UNITED STATES ARMY

TRAINING MANUAL No. 43

THE FIELD LINEMAN

INSTRUCTORS GUIDE
FOR ALL ARMS

PREPARED UNDER THE DIRECTION OF THE
CHIEF SIGNAL OFFICER

1925

WASHINGTON
GOVERNMENT PRINTING OFFICE
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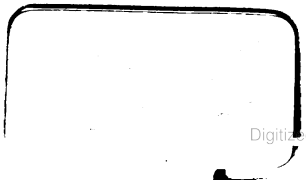

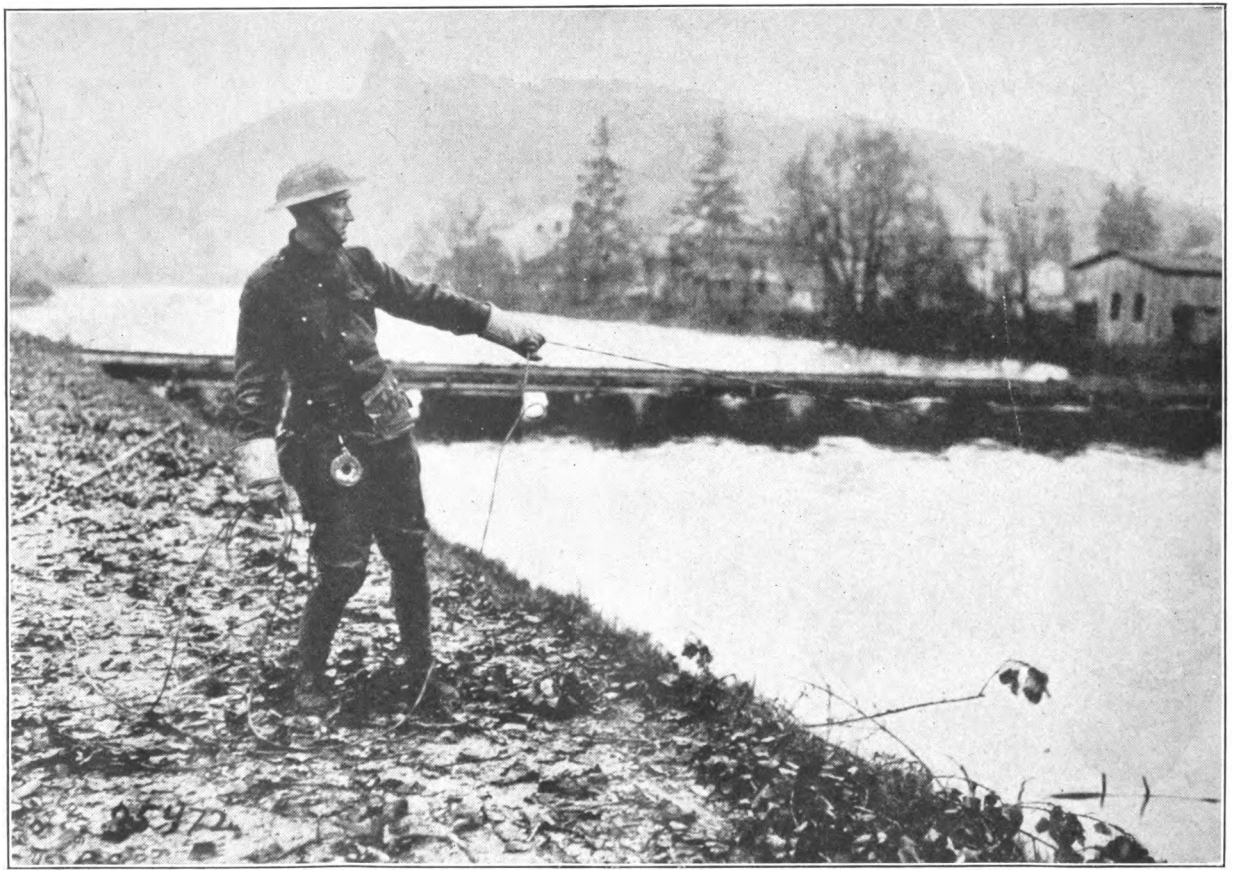

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CERTIFICATE: By direction of the Secretary of War, the matter contained herein is published as administrative information and is required for the proper transaction of the public business.

WAR DEPARTMENT,
WASHINGTON, *March 4, 1925.*

Manuals for training in the Army are to be prepared and revised from time to time by the branches of the service concerned, and when approved, published by The Adjutant General of the Army in pamphlet form in a series of training manuals.

In accordance with this plan there has been prepared by the Signal Corps a series of pamphlets relating to signal communication specialists.

The pamphlets in this series are titled as follows:

Training Manual No. 20—Basic Signal Communication,

ERRATA

Instructors should note the corrections for Unit Operations Nos. 19 and 20 and Information Topic No. 3 in the Students Manual sections of this Instructors Guide. These corrections have been included in the Students Manual, Training Manual No. 42.

tors Guide.
Training Manual No. 26—Radio Operator, Students Manual.
Training Manual No. 27—Radio Operator, Instructors Guide.
Training Manual No. 28—Telegraph Operator, Students Manual.
Training Manual No. 29—Telegraph Operator, Instructors Guide.
Training Manual No. 30—Meteorological Observer, Students Manual.
Training Manual No. 31—Meteorological Observer, Instructors Guide.
Training Manual No. 32—Pigeoneer, Students Manual.
Training Manual No. 33—Pigeoneer, Instructors Guide.
Training Manual No. 42—Field Lineman, Students Manual.
Training Manual No. 43—Field Lineman, Instructors Guide.

This pamphlet is published for the information and guidance of all concerned.

BY ORDER OF THE SECRETARY OF WAR:

J. L. HINES,
Major General,
Chief of Staff.

OFFICIAL:
ROBERT C. DAVIS,
Major General
The Adjutant General.

PREFACE

1. The Instructors Guide of the Field Lineman is designed to help instructors in the training of Field Linemen of All Arms.

2. The Field Lineman Instructors Guide includes the following:

   a. The text of the various Unit Operations, as they appear in the Students Manual, but printed on blue paper.

   b. The Information Topics, as they appear in the Students Manual.

   c. Material prepared for the assistance of the instructor who is teaching a class in this subject, which is printed on white paper.

3. This Guide contains an analysis of the methods of giving instruction to the Field Linemen on equipment used by the combat units of a division up to the point where such lineman participate with Telephone Operators (F. A.) or Telephone Orderlies, Telephone Switchboard Operators, Message Center Personnel, and others in combined section field training. The work has been laid out for the student to do, step by step, together with such questions as will not only lead him to think and to experiment, but which will also assist the instructor to lead his students in this process.

4. This Guide leaves the officer commanding a signal communication unit free to direct and improve the character of instruction, rather than to spend his time preparing a schedule, texts, etc.

5. It is assumed that each member of the construction details of all wire sections will have received instruction in Training Manual No. 21, "Basic Signal Communication," before receiving instruction in this manual. Therefore the instruction in this Manual includes such subjects as are required in addition to those included in Training Manual No. 21 in order for the construction men to learn to do the things and acquire the knowledge listed in the minimum specifications.

6. Minimum Specifications for Men of Wire Sections, Infantry, and Field Artillery

Part I—Infantry

The following Minimum Specifications for men of the construction details of Infantry wire sections has been extracted from a memorandum of the Office of the Chief of Infantry and furnishes the basis for the matter contained in this manual:

SERGEANTS, CORPORALS, LINEMEN, PIKEMEN, AND MISCELLANEOUS PRIVATES

Demonstrate ability to:

Make ties and splices in field wire.
Make proper connections of a field telephone and call switchboard operator.
Change batteries in a field telephone.
Send and receive with buzzer eight words of five letters each per minute.
Operate a monocord switchboard.
Describe in general terms and explain the use of the signal equipment issued the section.

Demonstrate a working knowledge of elementary electricity to include that information necessary in the performance of their duties.

PIKEMEN

(In addition to the above)

Demonstrate ability to:

Use a pike skillfully in laying wire from a wire cart.
Make simple line tests.

SERGEANTS, CORPORALS, AND LINEMEN

(In addition to the above)

Demonstrate ability to:

Locate line faults and troubles and remove same.
Make ordinary line tests with the equipment furnished.
Interpret and follow wiring diagrams and line route maps.
Construct all types of field lines used in his organization.
Install and remove a monocord switchboard.
Use climbers and lineman's safety belt.
Distinguish and give the general characteristics of field wire used by Infantry.

SERGEANTS AND CORPORALS

(In addition to the above)

Demonstrate ability to:

Select routes for wire lines to avoid shell fire and traffic.

Make route sketches of wire lines.

Supervise and direct the construction of the wire lines of the unit to which they belong and the installation of wire instruments.

Demonstrate a working knowledge of signal equipment issued to the section to which they belong.

Part II—Field Artillery

The following tentative Minimum Specifications for a "Lineman" and "Telephone Corporal," Field Artillery, furnishes the basis for the matter contained in this manual pertaining to the Field Artillery.

LINEMAN

Qualifications of Private, Field Artillery.

Demonstrate ability to:

a. Make ties and splices with insulated wire.

b. Make proper connections of a field telephone and call switchboard operator.

c. Determine serviceability of dry cells.

d. Make 100 per cent test on telephone and to be able to install new battery in the phone.

e. Install and remove monocord switchboard.

f. Make ordinary line tests with the equipment furnished.

g. Interpret and follow wiring diagrams and line route maps.

h. Construct all types of field lines used in his organization.

i. Use climbers and lineman's safety belt.

Demonstrate a working knowledge of elementary electricity to include that necessary in the performance of his duty.

TELEPHONE CORPORAL

(In addition to the above)

Demonstrate ability to:

a. Make all tests prescribed for the field telephone.

b. Make all repairs authorized for the field telephone.

c. Operate monocord switchboard.

d. Make ordinary tests for troubles in the monocord switchboard and be able to clear trouble by repairs or replacements.

Demonstrate ability to—Continued.

e. Install night bell circuits.

f. Supervise the organization of the telephone central so it handles the telephone traffic smoothly and without delay.

g. Supervise the installation of his organization wire net.

h. Supervise the construction of all types of lines used in his organization.

i. Select routes for wire lines to avoid shell fire and ground traffic.

j. Make line route maps and circuit diagrams.

Demonstrate a working knowledge of:

a. Telephone code systems.

b. Elementary electricity, to include that necessary in the performance of his duty.

7. This Manual with its Instructors Guide must fulfill the following requirements:

a. It must analyze the steps in training Field Linemen in the various combat units of a division, up to the point where the joint training of the several sections of a signal communication platoon or detail takes place, so that officers, in time of war, can quickly train such men for duty with combat units in the field.

b. It must provide directions for the students to follow these steps, and such suggestions for the instructor as will permit him to train efficient linemen in a minimum time.

c. It must provide tests so that instructors can determine the progress of their students, and when the course is completed to determine their proficiency, so that the term "Field Lineman" shall come to mean, just as "Expert Rifleman" means, a soldier who can do certain things in a certain time with a given degree of accuracy.

d. The instruction so outlined must be of such a nature that it can be given under conditions as they exist in the service.

e. It must provide tests by means of which unit commanders can obtain the relative proficiency of the linemen within their units.

f. It must provide a method of instruction for our peace-time Army—Regular, National Guard, and Reserve, and also for the R. O. T. C. and C. M. T. C.—which will require no change of any kind for the training of these specialists in the larger Army which a National emergency may demand.

Notification of errors and suggestions for improvement of this Manual should be addressed to the Chief Signal Officer, Washington, D. C.

LINEMANS MANUAL, INSTRUCTORS GUIDE FOR ALL ARMS

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FIELD LINEMAN, INSTRUCTORS GUIDE

INTRODUCTION

1. **Instructors Guide.**—*a.* The instruction in this Guide is based upon the principle that the student learns by doing certain things. The student is accordingly brought into direct contact with tools and equipment at the very start. Thus his interest is aroused from the beginning, and he is consequently enabled by actual experiment as well as by thoughtful attention to get a clear understanding of the task and the principal involved.

b. The student must not only be able to do things; he must also know the essential facts and information necessary for an intelligent understanding of his work.

c. To determine just how much a student can do, as well as to find out just what he knows, certain definite types of questions and tests have been devised for the use of the instructor and are included in the Instructors Guide.

2. **Types of questions for Instructors Guide.**—The questions appearing in the Instructors Guide may be of two types:

a. Questions to be asked by the instructor at the first assembly of the class for each Unit Operation.—These questions should determine whether the students understand the directions, demonstrations, or explanations. At this time no question should be asked that will carry the men far afield, or which will divert their attention from the immediate and specific operation in hand.

Samples.

(1) *How should the battery in the telephone, type EE–5, be tested?*

(2) *How should the spurs on climbers be sharpened?*

(3) *Why should the wire on a reel cart be tested before it is laid?*

b. Informal questions such as would be asked by the instructor as he makes his rounds.—These should be such as are designed to help a man who is experiencing difficulty in the doing of the operation assigned, or who may need a clearer understanding of some phase of the operation upon which he is engaged. Questions of this type will be of immediate value in the completing of the operation. They will differ from those described in Par. 2 *a* above, in that the knowledge which has been secured in the first part of the operation is necessary in order to answer the questions.

Samples.

(1) *If, after filling a breast reel, it was found that the wire tested bad, what should be done?*

(2) *On the breast reel, type RL – 9, why is a latch provided at the end of the shaft opposite the crank?*

(3) *Why is the top strap of a climber equipped with a leather pad?*

3. **Types of tests for Instructors Guide.**—*a.* The tests which appear in this Guide are designed for three different purposes which are indicated by the names applied to them. These three kinds of tests are designated as:

(1) Instruction tests.
(2) Progress tests.
(3) Proficiency tests.

Each of these is described in greater detail below in paragraphs 4 to 10, inclusive.

b. The questions and problems of each of the above three types of tests naturally divide themselves into two classes, which for simplicity are called:

(1) Performance tests.
(2) Information tests.

Throughout this Guide all performance tests are labeled A and all information tests are labeled B. Each of these is described in greater detail below.

4. **Instruction Tests.**—A brief and informal test is given at the end of each teaching period or upon the completion of each unit operation. This is known as an Instruction Test. As the name implies, it is a device to aid instruction and may be used for the following purposes:

a. To determine if the student has correctly followed directions for the Unit Operation.

b. To determine if he understands the application of the principles taught to actual conditions as they may arise in the field.

c. To call special attention to those facts or processes which it is most important for him to know.

d. To arouse the interest and curiosity of the student.

e. To build up the spirit of competition. Students should be encouraged to look upon an Instruction Test as a game rather than an examination.

f. To improve the quality of instruction. Any attempt to measure improvement in teaching requires a frequent and regular measurement of the student's understanding of what he is being taught.

g. To adapt instruction to individual needs. Without the aid of some such device as the Instruction Test it is not easy to locate the deficiencies or difficulties of each individual student.

h. To bring immediate aid to the student who needs it. On the other hand, an Instruction Test will also indicate the point beyond which further teaching or additional practice is unnecessary.

Samples.

See the Instruction Tests which have been prepared for the various Unit Operations.

5. *a.* If Instruction Tests are properly handled, the instructor may find that some of the students have not profited as much as they should have from the field work and instruction. Under such circumstances the instructor can change his methods to fit individual cases. These tests bear the same relation to signal communication men that close order drill, subcaliber practice, and range firing bear to another type of military training. Instruction Tests also require frequent repetition if a standard of proficiency, equivalent to that obtained in other types of military training, is to be established. An Instruction Test, particularly the performance part, thus becomes a valuable device for purposes of drill and should be frequently used with this end in view.

b. In many instances the instructor in charge of the class may not wish to include an examination on both the *know* and the *do* parts of a Unit Operation in the same instruction test. In such cases it is allowable to divide the Instruction Test, examining for performance at one period and for information at another.

6. The Instruction Tests as given in this Guide are samples only. The instructor should devise others similar to the samples given. Questions which admit of one or more answers, and which tend to produce a discussion, even if they have previously been made use of, should be collected and included in the instruction test.

7. Instruction Tests may be scored by the instructor or, better, by the students themselves. In the latter case, the students should first exchange papers, and then be required to score the test from correct answers given out by the instructor. The tests should then be collected and carefully studied by the instructor for the purpose of determining in just what particulars each individual student is lacking.

8. **Progress Tests.**—*a.* Progress Tests differ from Instruction Tests (which are given on the completion of a single Unit Operation) in that they are given at the end of a group of related Unit Operations. A Progress Test marks the point at which there is a more or less distinctive change in the subject matter, or where further practice or instruction on the know or do things, in that group will not be continued unless the Progress Test should indicate failure on the part of the student to meet the requirements specified. Successful completion of a Progress Test should indicate that the student is

capable of using the principles covered in combination with new or different ones.

b. Progress Tests should be used by the instructor:

(1) As an aid in determining upon the completion of any group of related Unit Operations whether the students are making satisfactory progress. The instructor will thus not need to wait until Proficiency Tests are given to determine whether students must have additional work on a group of related Unit Operations.

(2) To find out how accurately and quickly the student can perform specified operations, and to discover in what particular things students are below proficiency. An opportunity is thus provided to bring students up to the required degree of expertness.

c. Progress Tests are to be scored by the instructor and should be systematically recorded. The score made by each student will at once indicate whether he should be placed in a special class for additional coaching and instruction.

9. **Proficiency Tests.**—*a.* Proficiency Tests differ from Instruction Tests and Progress Tests in that any Proficiency Test must cover the *entire* range of instruction and operations given in this Manual which is applicable to any given combat unit. Proficiency Tests are prepared in the same manner in which Progress Tests are prepared.

b. Proficiency Tests are given at the completion of a course in this Manual by instructors or unit commanders:

(1) To determine the character of the instruction given and the proficiency of their men in this subject.

(2) To determine the *relative* proficiency of their men in this subject.

(3) To rate their men in this subject, if notation of the fact that they have successfully completed this subject is desired on their service records.

c. Proficiency Tests may be used by higher unit commanders at any time:

(1) For determining the relative proficiency of men in different units.

(2) For determining which men must take instruction, in what units they are located, and in what they are deficient.

(3) For selecting men for various assignments which demand the knowledge and skill which the instruction in this Manual provides.

10. **The details of a test.**—*a.* Instruction, Progress, and Proficiency Tests should include both performance tests and information questions. The first part (labeled A) should be made up of Performance Tests only, and the second part (labeled B) should

include as many of the different types of the other five forms of questions as it is possible to devise. These five forms of questions are described in detail, beginning with Par. 12.

b. Tests should be given as frequently as possible, since they prepare the student for those varying conditions and situations that arise in the field and which the students must learn to meet by their own unaided efforts. The directions for preparing both parts of a test which will fulfill these requirements are given below.

11. **The performance part of any test.**—*a.* In preparing the performance part of any test arrange a list of those operations which students are required to do, either for an entire class to perform at one time or for each student to perform individually. The necessary directions for carrying out the test should be included, together with such other information regarding the conditions of the test as may be needed.

b. The character and form of the Performance Test are most easily understood by referring directly to the various tests which are distributed through this Guide. Suggestions for conducting each Performance Test are given just preceding such tests and include a method for scoring each of them. The points assigned to the different parts of any particular Performance Test for the purpose of scoring are based on the relative values of the different portions of the test with respect to each other as determined by the best available opinions of trained instructors. The total scores of the various Performance Tests have been so arranged that the more important receive the highest score and the less important smaller scores. These scores have been determined from the experience of all available trained instructors who have assisted in the preparation of this text.

c. Scoring system for all Performance Tests.

(1) The *total* score for a complete or perfect performance will always appear under "Scoring."

(2) The score required to pass the test will always appear under "Scoring." If no partial score is allowed there will appear the statement "No partial score allowed." Partial scores refer to steps in the performance.

(3) The detailed directions for scoring, including any partial scoring, will appear under "Scoring."

12. **The information part of any test.**—*a.* In preparing the information part of any test:

(1) Make a brief, clear, and explicit statement of just what information is required by the examiner on "know" questions.

(2) In order that there may be an equally clear, brief, and explicit answer from the student provide a *definite place* on the examination paper itself for such answers.

(3) Prepare questions covering the information which the students are presumed to know and ask as many of these questions as the best student in the class may reasonably be expected to answer during the examination period.

b. Tests composed of questions of the kinds described in Pars. 13, 14, 15, and 16 are most satisfactorily administered and scored by having the entire test typewritten, or mimeographed, and one copy placed in the hands of each person to be examined. If this is not practical, the test can be placed on the blackboard or on large sheets of paper. In the latter case, the sheets of paper can be used over again with the same or successive classes, or different combinations of them can be made up and used in Proficiency Tests. The time thus required to prepare the test is more than compensated for by the ease and economy of time in grading and scoring. Since the answer for each question will have a definite place assigned for it on the examination paper, either at the end of a line or on a particular dotted line, the grading or scoring of papers may be done almost automatically by means of an approved answer sheet.

c. For clearness and convenience, the various types of questions to be included in the information part of any test will be arbitrarily designated as:

(1) Completion questions.
(2) Recognition questions.
(3) True-False questions.
(4) Single-word questions.
(5) Observation questions.

d. In order to make clear just what is meant by the above, a very simple problem will be put into question form and asked in five different ways. The appropriate directions to the student will accompany each type of question, as well as instructions for devising and scoring such questions. These directions for devising information questions apply in all cases and for this reason are not repeated for each test throughout the Guide.

13. Completion questions.

a. SAMPLE: *Directions.*—Below is a sentence from which a word has been omitted. This word which has been omitted is indicated by a short dotted line, inclosed in parentheses, thus (.....). Fill in this blank space with a word which will make good sense and at the same time be technically correct. A word spelled with a hyphen, like "armor-plated" or "back-fire," counts as one word.

The breast reel will hold (_____) hundred feet of twisted pair outpost wire. Answer: Six.

b. (1) In devising completion questions every omitted word should be indicated by a short dotted line inclosed in parentheses thus (_____).

(2) "A," "an," and "the" are to be counted the same as any other words. If two or more words in succession are omitted, each omitted word is to be represented by a dotted line inclosed in parentheses.

(3) Do not omit too many words nor unimportant words, as the question then becomes a mere puzzle and not a real test.

(4) Do not make the sentences too long.

c. In scoring, one point will be allowed for each numbered paragraph of one or more sentences. One point will also be allowed for each subparagraph (of one or more sentences) to which a letter is assigned as *a*, *b*, *c*, etc. A satisfactory solution in each case will consist in filling in all the blank spaces so that each sentence will make sense and at the same time be technically correct.

14. **Recognition questions.**

a. SAMPLE: *Directions.*—Below are a number of questions and unfinished statements, each followed by several numbered words or phrases, one of which correctly answers the question or correctly completes the statement. Write the *number* of this word or phrase on the *dotted line* at the right of each question or statement.

The amount of twisted-pair outpost wire that a breast reel will hold is

(1) 100 feet. (2) 200 feet. (3) 600 feet.
(4) 1,000 feet. (5) 1,500 feet.

b. In devising recognition questions:

(1) Give a choice of four or five possible answers, only one of which is correct.

(2) Vary the relative position of the correct answers from line to line, being careful to avoid any regular position or system for placing the true answer among the other three or four.

(3) In order to test the student's ability to discriminate, include among the wrong answers some which are partly right or which look like the correct answer.

c. In scoring, one point will be allowed for each correct answer.

15. **True-False questions.**—There are several variations of this type of question which may be used, two of which are as follows:

a. SAMPLE: *Directions.*—Below are a number of sentences and just after each the words "True" and "False." Read each sentence carefully, and if what it says is true draw a line under the word "True." If what it says is not true, draw a line under the word "False."

The breast reel will hold 1,000 feet of twisted-pair outpost wire.
True. False.

Answer: The word *False* should be underscored.

b. SAMPLE: *Directions.*—Below are a number of sentences. Read each sentence carefully, and if what it says is true (correct) place a plus sign (+) on the *short dotted line* in the right margin. If what it says is not true (incorrect), place a minus sign (−) on the dotted line.

The breast reel will hold 1,000 feet of twisted-pair outpost wire. .....

Answer: A minus sign (−) should be placed on the dotted line, thus −

b. (1) In devising true-false questions, have approximately the same number of true statements as false.

(2) Vary as much as possible the order in which true and false sentences are presented. Do not put first all true statements and then all false, but mix them up, avoiding any regular system.

(3) Test the student's power of discrimination by purposely wording false statements so that they will appear to be true.

(4) In devising a true-false test ask as many questions as conveniently possible. The purpose of this is to overcome any tendency that a student will make points through mere chance by a number of lucky guesses.

c. The total score will be the number of questions correctly answered. Other ways of scoring might be used for this particular test, but this method is the simplest.

16. **Single-word questions.**—a. The question is carefully worded so that the answer will consist of a single word, phrase, number, or symbol. It is sometimes allowable to permit the use of more than one word, but this should be avoided if possible.

SAMPLE: *Directions.*—The following questions can be answered by a single word or phrase. Write the answer on the short dotted line.

How many feet of twisted-pair outpost wire will a breast reel hold? .....

Answer: Six hundred.

b. In devising single-word questions be careful to call for answers which can be stated, as far as possible, by a single word, phrase, number, or symbol.

c. In scoring, one point will be allowed for each question correctly answered, or for each statement properly completed.

17. **Observation questions.**—*a.* (1) For this type of question a drawing of the equipment is placed on the blackboard, or on a large sheet of paper. If more convenient, the equipment itself, instead of a drawing, may be placed on a table with the parts labeled or numbered. In either case simple and direct questions like the following are asked: "What is the name of this part?" "What

does it do?" "What is it for?" If the actual equipment is used, it should be plainly labeled with the number of the question, as, for example, "Question No. 7."

(2) Thus a breast reel could be displayed with a label, "Question No. 7." On the test paper would appear "What do you call the piece of equipment labeled "Question No. 7"?" "What is it used for?" "What kind of wire should be put on it?" "How many feet of this wire will it hold?"

Fig. 1 – IG.—The breast reel, incorrectly slung

(3) A very important and useful variation of this test is to show a piece of equipment from which an essential part has been deliberately left out or in which it has been improperly connected. The student is asked to indicate on his test paper the names of parts designated and to state whether there are any missing parts or wrong connections.

SAMPLE 1: *Directions.*—In the corresponding spaces provided below insert the names of the parts to which the numbered arrows in Fig. 1 – IG refer:

1_____ 2_____ 3_____
4_____ 5_____

SAMPLE 2: *Directions.*—If there are any wrong adjustments in this figure, state what they are and how to correct them.

SAMPLE 3: *Directions.*—Fig. 2 – IG shows a terminal strip. Complete the connections in Fig. 2 – IG so that it will represent a test station for two trunk lines.

SAMPLE 4: *Directions.*—A student was required to connect a terminal strip into two trunk lines so as to make a test station. He did it as shown in Fig. 31.

(*a*) If the student performed the operation correctly, write Yes here_____

(*b*) If the student performed it incorrectly, write No here_____ and show how it should have been done by drawing the proper connections in Fig. 31.

Fig. 2 – IG.—Terminal strip, type T. M. 84

b. (1) In devising observation questions remember that pictures, drawings, or diagrams must be large enough to be easily seen.

(2) All labels or numbers on either pictures or the equipment itself must be so placed that there will be no doubt as to exactly what they refer.

c. In scoring, one point may be allowed for each item correctly given, or a certain number of points may be arbitrarily assigned for a complete answer to the whole question.

18. **Heading.**—Having prepared the questions and the directions for each type there are a number of small items that require some attention. For instance, a test should have a title indicating its nature, whether Information, Progress, or Proficiency. The title should show the subject or course in which the test is given. A place should be provided for the student to write his name, rank, organization, and date. If the same test is to be given to different classes, a space should be provided for the name of the class to be written.

19. **Arrangement.**—The directions given below should be followed in printing or typing the information part of a test:

a. Do not put part of a question on one page and part on another page.

b. At the bottom of each page place the words "*Turn immediately to the next page.*" On the last page insert the words "*The End.*"

c. Recognition, true-false, and single-word questions should be single spaced. The short dotted lines which are provided for the answers to these types of questions should be in the right-hand margin of the page opposite the last line of each question. They should not be staggered. The text of these questions should be kept to the left of the column of short dotted lines which mark the place where the student is to write his answers.

d. Completion questions should be double spaced in order to provide sufficient space for the missing words to be written in. Inclose the blank space for each missing word in parentheses. (If this is not done, printers and typists may make errors and provide too few or too many blank spaces.) Have the blank spaces at least 1½ inches long.

e. Provide triple space between completion questions and double space between questions of other types.

f. Allow a space of a half inch or more between groups of different types of questions.

g. Place the number of each question to the left of the words of the question, so that the numbers of the questions are not entangled with the words. This is especially important where questions are single spaced.

20. **Scoring information questions.**—When the instructor has a large number of test papers to score, the use of scoring stencils will greatly simplify the scoring and will save time. To make stencils when tests are mimeographed, procure a piece of cardboard or heavy paper. Place a copy of the test paper on the cardboard with a piece of carbon paper in between. Draw a rectangle around each of the blank spaces provided on the test paper for the answers to questions, and the rectangles will be outlined in carbon on the cardboard. Cut out these rectangles from the cardboard. Then when the cardboard is placed over the test paper and properly lined up only the answers to the questions will show through the openings. Write the approved answer or answers just over each opening. A student's answers to the test can then be quickly checked against the approved answers and can be easily marked with a colored pencil by marking the test paper through the openings. Except in the case of a test composed of Completion Questions the stencils for several pages of a test can be made on a single piece of cardboard the size of the test paper. (See Fig. 3 – IG.)

Fig. 3 – IG.—Sample test with stencil

21. **Passing scores.**—*a.* In determining a student's standing in any test, whether Instruction, Progress, or Proficiency, it will be necessary to take into account his score both for performance and information.

b. For each performance, or "A," part of any test the score necessary for a passing grade is stated definitely in the directions for conducting each test.

c. For each information, or "B," part of any test the score necessary for a passing grade has been arbitrarily fixed at 75 per cent of the total number of possible points. For example, if the total number of points which can be scored for the B part of a test is 28 points, the passing score will be 21 points.

GENERAL SUGGESTIONS FOR THE INSTRUCTOR

22. The suggestions offered here are applicable to all the Unit Operations of this manual and for the sake of simplicity are grouped at the beginning of the Manual.

23. If the class is larger than 20 students, provide, if possible, an assistant instructor for each 10 students.

24. Divide the class into groups of such size as is best suited for the particular Unit Operation. In some cases students can work better individually, while in others the class should be divided into groups of 2, 3, or 4 persons.

25. Provide the equipment listed under each Unit Operation in the Students Manual and arrange it so that the class will lose no time in performing the Unit Operation.

26. At the first assembly of the class explain the use of the equipment to be handled and show by demonstration, how to handle and use this equipment correctly.

27. After the demonstration have each group of students perform the Unit Operation as laid down in the Students Manual.

28. After the class has completed any section of a Unit Operation, or the complete Unit Operation, assemble the class and go over the questions in the Unit Operation. Also ask any other questions, at your discretion, that will bring out important points in the Unit Operation.

29. At the completion of the Unit Operation have the students perform applicatory problems, using the knowledge just learned.

30. At the completion of the Unit Operation, give an Instruction Test similar to the test given in the text.

31. Since the selection and arrangement of the different Unit Operations have been carefully worked out, an instructor should not try to present more material than is contained in a given Unit Operation without first ascertaining whether the additional material

which he proposed to insert is not already given in some other Unit Operation together with other instruction matter more closely related to it.

32. The instructor should issue to each student for the duration of the course the following equipment:

a. 1 knife, electrician.
b. 1 pair pliers, side cutting.
c. 1 roll friction tape.
d. 1 roll rubber tape.

CLIMBING

Equipment (for each student).

1 pair climbers.
1 lineman's belt with safety.

Information.

Each climber is provided with two straps, a top strap 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 in order to prevent the climber from chafing the leg. (See Fig. 1.)

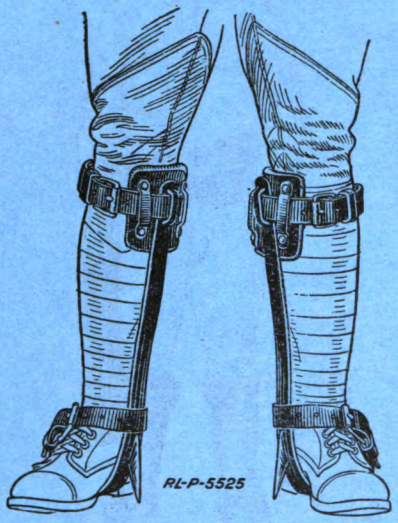

Fig. 1.—Lineman's climbers, properly adjusted

When fitting the climber on the leg the upper end of the shank of the climber should rest about 2 inches below the knuckle joint of the knee. Both straps should fit snugly around the leg, care being taken that the buckles do not rest on the shin or the instep of the foot. (See Fig. 1.)

Spurs should be sharpened by filing or grinding the half-round or outer side of the spur. Never grind or file the inside of the spur.

The belt is equipped with a safety strap for safety and ease while working on poles. Loops are also provided on the belt for carrying the various lineman's tools.

The belt should be fitted loosely around the body, but sufficiently tight to prevent its falling over the hips. (See Fig. 2.)

The belt and safety strap should be inspected for defects and adjusted before climbing the pole. This inspection should include all snaps, buckles, rings, and parts on which any strain will be placed. A defective belt or strap should never be used.

The student should always endeavor to attain the correct form in climbing; climb slowly at the beginning, taking short steps, and thrust the foot downward so that the spur will enter the pole at an

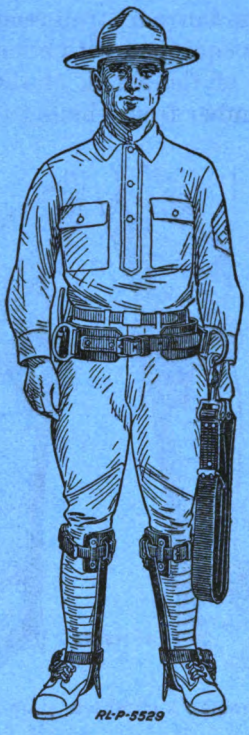

Fig. 2.—Lineman's equipment, properly adjusted

angle of about 30°. (See Fig. 3.) Always keep the knees and the body well away from the pole. (See Fig. 5.) Do not attempt to climb high at first, as it is considerably more difficult for a beginner to descend than to ascend.

Directions.

1. *Inspecting equipment.*—Inspect the climbers, belt and safety to see that they are in proper condition, and make sure that the correct sizes have been furnished.

2. *Putting on climbers.*—Fasten the climbers on the legs as shown in Fig. 1.

3. *Putting on and adjusting belt and safety.*—Put on and adjust properly the belt and safety as shown in Fig. 2.

4. *Taking position to climb.*—Take natural standing position at the foot of the pole with toes about six 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 the full length of the arms.

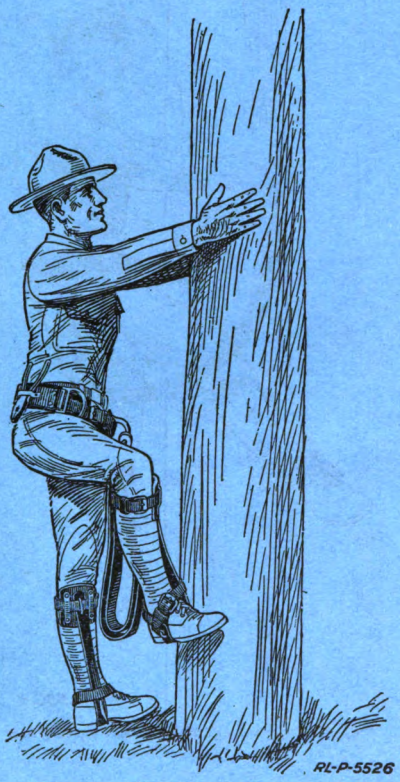

Fig. 3.—Climbing pole, first step

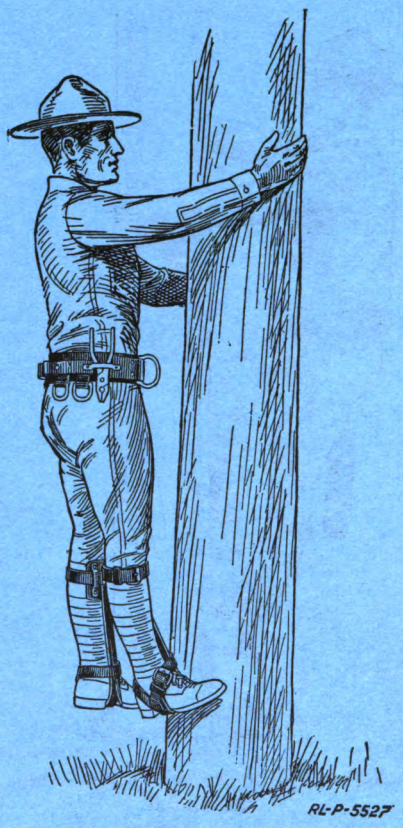

Fig. 4.—Climbing pole, second step

5. *Climbing.*—*a.* Raise the right foot about ten inches from the ground, keeping it about one inch from the pole, and with a downward thrust engage the spur of the climber in the face of the pole about eight inches from the ground. (See Fig. 3.)

b. 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. (See Fig. 4.)

c. From this position raise the left leg and repeat the thrust in the same manner as before, and at the same time raise the left hand about ten inches on the pole, balancing the body with the right hand. (See Fig. 5.)

d. Continue climbing in this manner until a height of from four to six feet has been attained.

6. *Descending.*—Use the same procedure in descending as in ascending except to throw the weight of the body slightly to the

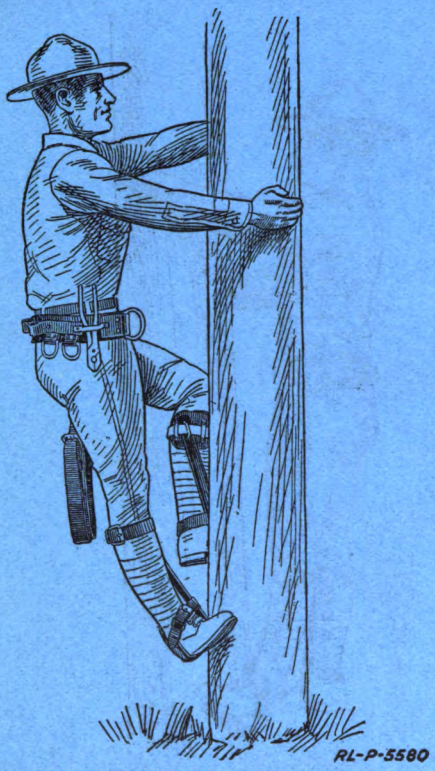

Fig. 5.—Climbing pole, second step completed

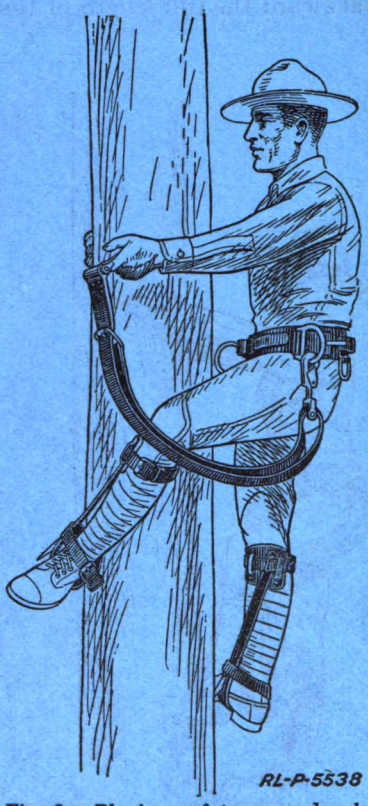

Fig. 6.—Placing safety around pole

right or left, as the case may be, in order to place more force or weight on each downward thrust and thereby insure a better hold on the pole.

7. *Using the safety.*—Ascend the pole to a height of about six feet above the ground. 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 five inches away

from the side of the pole. Grasping the pole with the right hand, unsnap one end of the safety belt and pass the end around the pole to the right hand. (See Fig. 6.) Aid the support of the body with the left hand and with the right hand fasten the loose end of the safety to the ring on the body belt as shown in Fig. 7. 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 the same level with the right foot. The heels, when in the

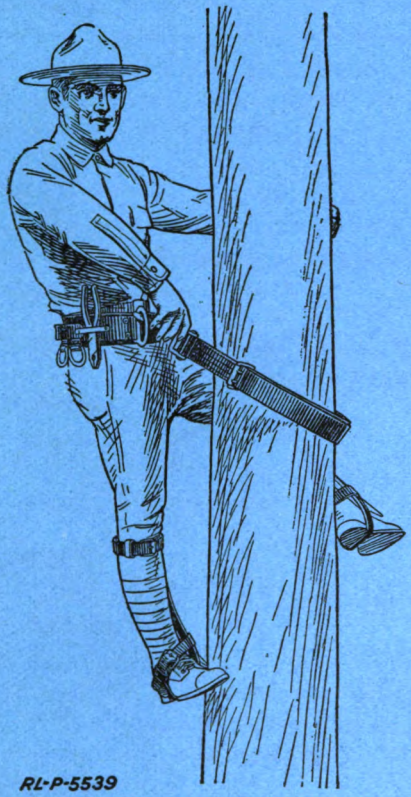

Fig. 7.—Securing safety

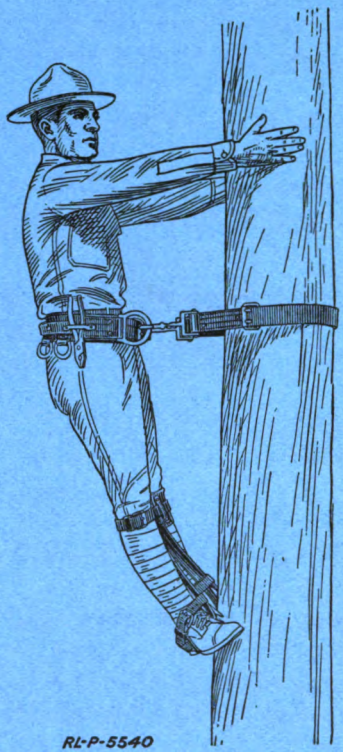

Fig. 8.—Safety, properly adjusted

proper and most comfortable position, should be about 3 inches apart. (See Fig. 8.) Lean backward gradually, placing the weight of the body on the safety strap. (See Fig. 8.) Adjust the safety strap to its proper position on the pole. Unhook the safety strap and descend the pole, using the same procedure except in inverse order.

