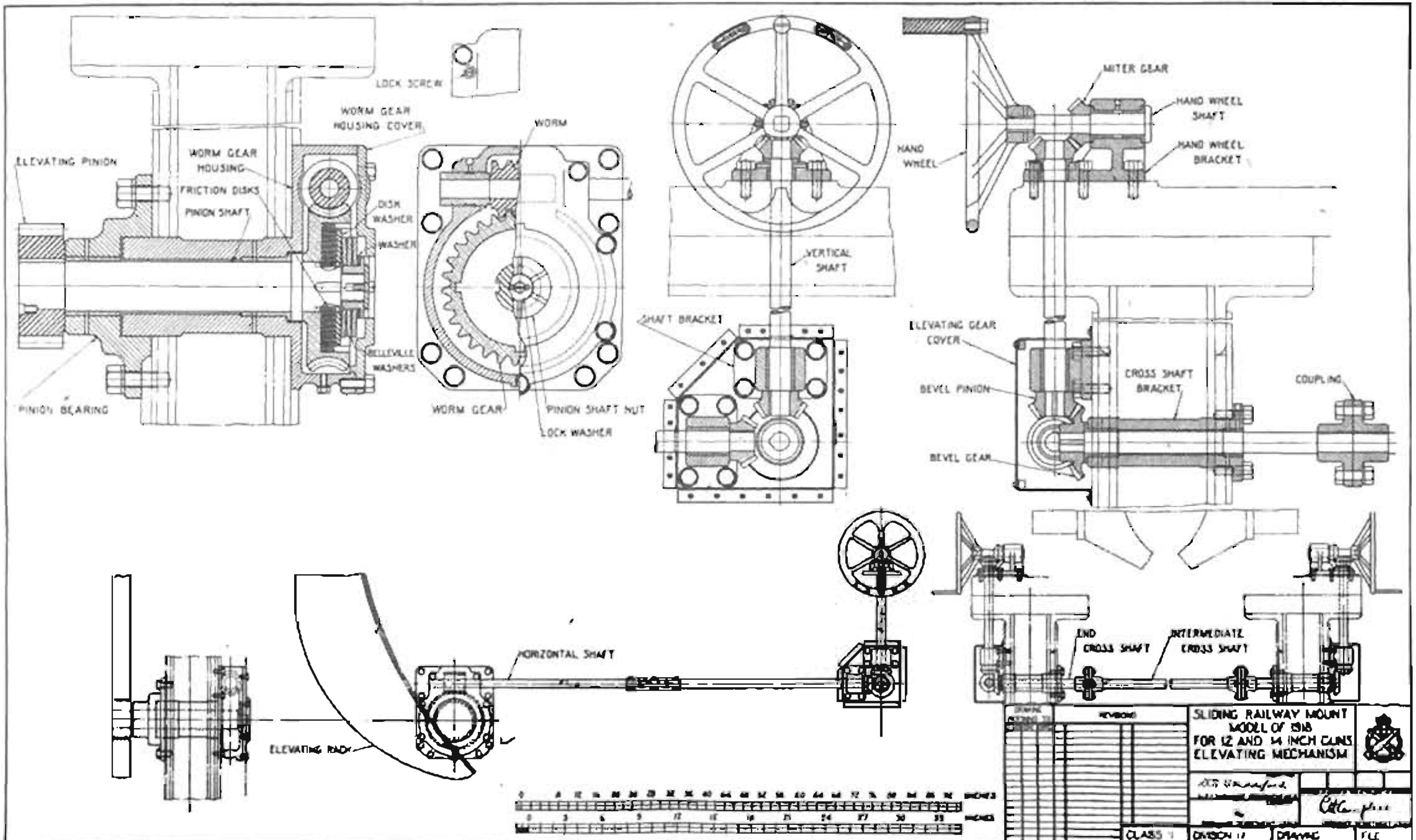


12 INCH GUN MODEL OF 1918
(BETHLEHEM).
BREECH MECHANISM

12 INCH GUN MODEL 1918 (BETHLEHEM) BREECH MECHANISM
CLASS 36	DIVISION 1C	DRAWING 52	FILE

PLATE 171


TRUNNION BAND
TRUNNION PLUG
TRUNNION CASTING
OIL CUP
CAP SQUARE
FULCRUM
LEVER BLOCK
LOWER BLOCK DOWEL
BELLEVILLE WASHERS
BELLEVILLE WASHER BOLT
LEVER
ADJUSTING SCREW
SLIDING RAILWAY MOUNT
FOR 12 AND 14-INCH GUNS
ANTI-FRICTION DEVICE



LOCK SCREW
WORM GEAR HOUSING COVER
WORM
ELEVATING PINION
WORM GEAR HOUSING
FRICTION DISKS
PINION SHAFT
DISK WASHER
WASHER
BELLEVILLE WASHERS
PINION BEARING
WORM GEAR
PINION SHAFT NUT
LOCK WASHER
VERTICAL SHAFT
SHAFT BRACKET
MITER GEAR
HAND WHEEL SHAFT
HAND WHEEL BRACKET
HAND WHEEL
ELEVATING GEAR COVER
BEVEL PINION
CROSS SHAFT BRACKET
COUPLING
BEVEL GEAR
HORIZONTAL SHAFT
ELEVATING RACK
END CROSS SHAFT
INTERMEDIATE CROSS SHAFT
INCHES
REVISIONS
SLIDING RAILWAY MOUNT
MODEL OF 1918
FOR 12 AND 14 INCH GUNS
ELEVATING MECHANISM
CLASS
DIVISION
DRAWING
FILE

PLATE 173

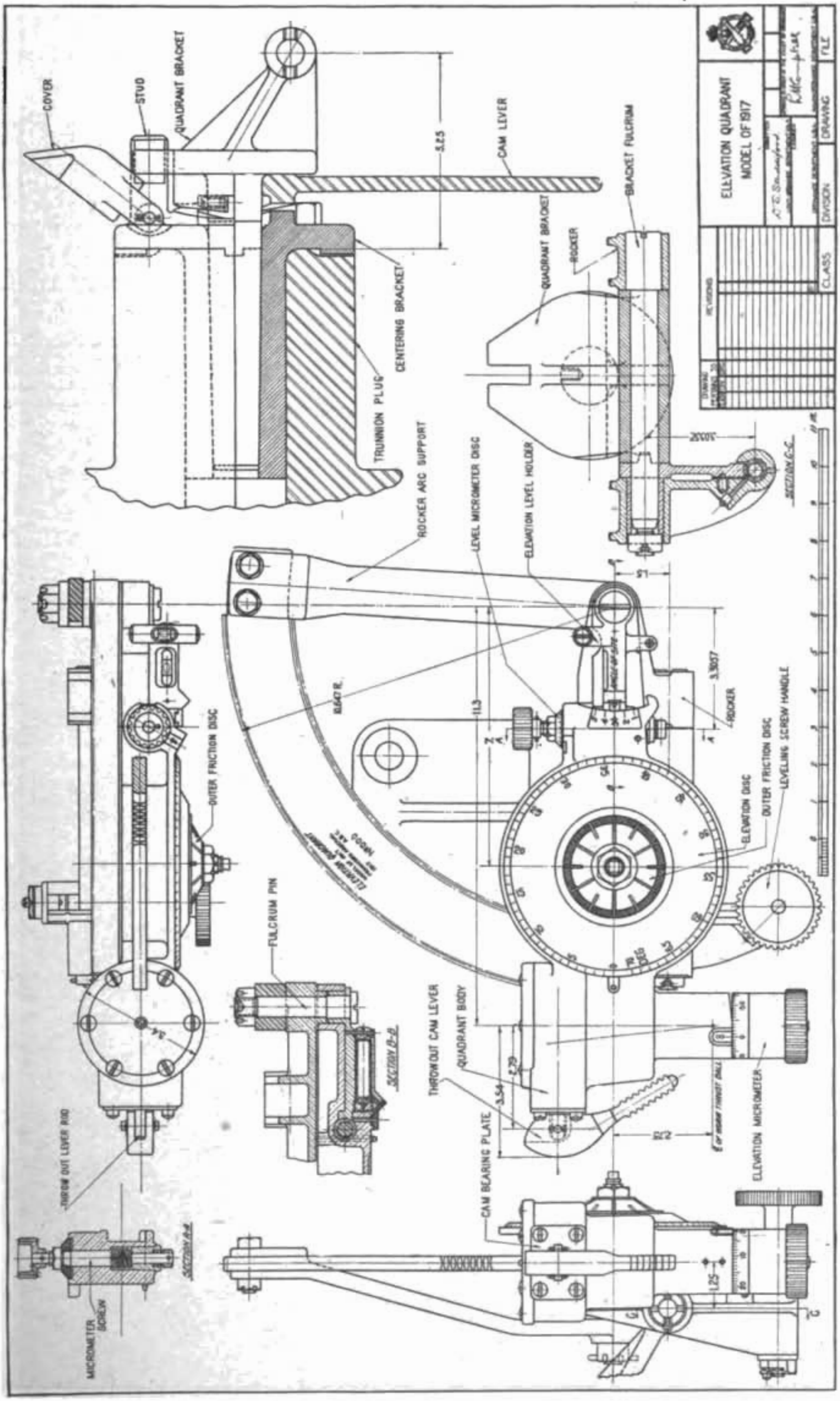

COVER
STUD
QUADRANT BRACKET
CAM LEVER
3.25
CENTERING BRACKET
TRUNNION PLUG
ROCKER ARC SUPPORT
LEVEL MICROMETER DISC
ELEVATION LEVEL HOLDER
BRACKET FULCRUM
QUADRANT BRACKET
ROCKER
ELEVATION QUADRANT
MODEL OF 1917
REVISIONS
DIVISION
DRAWING
CLASS
FILE
SECTION C-C
OUTER FRICTION DISC
ROCKER
ELEVATION DISC
OUTER FRICTION DISC
LEVELING SCREW HANDLE
FULCRUM PIN
SECTION B-B
THROW OUT CAM LEVER
QUADRANT BODY
CAM BEARING PLATE
ELEVATION MICROMETER
THROW OUT LEVER ROD
MICROMETER SCREW
SECTION A-A

PLATE 174

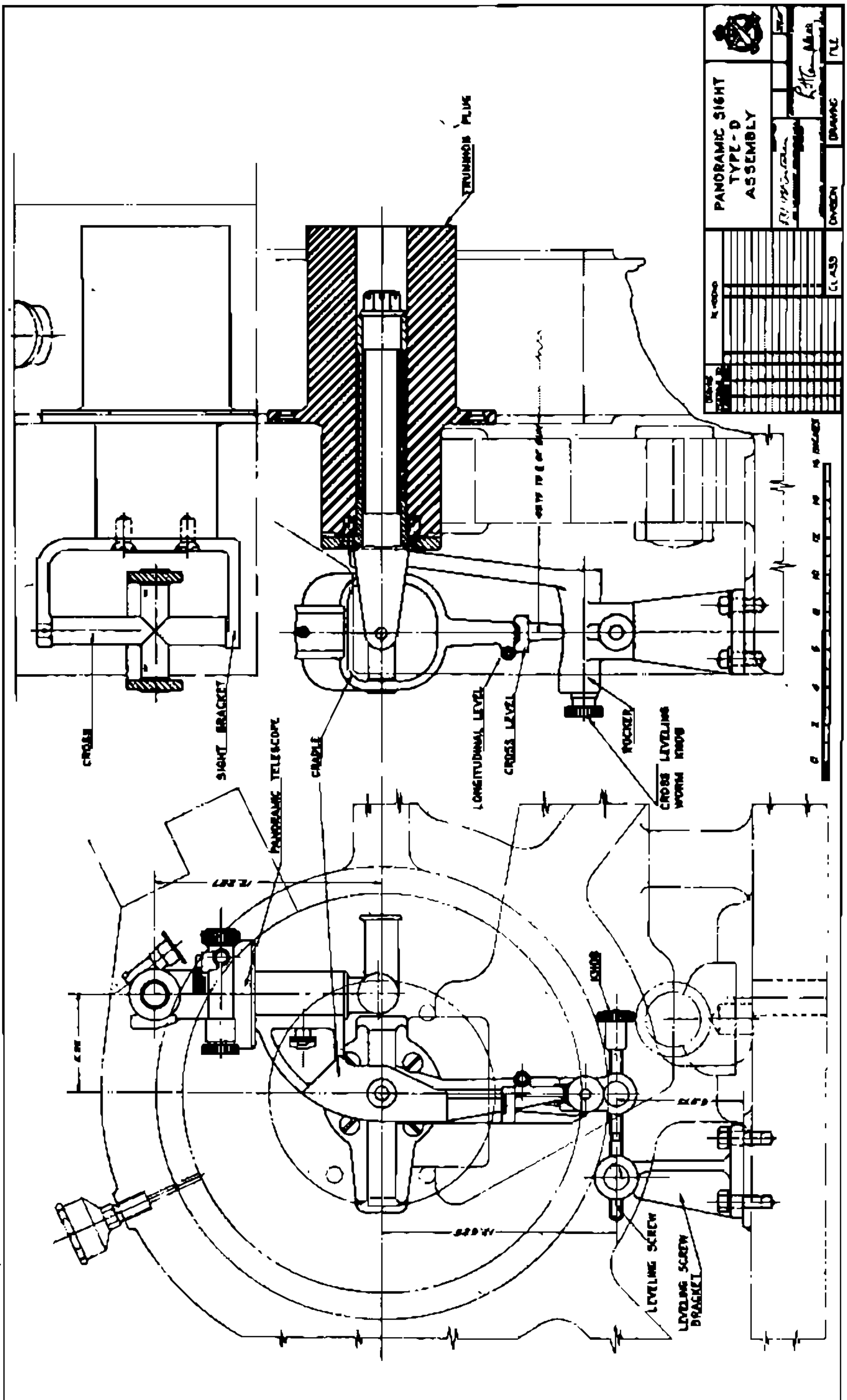

PANORAMIC SIGHT
TYPE-D
ASSEMBLY
TRUNNION PLUG
CROSS
SIGHT BRACKET
PANORAMIC TELESCOPE
CRADLE
LONGITUDINAL LEVEL
CROSS LEVEL
ROCKER
CROSS LEVELING
WORM KNOB
KNOB
LEVELING SCREW
LEVELING SCREW
BRACKET

PLATE 175

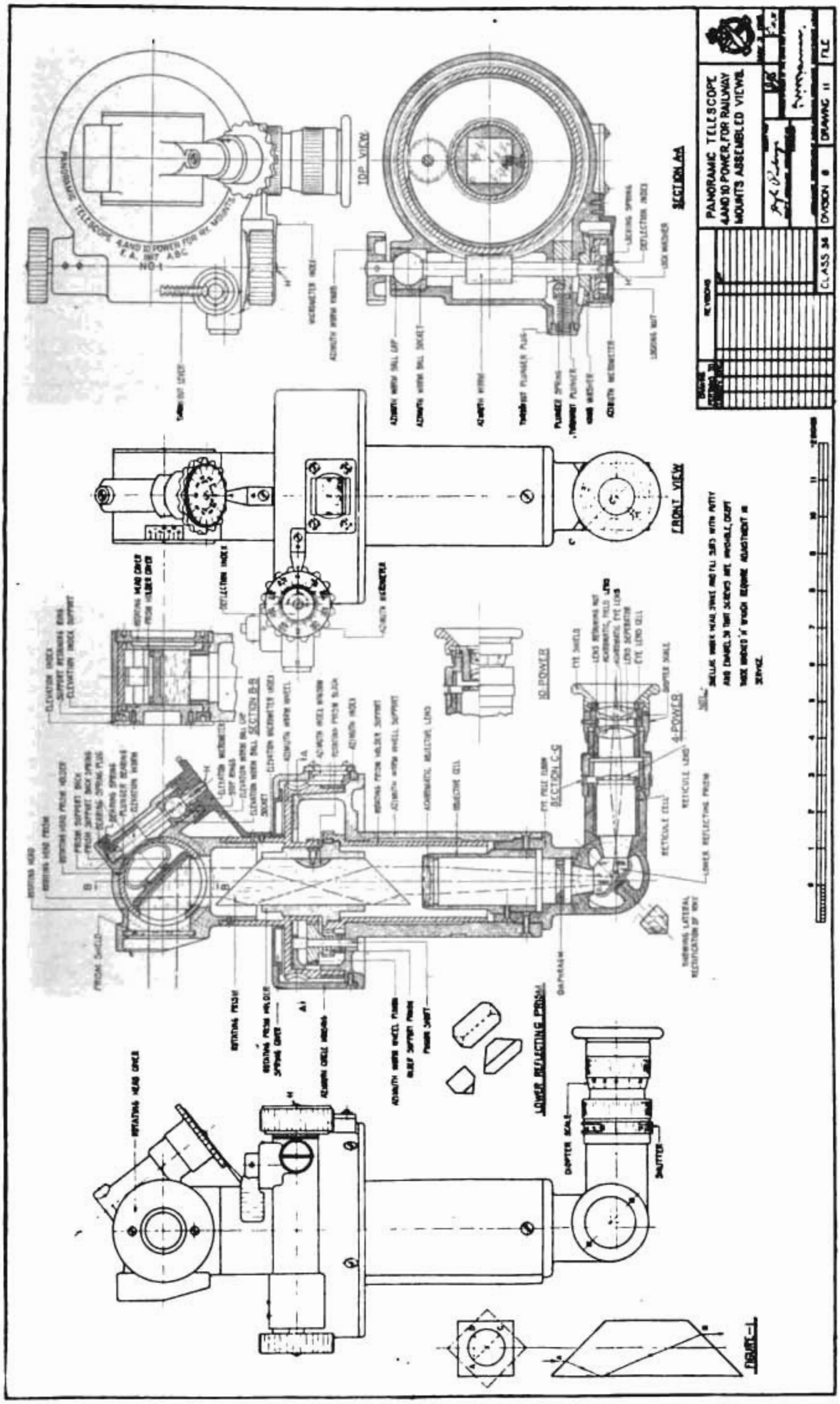

TOP VIEW
SECTION A-A
FRONT VIEW
SECTION B-B
SECTION C-C
10-POWER
4-POWER
LOWER REFLECTING PRISM
FIGURE-1
PANORAMIC TELESCOPE 4 AND 10 POWER, FOR RAILWAY MOUNTS ASSEMBLED VIEWS

PLATE 176

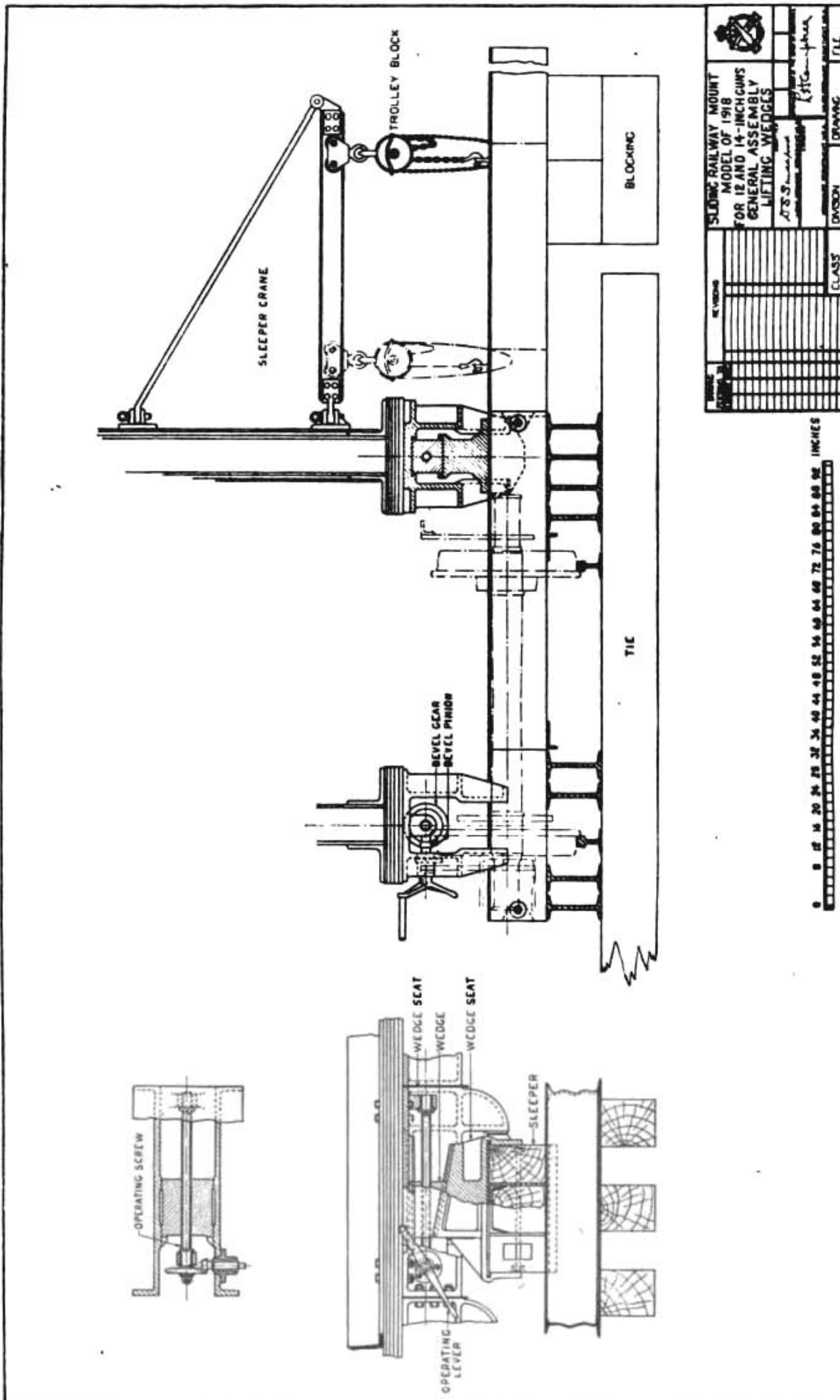

TROLLEY BLOCK
SLEEPER CRANE
BLOCKING
TIE
BEVEL GEAR
BEVEL PINION
WEDGE SEAT
WEDGE
WEDGE SEAT
SLEEPER
OPERATING SCREW
OPERATING LEVER
INCHES
SLIDING RAILWAY MOUNT
MODEL OF 1918
FOR 12 AND 14-INCH GUNS
GENERAL ASSEMBLY
LIFTING WEDGES
REVISIONS
CLASS
DIVISION
DRAWING
TLL

PLATE 177

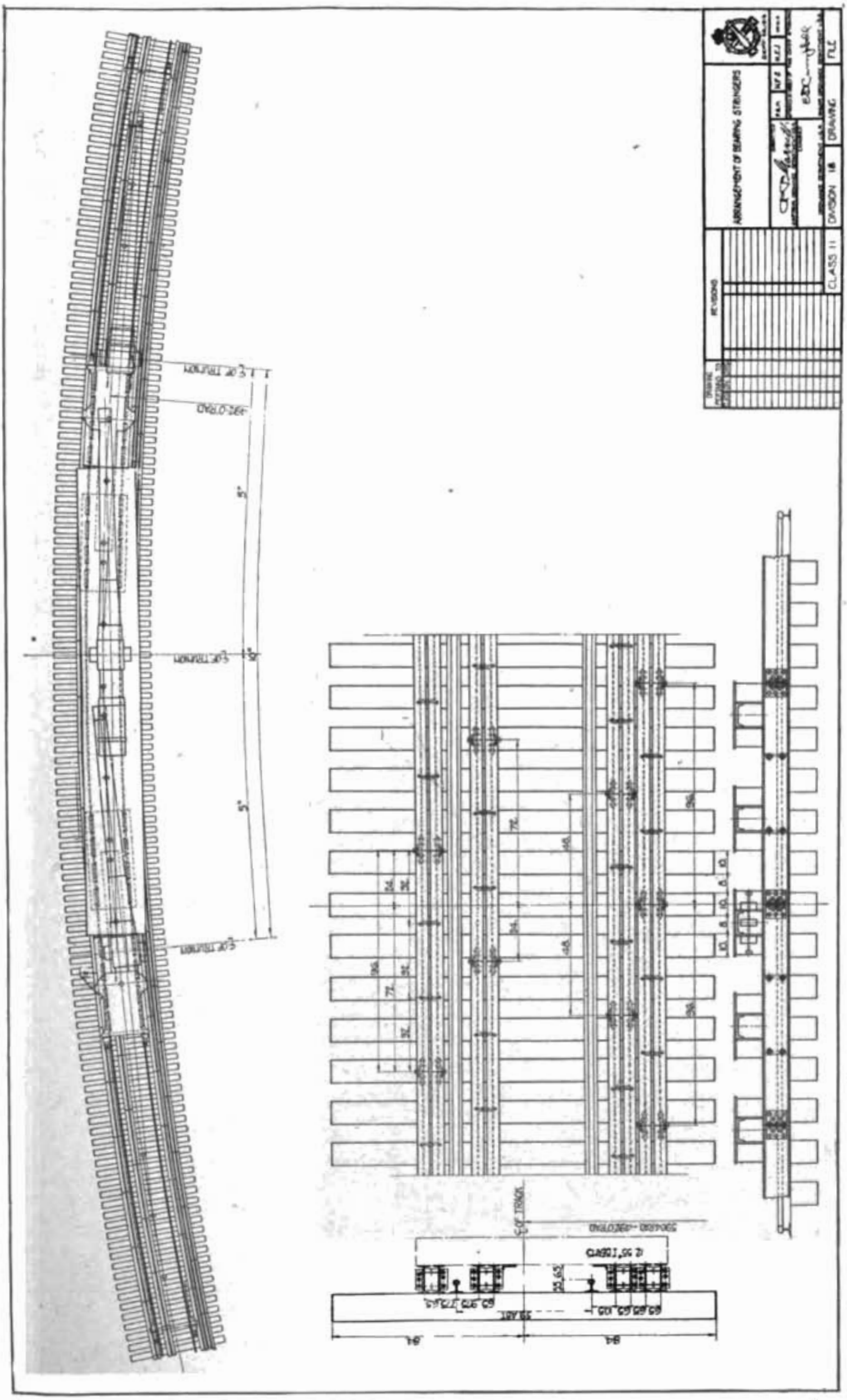

ARRANGEMENT OF BEARING STRINGERS
REVISIONS
CLASS 11
DIVISION 18
DRAWING
FILE
¢ OF TRUNNION
¢ OF TRACK

PLATE 178

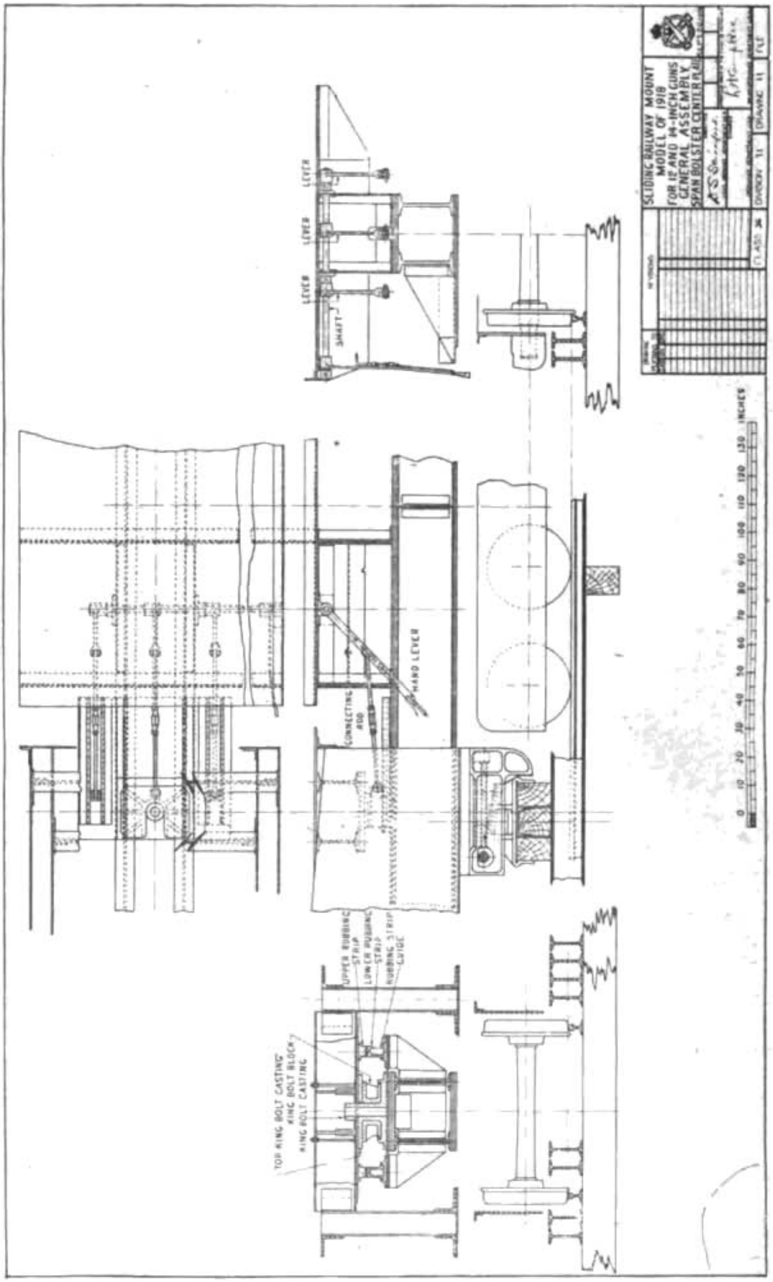

SLIDING RAILWAY MOUNT
MODEL OF 1918
FOR 12 AND 14-INCH GUNS
GENERAL ASSEMBLY
SPAN BOLSTER CENTER RAIL
LEVER
LEVER
LEVER
SHAFT
HAND LEVER
CONNECTING ROD
UPPER RUBBING STRIP
LOWER RUBBING STRIP
RUBBING STRIP GUIDE
TOP KING BOLT CASTING
KING BOLT BLOCK
KING BOLT CASTING
INCHES

PLATE 170

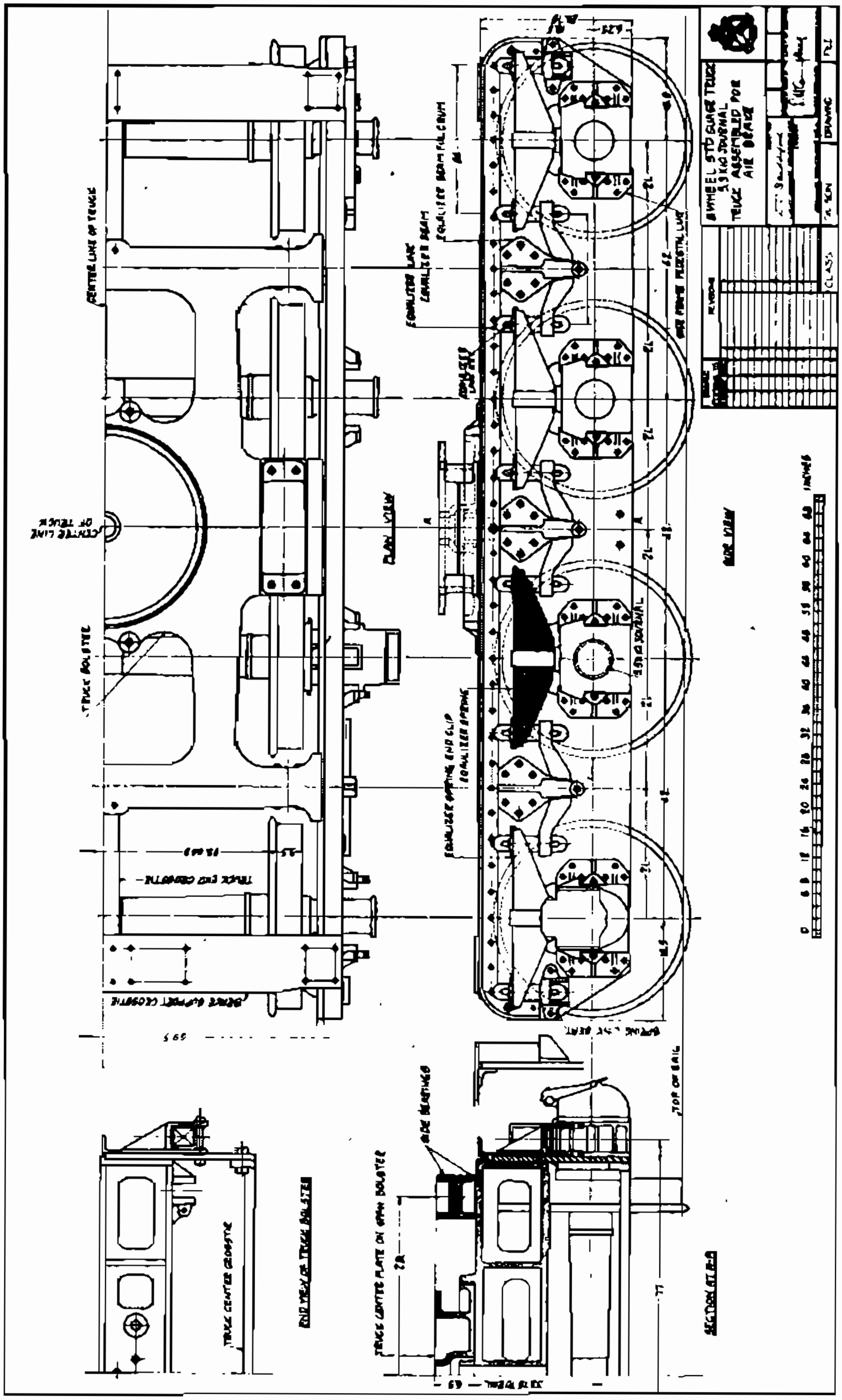

8 WHEEL STD GUAGE TRUCK
13X10 JOURNAL
TRUCK ASSEMBLED FOR
AIR BRAKE
PLAN VIEW
SIDE VIEW
SECTION AT A-A
END VIEW OF TRUCK BOLSTER
CENTER LINE OF TRUCK
TRUCK BOLSTER
TRUCK END CROSSTIE
BRAKE SUPPORT CROSSTIE
EQUALIZER BEAM FULCRUM
EQUALIZER LINK
EQUALIZER BEAM
SIDE FRAME PEDESTAL LINE
EQUALIZER SPRING
TOP OF RAIL
SIDE BEARINGS
TRUCK CENTER CROSSTIE
TRUCK CENTER PLATE ON OPEN BOLSTER
INCHES

PLATE 180

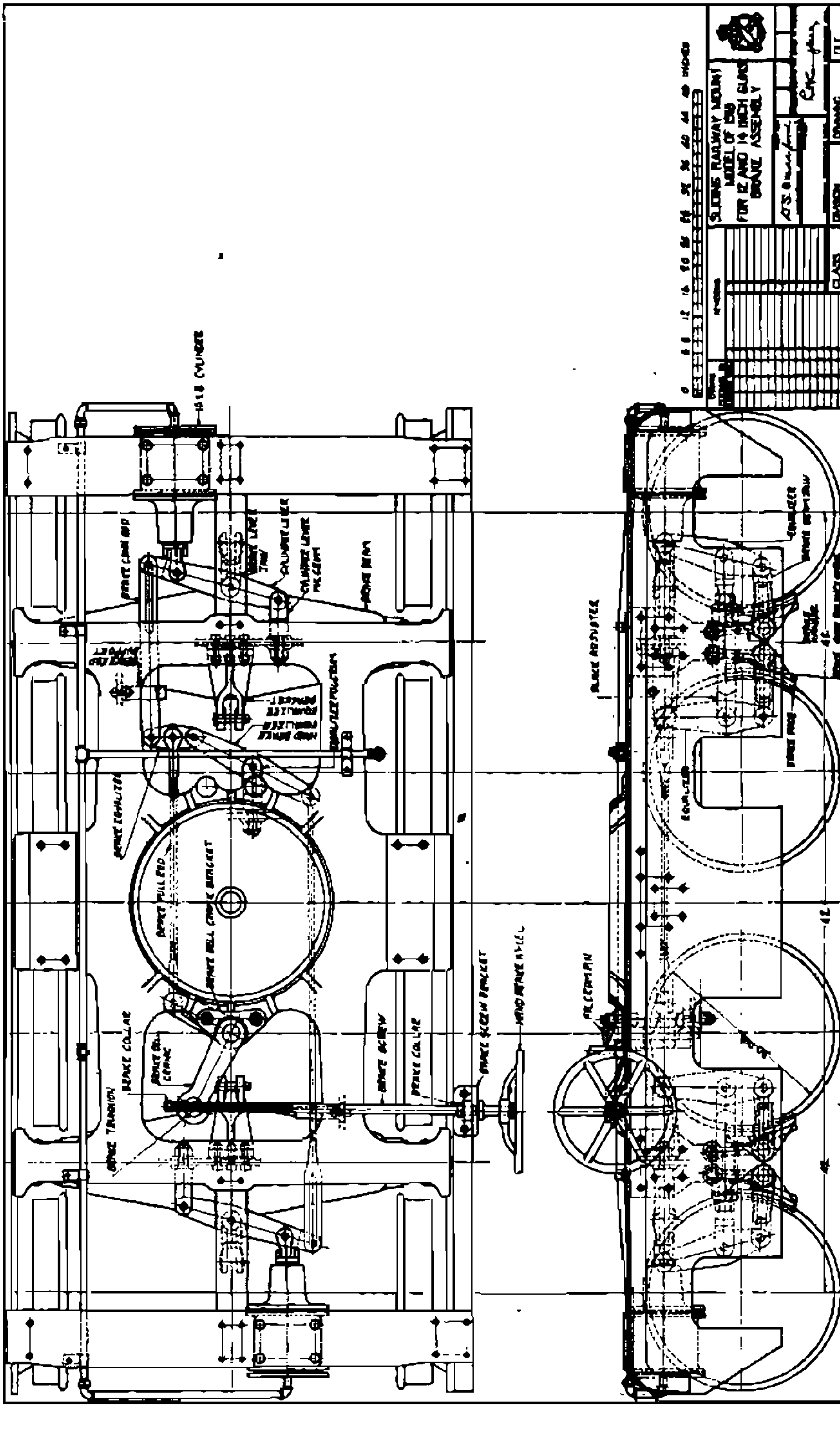
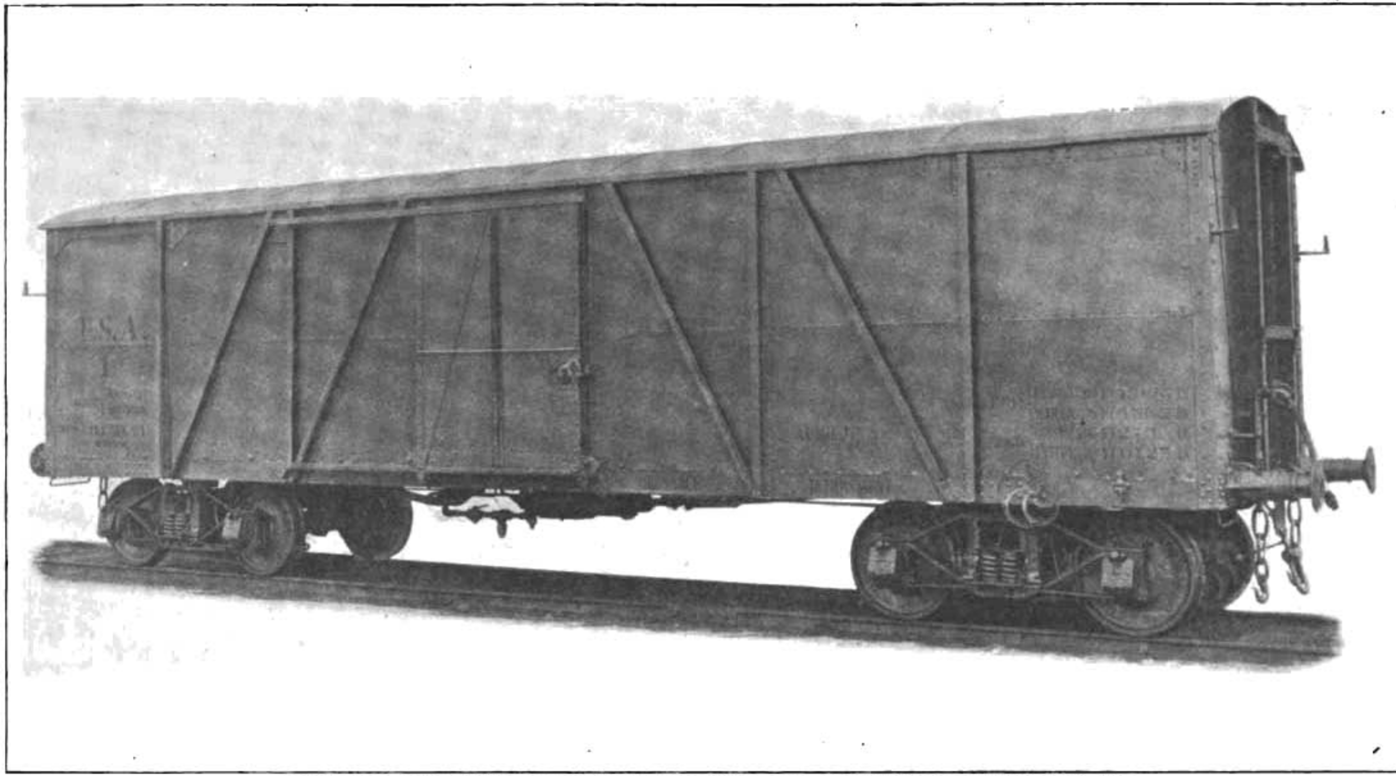

SLIDING RAILWAY MOUNT
MODEL OF 1918
FOR 12 AND 14 INCH GUNS
BRAKE ASSEMBLY

PLATE 181



STANDARD AMMUNITION CAR FOR USE WITH ALL AMERICAN RAILWAY MOUNTS.

PLATE 182

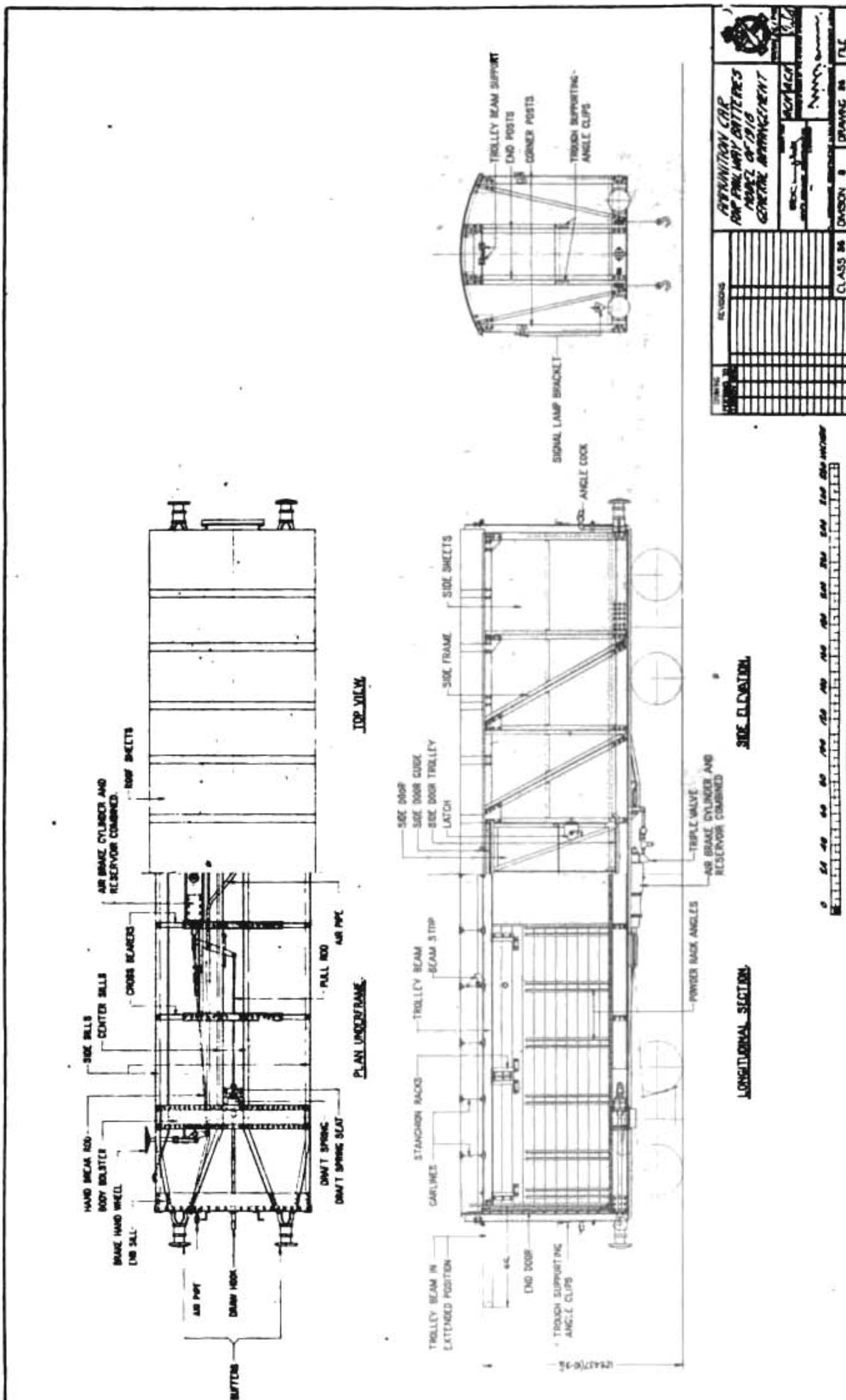
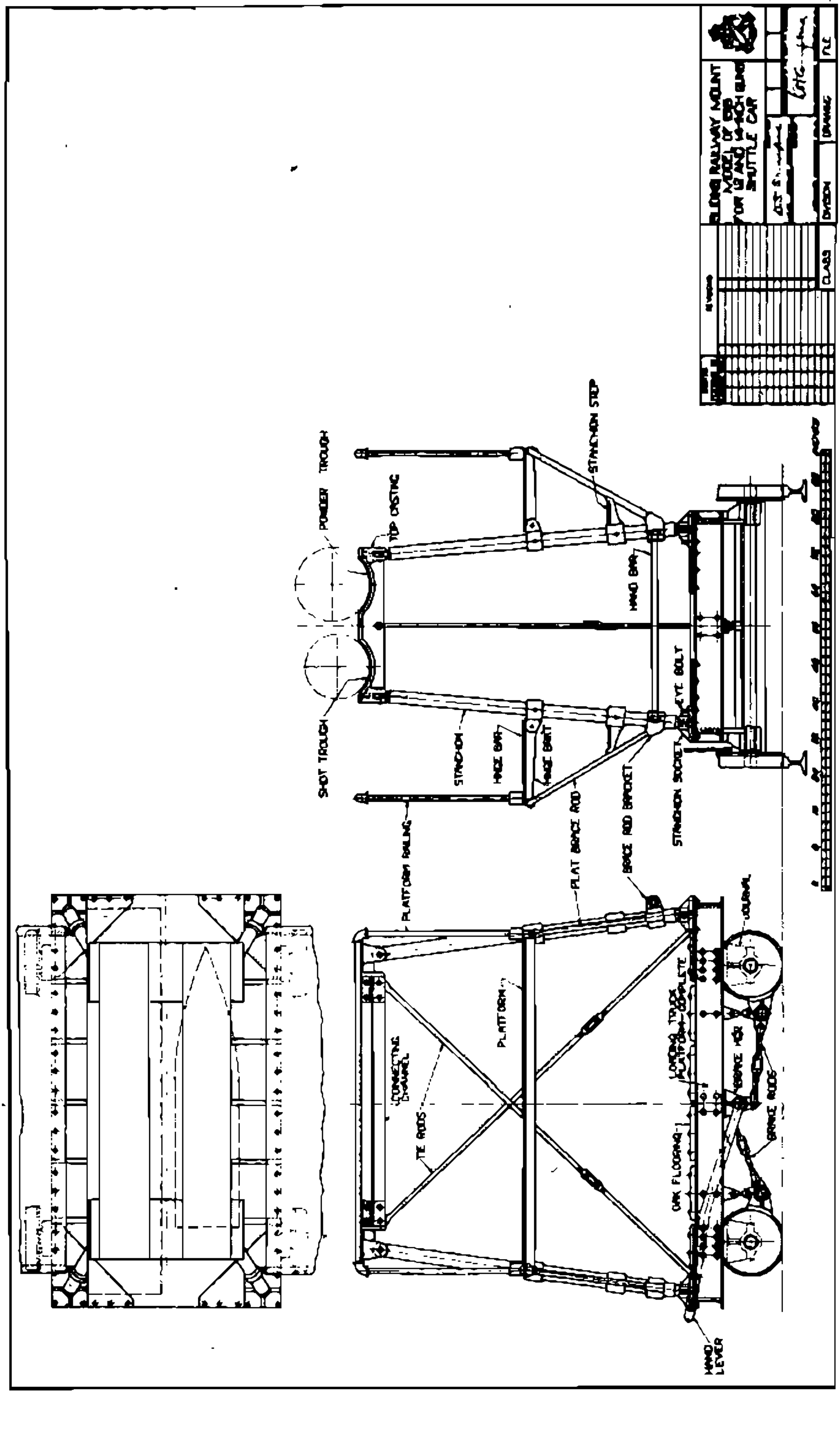
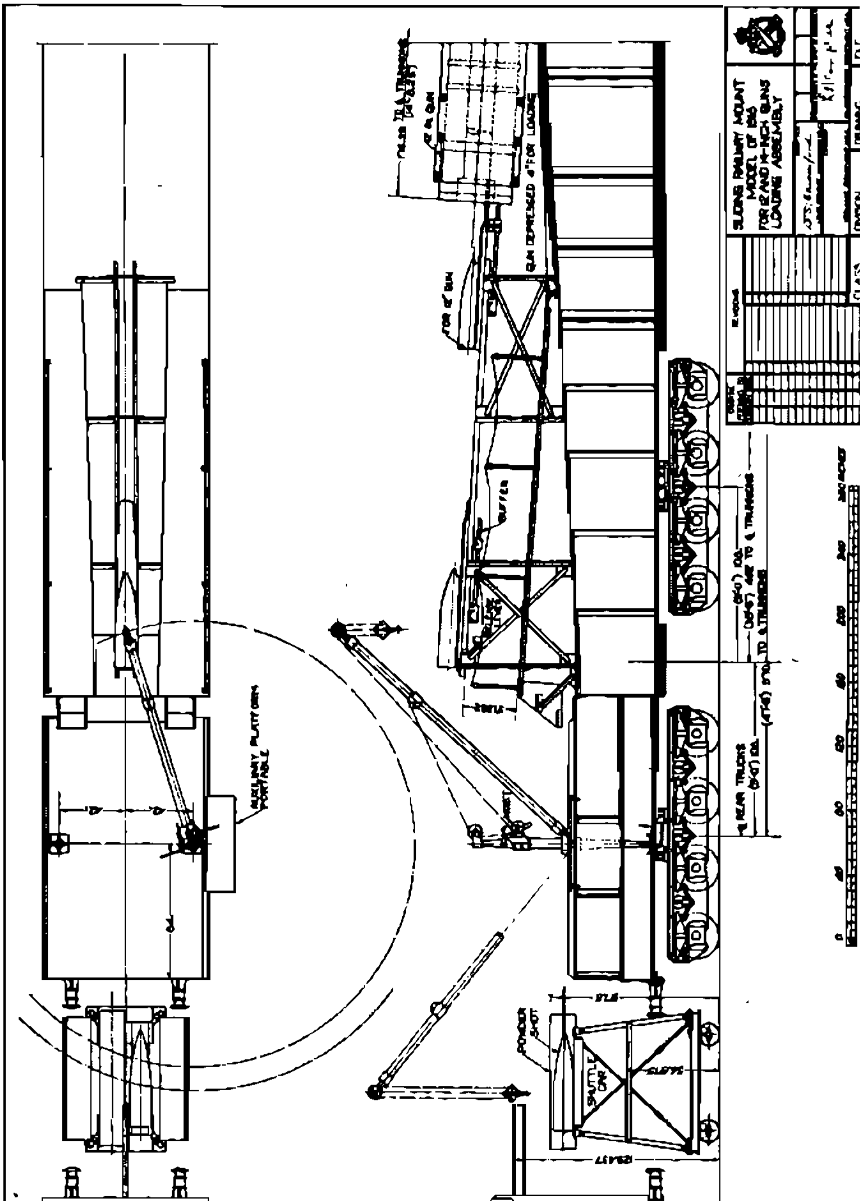

TOP VIEW
PLAN UNDERFRAME
SIDE ELEVATION
LONGITUDINAL SECTION
AMMUNITION CAR FOR RAILWAY BATTERIES MODEL OF 1918 GENERAL ARRANGEMENT

PLATE 188



SHOT TROUGH
POWDER TROUGH
TOP CASTING
STANCHION
HINGE BAR
HINGE BRKT
HAND BAR
STANCHION STEP
EYE BOLT
STANCHION SOCKET
BRACE ROD BRACKET
PLAT BRACE ROD
PLATFORM RAILING
PLATFORM
CONNECTING CHANNEL
TIE RODS
JOURNAL
BRAKE RODS
CAR FLOORING
HAND LEVER
CLASS
DIVISION
DRAWING
FILE

PLATE 184


SLIDING RAILWAY MOUNT
MODEL OF 1918
FOR 12 AND 14-INCH GUNS
LOADING ASSEMBLY
AUXILIARY PLATFORM PORTABLE
SHUTTLE CAR
POWDER SHOT
AMMUNITION CAR
BUFFER
GUN DEPRESSED 4° FOR LOADING
REAR TRUCKS
DIVISION
DRAWING
CLASS
FILE

8.—AMERICAN 12-INCH HOWITZER ON RAILWAY MOUNT. (21)

193. This entire design was made up in response to a request from the Expeditionary Forces in France for a long 12-inch mortar with a range of 20,000 yards, mounted on a carriage that would be emplaced in a manner similar to the 8-inch gun and 12-inch mortar carriages, and from which the mortar could be fired over either end, and with a traverse of from 20 to 30 degrees on each side of the center. Accordingly a cannon of 20 calibers length and capable of being operated at a pressure that would give sufficient muzzle velocity to attain the desired 20,000 yards range was designed and was mounted on a carriage similar to the carriage used for the 8-inch gun and 12-inch mortar. The difference between the details of this and the previous designs will be pointed out later. It is probable that this represents the limit of the ability of the designer to combine in one unit a gun of so great an elevation as 65 degrees and a traverse of 360 degrees from a carriage equipped with self-contained emplacing facilities which enable the mount to be emplaced for action on any existing standard track in less than one hour. From the standpoint of these characteristics of great muzzle energy, high elevation, wide traverse, and rapid emplacement it is felt that this is among the most valuable, if it is not actually the most valuable, mount now in the possession of the American Army. Recent investigations indicate that with the addition of a new cradle it will be possible to operate an 8-inch, 50-caliber gun from the same carriage. The mount and its details are illustrated on plates 185 to 215 and 125.

