179. **Tenders.**—The capacity of the tender in fuel and water is determined by the local conditions, and since the establishment of pumping and coaling plants entails considerable time and labor, the tender should carry more fuel and water than would be desirable under commercial conditions.

On standard gage railways, tenders usually carry from 3,000 to 7,000 gallons of water and from 5 to 10 tons of coal.

180. **Number of locomotives.**—Knowing the amount of supplies to be carried by the railroad and the amount that can be handled in one train, the **number of locomotives** can be easily computed; but in providing **locomotives provision must** be made for a great many accidents, and the number of locomotives ordered should be about one and one-half times the number that it is expected to use at one time, thus allowing one-third of the whole number to be in the repair shop at one time.

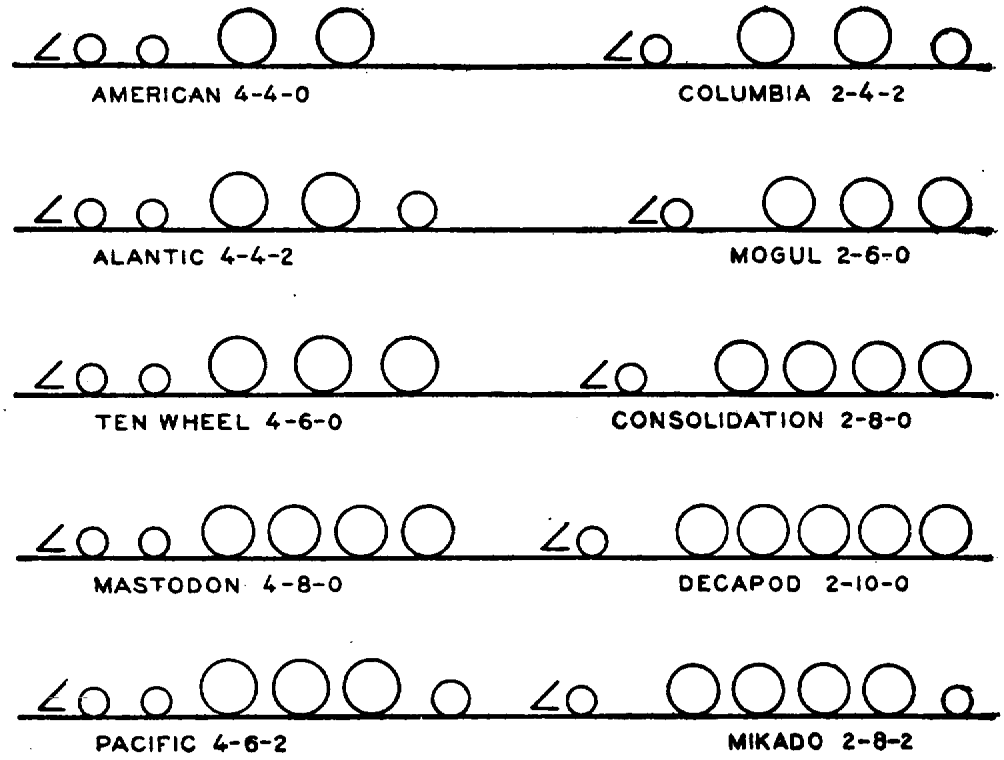

FIG. 126.

181. **Interchangeable parts.**—Whatever kind of locomotive is purchased, the specifications should require that all the parts should be interchangeable in all locomotives of the same class.

Fig. 125 shows a locomotive with all parts numbered and named.

182. **Locomotives are classed** by the number and disposition of their wheels. The most common types and the names by which they are known are illustrated in Fig. 126, in which the larger circles represent drivers and the smaller ones truck wheels, the direction of forward motion being indicated by the cowcatcher.

A better system, rapidly coming into use, is to describe the running gear by giving the no. of wheels in the three following groups in the order named: (1) **Forward non-drivers,** (2) **drivers,** and (3) **rear non-drivers.** Thus an engine with 2 forward truck wheels, 4 drivers, and 2 rear truck wheels is indicated by 2—4—2, etc.

By this system the Atlantic type becomes 4—4—2; the Columbia, 2—4—2, etc.

Locomotives are also classed as passenger and freight, the former having large drivers and other proportions adapted to high speed.

183. **Cars.**—In deciding upon the cars to be used on a supply railway, the gage of the track will almost entirely govern the kind of cars to be used. There is one rule that should be followed in purchasing or designing an equipment for such a road; that is, to have the axle load for loaded cars the same as that for locomotives whenever practicable. This will not be difficult for narrow-gage equipment, but on standard-gage roads the weight of some of the engines is so great that it is not economical to have the axle load of the cars equal to the axle load of the locomotives. If all axle loads were the same, there would be considerable economy in cars, and the track would then be utilized to its greatest working value by every wheel that went over it.

184. **Passenger equipment.**—Passenger cars may be divided into day coaches, standard sleepers, tourist sleepers, dining cars, baggage cars, and kitchen cars. It will be impossible to obtain a narrow-gage passenger equipment in this country, except by special order with plenty of time for building the new equipment.

The narrow-gage equipment of the Barsi Railway in India is for a 2 ft. 6 in. gage. These cars are compartment cars with side entrances. Their length is 40 ft. 6 ins.; width, 6 ft. 2 ins. inside; weight, about 20 tons.

The second-class cars will carry, crowded, 64 passengers; the first-class cars will carry about 24 passengers. One train on this road carried comfortably 30 first-class and 736 second-class passengers in 13 cars. (Distance not stated, but less than 21 miles.)

The baggage cars would not differ materially, except in size, from the standard baggage car.

Passenger equipment for a standard-gage road would not be difficult to obtain from the various roads in this country, and in a foreign country such cars could be shipped from this country, or purchased from some neutral, or captured from the enemy.

185. **Day coaches.**—A standard day coach will carry about 60 persons, seating two in a seat. Unless there were an emergency, only three men would be put in a double seat, leaving the remaining room for the soldiers' equipment. About 45 men per car can be counted on by this arrangement. Whatever kind of coach is decided upon, the toilet arrangements and drinking supply should be ample for the car when fully loaded.

In an emergency about 30 persons can stand in the aisles. By running a detail on the seats, 90 persons per car can be carried for a daylight trip with no hardships.

186. **Sleeping cars.**—A standard sleeper has about 15 sections counting the drawing room, and will carry, crowded, about 45 people. A tourist sleeper is similar to a standard sleeper, except in its appointments, and will carry about the same number of people. The remarks as to water supply and toilet arrangements with reference to coaches apply equally to sleepers.