8. Repeat Unit Operation at various heights until proficient in climbing and working on poles of any height.

SUGGESTIONS FOR THE INSTRUCTOR

1. Inspect the students and be sure that their equipment fits properly. Draw attention to any ill-fitting equipment and explain what might result from the use of such equipment.

2. While demonstrating the proper position to take for climbing, draw the student's attention especially to the position in which the knees and body are kept while climbing. Demonstrate how the spurs may become disengaged from the pole if the knees are not kept away from the pole.

3. Have each student climb to a height of about 6 feet, attach his safety, and circle the pole.

4. Those men who fail to qualify in this Unit Operation should be given 20 or 30 minutes' practice in climbing, daily, until they are proficient.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 1-A (PERFORMANCE)

Equipment.

1 pair of climbers.
1 lineman's belt with safety.
1 pair lineman's pliers.

Procedure.

1. Issue one set of equipment as listed above to each student who is to be tested.

2. Select a pole to be used for the test, preferably one of about 30 or 35 feet in height with no lighting or high-tension circuits on it.

3. Explain to the student that he is to put on and adjust his equipment; climb the pole to a height of 25 feet; attach his safety, circle the pole, and descend.

4. Ask if there are any questions; and if so, answer them.

5. Direct the student to go to the pole and to face the instructor.

6. Direct: "About face. Begin."

7. Note and record the time taken by the student to perform the work.

Scoring.

1. The maximum possible score for the test is 60 points.

2. The score required to pass this test is 45 points.

3. DIRECTIONS FOR SCORING.

	Points
a. Putting on and adjusting the equipment:	
(1) If the equipment is put on and adjusted properly	20
(2) No partial scores allowed.	
(3) The following constitute errors:	
(*a*) Failure to examine equipment for defects.	
(*b*) Climbers not properly put on. (See Fig. 1.)	
(*c*) Belt and safety not properly put on and adjusted. (See Figs. 3 and 4.)	
If any of the above errors occur	0
b. Climbing the pole:	
(1) If the student climbs the pole, attaches his safety, circles the the pole, correctly	20
(2) The following constitute errors:	
(*a*) Failure to use prescribed method in attaching safety. (See Figs. 13, 14, 15, and 16.)	
(*b*) Failure to circle the pole.	
If either of the above errors occur	0
c. Descending the pole:	
(1) If student descends correctly	20
(2) The following constitute errors:	
(*a*) Using less than 8 steps in descending the pole.	
(*b*) Failure to hook the safety strap end on the body belt.	
If either of the above errors occur, deduct	10

INSTRUCTION TEST NO. 1–A (PERFORMANCE)

Directions to the student.—*a.* The instructor will issue you the following equipment:

1 pair climbers.

1 lineman's belt with safety.

b. When the inspector says "Begin," inspect your equipment; put on and adjust your equipment; ascend the pole to the point designated by the instructor; attach your safety, circle the pole, detach safety, and descend the pole.

c. Do the work quickly.

d. Notify the instructor when you are through by calling your name.

INSTRUCTION TEST NO. 1–B (INFORMATION)

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the *short dotted line* in the right margin. If what it says is not true (incorrect) place a minus sign (−) on the dotted line.

1. When fitting the climber on the leg the upper end of the shank should rest about 2 inches below the knuckle joint of the knee. ------

2. Spurs should be sharpened by grinding the half round or outside of the spur. ------

3. The safety should not be used when working on a pole at a height of only 10 or 12 feet. ------

4. When climbing, the knees should be kept close in to the side of the pole. ------

5. Not more than three steps should be used in descending a 25-foot pole ------

6. The buckle of the bottom strap on the climber should rest on the top of the instep of the foot. ------

7. The body should be held well away from the pole when climbing. ------

8. When inspecting the belt or safety, it is unnecessary to inspect the metal parts. ------

9. The safety should always be used when working on a pole. ------

10. When working on poles, such as soft cedar, sharp spurs are not desirable. ------

TESTING WIRE WITH MAGNETO TELEPHONE

Equipment (for each student).

1 roll friction tape.
1 telephone, type EE – 4 or type EE – 5.
25 feet twisted-pair field wire.
1 pliers, side-cutting, 6-inch.

Information.

Testing wire and wire lines in the field is one of the most important duties of linemen. If a lineman can quickly determine the nature of the trouble on a circuit, it is usually not a difficult matter to clear it promptly. Thus it is very essential that all linemen be able to use efficiently any one of the testing instruments which may be at hand. Quite frequently the only testing instrument available will be the magneto telephone.

The type EE – 4 telephone is so wired that the ringer is across (in parallel with) the line circuit at all times. Thus, when the generator crank is turned on open circuit the bell will ring. The type EE – 5 telephone is wired in such manner that the ringer circuit automatically opens when the generator crank is turned. Therefore a lineman testing with this type telephone must be able to tell the condition of a line from the manner in which the generator crank turns, i. e., easily or hard.

The generator crank of either type telephone will always turn easily on open circuit (see Fig. 9) and hard on short circuit (see Fig. 10).

Directions.

PART I. TESTING WITH THE TYPE EE – 4 TELEPHONE

1. Connect one end of a twisted-pair wire to the L_1 and L_2 terminals of the EE – 4 telephone, as shown in Fig. 9, and turn the generator crank. Note whether the crank turns easily or hard and whether or not the bell rings.

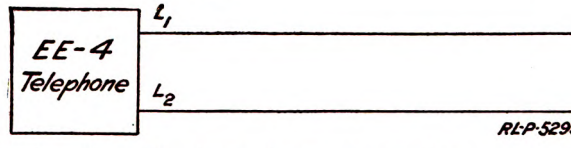

Fig. 9.—Type EE – 4 telephone connected to open circuit

Questions.

(1) *Did the crank turn easily or hard?*

(2) *Did the bell ring?*

(3) *What did this indicate?*

Directions.

2. Short the free end of the twisted pair as shown in Fig. 10 and again turn the generator crank.

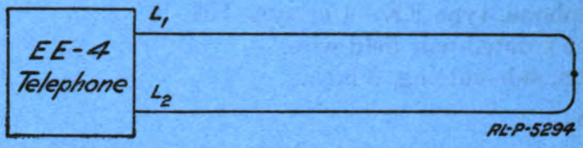

Fig. 10.—Type EE – 4 telephone connected to shorted circuit

Questions.

(4) *Did the crank turn easily or hard?*

(5) *Did the bell ring?*

(6) *What did this indicate?*

(7) *Why is it necessary to make both a continuity and a short circuit test to determine the condition of a twisted-pair wire?*

Directions.

PART II. TESTING WITH THE TYPE EE – 5 TELEPHONE

3. Connect one end of a twisted-pair wire to the "Line" and "Grnd." terminals of the EE – 5 telephone as shown in Fig. 11 and turn the generator crank. Then blow in the transmitter and note whether the sound can be heard in the receiver.

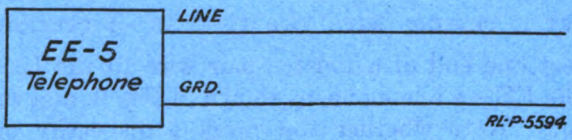

Fig. 11.—Type EE – 5 telephone connected to open circuit

Questions.

(8) *Did the crank turn easily or hard?*

(9) *Was blowing heard in the receiver?*

(10) *What did this indicate?*

Directions.

4. Short the free end of the twisted pair as shown in Fig. 12 and again turn the generator crank. Then blow in the transmitter and note whether the sound can be heard in the receiver.

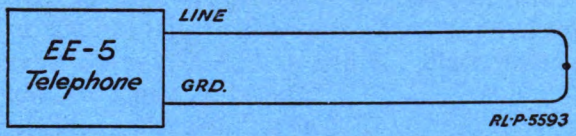

Fig. 12.—Type EE – 5 telephone connected to shorted circuit

Questions.

(*11*) *Did the crank turn easily or hard?*

(*12*) *Was blowing heard in the receiver?*

(*13*) *What did this indicate?*

(*14*) *Why is it necessary to make both a continuity and a short-circuit test to determine the condition of a twisted-pair wire?*

(*15*) *How would this test be made on a ground return circuit?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Divide the class into groups of two students.

2. Provide in advance six pieces of twisted-pair wire of various lengths, about 200 feet long. Place a tag on the end of each piece of wire and number them 1, 2, 3, 4, 5, and 6. Place faults as follows:

a. On circuit No. 1 place a "short."

b. On circuit No. 2 place an "open."

c. On circuit No. 3 place a "short" and further out place an "open."

d. On circuit No. 4 place an "open" and further out place a "short."

e. On circuit No. 5 place a "short" and further out place another "short."

f. On circuit No. 6 place an "open" and further out place another "open."

3. Where a circuit has two faults, place them some distance apart. Do not try to conceal the faults but make them so obvious that when a man goes out to find them he will be sure to see the first one he comes to.

4. After the class has performed the directions in the Unit Operation, using the good piece of wire provided, have one member of each group test each of the tagged circuits in turn and determine the nature of the trouble and clear it. While one member of a group is testing have the other member go to the distant end of each circuit as it is tested and open or short the circuit as directed by the student doing the testing. When the first member of the group has completed all six circuits, replace the faults and have the members of the group exchange places and repeat the tests. Do not require them to permanently repair the fault, but merely place it temporarily in the clear. For example, if the fault is a "short" caused by the insulation being removed and the two wires being placed together, have the student, when clearing the trouble, merely separate the wires (not taping the bare wire). The reason for this is so that the fault can be replaced on the circuit for the next student.

5. Have the student, when he rings on the circuit, announce what the fault is before he goes out on the circuit to clear it. When he goes out to clear the fault require him to temporarily clear the first fault he finds and then to go back to his telephone and test again to determine whether the circuit is clear or has still further faults on it. The reason for this is that circuits Nos. 3, 4, 5, and 6 each have more than one fault on them and the first test will only determine the nature of the one nearest the test telephone.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 2-A (PERFORMANCE)

Equipment.

1 telephone, type EE-4 or EE-5.
3 spools of coils of field wire.

Procedure.

1. Prepare in advance three spools or coils of twisted-pair field or outpost wire, with one coil short circuited at some central point, one coil with an open circuit, and one coil O. K. Make the faults so obvious that the student will find them when he examines the wire.

2. Inform the student that he is to test each coil, determine its condition, and place a tag on it showing the condition of the wire.

3. Check the student's work to make sure that he has correctly determined the condition of each coil, and then direct him to make the necessary repairs.

4. Note and record the time taken by the student to test and determine the condition of the three spools of wire.

Scoring.

1. The maximum possible score for this test is 60 points.
2. The score required to pass this test is 40 points.
3. DIRECTIONS FOR SCORING.

	Points
a. Testing and determining the condition of the wire (per spool):	
(1) If the student determines correctly the condition of a spool or coil of wire in three minutes allow	10
(2) No partial scores allowed.	
(3) If the student fails to determine the condition of a spool or coil within three minutes per spool	0
b. Repairing the wire (per spool):	
(1) If the student makes the necessary repairs correctly allow per spool	10
(2) No partial scores allowed.	
(3) The following constitute errors:	
(a) Failure to use both rubber and friction tape in repairing the insulation of the short circuited pair.	
(b) Failure to make a standard square-knot splice in both sides of the open circuit pair.	
If either of the above errors occur per spool	0

INSTRUCTION TEST NO. 2–A (PERFORMANCE)

Directions to the student.—*a.* The instructor will issue you the following equipment:

1 telephone, type EE – 4 or EE – 5.
3 spools or coils of field wire.

b. When the instructor directs, test the spools or coils of wire designated by the instructor; determine the condition of each coil; and place a tag on each coil showing its condition. Notify the instructor when you are through by calling your name.

c. The instructor will then direct you to make any necessary repairs to this wire.

d. When the instructor directs make the necessary repairs of the wire correctly. Do the work quickly and neatly and notify the instructor when you are through by calling your name.

INSTRUCTION TEST NO. 2–B (INFORMATION)

Directions.—Below are a number of unfinished sentences, each followed by several numbered statements, one of which correctly completes the sentence. Write the *number* of this statement on the *dotted line* at the right of each sentence.

1. When ringing on a shorted circuit with the type EE – 4 telephone,
   (1) the bell will ring.
   (2) the bell will not ring.
   (3) the generator crank will turn easily.
   (4) the telephone must be grounded.
   (5) the receiver must be off the hook. ------
2. When ringing on an open circuit with the EE – 5 telephone,
   (1) the generator crank will turn hard.
   (2) the buzzer will not sound.
   (3) the buzzer will sound.
   (4) the Gnd binding post must be connected to ground.
   (5) the button on the hand set must be pushed. ------
3. If both sides of a circuit become grounded.
   (1) a type EE – 5 telephone can not be used for testing the circuit.
   (2) the circuit will test "open."
   (3) the circuit will test "short."
   (4) it will not interfere with telephone conversations over the circuit. ------

4. The call buzzer in the type EE – 5 telephone
   (1) is bridged across the "Line" and "Gnd." terminals.
   (2) is disconnected by pressing the transmitter button.
   (3) is in series with the "Line" terminal.
   (4) is connected to the switch hook. ------

5. When a circuit has two faults (first an open and then a short), the first test with a magneto telephone,
   (1) will show both faults.
   (2) will show neither fault.
   (3) will show the fault nearest the telephone.
   (4) will show the fault fartherest away from telephone.
   (5) will show a short circuit. -------

6. If when making a test of a circuit, on which the distant ends have been connected together, it rings "open,"
   (1) there is sure to be no other fault on the circuit.
   (2) there might be a "short" between the test phone and the "open."
   (3) there might be other "opens" or "shorts" beyond the first "open." -------

7. If when testing a circuit, the distant ends of which have been connected together, a sound can be heard in the receiver when blowing in the transmitter, it indicates
   (1) there is a "short" somewhere besides the connection at the distant end.
   (2) the circuit is O. K.
   (3) the circuit has an "open" on it.
   (4) the circuit has no "opens" on it. ------

8. If when testing a circuit, the distant ends of which are *not* connected together, the generator crank turns hard, it indicates
   (1) a "short" on the circuit.
   (2) no "opens" anywhere.
   (3) an "open" on the circuit.
   (4) no "shorts" on the circuit. ------

TYING IN AND TAGGING FIELD LINES

Equipment (for each student).

25 or 30-foot length of twisted-pair outpost wire.
2 knobs, porcelain or wood.
2 screws for mounting same.

Information.

Line circuits always terminate on a line terminal strip at the switchboard end, and to prevent their being pulled loose from the terminal when a strain is placed on the wire, they are securely fastened to a post or tree, or to some other firmly anchored object. The making fast of a circuit to an object is called "tying in." (Fig. 13.) It is

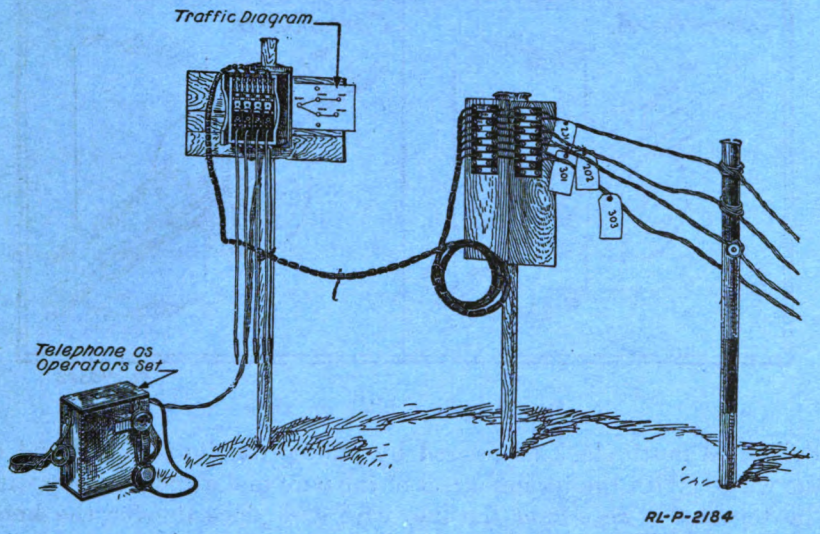

Fig. 13.—Field telephone central

also necessary to tie in at various points along the route between switchboards, such as at curves and road crossings. There are two knots used for tying in, the "clove hitch" and the "square knot." The clove hitch, as shown in Figs. 14 and 15, is used in every case where it is practicable to make it. If impracticable to make the clove hitch, the square knot is used, as shown in Fig. 16.

In tying in at terminals, the circuits are given the same relative positions on the object to which they are secured as they will occupy on the terminal strip, i. e., in numerical order beginning with the lowest numbered local circuit at the top and ending with the highest numbered trunk circuit at the bottom. This is done in order to simplify the tracing of circuits.

Tags are numbered to correspond with the numbers shown on the circuit diagram and are tied to their corresponding line circuits about one foot from the terminal strip. (See Fig. 13.)

Questions.

(*1*) *What would happen if line circuits were not tied in?*

(*2*) *Would the granny knot be suitable for tying in?*

TO MAKE A CLOVE HITCH ON A KNOB

Directions.

1. Stand facing the knob. Make a loop in the wire with the terminal wire behind the line wire. (The terminal wire is the one which is to go to the terminal strip.) Place the loop over the knob.

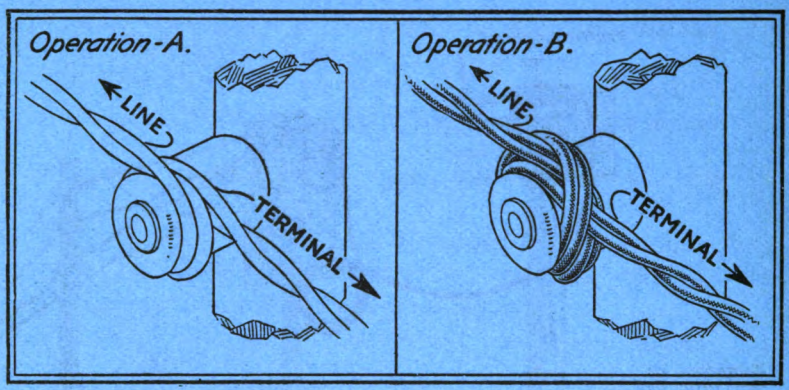

Fig. 14.—Clove hitch on knob

Pull in as much slack as desired by pulling on the terminal end of the wire. With the terminal end of the wire make another loop with the terminal wire *behind* the line wire and place it over the knob beside the first loop. Draw the loop tight. (See Fig. 14.)

Questions.

(*3*) *What would be the result if the terminal end of the wire was placed in front of the line wire in the second loop?*

(*4*) *How would you tie this knot if there was no slack on the terminal end of the wire?*

TO MAKE A CLOVE HITCH AROUND A TREE, POST OR STAKE

2. Pass the free end of the wire around the post and *under* the line wire. Pull in as much slack as desired. Pass the free end around the post again, *over* the line wire and *down* through the *top* loop. Pull the hitch tight. (See Fig. 15.)

Questions.

(5) *How would you tie this knot if neither the terminal end nor the line end of the wire was free?*

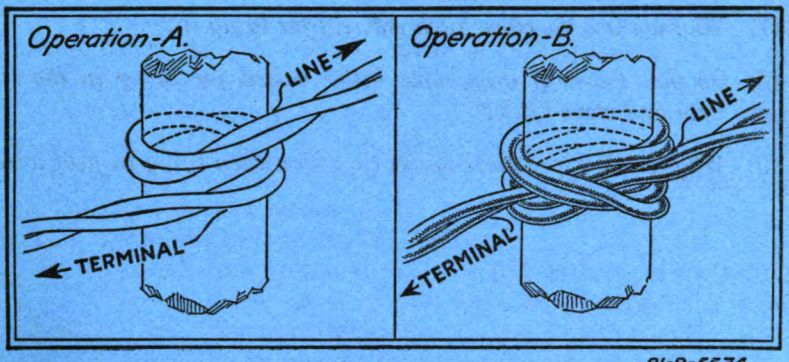

Fig. 15.—Clove hitch around post

TO TIE TO A TREE OR POST USING A SQUARE KNOT TIE

3. Stand facing the tree on the side on which the wire is being laid. Pull in enough slack to make a loop to go around the tree with about 6 inches left over. Place the loop around the tree from the front around the side toward which the wire is being laid. With

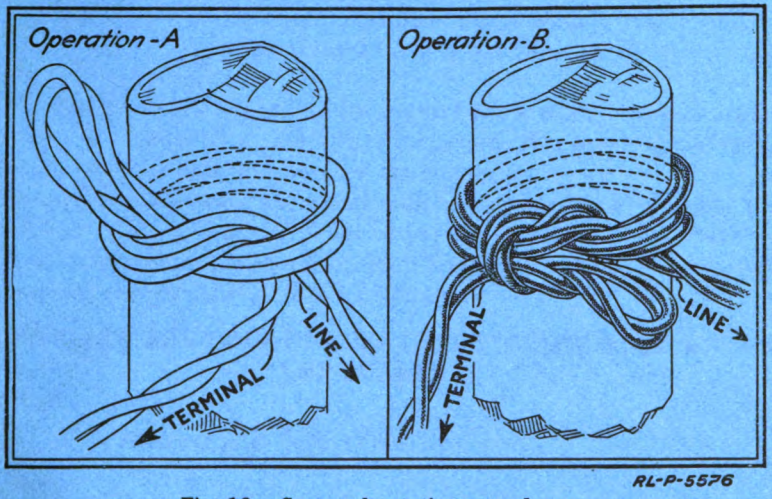

Fig. 16.—Square-knot tie around post

the end of the loop and the two wires forming the neck of the loop, tie the first half of a square knot. Then with the end of the loop and the wire leading to the reel complete the square knot. (See Fig. 16.)

Questions.

(6) *Why is it advantageous to use only the square knot and clove hitch for tying in field wire?*

(7) *Why not use the clove hitch entirely for tying in?*

(8) *Do you know of any knots better suited for tying in than the square knot and clove hitch?*

(9) *Why is it not practical to use tie wires when tying in field wire?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Prepare in advance a course over which the students will be required to run and tie in a twisted-pair field or outpost wire. Indicate the successive points at which the student is to tie in with tags marked A, B, C, D, etc. The purpose of the exercise is to require the student to tie in using the several different kinds of ties. For this reason the distances between the points make no difference except that it is desirable to have them as short as possible. Provide several knobs for use at points where only knobs can be used, such as on the side of a house.

2. A course might be prepared as follows:

Point A.—Initial terminal strip with a post near by with a knob on it. The tie used should be a clove hitch on the knob.

Point B.—Tree or telephone pole. The tie used should be a square knot tie around the tree or post.

Point C.—House. The tie should be a clove hitch on a knob which must be attached to the side of the house by the student.

Point D.—Tree with knob on it. The tie should be a clove hitch on the knob.

Point E.—Short post. The tie should be a clove hitch placed over the top of the post.

Point F.—Final point. Terminal strip with a tree near by. The tie should be a clove hitch made around the tree.

3. When the class first assembles require the students to make each of the ties as described in the Unit Operation, repeating the exercise until each student can make every tie correctly.

4. When the students have had sufficient practice in making the various ties, issue to each of them in turn, a coil of wire of sufficient length to cover the course which has been laid out, and have each one perform the exercise described above.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 3–A (PERFORMANCE)

Equipment.

50 feet of twisted-pair field or outpost wire.

Procedure.

1. Prepare a course for the test as follows:

a. Attach the wire to some convenient object.

b. About 6 feet from the point at which the wire is attached set up a short post. Place a sign on it which reads, "Make a clove hitch around this post."

c. About 6 feet farther set up a post with a knob on it. Place a sign on this post which reads, "Make a clove hitch on the knob."

d. About 6 feet farther set up a third post. Place a sign on it which reads, "Make a square-knot tie around this post."

e. About 6 feet farther set up a fourth post which is of such a length that the student can not reach the top. Place a sign on it which reads, "Make a clove hitch around this post."

2. Direct the student that he is to make a tie on each of the posts, four in all, and that the kind of tie to be made in each case is indicated by the sign on the post. Tell him he will be allowed three minutes from the command "Begin," in which to complete the four ties.

3. Have the student stand in front of the first post and when he is ready, command "Begin."

Scoring.

1. The maximum possible score is 40 points.
2. The score required to pass the test is 30 points.
3. DIRECTIONS FOR SCORING.

	Points
a. If a clove hitch is properly made on first post	10
b. If a clove hitch is properly made on knob on second post	10
c. If a square-knot tie is properly made on third post	10
d. If a clove hitch is properly made on fourth post	10
e. If the total time required exceeds 3 minutes, deduct 10 points for each seconds in excess thereof	30

INSTRUCTION TEST NO. 3–B (INFORMATION)

Directions.—The following questions can be answered by a single word or phrase. Write the answer on the short dotted line.

1. What kind of a tie is used when tying in to a tree at a corner? _____
2. What kind of a tie is used when tying in on a knob? _____
3. What kind of a tie is used when tying in to a pole at the end of a circuit just before connecting into a terminal strip? _____
4. What quality has field and outpost wire which makes it practical to use the ties described in the Unit Operation? _____
5. Is a tie wire necessary to tie in field or outpost wire? _____
6. What kind of a tie would be used to tie in to trees or poles in crossing over a road? _____
7. With what kind of wire would tie wires be necessary for tying in? _____
8. How many kinds of ties must a field lineman be able to make when laying outpost wire? _____

THE BREAST REEL

Equipment (for each student).

1 breast reel, type RL – 9.
1 extra spool.
1 commercial spool filled with twisted-pair outpost wire.
2 wooden supports for commercial reel.
1 iron pipe or shaft about 6 feet long.
1 telephone EE – 4.

Information.

The breast reel will hold 600 feet of twisted-pair outpost wire. It may be used by either mounted or dismounted troops for laying or recovering wire.

In laying wire, the reel may be carried on the breast (Fig. 18) with the crank pointing to the right, in which case it is necessary to pay out the wire by hand. It may also be carried on the back (Fig. 19) with the crank pointing to the left, in which case the tension of the wire is sufficient to unwind the wire from the spool. The latter method is generally used by mounted troops.

In recovering wire with the breast reel, the reel is always carried on the breast with the crank pointing to the right. This enables the operator to turn the crank with his right hand while using his left hand to distribute the wire evenly on the spool. When the crank is turned in a clockwise direction the two gears which mesh will cause the spool of wire to revolve in the opposite direction; that is, *toward* the operator. (See Fig. 18, in which the direction of the hand is indicated by an arrowhead and dotted line. The accompanying movement of the spool and wire is shown by the arrowheads with solid lines.)

In order to prevent the occurrence of unnecessary trouble on field lines, all wire should be carefully tested and inspected and all damage repaired before it is placed on reels. After filling the reels the wire should again be tested in order to determine whether or not any damage has occurred to the wire while it was being wound on the reel.

TO CHANGE SPOOLS

Directions.

1. Press the latch at the end of the shaft opposite the crank. Pull the shaft out of the frame, turning it so as to bring the lug on the shaft out through the slot in the frame, and lift out the spool.

2. Place the spool to be used in position in the frame. Replace the shaft, taking care that the lug on the shaft passes through the slot in the frame. Note that the shaft locks in place automatically.

ADJUSTING THE REEL

3. Make a preliminary adjustment of the straps. The straps may be crossed in back or not as the wearer prefers. Place the reel on the breast with the crank pointing to the right. Fasten the straps to the rings in the bottom of the frame, and make final adjustment so that the reel will fit properly on the breast.

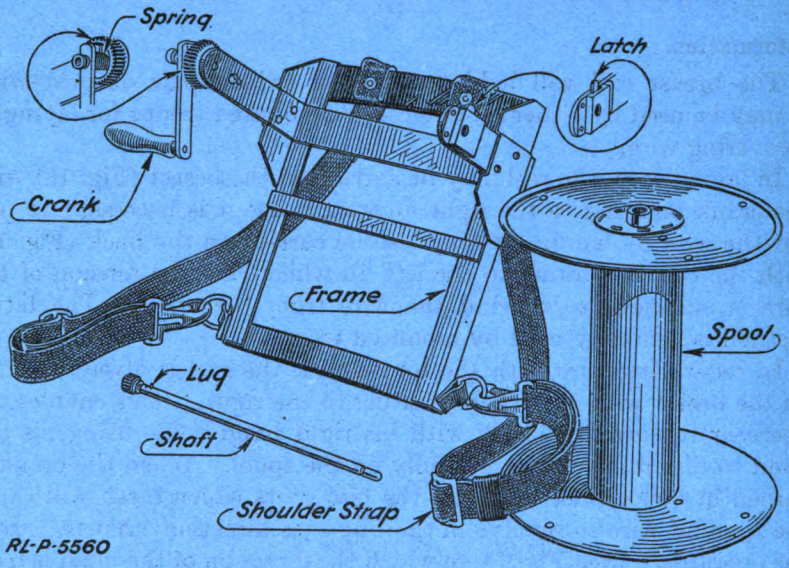

Fig. 17.—The breast reel, type RL – 9

TO FILL A SPOOL

4. Place the iron pipe through the hole in the center of the commercial spool of wire, and rest the ends of the pipe on the wooden supports, so that the spool will turn freely. Test the wire on the commercial spool as described in Unit Operation No. 1. Insert the free ends of the wire through the hole in the breast reel spool. Make sure that these ends protrude far enough to permit of testing the wire. Wind the wire on the spool in turning the crank with the right hand using the left hand to distribute the wire evenly on the spool. When the breast reel spool is filled, again test the wire.

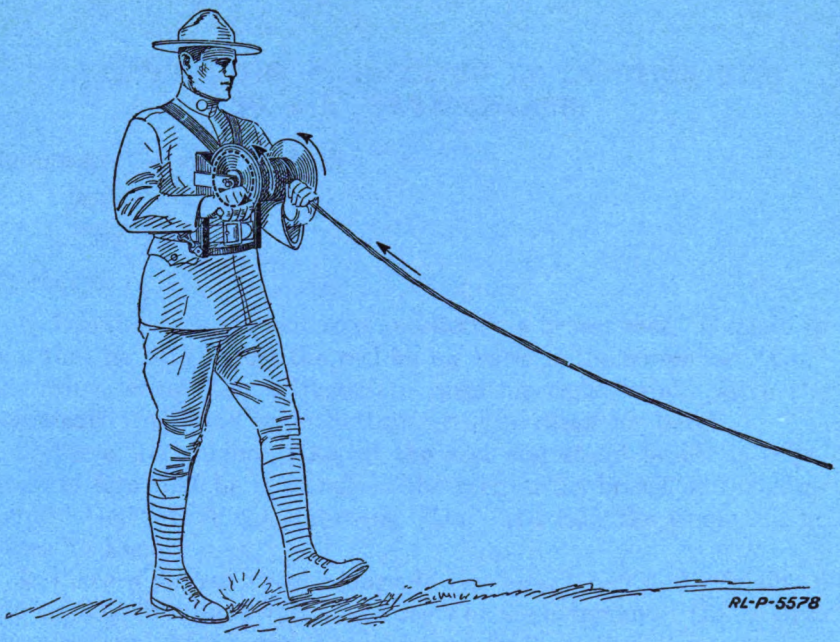

Fig. 18.—Recovering wire with a breast reel

Questions.

(1) *How much twisted-pair outpost wire will the breast reel hold?*

(2) *What are the principal uses of the breast reel?*

(3) *Why is it necessary to test wire before using it to lay field lines?*

(4) *If splices are found in the wire which is being wound on the spool, what should be done?*

(5) *If the wire on the commercial spool does not test out O. K., what should be done?*

(6) *If the wire after it is wound on the breast reel spool does not test O. K., what should be done?*

(7) *If old wire is being used and it does not test O. K., where would the, trouble most likely be found?*

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 4–A (PERFORMANCE)

Equipment (for each student).

1 breast reel (filled).
1 extra spool.

Procedure.

1. Require each student to stand beside a breast reel. Explain to him that he is to adjust the reel on his back at the command "Go," and when completely adjusted to raise his right hand. Give the command "*Go*," and take the time until he raises his hand.

2. Have the student take off the reel and stand beside it. Explain to him that he is to adjust the reel on his breast at the command "Go." Give the command "Go," and take the time until he raises his hand.

3. Place a second spool alongside the breast reel and explain to the student that he is to change spools at the command "Go." Give the command "Go," and take the time until spool is changed.

Scoring.

1. The maximum possible score is 30 points.
2. The score required to pass the test is 20 points.
3. DIRECTIONS FOR SCORING.

	Points
a. Adjusting the reel on the back:	
(1) If equipment is put on and adjusted properly within 30 seconds	10
(2) If equipment is put on and adjusted properly but time exceeded 30 seconds, deduct 2 points for each 5 seconds or part thereof over 30 seconds.	
(3) No partial score allowed if equipment is put on or adjusted improperly.	
b. Adjusting the reel on the breast:	
(1) If equipment is put on and adjusted properly within 30 seconds	10
(2) If the equipment is put on and adjusted properly but the time exceeds 30 seconds, deduct 2 points for each 5 seconds or part thereof over 30 seconds.	
(3) No partial score allowed if the equipment is put on or adjusted improperly.	
c. Changing spools:	
(1) If spool is changed correctly within 60 seconds	10
(2) If spool is changed correctly in less than 90 seconds but more than 60 seconds	5
(3) No other partial score allowed.	

INSTRUCTION TEST NO. 4–B (INFORMATION)

Directions.—Below are a number of sentences from which certain words have been omitted. Each word which has been omitted has been indicated by a short dotted line, inclosed in parentheses, thus (----------). Fill in this blank space with a word which will make good sense and at the same time be technically correct.

1. The breast reel will hold (----------) feet of wire.
2. The breast reel is carried on the (----------) when recovering wire.
3. Wire should be (----------) before it is placed on a breast reel to be laid later.
4. After wire has been placed on a breast reel it should always be (----------).
5. In order that wire on the reel may be tested the ends must be placed through the (----------) in the side of the (----------).
6. The spool is made (----------) so that when the wire on it has been laid it can be quickly (----------).
7. In order to test the wire on a breast reel a (----------) (----------) is needed.
8. When the reel is carried on the breast the crank should be to the (----------).

LAYING AND RECOVERING WIRE WITH THE BREAST REEL

Equipment.

(For each group of four men:)

1 switchboard, type BD – 9, with cable and switchboard terminal strip attached.
1 telephone, type EE – 4 or 5 (switchboard operator).
1 terminal strip, type TM – 84.

(For each man:)

1 breast reel, type RL – 9, filled with twisted-pair field or outpost wire.
1 telephone, type EE – 5.
2 tags.

Information.

The breast reel may be used by either mounted or dismounted troops for laying and recovering wire. Only one man is required to lay or to recover a circuit with the breast reel.

Directions.

1. Unreel enough wire to tie in and to make the connection at the terminal strip. Tie in and connect the end of the wire to the proper terminals. Tag the wire with the number of the circuit. Notify the chief operator that you are going to install that particular circuit in order that he may have the necessary jumper connections made.

Questions.

(*1*) *Why should the wire be tied in before it is connected to the terminal strip?*

(*2*) *Why should the wire be tagged and connected to the terminal strip before the circuit is laid?*

(*3*) *Why should the chief operator be notified that the circuit is connected to the terminal strip?*

Directions.

2. Put on and adjust the breast reel as described in Unit Operation No. 4. Strap the EE – 5 telephone over your shoulder in the most comfortable position. Walk to your destination, unreeling the wire from the spool.

Questions.

(4) *Why is the circuit tied in and connected to the terminal strip before the breast reel is put on?*

(5) *Why is it necessary to take along the telephone?*

Directions.

3. Install the EE – 5 telephone as previously directed. Connect the circuit to the telephone. Ring on the circuit, and when the operator answers request him to ring you. If this test is O. K., notify the

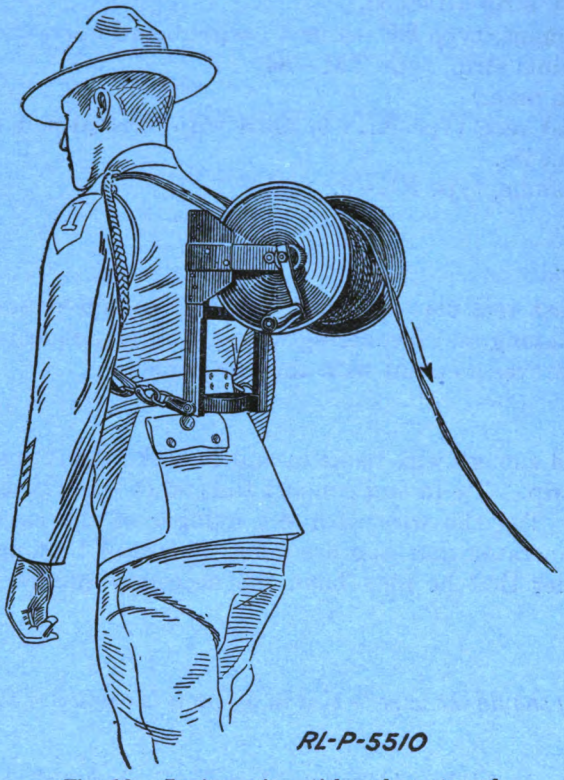

Fig. 19.—Laying wire with a breast reel

operator that the circuit is O. K. If either the telephone or circuit does not test out O. K., determine where the trouble is and repair it.

Questions.

(6) *Why is it necessary to test the circuit after completing the installation?*

(7) *Why is it necessary to report the circuit O. K. to the operator?*

Directions.

4. Disconnect the telephone. Put on the breast reel. Strap the telephone over your shoulder as previously done. Attach the end of the wire to the breast reel and recover the line.

SUGGESTIONS FOR THE INSTRUCTOR

1. Mount the switchboards listed in the equipment with their cable and line terminal strips. If eight or twelve line switchboards are available use them. Provide an operator for the switchboard.

2. Direct each student to lay a circuit, giving him the point to which the circuit is to be laid and the number of the circuit.

3. After the class has complied with the directions in the Unit Operation further practice may be given as follows.

4. Provide each man with a breast reel and an extra spool. The students can be required to fill the spools as part of the exercise. They can take turns about using the equipment if there is a shortage of equipment, or the class may be divided into groups of two, one man operating the reel and the other tieing in and splicing.

5. Direct each man to lay a circuit to some point far enough away to require the use of the wire on both spools. Pick out a route which will offer opportunities for tieing in frequently. Require the men to tie in as near as practical about every 100 feet.

6. When the distant points have been reached by the various men have them exchange places and each recover the circuit laid by some other man.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 5-A (PERFORMANCE)

Equipment.

Same as "Equipment" under Unit Operation 5, Students Manual.

Procedure.

1. Set up switchboards with terminal strips at suitable points and provide an operator for each switchboard. Issue to each student the equipment listed.

2. Explain to each student what will be his equipment for the test, and give him an opportunity to look over his equipment. Note if he tests the telephone and reel. If he finds trouble, allow time to make repairs. Do not caution the men to test their equipment.

3. Explain that at the command "*Go*" each student will lay a circuit 300 yards long (to an indicated point), and that when the circuit line is completed he is to hold up his right hand. Give the command "*Go*" and take the time until student holds up his hand.

4. Explain that at the command "*Go*" each student will reel up the circuit just laid, and that when this is completed he is to hold up his right hand. Give the command "*Go*" and take the time until student holds up his hand.

Scoring.

1. The maximum possible score is 90 points.
2. The score required to pass test is 60 points.
3. DIRECTIONS FOR SCORING.

	Points
a. Testing equipment:	
(1) If student tests phone	5
(2) If student tests reel	5
(3) No partial score allowed.	
b. Laying a circuit:	
(1) If circuit is laid correctly and tests O. K. within 4 minutes	40
(2) If circuit is laid correctly and tests O. K. within 6 minutes, deduct 3 points for each 30 seconds or fraction thereof over 4 minutes.	
(3) If time exceeds 6 minutes	0
(4) For each of the following irregularities that occur, deduct 5 points from the score they would have received without irregularities under (1) and (2):	
1. Failure to tie in.	
2. Failure to tag.	
3. Failure to connect to terminal strip.	
4. Failure to notify chief operator that he is going to install circuit.	
5. Failure to notify chief operator that the circuit is O. K.	
(5) If circuit does not test O. K. or if the operator fails to install phone and to test line within 6 minutes	0
c. Question 3:	
(1) If circuit is picked up correctly within 4 minutes	30
(2) If circuit is picked up correctly within 6 minutes, deduct 3 points for each 30 seconds or fraction thereof over 4 minutes.	
(3) If time exceeds 6 minutes	0
(4) If student fails to splice wire on to reel	0
(5) For each of the following irregularities that occur deduct 5 points from the score he would have received without irregularity under (1) and (2):	
1. Failure to use rubber tape on splice.	
2. Failure to use friction tape on splice.	
3. Failure to test reel when wire is reeled up.	

INSTRUCTION TEST NO. 5-B (INFORMATION)

Directions.—Below are a number of statements each followed by several numbered words or phrases, one of which correctly completes the sentence. Write the *number* of this word or phrase on the *dotted line* at the right of each sentence.

