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ROY E. BAKER

WAR DEPARTMENT

ENGINEER FIELD MANUAL

VOLUME I

ENGINEER TROOPS

U S. Army Military History Institute

ENGINEER FIELD MANUAL

VOLUME I

ENGINEER TROOPS

PREPARED UNDER THE DIRECTION OF
THE CHIEF OF ENGINEERS

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BY ORDER OF THE SECRETARY OF WAR:

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Volume I

ENGINEER TROOPS

(The matter contained herein supersedes TR 445–15, Mar. 1, 1926, 445–18, Aug. 1, 1928, and 445–19, Oct. 1, 1929.)

CHAPTER 1

GENERAL PRINCIPLES

SECTION I

MISSION, FUNCTIONS, AND DUTIES OF ENGINEERS

1. Mission.—The mission of engineers in war is to assist the operations of the field forces by means of engineering works.

2. Functions.—*a.* The functions of the engineers in the theater of operations include—

(1) All work of construction and the repair and maintenance of all structures of every character, except such as are specifically assigned to other arms and services.

(2) Military mining, demolitions, and protective measures against enemy mines.

(3) The operation of railways, portable and fixed electric light and power systems, water supply systems, and all other utilities of general service, except such as are specifically assigned to other arms and services.

(4) The execution of surveying and mapping, including the production and distribution of maps.

(5) The procurement, storage, and issue of all materials for construction work, for the organization of defense systems, and for all other operations assigned to the engineer arm, including all plant, tools, and appliances for such work.

b. The most important function of the Corps of Engineers is the maintenance, improvement, and construction of routes of communication and movement. This is a continuous operation and employs the major portion of the engineer personnel.

3. Duties.—*a. In the zone of the interior.*—The duties of the Corps of Engineers in the zone of the interior in both peace and war include the following:

(1) Training of the engineer personnel for their war duties.

(2) Participation in the selection of sites, and the preparation of plans and estimates for military defenses; construction and repair of fortifications and their accessories, including shore installations pertaining to submarine mine systems, the installation and maintenance of searchlights and electric power and lighting systems, installation of fire-control systems, and the maintenance of fire-control systems when structural work is involved.

(3) Preparation and reproduction of special military maps, including cooperation with other Government and private mapping agencies, and reconnoitering and surveying for military purposes; distribution of military maps of the United States and its possessions; distribution to military personnel of all maps of the United States and its possessions; photographic and cinematographic work pertaining to terrestrial reconnaissance, terrestrial surveying and map making, map reproduction, and the technical training of engineer troops.

(4) Development, procurement, storage, and issue of certain classes of supplies and equipment.

(5) The execution of river and harbor improvements and such civil works as may be assigned by law or by Executive order.

b. In the theater of operations.—The duties of the Corps of Engineers in the theater of operations include among other activities the construction, repair, and maintenance of roads and trails; of bridges and other means for crossing rivers and similar obstacles; of shelter for troops and animals, including huts, hospital buildings, barracks, stables, and accessory structures; of storehouses, shop structures, hangars and flying fields, including, in proper cases, the installation of the neces-

sary machinery; of wharves, railroads, and light railroads; the provision of water supply, including sterilization in bulk; the provision and installation of baths, disinfectors, dipping vats, and incinerators; the installation of plumbing, sewage disposal, and heating plants; the installation of machinery for refrigerating plants, laundries, and other mechanical plants; assistance to other arms in intrenching, and in organizing defensive lines; the organization and construction of rear lines of defense; the construction of bombproofs, observation stations, machine-gun emplacements, and other special works of defense; the execution of special measures for destroying or overcoming enemy obstacles; the supply of camouflage material and the supervision and inspection of its use; the preparation of signs for the direction of troops, including road signs, traffic signs, signs indicating the location of water points and other establishments, and signs safeguarding against the use of impure water; the operation of electric light, gas, and power plants and water supply plants; the operation of shops for the erection and repair of railroad rolling stock, of construction machinery of all kinds, and for the manufacture of special appliances for engineer operations; photographic and cinematographic work pertaining to terrestrial reconnaissance, and terrestrial surveying; map making, map reproduction, and map supply; the training of engineer troops for all their duties, and the compilation of technical data and the preparation of training literature on subjects pertaining to any of the operations assigned to the Corps of Engineers.

SECTION II

RELATION OF ENGINEERS TO OTHER ARMS

4. Unit engineer.—An engineer officer, termed the "unit engineer," is provided on the staff of every command to which engineer troops are assigned. This officer commands all engineer troops forming a part of his unit not assigned or attached to subordinate organizations within that unit and is responsible to his unit commander for initiating, recommending, and carrying out the necessary engineering work in accordance with the known desires of that commander. Unit engineers of the several territorial and tactical subdivisions have the following designations:

Theater of operations, chief engineer.
Communications zone, engineer, communications zone.
Section, communications zone, section engineer.
Army, army engineer.
Corps, corps engineer.
Division, division engineer.

a. Relation to commander.—Primary responsibility for performance of all duties, engineer duties included, rests upon the military commander. The unit engineer is his engineering assistant, but no statement of the duties of a particular unit engineer should be construed as an encroachment upon the authority of a unit commander.

b. Relation to staff and other unit commanders.—(1) The unit engineer is a member of the special staff of the unit commander. The relation between the engineer of one unit and the engineer of a subordinate unit is in no way one of command. The unit engineer commands only those engineer troops which are not assigned to subordinate units, and he receives orders only from or through his unit commander, except in the very unusual case where officers in authority over his unit commander choose to give him orders direct.

(2) Every unit engineer has authority to make such technical inspections as are necessary of engineering work in the area controlled by his unit commander, even though the troops engaged on such work are not under his command. He also has authority to call for such technical reports as are necessary direct from engineers of subordinate units.

(3) It is his duty to supervise by means of these inspections and reports the execution of the engineering work of the subordinate units to whatever extent is necessary to assure him that the work is being done in accordance with the plans of his commander and in pursuance of that commander's mission.

(4) A spirit of unity and thorough cooperation by the engineers of higher and lower units is essential to the best service, and a direct and full understanding between them adds greatly to celerity and efficiency in the execution of the engineer mission.

(5) The unit engineer confers with the members of the other special staffs in the preparation of plans or projects in which several of them may be concerned so that when a plan is presented it will carry as full concurrence as possible.

(6) The unit engineer keeps in close touch with the commanders of the other components of his unit. By so doing he secures a general idea of the engineer problems of these components and is able to give first-hand advice and assistance in the solution of these problems.

5. **Assistance to other arms and services.**—As a general principle, assistance, other than supply of engineer materials, is furnished by the engineers to other arms and services only when the latter can not with their own personnel perform the required work. Engineer assistance may vary from technical supervision only to assumption by the engineers of the entire work.

SECTION III

ENGINEER TROOP UNITS

6. **General.**—Engineer troop units are organized and equipped primarily for the execution of engineer work and consist of engineer headquarters, regiments, battalions, and companies, which are assigned to the major tactical units and to the communications zone.

7. **Classification.**—*a.* According to place of service, engineers are either divisional or nondivisional. The divisional engineers include the combat regiment with the infantry division and the squadron with the cavalry division, and constitute about one-sixth of the engineer force in the theater of operations. All other engineer troop units are nondivisional engineers and are employed normally behind the divisions. They constitute about five-sixths of the engineer force.

b. According to the nature of the work upon which they are employed, engineers are either general or special. General engineer troops execute general engineer work. They include the combat and general service regiments and the mounted and separate battalions, and constitute about four-fifths of the engineer force. All other engineer troops are special engineer troops, and are organized, equipped, and trained for certain special engineer work. They constitute about one-fifth of the engineer force.

8. **Assignment.**—The proportion of engineers with a balanced force operating in an independent theater of operations remains approximately the same, no matter what may be the

size of the force. Engineers constitute about one-eighth of the total strength of such a force. The engineer strength is distributed among the engineer services of the various echelons in accordance with the location and the amount of the engineer work. The normal distribution of the total engineer strength is about as follows: One-seventh as organic troops of the infantry divisions; one-fourth with the corps troops; one-fourth with the army troops; and the remainder with the troops of the communications zone and the general headquarters reserve. If the composition of a force is such that it does not include the major tactical echelons (corps and army) the necessary proportion of nondivisional engineers is nevertheless about five-sixths of the engineer strength, the nondivisional engineer units being assigned as communications zone and general headquarters reserve troops. The strength in nondivisional engineer troop units may be decreased when civilian labor is available for engineer work in the rear areas. For assignment of engineer troop units with forces of various sizes, see paragraph 18.

9. Equipment and armament.—*a.* Tools and transportation are the primary equipment of engineer troops. As a general principle, the tools and machinery used by engineer troops are standard commercial items. Hand tools form the basic equipment of the various units. Labor-saving mechanical devices form part of the equipment to as great an extent as practicable, consistent with mobility and the transportation available, and are normally used behind the front-line divisions.

b. The amount and kinds of transportation assigned to an engineer unit are based upon the needs of the unit for executing engineer work. An engineer unit requires the use of all its transportation in inspection, reconnaissance, transportation of material and plant, and the operation of road machinery and other mechanical appliances.

c. Engineer troop units are armed for their own protection, for guard purposes, and for emergency use in combat as riflemen. The principal weapon is the rifle.

10. Training.—All engineer soldiers are given basic military training. Engineer troop units are trained for coordinated action in engineer work and combat. The principal training is in the performance of engineer work. Combat training covers the employment of the engineers in combat as riflemen in their normal working organizations.

11. Employment.—*a.* Engineer troops are normally employed upon engineer work. Units are assigned tasks suited to their equipment and strength and are employed in such a manner as to preserve the organizational integrity of the units and of their component elements.

b. The engineer needs of the troops preclude the employment of the engineers in rifle combat except in emergencies and for short periods of time. Their organization and strength are not suitable for a long-sustained effort and employment in rifle combat necessitates the abandonment of their primary mission which is engineer work.

SECTION IV

ENGINEER WORK

12. Time factor.—The primary requisite for all engineer work is that it be completed in time to meet the needs of the troops. This is accomplished by estimating requirements and preparing plans well in advance; by commencing work promptly; by arranging material supply so as to keep troops employed continuously; by following previously prepared designs and construction methods; by utilizing standard materials; by employing the engineer troop units in the organizational subdivisions in which they are trained to operate; by exploiting local resources; by utilizing improvised methods and materials when necessary; and by adapting existing structures rather than constructing new ones.

13. Character.—Military engineering work is characterized by types of design and construction that meet the bare necessities of the situation. Time limitations and economy of men and materials demand a rigid exclusion of many features deemed essential in civil practice. Appearance is disregarded, factors of safety are reduced, and the degree of permanency of the construction is limited by the probable duration of its use. Typical designs of engineering work suitable for military operations, general principles involved in the various classes of work and methods of construction and improvisation are included in Volume II, Military Engineering.

14. Distribution.—The bulk of the engineer work is found behind the area occupied by the front-line divisions and is executed by the engineers of the corps, the army, and the com-

munications zone. It is here that the major construction projects and the heavy work upon routes of communication must be executed. With the front-line divisions, the engineer work is of a hasty or temporary nature to meet the immediate needs of the division. The major portion of the engineer troops is found behind the front-line divisions.

CHAPTER 2

ENGINEER TROOPS

SECTION I

GENERAL

15. Classification.—Engineer troops are of three classes: General, special, and headquarters. Most of the engineering work in the theater of operations can be met by units organized and trained for general engineer work, including a few specialists to meet special requirements as they arise. As far as practicable, only general engineer troops are assigned to tactical units in the forward areas. However, in the theater of operations, duties of a technical nature arise with such frequency and of such extent as to warrant the provision of units for special work. These units are generally assigned to the tactical echelons higher than the division and are employed wherever circumstances may require. Engineer headquarters sections are provided for tactical and area commands higher than the division and for railway and other special engineer operations.

a. General engineer troops may be classified as follows: Divisional, including combat regiments and squadrons, and nondivisional, including general service regiments and separate battalions.

b. Special engineer troops may be classified as follows: Camouflage units; ponton bridge units, including heavy ponton battalions, light ponton companies, heavy bridge trains and light bridge trains; mapping units, and GHQ and army topographic battalions; railway units, including railway battalions and railway-shop companies; and supply units, including water supply battalions, dump truck companies, depot companies, and shop companies.

c. Engineer headquarters sections may be classified as follows: General, such as corps, army, GHQ, and communications zone engineer headquarters, which control the operations of all classes of engineer troops; and special, such as railway headquarters, which control the operations of groups of special units.

16. Characteristics.—*a. Combat regiment.*—This unit executes the engineer work in the infantry division. The officers are mounted. The majority of the men are dismounted. The basic work unit is the 4-squad operating section of the platoon. There are 12 such units in the regiment, 6 in each battalion. The equipment consists largely of hand tools for pioneer work. Equipment and supplies are carried for general work to be done for and by the other divisional troops. The transportation includes packs, wagons, and motors. Each platoon has a tool wagon. The primary weapon is the rifle. There are two automatic rifles per platoon. The unit is trained to take part in combat as riflemen in emergencies. It is self-sustaining and has sufficient headquarters personnel to permit the attachment of engineer battalions, companies, and detachments. It has sufficient officers and enlisted specialists to permit the execution of a number of semidetached missions in the divisional area. The battalion is merely an inspection and command unit. The regiment with its equipment has the same mobility as the division. Division engineer headquarters is included in the regimental headquarters organization. In motorized divisions animal transportation is replaced by motors, light tractors, and trailers.

b. Squadron.—This unit executes the engineer work in the cavalry division. It is motorized except for one mounted troop. The work unit is the 4-squad operating section of the platoon. There are 6 such units in the squadron. The equipment is simi-

lar to that of the combat regiment but with much less divisional equipment. Each platoon has transportation for its tools, either pack or truck. The primary weapon is the rifle. Each lettered troop has machine rifles. The unit is trained to take part in combat as riflemen, and in emergencies may be so employed. Division engineer headquarters is included in the squadron headquarters organization.

c. General service regiment.—This unit executes general engineer work. Most of the officers and men are dismounted. The basic work unit is the 4-squad operating section of the platoon. There are 18 such units in the regiment, 9 in each battalion. The equipment is similar to that of the combat regiment except that there are tools for a wider variety of work. The regimental equipment includes construction machinery. The transportation includes wagons and motors. Each platoon has a tool wagon. By reason of its greater strength, larger number and variety of occupational specialists, additional tools and machinery, and longer time in an area, the general service regiment is capable of executing more extensive and more permanent work than the combat regiment. The primary weapon is the rifle. The unit is trained as riflemen for its own security, interior guard, and for use in combat in emergencies. It is self-sustaining, and its headquarters organization permits it to operate in an area and to direct the operations of attached battalions, companies, and detachments. The battalion, as in the combat regiment, is merely a command and inspection unit. The regiment has sufficient transportation to carry its normal equipment on the march. Equipment for special work is usually issued from depots for the work in prospect and generally remains upon the work when the regiment moves. The regiment may be motorized, in which case motors and light tractors and trailers replace the animal transportation.

d. Separate battalion.—This unit executes general engineer work. The basic work unit is the 4-squad operating section of the platoon. There are 24 such units in the battalion (6 in each company, 3 in each platoon). The equipment is similar to that of the general service regiment except that the headquarters equipment does not include construction machinery. The transportation is all motor. Each platoon has a tool truck. The officers are capable of planning and executing any class of general engineer work. It has a smaller percentage of officers,

smaller overhead, less transportation, and fewer occupational specialists than the general service regiment. With the addition of special equipment and a few occupational specialists, it can execute the same class of work as the general service regiment. The primary weapon is the rifle. It is trained as riflemen for its own protection and for interior guard and police, and may be employed in combat in emergencies. It is self-sustaining and capable of executing engineer work in an area, including the direction of the operations of attached companies and detachments. The battalion has sufficient transportation to carry its normal equipment on the march. Special equipment issued to the battalion usually remains in the area or on the work when the battalion moves.

e. Ponton bridge units.—These units transport and care for the equipage for constructing ponton bridges. The actual construction of ponton bridges is usually the function of general engineer troops. Ponton bridge units are trained in the use of the equipage, can instruct and train troops in the construction of the bridge, may be utilized as bridge guards, may dismantle the bridge, and, when the time factor is not an important item, may construct the bridge. The primary weapon is the rifle. The units are trained as riflemen for their own protection and for guard and police.

(1) *Heavy ponton battalion.*—This unit is equipped with the heavy wooden ponton that will ferry an infantry rifle platoon and permit construction of a bridge that will pass the 23-ton tank. The bridge equipage may be animal or tractor drawn. All men are mounted on the vehicles. The smallest complete bridge unit is the bridge platoon which carries equipage for a bridge 208 feet long. There are 4 such units in the battalion, 2 in each company.

(2) *Light ponton company.*—This unit is equipped with the light metal ponton that will ferry an infantry rifle section and permit the construction of a bridge that will take the normal division loads. The bridge equipage may be animal, motor, or tractor drawn. All men are mounted on the vehicles. The smallest complete bridge unit is the bridge platoon which carries equipage for a bridge 224 feet long. There are 3 such units in the company.

(3) *Special bridge units.*—In some operations it may be advisable to organize special bridge units to carry portable bridges

other than of the floating type, such as trestle or girder bridges. These units will usually be motorized and include machinery to assist in rapid erection.

f. Map units.—Map units execute surveying, mapping, map reproduction, and printing. The officers and men are dismounted. The transportation consists of motor vehicles. The personnel consists almost entirely of occupational specialists.

(1) *Army topographic battalion.*—This battalion has the primary function of rapidly producing maps for the army. It makes use of every available mapping method, including aerial photographic surveying, ground surveying, and the compilation of existing data. In war of movement it is normally required to furnish guide maps of advanced terrain, based largely upon aerial photographs, in time to be used by the most advanced troops of the army and by the staffs in planning the operations of these advanced elements. It includes a portable map reproduction plant and units for control, surveying, topography, and drafting. It includes a large number of topographers, and topographical draftsmen skilled in reading aerial photographs. It is provided with motor transportation to carry its equipment and to carry on its surveying operations.

(2) *GHQ topographic battalion.*—This unit is similar to the army battalion, except that its primary function is map reproduction and printing, and that its reproduction plant contains heavier machinery and has less mobility. Its surveying units have the same mobility as in the army battalion. The reproduction plant operates as the base plant for the GHQ force.

g. Railway units.—Railway units operate and maintain standard gauge military railway. They may be assigned to the operation and maintenance of light railways. Railway construction is a function of general engineer troops.

(1) *Railway battalion.*—This unit is capable of operating and maintaining a railway division of from 50 to 100 miles. Most of its personnel is drawn from the railways of the zone of the interior. It operates in accordance with civil railroad practice and includes a company for train operation, a company for maintenance of way, and a company for light shop operations. It is equipped with railway tools and machinery and railway cars for the transportation and storage of this equipment. Locomotives and rolling stock are assigned by the director general of military railways.

(2) *Railway shop company.*—This unit handles the heavy shopping of several railway battalions. Its shop equipment is not mobile. It is probable that a battalion organization will be developed to replace the present railway shop company.

h. Supply units.—Supply units execute supply functions under the control of unit engineers.

(1) *Water supply battalion.*—This is primarily a motorized unit for transporting water. The officers and men ride upon the vehicles. It is equipped to pump, purify, and transport water, and has medical personnel to pass upon the quality of the water. The basic water transportation unit is the tank truck section of 9 trucks (each truck of 500-gallon capacity). There are 15 such units in a battalion, 5 in each company. The basic purification unit is the purification section (1 purification truck and 5 men). There are 12 such units in the battalion.

(2) *Dump truck company.*—This is primarily a unit for transporting road metal. The basic transportation unit is the dump truck section of nine 2-ton dump trucks. There are 5 such units in the company. The officers and men ride on the vehicles. Exclusive of dump trucks, the equipment is that necessary for the maintenance of the unit in the field.

(3) *Depot company.*—This unit operates depots and supply points. It is a dismounted unit with motor transportation for its interior supply and for reconnaissance. Its organic equipment is that necessary for the operation of its various depot detachments. Its depot stock is supplied by railway, wagons, or truck, and can not be moved by the company transportation. The basic work unit is the depot section of about 30 men. There are 4 such sections in the company. The company may form the nucleus of large depots, or depot sections or detachments therefrom may assist in the operation of supply points in all areas, and may be attached to divisions.

(4) *Shop company.*—This unit executes general shop work except for railways and camouflage. It is a dismounted unit. Transportation is provided for reconnaissance and for interior supply of the unit. It has some portable equipment, but usually operates at one location for some time or takes over the operation of established shop utilities. It may form the nucleus for the operation of a large central shop.

i. Camouflage units.—Camouflage units are primarily for inspection, training, and camouflage manufacturing. Their per-

sonnel consists almost entirely of skilled mechanics and specialists.

(1) *Army camouflage battalion.*—This unit is primarily for camouflage inspection, discipline, and training in the army area. Small detachments from this unit may be dispersed through a large area, or the unit may operate from a central point. The basic working unit is the platoon (1 officer and 10 men). There are 16 such units in the battalion (4 in each company), permitting the assignment of one to each area equivalent to that of a division. A limited amount of manufacture and supply is provided for by the headquarters. The equipment consists largely of special camouflage kits carried by the individual camoufleurs. Camouflage work is executed by general engineer troops and by the troops of all arms. The camouflage platoons assist by executing special work and by demonstration and instruction.

(2) *GHQ camouflage battalion.*—This is primarily a manufacturing unit. It includes personnel for camouflage inspection and training in the area behind the armies and for depot work. Its equipment is similar to that of the army camouflage battalion, except that its factory equipment is not as mobile. It forms the nucleus for the organization of large camouflage factories and depots.

j. Engineer headquarters sections.—The engineer headquarters section provides the personnel and special engineer equipment for the office of the unit engineer and his staff and makes up the engineer section of the staff of the commanding general of the unit. Engineer headquarters sections are provided for the corps, army, communications zone and its sections, general headquarters reserve, and general headquarters.

k. Special engineer headquarters.—The railway headquarters controls the operations of several railway battalions and shop companies. Similar headquarters may be organized to form the command group for other special operations.

l. Medical detachments, bands, and chaplains.—Each engineer regiment and each battalion which is not part of a regiment has a medical detachment consisting of medical and dental personnel. Veterinary personnel is included in the medical detachments of regiments and battalions having animal-drawn transportation. Each engineer regiment has a band. A chaplain is assigned to each regiment.

17. Organizational balance.—In the preparation of engineer Tables of Organization and Tables of Basic Allowances, a certain balance has been maintained among the factors of personnel, functions, weights, and mobilities. In making changes in these tables to meet the requirements of specific theaters of operations, it is necessary to recognize and preserve this balance. Tools have been provided in sufficient numbers to permit all the available personnel to do the work required. The weight of tools has been kept within the cargo capacity of the assigned vehicles. The vehicles are drawn by animals or tractors which are also used on the work. The vehicles move at the rate of marching troops and remain with the work units. When changes are proposed in the tool equipment, it is necessary to determine whether the weight of added tools does not exceed the cargo capacity of the vehicles, and whether there are men in the organization to use the tools. Similarly, proposals to change from animal to mechanical transport must envisage the provision of tractors to replace the animals on work, and, to preserve the principle of not separating the engineers from their tools, must look to the provision of transport for the men as well as for their equipment.

18. Assignment.—*a. Definition of a GHQ force.*—A GHQ force is a force that includes all of the troops that operate in an independent theater of operations under the immediate command of the commanding general, GHQ, or expeditionary force, and consists of—

(1) Infantry divisions.

(2) Corps headquarters and corps troops.

(3) Army headquarters, army troops, and cavalry divisions.

(4) Communications zone headquarters and communications zone troops.

(5) General headquarters reserve troops.

(6) General headquarters.

b. Engineer needs in a GHQ force.—If a GHQ force operating in an independent theater of operations comprises only one infantry division without supporting troops, the engineering needs of the rear areas will require so many working details that the power of the division will be greatly reduced. The engineer combat regiment with such a GHQ force, even with additional equipment, is insufficient to perform the necessary engineer work and line troops must therefore be diverted to engineer

tasks with consequent detriment to the combatant strength of the force. A GHQ force which is so constituted that its divisional troops are available at all times for combat use may be called a balanced force. Table I shows the requirement in engineer troops for a balanced GHQ force of 54 divisions, or 6 field armies. In general, it may be stated that the strength of the engineer component of a balanced GHQ force of a lesser number of divisions is in proportion; thus, the engineer strength for a balanced force of 9 divisions is 9/54 or 1/6 of that for 54 divisions.

SECTION II

ENGINEER EQUIPMENT

19. General principles.—*a.* Detailed lists of the items of engineer equipment furnished to engineer troops are contained in Tables of Basic Allowances. The brief descriptions of the equipment of engineer units contained in the subsequent paragraphs of this section give information useful in the field and essential to an understanding of the sections of this manual dealing with the organization, armament, equipment, and operation of the various classes of engineer troop units.

b. For convenience of issue, engineer tools have been assembled into sets suitable for the execution of different classes of work by a work unit of the usual size. These sets include the essential tools required for the usual types of work, in sufficient quantity to equip all of the men.

c. The basic sets are those issued to the combat regiment. Many of the basic sets are issued to all classes of engineer troops. In addition to the basic sets, engineer equipment includes what is termed "supplementary equipment." The latter supplements the basic sets in order to give the proper number of tools for the strength of the unit and to enable the execution of a wider variety of work. In many cases the issue of a basic set, or multiples thereof, would not meet the requirements of a unit as it would give many tools that are not needed and could not be used and would unduly increase the load carried by the vehicles. The use of supplementary sets in connection with one or more basic sets permits the issue of a properly balanced equipment within the allowable weight.

d. In general the items of engineer equipment are standard articles obtainable in the commercial market. Tools which have several uses are preferred to those that can be employed on only one class of work. Since the organic engineer equipment must be portable, it consists mostly of hand tools, but mechanical appliances are made available to replace hand tools where practicable and they frequently form part of the equipment of regiments and battalions and special units.

e. Engineer equipment sets comprise a small amount of miscellaneous materials in addition to the tools.

f. Sets of tools that can be used upon engineer work are also issued by supply arms and services other than the engineers. Quartermaster tool sets in particular are used to augment the engineer equipment of engineer troop units.

20. Individual equipment.—Individual equipment includes clothing, camping and messing equipment, weapons, and special articles for professional use. Riding equipment is provided for mounted personnel.

21. Officers' equipment.—For a list of authorized and optional individual equipment for officers and warrant officers, see Tables of Basic Allowances for Engineers.

22. Enlisted men's equipment.—Equipment of engineer dismounted enlisted men is in general as for infantry, omitting such items as intrenching equipment, grenade dischargers, etc. Mounted engineers enlisted men are equipped in general as for cavalry, omitting such items as sabers, etc. For a list of authorized individual equipment for engineer enlisted men, see Tables of Basic Allowances for Engineers.

23. Supplementary engineer equipment.—*a. For the combat regiment.*—(1) *Company set A* (tools to supplement the platoon equipment primarily for road work) includes 3 blocks (2 double, 1 snatch); 4 each of the following: Road brooms, stone forks, hoes, pick-mattocks, rakes, square-point shovel, road tampers; 1 drag scraper, and 2 wheelbarrows. Weight, 483 pounds.

(2) The components of *Company set B* (general engineer supplies) vary with the situation. The standard set includes about 739 pounds of sandbags, driftbolts, machine bolts, nails, rope, barbed wire, and steel wire.

(3) The *regimental set* includes about 4,300 pounds of road tools and miscellaneous engineer supplies for issue to battalions and may vary with the situation. The standard set includes 2 plows, 6 drag scrapers, demolition supplies, including 1,000 pounds of TNT, drift and machine bolts, nails, and steel.

b. For the general service regiment.—The items comprising the supplementary equipment set for the general service regiment have not yet been approved. This set, when authorized, will include a supply of road, railway, and general construction tools adequate to supplement the other unit equipment so that the command may be efficiently employed on the usual tasks. Provision for transportation of the supplementary set has been

made in the unit transportation. The set will be divided into platoon, company, and regimental components.

c. For the separate battalion.—The provisions of *b* above apply also to the separate battalion.

d. For the squadron.—This set is similar to that in the combat regiment, but includes less than half as many tools or supplies. It is issued entirely to headquarters and service troop and is made available to the lettered troops as the necessity therefor arises.

e. For other engineer units.—Sets of supplementary equipment are provided for certain other engineer units where basic sets are not suitable for their organization and employment. These supplementary equipments are described elsewhere in connection with the organization, armament, and equipment of the several organizations.

24. Blacksmith tools.—This is the standard issue quartermaster set supplemented by engineer tools and supplies. It furnishes specialist equipment adequate for the operation of 2 blacksmiths and 2 helpers, includes horseshoer's tools and a supply of steel for general repair work. Weight of tools, 566 pounds; of supplies, 200 pounds.

25. Blue print and ammonia print equipment.—The principal items of this equipment are a printing frame, 24 by 30 inches, a supply of sensitized paper and an ammonia gas tube. With this equipment ordinary blue prints, brown prints, and blue line prints may be made. Using the ammonia gas tube, prints on special paper can be developed giving a reddish design on a white background. The ammonia process is standard in general engineer troop units. This equipment is used in making reproductions of drawings, charts, diagrams, and maps where large numbers of prints are not required. Weight about 230 pounds.

26. Carpenter equipment, platoon set.—The carpenter chest contains a complete set of tools suitable for a skilled carpenter, together with extra saws, hammers, and hatchets. This equipment, when combined with the pioneer equipment, is sufficient to equip 4 squads employed upon carpenter work. Total weight about 160 pounds.

27. Carpenter and wheelwright equipment (quartermaster issue).—This is specialist equipment used by a company carpenter for general company work. Weight 150 pounds.

28. Cobbler equipment (quartermaster issue).—This is a chest containing hand tools and supplies for shoe repairs. Weight 136 pounds.

29. Demolition equipment, platoon set.—*a.* This set consists of 100 pounds of explosives (TNT) with the necessary accessories for detonation by time and electric fuses. Tools used in placing the charges are contained in the pioneer and carpenter sets. Total weight about 235 pounds.

b. The principal items are cap box; match box; crimper; circuit detector; cordeau drills; magneto exploder; pliers; reel; cordeau slitters; 1,000 feet of firing wire, electric caps; nonelectric caps, detonating cord; explosive; time fuse; instantaneous fuse; 50 fuse lighters; matches; friction tape; twine; and detonating cord unions.

c. The above supply of explosives will permit of any of the following: Cut 100 steel rails; cut ten 20-inch trees with external charges, or thirty-two 20-inch trees with internal charges; destroy 1 abutment of an ordinary highway bridge; disable 4 wooden highway bridges; disable 2 steel bridges; or disable 1 concrete highway bridge. It is not sufficient to destroy a railroad bed at a culvert or to make an effective crater in a first-class highway unless conditions are exceptionally favorable in each case.

30. Drafting and duplicating equipment.—A combined drafting and duplicator set suitable for two draftsmen. The duplicator uses a 9 by 14 inch gelatine film. Colors may be used in printing. The chest is designed to serve as a drafting table. The set consists of 1 chest; drawing board 16 by 22 inches; steel eraser; 12 duplicator films 9 by 14 inches; film holder; drawing instruments; map measurer; protractor; 2 scales, architect and engineer; erasing shield; 2 triangles; T-square; and expendable items, including erasers, pencils, pens, inks, paper, and tracing cloth. Weight 76 pounds.

31. Regimental drafting equipment.—Equipment used by the map section of unit headquarters for drafting of maps, plans, and estimates. It is a complete set of office instruments and supplies for 2 draftsmen. The equipment is carried in 2 chests and a crate. The crate contains the 2 drawing boards (106 pounds). Chest A contains instruments and miscellaneous drafting supplies (78.4 pounds). Chest B contains a pantograph, T-squares, tin tubes, paper, and cloth (196.2 pounds). Total weight 381 pounds.

32. Duplicator equipment.—A gelatine film duplicating set (19½ by 23½ inches), for work in 1 to 5 colors using copying pencil, duplicating ink, or typewriter duplicating ribbons. Weight 135 pounds.

33. Duplicating machine (quartermaster issue).—This is a mimeograph outfit with stationery and supplies. Weight 160 pounds.

34. Portable electric-lighting equipment.—This is a portable electric lighting set for headquarters in the field. It includes a 5-k.w. power unit with accessories and fixtures to install and maintain about 100 lights. The generator set weighs about 800 pounds. For field service, such equipment and supplies as may be necessary for installation and operation are carried in one truck, including the generator set unit, reels and reel stand with wire and connections thereon, and such lamps and accessories as may be desirable for the operations in view. The outfit can be set up and put into operation in one-half hour. One man is needed for operation; 3 men for normal field wiring. Weight 2,070 pounds.

35. Map-enlarging equipment.—This is a photographic map enlarging or reducing outfit, using 5 by 7 inch negatives, and enlarging up to 20 inches square. Illumination is furnished by a 500-watt electric lamp. It can be used for reproducing maps in limited quantities. The prints are made on bromide paper, which is not very suitable for maps. The set includes the camera with lamp, four 50-yard rolls of bromide paper, and a supply of chemicals and equipment for developing and fixing. Weight about 300 pounds.

36. Footbridge equipment.—*a. Kapok type.*—Portable kapok raft footbridge equipage for use in crossing foot troops, consisting of forty-four 12-foot kapok rafts with accessories. Carried usually in 4 trucks. The rafts are fastened end to end on shore and the entire bridge launched at one operation. Weight about 11,800 pounds.

b. Lampert type.—The Lampert type footbridge is a portable floating footbridge in which the buoyant supports are small canvas pontons. One unit will furnish a bridge 285 feet in length, and can be carried in two 1½-ton trucks, in three escort wagons, or in one 3-ton truck. The canvas pontons are assembled on shore, launched, connected with the walkway, and the bridge anchored in about 35 minutes. Weight 4,500 pounds.

37. Horseshoer equipment (quartermaster issue).—Horseshoer's tools are included in the blacksmith's set. The horseshoer's set carried by the horseshoer on the march consists of a roll containing hammer, nippers, knife, rasp, and pincers taken from the blacksmith's set.

38. Illuminating equipment.—Lanterns for use in headquarters or drafting room. The set consists of a box containing two gasoline pressure lanterns, with accessories. Weight 70 pounds.

39. Intrenching equipment.—*a. Infantry division.*—Hand tools and materials for infantry and other divisional troops for intrenching and general engineer work. Each set includes 26 axes, 26 saws, 125 pick-mattocks, 250 shovels, burlap sandbags, nails, tracing tape, and similar items. Weight of one set, 2,977 pounds. Six sets are issued to each divisional engineer regiment and are carried in 6 escort wagons. Each wagon load permits the employment of men at one time upon all of the following operations: Digging, 48 squads; cutting and clearing, 14 squads; a total of 62 squads, or approximately one infantry battalion. Total weight, 6 sets, 17,862 pounds.

b. Cavalry division.—The intrenching equipment carried by the engineer squadron for use in the cavalry division consists of hand tools and materials for intrenching and general engineer work. Each set includes 13 axes, 13 saws, 65 pick-mattocks, 130 shovels, 500 burlap sandbags, and nails, tracing tape, and similar items. The weight of one set is about 1,754 pounds. Four sets are issued to each engineer squadron and are carried in 4 escort wagons. Each wagon load permits the simultaneous employment of the men of about one squadron on digging, cutting, and clearing. Total weight, 4 sets, 7,016 pounds.

40. Lithographic equipment.—A hand-operated lithographic press with necessary accessories and supply for field work. Lithographic methods are being greatly simplified commercially, and future developments of the field equipment will result eventually in the substitution of a press operating on the offset principle in place of the present press of flatbed type. The principal items are 20 zinc plates, 17 by 28¾ inches; lithographic drawing instruments; 4 colors of ink; lithographic chemicals and accessories; map and transfer paper. The equipment is packed in 4 chests. Chest A contains the press with cheesecloth and absorbent cotton (380 pounds). Chest B con-

tains instruments, plates, and paper (311.6 pounds). Chest C contains inks, chemicals, and containers (244.7 pounds). Chest D contains oil stove, kerosene, and turpentine (156 pounds). Total weight of equipment and supplies, 1,093 pounds.

41. **Truck-crane unit.**—This unit consists of a truck crane with a ½-yard clamshell bucket and a ½-yard drag line bucket for general use as a piece of construction plant. The crane is mounted on the 5½-ton truck with a 180-inch wheel base. The crane has a full circle (360°) swing with a winch head on each side of the frame. It has a 24-foot boom with an 8-foot base extension, and for hoisting, swinging and winching is operated by a separate gasoline engine. At a 10-foot radius the boom has a lifting capacity of 17,000 pounds which reduces to 3,400 pounds at a 32-foot radius. The truck is equipped with a crawler attachment for use in moving over soft ground. By improvising leads this equipment can be used to drive piles up to 30 feet in length with a drop hammer. The gross weight of the unit including the buckets is 38,700 pounds.

42. **Pack equipment.**—*a. Combat regiment.*—The standard engineer pack loads consist of 5 packs, numbered 1 to 5, respectively. Each engineer load is carried in 2 pack boxes, one of which rides on each side of the pack animal. The weight on the pack animal is approximately as follows:

	Pounds
Pack saddle	75
Pack boxes	75
Tools and supplies	125
Total	275

(1) *Pack No. 1* is primarily a carpenter and bridge repair pack, but also includes harness maker and horseshoer equipment. The carpenter tools will equip one squad and include auger bits in sizes from ¼ to 1 inch by eighths, a ratchet brace, chisels, stone drills, hammers, hatchets, crosscut saws, steel square, 50-foot tape and about 50 pounds of supplies including 16d and 60d nails, driftbolts, chalk and pencils. The harness maker equipment is a small set for field repairs, and contains 4 pounds of tools and materials. The horseshoer's set is a field kit for one man and contains 10 pounds of tools and 13 pounds of materials.

(2) *Pack No. 2* is a demolition pack. It contains equipment for both electrical and time fuse firing including a ship auger, pinch bar, cold chisel, detonating cord, cap crimper, cordeau drill, cordeau slitter, knife, magneto exploder, side-cutting pliers and 500 feet of firing wire on a reel; and material for demolitions including 90 pounds of explosives (TNT), blasting caps, detonating cord, blasting fuse, fuse lighters, matches, twine and detonating cord unions.

(3) *Pack No. 3* is a demolition pack and is exactly like pack No. 2 in all respects.

(4) *Pack No. 4* is a pioneer pack, containing axes, sledges, mining picks, and mining shovels. It will equip 3 squads for digging and 1 squad for cutting and clearing.

(5) *Pack No. 5* is a pioneer pack containing rope, blocks (single, double, and snatch), hatchets, machetes, and crosscut saws. It will equip 1 squad for rigging and 2 squads for cutting and clearing.

(6) *Pack saddles.*—The 5 standard engineer packs and any general cargo packs are carried on cargo type Phillips pack saddle equipment issued by the Quartermaster Corps. This equipment includes the saddle with two cinchas, bridle with halter, breast collar, breeching, and a mohair pad.

b. Squadron.—The engineer pack loads of the engineer squadron consists of 5 pack loads of the same general character as those of the combat regiment described in *a* above, except that the weight of the equipment is reduced by the elimination of tools so that the gross load on the pack animal does not exceed 200 pounds. This reduction in weight has been found necessary in order to give the engineer pack animals the same mobility as the cavalry division. The engineer pack loads and any general cargo loads with the squadron are carried on the cavalry type Phillips pack saddle equipment issued by the Quartermaster Corps. This equipment includes the saddle with two cinchas, bridle with halter, breast collar, breeching, and a mohair pad. The weight on the individual pack animal is approximately as follows:

	Pounds
Pack saddle	75
Pack boxes (or other containers)	35
Tools and supplies	80
Total	190

43. **Photographic equipment.**—*a.* The *regimental set* comprises a 3A Graflex camera and developing and printing outfit. It consists of a chest in which the principal items are camera, printing frames, dark room light, developing tank, trays, developing chemicals, 3¼ by 5½ inch films, and developing paper. Weight 150 pounds.

b. The *company set* comprises a 3A autographic kodak, with tripod, instruction manual, negative album, notebook, and 24 rolls of 3¼ by 5½ inch films of 6 exposures each. The above is equipment solely for making exposures. Additional equipment is required for developing the negatives and printing the pictures. Weight 9 pounds.

44. **Pioneer equipment, platoon set.**—This consists largely of hand tools for cutting, digging, rigging, and general pioneer work, and a supply of rope and nails. It permits the equipment of the men for the more important classes of group work as follows: 4 squads with shovels, 2 squads with picks, 2 squads with axes and adzes, 2 squads with brush cutting tools, 2 squads with rock breaking tools, 1 squad with wire cutters, and ½ squad with saws. The equipment is used principally upon road, bridge, and field fortification work. Some of it may be used for carpenter and demolition work.

a. The principal items are 2 adzes; 13 axes; 3 pinch bars; 2 wrecking bars; 2 double blocks; 1 snatch block; 1 log chain; 1 pair climbers; 5 tool containers (3 axe boxes, 1 tool grinder box, and 1 pioneer chest); 2 come-alongs; 3 wire cutters; 8 stone drills (three 18-inch, three 30-inch, and two 48-inch); 1 mining drill; 1 hacksaw frame; 1 tool grinder; 2 mason's hammers; 3 napping hammers; 2 brush hooks; 2 screw jacks; 4 machetes; 2 pick-mattocks; 2 mauls; 1 oiler; 2 peavies; 2 drifting picks; 14 railroad picks; 6 pliers; 2 crosscut saws, 2-man; 24 D-handled shovels; 8 long-handled shovels; 4 sledges; 1 miner's spoon; 1 saw tool; 1 trowel; 2 steel wedges; and 6 wrenches (monkey, one 8-inch, two 12-inch, and one 18-inch; and pipe, two 18-inch). Weight about 905 pounds.

b. The supplies include 12 hacksaw blades; 40 driftbolts; 1 gross lumber crayons; 22 spare handles (1 adze, 6 axe, 3 hammer, 8 pick, and 4 sledge); 10 pounds of marline; 135 pounds of nails (fifty 60d, twenty-five 30d, fifty 10d, and ten 8d); 1 pint lard oil; 250 feet 1-inch rope; 200 feet ¾-inch rope; 360 feet of ½-inch rope; and 3 rolls of tracing tape. Weight about 380 pounds. Total weight about 1,285 pounds.

45. Pipe-fitting equipment.—This equipment is for special work at water points and for miscellaneous construction and repairs. The set consists of chest containing pipe cutter, hacksaw frame with 12 blades; ball pein hammer; oiler; slip joint pliers; burring reamer; rule; 4 lag screws; 2 sets of stocks and dies (¼ to 1 inch, and 1¼ to 2 inch); pipe vise; 2 pipe wrenches; 2 extra sets of dies; 1 pound of white lead; and 1 gallon of lard oil. Weight 100 pounds.

46. Ponton-bridge equipage.—Ponton equipage is of two standard types: The light equipage, M1926 (aluminum pontons), to accompany infantry or cavalry divisions for the construction of floating bridges capable of carrying divisional loads; and the heavy equipage, M1924 (wooden pontons), for the construction of bridges capable of carrying all army loads. Pending the issue of these types to the service, M1869 equipage both heavy and light will be used as limited standard for training purposes. The heavy equipage, M1869, can be modified so as to have the same characteristics as the light equipage, M1926, and when so modified may be issued in lieu thereof to light ponton companies. The "unit" of ponton-bridge equipage is the amount transported by one bridge platoon. The characteristics of the two standard types are shown in Table II.

47. Reference library.—*a. Company.*—This is a small engineer reference library consisting of an architect handbook, a civil engineer handbook, and an electrical engineer handbook. Weight 9 pounds.

b. Regimental.—This library consists of a pressed steel book box containing 18 standard engineering handbooks covering building construction, automotive engineering, chemistry and physics, civil, mechanical, and electrical engineering, engineering forumulas, explosives, railways, waterworks, power plants, and surveying. A dictionary and a book of reference tables are also included. Weight 33 pounds.

48. Saddler equipment (quartermaster issue).—This is a chest containing the tools necessary for saddle and leather work. Weight 61 pounds.

49. Sign-painting equipment.—Equipment sufficient for one sign painter and several helpers. Includes paint brushes, stencils for 5, 3, and 1½ inch letters, an assortment of colored paints, and a limited supply of tin sheets for use as signboards. The brushes and stencils are carried in a chest. The paints are carried in a crate. Total weight 200 pounds.

50. Sketching outfit.—This set is contained in a convenient chest with a handle. It includes a small sketching board with a demountable tripod, a clinometer for measuring vertical angles, and a triangular alidade. It is used as a plane table for topographical sketching, and for any field purpose requiring a small drawing board. The chest also contains a prismatic compass, a pace tally, and a supply of paper, celluloid sheets, and pencils. Total weight 23 pounds.

51. Stereoscopes.—The stereoscope is a folding lorgnette stereoscope for use in reading aerial photographs. Weight ½ pound.

52. Regimental surveying equipment.—The principal items are: Plane table, level, transit, stadia and level rods, tapes and reconnaissance instruments, including aneroid barometers, an odometer, a hand locator level, and a pocket sextant. Weight 250 pounds.

53. Telephone equipment.—This set, issued by the Signal Corps, contains the following principal items: Reel cart, 2 switchboards, 5 telephones, and 1 mile of outpost wire with tools and accessories for installation.

54. Tinsmith equipment.—A set suitable for a tinner and one helper for special work. It consists of 2 soldering coppers; snips; blow torch; ½ pound of soldering paste; and 5 pounds of half-and-half solder. Weight 32 pounds.

55. Transportation.—*a.* Engineer transportation can be divided into two general classes:

(1) That required for the proper execution of engineer work and necessary to engineers as technical troops.

(2) That which is common to troop units of all arms and services.

b. Under the first group may be found:

(1) Riding animals; necessary for engineer reconnaissance, the control and inspection of engineer work, and for emergency use with carriers to transport material.

(2) Draft animals; required to draw the engineer vehicles carrying tools, to draw these same engineer vehicles when carrying engineer construction material, and to draw appliances such as plows and scrapers.

(3) Pack animals; to transport tools and material for working parties in difficult country.

(4) Tractors; required to draw the engineer vehicles carrying tools, to draw these same engineer vehicles when carrying engineer construction material, and to operate appliances and machinery such as plows and scrapers.

(5) Vehicles, such as motor cycles and cross-country and commercial motor cars; for engineer reconnaissance, messenger work, extended inspections, and transport of small items of equipment.

(6) Vehicles, such as trailers, wagons, and trucks; to carry engineer equipment on the march and engineer material when the equipment is placed upon the work after the march is completed.

(7) Vehicles, such as dump and tank wagons, trailers, and trucks; normally assigned for supply use only, carrying road material, gas, or water.

(8) Special vehicles and trailers, such as ponton wagons, machine shop trucks, purification units, crushers, rollers, scrapers, sprinkling wagons, and other mobile work units or special vehicles designed to carry special loads.

c. Under the second group may be found the escort wagons and trucks of the field train carrying rations and baggage and organizational equipment common to all arms, and certain vehicles of the combat train, such as rolling kitchens, spring wagons, and water carts and tanks.

d. Transportation of the first class must be with the engineer unit at all times. It is as much a part of the engineer unit as the machine gun is of the machine-gun company. Without this transportation, engineers cease to be engineers. On the march the cargo carriers are used to transport equipment and baggage only, but when the movement ends and engineer work begins, this transportation begins to perform its real function. Engineer work can not go on without material and the major function of the engineer vehicle is to transport this material.

e. Transportation of the second class does not have to be with the engineer unit throughout the entire day. Engineer operations, however, frequently require these vehicles and their draft for use on engineer work.

f. The nature of engineer operations in the theater of operations is such that as a general rule organizations are distributed over rather extensive areas in basic working parties. This

requires grouping tools and material into a number of small sets so as to make each unit as self-supporting in its work as possible. Although a combat regiment could carry all of its platoon equipment in four 3-ton trucks attached to the headquarters and service company, such an arrangement would increase the time required for starting engineer work. The plan of assigning tools and transport to each platoon is more practicable from an operating point of view.

56. Water-supply equipment.—*a. For combat regiments.*—Equipment for providing water points for a division. The principal items are a portable centrifugal pumping set, 5 hand lift and force pumps, 2½-inch suction and 2-inch discharge hose, three 20 by 20 foot canvas basins, and 12 water sterilizing bags. Weight 2,950 pounds.

b. For general service regiments.—Two sets of the unit set described in *a* above are issued to general service regiments.

57. Water-purification unit.—This unit is mounted on a 3½-ton cargo truck. It consists of a pump, a sand filter, a chlorinating device, and a laboratory for testing water. The pumping unit consists of a centrifugal pump which has a rated capacity of 100 gallons per minute against a 75-foot head when operating at 1,150 r.p.m. The actual delivery of water from the purification unit for a run of several hours averages 70 gallons per minute (4,200 gallons per hour) against a 75-foot head.

58. Other supplementary equipments.—Numerous other supplementary and special engineer equipments are carried in engineer depots for issue to troops engaged upon various classes of engineer work. Included in this category are road construction machinery and tools, including road rollers, tractors, water wagons, road brooms, road graders, wheelbarrows, road tampers, etc.; general construction equipment, including portable power saws, bench vises, illuminating equipment, and general carpenter's tools; quarry equipment, including rock crushers, rock drills, explosives, etc.; shop equipment, including machines for various metal and wood working and foundry operations; water supply equipment; railroad construction equipment; lumbering equipment; and numerous individual items of construction plant, including concrete mixers, compressors, engines, derricks, pile drivers, pumps, etc.

SECTION III

ENGINEER HEADQUARTERS

59. General.—Engineer headquarters are established for each echelon of the field force, including general headquarters, communications zone, the group of armies, the armies, corps, and divisions. These headquarters are essentially sections of the staffs of the military commanders, and, in general, perform staff duties. The organization of each engineer headquarters conforms in general to the organization of the engineer headquarters of the next higher unit, in so far as that scheme of organization is applicable, so as to facilitate the transaction of business between them.

60. Typical organization.—The typical organization of an engineer headquarters follows in general the organization of the staffs of tactical commanders as prescribed in the Staff Officers' Field Manual. The staff of the unit engineer consists of two groups—one group having duties of a general functional character and the other having duties pertaining to administrative and technical matters. Each officer of the general group deals with one or more of the following matters: Personnel, information, operations, training, and supply. Each officer of the administrative and technical group deals with one or more of the following matters: Administration, finance, railways, roads and bridges, water supply, camouflage, depots, quarries, construction, fortification, topography and map reproduction, and shops. The number of sections of the technical group is diminished or increased according to circumstances. The duties of the unit engineer and his staff are as follows:

a. The *unit engineer* is responsible for carrying out within the area over which his unit commander has jurisdiction all of the duties with which the Corps of Engineers is charged, except

such as may have been taken over by higher echelons or otherwise exempted from the commander's control. He has a dual rôle as a member of the staff of the unit commander and as the commander of those troops of the engineer arm which have been allocated to the unit. In his capacity as a staff officer and technical advisor to the unit commander on engineer subjects, he submits recommendations and plans in connection with—

(1) The training in military engineering of all troops of the unit.

(2) The selection of routes for the advance of the unit with special reference to location of supply points.

(3) The organization and control of routes for traffic within the unit area, including the preparation of traffic control maps.

(4) The selection of defensive positions by the unit commander or his staff, including the selection of sites for observation posts.

(5) The preparation of paragraphs in unit field orders or annexes thereto which relate to engineering operations.

(6) The destruction of military stores threatened with capture.

(7) Regulations concerning the use of water, electricity, or other utilities, especially when new installations may tax the capacity of the existing systems.

(8) The selection of sites for any major activities in the unit areas, such as supply depots, rest areas, prisoner-of-war inclosures, hospitals, and airdromes. In his capacity as the commander of the troops of the engineer service of the unit, he is responsible for the execution of all the engineer work necessary to further the tactical and strategical operations of the unit. He is director of railways within the unit area and directs all topographical projects and construction activities.

b. The *executive officer* of the unit engineer's staff has duties with respect to the engineer arm analogous to those of a chief of staff with respect to a tactical command. He also exercises the functions of the unit engineer during the latter's absence.

c. The *personnel officer* studies and makes recommendations to the unit engineer concerning personnel policies, replacements, school details, awards, trials, investigations, leaves of absence, promotions, transfers, and assignments.

d. The *information officer* supervises the collection, digest, and dissemination of engineer information; maintains a li-

brary of engineering literature and photographs; compiles technical data on the geographical and geological character of the area including water and forest resources and the character of the soil and rocks; compiles data on the technical operations of engineer troops; supervises the distribution of maps throughout the unit; and makes recommendations for initiating surveys and mapping activities.

e. The *operations officer* makes recommendations to the unit engineer concerning the allocation of engineer troops to lower echelons; drafts the operations orders to be issued by the unit engineer to troops under his command; coordinates and drafts the plans and orders for engineer reconnaissance; drafts the engineer paragraphs of and engineer annexes to orders to be issued by the commander upon whose staff the unit engineer serves; makes arrangements for engineer troop movements; and drafts reports to be made to the commander as to the current engineer situation.

f. The *supply officer* makes studies of the engineer supply situation in the unit area and makes reports to the unit engineer as to the sufficiency and accessibility thereof to using troops. He plans the forward displacement of engineer depots as the troops advance and arranges for the conservation of stocks relinquished by lower echelons. He controls transportation and coordinates with the operations officer the allocation of transportation to subordinate units for engineer work. He examines requisitions, designating depots to make issues, and abstracting to higher supply echelons those items to be supplied by depots not controlled by his unit. He makes studies of demands for engineer supplies from the various elements of the command and recommends the establishment of credits to the end that supply will be equitable and prompt.

g. The *training officer* devises policies for the conduct of engineer training activities, including schools for officers and enlisted men of engineers and for the teaching of field engineering to troops of other arms and services.

h. The *railway officer* keeps record of the condition, maintenance, and operation of all railways, both narrow and standard gauge, within the unit area, and makes recommendation to the unit engineer concerning the allocation of rolling stock and locomotives and the construction of new lines. He exercises general supervision over the operation of the railways and of railway shops; maintains liaison with civilian staffs

of railways not operated by military personnel; approves plans for and makes inspection of new construction; and may act as railway manager of such lines as are not controlled by other echelons of the field force.

i. The *construction officer* keeps records of the location and progress of construction projects within the unit area, and recommends general construction policies. He makes and issues type plans which are then adapted to local conditions by the constructing units.

j. The *roads and bridges officer* keeps informed of the road situation throughout the area occupied or about to be occupied by the unit, and recommends general policies for road and bridge construction and maintenance. He is the logical officer to recommend a plan of traffic circulation for the unit so far as the physical conditions of the roads and the capacity of the troops to maintain them are concerned, and he, therefore, studies carefully the relation of the road net to the installations of every character throughout the area in order that his recommended plan of traffic circulation may fit the necessities of the situation.

k. The *water supply officer* makes a survey of water resources of the area of present and proposed operations of the unit, and proposes a water supply plan together with such regulations as to water consumption as may be necessary. He recommends as to the allocation of water supply troops to lower echelons and sees that depots are adequately stocked with water supply equipment.

l. The *camouflage officer* studies the camouflage possibilities of the unit area and recommends ways and means of deceiving the enemy by camouflage. He proposes regulations for the camouflage discipline of the troops; recommends disposition of camouflage troops in the area; sees that depots contain stocks of suitable camouflage material; and supervises the operation of camouflage factories.

m. The *topographical officer* studies the map needs of the command and recommends mapping projects to be executed by the troops. All work orders for map reproduction are passed upon by him. He arranges for cooperation by the Air Corps in mapping projects. He sees that necessary geodetic surveying for fire control is executed for the artillery.

n. The *depot officer* is concerned with the general question of depot stocks. Directly under him is a group of individuals

who are expert in the technical nomenclature of engineer items of every class and who edit the requisitions sent to higher supply echelons for stocks to be placed in depots in the unit area. He studies the labor situation at the various depots and recommends the allocation or transfer of depot troops so as to permit efficient and satisfactory depot operation.

o. The *fortification officer* is not always necessary but may be provided on the higher engineer staffs to look out for the general question of defense if circumstances warrant. He makes studies of the terrain with a view to its strengthening for defensive purposes and makes plans for the fortification of rearward areas. He also keeps situation maps and charts showing the state of the defensive works which are occupied by the unit.

p. The *shop officer* passes upon work orders for major manufacturing to be done in shops operated or controlled by the unit engineer. He recommends the allocation of troops to shops in the area and sees that products of the shops are turned over to the designated consumers or storage places.

q. The *enlisted personnel* of the unit engineer's office includes clerks, draftsmen, map reproduction technicians, technical engineering specialists, messengers, orderlies, and chauffeurs. Those above the grade of corporal, and cooks are armed with the pistol. Corporals and privates (except cooks) are armed with rifles.

61. Equipment.—The equipment of an engineer headquarters section includes drafting equipment, map reproduction equipment, office equipment, photographic equipment, and portable electric-lighting sets for illuminating the unit headquarters. Transportation includes motor cars, cross-country cars and motor cycles with side cars for use in engineer reconnaissance, visits of inspection, and messenger service.

62. General headquarters.—*a.* The chief engineer of the field force is the unit engineer of general headquarters and, as such, is responsible for initiating and carrying on in the entire theater of operations the duties with which the Corps of Engineers is charged.

(1) He formulates the general plan for the engineer operations in the theater of operations, and he deduces from it the general requirements as to engineer personnel, troop equipment, materials, and supplies.

(2) He submits recommendations as to the allocation of engineer personnel, troop equipment, materials, and supplies between the several armies and the communications zone.

(3) He commands all engineer troops not allocated to the armies or to the communications zone.

(4) He is director of railways for the theater of operations.

b. The organization shown in Tables of Organization is to be regarded as a nucleus for initial operations to be expanded or reduced to fit conditions. It includes the chief engineer and his deputy engineer, a group of staff officers with general functions as described in paragraph 60, and such number of technical staff sections described in paragraph 60 as the circumstances of the war make desirable.

63. Communications zone.—*a. Engineer communications zone.*—(1) An officer of the Corps of Engineers is detailed as engineer, communications zone, for every theater of operations. His duties include the procurement, storage, and issue of engineer supplies; the construction, including detailed plans, involved in all projects of the communications zone except telephone and telegraph lines; the operation of such public utilities as may be placed under military control or as may be constructed for military use. He is director of railways for the communications zone, and controls through military and civilian personnel under his command the operation and maintenance of all railways committed to the commanding general, communications zone. In his function as director of railways for the communications zone he is under the technical control of the chief engineer, who is a director of railways for the entire theater of operations.

(2) The duties of the engineer section of the headquarters of the communications zone are similar to those outlined above for the engineer section of general headquarters. The organization and personnel are similar to that of the engineer section of any headquarters.

(3) If the theater of operations is of any considerable magnitude, the functions of the commanding general of the communications zone and the various members of his staff will usually be so extensive as to necessitate the division of the area behind the armies into a number of communications zone sections designated by number, area, or location, each section under a commanding general with a staff of his own.

b. Section engineer.—(1) An officer of the Corps of Engineers is detailed as section engineer for each section of the communications zone. The section engineer is a member of the staff of the commanding general of the section. He is responsible for carrying out in his section the various duties and activities with which the Corps of Engineers is charged, except such as are not committed to the commanding general of his section.

(2) The organization of the engineer section headquarters is not fixed, but varies according to the nature of the military situation and the character and location of the theater of operations. The organization shown in Tables of Organization is, therefore, to be considered as a nucleus to be expanded or reduced to fit conditions.

64. Army.—*a.* An officer of the Corps of Engineers is detailed as army engineer for each army in the field. He is responsible for carrying out in the army area the various duties and activities with which the Corps of Engineers is charged except such as may have been turned over to the communications zone or otherwise exempted from the control of the army commander.

b. The army engineer headquarters includes a group of engineer staff officers with general functions and a group with technical staff functions, as described in paragraph 60. The general group usually consists of four officers; namely, personnel officer, intelligence officer, operations and training officer, and supply officer. The technical group may include any or all of the officers listed in paragraph 60.

65. Corps.—*a.* An officer of the Corps of Engineers is detailed as corps engineer with each army corps. He is responsible for carrying out in the corps area the various duties and activities with which the Corps of Engineers is charged, except such as are carried out by army engineer troops or otherwise exempted from the control of the corps commander.

b. The corps engineer headquarters includes a group of engineer staff officers with general functions and a group with technical functions as described in paragraph 60. The general group usually consists of 3 officers; namely, the executive officer, who combines the duties of executive, personnel, operations, and training officer, as described in paragraph 60; information officer; and supply officer. The technical group includes a camouflage officer and general engineering officer. This staff exercises supervision over the engineer operations

in the corps. On account of the small size of this staff, it is possible for each officer to be familiar with practically all phases of the engineer operations of the corps in addition to the special aspects for which his office is particularly provided.

66. Division.—*a.* The commanding officer of the engineer combat regiment with an infantry division or the engineer squadron with a cavalry division is the division engineer. The division engineer is responsible for carrying out within the division area the various duties and activities with which the Corps of Engineers is charged, except such as are carried out by corps engineer troops or otherwise exempted from the control of the division commander.

b. The division engineer maintains at or near division headquarters a division engineer section consisting of an officer and a few enlisted men. This personnel is provided for in the organization of the division engineer unit (combat regiment or squadron). The function of the engineer section at division headquarters is to maintain liaison between the divisional headquarters and the divisional engineer troop unit, and to assist in the preparation of the engineer features of the division plans and orders.

67. GHQ reserve.—A unit engineer is included in the staff of GHQ reserve headquarters whenever the latter is constituted. He is assisted by an engineer staff organized in general as described in paragraph 60. The principal duties of the unit engineer and his staff are the coordination and supervision of the engineer training and equipping of the troops of GHQ reserve, and the operation of such schools for engineer training as may have been placed under the control of the commanding general of GHQ reserve.

68. Group of armies.—When several armies are formed into a group of armies, an engineer headquarters is organized for the group. This headquarters is principally concerned with the allocation of engineer troops and supplies among the armies.

SECTION IV

ORGANIZATION AND EQUIPMENT OF ENGINEER TROOP UNITS

69. General principles of organization.—*a.* (1) Engineer troop units are organized as regiments, battalions, and companies. All of these organizations without regard to the special purposes for which they are designed have certain characteristics in common.

(2) Engineer organization is based upon the principle of operating by means of basic work units, each of such a size that it can be commanded and controlled upon engineer work by an experienced sergeant. In the larger general engineer troop organizations, this basic unit is the 4-squad operating section. Engineer units from the platoon up consist of combinations of basic work units with command and service personnel and equipment. One or more basic work units with a headquarters and a tool section constitute a platoon.

(3) The command and service personnel of each echelon of an engineer organization includes a commissioned officer as commander, personnel for the usual staff functions necessary to operations, and personnel with equipment for engineer supply and special engineer work. In the lower echelons many of these functions may be combined. In the company, the command and service personnel is included in company headquarters. In some kinds of companies the number of special technical personnel is sufficient to form an engineer section of the headquarters, as in the company of the general service regiment. In regiments and independent battalions a headquarters and service company is provided which furnishes officers for the staff sections of the regimental or battalion headquarters and enlisted personnel, equipment, and transportation for carrying on general command and service functions.

(4) The regiment is the only engineer unit that has an officer as second in command. Bands and chaplains are provided only for regiments. Medical detachments are provided only for regiments and independent battalions. Veterinary personnel is provided only for those units having a large number of animals.

b. Regiments.—(1) *Component parts.*—Regiments are organized into headquarters, band, headquarters and service company, two battalions, medical detachment, and a chaplain. The headquarters includes the regimental commander and his commissioned staff. The enlisted personnel for the staff sections of regimental headquarters comes from the headquarters and service company.

(2) *Duties of the regimental staff.*—(*a*) The *regimental commander* is responsible for every activity of the regiment, including all policies, plans, or basic decisions which affect the condition, morale, training, or employment of his command.

(*b*) The *executive officer* is second in command. He acts for the regimental commander in his absence, carrying out his plans and orders and putting into execution the orders received from higher authority when immediate communication with the regimental commander is impracticable. He directs and coordinates the work of the other staff officers. He obtains basic decisions from the regimental commander and then makes necessary decisions supplementary thereto and gives necessary instructions to the staff in furtherance of the basic decision of the regimental commander. He obtains drafts of plans and orders from other staff officers and submits to the regimental commander a completed plan. He reviews and coordinates all instructions that are to be published to the command and assures himself that they are strictly in accord with the policies and plans of the commander. He makes a continuous study of the situation with a view to being prepared for future contingencies.

(*c*) The *adjutant* is in direct charge of the operation of the administrative section of the headquarters platoon of the headquarters and service company. He is responsible for the administration of the regiment and handles matters relating to personnel, morale, discipline, clerical work, regimental orders, publications, interior guard, police, mail service, and message center. He commands the band.

(*d*) The *operations officer* is in direct charge of the operations section of the headquarters platoon of the headquarters and service company. He is charged with the formulation and draft of plans, estimates, and orders for operations, the preparation of training programs and schedules, training inspections, engineer reconnaissance, supervision of the operation of electric lighting and pumping units, and is the regimental gas officer.

(*e*) The *intelligence officer* is in direct charge of the operation of the drafting and designing or map section of the headquarters platoon of the headquarters and service company. He is in charge of surveys, miscellaneous drafting and designing, blue printing, lithography, photography, map reproduction, mapping, topographical reconnaissance, graphical reports, map requisitions and issues. When the regiment is engaged in combat, he is responsible for combat intelligence, including the collection and evaluation of information concerning the enemy and the dissemination of the resulting military intelligence. He maintains close liaison with the intelligence sections of higher, lower, and adjacent units.

(*f*) The *supply officer* is in direct charge of the supply section of the headquarters platoon and the service platoon. He procures and issues routine supplies (food, clothing, equipment, and ammunition) for the regiment and supervises the procurement of supplies for engineer operations when this requires arrangement with higher supply echelons. He coordinates with the operations officer the allotment of transportation to units for engineer work. He is also the commanding officer of the headquarters and service company and is charged with further duties in this connection as described in *c* below.

(*g*) The *regimental surgeon* is the senior medical officer with the medical detachment. He serves in both an advisory and administrative capacity.

(*h*) The *chaplain* is in charge of religious activities and is assistant to the commanding officer in general welfare work.

c. Headquarters and service company.—The headquarters and service company is divided into a headquarters platoon which furnishes the enlisted personnel for the staff sections of regimental headquarters; a service platoon, operating under the supply officer, which furnishes supply and transportation service to the entire regiment; and a company headquarters, also under the supply officer who, as commanding officer of

the headquarters and service company, is charged with the administration and interior economy of the headquarters and service company. In the headquarters and service company of a general service regiment there is an engineer platoon for certain technical operations.

d. Band.—(1) The band is commanded by the regimental adjutant. It is generally attached to the headquarters and service company for rations and quarters, but may be attached to any company unit. Its primary function is to furnish music for the regiment, and it is habitually employed upon this duty. Under combat conditions where it can not exercise this function, the band, if present with the regiment, may be used in an emergency, when directed by the regimental commander, for service with the rear echelon of the regiment to assist in the maintenance of supply.

(2) The band leader is a warrant officer. He is in immediate command of the band and responsible for musical instruction.

(3) The drum major is a bandsman other than the technical or staff sergeant, selected by the band leader for his soldierly appearance, knowledge of band formations and movements, and skill in the manual of the baton and execution of signals. He gives signals and commands for the movements of the band when in playing formation or as directed by the band leader.

(4) The field music composed of the 14 company buglers forms with the band as field music at ceremonies or when directed by the regimental commander.

e. Battalions.—Independent engineer battalions and squadrons are organized into battalion headquarters, a headquarters and service company, several companies and a medical detachment. Battalions which belong to regiments have a battalion staff but no headquarters and service company nor medical detachment and hence are not available for independent missions away from their regiments unless provided with a provisional service unit. The duties of the battalion commander and his staff follow, in general, the description give in *b* above for the duties of the regimental commander and his staff, except that in the battalion several staff functions are combined under one officer. The general principles of organization of the headquarters and service company are the same as those described in *c* above for the headquarters and service company of the regiment.

f. Companies.—The company is divided into a company headquarters and several platoons.

(1) *Company headquarters.*—(*a*) The personnel of the company headquarters may be classified according to the nature of its duties as administrative personnel and as operations personnel and, where numerous enough to warrant it, the personnel so classified may be organized into separate sections.

(*b*) The duties of the headquarters are as follows: The company commander is responsible for the training, welfare, and employment of his company. He is assisted by one officer. The first sergeant is responsible under the company commander for the maintenance of all company records. He makes out details for guard and fatigue, supervises police of barracks and camp, maintains discipline, and enforces the orders of the company commander. The mess sergeant is in charge of the procurement and preparation of the ration and feeding of the men. The stable sergeant is in charge of the stables, the animals, and the animal-drawn vehicles. In companies equipped principally with motor vehicles, a sergeant, truckmaster, is in general charge of the care and operation of the motor vehicles. The supply sergeant is in charge of routine supply. Other sergeants are technical specialists charged with giving expert assistance to platoon commanders for special operations where experts are needed, as in the operation of machinery. The other personnel of the company headquarters includes cooks for the mess, horseshoers, saddlers, wagoners, clerks, chauffeurs, and draftsmen, all having duties suggested by their designations.

(2) *Platoon.*—(*a*) The platoon is divided into a headquarters and one or more operating elements according to the kind of platoon. The platoon is commanded by a commissioned officer who is assisted by a platoon sergeant. The actual handling of the platoon or engineer work is the duty of the platoon sergeant, the officer being free to move about exercising general supervision. The headquarters also includes technical specialists who are assigned, as needed, for work with the operating elements of the platoon.

(*b*) The operating elements include the mass of the platoon personnel organized into squads and sections each under an appropriate leader, the characteristics of the personnel and their training depending upon the kind of equipment and transport with which the platoon is provided.

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g. Medical detachments.—Medical detachments are provided for regiments and independent battalions. Their organization and duties are in accordance with the general principles prescribed in TR 405–40 and 405–2040. The organization usually includes a detachment headquarters, a medical section, a dental section, and a veterinary section. The detachment commander is the regimental or battalion surgeon. The officer and enlisted personnel is assigned duties by the surgeon to meet the requirements of the current operations. If the unit is employed as riflemen in combat, the entire detachment may be employed wholly on medical service.

h. Armament.—Engineer troops of all classes are in general armed as riflemen. Officers and noncommissioned officers above the grade of corporal carry pistols. In the lettered companies of the combat regiment, engineer riflemen are equipped with bayonets. Grenade dischargers are not issued to engineer troops. Combat regiments have 2 automatic rifles per platoon. Squadrons have 1 machine rifle per platoon. Trench mortars, 37-mm. guns, and machine guns are not issued to engineer units. Combat regiments and other engineer units operating in the presence of the enemy carry their arms with them at all times. In rear areas engineer units may store a portion of their arms using only the weapons required for guard duty and training. The usual allowances of ammunition are 60 rounds per rifle in divisional units and 40 rounds per rifle in nondivisional units. These may be increased or decreased by order of higher commanders.

70. Combat regiment.—*a. Organization.*—The combat regiment consists of a regimental headquarters, band, headquarters and service company, two battalions, and medical detachment organized, in general, as follows:

(1) The *regimental headquarters* includes the commanding officer and his staff. The regimental commander is also the division engineer. The enlisted men pertaining to regimental headquarters are in the headquarters and service company. The designations and duties of the staff officers are as follows:

(*a*) The *executive officer* is second in command.

(*b*) The *regimental adjutant* commands the band, handles administrative matters, and accompanies the rear echelon when the situation makes a separation of the headquarters into two or more echelons necessary. He maintains direct liaison with the division adjutant.

(*c*) The *assistant division engineer* is in direct charge of the operation of the division engineer section of the headquarters platoon of the headquarters and service company. He acts in accordance with the division engineer's announced policy during the latter's absence from division headquarters. He assists the division engineer in the review and preparation of requisitions and estimates. He usually remains with division headquarters when it is not in close proximity to the headquarters of the division engineer regiment. He is also the division camouflage officer.

(*d*) The *intelligence officer* handles graphical reports and graphical reproduction processes, and in combat is the agency for the collection and dissemination of information of the enemy. He maintains liaison with G–2 of the division staff as to maps and map requirements and combat intelligence. He is normally with the forward echelon of the regiment.

(*e*) The *operations officer* is charged particularly with the preparation of the drafts of plans and orders for operations, and the conduct of engineer reconnaissance operations. The operation of lighting and pumping units is under his supervision. He is the regimental gas officer. Normally his post is with the forward echelon of the regiment.

(*f*) *Other officers.*—The chaplain and the officers of the medical detachment perform regimental headquarters duties in connection with their technical operations. The chaplain and the regimental surgeon appear with the regimental staff at ceremonies. All officers of the headquarters and service company perform regimental headquarters duties as well as company duties.

(2) *Band.*—The band is organized as described in paragraph 69*d*.

(3) The *headquarters and service company* includes the personnel for operating the various regimental headquarters sections, the routine supply service for the regiment, and the engineer supply service for the division. It consists of a company headquarters, a headquarters platoon, and a service platoon.

(*a*) The *company headquarters* handles the administration, routine supply, and messing of the headquarters and service company and the messing of the regimental headquarters. The company commander is also the regimental supply officer. He is assisted by a commissioned officer who handles the details

of the company headquarters including company administration and routine supply and the regimental headquarters messing. Another commissioned officer assists him as supply officer and may be assigned to any duty.

(*b*) The *headquarters platoon* includes the enlisted personnel for the operation of the staff sections of regimental headquarters. It consists of five sections, as follows: Division engineer, administrative, map, operations, and supply.

1. The division engineer section includes the clerical and technical personnel making up the office of the division engineer. It operates under the immediate supervision of the assistant division engineer. It is a liaison and operating agency for the division engineer on engineer matters pertaining to the division.