187. **Baggage cars.**—Baggage cars carry about 2,500 cu. ft. of baggage. This gives about 150 lbs. in 13 cu. ft. for about 193 passengers. This will allow for rations for the men, as well as for their luggage. These cars should have end doors for communication while the train is in motion. **Kitchen cars** are baggage cars equipped for cooking.

188. **Freight equipment.**—The freight equipment of a road is of first importance, and in an emergency the troops can be moved in the freight equipment by arranging benches in the box cars, stock cars, and flat cars.

189. **Box cars** for narrow-gage roads would be similar in construction to, but smaller in dimensions than, those for a standard-gage road. Box cars on a 2 ft. 6 in. railway can be built to carry 15 tons, and the carrying capacity varies from this up to 40 tons for a good standard-gage box car (see fig. 127).

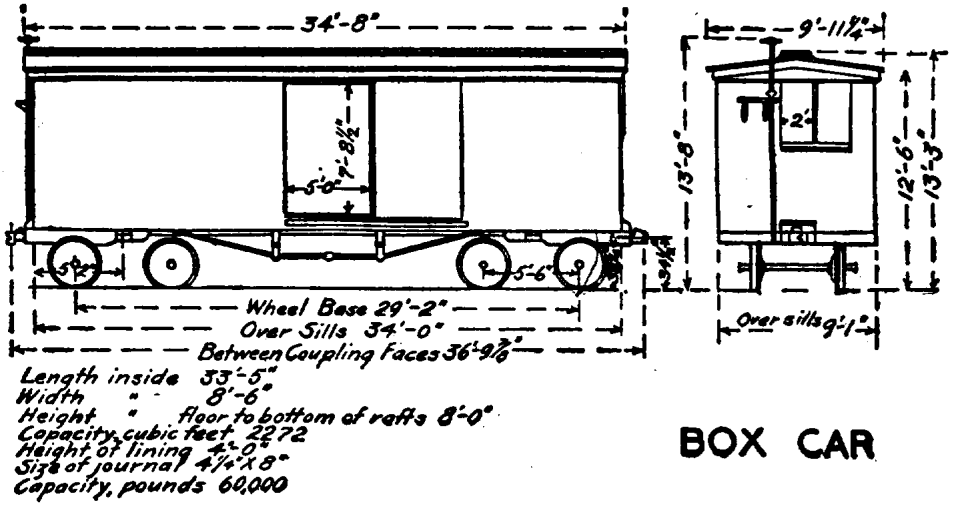

FIG. 127.

190. **Stock cars** on a narrow-gage road would have to be built to carry the animals lengthwise of the car. A 34-ft. car 7 ft. wide would carry from 8 to 12 horses. Padded **cross gates** would have to be put in to keep them from being injured by the

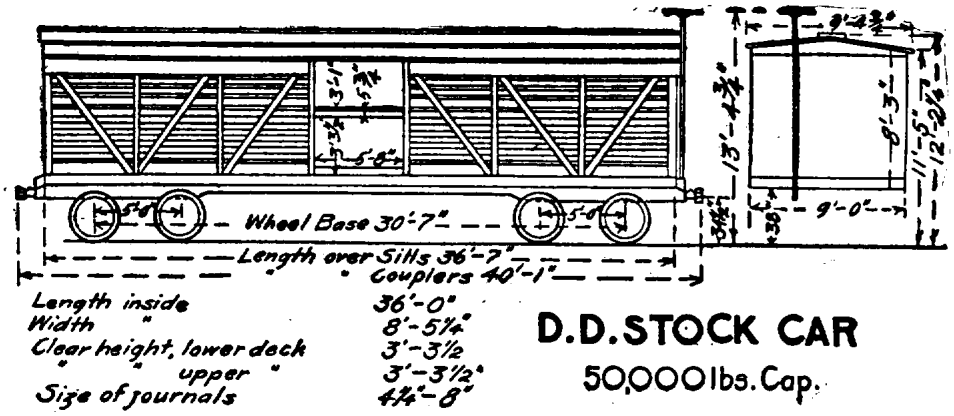

FIG. 128.—DOUBLE-DECK STOCK CAR.

movement of the train. Standard-gage stock cars carry from 16 to 20 animals. Some stock cars are fitted for feeding and watering en route, but the ordinary ones have no feeding arrangements, except for hay (see fig. 128).

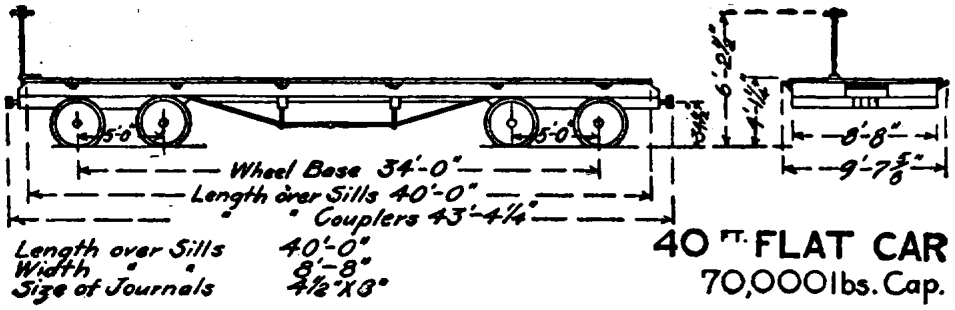

FIG. 129.

191. **Flat cars** are used for carrying heavy and bulky articles that will not be injured by exposure to the weather. The capacity of these cars varies from 15 or 20 tons on a 2 ft. 6 in. road to 50 tons on a standard-gage road. The average capacity of a standard-gage flat car is about 70,000 lbs. (see fig. 129).

