BASIC FIELD MANUAL
SIGNAL COMMUNICATION

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BASIC FIELD MANUAL

VOL. IV
SIGNAL COMMUNICATION

PREPARED UNDER THE DIRECTION OF
THE CHIEF SIGNAL OFFICER

UNITED STATES
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WAR DEPARTMENT,
WASHINGTON, *April 6, 1931.*

Basic Field Manual, Volume IV, Signal Communication, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

DOUGLAS MACARTHUR,
General,
Chief of Staff.

OFFICIAL:

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

ERRATA SHEET

BASIC FIELD MANUAL, VOLUME IV, SIGNAL COMMUNICATION

Page 1. Line 4 of paragraph 1, and line 2 of paragraph 2. Change "chapter 7" to "chapter 8."

Page 195. Line 2 of paragraph 180. Change "chapter 7" to "chapter 8."

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U. S. GOVERNMENT PRINTING OFFICE: 1931

LIST OF FIELD MANUALS

A MANUAL FOR COMMANDERS OF LARGE UNITS. (M. C. L. U.)

Vol. I. *Operations.*—A guide for commanders and staffs for tactical operations of large units.

II. *Administration.*—A guide for the administration of large units in a theater of operations.

STAFF OFFICERS' FIELD MANUAL. (S. O. F. M.)

Staff principles and functions applicable to the staffs of all units, together with pertinent reference data.

BASIC FIELD MANUALS. (B. F. M.)

Training, administrative, and reference data applicable to more than one arm, with special reference to the smaller units.

Vol. I. *Field service pocketbook.* (F. S. P.)—The individual.

II. *Infantry drill regulations.* (I. D. R.)—Drill, dismounted ceremonies and inspections; the infantry pack, display of equipment and tent drill.

III. *Basic weapons.* (B. W.)—Marksmanship and mechanical training of the rifle, automatic rifle, pistol, machine gun, 37-mm. gun, 3-inch trench mortar, bayonet and grenade instruction, technique of fire (37-mm. gun, 3-inch trench mortar and machine gun); musketry and combat practice of small units; instruments.

IV. *Signal communication.* (S. C.)—Signal regulations and technical information needed by officers and enlisted men on signal communications duty of arms other than the Signal Corps.

V. *Transport.* (T.)—Equitation, training remounts, use and care of animals and of animal-drawn, pack, motor, and tractor transport.

VI. *Administrative regulations.* (A. R.)—Army Regulations essential to small units.

VII. *Military law.* (M. L.)—The Manual for Courts-Martial, including the Articles of War; the Rules of Land Warfare, including recent conventions relative to the sick and wounded of armies in the field and to prisoners of war; an epitome of the legal principles applicable to military forces when aiding the civil power.

VIII. *Operations of combined arms (small units).* (O. C. A.)—The principles, doctrines, and methods governing the tactical employment of combined arms with reference to the small units.

FIELD MANUALS FOR THE ARMS

The manual for each arm contains, primarily, the principles, doctrines, and methods governing the employment of that arm and pertinent reference data.

Infantry Field Manual. (I. F. M.)

Vol. I. *Units other than tanks.*

II. *Tank units.*

Cavalry Field Manual. (C. F. M.)

Field Artillery Field Manual. (F. A. F. M.)

Vol. I. *Organization and drill.*
II. *Tactics and technique.*

Coast Artillery Field Manual. (C. A. F. M.)

Vol. I. *Harbor defense, railway and tractor-drawn units.*
II. *Antiaircraft artillery units.*

Air Corps Field Manual. (A. C. F. M.)

Engineer Field Manual. (E. F. M.)

Vol. I. *Engineer troops.*
II. *Military field engineering.*

Signal Corps Field Manual. (S. C. F. M.)

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BASIC FIELD MANUAL, VOLUME IV

SIGNAL COMMUNICATION

(This pamphlet supersedes paragraphs 3, 8, 9, 14, 16, 18–21, 24, 25, 27–30, and 32 and Sections V, IX, X, and XI, TR 160–5, June 28, 1929; TR 160–6, June 29, 1929; TR 160–10, June 28, 1929; Sections II, III, and IV and paragraphs 27–29, TR 162–5, April 20, 1926; and TR 163–5, October 1, 1929.)

CHAPTER 1

GENERAL

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SECTION I.	Objective of this and other texts relating to signal communication	1–2
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SECTION I

OBJECTIVE OF THIS AND OTHER TEXTS RELATING TO SIGNAL COMMUNICATION

1. Objective of this text.—This text includes signal regulations and technical information needed by officers and enlisted men of arms other than the Signal Corps engaged in signal communication. It supplements the matter contained in chapter 7, Basic Field Manual, Volume VIII, and prescribes in detail the installation, maintenance, and operation of signal communication agencies which are employed at and forward of brigade headquarters.

2. Other official texts relating to signal communication.—*a. Chapter 7, Basic Field Manual, Volume VIII,* includes information of signal communication required by officers of all arms whether or not on communication duty. This chapter prescribes general principles and methods which apply to the signal communication systems of all units.

b. Signal Corps Field Manual gives information relating to systems and services handled by Signal Corps personnel. The Signal Corps Field Manual supplements this manual (B. F. M., Vol. IV) and covers systems, equipment, and methods of greater

technical complexity than those used at and forward of brigade headquarters. The Signal Corps Field Manual is ordinarily required by Signal Corps personnel only.

c. Technical Regulations give technical information and detailed description of communication equipment. At present this information is published as training, wire communication, and radio communication pamphlets. When reprinting is necessary, however, these pamphlets will be renumbered in the Technical Regulations series.

d. Training Manuals describe methods of training signal communication specialists.

SECTION II

STAFF DUTIES OF SIGNAL COMMUNICATION OFFICERS

3. Communication officer member of staff.—The unit signal or communication officer is a member of the staff of his commanding officer. He is responsible to his commanding officer that both tactical and technical control of signal communication are properly exercised throughout the command. This control is exercised, upon the approval of his commander, through the normal channels of command, except that technical control over routine matters may be exercised directly among the signal or communication officers concerned.

4. Responsibility for signal communication.—The responsibility for signal communication, being a function of command, can not be delegated by the commander. However, each commander is provided with a member of his staff who is trained as a specialist in signal communication, and this staff officer is charged with the execution of all command functions pertaining to signal communication, under such restrictions as may be prescribed by the commander. This officer is called the signal officer or the communication officer. In this manual the term "signal officer" will be used irrespective of the name applied to this officer by Tables of Organization. It should be noted that two channels are utilized in securing control over signal communication. All orders affecting the tactical employment of agencies of signal communication are issued through the normal channels of command and are coordinated with orders issued to other tactical or technical agencies by the appropriate staff section prior to issue. But orders which are issued for the technical

control of an agency of signal communication in routine matters, which do not need coordination with orders issued to other elements of the command, may be issued in the name of the commander, direct by the signal officer of the superior unit to the signal officers of subordinate units. The employment of the direct channel by signal officers depends upon the relation existing between the individual commander and his signal officer. In well-trained organizations only those matters which need coordination with other than signal activities follow the normal channels of command. All purely signal communication activities are controlled by the signal officers concerned, in accordance with the general policies prescribed by the commander. The above principles govern the method of issuing orders to signal communication troops of subordinate units by unit signal officers. The unit signal officer must first secure the approval of his commander to all plans for signal communication prior to their issue in the form of orders. The approval of the commander is secured by one of three methods:

a. Routine matters are covered by general policies promulgated by the commander.

b. Plans for furnishing signal communication which affect functions which have been delegated to other staff sections are approved by the chief of the staff section concerned.

c. Plans for furnishing signal communication may be approved by the commander in person.

5. Duties of unit signal officer.—The general duties of the unit signal officer may be divided under two headings:

a. Duties during training periods.—During training periods the unit signal officer—

(1) Prepares the training programs for signal communication troops of his unit and lower units under the general policies laid down by his commander and by higher authority.

(2) Organizes and supervises such specialists' schools as may be authorized by his commander or required by orders of higher authority.

(3) Makes such inspections of the signal communication personnel and equipment of his own and subordinate units as his commander may direct or authorize and submits recommendations to the latter concerning action that should be taken to correct deficiencies that may exist or to improve training methods or doctrines.

(4) Takes steps to secure and supply ample training and organizational signal equipment throughout the command.

(5) Prepares such orders, regulations, and signal operation instructions as may be needed for the efficient training of the signal communication personnel of the command.

(6) Personally conducts the training and secures the training and organization equipment for the signal communication troops of his unit in brigades and smaller units.

b. Duties during combat or under simulated combat conditions.—During combat or under simulated combat conditions he—

(1) Prepares or secures from higher authority such orders and signal operation instructions as may be needed to insure the technical and tactical control of the signal communication systems of his unit. He insures the proper distribution of such orders and signal operation instructions throughout his unit.

(2) Acts as technical adviser to his commander and his staff on all matters pertaining to signal communication.

(3) Submits recommendations as to the location of the axes of signal communication and command posts of each subordinate unit and of his own unit when not prescribed by higher authority.

(4) Prepares the plans for the employment of the signal communication agencies of his own and subordinate units so as to insure the most efficient employment of these agencies at his own command post and the necessary coordination and technical control of the agencies of subordinate units, subject to orders received from higher authority. He submits these plans to his commander or appropriate staff officer for approval.

(5) Prepares all orders to signal communication troops based upon the approved plan and insures the promulgation of these orders.

(6) Supervises the signal communication systems employed by his own and subordinate units, to correct deficiencies and secure coordination between systems during combat.

(7) Takes steps to procure and supervises the replacement of signal equipment and personnel of his own and subordinate units.

SECTION III

ORGANIZATION FOR SIGNAL COMMUNICATION

6. Division of duties.—Signal communication within brigades and smaller units is conducted by the personnel of the unit concerned. Other signal communication is handled by the Signal

Corps. Provision is made in the organization and equipment of each unit for the conduct of its own communication.

7. Communication agencies.—The principal communication systems relied upon are messenger, wire, and radio, but visual and acoustic signaling are used for special purposes. It is unwise to rely upon one means to the exclusion of others, because special circumstances may make that preferred system inoperative when communication is urgently needed. Communication units are therefore organized for the operation of the several agencies appropriate to the special needs of the unit concerned.

8. Each unit system a part of a larger system.—By the organization outlined above there are in a large tactical unit many small communication systems each installed, maintained, and operated by personnel of a separate unit. Each of these systems, however, is so conducted as to form a part of the general system so that messages may be transmitted rapidly and efficiently from one headquarters to any other headquarters in the system. Economy of equipment and labor frequently requires that a system installed by one unit be turned over to another. It is evident therefore that there should be uniform methods of procedure and construction throughout all units.

9. Cooperation between communication units.—To insure successful signal communication the communication troops must work as a team regardless of arm or service. There should exist a spirit of mutual helpfulness and cooperation. Personnel of adjacent units should take every suitable opportunity to become personally acquainted, to understand the special problems and conditions in neighboring systems, and to offer such assistance and cooperation in the solution of difficulties as may be practicable.

CHAPTER 2

FIELD WIRE SYSTEMS

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SECTION I

GENERAL

10. Purpose and scope.—The purpose of the following instructions is to standardize the installation, maintenance, and operation of the field wire systems of tactical units of the different arms. This standardization is necessary in order to secure more efficient signal communication service for the Army. The term "signal" as used in this manual applies to all personnel, units, or agencies employed in signal communication work. In providing methods of technique, a standard practice is prescribed, disregarding the individual duties assigned to the personnel of signal communication units. These duties are specifically explained in the training publications pertaining to the different arms and tactical units.

11. Composition of wire systems.—*a.* The *wire system* of a tactical unit consists of the telephone and telegraph communication normally installed and operated by the signal personnel assigned to the headquarters of such a unit. The *collective wire system* of a tactical unit comprises its own wire system and the wire systems installed and operated by all subordinate units. For example, the *division wire system* includes only the wire communication installed and operated by the division signal company or troop, whereas the *collective division wire system* includes its own wire system and all other wire communication installed and operated within the division by subordinate units.

b. A wire system includes all means of signal communication utilizing wire lines. From the viewpoint of matériel, it consists

of wire circuits, connecting and operating equipment, and certain special apparatus for testing the circuits.

c. A general classification of wire circuits is made according to their use, as follows:

(1) Trunk circuits, which connect telephone centrals.

(2) Local circuits, which connect telephones to centrals or other telephones.

d. A further special classification of wire circuits is made according to the number of physical wires used in the circuit:

(1) Metallic circuits, in which two wires form a complete path for the electric current.

(2) Ground return circuits, in which one wire is used, with the earth taking the place of the second wire.

Of the two circuits the metallic has proved to be the more satisfactory. It is less susceptible to interference from other circuits, earth currents, or conversation interception by hostile listening stations. The communication range may, however, be usually increased by the use of a ground return circuit.

e. Additional special circuits may be derived from these metallic circuits by the use of repeating coils, as follows:

(1) A single metallic circuit may provide both a telephone and a telegraph circuit without mutual interference. This type of telegraph circuit uses a ground return and is known as a *simplex* circuit.

(2) Two metallic circuits may provide a third telephone or telegraph circuit without interference from one another. This third circuit is known as a *phantom* circuit.

f. Connecting and operating equipment includes telephone and telegraph instruments, switchboards and auxiliary supplies.

g. Testing apparatus includes telephone and telegraph instruments and special test sets.

12. The telephone; powers and limitations.—*a.* The greatest advantage of the telephone is that it affords immediate personal contact between two individuals. Disadvantages of the telephone are the lack of record of the conversation, and the tendency to consume too much time in conversation.

b. The efficiency of the telephone system depends upon a number of factors, the most important of which are—

(1) Type of wire line construction.

(2) Types of telephones, switchboard, and other equipment.

(3) The weather.

(4) The training of the personnel operating and using the system.

c. The distance over which telephone conversation is possible is limited by the electrical characteristics of the complete telephone circuit. A given type of wire circuit, under normal conditions, has a definite talking range. The wire factors which increase the talking range are—

(1) Better electrical conductivity of the material of which the wires are made.

(2) Larger diameter of the wire.

(3) Greater spacing between wires and between wires and ground, within certain limits.

(4) Better electrical insulation between wires and between wires and ground.

The converse of these factors decreases the range of telephone conversation.

d. The following conditions tend to decrease the efficiency of telephone circuits and the range of telephone conversation:

(1) Snow, ice, rain, heavy dew, or fog.

(2) Moisture in the telephone instrument, especially in the transmitter.

(3) Exhausted dry batteries in local battery (magneto) telephones.

(4) Additional telephones (party line).

(5) Additional switchboards.

13. The telegraph; powers and limitations.—The wire telegraph is one of the most rapid and accurate electrical means of transmitting messages. The simultaneous transmission of telephone conversations and telegraph messages over the same circuit is common practice. The ranges of telephone and telegraph circuits are limited by the same factors. Most telegraph instruments have a much greater range than telephones over a given circuit. A failure to utilize telegraph channels overburdens the telephone system.

14. Wire communication during movement of command posts.—The maintenance of wire communication is usually more difficult during the movements of command posts than at any other time. The initial installation of each wire system should be planned with the objective in view of maintaining continuous wire communication with subordinate units during and after the movement of command posts. A satisfactory solution in any given situation is normally a combination of the general methods described below.

a. Single-axis method.—In Figure 1 (for a description of symbols see par. 20), assume that the command post of a unit is located at 3 and that the command posts of its subordinate units are at 1 and 6, respectively: The axes of signal communication of these units are 3–5, 1–2, and 6–7, respectively. The superior unit runs one circuit from 3 to 1 via 4 and another circuit from 3 to 6 via 4. Prior to the movement of the command posts of the subordinate units to 2 and 7, respectively, two circuits are run by the superior unit from 4 to 5, one circuit is continued from 5 to 2 and the other circuit from 5 to 7. When the command post of the subordinate unit at 6 moves to 7, the 3–4–6 circuit is used until the moment the command post closes

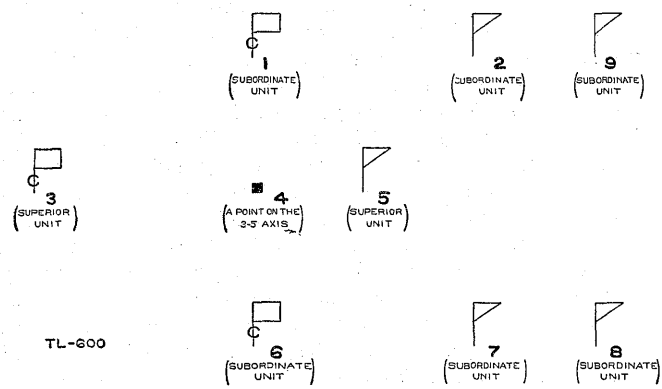


FIGURE 1.—Schematic location of command posts for selection of wire axis

at 6 and opens at 7. At this instant the 3–4–6 circuit is disconnected at 4 and the 3–4 section of this circuit is connected to the 4–5–7 circuit. The 4–6 circuit may then be recovered or assigned to some other unit. The procedure during the movement of the other command post from 1 to 2 is similar.

b. Multiple-axis method.—(1) In Figure 1, assume the same initial location of command posts and axes of signal communication as before. The superior unit runs two circuits, one from 3 to 1 and the other from 3 to 6. It then lays one circuit along the axis of signal communication of each subordinate unit, passing through 2 and 7, respectively. When the command post of the unit at 6 moves to 7, the 6–7 circuit is connected to the 3–6 circuit. The superior unit maintains the 3–6–7 circuit. The

procedure during the move of the command post of the other subordinate unit from 1 to 2 is similar.

(2) As compared with the single-axis method, this multiple-axis plan often results in a saving of wire. The following disadvantages of the multiple-axis method may be noted:

(*a*) Personnel is dispersed during installation and maintenance.

(*b*) Resulting system is not so flexible as in the single-axis method.

(*c*) More personnel is required for installation and maintenance of the system than in the single-axis method.

c. Joint-axis method.—In Figure 1, assume that the initial command post of the unit is located at 3, and that the initial command posts of its subordinate units are 1 and 6, respectively. The axes of signal communication of these units are 3–1–2–9, 1–2–9, and 6–7–8, respectively; the axis of the superior unit coinciding with the axis of its left subordinate. The superior unit makes the initial trunk installation by laying circuits 3–1 and 3–6. Should all three units move to position from a common assembly area, or from the same column in march, these circuits might, by agreement, be laid by the subordinate units en route to position. Should the left subordinate desire at any time to advance to another command post, as 2, it will lay circuit 1–2, and having decided to open at 2, circuit 1–2 will be joined to 3–1 at 1, and communication maintained over circuit 3–1–2. The movement from point 1, and the joining of circuits at that point will be accomplished without interruption of wire traffic. (Several suitable methods of joining circuits appear in Sec. III.) Assume that the subordinate units have advanced, by the above method, to points 9 and 8, respectively. At this time the superior unit decides to advance to 2, located on the axis shared jointly with its left subordinate unit. The superior unit will first lay a circuit 2–8 and so install a switchboard at 2 that traffic may be handled over circuits 3–1–2, 2–8, and 2–9. At a suitable time, the board at 3 will be removed and the board at 2 will begin to serve the new command post. Should a circuit from 3 to the rear exist, this circuit will be joined at 3 to the circuit 3–1, no traffic being interrupted.

d. (1) In the methods described above, if the command post of either subordinate unit moves to the new location, prior to the extension of the circuit by the signal personnel of the superior

unit, wire communication will be interrupted. In rapidly moving situations, continuous wire communication between any unit and its subordinate units can be insured only by coordination between those units. The following method is based upon this coordination.

(2) In Figure 1, assume the same initial location of command posts. Assume also that each unit installs its wire system by the single-axis method, but that the 4–5–2 and 4–5–7 circuits are not completed by the superior unit until after the movement of the command posts of the subordinate units to 2 and 7. Each subordinate unit has laid at least one circuit along its axis, passing through 2 and 7, respectively. When the command post at 6 moves to 7, the 6–7 circuit laid by that unit is connected to the 3–4–6 circuit laid by the superior unit. When the 4–5–7 circuit laid by the superior unit reaches 7, the 3–4–6–7 circuit is disconnected at 4 and the 3–4 section of the circuit is connected to the 4–5–7 circuit. Communication is then maintained by the superior unit over the 3–4–5–7 circuit. The 4–6–7 circuit may be recovered or assigned to another unit. The procedure during the movement of the command post of the other subordinate unit from 1 to 2 is similar. This method makes use of circuits previously laid, but no longer required, by a subordinate unit. It conserves personnel, simplifies construction and maintenance, makes the maximum use of the initial system, and facilitates the continuity of wire communication during the movement of command posts.

15. Test stations.—Test stations are installed on a wire line to facilitate the testing and reallocation of circuits. They may be located at points where circuits diverge, at the end of a wire line not terminating in a switchboard, near points where circuits are most liable to damage, at probable future locations of a command post, or at other convenient points on the line. For example, in the situations described in paragraph 14*a* and *c*, the location of test stations at points 4 and 5 would facilitate the reallocation of circuits after the movement of the command posts of the subordinate units. If a command post is established where a test station has been previously installed, the test station can be easily converted into a central. Test stations are usually given a geographical designation; e. g., Jones Farm Test.

16. Switching centrals.—A switching central is a telephone central, installed at a point other than a command post, for the

principal purpose of trunk switching. Switching centrals permit flexibility in the interconnection of trunk circuits. Their judicious use enables better telephone service to be furnished with the same number of trunks. On the other hand, switching centrals require additional personnel and equipment, necessitate an additional switching operation, and add a sensitive spot, subject to damage and interruption of service. They are used habitually in the wire systems of corps and larger units and whenever expedient in the systems of smaller units.

17. Orders and instructions.—*a.* Telephone codes and directories and general instructions for the operation or use of the telephone system are issued as required. If of interest to the entire command, such information or instructions may be published in general orders or circulars. If of interest to signal personnel only, they are usually published as signal operation instructions.

b. In divisions and higher units, general instructions concerning the wire system for a particular operation are usually included in a signal communication annex or an appendix thereto. In brigades and lower units the corresponding instructions are usually issued orally. In either case the plan of installation can best be shown by the use of a line route map and a circuit diagram.

18. Line route map.—*a.* A line route map is a map or map overlay containing the following information:

(1) *Map or overlay proper:*

(*a*) At least two orientation points (if an overlay).

(*b*) Location of each headquarters or establishment served by the wire system.

(*c*) Locations of telephone centrals, switching centrals, and test stations.

(*d*) Locations of local telephones not installed in the immediate vicinity of the telephone central.

(*e*) Route of each wire line showing whether installed or proposed, the type of line construction and the number of physical circuits (trunks and long locals) in each section of line.

(*f*) Explanation of any special symbols not regularly authorized.

(2) *Heading, legend, and authentication.*—When the line route map is issued by a headquarters for the guidance of units not

forming a part of that headquarters, or as an annex or appendix to formal field orders, it will include the following information:

(a) *Heading and legend:*

1. Unit issuing.
2. Title, showing whether issued as an appendix to a signal communication annex, as signal operation instructions, or as a part of the orders of the commander of a signal communication unit.
3. Date and hour effective.
4. Map with which used (if an overlay).

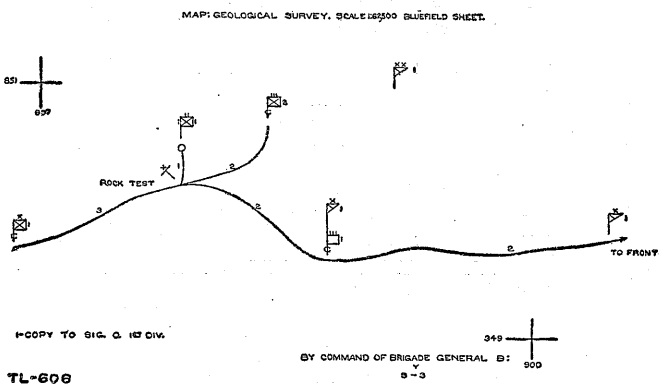


FIGURE 2.—Line route map, brigade

(b) *Authentication:*

1. When intended for the information or guidance of lower units, it is issued in the name of the commander. It is authenticated by the assistant chief of staff, G–3, in divisions or higher units, and by the appropriate staff officer in lower units.
2. When intended only for the signal troops of the tactical unit in which issued, it is signed by the unit signal officer.

b. The line route map should contain as few lines, symbols, and notations as is consistent with its purpose. It should show line routes rather than the actual connections at telephone centrals or test stations.

c. Figure 2 is an example of a line route map, showing a brigade wire system for an attack in a meeting engagement.

19. Circuit diagram.—*a.* A circuit diagram is a schematic illustration containing the following information:

(1) *Diagram proper:*

(*a*) Units on establishments served by telephone centrals, indicated by conventional signs and telephone code names.

(*b*) Number of circuits, including trunks and long locals in each section of line.

(*c*) Numerical designation of each circuit.

(*d*) Telephone centrals and switching centrals; circuit connections at each.

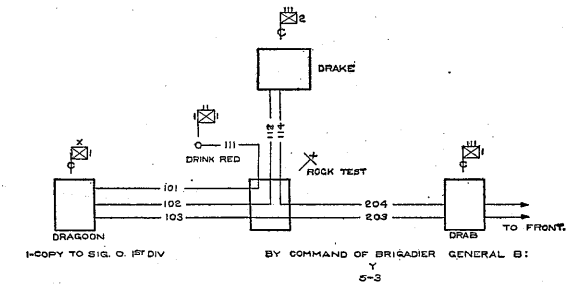


FIGURE 3.—Circuit diagram, brigade

(*e*) Test stations; circuit connections at each.

(*f*) Simplexed circuits.

(*g*) Phantomed circuits.

(*h*) Local circuits, in special cases.

(*i*) Type of line construction.

(2) *Heading and legend.*—As for a line route map.

(3) *Authentication.*—As for a line route map.

b. Figure 3 is an example of a circuit diagram to accompany the line route map shown in Figure 2.

20. Special symbols.—The following special symbols are authorized for use as indicated:

a. Basic symbols for circuit diagrams, indicating circuits, connections, and installations.

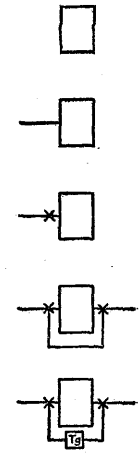
Terminal frame

Circuit ending at telephone central

Simplexed circuit

Simplexed circuit bridged around switchboard or test station

Telegraph way station on simplexed circuit



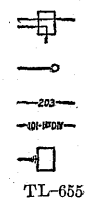
TL-654

Circuits entering and leaving terminal frame but not entering a switchboard

Circuit terminating in a telephone

Method of numbering circuits

Ground return circuit



TL-655

b. Basic symbols for line route map, indicating circuits.

Wire line

Indicating number of circuits in a wire line

Standard pole line



TL-656

c. Symbols for circuit diagrams and line route maps indicating wire installations.

(1) *Basic symbols.*

Telephone central at a command post---

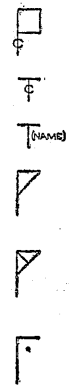
Switching central----------

Test station----------

Probable future locations of a cavalry command post to indicate a point on the axis of signal communication------

Probable future locations of an infantry command post to indicate a point on the axis of signal communication------

Probable future locations of an artillery command post to indicate a point on the axis of signal communication------



NOTE.—The foot of staff points to the actual location on the line route map or to the symbol on the circuit diagram.

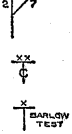
(2) The above symbols may be used in combination with basic symbols and special abbreviations to show the various units or activities to which they pertain, as prescribed in the Staff Officers' Field Manual. The following examples illustrate a few possible combinations:

Telephone central at command post 3d Infantry----------

Probable future location of a command post 2d Squadron, 7th Cavalry (a series of such symbols indicates the axis of signal communication)----------

Division switching central----------

Brigade test station----------



TL-657

d. Basic symbols for traffic diagram.

Telephone channel----------

Indicating number of telephone channels-

Telephone central
Switching central ----------

Telephone----------



TL-658

21. Designating lines and circuits.—*a.* Wire lines and circuits are given individual designations by the organization installing them. These designations are used in orders and reports.

b. In large wire systems, as those of corps or armies, each important wire line is designated by a name or number, for example, cable No. 2 or GETTYSBURG-CHAMBERSBURG line. In such systems, each wire circuit is given a number, for example, circuit No. 612. The designation of wire circuits in such a system consists of the number of the circuit followed by the name or number of the line, for example, circuit No. 50, cable No. 6, or circuit No. 561, NEW YORK-WASHINGTON line.

c. In smaller wire systems, circuits are not normally designated by name. A wire circuit in such a system is designated by its individual number, followed by the title of the organization constructing the circuit. For example, "No. 101–1st Div." In battalions and smaller units, the numbering of circuits may also be omitted whenever the omission will not render prompt identification, test and maintenance more difficult. However, in such cases, the name of the unit to which the circuit belongs and the purpose it serves should be given, for example, "1st Bn 2d FA—OP." The complete circuit designation should be used in circuit diagrams, orders or reports, whenever necessary to avoid confusion.

d. In assigning numbers to wire circuits the following general rules should be observed:

(1) No two circuits in a named or numbered wire line are given the same number.

(2) No two circuits constructed by the same organization during a single operation are given the same number.

(3) All wire lines are divided into sections. A section begins and terminates at successive centrals, test stations, or (in the case of a long local) at a telephone. A circuit passing from one section to another is given a different designation on entering the new section.

e. In the wire systems of divisions and lower units, construction and maintenance are facilitated by a numbering system which identifies the general position of each circuit with respect to other circuits in the same system. Figure 3 illustrates one system of numbering which is given only as a guide. However, any system of numbering that will meet the requirements of the situation and which in general conforms to the provision of this paragraph may be used. The system of num-

bering illustrated herein provides for the allotment of a block of numbers to each section of the line along the axis and to each section of the line laterally from the axis both to the right and left. Beginning at the rear echelon of the division (the rearmost central in the wire system) each section of the line along the axis is allotted a block of 10 numbers of three digits each—hundreds, tens, and unit. The hundreds begin at 1 and increase in arithmetical progression for each section of the line. The last two digits are from 01 to 10, in each section of the line. Laterally to the left each section of the line is allotted a block of nine numbers, the hundreds number, being the same as the section of the axial line, terminating at this point of divergence. The last two digits are from 11 to 19. The next section to the left maintains the same hundreds number and takes the next block of nine numbers beginning with an odd number; i. e., 31 to 39, etc. The same method is applied to the allotment of numbers to the sections to the right of the axis, using however, for the last two digits, blocks of nine beginning with even numbers; i. e., from 21 to 29; 41 to 49, etc.

22. Reports and records.—*a.* In order to make the most efficient use of the collective wire system, the signal officer should keep himself informed of the condition of the systems of his own and subordinate units. Subordinate units report to next superior units when the wire system is first installed and thereafter whenever important changes are made. These reports are usually made by telephone or telegraph, supplemented by line route maps and circuit diagrams.

b. The signal officer requires the signal troops under his immediate supervision to keep such records relating to the wire system as are absolutely essential to their efficiency. These records cover installation, maintenance, and operation. Such records will seldom be kept in small units where few circuits are maintained. Reports are made by the chief of construction on the installation or recovery of wire lines. When necessary the operating personnel keep station logs and test and trouble reports. (See pars. 64 and 72.)

SECTION II

TECHNIQUE OF FIELD WIRE LINE CONSTRUCTION

23. Types of field wire.—There are four types of wire in common use in the field: Field wire, single-conductor, type W–39; field wire, twisted pair, type W–40; outpost wire, single-conductor, type W–43; and outpost wire, twisted pair, type W–44. The characteristics of these wires appear below.

Standard field wires

Type No.	Number of conductors	Composition of conductors	Type of insulation	Weight per one-half mile w/o spool	Tensile strength (approximate)	Miles equivalent to transmission over 30 miles standard cable	Resistance per mile of single conductor, in ohms
				Pounds	*Pounds*		
W-39	1	10 steel 12 mils twisted about 1 copper 28 mils.	Moisture proof.	45	160	20	52.46
W-40	2	do	do	92	320	15	53.51
W-43	1	1 bronze and 3 steel 13 mils twisted about 1 bronze 14 mils.	do	32	60	11	160.90
W-44	2	do	do	65	120	9	163.90

24. Skinning wire.—In all types of splices made with insulated wire, the insulation is skinned or removed from that portion of the wire used in making the splice. Insulation is best removed by using pliers. The side-cutting pliers issued to all signal personnel are suitable. The insulation should be bruised and removed by squeezing it in the heel of the pliers, as shown in Figure 4. Next grip the bruised insulation between the jaws of the pliers and pull it off the wire. If a sharp line of demarcation is made between the bruised and unbruised insulation, the insulation will part at this point. The edges of the plier's jaws should not touch the wire during the process. After the insulation is removed the wire should be cleaned and brightened to free it from corrosion, by scraping carefully with the jaws of the pliers.

25. Wire splices.—*a. General.*—The type of splice depends upon the types of wire to be connected. Installation of field wire systems requires the splicing together of various types of stranded and solid conductor wire, stranded wire to solid conductor wire, and single conductor to twisted pair.

(1) When splicing two pieces of twisted pair wire, the splices in the two wires should be staggered at least 6 inches apart to prevent possible short circuits. This method of staggering splices is shown in Figure 5. To stagger the splices in twisted pair wire, the ends of the two pieces of wire should first be cut off even. The ends of each piece should then be untwisted a distance of at least 14 inches. One wire of one pair—the tracer

wire if there is one—is cut off about 7 inches from the end. The end of the short wire should then be held against the end of the corresponding wire in the other pair. The long end of the first

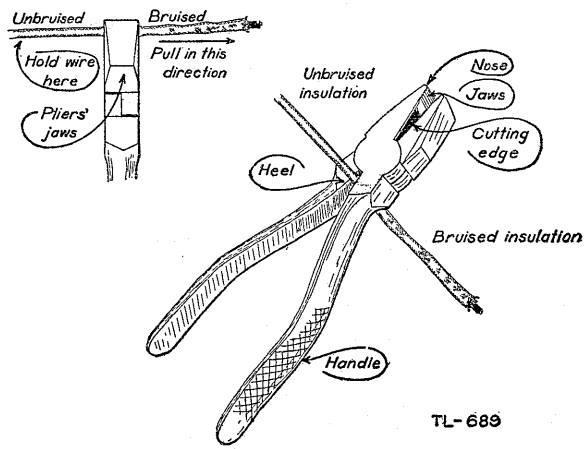


FIGURE 4.—Method of using side-cutting pliers to remove insulation from wire

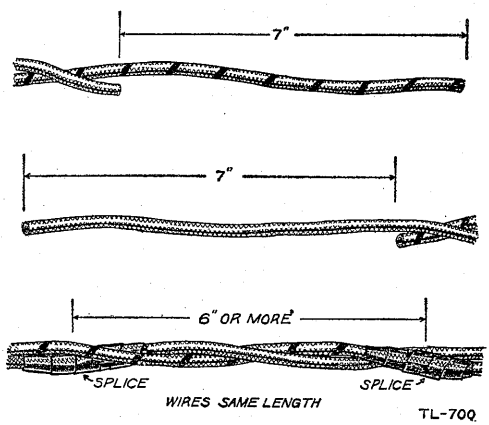


FIGURE 5.—Splices staggered in twisted pair wire

pair will then lie along both wires of the second pair. Cut the proper wire of the second pair so that the ends of each pair will abut and the joints will be about seven inches apart. The long

wire of one piece should then be spliced to the short wire of the other piece. After completing this splice, the remaining long wire should be carefully wrapped about the splice with the original lay. Wrappings may be extended at least 6 inches beyond the first splice. The remaining long end should then be spliced to the remaining short end. The second splice should be made at least 6 inches from the first so that the two wires in the completed splice are exactly the same length. If one wire has been left shorter than the other at the completed splice, the short wire will bear all strain at that point and will, therefore, be easily broken.

(2) Stranded wire is normally connected to solid conductor wire only where it is necessary to splice a stranded wire circuit

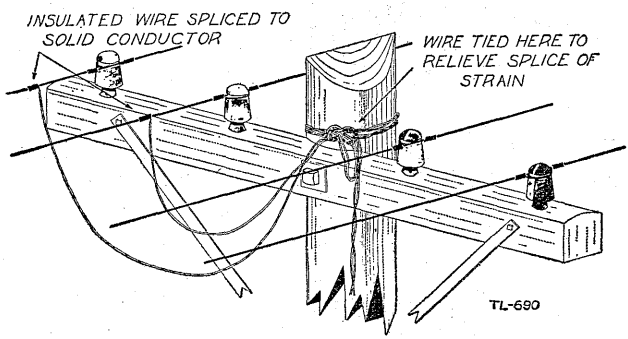


FIGURE 6.—Method of tying to relieve splice of strain

in a field line to a solid conductor wire circuit on a pole line. In this case the stranded wire should be tied in to some solid object (cross arm or pole) near the splice and a little slack left between the tie and the splice, as shown in Figure 6. In the tie, the knot should take the strain, since the splice is not strong enough to withstand a strong pull.

b. Splices, description, and method of making.—(1) *Standard field wire splice.*—The standard field wire splice is used to splice wire, type W–39, W–40, or other stranded wire with a copper core. To make the splice, strip off the insulation for a distance of 6 inches on the ends of the wires. Separate the copper core strands from the steel strands. Clean the strands so they are bright and free from corrosion. Tie a square knot in the wires, leaving three-eighths of an inch or less between the knot and the

insulation on the wires. The knot should be tied with the steel strands only, the core strands being left free. To tie the square knot, hold one wire in each hand, ends to the front. Lay the end of the right-hand wire over the left and pass it toward the left once completely around the left-hand wire until the point is again to the front. Turn it back in the direction of and alongside its starting point over the original left end. Bring the latter up around the first, down through the loop, and pull taut. *Caution:* The standing and running parts of each wire must pass through the loop of the other part in the same direction, otherwise a useless knot known as the granny is formed. Figure 7 illustrates the steps in making the square knot. Continuing with the splice, cut off the protruding ends of the steel strands just short of the insulation. Place the core strands from both wires along the wire parallel to its axis, allowing them to extend beyond the knot on either side. Take the core strand on the right-hand side of the knot and bend it at a right angle to the axis of the wire just beyond the knot. Then proceed to wrap it firmly around the wire and other core strand, seizing them firmly together. The wrappings extend back onto the insulation for several turns, each turn being placed close to the preceding turn, as shown in Figure 8. Next wrap the remaining core strand about the left-hand side of the knot in a similar manner. Wrap the splice with two layers of friction tape. The tape wrappings begin and end in the center of the splice and extend over the insulation of each wire for a distance of one inch, as shown in Figure 9. The tape must be drawn tightly against the insulation, particularly at the ends, to insure a secure wrapping and thereby prevent seepage of water into the bare wire joint.

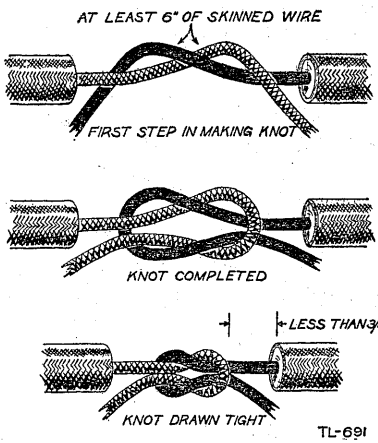


FIGURE 7.—Method of tying a square knot

(2) *Standard outpost wire splice.*—The standard outpost wire splice is designed for wire, type W–43, W–44, or other stranded

wire without a copper core, but may be used with any stranded wire. It is least satisfactory for wire, types W–39 and W–40, because of the stiff steel strands found in these two types of wire. To make the splice, strip off the insulation for a distance of 6 inches from the ends of the wires. Clean the wire strands so they are bright and free from corrosion. Tie a square knot in the wires, leaving three-eighths of an inch or less between the knot and the insulation on the wires. Take the protruding ends of the wires and bend them back onto the opposite sides of the knot. Wrap the ends tightly around the main wire, drawing the turns up close against one another. Extend the wrappings back onto the insulation of the main wires for several turns. With the pliers, bend down the ends so that the points of the strands will not puncture the tape wrappings. Figure 10 illustrates the manner of making this type of splice. The splice is wrapped with two layers of friction tape. The tape wrappings begin and end at the center of the splice and extend back onto the insulation of the wire on both sides of the splice wrappings for at least 1 inch.

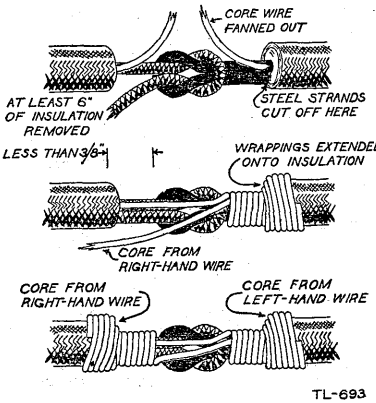


FIGURE 8.—Standard field wire splice

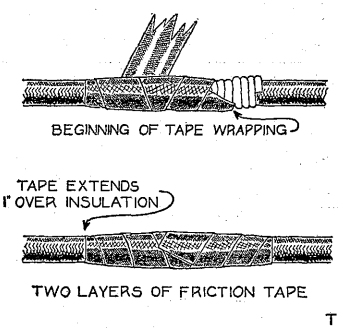


FIGURE 9.—Splice wrapped with tape

(3) *Combination seizing wire splice.*—The combination seizing wire splice is used to connect stranded wire without a copper core to a solid conductor wire. To make the splice, strip off about 1 inch of insulation from the end of the stranded wire. Clean both wires by remov-

ing the corrosion so that they are bright. Lay the stranded wire bared end along the solid conductor wire. Take a piece of seizing wire 12 inches long, which has been cleaned and brightened, and wrap it about the bundle, seizing the stranded wire firmly against the solid conductor wire. Begin the seizing by several turns at a point on the solid conductor wire ahead of the base end of the stranded wire. Continue the wrapping, including the bare end, several turns over the insulation of the stranded wire and finishing with several turns only around the solid conductor. Wrap the seizing wire tightly and draw the turns close against one another. Tape the splice with two layers of friction tape. The first layer begins at the left-hand side of the splice and continues to the right-hand side, with the insulated stranded wire being brought out between the turns of the tape which goes beyond it, as shown in Figure 11. Reaching the end, the tape wrappings are reversed and the outer layer wrapped about the splice in the opposite direction.

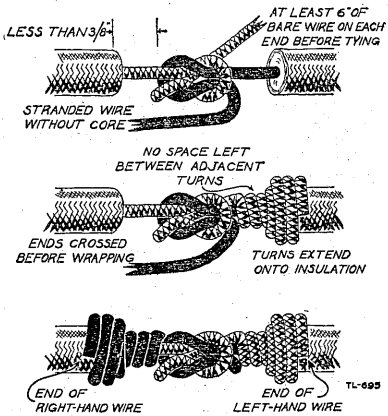


FIGURE 10.—Standard outpost wire splice

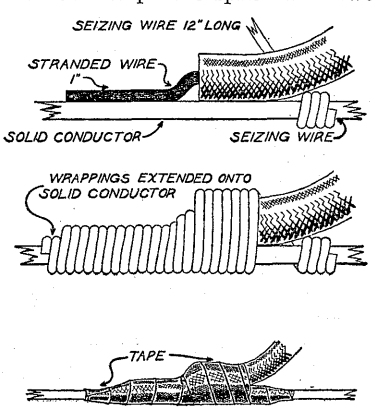


FIGURE 11.—The combination seizing wire splice

(4) *Combination core splice.*—The combination core splice is used to connect stranded wire with a copper core strand to a solid conductor bare wire. To make the splice, strip off the insulation

for a distance of 12 inches from the end of the stranded wire. Separate the core strand from the steel strands. Cut off the steel strands, leaving only about 1 inch protruding from the insulation. Clean the wires (core strand, steel strands, and the part of the solid conductor bare wire, where the splice is to be made) so that all are bright and free of corrosion. Lay the copper core bare end of the stranded wire along the solid conductor wire. Bend the core strand at right angles to the wire and using it as a seizing wire, wrap the steel strands firmly against the solid conductor wire. The turns are placed close against one another continuing for several turns beyond the steel strands, and around the solid conductor alone, for several turns. The splice is wrapped with two layers of friction tape. The first layer begins at the left-hand side of the splice and continues to the right-hand side. The insulated stranded wire is brought out between the turns of the tape which is further wrapped around the solid conductor wire for several turns. Reaching the end, the tape wrappings are reversed and the outer layer wrapped about the splice in the opposite direction. Figure 12 illustrates the manner of making this type of splice.

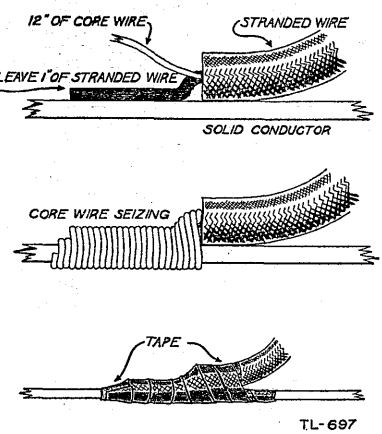


FIGURE 12.—The combination core splice

(5) *Combination splice.*—The combination splice is used to connect the end of a stranded wire to the end of a solid conductor wire without the use of seizing wire. To make the splice, strip off the insulation from each wire for at least 6 inches. Clean both wires so that every strand is bright and free from corrosion. Tie an overhand knot in the stranded wire close to the insulation and slip it over the solid conductor to within three-eighths of an inch of the insulation. On that wire pull the knot tight, and wrap the stranded end around the solid conductor from the knot to the insulation. Cut off the protruding end. Next bend the

solid conductor back at the knot, and seize the stranded wire, continuing up over the insulation for several turns. Cut off the end, making sure that no protruding tip will cut through the insulation tape. Wrap the solid conductor over the stranded wire in a direction opposite to the wrapping of the stranded wire, otherwise the solid wire will fail to hold the strands in place. Tape the splice with friction tape. Figure 13 illustrates the splice.

(6) *Commercial splice.*—The commercial splice is used to connect a solid conductor wire with a free end to another solid conductor wire without a free end. An example of this type of splice is its use in splicing an insulated solid conductor wire to a bare copper wire in an overhead line. Here the wire should be tied in to the pole or cross arm. (See fig. 6.) In all cases where insulated twisted pair wire is to be tied in, the tie should be made to a wooden support. For example, tie to a cross arm and not to a cross arm brace since the insulation wears more quickly when tied to a metal support. To make the splice, remove the insulation for a distance of 6 inches from the end of the wire and clean the wires so that they are bright and free from corrosion. Lay the bare end of the insulated wire along the bare line wire. Bend this end at right angles to the line wire. Wrap the end around the line wire, making at least five turns, drawing them tightly and closely together. Wrap the splice with two layers of friction tape. Figure 14 illustrates the splice.

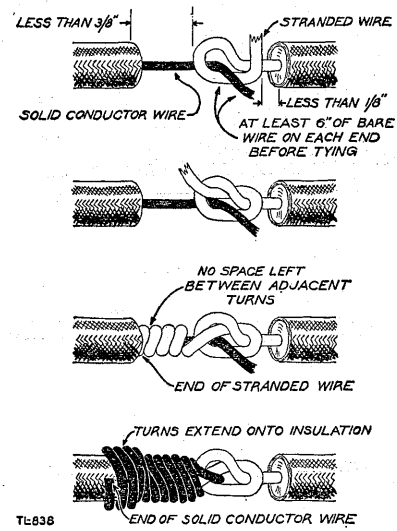


FIGURE 13.—The combination splice

(7) *Western Union splice.*—The Western Union splice is used to connect two solid conductor wires. It derives the name from its use in commercial telegraph line construction. To make this

splice, remove the insulation for about 6 inches from each end of the wires and clean the wires. Twist the bared ends together in the center, for about 1 inch, as shown in Figure 15. Bend the ends at right angles to the length of wire, and wrap each end around the wire at least five times. Cut off the ends as close as possible, being careful not to leave a sharp point that will work through the tape. Tape the splice with two layers of friction tape.

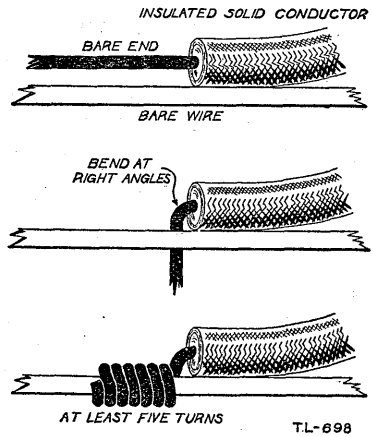


FIGURE 14.—The commercial splice

26. Wire ties. — The kind of tie used to secure wire to an object depends upon the type of wire and the nature of the object. The following kinds of ties should meet all conditions in field wire system construction.

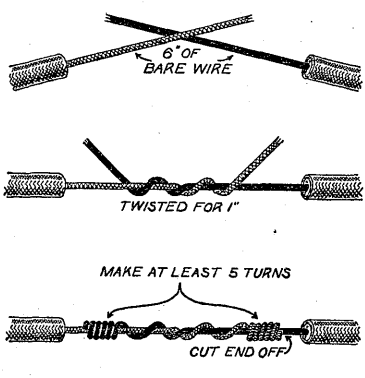


FIGURE 15.—The Western Union splice

Where the wire is tied above equipment to which it is connected, arrange a drip loop in the wire. To make a drip loop, bend the wire in the slack part between the tie and the connection to the equipment so that the wire falls from the tie to a point below the connection and then runs up to the connection. Figure 16 shows a drip loop at a terminal strip. Water running down the wire will drip off from the bottom of the loop and will not be led into the equipment, thereby causing possible short circuits. See paragraph 59, reference protection of equipment against moisture.

a. Clove hitch tie.—The clove hitch tie is used in tying wire to a knob, insulator, stake, post, or other small object where one end of the object is exposed so that the wire may be placed over it. To make the clove hitch, stand facing the knob to which the wire is to be tied. Make a loop in the wire with the standing part (that end of the wire coming from the point where the wire laying began) behind the running end (the end of the wire coming from the spool being laid). Place the loop over the knob. With the standing part of the wire, make another loop with the standing part behind the running end and place it over the knob beside the first loop. Draw the loops tight. Forming the two loops and placing them on the knob may be accomplished in a number of different ways, any of which are satisfactory so long as the results described herein are obtained. Figure 17 shows the clove hitch made over a knob and Figure 18 shows the same tie around a post.

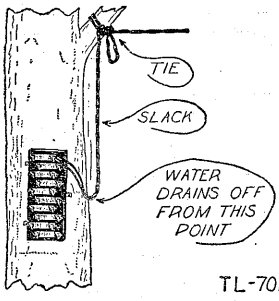


FIGURE 16.—A drip loop formed in wire leading to a terminal strip

b. Square knot tie.—The square knot tie is used in tying wire to a tree, pole or other object around which the wire can be

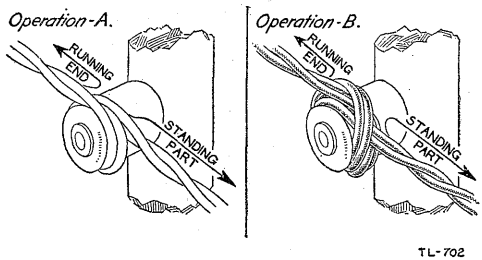


FIGURE 17.—Clove hitch tie around a knob

placed, but which does not have an exposed end. Stand facing the tree or other object on the side on which the wire is being laid. Pull in enough slack to make a bight to go around the tree, with about 6 inches left over. A bight is a loop formed on the wire, so that the two parts lie alongside one another. Place the bight around the tree from the front, going around the side

toward which the wire is to be laid. With the end of the bight and the two wires forming the neck of the bight, tie the first half of the square knot. Then with the end of the bight and wire leading to the reel, complete the square knot, as shown in Figure 19.

c. Loop knot tie.—The loop knot tie is used in tying field wire to a tree, pole or other object around which the wire can be

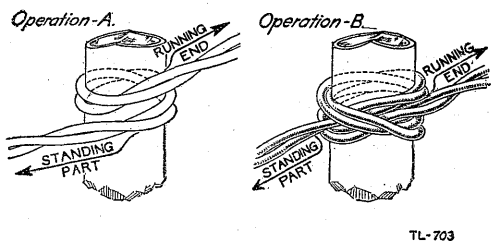


FIGURE 18.—Clove hitch tie around a post

placed. This tie has the advantage of untying and falling away from the tree when the protruding loop is pulled. To make the tie, stand facing the tree on the side on which the wire is being laid. Pull in enough slack to make a turn around the tree with about 18 inches left over. Form a bight in the wire and place

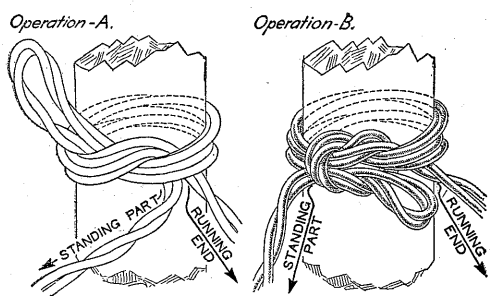


FIGURE 19.—Square knot tie around a post

it around the tree from the front, going around the side toward which the wire is being laid and returning to the front on the side from which the wire has been laid. Bring the bight out underneath the neck formed by the standing part and running end, and pass it around the neck for one turn. The V opening formed in front of the tree when the bight was placed

about the tree is divided into a front and rear section by the turn. Reach through the front opening and pull through it a small bight formed by doubling the standing part of the original bight. Snugly draw up this resulting bow knot. The steps in making this type of tie are shown in Figure 20.

d. Knob tie.—The knob tie is used in tying twisted pair wire to a knob, insulator, stake, small post, or other small object, one

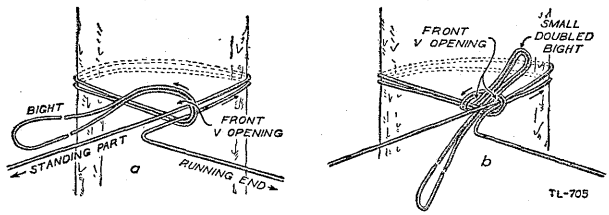


FIGURE 20.—Loop knot tie around a tree

end of which is exposed so that the wire may be placed over it. It is not suited to ties over an object larger than an insulator or knob. To make a knob tie, form a loop in the twisted pair wire. Separate the two wires in the loop and bend each back around its side of the length of wire, so that they again touch each other 180° opposite the original position of the loop. Place the loop

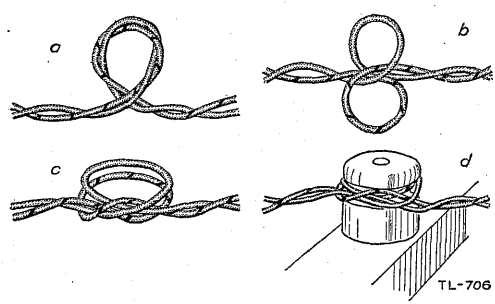


FIGURE 21.—Knob tie made with twisted pair

over the knob and draw it tight around the knob. Figure 21 illustrates this method of tying.

e. Standard U *tie.*—The standard U tie is used in securing bare wire to an insulator. Hold the line wire in the insulator groove. Take a piece of wire about 8 inches long, placing the center of this piece in the insulator groove on the side opposite

the line wire. Bend it around the insulator, with the ends under the line wire. Wrap each end around the line wire. Make at least five complete turns with each end and cut off the remaining ends. Figure 22 shows this tie.

f. Marline tie.—The marline tie is used in tying wire where it is desired to suspend it from an iron cross arm, or other metal support. Take a piece of marline which, when doubled, will reach from the wire in its suspended position, twice around the support and down to the wire again, with about 4 inches left over for tying. Double the marline and place it around the wire. Insert the ends through the loop and draw the marline tight around the wire on one side of the support. Pass the doubled marline twice around the support and back to the wire, tying it securely with a double overhand knot. To tie an overhand knot as shown in Figure 23, place the marline around the wire and pass the running ends over the standing part and down through the loop. Draw the knot tight.

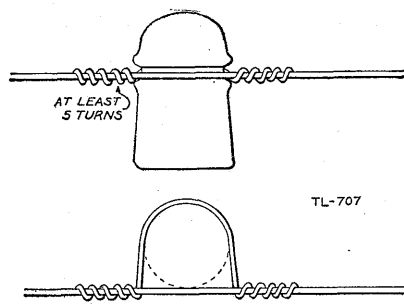


FIGURE 22:—Standard U tie to insulator

g. Marline knob tie.—The marline knob tie is used in tying wire to a wooden knob. (See fig. 24.) This tie is used principally where most of the wire circuit is supported on knobs or insulators and where marline is available. It is applicable to either single conductor or twisted pair. For occasional ties to knobs, the *knob tie*, described in *d* above, is generally used for twisted pair.

27. Circuit marking tags.—A field wire circuit is identified by means of a designation appearing on a tag tied to the wire. The tag should be of rope stock or other fairly waterproof substance which will show the marks made by a soft pencil or crayon. A short length of soft iron wire is fastened to one end of the tag for fastening to the circuit wire. The designation of the circuit is marked on the tag. (See par. 21.) Figure 25 shows a circuit marking tag. The tag is fastened to the wire about a foot from where the wire is connected to an instrument, terminal strip, or switchboard when installed without a terminal frame. This facilitates the identification of the circuit at the installation.

Tags may also be desirable along the wire route, especially at points where the type of construction changes, as from surface to overhead.