2. The administrative section includes clerical personnel making up the office of the regimental adjutant and operates under his direct charge. It handles the routine administrative paper work, mimeograph, postal service, and message center.

3. The map section includes the draftsmen, surveyors, lithographers and photographers working under the direct supervision of the intelligence officer.

4. The operations section, under the operations officer, handles plans, orders, estimates, engineer reconnaissance, and inspection of engineer work. It supervises the operation of electric lighting and pumping plants and special machinery.

5. The supply section, under the direction of the supply officer, handles the administrative work for all routine supply for the regiment. In addition to regimental supply this section handles all engineer supply for the division exclusive of maps. It utilizes the service platoon for operations.

(*c*) The *service platoon* consists of platoon headquarters and four sections—motor, mounted, pack, and wagon.

1. Platoon headquarters includes the personnel necessary for control, dispatching, repair and upkeep of the transportation and general regimental engineer equipment.

2. The motor section includes all motor vehicles of the regiment not assigned to battalions or companies.

3. The mounted section furnishes mounted orderlies for the headquarters riding animals and maintains a pool of riding animals for the use of the headquarters personnel in engineer reconnaissances and inspections.

4. The pack section consists of a section commander and two 8-horse pack trains for the transportation of engineer equipment and miscellaneous supplies when they are needed in the operations of any of the battalions or companies in the regiment.

5. The wagon section includes all animal-drawn vehicles not assigned to battalions or companies.

(4) *Medical detachment.*—For the composition and duties of the medical detachment, see paragraph 69 *g.*

(5) The *battalion* is a command unit. It consists of a battalion headquarters and 3 companies. Battalion headquarters is a command and inspection headquarters for the supervision of engineer tasks requiring from 2 to 3 companies. It includes the battalion commander, the adjutant, the battalion sergeant major, an operator for the motor cycle and side car or cross-country car used for inspection and reconnaissance or messenger service, and a mounted man who is employed upon orderly and messenger work.

(6) The *company* is the basic administrative unit. It is the smallest unit of the regiment that can sustain itself in the field, and is the smallest unit commonly employed upon a detached mission. It is organized primarily for engineer work, and consists of a headquarters and 2 platoons (4 officers, 106 enlisted men). For operations, it is divided into a forward and a rear echelon.

(*a*) Company headquarters consists of 2 officers and 24 enlisted men, organized in general as described in paragraph 69 *f.* The personnel includes a staff sergeant, construction foreman, who is in charge of engineer supply in field operations and assists in engineer reconnaissance and any other duties to which assigned; 2 sergeants—a construction foreman and a general mechanic, who assist at engineer reconnaissance, engineer supply, and engineer operations and who may be assigned to any duty; a corporal in charge of the tools carried on the company tool truck; a blacksmith who maintains company transport and does general blacksmithing for engineer operations; a general carpenter in charge of company headquarters

carpenter work; a chauffeur for the company tool truck; and a general draftsman who prepares work plans and designs and does topographical tracing.

(*b*) The forward echelon consists of the command group of company headquarters and the 2 platoons.

(*c*) The rear echelon consists of the administrative and supply group of company headquarters and such transport as is not assigned to the forward echelon.

(7) The *platoon* is the smallest engineer unit that contains the elements of its own engineer supply. It is organized primarily for engineer work and consists of a platoon headquarters, an operating section, and a tool section.

(*a*) Platoon headquarters consists of 1 officer who is the platoon commander, a platoon sergeant who assists the platoon commander in work, drill, and combat, and who forms the platoon and receives the reports of squad leaders; a bugler for messenger service; and 3 technical specialists: A bridge carpenter, a general rigger, and a demolition man. The latter are assigned to special work by the platoon commander and they assist in engineer reconnaissance and supply.

(*b*) *1.* The operating section consists of 2 sergeants and 4 squads (34 men). It is the basic work unit of the engineer regiment. In combat it is divided into 2 automatic rifle sections. The section sergeants are construction foremen and handle working parties, automatic rifle sections, and detachments as directed by the platoon commander. At formations they are the right and left guides of the platoon.

2. The 4 squads make up the normal working parties of the platoon. The 4 corporals work with their men and command their squads on such working parties as may be directed by the platoon commander. Of the 28 privates 11 are occupational specialists, as follows: 4 basic carpenters, general electrician, demolition man, 2 general mechanics, general rigger, and 2 automatic riflemen. The remaining 17 men are skilled in the use of the common engineer tools—hammer, saw, pick, and shovel. No. 3 of the rear rank of the 1st and 4th squads is an automatic rifleman and carries the automatic rifle when it is not in the platoon tool wagon.

3. The tool section consists of the platoon tool wagon, the tool corporal, and a wagoner. The tool corporal commands the section and is in direct charge of the care and upkeep of the platoon engineer equipment. The wagoner is the driver of the tool wagon. The mounted demolition man normally accompanies the tool section at ceremonies.

b. Equipment.—(1) *Regimental equipment.*—The principal items of equipment carried by the regiment, in addition to that which the several companies carry, comprise camping and office equipment for the regimental headquarters and for the headquarters and service company; supplementary engineer equipment used to augment the equipment carried by the lettered companies of the regiment; equipment and supplies for general divisional use; and wagon, pack and motor transport. For a description of the items of equipment, their capacities and limitations, see Section II, Chapter 2. The amount of each kind of equipment provided for a regiment is shown in Tables of Basic Allowances. The purposes of the principal items are as follows:

(*a*) The *headquarters and service company* is equipped with camping and office equipment for its own uses and, in addition, equipment and supplies for the following: The offices of the regimental headquarters; the messing and routine supply and administration of the band, the company and regimental headquarters; shelter for offices and officers, and for engineer work by headquarters and service company personnel; certain engineer work by the battalions and companies; engineer work by other troops of the division; engineer supply of the regiment; and engineer supply of the division. The company tools include sets of standard equipment for the following kinds of work: Blacksmith, horseshoer, carpenter, wheelwright, cobbler, plumber, saddler, sign painter, and tinsmith.

(*b*) The *headquarters equipment* is composed of office equipment, mess equipment, and miscellaneous supplies for the offices of regimental headquarters and is a part of the equipment of the service platoon. The office equipment includes field desks with a supply of stationery for the company headquarters and for the regimental headquarters, typewriters, tables, a mimeograph machine, a field safe, a library of engineer handbooks, and telephone equipment. The band is equipped with musical instruments and music pouches. As the

band has no transportation, its equipment, if necessary, is carried in the vehicles of the service platoon.

(*c*) *General engineer equipment.*

1. The drafting and reproduction equipment is used by the map section of regimental headquarters for regimental and division needs. The drafting equipment is used for drawing maps, plans, and estimates. The sketching outfits are used for reconnaissance and for general regimental headquarters use. The stereoscopes are used by the map section in reading aerial photographs, and they may be issued to other personnel when necessary. The reproduction equipment includes a duplicator, a blue-printing outfit, and lithographic equipment.
2. The electric lighting equipment is used by the operations section for illuminating division and regimental headquarters in the field.
3. The portable kapok footbridge is used in crossing foot troops over streams. It is carried in 4 trucks and issued to units when needed.
4. The illuminating equipment is used in company headquarters and the map section.
5. The photographic equipment is used by the map section to take pictures and print from photographic negatives for all of the companies.
6. The surveying equipment is used by the map section or issued to other personnel for special work, generally construction surveys.
7. The water supply equipment is handled by the operations section or is issued to units for operation. Its purpose is to provide water points for the division.
8. The 6 wagon loads of intrenching equipment are for general divisional use. The vehicles are available to the combat regiment for engineer work.
9. The purposes of the regimental supplementary engineer equipment are explained in paragraph 23.

(*d*) *Pack equipment.*—The two sets of pack equipment contain engineer tools and materials. These packs are transported by the pack section and are assigned to battalions, companies, and detachments for use in engineer work.

(*e*) *Transport.*—The transportation of the regiment, exclusive of that permanently assigned to the lettered companies, is as follows:

1. Two bicycles are assigned to the headquarters and service company for use by the buglers upon messenger work.
2. The motor vehicles are operated by the motor section. The 5-passenger motor car is used by the regimental commander for reconnaissance and inspection. The motor cycles or the light motor cars (whichever are assigned) are used by regimental and company headquarters for messenger service, reconnaissance, and the transportation of small items of equipment. The light trucks are operated for general purposes in the regiment in the movement of small items of equipment and supply in emergencies and are frequently assigned to a battalion or company when temporarily detached. The heavy trucks are used to transport regimental and company tools and engineer supplies on the march and to supply engineer materials while at work. The latter is their most important use. The loading of the cargo-carrying vehicles varies with the situation and the nature of the work in prospect. When engineer operations must be carried on during a march, or immediately upon the termination of the march, loads are distributed so as to facilitate placing equipment where it is to be used, thus freeing vehicles for use in engineer supply. The loads are prescribed by the regimental commander, and are generally somewhat as follows:

   No. 1. Electric lighting set for division headquarters.
   No. 2. Water supply equipment for divisional use.
   No. 3. Water supply equipment for divisional use.
   No. 4. Footbridge for divisional use.
   No. 5. Footbridge for divisional use.
   No. 6. Footbridge for divisional use.
   No. 7. Footbridge for divisional use.
   No. 8. Map section equipment.

No. 9. Ammunition and explosives.
No. 10. Band instruments and equipment.
No. 11. Supplementary engineer equipment.
No. 12. Regimental and company headquarters office equipment.
No. 13. Service platoon headquarters tools and equipment.
No. 14. Gasoline and oil and miscellaneous supplies.

3. The animal-drawn vehicles are operated by the wagon section. They include the 6 tool wagons loaded with infantry intrenching tools and 5 ration and baggage wagons for carrying the forage, rations, water, mess equipment, baggage, and miscellaneous supplies and equipment.

(2) *Battalion equipment.*—There is no engineer equipment assigned to battalion headquarters other than that issued to officers and men as individuals. The battalion transportation, which consists of 3 riding horses and a motor cycle with side car, is employed primarily upon engineer reconnaissance. Tables of Basic Allowances authorize for issue to the regiment, upon a battalion basis, certain items of organizational equipment, and supplies for which some transportation must be provided. The total weight is about 880 pounds. It consists of camp and office equipment. It is normally carried by the regimental headquarters and service company and is delivered to the battalion command post at the end of the march. When the battalion operates at some distance from regimental headquarters, part or all of this equipment must accompany the battalion. Under these conditions it is carried by distribution among the vehicles or by a light truck or other vehicle attached from the headquarters and service company. All of this equipment is needed when the battalion is operating under conditions where the operation of a battalion officers' mess is desirable. In many situations the battalion personnel is attached to companies for subsistence, and the baggage may be limited to bedding rolls only.

(3) *Company equipment.*—(*a*) The organizational equipment and supplies assigned to a combat company consist of: Tools and supplies for executing engineer work; tools, equipment and materials for routine supply, repair, and upkeep, and for messing and administration; ammunition; chemical warfare

equipment; and transportation for movements, engineer work, messenger service, and engineer reconnaissance. This equipment is carried by the platoon tool wagons, the company tool truck, the ration and baggage wagon, and the rolling kitchen, and by the transportation of the regimental headquarters and service company. The loading varies with the nature of the operation upon which the company is employed. The platoon tool wagons usually carry the normal platoon equipment with a few additional items for engineer work. The company transportation carries such equipment as may be needed for the work to be encountered. The regimental transportation cares for such company equipment and supplies as may be in excess of the cargo capacity of the company vehicles for the particular operation. The company on a detached mission is normally assigned additional transportation from the headquarters and service company.

(*b*) The principal items of equipment are leather palmed gloves for handling barbed wire, blacksmith equipment, carpenter and wheelwright equipment for the company carpenter, marking outfits and sign painting equipment, pipe fitting equipment for special work at water points and for miscellaneous construction and repairs, saddler equipment, tinsmith equipment, and supplementary tools for issue to the platoons for road maintenance and repair, including drag scraper, 2 wheelbarrows, enough hand tools to equip 2 squads, and general engineer supplies for emergency use.

(*c*) Miscellaneous equipment and supplies include equipments for self-maintenance of the company, such as cobbler, horseshoer, and harness mender equipments; gas masks, carried either on the person or in regimental transportation; company field desk, with stationery and typewriter; drafting and duplicator equipment; illuminating equipment for use in company headquarters for drafting and illumination; a reference library; a canvas litter; a cooking outfit, consisting of a rolling kitchen which has a capacity for feeding over 200 men, thus permitting the attachment of other troops to the company; cavalry pack cooking outfits less packs, for issue to platoons when operating at some distance from the rolling kitchen; a camera for photographic reconnaissance and photographic reports; a sketching outfit for topographical reconnaissance; and a miscellaneous lot of organizational equipment and supplies common to all troop units, including blacksmith coal, horseshoer supplies and

extra ammunition. The amount of such supplies carried in the field is determined by the regimental commander and normally does not exceed 3 days' supply.

(*d*) *1.* The company transport includes a tool truck, a motor cycle with side car, a rolling kitchen, a ration and baggage wagon, and 3 riding horses. The company truck is a light truck, generally with a dump type body. Full use of the cargo capacity of this truck is necessary in order to insure the supply of materials of construction to the working parties. The truck and its contents are an essential part of the company equipment, and should be made available to the company at all times. The truck transports the engineer equipment close to the site of the work, where the load is removed and the truck is employed for hauling and distributing construction equipment and personnel. It may be used to furnish mechanical power in moving heavy weights and operating road machinery. The march load consists of equipment for the company specialists, road tools, and miscellaneous supplies. The normal operating load, after the march is completed, is road and bridge materials. The march load varies with the nature of the operations, the work in prospect, and the condition of the roads.

2. The motor cycle with side car is used for engineer reconnaissance, engineer inspection, messenger work, and transportation of small articles needed in the execution of engineer work. It is part of the combat train and should be available to the company at all times during engineer operations in the field.

3. The ration and baggage wagon is a 4-mule escort wagon. While normally part of the field train, conditions are often such that it has to be utilized in engineer work and must be considered as part of the combat train. The march load consists of rations and organizational baggage and supplies. The normal operating load after the march is completed is road and bridge material.

4. The rolling kitchen is a 4-mule vehicle so designed as to permit cooking on the march, and carries 1 day's ration and a supply of wood.

5. The riding horses are assigned to individuals, but they are used by the company commander as may be necessary in the execution of his engineer mission, and are employed for messenger work, engineer reconnaissance, and engineer inspection.

6. The draft animals of the company are used for the operation of road equipment and the transportation of materials as well as for hauling the company's vehicles.

(4) *Platoon equipment.*—(*a*) The set of engineer tools carried in the platoon tool wagon is the primary equipment of the platoon. It is grouped into 4 sets of equipment: Carpenter, demolition, pioneer and sketching. There are enough tools to keep the 4 squads employed at one time upon any of the following classes of work: Digging, cutting and clearing, wrecking, rigging, or rough carpentry. The carpenter equipment, when combined with pioneer equipment, is sufficient to keep the 4 squads employed upon carpenter work. The demolition equipment is sufficient for a limited amount of demolitions but for extensive demolition missions, additional explosives must be issued to the platoon. The pioneer equipment is used principally upon road, bridge, and field fortification work. For more extensive road work and special work, additional equipment may be assigned the platoon by the company commander from tools drawn from the company regimental tool trucks.

(*b*) The ammunition carried by the platoon, or available to it in the regimental echelons, is sufficient to provide for the protection of the platoon while at work and for normal combat operations. Extra ammunition must be supplied from the division train or other sources in the event of the engineer platoon being used as riflemen in combat. Automatic rifles when not carried in ranks are carried with their accessories in the platoon tool wagon.

(*c*) *Transport.*

1. The *platoon transport* consists of the platoon tool wagon, two mounts, and one bicycle. The platoon tool wagon is an essential part of the platoon equipment. It is used not only to transport the platoon engineer equipment but also to provide for

the engineer supply of the platoon at work. The wagon accompanies the platoon at all times in the field except when the platoon is employed in combat as riflemen. The tools are dumped near the site of the work and the wagon is used to transport materials, supplies, and men. The animals may be used to snake logs and timber, to move heavy weights, to operate slip scrapers, road machinery and other animal-operated appliances, or by means of panniers to transport equipment and supplies. The normal combat load of the platoon tool wagon, exclusive of personnel and wagon spare parts and accessories, is 2,022 pounds. This includes ammunition, 96 pounds; grain rations, 36 pounds; automatic rifles and accessories, 160 pounds; and engineer tools, 1,730 pounds. Rations and baggage pertaining to the platoon are carried by the company ration and baggage wagon and the rolling kitchen.

2. The bicycle is used in messenger work and is normally assigned to the bugler. It accompanies the platoon in the field and when not engaged upon detached work takes its place in the route column in rear of the foot section of the platoon. It may be carried in the platoon tool wagon.

3. The platoon commander and one demolition man are mounted. Their horses are used in messenger work, engineer reconnaissance and inspection, and in some situations for transporting materials by means of the panniers carried in the tool wagon.

71. The general service regiment.—*a. Organization.*—The general service regiment consists of a regimental headquarters, band, headquarters and service company, 2 battalions, and a medical detachment. It is organized in general as follows:

(1) The *regimental headquarters* includes the commander and his staff. The staff of the regimental commander includes an executive officer, an adjutant, an intelligence officer, an operations officer and assistant operations officer, a supply officer, a surgeon, and a chaplain, all having duties as described in paragraph 69*b*. The enlisted men pertaining to the regimental headquarters are in the headquarters and service company.

(2) The *band* is organized as described in paragraph 69*d*.

(3) The *headquarters and service company* consists of a company headquarters, a headquarters platoon, a service platoon, and an engineer platoon.

(*a*) The *company headquarters* has the general organization and performs the same functions that are performed by the company headquarters of the headquarters and service company of the combat regiment.

(*b*) The *headquarters platoon* consists of four staff sections for the operation of regimental headquarters. The administrative, operations, and supply sections perform duties as described for the headquarters of a combat regiment. The drafting and design section includes the draftsmen, surveyors, and photographers working under direct supervision of the engineer intelligence officer.

(*c*) The *service platoon* is divided into a platoon headquarters and motor section and an animal section performing duties as described for the combat regiment.

(*d*) The *engineer platoon* is divided into a platoon headquarters section and an engineer section. The platoon headquarters furnishes technical specialists who act as overseers and foremen. The engineer section includes specially qualified enlisted men who operate special machinery such as locomotives, pumps, road rollers, etc.

(4) *Medical detachment.*—For the composition and duties of the medical detachment, see paragraph 69 *g*.

(5) The *battalions* are organized like battalions of the combat regiment as described in paragraph 70 *a*.

(6) The *company* is the basic administrative unit. Being self-sustaining, it is the unit most generally employed on a detached mission. It consists of 4 officers and 160 men, organized primarily for the execution of engineer work. The company is divided into a company headquarters and 3 platoons.

(*a*) *Company headquarters* consists of 1 officer and 37 enlisted men divided into an administrative section and an engineer section and organized in general as described in paragraph 69 *f*.

1. The administrative section includes the company commander; the first sergeant; a staff sergeant, construction foreman, who is available for any duty; the stable sergeant; the mess sergeant; the supply sergeant; a corporal, company clerk; and about

16 privates who are employed as buglers, chauffeurs, clerks, cooks, horseshoers, saddlers, and wagoners for the ration and baggage wagon, rolling kitchen, and water cart.

2. The engineer section includes a staff sergeant, construction foreman, who commands the section, acts as platoon sergeant of company headquarters section at dismounted assembly, and is available for general assignment upon construction work; 4 sergeants—a construction foreman, concrete worker, who is an overseer for concrete and general construction; a highway construction foreman who is overseer for roads and bridges; a general mechanic who is in charge of the operation of machinery attached to the company from regimental headquarters; and a railroad section construction foreman who acts as overseer for light and standard railroad construction; a corporal, power electrician, who is in charge of electrical work and the operation of electrical machinery and when not engaged on his specialty is available for general utility work; a tool corporal who has charge of the tools carried in the company tool truck; and a number of privates, technical specialists—blacksmith, general carpenter, general draftsman, pipefitter, stone mason, road roller operator, winch operator, and painter. These privates are employed upon their specialties and are utilized for assignment to platoons and to attached units. When the work in progress does not require these specialties, the men are utilized for general utility as a detachment under their sergeants or are attached as a unit to a platoon, thus reinforcing the working force of the platoon.

(*b*) The *general service company* includes a large number of specialists, as the company must be prepared to perform all classes of engineer work and to furnish foremen and specialists to assist the platoons and to supervise and assist units of the engineer separate battalions. Specialists from company headquarters are used for detached work in preference to detailing men from the platoons.

(7) The *platoon* is the smallest unit that contains the elements of its own engineer supply. It consists of 1 officer, 41 enlisted men, and a tool wagon. It is divided into a platoon headquarters, an operating section, and a tool section.

(*a*) *Platoon headquarters* consists of 1 officer, who is the platoon commander; a staff sergeant, who is the platoon sergeant; and 4 privates, technical specialists, qualified as bridge carpenter, general carpenter, stationary engineman, and general rigger, who assist the platoon commander in reconnaissance and supply and are available for work with the operating section.

(*b*) The *operating section* comprises the 4 squads with their corporals and 2 sergeants, construction foremen, who take charge of working parties, rifle sections, and detachments as directed by the platoon commander. For combat, it is divided into rifle sections. The squads make up the normal working parties of the platoon and contain many men qualified as occupational specialists as follows: Carpenters, general electricians, firemen, general mechanics, quarrymen, general rigger, concrete worker, railroad section worker, sheet metal worker, and structural iron worker.

(*c*) The *tool section* includes the tool corporal and the wagoner, who go with and care for the 4-mule tool wagon which carries the platoon equipment.

b. Equipment.—(1) *Regimental equipment.*—The principal items of equipment carried by the regiment in addition to that which the several companies carry comprise camping and office equipment for the regimental headquarters and for the headquarters and service company, supplementary engineer equipment used to augment the equipment carried by the lettered companies of the regiment, and wagon and motor transport. Unlike the combat regiment the general service regiment does not carry equipment for the use of other troops. For a description of the items of equipment, their capacities, and limitations, see paragraphs 19 to 58, inclusive. The amounts of each kind of equipment provided for a regiment are shown in Tables of Basic Allowances. The purposes of the principal items are as follows:

(*a*) The *headquarters and service company* is equipped with camping and office equipment for its own use, and, in addition, equipment and supplies for the following: The offices of the

regimental headquarters; the messing and routine supply and administration of the band, the company, and regimental headquarters; shelter for offices and officers and for engineer work by personnel of headquarters and service company; certain engineer work by the battalions and companies; and engineer supply of the regiment. The company tools include sets of standard equipment for the following kinds of work: Blacksmith, horseshoer, carpenter, wheelwright, cobbler, plumber, saddler, sign painter, and tinsmith.

(*b*) The *headquarters equipment* is similar in kind and purpose to that provided for combat regiments as described in paragraph 70 *b*.

(*c*) *General engineer equipment.*—The drafting and reproduction equipment is used by the drafting and designing section of regimental headquarters for drawing maps, plans, and estimates. The sketching outfits are used for reconnaissance and general regimental headquarters use. The reproduction equipment includes a duplicator and a blue printing outfit. The illuminating equipment is used for lighting regimental headquarters and the drafting room. The photographic equipment is used by the drafting and designing section to take photographs and to develop and print from photographic negatives taken by the companies. The sign painting equipment is used by the drafting and designing section for making road signs. The surveying equipment is used by the drafting and designing section or issued to other personnel for special work, generally construction surveys. The water supply equipment is handled by the operations section or is issued to the lettered companies for use in establishing water points.

(*d*) *Supplementary equipment.*—The regiment is equipped with the supplementary engineer equipment described in paragraph 23. Equipment not included in the above sets and needed for special work is obtained upon requisition.

(*e*) *Transport.*—The transportation of the regiment, exclusive of that permanently assigned to the companies, is as follows:

1. Two bicycles are assigned to the headquarters and service company for use by the buglers upon messenger work.
2. The regimental staff is mounted, and there are 5 mounted orderlies in the animal section of the service platoon. The stable sergeant, the section

sergeant of the animal section, and the corporal of the animal section of the service platoon are also mounted.

3. The motor vehicles are operated by the motor section of the service platoon. The 5-passenger motor car is used by the regimental commander for reconnaissance and inspection. The light motor cars are used by the regimental and company headquarters for messenger service, reconnaissance, and the transportation of small items of equipment. The machine-shop truck operates under the direction of the operations section of the headquarters platoon. As a motor vehicle it is maintained by the motor section of the service platoon. The fifteen 2-ton tool trucks carry the regimental and company tools and engineer supplies on the march and supply engineer materials while at work. The latter is their most important use.

4. The animal-drawn vehicles include the rolling kitchen for the company mess, the ration and baggage wagon to transport the baggage of the regimental headquarters and the headquarters and service company, and the water wagon which is used for the supply of potable water and also upon engineer work.

(2) *Battalion equipment.*—There is no engineer equipment assigned to battalion headquarters other than that issued to officers and men as individuals. (See par. 70 *b*.)

(3) *Company equipment.*—(*a*) The company of the general service regiment is equipped in general like the company of the combat regiment as described in paragraph 70 *b* but with different supplementary engineer equipment. The supplementary equipment of the company is described in paragraph 23.

(*b*) The transport is an essential part of the company equipment. It is used not only for transportation of equipment and baggage on the march, but also for the transportation of materials while the unit is at work.

1. The truck carries the company engineer equipment, and is used for general supply of engineer materials. It is part of the combat train.

2. The 4-mule escort wagon carries the rations and baggage. It is part of the field train, and may be utilized for work purposes.
3. The rolling kitchen is part of the combat train. The animals may be used for work purposes in camps and bivouacs.
4. The water cart is part of the combat train. Its capacity is 180 gallons. It is used to supply water for cooking and drinking and may be used for work purposes.
5. The company has 3 riding horses and 12 draft mules, not counting the mules which draw the platoon tool wagons. The riding horses, while serving as mounts for the individuals to whom assigned, must be considered as available for general use in the company for reconnaissance and inspection work during engineer operations. The draft animals when not employed with their vehicles are used for animal-operated appliances such as slip scrapers, road machines, and ploughs.
6. The two bicycles are usually issued to the buglers. On the march they may be carried on the company truck.
7. The light motor cars furnish the principal means for reconnaissance, supervision, and inspection. They are used also for messenger service and the transportation of small items of equipment and supply. They are part of the combat train.

(4) *Platoon equipment.*—The equipment of the platoon of the general service regiment is about the same as the equipment of the platoon in the combat regiment with the addition of the supplementary equipment described in paragraph 23. It includes the equipment of the individuals, pioneer, carpenter, demolition, and sketching equipment, and a platoon tool wagon.

72. Separate battalion.—*a. Organization.*—The separate battalion is a command, administrative, and tactical unit. It consists of battalion headquarters, headquarters and service company, a medical detachment, and 4 companies. It is organized in general as follows:

(1) The *battalion headquarters* includes the battalion commander and his staff. The enlisted personnel for the battalion

headquarters is in the headquarters and service company. The designations and the duties of the staff officers are as follows:

(*a*) The *battalion adjutant* is in charge of the administrative section of the headquarters and service company and has the duties of a unit adjutant as described in paragraph 69 *b*.

(*b*) The *operations officer* is in charge of the engineer section of the headquarters and service company and has the duties of an operations officer as described in paragraph 69 *b*. In addition he is the battalion intelligence officer.

(*c*) The *battalion supply officer* is the commanding officer of the headquarters and service company and is in charge of the supply section of the headquarters and service company. He is assisted by one officer who handles company administration and the battalion officers' mess.

(*d*) The *battalion surgeon* is the senior medical officer with the medical detachment.

(2) The *headquarters and service company* includes the personnel for operating the battalion headquarters sections, the supply service for the battalion, and the supervision of engineer operations. It is divided into a company headquarters, and administrative section, an engineer section, and a supply section.

(*a*) The *company headquarters* handles the administration and routine supply of the company, the company transportation, and the messing of the company and battalion headquarters. The company commander is also the battalion supply officer. He is assisted by a commissioned officer who handles the details of company headquarters including company administration and the battalion officers' mess.

(*b*) The *administrative section* working under the immediate supervision of the battalion adjutant and the battalion sergeant major furnishes clerical personnel for battalion headquarters.

(*c*) The *engineer section* working under the immediate supervision of the battalion operations officer and the sergeant, construction foreman, furnishes the personnel to operate special tools carried by headquarters and furnishes technical specialists to the companies. It includes blacksmith, carpenter, draftsmen, stationary enginemen, general electricians, firemen. pipe fitters, general mechanic, road roller operators, winch operators, sign painters, photographers and quarrymen.

(*d*) The *supply section* works under the immediate supervision of the battalion supply officer and the battalion supply sergeant. It includes clerical personnel only.

(3) *Medical detachment.*—For the general organization and duties of the medical detachment see paragraph 69 *g*.

(4) The *company* is the basic administrative unit and is the smallest unit that can sustain itself in the field. It is organized primarily for engineer work and consists of a company headquarters and 2 platoons. Company headquarters consists of 2 officers and 28 enlisted men organized, in general, as described in paragraph 69 *f*.

(5) The *platoon* is the smallest unit commanded by a commissioned officer. It consists of 1 officer and 111 enlisted men. It is divided into a platoon headquarters, a tool section, and 3 operating sections.

(*a*) *Platoon headquarters* consists of an officer who is the platoon commander, a platoon sergeant who assists the platoon commander in work, drill and combat, and who forms the platoon and receives the reports of the section leaders, and 3 technical specialists; a general carpenter, a general mechanic, and a quarryman. The latter are assigned to special work by the platoon commander and they assist in engineering reconnaissance and supply.

(*b*) The *tool section* consists of the platoon tool truck, tool corporal, and chauffeur.

(*c*) The *operating section* consists of 4 squads, each commanded by a corporal. It is the basic work unit of the separate battalion. It is commanded by a section chief who is assisted by 2 sergeants qualified as construction foremen, and who act as overseers. At formations the latter are right and left guides of the section.

b. Equipment.—(1) *Battalion equipment.*—The separate battalion is equipped in general like the combat regiment. The equipment is such as to permit the battalion to operate on an independent mission, but it does not include items for the use of other troops in an area or for engineer supply other than for the battalion itself. The equipment pertaining to the battalion as a whole is carried and cared for by the headquarters and service company.

(2) *Headquarters and service company equipment.*—The headquarters and service company is equipped in general like

the headquarters and service company of the combat regiment, except that it does not carry as much special and technical equipment and does not carry tools and equipment such as the combat regiment carries for divisional use.

(*a*) The *headquarters equipment* of the separate battalion is similar to that described in paragraph 70 *b* for the headquarters equipment of the combat regiment. The quartermaster equipment is that authorized by Tables of Basic Allowances for a separate battalion and for a detachment of over 50 men, the medical detachment being combined with the headquarters and service company for general routine supply.

(*b*) The *general engineer equipment* includes demolition equipment, drafting and duplicating equipment, sketching equipment, stereoscope, illuminating equipment, photographic equipment, regimental library, and the supplementary engineer equipment for the separate battalion described in paragraph 23.

(*c*) *Transport.*—The engineer equipment is carried in the 2-ton tool truck. Rations and baggage are carried in the 2-ton ration and baggage truck. The kitchen trailer is attached to the ration and baggage truck. The light motor cars are used for reconnaissance, messenger service, and transportation of individuals and small articles of equipment and supplies. The 5-passenger motor car is used for reconnaissance and inspection. The amount of transportation in the separate battalion headquarters unit is much less than that in the combat regiment headquarters unit, since the separate battalion does not have to carry equipment and supplies for the engineer supply of a division or for many types of special work, such as are required of the combat regiment by the infantry division.

(3) *Company equipment.*—(*a*) *Equipment.*—The company of the separate battalion is equipped in general like the company of the combat regiment, as described in paragraph 70 *b*, except that it has no riding animals or animal-drawn transport and has different supplementary engineer equipment. The supplementary equipment is described in paragraph 23.

(*b*) *Transport.*—The company tool truck has a normal cargo capacity of 2 tons. Together with a ration and baggage truck it is used to transport company equipment, rations, and baggage on the march, and for general work and supply purposes during operations. The light motor cars are used for messenger service, reconnaissance, and the transportation of individuals and small articles of supply and equipment. The kitchen trailer is

usually attached to the ration and baggage truck. The water trailer is usually attached to the tool truck.

(4) *Platoon equipment.*—The equipment of the platoon is similar to that of the platoon of the general service regiment, with the addition of supplementary equipment which gives the added tools necessary for the larger platoon of the separate battalion. The platoon equipment is carried in the platoon tool truck which is also used for engineer work. The platoon should not be separated from its tool truck and platoon equipment.

73. Squadron.—*a. Organization.*—The engineer squadron is a command, administrative, and tactical unit. It consists of squadron headquarters, headquarters and service troop (motorized), 3 lettered troops (one mounted and 2 motorized), and a medical detachment. It is organized in general as follows:

(1) The *squadron headquarters* includes the squadron commander and his staff. The squadron commander is the division engineer. The designations of the staff officers are:

(*a*) Squadron executive;

(*b*) Adjutant;

(*c*) Intelligence, topographical, and operations officer;

(*d*) Supply officer; and

(*e*) Surgeon.

Their duties are in general as described in paragraph 69 *b*.

(2) The *headquarters and service troop* includes the personnel for operating the various squadron headquarters sections, the routine supply service for the squadron, and the engineer supply service for the division. It consists of 6 sections, as follows: Troop headquarters, division engineer section, administrative section, map and operations section, supply section, and service section. Each section is organized in general like the corresponding parts of the headquarters and service company of the combat regiment, as described in paragraph 70 *a*, except that the service section contains motor transportation only. The troop commander is also the squadron supply officer, and is in charge of engineer supply for the cavalry division.

(3) The *troop* is the basic administrative unit. As it is the smallest unit that can sustain itself for an extended period of time in the field, it is the unit most commonly employed upon a detached mission.

(*a*) The *mounted troop* is organized into a troop headquarters and 2 platoons. All but 9 of the 126 officers and enlisted men

are mounted. It is organized primarily so as to operate with the advance elements of the cavalry division or with units of the division which may operate on roads where motor trucks can not go, and to execute such work as may be accomplished with its pack tools. It is equipped with a limited amount of motor transportation for carrying extra equipment and supplies to supplement its pack equipment and to be used where the situation permits.

1. *Troop headquarters* consists of 2 officers and 26 enlisted men, and is organized in general as prescribed in paragraph 69 *f*. The 9 dismounted men are assigned to this section and consist of 1 tool corporal, 4 chauffeurs, 3 cooks, and 1 auto mechanic. They are normally transported in the motor vehicles of the troop.
2. The *platoon* (mounted) consists of 1 officer and 48 enlisted men. It is organized into a platoon headquarters, an operating section, and a tool section.
   (a) Platoon headquarters includes an officer who is platoon commander, a platoon sergeant who is second in command, and 3 privates consisting of a bugler, a carpenter, and a horseshoer.
   (b) The operating section consists of 2 sergeants, construction foremen, the senior of which is section leader, and 4 squads. The 4 squads make up the normal working parties of the platoon. The corporals work with their men and command their squads on such working parties as may be directed by the platoon commander. Of the 28 privates at least 2 are trained in the use of the machine rifle, and the other men include men specially qualified as carpenters, electricians, demolition men, general mechanics, and riggers.
   (c) The tool section includes the personnel for handling the 8 pack horses of the section. It consists of 1 sergeant, packmaster and the section leader, 1 corporal in charge of the tools, and 8 privates.

(*b*) The *motorized troop* consists of 4 officers and 106 enlisted men. It is organized into a troop headquarters and 2 platoons. It is organized primarily to care for the general engineer work of the cavalry division including that necessary for the motorized units.

1. *Troop headquarters* consists of 2 officers and 22 enlisted men and is organized in general as prescribed in paragraph 69 *f*.
2. The *platoon* (motorized) consists of 1 officer and 42 enlisted men. It is organized into a platoon headquarters, an operating section, and a tool section.
   (a) Platoon headquarters includes 1 officer, platoon commander, 1 platoon sergeant who is second in command, and 5 privates consisting of 1 bugler, 1 carpenter, bridge, and 3 chauffeurs.
   (b) The operating section consists of 2 sergeants, construction foremen, the senior of which is section leader, and 4 squads. The 4 squads make up the normal working parties of the platoon. The corporals work with their men and command their squads on such working parties as may be directed by the platoon commander. Of the 26 privates at least 2 are trained in the use of the machine rifle, and the other men include men specially qualified as carpenters, electricians, demolition men, general mechanics, and riggers.
   (c) The tool section includes the personnel for handling the platoon tool equipment and consists of 1 corporal in charge of the tools and 1 chauffeur for the platoon tool truck.

(4) The *medical detachment* consists of one officer and 9 enlisted men and is provided with 1 motor car, 3 riding horses and 1 ¾-ton truck. Its duties are as described in paragraph 69 *g*.

b. Equipment.—(1) The *squadron equipment* as distinguished from that of the several lettered troops is carried by the headquarters and service troop. In general it comprises camping and office equipment for squadron headquarters and the head-

quarters and service troop, supplementary engineer equipment used to augment the equipment carried by the lettered troops, equipment and supplies for general divisional use, and motor transportation. For a description of the items of equipment, their capacities, and limitations, see paragraphs 19 to 58, inclusive. The amounts of each kind of equipment provided are shown in Tables of Basic Allowances.

(*a*) The *headquarters and service troop* is equipped with camping and office equipment for its own use and, in addition, equipment and supplies for the following: The offices of squadron headquarters; the messing and routine supply and administration of the troop and squadron headquarters; the shelter of offices and the officers of the troop and squadron headquarters; engineer work by headquarters and service troop personnel; certain engineer work by other troops of the division; and engineer supply of the squadron and division. The troop tools include sets of standard equipment for the following kinds of work: Blacksmith, carpenter and wheelwright, cobbler, plumbing, sign painting, tinsmith.

(*b*) The *headquarters equipment* is composed of office, mess, and miscellaneous equipment and supplies for the offices of squadron headquarters and is a part of the equipment of the service troop. The office equipment includes field desks with a supply of stationery, for troop and squadron headquarters, typewriters, tables, a duplicating machine, a library of engineer handbooks, and other necessary small items of equipment and supply.

(*c*) The *general engineer equipment* carried by the headquarters and service troop may be grouped as follows:

1. *For the map section.*—One set blue printing equipment, 1 set drafting equipment, 1 set duplicator, 2 sketching outfits, 1 stereoscope, 1 set photographic equipment, 1 set surveying equipment "A." The drafting equipment is used in preparing maps, plans, and estimates. The sketching outfits are used for reconnaissance and general squadron use. The stereoscope is for reading aerial photographs. The reproduction equipment consisting of the blue printing and duplicator sets is used for supplying the squadron and division with copies of maps, sketches, plans, etc. The photographic equipment is used to take pictures and print from negatives

for the troops. The surveying equipment is used for map work or other special work, such as construction surveys and may be issued to other personnel for this purpose.

2. *For general squadron use.*—One set supplementary equipment, engineer squadron.

3. *For divisional use.*—One set electric lighting equipment, portable, for illuminating division headquarters in the field; 4 sets intrenching equipment, cavalry, for general divisional use; and 1 set of water supply equipment for supplying water for the division.

4. *Motor vehicles.*—The motor vehicles assigned to headquarters and service troop are 1 medium motor car, 3 light motor cars; one ¾-ton truck, 1 tank truck; and eleven 1½–2 ton trucks. There are also 1 kitchen trailer and 1 tank trailer (300-gallon) which are drawn by 2 of these trucks. These motor vehicles are operated by the service section. The medium motor car is used by the squadron commander. The 3 light motor cars form a pool for use by the squadron staff officers for reconnaissance inspection and other duties necessary to operations in the field. They are generally used by the following:

   (a) The squadron executive;
   (b) The headquarters and service troop commander (who is also squadron supply officer); and
   (c) The intelligence, topographical, and operations officer.

   The trucks are used to transport personnel, equipment, and supplies on the march and to supply engineer materials while at work. The loading of the trucks varies with the situation and the nature of the work in prospect. When engineer operations must be carried on during a march or immediately upon its termination, loads are distributed so as to facilitate placing equipment where it is to be used and freeing vehicles for engineer supply. The loads are prescribed by the squadron commander to conform to the situation.

Normally the ¾-ton truck is used for carrying tools and repair parts for the motor vehicles; the tank truck carries gasoline and oil for the squadron motor vehicles; the normal loads of the eleven 1½–2 ton cargo trucks are as follows:

No. 1. Electric lighting set for division headquarters.
No. 2. Water-supply equipment for division use.
No. 3. Two sets of cavalry intrenching equipment.
No. 4. Two sets of cavalry intrenching equipment.
No. 5. Headquarters and service troop: Personnel.
No. 6. Map section and equipment.
No. 7. Squadron headquarters: Personnel, office equipment, baggage, and tentage.
No. 8. Headquarters and service troop: Baggage, tentage, and rations.
No. 9. Headquarters and service troop: Engineer and miscellaneous equipment and supplies.
No. 10. Ammunition and explosives.
No. 11. Supplementary equipment.

(2) *Troop equipment.*—(*a*) The organizational equipment and supplies assigned to the engineer troop consist of tools and supplies for executing engineer work; tools and equipment and materials for routine supply, repair, and upkeep, and for messing and administration; ammunition and chemical warfare equipment; transportation for movements, engineer work, messenger service, and engineer reconnaissance. This equipment is carried, in the case of the mounted troop, in the platoon pack sections and in the troop trucks, and in the case of the motorized troops in their trucks.

(*b*) The principal miscellaneous items of equipment which are common to all the troops consist of equipment for camping, administration, and messing, and include gas masks, carried either on the person or in the transportation; troop field desk, with stationery; illuminating equipment; a reference library; a canvas litter; a cooking outfit (a No. 1 field range for the mounted troop, and kitchen trailers for the motorized troops); supplementary cooking outfits for use of the platoons when on detached missions; a camera for photographic reconnais-

sance and photographic reports; extra ammunition; and certain miscellaneous equipment and supplies common to all troop units including quartermaster blacksmith equipment, set No. 1, blacksmith coal, marking outfits, cobbler's tools, lanterns, buckets and galvanized iron cans, a small number of axes, shovels, and pickaxes for troop maintenance in the field.

(*c*) Because of the basic difference in organization of the mounted troop and the two motorized troops there is a corresponding difference in their major items of equipment and in their transportation.

(*d*) The mounted troop is equipped with the following standard sets of engineer equipment distributed as shown:

1. Troop headquarters section, carried in the troop tool truck: One set carpenter equipment, platoon; 1 set pioneer equipment, platoon; 1 set tinsmith equipment; 1 set photographic equipment, company; 1 set library, company; 1 set illuminating equipment; 1 set sign-painting equipment; 1 sketching outfit; 1 stereoscope; 1 set blacksmith equipment made up from the quartermaster blacksmith set No. 1, and certain items from the engineer blacksmith supplementary set.

2. The pack equipment is the normal equipment of the mounted platoon. It is composed of 8 sets of pack equipment consisting of 5 engineer packs and 3 packs of such of the following as may be required by the situation: Machine rifle with ammunition, picket line, kitchen pack, ration pack, and engineer supplies. The 5 engineer packs are described in paragraph 42 *b*.

(*e*) The mounted troop is supplied with the following wheeled transportation for its equipment and personnel, all of which is normally assigned to the troop headquarters section:

1 light motor car.
1 truck, ¾-ton.
1 truck, R & B, 1½–2 ton.
1 truck, tool, 1½–2 ton.
1 water trailer, 300-gallon.
1 wagon, spring, 4-horse.

(*f*) The motorized troops are equipped with the following standard sets of engineer equipment distributed as shown:

1. Troop headquarters section, carried in the troop tool truck: One set blacksmith, supplementary, engineer; 1 set library, reference, company; 1 set photographic equipment, company; 1 set sign painting equipment; 1 set tinsmith equipment; 1 set illuminating equipment; 1 stereoscope; and 1 sketching outfit.
2. For each platoon, carried in the platoon tool truck: One set carpenter equipment, platoon; 1 set demolition equipment, platoon; 1 set pioneer equipment, platoon.

(*g*) The motorized troops are supplied with the following motor transportation for equipment and personnel, with normal distribution as shown:

To troop headquarters section:

2 light motor cars.
1 truck, R & B, 1½–2 ton.
1 truck, tool, 1½–2 ton.
1 trailer, water, 300-gallon.
1 trailer, kitchen.

To each platoon:

1 light motor car.
2 trucks, personnel, 1½–2 ton.
1 truck, tool, 1½–2 ton.

74. Camouflage battalion, GHQ.—*a. Organization.*—The GHQ camouflage battalion consists of a headquarters, a headquarters and service company, a camouflage company, and a shop company. It is organized in general as follows:

(1) The *battalion headquarters* includes the battalion commander and his staff. The designations of the staff officers are adjutant, supply officer, assistant supply officer, and surgeon. Their duties are in general as described in paragraph 69 *b*, the adjutant combining the functions of operations, administration, intelligence, and training. The enlisted personnel for the staff sections of battalion headquarters is furnished by the headquarters and service company.

(2) The *headquarters and service company* includes the personnel for operating the various staff sections of battalion headquarters and for the supply service for the battalion. It is divided into a company headquarters, an administrative section, a technical section, and a supply section.

(*a*) *Company headquarters* includes the company commander, a commissioned assistant, and 22 enlisted men organized in general as described in paragraph 69 *f*. The company commander is also the battalion supply officer. His commissioned assistant handles the details of company administration and the battalion mess.

(*b*) The *administrative section* includes the clerical personnel making up the office of the battalion adjutant and operates under his direct charge. It handles the routine administration, clerical work, mimeographing, postal service, and message center. The enlisted personnel is under the supervision of the battalion sergeant major.

(*c*) The *technical section* includes the personnel that operates under the operations officer (adjutant). The enlisted personnel includes a staff sergeant, camoufleur, who is in immediate charge of the other enlisted men of the section; a sergeant, camoufleur; and 10 privates qualified as camoufleurs, clerks, draftsmen, and photographers. This section makes studies of camouflage needs in the communications zone, recommends measures to meet these needs, and by study of aerial photographs, reports, inspections, and other means determines the effectiveness of the measures adopted. It also prepares technical instructional matter to be distributed to troops of other arms in connection with camouflage operations.

(*d*) The *supply section* is under the direction of the supply officer. The enlisted personnel includes a technical sergeant who is the battalion supply sergeant and a corporal and 5 privates qualified as clerks who do clerical work in connection with handling the battalion supply.

(3) The *camouflage company* is composed of a company headquarters, a headquarters platoon, and a camouflage platoon.

(*a*) *Company headquarters* consists of the company commander, a commissioned assistant, and 16 enlisted men organized in general as described in paragraph 69 *f*.

(*b*) The *headquarters platoon* consists of platoon headquarters, a depot section, and a school section.

1. Platoon headquarters includes the platoon commander, a commissioned assistant who is available for any duty, a staff sergeant who is the platoon sergeant and 5 privates who furnish mes-

sengers and chauffeurs for the vehicles assigned to the headquarters platoon.

2. The depot section consists of 3 sergeants, storekeepers; 3 corporals, camoufleurs; and 18 privates qualified as carpenters, mechanics, and clerks. This section contains sufficient personnel to operate 3 separate camouflage depots or dumps.

3. The school section consists of 3 technical sergeants, camoufleurs; 8 corporals, camoufleurs; and about 36 privates qualified as carpenters, camoufleurs, and painters. The school section provides demonstration personnel for camouflage schools in the communications zone.

(*c*) The *camouflage platoon* consists of a platoon headquarters and a camouflage section.

1. The platoon headquarters includes 1 officer, who commands the platoon, 1 officer, who assists the platoon commander, a staff sergeant, camoufleur, who supervises the activities of the enlisted personnel of the platoon headquarters, and assists the platoon commander in planning, and 4 privates who furnish chauffeurs for the light motor cars and messengers.

2. The camouflage section includes 4 officers, who act as field supervisors of camouflage projects, 4 staff sergeants, camoufleurs, who take charge of field groups engaged on camouflage operations; 8 sergeants and 2 corporals, who execute camouflage work; and about 30 privates qualified as camoufleurs. carpenters, or painters.

(4) The *shop company* consists of a company headquarters, a headquarters platoon, and a factory platoon which operates a central camouflage factory for the preparation of materials to be delivered to using troops in either the communications zone or the combat zone.

(*a*) The *company headquarters* consists of 2 officers and 12 enlisted men organized in general as described in paragraph 69 *f*. The company commander is the factory superintendent and he is assisted by an officer as assistant factory superintendent.

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(*b*) The *headquarters platoon* is composed of platoon headquarters, a supply section, a transportation section, a repair and maintenance section, and a design section.

1. Platoon headquarters consists of 1 commissioned officer who is the platoon commander; 1 commissioned assistant, who is available for any duty; a staff sergeant who is the platoon sergeant; a miscellaneous sergeant who assists the platoon commander in planning; and 3 privates who do clerical work.
2. The supply section consists of a staff sergeant in charge of the section; 2 sergeants who have charge of the storage and issue of materials to the various departments of the factory; 2 corporals, storekeepers; and 4 privates who do clerical work in connection with supply.
3. The transportation section consists of a staff sergeant, truckmaster, in charge of the section; 2 corporals, assistant truckmaster; and about 20 privates who operate the motor vehicles assigned to the section.
4. The repair and maintenance section consists of a technical sergeant, millwright, in charge of the section; 2 sergeants, foremen, who take charge of repair work as directed by the section leader; 4 corporals, assistant foremen; and 10 privates qualified as blacksmiths, carpenters, electricians, pipe fitters, machinists, or mechanics. This section is charged with general maintenance of factory equipment and transportation.
5. The design section consists of a technical sergeant, accountant, in charge of the section; a technical sergeant, camoufleur, in charge of camouflage design; and 9 privates qualified as camoufleurs, clerks, or draftsmen. This section sets up pilot models of camouflage installations, develops new camouflage devices and gives instructions to and furnishes drawings for the use of the personnel of the shop company. It is also charged with compiling statistical information concerning factory production.

(*c*) The *factory platoon* is composed of a platoon headquarters, a sewing and weaving section, and a painting section.

1. The platoon headquarters consists of the platoon commander, and a commissioned assistant who is available for any duty; a staff sergeant, platoon sergeant; a sergeant, camoufleur, who assists the platoon sergeant and is available for any duty; and 3 privates who do clerical work and furnish messenger service.
2. The sewing and weaving section consists of a staff sergeant in charge of the section; 2 sergeants, assistant foremen in charge of sewing and weaving operations; 4 corporals, assistant foremen; and about 62 privates qualified as canvas workers and camoufleurs, who manufacture camouflage fabrics.
3. The painting section consists of a technical sergeant, painter, in charge of the section; 2 sergeants, foremen in charge of the preparation of paint and its application; 5 corporals and about 29 privates who apply paint.

b. Equipment.—The camouflage battalion is equipped to fabricate and erect camouflage materials, to transport inspection and demonstration parties, and to operate schools for camouflage instruction. The equipment of the various elements of the battalion is as follows:

(1) *Battalion equipment.*—Battalion equipment includes organizational equipment and supplies for the following purposes: The office of the battalion headquarters, routine administration and supply, shelter, and the battalion mess. The principal engineer equipment carried includes sets of standard engineer equipment for the following kinds of work: Canvas work, drafting, photography, and camoufleur's kits. The transportation required by the battalion headquarters and the headquarters and service company is assigned to company headquarters. It consists of a motor car and 2 light motor cars for reconnaissance and inspection, a kitchen trailer and a water trailer for the mess, and 3 cargo trucks for the transportation of supplies.

(2) *Camouflage company equipment.*—For purposes of messing, administration, and supply, the camouflage company is equipped in general like the company of the combat regiment. The engineer equipment includes drafting and duplicating equipment, illuminating equipment, a reference library, photographic equipment, sketching equipment, carpenter equipment, pioneer

equipment, camoufleur's kits, and paint sprayers. The transportation includes 11 light motor cars in which the camouflage field groups make reconnaissances and inspections, a kitchen trailer and a water trailer for the mess, and 8 cargo trucks for the supply of camouflage materials.

(3) *Shop company equipment.*—Organizational equipment and supplies for routine upkeep and repair, messing, and administration are similar to those provided for the company of the combat regiment. Engineer equipment for the operations of the company includes a drafting and duplicating set, reference library, blacksmith, carpenter, and pioneer tools, and shop equipment. The shop equipment consists of a gasoline electric generating set for power; electric motors for operating the plant; lathes, planers, pulleys, and saws, for woodworking; and chaff cutters, belt conveyors, paint grinding machines, paint spraying machines, eyelet punching machines, scraping machines, paint mixing machines, sewing machines, glue boiling tanks, and barrel trucks for the manufacture of camouflage material. The transportation includes a kitchen trailer for the mess, motor cycles with side cars or light motor cars for messenger service, reconnaissance, inspection, and the supply of small items of equipment, and 8 cargo trucks for supply.

75. Camouflage battalion, army. — *a. Organization.* — The army camouflage battalion consists of a headquarters, a headquarters and service company, and 4 companies. It is organized in general as follows:

(1) The *battalion headquarters* includes the battalion commander and his staff. The designations of the staff officers are adjutant, operations officer, supply officer, and surgeon. Their duties are in general as described in paragraph 69 *b*. The enlisted personnel for the staff sections of battalion headquarters is furnished by the headquarters and service company.

(2) The *headquarters and service company* includes the personnel for operating the various staff sections of the battalion headquarters, the supply service for the battalion, and the manufacture of camouflage materials used by the battalion. It is divided into a company headquarters, a headquarters platoon, and a service platoon.

(*a*) The *company headquarters* handles the administration and routine supply of the company and the messing of the company and battalion headquarters. The company commander is also the battalion supply officer. He is assisted by

one commissioned officer who attends to the details of the company administration and the battalion mess. The enlisted personnel is organized in general as described in paragraph 69 *f*.

(*b*) The *headquarters platoon* is composed of an administrative section, an operations section, and a supply section.

1. The administrative section includes the clerical personnel making up the office of the battalion adjutant, and operates under his direct charge. The enlisted personnel is under the direct supervision of the battalion sergeant major.
2. The operations section is under the direction of the operations officer. The enlisted personnel includes 3 sergeants, of whom one is a camoufleur, one is a carpenter, and one is a draftsman; a corporal, painter; and 10 privates qualified as camoufleurs, draftsmen, mechanics, and painters. The operations section sets up pilot models of camouflage installations, and gives instruction to and furnishes drawings for the use of the personnel of the camouflage companies.
3. The supply section is under the direction of the supply officer. The enlisted personnel includes a technical sergeant, who is the battalion supply sergeant, charged with the general supervision of camouflage material; and a corporal and 3 privates, qualified as clerks, who do clerical work in connection with the handling of the camouflage supply.

(*c*) The *service platoon* is composed of a platoon headquarters, a factory section, and a transportation section.

1. The platoon headquarters includes an officer who commands the platoon; a staff sergeant, camoufleur, who assists the platoon leader; and 2 privates, who act as messengers.
2. The factory section is commanded by an officer. The enlisted personnel includes 3 sergeants, of whom one is a camoufleur and supervises the factory operations, one is a draftsman who makes working drawings for factory use and for reports, and one is a storekeeper in charge of factory supplies and equipment; 3 corporals of whom one is a car-

penter foreman in charge of carpenter work at the factory, one is a clerk who handles factory accounting, and one is a painter who is foreman of factory operatives engaged in applying paint to camouflage materials; and 20 privates qualified as camoufleurs, carpenters, mechanics, or painters.

3. The transportation section is commanded by a corporal truckmaster. The other enlisted personnel includes 11 chauffeurs and 5 assistant chauffeurs, who operate the motor vehicles assigned to the battalion, and 2 auto mechanics who handle general repairs to motor equipment.

(3) The *camouflage company* is composed of a company headquarters and 4 camouflage platoons.

(*a*) The *company headquarters* consists of the company commander and 16 enlisted men, organized in general as described in paragraph 69 *f*.

(*b*) The *camouflage platoon* is commanded by a commissioned officer. The enlisted personnel includes a staff sergeant, camoufleur, who is the platoon sergeant and who assists the platoon commander in the supervision of the operations of the platoon; 2 sergeants, camoufleurs, who act as overseers with detached sections of the platoon; 4 corporals, of whom 2 are camoufleurs, 1 a general carpenter, and 1 a painter; and 4 privates, qualified as camoufleurs and painters.

(4) The *medical detachment* is organized in general as described in paragraph 69 *g*.

b. Equipment.—The equipment of the army camouflage battalion is similar to that for the camouflage battalion in the communications zone described in paragraph 74 *b*, except that the army camouflage battalion has no shop company and is not equipped with so extensive a plant for the manufacture of camouflage materials. The equipment of the factory section of the service platoon of the headquarters and service company of the army camouflage battalion is suitable principally for the adaptation of materials previously fabricated in the camouflage factories located in the communications zone.

76. Heavy ponton battalion, motorized.—*a. Organization.*—The heavy ponton battalion (motorized) consists of a headquarters, headquarters and service company, medical detachment, and two companies. It is organized, in general, as follows:

(1) The *battalion headquarters* consists of the battalion commander and his staff. The designations of the staff officers are adjutant, supply officer, and surgeon. Their duties are, in general, as described in paragraph 69 *b*, the adjutant performing the functions of operations, plans and training, and intelligence. The remainder of the personnel pertaining to battalion headquarters is furnished by the headquarters and service company.

(2) The *headquarters and service company* provides the personnel for the adjutant's office, the supply officer's office, the headquarters of the headquarters and service company, and for general supply and maintenance service for the battalion.

(*a*) The *company headquarters* includes the captain, who is the commanding officer of the headquarters and service company; 1 officer, who assists the company commander and handles company administration and the battalion officers' mess; and about 17 enlisted men organized, in general, as described in paragraph 69 *f*. The company commander is also the battalion supply officer.

(*b*) The *administrative section*, working under the immediate supervision of the battalion adjutant and the battalion sergeant major, furnishes clerical personnel for the battalion headquarters.

(*c*) The *supply section* works under the immediate supervision of the battalion supply officer and the battalion supply sergeant. It includes clerical personnel only.

(*d*) The *maintenance section* is supervised by the battalion supply officer. The enlisted personnel includes a sergeant, general mechanic, in charge of the section; a tool corporal in charge of the tool truck, and about 14 mechanics. The duties of the maintenance section include the repair and maintenance of the ponton equipage with which the battalion is equipped and the vehicles upon which the equipage is transported.

(*e*) The *depot section* operates under the supervision of the battalion supply officer. It includes the personnel charged with the care of the spare ponton equipage carried by the battalion for the purpose of replacing losses occurring in the equipage carried by the companies of the battalion. The section is commanded by a staff sergeant, truckmaster, and includes 3 corporals, subsection truckmasters, and a chauffeur and assistant chauffeur for each vehicle.

(3) The *company* consists of a headquarters platoon and 2 bridge platoons.

(*a*) The *headquarters platoon* is divided into a company headquarters section and a service section.

1. The company headquarters section includes the captain who is the company commander; a second lieutenant who is assistant to the company commander; and 12 enlisted men organized, in general, as described in paragraph 69 *f*.

2. The service section is under the general supervision of a staff sergeant who is a general mechanic. The other enlisted personnel consists of a sergeant, general mechanic, a tool corporal, a corporal truckmaster, and 24 privates who furnish the mechanics, boat carpenters, painter, riggers, and wheelwright for the repair of bridge equipage; and the chauffeurs who operate the vehicles of the headquarters platoon.

(*b*) The *bridge platoon* is divided into a platoon headquarters, 3 ponton sections, and 2 trestle sections.

1. The platoon headquarters consists of a first lieutenant who commands the platoon; a staff sergeant who is the platoon sergeant; and 2 sergeants, truckmasters. The duties of the latter are to supervise the operations of 2 or more ponton or trestle sections when combined.

2. The ponton section cares for and transports the equipage used in the construction of 3 floating bays of bridge. It consists of a corporal, truckmaster, in charge; and a chauffeur and an assistant for each motor vehicle.

3. The trestle section transports and cares for the equipage used in the construction of nonfloating parts of the bridge, including abutment, trestle, and hinge spans. It consists of a corporal, truckmaster, in charge; and a chauffeur and an assistant for each motor vehicle.

b. Equipment.—(1) *Battalion equipment.*—The battalion is equipped to transport and furnish to using troops heavy ponton equipage, M1924. It also has tools and spare parts for the maintenance of the equipage and organizational equipment for *self-maintenance, interior* administration, and supply. The

equipment pertaining to the battalion as a whole is carried and cared for by the headquarters and service company.

(2) The *headquarters and service company equipment* includes organizational equipment and supplies for the following purposes: The offices of the battalion headquarters; routine administration and supply; shelter; the battalion mess; and the repair and upkeep of the ponton equipage carried by the companies. The principal engineer equipment carried includes: Blacksmith equipment, carpenter equipment, illuminating equipment, pipe fitting equipment, tinsmith equipment, sign painting equipment, and spare ponton equipage. The latter includes trailers, like those carrying the equipage in the companies, with loads of tools and spare balk, chess, pontons, and trestles. In addition to the spare bridge equipage, the company is equipped with motor cars for reconnaissance and inspection; a kitchen trailer, water trailers, and a ration and baggage truck for the mess; and a 250-gallon tank truck for gasoline.

(3) The *company equipment* includes organizational equipment and supplies for routine repair, messing, and administration similar to that provided for the company of the combat regiment. The principal engineer equipment is the ponton equipage of which the company transports 18 pontons and 8 trestles, sufficient for the construction of 416 feet of bridge. Each bridge platoon is equipped with one "unit" of bridge equipage, which includes 9 pontons, 4 trestles, and accessory equipment sufficient to construct 208 feet of bridge. For data as to length and capacities of bridge constructed with the equipage, see Tables II and XII.

77. Railway battalion.—*a. Organization.*—The railway battalion consists of battalion headquarters, headquarters and service company, medical detachment, a maintenance of way company, a maintenance of equipment company, and an operating company. It is organized in general as follows:

(1) The *battalion headquarters* includes the battalion commander and his staff. The enlisted personnel for the battalion headquarters is in the headquarters and service company. The designations and the duties of the staff officers are as follows:

(*a*) The *battalion commander* is the division superintendent of the railway division assigned to his battalion. He supervises the preparation of demolition plans for his railway division and executes such plans when directed by the

proper military authority. He makes such reports and keeps such records as may be necessary to assure efficient handling of rolling stock and personnel and as may be required by higher authority. He should be prepared to make recommendations for increasing the capacity of his division. When located in the forward area, he should by reconnaissance keep himself informed of conditions which will confront the battalion in case the railheads of his railway division are moved forward.

(*b*) The *assistant division superintendent* is the executive officer on railway matters.

(*c*) The *battalion adjutant* has all the duties of an adjutant, as described in paragraph 69 *b*, and in addition is the operations, training, and intelligence officer of the battalion.

(*d*) The *supply officer* is the commanding officer of the headquarters and service company and is in charge of the supply and transportation section of the headquarters and service company.

(*e*) The *battalion surgeon* is the senior medical officer with the medical detachment.

(2) The *headquarters and service company* consists of company headquarters and 6 sections, as follows: Administration, technical, supply and transportation, mess, train movement, and signal maintenance. The function of the headquarters and service company is to provide in one organization technical, administrative, and supply personnel necessary to enable the battalion commander to supervise and coordinate the activities of the battalion and to operate certain activities common to all the companies, such as signal communications.

(*a*) The *company headquarters* handles the administration and routine supply of the headquarters and service company and the messing of the company and battalion headquarters. The company commander is also the battalion supply officer, railway division storekeeper, and railway division mess officer. As a supply officer he maintains routine supply, such as food, clothing, ammunition, and equipment. As the division storekeeper he coordinates the technical supply requirements of the railway division. The section includes a first sergeant and the necessary clerks for administrative duties.

(*b*) The *administrative section* reports to the battalion adjutant and under the direction of the sergeant major handles routine battalion administration.

(*c*) The *technical section* reports to the division superintendent or his assistant. It takes care of the technical administration, drafting, and photography for the battalion. One master sergeant is chief clerk to the division superintendent and has charge of railway office management and supervision of reports on railway operations records and data relating to the railway. Another master sergeant is wrecking foreman, and has charge of the removal of wrecks, the operation of wrecking cars on wrecking work, and the condition of wrecking equipment. He assists in the preparation of demolition plans, and is the custodian of such plans after they have been approved. The remaining enlisted men do drafting, photographic, and clerical work.

(*d*) The *supply and transportation section* provides the clerical personnel for the division storekeeper's office and for the operation of the motor vehicles of the headquarters and service company. It reports to the battalion supply officer and works under his direct supervision.

(*e*) The *mess section* operates messes along the railway line where men from more than one company may mess. The section reports to the battalion supply officer.

(*f*) The *train movement section* reports to the railway division superintendent or his assistant and handles the movement of trains, the distribution of cars and motive power, and the keeping of car, locomotive, and movement records. The first lieutenant is the chief dispatcher. Operating under the division superintendent, he is responsible for train movements, for train orders for the prompt movement of business, for the dispatching and distribution of motive power so as to be in a position to move all traffic in a prompt and efficient manner. He supervises car ordering and movement of empty equipment over the railway division as well as the prompt loading and unloading of cars and the distribution of surplus equipment. He supervises the work of dispatchers and sees that they are handling *trains safely and* expeditiously. He sees that dispatchers and operators issue and copy train orders in a correct manner and investigates train delays on the road. He keeps a record of all cars set-off at nonagency stations when in bad order or otherwise, and arranges for prompt repairs, unloading or loading,

as the case may be. He reports immediately any violation of the rules by train crews to the superintendent or trainmaster. He notifies the various department heads of any materials consigned and moving to them, point and time at which consignment will be sent so that they may arrange for unloading. He sees that all fuel stations are amply supplied with fuel and that sufficient quantity is kept en route. He keeps himself informed of the condition of facilities, such as water columns, signals, fuel stations, etc., and calls the proper officer's attention to failures. He arranges to dispatch trains on a priority basis as directed in orders from the superintendent. He maintains a record of train movements. He sees that proper authority is obtained as to cars wanted and car surplus on territory under his supervision. He is assisted by the necessary dispatchers, telegraphers, and clerical personnel.

(*g*) The *signal maintenance section* reports to the division superintendent or his assistant. It is responsible for the maintenance of the communications of the railway division and for the operation of switchboards. Its duties include the repair of telephones, telegraphs, and other signal instruments and the maintenance of signal lines. The first lieutenant is the signal engineer in charge of the section. He cooperates with the Signal Corps on technical matters.

(3) The *maintenance of way company* (*Company A*) is composed of a company headquarters, a bridge and building maintenance platoon, and a track maintenance platoon.

(*a*) The *company headquarters* consists of the necessary personnel to take care of normal administration and supply of the company, the coordination of railway maintenance activities, and the operation of certain specialties common to the two platoons. The company commander is the engineer, maintenance of way, and is directly responsible to the railway division superintendent. His position corresponds to that of division engineer on civil railways. He supervises the water supply as to quality and quantity, and is responsible for the maintenance of track, road bed, bridges, buildings, fences, and other structures. His territorial limits are the same as those of the division superintendent. He is assisted by a commissioned officer, who normally handles administration and supply matters and may be delegated such other duties as the situation requires.

The company headquarters also includes enlisted personnel for the administration and messing of the company, a first sergeant, and enlisted technicians, such as surveyor, railroad draftsman, welders, and storekeepers.

(*b*) The *bridge and building maintenance platoon* consists of a platoon headquarters and 3 bridge and building sections. The platoon is normally charged with all railway maintenance other than rolling stock, motor vehicles, shop, roadbed, and signal lines. The principal duties of this platoon are maintenance of bridges and buildings and maintenance of coaling and water facilities.

1. Platoon headquarters, consisting of 1 officer and 3 enlisted men, coordinates and inspects the activities of the bridge and building sections and furnishes certain technical service for the platoon. The platoon commander is supervisor of bridges and buildings. He reports to the engineer, maintenance of way, to whom he is responsible for maintaining emergency supplies of bridge material to replace structures washed out, burned out, or destroyed by the enemy. He is assisted by a staff sergeant, supervisor of tanks, pumps, and water service in general; a sergeant, bridge inspector, who keeps all bridge records, makes recommendations for bridge repairs, prepares requisitions for bridge materials, prepares bridge reports, and keeps informed of the location of bridge materials; and 1 private, who is a general mechanic, charged with maintenance of pumps and water lines.

2. The bridge and building section consists of 15 enlisted men. It is a working group organized and equipped to maintain structures. It builds new structures within its capacity. It maintains signal lines only when directed by the battalion commander. It includes a staff sergeant, construction foreman, in charge of the section, a bridge carpenter, a general carpenter, and 12 privates qualified as blacksmith, carpenter, carpenter helpers, fireman, pipe fitter, stone mason, locomotive crane operator, painter, and structural iron workers.

The crane operator and the fireman operate the locomotive crane when it is attached to the unit for work.

(*c*) The *track maintenance platoon* is composed of a platoon headquarters and 6 track maintenance sections of 2 squads each. The platoon is charged with the safe condition and proper maintenance of roadbed, track, tunnel, right of way, station grounds, driveways, crossings, fences, cattle guards, track signs, etc., within the railway divisional area.

1. Platoon headquarters consists of 1 officer and 4 enlisted men, who supervise the activities of the track maintenance sections, supervise the distribution of tools and materials, prepare and forward requisitions, and make routine and inspection reports. The platoon commander is the roadmaster or track supervisor, and reports to and receives instructions from the engineer, maintenance of way. He assigns territorial limits to track and maintenance sections and prescribes their duties. He is assisted by a staff sergeant, second in command, who is the assistant roadmaster and handles such matters as may be delegated to him by the platoon commander; a sergeant, assistant roadmaster, who is the office assistant of the platoon commander for matters relating to administration and supply; a corporal, storekeeper, who prepares requisitions, maintains distribution of materials, keeps records, and performs other supply functions; and 1 private, clerk, who performs routine clerical duties.

2. The track maintenance section consists of a section leader and 2 track maintenance squads of 8 enlisted men each. The track maintenance section is assigned to a prescribed territory by the platoon commander. It is responsible for all maintenance work within the territorial limits of the section, except that expressly delegated to other units. The section leader is a railroad section foreman and is responsible for discipline and training of his men and the quality and quantity of their work. Each track maintenance squad is composed of 1 cor-

poral and 7 privates. The corporal performs the technical duties performed by a section foreman on civil railways. This includes the inspection of tracks, roadbed, and right of way of the territory allocated to him.

(4) The *maintenance of equipment company* (*Company B*) is designed primarily to take care of running repairs to rolling stock, and its duties are equivalent to those of a roundhouse organization on a civil railway. It is composed of a company headquarters, a car repair platoon, and a locomotive repair platoon.

(*a*) *Company headquarters* consists of personnel to supervise the technical operation of the two platoons to administer and feed the company, to procure, store, and issue tools and materials for which the company is responsible, and to operate the drafting room. The company commander is the master mechanic and is responsible to the railway division superintendent. He handles the repair of rolling stock, tools, and mechanical appliances, and maintains the fuel and lubricant reserve and coaling stations. He is assisted by a commissioned officer who usually has charge of the drafting room and the procurement, issue, and storage of tools, materials, and supplies. The company headquarters also includes enlisted personnel for the administration and messing of the company, a first sergeant who is charged with the keeping of all records of both an administrative and a technical nature, and the necessary technical personnel, such as draftsmen, photographers, and storekeepers.

(*b*) The *car-repair platoon* is composed of a platoon headquarters, a wrecking crew, and two car-repair sections. This platoon is charged with the maintenance, repair, and inspection of cars, the operation of the wrecking trains, and the execution of all sign painting. Car repair section No. 1 is larger than car repair section No. 2. The former normally runs the day shift, and the latter the night shift. They may be combined and both work during the day if it is in the interest of more efficient operation to do so.

1. Platoon headquarters, consisting of 1 officer and 8 enlisted men, supervises the operation of the car-repair shop and inspects all cars passing over the division. The platoon commander is the general car foreman and reports to the master mechanic

and has direct charge of the car-repair shop. He is responsible for the inspection and tests of air brakes and air equipment in addition to the repair of cars. He had direct supervision of car inspection and the supply of car-repair materials. He is assisted by a staff sergeant, platoon sergeant, and second in command, who is the foreman in charge of the car shop and a number of car inspectors.

2. The wrecking crew consists of 11 enlisted men. It has sufficient personnel to operate the equipment assigned to the wrecking train and to supervise the removal of wrecks or other line obstructions. This crew works under the direction of the wrecking foreman in the technical section of the headquarters and service company while engaged upon wrecking activities.

3. Car repair section No. 1 performs all the car repairing and maintenance work during the day shift, assisted by personnel from the wrecking crew when assigned to it. It is responsible for all sign painting for the battalion.

4. Car repair section No. 2 performs emergency car repair work during the night shift. It is combined with car repair section No. 1 when it is expedient to do all repair work during the day.

(*c*) The *locomotive repair platoon* is composed of a platoon headquarters and 3 locomotive repair sections. The platoon is charged with the maintenance of locomotives, locomotive mechanical appliances, and the operation of locomotive cranes used for coal and ash handling. It is organized to permit operation of the running repair shop on a 3-shift basis. It may be organized to operate on a 1 or 2 shift basis.

1. Platoon headquarters, consisting of 1 officer and 10 enlisted men, has sufficient personnel to supervise the operation of the running repair shop, to inspect locomotives, and to handle administrative matters in connection with the activities of the platoon. The platoon commander is the general shop foreman. He reports to and receives instructions from the master mechanic. He has charge of the shop train or engine house and other terminal *facilities for handling* power and supervises the

dispatch of engines. He is assisted by a staff sergeant, engine house foreman, who is the administrative assistant of the general shop foreman, and is responsible for engine dispatching for service and the necessary inspectors. In the performance of the latter duty he is assisted by 3 corporals, inspectors of engines, and 3 privates, inspectors of engines. The sergeant, general electrician, is charged with the supervision of electrical repairs to rolling stock and to electrical installations, including power for shop trains or running repair shops. He reports to the platoon commander. The corporal, shop clerk, handles clerical matters relating to shop activities and the administration of shop personnel. He is assisted by one private, clerk. The 3 corporals, inspectors of engines, inspect incoming and outgoing engines. Each is provided with 1 private, clerk. The 3 corporals, inspectors of engines, provide 24-hour inspection service at the terminal with 1 inspector and his assistant on each shift. The privates include 1 clerk and 3 inspectors of engines.