By means of the platforms or ramps, guns and vehicles can easily be loaded on these cars. By removing the tongues and chocking the wheels, the vehicle is ready for shipment. Empty wagons and other vehicles should have both wheels and

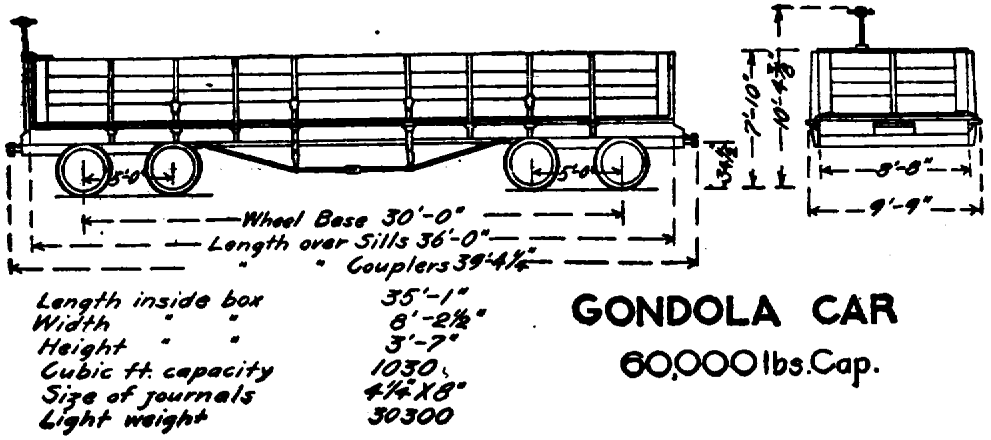

FIG. 130.

tongues removed for shipment in order to allow a greater number to be shipped on one car.

192. **Gondolas.**—A gondola is a flat car with sides and ends from 2 ft. to 3 ft. 6 ins. in height. The remarks about flat cars apply to gondolas (see fig. 130).

193. **Cabooses** or **way cars** are cars for use with freight trains for the accommodation of the train crew (see fig. 131).

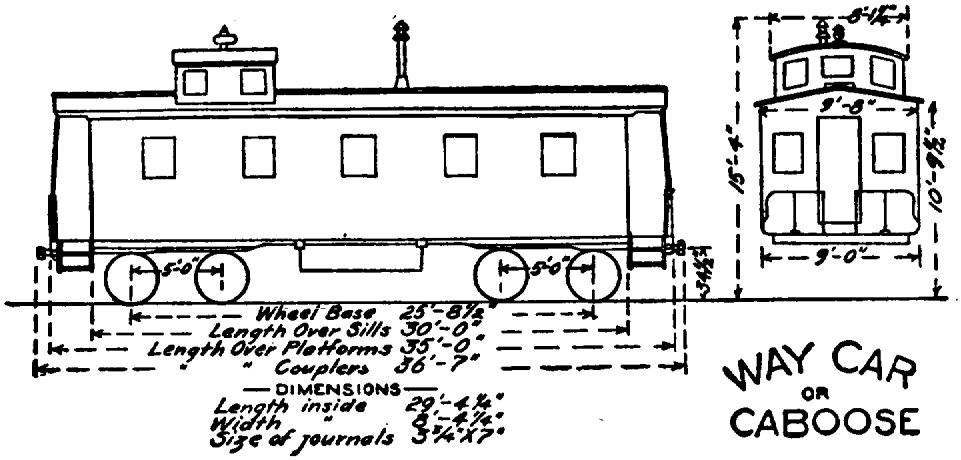

FIG. 131.

In addition to the freight equipment mentioned above, there are **refrigerator** cars, **furniture** cars, **vehicle** cars, and **special ballast** cars, all of which would be made use of under special conditions.

Refrigerator cars would be especially useful in the supply of an army, and should form a part of the original equipment.

Furniture cars and vehicle cars are extra large box cars for carrying freight of the names specified. They will be useful for hay, camp equipage, and other light, bulky freight.

194. **Interchangeable parts.**—Whatever equipment is purchased, care should be taken to have wheels, trucks, and all other parts the same, as far as is practicable, for all kinds of cars. This facilitates repairs both in time and money.

195. In addition to the cars above referred to, there are certain smaller cars used for maintenance and **inspection purposes.** These are the **velocipede motor car,** and **hand car,** which are illustrated in figs. 68, 70. All of these cars are now made equipped with gasoline motors, and for speed are preferable to the old type. Special cars for transportation and service of heavy field artillery will doubtless be provided in the future.

196. **Track capacity.**—In figuring on the length of sidings, the length of the cars and locomotives must be known. These lengths for a 2 ft. 6 in. gage may be taken about as follows:

Locomotives, 50 ft.
Box cars, 30 ft.
Flat cars, 30 ft.
Passenger equipment, 45 ft.
Stock cars, 34 ft.

The length for a standard-gage road may be taken about as follows:

Locomotives, 65 ft.
Day coach, 60 ft.
Sleepers, 75 ft.
Baggage cars, 50 ft.
Box cars, 37 ft.
Furniture cars, 50 ft.
Flat cars, 44 ft.
Gondolas, 40 ft.
Refrigerator cars, 40 ft.
Cabooses, 40 ft.
Stock cars, 40 ft.

Certain special cars will be longer than these lengths given; but in the general run of a train, taking all cars as they come, these lengths will give a fair estimate of the length of a train. (See Table XVI for exact data.)

197. **Capacity of a 36-ft. open car.**

Heavy bridge equipage:
1 ponton or trestle wagon loaded, or
2 chess wagons, or 2 company tool wagons, or 2 field wagons.

Light bridge equipage:
1 ponton or trestle wagon, loaded, or
2 company tool wagons, or 2 chess wagons.

Light artillery and horse artillery material:
1 gun and limber and 2 caissons and limbers, or
2 caissons and limbers and 1 store or battery wagon, or
2 field wagons, or 3 reel carts.

4.7″ gun matériel:
1 4.7″ gun, carriage and limber; 2 4.7″ limbers, and 1 4.7″ caisson.
A 4.7″ gun, battery wagon and forge limber, or its store wagon and store limber takes same space as the 4.7″ gun carriage limber.

4.7″ howitzer matériel:
1 4.7″ howitzer and carriage, 2 4.7″ howitzer caissons, 2 4.7″ howitzer limbers, and 1 4.7″ howitzer carriage limber, or
1 4.7″ howitzer battery wagon and 1 forge limber, and 2 4.7″ howitzer caissons, and 2 4.7″ howitzer limbers.
A 4.7″ howitzer store wagon and store limber require the same space as a battery wagon and forge limber.

6″ howitzer matériel:
Same as for a 4.7″ gun battery, substituting 6″ howitzer for 4.7″ gun.

Signal Corps matériel:
2 instrument wagons and 1 kit wagon; or
4 wire carts, or 2 field wagons; or
1 repair and 2 telephone or telegraph wagons.

198. **Capacity of a 40-ft. open car.**

Heavy bridge equipage:
1 ponton or trestle wagon, loaded, and 1 chess, or company tool, or field wagon; or
3 chess, company tool, or field wagons.

Light bridge equipage:
2 ponton or trestle wagons, loaded; or
3 company tool or chess wagons.