28. Terminal strips.—A terminal strip comprises a block of insulating material to which is fastened a number of binding posts or stud bolts with washers and nuts. The binding posts are connected in pairs by metal strips, so that a wire connected to a binding post on one side will be joined electrically to another wire connected to the opposite post. Terminal strips are now issued in several styles. The type TM–84 (fig. 26) is provided with 10 through connections and will handle five pairs of wires. The connections are made by means of wing-nut binding posts fitted with a washer and skinner lug. The skinned wire is connected by placing the wire in the skinner lug and around the bolt under the washer in the direction that the wing nut tightens, then back through the skinner lug. The protruding end of the wire is cut off. The wing nut is then tightened. The type TM–84–A (fig. 27) is also a 5-pair terminal strip and differs from the TM–84 only in the structure of the binding posts.

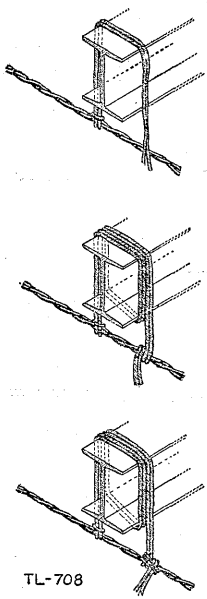


FIGURE 23.—Marline tie to a metal support

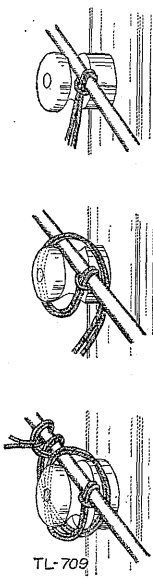


FIGURE 24.—Marline tie to a knob

29. Wire laying equipment.—*a.* Field wire is carried forward and laid by any one of the following means, depending upon the condition of the roads and terrain, traffic conditions, and character of hostile fire: Motor trucks; specially constructed horse and motor-drawn carts and reels; escort wagons; reel carts, hand drawn or towed behind communication carts; pack reels; breast reels; spools or coils carried by hand.

b. If issued on wooden spools, wire may be laid by inserting an iron bar through the axial opening in the spool and paying off from the spool, or the wire may be rewound onto a spool of special design used with a horse or motor-drawn cart or reel, reel cart, breast reel, or pack reel.

(1) Motor trucks are used for laying wire but no special design exists for this purpose. The wire is either paid off from the spool as issued, or from a pay-out reel of commercial or improvised type. This method is applicable where the route lies along a hard-surfaced road not subject to enemy shell fire.

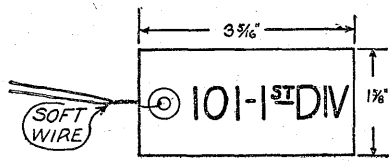


FIGURE 25.—Circuit marking tag

(2) Specially constructed horse-drawn wire carts are authorized for brigades and larger units within the cavalry and infantry divisions. The carts are designed for a 2-horse team and are so used within the infantry division. Cavalry units commonly use a 4-horse team. The wire cart embodies features for paying out and reeling up the wire. Each cart has two reels for holding wire with a combined capacity of 5 miles of type W–39 or approximately 2 miles of type W–40 wire. It is necessary to transfer the wire from the issue spools to the cart reels. One or both reels may be operated at the same time.

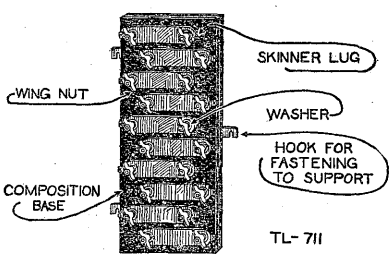


FIGURE 26.—Terminal strip, type TM–84

(3) Field artillery units are equipped with specially designed horse or tractor-drawn reels, which are used to lay wire for their fire-control and command systems. The battery reel (4-horse) carries approximately 1.7 miles of type W–40 wire. The artillery reel (6-horse) carries 3.2 miles of type W–40 wire. This type is used in field artillery battalions, regiments, and brigades.

(4) When conditions warrant, escort wagons may be used in the same manner as motor trucks for paying out wire. Here also the wire may be laid by inserting an axle through the wooden

reel or by using a pay-out reel. The escort wagon is not so mobile as the horse-drawn wire cart, but carries more wire and affords an additional means of laying when other facilities are not available.

(5) Hand reel carts, shown in Figure 30, are issued within the division. These small carts are pulled by hand or may be towed behind communication carts. Each cart carries two steel spools of wire. The spools may be removed from the cart chassis and replaced by filled spools when they become empty. Each spool has a capacity of approximately one-half mile of type W–44 wire. The cart is so designed that it may be taken apart for packing.

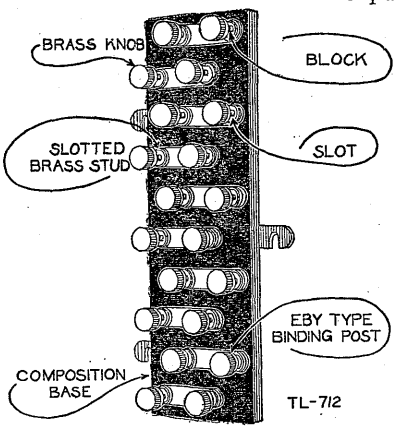


FIGURE 27.—Terminal strip, type TM–84–A

(6) Pack reels are designed for the pay out and recovery of wire from a pack animal. They are normally used by cavalry and pack artillery.

(7) Breast reels, as shown in Figure 31, may be strapped onto the breast or back of a mounted or dismounted man. The

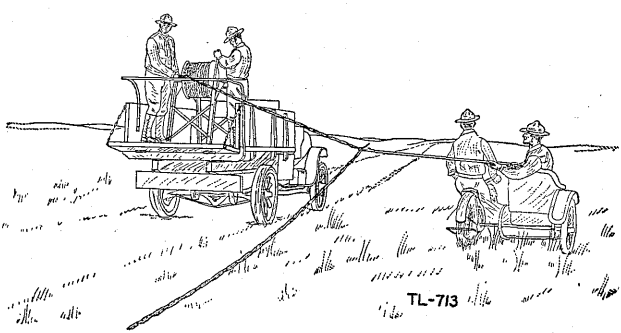


FIGURE 28.—Truck adapted to wire laying

wire may be recovered by the use of a crank. The breast reel holds about 600 feet of type W–44 wire.

(8) In laying wire by hand, the wire may be paid out by placing the spool of wire on a stationary axle and carrying the

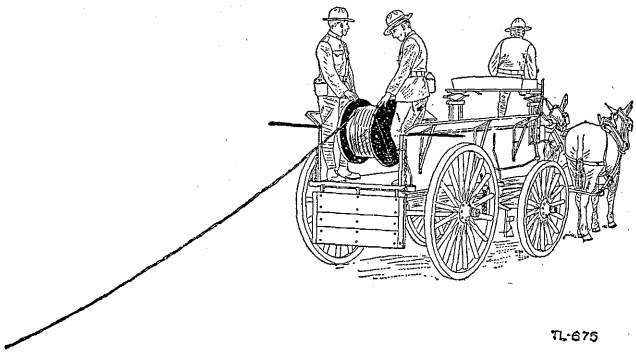


FIGURE 29.—Escort wagon adapted for wire laying

wire away from the spool; by carrying the spool on an axle and paying out the wire while walking along the route; or by making

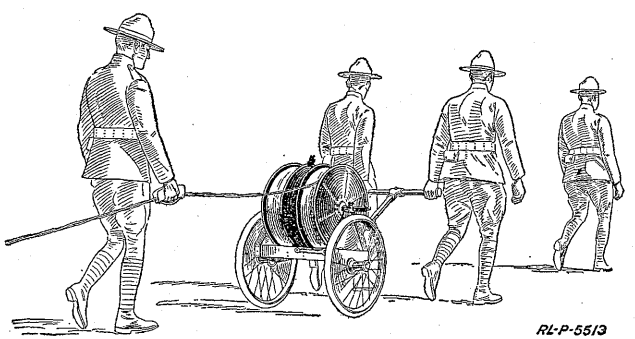


FIGURE 30.—Reel cart, type RL–16

up coils of wire into such weights that a man can carry a coil and pay out the wire while walking.

c. After the wire has been laid from the wire-laying device it should be removed promptly from the path of the vehicle to protect it from traffic. In this case the wire-laying device is followed by personnel who use wire pikes (wooden poles with hooks on the end) or the hand for moving the wire into its

desired position. Likewise, in the recovery of wire, the reel is preceded by a lineman, who, with the use of a pike or the hand, places the wire back on the road or path of the reel.

30. Pole climbing.—*a. Description of equipment.*—The lineman's equipment for pole climbing is a pair of climbers, lineman's belt, and safety strap. Each climber is provided with a top and a bottom strap. The top strap is for the purpose of holding the climber securely against the leg, while the bottom strap secures the climber near the ankle. The top strap is equipped with a leather pad which is placed between the upper end of the shank of the climber and the leg to prevent the climber from chafing the

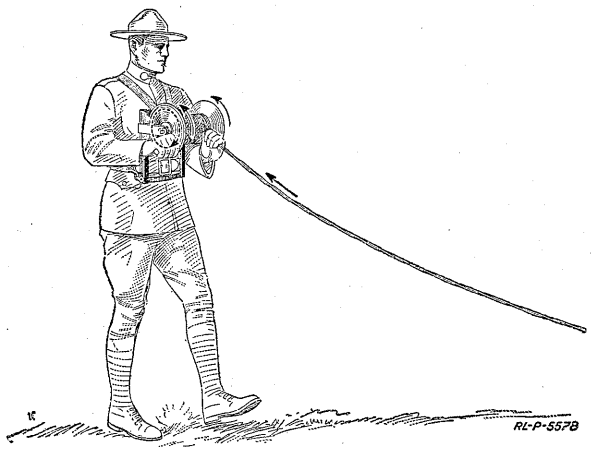


FIGURE 31.—Breast reel, type RL–9

leg. The lineman's belt is provided with loops for carrying the various lineman's tools and two rings to which the safety strap is fastened. The safety strap is placed about the pole for safety and ease while working.

b. Fitting equipment.—Climbers should be fitted to the leg so that the end of the shank rests about 2 inches below the knee joint. Both straps should fit snugly around the leg. Care should be taken that the buckles do not rest on the shin or the instep. The belt should fit loosely around the body but sufficiently tight to prevent its falling down over the hips. The safety strap should be fastened to the belt by snapping both ends to the ring on the left-hand side of the belt. (See fig. 32.) The equipment should be carefully inspected before it is put on.

c. Procedure in climbing.—(1) *To ascend the pole,* take a natural standing position at the foot of the pole, with the toes about 6 inches from the pole. Raise and extend the arms to a horizontal position, grasping the pole with the palms of the hands, at the same time allowing the body to fall backward to the full length of the arms. Raise the right foot about 10 inches from the ground, keeping it about 1 inch from the pole. With a downward thrust, engage the spur of the climber in the face of the pole about 8 inches from the ground. Lift the body by straightening the right leg and placing the weight on the spur which is engaged in the pole. Let the left leg hang free and keep the body away from the pole, as shown in Figure 34. From this position raise the left leg and repeat the thrust in the same manner as before. At the same time raise the left hand about 10 inches on the pole, balancing the body with the right hand. Continue to climb in this manner.

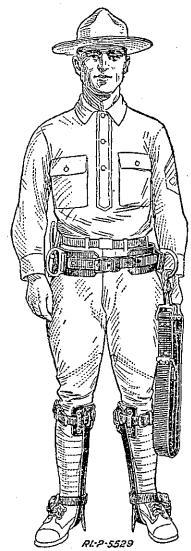


FIGURE 32.—Method of wearing pole-climbing equipment

(2) *Use of safety strap.*—Climb to the desired height. Thrust the spur of the right foot into the pole and shift the weight of the body to the right foot. Pass the left leg around the pole in such a manner as to aid the right hand in supporting the body. Keep the right knee about 5 inches away from the side of the pole. Grasping the pole with the right hand, unsnap one end of the safety strap and pass the end around the pole to the right hand. Aid the support of the body with the left hand and with the right hand fasten the loose end of the safety strap to the right ring on the belt, as shown in Figure 37. Clasp the pole with both hands. Remove the left leg from around the pole and with a downward thrust engage the spur of the climber in the pole on a level with the right foot. The heels when in the proper and most comfortable position should be 3 inches apart. Lean backward gradually, placing the weight of the body on the safety strap, as shown in Figure 38. Adjust the safety strap to its proper position on the pole.

(3) *To descend the pole,* unhook the safety strap, using the above procedure in the reverse order. Climb down the pole, throwing the weight of the body slightly on the right or left leg, alternately, in order to place more force on each downward thrust.

31. Wire lines, definitions and types.—A wire line consists of one or more wire circuits along the same route. Military wire lines are classified according to their general type of

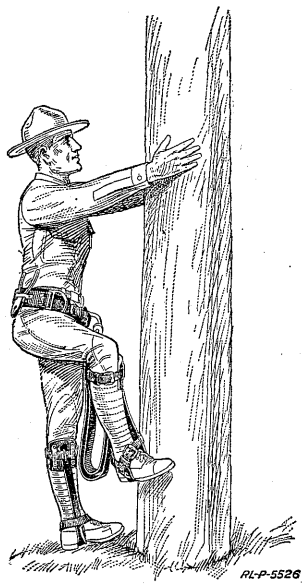


FIGURE 33.—First position in climbing

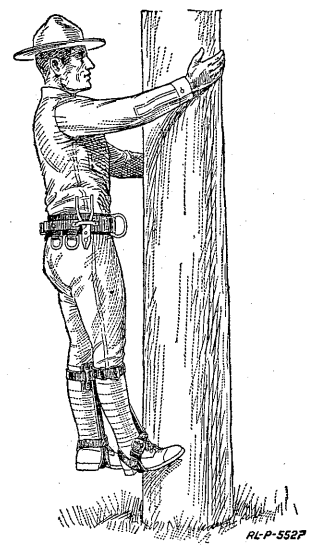


FIGURE 34.—Second position in climbing

construction as cable lines, standard pole lines, semipermanent pole lines, and field wire lines.

32. Surface line construction.—During movement of units in combat, field wire lines are laid hastily on the ground. This type of wire line is termed a *surface line.* Surface lines must be protected from traffic at command posts, road crossings or other places where traffic lanes cross the line. Surface lines are laid loosely in order that the wire may be flat on the ground and so as to provide sufficient slack for repairing breaks and facilitating subsequent changes in the type of construction.

At suitable intervals, surface lines should be attached to objects such as trees or posts in order to leave sufficient slack, and so as to prevent passing troops and transports from pulling the wire into traffic lanes. The wire is tied to the tree or post at the ground level. When surface lines are routed along a road, the wires must be kept off the traffic lane. If the road curves in one general direction, the line should, if practicable, be routed along the concave side. When surface lines are routed along the convex side of a road, the line must be secured at several

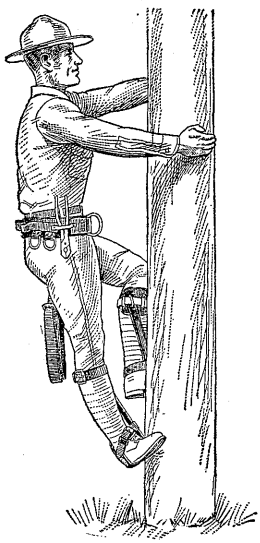


FIGURE 35.—Third position in climbing

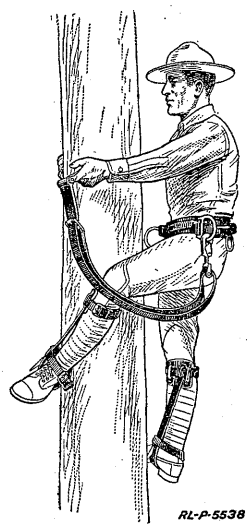


FIGURE 36.—First position in using the safety strap

points along the curve. Advantage should be taken of objects, such as trees or posts, along a curve in the road to prevent the wires being pulled into the traffic lane. Connections between surface lines and standard pole lines are made preferably at existing terminals of the standard pole line; if such terminals are not conviently located a test station may be established. When surface lines connect with permanent overhead construction, the surface line must be securely tied at the base of the pole at which the connection is made and again just above the cross arm or terminal can where the connection is to be made.

If more than one surface circuit is to be connected to a permanent line, a test station should be installed at the junction of the two types of lines. Connections to aerial or buried cables are made only at standard cable terminals.

33. Overhead construction.—Field wire lines are placed overhead by fastening the wire to small knobs attached to trees, buildings, or existing poles at a height of 14 feet above the ground. In case knobs are not available, the wire is fastened to the supports by means of standard field ties. This type of construction is employed near command posts, test stations, overhead road crossings, and other points along surface lines where traffic lanes cross the wire. Test stations should be installed at the head of construction and at the junctions of overhead lines with other types of construction. At junctions between overhead and other types of construction the wires are tied securely to the bottom of the support and tagged.



FIGURE 37.—Second position in using the safety strap

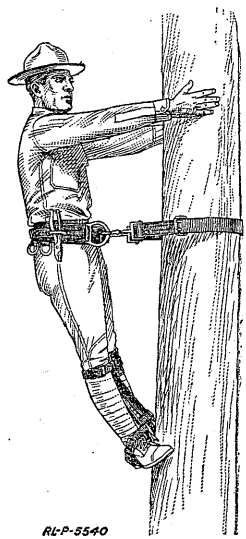


FIGURE 38.—Third position in using the safety strap

34. Road crossings.—*a.* Where possible, field wire lines should cross roads at culverts. The wires are passed through the culvert and tied at the entrance and exit to prevent contact with water.

b. Wires which cross roads overhead must clear the crown of the road by 14 feet. When a surface line crosses a road on poles or other objects, the wires should be tied at the base and top of the object on each side of the road. The strain which occurs along the line is met by the tie at the base.

c. If neither of the above methods can be used, the line wires should be buried in a trench, crossing the road at right angles. The wires must be laid snug and secured at both ends of the trench to prevent their being pulled out. A small amount of slack wire should be left at each side of the road to permit replacement of the portion under the road should it become worn or water soaked. Lines are tied to trees, posts, stakes, or other suitable objects.

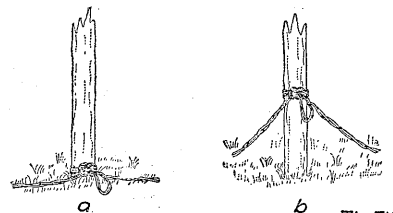


FIGURE 39.—Method of tying wire at ground level; (a) correct, (b) incorrect

d. Circuits crossing roads in any of the above methods are tagged at both sides of the road.

e. The passage of captive balloons along roads requires that their movements be unhampered by interference from overhead

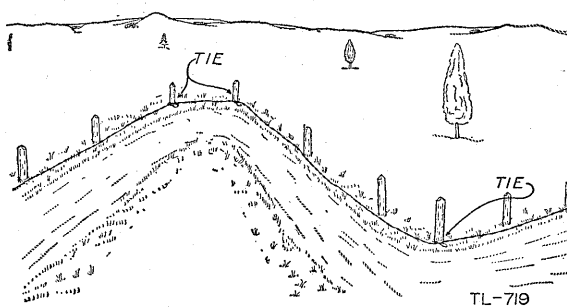


FIGURE 40.—Method of tying wire along curve in road

wires. Therefore, when practicable, wires should be routed underneath roads. When overhead construction is necessary provision should be made to permit the wires to be lowered to the road surface. Little or no damage will result to the wires by the occasional passage of balloon vehicles over them.

35. Railroad crossings.—Field wire lines should cross railroads under the rails. If a bridge or culvert is available, the wire should be laid through the bridge or culvert, as described in paragraph 34.

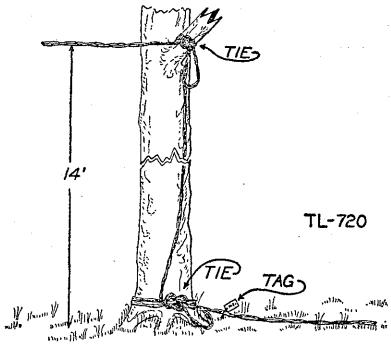


FIGURE 41.—Method of tying wire at junction of surface line with overhead construction

36. River crossings.—*a. Overhead.*—Small stream crossings are made in the same manner as overhead road crossings, except that the wires need be only high enough to clear traffic. A span of more than 150 feet should not contain a splice. Long spans can be made with field wire, but special construction is necessary for resisting the strain. Figure 46 illustrates methods which have been adopted for military telegraph lines in Alaska, where

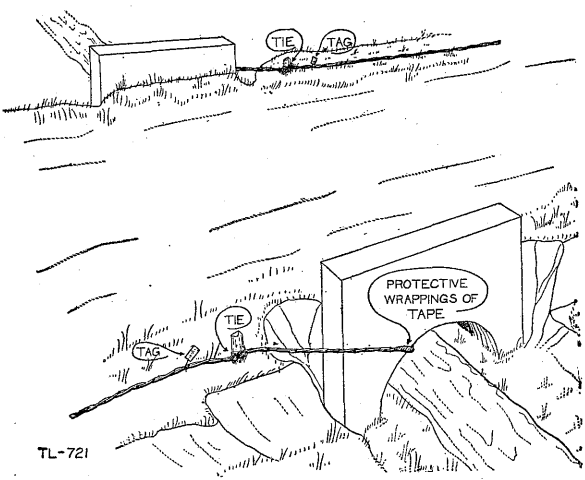


FIGURE 42.—Wire crossing road through culvert

it was necessary to cross swift rivers and mountain gorges. Figure 46 *a* and *b* shows two methods of providing support for

excessive strain on long spans. The line wire is made fast at G, laid in the saddle at D, pulled up at saddle at C, and made fast at strain insulator attached to H. As much sag as practicable

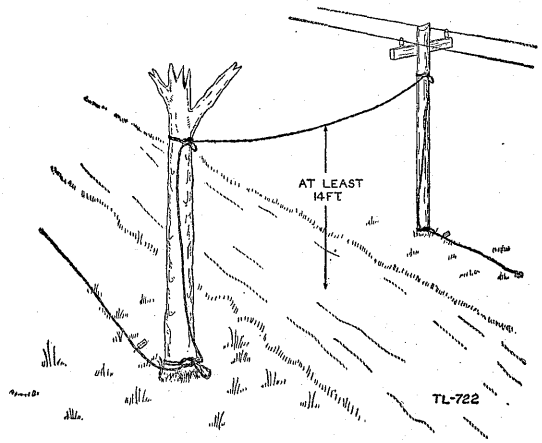


FIGURE 43.—Wire crossing over road on supports

should be allowed, as the strain increases rapidly as the wire is pulled taut. Figure 46 *c* and *d* shows method of constructing saddles for supporting long spans. Figure 46 *e* shows an addi-

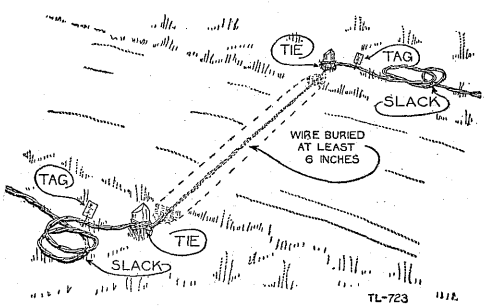


FIGURE 44.—Wire crossing under road in trench

tional method of terminating a long span wire, the wire having passed over a saddle not shown in the figure. A modification of the above method must be made to fit the material at hand in

each case, but the principles of guying illustrated above should be followed.

b. Submerged.—When field wire lines must cross bodies of water, such as rivers, where it is impracticable to make overhead crossings as described above, the wire should be submerged. The wire is tied in securely on the near bank, laid by paying out from reel across the water, and tied in securely on the far bank. When the water level is affected by tidal raises the ties should be above the high-tide level. The insulation on the wire should be sound. If the width is such as to necessitate the splicing of more than one length of wire together, the splicing should be

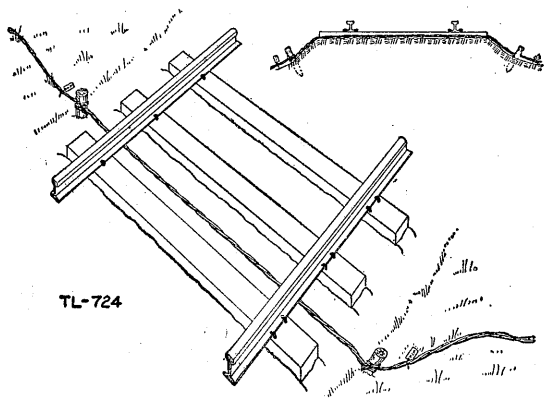


FIGURE 45.—Wire crossing under railroad tracks

done on the near shore and the entire length of wire made up into a single coil or placed on one reel. Such splices should be wrapped with rubber tape and then with friction tape. When the width is one-half mile or less a reel cart, type RL–16, may be placed in a pontoon or small skiff and the wire payed out from the reel while the boat is rowed across the water. When the current in the water is such as to wash the wire in the direction of the current, weights should be placed on the wire at suitable intervals during the laying to insure the wire will submerge to the full depth. The current of moving water should be considered and the effect of the current on the path of the boat computed to determine the approximate length of wire required for the crossing so that it may be prepared prior to the crossing. Splicing in midstream is impracticable.

37. Construction at circuit terminals.—The following procedure should be followed as far as practicable in the laying of field wire away from a terminal and approaching a terminal:

a. At the starting point, the free end of the wire is tagged to show the circuit designation, as in Figure 25. This tag is placed about 1 foot from the end of the wire.

b. Leaving sufficient wire at the free end to reach the terminal frame or other fixed installation, the wire is tied in to some object.

c. The free end of the wire is connected to the binding posts on the terminal frame or instrument. If a terminal frame is to be

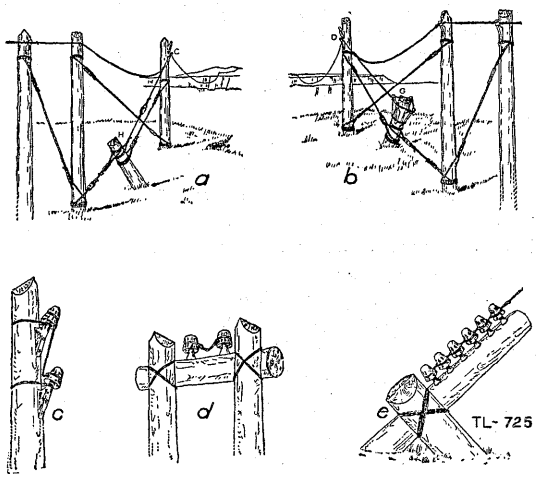


FIGURE 46.—Construction of terminals for stream crossings

installed later, the wire is connected to a telephone or other instrument, which may be used in making tests on the circuit until the frame is installed.

d. The chief of construction directs the laying of the wire. He follows the general route prescribed by the signal unit commander.

e. The wire is laid to the designated point. It is tagged and tied in and a free end left with sufficient slack to run to the operating installation (terminal frame or instrument). The circuit is then tested. When the circuit is found to be in order, it is turned over to the operating detail, who connect it to the terminal frame or instrument. After the circuit is connected, the chief of construction calls back over this completed circuit to

the starting point or wire chief, reporting the installation and receiving confirmation as to its operating condition. If the circuit has been connected to a switchboard or a terminal frame through which it is connected to a switchboard, he places his call through the switchboard. If connected to a local instrument, the call is made from this instrument. Thus, any fault in the terminal connection is detected and corrected before the chief of construction makes his report over the circuit. If the operating detail has not arrived at the terminal, the chief of construction will leave a member of his detail at the end of the wire. This man is equipped with a telephone or suitable test instrument which he connects to the circuit. He remains to turn the circuit over to the operating detail on their arrival and to test back over the circuit after it is connected, or awaits competent orders directing otherwise.

f. The chief of construction makes any additional notes necessary on his line route map and circuit diagram to complete the record of the circuit. He turns this information over to his immediate superior at the first opportunity.

38. Test station construction.—*a.* Test stations are installed in a field wire system to facilitate testing and cross connecting circuits within the adjoining sections. For identification, a test station is given a name derived from its geographical location, for example, *Knob Hill Test.* Test stations are located at points along wire lines where it is considered desirable to adapt the construction of the line for ready testing, or at points where command posts have been, or are likely to be, located.

b. Test stations are constructed when the wire lines are initially laid or are cut in on the lines later, and are cut out when their use is no longer advantageous. The site selected for the location of the test station should afford cover from hostile observation and fire and protection from friendly troop movements and should be accessible for testing. A test station consists of one or more terminal strips. The circuits are connected to pairs of binding posts on the right-hand side of the terminal strip. Circuits are cut through the test station by jumpering the corresponding binding posts on the left-hand side of the terminal strip. The jumpers for this purpose are pieces of flexible insulated wire. The terminal strips are fastened to a support such as a tree or fence post. The wire circuits are tagged and tied in before being connected to the terminal binding posts.

(1) *Construction of test station during initial installation of wire lines.*—Locate the site of the test station. Lay wires to this location. Tag and tie in circuits near the terminal-strip position. Secure the terminal strip or strips to a support. The number of strips used depends upon the number of circuits entering and leaving the test station, as there must be a pair of binding posts for each circuit. Connect the lowest numbered circuit entering the test station to the top right-hand pair of binding posts on the terminal strip. Connect the next lower numbered circuit to the next lower pair of binding posts and continue in this manner until all are connected. The wires extending forward from the test station are laid, being tied in near the terminal strip. The lowest numbered of these circuits is connected to the pair of binding posts at the top of the lower half of the terminal strip, and so on until all are connected. When an even number of terminal strips is used, the number of pairs of binding posts will be even and can be evenly divided into an upper and lower half. If the number is odd, the number of pairs of binding posts will be odd. In this case, leave the odd pair between the upper and lower halves. Take jumpers, prepared from lengths of flexible insulated wire, which are sufficiently long to reach from the top binding post to the lowest binding post on the terminal. Connect the proper circuits together. The installation is shown in Figure 47. A telephone or other suitable instrument is connected to the designated test circuit as prescribed in paragraph 75.

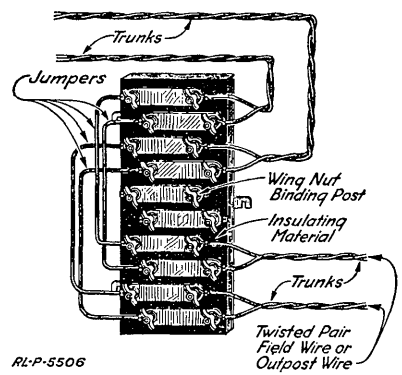


FIGURE 47.—Test station constructed during initial installation of wire lines

(2) *Construction of test station after initial installation of wire lines.*—Locate site of the test station along the route of the line. Secure the terminal strips to a support. Take the lowest numbered circuit and pull in slack on the wire. Tie in the wire near the terminal strip. At a point where the wire reaches the terminal, strip off about 2 inches of insulation from one wire and attach it to the top right-hand binding post. Remove the

same amount of insulation from the other wire and connect it to the lower binding post of the pair, as shown in Figure 48.

Measure off a sufficient length of wire to reach to the binding posts of the pair from which the circuit is to leave the terminal, and by removing the insulation as before, connect the wires to these binding posts in the same order. Tie in the wires near the strip. Jumpers are now connected to the corresponding binding posts on the left-hand side of the terminal strip. The loop in the circuit wire between the upper and lower pair of binding posts is cut away, cutting the wire close to the binding posts. Other circuits are cut in to the test station terminal strip

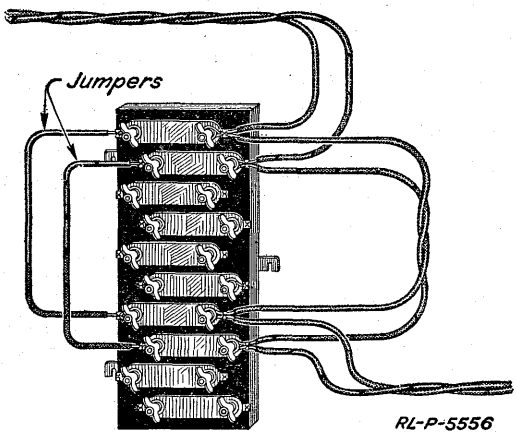


FIGURE 48.—Method of connecting wires to terminal strip in construction of test station after initial installation

in a like manner. Beginning at the top with the lowest numbered circuit, circuits will be cut in in numerical order.

c. Removal of a test station.—When a test station is to be abandoned, it is the usual practice to leave the terminal strip connected. It may happen that, due to shortage of terminal strips, it is necessary to remove the terminal strip and splice the circuits through. Before removing any circuit from the strip, the lineman on duty at the test station first listens in on it and satisfies himself that it is not in use. He then calls on the circuit and notifies the switchboard operator that the test station is to be removed and the circuits cut through. Then, taking two wires that are connected together by the same jumper, he

removes them from the binding posts and splices them together. The other wires of the pair are then spliced in a like manner. Other circuits are removed from the strip and spliced similarly.

39. Routing field wire lines.—*a.* The signal officer prescribes the general route to be followed. The chief of construction is usually allowed considerable latitude in the selection of the actual route.

b. Maintenance is facilitated by using the minimum number of routes. The route should be adapted to the means available for laying the wire. It should be so located that the line can probably be used by the same or another friendly unit after the movement of command posts. It should afford cover from hostile observation and fire. Main traffic routes, shelled areas, and the areas over which tanks or tractors are likely to pass should be avoided wherever practicable.

40. Construction orders.—*a.* The chief of construction should receive orders prescribing the number of circuits to be installed, the priority of installation, and the action to be taken on completion of the installation. He should receive the following descriptive information relative to each circuit to be laid:

(1) Numerical designation.
(2) The route.
(3) Whether a trunk or local circuit.
(4) Whether a metallic or ground return circuit.
(5) Type of wire.
(6) The centrals and test stations which it will connect or pass through, including code names and organizations served.
(7) Approximate length.
(8) Type of construction.
(9) Nature of roads and terrain.
(10) Precautions to avoid damage from friendly troops and matériel.
(11) Tests and reports required.

b. This information is imparted by the use of a line route map and circuit diagram, supplemented by oral or written instructions from the signal unit commander.

41. Procedure in laying field wire.—*a.* The wire for the circuits is tested before starting to insure the continuity of each spool. Spools of wire which when tested do not show a continuous circuit are not used until the trouble is corrected.

b. The terminal connection is made as prescribed in paragraph 37. The detail then moves out and the chief of con-

struction directs the laying of the wire over the detailed route. When necessary, he causes the wire to be placed to the side of the path of the wire-laying vehicle, so as to give the required protection to the wire. He determines the type of construction to be used if not already prescribed in his orders, as well as any changes in the type of construction, directing when and where they are to be made. He causes a test to be made back

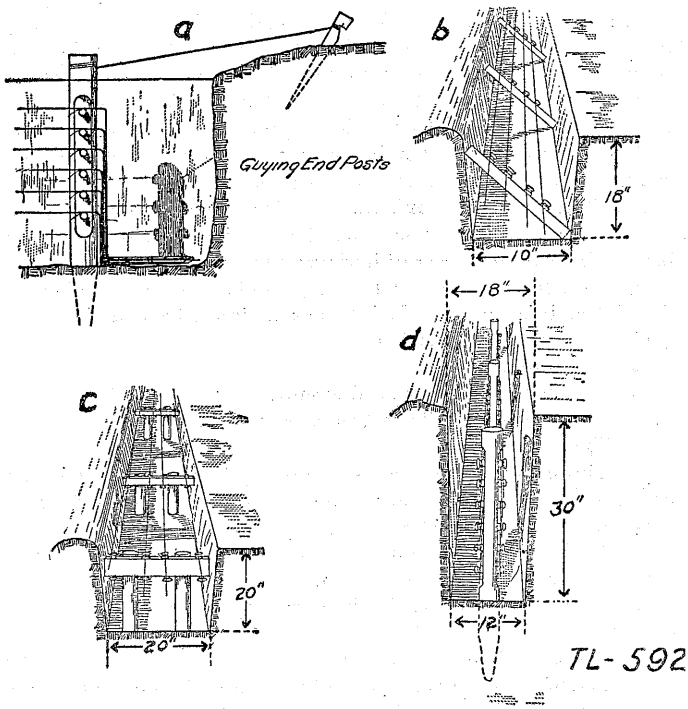


FIGURE 49.—Wire trench construction

to the starting point before and after making a splice in the wire being laid, in order to insure the continuity of the splice. When connections are made at terminal strips, he causes the circuit to be tested from the far side of the connection back to the starting point. Should the wire be laid to any location where a central is to be installed but where the equipment for the installation has not arrived, the chief of construction leaves

a man at this point to inform the arriving personnel of the location of the circuit and to assist in making the terminal connections. Sufficient slack is left at these places to permit running of the circuit to the probable location of the central.

c. The wire having been laid to the designated installation, the terminal connections are made and the circuit tested and reported, as prescribed in paragraph 37.

42. Trench line construction.—*a.* In zone defense, field wire lines are often installed in trenches. In general, two kinds of trenches are used:

(1) *Wire trenches* constructed for this purpose, and

(2) Trenches that are constructed primarily for other purposes, such as *fire* and *approach* trenches.

b. (1) Wire trenches vary in size from 10 inches wide by 10 inches deep to 36 inches wide by 30 inches deep. They afford considerable protection from shell fire but offer an obstacle to friendly traffic. The wire may be fastened to cross arms which are attached horizontally to short poles or rest against or project into the sides of the trench. Instead of using cross arms, the wire may be fastened to the sides of vertical poles. Twisted pair may be tied directly to these supports with wire or string, but it is preferable to tie the wire to wooden or porcelain knobs or insulators.

(2) The wire trench route should be chosen with a view to concealment, cover, and ease of construction. The wire is kept in the main trunk-line trenches as much as practicable. Switching centrals may be installed at important trench junctions.

(3) In digging the trench, the workers are divided into groups of two men each, each group equipped with a pick and shovel. Two men can dig from fifteen to thirty-five lineal yards of trench per day in good ground, depending on the type of trench.

(4) Trench posts are set in the ground at intervals of fifteen to twenty-five feet. They are guyed at turns and at the ends of the line. When fastening wire to vertical poles, insulators may be nailed on opposite sides of each pole. As many as 14 twisted pairs can be carried on a single pole line of this type in a trench about thirty inches deep. A liberal allowance of wire should be made for sag.

(5) Trench lines may be terminated by running directly into a telephone central or test station or connecting to some other type of construction.

(6) When necessary to cross a road with a wire trench, the line should preferably be placed in a buried conduit of wood, clay, or iron. If this is impracticable, the wires should be carried overhead on poles.

c. (1) When it is impracticable to construct wire trenches, field wire may be installed in fire or approach trenches. This will be normal within the intrenched area of the infantry regiment. Owing to the great use made of these trenches by combat troops, they are not satisfactory except for temporary wire installations.

(2) Except in narrow fire trenches, wire lines should be kept ordinarily on the side of the trench nearest the enemy. Wire

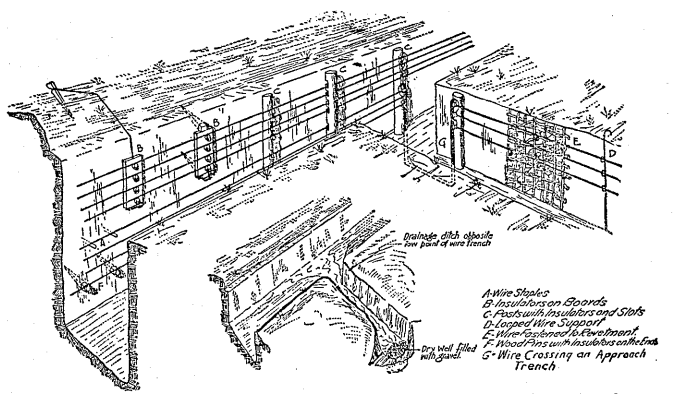


FIGURE 50.—Wire line construction in approach trenches

placed at heights between 10 and 30 inches from the duck boards or bottom of the trench is least subject to damage from cave-ins, water, and traffic.

(3) Field wire may be fastened to the side of a trench, as shown in the composite Figure 50, by—

(*a*) Staples made of stiff wire and about 12 inches long. The staples are driven into the ground as far as possible, thus holding the wire closely against the side of the trench.

(*b*) Attaching the wire to insulators mounted on boards which are fastened to the sides of the trench by rods or staples.

(*c*) Attaching the wire to insulators nailed to the ends of wooden stakes or pegs which are driven into the trench wall.

(*d*) Attaching the wire to insulators nailed to posts which are driven into the bottom of the trench close to the side.

(*e*) Passing the wire through supports made of No. 9 or heavier GI wire. One end of the support wire is attached to a stake driven into the ground just outside the edge of the trench.

(*f*) Attaching the wire to revetment posts, either directly or on insulators.

d. Trench wire lines are tagged at intervals of not more than 150 feet or at junctions with other lines.

SECTION III

INSTALLATION AND OPERATION OF TELEPHONES AND CENTRALS

43. General.—This section furnishes information for both the operating and using personnel. It prescribes in detail the training needed for the operating personnel with a few cautionary references of value for the using personnel and message centers.

44. Telephone centrals.—*a.* A telephone central is established at each echelon at a headquarters where two or more local telephones are installed and at junctions of wire lines where interconnecting is desired.

b. The telephone central serves the following purposes:

(1) To provide flexible intercommunication between local telephones and to afford connection to circuits leading to other units.

(2) To serve as a switching central at a junction of wire lines, thereby reducing the number of circuits required and adding flexibility to the system.

(3) To furnish a place at which all circuits are accessible for test and from which maintenance may be directed.

45. Telephone conversations.—*a.* Telephone conversations should be brief, as long conversations deprive others of the use of the circuits. This can best be accomplished by mentally preparing the subject matter of telephone conversations before the call is made. The telephone should not be used for long reports, orders, or messages when messenger or telegraph would

serve as well or better. Telephone conversations must be discreet, since secrecy is never assured. Telephone conversations may be intercepted by direct tapping of the line, by induction from our own lines, and by leaks to the ground and thence to enemy listening sets.

b. No unnecessary conversation should be held with the switchboard operator. In case it is desired to make a complaint regarding the service ask for the *chief operator* or communication officer. The operator should not be directed how to route a call. The switchboard operator should be spoken to in a civil manner.

46. Use of telephone code names.—*a.* To simplify and expedite the operation of a telephone system, and to conceal the identity of tactical organizations, code names are assigned to tactical units. These code names are prepared by division signal officers for use throughout the division. In corps and armies the signal officer prepares code names for the unit headquarters and for corps and army troops. A telephone central takes the code name of its tactical unit.

b. The manner in which code names may be assigned is illustrated in the following partial list for the 1st Division. These coded names are given as examples only. They do not remain fixed, but are changed from time to time.

Unit	*Code name*
Headquarters, 1st Division	Danger.
* * * * *	* * * * *
1st Signal Company	Daylight.
* * * * *	* * * * *
1st Field Artillery Brigade	Denver.
1st Field Artillery	Dollar.
1st Battalion	Dollar Red.
2d Battalion	Dollar White.
* * * * *	* * * * *
1st Brigade	Dig.
1st Infantry	Deer.
1st Battalion	Deer Red.
2d Battalion	Deer White
3d Battalion	Deer Blue.
* * * * *	* * * * *

47. Designations for officers and offices.—*a.* Enlarging upon this system of unit code names, officers, and offices at a

headquarters are given code designations for use in telephone conversations. The complete designation consists of the unit code name and a distinguishing number.

b. The following list shows the assignment of code-number designations to officers and offices at a headquarters. This assignment remains fixed.

Title	*Code number*
Commanding officer or C. G	6
Adjutant (not G–1)	7
Chief of staff or executive officer	5
S or G–1 or administrative officer	1
S or G–2 or intelligence officer	2
S or G–3 or operations officer, or plans and training officer	3
S or G–4 or supply officer	4
Ordnance officer	8
Inspector	9
Signal or communication officer	10
Message center	11
Machine-gun officer or machine-gun and howitzer officer	12
Aide-de-camp	13
Air officer	14
Engineer officer	15
Surgeon or medical officer	16
Judge advocate	17
Finance officer	18
Chaplain	19
Postal officer	20
Quartermaster (not supply officer)	21
Chief of artillery or artillery officer	22
Gas officer	23
Liaison officer	24
Munitions officer	25
Pigeon loft	26
Provost marshal, commanding officer special troops or headquarters commandant	27
Radio station	28
Reconnaissance officer	29
Telegraph office	30
Telephone wire chief or trouble chief	31
Veterinarian	32
Public telephone	33

c. In placing a telephone call, the code name of the organization and the designating number of the office or individual are used rather than the organization name and individual's title. For example, in calling the executive officer of the 1st Brigade, call for "Dig five," and to call the commanding officer, 1st Battalion 1st Infantry, call for "Deer Red six." Code name and number lists should be posted at each telephone instrument.

48. Use of phonetic alphabet.—Certain letters of the alphabet have similar sounds and are often confused in telephone conversation. To avoid this difficulty, the following pronunciation of letters over the telephone should be used habitually. Words that are liable to be misunderstood will always be spelled out. For example, in transmitting the plain text words BARTS CHURCH the word BARTS is apt to be misunderstood. Its phonetic spelling would be as follows: BOUGH-ACK-R-TOC-ESSES. The phonetic alphabet has its especial value in the transmission of telephone or cryptograph messages in which groups are almost entirely unpronounceable; for example, the code group XISV would be spelled X-I-ESSES-VIC. Do not use the expression "A as in ACK."

A pronounced ACK.
B pronounced BOUGH.
C pronounced CAW.
D pronounced DON.
E pronounced E.
F pronounced F.
G pronounced GOGO.
H pronounced H.
I pronounced I.
J pronounced JIG.
K pronounced K.
L pronounced L.
M pronounced EMMA.
N pronounced N.
O pronounced O.
P pronounced PIP.
Q pronounced QUASH.
R pronounced R.
S pronounced ESSES.
T pronounced TOC.
U pronounced U.
V pronounced VIC.
W pronounced W.
X pronounced X.
Y pronounced YOKE.
Z pronounced ZED.

This list is posted on each telephone instrument for the convenience of the using personnel.

49. Pronunciation of numerals.—*a.* The following pronunciation of numerals is used habitually in telephone conversation:

Numeral	Pronounced	Principal sounds
0	Ze-ro	Long O.
1	Wun	Strong W and N.
2	Too	Strong T and long OO.
3	Th-r-ee	Slightly rolling R and long EE.
4	Fo-wer	Long O, strong W and final R.
5	Fi-iv	I changing from long to short and long V.
6	Siks	Strong S and KS.
7	Sev-ven	Strong S and V, and well-sounded EN.
8	Ate	Long A and strong T.
9	Ni-yen	Strong N, long I, and well-sounded YEN.

This list is posted on each telephone instrument for the convenience of the using personnel.

b. When transmitting numbers, each numeral will be pronounced separately except in the case of even hundreds, thousands, or millions, when the word "hundred," "thousand," or "million" will be used. For example:

44 is pronounced Fo-wer fo-wer.

80 is pronounced Ate ze-ro.

136 is pronounced Wun th-r-ee siks.

500 is pronounced Fi-iv-hun-dred.

1478 is pronounced Wun fo-wer sev-ven ate.

7000 is pronounced Sev-ven thou-sand.

12084 is pronounced Wun too ze-ro ate fo-wer.

16000 is pronounced Wun siks thou-sand.

c. When calling a number, speak the name of the central deliberately and distinctly, pausing between the name and the first digit. Speak each digit separately, pausing slightly between digits. In the following examples a short dash represents a pause of about one second, and a long dash indicates a slight pause.

Table 44; "Ta-ble - Four—Four."

Turkey 80, "Tur-key - Eight—Zero."

Track 6100, "Track - Six—one—hundred."

50. Preparing cable for monocord switchboards.—Each monocord and camp switchboard is equipped with a switchboard cable and terminal strip as a part of a central installation prior to its use in the field. Once the cable and strip are connected to the switchboard they remain an integral part of it and should not be disconnected except for replacement. Cable for the monocord switchboard may be improvised in the following manner:

a. Take any type of twisted pair wire (outpost twisted pair is suitable, as it is flexible and light) and cut it into 11-foot lengths, cutting one more length than there are units on the switchboard.

b. Stand facing the switchboard, connect one pair of wires to the left-hand line circuit terminals of the switchboard and temporarily attach the other end of the pair to the upper left-hand pair of binding posts on a terminal strip, placed about 8 feet from the switchboard. To connect to the switchboard line circuit terminals, skin off only enough insulation from the end of each wire, so that when the wire is fully inserted in the binding post the insulation will touch the binding post. Similarly connect the other circuits in order from left to right on the switchboard and from top to bottom on the terminal strip. Leave the unused pair sufficiently long so that each free end will reach to any pair of binding posts; this is a spare pair for use in case one of the others becomes unserviceable.

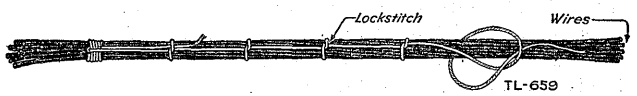


FIGURE 51.—The lock stitch

c. Take a piece of lacing twine or other stout cord and, beginning at the switchboard, lace the wires together neatly and securely, using a lock stitch, as shown in Figure 51. Each pair of wires should leave the cable together as a pair (see fig. 52) rather than as individual wires. Work toward the terminal strip in lacing, spacing the stitches about 1½ inches apart and pushing the slack in the wires ahead of the lacing so as to make a neat and compact cable. At the terminal strip the wires of each pair should come out as a pair, opposite the desired left-hand binding posts on the terminal strips. Cut the wires so that each will be of the proper length for attaching to its proper binding post and then attach them in the same order as before. Leave the ends of the spare pair free until the cable is completed, then lace them down with a separate piece of twine so that when needed it will not be necessary to cut the main lacing of the cable.

d. Secure the cable to the switchboard to relieve the binding post connections of all strain. Route the cable down the left or right hand side of the switchboard. The arrangement as shown in the figures is for illustrative purposes only. Equipment should be so arranged that it can be most effectively operated under

existing conditions. Secure cable to wooden back by clamping it with strips of leather held down with brass screws. Terminal strips may be mounted on a wood strip and cable secured to wood to relieve the terminal strip binding post connections of strain. Cable is coiled during transportation to prevent injury.

51. Installation of terminal frames.—*a.* Terminal strips are installed to provide terminal connections for line circuits.

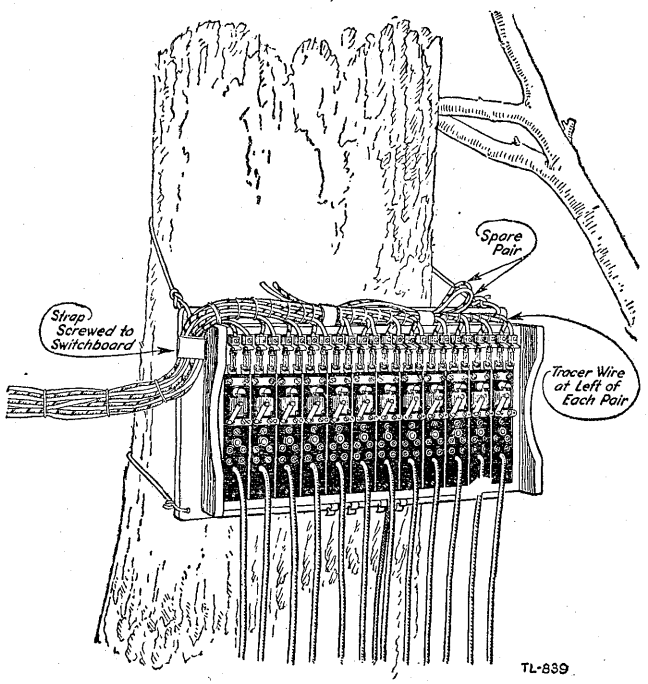


FIGURE 52.—Cable secured to monocord switchboard

Where line circuits terminate in a terminal strip it is known as a *line terminal strip*. Where a switchboard cable terminates in a terminal strip it is known as a *switchboard terminal strip*. The two together constitute the *terminal frame*. The terminal frame should be located near the switchboard and to the rear or to one side, either right or left, so that the switchboard operator will not be disturbed by personnel working at the frame. When

two sets of terminal strips are used as a line terminal strip and a switchboard terminal strip, they are placed about 8 to 12 inches apart and the corresponding circuits are connected by jumpers.

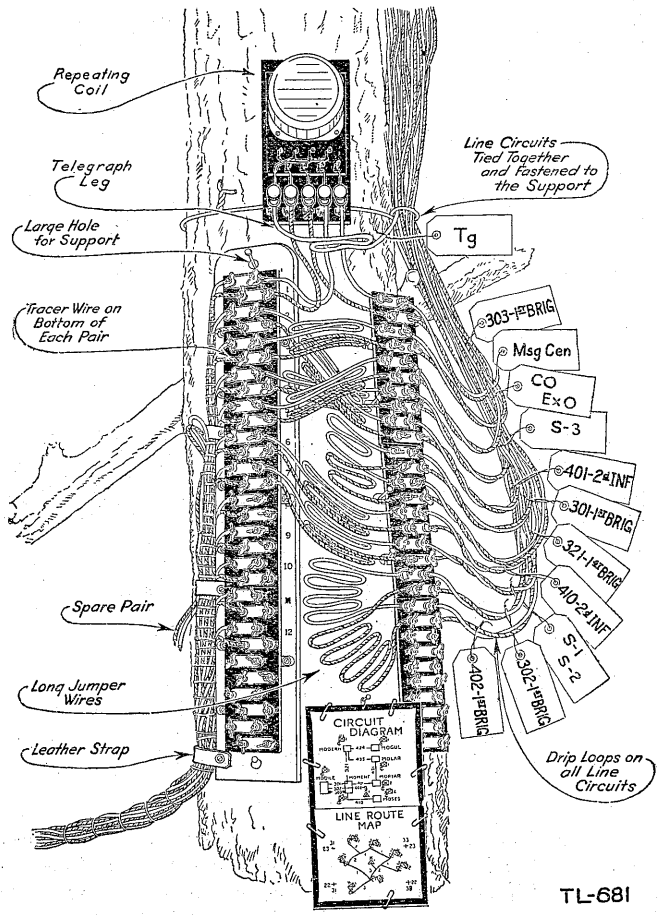


FIGURE 53.—Terminal frame installation

Circuits connected by jumpers are spoken of as *jumpered.* Sets of terminal strips to be used as line and switchboard terminals are *not* made up as a unit for central installation. The procedure

of converting a test station into a central or cutting out a central and leaving a test station is built on the principle that the line terminal strips are an integral part of the line and not a part of the central equipment. When it is desired to mount the terminal strips on boards for convenience in installation, the switchboard terminal strips are mounted on one board and the line terminal strips on another board.

b. To connect field or outpost wire to the binding posts:

(1) *On type TM–84, terminal strips.*—Skin off 3 inches of insulation from the end of the wire to be connected. Pass the wire through the skinner lug and around the binding post under the washer, going in the direction the wing nut is turned in tightening, and again through the skinner lug. Tighten the

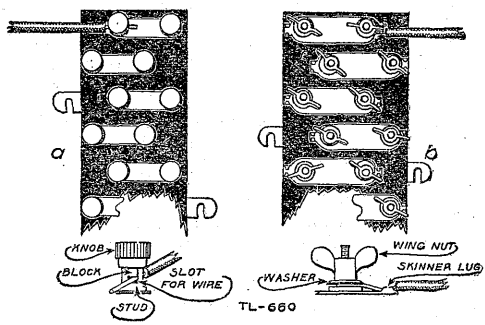


FIGURE 54.—Wire connected to terminal strips; (*a*) type TM–84–A and (*b*) type TM–84

wing nut. Cut off the projecting loose end and about one-eighth of an inch beyond the skinner lug without leaving loose strands projecting that might touch adjacent connections.

(2) *On type TM–84–A, terminal strip.*—Skin off about three-quarters of an inch of insulation from the end of the wire to be connected to the binding post. Open the slot in the post to the full extent. Insert the wire end into the slot so that it projects through the post. Firmly tighten the knob clamping the wire with the fingers. Do not use pliers to tighten these binding posts, as their threads may become stripped.

c. Jumpers are prepared from flexible insulated wire of sufficient length to permit their being connected between the top and bottom binding posts on the strips. The ends may be connected in the same manner as stated in *b* above, or may be fitted

with either lugs or clips for rapidity in making connections to the type TM–84 strip.

52. Repeating coils—use and installation.—*a.* Repeating coils now issued are of commercial design. The ends of the coils are brought out to terminals numbered 1 to 8 as shown in Figure 55.

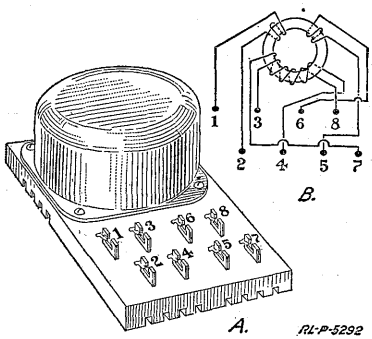


FIGURE 55.—Repeating coil

b. Repeating coils are used in field wire systems for the construction of simplex and phantom circuits. Additional telephone or telegraph channels may be secured by the use of these coils.

(1) A simplex circuit is a ground-return circuit superimposed on a metallic circuit. The simplex circuit may be used for telephone or telegraph. This permits the simultaneous use of the simplex circuit for telephone or telegraph and the metallic circuit for telephone, without mutual interference.