2. Locomotive repair section No. 1 operates the shop and terminal facilities during the day shift and performs the major part of the repair work. It does all engine painting.

3. Locomotive repair section Nos. 2 and 3 are organized alike and provide the personnel to man the running repair shop during the second and third shifts.

(5) The *operating company* (*Company C*) is organized to operate the trains, yards, and stations within the territorial limits of the railway division. It is composed of a company headquarters, a yard and station section, and a train operating platoon.

(*a*) The *company headquarters* consists of the personnel for the supervision, inspection, and administration of the company. The company commander is the trainmaster for the railway division. He is assisted by a commissioned officer who is road foreman of engines and usually handles routine administrative matters. The company headquarters also includes enlisted personnel for the administration and messing of the company, and men technically qualified in handling railway records.

(*b*) The *yard and station section* is responsible for the yard and station operation of the railway division. The section commander is the yardmaster. He has charge of the making up of trains and the distribution of cars in the yards. He is responsible that the train operating platoon receives early information concerning train movements, so that crews will be available. He sees that cars are properly placed for loading and unloading and that all cars needing repairs are sent to repair tracks or to the shop. The 3 staff sergeants are assistant yardmasters. One assistant yardmaster is provided for each shift, to provide 24-hour yard operation. Four sergeants are station agents. They are assigned to duty at station locations in the divisional territory. A station agent is the representative of the railroad at the station. Two sergeants act as assistant yardmasters at terminals with more than one yard, or on divisions which have more than one yard. When not employed as yardmasters they are used as station agents or on other duty. The 3 corporals are railroad conductors. They report to and receive instructions from the assistant yardmaster in charge of the yard in which they operate. One conductor is in command of a crew which runs a switching engine. Each conductor has an engineer, a fireman, and 2 brakemen as assistants.

(*c*) The *train operating platoon* is composed of a platoon headquarters and 24 train crews. It is charged with the operation of trains between terminals.

1. Platoon headquarters consists of 1 officer and 3 enlisted men. It is charged with the supervision, dispatch, and inspection of train crews. The platoon commander is the assistant trainmaster. He reports to and receives instructions from the trainmaster. He corresponds to what on some civil railways is called the traveling engineer. He is responsible for the condition and the handling of rolling stock during the time it is being operated by personnel under his supervision. The staff sergeant, assistant road foreman of engines, performs such duties as may be delegated to him by the platoon commander. He normally handles administrative matters, keeps platoon records, and supervises the dispatching of crews. He is assisted by the sergeant, crew dispatcher. The crew dispatcher is responsible for the crew roster and sees

that crews report promptly for service. The inspector assists the platoon commander in the performance of his inspection and training duties.

2. A train crew consists of 5 enlisted men. It is organized to operate either a freight or a passenger train.

(6) *Medical detachment.*—For the composition and duties of the medical detachment, see paragraph 69 *g*. The battalion commander designates the location of the battalion dispensaries or aid stations, and local aid posts if necessary, upon the recommendation of the battalion surgeon.

b. Equipment.—(1) *Battalion equipment.*—The battalion is equipped with organizational equipment and supplies for the following purposes: The office of battalion headquarters, messing, routine supply and administration of the headquarters and service company, and shelter. The transportation assigned to the headquarters and service company includes a 5-passenger motor car used by the battalion commander for reconnaissance and supervision of operations, 3 motor cycles with side car for messenger service, and 4 cargo trucks for battalion supply. The transportation also includes 4 box cars on standard-gauge railroad underframe, 2 of which are used as a battalion office, 1 for the battalion mess, and 1 for equipment and supplies. The signal maintenance section is equipped with tools for maintaining the telephone and telegraph lines pertaining to the railway. The mess section is equipped with messing equipment for operating the battalion mess and with a number of portable mess equipments for use with the detachments. The supply and transportation section is equipped with motor vehicles used in distributing routine battalion supplies. The technical section is equipped with drafting equipment and blue-printing equipment. The train movement section is equipped with telegraph and telephone equipment. The company headquarters, in addition to the equipment necessary for company maintenance, carries a reserve of watches, signal flags, lanterns, fuzes, and torpedoes used in railway operations.

(2) *Operating company equipment.*—The operating company is equipped with tools and supplies grouped into sets which are used in operating trains. These sets include caboose sets, locomotive sets, yardmaster's sets, and railway agent's sets. The company headquarters carries a reserve of supplies used in

train operation, including lanterns, torpedoes, signal flags, oilers, and lubricants. The transportation of the operating company includes a cargo truck for general company supply, 2 railway motor cars for railroad inspection, and 4 box cars, of which 1 is used for an office, 1 for the company mess, and 2 for the storage of company supplies.

(3) *Maintenance of way company equipment.*—The maintenance of way company is equipped to maintain roadbed and structures on a railway division approximately 75 miles in length. The bridge and building maintenance platoon is equipped with carpenter equipment, blacksmith equipment, pipe fitting equipment, tinsmith equipment, pioneer equipment, painters' equipment, and miscellaneous equipment, including lanterns, signal flags, fuzes, and torpedoes. The sets of equipment here listed are not the standard engineer equipments issued to other engineer troops but are especially made up for railway work. The bridge and building maintenance platoon is also equipped with a 25-ton locomotive crane with pile-driving leads and a portable gasoline engine driven air compressor, with pneumatic tools and a box car equipped with work benches. The track maintenance platoon is provided with equipment for track maintenance, including a push car, shovel box, track wrenches, and jacks used in aligning and surfacing track. The track maintenance section is equipped with a railway motor car, railway drills, rail bender, track shovels, ballast forks, and supplies, including lubricating oil, torpedoes, and track accessories. The company headquarters carries a reserve of supplies including lanterns, torpedoes, signal flags, and surveying equipment including levels and transits. The transportation of the company includes a cargo truck for general company supply, and 4 box cars of which 1 is used as an office, 1 as a mess, and 2 for storage of company equipment.

(4) *Maintenance of equipment company equipment.*—The equipment for the maintenance of equipment company is composed of two parts, a wrecking train and a mobile shop. The wrecking train consists of a railway wrecking crane of 100-ton capacity, equipped with an air compressor, ballast cables, pulleys, and jacks; a tool car; a dispensary car; a boom car to support the crane boom; and two supply cars. The equipment of the wrecking train is sufficient to permit the expeditious handling of wrecks and includes jacks, steel cables, blocks, oxy-acetylene welding and cutting outfit, car movers, fire extin-

guishers, and miscellaneous tools and supplies. The mobile shop train consists of 2 locomotive cranes and 8 box cars equipped with electric generating sets which supply current to the machines; air compressors; the following machine tools: Engine lathe, crank shaper, radial drill, bolt cutter, pipe machine, hacksaw, grinder; pneumatic tools as follows: Drills, grinders, riveters, and hammers; and tools for running repairs to rolling stock. The transportation of the company includes a cargo truck for general company supplies and 4 box cars of which 1 is used as an office, 1 for the mess, and 2 for the storage of company equipment.

78. Topographic battalion, army.—*a. Organization.*—The topographic battalion, army, consists of a headquarters, a headquarters and service company, one reproduction company, and two surveying companies. It is organized, in general, as follows:

(1) The *battalion headquarters* includes the major commanding the battalion and 2 captains, of whom one is the adjutant of the battalion and the other the operations officer. The latter is the chief technical advisor of the battalion commander. The enlisted men pertaining to the battalion headquarters are in the headquarters and service company which is commanded by the supply officer. An assistant to the supply officer operates the battalion officers' mess.

(2) The *headquarters and service company* includes the personnel for the administrative and operations sections of the battalion headquarters and for the handling of routine supply and transportation under the battalion supply officer. It is divided into a company headquarters, an administrative section, an operations section, a supply section, and a transportation section.

(*a*) *Company headquarters* includes the company commander, a commissioned assistant, and about 15 enlisted men, organized, in general, as described in paragraph 69 *f*. The company commander is also the battalion supply officer. A commissioned assistant handles the details of company administration and the battalion officers' mess.

(*b*) *The administrative section* includes the clerical personnel making up the office of the battalion adjutant and operates under his direct charge. It handles the routine administration, paper work, mimeographing, postal service, and message

center. The enlisted personnel is under the supervision of the battalion sergeant major.

(*c*) The *operations section* under the battalion operations officer includes a master sergeant topographer and several enlisted assistants, who assist the operations officer in making plans for the employment of the battalion.

(*d*) The *supply section* is under the supervision of the supply officer. It includes a master sergeant, who is the battalion supply sergeant, and a few enlisted assistants qualified as clerks, who do paper work in connection with handling the battalion supply.

(*e*) The *transportation section* under a commissioned assistant to the supply officer includes a staff sergeant, truckmaster, and about 25 chauffeurs and mechanics for the operation and maintenance of motor transportation used in the general supply of the battalion.

(3) The *surveying company* is organized primarily to establish the control upon which to base all mapping. It also executes such terrestrial topographic surveying as may be required. The company consists of a company headquarters, a control platoon, and a topography and drafting platoon. The control platoon includes platoon headquarters, a horizonal control section, and a vertical control section. This platoon executes horizontal control by triangulation, using towers or searchlight beams, and vertical control by spirit levels or trigonometric leveling. The topography and drafting platoon includes a platoon headquarters, a topography section, and a drafting section. These sections are used principally for making terrestrial surveys in connection with the identification of triangulation points when the aerial photographic method is used, and for making terrestrial surveys by ground methods when for any reason the use of airplane photographs is impracticable.

(4) The *reproduction company* includes a company headquarters, 2 lithographic platoons, and a photomapping platoon. The lithographic platoons are organized into sections for drafting, photographic work, preparation of plates, and the operation of lithographic presses in connection with the printing of maps by the customary methods of lithography. The photomapping platoon is organized into 3 sections, all identical, for the purpose of continuous 24-hour work in making maps from airplane photographs. The personnel of this platoon consists mainly of topographic draftsmen.

b. Equipment.—(1) *General.*—The battalion is completely motorized. The reproduction machinery of the reproduction company is not mounted on vehicles and transportation must therefore be obtained from army headquarters for the comparatively rare movements of this company. The armament includes rifles and pistols (see par. 69 *h*). The technical equipment is such as to allow the following types of work to be executed:

Astronomic work for preliminary geodetic locations.

Geodetic surveying and lower orders of control work.

Vertical control work, either differential or trigonometric leveling.

Topographical work, including all types of work connected with the production of maps.

Drafting work, including preparation of maps from aerial photographs, compilation of field surveys, and general drafting.

Lithographic reproduction, including single or multicolor reproductions.

(2) *Headquarters and service company equipment.*—The headquarters and service company is equipped with camping and office equipment for its own use and, in addition, equipment and supplies for the following: The offices of the regimental headquarters; the messing and routine supply and administration of the company and regimental headquarters; and general supply of the battalion. The transportation includes passenger cars for making reconnaissances and inspections, a kitchen trailer, tank trailer and a ration and baggage truck for the mess, a heavy tank truck for the transportation of gasoline, and a cargo truck and two light utility trucks for carrying on general battalion supply.

(3) *Surveying company equipment.*—(*a*) The *control platoon* is equipped with instruments for astronomic location including a radio set for receiving time signals, a theodolite, chronometers, and watches; base measuring equipment, including levels, transits, scales, tape stretchers, tapes, thermometer, and miscellaneous items for use in the accurate measurement of a base line; tower erecting equipment including demountable steel triangulation towers, signal lamps, transits, and tapes; pioneer equipment for erecting towers; in special cases searchlight equipment for establishing vertical beam targets; observing equipment including theodolites, signal lights, plane tables and alidades, tables, scales, rods, compasses, field glasses

and supplies; and vertical control equipment including transits, rods, and accessories. The platoon headquarters carries equipment and supplies for the drafting room including large drawing boards, scales, beam compasses, reference books, tables, drafting and surveying supplies, and blank forms for computations.

(*b*) The *topographic and drafting platoon* is provided with equipment for topographic surveying and drafting including alidades, barometers, drawing instruments, pantographs, scales, drawing boards, stereoscopes, plane tables, and supplies including reference books and tables, blank books, signal cloth, paper, pencils, ink, rubber cement, paper weights, etc.

(*c*) The *company headquarters* is equipped with tools and materials for routine supply and maintenance and for messing and administration, and in addition certain engineer basic sets of equipment for use in assisting the platoons in the execution of their surveying missions, including carpenter equipment, pioneer equipment, and sign painting equipment. The transportation includes 3 motor cars for reconnaissance, inspection, and messenger service; a kitchen trailer; a tank trailer; a ration and baggage truck for the mess; 4 heavy cargo trucks (or their equivalent in trucks and trailers) for the transportation of demountable triangulation towers; and 10 light and 3 medium trucks for the transportation of tools for the erection of towers and surveying equipment for the surveying parties.

(4) *Reproduction company equipment.*—(*a*) The *lithographic platoons* are equipped for all the processes incident to lithographic map reproduction, including lithographic presses, wet plate camera, paper cutting machinery, power equipment, and process chemicals.

(*b*) The *photomapping platoon* is equipped to make maps from aerial photographs. This equipment includes pantographs, drafting tables, straightedges, scales, proportional dividers, drafting instruments, and supplies, including rubber cement for assembling photographs, transparent celluloid sheets, drafting paper, ink, pencils, etc.

(*c*) The *company headquarters* is equipped with tools and supplies for routine supply and maintenance and for messing and administration, and certain sets of engineer equipment used to assist the platoons in setting up their machines and other equipment including carpenter equipment, pioneer equipment, and tinsmith equipment. The transportation includes a motor

car for the company commander, a kitchen trailer, a tank trailer and 2 ration and baggage trucks for the mess, and a tool truck for the transportation of items incident to the maintenance of the reproduction machinery. No transportation is provided organically for the movement of the reproduction plant. The latter is composed of machinery susceptible of transportation from place to place upon motor trucks but it is not permanently mounted upon the trucks and for the comparatively rare movements of the reproduction plant additional transportation must be furnished.

79. Water supply battalion.—*a. Organization.*—The water supply battalion consists of a headquarters, a headquarters and service company, a medical detachment, a motor repair section (QMC), and 3 companies. It is organized, in general, as follows:

(1) The *battalion headquarters* includes the battalion commander and his staff. The designations of the staff officers are battalion adjutant, operations officer, supply officer, and surgeon. Their duties are, in general, as prescribed in paragraph 69 *b*, except that the operations officer combines the duties of operations, intelligence, plans, training, and gas defense. The operations officer has an assistant whose principal duty is concerned with the compilation and distribution of water supply information. The enlisted personnel for the staff sections of battalion headquarters is furnished by the headquarters and service company.

(2) The *headquarters and service company* includes the personnel for operating the various staff sections of the battalion headquarters, the supply service for the battalion and the supervision of water supply operations. It is divided into company headquarters, the headquarters platoon, and a service platoon.

(*a*) The *company headquarters* handles the administration and routine supply of the company and messing of the company and battalion headquarters. The company commander is also the battalion supply officer. He is assisted by a commissioned officer who handles the details of company headquarters, including company administration, routine supply, and company and battalion headquarters messing.

(*b*) The *headquarters platoon* is composed of an administrative section, a supply section, and an operations section. All the personnel of the platoon report to staff officers at battalion headquarters for duty.

1. The administrative section includes the clerical personnel making up the office of the battalion adjutant and operates under his direct charge. It handles the routine administration, clerical work, mimeographing, postal service, and message center.

2. The supply section provides the personnel for the operation of the battalion supply office. It operates under the direction of the battalion supply officer.

3. The operations section provides the personnel for work under the operations officer and handles plans, orders, estimates, engineer reconnaissance, and inspections of engineer work.

(*c*) The *service platoon* is composed of a platoon headquarters, a transportation section, and a purification section. It is responsible for the care, dispatch, and operation of the vehicles assigned to the headquarters and service company.

1. Platoon headquarters includes the personnel necessary for the control, dispatch, and repair of the equipment of the platoon and repairs to any equipment pertaining to the battalion for which the companies have no facilities.

2. The transportation section is charged with the operation of all vehicles assigned to the headquarters and service company except water-purification trucks. It includes the truckmaster and the chauffeurs for the vehicles.

3. The purification section is composed of 6 water-purification units.

(3) The *medical detachment* is similar in organization and duties to the medical detachment described in paragraph 69 *g*, except that the medical detachment with a water supply battalion has, in addition, a water analysis section which is charged with the analysis of the water provided for troops by the water supply battalion to determine its suitability for the use for which intended. The water analysis section consists of a headquarters and 3 field groups. Each field group is composed of 1 officer and several enlisted men.

(4) Each *company* is composed of a company headquarters, 2 transportation platoons, and 1 service platoon. Company headquarters consists of 1 officer and 19 enlisted men, organized, in general, as described in paragraph 69 *f*.

(5) Each *transportation platoon* is composed of a headquarters and 2 tank truck sections. Each tank truck section is composed of a headquarters and 3 subsections of 3 tank trucks each.

(*a*) *Platoon headquarters* has sufficient personnel to operate and care for the vehicles assigned to the platoon and to maintain the gasoline supply. A commissioned officer commands the platoon. The enlisted personnel includes a staff sergeant, platoon sergeant, who is second in command; a sergeant, platoon mechanic, who supervises repairs to the motor vehicles of the platoon and makes inspection of their mechanical condition; chauffeurs for the gas tank trucks and the light motor car; and a platoon messenger.

(*b*) The *tank truck section* is divided for purposes of control into a headquarters and 3 subsections of 3 tank trucks each. The headquarters consists of the section sergeant and the section mechanic. A subsection includes a corporal and 6 privates. One chauffeur and an assistant chauffeur are provided for each vehicle.

(6) The *service platoon* is composed of a headquarters, a tank truck section, a purification section, and an installation section. It provides personnel and equipment for the purification and pumping of water and provides an additional tank truck section to supplement the transportation platoon.

(*a*) The *platoon headquarters* includes one officer who commands the platoon and sufficient personnel to operate the vehicles assigned to the platoon headquarters and to maintain the supply of gasoline. Enlisted personnel includes a staff sergeant, platoon sergeant, who is second in command, and chauffeurs for the gas tank truck and light motor car.

(*b*) The *tank truck section* is organized like the tank truck section of the transportation platoon described in (5) above.

(*c*) The *purification section* operates one purification truck on a two-shift basis. It is supervised by a staff sergeant who is a water purification expert. The other enlisted personnel includes a chauffeur for the purification truck, an engine man for the pumping plant, and a filter operator.

(*d*) The *installation section* is divided into a headquarters and 2 installation squads. The installation squad maintains and operates the canvas basins and pumps assigned to it and cares for the motor transportation. The headquarters consists of the section sergeant. Each installation squad consists of a

corporal and 7 privates whose duties include the operation and installation of the water-supply equipment which they carry in a cargo truck.

(7) The *motor repair section* (QMC) consists of 1 officer and 35 enlisted men. A master sergeant is in immediate charge of the section. The section makes repairs to motor vehicles which are beyond the scope of the personnel and equipment of the companies.

b. Equipment.—(1) *Battalion equipment.*—Equipment other than individual is carried by the service platoon of the headquarters and service company. It includes organizational equipment and supplies used in the office of the battalion headquarters for messing and routine supply and administration of the company and battalion headquarters; for shelter; for engineer work by the headquarters and service company and for work by other companies of the battalion or by other troops. The principal equipment includes sets of standard equipment for the following kinds of work: Blacksmithing, carpenter work, canvas work, drafting, illuminating, photography, pipe fitting, sign painting, tinsmithing, sketching, and water supply. The transportation is assigned to the transportation section except the 6 purification trucks which are assigned to the purification section. It includes vehicles for control, reconnaissance, inspection, and supply. For description of the water purification truck see paragraph 57.

(2) *Company equipment.*—The company is equipped with office equipment, illuminating equipment, drafting and duplication equipment, and transportation. The latter includes a light motor car for reconnaissance and inspection, a cargo truck for transporting supplementary equipment, 2 cargo trucks for supply, a light repair truck, and a kitchen trailer.

(*a*) The *transportation platoon* is equipped with 18 water tank trucks of 500 gallons each and one gas tank truck of 750 gallons. Each vehicle is provided with unit equipment sufficient to make minor repairs on the road.

(*b*) The *service platoon* has no organizational equipment except that which goes with the installation squads. Each installation squad is equipped with carpenter tools, pipe fitting tools, and tinsmith tools. This equipment is carried in a cargo truck assigned to the installation section. The service platoon is provided with a light motor car for reconnaissance and inspection, and a gas tank truck for gasoline supply.

(3) *Motor repair section equipment.*—The motor repair section is equipped with a tractor for towing disabled vehicles, a stockroom trailer with a supply of spare parts, a portable machine shop mounted on a truck, a wrecking truck, and trucks for gasoline and other automotive supplies.

80. Depot company.—*a. Organization.*—The depot company consists of a headquarters platoon and 3 depot platoons. It is organized in general as follows:

(1) The *headquarters platoon* consists of a company headquarters section and a depot section.

(*a*) The *company headquarters section* consists of the company commander and 18 enlisted men organized in general as described in paragraph 69 *f*.

(*b*) The *depot section* of the headquarters platoon is identical in organization with the depot section of the depot platoon described below.

(2) The *depot platoon* consists of a platoon headquarters section and a depot section.

(*a*) The *platoon headquarters section* includes the platoon commander, a staff sergeant who is the platoon sergeant, a sergeant and several clerks who handle the paper work at platoon headquarters and the clerical work of the depot to which the platoon may be assigned for operations.

(*b*) The *depot section* includes a sergeant in charge of the section, a sergeant storekeeper, who is charged with the supervision over the stocks kept in the depot, 4 corporals and 27 privates, who do clerical work in connection with handling stocks, general warehousing, assembling of equipment, and general repairs to salvaged articles returned to the depot.

b. Equipment.—For purposes of messing, administration, and its own supply, the depot company is equipped in general like the company of the combat regiment. Its transportation includes a light truck for company supply and 4 cargo trucks of 1½ to 2 ton capacity for handling depot supplies and transporting depot operating equipment, and motor cycles for reconnaissance and inspection. The equipment for depot operations includes standard engineer sets of drafting and duplicating, *illuminating, tinsmith*, photographic, pipe fitting and sign painting equipment, and supplementary equipment, including the following items: A library of engineering handbooks and catalogs, nail pullers, crate openers, marking brushes, funnels, pinch and wrecking bars, marking pots, chain hoists, screw jacks, packing

needles, car movers, dollies, blocks and tackle, warehouse trucks, push cars, measures for liquids, scales, and a supply of wrapping paper, twine, and shipping tags.

81. Dump truck company.—*a. Organization.*—The dump truck company consists of a headquarters platoon and 2 transportation platoons.

(1) The *headquarters platoon* is divided into a company headquarters and a dump truck section.

(*a*) The *company headquarters* consists of 2 officers and about 23 enlisted men, organized in general as described in paragraph 69 *f*.

(*b*) The *dump truck section* of the headquarters platoon is identical in organization with the dump truck sections of the transportation platoons, as described in (2) (*b*) below.

(2) The *transportation platoon* consists of a headquarters section and 2 dump truck sections.

(*a*) The *headquarters section* consists of 1 officer, who is the platoon commander; a platoon sergeant, who assists the platoon commander; a sergeant, auto mechanic, who inspects the motor vehicles of the platoon for mechanical condition; a bugler for messenger service; a chauffeur to operate the gas tank truck; a motorcyclist to operate the platoon motor cycle; and 1 miscellaneous private for general utility.

(*b*) The *dump truck section* consists of a sergeant, truckmaster; 3 corporals who have charge of dump truck subsections of 3 trucks each; a chauffeur and 1 man for each dump truck; and 1 auto mechanic for minor repair work.

b. Equipment.—For the purposes of messing, administration, and supply, the dump truck company is equipped in general like the company of the combat regiment. The principal equipment of the dump truck company consists of the dump trucks. These are of 1½ to 2 tons capacity. Nine trucks are provided for each dump truck section; 46 for the entire company. For data as to truck tonnage see Table VI. In addition, the company is equipped with a motor car and 3 motor cycles for reconnaissance, inspection, and supervision of operations; a kitchen trailer; a water trailer; and 3 gas tank trucks of 750 gallons capacity each.

82. Light ponton company, motorized.—*a. Organization.*—The light ponton company, motorized, consists of a headquarters platoon and 3 bridge platoons organized, in general, as follows:

(1) The *headquarters platoon* consists of a company headquarters section and a service section.

(*a*) The *company headquarters section* includes the company commander and 12 enlisted men organized, in general, as described in paragraph 69 *f*.

(*b*) The *service section* is under the general supervision of the staff sergeant, who is a general mechanic. The other enlisted personnel includes a sergeant in charge of general repairs to the motor vehicles of the section; a sergeant, truckmaster; a corporal, in charge of the tool trailer; a corporal, who is assistant truckmaster; about 20 privates, who furnish the mechanics for maintenance of the bridge equipage and the motor vehicles assigned to the company; and chauffeurs for the operation of the motor vehicles assigned to the service section.

(2) The *bridge platoon* consists of a platoon headquarters, 4 ponton sections and 1 trestle section.

(*a*) The *platoon headquarters* includes the platoon commander; a staff sergeant, who is the platoon sergeant; 2 sergeants, truckmasters, who supervise the combined operations of two or more of the ponton and trestle sections; and a chauffeur for the light motor car assigned to the bridge platoon.

(*b*) Each *ponton section* includes a corporal in charge of the section, a chauffeur for each of the tractors or trucks which draw the ponton trailers, and 1 man to ride on each trailer. The ponton sections care for and transport the equipage used in the construction of the floating bays of the bridge.

(*c*) The *trestle section* consists of a corporal, truckmaster, a chauffeur for each of the tractors which draw the trestle equipage, and 1 man to ride on each trailer. The trestle section transports and cares for the equipage used in the construction of the nonfloating sections of the bridge.

b. Equipment.—For purposes of messing, administration, and supply the light ponton company is equipped in general like the company of the combat regiment. The principal equipment of the light ponton company is the ponton equipage which the company cares for and transports. It comprises ponton trailers, tool trailers, abutment trailers, and trestle trailers with their loads. In addition to the ponton equipage the company is equipped with light motor cars for reconnaissance and supervision of operations, a kitchen trailer, a

water trailer, ration and baggage trucks, and a tank truck. The tool trailers carry standard engineer equipment for making repairs to the ponton equipage and the vehicles upon which it is transported. The ration and baggage trucks transport equipment for self-maintenance of the company. The ponton equipage carried by the light ponton company is the M 1926 light ponton equipage, which is designed for carrying loads up to 7 tons. It is transported on vehicles especially designed for easy traction, which are capable of being drawn by animals, trucks, or tractors. For data as to the length of bridge which can be constructed with the equipage carried by the company see Table XIII. The ferrying capacity of each ponton is 25 men in addition to the crew. Each bridge platoon transports 12 pontons. The entire company transports 36 pontons. Other data concerning the equipage are shown in Table II.

83. Light ponton company, animal.—The light ponton company (animal) is organized in general like the light ponton company (motorized), as described in paragraph 82. It carries the same amount and kind of bridge equipage. The vehicles are drawn by animals. The personnel includes horseshoers, wagoners, etc., for handling the animal-drawn vehicles in lieu of the mechanics, chauffeurs, truckmasters, etc., of the motorized company.

84. Shop company.—*a. Organization.*—The shop company consists of a headquarters platoon, a woodworking platoon, a shop platoon, and a metal working platoon. It is organized in general as follows:

(1) The *headquarters platoon* consists of a company headquarters section, a technical section, a supply section, and a power section. It is charged with the general coordination of the work of the other platoons of the shop company.

(*a*) The *company headquarters section* is organized in general as described in paragraph 69 *f*.

(*b*) The *technical section* includes a staff sergeant, millwright foreman; a sergeant, mechanical draftsman, who makes plans and working drawings; a sergeant, instrument repairer, who repairs fine engineering instruments; a corporal who assists the mechanical draftsman in the preparation of working drawings; a corporal, painter, who has charge of painting the finished products of the shops; a corporal, upholsterer, who has charge

of any work calling for the use of fabrics; and 4 privates, who assist the noncommissioned officers with their work.

(*c*) The *supply section* includes a sergeant, storekeeper, who is in charge of the section; 2 corporals, who are qualified as clerks and handle the paper work; a private, in charge of the tool room; and 2 privates, helpers.

(*d*) The *power section* includes a staff sergeant, who is the power electrician and is in charge of the section; a sergeant, general electrician, who assists the staff sergeant in the supervision of the power installations used in the shops; a corporal who is familiar with the operation and repair of electrical machinery; and 17 privates, qualified as stationary enginemen, firemen, and operators for the electrical machinery used either at the central power station or in the several shops.

(2) The *woodworking platoon* consists of a carpenter section and a pattern making section. It operates a woodworking shop, which is under the direction of a commissioned officer.

(*a*) The *carpenter section* includes a staff sergeant, who is the foreman of the woodworking shop; a sergeant, general carpenter, who supervises assembling of wooden manufactures; 2 corporals, who are cabinet makers and work under the general carpenter; and 16 privates qualified as carpenters.

(*b*) The *pattern making section* includes a sergeant, who is a pattern maker and in charge of the section; and 4 privates, qualified as pattern makers, who assist in the making of the wooden patterns which are used in the metal working sections of the shop company.

(3) The *shop platoon* includes the personnel which operates the machine shop. It is commanded by a commissioned officer who is experienced with shop machinery. The enlisted personnel includes a staff sergeant, who is a master machinist and is foreman of the shop; 2 sergeants, machinist, and mechanic; 5 corporals, who operate special machines; and 33 privates, qualified as pipe fitters, machinists, and mechanics.

(4) The *metal working platoon* consists of a forge and foundry section and a sheet metal and welding section. It is commanded by a commissioned officer who is familiar with *general foundry* and sheet-metal practices.

(*a*) The *forge and foundry section* includes a staff sergeant, who is the foreman of the foundry; 2 sergeants, qualified in

blacksmith and foundry work; 2 corporals, who are blacksmiths and boilermakers; and 18 privates, qualified as blacksmiths, boilermakers, or foundry men.

(*b*) The *sheet metal and welding section* includes a sergeant who is familiar with welding operations; 2 corporals, of whom one is a coppersmith and one is a sheet metal worker; and 11 privates, qualified as welders, sheet metal workers, or structural iron workers.

b. Equipment.—For purposes of messing, administration, and supply the shop company is equipped in general like the company of the combat regiment. The supplementary equipment includes individual kits of specialists' equipment, such as draftsmen's, carpenter's, machinist's, pipe fitter's, and tinsmith's kits; and a limited amount of portable shop equipment such as blacksmith and welding equipment, drills, shears, etc.

85. Railway shop company.—*a. Present organization.*—The railway shop company as at present, 1931, organized is exactly the same as the maintenance of equipment company of the railway battalion. This organization was tentatively adopted to furnish a nucleus of personnel for major railway shopping operations to be expanded according to the necessities in the theater of operations where it is employed.

b. Battalion organization.—Studies of the method of expanding the railway shop company indicate that the grouping of several shop companies into one shop would be an unsatisfactory arrangement, as it would necessitate a grouping of the enlisted personnel for work under other than their own officers. An initial organization as a battalion is therefore contemplated, the battalion to consist of a headquarters and service company, a company for the repair of locomotive machinery, a company for the repair of locomotive boilers and miscellaneous repairs, and a company for car repairs. The approximate strength of the battalion will be 600 enlisted men and 18 officers. The details of interior organization are the subject of study and have not yet been fully worked out.

c. Equipment.—The equipment of the railway shop company includes organizational equipment for routine administration, supply, and self-maintenance similar to that provided for the company in the combat regiment. The shop equipment does not differ appreciably from that found in railway back shops in ordinary civilian railway practice.

86. Headquarters, engineer railway service.—*a. Organization.*—The headquarters, engineer railway service, consists of a general superintendent and his staff and an operatious section, an engineer section, an equipment section, and a supply section. It is organized in general as follows:

(1) *General superintendent and staff.*—The general superintendent commands the headquarters and the railway grand division which operates under the supervision of the headquarters. He is assisted by a lieutenant colonel, who is the chief engineer of the railway grand division; a lieutenant colonel, who is the supervisor of mechanical equipment, including motive power, rolling stock, and shops; a major, who is assistant general superintendent in charge of operations; and a major, who is general storekeeper in charge of railway supplies and spare equipment.

(2) The *operations section* is controlled by the assistant general superintendent. The enlisted personnel includes a master sergeant, who is chief clerk; a technical sergeant, who is in charge of records, car distribution and tracers; and 2 privates, qualified as clerks.

(3) The *engineer section* is directed by the chief engineer of the railway grand division. He is assisted by 3 commissioned officers, of whom one is chief engineer of structures, including bridges and buildings, clearances, and weight limits; one is signal engineer in charge of signals, interlocking towers, and communication; and one is the supervisor of water service. The enlisted personnel includes a master sergeant, who is a railroad draftsman; 3 technical sergeants, who are signal and tower inspector, bridge inspector, and topographer; 1 staff sergeant, who is a railroad draftsman; and 3 privates, qualified as clerks.

(4) The *equipment section* is directed by the mechanical supervisor. He is assisted by 1 commissioned officer, who is a mechanical engineer. The enlisted personnel includes a technical sergeant, who is a mechanical draftsman; and 3 privates, qualified as clerks.

(5) The *supply section* is directed by the general storekeeper. He is assisted by 1 commissioned officer, who is the fuel agent for the railway grand division. The enlisted personnel includes 1 master sergeant, who is chief storekeeper; 1 staff sergeant, who is assistant storekeeper; and 9 privates, qualified as chauf-

feurs, clerks, cooks, motorcyclists, or messengers. The latter personnel furnish the operators for the motor vehicles assigned to the headquarters.

b. Armament.—All personnel of the headquarters engineer railway service is armed with the pistol.

c. Equipment.—The equipment of the headquarters engineer railway service includes office and drafting equipment and transportation used by the personnel in making visits of inspection throughout the territory of the railway grand division.

CHAPTER 3

ENGINEER TRAINING

SECTION I

GENERAL PRINCIPLES

87. Basic considerations.—*a.* All engineer soldiers are given the basic military training prescribed for the individual soldier.

b. The procedure in the technical training of engineers is first to train the individual to execute the duties pertaining to his assigned position in the organization and then to train the groups of individuals to execute combined tasks under their appropriate commanders.

c. Command training is important. The noncommissioned officers must know how to keep the privates employed, preferably upon the execution of a combined task. The officer must know how to plan and estimate work and how to divide work among the subordinate units and commands so as to commence an assigned mission promptly and execute it rapidly.

d. The amount of time to be allotted to various classes of training depends upon the amount of time available and the rapidity with which results are obtained. Results obtained from training and not hours consumed in training are important. In peace time training, men may be trained to fill a number of positions in the organization. In mobilization training, time will rarely permit the training of the individual to fill other than his specific position in the organization.

e. In order to emphasize smartness, precision, attention, and discipline, close-order formations and drills are prescribed for engineer units. In general such drills follow the principles laid down for infantry drill.

f. In combat training, engineer units are employed in the normal engineer organization and are not reorganized into provisional infantry organizations.

88. Classes of training.—Engineer units undertake the following classes of training: Disciplinary training, physical training, combat training, and technical training. The purpose of disciplinary training is to develop the habit of obedience, to promote teamwork within the organization, and to develop morale and leadership. The purpose of physical training is to develop the physique of the soldier. It includes competitive games as well as calisthenic drills. The purpose of combat training is to prepare for participation in combat and for providing security when on the march or while employed on engineer work. Technical training embraces all training undertaken for the purpose of qualifying individuals and units in the performance of duties relating to the special classes of engineer work for which the units are organized.

89. General engineer troops.—General engineer troops are trained in—

a. The engineer needs of the other arms.

b. Engineer supply.

c. Construction.

d. Engineer reconnaissance.

e. Operation of utilities in the theater of operations for which special troops of engineers or other arms are not provided.

f. Combat principles applicable to their armament and organization.

g. Obstacles, demolitions, military mining, defensive positions, and floating bridges.

90. Special engineer troops.—Special engineer troops are trained in their respective specialties, including mapping and map reproduction, operation of military railways, water supply transport, camouflage, engineer shops, engineer depots, transportation of ponton bridge equipage, and special operations for which the need is so great as to require special troops to be organized.

91. Responsibility.—Supervision, coordination, control of and responsibility for the training of any command, including production of the necessary specialists, are vested in the commander thereof. His staff assists in these activities in an advisory capacity only. It is his duty to prepare programs of training for his own unit based upon War Department orders, the training directives of his tactical superiors, and the present stage of training of the unit for which the program or schedule is intended. Inspection is a function of command and inspec-

tions are frequently made by commanders of every grade and their staff officers to satisfy themselves that programs are being followed and that approved doctrines, principles, and methods are being used, and to test proficiency.

SECTION II

SCOPE OF TRAINING

92. Individuals.—*a. Individual soldier.*—The individual engineer soldier is trained—

(1) In the basic military subjects: Military courtesy, customs and regulations, wearing of the uniform, discipline, guard duty, first aid, hygiene, gas defense, tent pitching, the infantry pack, and the Articles of War.

(2) In the use of the weapons with which he is armed.

(3) In the use of the tools with which he is equipped.

(4) To perform the particular duty to which he is assigned.

(5) To execute the movements of close order and extended order.

(6) In combat principles, so as to take his place in combat.

(7) In scouting and patrolling, so as to take his place in the security and reconnaissance patrol.

(8) If a technical specialist, in his specialty, so as to estimate the time and materials required for a definite task and to execute a task including the supervision of men assigned to him as helpers.

(9) If mounted or in an animal-drawn unit, in animal management and equitation.

b. Noncommissioned officer.—The noncommissioned officer is trained to perform the duties of his position in the organization. The conditions under which engineer work must be done in the field are such that the noncommissioned officer has to perform much of his work not under the immediate observation of an officer. Hence, the most important training of the noncommissioned officer is that of command. This means that he must be trained to take charge of a detachment and to execute an assigned engineer task in all its details. The noncommissioned officer must accordingly be given responsibility, be called upon for results, be left to work out the details of his work, be encouraged to use his initiative, and be trained to work under the supervision rather than under the constant direction of an officer.

c. Commissioned officer.—The commissioned officer is trained to the habit of command; in the means and methods employed in the execution of work; to utilize existing subordinate units under their leaders for the execution of work; to supervise work, seeing that tasks are properly executed, that correct methods are used, and that the supply of materials is maintained; in planning for the various conditions under which he may have to operate.

93. General engineer units.—*a. Squad.*—While the squad is not a basic engineer work unit, it is nevertheless desirable wherever practicable to have the members of a squad trained under the leadership of their own corporal. The squad leader is a working member of the squad. The training of the squad includes its use as a combat or reconnaissance patrol.

b. Platoon.—The platoon is trained in—

(1) Engineer operations so as to permit a rapid and orderly organization for and execution of engineer tasks.

(2) The mechanics of extended order.

(3) Combat principles applicable to engineer troops.

(4) Close-order drill without the tool section for discipline and precision, and preparatory for drill with transportation.

(5) Close-order drill with the tool section for participation in marches, reviews, and ceremonies as engineers.

c. Company.—(1) The individuals pertaining to company headquarters are trained to perform the duties of various headquarters groups to which they are assigned, such as administration, messing, stables, supply, and transport. Certain individuals are trained in the use of special engineer equipment. The training of the company headquarters consists in the actual operation of the machinery for administration and supply, and for special engineer operations is best accomplished by employing the company upon a definite engineer task within the limits of its personnel and equipment, and capable of being executed by division into platoon tasks. The company must be trained in engineer operations so as to permit a rapid and orderly organization for and execution of engineer work.

(2) The company is trained in close-order drill for discipline and preparation and for participation in reviews and ceremonies as engineers.

(3) The company is trained in combat principles applicable to the engineer company.

(4) The specialists having once qualified as such receive ample training in the execution of the normal work that falls to an engineer company. With the limited personnel and the rather extensive variety of equipment and the frequent use of the company upon detached work, it is necessary to qualify men in more than one specialty, and it is to be expected that most of the sergeants should be able to use any of the equipment for ordinary work, and to instruct others in the use of the equipment.

d. Battalion.—(1) Battalion headquarters is trained in the mechanics of issuing orders; in the planning of battalion operations; in the proper distribution of work to companies; in the handling of the company transportation, and in inspection of the execution of engineer work.

(2) The battalion is trained in engineer operations, in combat principles applicable to the engineer battalion, and in such close-order drill as may be necessary to enable it to take part in ceremonies as an engineer unit.

e. Squadron.—Engineer squadrons are trained to operate with the cavalry division. In addition to the training prescribed for other general engineer units, their training includes mounted drills for the mounted troop, army engineer reconnaissance, and the general principles of the tactics and technique of cavalry.

f. Regiment.—(1) Regimental headquarters is trained in the mechanics of issuing orders; in engineer reconnaissance; in the planning of regimental operations; in the handling of battalions and attached units; in the inspection of engineer work; and in the engineer needs of troops of other arms.

(2) *Methods of training.*—While special subjects may be taught by regimental schools under specialized instructors, it is important that as soon as possible all individuals receive training in performing their normal duties in the regiment under the supervision of their immediate commanders. A smooth-working team rather than an aggregation of highly specialized individuals is desired. Current routine work and all regimental exercises should be carried on through the chain of command and wherever possible through the medium of field orders.

(3) *Training for special work.*—If the operations require a large amount of special work, additional training must be prescribed in order to meet the situation. The regiment is organized for general engineer work and can not be expected to act as a special engineer unit without special training.

g. Subdivision of training time.—The following suggested subdivision of available training time indicates the relative importance of the various subjects in which training should be given in order to develop well-rounded general engineer units. The percentages of time shown are approximate only and should be considered merely as a guide.

	Percentage of training time
(1) *Individual training.*—(*a*) *Basic instruction of the soldier* includes instruction of the soldier dismounted with and without arms; bayonet training; gas defense; scouting and patrolling; sketching; map reading and reconnaissance; and for mounted soldiers, equitation and animal management	5
(*b*) *Physical training* includes setting-up exercises, competitive games, matches, etc	3
(*c*) *Marksmanship* includes preliminary preparation for marksmanship; target practice (rifle, pistol, and automatic rifle, and for squadrons, machine rifle)	8
(*d*) *Duties and responsibilities of the soldier* include hygiene and first aid, Articles of War, military courtesies, customs of the service, regulations and orders	2
(*e*) *Individual equipment* includes the care and use of arms and personal equipment; display of equipment; tent pitching	1
(*f*) *Military engineering* includes the use of common engineer tools; knots and lashings; and for specialists, their special duties and use of special engineer equipment	7
Total percentage of available time devoted to individual training	26
(2) *Group training.*—(*a*) *Drill* includes close-order drill and extended-order drill; for mounted troops, close-order drill mounted and dismounted; ceremonies	14
(*b*) *Combat principles* include musketry; employment in combat as riflemen dismounted; defense against aircraft and chemical attack	11
(*c*) *Military field exercises* include marching; security measures; camp and bivouac	6

	Percentage of training time
(*d*) *Engineer drill* includes wire entanglements; footbridges and ponton bridges; issue of tools; deployment for intrenching	12
(*e*) *Engineering technique* includes rigging, framing, revetting; and operation of machinery	11
(*f*) *Engineering operations* include roads; footbridges; ponton bridges and ferrying; fixed bridges and bridge expedients; explosives and demolitions and obstacles; field fortifications; camouflage and concealment; water supply; mapping and reconnaissance; construction; military mining	15
(*g*) *Inspections and tests*	5
Total percentage of available time devoted to group training	74
Total percentage	100

94. Special engineer units.—The training of the special engineer units covers the subjects outlined above for general engineer units where applicable, with the obvious modifications due to differences in organization, mission, and equipment. In addition, special engineer units are given training in the subjects outlined below.

a. Ponton bridge units are trained in the care and operation of transportation, in the nomenclature and use of the special equipment assigned to the units, in the technique of bridge construction, in the handling of traffic on floating bridges, and in the dismantling of the bridges.

b. Water supply battalions are trained in the operation and care of the motor vehicles and special machinery assigned to the unit, in the handling of motor convoys, in the exploitation of water resources, including the installation of temporary water points, and in the principles and technique of water purification.

c. Depot companies are trained in the methods of storage of all classes of engineer equipment and supplies, in the standard engineer equipment of troop units, in the classes of material and equipment needed for engineer work, and in the paper work involved in the receipt, storage, and issue of engineer equipment and supplies.

d. Map reproduction units are trained in the principles of all processes used in the reproduction of military maps, in printing,

in the operation and care of the presses and other special machinery assigned to the unit, in mechanical and topographical drafting, including the rapid production of military maps from aerial photographs, in the mounting of maps, in the fabrication of relief maps, in the keeping of filing systems, for map stocks, and in the nomenclature and stocking of chemicals, inks, and paper.

e. Railway battalions are trained in railway work, to execute rapidly and in orderly fashion the engineer work which may be assigned to them in the maintenance and operation of railways, in the care and use of tools assigned to the units, in the rules and regulations governing safety and train movements. Training emphasis is placed upon the development of specialists qualified to perform the work and operate the machines of the unit. This type of training must be continuous, and is carried on by the apprentice system used on civil railways. This training should not interfere with the maintenance and operations of the railway.

f. Camouflage units are trained in the principles and practice of camouflaged technique; in the construction and erection of special devices used in camouflage operations and the manufacture of camouflage materials; in the rules of camouflage discipline for troops of all arms and the means of teaching and enforcing it; in the interpretation of aerial photographs with special attention to the effect of camouflage on visibility from the air and the detection of camouflaged enemy activities; in the care and use of tools used in camouflage operations; in the selection of positions for installations of all kinds with a view to the maximum protection from enemy observation and detection; and in the principles of supply of camouflage materials to units of all arms. In view of the special nature of the activities of members of camouflage units, attention must be paid in training to the necessity for close cooperation with units of other arms.

g. Dump truck companies are trained in the operation and care of motor vehicles, in the delivery of material to working parties, and in the handling of motor convoys.

h. Topographic units are trained in the care and use of surveying instruments, in the methods of making terrestrial surveys, in the use of aerial photographs in mapping, in topographical drafting, in the preparation of guide and reconnaissance

maps, and in the correction of existing maps executed so as to be completed in time to be of use to the troops in the advance; and in map reproduction.

i. Shop companies, railway shop companies, and other special units.—From the nature of the work on which these units are employed, it is essential that the personnel be recruited from men trained in civil life to do the work expected of them in the Army. It is impossible to give special training in mobilization camps where the equipment they use is lacking. However, during actual military operations, the unit commanders should constantly train additional personnel in all essential tasks utilizing the apprentice system to the end that casualties due to sickness will not cripple the work of their units and that ready expansion can be made to meet military emergencies.

CHAPTER 4

DRILLS, CEREMONIES, AND INSPECTIONS

SECTION I

GENERAL PRINCIPLES

95. Purpose.—*a. Close-order drill.*—Close-order drill is utilized for disciplinary purposes, to prepare for participation in ceremonies, and to develop efficient engineer work units by giving mobility and cohesion. Disciplinary drills for engineer troops are not usually executed by echelons higher than the 4-squad platoon or the 4-squad operating section. Drills for higher echelons are confined to such movements and maneuvers as may be necessary to execute ceremonies and to pass in review.

b. Extended-order drill.—Extended-order drill is executed only by the 4-squad platoon or the 4-squad operating section. It prepares the unit to take part in combat exercises and aids in developing an efficient basic work unit.

c. Ceremonies.—In ceremonies, reviews, and parades engineer troops are formed and maneuvered as engineer units in accordance with their normal organization, each subordinate fraction being commanded by its own leader. Participation in ceremonies gives mobility and cohesion, increases morale, and permits the display of the personnel, organization, and transportation of the units.

d. Inspections.—Formal inspection is utilized to make a careful examination of the personnel, equipment, and transportation. It is usually conducted by platoon or company, and always includes an inspection of the engineer equipment. Tactical inspections are used to test the engineer efficiency of the unit and

consist in employing the unit upon a tactical engineer mission suitable for the unit and its equipment.

e. Engineer drills.—Engineer drills are utilized in training the individual to use special tools and equipment and in training groups of individuals to execute definite engineer tasks under the command and supervision of the noncommissioned and commissioned commanders.

f. General.—The primary purpose of drills for engineers is to develop efficient work units in all classes of engineer troops and to familiarize all concerned with the organization, personnel, transportation, and equipment of the engineer troop units employed in war.

96. Formations.—The formations used by engineer troops are, in general, similar to those used by dismounted and mounted organizations of the other arms. (See Basic Field Manual, Vol. II (Infantry Drill Regulations), and Cavalry Field Manual.*) As a basic principle, the formations used by engineer troops are such as to display the units in the various echelons and subdivisions that make up their organization, with emphasis upon the basic work units. As personnel, organization, and transportation differ in each type of engineer troop unit, each unit must have its own formations.

a. Dismounted assembly.—(1) This formation is used on the company parade for reveille, retreat, and roll call. It is not a drill formation, but is habitually used for inspections without transportation. It follows the general principles prescribed for the headquarters company in the infantry. The essential feature of this formation is that it displays the company in its operating echelons and enables the company commander to verify at once the exact strength of each small echelon. It serves to train the men to operate under their immediate leaders.

(2) In companies of the battalions, the company headquarters forms as a separate unit at platoon interval to the right of the right platoon. The guidon, if present, marks the right element. If the company headquarters is large and divided into several sections, each section forms separately with section interval between sections. If the platoon is large and composed

* Pending publication of Basic Field Manual, Volume II (Infantry Drill Regulations), and the Cavalry Field Manual, the appropriate Training Regulations listed in TR 1–10 should be used.

of several sections, its sections are formed separately with section interval between sections.

(3) The headquarters and service company forms in a similar manner with company headquarters on the right at platoon interval. Each platoon forms by its sections at section interval with the platoon headquarters on the right. The usual method of forming the individual section is section leader 3 paces in front, the senior noncommissioned officer on the right of the front rank, the next senior on the left of the front rank, and the other men in order of rank from right to left and front to rear.

b. Mounted assembly.—This is the formation taken by the company with transportation. The company is usually assembled dismounted, and verified and then directed to assemble mounted. Company headquarters personnel not with transportation is distributed among the platoons of the company. Dismounted personnel forms on the company parade. Transportation forms at some designated place off of the company parade. Special formations are required for headquarters and service companies having much transportation and for companies consisting entirely of vehicles. For drills and ceremonies, as many men as possible are mounted upon vehicles, and somewhat as follows: Five men in each motor car, 2 in each motor cycle with side car, 2 on each animal-drawn wagon, 4 on each truck, and 2 on each trailer.

c. Transportation.—The platoon tool vehicle follows in rear of the center of its platoon. The vehicles of the company and of the headquarters and service company are grouped into sections or subsections of from 2 to 4 vehicles (usually 3). Such a section or subsection occupies a frontage of 15½ paces in line. There are 6 paces between vehicles in column. Sections may be made up according to assignment of vehicles or according to type of vehicle. Motor and animal-drawn vehicles are not placed in the same section. Transportation sections may be combined into larger units, such as transportation platoons, companies, and battalions. They are formed in one or more lines in rear of the companies, with animal-drawn vehicles on the right or in the first line. Each transportation section of 3 vehicles is in rear of one of the platoons. When the platoons are in column of squads the transportation sections are in column of vehicles; otherwise they are in line.

Transportation passes in review in column of sections unless the troops pass in review in column of squads.

The platoon tool vehicles accompany their platoons in the pass in review. The other transportation may be consolidated by company, battalion, or regiment, and pass in review as a transportation unit in the following order: Mounted men, pack transport, animal-drawn vehicles, motor vehicles. If inspection follows the review, transportation rejoins its company.

d. Route march is the usual formation taken for movements in the field. Individuals of company headquarters not on a detached mission or accompanying transportation march as directed by the company commander, usually in column of fours at the head of the company. Men are assigned to places on all vehicles, but the disposition varies with the situation and with the type of unit. Similar disposition is made of the personnel of the headquarters and service company, those not accompanying vehicles or on a detached mission marching at the head of the column or as may be directed by the unit commander.

e. Drill formations.—The normal formation for drill is the mounted assembly. Company transportation drills independently of the other elements of the company. The normal drill formation of the dismounted elements is that of a 4-squad infantry rifle platoon formed from the basic work unit. In some organizations, such as the companies of the railway battalion and medical detachments, the basic work units do not fit this drill formation and a special drill formation is prescribed which is merely a 3 or 4 squad platoon made up, as far as possible, from the basic work unit of the organization.

97. Reviews and ceremonies.—The usual formations at review and ceremonies are with the companies in line or in column of platoons. For inspection, the usual formation is with companies in line. The pass in review is usually in column of 4-squad platoons or 4-squad sections. Units form for review as may be directed by the unit commander. For echelons above the platoon special directions must be given for the formation of the transportation.

98. General rules.—*a. Close-order drill.*—The general rules for dismounted and infantry drill apply to dismounted engineer units with certain minor changes in personnel, distances, and intervals. See Basic Field Manual, Volume II (Infantry *Drill Regulations*).

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(1) The squad is drilled as an infantry rifle squad.

(2) The platoon is drilled as an infantry rifle platoon of 4 squads.

(3) The company is drilled as an infantry rifle company with such modifications as may be necessary on account of the presence of the tool vehicles with the platoons. Movements are confined to those necessary for forming for ceremonies, street parades, and reviews.

(4) The battalion is drilled, in general, as an infantry battalion with such modifications as may be necessary due to the different organization of the companies and the presence of transportation with the companies and platoons. The battalion does not engage in prescribed drills.

(5) The band or the field music drills as prescribed in TR 130–10.

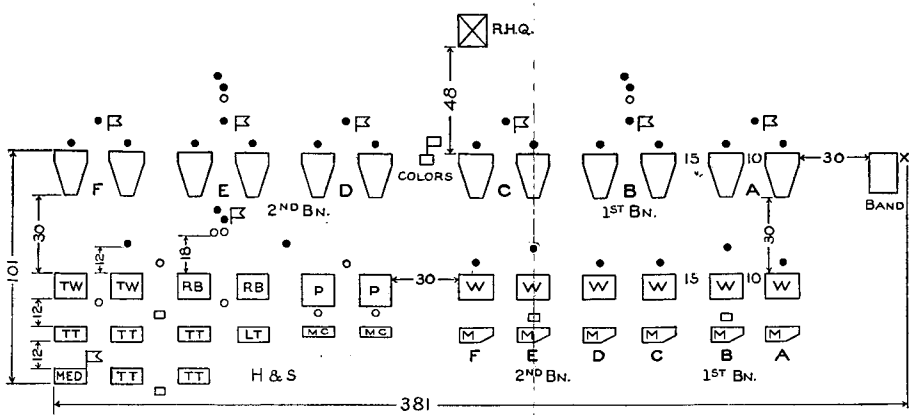
(6) The personnel of the headquarters and service company is employed in carrying on administration, special technical operations, and the supply of the battalion or regiment. The company as a unit does not engage in prescribed drills. The members of its personnel, being specialists, receive their principal instruction and training in the practical application of their respective duties as prescribed in Training Regulations and Training Manuals for their specialties. In addition to this instruction, short drills are conducted for the purpose of developing physique, discipline, marksmanship, equitation, and skill in driving and handling transportation.

(7) The regiment does not engage in prescribed drills. It may be drilled, however, in forming for ceremonies, street parades, and reviews.

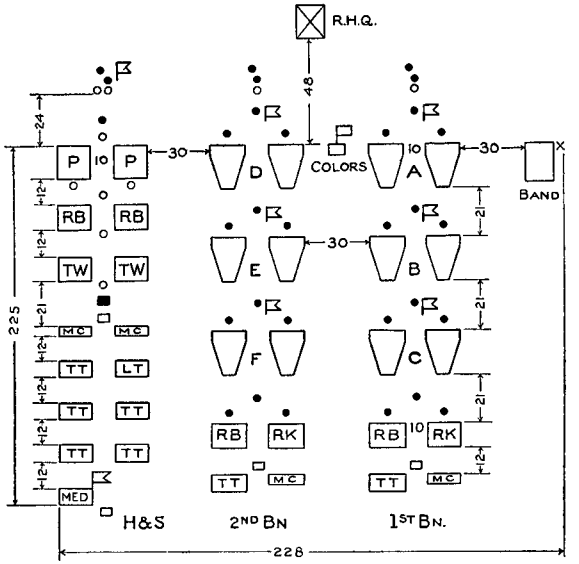
(8) When engineer units engage in drills without transportation, the usual infantry rules apply except that companies are made up of 4-squad platoons and the engineer organization of the unit is retained.

(9) The general rules of mounted and cavalry drill as prescribed in the Cavalry Field Manual apply to the mounted troop of the squadron and to mounted sections and detachments. In the squadron a tool section accompanies each platoon, following *in rear*. *Troop* transportation accompanies the troop and the headquarters and service troop.

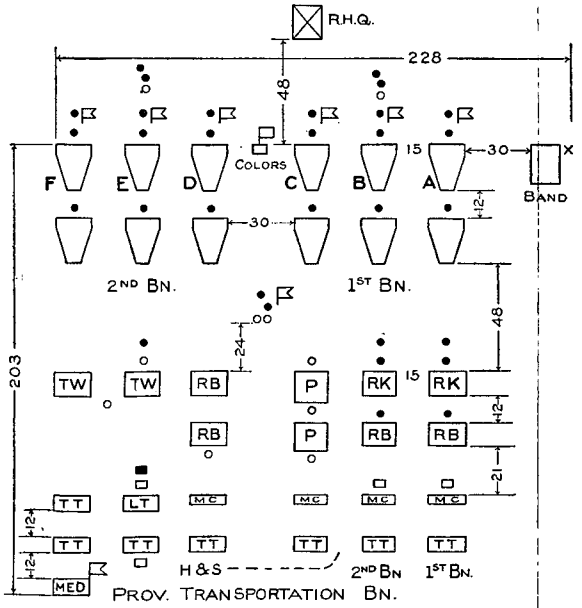
(10) Motorized elements of all engineer units drill with transportation formed in sections or subsections of 3 vehicles each.



① LINE- TRANSPORTATION OF EACH BATTALION CONSOLIDATED BY COMPANY SECTIONS



② LINE- BATTALIONS IN COLUMNS OF COMPANIES-TRANSPORTATION OF EACH BATTALION CONSOLIDATED BY TYPE



③ LINE- BATTALIONS IN LINE OF COMPANIES IN COLUMNS OF PLATOONS TRANSPORTATION CONSOLIDATED INTO TRANSPORTATION BATTALION

- • BATTALION OR COMPANY OFFICER MOUNTED.
- X WARRANT OFFICER.
- o ENLISTED MAN MOUNTED.
- ■ OFFICER IN MOTOR CAR.
- □ N.C.O. IN SIDE CAR.
- ⚑ GUIDON.

TRANSPORTATION SECTIONS OR SUB-SECTIONS.

W	COMPANY WAGON.	TW	TOOL WAGON.
M	COMPANY MOTOR.	TT	TOOL TRUCK.
RK	BATTALION ROLLING KITCHEN.	LT	LIGHT TRUCK.
RB	RATION & BAGGAGE WAGON.	MC	MOTORCYCLE.
P	PACK	MED	MEDICAL.

DISTANCES AND INTERVALS ARE IN PACES.

95773°—32 (Face page 125)

FIGURE 1.—Combat regiment—Regimental formations with transportation

The commands and movements are in general as prescribed in paragraph 103 for the elements of the water supply battalion.

(11) Medical detachments drill in accordance with the general principles prescribed in TR 405–40.

b. Extended-order drill.—This is executed in general as prescribed for infantry. Units of the engineer squadron drill in extended order and to fight on foot. They do not execute drill with a view to mounted combat.

c. Inspections are executed in general accordance with the rules prescribed for mounted and dismounted troops. The inspection without transportation is executed from the dismounted assembly. The inspection is normally executed by company with transportation. Tools are laid out for inspection. Platoon commanders open ranks and close ranks and give orders to lay out and load tools.

d. Engineer drill.—In general, engineer operations are not fettered with formal drill regulations. Such methods of procedure as may be described in regulations are modified to suit conditions. Most of the tasks given an engineer unit present unique problems that must be solved on the ground by the unit commander, using the men, equipment, and materials available, and can rarely be accomplished by following formal drill. However, certain engineer tasks executed with standard equipment are susceptible of prescribed drill. Some of these are the erection of wire entanglements, the construction of ponton bridges, deployment on work, and the unloading and loading of tools. When a unit is employed upon a task that involves a repetition of a number of identical operations, systematized organization may result in what closely approximates a formal drill.

SECTION II

CLOSE-ORDER DRILL

99. Combat regiment.—*a. Regimental staff.*—For all formations except route march the regimental headquarters is augmented by medical officers and mounted enlisted men from the mounted section and the medical detachment. The officers form in line 3 paces to the rear and with the right 1 pace to the right of the regimental commander. The order from right to left is lieutenant colonel, adjutant, other engineer officers in order of grade, medical officers in order of grade, and chaplain.

Mounted enlisted men in order of grade form 3 paces in rear of the regimental staff.

b. Band.—The band forms 30 paces to the right of the battalion in line or 48 paces to the front of the leading battalion in column. In column of squads it takes its place as directed by the regimental commander.

c. Headquarters and service company.—(1) The supply officer commands the transportation which is formed as a provisional battalion with the senior lieutenant acting as adjutant. The other lieutenants command provisional platoons or companies.

(2) Mounted enlisted men not utilized with regimental headquarters or the transportation sections form 3 paces in rear of the acting adjutant.

(3) The colors accompany the left or rear company of the right or leading battalion. Their position in line is in the interval between the battalions.

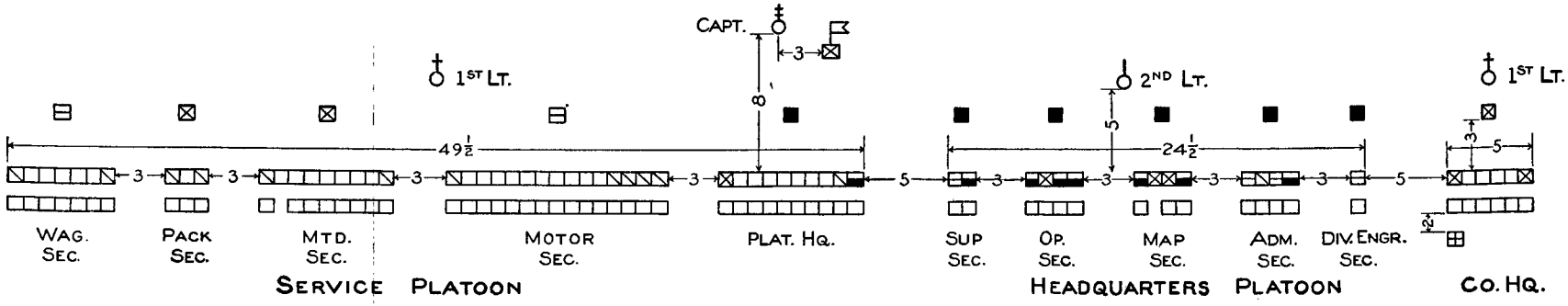
(4) The transportation is disposed in rear or to the left of the battalion as may be directed by the regimental commander.

d. Medical detachment.—In ceremonies the mounted personnel joins the regimental staff. The dismounted personnel not mounted on vehicles is attached to the headquarters and service company. The transportation forms as the left or rear subsection of the headquarters and service company transportation unit. The guidon is carried in the side car. In dismounted ceremonies the detachment forms in drill formation as the left or rear company of the left or rear battalion under command of the assistant surgeon.

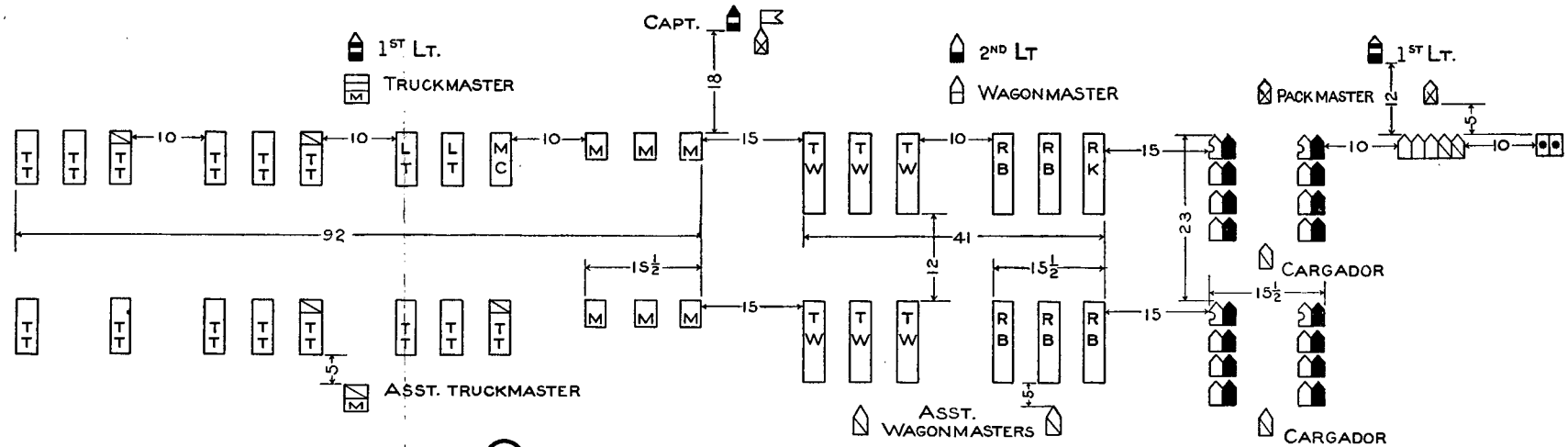
e. Regimental and headquarters and service company formations.—See Figure 3.

f. Battalion.—(1) The usual formations of the battalion are line for ceremonies; column of squads for movements to and from ceremonies; and route column for movements in the field. Formations used in ceremonies are shown in Figure 4. In column of squads the distances are as follows: Between rear of battalion staff and leading captain, 9 paces, and between rear of a company and captain of following company, 6 paces. Route column is as prescribed by the battalion commander.

(2) The company wagon sections and motor sections are normally formed in rear of their companies, with the battalion motor cycle and side car with the motor section of the right or leading company.



① DISMOUNTED ASSEMBLY—LINE—ALL MEN PRESENT.



② MOUNTED ASSEMBLY—LINE—ALL MEN PRESENT.

■ MASTER SERGEANT. ▣ SERGEANT.
▬ TECHNICAL SERGEANT. ▧ CORPORAL.
⊞ FIRST SERGEANT ▭ PRIVATE.
⊟ STAFF SERGEANT. ⬯ MOUNT.

◙ BUGLER BICYCLIST. RK ROLLING KITCHEN. TW TOOL WAGON.
⚲ PACKER. MC MOTOR CAR. RB R&B WAGON.
⬮ PACK. TT TOOL TRUCK. LT LIGHT TRUCK.
M MOTORCYCLE WITH SIDE CAR.

MEN NOT SHOWN ARE MOUNTED ON VEHICLES.
DISTANCES AND INTERVALS ARE IN PACES.

FIGURE 3.—Combat regiment—Assembly formations, headquarters and service company

(3) When directed by the battalion commander, these vehicles may be consolidated by type into provisional sections and

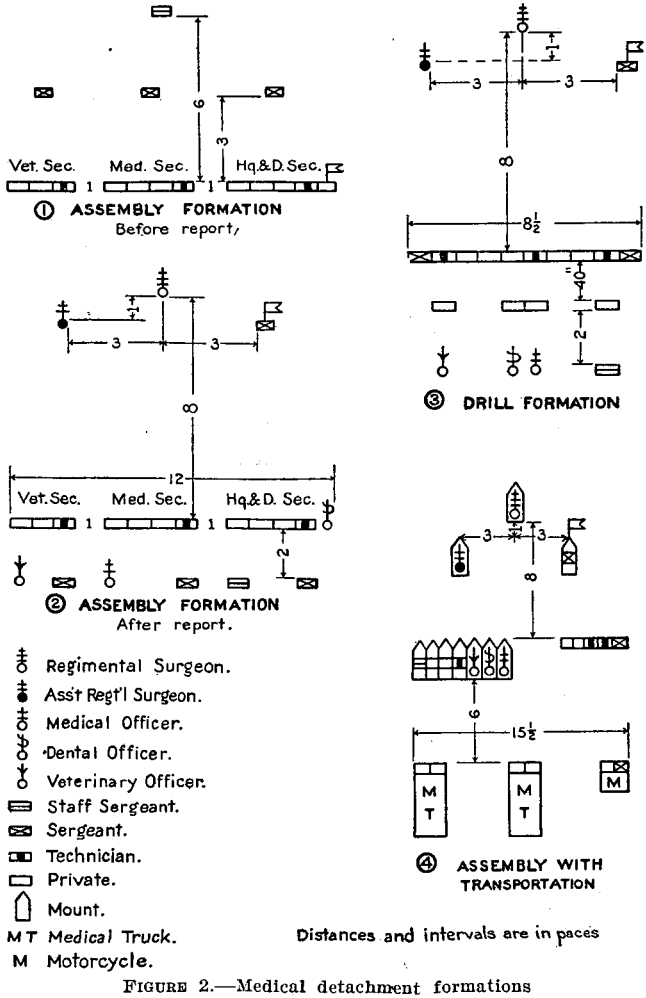


FIGURE 2.—Medical detachment formations

formed in one or two lines behind the companies with animal-drawn vehicles on the right or in the first line. Provisional

sections form on the frontage of the platoon in line. The sections in order from right to left are rolling kitchen section, ration and baggage wagon section, motor cycle section, and tool

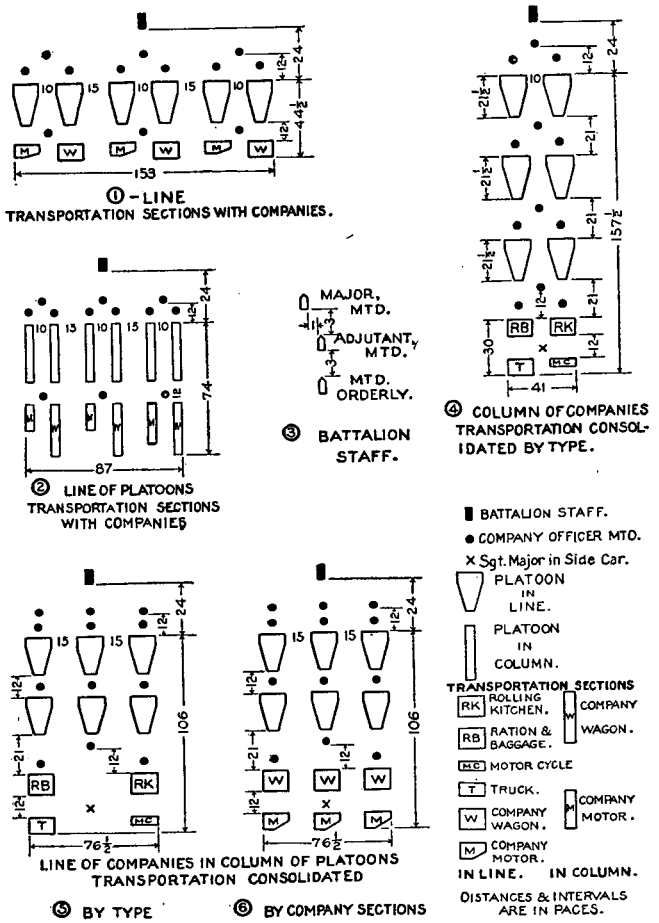


FIGURE 4.—Combat regiment—Battalion formations

truck section. The senior second lieutenant commands this provisional transportation company. A lieutenant or the sergeant

major in the side car may command the consolidated motor vehicles.

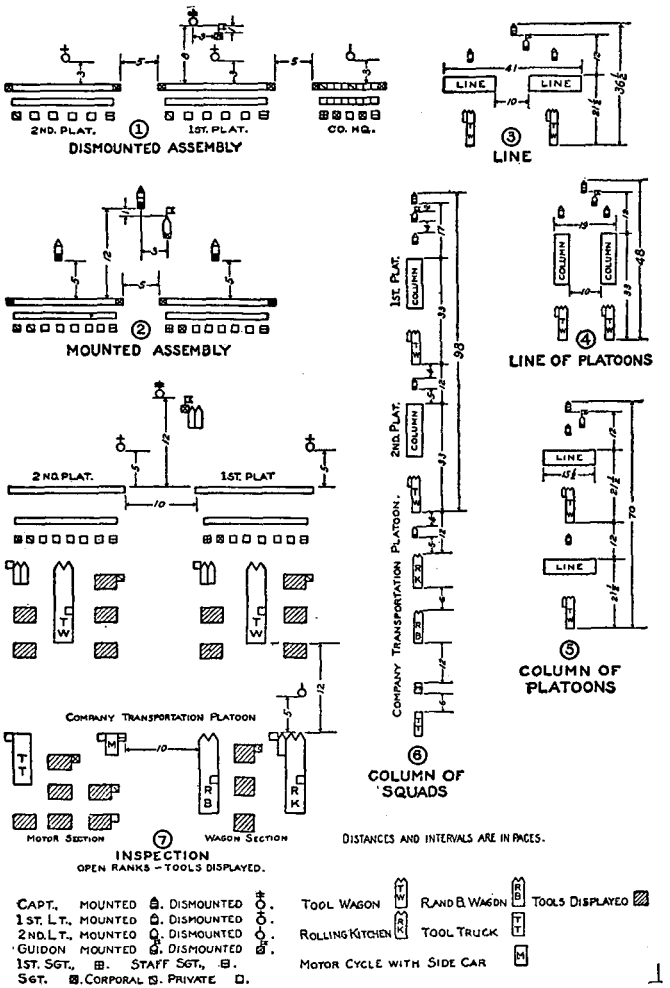


FIGURE 5.—Combat regiment—Company formations

(4) Transportation passes in review by sections. All vehicles join companies for the inspection of tools and equipment. Com-

pany and combined transportation when present at formations conforms to the movements executed by the companies. Battalion drill is usually executed without the company wagon and motor sections, these being generally drilled separately.

