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FM 4–51

WAR DEPARTMENT

COAST ARTILLERY FIELD MANUAL

—

OPERATION AND CARE OF RAILWAY ARTILLERY EQUIPMENT

May 3, 1943

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OPERATION AND CARE OF RAILWAY ARTILLERY EQUIPMENT

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OPERATION AND CARE OF RAILWAY ARTILLERY EQUIPMENT

CHAPTER 1

GENERAL

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SECTION I

MAINTENANCE RESPONSIBILITY AND STANDARDS

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■ 1. RESPONSIBILITY FOR RAILWAY EQUIPMENT MAINTENANCE.—Railway artillery trains differ from other railway trains in that the locomotives and cars are neither the property of commercial railroads nor materiel assigned for the use of military railways. The fitness of railway artillery equipment for movement is therefore a responsibility of the railway artillery commander and not of the transportation agency. Railway artillery commanders must keep their units ready for movement at all times and their materiel in acceptable running condition in accordance with commercial railway rules and military railway requirements.

■ 2. RELATION WITH OTHER ARMS AND SERVICES.—*a.* In transit, the operation and maintenance of railway artillery trains is a function of the transportation agency, whether a commercial railroad or the Military Railway Service, Transportation Corps.

b. Trackage assigned to or constructed by the Coast Artillery Corps for railway artillery use will be maintained by the Coast Artillery Corps or attached personnel. Military

railway trains will not operate on or foul tracks under Coast Artillery Corps control except by authority of the latter. Railway artillery trains will not operate on or foul tracks under military railway or commercial railroad control without the permission of the military railway or commercial railroad authorities.

c. Military railway authorities control all movements of railway artillery trains when they are operated over military railway tracks. This control includes scheduling, routing, dispatching, and the conduct of transportation. Locomotives, train crews, and locomotive crews for such operations will normally be furnished by the Military Railway Service. When the locomotive is furnished by the Coast Artillery Corps, pilots will be furnished by the railway operating battalion over whose trackage the movement is to be made.

d. Locomotives and crews may be furnished by the Military Railway Service and attached to the Coast Artillery Corps for the operation of railway artillery on tracks under Coast Artillery Corps control. The Coast Artillery Corps will be responsible for the maintenance of such equipment.

e. In time of war, repairs to the railway equipment of the Coast Artillery Corps, except the maintenance work normally classified as running repairs, will be made at military railway shops by personnel of the Military Railway Service.

■ 3. MAINTENANCE STANDARDS.—*a.* Appendix III gives the distribution of the maintenance standards referred to in this paragraph. The method to be followed in obtaining additional copies is also explained in appendix III.

b. The current "Code of Rules" of the Association of American Railroads, governing the condition of and repairs to freight cars for the interchange of traffic, is the standard to which railway artillery cars will be maintained.

c. Safety appliances will be maintained in accordance with the United States Safety Appliance Standards as set forth by the Interstate Commerce Commission.

d. Diesel-electric locomotives will be maintained in accordance with the Interstate Commerce Commission's laws,

rules, and instructions for the inspection and testing of locomotives other than steam.

e. In time of war, arbitrary maintenance standards and safety rules may become secondary to military necessity and the successful performance of a mission.

SECTION II

DESTRUCTION OF MATERIEL

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General principles 4
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Rolling stock 6

■ 4. GENERAL PRINCIPLES.—*a.* Tactical situations may arise when, due to limitations of time or transportation, it will become impossible to evacuate all equipment. In such situations it is imperative that all materiel which cannot be evacuated be destroyed to prevent:

(1) Its capture intact by the enemy.

(2) Its use by the enemy, if captured, against our own or allied troops.

b. The working principles to be followed are:

(1) Methods for the destruction of materiel subject to capture or abandonment in the combat zone must be adequate, uniform, and easily followed in the field.

(2) The destruction accomplished must be as complete as the available time, equipment, and personnel will permit. If thorough destruction of all parts cannot be completed, at least the most important features of the materiel should be destroyed and parts essential to the operation or use of the materiel ruined or removed. *The same essential parts must be destroyed on all like units to prevent the enemy's constructing one complete unit out of several damaged ones.*

(3) The destruction of materiel, subject to capture or abandonment in the combat zone, will *be undertaken only when in the judgment of the harbor defense or higher commander such action is necessary.*

c. To accomplish adequate and uniform destruction of materiel, it is essential that:

(1) All echelons prepare plans for the destruction of materiel in the event of imminent capture. Such plans must be flexible enough to meet the situation as to the available time, equipment, and personnel.

(2) All echelons be trained to effect the desired destruction of materiel issued to them. *Training will not, however, involve the actual destruction of any item of materiel.*

d. Certain of the methods outlined require special tools and materials, such as TNT, which may not be items of issue normally. The issue of such special tools and materials, the vehicles for which issued, and the conditions under which destruction will be effected are *command decisions in each case, according to the tactical situation.*

■ 5. RAILWAY TRACKS.—*a.* The most vulnerable points of attack are switch points, frogs, crossings, and curves as they are the most difficult to replace.

b. Without explosives, railway tracks may be temporarily disabled by distributing men along a section of the line and overturning it, preferably at an embankment, or fill; or the joint bars may be removed at one end, a heavy chain fastened to the track, and the entire track pulled up with a locomotive. The ties may then be loosened from the rails, piled, and burned. The rails may be thrown on the fire and twisted while hot.

c. (1) With explosives, railway tracks may be demolished by placing explosives at switch points and frogs. One or two blocks of TNT, tamped with loose earth or sandbags, will break railroad rail. If two charges are used to cut a section of rail, they should be placed on opposite sides at a distance of about 2 feet from each other to produce a shearing effect.

(2) A considerable extent of track may be demolished in a short time by employing a squad of eight men and a push car loaded with explosives, caps, fuze, and wire. The car is pushed by two men while two men prepare the charges and primers, and hand them, together with the necessary wire

and wedges to two men walking beside the car who properly place, bind, and tamp them. Two men follow at a distance of 250 yards to detonate the charges.

■ 6. ROLLING STOCK.—*a. General.*—(1) To demolish rolling stock, the same parts on all locomotives and cars should be destroyed so that parts may not be interchanged. To accomplish this task thoroughly it is advisable to detail men to destroy definite parts.

(2) The truck is the critical part of a car or locomotive. Demolition of the trucks will effectively prevent the movement of rolling stock. If the trucks function properly, the car or locomotive can be moved even though other car and locomotive parts, such as superstructure, couplers, and air brakes, are destroyed.

b. Cars.—(1) The parts contained in the journal boxes of the car truck are the most important to attack in the demolition of railway cars. Only one journal box and the parts contained therein need be destroyed for each pair of wheels as the wheels are pressed on the axle and must rotate together. The journal box and journal-box parts may be destroyed by:

(*a*) Explosives placed inside plain journal box and detonated. Journal-box packing should be removed before explosives are placed in the box. The machined surface of the axle journal may be mutilated or defaced by a sledge or track chisel. The journal bearing and journal-bearing wedge should be broken with a sledge.

(*b*) Explosives placed inside or on the outside of roller-bearing journal boxes and detonated.

(2) The coupler knuckle pins may be removed and the knuckles thrown away. The lack of coupler knuckles will prevent coupling of cars together except by the use of chains.

(3) The triple or AB valve may be broken by a sledge. The destruction of this valve will render the air brakes useless.

(4) The air brake hoses at the ends of each car should be cut off.

(5) Wooden parts of railway cars may be saturated with gasoline and burned.

(6) If motive power is available, the railway cars should be derailed before car parts are destroyed by:

(*a*) Running them through a switch with the switch points open.

(*b*) Running them off the ends of spur tracks.

(*c*) Removing a rail and running the cars off the track.

(*d*) Disconnecting the rail at a rail joint, spreading the rail, and running the cars off the track.

(*e*) If possible, cars should be derailed down an embankment.

c. Locomotive.—(1) The Diesel-electric locomotive may be demolished by explosives placed:

(*a*) In the journal boxes.

(*b*) At the main generator.

(*c*) At the electrical control panel.

(*d*) At each traction motor.

(2) The locomotive may be made unserviceable by destroying certain auxiliary parts such as the electrical controls and the fuel injection nozzles with a sledge.

d. Guns.—See appropriate service of the piece manual. Destruction of the guns will have priority over the destruction of other railway artillery equipment.

CHAPTER 2

TRACK CONSTRUCTION

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■ 7. GENERAL.—Railway artillery tracks may be tracks in harbor defenses, tracks in coastal sectors outside of harbor defenses, or, in land warfare, those of military railways in the theater of operations. To avoid interference with train movement over existing tracks and to permit movement into areas from which the railway artillery can perform its mission, it is normally required to build tracks for the specific use of the railway artillery. This trackage may include approach tracks, firing spurs, and tracks for the parking of fire-control and rear echelon cars.

■ 8. REFERENCES.—This chapter includes only the basic principles of railway track construction. For a more detailed discussion of track construction reference is made to FM 5-10, Engineer Field Manual, *Communications, Construction, and Utilities;* and the Maintenance of Way Manual of the Military Railway Service, Transportation Corps, and other publications listed in appendix III.

■ 9. RAILWAY TRACK.—*a.* Railway track comprises two parallel lines of steel rails fastened to transverse ties of wood or metal with the necessary fastenings. It is laid on a prepared roadbed, with or without ballast, or carried on bridges. It should be maintained in proper alinement, gage, and surface.

b. Railway track has two functions. It provides a structure for the support of rolling loads on flanged wheels, and it acts as a path or channel for the circulation of railway traffic.

c. Railway tracks consist of main tracks and side tracks (fig. 1). The latter, if connected to the main track at both ends, are called passing tracks. If side tracks are connected to the main track at only one end, they are called spur tracks. A series of side tracks with their necessary connections is called a yard. The track connecting a yard or a series of spur tracks with the main track is referred to as the lead track. Tracks are laid as a succession of straight sections called tangents, connected by curves. Tracks are connected to each other by turnouts or cross-overs.

d. Railway track is subjected to vertical stresses due to the wheel loads and dynamic forces set up by unbalanced rotating parts, and to horizontal stresses due to wheel flange pressures. These stresses are increased by irregularities of line, gage, surface, and the impacts due to train speeds.

■ 10. GAGE.—The gage of a track is the distance between the inside faces of the two rails and is measured at a point

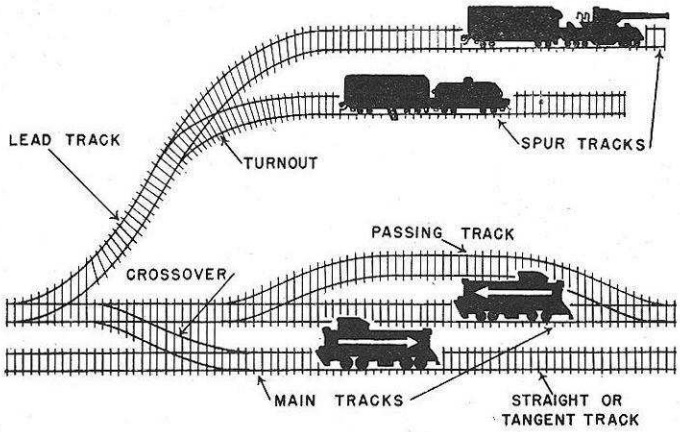
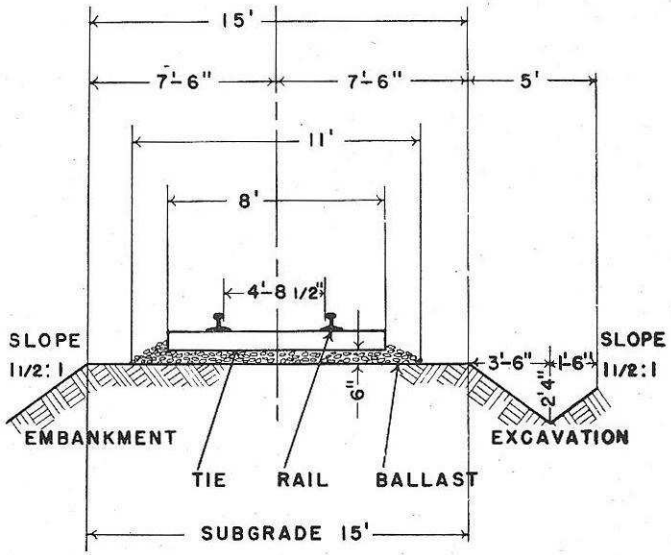
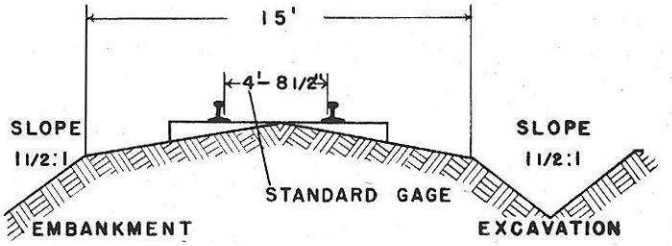


FIGURE 1.—Types of railway track.



BALLASTED TRACK



TRACK NOT BALLASTED

FIGURE 2.—Cross-section of railway track.

⅝ inch below the top of the rails (see figs. 2 and 3). The standard gage of track in the United States is 4 feet 8½ inches. The track gages adopted by various countries are listed in appendix II.

■ 11. ROADBED.—*a.* The roadbed is the support prepared for the tracks. It generally consists of the subgrade and the ballast with dimensions approximately as shown in fig. 2. The ballast affords drainage and distributes the load over the subgrade. Gravel, crushed rock, slag, cinders, and similar hard material, if available in large quantities, may be

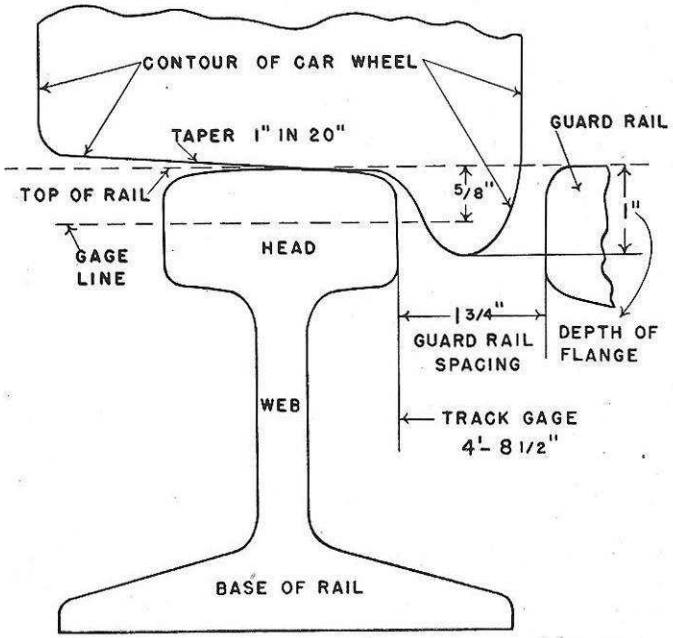


FIGURE 3.—Wheel-rail relation.

used for ballast. If the subgrade is of such material that drainage is obtained, or if rains are extremely unlikely during the period the track is to be used, ballast is unnecessary.

b. The roadbed at railway artillery gun positions must be level in order that gun mounts may be emplaced and leveled without delay. At the gun positions, ballast should be used to provide a foundation that will absorb the energy of recoil without permitting movement of the track structure.

■ 12. TIES.—*a.* Ties are simple wooden beams of rectangular section from 6 inches thick by 8 inches wide to 7 inches thick by 10 inches wide. Cross ties are usually 8 feet to 8 feet 6 inches long. The functions of cross ties are to bind the rails together, to hold them to gage, and to distribute the loads to the subgrade or ballast. Switch ties vary from 9 feet to 16 feet in length. The essential purpose of switch ties is to avoid overlapping the ends of the cross ties which would interfere with proper tamping. Switch ties are normally used throughout the length of cross-overs, under most crossings, and in turnouts.

b. Almost any available wood will serve as ties if sawed to the approximate dimensions indicated in *a* above. Hewed ties should have the same cross sectional area as sawed ties and faces not less than 6 inches wide.

c. The number of ties per mile of railway artillery track will average approximately 2,800. Normally, spacing between ties should not be less than 12 inches, to permit easy tamping.

■ 13. RAIL.—That portion of the heads of standard American rails, which is in contact with the wheel, has the same general contour (see fig. 3), irrespective of weight, height, and width of the rail. Most rail is cut in lengths of either 33 or 39 feet. Rail is designated by its weight in pounds per yard of length. On military railways, rail will weigh from 65 to 85 pounds per yard, the latter weight being the standard. The main lines of commercial railroads use rail weighing from 90 to 152 pounds per yard.

■ 14. RAIL FASTENINGS.—*a. Rail joint.*—(1) A rail joint (fig. 4) is the fastening designed to unite the ends of adjoining rails. The fastening is usually a steel angle bar which is called a joint or splice bar. Joint bars are used in pairs, one on each side of the rail. They are designed to fit closely the space between the head and base of the rail. Joint bars are held in position by track bolts that extend through the bars and the web of the rail.

(2) To allow for the expansion and contraction of rails with changes in temperature, an opening is left between the ends of rails when the track is built. The allowance to be made depends upon the temperature at the time the track is laid as given in the table in appendix II.

b. Tie plate.—(1) The tie plate is a metal plate used between the rail and the tie (fig. 5) for the primary purpose of protecting the tie from the cutting action of the rail. In

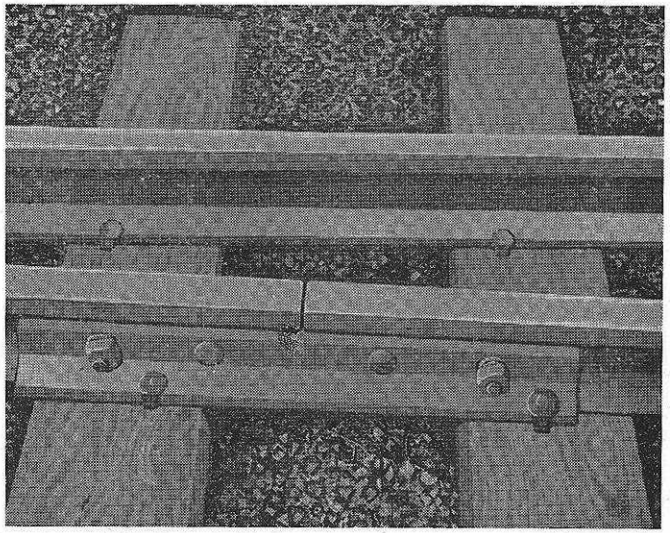


FIGURE 4.—Rail joint.

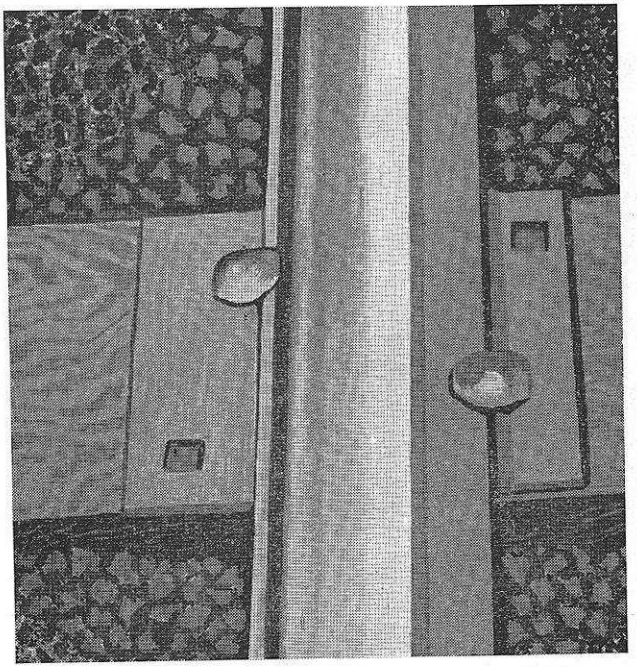


FIGURE 5.—Tie plate installed between rail and tie.

addition, the tie plate is provided with at least one shoulder to hold the rail rigidly to gage, and is punched with suitable holes for the track spikes.

(2) Tie plates are not essential to the construction of railway artillery tracks. If available, tie plates should be used with preference being given to locations at the sharpest curves.

c. Track spike.—(1) The ordinary track spike is made with a 9/16-inch or ⅝-inch square cross section and tapered to a chisel point. It has an eccentric head that is designed to clamp the rail when the spike has been driven into the tie and against the base of the rail.

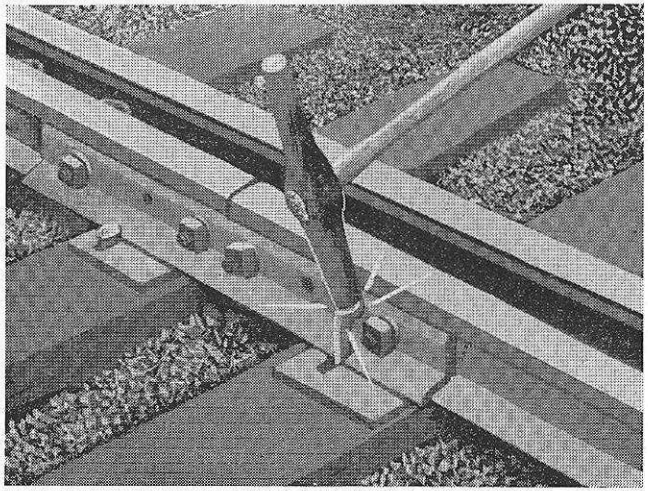


FIGURE 6.—Driving track spike.

(2) Track spikes should be driven vertically (fig. 6) into the ties. Four spikes are ordinarily driven into each tie with the outside spikes set ahead of the inside spikes to prevent slewing of the tie. On curves and at turnouts the outside edge of the outer rail is frequently double-spiked to hold the rail to gage. When a spike is being driven, the tie should be held up against the rail base to produce a solid bearing.

■ 15. CURVES.—*a. General.*—Railway curves are usually arcs of a circle. They may be either simple, compound, or reverse. A simple curve is a curve with a constant radius. A compound curve is one composed of two or more simple curves of different radii, curving in the same direction and having a common tangent at their point of meeting. A reverse curve is composed of two simple curves, curving in opposite directions and having a common tangent at their point of meeting.

b. Designation of curves.—(1) In the United States it is customary to express track curvature by the number of degrees of central angle subtended by a chord 100 feet in length. One degree of curvature is equal to a radius of 5,730 feet. Therefore, the curvature in degrees divided into 5,730 gives the approximate radius in feet, and conversely, the radius in feet divided into 5,730 gives the approximate number of degrees of curvature. For example, an 8-degree curve has a radius of $\frac{5,730}{8} = 716.25$ feet, and a curve with a radius of 382 feet has a curvature of $\frac{5,730}{382} = 15$ degrees.

(2) It is frequently desirable to determine the curvature of existing track. A rule which gives results close enough for practical purposes is to take a string 62 feet long with a knot in its exact center, and stretch the string along the inside of the curve with the ends against the head of the rail as shown in fig. 7. The middle ordinate of the curve, or the distance from the knot to the rail, measured in inches, equals the degree of curvature. If the distance is 10 inches, the curvature is 10 degrees.

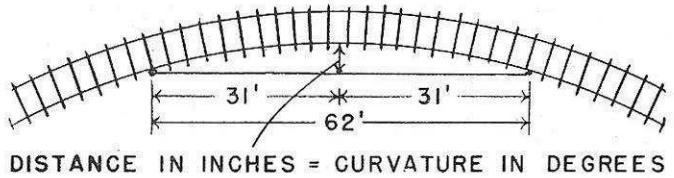


FIGURE 7.—Determining track curvature.

■ 16. TURNOUTS.—*a. General.*—A turnout (fig. 8) is an assemblage of ties, rails, frog, switch, switch stand, and guard rails, with their fastenings and connections, arranged to permit the passage of locomotives and cars from one track to another track, as from a main track to a siding. Two turnouts connected together to afford passage between two continuous and generally parallel tracks make up a crossover.

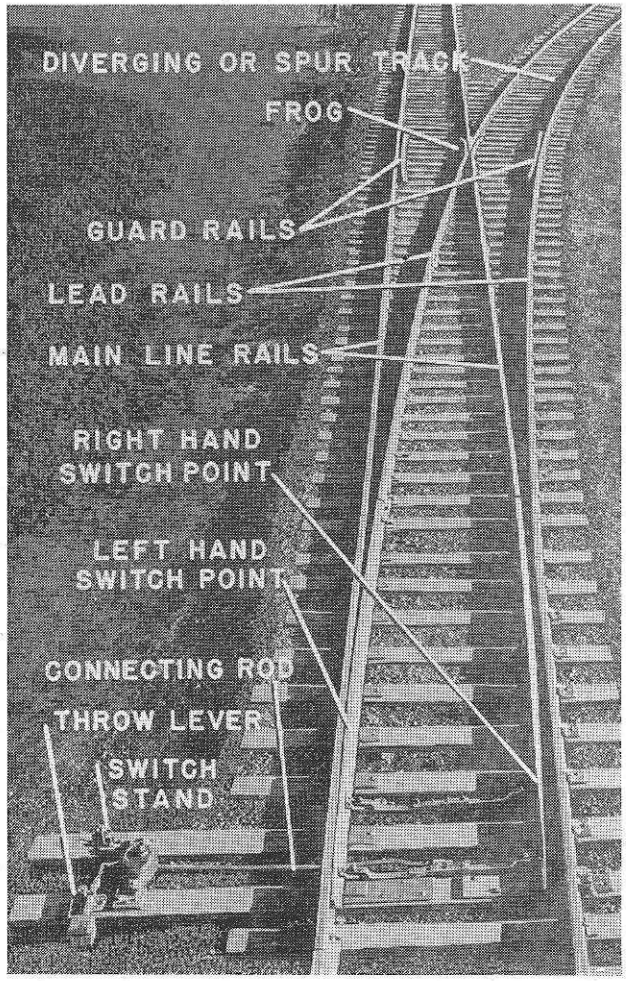


FIGURE 8.—Track turnout.

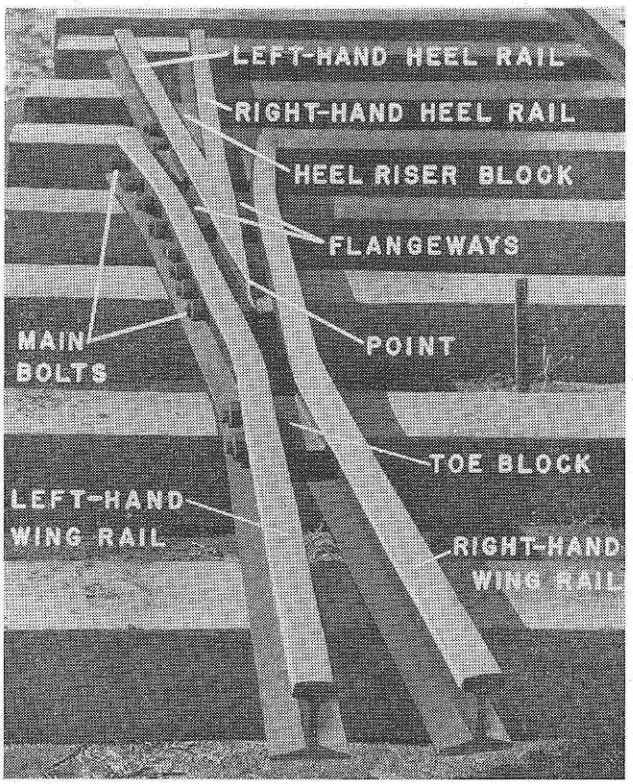


FIGURE 9.—Principal parts of a track frog.

b. Switch.—The switch is a pair of movable rails, each planed to a long tapering point with one side of the railhead shaped approximately to the contour of a standard rail's running surface and the other side planed *to fit* against the running side of a standard rail. Switch points are designated right-hand or left-hand and one of each is required for a switch. A right-hand switch point is the one on the right as viewed from the point of switch and looking toward the frog.

Switch points are connected together by rods securing them at the proper spacing. The head rod is connected by a throw rod to the switch stand by means of which the switch is thrown from one position to the other to guide the wheel flanges to either one of two tracks as desired.

c. Frog.—(1) It is evident that at a turnout, one rail of the turnout track must cross one rail of the main track. As the flanges of the wheels extend below the top of the rail, an opening must be made through the heads of both the main track rail and the turnout rail where they cross, to permit the wheel flanges to pass along either track. The device used to permit the wheel flanges to pass the point at which two rails cross is called a frog (fig. 9). As the treads of the wheels are wider than the railheads, the wing rails of the frog help to carry the weight of each passing wheel over the gap made by the flangeways, until it is picked up by the rails forming the point structure. The wing rails also serve to guide the wheel flanges through the flangeways of the frog.

(2) The angle formed at the point of the frog by the main and turnout rails is called the frog angle. It may be expressed in degrees, but it is generally expressed as the ratio of length to spread. For example, if the main and turnout rails spread apart at the rate of 1 inch for every 8 inches of frog length, the frog is said to have a spread of 1 to 8 and is called a No. 8 frog.

d. Guard rails.—Guard rails are short lengths of rail with the ends bent toward the center of the track. They are located parallel to the main and turnout rails opposite the frog. By means of the pressure of the outer side of its head against the back of the wheel flanges, the guard rail acts to prevent the flanges of the opposite wheels from taking the wrong side of the frog point. Guard rails are sometimes used along the inner rail on sharp curves to prevent the wheel flanges from climbing the outer rail. They may also be employed on bridges to hold the train on the bridge in case of derailment.