(2) A phantom circuit is a metallic circuit constructed from two physical metallic circuits. This installation permits the simultaneous use of the phantom circuit for telephone or tele-

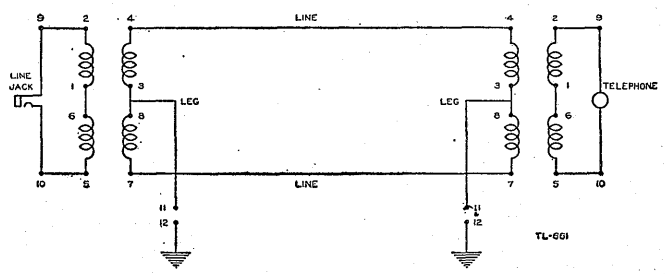


FIGURE 56.—Simplex circuit constructed with repeating coils

graph and the two physical metallic circuits for telephone, without mutual interference. The two physical circuits are known as *side circuits*. The third metallic circuit is known as a *phantom circuit*. The combination of the three circuits is known as a *phantom group*.

c. The simplex circuit.—A simplex circuit is constructed by placing a repeating coil at each end of a metallic circuit as shown in Figure 56. Nos. 1 to 8 refer to terminals as marked on the repeating coil shown in Figure 55. Nos. 9 and 10 are the terminals of the telephone circuit which may be connected to a switchboard, local telephone, or another telephone line. Nos. 11 and 12 are the terminals of the simplex circuit which may be connected to a switchboard, local telephone, or another telephone line for use as a telephone line or which may be connected to telegraph instruments for use as a telegraph line. The connection to the mid-point of the line side of the repeating coil is sometimes termed the *telegraph leg* or *Morse leg.*

d. The phantom circuit.—A phantom circuit is constructed by placing a repeating coil at both ends of each of two physical

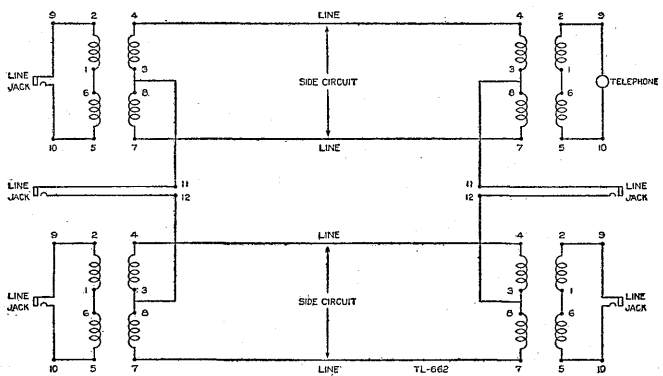


FIGURE 57.—Phantom circuit constructed with repeating coils

circuits and connecting the center points of the line sides of the two repeating coils at each end of the side circuits as shown in Figure 57. Nos. 1 to 8 refer to the terminals on the four repeating coils, as marked on the repeating coil shown in Figure 55. Nos. 9 and 10 are the terminals of the two side circuits. Nos. 11 and 12 are the terminals of the phantom circuits. The terminals of the side and phantom circuits may be connected to a switchboard, telephone, or another telephone line. Telegraph instruments may be connected to the terminals of the phantom circuit if a metallic telegraph circuit is desired.

e. Effect of repeating coils on transmission range.—The introduction of a repeating coil reduces slightly the efficiency of the

metallic circuit to which the coil is connected. Simplex circuits and phantom circuits are more efficient than the physical or side circuits upon which they are superimposed.

f. Mutual interference.—In the above types of construction mutual interference results only when each wire in the simplex or phantom group does not have the same impedance. It is important that the repeating coil be connected as shown, as the half of the repeating coil connected to the line is more carefully constructed than that intended for connection to the local instrument or switchboard. If the two halves of the complete electrical path between terminals 3–8 on one coil and terminals 3–8 on the coil at the far end of the circuit are not exactly of the

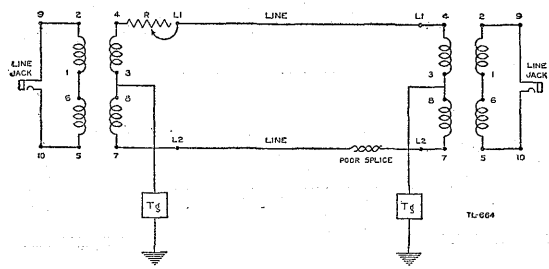


FIGURE 58.—Resistance (R) connected to balance simplex circuit

same impedance the circuit is said to be *unbalanced,* and interference between simultaneous signals passing over the side circuit and phantom circuit on the physical circuit and the simplex circuit will occur. It is impossible to obtain a perfect balance in a field wire system, but the mutual interference may be reduced to a negligible value. Poor splices are the primary cause of unbalance in field wire lines. A variable resistance may be inserted in the low resistance side of an unbalanced field line to improve the *balance.* The low resistance side is determined by trial first with the resistance in one side and then in the other. After determining the low resistance side the resistance is varied until the line is balanced or the interference is reduced to a minimum.

Figure 58 shows the method of connecting the variable resistance unit in an unbalanced simplexed line. Nos. 1 to 8 refer to the numbers on the two repeating coil terminals. L_1 and L_2 are the two wires of a twisted pair. L_2 is slightly defective. The variable resistance R is inserted in L_1 between the repeating coil

terminal and the terminal of the wire at one end of the circuit and is varied until an approximate balance is obtained.

g. Installation of repeating coils.—(1) Prior to being taken into the field, repeating coils of commercial types should be prepared for field installation as shown in Figure 59. Terminals 1 and 6 and 3 and 8 are connected together. Terminals 4 and 7 are connected to binding posts marked L_1 and L_2. Terminals 2 and 5 are connected to binding posts marked Tp_1 and Tp_2. Terminals 3 and 8 are connected to a binding post marked Tg. All connections must be soldered and all wires must be protected from mechanical injury. The binding posts are screwed to a thin piece of wood on which the repeating coil is mounted.

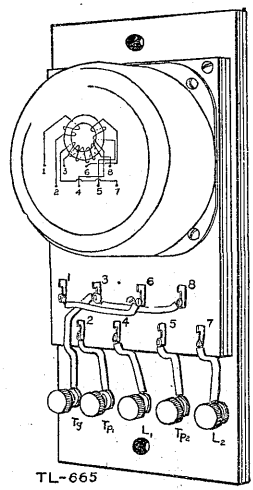


FIGURE 59.—Repeating coil adapted for field use

(2) Repeating coils installed at a switchboard are mounted between the line and switchboard terminal strips either above or below. (See fig. 60.)

(3) Repeating coils installed at a test station are mounted to the left of the terminal strip.

(4) Repeating coils must be protected from moisture.

53. Installation of monocord switchboard. — *a.* The monocord switchboard with cable and switchboard terminal strip attached is installed in the following manner:

(1) Secure the switchboard to a support. Holes in the wooden back permit the tying of the switchboard to a support with a piece of wire or stout cord. Unit and operator's cords should hang free without allowing the plugs to touch the ground. The switchboard should be vertical or tilt slightly forward to permit the drops to fall when released.

(2) Complete the terminal frame by installing the switchboard terminal strip between 8 and 12 inches to the left-hand side of the line terminal strip. Route the cable from the switchboard to the terminal strip so as to afford maximum protection against injury.

(3) Jumper circuits from line terminal strip to appropriate binding posts on switchboard terminal strip.

(4) Connect the operator's telephone to the switchboard terminals marked L_1 and L_2. Connect the ground rod to the terminal marked G. Connect the night bell to the terminals A and A_1 and the bell battery to terminals B and B_1. Move the shutter locks of the units to be connected to line circuits to a horizontal position. Write with a lead pencil (not ink or indelible pencil) the designation of the circuits on the small white celluloid strips on each switchboard unit.

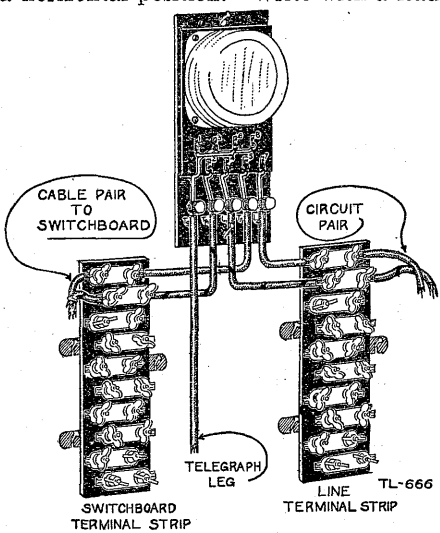


FIGURE 60.—Repeating coil mounted at terminal frame

(5) Test the installation to insure satisfactory operative condition. Tests applicable are described in paragraph 74.

b. Caution. — The arrangement of the equipment as shown in the illustrations is not mandatory but for illustrative purposes only. The equipment should be so arranged as to permit the most effective operation of the installation under the existing conditions.

54. Installation of monocord switchboards in parallel.— *a.* Circumstances may arise where one monocord switchboard is insufficient for the number of circuits. In this case two or more monocord switchboards may be connected in parallel. Usually only two will be necessary, as organizations requiring more will be equipped with switchboards of a type having a greater number of drops. The number capable of being installed in parallel, except as in *b* below, is limited by the length of the cords, which must be sufficiently long to reach any jack in the group. Installation is made as follows:

(1) Install first monocord switchboard as prescribed in paragraph 53, leaving sufficient space between the switchboard and operator's telephone to place the desired number of additional switchboards.

(2) Install additional monocord switchboards to the right-hand side of the first. Installation is the same, except that only

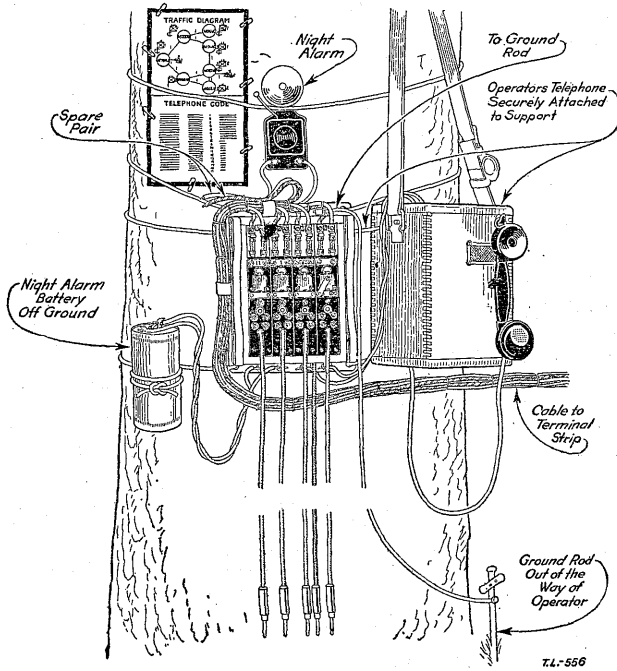


FIGURE 61.—Installation of monocord switchboard

certain terminals are connected and these are connected in parallel to the corresponding terminals on the first switchboard as shown in Figure 62; to ground the switchboard, connect terminals G to G; to make use of the night alarm, connect terminals A_1 to A_1 and B_1 to B_1; when the operator's cord on the first switchboard is not sufficiently long to reach all units on the additional switchboards connect terminals L_1 to L_1 and L_2 to L_2.

b. When the monocord switchboards connected in parallel are installed in a manner which prohibits the plugging in of any unit cord in all of the other unit jacks, full use may be made of the switchboards by trunking the switchboards together. This is accomplished by reserving for trunking one or more units on the right-hand side of the left-hand switchboard and a like number of units on the left-hand side of the right-hand switchboard. Plug the cord of the unit of the left-hand switchboard into the jack of the unit of the right-hand switchboard and leave this connection up throughout the operation of the switchboards in parallel. Any connection to be made between the switch-

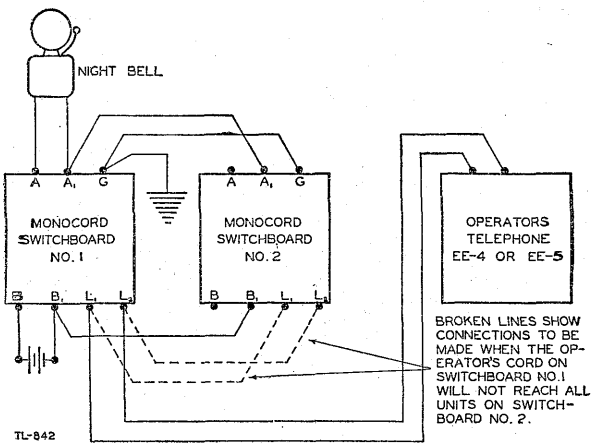


FIGURE 62.—Two monocord switchboards in parallel

boards where the unit cords will not reach may be made through these two units which are trunked together.

55. Installation of telephone centrals.—*a.* Installation of a telephone central includes installing the switchboard with operator's telephone and auxiliary equipment, connecting line circuits through to the switchboard terminal strips, installing testing equipment, installing local circuits, and connecting instruments thereto, testing the installation to insure its proper functioning, preparing and posting a traffic diagram and telephone code, and making a record of the installation. These several operations are described below:

(1) Select a convenient site for the location of the telephone central affording as much shelter as possible.

(2) Install the switchboard with its auxiliary equipment and line terminal strips as prescribed in paragraphs 53 and 54. Connect the line circuits to the line terminal strip and jumper to the switchboard terminal strip. If a line terminal strip is not to be used, connect the line circuits direct to the switchboard terminal strip. If the switchboard is to be used without

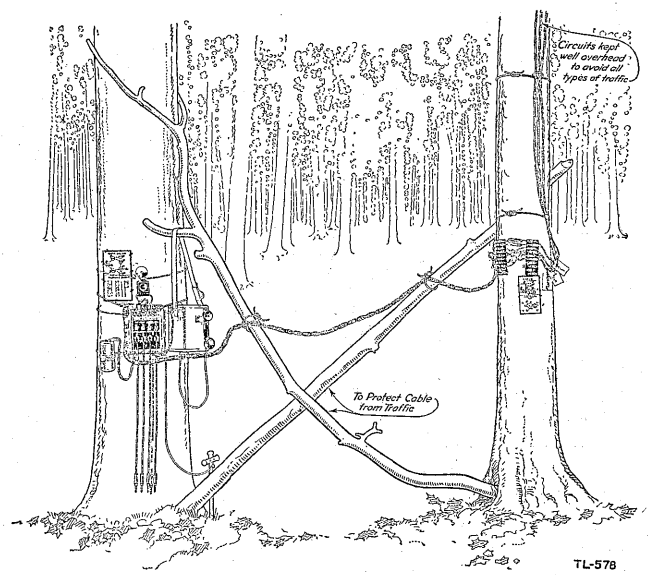


FIGURE 63.—Telephone central using double terminal strips

a cable and switchboard terminal strip, connect the line circuits direct to the switchboard unit terminals.

(3) Short local circuits are installed by the operating details in the manner prescribed in paragraph 37. These details install the local telephones and maintain the local circuits. When circuits which have been laid by the construction details are turned over, the chief of the operating detail has them connected to the proper pairs of binding posts on the line terminal strips.

(4) Install the testing equipment as prescribed in paragraph 73.

(5) Test each circuit and when in satisfactory operative condition report the fact to the chief operator, record the time the

circuit is connected, and inform the message center of the available service.

(6) After the central is installed and the circuits are working, rearrange the equipment to improve the appearance of the layout and to facilitate maintenance. Prepare a traffic diagram and telephone code and place them in a convenient location for the operator.

b. Care must be exercised that the circuits radiating from a telephone central are not an obstacle to troops and traffic at the headquarters. They should be buried or placed overhead.

c. The use of circuits should not be delayed pending the installation of the telephone central. If trunk circuits are available before they can be connected to the switchboard, they should be connected directly to telephones to give temporary service pending the installation of the switchboard.

d. Priority in which telephones are installed at a headquarters varies with the situation and the orders of the commander.

(1) At a command post, telephones are normally installed in the following order of priority:

Message center.
Commander and C. of S. or Ex.
Signal service.
Operations and training section.
Intelligence section.
Personnel section.

A general utility telephone for personnel not furnished individual telephones.

Other staff officers and activities as required.

(2) At small headquarters, as in battalions and regiments, one telephone ordinarily serves two or more staff officers. At larger headquarters, more than one telephone may be required in each staff section.

(3) At rear echelons telephones are reduced to minimum requirements. All routine administration is handled personally or by messenger so far as practicable, leaving the telephone system free for urgent messages. Telephones are normally installed in the following order of priority:

Message center.
G–4 representative.
Ordnance or munitions officer.
Quartermaster.
Adjutant.

A general utility telephone for personnel not furnished individual telephones.

Other staff sections and activities as required.

56. Installation of switching centrals.—Switching centrals are installed in the same manner as telephone centrals.

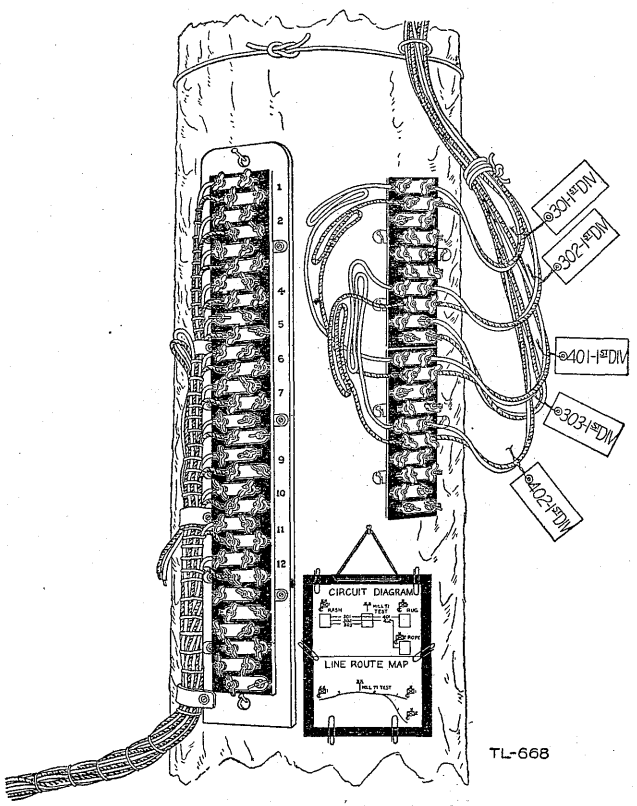


FIGURE 64.—First step in converting test station into a central

Only trunk circuits are normally handled at a switching central.

57. Converting a test station into a telephone central.—The switchboard is set up so as to allow the switchboard terminal strip to be installed to the immediate left of the test station terminal strip. Take four jumpers, preferably one having test

clips fitted to the ends. Temporarily jumper each circuit, one at a time, from the right-hand side of test station terminal strip to the left-hand side of the switchboard terminal strip. At the switchboard, plug through the two units to which the 2-line circuits are to be connected, so as not to interrupt any possible

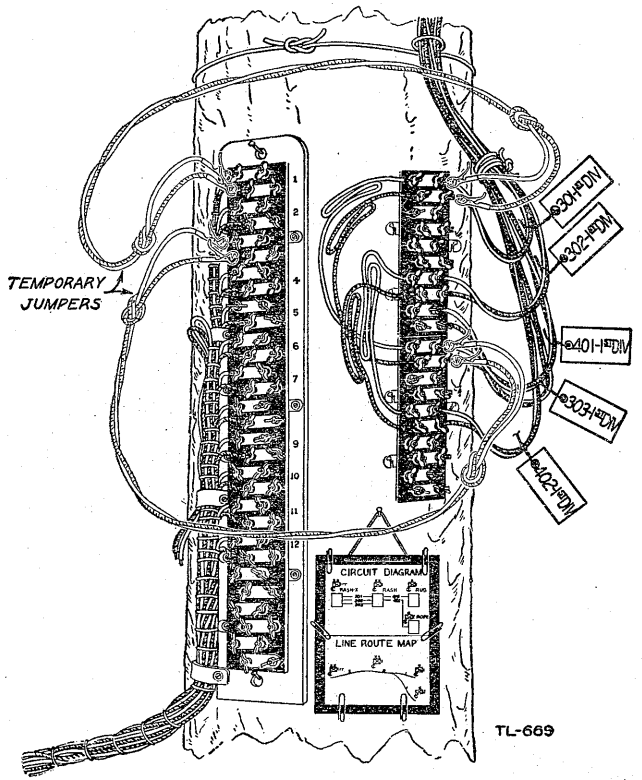


FIGURE 65.—Second step in converting test station into a central

conversation over the circuits during the installation of the central. With the temporary jumpers still on, remove the jumpers on the left-hand side of the test station terminal strip that connect this circuit through the test station. Cross connect the circuit between the two terminal strips. Remove the tem-

porary jumpers. Repeat this procedure on the remaining circuits. Listen in on each circuit entering the switchboard and if a circuit is not busy remove its plug, thus clearing the through connection. Call on each circuit and inform the answering operator that the test station has been converted into a central,

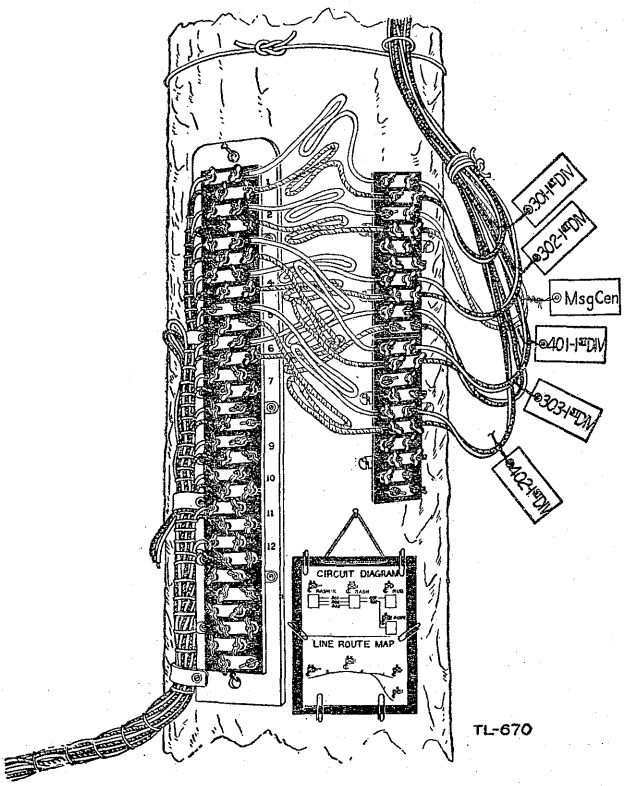


FIGURE 66.—Test station converted into a central

giving the code name and any special information applicable. This procedure is reversed when a central is to be converted into a test station.

58. Installation of field telephones.—To connect a field telephone to a metallic circuit, connect the two wires to the

2-line terminals of the telephone. When connection is made to a ground return circuit, connect one line terminal to the line wire and the other to a ground rod. Place the telephone in a position convenient for the user. Tie in the circuit near the instrument, leaving sufficient slack between the tie and the instrument to permit some movement of the telephone. If the circuit enters the place of installation (building, dugout, or tent) from an overhead line, provide a drip loop to drain the water away from the telephone. The telephone code name and office number are marked on a tag fastened to the telephone; this is for the convenience of the user, who is notified as soon as the telephone

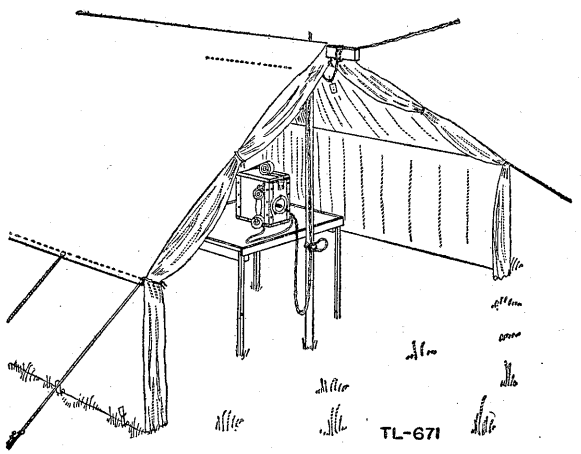


FIGURE 67.—Field telephone installed in a tent

has been tested and found ready for use. A copy of the telephone code should be with each telephone for the information and use of the user.

59. Shelter for equipment.—Wire operating equipment should be provided with shelter during inclement weather. Excessive moisture will affect the operation of telephones, telegraph instruments, test sets, switchboards, terminal strip connections and repeating coils. This shelter must frequently be improvised. Improvised shelter may be secured by using paulins, shelter halves, tent flys, or lean-to structures built from foliage, metal, or wood, the design of which must be left to the ingenuity of the detail. Terminal strips can be mounted in weatherproof

boxes with sufficient space to permit using the box either as a test station or as a terminal frame housing. Light wagons or trucks may be used to house centrals and telegraph stations.

60. Operation of telephones.—*a.* Two types of field telephones are in common use on field wire systems, the type EE–4–A and the type EE–5. In addition to these the service buzzer, type EE–63, can be used.

b. These instruments have common operating characteristics but vary in details of construction.

(1) The type EE–4–A telephone is equipped with a magneto for ringing, and a hand set, hung from a hook switch, for talking and listening.

(2) The type EE–5 telephone is equipped with a magneto for ringing and a hand set for talking and listening. The push

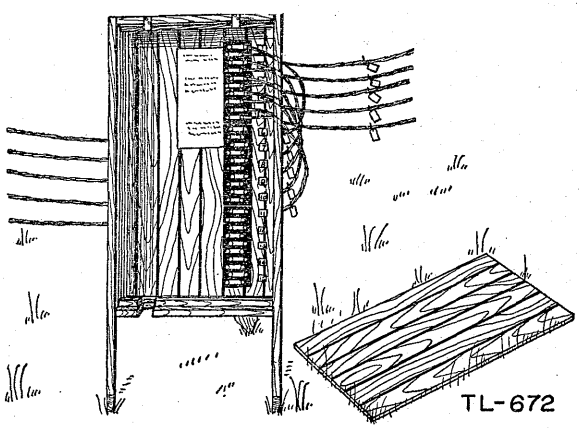


FIGURE 68.—Improvised shelter box for terminal strips

button on the hand set must be pressed down while talking but should be released when one is merely listening, as it uses up the talking battery when depressed.

(3) The service buzzer employs a buzzer call. The receiver is used for buzzer and telephone reception. A special telephone transmitter is provided. The push button switch on the transmitter must be pressed down while talking. This instrument should not be used for signaling a switchboard operator as its buzzer call interferes with all telephone conversations through his switchboard.

c. Adherence to the following rules is essential for efficient telephone operation:

(1) *To signal the operator* with a field telephone, turn the magneto crank several times, holding the instrument firmly. Do not remove the hand set from hook when ringing on a type EE–4–A. Do not press the push button when ringing on a type EE–5 telephone. Lift the hand set from the hook or press the button while talking. When the switchboard operator answers the call, state the connection desired, for example "Magic—one–zero." When the called party answers, identify yourself and proceed with the conversation.

(2) *To answer a call* on the telephone instrument, remove the hand set from the hook, or press down the button. Hold the hand set in a natural position with the head erect. Never say "hello" in answering. State the designation of the telephone and of the individual answering, for example "Magic—one–three speaking."

(3) When through using the telephone or when it is desired to again attract the attention of the operator, replace the hand set on the hook, or release the button. Turn the magneto crank to "ring off," indicating to the switchboard operator that the connection may be removed, or that you want some other service from him.

(4) Always speak directly into the transmitter mouthpiece. Speak distinctly and in a natural tone. Raise the voice slightly when necessary, but never shout.

61. Operating phrases.—The following phrases are prescribed for use by switchboard operators and should be used by them in all cases where they apply, to the exclusion of other phrases of similar meaning:

a. "Magic operator." Used by operator at "Magic" in answering any incoming call, either from a local telephone or other centrals.

b. "Captain Blank's code number is Magic—four; I will connect you." Used by an operator when a call comes in by name or by some designation other than a telephone code number.

c. "Waiting?" Used by an operator in challenging on a connection to determine whether the called party has answered and in supervising a connection.

d. "Hello, Magic," or "Hello, Magic—three." Used by an operator when there is confusion or interruption on a connection through two or more centrals and he is trying to get a distant operator or called party back on the line.

e. "Here's your party." Used by an operator whenever it is necessary for him to start the conversation over a connection. For example, if the called party should answer before the operator has connected him through to the calling party, the operator after completing the connection should start the conversation by using this phrase.

f. "I can give you the message center." Used by an operator in appropriate cases, after reporting that the called party's telephone is out of order, the called party does not answer, or that the called party has no telephone; if the called party has no telephone but answers over another number this latter phrase does not apply.

g. "I will ring again." Used by an operator when he has cut in on an incompleted call and has been told that the called party did not answer.

h. "What number were you calling?" May be used by an operator when a party calls and reports that he has been given a wrong number. In case a connection between two parties is broken before they have finished and either party tells the operator that he was cut off from his party, the same phrase may be used.

i. "Magic—one–one?" Used by operator in repeating the call to a calling party or another operator when such a call has been given him to put through.

j. "Magic—one–one does not answer." Used by an operator in reporting to the calling party that the called party does not answer.

k. "Magic—one–four has no telephone." Used by an operator in reporting to the calling party that the called party has no telephone.

l. "Magic—one–one is busy." Used by an operator in reporting to the calling party that the called party's circuit is busy.

m. "Magic—three–zero has no telephone, but I will give you Magic—one–one. You may get him there." Used by an operator when the called party has no telephone but can be reached over another telephone.

n. "What number is calling?" Used by an operator if, after challenging, he has been given a new number to call. This phrase enables the operator to determine which one of the two parties previously connected is now requesting a new connection.

62. Operation of monocord switchboards.—The following procedure is prescribed for use by an operator in handling calls on a monocord switchboard.

a. To make a local connection. Example.—Magic—three calls Magic—one–one. The telephone at Magic—three is connected to drop No. 2 and that at Magic—one–one to drop No. 5 on the switchboard. When the shutter on drop 2 falls, the operator's plug is inserted into the jack on unit 2. The operator answers the call by stating his code designation, "Magic operator." The calling party states the number desired, "Magic—one–one." The operator repeats back "Magic—one–one," then removes the operator's plug from the jack of unit 2 and inserts it into the jack of unit 5. He rings, then immediately inserts No. 5 plug into No. 2 jack.

b. To make a trunk connection. Example.—Magic—one calls Mutton—one. The telephone at Magic—one is connected to drop No. 1 on the Magic switchboard. The circuit to Mutton passes through Maytime switchboard, and is connected to drop No. 7 on Magic switchboard. The circuit from Magic is connected to drop No. 3, and the circuit to Mutton to drop No. 4 at Maytime. When the shutter on drop No. 1 at Magic falls, the operator's plug is inserted into No. 1 jack. The operator answers "Magic operator." The calling party states, "Mutton—one." The Magic operator repeats back "Mutton—one," then removes the operator's plug from No. 1 jack, inserts it into No. 7, and rings. When the Maytime operator answers, the Magic operator states, "Mutton—one." After the Maytime operator repeats back "Mutton—one," the Magic operator inserts No. 7 plug into No. 1 jack. The Maytime operator (at the intermediate switchboard) inserts his operator's plug into his No. 3 jack when the shutter falls on the Magic operator's signal, and answers the call, stating, "Maytime operator." The Magic operator states the connection desired, "Mutton—one." The Maytime operator repeats back "Mutton—one," removes the operator's plug from No. 3 jack and inserts it into No. 4 jack and rings. When the Mutton operator answers, the Maytime operator states, "Mutton—one." When the Mutton operator has repeated "Mutton—one," the Maytime operator inserts No. 4 plug into No. 3 jack. The Mutton operator then handles the call as a local connection.

c. To supervise a connection.—A switchboard operator supervises each connection: (1) To insure that conversation is established between the calling party and the called party, and (2) to remove the connection as soon as possible after the conversation is completed. The operator listens in after making a connection,

waiting to hear the called party answer and conversation begin. He then removes the operator's plug and restores the shutter. Should another call enter his switchboard before he has supervised this connection he removes the operator's plug and answers this latter call. The shutter is not restored until he has gone back to the connection and supervised it. In supervising the first call, the operator inserts his plug into the jack of the called party and listens. If no conversation is heard he challenges by questioning, "Waiting?" If he receives no response he takes down the connection. If he is notified that a called party has not answered, he answers, "I'll ring again," and proceeds to do so. If he receives an answer informing him that the connection is being used he removes the operator's plug and restores the shutter. When a shutter falls on a completed connection, the operator inserts his operator's plug into the jack corresponding to the fallen shutter and challenges by questioning "Waiting?" If he receives no response, he takes down the connection and restores the shutter. If a new number is given him, he repeats the new number and adds "What number is calling?" After receiving the number of the calling party he takes down the old connection and completes the new call in the usual manner. Connections that remain up for more than a reasonable time are supervised in a manner similar to the above method.

d. To take down a connection.—The operator inserts his plug in the jack of the called party and listens. If no conversation is heard, he challenges "Waiting?" If no answer is received to the challenge, he removes both plugs and restores the shutters if down.

63. Records and reports.—At each telephone central, such records covering its operation are kept as may be necessary in preparing the required reports. These records may include a station log, a traffic diagram and test and trouble records. (See par. 72 for preparation of test and trouble records.) Reports on the operation are normally rendered to the signal officer through the message center.

64. Station log.—The station log should contain the following information:

Place, date, and hour station opened.

Place, date, and hour station closed.

Schedule of operators.

Time of connecting or removing a circuit.

Interruptions to circuits (duration and nature if known).

This record is kept by the switchboard operator on duty, under the supervision of the chief operator. A simple blank form prepared for a station log is shown below.

STATION LOG

STATION: _____

OPENED			CLOSED		
PLACE	DATE	HOUR	PLACE	DATE	HOUR

SCHEDULE OF OPERATORS

CIRCUIT NO.	TIME CONNECTED	TIME REMOVED	INTERRUPTIONS OF SERVICE		NATURE OF TROUBLE	REMARKS
			FROM-	TO-		

SIGNATURE OF CHIEF OPERATOR

TL-673

FIGURE 69.—Station log for a telephone central

65. Traffic diagram.—*a.* A traffic diagram shows by number the telephone channels connecting telephone centrals and distant local telephones in a net. The actual circuits connecting any

two centrals are shown as one line with a figure indicating the total number of telephone channels between the two centrals. The units to which each switchboard or distant local belongs are indicated by the telephone code name and conventional sign of the unit.

b. Figure 70 shows a traffic diagram.

c. The traffic diagram is prepared at each switchboard from data contained on the circuit diagram. Special symbols for this purpose are shown in paragraph 20.

66. Reports to message center.—The operating personnel should keep the message center informed of telephone communi-

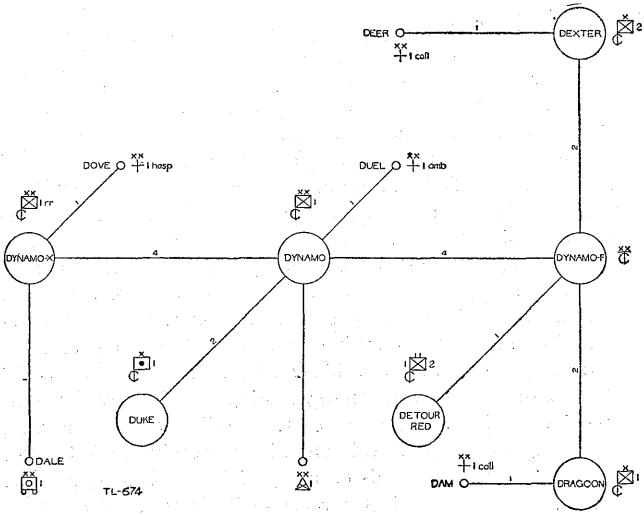


FIGURE 70.—Traffic diagram, 1st Division, 11 p. m., May 15, 1927

cation available to other centrals in the net. Interruptions and other changes should be reported promptly to the message center.

SECTION IV

INSTALLATION AND OPERATION OF FIELD TELEGRAPH SETS AND STATIONS

67. The buzzer phone.—*a.* The buzzer phone, type EE–1–A, is a portable wire telegraph set, designed to provide an additional channel of wire communication over any existing field wire system. Its advantages are—

(1) It provides an extra channel of communication over lines that at the same time carry telephonic communication without interference from buzzer phone, except when the call signal is used.

(2) It may be operated by radio operators with little additional instruction.

(3) Its secrecy. Messages sent by buzzer phone can be intercepted only by a similar instrument cut in on the line.

(4) It does not cause interference with other types of electrical signal communication, except with its call buzzer.

Its disadvantage is that it does not work well over leaky or long lines.

b. The buzzer phone can be used on ground return, metallic simplexed, or phantom circuits, except that when more than two buzzer phones are to be connected to the same circuit, all of the stations are either connected between a line wire and ground or are bridged across a metallic circuit.

c. To operate a buzzer phone, connect the line circuit to the L and G terminals. To call a distant operator press the switching key to the position marked *call.* This produces a highly inductive signal which interferes with telephone conversation, and therefore should not be used except during the minimum time required for calling. In the normal or nonoperating condition, the switching key is in the position marked normal. The receiver is then across the circuit and will produce a signal when the distant operator calls with his call buzzer. After such a call signal is made or received, the switching key is moved to the send-receive position. Then, when the sending key is depressed, an audible signal is produced in the distant receiver. When the switching key is in the send-receive position and no signals are being sent, a steady tone in the receiver indicates a difference in potential between the two ground connections. A potentiometer is provided to compensate for this condition. Move the potentiometer key slowly to right or left until the tone is least apparent.

68. The service buzzer.—*a.* The service buzzer, type EE–63, is a combination telephone and telegraph instrument. (See par. 60 for use as a telephone.) When used as a telegraph instrument, messages are transmitted by producing a series of buzzes instead of the double clicks common to Morse telegraph sounders.

(1) Its advantages are—

(*a*) It may be operated by radio operators with little additional instruction;

(*b*) It works great distances over leaky lines; and
(*c*) It is readily portable and very rugged.

(2) Its disadvantages are—
(*a*) The signals are readily intercepted;
(*b*) It produces interference on neighboring electrical signaling equipment, and consequently cannot be used ordinarily over simplexed telephone circuits.

b. The service buzzer may be operated over metallic or ground return circuits. The line circuit wires, or line circuit wire and ground, are connected to the L and G terminals, respectively. When the change-over switch is thrown to the *buzz* position, telegraph transmission is accomplished by working the key. Incoming signals are heard in the receiver, which is cut into the circuit when the sending key is up. If the buzzer is to be operated over existing Morse telegraph lines, the switch for short-circuiting the line condensers should be opened; this places the line circuit condensers in the line circuit of the service buzzer and prevents grounding the Morse telegraph circuit.

69. Simplex circuits.—Telegraph circuits used in field wire systems are obtained generally by simplexing the existing telephone circuits, thus eliminating the necessity for constructing additional circuits for telegraph purposes. Repeating coils are used for this purpose, as explained in paragraph 52. It is important that the repeating coils be installed at the telephone terminal frame, rather than at the telegraph station, so that telephone trunk circuits, for the maintenance of which the telephone line personnel is responsible, will not run through instruments or equipment for which the telegraph operating personnel is responsible. If the repeating coils were installed at the telegraph station, telephone trunk-line circuits would have to run from the telephone terminal frame to the telegraph station and back again to the same frame. With the repeating coil at the telephone terminal frame, only one wire is run to a terminal telegraph station from the "Tg" terminal of a repeating coil at that frame, this wire being the telegraph leg providing the wire connection to the telegraph circuit. The ground for the telegraph ground connection can be located at the telegraph office. Such a method saves time and line material, reduces possibilities of trouble on the telephone circuits, and facilitates the testing of the telephone circuits, without in any way interfering with the telegraph circuit.

70. Telegraph operating procedure.—Operating procedure for the buzzer phone and service buzzer follows radio procedure. (See ch. 3, Sec. II.)

SECTION V

MAINTENANCE OF FIELD WIRE SYSTEMS

71. General.—Field wire systems are subject to interruption due to injury or physical destruction and from defective circuit equipment. All such interruptions are termed *troubles*. Maintenance of a field wire system includes the prevention, location, and correction of trouble in the system. Such maintenance is continuous. The means of preventing trouble and of locating it after it occurs in a field wire system are—

a. Careful packing of all wire and equipment and careful handling while it is in use.

b. Protection of equipment from moisture while in storage, in transit and, in so far as possible, after it is installed.

c. Training of all operating and using personnel in the care and use of wire equipment.

d. The inspection, cleaning, testing, and repair of the wire lines and associated equipment, when removed from storage for training or field service, and periodically during use.

e. Special tests for wire and equipment found to be defective.

f. Routing of wire lines and locating of centrals and stations so as to avoid hostile shell fire, and so as to protect the lines from the traffic of friendly troops or transport. Friendly tanks, balloon units, artillery, and tractors are especially destructive of wire lines.

g. Establishment of test stations at important wire-line junctions and near points at which trouble is anticipated.

72. Periodic tests of line circuits and installed equipment.—*a. Orders and instructions* concerning the wire system usually include instructions relative to periodic tests and the frequency with which these tests are to be made. (See par. 17.) Tests of line circuits include the testing of the operating equipment connected to such circuits.

b. Telephone line circuit testing.—(1) In the division or larger units frequent calls from the telephone central for the purpose of testing local telephone circuits and equipment may become a nuisance to the users. Such calls may be avoided by having a trouble man go to each local telephone and test back to the tele-

phone central. In smaller units, where the number of maintenance personnel is more limited, the local circuits are usually tested in the same manner as the trunk circuits. (See (2) below.)

(2) Inasmuch as the telephone operator will generally not have time to make periodic tests, the wire chief should make such tests from his terminal frame. However, the operator may be called upon to make periodic tests when such testing does not interfere with the expeditious handling of traffic.

(3) In making periodic tests at a point designated for testing telephone circuits, each circuit is first tested by ringing the party or central connected to it. If an answer is obtained, the test man

TEST AND TROUBLE RECORD

STATION _____ DATE _____

Circuits tested every ___ minutes

CIRCUIT	TESTED		CLEARED		REMARKS
	TIME	BY	TIME	BY	(Nature of trouble, etc)

CHIEF OPERATOR

TL-727

FIGURE 71.—Form for test and trouble record

states the code name of his central, followed by "testing, thank you," thus: "Surprise testing, thank you," and then goes on to test the other circuits. A busy telephone circuit is not interrupted to make a test; the fact that it is busy shows that it is not in trouble. In case trouble is found on a circuit, the proper maintenance personnel is immediately given all available information as to the nature and location of the trouble.

(4) Records of tests and troubles found on the trunk circuits are kept by the wire chief at each telephone central on the test

and trouble record. (See par. 63.) This record gives the following information:

(*a*) Frequency at which periodic tests are to be made.

(*b*) For a circuit found to be in trouble; the number of the circuit, when and by whom tested, when and by whom cleared, and the nature and location of the trouble. A form for the test and trouble record is shown in Figure 71.

c. Telegraph line circuit testing.—Periodic testing of telegraph circuits in a field wire system follows the same general princi-

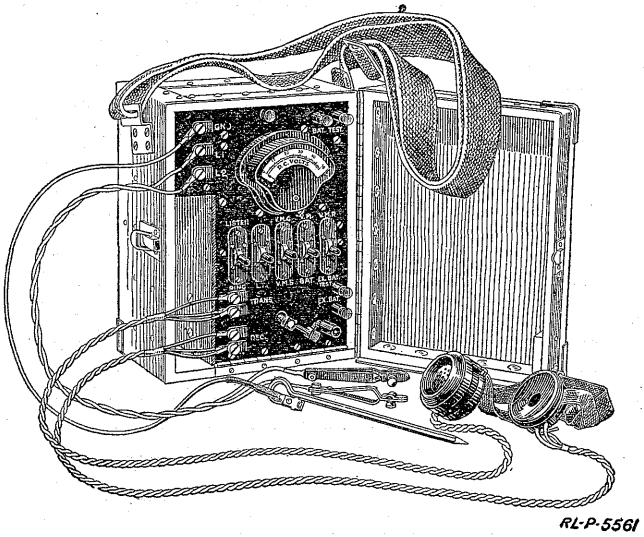


FIGURE 72.—Universal test set, type EE–65

ples stated above for telephone circuits. The telegraph operator makes the tests and notifies the wire chief of the results.

73. Equipment used for testing.—*a. The Signal Corps test set.*—(1) Figure 72 shows the test set, type EE–65, which is an instrument designed to provide, in a compact portable form, circuit testing equipment particularly adapted to field use. The set can be used either in a vertical or horizontal position. If the voltmeter fails to read *zero* when all keys are in the normal, straight-out position, properly adjust the needle by means of the screw on the face of the voltmeter. The following

tests which can be made with this test set are described as for line circuits. However, this test set is equally convenient in testing the circuits of Signal Corps wire equipment. For such tests, the frame of the instrument being tested is generally considered as the *ground*. Before beginning any test be sure that all keys on the test set are in the normal or center position. In the following directions the keys are considered to be numbered from 1 to 5 from left to right. Prior to making any voltmeter tests with this set the voltmeter battery of the set should be tested by moving No. 4 key to the BAT position. The voltmeter will then indicate the voltage of the voltmeter battery. This battery consists of two BA–2 batteries connected in series and, if new, should register 45 volts. If BA–2 batteries are not available, other batteries, connected to give from 40 to 50 volts, may be connected to the binding posts marked EX BAT. When using external batteries remove the BA–2 batteries from the set. The cylindrical BA–1 battery of the test set, used as the transmitter battery, should also be tested by removing it from the set and proceeding as in (3) below.

(2) *Circuit tests.*—These tests are described in the order they are made during the normal testing of circuits in trouble.

(*a*) *Ringing and talking test.*—Connect the ends of the telephone circuit under test to the L_1 and L_2 binding posts on the test set. If the circuit is a ground return circuit, connect L_1 to the metallic side of the circuit and L_2 to ground by means of the ground rod and its lead. Adjust the receiver to the ear so that it is held comfortably in place by means of the elastic band. Operate No. 1 key to the RING position. Turn the generator crank through at least three complete turns. Then operate No. 1 key to LISTEN position. If the called party answers, press the button on the transmitter; conversation may then begin. After conversation has been completed, return No. 1 key to its normal position.

(*b*) *Test for a complete short or open circuit.*—Connect the ends of the metallic or ground return circuit under test to the L_1 and L_2 binding posts on the test set. Operate No. 3 key to the VMB position. If the circuit is complete the voltmeter will give a continuous reading; if open, there will be *no* continuous reading. If a ground return circuit is to be tested at a place where

the lead to the ground connection of the circuit is not available, connect the metallic side of the circuit to the L_1 binding post on the test set and make certain that the test set binding post marked GND is connected to ground by means of the ground rod and its lead. Operate No. 3 key to the VMG position. If the circuit is grounded, the voltmeter will give a continuous reading; if open there will be *no* continuous reading. Upon completion of these tests, return No. 3 key to normal position.

(*c*) *Test for a condenser.*—If in the test described in (*b*) above a circuit tests *open*, leave No. 3 key in the VMG position and operate No. 2 key several times between its normal and LR positions. If there is a condenser across the circuit there will be a voltmeter reading only while the key is being operated. If this test shows a condenser across the circuit, there is probably an EE–4–A telephone or other instrument with a condenser across the line circuit. An EE–5 telephone, or a monocord or camp switchboard connected to a line circuit, shows a complete circuit. The set can be calibrated by reading the deflection on lines having one bell and condenser, two bells and two condensers, and so on. The condenser at the station is charged and then discharged by the opening and closing of the circuit under control of key No. 2.

(*d*) *Test for a grounded circuit.*—Connect the ends of the circuit to be tested to the L_1 and L_2 binding posts on the test set. Make certain that the GND binding post on the set is connected to ground. Operate No. 3 key to the VMG position. A voltmeter reading indicates a ground on the circuit. If the circuit tested open in the test for an open circuit, the circuit wire connected to the L_1 binding post is grounded. Leaving No. 3 key in the VMG position, operate No. 2 key to the LR position to reverse the connections of the external circuit. If the circuit previously tested open, a voltmeter reading then indicates a ground on the circuit wire connected to the L_2 binding post. Upon completion of the test for a grounded circuit, return No. 2 and No. 3 keys to normal position.

(*c*) *Test for a cross with another circuit.*—Connect the ends of the circuit under test to the L_1 and L_2 binding posts on the test set. Connect one wire of the circuit with which the circuit under test is believed to be crossed to the GND binding post on the set. Be sure that for this test the ground binding post is not grounded. Operate No. 3 key to the VMG position. A voltmeter reading indicates a cross between the circuit wire connected to the L_1 binding post and the circuit wire connected to the GND binding post. To test for a cross between the circuit wire connected to the L_2 binding post, and the wire connected to the GND binding post, operate No. 2 key, down, to the LR position, leaving No. 3 key in the VMG position. A voltmeter reading indicates a cross. Remove the wire connected to the GND binding post, connect the other side of this other circuit to the GND binding post and repeat above tests to determine if either side of the circuit under test is crossed with this second wire of the other circuit. Upon completion of these tests, return No. 2 and No. 3 keys to normal position.

(3) *Measuring voltage of a battery.*—Connect the battery to the terminals marked BAT TEST. Be sure to have the positive terminal of the battery connected to the plus (+) or left-hand binding post. Operate No. 5 key to the EX BAT TST position. The voltmeter is thereby connected across the terminals of the battery. The voltage of the battery can be read from the voltmeter scale. Do not make this measurement on a battery whose voltage is likely to be greater than the maximum-voltage reading of the voltmeter scale.

b. Field telephone, type EE–4–A, as a test instrument.—This type of field telephone may be used for testing line or instrument circuits. Prior to using a particular telephone for testing, it should be tested as described in paragraph 81 *b* to determine whether the instrument is in operating condition. In using the telephone for test purposes it is essential that the *feel* of the hand-generator crank of the telephone used in making the test be known. The manner in which it turns on ringing over an open circuit, a short circuit, a complete circuit to which another serviceable telephone or switchboard is connected, and for a grounded circuit in the case of a ground-return circuit, should be determined prior to its use for testing purposes. The following tests may be made with this type of telephone:

(1) *Ringing and talking test.*—Connect the ends of the telephone circuit to be tested to the L_1 and L_2 binding posts of a serviceable telephone. If the circuit to be tested is a ground-return circuit, connect L_1 to the metallic side of the circuit and L_2 to ground by means of a ground rod and lead. Move the hook-switch lever out and suspend the hand set from it. Turn the hand-generator crank through at least three complete turns. If the line circuit and the signaling apparatus of the distant instrument are in serviceable condition, the crank should turn with a slight drag. Remove the hand set from the hook switch and place the receiver to the ear, holding the head vertical in a normal position with the transmitter before the mouth. If the called party answers, and can hear, the test shows that both the line circuit and the instruments are in serviceable condition. After conversation has been completed, return the hand set to the hook switch and turn the hand-generator crank through at least one complete turn, to ring off.

(2) *Test for an open circuit.*—Connect the ends of the metallic or ground return circuit to be tested to the L_1 and L_2 binding posts on the telephone. Leaving the hand set suspended from the hook switch, turn the hand generator crank through at least three complete turns. If the circuit is open the bells should ring and the crank should turn freely without any drag.

(3) *Test for a short circuit.*—Connect the ends of the metallic or ground return circuit to be tested to the L_1 and L_2 binding posts on the telephone. Suspend the hand set from the hook switch and turn the hand generator crank through at least three complete turns. If the circuit is short, the crank should turn with difficulty as though a heavy drag had been placed on it, and the bells should not ring.

(4) *Test for a grounded circuit.*—Connect one side of the metallic circuit to be tested to the L_1 binding post of the telephone. Connect the L_2 binding post to ground by means of a ground rod and lead. With the hand set suspended from the hook switch, turn the hand generator crank through at least three complete turns. If the circuit wire connected to the L_1 binding post is grounded, the results noted upon turning the crank will be the same as for a short circuit, i. e., the crank should turn with difficulty and the bells should *not* ring. Remove the circuit wire connected to the L_1 binding post and connect the other side of the circuit to L_1. Repeat the above test to determine if this side of the circuit is grounded. To test a ground return circuit

for a ground, have the circuit opened at the distant end and then test as described above.

(5) *Test for a cross with another circuit.*—Connect one side of the circuit to be tested to the L_1 binding post of the telephone. Connect one wire of the circuit, with which the circuit under test is believed to be crossed, to the L_2 binding post on the telephone. Make a test for a short circuit, outlined in (3) above. If these two wires are crossed, the test should indicate a short circuit. If the two wires are not crossed, the test should indicate an open circuit. Remove the circuit wire from the L_2 binding post, connect the other side of the same circuit to that binding post, and repeat the test. Next remove from the L_1 binding post the circuit wire being tested and connect the other side of this

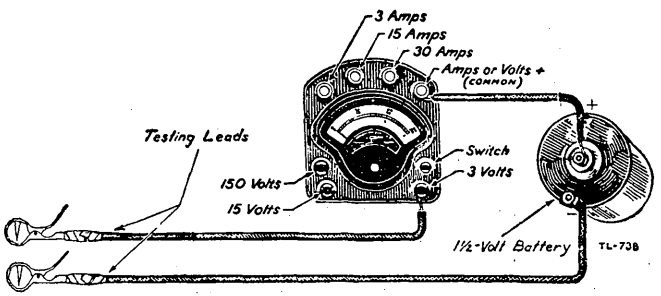


FIGURE 73.—Voltmeter and battery connected for use in testing circuits

circuit to L_1. Repeat above test to determine if this side of the circuit being tested is crossed with either of the wires in the other circuit.

c. Field telephone, type EE–5, as a test instrument.—The methods of testing with this type of telephone are the same as with the field telephone, type EE–4–A, with the following modifications:

(1) A buzzer is used for signaling purposes instead of a bell and it should never operate when the hand generator crank is turned; and

(2) Substitute L for L_1 and G for L_2.

d. Voltmeter and battery used in testing.—Figure 73 shows a voltmeter and battery connected in series and equipped with wire leads. This provides a simple arrangement for testing equipment circuits. The terminals of the wire leads may be

fitted either with test clips or short lengths of stiff copper wire for convenience in making contacts with the equipment circuits. This apparatus is suitable for making the following tests:

(1) *Test for a complete circuit.*—Connect the test leads to the ends of the circuit to be tested. Complete the circuit by depressing the push-button switch on the voltmeter. If the circuit is complete the voltmeter needle will indicate a reading.

(2) *Test for an open circuit.*—Connect the test leads to the ends of the circuit to be tested. Complete the circuit by depressing the push-button switch on the voltmeter. If the circuit is open, the voltmeter needle will *not* indicate a reading.

(3) *Test for a short circuit.*—Connect the test leads to the ends of circuit to be tested. Open the other end of the circuit. Complete the circuit by depressing the push-button switch on the voltmeter. If the circuit tests short, the results will be the same as for a complete circuit; i. e., the voltmeter needle will indicate a reading.

(4) *Test for a grounded circuit.*—Connect one test lead to the circuit to be tested. Connect the other test lead to ground. Complete the circuit by depressing the push-button switch on the voltmeter. If the circuit is grounded, the results noted will be the same as for a complete circuit, i. e., the voltmeter needle will indicate a reading.

(5) *Test for a cross with another circuit.*—Connect one test lead to the circuit to be tested. Connect the other test lead to the circuit with which the circuit to be tested is believed to be crossed. Complete the circuit by depressing the push-button switch on the voltmeter. If the circuit is crossed with the other circuit, the results noted will be the same as for a continuous circuit; i. e., the voltmeter needle will indicate a reading.

e. Receiver and battery used in testing.—Figure 74 shows a telephone switchboard receiver connected in series with a battery and fitted with leads for testing. The terminals of the test leads may be equipped either with test clips or short lengths of stiff copper wire. The apparatus is suitable for making the tests outlined for the voltmeter and battery in *d* above. However, instead of a reading indicating a complete circuit, in this case when the circuit is completed by touching or connecting the test leads, a click in the receiver indicates a complete circuit. A failure to obtain a click on completing the circuit indicates an open circuit.