1. A circuit is connected into the switchboard when the lineman starts to lay it
   (1) so there will be something to pull against.
   (2) so lineman can test back.
   (3) to make ends fast.
   (4) so that the job will be neat.
   (5) to prevent short circuits. -----

2. The reason that a circuit is tied in near the terminal strip is

(1) to prevent shorting the circuit.
(2) to provide a place to tag the circuit.
(3) to take the slack out of the wire.
(4) to prevent it from being pulled loose from the terminal strip.
(5) to provide a place to test. ------

3. A lineman when laying a circuit should, in order to test, carry

(1) connectors. (2) a knife. (3) a field telephone.
(4) climbers. (5) a universal test set. ------

4. The detail required to lay a circuit with a breast reel consists of

(1) two men. (2) a lineman and an operator.
(3) three linemen.
(4) two linemen and an operator. (5) one lineman. ------

5. Wire is attached to a partly filled breast reel by

(1) splicing it to the wire on the reel.
(2) putting the ends through the hole in the side of the spool.
(3) making a clove hitch around the spool.
(4) means of connectors. ------

6. The number of breast-reel spools required to lay a circuit one-quarter of a mile long is

(1) one. (2) three. (3) two. (4) four. (5) five. ------

7. In order that he can test back on the circuit, the lineman, when he starts to lay a circuit,

(1) shorts the ends.
(2) leaves his telephone connected to the end.
(3) has an assistant remain at the end with a telephone.
(4) notifies the chief operator who has it connected into the switchboard. ------

THE PACK REEL CART (TYPE RL – 16)

Equipment (for three students).

1 reel cart, type RL – 16, with two extra spools.
1 commercial reel of field wire.
1 telephone, type EE – 4 or type EE – 5.
15 feet copper seizing wire.

Information.

The pack reel cart, type RL – 16, is constructed on the knock-down principle in order that it may be taken apart and packed on the back of an animal. It may be assembled or knocked down in a few minutes without the use of tools, as the parts are provided with tapered sockets and drawn together with clamps which hold it in place.

This cart will carry two steel spools, each holding about one-half mile of twisted-pair field wire.

To knock down the cart, the spool axle is first detached and each wheel is removed together with the support for the spool axle to which it is permanently attached. The tongue is detached from the main frame. The cart when knocked down consists of the following separate parts:

2 wheels, solid rubber tired, ball-bearing motor-cycle type.
1 frame.
1 tongue.
1 spool axle.
6 spools.

The cart weighs 105 pounds when equipped with two empty spools.

The reel cart is intended for use in laying wire in forward areas between points inaccessible to animal-drawn or motor vehicles. The cart is operated by three men, two of whom draw the cart, while the third assists in paying out the wire, and operates the crank in recovering wire. A noncommissioned officer is in charge of this detail.

The cart should be kept well painted at all times in order to prevent rust, and, as with all rolling equipment, the wheels must be lubricated from time to time. The tapered sockets must be free from dirt and other foreign matter. Other than this, very little attention is required.

In order to transport the reel cart, it is knocked down and packed either in animal-drawn or motor vehicles, or packed on the back of animals. In the latter case the regulation aparejo is used.

TO KNOCK DOWN THE REEL CART

Directions.

1. Remove the crank from the spool axle and attach it in its proper place at the back of the frame, being careful to fasten it in place with the cotter pin provided.

2. Unfasten the latches which hold the spool axle in place and remove the spool axle with the spools which are on it. Close the latches and fasten them by means of the wing nuts provided. (Do not leave these latches open as they are likely to be broken off.)

3. Roll the two spools which are fastened to the spool axle until the latch on the axle which holds the spools in place is on the top side of the axle. Place the hand between the two spools and grasp the

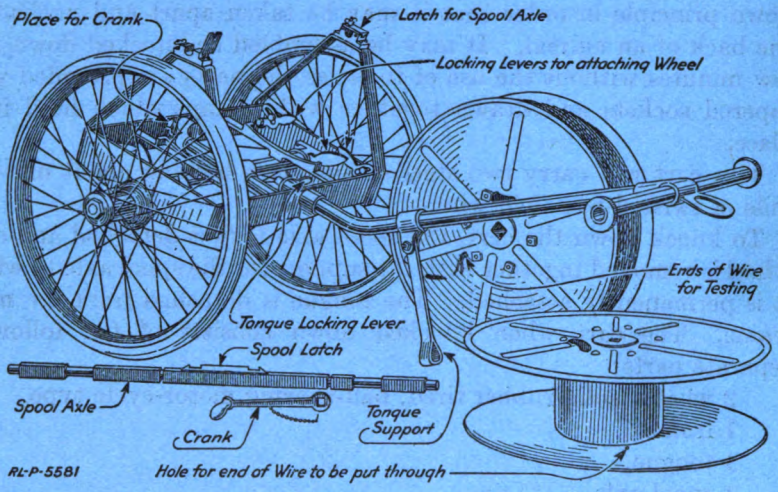

Fig. 20.—The pack reel cart, type RL – 16

axle and latch. Press down on the latch with the palm of the hand, thus releasing the spools. Then raise one end of the axle and remove the spool on that end. Then withdraw the axle from the other spool.

4. Move the short lever on the front of the main frame which locks the tongue in place. Secure the tongue support to the tongue by means of the strap provided and remove the tongue. Be careful that the frame does not spin around and strike the floor, as the spool supports may be broken.

5. Move the short levers in the corners of the frame and on the main axle and remove the wheels.

6. The crossbar on the tongue can be released by removing a pin so that it can be moved to one side or the other to facilitate packing, but this crossbar can not be entirely removed from the tongue.

TO SET UP THE REEL CART

7. Lay one wheel on its outside face. Its axle is then pointing up vertically. Be sure that the locking levers are in the position so that the locking lugs will enter the holes provided to receive them. Hold the frame on end and place it so that the locking lugs enter the holes provided to receive them. Lock the wheel in place by means of the locking levers. If the nuts on the locking lugs are too loose remove the cotter pins, tighten the nuts and replace the cotter pins.

8. With the frame standing on end on the wheel which has been attached, see that the locking levers are in the proper position, put the other wheel in place and fasten it by means of the locking levers. Tighten the nuts if necessary as described in Direction 7.

9. Tip the cart over so that it rests on both wheels; see that the tongue locking lever is in the proper position; place the end of the tongue in the hole provided to receive it and lock it in place. Unfasten the tongue support and rest the tongue on it. Tighten the locking nut, if necessary, as already described.

10. Put the spool axle through one of the spools and push it in until it locks in place. Then tilt the other end of the axle up and place the other spool on the axle, pushing it down until it locks in place.

11. Open the latches which hold the spool axle in place. Then place this axle with the two spools on it in position and fasten it by means of the latches and wing nuts provided.

12. Remove the crank from the rear of the frame and attach it to the spool axle with the cotter pin provided.

TO CHANGE SPOOLS ON THE REEL CART

13. Lay the tongue of the cart on the ground (not upon the tongue support). Unfasten the spool-axle latches and remove the axle and spools.

14. Remove one or both spools as described in Direction 3. Place one or both new spools on the axle as described in Direction 10.

15. Replace the axle with the new spools on it as described in Direction 11.

TO PLACE WIRE ON SPOOLS ON REEL CART

16. Test the wire to be used as described in Unit Operation No. 1. Place the commercial or other type of reel from which the wire is to be obtained on an iron bar or pipe between two supports. (If another reel cart is available, the commercial spool may be placed on the spool axle of this cart and fastened by means of wooden wedges.)

17. Block the wheels of the cart.

18. Place the ends of the wire through the hole in the side of the spool near the axle and tie a knot in it to hold the ends on the outside of the spool. (This is to provide a means of testing.)

19. Fill the spool or spools by turning the crank and guiding the wire on so that it will wind evenly and tightly. Make the tests as described in Unit Operation No. 1.

Questions.

(1) *Why should special care be taken to see that the crank is always fastened in place by means of the cotter pin provided?*

(2) *Is there any advantage in having a "knock-down" cart in units that do not have pack animals?*

(3) *What special tools are required to set up the cart for operation?*

(4) *How many men are required to set up the cart?*

(5) *Are any special tools required to change a spool on a cart?*

(6) *Does the cart have to be "knocked-down" to change a spool?*

(7) *With wire on the cart, is it easier to change a spool or to refill one?*

(8) *What must be the condition of the wire before it is placed on a spool?*

(9) *How is the condition of the wire determined?*

(10) *What must be done if the wire is not in proper condition and no other wire is available?*

(11) *What could be done to fill the reels if the crank were lost?*

(12) *What precautions must be taken when attaching wire to the spools?*

(13) *Can two spools be filled at the same time?*

(14) *What part of the cart is most likely to become lost, broken, or out of order?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Have each student, by himself, "knock down" and "set up" the reel cart in accordance with the directions in the Unit Operation. Have each student repeat the exercise, if necessary, until he thoroughly understands how to do it.

2. Provide in advance sufficient wire on commercial spools or in coils to provide a spool or coil for each group of three students. If possible provide wire with some faults and some splices in it. Divide the class into groups of three students each. Provide a reel cart and four spools for each group.

3. Require each group to fill the four spools with wire in accordance with the directions in the Unit Operation for placing wire on the spools and changing spools.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 6-A (PERFORMANCE)

Equipment (for each student).

1 reel cart, type RL – 16 (with two spools filled).
1 telephone, type EE – 4 or EE – 5.
1 extra spool filled.

Directions.

1. Place a short on one of the spools, an open circuit on a second spool and have the third spool O. K.

2. Issue the above equipment to each student and give him an opportunity to look it over.

Procedure.

1. Explain to the student that at the command "Go," he is to "knock down" the reel cart and to indicate by raising his hand when the operation is complete. Give the command "Go," and take the time until student holds up his hand. Note if student completely "knocks down" reel cart.

2. Give the student one assistant and explain to the student that at the command "Go," he is to "set up" the reel cart and to indicate by raising his hand when the operation is complete. Give the command "Go," and take the time until the student holds up his hand. Note whether or not the student "sets up" the reel cart correctly.

3. Give the student one assistant and explain to the student that at the command "Go," he is to change one spool on the reel cart

and to indicate by holding up his hand when the operation is complete. Give the command "Go," and take time until student holds up his hand.

4. Explain to the student that he is to test each of the three spools and to tell what kind of fault is on each spool.

Scoring.

1. The maximum possible score is 100 points.
2. The score required to pass test is 75 points.
3. DIRECTIONS FOR SCORING.

	Points
a. Knocking down reel cart:	
(1) If the student completely "knocks down" reel cart within 75 seconds	40
(2) If the student completely "knocks down" reel cart within 3 minutes, deduct 5 points for each 15 seconds or fraction thereof over 75 seconds.	
(3) If the student completely "knocks down" reel cart but time exceeds 3 minutes or if reel is not completely "knocked down"	0
b. Setting up reel cart:	
(1) If student completely "sets up" reel cart within 3 minutes	40
(2) If student completely "sets up" reel cart within 5 minutes deduct 5 points for each 15 seconds or fraction thereof over 3 minutes.	
(3) If student completely "sets up" reel cart but time exceeds 5 minutes or if reel is not completely "set up"	0
c. Changing spools:	
(1) If student changes spool within 60 seconds	15
(2) If student changes spool within 75 seconds, deduct 1 point for each second over 60 seconds.	
(3) If spool is changed but time exceeds 75 seconds	0
d. Testing spools:	
If student states correctly what is wrong with a spool, per spool	5

INSTRUCTION TEST NO. 6-B (INFORMATION)

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the *short dotted line* in the right margin. If what it says is not true (incorrect), place a minus sign (−) on the dotted line

1. Special tools are required to knock down and set up the reel cart. ------
2. The reel cart carries two spools. ------
3. The reel cart, with two empty spools, weighs about 105 pounds. ------
4. The reel cart is used when enemy fire, or other conditions, render the use of animal or motor transportation impracticable. ------

5. It is not necessary to lubricate any part of the reel cart. ------
6. The purpose of having the reel cart made on the "knock down" principle is to provide for shipping by rail. ------
7. It is necessary to "knock down" the reel cart in order to change spools. ------
8. To operate the reel cart in recovering wire requires only one man. ------
9. Two circuits can be laid simultaneously with the reel cart. ------
10. The spools of the reel cart operate independently of each other. ------
11. It requires three men to knock down or set up the reel cart. ------
12. Each reel-cart spool holds about one-half mile of twisted-pair outpost wire. ------

LAYING AND RECOVERING WIRE WITH A TYPE RL - 16 REEL CART

Equipment (for each group of four students).

1 pack reel cart, type RL – 16.
1 field telephone, with leads and Frankel test clips attached.
1 set lineman's equipment.
2 terminal strips, type TM – 84.
Nails for terminal strips.
Tags for tagging circuit.
1 hand pad.

Information.

To lay wire efficiently with a type RL – 16 reel cart the detail should consist of a noncommissioned officer and three men, Nos. 1, 2, and 3. The noncommissioned officer is in charge. He leads the

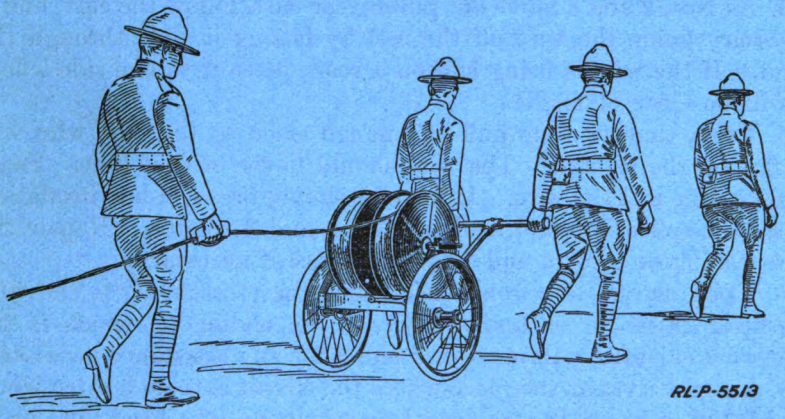

Fig. 21.—Laying wire with a pack reel cart

detail, when laying wire, and picks out the route. When there are only three men in the detail, No. 1 is in charge. When the circuit to be laid does not begin at a switchboard, it is desirable to have an additional man equipped with a field telephone to remain at the initial terminal strip so that the laying detail can test back to him.

LAYING WIRE

Directions.

1. *Noncommissioned officer in charge of the detail.*—See that the wire on the reels test O. K. before starting to lay a circuit. Indicate the place where the line terminal strip is to be installed or point out the one already installed to which the circuit is to be connected.

See that the wire is securely fastened to some object and that it is connected to the terminal strip and properly tagged.

2. Direct the detail to follow and move out over the route on which the wire is to be laid. (See Fig. 21.) Pick the best route, considering both the ease with which the cart can be pulled and the natural facilities for placing the wire in the clear. Supervise the work of the detail.

3. When the job is complete, report the circuit installed to the chief of the operating detail at the destination. If there is no operating detail present, report it by telephone to the chief of the operating detail at the initial point.

4. *No. 1 of the detail.*—Install the line terminal strip at the place indicated if one is not already up. Take the free end of the line wire from No. 2 and connect it to the line terminal strip. Notify the operating detail that the circuit has been connected to the line terminal so that it can be connected into the switchboard in order that the operator can answer test calls on it.

5. As Nos. 2 and 3 move out pulling the cart, follow the cart, and if necessary guide the wire off the reel by letting it slide through the hand. If the wire is being laid on a road, place it to one side where it will be clear of traffic.

6. From time to time pull off enough slack so that the wire will lie flat on the ground. The wire should never be laid taut. From time to time test the wire. If the wire should break, if bad insulation or a poor splice is found, call to Nos. 2 and 3 to stop. Repair the wire, calling on Nos. 2 and 3 for assistance if necessary.

7. Upon arrival at a road which must be crossed, place the wire overhead (Fig. 30) or under the road, depending on which is the most convenient. Call on Nos. 2 and 3 for any assistance necessary.

8. Upon arrival at the place where the circuit is to end, after No. 2 has tied in, connect the free end to a telephone (if a local line) or to the terminal strip (if a trunk line), and then test the circuit.

9. *No. 2 of the detail.*—Unreel enough wire to tie in and connect to the line terminal strip. Tie the wire to some object using a clove hitch. Then give the free end to No. 1 for connecting to the terminal strip.

10. When the noncommissioned officer in charge directs, follow him, pulling the cart with No. 3. Regulate the gait on No. 1.

11. Assist No. 1 when necessary in repairing the wire and in placing it in the clear.

12. Upon arrival at the place where the circuit is to end, unreel enough wire to tie in and reach the terminal strip. Tie in and give the free end to No. 1.

13. *No. 3 of the detail.*—When No. 1 connects the circuit to the terminal strip, tag it with its proper number.

14. When the noncommissioned officer in charge directs, follow him, pulling the cart with No. 2. Regulate the gait on No. 1.

15. Assist No. 1 when necessary in repairing the wire and in placing it in the clear.

16. From time to time tag the circuit with its circuit number. This can be done when it is necessary to stop to wait on No. 1.

17. Upon arrival at the place where the circuit is to end, when Nos. 1 and 2 have tied in and connected, tag the circuit at the terminal strip with its circuit number.

LAYING A SHORT LOCAL CIRCUIT

Information.

Often when it is necessary to lay a short local circuit from a type RL–16 reel cart, it is more convenient to leave the cart in the vicinity of the switchboard and have a man pull the wire out to the location of the subscriber's telephone, unreeling it from the cart. To lay a circuit in this manner it is desirable to have a detail of two men, Nos. 1 and 2. If the detail consists of only one man, he must use care in pulling out the wire so as not to cause the reel to spin and tangle the wire. After completing the directions for No. 1 he then performs the duties of No. 2.

Directions.

18. *No. 1 of the detail.*—Place the reel cart near the line terminal strip with the tongue in the opposite direction from which the circuit is to be laid. Block the wheels of the cart so that it will not move as the wire is being pulled out. Take the end of the wire and pull it out to the location for the subscriber's telephone. When this point is reached, signal to No. 2 and then set up the subscriber's telephone and connect it.

19. *No. 2 of the detail.*—Stand by the reel cart as No. 1 pulls the wire out to the position where the local telephone is to be installed, and prevent the wire from tangling. Brake the reel if it turns too fast. When signalled by No. 1, cut the wire, connect it to the line terminal strip and tag it with its proper number. Then report the circuit to the operator as installed.

RECOVERING WIRE

20. *Noncommissioned officer in charge.*—See that the wire to be recovered is disconnected from the terminal strip and properly attached to the reel on which it is to be wound.

21. Direct the detail to move out. Follow the cart, guiding the wire on the reel, so that it goes on evenly and tightly. Examine all splices and have No. 1 make any repairs that are necessary. See that when the job is finished the wire on the reel tests O. K.

22. *No. 1 of the detail.*—Disconnect the circuit from the terminal strip and if there are no other circuits connected to it, take down the terminal strip.

23. When No. 2 has untied the circuit, take the free end and attach it to the reel. If the reel is empty, attach it by inserting the ends through the holes in the side of the spool so as to leave these ends available for testing. Tie a knot in the wire to keep the ends from slipping back through the hole. If there is some wire already on the reel, attach the line wire by splicing it to the ends of the wire on the reel. Be sure that the ends of the wire that have the tracer thread are spliced together.

24. As Nos. 2 and 3 pull the cart along in the direction of the wire, wind in the wire by turning the crank. Call on Nos. 2 and 3 to stop whenever necessary.

25. Whenever breaks in the wire, bad insulation or poor splices are encountered, repair the wire before winding it on the reel.

26. Test the wire occasionally to make sure that it is O. K. Never fill a reel with wire that will not test O. K. Locate the trouble and fix it.

27. When the end of the circuit is reached and the spool filled, fasten the end to the hole in the rim of the spool. Test it and tag it O. K. when it tests out in good order.

28. *No. 2 of the detail.*—When No. 1 disconnects from the terminal strip, untie the wire from the object to which it is anchored, cut off any tangled ends and give the end to No. 1.

29. *Nos. 2 and 3 of the detail.*—Pull the cart along the route of the wire. Stop and give assistance to No. 1 whenever called upon. When it is necessary to place the wire in the clear, stop the cart, go ahead and place the wire in the clear for recovering. Then return and assist in pulling the cart. Take turn about in clearing the wire.

Questions.

(1) *What is a wire line?*

(2) *How many men are necessary to efficiently operate the reel cart when laying wire?*

(3) *What are the duties of each man of the detail?*

(4) *What precaution should be taken in regard to the condition of the wire before it is laid?*

(5) *At what piece of apparatus does a trunk circuit always terminate?*

(6) *What points should be considered when picking out a route for a wire circuit to be laid with a reel cart?*

(7) *What is always done to identify a circuit when the end is connected before starting to lay it?*

(8) When does the chief of the detail get the information necessary in order to identify the circuit?

(9) Is the wire ever laid by pulling the reel cart along on a road?

(10) What precautions should be taken to protect the wire when it is laid along a road?

(11) At what points is the wire tied in?

(12) Is the wire laid tight or slack?

(13) Why is it so laid?

(14) What should be done if the wire should break while it is being laid?

(15) At what times would you test the wire while it is being laid?

(16) What must be the condition of the wire before it can be left after it is laid?

(17) Who is responsible that the circuit when laid is properly tagged and tested?

(18) How is a circuit tested?

(19) What kind of a tie is used to tie in at the terminal of a circuit?

(20) What kind of a tie is used to tie in at some point along the route?

(21) When would it be impracticable to use a reel cart?

(22) What precautions should be taken when attaching a wire to a reel to be recovered?

(23) What is done with a terminal strip when the last circuit is disconnected from it?

(24) What should be the condition of any wire before it is recovered?

(25) Why is it required that all wire be repaired before it is wound on the reels?

(26) Why is it better to repair wire while recovering it than while laying it?

(27) What kind of a splice is used in twisted-pair field wire?

(28) Why is the wire tested and tagged O. K. when the reel is filled?

(29) How many miles of wire will a reel cart with two reels on it hold?

SUGGESTIONS FOR THE INSTRUCTOR

1. The instruction in this Unit Operation can be accomplished to good advantage by having two switchboards installed in advance, situated about one-half mile apart and requiring the details to lay wire from them. Do not mount any line terminal strips.

2. Divide the class into details of four men each. Designate the noncommissioned officer in charge and Linemen Nos. 1, 2, and 3. From time to time during the exercise rotate the men within the details on the various jobs. Provide each detail with a set of equipment as listed in the Unit Operation.

3. Have half of the details go to one central and half to the other. Direct each detail in turn to lay a circuit, in accordance with the directions in the Unit Operation, to the other central, giving the following data:

a. To what point the circuit is to be laid.

b. Number of circuit.

c. Route to be followed. Give the groups different routes.

4. As each group completes its job, give directions to the acting noncommissioned officer to lay a local circuit to some point not over 300 yards away from the central.

5. As each detail completes laying its local circuit, give directions to the acting noncommissioned officer to recover a trunk circuit which was laid by some other detail.

SUGGESTIONS FOR CONDUCTING INFORMATION TEST NO. 7-A (PERFORMANCE)

Equipment.

Same as listed in Students' Manual and, in addition, one switchboard, type BD-9, BD-10, or BD-11, according to number of circuits being laid.

Directions.

Divide the class into groups of four men each, one acting as the N. C. O. in charge, the other three being designated as Nos. 1, 2, and 3. Provide a switchboard operator and have him set up the switchboard and line terminal strip. Have a marker placed about 1,000 yards from the switchboard and so located that in running a circuit to it the line will cross a road at some point where it will be practicable to tie the wire overhead.

Procedure.

1. Form the class in the vicinity of the switchboard and assemble the N. C. O.'s. in charge of each group. Give the following order: "Install a circuit from the switchboard to the O. P. (represented by that marker). Notify me at the switchboard when the circuit is installed." Take the time required to lay the circuit from the moment the order is given until the report is received. Allow 20 minutes for installation of the circuit. Inspect the circuits for irregularities. (See Scoring.)

2. When the circuit has been installed give the following order to the assembled N. C. O.'s: "Pick up the circuit from O. P. to the switchboard. Report to me at the switchboard when the circuit is picked up." Take the time it required to pick up the circuit from the moment the order is given until the report is received. Allow 20 minutes for picking up the circuit. Note any irregularities. (See Scoring.)

Scoring.

1. The maximum possible score is 100 points.
2. The score required to pass the test is 75 points.
3. The score is for the entire group and each member of the group receives the same score.

4. LAYING A CIRCUIT.	Points
a. If circuit is correctly laid within 10 minutes	60
b. If circuit is correctly laid but the time exceeds 10 minutes, deduct 5 points for each minute or part thereof over 10 minutes.	
c. If circuit is laid correctly, but time exceeds 20 minutes	0
d. For each of the following irregularities that occurs, deduct 10 points:	
(1) Failure to notify switchboard operator that circuit is being laid.	
(2) Failure to connect wire to line terminal strip.	
(3) Failure to tie in.	
(4) Failure to tag circuit at switchboard.	
(5) Failure to put wire overhead at crossing.	
(6) Failure to test line when laid.	

5. RECOVERING A CIRCUIT.	
a. If circuit is correctly picked up within 10 minutes	40
b. If circuit is correctly picked up but the time exceeds 10 minutes, deduct 4 points for each minute or part thereof over 10 minutes.	
c. If circuit is correctly picked up, but time exceeds 20 minutes	0
d. For each of the following irregularities which occur, deduct 10 points:	
(1) Failure to notify switchboard operator that circuit is to be picked up.	
(2) Failure to correctly *splice* wire to wire on reel cart.	
(3) Failure to remove tags from line.	
(4) Failure to have wire "test O. K." on reel when reporting circuit "picked up."	

INSTRUCTION TEST NO. 7–B (INFORMATION)

Directions.—Below are a number of unfinished statements each followed by several numbered words or phrases, one of which correctly completes the statement. Write the *number* of this word or phrase on the *dotted line* at the right of each statement.

1. The detail for laying wire with a reel cart consists of
   (1) one lineman. (2) one lineman and one N. C. O.
   (3) three linemen and one N. C. O.
   (4) two linemen and two N. C. Os. (5) two linemen. ------
2. When a single circuit or two or more circuits are installed on the same line of supports, laid on the ground along the same route, or buried in the same trench, the installation is called
   (1) a wire line. (2) a circuit. (3) a wire route.
   (4) an axis. (5) a lead. ------
3. It is desirable to have an additional man in the wire-laying detail for testing purposes
   (1) when the circuit is laid through woods.
   (2) when laid in wet weather. (3) when a trunk is laid.
   (4) when the circuit does not begin at switchboard.
   (5) when more than one circuit is being laid. ------
4. Wire must always be laid
   (1) taut. (2) slack. (3) overhead. ------
   (4) on bushes, trees, etc. (5) along a road.
5. When the installation of a circuit has been completed, the noncommissioned officer in charge of the laying detail reports this fact to the
   (1) signal communications officer. (2) commanding officer.
   (3) message center. (4) chief of construction detail.
   (5) chief of the operating detail. ------
6. The duties of No. 2 of the reel-cart detail at the initial point, when preparing to lay a circuit are to
   (1) tie in the wire to some object.
   (2) connect to line terminal strip and notify operator.
   (3) tag circuit with its number. (4) test wire.
   (5) ground circuit. ------
7. The duties of the noncommissioned officer in charge of the reel-cart detail when laying a circuit are to
   (1) place the wire in the clear.
   (2) pick out route to follow.
   (3) follow cart and guide the wire off of the reel.
   (4) pull cart. (5) pull in slack. ------

8. The duties of No. 1 of the reel-cart detail, when recovering a circuit are to
(1) pick out route for cart to follow. (2) tag the wire.
(3) guide the wire on the reels. (4) pull the cart.
(5) turn the crank to wind in the wire. ------

9. A trunk line always terminates at a
(1) subscriber's telephone. (2) test station.
(3) line terminal strip. (4) test set.
(5) message center. ------

10. When laying a circuit around a corner the wire is
(1) placed overhead. (2) looped back.
(3) placed underground. (4) tied in.
(5) left loose to prevent kinks. ------

11. Circuits are identified by wire details which lay them by
(1) using different colored wires.
(2) by their location. (3) marking switchboard drop.
(4) tagging with proper number. (5) testing.

12. The detail to lay a short local circuit from a reel cart is
(1) three linemen. (2) two linemen and an operator.
(3) two linemen and an N. C. O.
(4) three linemen and an N. C. O.
(5) two linemen. ------

13. A single circuit which connects a subscriber to a switchboard is called a
(1) trunk. (2) wire line.
(3) local. (4) branch. (5) a lead. ------

14. When the detail for laying wire with a reel cart consists of three men only (there being no noncommissioned officer in charge)
(1) No. 1 is in charge. (2) No. 2 is in charge.
(3) No. 3 is in charge. (4) No. 4 is in charge. ------

WIRE CART, TWO-HORSE, INFANTRY, SIGNAL CORPS, AND CAVALRY

Equipment (for each group of three students).

1 wire cars, two-horse, and team.
1 telephone, type EE – 4 or type EE – 5.
2 commercial spools of field wire.
1 iron rod or 2-inch pipe 6 to 8 feet long.
2 supports for pipe.

Information.

The two-horse wire cart is a two-wheel reel cart used for the rapid laying and recovering of telephone and telegraph lines in the field. It is completely equipped with two reels, mechanically rotated and

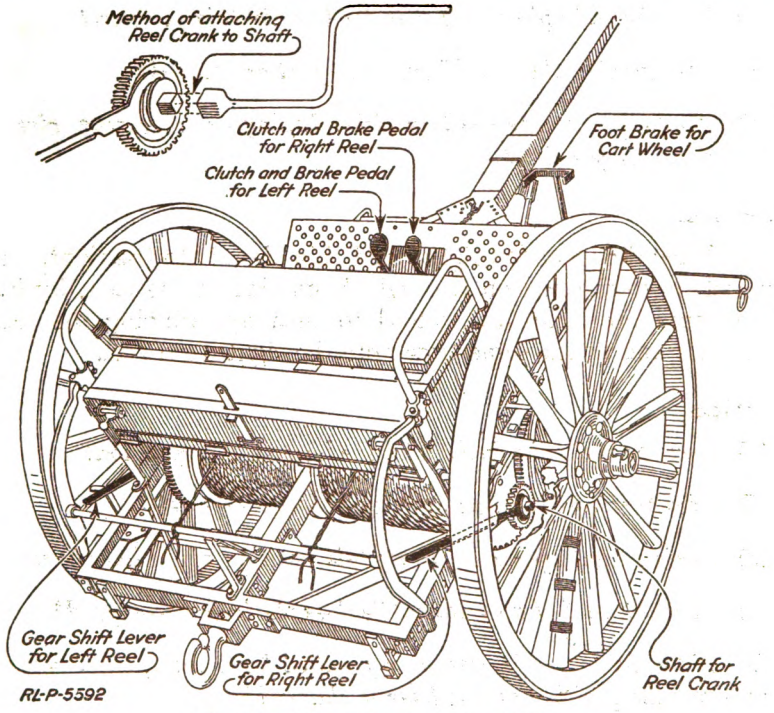

Fig. 22.—The wire cart, two-horse

controlled, one chest with wire-laying equipment, a driver's seat, and appropriate parts and fittings especially designed for and used only on this cart. It is designed to carry 5 miles of single conductor standard field wire or approximately 2½ miles of twisted-pair field wire.

This cart is used for laying wire along roads or on smooth ground in rear of regimental headquarters. It is issued to division signal organizations and brigade headquarters in both Infantry and Cavalry.

OPERATION OF THE WIRE CART

Directions.

1. Go to the rear of the cart and note the levers extending from the axle on both sides of the cart. (Fig. 22.) Take hold of the lever on the right-hand side, lift it up about half an inch and throw it to the left. Now try to move the reel on the right side of the cart by hand. Then move the cart so that the right-hand wheel will turn (this can be done by swinging the tongue to the left) and at the same time note the reel on the right-hand side.

Questions.

(1) *Does the reel spin freely with the lever in this position?*

(2) *Does turning the wheel have any effect on the reel?*

(3) *Would the cart be used in either laying or recovering wire with the lever in this position?*

Directions.

2. Throw the lever (on right-hand side of cart) to the right. Now try and move the reel on the right-hand side of the cart, by hand. Then cause the right-hand wheel to turn by swinging the tongue to the left and at the same time note the right-hand reel.

Questions.

(4) *Does the reel spin freely with the lever in this position?*

(5) *Does turning the wheel have any effect on the reel?*

(6) *During what operation would this position of the lever be used?*

(7) *To what part of an automobile does the lever correspond?*

(8) *If the cart were in use, being pulled by a team, what should be done before the position of this lever is changed?*

Directions.

3. Try the same experiment with the lever on the left-hand side of the cart and note its effect on the reel on that side.

Questions.

(*9*) *What happens if the lever on either side is thrown in the direction away from the cart? Toward the cart?*

(*10*) *Do the reels act independently of each other?*

(*11*) *Would it be possible to lay one line and recover another at the same time?*

(*12*) *Would it be practicable to pull this cart by hand?*

Directions.

4. Take position in the driver's seat. Try to operate the levers referred to above, from this position.

Questions.

(*13*) *Would it be practicable for the cart driver to operate the levers?*

Directions.

5. Push down both of the pedals in the center of the foot board with the foot and leave them in the forward position.

6. Dismount from the cart, go to the rear, and throw both levers so that the reels are in gear. Try to move them by hand.

Questions.

(*14*) *Do they spin freely?*

(*15*) *What is the purpose of these pedals?*

(*16*) *During what operation and for what purpose woud they be used?*

(*17*) *What might happen if these pedals were not provided?*

Directions.

7. Have an assistant spin the right-hand reel by pulling and unwinding the wire from it. When it is spinning freely, push down hard on the right-hand pedal. Have the assistant note what happens.

Questions.

(*18*) *Do the pedals on the foot board act on the reels of their respective sides independently of each other?*

(*19*) *What different operations can oe performed by each pedal?*

(*20*) *Can wire be laid with the reels in gear? If so, why is it not done?*

(*21*) *To what part of an automobile do these pedals correspond?*

Directions.

8. Set the brake on the right of the driver's footboard. (See Fig. 22.) Dismount and try to move the cart by swinging the tongue to either one side or the other.

Questions.

(*22*) *Do the wheels turn freely? If not, why?*

(*23*) *What might happen if this brake lever were left in position part of the way down but not far enough to lock the wheels, when the cart was being used?*

Directions.

9. Take the crank from the compartment under the driver's seat. Fit it on one of the square shafts which will be found at the end of the gear shift lever on either side of the cart. (See Fig. 22.) Throw the lever to the position which allows the reel to spin freely. Turn the crank and note the action of the reel.

Questions.

(*24*) *Does one or ao both reels turn?*

(*25*) *For what purpose is the crank used?*

(*26*) *Can any other method be devised for accomplishing the same result?*

(*27*) *Can you think of a time when it would be desirable to use a crank?*

PUTTING WIRE ON WIRE CART

Information.

A detail of three men is required to put wire on a wire cart. For convenience in this Unit Operation these three men will be designated Nos. 1, 2, and 3.

Directions.

10. If the wire which is to be used is on unopened spools, remove the lagging from two of them and mount them side by side in rear of and parallel to the axle of the wire cart on an iron rod so that they will revolve. The spools might also be mounted separately, one in front of the other. Test the wire on the spools. If it tests O. K., proceed without further testing. If it does not test O. K., watch it carefully and test as described in Unit Operation No. 1.

11. Fill the reels on the cart as follows:

a. No. 1.—Attach a wire to one of the reels by placing the ends through the holes provided in the side of the reel and tie a knot in the

wire to keep it from slipping back through the hole. This will leave the ends available for testing purposes. Throw the reel out of gear by means of the gear shift lever. Guide the wire on the reels while No. 2 turns the crank.

b. No. 2.—Attach the crank to the shaft and proceed to wind the wire on the reel, being sure to wind in the proper direction so that the wire will go on the reel at the top. (If the wire goes on from the bottom, the wire will be unreeled when the cart is moved forward in gear instead of being reeled up.)

c. No. 3.—Stand by the commercial spools. If they spin too fast, they may be braked by means of a board. Do not allow slack wire to be unreeled. Watch for tangles and, in old wire, for bad splices.

12. When the reel has been filled, test and tag the wire with some such notation as "Tested 9/13/23 by I. S." and secure the loose end.

13. Fill the other reel in the same manner.

Questions.

(*28*) *Is it possible to fill both reels simultaneously by this method?*

(*29*) *When would it be an advantage to fill both reels simultaneously?*

(*30*) *How many men are necessary to fill a reel properly?*

(*31*) *What should be the specific duties of each man?*

PUTTING WIRE ON WIRE CARTS WHEN NO CRANK IS AVAILABLE

Information.

In field service it may happen that the crank will be lost. In this case it will be necessary to use some improvised method of filling the reel. Two of these methods are given below. Many men use the first method in preference to using the crank.

Directions.

FIRST METHOD

14. Raise the end of the tongue, remove the tongue support, and lay the end of the tongue on the ground. Place a box or other support which will just fit, under the right-hand rear corner of the cart.

Now take hold of the end of the tongue, raise it, and place the tongue support in position to hold it up. This will raise the right-hand wheel several inches off the ground.

15. *a. No. 1.*—Attach the wire to the reel, throw the reel in gear, and guide the wire on the reel.

b. No. 2.—Throw the reel in gear and turn the wheel of the cart, winding in the wire.

c. No. 3.—Stand by the commercial spools and see that these unwind properly.

16. Fill the other reel in the same manner and make the necessary tests to determine the serviceability of both reels.

SECOND METHOD

17. Mount the commercial spools as described above and attach the ends of the wires to the reels. Hitch the team to the cart and move out with the reels in gear, winding in wire. Be sure that the commercial spools are securely mounted, as they will have to withstand considerable pull.

18. *a. No. 1.*—Operate the gear shift lever and guide the wire on the reels.

b. No. 2.—Drive the team and operate the reel brake pedals.

c. No. 3.—Stand by the commercial spools and see that these unwind properly.

19. When the cart has proceeded about one-quarter mile, turn around and return to the commercial spools, picking up the wire on the ground.

20. Repeat the operation until the reels on the cart are full.

Questions.

(*32*) *Which improvised method do you prefer?*

(*33*) *Which should be used to put wire on the cart when no team is available?*

(*34*) *Can you think of any better method of putting wire on the wire cart when no crank is available?*

(*35*) *What would be the result of getting too much wire on the reels?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Have each individual of the class perform Directions 1 to 9 inclusive. If the class is large and a sufficient number of wire carts are not available, have these directions performed by a group, by directing that one man of the group follow the directions while the remainder observe and answer the questions in the Unit Operation. Repeat this part of the Unit Operation until all the members of the class thoroughly understand the use of the controls on the cart.

2. Before continuing with the remainder of the Unit Operation impress upon the class that the wire carts should be kept filled with wire and that at the first opportunity after using a cart to lay wire, the reels should be refilled. Make clear the importance of closely inspecting and testing wire that is being put on a reel and of repairing any poor splices and damaged insulation that is found in the wire, so that in an emergency wire can be laid in a minimum amount of time and be in working order when the laying is completed.

3. Divide the class into groups of three. Assign each group to a wire cart. If there are not sufficient carts available, have the groups take turn about filling a reel.

4. Have each group fill or partly fill a reel by each of the methods given in the Unit Operation. Make sure that every man knows how to attach the wire to an empty reel and how to secure the wire when a reel is filled.

5. To give the groups further practice in putting wire on the wire cart, the following are suggested:

a. Provide a wire cart but no team. Provide a commercial spool partly filled and two reels from an RL – 16 reel cart. See that the wire has faults in it, such as a bad splice, or an open circuit. Direct the group to fill the wire cart with wire.

b. Provide a wire cart and a team. Have the wire on the cart badly tangled and have several faults such as breaks, shorts, or opens. Inform the group that they will be required to lay the wire later and to get the cart ready.

c. Provide an empty wire cart without team, with crank missing and nothing provided to block up a corner of the cart. Direct the group to fill the cart with wire from a spool of faulty wire.

6. Continue the above or similar exercises until each member of the class can fill a cart satisfactorily.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 8–A (PERFORMANCE)

Equipment (for each group of three students).

1 wire cart, two-horse (without team).
2 reels, from a type RL – 16 reel cart, filled with wire that has faults in it.
1. commercial spool of wire.
1 iron pipe or rod, 4 to 5 feet long, with two supports.

Procedure.

1. In this test each group of three students will be required to fill a reel of the wire cart under assumed field conditions.

2. Divide the class into groups of three students each and assign them to a set of equipment. Designate the students as Nos. 1, 2, and 3.

3. Direct the group, "Fill one reel on the wire cart."

Scoring.

1. The maximum score on this test is 90 points.
2. The score required to pass this test is 70 points.
3. DIRECTIONS FOR SCORING.

	Points
If the wire is properly connected to reel with ends available for testing	10
If the wire is wound on from top of reel	10
If the wire is wound on with sufficient tightness	10
If the necessary splices are properly made with wires which have tracer threads connected together	10
If when reel is filled wire tests O. K	40
If when reel is filled, the end of the wire is tied to bar across the back of the cart	10

INSTRUCTION TEST NO. 8–B (INFORMATION)

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the *short dotted line* in the right margin. If what it says is not true (incorrect), place a minus sign (–) on the dotted line.