■ 17. TURNOUT CONSTRUCTION.—*a. Curvature.*—When a switch is on the inside of a curve, the degree of curvature of the switch is approximately its normal degree plus the degree

of curvature of the main line; if outside, the degree of curvature of the switch is the difference of these two. Thus, if a No. 8 frog, calling for a curve of 11°47′, is installed on the inside of a 6°0′ curve, the curvature through the turnout would be 11°47′ + 6° = 17°47′. Safety against derailment and economy in maintenance require that switches be located so that the curvature of the turnout will not be in excess of 20°. Switches should always be located on tangents, if possible, to simplify switch layouts.

b. Location of switch point.—After the location and number of the frog have been determined, a stake in the center of the track or mark on the rail should be placed to locate the point of frog. The lead distance is measured from this point to determine the location of the switch point. The lead distance and turnout data are given in appendix II.

c. Rail cutting.—Measurements should be taken to determine the number and length of the rails to be cut. Joints must not fall in the continuous rails between the point and heel of the switch points or between the ends of the guard rails. Rail cuts should be made before commencing to install the switch. The method of cutting rails in the field is described in FM 5-10.

d. Subsequent procedure.—(1) Pull all spikes from every other cross tie throughout the length to be occupied by switch ties, and remove the ballast from around these unspiked cross ties. If switch ties are not available, no cross ties are removed, but additional cross ties are interlaced with the existing cross ties.

(2) Set track jacks under the rail and loosen the track by jacking it up very slightly.

(3) Withdraw the loose ties and substitute switch ties of the proper lengths.

(4) Remove the remainder of the cross ties and substitute switch ties in a similar manner.

(5) Set the frog. This consists of taking out the rail where the frog is to be located, setting the frog into place, spiking it up to gage, making the connection with the proper

length of cut rail, and installing a guard rail opposite the frog.

(6) Assemble the inside lead rail, join it to the frog and the switch point, and spike it up so as to allow 6¼ inches' clearance between the heads of the rail at the heel of the switch, leaving the rail to be shifted back and forth between the heel of the switch and the frog.

(7) Aline the lead rail by eye and spike it.

(8) Unspike and line out the main line rail on the turnout side.

(9) Fit the slide plates beneath it and place the switch point against it. When the main line rail (stock rail) is alined to the proper point, the gage will fit from the opposite main line rail to the gage line of the switch point. Both the switch point and the stock rail should then be spiked, and the rail bender should be applied so as to produce a slight kink in the stock rail 8¼ inches ahead of the switch point. The switch point will then fit against the stock rail without creating a line kink.

(10) Lay the outside lead rail to connect with the stock rail at the proper gage distance from the inside lead rail.

(11) Install the guard rail opposite the frog on the outside lead rail. It is important that the gage fit exactly from the point of frog to the outside lead rail, and that the guard rail provide a flangeway of 1¾ inches.

e. Installation of switch points and switch stands.—The main line side switch point may now be installed, the head and back rods applied, switch stand set up on the turnout side of the main line, and the connecting rod installed. It will always be necessary to adjust the head and back rods in such a manner that each switch point will fit snugly when thrown against the stock rails.

■ 18. TEMPORARY TURNOUTS.—*a.* Temporary turnouts may be installed by railway artillery units when speed of construction is essential, when the turnouts will only be used a few times, or when switches and frogs are not available.

b. Figure 10 shows one method of making a temporary turnout using lead rails that are spiked in position, and a

short section of rail that is used in place of a frog. The rail joints in the main line at the point of turnout must be directly opposite each other. To change the movement of trains from the main line to the diverging track requires

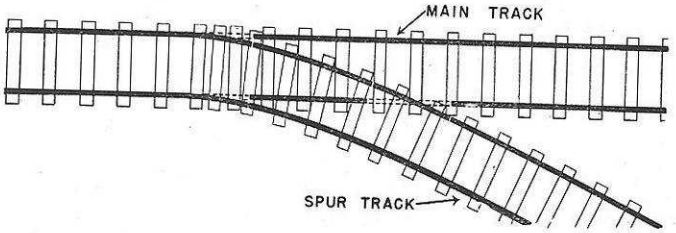


FIGURE 10.—Temporary turnout made without shifting ties.

only that the main line track joints be disconnected, a few spikes pulled from the main line rails so that the rails may be joined to the turnout leads, and the short section of rail connected to the inside lead rail.

c. Figure 11 shows a method of making a temporary turnout by lining over a short section of the main line track to connect with the diverging track. All the ties may be moved with the rails or half of the ties may be unspiked and left undisturbed. The main line track may be moved over by several men using lining bars, or may be dragged into position by the use of a tractor or motor vehicle.

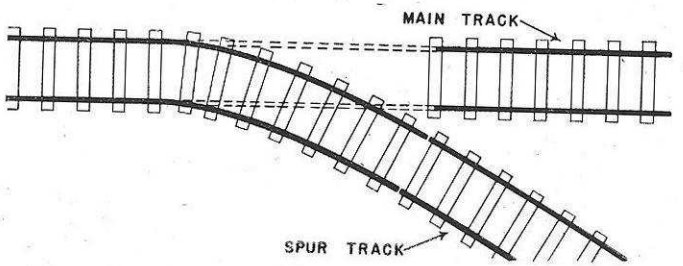


FIGURE 11.—Temporary turnout made by shifting main track.

■ 19. TRACK CLEARANCES—*a.* Railway structures include bridges, tunnels, fences, loading platforms, fuel and water

stations, and railway buildings. They are referred to here only in relation to the free passage of locomotives and cars on main tracks and sidings.

b. Most railway structures are fixed and can be definitely located with respect to the track. Some are movable, such as mail cranes, water columns, and coal chutes. In some cases, railway structures are so close to the tracks that it is not possible for large locomotives and cars to pass, and detours are necessary. The Corps of Engineers collects and supplies all necessary information regarding railway clearances.

c. Drawings, showing a cross section of the roadway and including an outline within which no part of any fixed structures extend, are called "clearance diagrams." Similar diagrams are prepared for railway artillery rolling stock to show the outline beyond which no part of locomotives or cars extends. Clearances may have to be increased on curved track to allow for the overhang and the tilting of cars in traversing curves. There must be a reasonable amount of free space between the clearance line for structures and the clearance line for rolling stock to allow for oscillation due to irregularities of track and the action of car springs. All parts of railway artillery equipment must be stowed and secured so as not to project beyond clearance limits. All personnel must be warned regarding clearance conditions, especially where structures are a menace to personnel standing on the top of rolling stock or clinging to the side ladders of cars.

d. The American Railway Engineering Association recommends a distance of 13 feet between the center lines of parallel tracks, to which should be added a correction for overhang and tilting of rolling stock on curves. The standard minimum main-track overhead clearance of 22 feet above the top of the rail is generally observed by the railway companies of the United States. Overhead clearances of between 18 feet 6 inches and 22 feet are generally permitted only when the encroachment is protected by a bridge warning or tell-tale to notify personnel on approaching cars in time so they may avoid being injured.

CHAPTER 3

TRAIN MAKE-UP

Paragraph
Cars for personnel 20
Armament trains 21
Tonnage 22

■ 20. CARS FOR PERSONNEL.—For long journeys, the movement of railway artillery personnel will be made in passenger cars furnished by the commercial railroads or the military railways. Railway passenger cars are designed specifically for operation in passenger trains; they should not be operated in the armament trains of the railway artillery unless it is impracticable to arrange for a separate passenger train. When it is necessary to operate passenger cars in armament trains, the passenger cars should be attached to the rear of the train, except in cold weather; they must then be located at the head of the train so that they may obtain steam from the locomotive for heating purposes. When passenger cars are located at the head of the train the number of armament cars that can be coupled to the passenger cars and operated safely in transit will be restricted by the structural limitations of the passenger equipment. In making up a train with the passenger cars located ahead of the armament cars, the railway artillery personnel should be guided by the advice of civilian or military railway officers.

■ 21. ARMAMENT TRAINS.—*a. General.*—For long journeys, the cars in the armament train should be arranged in an order to facilitate train operation rather than placed in the train in a sequence that is preferred for tactical reasons. The train should be rearranged for movement into firing positions at a point near the destination where tracks for switching movements are available. For relatively short journeys the armament train may be made up in the proper order for movement directly into position.

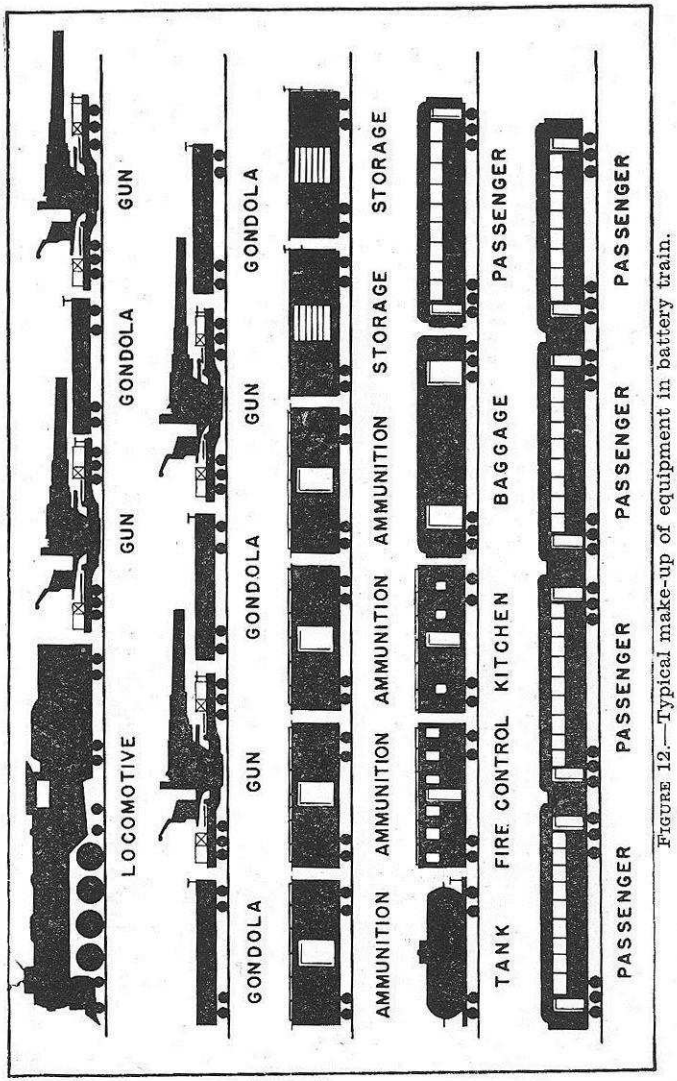


FIGURE 12.—Typical make-up of equipment in battery train.

b. Distribution of cars.—(1) *Gun cars.*—Better control of a train in transit is obtained by locating the heaviest cars near the head end of the train. Unless governed otherwise, by tactical requirements, the gun cars should be placed near the head end of the train (fig. 12). Guns extending over the ends of their car mounts require the use of an idler car, either a low-side gondola car or a flat car, coupled to the muzzle end of the gun car. Gun cars should be moved in a train with the muzzles trailing except when the military situation requires the gun to be moved with the muzzle pointed in the direction of the field of fire.

(2) *Ammunition cars.*—Loaded ammunition cars should be located as nearly as practicable in the middle of the train. When the length of the train will permit, ammunition cars should be not nearer than the sixteenth car from the locomotive nor the eleventh car from the rear end caboose. When switching loaded ammunition cars, they should not be nearer than the second car from the locomotive. In a train, ammunition cars should not be placed next to the following:

(*a*) Dead locomotives.

(*b*) Tank cars with inflammable lading.

(*c*) Flat or gondola cars with wooden underframes.

(*d*) Cars loaded with lumber, steel, or similar articles liable to break through the ends of the cars due to rough handling.

(*e*) Cars containing lighted heaters, stoves, or lanterns.

■ 22. TONNAGE.—*a. General.*—The length and weight of a railway artillery train is limited by the motive power available for moving the train, the train resistance, and in some situations by the car capacity of tracks at the destination and passing sidings en route. When the movement is made over the tracks of commercial railroads, the decision as to the maximum length and tonnage of railway artillery trains should be made on the basis of information supplied by the commercial railroads.

b. Train resistance.—(1) *Straight level track.*—The motion of a train on straight level track is resisted by journal friction, the retarding effect of air pressure, and by miscellaneous factors such as flange friction, oscillation, and the rolling of the wheels on the rails. The resistance on straight level track varies with the weight of the cars and locomotives, the speed, and weather conditions. At low speeds, an average of 6 pounds per ton of weight may be used as the resistance on straight level track.

(2) *Grade resistance.*—The operation of railway artillery trains will usually include movement over ascending grades. If a grade is expressed in percent, the grade resistance is 20 pounds per ton of train weight for each percent of grade.

(3) *Curve resistance.*—Curves retard the motion of a train. A fair average for curve resistance has been determined by test to be 0.8 pound per ton per degree of curvature. When a curve is located on a grade, the grade along the curve is often reduced sufficiently to make the combined resistance of the curve and grade equal to the resistance of a straight grade. The grade is then said to be "compensated." A fully compensated grade is one that has a reduction of 0.04 percent in grade for each degree of curvature.

(4) *Total train resistance.*—The total train resistance is the sum of the resistance on straight level track, grade resistance, and curve resistance. The following example will illustrate the method of determining approximately the total resistance of a train:

What is the total resistance of a 1,500-ton train on a 1.2-percent uncompensated grade with a maximum curvature of 6 degrees?

Resistance on straight level track = 6 pounds per ton.
Grade resistance = 1.2×20 = 24 pounds per ton.
Curve resistance = 0.8×6 = 4.8 pounds per ton.
Total resistance per ton 34.8 pounds.
Total train resistance = $34.8 \times 1{,}500 = 52{,}200$ pounds.

Therefore, a locomotive must exert a drawbar pull of 52,200 pounds to keep the train in motion.

CHAPTER 4

TRAIN OPERATION

	Paragraph
General	23
Signals	24
Operating rules	25
Duties of enginemen	26
Duties of firemen	27
Duties of switchmen	28
Duties of section foremen	29

■ 23. GENERAL.—*a.* The movement of railway equipment assigned to the railway artillery is made in accordance with the rules governing train operation on the trackage over which the movement is to be made. Railway artillery personnel operating railway equipment on its own tracks must know the rules prescribed in this manual. When operating over trackage on which train movement is controlled by timetable, train orders, and automatic signals, the railway artillery locomotive and train crews must know the rules and regulations set forth in TM 5-415, Operating Manual for the Military Railway Service, Transportation Corps.

b. The general rules governing the operation of railway artillery trains are:

(1) All railway artillerymen will be on the alert at all times to detect defective or unserviceable track and equipment. If facilities are not immediately available for making the necessary repairs, proper protection must be given to insure the safety of personnel and equipment.

(2) Any condition that may adversely affect the movement of locomotives and cars will be reported by the quickest available means to the proper officer.

(3) All railway artillerymen must know the locations of structures or obstructions where clearances are close. (See fig. 13.)

(4) Railway artillerymen must not stand on the track in front of an approaching locomotive or car for the purpose of boarding the locomotive or car.

(5) All railway artillerymen must expect locomotive and car movements at any time, on any track, in either direction.

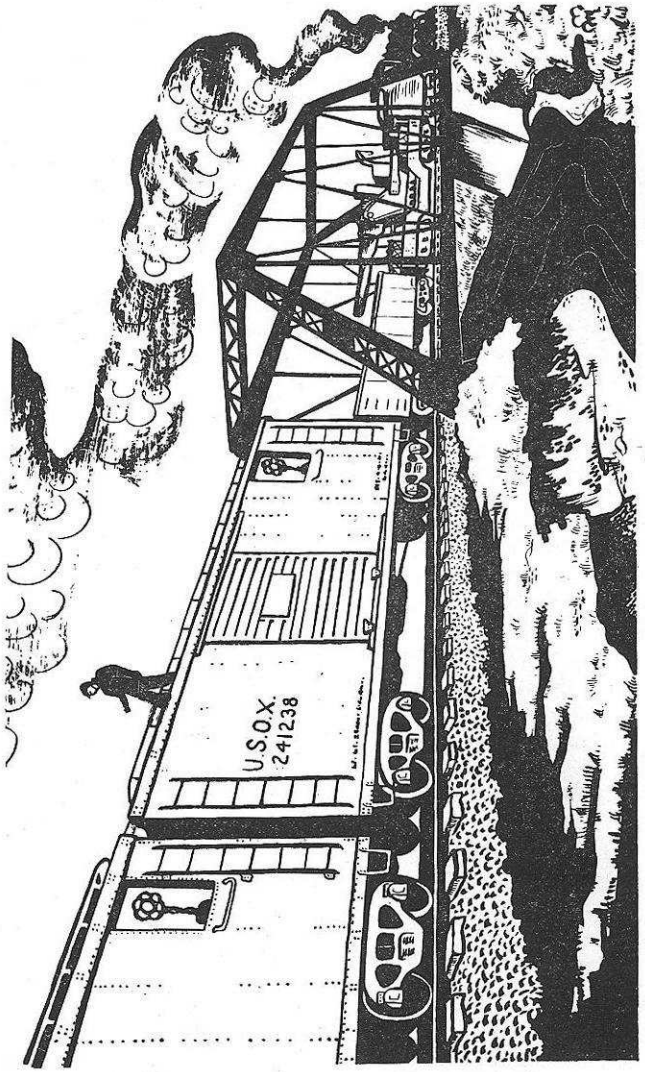


FIGURE 13.—Men riding cars must know where clearances are close.

■ 24. SIGNALS.—*a. General.*—(1) Railway artillerymen, whose duties require them to give signals, will provide themselves with the proper appliances and keep them in good order and ready for use.

(2) Flags of the prescribed color must be used by day and lights of the prescribed color by night. The use of lights as signals of any kind during blackouts or other special situations will be subject to such instructions as may be issued at the time.

(3) When day signals cannot be seen plainly, night signals must be used in addition.

b. Color signals.—The indications of the various color signals are:

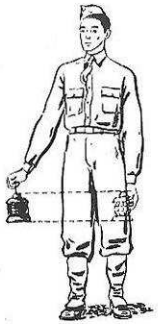
Color	*Indication*
Red	Stop.
Yellow	Proceed at reduced speed.
Green	Proceed.
Blue	See paragraph 25*b*.

c. Hand, flag, and lamp signals.—(1) The hand or a flag, moved the same as the lamp, illustrated in figures 14*a* and 14*b*, gives the same indication, except in the observance of the signal, "stop," the hand or flag movement may be above the shoulder.

(2) Signals must be given from a point where they may be plainly seen (fig. 15) and in such a way that they cannot be misunderstood. *If there is doubt as to the meaning of a signal, or for whom it is intended, it must be regarded as a stop signal and not acted upon further until fully understood.*

(3) Any object waved violently by anyone on or near the track is a signal to stop.

d. Locomotive whistle or horn signals.—The whistle or horn signals prescribed are illustrated by "o" for short sounds; "——" for longer sounds. The sound of the whistle or horn should be distinct, with its intensity and duration proportionate to the distance the signal is to be conveyed. The use of the whistle or horn may be restricted or prohibited by special instructions.



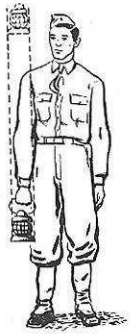
STOP

Swung across the track



REDUCE SPEED

Held horizontally at arm's length



PROCEED

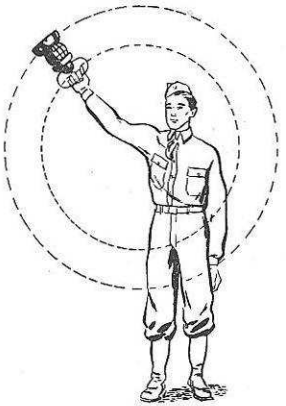
Raised and lowered vertically



BACK

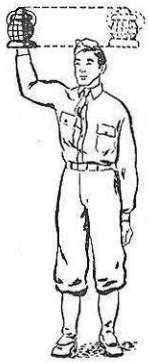
Swung vertically in a circle at half arm's length across the track

FIGURE 14*a*.—Hand, flag, and lamp signals.



TRAIN HAS PARTED

Swing vertically in a circle at arm's length across the track when train is running



APPLY AIR BRAKES

Swung horizontally above the head when standing



RELEASE AIR BRAKES

Held at arm's length above the head when standing

NOTE–1

Any object waved violently by anyone on or near the track is a signal to stop.

NOTE–2

The hand, or a flag, moved the same as lamp, as illustrated in these diagrams, gives the same indication, except in the observance of the signal "stop" the hand or flag movement may be above the shoulder.

FIGURE 14*b*.—Hand, flag, and lamp signals.

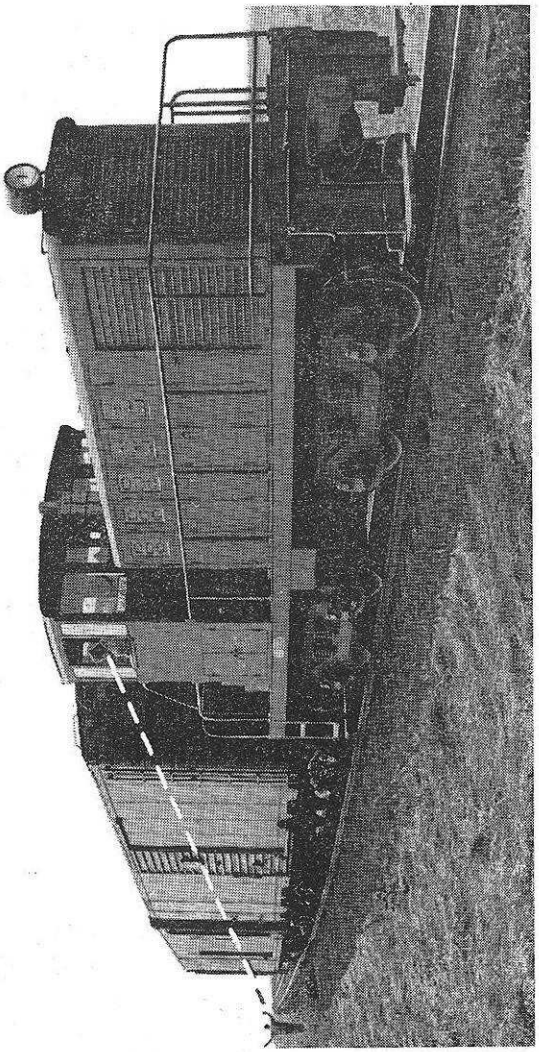


FIGURE 15.—Signals must be given from a point where they may be plainly seen.

Sound	*Indication*
o	Apply brakes. Stop.
— —	Release brakes. Proceed.
— o o o	Flagman protect rear of train.
— — — —	Flagman may return from west or south as prescribed by paragraph 25*h*.
— — — — —	Flagman may return from east or north as prescribed by paragraph 25*h*.
o o	Answer to signal not otherwise provided for.
o o o	When standing. Back.
o o o o	Call for signal.
— — o —	Approaching highway crossing at grade. To be prolonged or repeated until crossing is reached.
———	Approaching stations, junctions, railway crossings at grade, and drawbridges, as may be required.
o —	Inspect train line for leak or for brakes sticking.
Succession of short sounds	Alarm for persons or animals on the track.

■ 25. OPERATING RULES.—*a*. Railway artillery locomotives will display the headlight to the front and rear by night, unless prohibited by special instructions.

b. Except as otherwise prescribed, a blue signal displayed at one or both ends of a locomotive, car, or train indicates

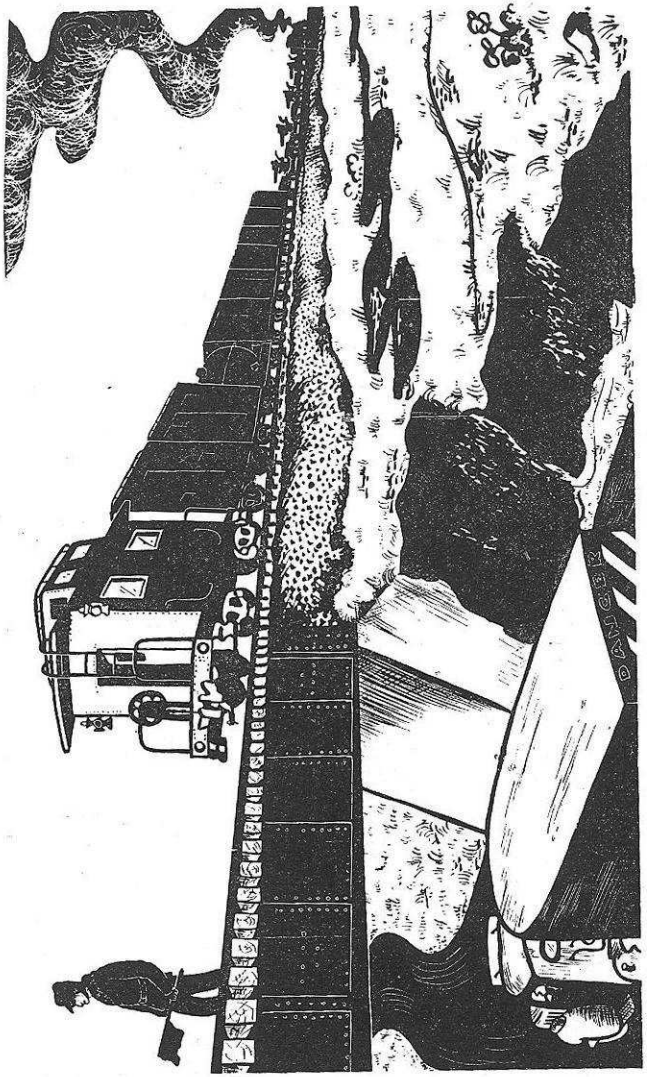


FIGURE 16.—At stops, the railway artillery train must be protected by a flagman.

that workmen are under or about it; when thus protected, the locomotive, car, or train will not be coupled to or moved. The workmen who display the blue signals are alone authorized to remove them. Other equipment will not be placed on the same track where men are working without first notifying them. When emergency repair work is to be done under or about cars in a train and a blue signal is not available, the engineman and fireman will be notified and protection will be given to those making the repairs.

c. Unless prohibited by special instructions, the locomotive bell will be rung when a locomotive is about to move, when the locomotive is approaching and passing highway grade crossings, and while moving over tracks near which railway artillerymen or other personnel are stationed.

d. The unnecessary use of either the whistle, horn, or bell is prohibited.

e. Railway artillerymen stationed at highway grade crossings will use stop signals when necessary to stop trains. They will use prescribed signals to stop highway traffic.

f. A locomotive or train will not start until the proper signal is given.

g. Railway artillery trains will be prepared to stop when approaching the end of two or more tracks, junctions, railroad grade crossings, or drawbridges, unless the switches are properly lined, signals indicate proceed, and the track is clear. Where required by regulations, trains will stop.

h. When a railway artillery train stops under circumstances in which it may be overtaken by another train, the flagman must go back immediately with flagman's signals (fig. 16) a distance sufficient to insure full protection. When recalled, and safety to the train will permit, he may return. The front of the train will be protected in the same way, if necessary, by the head trainman or the fireman. Locomotive and train crews are responsible for the protection of their trains.

i. When cars are pushed by a locomotive, and the conditions require it, a trainman will take a conspicuous position

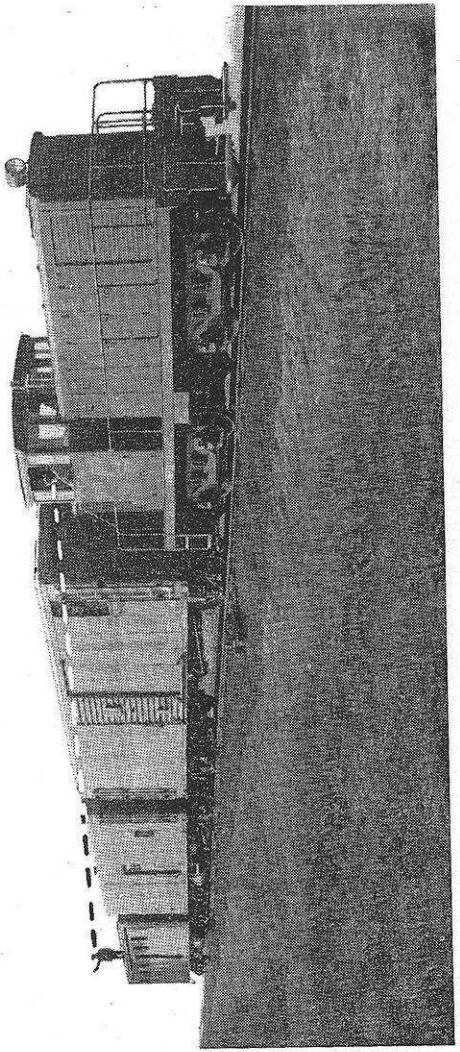


FIGURE 17.—A trainman must take a position on the leading car.

(fig. 17) on the leading car. When switching over unprotected highway crossings at grade a member of the train crew must protect the crossing.

j. Locomotive and train crews are responsible for the position of switches used by them. Before starting to make a movement, personnel will see that all switches are properly lined, and will not restore them to normal position until the movement is completed. Switches will be lined properly after use. A switch will not be left open for a following locomotive or train unless it is in the charge of a member of the crew on the following locomotive or train. When practicable, the engineman will see that the switches near the locomotive are lined properly. When waiting to cross from one track to another, and during the approach or passage of a locomotive or train on the tracks involved, all switches connected with the movement will be secured in the normal position.