Light artillery and horse artillery matériel:
1 gun and limber and 3 caissons with limbers, or
2 caissons and limbers and 1 store or battery wagon; or
3 field wagons or reel carts.

4.7"gun, 4.7" howitzer, and 6" howitzer matériel:
Same as for a 36-ft. car, but one more limber or one more caisson can be added.

Signal Corps matériel:
3 field wagons, or 2 instrument and 1 kit wagons; or
2 lance trucks and 1 field or repair wagon.

OPERATION AND MAINTENANCE.

(For general regulations concerning the Service of Military Railways, see Army Regulations and Field Service Regulations.)

199. Whether a road is constructed or merely taken over for military purposes makes no difference in the operation and maintenance of the line.

The **unit of organization** is the **division;** such a division is a section of line from 150 to 300 miles in length, and is self-contained. As to operation and maintenance, the general principles and rules are laid down by the higher authorities, but the details are left to the Division Superintendent to work out as he thinks best. The results show in the economy and efficiency of his division, which are the tests of the soundness of his methods.

200. **Organization and duties.**—The persons in charge of a military railway can be divided into two classes: **Military controlling staff** and **civilian officials.** The military controlling staff will be chosen from engineer officers and others who have had railway experience, and their function is to make known the military desires and to see that the roads are operated so as to attain these ends. Having given their instructions, they allow the civilian officials and employees to work out the technical details in the manner dictated by their railway experience; the military staff will only interfere in cases where they believe that the civil officials are not endeavoring to carry out the military plans, or are not succeeding in doing so.

The organization and **line of responsibility** are shown in fig. 132.

The relation of the military controlling staff to the civilian officials is shown in that figure.

The presence of civilian employees on a military railroad, particularly in the lower grades, is likely to prove a source of friction with the personnel of the service of defense, with the railroad troops, and with troops of all kinds traveling on the line. Furthermore, the lack of military discipline is prone to cause difficulty in strikes, disagreements as to pay and promotion, and individual insubordination and desertion. It will seldom if ever be practicable in the United States to secure a purely military organization, but in the case of railroads operated in occupied foreign territory effort should be made to secure a military organization with fixed military rank, pay, and allowances for all employees, if possible, and in any case for all train crews, dispatchers, yard operatives, and the higher officials. It will seldom be practicable to include laborers or mechanics of construction and repair gangs or those employed in shops, roundhouses, warehouses, etc.

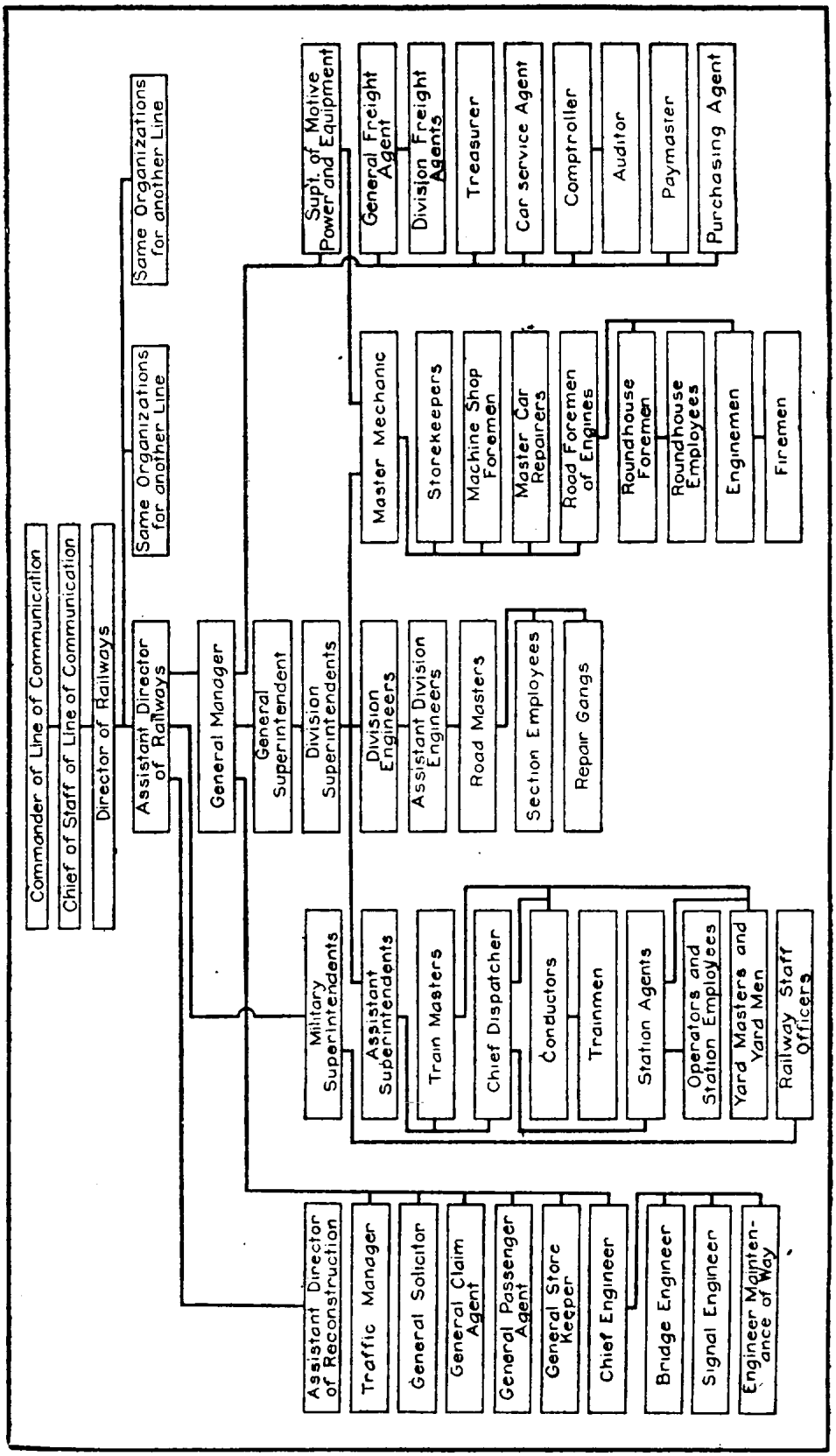

FIG. 132.

No organization has been provided for railway troops in the United States Army. The war organization of the pioneer regiment, which is outlined below, may be adapted to railway troops, special designations, such as wagoner, being maintained in order to facilitate rating as to pay and allowances.