74. Testing defective line circuits—locating and clearing trouble.—Defective line circuits are tested and their troubles are located with the aid of testing equipment employed in the general manner laid down in paragraph 73. The special supplementary procedures applicable for locating the various line circuit troubles are set forth below.

a. Telephone line circuits.—A trouble developing in a telephone line circuit is detected either by telephone personnel while making prearranged tests or by a telephone operator or user when the circuit fails to give satisfactory service. In either case the trouble should be reported immediately to the chief operator,

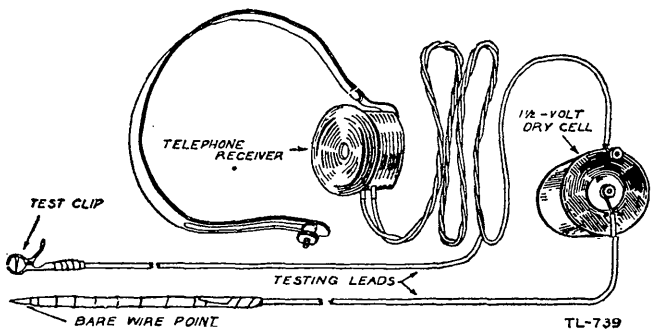


FIGURE 74.—Receiver and battery connected for use in testing circuits

wire chief, or other individual detailed to handle such cases, who proceeds as follows:

(1) *A short local circuit in trouble.*

(*a*) First determine the nature of the trouble, i. e., whether open, short, ground or cross, by tests described in paragraph 73. If the trouble is caused by an open, place a short on the defective circuit at the line side of the line portion of the circuit leading to the switchboard. If the trouble appears in this part of the circuit, short the circuit at the switchboard side of the switchboard terminal strips and repeat the test. If this test shows an open circuit, place a short at the switchboard line terminals and again repeat the test. If it is determined that the trouble is in the switchboard, test the fuses, jack, and drop unit as described in paragraph 82. If the trouble is caused by a short,

ground, or cross, open the defective circuit at the line board side of the line terminal strip and test that portion of the circuit toward the switchboard. If the trouble is in this part of the circuit, open the circuit at the switchboard terminal strip and repeat the test. If the trouble is still present, open the circuit at the line terminals of the switchboard and repeat the test. If the trouble is in the switchboard, test the fuses and drop unit as described in paragraph 82. If the trouble is in the terminal strip, either repair or change to another pair of binding posts on the strip. If the trouble is in the cable, substitute a spare pair for the unserviceable pair. If the trouble is in the fuses, replace the defective fuses. If the trouble is in the drop circuit, either connect the circuit to another drop circuit on the switchboard, or in the case of a monocord switchboard, replace the unserviceable unit with a serviceable unit. In any of the above tests, make ringing and talking tests, test for a short and open circuit, test for a grounded circuit, and, if applicable, test for a cross with another circuit. It is always proper to assume that the trouble may lie within the equipment of the telephone central, and time will generally be saved by first testing this side of the circuit.

(*b*) If, upon making the first test described above at the line terminal strips, the trouble is found to be toward the user's telephone, reconnect the circuit, if opened, and dispatch a troubleman with a serviceable telephone, to the user's instrument. On his way he should inspect the circuit for visible sources of trouble and repair any that he finds. He should then make a ringing and talking test with the user's telephone. If he can not signal the operator with it, he should replace the local instrument with his own instrument, and repeat the test. If he can now signal and converse with the operator, the trouble was in the local telephone which should be tested as in paragraph 81, and either repaired or replaced. If he can not signal the operator, the trouble is probably in the local line circuit, and he

should first test for a short and an open circuit, then test for a grounded circuit, and if applicable, test for a cross with another circuit. If trouble is located in the line wire, work back toward the telephone central, testing at frequent intervals until the trouble is found.

(*c*) After trouble has been located and cleared, notify the user that the service is again available.

(2) *Trunk circuits in trouble.*

(*a*) Determine the nature of trunk circuit trouble and whether it is in the telephone central or outside thereof in the same manner as described for local circuits, and if the trouble is found to be inside, locate and repair. Proceed as in (1) (*a*) above. If the trouble is found to be outside, proceed as outlined below.

(*b*) *An open circuit.*—If an additional circuit is available call the distant operator and request him to place a short on the defective circuit at the line terminal strip. If this short completes the circuit, it indicates that the circuit between the two centrals is in order and that the trouble is at the distant central. So inform the distant operator and request him to have the trouble cleared. If the short does not complete the circuit, the trouble is between the two centrals, in which case a lineman should be dispatched to locate and clear the trouble. If an additional circuit is not available, send a lineman out on the defective circuit to locate and clear the trouble. In either case the lineman proceeds as outlined in (*d*) below.

(*c*) *A short or grounded circuit.*—If an additional circuit is available, call the distant operator and have him open the defective circuit at the line terminal strip. If this clears the circuit it indicates that the circuit between the two centrals is in order and that the trouble is at the distant central. Inform the distant operator to this effect and request him to have the trouble cleared. If the open does not clear the circuit, the trouble is between the two centrals, in which case a lineman should be dispatched to locate and clear the trouble. If an

additional circuit is not available send a lineman out on the defective circuit to locate and clear the trouble. In either case the lineman proceeds as outlined in (*d*) below.

(*d*) The wire chief should determine as accurately as his instruments permit the approximate location of the trouble. This will facilitate the testing and materially shorten the time required to locate and clear the trouble. The lineman, starting at the telephone central, carefully examines the circuit as he proceeds on his inspection, particularly scrutinizing the insulation, splices, underground and overhead road crossings and places where the wire has been passed over or pulled out of place by traffic. Fouled insulation, poor splices and other evidences of possible trouble should be repaired and the circuit tested in order to determine if the trouble has been cleared.

The lineman in testing the defective circuit for an open connects his testing equipment across the circuit without opening it. To test for a short or grounded circuit he opens the circuit and then tests in both directions. On completion of the test the circuit is reconnected. In case it is necessary to open the circuit it should be done at a splice or at a test station, if practicable.

(*e*) A defective circuit may have more than one case of trouble. These may be of the same nature or different. It is essential that the lineman, after clearing a case of trouble, test the circuit in both directions to insure that it is in order. If trouble still exists he continues his inspection until all trouble has been located and cleared.

b. Telegraph line circuits.—Field telegraph instruments are operated either on circuits used only for wire telegraphy, or on simplexed telephone circuits. Personnel testing a defective telegraph circuit should be equipped with testing equipment with which they can communicate with each other or with a telegraph office. Telegraph line circuits are subject to the same troubles as are telephone line circuits. Such troubles are located and cleared in a similar manner, the method of making the different tests being governed by the testing equipment em-

ployed, and modified as necessary when a telegraph sending and receiving instrument is made a part of the testing equipment.

c. Locating and clearing trouble on defective circuits which pass through test stations manned by linemen are facilitated by the fact that the wire chief can call each successive test station operator and quickly determine the section of the line in which the trouble lies, as explained in paragraph 75. The nearest test station can then be directed to dispatch a lineman to definitely locate and clear the trouble. In the meantime serviceable sections of two or more unserviceable circuits can be patched through a test station, to provide at least one complete serviceable circuit out of sections of two or more unserviceable circuits, as described in paragraph 76.

75. Operation of test stations.—(See also par. 37.) The personnel at a test station consists of one or more linemen, as the situation requires. A test telephone is kept bridged across a circuit, usually the lowest numbered telephone circuit passing through the test station, or on a special circuit ending at the test station and temporarily reserved for test purposes. The personnel on duty at the test station is instructed to answer prearranged signals, usually three rings only. When this prearranged signal is answered, the test station personnel should give the name of the test station. For example, "Knob Hill Test." The test station personnel may then be instructed as to patching, testing, or repairing, as the situation requires. A copy of the circuit diagram and line route map indicating all circuits passing through or ending at the test station is kept posted at the test station.

76. Patching circuits at test stations.—The patching of circuits at test stations frequently results in maintaining communication between centrals over these patched circuits during the locating and clearing of trouble on the defective sections of the original circuits. If this patching were not done, communication would be interrupted until the trouble had been cleared. The example given herewith illustrates a case where patching may be used advantageously. Assume that two telephone centrals are connected by three circuits, all of which pass through two test stations, as shown in Figure 75. The telephone switchboard operator at Magic reports to the Magic wire chief that circuits 102 and 103 to Maytime are out of order. The wire chief at Magic tests these two circuits with the aid of a serviceable circuit to his test stations. He finds that the trouble on the 102 circuit lies in section 202, between Test A and Test B;

and that the trouble on the 103 circuit lies in section 303 between Test B and Maytime. He then instructs the lineman at Test B to remove the jumpers connecting circuit 202 to circuit 302, and circuit 203 to circuit 303; and to jumper circuit 203 to circuit 302, and circuit 202 to circuit 303. This gives immediately one built-up circuit from Magic to Maytime in addition to the 101–201–301 circuit. Until the trouble on the two defective sections (202 and 303), which are now in one circuit, has been located and cleared this built-up circuit (102–202–303) will be available, and the Magic wire chief advises the linemen at Tests A and B and the Maytime wire chief of the changes so that all circuit diagrams can be temporarily changed accordingly. When the interrupted circuits have been repaired the wire chief is notified. Upon instructions from him the original connections will be re-

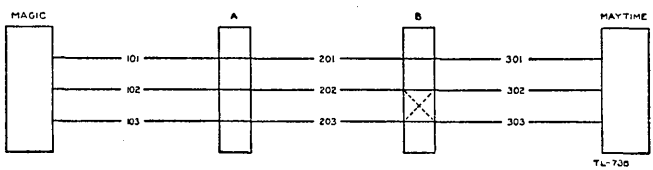


FIGURE 75.—Circuits patched at a test station

stored during an interval between busy periods of the patch circuit and all concerned notified to this effect.

77. Patrolling wire lines.—In shelled areas or where wire lines are subject to frequent damage from other causes, periodic testing from designated points is supplemented by patrolling the sections most subject to damage. Whenever possible, the personnel that has constructed a given section is also assigned the mission of patrolling that section. Wire patrols, to be effective, must carefully inspect every foot of the wire in the sections they cover. This is made possible by the use of the wire pike or an improvised wire guide made by fastening a bridle ring to a hand grip. Wire patrols repair trouble whenever found. They replace doubtful splices or sections of the line, tape abrasions in insulation, and wherever possible they improve the construction.

78. Testing field wire on reels.—All insulated wire must be carefully reconditioned after use, as follows:

a. Mount an empty reel and the reel containing the wire to be tested, so that the wire may be wound from the full reel onto the empty reel.

b. Pass the end of the wire through the hole provided near the drum of the empty reel and secure it so that the end will protrude from the side of the reel. This end must be free for use in future testing.

c. Station an experienced man between the reels to carefully examine the wire as it is slowly wound onto the empty reel. Cover with tape each abrasion or break in the insulation. If only the braid is broken, apply one layer of friction tape. If the bare wire is exposed, remove the ragged portions of insulation and cover the wire with two layers of friction tape as described in paragraph 25 *b* (1). Carefully splice breaks in the conductor. Untape and examine each old splice; if the splice is poorly made, cut it out and splice the wire properly. If the insulation has been damaged over a long section of the wire, or if there are several splices very close together, cut out the faulty section.

d. After each splice, and also when all the wire of a reel is completely repaired, test the wires on the reel being filled for an open circuit and a short circuit or for a cross between the two wires if the wire is of a twisted pair type. These tests may be made by any of the equipment used for testing as described in paragraph 73, by applying the tests in the manner prescribed therein.

79. Terminal strip.—Terminal strips are subject to failure as a result of abuse, corroded or dirty contacts, or of loose binding posts. Screws which pass through the block connect the binding posts to metal connecting strips. If these screws become loose, poor contact results between the binding post and the strip with which it should make contact. To tighten a loose binding post, remove the sealing wax from around the end of the screw at the back of the block and tighten the screw; then reseal with sealing wax. A loose binding post of a terminal, type TM–84, may be tightened without removing the wax from the back of the screw, by holding fast to the round nut of the binding post next to the strip, and then turning the stem of the binding post in a counterclockwise direction by means of pliers. In performing this operation, the wing nut should be on its stem as this operation sometimes strips some of the top threads of the stem, making it difficult to replace the wing nut if previously removed. This method is particularly applicable when the trouble occurs after a terminal strip is already installed. During the inspection, clean and brighten the contact surfaces

of the binding posts with sandpaper or emery cloth. After cleaning and tightening them, make a test for an open circuit, as in paragraph 73, or connect a telephone to each side of the top pair of strips and ring between telephones. Next, while listening at one telephone, try to move each of the four binding posts of each pair of strips; a loose terminal will produce a grating noise in the receiver. If trouble develops, repair as indicated above. Repeat this test for each pair of strips on the block.

80. Primary batteries.—(See also ch. 3, Sec. XI.) The source of electrical power used to operate all equipment of a field wire system is obtained from primary batteries (dry batteries). Inefficient operation of wire equipment is often due to weak or run down batteries.

a. An excellent indication of the condition of a primary battery is its voltage *while it is in normal use.* If a dry battery can not be conveniently tested while in use, its voltage when not in use (open circuit test) gives some indication of its condition, although a dry battery may give a satisfactory voltage reading with the open circuit test but may be unserviceable.

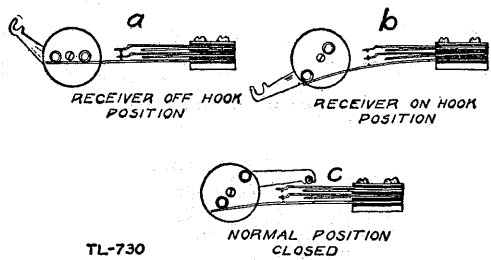
(1) The voltage of a battery can be tested by means of a portable voltmeter, or by making use of the voltmeter in the universal test set, as described in paragraph 73*a* (3). In either case care must be exercised to connect the positive terminal of the battery to the positive (+) binding post of the voltmeter or test set, and the negative terminal of the battery to the negative (−) binding post of the instrument.

(2) The normal open circuit voltage of each of the primary batteries used in field wire systems is given in the following table. The closed circuit voltage of a dry battery in good condition should be very little less than its open circuit voltage when the battery is in a use for which it was intended. The open circuit voltage of any dry battery in good condition is approximately 1.5 multiplied by the number of cells in the battery.

Battery type	Identification of terminals		Open-circuit voltage
	Positive	Negative	
BA-1	Top, center	Zinc case	3.1
BA-2	Red	Black	22.5
BA-8	do	do	22.5
BA-9	Short strip	Long strip	4.5
BA-17	Top, center	Zinc case	1.5

b. If a voltmeter is not available for testing a dry battery it should be tested in the instrument in which it is normally used. A battery should give satisfactory results when used with such an instrument.

81. Field telephones.—*a. General.*—While in use, poor operation will normally be reported by the users, but in order to maintain the confidence of the users of the system it is necessary that all equipment be in good operating condition at the time of installation and continuously thereafter. The signal communication personnel should, therefore, by periodic tests and necessary repairs of the telephones, make certain that at all times they are in the most serviceable condition possible. When telephones are removed from an installation they should be tested as to



[FIGURE 76.—Hook switch in telephone, type EE-4-A

their operating condition, and necessary repairs should be made before they are again installed or stored.

b. Field telephone, type EE-4-A.—Make certain that a serviceable battery is in the battery compartment.

(1) Test the hook switch. Fold the hook switch lever out, and move it up and down. The lever when released should move up; in so doing it should make two contacts, as shown in Figure 76 a. When it is pulled down these two contacts should break, as shown in Figure 76 b. While the hook switch lever is folded in, as when the telephone is not installed, the contacts should break, as shown in Figure 76 c.

(2) Test the transmitter and receiver circuits.

(*a*) Short the line terminals, L_1 and L_2. (See fig. 77.) Blow lightly into the mouthpiece; if the talking circuit is in good operating condition, this sound or side tone should be heard in the receiver. If this side tone is not heard, or is weak, a fresh battery should be installed and the test repeated. If this

side tone still is not heard the talking or receiver circuit is in trouble and the telephone should be repaired by a trained repairman. Ability to determine the serviceability of the talking circuit by this test is acquired only by constant practice in comparing the strength of such sounds in different types of telephones, then by comparing the operating efficiency of the various telephones tested, when they are in use on long circuits.

(*b*) If the tests in (*a*) above show the talking or receiver circuit to be in trouble, this trouble can be more

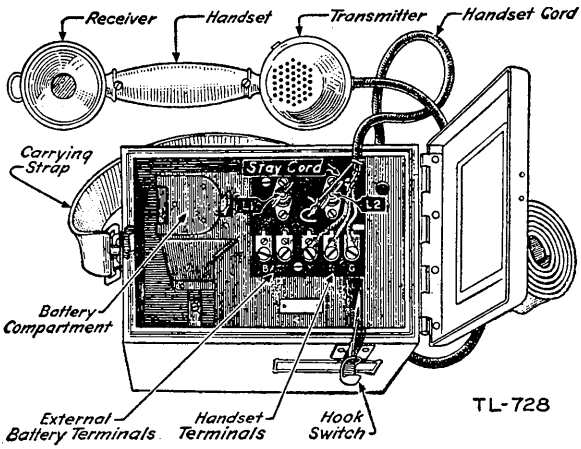


FIGURE 77.—Top view of telephone, type EE-4-A

definitely located by connecting the telephone being tested to a serviceable telephone and testing as follows: Release the hook switch of each telephone. Blow into the transmitter of the good telephone. If the side tone is heard in the receiver of the telephone under test, the receiver circuit of this telephone is in working order. Blow into the transmitter of the telephone under test. If the side tone is heard in the receiver of the good telephone, the transmitter circuit of the telephone under test is in working order.

(3) Test the signaling circuit.

(*a*) When the crank of the hand generator is turned the bell in the telephone should ring and the crank should turn easily.

(*b*) Moisten the ends of the fingers and touch the two line terminals, L_1 and L_2, and at the same time slowly turn the crank of the generator. A shock should be felt in the fingers.

(*c*) Short the line terminals of the telephone and turn the crank. The crank should turn hard, as though a drag had been placed on it, and the bell should *not* ring.

(*d*) If any of the above tests fail, the ringing circuit is unserviceable and the telephone should be repaired by a trained repairman.

c. Field telephone, type EE–5.—(1) This telephone has a push button in the hand set instead of a hook switch in the set box, as in the telephone, type EE–4–A. It is so connected that the user can hear without depressing the push button, but in order to transmit, the push button must be depressed. To test the push button depress and release it. If it returns to its normal position, it is probably in a serviceable condition.

(2) Test the talking and receiving circuit.

(*a*) Short the line binding posts L and G and depress the push button. Blow lightly into the transmitter. The side tone should be distinctly audible in the receiver. If no side tone is heard, install a new battery and repeat the test. If this does not alter the result, the talking or receiver circuit is in an unserviceable condition.

(*b*) If the tests in (*a*) above show the talking or receiver circuit to be in trouble, this trouble can be more definitely located as follows: Connect a serviceable telephone to the telephone under test, depress the push button of the telephone under test and blow lightly into the transmitter; if a side tone is distinctly audible in the receiver of the serviceable telephone the talking circuit of the telephone under test is serviceable; if not distinctly audible the talking circuit is unserviceable; depress the push button of the serviceable telephone and blow lightly into the transmitter; if the side tone is dis-

tinctly audible in the receiver of the telephone under test the receiver circuit is serviceable; if not, it is unserviceable.

(3) Test the ringer circuit.

(*a*) Turn the crank of the hand generator. It should turn easily and the buzzer should not operate.

(*b*) Moisten the ends of the fingers and touch the line binding posts L and G and at the same time slowly turn the crank of the hand generator. A distinct shock should be felt in the fingers, its intensity

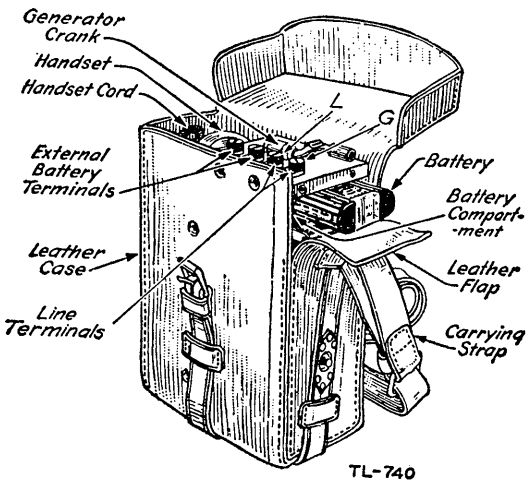


FIGURE 78.—Telephone, type EE-5

depending upon the rapidity with which the crank is turned.

(*c*) Short the line binding posts L and G and turn the crank of the hand generator. The crank should turn hard as though a drag had been placed upon it and the buzzer should not operate.

(*d*) Connect the telephone under test to a serviceable telephone. Turn the crank of the hand generator of the telephone under test. The buzzer in the serviceable telephone should operate. Turn the crank of the hand generator of the serviceable tele-

phone. The buzzer of the telephone under test should operate.

(*e*) In the event that a serviceable telephone is not available, the telephone under test may be removed from the leather case and the make and break contacts of the generator shunt switch short-circuited with a screw driver or knife blade. When the generator crank of the telephone is turned, its own buzzer will operate if it is in serviceable condition.

(*f*) If any of the above tests fail, the telephone is unserviceable and should be repaired by a trained repairman.

82. Monocord switchboards.—*a.* Before removing the monocord switchboard from the supply room for installation, and immediately upon installation, the following inspections and tests should be made:

(1) Set up the switchboard vertically in an operating position and release its shutter locks.

(2) Inspect the switchboard for damaged or missing parts.

(3) Connect a dry cell across terminals B and B_1 as shown in Figure 79.

(4) Connect a low resistance buzzer or bell across terminals A and A_1.

(5) Connect a serviceable magneto telephone to terminals L_1 and L_2.

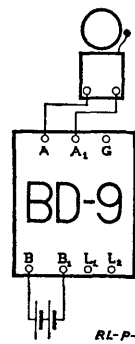


FIGURE 79.—Monocord switchboard, type BD-9

b. Tests and troubles.—(1) *Operator's cord circuit.*

(*a*) Turn the hand generator of the telephone. The crank should turn easily. If the generator crank does not turn easily, the trouble is due probably to a short circuit in the plug or at the cord fasteners.

(*b*) Short-circuit the operator's plug and again operate the hand generator. The crank should turn hard. If the crank does not turn hard, the trouble is due probably to an open in the plug connections or cord or at the cord fasteners.

(2) *Switchboard units, type EE–2.*

(*a*) Place the operator's plug between the line terminal binding posts of unit No. 1, so that the tip makes contact with one binding post and the sleeve with the other. Turn the hand generator of the

telephone. The generator should turn easily. The shutter of the unit should fall and the night alarm buzzer or bell should operate. If the generator crank turns hard, the trouble is due probably to a short circuit either in the unit plug, at the cord fasteners, between the line terminals and lightning arrester, or at the jack. If the crank turns easily and the drop fails to fall, the trouble is due probably to an open fuse, drop out of adjustment, contact spring out of adjustment, or to an open connection at the jack, at the drop, or within the drop. If the trouble can not be located by inspection, test each section of the wiring with a voltmeter and dry cell, or with a dry cell and receiver connected in series. See Figures 73 and 74 for connections.

(*b*) Insert the operator's plug into the jack of unit No. 1. Short-circuit the line binding posts and operate the hand generator. The crank should turn hard. If the crank does not turn hard, the trouble is due probably to a failure of the plug to make contact in the jack.

(*c*) Remove the short from the line circuit binding posts. Short-circuit the tip and sleeve of plug No. 1 and again operate the hand generator. The crank should turn hard. If the crank does not turn hard, the trouble is due probably to an open in the plug, cord or at the cord fasteners.

(*d*) Test the other units in the same manner.

(*e*) If trouble develops in any unit that can not be readily repaired, replace the unserviceable unit with one that is serviceable.

83. The buzzer phone.—The buzzer phone, type EE–1–A, is a very well made instrument which will give good service if not tampered with. The only permissible servicing consists in keeping the battery springs and contacts clean and bright, and in making necessary adjustments in the call buzzer as described in *a* below.

a. To adjust the call buzzer, loosen the locking screw, back off the contact screw, and turn the vibrator adjusting screw until the armature on the end of the vibrator stands in the center of the gap in which it moves. Press the switch key on the top of the panel to CALL and turn the contact screw in

until a strong and positive note is obtained. The locking screw should then be set tight.

b. To test the buzzer phone for secrecy, connect its terminals to those of a second buzzer phone whose switch key is in the STAND-BY position. Put the switch key of the first buzzer phone in the SEND-RECEIVE position and operate the key while listening in the receiver of the second. In this case no tone or clicks should be heard until the switch of the second buzzer phone is moved to SEND-RECEIVE.

c. The sending key should have no side play. It should have at least one-thirty-second of an inch opening at the front contact. The lock nuts on the key and the nuts under the base, which clamp the ends of the receiver cords, should be tight at all times.

d. The battery adjacent to the coils in the set box is the one which operates the set. It is exhausted much sooner than the potentiometer battery. If the operating battery becomes exhausted, it may in an emergency be exchanged with the potentiometer battery, which is not so important in the operation of the set.

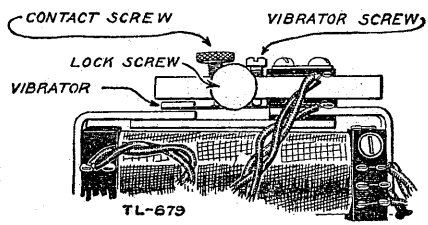


FIGURE 80.—Call buzzer adjustments of buzzer phone

e. In case the buzzer phone fails to operate, no field repairs can be made beyond ascertaining if any connections on the bottom of the panel have worked loose or broken off or if replacement of batteries is necessary.

84. The service buzzer.—*a. The battery chamber.*—The battery chamber of the service buzzer, type EE–63, is a frequent source of trouble unless it is kept clean. The tips of the conical springs at the bottom of the battery chamber and the brass contacts on the door should be kept bright and free from any signs of corrosion.

b. The key.—The key, Figure 81, is pivoted between two trunnion screws, which should be so adjusted and locked by the set nuts that the front contact on the key lever mates exactly with the contact on the base and not to the right or left of it. They should be kept tight enough to eliminate side play of the key lever without restricting its up-and-down movement. The spring screw is adjusted to suit the individual operator; the upper

contact screw should be up far enough to insure a positive break at both contacts under the key when the key is up.

c. The vibrator.—The vibrator is adjusted by loosening the lock screw, backing off the contact screw and turning the vibrator screw until there is a gap of about one and one-half times the thickness of the vibrator between it and the core of the induction coil. The contact screw should then be turned in and clamped by the lock screw at the point where a clear and strong note is obtained when pressing the key. If the vibrator clicks on working the key, even when the contact screw is backed off, the vibrator condenser is short-circuited. If the vibrator

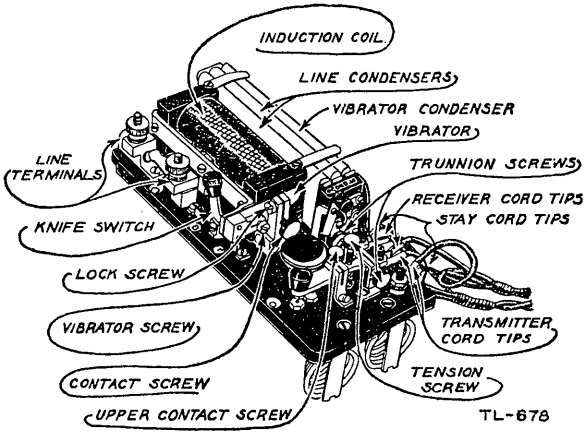


FIGURE 81.—Top view of service buzzer operating panel

sparks excessively and there is no change in tone on removal of the vibrator condenser, the condenser is open. When trouble is experienced with the vibrator condenser, it may be replaced in an emergency by one of the other two condensers which are not so essential to the operation.

d. Transmitter and receiver.—The cord tips should be firmly clamped on the binding posts and in such positions that there is no danger of their touching either each other or the metal frame of the case. To test the transmitter and receiver, throw the knife switch to talk T, short-circuit the line terminals, press the button on the side of the transmitter, and blow into the transmitter. A distinct audible sound should be heard in the re-

ceiver. On connecting one terminal only to one terminal of of another buzzer, signals should be heard between buzzers if the switch is thrown to B in each instrument and they are in good order.

85. Repeating coils.—Repeating coils are designed to withstand moisture and a certain amount of rough handling. They are subject to failure, due to broken connections and corroded or dirty terminals. Repeating coils should be inspected before installation, for broken or loose connections outside of the metal cover. During the inspection loose or broken connections should be resoldered and corroded or dirty terminals should be thoroughly cleaned and brightened with sandpaper or emery cloth. Repeating coils should be completely tested as follows:

a. Clean the terminals and replace loose connections outside of the metal cover.

b. Connect two repeating coils by short pieces of wire of equal length, as described in paragraph 52 *c*, for simplexing. Then connect four serviceable telephones to the two coils, one pair of telephones to the metallic circuit and one pair of telephones to the ground return circuit, as described in paragraph 52 *c*. The test consists in ringing and talking over each circuit. If unable to ring or talk over either circuit, test each of the jumpers between each binding post and the corresponding coil terminal, both for continuity and for cross with any other jumper. If the jumpers are clear of trouble, the trouble is probably in the coil windings which are inside the iron case.

c. If the first test shows that both circuits are clear, ring and talk over each circuit while listening over the other circuit. If the ringing or talking over one circuit can be heard over the other circuit, the coil is defective. *Do not remove the iron case.* A defective repeating coil should be sent to a signal depot for repair.

86. Transportation of wire equipment in the field.—*a. Operating equipment.*—Operating equipment is comparatively delicate and its serviceability is governed to a great extent by care in methods of packing it for transportation. Operating equipment is packed and loaded in such manner as to protect it from—

(1) Dust and dirt.
(2) Weather.
(3) Shocks of the road.
(4) Injury from other articles loaded in the same vehicle.

b. Telephones are packed in the BC–5 pack chests when provided. The EE–4–A telephones are packed with the hook switch turned in, crank handles turned up so as to be flush with the case, hand set cord neatly wound around hand set, and hand set inserted in the case with the receiver end down, the lid closed and latched and the carrying strap tightly buckled and coiled on top of the lid. The EE–5 telephones are packed in the same manner except that the crank is removed from the generator shaft and placed under the spring catch provided on the panel of the telephone. Care must be exercised in winding the cord around the hand set to see that it does not press on the button switch on the side of the hand set. Certain types of wire-laying vehicles have built-in compartments for transporting telephones. Telephones transported in such compartments should be packed in a manner similar to that described above.

c. Switchboards.—Monocord switchboards with cable and switchboard terminal strip attached are packed in a BC–5 pack chest separate from telephones. Before placing in the pack chest, the switchboards are placed in their carrying cases with shutters locked and cable neatly coiled. The monocord switchboard sometimes is packed for transportation in compart ments provided for the purpose in certain types of vehicles; when so packed the same precautions are taken as when packing in the pack chest.

d. Repeating coils, terminal strips, spare batteries, and spare parts are carried in the pack chests provided, packed in such manner as to prevent injury to themselves or other equipment in the same chest.

e. Service buzzers and buzzer phones are carried in cases of more sturdy construction than those used for other operating equipment, and they may be packed outside of special pack chests without danger of injury. However, where pack chests are available, it is desirable to use them for packing this equipment as a more compact and more easily handled load results.

f. Wire.—The principal precaution necessary in transporting wire is that the metal drums or commercial spools be not dropped from vehicles or handled in such a manner as to injure or bend them and thereby make difficult their refilling and use.

CHAPTER 3

RADIO

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SECTION I

GENERAL

87. Employment.—*a.* Radio is used as a means of communication between all combat units down to and including battalions and individual airplanes.

b. Radiotelegraphy is the normal means of radio communication. There are at present certain limited uses for the radiotelephone, such as between airplanes and between ground and airplanes.

c. Radio communication within a tactical unit on the march is established at such prearranged times or places as may be necessary.

88. Powers and limitations.—*a.* The range and quality of radio communication are independent of conditions of roads and traffic and are only slightly affected by the nature of the intervening terrain.

b. Radio communication can be used between rapidly moving units when distances are so great and movement so continuous that wire and messenger communication can not be maintained. Under these conditions arrangements may be made for radio communication between distant stations at fixed hours.

c. Radio communication is not secret. This disadvantage necessitates the habitual use of cryptograms in transmitting messages.

d. The approximate number, types, and locations of our radio stations can be determined by hostile goniometric stations. From this information and a knowledge of our radio organization, the enemy can estimate the organization and distribution of our forces. This disadvantage can be minimized by—

(1) Curtailing the use of radio during a period of concentration or stabilization; or

(2) Establishing dummy stations.

e. Hostile stations can interfere deliberately with our radio communication. Such a practice, however, ordinarily interferes with hostile radio stations as much as with our own and is therefore not generally employed.

f. Serious interference, called "static," may result from certain atmospheric conditions.

89. Radio nets.—In order that radio communication may follow the proper channels of tactical command, the radio station of a superior unit and the radio stations of the next subordinate units are grouped into one radio net. Each net is designated by the name of the superior unit. The division net includes the division headquarters station, the brigade headquarters stations, and the stations at the headquarters of auxiliary or attached troops under direct division control. The brigade net includes the brigade headquarters station and the regimental headquarters stations. The regimental net includes the regimental and battalion headquarters stations and the stations of units attached to or supporting the regiment.

90. Assignment of frequencies.—In order to prevent interference between stations operating in a restricted area and to coordinate all radio activities within larger units, each radio net is assigned certain definite frequencies, wave lengths, or tuner settings on which to operate. These frequencies are normally allotted by army headquarters and assigned to units through corps and division headquarters. The use of any frequency not assigned by higher headquarters is prohibited.

91. Net control stations.—The operation of radio nets must conform to tactical conditions. Stations in these nets advance and retire with their units. In emergencies, messages of vital military importance must be given the right of way. The varying tactical situation requires net discipline and central

control, in order that the radio net may serve promptly the will of the commander. To insure this control a net control station (NCS) is designated for each net. The NCS is normally the station of the superior tactical unit represented in the net for the reason that the superior commander has control over the radio communication of his subordinate units. The NCS is charged with the clearing of message traffic within the net, with dispatching internet traffic expeditiously, and with maintaining operating discipline within the net. Its orders on such matters will be obeyed by the other stations in the net.

92. Location of stations.—The following considerations are important in the location of radio stations:

a. The station should be quiet, dry, and protected from the enemy fire. Incoming radio signals are sometimes very faint, and noise and confusion make it difficult for the operator to copy them.

b. Stations should not be placed in the immediate vicinity of electric-light plants, telephone exchanges, or wires carrying alternating current. Interference may also occur when two radio stations are placed too close to each other.

93. Special uses.—*a.* Radio is used in the military service for the following special purposes:

(1) *Reception only.*
   (*a*) Goniometric location of enemy radio stations.
   (*b*) Goniometric location of enemy airplanes.
   (*c*) Interception of hostile radio messages.
   (*d*) Interception of friendly radio messages (supervision).
(2) *Transmission and reception.*
   (*a*) Meteorological information.
   (*b*) Time signals.
   (*c*) Press reports.

b. The goniometric and intercept services and the meteorological service are operated and maintained by the signal services of the higher units, usually the army.

c. At army headquarters, for purposes of supervision, one or more radio sets are usually assigned the special mission of intercepting our own radio traffic within the different nets. These sets are adjusted to the frequency of the net or station to be supervised and copy all matter transmitted. The sending of messages in clear, or any other violation of regulations, is reported to the proper authority for correction.

d. Official time signals are broadcast at stated times by a set located in the rear area. Designated field radio stations copy these signals in order that timepieces may be synchronized throughout the command. Time signals may also be sent by wire telegraph.

e. At army and corps headquarters a radio set is assigned the duty of copying press reports and summaries which are broadcast by radio stations in the rear area. A set at division headquarters may also be assigned this duty when it is available. At headquarters where no special set has been assigned this duty the sets designated for other purposes will not ordinarily be permitted to copy press, since, while they are being used for this purpose, they may not hear stations in their own radio net that wish to communicate with them.

f. Meteorological information is normally distributed by radio at fixed hours to units concerned.

SECTION II

OPERATING REGULATIONS

94. Introductory remarks.—*a.* These regulations are based on the Joint Army and Navy Radio Telegraph Procedure approved by the Secretaries of War and Navy August 16, 1928, and contain the rules governing radio communication in the tactical nets of the Army. Details for intercommunication by radio between the Army, Navy, and Marine Corps will be made by the senior officers of these services in the area concerned.

b. Strict compliance with the regulations insures the accurate reception and delivery of radio messages with a minimum of transmission. Every operator must understand the correct procedure for use in any particular case. Deviation from the regulations will cause confusion in the mind of the receiving operator and will not only retard communication but in many cases will result in serious errors.

95. The international signal of distress ($\overline{\text{SOS}}$).—The subparagraphs below are quoted from the general and supplementary regulations agreed to at the International Radiotelegraph Conference of Washington, 1927.

a. "The distress signal shall consist of the group . . . — — — . . . which indicates that the ship, aircraft, or other mobile station sending it, is threatened by grave and immediate danger, and requests immediate assistance.

b. "The distress call shall consist of the distress signal sent three times, followed by the word DE and the call sign of the mobile station in distress, sent three times. This call has absolute priority over all other transmissions. All mobile or land stations hearing it must immediately close all transmission capable of interfering with the distress calls or messages and must listen on the wave used for the distress call. This call must not be addressed to a particular station. The same rules apply to the radiotelephone distress call which consists of the spoken expression MAYDAY (corresponding to the French pronunciation of the expression 'M'Aider' (help me))."

* * * * * * *

c. "When distress communications are ended and silence is no longer necessary, the station which has controlled these communications will send a message on the distress wave addressed CQ, indicating that the distress communications are ended."

96. Codes and ciphers.—Several types of codes and ciphers are used for cryptographing messages. A partial list of the various message codes and ciphers with their identification groups and the number of characters comprising each code group follows:

Name of code or cipher and code indicator:	Number of characters per group
The War Department Telegraph Code (WTC)	5
The Army Field Code (AFC, followed by a number)	5
The Division Field Code (DFC, followed by a number)	4
The Fire-Control Code (FCC, followed by a number)	2
The Air-Ground Liaison Code (AGC, followed by a number)	2
The Radio Service Code (RAD, followed by a number)	3
The Meteorological Code (M, followed by two letters)	4, 5, 6, or 7
Cylindrical Cipher Device, M–94 (CD)	5

97. Transmitting rules.—*a.* An operator will listen on the transmitting frequency assigned his station before making any call or other transmission. If there are other stations working on the frequency he will not interrupt communication unless such interruption is warranted by the class of his traffic. (See par. 122 *b.*) An operator must not cause interference that will prevent

other operators from handling traffic if there is any possible way to avoid it.

b. All transmissions must be as short and concise as possible. No superfluous calls or signals of any kind will be sent. An operator may test his transmitting set before the first transmission by sending a few "V's" and then signing his own station call.

c. Messages must be sent at a speed which will allow the stations addressed to receive them at the first transmission. Special care must be used when communicating with stations at which inexperienced operators are likely to be on watch. In sending a message to more than one station at a single transmission a speed of 16 words per minute should never be exceeded.

d. Particular care is necessary that all call signs are made slowly and distinctly.

98. Procedure signals.—*a.* Certain nonsecret, arbitrary signals known as procedure signals have been adopted to assist operators in handling traffic in the shortest possible time. They must be kept posted or otherwise available in some convenient form near the operator.

b. Procedure signals are never under any circumstances to be mixed with groups from other codes, or with cipher groups, in a transmission.

99. Transmissions.—*a.* A radio station will transmit only those messages authorized by competent authority. All transmissions and messages handled will be considered as official.

b. At times there is need for certain inquiries, instructions, and information in connection with the handling of radio traffic. In general, this need is adequately met by the system of procedure signals. When procedure signals can not be used a message will be employed. The exchange of transmissions in other than authorized form is prohibited.

c. The chief operator of a radio station has full authority to authorize the transmission of messages relating to the communication service. Such messages will be signed with the call letters of the station of origin, and will be in an approved code, normally the Radio Service Code.

d. Every operator will read through the text of each message filed to ascertain that each word or the individual letters of each code group are clear and unmistakable. If there is any doubt about any of the words or letters he will have them verified.

100. Time entries and the " radio day."—When stations in the same net are in different time zones, the following will hold:

a. Time entries on the station records will be made in the time of the zone in which the station is located.

b. Transmissions involving the specifying of time (time broadcasts, transmissions as to the time a station will call another station or return to a net, etc.) will likewise use the time of the zone in which the station is located.

c. The "radio day"—i. e., the 24-hour period covered by a complete set of station records—will commence at midnight of the time zone in which the station in control of the net is located, and end at the following midnight of the same zone. Station records (including number sheets when used) of all stations in the net will be opened and closed in accordance with the above-mentioned rule.

101. Cooperation with the message center.—*a.* There must be close cooperation between a radio station and its message center. The station will keep the message center informed at all times of the stations actually present in the net and the probable time of return of any absent stations.

b. Message centers keep track of the average delay time on messages, and usually mark them with an expression such as, "Notify this message center if unable to transmit before ———." If from the state of traffic or other conditions operators can determine that a message will be delayed beyond the allowed time, they will at once notify the message center. The message center has authority to change the means by which the messsage is to be transmitted. The radio station will always notify the message center when it has been unable to send messages within a reasonable time or the delay time prescribed.

102. Reception.—*a.* All received messages are copied at the radio station in duplicate. Code messages will be printed or will be copied on the typewriter. Printed characters will be formed in accordance with standard practice and copied, five code words to the line. In using the typewriter, 5 or 10 code words will constitute a line.

b. The originals of all messages received at a radio station and addressed to that station will be turned over to the message center at once unless the message is in the Radio Service Code or in the abbreviated form. If the message is in the Radio Service Code, it will at once be decryptographed within the radio station.

If it does not concern the radio service, it will immediately be turned over to the message center. If the message is in the abbreviated form, it will be turned over to the responsible officer by the quickest method available. If the message is in a code other than the Radio Service Code, it must be decryptographed by the cryptographer.

c. The originals of all messages received for relay by radio will be put at the bottom of the file of other messages of the same class on hand and awaiting transmission. If the message is for a radio station in a net which has a station at the headquarters served by the receiving station, the message will be passed to the linking station in the same manner that a message is sent to the message center.

d. The originals of all messages received for relay, which can not be relayed by radio, will be turned over to the message center at once.

103. Operator's sign.—Each operator will be identified by a personal sign of one or two letters. No two operators in the same station will use the same sign. The personal sign of an operator will never be transmitted but will be used only in connection with the keeping of station records.

SECTION III

THE CALL UP AND ANSWER

104. Calls.—A call consists of the call sign(s) of the called station(s) followed by the procedure signal V and the call sign of the calling station. When it is desired to communicate with more than one station at the same time there are provided the following three methods of calling:

a. Collective call.—A collective call is one containing some prearranged call sign definitely calling two or more stations without the use of their individual call signs. A collective call may also be used in sending to more than one station a transmission consisting only of procedure signals. Under this classification are included the three general calls ZLV, USA, and USN.

(1) The general call ZLV is used principally when press, meteorological, and other data are broadcast from some central station to all stations within hearing. Stations listening are to copy but not answer. Such transmissions terminate with $\overline{VA}$ and if receipt or answer regarding reception is desired, it is obtained by an individual call up.

(2) The general calls USA and USN are for all Army, Navy, and Marine Corps stations. The appropriate general call will be used to establish communication in case the call sign of the station with which communication is desired is not known.

Example: An Army station, BA, desires to communicate with any Navy or Marine Corps station within range. BA would send—

USN USN USN V BA BA BA K

b. Net call.—In addition to assigning call signs to individual stations in a net there is also provided a call sign for the whole net. This is known as the *net call.* Such a call sign is used to call all of the stations in a net at one time.

c. Multiple call.—A multiple call is one containing the individual call signs of two or more called stations. It must always be used in transmitting a message (as distinguished from transmissions consisting of procedure signals only) to more than one station in a single transmission. It may also be used in transmitting procedure signals to more than one station.

105. Call up.—*a.* A call up consists of a call, followed by the ending signal K. Procedure signals, if necessary, may follow the call in order to convey certain information to the called station(s). In this case either K or $\overline{VA}$ completes the call up, depending upon whether or not the calling operator desires an answer.

b. When the calling station has not recently been in communication with the called station(s), or when it is known that the stations are not working well together, all call signs in a call up will be made three times, and any informatory transmission preceding the K or $\overline{VA}$ will be made twice.

Example 1.—DB has routine messages for DA and communication with that station is not known to be good. He transmits—

DA DA DA V DB DB DB K

Example 2.—DB has a priority message for DA. He transmits—

DA DA DA V DB DB DB P P K

Example 3.—Same conditions as in Example 2 except that DB, having made some adjustments in his transmitter since he was last in communication with DA, also desires to know how DA is receiving him.

He transmits—

DA DA DA V DB DB DB P P ZJF ZJF K

c. In calling up a single station, when the calling station knows that it is in easy touch with the called station, call signs and procedure signals will be sent once only. In certain cases, such as successive transmissions between the same two stations, when there can be no confusion as to the identity of the stations, the call may be omitted after the initial transmission.

Example.—DA and DB have been in communication. DA has told DB that his signals are good and has transmitted a message to him. DB wishes to call DA and receipt for the message. He may transmit either—

DA V DB R NR3 K (or $\overline{\text{VA}}$)

or

R NR3 K (or $\overline{\text{VA}}$)

106. Failure of called station to answer.—When a station fails to answer a call up, the following rules will be observed:

a. The call up will be repeated once immediately. If the second call up is not answered the transmitting station will wait at least two minutes before repeating the call up. Thereafter he will call only at 5-minute intervals unless he has an O or P message, in which case no restriction is placed upon the repetition of the call.

b. If, within a reasonable time, or the delay time specified by the message center, the calling operator is unable to get in touch with the called station, he will return the message to the message center with the proper notations made thereon, "Unable to raise station." When convenient this information may be given verbally.

c. If a message is so returned to the message center bearing such a notation, the message center may—

(1) Send the message by other means.

(2) Direct the operator to continue calling for a specified time.

(3) Direct the operator to send his message without preliminary call up and answer. In this case the operator would terminate his transmission with K. If he fails to receive a receipt from the called station he may request it not oftener than once every five minutes. If he fails to receive such receipt

within a reasonable time, or the delay time specified by the message center, he will so notify the message center. This method is provided so that a station whose transmitter is out of operation but whose receiver is still operating will be able to receive all messages intended for it even though it can not receipt for them by radio. All operators should therefore continue to listen in even though their transmitters are out.

107. Collective or multiple call up.—In a collective or multiple call up, when the calling station knows that it is in easy touch with the called stations, the call sign(s) of the called stations will be made twice and the remainder of the transmission once only. The exception to this is in the case of sending a message without preliminary call up and answer. (See par. 123*a* (3).)

108. Answering.—*a.* An answer to a call up is similar to the call up and follows the rules given in paragraph 105. For reporting signal strength in an answer, see paragraph 109.

b. A general call up terminating in "K" calls for an answer from any nonsilent station hearing the call up, unless the included informatory transmission specifies otherwise.

Example.—DA wishes to establish radio communication with any Army station. He transmits—

USA USA USA V DA DA DA K

Any nonsilent Army station hearing the above call up will answer.

c. A net call up requiring an answer is answered by the called stations in the alphabetical order of their call signs.

d. A multiple call up requiring an answer is answered in the order in which the stations were called. If a called station fails to answer in its turn, the next station in the order of answering, after waiting 15 seconds, will answer and the delinquent station will not answer until all other stations have finished. If the delinquent station still fails to answer, the calling station will call it individually.

Example 1.—DA, DB, DC, and DF constitute a net whose call sign is DAB. DA, the net control station, wishes to tell all stations to "close station." All stations have been in easy touch with one another. DA transmits—

DAB DAB V DA ZZX K

DB answers—

DA V DB R $\overline{\text{VA}}$

DC fails to answer.
After 15 seconds DF answers—

DA V DF R $\overline{\text{VA}}$

DC still failing to answer, DA transmits—

DC DC DC V DA DA DA ZZX ZZX K

and DC then answers—

DA V DC R $\overline{\text{VA}}$

Example 2.—Under the same conditions as in Example 1, DA wishes a report of traffic from DB and DF only.
DA transmits—

DF DF DB DB V DA ZAQ K

DF answers—

DA V DF ZAR FOUR DB $\overline{\text{VA}}$

DB answers—

DA V DB ZBJ $\overline{\text{VA}}$

109. Indicating strength of signals or interference.—*a.* The strength of signals or interference will normally be reported by use of the table of signal strength, which is as follows:

Strength:	*Meaning*
1	Very weak, hardly audible.
2	Moderately weak.
3	Medium strength.
4	Moderately strong.
5	Strong.

b. Readability of signals is indicated after the procedure signal R, by means of the table below:

(1) Unreadable.
(2) Poor but readable; plain language twice; code unreadable.
(3) Fair; readable; plain language once, slowly; code twice.
(4) Good; readable; plain language or code once.
(5) Perfectly readable.

c. The procedure signals S or R followed by a number from the table of signal strength or table of readability will be used to indicate the strength or readability of the received signal.

Example 1.—DA, having called DB, the latter would report DA's signal strength as follows:

DA DA DA V DB DB DB S4 S4 K

Example 2.—DA, in receipting for a message to DB, wishes to report a material change of signal strength from DB. He might transmit as follows:

DB V DA R NR4 S2 $\overline{VA}$

Example 3.—DA, in answering DB, wants to inform him that his signals are moderately strong and readability fair:

DB V DA S4 R3 K

d. The "strength of signals" will be indicated under the following conditions:

(1) In answer to an original call up or message when communication is first established.

(2) In the first transmission the original calling station makes after receiving an answer to its original call up.

(3) If the strength of the received signal has changed materially since establishing communication.

(4) In answer to a request made by a procedure signal as to the strength of signals.

(5) Whenever a station desires another station to increase or decrease signal strength.

e. The transmitting station will make every effort to maintain a signal strength of "4" for the receiving station. When this is impossible great care must be exercised in transmitting messages. The sending must be heavy so the dots will carry through and the spacing must be good. It is also advisable under these conditions to follow extremely difficult groups with $\overline{IMI}$ and then repeat the groups. When the signals are reported as strength "2" or below, all groups will be sent double unless the receiving station requests otherwise.

f. A receiving station will always request that each group or each message be sent two or more times when the signals are hard to copy due to static, radio interference, swinging, fading, or any other cause. While the repeating of groups or messages is not to be encouraged, traffic can, in many cases, be handled more quickly this way than by sending single and causing the receiving operator to ask for numerous, repetitions.

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g. The strength of interfering radio signals and static may be indicated in a like manner by using W and X, respectively.

Example.—DA, having called DB, the latter wishes to report DA's signals as "moderately weak" and radio interference as "medium strength" and static as "strong."

DB might transmit—

DA DA DA V DB DB DB S2 S2 W3 W3 X5 X5 K

h. When radio interference is coming from a known station the call letters of the station may be sent after the "W" and a number from the table of signal strength.

Example.—DA, having called DB, the latter reports DA's signals "moderately strong" and radio interference from BX, as:

DA DA DA V DB DB DB S4 S4 W4 W4 BX BX K

Section IV

STATION RECORDS

110. Operator's number sheet.—*a.* In regimental and brigade nets, messages are normally identified, both upon station records and during transmission, by the serial number assigned to the message by the message center. This method is particularly suited to stations whose operation is intermittent, and whose employment is such as to limit the use of records. Should conditions warrant, the officer responsible for the operation of any one of the above-mentioned nets may direct the employment of station serial numbers as prescribed below.

b. In nets above the brigade, station serial numbers are used on all normal form messages (see par. 119) to assist each station in ascertaining that all such messages, both incoming and outgoing, have been received. They will be used as follows:

(1) By each station, using a separate "transmitted" series and a separate "received" series for each station communicated with during a "radio day," The first normal form message sent to each station after midnight will be numbered "1." Similarly the first normal form message received from each station after midnight will also be numbered "1." Succeeding messages are numbered consecutively until the following midnight when a new transmitted series and a new received series commence for each station communicated with.

(2) Messages sent by means of a collective call or in abbreviated form and transmissions consisting of procedure signals will not be given a serial number by the transmitting station.

(3) A message sent by means of a multiple call will be given the proper serial number for each station called by the transmitting station.

(4) The station serial number applies only between the transmitting station and the station to which the message is transmitted. If the message is to be relayed by radio, a new station serial number is assigned to it by the relaying station.

c. A record of the consecutive station serial numbers with each other station will be kept on an operator's number sheet in the following manner:

(1) On the completion of the transmission or reception of a normal form message(s), each key operator concerned will draw a line through the number(s) of the message(s) sent (or received), on the number sheet, in the column(s) assigned to the other station(s) involved.

(2) When an operator is relieved he will affix his sign to the number sheet to indicate the blocks of numbers he has handled. This may be done by any convenient method such as inclosing these numbers by a pencil line and affixing his sign in the space in the margin.

(3) The following form indicates a satisfactory number sheet for recording station to station serial numbers:

SIGNAL CORPS, UNITED STATES ARMY

Operator's number sheet

Station_____ Date_____, 19__

Sent	Recd.	Sent	Recd.	Sent	Recd.	Sent	Recd.	Sent	Recd.
1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19	19	19
20	20	20	20	20	20	20	20	20	20

d. In case of irregularity in the number sheet and the files of transmitted and received messages, the chief operators of the stations concerned will be notified at once and every reasonable

effort made by the stations and their message centers to locate the discrepancy. In all cases the following rules will be observed:

(1) If the discrepancy can not be located in the time available, a new series of numbers will be started between the stations concerned, commencing with the first number which both stations agree is free. Explanatory notations will be made on the number sheets covering the occurrence.

(2) If two messages have been assigned the same number, the one bearing the more recent filing time will be assigned the half number above the number concerned by the station(s) affected.

(3) If a number has been omitted the word "blank" will be written opposite it by the station(s) affected.

e. Station serial numbers should be checked by comparing numbers with each other station worked before closing station, or as soon as possible after midnight. If any discrepancy in station serial numbers is found in the comparison, and if the error can not be corrected by procedure signals, messages will be sent making the necessary corrections.

111. The station log.—*a.* A radio station log shows, in conjunction with the files of transmitted and received messages, a complete and continuous record of all transmissions and operating conditions occurring during a "radio day" of which the operators on duty have knowledge. Such a log will be kept as follows:

(1) If there are two operators on duty at a station, the senior operator, known as the key operator, will be responsible for the transmission and reception of messages and the keeping of number sheets. The junior operator, known as the log operator, will keep the station log and enter thereon all transmissions of which he has knowledge, except messages transmitted by his own station.

(2) If only one operator is on duty, he will perform the duties of the key operator and in addition will keep the station log as prescribed for the log operator, except that messages intended for his station will not be copied in the log. The following form is a satisfactory example of station log:

STATION LOG

Date_____19__ Net_____ Sheet No.___
Station call_____ Net call_____ Station opened____M
_____Senior operator _____Junior operator

Time	To	From	Traffic

b. The following rules concerning entries made on the station log will be observed by all operators:

(1) In every case where message transmissions are not copied in the log an explanatory entry, such as "Sent NR3 DB" (transmitted our message No. 3 to station DB), or "Rcd NR 6 to 9DF" (received messages Nos. 6 to 9, inclusive, from DF), will be made.

(2) All call signs, calls, call ups, answers, transmissions, or messages sent more than once need be copied but once. In case of excessive or unnecessary transmissions, repetitions, or repeat backs, sufficient explanatory notation should be made to render the log record complete and understandable.

(3) An entry will be made in the log at least once every five minutes during the time a station is in operation. If there is no traffic being handled in the net or on the frequency guarded, an entry to that effect will be made.

(4) The time associated with each entry will be entered on the log in a separate column.

(5) In addition to the entries prescribed in connection with actual transmissions, the heading of each log sheet will be completed and an entry will be made covering any unusual occurrence or any violation of procedure rules.

(6) When the operator in charge of the log is relieved he will make as his last entry on the log a statement, such as:

"631 P-Cpl. Jones relieved by Sgt. Smith."

Each operator will sign his name and grade on the next line below.

c. Signal or communication officers will inspect the log sheets of all stations under their command and ascertain that the preceding rules have been carried out and that logs are being kept in a neat and legible manner. From a study of a properly kept log sheet, violations of procedure rules and faults in net operation can be located and the delay time on messages computed. This renders the log a particularly valuable aid in training.

112. Filing station records.—All copies of transmitted messages, the carbon copies of messages received, the station log, number sheets, and any other records connected with the operation of a station for a "radio day" will be placed together in a packet as soon as possible after the conclusion of such period and plainly marked with the date and a description of the contents. These records will be disposed of as prescribed by the unit signal or communication officer.

SECTION V

TACTICAL RADIO NETS

113. Radio nets.—*a.* Army radio stations are organized into radio nets for the purpose of facilitating the handling of traffic. Stations normally having the greatest amount of intercommunication are assigned to the same net. Definite rules for the handling of net and internet traffic and the maintenance of net discipline are provided.

b. Tactical nets are made up of mobile, low-power radio stations of tactical units in the field. Tactical nets are generally given a name indicative of the senior organization in the net that is, the GHQ net, the First Army net, the II Corps net, the 3d Division net, the 4th Field Artillery Brigade net, etc.

c. Nets operate either on schedule or with a continuous watch. Nets operating on schedule handle traffic only at definite, prearranged times and in accordance with a prearranged schedule of intercommunication. Nets operating on continuous watch are prepared to handle traffic at any time; they maintain operators on duty at all stations in the net at all times.

d. All stations in a tactical net normally operate on the same frequency.

114. Net control.—*a.* In every Army tactical net one of the stations is designated as the net control station abbreviated NCS. The NCS is charged with the clearing of traffic within the net, with dispatching internet traffic as quickly as possible,

and with maintaining order within the net. Questions concerning traffic are referred to the NCS for decision. The authority of the NCS extends only to the operation of the net on the air, and is in no way concerned with the interior administration of any station, nor with its tactical operation or movement. Within its scope, however, the authority of the NCS is absolute, its decisions are final, and its orders will be strictly obeyed. These orders are generally transmitted in the form of procedure signals, or messages, but may be contained in written orders, circulars, or letters of instruction.

b. The NCS controls transmission by means of $\overline{\text{HM}}$, $\overline{\text{UO}}$, $\overline{\text{AS}}$, K, and other procedure signals.

c. Duty as NCS is generally assigned to the station of the senior organization in the net, but may be assigned to any station in the net which can best fulfill the duties. All other stations in the net are known as secondary stations and are under the control of the NCS.