194. Gun.—The gun for this carriage is a 12-inch, 20-caliber howitzer, model 1919, of built-up design. This howitzer has, at various times, been termed a "long mortar" and a "howitzer"; in this treatment, however, it will be known as a howitzer. It is fitted with a breechblock of the interrupted thread design, which is fitted with a mechanical firing mechanism. It has 108 grooves and the rifling twists to the right, the pitch increasing from one turn in 40 calibers to one turn in 20 calibers. Its probable life is 500 rounds.

195. Recoil Mechanism.—The recoil mechanism, plates 196 and 197, comprises two hydraulic recoil cylinders fitted into the cradle on either side of the center at the bottom, and a pneumatic recuperator attached to the top of the cradle in the center. The maximum length of recoil is 37.5 inches. The design of the recoil cylinders, plate 198, is not unlike that of the cylinders used on previously designed mounts. The design of the recuperator, plate 199, is essentially the same as the recuperator described in detail under the 12-inch mortar. An air bottle is carried on the left side of the carriage and is permanently connected by small tubing with the rear of the recuperator cylinders, plate 197. Gauges for measuring

the initial air and liquid pressures are mounted on the left side of the cradle. A liquid pump, plate 200, for maintaining the floating piston in the recuperator in its proper relative position is likewise mounted on the left side of the cradle between the two gauges.

196. Elevating Mechanism.—The elevating mechanism comprises a circular rack bolted to the right side of the cradle, a pinion meshing with this, and a train of spur gears leading to the single handwheel mounted on the right side of the carriage, plate 201. As a substitute for the usual slip friction device, this mechanism includes a brake on the handwheel of a design similar to that of the service brake of an automobile. The drum is a part of the handwheel, plate 201, and the brake grips it tightly except when the foot pedal, plate 202, is pressed down. This elevating mechanism comprising spur gears only, follows the design of the elevating mechanism of the 16-inch howitzer mechanism which was found particularly efficient. An antifriction device, plate 203, is mounted with each trunnion to reduce the effort required in elevating and depressing the gun. The principle of the operation of this device is the same as that of other devices already described, although it differs in the details of its design. The elevation quadrant used with this mount is the special elevation quadrant, model 1917, plate 173, designed for use with railway mounts.

197. Traversing Mechanism.—The traversing mechanism comprises a circular rack bolted to the inside of the base ring, plate 196, a pinion meshing with this, and a vertical shaft leading to the worm wheel, worm and hand wheel, plate 204, mounted on the left side of the carriage. The ratio of the gearing is one turn of the handwheel for 1.028 degrees of traverse. The panoramic sight used with this mount is identical with that shown on plates 174 and 175.

198. Gun Carriage.—The top of the gun carriage comprises a cradle of grid-iron design, plate 197, a top carriage body made up of two cast steel side frames and light front and rear transoms connecting these, plates 186, 187, and 196, a structural steel working platform carrying the ammunition table and crane, plates 196, 205, and 206, all of which are carried on a cast steel racer, plate 196. Attention is invited to the differences in the details of the design of this racer, plate 196, and the racers for the 8-inch gun and 12-inch mortar, plates 33 and 38.

199. Railway Car Body.—The railway car body, plates 196 and 207, is in its details quite unlike that of the 8-inch gun and 12-inch mortar. The 8-inch gun and 12-inch mortar car bodies are built entirely of structural steel. Even with the best work that it was possible to secure on these mounts, the bed on which the base ring rests was invariably so buckled as to require an undue amount of lining up, and even after being properly lined, was not satisfactorily rigid. In this design the car body is composed of three parts,

the two ends of structural steel and the center a steel casting. It will be noted that the casting has sufficient drop at the center to permit it to rest on the firing beams, sleepers being used only at the ends. It is likewise satisfactorily rigid, and eliminates entirely the necessity for lining up already mentioned for other mounts. The structural steel ends are bolted to the center section. It is possible that the car body of this design can not be so quickly manufactured as if it were entirely of structural steel, but it is believed that the advantages in having so rigid a base outweigh the disadvantages in time of construction. Attention is called to the fact that this cast-steel section is open in the center permitting the gun to recoil practically to the level of the ties. Comparison of this mount with the 8-inch railway mount will show that this principle of permitting the gun to recoil through the base ring of the top carriage and center ring of the car body has resulted in decreasing considerably the distance from the center line of the trunnions to the top of the rails. This, of course, decreases the distances between the trunnions and the point at which the outriggers are attached and when firing at wide angles to the track the line of recoil is more nearly in line with the outriggers and the mount is much more stable. The draft gear, plate 208, is so designed as to reduce the severe buffing shock when the mount is being made up into a train or when it is traveling.

200. Anchorage.—The system of anchorage is essentially like that of the 8-inch gun and 12-inch mortar mounts. The outriggers, plates 186, 187, and 209, are attached to the car body by means of universal joints giving a much wider range of action than the ball joints used on the other mounts. Tension rods permanently attached to the car are provided for each of the struts to counteract certain tendencies of the car to jump when gun is fired at low elevations. In emplacing the mount for action, built-up beams are placed across the rails, plate 210, and the car is raised by means of four screw jacks, plate 211. When the carriage has been raised a sufficient amount, the built-up steel firing beams are placed on the ties outside the rails with two sleepers across each end. The mount is then lowered until it rests on these sleepers and beams. The cast-steel center section of the car body rests directly on these structural-steel firing beams. In transit the firing beams, sleepers, cast bearing plates and floats are arranged on the mount as shown on plate 191.

201. Trucks.—This mount is provided with two 6-wheel trucks with 28-inch steel wheels and 5.5 by 10-inch outside journals, plate 212. The trucks are equipped with both hand and air brakes, plates 213 and 214.

202. Ammunition Supply System.—Ammunition tables and trays are built into each end of the car body, plate 186. A loading stand is built into the working platform in the center at the rear, plate 215.

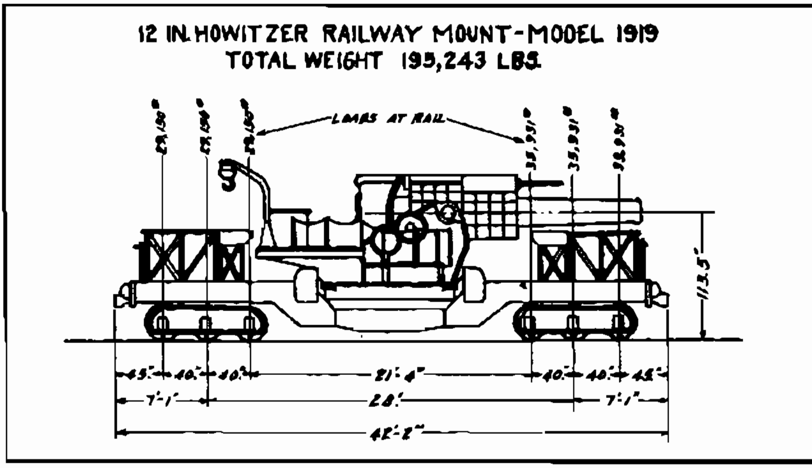
and projectiles are transferred to it from the table on the car body by hand operated jib cranes, plates 215 and 216. Experience on railway artillery in France resulted in the specification that the ammunition supply system for this mount be so designed as to permit of operation of the gun from either end of the car with equal facility. The gun can be traversed through 360 degrees and no matter how it may be run in on its emplacement, it can be operated in any direction. As long as the gun operates within the scope of either end of the car, ammunition can be supplied directly from the ammunition car to the tray at the end and from the tray by means of the cranes to the ammunition table on the top carriage. When the gun is operated at wide angles to the track, after each third shot the gun carriage must be traversed back within reach of the shell tray on the car. This is not a disadvantage, however, since the carriage can be traversed easily and quickly and no time will be lost. The tables on either end of the car, plates 189 and 190, will hold seven projectiles each, and the ammunition stand on the working platform will hold three projectiles.

203. Maintenance.—It is not believed that any difficulty will be experienced in the service of a mount of this design. Quite probably the attention required on the recoil cylinders and the recuperator, together with the minor service to keep the elevating and traversing mechanisms in good shape will constitute the bulk of the maintenance.

204. Merits.—For a gun of this caliber and length, this is the best designed in all of its details that the writer has seen in any army. Its recoil mechanism is unusually fine, the elevating and traversing mechanisms are rapid and efficient; the car-body design, involving the use of a centrally cast-steel section is excellent; the details of the anchorage system are very good and the ammunition supply system equally good. When handled with care and by experienced artillerymen, this gun will probably render more efficient service than any other railway mount possessed by the American Army.

205. Demerits.—There seems to be no ground for criticism of any part of the mount except possibly the elaborate design of the cradle. The objection that is raised to this design is the time required to make patterns, the time required to make the castings, and the difficulties involved in making perfect castings. Under peacetime manufacturing conditions such a design may not be due for much criticism. Under stress of war-time conditions, however, it can not be manufactured with satisfactory speed, and is likely to tie up shop facilities for an undue length of time. Cradles of foreign design have been observed which are practically smooth cylinders. It is quite true that such cylinders are not as rigid as the design under discussion, but they have been used with 15-inch 45-caliber guns, and have not developed serious faults.

PLATE 185


12 IN. HOWITZER RAILWAY MOUNT-MODEL 1919
TOTAL WEIGHT 195,243 LBS.
LOADS AT RAIL
113.5"
21'-4"
7'-1"
28'
7'-1"
42'-2"

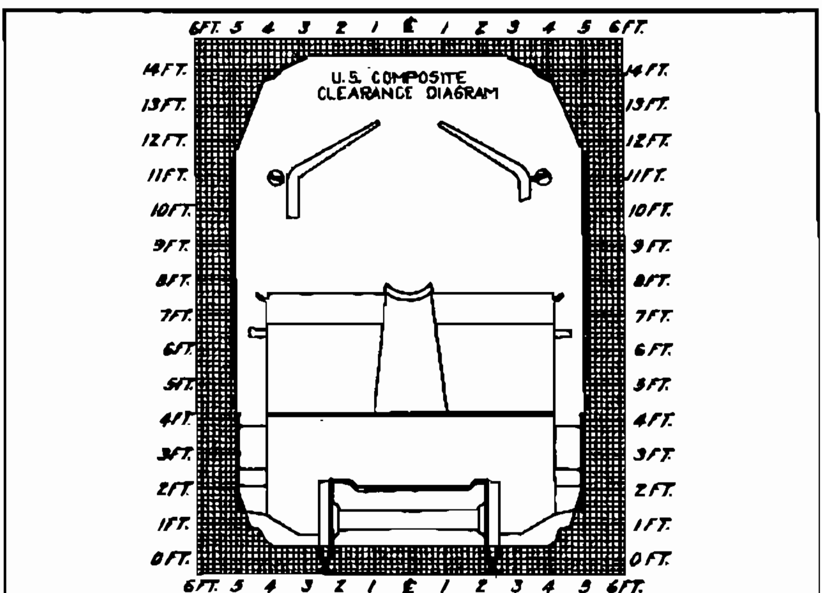

U.S. COMPOSITE
CLEARANCE DIAGRAM
6FT. 5 4 3 2 1 ℄ 1 2 3 4 5 6FT.
14FT.
13FT.
12FT.
11FT.
10FT.
9FT.
8FT.
7FT.
6FT.
5FT.
4FT.
3FT.
2FT.
1FT.
0FT.

PLATE 186

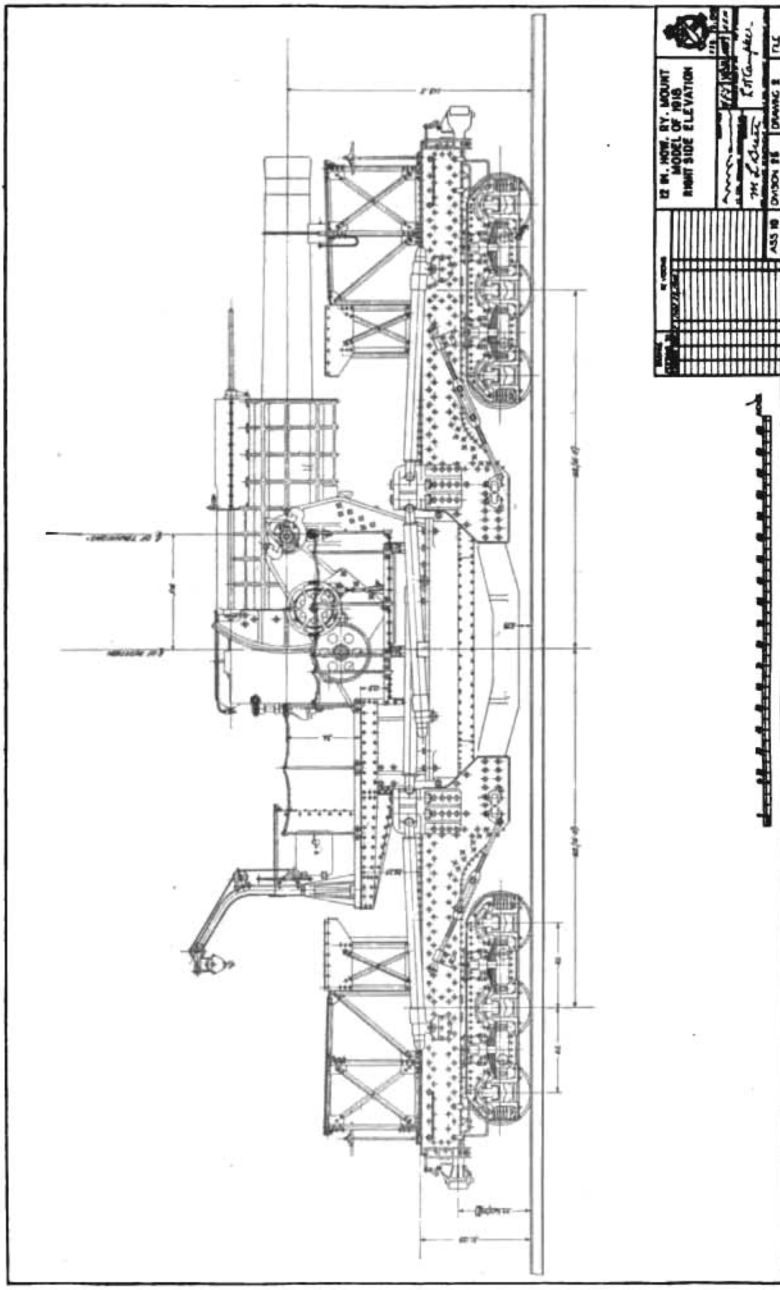


PLATE 187

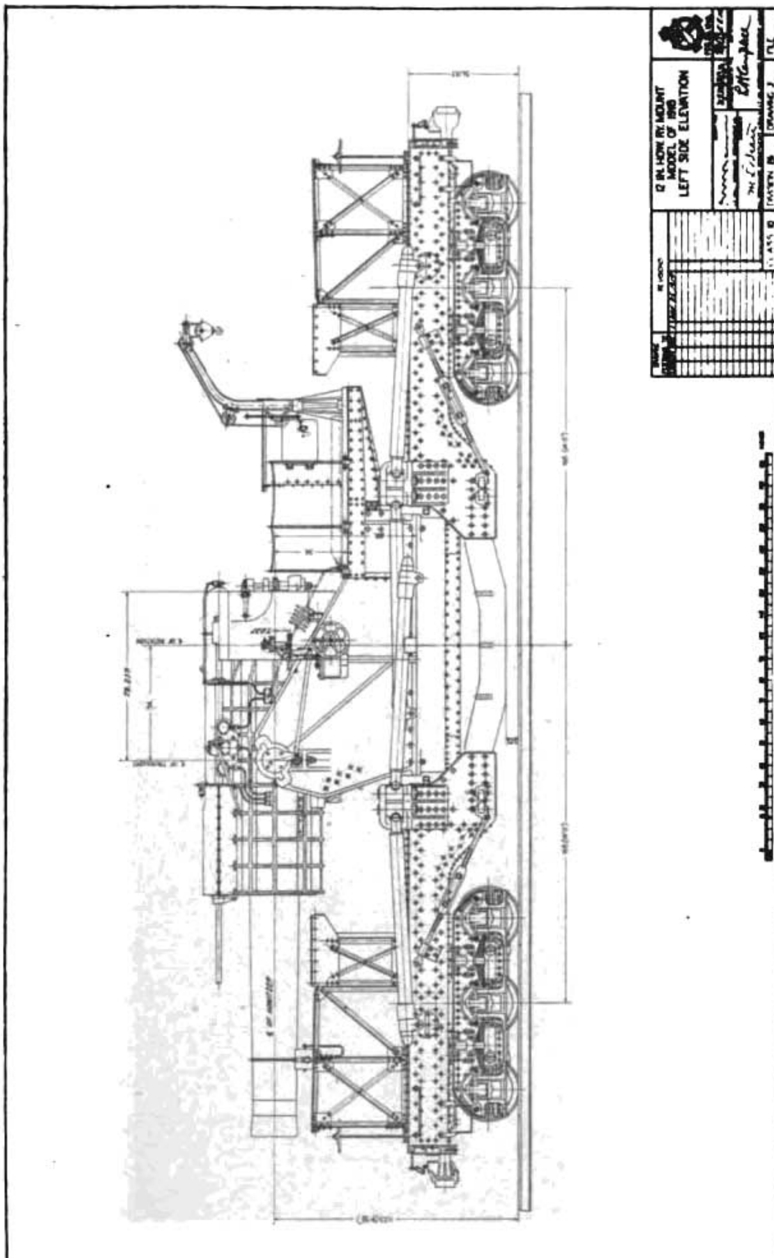


PLATE 188

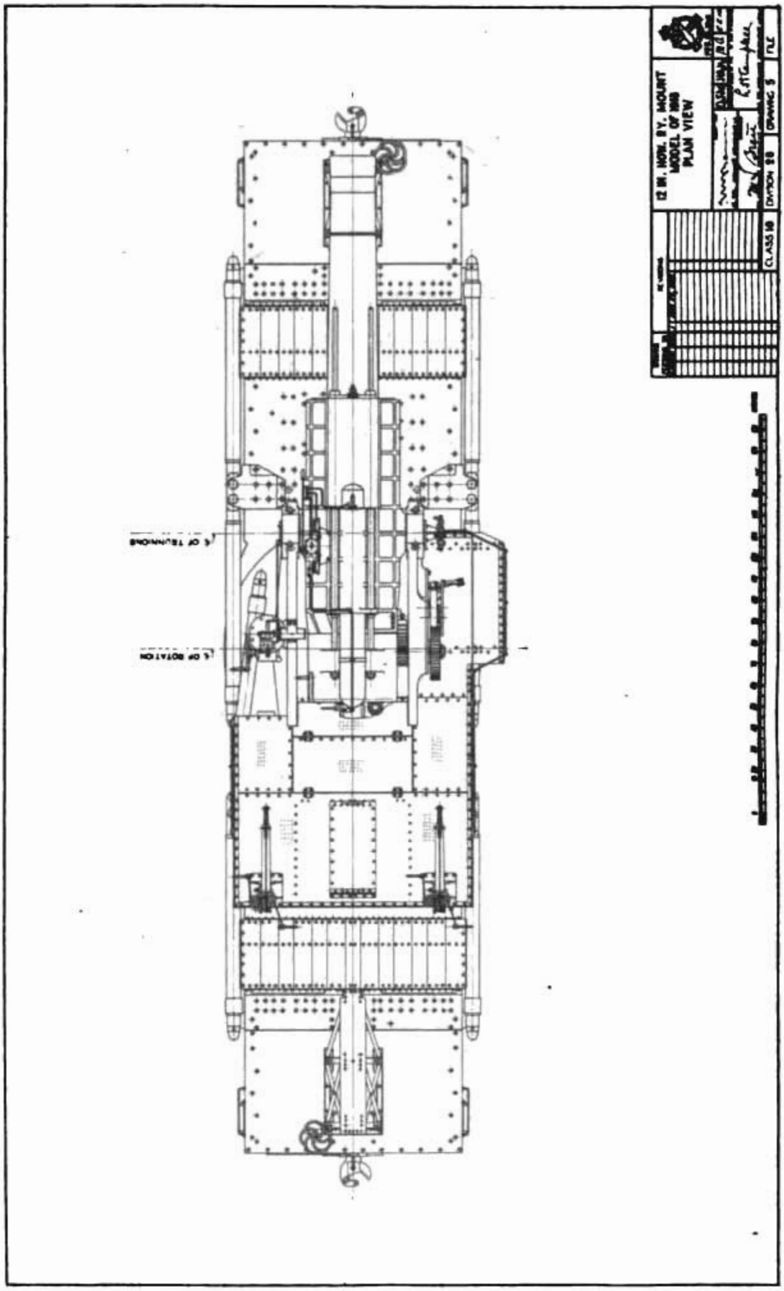

12 IN. HOW. RY. MOUNT
PLAN VIEW
℄ OF TRUNNIONS
℄ OF ROTATION
CLASS 10
DIVISION 28
DRAWING 5
FILE

PLATE 189

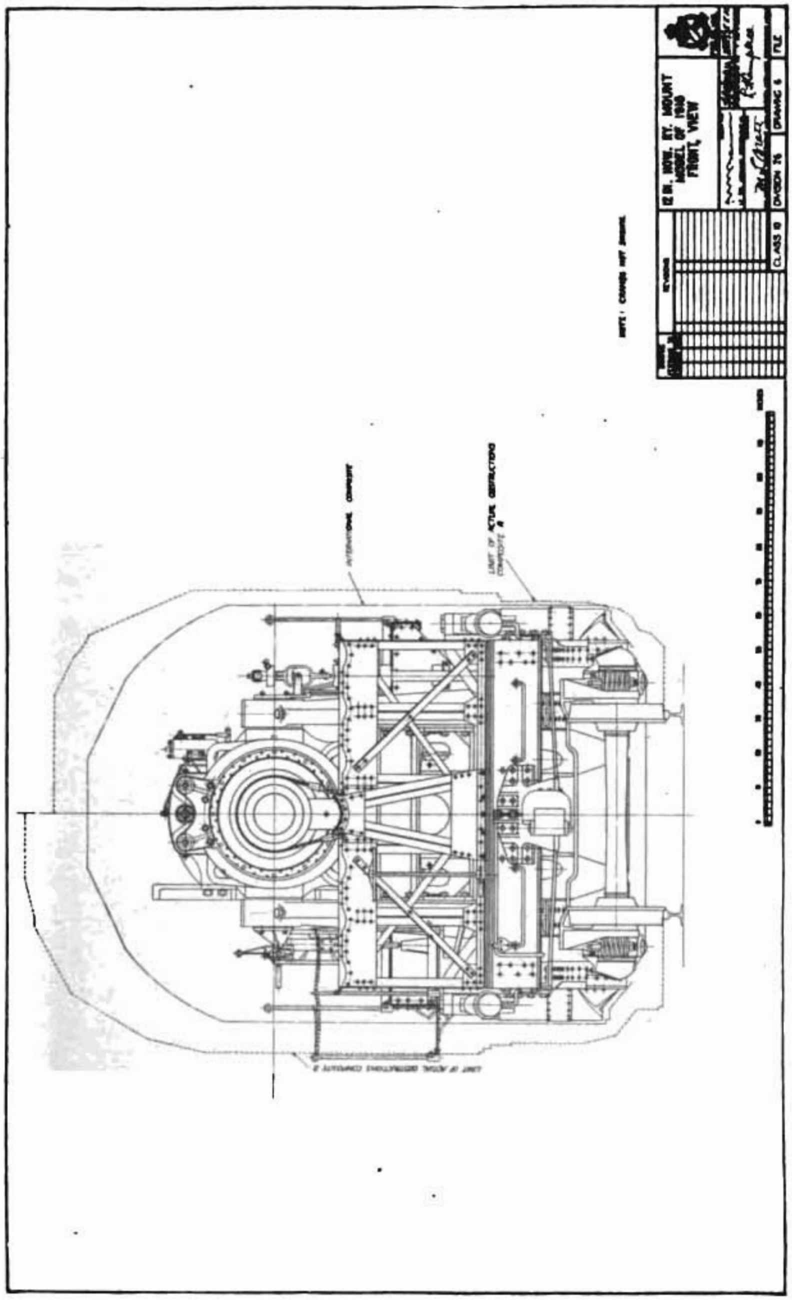


PLATE 190

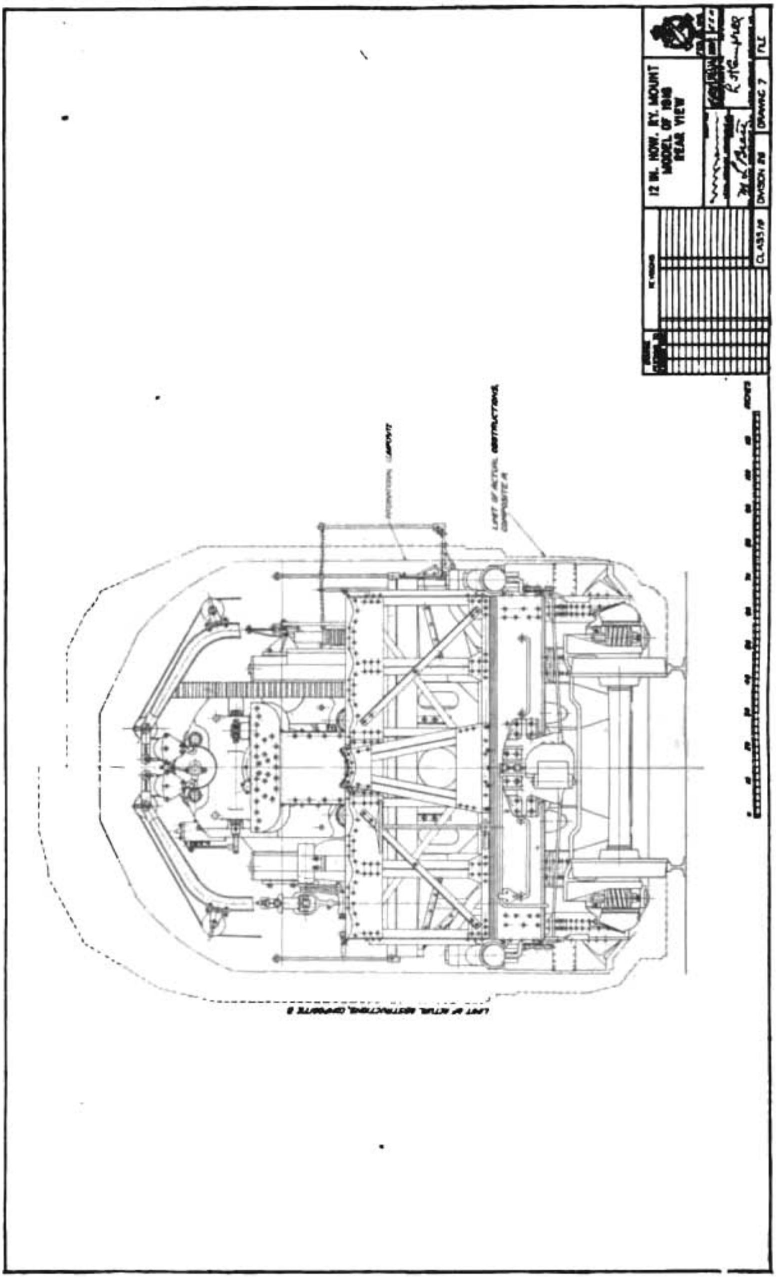


PLATE 101

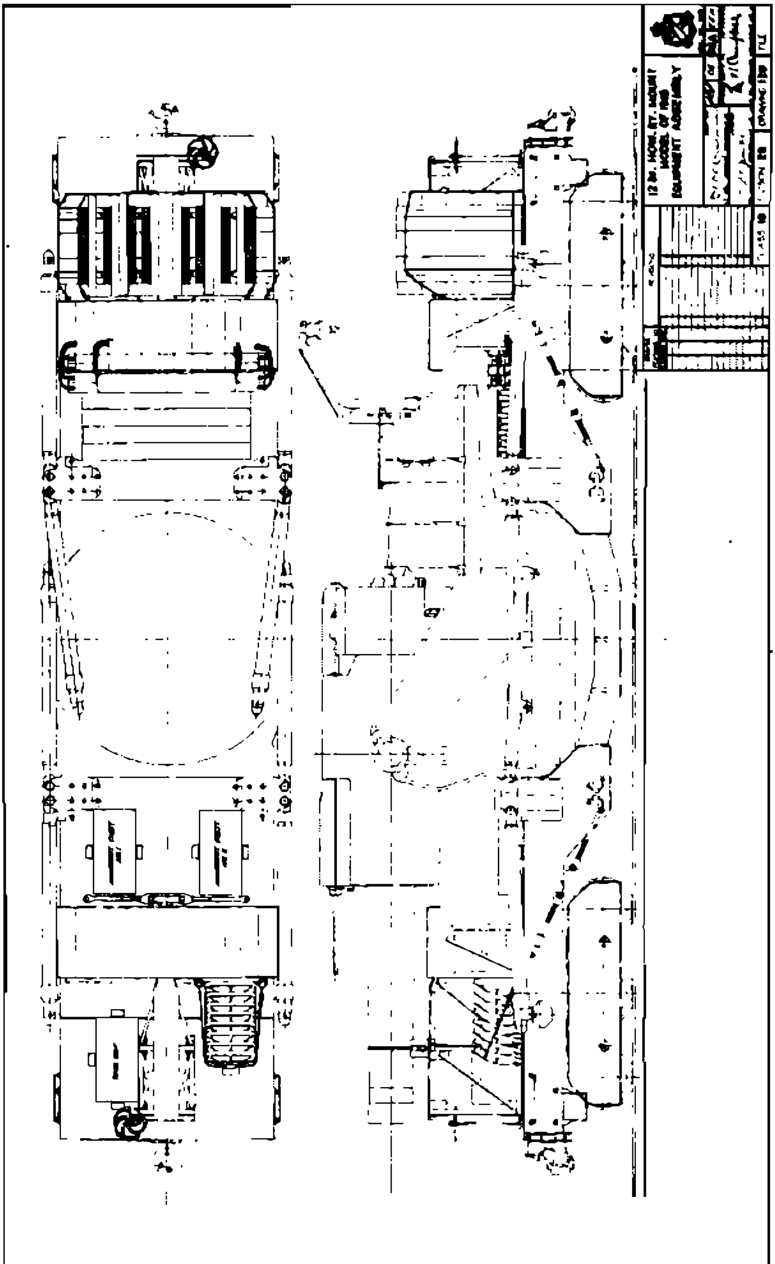
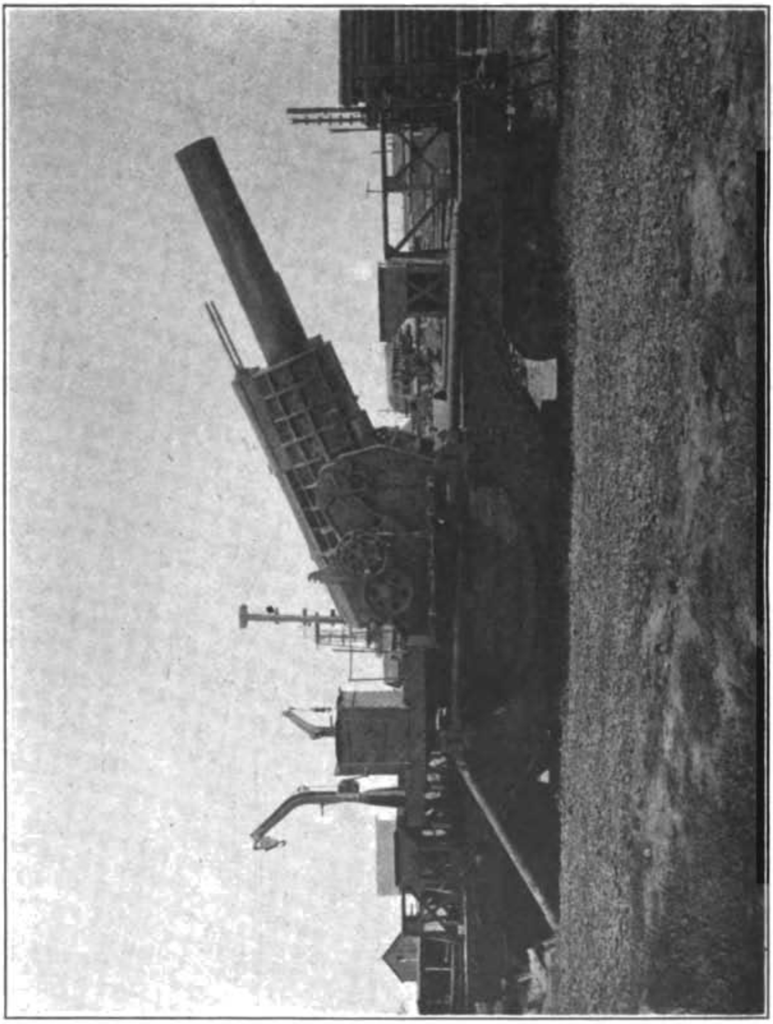


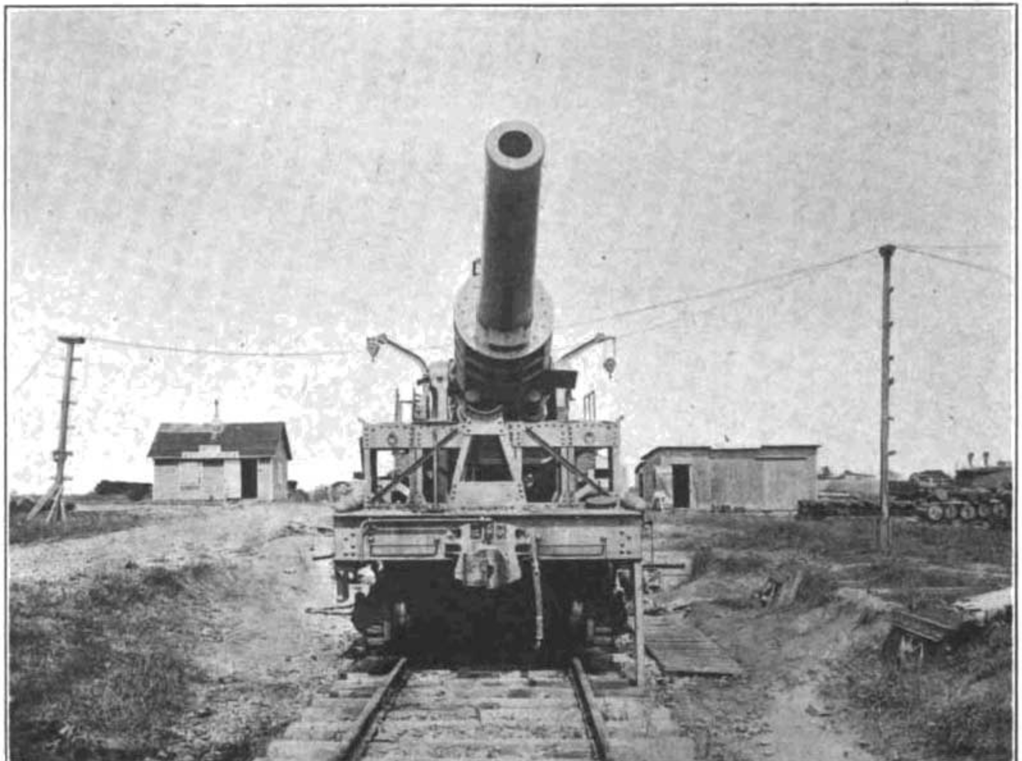
PLATE 192



12-INCH, 20-CALIBER AMERICAN HOWITZER AND MOUNT (RIGHT SIDE).

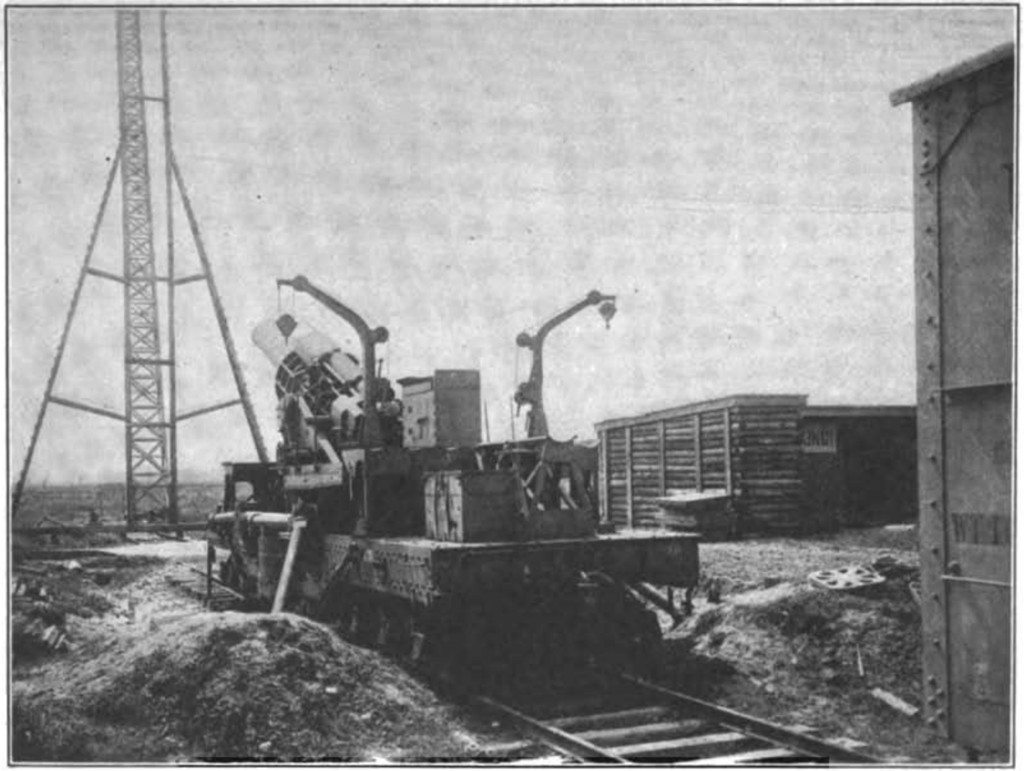
12-INCH, 20-CALIBER AMERICAN HOWITZER AND MOUNT (LEFT SIDE).

PLATE 194



12-INCH 20-CALIBER AMERICAN HOWITZER AND MOUNT (FRONT).

PLATE 195



12-INCH 20-CALIBER AMERICAN HOWITZER AND MOUNT (REAR).