■ 26. DUTIES OF ENGINEMEN.—*a.* Before leaving the initial starting point, enginemen must make a personal inspection of the locomotive to see that it is in a safe and proper working condition; they must know that the locomotive is furnished with necessary tools, fuel, water, and supplies.

b. Before moving the locomotive, the engineman must ring the bell and assure himself that no one can be injured, and that the movement is not obstructed; while on the road the engineman must keep a constant lookout for signals and obstructions.

c. Enginemen must exercise good judgment and caution in starting and stopping trains, allowing ample time for the air brakes to release before attempting to start the train. In starting a train, the slack must be taken out gradually to prevent damage to equipment. In moving and coupling cars, enginemen must use caution to avoid disturbance and injury to railway artillerymen and railway artillery equipment.

d. Enginemen must sound the whistle at all places required by regulation or law, or when necessary to prevent an accident.

e. When running after dark, enginemen must know that the headlight is lighted and in good order unless the use of a headlight is restricted by special instructions; they must have in the cab, lighted and in good order, a red lantern and a white lantern to be used in case of danger.

f. Enginemen must not permit railway artillerymen to ride on the locomotive unless authorized to do so.

g. Enginemen must not permit an unauthorized person to run the locomotive; they may not leave the locomotive during a trip, except in case of necessity, and then must leave the fireman in charge.

h. At the end of each trip, enginemen will report defects which in their judgment should be repaired. Before leaving the locomotive they must see that the throttle is closed, the reverse gear is in the neutral position, the engine stopped, and the hand brake applied.

■ 27. DUTIES OF FIREMEN.—*a.* Firemen must be familiar with the operating rules; they must understand the use of all signals and be prepared to use them promptly when necessary.

b. When required, firemen will assist in switching and making up trains, keeping a lookout for all signals and obstructions. They must also call the position of signals to the engineman.

c. During the absence of the engineman the fireman will take charge of the locomotive. He must not run the locomotive in the absence of the engineman, unless in an emergency he is directed to do so by someone in authority.

■ 28. DUTIES OF SWITCHMEN.—*a.* Railway artillery switchmen must keep a constant lookout for signals and act promptly in the protection of railway artillery trains and personnel. They must obey those signals from the engineman that are prescribed by the rules, but they must never wait for orders or signals when railway artillery trains need protection.

b. Switchmen must be familiar with and carry out the instructions on the handling of air brakes. When required, they must be prepared to apply the hand brakes.

c. Switchmen must sometimes ride the top of railway artillery cars, for the safe movement of trains.

d. Railway artillery switchmen will properly display and take care of train and flagmen's signals.

e. Railway artillery switchmen will examine and determine for themselves that all brake shafts and attachments, ladders, running boards, steps, handholds, and other safety appliances are in good condition.

■ 29. DUTIES OF SECTION FOREMEN.—*a.* Section foremen will have charge of the repairs to the railway artillery tracks assigned to their respective battalions; they are responsible for the inspection and safety of the track, bridges, and culverts.

b. The section foreman must see that the track is in good line and surface, and properly spiked; that it is in true gage; that the cross ties are properly spaced, lined and tamped; that the roadbed is in good order; that the culverts and drainage system are frequently inspected, and that the proper slopes and ditches are preserved.

c. Section foremen must watch points where obstructions are liable to occur, examine the slopes of cuts and remove anything likely to fall or slide; remove combustible materials from the vicinity of the track, except ammunition and fuel required for military operations; extinguish fires that may occur along the tracks; report promptly any derangement of communication lines; see that old material is removed and that their sections are in proper condition; and render prompt assistance in case of an accident.

d. Section foremen must not permit anything to be placed near the tracks where it will endanger the movement of railway artillerymen or railway artillery equipment.

e. During storms by day or night, they must go over their sections with their men and take every precaution to prevent accident. They must also report the condition of the track to the commanding officer.

f. Any work that interferes with the safe passage of trains at full speed is an obstruction, and must not be attempted without full protection in both directions. If

merely a reduction in speed is necessary, caution signals must be placed at a sufficient distance from the obstruction. Where it is necessary for trains to come to a stop before reaching the obstruction, section foremen must send a flagman out a sufficient distance with stop signals to insure full protection.

g. When using motor cars or hand push cars, a lookout must be kept ahead and behind for trains. These cars must be protected with hand signals when necessary.

CHAPTER 5

LOCOMOTIVE (DIESEL-ELECTRIC) OPERATION AND MAINTENANCE

	Paragraphs
SECTION I. Operation	30–35
II. Inspection	36–42
III. Maintenance—Diesel-engine	43–51
IV. Maintenance—Electrical equipment	52–55

SECTION I

OPERATION

	Paragraph
General description of locomotive	30
Preliminary instructions	31
Moving the locomotive	32
Stopping the engine	33
Leaving the locomotive	34
Traction-motor pinion	35

30. GENERAL DESCRIPTION OF LOCOMOTIVE.—The 60-ton Diesel-electric locomotive assigned to the railway artillery has a 420-h.p. Diesel engine which is directly connected to a d.c. shunt-wound generator. This develops electrical power for the traction motors mounted on the axles. The locomotive has two four-wheel swivel trucks with each axle driven individually by a d.c. series-wound traction motor through single-reduction spur gearing. On the right-hand side of the cab, at the engine end, are located the throttle lever, reversing lever, air brake valve, sander valve, bell and horn controls, window wiper controls, engine start switch, gage panel, and the tumbler switches controlling the lights and heater. The tractive force developed by the locomotive varies with the speed, from 35,000 pounds at approximately 2 m.p.h. to 2,500 pounds at 40 m.p.h., the maximum permissible speed. (See fig. 18.) The principal parts of the locomotive are shown in figure 19 and locomotive data are given in appendix II.

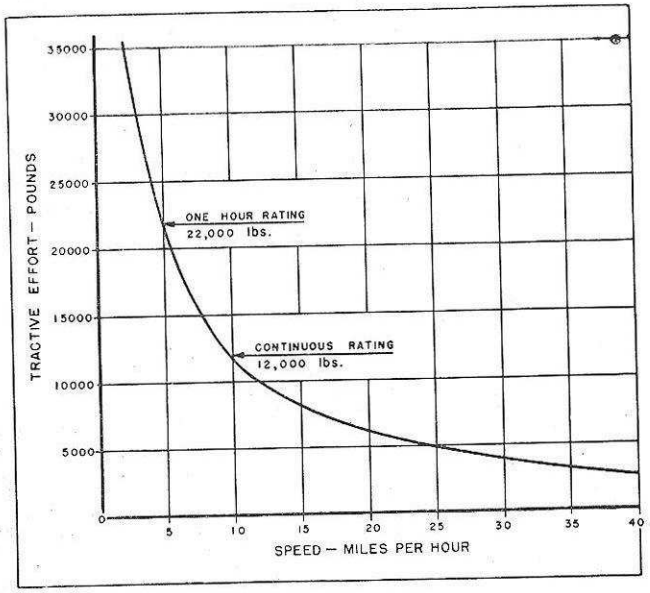


FIGURE 18.—Speed-tractive force curve.

■ 31. PRELIMINARY INSTRUCTIONS.—*a. Diesel engine.*—Before starting the engine and before doing any work on it, study the manufacturer's instructions and make sure the engine is in operating condition. While operating the engine, make a regular check of the lubricating oil pressure and the cooling water temperature. If the engine becomes overheated, stop the engine, if practicable, and determine and correct the cause before again operating the engine. Never add water to the cooling system until the engine has cooled down. After working the engine under heavy load, allow the engine to idle for a few minutes before stopping to prevent boiling of the cooling water. When adjustable engine-hood latches are provided, these should be opened during operation in warm weather.

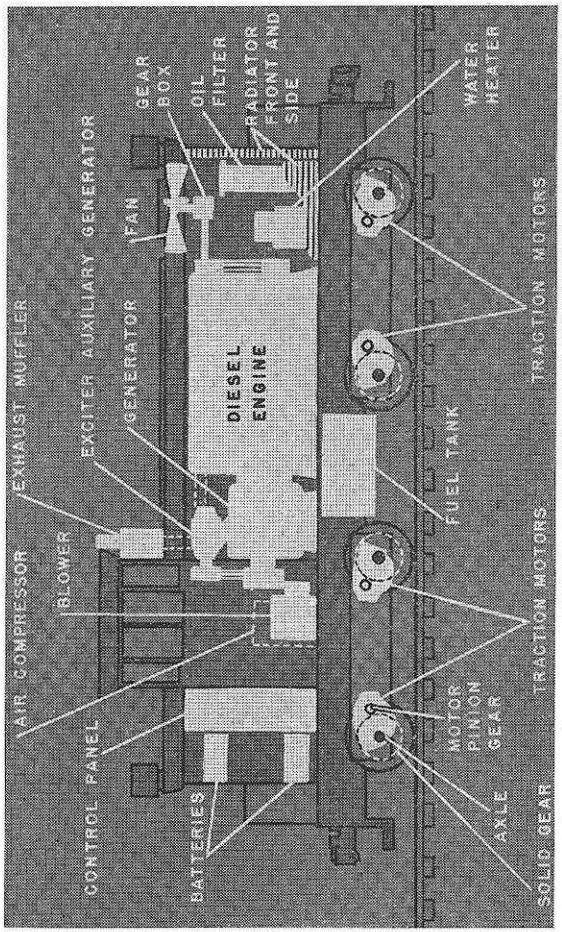


FIGURE 19.—Principal parts of the Diesel-electric locomotive.

b. Brakes.—When the air compressor is shut down, do not depend on the air brakes to hold the locomotive on a grade; set the hand brakes, or block the wheels, using wedge-shaped blocks, if available. Before moving the locomotive, make sure the air brakes work properly. In emergencies, apply the air brakes at once and shut off the power afterwards. Because there is less friction in a Diesel-electric locomotive than in a steam locomotive, engineers operating the Diesel-electric locomotive for the first time should be cautioned to apply the brakes earlier than they would on a steam locomotive in order to stop at a particular spot.

c. Throttle or controller lever.—To prevent accidental starting of the locomotive, always leave the throttle handle or the controller handle in that position which will keep the traction motors disconnected from the generator when the engine is started. Never leave the operating position without first placing the reverser handle in the neutral position. If the reverser handle is of the portable type, remove it for further protection.

d. Lubricating oil and water.—Prior to starting the engine, be sure that it is supplied with the proper quantity of suitable lubricating oil, and that the water system is filled. Before running the locomotive, read the lubricating instructions and refer to the locomotive lubricating chart in checking all parts for proper lubrication.

e. Starting the engine.—After the foregoing instructions have been observed, the power plant is started as follows:

(1) Close the battery and control switches or circuit breakers. If the locomotive is equipped with engine, generator teaser-field, or exciter-field cut-out switches, see that they are closed.

(2) Place the reverser handle in the neutral position and the throttle handle in the idling position. In cold weather it may be necessary to advance the throttle beyond the idling position to start the engine.

(3) Start the engine by pushing the starting button and observe the operation of the engine.

(4) Observe the operation of the oil pressure system. On this locomotive the lubricating system is protected by a pressure switch which stops the engine if the oil pressure drops below 4 pounds per square inch, and prevents its operation unless the oil pressure builds up to 12 pounds per square inch. If the engine is shut down by operation of the pressure switch, always remedy the cause of the failure before attempting any further use of the engine. During starting, the pressure switch is short-circuited to render it inoperative, but as soon as the starting button is released, the switch becomes operative and will stop the engine unless the oil pressure has reached 12 pounds per square inch. After an overhaul, when the engine is to be started for the first time, the period required for the oil pressure to build up sufficiently to close the pressure switch may be shortened by filling the lubricating oil filters by hand with clean oil.

(5) Allow the air compressor to pump air until the main air reservoir gage hand indicates 110 pounds per square inch. See that the air compressor functions properly.

(6) Permit the engine to operate at idling speed a sufficient length of time to warm up; to pump up the air quickly, advance the throttle to three-fourths speed. Reduce the engine speed to idling when full air pressure is obtained.

(7) Apply the air brakes to check their operation.

(8) Observe the operation of all belt-driven machinery and other equipment to see that they function properly.

(9) See that the battery is being charged as indicated by the battery meter.

■ 32. MOVING THE LOCOMOTIVE.—*a.* It is assumed that the locomotive has been prepared for operation with the engine running and the main air reservoir fully charged. Before attempting to start the locomotive, the hand brake must be released. Move the reverser handle to the forward or reverse position as desired. When the throttle handle is then advanced, certain control circuits are energized which close the line contactors and establish a connection between the

traction motor and the generator. Increased current through the traction motors and acceleration of the locomotive is obtained by advancing the throttle handle.

b. To change the direction of the locomotive, the throttle handle should be placed in the idling position and the locomotive brought to a stop before advancing the throttle again. The reverser handle is then moved to the opposite position and the throttle opened. The locomotive should never be reversed while in motion except in extreme emergencies.

c. When there is a tendency for the wheels to slip, the throttle should be closed and sand applied to the rails after the wheels have stopped slipping.

d. When coming to a stop on an ascending grade, the brakes should be applied before closing the throttle. Likewise, when starting on an ascending grade, do not release the locomotive brakes until the throttle has been opened sufficiently to prevent the locomotive or train from drifting backward.

e. If the current fails for any reason, close the throttle and, if on a grade, apply the brakes.

■ 33. STOPPING THE ENGINE.—To stop the Diesel engine, proceed as follows:

a. Move the throttle into the extreme forward position.

b. Open the control switch.

c. If the locomotive is provided with engine shut-down rods, pull the button marked, "Engine Shut-Down," and hold it until the engine comes to a stop.

d. If at any time the engine fails to come to a stop under normal conditions, or if it overspeeds, operate the overspeed governor trip by hand, or close the outlet valve in the line between the service tank and the high-pressure pump.

e. If the throttle valve should stick in open position, close it by hand.

■ 34. LEAVING THE LOCOMOTIVE.—Before leaving the locomotive, stop the engine, open all switches, close all doors,

windows, and hatches, cover the exhaust stack, close the radiator shutters, and set the hand brakes. If there is any danger of freezing the cooling water in the engine, drain the entire cooling system, unless anti-freeze is used, or the water heater is placed in operation.

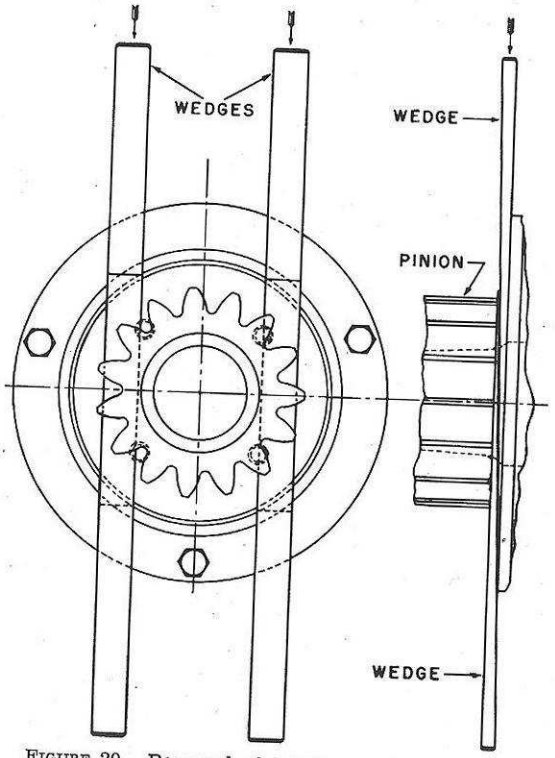


FIGURE 20.—Removal of traction-motor pinion.

■ 35. TRACTION-MOTOR PINION.—*a. Removal.*—When the locomotive is moved "dead" (motors not in operation) in a train operating at speeds in excess of 40 miles per hour, the traction-motor pinion must be removed by the following method:

(1) Remove pinion nut and apply four wedges as shown in figure 20. Wedges must be smooth and free from dirt and paint; cover wedges with a coating of cup grease to facilitate sliding action under heavy pressure. The wedges should be applied as close to the motor shaft as possible to prevent damage to the seal portion of the shrink ring.

(2) Drive the wedges adjacent to the motor with a machinist's hammer. If possible, drive the wedges simultaneously on both sides of the shaft. Hammer blows applied as indicated by the arrows in figure 20 will force the pinion off the shaft.

(3) If it is impossible to assemble the wedges vertically as shown in the illustration, any convenient angle may be used. It may be necessary to remove one or more of the end cover bolts where these would interfere with the operation of the wedges.

b. Assembly.—To assemble the pinion on the traction motor shaft—

(1) Thoroughly clean the taper of the shaft and the bore of the pinion. Use carbon tetrachloride to remove every trace of oil or grease.

(2) Inspect shaft for upset metal at end of taper and nicks, which should be corrected to obtain a perfect fit.

(3) Inspect bore of pinion for any possible damage. The pinion should have at least an 80-percent perfect fit on the shaft.

(4) Mount the cold pinion by placing it on the shaft and snapping it into position by hand. Measure the "cold position" of the pinion on the shaft, using a micrometer depth gage. Mark at the circumference of the pinion the two places where the depth gage was resting; this may increase the accuracy when determining the final position of the pinion.

(5) Remove the pinion from the shaft and mark it so the pinion will be mounted on the same shaft.

(6) Heat the pinion in a suitable oven, or in oil if an oven is not available, to a temperature of 265° F. Care must be taken never to heat the pinion over 375° F., as the pinion

will be softened, but it is recommended that the pinion be heated a few degrees above the required temperature. Attach a thermometer, using putty over the bulb, and wait until the pinion has cooled to the temperature required.

(7) Mount the pinion without delay, snapping it into position by hand. To control the stresses in the pinion, the advance on the shaft from "cold position" to "hot position" along the axis of the shaft should be held within limits of 0.050 to 0.055 inch. The actual advance on the shaft should be checked with the micrometer depth gage at the same points used in measuring the "cold position." The temperature rise recommended for mounting should be used only as a guide and may be varied slightly to obtain an advance on the shaft from "cold position" to "hot position" within the limits specified.

(8) Apply the lock washer and nut which must be firmly tightened and locked.

SECTION II

INSPECTION

	Paragraph
General	36
Inspection by crew before leaving terminal	37
Inspection upon returning to terminal	38
Inspection every 160 locomotive hours	39
Inspection every 680 locomotive hours	40
Inspection and overhaul at periods greater than monthly	41
Inspection of running gear	42

■ 36. GENERAL.—Regular inspection routine should be established for each locomotive with certain parts being inspected every time the locomotive is operated. Routine inspections must be made at least once every 24 hours. Further inspection should be made at less frequent intervals. Any defects observed during operation of the locomotive should be corrected at the time of inspection if it is not necessary to make the correction when the defect is found.

■ 37. INSPECTION BY CREW BEFORE LEAVING TERMINAL.—*a.* The engineer is responsible for the condition of the locomotive prior to leaving the terminal. If any defects are found he must report them to the proper individual.

b. A member of the engine crew must:

(1) Check radiators for the proper height of cooling water.

(2) See that the lubricating oil in the engine crankcases or in the lubricating oil reservoirs is at the correct level.

(3) Start each engine and see that it operates properly. Check the lubricating oil pressure.

(4) See that the air compressor operates properly and that the oil is at the proper level. Also check the pilot valve or governor adjustment by noting the pressures at which the compressor cuts in and out. Readjust if necessary.

(5) Examine the radiator fan.

(6) Check the traction motor blowers.

(7) Operate the air brakes and observe their functioning.

(8) Apply the brakes and open the throttle handle or the controller handle slightly for each direction of motion to determine if power is available.

(9) Check battery charging by noting if the electrical meter in the battery circuits shows "charge."

(10) Check all auxiliary circuits for blown fuzes and lamp circuits for defective lamps.

(11) See that the sand boxes are filled and that the sanders operate.

■ 38. INSPECTION UPON RETURNING TO TERMINAL.—*a.* When a locomotive returns to an inspection terminal at the completion of an assignment, a complete inspection of the entire locomotive should be made as soon as possible after the crew has left.

b. This inspection should include:

(1) The items checked by the crew prior to leaving the terminal.

(2) Any defects or difficulties reported by the crew and the necessary corrections.

(3) All lubrication that depends upon daily application. Certain parts such as pedestal shoes should not be lubricated until just prior to the locomotive's departure.

(4) The brake cylinder piston travel and replacement of any broken or badly worn brake shoes.

■ 39. INSPECTION EVERY 160 LOCOMOTIVE HOURS.—*a.* In addition to the items covered by the daily inspections, terminal inspection should be made every 160 locomotive hours.

b. Terminal inspection should include the engine inspection recommended by the manufacturer and the lubrication, as recommended in the lubrication chart, of the following:

(1) Generator bearings.

(2) Traction motors.

(3) Auxiliary equipment such as radiator fans and traction motor blowers.

(4) Locomotive journals and motor axle bearings.

(5) Traction motor gears.

■ 40. INSPECTION EVERY 680 LOCOMOTIVE HOURS.—*a.* In addition to the items covered by inspections already outlined, additional inspection should be made every 680 locomotive hours. This additional inspection should include:

(1) The cooling water system: Drain, flush to remove sediment, and refill with clean water. If an anti-freeze solution is used, it may be replaced after the system has been flushed out, but care should be taken that proper proportions are used to prevent freezing.

(2) Engine inspection and maintenance prescribed by the manufacturer's instructions.

(3) The generator for condition of commutator, armature clearance, fields, brushes and brush holders, tension on brushes, generator leads, and generator bus rings. Blow out with clean, dry air.

(4) The traction motors for the condition of the commutators, armature clearance, fields, brushes and brush holders, tension on brushes, and motor leads. Blow out with clean, dry air.

(5) The contactors and relays for loose connections and worn parts. Check the tension on the fingers of the interlocks. Inspect the contactor tips and arc chutes and re-

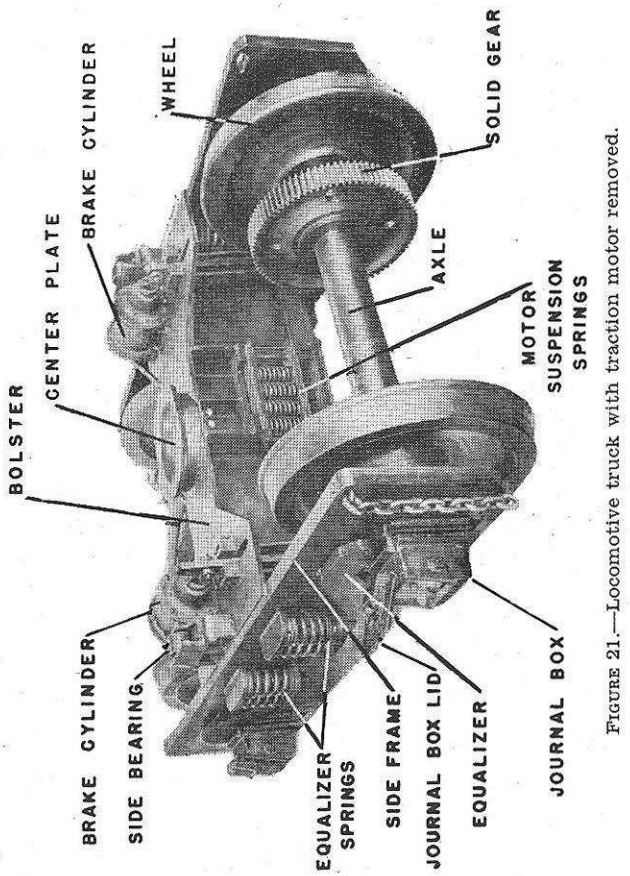


FIGURE 21.—Locomotive truck with traction motor removed.

new any that are badly burned. Blow out the control equipment with clean, dry air. Examine and clean the fingers of the controllers and inspect the wire connections. Inspect all hand switches for loose or broken parts.

(6) The battery and its terminals; apply vaseline to the terminals to prevent corrosion. Check the height of the electrolyte. Clean out the battery compartment.

(7) The running gear for loose bolts, especially on axle caps and gear cases. Inspect the wheels, brake shoes, and brake rigging. Oil the truck center plates.

■ 41. INSPECTION AND OVERHAUL AT PERIODS GREATER THAN MONTHLY.—*a.* For the care of the engines, compressors, and the electrical equipment, see the manufacturer's instructions.

b. At least twice a year the fuel oil tanks should be drained and cleaned.

c. At least once a year, or more often if experience proves it necessary, the following should be inspected, cleaned, and repaired:

(1) Gears and pinions, and other driving parts.

(2) Journal bearings, motor axle bearings, journal boxes, wearing plates on journal boxes, and frame pedestals.

(3) Wheel treads.

(4) Center plates.

(5) Brake rigging and air brake equipment.

■ 42. INSPECTION OF RUNNING GEAR.—*a.* The trucks (fig. 21) and other parts of the running gear should be inspected as frequently as service conditions may require for loose or missing bolts and nuts, worn wearing plates, and defective parts.

b. This inspection should include:

(1) Gears and gear cases.

(2) Motor axle caps and supporting bolts, nuts, and linings.

(3) Motor armature bearings.

(4) Motor nose suspension bolts, springs, safety lugs, and hangers.
(5) Intermediate gear bearings.
(6) Universal joints and driving shafts.
(7) Driving chain.
(8) Journal boxes.
(9) Journal-box wearing plates.
(10) Journal bearings.
(11) Pedestal wearing plates.
(12) Equalizers and springs.
(13) Dust guards.
(14) Thrust plates at ends of axles.
(15) Wheels and tires.
(16) Hub liners.
(17) Center plates.
(18) Side bearings.
(19) Brake rigging.
(20) Traction motor air ducts.
(21) Sander hose and pipes.
(22) Couplers.
(23) Motor leads and supporting clamps.

SECTION III

MAINTENANCE—DIESEL ENGINE

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Lubrication system	44
Cooling system	45
Fuel system	46
Speed regulating governor	47
Bearings	48
Pistons	49
Cylinder head and liner	50
Intake and exhaust valves	51

■ 43. GENERAL.—The maintenance of Diesel-electric locomotives by the railway artillery includes the daily servicing of the equipment and the making of light or running repairs.

The railway artillery is not equipped or trained to make heavy repairs. These will normally be made in the maintenance shops of the Transportation Corps or of the commercial railroads. It is essential that the maintenance detail study and understand the instructions and recommendations of the locomotive builder before attempting any repairs or adjustments of the equipment.

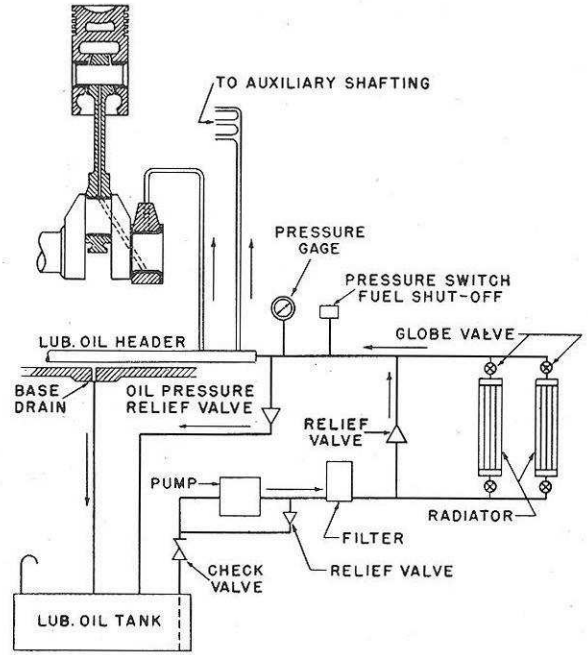


FIGURE 22.—Lubrication system.

■ 44. LUBRICATION SYSTEM.—*a. Lubricating oil pressure.*—The regulation of the lubricating oil pressure is obtained by a spring-loaded valve connecting the oil header to the tank or reservoir (fig. 22). The amount of oil pressure can be varied within certain limits by turning the adjusting screw in or out; turning the screw in compresses the spring and

raises the oil pressure. Low oil pressure may result from various causes, and some of these are listed below in the most probable order in which they may appear:

(1) Dirty filter.

(2) Improper adjustment of pressure valve or foreign matter in valve.

(3) Insufficient oil in system.

(4) Clogged suction check valve.

(5) Leak in suction line to pump.

(6) Loose or broken connection in pressure lines.

(7) Excessive clearance in bearings permitting oil to flow away too freely.

b. Automatic shut-off valve.—A pressure switch stops the engine automatically if the lubricating oil pressure drops to a predetermined dangerous level. This switch has an adjustment that permits changing the pressure at which the switch and the shut-off valve will function, so that this device may be set for any minimum oil pressure desired.

c. Lubricating oil pump.—This unit should require no attention other than a very infrequent adjustment of the stuffing box. A slight leakage is desirable to insure lubrication of the packing.

d. Strainer.—The strainer should be cleaned regularly as needed. A partially clogged strainer may reduce the oil pressure to the engine and a badly clogged strainer may reduce it to a dangerous point.

e. Lubricating oil cooler.—The lubricating oil cooler consists of one or more of the sections built integrally with the sectional type water radiator. The outside sections are usually used for oil cooling and their connections are entirely independent of that part of the radiator devoted to water cooling. Globe valves are installed in the cooler inlet and outlet lines, and a relief valve is provided across these lines, so that if the cooler becomes clogged or it is desired to shut it off, the oil may be by-passed around the cooler without stopping the engine. If the cooler gradually loses its

cooling effect, the indication is that one or both sides of the tubes are becoming dirty; then both the inside and outside of the sections should be examined and cleaned.

f. Lubricating oil.—All lubricants should be neutral mineral oils, not compounded, and should be produced by reputable refiners. For this engine an oil conforming to S.A.E. No. 30 or 40 is recommended.