115. Types of nets.—*a.* An Army tactical radio net may be operated as—

(1) A "free net," in which case any station can communicate with any other station in the same net without first obtaining permission to do so from the NCS.

(2) A "directed net," in which case no station, except the NCS, can communicate, except for the transmission of urgent messages, with any other station without first obtaining the permission of the NCS. Permission granted to a station to transmit one or more messages covers all communication necessary to complete the transmission of such messages.

b. Nets ordinarily are operated free, but the NCS may change to directed net operation at any time if it is unable otherwise to maintain proper control. In a directed net, traffic moves more slowly than in a free net. A directed net should only be used when all other means of obtaining order have failed. Free net operation will be resumed in all cases as soon as the necessity for directed net operation has passed.

c. Secondary stations will always inform the NCS when they know they will be unable to follow out their schedules, or unable to have their station on continuous watch at any time during which a continuous watch is to be maintained. If it is impossible to notify the NCS by radio it will be done by some other means of communication with the least possible delay.

116. Transmission in secret and in clear language.—Normally all messages transmitted in Army tactical nets will be cryptographed. When the tactical situation is such that time can not be spared for cryptographing and decryptographing, and when the information to be transmitted can not, if picked up by the enemy, be acted upon in time to influence the situation, a commanding officer or his representative may order the transmission of a message in plain language, *provided that he makes this authorization in writing over his signature.* Cryptographing and decryptographing will normally be performed by a cryptographer who is provided with the proper codes and cipher keys. Messages relating to the radio service may be cryptographed by the radio personnel.

117. Traffic in tactical nets.—*a.* Tactical nets must be prepared to assume the entire traffic load of their units at any time. For this reason close cooperation with the message center is essential. Tactical radio stations will be given a telephone connection whenever possible. A continuous check on outgoing messages by radio should be kept by the message center so that it may ascertain at any time those messages which are at the radio station awaiting transmission.

b. In order to protect urgent traffic, no station in a tactical net save those concerned in a communication will transmit during the communication, nor for a period of 15 seconds after the completion of the series of transmission which make up the communication, except to transmit urgent traffic. Interruption will then only be made when certain that the communication being interrupted concerns traffic of a lower class.

c. Urgent messages will be transmitted to the station of destination, or to a linking station, as soon as possible, under the restriction imposed in *b* above, without in any case obtaining permission from an NCS. If such traffic is for a station in another net, the operator will report back into his own net upon completion of his internet communication.

118. Establishing a tactical net.—*a.* Before going into the field, station call signs, net call signs, duties and frequencies will be assigned to the various stations and nets.

b. Radio stations in tactical nets conform to the movements of the organizations served. As soon as a tactical radio station is set up and in operation at the desired location it will endeavor to report into the net of which it is a part.

c. The first station set up will act as NCS and the second station as NC2 until the regularly appointed NCS reports into the net and takes control. The NCS will, when necessary, cause each new station reporting into the net to adjust its frequency until all stations can be heard on the same dial setting of the receiver of the NCS. The NCS may adjust its frequency in accordance with directions from one of the secondary stations until that station receives the NCS and all other stations in the net on the same dial setting. This adjustment of net frequency will be made when the third station reports into the net and each station reporting thereafter with an incorrect adjustment will be caused to adjust its frequency before it transmits any traffic. The NC2 takes over the duties of the NCS in case the NCS disappears from the net or leaves the net without giving other instructions.

Example 1.—Stations DA, DB, DC, and DF go into the field to establish a net. Station DA has been appointed the NCS. The net call sign is DAB and the net frequency 450 KC. Assume that station DA is the first station set up. DA will first listen on 450 KC and if nothing is heard will transmit—

DAB DAB DAB V DA DA DA ZZA ZZA U U K

This indicates to any secondary station who might in the meantime have set up and be listening that the NCS is in the net and that he has taken control thereof. None other than the regular NCS is permitted to use the signal U. If no answer is received, DA will continue to listen on the net frequency and will transmit as above once each five minutes until some station answers or reports into the net. The NCS transmits as follows once each five minutes thereafter until all stations have reported in, except that traffic will not be delayed for this purpose:

DAB DAB DAB V DA DA DA U U VA

Assume that DB is the next station set up. After listening on the net frequency and hearing no station, DB will transmit—

DAB DAB DAB V DB DB DB ZZA ZZA K

DA hears DB report in and answers him with a report of signal strength, the type of net and the call signs of the other stations, if any, in the net:

DB DB DB V DA DA DA S4 S4 ZZF ZZF K

DB has no traffic to send so answers with a report of signal strength, as—

DA V DB S5 $\overline{VA}$

DA does not answer.

DC is now set up and reports into the net. Assuming that he heard DB report in previously to DA, or upon hearing DA send the net call followed by U, he would send as follows:

DA DA DA V DC DC DC ZZA ZZA K

DA answers just as in the case of DB, except that he tells DC that DB is in the net.

DC DC DC V DA DA DA S5 S5 ZZF ZZF ZZK ZZK DB DB K

DC answers—

DA V DC S4 $\overline{VA}$

Example 2.—If, in Example 1, DC's signals did not come in at the same point on the receiver as DB's did, DA would cause DC to adjust to the same point by the use of the proper procedure signal. DC reports into the net as in Example 1, and DA answers—

DC DC DC V DA DA DA ZLG ZLG K

DC decreases frequency slightly and reports again as—

DA DA DA V DC DC DC S4 S4 ZZA ZZA K

DC's frequency is correct now and DA answers him as in Example 1.

DB has been standing by listening to DA and DC.

DA now calls DB and requests information as to his own frequency, thus:

DB V DA ZLC K

DB answers—

DA V DB ZLF K

DA adjusts his frequency and sends—

DB DB DB V DA DA DA ZLC ZLC K

NOTE.—DA must send all call signs three times, as in the original call, after any change in his transmitter.

DA's frequency is correct now and DB answers—

DA V DB S5 $\overline{VA}$

The net is now established as a free net with the stations able to intercommunicate without change in the setting of the receiver dials.

d. The NCS, as soon as the net is established and he has taken over control, will designate as net control station No. 2 (NC2) a secondary station in the net. The NC2 will assume command of the net under orders from proper authority or in the event the NCS disappears from the net or leaves the net without giving other instructions. In this case the NC2 will immediately designate another secondary station as an NC3 to take command in case NC2 becomes silent.

Example.—DA wants to appoint BD NC2. DA sends—

DB V DA ZFQ NC2 K

DB answers—

DA V DB R $\overline{\text{VA}}$

e. A secondary station will always inform the NCS when it leaves or enters the net unless it has an urgent message for a station in another net. In cases involving urgent messages a station may leave its own net without informing the NCS.

Example.—DC receives orders to move and knows the move will take two hours. DC sends to DA, the NCS:

DA V DC ZZB TWO K

DA answers—

DC V DA R $\overline{\text{VA}}$

When DC reports back into the net he will do so in the same manner as when the net was originally established.

f. The NCS may change the type of net operation whenever necessary by sending out the net call followed by the appropriate procedure signal.

Example.—DAB is the call sign of a net which has been operating free and DA the NCS wishes to change to a direct net. DA sends—

DAB DAB V DA ZZD K

All stations in the net receipt for this in the alphabetical order of their call signs.

DB answers—

DA V DB R $\overline{\text{VA}}$

DA does not answer.
DC next answers—

DA V DC R $\overline{\text{VA}}$

DA does not answer.

g. When necessary, an authorized station may silence a whole net, certain stations in a net, or all stations on a certain frequency, by use of the "silence" signal ($\overline{\text{HM}}$). The silence signal is construed as a command and must be obeyed as such. Its use is confined to those stations in authority such as airplanes and net control stations. It will not be used until other less drastic methods of obtaining order have failed. It will be annulled as soon as the emergency has ceased to exist.

Example 1.—DA, the NCS of a net whose call is DAB, wishes to silence the net. DA sends—

DAB DAB V DA $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{VA}}$

All stations in the net stop transmitting and remain silent. They will not transmit again, except to send urgent traffic or to answer a call from the NCS, until the NCS indicates that silence is no longer necessary. To lift the silence, DA sends—

DAB DAB V DA $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{VA}}$

Example 2.—DA wishes to silence one station, DB, in his net. DA sends—

DB V DA $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{VA}}$

DB will remain silent but the other stations in the net are not affected.

Example 3.—DA wishes to lift silence from a certain station, DB, in the net but not from the whole net. DA sends—

DB V DA $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{OU}}$ $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{UO}}$ $\overline{\text{VA}}$

SECTION VI

MESSAGE FORMS AND CLASSIFICATION

119. Normal form of message.—*a.* The normal form of message is to be used for all messages except those broadcast after a collective call (see par. 104 *a* (1)), unless specific instruc-

tions are given to the effect that the abbreviated form will be used. See paragraph 120 for authorized uses of the abbreviated form.

b. The subdivisions of the transmission of any message in the normal form appear below.

Part	Example	When used	Subparagraph
Call	NA V BA	Always	(1)
Number	NR3	Usually	(2)
Operating instructions	G (etc.)	Special cases only	(3)
Class	(O or P)	Urgent or priority messages only.	(4)
Check	GR7	Usually	(5)
Break	BT	Always	(6)
Text	The message in secret or clear language.	do	(7)
Time of origin	923A	Usually	(8)
Ending signal	AR (followed by K, B, VA, etc.)	Always	(9)

(1) The call consists of the call sign(s) of the station(s) called (in alphabetical order), followed by V and the call sign of the station calling.

(2) (*a*) *Regimental and brigade nets* transmit here, preceded by the procedure signal NR, the serial number given the message by the message center. In case no such number is given this group is omitted.

(*b*) *In nets employing the operator's number sheet and station serial numbers*, a message transmitted to a single station carries here an identifying serial number preceded by the procedure signal NR. If a message to a number of stations is transmitted simultaneously by means of the multiple call, an identifying serial number for each called station, preceded by the call sign of the called station and the procedure signal NR, will be inserted in the order in which the stations are called. If a message to a number of stations is broadcast by means of a collective call, no entry will appear here.

(3) Instructions to the station(s) called (F, G, etc.) appear here if necessary.

(4) A procedure signal (O or P) designating the class appears here except in the case of a message of routine classification, which carries no symbol.

(5) The actual number of groups, as counted by the message center and verified by the operator, preceded by the group(s) sign GR, appears here. Everything between the $\overline{BT}$ and $\overline{AR}$ is counted. The writer's number, code indicator, and time of origin are each counted as a group.

(6) The text is always preceded by the break signal $\overline{BT}$ and followed by the end of message signal $\overline{AR}$.

(7) In a cryptographed tactical message the text will normally include the writer's number as the first group. The last group will normally be the time of origin if this is placed on the original message by the author. The code indicator may or may not be shown depending upon the amount of traffic in one code handled by the stations concerned. If used, it appears as the second group of the text.

(8) The time of origin is transmitted as a group of four or five characters, the last being A or P, to indicate AM or PM; thus 653A or 1057P.

NOTE.—In intercommunication between Army and Navy units the time of origin will be expressed by the 24-hour clock method. Thus the two times shown above would read 0653 and 2257.

(9) The "end of message" signal, $\overline{AR}$, will always be used to terminate each message. If it is the last message to be sent, it will be followed by K, $\overline{VA}$, or such other procedure signal as conveys the desires of the transmitting operator with respect to the transmission to follow.

c. A tactical message in the normal form as copied by the receiving operator will ordinarily appear as below:

DA V DB 5 P (D) 9 (13 Sept)
NR1Ø DFC4 PXQT RVMO TZXM
BRTL OPTZ MABY 956A
(1145A)

NOTE.—The characters inclosed in circles constitute the receiving operator's service. "D" is his personal sign, "13 Sept" the current date, and "1145A" the time that the message was receipted for. The location of the personal sign and date within the message is so planned that they may be written during the reception of the signals GR and $\overline{BT}$, which are not copied, thus permitting the operator to copy consecutive messages without pause for servicing. If, due to the type of traffic, the above locations prove inconvenient, local station regulations may prescribe that they be written in any convenient place upon the message.

120. Abbreviated form message.—*a.* Local operating conditions and varying types of traffic may cause different items of

the normal form message to be omitted. The greatest possible abbreviation of the message form is found in the direct transmission between command posts of urgent messages in clear.

This type of message will frequently be handed direct to the radio station without passing through the message center. They are always of urgent nature and no class, station serial number, or check is transmitted.

Example.—The commanding officer, 1st battalion (at RB), wishes to send an important message in clear to the regimental commander (at RA). After authorizing its transmission in clear, as prescribed in paragraph 116, he hands it to the operator and directs that he transmit it at once. RB sends—

RA V RB $\overline{\text{BT}}$ PENETRATED HOSTILE MAIN LINE OF RESISTANCE AT FIVE A. M. $\overline{\text{AR}}$ K

RA answers—

RB V RA R $\overline{\text{VA}}$

The operator at RA causes the message to be delivered to his commanding officer by the quickest available means.

b. The advantage gained by the use of radio for messages of this kind can not be overestimated. In many cases prearranged code words will convey all of the information that is necessary, and if commanding officers have knowledge of the brief messages that may be sent by the use of these words, the transmission of radio traffic of this nature is greatly expedited.

c. Fire-control messages will generally be in a prearranged code for which no code indicator is necessary, and consequently their transmission will consist of the call; the preparatory command sign $\overline{\text{IX}}$ when necessary; the break sign $\overline{\text{BT}}$; the text and the end of the message sign $\overline{\text{AR}}$. Call signs may be eliminated in the case of a continuous exchange of messages, such as occurs in artillery fire control, when there is little chance of confusion as to the identity of the stations. (See par. 139.)

121. Preparation of messages for transmission.—Messages to be transmitted by radio will usually be filed at the message center. The message center places them in proper form for transmission, cryptographing if necessary.

a. Before sending a message to the radio station for transmission, all data which are supplied by the message center for inclusion in the heading of the message will be written across the top of the face of the message. These may include—

(1) Message center serial number.
(2) The class of message.
(3) Operating instructions.
(4) The check.
(5) The destination of the message indicated by the call sign(s) of station(s) of destination, as "send to NB." If the message center can not supply the station call sign(s), it must supply the name of the organization(s) of destination in clear, as "send to 1st F. A."

b. All other data, such as the maximum delay time, etc., will be inserted as a distinct and isolated group on the face of the message so as not to mar the text.

c. Under exceptional circumstances, or when no message center is available, messages may be delivered direct to the radio station. In this case the operator will perform the duties ordinarily performed by the message center in supplying data for the heading of the message. If the message is to be sent in clear, it must be authorized by competent authority.

122. Classification of messages.—*a.* Messages are classified to show the relative order in which they will be transmitted. This order is as follows:

Class	*Classifying symbol*
Urgent	O.
Priority	P.
Routine	None.

b. The urgent classification is reserved for messages requiring the greatest speed of handling. Urgent messages will be sent immediately upon receipt, except when communication involving another urgent message is being carried on. The urgent classification is used only in combat, or when combat is imminent (real or simulated), to indicate that the message following conveys most urgent orders, information, or request pertaining to the combat.

c. Priority messages are of such importance that they are given precedence over all routine messages waiting to be sent. Communication will not usually be interrupted to send a priority message. Messages giving orders for the immediate movement of troops, requesting authority for or reporting events affecting such movement, and messages requesting or controlling fire of any kind not immediately needed, are examples of the type of message which may be classed as priority in tactical nets.

d. Routine messages require no special precedence. They are transmitted in the order in which they are received, or in such order as will clear the traffic in the shortest possible time.

SECTION VII

METHODS OF SENDING MESSAGES

123. Methods of radio communication.—*a. Ordinary.*—(1) The greater percentage of messages routed by radio will bear no operating instructions, such as the procedure signals F or G. The handling of those special cases in which these procedure signals occur will be discussed in *b* below. The fact should be kept in mind that there is only one normal form of radio message and only one ordinary method of transmitting it. In rare instances, tactical necessity may require a method or combination of methods of handling traffic not prescribed in detail herein. In such cases the signal or communication officer concerned will, through his knowledge of the situation and the regulations, prescribe the necessary details to meet the situation. (See *b* (3) below.)

(2) Messages are normally handled either singly or in series of three or four, depending upon the number on file for each station. Ordinarily four transmissions are used; call up, answer, transmission of the message(s), and receipt for the message(s). A receipt must be obtained by the transmitting operator for every outgoing message before it can be considered as transmitted unless the operating instructions are such as to indicate that no receipt is necessary. Such cases as this latter will be shown in *b* below. Where the operator is communicating with another station about things pertaining to signal communication, and is using Z signals, he may or may not request a receipt, depending upon the nature of the correspondence or his own desires in the matter.

(3) When it is known that stations are in easy touch with each other the *call up* and *answer*, indicated in (2) above, may be eliminated. In this case the transmitting operator calls the station with which he desires to work, making all call signs three times, and then transmits his traffic.

Example.—DB has a message for DA and by having communicated with him previously knows that DA receives him very well. DB may dispense with the preliminary call up and answer, thus:

DA DA DA V DB DB DB NR8 GR9 $\overline{BT}$
NR6 DFC4 XBQM TRMO YTSR
BROT BMPL MLHI 926A $\overline{AR}$ K

DA would receipt for the message:

DB V DA R NR8 $\overline{VA}$

It is impossible to lay too much stress on transmitting messages in this manner and operators must be practiced constantly in reading messages so sent. If attention is given to this a preliminary call up will seldom be necessary and the result will be a considerable saving of time.

b. Special.—(1) The importance of absolute accuracy in the handling of some messages may be such that the receiving operator should repeat the message back to the transmitting operator in order to check for errors. If this condition obtains, the procedure signal G, "Repeat back," will be included in the heading of the message.

Example.—DB has been directed by his message center to have a priority message for DA repeated back. He transmits the message as follows:

DA V DB NR5 G P GR7 $\overline{BT}$ NR1Ø DFC4
XPQR TMST RQMO LTHJ 1Ø3ØP $\overline{AR}$ K

DA repeats the message back as he received it and DB underscores each word repeated back correctly. If the message was received correctly in its entirety DB sends—

DA V DB C $\overline{VA}$

Any incorrect portions are corrected by DB before giving DA the C signal.

(2) When it is desired to send a message to a silent station whose location must not be disclosed to the enemy, the procedure signal F, "Do not answer," will be placed in the heading in the space provided for operating instructions. In such messages each group will be sent twice and the transmission terminated with the "end of communication" signal $\overline{VA}$.

Example.—DB has a message for a silent station, DA. DB sends the message as follows:

DA DA DA V DB DB DB NR3 NR3 F F P P
GR6 GR6 $\overline{BT}$ $\overline{BT}$
NR2 NR2 DFC4 DFC4 QXTS QXTS
RMIT RMIT SMRA SMRA ZTMO ZTMO
$\overline{AR}$ $\overline{AR}$ $\overline{VA}$ $\overline{VA}$

DA does not answer.

(3) It may be desired not only to prevent enemy goniometric and intercept stations from locating a unit but also to keep from him any knowledge of its existence, and at the same time have one-way radio communication with such unit. This may be accomplished by sending the message to a third station, not concerned therewith, by the G method. The radio station of the concealed unit is required to copy and turn over to its message center all G messages transmitted on the net frequency.

124. Relaying messages.—By the use of the procedure signal T, meaning "transmit to," a message may be relayed through an intermediate station in reaching its destination. An example of the transmission used in relaying a single address tactical message follows:

Example.—DF has a message for XB which he wants to relay through AC.

AC V DF NR6 T XB V DF GR5 $\overline{\text{BT}}$
NR8 DFC4 PQXT NUMR 9$\underline{1}$5A $\overline{\text{AR}}$ K

The transmission from AC to XB—

XB V AC NR$\underline{1}$Ø XB V DF GR5 $\overline{\text{BT}}$
NR8 DFC4 PQXT NUMR 9$\underline{1}$5A $\overline{\text{AR}}$ K

It will be noted that AC uses his own station to station serial number when retransmitting to XB and that the procedure signal T has been omitted.

125. Single transmission of the same message to several stations.—A message may be sent to two or more addresses at one transmission. (See par. 104*c*.)

Example.—DA wishes to transmit a routine message addressed to DB, DC, and DF. He may either make a call up and obtain an answer from each station before transmitting the message, or he may send it without preliminary call up and answer as follows:

DB DB DB DC DC DC DF DF DF V DA DA DA NR$\underline{1}$ DB
NR4 DC NR5 DF GR$\underline{1}$Ø $\overline{\text{BT}}$
NR$\underline{1}\underline{1}$ DFC4 XQPM DMTR XGRA
MLOP ACFR NYMS VUXB $\underline{1}$Ø$\underline{1}$ØA $\overline{\text{AR}}$ K

Individual receipts are taken from each station in the order in which called.

126. Internet traffic.—*a.* Figure 82 is used in connection with examples of internet traffic and the handling of messages which must be relayed. It may be considered as representing a system of tactical nets. It should be noted that the D and R and the D and X nets are linked physically by having two stations at a common headquarters, while the A net is physically isolated. Consequently, while a message originating in the X net with destination in the R net could be handled either by relay through the D net or by direct communication—i. e., going to internet

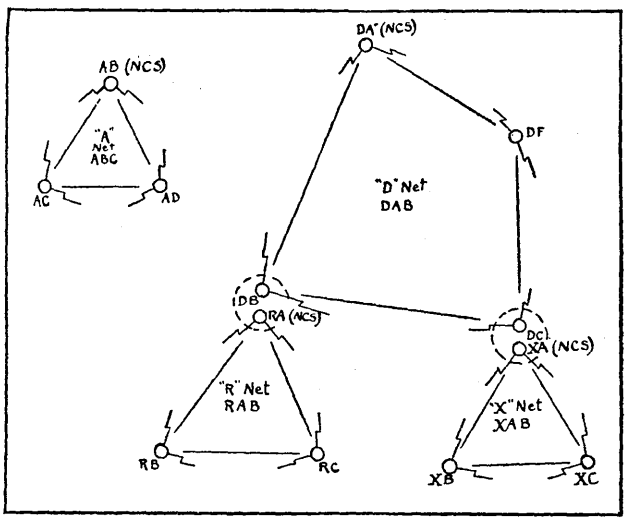


FIGURE 82.—Tactical radio nets

traffic—all traffic to or from the A net must be handled by internet methods.

b. A station may desire to leave its own net and go into another net in order to send traffic to stations in that net. In all such cases except for transmission of urgent messages the station must obtain permission from its own NCS to leave the net, stating with what station it is going to work, and must report to the NCS of the new net before transmitting any traffic in that net. A station will report back into its own net as soon as its business is finished in the outside net. In case the station does not know the call sign of the net or of the NCS, or the fre-

quency to be used, it will ask for such information in its request to leave its own net. The only exception to the rule above is in the case of an urgent message, in which case a station will get the message through with a minimum of transmission; that is, a direct call up if possible. (See par. 117*c*.)

Example 1.—DC has a priority message for AC. DC transmits—

DA V DC ZAR P AC K

DA sends—

DC V DA ZZH $\overline{\text{VA}}$

DC changes to A net frequency and makes—

ABC ABC ABC (or AB AB AB) V DC DC DC ZZA ZZA ZAR ZAR P P AC AC K

AB answers—

DC DC DC V AB AB AB S4 S4 ZZH ZZH $\overline{\text{VA}}$

DC sends—

AC AC AC V CD DC DC P P K

AC answers—

DC DC DC V AC AC AC S4 S4 K

DC then transmits his message and reports AC's signal strength as S3. AC receipts for the message—

DC V AC R NR1 $\overline{\text{VA}}$

DC reports back into the D net—

DAB DAB DAB (or DA DA DA) V DC DC DC ZZA ZZA K

DA answers—

DC DC DC V DA DA DA S5 S5 $\overline{\text{VA}}$

Example 2.—If in Example 1 DC had not known what frequency to go to or whom to call, its request to leave the net would have been—

DA V DC ZBE P AC K

and DA would have answered—

DC V DA ZBF ABC (or AB) FOUR FIVE ZERO $\overline{\text{VA}}$

and the remainder of the communication would have been as in Example 1.

Example 3.—(*a*) If DC has an urgent message for AC but does not know AC's frequency, he requests tnis information of his own NCS, and then calls AC direct.

(*b*) If DC has an urgent message for AC and knows AC's frequency, he calls AC direct.

SECTION VIII

MESSAGE HANDLING

127. Receipting for messages.—*a.* A receipt being one form of answer, the rules given in paragraph 105 apply to receipting as well as to answering.

b. In receipting for a transmission consisting of procedure signals the received signal R is used without additional informatory data, except possibly a number from the table of readability, as provided in paragraph 109.

c. In receipting for all messages identified by station serial numbers the received signal R followed by NR and the station serial number assigned by the transmitting operator will be used. When station serial numbers are used, receiving operators will always check the assigned station serial numbers and errors will be corrected with the transmitting station. Delivery of messages will not be delayed to make such corrections.

d. When several messages have been received in a series the R is followed by NR and the station serial numbers of the first and last messages received in the transmission, separated by "to." Any messages missed in the series or any repetitions desired must be obtained before receipting for the series; otherwise all messages in the series will be considered as receipted for.

Example.—DA has sent a series of four messages to DC, messages Nos. 8 to 11, inclusive. After obtaining any necessary repetitions, DC sends—

DA V DC R NR8 to NR11 $\overline{\text{VA}}$

DA does not answer.

e. Receipting for net or multiple call ups and multiple call messages follows the rules laid down for answering in similar cases (par. 108 *c* and *d*), except that if a station fails to receipt for a multiple call message in its proper turn and fails to receipt after all other called stations have receipted, the transmitting operator will call the station individually and request such receipt.

128. Servicing of messages.—*a.* Every message is serviced by the transmitting operator and the receiving operator(s) upon the completion of its transmission. The transmission of a message requiring a receipt or a repeat back is not considered complete until such receipt or repeat back is received by the transmitting operator.

b. The transmitting operator's service may be written in any convenient space on the message. Many operators will perform this service with one hand while handling the key with the other. This service consists of—

(1) The station serial number of the message, followed by the call sign of the called station. If it is a multiple call message, each station serial number and its associated call sign will be recorded. If the message carries no serial number the call sign(s) of the called stations will be recorded.

(2) The personal sign of the transmitting operator.

(3) The time of dispatch; that is, the time transmission of the message was completed.

c. A receiving operator's service consists of—

(1) The personal sign of the receiving operator, which is entered on normal form messages immediately following the last station serial number, or the class if indicated, which appears in the heading. If no identifying serial number is used on collective call and abbreviated form messages it is inserted immediately after the group (GR) signal.

(2) The time of receipt, TOR; that is, the time transmission of the message was completed. This is entered immediately below the end of the message. (See par. 119*c*.)

129. Errors in transmitting.—*a.* The error signal is used to correct a word or group which has been incorrectly transmitted. Should an operator in the course of a transmission make a word or group incorrectly, he will immediately make the error sign, then make the last word or group which was correctly transmitted and continue the transmission. The repeat sign, IMI, will never be used to correct a mistake made in transmission.

Example.—DA makes an error in transmitting a message to DB and corrects himself as follows:

DB V DA NR2 GR8 BT NR14 DFC4
KU EEEEEEEEEEEEEEE DFC4 KWSN OVRL
XNTS RQAD KOGY 1Ø5ØA AR K

b. If, during the transmission of a message, it is discovered that a mistake has been made in transmission and it can not be

corrected by the use of the error sign, the operator will make use of the procedure signal ZCR and will then start the message over again or proceed with other traffic, as the case might be.

Example.—DA is transmitting a message to DB that should have been sent to DC. He discovers the error before he has completed the transmission and cancels the transmission as follows:

DB V DA NR4 P GR1Ø $\overline{\text{BT}}$ NR5 II
ZCR ZCR K

DB answers—

DA V DB R K

DA answers DB and either tells him that he has no more messages for him or sends the other traffic he has for him.

c. A separate message must be sent to cancel a message which has been completely transmitted and for which a receipt has been given.

130. Repetitions.—*a.* Repetitions are obtained by a receiving station, before receipting for a message, by means of the procedure signals $\overline{\text{IMI}}$, AA, AB, BN, and WA.

b. Short messages will generally be repeated in their entirety when repetitions are asked for.

c. Requests for a repetition of a portion of a message require—

(1) Quoting the correctly received portions which stand next to, or on both sides of, the faulty portion, or

(2) Indicating the groups by number which stand next to or on both sides of the faulty portion.

d. It will be noted that *c* (1) above is applicable to all messages whether in clear or secret language, while (2) will more often be used in long cryptograph messages where a given group may appear more than once. It is obvious that in a long cryptographed message it is easier to find the seventieth group than group CAPJ. In all cases, the transmitting station will repeat the correctly received portion(s) quoted or indicated by the receiving station as well as the faulty portion on which the repetition is requested. This gives a double check, as it shows beyond a doubt that it is the right portion being repeated, and that the faulty portion has been repeated in its entirety.

e. The repetition of a message or portions of a message is to be made through once only, unless the sending station has been informed that reception is bad, in which case it may be repeated twice, or as many times as requested.

Example 1.—DA has transmitted a message to DB; DB will secure repetitions on this message in the manner shown in cases I to X. The message as transmitted by DB is as follows:

DB V DA NR3 P GR13 BT
(1) (2) (3) (4) (5) (6) (7)
NR6 DFC4 WXKZ RNTZ LOPY QRKS TNTU
(8) (9) (10) (11) (12) (13)
XART NQRK WFTS RXZY KOGY 62ØP
AR K

Example 2.—Any repetition that can possibly be asked for must fall within one or more of the following classes:

Case I.—DB desires a repetition of the whole message.

DB transmits—

DA V DB IMI K

DA answers—

DB V DA NR3 P GR13 BT
NR6 DFC4 WXKZ RNTZ LOPY QRKS TNTU
XART NQRK WFTS RXZY KOGY 62ØP AR
K

Case II.—DB requests a repetition of the whole text.

DB asks thus—

DA V DB IMI AA BT K

DA answers—

DB V DA BT NR6 DFC4 WXKZ RNTZ LOPY
QRKS TNTU XART NQRK WFTS RXZY
KOGY 62ØP AR K

Case III.—DB has missed some portion of the heading. He must request a repetition of the whole heading.

DB asks thus—

DA V DB IMI AB BT K

DA answers—

DB V DA NR3 P GR13 BT K

Case IV.—DB requests all after group No. 10.

DB asks thus—

DA V DB IMI AA GR1Ø K

DA answers—

DB V DA WFTS RXZY KOGY 62ØP AR K

Case V.—DB requests all after the group WFTS.

DB asks thus—

DA V DB IMI AA WFTS K

DA answers—

DB V DA WFTS RXZY KOGY 62ØP AR K

Case VI.—DB requests all before group No. 3.
DB asks thus—

DA V DB IMI AB GR3 K

DA answers—

DB V DA NR3 P GR13 BT NR6 DFC4 WXKZ K

Case VII.—DB requests all before the group WXKZ.
DB asks thus—

DA V DB IMI AB WXKZ K

DA answers—

DB V DA NR3 P GR13 BT NR6 DFC4 WXKZ K

Case VIII.—DB requests the groups from No. 1 to No. 3.
DB asks thus—

DA V DB IMI BN BT II RNTZ K

DA answers—

DB V DA BT NR6 DFC4 WXKZ RNTZ K

Case IX.—DB requests group No. 4.
DB asks thus—

DA V DB IMI BN GR3 II GR5 K

DA answers—

DB V DA WXKZ RNTZ LOPY K

Case X.—DB requests groups Nos. 5 and 9.
DB asks thus—

DA V DB $\overline{\text{IMI}}$ WA GR4 II WA GR8 K

DA answers—

DB V DA RNTZ LOPY II XART NQRK K

f. When requesting a repetition on one or more messages that have been sent in a series, the request must always indicate the serial number(s) of the message(s) involved.

Example.—DA has sent DB four messages starting with NR3 and ending with NR6.

(1) DB asks for repetition of message No. 5 as—

DA V DB $\overline{\text{IMI}}$ NR5 K

(2) DB asks for a repetition of groups 4 and 5 in message NR6, as—

DA V DB $\overline{\text{IMI}}$ NR6 II BN GR3 II GR6 K

131. Verifications.—*a.* Verifications and repetitions are requested from the originating station by means of the procedure signal J. This means "verify and repeat."

b. The term, "verify and repeat," means that the message center at the originating station must have the officer originating the message verify the phraseology of the message and correct any errors. If cryptographed, the message center will check the cryptographing.

c. In using the J signal it is always necessary to designate the message to be verified, and for this purpose the station serial number will be used.

Example.—DB has a message from DC and wants it verified and repeated. It is the first message DC sent DB. DB calls and asks DC to J his No. 1, as follows:

DC V DB J NR1 K

DC answers—

DB V DC R $\overline{\text{VA}}$

DC would have the message verified by the message center which would check it with the originating officer as soon as possible. When the verified message was received, DC would repeat it back to DB as follows:

DB V DC ZCT NR1 II (The verified message) K

d. It will sometimes happen that only a portion of a message is doubtful, and if it is a long normal form message it is not necessary to have the whole message verified. When only a portion of a message is to be asked for the same rules will be followed as in asking for repetitions, substituting J for IMI and using the other procedure signals as indicated.

132. Questioning accurate reception.—Before receipting for a message the receiving operator may desire to check his reception of a word, group, or portion of the message. In which case the "is this correct?" signal, INT, will be used.

Example 1.—DA has transmitted a long message to DC, who has copied the correct number of groups but doubts the accuracy of the reception of the 26th group.

DC sends—

DA V DC INT GR26 XBOY K

DA, finding that DC's reception is correct, answers—

DC V DA C K

DC then receipts for the message.

Example 2.—In Example 1, if the 26th group had been XBGY instead of XBOY, DA would have answered—

DC V DA GR26 XBGY K

DC would have corrected his copy and receipted for the message.

133. Challenging the check.—*a.* When a message is received at a station and the check does not correspond with the number of groups in the text, the receiving operator will immediately challenge the check. To challenge the check of a message an operator calls and sends INT GR followed by the number indicating the check, as he counts it, and the signal K.

b. When the check is challenged, the transmitting operator will immediately recount the number of groups in the text of the message; and,

(1) If the check as sent by the receiving station is correct, he will answer by calling and sending the sign C followed by the ending signal K.

Example.—DA sends a message to DB as follows:

DB V DA NR3 P GR14 BT

(1)	(2)	(3)	(4)	(5)	(6)	(7)
NR6	DFC4	WXKZ	RNTZ	LOPY	QRKS	TNTU
(8)	(9)	(10)	(11)	(12)	(13)	
XART	NQRK	WFTS	RXZY	KOGY	62ØP	AR K

DB receives the whole message, counts the check and finds it should be GR13, and sends—

DA V DB INT GR13 K

DA recounts the text and answers—

DB V DA C K

DB answers—

DA V DB R NR3 K (or VA)

(2) If the check as sent by the receiving station is incorrect, he will answer by calling and sending the correct check. The transmitting operator will then "letter the text"; that is, send the initial letter of each group of the text, and follow with the ending signal K. To letter the text the first letter or figure of each word or group in the text is sent.

Example.—DA sent the message in the example in (1) above with the correct check GR13 in the heading but DB fails to get one entire group, LOPY, and therefore counts the check as 12 instead of 13. DB sends—

DA V DB INT GR12 K

DA answers, giving the correct check as GR13 and letters each group and word—

DB V DA GR12 II N D W R L Q T X
N W R K 6 AR K

DB checks the first letter or figure of each group as DA sends them and discovers that the group starting with L is missing.

DB answers, requesting a repetition of the group starting with L—

DA V DB IMI WA GR4 K

DA answers—

DB V DA RNTZ LOPY K

DB answers—

DA V DB R NR3 K (or VA)

134. Incomplete messages.—A message may be received at a radio station with several groups missing. If possible, the radio station secures a repeat and completes the message. If it is impossible to get the message completed within a reasonable time the operator must forward it and indicate the missing groups with the "blank" sign AAA. Fragments of messages are sometimes very valuable and radio operators must always forward them even though they may seem of little value. In all cases the completed version will be obtained and forwarded as soon as possible.

Example.—DA has transmitted a message to DB as follows:

DB V DA NR3 T DC V DA P GR1Ø
BT NR16 DFC4 ERLU HTNK FBZL ACSM
OVXG WRBY NPFT 93ØA AR K

DB misses the groups underlined and due to lack of time, failure of communication, or other cause is unable to obtain a complete copy. The message would be retransmitted to DC as follows:

DC V DB ZCL II NR8 DC V DA P GR1Ø BT
NR16 DFC4
AAA AAA FBZL
ACSM OVXG WRBY NPFT 93ØA AR K

DC would copy the message in the same manner as sent by DB above, receipt for it, and before sending it to the message center would add a notation to the effect that the missing groups were so sent by DB.

135. Spacing.—The "space" signal, the letters II made separately, is used for the separation of procedure signals or other parts of the transmission when it is feared that confusion of signals might otherwise result. Space signals are not used to separate words or groups of the text; they are sometimes useful in the heading of a message or in messages consisting of procedure signals. (See examples, pars. 130 and 133.)

136. Repeating difficult portions.—In transmitting messages in the clear or in the abbreviated form, difficult words or portions of the message may be repeated at once by the use of the "repeat" sign followed by a repetition of the difficult portion. This use of the repeat sign must not be confused with the use of the error sign in correcting a mistake. (Par. 129.)

Example.—DA, in transmitting an abbreviated message to DC, the text of which contains the proper name *Viscaya Zulanga,* might transmit the message as follows:

DC V DA BT BODY OF VISCAY A ZULANGA IMI
VISCAYA ZULANGA JUST FOUND AR K

137. Delays during a transmission.—When it becomes necessary for an operator to stop during a transmission, he will, if the delay is to be of short duration, make the "wait" signal, AS, and if of long duration make the appropriate procedure signal(s).

a. When the wait signal, AS, is used it will be repeated at least once every 30 seconds until transmission is resumed, and the last group sent prior to the interruption will be repeated in continuing.

Example.—DA, while transmitting a message to DB, wishes to interrupt his own transmission in order to make some adjustment in his set, check on a group of the message he is transmitting, or for some similar purpose. He would transmit as follows:

DB V DA NR7 GR1Ø BT NR4 DFC4 MRNF OZLU
AS (30 seconds) AS (30 seconds) IMI
OZLU KTRO VNVF HJTO EXYB GRQL 1Ø15P AR K

b. When an operator expects a delay of long duration he will so notify the receiving operator(s) by the use of the proper procedure signals. When such interruption occurs during the transmission of a message he will cancel the message and transmit it in its entirety when communication is resumed. (See example, par. 129*b*.)

138. Transmitting long messages.—When transmitting long messages the text will be broken up into portions, each portion not to exceed 50 groups at each transmission. In order to insure that each portion is received before proceeding with the next portion, the procedure signal B, followed by a numeral indicating the number of groups that have been sent, is used before the procedure signal K. If the receiving operator has received the first portion without error, he will answer with the procedure signal R, a numeral indicating the number of groups received, and K. The sending station will then transmit the next portion, and again use the signals B and K. The receiving station will answer as before. When the message is completed, the sending operator will send AR K. The receiving operator will then receipt for the complete message.

Example.—DA must send a message of 122 groups to station DC. After DA had called DC and DC had told him to "go ahead" he would transmit as follows:

DC V DA NR5 GR122 BT (50 groups, the last group being XASP) XASP B 5Ø K

DC would answer—

DA V DC R 5Ø K

DA would resume—

DC V DA (50 more groups, the last group being JAPY) JAPY B 1ØØ K

DC would answer—

DA V DC R 1ØØ K

DA would resume—

DC V DA (and send the remaining 22 groups of the message) AR K

DC would answer—

DA V DC R NR5 VA

Section IX

ARTILLERY FIRE CONTROL

139. Control of artillery fire by radio.—The abbreviated form message is authorized for the exchange of communications controlling or directing the fire of artillery. Its use makes possible the control of fire by radio, when the radio station of the observer and the radio station of the battery are in direct touch. The call signs of the radio stations concerned are considered as the address and signature groups of the officers in charge at those stations. The radio stations of the battery and of the observer must be in direct radio touch with each other to use this method. It is practically impossible to relay fire-control messages through linking radio stations. The term "radio station of the battery" is used to indicate the battalion radio station which will be in direct communication with the battery firing.

a. When abbreviated form is used for the transmission of firing data only, no special prefixes are necessary and the message takes the following form:

Transmission	*Meaning*
Call sign of the station called	Used as the address.
V	From.
Call sign of the station calling	Used as the signature.
$\overline{BT}$	Break sign.
Text of message in secret or clear language.	
$\overline{AR}$	End of message.

This must be followed immediately by another message or by an appropriate procedure signal.

b. Abbreviated forms for answering in controlling fire by radio are shown below:

(1) Where a receipt is required only for a previous transmission, the form will be as follows:

Transmission	*Meaning*
Call sign of station called	Used as the address.
V	From.
Call sign of station calling	Used as signature.
R	Received.
Followed by appropriate ending sign.	

(2) Where the nature of the answer is such as to indicate clearly that the previous transmission has been received, the received sign R need not be sent as shown in (1) above. This is illustrated in various examples which follow.

(3) When a receiving station misses any part of the transmission of a fire-control message in abbreviated form, a request for a repetition of the whole message will be made as follows:

Transmission	*Meaning*
Call sign of called station	Used as the address.
V	From.
Call sign of calling station	Used as the signature.
$\overline{IMI}$	Repeat previous transmission.
K	Go ahead.

c. Three special procedure signals are used in controlling or directing fire by radio.

Signal	*Meaning*
IX	Message following is a preparatory command and is not to be carried out until the signal or command of execution is received.

5-second dash---- Signal (command) of execution. This is the command of execution and means execute the last preparatory command or the preparatory command indicated by the identification data. It should be sent by the observer only. It is always preceded by a call and followed by AR. It should never be canceled or annulled.

2-second dash---- Salvo mark (battery fired; i. e., on the way). This is sent by the operator at the battery radio station just as the battery fires. It may be followed by a numeral indicating the time of flight of the projectile in seconds if necessary or advisable. It is never preceded by a call and should be sent by the battery station only.

(1) When it is desired to conduct fire by radio, the preparatory command signal, IX, is inserted in the heading of the message just before BT, provided the officer conducting fire desires the battery to fire at his command. Operators receiving messages with an IX in the heading will know that the message following is a preparatory command and that a signal directing the execution of it will follow shortly. The transmission of a preparatory command, in conducting artillery fire by radio, would be as follows:

Transmission	*Meaning*
Call sign of called station----------	Used as the address.
V----------	From.
Call sign of calling station----------	Used as signature.
IX----------	Preparatory command follows.
BT----------	Break sign.
Text of message in secret or clear language.	
AR----------	End of message.
AS, K or the transmission in (2)------	Wait, go ahead, or the command of execution.

(2) To safeguard the 5-second dash or sign of execution and prevent a preparatory command from being executed prematurely on account of a key sticking or the accidental transmission of a long dash, the 5-second dash must always be preceded by a

call and followed by $\overline{AR}$. Thus the preparatory command in (1) above may be executed at once by sending the following:

Transmission	*Meaning*
Call sign of called station	Used as the address.
V	From.
Call sign of calling station	Used as signature.
5-second dash	Execute preparatory command.
$\overline{AR}$	End of message.
K	Go ahead.

If the observer desires he may send the call at any time previous to the 5-second dash. He can then keep contact with the battery by the wait signal $\overline{AS}$ until in position to observe, when the 5-second dash will be sent.

(3) The battery station would then, if the preparatory message and the signal of execution has been received correctly, answer by sending a 2-second dash or salvo mark just as the battery fires. The salvo mark may be followed by a numeral indicating the time of flight, if necessary or advisable, thus:

Transmission	*Meaning*
2-second dash	Salvo mark.
35	Time of flight.
K	Go ahead.

(4) If the battery station had failed to receive the preparatory command it would request a repetition as in *b* (3) above.

d. The actual transmissions with their meanings are stated in (1), (2), (3), and (4) below for four separate cases. In all of the examples shown the transmission is single; i. e., groups are not repeated. When the two radio stations do not have easy radio communication with each other, the groups may be sent twice. No mention is made in any case of the position of the observer. He may be on the ground or in the air, as his location does not affect the form of message. For purposes of illustration, the following call signs will be used:

Call sign of the observer—OB.

Call sign of the battery—BA.

(1) *Case No. 1.*—An observer who is in a position to make continuous observations establishes a radio station and calls the battery telling them he is ready to observe. He then observes several shots, as follows:

(*a*) The observer reports that he is ready.

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
$\overline{BT}$	Break sign.
OI	Will observe fire of unit indicated.
$\overline{AR}$	End of message.
K	Go ahead.

(*b*) The battery answers, giving the target, and then fires.

Transmission	*Meaning*
OB	Observer's call sign.
V	From.
BA	Battery's call sign.
$\overline{BT}$	Break sign separating heading and text.
OS	Observe fire-on.
UB	Target at.
3947	3947.
$\overline{AR}$	End of message.
2-second dash	Salvo mark.
35	Time of flight.
K	Go ahead.

(*c*) The observer calls the battery and gives them his observation.

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
$\overline{BT}$	Break sign separating heading and text.
Ø44	4Ø.
RR	Right.
SS	Short.
$\overline{AR}$	End of message.
K	Go ahead.

(*d*) The battery fires and sends a salvo mark.

Transmission	*Meaning*
2-second dash	Salvo mark.
4Ø	Time of flight.
K	Go ahead.

(*e*) The observer calls the battery and reports the accomplishment of his mission.

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
$\overline{\text{BT}}$	Break sign separating heading and text.
RZ	Result accomplished.
$\overline{\text{AR}}$	End of message.
K	Go ahead.

(*f*) The battery calls the observer and tells him that the problem is ended.

Transmission	*Meaning*
OB	Observer's call sign.
V	From.
BA	Battery's call sign.
$\overline{\text{BT}}$	Break sign.
RZ	Result accomplished.
$\overline{\text{AR}}$	End of message.
$\overline{\text{VA}}$	Communication finished, no reply required.

(2) *Case No. 2.*—An observer who is not in a position to observe fire continuously wishes the battery to fire at his command.

(*a*) The observer calls the battery and instructs them as follows:

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
$\overline{IX}$	Preparatory command follows.
$\overline{BT}$	Break sign.
OI	Will observe fire of unit indicated.
MC	Fire at my command.
$\overline{AR}$	End of message.
K	Go ahead.

(*b*) The battery calls the observer and gives him the target and states that the battery is ready to fire.

Transmission	*Meaning*
OB	Observer's call sign.
V	From.
BA	Battery's call sign.
$\overline{BT}$	Break sign.
OS	Request observation.
UB	On target at.
3947	3947.
BY	Battery ready.
$\overline{AR}$	End of message.
K	Go ahead.

(*c*) The observer calls the battery and tells them to fire.

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
5-second dash	Execute preparatory command.
$\overline{AR}$	End of message.
K	Go ahead.

(*d*) The battery fires, sending a salvo mark to the observer at the same time.

Transmission	*Meaning*
2-second dash	Salvo mark.
35	Time of flight.
K	Go ahead.

(*e*) The observer calls and gives his observations.

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
IX	Preparatory command follows.
BT	Break sign.
Ø44	4Ø.
RR	Right.
2Ø2	2ØØ.
00	Over.
AR	End of message.
K	Go ahead.

(*f*) The battery station misses a part of the message and asks for a repeat.

Transmission	*Meaning*
OB	Observer's call sign.
V	From.
BA	Battery's call sign.
IMI	Repeat previous transmission.
K	Go ahead.

(*g*) The observer calls the battery and repeats the whole message.

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
IX	Preparatory command follows.
BT	Break sign.
Ø44	4Ø.
RR	Right.
2Ø2	2ØØ.
00	Over.
AR	End of message.
K	Go ahead.

(*h*) The battery calls the observer and states it is ready to fire.

Transmission	*Meaning*
OB	Observer's call sign.
V	From.
BA	Battery's call sign.
BT	Break sign.
BY	Battery ready.
AR	End of message.
K	Go ahead.

(*i*) The observer calls the battery and tells it to fire.

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
5-second dash	Execute preparatory command.
AR	End of message.
K	Go ahead.

(*j*) The battery transmits a salvo mark indicating that the battery fired.

Transmission	*Meaning*
2-second dash	Salvo mark.
K	Go ahead.

The observer calls, reports, and the battery fires until the mission has been accomplished.

(3) *Case No. 3.*—An observer wishes to conduct fire.

(*a*) He calls his battalion, reporting target, and states that he can adjust upon it.

Transmission	*Meaning*
BA	Battalion's call sign.
V	From.
OB	Observer's call sign.
BT	Break sign.
YK	Counterattack.
FT	Concentrating at.
4267	4267.
WA	Will adjust on target just reported.
AR	End of message.
K	Go ahead.

(*b*) The battalion answers, assigning a battery.

Transmission	*Meaning*
OB	Observer's call sign.
V	From.
BA	Battalion's call sign.
BT	Break sign.
CI[1]	Battery B will fire.
AR	End of message.
K	Go ahead.

(*c*) The observer wishes the battery to fire at his command in order to place the first salvo on a crossroad just as the target approaches it. The procedure sign IX is inserted in the heading so that the firing data will be treated as a preparatory command.

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
IX	Preparatory command follows.
BT	Break sign.
BD	Base deflection.
LL	Left.
12Ø	12Ø.
SI	Site.
295	295.
SP	Shrapnel.
KR	Corrector.
35	35.
B1	Battery one round.
MC	At my command.
4ØØ	4ØØ.
MM	More.
AR	End of message.
K	Go ahead.

[1] This group can be a prearranged code designation of Battery B if desirable.

(*d*) The battery answers that it is ready to fire.

Transmission	*Meaning*
OB----------	Observer's call sign
V----------	From.
BA----------	Battery's call sign.
$\overline{BT}$----------	Break sign.
BY----------	Battery ready.
$\overline{AR}$----------	End of message.
K----------	Go ahead

(*e*) The observer is not ready for the battery to fire, so he answers, receipts for the message, and tells them to wait.

Transmission.	*Meaning*
BA----------	Battery's call sign.
V----------	From.
OB----------	Observer's call sign.
WM----------	Wait a few minutes.
$\overline{AR}$----------	End of message.
$\overline{AS}$----------	Wait.

The observer should make the procedure signal $\overline{AS}$ every 30 seconds. This is done in order that the battery radio operator will know he is still receiving the observer's station. In the same manner, if it is necessary for the battery operator to keep the observer waiting, he will send $\overline{AS}$ every 30 seconds.

(*f*) When the observer is ready for the battery to fire he sends—

Transmission.	*Meaning*
BA----------	Battery's call sign.
V----------	From.
OB----------	Observer's call sign.
5-second dash--	Execute preparatory command.
$\overline{AR}$----------	End of message.
K----------	Go ahead.

(*g*) The battery replies with a salvo mark but sends no time of flight, as the observer has the data already. He is conducting the fire.

Transmission	*Meaning*
2-second dash--	Salvo mark.
K----------	Go ahead.

(4) *Case No. 4.*

(*a*) If the observer in (3) (*f*) above desires that the battery fire as soon as it receives the data, he will send as follows:

Transmission	*Meaning*
BA	Battery's call sign.
V	From.
OB	Observer's call sign.
$\overline{BT}$	Break sign.
LL	Left.
3Ø	3Ø.
LC	On No. 4 close.
5	5.
D	Down.
5	5.
SR	Salvo right.
2ØØ	2ØØ.
LS	Less.
$\overline{AR}$	End of message.
K	Go ahead.

It must be noted that in this case $\overline{IX}$ is left out of the heading and the battery will fire as soon as the range is given. The battery fires and sends a salvo mark.

(*b*) Assuming now that the battery and observer (or battery commander) are working well together, and that there is no interference, the transmission might take the following form:

Transmission	*Meaning*
RR	Right.
1Ø	1Ø.
$\overline{FO}$	On No. 1 open.
3	3.
U	Up.
3	3.
B2	Two rounds.
SM	Same.
RG	Range.
$\overline{AR}$	End of message.
K	Go ahead.

(*c*) This procedure is continued until the mission is accomplished.

PROCEDURE SIGNALS

140. Rules governing use of procedure signals.—*a.* The use of a procedure signal with any meaning other than that prescribed in paragraph 141 is prohibited.

b. Procedure signals commencing with Z ("Z" signals) which have an affirmative meaning are given a negative meaning by adding "ZPA" to the signal.

Example.—"ZAG ZPA DC" means "Am not in communication by radio with DC."

c. Procedure signals having an affirmative meaning can not be given an interrogatory meaning by use of INT, IMI, or any modification other than that indicated above. If a signal conveying the desired meaning does not exist, a message must be employed.

d. Referring to meaning of procedure signals as given in paragraph 141, the following rules must be observed in making use of those which involve, or may involve, an additional transmission to complete the meaning as indicated by the blank space(s).

(1) All blank spaces not inclosed in brackets must be filled in to complete the meaning of the signal.

(2) A blank space(s) inclosed in brackets either change(s) (if statement commences with "or") or add(s) to the basic meaning of the signal, and may or may not be filled in to complete the meaning.

(3) In using signals with blank spaces filled in to convey the desired meaning, the signal is always sent first (followed by ZPA, if necessary), followed by the additional information in the same order as the blanks appear in the meaning of the signal.

Example.—"ZAK 4ØØP THREE SEVEN FIVE" means "Call me again at 4 p. m. on 375 KCS."

(4) Referring to (1) and (2) above, whenever it is required that blank spaces occurring before the word "message(s)" be filled, both the number of messages of each class and the class will be given in full. If it is not necessary to fill such a blank space, the desired meaning may be conveyed by omitting either the number of messages of each class, or the class, or both.

Examples.—"ZAR ONE O AB II TWO P ONE DC" means "I have one urgent message for AB and two priority and one routine for DC."

The answer to this might be:
"ZZH," meaning "Transmit all messages."

"ZZH O," or "ZZH AB," meaning "Transmit your urgent message to AB."

"ZZH O II P," meaning "Transmit your urgent and priority messages," or "ZZH AB II ONE P DC," meaning "Transmit your message to AB and one priority message to DC," etc.

(5) Whenever a blank which follows the word "message(s)" is filled, the number sign, NR, and the station serial number(s) concerned must be used. If the message(s) in question did not carry serial number(s), other identifying data may be inserted. The signal will be used alone only when no convenient method of identification is available, and then only in referring to the last message transmitted.

Example 1.—"ZBZ NR3 TO 6 K" means "Are you certain of the reception of my messages Nos. 3 to 6, inclusive?"

Example 2.—"ZCX ABC" means "Have you received my message sent after the net call?"

NOTE.—Collective call messages do not carry serial numbers.

Example 3.—"ZCX" means "Have you received my last message?"

NOTE.—Referring to an abbreviated form message, which would not carry a serial number.

(6) Whenever numerals are used in filling in blanks to complete, change, or amplify the meaning of a procedure signal, words will be substituted for the numerals in the actual transmission, except in the case of station serial numbers, group numbers, and numerals appearing in a time group.

141. List of procedure signals.—The following procedure signals are prescribed for communication between the Army and Navy and in all Army tactical nets:

Signal	*Meaning*
$\overline{\text{AAA}}$	Blank, representing missing or doubtful portions.
AA	All after ____ (to be used in requesting a repetition or verification).
AB	All before ____ (to be used in requesting a repetition or verification).
$\overline{\text{AR}}$	End of message.
$\overline{\text{AS}}$	Wait.

Signal	*Meaning*
B	There is more to follow.
BN	All between (to be used in requesting a repetition or verification).
BT	Break, separating heading and text.
C	You are correct.
EEEEEEEEEE	Error.
F	Do not answer.
G	Repeat back.
GR	Group(s).
HM	Silence.
II	Space.
IMI	Repeat, I will repeat, interrogatory.
INT	Is this correct?
IX	Message following is a preparatory command not to be carried out until the signal (command) of execution is received.
5-second dash	Signal (command) of execution.
2-second dash	Salvo mark (battery fired; i. e., on the way).
J	Verify and repeat.
K	Go ahead (i. e., answer—and ending signal).
N	Nothing (or not) received.
NR	Number.
O	Urgent.
P	Priority.
R	Received or readability (according to context).
S	Signal strength.
T	Transmit to ---------.
TOFO	Time of origin.
TOR	Time of receipt.
U	Radio guard (Navy). Net control station (Army).
UO	Negative silence.
V	From.
VA	End of communication; finished; (and ending signal).
W	Interference.
WA	Word after ---- (to be used in requesting a repetition or verification).
X	Static interference.
ZAA	Call me by wire telephone.

Signal	*Meaning*
ZAB	Are you in communication by visual with ----------?
ZAC	Are you in communication by radiotelephone with ----------?
ZAD	Am in communication by visual with ---------- (through ----------).
ZAE	Am in communication by radiotelephone with ----------.
ZAF	Are you in communication by radio with ----------?
ZAG	Am in communication by radio with------ (through ----------).
ZAH	Have you heard ----------?
ZAI	It is forbidden to transmit (until ----------).
ZAJ	Try radiotelephone (on ------ KCS).
ZAK	Call me again at ------ (on ------ KCS).
ZAL	Can you hear ----------? If so, what is his signal strength?
ZAM	Can hear ------; his signal strength is -----.
ZAN	Did ---------- send anything for me? If so, please repeat.
ZAO	Following is what ---------- sent (at ------ o'clock).
ZAP	Have (or ---------- has) been calling you since ---------- (on ---------- KCS).
ZAQ	Of what class and to whom are your messages?
ZAR	Have ---------- messages for ----------. (If blanks not filled means "Have a message for you").
ZAT	---------- reports radio telephone -------.
ZAU	I (or ----------) will call you again as soon as I (he) can (or at ------ o'clock) (on ------ KCS).
ZAV	---------- is calling you (on ------ KCS).
ZAW	Inform ---------- that I am calling him (on ------ KCS).
ZAX	Nothing received from ---------- (at ------).