PLATE 180

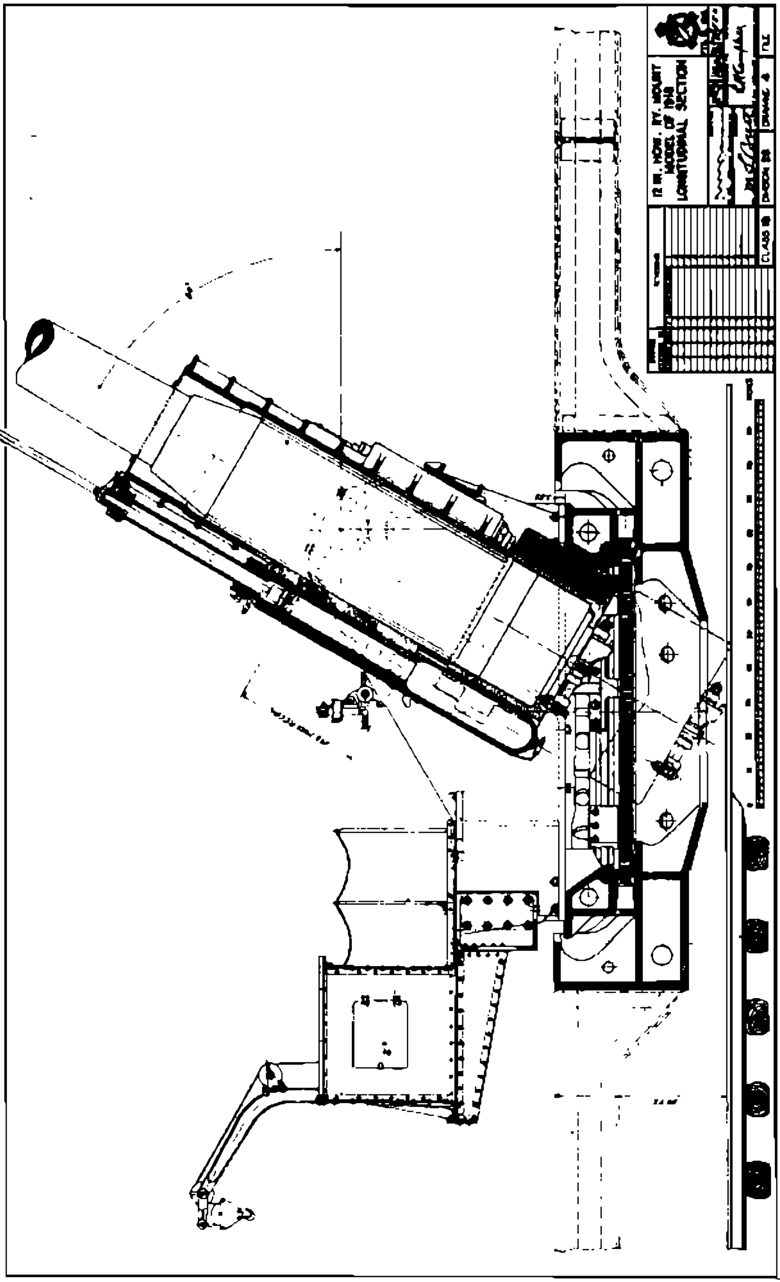

12 IN. HOW. RY. MOUNT
MODEL OF 1918
LONGITUDINAL SECTION
CLASS
DRAWING
FILE

PLATE 197

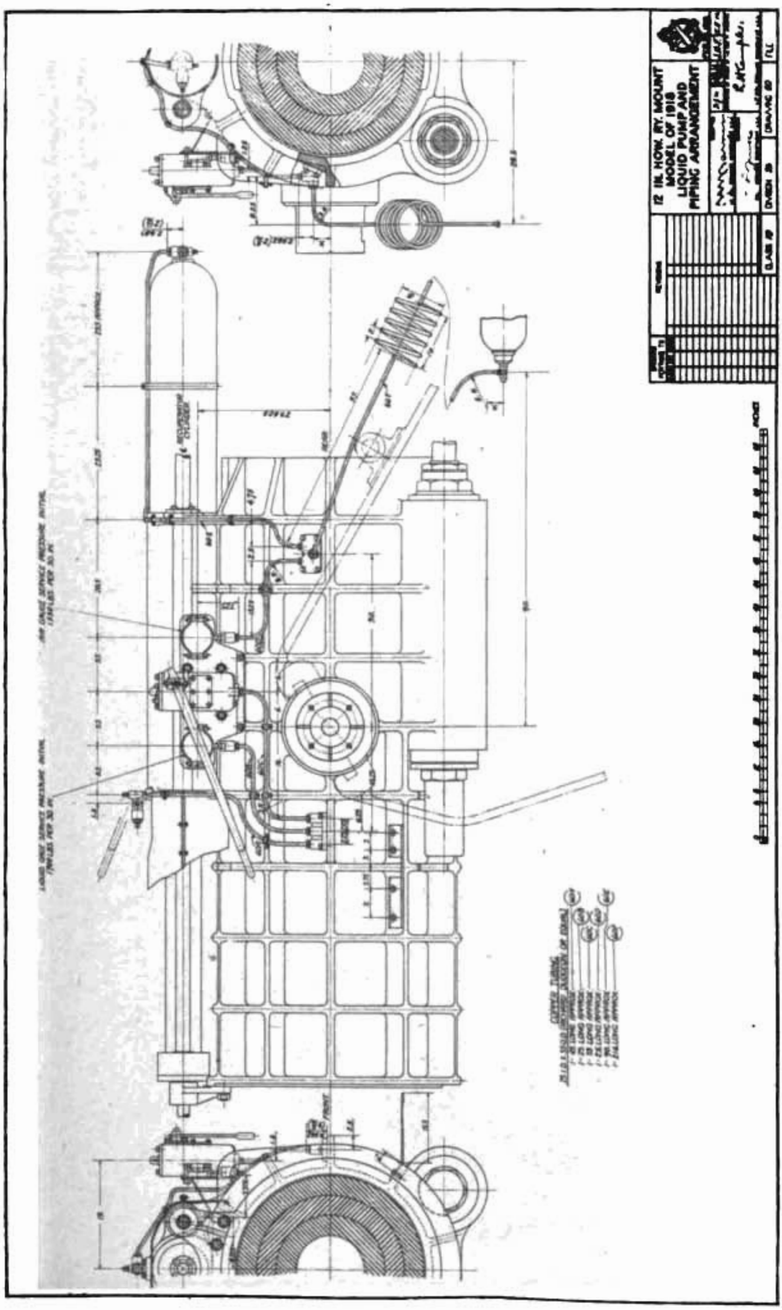

12 IN. HOW. RY. MOUNT
MODEL OF 1918
LIQUID PUMP AND
PIPING ARRANGEMENT

PLATE 193

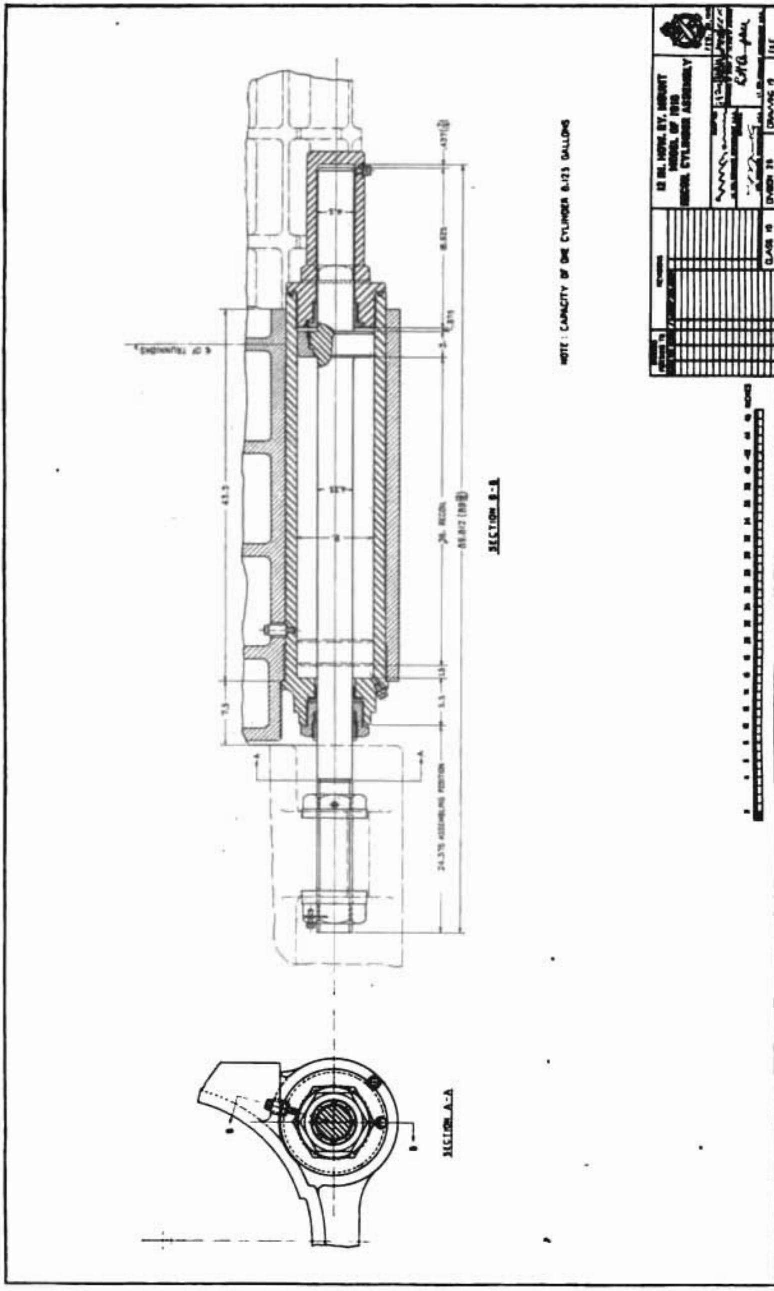


PLATE 100

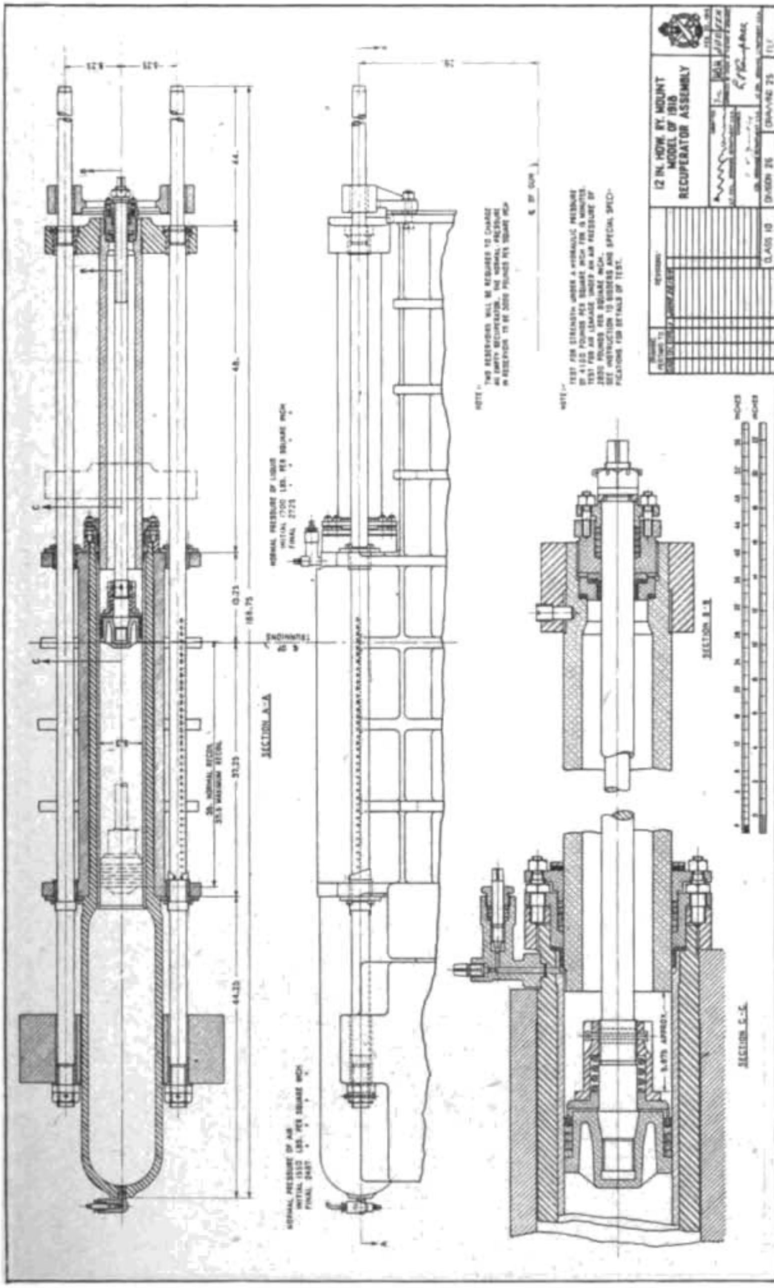

12 IN. HOW. RY. MOUNT
MODEL OF 1918
RECUPERATOR ASSEMBLY
SECTION A-A
SECTION B-B
SECTION C-C

PLATE 200

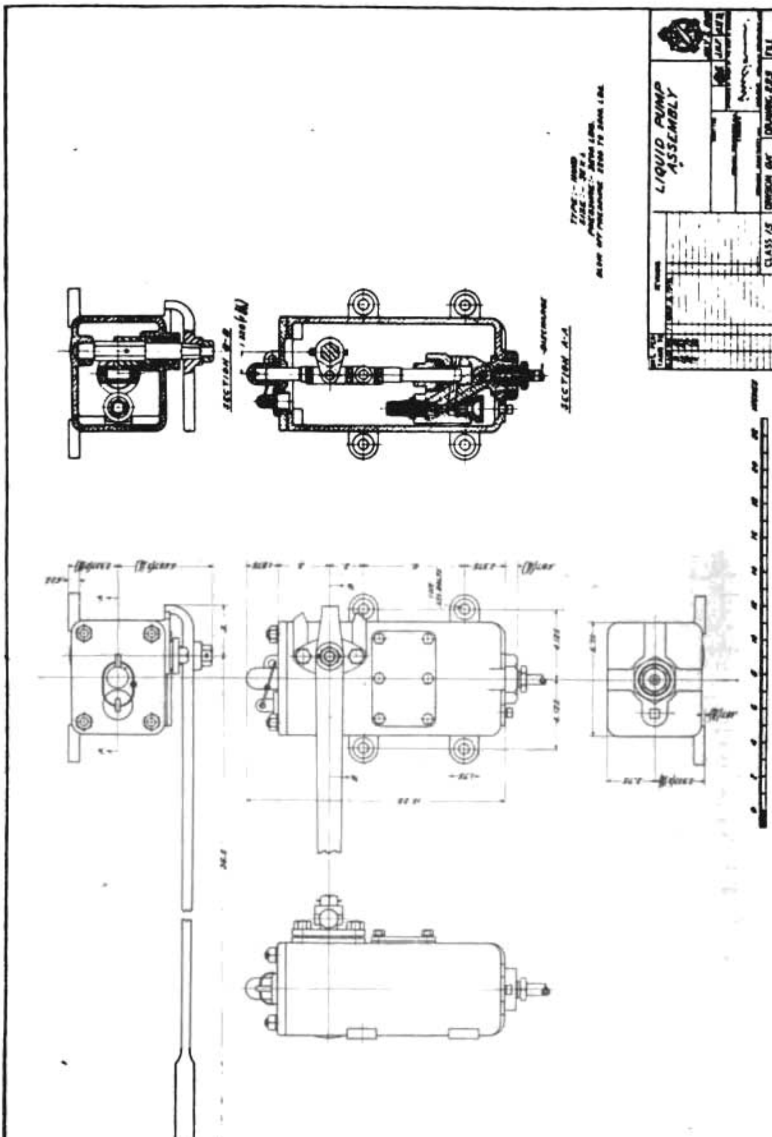


PLATE 201

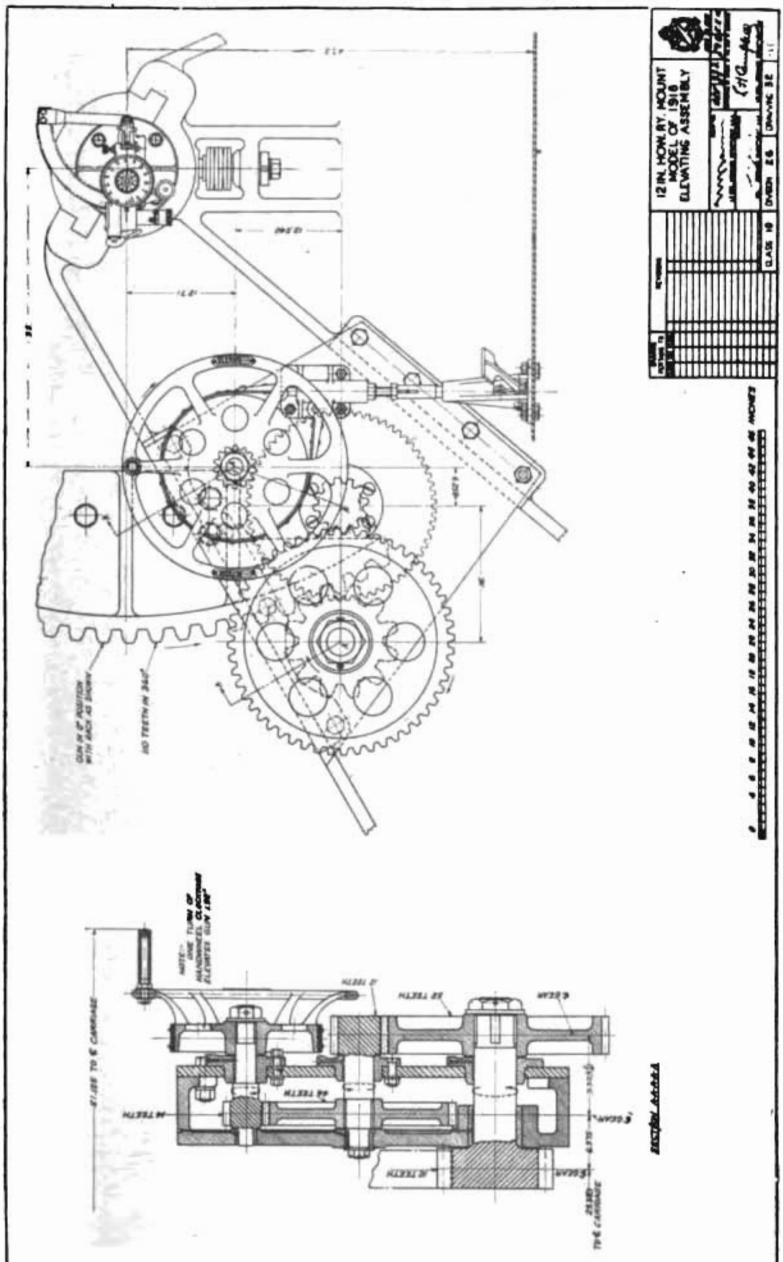


PLATE 202

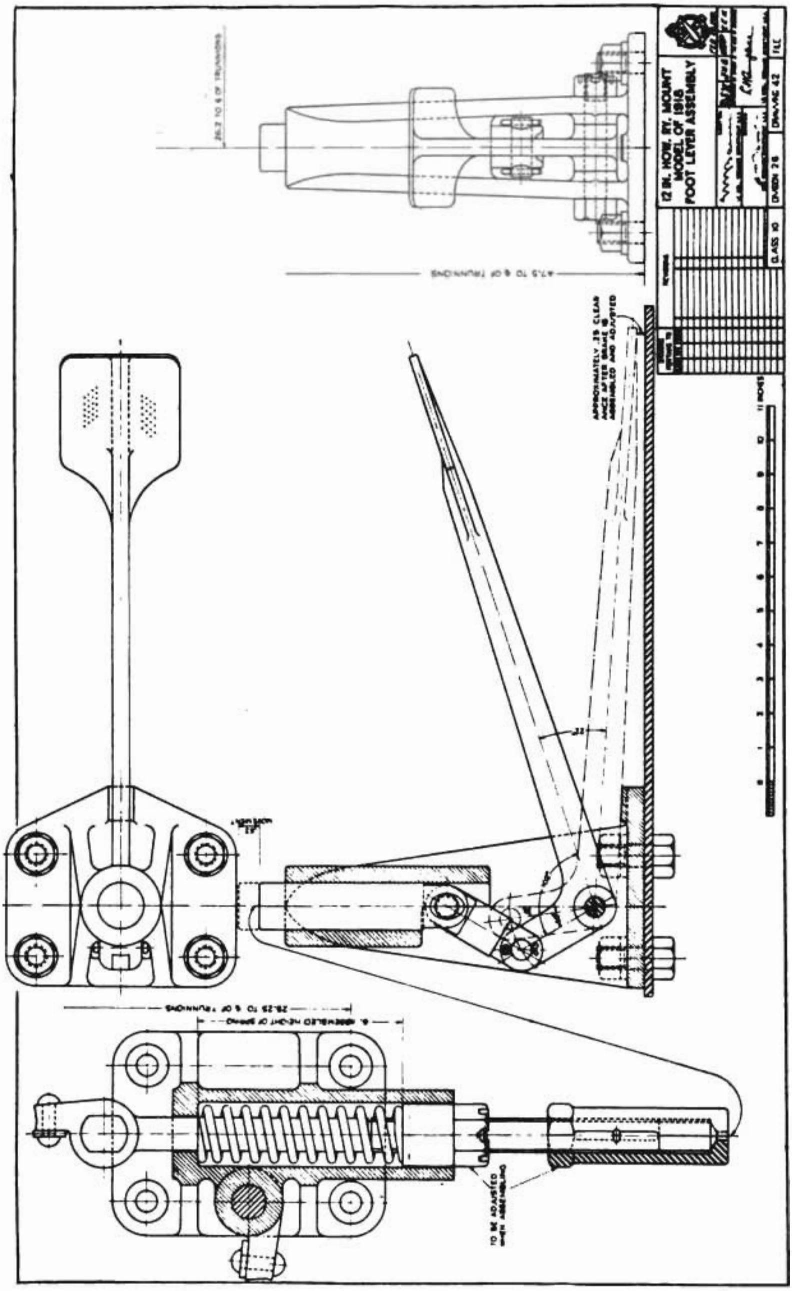
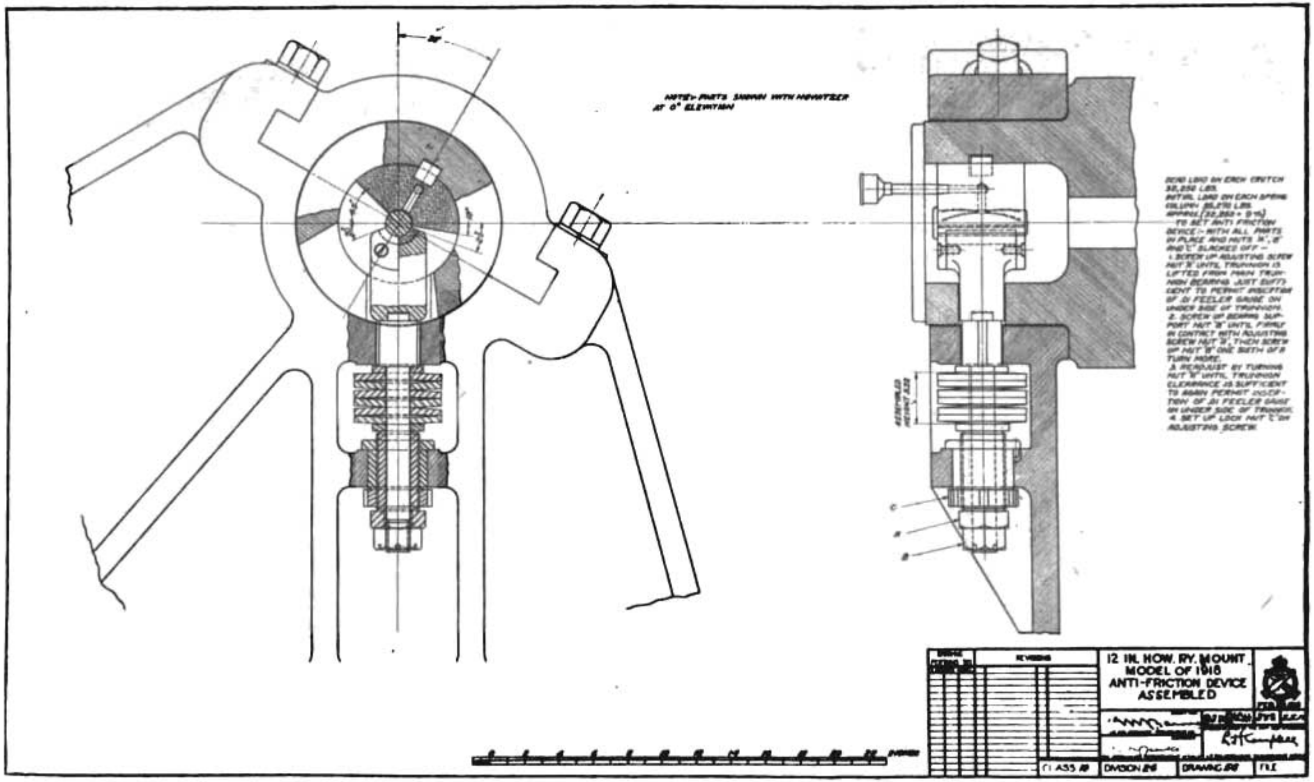

12 IN. HOW. RY. MOUNT
MODEL OF 1918
FOOT LEVER ASSEMBLY
CLASS 10
DIVISION 28
DRAWING 42

PLATE 203



NOTE:- PARTS SHOWN WITH HOWITZER AT 0° ELEVATION
12 IN. HOW. RY. MOUNT
MODEL OF 1918
ANTI-FRICTION DEVICE
ASSEMBLED

PLATE 204

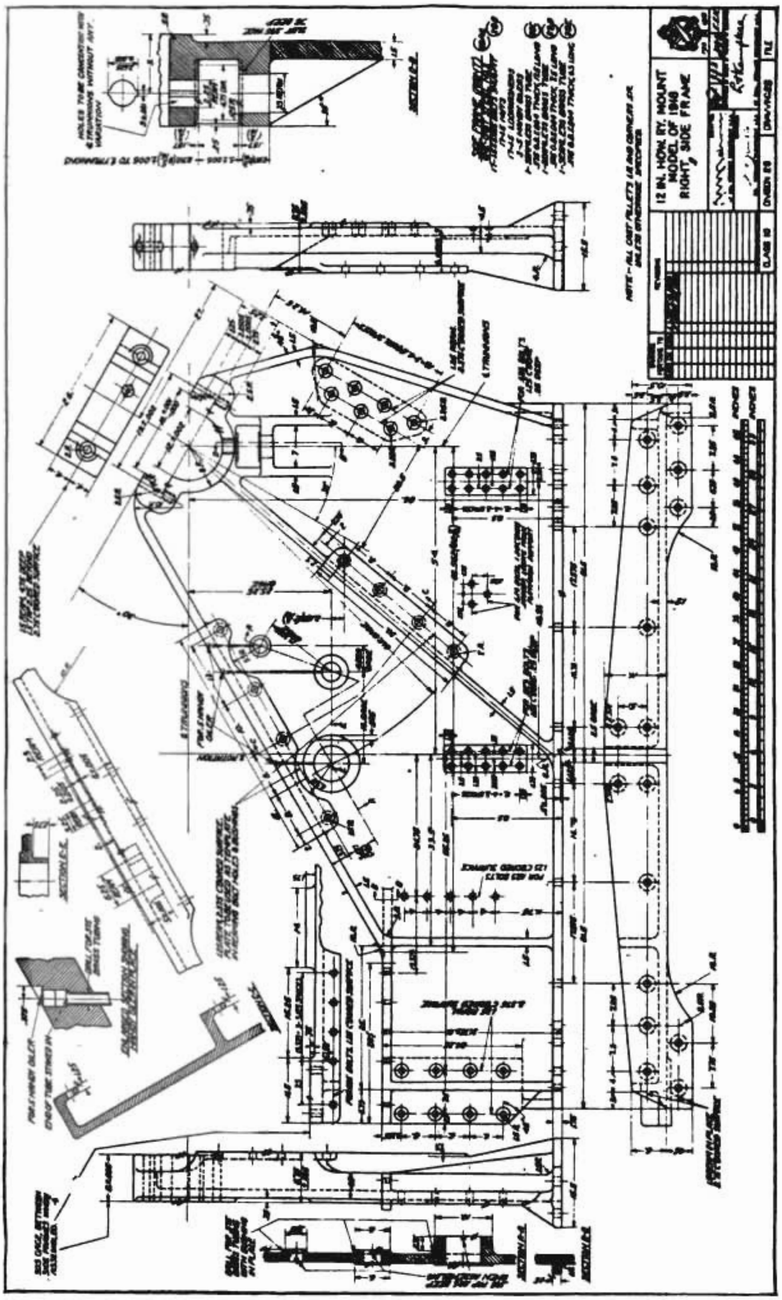


PLATE 205

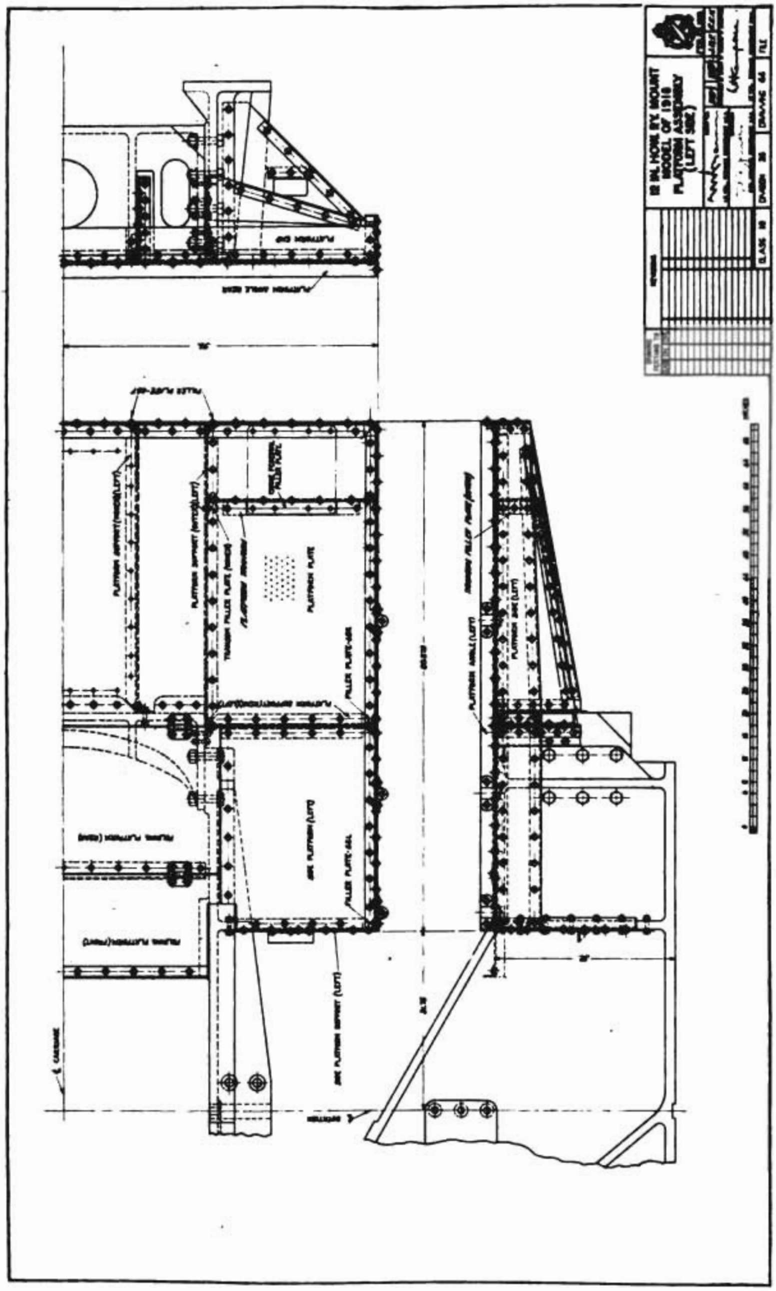


PLATE 206

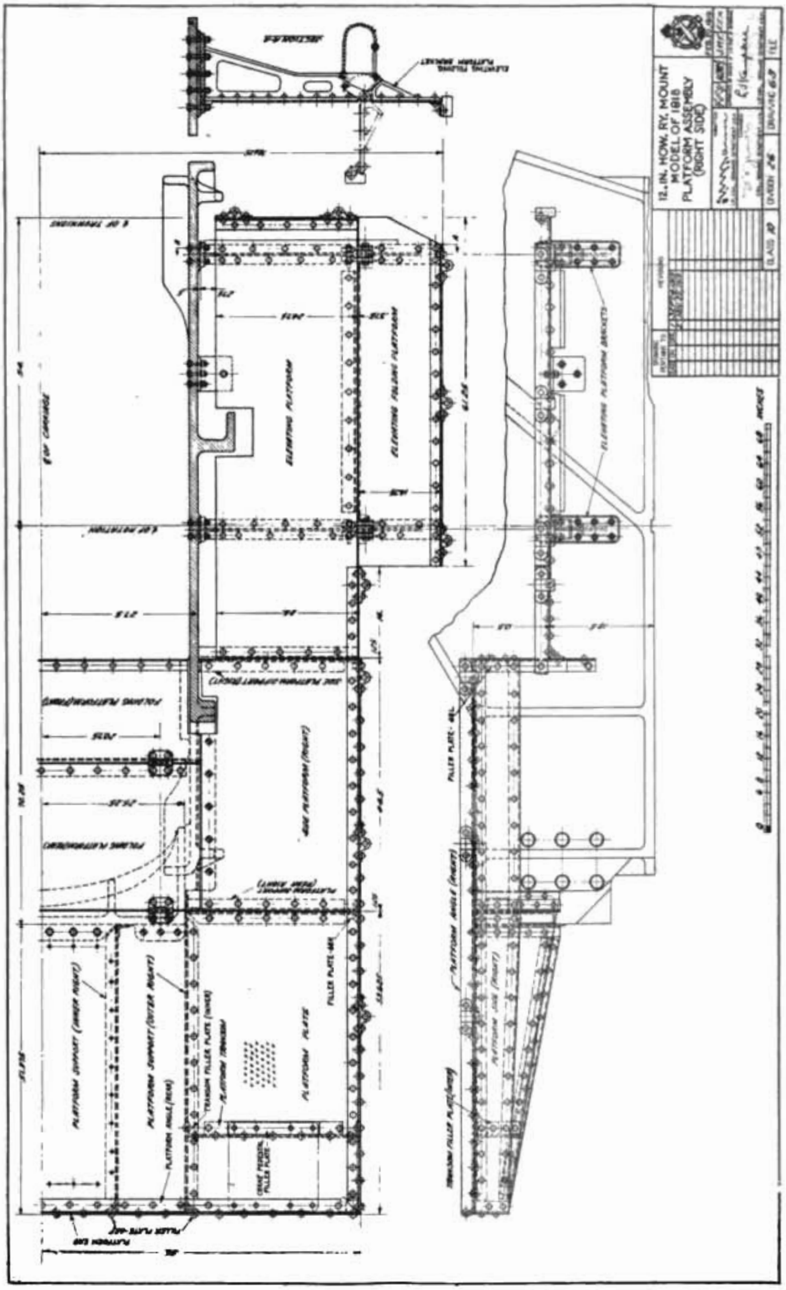

12-IN. HOW. RY. MOUNT
MODEL OF 1918
PLATFORM ASSEMBLY
(RIGHT SIDE)

PLATE 207

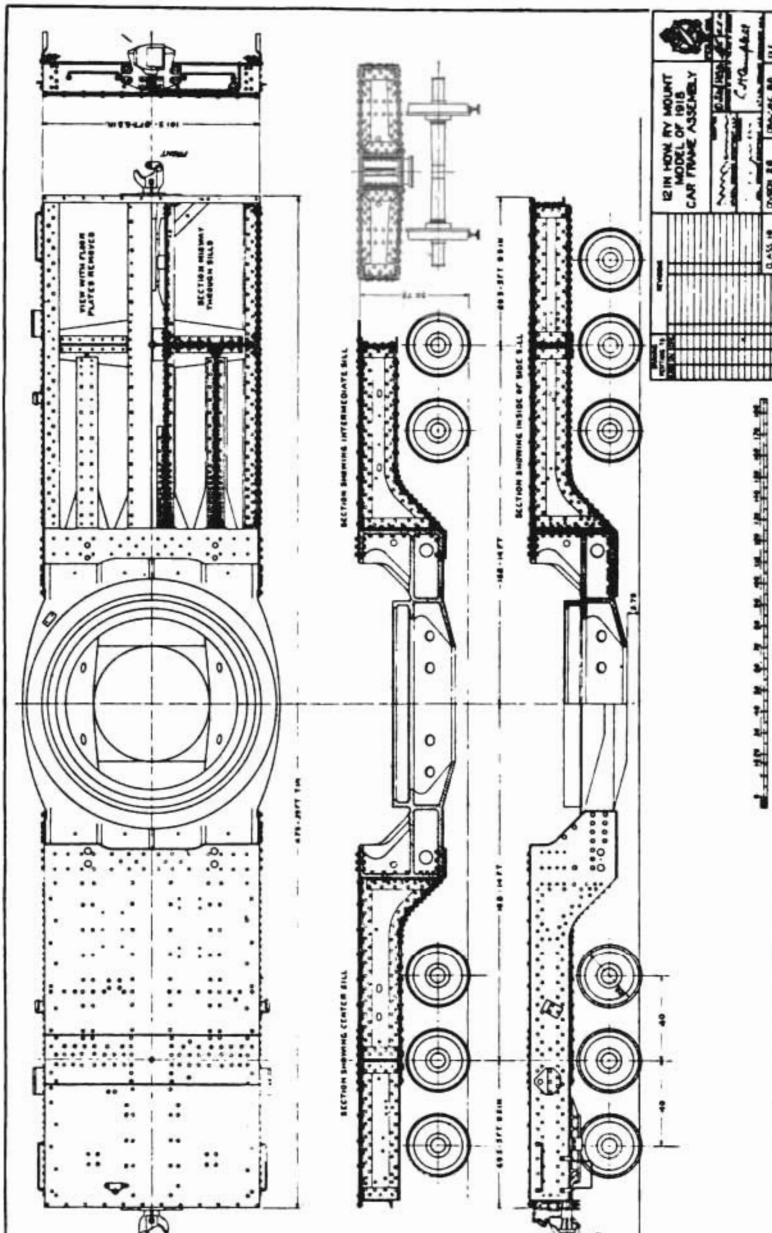

12 IN. HOW. RY MOUNT
MODEL OF 1918
CAR FRAME ASSEMBLY
CLASS 10
DIVISION 26
DRAWING 80
FILE

PLATE 208

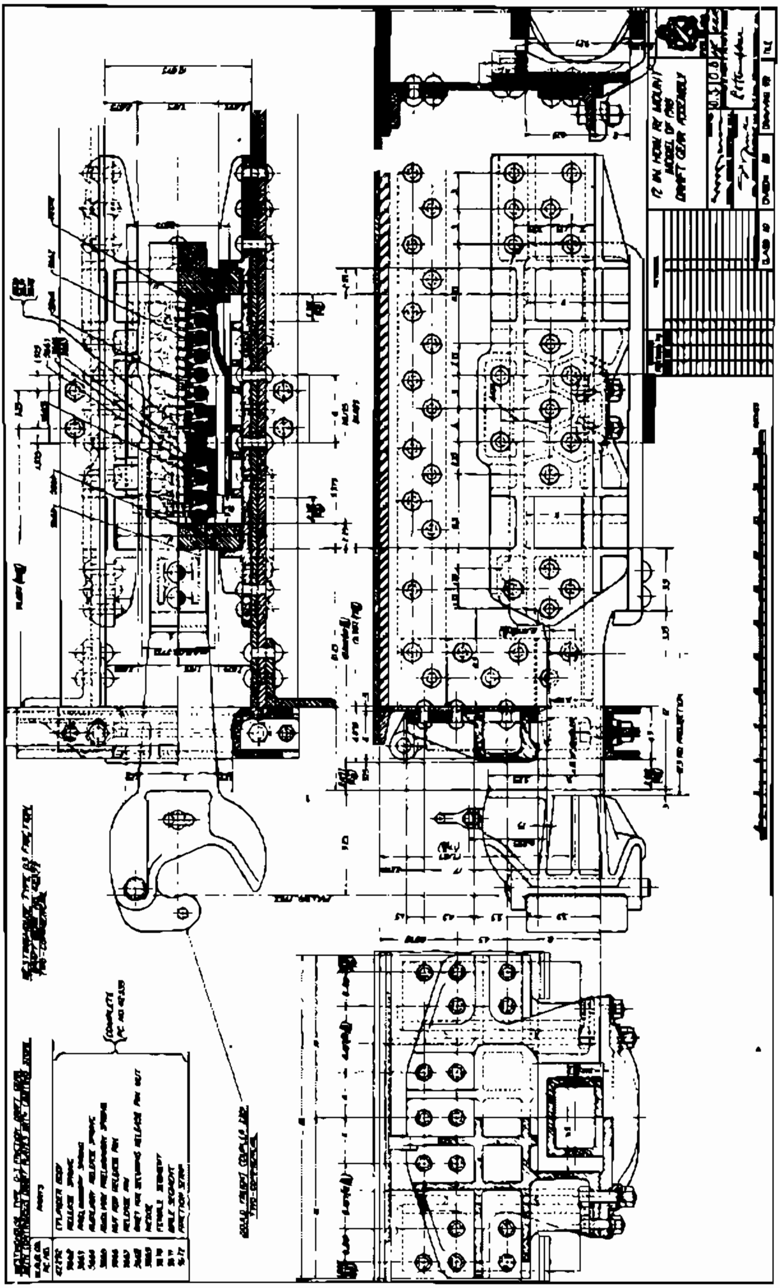


PLATE 209

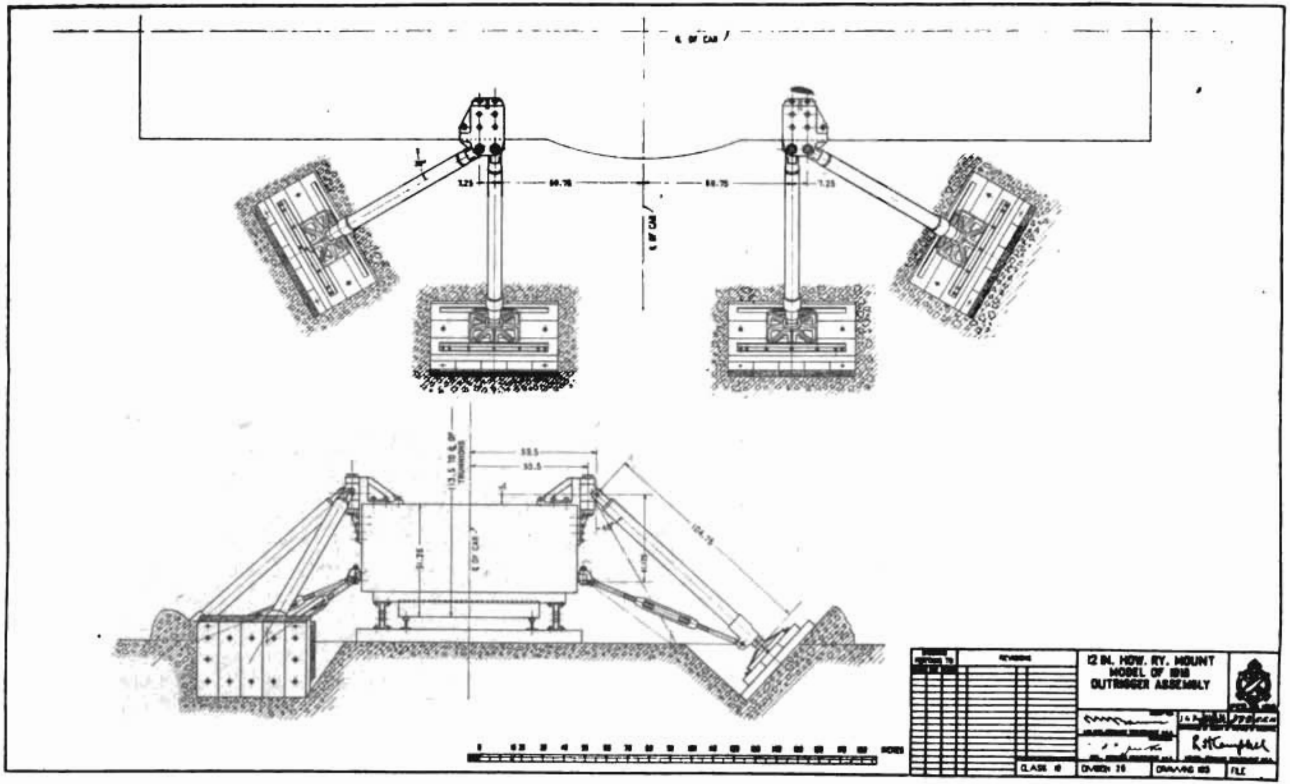

12 IN. HOW. RY. MOUNT
MODEL OF 1918
OUTRIGGER ASSEMBLY
TRUNNIONS
REVISIONS

PLATE 210

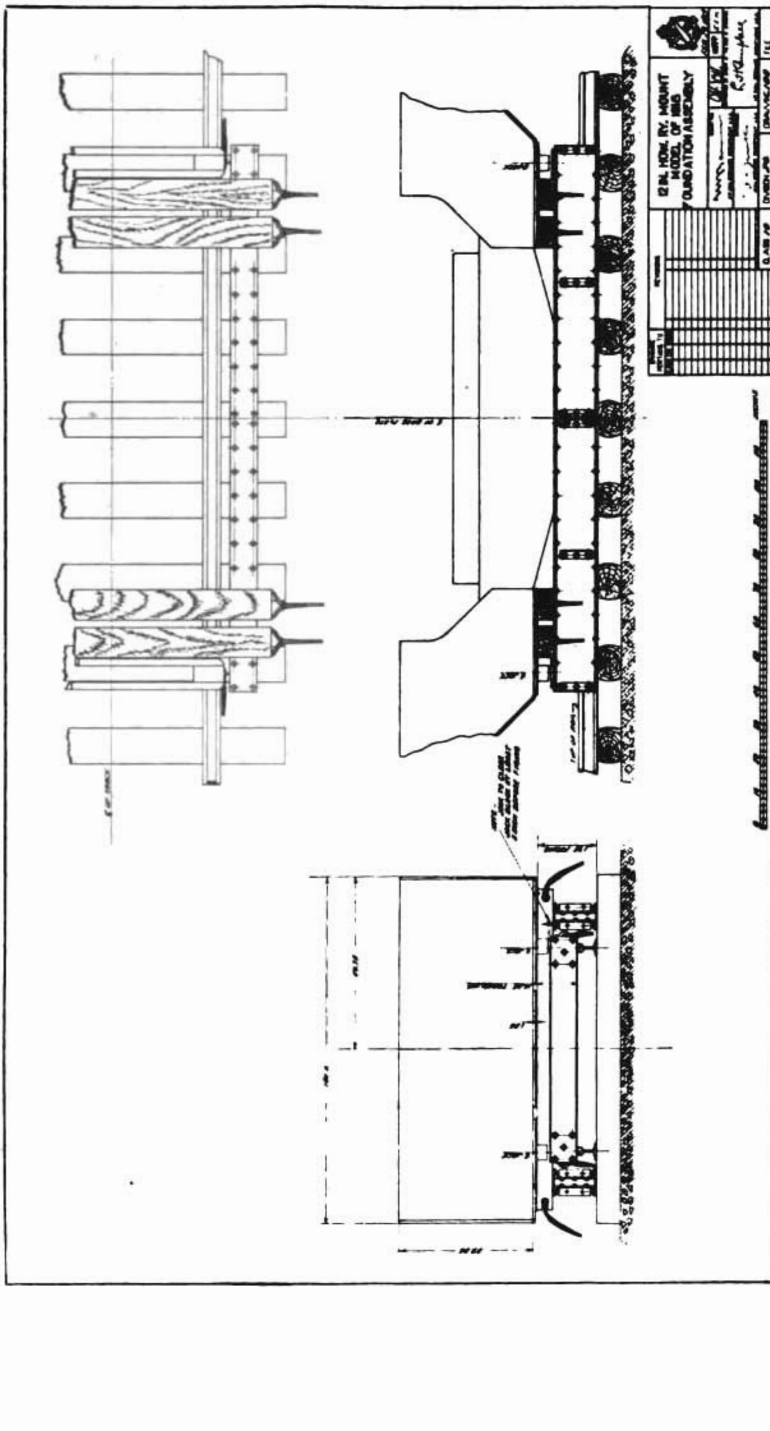


PLATE 211

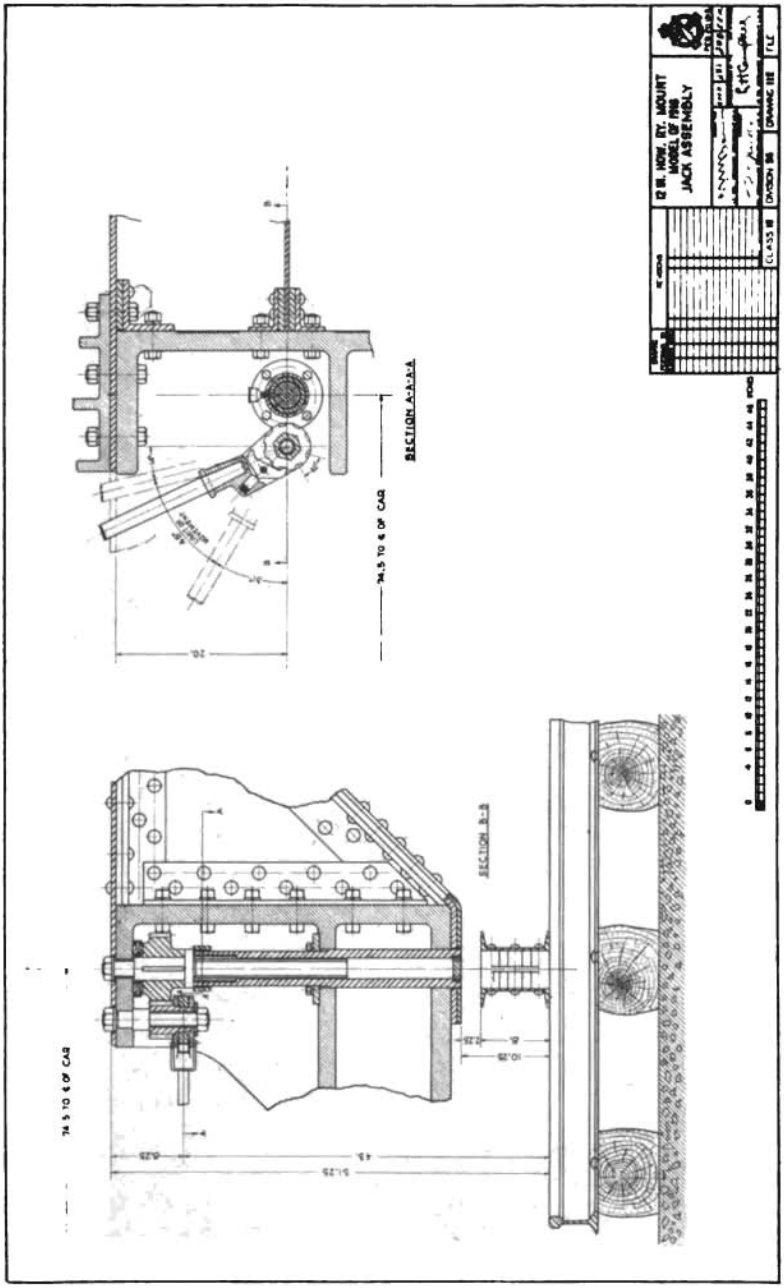

12 IN. HOW. RY. MOUNT
MODEL OF 1918
JACK ASSEMBLY
SECTION A-A-A-A
SECTION B-B

PLATE 212

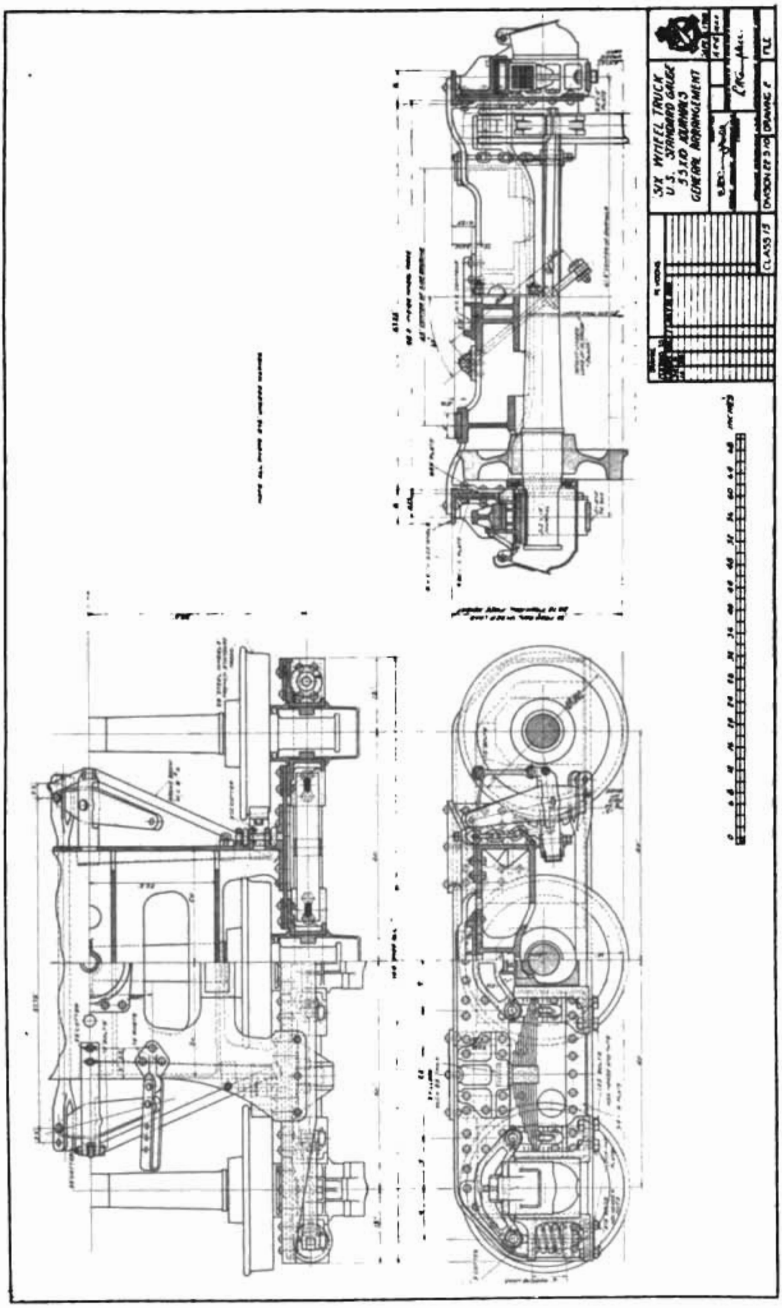

SIX WHEEL TRUCK
U.S. STANDARD GAUGE
5 1/2 X 10 JOURNALS
GENERAL ARRANGEMENT
CLASS 15

PLATE 213

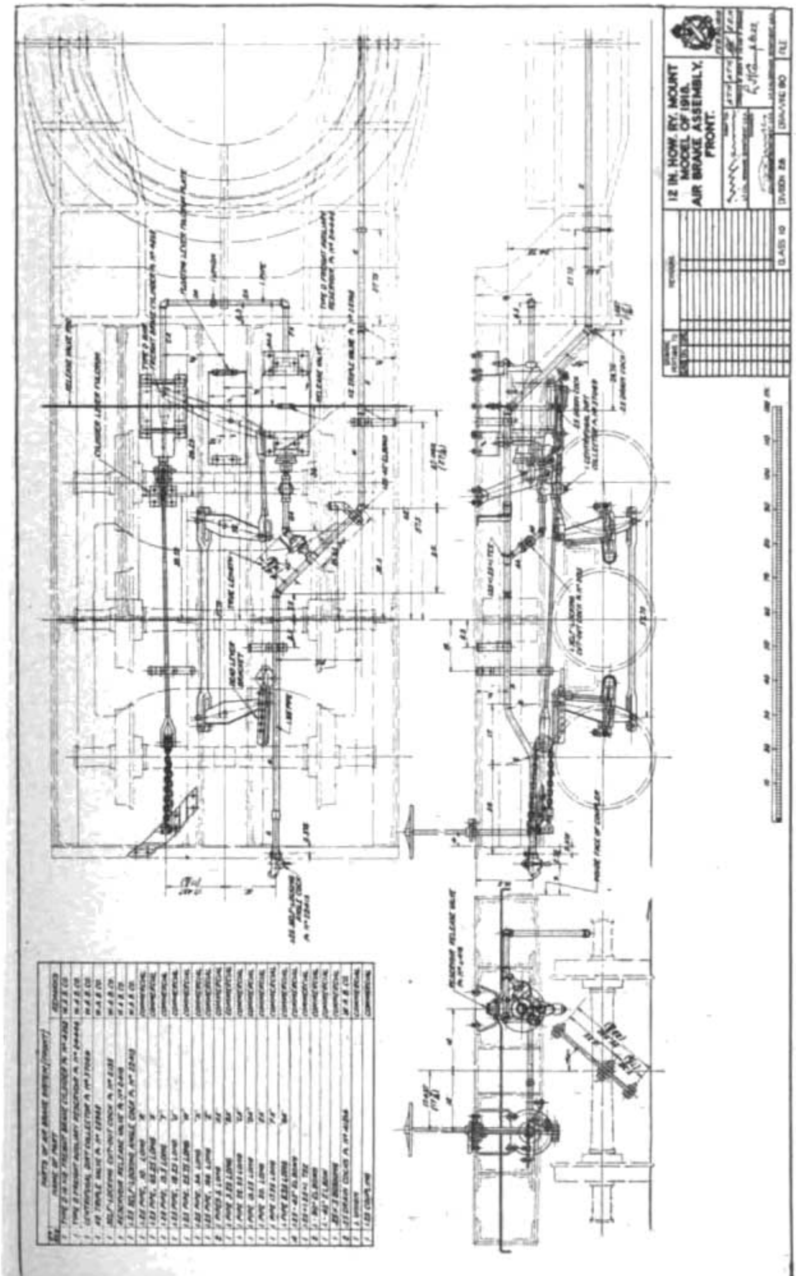


PLATE 214

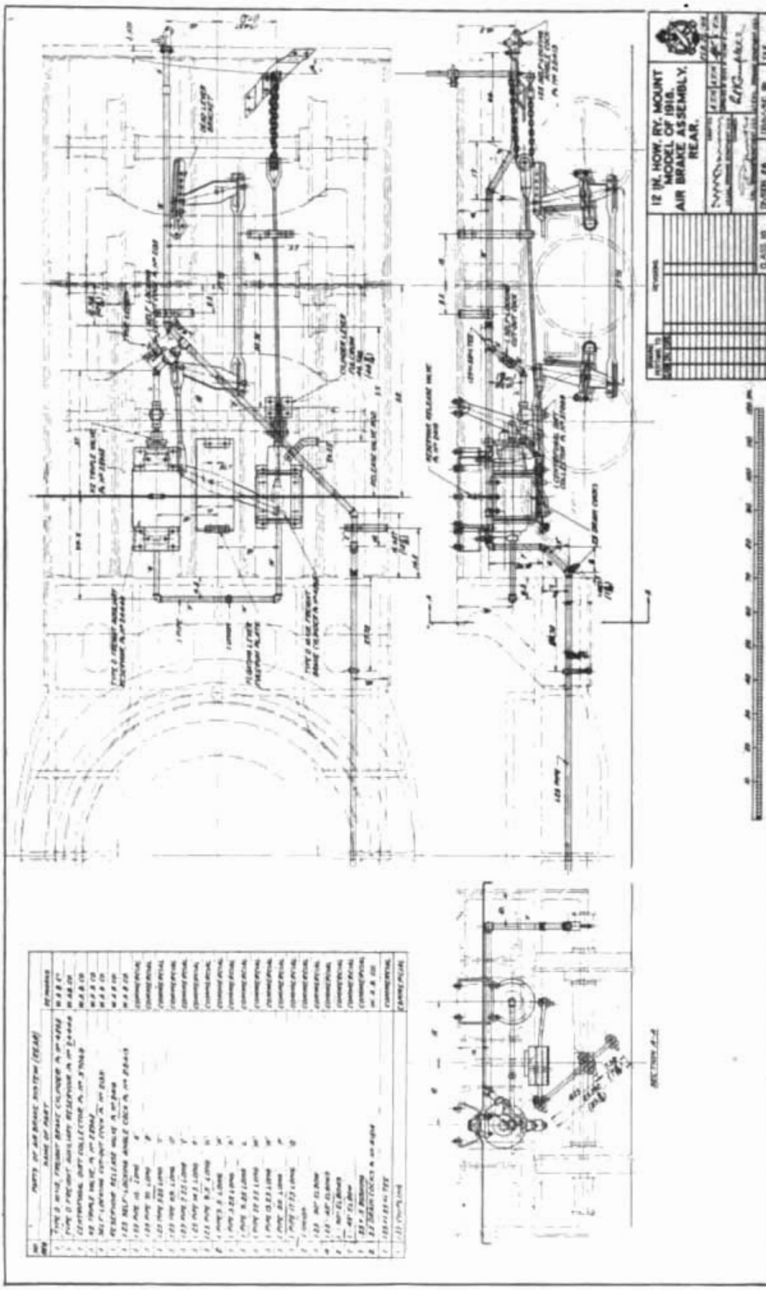
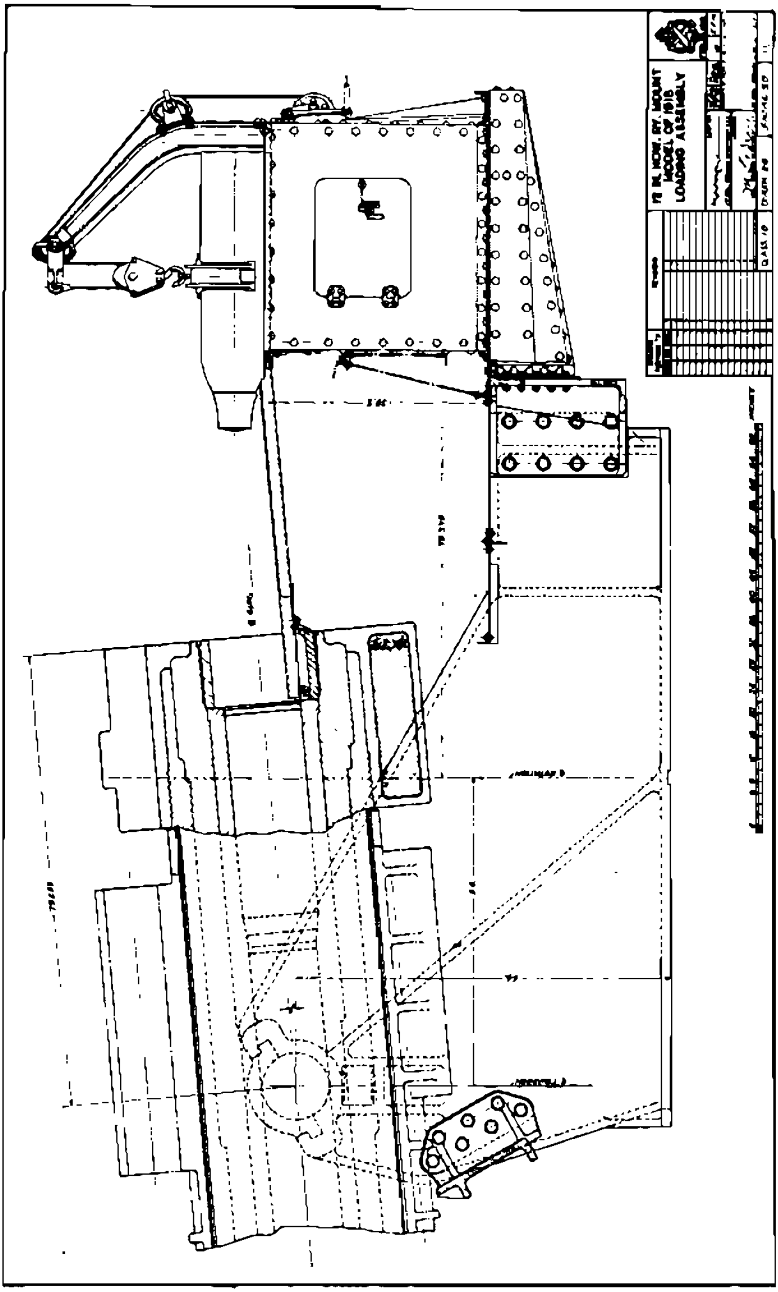

12 IN. HOW. RY. MOUNT
MODEL OF 1918.
AIR BRAKE ASSEMBLY,
REAR.
SECTION A-A

PLATE 215



9.—14-INCH GUN ON RAILWAY MOUNT, MODEL E. (22)

206. This is a mount the design of which was practically finished prior to our entrance into this war. It was designed primarily for service in the coast defenses, although a number of special provisions were made for its service as a field mount and even those features which adapt it especially for coast defense, adapt it likewise for certain types of field service. It can be operated either as a sliding or as a fixed emplacement mount. Only one mount of this design has been finished, but it has made so favorable an impression from its performance in recent tests against a moving target, at a distance of 6,000 yards, when the difficulties of following a rapidly moving target are extreme, that it is probable that a new mount embodying most of its desirable features, as well as other features found imperative for field service, will be made up very shortly. General views are shown on plates 217, 218, 219, and 220.