■ 45. COOLING SYSTEM.—*a. Water jacket.*—The care of the water jacket surface in the engine depends largely upon the character of the water used. Jacket inspection covers and plugs should be removed periodically. If sediment is present, the jacket should be washed out. If the condition of the cooling water has been neglected causing scale to deposit in engine jacket, radiator, and piping, then proper steps should be taken without delay to remove the scale deposits. Cleaning compounds developed especially for removing scale are available from manufacturers of cleaning and water conditioning products, and should be used for this purpose. Inquiry should be made to the Transportation Corps or commercial railroads for recommendations on the type and manufacturer of a cleaning compound to be employed in removing the scale. The detailed instructions furnished by the manufacturer should be followed carefully when using a cleaning compound. It is important to flush the cooling system thoroughly and also neutralize the system immediately after completion of the cleaning and before the engine is returned to service.

b. Radiator.—If the radiator gradually loses its cooling effect, the indication is that one or both sides of the tubes are becoming dirty. It is usually the inside that becomes coated or plugged, and to prevent or correct this condition, the entire system should be drained and flushed out with a water hose carrying a pressure of not over 20 pounds per square inch. Then the radiator is boiled or steamed out. In severe cases, the sections can be taken apart, both for cleaning and repairs, or for renewal. If the radiator airstream passages become clogged, they should be cleaned out with an air hose by blowing the particles out in the direction from which they came.

c. Centrifugal water pump.—Keep the shaft stuffing box tight, but not too tight, as it is normal to have a leak of one or two drops a minute to lubricate the packing. In repacking, ¼-inch square braided flax packing, or other packing suitable for water, can be used. New packing should be cut into lengths that will go around the shaft once, making a neat joint. Pull up the gland nuts evenly with a wrench to form the packing to the shaft and the stuffing box, then slack off on the nuts and set them up fingertight only. In case the pump or piping is dismounted for any reason, care should be used in reassembling to avoid binding of the impeller or the shaft.

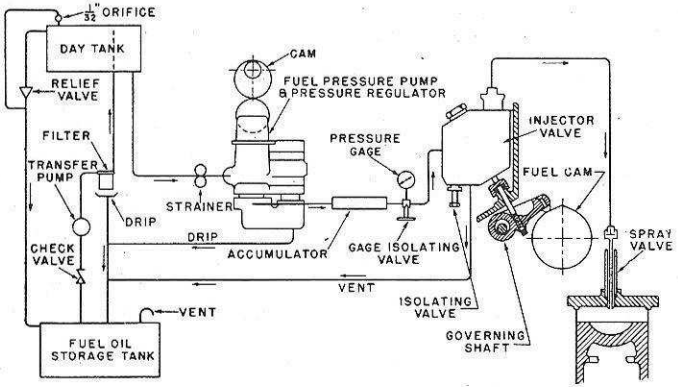


FIGURE 23.—Fuel system.

■ 46. FUEL SYSTEM.—*a. Fuel transfer pump.*—This pump fills the fuel service tank from the main storage tank (fig. 23) and requires little attention other than the adjustment of the stuffing box packing. Replacement packing should contain no rubber and should be cut into rings that go around the shaft so as to make a neat joint.

b. Fuel pressure pump.—The pump and regulator should require little attention if the fuel is kept clean. Foreign particles will cut and interfere with the operation of close fitting parts such as lapped plungers and barrels. Most

difficulties can be traced to this source. The pump plungers and bushings are hardened steel, accurately ground and lapped together. These parts come in sets and no attempt should be made to replace them separately. Do not grind the valves unless they need it, and then use only a good grade of fine or medium grinding compound. It is best to remove the valve and seats from the pump when regrinding to prevent the grinding compound from working into the rest of the system. The pump has a built-in relief valve which is set to relieve at 10,000 pounds per square inch pressure. This valve merely serves as a safety valve and, as it functions only in case of an emergency, it should require very little attention.

c. Fuel injector.—Clean the fuel strainer located in the inlet fitting of the injector block. The fuel line leading to the strainer connection must be disconnected to permit this fitting to be screwed out. See that the isolating valves are screwed down to the point where the balance valve at the top end is seated. No attempt should be made to reduce the quantity of fuel to any cylinder by means of this valve. The injector valves and seats are lapped together, as are also the valve stem and barrel. The latter should always be replaced as a unit.

d. Injection nozzle.—Keep all fuel connections free from leaks, especially those coming from the injector valve, and keep the holes in the nozzle tip clean, using clean needles for this purpose. Periodically clean the edge-type filter located in the inlet connection to the nozzle holder.

e. Injection nozzle troubles.—When the engine is operating and loaded in excess of one-fourth load, and some of the cylinders are not functioning properly, one of the following may be the cause:

(1) Nozzle valve is sticking in the open position. If this is the cause, this particular cylinder will continue to operate with a slightly higher than normal exhaust temperature.

(2) Nozzle valve is sticking in the closed position.

(3) Holes in nozzle tips are plugged.

(4) Spring tension on nozzle valve is too high for the fuel pressure.

(5) No fuel is being delivered by the injector valve. This can be determined by slacking off the vent screw or the tube union a small amount.

If the cause of injection nozzle trouble is due to (2), (3), (4), or (5), the cylinder will cease firing and the exhaust temperature will drop.

■ 47. SPEED REGULATING GOVERNOR.—The governor and its linkages are properly adjusted at the factory. No disassembly or adjustment within the governor itself should be made. In case the adjustment of the linkage from the governor to the injector becomes disturbed, it should be set so that when the governor power piston is in the shut-down position, the injector valves do not open when the rockers are on the high fuel cam. This will insure the ability of the governor to shut off the fuel. An overspeed governor is provided as a safety device to stop the engine in case the speed should for any reason exceed a predetermined figure, usually about 10 percent above the normal rated speed. If the engine shuts down due to the action of this governor, it is necessary to manually close the safety before the engine can again be started. The cause of the overspeeding should be investigated and corrected before the engine is started.

■ 48. BEARINGS.—With good clean oil the main bearings will run about 8,500 hours, and the crankpin bearings, 5,000 hours, before adjustment is necessary. The adjustment or replacement of bearings should be entrusted to a mechanic thoroughly acquainted with work of this nature.

■ 49. PISTONS.—The frequency with which the pistons will be pulled depends upon the speed at which the engine has been operated and the general care and service accorded it. An engine operated at moderate speeds under proper conditions should run 8,500 hours before it is necessary to pull its pistons. Good indicators of the piston and ring condition are the compression within the cylinder and the wear shown by the combustion chamber and the cylinder liner walls.

The carbon should be scraped and cleaned out of the cylinder counterbore before pulling the piston. After the pistons are pulled, hard carbon above the top piston ring should be scraped off by the careful use of an end scraper. Rings that are to be used again should not be removed from their grooves if it can be avoided, as springing them out of their grooves distorts them slightly. They should be cleaned in the grooves with kerosene or fuel oil. Since the top rings hold the greatest portion of the cylinder pressure, these rings wear faster, and have to be replaced more often than the others. When new rings are installed the grooves must be cleaned carefully to prevent injury to the lower, or seating, side of the grooves. If this side is worn badly, it should be cleaned up in a lathe and an over-width ring installed. The end or butt clearance of a ring should be checked by inserting it squarely in its cylinder at the smallest diameter, which is usually where the rings travel at the bottom of the stroke.

■ 50. CYLINDER HEAD AND LINER.—*a. Removing cylinder head.*—All water must be drained out of the cylinder block. Then remove or disconnect water, air intake and exhaust ells, lubrication oil line to rocker, and the fuel connection to the cylinder head. Next, remove the six nuts holding the cylinder liner to the cylinder head, making certain not to overlook the one under the valve rocker bracket which, to make the nut accessible, requires the removal of the bracket. After removing the four large nuts on the tension rods, take a slight lift on the cylinder head to see if it raises the liner with it. If the liner moves, jar it free by hitting the top ends of the six liner studs with a soft-faced hammer. Care must be taken not to break the gasket between the top of the block and the outer part of the cylinder head. If this gasket is broken, a new section must be scarfed into it. The rubber grommets or water seals over the water tubes, between the cylinder head and the liner, should be renewed, as they are seldom tight if used a second time.

b. Installing a liner.—Drain all the water from the jackets. After the head and piston have been removed, the liner can be lifted out by attaching a chain hoist to a plate or U-strap

inserted under the nuts of two diametrically opposite studs. Before installing a new liner, be sure that all of the close-fitting surfaces are clean, smooth, and in good order. The diameter of the cylinder bore must be checked with micrometers, both at the bottom of the counterbore and in the region of the lower grommet. The liners come with the bore out of round less than .001 inch. The correct rubber grommets should be put on both the top and bottom shoulders and they should be tight enough to stick in position. The liner is lowered into position very carefully with the hoist, in order not to pinch or shear off any of the grommets. Next, clamp the top of the liner flush with the top of the cylinder block. Recheck the cylinder bore at the same locations checked previously to see if there has been any distortion; rubber, when confined, can easily distort a liner if the pressure cannot equalize. Test with water to check the grommets for tightness.

■ 51. INTAKE AND EXHAUST VALVES.—*a. General.*—The rocker arms and the valves are lubricated by the engine oil system and should require little attention. After long periods of idleness, the valves should be checked for free movement in the guides by opening and closing them a few times by hand, using a small pinch bar if necessary. A penetrating oil, or a few drops of a mixture of half lubricating oil and half kerosene, should be put in the top of the retainer where it will work by the ends of the split keeper and down the valve stem.

b. Grinding valves.—The length of time between grinding of the exhaust valves should vary between 1,200 and 4,000 hours with average fuel, proper fuel adjustments, and operation at rated load. With lighter loads this period can be increased, and with overloads, decreased. The intake valves normally run twice as long as the corresponding exhaust valves. A medium grade of grinding compound should be used for rough grinding, and a fine grade for finish grinding. If it is necessary to reface the valves in a lathe, the valves should be placed between centers and straightened, if the stems do not run true, before a cut is taken.

c. Valve seats.—The exhaust valve seats are removable steel inserts which can be replaced as necessary. The outside diameter of the insert is sufficiently larger than the counterbore in the cylinder to produce a pressure fit. The insert can be assembled by cooling it in a mixture of alcohol and dry ice for about 10 minutes.

d. Timing valves.—When checking the valve timing, it is necessary to use the corresponding tappet clearance as given in the engine data sheet. The engine is turned over in the direction of rotation and the position of opening and closing of each valve is noted as indicated by marks on the flywheel. A variation of plus or minus 4 degrees in valve timing does not have a detrimental effect on the operation of the engine.

SECTION IV

MAINTENANCE—ELECTRICAL EQUIPMENT

	Paragraph
General	52
Traction and exciter-auxiliary generators	53
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Batteries	55

■ 52. GENERAL.—Maximum service can be obtained from electric machinery only when it is kept dry and clean. This is especially true when copper dust, brake shoe dust, or other metallic particles may collect in or about the apparatus. All electrical equipment should be blown out using dry compressed air, and accessible parts should be wiped off with clean wiping rags. Washed wiping rags are preferable to cotton waste, as they are less liable to leave lint. When using air in the vicinity of exposed mica insulation, care should be taken not to use high air pressure as small flakes of mica will be blown off, resulting finally in the complete destruction of the insulation. Oil is very destructive to insulating materials, since, as it collects dust and dirt, it causes them to break down electrically. When lubricating the apparatus, extreme care should be taken to prevent the lubricant from getting on the insulated parts; if any should

get on these parts, it should be wiped off thoroughly with clean wiping rags. All screws, bolts, and nuts which secure electrical connections should be kept tight to insure good contact.

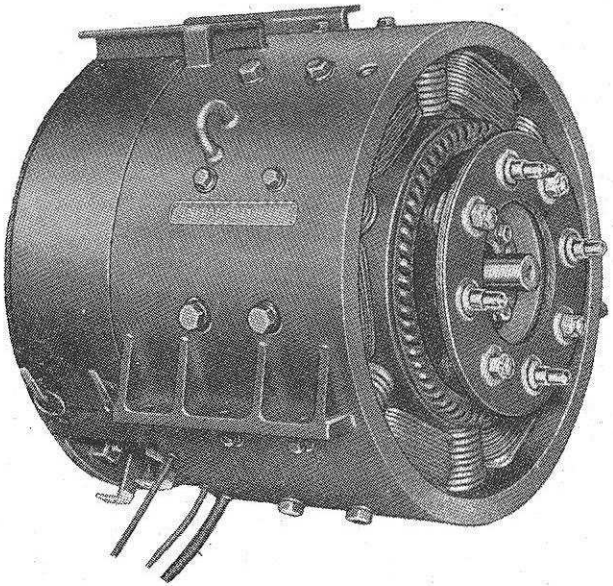


FIGURE 24.—Traction generator.

■ 53. TRACTION AND EXCITER-AUXILIARY GENERATORS.—*a. Ventilation.*—Both the traction generator (fig. 24) and the exciter-auxiliary generator have ventilating fans mounted on the armatures which draw air into the machines for cooling. Air enters at the commutator end and is exhausted through the fan. It is essential that there be an unrestricted supply of cool, clean air at the air intakes, with provision made to prevent the exhaust air from being used again.

b. Cleaning.—The apparatus must be kept clean at all times. At least once a month blow out all dust with dry

compressed air, taking care not to mar the commutator surface with the nozzle of the air hose. Wipe off the insulated band on the commutator cap, as this string band must be free of oil and dirt and have a smooth glossy finish. Every 6 months after cleaning, and when dry, paint with a recommended varnish. The brush holder support insulators must be wiped clean.

c. Commutator.—The commutator should present a polished surface free from pitting. If it becomes pitted from arcing at the brushes, it should be cleaned with fine sandpaper (not carborundum or emery), or stoned. When stoning the commutator, use a cardboard shield to keep the copper dust from the windings; it is also recommended that the fan on the main generator be removed to keep it from sucking the dust into the machine. After stoning or sanding, the machine should be blown out carefully with dry compressed air. Lubricant must not be applied to the commutator, because, with grease or oil on the commutator, carbon dust will collect in the grooves between the segments and will tend to cause a short circuit.

d. Armature.—The armature should be closely inspected for the condition of bands, wedges, coils, insulation, general assembly, and the commutator. The armature bands and core wedges should be tight and secure. If solder has been thrown off, the cause should be determined and corrected and the bands replaced.

e. Brushes.—Periodically examine the surface condition and the wear of the brushes, and replace short or broken brushes with new ones of the proper grade. Do not mix grades of brushes in the same machine. When new brushes are put in, they should be fitted to the commutator by sandpapering. Keep the sandpaper close to the commutator to avoid rounding the edges of the brush, and draw it under the brush in the direction of rotation of the machine. The brushes should move freely in the holders. Care should be used not to snap the springs, as this may chip the brush.

f. Brush holders.—The generator brush holders should be kept bolted rigidly in place. The flexible copper leads from

the brush holder bus rings to the brush holder studs should be kept twisted tightly, so that they stand in a straight line from the bus ring to the terminal. When the brush rigging is lowered as the commutator wears, a half turn can be let out of the twisted leads to increase their length sufficiently to follow up the brush holder movement. A tram is furnished with each main generator to facilitate the resetting of the brush position after the setting has been disturbed for any reason. The position of the first set of brushes from the vertical centerline at the top of the machine, facing the commutator end, may be located with respect to the magnet frame by use of the tram. The long tip of the tram fits into a conspicuous prick punch mark just above the frame-head fit on the inside surface of the frame ring, which is in line with the end of the commutator. The other tram tip should touch the end of the commutator brush surface opposite the center of the brush. The brushes on the remaining studs should be equally spaced around the commutator with respect to the one set of brushes thus located. The edges of the brushes should line up parallel with the edges of the commutator segments.

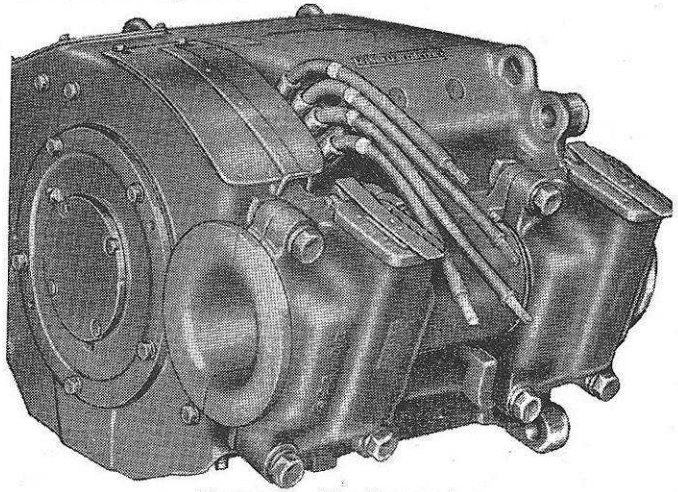


FIGURE 25.—Traction motor.

■ 54. TRACTION MOTORS.—The maintenance of the traction motors (fig. 25) is similar to that of the traction generator.

■ 55. BATTERIES.—Current from the batteries starts the engine by using the main generator as a starting motor. To keep the batteries in condition the following rules should be observed:

a. Maintain batteries in charged condition by providing the correct adjustments of the voltage regulator.

b. Add water at regular intervals.

c. Keep outside of batteries clean.

CHAPTER SIX

CAR INSPECTION AND MAINTENANCE

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SECTION I

INSPECTION

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■ 56. GENERAL.—*a.* Railway artillerymen inspecting equipment should be able to name each part of the railway car equipment of the railway artillery. See appendix I for the nomenclature of railway cars.

b. Railway artillery cars must be given a thorough inspection at least once every 2 weeks and immediately prior to a movement to new positions. The bearings must be lubricated properly. All parts of the cars must be within prescribed limits of wear and secured so that they will reach the destination safely without requiring repairs en route. Limits of wear referred to are the limits set by the current interchange rules of the Association of American Railroads. These rules govern the condition of, and repairs to, freight and passenger cars for the interchange of traffic.

■ 57. CAR BODY.—*a.* Defective or loose metal sheathing on the car sides and roof must be repaired or renewed. It is especially important that the roof and side sheets be kept

tight to protect the lading and eliminate damage from leakage. All painted surfaces must be maintained in good condition to prevent corrosion.

b. Car doors must operate safely and freely. The door fixtures must be maintained in a good condition, properly secured to the car and the door. Doors designed for lubrication should receive periodic oiling. Bottom door tracks must be kept clean and the doors should fit properly at the spark irons. Any condition that permits vertical play at the top or bottom of the side doors must be corrected to prevent these doors from falling off.

■ 58. UNDERFRAME.—The underframe must be inspected for cracked or broken center and side sills. All rivets and bolts must be tight and should be replaced where missing. Painted surfaces must be maintained in good condition to eliminate corrosion.

■ 59. CAR TRUCK.—*a. Frame.*—The car truck frame must be inspected for cracked and broken parts. Cars equipped with trucks having arch-bar side frames are prohibited in interchange traffic and must be confined to car owner's tracks. All railway artillery cars built since 1930 have been equipped with trucks having cast-steel side frames. All railway artillery cars built prior to 1930 must be inspected to make sure that arch-bar side frames have been replaced with cast-steel side frames.

b. Wheel and axle.—All wheel and axle defects are fully defined in the "Wheel and Axle Manual" and the "Interchange Rules" of the Association of American Railroads.

(1) *Wheels.*—Car wheels are condemned for many defects caused by natural wear; however, railway artillery cars will ordinarily accumulate insufficient mileage to produce car wheel defects resulting from natural wear. Some of the more common defects for which wheels on railway cars may be condemned are as follows:

(*a*) Flat spot on tread, 2½ inches or more in length or if there are two or more adjoining flat spots, each 2 inches or more in length.

(*b*) Shelled-out spots, 2½ inches or more in length on cast-iron or cast-steel wheels.

(*c*) Burned rim, shattered rim, spread rim, subsurface defect, a shelled-out tread on wrought-steel, or steel-tired wheels.

(*d*) Out-of-round wheels with a deviation in excess of 1/16 inch within an arc of 12 inches, as measured by the out-of-round gage.

(*e*) Loose wheels; often indicated by oil seepage from inside of the wheel fit on the axle.

(2) *Axles.*—Defects requiring their removal or reconditioning:

(*a*) Journal cut from overheating, caused by a hot box.

(*b*) Bent, cracked, or broken axles.

(*c*) Seamy journal on axles.

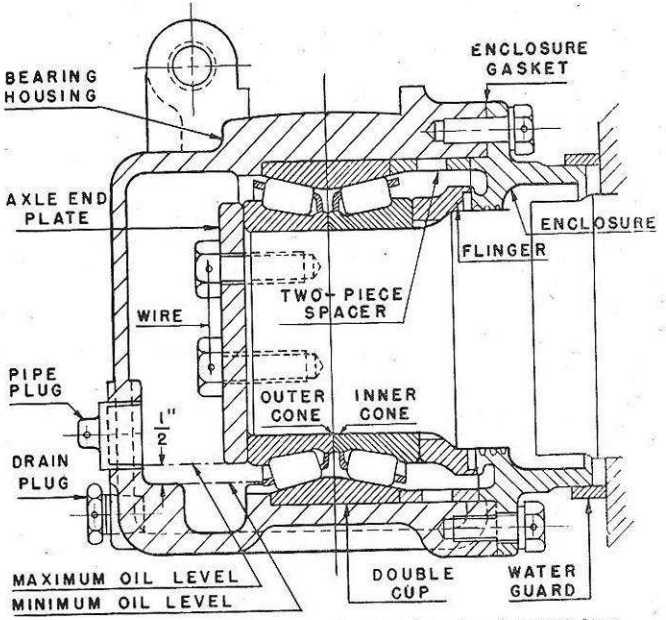


FIGURE 26.—Cross-section of roller-bearing journal box.

c. Anti-friction journal bearings.—The anti-friction bearings normally applied to railway car axles are of the roller-bearing type. Inspection of the oil level in the roller-bearing journal box should be made once a month. If the oil level is at or below the boss inside the box (see fig. 26), oil must be added until it reaches the level of the pipe plug hole.

d. Journal box with plain bearing.—The inspection of the parts contained in the journal box is extremely important as delays caused by journal boxes running hot will be kept to a minimum if railway artillerymen do this work in the proper manner. Inspection should be made as follows:

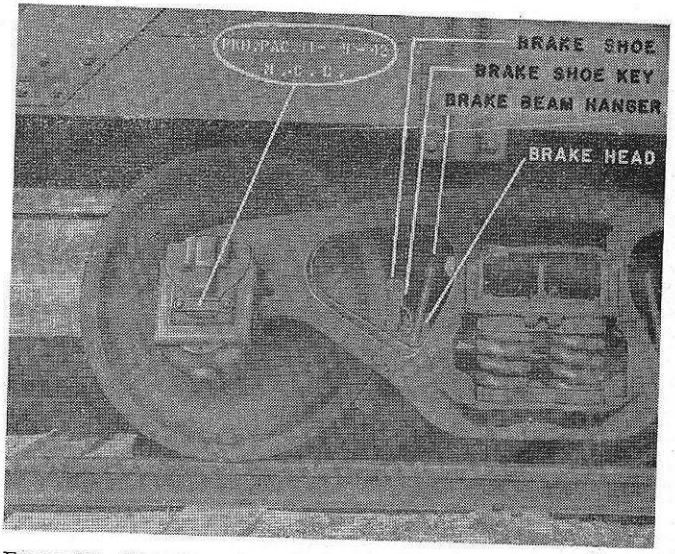


FIGURE 27.—Stenciling shows last date journal boxes were packed.

(1) Check the stenciling (fig. 27) on the car for the last date the journal boxes were repacked. Journal boxes must be repacked if the stenciled date is over 15 months old.

(2) All journal box lids must be raised and the journal boxes examined weekly. If sand, grit, or foreign particles are found in a journal box the packing and the brass must

be removed, the brass, wedge, and journal examined, and the box repacked with fresh packing. (See par. 66.) When evidence is found indicating that the journal has been subjected to above-normal temperature, the packing, wedge, and bearing must be removed, the cause determined, and the condition corrected. The packing, if in good condition, may be reapplied.

■ 60. BRAKE EQUIPMENT.—*a. Cleaning.*—Railway artillery cars equipped with the AB air brake equipment (see ch. 7) must have the air brakes cleaned when the stenciled cleaning date is more than 36 months old. Cars equipped with the old type K air-brake equipment (see ch. 7) must have the air brakes cleaned when the stenciled cleaning date is over 15 months old.

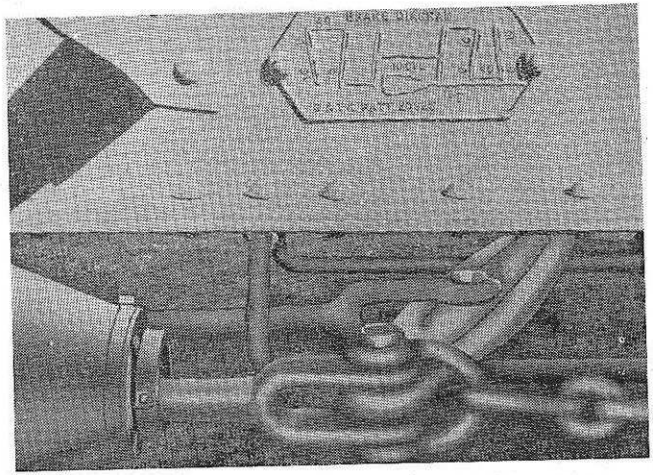


FIGURE 28.—The brake diagram badge plate shows lever dimensions.

b. Brake rigging.—(1) All defective parts must be renewed or repaired. New levers applied must conform to the dimensions shown on the brake diagram badge plate (fig. 28) or to the original dimensions.

(2) Brake shoes should be renewed when they are missing, worn to ½ inch at thinnest point, broken and part missing, or when the wear metal is broken.

(3) Brake beams require renewal when the truss rods are cut or worn to 5/16 inch or more below the original diameter, or when the brake heads are defective.

(4) Brake beam hanger pins or bolts, originally less than 1 inch in diameter, must be renewed when these parts are worn to ¾ inch or less at any point. Brake beam hanger pins or bolts, originally 1 inch or more in diameter, must be renewed when they are worn to ⅞ inch or less at any point.

c. Hand brakes.—The hand brakes must be tested to insure that all parts are in a safe and serviceable condition. When the brake-cylinder push rod and the hand-brake chain are in the full release position, the hand-brake chain must have a minimum of slack. The hand-brake chain must wind up on the brake-staff drum without jamming.

d. Air brake hose.—The air brake hose should be renewed for any of the following defects:

(1) Burst hose.

(2) Air leakage discernible without a soap suds test.

(3) Abrasions of the air hose which have worn through the outer covering and indicate damage to the first layer of duck.

(4) Cracked air hose. Longitudinal or spiral cracks indicate damage to the first layer of duck.

(5) Soft spots in the hose which clearly indicate that the fabric is broken down.

(6) Loose or defective fittings on either or both ends.

(7) Loosening of the hose from either nipple or coupling ⅜ inch or more from the shoulder.

(8) Porous deterioration as determined by soap suds test.

■ 61. SAFETY APPLIANCES.—Safety appliances must be inspected and maintained strictly in accordance with the "United States Safety Appliances Standards." The number,

size, location, and securing of such parts as running boards, sill steps, grab irons, roof handholds, and ladders met the requirements of the safety appliance law when the cars were constructed. Therefore, these parts must be maintained in their original condition. The heads of bolts or rivets on floors (except steel floors), running boards, and hand-brake footboards should not project beyond the surface of the material in order to prevent stumbling and injury to personnel.

■ 62. DRAFT GEAR.—Draft gears require removal if they are defective or if the total slack exceeds 1½ inches. The slack or free movement is determined by pushing the coupler in as far as possible and then by pulling it out as far as possible by means of a bar or lever; the difference between the measurements is the total free slack.

■ 63. COUPLER HEIGHT.—Empty cars having a coupler height of 32½ inches or less, and loaded cars with a coupler height measuring 31½ inches or less should have the coupler height adjusted to the standard height of 34½

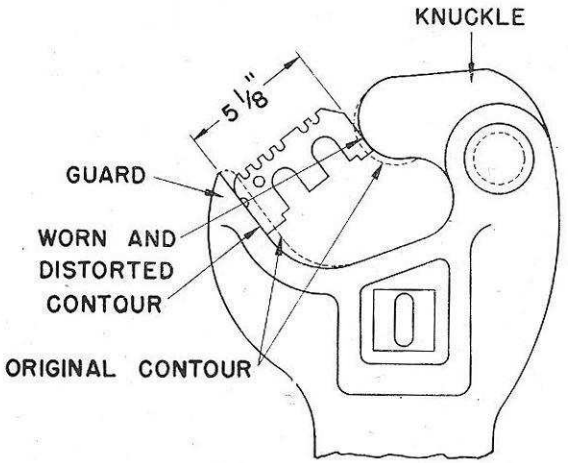


FIGURE 29.—Inspection of worn coupler.

inches on empty cars and 33½ inches on loaded cars. The coupler height is measured from the top of the rail to the center of the face of the coupler knuckle. Coupler height may be measured by the use of a straightedge laid across the track and a 6-foot rule.

■ 64. COUPLER.—Couplers with the distance between the knuckle and guard exceeding 5⅛ inches (fig. 29) must have the defective part or parts renewed to bring the coupler within the required gage of 5⅛ inches. Couplers must be removed when cracked or broken.