(5) *Battalion staff.*—(*a*) The battalion commander supervises the formation from such positions as will best enable him to correct alignments and distances. He takes post in time to receive the report of the battalion adjutant.

(*b*) The battalion adjutant takes post 1 pace to the right and 3 paces to the rear of the battalion commander.

(*c*) The battalion sergeant major carries the color at ceremonies. When the color is not carried or when the regimental color sergeants are present, the battalion sergeant major rides in the side car of the battalion motor cycle and may command the consolidated motor vehicles.

(*d*) The motorcyclist with motor cycle when not used to transport the commander of the motor vehicles takes post either in the center of the motor section of the right or leading company or on the right of the provisional motor cycle section when motor cycles are consolidated into one section.

(*e*) The mounted orderly takes post 3 paces in rear of the adjutant.

(*f*) Attached medical or other mounted staff officers and mounted enlisted men if present at ceremonies take post in order of grade from right to left on the left of the adjutant and mounted orderly, respectively.

g. Company.—(1) The formations of the company are dismounted assembly, column of platoons, column of squads, and route march.

(*a*) Mounted assembly is the formation used on the company parade preparatory to drill and ceremonies. The transportation under command of the second lieutenant joins the company outside of the company parade as directed by the company commander.

(*b*) Line, line of platoons, column of platoons, and column of squads are the formations in which the company appears in ceremonies and reviews. Except column of squads, these formations are close-column and close-line formations and movements therefrom are usually executed successively by platoons. Column of platoons is the formation generally employed in street

parades and in the pass in review. Line and column of platoons are the formations used for inspection.

(*c*) Route march is the formation taken by the company for field marches. File closers march at the head and rear of their platoons or company, and necessary personnel accompany the company transportation.

(2) *Company headquarters.*—(*a*) Except in the dismounted assembly and in the route march, company headquarters does not appear as a separate unit, as its personnel is distributed among the platoons and the company transportation sections.

(*b*) In dismounted assembly, company headquarters forms on the right of the company as a 2-squad platoon commanded by the second lieutenant. Sergeants are guides and file closers. The first sergeant's post, after reporting, is in the file closers in rear of No. 4 of the left squad. The staff sergeant's post, after the command *posts,* is in the file closers in rear of No. 1 of the right squad. If the guidon is directed to be present, the stable sergeant carrying the guidon takes post on the right of the right guide of company headquarters. He joins the captain when the first sergeant reports unless otherwise directed.

(*c*) For company drill and ceremonies only such men of company headquarters are normally used as will fill the vacant files in the platoons, make up 8 file closers for each platoon, and occupy seats on the company vehicles. In the event of there being more than 8 men in the file closers of either platoons, these men form an extra rank at the tail of the platoon when in column of squads. The second lieutenant, if present without the company transportation, takes post 1 pace to the rear and 3 paces to the left of the captain. The guidon at mounted assembly takes post on the line 5 paces to the right of the right guide of the right platoon. When the first sergeant reports, the guidon takes post 1 pace to the rear and 3 paces to the right of the captain. The first sergeant's post, after reporting, is in the file closers in rear of No. 4 of the left squad of the right platoon.

(3) *Company transportation platoon.*—(*a*) This platoon is commanded by the second lieutenant. It consists of a wagon section and a motor section. It is generally maneuvered by sections. It joins the company for inspection after the pass in review. Its formations are line (10 paces between sections) and column (12 paces between sections). When formed with

the company, it is 12 paces to the rear of the platoon tool wagons. The wagon section is the leading or right section. When the company is in line, the wagon section is in rear of the left platoon. The platoon conforms to the movements executed by the company. The company may pass in review with the company transportation following as a unit. Usually, in regimental and battalion ceremonies, the company transportation platoon is consolidated into one group with similar sections of the regiment or battalion or is formed with the company, and for the pass in review is consolidated with similar sections of the regiment or the battalion. In the route march, the position varies with the conditions of the march and the engineer work required during and after the march.

(*b*) The wagon section consists of the rolling kitchen and the ration and baggage wagon. The second lieutenant accompanies this section when it is separated from the motor section. In ceremonies and drill, in addition to the wagoners, one cook rides on rolling kitchen, and a mess sergeant on ration and baggage wagon.

(*c*) The motor section consists of the motor cycle and side car and the company tool truck. The staff sergeant, riding in the side car, commands this section. The chauffeur, supply sergeant, tool corporal, and blacksmith ride on the company tool truck.

(*d*) The formation of the sections is line and column. The frontage in line is 15½ paces. The distance between vehicles in the section is 6 paces.

(*e*) Movements and command for sections.

1. From column into line.

1. ***By the right (left) flank,*** 2. ***MARCH.***
1. ***On right (left) into line,*** 2. ***MARCH.***
1. ***Right (left) front into line,*** 2. ***MARCH.***

2. From line into column.

1. ***By the right (left) flank,*** 2. ***MARCH.***
1. ***Right (left) by vehicle,*** 2. ***MARCH.***

3. To change direction.

From column. 1. ***Column right (left),*** 2. ***MARCH.***
From line. 1. ***Right (left) turn,*** 2. ***MARCH.***

4. Dismounted and mounted assembly.—The company is formed by the commands prescribed for the infantry rifle company.

5. *Dismissal.*—The company is dismissed by the commands prescribed for the infantry rifle company. Tool sections and company transportation are directed to fall out before the company returns to the company parade.

6. *Ceremonies and reviews.*—The formations shown in Figure 6 are the formations in which the company appears in the line at ceremonies and review. Greater or less distances and intervals may be taken by adding to the commands "at so many paces distance (interval)." The company passes in review in column of platoons. Companies execute *column of squads* successively by platoons and at the second change of direction form column of platoons but do not close up the distance. The company takes up the double time for 100 paces after its tail has passed the reviewing officers; 50 paces unless otherwise directed.

7. *Drill without transportation.*—This drill is executed in preparation for drill with transportation and to emphasize smartness, attention, and precision. The company is formed and drilled as an infantry rifle company of two platoons.

h. Platoon.—The formations of the platoon are line and column. In both line and column the tool section, commanded by the tool corporal, follows at 6 paces, and conforms to the movement of the main body of the platoon, moving by the most direct route and increasing or diminishing gait as may be necessary to take its place in rear. Separate commands are given for the tool section when it does not take its normal position or when it does not conform to the movement of the main body of the platoon. Either section may be moved independently by designating the section to execute the movement. Movements may be executed at double time. The platoon commander dresses his platoon facing the point of rest, and minor errors in the positions of the tool section are ignored on account of the difficulty of moving the platoon tool wagon. In drill *without the tool section, all personnel* is dismounted.

100. General service regiment.—In general the drill is the same as that of the corresponding units of the combat regiment. The battalion and regiment drill in general as in the combat

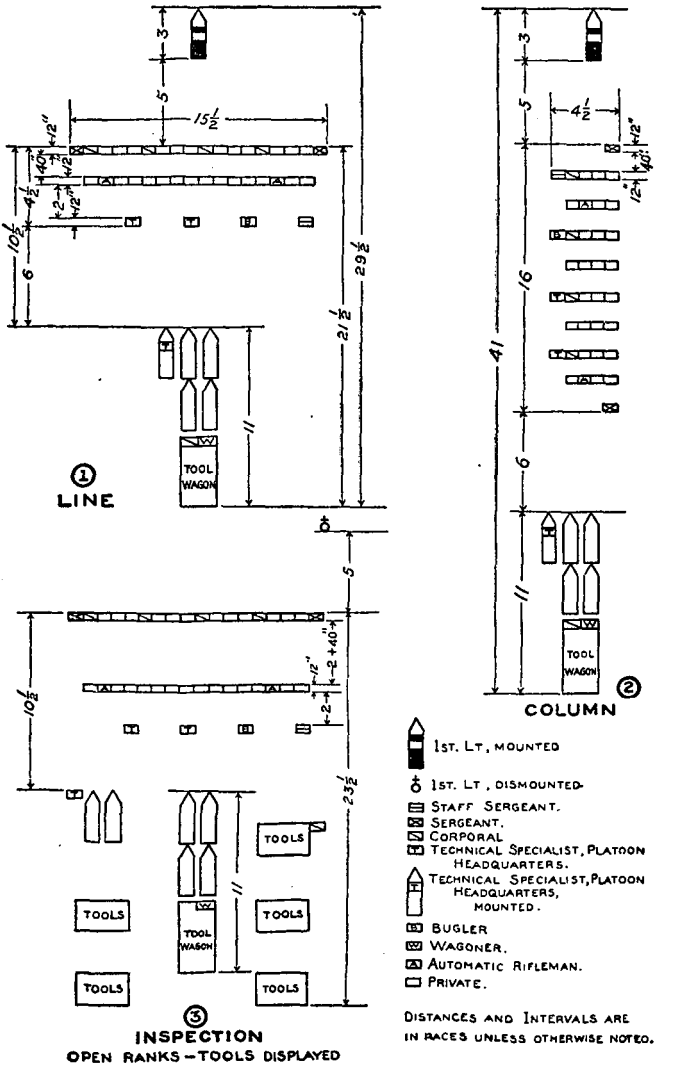


FIGURE 6.—Combat regiment—Platoon formations

regiment. There are usually sufficient men in the headquarters and service company who are not mounted on horses or vehicles to form a dismounted company.

a. Headquarters and service company.—The headquarters and service company drills in general as does the same unit in the combat regiment. At dismounted assembly the order from right to left is company headquarters, headquarters platoon (administrative section, drafting and designing section, operations section, and supply section), service platoon (platoon headquarters, motor section, and animal section), and engineer platoon (platoon headquarters and engineer section). In the mounted assembly the order from right to left is dismounted personnel, animals, motors.

b. Company.—Company drill is the same as that of the company of the combat regiment with certain minor exceptions. There are 3 platoons. A mounted man, the horseshoer, accompanies the leading vehicle of the wagon section of the transportation platoon. There are 3 vehicles in the wagon section in the order: Tool wagon, ration and baggage wagon, and water wagon. The distance between the captain and the leading guide in column of squads is 12 paces. In the dismounted assembly, company headquarters is commanded by the platoon sergeant, whose post is the same as that of a platoon commander. It forms on the right of the company in 2 sections under the general rules prescribed for headquarters units with administrative and supply section on the right and engineer section on the left with 3 paces interval.

c. Platoon.—Platoon drill is the same as that of the combat regiment, except that the platoon commander is dismounted and 3 paces in front of the platoon in line and abreast of the leading guide in column. There are no mounted men with the tool wagon, no automatic riflemen, and no bugler. There are 5 men in the file closers.

101. Separate battalion.—*a.* In general, the formations and drill for battalion headquarters, headquarters and service company, and medical detachment are the same as for the combat regiment, making allowances for the differences in organization and transportation.

b. Company formations and drills are, in general, as prescribed for the combat company except that close-order drill for units above the 4-squad operating section is confined to such

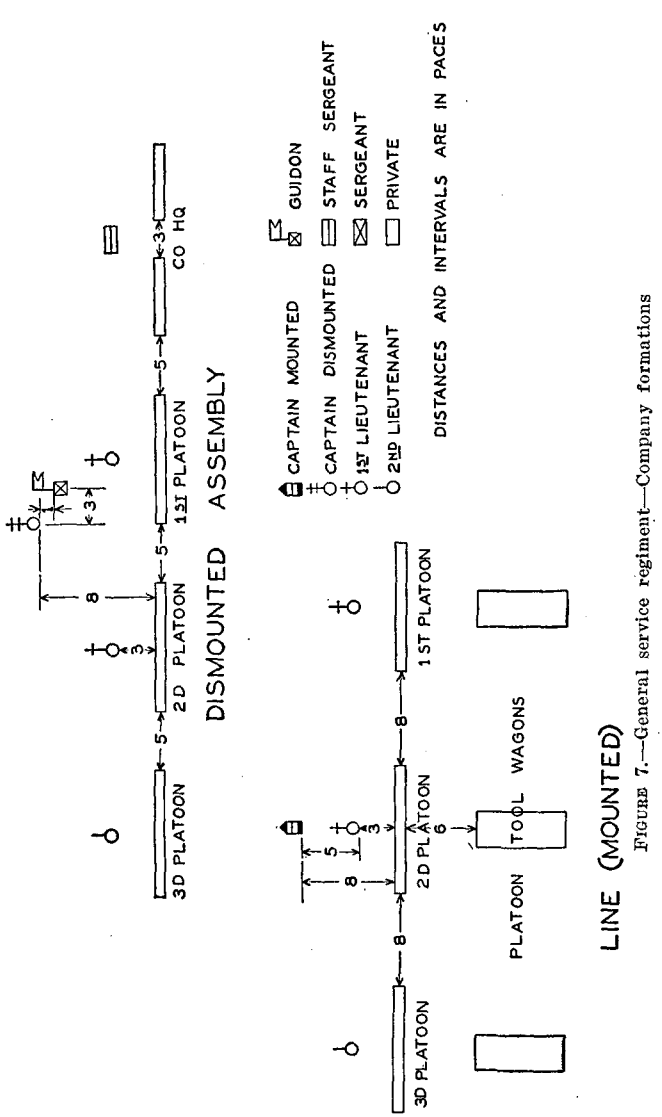


FIGURE 7.—General service regiment—Company formations

movements as may be necessary for participation in ceremonies and reviews.

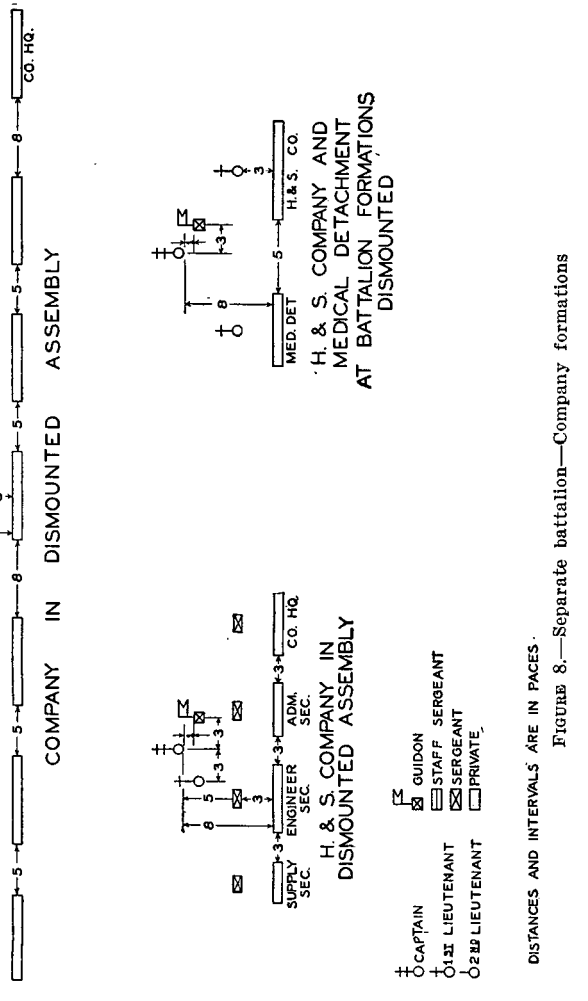


FIGURE 8.—Separate battalion—Company formations

o. For additional details, see Figures 8 and 9.

102. Squadron.—The engineer squadron executes close-order drill as prescribed for cavalry in the Cavalry Field Manual.

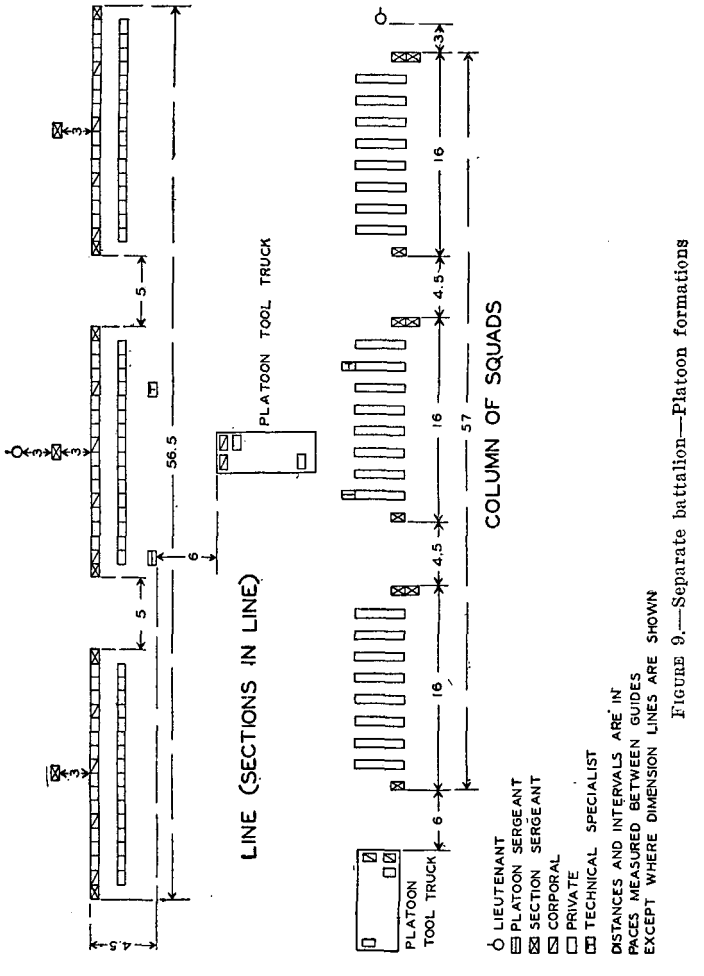


FIGURE 9.—Separate battalion—Platoon formations

The motorized troop executes only dismounted drill. The mounted troop executes both dismounted and mounted drill.

The formations of the troops are those necessary to operate in the field and to take part in ceremonies and are shown in

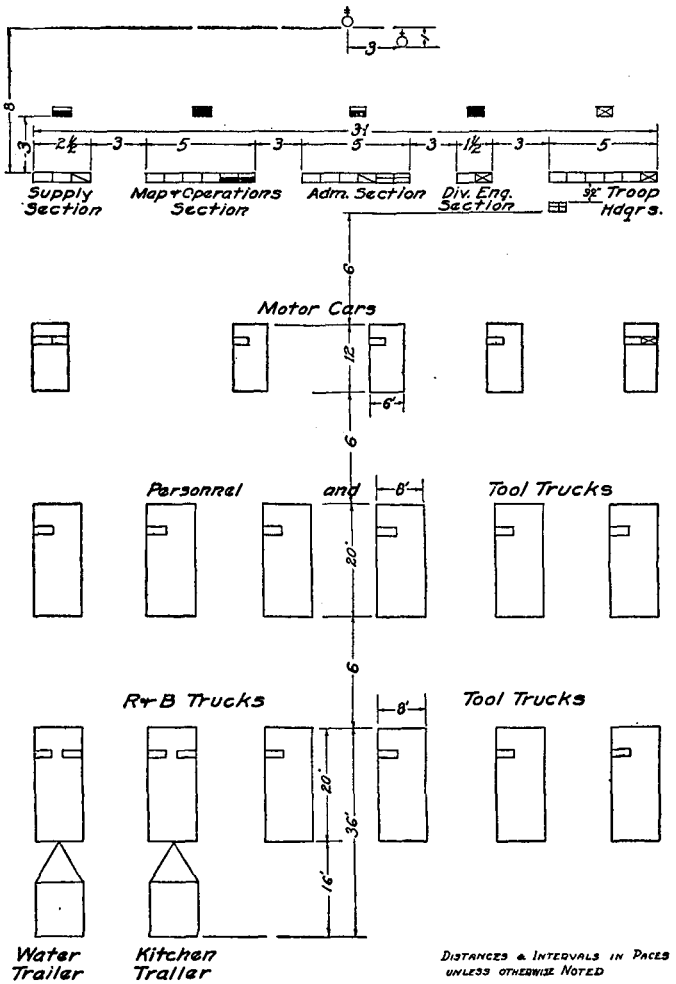


FIGURE 10.—Squadron—Headquarters and service troop in line

Figures 10 to 14, inclusive. The medical detachment forms on the left of the headquarters and service troop as a separate unit

The interval between troops in line and in mass is 10 yards. The post of the battalion staff is 12 yards in front of the captain of the base troop.

103. Water supply battalion.—The normal drill of the water supply battalion is with transportation. Drill without trans-

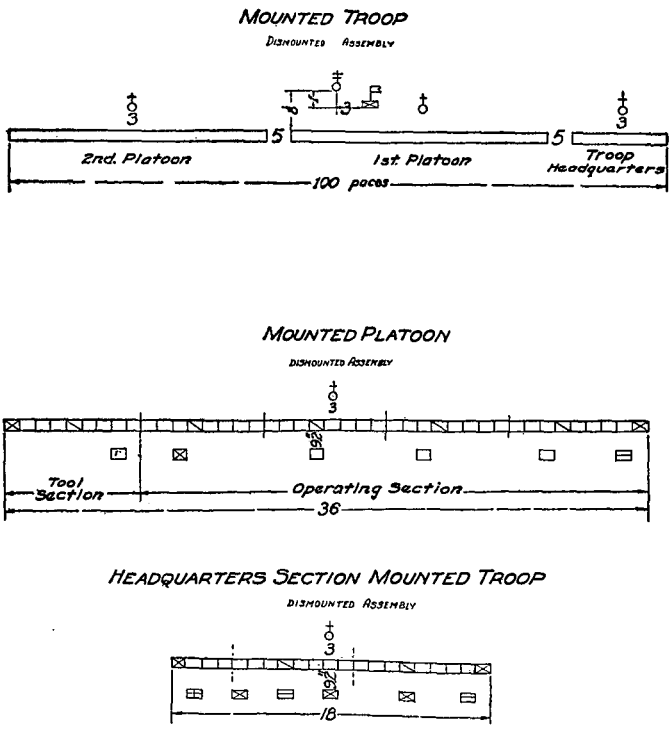


FIGURE 11.—Squadron—Mounted troop and platoon in dismounted assembly

portation is executed by platoon. The drill of units higher than the platoon is confined to such formations as may be necessary for participation in dismounted ceremonies.

a. Battalion staff.—At battalion formations with transportation the battalion staff rides in the 5-passenger car, the light motor car of the operations officer and the light motor car

of the battalion surgeon. The relative positions of these cars are as prescribed by the battalion commander. At battalion formations without transportation, the staff forms as follows: Battalion adjutant, 3 paces to the rear and 1 pace to the right of the battalion commander; operations officer, assistant operations officer, and surgeon in order of grade abreast and to the left of the adjutant. The sergeant major and 2 other enlisted men, designated by the commander, form 3 paces in rear of the commissioned staff.

b. Headquarters and service company.—(1) The dismounted assembly is as shown in Figure 15.

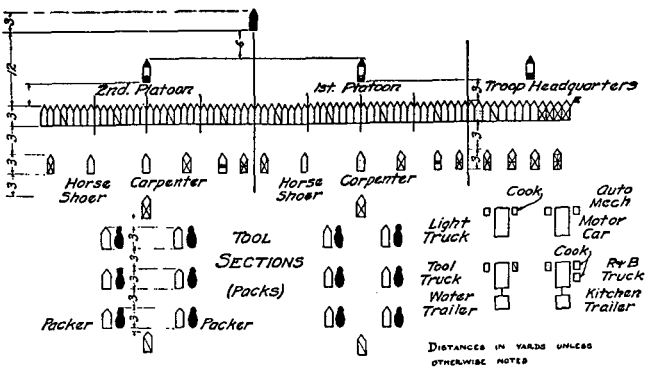


FIGURE 12.—Squadron—Mounted troop in line

(2) In drill with transportation, for ceremonies and battalion formations the vehicles of the headquarters and service company, motor repair unit, and medical detachment are combined into one company commanded by the supply officer.

c. Company.—(1) The dismounted assembly is as shown in Figure 15.

(2) In the dismounted drill assembly the company forms as 3 platoons. Personnel of the company headquarters is attached to the service platoon.

(3) In drill with transportation, the transportation platoon forms in 2 sections. The service platoon and company headquarters form a platoon of 2 sections, the first section consisting of the tank truck section and the second section consisting

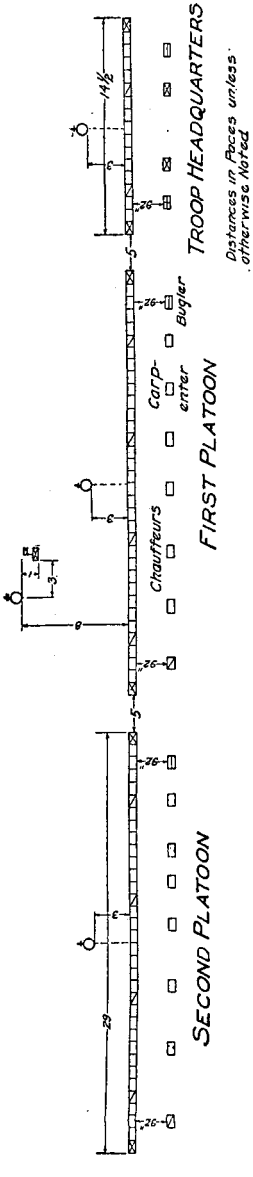


FIGURE 13.—Squadron—Motorized troop in dismounted assembly

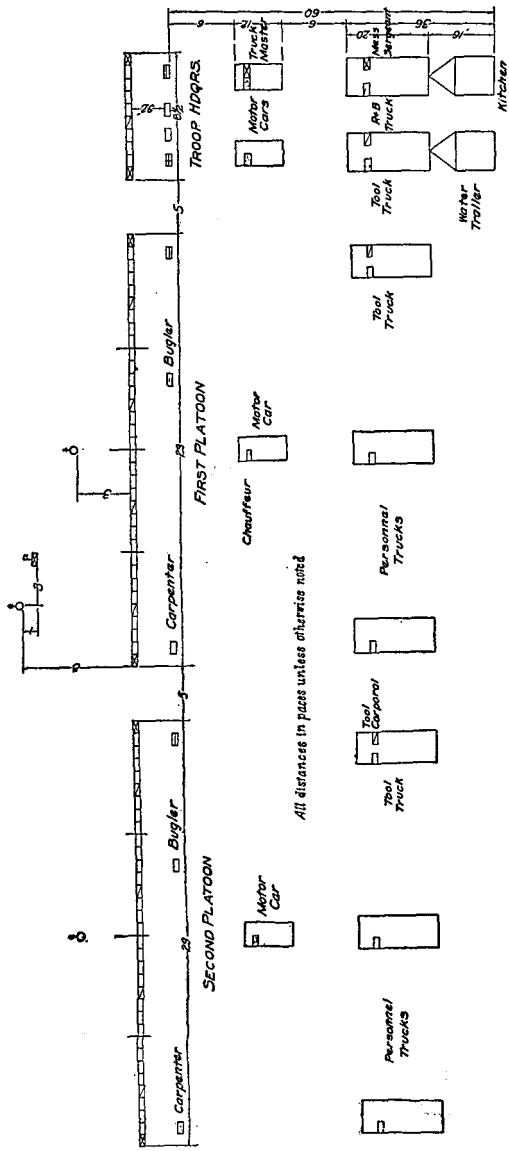


FIGURE 14.—Squadron—Motorized troop in line

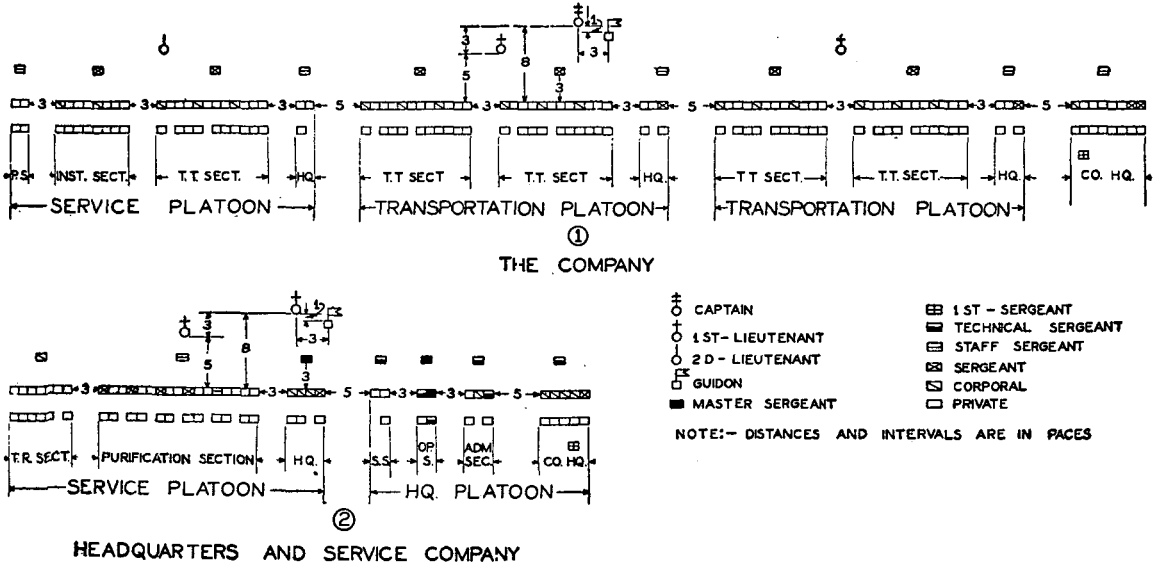


FIGURE 15.—Water supply battalion—Assembly formations

of the remaining vehicles of the service platoon and the company headquarters vehicles less the light motor car. The company commander indicates to the platoon commanders the formation and place. Platoons take up the prescribed formation individually. Change of direction is made in column of trucks or column of subsections.

d. Platoon.—(1) The dismounted assembly is as shown in Figure 15.

(2) Dismounted drill assembly is formed from dismounted assembly, the platoon forming as a 4 to 6 squad platoon.

(3) In drill with transportation, the distance between vehicles while moving is prescribed by the appropriate unit commander. Distances and intervals between units while at halt are shown in Figure 16. Distances and intervals are modified by unit commanders to satisfy local conditions, when it is evident that prescribed distances and intervals are not practicable. Any of the formations may be used as a parking formation. Units normally enter and leave the park in column of vehicles.

104. Heavy ponton battalion.—*a.* The platoon is the largest element of the heavy ponton battalion that participates regularly in disciplinary drill. Larger elements take part in drill to the extent necessary to permit participation in ceremonies and marches. Ceremonies are with transportation when conditions permit. The battalion drills according to the principles governing drill for the water supply battalion. (See par. 103.)

b. Headquarters and service company.—At dismounted assembly the headquarters and service company forms in line from right to left as follows: Company headquarters, administrative section, supply section, maintenance section, depot section.

c. Company.—(1) The order of formation at dismounted assembly from right to left is headquarters platoon (company headquarters section and service section); first bridge platoon (first, second, and third ponton sections, first and second trestle sections); second bridge platoon (fourth, fifth, and six ponton sections, third and fourth trestle sections).

(2) In drill with transportation, the headquarters platoon forms as 1 section and the bridge platoon forms in 5 sections, each section consisting of two 3-vehicle subsections (except that 1 subsection of each trestle section has only 2 vehicles).

d. Platoon.—The platoon drills in the manner described for the platoon of the water supply battalion. (See par. 103.)

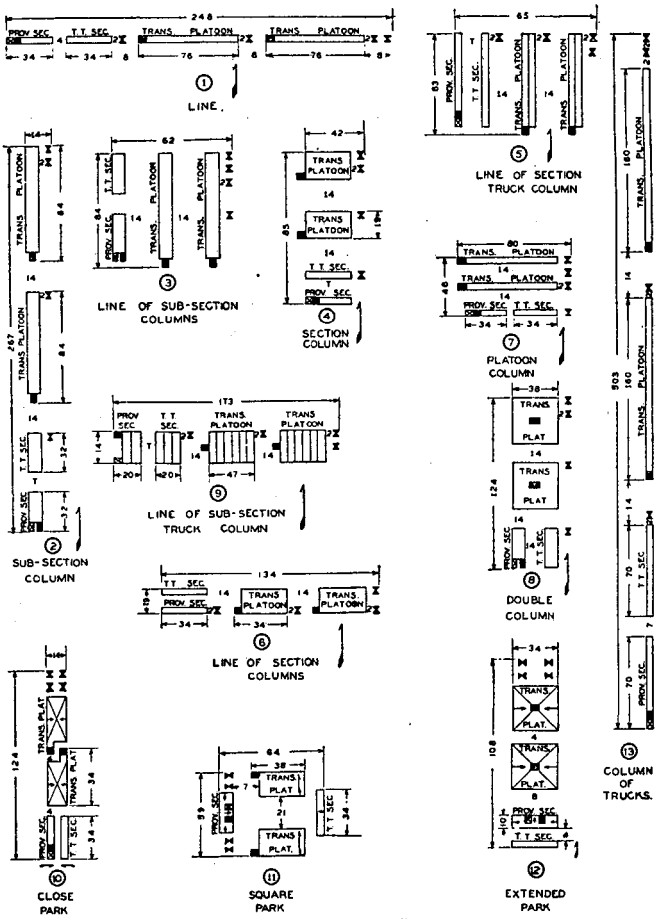


FIGURE 16.—Water supply battalion—Company vehicle formations

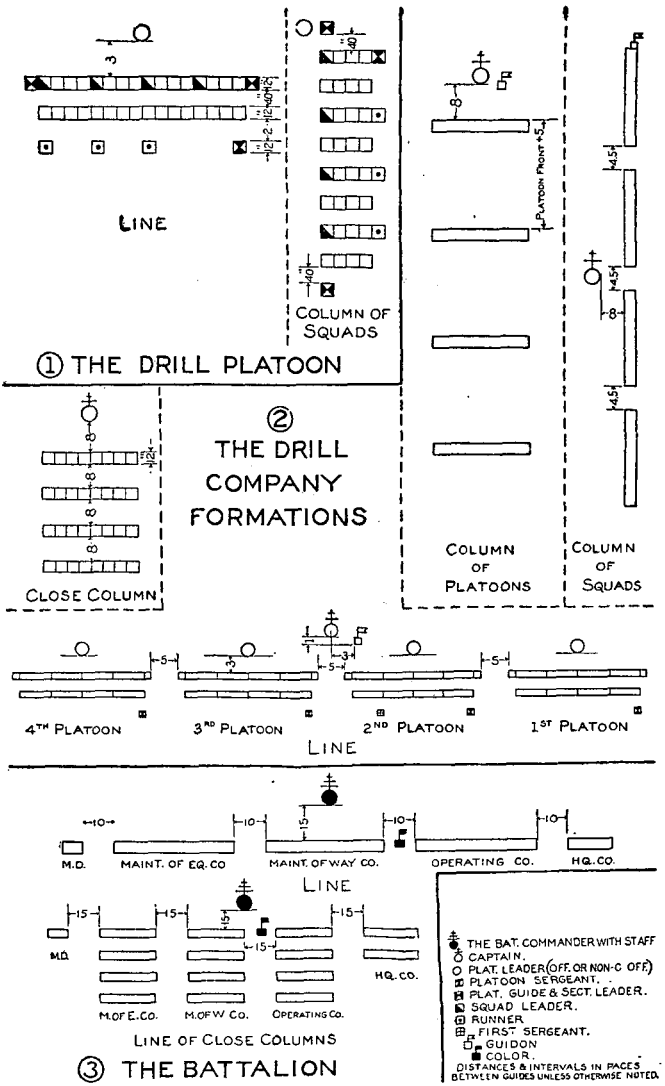


FIGURE 17.—Railway battalion—Formations for drill and ceremonies

105. Railway battalion.—*a. General.*—The organization of the companies of the railway battalion as given in Tables of Organization shows personnel as grouped while engaged upon railway work. This organization is not suitable for drill, ceremonies, or combat. For such purposes companies are organized into provisional platoons. Companies always assemble according to their work formation. In case drill or ceremonies follow, the provisional formation is taken up after the roll is called. Personnel of provisional platoons should, so far as practicable, remain the same. Noncommissioned officers are assigned to duty as platoon leaders, platoon sergeants, platoon guides, or squad leaders. Commissioned officers are normally assigned to the command of the first and second platoons.

b. Provisional organization.—(1) *The section.*—The section is composed of a section headquarters and 2 squads. The section headquarters consists of a section leader. No section guides are provided.

(2) *Platoon.*—The provisional platoon is composed of a platoon headquarters and 4 squads. The platoon headquarters comprise the platoon commander, the platoon sergeant (second in command), and 3 runners. For the purpose of drill or ceremonies the runners may be used to fill blank files. The platoon commander may be an officer or noncommissioned officer.

(3) *Company* (other than headquarters and service company).—The company is composed of a company headquarters and 4 platoons. Company headquarters consists of the company commander and one other officer and 20 or more enlisted men. For the purposes of drill or ceremonies, the personnel of company headquarters is attached to platoons to fill blank files or to occupy positions in the file closers.

(4) *Headquarters and service company.*—This company, for purposes of drill and ceremonies, is formed into two or one provisional platoon of 4 squads each, depending upon the number of men available. Extra men are placed in the file closers.

(5) *The battalion.*—The battalion is composed of 3 companies of 4 platoons each and the headquarters and service company of 2 platoons. Units of the battalion are arranged in the following order from front to rear or from right to left: Headquarters and service company, the operating company, the maintenance of way company, the maintenance of equipment company, and the medical detachment. The battalion commander's staff for ceremonies consists of the assistant division superintendent,

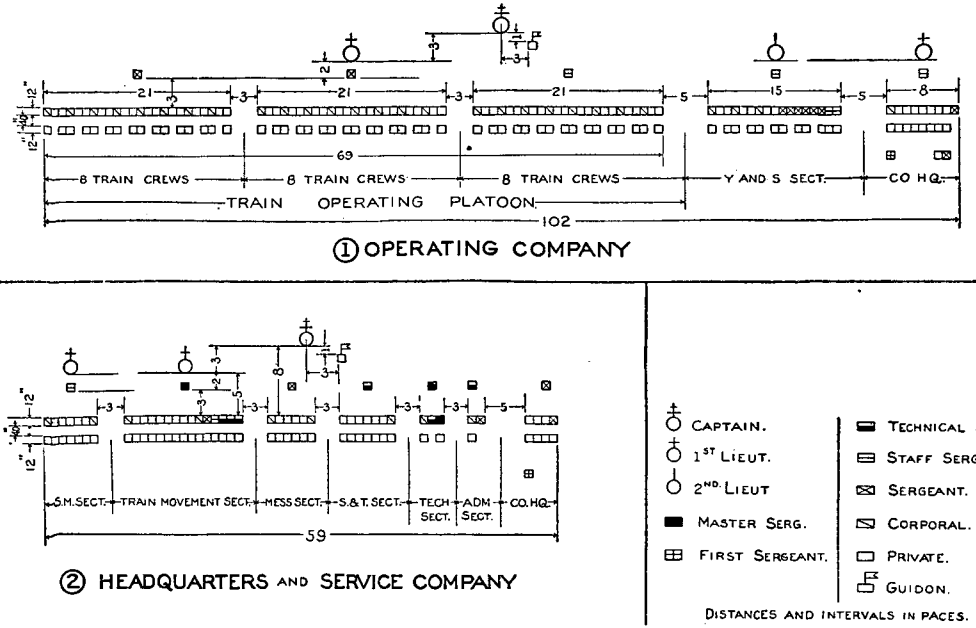
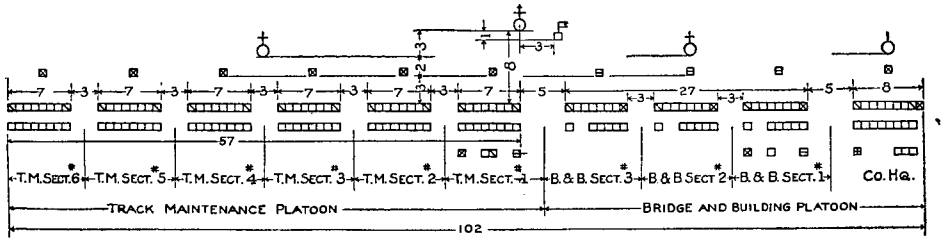
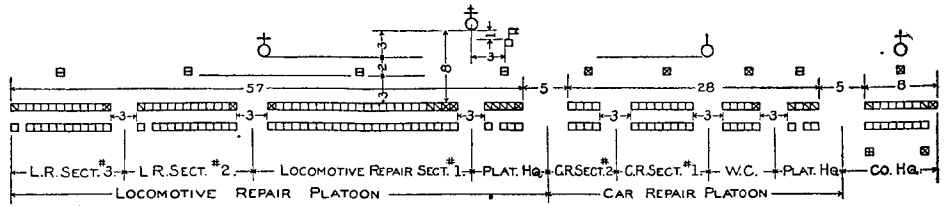


FIGURE 18.—Railway battalion—Assembly formations



① MAINTENANCE OF WAY COMPANY



② MAINTENANCE OF EQUIPMENT COMPANY

CAPTAIN.
1ST LIEUT.
2ND LIEUT.
FIRST SERGEANT.
TECHNICAL SERG.
STAFF SERG.
SERGEANT.
CORPORAL.
PRIVATE.
GUIDON

NOTE: DISTANCES AND INTERVALS IN PACES.

FIGURE 19.—Railway battalion—Assembly formations

the adjutant, and the battalion surgeon. The enlisted personnel of the battalion commander's staff consists of the assistant chief dispatcher and a private from the headquarters and service company under the command of the assistant chief dispatcher.

106. Camouflage battalion (GHQ).—*a. The headquarters and service company.*—The order of formation at dismounted assembly from right to left is company headquarters, administrative section, technical section, supply section.

b. Camouflage company.—The order of formation at dismounted assembly from right to left is headquarters platoon (platoon headquarters, depot section, school section); camouflage platoon (platoon headquarters, camouflage section).

c. Shop company.—The order of formation at dismounted assembly from right to left is headquarters platoon (platoon headquarters, supply section, transportation section, repair and maintenance section, design section); factory platoon (platoon headquarters, sewing and weaving section, painting section).

107. Dump truck company.—*a.* The order of formation at dismounted assembly from right to left is headquarters platoon (company headquarters and fifth dump truck section); first transportation platoon (headquarters section, first dump truck section, second dump truck section); second transportation platoon (headquarters section, third dump truck section, fourth dump truck section).

b. Drill with transportation follows the general principles described for the company and platoon in the water supply battalion. (See par. 103.)

108. Light ponton company.—*a.* The order of formation at dismounted assembly from right to left is headquarters platoon (company headquarters section and service section); first bridge platoon (first, second, third, and fourth ponton sections, and first trestle section); second bridge platoon (fifth, sixth, seventh, and eighth ponton sections, and second trestle section); third bridge platoon (ninth, tenth, eleventh, and twelfth ponton sections, and third trestle section).

b. Drill with transportation.—(1) The headquarters platoon forms as 2 sections and the bridge platoon as 5 sections, each section consisting of 3 vehicles (except trestle sections which have 5 vehicles).

(2) The distances and intervals between vehicles are as prescribed by the unit commander. Vehicles normally enter and leave park in a column of trucks.

109. Depot company.—The order of formation at dismounted assembly from right to left is headquarters platoon (company headquarters section, fourth depot section); first depot platoon (platoon headquarters section, first depot section); second depot platoon (platoon headquarters section, second depot section); third depot platoon (platoon headquarters section, third depot section).

110. Camouflage battalion, army.—*a. Headquarters and service company.*—The order of formation at dismounted assembly, from right to left, is headquarters platoon (administrative section, operating section, supply section); service platoon (platoon headquarters, factory section, transportation section).

b. Company.—The order of formation at dismounted assembly, from right to left, is company headquarters (first camouflage

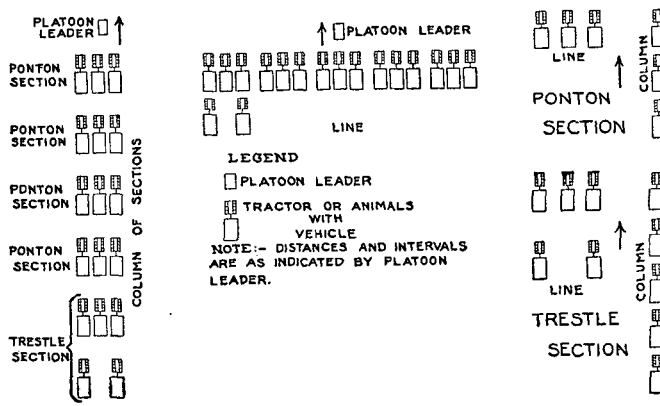


FIGURE 20.—Light ponton company—Bridge platoon formation

platoon, second camouflage platoon, third camouflage platoon, fourth camouflage platoon).

111. Shop company.—The order of formation at dismounted assembly, from right to left, is as follows: Headquarters platoon (company headquarters section, technical section, supply section, power section); woodworking platoon (carpenter section, pattern-making section); shop platoon; metal-working platoon (forge and foundry section, sheet metal and welding section).

112. Topographic battalion.—*a. Army.*—(1) *Headquarters and service company.*—The order of formation at dismounted assembly, from right to left, is company headquarters, adminis-

trative section, operations section, supply section, and transportation section.

(2) *Reproduction company.*—The order of formation at dismounted assembly, from right to left, is company headquarters; first lithographic platoon (platoon headquarters, drafting section, photographic section, plate section, press section); photomapping platoon (platoon headquarters, first section, second section, third section).

(3) *Surveying companies.*—The order of formation at dismounted assembly, from right to left, is company headquarters; control platoon (platoon headquarters, vertical-control section, horizontal-control section); topography and drafting platoon (platoon headquarters, topography section, drafting section).

b. GHQ.—The order of formation of the units is the same as that prescribed in *a* above.

SECTION III

EXTENDED-ORDER DRILL

113. General principles.—For the general principles governing extended-order drill see Basic Field Manual, Volume II (Infantry Drill Regulations). Extended-order drill is not executed by engineer units higher than the platoon.

114. Platoon of the combat regiment.—*a. Squad.*—The engineer squad executes extended-order drill as an infantry rifle squad.

b. Platoon.—The drill is executed without transportation, and all personnel is dismounted. In preparation for this drill, the platoon commander divides the platoon into 2 automatic rifle sections; assigns sergeants to command sections; assigns corporals as section guides for sections with more than 1 squad; assigns runners to observe on the right and left; assigns a runner, usually a bugler, for post with the platoon commander; and assigns extra and attached men to squads. The platoon deployed in 2 lines occupies about 80 paces. The platoon deployed in 1 line occupies about 160 paces.

115. Platoon of the general service regiment.—The principles given above for extended-order drill for the combat platoon apply to the platoon of the general service regiment except that there are no automatic riflemen in the platoon of the general service regiment.

116. Platoon of the separate battalion.—*a.* The normal squad and section organization is retained in this drill. The platoon as a whole does not execute extended order.

b. The *squad* executes the drill as an infantry rifle squad, all men armed as riflemen.

c. The *operating section* executes the drill in general like the platoon of the combat regiment, except that it has no automatic rifles. The operating section is divided into 2 rifle sections. Personnel for messenger and observation service is attached from the platoon or company or is taken from the squads.

117. Platoons of the engineer squadron.—*a.* The *mounted platoon* is trained to execute extended-order drill mounted and dismounted both with and without the tool section, in order that it may cross fire-swept terrain, pass obstacles, and avoid airplane observation. The squad of the operating section executes extended-order drill as prescribed for the cavalry squad in the Cavalry Field Manual, with the exception of the mounted attack. The operating section executes extended-order drill as prescribed for the cavalry rifle platoon in the Cavalry Field Manual, with the exception of the mounted attack. The tool section, when present, always follows in the rear of the operating section at such distance as the platoon commander may direct. The tool section deploys and assembles in accordance with the same commands in a manner similar to the operating section, a trooper with his led horse being considered as one individual.

b. The *motorized platoon* is trained to execute extended-order drill dismounted only in accordance with the principles prescribed for cavalry in the Cavalry Field Manual.

Section IV

INSPECTIONS

118. Formal.—*a. Combat regiment.*—The regiment may be formed in any suitable formation required by the space and ground available. The transportation usually joins the companies and the elements are so disposed as to permit the layout of tools. Before opening ranks, battalions and companies are extended to full distance. Battalions are prepared for inspection as prescribed below. Upon the approach of the inspecting officer each battalion commander brings his battalion to atten-

tion and salutes. Battalion inspection follows. Regimental inspection is ordered only in very exceptional situations.

(1) *Battalion.*—As a general rule an inspection by battalion is not made unless special conditions make it desirable. Ordinarily it is preferable to inspect each company in its own area or have the companies march successively to a designated place in time to be inspected. When battalion inspection is made, the procedure is in accordance with the principles prescribed for battalion inspection in Basic Field Manual, Volume II (Infantry Drill Regulations). Transportation usually joins the companies and the elements are so disposed as to permit the display of tools. Any formation with the platoons in line is suitable for inspection. The major commands: ***PREPARE FOR INSPECTION.*** At this command each company is prepared for inspection. The major then commands: ***REST,*** returns saber, and dismounts. The staff dismounts. The mounted orderly holds the horses of the major and the adjutant. The major then proceeds with the inspection. The sergeant major, if not carrying the color, and the motorcyclist take position to the right and left, respectively, of the motor cycle under the command of the lieutenant commanding the transportation platoon to which the motor cycle is attached.

(2) *Headquarters and service company.*—The company is assembled in the mounted assembly. The captain commands: ***PREPARE FOR INSPECTION.*** The dismounted men, if any, open ranks; other men remain mounted. The captain remaining mounted inspects the platoons in succession. Each platoon is brought to ***attention*** before the captain arrives and is given ***at ease*** after he departs. The captain then calls the company to attention and commands: ***LAY OUT EQUIPMENT,*** followed by ***AT EASE.*** Platoon commanders and all men, except wagoners, dismount, and proceed to lay out equipment. The captain dismounts and makes a detailed inspection of the platoons in succession.

(3) *Company.*—(*a*) The usual formations for inspection are line and column of platoons, as these formations permit the layout of the engineer tools. As the company is equipped and organized primarily for the execution of engineer work, it is essential that the equipment used in engineer work be present with the company and be laid out for inspection. Unless otherwise directed, the engineer equipment in the tool vehicles is laid out for inspection. When specially directed, the spare

parts and accessories of the vehicles and the load on the ration and baggage wagon are laid out for inspection. The motor section and the wagon section join the company for inspection.

(*b*) *Formation and procedure.*—The captain commands: 1. ***Prepare for inspection,*** 2. ***MARCH.*** Platoons open ranks successively and lay out tools as prescribed for the platoon. The second lieutenant dismounts, turns his mount over to the extra man on the rolling kitchen, and supervises the laying out of the equipment of the transport platoon. The captain may direct extra men from the platoons to assist. Tools having been laid out, the captain commands: 3. ***REST,*** and proceeds to inspect. As he approaches each platoon, the platoon leader faces to the left, commands: 1. ***Platoon,*** 2. ***Attention,*** 3. ***PREPARE FOR INSPECTION,*** faces to the front, and upon being inspected accompanies the captain. The platoon having been inspected, tools are loaded and ranks closed at the command of the platoon commander, the platoon is given ***rest,*** and the platoon leader takes his post in front of the center of his platoon.

(*c*) If the inspection is to include an examination of the individual equipment while in ranks, the captain, after the inspection of arms and tools has been completed, causes the platoons to stack arms, take intervals, and display equipment. The tool, motor, and wagon sections may be dismissed.

(4) *Platoon.*—(*a*) Unless otherwise directed, all equipment on the tool wagon, except wagon parts and accessories, is laid out for inspection.

(*b*) The commands and movements are: 1. ***Open ranks,*** 2. ***MARCH.*** The tool section stands fast. The platoon commander aligns the platoon, takes post 5 paces to the front of the right guide, faces to the left, and commands: 3. ***FRONT,*** 4. ***LAY OUT TOOLS,*** 5. ***AT EASE.*** He dismounts and supervises the laying out of the tools. The mounted demolition man joins the platoon commander, dismounts, takes the commander's horse, and holds both horses in rear of the left of the platoon on a line with the lead mules of the platoon tool wagon. The tool corporal dismounts and, assisted by men from the file closers and the rear rank, lays out the tools. The tools are laid out in several lines to the sides and rear of the wagon, within the frontage of the platoon. Space is left between and around sets to permit of ease in inspection. The manner in which the tools appear in the layout is as prescribed by regimental or separate unit commanders. The wagoner remains on his vehicle. The

tools being laid out, all take posts. The tool corporal's post is on the right of the front line of tools. The platoon commander takes post 5 paces in front of the right guide, faces to the left, and commands: 1. *Platoon,* 2. *Attention,* 3. ***PREPARE FOR INSPECTION.*** Accompanied by the platoon sergeant, he inspects the platoon. The tool corporal, upon being inspected, accompanies the platoon commander in the inspection of the tool section. Inspection having been completed, the platoon leader commands: 1. ***LOAD TOOL WAGON,*** 2. ***AT EASE.*** The tools are loaded. The platoon commander and the demolition men mount. All resume posts. The platoon commander, from his post 5 paces in front of the right guide, commands: 1. *Platoon,* 2. *Attention,* 3. *Close ranks,* 4. ***MARCH.*** He resumes his post in front of the platoon.

(*c*) If the inspection is to include an examination of the individual equipment while in ranks, the platoon leader after the inspection of arms and tools has been completed causes the platoon to stack arms, take intervals, unsling equipment, and open packs as prescribed for infantry units. The tool section may be dismissed.

b. General service regiment.—The rules prescribed in *a* above for the combat regiment, battalion, company, and platoon apply with minor modifications. The headquarters and service company always has a dismounted platoon. The captain is the only mounted officer in the company in the battalion.

c. Separate battalion.—The general rules prescribed in *a* (1) above for the battalion of the combat regiment apply. The inspection includes an inspection of the tools and transportation and the elements are disposed so as to facilitate the display of tools.

(1) *Headquarters and service company.*—At the captain's command to prepare for inspection the sections open ranks and then lay out tools. The men on the vehicles (less chauffeurs) dismount and form in two ranks in front of these vehicles on a line with the dismounted section. The vehicles move back 8 yards and chauffeurs dismount. Sections open ranks and tools are laid out at the command of the section commanders.

(2) *Company.*—The captain commands: ***PREPARE FOR INSPECTION.*** Platoons, including the transportation platoon or section, are prepared for inspection and tools displayed.

(3) *Platoon.*—The platoon is prepared for inspection in general accordance with the principles prescribed for the company of the combat regiment in *a* above. The tool corporal directs the layout of the tools of the tool section. Tools are displayed in general accordance with the rules prescribed for the platoon of the combat regiment.

(4) *Operating section.*—Ranks are opened and closed at the command of the section sergeants.

d. Squadron.—Formal inspection for the engineer squadron is conducted in accordance with the general rules prescribed for the cavalry squadron in the Cavalry Field Manual, except that the inspection may include an inspection of tools and transportation, in which case the elements are disposed so as to facilitate the display of tools.

e. Inspection for other units.—(1) As a general rule, a battalion is not inspected as a unit. When the companies of a battalion are to be inspected the battalion commander, accompanied by his staff, usually makes an inspection of each company in turn.

(2) A company is inspected either as a unit or by platoon. The formation for dismounted inspection is the dismounted assembly formation described elsewhere. Companies of the water supply battalion, ponton bridge units, and dump truck companies are usually inspected with their transportation. When inspected with transportation they form in line, line of subsection columns, or column. Men riding on vehicles, except wagoners, dismount and stand abreast of their vehicles. Personal equipment and tools pertaining to the vehicles are displayed on the ground.

(3) If the unit commander is to act as inspecting officer of his unit, he proceeds immediately with his inspection. If the inspecting officer is other than the unit commander, the latter prepares his unit for inspection and awaits the arrival of the inspecting officer. If the inspecting officer is at some distance from the unit, its commander may give the command ***REST,*** and await the inspector's arrival. Upon the approach of the inspector the unit commander calls his unit to attention and salutes him, the inspector returns the salute and instructs the unit commander as to the kind of inspection he desires. The commander then gives the necessary commands and after being *himself inspected accompanies the* inspector.

119. Tactical.—The tactical inspection of an engineer unit is made by testing the unit upon a tactical engineer mission appropriate to the unit and its equipment. It should be in the form of a problem or series of problems that will test the unit in the march to, the organization for, and the execution of a definite engineer mission. The equipment and transportation are always present. Practical tests are conducted in the use of the special equipment carried by the unit. This can be done either by requiring the execution of a prescribed task or by inspecting work that has been done by the unit with this equipment. Tactical inspection is primarily a test of the organization as a working unit. Cognizance is taken of engineer work that the unit may have been engaged upon during the period immediately preceding the time of the inspection.

CHAPTER 5

COMBAT PRINCIPLES

SECTION I

GENERAL

120. Basic principles.—*a.* The primary mission of all engineer troop units is engineer work and not combat. In emergency, however, it may be necessary to employ them in combat. In general, they then follow the principles prescribed in Training Regulations for Offensive Combat for Infantry, or Basic Field Manual, Volume VIII (when published), with such modifications as may be necessary on account of the differences between infantry and engineer units in organization, armament, and equipment. Mounted engineers when used in combat in like emergencies follow the principles prescribed in Training Regulations for Cavalry in dismounted action, allowance being made for differences between mounted engineers and cavalry.

b. Engineers are armed not as infantrymen or cavalrymen but as *riflemen.* Engineer units are not provided organically with 37-mm. guns, trench mortars, machine guns, or rifle grenades, nor with certain important means of signal communication. The combat power of engineer units is therefore not easily comparable with that of corresponding units of infantry or cavalry. Without infantry supporting weapons the engineer combat regiment has a fighting power about equal to an infantry battalion, less the machine-gun company. If afforded the assistance of infantry, machine guns, and supporting weapons, the fighting power may be considered about equal to that of an infantry battalion. The fighting power of the engineer squadron in dismounted action is about half that of the cavalry squadron.

c. Engineer units enter combat without changes in their basic organization. They fight as engineers, and do not make changes

in order to simulate units of other arms. Engineer companies and higher echelons are divided into forward and rear echelons for combat. The forward echelon comprises the fighting elements and the command section of headquarters. The rear echelon comprises the transportation and engineer equipment and the administrative and supply sections of headquarters.

d. In preparation for combat, provision must be made for the engineer equipment and transportation, having in mind the early resumption of engineer work. Special arrangements may have to be made for an additional supply of ammunition.

e. The normal uses of engineers in combat are as a reserve unit to carry on an assault, to fill a gap in a line, to relieve some unit in the line, and to make a counterattack; they are rarely used in the pursuit, for long-sustained actions, or for deep penetrations.

f. The employment of engineers in combat means the abandonment of engineer work. This is a serious matter and must not be overlooked. Without constant maintenance the routes of communication rapidly deteriorate and may break down altogether. The employment of engineers in combat may result in the employment of other combat troops, usually less efficient for the purpose, upon engineer work which should properly be done by the engineer troops.

121. Combat intelligence.—*a. Definition.*—Combat intelligence is information of the enemy secured in the field. It includes a knowledge of the location, strength, composition, armament, equipment, supply, tactics, training, discipline, morale, movements, intentions, conditions, and the situation of the enemy forces opposing a combat unit, and the terrain over which a combat unit is to operate or is operating. This intelligence furnishes a basis for the tactical decisions of the commander.

b. Responsibility for collection.—Each commander of a combat unit is responsible for securing information concerning the enemy forces opposing him. The staff agency for combat intelligence is the intelligence personnel. The operating personnel includes any persons or groups who may be directed to procure information. In addition all individuals have the duty to report to their superiors any enemy information falling into their hands.

c. Training and employment.—Intelligence personnel is trained and employed in accordance with the principles prescribed in

TR 210–5, or Basic Field Manual, Volume VIII (when published).

d. Combat intelligence for engineer units.—(1) When a general engineer unit is employed in combat, the unit intelligence officer with a small detail of the headquarters of the unit is at the command post in charge of combat intelligence. He receives, evaluates, and disseminates information received from higher headquarters, from the fighting units, from adjacent units, and from special patrols. He interrogates prisoners. He establishes observation posts and directs their operation. He keeps a current situation map for the information of the commander and other members of the staff, and from time to time distributes sketch maps which show the situation to the fighting elements.

(2) Special engineer units may in extreme emergency be engaged in combat. In units for which the Tables of Organization or Training Regulations do not prescribe the intelligence personnel, the commander designates an officer and several enlisted men as such.

122. Ammunition supply.—*a. Initial supply.*—The initial supply of ammunition is carried in part on the individual and the balance upon the combat wagons of the unit combat train. The part carried on the combat wagons, termed "extra munitions," is issued prior to, or during combat. The wagons are then used for procuring and distributing replenishments of ammunition.

b. Distribution.—(1) Distribution during combat is accomplished through ammunition distributing points established by all echelons from the regiment to the platoon, inclusive.

(2) In regiments the supply officer is responsible for the procurement of the ammunition and its delivery to battalion ammunition distributing points. To do this he uses the vehicles of the headquarters and service company as far forward as they may go with reasonable safety. From there on he uses carrying parties or pack animals, if available, and delivers the ammunition to the battalion ammunition distributing points. In some cases it may be practicable for the supply officer to make deliveries to company ammunition distributing points.

(3) The battalion commander is responsible that his companies are supplied with ammunition. He may handle this by detailing carrying parties from the company in reserve. Such parties do not return, but remain as reinforcements at

the front. If it be impracticable to send carrying parties, he may direct the companies in the firing line to send back details to the battalion ammunition distributing point.

(4) The company ammunition distributing point is some convenient spot directly in rear of the company from which the company commander effects delivery to his platoons. In effecting forward delivery the company commander may designate carrying parties from the support platoon or he may require each platoon to do its own carrying.

(5) The principles of ammunition supply given above apply to all engineer units, general or special, when engaged in combat.

123. Signal communication.—By the term *signal communication* is meant all methods and means employed to transmit dispatches. The agencies of signal communication ordinarily available to engineer units include the message center, messenger system, wire system (telephone), runners, and whistle signals. Some of the agencies used by troops of other arms, but not usually available to engineer units, include radio, panels, pigeons, pyrotechnics, the telegraph, and signal lamps.

a. Regimental signal agencies.—Engineer regiments establish wire communication with the command posts of their battalions. If the regiment is attached to a brigade, the brigade signal personnel establishes wire communication with the regimental command post. The regiment establishes a messenger service of motorcyclists, bicyclist, mounted messengers, or runners, as conditions warrant, from the regimental command post to the command posts of its battalions, attached units, adjacent regiments, and of the brigade (if attached to a brigade, otherwise to the division command post), to the regimental rear echelon, and to supporting units.

b. Battalion signal agencies.—The regiment establishes wire communication to the battalion. Wire communication from battalion to lower units is not employed. The battalion establishes a message center and a messenger service of runners or other class of messengers from the battalion command post to the command posts of the companies, adjacent battalions, attached units, supporting units and the regiment.

c. Company signal agencies.—The first sergeant is usually the company message center. Runner communication is established to the platoons, to adjacent companies, to supporting and attached units, and to the battalion.

SECTION II

DIVISIONAL ENGINEERS IN COMBAT

124. Combat regiment.—The combat regiment when employed as a unit in combat operates under the general principles prescribed in TR 420–100 and 420–170, or Infantry Field Manual, Volume I (when published), with such modifications as may be necessary on account of the difference in organization and equipment of its various echelons. The following infantry weapons are lacking: Machine guns, infantry howitzers, 37-mm. guns, and rifle grenades. Its headquarters and service company lacks a communication platoon and an intelligence platoon. The regiment enters into combat as a 2-battalion regiment, each battalion with 3 companies and each company with 2 platoons of 4 squads each. The regimental headquarters is divided into a forward echelon and a rear echelon. In preparation for combat the regimental commander designates the position or positions to which transportation is conducted, designates personnel to remain with transportation. has the ammunition issued, and arranges for an additional supply of ammunition.

a. Echelons.—(1) The *forward echelon* comprises the two battalions and the regimental command group. The command group operates the regimental command post and directs and controls the actions and movements of the regiment and maintains communication with the battalions and with adjacent units. It consists of the regimental commander, the executive officer, the intelligence officer, the operations officer, and reconnaissance and communication personnel from the headquarters and service company.

(2) The rear echelon consists of the adjutant, the supply officer, regimental transportation and equipment not utilized in the operation, the rear echelons of the battalions, the band, and such personnel of the headquarters and service company as may not be employed with the forward echelon. The number of men with the rear echelon depends upon the tactical situation and is decided by the regimental commander. The rear echelon may be dispersed in several locations as it may be necessary to supply engineer service at division headquarters, at supply and water points, and other locations while the regiment is employed in rifle combat.

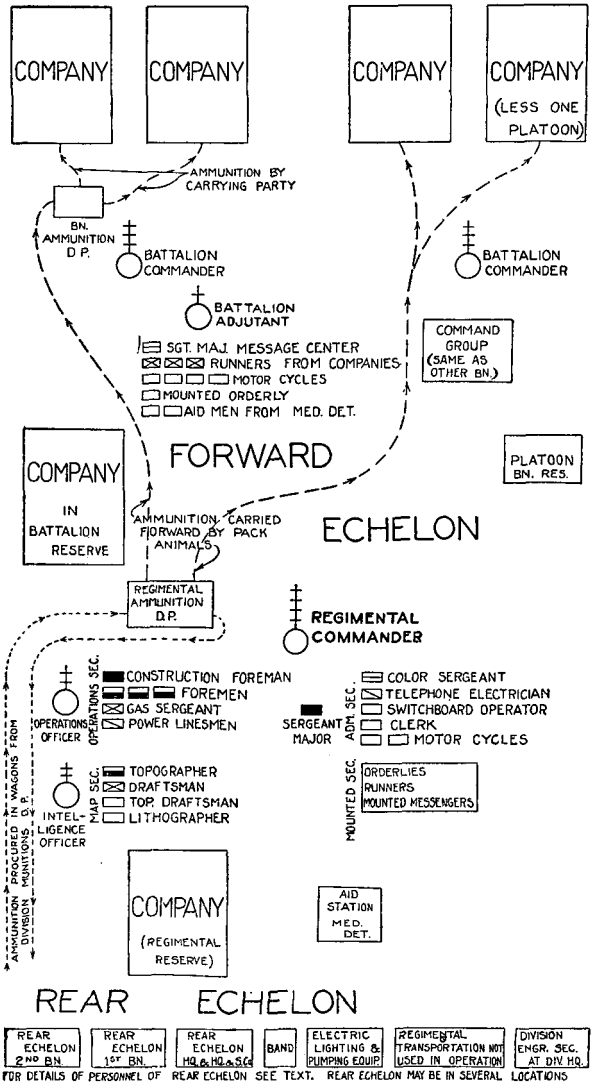


FIGURE 21.—Combat regiment in combat. (Tactical dispositions shown hereon are not prescribed. Schematic only. Not to any scale)

b. Band.—The band forms part of the rear echelon and is employed in the emergency as directed by the regimental commander. It may be employed to assist in the care of the regimental transportation and equipment, thus releasing men for service with the forward echelon, or to assist in supply operations and engineer service or to assist the medical detachment.

c. Headquarters and service company.—(1) The headquarters and service company furnishes the personnel for the regimental command post, cares for the engineer transportation and equipment not employed in the combat operation, carries on such divisional engineer service as may be necessary to continue, provides for the ammunition and general supply of the companies in the line, and may furnish personnel to replace losses in the line companies. It does not enter into combat as a unit. The allotment of its personnel to various duties follows no prescribed rules but varies to meet the various situations from the unusual case when all engineer functions are dropped by the regiment and transportation and equipment are abandoned, to the normal case where the regiment is employed in combat for a relatively short period of time after which all engineer functions are resumed immediately.

(2) The company headquarters usually forms part of the rear echelon handling routine company supply, administration, and messing. The second lieutenant remains in charge.

(3) The headquarters platoon is divided between the forward and the rear echelons.

(*a*) *Division engineer section.*—The division engineer section, with the assistant to the division engineer in charge, remains at division headquarters and carries on the routine functions of the office and keeps liaison with the division headquarters.

(*b*) *Administrative section.*—The sergeant major, one staff sergeant, telephone electrician, switchboard operator, and one clerk, assisted by personnel from other sections, operate the message center at the command post and connect the battalions to the command post by telephone. The adjutant, with the remaining personnel, remains with the rear echelon handling administrative matters and the message center work of the rear echelon.

(*c*) *Map section.*—The intelligence officer with 4 men is at the command post in charge of combat intelligence. The master sergeant, with the remaining personnel, remains with the rear

echelon prepared to execute emergency reproduction work and map issues.

(*d*) *Operations section.*—The operations officer, with the noncommissioned officers of the section, is usually at the command post. The enlisted personnel assists in the preparation and execution of orders and is available for combat reconnaissance. The electrician and stationary engineers are in the rear echelon in charge of the care or operation of the electric lighting and pumping equipment. The linesman usually joins the message center and assists in the maintenance and operation of the telephone system.

(*e*) *Supply section.*—The supply section, with the supply officer and assistant supply officer, is at the rear echelon. It handles routine supply and the supply of munitions.

(4) The service platoon is divided between the forward and the rear echelon.

(*a*) *Platoon headquarters.*—The platoon commander is in immediate charge of the transportation at the rear echelon. The noncommissioned officers in general are at the rear echelon and assist in the care and operation of the transportation and tools. One horseshoer, 3 storekeepers, and the saddler are at the rear echelon. The remaining 10 privates may be attached to the forward echelon for patrol or observation duty or for use with the companies.

(*b*) *Motor section.*—The motor car is held at the rear echelon at the disposition of the regimental commander. The motor cycles are employed as follows: One remains with the division engineer section, 2 at or near the command post attached to the message center, 1 with the adjutant at the rear echelon, 1 with the supply officer at the rear echelon, and 3 in the rear echelon in reserve. The trucks (less such as remain in operation on engineer work) are in the rear echelon. If these trucks are made immobile, then a maximum of 2 squads may be used in the forward echelon. In such a case the truckmaster and 3 assistants, truckmasters, remain with the transportation.

(*c*) *Mounted section.*—The mounted section (less saddler and 2 orderlies for the rear echelon) joins the regimental command post for employment as orderlies, messengers, or on patrols. If the conditions are such as to preclude the use of mounted men at the command post, about 1 squad dismounted is available for use in the forward echelon.

(*d*) *Pack section.*—The pack section is in the rear echelon. It is utilized by the supply officer in getting munitions and supplies forward to the battalions.

(*e*) *Wagon section.*—The wagon section is in the rear echelon. The tool wagons are held available for the forward supply of intrenching tools. The rolling kitchen operates with the company headquarters section for messing. The ration and baggage wagons operate under the supply officer. Under emergency conditions the animals may be placed on a picket line and about one squad released for use with the forward echelon.

d. Medical detachment.—(1) The medical detachment operates in combat in general as prescribed in Sections IV and V, TR 405–40, with such modifications as may be necessary, on account of differences in organization between an engineer and an infantry regiment.

(2) Company aid men are not employed because the engineer battalion, having only 24 combat squads, is only 6 squads larger than an infantry rifle company. Two aid men are attached to each battalion. There is no battalion aid station, as the regimental aid station performs this function for both battalions. The veterinary officer, veterinary sergeant, and one enlisted man are with the rear echelon of the regiment. The remainder of the detachment is at the regimental aid station. The regimental surgeon maintains close liaison with the regimental command post.

e. Employment.—(1) The regiment may deploy with the battalions in depth or abreast. The deployment in depth is used for a deep advance, a long-sustained action, or a movement involving maneuver. The deployment abreast is used for a short advance, a brief action, or a movement in which the maneuver is not required. The regiment in the attack is made responsible for a front of from 180 to 500 yards.

(2) In the event of the regiment being supplied with infantry supporting arms, such units are handled by the regimental commander in general accordance with their employment with an infantry battalion.

(3) On account of the necessity of caring for its equipment and transportation, the regiment is rarely used for the pursuit, for long-sustained actions, or deep penetrations.

(4) In an organized defensive position the regiment occupies a sector with a front of from 500 to 1,000 yards.

f. Battalion.—The battalion, when employed as a unit in combat, operates under the general principles prescribed for Infantry in appropriate Training Regulations or Infantry Field Manual, Volume I (when published), with such modifications as are made necessary by the differences in organization. It enters into combat as a 3-company battalion, each company consisting of two 4-squad platoons.

(1) *Echelons.*—(*a*) The *forward echelon* consists of the battalion command group and the 3 companies. The command group directs and controls the actions and movements of the battalion and maintains communication within the battalion and with higher and adjacent units. It consists of the battalion commander, the adjutant, and personnel for messenger and observation service. The sergeant major acts as message center and is in direct control of the observation and messenger service. The other personnel available includes 3 sergeants (1 from each company), 4 motorcyclists (1 from battalion headquarters and 1 from each company), and the battalion mounted orderly. When operating with the regiment, personnel may be added from the headquarters and service company for telephone operation and for additional communication and observation service.

(*b*) The *rear echelon* of the battalion consists of the rear echelons of the companies and such battalion headquarters transportation as may not be utilized in the forward echelon. It includes all transportation pertaining to the battalion and its components with such attendant personnel as may be present. The number of men retained with the rear echelon depends upon the tactical situation and is decided by the battalion commander.