207. Gun.—The piece used on this mount is a wire-wound 14-inch gun, model 1919, of 40 caliber length. It is provided with an interrupted thread breech, which is fitted with a mechanical firing mechanism. There are 126 grooves and the twist of the rifling is to the right, progressing from one turn in 50 calibers to one turn in 25 calibers.

208. Recoil Mechanism.—The recoil mechanism is of the hydro-spring type and is composed of one hydraulic recoil cylinder attached to the bottom of the cradle in the center, and of the design shown on plate 221, and six spring recuperator cylinders arranged about the cradle and of the design shown on plate 222. This recoil mechanism has functioned very satisfactorily in all of the tests so far conducted. It is quite probable, however, that a pneumatic recuperator will be substituted for the spring recuperator on the new design that will be made up for other 14-inch guns. There are no features in the design of either the recoil cylinder or spring recuperator that are unusual. The maximum length of recoil is 60 inches. A by-pass providing an additional oil passage between the end of the buffer and outlet on the bottom of the cylinder is shown on plate 221. This is provided to permit of an adjustment to secure the full recoil of the gun at low elevation as well as for reduced powder charges.

209. Elevating Mechanism.—Provision is made for elevating the gun from its loading angle, zero degrees, to a maximum elevation of 30 degrees The details of the elevating mechanism are shown on plates 221 and 223. This elevating mechanism is essentially the same in design as that provided on the 14-inch Navy mounts, Marks I and II. It will be observed on the above noted plates that the mechanism is made up of one large screw hinged to the bottom of the cradle by means of a yoke and trunnions and passing through a large nut in the oscillating housing which is in

turn supported by its trunnions in bearings attached to the car body. This nut is provided with a ball thrust bearing as shown on plate 223, and is driven by miter gears which communicate with the handwheel through the horizontal cross shaft and two more sets of miter gears. The elevating handwheel is mounted on the right side of the carriage just behind the trunnion. Each trunnion is equipped with an antifriction device of the design shown on plate 224. This is of the rolling wedge or knife edge type and again is almost identical in design with the antifriction device provided on the Navy 14-inch mounts, plate 270. It is composed of a fulcrum arm whose rounded lower end rests in a bearing block which in turn rests on the adjusting wedge. The upper end of the fulcrum arm is rounded to a radius equal to the distance from the center of the lower end to the center of the top, and bears directly against the under side of an extension of the main trunnion. Both the fulcrum arm and the trunnion are fitted with gear-toothed segments which mesh with each other and prevent slipping of the arm. The device is adjusted by means of the wedge under the bearing block at the bottom of the arm. When properly adjusted, this device carries the weight of the gun while it is being elevated and depressed, thereby reducing considerably the effort required. When the gun is fired the force of recoil is transmitted, even at the maximum firing angle of 30 degrees, almost entirely into the main trunnion bearing. This mechanism is inferior to the type used in the service of the other mounts already described, in that it contains no flexible parts that can bend or be compressed under the force of recoil and permit that force to be communicated more easily and directly to the main trunnion bearings. One turn of the slow, operating handwheel elevates the gun through 0.33 degree and one turn of the fast-operating crank elevates the gun through 0.545 degree.

210. Traversing Mechanism.—This mount can be traversed through 360 degrees by means of a mechanism, the design and details of which are shown on plates 225, 226, and 227. The entire mount rests by means of four conical rollers on a cast-steel base plate. To the center of the base plate is bolted a pintle which takes the horizontal component of the force of the recoil; gears are cut on the inside of the roller path to serve as a traverse rack. The traverse pinion is cut in the bottom end of a vertical shaft which can be raised for traveling, or lowered to mesh with the traversing rack for traversing the mount. This shaft passes through and is driven by the large horizontal miter gear, as shown on plate 227, which is in turn driven through miter gears by the two handwheels on the sides of the carriage. The gear case through which the horizontal driving shaft passes on the left side of the carriage, plate 227, contains a

large miter gear, loose on the shaft, but which may be thrown into gear with the shaft by the foot-pedal operated clutch. When the clutch engages the miter gear, the traversing mechanism is operated by the handwheel somewhat to the rear of the handle and shown on plate 218. This gear is used for the final fine adjustment.

211. It has been noted before that the gun can be fired without the use of a firing platform to an elevation of 22 degrees. To secure any great amount of traverse under this elevation, it is of course necessary to operate the mount on a curved track. For fine adjustment, a car body traversing mechanism of the design shown on plates 228 and 229 is used. It will be observed here, that cast-steel body bolsters shown in detail on plate 230, riveted into each end of the car, carry a traversing beam which is fixed with respect to the truck when the lifting bolster is down. Between this traversing beam and the body bolster are two rollers, 5.33 inches in diameter and 23 inches in length, on each end of which are cut spur gears which mesh with racks attached to the body bolster and the traversing beam. The traversing beam is connected with the handwheel on the left side of the carriage, plates 218 and 228, by means of a screw and spur gears. The mount is capable of being traversed 0.25 degree on each side of the center, at each end of the car, by means of this mechanism, thereby securing a total traverse of 1 degree. One turn of the handwheel moves one end of the car through 0.093 degree. As the handwheel is turned, the traversing screw moves either in or out of the traversing beam. As noted before, the traversing beam is fixed with respect to the trucks the car body must therefore mov on the traversing rollers.

212. Gun Carriage. In this mount the gun carriage is incorporated with and is a part of the car body. The gun is carried in a cast-steel cradle which is swung directly by means of its trunnions, between the side girders of the car body.

213. Car Body.—The car body is made up of two single-web structural steel side girders connected by a series of structural and cast steel transoms, plate 230. The cast-steel body bolsters at the front and the rear, the cast-steel pintle bearing in the center at the bottom, and the cast-steel jack bolster at the rear serve further to stiffen it. Two cast-steel side frame yokes serve further to stiffen the car body at the top and one carries the forward end of the I-beam ammunition trolley, plate 243.

214. Anchorage.—The mount may be operated to an elevation of 22 degrees without the use of auxiliary anchorage equipment, if desired. To this elevation it may be operated as a sliding type mount. On plates 231 and 232 are shown the cast-steel sliding shoes which are bolted to the bottom of the lower chords of the side girders at the front and the rear. These shoes bear on two auxiliary rails placed on

the ties one on the outside of each of the service rails. When ready for firing the mount is let down until the entire weight rests on the auxiliary rails through these shoes. In a series of trials that have been made, the length of recoil varied from 11 to 17 feet.

215. For firing above angles of 22 degrees, it is necessary to place the mount on the cast-steel base ring, the design of one half of which is shown on plate 233. This base ring may be laid either on a concrete sub-base or on rock ballast. When placed on rock ballast, it is necessary to brace it against lateral movement by means of 64 steel piles, 4 feet long, driven around its circumference. The base ring is in halves and in traveling is carried on a standard flat car, as shown in plate 234. The full capacity of a 160-ton locomotive crane is required to handle it in process of installation. It is first removed from the car and placed on the ground beside the emplacement, as shown on plate 235. On plate 234 a lifting eye will be observed attached to the hinge pin between the two sections. After the base has been placed on the ground, it is picked up first by means of this eye, as shown on plate 236, after which two chains are attached to the two half segments. The platform is then spread, plate 237, and laid in place on the leveled ballast surface of the prepared position, plate 238. The two segments are then bolted together with eight bolts on each side of the center and the steel piles driven around the circumference, plate 239. Four special rail sections are placed over the conical roller path and are bolted to the rails of the approach track. After these rail sections are installed, the mount is run into position over the emplacement and lowered until the traversing rollers rest on the roller path and the pintle engages with the pintle bearing, plate 240.

216. The mount is lowered by means of two identical lifting devices installed on the front and rear trucks and of a design shown on plates 228 and 229. Above the center of the front truck, plate 218, a capstan mounted on the shaft of the pinion, which drives this lifting gear, can be seen. This pinion meshes with two large spur gears which are attached to the ends of identical screws which screw into the lifting bolster. As the capstan is turned and drives these screws, the bolster is raised or lowered with respect to the car, thereby lowering the car onto, or raising it from the emplacement. This device is supplemented by a hydraulic lift, incorporated in the center plate of the truck. However, when this is used the movable bolster must be raised or lowered by hand to maintain the side bearing clearance and prevent the mount from overturning. The lifting bolster is shown in its traveling position on plate 228. On plate 229 it is shown as located when the mount is resting on the emplacement and the trucks are removed or ready to be removed. The eight conical traversing rollers, plate 240, are removed in traveling.

217. When the lifting bolsters are raised the mount can be traversed until the rear end is over the supports, plate 241. This supporting device with the support beams is shown on plates 242, 243, and 244. The cast steel support beams are made up in segments and are placed on short sections of I-beams which rest directly on stone ballast. A cast steel transom carrying two hydraulic jacks and one screw jack is riveted to the rear of the car body. These hydraulic jacks have swinging shoes which rest on the support beams and serve to prevent the mount from turning over in firing. Tests have been made which prove that the mount can be operated without supports of this kind when the base ring is bolted to a concrete subbase. The design of the hydraulic support cylinder is shown on plates 244 and 245. No special mechanism is provided for raising or lowering the hydraulic cylinders. They can easily be raised or lowered by any sort of lever, such as a crowbar, and move easily when moved very slowly. In preparing for action the supporting beams are leveled very carefully and the hydraulic jack shoes are lowered until they bear on the greased top surface of the supports. A small cable is attached to the top of the movable cylinder and passes over the top of the pulley to the counterweight which balances its weight. The cylinder will remain in any position. As the cylinder moves up or down, the oil between it and the ram must pass through the valve shown in the center of the bottom of the ram, plate 245. Any attempt to move the cylinder rapidly as is the case when the gun is fired, simply serves to close this valve and prevent the cylinder from moving. Thus the cylinder can be brought down until its bearing plate rests on the support segments, and inasmuch as it exerts no pressure, no difficulty is caused in traversing; but the cylinder furnishes a positive support in firing, since as noted above, any attempt to move it rapidly closes the valve in the ram. The top surface of the support beams is kept well greased.

218. Trucks.—The trucks are constructed of structural steel and steel castings and carry four axles each, with 6 by 11 inch outside journals and 31-inch wheels. Both hand and air brakes are provided. The two trucks are identical in design. The axles are equalized throughout, thereby transmitting the load evenly throughout the entire truck. The design is shown on plates 246, 247, 248, and 249.

219. Ammunition Supply System.—The design of the loading gear is shown on plates 250 and 251. It will be seen on the first plate that the projectiles can be picked up from the ground or from a platform at the rear of the carriage by means of a chain hoist carried on an I-beam trolley. The projectile is carried forward and placed on the shot truck, the wheels of which ride on angle iron rails. The shot truck is run forward with as great a velocity as possible until its

buffer strikes the breech of the gun, when the projectile slides on into the powder chamber. The projectile is then rammed by hand. The powder charge is picked up from the rear and placed on the shot truck by means of the same hoist. The shot truck is run forward to the breech of the gun and the charge pushed into the chamber by hand. A speed of firing of seven shots in 14 minutes has been attained in recent tests. In these tests it was necessary to lift the projectiles from the ground. Had the projectiles been located on a platform, level with the working platform of the carriage, it is believed that this time might have been reduced to one shot per minute.

220. Maintenance.—In the service that this one mount has so far seen, it has proved very sturdy and practically no maintenance except the ordinary attention required for the various mechanisms has been necessary. It is believed that no serious difficulty would have been experienced with mount of this design even under the severe conditions prevailing in France during the war.

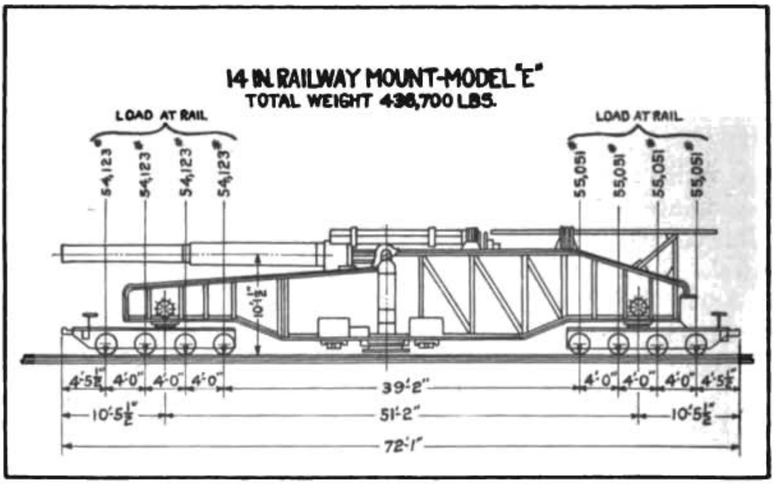
221. Difficulties Involved in Service.—The one feature of this mount which might cause what may be termed difficulties in service, is its emplacement for high angle firing. This emplacement required the full capacity of a 160-ton locomotive crane for installation and removal. To those acquainted with field service of heavy artillery in this war, it is not certain, however, that this constitutes a difficulty that is serious. A heavy locomotive crane was to be included in the equipment of the organization maintaining railway artillery in the park of the Railway Artillery Reserve in France, and since such a crane is required for the ordinary service of maintenance, it would of course, be available for the installation of the equipment of such a gun as this, of which any army would certainly have only a limited number. This emplacement permits of operation at 90 degrees to any existing railway line and it can be installed in less than a day. The platform used with the Navy 14-inch mounts Mark I, and with French 340-millimeter guns and 400-millimeter howitzers required at least two days for installation and the maximum traverse that can be secured in any one position with these mounts is not more than 10 degrees. As a consequence, it is felt that no serious difficulties would be experienced in the service of this mount for land warfare. Trials have proved it particularly easy of service and efficient for coast defense.

222. Merits.—The merit of this design is that it embodies most of the features found desirable in mounts for large guns during the present war. For a gun of this size, it can be emplaced in a very reasonable time and it can be trained on a target in any direction from any position. It can be operated from a curved track as a sliding mount and has an internal car traversing mechanism. The

speed of operation developed in recent tests of 7 shots in 14 minutes with probability of its reduction to 1 shot per minute is excellent.

223. Demerits.—The only criticism that occurs to the writer in connection with this design is in the matter of the limited elevation to which the gun can be operated either as a sliding or as a fixed emplacement mount. The maximum elevation for operation as a sliding mount is 22 degrees, and 30 degrees for operation as a fixed emplacement mount. The limit for service as either a sliding or fixed emplacement type of mount should be at least as high as 45 degrees and preferably 50 degrees.

Plate 216



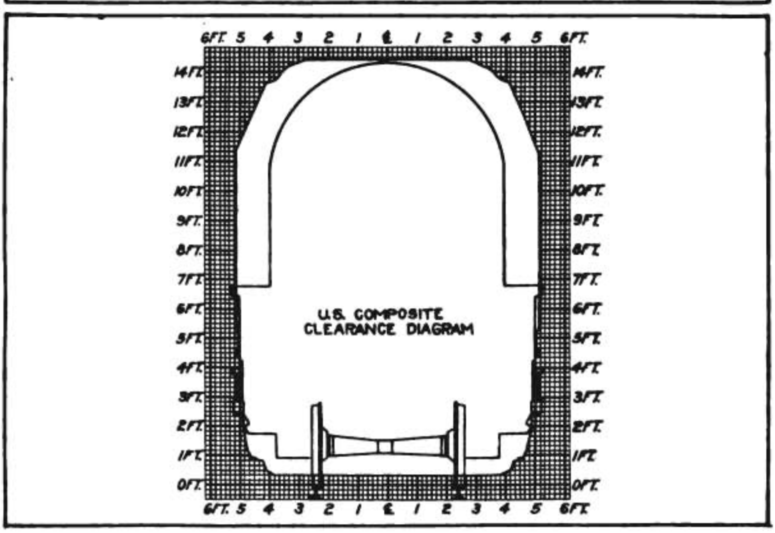
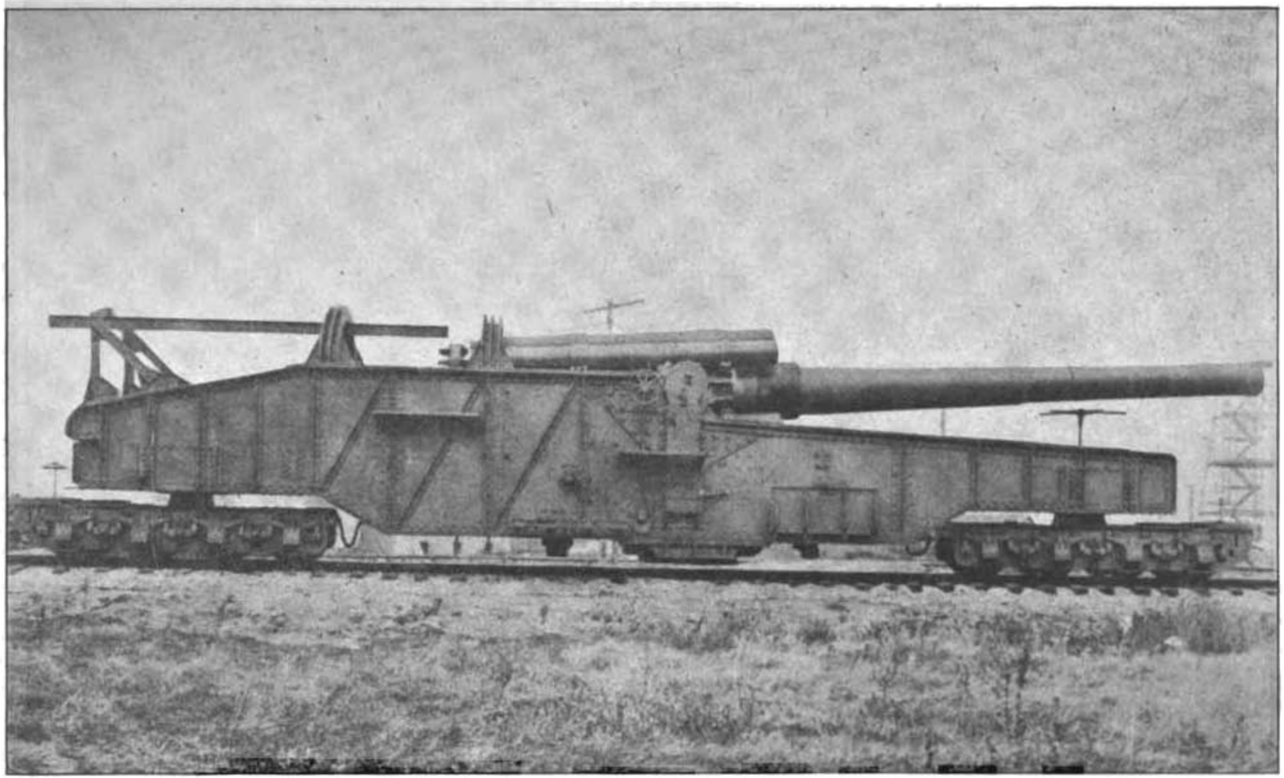
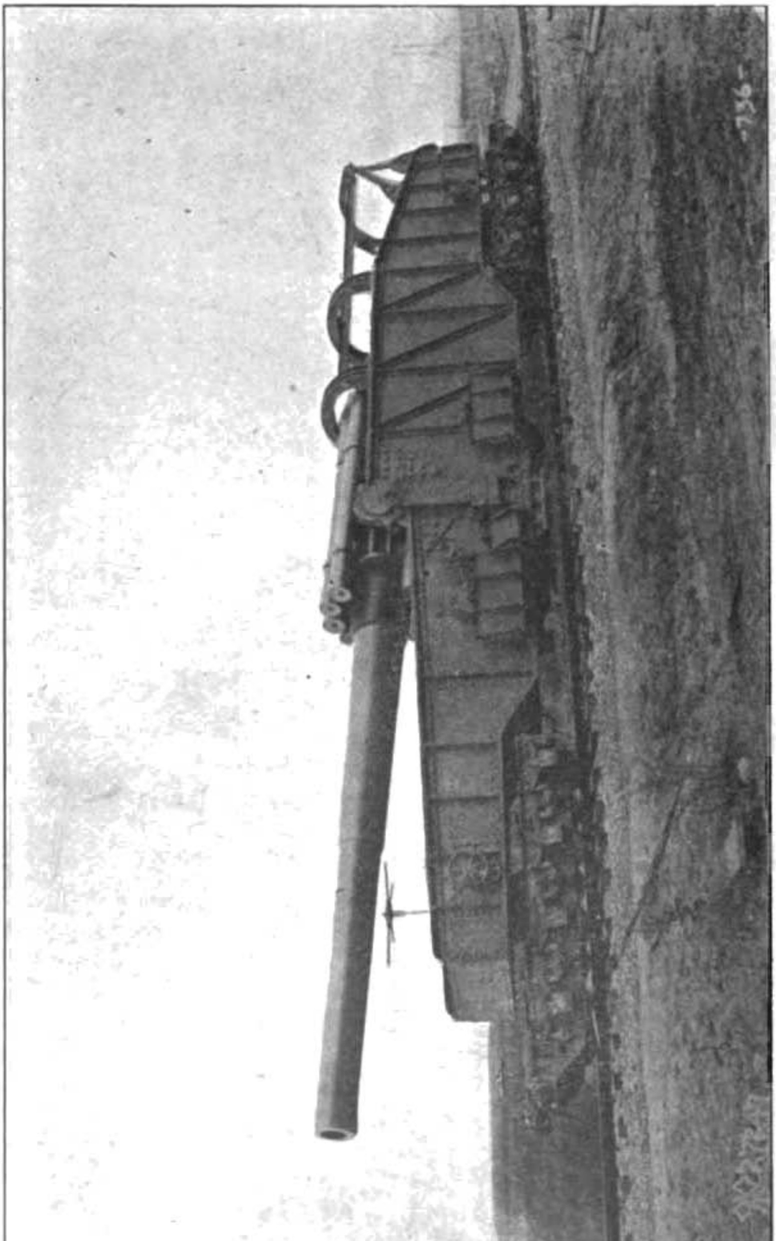


PLATE 217



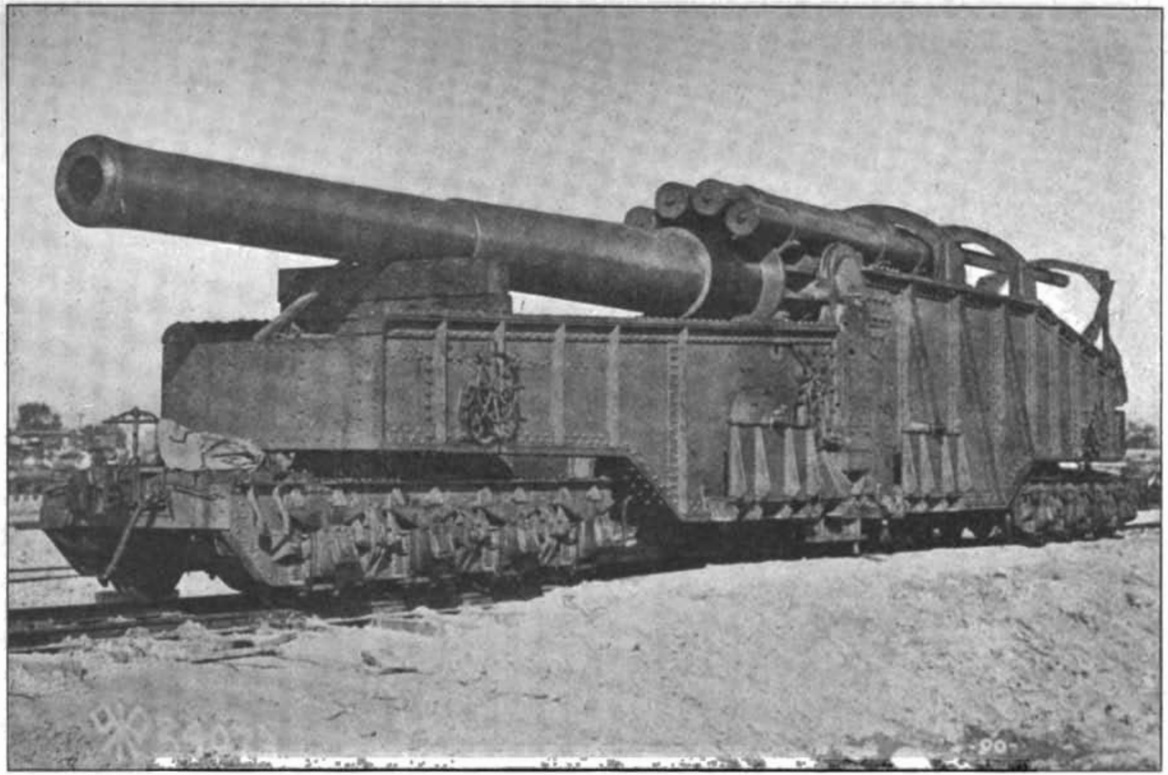
14-INCH, 45-CALIBER AMERICAN GUN ON RAILWAY MOUNT, MODEL "E" (RIGHT SIDE).

PLATE 218



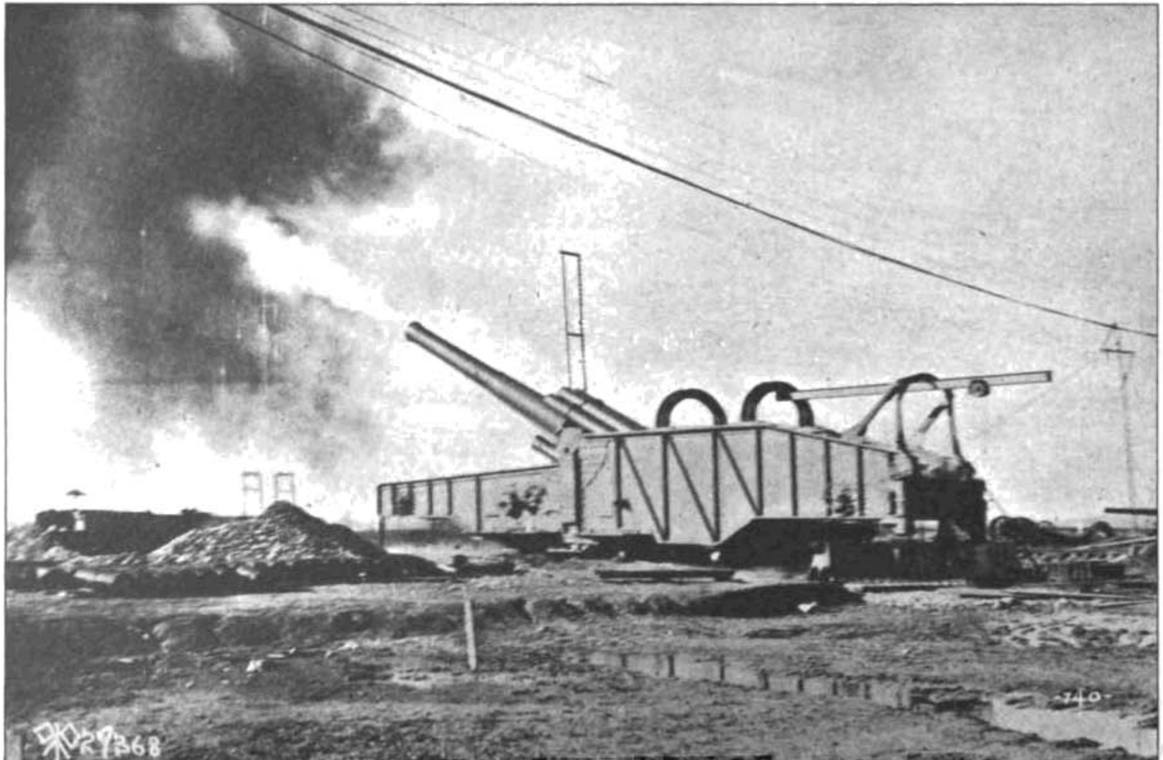
14-INCH, 45-CALIBER AMERICAN GUN ON RAILWAY MOUNT, MODEL "E" (LEFT SIDE).

PLATE 219



14-INCH, 45-CALIBER AMERICAN GUN ON RAILWAY MOUNT, MODEL "E" (LEFT SIDE).

PLATE 220



14-INCH, 45-CALIBER AMERICAN GUN ON RAILWAY MOUNT, MODEL "E" (FIRING).