REGIMENT OF ENGINEER TROOPS.

Commissioned:
- 1 colonel.
- 1 lieutenant colonel.
- 1 captain, adjutant.
- 1 captain, quartermaster.
- 1 captain, engineer.

Enlisted:
- 4 master engineers, senior grade.
- 1 sergeant major.
- 2 supply sergeants.
- 2 color sergeants.
- 1 sergeant bugler.
- 2 sergeants.
- 1 cook.
- 25 wagoners.

And two battalions.
Total: 33 commissioned; 1,036 enlisted.

BATTALION OF ENGINEER TROOPS.

Commissioned:
- 1 major.
- 1 captain, adjutant.

Enlisted:
- 1 sergeant major.
- 6 master engineers, junior grade.

And three companies.
Total: 14 commissioned; 499 enlisted.

COMPANY OF ENGINEER TROOPS.

Commissioned:
- 1 captain.
- 2 first lieutenants.
- 1 second lieutenant.

Enlisted:
- 1 first sergeant.
- 3 sergeants, first class.
- 1 mess sergeant.
- 1 supply sergeant.
- 1 stable sergeant.
- 8 sergeants.
- 18 corporals.
- 1 horseshoer.
- 2 buglers.
- 1 saddler.
- 3 cooks.
- 31 privates, first class.
- 93 privates.

Total: 4 commissioned; 164 enlisted.

A regiment of railway troops if organized in time of war from volunteer troops should secure a personnel as follows:

Colonel and three other officers from the Corps of Engineers of the Regular Army; remaining officers should be appointed from men actively engaged in railway work and holding some of the higher positions; e. g., general manager, general superintendent, division superintendent, assistant superintendent, chief engineer, division engineer, signal engineer, engineer maintenance of way, superintendent motive power and rolling stock, master mechanic, general freight agent, general passenger agent, road foreman of engines, train master, road master, superintendent bridges and buildings, car service agent, general storekeeper. The noncommissioned staff, regimental and battalion, should be selected from such positions as chief clerk, storekeeper, and special foreman.

The transportation and equipment of railway troops should be that provided for an engineer regiment in so far as relates to supply, shelter, and administration; technical equipment with its necessary transportation will be furnished as deemed necessary from the base by the director of railways. Sanitary personnel and equipment should be the same as provided for an engineer regiment.

The following organizations are suggested as advisable in so far as practicable for railway regiments assigned to the indicated classes of work:

SHOP REGIMENT.

Regimental headquarters:
- Colonel: Superintendent.
- Lieutenant colonel: Assistant superintendent.
- Captain, adjutant: Advisory engineer.
- Captain, quartermaster: Supply officer.
- Captain, engineer; Chief engineer, superintendent of motive power.
- 13 enlisted men: Draftsmen, designers, officemen, etc.
- 27 wagoners: Watchmen, janitors, messengers, waiters, etc.

Battalion headquarters:
- 2 majors: Shop superintendents.
- 2 captains, adjutant: Chief master mechanics.
- 7 enlisted men: Draftsmen, designers, officemen, etc.

Companies:
- 6 captains: Master mechanics.
- 18 lieutenants: Shop foremen.
- 164 enlisted men per company, as follows: 35 noncommissioned officers as shop foremen, draftsmen, storekeepers, etc., 3 cooks, 2 buglers, 8 stationary engineers, 4 locomotive engineers, 4 machinists, 4 boilermakers, 4 blacksmiths, 4 mechanics, 3 clerks and stenographers, 93 engineers, firemen, machinists, and helpers.

CONSTRUCTION REGIMENT.

Regimental headquarters:
- Colonel: Chief engineer.
- Lieutenant colonel: Assistant chief engineer.
- Captain, adjutant: Advisory engineer.
- Captain, quartermaster: Supply officer.
- Captain, engineer: Chief engineer, maintenance of way.
- 13 enlisted men: Draftsmen, civil engineers, officemen, etc.
- 27 enlisted men: Wagoners, at least half to be chauffeurs.

Battalion headquarters:
- 2 majors: Division engineers.
- 2 captains, adjutant: Division engineers, maintenance of way.
- 7 enlisted men: Draftsmen, civil engineers, officemen, etc.

Companies:
- 6 captains: Engineers, maintenance of way.
- 18 lieutenants: Supervisors or roadmasters.
- 164 enlisted men per company, as follows: 35 noncommissioned officers as foremen, draftsmen, storekeepers, surveyors, etc., 3 cooks, 2 buglers, 4 blacksmiths, 14 bridge carpenters, 3 clerks and stenographers, 4 stationary engineers, 6 drivers, 93 track layers and ditchers.

OPERATING REGIMENT.

Regimental headquarters:
- Colonel: General superintendent.
- Lieutenant colonel: Assistant general superintendent.
- Captain, adjutant: Advisory engineer.
- Captain, quartermaster: Supply officer.
- Captain, engineer: Chief engineer, maintenance of way.
- 13 enlisted men: Draftsmen, master mechanics, chief dispatchers, designers, officemen, etc.
- 27 enlisted men: Wagoners, at least half to be chauffeurs.

Battalion headquarters:
- 2 majors: Division superintendents.
- 2 captains, adjutant: Division engineers, maintenance of way.
- 7 enlisted men: Draftsmen, master mechanics, chief dispatchers, designers, officemen, etc.

Companies:

6 captains: Assistant division superintendents.
18 lieutenants: Assistant division engineers, maintenance of way.
164 enlisted men per company, as follows:

8 conductors.	7 electricians, linemen, and signal maintainers.
16 brakemen.	2 gas-engine men.
12 locomotive engineers.	3 clerks and stenographers.
12 locomotive firemen.	2 draftsmen.
4 stationary engineers.	2 surveyors.
4 yard foremen.	12 car inspectors and repairers.
8 switchmen.	2 storekeepers.
8 machinists.	2 pile-driver engineers.
4 blacksmiths.	2 pipe fitters.
6 boiler makers.	1 locomotive inspector.
12 operators and agents.	1 wreck-derrick engineer.
4 dispatchers.	1 water-supply man.
14 track foremen.	3 cooks.
14 B and B force.	

35 noncommissioned officers included in these 164 enlisted men to be supervisors, section foremen, bridge foremen, carpenter foremen, and men of that type.

201. **Duties of the director of railways and his staff.**—The duties of the director of railways of an army and his staff are, to operate the railroads so as to promote the plans of the commanding general, to supply the military knowledge not possessed by the technical railway staff, and to shield the railway operatives and officials from unauthorized military interference.