Signal	*Meaning*
ZAY----------	Report when you are in communication by visual with ----------.
ZAZ----------	Report when you are in communication by radio with ----------.
ZBA----------	Wait, I must shift to copy another station (or ----------) but will call you as soon as I can (or at ------ o'clock).
ZBB----------	Radio telephone indistinct, send by key.
ZBE----------	Whom shall I call, and on what frequency, to report ---------- messages for---- ------?
ZBF----------	Report messages to ---------- (on ------ KCS).
ZBG----------	Through whom shall I relay ---------- messages for ------?
ZBH----------	May I relay ---------- messages for ---------- through you or (through ----------)?
ZBJ----------	Have nothing to transmit.
ZBK----------	Reception impossible. Send series of six dashes if transmission received or send series of six dots if transmission not received. Send receipt for message when communication next established.
ZBM----------	Fragments only received (from ----------).
ZBN----------	Send each message twice. I have difficulty receiving.
ZBO----------	Send each message once only. Reception is good.
ZBP----------	Send faster.
ZBQ----------	Send slower.
ZBR----------	You are missing dots.
ZBU----------	Your Morse is difficult to read.
ZBV----------	Reception very bad; send each group ------ times.
ZBW----------	Reception exceptionally bad; send each character ------ times.
ZBX----------	Reception impossible.
ZBY----------	Accuracy of reception of message ---------- is doubtful.

Signal	*Meaning*
ZBZ----------	Are you certain of accuracy of reception of message(s) ---------- (or of group(s) ---------- in message ----------)?
ZCA----------	Cease listening in for messages from ----------.
ZCB----------	Groups ---------- in message ---------- should apparently read as follows: ----------.
ZCC----------	Has executive sign (signal of execution) for last message (or for message following ----------) been made?
ZCD----------	Have you received the signal to execute last message?
ZCE----------	Can not trace message referred to. Give more references.
ZCF----------	Have you received SOS just made (by ----------) (at ------ o'clock)?
ZCG----------	Listen in for messages from ---------- (on ---------- KCS).
ZCH----------	Letter each group (in message ----------).
ZCI----------	I will letter each group (in message ----------).
ZCJ----------	Message (----------) does not concern you (or ----------).
ZCK----------	Message which you just forwarded was incorrectly transmitted.
ZCL----------	Message following was incompletely received; groups missed are indicated by the "blank sign" (AAA).
ZCN----------	Number of groups (in message ----------) was ----------.
ZCP----------	Repeat message(s) from ---------- (at ------ o'clock).
ZCQ----------	Reply to message ---------- is to be transmitted now.
ZCR----------	Cancel this message.
ZCT----------	Following is correct version (of message ----------).
ZCU----------	The following is heading of message (----------) as received. Check to origin if necessary and repeat.

Signal	*Meaning*
ZCV----------	Transmit your message in strings of ----------.
ZCW----------	Am going to transmit messages in strings of ----------.
ZCX----------	Have you received my message ----------?
ZCZ----------	Delay was due to fault in my receiving apparatus.
ZDA----------	Delay was due to fault in my transmitting apparatus.
ZDB----------	You are causing delay by slowness in answering.
ZDC----------	You are causing delay by answering out of turn.
ZDD----------	Request immediate reply to my message (----------).
ZDF----------	Send receipt for message (----------) when communication next established.
ZDG----------	Transmit all your messages one after the other.
ZDH----------	When may I expect an answer to my message ----------?
ZDM----------	Continuous frequency.
ZDN----------	Vacuum tube transmission.
ZDP----------	Land wire or cable.
ZDR----------	Radiotelephone.
ZDV----------	Tonic train (chopped CW) transmission.
ZDW----------	Visual.
ZDX----------	Frequency.
ZDY----------	Type ---------- transmitter.
ZDZ----------	Type ---------- receiver.
ZFA----------	Model ---------- receiver.
ZFJ----------	---------- is radio guard on ------ KCS (net control station for net whose call is ----------).
ZFK----------	Am ready to take over radio guard (to act as net control station).
ZFL----------	Are you radio guard (net control station) (for ----------)?
ZFM----------	Indicate ships (stations) for which you are radio guard (net control station).

Signal	*Meaning*
ZFQ----------	(----------) Act as ---------- (until ----- o'clock) (on ------ KCS).
ZFW----------	Am in your zone. Relay communications for me.
ZFX----------	Expect to be out of communication for radio until ---------- o'clock. Handle radio communication for this ship (station).
ZFZ----------	Am (or ---------- is) unable to ----------.
ZGA----------	Are you (or -------- is) unable to --------?
ZGB----------	Am going to use (or am shifting to) --------.
ZGC----------	Am (or ---------- is) unable to use --------.
ZGD----------	Am (or ---------- is) using.
ZGF----------	Use ----------.
ZGG----------	My antenna (or antenna of ----------) has been damaged (or carried away).
ZGJ----------	My receiving apparatus is temporarily out of commission.
ZGK----------	Repairs completed. Am in commission.
ZGL----------	There appears to be something wrong in your (----------) receiving equipment.
ZGM----------	There appears to be something wrong in your (----------) transmitter.
ZGN----------	My ---------- (or --------- of ---------) is defective.
ZGO----------	Your ---------- appears to be defective.
ZGP----------	I can not transmit on ---------- KCS.
ZGQ----------	Your antenna appears to be grounding.
ZGR----------	At the end of this transmission I (or -------) will transmit on CW.
ZGS----------	I have increased my radiation.
ZGT----------	My radiation is good.
ZGU----------	I can not receive (----------).
ZGV----------	How is my note?.
ZGW----------	Lower your note.
ZGX----------	Raise your note.
ZGY----------	Your note is bad.
ZGZ----------	Your note is clear and musical.
ZJA----------	Your note is rising and falling.
ZJB----------	Decrease strength of signals.
ZJC----------	Increase strength of signals.
ZJD----------	How are my signals?
ZJF----------	What is my signal strength?

Signal	*Meaning*
ZJG----------	Your signals are unreadable owing to your bad note.
ZJJ----------	Your spark is broken.
ZJK----------	Your signals fade.
ZJL----------	Cease using ----------.
ZJM----------	Act as relay between me and ----------.
ZJN----------	Give me your message for ----------; I will forward it.
ZJQ----------	Inform me when this message (or message ----------) has been received by the addressee (or by ----------).
ZJR----------	Message ---------- has been received by the addressee (or by ----------).
ZJV----------	Message(s) ---------- has (have) been sent by land wire.
ZJY----------	Take no further action with regard to forwarding message -------- (to --------).
ZJZ----------	Transmit this message now (or at ---------) by "F" method.
ZKA----------	Transmit this message now (or at ---------) without preliminary call up.
ZKC----------	Transmit this message now (or at ---------) by intercept method.
ZKG----------	Pass following message to destination by dispatch mail system.
ZKH----------	Distribute this message by dispatch where no charges are involved and to all others by mail.
ZKM----------	Forward this message by commercial nite letter.
ZKN----------	Send V's on your present frequency (or ------ KCS).
ZKO----------	Am going to send V's on my present frequency (or ------ KCS).
ZKP----------	Am going to transmit on ------ KCS.
ZKQ----------	Am shifting to receive on ------ KCS.
ZKR----------	Am (or ---------- is) unable to transmit on ------ KCS.
ZKU----------	Am (or ---------- is) transmitting on ---- KCS.

Signal	*Meaning*
ZKX	On receiving "K" on ------ KCS I shall (or ---------- will) transmit message to you on ------ KCS. Answer on your present frequency (or ------ KCS).
ZKY	Shift to receive on ------ KCS until further orders.
ZKZ	Shift to ------ KCS.
ZLA	Transmit and receive on ------KCS.
ZLB	What frequency are you (or is ----------) using?
ZLC	How is my frequency?
ZLD	Your frequency appears to be correct.
ZLF	Increase your frequency a trifle (or ------ KCS).
ZLG	Decrease your frequency a trifle (or ------ KCS).
ZLH	Your orientation is wrong; check it immediately.
ZLJ	Transmit on ------ KCS.
ZLK	Shift from telegraph to compensating frequency or vice versa.
ZLL	Check your frequency.
ZLV	General call; all stations copy.
ZMC	Who is interfering with you?
ZMF	I am being interfered with by ---------- (on ------ KCS).
ZMG	Listen in before transmitting. You are causing unnecessary interference.
ZMJ	Do not interfere, I am receiving from ------.
ZMK	You are causing interference.
ZML	You are causing interference by inattention to order to wait.
ZMM	You are causing interference. Send on another frequency.
ZMN	You are sending at the same time as ------.
ZNO	Answer --------- and take his message(s).
ZNP	Answer calls for me (or for ----------).

Signal	*Meaning*
ZNU----------	Answer in alphabetical order of call signs.
ZNV----------	Answer in ------ KCS.
ZPA----------	Negative, No, Not. (For use with operating signals only.)
ZPB----------	Affirmative, Yes. (For use with operating signals only.)
ZPF----------	Send ---------- (weather, obstruction, storm warnings, press, etc.) last received (or received at ------) to me (or to ----------).
ZPG----------	Set clocks to ------ o'clock upon receiving signal of execution.
ZPH----------	What time is it?
ZPJ----------	Message ---------- undelivered; addresses unknown.
ZPN----------	Message ---------- undelivered; station out of range.
ZPO----------	Message ---------- refused.
ZPP----------	Message undelivered; addressee no longer here (or not here).
ZPR----------	Message ---------- accepted by ---------. State if correct.
ZPV----------	Address on message ---------- is ---------. Try again.
ZPW----------	Address on message ---------- insufficient. Give better address.
ZPX----------	Message ---------- now delivered O. K.
ZQO----------	Send report of weather conditions your vicinity.
ZXA----------	What was station serial number of last message received from this station (or from ----------)?
ZXB----------	Station serial number of last message received from you (or from ------) was ---------.
ZXC----------	What was station serial number of last message you transmitted to me (or to ----------)?
ZXD----------	Station serial number of last message transmitted to you (or to ----------) was ----------.

Signal	*Meaning*
ZXF----------	Prior to closing station records, last message transmitted to you (or to ----------) was message ----------; last message received from you (him) was message ----------; (last message transmitted to ---------- was message ----------; last message received from him was message --------).

NOTE.—Repeat for as many stations as necessary to complete the check.

ZZA [1]----------	Station reports into the net.
ZZB [1]----------	Station leaves net temporarily (or for ------ hours) (to communicate with ---------). (Will be on ------ KCS.)
ZZC [1]----------	Is net directed or free?
ZZD [1]----------	Net is directed.
ZZF [1]----------	Net is free.
ZZH----------	Transmit (----------) message(s) (to ----------) (on ------ KCS).
ZZK [1]----------	The following stations are now in the net: ----------.
ZZO [2]----------	Broadcast your messages without preliminary call up.
ZZP [2]----------	Do not broadcast. Call your station first.
ZZX----------	Close your station.
USA----------	General call. Any Army station hearing will answer.
USN----------	General call. Any Navy or Marine Corps stations hearing will answer.

SECTION XI

DRY BATTERIES

142. General construction.—*a.* The common form of dry cell is contained in a zinc can which serves both as the battery jar and as the negative electrode. This can contains as electrolyte a solution of ammonium chloride, generally called "sal ammoniac," dissolved in water and mixed with some absorbent material such as flour, starch, etc., to form a jelly or paste.

[1] This signal is not in the Navy list. It should not be used in communication with naval stations.

[2] The term *broadcast* as here used means that the call up and answer *may be omitted.* (See par. 123 *a* (3).)

Thus the dry cell is really *not dry*, but is sufficiently wet to behave electrically like a wet cell.

b. The positive or center pole of the cell is a carbon rod, which is surrounded by carbon dust held in a cloth bag. The space between this bag and the paper lining of the zinc can is filled with manganese dioxide and the whole is saturated with the electrolyte.

c. The interior of the cell must be kept moist, and this is accomplished by an inner seal of paraffin poured on top of the material between the carbon rod and can and by an outer seal of sealing compound poured on top of and separated from the paraffin by a cardboard disk.

143. Care of dry cells.—*a.* As dry cells are supplied completely assembled, the first part of their care pertains to the conditions of storage. All cells will deteriorate to a certain extent in storage, due to local chemical action within the cell and on the zinc can. There is no method of preventing this, but the effects can be reduced to a minimum by keeping the cells in storage at ordinary temperatures for the minimum length of time. In general, the deterioration is more rapid in the case of small cells and at the higher temperatures. Thus if a small-sized low-grade cell is kept in storage under average conditions for a few months, it may be nearly useless when withdrawn for service. On the other hand, a large sized high-grade cell may often be kept in storage for six months and yet give nearly as good service as when new.

b. The best practice would be to obtain a supply of cells from the manufacturer as they are needed and to issue them immediately. This is approximated as closely as practicable, yet cells must generally be kept for a certain length of time in storage. This necessary time in storage may be reduced if the user of dry cells submits his requisitions at frequent intervals for quantities actually needed and without attempting to set up a local reserve supply.

c. In order to tell the age of the cells, the date of manufacture is generally stamped on the cardboard case or carton. When cells are withdrawn for use the oldest in storage should be withdrawn first in order that no cells will be used which have deteriorated to any serious extent.

d. Dry cells should be kept free from dirt and moisture in order to avoid short circuits.

e. Individual cells are contained in a cardboard case or carton, which serves principally to insulate the zinc can, but also to a certain extent to protect the zinc aginst mechanical injury. The carbon should not be removed from the cell in ordinary use.

SECTION XII

STORAGE BATTERIES

144. General.—The following brief discussion is intended for the user of Signal Corps storage batteries in the field. TR 1190–5 (now printed as TR 1160–5), which is a much more complete discussion, is provided for the information of the specialists assigned to battery-charging stations.

145. Charging and discharging.—The storage battery generates electricity by chemical reaction, but before it can generate electricity it must first be *charged.* In other words, a direct current from an outside source of electricity, commonly called a generator, must be sent through the battery. Usually this current is applied for a number of hours until the necessary chemical changes have taken place inside the battery. The battery is then ready for use. When current is taken from a storage battery the battery is said to be *discharging.* After a battery has been used for a certain number of hours it becomes discharged and can not be used again until the charging process is repeated.

146. Lead-cell battery.—For communication purposes, the Army uses lead-cell batteries. These cells consist of a hard rubber or composition jar in which are placed two sets of lead plates. The plates of one set, fastened together to a common terminal, form the negative group of the battery, while the plates of the other set, also fastened together to a common terminal, form the positive group of the battery. The negative plates are made with small rectangular indentations or pockets on both sides. These pockets are filled with active chemical material. The positive plates are made in the same manner, but are filled with a different active chemical material. The group of negative plates is immeshed with the group of positive plates in such a manner that beginning from one side of the cell the first plate is negative in polarity, the next plate positive, the next negative, and so on. In order to keep the plates from touching one another, wooden or hard-rubber separators are placed between the plates. The cell jar is filled with a dilute solution of sulphuric acid.

147. General description.—The batteries used in the Army for field radio purposes consist of two cells. In order to protect the cells against damage, they are inclosed in a strong wooden box or are mounted in a monoblock container and provided with a carrying strap.

148. Capacity or ampere-hour rating.—The capacity of a storage battery is represented by its rating in "ampere-hours." This rating theoretically represents any discharge rate in amperes multiplied by the number of hours the battery may be discharged at that rate. For instance, the BB–29 battery is rated at 90 ampere-hours. Theoretically it will deliver 90 amperes for 1 hour or 45 amperes for 2 hours. These rates of discharge, however, are too great, and in a very short time would cause the battery to become completely ruined. It is necessary therefore to discharge this battery at a lower rate. Experience has determined for each battery a rate of discharge which can not be exceeded without injury to the battery. This rate is called the normal rate of discharge for the battery. For the BB–29 this normal rate is 18 amperes; it will deliver this current for 5 hours. It will deliver a smaller current for a correspondingly longer time, 9 amperes for 10 hours, 5 amperes for 18 hours, 1 ampere for 90 hours, etc.

149. Spilling acid.—The storage batteries used by the Army for field service are of the nonspill type. However, this will not prevent the acid from leaking should the battery remain overturned for more than a few moments. To avoid leaking always keep the storage battery in an upright position. If any acid should spill or leak from the cell it must be carefully wiped off at once as it causes corrosion of the cell terminals. Take care never to get the acid on the hands or clothing as it will cause a burn on the body or eat holes in the clothing.

150. Keeping terminals clean.—The action of the acid on the terminals of the cell is such as to cause a green insulating material to collect upon them. Should this material collect in too great quantities it will thoroughly insulate the terminal, thus making it impossible to secure a good contact. Care must be taken that both terminals of the storage battery are kept clean.

151. Testing.—Never short-circuit a storage battery to determine its state of charge, as this may buckle the plates and permanently ruin the battery. A storage battery should be tested in the field by means of a voltmeter. When the battery is fully charged the voltage should be from about 2.0 to 2.2

volts per cell. The voltage drops as the battery is used, until when completely discharged the e. m. f. is about 1.8 volts per cell. When a partially discharged storage battery has been removed from the circuit, its open-circuit voltage gradually increases, although the true condition of the battery has not appreciably improved. When the battery is again connected in the circuit this "recovered" voltage is rapidly reduced to a value corresponding to the state of charge of the battery. It is therefore apparent that the voltage reading should be taken after the battery has been connected in a circuit and has been discharging for a few minutes.

152. No testing by ammeter.—As the short-circuit current of a storage battery is very high it is impracticable to determine its serviceability by the short-circuit test. Under no conditions should an ammeter be connected across the terminals of a storage battery, as this action may result in the burning out of the meter.

153. Using one cell.—Sometimes it may be necessary to use only two volts instead of four volts. If only one cell of the battery is used the cells should be used alternately so as to discharge the cells to the same degree. This is to facilitate charging.

154. Dropping batteries.—The case of each cell is made of hard rubber which, if subjected to severe usage, will crack and allow the acid to leak. The battery, therefore, should never be thrown down on the ground or dropped.

155. Height of electrolyte.—The maintenance of the proper quantity and density of electrolyte is ordinarily the duty of the battery charging personnel, adjustment being made at the charging station each time the battery is returned. When a battery is to remain away from the charging station for more than three days, however, the maintenance of the proper level of electrolyte becomes the duty of the user. In such a case the battery should be inspected daily and the proper level, ½ inch over the tops of the plates, should be maintained by the addition of the purest water available, preferably distilled water.

156. Maintenance of charge.—A fully charged battery loses between one and two per cent of its charge each day when standing idle and if allowed to remain partly or fully discharged for a long time the battery becomes greatly deteriorated. Every battery should be returned to the charging station at least once a month whether or not the battery has been used.

157. Tactical replenishment.—There are three sets of storage batteries issued for each radio set. Assuming continual radio operation, one set of batteries will be in use, another on charge and the third set en route to or from the charging station or else fully charged and in reserve at the radio station. Because of the difficulty of resupply of batteries during an attack, it is very desirable that each radio station be equipped with fresh batteries before the attack begins.

158. Data table.—The following data are given for the two batteries most used for communication purposes:

Battery type No.	Volts	Capacity in ampere-hours	Normal discharge rate in amperes not to be exceeded	Weight of battery complete (pounds)	Material of case
BB–29	4	90	18	38	Hard rubber monoblock.
BB–41	4	16	3.2	13¼	Steel.

CHAPTER 4

VISUAL SIGNALING

		Paragraphs
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SECTION I

LAMPS

159. Reference.—For general remarks on visual signaling and use of lamps, see chapter 8, Basic Field Manual, Volume VIII.

160. Equipment.—Signaling lamps are made in two sizes, called the 14 and 24 centimeter lamps, respectively. These dimensions indicate the diameter of the reflector. The 24-centimeter lamp consists of a portable searchlight, similar in principle to an automobile headlight, but equipped with a sighting or aiming tube on top, a hinged lid to cover the glass reflector, and a 2-wire cable used to connect the batteries for lighting the bulb. The battery consists of eight dry cells in series, carried in two leather pouches, each pouch holding four cells. These pouches are attached to a leather belt supported by shoulder straps. The belt has also an additional pouch in which three extra lamp bulbs are carried. A brass push button which projects through this pouch serves as a telegraph key for completing the battery and lamp circuits. The working of this key produces signals of short or long flashes. Connection between the lamp and socket is completed by the 2-wire cable and the plug and socket connector. The complete apparatus, comprising the lamps, belt, three spare light bulbs, and eight dry batteries, is furnished in a wooden carrying case. The 14-centimeter lamp is similar to the 24-centimeter but smaller, using a battery of four dry cells and being slightly different in the manner in which it is carried.

161. Care.—*a.* The reflecting apparatus of a lamp is carefully adjusted before it is issued. However, it is possible that a slightly different adjustment will give better results when a new

bulb is inserted. To focus the lamp, the light is flashed against some dark background, such as a wall a few yards away, and the screws supporting the parabolic mirror are carefully turned until the light becomes concentrated in the smallest possible circle. The adjustment screws are then carefully tightened.

b. The following precautions are necessary in lamp signaling:

(1) Lamp cover is closed when lamp is not in use.

(2) Cover is opened at start of transmission.

(3) Mirror should not be touched except to clean with gauze or cotton or clean water.

(4) Wire cable connections must be secure and durable.

(5) Broken or burned-out bulbs should be thrown away unless otherwise ordered.

(6) The lamp should not be used for illuminating purposes.

162. Use.—*a.* The lamp is constructed so as to project a beam of light whose rays are parallel. This tends to limit observation to those for whom signals are intended and increases the range of the beam.

b. The following approximate ranges are obtained with the two authorized types of signal lamps under favorable conditions with the naked eye:

Type	Diameter of reflector (centimeters)	Day range (yards)	Night range (yards)
EE–6	14	1, 100–3, 300	2, 200–6, 600
EE–7	24	1, 100–6, 600	3, 300–11, 000

The maximum ranges indicated above can be obtained only under most favorable conditions of atmospheric visibility and fixed operating conditions. Signals may be transmitted by using either white or red bulbs. At night the white bulb is visible at a greater distance than the red, but in daylight the red bulb has greater visibility.

c. In lamp signaling one of the chief difficulties is that of acknowledgment. It is a general principle that lamp signals will be confined to signaling from the front toward the rear, acknowledgment being made at the rear station by means of pyrotechnics or some means other than by flag or lamp. This tends to prevent the location and consequent destruction of stations by the enemy. Since lamp stations are usually estab-

lished near command posts, the knowledge of these locations is also extremely valuable to the enemy. Situations will occur, however, especially in the Field Artillery and during open warfare, when communication is equally feasible in both directions. When such is the case acknowledgment is made by the same means as is used in sending. The fullest possible use should be made of lamps in order to insure that lamp operators will be proficient when occasions arise which will demand or favor lamp signaling.

d. Lamps are essentially a means for signaling over short distances and are used to the best advantage within the battalion. To operate efficiently over longer distances, their use is confined to stabilized situations where time permits of the accurate location and testing of stations with reference to one another. At certain times it is possible to signal from battalion to regiment and from regiment to brigade, but the occasions are few in open warfare. In all transmissions the rays of the sending station must be directed upon the receiving station and acknowledgment made. Blind messages (messages receipt of which is not acknowledged) are of little value. The greater the distance between stations, the greater the need for accuracy in ray direction. For long distances, the alignment of the beam upon the distant station usually requires much time. Hence lamps are used generally over the shorter distances where the receiving station can be seen and the lamp readily sighted.

e. Lamps may be used both for day and night signaling. The range for day signaling is shorter than that for night signaling. By day, light conditions are less constant. Shadows, reflections, and weather conditions materially affect sending efficiency. It is best for day signaling to place the lamp in a deep shadow where the light conditions have less effect on the prominence of the beam. Sunlight falling on the face of the lamp may produce a continuous glare from the reflector and make the electric light signal undistinguishable. It is essential that the lamp be held firmly and the sighting tube aimed exactly at the receiving station during signaling. A slight movement of the lamp makes signals appear blurred or entirely invisible to the receiving station. A lamp may be held in the hand while signaling, but it is preferable to fasten it to something which will aid stability.

163. Training.—The steps to be followed in training lamp operators are as follows:

a. Learning the general service code, as applied to lamp signaling.

b. Learning the conventional signals and procedure signs used with the lamp.

c. Inside and outside practice in transmission and reception of signals over distances which permit of verbal communication between stations or groups.

d. The transmission and reception of messages and signals between stations or groups located beyond speaking distance.

e. Instruction in the use of the compass and map reading.

f. The establishment, operation, and maintenance of visual stations under assumed tactical situations.

g. It is a mistake to assume that an operator accustomed only to signals received by the ear can without further training read lamp signals or transmit lamp signals satisfactorily. Such an operator, however, with a few days' training, should develop into a good lamp signalman.

164. Procedure signs.—The following procedure signs are used:

$\overline{\text{AR}}$—End of message, sent (. — . — .) and not (. — — . —.)
B—More to follow (— . . .)
E (ten times)—Error or Erase (. . . . . .)
K—Go ahead (— . —)
$\overline{\text{AS}}$—Wait (. — . . .)
V—From (. . . —)

165. Message transmission.—*a.* In message transmission, every time a letter can be omitted the chance of error is reduced. For beginners or in other cases where slower sending is necessary, the speed of sending letters and characters is constant. Speed is decreased by increasing the time intervals between letters and characters.

(1) A dot is made by a short flash of about one-half second duration.

(2) A dash is a longer flash of about 1 and one-half seconds duration.

(3) The interval between dot and dash is of about one-half second duration.

(4) The interval between letters is of about one and one-half seconds duration.

(5) The interval between words is of about three seconds duration.

b. In order that lamp signals may be read easily it is necessary that the signals be sent slowly. Ten to fifteen characters per minute should be taken as the maximum. Successive letters must be well spaced. In general, two men for each shift are necessary to operate a lamp station. At the sending station one man dictates the message letter by letter. The operator watches the receiving station and sends the message. At the receiving station one man receives the message and calls it off letter by letter to his assistant, who writes it down.

c. To call a station its call sign should be sent several times, and at intervals the station calling should signal its own call sign. As soon as a station observes that it is being called it will answer by prearranged pyrotechnics or some means other than by lamp or flag. The message is then transmitted and the receiving station acknowledges receipt.

d. A message will consist of the following:

(1) The call, which consists of the call sign of the called station, the procedure sign "from" (V), and the call sign of the calling station.

(2) The body of the message.

e. The following is an example of a message: Station A has just received from its message center a message already encoded to be sent to Station C. The text of the message is KEAL LOGW WYNF YTTU. Station A would first "call up" Station C. After Station C has answered, Station A would send as follows:

CC (call sign of receiving station).
V (from).
DD (call sign of sending station).
KEAL LOGW WYNF YTTU.
$\overline{\text{AR}}$ (ending sign).

166. Methods of providing improvised equipment.—*a.* In permanent and semipermanent stations an arrangement for holding the lamp in a fixed position, directed at the receiving station, should be installed. In addition a wooden tube, tapering down toward the outer end and being 6 to 9 feet long and approximately the size of the lamp at the inner end, should be constructed and also permanently aligned on the receiving station. This reduces the diffusion of the rays of the lamp and

also minimizes the possibility of the signals being read where not intended. An additional advantage is the constant direction of the lamp and readiness for operation.

b. In the event the lamp system is put out of commission, any possible means of establishing flash communication may be used. The ordinary pocket flashlight may serve this purpose.

SECTION II

FLAGS

167. Care.—Signal flags should be examined at the close of drill or practice and repairs made to any rent or loose ties discovered. Flags, when soiled, should be thoroughly washed and dried in the sun. Signals made with clean flags are much more easily read than those made with dirty flags.

168. Use.—*a.* In selecting a flag signal station a point should be chosen which is in view of the station with which communication is desired. Stations should be located where they are most difficult of discovery by the enemy. Great care should be taken in transmitting cipher or code messages and, when practicable, they should be repeated. The flagman should stand in such a position that the background will be of the same color for every position of the flag. The color of the flag must contrast as strongly as possible with that of the background.

b. The azimuth of all stations with which another station has to work will be carefully noted and recorded. In addition, guide lines may be established by driving two stakes into the ground relatively close to each other so that an imaginary line through the stakes will strike the distant station. Each set of stakes should be tagged with the name of the station on which aligned.

c. Each station should be provided with a list of "calls" of stations with which communication is expected.

d. Whenever a call is observed, the called station will at once respond, making the signal for "acknowledge." The calling station will at intervals, when calling, give its own call.

e. When a station has sent all messages on hand, the signal "end of message" or "finish" will be made.

f. If a signal station should ask another to move its station either to the right or left, so that its signals will be more distinct, a signalman at each station will hold a flag above his head. The station asking for the change will lower its flag

immediately when the distant station arrives at a position with a good background.

g. Signalmen should examine from time to time every prominent point within signaling distance to see if communication is being attempted therefrom. Attempts to attract the attention of a station, in order to be successful, must be persistent.

h. When not in immediate contact with the enemy, stations may communicate in any direction and may furnish a readily available means of communication.

i. When in immediate contact with the enemy, communication by means of flags will generally be employed only from front to rear or perhaps laterally. Acknowledgment from rear to front will be made by pyrotechnic signal or some means other than by lamp or flag.

169. Training.—Steps to be followed in training flag signalmen are as follows:

a. Learning the general service code as applied to flag signaling. This is accomplished by practice with wands or sticks of light wood about 18 inches long and one-half inch in diameter. The wand is held loosely between the thumb and forefinger and waved rapidly to the right or left to indicate the letters of the alphabet. Signals made are intended only to be read at very short distances. The effectiveness of such wands may be increased by tying a handkerchief or cloth near the outward end.

b. Outside practice in transmission and reception of signals over distances which permit of verbal communication between stations or groups.

c. The transmission and reception of messages between stations or groups separated beyond speaking distance.

d. Instruction in the use of the compass and map reading.

e. The establishment, operation, and maintenance of flag stations under assumed tactical situations.

170. Procedure signs.—Procedure signs are the same as for lamp signaling with the exception of those listed below:

	Wigwag	Semaphore
End of word	Front	Interval.
End of sentence	Front, front	Chop, chop (made twice).
End of message	Front, front, front	Chop, chop (made 3 times).
Move to your right	MR	MR.
Move to your left	ML	ML.
Move up	MU	MU.
Move down	MD	MD.

171. Semaphore code.—The code used with the 2-arm semaphore is shown in Figure 83. The "chop chop" signal is made by extending both arms to the right horizontally, and then moving the flags up and down with a cutting motion. As the flag in the right hand is moved up, that in the left hand is moved down.

172. Wigwag motions and position.—For wigwag flag signaling there are three motions and one position. Position is with the flag held vertically, the signalman facing directly toward

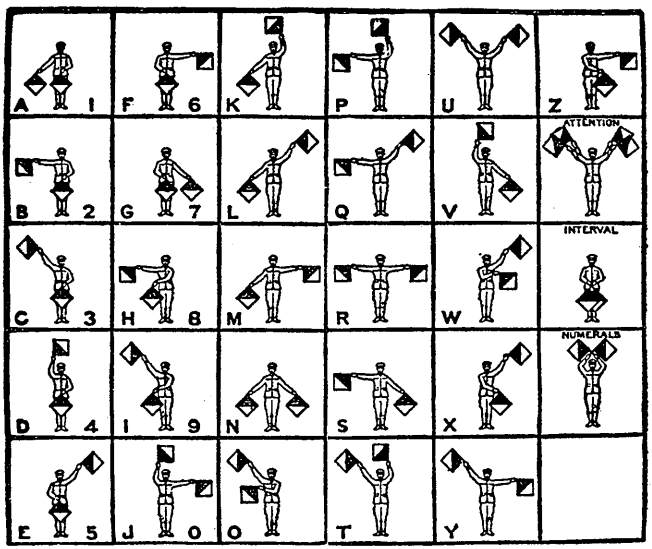


FIGURE 83.—The 2-arm semaphore code

the station with which it is desired to communicate. The first motion (the dot) is to the right of the sender, and will embrace an arc of 90°, starting with the vertical and returning to it, and will be made in a plane at right angles to an imaginary line connecting the two stations. The second motion (the dash) is a similar motion to the left of the sender. The third motion (front) is downward directly in front of the sender, and instantly returned upward to the first position. Front is used to indicate an interval.

173. Station operation.—*a.* A flag station is normally manned by two men. One man records incoming messages and

calls off the words of a message in transmission. A second man manipulates the sending equipment and reads and calls off incoming messages for the recorder.

b. The call letters prescribed for lamp stations are the same as for flag stations. Transmission procedure by flags and by lamps is identical so far as the form of the message is concerned.

174. Methods of providing improvised equipment.—Strips of white or colored cloth tied toward the outward end of sticks of wood or bayonets will serve for flag communication.

SECTION III

PYROTECHNICS

175. Description.—*a.* The pyrotechnic devices now used by the Army consist of rockets, Very pistol, position lights, airplane flares and special dischargers.

b. The signal rocket at the present time is probably the best known of military pyrotechnic devices. It is complete in itself and in its entirety does not weigh more than 2½ pounds. The signal rocket consists of a case or carton approximately 12 inches long by 1¼ inches inside diameter. Attached to the rocket body is a small cylinder or carton containing a composition which is ignited at the same time as that of the propelling charge. This device is called a smoke tracer, and leaves behind it a trail of smoke which aids the observer in determining from what point the rocket made its flight. Attached to the rocket body by means of a socket is a stick ⅝ inch square and 6 feet long which serves as a balance for the upward flight of the rocket. The propelling charge is of such composition and of such weight that it will force the rocket upward in its flight to a height of from 800 to 1,000 feet. The rocket is so designed that when the propelling charge has completed its work and the rocket has reached its height a blowing charge is ignited which expels the garniture from the head, throwing the parachute and signal to a distance of about 40 feet. During this flight the parachute frees itself and opens out holding the signal suspended. The signals are so designed that they are ignited by the blowing or expelling charge. Signal rockets may contain either a single star supported by a parachute or a single star or cluster of stars unsupported. These signals may be in three colors—white, green, and red. In addition there are special day signals of a red or yellow smoke or flag supported by a parachute.

Labels giving directions for the firing of the rockets are pasted on the waterproof rocket wrapper, on the rocket head, and at the ignition end of the rocket.

c. The Very pistol cartridge is a pyrotechnic cartridge which is fired from a specially designed pistol. The cartridge, which is similar to a shotgun cartridge, holds the signal which is propelled about 200 feet, burning from 6 to 8 seconds, the ignition taking place about 50 feet from the muzzle of the pistol. The Very pistol cartridge may have either red or white single stars, red caterpillar with parachute, red star cluster, or yellow smoke with parachute.

d. V. B. cartridges are pyrotechnic devices which are fired from a discharger (tromblom) attached to the muzzle of a rifle. They are used for signaling purposes and are usually fired to a height of about 500 feet. The charge, which is projected into the air, consists of small briquettes which burn with a brilliant light and produce a meteor effect, or colored lights suspended from a parachute which can be easily distinguished from the meteor effect. The V. B. cartridge is shot out by means of the explosion of a blank cartridge in the rifle. The discharger is portable and may be attached to any standard type of rifle. The blank cartridge used for the V. B. cartridge is supplied with a reduced charge. Each V. B. cartridge has a blank rifle cartridge attached to it so that men in the field are supplied with a special cartridge to fire it.

e. Position lights are made to burn with a white, red, or green illumination. Such pyrotechnic devices are relatively small, can be easily transported, and are efficient for illuminating purposes as well as for signaling. The position light is cylindrical in form, 2½ inches high by 1½ inches inside diameter, and is loaded with an illuminating composition. Ignition is accomplished by means of the striker disk and the prime blob.

f. Airplane flares, wing-tip flares, and wind-direction signals are illuminating devices and aids to navigation.

g. Pyrotechnic devices which lend themselves most readily to the use of small cavalry units are Very pistol cartridges and position lights. When their use is probable, position lights may be carried in saddle bags.

176. Care.—*a.* Signal and lighting fireworks must not be mingled with ammunition or other fireworks. Signal fireworks (red or green) are loaded with compositions which are liable to explode in certain cases, and hence these should be separated from other signal or lighting fireworks whenever this is feasible.

b. Since Very pistol cartridges and V. B. cartridges are discharged by percussion, due caution will be exercised to prevent accidental discharge. Boxes will be placed flat, top side up, and protected against moisture. In storehouses and depots fireworks will, as far as possible, be classed by lots manufactured about the same time; the oldest will be distributed first. Fireworks whose serviceability is uncertain will be tested.

177. Use.—*a.* Pyrotechnic signals are important for acknowledging lamp signals and, to a more limited extent, flag signals.

b. In order to insure transmission through fog, smoke, and dust it may be necessary to establish a chain or series of stations equipped with pyrotechnic devices.

c. The primary use of position lights is to mark the location of the front line upon request by aerial observers. The grouping of position lights by ones, twos, or threes might be used to convey information. They should be distributed evenly along the front line and never lighted except on request by the airplane. It is generally possible to screen the lights from enemy view by placing them at the bottom of a shell hole or behind a screen of some sort. Position lights are not projected and consequently have a limited range of visibility in any but a vertical direction.

d. Due to the rather high recoil of the V. B. cartridge, the butt of the rifle is placed on the ground before discharge. The desired angle which will project the light either for signaling or for illuminating is obtained by inclining the rifle.

e. Due to the danger involved, rockets should be fired from a tube or trough whose position is nearly vertical.

178. Training.—The steps to be followed in training pyrotechnic men are as follows:

a. The firing and reading of signals.

b. The employment and tactical use of pyrotechnic signals

c. Care, handling, and distribution of fireworks.

d. Instruction in the use of the compass and in map reading.

e. The transmission and reception of messages.

f. The establishment, operation, and maintenance of pyrotechnic stations under assumed tactical situations.

179. Pyrotechnic signals.—*a.* The following are the standard pyrotechnic signals:

(1) *Ground service—projected signals.*—Single star, parachute, red; single star, parachute, white; caterpillar, parachute, red; star cluster, red; yellow smoke, parachute; phosphorus smoke; message signal.

(2) *Air service—projected signals.*—Single star, parachute green; caterpillar, parachute, white; caterpillar, parachute, green; star cluster, white; star cluster, green; airplane flare, parachute, white; wind direction signal; orb; streamer; yellow smoke, parachute; phosphorus smoke; message signal.

(3) *Ground service and air service.*—Position lights, red; position lights, white; position lights, green; wing tip flare.

b. A sample pyrotechnic code is as follows:

(1) For use by the liaison airplane.

I am the airplane of the 4th Division.	Single star parachute, green.
Understood	Caterpillar, parachute, white.
Where are you?	Star cluster, white.

(2) For use by the Infantry.

Request for artillery fire in preparation for our attack.	Single star parachute, white.
We are ready to attack	Yellow smoke rocket.
We are going to advance; lengthen fire.	Caterpillar parachute, red.
Understood or am ready	Star cluster, red.
Request for artillery barrage	1 red star.
Our front line position, all is going well.	Position lights, white.
Our front line position, we are held up.	Position lights, red.

c. Additional pyrotechnic signals which may be used:

Request for grenades	(To be provided.)
Field artillery fire is falling short	Do.
Heavy artillery fire is falling short	Do.
Objective reached	Do.
Repeat message (or signal) or not understood.	Do.
We are stopped before reaching objective.	Do.

SECTION IV

PANELS

180. Reference.—For description of panels and general information on panel signaling see chapter 7, Basic Field Manual, Vol. VIII. The panel codes are published on cards and issued to using organizations. (See par. 204 *d.*)

181. Care.—Panels should be examined before and after use and repairs made to any rent or loose grommets. When soiled, panels should be thoroughly washed and dried in the sun. Signals made with clean panels are much more easily read than those made with dirty panels. Panels which are damp or wet should be thoroughly dried before folding for carrying. This prevents deterioration and also lessens the weight of the panels.

182. Use.—Signals made with identification panels should appear as pictured to the observer in rear of them and facing the enemy. In view of the fact that enemy airplanes can also locate command posts when identification panels are displayed, they are removed when not in actual use. To facilitate identification and location of command posts and headquarters, it is necessary for a friendly airplane observer to have noted on his map the location of the headquarters or command post with which he works and to call for identification as he needs it.

183. Training.—The steps to be followed in training panel men are—

a. The memorizing of the designs for panel numerals, special signals, and identification panel groups of their own headquarters.

b. The displaying of panel numerals, special signals, and identification panel groups on the ground by means of panels.

c. Simulated practice in sending messages or signals to the airplane.

d. Location of panel ground and actual transmissions to an observer in an airplane.

CHAPTER 5

DROPPED AND PICK-UP AIRPLANE MESSAGES

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SECTION I.	Dropped messages	184–187
II.	Pick-up of messages	188–193

SECTION I

DROPPED MESSAGES

184. Use.—Dropped messages are normally received by units down to and including the battalion, but in emergency or by prearrangement messages may be dropped to any unit, detachment, or individual. During heavy shelling by friendly batteries, except in emergencies, dropped messages are not sent to units in front of the light artillery positions.

185. Dropping grounds.—Message-dropping grounds or panel-display grounds are located near the radio station. Unit panels are displayed on these grounds when there is a message for the airplane or when the airplane calls for panels. A dropping ground should be an open space removed from high trees, bodies of water, and weeds. A panel-display ground must be so located if possible that the panels can be seen from airplanes at wide angles from the vertical.

186. Procedure in dropping a message.—When an airplane desires to drop a message for a particular unit, it makes a prearranged wing or pyrotechnic signal, meaning "attention," over the unit for which the message is intended. The unit displays its identification panel and makes a panel or pyrotechnic signal meaning "understood." The message is then dropped by the airplane in the nearest clear space to the point where the ground troops made the signal. On the approach of a friendly airplane, all ground troops observe the airplane for a dropped message. Whether or not prearranged signals are made from the airplane, the message will be picked up by the nearest troops and taken at once to the unit message center or to the commanding officer.

187. Equipment.—*a.* The message bag and streamer are improvised by Air Corps personnel, the bag being made of heavy cloth. It is 7½ inches long by 4¼ inches wide. In order to mark for ground troops the line of descent of the bag and its location on the ground, it has two 72-inch streamers, one yellow and one white. Two ounces of sand are placed in one end so that the bag will fall straight to the ground. The bag also contains one-fourth ounce of kapok to keep it afloat if dropped in water. A draw string or other suitable means is provided for securely fastening the message compartment. Printed on the bag are the words, "MAIL OR DELIVER TO THE NEAREST U. S. AIR CORPS TROOPS."

b. Metal tubes are provided by the Air Corps for dropping maps or photographs; these tubes, made of duralumin, are 9¾ inches long and 1⅜ inches in diameter. A chrome-yellow streamer 30 by 3½ inches is attached. The tube is closed by a rubber stopper.

SECTION II

PICK-UP OF MESSAGES

188. Use.—The method of pick-up described herein is used when it is desired to pick up messages or other light packages from localities where landing fields are not available.

189. Pick-up field.—An open field is selected 300 yards or more in length, with clear approaches up and down wind—i. e., there should be no obstacle in the line of flight of the airplane which would keep it from flying close to the ground. The direction of the wind must be carefully noted as the line of flight of the airplane will be into (against) the wind. The degree of success obtained will depend largely upon the selection of the field and the careful layout of the apparatus.

190. Equipment.—*a.* The materials required are—

Two light poles, 12 to 14 feet long and about 2 inches in diameter, or two rifles with bayonets attached.

Two 20-penny nails, with heads filed off, or two pieces of stiff wire. (No nails or wire are needed if rifles and bayonets are used.)

One hundred feet of cord about three thirty-seconds inch in diameter or any flexible material of equal strength and weight.

Two code-and-distinguishing panels (12 by 2⅓ feet each).

Two streamers approximately 16 inches by 3 feet, preferably white.

One message bag.

b. The issue of standard equipment for message pick-up is not contemplated, it being assumed that the items listed, or satisfactory substitutes therefor, are either supplied the unit for other purposes or can be improvised locally.

191. Preparation and arrangement of equipment.—*a.* The equipment is prepared as follows:

(1) A 20-penny nail with head filed off is partly driven into each pole about 6 inches from the top. It is important that the nails be carefully smoothed off so that the string can not foul. If rifles with bayonets attached are used in lieu of poles, the hilt of the bayonet is used in the same manner as in prescribed below for the nail.

(2) A white streamer is tied around or otherwise fastened to the top of each pole so that it hangs down the side of the pole opposite the nail. These streamers mark the tops of the poles for the pilot.

(3) The cord is then tied into a continuous loop and the message bag is attached to one side thereof. Each message bag should weigh about 1 pound. If the weight of the bag and message is less than 1 pound, some foreign substance of small volume should be added to make the weight about 1 pound. This weight, however, should not be exceeded.

b. Figure 84 illustrates the arrangement of the equipment for pick-up work. The poles are placed about 40 to 50 feet apart and are held upright in such a manner that the nails point into (against) the wind. The streamers on the poles assist in placing them in the proper position with respect to the wind. The cord loop is then so placed over the nails that the message bag will be equidistant from the poles and hang clear of the ground, the complete cord loop thus forming a triangle whose plane is perpendicular to the direction of the wind and whose apex, to which the message bag is attached, points to the ground. The taut horizontal portion of the cord is that by which the pick-up is to be accomplished.

c. The panels are now laid out, one extending from the base of each pole in the direction toward which the wind is blowing. These panels assist in marking the position for the pilot.

192. Procedure in picking up the message.—*a.* When all is ready, the airplane is signaled by panel to pick up the message.

The airplane will then approach against the wind with about 50 feet of the radio antenna (or other weighted line) trailing, and will pick up the cord loop and message by fouling the top of the cord loop by the antenna or line. The antenna or line is then hauled into the airplane and the message removed. The ground detail immediately takes up the "pick-up message" panel signal.

b. More than one attempt may be necessary, however, before the message is successfully picked up. If a pick-up attempt is unsuccessful, the ground detail will prepare for another trial.

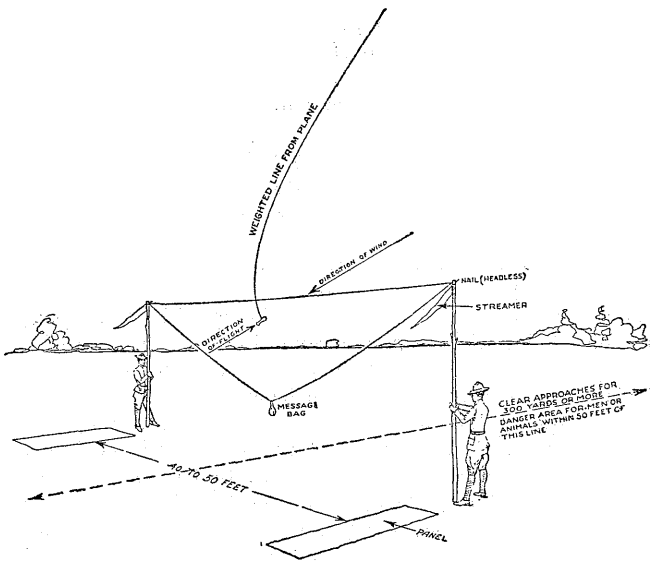


FIGURE 84.—Arrangement of equipment for message pick-up

If repair or rearrangement of equipment is necessary, the panel signal for "pick-up message" will be removed until all is ready for the next attempt.

c. All members of the ground detail should watch the approaching airplane, and especially the weight on the end of the antenna or line. Since it is difficult for the pilot to exactly control the path of the line and weight, the ground men should be alert to avoid being struck by the weight and also to prevent the fouling of the line with the poles.

193. Training.—In preparing yearly training programs, provision should be made where practicable for training in message pick-up. In order to impress on all personnel the possibility of the use of this means of communication without special equipment, the ground troops should be required to entirely improvise the equipment required, utilizing for the purpose organizational equipment, personal equipment and clothing, or articles obtained locally. For example, two small trees might be used for poles, stubs or branches being utilized in lieu of nails or wire, undershirts might serve as panels, handkerchiefs as streamers, an old rag for message bag, and unraveled shelter-tent ropes for cord.

CHAPTER 6

MESSAGE CENTER

		Paragraphs
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SECTION I

GENERAL

194. Reference.—For the classification of messages according to necessity of speed in their transmission, see paragraph 122, and chapter 8, Basic Field Manual, Volume VIII.

195. Definition.—The term "message" as used in this chapter includes all instructions, reports, orders (either cryptographed or in clear text), documents, photographs, or maps transmitted by agencies of signal communication.

196. The message center defined.—*a.* The message center is the agency at each headquarters or command post charged with the receipt, transmission, and delivery of all messages except the following:

(1) Messages transmitted from the originator to the addressee by telephone or personal agency.

(2) Messages handled by the Military or Civilian Postal Service.

(3) Messages passing directly from the originator to a signal communication agency (as a radio station) for immediate transmission, in cases authorized by the commander.

b. The unit message center exists primarily for service to the commander and his staff and furnishes this service by—

(1) Providing a fixed locality to which messengers or messages may be directed.

(2) Coordinating the use of various agencies of signal communication.

(3) Keeping temporary but reliable records to insure the prompt and accurate handling of all messages passing through the message center.

c. The message center is not organized or equipped to perform stenographic or clerical work pertaining to the different sections of the staff, nor to prepare additional copies of incoming messages for multiple distribution.

197. Principles of operation.—*a.* During active operations message center service is continuous, and is effected as follows:

(1) Message centers may function during the march to afford communication between columns, communication within the column, and communication with aerial or ground reconnaissance troops.

(2) A message center is established at each echelon of the headquarters. When a headquarters echelon moves, the message center opens at the new location prior to the closing of the message center at the former location.

b. The message center and the routes leading thereto are marked with appropriate signs. On the march the position of the message center in column is made known to all concerned.

c. In coordinating the use of the various agencies of signal communication, the message center employs the most suitable means available for the transmission of any message. To this end the message center must be kept informed as to the availability of all agencies. The considerations governing the means of transmission to be employed are—

(1) Messages to go only a very short distance should ordinarily be sent by messenger.

(2) Short messages going a comparatively long distance should be sent by some electrical means.

(3) Very long messages should usually be sent by messenger.

(4) When necessary to send long messages by radio, they should be broken up into several transmissions.

(5) If the importance of the message so warrants, it may be sent by two or more means.

(6) Urgent and priority messages are sent by the most rapid means available.

198. Abbreviations.—In designating the agency by which messages may be sent the following abbreviations, in addition to those listed in AR 850–150, are authorized:

Tp=Telephone.	Pgn=Pigeon.
Tg=Telegraph.	Run=Runner.
Msgr=Messenger.	Mtclt=Motorcyclist.
Rad=Radio.	Bclt=Bicyclist.
Vis=Visual.	Mtd=Mounted.
Msg Cen=Message center.	Sp Msgr=Special messenger.
Msg=Message.	

199. Prescribed procedures.—In keeping records of traffic, the message center follows the simplest procedure consistent with the prompt and accurate handling of messages. A simpler procedure can be followed in small units than in large ones. For this reason, two methods of message center procedure are authorized by this manual. The first procedure (Sec. IV) is applicable to divisions and higher units, while the second (Sec. V) is usually employed by brigades and lower units. However, nothing in this manual will be construed to restrict brigades and lower units from using the procedure prescribed in Section IV, if found advisable.

SECTION II

MILITARY CRYPTOGRAPHY

200. Use of cryptograms.—All messages to be transmitted by radio or other means, when danger of hostile interception exists, are cryptographed, except in the following cases:

a. The commander may direct that a message be transmitted in clear text when in his opinion the information contained is of no value to the enemy, or when the urgency of the message outweighs its value to the enemy. Such messages will be marked "Send in clear," over the commander's signature.

b. Commanders may authorize the normal transmission of artillery fire-control messages in clear.

c. All cryptographing and decryptographing of messages at a headquarters are performed in the message center, except as authorized in paragraph 223, unless the message requires a code or cipher not in the possession of the message center. The message center is provided with the authorized codes, cipher devices, and keys.

d. If it becomes necessary to modify the wording of a message to facilitate cryptographing, the modified text will be submitted to the originator for approval before transmission.

201. Definitions.—A knowledge of the following terms is essential for all personnel handling code and cipher communications.

a. Plain text, or *clear text,* or *plain anguage* is the text of a writing which, on its face, conveys an intelligible meaning in a known language.

b. Secret text or *secret language* is the text of a writing which, on its face, conveys no intelligible meaning in any known language. The secret text of a message constitutes a cryptogram.

c. Cryptography is the science which embraces all the methods and devices whereby plain text may be converted into secret text.

d. Cryptograms are of three fairly distinct types as follows:

(1) *Cipher.*

(*a*) A cryptogram in *cipher* is one which has been produced by taking the individual letters of the plain text as units and applying to them either or both of two cryptographic processes known as *transposition* and *substitution,* explained below. The resulting secret text is called *cipher text,* and the operation of producing it is called *enciphering;* the reverse operation, that of reproducing the plain text from the cipher text by a *direct reversal* of the steps involved in its enciphering is called *deciphering.*

(*b*) The basis of every cipher system is an agreement between correspondents covering the general method and the steps to be followed in cryptographing. That portion of the agreement which specifically controls the steps under the general method is termed the *key.* The key is usually of a variable nature, changeable at the will of the correspondents. Normally it consists of an easily remembered word, phrase, or sentence; or of a number or series of numbers derivable from a word, phrase, or sentence.

(*c*) The crytographic process known as *transposition* consists in rearranging the letters constituting the plain text (rarely syllables or whole words) so that the resultant text becomes unintelligible. The letters undergo no change in identity; only their relative order is altered. A cryptogram which has been produced in this way is termed a "*transposition cipher.*"

(*d*) *Substitution cipher.*—The cryptographic process known as *substitution* consists in replacing the letters constituting plain text by other letters, figures, symbols, or the like. Here the letters undergo a change in identity, without a change in their relative order. A cryptogram which has been produced in this way is termed a "*substitution cipher.*"

(*e*) *Combined cipher.*—When both of these processes have been applied in producing a cryptogram the latter is termed a combined "*substitution-transposition cipher.*"

(2) *Code.*

(*a*) A cryptogram in *code* is one which has been produced by taking whole sentences, phrases, words, letters, or numbers of plain text as units and replacing them by arbitrary groups of symbols given as their equivalents in a *code book.* The resulting secret text is called *code text,* and the operation of producing it is called *encoding;* the reverse operation, that of reproducing the plain text from the code text by reference to the code book, is called *decoding.* A "one-part code" consists of only one section, which serves for either encoding or decoding. A "2-part code" consists of two sections, one section arranged to facilitate encoding and the other to facilitate decoding. A 1-part code is very much less secret than a 2-part code.

(*b*) *Code groups* or *code words* are arbitrary groups of symbols constituting code text. They usually consist of letters or figures or rarely of both letters and figures.

(3) *Enciphered code.*—A cryptogram in *enciphered* code is one which has been produced by first encoding the plain text and then enciphering the code text.

e. To *cryptograph* a message is to convert its plain text into secret text. This is a convenient term to use in referring to the processes involved without indicating or specifying whether they are methods of enciphering or encoding.

f. To *decryptograph* a message is to reconvert its secret text into plain text by a *direct reversal* of the operations involved in its cryptographing. This is a convenient term to use in referring to the processes involved without indicating whether the crypto-

gram is in cipher, in code, or in enciphered code. Thus, just as enciphering and encoding are forms of *cryptographing*, so deciphering and decoding are forms of *decryptographing*.

g. Cryptanalysis is the name applied to the steps and processes involved in converting cryptograms (usually of hostile origin) into plain text by means other than those normally employed in decryptographing messages of friendly origin.

202. Safety afforded by cryptography.—Codes and ciphers are used in military communications for either or both of two purposes—condensing messages and maintaining secret, except from the addressee, the contents of messages. Unless secrecy is accomplished with certainty, all of the additional time, labor, and danger of error involved in cryptographic messages is wasted; moreover, the correspondents may be lulled into a false sense of security in the belief that their messages are secret, when, in fact, the enemy may have cryptanalyzed them and taken action accordingly. With the increased use of radio, as well as other means of electrical communication, the safeguarding of codes and ciphers has assumed a paramount importance. In general it may be stated that no cryptographic system suitable for a voluminous official correspondence is absolutely proof against the organized, cooperative efforts of a large and well-trained staff of cryptanalysts. Practically every cipher system that has ever been employed for military purposes has been solved, and practically any code book can be reconstructed by analysis, given a sufficient number of cryptograms and the personnel and time necessary to accomplish it.

203. Comparison of codes and ciphers.—*a.* Each of these two general methods of secret communication is needed in the military service. A cipher machine meeting all the requirements of practicability and secrecy has not yet been produced. The principal factors to be taken into account in comparing code and cipher methods as systems of secret communication are—

(1) Simplicity, rapidity, practicability.
(2) Secrecy.
(3) Accuracy.
(4) Economy.

b. In general, it may be said that code is a more rapid and more simple method of secret communication than is cipher. The processes of enciphering and deciphering require very close mental attention to avoid errors, and are usually much slower than those of encoding and decoding, which more nearly ap-

proach automatic processes and thus require less concentrated mental effort. This is of greatest importance in the combat zone. There are some very small cipher devices which tend to reduce the mental strain to a minimum, but in general the cryptograms they yield are not as secret as those produced by a good code, especially when many messages are available for interception by the enemy.

c. Code systems are, on the whole, more secret than cipher systems, depending upon—

(1) The type of code. A 2-part code is more secret than a 1-part.