SECTION II

MAINTENANCE

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■ 65. GENERAL.—*a. Corrosion.*—Corrosion is the chief cause for much of the maintenance work on railway artillery cars, and corrosion is accelerated by prolonged idleness of the cars. Therefore, all railway artillery cars should be moved at least once a month to keep the wheel journals lubricated, the brake rigging in operating condition, and to check the serviceability of all moving parts. When it is impracticable to move railway artillery cars, the wheel journals should be covered completely with a lubricant or a rust preventive. It is possible to couple a locomotive to a car, charge the air-brake system, and operate the air brakes even though the car is emplaced and cannot be moved.

b. Maintenance of standards.—No substitution should be made for parts standard to railway artillery cars, excepting in an emergency.

c. Use of oxy-acetylene cutting torch.—When using the oxy-acetylene cutting torch, extreme care must be taken to prevent fire, and the operators must have a container filled with water or chemicals ready to extinguish fires. The oxy-acetylene cutting torch must not be used when making repairs to loaded ammunition or fuel cars. When using the cutting torch on cars of wood construction, the wood parts must be thoroughly wet with water before work is started and after it is completed; the torch must be held when cutting so that the direction of its sparks is away from wood parts.

d. Bolts.—Bolts should be of the correct size and long enough to extend one thread through the nut, but should not extend more than ¼ inch on bolts of less than ⅝ inch in diameter, and ½ inch on bolts over ⅝ inch in diameter. The use of washers or slip nuts to reduce the extension of a bolt through a nut is prohibited. Bolts must not be used in locations where rivets should be applied, when riveting facilities are available.

e. Nuts.—When applying nuts with or without nut locks, the flat face of the nut should be applied next to the work. Where lock nuts are used, the round face of the common nut should be applied next to the work.

f. Cotter keys and split keys.—Cotter keys and split keys should be renewed when worn, broken, or undersize. When the hole in a pin is worn sufficiently, the next larger size of cotter key should be used. All cotter keys and split keys are to extend through the hole from ¾ inch to 1⅛ inch and will be spread as shown in figure 30.

g. Stenciling.—In changing the stenciled markings, the stencil material used should consist of pure white lead and boiled linseed oil mixed to a consistency that can be readily applied with a brush.

h. Removal of loose metal parts.—After repairs have been made, the railway artillery cars should be inspected to see that no loose metal parts have been left on any part of the car bodies or trucks. This precaution is necessary to prevent any loose parts from interfering with car movement or causing a derailment.

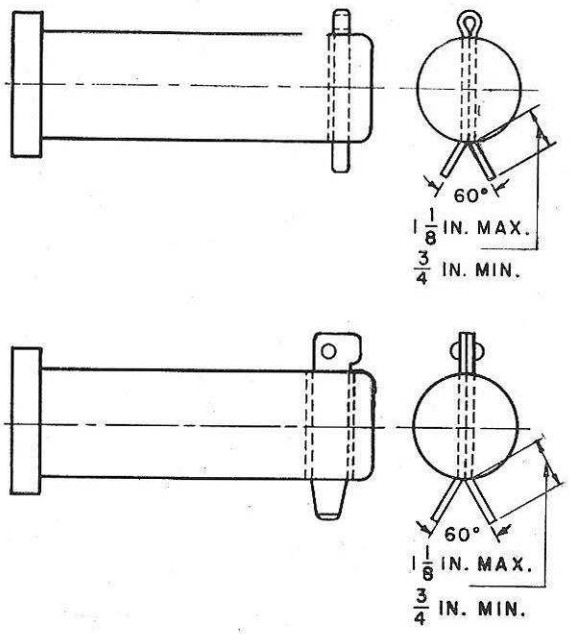


FIGURE 30.—Application of cotter keys and split keys to pins.

i. Lubricants.—(1) Center-plate grease or other suitable lubricant should be used for center plates and friction side bearings.

(2) Car oil must be used for lubricating journals, saturating journal box packing, lubricating journal bearings when being applied to journals, and lubricating door rollers and hand brakes. The specification for new car oil is given in appendix II.

(3) Car oil mixed with graphite, 8 pounds of graphite to 1 gallon of car oil, should be used for lubricating the back of journal wedges.

(4) Air-brake compound must be used for the lubrication of air-brake cylinders.

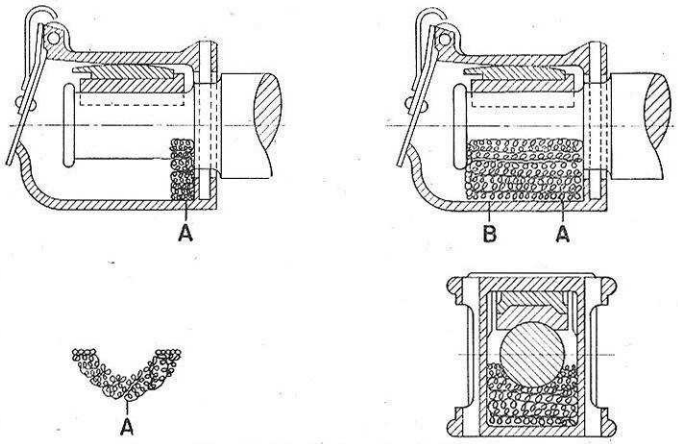


FIGURE 31.—Method of packing journal box.

■ 66. JOURNAL BOX WITH PLAIN BEARINGS.—*a. Lubrication.*—The journal box packing should be adjusted and reset at monthly intervals. Car oil must be added as required. Adjusting and resetting of the packing should be done as follows:

(1) Feel in the back end of the box with the packing iron and note the position of the back roll and packing.

(2) Set the back roll firmly against the fillet.

(3) Set the body of the packing firmly against the journal by working from the back to the front of the box, turning the packing iron away from journal in a downward movement in order to turn all loose ends away from journal.

(4) Keep the packing at least 1 inch below the center line of the journal.

(5) After the packing is set, oil should be visible in the bottom of the box. Add oil if necessary; an excessive amount of oil must not be added as it may destroy the resiliency of the packing and thus prevent the packing from retaining its position in contact with the journal.

b. Packing journal box.—(1) *Preparation of new packing.*—Colored wool waste is used for packing the journal boxes. The waste must be loosened thoroughly, placed in a saturating vat, and kept completely submerged in new car oil at a temperature of not less than 70° F., for at least 48 hours to insure thorough saturation. Then the packing should be drained until it is in a resilient or elastic condition. Oil should not drip from the drained packing when lifted from the drain rack, but oil should flow from it when it is squeezed in the hand. Prepared packing in storage should be turned over once each 24 hours; or, the oil which has accumulated in the bottom of the container should be drawn off and poured over the top of the prepared packing.

(2) *Cleaning journal box.*—Before packing a journal box, the oil cellar should be cleaned thoroughly of all dirt, sand, scale, and grit. Any water in the bottom of the box must be removed.

(3) *Application.*—(*a*) In packing a journal box, insert a back roll and work it back under the journal to the extreme back of the box. (See A in fig. 31.) The roll should be well up against the journal to lubricate properly the fillet at the end of the journal, and to keep out the dust. Three-inch rolls will insure better contact than a smaller size. The length of the rolls must be made to suit the journal diameter; the ends must not extend within less than ½ inch, or more than 1 inch of the center line of the journal. To form the roll, dry packing is laid on a flat surface and rolled to the proper length. The roll is twisted and wound with twine (3-ply jute, No. 18 B.C. flax, or "mail" twine are suggested) to hold its shape; it will glaze quickly if it is twisted too tightly. The roll is soaked in oil and drained the same as other packing.

(*b*) The front of the box must be wiped clean before the body of the packing is applied. Then sufficient waste to fill the space B in figure 31, preferably in one piece, is packed firmly under the journal, care being exercised to insure that the packing bears evenly along the full length of the lower half of the journal. To accomplish this, the packing should be placed across the full width of the mouth of the journal

box. Allow the strands to hang down outside the box and add more packing before placing the hanging strands inside the box to bind the packing into one mass. The top of the packing should be 1 inch below the center line of the journal along the sides to prevent the waste from rolling under the bearing. By placing the packing under the journal until the outer edge of the journal collar is reached, the front end of the packing presents an inclined surface toward the box. No loose ends or threads should protrude at the sides or ends; all loose ends should be tucked carefully along the side of the journal. Pieces of packing should not be laid along the side of the journal as they may catch under the bearing and cause a hot-box.

■ 67. ROLLER-BEARING JOURNAL BOX.—*a.* Roller-bearing journal boxes require only that the lubricating oil be of the proper grade and maintained to the level of the bottom of the pipe plug hole. (See fig. 26.) The pipe plug should be wire-sealed to the nearest bolt head to prevent loosening.

b. (1) The lubricant used in the roller-bearing journal boxes should be a well-bodied mineral oil of the following specifications:

Flash point	not below 500° F.
Gravity at 60° F.	not below 22° Baume.
Viscosity at 210° F.	125-150 sec.
Cold test	not above 30° F.

(2) During extremely cold weather, it may be necessary to dilute the oil with winter-grade car oil to secure a fluid or semi-fluid consistency at the lowest atmospheric temperature. When the warm season returns, the diluted oil should be replaced by oil of the above specification.

■ 68. REMOVAL OF CAR TRUCKS.—*a. Gun car.*—Normally, one truck is removed from under the car at a time. The removal of the truck is accomplished in the following manner:

(1) Set the brakes and block the wheels of the truck under the opposite end of the car.

(2) Elevate the gun mount either by the use of the built-in lifting jacks or by use of separate jacks of sufficient capacity placed under the end of the car from which the

truck is to be removed. The mount must be raised sufficiently to disengage the car and truck center-bearing castings.

(3) Disconnect the brake rod connection to the truck by removing the pin connecting the brake rod and the truck brake lever. Replace the pin in the lever hole for safekeeping.

(4) Place blocks under both sides of the gun mount as a precaution in case of failure of the jacks. The firing pedestals may be used instead of blocking, if they are placed in their normal positions under the base plate.

(5) Roll the truck out from under the car.

b. Other railway artillery cars.—The trucks of railway artillery cars other than gun cars should be removed in the following manner:

(1) Block the wheels of the truck at the opposite end of the car.

(2) Place one jack of 25-ton or greater capacity under each side and near the end of the car. If the ground is soft, blocks to provide good footing should be placed under the jacks. A small block of wood between the top of the jack and the side sill will prevent the jack from slipping.

(3) Elevate the car until the car and truck center castings are disengaged. Make sure the wheels will clear the end sills and coupler when the truck is rolled out from under the car.

(4) Disconnect the brake rod and the truck brake lever by removing the pin. Replace pin in brake lever hole for safekeeping.

(5) Place blocks under both sides of the car as a precaution in case of failure of the jacks.

(6) Roll the trucks out from under the car.

■ 69. CHANGING WHEELS.—*a. Gun cars.*—(1) The wheels of gun car trucks cannot be removed and replaced unless the truck frame is lifted off the journal boxes. This work should be performed where a crane is available to raise the truck frame. It can be done with jacks and blocking when hoisting equipment is not available.

(2) To remove the wheels:

(*a*) Remove the steel binders that are bolted to the truck frame underneath the three journal boxes on each side of the truck.

(*b*) Block under the spring hangers to prevent the spring rigging from dropping as the truck frame is raised.

(*c*) Raise the truck frame off the journal boxes. The truck frame must be elevated, either by a crane or by jacking, to a height that will clear the top of the wheels.

(*d*) Roll the wheels out from under the truck frame.

(*e*) Remove the journal boxes from the wheels to be changed, and apply them to the new wheels if the journal boxes are of the plain-bearing type. If the wheels are equipped with roller bearings, the bearings cannot be removed from the wheels except by the use of a power press. New wheels must be delivered with the bearings and boxes already mounted on the wheel journals.

(*f*) Roll wheels under the truck frame, lower the frame, remove blocking, and bolt the binders into position.

b. Other railway artillery cars.—(1) All railway artillery cars other than gun cars have trucks with cast-steel side frames. The trucks equipped with plain bearings have the journal boxes cast integrally with the side frames. The trucks equipped with roller bearings have the journal boxes located between pedestal jaws. These journal boxes are held in place by the weight of the car and by a large bolt passing through lugs at the top of the box and a lug cast in the side frame.

(2) To remove the wheels from a truck equipped with plain bearings:

(*a*) Remove the truck from underneath the car.

(*b*) Jack up the truck bolster far enough to remove the coil springs.

(*c*) Slide the spring plank (the base on which the coil springs rest) out of the side frames.

(*d*) Lower the bolster to the openings in the bottom of the side frames.

(*e*) Remove the wedges and bearings from the journal boxes. The side frames must be raised slightly to take the weight off the journal wedges and bearings. A lever, hooked under the top center of the side frame and resting on a wood block as a fulcrum, is a convenient method of raising the side frame. After the wedges and bearings have been removed, the side frames can be swung off the journals by use of the same lever.

(*f*) Roll the old wheels out and replace with the new wheels.

(*g*) Apply the wheels by performing the preceding operations in the reverse order.

(3) To remove the wheels from a truck equipped with roller bearings:

(*a*) Jack up the truck frame a sufficient height to permit removal of the bolts at the top of the boxes.

(*b*) Elevate the truck frame until the boxes are clear of the pedestal jaws.

(*c*) Roll the wheels out from under the truck frame.

(*d*) Apply the new wheels. New wheels must have the roller bearings mounted on the axles before installation.

■ 70. JOURNAL BEARING.—*a. Removal.*—To remove a plain journal bearing—

(1) Jack up the car to remove the weight from the truck.

(2) Place a small jack under the journal box and elevate the box until the journal wedge and bearing are free.

(3) Remove the wedge and the bearing, using a packing iron or tongs to pull them out of the box.

b. Renewal.—When renewing a journal bearing, the following procedure should be used—

(1) Clean the bearing and journal surfaces with a cloth.

(2) Apply a small quantity of car oil on the center of the bearing.

(3) Place the bearing on the journal to see that it fits the full length of the journal.

(4) Use a small amount of mixed oil and graphite on the center of the back of the journal wedge before inserting it in the journal box.

(5) Lower the jacks holding the journal box and the car.

(6) Repack the box.

■ 71. RAISING COUPLER HEIGHT.—When the coupler height is not within the prescribed limits, it may be raised by the insertion of wood filler blocks over or under the truck springs. The end of the car must be jacked up to take the weight off the truck. Then a small jack is used to raise the truck bolster far enough to clear the springs. The wood blocks inserted on top of the springs must be cut to a size that will cover the entire spring group.

■ 72. UNDERFRAME.—Cracked or broken underframe members must be renewed or repaired. These parts may be repaired by welding or by the use of riveted patches. For the most part, painting of the underframe to prevent corrosion should be the only maintenance work necessary.

■ 73. SAFETY APPLIANCES.—Safety appliances must be maintained in their original condition. Most of the defects in grab irons, sill steps, handholds, and ladders will consist of bent and loose parts. Bent parts should be straightened after heating. Loose parts must have the bolts or rivets either tightened or renewed. Wood running boards must be kept free of protruding nails or bolts. Broken or rotten boards must be replaced.

■ 74. CAR BODY.—The maintenance work on the car body consists mainly of keeping the superstructure painted to prevent corrosion. It is important also to maintain the door fixtures and the door-opening devices so the cars can be opened without delay at all times. These parts should be lubricated to prevent rusting. They should be inspected during cold weather to make sure ice has not formed around the moving parts and made them inoperative.

CHAPTER 7

AIR AND HAND BRAKES

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SECTION I

CAR AND LOCOMOTIVE BRAKES

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■ 75. TYPES OF AIR BRAKE EQUIPMENT.—*a.* All railway artillery cars built since 1933 have type AB air brake equipment (see fig. 32). With AB equipment, the valve, brake cylinder, and the combined reservoir are mounted separately near each other and connected by piping. The AB valve has two assembled body parts, the emergency portion and the service portion, one on each side of a common pipe bracket. The bracket is bolted to the car underframe and all valve-pipe connections are made to it.

b. Railway artillery cars built prior to 1933, except gun and mortar cars, have the air brake cylinder and the auxiliary reservoir connected together, end to end. A pipe running through the body of the auxiliary reservoir connects the brake cylinder with the triple valve mounted on the opposite end of the auxiliary reservoir from the brake cylinder. This type of air brake is called the KC equipment, *C* meaning "combined."

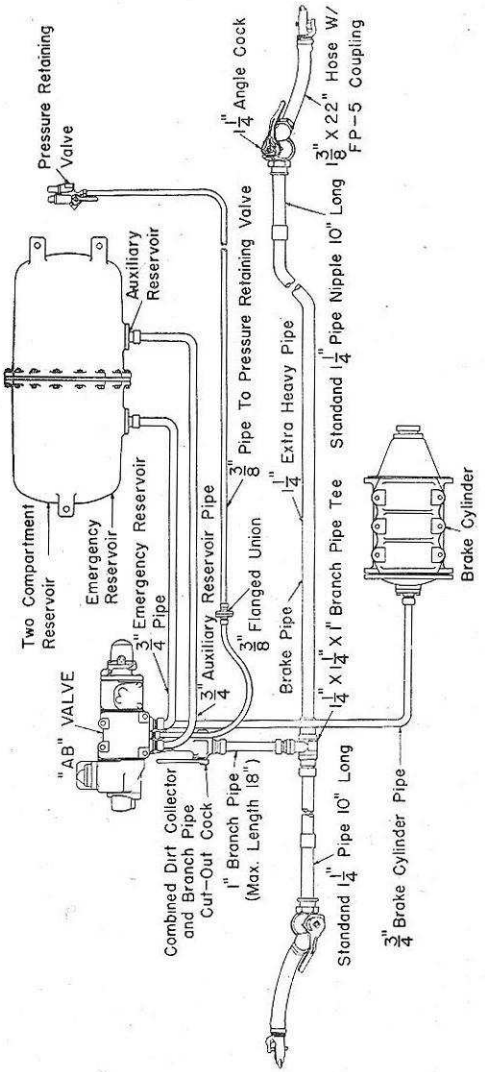


FIGURE 32.—AB air brake system.

c. The rods, which connect the brake rigging of the two trucks under ammunition, fire-control, and other box-type cars, cannot be used on gun or mortar cars, because the frames of these cars are bent downward in the middle making what is called a depressed-center car. On the latter cars, a separate set of air brake equipment must be installed for each truck (see fig. 33). On the gun and mortar cars built prior to 1933, sufficient space to install the KC equipment was not available and KD equipment was installed, *D* meaning "detached." Gun cars built since 1933 have two sets of AB equipment.

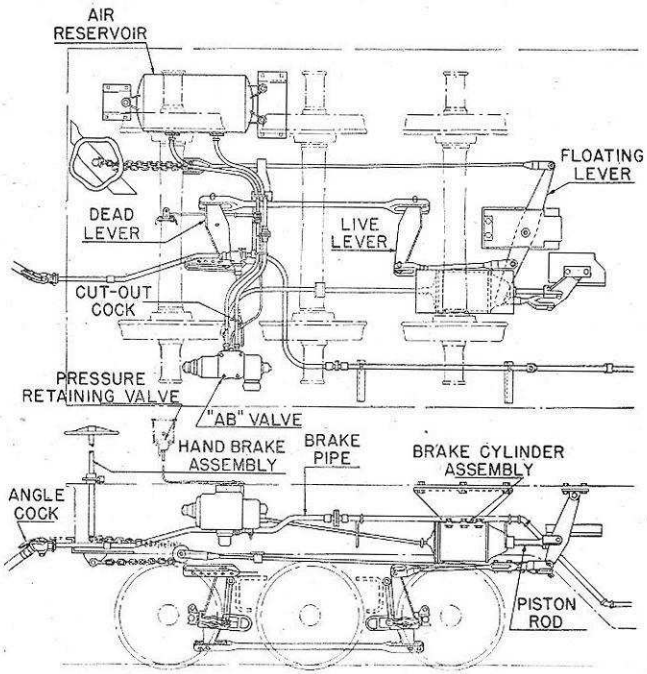


FIGURE 33.—Arrangement of air brake equipment on gun car.

■ 76. BRAKES AND BRAKE RIGGING.—*a.* All railway artillery cars are equipped with brakes which can be operated either by hand or by compressed air supplied from the locomotive.

b. All car trucks have brake beams equipped with brake heads fitted with brake shoes. These are forced against the treads and flanges of the car wheels by a system of rods and levers (fig. 33) when the brake wheel is turned or the air brake applied. One of the brake levers mounted on the underside of the car is connected by a rod and chain to the hand-brake staff. By means of this arrangement the brakes are applied when the hand-brake wheel is turned. This same lever is connected to the piston rod of the air brake cylinder. When the compressed air stored in the brake system is admitted into the cylinder, it pushes out the piston and the piston rod and moves this lever, which in turn moves the rods, other levers, and brake beams, and forces the brake shoes against the wheels. The brake rigging of all cars has at least one connection in the system of rods and levers that is adjustable, generally, by changing the connecting pin from one hole to another so as to take up the slack in the rigging. By this means, the amount of piston travel can be adjusted within prescribed limits.

■ 77. BRAKE CYLINDER.—The brake cylinder contains a piston and piston rod, the latter having a coil release spring around it to return the piston to its release position when the air is exhausted from the pressure end of the cylinder. The supply of air to the cylinder comes from the auxiliary reservoir and is controlled by the triple valve. The cylinders require cleaning and oiling at least once every 36 months for AB equipment. For K equipment, the cleaning period is every 15 months.

■ 78. AUXILIARY RESERVOIR.—Each car has a cast-iron air tank, called the "auxiliary reservoir," which is charged with air from the main reservoir on the locomotive through the brake pipe or train line. The passage of air from the auxiliary reservoir to the brake cylinder is controlled by the AB valve in the AB equipment and the triple valve in type K equipment. With AB brake equipment there are two reservoirs, one being the auxiliary reservoir, the other an emergency reservoir. These are usually combined into a single reservoir having a dividing partition (see fig. 34).

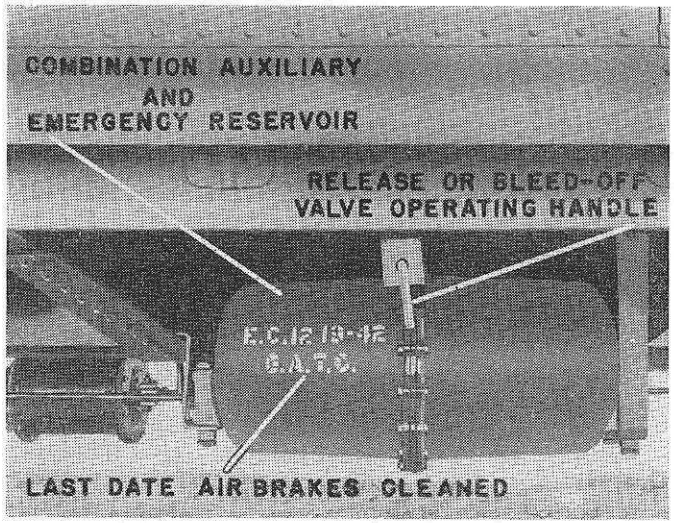


FIGURE 34.—Release valve and stenciled date air brakes were cleaned.

■ 79. RELEASE OR BLEED-OFF VALVE.—A release valve is attached to the AB valve, by means of which the auxiliary reservoir pressure may be drained alone, or both the auxiliary and emergency reservoir air may be drained at the same time. Rods connected with the release valves extend to each side of the car (see fig. 34). This permits the valves to be operated by a person standing on either side of the car. Pulling this rod through part of its travel will operate the release valve to discharge the air in the auxiliary reservoir, while pulling the rod as far as it will move releases the air from both the auxiliary and emergency reservoirs of the AB equipment. The release valve is attached to the auxiliary reservoir of type K equipment and releases the air from this reservoir, when it is operated by means of the rods extending to the sides of the car.

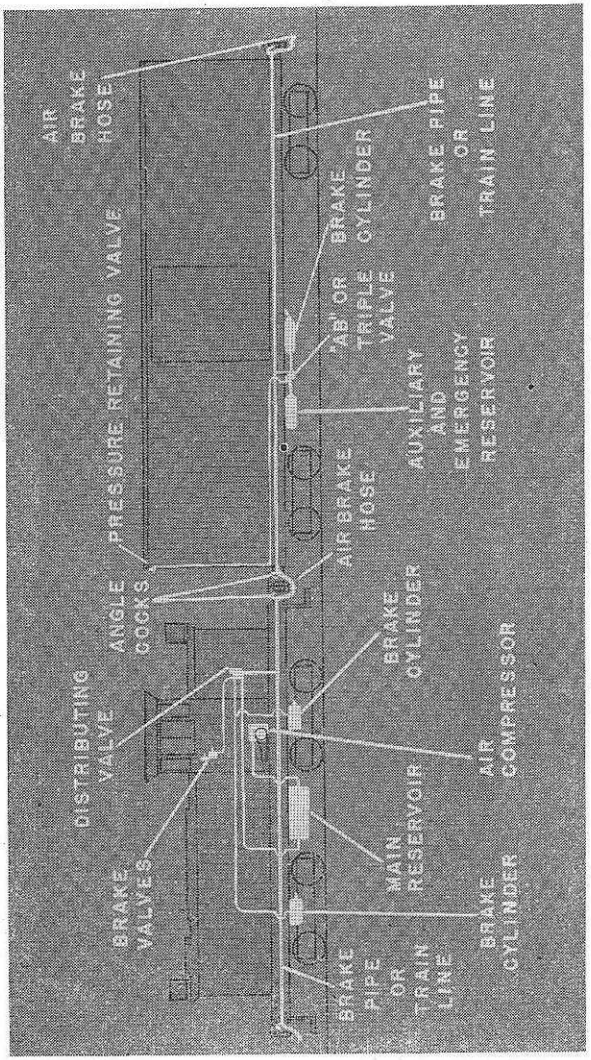


FIGURE 35.—Principal parts of train air brake system.

■ 80. BRAKE PIPE OR TRAIN LINE.—The brake pipe or train line running the full length of each car (fig. 35) includes a tee from which a branch pipe leads off through a cut-out cock to a centrifugal dirt collector. From there it goes to a triple or AB valve, through which the air supply to the car reservoirs and the brake cylinder is controlled. The air brake pipe of each car has at each end a valve called an angle cock, to which the air brake hose is attached. Turning the handle of this cock parallel to the pipe opens it to permit the flow of air through the brake pipe. Turning the handle crosswise shuts off the flow of air. If any angle cock in the train is closed, except the one on the head end of the locomotive and the one on the rear of the last car, the air brakes on all cars to the rear of the closed angle cock are inoperative. Each air brake hose has a coupling at its outer end to engage the coupling of the hose on the next car, the couplings being provided with rubber gaskets to make the joint between them airtight.

■ 81. CUT-OUT COCK.—The cut-out cock in the branch pipe of the brake pipe of each car enables the air brake on that car to be cut out of service while still permitting the flow of air through its brake pipe to the remaining cars of the train.

■ 82. CENTRIFUGAL DIRT COLLECTOR.—The centrifugal dirt collector is a device placed in the branch pipe that catches any flakes of iron rust or other dirt in the brake pipe. The centrifugal dirt collector deposits the dirt in the bottom of the collector, from which it may be removed. This keeps the triple valve clean.

■ 83. THE TRIPLE VALVE.—*a*. The AB valve functions as a triple valve in type AB equipment. The triple valve is so named because it controls three different operations:

(1) Charging the car reservoirs.

(2) Applying the brakes.

(3) Releasing the brakes.

b. The triple valve is mounted with or near the car reservoirs and brake cylinder of each car, and is connected with them. It consists of a body containing moving parts such as

a piston and slide valve with various air passages and ports. It must be cleaned and oiled at least every 15 months for type K equipment and every 36 months for type AB equipment.

■ 84. PRESSURE-RETAINING VALVES.—*a.* The triple valve has an opening in its housing through which the air from the brake cylinder escapes when the brake is released. A small pipe is threaded into this opening and led along the car body and up to a point near the hand-brake wheel (fig. 35) where it connects to a small valve known as a pressure-retaining valve. If the handle of this valve is turned at right angles to the pipe, the exhaust of the air from the pipe, and hence from the brake cylinder through the triple valve, will take place until pressure is reduced to 10 pounds per square inch. This pressure will be retained in the brake cylinder. If the handle of the retaining valve is placed at a 45-degree angle to the pipe, the pressure retained is 20 pounds per square inch. When the handle of the automatic-brake valve in the locomotive cab is placed in the release position, these reduced pressures are retained in the brake cylinder.

b. It is an inherent characteristic of the air brake system that before another brake application can be made, the brakes must be released from the previous brake application in order to recharge the auxiliary reservoirs. Before descending heavy grades, the handles of the pressure-retaining valves of a designated number of cars at the head of the train are turned up by trainmen so that the brakes of these cars will remain partially applied. This action holds the train while the engineman releases the brakes to recharge the auxiliary reservoirs so that another application of the brakes can be made. In addition to retaining pressure, the air is exhausted through choked passages. As a consequence of the gradual release of the air the action of the brakes is retarded. This provides more time for recharging. Valve handles are restored to normal position when the need for using the valves ceases, as otherwise the brakes on these cars could not be released by the engineman's operation of his automatic-brake valve.