1. The two-horse wire cart is a two-wheeled reel cart used for laying wire in areas forward from battalion headquarters. ------
2. The reels on a wire cart are mechanically rotated by the cart wheels, by means of gears. ------
3. The wire cart holds from 2 to 2½ miles of twisted-pair outpost wire. ------
4. The wire cart is issued to Brigade wire sections. ------
5. The reels on the wire cart should be "in gear" when laying wire. ------

6. The reels on the wire cart can be operated independently of each other. ------

7. It would be impossible to lay one circuit and recover another at the same time. ------

8. The pedals at center of the footboard of the reel cart act only as brakes for the reels. ------

9. Wire should be laid with the reels braked. ------

10. It is not practicable for a man on the seat of a wire cart to operate the gear shift levers. ------

11. The detail required for putting wire on a wire cart is three men. ------

12. Wire can not be put on the reels of a wire cart unless there is a hand crank for the reels. ------

13. When filling an empty reel, the end of the wire is attached to the empty reel by means of a clove hitch around the reel. ------

14. To brake a reel when laying wire, it is necessary to push down the pedal on the footboard. ------

15. Wire can be put on a wire cart by a detail of three men when there is no crank or team available. ------

16. When a reel is being filled, the reel should be turned so that the wire will be wound on from bottom of the reel. ------

BATTERY REEL (ORDNANCE), FIELD ARTILLERY BATTERIES

Equipment.

1 battery reel.
1 type EE – 5 Telephone.
1 iron rod or 2-inch pipe, 6 to 8 feet long.
2 supports for pipe (sawhorses, boxes, etc.).
2 commercial spools of wire.

Information.

The battery reel is a single two-wheeled vehicle used for the rapid laying and recovering of telephone and telegraph lines in the field. It is completely equipped with one drum, mechanically rotated and controlled; one large chest (instrument); one small chest (with two compartments); plotting-board chest; wireman's seat; and appropriate parts and fittings especially designed for and used only on this cart. It is designed to carry approximately 2½ miles of twisted-pair, 11-strand field wire.

The cart is used for laying field wire, by Field Artillery gun batteries.

OPERATION OF THE BATTERY REEL

Directions.

1. Go to the rear of the cart and note the hand lever (Fig. 23) extending from the axle on the left side of the cart. Take hold of this lever and throw it into a mid position (called neutral). Now try to

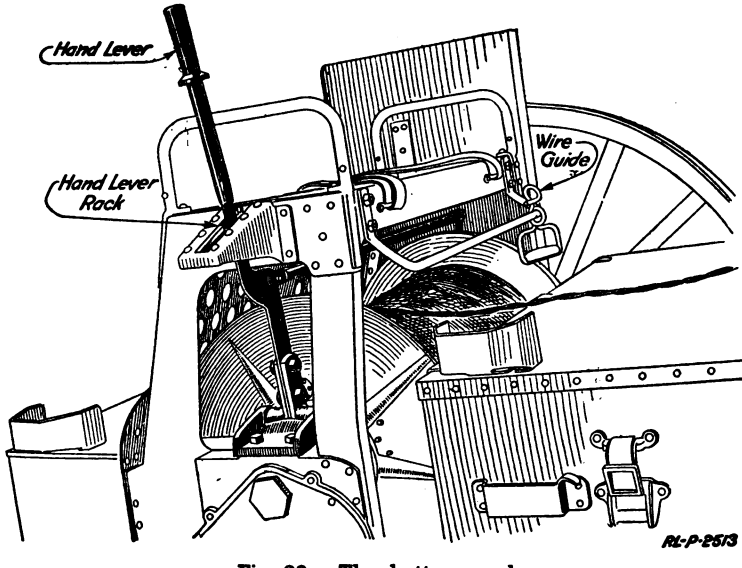

Fig. 23.—The battery reel

spin the drum by hand. Move the cart so that the left-hand wheel will turn (this can be done by swinging the pole to the right), and at the same time note effect on the drum. Try to spin the drum while the left wheel is being turned by an assistant.

Questions.

(*1*) *Does the drum spin freely with the lever in this position (neutral)?*

(*2*) *Does turning the left wheel have any effect on the drum?*

(*3*) *Would the cart be used in either laying or recovering wire with the lever in this position?*

(*4*) *Why was the left wheel turned?*

Directions.

2. Throw the hand lever as far as possible to the right and engage the catch of the lever in the lever rack. Try to move the drum by hand. Cause the left wheel to turn by swinging the pole to the right and at the same time note the drum.

3. Place the lever in the neutral position and then have an assistant spin the drum by pulling and unwinding the wire from it. When it is spinning freely, throw the lever to the right. Note what happens.

Questions.

(*5*) *Does the drum spin freely with the lever in this position?*

(*6*) *Does turning the wheel have any effect on the drum?*

(*7*) *What is the purpose of throwing the lever in this position?*

(*8*) *During what operation would this position of the lever be used?*

(*9*) *To what part of an automobile does the lever correspond when in this position?*

(*10*) *What might happen if this position was not provided?*

Directions.

4. Throw the lever as far as possible to the left and hold it in this position. Have an assistant try to turn the drum by hand. Have an assistant swing the pole to the right so the left wheel turns. Note the effect on the drum while this is being done.

Questions.

(*11*) *Does the drum spin freely with the lever in this position?*

(*12*) *Does turning the wheel have any effect on the drum?*

(*13*) *During what operation would this position of the lever be used?*

(*14*) *What is the purpose of the lever in this position?*

(*15*) *Would it be practicable to pull this cart by hand?*

PUTTING WIRE ON A BATTERY REEL

Information.

The wire used on the battery reel should be 11-strand, twisted-pair, field wire. This wire is issued on commercial wooden spools, 1 mile to the spool, and since these spools can not be inserted in the reel, the wire must be transferred to the drum. In order to do this, a detail of one noncommissioned officer (Signal Corporal No. 2) and two linemen will be required. One of the following methods is recommended:

Directions.

PRELIMINARY STEPS COMMON TO BOTH METHODS

5. *Signal Corporal No. 2.—a.* If the wire to be used is on unopened spools, remove lagging from two spools.

b. Mount one spool with the iron rod or pipe as an axle supported at either end on sawhorses or boxes, so that the axle for the wooden spool will be parallel to the axle of the drum on the reel cart. Have the supports high enough to allow the wooden spool to revolve.

c. Test the spool of wire; if it tests O. K. proceed with *d.* If it does not test O. K., watch the wire carefully for faults as it goes on the reel.

d. Attach the wire from the wooden spool to the reel as follows: Place the end of the wire through the hole near the axle in the right end of the drum. Tie a knot about 6 inches from the end to keep the wire from slipping back through the hole. This will leave the end available for testing later.

6. *Linemen Nos. 1 and 2.*—Assist Signal Corporal No. 2 in above operations.

FIRST METHOD

7. *Signal Corporal No. 2.—a.* Raise the end of the pole; direct Lineman No. 1 to raise the pole prop; lower the end of the pole to the ground.

b. Place a support (box, jack, etc.) that will just fit, under the left-hand rear corner of the cart chest.

c. Assisted by Lineman No. 2, raise the pole and direct Lineman No. 1 to lower the pole prop. The left wheel should now be several inches off the ground.

d. Throw the hand lever as far to the left as possible and block it in this position with a small chock of wood.

e. Direct Lineman No. 1, "Turn the wheel."

f. Stand by the commercial spool and see that it unwinds properly. If it spins too fast, brake by means of a plank or board on the rim of the wooden spool. Do not allow slack wire to be unwound. In old wire watch for bad places in the wire.

g. When the commercial spool is empty, test the wire on the drum. If it tests O. K., proceed with *h.* If it does not test O. K., unreel onto the wooden spool until the fault is located. Repair the fault and reel the wire back onto the drum. Repeat until wire on drum tests O. K. and then proceed with *h.*

h. Replace the empty spool with a full spool. Test the wire, splice the end on the drum, and proceed as above. Repeat until drum is filled.

i. When drum has been filled, test it. If it tests O. K., tag it with some such notation as "Tested O. K." If it does not test O. K., unreel onto drum. Repeat until the drum tests O. K.

8. *Lineman No. 1.—a.* Raise and lower the pole prop at the direction of Signal Corporal No. 2.

b. Turn the left wheel in a counterclockwise direction at command of Signal Corporal No. 2, to "Turn wheel."

c. Assist Signal Corporal No. 2 when it is necessary to change commercial spools.

9. *Lineman No. 2.—a.* Assist Signal Corporal No. 2 to raise the wheel from the ground.

b. Guide the wire on the drum as it is reeled up, by allowing it to run through your gloved hand, or through a wire guide *attached to reel.*

c. If the wire did not test O. K. on the preliminary test, watch for trouble and repair it.

SECOND METHOD

Information.

An artillery pair, with driver, will be needed for this method.

Directions.

10. *Signal Corporal No. 2.—a.* Direct the reel-cart driver to harness his pair and hitch them to the cart.

b. Mount beside the wireman.

c. Command, "Forward, march."

d. When reel cart has moved out about one-quarter mile, command: "Left about, march," and direct the wireman to reel up the paid out wire.

e. Replace spools and test the wire in the same manner as in the first method.

11. *Driver.*—*a.* Harness the pair and hitch it to reel cart.

b. At the command "Forward, march," move out in a direction normal to the axle of the wooden spool.

c. At the command "Left about, march," make a left about with team and return over the wire which was paid out on the ground.

12. *Lineman No. 1.*—*a.* Stand by the commercial spool and see that it unwinds properly. If it spins too fast, brake by means of a plank or board on the rim of the wooden spool. Do not allow slack wire to be unwound. With old wire, watch for bad places in the wire.

b. Assist Signal Corporal No. 2 when it is necessary to replace the commercial spool.

13. *Lineman No. 2 (wireman).*—*a.* Mount to the wireman's seat when Signal Corporal No. 2 mounts.

b. Operate the clutch hand lever and proceed to reel in the wire (when cart is in motion), guiding the wire on the reel by allowing it to run through wire guide attached to reel.

c. Assist Signal Corporal No. 2 when it is necessary to replace the commercial spool.

Questions.

(*16*) *Which method do you prefer?*

(*17*) *Which method would you use at night?*

(*18*) *Can you think of a better way?*

(*19*) *Why was the left wheel jacked up in the first method?*

(*20*) *Would the first method work if the right wheel was jacked up and turned?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Place several faults on one of the commercial spools prior to starting the Unit Operation.

2. Have each student perform, individually, Directions Nos. 1 to 4, inclusive.

3. Explain to the class that reel carts should be kept filled with serviceable wire at all times. Explain the importance of closely inspecting the wire; repairing breaks, poor splices, and damaged insulation; and testing the wire that is being put on the reel cart. Impress on the class the reasons why a reel cart should be left with wire that will test O. K. on the drums.

4. Divide the class into groups of three. Designate the men of the groups as Signal Corporal No. 2, Linemen Nos. 1 and 2, and assign the groups to reel carts.

5. Have the groups perform Directions Nos. 5 to 9, inclusive.

6. Provide an artillery pair, with driver, for each group and have them perform Directions Nos. 10 to 13.

7. At the completion of the Unit Operation, rotate the numbers of the groups so all men are familiar with the workings of the cart.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 9–A (PERFORMANCE)

Equipment (for each group of three students).

Same as listed under Equipment, Unit Operation No. 9—S. M.
Commercial spools to be filled with faulty wire.

Procedure.

1. This test is a group test and is to be performed by a group of three students.

2. Divide the class into groups of three students and designate them Signal Corporal No. 2, Linemen Nos. 1 and 2.

3. Give the following directions to the groups: "Fill the drum on the battery reel."

4. Repeat the test, using the second method.

Scoring (each method separate).

1. The maximum score on this test is 90 points.
2. The score required to pass this test is 70 points.
3. DIRECTIONS FOR SCORING:

	Points
If the wire is properly connected to the drum with ends available for testing	10
If the wire is wound on from the top of the drum	10
If the wire is wound on with sufficient tightness	10

	Points
If necessary splices are properly made with wires which have tracer threads connected together	10
If, when the drum is filled, the wire tests O. K	40
If, when the drum is filled, the end of the wire is tied to the bar across the back of the cart and tagged	10
If the group reports cart filled but the wire tests faulty	0

INSTRUCTION TEST NO. 9–B (INFORMATION)

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the *short dotted line* in the right margin. If what it says is not true (incorrect) place a minus sign (−) on the dotted line.

1. The battery reel is a two-wheeled cart used by all artillery details for laying wire. ---------
2. The drum on a battery reel is mechanically rotated by the wheels by means of a set of gears. ---------
3. The battery reel is normally issued to brigade details. ---------
4. The battery reel holds approximately 2½ miles of twisted-pair outpost wire. ---------
5. The drum on the battery reel should be "in gear" when laying wire. ---------
6. The battery reel has two drums which can be operated independently of each other. ---------
7. The drum brake is operated by a foot pedal on the footboard. ---------
8. Wire should be picked up with the drum in gear. ---------
9. The drum is operated from the left wheel. ---------
10. It is not practicable for a man to operate both the brake lever and the clutch lever. ---------
11. The detail required for putting wire on the battery reel is three men. ---------
12. Wire can be put on the battery reel by using a hand crank for the drum. ---------
13. When filling the empty drum the end of the wire should be attached to the empty drum by means of a square knot or a clove hitch around the drum. ---------
14. To "brake" the drum when laying wire it is necessary to throw the hand lever to the right. ---------
15. When the drum is being filled, the drum should be turned so that the wire will be wound on from the bottom of the drum. --------
16. To put the drum "in gear" the hand lever should be thrown as far as possible to the left. --------

ARTILLERY REEL (SIX-HORSE), MODEL 1909 M. I. (ORDNANCE)

Equipment.

1 artillery reel (six-horse) unlimbered.
1 type EE – 5 telephone.
4 commercial spools of wire.
1 iron rod or 2-inch pipe 6 to 8 feet long.
2 supports for pipe (sawhorses, boxes, etc.).

Information.

The artillery reel (Model 1909 M. I.) is designed to carry, lay, and recover 4 miles of 11-strand twisted-pair field wire, and to act as limber for the artillery cart (instrument). To use as a reel the artillery reel is unlimbered from the artillery cart and used as a separate vehicle. The artillery reel is completely equipped with two drums, mechanically rotated and controlled; an operator's seat; small tool chest; and appropriate parts and fittings necessary in the operation of the reel.

The artillery reel is used by Field Artillery battalions, regiments, and brigade details.

Directions.

1. Go to the rear of the reel cart and note the handwheel at the upper end of standard (Fig. 24) mounted on the right axle bracket. This wheel controls the driving gear clutch. Take hold of this handwheel and turn it as far as possible in a clockwise direction (neutral position). Try to spin the right drum by hand. Have an assistant move the right wheel of the reel by swinging the pole to the left. Note the effect on the right drum.

Questions.

(*1*) *Does the right drum spin freely with the clutch handwheel in this position?*

(*2*) *Does turning the right wheel have any effect on the right drum?*

(*3*) *Would the cart be used in laying or picking up wire with the handwheel in this position?*

Directions.

2. Turn the handwheel counterclockwise as far as possible. Try to move the right drum by hand. Have an assistant move the pole to the left so as to move the right wheel of cart. Note the effect on the right drum. Try to turn the right drum toward you as the right wheel is being turned.

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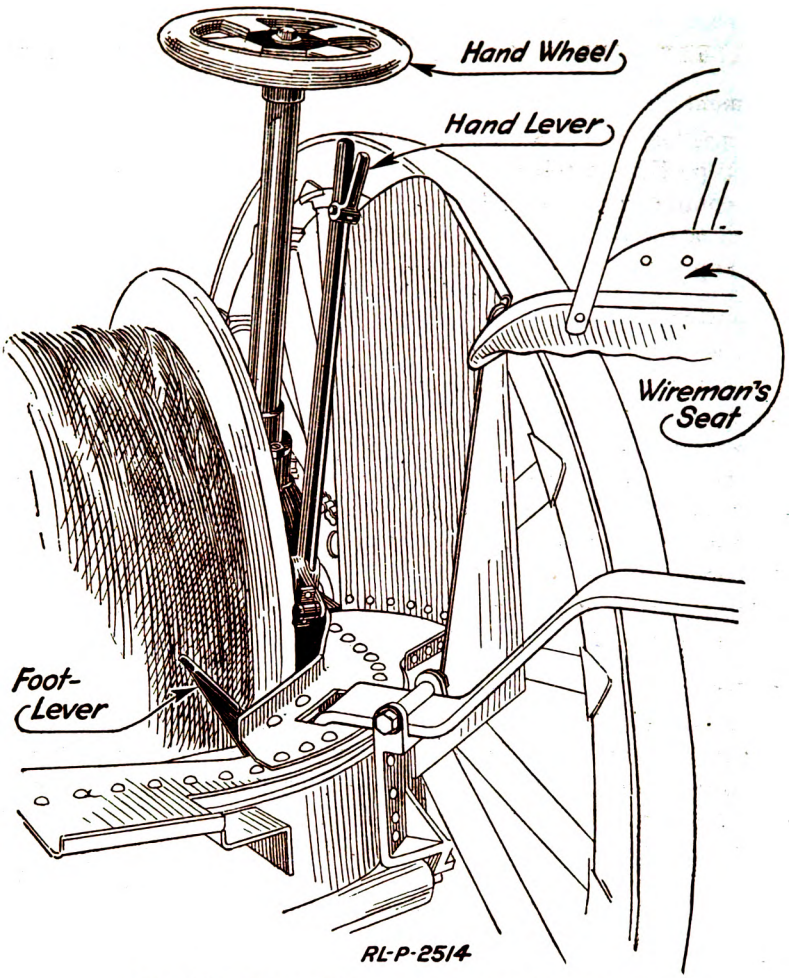

Fig. 24.—The artillery reel, wireman's controls

Questions.

(4) Does the right drum spin freely with the handwheel turned to its counterclockwise position?

(5) Does turning the right wheel have any effect on the right drum?

(6) During what operation would the reel cart be used with the handwheel in this position?

(7) To what part of an automobile does the handwheel correspond?

(8) Why was the cart's right wheel moved?

(9) What effect has turning the left wheel and holding the right wheel fast have on the right drum?

Directions.

3. Look at the left end of the left drum. Find the small handle (clutch rod handle) near the axle. Pull this handle out; turn it one-quarter turn and then release handle. Turn the left reel slowly until the drum clutch catches, which will be indicated by a click. Turn the handwheel clockwise. Try to spin the right drum, holding the left drum still. Try to spin the left drum, holding the right drum still. Repeat Directions 1 and 2, noting the effect on the drums.

Questions.

(*10*) *Will either drum spin free of the other with the drum clutch in this position?*

(*11*) *Do both drums spin (together) when the handwheel is in its clockwise position? In its counterclockwise position?*

(*12*) *What effect does turning the right wheel have on the left drum when the handwheel is in its clockwise position? In its counterclockwise position?*

(*13*) *Is it possible to lay a wire with the left drum and pick one up with the right drum? Why?*

(*14*) *Is it possible to lay a wire with the right drum and pick one up with the left drum? Why?*

(*15*) *Theoretically it is possible to pick up two wires at once, but practically it can not be done. Why?*

(*16*) *Can two wires be laid simultaneously?*

Directions.

4. Note the hand lever (drum latch lever, Fig. 24) on the right side of the reel (between the operator's seat and the driving-gear clutch standard). Work this lever back and forth. Note that a catch engages in two notches when the lever is pushed forward. Turn the handwheel in a clockwise direction (disengaging clutch). Push the hand lever until the catch engages in forward notch. Spin the drum. Push the hand lever forward as far as possible and note the effect on the drum. Pull the lever slowly and revolve the drum until the lever stud engages between the (gears) of the reel lug (traveling position). Try to spin the wheel.

Questions.

(17) Do the drums spin freely with the hand lever engaged in its forward notch?

(18) What effect does pushing the hand lever forward have on the drums when they are spinning?

(19) Why are there two gears on the reel lug?

(20) What part of an automobile does the hand lever correspond to?

Directions.

5. Pull the clutch-rod handle of the left drum out and turn it one-quarter of a turn so that it frees the drums. Spin the left drum, push the hand lever forward and note the effect on the left drum. Put hand lever in its traveling position and try to spin the left drum.

Questions.

(21) What effect has the hand lever on the left drum with the drums free?

(22) What relation must the drums bear to each other in order to have the traveling position of the hand lever function for both drums?

Directions.

6. Mount to the operator's seat, push down on the foot lever and then (Fig. 25) release it. Note the effect. Have an assistant spin

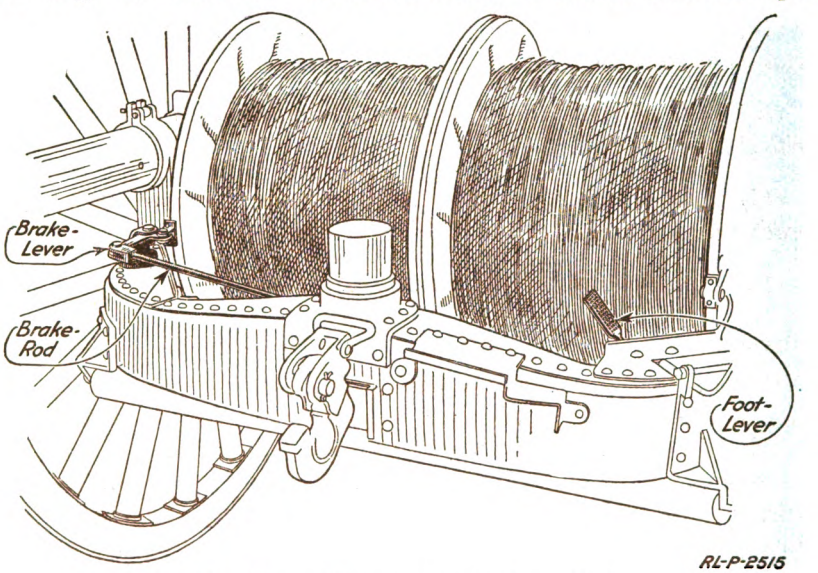

Fig. 25.—The artillery reel, near drum brake

the left drum. Then push down on foot lever and note the effect on the left drum. Spin the right drum. Then push down on the foot lever and note the effect on the right drum. Lock both drums together by engaging the clutch rod. Then spin the drums, push down on foot lever, and note the effect on the drums.

Questions.

(*23*) *What is the purpose of this lever?*

(*24*) *What effect has the foot lever on the right drum when the drums are free? Locked together?*

(*25*) *Does the foot lever, when released, after being pushed down, return to an off position?*

PUTTING WIRE ON AN ARTILLERY REEL

Information.

The wire used on the artillery reel should be 11-strand, twisted-pair, field wire. This wire is issued on commercial wooden spools, 1 mile to the spool. Since these spools cannot be inserted in the drums, the wire must be transferred to the reel. In order to do this, a detail of one noncommissioned officer (Signal Corporal No. 2) and two linemen, will be required. One of the following methods is recommended:

Directions.

PRELIMINARY STEPS COMMON TO BOTH METHODS

7. *Signal Corporal No. 2.—a.* If the wire to be used is on unopened spools, remove the lagging from two spools.

b. Mount one spool with the iron rod or pipe as an axle, supported at either end on sawhorses or boxes, so that the axle for the wooden spool will be parallel to the axle of the drum on the reel cart. Have the supports high enough to allow the wooden spool to revolve.

c. Test the reel of wire. If it tests O. K., proceed with *d.* If it does not test O. K., watch the wire carefully for faults as it goes on the drum.

d. Attach the wire from the wooden spool to the right drum as follows: Place the end of the wire through the hole near the axle in the right end of the drum. Tie a knot about 6 inches from the end to keep the wire from slipping back through the hole. This will leave the end available for testing later.

8. *Linemen Nos. 1 and 2.*—Assist Signal Corporal No. 2 in the above operations.

FIRST METHOD

9. *Signal Corporal No. 2.—a.* Raise the end of the pole. Direct Lineman No. 2 to raise the pole prop, and lower the end of the pole to the ground.

b. Place a support (box, jack, etc.) that will just fit under the right-hand rear corner of the reel cart.

c. Assisted by Lineman No. 2 raise the pole and direct Lineman No. 1 to lower the pole prop. The right wheel should now be several inches off the ground.

d. Turn the handwheel (driving-gear clutch) as far counterclockwise as possible.

e. Direct Lineman No. 1 to turn the wheel.

f. Stand by the commercial spool and see that it unwinds properly. If it spins too fast, brake by means of a plank or board on the rim of the wooden spool. Do not allow slack wire to be unwound. In old wire, watch for bad places in the wire.

g. When the commercial spool is empty, test the wire on the reel. If it tests O. K., proceed with *h*. If it does not test O. K., unreel onto the wooden spool until the fault is located. Repair the fault and reel the wire back onto the drum. Repeat until the drum tests O. K. Then proceed with *h*.

h. Replace the empty spool with a full spool. Test it. Splice the end of the wire to the end on the drum and proceed as above. Repeat until the drum is filled.

i. When the drum has been filled, test it. If it tests O. K., tag it with some such notation as "Tested O. K. 9/13/23 by F. P." and secure the loose end by tying it to the roller. If it does not test O. K., unreel onto wooden spool until the fault is located. Repair the fault and reel the wire back onto the drum. Repeat until the reel tests O. K.

j. Fill the left drum in the same manner as described above for the right drum.

10. *Lineman No. 1.—a.* Raise and lower pole prop at the direction of Signal Corporal No. 2.

b. Turn the right wheel in a clockwise direction at the command of Signal Corporal No. 2 to "Turn wheel."

c. Assist Signal Corporal No. 2 when it is necessary to replace the commercial spools.

11. *Lineman No. 2 (wireman).—a.* Assist Signal Corporal No. 2.

b. Guide the wire on the drum as it is reeled up, by allowing it to run through your gloved hand, or through the wire guide attached to the reel.

c. If wire did not test O. K. on preliminary test, watch for trouble and repair it.

SECOND METHOD

Information.

An Artillery pair, with driver, and a mount for Signal Corporal No. 2 will be needed for this method.

12. *Signal Corporal No. 2.—a.* Direct the driver to harness his pair and hitch them to the cart.

b. Mount.

c. Command "Forward, march."

d. When the reel cart has moved out about one-quarter mile, command, "Left about, march."

e. When a commercial spool is emptied, test the wire on the reel and replace the commercial spool as described for the first method.

13. *Driver.—a.* Harness and hitch the pair to reel.

b. At the command, "Forward, march," move out in a direction normal to the axle of the wooden spool.

c. At command, "Left about, march," make a left about with the reel and return over wire which is paid out on the ground.

14. *Lineman No. 1.—a.* Stand by the commercial spool and see that it unwinds properly. If it spins too fast, brake by means of a plank or board on the rim of the wooden spool. Do not allow slack wire to be unwound. In old wire, watch for bad places in the wire.

b. Assist Signal Corporal No. 2 when it is necessary to replace the commercial spool.

15. *Lineman No. 2 (wireman).—a.* Mount to the wireman's seat when Signal Corporal No. 2 mounts.

b. Operate the clutch handwheel and proceed to reel in wire while the reel cart is in motion, guiding the wire onto the drum by allowing it to run through wire guide attached to the reel.

c. Assist Signal Corporal No. 2 when it is necessary to replace the commercial spool.

Questions.

(*26*) *Which method do you prefer?*

(*27*) *Which method would you use at night?*

(*28*) *Can you think of a better way?*

(*29*) *Why was the right wheel jacked up in the first method?*

(*30*) *Would the first method work if the left wheel was jacked up and turned?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Before allowing the students to perform this Unit Operation, make the following adjustments on the artillery reel:

a. Disengage the drums so they will spin free of one another.

b. Set the hand lever in the forward position so as not to "brake" or "lock" the right drum.

2. Place several faults in the wire on one of the commercial spools prior to starting the Unit Operation.

3. Have each student perform individually Directions Nos. 1 to 6, inclusive.

4. Explain to the class that reel carts should be kept filled with serviceable wire at all times. Explain the importance of closely inspecting the wire; repairing breaks, poor splices, and damaged insulation; and testing the wire that is being put on the reel cart. Impress on the class the reasons why a reel cart should be left with wire that will test O. K. on the drums.

5. Divide the students into groups of three and designate them as follows: "Signal Corporal No. 2," "Lineman No. 1," and "Lineman No. 2."

6. In the part of the Unit Operation headed "Second method, Putting wire on an artillery reel," provide an artillery pair with a driver, and a mount for Signal Corporal No. 2.

7. Have the groups perform Directions Nos. 7 to 15, inclusive.

8. At the completion of the Unit Operation rotate the members of the groups so that all men will become familiar with the workings of the cart.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 10–A (PERFORMANCE)

PART I

Equipment (for each group of three students).

Same as listed under Equipment, Unit Operation No. 10—S. M.

Commercial spools, to be filled with faulty wire.

Procedure.

1. This test is a group test and is to be performed by a group of three students.

2. Divide the class into groups of three students and designate them Signal Corporal No. 2, Linemen Nos. 1 and 2.

3. Give the following directions to the groups: "Fill the left drum on the artillery reel."

4. Provide an artillery pair with driver and a mount for Signal Corporal No. 2 and give the following directions: "Fill the right drum on the artillery reel."

Scoring (each method separate).

1. The maximum score on this test is 90 points.
2. The score required to pass this test is 70 points.
3. DIRECTIONS FOR SCORING.

	Points
If the wire is properly connected to the drum with the ends available for testing	10
If the wire is wound on from top of drum	10
If the wire is wound on with sufficient tightness	10
If necessary splices are properly made with wires which have tracer threads connected together	10
If, when the drum is filled, the wire tests O. K	40
If, when the drum is filled, the end of the wire is tied to the bar across the back of the cart and tagged	10
If the group reports cart filled, but the wire tests faulty	0

INSTRUCTION TEST NO. 10–B (INFORMATION)

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the *short dotted line* in the right margin. If what it says is not true (incorrect), place a minus sign (−) on the dotted line.

1. The artillery reel is a two-wheeled cart used by all Artillery details for laying wire. ------
2. The drums on an artillery reel are mechanically rotated by the wheels by means of a set of gears. ------
3. The artillery reel is normally issued to Brigade details. ------
4. The artillery reel holds approximately 2½ miles of twisted-pair outpost wire. ------
5. The right drum on the artillery reel should be "in gear" when laying two wires simultaneously. ------
6. The drums of an artillery reel can be operated independently of each other without stopping the reel when picking up wire. ------
7. Both drum brakes are operated by foot pedals. ------
8. Wire should be picked up with the drums in gear. ------
9. The right drum is operated from the left wheel. ------
10. It is not practical for a man to operate both the brakes and the clutch wheel. ------
11. The detail required for putting wire on the artillery reel is three men. ------
12. Wire can be put on the artillery reel by using a hand crank to turn the drum. ------

13. When filling an empty drum, the end of the wire should be wound around the empty drum and tied in a square knot or a clove hitch. ------

14. To "brake" the left drum when laying two wires, it is necessary to pull the brake lever to the rear. ------

15. When the drum is being filled, the drum should be turned so that the wire will be wound on from the bottom of the drum. ------

16. To put the drum "in gear," the handwheel should be turned as far as possible in a clockwise direction. ------

THE WIRE PIKE

Equipment.

1 wire pike for each student.
1 horse, riding, for each student.
1 wire cart, battery reel or artillery reel (filled with wire), and team for each group of four students.

Information.

The wire pike consists of a hook mounted on the end of a staff, about 9 feet long. It is designed for the use of mounted men in order to provide a means by which they can handle the wire without dismounting.

When laying wire with a wire cart, battery or artillery reel, the wire-laying detail includes one or more pikemen (linemen in the Field Artillery) who are mounted on horses. It is the duty of these pikemen (linemen) to guide the wire off the reels and pike it to the side of the road. These pikemen (linemen) also often have to place the wire overhead on trees, etc. By using the pike they can accomplish practically everything that they need to do without dismounting.

There are several different kinds of pikes. Some have a roller for the wire to pass over, and others have a tongue or point on the end of the hook to facilitate picking up wire which is lying on the ground. (See Fig. 26.)

TO PICK UP WIRE

Directions.

1. *Old type.*—Place the end of the pike on the ground and turn it over until the tip of the point or tongue is on the ground on the near side of the wire. Push the pike so that the tongue slips under the wire. Turn the hook over with the hook down and push it farther under the wire until the wire is on the back of the center of the hook. Turn the hook over and the wire will drop into it.

2. *New type.* With roller (Fig. 26).—Place the end of the pike on the ground so that the point of the large prong rests on the ground on the far side of the wire. Pull the pike so that the prong slips under the wire and the wire drops into the hook of the roller.

Questions.

(*1*). *Why has the pike two curved prongs?*

(*2*). *Why is a point or tongue necessary on one kind of pike but not on the other?*

(*3*) *Would it be necessary to dismount to pick up the wire when equipped with a pike?*

(*4*) *With which pike is it easiest to pick up wire from the ground?*

TO PLACE WIRE OVERHEAD

Directions.

3. Pick up the wire as described above. Raise the hook end of the pike with the hook turned up. The wire will drop into the near or small end of the hook. Now push it up and lay the wire on the object on which it is to rest and unhook the pike.

TO GUIDE WIRE OFF REELS

4. With the wire in the hook of the pike follow the reel closely and, depending upon the type of pike being used, allow the wire to run

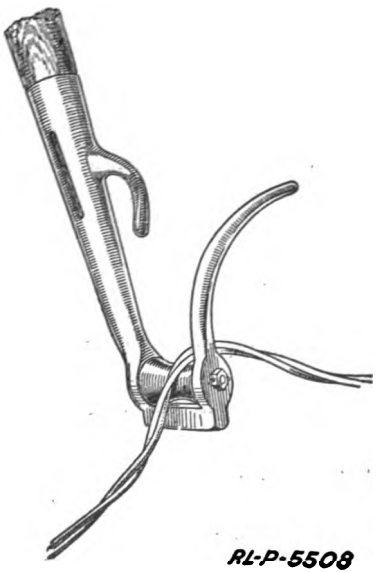

Fig. 26.—The wire pike.

through the pike on the larger hook or roller. To pike to the side of a road on which the wire is being laid, move to the side of the road and allow the wire to run through the pike so that it will be in the proper place as it drops on the ground.

Questions.

(5) *Why is a mounted pikeman used with a wire cart instead of a dismounted man with a hand pad?*

(6) *Why is a pike with a roller in it desirable?*

(7) *Why is a roller not provided in the small end of the pike hook?*

(8) *Why is it necessary, when mounted, to have something like a pike instead of a hand pad?*

TO GUIDE WIRE ON REELS

Information.

When picking up wire with a wire cart, the cart moves forward with the wire attached to the reel for about 60 yards before the clutch is thrown in and the reel starts to wind in. This leaves a loop extending about 30 yards in rear of the cart. The clutch is used to maintain the loop at about this distance.

Directions.

5. To guide the wire from the side of the road with a pike preparatory to picking up, precede the cart, and, with the wire running through the pike, guide the wire from the side of the road into the clear, thus disengaging it from bushes, etc. To "ride the loop" (Fig. 27), follow the cart with the pike in the loop and with the

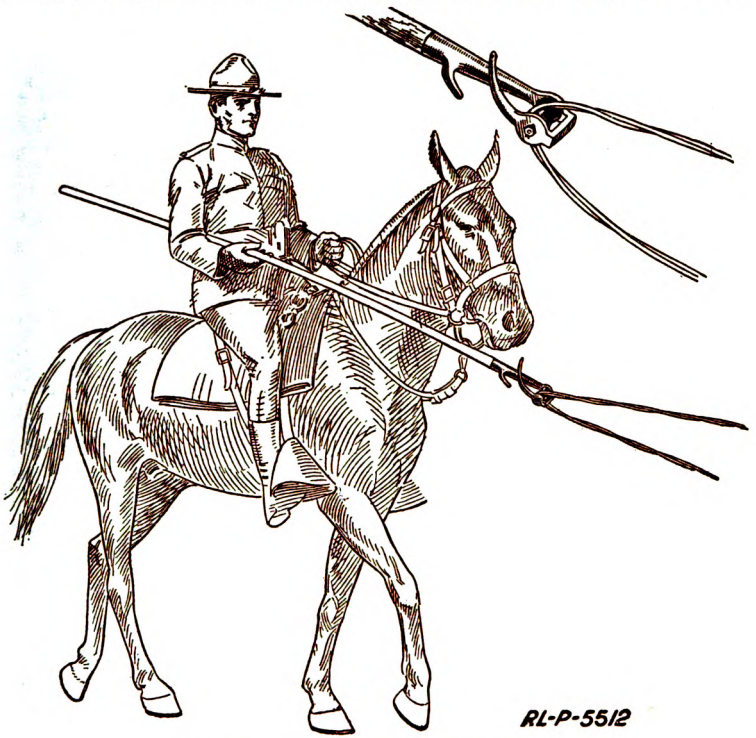

Fig. 27.—Riding the loop with a pike

wire running through the pike, guide it to a point directly in rear of the reel which is being filled. Hold back on the loop enough so that the wire will go on the reel tightly. A dismounted lineman with a hand pad, walking in rear of cart, guides the wire accurately on the reel.

Questions.

(9) *How many pikemen are needed to recover wire with a horse-drawn wire cart?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Provide in advance several hundred yards of twisted-pair field or outpost wire laid on the ground near trees, bushes, etc.

2. Provide an assistant for each wire-cart driver and make sure that he knows how to operate the reels sufficiently well for the purposes of this Unit Operation. Caution him that when the wire is being picked up he is to keep the proper loop in rear of the wire cart.

3. Assign the members of the class to mounts. Be careful to put the inexperienced riders on gentle horses, as the horse may become frightened and hard to handle when a man mounts with a pike. Do not use any horses that are likely to cause trouble.

4. Have the class, one at a time in turn, mount with a pike and practice picking up the wire. Have them place it on the bushes, in the trees, and in any other place available, and then have them place it in the clear. Continue until every man can handle his pike.

5. Assign four men to each wire cart. Give the cart driver directions to lay wire down a road which offers no special difficulties for the pikeman. Have the four students take turn about, guiding the wire from the reel and piking it to the side of the road.

6. When the four men have had sufficient practice in the above, have the wire-cart driver turn around and pick up the wire. Direct the four pikemen to take turn about, guiding the wire on the reel and in riding the loop.

7. Further practice in the use of the pike will be given in Unit Operation No. 12, "Laying and recovering wire with a two-horse wire cart."

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 11–A (PERFORMANCE)

Equipment (for each student).

1 wire cart, battery or artillery reel, with pair, drivers and wiremen.
1 wire pike.
1 horse, riding.

Procedure.

1. Direct the wire-cart driver to tie in the wire to any available tree and to proceed to lay the wire for a distance of about 200 yards, and afterward to return and recover it.

2. Direct the pikemen to perform the following operations while the wire cart is in operation:

a. Pick up the wire off the ground with the pike without dismounting.

b. Pike the wire to the right of road.

c. Place the wire overhead in at least two trees.

d. Take the wire down from overhead.

e. Ride the loop when recovering the wire.

Scoring.

1. The maximum score is 50 points.
2. The score required to pass the test is 30 points.
3. DIRECTIONS FOR SCORING:

	Points
a. If the wire is picked up with the pike on the first trial	5
b. If the wire is properly piked to the side of the road when laying wire	5
c. If the wire is properly placed overhead with the pike	10
d. If the wire is properly taken down from overhead with the pike	10
e. If the wire is properly guided on the reel and with sufficient tightness while the pikeman rides the loop	20

INSTRUCTION TEST NO. 11–B (INFORMATION)

Directions.—The following questions can be answered by a single word or phrase. Write the answer on the short dotted line.

1. How many feet long is a wire pike? ----------
2. Is the pike used mounted, or dismounted, or both? ----------
3. What are men called who use the pike? ----------
4. Is the pike used when laying wire, recovering wire, or both? ----------
5. Where does a man with a pike stay to guide wire on a reel cart when recovering? ----------
6. How many men with pikes are used when recovering wire with a two-horse wire cart? ----------
7. The hook on the near end of the pike is used for placing wire where? ----------
8. What does the man do who goes ahead of a wire cart with a pike when recovering wire? ----------

LAYING AND RECOVERING WIRE WITH A TWO-HORSE WIRE CART

Equipment (for each group of seven students).

1 wire cart, two-horse, with team.
3 horses, riding.
2 pikes.
1 lineman's equipment.
2 field telephones, with leads and Frankel clips.
Terminal strips.
Tags.
Nails for terminal strips.

Information.

The detail to lay wire with a two-horse wire cart should consist of one noncommissioned officer in charge (preferably mounted), one wagoner, one lineman or assistant wagoner on the cart (No. 1), two mounted pikemen (Nos. 1 and 2), and two dismounted linemen (Nos. 2 and 3). When the circuit to be laid does not begin at a switchboard, it is desirable to have an additional man equipped with a field telephone to remain at the initial terminal strip, so that the laying detail can test back to him.

The satisfactory operation of the circuits depends largely upon the care with which they are laid. Carelessly laid circuits are apt to cause much delay and annoyance. The construction detail is responsible that a circuit is properly laid, tested, tagged, and connected to the terminal strip ready for use.

The noncommissioned officer in charge of the construction detail, when he is ordered to lay a circuit, will be given instructions as to where the circuit will begin and terminate and the route along which it will be laid.

LAYING A CIRCUIT

Directions.

1. *Noncommissioned officer in charge of detail.*—Make sure that the wire on the reels of the wire cart is O. K. before starting to lay a circuit. Indicate the place where the line terminal strip is to be installed to which the circuit is to be connected. See that the wire is properly anchored, connected, and tagged, and then move out over the route, directing the cart driver to follow. (Fig. 28.)

2. Pick out the best route as laid down by the directions, considering both the ease with which the wire cart can be handled and the natural facilities for placing the wire in the clear.

3. Supervise the work of the detail.

4. When the job is complete, report the circuit installed to the chief of the operating detail at the destination. If there is no operating detail present, report it by telephone to the chief of the operating detail at the initial point.

5. *Wagoner.*—When the noncommissioned officer in charge directs, follow him over the route on which the wire is to be laid. Regulate the gait according to the directions from Pikeman No. 1.

6. *Lineman No. 1.*—Ride on the wire cart and operate the reel brakes in accordance with directions from Pikeman No. 1. Assist Pikeman No. 2 in stringing the wire under or over any roads which must be crossed. Upon arrival at the destination, dismount from the cart. Take a terminal strip from the cart, unless there is one already up, and install it. Take the free ends of the wires from Pikeman No. 1 and connect them to the terminal strip. For proper methods of making overhead crossings. (See Fig. 30.)