(2) The extent of its vocabulary or contents.

(3) The extent to which the code is used; that is, the number of messages transmitted.

d. Furthermore, the solution of one message does not as a rule entail the immediate breakdown of the whole system, with the consequent solution of all other messages in the same key, as is the case in ciphers. On the other hand, in the case of code it is absolutely necessary to guard at all times the code book, so that it does not fall into the hands of the enemy. Actual possession is not always necessary, for a single opportunity to copy or memorize certain portions is sufficient to compromise the whole code.

e. On the whole, it may be said that code systems are less accurate than cipher systems and are more subject to the necessity for repetition of messages. This is because a mistake in one or two code groups may obscure, alter, or render unintelligible the meaning of a whole message, whereas, in the case of ciphers, the meaning of a few letters which are in error may be supplied by the context.

f. Since code text is usually shorter than the equivalent plain text, the latter is more economical to handle than cipher. This is of great importance where the amount of signal traffic is heavy. On the other hand, for the purpose of maintaining secrecy in military communication, codes of the 2-part type must be changed rather frequently. This necessitates repeated processes of preparation, printing, and distribution, all of which take much time and labor.

204. Authorized military codes.—Among others, the following codes are authorized for general use in the military service:

a. War Department Telegraph Code.—This code is a nonsecret code primarily intended for economy. It furnishes no security

from code experts, and should never be used for encoding secret messages. It is issued to all those who are required to handle any considerable volume of business by telegraph, radio, or cable.

b. Army Field Code.—This code is issued to message centers of divisions and higher tactical units up to and including general headquarters. It is confidential.

c. Division Field Code.—This code is issued to message centers of divisions and all lower tactical units down to and including the battalion, and in peace time for training purposes it may be issued down to companies. It is confidential.

d. Aerial Observation Codes and Panels.—These codes are prepared by the War Department or the headquarters of the field forces and are issued to all units that engage in communication between ground and air. Blank groups are left in both, for assignment of special meanings by local commanders, to meet special situations. There are two parts:

(1) The Fire-Control Code is fixed and nonconfidential and is used in adjustment of fire.

(2) The Air-Ground Liaison Code is confidential and is employed in general observation and reconnaissance. In emergencies it may also be used in the absence of other cryptographic means for communication between forward ground stations. It is revised frequently, for purposes of secrecy, by rearrangement of code groups and their meanings.

e. Special codes.—Such codes as address and signature codes, telephone codes for organizations and officers, geographic, meteorological, and supply catalogue codes, as well as appendices to the various codes listed above, will be published from time to time.

205. Authorized military ciphers.—Among others, the following ciphers are authorized for use in the military service:

a. Cipher Device, Type M–94.—This cipher is explained in Section III. It is normally used for messages, the origin or destination of which is forward of battalion headquarters.

b. Printing Telegraph Cipher System.—This is a cipher system operated in connection with printing or automatic telegraph machines, and is used only between the larger headquarters where traffic is very great.

206. Rules for use of codes and ciphers.—The following general rules govern the use of codes and ciphers:

a. The instructions contained in each code book or furnished with each cipher system must be carefully studied and thoroughly understood before the code or cipher is used.

b. Care should be exercised to prevent the loss or compromise of a code book or cipher key. If a code book is lost or possibly compromised, the fact should be reported promptly to higher headquarters.

c. Except in emergency, no code or cipher which has not been approved by higher authority should be employed within any unit.

d. Care should be exercised that only one edition of a code of a particular class, or only one cipher key is being used within a unit at one time. When a code is replaced by a new code or a new edition, the replaced code will be destroyed by burning, unless otherwise ordered.

e. Cryptographic messages should be short and concise. Long messages facilitate the solution by the enemy.

f. Never repeat a message in a code or cipher other than the one in which it was originally sent. If the enemy has already solved one of the codes or cipher keys used, he will translate the message by that code or cipher key and will thus be given clues to the solution of the other code or cipher key.

g. Never cryptograph a message which has been sent previously in clear, and never send a message in clear which has been sent previously as a cryptogram. If the enemy compares the cryptographic message with the clear message he will be able to break into the code and solve other messages, or, in the case of ciphers, he will have the key for the solution of all other messages.

h. Never mix secret and clear text in the same message. This applies also to abbreviations and signs of punctuation, which are equivalent to clear text. If clear text of any kind whatever is left in the message, the enemy can more easily discover the meaning of the secret text. If cryptographed at all the entire message must be cryptographed.

i. A decryptographed message never should be filed with the clear message. If it is desired to keep the two attached for any purpose, the clear copy should be paraphrased.

j. Capital letters should be employed throughout in writing cryptograms in order to avoid errors. In the case of code, the grouping of the letters of the code text corresponds to the length of the code groups as given by the book; in the case of cipher, the text is written and transmitted in groups of five letters.

SECTION III

DESCRIPTION AND USE OF THE CIPHER DEVICE, TYPE M–94

207. Purpose and distribution.—Cipher device, type M–94, is a cryptographic instrument that is an item of equipment issued by the Signal Corps to all message centers as one of the authorized means for secret communication. It is also an item of equipment possessed by all naval units and stations, including those of the Marine Corps, and can be employed in certain classes of secret intercommunication between the Army and the Navy when specific arrangements therefor have been made by the appropriate commanders.

208. General description.—*a.* The device is made of aluminum alloy and consists of the following parts:

(1) A central *shaft*, the left end of which terminates with a projecting shoulder, the right end of which is threaded;

(2) A set of 25 *alphabet disks*, on the rim of each of which there is stamped a different, completely disarranged alphabet;

(3) A *guide-rule disk*, consisting of a blank or unlettered disk from which there projects a guide rule;

(4) A *retaining plate*, consisting of a thin disk upon one surface of which is stamped the name and type number of the device;

(5) A knurled thumb nut.

b. Each disk has a hole at the center suitable for mounting it upon the central shaft, upon which the disk can be revolved forward or backward. The left face of each alphabet disk is provided with a circle of 26 equidistant slots; the right face is cupped, and carries at one point on the inside rim of this cup a small projecting lug. The guide-rule disk also carries such a lug. When the disks are assembled upon the shaft, the lug on each disk engages with one of the slots on the adjacent disk on the right and thus the disks can be held in engagement in any desired relative positions by screwing down the knurled thumb nut against the retaining plate, which is inserted between the last alphabet disk and the nut.

c. When the thumb nut and the retaining plate are removed and the alphabet disks are taken off the shaft, it will be noted that each alphabet disk is stamped on its inside or cup surface with an identifying symbol consisting of a number that is above the central hole and a letter that is below it. The numbers run from 1 to 25, inclusive, the letters from B to Z, inclusive. These symbols

are employed to designate the sequence in which the alphabet disks are to be assembled upon the shaft in cryptographing or decryptographing messages, as described in paragraph 210. Either symbol may be used for this purpose (as prearranged) but for the present only the numerical identifying symbols will be so used.

209. Necessity for key and providing for changes therein.—*a.* Messages cryptographed by the same sequence of alphabet disks can remain secure against solution by a well-organized and efficient enemy cryptanalytic section for only a relatively short time. It is impossible to state exactly how long, because solution depends upon a number of variable factors; a conservative estimate would place the minimum at six hours, the maximum at two or three days. For this reason it is necessary to change the sequence from time to time, and the method for determining or indicating the new sequence must be agreed upon in advance and thoroughly understood by all who are to use the instrument.

b. The sequence in which the alphabet disks are assembled upon the shaft constitutes the *key* in this cipher system. When a change in key is to take place, exactly what the new key will be and the exact moment that it is to supersede the old key will be determined by the proper commander and will be communicated in signal operation instructions (see par. 241).

210. Detailed instructions for setting the device to a predetermined key.—*a.* The method prescribed herein is based upon a *key word* or *key phrase* from which the sequence of numbers constituting the key for assembling the alphabet disk can be obtained by following a simple, standardized procedure. The reason for employing such a procedure is that it makes it possible to derive, at will, a relatively long sequence of numbers (which would be difficult to remember) from a word or phrase (which is easy to remember) and thus eliminates the necessity of carrying the key in written form upon the person. It is this basic key word or key phrase which is communicated throughout the command in signal operation instructions. The exact method of deriving the numerical key sequence from the key word or key phrase is given step by step in the following subparagraph.

b. Assume that the key phrase so communicated is CHINESE LAUNDRY. The following are the detailed steps to be followed in deriving the numerical key sequence:

(1) A set of rows of cross section squares, 25 squares in each row, is prepared. (Prepared sheets of ¼ inch squares are suitable.)

(2) In the top row the series of numbers 1, 2, 3–25 are inserted. Thus:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

(3) Beginning under the number "1," the successive letters of of the key phrase are written in the second row of squares, under the successive numbers. Thus:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y											

(4) The key phrase is extended by repetition until there is a letter under the number "25," making a *key sequence* of 25 letters.[1] Thus:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N

(5) The letters of the key sequence are now to be numbered serially from left to right in accordance with the relative position that each letter occupies in the ordinary alphabet. Since the letter "A" comes first in the ordinary alphabet, and since this letter occurs twice in the illustrative key sequence, the number "1" is written under the first appearance of A in this sequence, and the number "2" is written under its second appearance. Thus:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
								1														2		

(6) The next letter in the ordinary alphabet is B. The key sequence is carefully examined to see if it contains the letter "B." Since this letter does not appear in the illustrative key sequence, the latter is examined to see if it contains the letter "C." This letter occurs twice in the illustrative key sequence

[1] If the key consists of a word or phrase containing more than 25 letters, those after the twenty-fifth letter are merely omitted.

and the first C, therefore, is assigned the number "3," the second C the number "4." Thus:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
3								1						4								2		

(7) The next letter in the ordinary alphabet is D, which, being present in the key sequence, is assigned the next number, and so on. Thus, the process is continued until each letter has been assigned a number. The work must be done carefully so as not to overlook a single letter. If an error is made in the early stages of the work, it necessitates starting afresh. The operator should be especially careful with letters which immediately follow one another in the ordinary alphabet but are present in the key sequence in reversed order, such as ED, FE, ON, and so on. It is easy to make a mistake in such cases and to assign these letters numbers in a sequence that is the reverse of what it should be.

(8) When the numbering process has been completed, and if the work has been correctly performed, it will be found that every letter of the key sequence has a number under it, and that the greatest number that appears is 25. If this is not the case, it is an immediate signal that an error has been made. It can not, however, be assumed that so long as every letter has a number under it, with the greatest number 25, this is immediate and conclusive proof of accuracy in the work. The operator should *invariably* check his work; better yet, if two clerks are available each one should derive the numerical key independently and the final results checked by comparison.

(9) The key phrase selected as an example in the foregoing description yields the following numerical key:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
3	10	12	16	6	21	7	14	1	23	17	5	20	25	4	11	13	18	8	22	9	15	2	24	19

(10) It is this sequence of numbers which indicates the order in which the successive alphabet disks are to be assembled upon the shaft from left to right. Thus, according to the foregoing key sequence, alphabet disk No. 3 comes first, that is, immediately to the right of the guide-rule disk; alphabet disk No. 10 comes next, and so on. Alphabet disk No. 19 is the last in this particular key, and after it has been placed on the shaft, the retaining plate and thumb nut are added and the latter screwed down a

distance sufficient to keep the assembly together and yet permit of revolving individual disks freely upon the shaft. The instrument is now ready for use in either cryptographing or decryptographing messages.

211. Cryptographing a message.—Suppose the following message is to be enciphered with the key derived in paragraph 210:

CO 3d INF

HAVE JUST REACHED EASTERN EDGE OF WOODS ALONG 552–592 ROAD. WILL REMAIN IN OBSERVATION.

CO 2d BN

a. The message is written down on the work sheet underneath the key in lines of 25 letters each. Space is left under each line for the insertion of cipher letters. (For procedure in connection with abbreviations and numbers appearing in the text of messages, see par. 212.) Thus:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
3	10	12	16	6	21	7	14	1	23	17	5	20	25	4	11	13	18	8	22	9	15	2	24	19
C	O	T	H	I	R	D	I	N	F	H	A	V	E	J	U	S	T	R	E	A	C	H	E	D
E	A	S	T	E	R	N	E	D	G	E	O	F	W	O	O	D	S	A	L	O	N	G	F	I
V	E	F	I	V	E	T	W	O	D	A	S	H	F	I	V	E	N	I	N	E	T	W	O	R
O	A	D	W	I	L	L	R	E	M	A	I	N	I	N	O	B	S	E	R	V	A	T	I	O
N	C	O	S	E	C	O	N	D	B	N														

b. By revolving the disks upon the shaft, one by one, the first 25 letters of the message are aligned to form a continuous horizontal row of letters reading from left to right along the outside of the cylinder. The guide-rule will be found very convenient in marking the row upon which the letters are being aligned, thus relieving the eyes of unnecessary strain and reducing the chance of making errors. After all 25 letters have been aligned, the assembly is locked in position so that no disk can become displaced accidentally in further manipulation of

the cylinder. *The row of letters is immediately checked to make sure that no displacement has occurred among the first few disks while manipulating the last few.*

c. The outside of the cylinder now presents a series of 26 rows of letters, of which 24 rows are fully visible, the other two being hidden or partially obscured by the guide-rule. One of the 24 visible rows is the plain-text row that has just been set up, and the other 23 rows are cipher-text rows *any one of which may be selected to represent the plain-text row.* One of these cipher-text rows is selected at *random*, and the letters composing this row are written underneath the row of plain-text letters on the work sheet. Thus, supposing the row beginning LYEUJ has been selected, the first cipher line will read as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
3	10	12	16	6	21	7	14	1	23	17	5	20	25	4	11	13	18	8	22	9	15	2	24	19
C	O	T	H	I	R	D	I	N	F	H	A	V	E	J	U	S	T	R	E	A	C	H	E	D
L	Y	E	U	J	D	J	N	Y	P	Q	B	F	Y	N	E	C	N	H	P	F	A	G	P	G

It is not necessary to make any record on the work sheet as to which cipher-text row (above or below the plain-text row) was selected, nor is it necessary to indicate it in any manner whatever in the cipher message.

d. The thumb nut is loosened, but not removed from the shaft. The next 25 letters of the message are aligned, the thumb nut screwed down against the retaining plate, the letters in the alignment are checked, and again any one of the 23 visible cipher-text rows, except the one used to encipher the first line, is selected at *random* for the cipher text. The letters in the row selected are written down under the second line of plain-text letters on the work sheet. Thus, supposing the row beginning KZBYJ was selected, the work sheet now appears as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
3	10	12	16	6	21	7	14	1	23	17	5	20	25	4	11	13	18	8	22	9	15	2	24	19
C	O	T	H	I	R	D	I	N	F	H	A	V	E	J	U	S	T	R	E	A	C	H	E	D
L	Y	E	U	J	D	J	N	Y	P	Q	B	F	Y	N	E	C	N	H	P	F	A	G	P	G
E	A	S	T	E	R	N	E	D	G	E	O	F	W	O	O	D	S	A	L	O	N	G	F	I
K	Z	B	Y	J	I	A	H	N	S	R	A	N	D	J	M	E	F	S	Y	R	I	T	S	N

e. This process is continued in similar manner with the third and fourth lines of the plain-text message. *It should never be made a practice to "favor," i. e., frequently to select a particular*

cipher-text row above or below the plain-text row. As irregular a selection as possible should be made, and the selection of the cipher-text row immediately above the plain-text row or immediately below the lower edge of the guide-rule should be avoided. Supposing these instructions to have been followed and that there has been selected for the cipher-text row representing the third plain-text line of the message the row beginning RAMTF, and for that representing the fourth line, the one beginning PJNSY, the message now stands as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
3	10	12	16	6	21	7	14	1	23	17	5	20	25	4	11	13	18	8	22	9	15	2	24	19
C	O	T	H	I	R	D	I	N	F	H	A	V	E	J	U	S	T	R	E	A	C	H	E	D
L	Y	E	U	J	D	J	N	Y	P	Q	B	F	Y	N	E	C	N	H	P	F	A	G	P	G
E	A	S	T	E	R	N	E	D	G	E	O	F	W	O	O	D	S	A	L	O	N	G	F	I
K	Z	B	Y	J	I	A	H	N	S	R	A	N	D	J	M	E	F	S	Y	R	I	T	S	N
V	E	F	I	V	E	T	W	O	D	A	S	H	F	I	V	E	N	I	N	E	T	W	O	R
R	A	M	T	F	O	M	O	K	E	N	C	S	H	C	S	P	M	X	H	T	E	X	G	M
O	A	D	W	I	L	L	R	E	M	A	I	N	I	N	O	B	S	E	R	V	A	T	I	O
P	J	N	S	Y	V	A	W	U	C	H	Y	F	H	E	Y	T	B	G	P	Y	K	G	M	G

f. There are left only eight letters to be enciphered, not enough to make a complete row of 25 letters. This, however, makes no difference in procedure; these eight letters are merely aligned and a cipher-text row is selected to represent them. Supposing the row beginning URZGH is selected, the message now stands as follows:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
3	10	12	16	6	21	7	14	1	23	17	5	20	25	4	11	13	18	8	22	9	15	2	24	19
C	O	T	H	I	R	D	I	N	F	H	A	V	E	J	U	S	T	R	E	A	C	H	E	D
L	Y	E	U	J	D	J	N	Y	P	Q	B	F	Y	N	E	C	N	H	P	F	A	G	P	G
E	A	S	T	E	R	N	E	D	G	E	O	F	W	O	O	D	S	A	L	O	N	G	F	I
K	Z	B	Y	J	I	A	H	N	S	R	A	N	D	J	M	E	F	S	Y	R	I	T	S	N
V	E	F	I	V	E	T	W	O	D	A	S	H	F	I	V	E	N	I	N	E	T	W	O	R
R	A	M	T	F	O	M	O	K	E	N	C	S	H	C	S	P	M	X	H	T	E	X	G	M
O	A	D	W	I	L	L	R	E	M	A	I	N	I	N	O	B	S	E	R	V	A	T	I	O
P	J	N	S	Y	V	A	W	U	C	H	Y	F	H	E	Y	T	B	G	P	Y	K	G	M	G
N	C	O	S	E	C	O	N	D	B	N														
U	R	Z	G	H	E	J	Q	S	M	D														

g. The cipher text is now to be copied on the message form, in 5-letter groups. It is as follows:

```
L Y E U J  D J N Y P  Q B F Y N  E C N H P  F A G P G
K Z B Y J  I A H N S  R A N D J  M E F S Y  R I T S N
R A M T F  O M O K E  N C S H C  S P M X H  T E X G M
P J N S Y  V A W U C  H Y F H E  Y T B G P  Y K G M G
U R Z G H  E J Q S M  D
```

h. The last group of the cipher message is, however, not a complete group of 5 letters. It is made so by adding four X's. *These are not to be cryptographed;* they are added merely to complete the last cipher group. The final message becomes as shown below:

```
L Y E U J  D J N Y P  Q B F Y N  E C N H P  F A G P G
K Z B Y J  I A H N S  R A N D J  M E F S Y  R I T S N
R A M T F  O M O K E  N C S H C  S P M X H  T E X G M
P J N S Y  V A W U C  H Y F H E  Y T B G P  Y K G M G
U R Z G H  E J Q S M  D X X X X
```

The message as it now reads is but *one* of many different forms in which this same message could appear externally, depending on exactly which of the available cipher-text rows is selected for each line of the encipherment.

212. Cryptographing abbreviations, punctuation signs, and numbers.—*a.* Authorized abbreviations appearing in the original plain-text message may be enciphered as abbreviations without periods. Examples: Am Tn=AMTN; E. V. Brown Sch=EVBROWNSCH.

b. Normally, the writer of a message spells out the punctuation signs he wishes transmitted, as, for example, STOP, COMMA COLON, etc. If a message contains punctuation signs not so spelled out, the message center chief must indicate whether they are to be omitted or spelled out and transmitted.

c. Cardinal and ordinal numbers when spelled out in letters in the original plain-text message are always enciphered exactly as spelled.

d. Cardinal numbers when expressed in figures in the original plain-text message must always be spelled out, digit by digit, in cryptographing. Examples:

4=FOUR
40=FOURZERO (and *not* FORTY)
400=FOURZEROZERO (and *not* FOUR HUNDRED)
455=FOURFIVEFIVE
450.7–758.8=FOURFIVEZEROPOINTSEVENDASHSEVEN-FIVEEIGHTPOINTEIGHT
2005=TWOZEROZEROFIVE
12.01 a. m.=ONETWOZEROONEAM
5.15 p. m.=FIVEONEFIVEPM

e. Ordinal numbers above the ordinal number 10th, when expressed in figures followed by "d," or "th," are cryptographed merely as digits spelled out, without adding the "d" or "th." The omission of the "d" or the "th" will cause no confusion or ambiguity. Examples: 3d Bn=THIRDBN; 7th Pack Tn=SEVENTHPACKTN; 11th Regt=ONEONEREGT; 403d Am Tn=FOURZEROTHREEAMTN.

213. Decryptographing a message.—*a.* Knowing the key word or key phrase, the numerical key is developed as described under paragraph 210, and the set of alphabet disks is assembled accordingly. The message to be decryptographed is written down in lines of 25 letters, on cross section paper, if available, space being left under each line for the insertion of plain-text letters. Using the cipher message given under paragraph 211 *h*, it appears under the key in the following form:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
3	10	12	16	6	21	7	14	1	23	17	5	20	25	4	11	13	18	8	22	9	15	2	24	19
L	Y	E	U	J	D	J	N	Y	P	Q	B	F	Y	N	E	C	N	H	P	F	A	G	P	G
K	Z	B	Y	J	I	A	H	N	S	R	A	N	D	J	M	E	F	S	Y	R	I	T	S	N
R	A	M	T	F	O	M	O	K	E	N	C	S	H	C	S	P	M	X	H	T	E	X	G	M
P	J	N	S	Y	V	A	W	U	C	H	Y	F	H	E	Y	T	B	G	P	Y	K	G	M	G
U	R	Z	G	H	E	J	Q	S	M	D														

b. The first 25 letters of the cryptogram are set up on the device, the letters being aligned in a row from left to right, just above the guide rule. Fixing the disks in this position by screwing down the thumb nut, the whole cylinder is turned slowly, forward or backward, and each row of letters is carefully examined. One of these rows *and only one* will read intelligibly all the way across from left to right. That is the row which gives the plain text for the first 25 cipher letters. These letters are inserted in their proper place on the work sheet, giving the following:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	H	I	N	E	S	E	L	A	U	N	D	R	Y	C	H	I	N	E	S	E	L	A	U	N
3	10	12	16	6	21	7	14	1	23	17	5	20	25	4	11	13	18	8	22	9	15	2	24	19
L	Y	E	U	J	D	J	N	Y	P	Q	B	F	Y	N	E	C	N	H	P	F	A	G	P	G
C	O	T	H	I	R	D	I	N	F	H	A	V	E	J	U	S	T	R	E	A	C	H	E	D

c. The thumb nut is then loosened, the next 25 cipher letters are set up, the assembly is locked into position, again the whole cylinder is slowly revolved, and the plain-text row of letters found. These are written down in their proper place, and the process is continued with the rest of the cipher letters until the message has been completely decryptographed.

d. In the case of a cryptogram the last few letters of which do not form a complete set of 25, if any difficulty is experienced in picking out the plain-text row, the context of the preceding part of the message should give a good clue. In the case of the illustrative message above, it should be realized that the last four letters of the cryptogram are not to be decryptographed since they were merely added *after* cryptographing to make the last group of the cryptogram a complete group of five letters. They are omitted from the work sheet.

e. The plain-text message is then copied on a message form. The code clerk may, if authorized to do so by the message center chief, convert numbers, which had to be spelled out in letters to permit of their cryptographing, into their equivalent arabic figures. Abbreviations and punctuation signs are, however, copied exactly as they stand in the decryptographed message.

214. Precaution.—*When in danger of capture, the alphabet disks of a device that has recently been used to cryptograph or decryptograph a message must be taken off, thoroughly disarranged, and reassembled.*

SECTION IV

PROCEDURE IN DIVISIONS AND HIGHER UNITS

215. Organization.—*a.* The size of the message center depends largely upon the type and size of the unit. For convenience in outlining the procedure, the following message center personnel are referred to by title: Message center chief, delivery clerk, and code clerk. When traffic is light all the duties of the message center may be performed by one or two men. When the traffic is heavy, five or more men may be required.

b. Each member of the message center will be so trained that any man can assume the duties of any other man in the message center.

216. Types of messages.—For the purpose of illustrating the operation of the message center, messages are considered to fall within one of four types as follows:

a. Outgoing messages.—Messages originating in a headquarters and filed at the message center serving that headquarters, for transmission to an office or individual served by another message center.

b. Incoming messages.—Messages received by the message center from its various agencies of signal communication, or from agencies of other message centers, to be delivered direct to addressees.

c. Relayed messages.—Messages received from a message center for transmittal to another message center by the intermediate message center.

d. Local messages.—Messages originating at a headquarters for delivery to another office or individual at the headquarters served by the same message center.

217. Methods of handling.—*a.* In general, all outgoing messages are handled only by the message center chief who registers and records them. An exception to this is the case of a message to be cryptographed, which is also handled by the code clerk.

b. Messages to be relayed are received by the delivery clerk at the intermediate message center who passes them to the message center chief. They are thereafter treated as outgoing messages.

c. Usually the delivery clerk handles only incoming messages. The exceptions to this rule are local messages and messages routed by messenger, which are handled by both the message center chief and the delivery clerk.

218. Procedure in handling outgoing messages.—The following examples illustrate the procedure in handling outgoing messages:

a. Radio.—(1) The message shown below was delivered to the message center chief by Maj. A. N. Jones, G–4, 1st Division at 12.01 a. m., December 17, 1927. The message center chief registers and routes the messages as follows: He enters the time and date filed, 1201 A–17 (the date is inserted here only when the date filed differs from the date signed). He gives this mes-

sage the message center number 1. This is the first message since midnight and the message center chief numbers all outgoing messages serially, beginning anew at midnight. He decides to send this message by radio and enters "Rad" in the space "How sent."

These spaces for message center only

Time Filed 1201A–17	MSG. CEN. NO. 1	HOW SENT Rad

(*Priority*) MESSAGE

NO. 26 DATE 16 Dec. 27

TO C G 1st Brig

Field trains released at once

C G 1st Div — Official designation of sender

1150P — Time signed

A M Jones, Major
Signature and grade of writer

(2) The message center chief records the message on his register as the first message of the day. The message is given the message center number 1. The time filed and how sent are taken from the registry on the message; the writer's number, "from," and "to" are also taken from the message.

MESSAGE CENTER REGISTER

DATE 17 Dec 27 ORGANIZATION 1st Div SHEET NO. 1

1 Message center serial number	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201 A	Rad	26	C G	C G 1st Brig	
2						
3						
4						
5						
6						
7						
8						
9						
0						

(3) The message center chief passes the message to the code clerk who encodes it (making no carbon copy) and prepares it for transmission by radio. In preparing the message for transmission by radio the code clerk enters in the space at the top of the message blank—

(*a*) The designation of the message, as "Send to NA" or "Send to 1st Brig."

(*b*) The class (if urgent or priority).

(*c*) The check; that is, the number of groups in the text of the message.

(*d*) Any special instructions necessary. (See Sec. VI.)

(4) The code clerk copies the message center registry data in the spaces provided on the code text. See example below:

These spaces for message center only

TIME FILED 1201A–17	MSG. CEN. NO. 1	HOW SENT Rad

Send to NA P GR 14

MESSAGE

No._____ DATE_____

TO_____

NR26 DFC4 YSIP NAWU LEGT ERUV LIOP OHIG RAKQ
LATU JOFX GISN TUVI 1150P

Official designation of sender | Time signed

Signature and grade of writer

(5) The code clerk sends the code text direct to the radio station and files the clear text.

(6) When the message has been transmitted, the radio station notifies the message center chief of the time receipt was obtained; 12.12 a. m. The message center chief enters that time in column 7 of his register as shown below:

MESSAGE CENTER REGISTER

DATE 17 Dec. 27 ORGANIZATION 1st Div. SHEET NO. 1

1 Message center serial No.	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201A	Rad	26	C G	C G 1st Brig	1212A
2						
3						
4						
5						
6						
7						
8						
9						
0						

b. Telegraph.—(1) The message is delivered to the message center chief, who registers and routes it as shown below. Assume this message to have been received by the message center chief at 12.15 a. m., as the second message since midnight.

These spaces for message center only

TIME FILED 1215A | MSG. CEN. NO.2 | HOW SENT Tg

MESSAGE

No. 1 DATE 17 Dec 27

TO CG 1st Brig

Report your effective strength by four AM

C G 1st Div Official designation of sender	1205A Time signed

A R Smith, Lt Col G–1
Signature and grade of writer

(2) The message center chief records the message:

MESSAGE CENTER REGISTER

DATE 17 Dec. 27 ORGANIZATION 1st Div. SHEET NO 1.

1 Message center serial No.	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201A	Rad	26	C G	C G 1st Brig.	1212A
2	1215A	Tg	1	C G	C G 1st Brig.	
3						
4						
5						
6						
7						
8						
9						
0						

(3) The message center chief passes the message to the telegraph station for transmission. If this message required cryptographing, the procedure would be the same as for a radio message.

(4) The telegraph station, having transmitted the message, notifies the message center chief of the time receipt was obtained. The message center chief enters that time in column 7 of his register.

MESSAGE CENTER REGISTER

DATE 17 Dec. 27 ORGANIZATION 1st Div. SHEET NO. 1

1 Message center serial No.	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201A	Rad	26	C G	C G 1st Brig.	1212A
2	1215A	Tg	1	C G	C G 1st Brig.	1217A
3						
4						
5						
6						
7						
8						
9						
0						

c. Telephone.—(1) The message is delivered to the message center chief, who registers and routes it as shown below. Assume this message to have been received by the message center chief at 1 a. m. as the third message since midnight:

These spaces for message center only

TIME FILED 100A | MSG. CEN. NO. 3 | HOW SENT Tp

MESSAGE

NO. 2 DATE 17 Dec 27

TO C O 1st Engrs

Destroy bridges at BRIDGEPORT and MEYERS MILL at once

C G 1st Div
Official designation of sender

1255A
Time signed

G R Catts Maj G–3
Signature and grade of writer

(2) The message center chief records the message:

MESSAGE CENTER REGISTER

DATE 17 Dec.27 ORGANIZATION 1st Div. SHEET NO. 1

1 Message center serial No.	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201A	Rad	26	C G	C G 1st Brig	1212A
2	1215A	Tg	1	C G	C G 1st Brig	1217A
3	100A	Tp	2	C G	C O 1st Engrs	
4						
5						
6						
7						
8						
9						
0						

(3) The message center chief passes the message to the telephone orderly for transmission.

(4) The telephone orderly, having transmitted the message, notifies the message center chief of the time receipt was obtained and the message center chief enters this time in column 7 of his register.

MESSAGE CENTER REGISTER

DATE 17 Dec. 27 ORGANIZATION 1st Div. SHEET NO. 1

1 Message center serial No.	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201A	Rad	26	C G	C G 1st Brig	1212A
2	1215A	Tg	1	C G	C G 1st Brig	1217A
3	100A	Tp	2	C G	C O 1st Engrs	105A
4						
5						
6						
7						
8						
9						
0						

d. Messenger.—(1) The message is delivered to the message center chief, who registers and routes it as shown below. Assume this message to be a bundle of maps received by the message center chief at 1.10 a. m., as the fourth message since midnight:

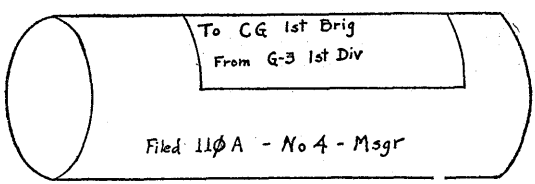


FIGURE 85.—Method of marking message delivered by messenger

(2) The message center chief records the message:

MESSAGE CENTER REGISTER

DATE 17 Dec. 27 ORGANIZATION 1st Div. SHEET NO. 1

1 Message center serial No.	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201A	Rad	26	C G	C G 1st Brig	1212A
2	1215A	Tg	1	C G	C G 1st Brig	1217A
3	100A	Tp	2	C G	C O 1st Engrs	105A
4	110A	Msgr	(Maps)	G-3	C G 1st Brig	
5						
6						
7						
8						
9						
0						

(3) The message center chief passes the message to the delivery clerk for transmission by messenger.

(4) The delivery clerk handles the message as prescribed in paragraph 219 and after the messenger has returned, the delivery clerk notifies the message center chief of the time receipt was obtained (1.30 a. m.) as shown by his delivery list.

The message center chief enters this time in column 7 of his register:

MESSAGE CENTER REGISTER

DATE 17 Dec. 27 ORGANIZATION 1st Div. SHEET NO. 1

1 Message center serial No.	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201A	Rad	26	C G	C G 1st Brig	1212A
2	1215A	Tg	1	C G	C G 1st Brig	1217A
3	100A	Tp	2	C G	C O 1st Engrs	105A
4	110A	Msgr	(Maps)	G–3	C G 1st Brig	130A
5						
6						
7						
8						
9						
0						

e. Pigeon.—(1) The message is delivered to the message center chief, who registers and routes it as shown below. Assume this message to have been received by the message center chief at 1.55 a. m. as the fifth message since midnight:

These spaces for message center only

TIME FILED 155A | MSG. CEN. No. 5 | HOW SENT Pgn

MESSAGE

No. 3 Date 17 Dec 27

TO C G I Corps

This division will attack at three-thirty AM

C G 1st Div — Official designation of sender | 150A — Time signed

C A Nutman, Col C of S
Signature and grade of writer

(2) The message center chief records the message:

MESSAGE CENTER REGISTER

DATE 17 Dec.27 ORGANIZATION 1st Div. SHEET NO. 1

1 Message center serial number	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201A	Rad	26	C G	C G 1st Brig	1212A
2	1215A	Tg	1	C G	C G 1st Brig	1217A
3	100A	Tp	2	C G	C O 1st Engrs	105A
4	110A	Msgr	(Maps)	G-3	C G 1st Brig	130A
5	155A	Pgn	3	C G	C G I Corps	
6						
7						
8						
9						
0						

(3) The message center chief passes the message to the code clerk for cryptographing. The code clerk cryptographs the message on a tissue sheet of the field message book, and prepares it for transmission by pigeon.

(4) The code clerk passes the cryptographed text to the delivery clerk and files the original clear text.

(5) The delivery clerk, having attached the message to the bird and released it, notifies the message center chief of the time of release. The message center chief enters this time in column 7 of his register.

MESSAGE CENTER REGISTER

DATE 17 Dec.27 ORGANIZATION 1st Div. SHEET NO. 1

1 Message center serial number	2 Time filed	3 How sent	4 Writer's identification	5 FROM	6 TO	7 Time cleared
1	1201A	Rad	26	C G	C G 1st Brig	1212A
2	1215A	Tg	1	C G	C G 1st Brig	1217A
3	100A	Tp	2	C G	C O 1st Engrs	105A
4	110A	Msgr	(Maps)	G-3	C G 1st Brig	130A
5	155A	Pgn	3	C G	C G I Corps	210A
6						
7						
8						
9						
0						

f. Miscellaneous.—(1) All outgoing messages are handled in a similar manner to those illustrated above.

(2) The sheets of the message center register are numbered serially, beginning anew at midnight. The lines of the register under column 1 are numbered for convenience in entering message center numbers. On sheet 1 when the tenth message is recorded, it is only necessary to insert the figure 1 in front of the zero. On sheet 2, it is only necessary to insert the figure 1 in front of the figures on each line except the last, where the figure 2 would be inserted when the twentieth message was recorded. The message center numbers on succeeding sheets are handled similarly.

219. Procedure in handling incoming messages.—The following examples illustrate the method of handling incoming messages:

a. Radio.—(1) The message is brought to the code clerk from the radio station in the form shown below:

These spaces for message center only

TIME FILED | MSG. CEN. NO. | HOW SENT

BA V BC 1 P CA GR11 17 Dec

MESSAGE

NO. ---------- DATE----------

TO----------

NR2 DFC4 JOFX RABU IXUB RUHG MILZ YSIP NAWU XUBO 1Ø5A

(115A)

Official designation of sender | Time signed

Signature and grade of writer

(2) The code clerk decodes the message, making one clear text, which includes all data as shown below. When he has finished he writes, at the bottom of the blank, the time the message was received at the radio station.

These spaces for message center only

TIME FILED | MSG. CEN. NO. | HOW SENT

BA V BC 1 P CA GR11

MESSAGE

NO. 2 DATE 17 Dec. 27

TO C G 1st Div

Objective reached at one AM

C G 1st Brig Official designation of sender	105A Time signed

(115A)
Signature and grade of writer

(3) The code clerk passes the clear text to the delivery clerk and files the cryptographed text.

(4) The delivery clerk enters the following data on his delivery list as shown by the example below. This being the first message received since midnight, the delivery clerk starts a new delivery list as sheet No. 1 and fills in his organization and the date in the heading. Under "agency" he enters "1" in the "Rad" column, this being the radio station's station-to-station serial number. Under "Received from" he enters "C. G. 1st Brig" which is taken from the decryptographed text of the message. Under "Addressee" he enters "C. G." (1st Division), which also is taken from the decryptographed text. He then sends the clear text with the delivery list by messenger to the addressee.

DELIVERY LIST

ORGN. 1st Div DATE 17 Dec 27 SHEET No. 1

AGENCY				Received from	Addressee	Received by	Time
Rad	Tg	Tp	Msgr				
1				C G 1st Brig	C G		

(5) The messenger returns the delivery list, with the message receipted for thereon, to the delivery clerk, who files it for his record. The delivery list as returned is shown below:

DELIVERY LIST

ORGN. 1st Div DATE 17 Dec 27 SHEET No. 1

AGENCY				Received from	Addressee	Received by	Time
Rad	Tg	Tp	Msgr				
1				C G 1st Brig	C G	C. A. NUTMAN Col. C of S	125A

b. Telegraph.—(1) The message is brought to the delivery clerk from the telegraph station as shown below:

These spaces for message center only

TIME FILED	MSG. CEN. NO.	HOW SENT

BO V BD 1 D 12 17 Dec.

MESSAGE

NO. _____ DATE _____

TO G–4 1st Div

Administrative order not yet received

S–3 2d Brig Official designation of sender	100A Time signed

(120A)
Signature and grade of writer

(2) The delivery clerk enters the necessary data on his delivery list and sends the message and delivery list by messenger to the addressee. The delivery list as sent out by the delivery clerk appears as below:

DELIVERY LIST

ORGN. 1st Div DATE 17 Dec 27 SHEET No. 2

AGENCY				Received from	Addressee	Received by	Time
Rad	Tg	Tp	Msgr				
	1			S-3 2d Brig	G-4		

(3) The messenger returns the delivery list to the delivery clerk with the telegraph message properly receipted for thereon.

c. Messenger.—(1) The messenger delivers his message to the delivery clerk. The delivery clerk signs for the message on the delivery list accompanying the message and returns the delivery list to the messenger. Assume that a message was received by messenger from the 2d Brigade and the delivery list accompanying the message is as shown below. Corporal R. A. Dun is the delivery clerk who receipted for the message at the 1st Division message center.

DELIVERY LIST

ORGN. 2d Brig DATE 17 Dec 27 SHEET No. 1

AGENCY				Received from	Addressee	Received by	Time
Rad	Tg	Tp	Msgr				
			9	C G 2d Brig	C G	Msg Cen 1st Div Corp R. A. Dun	110A

(2) The delivery clerk enters the message on a delivery list which he prepares and sends the message and delivery list to the addressee. When this delivery list is returned to the delivery clerk, it appears as shown below:

DELIVERY LIST

ORGN. 1st Div DATE 17 Dec 27 SHEET No. 3

AGENCY				Received from	Addressee	Received by	Time
Rad	Tg	Tp	Msgr				
			9	C G 2d Brig	C G	C. A. Nutman Col C of S	115A

Note that the number used on the 1st Division delivery list is the message center number assigned this message by the 2d Brigade.

220. Receipts for incoming messages.—Incoming messages are sent by the delivery clerk direct to the office of the addressee. Messages are receipted for by the addressee or his authorized representative.

221. Special instructions concerning messengers, delivery lists, and message center numbers.—Instructions regarding the use of message center numbers on certain messages, delivery lists for certain messages, and reception of traffic from messengers are given below:

a. When messengers are sent with messages to points other than in the immediate vicinity of the command post, the delivery list is made out in duplicate by inserting a piece of carbon paper between the sheets. When the original delivery list is returned to the delivery clerk, the duplicate is destroyed.

b. When preparing a delivery list for outgoing messages routed by messenger from his own message center, the delivery clerk uses the message center number assigned by his own message center chief.

c. The message center number assigned by the distant message center to a message received by telephone or messenger is used by the delivery clerk in preparing a delivery list for this message.

d. If an incoming message is received from an agency not shown on the delivery list, the delivery clerk enters such agency in the blank column provided and lists his message accordingly.

e. All traffic routed by messenger to a division or higher unit is delivered to the message center of the division or higher unit and is signed for by the delivery clerk. The delivery clerk then provides for local delivery as in the case of other messages. In listing the messages on his delivery list he uses the message center numbers assigned by the originating message center.

f. All messages routed by scheduled messenger from the division to brigades or lower units will be delivered to the message center of the brigade or lower unit and signed for by that message center.

SECTION V

PROCEDURE IN BRIGADES AND LOWER UNITS

222. General.—The procedure outlined in this section is a modification of the procedure outlined in Section IV, and is particularly applicable to brigades and lower units.

223. Organization.—*a.* In order to provide for continuous operation, when the command post is moved, the message center should be able to operate as two separate teams. During certain phases of operation the volume of traffic will be so large that the message center chief will require several assistants. At other times, when there is little traffic, one man may be able to conduct all the activities of the message center. For this reason each member of the message center must be trained to perform all the duties incident to message center operation.

b. It may be advisable to have the radio section cryptograph and decryptograph messages handled by it. (See par. 200.)

224. Outgoing messages.—*a.* Messages to be transmitted are furnished in duplicate, whenever practicable, to the message center chief, who notes on both copies the time filed, a message center serial number, and how the message will be sent. All outgoing messages are numbered serially from midnight to midnight by the message center chief, who keeps a record of such numbers in any convenient manner. If the message is to be transmitted by messenger, he also prepares a delivery list or envelope. The message center chief then sends or hands the original to the agency he has selected for its transmission, unless it is necessary to cryptograph the message. In the latter case he passes it to a code clerk, who, after cryptographing, passes it to the designated agency. The duplicate is retained in a live file until receipt has been obtained and reported by the transmitting agency. When such report is made the time of receipt is written across the face of the duplicate copy which is removed from the live file and held until collected by the officer charged with keeping the unit journal.

b. When only a single copy of a message for transmission is furnished the message center chief, he will record on a field message blank sufficient data to identify the message. The blank bearing these data will then be handled as described above for a duplicate.

c. A messenger given a message for delivery will promptly deliver it in person to the addressee or an authorized representative, except in case of messages addressed to divisions or higher units which are delivered to the unit message center of the division or higher unit, obtaining from the latter a receipt on the delivery list or envelope, returning to his message center chief and giving him the receipt. This delivery list is not used again. (See par. 225 *c.*)

d. A message to be transmitted by any agency other than messenger is handed or sent by the message center chief to the proper agency for transmittal, except that messages to be cryptographed pass from the message center chief through a code clerk to the agency designated for transmittal.

e. When a message has been transmitted visually, by wire, or by radio, the operator promptly notifies the message center chief of the time receipt was obtained.

225. Incoming messages.—*a.* Incoming messages are delivered direct to the addressee or an authorized representative.

b. Receiving agencies are responsible for the direct delivery of messages to the addressee or an authorized representative, except in the case of messages which are received in the form of cryptograms. In this case the cryptogram is sent to a code clerk, who decryptographs it and is charged with the delivery of the clear text. Receipt is obtained on the duplicate of the message as delivered.

c. An incoming messenger goes first to the message center and shows his message. Personnel of the message center indicate to him the person for whom the message is intended. The messenger then personally deliveres the message, obtaining a receipt therefor on a delivery list or envelope. For exceptions to this rule in the case of scheduled messengers from division see paragraph 221.

d. An incoming message received by an agency other than messenger (after being decryptographed if received in secret text) is delivered direct to the addressee. The signature of the addressee or an authorized representative and the time of delivery are obtained as a receipt on the duplicate of the message as delivered.

SECTION VI

RELATED PROCEDURES

226. Transmitting a message by telephone.—*a.* In transmitting a message by telephone, the sender transmits his message phrase by phrase, each phrase being clearly and distinctly spoken into the telephone transmitter. Proper names, dates, hours, coordinates, and code or cipher groups are transmitted singly. In all cases where spelling is necessary, the prescribed phonetic alphabet will be used. Any word which is apt to be misunderstood will be spelled out immediately after transmission; for example, "Conewago, CAW–O–N–E–W–ACK–GOGO–O." Code or cipher words or groups, being for the most part unpronounceable, are transmitted entirely by spelling.

b. The receiver, during each pause by the sender, writes down the word or phrase transmitted and repeats it. The repetition is made clearly and distinctly, spelling out single words just as they were transmitted. This method checks the message item by item as it is sent, insures immediate correction of errors, and allows sufficient time for the receiver to make a legible copy. In case the receiver does not understand a word or phrase, he says, "Repeat." The sender then repeats the misunderstood portion. In case the receiver incorrectly repeats a word or phrase, the sender says, "Error," and retransmits the word or phrase, placing especial emphasis on that part in which the error occurred.

c. The procedure is as follows: After calling his party and identifying himself to the called party, the individual telephoning a message proceeds to transmit by telling the called party, "Take this message" (or "Take this urgent message"). He then proceeds to transmit all the matter that appears in the message, beginning with the writer's number and concluding with the "hour signed." Necessary message center data, such as message center number, number of groups (in case the message is in secret text) are then given by the transmitting party and are written in the appropriate spaces on the message blank by the receiving party. The receiving party, having copied the message in duplicate, then receipts for the message by saying, "O. K.," noting the time on the foot of his copy. When the transmitting party receives the "O. K." he also notes the time on the foot of his transmitted message. He then proceeds to transmit another

message, or, if he has no further business for that particular party, he says "That's all," hangs up his hand set, and rings off.

227. Printing.—In order to secure legibility, such as in copying cryptograms and in other cases where a printed character better serves the purpose, the following system of manual printing is prescribed. The examples shown below indicate how letters and figures should be formed and the sequence to be followed in making the various strokes:



FIGURE 86.—Straight-line letters

The straight-line I is the foundation stroke. The letters, E, Z, X, and K are made slightly smaller at the top. The letters H, E, and F have the center horizontal strokes slightly above the middle. The latters X, Y, and K have the junction slightly above the middle.

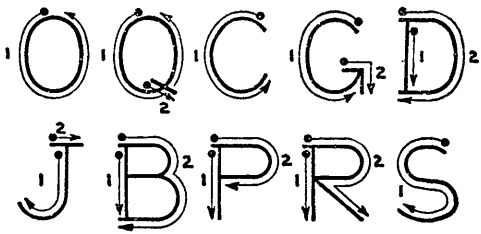


FIGURE 87.—Curve-line letters

The letters O, Q, C, and G are made in circular form. The letter B is slightly smaller at the top and has the center horizontal part slightly above the middle. The letters R and S are slightly smaller at the top.

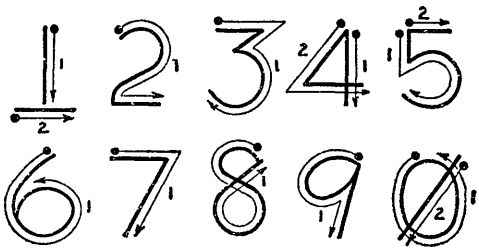


FIGURE 88.—Figures

The bar under the numeral 1, the top of the 5 and 7, and the bottom of 2 are straight lines. The figure one (1) has a bar under it, slightly below the stem to distinguish it from the letter I, and the cipher (Ø) has a bar diagonally through it to distinguish it from the letter O.

228. Related radio and telegraph procedure.—*a.* It is important that message center personnel have sufficient knowledge of radio and telegraph procedure to enable them to properly prepare radio and telegraph messages for transmission and delivery.

b. In preparing cryptograms for transmission the code clerk first cryptographs the message, printing five groups per line with pencil or five or ten groups per line with typewriter. The field-message blank or other suitable paper may be used for this purpose. The order in which the words of the clear text appear in the cryptogram is as follows:

(1) The writer's number in clear, as NR6.

(2) The code indicator when used. If no writer's number is furnished, the code indicator may be the first group. The code indicator may be omitted when its omission will not cause delay or confusion in decryptographing the message, for example, in the case of messages between units of a division where the codes and ciphers prescribed for use are coordinated by a common headquarters. The code indicator must appear in the text of the message in all messages between elements of the Army and Navy, and between all elements of the Army where the codes or ciphers prescribed for use are not coordinated by a common headquarters.

(3) The cryptographed address. (May be one or several groups. In time of war a special code may be employed for cryptographing the address and the signature.)

(4) The cryptographed body of the message.

(5) The cryptographed official designation of the sender. (The signature and rank of the writer are ordinarily not transmitted.)

(6) The time of origin (time signed) in clear, as 1220A.

c. The code clerk is required to transcribe the message center registry data (time filed, message center number, and how sent) from the clear text to the cryptogram and to indicate on the blank at the top thereof, in such manner as not to mar the secret text, the following data:

(1) The destination of the message expressed with the call sign(s) of station(s) of destination, as "Send to NB." If the code clerk can not indicate the station call sign(s), it must supply the name(s) of the organization(s) or destination in clear.

(2) The class (if other than a routine message).

(3) Special instructions, if any, as to how the message it to be transmitted; i. e., no answer method, repeat method, or reports to be made in case transmission is delayed. These instructions are indicated by the message center chief on the clear text.

(4) *The check.*

(*a*) In code or cipher messages each group of the text, whether numeral, letter, or mixed numerals and letters, is counted, including, when sent, the writer's message number, the code or cipher indicator, and the time of origin.

(*b*) In plain language messages (except abbreviated form messages, see Chap. 3), each dictionary word of the text is counted. The writer's message number is counted as one word; the time of origin or any contiguous group of letters and numerals is counted as one word.

d. (1) The following procedure signals are used where applicable in making the entries noted above:

O—Urgent.

P—Priority.

GR—Followed by the number of words or groups in the text of the message. (See *c*(3) above.)

F—Indicates the message is to be sent to a silent station (no answer method).

G—Indicates that the message is of such importance or the context of such nature that to insure accurate reception it must be repeated back.

(2) See examples shown in paragraph 218, which show the parts of the above procedure most commonly used and the applications thereof.

e. In preparing received cryptograms for delivery, the code clerk transcribes all operator's data shown on the received cryptogram to the clear text which he passes to the delivery clerk for delivery to the addressee. (See par. 219*a*(2).) The delivery clerk is concerned with the class and the serial number assigned by the station which transmitted the message. The class indicates to the delivery clerk the precedence the message takes in delivery. The example in paragraph 219*a*(4) illustrates how the delivery clerk employs the station to station serial number on his delivery list to indentify the message.

229. Army and Navy methods of specifying time.—*a.* The ordinary 12-hour clock will be used in the Army. The new day starts at midnight. Time will be transmitted in three or four figure groups with an "A" added if before noon and a "P" added for all times from noon to midnight.

b. The Navy uses the 24-hour clock. Navy 24-hour time is always expressed by a group of four figures. The first two figures of the group denote the hour and the last two figures the minutes after the hour. Ordinary or 12-hour time may be converted to 24-hour time by adding 12 hours to all times from 1 p. m. to 11.59 p. m., inclusive.

c. Examples of time as expressed in the Army and Navy are shown below:

Army	Time	Navy	Army	Time	Navy
12ØØA	Midnight	24ØØ	12ØØP	Noon	12ØØ
12Ø1A	12.01 a. m.	ØØØ1	1259P	12.59 p. m.	1259
117A	1.17 a. m.	Ø117	6Ø8P	6.08 p. m.	18Ø8
1135A	11.35 a. m.	1135	1159P	11.59 p. m.	2359

230. Station lists.—The operation of the message centers of divisions and higher units is facilitated when station lists are provided. The station list gives the location of the various headquarters and elements of the command. It is prepared by the adjutant's office.

231. Telephone code names.—The message center is furnished the telephone code names of all headquarters with which it may be concerned.

232. Radio and telegraph call signs.—The message center should be furnished a list of the call signs of all radio and telegraph stations with which it may be concerned. These call signs are used by the code clerk and the delivery clerk to expedite the handling of messages by such agencies.

SECTION VII

PIGEONS AT MESSAGE CENTERS

233. References.—For the general use of pigeons for message carriers see Basic Field Manual, Volume VIII.

234. Pigeon posts.—*a.* Pigeon posts are normally provided with from two to eight birds. The birds are carried in baskets suitable to the transportation available. Pigeons are assigned to tactical units as needed. The personnel for a pigeon post is furnished by the unit which the post serves. In battalions and larger units pigeons are usually handled by message center personnel, whose training should include instructions in this service.

b. Pigeons are also used for messenger service from aircraft.

235. Care of pigeons at the message center.—*a.* Arrangements for the delivery of pigeons to the message centers and other pigeon posts of a division are made by the division signal officer.

b. The following material should be delivered with the pigeons and turned over to the message center personnel:

(1) Baskets of the proper number and size for the number of birds delivered and suitable for the purpose for which required.

(2) Water container for each basket.

(3) Feed.

(4) Message capsule attached to each bird.

(5) Gas bag for each basket.

(6) Rat-proof cage for each basket (when required).

c. When pigeons are received at a message center, they should be placed where they are free from exposure to rain, draft, or dampness.

d. The message capsule which is attached to each bird's leg should not be removed.

e. The only grain fed should be that which is received with the birds from the loft. As damp grain is very injurious to pigeons, care should be taken that this feed is kept dry. Since hunger and the knowledge that food awaits the return to the home loft are strong influences for quick flight, it is desirable that pigeons be

not fed within 24 hours prior to release. If, however, it becomes necessary to keep the birds at the liberating post more than 24 hours they should be fed mixed grain twice a day at the rate of a teaspoonful per pigeon per feeding. When early release of a pigeon can be foreseen, the last regular feeding should be omitted.

f. The above principle of hunger does not apply to thirst. Fresh water should be offered the pigeons every six hours, and also 15 or 20 minutes before release when time of release can be foreseen.

g. The birds should be protected from cats, rats, and other animals. Special wire cages, in which the baskets may be placed, are provided when required.

h. The pigeons should be kept in a dry place and protected from wind and drafts. Special care should be taken to prevent the feathers becoming muddy and caked as the flight would thereby be greatly retarded.

i. Pigeons should be handled gently and care should be taken that they are not unnecessarily annoyed or excited.

236. Transporting pigeons.—*a.* Pigeons are delivered to the message center in assault or in stock baskets.

b. The assault basket is a very small willow, wicker, or rattan, unlined basket, which holds two birds and is used by forward message centers. It is of inferior make and may be thrown away when the birds have been released. As birds have very little space for movement in this basket, they should not be kept in it longer than 48 hours.

c. Stock baskets are plain willow, wicker, or rattan baskets lined or partly lined with muslin; they are without partitions or corselets, and are made in sizes to hold 4, 8, 15, and 30 birds. They are less confining than the assault or corselet baskets; therefore, when they are available, birds should be placed in them rather than in assault baskets.

d. For transportation over rough ground and on long marches, the Infantry is provided with a 4-bird Infantry basket, shown in Figure 89.

e. For the use of the Cavalry, a small basket similar to the Infantry basket is provided. This basket holds two birds and can be attached to a man's back as shown in Figure 90.

f. In both the Cavalry and Infantry baskets the birds are placed in corselets to prevent injury by being bumped around in the basket. As this method of basketing birds is very confining, whenever a halt is to be made for 20 minutes or more and also

before releasing the birds, the collapsible aviary should be set up and the birds placed in it in order to stretch their legs. The method of corseleting pigeons and the collapsible aviary are both shown in Figure 91.

237. Maximum time before release.—Pigeons must not be kept confined away from their loft for a longer period than

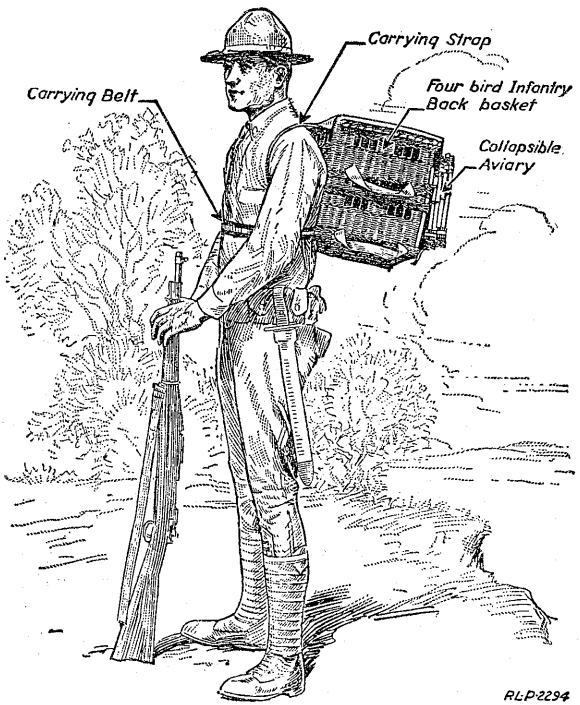


FIGURE 89.—Four-bird Infantry basket

two days and three nights. After the third night they must be released, with a message informing the loft of the reason and time of release.