■ 85. LOCOMOTIVE BRAKES.—*a. General.*—The Diesel-electric locomotives assigned to the railway artillery have brakes on all wheels operated by compressed air, and a hand brake arranged to operate the brakes on one truck.

b. Air compressors and governors.—The compressed air supply for the locomotive and train air brake systems is produced by one or more power-driven air compressors on the locomotive. These are equipped with lubricators and with governors. The governors regulate the air pressure and stop and start the compressors automatically as the pressure rises above or falls below that for which the governor is set.

c. Main reservoir.—The main reservoir consists of two or more steel tanks mounted on the locomotive which store the compressed air delivered by the compressors.

d. Feed valve.—The feed valve is used to maintain automatically a predetermined air pressure in the brake system.

e. Reducing valve.—The reducing valve reduces the main reservoir pressure for "straight-air" or independent operation of the locomotive brakes.

f. Air gages.—Two duplex air gages are supplied, one of which indicates the equalizing reservoir and the main reservoir pressures, the other the brake pipe and locomotive brake-cylinder pressures.

g. Brake valve.—The brake valve consists of two parts, an automatic portion and an independent portion. The automatic portion controls the operation of the locomotive and train brakes; the independent portion controls the operation of the locomotive brakes only. By proper movements of the automatic-brake valve handle, the engineman is able to charge the entire brake system on the locomotive and train, apply the brakes and hold them in the applied position, release the brakes on the locomotive and train, or hold the locomotive brakes in the applied position while releasing the train brakes and recharging the entire system. By the proper movement of the independent brake valve handle, the locomotive brakes can be operated independently of the train brakes at any and all times.

h. Equalizing reservoir.—The equalizing reservoir adds volume to the space above the equalizing piston in the brake valve, so that the reduction in brake-pipe pressure may be made properly during service application of the brakes.

i. Distributing valve.—The distributing valve bears a relation to the locomotive brakes similar to that which the triple valve bears to the car brakes. This valve automatically controls the flow of air from the main reservoirs to the locomotive brake cylinders when the brakes are released. It also automatically maintains the locomotive brake-cylinder pressure against leakage.

j. Brake cylinders.—Two duplex brake cylinders with pistons and rods are located on each truck.

k. Centrifugal dirt collectors.—Three centrifugal dirt collectors are included, two for the protection of the distributing valve and the other for the protection of the feed valve and the reducing valve. The function of the dirt collector is to prevent pipe scale, cinders, and foreign particles of any kind from entering the valves.

l. Combined strainer and check valve.—The combined strainer and check valve, together with a cut-out cock, constitutes the dead engine fixtures. They enable the locomotive brakes to be operated like those on any car when the locomotive is hauled dead in a train.

SECTION II

THE AIR BRAKE SYSTEM

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Release and recharge	90

■ 86. PRINCIPLES OF OPERATION.—From the foregoing descriptions of the units of the air brake apparatus, it is evident that the brake pipe or train line acts as part of a control system for the application and release of the brakes. It is important to note that it requires a *reduction* of the

brake-pipe pressure to build up a pressure in the brake cylinders to *apply* the brakes, and an *increase* of pressure in the brake pipe to *release* the brakes. It is this feature of the system that contributes most to its safety of operation, because it practically insures that the brakes will be applied in case of undue leakage in the brake pipe or a rupture of its continuity by the breaking of a pipe or the bursting of an air brake hose.

■ 87. CHARGING THE TRAIN.—When the locomotive is coupled to the cars and all angle cocks, except those on the front of the locomotive and the rear of the last car, are open, air flows from the main reservoir into the brake pipe, and builds up the air pressure in this pipe when the automatic brake valve handle is in the release or running position. This pressure causes the parts of the triple valve on each car to move so as to do three things:

a. Close the passage from the auxiliary reservoir to the brake cylinder.

b. Open the passage from the brake pipe to the auxiliary reservoir, and to the emergency reservoir with AB equipment.

c. Open the passage from the brake cylinder to the atmosphere. This causes the car reservoirs and the brake pipe to be charged with the air under pressure.

■ 88. SERVICE APPLICATION.—*a.* When it is desired to make a service application of the brakes, which is the one ordinarily used to stop or slow the train, the engineman moves the handle of the automatic brake valve to the service position. This opens a port in that valve to the atmosphere and allows air to escape from the brake pipe. The equalizing reservoir pressure, as indicated by the black hand on the larger gage in the cab, is allowed to drop anywhere from 5 to 20 pounds per square inch, and the valve handle is then placed in the lap position. This drop of pressure in the equalizing reservoir controls a similar drop in the brake pipe, which activates the parts of the triple valve of each car to move so as to:

(1) Close the passage from the brake pipe to the auxiliary reservoir.

(2) Open the passage from the auxiliary reservoir to the brake cylinder.

b. The air pressure builds up in the brake cylinder and applies the brakes. Placing the automatic brake valve in the lap position cuts off the supply of air from the main reservoir to the brake pipe so that no air except that stored in the auxiliary reservoirs is used in the application.

■ 89. EMERGENCY APPLICATION.—*a.* If it is necessary to stop the train very suddenly, the handle of the automatic-brake valve in the locomotive cab is placed in the emergency position. This produces a larger opening of the brake pipe to the atmosphere and a rapid drop in the brake-pipe pressure. The same things occur if the rear angle cock of the train is opened, or if an air hose becomes uncoupled or bursts. This rapid pressure drop in the brake pipe causes the parts of the triple valve on each car to move. They not only open the passage from the auxiliary reservoir to the brake cylinder, as in a service application, but also temporarily open a passage from the brake pipe to the brake cylinder. Thus, in addition to the air from the auxiliary reservoir expanding into the brake cylinder, added pressure is supplied from the brake pipe itself, causing a more powerful application of the brakes. In this operation the auxiliary reservoir maintains its connection to the brake cylinder instead of being cut off as in a service application.

b. With the AB equipment, brake pipe air is vented to the atmosphere. The emergency reservoir and the auxiliary reservoir are connected to the brake cylinder.

c. Emergency brake applications are so severe and so liable to cause damage to railway artillery trains that they are to be avoided as much as possible. Features of the AB equipment reduce the necessity for their use to a minimum.

■ 90. RELEASE AND RECHARGE.—*a.* When the train has been stopped or its speed reduced by the application of the brakes, and it is desired to release the brakes, the engineman

places the handle of the automatic-brake valve in the running position. This shuts off the escape of air from the brake pipe and the stored air from the main reservoir flows into the brake pipe to build up the pressure in it. This pressure moves the parts of the triple valve on each car to:

(1) Close the passage from the auxiliary reservoir to the brake cylinder.

(2) Vent the brake cylinder to atmosphere.

(3) Recharge the car reservoir.

b. These operations release the air pressure from the brake piston, so that, due to the recoil of the spring around the piston rod, the piston is restored to its normal position. When the brakes have released and the gage in the cab shows that the brake-pipe pressure has been built up to 70 pounds per square inch, the brake pipe and auxiliary reservoirs are charged and ready for another application when they are needed.

SECTION III

AIR BRAKE OPERATING INSTRUCTIONS

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■ 91. LOCOMOTIVES.—*a. Condition of brake apparatus.*—When enginemen take charge of a locomotive, they will see that the brake apparatus on the locomotive is in good work-

ing order; that the air compressor and lubricator work properly; that the engineman's brake valves are working in all the different positions; that the required pressure is obtained, and not exceeded, in the brake pipe when the handle of the automatic brake valve is in running position; that the governor controls the compressor when the maximum pressure is obtained in the main reservoir; and that, when the brakes are fully applied, the locomotive and tender brakes have proper piston travel, and are in good order.

b. Locomotive brake piston travel.—The piston travel on Diesel-electric locomotives will not be permitted to exceed 6 inches. The minimum piston travel should be sufficient to provide proper brake-shoe clearance when the brakes are released.

c. Main reservoir and brake-pipe pressures.—An air pressure of from 90 to 130 pounds per square inch will be carried in the main reservoir, depending on the type of compressor governor used on the locomotive. A pressure of 70 pounds per square inch will be carried in the brake pipe except as modified by special instruction or when descending heavy grades. The black or red hands of locomotive air brake pressure gages are marked to show whether they indicate brake pipe or reservoir pressures.

■ 92. TRAINS.—*a. Percentage of air brakes in use.*—All railway artillery trains must have the air brakes of all cars in the train coupled up, except as provided for in the instructions for cutting out defective air brakes.

b. Making up trains.—Connect the brake pipes of all cars in the train by coupling the air hose (fig. 36) on each car with the corresponding air hose of the next car. Turn each angle-cock handle slowly, in line with the hose. Open the angle cock nearest the locomotive first. Then see that the cut-out cock handle is crosswise of the pipe, that the handle of the pressure-retaining valve is in release position, pointing downward, and that the hand brakes are released.

c. Dead locomotives in a train.—A dead locomotive in a freight train should be coupled up the same as a freight car. On Diesel-electric locomotives equipped with the No. 14-EL

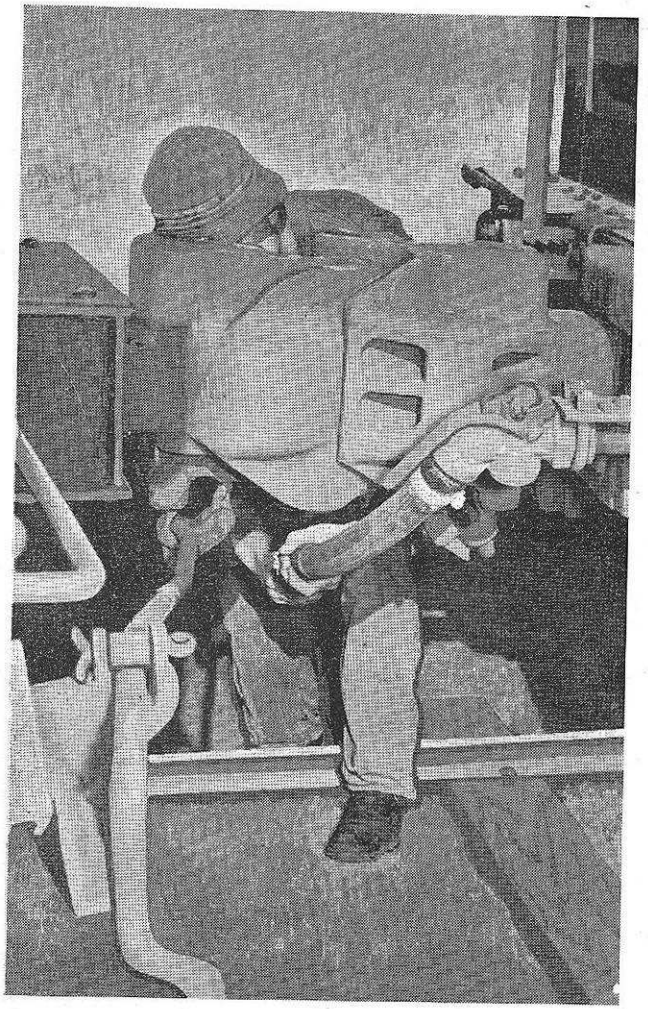


FIGURE 36.—Coupling air hose.

brake equipment, place the handle of the automatic-brake valve in running position, close the double-heading cock under the brake valve, and open the dead-engine cock.

■ 93. TESTING BRAKES.—*a.* After the locomotive has been coupled to the train, the train should be stretched to see that all cars are coupled. When this is known and before the brake hose between the tender and the train has been coupled, the engineman should make a brake-pipe reduction of 10 pounds per square inch, and hold the locomotive brake applied until the proper signal to charge the train has been received. After the air has been admitted into the train line, the engineman will place the automatic-brake-valve handle in release position and allow it to remain there until the required brake-pipe pressure is obtained, for a test of the brakes. The brake-valve handle should then be placed in running position, and if the brake-pipe pressure falls more than 5 pounds per square inch below the required pressure, the brake-valve handle should be returned to release position until the desired pressure is obtained.

b. In no case will a train be started until one of the trainmen or inspectors has personally notified the engineman as to the condition of the brakes, the number of cars in the train, and the number of brakes operative.

c. To first apply the brakes, or after a test has been made, should it be necessary to make additional applications of the brakes on account of defects found while passing along the train, inspectors or trainmen will signal the engineman by use of the prescribed hand, flag, or lamp signal. (See par. 24*c*.) The prescribed signal will also be given for the release of the brakes.

■ 94. TERMINAL TEST.—*a.* As soon as the locomotive has been coupled to the train and the required pressure equalized throughout the train, the engineman, upon request or proper signal from a trainman or inspector, will make a service application of 15 pounds per square inch reduction in pressure and hold the brakes applied until the trainmen or inspectors have examined the brakes on each car. Brake pipe leakage must be reduced to a minimum and must not

exceed 7 pounds per square inch per minute, following a service reduction of 15 pounds per square inch from standard brake-pipe pressure with the brake valve in lap position. If the trainmen or inspectors find the brakes in proper condition, they will signal from the rear car of the train to the engineman, who will then release the brakes. A test of the brakes is not complete until the trainmen or inspectors have reexamined the brakes to see that they have released properly without the use of the release valve, after which they must report to the engineman the condition of the brakes. The engineman and train crew will be held responsible for securing this information.

b. The terminal test must be made after every change in the make-up of a train. Before a train is operated down a grade requiring the use of pressure retaining valves, it must be known that the valves are in such condition that the speed of the train can be safely controlled by the engineman.

■ 95. ROAD TEST.—When a train has been parted, or an angle cock closed for any reason, at or between terminals, and the train coupled again, the engineman upon receiving the proper signal, will give one blast of the locomotive whistle, except at points where blowing the whistle is prohibited, and make a service application of the brakes for test, being careful to note that the brake valve discharges the proper amount of air from the brake pipe. The trainmen or inspectors stationed at the rear of the train, upon seeing that the brakes have applied properly, will signal for the release. If the latter takes places, it will indicate that no angle cocks in the brake pipe have been left closed.

■ 96. FAILURE TO MAINTAIN REQUIRED PRESSURE.—When, from any cause, the pressure required for the safe handling of the train cannot be maintained, the engineman must immediately notify the train crew, and both enginemen and train crew will be held responsible for taking the necessary action to insure the safe movement of the train.

■ 97. HAND BRAKES.—*a.* All railway artillery trains must be controlled by air brakes to insure the safe movement of the trains. The usual call for hand brakes, one short blast of the

locomotive whistle, will signify that they must be applied as a supplement to the air brakes; but continuous calling for brakes will signify "no air." In the latter event, the angle cock at the rear of the train must be opened and the hand brakes must be promptly applied on all cars until the train has been stopped. The engineman and the train crew must then agree as to the method in which the brakes should be handled to insure safe operation to the next point where orders may be received. This should be done before the train is allowed to proceed.

b. When a locomotive is detached from a railway artillery train, whether purposely or accidentally, or the air brake becomes inoperative on a heavy grade, trainmen will be governed as follows:

(1) On ascending grades, the hand brakes must be promptly applied on each car beginning with the rear car in train. If necessary, wheels should be blocked.

(2) On descending grades, trains must be secured in the same manner but beginning with the first car in the train. If blocking has been used, it must not be removed nor must the hand brakes be released until after the *terminal test* has been made.

■ 98. PRESSURE RETAINING VALVE.—The pressure retaining valve, located at the end of the car near the brake wheel, must be used on grades where it is necessary to hold the brakes applied while recharging auxiliary reservoirs, and to hold the slack of the train when operating conditions require. The train crew is responsible for knowing that the handles of the pressure retaining valves are in the proper position. Trainmen will set these for use when necessary and will change them back to vertical position as soon as their use is no longer required. Neglecting to do this will cause the brakes to drag and may cause damage to the wheels.

■ 99. RELEASING BRAKES AT LOW SPEED.—The brakes on railway artillery trains of 20 or more cars will not be released at speeds of less than 20 miles per hour until after the train has come to a stop. With retainers "up" on the

head-end cars, release of the brakes while running is facilitated. The AB brake also facilitates release while running. A reduction in train line pressure of at least 10 pounds per square inch is desirable before releasing the brakes, and on longer trains, a reduction of from 15 to 20 pounds per square inch is desirable before attempting release.

■ 100. FREQUENT APPLICATION AND RELEASE OF BRAKES.—As the brakes are applied by air from the auxiliary reservoirs, frequent application and release reduces the pressure and consequently the power to apply the brakes, because the supply of air to the auxiliary reservoirs is cut off while the brakes are applied. Therefore, after each release, the handle of the brake valve must be left in release or running position until the moment the brakes are applied again, or until the required pressure is obtained in the brake pipe and auxiliary reservoirs.

■ 101. EMERGENCY APPLICATION.—If the brakes are applied suddenly, either accidentally or intentionally, the locomotive throttle valve must be closed. The brake-valve handle should be moved to lap or emergency position to conserve the main reservoir air used in recharging and should be held there until the train has stopped. With the AB brake after an emergency application, the vent valve remains open a definite period of time and there is a slight exhaust at the main exhaust port of the emergency AB valve for at least 1 minute. The brake should not be considered defective due to the leak at this exhaust port unless the "blow" continues longer than 2 minutes.

■ 102. STARTING, STOPPING, OR RETARDING SPEED OF TRAIN.—When starting trains, great care must be exercised. The locomotive throttle valve must not be opened until sufficient time has been given to insure the full release of all brakes throughout the train. When stopping or retarding speed of trains, in all cases, the brakes must be applied and released in such a manner as to prevent shocks and injury to cars and lading. The longer the train, the more slack there is, and more time should be taken so that the train slack will be closed or opened gradually.

■ 103. TRAIN DRAGGING.—If the train is found to be dragging because of slightly applied brakes, the engineman will make an effort to release the brakes by making a service application and release of the brakes in the usual manner, provided the train length and speed will permit a running release. If the brakes cannot be released as oultined, the train must be stopped and the trainmen notified to examine the brakes, making sure the retaining valves are not set up.

■ 104. DETACHING CAR FROM TRAIN.—*a.* See that all the brakes on the car or locomotive to be cut off are released.

b. Turn the angle-cock handles crosswise of the pipe on each side of the couplings to be separated, turning the handle farthest from the locomotive first.

c. Disconnect the brake hose couplings. This must be done before the cars are separated.

d. The hand brakes and not the air brakes must be applied to all cars detached from a locomotive.

■ 105. CUTTING OUT A DEFECTIVE BRAKE.—*a.* To cut out a defective brake, turn the handle of the cut-out cock in the branch pipe in line with the pipe and open the release valve, holding it open until all the air is exhausted from the reservoir. A prompt report should be made to the proper authority.

b. When it is necessary to place cars with defective brakes on the rear of a train, the air hose must be coupled and the angle cocks, except the one at the rear of the train, left open, so that the air can pass into the brake pipes of all cars. When the brake pipes are not in good condition, the angle cock at the forward end of the defective cars must be closed and both the engineman and the train crew notified.

■ 106. APPLYING BRAKES FROM TRAIN.—The air brakes should be applied from the train only in an emergency and never from the rear car of the train except to avoid an accident. Trainmen must endeavor to attract the engineman's attention by signaling before applying the brakes from the train. The engineman will look back along the

train for signals as often as possible. When necessary to apply the brake from the train, application may be made by either of the following methods:

a. By disconnecting the couplings between two cars.

b. By opening the angle cock on the rear of the last car in the train.

c. If the train includes a caboose or other car equipped with a conductor's valve, by opening this valve and allowing it to remain open until the train is stopped.

■ 107. DEFECTIVE AIR HOSE.—*a.* In case of a burst air hose, turn the angle-cock handle immediately in front of the defective hose crosswise of the pipe and signal the engineman to release the brakes. After the defective hose has been replaced, unite the couplings in the usual way and make the road test.

b. Air brake hose which becomes defective on trains en route must be removed and properly tagged, showing the initials and number of car or locomotive, and the date and place of removal. Defective hose will be turned in to the designated officer.

c. In applying air-hose gaskets, the groove in the hose couplings provided to receive the gaskets must first be cleaned out to admit the gasket. Trimming the hose gaskets in order to have them enter the groove of the couplings is not permissible.

■ 108. PARTING OF TRAIN.—If a train breaks in two, turn the angle-cock handle crosswise of the pipe on the rear end of the car immediately in front of the break, then signal the engineman to release the brakes. After the train and hose have been coupled, close the angle-cock on the rear portion of the train immediately in back of the break. Then test the air brake hose before charging the rear portion of the train and releasing the brakes. After the brake system has been fully recharged, a road test of the brakes must be made.

■ 109. DEFECTIVE AIR BRAKE CARDS.—*a.* Railway artillery personnel will not remove defective air brake cards, bad

order, or other cards or markings placed on their cars by commercial or military railway inspectors, without proper authority. When it is necessary to attach a defective air brake card to a car, the particular defect for which the brake is cut out is marked on the card for the information of other trainmen and inspectors.

b. In case the defect is such that the car can be placed between other cars with the air brake operative, the defect card is attached to the branch pipe near the triple valve. If the car cannot be placed between other cars, the defect card is made out in duplicate, and one card attached to the brake pipe near the angle cock on each end of the car. Cars having defective air brake cards attached will be repaired at the first opportunity. When these repairs are made, the cards are removed, properly filled out, and forwarded as prescribed thereon.

c. Railway artillery personnel, not provided with defective air brake cards or other prescribed forms, will nevertheless report all known defects to any authority to whom railway artillery cars are turned over for any purpose.

SECTION IV

MAINTENANCE

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■ 110. IMPORTANCE OF PROPER AIR BRAKE MAINTENANCE.—If the triple valve on any car works improperly, or if from any other cause its brakes should be applied when the brakes of the other cars are not applied, or if the brakes on any cars should go into the emergency application while the brakes of the other cars have a much lighter service application, there would be great danger of pulling the train in two. If this should occur on a curve at full speed, cars might be derailed. It is highly important to safe train operation that all triple valves work uniformly, that all brake hose and couplings, pipe fittings, and gaskets are in good condition,

and that all brake rigging is properly adjusted. Brake shoes should be replaced before becoming worn so thin that they are liable to break.

■ 111. INSPECTION.—*a.* All railway artillery personnel whose duty it is to make inspections of trucks and draft gear, will inspect the cars for the condition of the brakes, adjustment of brake rigging, brake-pipe hangers, angle cocks, air hose, couplings, and pipe connections. (See par. 60.)

b. Personnel assigned to the inspection of locomotives will see that all parts of the air brake apparatus on locomotives are properly inspected and tested after each trip. All main reservoirs will be drained after each trip. Air gages will be tested every 3 months in the manner prescribed by proper authority.

■ 112. REPAIRS TO AIR BRAKES.—*a.* When it is necessary to make repairs of any character to the brake rigging, brake shoes, or any part of the truck, the cut-out cock in the branch pipe will be closed and the air pressure drained from the auxiliary reservoir by means of the release valve.

b. Examine carefully all parts of the brake rigging, making repairs where required. These repairs will include:

(1) Replacement of defective valves, cylinders, and reservoirs.

(2) Tightening of pipe unions.

(3) Replacement of defective air hose.

(4) The adjustment of slack in the brake rigging. The clearance between the brake shoes and the wheels with the brakes released is the guide for this adjustment.

(5) The adjustment of piston travel to produce a piston travel of 8 inches under a full service application of the air brakes. Readjustment of piston travel will be made at intervals frequent enough to insure that the travel is never less than 7 inches nor more than 9 inches.

(6) The application of new brake shoes. Brake shoes are changed by driving out the key holding the shoe in the brake head, removing the worn shoe, inserting a new shoe, and reapplying the key.

(7) Tightening nuts and bolts securing all air brake equipment to the car.

(8) Checking the pressure retaining valves and other orifices which sometimes are plugged by mud wasps. These parts should be examined carefully if the brakes do not release properly.

c. Repairs and adjustments requiring the disassembling of valves and cylinders will be made by military railway personnel or by the air brake personnel of commercial railroads.

APPENDIX I

NOMENCLATURE—
RAILWAY ARTILLERY EQUIPMENT

A end of car.—The opposite end to that on which the hand brake shaft is located, the latter being called the B end. On all gun cars having two separate sets of brakes, one for each end, the end of the car at which the muzzle is carried when in traveling position is the A end, the opposite or breech end is the B end.

AB brake equipment.—AB is the designation for the type of brake equipment made standard for new freight cars built after September 1, 1933, and for rebuilt cars after August 1, 1937. AB brake equipment will be compulsory in interchange after January 1, 1945. (See figs. 32, 33, and 35.)

Air brakes.—In its widest sense, the term air brake may include any system of braking in which the mechanism is actuated by the manipulation of air pressures exerted on different parts of the apparatus. A more restricted meaning is general in the United States and covers only brakes which employ air under pressure above atmospheric as distinguished from vacuum brakes which employ pressures below atmospheric.

Air brake hose.—Laminated rubber and canvas tubing, attached to a nipple that screws into the angle cock at the end of the brake pipe. The other end of the hose is fitted with a coupling that engages a similar coupling on the adjoining car. The complete arrangement forms a flexible air connection between the brake pipes of the two cars.

Air brake hose coupling.—A special type of standardized fitting which is attached to one end of an air brake hose in order to provide means for connection and disconnection, securely and quickly, of the hoses by which the air brake

train line and the signal line are carried from car to car. The general design belongs to the fundamental group known as bayonet type.

Air brake hose coupling gasket.—A rubber-composition gasket which fits into the air brake hose coupling to seal the connection against air leakage. This gasket is of Association of American Railroad (A.A.R.) design and must meet standard specifications of the Association.

Air brake hose nipple.—A short metal tube, of standard A.A.R. design, formed on one end for forcing into the end of the standard air brake hose, where it is held by a suitable clamp. The other end of the nipple is threaded and screws into the angle cock.

Angle cock.—A special type of valve located at both ends of the brake pipe on passenger and freight cars. The free opening is threaded to receive the air-connecting hose nipple. When a train is made up, all angle cocks must be open except those at the ends of the train.

Axle.—The cylindrical steel shaft on which the car wheels are mounted. The axle not only holds the wheels to gage, but also transmits the load from the journal boxes to the wheels. Usually the axle turns, but in some installations of roller bearings, the axle is dead and the wheels rotate on the roller bearings. (See fig. 41.)

Axle collar.—A rim or enlargement on the end of a car axle which takes the end thrust of the journal bearings.

B end of car.—The end on which the brake shaft is located or the end toward which the brake cylinder piston travels. The breech end of a gun car when in traveling position.

Body (of a car).— The main or principal part in or on which the load is placed.

Body bolster.—The transverse members of the underframes over the trucks which transmit the load carried by the longitudinal sills to the trucks through the center plates. A double body bolster, a wide bolster with two transverse members, is for use on cars equipped with six-wheel trucks.

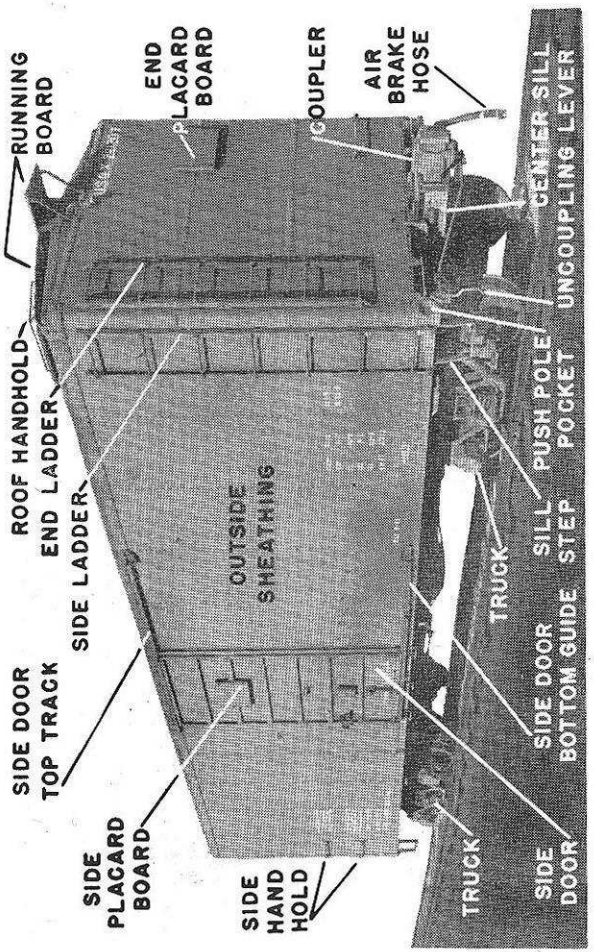


FIGURE 37.—Principal parts of box-type railway car.

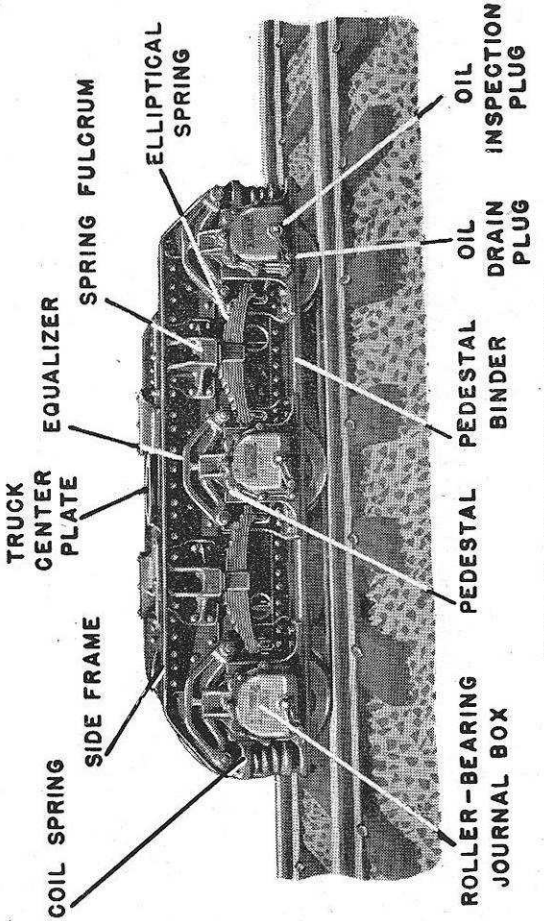


FIGURE 38.—Gun car truck—side view.

brake-pipe pressure to build up a pressure in the brake cylinders to *apply* the brakes, and an *increase* of pressure in the brake pipe to *release* the brakes. It is this feature of the system that contributes most to its safety of operation, because it practically insures that the brakes will be applied in case of undue leakage in the brake pipe or a rupture of its continuity by the breaking of a pipe or the bursting of an air brake hose.