PLATE 221

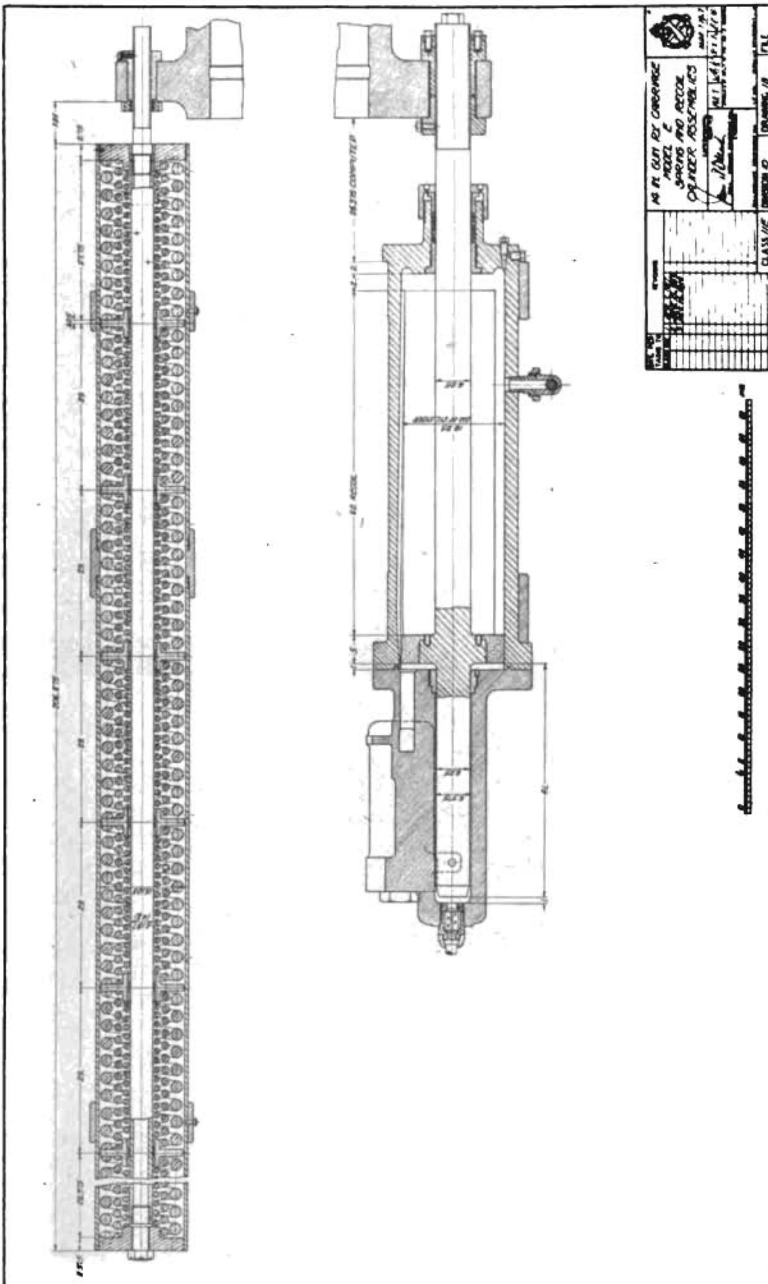


PLATE 222

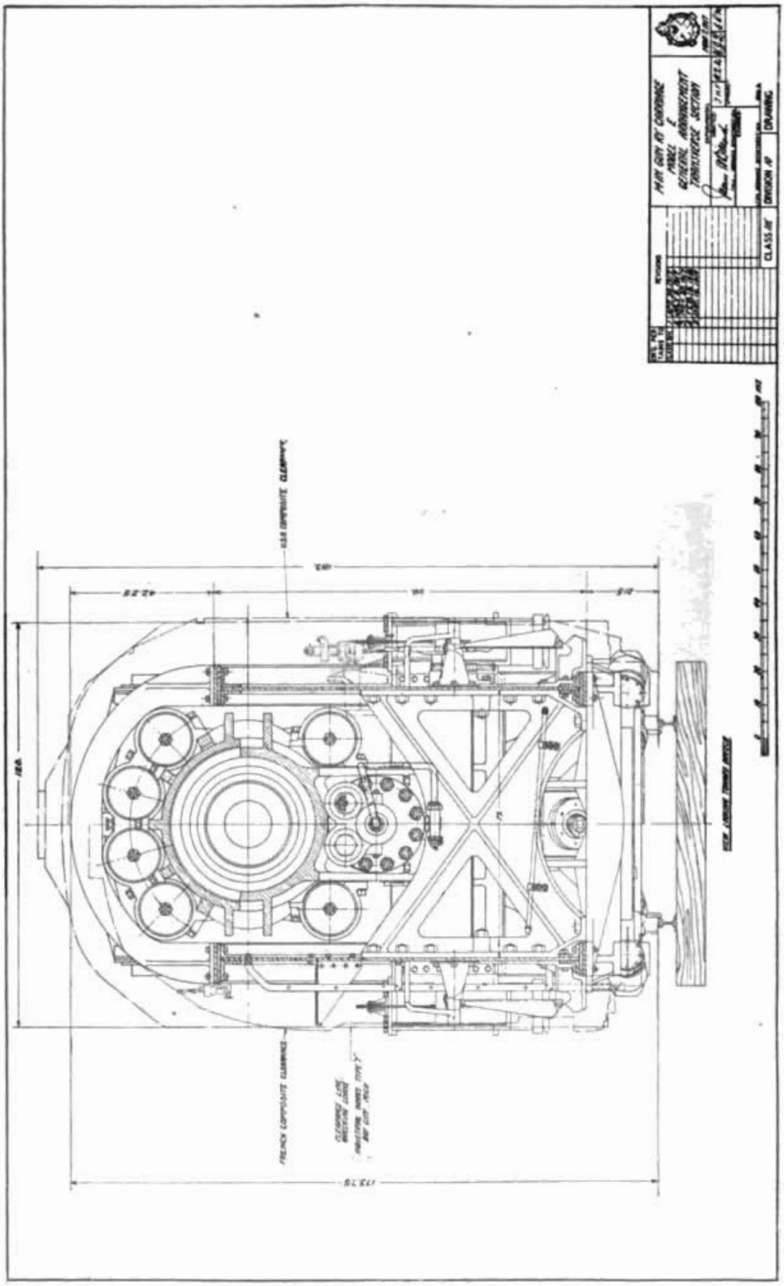


Plate 223

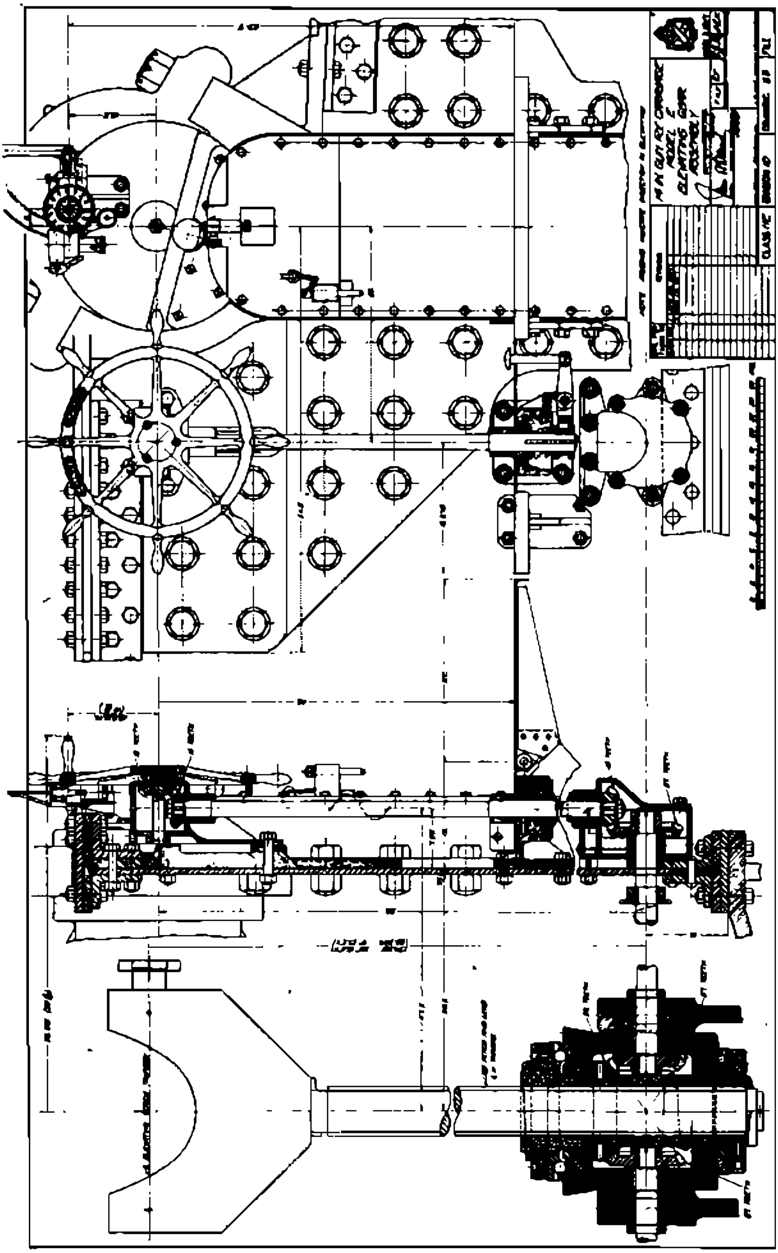


PLATE 224

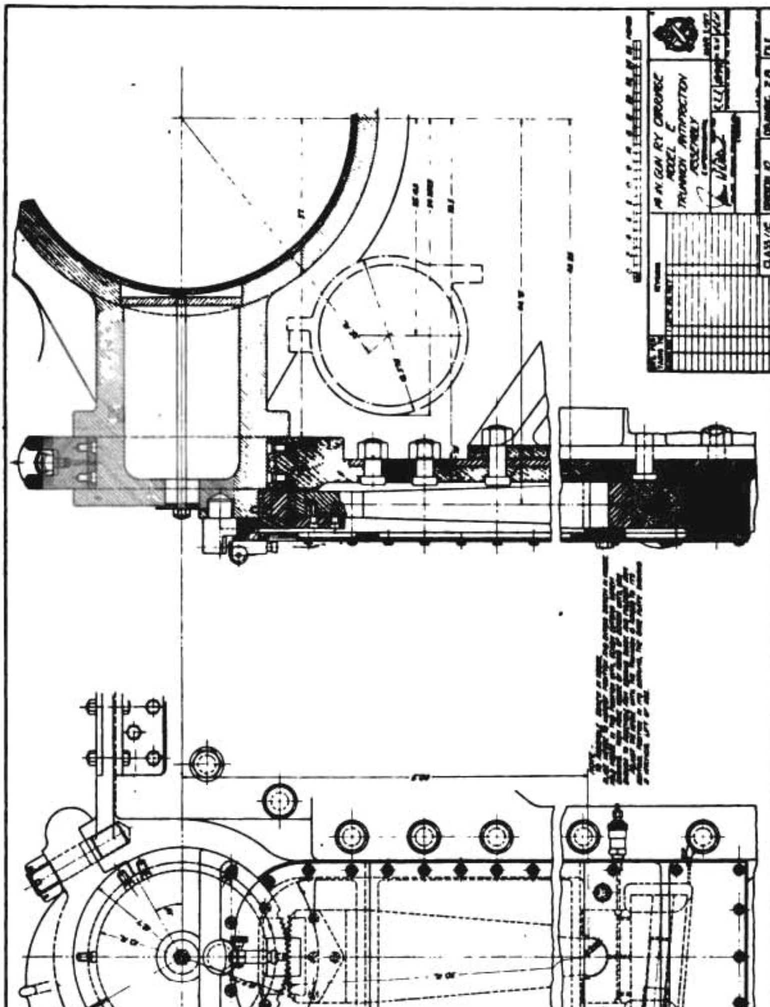


Plate 225

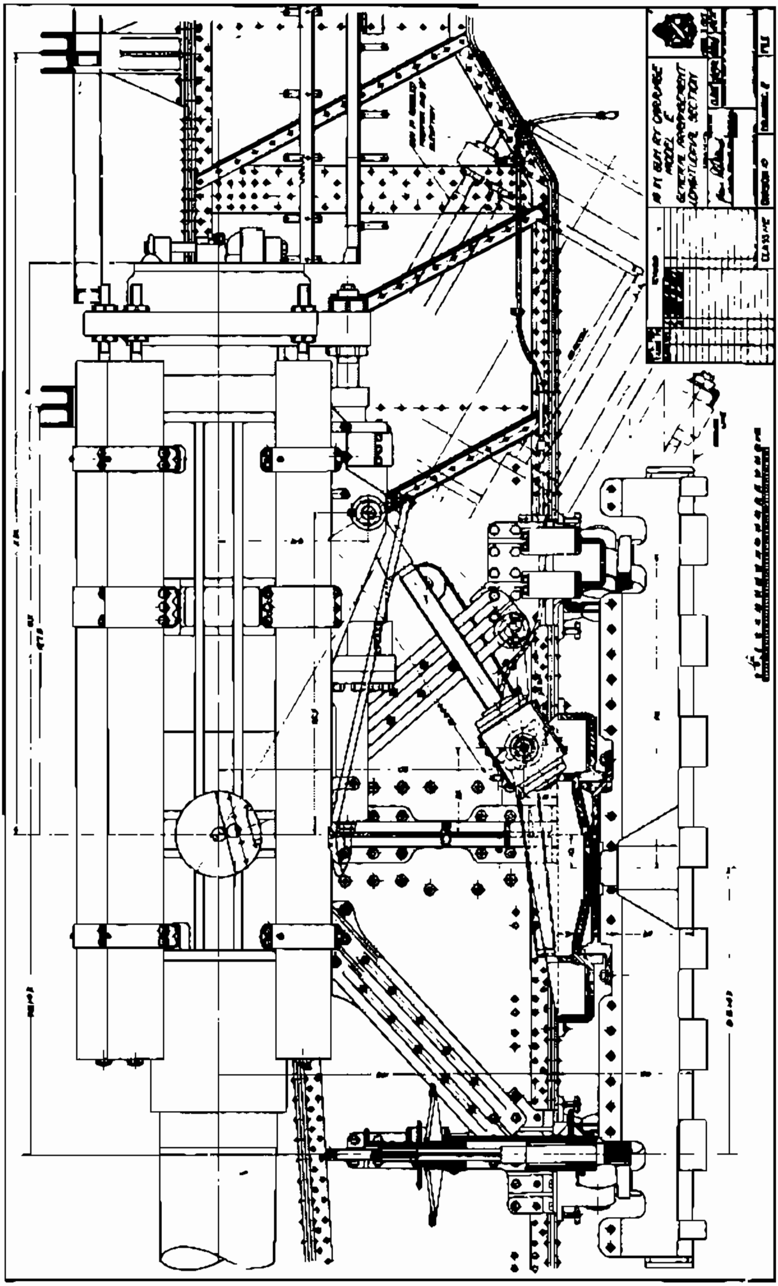


PLATE 226

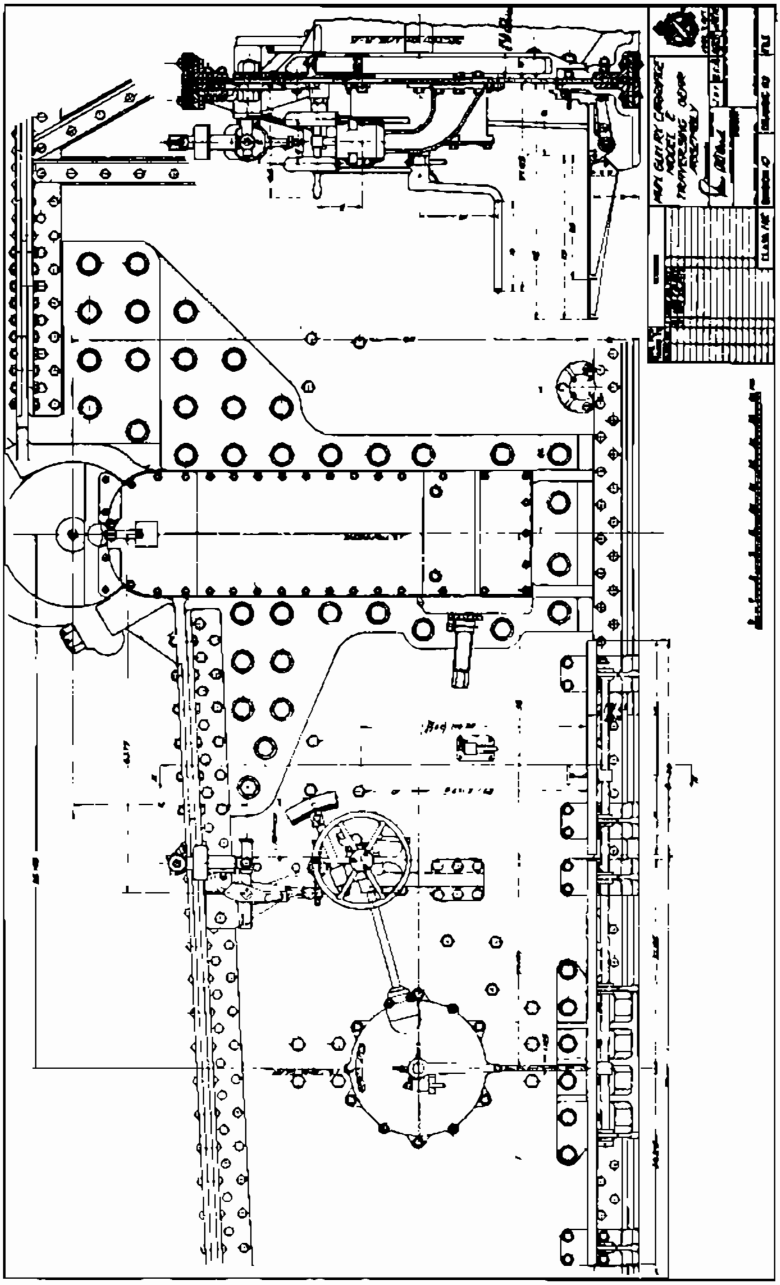


PLATE 227

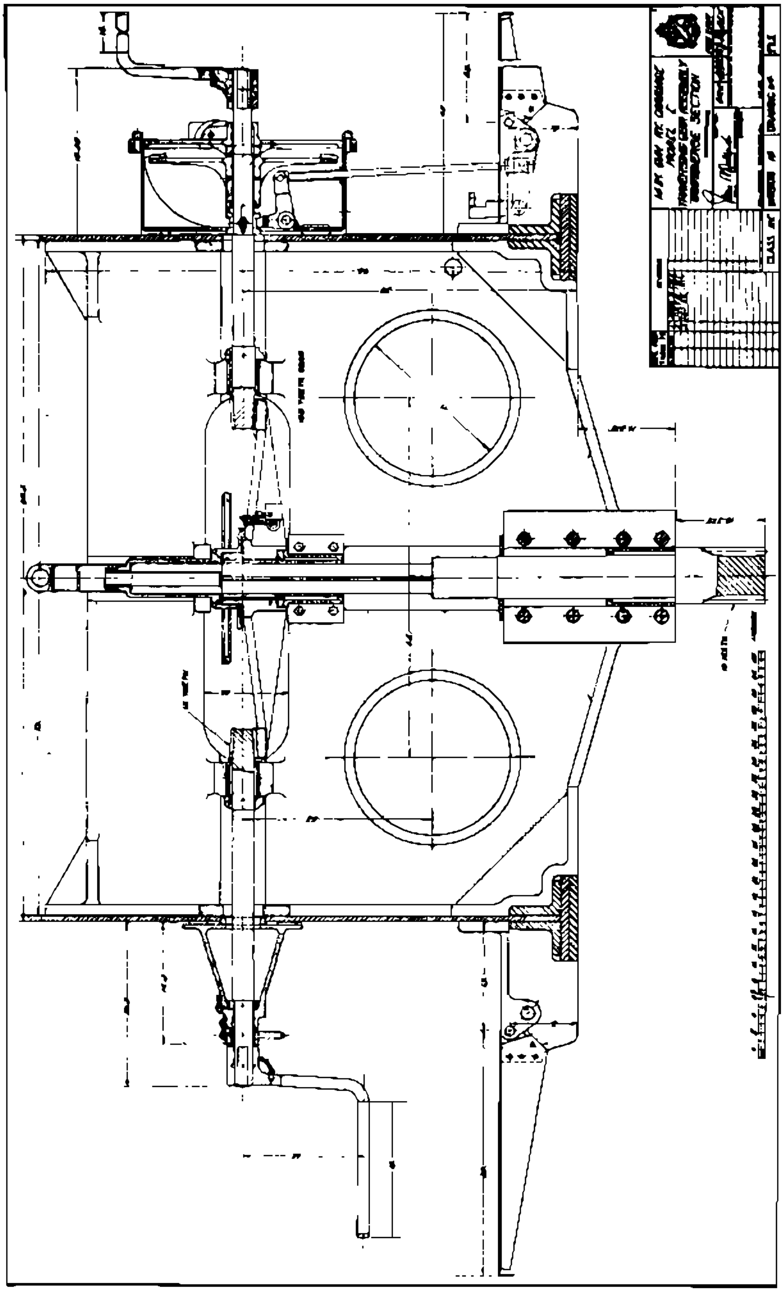


PLATE 228

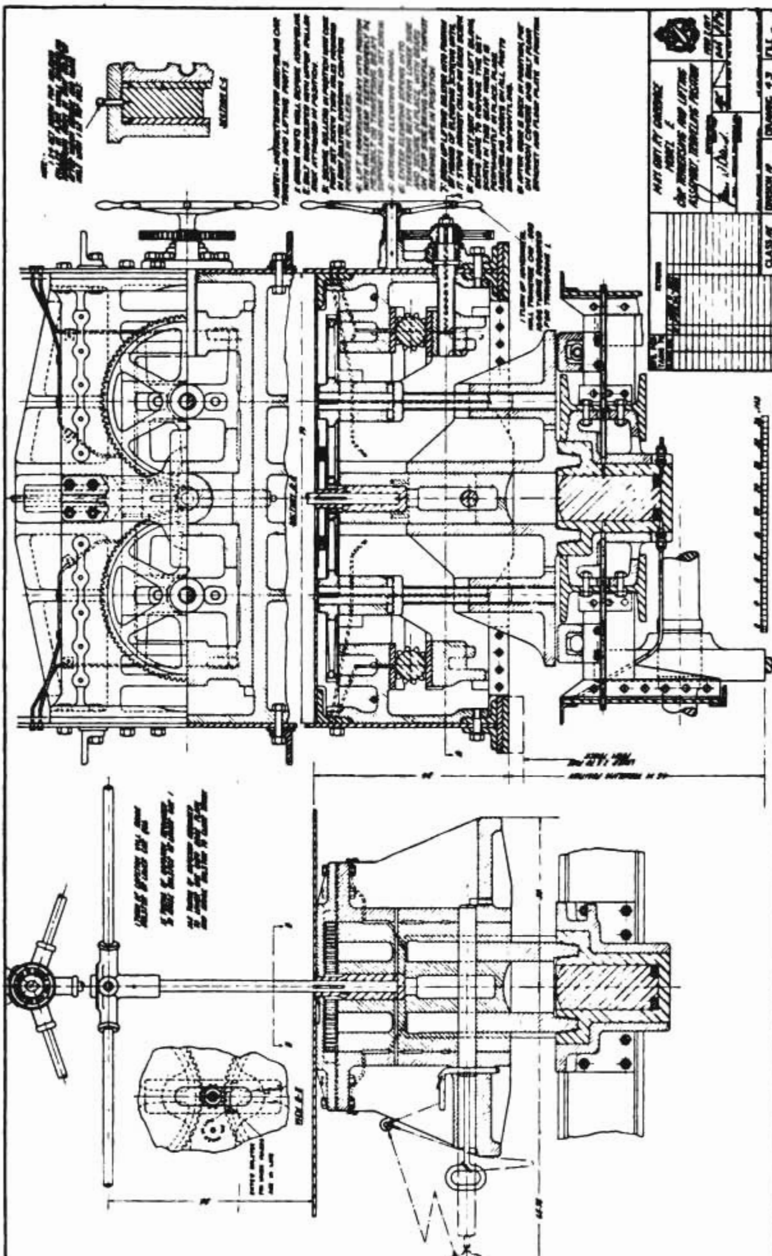


PLATE 229

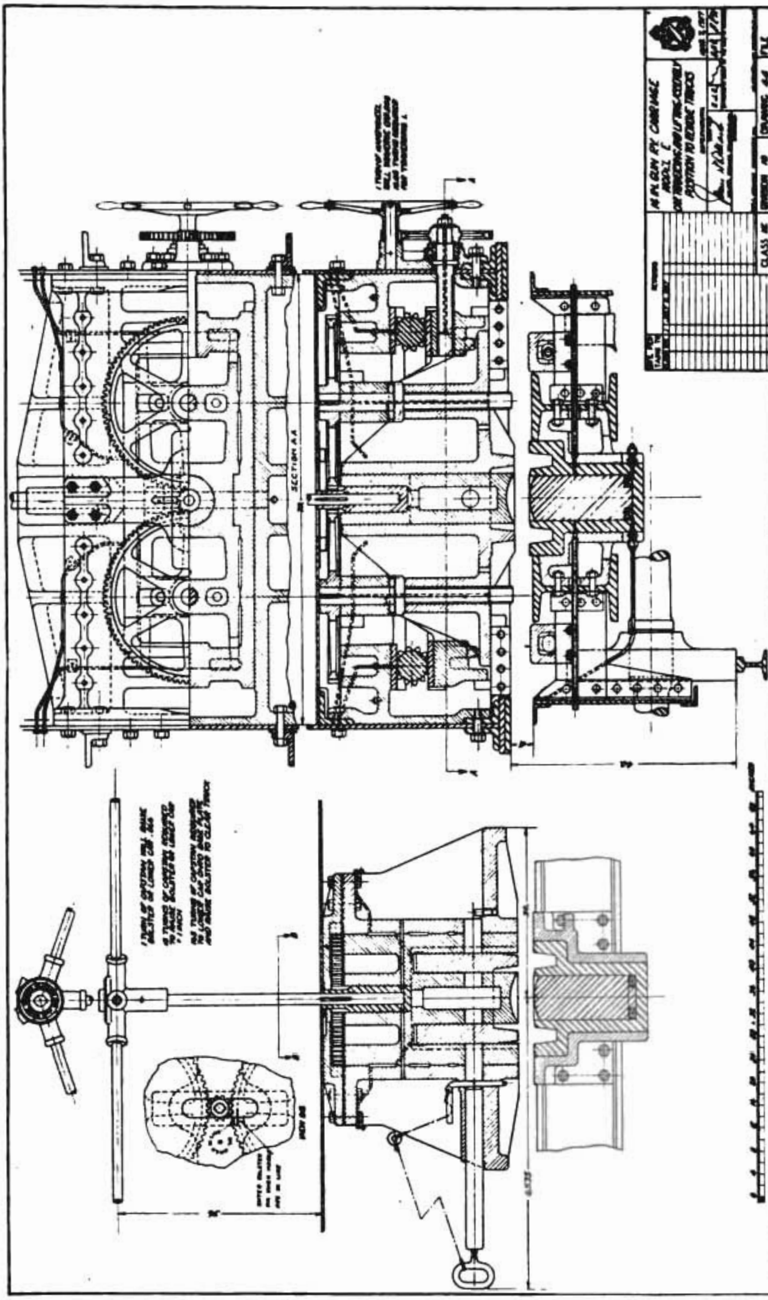
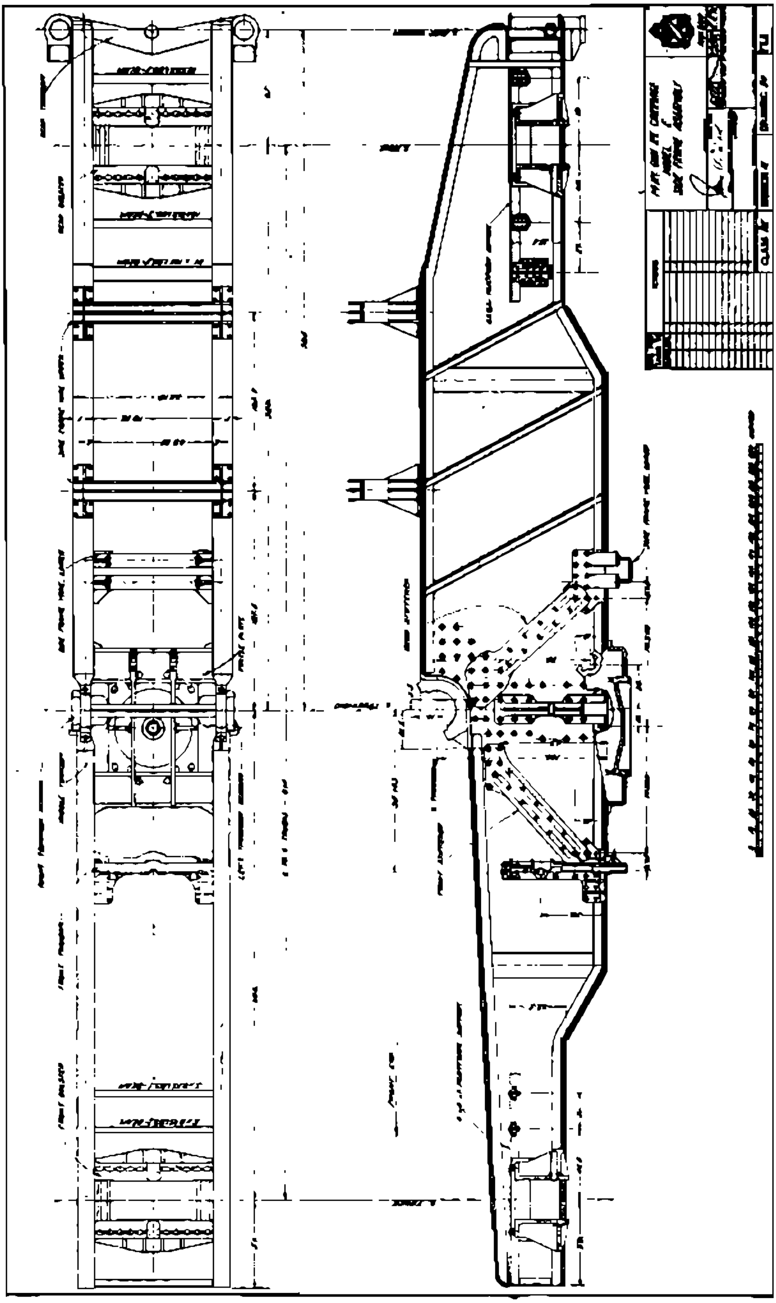
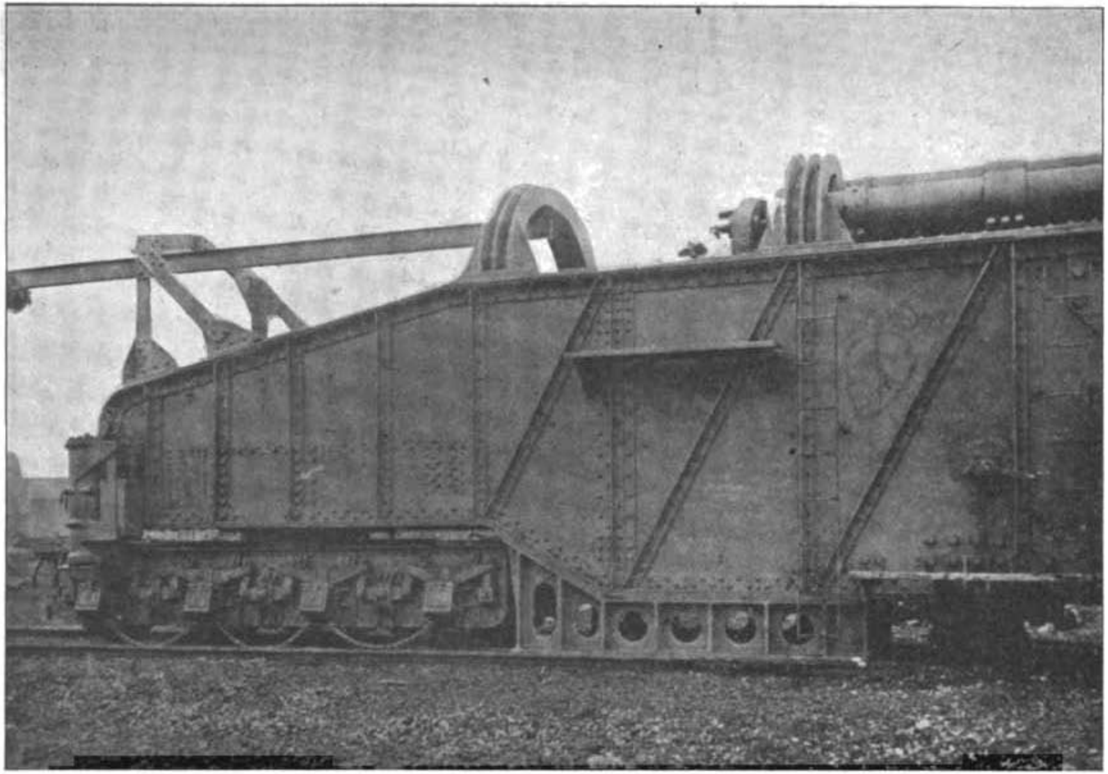


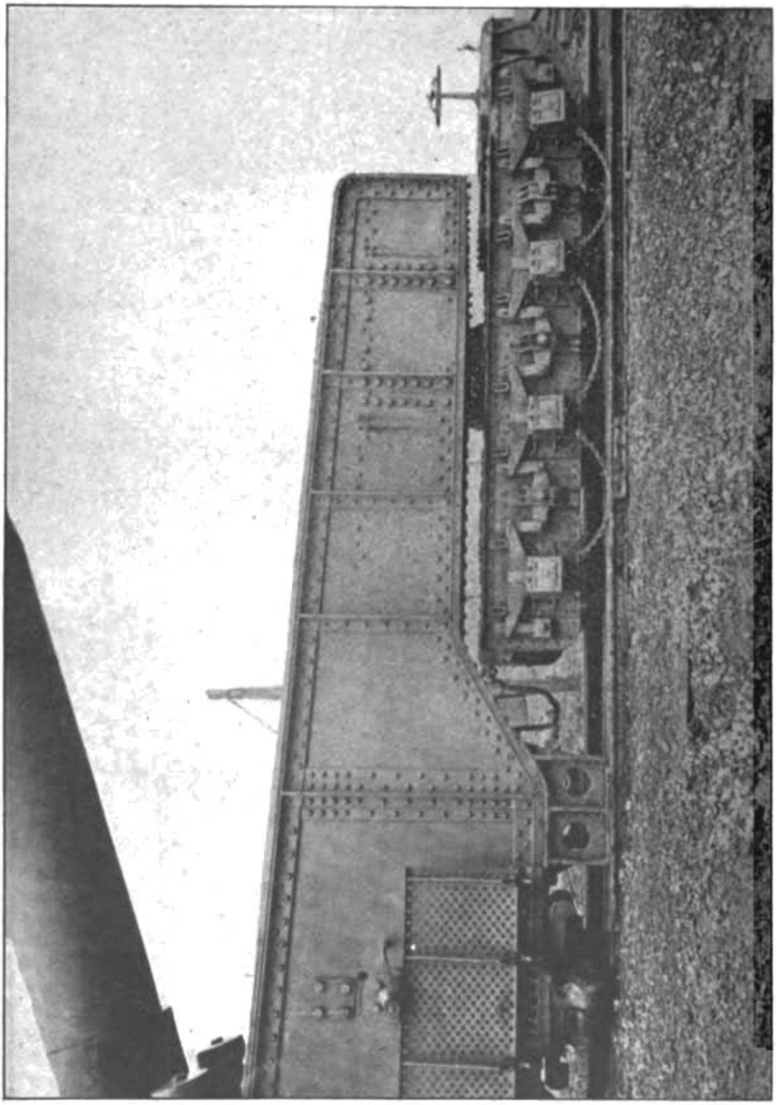
PLATE 230





STEEL SLIDE SHOES (FRONT) OF THE 14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E."

PLATE 232



STEEL SLIDE SHOES (REAR) OF THE 14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E."

PLATE 233

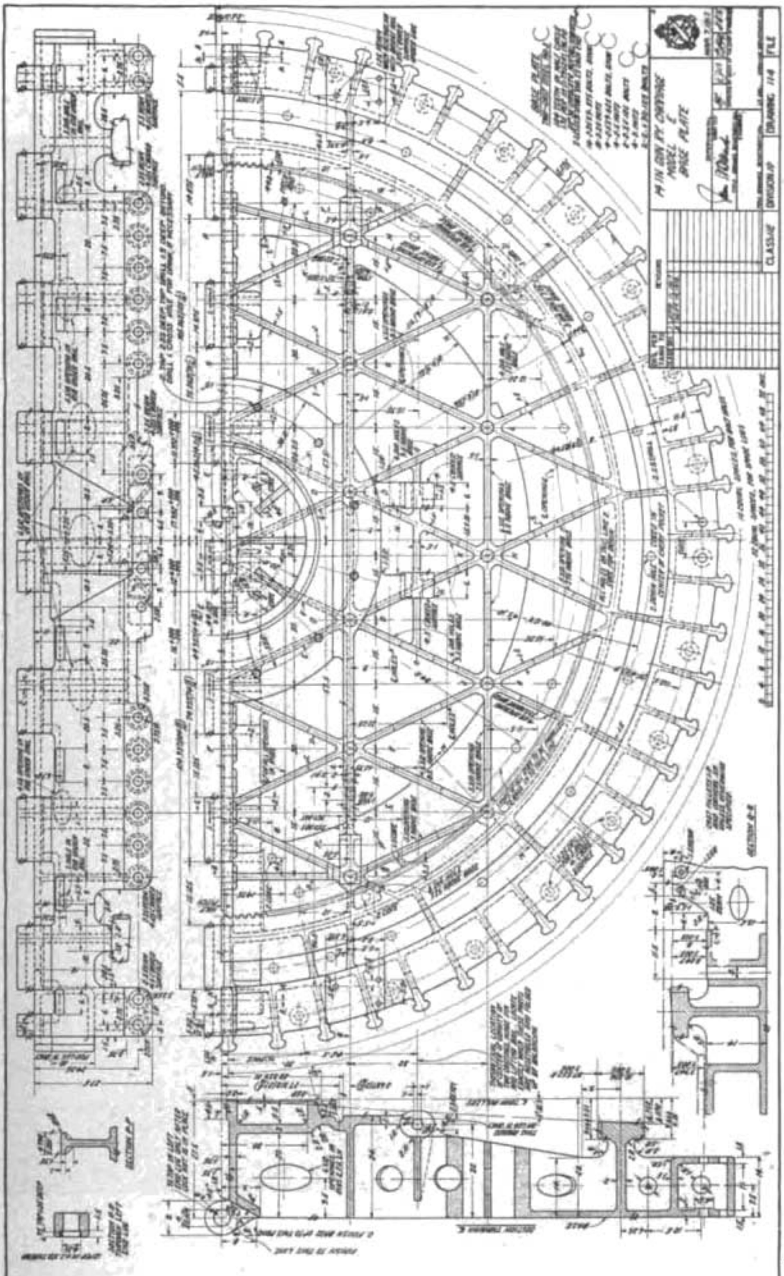
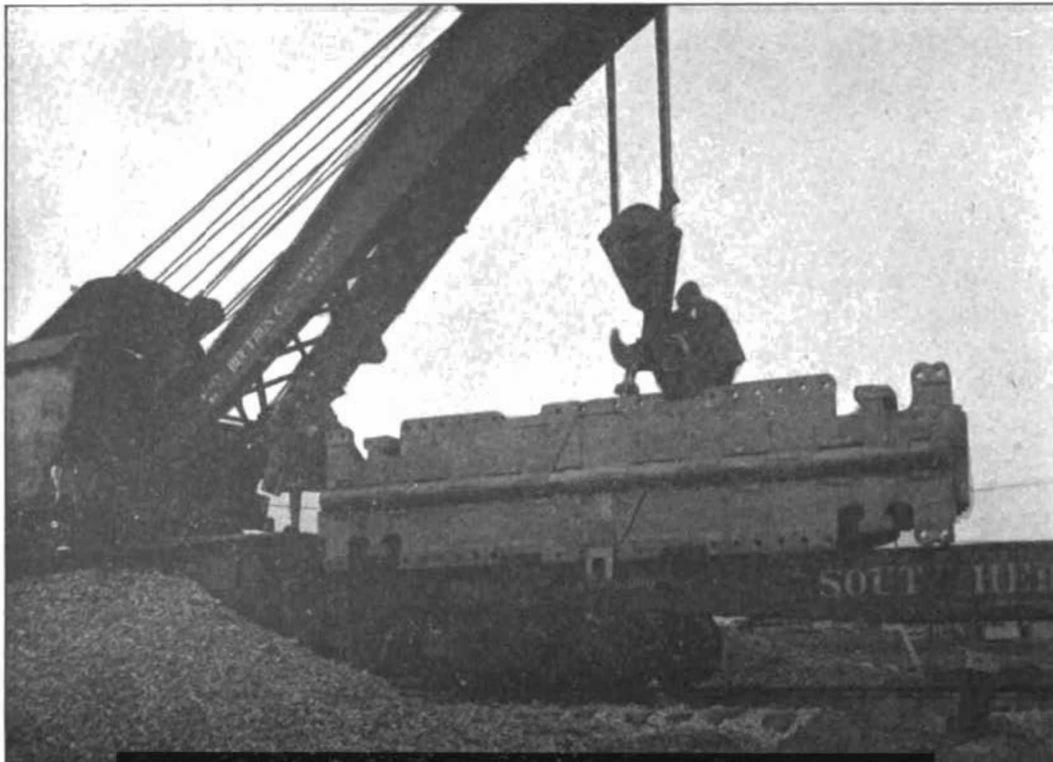
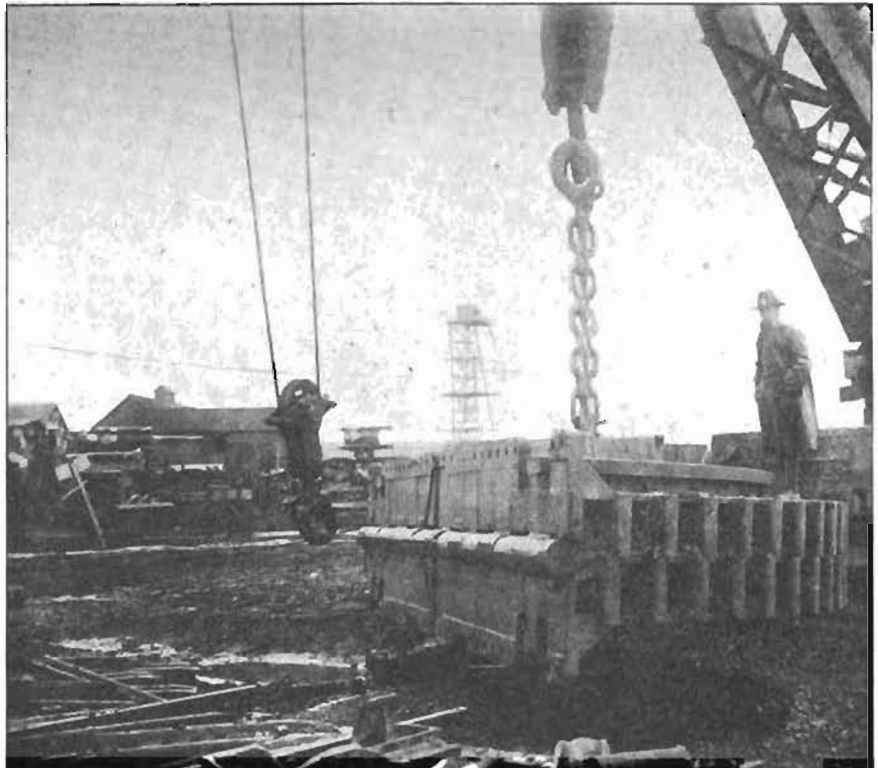


Plate 234



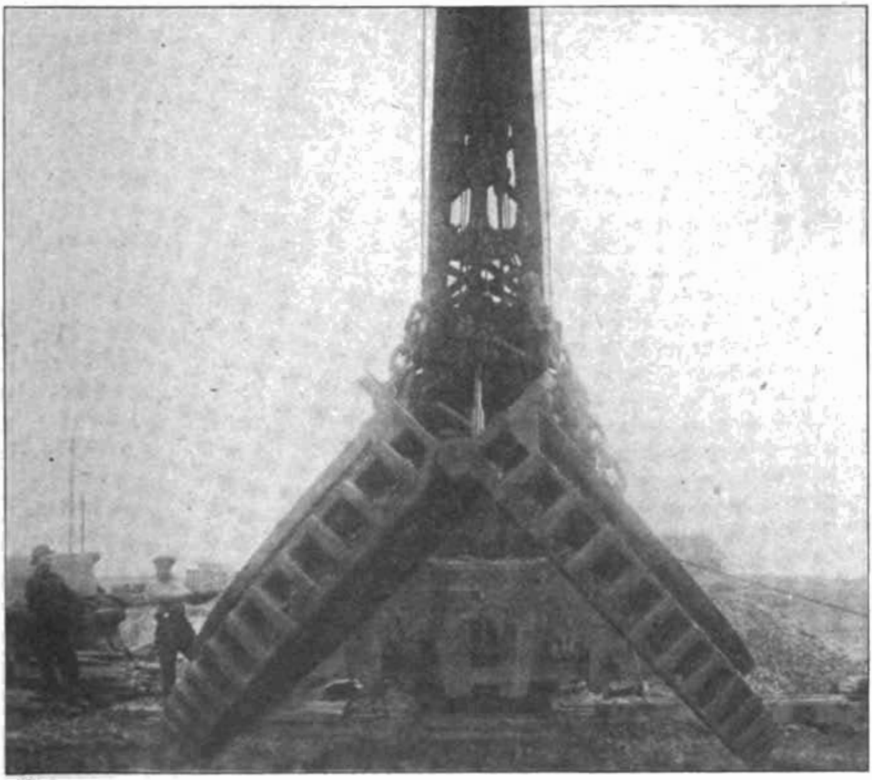
BASE RING OF THE 14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E."



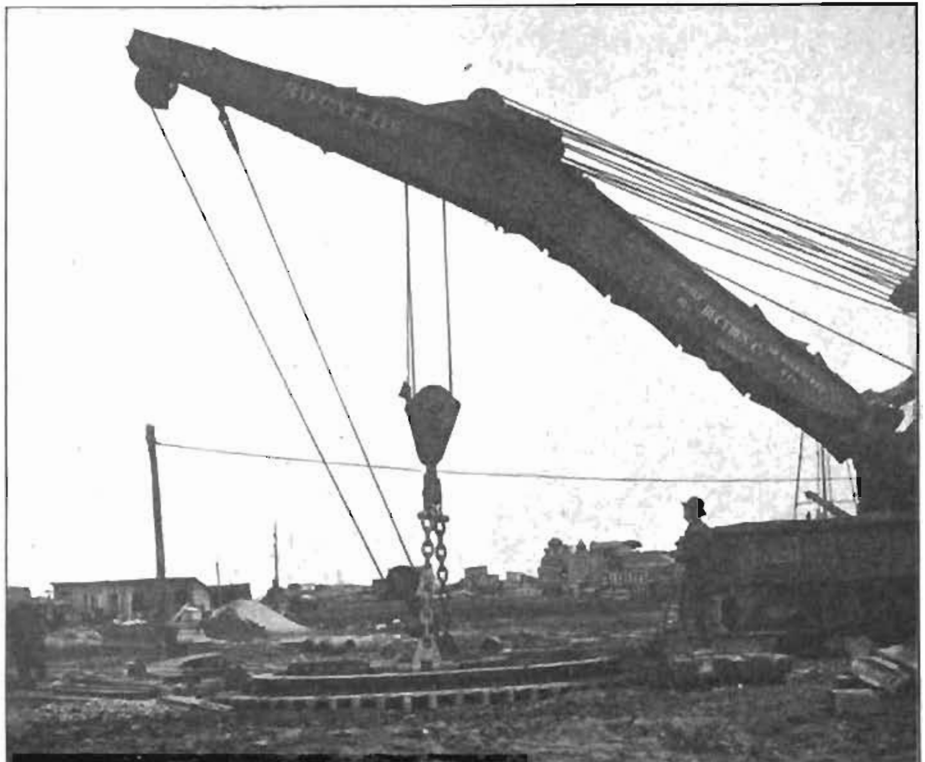
BASE RING OF THE 14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E" (FIRST STEP OF INSTALLATION).

BASE RING OF THE 14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E" (SECOND STEP OF INSTALLATION).

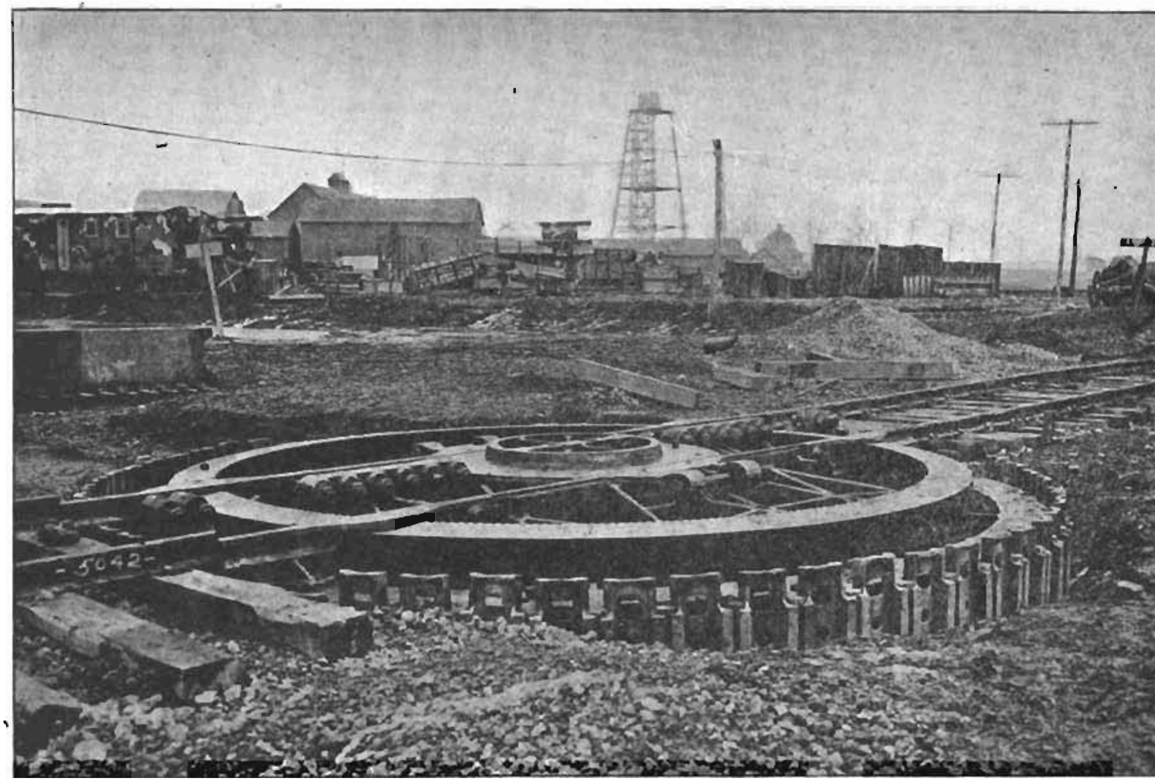
PLATE 237



BASE RING OF THE 14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E" (THIRD STEP OF INSTALLATION).

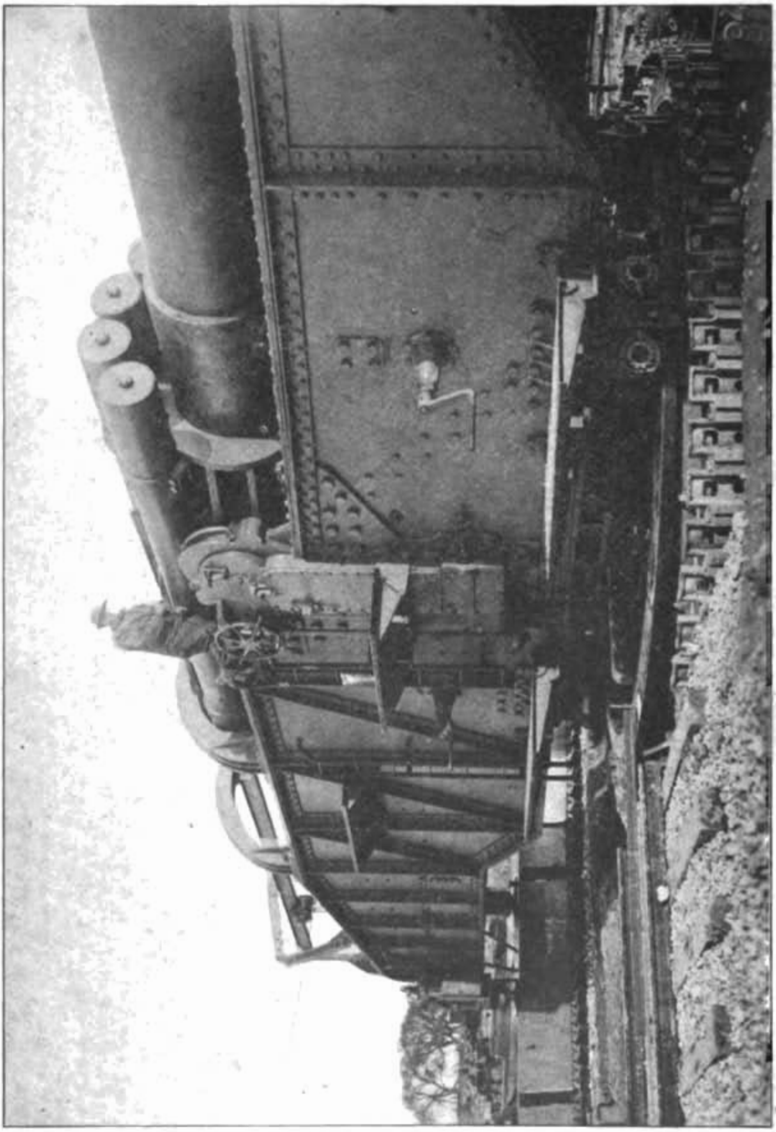


BASE RING OF THE 14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E" (FOURTH STEP OF INSTALLATION).

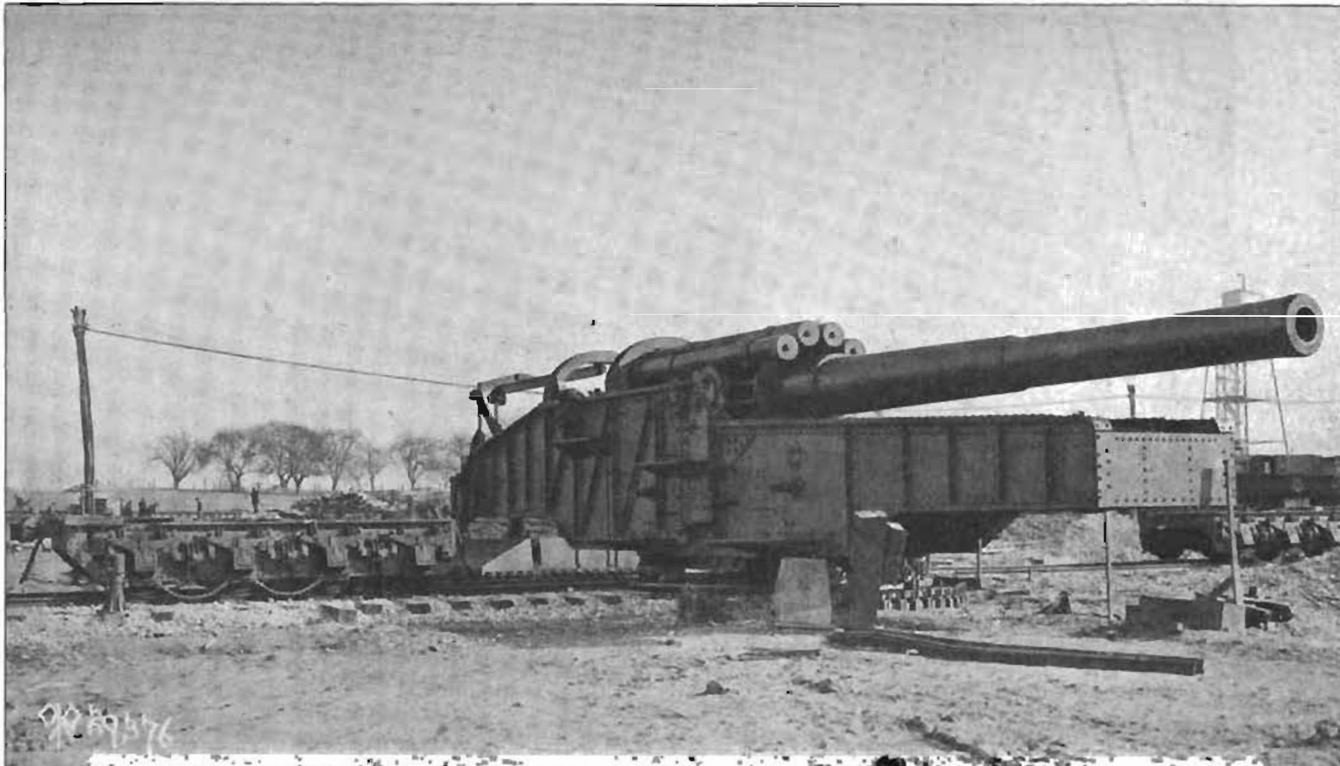


BASE RING OF THE 14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E" (FIFTH AND LAST STEP OF INSTALLATION).

PLATE 240

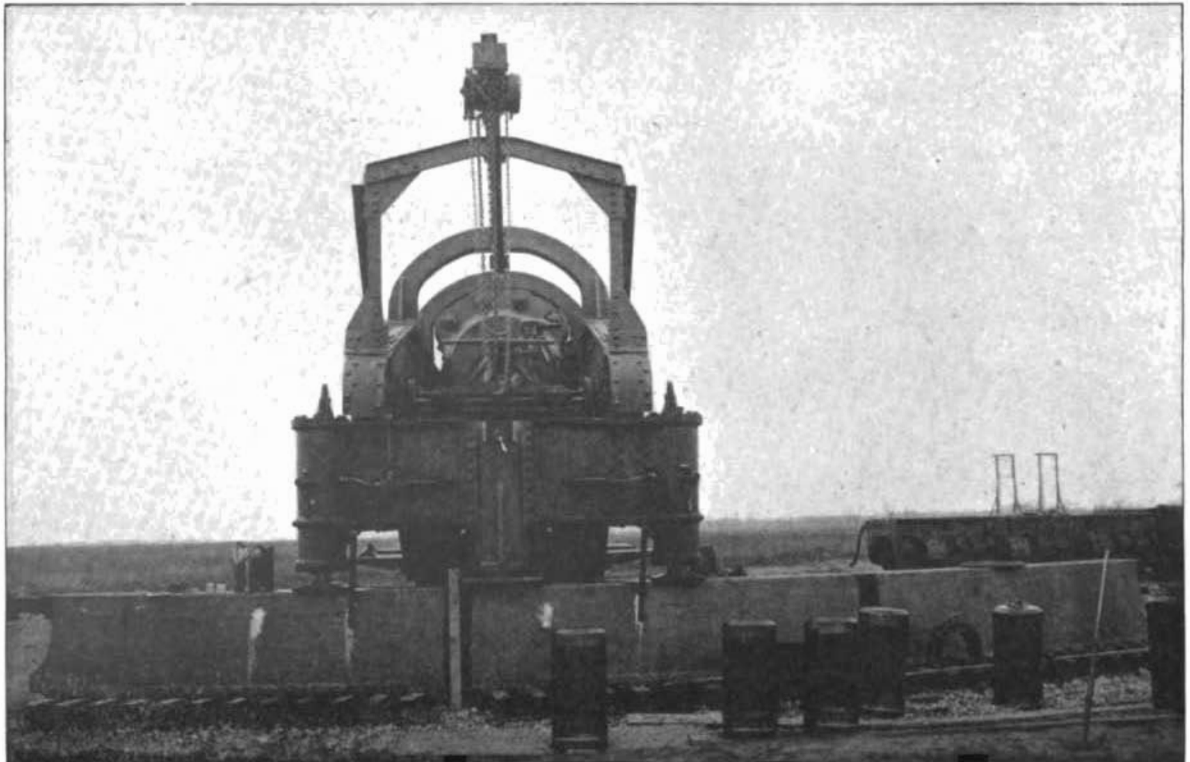


14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E," INSTALLED ON BASE RING FOR ACTION.



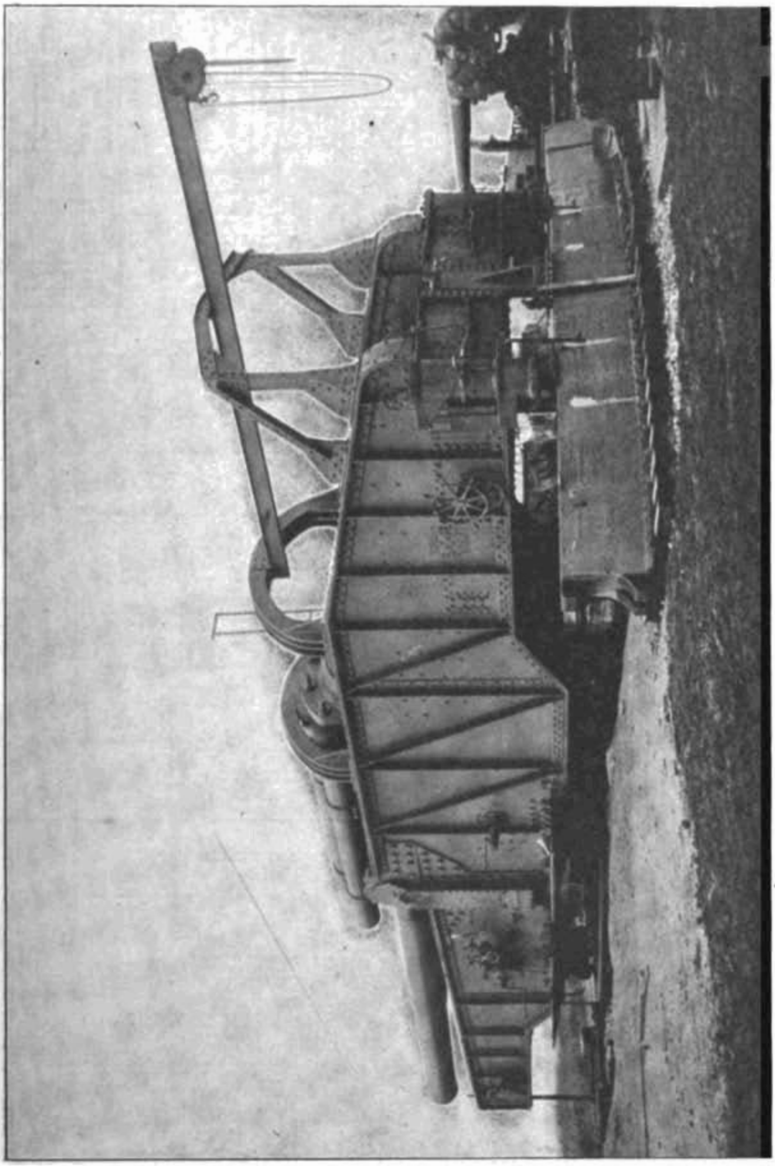
14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E," INSTALLED ON BASE RING FOR ACTION. (NOTE TRACKS.)

PLATE 242



SUPPORT BEAM FOR THE REAR OF THE 14-INCH, 45-CALIBER AMERICAN GUN MOUNT, MODEL "E."

PLATE 243



SUPPORT BEAM AND SUPPORTING MECHANISM OF THE 14-INCH 45-CALIBER AMERICAN GUN MOUNT, MODEL "E."

PLATE 244

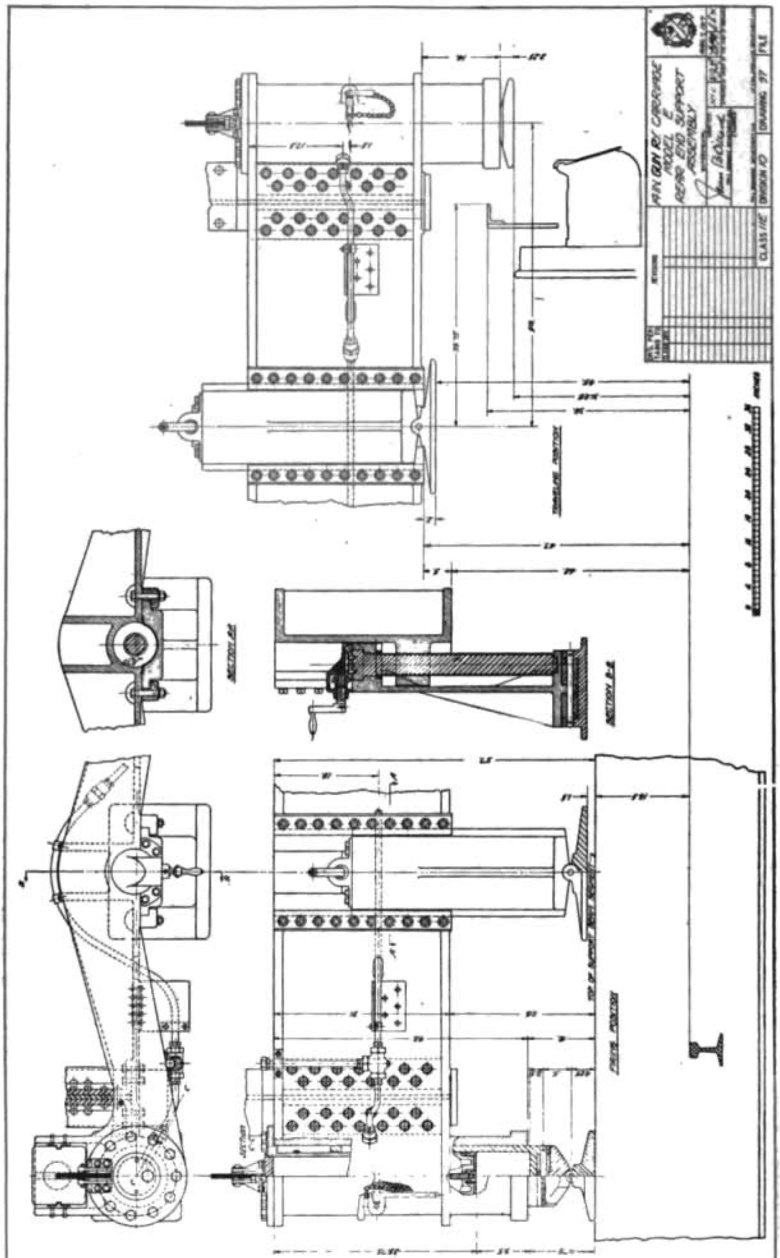


PLATE 245

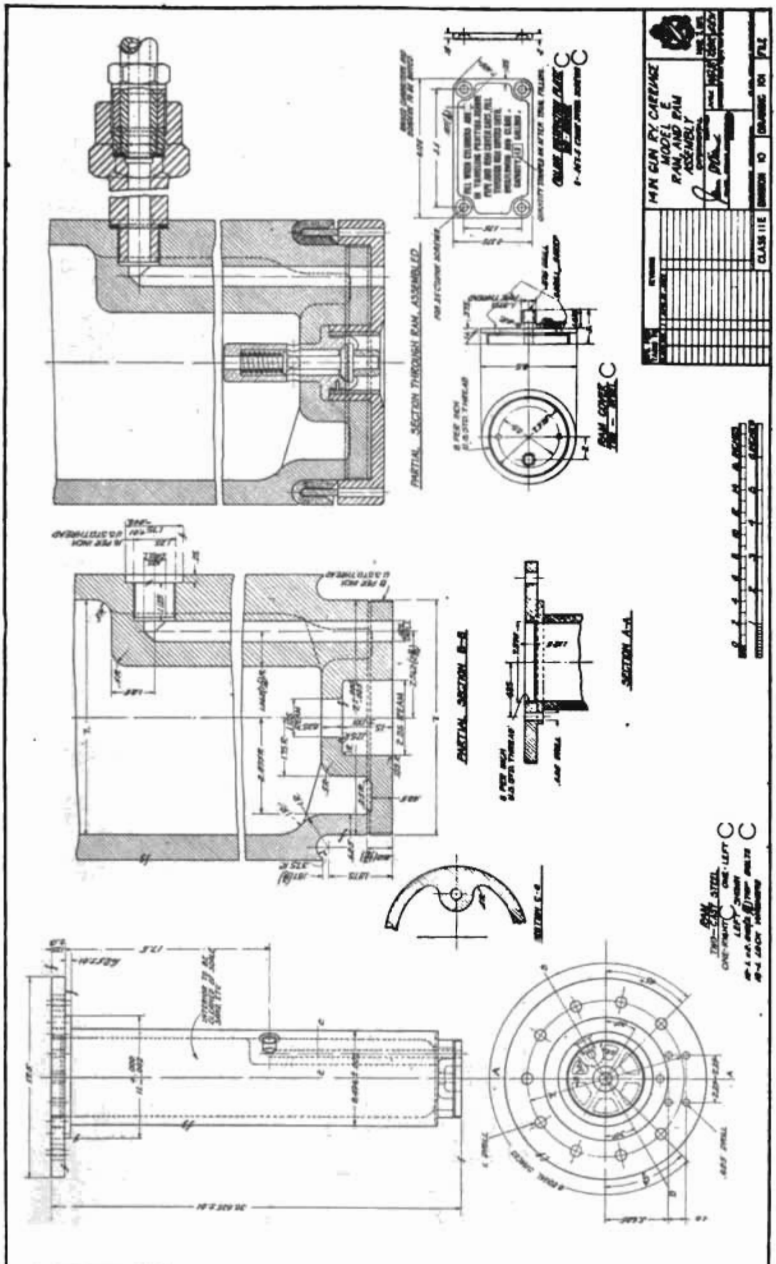

PARTIAL SECTION THROUGH RAM, ASSEMBLED
PARTIAL SECTION B-B
SECTION A-A
SECTION C-C
RAM COVER
14 IN. GUN RY. CARRIAGE MODEL E RAM AND RAM ASSEMBLY
CLASS II E