(2) *Employment.*—The battalion is rarely called upon to enter into combat except as part of a larger force. It normally deploys with 1 or 2 companies in the assault echelon and 2 or 1 company in the reserve echelon. The employment of all 3 companies in the assault echelon is exceptional. The battalion in the attack is made responsible for a front of 80 to 360 yards, depending upon the number of companies in the assault echelon. In an organized defensive position the battalion occupies a center of resistance, with a front of from 250 to 500 yards.

(3) *Fighting power.*—The fighting power of the battalion can not be compared directly with that of an infantry battalion because the platoons and companies of the former are smaller

and it lacks machine guns and infantry supporting weapons. It has 24 squads available for combat and has a fighting power equal to about one infantry rifle company reinforced by one platoon. The small size of its elements makes it somewhat easier of maneuver and control than such an infantry unit. If the battalion is given infantry machine-gun and supporting weapons assistance, the fighting power may be considered about equivalent to that of one-half an infantry battalion.

g. Company.—(1) *General.*—(*a*) The engineer company, when employed as a complete unit in combat, operates in general accordance with the principles prescribed for an infantry rifle company in TR 420–120, or Infantry Field Manual, Volume I (when published). It enters into combat with 2 platoons of 4 squads each. It has no rifle grenadiers and only 2 automatic rifles per platoon. It is divided into 2 echelons. The forward echelon consists of the command group of the company headquarters and the 2 platoons (less transportation and mounts). The rear echelon consists of the administration and supply group of company headquarters and the platoon and company transportation and mounts. The rear echelon cares for the company's engineer equipment during the combat.

(*b*) In preparation for combat, the company commander causes ammunition and automatic rifles to be issued if not already in the hands of the individuals and designates the personnel to serve with the forward echelon.

(*c*) The transport and mounts are conducted by the second lieutenant to such points as may be designated for the rear echelons of the companies by the battalion or regimental commander.

(2) *Echelons.*—(*a*) In the *forward echelon*, the command group directs and controls the actions and movements of the company and maintains communications within the company and with higher and adjacent units. It consists of the company commander and personnel for messenger and observation service. The first sergeant assists the captain and acts as message center. The staff sergeant, under supervision of the company commander and the first sergeant, is in charge of the functioning of the command group. One sergeant reports as runner to the battalion headquarters. The other sergeant acts as observer or runner with the company commander. Two privates act as platoon runners. Other men not with the rear

echelon assist in observing and act as runners or may be assigned to augment the platoons. The minimum requirements are 7 men in addition to the first sergeant.

(*b*) The *rear echelon* consists of the second lieutenant, the mess sergeant, the supply sergeant, the stable sergeant, the company clerk, the 3 cooks, the mail clerk, the 2 wagoners, and such other personnel as may be necessary to carry on the routine duties of administration and supply. The duties of the rear echelon are to procure, prepare, and issue the ration, maintain the supply of ammunition, handle routine administration, and care for the tools, transports, and mounts. The company and platoon transportation forms part of the rear echelon. It is normally consolidated with the transportation of other companies at points designated by the battalion or regimental commander. The motor cycle reports to battalion headquarters. The tactical situation may require the transportation to be immobilized so as to release the maximum number of men for assignment to the forward echelon. The number of men retained with the rear echelon depends upon the tactical situation. If engineer work is to be taken up again promptly, the transportation must be left fully manned. If the company is to remain in the combat for an indefinite period, only such men are retained in the rear echelon as will care for administration and supply and give the minimum necessary care to the transportation and mounts. These are the second lieutenant, mess, stable, and supply sergeants, company clerk, the mail clerk, 3 cooks, 4 wagoners, and 2 miscellaneous men. The composition of the rear echelon is decided by the company commander when the company is operating alone and by the battalion commander when the company is operating with the battalion.

(3) *Employment.*—The company is rarely called upon to act alone in combat. In engineer operations, portions of the company may be used as security detachments. Normally the company is called upon to operate with its battalion or regiment. The company normally deploys with one platoon in the assault echelon and one platoon in the support echelon. In exceptional cases both platoons may be used in the assault echelon. In a defensive position the company occupies a strong point.

(4) *Fighting power.*—The engineer company may be considered to have a fighting power between that of an infantry rifle platoon and that of one-half of an infantry rifle company.

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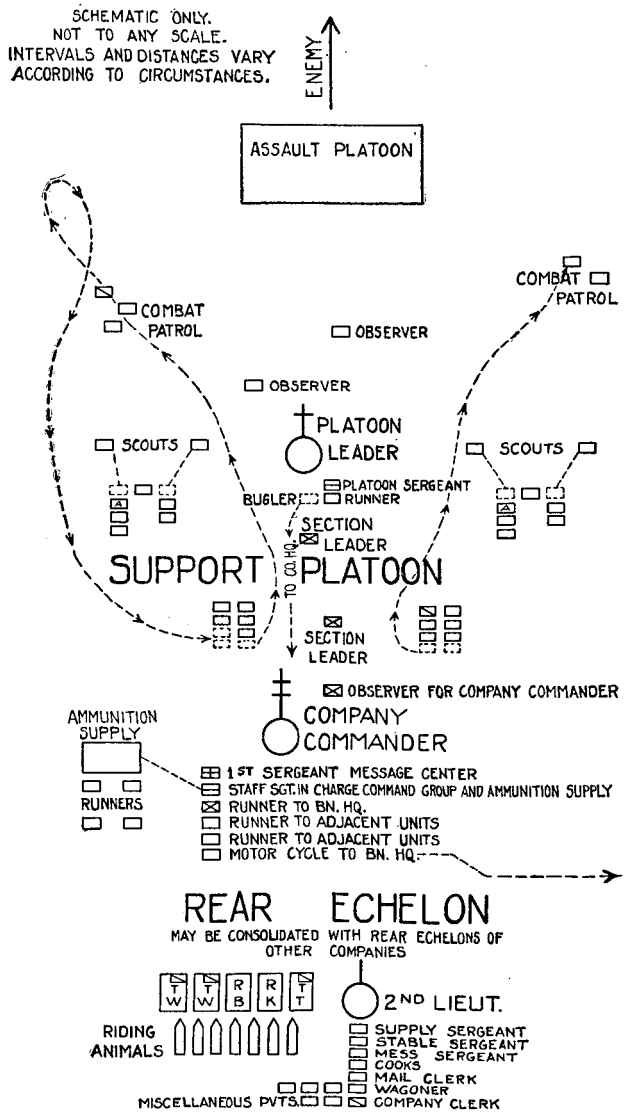

FIGURE 22.—Combat company in combat

h. Platoon.—The engineer squad operates in combat in general as an infantry rifle squad. The squad does not include a rifle grenadier. There is an automatic rifle in only one-half of the squads. Portable intrenching tools do not form part of the equipment. The combat operation most often required of the squad while its platoon is engaged upon engineer work is that of a reconnaissance patrol or a security detachment. The platoon commander divides the operating section of the platoon into automatic rifle sections for employment in combat. The automatic rifle section may consist of from 1 to 3 squads. It operates in combat in general as an infantry rifle section with one automatic rifle. The maneuvers of the sections are governed largely by the disposition made of the automatic rifle. The tool section remains in the rear under cover. The bugler is the platoon runner at the post of the company commander except when the platoon is operating alone. Before the platoon or any of its elements enter into combat, the ammunition carried in the platoon tool wagon is issued. Additional ammunition is provided by the company commander. The platoon operates in combat in general as an infantry rifle platoon at depleted strength.

125. Engineer squadron.—*a.* (1) The engineer squadron operates in combat in general accordance with the principles for a cavalry squadron in dismounted action. See the appropriate Training Regulations or the Cavalry Field Manual (when published).

(2) The squadron normally operates with 2 troops in the front line and 1 in support or reserve. Because of its mobility, the mounted troop is normally assigned to the support or reserve. As each troop normally deploys with only 1 platoon in the assault echelon, the squadron in the attack ordinarily is made responsible for a front of 200 to 300 yards only. The fighting power of the squadron in dismounted action is about half that of the cavalry squadron.

(3) The mounted troop is not armed for mounted combat and hence can not be used in mounted action. However, the horses greatly increase its mobility. This fact makes it especially valuable as a reserve permitting its rapid shifting from place to place in accordance with changes in the situation.

(4) The headquarters and service company does not enter into combat as a unit. It furnishes the personnel for the

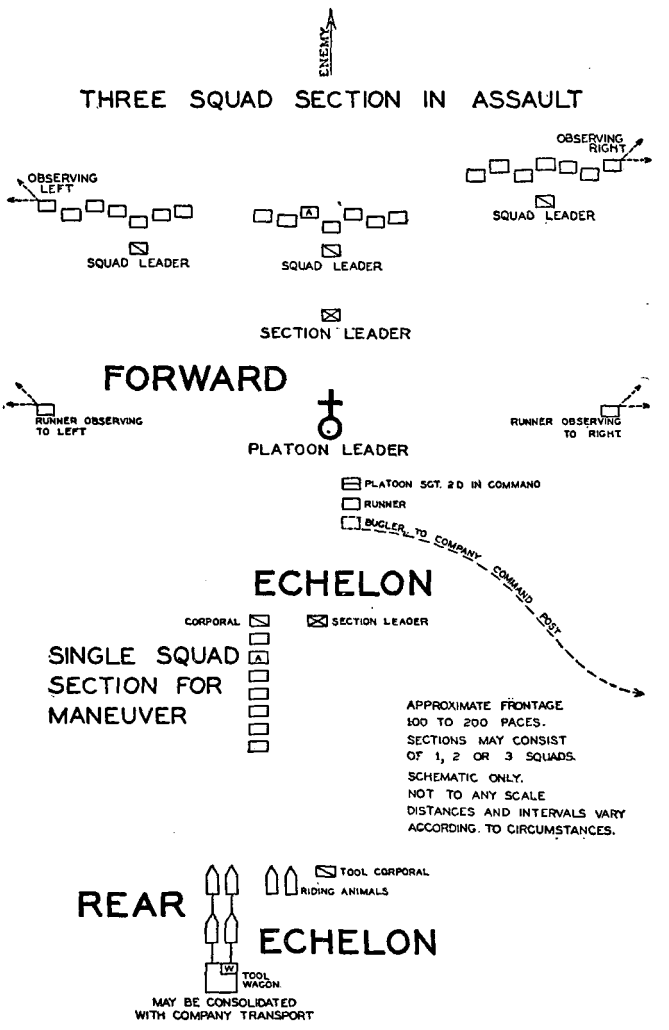

FIGURE 23.—Combat platoon in combat

squadron command post, cares for transportation and engineer equipment not employed in the combat, carries on such divisional engineering service as it may be necessary to continue, provides for the ammunition and general supply of the troops, and may furnish personnel to replace losses in the troops.

b. Echelons.—(1) The *forward echelon* consists of the command group and the 3 lettered troops. The command group controls the action and movements of the squadron and maintains communication with the troops and with adjacent units. It consists of the squadron commander, the executive officer, the operations and intelligence officer, and the necessary reconnaissance and communication personnel. The reconnaissance personnel is furnished by the map and operations section of the headquarters and service troop assisted by runners from the service section. The communication personnel operates the message center and maintains battle communications by runner. It comprises the sergeant major, the color sergeant, bugler, and one clerk from the administrative section at the headquarters and service troop. No telephone or other signal equipment is provided. Runners are furnished by the service section of the headquarters and service troop. The division engineer section remains at division headquarters.

(2) The *rear echelon* consists of the adjutant, the supply officer, the rear echelons of the troops, and such personnel of the headquarters and service troop as may not be employed with the forward echelon. The rear echelon may be dispersed in several locations as it may be necessary to supply engineer service at division headquarters, supply and water points, and other locations while the squadron is employed in rifle combat. The supply officer is responsible for ammunition supply.

c. Troop.—(1) *General.*—(*a*) The troop when employed as a complete unit in combat operates in general accordance with the principles prescribed for the cavalry troop in dismounted action. Compared to the cavalry rifle troop, the engineer troop has 1 less rifle platoon, has 2 machine rifles as compared to 6, has fewer men available for the command group of troop headquarters, and has tools and transportation to be cared for during combat. The troop normally deploys with 1 platoon in the assault echelon and 1 platoon in the support echelon. However, on account of the small size of each platoon, whenever the situation demands the prompt development of considerable

fire power, it is necessary to deploy the troop with both platoons in line.

(*b*) The troop is divided into a forward echelon and a rear echelon. The forward echelon consists of the command group of the troop headquarters and the 2 platoons (less transportation and equipment). The rear echelon consists of the administrative and supply groups of troop headquarters and the troop and platoon transportation, including the pack train in case of the mounted troop. In preparation for combat the troop commander causes ammunition and machine rifles to be issued, if not already in the hands of individuals. The transportation (including the pack train in case of the mounted troop) is conducted by a troop headquarters staff sergeant to such points as may be designated by the squadron commander for the rear echelons of the troops. In the case of the mounted troop, when the troop dismounts to fight on foot, the stable (guidon) sergeant takes charge of the led horses. Under the stable sergeant the platoon file-closer sergeants are responsible for the horses of their respective platoons. The troop commander indicates the general location for the led horses before leaving them. Thereafter, the stable sergeant is responsible for the disposition and movement of the horses and for maintaining communication with the troop commander.

(*c*) In the forward echelon, the command group directs and controls the actions and movements of the troop and maintains communication within the troop and with higher and adjacent units. It consists of the troop commander; the first sergeant, who remains with the troop commander, carries the field message book and is the troop message center; the 2 platoon buglers, who assist in maintaining communication, in observing, and receiving messages; and 2 runners, one from each platoon, who are used to maintain communication with the platoon.

(*d*) The rear echelon is charged with procuring, preparing, and issuing rations; securing and issuing supplies and ammunition; carrying on routine administrative matters and caring for and guarding tools and transportation (including the pack train in case of the mounted troop). It consists of one staff sergeant in command; the supply sergeant; the mess sergeant; the troop clerk; the 3 tool corporals; the blacksmith; the cooks; the saddler; the 4 chauffeurs and the personnel of the tool

section. These men carry on the duties as the staff sergeant may direct, including kitchen police and messenger service. Such men as are not needed in handling the work of the rear echelon are available for use with the forward echelon of the troop or the command group of squadron headquarters. The troop and platoon transportation forms part of the rear echelon. When the troop is used as a unit in combat the transportation is normally consolidated with that of the other troops at points designated by the squadron commander and left in care of small detachments under the general control of the headquarters and service troop. The tactical situation may require the transportation to be immobilized so as to release the maximum number of men for combat duty.

(2) *Employment.*—The troop is rarely called upon to act alone in combat. In engineer operations portions of the troop may be used as security detachments. Normally the troop operates with its squadron.

(3) *Fighting power.*—The engineer troop may be considered to have a fighting power approximately half as great as that of a cavalry troop in dismounted action.

d. Platoon.—The operating section, only, takes part in combat. The tool section remains in the rear under cover, generally with the troop rear echelon. The squads of the mounted troop dismount to fight on foot, and all squads operate in combat in general as prescribed for the cavalry rifle squad in dismounted action. The normal combat operation of the platoon acting alone is that of a security detachment for the local protection of the remainder of the troops engaged in engineer work. The platoon (operating section only) of the mounted troop dismounts to fight on foot, and all platoons operate in combat generally as prescribed for the cavalry rifle platoon. Deployed in 2 lines (2 squads in assault echelon and 1 in support), it occupies about 80 yards. Deployed in 1 line, it occupies about 160 yards. Before the platoon or any of its elements enter into combat, the ammunition carried in the platoon tool truck is issued. Additional ammunition is provided by the troop commander. The engineer platoon has a fighting power in dismounted action approximately equal to that of a cavalry rifle platoon dismounted. There are slight differences in that the engineer sergeants do not have rifles, and the engineer corporals and privates do not have pistols.

SECTION III

NONDIVISIONAL ENGINEERS IN COMBAT

126. General.—Nondivisional engineer troops when employed in combat follow the principles described in paragraph 124 for the combat regiment with such modifications as may be required by the differences in organization. The principal modifications are indicated in the succeeding paragraphs of this section.

127. General service regiment.—*a. Echelons.*—(1) The *forward echelon* consists of the regimental command group and the 2 battalions. The personnel for the command group is similar to that described for the combat regiment.

(2) The *rear echelon* includes the adjutant, the supply officer, the band, the rear echelon of the battalions, and such personnel and transportation as are not required with the forward echelon.

b. Headquarters and service company.—The headquarters and service company is employed in combat as follows:

(1) *Company headquarters.*—As in the combat regiment.

(2) *Headquarters platoon.*—As in the combat regiment, except that combat intelligence is handled by the drafting and designing section.

(3) *Service platoon.*—(*a*) *Platoon headquarters.*—As in the combat regiment.

(*b*) *Motor section.*—As in the combat regiment.

(*c*) *Animal section.*—The ration and baggage wagon is used by the supply officer in getting ammunition forward to the battalion. The riding animals are kept at the command post of the regiment for mounted orderlies and officers on reconnaissance. The rolling kitchen operates with the company headquarters section for messing.

(4) *Engineer platoon.*—The engineer platoon may furnish personnel for use as messengers or it may be used as a rifle section either in regimental reserve or attached to one of the battalions.

c. Medical detachment.—The medical detachment operates as described for the medical detachment with the combat regiment.

d. Employment.—(1) The general service regiment is employed in combat as described for the combat regiment. In an attack it is made responsible for a front of 270 to 750 yards.

(2) In an organized defensive position the regiment occupies a sector with a front of from 750 to 1,500 yards.

e. Battalion.—The battalion of the general service regiment operates in combat like the battalion of the combat regiment. Battalion frontage in an attack varies from 120 to 540 yards. In an organized defensive position it occupies a center of resistance with a frontage of from 375 to 750 yards.

f. Company.—The company of the general service regiment operates in combat like the company of the combat regiment. The personnel of the engineer section is utilized in the forward echelon of the company as a patrol, or it may be used to reinforce the platoons. The company normally deploys with 2 platoons in the assault echelon and 1 platoon in the support echelon. The company can be employed only as riflemen. It has no automatic rifles. The fighting power may be considered to be about equal to that of one-half of the infantry rifle company.

g. Platoon.—The platoon in the company of the general service regiment operates in combat, in general, like the platoon in the company in the combat regiment. One of the technical specialists of the platoon headquarters is the platoon runner at the post of the company commander except when the platoon is operating alone. The platoon has the same number of rifle squads as the platoon in the combat company. It has one more rifle squad than an infantry rifle section, but has no automatic rifles or rifle grenades. As a rough basis of comparison it may be considered to have about the same fighting power as an infantry rifle section and slightly less than that of the platoon of the company in the combat regiment.

128. Separate battalion.—The separate battalion engages in combat as a battalion of 4 rifle companies. The headquarters and service company and medical detachments are employed as in the combat regiment. The transportation joins the rear echelon. When the entire battalion is employed in combat it usually has 2 companies in the front line and 2 companies in reserve. In this formation it occupies a frontage of about 600 yards.

a. The *company* engages in combat in general according to the principles prescribed for the company of the combat regiment in paragraph 124. The employment of the company of the separate battalion in combat as riflemen is unusual, even when serving with the infantry division. When used in combat the company normally has 1 platoon in the assault echelon and 1

platoon in the support echelon. The fighting power of the company may be said to be approximately equal to that of two companies of the combat regiment.

b. The *platoon* engages in combat without changes in its basic organization, and operates in general accordance with the principles prescribed for the company in the combat regiment. The tool section remains with the rear echelon of the company. The platoon deployed in 2 lines occupies about 125 yards; in 1 line about 200 yards. The usual combat formation is with two sections in the assault wave and one in the support wave. The rifle power of the platoon is 50 per cent greater than that of the company in the combat regiment.

129. Other units.—The employment of special engineer units in combat is very rare, the principal combat uses being the small security patrol for protecting the operations of the units themselves. So far as practicable, they enter combat without changes in their basic organization. Special provision must be made for the supply of ammunition.

CHAPTER 6

ENGINEER OPERATIONS

SECTION I

GENERAL PRINCIPLES

130. Economy.—The military engineer exercises economy in the conduct of engineer operations, but economy of cost is a minor consideration. True military economy lies in accomplishing the mission with a minimum drain upon the military resources of the field force. It involves a consideration of the interrelation of available man power, materials, transportation, and time, and the required strength, durability, and capacity of the engineering structure. It frequently happens that to utilize materials locally available rather than to send back to a depot for more suitable materials effects such a saving of time and transportation that the resulting structure is truly economical, even though the use of the local material may have given it excess strength. At the same time economy requires as a general principle that engineering designs provide for only the minimum strength and durability. The engineer is careful to eliminate all nonessential features of the work.

131. Time element.—Strategical and tactical conditions set the limits on the time element for engineer operations. Since preliminary preparations greatly reduce the time element for engineer operations, warning as to decisions concerning prospective operations is given to the engineers at the earliest practicable moment.

132. Local resources.—Since engineer materials are generally heavy and require much transportation, the utmost use is made of materials obtained locally. This requires that active engineer reconnaissance be conducted for the location of materials and that steps be taken for the proper inventory and security of materials found. Skill and resourcefulness are required in adapting the means at hand to the accomplishment of the mission.

133. Practicability of engineer operations.—The practicability of engineer operations is determined by the factors of force, time, equipment, and materials. The time factor usually governs. Engineers never seek vague technical reasons for establishing the impracticability of proposed work. However, if technical considerations have a real bearing upon operations, they should be stated to the commander directly and simply as matters of fact.

134. Planning and control.—*a. General.*—The control of all operations, engineer operations included, is a function of the commander. General plans for the employment of the engineers are drawn up by his unit engineer. For certain especially important work the commander may prescribe the setting up of projects to be submitted for his approval.

b. Detailed planning and immediate control.—When an engineer unit has been directed to execute any general plan, the detailed planning for and immediate control of the operations are functions of the commander of the engineer unit assisted by his staff.

c. Estimate of the situation.—The engineer operation is preceded by a reconnaissance, an engineer estimate of the situation, and a decision. In general, the commander of the engineer unit charged with the execution of the work should make a personal reconnaissance. Regardless of reconnaissance previously made by his superiors, the leader of every subordinate echelon in the command makes further and more detailed reconnaissance. In making an engineer estimate of the situation, consideration is given to the mission to be accomplished, the time available, and the resources in men, materials, equipment, and transportation at the disposal of the unit commander. There is no prescribed form for an engineer estimate of the situation. In making an estimate of time, it is necessary to take account of the time

necessary for the transmission of orders, for the arrival of troops and equipment, for the movement of materials, and for deployment upon the work. The reconnaissance and estimate of the situation culminate in a decision which embraces—

(1) A plan for the employment of the troops.

(2) The general technical specifications of the work to be accomplished.

The decision of the engineer commander and his instructions to each echelon of his unit are made known to his command through the medium of field orders.

135. Command principles.—*a.* Engineer units must not be regarded as pools of laborers and mechanics to be allotted individually to each and every operation. An engineer organization is made up of a number of basic work units, each capable of executing a definite type and amount of work and of such a size as can be commanded by an experienced sergeant. It is so organized that it can be placed on a task rapidly and efficiently and so that it can be systematically combined with other units into larger groups for ease of control and supply. In combat regiments, general service regiments, and separate battalions, the basic work unit is the 4-squad operating section of the platoon. Company, battalion, and regimental organizations are agencies provided to coordinate, supervise, and inspect the work of groups of work units, to care for supply and administration, and to furnish men and equipment for tasks beyond the capacity of the normal means assigned to the basic work unit. Engineer supply is centered in the headquarters and service company, but the equipment of platoons and line companies is such as to provide for engineer supply. The above-mentioned organization for engineer tasks should be recognized by commanders of all units in making decisions as to the employment of engineer troops.

b. Regimental commanders usually apportion work to battalions and direct the use of the regimental headquarters units in assisting the battalion operations by furnishing transportation, supplies, special equipment, and expert technical personnel. The regimental commander and his staff officers make frequent visits to the various parts of the work, see that it is energetically prosecuted, and take corrective measures when such are found necessary.

c. Battalion commanders may be made responsible for all engineer work in a given area, or for all of one class of engineer work in a given area, or for one or more particular tasks. They assign their companies and attached units to parts or phases of the work and exercise the functions of command and inspection. They arrange with higher headquarters for the supply of engineer material, for the transportation of company equipment not taken on a special mission and for the attachment of extra personnel and vehicles as needed for a particular task.

d. Company commanders can usually divide their work into platoon tasks. The company headquarters then attends to the details of keeping the platoons supplied with materials, and in supervising and inspecting the work.

e. In the event of two or more engineer units being combined for work on a single task, as where a separate battalion is attached to a combat or general service regiment, the tactical disposition of such attached troops should preserve the chain of command within the attached organization. A portion of any attached unit should always be left under its own commander for work.

136. Transportation and supply.—The mission determines the use to be made of the transportation. Vehicles are loaded so as to meet the requirements of the engineer work in prospect. Transportation may be needed for working parties or for reconnaissance parties. The draft animals may be needed for work purposes. The most important use of the transport is for engineer supply. The equipment in the vehicles is unloaded so as to be available to the working parties. Empty vehicles are used in providing and maintaining the supply of engineer materials needed by the working parties. Materials may be drawn from local sources near the site of the work, from forward distributing points, or from engineer supply points. Many engineer missions require the assemblage of engineer material in quantity near the site of the work before construction is commenced. Much of the engineer supply must be done at night. Engineer supply is one of the main functions of the headquarters and service company. Every effort should be made to keep work units supplied so that they may place their full strength upon the actual execution of their work.

SECTION II

TECHNIQUE

137. Reconnaissance.—*a. Definition.*—Engineer reconnaissance is the technical examination or survey of an area, locality, installation, or utility with a view to obtaining engineering information upon which to base either tactical plans or plans for the initiation and execution of engineer work. It is a continuous function of every unit engineer and every engineer commander regardless of the size or character of his organization, and often involves the execution of a definite engineer operation primarily for the purpose of procuring engineer information.

b. Reconnaissance from the air.—The most advanced engineer reconnoitering element consists of engineer personnel accompanying the air service, or air service units which may have been given engineer reconnaissance missions. This reconnaissance may be by direct observation or it may be photographic.

c. Advanced ground reconnaissance.—The most advanced ground engineer reconnaissance is made by the engineer squadron with the cavalry. Army engineer reconnaissance is always one of the most important missions of this unit. The scope of this reconnaissance is very broad, embracing not only the engineer phases of the cavalry operations but also the entire engineer situation in the area so far as it may affect army operations in general.

d. In the infantry division.—In the infantry division the work of engineer reconnaissance devolves upon the engineer combat regiment. It centers in the operations officer, who, under the direction of the division engineer, causes the necessary reconnaissance operations to be undertaken and reconnaissance reports to be rendered. He evaluates the incoming information and decides upon its disposition. The work of actual compilation, graphical reproduction, and dissemination of the results of reconnaissance is handled by the intelligence officer. The foregoing should not be construed to mean that the conduct of reconnaissance is exclusively a function of any one engineer staff officer. The drafting of the order for a reconnaissance operation is supervised by the operations officer, but portions of the order are prepared by the other engineer staff officers. For example, the supply officer may prepare the plan

for the reconnaissance of engineer supply, and the intelligence officer may prepare a plan for topographical reconnaissance. Nevertheless, since reconnaissance is generally undertaken with a view to the initiation of engineer work, the operations officer is likely to be most vitally concerned with it.

e. In corps and army areas.—Continuous engineer reconnaissance of corps and army areas is conducted by the respective unit engineers. Close liaison is maintained among them and with unit engineers in adjacent areas and in the divisions. In an advance this liaison is especially important, rapidly changing conditions sometimes necessitating almost hourly reports.

f. Personal reconnaissance.—A unit engineer personally carries out reconnaissances which are of such critical importance that they may influence the decision of the commander with respect to the conduct of operations. In other cases he intrusts reconnaissance missions to officers and units under his orders. An engineer commander of a small unit makes a personal reconnaissance before every operation. Commanders of battalions and regiments make personal reconnaissances of a general nature, but usually delegate detailed reconnaissance to their subordinates.

g. Tactics of reconnaissance.—(1) When an engineer unit moves into a new area or locality, or undertakes a new type of work, an engineer reconnaissance of the area or locality or work is the first operation that should be initiated by the unit commander. This reconnaissance precedes the work, but should never delay it, since the troops may be given missions based upon information reports, maps, and photographs prior to the completion of the reconnaissance.

(2) In some cases, a brief visit by a single individual to the site of the work prior to the arrival of the troops may suffice as an engineer reconnaissance. In other cases the reconnaissance may require the employment of a large number of individuals or parties working under various commanders in accordance with a general scheme and may be an operation of considerable magnitude requiring careful preparation and time for its execution.

(3) A reconnaissance party may consist of an individual or a small group of individuals or it may be a detachment of considerable size. It includes a leader, usually a commissioned officer, and selected specialists who have the necessary technical knowledge to observe and report upon the essentials. If con-

sidered necessary, a number of messengers may be included in the party in order to bring back reports at stated intervals or when especially important information has been discovered by the party. If operating in territory where a foreign language is spoken, the reconnaissance party should include an interpreter. If operating in unfriendly territory, the party should include personnel whose principal mission is to furnish protection to the reconnoitering personnel.

(4) The reconnaissance party should be equipped with transportation, which may be horses, motor cycles, automobiles, airplanes, boats, or railway motor cars. The individuals should each carry a map, watch, compass, notebook, and several pencils including colored pencils. In addition to the foregoing essential items of equipment, any or all of the following articles may be found useful according to conditions: Camera, sketching board, field glasses, measuring tape, weapons, food, knife, candle or flashlight, matches, hatchet, chalk, and engineering manual.

(5) The leader of the reconnaissance party is informed as completely as practicable of the general conditions governing prospective tactical and engineer operations, in order that he may be able to evaluate correctly the possible effect of what he observes upon the general plan. He is also given all available information from information reports, maps, photographs, and military intelligence agencies.

(6) The reconnaissance party proceeds in accordance with a definite plan which is stated in clear and precise orders, usually in writing. The orders set forth such matters as the reason why information is desired, the area or installation to be reconnoitered, what particular information it is necessary to get, the route to be followed, the time of departure, the time and place at which reports are to be rendered, and information as to other patrols.

(7) The kind of information to be obtained by a reconnaissance party may be anything from a simple statement of a single fact to a complete catalogue of engineer information of an area. It is essential, therefore, that the leader of the party know the kind of reconnaissance which he is to make. The kind of reconnaissance most frequently required consists of a brief examination by a technical specialist, followed by an estimate of the steps to be taken and the materials required to carry out the engineer work which the reconnaissance shows to be necessary. The strength and capacities of important

structures are determined with as great precision as possible since an exaggeration in one sense or another can lead the commander to abandon the execution of certain operations which could have favored his plans, or to order operations to be undertaken only to have them fail or be retarded on account of technical difficulties.

h. Reports.—The results of the reconnaissance are usually embodied in a clear, concise, written report. The clarity of the report is enhanced by neat sketches or by photographs. The date, hour, and name of the person making the reconnaissance are always included. Blank forms may be devised for use both in making a reconnaissance and in reporting the results of a reconnaissance. A consideration of each item shown on a form insures against overlooking any important particular. The entry of exact data on forms serves to prevent exaggeration. The compilation of information obtained by a number of reconnaissance parties is facilitated when form reports have been used.

138. Intelligence.—Engineer reconnaissance is but one of the sources of engineer information. Routine and special reports giving engineer information are made by all engineer commanders to their superiors and all engineer commanders disseminate information to their subordinates. In any engineer headquarters the mass of information thus received is evaluated by the commander and his staff. Evaluated engineer information is engineer intelligence and becomes the basis of the decisions made by the engineer commander.

139. Orders.—*a. General.*—Engineer operations are initiated and carried on through the medium of field orders. Engineer field orders are generally composed in the 5-paragraph form prescribed in Field Service Regulations for combat orders. Such parts of the standard form as are manifestly unnecessary for the accomplishment of the mission may be omitted at the discretion of the commander. In addition to the formal field orders, operations may be carried on through the medium of dictated and oral orders, messages, and oral instructions.

b. Standard form.—Application of the standard form to engineer field orders is given below. It should be noted, however, that supply, construction, and the handling of engineer transportation are operations from the point of view of one engineer and that consequently the employment of troops upon these operations is directed in paragraph 3 of engineer field orders.

c. Heading.—The usual form for the heading is as follows: Title, place, date and hour of issue, serial number, and map references. The title appears in the upper right-hand corner of the first page. It is the official designation of the command and should show the numerical designation and kind of engineer unit and usually the tactical unit to which it pertains, for example:

6th Engrs (C) 3d Div,
345th Engrs (Gen Serv) I Corps,
Engr Hq II Corps,
501st Engrs (Sep Bn) First Army,
673d Engrs (Ry Hq) CZ.

d. Body of the order.—The body of the order consists of the usual five paragraphs as follows:

(1) *Paragraph 1* (information).—This paragraph usually has three subparagraphs. Subparagraph *a* contains information about the enemy. Subparagraph *b* contains information about our own troops and particularly about the major echelon of which the engineer command forms a part or serves. Subparagraph *c* contains engineering information essential to the unit for the execution of its engineer mission.

(2) *Paragraph 2* (decision).—This paragraph contains a general statement of what the engineer command is to do in the operation. It shows the composition of the command, its general mission and the area in which it works. If the field order covers the use of the engineer unit as riflemen in combat, this paragraph gives, when appropriate, the objective, the time of attack, the line of departure, the direction of attack, and the zone of action or sector of the command (boundaries).

(3) *Paragraph 3* (missions for subordinate units).—This paragraph gives a definite mission or task in an appropriately lettered subparagraph (*a*, *b*, *c*, etc.) to each of the fractions of the command. Subparagraph *x* is used for instructions applicable to all or several elements of the command and may include such items as priorities of work, reports, reconnaissance, and types and methods of construction to be employed.

(4) *Paragraph 4* (administrative details).—This paragraph is devoted to administrative details, including instructions for supply, evacuation, traffic, trains, personnel, and miscellaneous kindred matters, the order following in general that prescribed for an administrative order. These instructions are those es-

sential for the routine supply and administration of the engineer command itself. Instructions for the conduct of engineer service for the tactical command appear in paragraph 3.

(5) *Paragraph 5* (command).—This paragraph follows normal practice except that the location of the command posts of adjacent engineer units as well as tactical units may be necessary.

e. Annexes.—Annexes may be used to simplify the engineer field order or to amplify it when additional data in considerable detail are essential for the proper execution of the engineer plan. Maps, overlays, and sketches or layouts of the work to be done are particularly valuable in clarifying and simplifying the instructions. The various paragraphs of the engineer field order may be amplified by annexes as follows:

(1) *Annex to paragraph 1.*—An annex may be used to elaborate any one of the subparagraphs. Paragraph 1 *a* may be enlarged upon in a written annex, situation map, or overlay, showing a summary of enemy information with special reference to the engineer features of the enemy situation or terrain in our immediate front. Such an annex is prepared from data obtainable from general staff intelligence agencies. Similar annexes to subparagraph *b* might be used to give a general statement of the commander's plan of operation, the disposition of the major elements of our force, zones of action, boundaries, installations, and other details relating to our own force which may be necessary for the intelligent execution of the engineer work required in the operation. Subparagraph *c* may be elaborated by an annex showing the general engineer situation of our own force, including distribution of engineer troops, engineer supplies and installations, and the status of engineer work. This annex may be prepared from engineer intelligence reports and situation maps.

(2) *Annex to paragraph 2.*—This annex may be used to show the organization of the engineer command and the area disposition of the various engineer echelons as ordered for the operation.

(3) *Annex to paragraph 3.*—This annex may be used to show in detail the engineer work to be done, movement and march tables, priorities of work, types of construction, and various plans, such as the water-supply plan, engineer-supply plan, the camouflage plan, the reconnaissance plan, and the plan for organization of the ground. Each of the foregoing may be made

as a separate annex. Map, overlay, or sketch annexes are particularly valuable for this paragraph.

(4) *Annex to paragraph 4.*—This annex may be used to give such extracts from the administrative order issued by the tactical commander as may affect the routine administration of the engineer unit. It usually includes a copy of the circulation map and part of the traffic plan, since these are of especial interest to engineer troops engaged upon maintenance of roads.

(5) *Annex to paragraph 5.*—This annex may be used to give to the engineer units pertinent extracts from the signal communication plan and the location of the command posts of units of all arms within the area served by the engineer units.

(6) Annexes are numbered serially for each field order. The subject matter of an annex is indicated by its title.

f. Appendixes and exhibits.—When an annex has attached to it supporting or amplifying documents, the latter are called appendixes or exhibits. They are frequently necessary in the field orders issued by the unit engineer of large units. They are numbered serially for each annex and are given a title descriptive of the subject matter.

g. Distribution.—The distribution list given at the end of an order shows exactly to whom the order is sent, the number of copies issued, and the serial number of each copy. The unit engineer or engineer commander usually prescribes standard distribution lists for orders which he issues, such lists being designated as Distribution A, B, C, etc. The usual distribution of an engineer field order includes copies to the commander and the unit engineer of the next superior echelon, to the staff of the tactical unit to which the engineer unit pertains, to each subordinate fraction of the engineer command, and to commanders of other units with which the engineers are cooperating.

140. Engineer features of division, corps, and army field orders.—The unit engineer of the division, the corps, or the army prepares data for and submits to the general staff the engineer portions of the field or administrative orders and their annexes, appendixes, and exhibits which are issued by the commanding general of the division, corps, or army. These include—

a. Field orders.—(1) *Engineer paragraphs.*—(*a*) The tactical mission and disposition of the engineer elements of the

command appear as a subparagraph to paragraph 3. In a division field order this paragraph may direct the attachment of engineers to brigades or other tactical echelons, the employment of engineers in the organization of the ground, the use of the engineers as a combat reserve, the assignment of engineers to a demolition mission, or the use of engineers in operations involving river crossing. Such a subparagraph is generally brief. When the amount of detail is considerable, an annex to the field order may be required to amplify this subparagraph. In corps and army field orders this subparagraph may direct the attachment of engineer units to division or corps or the assignment of units to such missions as the organization of the ground. Frequently paragraph 3 of the field order of a corps or army contains no reference to the engineers, since it may happen the latter are to be employed exclusively on matters of logistics which are covered in paragraph 4.

(*b*) The major portion of the engineer mission is usually a matter that is appropriately included in paragraph 4 of the division, corps, or army field order. When the amount of engineer matter is very great, it is placed in the administrative order.

(2) *Engineer annexes.*—When the tactical employment of the engineers involves the statement of a plan in too great detail for inclusion in paragraph 3 of the unit field order, it may be necessary to include the plan in an annex. Such an annex is given a number and an appropriate title, usually "Engineer." It is a directive to be followed in the operation and serves primarily to inform all concerned of the part played by the engineer elements of the force. It may sometimes be practicable to use a copy of the engineer field order as this annex. Where no administrative order is issued, an annex to paragraph 4 may be used to set forth engineer phases of the logistics of the operation. In field orders, which direct the organization of the ground for defense, an annex entitled "Organization of the Ground" may be used to amplify paragraph 2 of the order.

b. Administrative orders.—(1) *Engineer paragraphs.*—Paragraph 4 of the field orders of divisions and larger units usually consists of simple reference to the administrative order. The unit engineer prepares those portions of the administrative order that cover engineer operations.

(2) *Engineer annexes.*—The major portion of the engineer mission usually appears in the administrative order of divisions and larger units in the form of an annex entitled "Engineer Plan." This annex is usually a brief statement of the engineer part in the operation in such detail as may be required to inform the major tactical units and the other arms and services of the salient features of the engineer plan. It may sometimes be practicable to use a copy of the engineer field order as this annex, but usually this entire order is not necessary, and an abstract containing only the essential features may be made for the purpose. Engineer instructions for the engineer arm of subordinate tactical echelons usually appear in this annex. In addition to the engineer plan, the unit engineer makes recommendations for the plan of circulation and is charged with the final preparation of the annex entitled "Circulation Map."

c. Engineer bulletins.—The unit engineer prepares engineer bulletins, either occasional or periodical, which serve to inform tactical commanders, staff officers, and heads of services as to the engineer situation. He also makes such reports as are required to the unit commander or his staff. The unit engineer is also concerned with the dissemination, to troop units of the engineer arm, of information and instructions with reference to the technique of engineer work.

141. Organization for the work.—In the great majority of tasks to be performed by engineers in the combat zone the troops can be placed upon the work without disrupting their basic organization. When the regular organization of engineer units is utilized, time is gained in getting the work started, and best efficiency is maintained, since all parts of the command work under the direction and observation of their own leaders. The engineer commander analyzes the work into elements which are suitable for assignment to subordinate subdivisions of his command. This may involve dividing the whole job into areas, to each of which a subordinate unit is assigned, or it may involve separation along functional lines such as supply, transportation, and erection, with a subordinate unit charged with each. Still another method is to divide the work into parts, assigning a unit to each part; thus, in a long bridge construction, the abutments, approaches, piers, and superstructure may be handled concurrently by separate fractions of the command.

142. **Execution of the work.**—*a.* Engineer tasks in general are fatiguing. The handling of earth, heavy timbers, and cumbersome machinery makes great demands upon the strength of the troops. It is, therefore, often advisable to work by shifts or reliefs.

b. An officer in charge of engineer work should leave the actual handling of the men to the noncommissioned officers. This permits the officer the freedom of movement necessary to proper supervision of the whole operation.

c. Technical specialists furnished by headquarters sections do not assume charge of operations, but on the contrary are placed under the orders of the commander of the unit charged with the work.

d. Nicety of execution or finish is not demanded.

e. The principal conditions favorable to satisfactory progress of engineer work are—

(1) Careful preparation.

(2) Employment of troops under their own leaders.

(3) So far as practicable, the permanency of the units upon a mission until it is accomplished.

(4) The maintenance of a reserve in supplies and man power to meet emergencies.

(5) The distribution of the command in such a manner as to permit removal of units for emergency use elsewhere.

(6) Organization of reliefs.

(7) Uninterrupted supply of material in accordance with needs.

(8) Constant regard for the morale and welfare of the troops.

(9) Presence of, and supervision of work by, the responsible officers.

f. Engineer work should be so carried out that the parts completed are immediately usable no matter what the progress of the project as a whole. Thus, it is better for military purposes to construct one railroad siding complete, ready for use, than it is partially to complete several sidings.

143. **Care and use of equipment.**—Tools are to the engineer soldier what weapons are to the infantry soldier, the implements with which he accomplishes his mission. Without his tools the engineer soldier is ineffective. With his tools in poor condition his efficiency is lowered. Reasonable care will keep

the tools available and in good shape. A systematic method should be used in the issue of tools. When a tool is no longer in use it should be returned. Cutting edges are kept sharpened. All tools are cleaned and oiled before returning to storage. Construction plant such as tractors, cranes, concrete mixers, and steam engines are kept in repair and when not in use are guarded to prevent pilfering.

SECTION III

SECURITY AND INTELLIGENCE

144. Security.—*a.* In general, security for engineer troops is provided by the security measures taken by the commander of the fighting troops. However, the engineers must always provide local security and may in unusual cases be called upon to furnish detachments for general security. The principles of security should be understood by all engineers.

b. When an engineer unit is engaged upon engineer work the leader of the unit takes steps for the security of his command. Aside from ordinary attacks and raids, the possibilities of enemy interference which must be guarded against include enemy patrols which infiltrate past our own front line; enemy aerial bombing and photographic activities; poison gas concentrations; partisans, guerrillas, and snipers; spies; and subterranean mines.

c. Protection against ground patrols and guerrillas is obtained by detailing patrols of from two men to a squad to circulate in the vicinity of the work prepared to fire upon any enemies and to give warning of their strength and disposition.

d. Protection against aerial activities is provided by detailing one or more observers to give warning of the approach of hostile aircraft. If there is reason to believe that the work is being observed or photographed by the enemy, the leader causes his men to disperse and take cover. Low-flying airplanes may be driven off by rifle fire.

e. When it is known that the enemy uses poison gas, one or more sentinels properly trained in gas detection should be detailed to observe shell bursts and approaching clouds of smoke or gas and to give warning by prearranged signal in order that the working troops may put on gas masks.

f. Snipers may sometimes seriously interfere with engineer work and may stop it altogether. The best protection is to post sentinels in groups of two in advantageous positions to observe and try to discover the location of the sniper. One man then fires while the other observes through field glasses and reports results.

g. Spies may often obtain employment with civilian groups doing work under engineer troop supervision. The engineer noncommissioned officers handling these groups are cautioned to observe and report any person in civilian clothes who shows unusual curiosity about the work or about troop activities in the vicinity.

h. Engineer troops engaged upon work at or near the front invariably stack arms near by under guard. The leader determines upon a plan of action in case of enemy interference and in large units this plan may be published in an order. In rear areas where enemy interference is improbable arms may be kept in camp or barracks while the troops are engaged upon engineer work.

i. When engaged in subterranean mining operations, listeners are posted to discover evidence of similar enemy operations. Flank galleries may be driven to permit listeners to protect the main gallery from countermining activity. When discovered, enemy underground structures are destroyed by camouflets.

j. In the unusual case when an engineer unit is furnishing advance, flank, or rear guards, the formations prescribed for infantry in similar circumstances are adopted. Engineers may have to furnish outposts for their own bivouac in which case the principles of outposts for infantry apply with the obvious limitations imposed by the lack of machine guns and howitzers in engineer units.

k. Commanders of engineer bridge trains and supply trains take steps to protect their columns when on the march in unfriendly territory. The general principles of march security apply and where the personnel of the unit is insufficient to furnish the protection demanded by conditions the commander applies for assistance from other troops.

l. In addition to security against enemy activity it is a general rule that all engineer commanders take measures to guard all equipment and stores in their possession.

145. Intelligence.—For the principles of combat intelligence see paragraph 121.

SECTION IV

DIVISIONAL ENGINEERS

146. General principles.—*a.* The divisional engineers comprise the engineer combat regiment which is an organic part of the division, and such additional general or special engineer troops as may be assigned or attached to the division.

b. The commanding officer of the combat regiment is the division engineer. He commands also any additional engineer troop units attached to the division unless they have been specifically exempted from his control.

c. The best results from the engineers may be obtained when all the engineer troops of the division operate solely under the orders of the division engineer and for the benefit of the division as a whole. Where engineers are attached to infantry or artillery brigades, it should be for the accomplishment of a particular task, upon the completion of which they revert to the control of the division engineer. For example, in a river crossing, engineers may be attached to the leading tactical elements to provide footbridges or ferries. Once the crossing has been effected, their attachment ceases and they again become subject to the orders of the division engineer.

d. Conditions may exist in which it is apparent that a tactical unit or group will have numerous but not definitely foreseen needs for engineer assistance over a considerable period of time. In such cases it is well to detach from the division engineer troops a suitable engineer contingent for duty with this unit or group. The use of engineers with an advance guard is an example. Good teamwork is facilitated when detachments to work with a given brigade or other tactical echelon are always made from the same battalion or company.

147. Combat regiment.—*a. Regimental headquarters.*—(1) The function of the regimental headquarters is to direct the execution of the engineer work required in the infantry division. It is a command and staff headquarters, its agencies being the administrative, planning, and supply sections of the headquarters platoon, the working units included in the service platoon, the band, the two battalions, and any attached troops.

(2) The regimental commander, having made an engineer estimate of the situation, determines upon a plan of operations, assigns missions to the various elements of his command, and

by close inspection and careful planning during the execution keeps all elements engaged upon such engineer work as may be necessary to assist the division in its operations. The battalion is the unit to which major missions are assigned but in exceptional cases companies or even platoons may be detached and given missions directly by the regimental commander. He decides as to the assignment of additional transportation to the battalions under special conditions. The proper utilization of the transportation in the maintenance of engineer supply to the working parties is one of the chief functions of regimental headquarters after missions have been assigned to commanders. The regimental commander must be prepared at all times with plans to meet probable developments and emergencies and his assignment of missions and distribution of troops must be made with these in view.

b. Band.—The primary mission of the band is to furnish music to aid the morale. When present with the regiment in the combat area, the band may be employed by the regimental commander upon such work as the emergency may require, usually to assist in the operation of the regimental headquarters and in the service of supply.

c. Headquarters and service company.—This unit is employed almost entirely on special work. It furnishes the personnel for the operation of the regimental headquarters sections, for the execution of special engineer work for the division as a whole, and for general engineer supply. Properly handled, it permits the battalions to execute their missions without being required to furnish details for headquarters service. Individuals and small detachments from the headquarters and service company may be attached to the battalions from time to time for the execution of special work, but the headquarters and service company can not be counted upon to furnish additional man power to the battalions.

(1) *Headquarters platoon.*—The administration of the headquarters platoon is carried on by the commander of the headquarters and service company, but the personnel of the various staff sections report for operations to the respective staff officers at regimental headquarters. The staff duties of these sections are covered elsewhere in this manual. The following subparagraphs describe some of the engineering operations which these sections perform.

(*a*) The *administrative section* operates under the adjutant. When engineering matter is reproduced on the mimeograph machine the stencils are drafted by the map section. The machine is operated by the administrative section. This section installs and operates the telephone equipment which permits a limited telephone service in the regiment and connection to the division telephone system. Under most situations when the battalions are separated and engaged upon area work they can be reached by telephone only through the division system, since only 4 telephones and 2 miles of wire are available in the combat regiment.

(*b*) The *operations section* reports to the operations officer. It furnishes the electricians to set up and put into operation the electric lighting equipment. One man is needed for its operation and 3 men for the ordinary field wiring. Field command post wiring takes about an hour and a half when the reels of wire have the leads with the sockets already attached. About 120 lights can be wired, and the plant must usually be within 300 yards of the command post. Thirty lights will meet the normal requirements of a division command post. The water-supply pumping set is operated by the enginemen in the operations section. This equipment can be put into operation in about half an hour. The hand pumping sets are usually issued to companies as needed. The storage basins are for erection at water points, the total capacities of the three basins being 12,000 gallons. The water sterilizing sets are used at water points or are issued to the companies for use as needed.

(*c*) The *supply section* handles the administrative work for all routine supply for the regiment and for all engineer supply for the division exclusive of maps. When an engineer distributing point is established a sergeant storekeeper is placed in charge.

(*d*) The *map section* prepares maps, plans, designs, and graphical reports for general use. The lithographic equipment, the duplicator, and the mimeograph are used in the reproduction processes. One of the most frequent requirements is the preparation of G–3 situation and operations overlays and G–2 situation maps. The photographer of the map section develops and prints films which have been exposed by the companies and those which have been taken with the regimental camera. Under special situations, a photostat machine may be carried by the map section. The surveying, sketching, and mapping equipment is cared for by the map section and the personnel

of this section may execute work with this class of equipment. Surveying and reconnaissance equipment may be issued by the regimental commander to the battalions or to detached companies for special work. Standard topographic map work is not a normal mission for the combat regiment. The transit, level, and plane table permit the making of ordinary location surveys and simple operation and control work. The sketching outfits are carried for general use and are employed on reconnaissance, locations, and estimates. The regiment is not equipped for general mapping. One plane table party, one transit and stadia party, and one level party are the maximum that can be used with the available equipment and the rate of progress of mapping rarely exceeds one square mile per day. For correction of existing maps with the aid of aerial photographs, the equipment may be supplemented by the sketching outfits and reconnaissance instruments and 4 plane table parties employed, but the personnel must be taken from the battalions for this work. The stereoscopes are available for correcting maps and making guide maps from aerial photographs. This work is done largely in the drafting room and can not be commenced until the photographs are available.

(2) *Service platoon.*—(*a*) The service platoon is the chief agency of the regiment and the division engineer for engineer supply for the regiment and for the division. It cares for and handles all means of transportation other than that assigned to the battalions and the medical detachment. As a general rule all transport is unloaded on the completion of a march and the vehicles are placed immediately upon the supply of engineer materials. The footbridge is carried for issue to the battalions or detached companies for use in tactical stream crossing operations where the engineers assist the assault troops, or it may be used by the engineers to facilitate the construction of bridges. The intrenching equipment carried in 6 tool wagons is for general use by the infantry of the division. It is transported by the engineer regiment and sent forward to be issued to the infantry according to tactical requirements. Additional explosives, ammunition, gasoline and oil, and chemical warfare protective equipment are normally carried by the service platoon.

(*b*) The personnel of the service platoon headquarters executes for the regimental headquarters, band, and headquarters and service platoons such repair and upkeep as may be necessary, including blacksmithing, carpentry, cobbling, harness re-

pairing, horseshoeing, painting, pipefitting, saddlery, tinsmithing, and minor repairs to the transportation and machinery. Much of its equipment is not in continuous use and individuals are not permanently assigned for the operation of each set of equipment.

(*c*) The motor section furnishes the motor car and motor cycles with side cars for reconnaissance and inspection.

(*d*) The mounted section cares for and delivers the mounts which are used by any personnel designated by the headquarters to conduct reconnaissance. Mounted section personnel may accompany such parties to furnish horse holders.

(*e*) In the pack section, the 16 pack animals are detailed to the battalions or to detached companies for general supply use where other forms of transportation are impracticable. The pack train is also used for the maintenance of ammunition supply when the regiment or its components are in line as riflemen in combat. When not so used the pack equipment may be drawn upon for demolition, pioneer, and carpenter tools for headquarters work and for the operation of small groups of men on special work in emergencies.

d. Medical detachment.—When the regiment is engaged upon engineer work, its echelons are frequently distributed over a wide area. This necessitates that medical personnel be attached to battalions or separate companies or that arrangements be made by the regimental surgeon to have medical service furnished by medical installations of other units in the division zone of action.

e. Battalions.—(1) The battalion headquarters directs, controls, and assists the operations of the 3 companies and any attached troops. The battalion has no special personnel for administration and supply, and such must be furnished by regimental headquarters if the battalion is to operate away from the regiment.

(2) The battalion commander, having made an engineer estimate of the situation, divides the work among the companies. He decides as to the manner of operation of the company transportation when conditions render it necessary or desirable to detach transportation from the companies. He arranges with the regimental headquarters for the supply of engineer material, for the transportation of company equipment which the companies may be temporarily unable to care for, and for the attachment of extra personnel and vehicles from the headquarters and

service company. His orders consist of definite directions to his company commanders. Only in special cases does he detach platoons for work not under their company commanders.

(3) The battalion is called upon either to accomplish a definite engineer task or to execute engineer work within the limits of a definite area. In the latter case the battalion commander is in charge of the execution and inspection of all work in this area, except work of a special nature that may be carried on by regimental headquarters or by higher echelons. The detailed execution of this work is carried out by the company commander in accordance with missions assigned by the battalion commander.

f. Companies.—The company headquarters directs, controls, and assists the operations of the 2 platoons. The company commander divides the work between company headquarters and the platoons in such a manner as to leave the platoons intact for operation as units. Routine, administrative, and supply operations, and miscellaneous small special tasks are assigned to company headquarters. Platoons are assigned tasks such as fully utilize their strength and equipment. Engineer reconnaissance and engineer supply are important functions of the company headquarters. Men from company headquarters may be used to replace losses in platoons or to augment the working strength of the platoons. The company can ordinarily operate on a detached mission provided all of its transportation is left available to it.

g. Platoons.—The mission assigned to a platoon must be within the limits of its equipment and strength unless additional material, equipment, or personnel is furnished. The platoon commander assigns definite missions to his sergeants and commanders of working parties and makes the necessary assignment of his technical specialists. He assigns men to working parties, retaining the squad organization as far as possible. Corporals and technical specialists actually perform work and are not used exclusively as overseers. The platoon commander must see that his working parties are supplied with material, and he uses his transport accordingly. The platoon commander should not in general command a working party in person, except in emergencies, and then only until a new commander for the party may be designated. As the nature of engineer work is such that the platoon commander can not be present at all times, the noncommissioned officers

are given responsibility. The tool wagon invariably accompanies the platoon while the platoon is engaged upon work. The tools are unloaded, and the wagon is used for hauling supplies.

h. Capacity for engineer work.—For general engineer work the combat regiment can furnish 12 basic work units or 384 men. By means of its planning and supply agencies it can so arrange and control the work as to keep these working parties fully employed, and by providing for supply can facilitate and accelerate the work of the battalions.

148. In an advance.—*a. Duties.*—In an advance, the division engineers are employed on any or all of the following duties:

(1) Engineer reconnaissance.

(2) The removal of obstructions on roads, including mines and traps.

(3) The repair, extension, and construction of roads for division traffic.

(4) Facilitating the passage of waterways by improving fords; strengthening, repairing, or constructing bridges; and installing and operating ferries.

(5) Marking routes and localities by signboards.

(6) The collection of data for the correction and amplification of existing maps.

b. Strength and position in column.—Engineer troops, when available, are invariably used with the advance guard. The strength of the engineer portion of an advance guard is fixed by the length of the march to be made and the estimate of the work to be done during the march. The usual allotment varies from a company to a battalion. From an examination of existing maps, from airplane photographs, and from such information as may be obtained from covering forces a fairly accurate forecast of the use of the engineers can be made. The strength for the engineer element of the advance guard and the position of the engineers in the column should be governed accordingly, consideration being given to the work to be expected of the engineers at the end of the day's march. As engineers are ineffective without their transportation and tools, it is an accepted principle that engineers in the advance guard must be accompanied by their vehicles. Where streams are to be crossed, bridge equipage should accompany the engineers of the advance guard, and it should never be

necessary to halt the column while bridge equipage is being brought up.

c. Command.—Engineers with the advance guard are under the orders of the advance guard commander, who is charged with the responsibility for facilitating the uninterrupted advance of the column. However, the senior engineer officer with the column exercises technical supervision over the operations of the engineers, and the commander of the engineer element of the advance guard makes such reports to the senior engineer as may be desired in connection with the technical features of the engineer work.

d. Execution of work.—It is desirable that the engineers have representatives with the most advanced elements of the advance guard, in order that timely warning may be given of engineering work which the engineers with the advance guard will be called upon to perform. The method of accomplishing tasks is to drop details at vital points where the need for engineer assistance exists or can be foreseen. These details may rejoin their unit, but ordinarily the demands for continuous maintenance at these vital points will preclude this being done. In this manner the engineer element of the advance guard may be rapidly depleted, and by the end of the march may be strung out along the roads at a number of points. The details may be picked up by trucks and carried in to their organization at the end of the march. It may become necessary to renew the strength of the engineer element of the advance guard by putting a new unit in during the march.

e. Security.—Security for the engineers is ordinarily provided by the infantry, but the leader of engineer troops engaged on work assures himself that such security is provided and so disposes his own forces that security patrols are maintained and that the engineers have ready access to their arms should hostile forces unexpectedly attack them.

f. Additional troops.—When the work essential to the advance is beyond the capacity of the advance-guard engineers to perform, it is necessary to ask for the assistance of troops of other arms. When such assistance is provided, the engineers may furnish technical experts, but the additional troops perform work under their own leaders.

g. Reconnaissance.—Continuous engineer reconnaissance is maintained during an advance and periodic reports of the results made to the next higher engineer echelons.

h. Employment of engineer troops.—(1) *Platoon.*—If a detached platoon is used with the advance guard, it can be expected to make only minor repairs, remove simple obstructions, and make a limited engineer reconnaissance, unless a prompt supply of material and extra personnel is made available. Usually not less than a company of engineers is assigned to the advance guard.

(2) *Company.*—The company is the smallest engineer unit that should be assigned to an advance guard under ordinary conditions. The company is strong enough to provide maintenance personnel for duty at the critical points encountered during the day's march. For long marches over poor roads, more than one company may be needed to keep the road open for the marching column. The company tool truck must be available for the rapid movement of material. The platoon tool wagons can be counted upon only for local hauling. In many situations the company must be reinforced by regimental personnel for reconnaissance and by specially loaded trucks from the regiment.

(3) *Battalion.*—In a movement upon one road, the battalion furnishing the engineers to the advance guard is normally assigned the mission of road maintenance during the march. It reinforces the advance guard engineers when they become depleted by the detachment of maintenance personnel, and is responsible that maintenance detachments are left at critical points until the column has cleared. On long and forced marches, it may be necessary to assign the leading battalion to the first half of the road and the rear battalion to the second half of the road. The company transportation and attached regimental transportation are made available for the road maintenance detachments and are disposed in the column accordingly. Company transportation may be consolidated if no work is required of the battalion during the march. If no work is required during or upon the termination of the march, company transportation may be entirely separated from the battalion. A battalion, with a marching column, having a road maintenance mission, keeps in communication with the engineers near the head of the column and disposes its elements so as to meet promptly the prospective requirements as to engineer work.

(4) *Regiment.*—The engineer regiment with a marching column has the primary responsibility of keeping the routes of communication open for the movement of the entire column.

In addition, it must arrange for engineer reconnaissance during the march and must have its various echelons disposed in the column so that they will be available for such special and general engineer work as may be required during and upon the termination of the march. Road maintenance and repair are usually assigned to the battalions reinforced by such additional transportation and equipment as may be necessary. The engineers are with the column to facilitate movement, and every effort must be made to have engineers present at critical points in ample time to remove obstructions and open the route without unduly delaying the advance of the column. The disposition of the transportation in column depends upon the work expected of the various echelons during the march and upon the termination of the march. The night march generally requires more engineers for road maintenance than the march in the daytime.

(5) *Special engineer troops.*—Special engineer troops needed with columns marching against the enemy are ponton bridge units and water supply battalions. The general rule for the location of ponton bridge units in the column is that they must be so placed that the equipage will be available at the proper time so that the column may cross the stream without waiting for the bridge equipage to be brought up. Water supply battalions may bring up water from points in rear of the columns and supply advance water points accessible to the most advanced troops.

(6) *Division engineer.*—The division engineer marches so as to be readily accessible to the division commander for consultation concerning the engineering features of the advance. He leaves the actual conduct of the operations of the regiment under the lieutenant colonel. He assures himself by inspection that the disposition of the regiment is such as to accomplish its mission and make such changes as appear necessary. He maintains liaison with the engineers of the advance guard, and if it should appear that their strength is about to be unduly depleted by detachments for engineer work, he recommends to the division commander the attachment of additional engineer troops to the advance guard. He keeps himself informed of the results of engineer reconnaissance by the advanced engineer elements.

149. **In a retirement.**—*a. Duties.*—In a retirement, some engineer troops are employed near the heads of the retiring columns on duties similar to those described in paragraph 148 for an advance and to accompany and assist the movement of the trains. In addition, engineers are needed at the rear of the columns for the following engineering work:

(1) To delay the enemy by destroying bridges, blocking roads, demolishing railways, and erecting barricades and other obstructions.

(2) To assist in the hasty organization of the ground for delaying action, including the preparation for defense of villages, farms, and woods.

(3) To destroy materials and stores so as to prevent their capture by the enemy, including guns, tanks, rolling stock, shops, ammunition, food, and other supplies.

b. The *engineers with the leading troops* reconnoiter for obstacles to the retreat and facilitate the retreat of the main body. They also place charges of explosives for the demolition of roads, bridges, and other important structures. The demolitions are then executed by the engineers of the rear guard.

c. Strength and position in the column.—The bulk of the engineers march at the tail of the retreating main body. The strength of the engineer component of a rear guard depends upon the work to be accomplished. It may vary from a company to a battalion with each column. Tool wagons must accompany the working units.

d. Demolitions.—Demolitions of important bridges or other structures are generally prescribed or authorized by the commander of the forces. It should be remembered, however, that when it is known that a bridge is to be destroyed the man on the ground is the best judge as to the proper time to destroy it. Engineer officers in charge of bridge demolitions must know the wishes of the commander of the forces and be prepared to execute the demolition at every place authorized.

e. Trains.—Trains are an encumbrance to a rear guard, and their number should be held to a minimum. Field trains and ration sections of combat trains of rear guard troops may march with the main body, usually at the tail, where they can readily join their organizations on halting. However, the engineer tool wagons must accompany the engineer work units.

f. Employment of the engineer troops.—(1) *Platoon.*—The tool wagon remains under the control of the platoon commander. A platoon executes successive demolitions along a route operated by echelons, namely, a charging party and a firing party. The necessary explosives are left at the demolition locations by the company and regimental supply agencies. The explosives in the platoon tool wagon should be used only for emergencies.

(2) *Company.*—The company is normally the smallest engineer unit detached for service with a rear guard. Its mission is generally demolitions and the construction of obstacles. Road maintenance is performed by men detached from units of the main body. As the column retreats, these men serve to augment the rear-guard engineers. The company moves by bounds and echelons. If extensive demolitions are contemplated, additional transportation is assigned the company. The company tool truck and motor cycle must be available for handling supplies.

(3) *Battalion.*—(*a*) The leading engineer battalion is usually responsible for road maintenance for the column and operates in a manner similar to that of the leading battalion in an advance.

(*b*) The rear battalion may or may not be assigned to the rear guard. If so assigned, it operates under the command of the rear guard commander. It coordinates and controls the work of the engineer companies.

(4) *Regiment.*—There are invariably engineering duties throughout the entire route of a division in a retirement. This requires a separation of the regiment into parts appropriate to the conditions at the head and tail of the column. The part at the tail is usually attached to the rear guard. This detachment varies in strength from one company to practically the entire regiment, depending upon the importance and extent of the engineer operations of the rear guard and the condition of the roads over which the division is retiring. If these roads are in poor condition, the maintenance of roads may be of more importance than any engineering needs of the rear guard action and may require the bulk of the engineer regiment.

(5) *Special engineer troops.*—Ponton bridge units, if available, precede the retreat in order promptly to place any ponton bridges required. These bridges remain in position until the bulk of the rear guard has crossed, the last covering troops being ferried over the stream. The decision as to the time for

removing floating bridges rests with the commander of the rear guard, but technical questions relating to the removal of the bridges and ferrying operations are handled by the engineers.

(6) *Division engineer.*—The most important duty of the division engineer in a retirement is to assure himself through reports and by personal inspection that the roads over which the division retires are kept passable.

150. In an attack.—*a. Duties.*—In preparation for and during an attack the divisional engineers may be employed as follows:

(1) To improve roads for troop movement, supply, and evacuation, and to provide a plan for traffic circulation.

(2) To accumulate stores of engineer materials for use in the attack and in the consolidation of captured ground.

(3) To assist in the organization of captured ground for defense against counterattack by the construction of defensive works and the supply of tools and engineer materials for other troops.

(4) To construct advance landing fields for the Air Corps.

(5) To locate, mark, and improve the sources of water supply in captured areas.

(6) To mark routes to the new locations for troops.

(7) To provide means for the rapid advance of the artillery and tanks over the shell-torn ground by filling in or bridging trenches and shell holes, clearing roads through woods, and bridging streams.

(8) To conduct reconnaissance for engineer supplies left by the enemy.

(9) To assist infantry in the passage of obstacles by constructing bridges and by cutting barbed wire entanglements with tools or explosives.

(10) To prepare posts of observation and command for unit commanders and artillery observers.

(11) To construct bridges over streams paralleling the direction of attack to facilitate the lateral movement of reserves.

b. Preparations.—It is essential that engineers be given warning of a proposed attack in ample time for them to make attack preparations. Prior to an attack, it is necessary to establish dumps of engineer material, especially road material to be used on shell-torn roads at the front immediately following the first phases of the attack. Where streams flow across the line of

attack, it is necessary to concentrate bridge-building material both for crossing foot troops and for crossing the artillery and trains of the division.

c. Consolidating new position.—If the attack is halted, the engineers may be used in consolidating the new position. This requires the construction of certain field-fortification works such as command posts and observation posts, and the provision of tools and materials with which the infantry clears fields of fire, erects obstacles, and digs trenches. The advancing of dumps of engineer tools and materials, the opening of water-supply facilities, and the placing of direction signs may be required.

d. Pursuit.—In the pursuit of the enemy following a successful attack engineers accompany the pursuing columns with duties similar to those described for engineers in an advance. The employment of the divisional engineer troops themselves upon a pursuit mission would involve the temporary abandonment of engineer work, but this may be justified by the higher necessity of inflicting decisive damage upon the retreating enemy. One or both of the battalions may be so used either jointly or independently.

e. Employment of the engineer troops.—(1) *Platoon.*—The engineer platoon in the attack may be assigned a special mission with some combat unit such as a battalion of infantry or a battalion of artillery. To be of greatest assistance, the platoon leader must work in close cooperation with the commander of the unit to which attached. The platoon should revert to its own company for use on other engineer work as soon as circumstances permit. The tool wagon is kept available, but in the early stages of the attack, material and equipment may have to be carried by hand. Part of the pack transportation of the headquarters and service company may be attached to the platoon.

(2) *Company.*—The company in the attack frequently operates at some distance from battalion or regimental headquarters. Usually it is employed upon the improvement of routes of communication. The amount of work that the company can do with its men and tools alone is relatively small. It is generally necessary that special material be procured and prepared in advance, and that arrangements be made for the supply of this material to the working units. The company should, wher-

ever possible, be given a definite mission, such as to repair certain bridges or open certain roads.

(3) *Battalion.*—The battalion usually has control of engineer operations within a definite area. It always has an assembly point for use in the event of its being required to participate in combat, but normally the battalion is kept engaged upon engineer work unless and until it is actually needed in the fight. Its usual mission is the improvement of routes of communication.

(4) *Regiment.*—(*a*) The headquarters and service company is used in preparing for an attack, to assemble materials at forward engineer dumps; to provide technical specialists for special tasks incident to the attack and for the internal supply for divisional engineers. Certain men are detailed to conduct special reconnaissance. If additional transportation has been attached to the division for engineer work, it operates under the direction of the commander of the headquarters and service company.

(*b*) The battalions are generally employed upon the routes of communication, the special engineer work being done by the headquarters troops. If engineers are attached to brigades for the operation, the division engineer must retain sufficient engineers under his own control to care for the road work behind the brigades and to operate the special equipment provided for the service of the division. Units attached to brigades should revert to regimental control as soon as they have accomplished the mission for which assigned. The regiment is to be considered as always available for division reserve and should always have forward points designated where it can assemble its combat echelons within a definite period of time for combat use in emergencies. Until such time, the regiment should carry on its engineer work and should not be held inactive in a position in reserve.

(5) *The division engineer.*—The division engineer has his command post at the headquarters of the combat regiment. He maintains contact with division headquarters and with all engineering operations within the division area whether under his direct supervision or not. He makes technical reports directly to the corps engineer, informing him of the engineering features of the attack.

151. In the defense.—*a. Duties.*—The duties of the engineers in the defensive are:

(1) To supply at convenient distributing points the tools and engineer material necessary for the organization of the ground for defense.

(2) To open, improve, and mark routes of communication necessary for troop supply and evacuation, and to recommend a plan for traffic circulation.

(3) To assist in organization of the ground by executing work of a special character such as demolitions or obstacles, by constructing works of general utility such as command and observation posts requiring strong protection against fire, and by technical assistance to other troops.

(4) To improve the facilities for water supply.

(5) To provide camouflage material and to give assistance and expert advice as to its use.

(6) To conduct mining and countermining operations.

(7) To provide maps and to record on existing maps the defensive works constructed by our forces.

(8) To construct rearward defensive positions.

b. The priority of work in advance positions is determined by the principle that considerations of fire effect take precedence over those of cover. After the location of combat emplacements has been fixed, first priority is ordinarily given to clearing the field of fire and removal of objects masking our own observation and of those within the position capable of serving as reference points for hostile observation and fire. These measures are ordinarily followed by provisions for camouflaging the works to be constructed; then construction of the various defensive works (fire trenches, observation posts, command posts, message centers, cover for reserves, obstacles, dummy works, masks) and the marking and preparation of routes of approach for reserves.

c. Employment of the engineer troops.—(1) *Platoon.*—An engineer platoon, assigned to some tactical unit in the defense, is normally employed upon the improvement of routes of communication, the execution of defensive works requiring technical skill or special tools, or the preparation and supply of material to be used in field fortifications, such as revetment, trench accessories, and wiring. The platoon tool wagon should be available to the platoon.

(2) *Company.*—The company is ordinarily the smallest engineer unit that is detached from the regiment and attached to a tactical unit in the defense. The company may be assigned to

some sector. If so, its mission is usually the improvement of communications and the execution of tasks requiring special technical skill. Under such conditions, the company commander becomes the sector engineer.

(3) *Battalion.*—The battalion usually is assigned control of engineer operations within a definite area. It always has a forward assembly point for use in the event of its being employed in the fire fight, but normally is engaged on engineer work until it is actually needed.

(4) *Regiment.*—The regiment in the defense operates in a manner similar to that described above for the regiment in the attack. The regiment is to be considered as always available for division reserve and should always have forward points designated where it can assemble its combat echelons within a definite period of time for combat use in emergencies. Until such time, the regiment should carry on its engineer work and not be held inactive in a position in reserve. The principal work is invariably the maintenance of the routes of communication.

(5) *Division engineer.*—The division engineer maintains his headquarters in close proximity to that of the division commander. He makes a careful reconnaissance of new defensive positions in rear and prepares a plan for their occupation should a withdrawal be directed by the commander. He makes visits to the subordinate echelons of his own command to sustain their morale and visits the command posts of other units to assure himself that the engineers are furnishing the assistance required by the fighting troops. He pays especial attention to the supply to the troops of all arms, tools, and materials which are needed to increase the defensive strength of the position. Liaison with the division engineers of divisions on the right and left and with the corps engineer is of great importance. When necessary, the division engineer requests additional troops for use on engineer work and arranges with the corps engineer to relieve the division engineer troops of responsibility for road maintenance as far forward as possible. He has a map of the sector prepared and kept up to date.

152. In a river crossing.—*a. General.*—River crossings require special preparations, both technical and tactical, proportionate to the size of the river and the strength of the command. Reconnaissance by division staff and engineer officers furnishes the basis for the selection of the crossing points and the execution of the necessary preparatory measures. As the

tactical features of a river crossing in the face of the enemy usually predominate over technical considerations, the engineers participating in the operation are usually attached to the tactical units making the crossing.

b. Tactical features.—The tactical features of a river crossing begin with the surprise crossing of the first few infantry troops under cover of darkness or smoke and the projection of artillery and machine-gun fire and fire from airplanes. These troops swim or cross on light footbridges, or they may be ferried in boats or on rafts. When a bridgehead has been established on the far bank of the stream, ponton bridges are constructed for the passage of trains and light artillery. When the progress of the leading troops warrants it, more substantial bridges are constructed for the passage of the remainder of the forces.

c. Engineering features.—The engineering features of a river crossing involve—

(1) The reconnaissance of the stream, to determine upon points suitable for ferrying and bridging operations, with special consideration of the routes leading to and away from the bridges. Aerial photographs are useful in making this reconnaissance.