■ 87. CHARGING THE TRAIN.—When the locomotive is coupled to the cars and all angle cocks, except those on the front of the locomotive and the rear of the last car, are open, air flows from the main reservoir into the brake pipe, and builds up the air pressure in this pipe when the automatic brake valve handle is in the release or running position. This pressure causes the parts of the triple valve on each car to move so as to do three things:

a. Close the passage from the auxiliary reservoir to the brake cylinder.

b. Open the passage from the brake pipe to the auxiliary reservoir, and to the emergency reservoir with AB equipment.

c. Open the passage from the brake cylinder to the atmosphere. This causes the car reservoirs and the brake pipe to be charged with the air under pressure.

■ 88. SERVICE APPLICATION.—*a.* When it is desired to make a service application of the brakes, which is the one ordinarily used to stop or slow the train, the engineman moves the handle of the automatic brake valve to the service position. This opens a port in that valve to the atmosphere and allows air to escape from the brake pipe. The equalizing reservoir pressure, as indicated by the black hand on the larger gage in the cab, is allowed to drop anywhere from 5 to 20 pounds per square inch, and the valve handle is then placed in the lap position. This drop of pressure in the equalizing reservoir controls a similar drop in the brake pipe, which activates the parts of the triple valve of each car to move so as to:

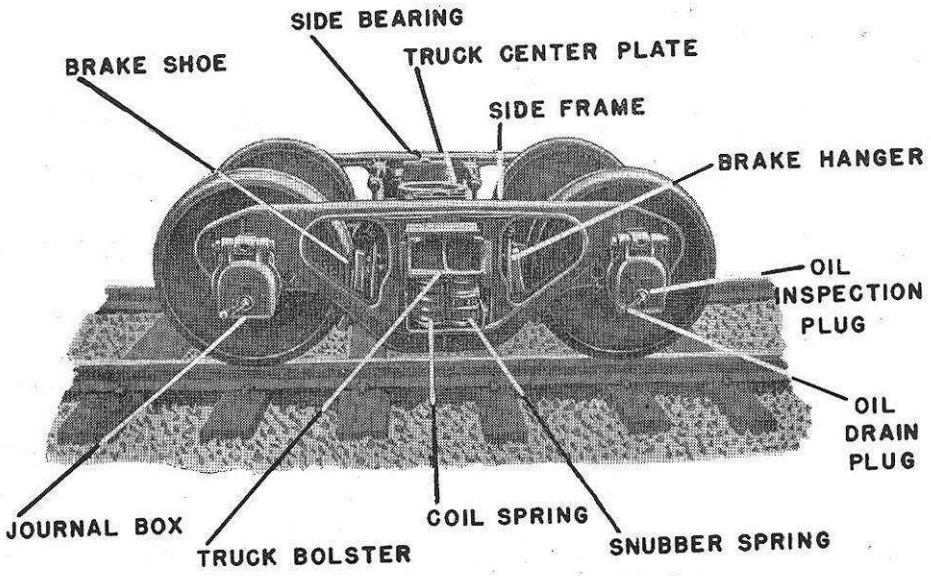


FIGURE 40.—Ammunition car truck—side view.

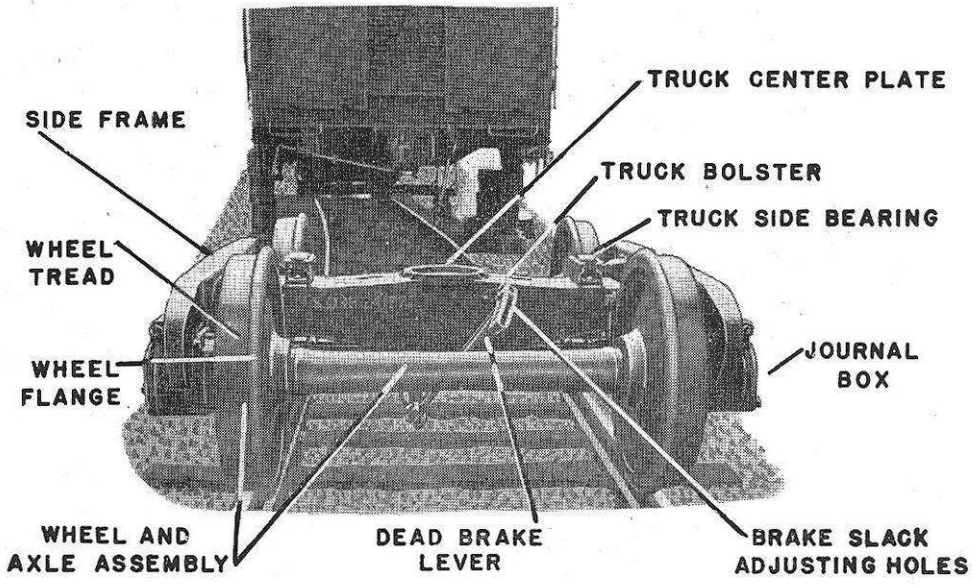


FIGURE 41.—Ammunition car truck—end view.

Bolster.—A cross member, on the under side of a car body and in the center of a truck, through which the weight is transmitted. The bolsters carry the body and truck center plates, the body bolster resting on the truck bolster. Truck bolsters are either swing bolsters, admitting of lateral motion to mitigate shocks, or rigid bolsters, which permit no lateral motion. See *body bolster* and *truck bolster.* (See fig. 41.)

Brake or brake gear.—The whole combination of parts by which the motion of a car or train is retarded or arrested. The foundation brake gear includes all parts by which the pressure of the air in the brake cylinder is transmitted to the wheels.

Car replacer.—A device for getting a derailed truck back on the track. It usually consists of an inclined plane or a curved surface by which the wheels are raised when the car is pulled, so that the flange of the outside wheel can ride upon and over the rail.

Carline.—Steel ribs which extend across the top of a car from one side to the other and support the roof.

Center bearing.—The place in the center of a truck where the weight of the body rests, the truck center plate. A body center plate attached to the car body rests on a truck center plate attached to the truck. The general term *center bearing* is used to designate the whole arrangement and the functions which it performs, in distinction from *side bearing.* See *center plate.* (See fig. 39.)

Center pin or *king bolt.*—A large bolt which passes through the center plates on the body bolster and truck bolster. The truck turns about the bolt, but the stress is taken by the center plates. It is, therefore, a mere pin and not a bolt in the usual sense. The name *king bolt* is derived from the name of the corresponding part of the front wheels of a wagon. *Center pin,* however, is the more common term. Some gun cars have no center pins.

Center plate.—One of a pair of plates which fit one into the other and which support the car body on the trucks, allowing them to turn freely under the car. The center pin or

king bolt passes through both, but does not really serve as a pivot. The body center plate or male center plate is attached to the under side of the body bolster, or, in cast steel bolsters, is made an integral part of the casting. The female, or truck center plate, is attached to the top side of, or is cast integrally with the truck bolster. When the car is tilted, as on a curve, part of the weight is carried on the side bearings. (See fig. 39.)

Center sill.—The central longitudinal member of the underframe of a car, which forms the backbone of the underframe and transmits most of the buffing shocks from one end of the car to the other. In the A.A.R. standard box car the center sill is one of the units for which a required standard has been established. In freight cars with cushioned underframe a special type of floating center sill construction is followed. See *cushioned underframe.* (See fig. 37.)

Center sill cover plate.—A flat plate riveted or welded across steel center sills, either above or below them, to give additional strength.

Clearance or *clearance limit.*—The limiting dimensions of height and width for cars in order that they may safely clear all bridges, tunnels, station platforms, and other structures.

Collar (of a journal).—A rim or enlargement on the end of the car axle. It takes the end thrust of the journal bearing.

Coupler (Car).—The device by means of which the connection of one car to another is automatically accomplished and maintained, and conversely by which cars can be disconnected. The coupler which is now standard on American railroads for both passenger and freight service is called the A.A.R. standard type E coupler. Two types of shanks are available; known respectively as the rigid shank and the swivel butt. The latter arrangement permits horizontal radial action of the coupler with respect to the longitudinal center line of the car. (See fig. 37.) The term coupler (also called coupling) is commonly applied to the connector which is used on air brake and steam heat hose.

Coupler head.—The portion of the coupler that houses the coupling mechanism.

Coupler knuckle.—See *knuckle.*

Coupler lock lifter.—The part of the mechanism inside the coupler head that is moved by the uncoupling rod and in moving lifts the knuckle lock so that the knuckle can open. Also designated as *coupler lock lift.*

Coupler shank.—The back end or body of a car coupler. Also called coupler butt.

Coupler yoke.—The yoke or strap that surrounds the draft gear and is riveted or keyed to the end of the coupler shank.

Crossbearer.—A transverse member of the underframe, placed between the bolsters, which acts as a tie between the various sills and helps to distribute the weight of the car. In steel car construction, the term crosstie is commonly applied only to those members which tie the center and side sills together. The crossbearer usually has a filler between the center sills and thus extends across the car.

Cushion underframe.—A term commonly used to designate the framework of a railway car. It carries the weight of the floor and body of the vehicle and is designed to permit the control of slack and of energy absorption capacity, so as to prevent the shocks and impact stresses from damaging the car structure or its lading. The principle involved in the cushion underframe is the application of a detached center sill that is permitted to travel longitudinally in either direction through the bolsters, crossbearers, and end sills. This travel is resiliently resisted and controlled by high-capacity cushion gears located within the center sill and adjacent to the body bolsters. New ammunition, fire-control, kitchen, and some store cars are equipped with cushion underframes.

Draft casting.—One of a set of castings riveted, bolted, or welded to the draft sills. It transmits to them the stresses received from the draft gear. The latter lies between the draft sills. The ends of its follower plates bear against shoulders on the castings. Also called cheek casting, draft lugs, and draft gear stops, respectively.

Draft gear.—The name of that unit which forms the connection between the coupler rigging and the center sill. The purpose of this unit is to receive the shocks incidental to train movements and coupling of cars, and spread out the force of impact so that the maximum unit stress is brought within the capacity of the car structure for freight service, and within the limits determined by passenger comfort in passenger service. The controlling action of the friction draft gear depends upon combined friction and spring elements. The purpose of the frictional element is to control the amount of recoil. The complete unit is housed within the coupler yoke.

Draft gear carry iron.—A plate which extends underneath the draft sills and supports the draft gear.

Draft key.—A key used with some forms of draft gear to connect the coupler shank to the yoke. It is extended to pass through key slots in the draft sills and cheek plates.

Draft spring.—A spring attached to a coupler or drawbar to give elasticity. They are arranged, by means of follower plates at each end, so as to resist either tension or compression.

Draw head.—The head of an A.A.R. automatic coupler, exclusive of the knuckle, knuckle pin, and lock.

End frame.—The frame which forms the end of a car body. It includes the posts, braces, belt rail, and end plate.

End post.—The vertical members in the end body framing between the corner posts.

End sill.—The transverse member of the underframe of a car. It extends across the ends of all the longitudinal sills. In steel underframe cars, a rolled or cast section, or a pressed plate.

End sill diagonal brace.—A horizontal brace extending from the end sill diagonally back to or beyond the bolster.

End stiffener.—A reinforcing member extending across the end of a freight car to prevent it from bulging or breaking out due to shifting of the load or end shocks.

Equalizer.—A wrought iron or steel piece which bears on top of the journal boxes and extends longitudinally from one to the other. On gun car trucks, the equalizer is connected to the truck springs at both ends. It is used to transfer part of the weight from one axle to the other, and thus equalize it on both; hence its name. (See fig. 38.)

Followers.—Rectangular or circular plates, or blocks of metal placed inside of the coupler yoke and bearing against each end of the draft gear. Their function is to protect the draft gear from the battering due to the movement of the drawbar and to transmit the stresses of compression or tension to the draft springs and the center sills. They literally "follow" the gear.

Foundation brake gear.—The levers, rods, and brake beams by which the piston rod of the brake cylinder is connected to the brake shoes.

Gage, track.—The distance in the clear between the heads of the rails of a railway; 4 ft., 8½ in., is the standard gage; if greater than this by more than ½ in., it is a broad gage; if smaller, a narrow gage. Wide gage usually means a minor and irregular or exceptional enlargement of a given fixed gage, in distinction from tight gage, a corresponding contraction. The term "narrow gage" also is used to designate a gage less than 4 ft. 8½ in., such as a 3-ft. gage or a meter gage. The term "broad gage" is commonly used to designate such gages as 5 ft. or 5 ft. 6 in., which are used in some countries. (See figs. 2, 3, and appendix II.)

Gondola car.—A freight car with sides and ends, but without a top covering. The floor or bottom is level or approximately so. Used for transportation of freight in bulk or as idler car in railway artillery service. Gondola cars are sometimes distinguished as high side, low side, drop end, drop bottom, general purpose, and convertible. (See fig. 49.)

Grab iron.—A rod or bar of iron attached to freight cars for the use of trainmen in boarding cars. Also termed handhold and grab handle. Often more definitely specified as roof, side, or end grab irons. See *safety appliances.* (See fig. 37.)

Hand brake.—The name applied to the brake apparatus with which all cars are equipped, which permits the brakes to be applied by hand. When cars are being switched in yards they are frequently in motion when no locomotive is coupled to them. A hand brake is necessary so that the trainmen may control them. See *safety appliances.* (See fig. 33.)

Hot box.—An overheated journal (commonly known as a hot box) is one that requires treatment or setting out of any car when such hot journal develops between originating point and destination of car.

Journal.—The part of an axle or shaft on which the journal bearing rests.

Journal bearing.—A combination of rollers and races or a block of metal, usually brass or bronze, in contact with a journal, on which the load rests. In car construction the term, when unqualified, means a car axle journal bearing. The standard A.A.R. journal bearing has a soft white metal lining, ¼ inch thick, which serves as a wearing surface where the bearing rests on the axle journal.

Journal bearing wedge.—A device used to hold the journal bearing in place, to distribute the load evenly over the bearing, and to allow it to be removed easily. Sometimes called a journal box key.

Journal box.—The metal housing which incloses the journal of a car axle, the journal bearing and wedge, and which holds the oil and packing for lubricating the journal. Also called an axle box, car box, grease box, housing box, oil box, or pedestal box. (See fig. 41.)

Journal box lid.—A door or lid covering an opening in the end of the journal box by means of which oil and packing are supplied, and journal bearings are inserted or removed. Such covers usually are made of cast iron, malleable iron, or pressed steel. They usually are held closed by a spring. (See fig. 21.)

Journal box lid spring.—A spring to hold the lid in place.

Journal brass.—A journal bearing.

Journal jack.—A small screw-type jack used for relieving the weight from car journals for the purpose of changing bearings or brasses.

Knuckle (coupler).—The rotating coupling hook by means of which coupling is effected when the knuckle is locked by the catch or lock. It must conform to certain contour lines adopted by the A.A.R.

Knuckle pin (coupler).—The pin holding the knuckle in the jaws of the coupler. Sometimes called pivot pin.

Ladder.—Bars of wood or iron attached to the side or end of a freight car or caboose so as to form steps by which personnel may climb to and from the top of the car. The individual bars, whether wood or iron, and whether round or square, are termed ladder rounds. They are sometimes fastened at their ends to ladder side rails. The handles alongside of the ladder are termed grab irons or handholds, or sometimes corner handles; the one placed on the roof near the ladder is called the roof grab iron or ladder hand rail.

Lateral motion.—The motion, perpendicular to the center line of the track, of all car parts except the wheels and axles. This lateral motion or end play results from the need for flexibility which must be provided in truck structure in order to permit easy and safe negotiation of track curvatures.

Lining.—The covering applied to the insides of the ends and sides of box cars and types of closed cars other than passenger-carrying cars. When the lining extends from the floor to the roof it becomes inside sheathing and is the only sheathing on some cars constructed with the frame exposed on the outside.

Load limit (in car).—That weight of load in a car which, when added to the light weight of the car, gives the maximum A.A.R. axle loading.

Load limit (on rail).—The combined light weight of a car and the load weight which gives the maximum A.A.R. axle loading.

Purlin or *purline.*—A longitudinal roof-frame member extending over the carlines from one end of the car to the other, to which the roof boards or sheets are fastened. Sometimes called a roof strip; but the latter more correctly applies to strips sometimes used above the purlins.

Push pole pocket.—A plate placed on the corners of freight cars, and having a cavity for inserting a pole or bar in switching, to enable the car to be moved from the side by an engine on a parallel track. (See fig. 37.)

Roller bearing.—The general term applied to a group of journal bearings which depend upon the rolling action of a set of rollers in order to reduce rotational friction. The different types are distinguished by the shapes of the rollers and their arrangement in the bearing. Three types of rollers are in common use for car journals: cylindrical, tapered, and spherical. In addition to the rollers the complete bearing includes a suitable housing, a set of supporting pieces called races (inner and outer), and in some cases, restraining pieces called cages. (See figs. 26 and 38.)

Roof.—As applied in car construction, the term roof refers to the covering which is laid over the carlines and purlins to form the covering and provide outside weather protection.

Roof hand hold (box car).—An iron bar bent to a required shape and fastened to the roof. It is to be grasped when ascending the ladder at the end of the car. Also called roof grab iron. (See fig. 37.)

Running board.—A plane surface made of boards or metal for trainmen to walk or run on. It is placed on the roof of box-type cars and at the sides of tank cars. Gondola, hopper, and flat cars usually have none. (See fig. 37.)

Running board extension.—The part of the running board which extends beyond the end of the car body so as to bring the ends of the running boards on adjoining cars nearer together. This facilitates the passage of trainmen from one car to another. (See fig. 37.)

Safety appliances.—Devices required by the Interstate Commerce Commission to assure safety in operation of cars and locomotives.

Sheathing.—The side and end covering of a car. Tongue and groove lumber is used on wooden cars and steel plates on all-steel cars. Lining is also used on some cars in addition to the ordinary outside sheathing. When it extends from floor to roof it is sometimes called inside sheathing. (See fig. 37.)

Side bearing.—Bearings attached to the bolsters of a car body or truck, 2 ft. or more from each side of the center plate. They steady the car and prevent excessive rocking while going around curves. The upper, or body side bearing, and the lower, or truck side bearing, are sometimes merely box-shaped castings with large flat bearing surfaces as contacts. To overcome contact friction, rollers, and rockers are used in many different ways. Such side bearings are ordinarily furnished complete as a device to fill the space between the body bolster and the truck bolster. If the portion containing the anti-friction member is fastened to the truck bolster, it is known as a truck side bearing; if fastened to the body bolster, it is considered a body side bearing. (See fig. 41.)

Side door.—Designated thus to distinguish from end door on both freight and passenger equipment. (See fig. 37.)

Sill (car).—The main longitudinal members of a car underframe which are connected transversely by the end sills, body bolsters, and crossties. Sills are divided into side sills, intermediate sills, and center sills. (See fig. 37.)

Striking plate.—A steel casting placed on the ends of the center sills of freight cars, against which the horn of the coupler strikes, thus preventing damage to the draft gear and center sills.

Stringer.—A term sometimes applied to a floor nailing strip or a steel member which acts as a support for a nailing strip. A longitudinal floor stringer sometimes occupies a position similar to that of an intermediate sill but it is not designed to perform its duties.

Train line.—The complete line of air brake, air signal, or steam heat pipes in a railroad train. These lines include the

rigid piping secured under the cars and the flexible connections between cars and between the cars, the tender, and the locomotive. (See fig. 35.)

Truck.—The general term covering the assembly of parts comprising the structures which support a car body at each end and also provide for attachment of wheels and axles. (See fig. 37.)

Truck bolster.—A cross member in the center of a truck on which the car body rests. The truck bolster is connected to the body bolster by a center pin which passes through both. (See fig. 41.)

Truck frame.—A one-piece structure made of cast steel, to which the journal boxes, pedestals, springs, and other parts are attached, and which forms the skeleton of a truck.

Truck side frame.—The longitudinal portion of a truck structure, on the outside of the wheels, which extends from one axle to the other, to which the journal boxes and bolsters are attached or of which they form a part. (See fig. 40.)

Uncoupling lever or uncoupling rod.—An iron or steel rod with a bent handle forming a lever, usually attached to the end sill, by which the lock of the automatic coupler is opened and the cars are uncoupled without going between them. The lever proper is the part attached to the rod and it operates the unlocking mechanism, but in the case of freight cars, the lever and rod are generally made in one piece. (See fig. 37.)

Underframe.—A framework, which receives the buffing and pulling stresses and carries the weight of the floor and body of the vehicle. In America, in both freight and passenger cars the underframe and body are rigidly connected and mutually stiffen and strengthen one another. Underframe includes all the framing below the floor: sills, platforms, bolsters, and crossbearers.

Waste.—Threads of wool, cotton, or mixtures of these into which is worked curled vegetable fiber, often coconut

fiber. This imparts to the product an elasticity not possessed by wool or cotton threads alone. The material is saturated with lubricating oil and placed in a journal box so that it comes in contact with the lower half of the journal. It is sometimes called packing or dope. (See fig. 31.)

Wedge.—The metal piece used to keep a journal bearing in its place in the journal box.

Wheel.—Wheels used under freight and passenger cars may be classified in four main groups: chilled cast iron, cast steel, rolled or wrought steel, and steel-tired. However, wheels belonging to the last-named group are now used in only a few special instances. The general subject matter concerning car wheels is far too comprehensive even to attempt in a short definition. A "Wheel and Axle Manual" compiled under the auspices of the A.A.R. *Committee on Wheels* covers essential data regarding specifications, standards, and recommended practices. (See appendix III.)

APPENDIX II

RAILWAY DATA

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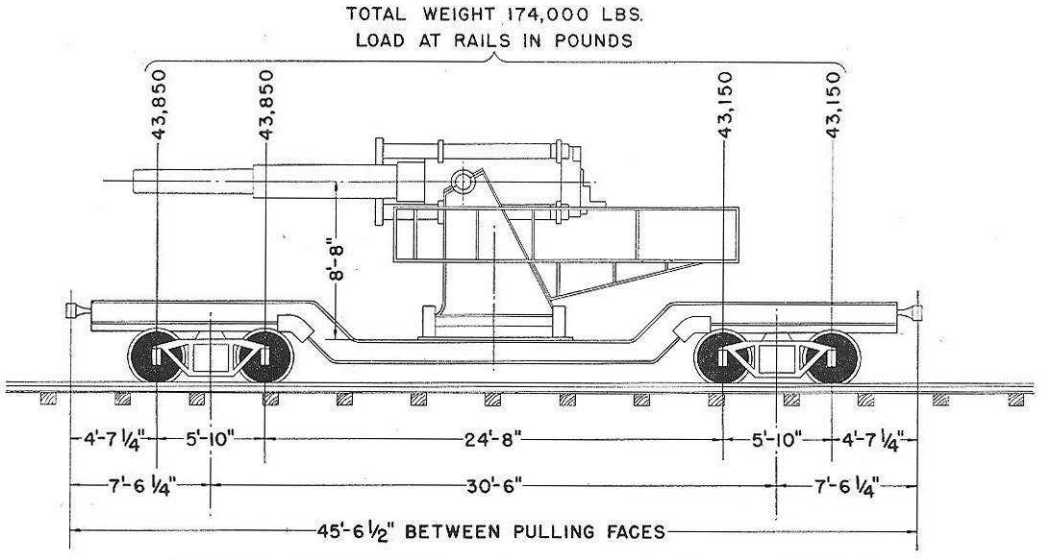


FIGURE 42.—8-inch barbette carriage, M1918, on railway car M1918M1.

8-INCH BARBETTE CARRIAGE, M1918, ON RAILWAY CAR M1918M1 (See fig. 42)

Total weight at rail	pounds	174,000
Weight on front truck (muzzle end)	pounds	87,700
Weight on rear truck (breech end)	pounds	86,300
Height (traveling position)	feet-inches	13-4
Length, between couplers	feet-inches	45-6½
Width (traveling position)	feet-inches	10-0
Diameter of wheels	inches	33
Journals, diameter and length	inches	6 x 11
Weight of car body	pounds	61,000
Weight of trucks, each	pounds	10,500
Maximum operating speed	miles per hour	25
Limitation of curvature on movement:		
Radius of curve	feet	270
Curvature	degrees	21.22

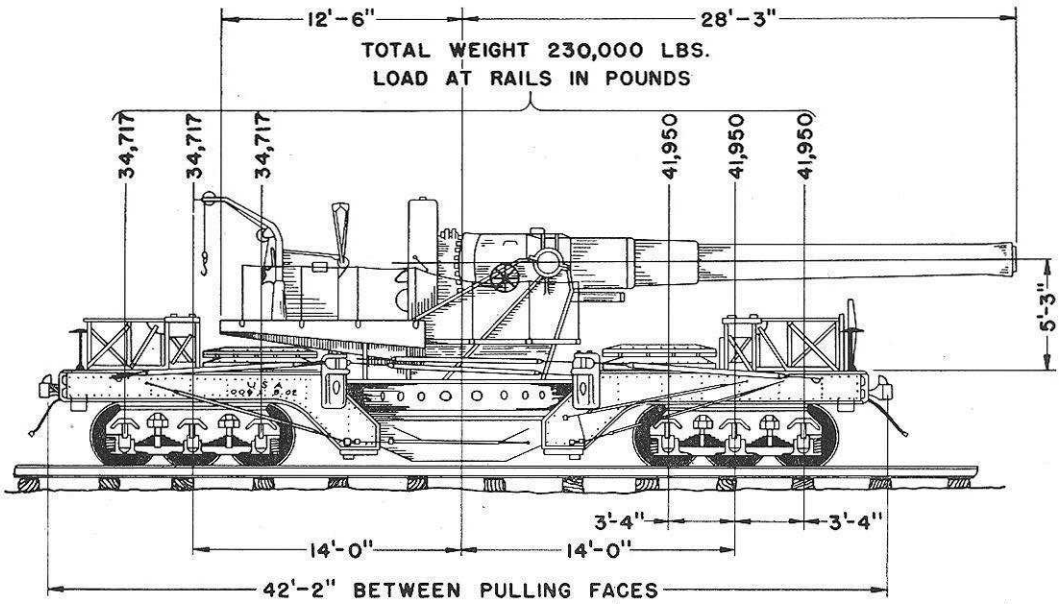


FIGURE 43.—8-inch gun, Mk. VI, Mod. 3A2, on railway mount M1A1.

8-INCH GUN MK. VI, MOD. 3A2, ON RAILWAY MOUNT M1A1 (See fig. 43)

Total weight at rail	pounds	230,000
Weight on front truck (muzzle end)	pounds	125,850
Weight on rear truck (breech end)	pounds	104,150
Height (traveling position)	feet-inches	13-10
Length, between couplers	feet-inches	42-2
Length, over-all (traveling position)	feet-inches	49-4
Width (traveling position)	feet-inches	10-3
Diameter of wheels	inches	28
Journals, diameter and length (plain bearings)	inches	5½ x 10

Maximum operating speeds for mounts with plain bearings:

Main line passenger tracks	miles per hour	50
Main line freight tracks	miles per hour	40

Branch line tracks...governed by local track condition.

Maximum operating speed for mounts with roller bearings:

Maximum freight train speed for trackage on which operating.

Limitation of curvature on movement:

By pinch bar over radius of curvature of approximately 60 feet.

At 5-10 miles per hour over track with radius of curvature of 270 feet.

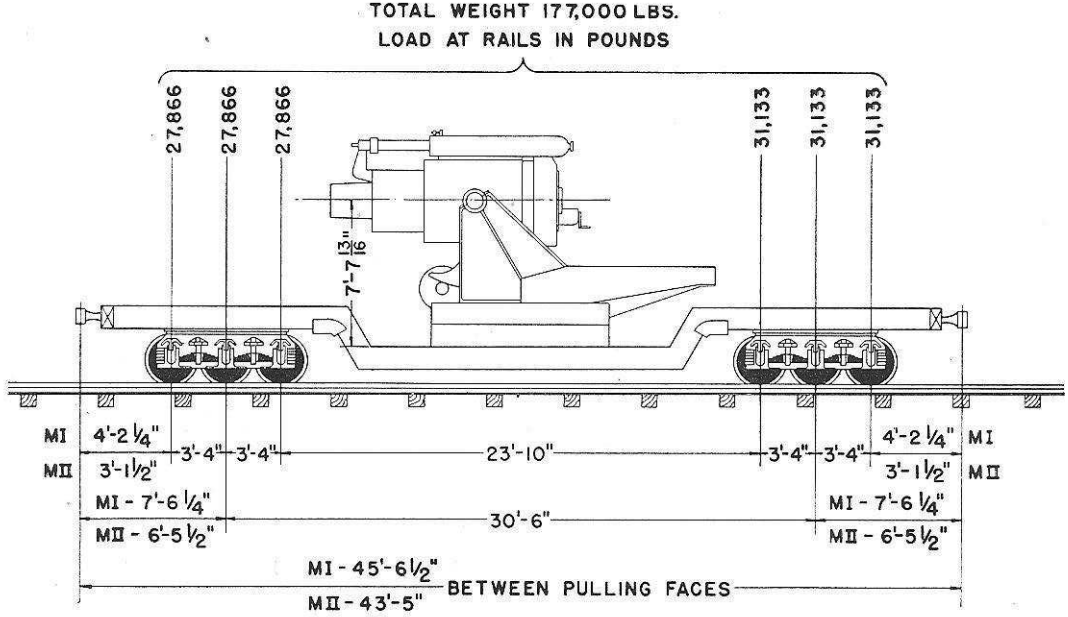
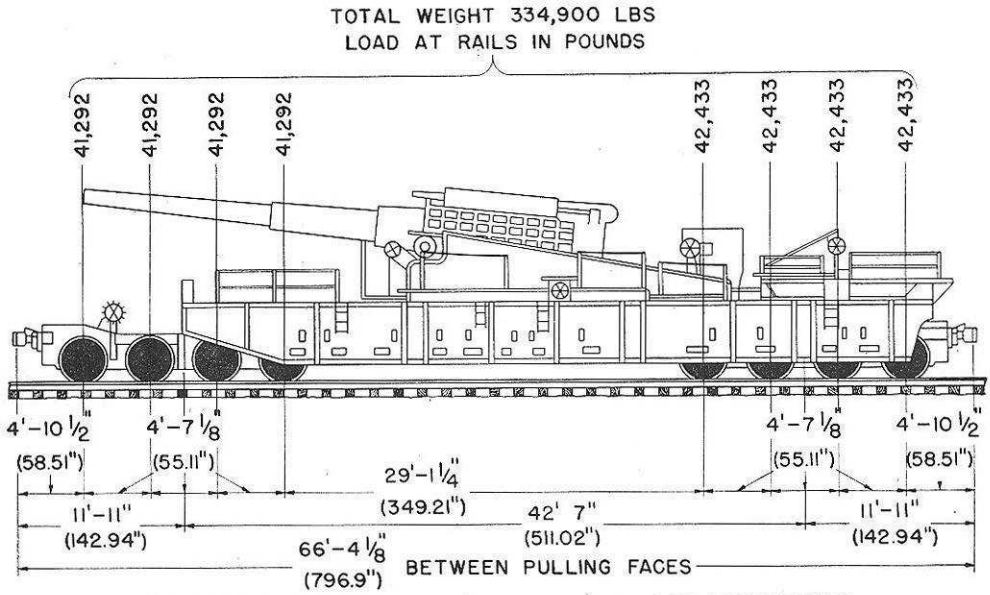


FIGURE 44.—12-inch mortar carriage, Model 1918, on railway car, Model 1918MII.