PLATE 246

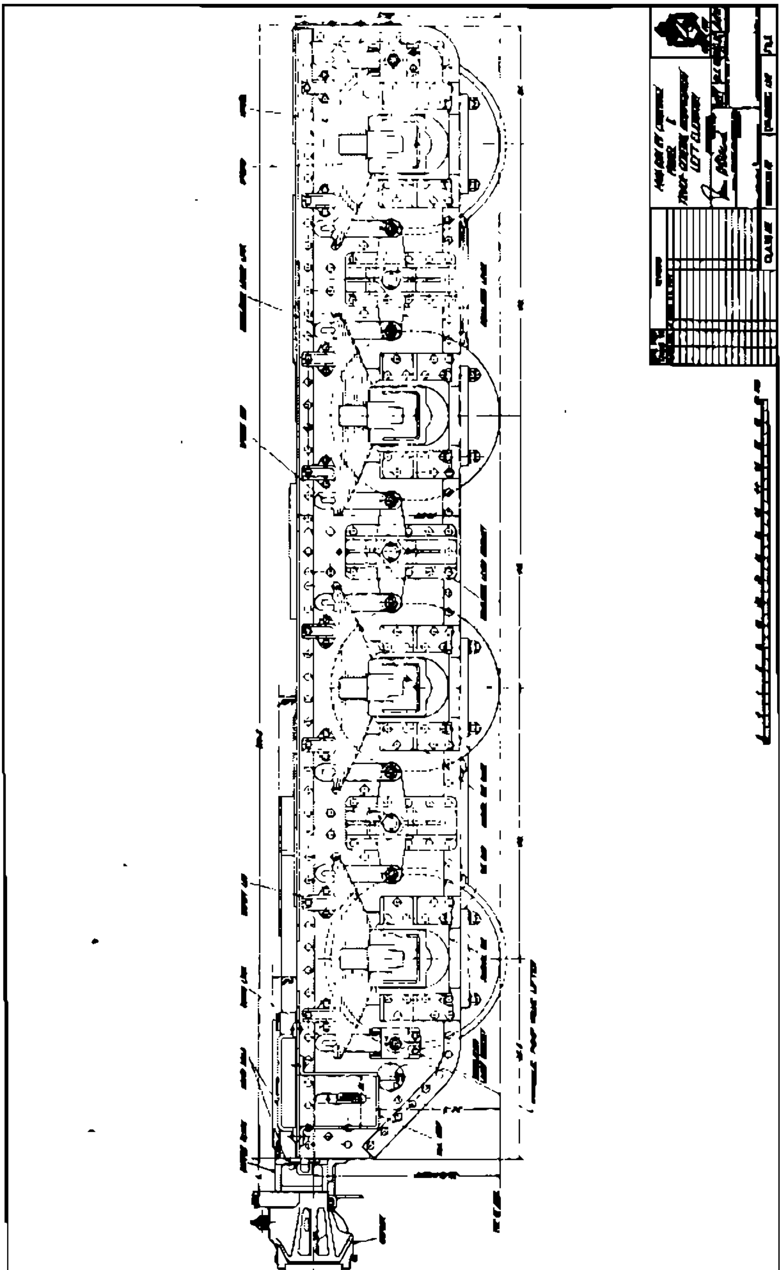


PLATE 247

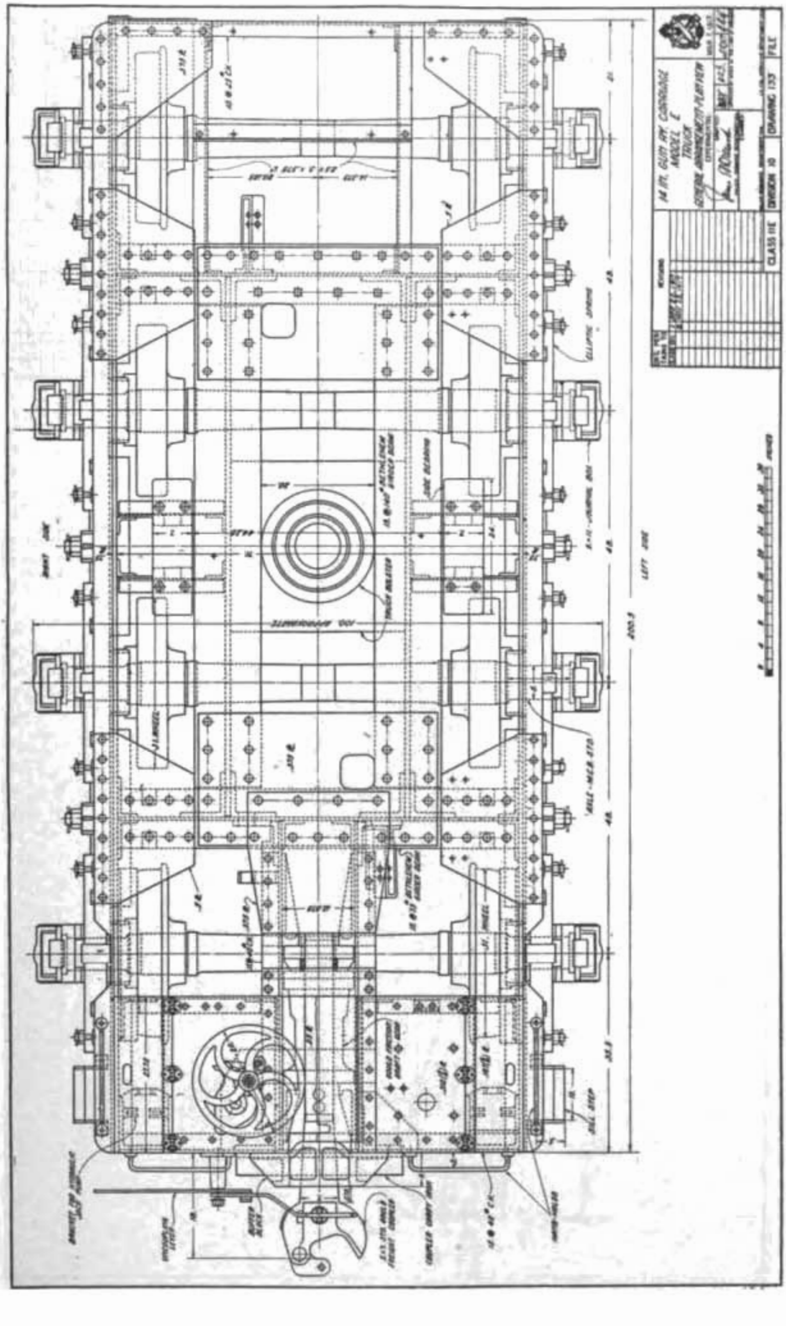


PLATE 248

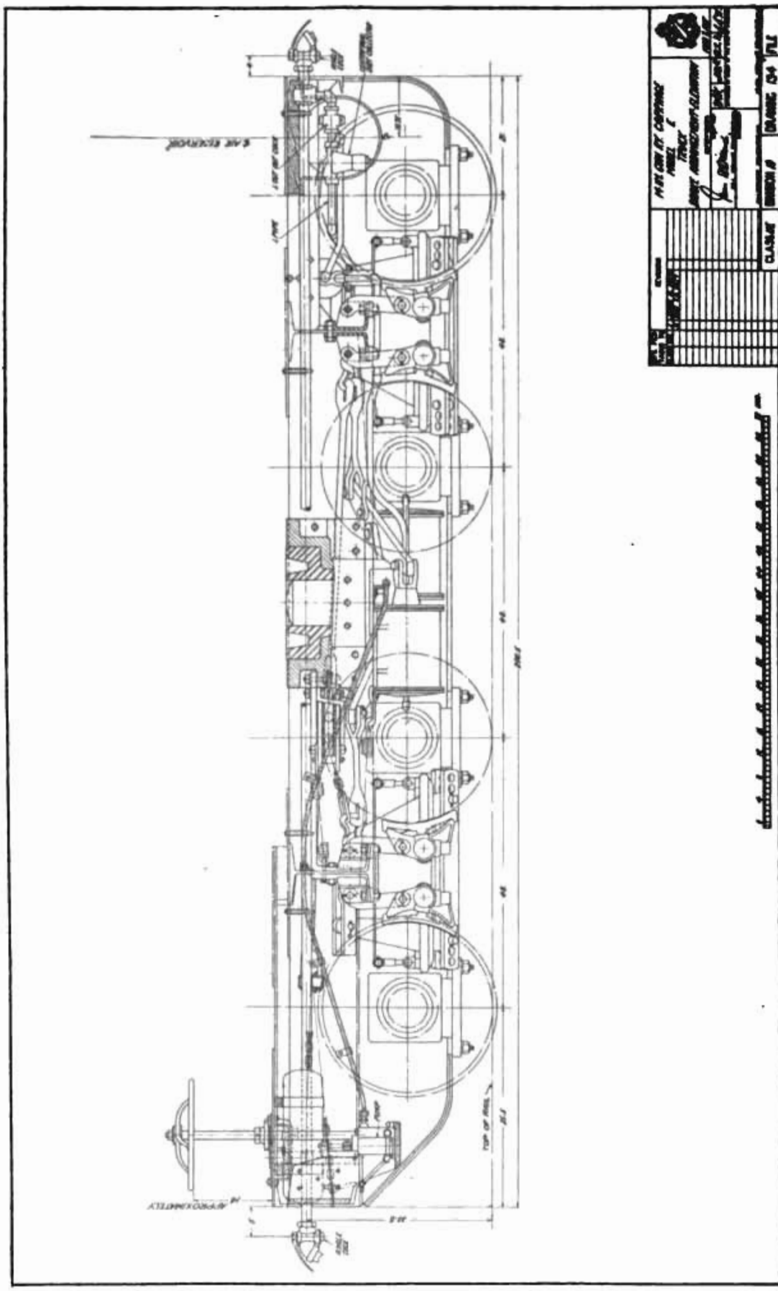


PLATE 249

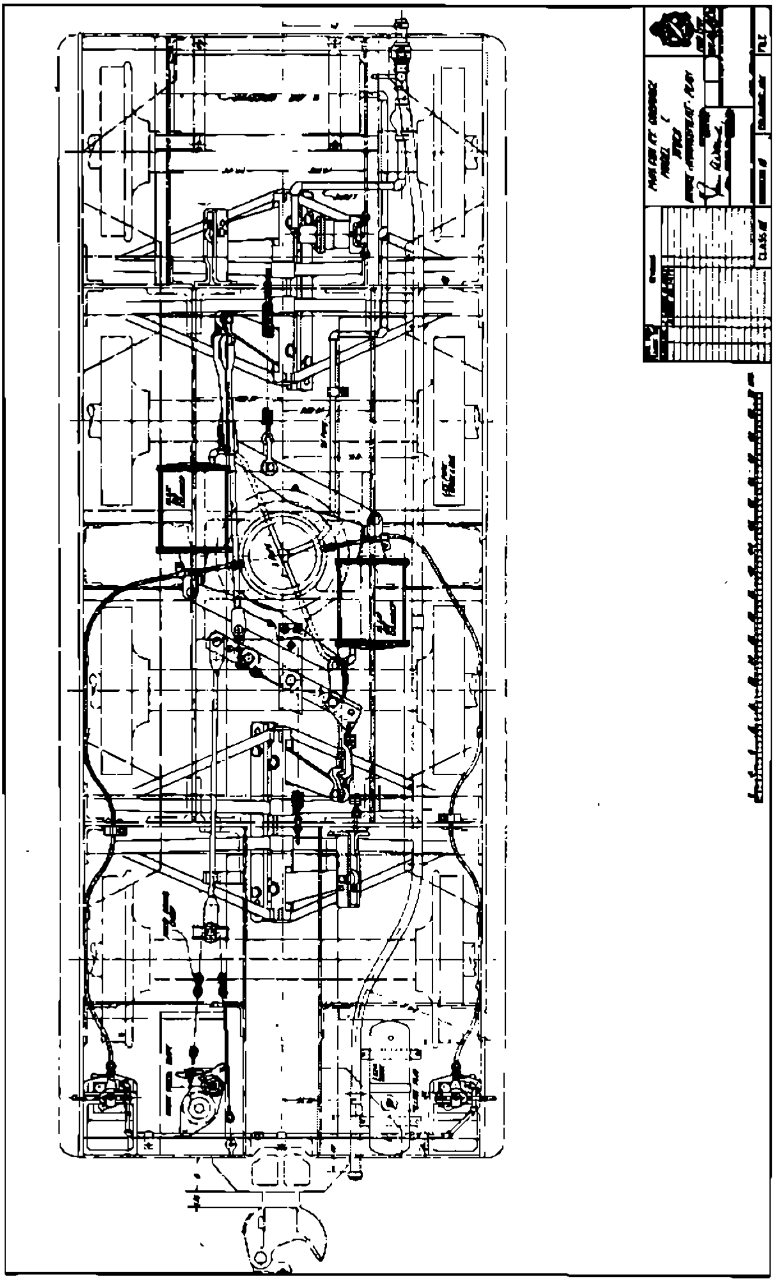


PLATE 250

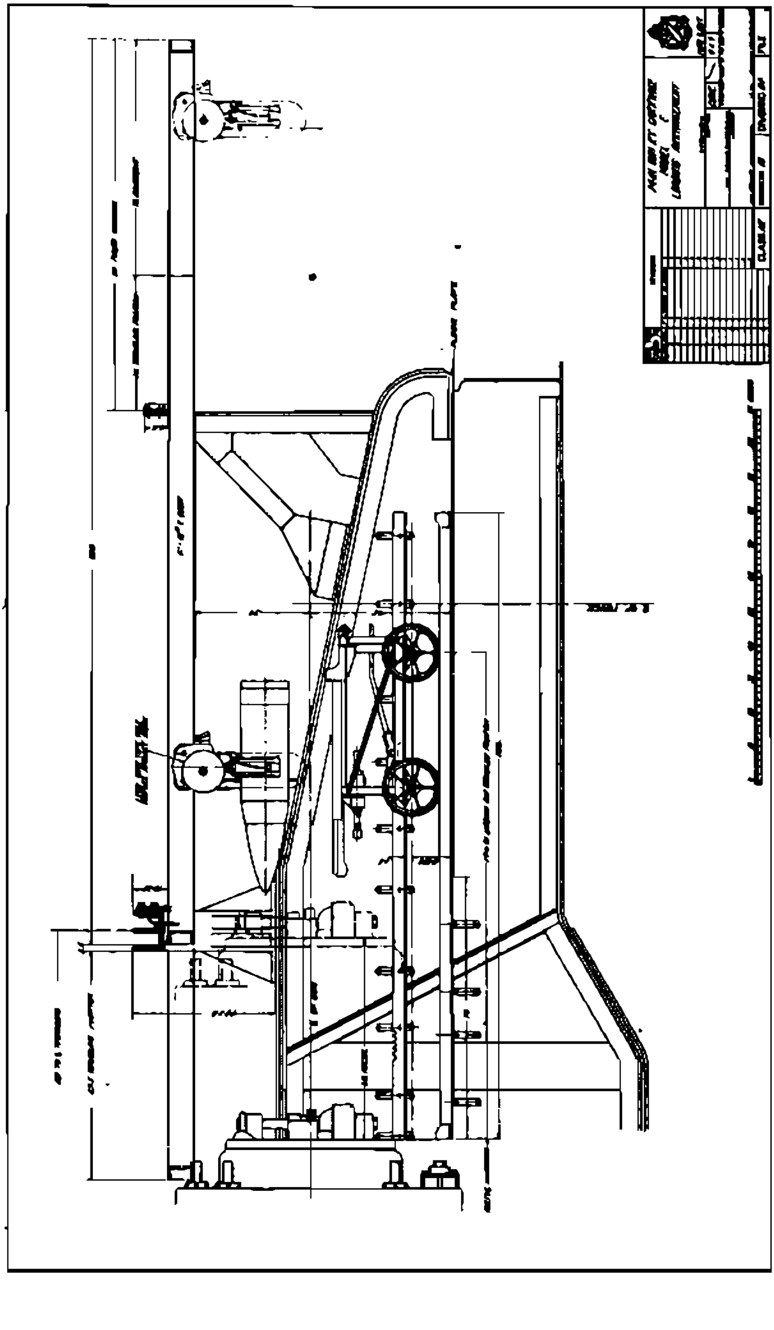
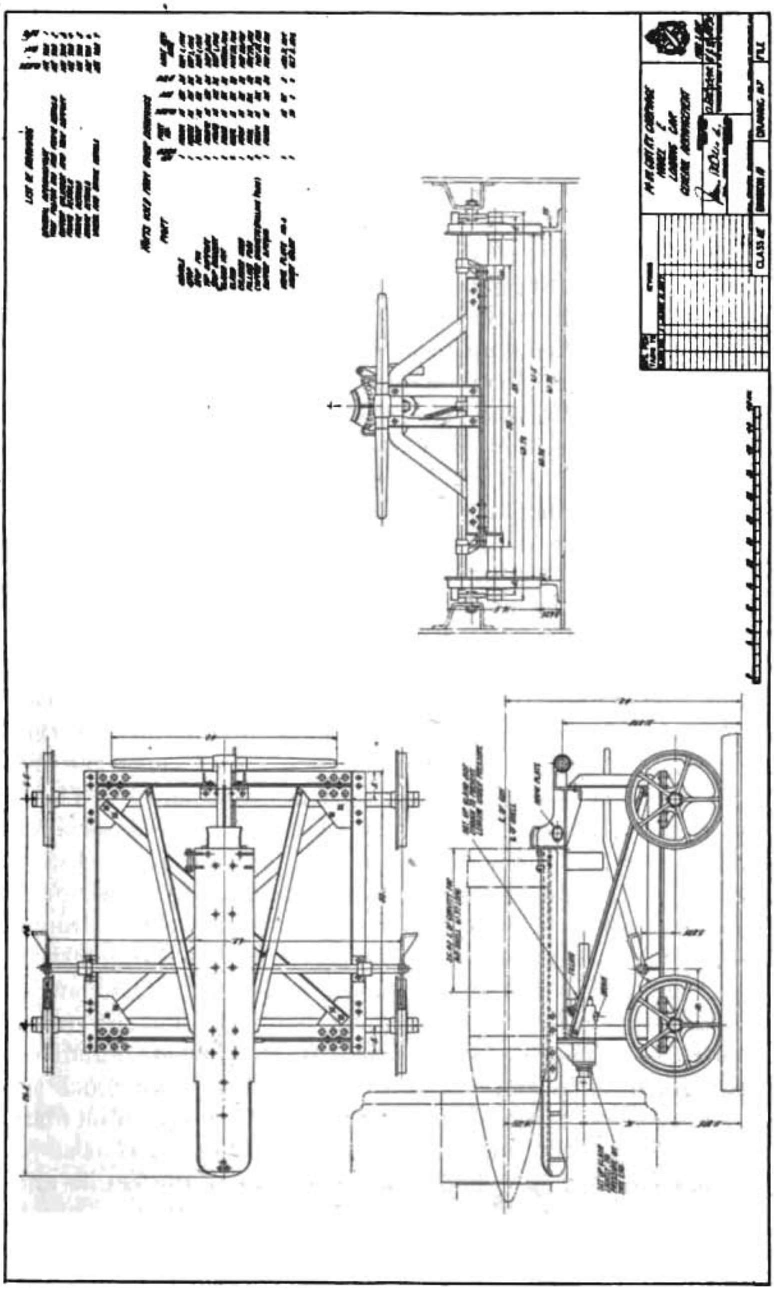


PLATE 251



10.—AMERICAN 14-INCH GUN, NAVAL RAILWAY MOUNT, MARK I. (23)

224. This mount is of the cradle recoil car traverse type. The gun is mounted in a cradle having combined hydrospring and hydropneumatic recoil mechanism. This cradle is supported in turn by its trunnions on two cast-steel deck lugs, similar to those used in the turret of the battleship, which are attached to the side girders of the carriage. The structural steel carriage is carried on two structural steel span bolsters which in turn rest on two 3-axle trucks each. The mount fires from its trucks at elevations between 10 and 15 degrees. When fired from its trucks it is possible to traverse the mount only by operating it on a curved track. At elevations between 15 and 45 degrees it is necessary to remove the trucks and operate the mount on a fixed emplacement. When operated on a fixed emplacement the internal car traversing mechanism is used to train the gun in azimuth. General views are shown on plates 253 to 263.

225. The guns used on these mounts are 14-inch naval rifles, Mark IV, Modification 1, of 50-caliber length. The gun is made up of 10 main parts, including a tube jacket, hoops, breech bushing, and locking rings. The rifling has a right hand twist increasing in pitch from one turn in 50 calibers at the origin, to one turn in 32 calibers at a distance of 574 inches from the origin. From this point to the muzzle the twist is uniform; that is, one turn in 32 calibers. Holes are drilled in the breech recess pointing toward the center of the powder chamber to admit air for ejecting the gases from the gun. The gas ejector valve is attached to the breech face of the gun, plate 256. The gun is provided with a breechblock of the Welin or stepped screw type and DeBange system of gas check. The breech recess is threaded and slotted into 16 sectors, one blank and three thread sectors being included in each of four groups, and only one-sixteenth of a revolution of the block is required to release or lock it. The block when rotated falls open by its own weight, dropping at an angle of 16 degrees to the right of a vertical line through the center of the bore and is checked by a combined spring and air buffer, shown at the bottom of the breech lug, plate 256, and shown in detail on plate 257. The breech is closed by air pressure admitted into the combined buffer and closing cylinder. The breechblock is fitted with a mechanical firing mechanism of the design shown on plate 258.

226. Recoil Mechanism.—The recoil mechanism consists of one recoil and four spring cylinders arranged about the cradle and of a design shown on plate 259. The recoil cylinder is the usual hydraulic brake, but uses throttling rods, three in number, instead of grooves or bars. The spring tubes each contain double spring columns, plate 267, divided into six sections and the ends of the spring rods are provided with air-tight pistons so that compressed air can be used to aid in returning the piece to battery at high elevations. When the

gun is being fired at elevations between 10 and 15 degrees, the mount recoils along the track a distance of from 30 to 40 feet. Under such circumstances the mount is returned to its firing position by a winch mounted on the front span bolster. The maximum length of recoil at the maximum elevation is 44.5 inches. When operated at elevations between 15 and 45 degrees, it is necessary to place the mount on a fixed emplacement which includes a pit to receive the breech of the gun at high elevations and into which the gun may recoil. The recoil and recuperator pistons are all attached to a yoke which is slipped over the breech of the gun from the rear and is secured to a collar on the gun, by means of a bronze locking ring.

227. Elevating Mechanism.—Elevation from 0 to 45 degrees is secured through a heavy screw hinged to the cradle at the breech end and working in a nut carried in an oscillating bearing at the center of the girder. This nut is rotated from a handwheel on the side of the mount by means of three sets of mite gears and intermediate shafting, plates 268 and 269. One revolution of the handwheel moves the gun through about 20 minutes in elevation. The elevating mechanism includes antifriction devices of the design shown on plate 270. It was mentioned under the head of Elevating Mechanism in the description of the 14-inch railway mount, model E, that the antifriction device of that mount is practically identical with that used on the Navy mounts. This mechanism works efficiently in reducing the trunnion friction, but as mentioned before, does not embody those flexible elements which permit the shock of recoil to be transmitted directly into the trunnion bearings without excessive strain on the antifriction mechanism.

228. Traversing Mechanism.—When the gun is fired at low elevations from the wheels, traverse is secured by moving the mount along a curved track by means of a small winch located on the front bolster. When the gun is to be fired at high elevations from the emplacement the latter is so placed as to give the gun approximately the correct azimuth. Small changes in azimuth are effected by traversing the mount on the jacks and jacking beams which support it, and around the pintle of the emplacement, by means of a screw located on the rear beam. A traverse of 2.5 degrees on each side of the center line can be secured with the jacking beams in any one position. It will be observed on plate 23 that when the gun is operated at high elevations, the carriage is supported on four hydraulic jacks placed under the ends of the two jacking beams. If it is desired to secure more than the total of 5 degrees traverse on one emplacement, the jacks can be lowered and the beams run to the extreme limit in the direction in which it is desired to traverse each end of the mount, and the jacks moved until they are in their proper position under the ends of the beams. By this procedure it is possible to secure a total traverse of about 10 degrees on one emplace-

ment. It would of course be possible to move the jack supports and secure greater traverse, but the emplacement is not so constructed as to take safely the shock of recoil at any very great side angle. The details of construction of the rear jacking beam with its traversing screw are shown on plate 271.

229. Gun Carriage.—The gun carriage is incorporated in the car body and the two are described together in the next paragraph.

230. Car Body.—The car body, plate 253, consists of two heavy single web structural steel girders connected by structural and cast steel transoms. The cradle is swung by means of its trunnions in the bearings of the deck lugs attached to the side girders. The elevating and traversing mechanisms already described, are likewise assembled to the girders. A bullet proof cab of 0.25 inch steel is constructed over the rear of the girders to shelter the personnel. This is the only mount that the writer has observed that is so heavily protected with armor. The Italian 38-centimeter railway mount has a shelter of armor plate over the working platform, but no side plates.

231. Anchorage.—When the gun is operated at elevations between 10 and 15 degrees, no anchorage other than wheel friction is required. For operating at high elevations a pit is dug, a bed of timbers is provided at each end of the car body and the weight of the car is transferred to these beds by hydraulic jacks placed between them and special jacking beams incorporated in the car body. The pit is about 9 feet deep, plate 272, and is lined with timbers. The timbers at the rear end of the pit are united into a mat or spade and are connected to the pintle near the center of the girders of the mount, by structural members and a trunnion bed plate casting so that the horizontal component of the shock of firing is taken against them. On plate 273 the emplacement is shown complete and ready to receive the mount. This firing platform is similar in general design to that required for the 340-millimeter French gun and the 400-millimeter French howitzer railway mounts, and for the American 16-inch howitzer when operating at its maximum elevation. The braces between the cast steel pintle block and the timber mat or spade in the pit for the three mounts just mentioned, are made up of 14-inch square timbers. The braces for this mount are built up of structural steel.

232. Trucks.—The four trucks are identical in construction and are 6-wheel locomotive type with 9 by 12-inch journals and 36-inch wheels. Each truck is provided with hand brakes. The details of construction are shown on plate 274. These trucks are connected in pairs by structural steel span bolsters and the ends of the main girders pivot on these span bolsters.

233. Ammunition Supply System.—For the service of ammunition an I-beam trolley track is so arranged along the roof of the cab of the

mount, plate 253, that it can be pushed to the rear and made continuous with a similar track in the ammunition car, plate 275, which is coupled just behind. The shell is picked up in the ammunition car by a trolley hoist, run along into the cab of the mount and let down onto the ammunition tray, plate 276. This tray runs on wheels along a track to the breech of the gun. It is provided with a buffer which brings it to a stop when it hits the breech and the shell continues on into the chamber of the gun and is arranged by hand. The gun is loaded at 0 degrees elevation.

234. MAINTENANCE.—Two serious defects in the design of this mount result in considerable difficulties in maintenance. First, the axle loads, especially on the front trucks, are so great as to make it practically impossible to transport the mounts for any great distance at a speed greater than from 5 to 10 miles an hour without more bearing trouble than is normally expected and certainly without more than can be tolerated in a mount carrying a gun of this value. Second, the structural steel members which connect the spade and the trunnion bed plate are so flexible as to give trouble in handling. They are inclined to buckle easily. An additional difficulty was encountered as a result of covering the entire working platform with armor. A great amount of moisture condenses on all metal surfaces within the cab and does not evaporate very rapidly because of the lack of circulation of air. This condition makes it necessary to pay a great amount of attention to all of the unpainted metal surfaces.

235. DIFFICULTIES INVOLVED IN SERVICE.—The winch that was supplied on the mount as originally designed is not powerful enough to move the mount along the track. It will be necessary to provide a more powerful winch for the operation of the mount at elevations under 15 degrees. The trunnion bed plate casting is very heavy, and difficulties were encountered in installing the emplacement with the special crane that was provided. It is probable that the casting is heavier than it need be, and it is likewise probable that the crane provided was not as powerful as it should be. The type of emplacement required for the operation of this gun at high elevation has always been considered objectionable because of the excessive time required for its installation. The platforms used by the French guns required from two to five days for installation and usually two days for removal. This platform can be installed a little more quickly, but from two to three days is a fair average. The use of this type of emplacement, of course, requires a special crane car or locomotive crane and the total battery equipment is unusually large.

236. MERITS.—In speaking of this carriage from the broadest standpoint it can not be said to have many merits. It can be fired without any track preparation up to an angle of 15 degrees, but it would be criminal to fire a gun of this type at any such angle except in an ex-

treme emergency. The loading mechanism is excellent in that it is simple and is operated entirely by hand.

237. Demerits.—It should be understood in dealing with this carriage that it is a carriage produced purely for the emergency and may be classed with what the French call "Affuts de Circonstance." When fired at an angle above 15 degrees it requires the same cumbersome firing platform that is used with the French 340-millimeter gun and 400-millimeter howitzer. The carriage is supported on two six-axle trucks, and the axle load on the front truck is so great as to cause considerable trouble with overheated journals and bearings. Considerable difficulty was experienced in securing permission to move this mount over French railways because the axle loads of the front truck exceeded by 13,000 pounds the permissible axle load for French railways. It seems quite certain that nothing but the desperate need for guns for this range and caliber could have secured the necessary permission to move them about. The axle load on the front truck is approximately 53,000 pounds. The maximum permissible axle load on French railways is approximately 39,000 pounds. It is understood that an axle load of 62,000 pounds is permissible on main lines in America. It seems quite certain, however, that serious difficulty would be experienced in moving these mounts over newly constructed lines laid over areas that had been badly shell torn. Fortunately it was not necessary to move the mounts on any lines except those that were on fairly settled ground.

238. In moving the five carriages of this type, which were operated by Navy personnel, from St. Nazaire to Camp Mailly, all of them but one developed serious difficulty with overheated journals, and the one that escaped this difficulty was run at an average speed of 5 miles an hour. In returning one of the mounts from Camp Mailly to Bordeaux for return to America, it was necessary to put it in the French shops three times to repair damages to overheated journals and bearings. It would seem possible to limit this difficulty by providing all of the bearings with hard grease cellars such as are used on large locomotives. This would provide a positive oiling system that probably would make it possible to operate the mounts already constructed with less difficulty. The armor-plate cab is probably more of a nuisance than an advantage. While the mounts were being operated against the railway yards of Montmedy and Longuyon from the vicinity of Verdun, the Germans located the battery positions. Some shells burst very close to the mounts. One of these bursts would have resulted in a number of casualties had the mount not been equipped with armor. This is one of the few cases on record in which the enemy were able to locate the railway positions accurately and fire on them with any effect. None of the heavy gun mounts in the French and British Armies were provided with any such armor and

apparently they never felt the need for them. As noted before, this steel cab gave considerable difficulty from the condensation of moisture on all metal surfaces within it, and it is felt that the chance case in which the enemy was able to locate the position does not warrant the providing of armor. The Italian 38-centimeter railway mount has an armor-plate roof over the working platform to protect the personnel from machine gun fire from air planes. The German 28, 24, and 21 centimeter guns were likewise provided with light armor, but it is felt that excessive use of heavy shelters, concrete as well as steel, by the Germans indicates rather a tendency toward proved needless and foolish precautions and should not be considered an example that is to be followed.

PLATE 252

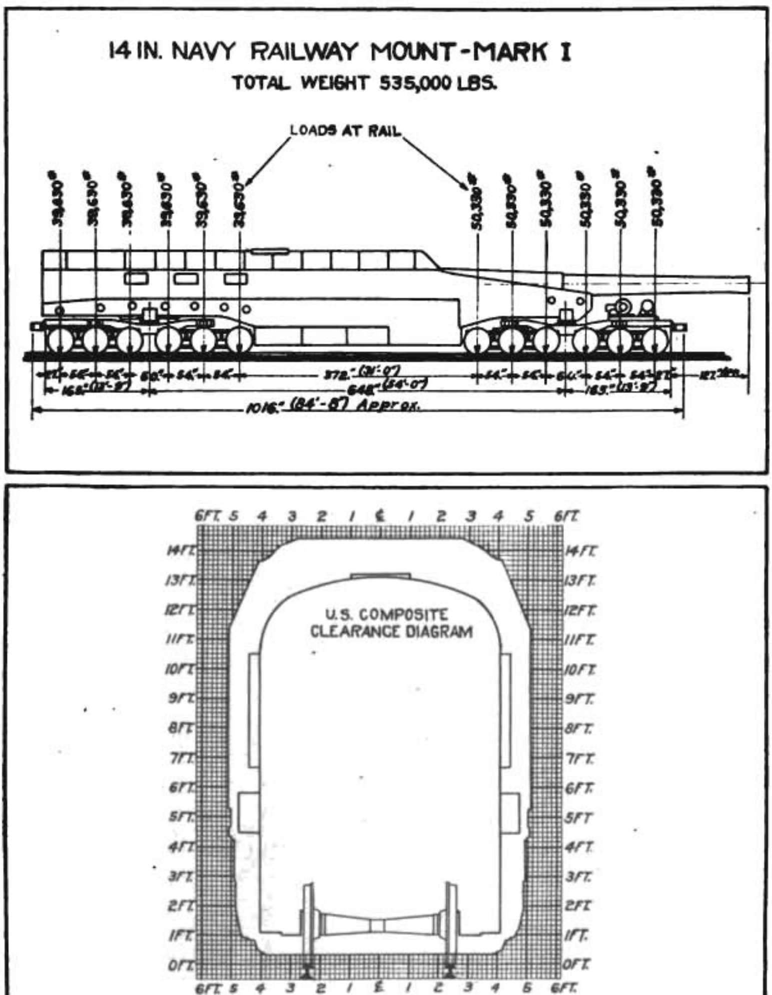
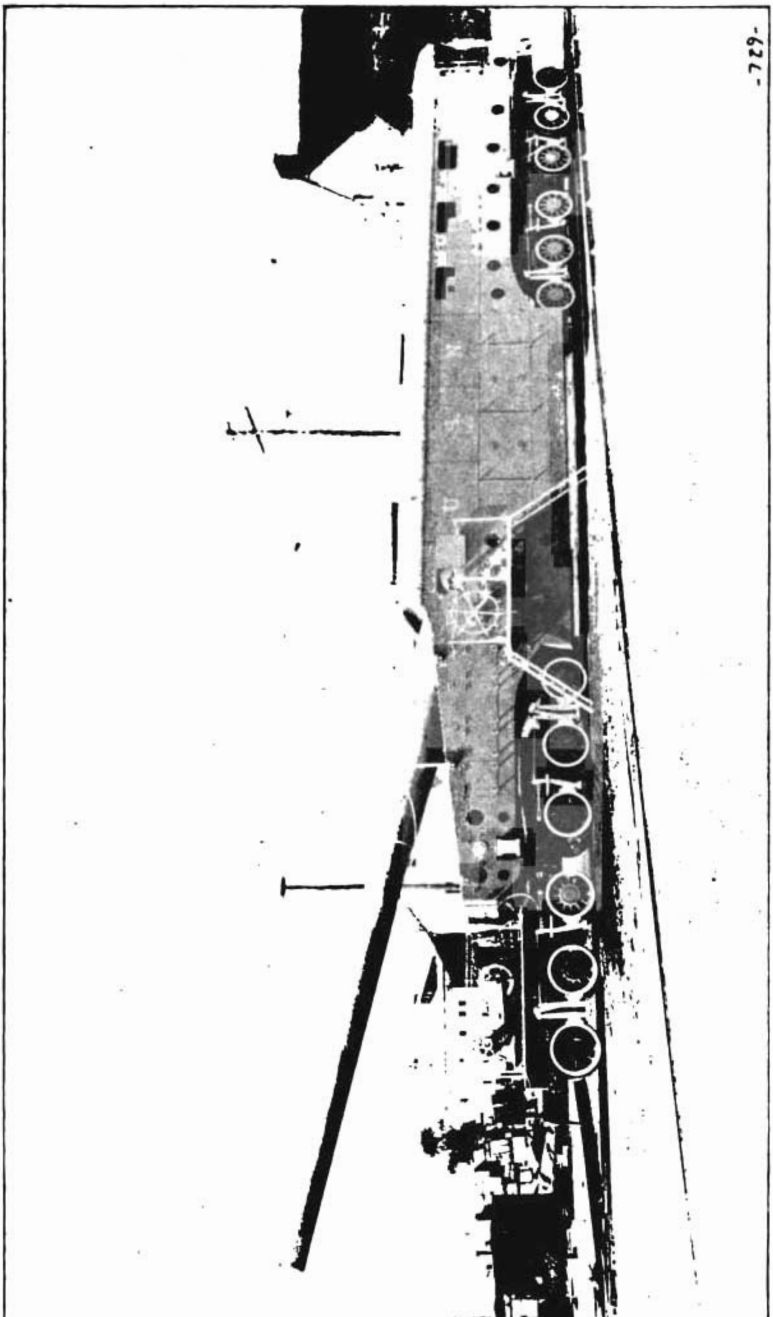


PLATE 254



14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK I.

PLATE 255

14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK I.

PLATE 256

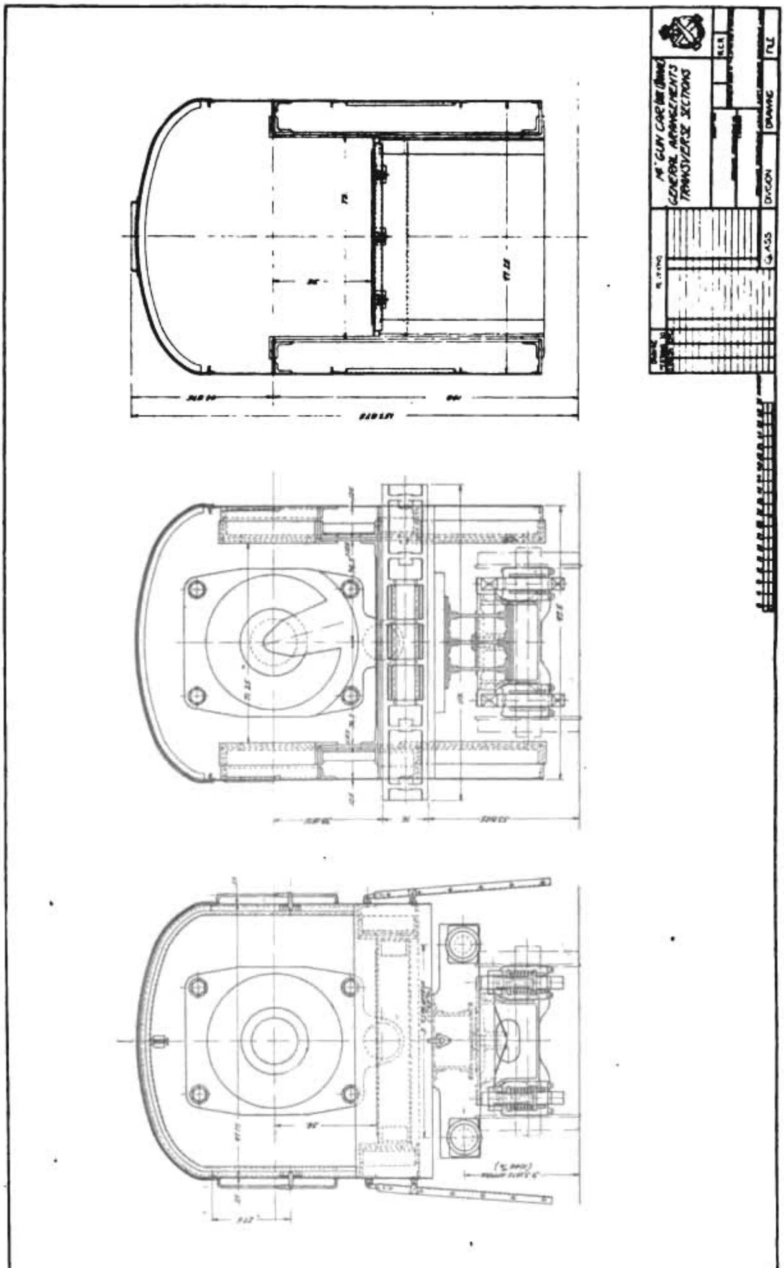
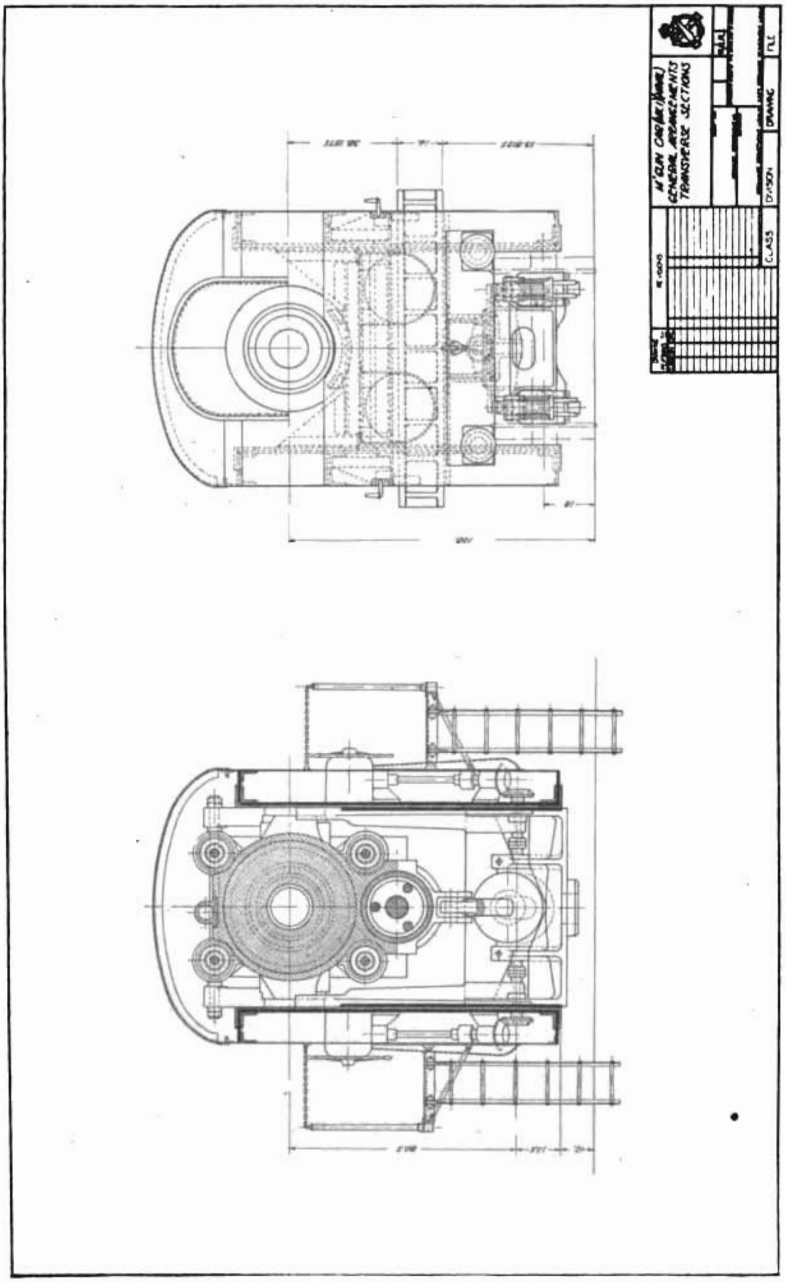
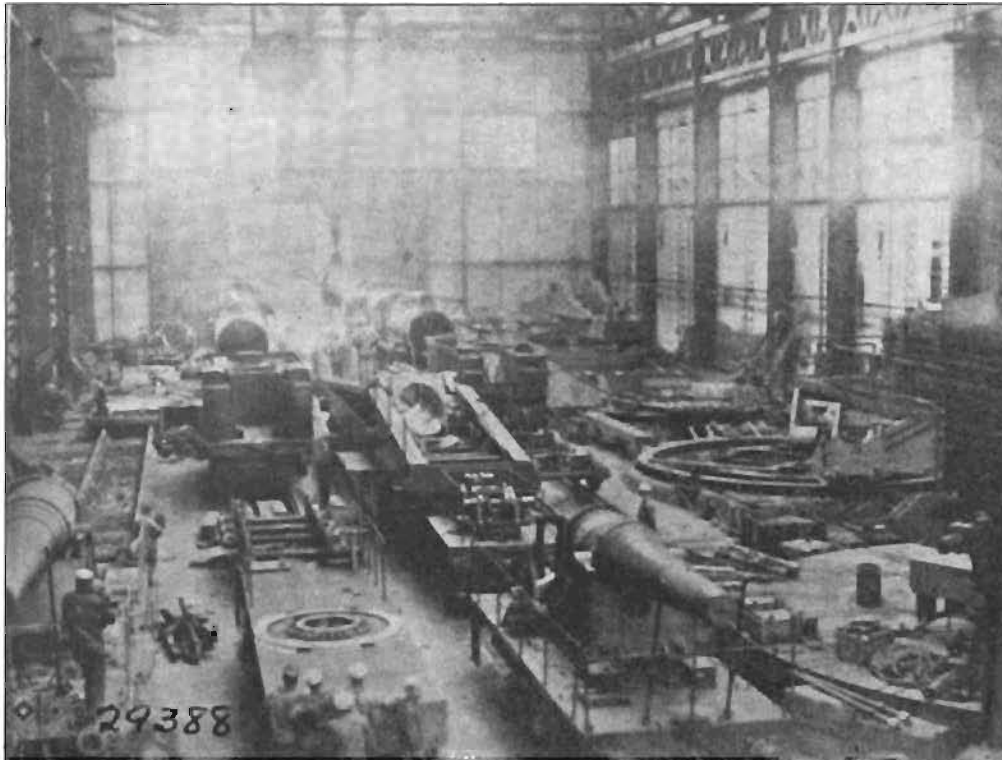

GENERAL ARRANGEMENTS
TRANSVERSE SECTIONS
DIVISION
DRAWING
FILE
CLASS

PLATE 257


GENERAL ARRANGEMENTS
TRANSVERSE SECTIONS
CLASS
DIVISION
DRAWING
FILE

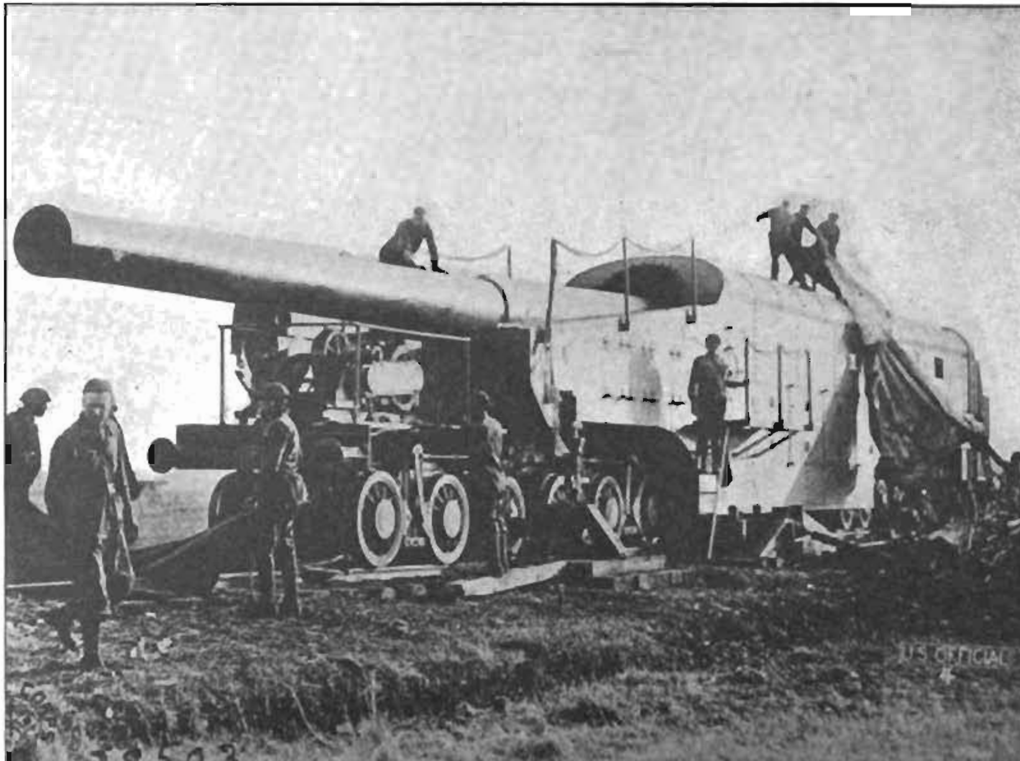


14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK I, IN COURSE OF ERECTION IN THE CHANTIERS DE LA LOIRE ST. NAZAIRE, FRANCE.

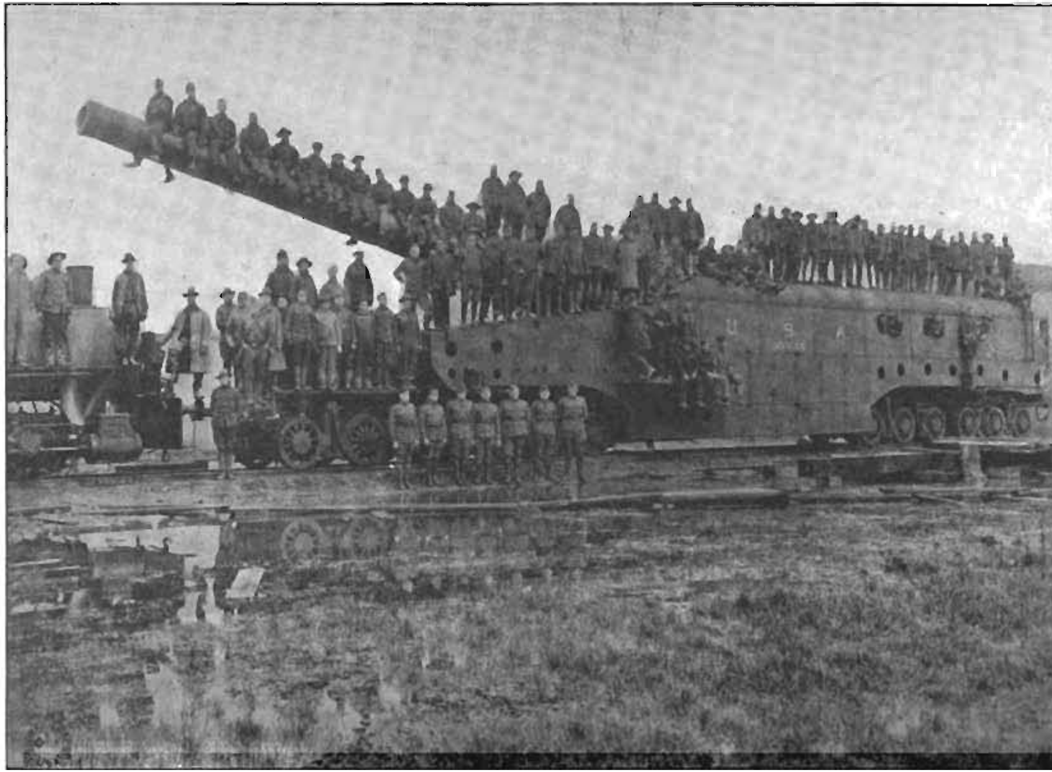
14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK I, PARTIALLY ERECTED IN THE CHANTIERS DE LA LOIRE, ST. NAZAIRE FRANCE.

14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK I, IN OPERATION NEAR VERDUN, AGAINST GERMAN RAILWAY YARDS AT MONT MEDY, NOVEMBER, 1918.

14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK I, IN OPERATION NEAR VERDUN, AGAINST GERMAN RAILWAY YARDS AT LONGUYON, NOVEMBER, 1918.



14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK I, LOCATED NEAR VERDUN, NOVEMBER, 1918 (BEING CAMOUFLAGED WITH CANVAS).



14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK I (JUST ARRIVED CHANTIERS DE LA GIRONDE, BORDEAUX, FRANCE, JANUARY, 1918, FOR DISASSEMBLY).