In any large theater of operations there will be one or more independent lines of railway. For military purposes all such lines should be operated as a single system under the director of railways. If only one line exists, the director of railways will act as the military executive of the line. If more than one line exists, he will act as military executor of the system composed of all the lines, and assign an assistant director of railways to each separate line to act as military executive of that line. In the description of duties, etc., that follows it will be assumed that more than one line of railway exists. If two or more lines of communications exist in one theater of operations, they might be operated as separate systems under separate heads if they were entirely separate lines physically; but if at any point they come together, they should be operated under a single director of railways. Such a case would be out of the ordinary, but if it did occur, the director of railways should be on the staff of the commanding general of the field forces, and the assistant director of railways in each line of communications would be on the staff of the general commanding the line of communications.

202. **Duties of the director of railways.**—This officer is responsible to his commanding officer for the successful operation and cooperation of all the railroads in his charge. He receives his orders from the chief of staff, and takes the necessary steps to have them executed by his subordinates. He must keep in close touch with his assistant directors and with the higher civil officials of all his railroads. He must make arrangements at home for the prompt and accurate filling of requisitions. He keeps in close touch with the general defense and the armored-train defense of the railways, but the direct control of that defense is under the commander of the district of the line of communications in which the armored trains are operating. He will have such assistants, both military and civil, as efficient operation and maintenance require.

The work on each line will usually be divided into two classes, the reconstruction of the line in rear of the army and the operation and maintenance of the reconstructed line.

The reconstruction work at the head of each line of railway will be in charge of an assistant director of railways of reconstruction, who is immediately responsible to the assistant director of railways in charge of that particular line of railway, or to the director of railways if only one line exists. Reconstructed line will be turned over to the operating department as rapidly as it is made fit for trains. The reconstruction work will be more or less of a temporary character, suited to passing a few trains at low speed, and will be done by railway troops with such civil or other military assistance as may be available. The more permanent work of reconstruction will be done by the maintenance department in the zone of the line of communications, using such labor, civil or military, as conditions require.

No organization has yet been provided in the United States service for railroad troops. If sudden need for their organization arises, models may be taken from the organization of foreign armies. In any case they should be armed and equipped as infantry, and lacking other means of raising such troops, infantry companies may be detailed for the duty, transferring thereto as many officers and men who are familiar with railroad work as may be available.

203. **The assistant director of railways** may be called the **military manager** of the road to which he is assigned, the **civil manager** being his close adviser, and the person through whom he controls his civil employees. He is charged with the efficient operation of the line to which he is assigned, including its operation, maintenance, and supply, and he advises the director of railways as to its requirements for defense. He has charge of the **special railway police** on his line.

The **military controlling staff** will decide what affairs will be left entirely to the civilian officials and what ones must be referred to the coordinate military officer for final decision. The assistant director of railways will decide the above points usually after consultation with his military and civilian assistants.

As regards his own immediate line, his duties are similar to those of the director of railways for the entire system, being limited only by the questions that he must submit to the director of railways for decision.

204. **Civil traffic.**—The assistant director of railways of each line, after consultation with his assistants and with the approval of the director of railways, will recommend such civil traffic on his line as will not interfere unduly with the military traffic. Regulations governing such civil traffic will be issued for the different lines by the commander of line of communications and only such traffic will be allowed as the orders permit.

205. **Military assistants** may be assigned to one or more divisions of the line, depending upon the road, and they may be termed the **military superintendents** of such divisions. The **civil superintendents** are their close advisers. They are responsible to the assistant director of railways for the efficient handling of their divisions. They supervise the personnel of their divisions, and must be thoroughly conversant with the possibilities and needs of such divisions. They must keep track, through the car distributor, of all rolling stock, and if cars are not promptly unloaded and released, will call the proper persons at the detaining station to account for it. They must correct all weaknesses in their divisions, or call upon higher authority to do so. They are responsible for the maintenance and the regular military police of their divisions, and for the transportation of troops and supplies within the limits of their divisions. They are responsible that the various stations have the proper sidings, platforms, ramps, stockyards, and watering facilities to fill the military requirements.

206. **Railway staff officers.**—At each **important station** there will be detailed a railway staff officer who will be independent of the commanding officer of any troops that may be stationed at that point and will be on the staff of the military superintendent.

The railway staff officers of stations look after the loading and unloading of troops and supplies at their stations. They keep the military superintendent fully informed as to all the **station requirements.** They are in charge of all railway employees while at that station, and will execute such authority, as a general rule, through the local station agent. They issue, on proper authority, **all transportation** from their stations, and forward with their indorsement **all communica-**

tions from the local officers to the railway officials. They are responsible that all cars are promptly unloaded and released, and that no empty cars are asked to be sent to their stations before the cargo will be ready for loading. They make arrangements for **food and hot coffee** for troops en route through their station, upon notification from proper authority.

The railway staff officer reports daily, to the military superintendent of his division, the organizations or parts of organizations that depart from or arrive at his station, and includes the following data: Destination, or starting point; the number of officers, men, guns, horses, vehicles, and the amount of supplies in each train; the number of the train, and the time of its departure or arrival.

The military superintendent consolidates all these reports for each week, and renders this **consolidated report** to the assistant director of railways, with such other information with reference to the movements as may be desired.

At the base the duties of this officer become very great and important because the greater part of all shipments originate or end at that place. The railway staff officer at the destination should always be promptly notified of the probable arrival of troops or animals in any large numbers or supplies in large quantities.

The railway staff officer is responsible that no **railway buildings** or **property** are used by the troops at the station, when necessary for railway use; and before permission is given for such military use, authority will be obtained from the military superintendent.

Upon the **arrival of troop trains,** the railway staff officer will be present and give the commanding officer on the train all information and proper assistance that he is able to give.

The railway staff officer will pay particular attention to the daily telegraphic car reports. (See par. 234.)

207. **Civil officials.**—On a road operated for military purposes, the head official is the **general manager.** The president, vice president, etc., are temporarily replaced by the higher military officers. The **general manager** is responsible for the entire working of the road and for all maintenance and construction thereon. He has the number of assistants necessary to relieve him of all minor details and leave him free to keep a keen oversight of the entire working of the road.

Fig. 132 shows the various other officials who report to him. Their duties are explained in the following paragraphs:

208. The **general solicitor** of the road is the legal adviser of the general manager, and even in time of war there would be many occasions on which this official would be necessary. He has the necessary number of assistants, and all **local attorneys** for the road report to him.