12-INCH MORTAR CARRIAGE, MODEL 1918, ON RAILWAY CAR, MODEL 1918MII

(See fig. 44)

Total weight at rail	pounds	177,000
Weight on front truck (muzzle end)	pounds	83,600
Weight on rear truck (breech end)	pounds	93,400
Height (traveling position)	feet-inches	10-9
Length, between couplers:		
Railway car, MI	feet-inches	45-6½
Railway car, MII	feet-inches	43-5
Width (traveling position)	feet-inches	10-0
Diameter of wheels	inches	28
Journals, diameter and length	inches	5½ x 10
Weight of car body	pounds	60,000
Weight of truck, each	pounds	15,000
Maximum operating speed	miles per hour	25
Limitation of curvature on movement:		
Radius of curve	feet	270
Curvature	degrees	21.22



NOTE: ALL DIMENSIONS IN FEET AND INCHES ARE APPROXIMATE.

FIGURE 45.—12-inch railway mount, M1918 (Batignolles).

12-INCH RAILWAY MOUNT, M1918 (BATIGNOLES)

(See fig. 45)

Total weight at rail.....pounds	334,900
Weight on front truck (muzzle end)..pounds	165,168
Weight on rear truck (breech end)..pounds	169,732
Height (traveling position).....feet-inches.	13-10
Length, between couplers.....feet	66.4
Width (traveling position).....feet-inches.	10-0
Diameter of wheels.....inches	36.22
Journals, inside, diameter and length. inches	6.693 x 12.2
Type of trucks.....	French
Weight of trucks, each.....pounds	32,500
Limitation of curvature on movement:	
Radius of curve .....feet	270
Curvature.....degrees ...	21.22

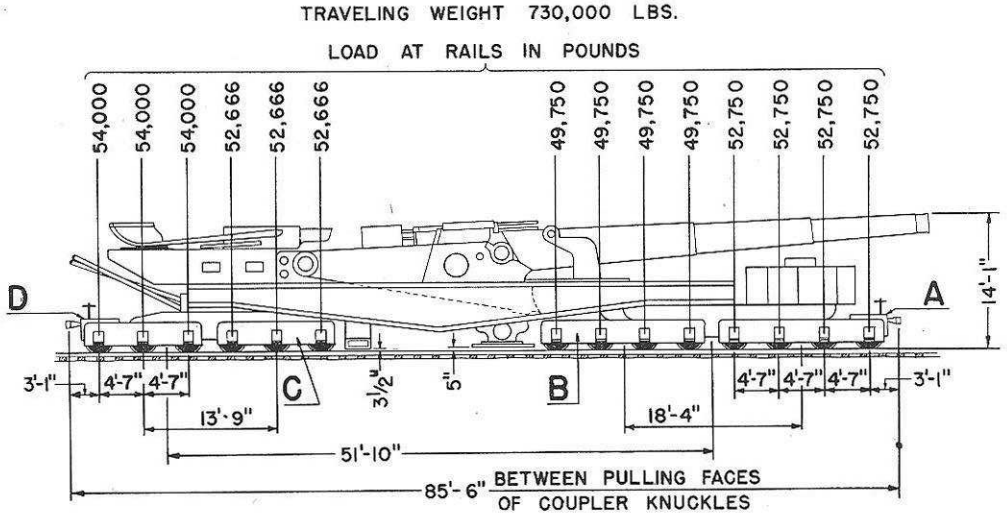


FIGURE 46.—14-inch railway mount, Model of 1920.

14-INCH RAILWAY MOUNT, MODEL OF 1920

(See fig. 46)

Total weight at rail	pounds	730,000
Weight on truck "A"	pounds	211,000
Weight on truck "B"	pounds	199,000
Weight on truck "C"	pounds	157,998
Weight on truck "D"	pounds	162,000
Height (traveling position)	feet-inches	13-10
Length, between couplers	feet-inches	85-6
Width (traveling position)	feet-inches	10-0
Diameter of wheels	inches	30
Journals, diameter and length	inches	6 x 11
Maximum operating speed	miles per hour	25
Limitation of track curvature on movement:		
Radius of curve	feet	270
Curvature	degrees	21.22
Weight of truck "A"	pounds	30,040
Weight of truck "B"	pounds	25,320
Weight of truck "C"	pounds	19,300
Weight of truck "D"	pounds	23,540

Trucks "A" and "D" are equipped with air and hand brakes, and draft gear.

Trucks "B" and "C" are equipped with translating mechanism.

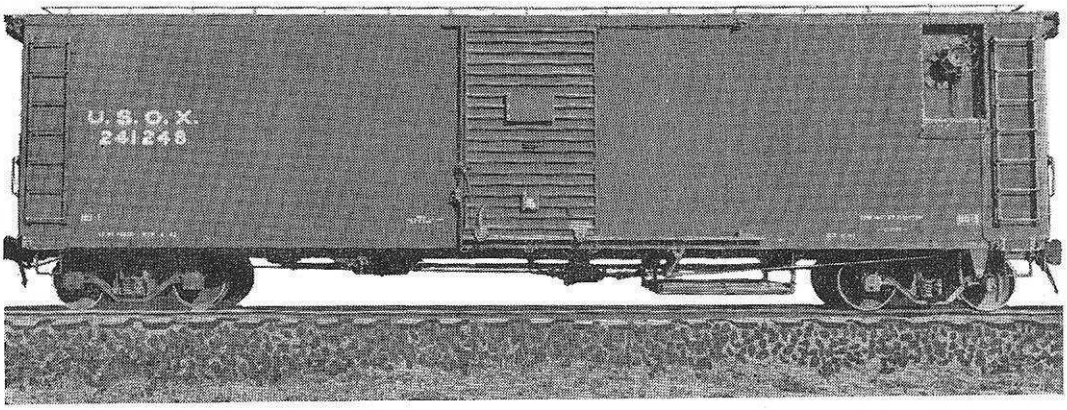


FIGURE 47.—Ammunition car, 8-inch.

Built	June 1942	Length, over-all	51 ft. 4 in.
Capacity	160 rounds	Length, interior	46 ft. 0 in.
Light weight	74,660 lbs.	Width, exterior	10 ft. 9 in.
Journals	Roller bearing	Width, interior	9 ft. 5 in.
Journals, size	5 in. x 9 in.	Height, exterior	14 ft. 3 in.
		Height, interior	9 ft. 5 in.

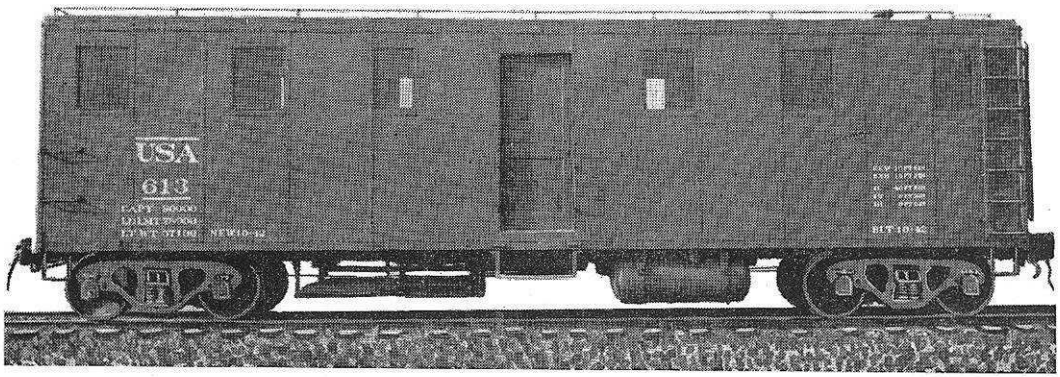


FIGURE 48.—Fire-control car.

Built	Oct. 1942	Length, over-all	46 ft. 2 in.
Capacity	80,000 lbs.	Length, interior	40 ft. 6 in.
Load limit	78,900 lbs.	Width, exterior	10 ft. 6 in.
Light weight	57,100 lbs.	Width, interior	9 ft. 3 in.
Journals	Roller bearing	Height, exterior	13 ft. 2 in.
Journals, size	5 in. x 9 in.	Height, interior	8 ft. 6 in.

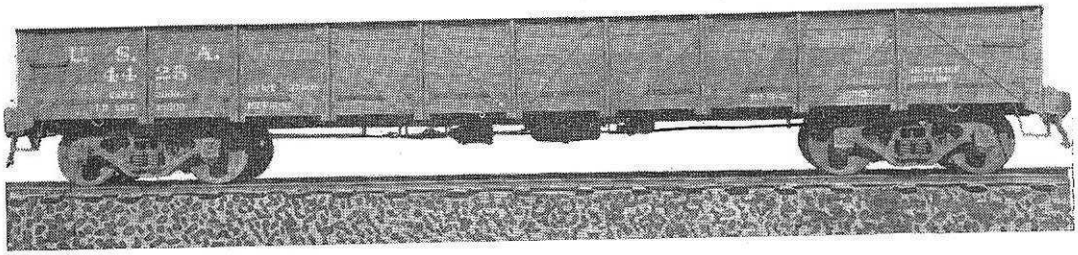


FIGURE 49.—Gondola (idler car).

Built	Nov. 1942
Capacity	80,000 lbs.
Load limit	98,200 lbs.
Light weight	37,800 lbs.
Journals	Plain
Journals, size	5 in. x 9 in.
Type	Drop-end
Length, over-all	45 ft. 6 in.
Length, interior	41 ft. 0 in.
Width, exterior	10 ft. 7 in.
Width, interior	9 ft. 6 in.
Height	6 ft. 9 in.

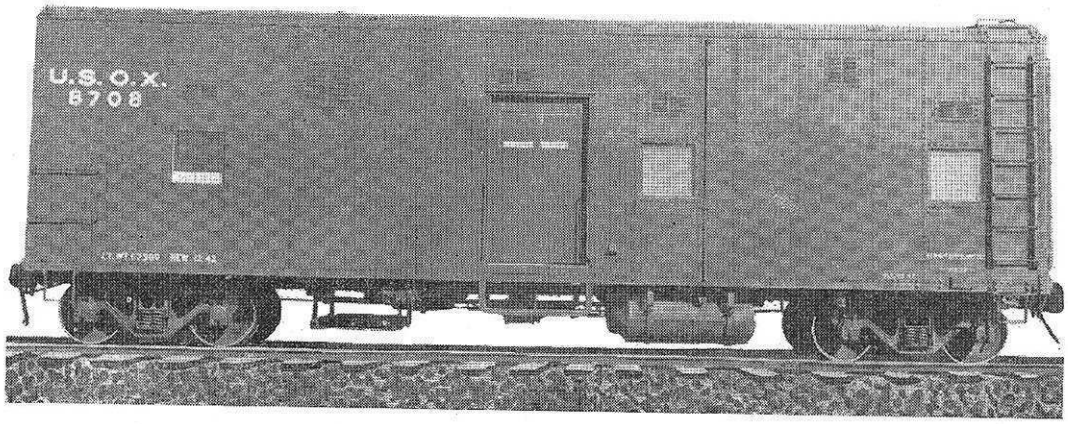


FIGURE 50.—Kitchen car.

Built	Dec. 1942
Light weight	67,300 lbs.
Journals	Roller bearing
Journals, size	5½ in. x 10 in.
Length, over-all	46 ft. 6 in.
Length, interior	40 ft. 6 in.
Width, exterior	10 ft. 6¼ in.
Width, interior	9 ft. 1 in.
Height, exterior	14 ft. 6½ in.
Height, interior	9 ft. 4 in.

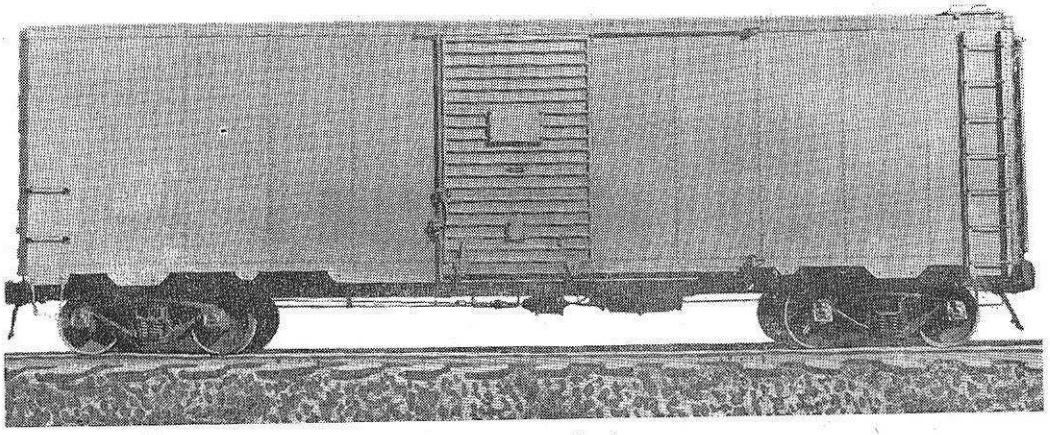


FIGURE 51.—Store (box) car.

Built	Dec. 1942	Length, over-all	44 ft. 6 in.
Capacity	80,000 lbs.	Length, interior	40 ft. 6 in.
Load limit	91,800 lbs.	Width, exterior	10 ft. 5 in.
Light weight	44,200 lbs.	Width, interior	9 ft. 2 in.
Journals	Plain and roller bearing	Height, exterior	13 ft. 11 in.
Journals, size	5½ in. x 10 in.	Height, interior	10 ft. 0 in.

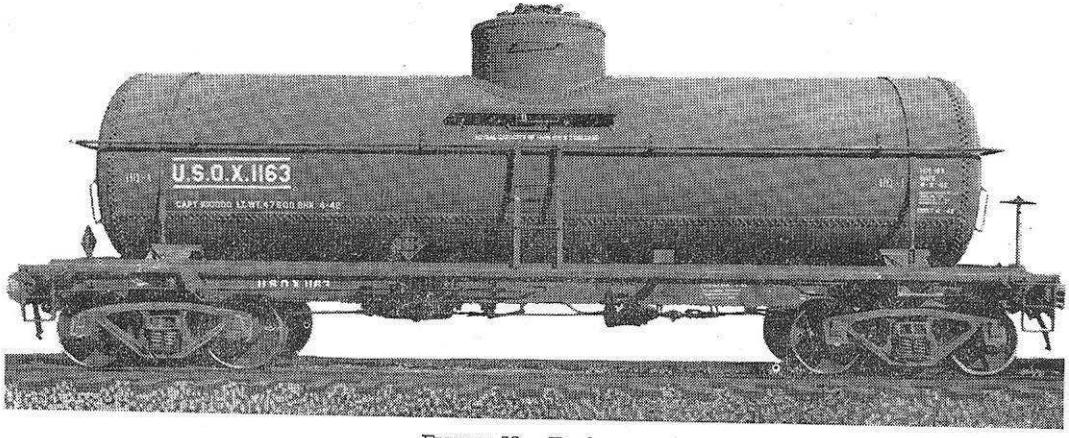


FIGURE 52.—Tank car.

Built	April 1942	Journals	Plain
Capacity	100,000 lbs.	Journals, size	5½ in. x 10 in.
Capacity	10,000 gal.	Length, over-all	39 ft. 4 in.
Light weight	47,600 lbs.	Width, exterior	10 ft. 3 in.
		Height, exterior	14 ft. 4 in.

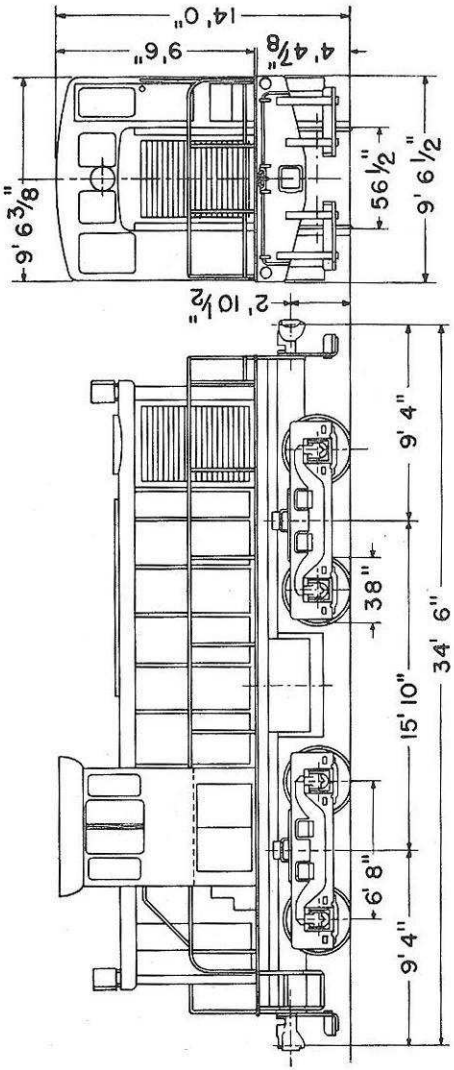


FIGURE 53.—Principal dimensions of Diesel-electric locomotive.

LOCOMOTIVE DATA (See fig. 53)

Builder	General Electric Company
Class	B-B-120/120
Horsepower rating	420
Tractive force:	
Starting, lb.	35,500
Continuous rating, lb.	12,000
One-hour rating, lb.	22,000
Maximum operating speed, m.p.h.	40
Maximum radius curve (locomotive alone), ft.	100
Diesel engine:	
Type	Cooper-Bessemer ENL-8
Maximum speed, r.p.m.	900
Idling speed, r.p.m.	350
Full-load speed, r.p.m.	900
Method of starting	Main generator (as motor)
Traction motors:	
Number	4
Gear ratio	81/16 single reduction
Capacity of fuel tank, gal.	210
Capacity of lubricating oil tank, gal.	30
Capacity of sand boxes, lb.	1,700
Maximum over-all locomotive dimensions:	
Height, ft.-in.	14-0
Width, ft.-in.	9-6⅜
Length, inside knuckles, ft.-in.	34-6
Weights:	
On drivers, lb.	120,000
Total locomotive, lb.	120,000
Driving wheels:	
Number (pairs)	4
Diameter, in.	38

Wheelbase:	
Each truck, rigid, ft.-in.	6-8
Total locomotive, ft.-in.	22-6
Journal bearings, type	Plain
Air brakes:	
Type	No. 14-EL
Number of brake cylinders	4
Brake cylinder size, diameter and stroke, in.	8 x 7

DIESEL ENGINE DATA

Bore and stroke, in.	8 x 10½
Firing order	1-3-2-5-8-6-7-4
Arrangement	Left-hand engine, clockwise rotation
Bearing clearances:	
Main, in.	.005-.006
Crankpin, in.	.005-.006
Piston pin, in.	.001-.0015
Camshaft, in.	.002-.004
Cooling system:	
Water outlet temperature, normal, deg. F.	160-170
Water outlet temperature, maximum, deg. F.	190
Cylinder pressures:	
Compression, hot, lb. per sq. in.	400
Firing, maximum, lb. per sq. in.	750
Relief valve setting, lb. per sq. in.	1,100
Fuel system—	
Fuel pressure:	
Full load, lb. per sq. in.	7,500
Idling load, lb. per sq. in.	3,000
Nozzle opening pressure, lb. per sq. in.	2,500
Injection timing	30 deg. B.T.C. to 0 deg. A.T.C.
Lubricating system:	
Oil pressure, recommended, lb. per sq. in.	25

Lubricating system—*Continued*	
Temperature, leaving cooler, maximum, deg. F.	150
Piston:	
Clearance in cylinder, in.	.012-.015
Ring clearance:	
Ring No. 1, side clearance, in.	.006-.0085
Ring No. 1, end gap, plain and step bevel, in.	.040-.007
Others, side clearance, in.	.004-.0065
Others, end gap, plain and step bevel, in.	.024-.017
Valve, main—	
Timing:	
Opens, inlet	20 deg. B.T.C.
Closes, inlet	35 deg. A.B.C.
Opens, exhaust	35 deg. B.B.C.
Closes, exhaust	20 deg. A.T.C.
Tappet clearance—	
Normal running, hot:	
Inlet, in.	.012
Exhaust, in.	.018
For timing, cold:	
Inlet, in.	.020
Exhaust, in.	.020

TRACK GAGES OF VARIOUS COUNTRIES

COUNTRY	GAGE	
	Feet-inches	Meters
India, Spain, Portugal, Argentina	5-6	1.676
Ireland, South Australia, Victoria, Brazil	5-3	1.600
Russia	5-0	1.524
United States, Great Britain, Canada, Mexico, European Continent (except Spain, Portugal, and Russia), Australian Commonwealth Railways, New South Wales, North Africa.	4-8½	1.435

(Continued on p. 150)

FROG NO	FROG ANGLE	LGTH. OF FROG		LENGTH OF SWITCH POINTS	DEGREE OF TURNOUT CURVE	LENGTH OF LEAD	TOT. LGTH. OF CONNECT. RAIL	GAGE LINE OFFSETS					
		POINT TO TOE	POINT TO HEEL					A	B	C	D	E	F
5	11°-25'	3'-6½"	5'-5½"	11'-0"	32°-40'	42'-6"	56'-4"	18'-0"	25'-0"	32'-0"	12"	20½"	2'-9"
6	9°-32'	3'-9"	6'-3"	11'-0"	22°-18'	47'-6"	65'-9"	19'-2¼"	27-4½"	35'-6¾"	12½"	21½"	2'-10"
7	8°-10'	4'-8½"	7'-3½"	16'-6"	15°-43'	62'-1"	82'-0"	26'-2¼"	35'-10½"	45'-6¾"	11½"	19½"	2'-7"
8	7°-09'	5'-1"	7'-11"	11'-0" 16'-6"	11°-05' 11°-47'	60'-11" 68'-0"	90'-0" 93'-0"	27'-7¼"	38'-8½"	49'-9¾"	12"	20½"	2'-8½"
9	6°-22'	6'-4½"	9'-7½"	16'-6"	9°-20'	72'-3"	99'-0"	28'-10¼"	41'-2½"	53'-6¾"	12"	21½"	2'-9½"
10	5°-43'	6'-5"	10'-1"	16'-6"	7°-21'	78'-9"	111'-10"	29'-11¾"	43'-5½"	56'-11¼"	12½"	21"	2'-8½"
11	5°-12'	7'-0"	11'-8½"	22'-0"	6°-11'	91'-10"	125'-10"	37'-8½"	53'-5"	69'-1½"	12½"	21½"	2'-10"
12	4°-46'	7'-9½"	12'-6½"	22'-0"	5°-11'	96'-8"	133'-10"	38'-8½"	55'-5"	72'-1½"	12½"	21½"	2'-10"
14	4°-05'	8'-7½"	14'-11½"	22'-0"	3°-37'	107'-1"	153'-0"	41'-1¼"	60'-2½"	79'-3¾"	13"	22½"	2'-10½"
15	3°-49'	9'-5"	14'-11½"	30'-0"	3°-20'	126'-4"	174'-0"	51'-9"	73'-6"	96'-3"	12"	21"	2'-10"
16	3°-35'	9'-5"	16'-7"	30'-0"	2°-51'	131'-4"	183'-11"	53'-0"	76'-0"	99'-0"	12½"	22"	2'-10"
18	3°-11'	11'-0½"	18'-2½"	30'-0"	2°-13'	140'-11"	199'-11"	55'-0"	80'-0"	105'-0"	13"	22"	2'-10½"
20	2°-52'	11'-0½"	19'-10"	30'-0"	1°-44'	151'-11"	221'-11"	57'-9"	85'-6"	113'-3"	13"	22½"	2'-11"

FIGURE 54.—Turnout data. (See fig. 55.)

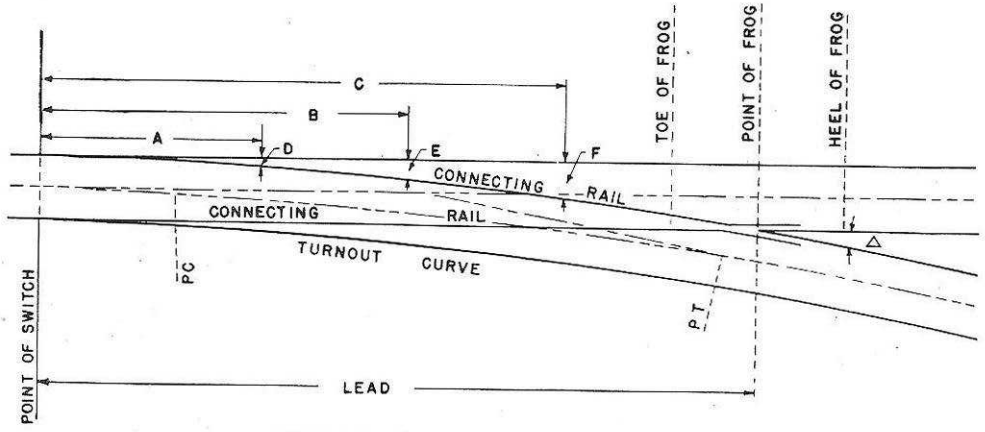


FIGURE 55.—Turnout diagram. (See fig. 54.)

TRACK GAGES OF VARIOUS COUNTRIES—*Continued.*

COUNTRY	GAGE	
	Feet-inches	Meters
Queensland, South Australia, Tasmania, New Zealand, Australian Commonwealth Railways, South and East Africa, Sudan, Japan, East India, Sweden, Norway.	3-6	1.067
Asia Minor (part), Algeria	3-5½	1.05
India, Burma, Malaya, Algeria, South America	3-3⅜	1.0
Ireland	3-0	0.941
Sweden	2-11	0.891
India	2-5½	0.75
Wales, India, South America	1-11½	0.6

TABLE OF EXPANSION OPENINGS AT RAIL JOINTS

Temperature Degrees Fahrenheit	Expansion Allowance—Inches	
	33-ft. rails	39-ft. rails
Minus 20 to zero	5/16	3/8
Zero to 25	1/4	5/16
25 to 50	3/16	1/4
50 to 75	1/8	1/8
75 to 100	1/16	1/16

NEW CAR OIL SPECIFICATIONS

	Summer Grade	Winter Grade	All-year Grade
1. Flash (open cup) minimum	300° F.	300° F.	300° F.
2. Saybolt universal viscosity:			
a. At 210° F., minimum desired	.....	.....	50 sec.
b. At 210° F., minimum permitted	55 sec.	40 sec.	47 sec.
c. At 100° F., maximum desired	450 sec.	260 sec.	.....
d. At 100° F., maximum permitted	725 sec.	300 sec.	300 sec.
3. Pour point	20° F.	0° F.	0° F.
4. Water, maximum	0.10%	0.10%	0.10%
5. Tarry matter, maximum	0.10%	0.10%	0.10%
6. Insoluble impurities (dirt) maximum	0.10%	0.10%	0.10%
7. Acidity	Neutral to methylorange and phenolphthalein.		

APPENDIX III

LIST OF REFERENCES

Construction and maintenance of railway track	FM 5-10 Maintenance of Way Manual—Military Railway Service
Diesel engines and fuels	TM 10-575
Destruction of materiel	FM 5-25 Appropriate service of the piece manuals
Foreign railways	Reports prepared by the Military Railway Service

*Non-military publications:

United States Safety Appliance Standards

Laws, Rules, and Instructions for Inspection and Testing of Locomotives Other Than Steam

Association of American Railroads Manual of Standard and Recommended Practices

Association of American Railroads Interchange Rules

Association of American Railroads Wheel and Axle Manual

Association of American Railroads Methods for Loading and Staying Carload and Less-Than-Carload Shipments of Explosives and Other Dangerous Articles—BE Pamphlet No. 6

*All non-military publications listed in appendix III have been approved for distribution to railway artillery units. Requisitions for additional copies should be submitted direct to The Adjutant General, Washington, D. C.

LIST OF REFERENCES—*Continued.*

No. 14-EL Brake Equipment for Diesel-Electric Locomotives

The AB Freight Brake Equipment

The Type-K Freight Brake Equipment

Operating Rules, Military Railway Service .....TM 5-415

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