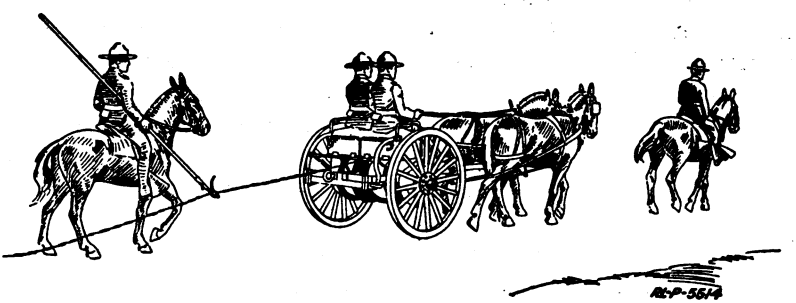

Fig. 28.—Laying wire with a two-horse wire cart

7. *Lineman No. 2.*—Install the terminal strip at the place indicated if one is not already up. Take the ends of the wires from Lineman No. 3 and connect them to the terminal strip. Tag the circuit with its proper circuit number. Follow the cart with Lineman No. 3. Test the circuit from time to time, tie in where necessary, clear any trouble, repair any breaks or bad splices, and be sure that the wire is in the clear at all points where this has not been properly done by the pikemen. From time to time tag the circuit with its circuit number. On arrival at destination make a final test of the circuit and report it O. K. to the man at the other end. Tag the circuit at the terminal strip.

8. *Lineman No. 3.*—Throw the gear lever of the reel which is to be used so that the reel spins freely. Unreel sufficient wire to allow for tying in and connecting. Tie the wire to some object (tree, post, or stake), using a clove hitch, and pass the free ends to Lineman No. 2. Then, as the cart moves out, follow with Lineman No. 2 and assist him.

9. *Pikeman No. 1.*—Follow closely behind the wire cart as it moves out and guide the wire from the reel. From time to time pull out sufficient slack so that the wire will at all times lie loosely on the ground (never taut). When the reel spins too freely and so unreels too fast, call "BRAKE" to Lineman No. 1. Call "RELEASE" to have him take off the brake. Call "STOP" when it is necessary to stop the cart and call "FORWARD" to start again. Act as horse holder for Pikeman No. 2 whenever it is necessary for him to dismount. Upon arrival at the destination, dismount, unreel sufficient wire to tie in, and connect. Cut the wire and tie it to some object (tree, post, or stake) and pass the free ends to Lineman No. 1.

10. *Pikeman No. 2.*—Follow in rear of Pikeman No. 1 as the cart moves out and pike the wire to the side of the road. At turns and other points where the wire is likely to be pulled into the way of traffic, dismount and tie in with the square knot tie. (Pikeman No. 1 will act as horse holder.) Upon arrival at a road crossing or other place where the wire must be put overhead or underground, dismount and place it underground by burying or by cutting it and running it through a culvert, if one is available. If placed overhead, suspend it at least 18 feet from the ground. Call on Lineman No. 1 to do any climbing necessary and for any other assistance.

Information.

To lay two circuits at the same time the procedure is the same as when laying one circuit. The commands given by Pikeman No. 1 for controlling the reels must be prefixed by the words "Right" or "Left," according to which reel is to be braked or released.

RECOVERING A CIRCUIT

Information.

In recovering wire, care must be taken to see that the wire is good when put on the reel; any breaks or weak places in the wire should be repaired during recovering, and wire should not be put on the reels until it will test O. K. As in the case of the reel cart, there is little or no use in putting wire on the reels which is not first put in good condition. It is better to spend the time repairing the wire while it is being recovered than while it is being laid for use.

When recovering a single circuit, the detail required consists of one noncommissioned officer in charge, one wagoner, one lineman or assistant wagoner (No. 1), and two pikemen (Nos. 1 and 2).

Directions.

11. *Noncommissioned officer in charge.*—See that the circuit to be recovered is disconnected from the terminal strip and properly attached to the reels on the cart. Direct the wagoner to follow and move out along the route of the wire. Assist when necessary, to place the wire in the clear. Supervise the work of the detail.

12. *Lineman No. 1.*—Disconnect the circuit to be recovered from the terminal strip, and if there are no other circuits than the one to be recovered connected to it take down the terminal strip. Untie the wire where it is anchored and attach it to one of the reels. If a reel is empty, attach the wire to it by inserting the ends through the hole in the side of the reel so as to leave these ends available for testing. Tie a knot in the wire to keep the ends from slipping back through the hole. If there is some wire already on the reel, attach the wire by splicing it to the ends of the wire on the reel. Be sure that the ends that have the tracer thread are spliced together. Signal to the chief of the section when finished.

13. As the cart moves out, follow the cart closely, and guide the wire on the reel evenly and tightly. Use a hand pad or an improvised pigtail for this purpose.

Fig. 29.—Pigtail or improvised wire guide

14. Whenever breaks in the wire, bad insulation, or poor splices are encountered, repair the wire before winding it on the reel. Test the wire occasionally to make sure that it is O. K. Never put wire on the reel which will not test O. K. Locate the trouble and repair it.

15. When the end of the circuit is reached or the reel is filled, fasten the end to the bar across the rear of the cart and make a final test of the wire. Tag it O. K. when it tests out O. K.

16. *Pikeman No. 1.*—Follow the cart and ride the loop in the wire which is being recovered and keep the pike in the loop. Keep sufficient tension on the wire to cause it to be wound on the reel tightly. (Fig. 27.) Keep the loop a sufficient distance from the cart by calling to the wagoner, when necessary, "CLUTCH" or "RELEASE CLUTCH." Also give the commands "STOP" and "FORWARD" when necessary.

17. *Pikeman No. 2.*—Precede the cart and place the wire in the clear.

18. *Wagoner.*—When the noncommissioned officer in charge directs, follow him over the route on which the wire is laid. When Pikeman No. 1 calls "CLUTCH," throw out the clutch by pressing down on the clutch pedal. When Pikeman No. 1 calls "RELEASE CLUTCH," release the clutch pedal. Stop and start the cart at the commands of Pikeman No. 1.

RECOVERING TWO CIRCUITS

Information.

When recovering two circuits at once, the detail for operating the wire cart should be increased by three linemen (Nos. 2, 3, and 4).

Directions.

19. *Noncommissioned officers in charge.*—Follow directions for recovering a single circuit.

20. *Lineman No. 1.*—Follow directions for recovering a single circuit and handle one of the circuits. Lineman No. 2 will handle the second circuit.

21. *Lineman No. 2.*—Follow directions for Lineman No. 1 for recovering a single circuit and handle the second circuit.

22. *Lineman No. 3.*—Precede the wire cart and place the wire in the clear.

23. *Lineman No. 4.*—Ride on the seat of the wire cart and operate the clutch pedal at the commands of the pikemen.

24. *Pikeman No. 1.*—Follow directions for recovering a single circuit and handle one of the circuits. Pikeman No. 2 will handle the second circuit.

25. *Pikeman No. 2.*—Follow directions given for Pikeman No. 1 for recovering a single circuit and handle the second circuit.

26. *Wagoner.*—Drive the cart and obey the commands to stop and start that are given by Pikeman No. 1.

Questions.

(1) How many miles of twisted-pair field wire, type W–40, will the two-horse wire cart hold?

(2) How many miles of twisted-pair outpost wire, type W–44, will the two-horse wire cart hold?

(3) What detail is required to lay wire with the wire cart?

(4) What detail is required to recover one circuit with a wire cart?

(5) What detail is required to recover two circuits at the same time with the wire cart?

(6) Why is it important to use great care when laying wire lines?

(7) What is the extent of the responsibility of the detail which lays a line?

(8) What information should the chief of the detail be given when he is ordered to lay a line?

(9) Is the wire on the cart tested before it is laid?

(10) If it does not test O. K., what must be done?

(11) Where is a circuit tied in when it is laid?

(12) Who picks out the route for the cart to follow?

(13) Where does he get his directions?

(14) Can two circuits be laid simultaneously with the wire cart?

(15) Who is responsible for placing the wire in the clear and out of the way of traffic?

(16) For what must Linemen Nos. 2 and 3 always be on the lookout while laying wire?

(17) Why is wire which is laid slack less likely to be injured than that which is not laid slack?

(18) How many circuits can be recovered at the same time with a wire cart?

(19) How many men are required to recover the maximum number?

(20) Why must Lineman No. 1 be provided with a set of linemen's equipment?

(21) What might happen if the wire is not kept taut while it is being wound on the reels?

(22) Who is responsible that it is kept taut?

(23) How high must the wire be put when stringing it overhead where it crosses a road?

(24) What must be provided for when attaching wire to an empty reel?

(25) What would be the result if this provision were not made?

(26) What care must be taken when splicing twisted-pair field or outpost wire?

(27) How many pikemen are required when recovering a single circuit? When recovering two circuits?

(28) What sort of tie is used when tying in on an overhead road crossing?

(29) When crossing under the road the wire would have to be cut and spliced. Would this be a good time to test?

SUGGESTIONS FOR THE INSTRUCTOR

1. Divide the class into wire-cart details of seven men each. Assign the men as follows: Noncommissioned officer in charge, linemen Nos. 2 and 3, pikemen Nos. 1 and 2, and wagoner. Assign one set of equipment to each detail and have them lay the wire in accordance with Directions Nos. 1 to 10 of the Unit Operation. When the wire on the carts has been laid, change the men around within the details and then have them recover the wire in accordance with Directions Nos. 11 to 17 of the Unit Operation.

2. Continue the exercise of laying and recovering single circuits until the students have had practice in the duties of each of the different members of the detail. Then have the details lay and recover two circuits simultaneously, repeating the exercise until all men have had practice in the duties of the various members of the detail.

3. If it is desired to give further practice with the wire cart, give problems to the details such as the following: Direct the chief of the detail to lay a circuit from Magic (give location) to Mobile (give location). Designate the number of the circuit and the route to be followed. Prescribe a route which will necessitate crossing various kinds of roads and will require turning corners and crossing fields.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 12–A (PERFORMANCE)

Equipment.

Same as for Unit Operation No. 12–S. M. with one additional field telephone with leads and Frankel clips.

Procedure.

1. In this test a group of students will be required to lay one circuit and recover another circuit with a two-horse wire cart. The arrangements made for this test contemplate that the first group of students tested will lay a circuit. A second group will recover this circuit and then lay one themselves. A third group will recover this circuit and so on. The first group will finally recover the circuit laid by the last group.

2. Pick out in advance a number of pairs of points for the locations of centrals from one-quarter to one-half mile apart, and connected by a road which crosses at least one other road.

3. Divide the class into groups of eight men each. The purpose of the additional man is to allow for necessary personnel to leave a man

at the initial point equipped with the additional field telephone which is to be supplied in order to provide a means of testing for the wire-cart detail.

4. When the first group is ready, direct them as follows:

a. The detail will lay one circuit from (give location of initial point) where Magic central will locate later to (give location of final point) where Mobile central will locate later.

b. The circuit will be numbered 601.

c. As the operating sections have not yet reached the points mentioned notify me when the job is complete.

5. When the circuit has been laid, give the following orders to the second group of students:

a. Magic central (give location) and Mobile central (give location) have closed and circuit No. 601 formerly connecting these two centrals is no longer in use.

b. The detail will recover this circuit.

c. When the job is complete report to me.

6. When the circuit has been recovered, have the detail lay a circuit. Give directions in accordance with paragraph 4, changing the locations.

Scoring.

1. Maximum score, 125 points.
2. Score required to pass the test, 90 points.
3. DIRECTIONS FOR SCORING THE LAYING OF A CIRCUIT.

	Points
Terminal strip properly installed at initial point	5
Circuit properly tagged at initial point	5
Circuit properly tied in at initial point	5
Circuit laid with proper amount of slack	5
Circuit tied in at corners	5
Circuit placed overhead at proper height at road crossings	10
Circuit placed at side of road clear of traffic	5
Circuit properly tied in, tagged, and connected to terminal strip at final point (5 points each)	15
Circuit in working order when job is complete	25

4. DIRECTIONS FOR SCORING THE RECOVERING OF A CIRCUIT.

Wire properly connected to reel	10
Terminal strips removed (since there is no other circuit)	5
Wire properly wound on reels	5
Wire on reels test O. K. when job is complete	25

INSTRUCTION TEST NO. 12-B (INFORMATION)

Directions.—Below are a number of unfinished statements each followed by several numbered words or phrases, one of which correctly completes the statement. Write the *number* of this word or phrase on the short *dotted line* at the right of each statement.

1. The number of men in the detail required to lay wire with a two-horse wire cart is
   (1) five. (2) four. (3) seven. (4) two. (5) six. ------
2. An additional man is needed in the wire cart detail when
   (1) two circuits are laid simultaneously.
   (2) when the circuit does not start at a switchboard.
   (3) the weather is bad. (4) when old wire is used.
   (5) when the personnel is inexperienced. ------
3. The construction detail is responsible for nothing further than that the wire
   (1) is laid. (2) is laid and tested.
   (3) is laid, tested, and tagged.
   (4) is laid, tested, tagged, and connected to the line terminal strip.
   (5) is laid, tested, tagged, and connected into the switchboard. ------
4. When a circuit has been installed by a wire-cart detail it is reported to the
   (1) communications officer. (2) commanding officer.
   (3) chief of the operating detail.
   (4) wire section chief. (5) message center. ------
5. The number of pikemen in a wire-cart detail is
   (1) three. (2) one. (3) five. (4) four. (5) two. ------
6. When laying wire with a two-horse wire cart, the gait is regulated on
   (1) Pikeman No. 1. (2) the wire cart.
   (3) Lineman No. 1. (4) Linemen Nos. 3 and 4.
   (5) the noncommissioned officer in charge. ------
7. The man who rides on the cart with the wagoner when laying wire with a two-horse wire cart is
   (1) Lineman No. 3. (2) Pikeman No. 1.
   (3) the noncommissioned officer in charge.
   (4) the wire chief. (5) Lineman No. 1. ------
8. The amount of twisted-pair outpost wire that the two-horse wire cart will hold is
   (1) 15 miles. (2) 2½ miles. (3) one mile.
   (4) 5 miles. (5) 7 miles. ------

9. The man who is guiding wire on a reel when recovering wire must take care
   (1) that there are no splices in the wire.
   (2) that the wire is tagged occasionally.
   (3) that the wire goes on the reel loosely.
   (4) that the wire goes on the reel tightly.
   (5) that all splices are cut out of the wire. ------

10. When the final point has been reached to which a circuit is being laid, the wire must be
   (1) anchored by tying it to some object.
   (2) short circuited so it can be tested.
   (3) spliced to the switchboard cable.
   (4) buried. (5) grounded. ------

11. When recovering a circuit with a wire cart, the wire is guided on the reel by
   (1) Pikeman No. 2. (2) the noncommissioned officer.
   (3) Lineman No. 1. (4) the wagoner.
   (5) Linemen Nos. 2 and 3. ------

12. When splicing twisted-pair outpost wire, care must be exercised to make sure that
   (1) a Western Union splice is used.
   (2) a staggered splice is never used.
   (3) a clove hitch is used.
   (4) the wires that have the tracer thread are spliced together.
   (5) the joint is soldered. ------

LAYING AND RECOVERING WIRE WITH A BATTERY REEL

Equipment (for each group of three students).

1 battery reel (with team).
1 horse, riding (for N. C. O.).
1 pike.
1 pair climbers, lineman's.
1 telephone, type EE – 5.

LAYING WIRE

Information.

The detail to lay wire with a battery reel should consist of the following personnel:

Signal Corporal No. 2 (N. C. O. in charge).
Lineman No. 2 (wireman).
Lineman No. 1 (with lineman's equipment).
Two drivers.

When the circuit to be laid does not begin at a switchboard, it is desirable to have an additional man (telephone operator) equipped with a field telephone, to remain at the starting point of the line so that the laying detail can test back to him. The satisfactory operation of the circuit depends largely upon the care with which it is laid. Carelessly laid circuits will need considerable attention and cause much delay and annoyance. The telephone section is responsible that a circuit is properly laid, tested, and connected to the switchboard or telephone, ready to use.

The noncommissioned officer in charge of the reel cart (Signal Corporal No. 2) will be given directions as to where the circuit will begin and terminate, and the route along which it will be laid.

Directions.

1. *Signal Corporal No. 2.*—See that the wire on the reel cart is O. K. before starting to lay a circuit. Indicate the place where the circuit is to start. See that the wire is properly tied and connected. Move out over the route to be followed, giving the command, "Follow me; forward, march."

Pick out the best route as laid down by the directions, considering both the ease with which the reel cart can be handled and the natural facilities for placing the wire in the clear.

Supervise the work of the detail. When the circuit is completed, report the circuit installed to the switchboard operator and the signal sergeant.

2. *Drivers.*—At command by Signal Corporal No. 2, "Follow me; forward, march," follow him over the route on which the wire is to be laid. Regulate the gait according to the direction of Lineman

No. 2 (wireman). When laying wire along a road lay it as far to the right as possible.

3. *Lineman No. 2 (wireman).*—Ride on the reel-cart seat and operate the hand lever so as to lay the circuit properly. If the reel spins too fast, it must be braked. Do not allow excessive slack wire to be unreeled. However, never lay wire taut. Allow enough wire to be unreeled, at points where the wire must be tied (road crossings, corners, etc.), for tying. Be careful in the use of the brake, as the wire will break easily. Give directions to the drivers in regards to gait. Upon arrival at the destination of the circuit, dismount, pull off enough slack wire to tie in, and cut the wire from the reel. Tie the wire in and see that it is connected to a telephone or switchboard. Test circuit. If it tests O. K., report the circuit in order to the operator at the starting point. If it does not test O. K. send Lineman No. 1 back over the line to find the fault and repair same. If all circuits have been laid, assist Lineman No. 1 on this duty. Report the circuit in order to Signal Corporal No. 2 when the circuit is complete.

4. *Lineman No. 1 (with climbers).*—Unreel sufficient wire to allow for tying in and connecting the wire. Tie the wire to some object (tree, post, or stake), using a clove hitch at the starting point, and see that it is connected into the switchboard or the telephone. Follow the reel cart, tie in the wire where necessary, repair any breaks or bad splices, and be sure that the wire is put clear of all traffic. Clear trouble if the circuit does not test O. K.

RECOVERING A CIRCUIT

Information.

The detail to recover a circuit with a battery reel should consist, at least, of the following personnel:

Signal Corporal No. 2 (N. C. O. in charge)
Lineman No. 2 (wireman).
Lineman No. 1.
Two drivers.

In recovering wire, care must be taken to see that the wire is good when put on the reel; any breaks or weak points in the wire should be spliced and covered with friction tape. In splicing, the wires having tracer threads should always be spliced together. No wire can be considered as being properly recovered unless it tests good with a telephone. The party recovering wire must take time to make the proper repairs in the wire, otherwise this will be a constant source of trouble later (when it is necessary to make use of this wire). In order that the wire can be tested upon completion of its recovery, the ends which are fastened on the drum are put through the hole provided for that purpose in the end of drum and connected to the binding posts on the side of the reel.

Recovering a telephone circuit includes testing of the line, closing of the telephone station, picking up of the telephone, picking up of the wire, and the removal of the wire from the switchboard. The telephone picked up is placed in its compartment in the reel cart or store limber if there is no further use for it.

If a circuit is to be recovered that has no telephone at the far end, a quick test to see that the circuit is clear of shorts is as follows: Connect a telephone to the near end of the wire, and give the magneto handle a few turns. If the handle turns freely, the line is clear. If the handle turns hard, and blowing in the transmitter (push button in) is heard in the receiver, the circuit is shorted.

Directions.

5. *Signal Corporal No. 2.*—Notify telephone operators at both ends of the circuit that it is to be recovered. Supervise the work of the detail.

a. Command, "Follow me; forward, march," as soon as Lineman No. 1 splices the wire. Move out in the direction of the wire. If third lineman is not available take the wire down from fences, trees, etc., and drop it to the ground so that the reel can pick it up.

b. As soon as the circuit has been recovered, report to the person who ordered the circuit recovered as follows: "Battery O. P. line recovered as ordered."

6. *Lineman No. 1.*—Test the circuit to be recovered and report results to Signal Corporal No. 2 and Lineman No. 2. Disconnect the wire from its terminal. Splice the end of the wire to the end of the wire on the reel.

Follow the reel cart with a pike or hand pad and lift the wire over bushes, stumps, stones, etc. (There is always a loop following the reel, and this loop must be kept clear.)

Repair all trouble that is found in the wire as it is being reeled up.

7. *Lineman No. 2.*—Mount to the seat of the reel cart and engage the clutch so that the drum will turn. Watch the drum to see that it does not reel up too fast. Always keep a loop in the wire behind the cart. Regulate the speed of reeling by use of the clutch and reel brake. Guide the wire on drum with the wire guide or hand pad. (See Fig. 29.)

If the wire tested faulty at the start, watch for breaks, poor splices, or other faults and repair any that are found. Also test at intervals of about one-half mile to see that the wire on the reel is O. K. If it tests faulty, unreel until the fault is located and repaired. If it tests O. K., proceed to reel up the wire.

When the end of the circuit is reached or the drum is filled, fasten the end to the wooden roller across the rear of the cart and make a test of the drum. If it tests faulty, unreel until the fault is located

and repair it. If the wire tests O. K., tag the drum as follows: "Tested O. K. by F. J. 9/13/23."

8. *Drivers.*—At the command, "Follow me; forward, march" (by Signal Corporal No. 2), move out, following Signal Corporal No. 2.

Questions.

(1) How many miles of twisted-pair, 11-strand field wire will the battery reel hold?

(2) What detail is required to lay wire?

(3) What detail is required to recover wire?

(4) Why is it important to use care in laying wire?

(5) What information should Signal Corporal No. 2 be given when he is ordered to lay a circuit?

(6) Should the wire be tested before laying a circuit?

(7) If the wire does not test O. K., what must be done?

(8) Where is a circuit tied in when it is laid?

(9) Who picks out the route for the cart to follow?

(10) Who places the wire clear of the traffic?

(11) Why is wire which is laid slack less likely to be injured than that which is laid taut?

(12) Why must lineman No. 1 be equipped with a pair of climbers?

(13) How high should wire be placed when stringing it over a road?

(14) What should Signal Corporal No. 2 do when a circuit is completed?

(15) What provision must be made when attaching wire to an empty reel?

(16) What would be the result if this provision were not made?

(17) Should the tracer wire of each pair be spliced together when splicing the ends of two wires together?

(18) When crossing under a road, the wire would have to be cut and spliced. What advantage should be taken of this?

(19) When ordered to pick up a circuit, what step should Signal Corporal No. 2 take before reeling up the wire?

(20) The circuit to be picked up tests faulty. You have reeled up one-quarter mile and wish to test the wire on the reel. It will be necessary to cut one wire of the twisted pair before testing with a telephone. Why?

SUGGESTIONS FOR THE INSTRUCTOR

1. Divide the class into groups of three men each and assign them the equipment listed in the Students Manual. Provide each battery reel with its drivers and their teams. Designate these men as Signal Corporal No. 2, Lineman No. 1, and Lineman No. 2.

2. At the starting point of a circuit provide a telephone operator with a telephone to connect to the circuit. This will allow the laying detail to test the circuit when laid.

3. When instructing several groups, in lieu of providing a telephone operator and telephone at the starting point of each circuit, one switchboard with telephone operator may be used as the starting point for all circuits.

4. Have each group of men perform the Unit Operation in the Students Manual.

5. Upon the completion of the Unit Operation change the men within the groups and repeat the Unit Operation. Continue this practice until all three men are familiar with all duties required in laying and recovering wire with the battery reel.

6. If it is desired to give further practice in the handling of the battery reel, give instructions to lay a circuit between points that will necessitate the crossing of roads, turning corners, crossing of streams, etc.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 13-A (PERFORMANCE)

Equipment.

Same as listed for the Unit Operation in the Students Manual.

Procedure.

1. Pick out in advance a starting point and provide a switchboard with operator at that point. Select another point about one-half mile distant that will necessitate crossing a road when laying a circuit to it. Mark this point with a marker visible from the starting point.

2. Divide the class to be tested into groups of three men each and designate them as Signal Corporal No. 2, Lineman No. 1, and Lineman No. 2.

3. Assemble the Signal Corporals No. 2 and give the following directions:

Lay a circuit from the switchboard to the O. P. at that marker.

4. When the circuit has been laid, inspect the circuit (see Scoring) and assemble Signal Corporals No. 2. Give the following directions:

Recover the O. P. circuit.

5. Note any irregularities in recovering the circuit. (See Scoring.)

Scoring.

1. Maximum score, 100 points.
2. Score required to pass the test, 80 points.
3. DIRECTIONS FOR SCORING THE LAYING OF A CIRCUIT.

	Points
a. If the circuit is properly connected to initial point	5
b. If the circuit is properly tied in at initial point	5
c. If the circuit is properly tied in at corners	5
d. If the circuit is placed overhead at proper height at road crossing	10
e. If the circuit is properly tied in at final point	5
f. If the circuit is in working order when job is complete	25
g. If the switchboard operator is notified that the circuit is installed	5

4. DIRECTIONS FOR SCORING THE RECOVERING OF A CIRCUIT.

a. If the switchboard operator is notified that the circuit is to be removed	5
b. If the wire is properly connected to reel	5
c. If the wire is properly wound on reels	5
d. If the wire on reels tests O. K. when job is complete	20
e. If the report "O. P. circuit picked up" is made	5

INSTRUCTION TEST NO. 13-B (INFORMATION)

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the *short dotted line* in the right margin. If what it says is **not** true (incorrect), place a minus sign (−) on the dotted line.

1. Five men are required in order to lay wire with a battery reel. ------
2. Two circuits may be laid simultaneously with a battery reel. ------
3. The reel-cart detail is responsible that the circuit is laid, tested, tied in, and connected into the switchboard. ------
4. When a circuit has been installed, it is so reported to the signal sergeant and switchboard operator by Signal Corporal No. 2. ------
5. There are two wiremen for each battery reel. ------
6. The gait of the battery reel when recovering wire is regulated by the wireman. ------
7. A circuit should be tied in at the final point by the Signal Corporal No. 2. ------

8. Signal Corporal No. 2 tests a circuit when it is laid to see that it is O. K. ------

9. The same detail is required to recover a circuit that is required to lay a circuit. ------

10. When splicing twisted-pair outpost wire, care must be exercised to make sure that staggered splices are never made. ------

11. The wires which have tracer threads should always be spliced together when splicing twisted pair wire. ------

12. It is unnecessary to test a circuit before recovering it. ------

LAYING AND RECOVERING WIRE WITH AN ARTILLERY REEL

Equipment (for each group of three students).

1 artillery reel, both drums filled (unlimbered from cart).
1 horse, riding (for N. C. O.).
1 pike.
1 pair climbers, lineman's.
1 telephone, type EE – 5.

LAYING WIRE, ONE CIRCUIT

Information.

The detail to lay wire with an artillery reel should consist, at the least, of the following personnel:

Signal Corporal No. 2 (N. C. O. in charge).
Lineman No. 2 (wireman).
Lineman No. 1 (with lineman's equipment).
Tnree drivers.

When the circuit to be laid does not begin at a switchboard, it will be necessary to have an additional man (telephone operator) equipped with a field telephone, to remain at the starting point of the line so that the laying detail can test back to him.

The efficiency with which circuits operate depends greatly upon the care with which they are laid. Carelessly laid circuits will need much attention and cause much delay and annoyance. Care must be taken that the wire on the cart is in good shape and will test good, before starting to lay a circuit.

The noncommissioned officer in charge of the reel (Signal Corporal No. 2) will be given directions as to where the circuit will begin and terminate and the route along which it will be laid.

Directions.

1. *Signal Corporal No. 2.*—See that the wire on the reel cart is O. K. before starting to lay a circuit. Indicate the place where the circuit is to start. See that the wire is properly tied in and connected. Move out over the route to be followed, giving the command, "Follow me; forward, march."

Pick out the best route as laid down by the directions, considering both the ease with which the reel cart can be handled and the natural facilities for placing the wire in the clear.

Supervise the work of the detail. When the circuit is completed, report the circuit installed to both the switchboard operator and the signal sergeant.

2. *Drivers.*—At command of Signal Corporal No. 2, "Follow me; forward, march," follow him over the route on which the wire is to

be laid. Regulate the gait according to the direction of Lineman No. 2 (wireman). When laying wire along a road, lay wire as far to the right as possible.

3. *Lineman No. 2 (wireman).*—Ride on the reel-cart and operate the clutch and brakes so as to lay the circuit properly. If the drum spins too fast, it must be braked. Do not allow excessive slack wire to be unreeled. However, never lay wire taut. Allow enough wire for tying to be unreeled at points where the wire must be tied (road crossings, corners, etc.). Be careful in the use of the brake as the wire will break easily. Give directions to the drivers in regard to the gait of the animals. Upon arrival at the destination of the circuit, dismount, pull off enough slack wire to tie in, and cut the wire from the reel. Tie the wire in and see that it is connected to a telephone or switchboard. Test the circuit. If it tests O. K., report the line in order to the operator at the starting point. If it does not test O. K. send Lineman No. 1 back over the line to find the fault and repair it. If all circuits have been laid, assist Lineman No. 1 in this duty. Report the circuit in order to Signal Corporal No. 2 when the circuit is complete.

4. *Lineman No. 1 (with climbers).*—Unreel sufficient wire to allow for tying in and connecting the wire. Tie the wire to some object (tree, post or stake), using a clove hitch at the starting point, and see that it is connected into the switchboard or to a telephone. Follow the reel cart, tie the circuit where necessary, repair any breaks or bad splices and be sure that the wire is put clear of all traffic. Clear trouble if the circuit does not test O. K.

TO LAY TWO CIRCUITS SIMULTANEOUSLY

Information.

Two circuits may be laid simultaneously with the Artillery reel. If this is done, two telephone operators, equipped with field telephones, must remain at the starting point of the line (if circuits do not connect into a switchboard) so that laying detail can test back to them. An additional lineman should be used to assist Lineman No. 1 in clearing the lines. Signal Corporal No. 2 will disconnect the two drums of the reel by throwing out the clutch rod. Otherwise, two circuits are laid as described for laying one circuit

RECOVERING A CIRCUIT

The detail to recover a circuit with an artillery reel should consist at least of the following personnel:

Signal Corporal No. 2 (N. C. O. in charge).
Lineman No. 2 (wireman).
Lineman No. 1.
Three drivers.

In recovering wire, care must be taken to see that the wire is good when put on the reel; any breaks or weak points in the wire should be spliced and covered with friction tape. In splicing, the wires having tracer threads should always be spliced together. No wire can be considered as being properly recovered unless it tests good with a telephone. The party recovering wire must take time to make the proper repairs in the wire, otherwise this will be a constant source of trouble later (when it is necessary to make use of this wire). In order to have the wire so it can be tested upon completion

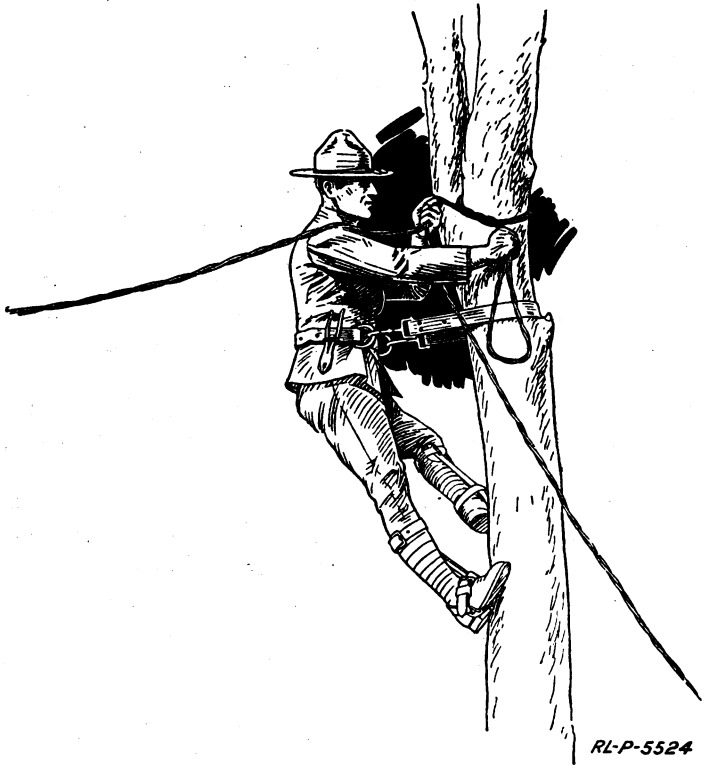

Fig. 30.—Lineman tying in overhead

of its recovery, the ends which are first fastened on the drum are put through the hole provided for that purpose in the end of the drum, and connected to the binding posts on the side of the reel.

Recovering a telephone circuit includes the testing of the circuit, the closing of the telephone station, the picking up of the telephone, the picking up of the wire, and the removal of the wire from the switchboard. The telephone picked up is placed in its compartment in the artillery cart if there is no further use for it.

If a line is to be recovered that has no telephone at the far end, a quick test to see that the circuit is clear of shorts is as follows: Connect a telephone to the near end of the wire, give the magneto handle a few turns. If the handle turns freely, the circuit is clear. If the handle turns hard, and blowing in the transmitter is heard in the receiver, the circuit is shorted.

Directions.

5. *Signal Corporal No. 2.*—Notify telephone operators at both ends of the circuit that it is to be recovered. Supervise work of the detail.

a. Command, "Follow me; forward, march," as soon as Lineman No. 1 splices the wire. Move out in the direction of the wire. If third lineman is not available, take the wire down from fences, trees, etc., and drop it to the ground so that the reel can pick it up.

b. As soon as the circuit has been recovered report to the person who ordered the circuit recovered, for example, as follows: "Battery O. P. circuit recovered as ordered."

6. *Lineman No. 1.*—Test the circuit to be recovered, report results to Signal Corporal No. 2 and Lineman No. 2. Disconnect wire from its terminal. Splice the end of the wire to the end of the wire on the reel.

Follow the reel cart with a pike or hand pad and lift the wire over bushes, stumps, stones, etc. (There is always a loop following the reel and this loop must be kept clear.)

Repair all trouble that is found in wire as it is being reeled up.

7. *Lineman No. 2 (wireman).*—Mount to the seat of the reel and engage the clutch so that the reel will turn. Watch the drum to see that it does not reel up too fast. Always keep a loop in the wire behind the reel. Regulate the speed of reeling by use of the clutch and reel brake. Guide the wire on the reel with a wire guide (see Fig. 29) or hand pad.

If the wire tested faulty at the start, watch for break, poor splice, or other fault and repair any that is found. Also test at intervals of about one-half mile to see that wire on reel is O. K. If it tests faulty, unreel until the fault is located and repair it. If it tests O. K., proceed to reel up the wire.

When the end of the circuit is reached or the drum is filled, fasten the end to the wooden roller across the rear of the cart, and make a test of the drum. If it tests faulty, unreel until the fault is located and repair it. If the wire tests O. K., tag the drum as follows: "Tested O. K., by F. J., 9/13/23."

8. *Driver.*—At the command, "Follow me; forward, march" (by Signal Corporal No. 2), move out, following Signal Corporal No. 2.

Information.

It is not practicable to reel up two lines simultaneously.

Questions.

(1) *How many miles of twisted-pair, 11-strand, field wire will the artillery reel hold?*

(2) *What detail is required to lay wire?*

(3) *What detail is required to recover wire?*

(4) *Why is it important to use care in laying wire?*

(5) *What information should Signal Corporal No. 2 be given when he is ordered to lay a circuit?*

(6) *Should the wire be tested before laying a circuit?*

(7) *If it does not test O. K., what must be done?*

(8) *Where is a circuit tied in when it is laid?*

(9) *Who picks out the route for the cart to follow?*

(10) *Who places the wire clear of the traffic?*

(11) *Why is wire which is laid slack less likely to be injured than that which is laid taut?*

(12) *Why must Lineguard No. 1 be equipped with a pair of climbers?*

(13) *How high should wire be placed when stringing it over a road?*

(14) *What should Signal Corporal No. 2 do when a circuit is completed?*

(15) *What provision must be made when attaching wire to an empty reel?*

(16) *What would be the result if this provision were not made?*

(17) *Should the tracer wire of each pair be spliced together when splicing the ends of two wires together?*

(18) *When crossing under a road the wire would have to be cut and spliced. What advantage should be taken of this?*

(19) *When ordered to pick up a line, what steps should Signal Corporal No. 2 take before reeling up the wire?*

(20) *The line to be picked up tests faulty. You have reeled up one quarter mile and wish to test the wire on the reel. It will be necessary to cut one wire of the twisted pair before testing with a telephone. Why?*

(21) *When laying two circuits, why should the two drums be disengaged?*

(22) *If wire is to be reeled up by the left drum, what precaution should the wireman take?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Divide the class into groups of three men each and assign them the equipment listed in the Students Manual. Provide each reel with its drivers and their teams. Designate these men as Signal Corporal No. 2, Lineman No. 1, and Lineman No. 2.

2. At the starting point of a circuit provide a telephone operator with a telephone to connect to the circuit. This will allow the laying detail to test the circuit when laid.

3. When instructing several groups, in lieu of providing a telephone operator and telephone at the starting point of each circuit, a switchboard with telephone operator may be used as the starting point for all circuits.

4. Have each group of men perform the Unit Operation in the Students Manual. Provide an extra lineguard per group when laying two circuits simultaneously.

5. Upon the completion of the Unit Operation, change the men within the groups and repeat the Unit Operation. Continue this practice until all the men are familiar with all duties in laying and recovering wire with the artillery reel.

6. If it is desired to give further practice in the handling of the artillery reel, give directions to lay a circuit between points that will necessitate the crossing of roads, turning corners, crossing of streams, etc.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 14-A (PERFORMANCE)

Equipment.

Same as listed for the Unit Operation in the Students Manual.

Procedure.

1. Pick out in advance a starting point and provide a switchboard with operator at that point. Select another point about one-half mile distant that will necessitate crossing a road when laying a circuit to it. Mark this point with a marker visible from the starting point.

2. Divide the class to be tested into groups of three men each and designate them as Signal Corporal No. 2, Lineman No. 1, and Lineman No. 2.

3. Assemble the signal corporals and give them the following directions:

Lay a circuit from the switchboard to the O. P. at that marker.

4. When circuit has been laid, inspect the circuit (see Scoring) and assemble the signal corporals. Give them the following directions:
Recover the O. P. circuit.
5. Note any irregularities in recovering the circuit. (See Scoring.)

Scoring.

1. Maximum score, 100 points.
2. Score required to pass the test, 80 points.
3. DIRECTIONS FOR SCORING THE LAYING OF A CIRCUIT.

	Points
a. If the circuit is properly connected at initial point	5
b. If the circuit is properly tied in at initial point	5
c. If the circuit is tied in at corners	5
d. If the circuit is placed overhead at proper height at road crossings	10
e. If the circuit is properly tied in at final point	5
f. If the circuit is in working order when job is complete	25
g. If the switchboard operator is notified that the circuit is installed	5

4. DIRECTIONS FOR SCORING THE RECOVERING OF A CIRCUIT.

a. If the switchboard operator is notified that the circuit is to be removed	5
b. If the wire is properly connected to reel	5
c. If the wire is properly wound on reels	5
d. If the wire is on reels tests O. K. when job is complete	20
e. If the report "O. P. circuit picked up" is made	5

INSTRUCTION TEST NO. 14-B (INFORMATION)

Directions.—Below are a number of unfinished statements each followed by several numbered words or phrases, one of which correctly completes the statement. Write the *number* of this word or phrase on the *dotted line* at the right of each statement.

1. The number of men required to lay wire with an artillery reel, exclusive of the drivers, is
(1) five. (2) four. (3) seven. (4) three. ------
2. The reel cart detail is only responsible that the wire
(1) is laid. (2) is laid and tested.
(3) is laid, tested, and tagged.
(4) is laid, tested, tagged, tied in, and connected to the line terminal strip. ------
3. When a circuit has been installed by the reel-cart detail, it is so reported by
(1) Lineman No. 1. (2) Lineman No. 2.
(3) Signal Corporal No. 2. (4) The wireman.
4. When a circuit has been installed by the reel-cart detail, it is so reported to
(1) Lineman No. 2. (2) Lineman No. 3.
(3) Signal Sergeant No. 2 (4) Switchboard operator. ------

5. The number of linemen required to lay wire with the artillery reel is
(1) two. (2) three. (3) four. (4) one. ------

6. When laying wire with a battery reel the gait is regulated by
(1) wheel driver. (2) Lineman No. 2.
(3) Lineman No. 1. (4) lead driver. ------

7. The duties of "wireman" are performed by
(1) Lineman No. 1. (2) Lineman No. 3.
(3) Signal Corporal No. 2. (4) Lineman No. 2. ------

8. The amount of twisted-pair outpost wire that an artillery reel will hold is
(1) 2½ miles. (2) 4 miles.
(3) 8 miles. (4) 1 mile. ------

9. When splicing twisted-pair outpost wire, care must be exercised to make sure that
(1) a Western Union splice is used.
(2) a staggered splice is never used.
(3) a clove hitch is used.
(4) the wires that have the tracer threads are spliced together. ------

10. Whenever a circuit is laid, it should be tested by
(1) Signal Corporal No. 2. (2) Lineman No. 1.
(3) Lineman No. 2. (4) Signal Corporal No. 1. ------

11. When laying two circuits simultaneously, the detail should be increased by
(1) 3 linemen. (2) 2 linemen.
(3) 1 lineman. (4) 1 lineman and 1 signal corporal. ------

12. A circuit should be tied in at the final point by
(1) Lineman No. 1. (2) Signal Corporal No. 2.
(3) Lineman No. 3. (4) Lineman No. 2. ------

TEST STATIONS AND TEST POINTS

Equipment (for each student).