238. Releasing pigeons at the message center.—The method of releasing pigeons at the message center is as follows:

a. Fold the message compactly in such a manner as to fit the message capsule and hold it between the teeth while catching the bird.



FIGURE 90.—Two-bird Cavalry basket

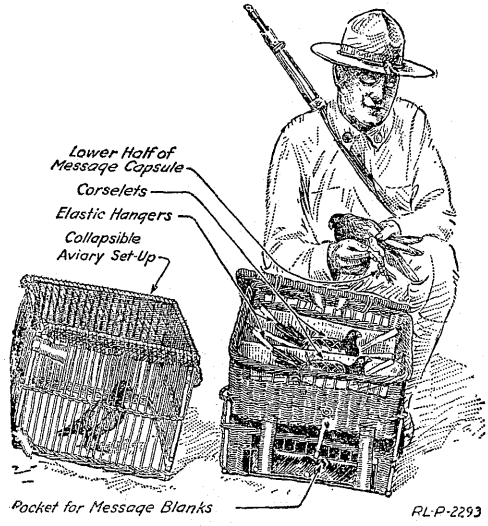


FIGURE 91.—Method of corseleting pigeons in Infantry basket

b. To catch the bird in its basket or container, place the palm of the right hand on the pigeon's back with the four fingers over its right shoulder and the thumb over its left, raise the wings on the bird's back with the tip of the thumb and little finger, and gently force him to the side or end of the container. (See fig. 92.)

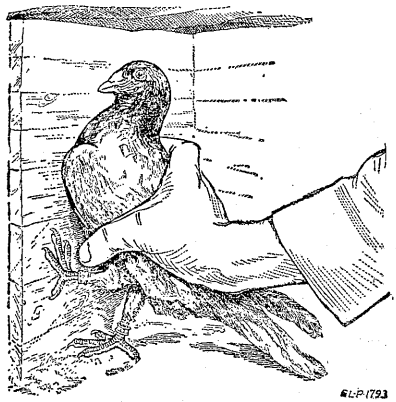


FIGURE 92.—Catching a pigeon in a basket or container

c. Use a gentle downward movement to the vent and catch the right leg under the middle finger and the left leg under the thumb; bring the legs, tail, and wings together and remove the pigeon from the container. (See fig. 93.)

d. Remove the bird from the container, as shown in Figure 94.

e. After the bird is removed from the container the position of the hand is as shown in Figure 95.

f. Separate the index finger from the middle finger of the left hand and bring the hand up under the bird as shown in Figure 96. Drop the bird's legs on the middle finger of the right hand as shown in Figure 97.

Close the index and middle fingers of the left hand, using just enough pressure to hold the bird's legs, and place the thumb over the tail and wings. Hold the bird loosely, do not squeeze; if pressure is applied it will make the bird attempt to release himself. (See fig. 98.)

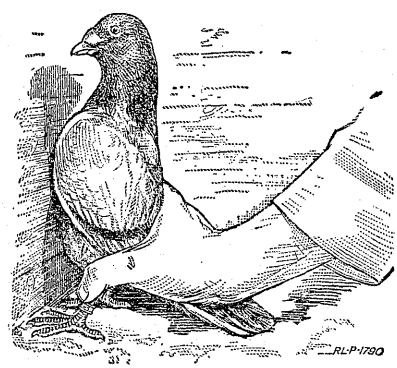


FIGURE 93.—Bringing a pigeon's legs, tail, and wings together for removal from container

g. Always hold the bird for all purposes as shown in Fig. 99. The legs, tail, and wings are immobilized and the bird will not struggle.

h. With the bird held in the position as described in *g* above, extend its leg and hold it by applying pressure at the knee joint with the ends of the index and middle fingers as shown in Figure 100. Remove the upper half of the capsule which is attached to the bird's leg and insert the folded message therein. Replace the upper half of the capsule in the lower half. (See fig. 101.)

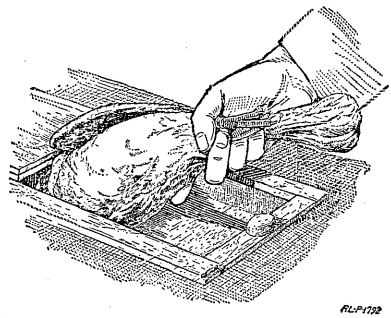


FIGURE 94.—Removing a pigeon from its container

i. The capsule should always rest on the front of the leg. If on the back of the leg it interferes with the bird's holding its legs up under its tail in flight and it also interferes with walking after the bird alights. The capsule should not fit tightly but should be free to move.

j. To launch a pigeon, place the right hand on the back of the bird, with the four fingers over the right shoulder and the thumb over the left. Using a gentle downward movement to the vent, bring the tail and flights together, keeping the thumb under the tail. (See fig. 102.)

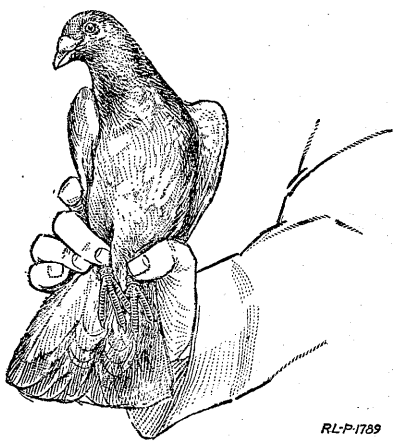


FIGURE 95.—Holding a pigeon in the right hand after removing from container

k. Release the bird's legs which are being held by the first and second fingers of the left hand, as shown in Figure 103.

l. When the legs have been released the bird will be in the position shown in Figure 104.

m. Hold the bird in the position shown in Figure 105, just before placing on the hand for launching.

n. Place the bird on the left hand, as shown in Figure 106. The bird is now ready for launching.

o. Release the hand which is holding the wings and tail, and allow the pigeon to take off. Do not toss the bird in the air.

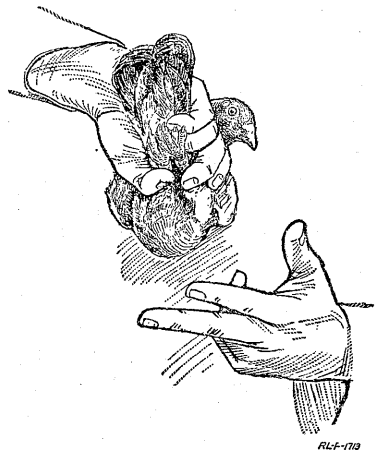


FIGURE 96.—Transferring a pigeon to the left hand

239. Releasing pigeons from aircraft.—*a.* Previous ground instruction in the proper method of catching, holding, and

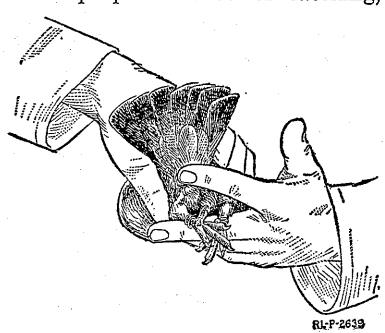


FIGURE 97.—Method of holding a pigeon's legs in the fingers of the left hand

handling the birds, in attaching message holders, and in launching should be given before a pilot is permitted to release from the air.

b. Care must be taken to insure a bird's clearing the machine when thrown from an airplane. If released while traveling at high speed it may be injured or stripped of its feathers by the rush of air. It is usually sufficient to slow down a few seconds and

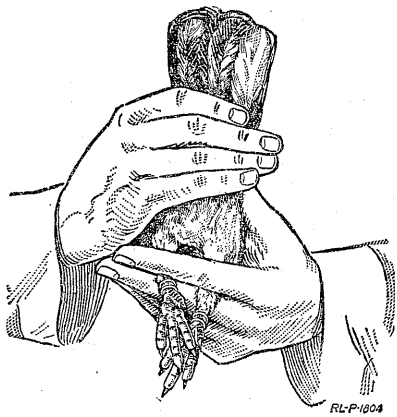


FIGURE 98.—Placing a pigeon in left hand

then to launch the bird in such a manner that it will be favored by air currents and prevailing winds.

c. A successful method is to free the pigeon from a side slip with power on or off, launching the bird backward with a straight

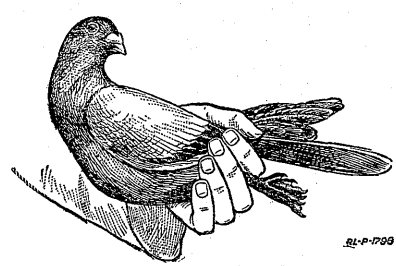


FIGURE 99.—Correct way to hold a pigeon

aim outward and backward under the upturned planes, with the bird facing rearward.

d. Another method is to climb at an angle of 45° while the bird is thrown backward over the tail of the airplane.

e. At night, in fog, or in very bad weather, pigeons should be liberated from aircraft only in cases of emergency, as the chance

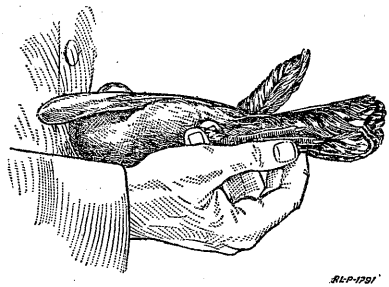


FIGURE 100.—Extending a pigeon's leg preparatory to attaching a message

of their homing under such conditions is doubtful. Nevertheless, if the bird can manage to find a safe landing place for the

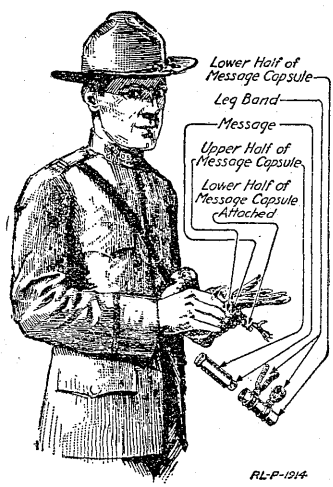


FIGURE 101.—Inserting message in message capsule on a pigeon's leg

night, it will resume its homeward flight during the early hours of the following day.

f. The method of launching the pigeon is as follows:

(1) Open the door of the box with the right hand and place the hand over the bird's back with the four fingers over the bird's left wing and the thumb over its right wing with the bird facing

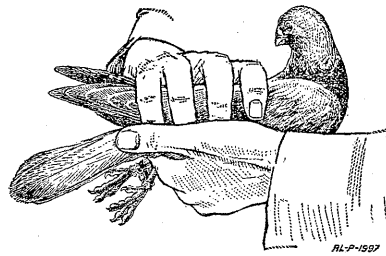


FIGURE 102.—Grasping a pigeon in the right hand preparatory to launching

along the forearm toward the body. Bring the bird close up to the side of the box.

(2) Using a gentle downward movement to the vent, bring the wings and tail together with the thumb and index finger close up

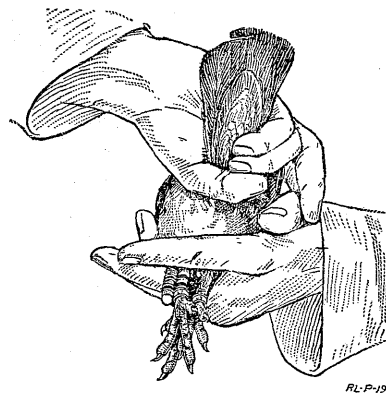


FIGURE 103.—Bringing a pigeon's tail and wings together in right hand preparatory to launching

under the vent and as close to the body of the bird as possible, leaving the legs free, and remove the bird from the box. (See fig. 107.) Keep the bird down in the cockpit where he will be protected from the propeller blast.

(3) Notify the pilot of the airplane, by some prearranged signal, such as tapping him on the back, that you are ready to

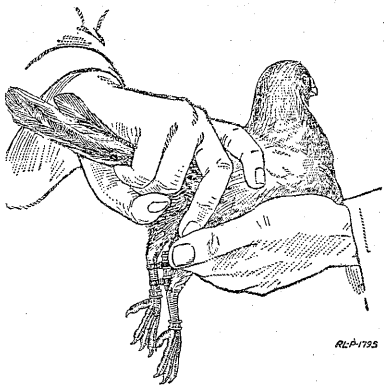


FIGURE. 104.—Releasing a pigeon's legs before launching

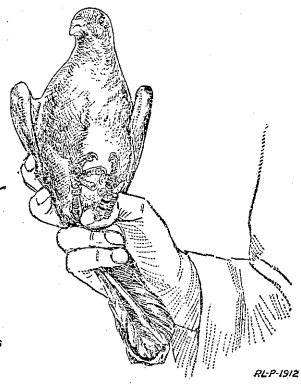


FIGURE 105.—Holding a pigeon in the right hand

release the bird. The pilot should throttle his motor to idling speed and "float" his airplane. It is not necessary to stall the airplane. The speed should be about 70 miles per hour.

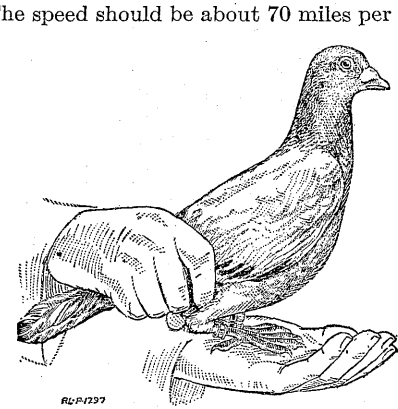


FIGURE 106.—A pigeon held on the left hand just before launching

(4) When the pilot has throttled the airplane, raise the right arm to about the height of the head, holding the bird well over the side of the airplane. Then swing the arm down and release

the bird at the bottom of the swing. The plane of the arc described by the hand should be about 30° out from the side of

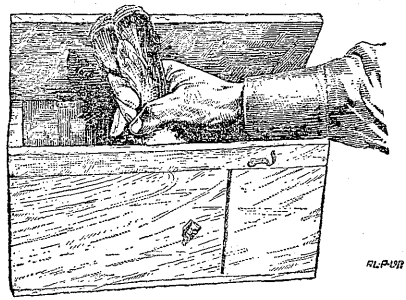


FIGURE 107.—Removing bird from box in airplane

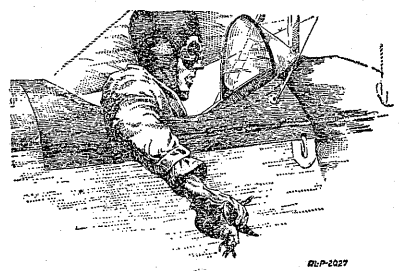


FIGURE 108.—Releasing bird from airplane

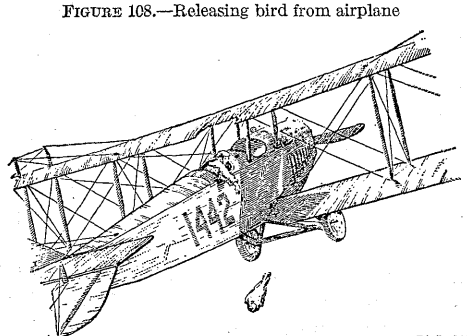


FIGURE 109.—Bird after being released from airplane

the airplane. (See fig. 108.) Use considerable force, but do not squeeze the bird. The force with which the bird is thrown down should cause him to clear the tail of the airplane. (See fig. 109.)

CHAPTER 7

ORDERS AND INSTRUCTIONS FOR SIGNAL COMMUNICATION TROOPS

240. General orders and circulars.—*a.* It will be found necessary from time to time to issue general orders and circulars from the headquarters of divisions and superior units to insure coordination of routine signal communication throughout the command. These orders or circulars are prepared by the signal officer and issued by authority of the unit commander. They contain matters of general and more than temporary interest relating to signal communication within the command, but do *not* deal with matters of an exclusively technical nature, which are of interest only to signal personnel.

b. Examples of subjects covered in general orders and circulars are—

(1) Changes in allowances of signal equipment.

(2) Correction of abuses in the use of signal equipment or signal service.

(3) Deficiencies in signal training or operations.

(4) General instructions regarding radio communication, as the responsibility for receipt of time signals, press reports, and meteorological data for designating the priority of field messages and for the sending of radio messages in clear.

(5) General instructions for the use of commercial wire communication systems, the interruption of wire lines leading into hostile territory, the protection of our own wire lines against damage by friendly troops, and the use of the telephone in forward areas.

(6) Useful data of a statistical nature.

241. Signal operation instructions.—*a.* Signal operation instructions are issued for the technical control and coordination of signal communication. They are prepared by the signal officer of the unit and are issued by authority of the unit commander. These instructions are of primary interest to signal communication troops. Units smaller than the division have little occasion to prepare signal operation instructions.

b. Signal operation instructions for a contemplated tactical operation are generally issued in advance of the operation. They may remain in effect during the entire operation or cycle of operations. They are issued or changed as circumstances require and not necessarily at fixed intervals.

c. Signal operation instructions are issued and distributed as separate items, each item being designated by a title descriptive of its contents and a number which is changed serially in successive editions.

d. (1) The items of signal operation instructions are indexed. Successive indexes are numbered serially. The index of signal operation instructions contains—

Heading: Unit, place, date and hour, title, and serial number.

Title and serial number of each item.

Date and hour each new item or change becomes effective, if subsequent to the hour stated in the heading.

Authentication—as for a field order.

Distribution.

(2) *Example of index.*

Index No. 8 to Signal Operation Instructions

1ST DIVISION, YORK, PA.,
September 29, 1927—1 a. m.

Title of item	Serial No.	Remarks
General:		
Index to Signal Operation Instructions	7	Supersedes No. 6, Sept. 30—1 a. m.
Index to Regulations and Orders on Signal Communication.	1	
Distribution "S" for Signal Operation Instructions.	2	Supersedes No. 1, Sept. 30—1 a. m.
Codes and ciphers:		
Army Field Code (AFC)	1	
Geographical Appendix to AFC–1	6	Supersedes No. 5, Sept. 30—12 noon.
Division Field Code (DFC)	5	
Geographical Appendix to DFC–5	8	
Radio Service Code	2	Supersedes No. 1, Oct. 1—1 a. m.
Meteorological Codes	1	
Air-Ground Liaison Code	1	
Fire Control Code	1	
Map Coordinate Strips	4	
Decoding Chart, Map Coordinate Strips	4	
Pyrotechnic Code	2	
Cipher key for cipher, type M94	20	Supersedes No. 19, Sept. 30—1 a. m.
Radio communication:		
Call signs and frequencies, I Corps net	11	
Call signs and frequencies, 1st Division net.	17	Supersedes No. 16, midnight—Oct. 1–2.
Wire communication:		
Telegraph call signs, I Corps	4	
Telegraph call signs, 1st Division	7	
Visual call signs, 1st Division	2	

By command of Major General A:

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Chief of Staff.

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Asst. C. of S., G–3.

Distribution: S–2, plus 4 copies to 101st FA

e. Each item of signal operation instructions has a characteristic distribution, which includes only those units or individuals concerned. A distribution list, covering all normal items of signal operation instructions, is compiled, given a letter designation, and is published as an item of signal operation instructions. This list shows the distribution to the major subdivisions of the unit and provides sufficient copies for redistribution to staffs and lower units.

242. Field orders of combat units.—Paragraph 5 of the field order contains the following information in the sequence indicated:

a. Paragraph 5 *a* refers to the signal communication annex, if one is issued. If an annex is not issued, reference is made to the index of signal operation instructions. For example: "5. *a.* See Annex No. 3, Signal Communication," or "See Index No. 6 to Signal Operation Instructions."

b. Paragraph 5 *b* announces the axes of signal communication of the unit and the next lower units.

c. Paragraph 5 *c* announces the locations of command posts of the unit and the next lower units. Field orders may repeat instructions from signal operation instructions when it is desired to particularly emphasize them, as, for example, a pyrotechnic signal.

d. If the information contained in any of the above subparagraphs is not necessary, the corresponding subparagraph is omitted and its letter designation is given to the next succeeding subparagraph.

243. Signal communication orders in divisions and higher units.—*a.* In divisions and higher units, orders for signal communication for a particular tactical operation may, when time permits, be issued as a signal communication annex to the field orders of the commander. These orders may also be issued in fragmentary form, verbally or in short written messages.

b. The signal communication order is prepared by the unit signal officer subject to the approval of the unit commander. It

has the same distribution as a field order; in addition, copies are distributed to the signal officers of lower units.

c. Form for a signal communication order, when issued as an annex to the field order:

ANNEX NO. ____ TO FIELD ORDERS NO. ____, ______ DIVISION
Unit.
Place.
Date and hour.

SIGNAL COMMUNICATION ORDER

Maps:

1. Such information of the enemy and of our own troops as is necessary for the signal communication troops. This may include the commander's general plan of action, boundaries of the unit and its major subdivisions, axes of signal communication and location of command posts, observation posts, supply and medical establishments which may require signal communication, and information relative to any existing signal facilities in the area.
2. General plan for the installation, operation, and maintenance of signal communication. If special considerations require an hour to be fixed for the establishment of signal communication, this hour will be stated.
3. *a.* Orders to the signal troops operating at the headquarters of the unit.
   b, etc. Orders to lower units necessary for the coordination of signal communication within the command as a whole.
   x. Orders applying to signal agencies of more than one unit not covered in the preceding subparagraphs.
4. Priority of signal troops on roads; location of signal supply distributing point and signal dump, park, or depot; special instructions relative to the issue of signal supplies, including pigeons; charging and replacement of storage batteries.
5. *a.* Reference to the index of signal operation instructions.
   b. Location of the signal office.

Signature.

Distribution:

244. Field orders of signal units.—*a.* A commander of signal troops issues the necessary orders to his subordinates, based upon the field order of the combat unit, the signal communication order and the signal operation instructions then in force.

In the signal units of divisions and lower units these orders are usually verbal and are often issued in fragmentary form. However, when practicable, the platoon or section chiefs are assembled and the order issued to all. The sequence of a field order is followed.

b. Form of field order for a signal unit:

	Unit.
FIELD ORDERS	Place.
No. —.	Date and hour.

1. The information of the enemy is practically the same as in the field order of the combat unit. The information of friendly troops is more extensive and very important. From the viewpoint of signal communication much of the information appearing in various paragraphs of the tactical field order and annexes is essential; for example, general plan of the commander, line of departure, zones of action, hour of attack, axes of signal communication, location of observation posts, and of all headquarters and establishments with which direct signal communication must be maintained.
2. The general plan of the signal unit commander is stated briefly. It is normally a statement of the agencies of signal communication which are to be used.
3. Detailed orders for the subdivisions of the signal unit, including reference to appropriate signal operation instructions, are given. Any convenient sequence may be followed.
   a. Orders for the message center may include location, changes in codes or ciphers, restrictions on use of telephone, routing of messages, handling of cryptograms.
   b. Orders for the messenger section may include general instructions relative to schedules and routes.
   c. Orders for the wire sections may include location of switching centrals and test stations; local telephones to be installed; line route map and circuit diagram; type of line construction, telegraph circuits, and stations; duties after completion of initial installation.
   d. Orders for the radio section may include location of radio and panel display station; location of storage battery charging plant (if operated by the unit); changes in call signs, frequencies, and codes; operating schedule; restrictions on operation prescribed by higher authority; copying time signals and press reports; other special service.

e. Orders for the visual section may include location of visual stations of the unit and of higher, lower, and adjacent units; changes in call signs; operating schedule and restrictions on operation.

x. Orders applicable to two or more sections are given last.

4. Orders relative to signal supply; i. e., location of signal supply dump and distributing point; issue of wire, tape, batteries, and pigeons; issue and collection of storage batteries; location of aid stations; messing and other administrative details are included herein.

5. The location of the commander of the signal unit, or the place (usually the message center) to which messages for the commander should be sent, is shown.

Signature.

Distribution:

CHAPTER 8

METEOROLOGICAL INFORMATION

245. Scope.—This chapter describes in general terms the organization and operation of the meteorological service. It indicates the meteorological information that should be made available to all arms and services for general use; the specialized types of information required by certain arms and services only; and the possibilities and limitations of the meteorological service. Two codes employed in the dissemination of meteorological information are described.

246. General description of organization and duties.—*a.* The meteorological service is a part of the signal service GHQ and also a part of the army signal service. Tables of Organization Nos. 207 W, 208 W, 209 W, 507 W, and 508 W contain details of organization. The meteorological service consists of a number of observation stations and a headquarters station, each provided with standard meteorological equipment and manned by trained personnel. Unless meteorological observations are made with standard equipment and in accord with standard practice, the results are likely to be valueless. The personnel at the stations make observations of the meteorological elements and reduce the results to forms that make the data readily usable by the several arms and services. When necessary, weather forecasts are prepared and issued. The developments in aviation, artillery and signal communication, and the use of gas and chemicals in warfare have increased the use of meteorological data by the Army.

b. The weather affects personnel, animals, and the supplies of the Army. Weather moves, generally, along fairly well-defined paths and in moving undergoes changes. Modern signal communication enables the meteorological service to get observations from widely scattered points and collect these reports at a central point in order to study the changes and movements of weather toward and in the Army area. The meteorological service, besides furnishing specialized services for aviation and artillery, makes weather forecasts for use by all arms and services and compiles statistical information showing average weather for

various seasons in various regions. In order to make weather forecasts successfully, reports from a large number of meteorological stations are needed. These reports should come from as large a region as practicable, particularly from points west of the area for which the forecasts are to be made if the area is outside of the tropics. Since a military meteorological service is seldom in a position to get from military sources the large number of reports desirable, arrangements should be made to get reports from any other meteorological service operating adjacent to the area covered by the military meteorological service.

c. The success of a meteorological service in forecasting weather depends largely on its ability to assemble quickly a large amount of meteorological information collected from widely scattered points; it follows therefore that the success of the meteorological service is dependent upon the maintenance of adequate signal communication, including telephone, telegraph, and radio. The meteorological service must also make extensive use of the communication system to distribute data, needed by various arms and services, that are based on the results of observations made locally. Because of its dependence for success on adequate communication, the meteorological service is organized as a part of the Signal Corps.

d. The meteorological service, regardless of the number of stations involved, should function as one service. Isolated meteorological stations, operating independently of the headquarters station, can not operate at a high degree of efficiency.

247. Kinds of meteorological information.—*a.* Meteorological information of interest to military units may consist of—

(1) Deductions made from records of past atmospheric conditions,

(2) Observations of current atmospheric conditions, or

(3) Forecasts based on either or both of the above, but chiefly on observations of current conditions.

b. This information may be of a local nature or it may be compiled for a larger area and be of a more general nature, according to the extent of the operations served. The mistake of applying information compiled for a large area to some particular locality within the area should not be made. Meteorological information, whether statistical, current or forecast, to be of value should be characteristic of the place or area and should be prepared with reference to the operation concerned.

c. The elements observed are air movement, pressure, temperature, humidity, and the related phenomena—visibility, fog, clouds, and precipitation. The first four elements have been observed at all levels reached by airplanes and projectiles, however only the wind speed and direction are regularly observed at high levels.

d. A 5 or 10 year record of these data is usually sufficient as a basis of statistical studies for military uses. The data observed and deduced at frequent intervals are of immediate interest to several arms and services, especially to the Air Corps, Field Artillery, Coast Artillery Corps, and Chemical Warfare Service. The data observed and the methods and equipment employed in their observation are the same for all arms. These data are reduced and distributed in such a manner as to render them most available to each arm or service using them.

e. When current observations made at uniform hours have been brought together from a sufficiently large area, they constitute the basis for the forecast of future weather conditions. These forecasts may be in considerable detail and may be valid for the next five or six hours, or they may be more general and be valid for longer periods up to six days. Special forecasts and observations may be made on short notice at other than the regular hours. These special forecasts may be for long or short periods, and in greater or less detail, according to the nature of the operation.

248. Location of stations—hours of observation.—*a.* Meteorological stations established at training centers make four regular daily observations at intervals of six hours, all stations observing on the same hour. Other observing stations in or near the training area are maintained as needed for forecast purposes. These stations report on the same hours as the stations at training centers.

b. Meteorological stations along the front make observations at 4-hour intervals throughout the 24-hour period, but all front-line stations do not observe on the same hour. It has been found advisable to employ two stations in every meteorologically distinct sector of the front. If stations A and B, in the same sector, report observations at hours 4, 8, 12, 16, 20, 24 and at hours 2, 6, 10, 14, 18, 22, respectively, stations C and D in the adjoining sector observe at hours 3, 7, 11, 15, 19, 23 and at hours 1, 5, 9, 13, 17, and 21, respectively. Stations E and F in a sector adjoining that served by C and D, but not adjoining that

served by A and B, report at the same hours as the stations A and B. This arrangement of hours insures sufficiently frequent receipt of current data by all units operating in any sector, and by the forecast station, and provides service for the sector in case one station is moving into a new position or is otherwise temporarily unable to report its observations. This arrangement also adapts itself easily to signal communication facilities.

c. A field headquarters meteorological station is organized in the vicinity of general headquarters for the administration of the meteorological service, for forecasts, and for observations. An army meteorological station is organized in the vicinity of the army headquarters for the administration of the army meteorological unit, for forecasts and for observations. In addition, one or more local forecast stations may be located in the training area.

249. Meteorological information for the several arms and services.—*a. Statistical data.*—Every arm and service is interested in statistical meteorological information applicable to its operations. The clothing and housing of personnel and the proper protection of matériel depend to a considerable degree upon the weather to be experienced. Future weather conditions are best indicated for long periods in advance by a statistical study of past weather conditions. Nearly all units are interested in the duration of sunlight, twilight, moonlight, and starlight in every 24-hour period.

b. Current data.—(1) In artillery firing, corrections for departures from standard atmospheric conditions are habitually applied, if time and conditions permit. The data used are specially reduced observations of wind speed and direction, and air density, known respectively as "ballistic wind" and "ballistic density." Corrections for variations from standard temperature are also made.

(2) The Air Corps requires frequent reports showing air movement and visibility at all levels up to the highest at which airplanes are likely to fly. Fog, precipitation, and the height, thickness, and form of clouds, while they are elements in the reported visibility, need separate and detailed mention in the reports to Air Corps units. These reports should be made frequently enough to keep up with the changes in meteorological conditions. Detailed wind data are particularly useful in planning bomb dropping expeditions. The distribution of the observing stations should be such as to cover, from a meteorological viewpoint, the entire region in which air operations may be conducted.

(3) Chemical warfare units are interested in the stability, temperature, density, and movement of the air, since the possible concentration and drift of gas clouds or smoke screens depend upon these elements. These elements also determine, to a great extent, the sort of gas that should be used in any particular operation. On the other hand, a knowledge of the elements mentioned is of value in predicting the time and probable nature of a hostile gas attack.

(4) The sound ranging service is especially interested in air temperature and movement since these data must be considered in computing the speed and direction of sound travel.

c. Forecast.—(1) The operations sections of all staffs are interested in a weather forecast covering the following points:

(*a*) Character of weather for each arm and service.
(*b*) Winds:
At surface.
At 2,000 yards.
At 5,000 yards.
(*c*) Cloudiness, including fog and haze.
(*d*) Height of clouds.
(*e*) Visibility.
(*f*) Precipitation.
(*g*) Temperature.
(*h*) Warning of weather conditions favorable for use of gas by enemy.
(*i*) Probable accuracy, or odds in favor of forecast.

(2) Such a forecast, issued twice daily, should enable any operations section to take advantage of all weather elements favorable to the operation which it is planning, and to take into proper account unfavorable elements. For large operations, extending over considerable territory and occupying a longer period of time than 24 hours, a special forecast is issued, as required, on a half hour's notice. This forecast is more general than the regular forecast, in proportion to the time and territory covered. Special forecasts, in greater detail than a regular forecast, are issued as required for specific local operations of short duration.

(3) Following is an example of a forecast prepared twice daily by the forecast section of the army meteorological company and issued from army headquarters:

FIRST ARMY,
October 1, 1928, 5.30 p. m.

Weather Forecast
No. J 270

Confidential until 6 p. m., October 2

Weather good for infantry, poor for aviation and observation.

Wind at surface weak—0 to 6 m. p. h. northerly night, 0 to 12 m. p. h. north to northwest day.

At 2,000 yds. weak—5 to 10 m. p. h. north.

At 5,000 yds. weak—8 to 15 m. p. h. northeast.

Sky overcast first part of night with occasional breaks or clear spaces before midnight. Fog early morning and forenoon. Overcast afternoon.

Cloud height 1,000 yds., night; 200 yds., morning; becoming 1,000 yds., afternoon.

Visibility poor—0 to 2 miles night and morning, 2 to 5 miles afternoon.

Mist or wet fog in morning.

Minimum temperature 35°, maximum 60°.

Conditions favorable for use of gas by enemy opposite sectors facing northwest, north, and northeast.

Odds in favor of forecast 7 to 1, except clouds 3 to 1.

By command of General A.

B,
Chief of Staff.

OFFICIAL:
X,
Assistant Chief of Staff, G–3.

Distribution:
Army commander and staff.
Army troops and services.
Each corps.

250. Distribution of meteorological information.—*a.* Meteorological data are usually transmitted by wire telegraph from observing stations to army meteorological stations, excepting front line stations, which usually transmit by radio. Codes are employed for this purpose. These codes are usually simple sequences of numbers designed primarily to condense the reports (see par. 251). When circumstances require secrecy, the codes may be modified to conceal the information.

b. All army and GHQ meteorological stations are equipped with radio receiving sets, by means of which they collect data directly from front line observing stations when the latter report to local tactical units. Much meteorological information that would not otherwise be available is intercepted by radio from hostile and friendly sources.

c. Simultaneously with the report of observed data to army meteorological stations, the observation stations begin the distribution of these data, appropriately reduced and coded, to all military units which are in their respective vicinities, and which

employ current data in their work. In the training area this local distribution is usually effected by wire or messenger, or by the posting of bulletins. Distribution is made at regular hours, but special observations may also be distributed. Near the front, the distribution is largely by radio. It occurs at specific hours and on an assigned frequency.

d. Forecasts are usually distributed by wire telegraph to army staff sections and to corps, divisions and other units requiring them. Forecasts are distributed uncoded.

251. Meteorological message codes.—*a.* Meteorological data are usually simplified for transmission by means of a non-secret code (see par. 250 *a.*)

b. Following is a code key and an example of a message sent from an observing station to the army meteorological station for use in forecasting. Data for the use of the Air Corps are distributed in the same form. Address and signature are omitted:

Key	Message	Translation
MABhh----	MAB18	Bolling Field; 6 p. m.
BBBDD----	99254	Barometer, 29.92; wind direction, west.
SSwwb------	14052	Velocity, 14 mph.; weather, sky three-fourths covered with clouds; barometric pressure, rising.
hALBM----	51651	Cloud height, between 1,000 and 1,500 yards; cloud form, fracto-cumulus; amount of low clouds, six-tenths; form of medium clouds, thin alto-stratus; amount of medium or high clouds, one-tenth.
TTRGV----	35716	Temperature, 35°; humidity, 70–79 per cent; ground solid, with dew; visibility, 4,000–10,000 yards.
HDDSS-----	26315	Altitude 500 yards; wind direction northwest; wind speed 15 mph.
HDDSS-----	37218	Altitude 1,000 yards; wind direction north; wind speed 18 mph.
HDDSS-----	46520	Altitude 1,500 yards; wind direction northwest; wind speed 20 mph.
HDDSS-----	55527	Altitude 2,000 yards; wind direction west; wind speed 27 mph.
HDDSS-----	66130	Altitude 3,000 yards; wind direction northwest; wind speed 30 mph.

NOTES.—The above arrangement is standard. Omission of any data is indicated by sending the letter X in the spaces reserved for such data.

MAB The first three letters indicate the observing station. A list of the designations of the stations is furnished by the army meteorological service.
Examples: MAB, Bolling Field; MEC, Langley Field.

hh The hour of observation is indicated by a number from 1 to 24, beginning at one hour after midnight.
Examples: 2 AM sent as 02, 3 PM as 15. A zero is inserted before the hours 1 to 9, inclusive, to complete the code group.

BBB The sea level barometer reading is used except that the first figure is omitted.
Examples: 29.82 sent as 982, 30.27 as 027.

DD Wind direction is given in one of 72 points and is determined by dividing the direction, in degrees, by 5.

Examples: 45° (northeast) is sent as 09, east as 18, west as 54.

SS Wind speed in miles per hour.

Examples: 9 m. p. h. sent as 09, 17 m. p. h. as 17.

ww This combination of two figures indicates the present weather conditions. The first figure represents the general condition and is amplified by the second figure.

Examples: An exceptionally clear, cloudless day sent as 00; a cloudy sky with a very dense fog as 29. (Code I.)

b One figure indicates barometric tendency. (Code II.)

h Height of base of low clouds. (Code III.)

A Form of low clouds. (Code IV.)

L Amount in tenths of low clouds. Since only one figure is allowed, ten-tenths clouds, or a totally covered sky, is sent as 0 (zero).

B The form of medium or high cloud. (Code IV.)

M The amount in tenths of medium or high clouds.

The entire cloud group (hALBM) is omitted when ww indicates that there are no clouds.

TT Temperature in Fahrenheit degrees. When the temperature is below zero, the number of degrees is subtracted from 100, and when the temperature is above 100, the first figure is omitted.

Examples: 8° sent as 08, 34 as 34, 3 below zero as 97, 102 as 02.

R Relative humidity. (Code V.)

G State of ground. (Code VI.)

V Visibility. (Code VII.)

H Height of upper wind. (Code VIII.)

DD Wind direction at height H.

SS Wind speed at height H.

Code I

Present weather (ww)

Code No.	Sky (0)	Haze or fog: Clear sky or sky not visible (1)	Haze or fog: Sky cloudy (2)	Precipitation with—: No fog (3)	Precipitation with—: Fog [1] or fog [2] (4)	Precipitation with—: Fog [3] (5)	Precipitation with—: Fog [4] (6)	Local storm—: Approaching (7)	Local storm—: Passing (8)	Local storm—: Disappearing (9)
0	Exceptionally clear	Dust haze		Drizzle				Wind only.		
1	Clear	Haze		Light rain				Thunder, lightning, or both.		
2	White	Fog [1]		Moderate rain				Wind and rain.		
3	One-fourth covered	Wet fog [1]		Heavy rain				Thunder, lightning, and rain.		
4	One-half covered	Fog [2]		Hail				Wind and hail.		
5	Three-fourths covered	Wet fog [2]		Rain and hail				Thunder, lightning, and hail.		
6	Covered but with clear spaces.	Fog [3]		Sleet				Wind, rain, and hail.		
7	Covered	Wet fog [3]		Light snow				Thunder, lightning, rain, and hail.		
8	Halo	Fog [4]		Moderate snow				Tornado.		
9	Aurora	Wet fog [4]		Heavy snow				Hurricane.		

Wet fog [1], or fog [1]=most distant object visible 500 to 1,000 yards.
Wet fog [2], or fog [2]=most distant object visible 250 to 500 yards.
Wet fog [3], or fog [3]=most distant object visible 100 to 250 yards.
Wet fog [4], or fog [4]=most distant object visible 0 to 100 yards.

In the two figures for present weather the order is as follows: The first figure will be taken from the top of the code table (to indicate the general class of weather) and the second figure from the side (to indicate the subclassification). Thus 61 would be "Light rain with very dense fog."

Code II

Code for barometric tendency (b) for last three hours:

0=steady.
1=unsteady.
2=rising.
3=falling.
4=falling, then rising.
5=steady, then rising.
6=steady, then falling.
7=falling, then steady.
8=rising, then steady or falling.
9=line squall—sudden rise with marked change in wind and weather.

Code III

Code for cloud heights (h):

0=clouds below 150 yards.
1=clouds between 150–300 yards.
2=clouds between 300–500 yards.
3=clouds between 500–750 yards.
4=clouds between 750–1,000 yards.
5=clouds between 1,000–1,500 yards.
6=clouds between 1,500–2,000 yards.
7=clouds between 2,000–2,500 yards.
8=clouds between 2,500–3,000 yards.
9=no low clouds.

Code IV

Code for form of low (A) and medium or high (B) cloud:

(A) Low cloud:	Average height (yards)
1=fracto-cumulus	1,500
2=mammato-cumulus	2,300
3=low strato-cumulus	Below 1,200
4=high strato-cumulus	Above 1,200
5=nimbus	1,200
6=cumulus	1,500
7=cumulo-nimbus	1,500
8=stratus	700

The above heights will be assumed whenever the message indicates the presence of low clouds but fails to give the height.

(B) Medium or high cloud:
1=cirrus.
2=cirro-stratus.
3=cirro-cumulus.
4=false cirrus.
5=thin alto-stratus.
6=thick alto-stratus.
7=low alto-cumulus, below 3,500 yards.
8=high alto-cumulus, above 3,500 yards

Code V

Code for humidity (R):

0=95–100 per cent.
9=90–94 per cent.
8=80–89 per cent.
7=70–79 per cent.
6=60–69 per cent.
5=50–59 per cent.
4=40–49 per cent.
3=30–39 per cent.
2=20–29 per cent.
1=10–19 per cent.

Code VI

Code for state of ground (G):

0=solid (dry or frozen)	Fit for landing.
1=solid (dew)	Do.
2=solid (light frost)	Do.
3=solid (heavy frost)	Do.
4=solid (snow or water in spots; parts of field usable)	Do.
5=solid (snow covered)	Do.
6=soft (from rain or thaw)	Do.
7=soft (from rain or thaw)	Unfit for landing.
8=flooded	Do.
9=solid (snow in deep drifts, or heavy snow, 10 inches or more)	Do.

Code VII

Code for visibility (V):

0=0–50 yards; dense fog.
1=50–200 yards; very bad
2=200–500 yards; bad.
3=500–1,000 yards; very poor.
4=1,000–2,000 yards; poor.
5=2,000–4,000 yards; indifferent.
6=4,000–10,000 yards; fair.
7=10,000–20,000 yards; good.
8=20,000–50,000 yards; very good.
9=50,000 yards and over; excellent.

Code VIII

Code for height of upper wind (H):

1=200 yards.
2=500 yards.
3=1,000 yards.
4=1,500 yards.
5=2,000 yards.
6=3,000 yards.
7=4,000 yards.
8=5,000 yards.

c. Artillery messages.—(1) There are two meteorological messages for artillery, known respectively as "message 2" and "message 3." Antiaircraft artillery uses the data contained in message 2. Terrestrial artillery uses the data contained in message 3 except for certain types of guns when fired at high angles of elevation, when it uses the data contained in message 2. The artillery firing tables will indicate which of these two messages is appropriate for use with a particular type of gun fired

at a particular angle of elevation. The two artillery messages are similar in form and the same basic data are used in the computation of both, the only difference being that different weighting factors are used in computing the messages.

(2) Each artillery message consists of a group of letters to designate the sending station, followed by a series of groups of figures, seven figures to each group, with the exception of the first, which includes only five figures. The first group of figures indicates that the message contains meteorological data for artillery, the altitude of the meteorological datum plane and the temperature. Each subsequent group of figures indicates the direction and speed of the ballistic wind and the ballistic density for a specified maximum ordinate.

(3) In preparing each message, the station designation (usually repeated) is placed first.

(4) The first figure of the first group of numerals is either 2 or 3, indicating that the data contained in the message are for the use of artillery. When the figure 2 is used, it indicates that the data in the message are computed for the use of antiaircraft artillery, or terrestrial artillery firing guns at high angles of elevation. When the figure 3 is used, it indicates that the data in the message are computed for the use of terrestrial artillery except in those cases where terrestrial artillery, firing guns at high angles of elevation, use the data contained in message 2. The next two figures indicate the altitude of the meteorological datum plane to the nearest hundred feet above sea level. The final two figures of this group indicate the temperature at the meteorological datum plane.

(5) Each of the subsequent groups of seven figures in both messages indicates the direction and speed of the ballistic wind and the ballistic density for certain maximum ordinates. The first figure in each of these groups shows the height of a maximum ordinate to which data indicated by the other figures in the group apply. The height of the maximum ordinate above the meteorological datum plane (M. D. P.) will be indicated by figures, as follows:

Figure	Altitude (feet)	Figure	Altitude (feet)	Figure	Altitude (feet)
0	0	5	6,000	9	18,000
1	600	6	9,000	0	24,000
2	1,500	7	12,000	1	30,000
3	3,000	8	15,000	2	36,000
4	4,500				

If it is necessary to furnish data for a higher maximum ordinate than 36,000 feet, the above table may be continued by adding 6,000 feet for each increase of 1 in the code number. For instance, if figure 3 is used the second time to indicate a maximum ordinate, it is understood that the data for the maximum ordinate of 42,000 feet are contained in that group of figures. The repetition of numerals in the code to indicate maximum ordinates should not lead to confusion, as the location of the figures in the message indicates their meaning. The data for various maximum ordinates are always sent in the order indicated above, namely, the surface data first, followed by the data for 600 feet, 1,500 feet, 3,000 feet, etc.

(6) The second and third figures of these groups indicate the direction from which the ballistic wind is blowing, on a basis of 64 points to the circle, starting from the north and measuring clockwise. Thus the figures 16 indicate that the wind is blowing from the east; the figures 32 indicate that the wind is blowing from the south; the figures 48 indicate that the wind is blowing from the west; and the figures 64 indicate that the wind is blowing from the north.

(7) The fourth and fifth figures in each of these groups indicate the speed of the ballistic wind in miles per hour.

(8) The sixth and seventh figures in each of these groups indicate the ballistic density in percentage of standard.

(9) The following is an example of meteorological message 3 for artillery:

Code groups	Explanations
MIFMIF-----	The letter M indicates that the message is a meteorological message. The letters IF are the code designation of Fort Sill, Okla. The code letters MIFMIF indicate that the message contains meteorological information from Fort Sill.
31256-----	The figure 3 indicates that the message contains data for terrestrial artillery; the figures 12 indicate that the meterorological datum plane (M. D. P.) is 1,200 feet above sea level; the figures 56 indicate that the temperature at M. D. P. is 56° F.

The remaining groups of figures indicate the direction and speed of the ballistic wind and the ballistic density for maximum ordinates, as follows:

Code groups	Maximum ordinate (feet)	Ballistic wind direction	Ballistic wind speed (m.p.h.)	Ballistic density
0320896	Surface.	32	8	96
1351196	600	35	11	96
2371496	1,500	37	14	96
3401596	3,000	40	15	96
4441696	4,500	44	16	96
5481896	6,000	48	18	96
6502197	9,000	50	21	97
7532297	12,000	53	22	97
8562497	15,000	56	24	97

CHAPTER 9

SIGNAL SUPPLY

252. Responsibility for supply.—The unit signal officer is responsible for the supply of Signal Corps equipment throughout the unit. The unit signal supply officer is charged with the actual procurement and distribution of these supplies. His general duties are prescribed in Army Regulations and in other orders and regulations pertaining to supply. In divisions the duties of unit signal supply officer are performed by the supply officer of the division signal company or the division signal troop.

253. Signal supply establishments.—Certain establishments for the storage and issue of Signal Corps supplies are organized in the theater of operations by divisions and higher units. The types and quantities of supplies stored in these establishments depend on the nature of the operations and are varied to meet the probable needs of the troops at any time. The amount of Signal Corps equipment stored in the combat zone is kept to a minimum at all times.

254. Methods of supply; general.—*a.* Signal supplies belong either to Class III or Class IV. During active operations such items as field wire, batteries, and tape, the distribution of which depends upon the nature of the operations, become Class IV supplies. The issue of Class III and Class IV signal supplies is made in conformity with the provisions of Manual for Commanders of Large Units, Vol. II.

b. In emergencies the unit signal officer may call on the signal officer of the next superior unit for supplies needed for immediate use, to be furnished if practicable from the reserve stock of the superior unit.

c. Requisitions are not forwarded to higher authority while the lower unit has supplies at its disposal from which requisitions may be filled.

255. Signal supply in the division.—*a.* Requisitions from unit signal supply officers are reviewed and consolidated by the division signal officer. The latter prepares a consolidated requisition which is forwarded to the army signal officer.

APPENDIX

RADIO COMMUNICATION EQUIPMENT

(This table is prepared for general information only. It should not be used as basis for requisitions)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
				Transmitting				Receiving					Storage batteries		Dry batteries		
SCR No.	Set box No.	Description	Described in	Type	Range (miles)	Frequency in kilocycles	Tubes or lamps used	Type	Frequency in kilocycles	Tubes or lamps used	Power	Spare vacuum tubes or lamps	In use	Spare	In use	Spare	Remarks
77–B	BC–9–A	Set, loop telegraph	RCP No. 43	CW	3–5	4,100–4,400	3 VT–1	CW	4,100–4,400	3 VT–1	4-v. storage battery	3 VT–1	1 BB–41	2 BB–41	9 BA–2	6 BA–2	Same tubes used for transmitting and receiving. Nine tuner settings.
79–A	BC–32–A BC–40	Set, transmitting and receiving telegraph	RCP No. 17	do	20	273–600	2 VT–2 1 LM–4		273–600	do	Dyn. PE–6 350-v. fm. 12-v. stge. (100 w. input)	3 VT–1 2 VT–2 3 LM–4	5 BB–29	6 BB–29	1 BA–4 2 BA–2	3 BA–4 2 BA–2	
82		Set, battery charging 2-KW. 25 and 115 v	TR 1215–5								Gas. Eng. GE–2 Gen. GN–9						
95	BC–40	Set, wavemeter	RCP No. 28			273–600			273–600	1 lamp LM–4	Buzzer and battery	5 LM–4			1 BA–4		Weight: 850 pounds.
109–A	BC–86–B BC–98–B SCR–125–A	Set, telegraph and telephone transmitting and receiving. Uses antenna, type AN–8–A.	RCP No. 27	CW ICW Tp	CW–60 ICW–30 Tp. 20	600–1,000	2 VT–4–B 1 VT–2	CW ICW Tp	273–1,000	3 VT–1	Dyn. DM–13–B or C, 750-v. from 12-v. storage battery or motor generator type MA–4.	2 VT–4–B 1 VT–2 3 VT–1	6 BB–29	6 BB–29	4 BA–2	4 BA–2	
109–A, modified	BC–86–B BC–98–B	Set, telegraph, modified for CW only	do	CW	100	600–1,000	2 VT–4–B 1 VT–2	CW ICW Tp	273–1,000	do	Dynamotor and storage battery or motor generator.	2 VT–4–B 1 VT–2 3 VT–1	do	do	do	do	
127	BC–7	Set, transmitting and receiving telegraph, pack.	RCP No. 26	do	60	273–545	4 VT–2	CW ICW Tp	273–857	3 VT–7	Hand-driven 350-v. and 8-v. generator, GN–29–A	5 VT–2 6 VT–7			2 BA–8 3 BA–23	2 BA–8 9 BA–23	VT–7 same as Westinghouse WX–12.
130	BC–7	Set, transmitting and receiving telegraph	do	do	60	273–545	do	CW ICW Tp	273–857	do	Dyn. PE–5 to 350-v. fm. 12-v. storage battery	5 VT–2 4 VT–1	3 BB–29	6 BB–29	2 BA–8	2 BA–8	
131	BC–148	Set, loop telegraph	TR 1210–50	do	5	3,960–4,360	VT–2 or UX–210.	CW	3,960–4,360	3 UX–864	Hand generator	6 UX–864			2 BA–23 2 BA–2	4 BA–23 4 BA–2	Under development.
132	BC–127 BC–118–A BC–138 BC–131	Set, transmitting and receiving, telegraph and telephone.	TR 1210–30	do ICW Tp	CW–600 ICW–600 Tp. 200	150–350	4 VT–4–B 3 VT–22	CW ICW Tp	100–1,000	7 VT–5	Motor generator GN–32 or MG–8. 2,000-v., 110-v., and 12-v. DC from 110-v. or 220-v. AC power lines or power equipment type PE–40.	14 VT–5 8 VT–4–B 6 VT–22	1 BB–41	1 BB–41	4 BA–23 2 BA–8 1 BA–1	8 BA–23 2 BA–8 1 BA–1	Ground to air range is approximately one-half of that shown.
133	BC–152 BC–129 BC–130	Set, airplane telephone	BC–152 receiver described in: Instructions GEI–4234.	do	5	856–1,499	3 VT–2	CW ICW Tp	250–1,500	8 VT–5	Dyn. BD–46. Driven from central power plant.	8 VT–5 3 VT–2	1 BB–4	2 BB–4	3 BA–2	6 BA–2	Obsolescent.
134	BC–114 BC–162 BC–119	Set, airplane telegraph and telephone	TR 1210–5	CW ICW Tp	CW–90 ICW–90 Tp. 30	400–857	1 VT–2 3 VT–4–B	CW ICW Tp	250–1,500	do	Dyn. BD–41 driven from central power plant	1 VT–2 3 VT–4–B 8 VT–5	do	do	do	do	
135	BC–110 BC–152 BC–120 BC–121	Set, airplane telephone	BC–152 receiver described in: Instructions GEI–4234.	CW ICW Tp	CW–250 ICW–250 Tp. 80	250–350	5 VT–4–B	CW ICW Tp	250–1,500	do	Dyn. Unit BD–43	1 VT–2 5 VT–4–B 8 VT–5	do	do	do	do	Do.
136	BC–122 BC–137	Set, ground telegraph and telephone	TR 1210–20	CW ICW Tp	CW–100 ICW–100 Tp. 30	333–867	1 VT–2 3 VT–4–B	CW ICW Tp	333–857	4 VT–5	PE–41 Gas engine driven generator 10 and 800-v. or motor generator type MA–4.	1 VT–2 3 VT–4–B 8 VT–5	1 BB–41	1 BB–41	2 BA–8	2 BA–8	
159	BC–86–B BC–98–B	Set, telegraph and telephone transmitting and receiving. Uses antenna type AN–12.	RCP No. 27	CW ICW Tp	CW–80 ICW–50 Tp. 30	600–1,000	2 VT–4–B 1 VT–2	CW Tp ICW	273–1,000	3 VT–1	Dyn. DM–13 B or C 750-v. fm. 12-v. storage battery. (25 watts output.)	2 VT–4–B 1 VT–2 3 VT–1	6 BB–29	6 BB–29	4 BA–2	4 BA–2	Same as SCR–109–A except for antenna.
161	BC–151	Set, loop telegraph	TR 1210–40	CW	5	3,760–4,120	3 UX–864	CW	3,760–4,120	3 UX–864	Hand generator	6 UX–864			2 BA–23 2 BA–2	4 BA–23 4 BA–2	Same tubes used for transmitting and receiving. Under development.
	BC–150	Wavemeter				100–2,000			100–2,000		Buzzer				1 BA–27	1 BA–27	
	BC–153	do				75–1,500			75–1,500		do				do	do	
162	BC–129 BC–130 BC–144	Set, D. B. boat telegraph and telephone for Coast Artillery.	TR 1210–75	CW Tp	5–10	850–1,500	3 VT–2	CW ICW Tp	600–1,300	4 VT–5	Dyn. Unit BD–46	3 VT–2 4 VT–5	1 BB–4	1 BB–4	2 BA–8	2 BA–8	
163	BC–157	Set, telegraph	TR 1210–32	CW	40	3,820–4,190	2 UX–210	CW	3,820–4,180	do	Hand generator	8 VT–5			4 BA–23 2 BA–8	8 BA–23 4 BA–8	Under development.
167	BC–123 BC–126	Set, airplane interphone, 2 stations	TR 1210–5														For intercommunication within observation or attack airplane. May be connected to radio receiver.
168	BC–10–C	Set, airplane interphone, 5 stations	TR 1210–5														For intercommunication within bombardment airplane. May be connected to radio receiver.
169	PE–43 BD–61	Set, battery charging ½ kilowatt, 32 volts	TR 1215–6								Gas engine and dynamotor						Weight: 225 pounds.
171	BC–156	Set, telegraph	TR 1210–31	CW	15	2,640–3,040		CW	2,640–3,040		Hand generator						Under development.
		Code practice equipment, type EE–81	TR 1215–10														Switchboard, one master position and 20 student positions for teaching code.

Legend: SCR—Set designation; CW=Continuous wave telegraph; D. B.=Distribution box; BC=Set box designation; ICW=Modulated CW; RCP=Radio Communication Pamphlet; VT=Vacuum tube; Tp=Telephone; TR=Technical Regulations; LM=Lamp; Dyn.=Dynamotor.

b. During active operations the division normally obtains its signal supplies directly from the army signal depot. When speed of supply is not of great importance, supplies may be obtained directly from the communications zone.

c. Upon arrival of the supplies at the refilling point they are distributed under direction of the division signal officer. He uses for this purpose the personnel and transportation of the supply section of the division signal company as far as practicable. The division quartermaster train may assist in emergencies. Signal supplies may be delivered directly to lower units from the refilling point, but it is often necessary to establish a distributing point, where distribution is made to the trains of the lower units. The distributing point may coincide with the division signal dump.

d. The division signal officer is responsible for charging the storage batteries of all units not equipped with charging plants. The division charging plant is operated by the division signal company. It is normally located at the division signal dump. Three sets of storage batteries are a component of most field radio sets. Prior to combat every effort is made to provide each radio set requiring them with two fully charged sets of batteries. In active operations one set of batteries will normally be on charge, one in transportation between the radio station and the charging plant, and one in operation. During combat the collection and distribution of storage batteries pertaining to radio stations of the lower units is usually made by the division signal company at distributing points.

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