(2) The adoption of a plan for the use of engineer troops, including both those attached to tactical units making the crossing and those remaining under the control of the division engineer.

(3) Preparation for the crossing by the procuring and placing of the bridge material and supplies for bridge construction. This may require the procurement of additional floating bridge equipage from higher engineer echelons, or it may require the extemporization of bridging expedients from local resources.

(4) The operation of ferries.

(5) The construction of ponton bridges.

(6) The construction of fixed bridges to replace ponton bridges.

(7) The maintenance and guarding of bridges and marking of routes of approach thereto.

d. Employment of the engineer troops.—(1) From the nature of this kind of operation, it is important that the assignment of engineer personnel to tasks incident to the crossing should be by organizational subdivisions and following the chain of command. Thus, where computation shows that the engineer work requires a certain number of engineer soldiers for pontoniers.

guides, and bridge-building details, the assignment of the tasks to an engineer unit (platoon, company, battalion, etc.) insures the coordination of, and best results from, the employment of the engineer troops.

(2) When ponton bridge units are attached to the division, they come under the command of the division engineer at a designated time and place. He assigns missions to their commanders which insure the delivery of the bridge equipage to the using troops in accordance with the plan of the operation. The ponton bridge unit commander with such personnel as he desires reconnoiters the routes over which he is to advance. He makes provision for the disposition of the transportation after the delivery of the equipage. When the crossing has been accomplished he assumes responsibility for the guarding and maintenance of the bridges, and at the proper time, under orders from the division engineer or of higher headquarters, dismantles them.

153. In beach combat.—*a. Forced landing.*—Prior to the initiation of the operation, the division engineer makes a reconnaissance of the beaches upon which the division is to land. This reconnaissance may be made by the examination of available maps, by offshore reconnaissance, or by an examination of aerial photographs. The object of the reconnaissance is to determine the existing routes of communication leading from the beaches to the objective and to help in devising a plan for the improvement or construction of the necessary additional routes and to determine the character and location of local resources which can be used in the engineering operations.

(1) The preparation for the engineering features of the landing should be as complete as possible. Ponton equipage is very useful for rafting tanks and artillery from the troop ships to the shore and for constructing piers. Some ponton equipage should be included in the cargo of the troop ships and should be so stowed that it can be easily launched in the early stages of the operation. In addition to the pontons, a limited supply of bridge timbers should be transported on the troop ships for use by the engineers in constructing or repairing wharves on the beach, especially if there is no standing timber in the locality which could be used for this purpose.

(2) The order in which the troops debark is fixed by the division commander. Some engineers should be among the first troops to land so as to make an early engineer reconnaissance

of the beach head. An engineer party should be debarked soon after the first infantry troops, to establish at once a suitable landing place for boats. This may require removal of obstructions. A wharf of some kind is usually the next work. This is followed by the construction or improvement of the routes of communication into the interior. If the country be mountainous, nothing more than paths up the sides of the hills and cliffs may be practicable at first. These paths are subsequently enlarged into trails for pack animals, and eventually are improved into roads. The strength of the engineer component of the beach party varies with conditions, but it is probable that one engineer company at each landing beach will suffice. If the transportation can not accompany the unit at first, the men carry pioneer tools and a limited supply of spikes and lashings. The pack animals of the regiment should be landed and made available for engineer work as soon as practicable.

(3) The question of adequate water supply is generally a serious matter. The engineers should be provided with water purification units, and a supply of casks for transporting fresh water should be on board each troop ship. In developing the beach head, the engineers construct storage tanks for water supply.

b. Beach defense.—(1) In the defense of the coast against hostile landing operations, the engineers assist in the laying out and construction of organized tactical localities and the placing of underwater obstacles if the tide and other conditions favor their use. While a passive defense in organized lines is unusual in coast defense, it is nevertheless the duty of the engineers to reconnoiter and mark, and perhaps prepare for defense, rearward positions which may be occupied in case the tactical situation demands it. They also plan demolitions to delay the enemy, but do not execute them except upon orders of the division commander, particularly where the structures to be demolished are of importance in contemplated counteroffensive operations.

(2) The routes for the movement of reserves are perfected and a plan is made for the employment of the engineers upon the routes for each possible enemy advance. On account of the uncertainty as to the exact point of the enemy's major effort, the maintenance of the road net over such a wide range as enemy activities may conceivably cover becomes the most important preoccupation of the division engineer.

(3) The engineers of the divisional regiment are deployed upon the roads in accordance with the estimate of their probable need which is made by the division engineer. Some portion of the regiment is held in reserve.

(4) The routes of communication over which reserves may move are marked with suitable signs.

154. In the rest area.—*a.* When the infantry division is in the rest area the engineers of the division conduct their own training and recuperation activities in accordance with the general programs and directives of the division commander. In addition, they are employed upon engineering work usually of a nature to increase the comfort and improve the morale of the division troops. Such work has good training value for engineers. This work may include:

(1) Repairing billets, stables, mess halls, and recreational structures.

(2) Constructing target ranges.

(3) Improving the water supply.

(4) Furnishing electric light.

(5) Maintaining roads in the area.

(6) Replacing engineer equipment of troops.

b. The troops occupying a given rest area change from time to time as the refreshed troops move out and tired troops come in. In order to maintain a continuity of engineering policy within the area the unit engineer keeps a file of pertinent papers and maps to turn over to his successor showing the lay-out of the area and the suitability of each part of it for troops of various classes, the status of construction work, the sources of water supply and road metal, an inventory of engineer supplies and their location, the condition of the roads, and the circulation plan for traffic.

155. Engineer squadron.—The engineer squadron performs or supervises the engineer work in the cavalry division.

a. General.—(1) *General principles of employment.*—The squadron may operate as a whole under the immediate command of the squadron commander, or it may be necessary to assign separate platoons or troops to subordinate tactical units of the division. On account of the differences in their transportation and tools an important decision required is whether to assign units of the motorized troops or of the mounted troop to these detached missions. The basis of the decision is the degree of mobility of the tactical unit concerned, and the character of the

engineer work required and the practicability of operating motor vehicles. The principle to be observed is that the engineer unit selected should have sufficient mobility to enable it to keep up with the cavalry unit to which attached, and at the same time have tool equipment appropriate to the work in view. In general the mounted troop should be employed in forward areas. Its primary mission is engineer reconnaissance and hasty repair. This is necessitated by the limited capacity of its engineer tools and transportation and by the necessity of its keeping up with the advance cavalry elements and performing hasty repair to insure their passage. As a general rule the mounted troop performs hasty repair and reports the nature and extent of the engineer work. The motorized troops with their more complete equipment and cargo capacity for engineer materials are then sent forward to do the necessary work.

(2) Cavalry operating in advance of the army, or the cavalry division with the army, executes the earliest tactical ground reconnaissance in the forward zones of the theater of operations. The engineer squadron of the cavalry division, therefore, executes the first engineer ground reconnaissance in these forward zones. Upon the thoroughness and promptness with which this reconnaissance is made may depend to a large degree the success of the engineer operations of the army. Therefore the plans of the squadron commander should provide for continuous and thorough engineer reconnaissance in addition to whatever engineer operations may be involved in the tactical plan of the cavalry division itself. Advantage should always be taken of the presence of the engineer units with the advance guard or other detachments to carry out such reconnaissance, and, whenever practicable, engineers should be attached to cavalry reconnoitering detachments for engineer reconnaissance purposes, even when not otherwise required. It is a function of the commander of the engineer squadron to assign additional means for this work to troops or platoons on detached missions. Members of the headquarters sections of the headquarters and service troop may be used for this purpose when not otherwise employed.

(3) The *headquarters and service troop* operates in general like the headquarters and service company of the combat regiment as described in paragraph 147.

(4) *Troop.*—The troop commander supervises the operations of the two platoons and uses the specialist personnel of the

troop headquarters for special work. The troop includes within itself the elements necessary for self-maintenance and can be employed upon a detached mission without special arrangements for messing and supply. The troop headquarters assists the platoons by performing reconnaissance and supply operations.

(*a*) The *mounted troop* is usually employed upon work in forward areas, advance guards, or with columns having only pack or animal-drawn transportation. Normally, the troop motor trucks are used to transport supplies from the squadron supply dump to troop headquarters or to the platoons. Some situations may necessitate that this work be done partially or entirely with pack transportation. As the operating sections of the platoons require personnel to care for the animals, the work capacity of the platoon of the mounted troop is somewhat less than that shown in Table XI for the basic work unit of other general engineer units.

(*b*) The *motorized troop* is usually employed upon work in rear areas or with columns having only motor vehicles.

b. In an advance.—Some engineers are invariably attached to the advance guard of a cavalry division. Their principal duties are engineer reconnaissance and hasty repair. The strength of the engineer component of the advance guard varies with conditions, but as a rough guide it may be said that a platoon of engineers should be near the head of each column when the cavalry division advances in two columns. When it is definitely known that the engineer work will be of such magnitude as to exceed the capacity of the advance guard engineers, the division engineer arranges to have additional engineers march at or near the head of the main body. Whether mounted or motorized troops are assigned to the advance guard depends primarily upon the conditions of the roads and the imminence of combat. Generally the engineers for the advance guard will be from the mounted troop. If the cavalry is advancing in two columns, one column on a good road and the other on a poor road, it might be desirable to assign motorized troops to the advance guard of the column on the good road and mounted troops to the advance guard of the column on the poor road, with additional motorized troops near the heads of the main bodies of both columns if road condition permits the use of motors. (See par. 148.)

c. In a retirement.—Engineer troops accompany the rear guard. Whether they are mounted or motorized depends upon

the roads and the military situation. Considerations to be weighed in deciding the composition of the engineers with the rear guard are the proximity of the enemy, the condition of the road to be used for withdrawal, and whether or not withdrawal will be blocked by enemy long-range artillery fire. The mission of the engineer component of a rear guard being generally demolitions and the construction of obstacles, it moves by bounds and echelons. Preparations for demolitions and obstructions are made by the leading echelon, and the work is completed by the echelons following in the rear. If the condition of the roads permits, on account of their greater mobility, motorized troops are employed with the rear guard and also with the leading elements of the main body of the retiring columns. In this case the mounted troop marches near the head of the main body and performs demolitions on either flank at such localities as can not be reached by the motorized troops because of poor roads.

d. In the attack.—Engineers with Cavalry are rarely detached from the squadron for duty with cavalry brigades or regiments for the attack. Such work as there may be incident to the improvement of communications or incident to assisting transportation over difficult ground is handled as a divisional matter under the division engineer. The most important task is keeping open the roads of communication and supply. Another important use of the engineer squadron in an attack is engineer reconnaissance. In a pursuit of a disorganized enemy following a successful attack the employment of the engineer squadron as a harassing force may be justified. Engineers accompany an encircling force in pursuit for the purpose of accomplishing demolitions. (See par. 150.)

e. In defense.—The engineer squadron in the defense operates in a manner closely approximate to that of the combat engineers. The engineer troop or squadron may be assigned to some sector in the defense. If so, its mission will normally be the improvement of communications and the execution of such tasks as may require technical skill and special tools and material. Under such conditions the troop or squadron commander becomes the sector engineer of the sector to which assigned. The engineer troop is an appropriate unit to attach to a cavalry regiment. This is suggested merely as a rough guide, the exact strength depending on the amount of work involved. (See par. 151.)

f. In a river crossing.—In a river crossing operations, light ponton bridge units may be attached to the cavalry division. They come under the control of the commander of the engineer squadron unless specifically exempted. They are employed in a similar manner to that described for ponton bridge units with the combat regiment in paragraph 152. Ponton work is normally assigned to one of the motorized troops rather than the mounted troop in order to release the mounted troop for engineer reconnaissance on a broad front and to enable it to execute hasty repair for the advance cavalry elements.

g. In the rest area.—In the rest area the engineer squadron operates in general as described for the combat regiment in the rest area in paragraph 149. The amount of construction work which the squadron is called upon to do takes into consideration the personnel and time necessary for the care of the animals of the mounted troop.

SECTION V

NONDIVISIONAL ENGINEERS

156. General service regiment.—*a.* (1) The general service regiment operates in general like the combat regiment of a division and may in exceptional cases be employed as a divisional regiment.

(2) The basic work unit is the 4-squad operating section of which there is one in each platoon. The regiment contains 18 basic work units. The work capacity of the basic work unit for various operations is shown in Table XI.

(3) By reason of its large headquarters organization and its numerous technical specialists, the general service regiment is well adapted to area assignment for work. By this it is meant that the regiment may be charged with the execution of all engineer work, of whatever character, within a prescribed geographical area. If parts of the work in the area require special engineer units, these are usually attached to the general service regiment and they operate under the control of regimental headquarters like other parts of the general service regiment. Additional general engineer troops, usually separate battalions, are frequently attached to the general service regiment.

(4) The regimental headquarters, band, and headquarters and service company operate in general like the corresponding elements of the combat regiment, as explained in paragraph 147. The engineer platoon of the headquarters and service company operates under the supervision of the operations officer. This platoon contains enlisted specialists qualified in the operation and care of heavy machines. When supplementary equipment, such as road rollers, steam shovels, compressors, pile drivers, etc., is assigned to the battalions for operations, the expert personnel to operate and care for these machines is, as a rule, furnished by this platoon. It also furnishes the operatives for the mobile machine shop which is assigned to the regiment. When not employed on special work, the engineer platoon can be considered as furnishing an additional 4-squad work unit and is normally used in regimental supply operations.

b. Battalion.—The battalion operates in general like the battalion of the combat regiment according to the principles stated in paragraph 152.

c. Company.—(1) The company consists of directing and planning agencies, supply agencies, and working units. The 3 platoons and the men from the engineer group of the company headquarters section furnish the directing, planning, and supply agencies. The staff sergeant of the administrative and supply section is in immediate charge of engineer supply for the company. Additional vehicles may be assigned the company, or the regiment may supply materials direct to the working units. Provision for messing the company while engaged upon engineer work must be planned carefully, as messing arrangements frequently determine the extent of the area over which a company can be dispersed.

(2) The company may be reinforced by a platoon from a separate battalion. This doubles the effective working force of the platoons of the company. The company rolling kitchen can mess these men, provided cooks are furnished with the attached platoon. The attached platoon is employed either as a unit under its own commander, or by sections with the general service platoons. In the latter case the commander of the attached platoon is attached to the company headquarters section. The operating sections of the attached platoon should be kept intact and allowed to work under their own sergeants,

assisted, if necessary, by specialists from the general service company.

(3) The platoon organization of the company is retained while on engineer work. Men for special and detached work are furnished from the engineer section of the company headquarters.

d. Platoon.—The platoon operates in general like the platoon of the combat regiment, as described in paragraph 147. With the equipment carried in the platoon tool wagon it is able to perform the same amount of work as the platoon in the combat regiment. It can be called upon for more varied and more highly technical work than the combat platoon, such as railroad construction, concrete construction, water supply development, bridge work, electrical installations, steel construction, and general construction of all classes, including the operation of utilities. In the execution of such work, additional specialists are assigned to the platoon and the special equipment necessary is made available.

157. Separate battalion.—*a.* (1) The separate battalion may be employed independently under the general supervision of the unit engineer, or it may be attached to a combat or general service regiment to augment its working force. In the latter case, the normal assignment is one battalion per regiment. When working with the regiment the battalion may work as a unit or may be used to reinforce the combat or general service battalions. If the battalion is divided, the normal assignments are to the combat battalion, 1 company which doubles the effective working force of the combat battalion; to the general service battalion, 1 company and 1 platoon which doubles the effective working force of the general service battalion. A portion of the separate battalion should be left for work under its own commander.

(2) The basic work unit is the 4-squad operating section of which there are 3 in each platoon. The battalion contains 24 basic work units. The work capacity of the basic work unit for various operations is given in Table XI. When the work allotted to the battalion is largely nontechnical, the battalion may be considered as furnishing about 850 men exclusive of foremen and overseers.

b. Headquarters and service company.—The principal functions of the headquarters and service company are administra-

tion and supply. It provides technical specialists to operate the battalion equipment.

c. Company.—The company headquarters operates the blacksmith and tinsmith equipment, performs the necessary drafting, and furnishes specialists to assist the platoons or to perform special work. Its most important functions are supply and service and the direction of operations. When the work allotted the company is largely nontechnical the company can be considered as furnishing 210 men for work. The company transport is not sufficient to keep up a constant supply of material for extensive road and railroad work. The company, being self-sustaining, can be employed on detached missions without special arrangements being made for routine supply. The company may be employed on a task under its own officers and under its battalion commander, or it may be attached to some other engineer unit. If attached to some other engineer unit it may be employed as a unit or may be assigned to work by platoons. In general the company should not be attached to another engineer company. The dispositions of the company by the commander of the engineer unit to which the company may be attached should be such as to retain the chain of command within the attached unit and especially such as to prevent disruption of the operating sections in the platoons.

d. Platoon.—The platoon operates by sections. Additional enlisted technical assistance is generally provided by technical foremen and specialists assigned from company or battalion headquarters or from the engineer unit or installation to which the platoon may be attached. The platoon may operate as a unit under its own commander on a definite task assigned by the company commander, or it may be attached to some other engineer unit, in which case it receives its assignments to work from the commander of the latter. The tool truck usually accompanies the platoon.

158. Camouflage battalion, army.—*a.* (1) The camouflage service in the army area consists of advice and assistance in the selection of positions from the point of view of effective camouflage, inspection of existing camouflage, the demonstration of correct camouflage technique and the operation of schools of camouflage instruction, the erection of minor camouflage which is of common interest to all troops, and the supply of special camouflage materials and tools.

(2) In general, camouflage work is executed by the troops of the activity or area being camouflaged. Major camouflage projects are executed by general engineer troops.

(3) The camouflage battalion is given an area mission; that is, it is made responsible for camouflage operations within a prescribed area. The subdivision of this area into subareas is published in army orders, which are based upon the recommendations made to the army engineer by the commanding officer of the camouflage battalion. The recommended subdivision may be by geographical areas in accordance with the difficulty of carrying out local camouflage operations, or it may be by tactical units, for example, a camouflage section with an infantry division, but the subdivision by tactical units is exceptional in a war of movement.

b. The *headquarters and service company* is assigned the work of adapting to local conditions the camouflage materials obtained from the army depot establishments and arranging for the delivery of the materials to the camouflage companies. The headquarters company may also be charged with developing and conducting a course of instruction in camouflage principles and technique in one or more army or corps schools. The commander of the headquarters and service company utilizes his factory section and his camouflage sections in carrying out the duties of adaptation, supply, and instruction assigned him by the battalion commander.

c. The *camouflage company* is charged with the coordination of the activities of its four camouflage platoons. The area which one platoon can cover varies from 10 to 50 square miles, depending upon the density of the concentration of troops and military installations. The members of the platoon travel through their assigned areas, observe the state of camouflage discipline, lend assistance, and give expert advice to the commanders of troops whose activities should be camouflaged, suggest corrective measures where errors of camouflage technique are discovered, and facilitate the distribution of camouflage supply. They make periodical and emergency reports to the company commander, who takes appropriate action, either directly or through channels. During concentration for an attack, concealment is a very important factor. As the troops arrive they must be informed as to the camouflage restrictions before they reveal their presence by exposing their equipment and personnel to

enemy aerial or ground observation. When an attack has stabilized and troops commence to construct field fortifications, the services of trained camoufleurs are needed to suggest and devise ways to conceal the location and extent of the works. Great zeal and initiative are required on the part of the personnel of the camouflage platoons to make early contact with all echelons in their areas in order that camouflage measures may be undertaken concurrently with, rather than subsequent to, the construction of field works and the location of armament. The platoons remain indefinitely in their areas, insuring the continuity of camouflage policy, regardless of the movements of the divisions and other troops. They study the local characteristics of the terrain and the effects of seasonal changes upon visibility, and record the successes and failures of their camouflage technique with reasons therefor. The platoons may be subdivided into sections and the latter given area missions.

159. Camouflage battalion, GHQ.—*a.* (1) The camouflage service rendered by the GHQ camouflage battalion comprises the manufacture of camouflage materials for supply to the communications zone and to the field armies; the inspection of camouflage operations in the communications zone; the conduct of schools for instruction of troops of all arms in camouflage principles; and the furnishing of personnel for handling depots of camouflage supplies.

(2) The battalion furnishes camouflage materials for the field forces. When extensive fabrication from raw materials must be done in the theater of operations, additional troops are needed, the manufacturing function of the camouflage battalion being usually confined to the adaptation to local conditions of materials previously fabricated in the zone of the interior. The battalion does camouflage construction to a limited extent where the works are for the benefit of all arms. In general, however, construction of camouflage work is executed by the troops of the arms whose activity is being camouflaged, the camouflage battalion furnishing specialists to assist. In a major camouflage project in the communications zone general engineer troops may be used.

(3) The commander of the battalion has his headquarters near that of the chief engineer of the field forces. He recommends to the chief engineer the disposition of his battalion and the chief engineer arranges to have this disposition pub-

lished in general orders for the information and guidance of the command.

b. The *shop company* furnishes the personnel for the operation of one or more factories for the manufacture and adaptation of camouflage materials. The company headquarters handles administration and messing. The headquarters platoon procures and distributes raw materials for camouflage manufacture, designs camouflage materials, and does experimental work. The factory platoon sews and weaves raw materials, makes nets, repairs salvaged materials, and applies colors by brushing or spraying. The special machinery used in these special processes includes chaff cutters, belt conveyors, paint grinding machines, paint spraying machines, eyelet punching machines, strippers, paint mixers, sewing machines, glue tanks, barrel trucks, and band saws.

c. The *camouflage company* operates in the areas behind the armies in the manner described in paragraph 158 for the operation of the army camouflage company. It handles the distribution of camouflage material to supply points in the communications zone. Personnel from the depot section may be attached to depots to assist in camouflage supply. Camouflage depots may be parts of general or engineer depots anywhere in the theater of operations. The school section is employed for demonstration and instructional purposes at training camps or schools in the communications zone. The camouflage platoon operates in a manner similar to that described in paragraph 158 for the platoon of the army camouflage company.

160. Ponton bridge units.—*a.* (1) Ponton bridge units are organized primarily to transport and care for the bridge equipage. The actual construction of ponton bridges and the operation of ferries with the equipage of these units are functions of general engineer troops.

(2) When orders are received attaching a ponton bridge unit to a tactical echelon, the commander confers immediately with the unit engineer of the echelon and arranges for the time and place of delivery of the equipage and for the amount of equipage required for the operations in view. It may be desirable for the troops who are to construct the bridge to have some preliminary drill, in which case the bridge unit furnishes a nucleus of trained personnel to give instruction in the technique of handling the equipage. Prior to the date of delivery of the

equipment the commander reconnoiters the route to the rendezvous and selects a bivouac position to which the transport may retire during the bridging operation. If the entire bridge unit is not needed the commander selects the elements to be sent forward, preserving the tactical integrity of the part so detached and giving instructions to its leader. When the bridge has been constructed the bridge guard is furnished by the bridge unit and the guard is given instructions for regulating traffic over the bridges. If the bridge becomes damaged due to any cause, the bridge guard repairs it. The bridge unit dismantles the bridge at the proper time and resumes its duties of maintenance and transportation of the bridge equipage. Assistance is needed if the bridge is to be dismantled rapidly.

b. Heavy ponton battalion.—This unit transports and delivers to using troops ponton bridge equipage for the construction of bridges that will carry all normal army loads.

(1) The headquarters and service company handles administration, supply, and the repair and maintenance of the equipage.

(2) The company transports the equipage for two complete units of bridge, each 208 feet long, including the abutments, the trestle spans, and the ponton spans. The headquarters platoon cares for company administration and ordinary repairs and instruction in the technique of bridge construction. The bridge platoon carries the bridge equipage. Sections from one platoon may be attached to other platoons or companies when this becomes desirable in order to furnish the number of pontons or trestles which impending operations require. Trestle piers are often useful at ferry points. For data as to lengths of bridge which can be constructed with the equipage carried by the various parts of the battalion see Table XII. Other data are shown in Table II.

c. Light ponton company.—(1) The company headquarters handles the administration and supply of the company, furnishes instruction personnel, and by means of its maintenance section keeps the bridge equipage in repair. It coordinates the operations of the 3 bridge platoons.

(2) The bridge platoons each carry a complete unit of bridge 224 feet long consisting of abutments, trestle bays, and ponton bays. The platoon headquarters supervises the operations of the 4 ponton sections and the trestle section. Ponton sec-

tions may be detached for duty with other platoons of the company or of other companies when it is desired to increase the length of bridge to be constructed. The trestle section carries the equipage for constructing the shore section of the bridge. Two trestle sections are always necessary for a complete bridge, but more may be necessary where the character of the river banks requires the addition of a number of trestle spans. The trestle section from one platoon may be attached to other platoons to fit the specific requirements of the bridging sites. They may also be given the mission of furnishing equipage for trestle piers at ferrying points. For data as to the lengths of the bridge which can be constructed with the equipage carried by the company see Table XIII. Other data concerning the equipage are shown in Table II.

161. **Railway battalions.**—*a. General.*—(1) The railway battalion employed on a railway division is capable of maintaining the normal supply of one field army over a single-track standard-gauge line, provided there are sufficient passing tracks and rolling stock to permit the handling of twelve 34-car trains each way per day. The length of a railway division to which a battalion is assigned is determined by the railway headquarters in conformity with the railway plan of the director of military railways. It depends upon the military situation, the terrain, condition of roadbed, ruling grade, terminal facilities, nearness to the front, etc. In general, it may be stated that the length of a railway division will vary from 50 to 100 miles. If daylight operation of railways adjacent to the front is prohibited, the length of the division may be less than 50 miles. The railway battalion has the personnel necessary to maintain and operate a 50-mile single-track railway division in advance of the regulating station. In a stabilized sector in rear of the regulating station, the battalion is capable of maintaining and operating a 75-mile division without an increase in personnel. The length of the division can be increased to 100 miles in rear areas by attaching general engineer units to the maintenance of equipment company. There may be conditions under which it will be possible for a railway battalion to operate 100 miles without increase in personnel. Where traffic is light men may be taken from the operating company and maintenance of equipment company and attached to the maintenance of way company.

(2) *Initial construction* of railways as distinguished from maintenance is not the duty of engineer railway battalions. Such work is normally done by general service regiments, assisted when necessary by engineer separate battalions or civilians. The use of railway battalions for work other than the maintenance or operation of railways should be avoided. When an unavoidable situation requires their employment on other work, they must be provided with suitable transportation and equipment.

(3) *Distribution of personnel.*—(*a*) The railway division, when operating in advance of the regulating station, is normally divided into 10 sections of approximately 5 miles each, and when operating in rear of the regulating station or in an area which is not subjected to severe conditions, such as frequent bombardments, poor roadbed, etc., 10 sections of approximately 7½ miles each.

(*b*) It is impracticable to lay down any fixed distribution of the personnel of the railway battalion, due to the varying conditions under which it operates. The following ideal distribution is given as a guide only:

At terminal A (see chart below):

Battalion headquarters and all other personnel not stationed at other locations. The battalion headquarters and shops are normally located at the principal terminal of the railway division.

At station b:

1 sergeant in charge of track maintenance section, maintenance-of-way company.
2 corporals—section foremen (M. of W. Co.).
14 section hands (M. of W. Co.).
3 telegraph operators (H. & S. Co.).
1 cook (H. & S. Co.).

21 total.

At station d:

Same as station b, with the addition of 2 cooks.
Total personnel, 23.

At station f:

Same as at station b.

At station h:

Same as at station b.

At terminal B:

The personnel at this terminal depends upon the situation. If it is at the end of the line, it requires the same personnel as station d plus such inspectors and emergency repairmen as may be required. It normally does not exceed 50 men. When the battalion is an intermediate one the personnel at terminal B normally does not exceed that stationed at d.

(c) Detachments at stations b, d, f, and h are each under the command of one man, usually a sergeant, from the maintenance-of-way company. He is responsible for that part of the railroad maintenance work allotted to him, usually from 10 to 15 miles. He is responsible for the administration, sanitation, discipline, and mess, and will exercise command in case it is necessary to engage in combat. He has, however, no control over technical activities of men who are not assigned to the maintenance-of-way company. Points a, c, e, g, and i indicate the limits of section responsibility.

Terminal A											Terminal B
	5 to 7½ miles	5 to 7½ miles	5 to 7½ miles	5 to 7½ miles	5 to 7½ miles	5 to 7½ miles	5 to 7½ miles	5 to 7½ miles	5 to 7½ miles	5 to 7½ miles	
	a	b	c	d	e	f	g	h	i		
Notes	2, 3, 4	1, 3		1, 2, 3, 4		1, 3		1, 3		2, 3, 4	
	50 miles										

Note 1.—Kitchen for signalmen and trackmen.

2.—Kitchen for train crews (continuous service).

3.—Water tanks.

4.—Fuel supply.

Length of the division increases to 75 miles when the length of section is changed from 5 to 7½ miles.

When railway battalions are adjacent to one another, the activities at terminal B will be performed by the adjacent battalion.

(*d*) The distribution of technical troops being often insufficient to meet the needs of certain specific tasks, economy of personnel must be practiced in railway activities. It may be necessary to modify, temporarily, certain units by reinforcing them with elements from others. However, such measures should be exceptional, since the personnel of each company should be kept under the orders of its commander in the interest of efficient administration. When it is necessary to increase the strength of one unit at the expense of another, subordinate elements under their leaders should be detailed whenever practicable instead of individuals.

(4) *Demolition of railways.*—The commander of a railway battalion prepares plans for the destruction of that part of the line over which he has control. The plan includes details concerning structures to be destroyed and their priorities, computations as to quantities of explosives required for complete demolition, and requisitions for material and supplies. Upon direction of higher authority, structures are prepared for destruction. Under abnormal conditions, railway battalions may be required by higher authority to destroy railway structures and track. Railway battalions are responsible for the prompt withdrawal of rolling stock to prevent confiscation by the enemy. Conditions may arise which make it necessary to risk the possibility of losing rolling stock in order to accomplish an important mission worthy of such risk. In such cases, railway personnel cooperates in every way possible with military commanders.

(5) *Additional personnel.*—Additional personnel may be placed at the disposition of railway battalions for the purpose of increasing the capacity of the railway. Such personnel may be civilians, engineer troops, or troops of other arms and services when engineer troops are not available. Civilians or troop units are assigned to the various departments of the railway in accordance with their needs. Civilians are attached to railway units and serve under the officers and noncommissioned officers of these units. Troops are employed under their own leaders, supervised by the appropriate officer of the railway service. The principal source of additional personnel is the engineer separate battalion. It is seldom necessary to attach more than one company of the separate battalion to a railway battalion. An operating section from a platoon is capable of taking over the track maintenance of 20 miles of single-track or 15 miles of

double-track; the platoon of 60 miles of single-line or 45 miles of double-track. In a large terminal an entire company may be used on track maintenance within the terminal.

(6) When a railway battalion operates a division between a regulating station and forward railheads, the division superintendent's office is normally located at the regulating station. When more than one railway battalion is required to operate the line between regulating stations and the front, a general superintendent's office may be located at the regulating station, The regulating officer, who is a general staff officer, determines shipment priorities and the engineer railway personnel operates the trains in accordance with these priorities.

(7) Railways are protected by combat troops located in the zone of operation of the railway. Where a line is subjected to frequent raids, it may be protected by armored trains manned and commanded by personnel from other arms. The railway battalion provides train crews for armored trains. Movements of armored trains over a railway are governed by tactical considerations, and may have priority of movement in an emergency.

b. The *headquarters and service company* provides the technical, administrative, and supply service necessary to enable the battalion commander to supervise and coordinate the activities of the battalion and to operate certain activities common to all companies, such as signal communications.

c. Maintenance of way company.—(1) The conditions frequently prevailing in the theater of operations make the task of the maintenance of way company very difficult. The rapid deterioration of the roadbed under heavy traffic and bombardment and the damage to other structures by the latter place a severe burden on this company. Since the personnel of this company is scattered over every mile of the railway division, authority is delegated to subordinates and constant supervision exercised by officers of the company in order to insure efficient maintenance.

(2) Maintenance of way includes the repair and upkeep of track, switches, bridges, culverts, water lines, water towers, buildings and all railway property whose maintenance and repair are not expressly delegated to other agencies. The maintenance of way company maintains signal, telegraph, and telephone lines when directed to do so by higher authority. If it is in the interest of efficient operation to charge the maintenance

of way company with full responsibility for maintenance and repair to signal lines, the signal maintenance section of the headquarters and service company is attached to it for duty.

(3) Upon the engineer maintenance of way company falls the duty of gradually improving the condition of the track as opportunity offers and of installing such additional facilities of a minor nature as may be found advisable for the purpose of improving train operation. Besides repairs, structures require almost constant and rigid inspection to prevent failure and possible accidents to trains.

(4) In the forward areas, an active enemy equipped with long-range guns and bombing airplanes, can be expected to damage the roadbed and structures frequently. The repairs must be rapidly and effectively accomplished. The maintenance of way company must have sufficient troops at its disposal to take care of emergency work of this character, without seriously interfering with normal maintenance. When necessary it requests additional personnel. The battalion commander provides the additional troops from other companies of the battalion or requests other troops from higher authority.

(5) The track maintenance platoon operates the water service.

d. The *maintenance of equipment company* is responsible for the repair of rolling stock, motor vehicles, tools, and mechanical appliances; for the inspection and conditioning of rolling stock; for the maintenance of the fuel and lubricant reserve; and for the operation of coaling installations. It takes care of running repairs to rolling stock, its duties being equivalent to those of a roundhouse organization on a civil railway. It is not expected that heavy repairs will be done by the maintenance of equipment company. Where general overhauling is required or major replacements must be made, rolling stock is sent to a back shop operated by railway shop companies. The maintenance of equipment company makes running repairs, tests, and inspections of rolling stock; repairs the motor vehicles assigned to the battalion; repairs all tools and mechanical equipment of the companies of the battalion; does all sign painting for the battalion; establishes and maintains a coal reserve for the battalion; establishes and maintains gasoline, oil, kerosene, and grease reserve for the battalion; and supervises coaling and the dumping of ashes.

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e. The *operating company* operates trains, yards, and stations within the territorial limits of the railway division. The number of trains which may be operated in 24 hours depends upon the length of line, the condition of the roadbed and equipment, and the number and location of passing tracks, the nearness to the front, etc. For the purpose of planning, it may be assumed that the company has sufficient personnel to operate 20 trains in 24 hours. This may be increased to 24 for short periods. Although 24 train crews are provided in the Table of Organization, the number of trains which can be operated normally must be reduced below the number of train crews provided in order to permit rest once a week and to take care of sickness. In case the operating conditions of the railway are such that a train crew can make a round trip in 12 hours or less, the personnel will permit the operation of more than 20 trains per day.

f. The *medical detachment* with the railway battalion must be a flexible organization capable of meeting the varying conditions under which it operates. The distribution of personnel and duties changes with the employment of the battalion. When operating a railway the battalion is scattered over a considerable area, varying in length from 50 to 100 miles. The detachment must take care of the usual sickness, and shop and line accidents. If it is impracticable to take care of isolated detachments, the battalion surgeon arranges with other near-by medical agencies for such service. The battalion commander designates the location of the battalion dispensary or aid station, and local aid posts if necessary upon the recommendation of the battalion surgeon. On railwork the principal aid stations are normally near the shops. The medical car in the wrecking train may be used for this purpose. Personnel of the medical detachment must be available at all times to proceed on short notice to the site of a wreck and furnish medical aid.

162. Headquarters, engineer railway service.—*a.* This organization exercises the functions of supervising and coordinating the operations of several railway battalions, railway shop companies, and attached troops, which have been combined into a railway grand division. In a military sense it corresponds to a regimental headquarters. The commanding officer is the general superintendent of the railway grand division. The general superintendent of a railway grand division located behind the line of regulating stations reports to the general mana-

ger of railways communications zone. In case the railway grand division is located in advance of the regulating station, the general superintendent usually reports to the regulating officer for train movement orders and to the general manager of railways of either the communications zone or the combat zone, according to circumstances, for technical supervision.

b. The general superintendent assigns the railway battalions to railway divisions and modifies the lengths of the railway divisions within his railway grand division according to the difficulties of operation and maintenance resulting from traffic density or enemy activity. He controls the distribution of motive power and rolling stock. He disposes of attached troops by assigning them to the railway battalions or shop companies, or he may reserve units for work under his own immediate direction.

163. Topographic battalions.—*a.* The headquarters of a topographic battalion and its map reproduction company or companies is normally located in the immediate vicinity of the headquarters of the command it serves. This facilitates close coordination among those concerned with the formulation and execution of map-making operations; viz, the assistant chief of staff, G–2, who states the map requirements of the unit; the unit engineer, who formulates the mapping program; the commander of the unit, who reviews and issues the approved program; the unit air officer, who directs the aerial photographic phases of the operation; and the commander of the topographic battalion, who executes the surveys and reproduces the maps.

b. Authority to make reproductions of any nature comes from the headquarters of the command to which the topographic battalion is assigned. Requests for work are passed upon by the appropriate engineer staff officer in the office of the unit engineer.

164. Army topographic battalion.—*a.* (1) The principal mission of the army topographic battalion is to make and supply maps for the army. The battalion commander obtains from G–2 all available maps of the area of proposed operations, and prepares plans for amplifying and correcting them. Data for correcting maps come largely from aerial photographs.

(2) In the early stages of operations, the staffs and the advanced troops require maps of a sort at once, and they are satisfied if they get immediate deliveries even if the maps are not

of the highest cartographic excellence. This means that the painstaking and accurate methods of instrumental topographic surveying will not meet requirements, since they can not produce maps of new areas with the necessary speed. The requirement is met by the hasty preparation of guide maps and the correction of existing maps from airplane photographs. Gradually the necessary control work is accomplished and in successive issues maps of the army area in more accurate form can then be published. The control work necessary includes the establishment of initial geodetic points, base line measurement, triangulation, and leveling. Control is carried as close to the front as practicable and serves as a base upon which to construct, from aerial photographs, maps covering the territory as deeply as possible into the enemy's country. While the occupied area is the only area actually controlled, the control, being kept close to the front, permits reasonably accurate maps to be prepared for some distance into enemy territory. Under good conditions the surveying company can advance control over an area about 15 miles wide, at a rate of about 15 miles per day. Where planimetric details are taken from airplane photographs the battalion can produce fair maps of hitherto unmapped country at the rate of from 400 to 600 square miles of area per day.

b. The *headquarters and service company* handles the administration and service of the battalion, furnishes the personnel for keeping the stocks of maps which have been prepared for issue, and provides transportation for the commander and his staff in making reconnaissances and inspections. The delivery of finished maps in quantity to distributing agencies is handled by the supply officer. The distribution of maps to using troops is not the function of the topographic battalion.

c. The *surveying companies* execute control, keeping it as close as possible to the front line. A surveying company may be made responsible for a front of from 10 to 15 miles, and under good conditions is able to advance control at the rate of 10 to 15 miles per day when using triangulation towers or searchlight-beam targets. In the event that tactical, meteorological, or other conditions make the use of towers or searchlights impracticable, the surveying companies may be required to execute control by the transit and tape method, in which case progress is much slower than the foregoing estimate. When the use of the

aerial photographic method of mapping is, for any reason, impracticable, the surveying companies may be required, in addition to executing control, to fill in topographic details also, thus producing the required map entirely by ground methods. On account of the slowness of the latter method of mapping its employment is unusual and it should be regarded as an emergency method for small areas only where great speed can not be expected.

d. The *reproduction company* is charged with all operations incident to the production of finished maps after the delivery to it of the aerial photographs covering the area to be surveyed, and the control data furnished by the surveying companies. The photomapping platoon makes the maps from the aerial photographs by means of graphical or stereoptico-mechanical methods. It is operated, if necessary, in three 8-hour shifts, one section being assigned to each shift in order to get continuous application to the mapping mission. The lithographic platoons, upon receiving finished copy from the photomapping platoon, make the necessary scale reduction by photographic methods, prepare the lithographic plates, and print the maps by lithography. In addition to the reproduction of maps the lithographic platoons execute such general graphical reproduction as may be required for the Army. This class of work includes the printing of general orders, intelligence maps, special maps showing traffic circulation or facilities, photographs of works or areas of special interest, overprints showing artillery or bombing objectives, etc.

165. GHQ topographic battalion.—This unit is generally located near GHQ. It does surveying of areas within the communications zone and operates a base printing plant for the field force.

a. The *headquarters and service company* handles the administration and supply of the battalion, the map stocks, and drafting room.

b. The *surveying companies* operate in a manner similar to the surveying of the army topographic battalion except that in the communications zone there is less call for the cruder and more rapid methods and more demand for accurate surveys. The companies are called upon for general mapping, for surveys of sites for camps and construction projects, and for geological surveys.

c. The *reproduction company* operates a base printing plant usually in the vicinity of general headquarters. It makes graphical reproductions by the use of the most modern processes.

166. Surveying battalions.—These are organized when the requirements for carefully controlled topographic surveying in the theater of operations require the operations of a battalion organized exclusively for surveying. They contain no map reproduction units.

167. The engineer reproduction plant, Washington, D. C.—This unit operates a base printing plant in the zone of the interior. It is a modern plant equipped for quantity production of graphical charts, maps, photographic prints, enlargements, lantern slides, blue prints, and photostats.

168. Water supply battalions.—*a.* (1) The major mission of the water supply battalion is to transport water by motors to troops operating in areas where the local supply of water is deficient. Such a deficiency may result from a congestion of troops in an area prior to and during an advance; a pollution of local water supply by enemy activities; or the hydrology of the area. Transportation of water by motors must be continued until local resources are further developed, until the congestion has ceased, or until pollution has been corrected. The battalion receives water at sources and delivers it at designated water-distributing points. The battalion may receive its water from tank cars at railheads.

(2) The basic water-supply unit is the company. The basic water-transporting unit is the tank-truck section.

(3) The battalion is equipped to receive water at sources, to purify it, and to transport it to water-distributing points. The water transporting capacity of the battalion is 60,000 gallons. The purification trucks assigned to the battalion will permit the chlorination of approximately 48,000 gallons of water per hour. The battalion is not equipped for construction work, such as the drilling of wells, construction of water-supply systems, erection of steel and wooden tanks, and the construction of reservoirs. Such work devolves upon other engineer troops.

(4) Under normal situations where a fair distribution of water resources exists, one water supply battalion can provide the water requirements for an army corps. When water is abundant and well distributed a water supply battalion can take care of the water-transporting needs of a field army.

(5) Water supply battalions assigned to the army are under the command of the army engineer, who usually exercises his control through a subordinate officer on his staff known as the army water-supply officer.

b. The *headquarters and service company* is an administrative and supply unit. It is not organized or equipped to transport water. Such work is performed by the lettered companies. Its purification units may be attached to the companies of the battalion or to tactical units.

c. The *company* may operate under the direct command of the battalion commander or may be attached to a corps or a division. It may also be attached to other engineer units to which water-supply work has been delegated in a given area. The employment of the platoons of the company depends upon the situation. Wherever possible the service platoon is charged with all features connected with the water source and the transportation platoon with transporting the water. In case it is necessary to charge a platoon leader not only with the transportation of water but also with the operation of his source of supply, it is necessary to attach personnel and equipment to his platoon in order to permit it to operate as a water supply unit. When platoon operations are required, an appropriate organization is provided by attaching one installation squad and one purification section to a transportation platoon. In order to form two such units in the company, one water purification truck with its personnel must be attached to the company from the headquarters and service company. When the company is given the additional assignment of installing and operating water points, the service platoon is charged with this work in addition to its duties at the water sources. When the company is operating by platoons, the work at the water points is performed by the attached installation squads. The company is capable of supplying five temporary water points of 4,000 gallons capacity each.

d. The *service platoon* may be operated as a unit, or sections thereof may be attached to transportation platoons.

e. The *transportation platoon* can be made a water-supply unit by attaching thereto an installation squad with its truck and one purification section. The tank truck section has a transporting capacity of 4,000 gallons.

169. Depot company.—*a.* (1) Depot companies are employed to operate all classes of engineer supply depots or

engineer sections of general supply depots anywhere in the theater of operations. When used in the larger depots of the communications zone where the tonnage of supplies handled is beyond the labor capacity of the depot company civilian labor may be employed or additional troops may be detailed. To obtain maximum results from the use of transient troop labor in the operation of supply depots the troops should be employed upon specific tasks under their own officers and utilizing as far as possible their tactical organization. In this case the nontransient personnel of the depot company is not divested of responsibility for the conduct of depot operations. When the conditions warrant the assignment of a unit of general engineer troops, such as a battalion, to an engineer depot, together with a depot company, the usual plan of operation is to charge the commander of the general engineer troop organization with sole responsibility for the conduct of the depot and attach the depot company to his organization for use as the depot overhead organization.

(2) When depot companies are assigned to tactical areas or commands for the operation of engineer supply installations, they are placed at the disposal of the unit engineer. As a general principle, depot companies are charged with engineer supply functions in a given area, normally one company in the army area, one company in each corps area, and one company to each section of the communications zone.

(3) In a war of movement concentration of engineer supplies from the rear in division, corps, and army areas is relatively small, but the collection of the engineer supplies found locally within the areas may become of considerable extent and importance. When the fighting becomes temporarily stabilized, accumulation of engineer supplies commences. In either case depot platoons or detachments from corps or army depot companies may be assigned to divisions to assist in the receipt and issue of engineer supplies. When the divisions advance or are relieved, this depot platoon or detachment personnel receives and cares for engineer equipment and supplies no longer needed by the divisions and remains in the area with the accumulated engineer stores.

(4) One engineer depot company can furnish the personnel to handle a depot of about 150,000 square feet of storage area. The company commander organizes the depot operations, assigning his depot platoons or sections to the handling of

supplies by categories, viz, transportation, water supply, explosives, electrical supplies, lumber and shelter, technical equipment (surveying and drafting instruments, etc.), road building equipment, camouflage, field fortification supplies, etc. Supply operations of the company include receipt, storage, and issue; assembly and test of machinery; repair and restocking of salvage. The depot officer is not concerned with establishing priorities, that being a staff function of higher authority. He issues upon requisitions submitted according to the principles outlined in chapter 8. He keeps the unit engineer informed at all times of the status of stocks and makes recommendations designed to avoid the accumulation of supplies not needed and to prevent the exhaustion of stocks for which there is a great demand. He maintains a guard to prevent unauthorized tampering with depot stocks and prepares plans for the removal and destruction of stores in the event of a withdrawal.

b. The *headquarters platoon* handles the administration of the depot company and coordinates the activities of the three depot platoons by means of its company headquarters section. The depot section of the headquarters platoon is used either in the operation of a part of a large depot in which the whole company may be engaged, or, where the company is assigned to an area within which its platoons are dispersed on several supply installations, it may be assigned to the operation of one of these installations, usually the one at company headquarters.

c. The *depot platoon* is suitable for employment in a portion of a large depot, where it may handle several departments, or for assignment to a tactical area such as a division area, for the operation of one or more dumps. The platoon headquarters section handles incoming requisitions routing them to the proper place for supply, prepares outgoing requisitions for stockages, keeps note of supply levels, and operates messenger service. The depot section handles the supply items, making receipts and issues, classifying, salvaging, repairing, and guarding the engineer stores.

170. Dump truck company.—Dump truck companies furnish transportation for the movement of bulk materials in connection with engineer operations. In their normal employment they are attached to organizations of general engineer troops engaged upon road and railroad construction involving earth cuts and fills and the placing of road metal and track ballast.

a. The *headquarters platoon* handles the administration, supply, and messing of the company, current repairs to transportation, and furnishes an additional dump truck section which may be used for detached work or to keep the platoons at full strength by furnishing replacements.

b. The *dump truck platoon*, consisting of two 9-truck sections, operates under the platoon commander.

(1) The dump truck section, consisting of three 3-truck subsections, operates under the section sergeant.

(2) The dump truck subsection operates under its corporal.

c. The determination of the size of the fraction of a dump truck company to be assigned to a unit for a specific operation involving haulage must take into consideration not only the cargo carrying capacity of the trucks but also the capacity of the unit served to handle the material at both the loading and receiving ends of the job. It must also take into consideration the limitations imposed by the site of the work upon the number of trucks which can be economically used.

171. Railway shop company.—The purpose of railway shop companies is to assemble locomotives and other railway equipment and make major repairs to rolling stock of the military railways. Running repairs are made by the maintenance of equipment companies of railway battalions. The shop equipment and methods of operation of railway shop companies do not differ essentially from those of standard railway shops (known as back shops) of civil practice, although they may be called upon to handle repairs to either broad or narrow gauge equipment. The normal allotment is one company to each railway headquarters handling a railway grand division of three railway battalions. Companies may be combined into larger shops under the direct supervision of the general manager of railways of the communications zone or GHQ. The shop organization may take over the operation of a shop already existing in the theater of operations, or it may operate a shop constructed and equipped especially for the work it will have to do.

172. Shop company.—Shop companies are assigned to armies and to the communications zone for the maintenance and repair of engineer machinery and plant and to do a limited amount of manufacturing of articles of a special nature.

a. The *headquarters platoon* under the supervision of the company commander handles the administration and supply for the company, and coordinates the operations of the platoons.

The company headquarters handles clerical work and messenger service. The technical section does drafting and light repair work. The supply section receives and issues stocks of materials for use in the shops. The power section operates the shop power station.

b. The *woodworking platoon* operates woodworking machinery and does carpentry. The carpenter section operates power saws, planers, etc., and works with hand carpenter tools. The pattern-making section makes wood patterns for foundry use.

c. The *shop platoon* operates the machine shop.

d. Metal-working platoon.—The forge and foundry section does blacksmith work with both hand tools and power tools. It makes moulds and pours castings. The sheet metal and welding section operates power shears, presses, and riveting machines, and does boiler making, and welding.

Section VI

ENGINEER SERVICE

173. In the division.—*a.* The duties of the division engineer are given in paragraph 60.

b. The operations of the engineer troops in the division have been covered in Section IV.

c. The operation of the engineer supply service in the division is covered in Chapter 8.

174. In the corps.—*a.* (1) The engineer service of the corps comprises the office of the corps engineer, and such engineer troop units and such engineer supply establishments as may be allotted to the corps. The normal allotment of engineer troops to a corps is shown in Table I. Additional engineer troops may be allotted from time to time by the army commander.

(2) The duties of the corps engineer are given in paragraph 65. The corps engineer is assisted by his staff. The members of the staff make studies, compile and disseminate engineering information, draw up projects, draft orders, and make technical inspections. The execution of work is assigned by the corps engineer to his engineer troops units.

(3) The usual method of handling engineering work in the corps area is to divide the area into subdivisions, making a unit (usually a general service regiment or a separate battalion) responsible for all of the engineering work within a subdivision.

Another method is to make a unit responsible for all work of a given class within its subdivision.

b. In an attack.—(1) The corps engineer is most vitally concerned during and immediately after an attack with the maintenance of roads and bridges. He maintains close liaison with the division engineers, paying special attention to the needs in transportation and supply, and takes over the responsibility for road maintenance as far forward as his resources permit. He keeps the corps commander informed as to the engineering situation and its effect upon the operations of the corps. He makes technical reports to the army engineer and arranges with him for the attachment to the corps of such additional engineer troops and transportation as the situation demands, and reports to him upon the adequacy of the operations of the army engineer troops working in the area of the corps.

(2) The corps engineer prepares and recommends to the chief of staff a traffic circuit plan which follows the general army plan which will be suitable for the divisions to use as a basis for their own traffic circuits and is within the maintenance capacity of troops available for road work.

(3) In an attack corps engineer troops follow closely behind the divisions and by taking over the maintenance of roads relieve the division engineers. The corps engineers replace the temporary bridging expedients used by the divisions with more substantial structures capable of carrying the heaviest military loads. They take over the engineer dumps released by the divisions. They may consolidate defensive positions in rear of the divisions. They assist the corps artillery and trains and may construct command posts for the corps commander and staff.

c. In the defense.—The corps engineer operates in the defensive in a manner similar to that described above for the attack. His principal care is to see that the routes of communication are maintained. He coordinates the plans for rearward defensive positions made by the engineers of the several divisions and insures the adequacy of engineer supply. He makes plans for engineer operations to be undertaken upon the resumption of the offensive. The activities of corps engineer troops are pushed as far forward as possible, relieving the division engineers for work at the front.

175. In the army.—*a.* (1) The army engineer service comprises the office of the army engineer, such engineer troop units

as may be allotted to the army, and those engineer-supply establishments within the army area which are not controlled by GHQ or the communications zone. The normal allotment of engineer troops to an army is shown in Table I. Additional engineer troops may be allotted to the army from time to time from the GHQ reserve.

(2) The duties of the army engineer are given in paragraph 64. The army engineer assisted by his staff operates the army engineer service in a manner similar to that described above for the operations of the corps engineer. He usually allots a portion of his available troops to the corps engineers and retains the rest for work under his own control.

b. In the attack.—(1) In the attack the principal duty of the army engineer is to see that the routes of communication forward are maintained. He keeps the army and corps engineer depots stocked with supplies and equipment necessary to the attack. He maintains close relations with the corps engineers. He keeps the army commander apprised of the engineer situation and makes timely recommendations to him when the situation demands the use of troops other than engineers upon engineering work. He sees that the information resulting from engineer reconnaissance is published and disseminated to all echelons to the end that full use may be made of engineer supplies captured from the enemy, that an intelligent use of the available roads may be made, and that troops will have access to the water points. He studies the habits of the enemy and informs all echelons as to the kinds of obstacles and traps the enemy employs and the means to overcome them.

(2) The army engineer plans the best employment of army troops on road repair and selects the best route circuits, or those which can be made the best, for corps and divisions. He then submits to the chief of staff his recommendations for route circuits for the army.

(3) Army engineer troops are used in preparation for, during, and after an attack, principally upon the maintenance of the routes of communication in rear of the several corps. They take over from the corps troops responsibility for the maintenance of communications as far forward as possible. Standard-gauge railroads are operated as far forward as the tactical situation permits.

c. In the defense.—The army engineer operates in the defensive in a manner similar to that described above for the attack. His principal care is to see that the routes of communication are maintained. He coordinates the plans for rearward defensive positions made by the several corps and insures the adequacy of engineer supply. He makes plans for engineer operations to be undertaken upon the resumption of the offensive. The activities of army engineer troops are pushed as far forward as possible.

176. In the communications zone.—*a.* The engineer service in the communications zone comprises the office of the engineer communications zone, section engineer headquarters, and such troops, engineer and other, as may be allotted to the communications zone for engineer work. The normal allotment of engineer troops to the communications zone is shown in Table I. The number of troops may vary from time to time depending upon availability of units of the GHQ reserve for work in the communications zone. Large numbers of civilians may be employed.

b. The duties of the engineer communications zone are given in paragraph 63. Assisted by his staff, he handles the engineer work with which he is charged by assigning his section engineer headquarters to appropriate areas and by assigning his available forces to the section engineers or to specific tasks under his immediate control. Under the general policies outlined by GHQ, he determines the location and priorities of work and the types of construction. His activities include the engineer work of the entire communications zone excepting such areas and activities as may be directly under GHQ, and including such portions of the army areas or such activities in the army areas as may be assigned to the communications zone.

c. Section engineers employ their allotted forces by areas or by functions within their sections.

177. In general headquarters.—*a.* The engineers of general headquarters comprise the office of the chief engineer and the engineer troops of GHQ reserve.

b. Table I shows a normal allotment of engineer troops to division, corps, armies, and the communications zone. All other engineer troops pertaining to the field force are part of the GHQ reserve. Engineer units from the GHQ reserve are allotted to the armies and to the communications zone, according to the needs of the military operations in view, upon

the recommendations of the chief engineer. While not so allotted, they may be in training areas for rest, recuperation, and training under GHQ, or they may be placed temporarily upon engineer work under GHQ or the communications zone. If engaged upon temporary assignment to work, they are employed in such a manner that they can readily be withdrawn for operations elsewhere.

c. The duties of the chief engineer are given in paragraph 62. The resources at his disposal for the accomplishment of the engineer mission embrace the entire engineer service of the field force. Without infringing upon the functions of area or tactical commanders, he coordinates and assists the engineers of all echelons by means of visits of inspection and technical reports and instructions. He controls the progress of engineering works in accordance with the general strategic needs of the military operations by the manner in which he increases or decreases the allotment of engineer troop units to the armies and the communications zone and by the establishment of priorities in supply. He also controls all engineer troops not allocated to tactical or territorial commanders, and with them he accomplishes all engineering work not otherwise provided for.

178. In the group of armies.—The engineer service in the group of armies consists of an engineer headquarters and such engineer troops from the GHQ reserve as may be assigned. The duties of the engineer consist largely of the coordination of the engineer work of the armies, the assignment of group-of-army engineer troops to the armies, the transfer of engineer troops between the armies, and the allocation of engineer supplies to the armies.

179. In the air division.—*a.* The air division may operate from several bases and is able to transfer its operations from one base to another at a great distance. It has peculiar engineering needs which, from their continuing nature, demand the constant attention of a specially trained and equipped engineer service. In general, its work is handled by general engineer troops which are provided with the necessary additional equipment.

b. The engineering tasks incident to Air Corps operations comprise:

(1) Preparation, maintenance, and repair of flying fields and routes thereto.

(2) Erection of structures for shelter of personnel and equipment.

(3) Installation of utilities.

(4) Camouflage.

c. The special equipment needed for the execution of the engineering tasks includes principally heavy machinery and transportation for moving earth, and repair equipment for the maintenance of machinery.

d. A suitable engineer component of an air division within a single theater of operations might include:

One general service regiment.
One or more separate battalions.
One dump truck company.

The operations of this mixed component call for detachments at a large number of flying fields. The personnel, transportation, and equipment are transferred from field to field according to the difficulties arising from enemy activity, meteorological disturbances, and Air Corps demands.

e. The colonel commanding the general service regiment is the unit engineer of the air division. He cooperates with the unit engineers of the armies within whose areas the air division may be operating, obtaining their assistance in the matter of engineer supply and additional personnel for engineer operations.

180. In the cavalry corps.—*a.* The engineer service of the cavalry corps comprises the office of the unit engineer and such engineer troop units as may be necessary for the operations in view. The normal allotment of engineer troops to the cavalry corps is a general service regiment, one or more separate battalions, one heavy ponton battalion, and two or more light ponton companies. Additional engineer troops may be allotted by the army commander according to needs. A cavalry corps operating in an independent theater of operations may need all classes of engineer troop units.

b. The unit engineer, assisted by his staff, has duties similar to those prescribed above for the corps engineer. One of the chief duties is the coordination of the engineer reconnaissance work of the engineer mounted battalions with the cavalry divisions and the prompt transmission of the results of this reconnaissance to the army engineer. The principal work of the engineer troops allotted to the cavalry corps is road and bridge work in the rear of the cavalry divisions.

SECTION VII

EMPLOYMENT IN SPECIFIC OPERATIONS

181. Roads in the combat zone.—*a. General.*—Construction and maintenance of roads are probably the largest operations the engineers are called upon to perform. The duty of keeping the roads open devolves upon the unit engineers, who always undertake this work without awaiting orders to do so from the commander.

b. Road reconnaissance.—The manner of employment of the divisional engineer regiment upon the roads within the division area depends upon the results of the initial reconnaissance. The division engineer causes the reconnaissance to be made and may participate personally in making it if he deems this necessary. Getting the troops upon the work may be expedited if a tentative assignment of the road net to battalions is made based upon available maps and aerial photographs. When the ground reconnaissance has been completed these tentative arrangements can be modified to conform to the actual conditions. Reconnaissance is kept up continuously, and a chart showing the condition of roads throughout the area is maintained by the intelligence officer.

c. Technical decisions.—The results of the reconnaissance having been compiled the division engineer decides upon the priority of works and the kind of work to be done; that is, the degree of clearing, widening, draining, or surfacing, which will be undertaken and, in the case of new construction, the design to be used; that is, whether trails, or tread, earth, or plank roads, etc. He also prescribes the load capacity of bridges and recommends the necessary traffic restrictions.

d. Work capacity of troops.—The normal combat operation is the maintenance of the existing roads and the construction of detours and turnouts. New construction of long stretches of road is the exception and on account of the press for time always demands the employment of troops additional to the divisional engineers. With an average haul of one-half mile the headquarters and service company transportation less packs can haul in one day material for 215 lineal yards of one-track macadam road, 430 lineal yards of paved one-track tread road, or 950 lineal yards of one-track plank road. The regiment can

maintain from 60 miles of two-track macadam road under ordinary traffic to 3 miles under continuous traffic in bad weather.

e. Regiment.—The division engineer assigns portions of the work to each of the battalions and attached organizations and then facilitates their work by the use of the regimental vehicles in supply. He makes a distribution of his resources in special equipment and specialist personnel so as to allow the maximum simultaneous execution. In making his allotment of work to subordinate units the guiding principle is to so distribute his command that he will be able to cope immediately with any situation likely to arise, without delaying to move troops. Most of the needs for road work can be foreseen and there are few surprises if an intelligent estimate of the situation is made.

f. Battalion.—The battalion commander subdivides this allotted road work to his companies. He arranges the work so as to make operation continuous and to prevent delays in execution. In general, each company is permitted to retain its own transportation but when the regimental headquarters and service company is unable to handle the supply of road materials to the battalion, the battalion commander may consolidate the transportation and designate one company to handle procurement and supply. With an average haul of one-half mile the battalion can then haul in one day material for 90 lineal yards of one-track macadam road, 180 lineal yards of paved one-track tread road, or 400 lineal yards of one-track plank road. On a two-track macadam road the battalion can maintain from 30 miles under ordinary traffic conditions to 1½ miles under continuous traffic in bad weather.

g. Company.—The company commander's job is usually the maintenance of a definite length of road. Under normal traffic this may vary from 400 yards where enemy activity is intense and weather is inclement to 10 miles where there is no enemy activity and weather is mild. The company commander divides the work among his platoons giving each platoon commander a definite responsibility. The principal task of the company commander is then to see that the platoons are kept supplied and fed. The practicability of supplying and subsisting the working units determines the length of road over which the company can be dispersed. For continuous maintenance a platoon could be assigned about 5 miles of road. The administrative handling of the company depends upon the road net. If

the work is on crossroads a central camp for the entire company may be advisable. Along a straight reach a company camp and two platoon subcamps may be necessary.

h. Platoon.—The manner in which the platoon commander employs his force upon the execution of his assigned task depends upon the factors of weather, traffic, time, enemy activity, and the supply of road material. Where the job consists of continuous day and night maintenance of an ordinary macadam road under military traffic and beyond the reach of enemy interference a feasible plan is to assign the squads to definite portions of the road. The corporal of each squad and one private designated as second in command work in 6-hour shifts as supervisors, the remainder of the squad being divided into three 8-hour shifts of two men each. The corporal patrols his assigned piece of road observing the effects of traffic and making note of the places where repairs should be undertaken. The two men on shift make the repairs directed by the corporal. The work consists mainly of opening drains, filling holes, and removing mud, débris, and obstructions. If damage to the road develops, which is beyond the capacity of this small detail to repair, the corporal sends a message to the platoon bivouac where steps are taken to send additional men to the critical point. Another method is to employ a platoon upon a section of road, using three squads on maintenance in three reliefs, and retaining the fourth squad for emergency work. The platoon headquarters personnel is used for inspection.

i. Road work in corps and army areas.—Within the sphere of activity of the corps and army engineers the road work is of a more substantial and durable nature than it is in the divisional areas. The corps and army take over the road operations as far forward as conditions permit, releasing the divisional engineers for work at the front. In this manner, as long as the number of corps and army troops permits of extension, the progress of the division is independent of the road-maintenance problem. When the road-maintenance troops in the rear have become extended to the practicable limit the divisional engineers can no longer be released from road work and the further progress of the division becomes dependent upon the ability of the divisional troops to keep road communications open to the rear. The closest liaison between the unit engineers of the division, corps, and army is necessary in order to know when this critical limit is approaching, as the division commander has then to decide between

diverting combatant troops to work on the communications, or pushing on without contact with his base.

j. Roads officer.—The corps and army engineers usually designate one officer on their staffs to handle road questions. His duties are purely staff in their nature and consist of drawing up projects, following up supply activities, maintaining progress reports, and compiling the results of reconnaissance.

k. Road troops.—The executive handling of the troops engaged upon road work is a function of engineer troop commanders. The usual method of handling road work, like other engineer work, is to charge a general service regimental commander with responsibility for the road net within prescribed limits. Additional troops and civilian labor may be attached to his regiment if necessary. The headquarters of a general service regiment is so organized that it can readily assume the directing and supplying of such additional troops. An engineer commander charged with road work in the corps or army area draws supplementary road-working equipment from the nearest engineer depot. The usual work consists of making repairs, resurfacing, opening ditches and drains, and strengthening bridges to take maximum military loads. It is usually necessary to operate quarries. Railroads are used as far as possible for transporting road metal. Dump truck companies may be obtained for handling rock and earth by application to the corps or army engineer.

182. General construction.—*a. Fundamental principles.*—(1) The scarcity of materials and transportation inherent in war makes imperative the maximum exploitation of available resources. It follows that in construction programs only bare necessities should be provided for. The decision as to what is absolutely necessary rests with the commander, but the engineer carefully scrutinizes demands for construction and in proper cases points out apparent violations of the rule of bare necessities.

(2) The factor of safety in military construction need not be as great as is demanded in civil practice, except where a structure is in itself vital, as where a military force is entirely dependent upon a single wharf for its supplies. Where a large number of buildings are being constructed for storehouses or shelter, the collapse of one or two of the buildings would be of small consequence compared to the great saving in material resulting from constructing the whole number of

buildings with a minimum factor of safety. Furthermore, the length of time a structure for military purposes will be required is always so uncertain that it does not pay to build for great durability.

(3) The principle of simplicity requires that all designs be of the simplest kind, requiring only the most common construction materials and methods.

(4) In planning construction where large expansion may develop it is proper that projects be so laid out that expansion is feasible. However, it is essential that the building program should be so carried out that each usable unit is completed in succession in such a way that it can be used immediately.

(5) Whenever possible type plans should be used. War planning and procurement for construction are done with type plans as a basis. It is, therefore, likely that the materials required for type structures will be available, whereas departure from type may require materials not readily obtainable. Type designs may be found in regulations. Time may, therefore, be saved by following them instead of delaying to make new designs.

b. Organization for construction.—(1) The organization for construction follows the principle of centralized control with decentralized execution. The construction policy is enunciated by the Commander in Chief based upon the recommendations of the chief engineer after consideration of the strategical plan, the construction requirements, the flow of construction supplies, the availability of labor and the general technical factors. The section engineers carry out the policy so far as the communications zone is concerned and the unit engineers of the army, corps, and divisions execute constructions within the combat zone. One of the most important functions of the chief engineer is the decision as to allocation of supplies and engineer troops among these agencies.

(2) Much of the construction in the communications zone may be done by contract. In this case the work is planned and inspected by the unit engineer. Much work may be done by hired labor. In this case the work is planned and executed and the forces organized by the unit engineer. Civilian labor for construction work may be organized in general like engineer separate battalion units. Prisoners of war are similarly organized when employed upon construction.

(3) Where the unit engineer has general engineer organizations at his disposal it is advantageous to so employ them that their basic organization is not disrupted. The commander of a unit is charged either with all the construction in a given area or with all of one class of construction in a given area. The interior operation of the unit is solely the commander's responsibility, the quality and progress of work being subject to inspection by the unit engineer. This principle is applicable to troops, other than engineers, who may be employed upon construction.

(4) To facilitate the employment of transient troops on construction a nucleus of engineer troops should be maintained permanently upon the work.

(5) The employment of special engineer troops should utilize to the full their special characteristics by assigning them to tasks closely related to their specialty whenever possible. Nevertheless when no work of a special nature needs to be done they are available for and should be used on general construction.

(6) Where a large number of structures of the same kind are to be constructed the work can generally be analyzed into parts and organization assigned to each. The work then assumes somewhat the nature of a drill and great efficiency and speed of construction result.

c. Reports.—Each engineer in charge of a project keeps progress charts and inventories of construction materials to the end that the existing status of the project may at all times be known. From time to time he makes reports to the next superior unit engineer and to the military commander. Terrestrial or aerial photographic reports are especially useful.

183. **Water supply.**—*a. General.*—The operations of water supply battalions are covered in paragraph 168. This paragraph covers the broad aspects of water-supply operations of the engineer troops in the division, corps, and army areas, and in the communications zone.

(1) Commanders of troops of all arms are responsible that their units are provided with an adequate supply of water. When conditions are such that troops are unable to meet their water needs themselves the engineers develop additional facilities to the extent necessary to satisfy the requirements of the area. Responsibility for the development of the water resources

of an area and the foundation of the water supply rests with the unit engineer. This responsibility includes the investigation, construction, maintenance, and operation necessary to make water available at water points and such recommendations as may be necessary to provide for an equitable distribution of the water.

(2) The transportation of water from water points to place of consumption and the sanitary supervision of water deliveries are the responsibilities of the commander of the troops using the water.

(3) The determination of the sanitary suitability or potability of water supplies is the function of the Medical Corps.

b. Activities.—The water-supply activities of the unit engineer may include—

(1) Reconnaissance of water resources.

(2) Development of water points.

(3) Regulation of traffic at water points.

(4) Posting of signs indicating location of water points and the sanitary quality of the supply.

(5) Preparation of maps showing location of water points.

(6) Maintenance of a record of water-supply installations within the area.

(7) Recommending suitable regulations for the proper use and conservation of water and for the prevention of pollution.

(8) Arranging with higher engineer echelons for the delivery of water by tank car or tank truck in the event of dearth of natural supplies.

(9) Construction incident to water-supply development.

c. Facilities.—The facilities usually provided at water points in any area and their priorities are—

(1) Water-cart fillers.

(2) Canteen fillers.

(3) Horse troughs.

(4) Lavatories.

(5) Shower baths.

(6) Swimming pools.

d. In the division.—In the division area, the installations are of the simplest character, usually consisting of elevated or ground-level canvas reservoirs and hand force pumps.

e. In corps and army areas.—(1) The corps and army engineers have responsibility for water supply within their re-

spective areas. Here the demands for water are greater and the character of the installations is more extensive than in the divisional areas. The allowances of water are more liberal, permitting of the use of water for such activities as the use of water in road construction. Tank reservoirs may be constructed and filled by power pumps. Delivery of water by pipe line may be found advisable, and in a stabilized situation the pipe system may be extended well forward. The transportation of water by tank cars to railheads will be of frequent occurrence.

(2) If the water situation demands it, the corps or army engineer may designate an officer on his staff as water-supply officer. The duties of this individual are shown in paragraph 60. All actual construction of water-supply installations is carried out by the general engineer troops at the disposal of the corps or army engineer.

f. In the communications zone.—In the communications zone the demands for water may be enormous. Some of the usual needs are for the operation of steam power plants of all kinds, the operation of railroads, the supply of large cantonments, the water supply for concrete construction and water-bound macadam roads. Where local resources are deficient, water to meet these needs is transported by rail or pipe line.

(1) The section engineer is charged with the development and operation of water supply in his section. His activities may include:

(*a*) The operation of existing plant.

(*b*) The construction of and operation of reservoirs, standpipes, pumping stations, filter beds, chlorination devices, and pipe lines.

(2) The same general considerations as to other construction activities in the section apply to water-supply activities. That is to say, the responsibility is that of the section commander, and the construction is according to policies laid down by and projects approved at GHQ.

g. Water-supply activities of the chief engineer.—The chief engineer makes recommendations as to water-supply policies which are then promulgated by the staff of the commander in chief. He also causes the projects for major water-supply constructions submitted by the engineer of the communications zone to be technically scrutinized, and recommends their approval or modification. The chief engineer makes allocation of

water supply battalions from the GHQ reserve to the several armies. He provides for depot stockage and priorities of issue of water-supply equipment to meet prospective operations. The intelligence officer on the staff of the chief engineer collects and compiles from all sources information as to water resources of the enemy territory, including geological investigation.

184. Engineer operations in ports.—*a.* At or prior to the beginning of operations involving oversea shipments the chief engineer makes studies of possible ports of debarkation and recommends to the commander in chief the best available sites from an engineer point of view and a comprehensive initial port development policy. Among the most important considerations influencing his recommendations are:

(1) The amount of tonnage the port may be expected to handle. This information is furnished by the general staff. If no definite figure is obtainable from this source, the chief engineer makes his own estimate based upon the strategical plan of the commander.

(2) The draft of the vessels which will use the port and whether the navy is to use the same port for a base.

(3) The tidal range and hydrographic complexion of the site.

(4) The existing facilities.

(5) Capacity of the site for expansion.

(6) The routes of communication from the port to the combat zone.

He reports to the commander the results of his studies, recommending a port or ports for adoption with reasons therefor and also recommending alternative sites.

b. A port having been selected, he formulates for approval a port policy which becomes the basis of subsequent engineer operations. This policy covers:

(1) The number and character of new berths to be constructed, including the necessary dredging.

(2) A plan of port control.

(3) The extent of port storage to be provided.

(4) The kind of cargo handling machinery to be installed.

(5) The general track layout for the port and the amount of rolling stock and motive power to be required for port operation.