1 test phone, type EE – 5.
I monocord switchboard with cable and terminal strip attached.
1 pair of short leads with Frankel clips attached to ends.
3 terminal strips, type TM – 84.
20 feet of outpost wire.

Information.

Test stations are stations placed along lines for the purpose of making tests and such cross connections as are ordered or necessary. These stations provide means for the temporary patching of lines in case of failure of one or more circuits. A terminal strip is installed at such stations and is cross-connected to the switchboard cable terminal strip without any tearing down or duplication of effort when a central moves in and occupies the position. Test stations are located not only between sections in the wire net but at such other points as are deemed advisable by the chief of the wire section. Such additional points might be determined with reference to their availability as future command posts or with reference to the patching through of damaged circuits.

Test stations are usually known by the name of a nearby town or the locality, but for the sake of clearness a code name may be given to a test station, provided such code name is known throughout the signal command. This code name designates a geographical point and not the detachment which makes or maintains the installation. Every test station is marked with a sign or marker to help messengers and signal communication personnel to find it.

The original installation of a test station consists of one or more terminal strips, type TM – 84. If more than one terminal strip is to be installed, they can be mounted on a board for convenience.

A terminal strip, type TM – 84 consists of a strip of insulating material about a foot long and 3 inches wide, weighing about one-half pound, on which are mounted 10 metal strips with a binding post at either end of each strip.

All circuits passing through the test station are connected to binding posts on the right half of the terminal strip, and are made continuous by means of jumpers connected to the proper binding posts on the left hand. (See Fig. 31.)

The test phone is connected by means of short leads which have clips fastened on one end. Its normal connection is on the circuit

designated as the "Control circuit," but if this circuit is also used for traffic, answers are made only to three short rings of the calling bell. In case of patching through, i. e., temporarily reassigning certain channels, jumpers for making the desired connection are inserted and the loops between the incoming and the corresponding outgoing circuit are cut away.

TO ESTABLISH A TEST STATION

Directions.

1. Proceed to the point on the trunk line where the test station is to be installed. Mount the terminal strip on some nearby object. If no suitable object is convenient, drive a stake or post for this purpose. Loosen all binding posts. If one terminal strip is used, connect

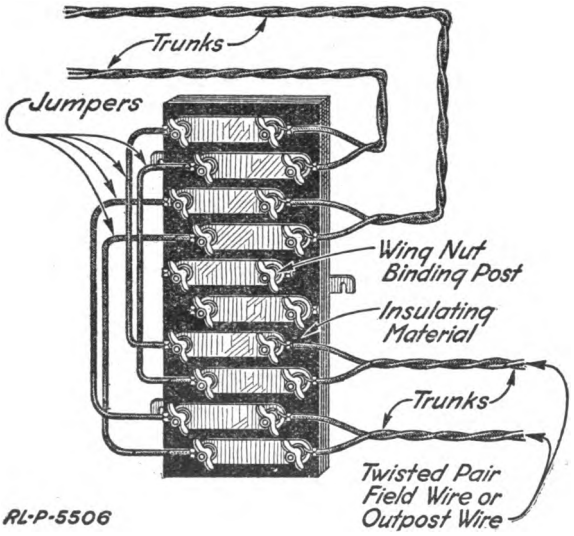

Fig. 31.—Field test station

the No. 1 pair of binding posts on the left side by means of jumpers to the No. 4 pair (numbering from the top). Then connect the No. 2 pair to No. 5 pair. If two terminal strips are used (providing 10 pairs of binding posts), connect No. 1 pair to No. 6 pair and No. 2 pair to No. 7 pair in the same manner as above. (See Fig. 31.) Proceed in a similar manner for three or more terminal strips.

2. Take the lowest-numbered circuit and remove about 2 inches of insulation from the wire which has the tracer thread in it. Make a loop in the bare part of the wire and attach it to the upper right-hand binding post on the terminal strip marked "A." (See Fig. 32.) Remove about 2 inches of insulation from the other wire of the same circuit and attach this to the next lower binding post.

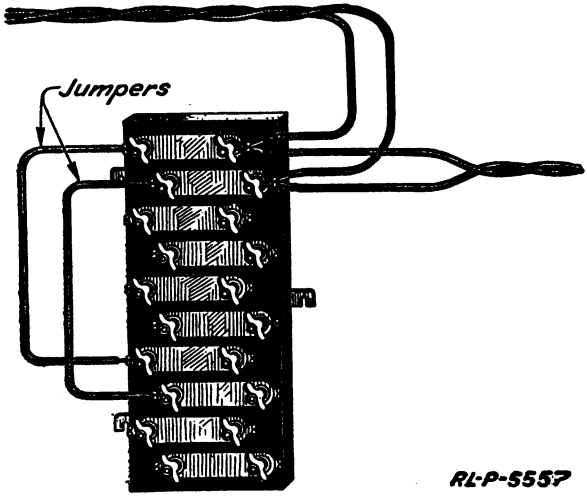

Fig. 32.—Establishing a field test station, first operation

3. Measure off sufficient length of the wire leading forward to reach the pair of binding posts marked "B" (Fig. 32) at the bottom of the terminal strip which has been previously jumpered to the top pair. At this point remove about 2 inches of insulation from the wire which has the tracer thread in it and attach to the top binding post of the pair marked "B." Now remove about 2 inches of insulation from the other wire and attach it to the other binding post. The circuit, though still continuous, is looped into the two pairs of binding posts. (See Fig. 33.)

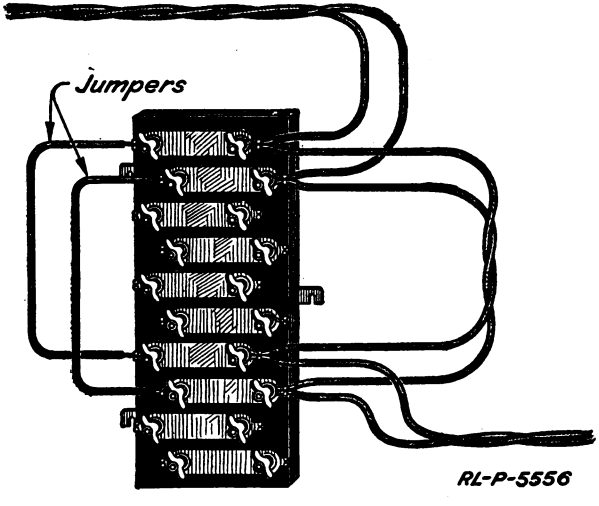

Fig. 33.—Establishing a field test station, second operation

4. Now cut away the loop of the wire between the two pairs of binding posts, marked "C" in Figure 33. Cut the wire off close up to terminal strip.

5. Cut into the test station in a similar manner any other circuits. When all circuits have been cut into the test station, tap in on the "control" circuit, ring, and notify the operator that answers, "This is Lineman Smith establishing VAIL TEST. I will answer to three rings on this circuit. Notify the operator at the other end of this circuit."

6. If the test station is to be cut in during the construction of a line and none of the circuits are in use, cut each circuit and connect the ends into the terminal strip to the proper pairs of binding posts and connect them by means of jumpers on the left hand side.

Questions.

(*1*) *What is the purpose of a test station?*

(*2*) *Where are test stations usually installed?*

(*3*) *Are test stations installed on local lines?*

(*4*) *Are test stations installed on trunks in the vicinity of the switch board?*

(*5*) *What personnel remains on duty at a test station?*

(*6*) *Would it be desirable to have a switchboard operator on duty at a test station?*

(*7*) *How does an operator at a central get in communication with a man at a test station on a trunk which terminates at his (the operator's) switchboard?*

(*8*) *What would be the result if the wire were cut before it was connected into the two pairs of binding posts?*

(*9*) *At what time, during the construction of a line or later, is a test station usually installed?*

(*10*) *What might be the reason for installing a test station between two centrals that had been operating for some time without it?*

(*11*) *What can be done at test stations besides testing?*

(*12*) *How is a test station usually designated?*

TO CONVERT A TEST STATION INTO A CENTRAL

Information.

When a test station has been converted into a central, the switchboard operator calls on all trunks and notifies the centrals at the other end of the circuits of the change.

Directions.

7. Mount the switchboard in a position to be operated at a point near enough to the test station so that the cable terminal strip can be mounted just to the left of the test station. Mount the cable terminal strip about 10 inches to the left of the test station.

8. Cut enough jumper wire to make all connections and remove the insulation from the ends for connecting.

9. Place a temporary connection on the right-hand binding posts of the lowest-numbered circuit, jumpering the circuit through the test station on the right-hand side of the terminal strip by means of short leads with Frankel clips attached. (See Fig. 34.) Remove the

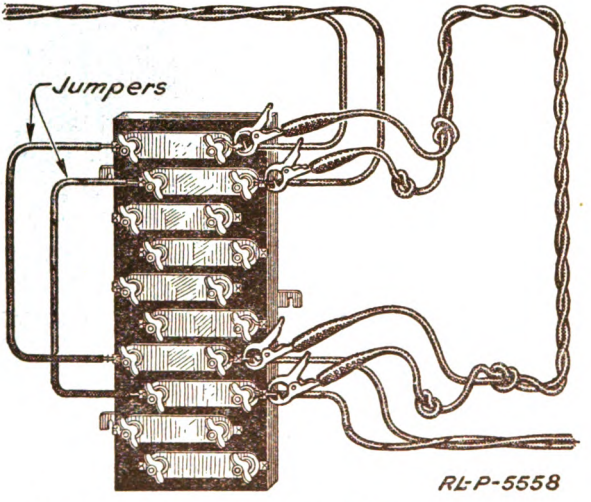

Fig. 34.—Use of Frankel clip leads in converting a test station into a central

jumpers on the left-hand side of the terminal strip and connect both of the circuits to the switchboard cable terminal strip. Then remove the temporary connection from the right-hand side of the terminal strip.

10. Proceed in the same manner to connect all other circuits to the switchboard in the same manner except those which are to be left connected through at the line terminal strip.

Questions.

(*13*) *Is it easier to make an original installation of a switchboard or to convert a test station into a central?*

(*14*) *Where are test stations usually found?*

(*15*) *How can circuits at a test station be identified without tapping in on them and calling?*

(*16*) *After a test station has been converted into a central, can the maintenance detail at that point be dispensed with?*

TO CONVERT A CENTRAL INTO A TEST STATION

Information.

It is a simpler process to convert a test station into a central than it is to install a central at a point on a line where there is no test station.

When a unit closes a central and moves forward, some unit advancing from the rear is apt to use the same location for their central. Therefore when a central is closed it is usually converted into a test station.

Even though there is little possibility that some other unit will use the location for a central, it is often the case that it will be desirable to establish a test station at that point on the line.

Before closing out a central the operator will call the other centrals with which he has connections, and notify them that the central will be closed and converted into a test station. He will give the connections to be made by giving the circuit number of circuits to be connected through, such as "202 to 302."

When all the centrals have been notified, the operator will notify the lineman who will connect through at the line terminal strip, one circuit at a time.

Directions.

11. Make sure that the circuits to be cut through are not in use.

12. Disconnect the lowest numbered circuit from the switchboard by removing the jumper wires between the line and cable terminal strip.

13. Pick out the circuit to which this first circuit is to be connected through, and remove the jumper connections on the cable terminal strip. Then connect through by connecting the ends just removed from the cable terminal strip to the left hand binding posts of circuit first disconnected. If these jumpers are not long enough, substitute longer ones.

14. The circuits could be cut through while they are connected together on the switchboard and still in use as follows: Make a tem-

porary connection on the right-hand binding posts of the line terminal strips by means of short wires with Frankel clips at either end. Then cut the circuit through and remove the temporary connection. This method will, however, seldom be necessary.

Questions.

(17) *Why is a central usually converted into a test station when it is closed out?*

(18) *Of what does a test station consist?*

(19) *What points should be considered when deciding upon a location for a test station?*

(20) *What are the short wires called which are used to connect through circuits which terminate at a test station?*

(21) *How may a lineman on duty at a test station be reached?*

(22) *Why is it necessary to notify centrals at the other end of trunks before converting a central into a test station?*

(23) *Is it easier to convert a central into a test station or to close out entirely, splicing through the circuit?*

(24) *What type of telephone is best suited for use at a test station?*

TO REMOVE A TEST STATION

Information.

When a test station is abandoned, it is the usual practice to leave the terminal strip connected. However, it may happen that, due to shortage of terminal strips, it is necessary to remove the terminal strip and splice the circuit through.

Before removing a test station the lineman calls on each trunk and notifies the operator who answers that the test station is to be removed and that the lines are to be spliced through. He asks the operator who answers to notify the operator at the other end of the circuit. When he has called on all circuits, he proceeds to cut out the test station.

Directions.

15. Call on the lowest-numbered circuit and notify the operator that the test station is to be cut out.

16. Pick out the wire having the tracer thread in it on the right-hand side of the terminal strip on a circuit which is connected through

by jumpers on the left-hand side. For the purpose of making a splice, remove about 4 inches of insulation from each wire at a point near the terminal strip. Listen in on the circuit, and when it is not in use cut the wires off leading to the terminal strip and splice the wire through. (See Fig. 35.) Then splice through the two wires which have no tracer thread in the same manner.

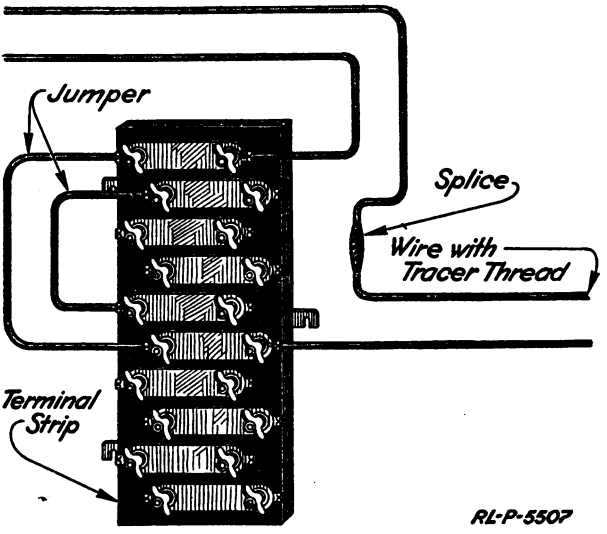

Fig. 35.—Removing a test station, first operation

17. Proceed in the same manner to splice through all the other circuits.

18. When all circuits have been spliced through, take down the terminal strip.

Questions.

(*25*) *When would it be desirable to close out a test station?*

(*26*) *What equipment is needed to close out a test station?*

(*27*) *How many men are required?*

(*28*) *Who determines where test stations are to be installed when lines are being constructed?*

(*29*) *Would it be advisable to install a test station on a single circuit if a maintenance detail were to be stationed at some point on the circuit?*

TO ESTABLISH A TEST POINT

Information.

Test points are intermediate points located along a line with a view to localizing and repairing line trouble rapidly. They are sometimes placed no more than a quarter of a mile apart. At a test point there are a few men with a telephone. Where several test points are located in a limited area, a receiver at each point is bridged across one of the circuits by the use of Frankel clips. The telephone ringer may be used by a very few points at a time because of its low resistance. Test points are designated "Test Point A," "Test Point B," etc., from rear to front. The chief of construction work will ordinarily assign a series of test letters to each section. Supervisory personnel at intermediate test points and test stations habitually keep their test phones on the lowest-numbered circuits or such other circuits as may be designated as the control circuit. In case this circuit has been assigned to traffic duty they answer only to calls of three short rings.

Directions.

18. Proceed to the point on the trunk where it is desired to establish a test point. Tap in on the lowest-numbered circuit with the test phone by means of the leads which have Frankel clips attached.

19. Call on the circuit and notify the operator that answers, "This is Lineman Smith establishing test point A at ..... I will answer to three rings on this circuit. Notify operator at the other end of this circuit."

20. Tap in on any other circuits and notify the operators in the same manner, giving the number of the circuit on which you will remain.

21. When an operator on all circuits has been notified, tap in again on the lowest-numbered circuit and wait for directions.

22. If the transmission is very poor on the lowest-numbered circuit and tapping in with the test phone impairs the transmission on the circuit, connect a receiver across the circuit and listen in for directions.

Questions.

(*30*) *What is a test point?*

(*31*) *How many men are stationed at a test point?*

(*32*) *What equipment is required to establish a test point?*

(*33*) *How does a test point differ from a test station?*

(*34*) *Can a test point be converted into a central?*

SUGGESTIONS FOR THE INSTRUCTOR

1. If sufficient equipment is available furnish one set for each student; otherwise divide the class into groups and provide one set of equipment for each group.

2. Install in advance a trunk line consisting of two circuits. If this is not practicable, have the class install the line before taking up the Unit Operation. The line should have about 100 feet of length for each student or group of students and have a monocord switchboard central installed at each end. Have an assistant stationed at each of the terminal centrals to answer calls. Tag the line at each 100-foot section with tags marked "A," "B," "C," etc.

3. If it is not practicable to take out a switchboard for each student, a terminal strip used to represent the cable terminal strip may be mounted and cross connected. The circuits may be jumpered through to represent their being connected through a switchboard. This is apt, however, to give some men the idea that two terminal strips, mounted side by side, are used at a test station.

4. Explain to the class that the installing of the switchboard and cross connecting from the switchboard terminal strip to the line terminal strip is usually done by the operating detail of the wire section. However, when converting a test station into a central or vice versa, the construction detail works in connection with the operating detail in order to do the work in the least time without placing the circuits out of service. Explain that in this Unit Operation the lineman is required to do all the work.

5. Direct that, in this Unit Operation, when a test station is converted into a central connections must be made on the switchboard to switch the circuits through before the switchboard is connected. The reason for requiring this is, so that any reports made by linemen will be answered by the assistants at the terminal switchboards.

6. Assign each student or group of students to a point on the line; the first student or group to point A, the second to point B, etc. Give them orders as follows, giving them the orders *b* when they have satisfactorily completed *a*, and following with the orders *c* when they have satisfactorily completed *b*, etc.:

a. Establish a test station.
b. Convert the test station into a central.
c. Convert the central into a test station.
d. Remove the test station.
e. Establish a test point.

7. In case the students have been divided into groups, repeat the Unit Operation until each man has had an opportunity to perform all the operations covered in the Unit Operation.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 15-A (PERFORMANCE)

Equipment (for each student).

2 terminal strips, type T M – 84.
2 50-foot lengths of twisted-pair wire.
1 5-foot length of twisted-pair wire with Frankel clips attached.
1 type EE – 5 telephone.

Procedure.

1. Give the following directions to the students, in the order indicated:

a. Lay out the two 50-foot lengths of twisted-pair wire side by side, straight on the ground so that their center will be near a post, tree, or pole. Assume that these are circuits.

b. Install a test station at the center of the circuits. Communication must not be interrupted over the assumed circuits.

c. Assuming that your second terminal strip is the terminal strip of a switchboard, install telephone central without interrupting service over circuit.

d. Replace the telephone central by a test station without interrupting service over circuits.

e. Remove the test station.

f. Establish a test point without interruption of service.

Note to instructor.—Note the method used by the student and the time required by him to perform each assigned task.

To determine whether or not communication is being interrupted, the following method is suggested: Connect a battery and buzzer in series to one end of the circuit and short the other end of the circuit. If communication is interrupted, the buzzer will stop sounding.

Scoring.

1. Maximum score, 45 points.
2. Score required to pass the test, 35 points.
3. ESTABLISHING A TEST STATION.

	Points
a. If the test station is established without interruption to communication within 5 minutes	10

4. CONVERTING A TEST STATION INTO A CENTRAL.

a. If the test station is converted into a central without interruption to communication within 5 minutes	10

5. CONVERTING A CENTRAL INTO A TEST STATION.

a. If the central is converted into a test station without interruption to communication within 5 minutes	10

6. REMOVING A TEST STATION.

a If test station is removed within 3 minutes and student listens in to see if he is interrupting communication	10

7. ESTABLISHING A TEST POINT.

a. If test point is established correctly within 3 minutes	5

No partial scores allowed.

INSTRUCTION TEST NO. 15–B (INFORMATION)

Directions.—Below are a number of unfinished statements each followed by several numbered words or phrases, one of which correctly completes the statement. Write the *number* of this word or phrase on the short *dotted line* at the right of each statement.

1. Test stations are established on
   (1) local circuits. (2) field lines only.
   (3) in forward areas only. (4) trunk lines.
   (5) at centrals. ------
2. Test stations on field lines are arranged so as to be quickly converted into
   (1) message centers.
   (2) centrals. (3) observation posts.
   (4) trunk circuits. (5) repeating stations. ------
3. The original installation of a field test station consists of one or more
   (1) switchboards. (2) repeaters. (3) terminal strips.
   (4) subscribers' telephones. (5) testing bridges. ------
4. If the control cirucit for a test station is also used for regular conversations, the lineman on duty at the test station
   (1) answers to three rings on the control circuit.
   (2) answers all calls on the control circuit.
   (3) listens in on all circuits.
   (4) must be given orders by runner.
   (5) calls periodically for orders. ------
5. The line wires come into a monocord switchboard
   (1) direct. (2) through the operator's set.
   (3) through a cable. (4) through a test station.
   (5) through a test set. ------
6. The object on which the line wires terminate at a monocord switchboard central is called a
   (1) test frame. (2) terminal strip. (3) jumper.
   (4) cable. (5) test station. ------
7. Two wires connecting two switchboards together forming a single channel for telephone conversation is called
   (1) a trunk circuit. (2) a local circuit.
   (3) local line. (4) a switchboard circuit.
   (5) a through circuit. ------
8. A single cuircit or two or more circuits laid along the same route is called a
   (1) local. (2) subscriber's circuit. (3) wire lead.
   (4) wire line. (5) wire circuit. ------

9. In addition to making tests the lineman at a test station can

(1) connect subscribers. (2) switch calls.
(3) repeat conversations. (4) supervise calls.
(5) patch circuits during trouble. ------

10. The short wires which are used to connect circuits through, which terminate at a test station are called

(1) jumpers. (2) connectors. (3) lead in wires.
(4) through leads. (5) patches. ------

11. The type of telephone that is best suited for use at a field test station is a

(1) universal test set. (2) type EE – 5 telephone.
(3) type EE – 4 telephone. (4) camp telephone.
(5) a buzzerphone. ------

12. A test station is removed when

(1) a central closes out. (2) a unit moves forward.
(3) a unit has no further use for it.
(4) when there is no further use for it and the terminal strip is needed for use elsewhere.
(5) trouble has been cleared. ------

13. A few linemen stationed out on a line with a telephone cut in on a circuit, comprise

(1) a test station.
(2) a trouble post. (3) a test point.
(4) a linemen's post. (5) an intermediate post. ------

14. The number of terminal strips required to establish a test station on a 4-circuit trunk line is

(1) one. (2) four. (3) three. (4) five. (5) two. ------

LINE ROUTE MAPS AND CIRCUIT DIAGRAMS

Equipment.

Pencils and paper.

Information.

It is desirable when installing a telephone system in the field to have a line route map and a circuit diagram. A line route map is an ordinary map or tracing of a map on which the following data is shown by conventional signs:

a. Location of various headquarters.

b. Location of switching centrals and such test stations as the unit signal officer deems advisable to prescribe.

c. Routes of trunk lines already laid or to be laid.

d. The number of circuits in each trunk line.

An example of a line route map is shown in Figure 36. This shows a regiment with one circuit forward to its switching central which has one circuit forward to each battalion.

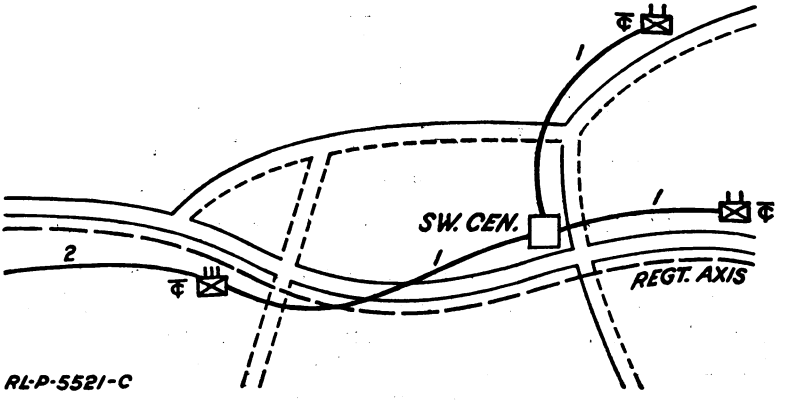

Fig. 36.—Regimental line route map

On this map the conventional signs indicate which is the regiment and which are the battalions. The switching central is indicated by a small square with the letters SW CEN. The numbers indicate the number of circuits along the route.

It is necessary for the wire section, when installing a telephone system or part of a telephone system in the field, to know what actual connections of circuits are made at the various centrals and test stations. In order to locate and trace circuits properly when clearing trouble and changing connections, the circuits must be marked according to some definite system. For these reasons the

circuit diagrams are made and all members of wire sections must know how to read them.

The circuit diagram is a conventional or schematic diagram showing individual circuits, the actual connections at the various centrals and test stations, the circuit numbers assigned to each circuit, and the telephone code names of the centrals. (See Fig. 37.)

To avoid confusion the divisional axis is ordinarily divided into sections. A section is of such length that it can be assigned as a task for a construction party with a view to the same party remaining in charge of maintenance of their section. A section begins and terminates at a switchboard or test station. A section usually consists of the area between a command post and the next superior or subordinate command post. The sections are numbered from rear to front in serial order, "Section zero," "Section one," etc. The circuits within each section will bear numbers, the hundreds corresponding to that section; thus a circuit in section two might be given the number "No. 209" and the same circuit continued in section three "No. 309," and so on.

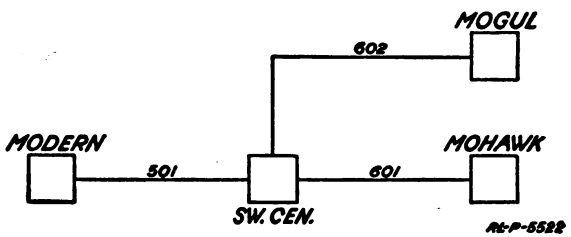

Fig. 37.—Regimental circuit diagram with a switching central

Thus for a lineman to make a report or to give a direction in regard to a trunk circuit, he need only say, for example, "Circuit No. 105." This means one particular circuit and no other.

Forward units obtain the information necessary to number their circuits correctly from the circuit diagram issued by the division signal officer. When there is no circuit diagram available, then the division signal officer may allot each of the brigades a block of numbers from which each brigade may allot a smaller block to each regiment and so on. In the event this latter scheme cannot be carried out, then forward units should tag their trunks with the name of the unit to which each trunk runs, as, for example, "1st Brig.," and later write the proper number on the tags.

A circuit diagram of the regimental net for which the line route map is shown in Figure 36 is shown in Figure 37.

If the regiment were to lay another circuit down to the switching central, a direct circuit to each battalion could be provided and the

switching central could be changed to a test station. The circuit diagram might then be as shown in Fig. 38. Note that the circuits are shown cut straight through at the test station.

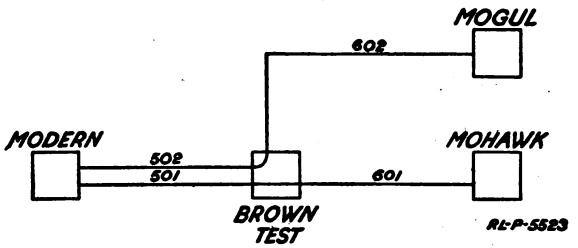

Fig. 38.—Regimental circuit diagram with a test station

Directions.

1. *a.* The command post of the 1st Infantry regiment is located at the road junction 2. (See map in Fig. 39.) The axis of signal communication of this regiment has been designated as "road junction 2, crossroad 4; stream crossing 6, crossroad 8." The command post of the 1st Battalion is at road junction 3, and the 2d

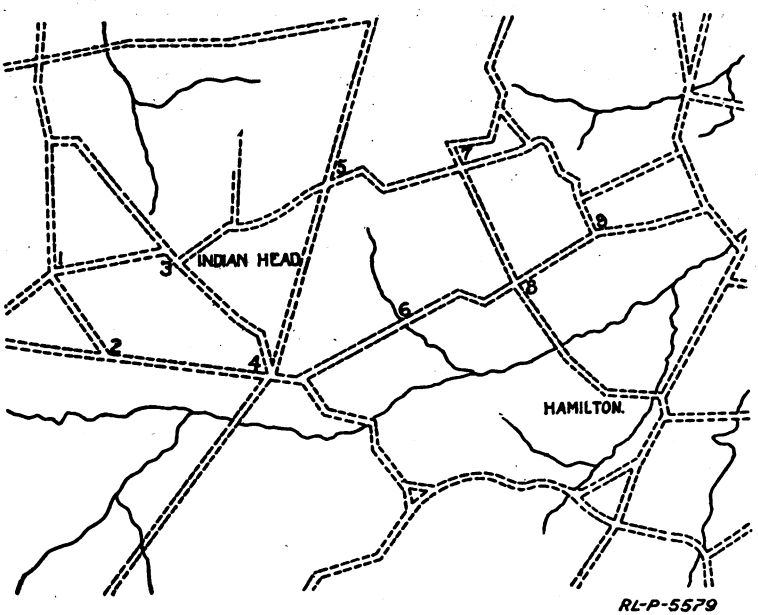

Fig. 39.—Sample map

Battalion at crossroad 4. The regiment has laid one circuit from its command post to the 2d Battalion and one circuit from the 2d Battalion to the 1st Battalion.

b. Make a sketch showing a line route map of the above wire net.

c. Make a circuit diagram of the above wire net.

Questions.

(1) *What is a switching central?*

(2) *Is the central at crossroad 4 in the above situation a switching central?*

(3) *If the regiment wants to call the 1st Battalion, how is it done?*

(4) *What would be the simplest way to arrange for a direct circuit to each battalion?*

(5) *Could a direct circuit to each battalion be arranged without increasing the number of maintenance personnel out on the lines?*

(6) *Would it be advisable to run a circuit by the most direct route from the regiment to the 1st Battalion? Explain why.*

Directions.

2. *a.* The command posts of the two battalions move forward to crossroad 5 and stream crossing 6. They lay wire forward to their new command posts in advance of the move so that there will be communication installed when the command posts move.

b. Make a sketch showing a line route map of the net and designate what must be established by the regiment at the old location of the command post of the 2d Battalion.

c. Make a circuit diagram of the net.

Questions.

(7) *In the above situation what would normally be established at crossroads 4?*

(8) *Who would be responsible for the installation and operation of whatever was installed at crossroads 4?*

(9) *Why is it more economical in personnel to have one unit to act as a switching central for another unit than it is to have a separate switching central?*

(10) *What is objectional about the layout of the net?*

(11) *Provided that sufficient time, men, and material were available how could the above layout be improved?*

Directions.

3. *a.* The regiment maintains its lines forward to battalion. Therefore the regimental communication officer finds he has a long line to maintain to the 1st Battalion and decides he will change it and

issues a line route map of the net as he wishes it to be. He does not want to maintain any switching centrals but decides it is a good idea to have a test station on the line.

b. Make a line route map of the net as you would have it when rearranged to cover the above points.

c. Make the circuit diagram.

Questions.

(12) What additional wire is it necessary to lay in order to permit changing a switching central at crossroad 4 into a test station?

(13) Would such a change economize on personnel?

(14) Would such a change cut down the time required to put calls through from regiment to battalion?

(15) How does a line route map show at a glance that it is desirable to relay the circuit from crossroad 4 to crossroad 5?

Directions.

4. *a.* The two battalions move forward to the crossroads 7 and 8 and install their lines to their new command posts, previous to the move. The regiment moves forward and opens at crossroads 4, and brigade moves up from the rear and occupies the location at road junction 2 which has been evacuated by the regiment. The communication officer of the regiment does not desire to maintain two long separate circuits one of which is not on the axis of signal communication. He desires however to have a direct circuit to each battalion. The brigade communications officer at the direction of the brigade commander runs a direct circuit to the brigade observation post which has been established near crossroad 9. This circuit follows the brigade axis which is the same as the right regiment the entire distance.

b. Make a line route map showing the wire net after the above installations have been completed.

c. Make a circuit diagram of the above.

Questions.

(16) What way would require the least wire to establish communication with the 1st Battalion, that would permit taking out the circuit from the regiment to the 1st Battalion, which passes through crossroads 5?

(17) How could the brigade obtain communication with the O. P. without laying a direct circuit all the way out to it?

(18) Should a direct circuit from the brigade to its observation post follow the main axis? Why?

(19) Would a line route map be of assistance to a lineman who was not familiar with the circuits and who was sent out on trouble?

Directions.

5. *a.* Assume that the 1st Division is to attack on a two-brigade front and that the division signal officer, from data furnished by the communications officer of subordinate units, has completed the line route map shown in Fig. 40. The following information is available:

(1) The section of the corps axis from corps headquarters to Vail test has been numbered "Section seven."

(2) Each brigade has a direct circuit to each of its regiments.

(3) The right brigade has a direct circuit to its observation point.

(4) The division has a direct circuit to its observation post which is located at the same point as the right brigade observation point.

(5) The Artillery Brigade has a direct circuit to each of its regiments.

b. Make a circuit diagram of the division wire net, using the following telephone code:

Corps	EAGLE.
1st Division	MAGIC.
1st Brigade	MOTIVE.
2d Brigade	MOBILE.
1st F. A. brigade	METAL.
1st Infantry	MUSTARD.
2d Infantry	MUSCLE.
3rd Infantry	MURMUR.
4th Infantry	MONARCH.
1st Field Artillery	MODERN.
2d Field Artillery	MINUTE.

Questions.

(*20*) *Why is it necessary for a construction party to have a line route map?*

(*21*) *In what respect does this map fail to give all the information necessary for the construction party?*

(*22*) *With what number would all circuits in "Section three" of a division telephone system begin?*

(*23*) *How are lateral circuits numbered?*

(*24*) *Do test stations come between sections?*

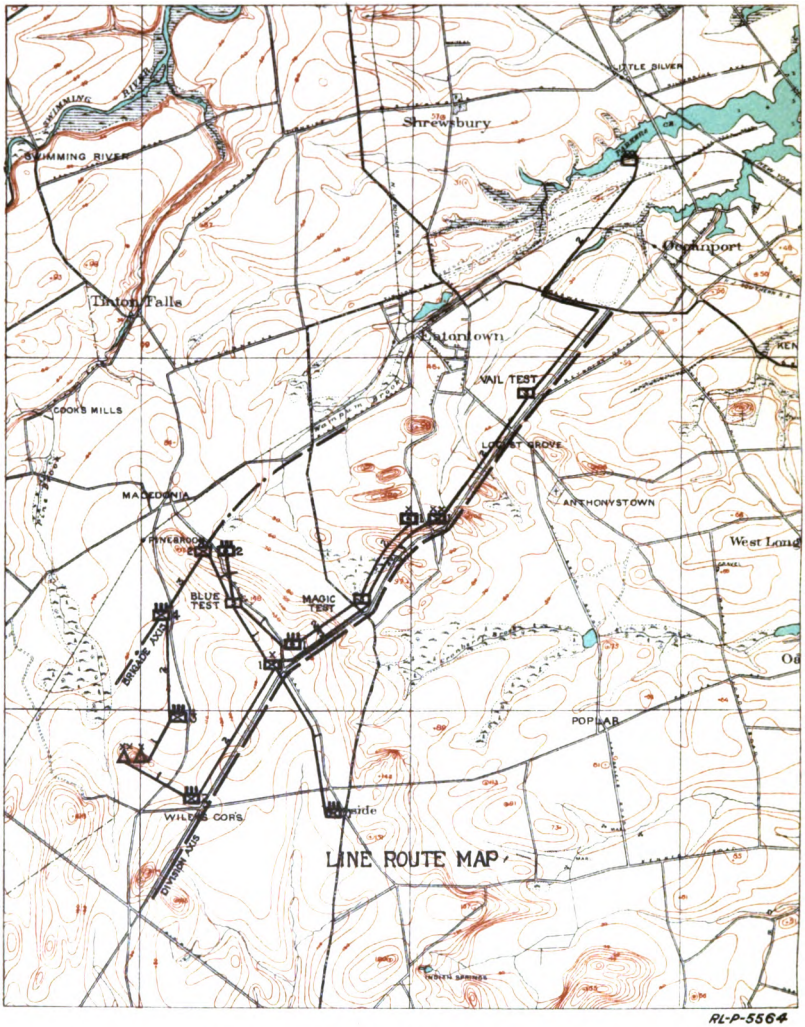

FIG. 40.—DIVISION LINE ROUTE MAP

SUGGESTIONS FOR THE INSTRUCTOR

1. This Unit Operation should be conducted indoors where each student can have an improvised drawing table.

2. *a.* Approved solutions for the problems contained in the Students Manual are as follows:

Problem, Par. 1 *b*—Fig. 4 – IG.
Problem, Par. 1 *c*—Fig. 5 – IG.
Problem, Par. 2 *b*—Fig. 6 – IG.
Problem, Par. 2 *c*—Fig. 7 – IG.
Problem, Par. 3 *b*—Fig. 8 – IG.
Problem, Par. 3 *c*—Fig. 9 – IG.
Problem, Par. 4 *b*—Fig. 10 – IG.
Problem, Par. 4 *c*—Fig. 11 – IG.
Problem, Par. 5 *b*—Fig. 12 – IG.

b. The code names and numbers on the circuit diagrams in Figs. 5 – IG, 7 – IG, 9 – IG, and 11 – IG have been assumed and would therefore be different in the diagrams prepared by the student.