209. The **general claim agent** has charge of all **claims** made against the road for damages. He investigates all such claims, procures all available information and witnesses to defend the case, and recommends the action to be taken. His function will be very important on a commercial line taken for military purposes, as claims against the Government will arise and agreement as to facts at the time of occurrence will save litigation at a later period.

210. The **general passenger agent** in time of peace is charged with the duty of procuring all passenger business that he can for the road. **In time of war** this duty would lapse, but he would be utilized in connection with the shipment of troops and the handling of passenger traffic generally.

211. The **general storekeeper** has charge of and issues all stores from the central storehouse. He keeps a supply of stores that will meet all possible needs of the road. The storekeepers at various points on the railroad make requisitions on him through the general manager and render their returns to him.

212. The **chief engineer** of the road is the engineer adviser to the general manager. He plans and has charge of all new construction, and he keeps a general oversight of the division engineers and the signal engineer. He has no control over the assistant director of railways of reconstruction

213. The **superintendent of motive power and equipment** has charge of all the rolling stock belonging to the road. He is charged with all repairs to locomotives, machinery, cars, and other equipment. He investigates all **failures of engines.** He keeps complete **records of performances** of locomotives and cars. He has charge of the discipline of all his employees, except enginemen and firemen who may violate operating department rules while on the road.

214. The **purchasing agent** of the road buys all supplies, equipment, etc., that may be used on the road, upon authorization of the general manager.

The **treasurer** is responsible for all funds received for operating the road and for the disbursement ol all moneys.

215. The **comptroller** has the final decision as to the correctness of expenditures and accounts, and he allows or disallows accounts according to their merits and the rules of the road. The treasurer and comptroller would be used to keep the account between the railway and the Government while the road is under military control.

216. The **general freight agent** of the road in time of war would have few of the duties that this official has in time of peace, but he will be useful to the general manager in the **handling of military freight.**

217. The **signal engineer** is under the chief engineer. He has charge of construction and maintenance of all **signals and telegraphs** and other work requiring electrical knowledge.

218. The **car-service agent** is charged with the proper distribution of rolling stock to the various parts of the road. He keeps track of all cars sent to foreign roads, the mileage of all cars on the road, and the length of time that foreign cars are held on the road.

219. In the operating department, the next official in rank to the general manager and his assistants is the **general superintendent,** who has charge of the operation, maintenance, and discipline of the road, the arrangement of time schedules, the distribution of motive power, and such other duties as may be assigned to him by the general manager. He has such assistants as may be necessary. The officials that report to him are shown in fig. 132. His control is through the various division superintendents.

220. **Duties of division superintendents.**—The road will be divided into divisions, and each division is in general charge of a **division superintendent.** These superintendents are directly under the general superintendent and his assistants. They have complete charge of their divisions, and are responsible to the general superintendent and general manager for the proper operation and maintenance of their divisions. **Matters of construction** that come under the division engineer are not under the division superintendent, and the subject of **repairs to rolling stock and equipment** is handled by the master mechanic direct with the superintendent of motive power and equipment and is not under the division superintendent.

While a division, from an operating standpoint, should be from 150 to 300 miles in length, the economic length of run with a single train crew for freight trains is from 90 to 140 miles, and for passenger trains about 150 to 200 miles. The length is largely fixed by the time consumed by the trains in running over it. Long divisions must therefore be subdivided into lesser units for train crews, but the division is the smallest self-contained unit on a railway.

The division superintendent is assisted in his work by one or more **assistant superintendents, division engineers, and master mechanics.**

221. Each **assistant superintendent** is charged with such duties as the superintendent may assign to him. In general, the division will be divided and each assistant superintendent will nave charge of one such subdivision. He handles all train movements and has charge of trainmen, agents, and operators. He is charged with the **discipline** of these men and with that of employees in the master mechanic's department for the violation of operating-department rules.

222. Each **division engineer** is charged with all maintenance and construction work on his division. For **maintenance** he is responsible to the superintendent, and for **construction work** to the chief engineer of the road.

The division engineer has the necessary number of assistants, and in general, the work under his office will be subdivided into **bridges and buildings, track work, masonry work, and water supply.** Each of these departments will be under a competent foreman, who will have charge of the tools and supplies necessary to carry out his work on the division. A fuller description of his department will be found under "Maintenance of Way," par. 494 et seq.

223. Each **master mechanic** is charged with the **inspection and repair** of all rolling stock. In all matters aside from the operating-department rules, the enginemen and firemen are directly under him. He has charge of the inspection department and of all roundhouses, machine shops, car shops, storehouses, etc., and the employees therein are under his orders. For all subjects that arise in his department on the road, he is responsible to the superintendent. Aside from this, he is under the direct supervision of the superintendent of motive power and equipment. He is responsible that all locomotives are in condition to haul their **tonnage rating** (par. 175).

The master mechanic is assisted in his work by one or more **traveling engineers,** or **road foremen of engines,** who look after the proper handling of the locomotives on his division and investigate accidents and failures that occur on the road.

Each roundhouse and shop is in charge of a foreman, who is responsible for the discipline of the shop and the employment of the necessary workmen, etc.

224. The **storekeepers** at various points are under the master mechanic. They issue supplies on requisitions signed by any division officer, and in an emergency will issue supplies direct, without the necessary approval, taking the proper receipts for the same.

225. The **assistant superintendents** are assisted by the necessary number of **train masters** and **dispatchers.** The **train masters** travel over their divisions and look after the movement of trains and the actions of trainmen and yardmen. They accompany all important shipments or movements of freight or troops over their divisions, and see that the movements take place promptly and properly. They recommend any discipline that may be necessary, and can issue orders for trains when they think necessary. They are directly under the assistant superintendent, but can receive orders from any higher officials. They give special attention to the prompt and regular movement of traffic and see that the full number of cars are moved by each locomotive, and that no more trains are run than are necessary. They inspect and report on the cleanliness of the passenger trains, and investigate delays in trains, as well as delays in loading and unloading of cars. In **case of an accident,** they proceed to the scene of the accident and take general charge in clearing up the road and protecting the wrecked property. They perform such other duties as may be assigned to them by the proper authority.

226. The **chief dispatcher** has entire charge of the movement of trains over his division, unless the train master interferes for some special reason. He distributes the cars and motive power; he places and displaces operators and subordinate dispatchers, subject to the approval of the division superintendent and of the signal engineer. He has charge of all telegraph matters and movement of trains by telegraph over his division. He sees that all train orders are issued according to prescribed forms, and gives special attention to the condition of the telegraph equipment on his division. He sees that only one person issues train orders over any territory at one time. He is responsible that all locomotives are worked up to their full tonnage rating.