(6) A plan of construction of troop reception facilities including barracks, mess halls, hospitals, and recreational centers.

c. The approved policy is put into execution by the commander of the section of the communications zone within whose

jurisdiction the port lies. The section engineer is the agency for carrying out the detailed project.

d. The section engineer employs upon the work such engineer troops as he controls, usually general service regiments or separate battalions; transient troop units; prisoners of war; civilians; and such other troops, engineer or otherwise, as the commander of the base section may place at his disposal.

e. In executing the work it is desirable that every effort be made to make some portion of the facilities immediately usable.

f. The section engineer makes periodic reports of progress to the chief engineer, who studies them in connection with the port necessities of the campaign and prepares to make recommendations to the commander in chief as to the cessation of certain activities or to the expansion of the project. When, due to acts of the enemy or other causes, the necessary materials of construction are unavailable or a shortage exists, the section engineer makes recommendations to the chief engineer for a modification of the project and he uses his initiative within the latitude allowed him, to develop the maximum efficiency of the port where minor deviations from the approved project seem warranted.

185. Operation of public utilities in occupied cities.—*a.* When cities are occupied by our military forces in enemy territory the operation of public utilities comes under the supervision of the unit engineer. It will be unusual for the necessity to arise for the use of engineer troops in the actual operation of the utilities, the normal civilian operating and administrative personnel being retained wherever possible and the needs of the civilian population being satisfied so far as is consistent with the military requirements.

b. The usual employment of the engineers is the placing of technically trained officers and noncommissioned officers at key positions to insure that the utilities are operated in accordance with the regulations prescribed by the military commander. The superimposition of a large military population upon the existing civil population causes congestion and scarcity of supplies which requires regulation. Some of the difficulties likely to arise are:

(1) Shortage of fuel for power plants.

(2) Shortage of electric-lighting material, such as incandescent globes and fuses.

(3) Water shortages or pollution of water supplies.

(4) Strikes or sabotage by civilian employees.

c. Immediately upon entering the occupied city the unit engineer makes contact with the engineering members of the civilian government and endeavors to induce them to retain their posts. He convinces them that it is in the interest of the civilian population that they should do this, and he arranges to guarantee them continuation of their salaries. Having established amicable relations, he superimposes upon their office a nucleus of military engineer personnel and immediately requires a detailed survey and report of the condition, location, and method of operation of all utilities. After the reconnaissance has been made he recommends to the commander such modifications in current procedure as seem advisable in the military interest.

186. Engineer operations with mechanized forces.—*a.* Engineer units operating with mechanized forces have mobility equal to that of the force they accompany and are equipped to economize or replace manual labor by machinery for the execution of a large part of the engineer work. As a general principle, their tools and special equipment accompany them, but some of the heavier equipment which may be used only in certain situations may be left in the rear echelon to be brought forward rapidly when need for its use arises.

b. While many elements of a mechanized force may possess the ability to move across country, the force as a whole is dependent upon roads and bridges. Its great range of action requires a very large road net. The maintenance of this road net is the major task of the engineer component.

c. The dependence of the mechanized forces upon their routes of communication implies that an effective defense against them lies in destroying, blocking, or otherwise controlling these routes. On the defensive the engineers therefore are employed in demolitions and the construction of mines, traps, and barriers along the hostile avenues of approach. On the offensive they are employed in overcoming the corresponding impediments to movement imposed by the enemy.

d. The engineers are employed upon the reconnaissance of routes of advance and the preparation of maps showing by appropriate symbols the availability of terrain for the maneuvers of mechanized forces. They also make engineer reconnaissance of the area to discover local sources of engineer mate-

rial and to assist in planning engineering assistance for the maneuver. Much of this reconnaissance is made either from airplanes or by means of aerial photographs.

e. The equipment of the mechanized engineer unit includes vehicles for the transport of all personnel and engineer material; vehicles for reconnaissance; portable bridges; machinery for excavation and trenching; tractors for engineer work; and power units for the operation of winding gear, pile drivers, power saws, and drills.

187. **Railway construction and operation.**—*a. Organization.*—(1) The chief engineer of the theater of operations is the director of railways, and is charged with the supervision of all railway activities within the theater of operations. He is assisted by a general manager and by an engineer of railway construction and such other railway officials as may be required. An assistant engineer of railway construction for the combat zone, reporting directly to the engineer of railway construction, exercises technical supervision over reconstruction and new construction in the combat zone and may be made responsible for its execution.

(2) The engineer, communications zone, is the director of railways, communications zone, and is in charge of all railway activities under its jurisdiction. He is assisted by an assistant general manager, an assistant engineer of railway construction, and such other railway officials as may be necessary. Technical supervision over railway activities in the communications zone is maintained by the director of railways, theater of operations, through his general manager and engineer of railway construction, who exercise technical supervision over the assistant general manager and assistant engineer of railway construction, respectively.

(3) The maintenance and operation of railways in general are responsibilities of the communications zone. In the usual case these responsibilities extend as far forward as the railheads. The control, however, of all train movement over railways beyond the regulating station is exercised by a staff officer from GHQ known as the regulating officer.

b. Construction.—(1) The plans for reconstruction or new construction of railways in the theater of operations are prepared by the director of railways under the direction of the commander of the theater of operations. Railway plans of army commanders and of the commander of the communications

zone are coordinated by the director of railways with the plans for the theater of operations as a whole. Reconstruction and new construction of railways in the combat zone are executed by army commanders and in the communications zone by the commander of the communications zone, except in cases where such work is placed directly under the director of railways, theater of operations.

(2) General engineer troop units are trained to perform railway construction work, but their organizational equipment is not sufficient to keep all the personnel occupied upon railway construction tasks. Such units are normally used for executing railway construction and for this purpose must draw additional equipment from depots when assigned to major railway construction or reconstruction tasks. Railway battalions are not organized or equipped for railway construction. (See par. 161 *a* (2).)

c. Operations.—(1) In a large theater of operations where railway operations are extensive, lines may be divided into grand divisions, the limits of which are determined by the military situation; the railway traffic, and the geographical location of the existing railways. Each grand division is under the charge of a general superintendent and is divided into two or more divisions each under the charge of a division superintendent, who is responsible for the operation and maintenance of his division. Military railway divisions are shorter and more numerous than is usual in the operation of commercial railways. They are self-contained units so far as operation and maintenance are concerned. An engineer railway battalion is organized and equipped to take over the operation and maintenance of a railway division. (See par. 161.) Major repairs to rolling stock are performed in the communications zone.

(2) General superintendents are charged with all operation and maintenance within their respective grand divisions and command all railway troops assigned to them for duty. A grand division is usually manned by a railway headquarters, two or more engineer railway battalions, and such railway shop facilities as the situation may warrant.

(3) The division superintendent (or general superintendent) at a regulating station is a member of the staff of the regulating officer. He is responsible for the movement of cars in accordance with military requirements as indicated to him by the regulating officer. He commands the railway personnel op-

erating the lines controlled by the regulating officer, provides and maintains rolling stock and other equipment, and controls all questions of a technical nature pertaining to railway operations.

(4) Each division superintendent is represented at all depots, railheads, and important railway stations in his district by officers who expedite the movement of troops and supplies at all points, and assist the military personnel traveling on the railways.

d. Light railways.—Light railways are employed in stabilized situations in lieu of or supplementing motor transport from the railhead forward. They may be employed also in mobile situations in terrain having few or no roads, or where the enemy has made complete demolition of roads and standard gauge railroads in his withdrawal. In an advance, standard gauge railheads are pushed ahead as fast as possible and the rear of light railway lines torn up and transferred to the front. Light railways will seldom, if ever, be joined into a system, their true function being that of distributing agents from railheads. They are operated under the control of the commander within whose sphere of activity they are employed. They are generally operated and maintained by general engineer troops. The operation of light railway lines approximates to some extent the operating methods of standard gauge railways; the detail operation is analogous to a truck system running on rails rather than on a highway.

CHAPTER 7

MOVEMENTS AND SHELTER

188. Movements and marches.—*a. General principles.*—(1) In the movement of large bodies of troops there usually is engineer work to be performed to facilitate the movement. Engineer work is also usually needed at the destination. It is, therefore, usual to find engineers among the first troops to move and among the last.

(2) In preparing for the movement of an engineer unit, allowance must be made for the time occupied in caring for engineer equipment. It often happens that engineer units have in their possession special equipment issued to them for special work which it is not desirable or practicable to take with them to their new location. Arrangements must be made to turn over this equipment either to other using troops or to army or corps depots prior to the movement. Detachments from depot companies may be employed to take over these supplies.

(3) When orders are received directing an engineer unit to move from one location to another, the commander of the unit makes a careful study of the instructions for the movement as issued from higher headquarters. He makes an estimate of the situation and a decision based upon the engineer and tactical elements involved. He directs reconnaissance of the routes to be followed and, if several routes are available to his unit, decides which shall be used. He usually calls a conference of his staff at which he gives instructions for the issue of a warning order, goes over the details and announces his decisions relative to the move, and directs the preparation of a field order.

(4) The unit adjutant makes arrangements for sending quartering parties. He details a quartering officer and a quartering party to precede the command and makes arrangements with the supply officer for their transportation. He informs the quartering officer of the probable time of arrival of the troops and gives him instructions concerning the duties of the parties as guides. He prepares a strength report upon which are based the estimates of transportation requirements. He arranges for the rerouting of mail and for the handling of the

routine administration of headquarters during and after the move.

(5) The unit operations officer prepares the warning order. He determines what combat supplies or special equipment will be taken. He divides the unit into groups according to the manner of movement as, by foot, motor, animal, or rail. He drafts the field order for the movement.

(6) The unit intelligence officer obtains suitable maps of the new area.

(7) The unit supply officer is charged with the arrangements for supply en route and at the new station. He fixes the methods and times of distribution of supplies, and handling of the field trains. In movements by truck or rail he furnishes the operations officer with data concerning tonnage requirements and assists in the selection of points of entrucking or entraining.

(8) The officer designated as quartering officer goes on ahead with his party. He selects the new camp site. He divides it into distinct areas and assigns an area to each major subdivision of the command. In certain cases he may procure supplies such as food and fuel for issue to the incoming troops. He arranges to have guides meet the troops upon arrival and conduct them to their allotted areas.

(9) Engineer troops may be moved by marching, motor, rail, or water, or by a combination of any of these methods.

b. Marches.—(1) *Divisional troops.*—In the movement of a divisional engineer unit the division engineer issues a march order based upon the march order of the division. His order covers the disposition of his command in the columns, the disposition of the transportation, the time of starting, routes to be followed, and measures for the maintenance of march discipline. In the march of a division there is almost invariably engineer work to be done, usually on the maintenance of the routes of march. This requires that some engineer troops march at the head of the columns and that details be placed at critical points along the roads to maintain the roads and bridges until the division has passed. Engineer work can not be done while the engineer troops themselves are marching. It is essential that the engineer tool wagons with the tools be with the working units. The routes are reconnoitered prior to the commencement of the march and timely measures are taken for the removal of obstacles, preparation of stream cross-

ings, etc. The reconnaissance also determines the suitability of the road for all classes of transportation and the grades on which it may be necessary to vary the rates of march. The reconnaissance is the basis for the recommendation made by the division engineer to the division staff concerning the engineer features of the movement. Special attention is given to the loading of vehicles so that needed tools will be accessible.

(2) *Nondivisional troops.*—(*a*) When nondivisional engineer units move in the combat zone, it is necessary that orders authorizing the movement be issued by the corps or army headquarters so that there may be no interference with the movements of other troops. Arrangements are made through the corps or army unit engineer who makes appropriate recommendation to the staff concerning the time, routes to be followed, and supply at destination. Nondivisional units of engineers, when attached to divisions, are included in division march orders. Orders for the movement of engineer troops, in the communications zone, are issued by the headquarters of the communications zone. Arrangements are made through the engineer, communications zone.

(*b*) In forward areas most of the movements of engineer troops are under cover of darkness and in small columns. In daylight movements provision must be made against enemy aerial observation and attack. The matter of concealing the movement of ponton bridge units is especially important, since information of their movements might reveal to the enemy the intentions of our commander.

c. Movements.—(1) *By motor transport.*—(*a*) *General principles.*—If engineer work is contemplated at the end of the journey, it is essential that the troops be accompanied by their tools. This means that the engineer motor vehicles with tools and special equipment must be incorporated in the column. The fact that foot troops are generally separated from their transport during truck moves makes it necessary to provide in plans and orders for their subsistence while thus separated. Rolling kitchens may be mounted on trucks; but for rapid or long moves rolling kitchens, except trail-mobile type, can not be trailed. The transportation of animals by motor transport, while unusual, may become necessary in emergencies. For this purpose side and end racks for each truck and a number of loading ramps are required.

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(*b*) *Divisional engineers.*—The division order for the movement shows the assignment of vehicles, the entrucking point, routes, times, and rates of movement. Based upon this the division engineer issues a field order to get the engineer command to the entrucking points, and to get the engineer motor vehicles into the column. The order prescribes the manner of taking engineer tools, whether in separate trucks or whether carried by the individual soldiers. The latter method should always be given consideration, since it is practically certain that the trucks can not get very near to the front, and it is important that the tools be available to the troops upon arrival at destination. The order also prescribes the disposition of the animal-drawn transport.

(*c*) *Nondivisional engineers.*—Nondivisional engineer units moving by truck follow the principles stated above for divisional engineers where applicable. The manner in which their equipment is transported depends upon the plan for the employment of the troops at the end of the journey. If this calls for immediate engagement in engineer operations, the equipment should precede or accompany the troops.

(2) *By rail.*—(*a*) *Divisional engineers.*

1. In preparation for the movement of a division, engineer work may be necessary in providing facilities at entraining points such as ramps and loading platforms, the construction of racks in box cars used for transporting animals, and assistance to troops of other arms in loading and chocking heavy loads, such as tanks and heavy artillery. Elements of engineers are generally placed in an early position on the schedule of movement in order that they may be available to perform engineer work at detraining points and in the new area.

2. The manner of assignment of engineers to trains depends upon the situation, but if the engineers are expected to perform engineer work immediately upon arrival in the new area it is necessary that the troops and their field and combat trains, including tool wagons and tools, be kept together. The normal loads are left in the vehicles when they are placed upon the railway cars, care being taken to prevent tampering by unauthorized persons.

3. In cold weather care must be exercised to prevent damage by freezing of radiators and cylinder blocks of power plants of vehicles and special engineer equipment. Vehicles may be driven onto railway cars under their own power. The water in the cooling system is then drained and the fact noted on a conspicuous tag fastened to the radiator. Similar precautions apply to water purification trucks, electric lighting sets, and pumping engines.
4. As a measure of security, troops keep their arms with them and arrangements are made to distribute ammunition when attack is imminent.
5. Animals are removed from railway cars and exercised at least once every 24 hours.

(*b*) *Nondivisional engineers.*—Nondivisional engineer troops moving by rail follow the principles described above for divisional engineers where applicable. A matter of prime importance is that arrangements be made for transporting the equipment with or prior to the troops if it is expected that engineer operations are to be undertaken immediately upon arrival at destination.

(*c*) Vehicles are grouped into classes according to the car space that they occupy for convenience in determining the number of cars needed for the movement.

(3) *By water.*—Troop movements by water generally take place through established ports. If the port is in the theater of operations and not an established port for military embarkation or debarkation, it may be necessary for the engineers to execute work both at the port and aboard the vessels prior to the passage of the troops of other arms through the port. The disposition of engineer troops in the vessels in a movement by water depends upon the tactical situation, as in many cases they and their equipment must be available for engineer work immediately upon landing at the destination. When ponton equipage is moved by water, it may, in some cases, be floated. The pontons may be consolidated into rafts upon which a decking is constructed using balk and chess. The vehicles of the bridge units may be transported on these rafts.

(4) *By air.*—Engineer troops in small parties may be transported by air, when urgently needed to initiate or execute special work at a great distance where time is of special impor-

tance. This means of transportation of engineers is of most frequent occurrence with engineer troops attached to Air Corps units.

189. Shelter.—*a.* In mobilization concentration camps the principles of shelter for engineer troops do not differ from those applying to troops of other arms and services.

b. In the theater of operations the wide dispersion of engineers affects the problem of shelter. In general, they should be quartered near their assigned work. Units are often split up into small detached subdivisions, each of which must have shelter and messing facilities.

c. Railway operation and maintenance engineers may be sheltered in blockhouses located at intervals along the railway line when operating in unfriendly territory.

d. In addition to shelter for men and animals most engineer units require storage space for engineer equipment.

e. Certain engineer technical operations are required to be sheltered. These include map reproduction, drafting, and photographic work.

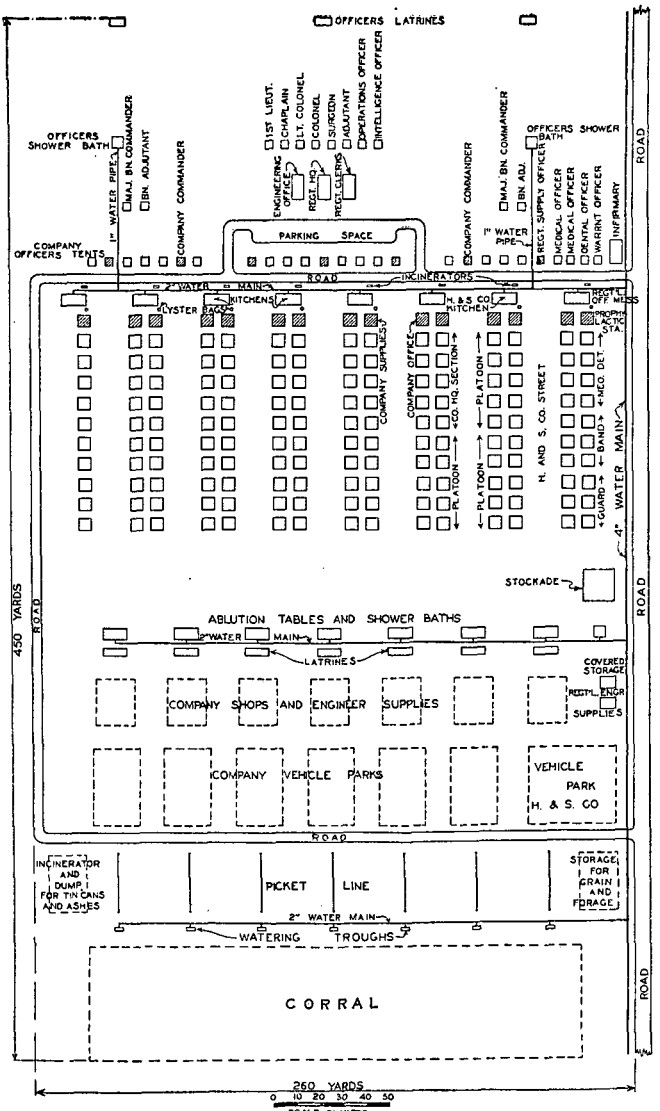

FIGURE 24.—Camp layout for the general service regiment while engaged in general construction

CHAPTER 8

ENGINEER SUPPLY

SECTION I

SUPPLY AGENCIES

190. Supply responsibilities of unit engineers.—In accordance with the basic principle of decentralization of supply operations the unit engineer of every command is charged with responsibility for the engineer supply of that command. Under each unit engineer within the theater of operations there are provided agencies whose primary duty is to provide for the requirements of the troops of that unit in engineer equipment, material, and supply. These supply agencies vary from a very limited personnel and a small amount of mobile supplies within the division to extensive depot and supply organizations in the army and communications zone. Figure 25 shows the route of requisitions and the flow of supplies in response to these requisitions to both communications zone units and combat zone units.

191. Supply agencies.—*a. GHQ.*—(1) The supply section of the office of the chief engineer, theater of operations, is an organization for control and planning. Actual supply operations are handled by the engineers of the communications zone and of the armies.

(2) The supply section is concerned with the determination of requirements in engineer supply, in the formulation of policies and priorities, and in the allocation of equipment, materials, and supply between the several armies and the communications zone, consideration being had for the general

arrangements, policies, and directives of G–4. The functions of procurement, storage, and issue of engineer supplies are charged to the engineer of the communications zone.

(3) The supply section of the office of the chief engineer is generally organized into three branches: Requirements branch, procurement branch, and storage and issue branch.

(*a*) The requirements branch is responsible in general that all requirements of the theater of operations are estimated sufficiently in advance of need and with sufficient factors of safety to insure that all needs will be met. It establishes credits at depots and approves such requisitions as are required to be submitted directly to the chief engineer, theater of operations.

(*b*) The procurement branch supervises purchasing within the theater of operations.

(*c*) The storage and issue branch supervises the depot system of the corps of engineers of the entire theater of operations.

b. Communications zone.—(1) The supply section of the office of the engineer, communications zone, is an operating agency as distinguished from the supply section of the office of the chief engineer at GHQ, which is a control and planning agency. The general character of the supply section of the office of the engineer, communications zone, is similar to that described above for the supply section of the office of the chief engineer, theater of operations. It exercises general control over the supply activities of the engineers of the various sections of the communications zone. The subdivisions of the supply section of the office of the engineer, communications zone, maintain close liaison with the corresponding subdivisions of the chief engineer, theater of operations.

(2) The replenishment of all depots both in the combat zone and in the communications zone is the direct responsibility of the engineer, communications zone, but the operation of the engineer depots as well as supply activities in ports may be placed directly under the section engineers within whose sections they lie.

(3) The supply officers of troops on engineer jobs operating under section engineers submit requisitions either to the section engineers or directly to the nearest depot with which they have been allotted credits.

(4) The supply section of the office of the engineer communications zone is generally organized into three branches:

The requirements branch, the procurement branch, and the storage and issue branch.

(*a*) The requirements branch is responsible that the estimate of requirements for all troops and projects of the Corps of Engineers in the communications zone is prepared sufficiently in advance of needs so that ample stocks can be built up in depots in time for issues when needed. It acts upon requisitions from the field, routing them to the storage and issue branch, when stocks are on hand, on order, or en route to the theater of operations. If the supplies requested are not on hand, on order, or en route. the requirements branch makes requisition through the chief engineer, GHQ, upon the zone of interior, or, if they can be purchased within the theater of operations, on the procurement branch of the supply section of the engineer, communications zone.

(*b*) The procurement branch makes purchases of supplies in the theater of operations in accordance with the procurement schedule furnished by the requirements branch.

(*c*) The storage and issue branch is responsible for the storage of supplies and their issue upon requisitions from the field. Requisitions may be approved by the engineer, communications zone, or the issue may be a proper charge against credits established by authority of the engineer, communications zone.

(5) Engineer depot companies furnish the office and outside organizations for depot operation.

c. Army.—(1) The army engineer of each army maintains and operates one or more engineer depots for the engineer supply of the troops of the army. As a rule in mobile warfare with rapidly changing situations divisions are supplied directly from army depots. When the situation assumes a condition of stabilization, or when the corps operations cover extensive areas, there is an advantage in allocating supplies in army depots to corps or in establishing advance army engineer depots primarily for the use of a particular corps, or establishing corps depots. In such cases, the corps becomes an intermediary link in the supply chain, and division engineers obtain supplies from the corps.

(2) *Credits.*—As an assistance in the equitable distribution of material. in the automatic check on waste, and as an assurance that supply will be certain, credits may be given to corps or divisions by the army for engineer supplies in army depots.

(3) *Requisitions.*—When credits have been established, there is no necessity for division engineers to submit requisitions. For supplies in which no credits have been established, requisitions are submitted to the corps or army, depending upon the method of supply involved.

(4) *Depot personnel.*—The personnel for the operations of army depots consists of depot companies. Platoons or sections may be detached from depot companies for the operation of smaller installations in the areas of the corps or divisions. When army supply activities are very extensive, general engineer troop units may be assigned to the operation of depots. For further details, see paragraph 169.

d. Corps.—(1) The corps engineer is responsible for the distribution of engineer supplies to corps troops. In addition, he may be a link in the chain of supply between the army and the divisions. He always exercises general supervision over supply to divisions, and assures himself that engineer supply to the divisions is adequate for the operations in view. He makes provision for relieving divisions of the care of accumulated materials.

(2) The corps engineer is in all situations a map supply agency, and is responsible for the procurement and distribution of maps for divisions and corps troops.

(3) One or more corps engineer depots may be established to facilitate engineer supply to the divisions and to corps troops. The stockage of corps depots may be general in its nature or may be limited to certain items especially needed for immediate operation. The area of the corps is combed for local engineer materials which are then accumulated in corps depots.

(4) The personnel for the operation of corps engineer supply establishments may be either depot companies or general engineer troops.

e. Division.—(1) The division engineer exercises his function as engineer supply officer of the division through the regimental supply officer of the division engineer regiment. A small reserve of engineer equipment, materials, and supplies is carried in the transport assigned to the regiment.

(2) The supply activities of the division engineer include the following:

(*a*) The establishment and operation of engineer dumps, distributing points, and supply establishments.

(*b*) The supply of maps.

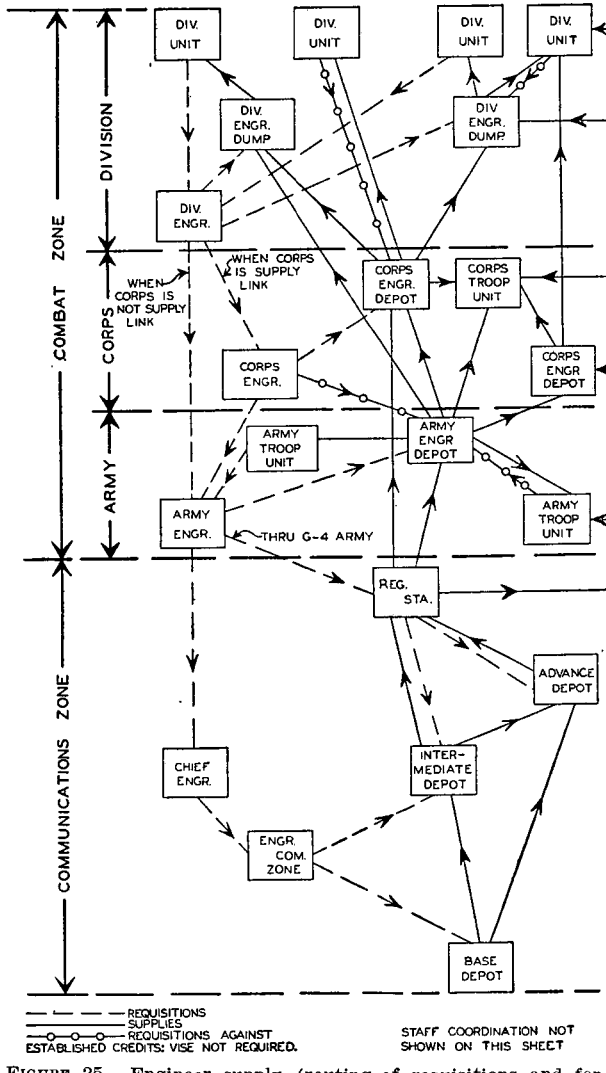

FIGURE 25.—Engineer supply (routing of requisitions and forwarding of engineer supplies in the theater of operations)

(*c*) The transporting and furnishing of intrenching tools and field fortification and camouflage materials to other units of the division.

(*d*) The transporting and furnishing of foot bridges.

SECTION II

SUPPLY, OTHER THAN ENGINEER, FOR ENGINEER TROOPS

192. Classification of supplies.—For simplicity and convenience of administration, supplies are divided into four classes, as follows:

Class I.—Supplies which are consumed at a relatively uniform rate and which do not necessitate special adaptation to meet individual requirements: Subsistence, forage, motor fuel and oils, and articles of a similar nature.

Class II.—Supplies which, though consumed at an approximately uniform rate, are for the personal use of the individual and require special arrangements to meet individual requirements: Clothing, gas masks, and similar articles.

Class III.—Individual and organizational equipment prescribed by Tables of Organization and Basic Allowances.

Class IV.—Supplies and equipment for which allowances are not prescribed, articles of an exceptional nature, and supplies and equipment, the distribution of which depends upon the conditions imposed by the operations: Ammunition, fire-control apparatus, radio apparatus, air-service supplies, medical supplies, engineer construction materials.

193. Supply in the combat zone.—*a.* (1) *Divisional engineer troops* are supplied in accordance with the same general principles that govern the supply of other troops in the division. Class I supplies are issued without requisition upon the basis of the strength reports submitted to division headquarters by the commanding officer of the division engineer troops, and will normally be delivered to the engineer regimental field train bivouac at a time designated in division orders.

(2) *Corps and army engineer troops* may be supplied by corps or army supply agencies or they may be attached to divisions for supply. As corps and army engineer troops frequently operate in divisional areas, the latter method is frequently used. The attached engineer troops are then supplied as described above for divisional engineer troops. When not attached to

divisions for supply, corps and army engineer troops send strength reports and requisitions direct to corps and army headquarters, respectively. They are then supplied from distributing points designated in corps or army administrative orders.

b. Special aspects of supply for engineer troops.—It is evident from the foregoing that, in general, the supply of engineer units in the combat zone is handled in the same manner as the supply of troops of other arms and services. However, the great dispersion of engineer troops on work throughout the combat zone makes the internal distribution of supplies to engineer units a special problem. In principle, the work units should not be required to divert their transportation from engineer work to the procurement of food, fuel, forage, clothing, etc. These items are generally delivered to them by the supply officer, although situations may arise in which the use of the ration and baggage wagons of the companies for this purpose may be necessary.

194. Supply in the communications zone.—*a.* Engineer troops in the communications zone obtain their supplies in accordance with detailed regulations prescribed by the commander of the communications zone, based on the following general principles:

(1) Articles of Classes I, II, and III are issued by depots on duly approved requisitions made direct to them.

(2) Requisitions for equipment of Class IV supplies, including those for construction work, are submitted to the chief of the service concerned who, after approval, sends them to the proper depot for issue.

b. Orders issued by unit engineers in the communications zone, disposing of engineer troops upon engineer work, usually designate the distributing point at which the units will draw routine supplies. If not so designated, distributing points for engineer troops are as directed in administrative orders issued by the headquarters of the communications zone section within which the engineer units are operating.

SECTION III

SUPPLY TRAINS

195. Supply trains in the infantry division.—The division train of an infantry division does not include an engineer section. The vehicles of the combat regiment perform train func-

tions for the division for engineer materials and equipment. When the division is on the march some of the vehicles of the headquarters and service company of the combat regiment carry engineer tools and materials for the general use of the division. These include the six tool wagons loaded with intrenching tools and trucks loaded with electric lighting equipment, footbridge equipment, water-supply equipment, and special supplies the need for which has been foreseen. When the division halts, any or all of the transportation of the combat regiment may operate as a train between the railhead; or refilling points and the engineer distributing points.

196. **Trains of the combat regiment.**—*a.* (1) *General.*—The nature of engineer operations in the field makes it impracticable permanently to classify the vehicles and cargo carriers of the combat regiment, as combat train, field train, or service train. When the regiment is engaged on engineer work all cargo carriers of the regiment are classified as the combat train, since the use of every available cargo carrier is then essential for handling construction material. When the division marches, the classification of the engineer vehicles depends upon the engineer work required during the march.

(2) *Position of trains in the column.*—The distribution of the engineer cargo carriers in the column must be determined for every march under the basic principle that tools and vehicles must be available for the work units as soon as the site of the work is reached. This involves a careful engineer estimate of the situation. The transport to accompany the troops immediately depends upon the work that must be provided for during the march and immediately upon its termination.

b. In the headquarters and service company.—In the headquarters and service company certain vehicles are always part of the combat train as they transport personnel and equipment essential to the operation of the headquarters sections. These include motor cars and motor cycles for reconnaissance and messenger service, the light cargo trucks, the electric-lighting truck, the map-reproduction truck, and the water-supply trucks. Other vehicles may be classified as service train or combat train depending upon the situation. These include vehicles transporting equipment for regimental and divisional use for special work, such as those carrying footbridge equipment, ammunition, explosives, supplementary equipment, and

intrenching equipment. The pack section is usually classified with the combat train.

c. In the battalions.—There are no trains permanently assigned to battalions. A portion of the pack train or other transport from the headquarters and service company may be attached to a battalion when needed. The battalion commander may combine company vehicles into a battalion train when the situation makes this desirable.

d. In the companies.—Motor cycles, tool trucks, and company rolling kitchens, together with such additional transportation as may be attached from the service platoon of the headquarters and service company under special situations, constitute the combat train of the company. When the trucks can not go with the company they are nevertheless a part of the combat train and are disposed in the column so as to be readily available for work purposes. The ration and baggage wagon is part of the field train on the march.

e. In the platoons.—The platoon tool wagon is always the combat train. It is essential to the engineer operations of the platoon and only in exceptional circumstances is it separated from the platoon.

197. Supply trains in the corps.—There is no corps engineer train. The transportation of engineer supplies and equipment for the use of corps troops is accomplished by the vehicles of the corps service train operated by the Quartermaster Corps. When corps engineer depots are established, supplies are usually transported to them by vehicles operating under the army.

198. Supply trains in the army.—There is no army engineer train. The transportation incidental to army engineer supply operations is accomplished by the vehicles furnished by the army service train operated by the Quartermaster Corps.

199. Supply trains in the cavalry division.—The division train of a cavalry division does not include an engineer section. The vehicles of the engineer squadron perform train functions for the division for engineer materials and equipment, when the division is on the march. Some of the vehicles of the headquarters and service troop of the engineer squadron carry engineer tools and materials for the general use of the division These include the two tool trucks loaded with intrenching tools, the truck carrying water-supply equipment, the truck carrying the electric-lighting equipment, and trucks carrying special supplies, the need for which has been foreseen. When the divi-

sion halts, any or all of the transportation of the engineer squadron may operate as a train between the railhead or refilling points and the engineer distributing points.

200. Trains of the engineer squadron.—The nature of engineer operations in the field makes it impracticable to permanently classify cargo carriers of the engineer squadron as combat, field, and service trains. When the squadron is engaged on engineer work all cargo carriers of the squadron are classified as the combat train, since the use of all available trucks or animals is then essential for handling engineer material. When the division marches, the classification of the engineer transport depends upon the engineer work required during the march of the division.

a. In the headquarters and service troop.—In the headquarters and service troop certain trucks are always classified as combat trains, since they transport personnel and equipment essential to the operation of the headquarters sections. These include the squadron commander's motor car, the truck containing squadron headquarters' baggage and equipment, and the truck containing the electric-lighting equipment for division headquarters.

b. In the troops.—The troop tool truck is a part of the combat train of the troop and should always go with the troop. If it accompanies or marches with the combat train of the squadron, this truck should be made immediately available to the troop whenever required. In certain cases this truck, together with the transportation of the platoons, is consolidated by the squadron into an engineer supply train under squadron control. In this case the bulk of the equipment is generally unloaded at the site of the work or at the rear echelon of the troop. The ration and baggage trucks are part of the field train and should join the rear echelon of the troop when the troop is at work. When desirable they may be used in engineer supply. The motor cars are part of the combat train and should be under control of the troop commander at all times.

c. In the platoon.—The tool truck of the platoon in the motorized platoons and the pack train of the platoon in the mounted troop are always classified as combat train. These carriers are essential to the engineer operations of these platoons and are only separated from the platoons in exceptional circumstances.

SECTION IV

SUPPLY OPERATIONS

201. General principles.—*a.* Constant and thorough engineer reconnaissance is necessary to determine requirements in material and supplies and the availability and character of local sources of supply.

b. A careful estimate of the supply situation is made by the unit engineer and his staff, consideration being given to the present and prospective operations, the probable supply demands, the available transportation, and time.

c. Based upon the reconnaissance and the estimate of the engineer supply situation, a plan of engineer supply is drawn up and published in orders. The plan sets forth the location of engineer supply establishments, the character of the items to be supplied therefrom, the troops, engineer or other, to be engaged in engineer supply operations, and the transportation to be allotted to supply agencies for movement of supplies.

d. In order that the supply plan may be successfully carried out, ample time for preparation should be provided. Preparations include the assembling and inventory of stocks locally available, the procurement and transportation of stocks from engineer supply establishments in the rear, and the placing of supplies near the points of probable use.

e. Engineer supply as an operation is one of the most important functions of the unit engineer of each echelon of the command. The working of the supply system is carefully watched by an officer on the staff of each unit engineer, called the supply officer. The supply officers of the several echelons maintain liaison among themselves with a view to rendering mutual assistance and making the maximum use of the available stocks of engineer supplies.

202. Supply in the offensive.—In the offensive, the principal item of engineer supply consists of materials for the repair and maintenance of the routes of communication. Road metal, procured from local quarries if possible, is placed in convenient piles by the side of the roads most vital to the operation. Road plank is concentrated at dumps for use in making turnouts around shell or mine craters in the roads or across fields where the use of dirt roads is impracticable. Bridge timbers are located near bridges which may possibly be destroyed by enemy

fire or which may need strengthening for heavy loads. As the attack progresses, dumps of engineer material are advanced. Captured supplies and local resources, such as rock quarries and standing timber, are exploited in order that transportation over the congested roads in rear of the attack may be kept to a minimum. This calls for active and persistent engineer reconnaissance of captured ground. As the divisions advance, corps and army engineers take over the operation of engineer dumps which the divisions relinquish, utilizing personnel of depot companies. They assist the division engineers by sending transportation and personnel for supply operations and by advancing materials from corps and army supply establishments to the new dumps established in the captured territory by the division engineers.

203. Supply in the defense.—When the defensive is assumed, the unit engineer sees that intrenching tools and fortification supplies reach the troops promptly. Large quantities of road, camouflage, and fortification materials are required. One or more engineer distributing points may be required. They are established well to the front so as to be easily accessible to the troops of all arms. Personnel from depot companies is usually furnished to assist in these operations. An engineer dump is usually established in the engineer regimental area. The engineer dump may also be an engineer distributing point. Corps and army engineers prepare to resume the offensive. Their supply operations consist principally of the concentration of engineer supplies in corps and army supply establishments which may be located well forward in the divisional areas.

204. Supply in a pursuit.—As a pursuit may be made by rapidly moving columns, whose location for supply purposes at any given time is difficult to determine in advance, engineer supply in a pursuit is limited mostly to the exploitation of local materials. Engineer supply operations, therefore, consist of reconnaissance to locate and classify local supplies and the movement of these supplies to the site of the work.

205. Supply in a retirement.—Engineer supply in a retirement is comparatively simple, since the troops in their retirement continually move towards supplies previously concentrated. The need for engineer supplies is generally limited to the requirements of the engineer troops and may require principally demolition supplies. Allied to the question of supply in a retirement is the question of the removal or destruction of supplies in

the area. The governing considerations are the necessity for secrecy and noninterference with the movement of combat troops by the movement of trains. Engineer supplies which can not be evacuated may be destroyed to prevent their falling into the hands of the enemy.

206. Operation of engineer supply establishments.—*a. Division dumps.*—When the tactical situation is such that accumulations of engineer supplies in dumps in the division area is desired, the operation of the dumps is the function of the supply officer of the combat regiment. For this purpose he utilizes the supply section of the service platoon of the headquarters and service company. As the demands upon the dumps increase, the corps or army engineer may, upon request, send a platoon or section of an engineer depot company to assist in the operation of the dumps. The supply officer uses this personnel as the situation demands, but he keeps in mind the eventual movement of the division and prepares to leave the dump stock in the care of the depot company detail. When the division moves, the latter may remain to guard and conserve the supplies, later making such disposition as is directed by higher authority. Division engineer dumps are handled without formality. Issues are made to troops of all arms, whether attached or belonging to a division, upon the simple statement of the commander that the supplies are necessary. A running account of stock is kept and studied to determine what items are available and what items are in demand. An orderly arrangement of stocks is maintained to promote efficient operation. Care is taken to camouflage the dumps as far as possible. Bombproof shelter may be provided for the personnel. Additional road facilities are frequently required to be constructed in and around the dump.

b. Corps and army establishments.—Corps and army engineer depots differ in character, mainly in size. Figure 26 shows a typical layout for a supply establishment in corps or army areas. The personnel for the operation of such establishments consists of depot companies with or without attached troops. For very large supply operations, a separate battalion may be assigned to the operation of the engineer supply establishment. Personnel of depot companies may then be attached to the separate battalion to furnish expert supply personnel. The location of a corps or army depot is generally central, is reached by roads and railroads either narrow or standard gage, and

is sufficiently advanced to facilitate supply without being unduly exposed to enemy artillery fire. Additional routes of communication are generally required to be constructed in and around the depot.

c. Depots in the communications zone.—In the communications zone an engineer depot may be exclusively an engineer establishment or it may be an engineer section of a general depot. An officer is designated as engineer supply officer at the depot. He has charge of the proper storage, care, maintenance, and issue of all engineer supplies, equipment, and material under such instructions as may be prescribed by the unit engineer of the communications zone. He controls the necessary technical personnel to handle the engineer supplies and the records pertaining thereto. He supervises the loading and unloading of engineer supplies, the proper marking of all shipments, and the transmittal of information in regard to shipments to consignees through prescribed channels. He arranges for transportation only through the duly constituted transportation agencies which are under the supervision of the commanding officer of the depot.

207. Typical general engineer supply depot.—*a. Organization.*—The engineer supply depot consists of a headquarters, a supply department, and an operating department. This organization must be flexible and capable of rapid expansion. A general outline of the organization of a large engineer supply depot is as follows:

(1) *Headquarters.*—(*a*) The *depot engineer officer* is in command and is responsible for the organization and operation of the depot.

(*b*) The *personnel officer* looks after all administration, camp orders, travel orders, and correspondence.

(*c*) The *chief clerk* looks after all the paper work of the depot. He has three sections directly under him.

1. The requisition section handles all incoming requisitions, gives them the depot requisition number, passes them to the supply department, and later checks shipments against the requisitions.

2. The inventory section receives the inventories from the sections of the supply department and consolidates them into a complete depot inventory.

The consolidated inventory is sent periodically to the unit engineer, under whose control the depot operates.

3. The mailing and filing section handles all correspondence for the depot.

(2) The *supply department* is under one of the depot engineer officer's assistants, and is divided into sections somewhat as follows:

(*a*) The *mechanical section* handles steam-operated equipment, cranes, boilers, engines, hoists, derricks, concrete mixers, gas engines, cable, etc.

(*b*) The *barracks and buildings section* handles wooden barracks, steel buildings, warehouses, hospital wards, corrugated-iron, roofing papers, etc.

(*c*) The *water supply section* handles pipe, pipe fittings, pumps, well drillers, bath supplies, plumbing, well casing, and all special water supply material.

(*d*) The *light railways section* handles light railway track, made-up sections of track, light railway locomotives, and all special light railway equipment.

(*e*) The *forestry section* handles sawmills, sawmill supplies, saws, axes, and special equipment that is required for lumbering operations.

(*f*) The *roads section* handles all road-making equipment, road graders, dump wagons, scrapers, plows, scarifiers, road rollers, and such special equipment as required for road construction.

(*g*) The *general section* handles all general hardware, small tools, hammers, carpenter tools, blacksmith tools, and all tools common to several departments.

(*h*) The *pioneer section* handles regimental equipment, technical supplies, special supplies for combatant troops, etc.

(*i*) The *explosives and construction materials section* handles dynamite, TNT, fuses, caps, exploders, lumber, sand, gravel, stone, duck boards, etc.

(*j*) The *electrical section* handles generators, motors, lamps, electric wire, insulators, switches, etc.

(*k*) The *railways section* handles rails, track gauges, lanterns, flags, track tools, and all railway equipment used for track construction exclusively.

(*l*) The *camouflage section* handles paints, paint brushes, burlap, chicken wire, and all special camouflage materials.

(*m*) The *searchlight section* handles searchlights and special material pertaining to them.

(*n*) The *mining section* handles mining supplies except explosives and all special equipment for mining operations.

(3) The *operating department* is divided into sections somewhat as follows:

(*a*) The *crane and yard equipment section* has charge of all crane crews, cranes, yard equipment, etc. It works in conjunction with all sections that require service in loading and unloading cars.

(*b*) The *transportation and shipping section* looks after the spotting of all cars and makes out bills of lading. This requires that well-posted men be placed in the receiving yards of the depots to mark all cars for the engineer depot, giving the track and yard location, and to assist the train crews in spotting the cars in the proper section and at the right place. The transportation and shipping section attends to the ordering of all empty cars for shipments and acts as the depot agent between all sections of the engineer depot and the railway service. It has charge of all convoys on convoyed shipments.

(*c*) The *less than carload-lots section* looks after all small shipments; that is, those less than carload lots. These shipments are taken from the different supply sections to the small-lot shipping platforms, whence they are shipped by truck or local freight to destination.

(*d*) The *trucks and local transportation section* handles all truck transportation assigned to the depot, and makes local deliveries for the small-lot shipping section.

(*e*) The *salvage section* receives all salvaged material, reclassifies it, and turns it over in good condition to the proper issuing sections for reissue.

(*f*) The *labor section* has charge of all pool labor of the depot, and assigns it to the various sections according to the amount of work each has for the day. Through this section the depot engineer officer can control priorities.

b. Typical operations.—When the supply department receives requisitions from depot headquarters, it requests the necessary cars from the operating department. When cars have been loaded, it notifies the operating department, giving data for preparation of the bill of lading, and then reports to depot headquarters that the requisition has been filled. The headquarters checks the filled requisition with the original and

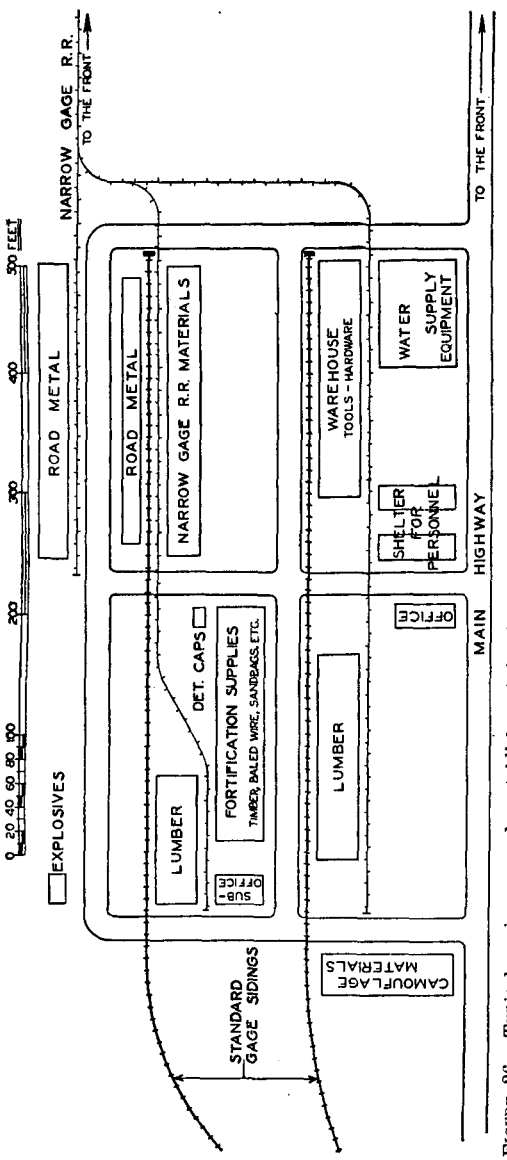

FIGURE 26.—*Typical engineer supply establishment in the combat zone (showing communications, expansion areas and layout of stocks)*

notifies the consignee by wire and letter, giving the car numbers, bill of lading number, and date of shipment. This permits the consignee to make plans for the receipt of the goods and to initiate a tracer of the shipment if necessary.

208. Advance engineer supply depots.—Advance engineer supply depots are about one-third the size of general engineer supply depots. They are located about six to eight hours freight haul from the railheads. They carry the more common engineer supplies and technical equipment for combatant engineer troops. The supply sections are not as numerous as in the organization of a general engineer depot, but they are built on the same lines, two or more of the general engineer depot sections being combined into one at the advance depots.

SECTION V

SUPPLY FOR OTHER ARMS

209. Troop equipment.—Standard items of engineer equipment are issued to troops of all arms and services in accordance with Tables of Basic Allowances. These items are for the most part sets of equipment similar to those issued to engineer troops. Replacements of such equipment for divisional troops are obtained on requisition through the division engineer, who obtains the articles requisitioned from the army engineer or from an army engineer depot with which he has a credit. No reserve of equipment of this class is carried with the division.

210. Supply in the division.—The engineer supplies used by the other arms in the infantry division vary considerably both as to kind and quantity, depending upon the character of warfare in which the division is engaged, and even with the varying situations of any given kind of warfare. The principal requirements may be summed up as follows: Intrenching equipment, construction materials required for organization of the ground, camouflage material, materials for road building and maintenance, water-supply equipment, and bridge material.

a. Intrenching equipment.—Intrenching equipment, intended primarily for the use of the infantry of the division in the preparation of defensive positions, is carried in the vehicles of the headquarters and service company of the combat regiment, wherein 6 wagons are provided. The articles composing this equipment are described in paragraph 39.

b. Fortification supplies.—The materials required for organization of the ground include trench revetment of various kinds, such as sandbags, wire netting, corrugated iron, expanded metal, brushwood, poles, etc.; trench boards, trench pumps, materials for construction of dugouts and mine galleries, principally lumber or concrete; and materials for construction of obstacles, such as barbed wire and pickets. As organization of the ground progresses, the requirements in construction material for this class of work grow very rapidly.

c. Camouflage supplies.—Some of the more important articles of camouflage supplies are burlap, cotton cloth, fish nets, paints, paint spraying machines, and wire netting. The division camouflage officer has no supply functions, but he carefully checks all requests for camouflage materials for necessity and adequacy of items and keeps the division engineer advised of the amount of materials needed for the camouflage operations under way or in prospect.

d. Road materials.—Materials for road repair, except road plank, are usually handled independently of the dumps for other supplies, and are delivered as near the work as possible. Road plank is stored at dumps of general supplies.

e. Water point supplies.—The water supply equipment carried by the engineer combat regiment includes horse troughs, water tanks, pumps, pipe, pipe connections, etc. It is intended for slight development of water points to make them more efficient for the division. Its principal items consist of 5 one-man, hand, force pumps; 1 gasoline engine-driven centrifugal pump of 30 to 40 gallons capacity per minute under a 60-foot head; 3 canvas storage basins 20 by 20 feet; and all necessary connections. This equipment will furnish under favorable conditions, for a short period, about 100,000 gallons of water per day. Water is normally procured from local sources and chlorinated. When the water supply in the division area is contaminated or limited, water-distributing points are established and operated by the engineers. These points and the units drawing from each one are designated in division administrative orders. When the water-supply equipment carried by the regiment is inadequate the division engineer secures additional equipment from the corps or army as in the case of other engineer supplies. If the water supply is insufficient after development to the fullest extent, the serv-

ices of a water-supply battalion are obtained from the corps or army engineer to haul water into the area.

f. Bridge materials.—Standard footbridge equipment and ponton-bridge equipage are carried in the vehicles of engineer units belonging to or attached to divisions, and are supplied to units of other arms according to need. Bridge materials placed in dumps consist principally of light portable bridges to assist artillery over rough ground, bridge timbers, and bolts. In some situations portable steel highway bridges may be provided.

211. In higher echelons.—The engineer supplies required by units pertaining to echelons higher than the division, and located principally behind the division areas, consist in general of replacements of unit engineer equipment, camouflage materials, fortification materials, and construction materials for work to be done by the units themselves. (See par. 5.) These supplies are obtained upon requisition through the unit engineer of the echelon to which the using troop units pertain or to which they may be attached.

SECTION VI

MAP SUPPLY

212. Responsibility for maps and mapping.—The Corps of Engineers is charged with the execution of surveying and mapping, including production and distribution of maps.

213. Classification.—Maps for use by the military forces are classed as standard and special.

a. Standard maps are those which, whether geographic or topographic in character, are ordinarily made in time of peace, as an element of preparedness or for the economic development of the country. They are printed in quantity for general use.

b. Special maps are those specially made for military use. The purpose ordinarily is to show, as to a particular area, certain details not found on the standard maps thereof. Special maps may be topographic sheets on special scales, or may be produced by drawing or printing on standard maps the data desired to be made available, or may be overlays.

214. Scales of standard maps.—The map scales adopted as standard for use by the military forces of the United States are as follows:

a. 1:20,000 (approximately 3 inches=1 mile), fire-control map, training map, or operation map for detailed work, enemy organization, artillery objectives, and map problems.

b. 1:62,500 (approximately 1 inch=1 mile), tactical map for general use in field operations.

c. 1:500,000 (approximately 1 inch=8 miles).

(1) Strategic map.

(2) Map showing transportation routes.

(3) Air navigation map.

(4) State maps published by the United States Geological Survey.

d. Smaller scale maps.

215. Special maps.—*a. General.*—Special maps are prepared by the military forces when necessary. Whenever possible, special maps are overlays for, overprints on, or reproductions or enlargements of, existing standard maps.

b. Larger scales.—When large scale maps are required, they will be prepared on a scale of 1:10,000 or 1:5,000.

c. Special maps in campaign.—(1) Special maps for military purposes, required by troops in campaign, differ according to the character of the operations and the nature of the terrain over which they are being conducted.

(2) The nature of the special maps to be prepared by an army in the field is fixed by the commanding general. Special maps include situation maps, operations maps, and circulation maps. The special information to be printed on such maps is prepared by the office of origin and the reproduction done by the unit engineer.

216. Unit engineers.—The unit engineer of a large unit is provided with certain personnel to maintain a topographic section which is charged with the following duties for his unit within the limits of the capacity of his equipment and personnel to execute.

a. The cartographic representation of all information obtained from the enemy either through subordinates, through the Military Intelligence Division, War Department General Staff, through the Artillery Information Service, or through the Air Corps.

b. The preparation of standard maps of such territory as may be assigned to his command by higher authority, and of such special maps as may be required.

c. Reproduction of maps, sketches, and graphical data.

217. Reproduction in the field.—Reproduction of standard or base maps and special maps in campaign is carried out by engineer topographic units and combat units. In general, standard or base maps are reproduced by the topographic troops at general headquarters, or at some other point in the theater of operations, and by the topographic troops with the armies. Topographic sections of smaller units reproduce such special maps or other maps as are required for the local uses of the unit. The unit engineer of every organization larger than a brigade is charged with all mechanical reproduction work which can be accomplished by his authorized reproduction equipment. He makes arrangements with the topographic section of the next higher unit for any reproduction work required for which his equipment is inadequate.

218. Duties of the Chief of Engineers.—The Chief of Engineers is charged with the procurement and supply of maps, except those from foreign sources, required by the military forces, including maps published by the War Department and those maps of the United States, or any part of the United States or its possessions, published by other agencies of the Government, or private agencies.

219. Allowances in the field.—The allowance of maps in the field in time of war is prescribed for each theater of operations by the commander thereof.

220. Map distribution in the field.—The engineer of every organization larger than a brigade is charged with the distribution of military maps, except such confidential or secret maps as may require special distribution. He obtains maps not published by himself from the engineer of the next higher unit.

221. Disposition of maps when troops leave sectors.—Whenever a tactical organization of any size is relieved from duty in a particular area it is the duty of its unit engineer, or of its commanding officer if it has no engineer, to see that all serviceable maps are turned over to the engineer or commanding officer of the succeeding organization, and that all nonserviceable, confidential maps are destroyed.

222. Size of sheets.—The topographic troops of the zone of the interior and of GHQ are equipped to produce sheets of any commercial size. Other engineer troops are limited by their equipment in the size of sheets issued. The standard map issued by an army topographic battalion does not exceed 19 by 25 inches.

CHAPTER 9

ENGINEER SPECIALISTS

223. General.—Engineer Tables of Organization list a large number of occupational specialists among the enlisted men of all grades. Their duties are to execute the work and handle the equipment pertaining to their specialties. Specialists ratings are authorized for about 30 per cent of the total number of privates in the engineer force. The qualifications for occupational specialists are those prescribed in War Department Document No. 1121 (Minimum Specifications and Index for Occupational Specialists) and in general may be readily understood from the ordinary civilian meaning of the names employed.

224. Qualifications.—Many kinds of specialists are common to all arms and services. A few, however, have a special significance in the Corps of Engineers. The more important of these are—

a. Platoon sergeant or chief, section sergeant or chief, and squad corporal.—These men in addition to having the usual military qualifications have the qualifications of foremen upon engineer work.

b. Camoufleur.—A man skilled in applying the principles of camouflage, who can design, construct, and supervise camouflage work. The related civil occupations are moving picture and stage carpenters and directors; outdoor scenery and property men; architects; landscape gardeners; sculptors; painters; draftsmen; and artists.

c. Demolition man.—A man skilled in military demolitions who can handle explosives and destructions by fire and mechanical means. The related civil occupations are quarrymen; wreckers; fire department firemen; blasters; powder men; and miners.

d. Packer.—A man skilled in the technique of handling packs and pack animals.

e. Pioneer.—A man skilled in the use of the common engineer tools such as axe, hammer, hatchet, pick, saw, and shovel.

f. Pontonier.—A man skilled in the handling of ponton boats and the construction of ponton bridges.

TABLE I.—*Engineer components of a balanced GHQ force of 54 infantry divisions*

Designation of units	Strength of one unit (less attached medical)			Engineer strength in total GHQ force of 6 armies				Division engineer troops (54 infantry divisions)				Corps engineer troops (18 army corps)				Army engineer troops (6 field armies)				Engineer troops in the communications zone				Engineer troops in GHQ reserve			
	Off.	WO-EM	Agg.	No. of units	Off.	WO-EM	Agg.	No. of units	Off.	WO-EM	Agg.	No. of units	Off.	EM	Agg.	No. of units	Off.	EM	Agg.	No. of units	Off.	EM	Agg.	No. of units	Off.	EM	Agg.
1. Combat regiment	38	811	849	54	2,052	43,794	45,846	54	2,052	43,794	45,846																
2. General service regiment	38	1,141	1,179	61	2,318	69,601	71,919					18	684	20,538	21,222	18	684	20,538	21,222	18	684	20,538	21,222	7	266	7,987	8,253
3. Separate battalion	21	1,050	1,071	127	2,667	133,350	136,017					54	1,134	56,700	57,834	36	756	37,800	38,556	9	189	9,450	9,639	28	588	29,400	29,988
4. Engineer squadron	18	384	402	12	216	4,608	4,824									12	216	4,608	4,824								
5. Number general engineer troops	4 types			254	7,253	251,353	258,606	54	2,052	43,794	45,846	72	1,818	77,238	79,056	66	1,656	62,946	64,602	27	873	29,988	30,861	35	854	37,387	38,241
6. Proportion of engineer strength (per cent)					73.8	78.6	78.6		100	100	100		88	92.6	92.5		66.2	76.4	76.1		51.6	57.1	57.1		56.9	65.2	65
7. Camouflage battalion (GHQ)	21	383	404	1	21	383	404																	1	21	383	404
8. Camouflage battalion (army)	27	330	357	6	162	1,980	2,142									6	162	1,980	2,142								
9. Depot company	4	160	164	30	120	4,800	4,920					18	72	2,880	2,952	6	24	960	984	6	24	960	984				
10. Dump truck company	4	150	154	12	48	1,800	1,848									6	24	900	924					6	24	900	924
11. Heavy ponton battalion	12	430	442	24	288	10,320	10,608									12	144	5,160	5,304					12	144	5,160	5,304
12. Light ponton company	4	160	164	36	144	5,760	5,904					18	72	2,880	2,952	12	48	1,920	1,968					6	24	960	984
13. Railway battalion	18	622	640	42	756	26,124	26,880													30	540	18,660	19,200	12	216	7,464	7,680
14. Railway shop company	4	176	180	12	48	2,112	2,160													8	32	1,402	1,440	4	16	704	720
15. Topographical battalion (army)	24	564	588	6	144	3,384	3,528									6	144	3,384	3,528								
16. Topographical battalion (GHQ)	24	609	633	1	24	609	633																	1	24	609	633
17. Water-supply battalion	18	596	614	12	216	7,152	7,368									6	108	3,576	3,684					6	108	3,576	3,684
18. Shop company	4	160	164	12	48	1,920	1,968									6	24	960	984	6	24	960	984				
19. Number special engineer troops	12 types			194	2,019	66,344	68,363					36	144	5,760	5,904	60	678	18,840	19,518	50	620	21,988	22,608	48	577	19,756	20,333
20. Proportion of engineer strength (per cent)					20.6	20.7	20.7						7	6.9	6.9		27.1	22.9	23		36.7	41.9	41.7		38.3	34.5	34.6
21. Corps headquarters	6	22	28	18	108	396	504					18	108	396	504												
22. Army headquarters	28	105	133	6	168	630	798									6	168	630	798								
23. Railway headquarters	10	27	37	12	120	324	444													8	80	216	296	4	40	108	148
24. Communications zone section headquarters	9	27	36	6	54	162	216													6	54	162	216				
25. Communications zone headquarters	63	125	188	1	63	125	188													1	63	125	188				
26. GHQ headquarters	32	58	90	1	32	58	90																	1	32	58	90
27. Number engineer headquarters	6 types			44	545	1,695	2,240					18	108	396	504	6	168	630	798	15	197	503	700	5	72	166	238
28. Proportion of engineer strength (per cent)					5.6	.7	.7						5	.5	.6		6.7	.7	.9		11.7	1	1.2		4.8	.3	.4
29. Total	22 types			487	9,817	319,392	329,209	54	2,052	43,794	45,846	126	2,070	83,394	85,464	132	2,502	82,416	84,918	92	1,690	52,479	54,169	88	1,503	57,309	58,812
30. Proportion of engineer strength (per cent)				100	100	100	100		20.9	13.7	13.9		21.1	26.1	25.9		25.5	25.8	25.8		17.2	16.4	16.5		15.3	17.9	18

g. Topographer.—A man skilled in reading and depicting topographical features from the ground, map or aerial photograph, and who can use surveying and drafting instruments and the stereoscope to apply topographical data to maps.

225. Occupational specialists for cadres.—In mobilizing new engineer troop units, a cadre is assembled and trained prior to the receipt of the bulk of the personnel. These cadres consist of the officers and a number of enlisted men to fill key positions, principally those for handling the routine administration and supply and for the basic military training of the recruits as they arrive. The enlisted men of the cadre are all occupational specialists with duties and qualifications as indicated by their names. The enlisted cadre for a headquarters and service company includes an assistant band leader (in units having bands), 2 clerks, 2 cooks, 1 first sergeant, 1 horseshoer, 1 mess sergeant, 1 sergeant major, 1 stable sergeant, 2 supply sergeants, 1 pack master, 1 truck master, 1 wagon master, and 1 engineer supply sergeant. The enlisted cadre for a company includes several chiefs or leaders (platoon sergeants), 1 company clerk, 2 cooks, 1 first sergeant, 1 mess sergeant, 1 stable sergeant, 1 supply sergeant, and one sergeant for engineer supply. In units having no animals the appropriate ommissions are made of personnel for animal management.

226. Occupational specialists for replacements.—Engineer troops in the theater of operations are maintained at full strength by means of replacements usually trained in the zone of the interior. The number of replacements dispatched depends upon the casualties suffered. In general the enlisted replacements are made in the grade of private as the noncommissioned officer replacement is usually effected by promotion within the organizations. Engineer replacements include a large number of occupational specialists. The number and type of occupational specialists that should be included in each 100 replacements for various types of units are given in Table III.

APPENDIX

REFERENCE DATA

TABLE II.—*Characteristics of ponton equipage*

	Light ponton equipage M1926 (aluminum pontons)	Heavy ponton equipage M1924 (wooden pontons)
Length	224 feet per bridge platoon 672 feet per light ponton company.	208 feet per bridge platoon. 416 feet per company. 832 feet per heavy ponton battalion.
Length per bay	16 feet	16 feet.
Traffic capacity	Light tanks (7½ tons) and all other divisional loads except loaded 3–5 ton trucks.	All army loads, including the 23-ton tank and the 155-mm. G. P. F. gun.
Width of roadway	10 feet	11 feet 3 inches.
Ferrying capacity	25 infantrymen plus arms in addition to crew.	58 infantrymen plus arms in addition to crew.
Number of pontons:		
Per bridge platoon	12	9.
Per company	36	18.
Per battalion	Not organized into battalions.	36.
Number of trestles:		
Per bridge platoon	2	4.
Per company	6	8.
Per battalion	Not organized into battalions.	16.

TABLE III.—*Occupational specialists*

FOR EACH 100 REPLACEMENTS FOR THE TYPES OF UNITS INDICATED

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Regiments		Battalions							Engineer squadron	Companies					
	Combat	General service	Separate	Heavy ponton (motor)	Camouflage	Railway	Topographic (army)	Topographic (GHQ)	Water supply		Light ponton (animal)	Light ponton (motor)	Depot	Dump truck	Shop	Railway shop
1. Artificer													3			
2. Bandsmen	3	2														
3. Blacksmith	1	1	1	1		2			1	1	1	1		1	2	5
4. Brakeman, railroad						10										
5. Bricklayer																
6. Camoufleur					21										10	
7. Carpenter	13	14	9	1	8	4	1	1	2	12	1	1	5		6	3
8. Chauffeur	8	7	3	60	13	1	8	10	42	16	1	54	4	52	1	1
9. Clerk	4	3	2	1	5	8	6	8	2	4	2	2	12	1	4	3
10. Cobbler	1	1		1	1	1	1	1	1	1	1	1	1	1	1	
11. Cook	3	3	2	2	2	3	3	3	2	2	2	2	2	2	3	2
12. Demolition man	2									1						
13. Draftsman	2	1	1		3	1	27	33	1	2			1		1	1
14. Electricians	3	3	1		1	1	2	2	2	2			3		3	2
15. Engineer, locomotive						4										
16. Engineman	1	4	1		1				5				1		1	1

17. Erector							1	1								
18. Expert, airbrake						1										3
19. Fireman	1	3	1			5									1	4
20. Fitter, pipe		1				1							1		1	
21. Fitter, steam																2
22. Horseshoer	2	1								1	2					
23. Hostler, locomotive						1										2
24. Inspector of engines						1										3
25. Inspector, railroad cars						2										3
26. Keeper, toolroom	2	2	1	1	1	1				3	1	1	3		1	2
27. Lineman, power						1										
28. Lithographer	1						3	10							2	11
29. Machinist		1			1	3										11
30. Machinist, locomotive						3										
31. Maker, boiler						1										2
32. Maker, boiler, helper						1										2
33. Maker, pattern															2	
34. Man, foundry						1									5	1
35. Mason, stone		1														
36. Mechanic	5	7	4	6	3	1	4	3	6	6	3	5	8	6	8	5
37. Motorcyclist	2				1	1							1	1	1	
38. Negative cutter							1	2								
39. Oiler, locomotive						1										3
40. Operator, electric plant		1						1								
41. Operator, filter		1							2							
42. Operator, locomotive crane						2										4
43. Operator, pump		1	1						1							
44. Operator, road roller		1	1													
45. Operator, steam shovel	1	1														
46. Operator, telegraph						5										
47. Operator, winch		1	1													
48. Packer	2									2						
49. Painter	2	1	1	1	10	1	1			1	1	1	1	1	2	2
50. Photographer	1				1		2	2		1						
51. Pioneer	4		20	4	13				4	9	2	4	13	4	10	
52. Pressman, lithographic							3	6								
53. Printer, composing							1	1								
54. Quarryman	5	5	3							5			1			
55. Recorder							10	2								
56. Repairer, instrument							1	1					1			
57. Repairer, railroad car						2										10

TABLE III.—*Occupational specialists*—Continued

FOR EACH 100 REPLACEMENTS FOR THE TYPES OF UNITS INDICATED—Continued

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Regiments		Battalions								Companies					
	Combat	General service	Separate	Heavy ponton (motor)	Camouflage	Railway	Topographic (army)	Topographic (GHQ)	Water supply	Engineer squadron	Light ponton (animal)	Light ponton (motor)	Depot	Dump truck	Shop	Railway shop
58. Repairer, signal						1										
59. Rigger	5	5	2	1	2		1	1	1	2	1	1	3		2	1
60. Saddler	1	1								1	1					
61. Sawyer															1	
62. Stenographer													1		1	
63. Storekeeper	3	3	1	2	2	3	2	2	2	3	1	1	5	1	2	3
64. Surveyor							15	3								
65. Wagoner	9	5								5	54					
66. Welder						1					1	1			1	
67. Wheelwright				1												
68. Wireman, interior															1	
69. Worker, canvas									1						1	
70. Worker, railway section	1	2	2			14										2
71. Worker, sheet metal	1	2	1			1									3	4
72. Worker, structural steel	1	2	1				2	2							3	2
73. Basic privates	10	13	40	18	11	10	5	5	25	20	25	25	30	30	20	0
74. Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

TABLE IV.—*Engineer depot stocks*

1. The items of engineer supply stocked in engineer supply installations consist of—

a. Replacement of engineer equipment of troops of all branches, based upon Tables of Basic Allowances.

b. Supplementary equipment for engineer troop units, to be held in corps, army, and communications zone depots to be issued when requested.

c. Items not included in *a* or *b* above which are necessary for engineer operations in the field, to be held in corps, army, and communications zone depots to be issued when required.

2. The following table lists the typical items of category *c* for a corps, army, or communications zone supply establishment. A division supply point normally stocks the items of category *a* and only such items categories *b* and *c* as are required for the particular situation.

ITEM

Anvils, blacksmith.
Arches, steel (elephant iron for shelters).
Asbestos, sheets.
Axes, single-bit.
Bags, burlap, sand.
Barrels, water.
Bars, pinch.
Basins, canvas, storage, water.
Batteries, dry-cell.
Blades, hack-saw.
Bolts, carriage.
Bolts, drift and machined, for bridge construction.
Braces, cross-arm.
Brackets, gooseneck type, for insulators.
Brackets, pole or house, for insulators.
Brushes, paint.
Brushes, whitewash.
Buckets.
Burlap.
Bushings, socket.
Cables, electric.
Canvas, 10-ounce.
Carbide.
Cars, narrow-gauge.
Carts, hose.
Cement, Portland.
Cement, quick-hardening.
Chains, log.
Chisels.
Chlorinators, manually controlled.
Chlorine, liquid.
Cleats, porcelain.
Cloth, cotton, white.
Coal, blacksmith.
Compound, pipe-joint, graphite.
Compressor sets, air.
Conduits, flexible.
Conduits, rigid.
Condulets.
Cord, lamp, No. 16.
Cross arms.
Cut-outs, fused, primary.
Cutters, pipe.
Drier, liquid, paint.
Drills.
Engines, gasoline, 1½ to 25 horsepower.
Exploders, magneto.
Explosives.

Eyelets, brass.
Fire brick.
Fire clay.
Flood lights.
Forges, blacksmith, portable.
Forks, stone.
Frames, hack-saw.
Furnace, soldering.
Fuses, electric.
Generator sets, 1½ to 25 k. w., 110 to 250 volt, d. c., complete with switchboards.
Glass, substitute.
Glue.
Graders, road.
Hasps, with staples.
Hatchets.
Heating plant, assemblies, for bathhouses.
Hinges, butt, strap and T.
Hoes, road.
Hooks, brush.
Hose, discharge, 1-inch.
Hose, rubber, ¾-inch, with couplings.
Insulators, porcelain.
Iron, corrugated, in sheets.
Iron, flat, sheets.
Iron, strap.
Knobs, porcelain.
Ladles, melting.
Lamps, acetylene, portable.
Lamps, electric.
Lanterns, gasoline.
Lath, metal, flat.
Lead, pig.
Lead, red.
Lead, shredded, for pipe joints.
Lead, white.
Lime, chloride.
Lumber, assorted, 12 by 12 inches to 1 by 2 inches for bridge work, plank roads, and building construction.
Mattocks.
Motors, ½ to 20 h. p., d. c.
Nails, barbed.
Nails, boat.
Nails, plaster board.
Nails, wire, common, assorted sizes.
Nets, camouflage.
Oakum, caulking.
Oil, linseed, boiled.
Oil, transformer.
Padlocks.
Paint, various colors for camouflage.
Paste, soldering.
Paulins, canvas, various sizes.
Pickets, angle iron.
Pickets, screw.
Picks, railroad, handled.
Pin, insulator, oak.
Pipe, wrought iron, ¾ to 4 inch.
Pipe fittings.
Poles, for piling, telegraph, etc.
Post, screw, anchor, intermediate and long.
Pot, lead melting.
Pumping sets, centrifugal, gasoline-engine drive.
Rail, 60-pound.
Rakes, steel, road.
Rivets, steel.
Roofing, asphalt.
Rope, manila, in various sizes.
Sawmill outfits.
Screws.
Shades, reflector, metal, conical.
Shovels.
Showerbath assemblies complete.
Sledges.
Sockets, key and keyless, for electric lamps.
Sodium, bichromatic, for glue paint.
Sodium, carbonate.
Solder.
Spikes.
Sprayers, paint.
Steel, reinforcement bars, in assorted lengths and sizes.
Steel, soft, flat, and round.
Steel, soft, in assorted lengths and sizes.
Steel, structural, I-beams, in assorted lengths.
Steel, tool.
Stocks and dies, pipe.
Switches, electric.

Tacks, carpet.
Tanks, water, galvanized, in various capacities.
Tape, friction, insulating.
Tape, tracing, 500-foot rolls.
Thread, cotton.
Threader, pipe.
Tongs for handling timber.
Track, narrow gage, straight and curved sections, complete.
Transformers, 5 to 15 kva.
Tubes, porcelain.
Turnouts, narrow-gage, left and right, complete.
Turpentine.
Twine.
Varnish.
Vises.
Wallboard.
Washers.
Well drillers, hand and power.
Wire, barbed.
Wire, copper for electric installations.
Wire, guy, galvanized.
Wire, iron, annealed, various gages.
Wire, netting, 1½-inch mesh, galvanized, in rolls.
Wire, screen, rolls.
Wrenches, assorted kinds.

TABLE V.—*Data used in computing road space*

	* Yards per man
Foot troops, in column of squads	½
Mounted troops, in column of fours	1
Bicyclists, in column of twos	4
	Yards each
Motorcyclists, solo or side car	20
Carts and wagons, 2-animal	15
Wagons, etc., 4-animal	20
Wagons, etc., 6-animal	25
Trucks, motor cars, etc	27
Trucks, with trailer	32
Tractors, with trailer	30
Tractors	20–30
Trailers	5

Personnel carried in vehicles

2 men per motor cycle.
1 man per riding animal.
2 men per wagon or truck.
4 men per truck with trailer.
5 men per motor car.
4 men per light motor car.
2 men per cart.
2 men per tractor.
2 men per trailer.
2 men per wagon trailer.
6 men per heavy cargo truck.