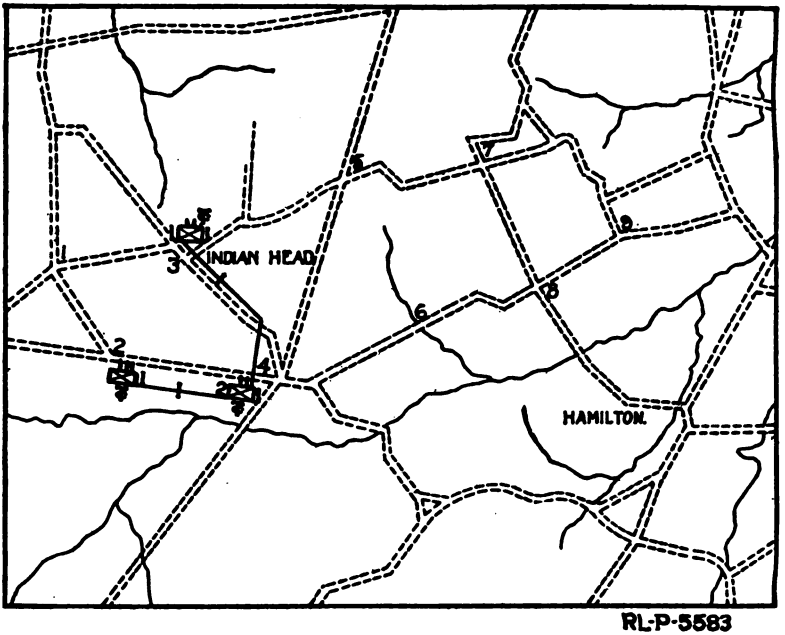

Fig. 4 – IG.—Line route map, approved solution, Problem, Par. 1 b

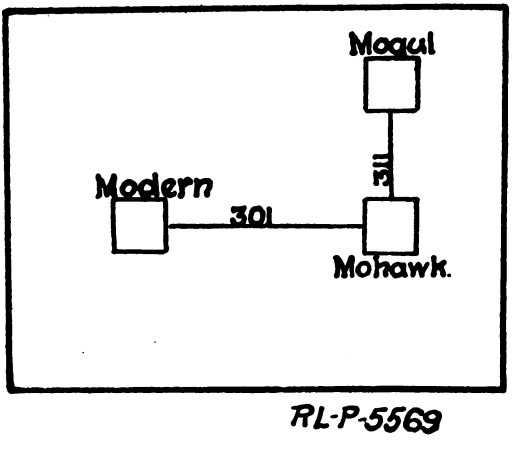

Fig. 5 – IG.—Circuit diagram, approved solution, Problem, Par. 1 c

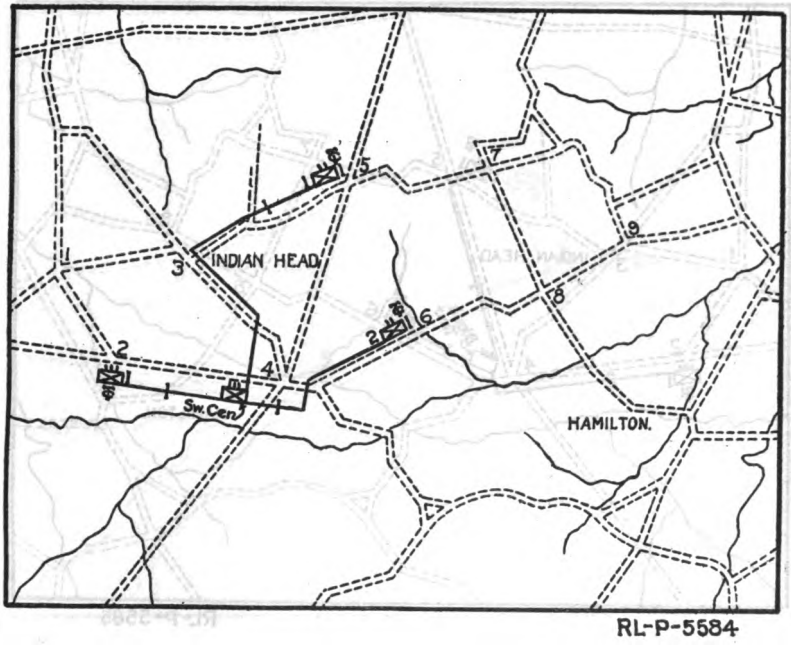

Fig. 6 – IG.—Line route map, approved solution, Problem, Par. 2 b

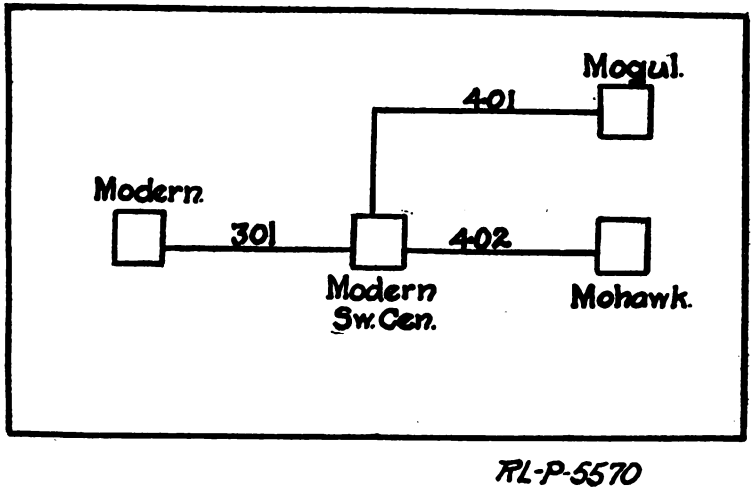

Fig. 7 – IG.—Circuit diagram, approved solution, Problem, Par. 2 c

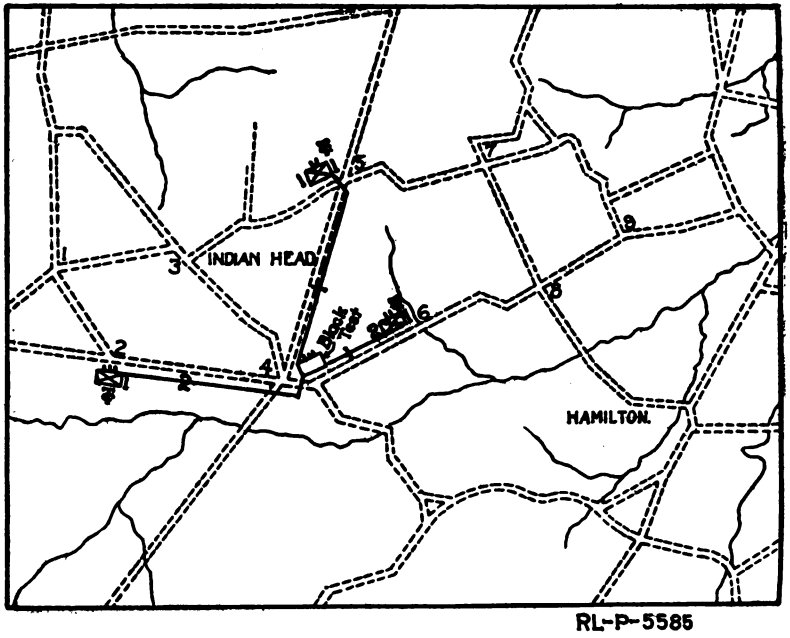

Fig. 8 – IG.—Line route, map approved solution, Problem, Par. 3 b

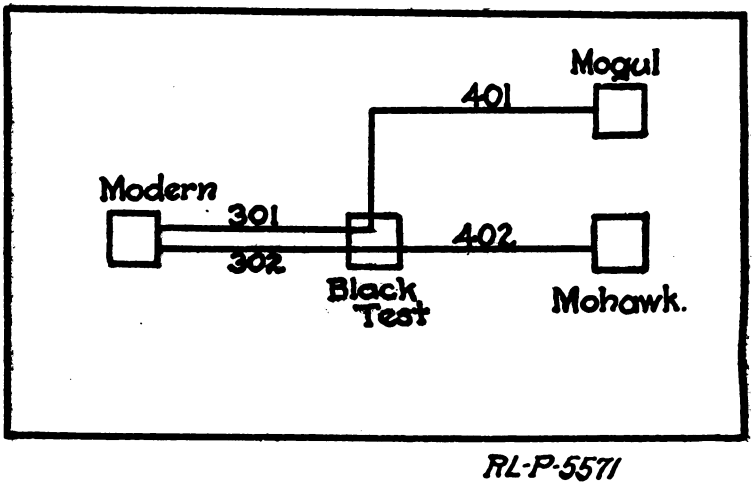

Fig. 9 – IG.—Circuit diagram, approved solution, Problem, Par. 3 c

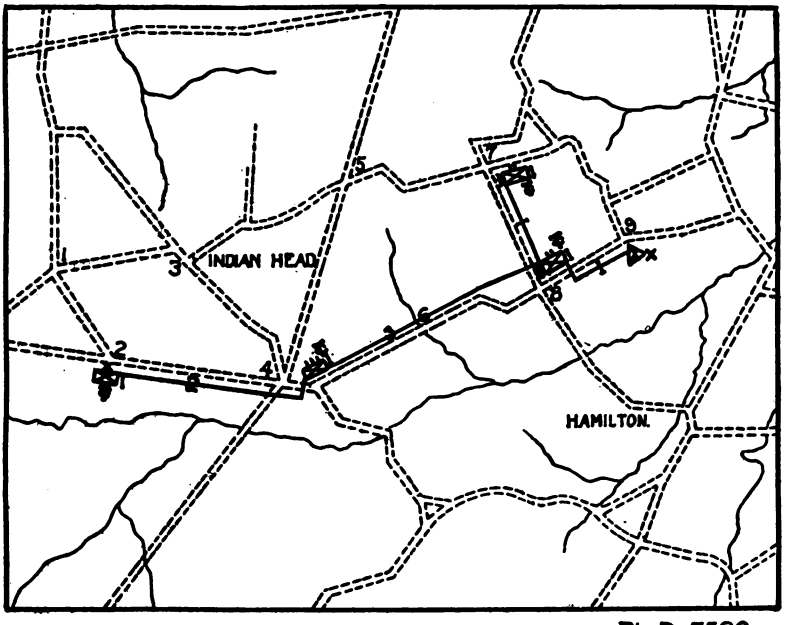

Fig. 10 – IG.—Line route map, approved solution, Problem, Par. 4 b

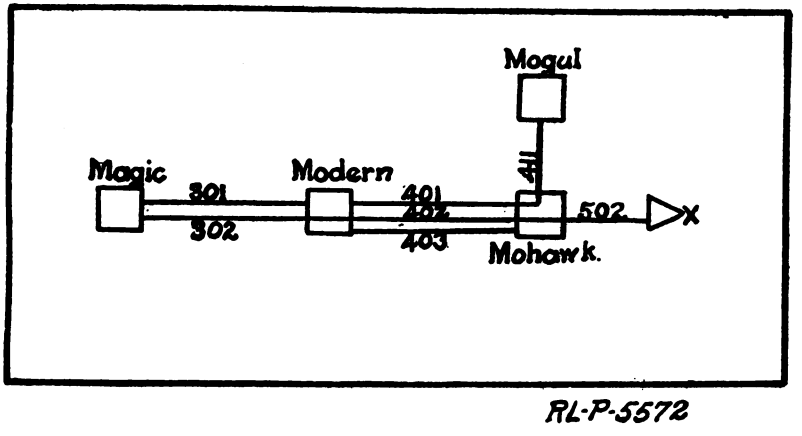

Fig. 11 – IG.—Circuit diagram, approved solution, Problem, Par. 4 c

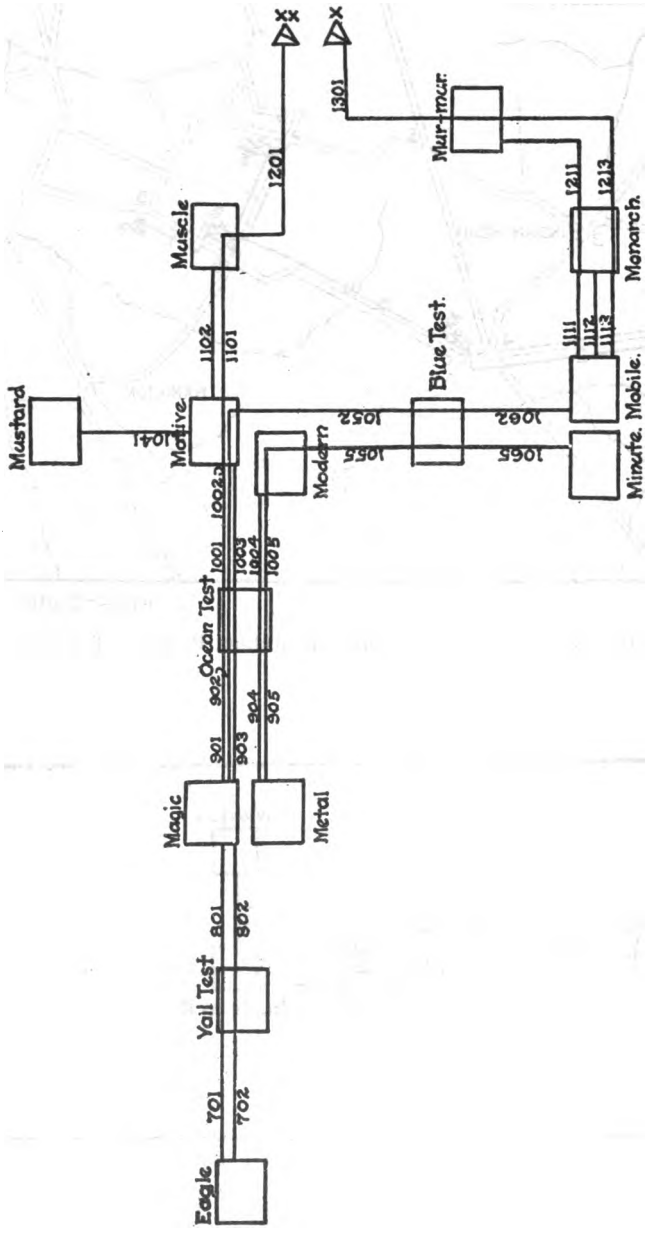

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Fig. 12 – IG.—Division circuit diagram, approved solution, Problem, Par. 6 b

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 16–A (PERFORMANCE)

Equipment.

Pencil and blank paper.

Procedure.

PART I. (Time allowance, 15 minutes)

1. Prepare in advance a copy of Fig. 13 – IG, on a blackboard, visible to all the class. In the absence of a blackboard, prepare copies of Fig. 13 – IG to be given to each student.

2. Give the following instruction to all students:

The 2d Division is to attack on a two-brigade front, the locations of the various units are as shown on Fig. 13 – IG. Complete the line route map from the following data:

a. Division has two direct circuits to its switching central.
b. Division has direct circuits from its switching central to its O. P. and to each Infantry brigade.
c. Each brigade has direct circuits to its regiments.

PART II. (Time allowance, 20 minutes)

3. Complete the line route map of Part I, as shown in Fig. 14 – IG. In the absence of a blackboard, prepare copies of Fig. 14 – IG to be given each student.

4. Give the following instruction to all students:

Prepare a "Circuit Diagram" from this line route map. The section from Corps Switchboard to Brest Test is to be numbered "Section 3."

a. The code names of the various units are as follows:

Corps	EAGLE.
1st Division	MAGIC.
1st Brigade	MOTIVE.
2d Brigade	MOBILE.
1st F. A. Brigade	METAL.
1st Infantry	MUSTARD.
2d Infantry	MUSCLE.
3d Infantry	MURMUR.
4th Infantry	MONARCH.
1st F. A	MODERN.
2d F. A	MINUTE.

b. Division has two direct circuits to its switching central, and direct circuits from its switching central to its O. P. and each Infantry Brigade.

c. Brigades have direct circuits to their regiments.

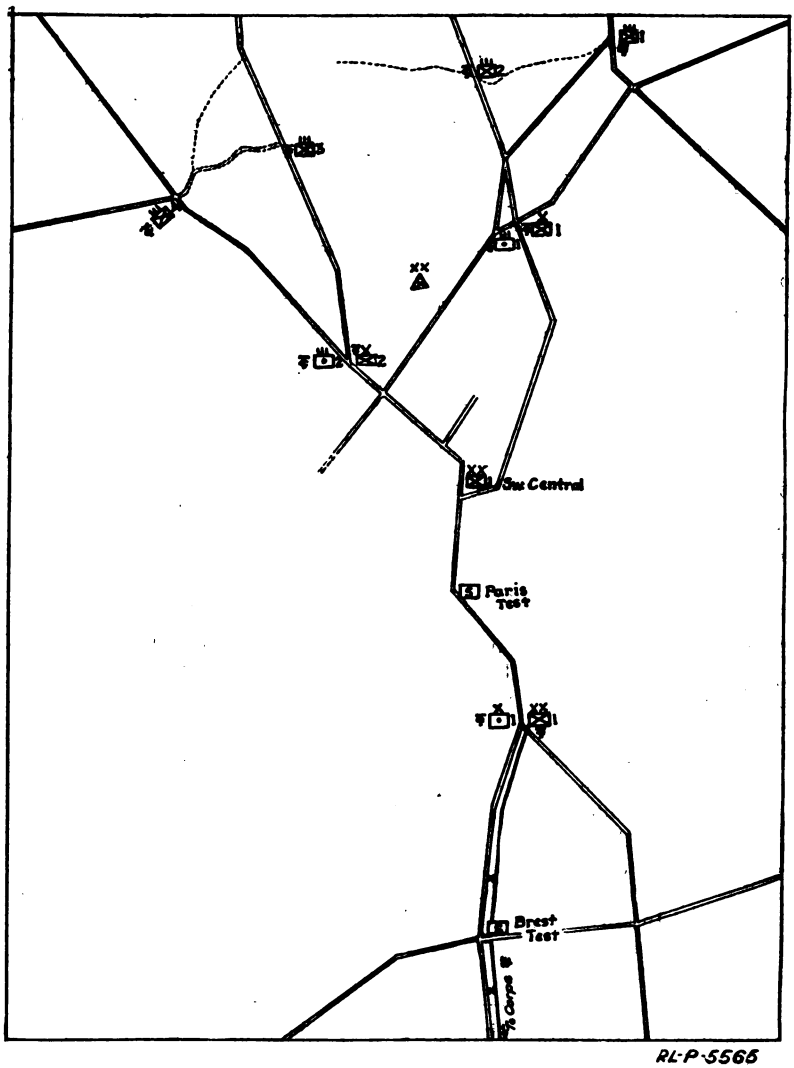

Fig. 13 – IG.—Skeleton line route map, Test No. 16–A

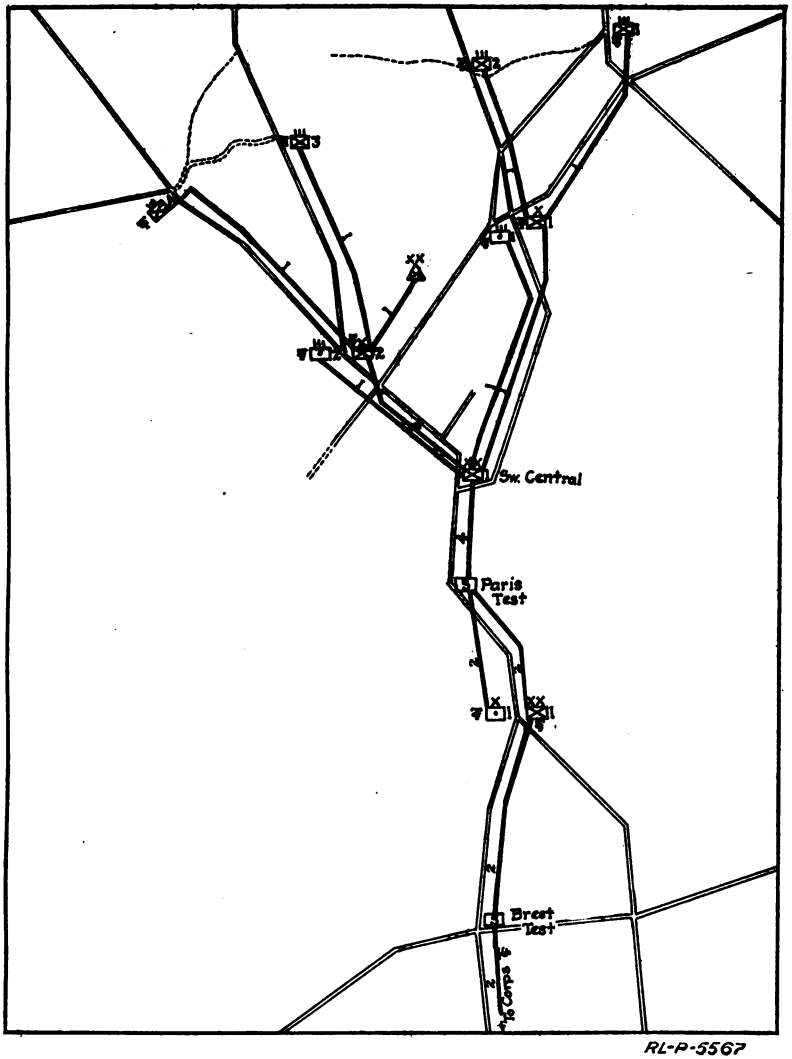

Fig. 14 – IG.—Line route map, approved solution, Test No. 16–A

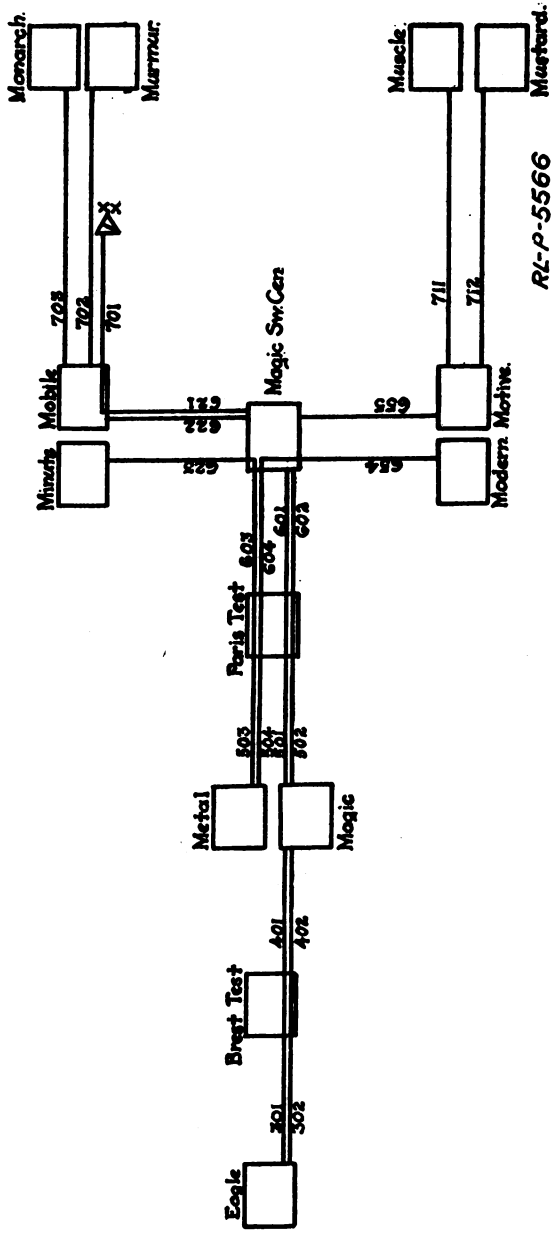

Fig. 15 – IG.—Circuit diagram, approved solution, Test No. 16-A

Scoring.

1. The maximum score for this test is:
   a. Part I, 24 points.
   b. Part II, 40 points.
2. The score required to pass the test is:
   a. Part I, 18 points.
   b. Part II, 30 points.

3. DIRECTIONS FOR SCORING PART I. (See Fig. 14–IG for an approved solution.)

	Points
a. If line route map is completed	24
b. For each of the following errors or omissions deduct points as follows:	
(1) Omitting a circuit	2
(2) Error in location of a circuit	2
(3) Erroneous numeral, representing number of circuits	1
(4) Omitting numeral, representing number of circuits	1

4. DIRECTIONS FOR SCORING PART II. (See Fig. 15–IG for an approved solution.)

	Points
a. If circuit diagram is completed	40
b. For each of the following errors or omissions deduct points as follows:	
(1) Omission of a circuit	2
(2) Erroneous circuit	2
(3) Circuit numbered incorrectly	1
(4) Omission of the number on circuit	1
(5) Failure to show circuits cut through at test stations	1
(6) Failure to show circuits 603 and 604 cut through Magic Switching Central	1
(7) Failure to show circuit 621 cut through Mobile	1

INSTRUCTION TEST No. 16–B (INFORMATION)

Directions.—Below are a number of sentences from which certain words have been omitted. Each word which has been omitted has been indicated by a short dotted line, inclosed in a parentheses, thus (----------). Fill in this blank space with a word which will make good sense and at the same time be technically correct.

1. A line route map shows the following data:
   a. Location of various (----------).
   b. Location of switching centrals and such (----------) (----------) as the unit signal officer deems advisable to prescribe.
   c. (----------) of trunk lines already laid or which are to be laid.
   d. The (----------) of circuits in each trunk line.

2. A circuit diagram shows the following data:
   a. The actual (_____) at the various centrals and test stations.
   b. The (_____) assigned to each circuit.
   c. The (_____) (_____) of the centrals.
   d. The individual (_____).

3. To avoid confusion the (_____) (_____) is ordinarily divided into (_____).

4. A section begins and terminates at a (_____) or (_____) (_____).

5. A through circuit which in Section Two is numbered 202 would be numbered (_____) in Section Three.

6. If "Section Three" were the section of the divisional axis between division and brigade, the section between brigade and regiment would be "Section (_____)."

7. If there were two circuits from a brigade to its left regiment, numbered 301 and 302, a circuit from that brigade to the brigade on its right could be numbered (_____).

8. Circuits are tagged with a number to correspond with the number on the (_____) (_____).

Note to Instructor.—When printing or mimeographing the following questions, in order to provide sufficient space for the answers, leave 3 blank spaces between Questions Nos. 9 to 16, inclusive, and 10 blank spaces between Questions Nos. 17 to 20, inclusive.

Directions.—Draw the conventional sign for each of the headquarters, units, etc., listed below. Make the drawing on the short dotted line in the right margin.

9. Switching central. ----------
10. VAIL test station. ----------
11. Headquarters of the 5th Infantry Regiment. ----------
12. MAGIC telephone central. ----------
13. 1st Brigade observation station. ----------
14. 1st Battalion 1st Infantry. ----------
15. 1st Division, Command Post. ----------
16. Company A, 3d Infantry. ----------

Directions.—Draw circuit diagrams from the data given in each of the problems below. The code names of units are: 1st Brigade is BOX, 1st Infantry is BOY, and 2d Infantry is BELL. The section of the divisional axis between division and brigade is "Section Three."

17. There are two circuits from the 1st Brigade to the 1st Infantry, one circuit from the 1st Infantry to the 2d Infantry.

18. There are two circuits from the 1st Brigade to the 1st Infantry and one of them is cut through direct to the 2d Infantry.

19. There are two circuits from the 1st Brigade to a switching central and one circuit from the switching central to each of the regiments, 1st and 2d Infantry.

20. There is one circuit from the 1st Brigade to each of the regiments, 1st and 2d Infantry, both circuits passing through EATONTOWN TEST.

THE UNIVERSAL TEST SET, TYPE EE–65

Equipment.

1 test set, Universal, type EE–65.
1 battery made up of a number of dry cells (not to exceed 30 cells in series).
5 telephones, type EE–4 or type EE–5.
7 circuits, numbered 1 to 7, as provided by the Instructor.

Information.

The type EE–65 test set was designed to provide a wire chief's testing equipment in a compact portable form, for use both in the field and in permanent central office installations. The complete testing, signaling, and talking equipment is installed in a substantial case, provided with a shoulder strap, and can easily be transported by one man. No additional equipment is necessary for its operation. (See fig. 41.)

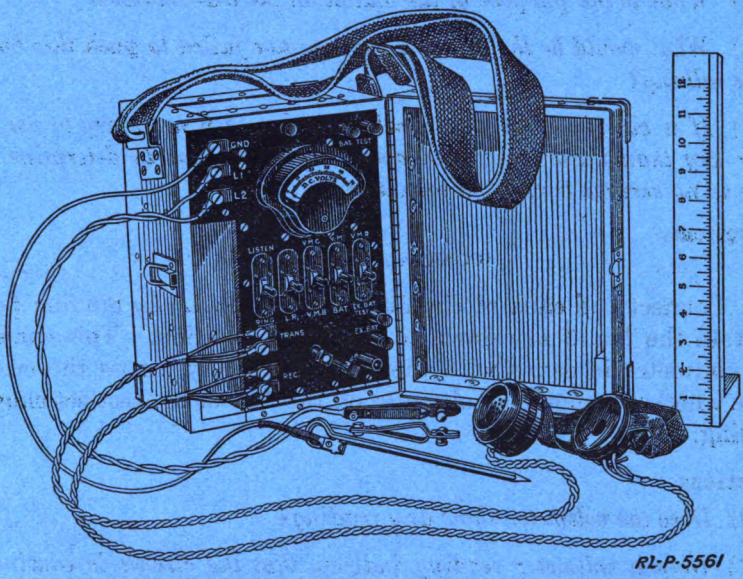

Fig. 41.—Universal test set, type EE – 65

Directions.

RINGING AND TALKING TEST

1. Connect the ends of circuit No. 1 to the binding posts on the test set which are marked L_1 and L_2. If the circuit is a ground return circuit, connect the metallic side of the circuit to L_1 and connect L_2 to ground by means of the ground rod. Be sure that all keys are in

the normal or center position. Adjust the receiver to the ear so that it is held in place comfortably by means of the elastic band.

2. Operate No. 1 key (keys are numbered 1 to 5 from left to right) down to the "Ring" position. Turn the generator crank three complete turns. If it is desired to give two or three rings, such as when ringing on a party line, operate the key from normal to ring position two or three times, meanwhile turning the generator crank. Then operate the No. 1 key up to the "Listen" position.

3. When the called party answers, press the button on the transmitter and say, "Test, thank you," and return the No. 1 key to normal position.

Questions.

(*1*) *What connection is made inside the test set when the No. 1 key is operated down to the "Ring" position?*

(*2*) *Why is it necessary to operate the No. 1 key up to the "Listen" position immediately after ringing?*

(*3*) *What is the purpose of the button on the transmitter?*

(*4*) *What would be the result if the operator failed to push this button while talking?*

(*5*) *If a circuit is in good working order, is it necessary to use any other key than those mentioned above on the test set to determine that there is no serious trouble on the circuit?*

Directions.

CONTINUITY TESTS

4. Connect the ends of circuit No. 2 to the L_1–L_2 binding posts. Operate the No. 3 key down to the VMB position. This connects the voltmeter in series with the test set battery across the circuit. Note whether or not the voltmeter on the face of the test set shows a reading.

Questions.

(*6*) *Does the voltmeter show any reading?*

(*7*) *Does a voltmeter reading indicate that the circuit is continuous from the L_1 binding post on the test set out over one side of the circuit and back to the L_2 binding post?*

(*8*) *What would happen if No. 1 key were operated to the "Ring" position during this test?*

Directions.

5. Make a similar test of circuit No. 3.

Questions.

(*9*) *If a field telephone were connected at the distant end of a circuit under test, would the voltmeter show a reading indicating that the circuit was continuous?*

(*10*) *If the telephone at the distant end of the circuit were disconnected and the distant ends of each side of the circuit were taped up would the voltmeter show a reading when this sort of a test were made?*

Directions.

6. Connect the test set to circuit No. 4 by connecting the line wire to L_1 on the test set and connecting the binding post on the test set marked "GND" to ground by means of the ground rod and lead. Operate the No. 3 key up to the "VMG" position and note whether or not the voltmeter shows a reading.

Questions.

(*11*) *Of what does the circuit for the current which operates the voltmeter consist?*

(*12*) *If the line wire were to become grounded accidentally about 10 feet from the test set, would this test still determine whether or not the circuit was continuous throughout?*

(*13*) *Why is it necessary to operate the No. 3 key up to the "VMG" position when testing a ground return circuit, and down to the "VMB" position when testing a metallic circuit?*

Directions.

RESISTANCE OF A CIRCUIT

7. Connect the ends of circuit No. 2 to the L_1 and L_2 binding posts. Operate the No. 3 key down to the "VMB" position and note the reading, if any, on the voltmeter. Then return the No. 3 key to normal and operate the No. 4 key down to the "BAT" position. This connects the voltmeter across the battery. (This method is used when measuring the voltage of the battery in the test set.) Calculate the resistance of the circuit by solving the following equation for X:

$$V' : V-V' = R : X \text{ or } X = \frac{R\,(V-V')}{V'}$$

V' = Voltmeter reading on continuity test.
V = Voltmeter reading obtained with No. 3 key operated to "BAT" position.
R = Resistance of voltmeter (which is 3,000 ohms).
X = Resistance of external circuit.

Questions.

(*14*) *If the voltmeter showed approximately the same reading on a continuity test of a metallic circuit as it did when connected directly across the battery, what would this indicate?*

(15) *How would the resistance of a ground return circuit be measured?*

(16) *If the resistance of a ground return circuit showed much less than it should, might poor splices be the cause?*

(17) *If a circuit 5 miles long had been found by test to have a short circuit on it, in what way would it be of advantage to know the normal resistance of the circuit?*

Information.

When a central is installed at which there is a Universal test set, the chief lineman makes a resistance measurement of all circuits connected to the switchboard and records this data for future reference. In case of trouble the resistance of the circuit, which is in trouble may be compared with the recorded resistance and thus give information as to the location of the trouble. For example, if the resistance of a circuit in good order measured twice what it did when the measurement was made while trying to locate trouble on the circuit, it would indicate, if the trouble were a short, that the trouble would be found about half way to the end of the line.

Having a knowledge of the resistance per foot or per mile of the wire used, the chief lineman can measure the resistance of a short-circuited circuit or a grounded circuit and determine approximately the distance to the trouble.

The resistances per mile of various kinds of wire is as follows:

	Weight per mile	Resistance per mile of single wire, in ohms
Hard-drawn bare copper wire:	*Pounds*	*Ohms*
No. 8, B. & S.	264. 0	3. 310
No. 9, B. & S.	209. 0	4. 200
No. 10, B. & S.	166. 0	5. 264
No. 12, B. & S.	104. 5	8. 370
No. 14, N. B. S.	103. 0	8. 400
Galvanized-iron wire of B. B. grade:		
No. 9, B. W. G.	314. 0	17. 84
No. 10, B. W. G.	258. 0	21. 71
No. 12, B. W. G.	170. 0	32. 94
No. 14, B. W. G.	99. 0	56. 56
Bronze, phosper, No. 17, B. & S.	33	95. 00
Outside distributing, twisted pair, copper clad, No. 17, B. & S.	199	95. 00
Field, 11-strand:		
Single	95. 70	52. 46
Twisted pair	195. 26	53. 51
Outpost, 7-strand (3 steel, 4 bronze):		
Single	56. 0	160. 90
Twisted pair	119. 0	163. 90
Buzzer (2 steel, 1 copper)	9. 9	332. 60
Cable, paper insulated and lead covered:		
No. 19, B. & S., 10 pair	5, 610	44. 0
No. 22, B. & S., 10 pair	3, 000	88. 0

Directions.

TEST FOR GROUNDS

8. Connect the ends of circuit No. 5 to the L_1 and L_2 binding posts. Connect the "GND" binding post to ground. Operate the No. 3 key up to the "VMG" position and note whether the voltmeter shows a reading. From Direction No. 5 it will be remembered that with the No. 3 key up, the connection is the same as for a continuity test of a ground return circuit with L_1 as the metallic side of the circuit.

Questions.

(18) If the voltmeter shows a reading, what is the external circuit from the L_1 binding post to the "GND" binding post?

(19) If the voltmeter shows a reading in the test above, does this indicate a ground somewhere in the circuit?

(20) If the circuit which has a ground on it somewhere is closed at the distant end, can it be determined on which side of the line the ground exists?

(21) If the test in Direction 8 above indicates that there is a ground on the circuit, and the circuit is open at the distant end, on which side of the circuit (L_1 or L_2) is the ground?

(22) If there were two circuits to another point where there was an operator, and one of the circuits tested out was grounded, what directions would it be necessary to give the distant operator in order to determine on which side of the circuit the ground existed?

(23) In the test made above, provided the distant end of the circuit is open and there are no grounds, is there any external circuit from L_2 binding post to "GND" binding post?

Directions.

9. With the connections made as described in the previous direction, operate the No. 2 key down to the "LR" position. This reverses the connection to the external circuit so that L_2 is now the metallic side of the external circuit from the test set to the distant end and back to the "GND" binding post. Note whether the voltmeter shows any reading.

Questions.

(24) If the circuit is open at the distant end, on which side of the circuit is the ground if the voltmeter shows a reading?

(25) What is the advantage of having a key which will reverse the connections to the external circuit?

(26) *What would be the effect on transmission if one side of a circuit were grounded?*

(27) *What would be the effect if each side of a circuit were to become grounded?*

Directions.

10. To test a ground return circuit to find out if there are any accidental grounds, remove the regular grounds at each end of the metallic side of the circuit and then connect the line wire to L_1 and make the regular test for ground as described in Direction 8. Make this test on circuit No. 5.

Questions.

(28) *What would be the effect of a partial ground, caused by leaky insulation, somewhere along a ground return circuit?*

(29) *How could this be distinguished from a good ground by this test?*

Directions.

TEST FOR CROSSES

11. Connect the ends of circuit No. 6 to L_1 and L_2 on the test set. Connect one side of circuit No. 7 to "GND" binding post. Operate No. 3 key up to the "VMG" position. This connects the voltmeter and battery across from L_1 side of circuit No. 6 to one side of circuit No. 7. Note whether the voltmeter shows a reading.

Question.

(30) *If the voltmeter shows a reading, what does it indicate in regard to the L_1 side of circuit No. 6 and the side of the circuit No. 7 which is connected to the "GND" binding post?*

Directions.

12. Operate the No. 2 key down to the "LR" and note whether the voltmeter shows a reading.

Questions.

(31) *What is accomplished by operating No. 2 key down to the "LR" position?*

(32) *What conclusions can be drawn if the voltmeter shows a reading?*

Directions.

13. Disconnect the wire from the "GND" binding post and connect the other side of circuit No. 7 to the "GND" binding post. Repeat the tests as in Directions 11 and 12.

Questions.

(33) *Is there any other way of connecting to the test set to make these tests?*

(34) *If there were cross talk between two circuits, would this test be likely to determine what was the trouble?*

(35) *Could this test be made with a magneto telephone by ringing?*

Directions.

MEASURING VOLTAGE OF BATTERY.

14. Connect the terminals marked "BAT TEST" to the battery whose voltage is to be measured. Be sure to have the positive terminal of the battery connected to the plus (+) or left-hand binding post. Operate No. 5 key down to the "EX BAT TST" position. This connects the voltmeter across the terminals of the battery. Note the reading of the voltmeter, do not make this measurement on a battery with such a number of cells that the voltage is likely to be greater than the voltage range of the voltmeter.

Questions.

(36) *Would this test set be of value when determining the serviceability of dry cells?*

(37) *What is the maximum number of dry cells in series that can be measured by the voltmeter in the test set?*

(38) *What is the maximum number of dry cells in parallel that can be measured by the voltmeter in the test set?*

(39) *What is No. 1 key when operated up to the "Listen" position used for?*

(40) *What is No. 1 key when operated down to the "Ring" position?*

(41) *What does a sounding of the 80-ohm buzzer indicate when ringing on a circuit?*

(42) *Can No. 2 key be operated both up and down?*

(43) *For what is No. 2 key used when operated down to the "LR" position?*

(44) *What is accomplished by operating No. 3 key up to the "VMG" position?*

(45) *What is accomplished by operating No. 3 key down to the "VMB" position?*

(46) For what tests is this key used?

(47) What is accomplished by operating No. 4 key up to the "VM" position?

(48) What other key is it necessary to operate when the No. 4 key is at the "VM" position before any tests can be made?

(49) For what purpose is the "BAT" position of the No. 4 key?

(50) For what is the up or "VMR" position of the No. 5 key?

(51) When testing the voltage of an external battery, to what position is key operated?

(52) What keys have nonlocking positions?

SUGGESTIONS FOR THE INSTRUCTOR

1. For the purposes of this Unit Operation the instructor should provide seven circuits as follows:

a. Circuit No. 1: 50 feet long with telephone at the distant end with a telephone orderly.

b. Circuit No. 2: 50 feet long with a telephone at the distant end.

c. Circuit No. 3: 50 feet long, open at the distant end.

d. Circuit No. 4: Ground return circuit 50 feet long with a telephone at distant end.

e. Circuit No. 5: 50 feet long, open at the distant end, grounded at center on one side.

f. Circuit No. 6: 50 feet long with a telephone at the distant end and with one side connected at the center to one side of circuit No. 7.

g. Circuit No. 7: 50 feet long with telephone at distant end and with one side connected at the center to one side of circuit No. 6.

2. Tag each circuit with its number.

3. Provide each student with a test set and have him make the tests as described in the Unit Operation. Make sure that he can answer all the questions pertaining to a test before he is allowed to progress to the next test.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 17-A (PERFORMANCE)

Equipment.

6 Universal test sets, type EE – 65.
100 feet of twisted pair wire.

Procedure.

1. There are six Universal test sets listed in the equipment for this test. If it is not practicable to get six sets, conduct the first problem for the entire class in turn; and then, using the same test set, conduct the entire second and following problems, thus requiring only one test set for the entire group of problems.

2. Arrange the six test sets on tables or benches and connect them as follows:

a. Connect a twisted pair to the test set to represent a metallic circuit for Tests Nos. 1, 2, and 6.

b. Connect a single wire to the L_1 binding post to represent a ground return circuit for Tests Nos. 3 and 4.

c. Connect a battery consisting of several dry cells to the EX BAT binding posts for Test No. 5.

3. Place directions on cards and place the cards on the test sets as follows:

a. "Test No. 1. Set keys for talking over this circuit."

b. "Test No. 2. Set keys for making a continuity test of this circuit."

c. "Test No. 3. Set keys for making a continuity test of this circuit which is a ground return circuit."

d. "Test No. 4. Set keys for making a test to find out if this wire has a ground on it."

e. "Test No. 5. Set keys to measure the voltage of this battery."

f. "Test No. 6. Set keys to reverse the circuit as connected to the test set."

4. Direct each student to go to each test set in turn and to comply with the directions on the card on the test set.

Scoring.

1. The maximum score is 60 points.
2. The score required to pass this test is 50 points.
3. DIRECTIONS FOR SCORING.

	Points
For each test, if the keys are set correctly	10

INSTRUCTION TEST NO. 17-B (INFORMATION)

(NOTE.—When answering the questions below the student should be supplied with a test set or a picture of a test set.)

Directions.—Below are a number of sentences. Read each sentence carefully, and if what it says is true (correct), place a plus sign (+) on the *short dotted line* in the right margin. If what it says is not true (incorrect), place a minus sign (−) on the dotted line.

1. To ring on a circuit, No. 1 key is operated to the up position. ------
2. The normal position of No. 1 key is the "Listen" position. ------
3. If a circuit is O. K., this can be determined by using only the No. 1 key. ------
4. The "VMB" position of No. 3 key connects the voltmeter and battery in series across the circuit when the test set is connected to a circuit. ------
5. A voltmeter reading with No. 3 key in the "VMB" position indicates that the circuit is continuous. ------
6. The "VMG" position of No. 3 key is used in making continuity tests of metallic circuits. ------
7. If the voltmeter reads backwards on a test, this can be corrected by operating the No. 5 key to the "VMR" position. ------

8. The "BAT" position of No. 4 key is used in testing an external battery. ------

9. If the voltmeter reading on the continuity test of a metallic circuit is approximately the same as the voltmeter reading taken directly across the battery, the circuit is shorted near the instrument. ------

10. The test for a ground on a "ground return circuit" is performed the same as a test for a short on a metallic circuit. ------

11. In testing for "grounds" on a "ground return circuit," the regular grounds at each end of the circuit must be disconnected. ------

12. No. 2 key is used in the "LR" position in testing for "crosses." ------

13. No. 4 key is used to test an external battery. ------

14. The maximum number of dry cells in series that can be tested with the Universal test set is 10 cells. ------

15. None of the keys has a nonlocking position. ------

16. The voltage of a bank of 20 dry cells in parallel may be tested with the Universal test set. ------

TESTING, LOCATING, AND CLEARING TROUBLE.

Equipment.

Telephone net complete (Fig. 16 – IG)
4 monocord switchboards, 4-line.
1 monocord switchboard, 8-line.
3 operator's sets.
6 extra terminal strips.
1 mile field or outpost wire.
1 test set, Universal.
1 test phone (type EE – 5 telephone).

Information.

Due to the fact that field lines in forward areas are often laid hastily on the ground and are subject to shell fire and traffic, they are frequently apt to have trouble occur on them. These troubles however are usually quite simple in their nature, consisting mostly of short circuits, open circuits, and grounds.

To facilitate the work of testing, the Universal test set is issued. This is a wire chief's testing equipment in a compact form for use both in the field and in permanent central office installations. (See Unit Operation No. 17.) However, all the tests necessary in forward units can be made with an ordinary field telephone.

For testing purposes the type EE – 5 telephone is preferred, as it is lighter and more convenient to carry. It is provided with flexible leads (lamp cord) with Frankel clips attached on the end of the leads.

In case of trouble on a circuit the report of the trouble will often specify the nature of the fault, such as short, open, or cross. The problem then consists in locating the fault and clearing it with the least possible delay. However, it is very often the case that a line is reported out of order without any specific report of the nature of the trouble being made. The problem then consists in determining the nature of the trouble first and then locating and clearing it.