PLATE 264

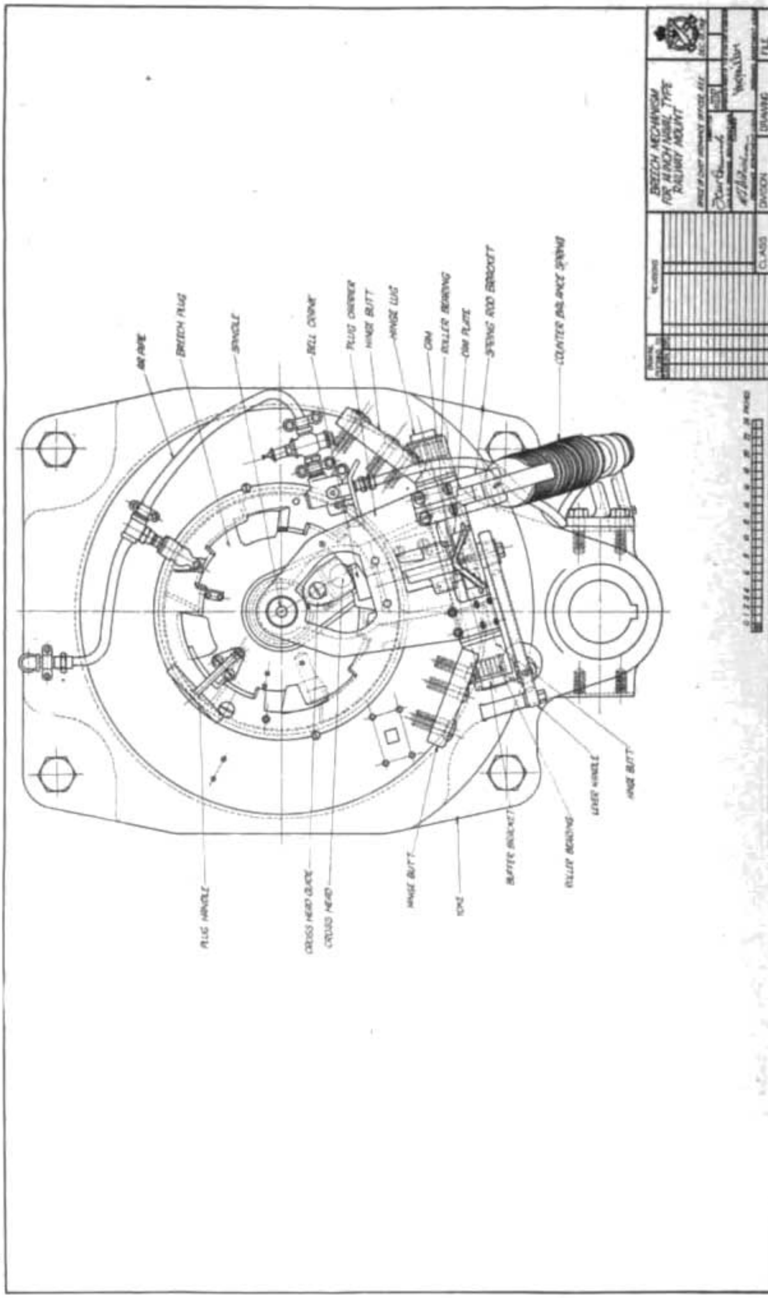

AIR PIPE
BREECH PLUG
SPINDLE
BELL CRANK
PLUG CARRIER
HINGE BUTT
HINGE LUG
CAM
ROLLER BEARING
CAM PLATE
SPRING ROD BRACKET
COUNTER BALANCE SPRING
PLUG HANDLE
CROSS HEAD GUIDE
CROSS HEAD
HINGE BUTT
YOKE
BUFFER BRACKET
ROLLER BEARING
LEVER HANDLE
HINGE BUTT
BREECH MECHANISM FOR 14 INCH NAVAL TYPE RAILWAY MOUNT
CLASS
DIVISION
DRAWING
FILE

PLATE 265

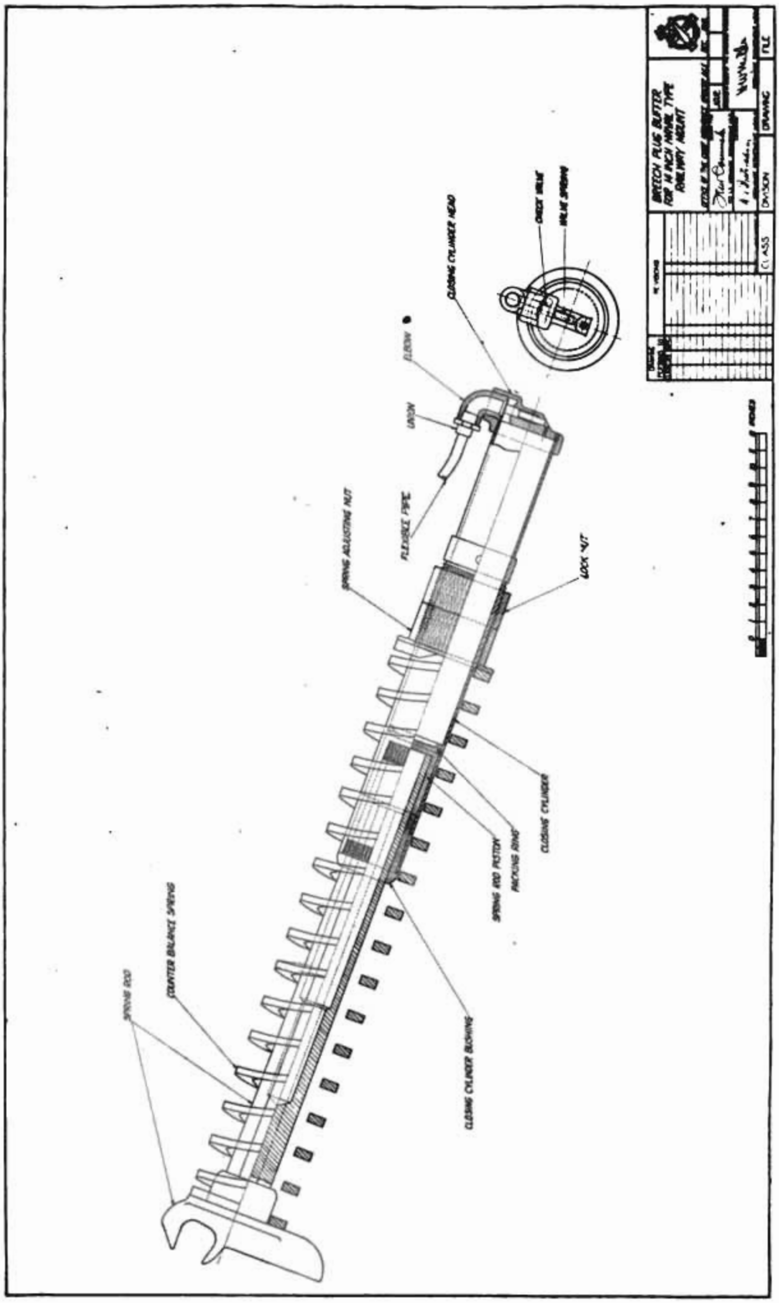

BREECH PLUG BUFFER FOR 14 INCH NAVAL TYPE RAILWAY MOUNT
CLOSING CYLINDER HEAD
CHECK VALVE
VALVE SPRING
ELBOW
UNION
FLEXIBLE PIPE
SPRING ADJUSTING NUT
LOCK NUT
CLOSING CYLINDER
PACKING RING
SPRING ROD PISTON
COUNTER BALANCE SPRING
SPRING ROD
CLOSING CYLINDER BUSHING
REVISIONS
CLASS
DIVISION
DRAWING
FILE
INCHES

PLATE 288

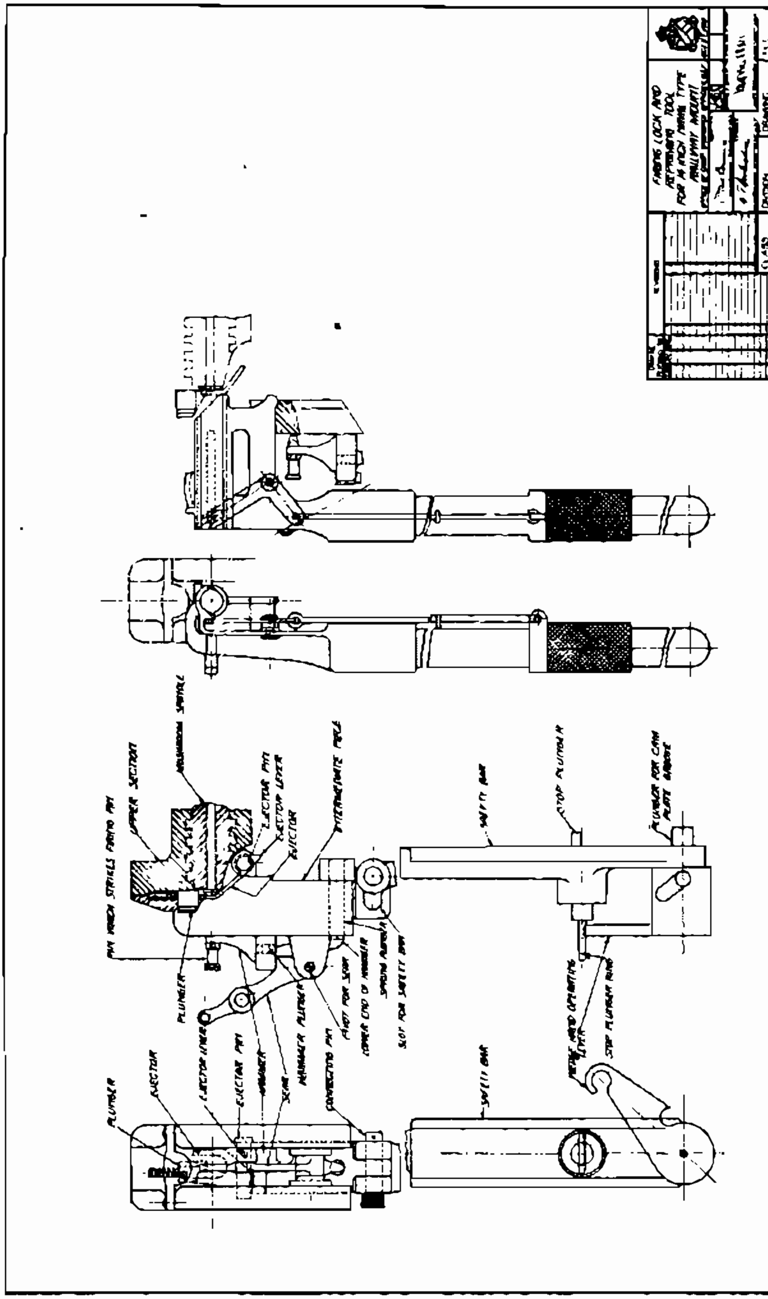

FIRING LOCK AND
PREPARING TOOL
FOR 16 INCH NAVAL TYPE
RAILWAY MOUNT
PLUNGER
EJECTOR
EJECTOR LEVER
EJECTOR PIN
HAMMER
SEAR
CONNECTING PIN
UPPER SECTION
MUSHROOM SPINDLE
INTERMEDIATE PIECE
PIVOT FOR STOP
SLOT FOR SAFETY BAR
SAFETY BAR
STOP PLUNGER
CLASS
DIVISION
DRAWING

PLATE 267

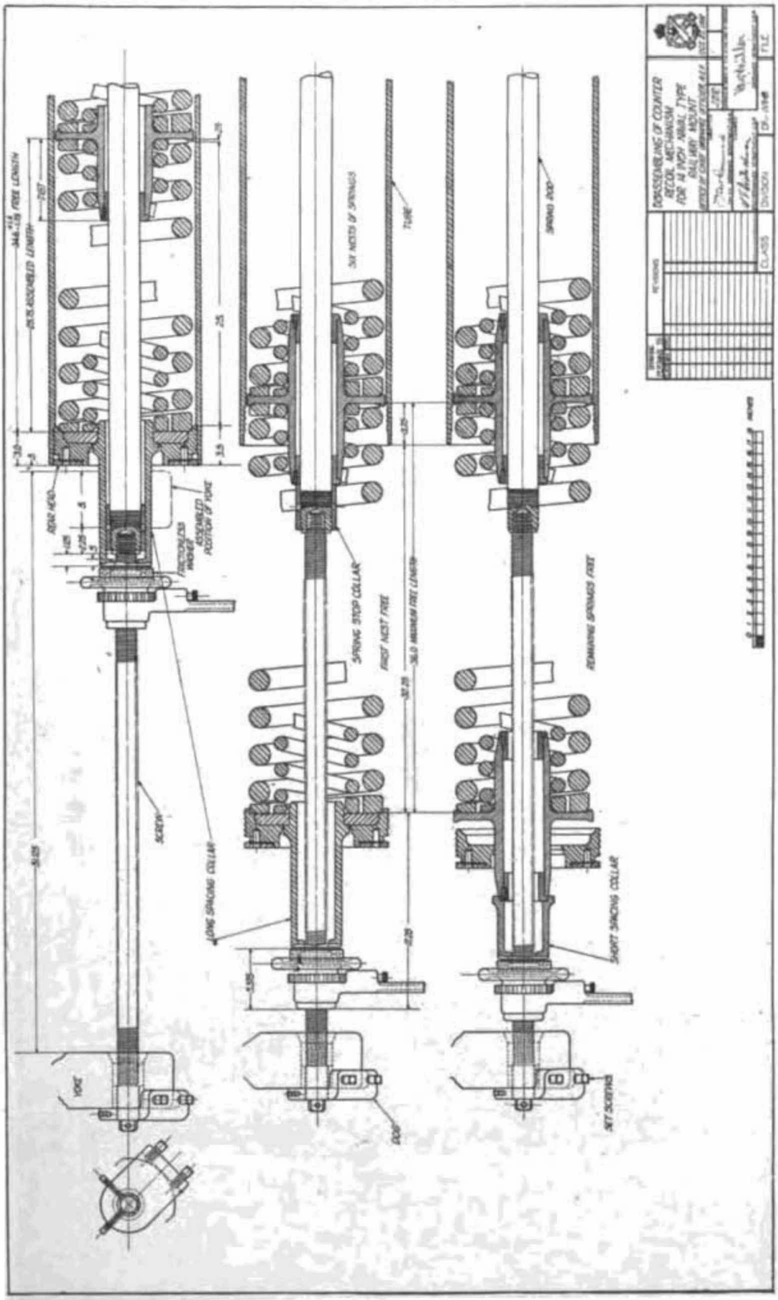

DISASSEMBLING OF COUNTER RECOIL MECHANISM FOR 14 INCH NAVAL TYPE RAILWAY MOUNT
SCREW
YOKE
REAR HEAD
LONG SPACING COLLAR
SPRING STOP COLLAR
FIRST NEST FREE
SIX NESTS OF SPRINGS
TUBE
SPRING ROD
REMAINING SPRINGS FREE
SHORT SPACING COLLAR
DOG
SET SCREWS

PLATE 268

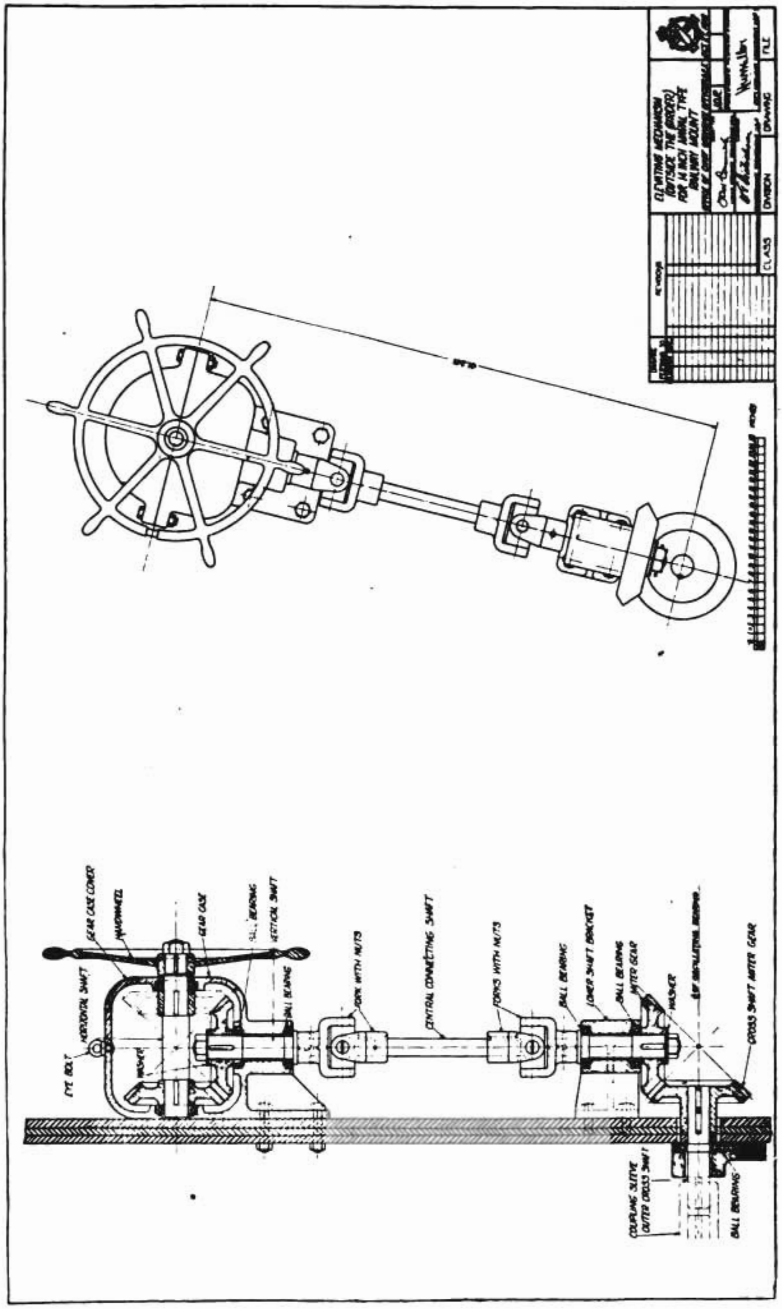


PLATE 269

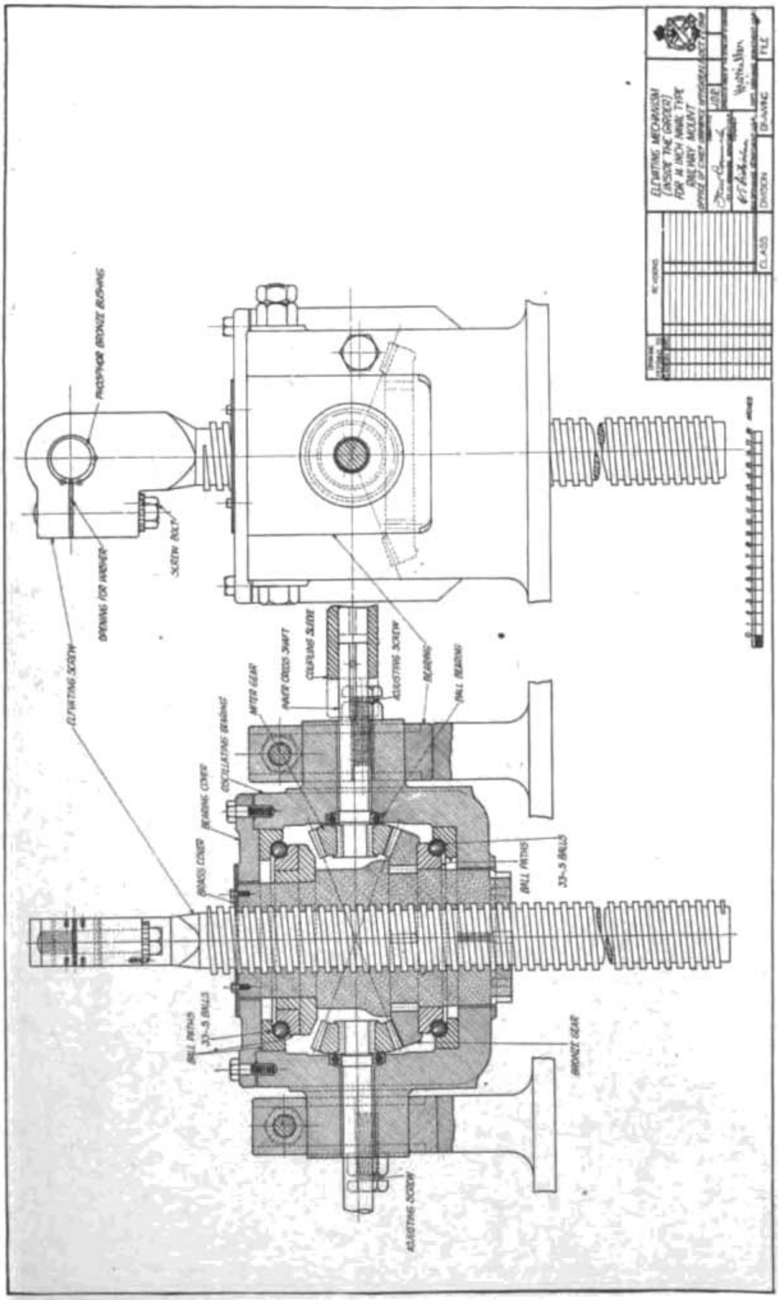

ELEVATING MECHANISM
(INSIDE THE GIRDER)
FOR 14 INCH NAVAL TYPE
RAILWAY MOUNT
PHOSPHOR BRONZE BUSHING
SCREW BOLT
OPENING FOR WASHER
ELEVATING SCREW
COUPLING SLEEVE
MITER GEAR
ADJUSTING SCREW
BEARING
BALL BEARING
OSCILLATING BEARING
BEARING COVER
BRASS COVER
BALL PATHS
33-.5 BALLS
BRONZE GEAR
CLASS
DIVISION
DRAWING
FILE

PLATE 270

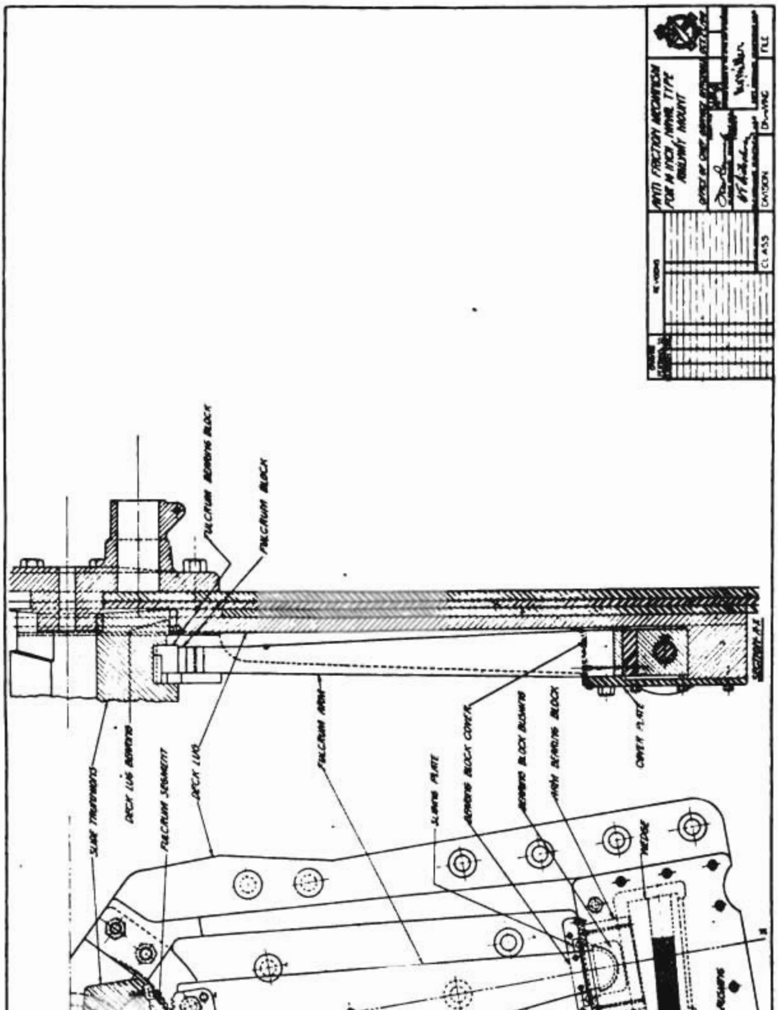

ANTI FRICTION MECHANISM FOR 14 INCH, NAVAL TYPE RAILWAY MOUNT
SLIDE TRUNNIONS
DECK LUG BEARING
FULCRUM SEGMENT
DECK LUG
FULCRUM ARM
FULCRUM BEARING BLOCK
FULCRUM BLOCK
SLIDING PLATE
BEARING BLOCK COVER
BEARING BLOCK BUSHING
ARM BEARING BLOCK
COVER PLATE
WEDGE
OIL HOLE
WEDGE ADJUSTING SCREW
FULCRUM ARM SEGMENT
HOLE FOR TAP BOLT OR EYE FOR HOISTING FULCRUM ARM
SECTION A-A
CLASS
DIVISION
DRAWING
FILE

PLATE 271

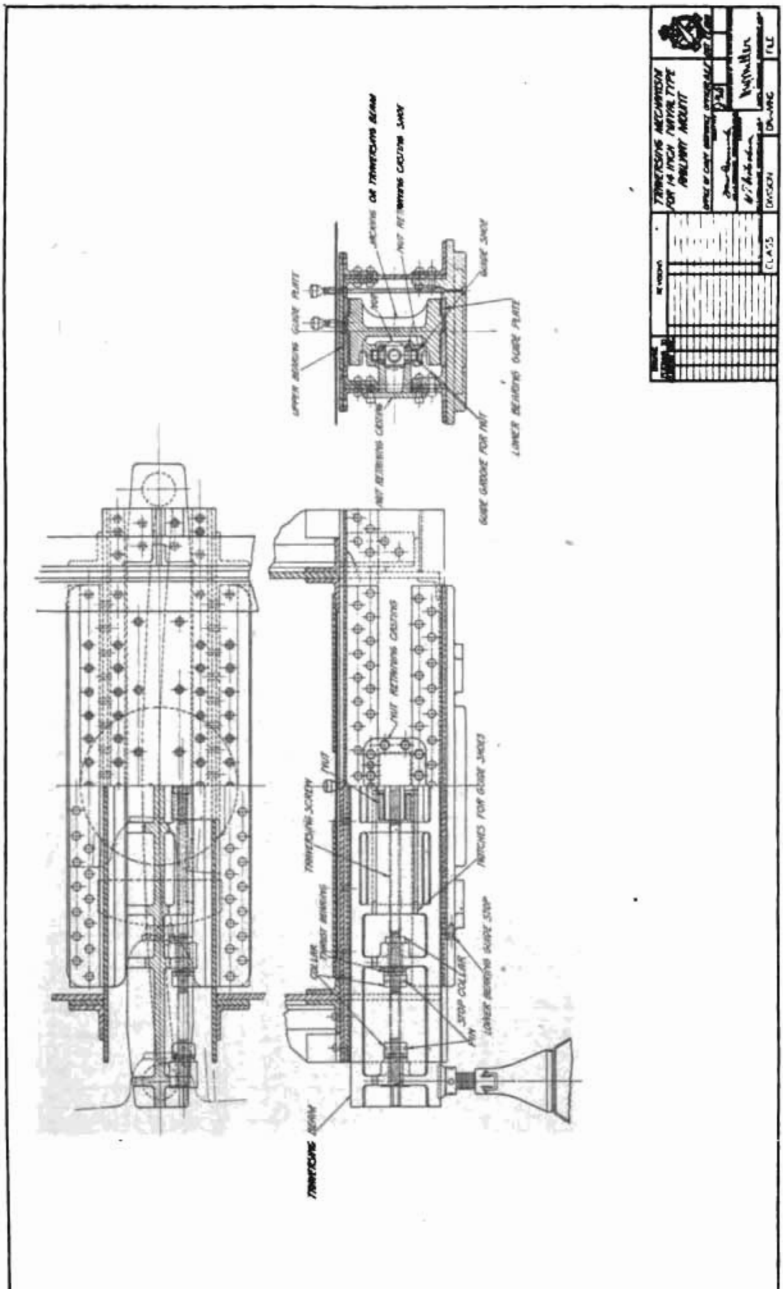

TRAVERSING MECHANISM
FOR 14 INCH NAVAL TYPE
RAILWAY MOUNT
UPPER BEARING GUIDE PLATE
LOWER BEARING GUIDE PLATE
GUIDE GROOVE FOR NUT
GUIDE SHOE
NUT RETAINING CASTING
TRAVERSING SCREW
NUT
THRUST BEARING
COLLAR
STOP COLLAR
PIN
NOTCHES FOR GUIDE SHOES
LOWER BEARING GUIDE STOP
TRAVERSING BEAM
CLASS
DIVISION
DRAWING
FILE

PLATE 272

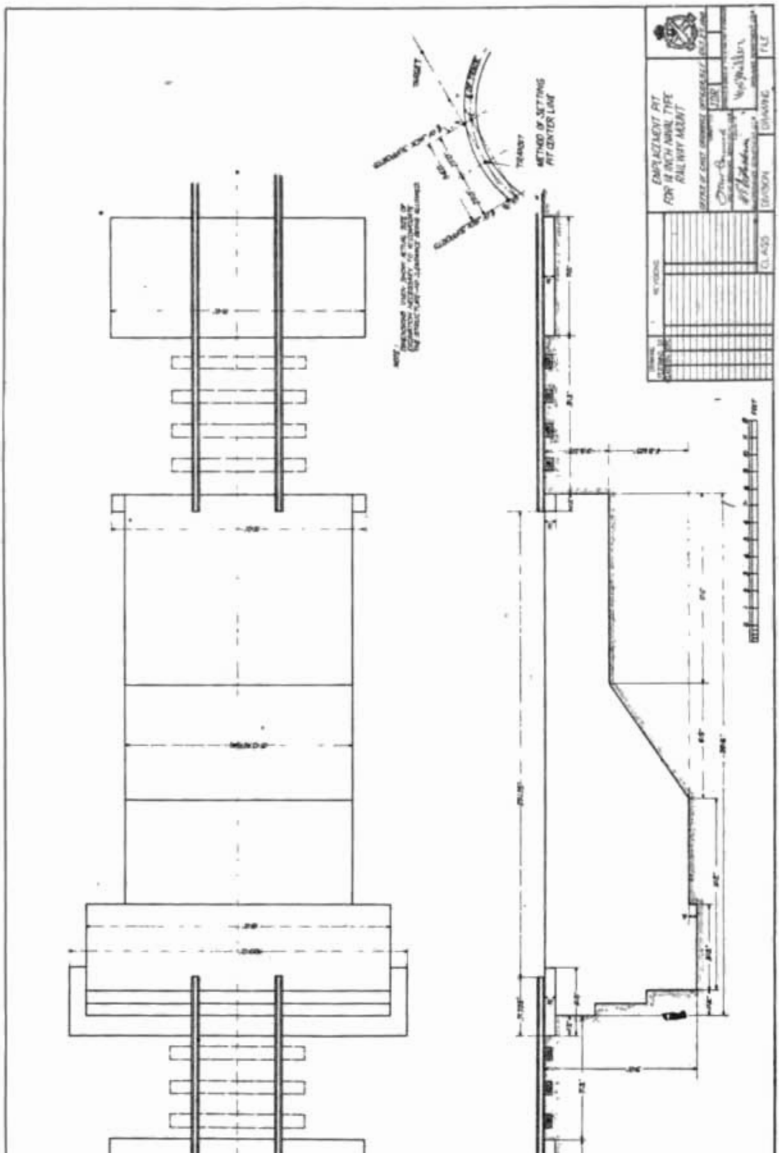

EMPLACEMENT PIT
FOR 14 INCH NAVAL TYPE
RAILWAY MOUNT
METHOD OF SETTING
PIT CENTER LINE
TRANSIT
TARGET
REVISIONS
DIVISION
CLASS
DRAWING
FILE

PLATE 273

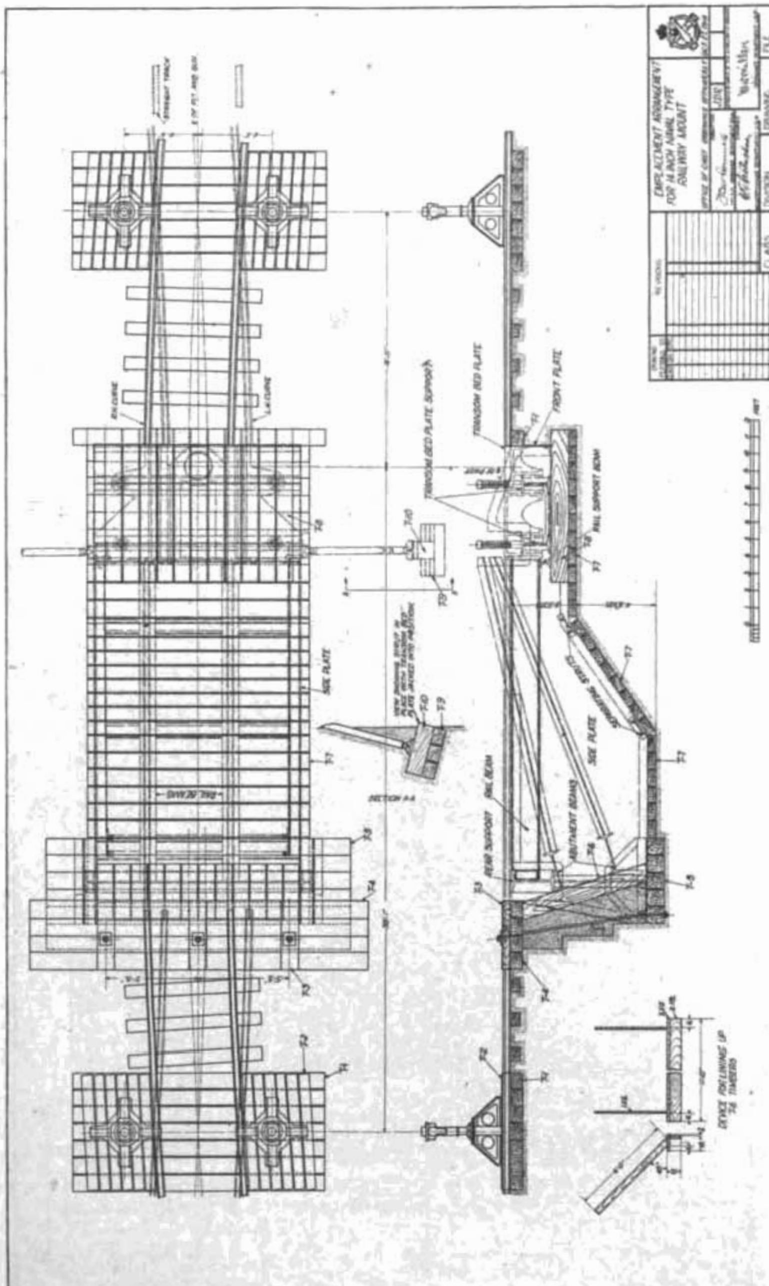

EMPLACEMENT ARRANGEMENT FOR 14 INCH NAVAL TYPE RAILWAY MOUNT
SIDE PLATE
RAIL BEAM
FRONT PLATE
TRANSOM BED PLATE
RAIL SUPPORT BEAM
ABUTMENT BEAMS
REAR SUPPORT
SECTION A-A
DEVICE FOR LINING UP T6 TIMBERS

PLATE 274

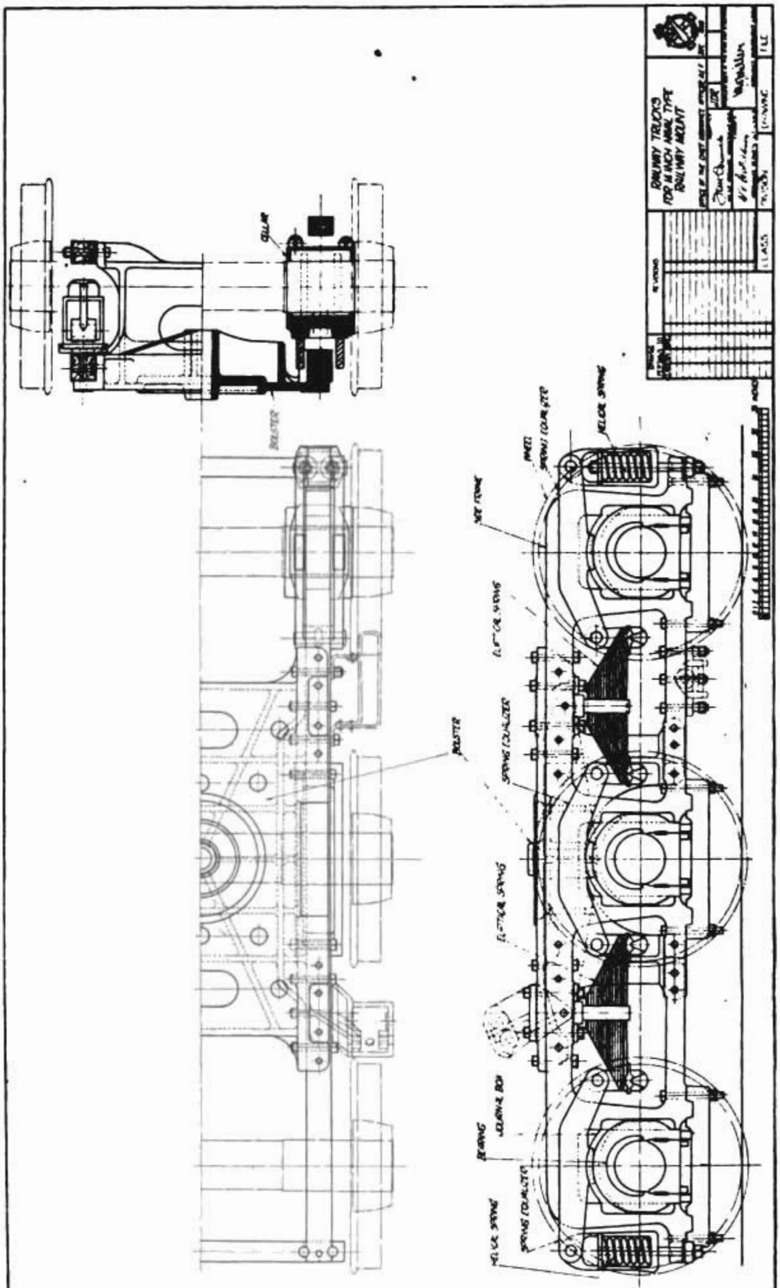
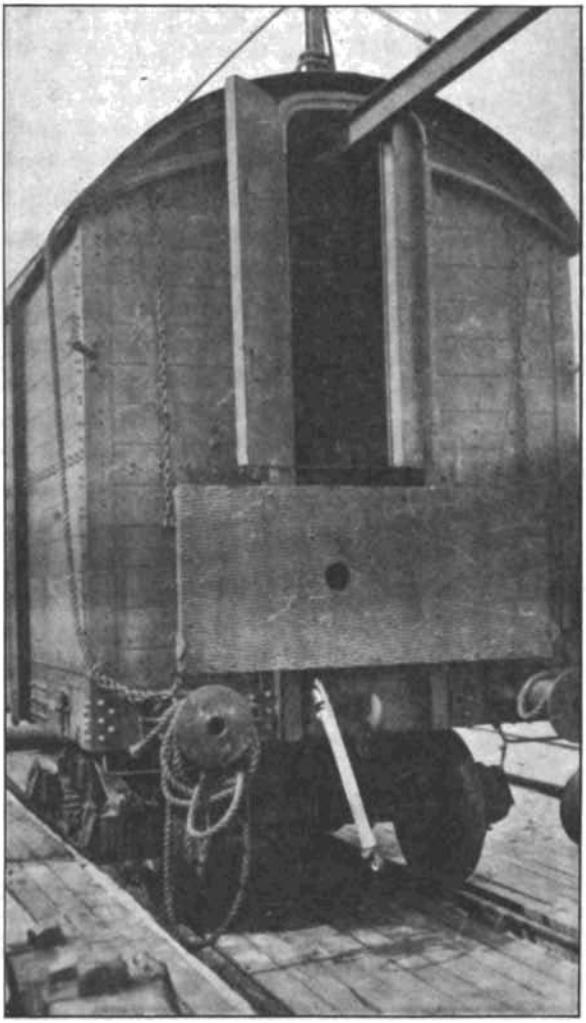
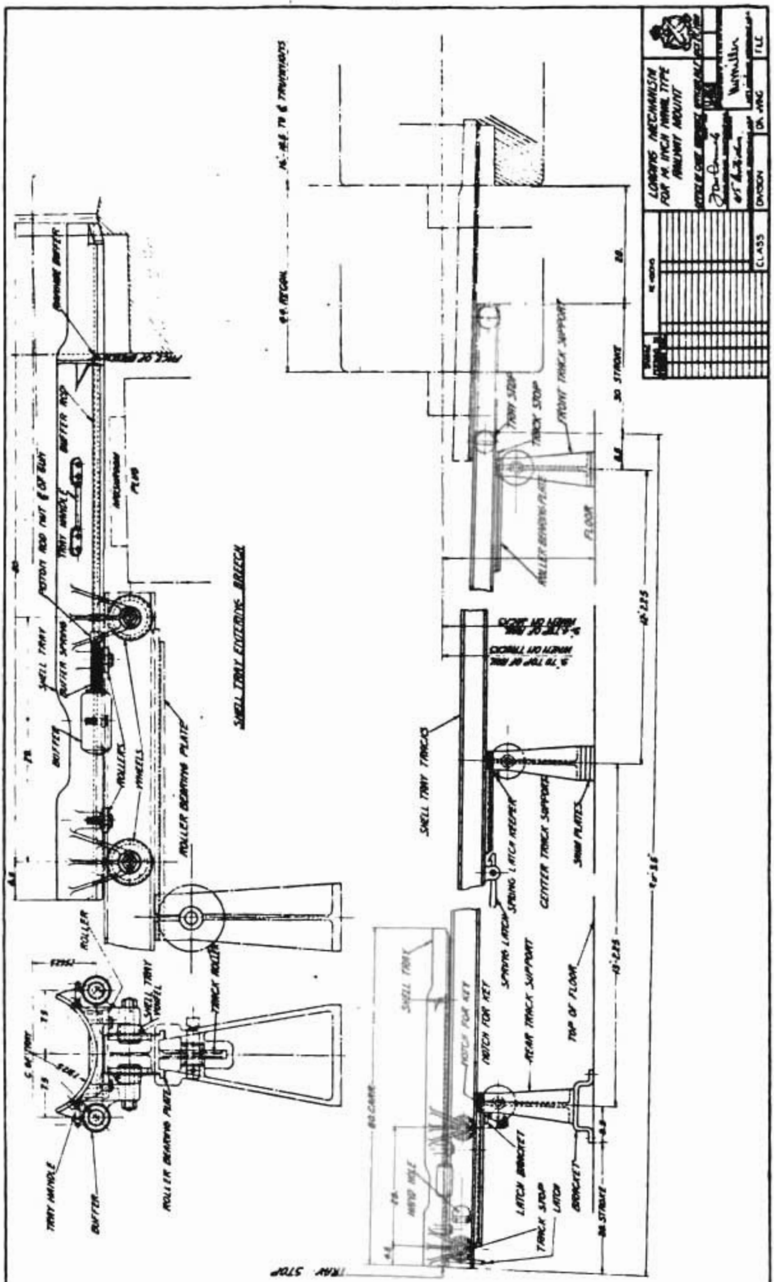

RAILWAY TRUCKS FOR 14 INCH NAVAL TYPE RAILWAY MOUNT
BOLSTER
COLLAR
SIDE FRAME
HELICAL SPRING
SPRING EQUALIZER
ELLIPTICAL SPRINGS
JOURNAL BOX
BEARING

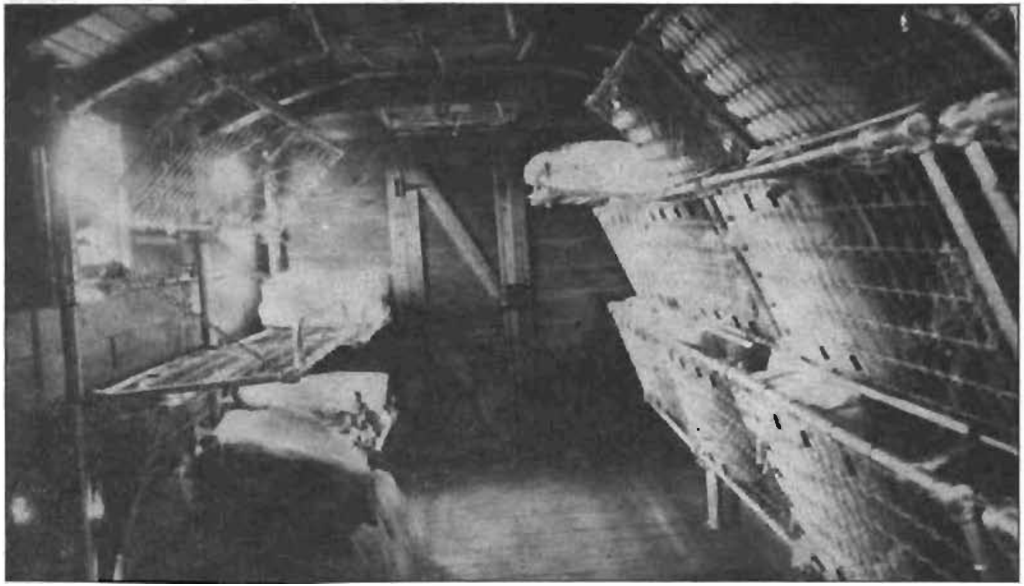
PLATE 275



AMMUNITION CAR FOR THE 14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNTS, MARKS I AND II.

PLATE 276


LOADING MECHANISM FOR 14 INCH NAVAL TYPE RAILWAY MOUNT
SHELL TRAY ENTERING BREECH
SHELL TRAY TRACKS
ROLLER BEARING PLATE
CENTER TRACK SUPPORT
REAR TRACK SUPPORT
FRONT TRACK SUPPORT
TOP OF FLOOR
TRAY STOP
TRACK STOP
SHIM PLATES
SPRING LATCH
TRACK ROLLER
ROLLER
BUFFER
TRAY HANDLE
NOTCH FOR KEY
LATCH BRACKET
HAND HOLE



INTERIOR OF PERSONNEL CAR FOR AMERICAN NAVY RAILWAY ARTILLERY.

11.—AMERICAN 14-INCH GUN ON NAVY RAILWAY MOUNT, MARK II. (24)

239. This mount is of the combined cradle and rolling recoil type. The gun is mounted in a cradle having a combined hydrospring and pneumatic recoil mechanism. This cradle is mounted in a heavy cast-steel slide which is carried in guides attached to the side girders. This slide is capable of moving upward at an angle of 45 degrees with the vertical, through a distance of 86 inches above the traveling position. The structural steel girder is supported at each end by a span bolster on two five-axle trucks. Neither the car body nor the gun is provided with any traverse, and it is necessary to operate the mount on a curved track. When the gun is fired, the entire mount rolls back on the track a distance of from 30 to 40 feet. General views are shown on plates 279, 280, 281, and 282.

240. Gun.—The gun for which this mount was primarily designed is identical with that used on the railway mount, Mark I—that is, a 14-inch naval rifle, Mark IV, Modification I, of 50-caliber length. It is possible, however, to mount a 9-inch gun with its cradle in the same slide.

241. Recoil Mechanism.—The recoil mechanism proper is in every respect identical with that of the 14-inch gun used on the railway mount Mark I, plate 34. The difference in respect to recoil, between the Mark II and Mark I mounts, is that on the Mark II mount the gun can be fired without any track preparation whatever to its maximum elevation of 40 degrees, while on the Mark I mount it is possible to fire the gun to an elevation of only 15 degrees without track preparation. The maximum recoil of the 14-inch gun is 44 inches when the gun is operated at the maximum elevation of 40 degrees. The recoil of the 9-inch guns at 43 degrees is 36 inches. The air for recuperator cylinder is supplied from the air pump installed on the front span bolster, plate 279.

242. Elevating Mechanism.—The elevating mechanism in its essential details is identical with that of the Mark I mount, shown on plates 268 and 269. The only difference is in the connections between the handwheels and cross shafts which drive the miter gears in the gear case. This modified connection is shown on plate 284 in the central figure. It will be observed here that handwheels are mounted directly on shafts which carry pinions on the inner ends meshing with spur gears carried directly on the cross shafts.

243. Traversing Mechanism.—It has already been mentioned that this carriage is not provided with any internal traversing mechanism. It is necessary to operate it on a curved track to train the gun in azimuth.

244. Gun Carriage.—The cast-steel slide in which the gun and its cradle are carried will be described under this head. One of the

qualifications desired of heavy railway mounts during the present war was a practicable means of rapidly installing an emplacement or otherwise preparing for action. With most heavy gun carriages it was necessary to provide some design of ground platform for operating the gun at high elevations. This provision of a heavy ground platform was necessitated by two considerations. When operating the gun at high elevations, the vertical component of the shock of recoil is ordinarily greater than can safely be transmitted through any except extremely heavy trucks. The second consideration is that if the gun is to be operated at its maximum elevation without the use of a subtrack platform and pit under the center of the gun, it is necessary either to place the trunnions very close to the breech of the gun or elevate the trunnions above the track by some method in order that the breech of the gun may not strike the ties at full recoil.

245. It was understood, of course, that any gun mount operating without a subtrack platform would have to be either of the sliding or rolling recoil type. On the Armstrong 14-inch mount this problem was solved by mounting the gun in a cradle, whose trunnions are close to the breech of the gun, and by connecting the rear end of the cradle with the piston of a large air cylinder by means of two connecting rods, in order that the extreme muzzle preponderance of the gun might be counterbalanced. On the new French 340-millimeter gun carriage the French designers solve this problem by providing two sets of trunnion bearings. The low trunnion bearings are to be used for transportation of the gun which will be transferred to the high trunnion bearings for firing. In the design made for the Army 16-inch gun early in 1918, it was proposed to raise the center line of the trunnions of the gun by means of a slide somewhat similar to this, but sliding in vertical instead of inclined guides.

246. The slide of the 14-inch Mark II mount is shown at its lowest position on plate 280 and at its highest position on plate 281. On plate 283 it is shown in detail with the mechanism used in elevating it. Two 9-inch pistons connected to the slide enter hydraulic cylinders attached to the body of the car. By means of these hydraulic cylinders it is possible to move the slide in the direction of the guides through a distance of 86.28 inches, thereby elevating the center line of the trunnions 61 inches. When at either its upper or lower position the slide is pinned to the carriage by means of two 10-inch pins which are entered or withdrawn by a screw operated by ratchet levers on the outside of the mount, plate 281. These pins, together with the slides and the hydraulic jack, carry the weight of the gun and cradle in transit and transmit the force of recoil into the carriage in firing. The same type of antifriction mechanism that is used on the Mark I mount is incorporated in this design. This is shown on plate 283.

247. Car Body.—The car body consists of two heavy single web structural steel girders connected by structural steel transoms. One noticeable difference between this car body and that of the Mark I mount is the absence of armor. All equipment on the top of the carriage, hand rail, hand rail standards, and ammunition trolley, plate 280, is removable for traveling.

248. Anchorage.—This is a rolling recoil type of mount and the only means of anchoring it is the friction of the brakes operated by hand. On firing, the entire mount rolls back on the track, a distance of from 30 to 40 feet. On the front span bolster, plate 280, is mounted a motor-driven winch carrying a cable which is attached to the track some distance ahead, and by means of which the mount is returned to its firing position.

249. Trucks.—The trucks are ten-wheel locomotive type with 6 by 12-inch journals and 36-inch wheels. As noted before, there are four trucks connected in pairs by structural steel span bolsters. The brakes provided on all trucks can be operated by hand as well as by air. Auxiliary air tanks are charged from the pump mounted just behind the winch on the front span bolster.

250. Ammunition Supply System.—On the rear span bolster is mounted a track carrying a steel tray. Both track and tray are practically identical in design with the track and tray provided on Mark I mount and shown on plate 276. When the shell tray is at the forward end of the track, plate 279, the shell is picked up by tongs suspended from the I-beam trolley, shown on plate 280. By means of this trolley the projectile is carried forward and placed on the tray suspended between the stand on the superplatform and the breech of the gun. The gun is loaded at an angle of minus 5 degrees. The loading tray is shown in position on plate 279; it is kept in the alternate position shown when the gun is being fired. A structural steel jib crane is likewise provided on the side of the mount, plate 279, to pick up ammunition from the ground or from another car in the event that it is not practicable to take the ammunition out of the car directly at the rear of the mount.

251. Maintenance.—These mounts have not seen any field service and it can not be estimated with certainty just what the extent of the maintenance will be. They are very sturdy in construction and it does not seem probable that they will require excessive service in maintenance. The loads on the axle are such as to avoid the overheating that gave so much trouble on the Mark I mount. The construction of the slide is simple and sturdy and it is not probable that it will give any trouble.

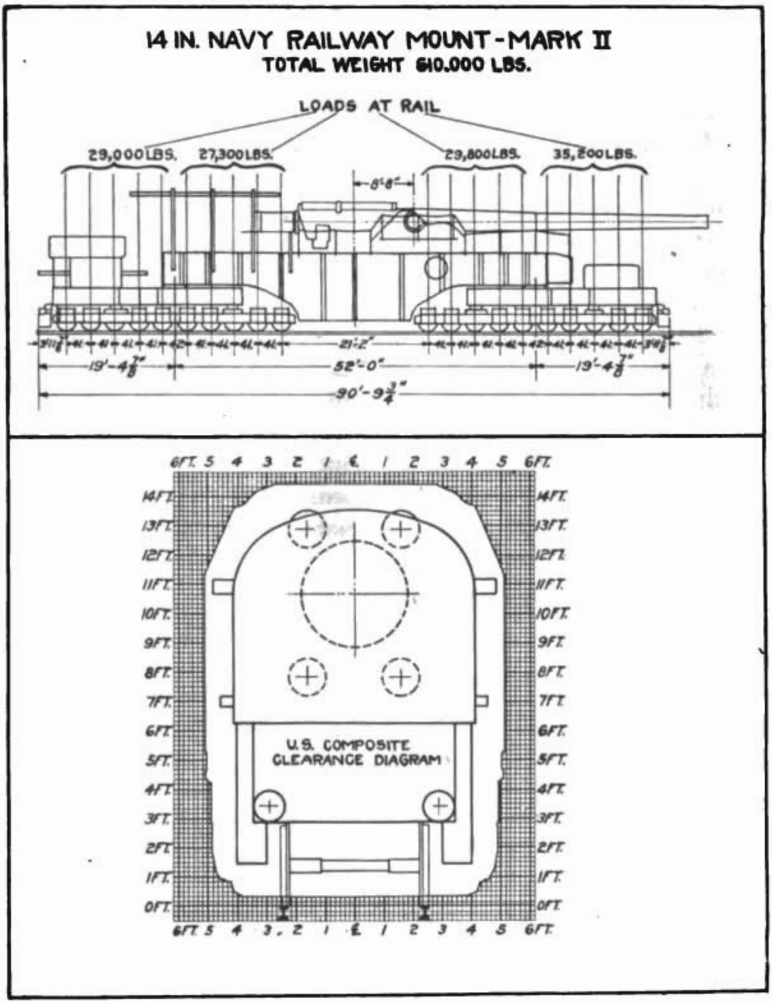
252. Difficulties Involved in Service.—The only difficulty that will be involved in the service, if it may really be termed a dif-

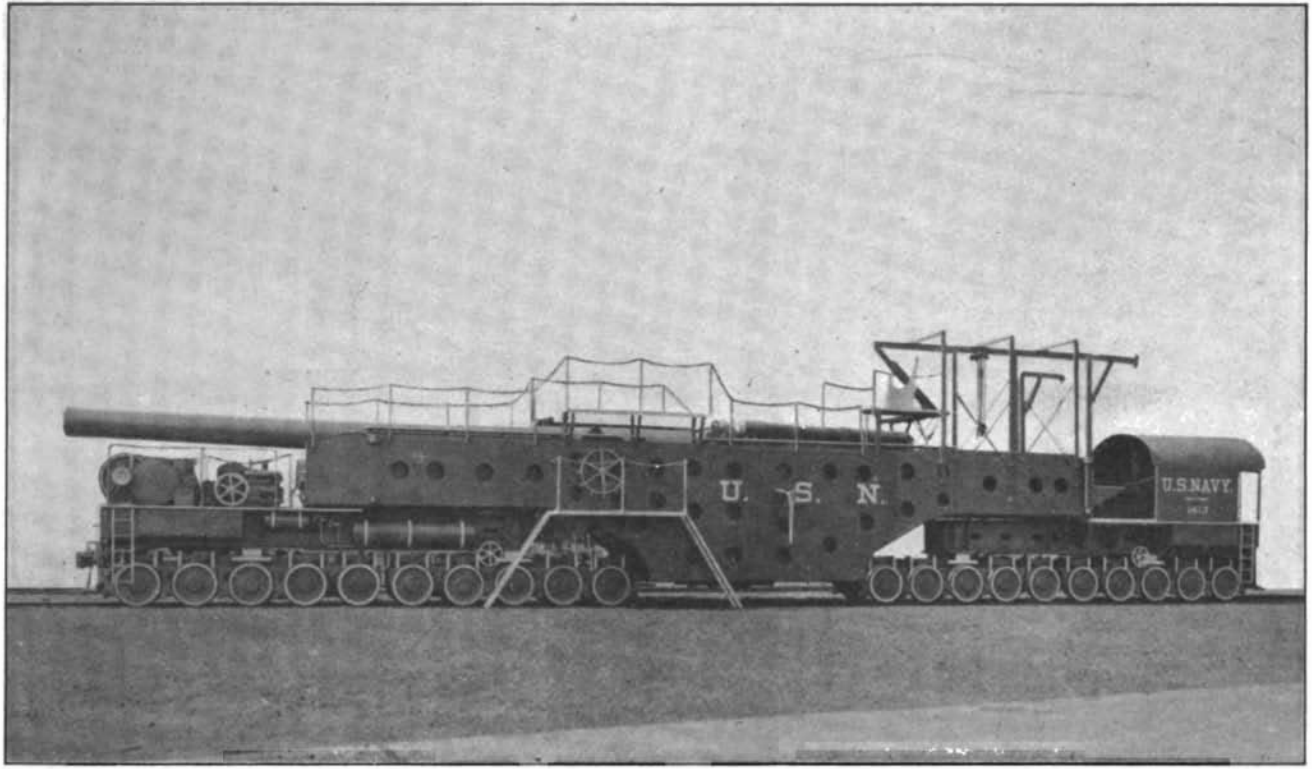
ficulty, will be the construction of the heavy firing positions or epis that are required for training the gun in azimuth. These firing positions are always very well prepared and require an unusual amount of ballast, extra heavy ties and rails, and considerable maintenance while the guns are being operated. The labor required in constructing these epis can not be considered a cause for complaint, because it is ordinarily difficult to keep the personnel of such a battery comfortably busy. The time required for the construction of such epis, however, frequently is a cause for complaint. The time required to lay a new firing track and prepare it for action may vary from two to three days.

253. MERITS.—The merit of the carriage is that it can be fired at the maximum elevation without the installation of firing platforms, which are difficult to install or transport. As just mentioned, occasionally the time required for the installation of a firing track may be a cause for complaint. This is not ordinarily true, however, since the targets on which such guns operate in land warfare, are fixed, and some leisure is available in preparing for action. They are practically self-contained, in that they require no auxiliary equipment for their service. The mount as it is seen on plate 280, practically in traveling order, can be made ready for action in less than an hour, as shown on plate 282.