227. **Train dispatchers** receive their instructions from the chief train dispatcher. They are assigned to certain subdivisions and issue orders governing the movement of trains over such subdivisions. They see that such orders are properly transmitted and recorded. They keep a record of the movement of all trains, or locomotives, over their subdivisions. They order the necessary number of locomotives in time to be ready to move when the train is made up. **Train orders** and **locomotive orders** are kept separate. One dispatcher keeps a book showing the

telegraphic address of every official and lineman that may be out of his office working along the division, so that they may be found if needed. On **double-track work,** the dispatcher's main duty is to see that the trains are kept moving and that no unnecessary delays occur. On **single-track work,** the position of train dispatcher is much more important than on double-track work, on account of the constant danger from collision in case of carelessness. He arranges the proper **meeting** and **passing** places for all trains, and in case one train is late, changes the meeting places to correspond. On going off duty, he makes a transfer of all orders that have not been fully executed, and sees that such orders are understood by his successor.

228. **Car distributor.**—One operator in the chief dispatcher's office is assigned the duty of distributing cars. He receives the **daily telegraph report** from each station (par. 234), and arranges the information for the chief dispatcher for use as described in par. 452. In this distribution of cars, due attention should be given to empties; otherwise a car famine may exist at one point on the line, while the road may be blocked with empties at another point. To avoid this and keep the entire line properly provided with the kind of cars needed, the chief dispatcher makes a daily report to the car-service agent at headquarters, similar to the one described in par. 234. Car-service agents at headquarters, on receiving these telegraph reports from the various chief dispatchers, distribute cars over the entire line just as the chief dispatcher distributes cars over his division. This report includes passenger as well as freight equipment.

229. **Station agents** are directly under the assistant superintendent and train masters. They have general charge of all station work. They are responsible for the condition of the station, the prompt placing of cars for loading and unloading, and for the proper arrangements for safety and comfort at the stations. They see that the ticket office is kept open at the proper time and that **tickets** are issued only on proper authority and to proper persons. They are responsible that the necessary **signals** are displayed. They are responsible that the track within the limits of their station is in good condition and that the proper switch signals are set. They see that the correct time, time-tables, and official notices are displayed in the depot. They inspect loaded cars, and when satisfied that they are loaded as indicated, they seal the car for shipment. They see that cars are not **overloaded** and that they are **properly loaded.** When cars are received, they promptly notify the persons to whom they are billed, and see that the cars are **promptly placed for unloading.** They will not allow any unauthorized persons to hang about the station, nor near the telegraph office, and they will see that all station employees do their duty properly. They will comply with all instructions from the railway staff officer of the station.

230. Where there is no railway staff officer, the **station agent** performs the railway duties of that officer, and the **commanding officer** of the troops at that station performs his military duties. At **larger stations,** the station agent is assisted by a station master in charge of the station and grounds, and by a ticket agent and such other employees as may be necessary.

231. At **terminals** and at **large stations** the **yard work** is in charge of a **yardmaster.** Yardmasters are directly responsible to the station agents and to the train master. They have charge of the employment of yardmen, the movement of trains and engines, and the distribution of cars in the yard under their charge. They see that all trainmen are called for duty on time, and that they report in condition for work. They have charge of the making up of all trains and the distribution of cars in the yards to facilitate the making up of trains. They are responsible that the trains leave on time and that the proper slips, or waybills, accompany each car. They see that all cars are properly secured and keep a record of the **car seals.** They keep a record of the cars received and delivered to other lines, they see that cars are properly placed for loading and unloading, and that all cars needing repairs are sent to the repair tracks or to the shops.

232. **Duties of subordinate employees.**—The duties of employees subordinate to those heretofore mentioned are covered very minutely in the rules and regulations of the operating department issued by all roads. The set issued by the particular road under military operation will probably be found best suited to its requirements. They will be changed when necessary to meet the military require-

ments or where a better rule can be substituted. The Standard Code of Train Rules of the American Railway Association are used by practically all railways in the United States and form a standard for any necessary changes. Changes in the standard code should be made with caution.

233. **Proportions of operatives.**—Based upon 1,017,653 employees on about 190,000 miles of railway in the United States involving the movement of about 140,000 ton-miles per employee, the following table shows the proportional distribution of employees in 18 different classes. (U. S. Dept. Labor Bulletin 37-1901.)

Classified employees on railways of the United States.

Class.	Number per 100 miles of line.	Per cent.	Class.	Number per 100 miles of line.	Per cent.
General officers	3	0.5	Section foremen	17	3.3
Other officers	2	.4	Other trackmen	118	22.0
General office clerks	17	3.2	Switchmen, flagmen, and watchmen	26	5.0
Station agents	16	3.1	Telegraph operators and dispatchers	13	2.5
Other station men	47	9.0	Employees on floating plant	4	.7
Enginemen	22	4.3	Other employees and laborers	65	12.4
Firemen	23	4.4			
Conductors	16	3.1	Total	529	100
Other trainmen	39	7.4			
Machinists	17	3.2			
Carpenters	24	4.6			
Other shopmen	60	11.0			

The foregoing table gives an idea of the number of men in different grades and classes necessary to operate a railway under peace conditions. The proportions would not hold on a line that had to be reconstructed after destruction by an enemy, but as a guide for preliminary preparation it has a certain value. In France the number of employees per 100 miles is about 2.5 times that shown for the United States; in Germany it is about 3.5 times as many.

234. **Daily telegraphic car report.**—Before 8 o'clock in the morning the agent at each station shall report, daily, to the chief dispatcher the following information with reference to freight equipment:

Local cars:

(1) *Number of empties wanted during next 24 hours.* State kind and size, destination, loading, and when wanted.
(2) *Number of empties on hand.* State kind and size.
(3) *Cars to unload.* State kind and size (O. H. 24 hours or less).
(4) *Cars to unload.* State kind and size (O. H. 24 to 48 hours).
(Special report for all cars O. H. loaded over 48 hours.)

Foreign cars:

(1) *Number of cars wanted.* State kind, size, destination, and when wanted.
(2) *Number of empties on hand.* State kind, initials, number, and size.
(3) *Cars to unload.* State kind, initials, number and size (O. H. 24 hours or less).
(4) *Cars to unload.* State kind, initials, number, and size (O. H. 24 to 48 hours).
(Special report for any car O. H. loaded over 48 hours.)