* These distances are for normal marching rate and include the length of the elements as well as the intervals between elements. When additional distance between groups or sections of elements is prescribed, such distances should be added after computation as above.

TABLE VI.—*Cargo capacity and loading of vehicles of engineer units*

Unit			Vehicles	Load (see notes)	Normal cargo capacity of vehicles (pounds)	Total cargo capacity for engineer operations (pounds)
Combat regiment.	Platoon		1 wagon, tool, 4-mule	A	2, 500	2, 500
	Company		Vehicles of 2 platoons	A	5, 000	
			1 truck, 1½ to 2 ton	B	3, 000	
			1 wagon, R. & B	C	2, 500	10, 500
			1 kitchen, rolling	D		
	Battalion		Vehicles of 3 companies			31, 500
	H. & S. Co	*Motor Section*	2 trucks, ¾-ton	E	3, 000	
			14 trucks, 1½ to 2 ton	F	42, 000	
	(Service Platoon).	Pack Section	16 pack horses	G	3, 600	
		Wagon Section	1 kitchen, rolling	D		
			5 wagons, R. & B	H	7, 500	
			6 wagons, tool	I	15, 000	71, 100
	Regiment		Vehicles of two battalions		63, 000	
			Vehicles of H. & S. Co		71, 000	
			Total regiment			134, 100
	Mounted platoon		8 pack horses	K	1, 000	
			1 spring wagon	Either E and/or M.	1, 000	2, 000

Engineer squadron.	Mounted troop	Cargo carriers of 2 platoons			4,000
		1 motor car	U.		
		1 trailer, water	Water.		
		1 truck, ¾-ton	E and/or M	1,500	
		1 truck, R. & B, 1½ to 2 tons	L	4,000	
		1 truck, tool, 1½ to 2 tons	N	4,000	13,500
	Motorized platoon	1 motor car	U.		
		2 trucks, personnel, 1½ to 2 tons	V	8,000	
		1 truck, tool, 1½ to 2 tons	W	4,000	12,000
	Motorized troop	Vehicles of 2 platoons		24,000	
		2 motor cars	U.		
		1 trailer, kitchen	D.		
		1 trailer, water	Water.		
		1 truck, R. & B., 1½ to 2 tons	X	4,000	
		1 truck, tool, 1½ to 2 tons	Y	4,000	32,000
	Hq. & Serv. troop	4 motor cars	U.		
		1 trailer, kitchen	D.		
		1 trailer, water	Water.		
		1 truck, ¾-ton	E	1,500	
		11 trucks, 1½ to 2 tons	O	44,000	45,500
		1 truck, tank	Gas and oil.		
	Squadron	Vehicles of—			
		1 Headquarters and Service troop		45,500	
		1 mounted troop		13,500	
		2 motorized troops		64,000	
		Total squadron			123,000
General service regiment.	Platoon	1 wagon, tool, 4-mule	A *	2,500	2,500
	Company	Vehicles of 3 platoons	A *	7,500	
		1 truck, tool, 1½ to 2 ton	B	4,000	
		1 wagon, R. & B	C	2,500	
		1 kitchen, rolling, 4-mule	D		14,000

TABLE VI.—*Cargo capacity and loading of vehicles of engineer units*—Continued

Unit			Vehicles	Load (see notes)	Normal cargo capacity of vehicles (pounds)	Total cargo capacity for engineer operations (pounds)
General service regiment—Continued.	Battalion		Vehicles of 3 companies			52,000
	H. & S. Co	Motor sec	1 truck, special machine shop 15 trucks, tool, 2-ton.	P	60,000	
		Animal sec	1 kitchen, rolling, 4-mule 1 wagon, R. & B., 4-mule. 1 wagon, water, 4-mule.	C	2,500	62,500
	Regiment		Vehicles of 2 battalions Vehicles of H. & S. Co Total regiment		104,000 62,500	166,500
Separate battalion.	Platoon		1 truck, tool, 2-ton	Q	4,000	4,000
	Company		Vehicles of 2 platoons 1 kitchen trailer 1 water trailer. 1 truck, R. & B., 2-ton 1 truck, tool, 2-ton	 D S R	8,000 4,000 4,000	16,000
	H. & S. company		1 kitchen trailer 1 truck, R. & B., 2-ton 1 truck, tool, 2-ton	D. T J	 4,000 4,000	8,000
	Battalion		Vehicles of 4 companies Vehicles of H. & S. company Total battalion		64,000 8,000	72,000

Dump truck company.	Dump truck section, transportation platoon.	9 trucks, dump, 2-ton	36,000	36,000
		Vehicles of 2 dump truck sections	72,000	72,000
		1 truck, tank, gas, 750-gal	750 gals.	
	Headquarters platoon	1 trailer, kitchen.		
		1 trailer, water, 250-gal	250 gals.	
		2 trucks, cargo, 1½ to 2-ton	3,000	
		10 trucks, dump, 2-ton	40,000	43,000
	Company	Vehicles of 2 transportation platoons plus headquarters platoon.		187,000

NOTES TO TABLE VI

A. 1 set each carpenter, demolition, pioneer, and sketching equipments.
96 pounds, 1,200 rounds, rifle ammunition.
5 pounds, pistol ammunition.
2 automatic rifles.
2 canvas panniers.
2 grain rations.

A.* Indicates that supplementary equipment is included in addition.

B. Ammunition and following equipments:
Barbed wire gloves.
Blacksmith and horseshoer equipment.
Pull-u-out block.
Drafting and duplicator equipment.
Carpenter equipment.
Illuminating equipment.
Library.
Litter.
Photographic equipment.
Pipe fitting equipment.
Sign painting equipment.
Sketching equipment.
Supplementary equipment.
Tinsmith equipment.
Miscellaneous equipment, including gas and oil.

C. Officers' baggage.
Cleaning and preserving materials.
Clerical equipment.
Cobbler equipment.
Cooking outfit.
Forage.
Marking outfit.
Rations.
Saddler equipment.
Veterinary equipment.
Water sterilizing equipment.
Water cans.
Miscellaneous equipment and supplies.

D. One day's rations and a supply of wood.

E. Miscellaneous small items of equipment and supplies.

F. Truck No. 1. Electric lighting set for division headquarters.
No. 2. Water supply equipment for divisional use.
No. 3. Water supply equipment for divisional use.
No. 4. Footbridge for divisional use.
No. 5. Footbridge for divisional use.
No. 6. Footbridge for divisional use.
No. 7. Footbridge for divisional use.
No. 8. Map section equipment.
No. 9. Ammunition and explosives.
No. 10. Band instruments and equipment.
No. 11. Supplementary engineer equipment.
No. 12. Regimental and company headquarters office equipment.
No. 13. Service platoon headquarters tools and equipment.
No. 14. Gasoline and oil and miscellaneous supplies.

G. Two sets of 5 packs each, as follows:
Pack No. 1. Carpenter and bridge repair equipment. Harness maker and horseshoer equipment.
Packs Nos. 2, 3. Demolition equipment.
Pack No. 4. Pioneer equipment: Axes, sledges, picks, shovels.
Pack No. 5. Pioneer equipment: Rope, blocks, cutting tools.

Six packs, combat cargo.

H. Rations, forage, and headquarters baggage.

I. Each wagon carries intrenching tools for general divisional use, including axes, picks, shovels, saws, sandbags, nails, etc.

J. Blacksmith equipment.
Carpenter and wheelwright equipment.
Drafting and duplicating equipment.
Demolition equipment.
Illuminating equipment.
Library.
Litter.
Photodeveloping and printing equipment.
Photographic equipment, company.
Pipe fitting equipment.
Pull-u-out block.
Sign painting equipment.

Sketching equipment, two sets.
Stereoscopes.
Supplementary equipment, battalion.
Tinsmith equipment.
Miscellaneous equipment, including gas, oil, blacksmith coal.
630 pounds, 7,720 rounds, rifle ammunition.
17 pounds, 378 rounds, pistol ammunition.

K. Five packs as indicated in Note G and 3 packs of such of the following as are required by the situation: Machine rifle with ammunition, picket line, kitchen pack, ration pack, engineer supplies.
Gross load per animal, 200 pounds.
Weight of pack saddle, 80 pounds.
New load per animal, 120 pounds.

L. Officers' baggage.
Cans and buckets, G. I.
Cleaning and preserving materials.
Clerical equipment.
Covers, canvas, rigging.
Field range No. 1.
Forage.
Lanterns.
Outfit, cooking, pack, cavalry.
Outfit, marking, metal.
Outfit, marking, leather.
Outfit, marking, stencil.
Rations.
Water sterilizing equipment.
Miscellaneous equipment and supplies.

M. Mess equipment and rations.

N. Ammunition.
Automatic rifles and extra magazines.
Blacksmith equipment.
Carpenter equipment.
Chemical warfare equipment and supplies.
Cobbler equipment.
Extra TNT.
Horseshoers' equipment.
Illuminating equipment.
Library.
Litter.
Photographic equipment.

Pioneer equipment.
Saddlers' equipment.
Sketching equipment.
Tinsmith equipment.
Miscellaneous equipment and supplies.

O. Truck No. 1. Electric lighting set for division headquarters.
No. 2. Water supply equipment for division use.
No. 3. Two sets of cavalry intrenching equipment.
No. 4. Two sets of cavalry intrenching equipment.
No. 5. Headquarters and service troop—Personnel.
No. 6. Map section and equipment.
No. 7. Squadron headquarters—Personnel, office equipment, baggage and tentage.
No. 8. Headquarters and service troop—baggage, tentage and rations.
No. 9. Headquarters and service troop—Engineer and miscellaneous equipment and supplies.
No. 10. Ammunition and explosives.
No. 11. Supplementary equipment.

P. 3 trucks—Drafting and designing section equipment, ammunition and explosives, band instruments and band equipment.
2 trucks—Regimental and company headquarters office equipment, service platoon headquarters tools and equipment.
3 trucks—Water supply equipment.
1 truck—Gasoline and oil and miscellaneous supplies.
6 trucks—Portable pile driver, and regimental supplementary equipment.

Q. Three sets, carpenter equipment.
One set, demolition equipment.
One set, pioneer equipment.
One sketching outfit.
96 pounds, 1,200 rounds, rifle ammunition.
10 pounds, 231 rounds, pistol ammunition.
Pull-u-out block.
Supplementary equipment, platoon.

R. Blacksmith equipment.
Carpenter and wheelwright equipment.
Drafting and duplicating equipment.
Illuminating equipment.

Library.
Litter.
Photographic equipment.
Pipe fitting equipment.
Pull-u-out block.
Sign painting equipment.
Sketching equipment.
Supplementary equipment, company.
Tinsmith equipment.
Miscellaneous equipment, including gas, oil, blacksmith coal.
384 pounds, 4,800 rounds, rifle ammunition.
12 pounds, 273 rounds, pistol ammunition.
NOTE.—This truck trails the water tank trailer.

S. Officers' baggage.
Cleaning and preserving materials.
Clerical equipment.
Cobbler equipment.
Cooking outfit, cavalry pack type.
Marking outfit.
Rations.
Water sterilizing equipment.
Miscellaneous equipment, kitchen, gas, oil.
NOTE.—This truck trails the kitchen trailer.

T. Officers' baggage.
Chemical warfare equipment for battalion.
Cleaning and preserving materials.
Cobbler equipment.
Messing equipment.
Office equipment.
Rations.
Miscellaneous equipment, including ordnance equipment, quartermaster equipment, gas, oil, and Pull-u-out block.
NOTE.—This truck trails the kitchen trailer.

U. Personnel, as may be assigned by commanding officer.

V. Troop personnel with personal equipment.

W. Ammunition.
Automatic rifle and extra magazines.
Carpenter equipment.
Chemical warfare equipment and supplies.
Demolition equipment.
Pioneer equipment.

Sketching equipment.
Miscellaneous equipment and supplies.

X. Officers' baggage.
Ammunition.
Cans and buckets, G. I.
Chemical equipment and supplies.
Clerical equipment.
Cobbler equipment.
Field range No. 2.
Lanterns.
Litter.
Outfit, marking, metal.
Outfit, marking, stencil.
Rations.
Miscellaneous equipment and supplies.

Y. Blacksmith equipment.
Illuminating equipment.
Library.
Photographic equipment.
Pipe fitting equipment.
Sign painting equipment.
Sketching equipment.
Tinsmith equipment.
Miscellaneous equipment and supplies.

TABLE VII.—*Approximate ship tonnage requirements for all engineer units*

Unit	Organizational equipment (ship-tons)	Vehicles, (ship-tons)	30 days' rations (ship-tons)	Animals (ship-tons)	Men (ship-tons)	Total
Combat regiment	171	947	104	2,064	3,484	6,770
General service regiment	109	1,174	144	1,640	4,828	7,895
Separate battalion	63	383	131	-------	4,380	4,957
Squadron	75	316	45	1,056	1,640	3,132
Camouflage battalion (GHQ)	84	573	48	-------	1,640	2,345
Camouflage battalion (army)	134	1,350	43	-------	1,452	2,979
Topographic battalion (GHQ)	24	421	71	-------	2,376	2,892
Topographic battalion (army)	25	1,289	73	-------	2,460	3,847
Heavy ponton battalion (motor)	30	3,643	53	-------	1,792	5,518
Railway battalion	151	66	71	-------	2,376	2,664
Water supply battalion	25	7,525	73	-------	2,460	10,083
Light ponton company (motor)	20	1,487	19	-------	656	2,183
Light ponton company (animal)	20	868	19	2,112	656	3,676
Shop company	6	22	19	0	656	701
Depot company	6	102	19	0	656	781
Dump truck company	6	1,332	19	-------	656	1,993

TABLE VIII.—*Camping and bivouac areas for all engineer troop units*

[Based upon war strength Tables of Organization, 1931]

Unit	Semipermanent camp		Bivouac	
	Dimensions in yards	Area in acres	Dimensions in yards	Area in acres
Combat regiment	330×240	16.4	180×200	7.5
General service regiment	370×260	19.9	150×330	10.5
Separate battalion	250×150	8.1	100×300	6.3
Squadron	300×150	9.3	265× 80	4.5
Camouflage battalion (GHQ)	130×210	5.7	120×130	3.2
Camouflage battalion (army)	235×100	4.7	250× 70	3.7
Depot company	60×100	1.2	50× 80	.8
Dump truck company	110×180	4.1	110×125	2.8
Heavy ponton battalion (motor)	300×140	8.8	250×140	7.2
Light ponton company (motor)	100×170	3.5	80×150	2.5
Light ponton company (animal)	125×250	6.4	125×180	4.7
Railway battalion	230×124	5.8	212× 86	3.7
Topographic battalion (army)	120×235	5.8	120×200	5.0
Topographic battalion (GHQ)	120×200	5.0	120×170	4.2
Water supply battalion	195×250	10.0	150×200	8.2
Shop company	60×100	1.2	50× 80	.8

NOTES TO TABLE VIII

1. The dimensions and areas in the foregoing table serve as a general guide only, in the selection of camp sites. Tactical and terrain considerations determine the actual dimensions and areas.

2. Areas are computed on the basis of war strength organization.

3. In semipermanent camps the computed areas are based on:

a. The use of large pyramidal tents for enlisted men at the rate of 8 men per tent.

b. The use of small wall tents for officers.

c. An interval of 8 yards between centers of adjacent pyramidal tents and width of 20 yards for company streets between centers of tents on opposite sides of street.

d. One yard per animal on picket line and a width of 10 feet per vehicle.

e. An interval of 20 yards between adjacent picket lines. rows of guns, or carriages in park.

4. The areas given provide for comfort and convenience, except under unusual terrain conditions. These areas can be reduced 20 per cent by narrowing company streets and using the space between company latrines and the organization tents for carriage parks and picket lines. No parade or drill grounds or athletic fields are included.

5. In bivouacs the computed areas are based on:

a. The use of the single shelter tents.

b. One yard per animal on picket line.

c. An interval of 12 yards between adjacent picket lines, except when picket lines are formed between vehicles.

d. A distance of 20 yards, center to center, between rows of vehicles.

e. The parking of tractors limbered to their loads with an interval of 5 yards, center to center, between adjacent tractors.

TABLE IX.—*Railway transportation required to move the personnel, animals, and equipment of all engineer units*

Unit	Railway cars required—Add to each train 1 box car for equipment, 1 caboose, 1 kitchen car.			
	Officers	Men	Animals	Vehicles
	Passenger coaches (39 officers per coach)	Box cars (36 men per car)	Box cars (18 animals per car)	Flat cars (see notes)
Combat regiment	2	23	25	25
General service regiment	2	33	11	32
Separate battalion	1	30	----------	17
Engineer squadron	1	11	8	24
Camouflage battalion (GHQ)	1	11	----------	16
Camouflage battalion (army)	1	10	----------	23
Depot company	1	5	----------	3
Dump truck company	1	5	----------	28
Heavy ponton battalion (motor)	1	13	----------	182
Light ponton company (motor)	1	5	----------	70
Light ponton company (animal)	1	5	15	51
Railway battalion	1	18	----------	5
Topographic battalion (army)	1	17	----------	25
Topographic battalion (GHQ)	1	17	----------	20
Water supply battalion	1	19	----------	102
Shop company	1	5	----------	1

NOTES TO TABLE IX

Vehicles require railway car space, as follows:

Type of Vehicle	Railway car space required
Motor cycles with side cars	1/10 flat or box car.
Bicycles (5)	Do.
Ambulance (animal drawn)	1/3 flat car.
Cars, light motor	Do.
Cars, motor, 5-passenger	Do.
Kitchens, rolling	Do.
Tractors, 5-ton	Do.
Trailers, cargo	Do.
Trailers, kitchen	Do.
Trailers, tank, gas or water, 180–300 gal	Do.
Trucks, cargo, 3/4-ton	Do.
Trucks, tank, gas, 3/4-ton	Do.
Wagons, escort, combat and medical	Do.
Wagons, tool (escort wagons)	Do.
Wagons, spring	Do.
Ambulances, motor	1/2 flat car.
Trucks, cargo, 1 1/2 to 2 ton	Do.
Trucks, light repair	Do.
Wagon, chess (old style, heavy or light)	Do.
Wagon, ponton tool (old style, heavy or light)	Do.
Trucks, cargo, 3 to 5 ton	2/3 flat car.
Trucks, machine shop	Do.
Trucks, tank, 750-gal	Do.
Trucks, wrecking	Do.
Wagons, ponton (old style, light)	Do.
Wagons, trestle (old style, light)	Do.
Wagons or trailers, ponton	1 flat car.
Wagons or trailers, trestle	Do.
Wagons or trailers, balk and chess	Do.

TABLE X.—*Truck transportation data*

1. The following personnel moves with the vehicles or animals pertaining to the unit:

2 men per motor cycle with side car.
1 man per riding animal.
3 men per wagon or truck.
5 men per motor car.
4 men per light motor car.
1 man per cart.
2 men per trailer.
2 men per tractor.

2. The vehicles pertaining to the unit must also carry the unit equipment.

3. When the above-mentioned personnel rides in the vehicles pertaining to the units, units require transportation for remaining personnel as follows:

Unit	Personnel requiring additional motor transport
Combat regiment	574
General service regiment	986
Separate battalion	964
Engineer squadron	115
Ponton bridge units (all kinds)	0
Camouflage battalion (GHQ)	265
Camouflage battalion (army)	138
Depot company	141
Dump truck company	0
Railway battalion	*621
Topographic battalion (GHQ)	487
Topographic battalion (army)	412
Water-supply battalion	0
Shop company	159

* The railway cars pertaining to the railway battalion are sufficient to transport all the personnel of the battalion by rail, which is the usual means of movement for this unit.

TABLE XI.—*One day's work capacity of the basic engineer work unit*

(In ordinary engineer tasks incident to military operations)

The basic engineer work unit is the 4-squad operating section. The number of basic work units available is: In the combat regiment, 12; in the general service regiment, 18; in the separate battalion, 24. The work day is 8 hours unless otherwise stated.

COMMUNICATIONS

General classification of work	Specific character of task	Prevailing conditions	Capacity of basic work unit per day (8 working hours)				Remarks
Roads	Maintenance and repair. Opening drains, filling holes, removing mud, debris, and *obstructions.*	Ordinary traffic in good weather.	5 miles				Capacity can be increased by providing additional transportation, automatic supply of material, messing facilities, and additional road equipment such as wheelbarrows, scrapers, and road machines.
		Continuous traffic in bad weather.	400 yards				
		Under heavy shelling	200 yards				
	Construction		Lineal yards of road				
			A	B	C	D	
	Emergency road work:						
	1. Grading		88	194	194	300	
	2. Placing large stones		130	288	---	---	
	3. Spreading small stones		375	825	---	---	
	4. Placing stones (2+3)		97	213	---	---	Road A: Macadam, 9 feet wide. 12 inches of rock. Ditch, 4.5 sq. ft. cross section.
	5. Placing plank		---	---	400	---	
	6. Spiking plank		---	---	900	---	Road B: Macadam, 12 inches of rock. 2.5 feet wide under each wheel tread. Ditch, 4.5 sq. ft. cross section.
	7. Laying plank road (5+6)		---	---	275	---	
	8. Cutting and placing corduroy		---	---	---	320	
	9. Construction (1+4) (1+7) (1+8)		46	101	114	155	Road C: Plank, 9 feet wide. Ditch, 4.5 sq. ft. cross section.
	10. Ditching		100	100	100	100	
	11. Construction (9+10)		32	50	53	61	Road D: Corduroy, 9 feet wide. Ditch 4.5 sq. ft. cross section.
	12. Unloading material		300	660	440	---	
	13. Construction (11+12)		29	47	47	---	

Bridges	Timber trestle	Materials on site, but not framed. Stiff bottom and flowing water.	1½ unit of bridge (see remark).	Capacity of bridge 7½-ton axle load. One unit of bridge equals one bent plus superstructure and bracing for one bay. Approximate dimensions 18 feet high and 15-foot span.
	Pile bridge	Materials on site. Pile driver available.	½ unit of bridge.	
	Crib bridge	Materials on site.	½ unit of bridge	Single basic work unit not adapted to construction with great rapidity.
	Ponton bridge	Equipage on vehicles at the site.	15 units light bridge (approximately 224 feet). 7 units heavy bridge (approximately 104 feet).	One unit of ponton bridge taken as one bay, approximately 16-foot span except hinge spans at 8 feet.
Railways	Narrow gauge:		Lineal yards:	Reconnaissance and location previously made. Special equipment furnished. Ballast, ties, and rails delivered over the line.
	Grading		50	
	Laying single track		800	
	Ballasting		150	
	Total		36	
	Standard gauge:			
	Grading		40	
	Laying ties		1,600	
	Laying, bolting, and spiking track.		800	
	Lining track		1,600	
	Placing ballast		100	
	Total	Assuming grading done by steam shovel.	80 yds.	

TABLE XI.—*One day's work capacity of the basic engineer work unit*—Continued

FIELD FORTIFICATIONS

General classification of work	Specific character of task	Prevailing conditions	Capacity of basic work unit per day (8 working hours)	Remarks
Intrenching	Simple standing trench	Medium soil	120 lineal yards.	
	Type A communication trench.	do	60 lineal yards.	
	Type A fire trench	do	48 lineal yards.	
	Type B fire or communication trench.	do	38 lineal yards.	
	Type C communication trench.	do	28 lineal yards.	
Wire entanglements.	Double apron entanglement.	Wire and stakes near by. Carrying party can keep wiring party supplied.	750 lineal yards	Work unit performing all operations, viz., preparing wire, carrying and constructing.
	High wire entanglement	do	450 lineal yards.	
Revetment	Sandbag	Front slope only materials at site. Type A trench.	40 lineal yards.	
	Wire mesh	do	320 lineal yards.	
Shelters	Surface shelter corrugated steel. 12-man capacity.	Materials on site. Protection against 3″ shell.	½ complete.	
	Cut and cover. Timber or steel. 24-man capacity.	do	⅛ complete.	

	Cut and cover. Concrete. 50-man capacity.	Materials on site. Protection against 12″ shell.	½4 complete.	
	Cave shelter. Gallery or recess. 30-man capacity.	Materials on site. Protection against 12″ shell. Two entrances.	¼4 complete.	
Emplacements	155 or 75 mm. gun battery, including platforms, parapets, trail supports, and cannoneer trenches, and wire entanglements.	Materials on site. Medium soil.	1 battery complete.	
Camouflage	Road screening	Using standard camouflage materials. Materials on site.	1,000 lineal yards of road.	Work unit can use in one hour the material it can gather in one day.
		Using poles and brush	Medium soil.	

CONSTRUCTION

Buildings	General carpentry	Materials on site	6,000 board feet lumber.	
	Standard barracks, 20 by 100 feet	do	7/10 barracks.	
	Standard warehouse, 50 feet wide, earth floor	do	6,400 square feet.	
	Hospital ward, 20 by 92 feet, 25-bed, plumbing included	do	½ ward.	
	Hospital ward, 20 by 184 feet, 50-bed	do	⅛ ward.	

TABLE XII.—*Heavy ponton battalion*

Model 1924 ponton equipage. Maximum capacity, 23 tons. Wooden pontons. Motor transportation. The heavy ponton battalion furnishes the equipage; construction of bridges is by other troops.

Unit	Bridge length (in feet)	Approximate time to construct after delivery of vehicles to bridge site	Remarks
Bridge platoon	208	2½ to 6½ hours	One bridge, using all equipage of the bridge platoon.
3 ponton sections (9 pontons).			
2 trestle sections (4 trestles).	80	1 hour	Trestle bridge, using trestles only (no floating spans).
Company:			
Two bridge platoons	416	2½ to 8 hours per bridge.	Combined length of two separate bridges; not necessarily of equal length.
(18 pontons).			
(8 trestles).	352	4 to 10 hours	One bridge, using only 4 trestles.
	416	4 to 10 hours	One bridge, using 8 trestles and 18 pontons.
	144	2 hours	Trestle bridge, using trestles only (no floating spans).
Battalion:			
Two companies	832	2½ to 10 hours per bridge.	Combined length of four separate bridges; not necessarily of equal length.
(36 pontons).			
(16 trestles).	640	6 to 12 hours	One bridge using 4 trestles.
	832	6 to 12 hours	One bridge, using 16 trestles and 36 pontons.
	272	4 hours	Trestle bridge using trestles only (no floating spans).

NOTES TO TABLE XII

The bridge is composed of ends and intermediate spans as follows:

Ends	Feet
Abutment to first trestle (abutment span)	16
First trestle to second trestle (trestle span)	16
Second trestle to hinge (hinge span)	16
* Two halves of two ponton spans	16
Hinge to third trestle (hinge span)	16

*As the hinge is normally hung at the middle of the first and last floating spans one-half of the first and last floating span does not enter into the effective length of the bridge. The position of the hinge may be varied about 4 feet either side of the center of the end floating spans. The total length of the bridge may accordingly be increased or decreased about 8 feet from the average figures shown.

	Feet
Third trestle to fourth trestle (trestle span)	16
Fourth trestle to abutment (abutment span)	16
Total for the ends, requiring two trestle sections and one ponton section	112

Intermediate spans

Each additional ponton	16
Each additional trestle	16

Rule for computing length of bridge.—Reflection will show that with the foregoing arrangement of the bridge structure the length of bridge which can be constructed with a given amount of equipage is

$$L=16\ (P+T)$$

Where L=length of bridge in feet.
P=number of pontons used.
T=number of trestles used.

TABLE XIII.—*Light ponton company*

Model 1926 ponton equipage. Maximum capacity, 7½ tons. Metal pontons. Animal or motor transportation. The light ponton company furnishes the equipage; construction of bridges is by other troops

Unit	Bridge length (in feet)	Approximate time to construct after delivery of vehicles to bridge site	Remarks
One bridge platoon—4 ponton sections (12 pontons). 1 trestle section (2 trestles).	224	2 to 4½ hours	One bridge, using all equipage of the bridge platoon.
	48	1 hour	Trestle bridge, using trestles only (no floating spans).
Two bridge platoons (24 pontons). (4 trestles).	448	2 to 4½ hours per bridge.	Combined length of two bridges not necessarily of equal length.
	416	3 to 6 hours	One bridge, using only two trestles.
	448	3 to 6 hours	One bridge using four trestles.
	80	2 hours	Trestle bridge, using trestles only (no floating spans).
Company—3 bridge platoons. (36 pontons). (6 trestles).	672	2 to 6 hours per bridge.	Combined length of three bridges not necessarily of equal length.
	608	4 to 8 hours	One bridge, using only 2 trestles.
	688	4 to 8 hours	One bridge, using 6 trestles and 36 pontons.
	112	3 hours	Trestle bridge, using trestles only (no floating spans).

NOTE TO TABLE XIII

The lengths of abutment, hinge, and floating spans of the light equipage are the same as those of the heavy equipage. The rules for determining lengths are as given in Table XII, allowing for the lesser number of trestles provided for the light equipage.

TABLE XIV.—*Water supply battalion, powers and limitations*

TRANSPORTING CAPACITY

Unit	Capacity (gallons)	Remarks
Tank truck	500	To obtain capacity per day multiply these figures by number of trips per day.
Tank truck section	*4, 000	
Transportation platoon	8, 000	
Water supply company	20, 000	
Water supply battalion	60, 000	

*Based on 8 out of 9 trucks in operation.

PURIFICATION RATE

(Includes pumping)

Unit	Rate (gallons per hour)	Remarks
Purification truck	4, 000	Chlorination and filtration.
	6, 000	Chlorination only.
Water supply company	4, 000	Chlorination and filtration.
	6, 000	Chlorination only.
Water supply battalion	*32, 000	Chlorination and filtration.
	*48, 000	Chlorination only.

*Based on 8 out of 9 trucks in operation.

PUMPING RATE

(Pumping only, without purification)

Unit	Rate (gallons per hour)	Remarks
Service platoon	12, 000	Recommended capacity.
Water supply company	12, 000	
Headquarters and service company	72, 000	
Water supply battalion	108, 000	

STORAGE CAPACITY

(Capacity of storage equipment carried by units)

Unit	Capacity (gallons)	Remarks
Canvas basin	4,000	
Headquarters and service company	*36,000	Based on 15 out of 18 sets in use.

*9 canvas basins.

NUMBER OF TEMPORARY WATER POINTS WHICH CAN BE SUPPLIED

Unit	Number of water points	Remarks
Water supply company	5	
Water supply battalion	15	

FILLING TIME

(Water pumped directly into tank trucks by one water purification truck. Discharge time is same as filling time)

Unit	Number of 500-gal. trucks	Time	
		Chlorination and filtration	Chlorination only
500-gal. tank truck	1	8 minutes	5 minutes.
Tank truck subsection	3	30 minutes	20 minutes.
Tank truck section	8	1 hr. 30 min	1 hour.
Transportation platoon	16	3 hours	2 hours.
Water supply company	40	7 hrs. 30 min	5 hours.

Illustrative order No. 1

Field order for the combat regiment

FIELD ORDERS
No. 22

301st Engrs (C) 76th Div
ALLENBY, PA
9 Aug 1928, 5:00 PM

Maps: First Army. 1:20,000; Special sheet A and 1:125,000, Martinsville

1. *a.* The enemy occupies a defensive zone along the general line_____. For details of enemy situation see Engineer Bulletin No 12 8 Aug—Enemy Information.

   b. Our army attacks at 5:00 AM 11 Aug. Our division, as left division of the right corps, attacks in the general direction CR 490—JONES MILL. Brigades in line. 151st Brig. on the left. For details of operation, zone of action, command posts and division installations see Annex No. 1—G-3 Information.

   c. Our regiment is disposed as directed in FO No 21. 1st Plat 405th Engrs (Dep) is attached to this regiment from 6:00 AM 10 Aug.

2. This regiment will assist the attack by maintaining the routes of communication and will be prepared to assemble at RJ 540 on two hours notice for use as division reserve.

3. *a.* The 1st Bn (less Co A) with 3 trucks H&S Co, attached, will operate in the area north of LIBERTY—WOLCOTT (both excl).

   b. The 2d Bn with Co A and 3 trucks H&S Co, attached, will operate in the area south of LIBERTY—WOLCOTT (both incl).

   c. The 1st Plat 405th Engrs will operate the engineer supply point at CR 625 under the Sup O.

   d. H&S Co will be disposed as follows:

      (1) Div Engr Sec and Electric Lighting Plant with Fwd Ech DHQ.

(2) Pump set at SMITH FARM from 6:00 AM 10 Aug.
(3) Remainder of Co (less dets) will operate from CR 626.

e. The band will remain attached to the H&S Co.

x. (1) Movements of units larger than a platoon will be effected at night.
(2) Priority of road maintenance will be given to divisional axial road and corps reserve road.
(3) Bridges will be strengthened for corps loads.
(4) Water points will be established at SMITH FARM and HOLLY FARM. Water point at WILTON will continue in operation.
(5) Engineer reports will be rendered in accordance with Engineer Bulletin No. 3.

4. *a.* Supply:
(1) Railhead: LEWIS.
(2) Delivery to F Tn bivouac will be made at 3:00 AM.
(3) Ammunition: DP WHITE.
(4) Engineer:
Army Depot: HORTON.
Corps Depot: WILLIS.
Div. DP: CR 626.

b. Aid Sta: CR 626. Evacuation through Coll Sta at LOWE.

c. For other administrative details see Annex No. 2 Extracts Adm O No 11.

5. *a.* Divisional axis of signal communication: ELLIS—SMITHSON—ARNDT.

b. CP's:
301st Engrs: CR 626.
1st Bn: RJ 680 after 5:00 AM 10 Aug.
2d Bn: LIBERTY after 5:00 AM 10 Aug.
1st Plat 405th Engrs (Dep): CR 626 after 6:00 AM, 10 Aug.
For CP's of divisional units see Annex No. 1.

E
Colonel.

Annexes:
No 1—G-3 Information
No 2—Extracts Adm O No 11.
Distribution: A

Illustrative order No. 2

Field order for a combat regiment in rifle combat

FIELD ORDERS
No 17

6th Engrs (C), 3d Div
WHITE FARM, PA
3 Aug 1928, 1:30 PM

Maps: Topographical Map, Gettysburg—Antietam, 1:21,120; Hunterstown—Arendtsville sheets

1. *a.* The enemy still occupies the observation station on hill 339 on the right boundary of the zone of action of the 5th (left) Brig.

   b. Our division continues the attack extending the zone of action of the 5th Brig to the left to include hill 242. 1st Bn, 4th Inf is on the right of the 5th Brig. 2d Bn, 30th Inf is on the left of the 6th Brig. 1st Bn, 10th F A, from positions near SMITH S.H. supports operations in the area including hill 339.

   c. Our regiment (less 1st Plat Co E and dets) has been withdrawn from divisional work and is assembling in its division reserve position at WHITE FARM prepared for combat. W Sup det remains at WILTON STA. Div Engr Sec remains with Div C P at COOKTOWN. 1st Plat, Co E remains on road maintenance.

2. This regiment will seize and hold the observation station on hill 339. Formation in column of battalions.

3. *a.* The 1st Bn will clear WHITE FARM and will attack at 2:00 PM, in the direction RJ 225—hill 339.

   b. The 2d Bn (less 1st Plat, Co 1) will await orders in regimental reserve in vicinity of RJ 225.

   c. The 1st Plat, Co E, with three trucks, H&S Co attached. will continue maintenance of the division axial road extending its operations to include COOKTOWN and RJ 243.

   d. The Rr Ech will await orders at WHITE FARM.

4. *a.* Am DP, RJ 225. S–4 will obtain extra ammunition by truck from LAWTON. Pack section will load with ammunition and proceed to RJ 225 and await orders.

   b. All vehicles will be held mobile and under cover in assembly positions near WHITE FARM.

   c. Aid Sta: Initial location, SW of RJ 225.

5. *a.* Ax Sig Com: WHITE FARM—RJ 225—RJ 282—hill 339.

   b. CP's:

   6th Engrs:

   Fwd Ech: WHITE FARM until 2:25 PM then RJ 225.

   Rr Ech: WHITE FARM.

   1st Bn: RJ 282 after 2:20 PM.

   2d Bn: RJ 225 after 2:25 PM.

   1st Plat, Co E: HOLT.

   1st Bn, 10th F A: SMITH S. H.

   4th Inf: LAND CR.

   30th Inf: MERRITT S. H.

A
Colonel

Distribution: A, and to CO's 4th Inf, 30th Inf and 1st Bn, 10th F A.

Illustrative order No. 3

Field order for a general service regiment

FIELD ORDERS
No. 38

350 Engrs (Gen Serv) II Corps
FAIRFAX, VA
5 Oct 1928, 1:00 PM

Map: U S Geological Survey, 1:125,000; Mt. Vernon quadrangle

1. *a.* The enemy opposes our army on the general line WOODBRIDGE—MANASSAS.

   b. Our army continues its preparations for the attack. The II Corps prepares to attack in the general direction HOLMES—MARTINDALE. For details see FO No. 36, 350th Engineers. Effective 5:00 AM 6 Oct the corps rear boundary is advanced to HILL—SEATON—RJ 258 (all incl) and the divisional rear boundary is advanced to the BARR—HOLMES—SMITHSON road (all excl).

   c. Army engineer troops take over engineer operations in rear of HILL—SEATON—RJ 258 (all excl) by 1:00 PM 6 Oct. The 351st Engrs (Gen Serv) First Army takes over the area work from the 350th Engrs. The P RR (HOYT—ALMER—WILTON) is taken over by the army for operation at 8:00 PM to-day. For disposition of engineer troops in II Corps, effective 5:00 AM 6 Oct see Annex No 1—Engineer Situation Map.

2. This regiment with 413th Engrs (Sep Bn) attached effective 5:00 AM 6 Oct will execute general engineer work in that portion of the corps zone of action west of HOLMES—HOLT—WILTON—SEATON (all incl) and will extend the P RR from ALMER JUNCTION to HOLMES.

3. *a.* The 1st Bn (less Co A), with Co D, 413th Engrs attached, will repair the P RR from _____ to _____

   b. The 2d Bn (less Cos E and F), with Co C, 413th Engrs attached, will continue general engineer work in its present area.

c. The 413th Engrs (less Cos C and D) with Co A, 1st Bn 350th Engrs attached, will continue maintenance of the corps axial road WHITE—HOLT—HOLMES and will extend their operations to include HOLMES.

d. Co E will take over general engineer operations in that portion of the corps zone of action to be vacated by the 3d Div.

e. Co F will take over general engineer operations in that portion of the corps zone of action to be vacated by the 2d Div.

f. The H & S Co will operate from ALMER. Detachments and equipment with units of regiment will remain unchanged.

g. The band will remain attached to the supply section of the H & S Co.

x. (1) Reconnaissance of new areas will be initiated at once.

(2) Troop movements will be effected after 7:00 PM to-night.

(3) For schedule of engineer work and priorities and distribution of regimental and special equipment, see Annex No 2—Engineer Work.

4. *a.* Supply:

(1) Railhead: ALMER JUNCTION.

(2) Class I Supplies: Distributing Point, ALMER. Supply officer will deliver to all units.

(3) Engineer:

Army depot: ALEXANDRIA.
Corps depots: SEATON and HOYT.
Regimental supply point: ALMER.

b. Evacuation:

(1) Aid Sta:

350th Engrs: ALMER.
413th Engrs: HOLT.

(2) Casualties by ambulance to ALMER.

c. For other administrative details see Annex No. 3—Extracts Adm O No. 25, II Corps.

5. Command posts:

a. Engineers:

350th Engrs: ALMER after 9:00 PM.

1st Bn: ALMER JUNCTION.
2d Bn: WHITE.
413th Engrs: HOLT after 5:00 AM 6 Oct.
Co. E, 350th Engrs: RJ 350 after 5:00 AM 6 October.
Co. F, 350th Engrs: CR 400 after 5:00 AM 6 October.
84th Engrs: (Dep): SEATON.

b. For command posts of other engineer units and corps and divisional troops see Annex No 4—Command Posts.

L
Colonel.

Annexes:
No 1—Engineer Situation Map
No 2—Engineer Work
No 3—Extracts Adm O No 25, II Corps
No 4—Command Posts.

Distribution: A

Illustrative order No. 4

Field order for an engineer squadron

FIELD ORDERS
No. 6

8th Engrs (Sq)
ARTESIAN WELL,
5 miles west of OLD FORT EWELL
3:00 PM 20 Nov 19—

Maps: Eighth corps area, 1:2,500,000: Prog Mil Map, 1:125,000 Cotulla, Nueces River, Pearsall, and Miguel Sheets.

1. *a.* The enemy situation is unchanged. RED cavalry patrols are occupying the general line: TILDEN ROAD—DULL'S RANCH—FRIO RIVER.

   b. Our army attacks at 6:30 AM 22 Nov 19— enveloping the RED left (east) flank. The 1st Cav Div, with attached troops, assists the attack by defeating the opposing RED cavalry and assisting the envelopment by attacking toward the northeast.

   c. For distribution and duties of army engineer troops supporting this division, troops of this squadron including the 91st Engrs (Lt Pont) and Co A, 25th Engrs (Dep), and engineer reconnaissance information, see Annex No. 1, Engineer Situation Map, 3:00 PM, 20 Nov. 19—, attached.

2. This squadron, with attached troops, will assist the attack by maintaining the routes of communication and operating water points.

3. *a.* Troop A, see Annex No. 2, Operations Map, attached. This troop will be prepared to make hasty repairs to communications at the request of unit commanders.

   b. Troop B, with one Br Plat, 91st Engrs, attached, see Annex No. 2, Operations Map. Construction of the ponton bridge at OLD FORT EWELL will commence at 6:30 AM, 21 Nov 19—.

c. Troop C, 8th Engrs, see Annex No. 2, Operations Map.

d. H & S Troop will establish dumps of bridge materials at the RJ just west of CHARLES BROTHERS' RANCH and at LA MOTTA RANCH.

e. The 91st Engrs, less 1 Br Plat attached to Troop B, see Annex No. 2, Operations Map.

f. Co A, 25th Engrs, see Annex No. 2, Operations Map. Water points will be ready for operation not later than 6:30 AM, 21 Nov.

x. (1) Reconnaissance reports will be made at 9:30 AM and 2:30 PM daily. Special information of roads and bridges, water sources, and map correcrections is desired.

(2) All movements to positions will take place under cover of darkness. Units will be in their new areas by 5:30 AM, 21 Nov.

(3) Machine rifles will be carried with the platoons.

(4) All units will be prepared for rapid movement forward.

4. *a.* SUPPLY.

(1) Railhead ENCINAL.

(2) Class I supplies will be delivered at troop and company bivouacs by 7:30 PM, today.

(3) Troop commanders will issue 60 rounds of rifle ammunition per man.

(4) Engineer, see Annex No. 1, Situation Map.

b. Aid Sta: LA MOTTA RANCH.
Evacuation by 1st Med Sq.

5. CP's: See Annex No. 2, Operations Map.

A
Lieutenant colonel

Distribution:
A
91st Engrs
Co A, 25th Engrs

Illustrative order No. 5

Field order for a separate battalion

FIELD ORDERS
No. 12

60th Engrs (Sep Bn) I Corps
HATTONVILLE
4 Aug 1928, 5:00 PM

Maps: Geological Survey, 1:125,000; Mt. Vernon and Hattonville quadrangles

1. *a.* No important change in the enemy situation.
   b. Our corps continues preparation for the attack.
   c. The 60th Engrs (Sep Bn) is attached to the 24th Engrs (Gen Serv) from 6:00 PM to-day. For distribution of Corps Engineers see Annex No 1 — Corps Engineer Troops. The 24th Engrs extends its operations by 5:00 AM 5 Aug to include Sxxxx—Bxxxx—Lxxxx (all incl). See Annex No 2— 24th Engrs. For details of engineer information in regimental area see Engineer Bulletin No 9, I Corps.
2. This battalion with Co A 24th Engrs attached will maintain the corps axial road Lxxxx—Axxxx—Bxxx—CR 498 (incl), and will make detachments to units of 24th Engrs.
3. *a.* Co A will report to CO, 1st Bn, 24th Engrs at Cxxx by 10:00 PM. It will march via Hxxxx—Rxxx—Cxxxx clearing RJ 347 by 9:00 PM.
   b. Co B will report to CO 2d Bn, 24th Engrs at Sxxxx by 10:00 PM. It will march via Hxxx—RJ 456—Sxxxx clearing RJ 347 by 9:15 PM.
   c. Co C (less one section) will take over road maintenance on section Axx (excl)—Bxxx—CR 498 (incl). It will march via Hxxx—Lxxx—Bxxxx clearing RJ 347 by 8:00 PM. One section will report to CO Co A 24th Engrs at HATTONVILLE by 6:00 PM for landing field work north of Axxxx.

d. Co D (less one sec) will operate the quarry at SMITH—south of Axxx. It will follow Co C at 100 yds. One section will report to CO Co D 24th Engrs at Fxxxx at 9:00 PM. It will march via Hxxxx—CR 421—Fxxx clearing CR 437 by 8:15 PM.

e. H&S Co (less dets) will operate from Axxxx. It will follow Co D.

f. Co A 24th Engrs will take over road maintenance on section Lxxx (incl)—A (incl). It will march via Gxxx—Wxxx—Lxxx by 10:00 PM.

x. Road will be maintained for two-way traffic. Detours will be marked with signs. Traffic will be controlled by engineers until taken over by Military Police.

4. *a.* Supply: Through S–4 24th Engrs at HILTON.

Class I supplies: DP, Mxxx at 3:00 PM, S–4 will draw for Bn (less dets) and Co A 24th Engrs.

Engineer:

Bn Sup Point: Axxx.

Regt Sup Point: HILTON.

Corps Sup Point: AMES.

b. Bn Aid Sta: Axxxx.

Coll Sta: Lxxxx.

c. P O: No change.

d. Trains: Released.

e. Other administrative details. No change.

5. CP's:

I Corps: ALTON.

Corps Engr: AMES.

24th Engrs: HILTON.

60th Engrs: Axxx after 9:00 PM.

Co C: Bxxxx after 10:00 PM.

Co D: SMITH after 9:30 PM.

Cos A and B: With 24th Engrs after 10:00 PM.

S

Major

Annexes:

No 1—Corps Engineer Troops

No 2—24th Engrs

Distribution: A

8 copies to CO 24th Engrs

Illustrative order No. 6

Field order for a railway battalion

FIELD ORDERS
No. 3

568th Engrs (Ry)
POTOMAC YARD, VA
12 May 1928, 9:00 AM

Maps: Geological Survey, 1:125,000; Mt. Vernon quadrangle. 1:20,000 Alexandria.

1. See Annex No. 1, Situation Map, for information of enemy, disposition of First Army and First Army railway installations.
2. This battalion will operate the regulating station yard in WASHINGTON and the army railway lines. It will be prepared to extend its operations along the RF&P RR as the army advances.
3. *a.* Maintenance of Way Co will operate from POTOMAC YARD with dets at CAMERON RUN JUNCTION and WASHINGTON.
   b. Maintenance of Equipment Co will operate from POTOMAC YARD.
   c. Operating Co will operate from POTOMAC YARD with det in WASHINGTON.
   d. Hq and H&S Co will operate from POTOMAC YARD.
      (1) Mess sec will provide mess for dets at CAMERON RUN JUNCTION and WASHINGTON.
      (2) Tn Movement Sec will supply operators at WASHINGTON, Signal Cabins A, B and C, between WASHINGTON and ALEXANDRIA UNION STATION and CAMERON RUN JUNCTION.
      (3) Tentative time-table will be prepared by 12:00 Noon.
   x. (1) Reconnaissance will be initiated at once. Recommendations as to operating plans and detailed dispositions of units will be submitted by 2:00 PM.

(2) All operations will be conducted with a view to concealment from aerial observation.

(3) Standard Code ARA rules will be used.

4. *a.* Supply:

(1) Railhead: ALEXANDRIA.

(2) Class I Supplies: DP at railhead at 3:00 PM, S–4 will draw for battalion and distribute from POTOMAC YARD.

(3) Engineer: Army depot ALEXANDRIA FREIGHT YARD.

b. Evacuation. Bn Aid Sta; Building 21 at POTOMAC YARD. Evacuation to ALEXANDRIA HOSPITAL. For det in WASHINGTON, Aid Sta at UNION DEPOT.

c. Post Office:

Army: APO 26 at ALEXANDRIA PO.

Bn: Adm Sec POTOMAC YARD.

d. Assignment of quarters and offices for POTOMAC YARD by Bn Adj at 11:00 PM.

e. Details of Army Adm O will be issued later.

5. CP's:

Bn and all Co's: POTOMAC YARD.

Regulating Office: UNION STATION WASHINGTON.

Engr Hq First Army: GEORGE MASON HOTEL.

Ry Sec: same, Room 8.

First Army: CITY HALL, ALEXANDRIA.

A

Major

Distribution:

Each Officer
Each Co Hq
Hq First Army
Hq I Corps
Hq II Corps
Engr First Army
Ry Sec Engr First Army
Regulating Office
Diary
File

Illustrative order No. 7

Field order for a water supply battalion

FIELD ORDERS
No. 9

76th Engrs (W Sup) First Army
VIVA, TEX
25 May 1928, 4:00 PM

Maps: U. S. Geological Survey, 1:125,000; Alton, Millis and Waverly quadrangles.

1. *a.* No important changes in the enemy situation.
   b. Our army continues its preparation for the attack.
   c. The water supply in the LEWIS FLATS area (ALLIS BOND—COLBY—DEVON (all incl)), must be supplemented by water transported in motor vehicles. Four tank cars are to be spotted at OLGA siding at 8:00 PM and 8:00 AM daily, commencing 26 May. Purification sections of Serv Plat, H&S Co, are attached to corps as follows: to I Corps two sections and to II Corps two sections. Engineer troops are in charge of general engineer work in the LEWIS FLATS area as follows: north of LEWIS—WATSON road (excl), III Corps; south of LEWIS—WATSON road (incl) and west of AUSTIN CREEK and MILL GULCH, 21st Engrs (Gen Serv) First Army; south of LEWIS—WATSON road (incl) and east of AUSTIN CREEK and MILL GULCH, 60th Engrs (Sep Bn) First Army.
2. This battalion (less dets) will transport water in the LEWIS FLATS area and will assist in the establishment and maintenance of water DP's.
3. *a.* Co A, with one purification sec, H&S Co attached, will report to the CG III Corps for operation in that portion of the LEWIS FLATS area within the corps zone of action. Clearing VIVA by 7:00 PM, it will

march via ELLSWORTH—COLBY road to LESLIE where it will pass to the control of the III Corps. It will revert to battalion control when the corps rear boundary is advanced to exclude the general line COLBY—DEVON.

b. Co B will operate from OLGA and transport water to water DP's in the area ALLIS—BOND—JONES ARM—BOWIE (all incl).

c. Co C will operate from OLGA and transport water to water DP's in the area LEWIS—WATSON road (incl)—JONES FARM—BOWIE (both excl).

d. Hq and H&S Co (less dets) will operate from OLGA. Storage facilities will be established at OLGA.

e. Water analysis dets will report to CO's of Cos A, B, and C.

x. (1) The battalion (less Co A and dets) will clear VIVA by 8:00 PM and will march via RJ 248 to OLGA. Order of march: Hq. Co B, Co C, H&S Co, Med Det.

(2) Reconnaissance of area will be initiated at once and detailed plans of operation submitted by 7:00 AM 26 May.

4. *a.* Supply:

(1) Railhead: OLGA after 4:00 AM 26 May.

(2) Class I supplies: DP's

Bn (less Co A and dets): OLGA 10:00 AM.

Co A: through III Corps.

(3) Engineer:

Army depot: LAWRENCE.

Army shop: LAWRENCE.

Bn Sup P: OLGA after 5:00 AM 26 May.

b. Aid Sta: OLGA after 5:00 AM 26 May.

Evacuation via Coll Sta: OLGA after 4:00 AM 26 May.

Medical mobile laboratories: WESTON and HOGAN.

Army medical laboratory: WHEATON.

Other administrative details: no change.

5. CP's:

Bn: OLGA after 5:00 AM 26 May.

Co B: same.

Co C: same.

Co A: through Engr Hq III Corps at HORTON.
Army Engr Hq: WHEATON.
Army Med Hq: WHEATON.
21st Engrs: HOLLY.
60th Engrs: WILBUR.

W
Major

Distribution: A and
21st Engrs
60th Engrs

Illustrative order No. 8

Engineer paragraph in a division attack order

FIELD ORDERS
No. 12

1st Division
KINGSDALE, PA
17 March, 1924, 8:00 AM

Maps: Topographical Map, Gettysburg—Antietam 1:21,120; Kingsdale and Bonneauville sheets.

1. ----------

2. ----------

3. *a.* ----------

b. ----------

c. ----------

d. ----------

e. ----------

f. The 1st Engrs (less dets) will be prepared to assemble at CR 725 on two hours' notice for use in division reserve.

x. ----------

4. See Adm O No 12.

5. ----------

By command of Major General A

X
Chief of Staff

Illustrative order No. 9

Engineer annex to a division field order

ANNEX NO 4 TO FIELD ORDERS NO 24

3D DIVISION

ENGINEER PLAN

3d Division
HOLTON, MD
26 Oct 1928, 10:00 AM

Maps: Gettysburg, Antietam (1925), 1:21,120; Emmitsburg, Taneytown and Kingsdale sheets

1. MISSION.

The division engineers will assist in the crossing of the MONOCACY RIVER while continuing the maintenance of the routes of communication.

2. ASSIGNMENT OF ENGINEER TROOPS.

a. The 1st Bn, 6th Engrs (less Co C) with two trucks with kapok footbridge H&S Co 6th Engrs and with 1st Bridge Plat and two ponton sections 2d Bridge Plat, 95th Engrs (Light Ponton) attached, will assist the 1st Brig in the river crossing in the vicinity of MYERS HILL. It will pass to the control of the 1st Brig at HAMPTON at 6:00 PM to-day.

b. The 2d Bn, 6th Engrs (less Co D) with two trucks with kapok footbridge H&S Co, 6th Engrs and with 3d Bridge Plat and one ponton section 2d Bridge Plat, 95th Engrs (Light Ponton) attached will assist the 2d Brig in the river crossing in the vicinity of PINEHALL MILL. It will pass to the control of the 2d Brig at DICK FARM at 6:00 PM to-day.

c. Co C and Co D, 6th Engrs will take over by 3:00 PM to-day the road maintenance work in the areas now occupied by their respective battalions and will operate directly under regimental headquarters. They will be prepared to reinforce the troops assigned to the river crossing operations.

d. The 95th Engrs (less detachments attached to 1st and 2d Bns, 6th Engrs) will be in reserve at JONES FARM from 11 : 00 PM and will be prepared to assist in the river crossing.

e. Remainder of the division engineers operate in accordance with Adm O No. 14, 3d Div.

f. Command post, 6th Engrs: HUNT.

3. FERRYING.

a. Ferrying will commence in each brigade zone of action at 11 : 00 PM—under orders of the brigade commanders.

b. Construction of ponton bridges will commence in each brigade as soon as a covering force of a battalion has crossed the river.

c. Bridges will pass to the control of the division after the brigades have cleared RJ 498 and CR 465.

By order of Major General A

B

Chief of Staff

Official

C

A C of S, G-3

Distribution. Same as FO No. 24.

Illustrative order No. 10

Engineer paragraphs in a division administrative order

ADMINISTRATIVE ORDERS
No 12

1st Division
MILTON
2 Aug 1928, 4:00 PM

Maps: Topographical Map, Gettysburg—Antietam 1:21,120; Emmitsburg, Taneytown and Kinsdale sheets.

1. Supply.

a. ----------

b. Class I Supplies.

DP's commencing 4 June
1st Engrs: RJ 62 9:00 AM.

c. ----------

d. Water.

(1) DP's: LEWIS FARM, AKRON, RJ 694.

(2) All water will be chlorinated for drinking purposes.

e. Engineer.

(1) RP: HOLT.

(2) DP commencing 3 June: CR 626.

f. ----------

2. EVACUATION.

a. ----------

b. ----------

c. ----------

d. Captured material.

(3) Engineer materials will be taken over by 1st Engrs and utilized for divisional work.

3. TRAFFIC.

a. Circulation.

(1) See Annex No 3—Circulation Map, effective 6:00 AM 4 June.

(2) Control:

(*a*) Traffic control posts will be maintained at GALT, CR 469, TANEYTOWN, WHITE MILL and BASHERS MILL—and at such temporary detours as may be established.

(*b*) Traffic priority: Ammunition vehicles, engineer vehicles, ration vehicles.

b. Construction and maintenance of routes.

(1) Divisional axial road: WESTMINSTER—TANEYTOWN—BRIDGEPORT—two-track.

(2) GALT—CR 538—TANEYTOWN road will be maintained for motor traffic—two-track.

(3) RJ 438—to RJ 490 road (South of TANEYTOWN) will be maintained for motor traffic—one-track.

(4) All crossings over PINEY CREEK will be maintained.

(5) Signs will be posted indicating direction of traffic as shown on circulation map.

4. TRAINS.

a. Service trains.

1st Engrs: RJ 626 Released.

---

b. Field trains.

1st Engrs: RJ 626 Released.

---

5. PERSONNEL.

a. ---

b. ---

6. MISCELLANEOUS.

a. ---

b. ---

c. For employment of engineer troops see Annex No. 7 Engineer Plan.

d. ---

By command of Major General A

X

Chief of Staff

Official

Y

Assistant Chief of Staff, G-4

Annexes

No 1 ----------
No 2 ----------
No 3 Circulation Map
No 4 ----------
No 5 ----------
No 6 ----------
No 7 Engineer Plan
No 8 ----------

95773°—32——23

Illustrative order No. 11

Engineer annex to a division administrative order

ANNEX No 7 TO ADMINISTRATIVE ORDERS No 18
1ST DIVISION

ENGINEER PLAN

1st Division
MILTON
2 Aug 1928, 4:00 PM

Maps: Gettysburg—Antietam, 1:21,120 Emmitsburg, Taneytown and Kingsdale sheets.

1. ROADS AND BRIDGES.

a. Priority will be given the following work:

Maintenance of ALTON TURNPIKE as two-track divisional axial road.

Maintenance of HOLT—CR 590—SEATON road as two-track reserved road for corps loads.

Repair and maintenance of CR 590—RF 600 road as one-track motor road for divisional loads.

Maintenance of roads in immediate vicinity of distributing points.

b. Other roads indicated on circulation map will be maintained for animal transport.

c. Road and traffic signs will be supplied for road system and all temporary detours.

d. All bridges over MARSH CREEK will be maintained.

e. Traffic control on temporary detours will be under the engineers until it can be taken over by the military police.

2. WATER SUPPLY.

a. Following water points for drinking water will be operated by the engineers commencing 5:00 AM 3 Aug.

AKRON. 8,000-gallon tank operated by divisional pumping set.

SMITH FARM, LEWIS S.H. and RJ 430, each a 4,000-gallon canvas tank.

b. Distribution of water will be controlled by the division engineer.

c. All water sources will be marked with signs in accordance with GO 8. Additional signs will be supplied by the engineers.

3. ENGINEER SUPPLY.

a. Supply points. Army depot: SMITHTOWN. Corps depot: ALLEN. Division supply point and distributing point: RJ 438.

b. Local and captured engineer material will be taken over for divisional use.

c. Intrenching tools for divisional troops will be delivered to rear echelons of regiments upon request of brigade commanders.

d. Dumps of engineer material in division area will be taken over by the corps as the advance progresses.

e. No changes in methods of issue.

4. MISCELLANEOUS.

a. Electric lighting set will accompany the forward echelon of division headquarters. The local plant at EIBERT will be operated for the rear echelon of division headquarters.

b. Map reproduction plant will operate from RJ 438 after 9:00 PM 2 Aug.

5. ENGINEER TROOPS.

a. 1st Bn 1st Engrs (less Co A) with command post at CR 500 will be in charge of general engineer work in the area north of CR 590—WOOD (both exclusive).

b. 2d Bn 1st Engrs with Co A attached, with command post at CR 480 on ALTON TURNPIKE will be in charge of general engineer work in the area south of CR 590—WOOD (both inclusive).

c. Division engineer section accompanies the forward echelon of division headquarters.

d. Command post, 1st Engineers: RJ 438.

By command of Major General A

X
Chief of Staff

Official

Y
A C of S, G–4

Distribution. Same as Adm O No. 18.

Illustrative order No. 12

Corps engineer field order

FIELD ORDERS
No. 12

Engr Hq XII Corps
ELKTON, DEL
2 Aug 1928, 10:00 PM

Maps: Geological Survey, 1:62,500; Wilmington, Elkton, Dover, Cecilton quadrangles.

1. *a.* The enemy has been driven back to the general line VANCE — ARMSTRONG — BOHEMIA. For details see Engineer Bulletin No 8—Enemy Information.

   b. Our corps prepares to continue the advance. The 1st 2d, and 3d Divs have crossed the CHESAPEAKE CANAL. The 4th Div is in corps reserve west of KIRKWOOD. Rear boundary of divisional zones of action, effective 5:00 AM 3 Aug, is CHESAPEAKE CANAL (excl).

   c. Bridges over the canal are destroyed except at DELAWARE. Roads north of the canal are damaged by bombs and shell fire. Light ponton bridges are in place at GEORGES, COOK and SUMMIT. For details see Engineer Bulletin No 9—Enemy Information. The 13th Engrs (C) 4th Div is available to the corps engineer from 5:00 AM 3 Aug.

2. The corps engineers will extend their operations to include CHESAPEAKE CANAL by 5:00 AM 3 Aug.

3. *a.* The 342d Engrs (Gen Serv) with 415th Engrs (Sep Bn) attached will execute general engineer work in area south of RYAN—PORTER and east of KIRKWOOD—CANAL (all incl). It will be prepared to take over, on four hours' notice, work in the area assigned the 13th Engrs (C).

   b. The 416th Engrs (Sep Bn) will execute general engineer work in area RYAN—PORTER—GLASGOW (all excl).

c. The 439th Engrs (Sep Bn) will execute general engineer work in area north of CHESAPEAKE CANAL and west of the GLASGOW—SUMMIT road (all incl).

d. The 13th Engrs (C) (less six 1½-ton trucks) will execute general engineer work in area CHESAPEAKE CANAL (incl)—CANAL—KIRKWOOD—PORTER. The six 1½-ton trucks will report to CO 430th Engrs (Dep) at PORTER by 6:00 AM 3 Aug.

e. The 430th Engrs (Dep) (less dets with divisions south of the canal) with det 13th Engrs (C) attached will continue operation of corps depots at PORTER and STATE.

f. The 603d Engrs (L Pon) while continuing to guard and maintain ponton bridges will be prepared to dismantle bridges and resume a position in readiness.

g. No change in disposition of Engr Hq Det.

x. (1) Highway bridges will be prepared for corps loads and a two-track road. Semipermanent bridges will be built at GEORGE, COOK and SUMMIT to replace ponton bridges.

(2) First priority on highway maintenance will be given two-track roads shown on Circulation Map XII Corps effective 5:00 AM 3 Aug.

(3) The railroad south of PORTER and railroad bridge near CANAL will be repaired. Priority will be given to highway work.

(4) Reports will be made twice daily as of 9:00 AM and 9:00 PM.

4. *a.* Supply:

(1) Railhead: Corps Tps, PORTER.

(2) Class I Supplies: DP, PORTER 3:00 PM.

(3) Engineer: Army Depot, WILMINGTON. Corps Depots, PORTER AND STATE. Priorities of issue by Sup O Engr Hq.

b. Evacuation:

(1) Casualties: WILMINGTON via Coll Sta at STATE.

(2) Captured material: Engineer material will be utilized by engineer area commanders.

c. For other administrative details see Annex No. 2 Extracts Adm O No 8, XII Corps.

5. CP's:

Engr Hq: ELKTON.
342d Engrs: CR 62, ½ mile south of CORBIT.
416th Engrs: BOOTH.
439th Engrs: RF 65, 2 miles west of KIRKWOOD.
13th Engrs: RJ 75, 1 mile west of KIRKWOOD.
430th Engrs: PORTER.
603d Engrs: 1 mile south of CORBIT.
Fwd Ech XII Corps: GEORGE.
Rr Ech XII Corps: STATE.
1st Div: RJ 34, 2 miles south of GEORGE.
2d Div: RJ 66, 2 miles west of PLEASANT.
3d Div: PLEASANT.
4th Div: KIRKWOOD.

E

Corps engineer

Annexes:

No 1—Engineer Situation Map.
No 2—Extracts Adm O No 8, XII Corps.

Distribution: A.

Illustrative order No. 13

Engineer annex to an army administrative order

ANNEX NO 5 TO ADMINISTRATIVE ORDERS NO 15

FIRST ARMY

ENGINEER PLAN

First Army
WOODSBORO, MD
2 June 1928, 9:00 AM

Maps: Geological Survey, 1:62,500; Hanover, Gettysburg, Fairfield, Westminster, Taneytown, Emmitsburg, Ijamsville, and Mount Airy.

1. RAILROADS.
   a. The 87th Engrs (Ry Hq) Com Z, from FREDERICK JUNCTION is operating the following railroads serving the army: B & O (FREDERICK—MOUNT AIRY), F RR (FREDERICK—THURMONT), NC RR (FREDERICK—KEYMAR), W M RR (THURMONT—WESTMINSTER). 50th Engrs (Ry) Com Z, with CP at FREDERICK RR STA, operates roads north of FREDERICK.
   b. The W M RR (THURMONT—HIGHFIELD) will be turned over to the 87th Engrs for operation at 5:00 PM 3 June.
   c. Army engineeer troops will be prepared to assist 50th Engrs in emergency repairs.
   d. The railroad system will be extended by the army engineers as the advance permits as follows: NC RR (KEYMAR—HANOVER), W M RR (HANOVER—GETTYSBURG—CARLISLE).
2. ROADS.
   a. First priority on road maintenance will be given to the following reserved roads: FREDERICK—THURMONT—EMMITSBURG—GETTYSBURG—HAR-

RISBURG; FREDERICK — KEYMAR — TANEYTOWN; WESTMINSTER — LITTLESTON — GETTYSBURG; WESTMINSTER—TANEYTOWN—GETTYSBURG; and LITTLESTON—HANOVER—YORK SPRINGS — MOUNT HOLLY — GETTYSBURG—CARLISLE.

b. Corps, until relieved by army troops, will strengthen bridges on these roads for army loads.

c. No new construction other than turnouts or short detours will be undertaken without orders from Army Headquarters.

d. Army engineers will take over by 6:00 AM 3 June repair and maintenance of roads from corps in the area south of WESTMINSTER — TANEYTOWN — EMMITSBURG road (incl). They will be prepared to take over repairs and maintenance of reserved roads south of GETTYSBURG and HANOVER by 5:00 PM 5 June on receipt of orders.

3. WATER SUPPLY.

a. The 76th Engrs (W Sup) (less dets at water points and with corps) will be available at WESTMINSTER to the I Corps for supply of troops in the area south of LITTLESTON from 6:00 AM 3 June. It will revert to army control when corps rear boundary is north of LITTLESTON.

b. Army engineers will take over the repair and operation of the water supply system at WESTMINSTER by 5:00 AM 3 June. They will be prepared to operate water supply points in corps zones of action as the corps advances.

4. GENERAL CONSTRUCTION.

a. A prisoner of war enclosure capacity 5,000 will be constructed at point ½ mile south of KEYMAR by 5:00 AM 5 June.

b. Standard warehouses will be constructed as follows:

(1) LIBERTYVILLE for Army Quartermaster—2,000 sq. ft.

(2) NEWMARKET for Army Air Corps—3,000 sq. ft.

c. Army engineers will be prepared to repair and maintain landing fields in the army service area.

5. CAMOUFLAGE.

Camouflage troops will continue operations as prescribed in Appendix No 3—Annex No 4—Engineer Plan, accompanying Adm O No 2.

6. MAPS AND SURVEYS.

a. 29th Engrs (Top) will be prepared to furnish survey detachments to assist the Army Artillery.

b. Special map in one sheet covering army zone of action to include IDAVILLE—EAST BERLIN will be available for issue by 5:00 PM 4 June.

c. Revision data for sheets north of line IDAVILLE—EAST BERLIN will be received to 8:00 AM 5 June.

7. QUARRIES.

a. Army engineer troops will operate quarries at CATOCTIN and LE GORE. They will take over operation of quarries at UNIONTOWN and ROCKY RIDGE by 5:00 AM 4 June. They will take over quarries developed by corps as the advance permits.

b. Corps will locate developed quarries in their zones of action in proximity to reserved roads.

8. ENGINEER SUPPLY.

a. Location of Engineer Depots.

(1) Army depot at FREDERICK will remain in operation until further orders.

(2) Corps depots at WESTMINSTER, KEYMAR and ROCKY RIDGE will be taken over by army troops by 5:00 AM 5 June.

(3) Advance depots will be established along the extension of the railway system as the advance permits.

b. Stockage of Engineer Depots.

(1) Depots will be stocked by the army as follows:

FREDERICK—all classes of engineer supplies.

WESTMINSTER—camouflage material, lumber, road plank standard trestle material, and artillery portable bridges.

KEYMAR—same and railway repair material.

ROCKY RIDGE—same as WESTMINSTER.

Advance depots—standard materials as may be required by situation.

(2) Requirements will be submitted by corps and army troops by 5:00 PM 3 June.

(3) Stock lists will be issued daily by depots as of 8:00 AM.

c. Issue.

(1) Issue will be in accordance with credit system prescribed in GO No 15, First Army.

d. Assignment to depots.

(1) FREDERICK—all troops south of line LIBERTY TOWN—WOODSBORO—(Incl) and corps and advance depots.

(2) WESTMINSTER—I Corps and army troops in I Corps zone of action and area WESTMINSTER (incl) — TAYLORSVILLE — (incl) — U N I O N (excl)—NEW WINDSOR (excl).

(3) KEYMAR—II Corps and army troops in II Corps zone of action and area NEW WINDSOR (incl), UNIONVILLE (incl)—LIBERTYTOWN (excl) — WOODSBORO (excl) — MONOCACY RIVER (incl).

(4) ROCKY RIDGE—III Corps and army cavalry and army troops in area west of MONOCACY RIVER (excl) and north of LEWISTOWN (excl).

(5) Assignments to advance depots will be made as the advance progresses.

9. SHOPS.

a. Railway shop work by 87th Engrs (Ry Hq) Com Z.

b. Army shop at FREDERICK.

10. ENGINEER TROOPS.

a. Engineer troops are in charge of engineer work as follows:

(1) 24th Engrs (Gen Serv); repair of railroad north of KEYMAR. CP at KEYMAR.

(2) 25th Engrs (Gen Serv); general engineer work north of LEWISTOWN—WOODSBORO and west of KEYMAR—TANEYTOWN—GERMANTOWN (all excl). CP at THURMONT.

(3) 26th Engrs (Gen Serv); general engineer work north of WOODSBORO—LIBERTYTOWN—TAYLORSVILLE (all excl) and east of

WOODSBORO (excl)—KEYMAR—TANEYTOWN—GERMANTOWN (all excl). CP at KEYMAR.

(4) 69th Engrs (Sep Bn); General engineer work south of LEWISTOWN—WOODSBORO (both incl) and west of LIBERTYTOWN—NEW MARKET (both excl). CP at WALKERSVILLE.

(5) 70th Engrs (Sep Bn); general engineer work south of WOODSBORO (excl) TAYLORSVILLE (incl) and east of LIBERTYTOWN—NEW MARKET (both incl). CP at LIBERTYTOWN.

(6) 71st Engrs (Sep Bn); Army depots and shop operation. CP at FREDERICK.

(7) 29th Engrs (Top); Maps and surveys. CP at FREDERICK.

(8) 41st Engrs (Cam); Camouflage operations. CP at WOODSBORO.

(9) Engr Hq First Army; Army engineer operations. CP's: Fwd Ech at WOODSBORO, Rr Ech at FREDERICK.

(10) Remainder of army engineer troops will be attached to troops in charge of area work except army ponton bridge units which will be in reserve at LIBERTYTOWN.

By command of Lt Gen A

B

Chief of Staff

Official

C

A C of S, G–4

Distribution: Same as Adm O No 15.

Illustrative order No. 14

Field order for a railway headquarters

FIELD ORDERS
No. 6

87th Engrs (Ry Hq) Com Z
FUNSTON
2 May 1928, 10:00 AM

Maps: Special Railway Map, 1:125,000, sheets A. M. and C.

1. The C&B RR north of WILD JUNCTION and HORTON, with railheads at FAIRFAX, SHUTE, AVERY, LOWE, SEONE, and WHITE has been repaired by army troops and passes to the communications zone for operations by 7:00 PM 4 May. The 88th Engrs (Ry Hq) takes over operations south of WILLING (incl) by 6.00 AM 4 May.
2. This railway headquarters will operate north of WILLING (excl) and will extend its operations to include C&B RR north of WILD JUNCTION and HORTON—effective 7:00 PM 4 May.
3. *a.* The 51st Engrs (Ry) will move at 6:00 AM 4 May to HORTON and will take over the C&B RR north of WILD JUNCTION and HORTON (both incl). Reconnaissance will be initiated at once.
   b. The 52d Engrs (Ry): No change.
   c. The 53d Engrs (Ry): No change.
   d. The 81st Engrs (Ry Shop): No change.
   e. Hq 87th Engrs: No change.
   x. No change in methods of operation.
4. No change in administrative details except supply for 51st Engrs will be from HORTON.
5. CP's: No changes except,
   51st Engrs (Ry): HORTON after 1:00 PM 4 May.
   First Army: HOLLY after 5:00 AM 4 May.
   Second Army: WOOD after 5:00 AM 4 May.
   Engr Hq Second Army: MILBUR after 5:00 AM May 4.

C
Colonel

Distribution: A and
CO 88th Engrs (Ry Hq)
CG's First and Second Armies
Engr Hq, First and Second Armies.

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