254. DEMERITS.—This mount was designed during the active period of the war and was so designed as to be capable of construction in a minimum of time with the manufacturing facilities available. No internal traversing mechanism for fine adjustment of the gun in azimuth has been provided. Such a mechanism is desirable and if more time had been available it is probable that it would have been provided. When considering large gun railway mounts from the standpoint of their use for coast defense, as well as for land warfare it is not certain that this is a desirable type. It is probable that a rolling recoil type of carriage can be operated successfully against a moving target, but it has not been satisfactorily proved. For such a valuable gun it seems now that its carriage should be so designed as to be fitted not only for field service, as this carriage is fitted, but likewise so designed as to be capable of installation on some type of rotable platform in order that it may be easily and accurately traversed and efficiently operated against moving targets.

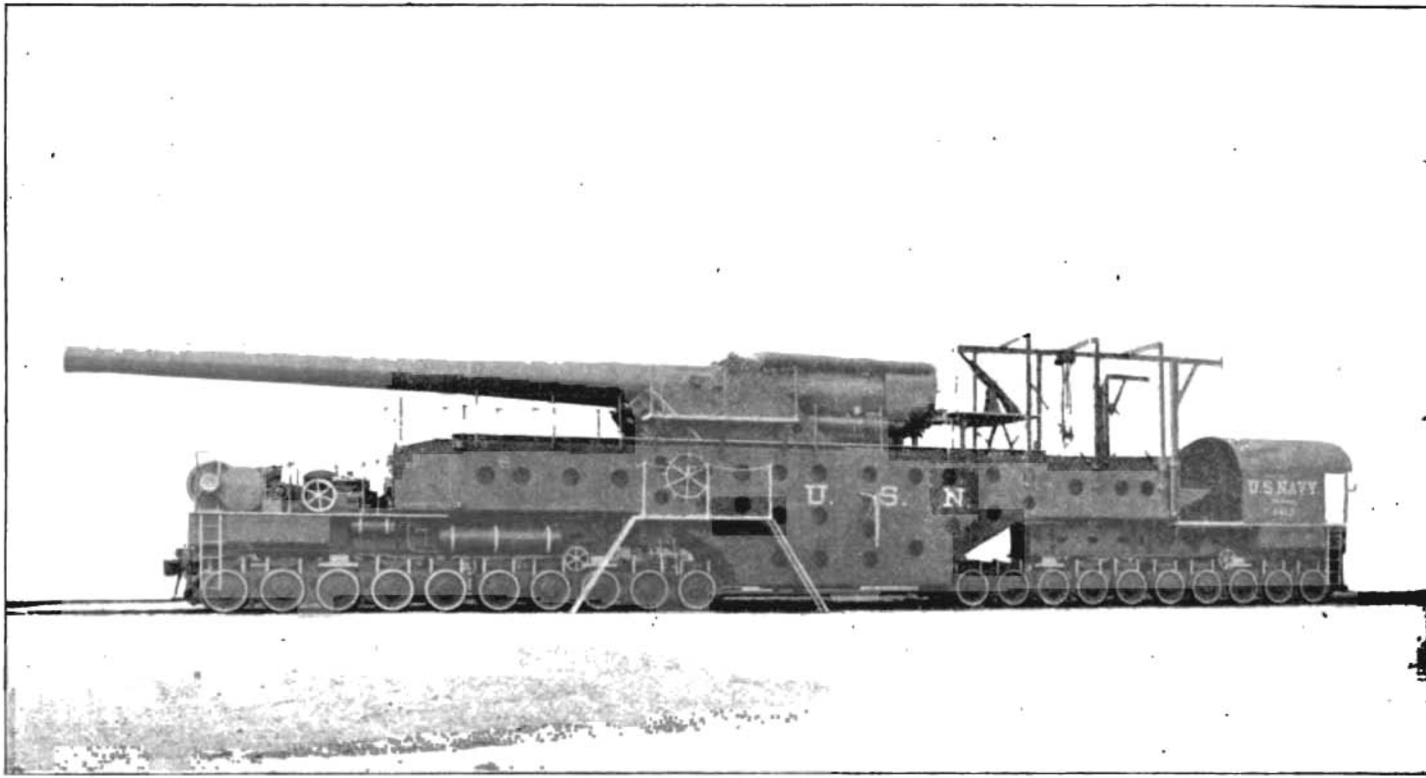
PLATE 278


14 IN. NAVY RAILWAY MOUNT-MARK II
TOTAL WEIGHT 610,000 LBS.
LOADS AT RAIL
29,000 LBS.
27,300 LBS.
29,800 LBS.
35,200 LBS.
8'-8"
21'-2"
19'-4 7/8"
52'-0"
19'-4 7/8"
90'-9 3/4"
U.S. COMPOSITE
CLEARANCE DIAGRAM

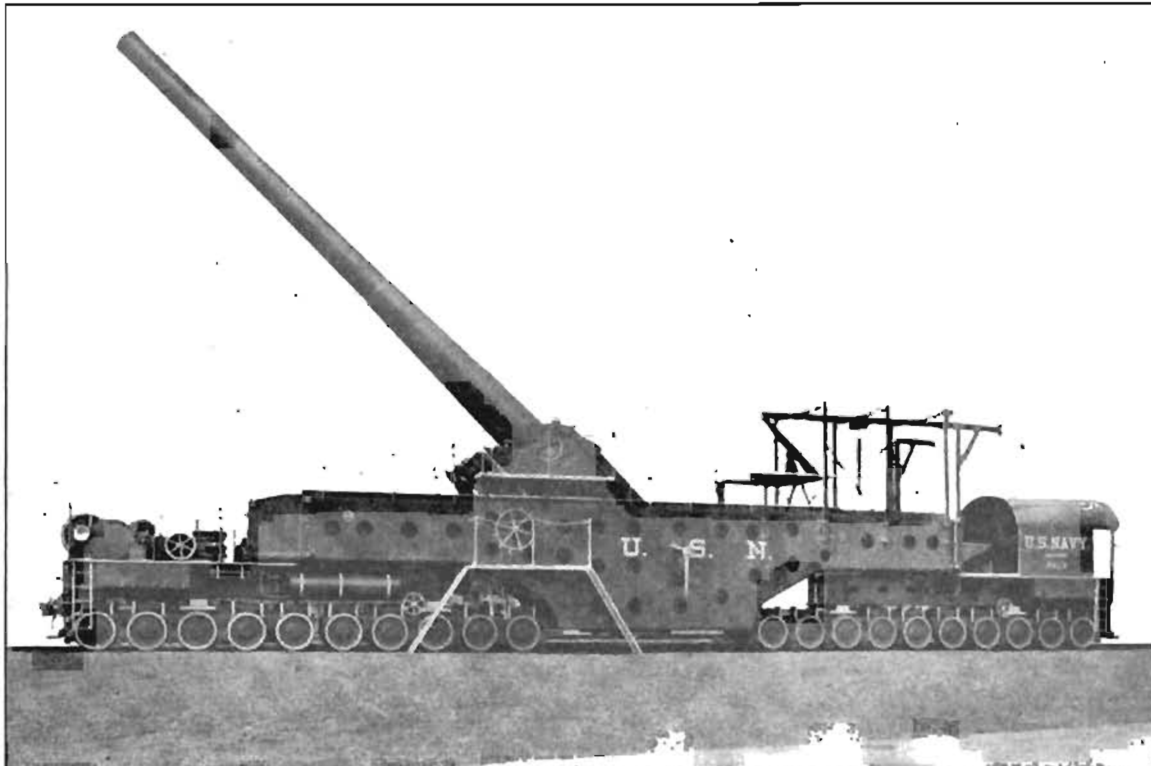


14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK II (ELEVATING CARRIAGE IN TRAVELING POSITION).

PLATE 281

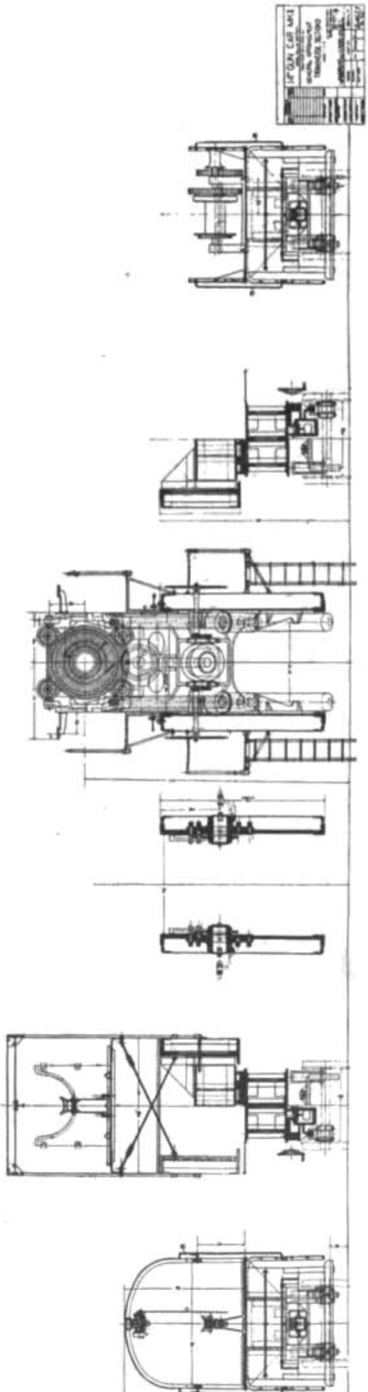


14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK II (ELEVATING CARRIAGE IN FIRING POSITION).



14-INCH, 50-CALIBER AMERICAN NAVY GUN MOUNT, MARK II (ELEVATING CARRIAGE IN FIRING POSITION, GUN AT 43° ELEVATION).

PLATE 284



12.—AMERICAN 14-INCH GUN ON SLIDING TYPE RAILWAY MOUNT, MODEL OF 1918. (25)

255. This is a mount of the sliding type. The gun is supported by means of its trunnions directly in bearings attached rigidly to the side girders of the car body. The gun and mount slide back together along the track in recoil exactly as the 10-inch and 12-inch sliding mounts. General views are given on plates 286, 287, 288, and 289. This is one of the two designs made up in France in August, September, and October, 1918, by a combined force of French and American engineers. The French Government had arranged to purchase forty-five 14-inch, 50-caliber guns from the United States; hence the decision on the part of the French and American technical services to combine on a common design of carriage. No carriages of this design have been manufactured and it is probable that none will be. The other of the two designs mentioned above is the next mount described. The essential difference between the two mounts is that on the model 1918 it was planned to use a maximum of structural steel, and on the model 1919 a maximum of steel castings. This resulted, of course, in radical differences in the details of design of many mechanisms, as will be observed in the detailed descriptions.

256. GUN.—The gun employed with this mount is the 14-inch naval rifle, Mark IV, Modification I, of 50-caliber length. It was to be fitted with a trunnion band screwed and shrunk on, plate 290, and it was intended to swing the breechblock to the side instead of down. The breech was likewise to be equipped with a counterweight, plate 291, to allow mounting the trunnions as near the breech end as possible. The breech mechanism has been described in detail under the 14-inch naval mount, Mark I.

257. RECOIL MECHANISM.—No recoil mechanism, as it is ordinarily understood, is used in this mount. When the gun is fired, the shock of recoil is transmitted by the trunnions directly into the car body and the entire mount slides back on the track, being stopped by the friction between the sleepers in the bottom of the car, and the special firing beams laid on the ties.

258. ELEVATING MECHANISM.—The gun can be elevated from 1 degree 30 minutes, the loading angle, to a maximum of 38 degrees, by a combined hand and electric power operated mechanism, the design of which is shown on plates 292 and 293. The elevating rack is bolted to the counterweight on the right-hand side, and as noted before, the gun can be elevated either by hand power through the handwheels mounted on the tops of the two side girders, or by means of the electric motor located some distance forward and between the girders. The power for operating the elevating motor was to be supplied from a gasoline-electric generator that was likewise to be

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mounted within the car body. This same generator was to furnish power for elevating the gun and for translating the mount along the track. To protect the generator from being damaged by excessive strains in firing, it was intended to mount it on a sliding base equipped with spring or hydraulic buffers. When operated by hand, one revolution of the handwheel moves the gun through 0.48 degree in elevation. The motor is 7½ horsepower and is connected with the worm shaft by means of a chain. A clutch is provided so that the handwheel does not rotate when the motor is being used. An antifriction device of the design shown on plate 294, is incorporated in the mechanism. This type of antifriction device is considered preferable to that employed on the model E and the naval mount, Mark I, in that it includes Belleville springs which are compressed on firing and permit the shock of recoil to be transmitted more directly through the trunnion bearings. It is the same in design as the mechanism used on the 12-inch, 50-caliber gun mount, plate 178, and the 16-inch howitzer mount, plate 357. Its action on the 16-inch howitzer mount has proved particularly efficient.

259. Traversing Mechanism.—Wide traverse can be secured with a mount of this type only by operating it on a curved track. The one difference between the operation of this mount and the 10-inch mount, under which the operations have been described in detail, is that the piece is both traversed and returned to the firing position by electric translating motors mounted in the extreme forward and rear trucks. This motor driven translating mechanism is shown on plate 295. The electric current is supplied from the gasoline-electric generator mounted in the car body. On this plate, it will be observed that the electric motor (20 horsepower), drives by means of a spur gear, a longitudinal shaft, which in turn drives a cross shaft by means of miter gears. This cross shaft drives by means of two sets of spur gears, two other cross shafts on the second of which are mounted three sprocket wheels. Chains connect these three sprocket wheels with other sprocket wheels on the three nearest axles. A solenoid operated clutch is provided to throw the motor out of gear in the event of an excessive overload. This translating mechanism on each truck can likewise be driven by hand by means of four handles, two on each side of the truck. Provision is made likewise for traversing the entire car body on the span bolsters in a manner similar to that employed on the 14-inch mount, model E. The details of this mechanism are shown on plates 296 to 302. A traverse of 2.5 degrees on each side of the center line is secured through the provision of a traversing table or bolster with a pivot casting rigidly bolted to it, plate 295, which at the bottom, turns in a center casting bolted rigidly to the main bolster and at the top, turns in a center casting which has guides machined on two sides, and slides in grooves

cut in a casting bolted rigidly to the car body. A nut is machined in the top of the upper center casting, in which the traversing screw turns. The ends of this screw are turned down, plain on one end and with rings at the other, plate 296, and are fitted with bearings which are a part of the casting bolted rigidly to the car body. When the car body is exactly on the center it may be locked for traveling, plate 297. On the extreme ends of the screw, are mounted sprocket wheels which are operated by chains, sprocket, pinion, and handwheels mounted on both sides of the car body, plates 298 and 299. The car body rests on the traversing table by means of two sets of rollers, plate 300, and the traversing table rests on rollers carried in the main bolster, and of a design shown on plate 302.

260. Gun Carriage.—The gun carriage is incorporated with the car body and the two are described together in the next paragraph.

261. Car Body.—The car body or main frame consists of two heavy structural steel box girders connected by deck plates and structural steel transoms. The design is shown in detail on plates 303 to 308. The cast-steel trunnion bearings equipped with antifriction devices are mounted on the tops of the side girders. The 50-kilowatt gasoline electric generator set is mounted forward between the girders, and the sleeper jacks and sleepers are assembled in the bottom of the girders.

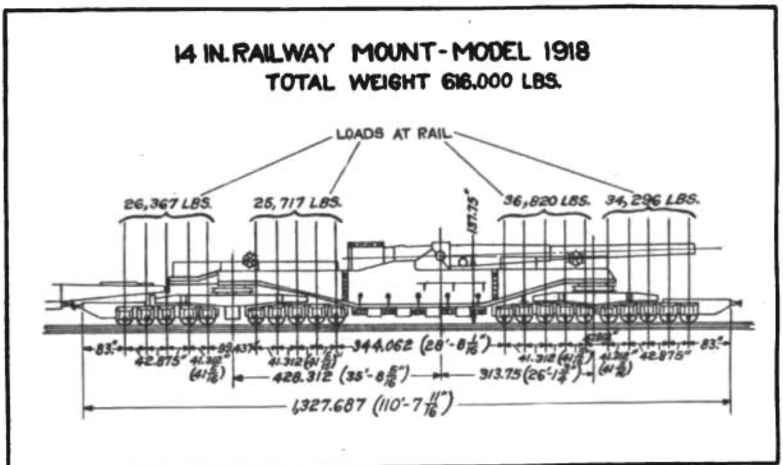
262. Anchorage.—The anchorage system is, in general, like that of the 10-inch and 12-inch mounts and the French sliding mounts. The bearing stringers on which the mount slides are 10-inch, 40-pound I beams. Eight lines of these are bolted to the ties on the inside and outside of the rails. Six sleepers, five under the main body of the mount and one under the rear span bolster, transfer the weight of the mount to the stringers and transmit the firing load. Each sleeper is made up of three heavy timbers bolted together and is supported on two jacks for vertical movement. The design of the jacks and sleepers is shown on plates 309 and 310. The sleeper under the rear span bolster is provided with steel shoes which bear directly on the rails. It is ordinarily estimated that about half of the weight of the mount is transferred to these sleepers in preparation for firing.

263. Trucks.—The trucks are special five-axle locomotive type with 6 by 11 inch inside journals and 33-inch cast steel wheels and structural steel side frames, deck plates, and transoms, plates 311 and 312. Hand and air brakes are installed on the exterior trucks, plate 313.

264. Ammunition Supply System.—Ammunition is transported from the ammunition car to the mount by means of a shuttle car, or transbordeur, of the design shown on plates 314 and 315. This transbordeur carries five full rounds of ammunition. The two ends of the top of the transbordeur are made up of hinged wings, which

are swung around and locked to the main frame in traveling. The transbordeur is equipped with an ammunition truck, which can be run forward on the forward wings by means of a hand-translating mechanism until it is under the jib crane mounted on the rear of the mount, plate 287. The projectile is transferred by this crane to another truck on the loading platform. This second truck has a tray of such length that when the truck is moved to the forward end of the loading rail and locked in place, the tray projects into the breech of the gun. The projectile is rammed by hand. Ammunition cars of the same design as those used with 8-inch guns, plate 106, but with special fixtures for this size and weight projectile, were to be used with this mount.

PLATE 285



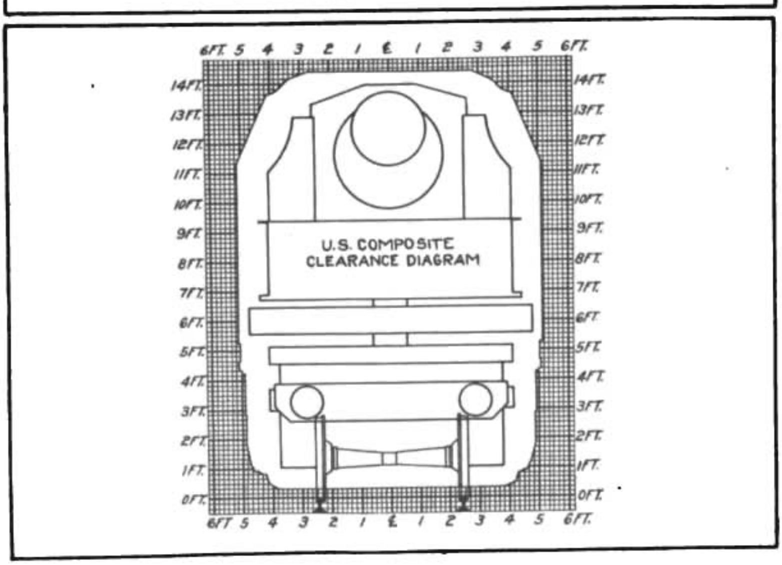


PLATE 286

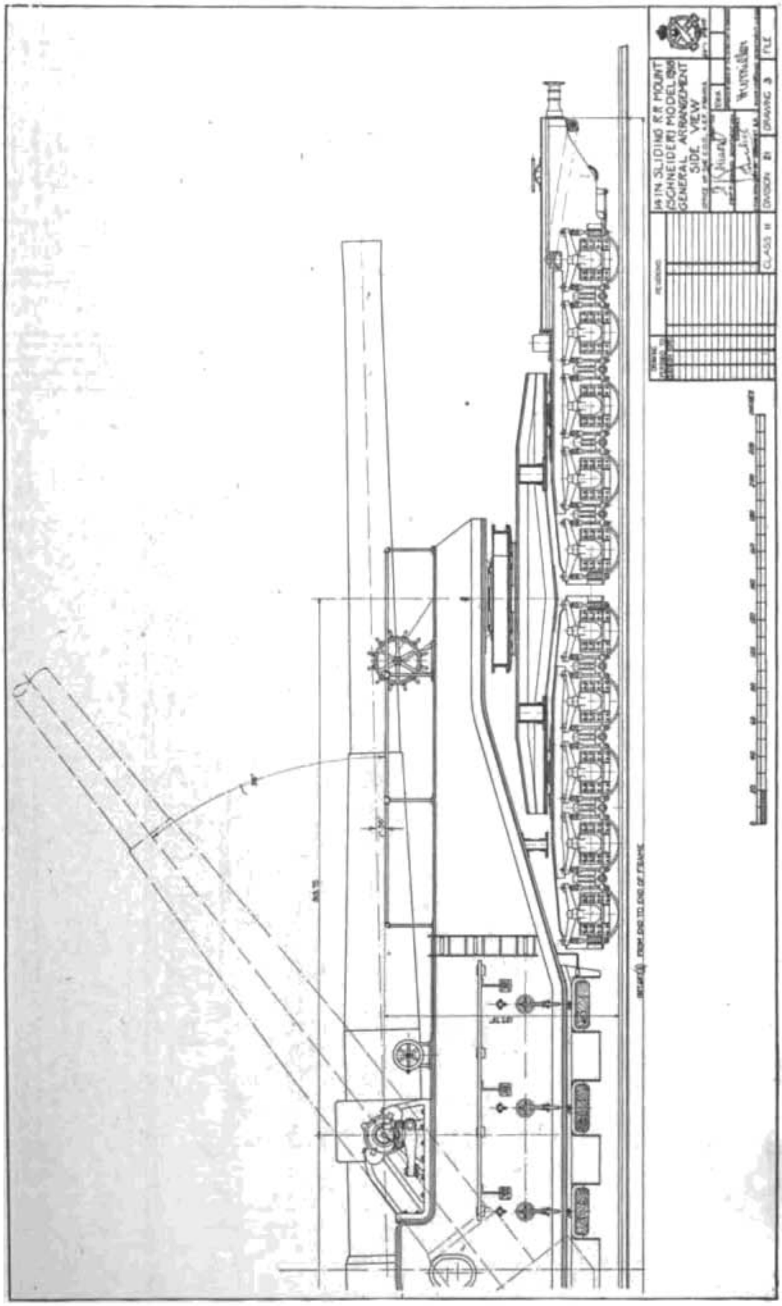

14 IN. SLIDING R.R. MOUNT
(SCHNEIDER) MODEL
GENERAL ARRANGEMENT
SIDE VIEW
CLASS II
DIVISION
DRAWING 3
FILE

PLATE 287

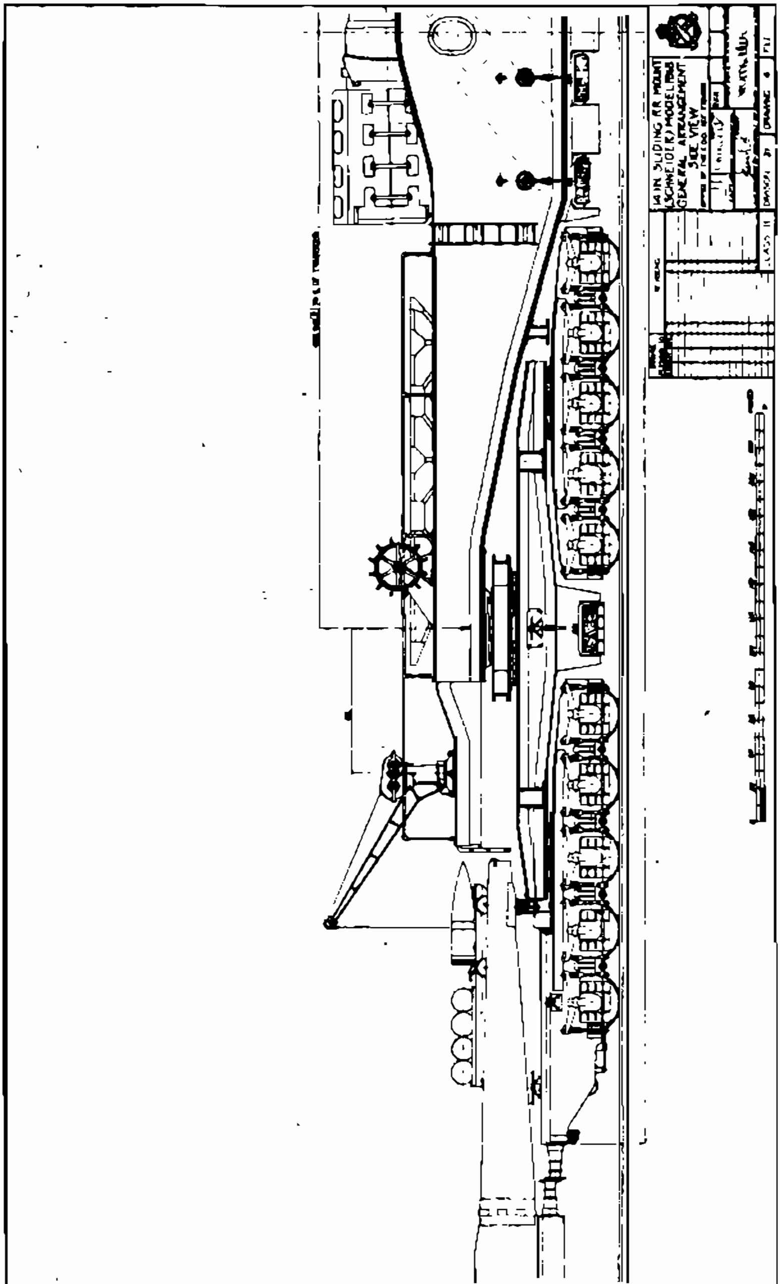

14 IN. SLIDING RR MOUNT
(SCHNEIDER) MODEL 1918
GENERAL ARRANGEMENT
SIDE VIEW

PLATE 288

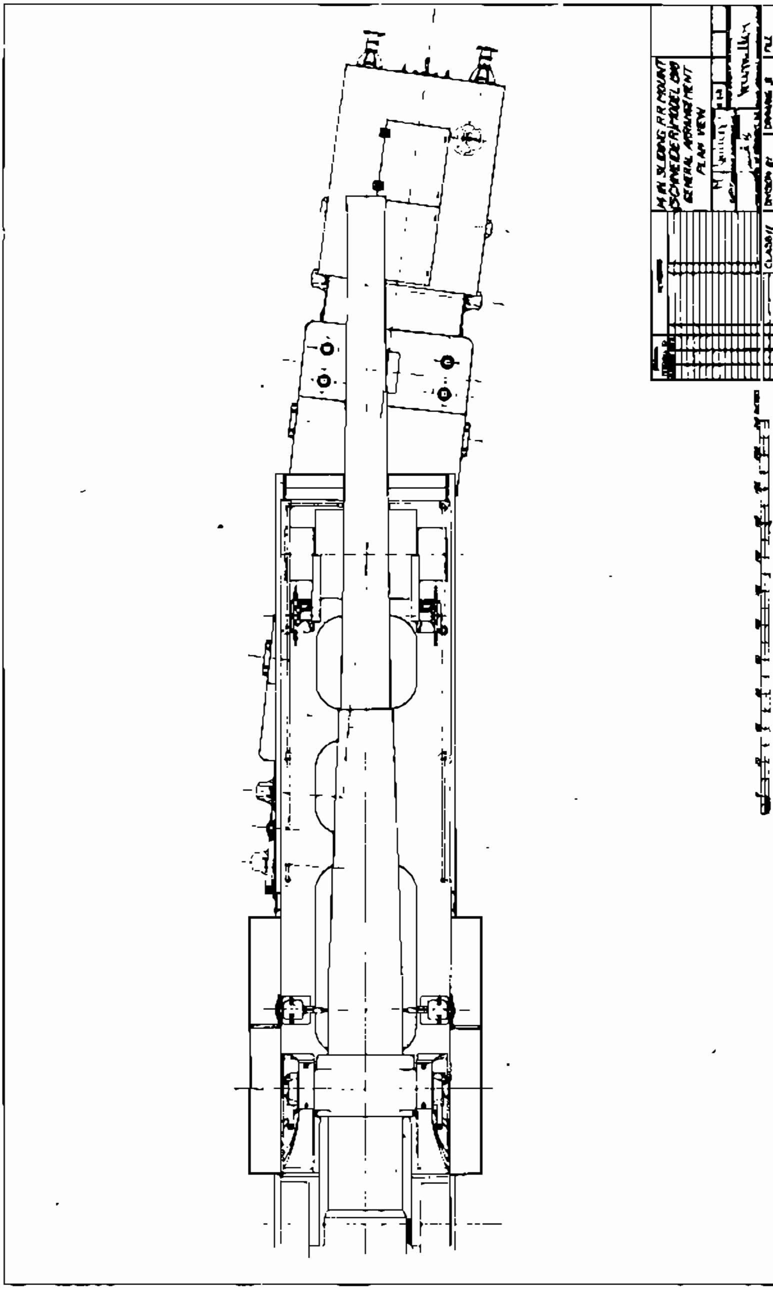


PLATE 289

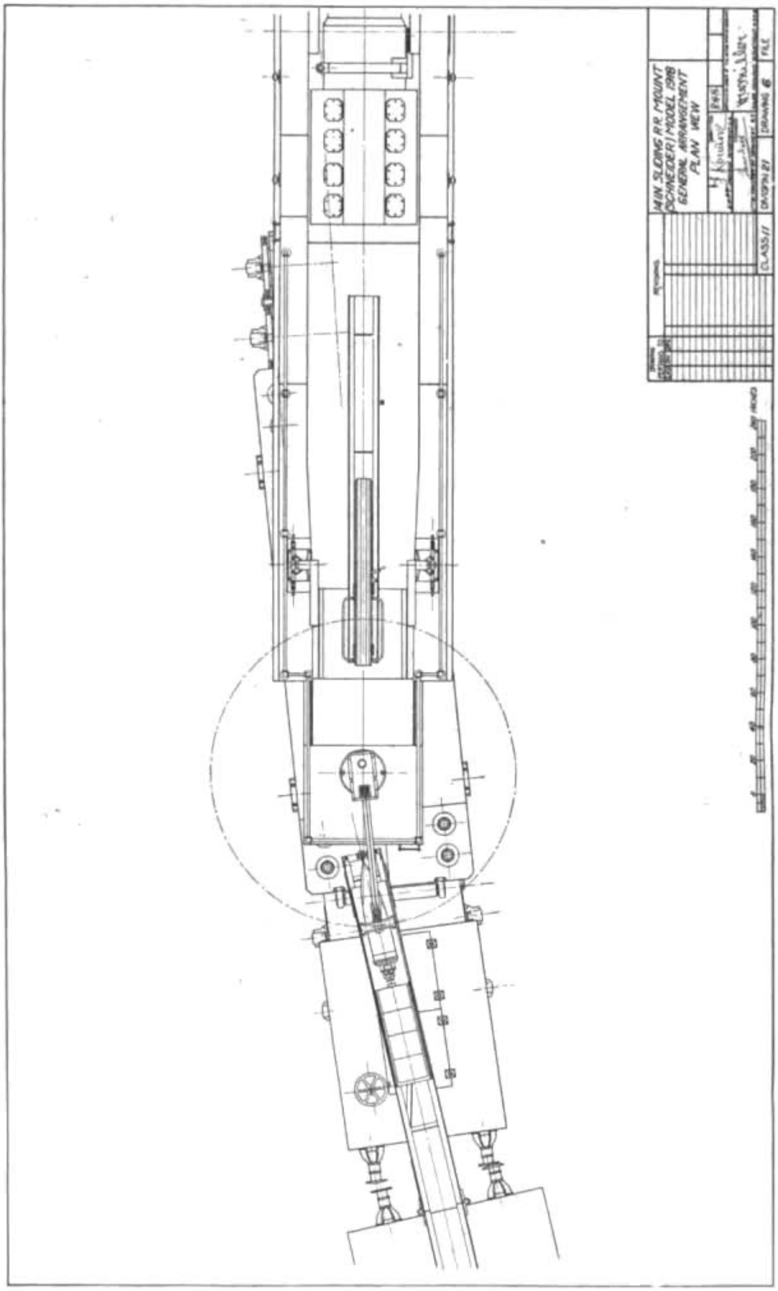

14 IN. SLIDING R.R. MOUNT
(SCHNEIDER) MODEL 1918
GENERAL ARRANGEMENT
PLAN VIEW
CLASS 11
DIVISION 21
DRAWING 6
FILE

PLATE 290

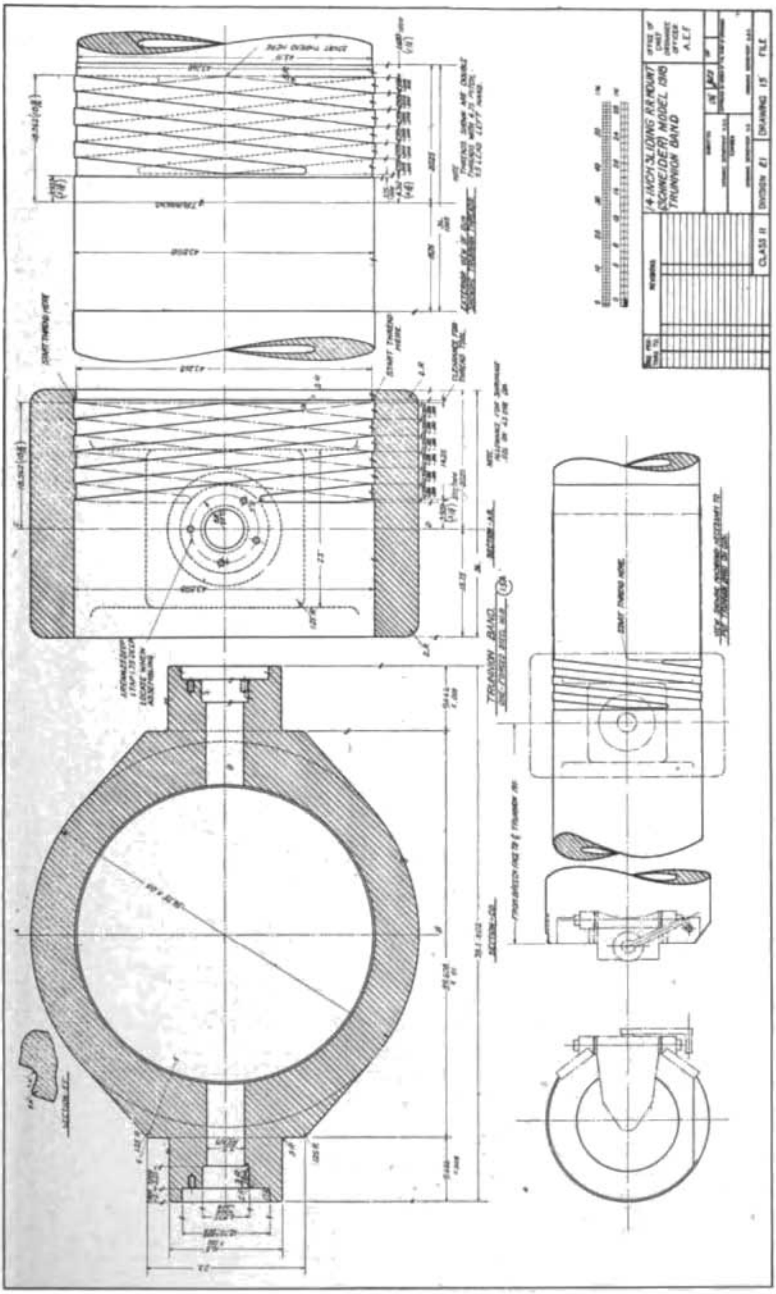

14-INCH SLIDING R.R. MOUNT (SCHNEIDER) MODEL 1918 TRUNNION BAND
TRUNNION BAND
SECTION A-A
START THREAD HERE

PLATE 291

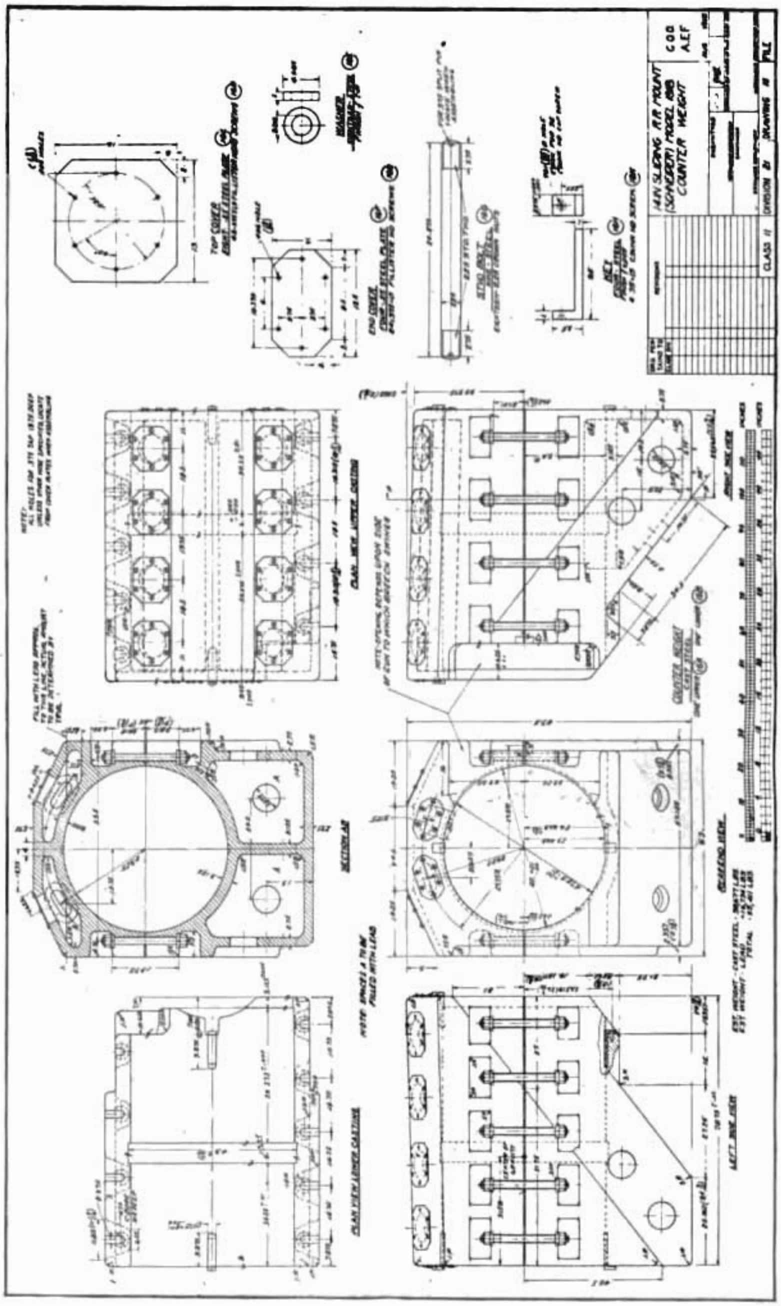

14-IN SLIDING R.R. MOUNT
(SCHNEIDER) MODEL 1918
COUNTER WEIGHT
G O G
A.E.F

PLATE 292

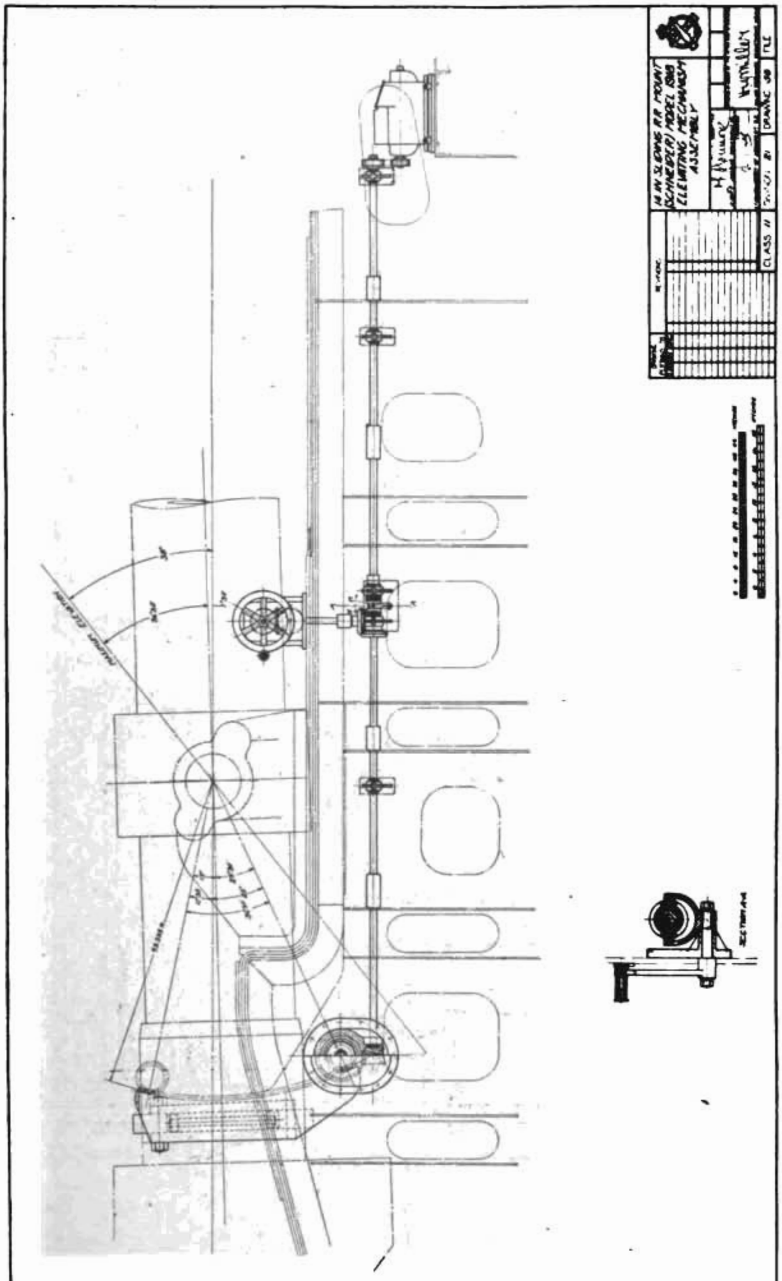

14 IN. SLIDING R.R. MOUNT
(SCHNEIDER) MODEL 1918
ELEVATING MECHANISM
ASSEMBLY
CLASS
DRAWING
FILE

PLATE 293

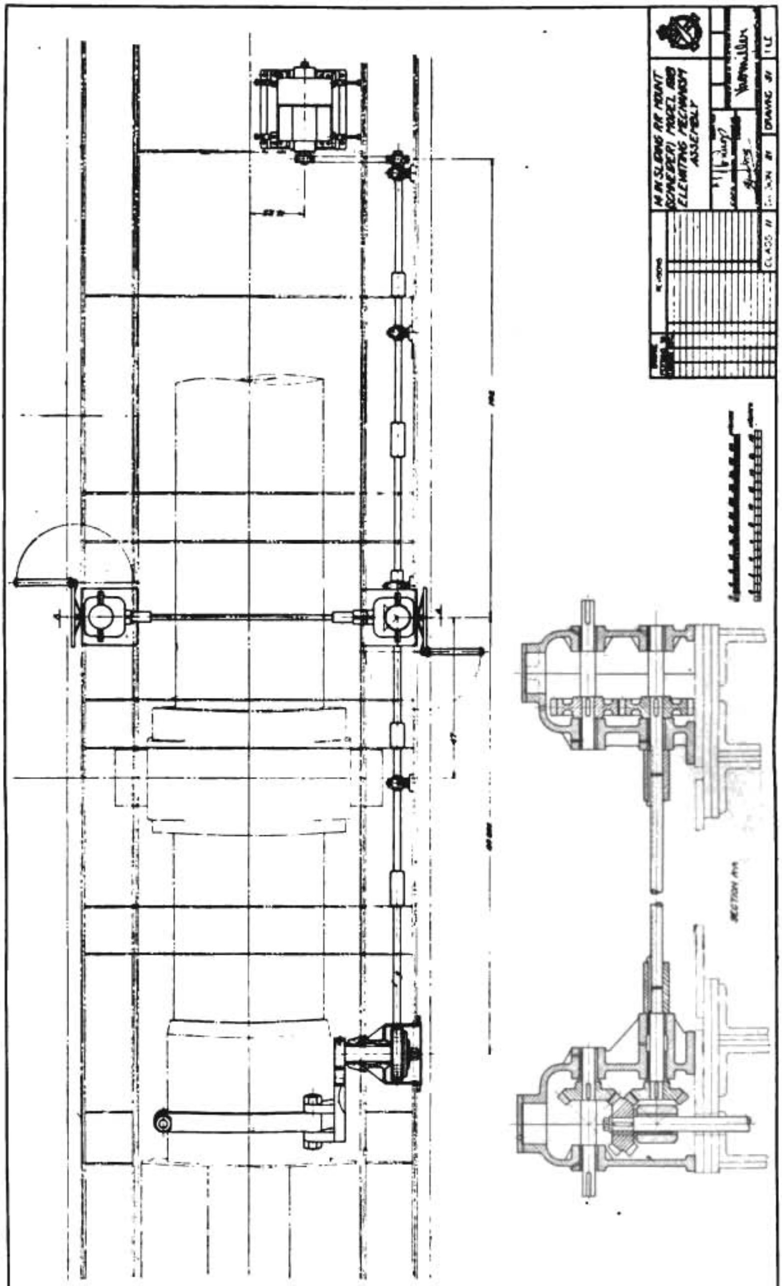
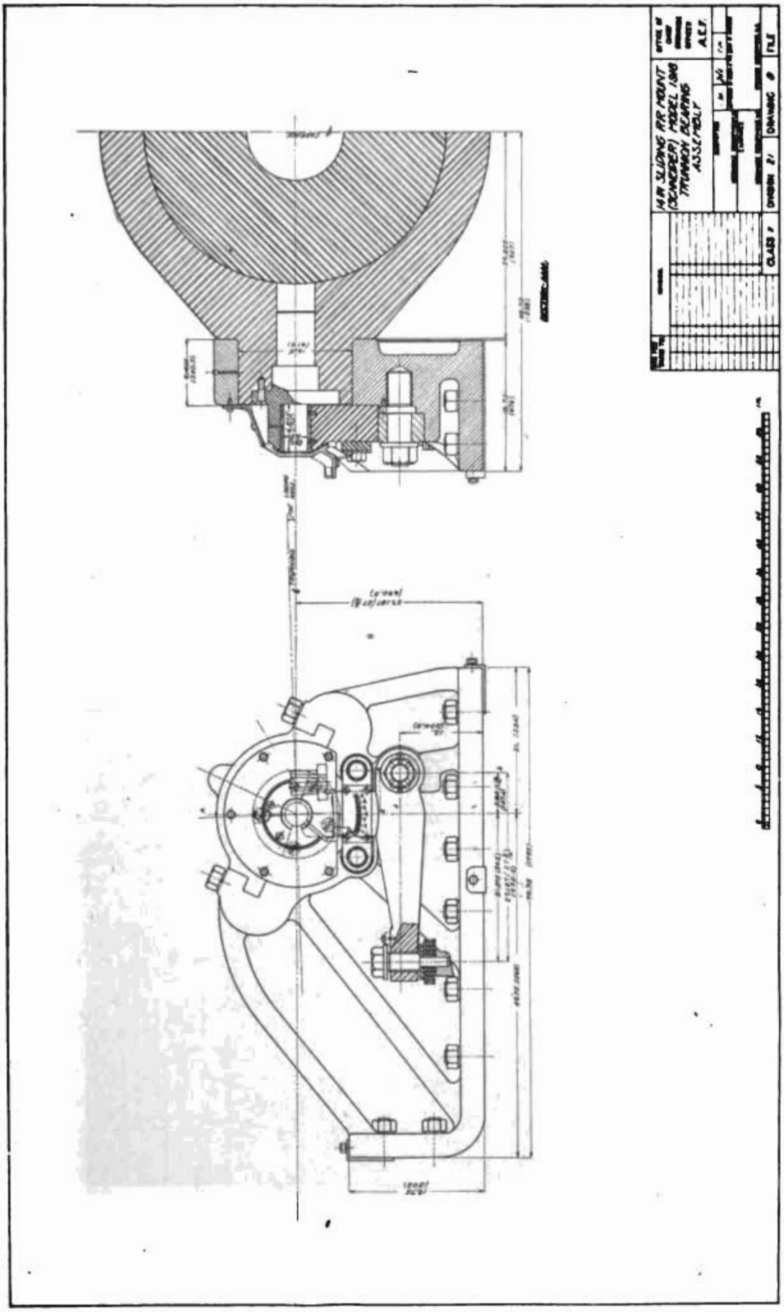
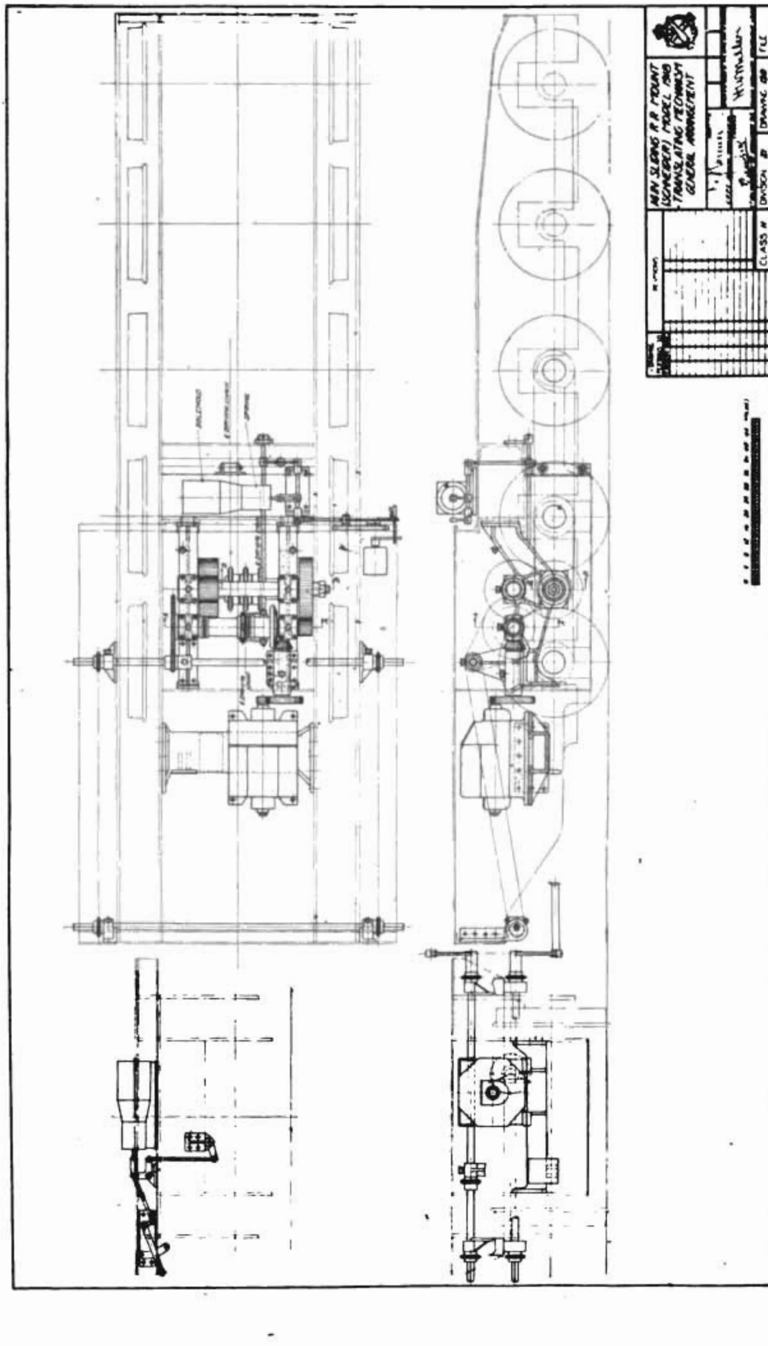


PLATE 294



4 IN SLIDING RR MOUNT (SCHNEIDER) MODEL 1918 TRUNNION BEARING ASSEMBLY

PLATE 295


MAIN SLIDING R.R. MOUNT
(SCHNEIDER) MODEL 1918
TRANSLATING MECHANISM
GENERAL ARRANGEMENT
CLASS #
DIVISION
DRAWING
FILE