If a circuit that is in trouble is a trunk circuit between two switchboards which are connected together by additional circuits, the testing can be simplified by using the additional circuit to direct a member of the same section at the distant end to open or close the circuit to facilitate locating the fault.

Only by systematic testing can trouble be located in the minimum amount of time.

Directions.

TRUNK CIRCUITS NOS. 201 AND 205 OUT OF ORDER

1. Go to the line terminal strip and open circuit No. 201 between the line and cable terminal strips by removing the jumpers. Make a ringing and talking test in both directions (on the switchboard terminals and on the line terminals). If an answer is received and you can hear and be heard from one direction, then the trouble is in the other direction.

Questions.

(*1*) *Why is it necessary to remove the jumper connections between the terminal strips before testing?*

(*2*) *Why is it necessary to make both a ringing and a talking test?*

(*3*) *If on ringing toward the switchboard the operator answers, can be heard, and understands when spoken to, what does it indicate?*

Directions.

2. If the trouble is toward the switchboard, make a ringing test and also a talking test in that direction.

a. If the operator does not answer a ring, tell him to plug in and talk. If he can hear and be heard, the trouble is probably in the line drop. Notify the chief operator, who will locate and repair the trouble.

b. If the line drop falls but the operator can neither hear nor be heard, notify the chief operator of the result.

c. If the drop does not fall and the operator can neither hear nor be heard, note whether the circuit rings short or open, and notify the chief operator of the result.

Questions.

(*4*) *If the trouble is determined to be in the switchboard line drop, why does the lineman do nothing further than to notify the chief operator?*

(*5*) *Although the lineman does nothing further than notify the chief operator about the trouble in the switchboard, why does he test to see whether it is a short or open?*

(*6*) *If the trouble consisted of a short in the switchboard cable, could the lineman get the operator at the distant central on the circuit?*

Directions.

3. If the trouble is toward the line, proceed as follows:

a. If another circuit is available, call the distant operator over this circuit and have the circuit opened at the terminal strip of the

distant central. Test, and if the circuit does not test open, there is a short on the line. Using the second circuit have the circuit shorted at the distant end. Test, and, if the circuit does not test short, there is an open on the line.

b. If no other circuit is available, make a ringing or continuity test and determine if the circuit is short or open. This test determines that there is a short or open either on the line or on the distant switchboard.

c. Test for grounds. If the circuit is shorted, measure resistance if a test set is available and figure the distance to the fault.

Questions.

(7) *If a circuit tests short, where is the first place that you would look for the trouble?*

(8) *What is the resistance per mile of field wire, type W–44?*

(9) *What is the resistance per mile of outpost wire, type W–40?*

Directions.

4. Having determined the nature of the trouble, proceed to locate it as follows:

a. If a resistance measurement has been made, go to the point where it has been figured to be.

b. If a resistance measured has not been made, go to a point one-fourth the distance to the distant central.

5. Open both sides of the circuit and test in both directions.

a. If one direction tests O. K., splice the circuit through and go one-half the distance from this point to the central in the direction of the fault and test again. Continue until the fault is located.

b. If both directions fail to test O. K. proceed as follows: Short the ends of either that tests open; leave either circuit open if it tests short. Then proceed to locate and clear the trouble in one direction. When this has been done, proceed in the other direction. When the fault has been located and cleared, spliced through where the circuit is open.

Questions.

(10) *If the wire used in the circuit is old salvaged wire, what places should be carefully examined for fault?*

(11) *If a circuit tests short, why does the lineman leave the circuit open when he goes out to test?*

(12) *If a circuit tests open, why does the lineman short the ends when he goes out to test?*

(13) If a circuit tests short, what else is determined in regard to the circuit and to the short?

(14) When going out on a line to locate trouble, what instrument would it be desirable to take along?

Directions.

6. When the trouble has been located and cleared, call in and notify the chief operator, giving the nature and location of the trouble.
7. Repeat the operations for circuit No. 205.

CROSSES BETWEEN TWO TRUNK CIRCUITS NOS. 211 AND 212

Information.

When a conversation which is being carried on over one circuit can be heard on another circuit, it is called "cross talk." This is often caused by crosses occurring on the line between the two circuits due to poor insulation and grounds. When a cross between two circuits exists, it is usually the case that the distant central can be called and conversation can be carried on over either circuit; however, this will interfere with the other circuit.

Directions.

8. Call the distant central and have the two circuits, Nos. 211 and 212, opened at the line terminal strip of the distant central. Then open both circuits at the line terminal strip and make a test for crosses with the Univeral test set on the circuits as described in Unit Operation No. 17. This will determine which wires are crossed.
9. Make a resistance measurement of the loop consisting of the wires which are crossed and figure the distance to the fault.
10. Proceed in the same manner as for a line out of order to locate and clear the fault.

Questions.

(15) When two circuits are crossed, is it possible to use one or both circuits?

(16) Why is a cross usually reported as such by the operator while other troubles such as opens and shorts are reported as "line out of order"?

(17) Is it possible for more than two circuits to become crossed together?

(18) After having determined which of the wires are crossed, why is a resistance measurement of value.

LOCAL CIRCUIT PAN–11 OUT OF ORDER

Information.

The maintenance of local circuits and telephones is one of the duties of the operating detail. However, it may happen that a lineman who is on duty at a central to locate and repair trouble may be sent out on local circuits which are out of order.

Directions.

11. Take an extra telephone and go to the subscriber's telephone, Pan–11, and test it to determine if the trouble is in the instrument. If the trouble is in the battery, replace it with a new one. If practicable, repair any other trouble which is found. If this cannot be done, replace the instrument with the extra one.

12. If the trouble is not in the subscriber's telephone, disconnect the telephone and test toward the switchboard and determine the nature of the trouble (short or open). If the trouble is an open, connect the ends of the circuit together. If the trouble is a short, leave the circuit open. Proceed as heretofore described, to test, locate, and clear the trouble.

Questions.

(19) What is the test which indicates a dead battery in a subscriber's telephone?

(20) What tests would indicate a packed transmitter?

(21) What tests would indicate a short in the magneto generator?

(22) What tests would indicate an open in the magneto generator cir cuit?

Fig. 42.—Circuit diagram of trunk lines

Information.

It is sometimes the case that several circuits on a trunk line which has a test station somewhere on it are out of order at the same time. When this is the case, it is sometimes possible to provide one or more circuits by patching through at the test station. For example, Fig. 42 above, shows two centrals connected by four trunks.

Suppose that all the circuits from MAGIC to MOBILE are out of order but that when the lineman at SMITH TEST, tests the circuits he finds circuits 101, 102, 203, and 204 to be O. K., but that all the rest are out of order. He can still provide two circuits from MAGIC to MOBILE by patching through as shown in Fig. 43 below.

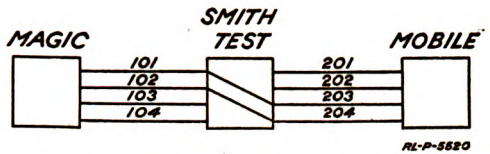

Fig. 43.—Circuit diagram, showing patching through of trunk lines

TESTING FROM TEST STATION—CIRCUITS NOS. 151 AND 152 OUT OF ORDER

Directions.

13. Go to BROWN TEST and open circuits Nos. 151, 152, 161, and 162, removing the jumpers on the test station terminal strip. Test in both directions to determine on which side of the test station the faults lie. If a section of each circuit tests O. K. in opposite directions, patch the circuits through at the test station and notify one of the switchboard operators.

14. If a Universal test set is available, determine the approximate location of the faults, and, if they are found to be near the centrals, notify the switchboard operators. If near the test station, send a lineman out to locate and repair the trouble.

Questions.

(*23*) *At what other times might a lineman be required to patch through circuits at a test station?*

(*24*) *What is gained by having linemen stationed at test stations?*

(*25*) *Is a switchboard operator stationed at a test station?*

(*26*) *How does a switchboard operator call a lineman on duty at a test station?*

(*27*) *Why are circuits connected into a terminal strip at test stations?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Provide centrals with circuits connected as shown in Fig. 16–IG. Place faults on the circuits as indicated. Also place a fault in the switchboard on either circuit No. 205 or circuit No. 201.

2. Provide operators to be on duty at PAN, PIN, POST, and MAGIC switchboards.

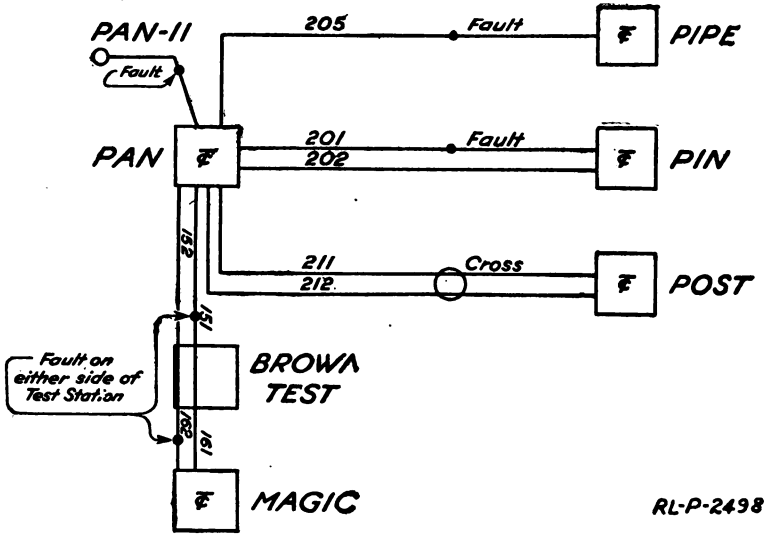

Fig. 16–IG.—Circuit diagram for U. O. No. 18

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 18–A (PERFORMANCE)

Equipment.

1 test set, Universal, type EE–65 (for each student).
1 telephone, type EE–5 (for each student).
1 telephone net complete (Fig. 17–IG).

Procedure.

1. Provide a telephone net with obvious faults, as shown in the following diagram, and with circuits not over 300 feet in length.

2. Provide operators at MINOR, MINUTE, and MAGIC switchboards and at MINUTE 3 and MINUTE 11.

3. Require the students to locate and clear the following faults:

a. Mirror 5 out of order (student at MIRROR switchboard).
b. Circuits 301 and 302 out of order (student at MINUTE switchboard).
c. Circuit 303 out of order (student at MINUTE switchboard).
d. Minute 3 out of order (student at MINUTE switchboard).
e. Circuits 211 and 212 crossed (student at MINUTE switchboard).

4. By providing assistants to take charge of the different tests, *a*, *b*, *c*, etc., the students can be required to go from one assistant to the other for the different tests in any order that best suits the instructor. Some of the tests may be made with the Universal test set and others with type EE – 5 telephone, or the whole exercise may be first performed with a Universal test set and then with a type EE – 5 telephone.

5. Note the time from the moment information is given a student that a circuit is out of order until the fault is removed and the circuit is in order.

6. Watch for any irregularities as noted in the scoring.

7. After the fault has been located and cleared, direct the student to replace the fault on the circuit as he found it, so that the next student can be tested.

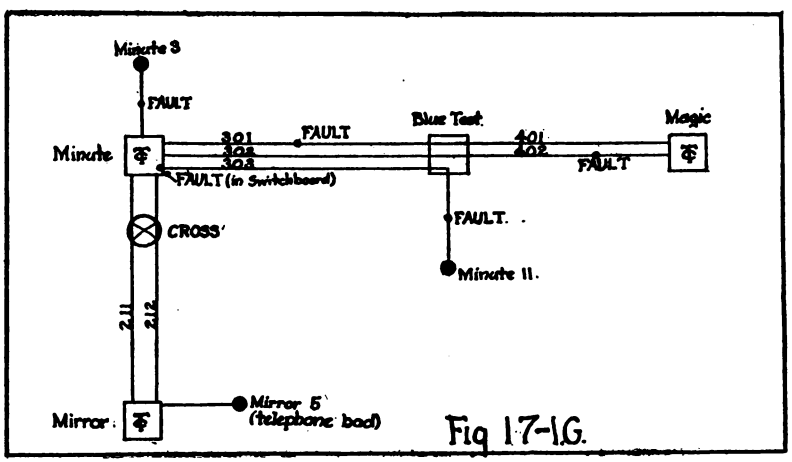

Fig. 17 – IG.—Circuit diagram for Test No. 18–A RL-P-5573

Scoring.

1. The maximum possible score is 80 points.
2. The score required to pass the test is 55 points.
3. DIRECTIONS FOR SCORING.

	Points.
a. Clearing fault on Mirror–5:	
(1) If fault is cleared within 3 minutes	10
(2) If fault is cleared in less than 5 minutes but more than 3 minutes	5
(3) If fault is cleared, but time exceeded 5 minutes	0
b. Clearing the faults on circuits 301 and 302:	
(1) If circuit 302 is patched through with circuit 401, and circuits 301 and 402 cleared within 10 minutes	30
(2) If circuit 302 is patched through with circuit 401, and circuits 301 and 402 cleared within 15 minutes	15

	Points.
b. Clearing the faults on circuits 301 and 302—Continued.	
(3) If circuit 302 is *not* patched through with circuit 401, but circuits 301 and 402 are cleared within 10 minutes	20
(4) If circuit 302 is *not* patched through with circuit 401, but circuits 301 and 402 are cleared within 15 minutes	10
(5) Any other combination than above	0
c. Clearing fault on Minute-11 (circuit 303):	
(1) If fault in switchboard is reported and fault to MINUTE-11 cleared within 10 minutes	20
(2) If fault in switchboard is reported and fault to MINUTE-11 cleared within 15 minutes	10
(3) Any other combination than above	0
d. Clearing fault on Minute-3.	
(1) If fault is cleared within 5 minutes	10
(2) If fault is cleared in less than 10 minutes but more than 5 minutes	5
(3) If fault is cleared but time exceeded 10 minutes	0
e. Clearing fault on circuits 211 and 212.	
(1) If fault is cleared within 5 minutes	10
(2) If fault is cleared in less than 10 minutes but more than 5 minutes	5
(3) If fault is cleared, but time exceeded 10 minutes	0

INSTRUCTION TEST NO. 18-B (INFORMATION)

Directions.—Below are a number of unfinished statements each followed by several numbered words or phrases, one of which correctly completes the statement. Write the *number* of this word or phrase on the short *dotted line* at the right of each statement.

1. When a conversation which is being carried on over one circuit can be heard on another circuit, it is called
   (1) interference. (2) inductive effect. ------
   (3) cross talk. (4) capacitive coupling. ------
   (5) corona effect. ------

2. The maintenance of local circuits and telephones is one of the duties of the
   (1) construction detail. (2) operating detail.
   (3) Signal Corporal No. 2. (4) linemen.
   (5) message center. ------

3. A lineman is at a test station on a two-circuit trunk line. Both circuits are in trouble. One circuit tests O. K. to the forward unit but not to the rear unit and the other circuit tests O. K. to the rear unit but not to the forward unit. The quickest way that he can provide one through circuit is by
   (1) locating and clearing the trouble on one circuit.
   (2) connecting for a ground return circuit.
   (3) using a service buzzer. (4) using a buzzerphone.
   (5) patching through. ------

4. If both sides of a circuit become grounded, the circuit would test
(1) open. (2) crossed with another circuit.
(3) O. K. (4) short. (5) dead. ------

5. A field lineman when going out to locate trouble should carry
(1) a type EE – 5 telephone. (2) a Universal test set.
(3) a wheatstone bridge. (4) a type EE – 3 telephone.
(5) a terminal strip. ------

6. A lineman patches through circuits on which there is trouble by means of
(1) jumpers. (2) cross connectors.
(3) Fahnstock clips. (4) sleeves. (5) line plugs. ------

7. In order that trouble on field lines can be quickly located and repaired
(1) additional circuits are provided for testing.
(2) leads are provided.
(3) switchboard operators are required to locate faults.
(4) linemen are stationed at test stations.
(5) splicing clamps are provided. ------

8. The distance that a lineman should go before opening the circuit and testing when he is sent out on a circuit to locate trouble is
(1) Two-thirds the distance to the far end.
(2) three-fourths of the distance to the far end.
(3) one-fourth the distance to the far end.
(4) one-half the distance to the far end.
(5) all the way to the far end. ------

9. If a circuit which is in trouble tests short, the lineman before he goes out on the line should, in order to provide for testing, leave the circuit
(1) short. (2) open. (3) grounded.
(4) connected together.
(5) connected to a telephone. ------

THE BUZZERPHONE, TYPE EE – 1

Equipment.

1 4-line monocord switchboard for every four students.
1 buzzerphone, type EE–1 for each instructor, assistant instructor, and student.
250 feet of twisted-pair field or outpost wire for each student.
3 messages per student.
Supply of message blanks.
1 pencil per student.

Information.

The buzzerphone, type EE–1, the American equivalent of the British fullerphone, is a combination telephone and field telegraph instrument. It consists of a portable case containing a telegraph key, head receiver, call buzzer, switches, and has the necessary electrical apparatus and power; the power being supplied by two type BA–1 batteries. A special hand set, which permits of being used as a telephone, may be attached when occasion demands. (See Fig. 44.)

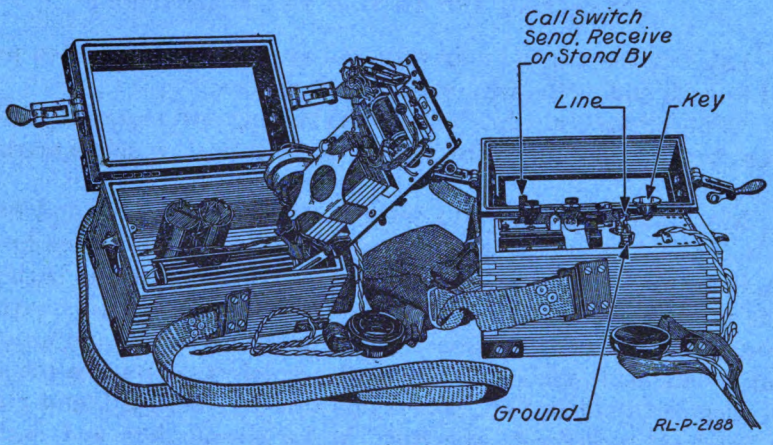

Fig. 44.—The buzzerphone, type EE – 1

The particular advantage of the buzzerphone is its secrecy when employed as a telegraph instrument, the interception of its messages being very difficult except by direct tapping of the line with a similar instrument. When employed as a telephone it is no more secret than any other telephone instrument. For efficient operation, it demands

a well-insulated circuit of good conductivity. It should be employed in forward areas where wire communication is possible, and where the use of the ordinary telephone or telegraph instruments would subject the communication to enemy interception. When not absolutely necessary, the telephone attachment will not be issued in forward areas because of the tendency of unreliable operators to employ the telephone instead of the secret telegraph. It should be attached when the buzzerphone is to be used in calling through a switchboard whose operator is equipped only with the ordinary magneto telephone. The call buzzer will work the drops on the monocord switchboard. When used through a switchboard supplied only with a magneto telephone, the switchboard operator cannot call the buzzerphone subscriber because the buzzerphone has no bell unless his switchboard is equipped with a buzzerphone, service buzzer, or equivalent high-frequency buzzer or unless the buzzerphone subscriber is also provided with a magneto telephone. The buzzerphone subscriber can, however, once the line is connected through to the distant buzzerphone, call the distant buzzerphone with the call buzzer of his own instrument. (For technical description, see Wire Communication Pamphlet No. 1.)

Directions.

CONNECTING AND TESTING THE BUZZERPHONE

1. Lay out the twisted-pair wire and require one student to proceed to each end of the wire with a buzzerphone.

2. Connect one of the line wires to the binding post marked "Line." Connect the other line wire to the binding post which is marked "Ground."

3. Move the switch key to the Send-Receive position and note whether the howler operates. If it does not, it will generally be found that the battery is dead. If the trouble is not in the battery, make no attempt to adjust the microphones. The manufacturer's adjustment of the microphones is not easily disturbed and adjustment is difficult to make. If the howler is defective, replace the set.

4. Connect the hand set, if it is not already connected, and place the hand set receiver to the ear. Make several dots and dashes with the key. Note whether a tone signal or click at the beginning and end of dots and dashes is heard. The set should not be used for confidential communication if these sounds can be heard, since under these conditions the signals may be readily picked up by induction or ground leakage methods by the enemy.

Questions.

(1) *Is the hand set used for receiving buzzerphone signals?*

(2) *Can conversation carried on by means of the hand set be heard in the buzzerphone receiver?*

(3) *If, when going out testing on a telephone circuit, would it be advisable to take a buzzerphone?*

(4) *If no telephones were available, could a buzzerphone be used in place of a telephone?*

(5) *Is the buzzerphone primarily a telephone instrument or a telegraph instrument?*

(6) *If a full metallic circuit were available between two points where there was no danger of interception by the enemy, would it be more advisable to use buzzerphone or telephone communication?*

(7) *What special qualifications should a buzzerphone operator have?*

(8) *Need an operator know the theory of electrical operation of a buzzerphone in order to operate one?*

Information.

When sounds are not heard in the receiver, as described in Direction 3, it is due to defects in either the sending or receiving circuits of the set and the set should be repaired or replaced. It is desirable to make a test of this character once a day, to ascertain if the condensers and inductance coils in the filter are in good condition.

Directions.

5. In case there is no hand set with the buzzerphone, call the distant operator and have him make dots and dashes with his key. Throw the switch key to the stand-by position and note whether or not the distant operator's dots and dashes can be heard as a tone or as clicks in the buzzerphone receivers. If either of these can be heard the trouble is the same as described above.

6. Be careful not to touch the terminals of the set with either hands or clothing as this may make the tone signals audible on the line or produce a leak from the line to ground, which might confuse the signals at other stations on the line.

Questions.

(*9*) *If only a few of the messages to be transmitted had to be sent secretly and the others could be transmitted by voice, would the buzzerphone be a good instrument to use?*

(*10*) *Is it necessary to encode a secret message before sending it by buzzerphone?*

(*11*) *Could a buzzerphone be expected to work well over a very poor circuit?*

Directions.

7. When ready to communicate with the distant operator, call him with the transmitting key. If he does not answer, move the switch key to the "Call" position, giving a buzz.

8. Operate the switch key to the Send-Receive position immediately and listen for acknowledgment from the distant station. Repeat the call, if necessary.

9. When acknowledgment is received, move the handle of the key to the left and proceed to send a short message.

10. When finished sending, remove the hand and allow the key to spring back to close the receiving contact. Wait until acknowledgment from the distant operator is received. Then, if the distant operator has nothing further, stand by and listen in for calls. If it is necessary to leave the buzzerphone, operate the switch key to the Stand-by position.

11. When a call is received, when the switch key is in the Stand-by position, operate it to the Send-Receive position and acknowledge the call; then release the sending key and listen.

Questions.

(*12*) *Should a call always be made first by using the sending key before resorting to the call buzzer? If so, why?*

(*13*) *What happens when the sending key is released?*

(*14*) *After calling the distant operator, why is it necessary to wait for acknowledgment before proceeding to transmit a message?*

(*15*) *Would it be advisable to have authorized abbreviated methods of calling and acknowledging?*

Information.

If certain words or phrases are not understood by the receiving operator, it is more convenient for him to secure a repeat at once on those particular words or phrases than to wait until the end of the message. Therefore, it is necessary for the receiving operator to be

able to stop the sending operator at any time during the transmission. It also is sometimes necessary to stop the reception of an ordinary or rush message in order to transmit a priority message. This stopping of the transmitting operator is called "breaking" him.

Directions.

12. If it is necessary to break while receiving a message, operate the sending key to the left. This opens the receiving contact and will so reduce the signals in the sending operator's receiver that he will know the circuit has been opened. He will stop and listen. If due to leaky lines, this is not sufficient to "break" the sending operator. Operate the call buzzer. This should only be done in emergency as it is very loud and unpleasant in the other operator's ear.

Questions.

(*16*) *When an operator is transmitting, how does he know when he is being "broken?"*

(*17*) *What effect might a leaky line have on one operator's efforts to "break" another?*

(*18*) *What is the particular advantage of the buzzerphone?*

BUZZERPHONE OPERATION

Information.

Buzzerphone communication, like telephone communication, involves the calling up of the desired party and his answer before any messages or information may be transmitted. In telephone communication each subscriber is designated by a number, while in buzzerphone communication, since there are generally only two stations on a line, all that is necessary is a "call." If the circuit is being operated by having the operators remain at the set listening in at all times, the "call" is made by transmitting the radio call sign of the station. If the operators are not required to listen in at all times, the call is made by means of the call buzzer. Care should be taken never to use this call buzzer when operators are listening in as it is very unpleasant to the ear.

Buzzerphones may be operated with more than two sets on the same circuit. In this case it is necessary to assign buzzer calls to the different stations, i. e., 1, 2, 3, etc., buzzes.

The radio personnel who are more familiar with the International Morse code than any other members of the communication platoons may at times be required to operate the buzzerphones. Therefore, the little procedure required for the operation of buzzerphones follows radio procedure. Thus radio operators will have no difficulty when required to take over buzzerphones. If they work on circuits which have radio operators at the other end, radio procedure can be used without modification. However, if they work on circuits which have

wire section operators at the other end they must be careful to use only that part of radio procedure which is prescribed for use with buzzerphones.

PROCEDURE FOR BUZZERPHONE OPERATORS

1. *General rules.—a.* Operators should listen in at all times with head set on.

b. The call buzzer should be used only when the called operator fails to answer a call by signals or when it is known that the called operator will not be listening in.

c. In case of more than two stations in a circuit, the operator should always listen in to see if the circuit is clear before he calls another station.

d. An operator should not interrupt two other stations which may be working on the same circuit unless he has a "Priority" message, and knows that a priority message is not being transmitted.

e. Messages to be transmitted will be received from the message center written on the Field Message Blank. Received messages will be written in duplicate on a Field Message Blank, both copies being sent to the message center.

f. When a message is received for transmission, the operator should enter the time received under "TIME FILED," and then count the number of words or groups in the body of the message and enter this number under "CHECK."

g. When the transmission has been completed, the transmitting operator signs his name under "SENT BY" and enters the time under "HOUR."

h. The receiving operator fills in the spaces at the bottom of the blank, "CLASS," "MESSAGE CENTER," "No." "CHECK" from the data sent in the prefix of the message. When the reception is completed, the receiving operator signs his name under "RECEIVED BY" and enters the time under "HOUR."

i. The space sign II will be transmitted between all words or groups of a message.

j. The buzzerphone operator must know the radio call signs of his own unit and those of units to which he is connected.

k. The buzzerphone operator must be thoroughly familiar with the following Radio Procedure signs:

Sign	Meaning	Sign	Meaning
$\overline{\text{AR}}$	Ending sign.	$\overline{\text{VA}}$	Finish.
B	More to follow.	Y	Request for acknowledge.
$\overline{\text{BT}}$	Break sign.	R	Acknowledgment.
G	Repeat back.	GR	Groups or words.
$\overline{\text{IMI}}$	Repeat.	II	Space sign.
K	Go ahead.	NR	Number.
Q	Wait.	ZTF	I have a message for you.
V	From.		

2. *Call up.*—(In this and the following examples XA1 is the call sign of the called station and XC2 is the call sign of the calling station.)

a. To call up another station when there are several stations on the circuit and where the operators are listening in, the calling operator sends:

XA1 V XC2 II ZTF $\overline{\text{AR}}$

b. If there are only two stations on the circuit the call signs are omitted and the call is transmitted:

ZTF $\overline{\text{AR}}$

c. When the operators do not remain at their sets listening in, the call is made by operating the call buzzer (in the case of party lines 1, 2, or 3, etc., buzzes). The called operator acknowledges by sending "K," or, if it is a party line,

XC2 II K

The calling operator then sends:

ZTF $\overline{\text{AR}}$

3. *Answer.*—*a.* When a called operator has received a call he answers by sending "K" or "Q."

4. *Transmitting a message.*—*a.* For example, suppose the 1st Brigade operator has received the following message (Fig. 45) to transmit, and that he has called the 1st Infantry operator and has sent ZTF and received the answer "K."

b. The operator first writes down the prefix of the message at the top of the message blank. The prefix of a message consists of the following data transmitted in the order indicated:

The message serial number	NR5
Space sign	II
The class of the message, "Ordinary"	D
The number of words or groups in the body of the message	GR8
Break sign separating the prefix from the rest of the message	$\overline{\text{BT}}$

c. The operator transmits the message as follows:

NR5 II D II GR8 $\overline{\text{BT}}$
NR3 II CO II 1st II Inf $\overline{\text{BT}}$
Your II regiment II will II be II
relieved II to-morrow II details II later $\overline{\text{BT}}$
CO II 1st II Brig II Ø615A II $\overline{\text{AR}}$

MESSAGE

No. 8 DATE 1 Jan 22

To CO 3d Inf AT

Your regiment will be relieved tomorrow. Details later.

CO 2d Brig | AT
TITLE AND ORGANIZATION OF SENDER (TRANSMITTED)

8:05 AM | B. O. Clark Brig Gen
HOUR SIGNED | NAME AND RANK OF SENDER (NOT TRANSMITTED)

Face Side of Blank

SPACES BELOW FOR MESSAGE CENTER PERSONNEL ONLY

2d Brigade	5	1 Jan 22	8:10 A M
MESSAGE CENTER	NO	DATE	HOUR

OD	Tp	SPECIAL INSTRUCTIONS
CLASS	HOW SENT	

			M
MESSAGE CENTER	NO	DATE	HOUR

		SPECIAL INSTRUCTIONS
CLASS	HOW SENT	

			M
MESSAGE CENTER	NO	DATE	HOUR

		SPECIAL INSTRUCTIONS
CLASS	HOW SENT	

SPACES BELOW FOR SIGNAL COMMUNICATION PERSONNEL ONLY

8:25 M				M
TIME FILED	CHECK	SENT BY	RECEIVED BY	HOUR

SPACES BELOW FOR USE OF ADDRESSEE ONLY

CIRCULATION CHART

	CIRCULATION	FINAL DISPOSITION	ACKNOWLEDGEMENT
C O			
Ex			
1			
2			
3			
4			

Reverse Side of Blank

RL-P-1127

Fig. 45.—A field message

5. *Repeats.—a.* If the receiving operator at any time during the reception of a message desires a repeat of a certain word or group, he will "break" the transmitting operator. When the transmitting operator stops sending, the receiving operator sends:

IMI II (Last word received correctly).

The transmitting operator will then recommence with that word and continue.

b. If the receiving operator after the transmission of a message has been completed, finds that he requires a repeat on any part or all of a message, he sends, for example:

IMI II entire message
or IMI II address
or IMI II words after "relieved"
or IMI II 5th word (or group)

6. The receiving operator, on receiving a message, checks his reception and, if no repetitions are necessary, acknowledges for the message by sending:

II R

7. *Series of messages.*—If the calling operator has more than one message to transmit instead of ending the first message with II AR, he ends it with IIR.

He then continues with second message.

Directions.

You will be assigned as operator to a buzzerphone.

1. Send the messages given you by the instructor at the prescribed time.

2. Answer all calls and receive all messages sent you.

Questions.

(1) *How does an operator call a distant station when he knows that the distant operator is listening in?*

(2) *How does an operator call a distant station when he does not know whether or not the distant operator is listening in, but believes that he is not listening in?*

(3) *Why is an ending sign used?*

(4) *If an operator missed the last five groups of a message, how would he obtain a repetition on them?*

(5) *Is it better to break a transmitting operator and obtain an immediate repeat on an erroneous word, or to wait until the end of the message?*

(6) *How is the repetition of an entire message obtained?*

(7) *What is the prefix of a message?*

(8) *Why is the prefix not omitted and just the message itself transmitted?*

(9) *How would a receiving operator check a message before acknowledging it?*

(10) *Suppose that as receiving operator you received a message which, while it made good sense and did not appear to have any words missing, yet did not agree with the "check." What would you do?*

(11) *Why is the number of words or groups in the message given in the heading?*

(12) *How many copies of a received message are made?*

(13) *What copy is sent to the message center?*

(14) *What entry is made on a message blank under "Time Filed"?*

(15) *Why do buzzerphone stations use the call signs of the radio stations of their organization?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Test the buzzerphones[1] to be used and see that they are in good working order.

2. For operation arrange the equipment as shown in Fig. 18 – IG with sufficient distance between students to provide for noninterference.

By means of this layout the instructor can call any one of the students and transmit a message and in turn can be called by each student when the student has a message to transmit.

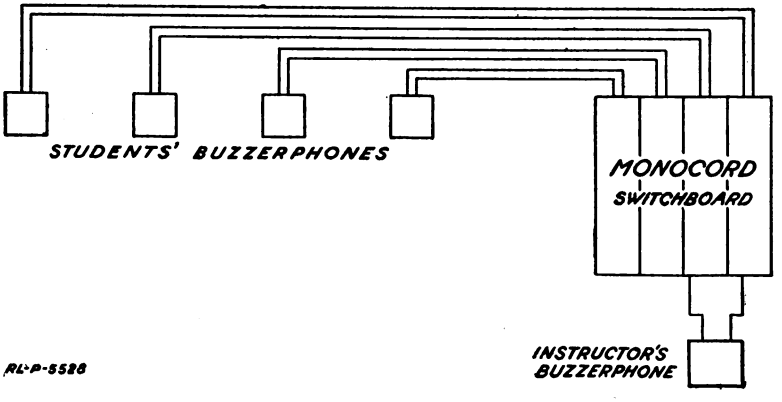

Fig. 18 – IG.—Diagram for buzzerphone instruction

3. Assign each student to a buzzerphone representing the 1st Infantry whose radio call sign is XA1. This buzzerphone connects with the switchboard representing the 1st Brigade whose call sign is XC2. The instructor or an assistant will be at XC2.

4. Give each student several messages addressed to the 1st Brigade.

5. Require the student to call the 1st Brigade and transmit the messages in the prescribed manner at the time indicated.

6. The instructor or his assistant will "Break" and ask for repeat so as to bring into use the various procedure signs.

7. At intervals the instructor or his assistant will call the students and transmit messages in the prescribed manner, and will intentionally make errors and correct them. He will garble words or groups so as to necessitate calls for repeats, etc.

8. The above will be continued until the students are proficient in operating the buzzerphone in the prescribed manner.

[1] Note:—Buzzerphone type EEI is obsolete but is included in this manual for instructional purposes.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 19–A (PERFORMANCE)

Equipment (for each group of three students).

3 buzzerphones, type EE – 1.
200 yards twisted-pair field or outpost wire.
6 messages (20 code groups of 5 characters each).
12 message blanks.
3 pencils.

Procedure.

1. Prepare in advance 6 messages (20 code groups of 5 characters each, 15 of which are letters only and 5 numerals only), two addressed to each of the following: XA–1, XA–2, and XA–3. See that the buzzerphones are in good working order.

2. Divide the class into groups of three men each, and assign them as operators at stations XA–1, XA–2, and XA–3. (Be sure to put one of your best student operators in each group.)

3. Direct each group to lay out 200 yards of twisted pair wire and connect their buzzerphones, one at each end and one in the center of the circuit, each man in the group connecting one of the buzzerphones.

4. Give the groups time to connect up, test, and clear trouble in the lines.

(5) Give each operator:

a. A prepared message addressed to each of the other stations on the line.
b. Four message blanks.
c. One pencil.

(6) Call the class to attention and direct XA–1 to start sending at eight words per minute, his message addressed to XA–2, when the instructor blows his whistle, and to stop sending when the whistle blows the second time. Also direct XA–2 and XA–3 to take the message. (NOTE.—XA–3 takes message for checking purposes only.)

(7) Blow whistle when ready to start.

(8) Five minutes later blow whistle to stop.

(9) Collect messages. Mark on each message: "Transmitted," "Received," or "Checked," and by whom.

(10) Repeat this procedure until all messages have been sent.

Scoring.

(1) To determine if an operator sent the message O. K., inspect the message as received by the other two operators. If both oper-

ators have the same mistake on receiving, assume that the sending operator made the mistake; otherwise assume that the receiving operators made the mistake.

(2) The operator receiving for checking purposes is not scored on the messages so taken.

(3) Mark number of mistakes in messages sent and received, each character not sent counting the same as a mistake for the *sending* operator. Any characters sent but received incorrect count as mistakes for the receiving operator.

(4) Total possible score, 100 points.

Score required to pass test, 75 points.

Sending or receiving:

	Points
a. Per message, allow	25
b. For each four mistakes or fraction thereof, deduct	1

INSTRUCTION TEST NO. 19–B (INFORMATION)

Directions.—Each of the following questions can be answered by a single word or phrase. Write the answer on the short dotted line.

1. For what other kind of communication, besides telephone, can a buzzerphone be used? ----------
2. What type of batteries are used in the buzzerphone? ----------
3. What piece of apparatus contains the telephone receiver and transmitter for the buzzerphone? ----------
4. What is the particular advantage of using a buzzerphone for communication in Infantry regiments and battalions? ----------
5. What advantage has a buzzerphone when used as a telephone over a type EE – 5 Telephone? ----------
6. By means of what does an operator call another operator who is not listening in on his set? ----------
7. What should be heard, if a set is in good working order, when the switch key is operated to the send-receive position? ----------
8. If the buzzerphone fails to work, what is the first thing to examine for trouble? ----------
9. What adjustment should be made on the microphones? ----------
10. If, when dots or dashes are made with the key and a click is heard in the receiver, is the set safe for secret communication? ----------
11. What code is used in buzzerphone communication? ----------

12. Who may be required to operate the buzzerphones besides the wire section men? ----------

13. What do buzzerphone operators do at all times which makes it unnecessary to use the call buzzer for calling? ----------

14. What call signs do buzzerphone stations use? ----------

15. If the receiving operator at any time during the reception of a message desires repeat of a certain word or group, what does he do? ----------

16. How many stations must there be on a circuit before it is necessary to use call signs? ----------

17. What is the meaning of the procedure sign $\overline{AR}$? ----------

18. What is the meaning of the procedure sign G? ----------

19. What is the meaning of the procedure sign $\overline{IMI}$? ----------

20. What is the meaning of the procedure sign Q? ----------

21. What is the meaning of the procedure sign II? ----------

22. What is the meaning of the procedure sign R? ----------

23. What is the meaning of the procedure sign V? ----------

24. What is the meaning of the procedure sign K? ----------

GROUND RETURN AND SIMPLEX CIRCUITS

Equipment.

1 wire net (Fig. 46), including 2 monocord switchboards, installed about 50 yards apart.
75 yards twisted-pair outpost or field wire.
2 field telephones (switchboard operators).
1 field telephone (for local subscriber).
1 46–A repeating coil
1 buzzerphone
1 type EE – 5 Telephone
} for each student.

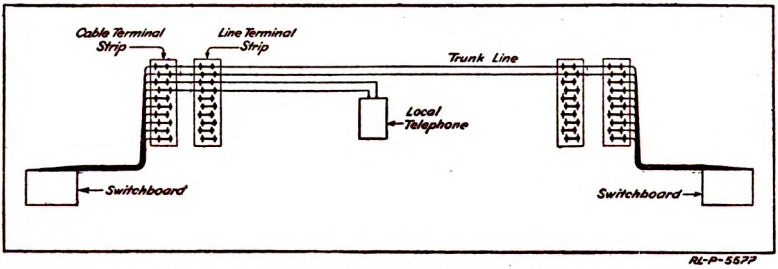

Fig. 46.—Metallic trunk and local circuits

Information.

A ground return circuit is one which uses a wire for one side of the circuit and the ground as the other side. For example, if two field telephones are to be connected together by means of a ground return circuit, the line wire is connected to one of the terminals on each telephone and the other terminal is connected to ground.

It often becomes necessary in the field, due to a shortage of existing circuits, or to trouble on existing circuits, to work telephones on ground return circuits.

When a shortage of circuits occurs and it is imperative to provide an additional circuit at once, it is possible to convert a single metallic circuit into two ground return circuits which, if they are not too long, will probably work satisfactorily.

When a circuit goes out of order due to a short on the line or on one side of the circuit, the two line wires can be tied together at the ends and used as one side of the circuit and the ground used as the other side, thus providing a ground return circuit. However, telephone conversation over ground return circuits is much more readily picked up by inductive or ground leakage methods than are conversations, over metallic circuits, and transmission over ground return circuits is not usually as good as that over metallic circuits. Therefore, grounded circuits should not be used for telephones except in emergencies. The following method should be used for connecting ground return circuits:

Directions.

TO CONVERT A METALLIC CIRCUIT INTO A GROUND RETURN CIRCUIT

Being at a switchboard:

1. *a.* Connect the wire or pair of wires which is to form the metallic side of the circuit to the top binding post of a pair on the line terminal strip. Connect the other binding post of the same pair to ground. (Fig. 47.)

b. If the circuit is a trunk, at the distant switchboard connect the line wire or pair of wires to one of the binding posts on the line terminal strip. Connect the other binding post of the same pair to ground. Then ring back on the line (or have the switchboard operator do so) and notify the operator who answers, that the circuit is installed and working.

c. If the circuit is a local at the subscriber's telephone, connect the line wire or wires to the binding post marked L_1 and connect L_2 to ground. Ring back to the switchboard and when the operator answers, notify him that the circuit is installed. (See Fig. 47.)

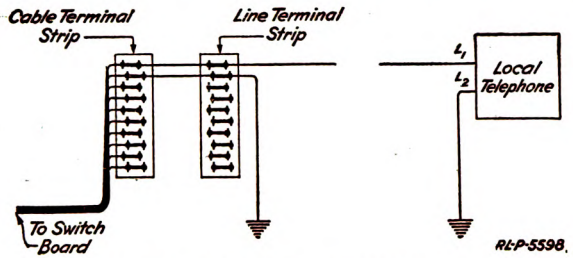

Fig. 47.—Ground return local circuit

Questions.

(1) *When might it be desirable to install a ground return circuit?*

(2) *Would less personnel be required to install a ground return circuit than a full metallic circuit?*

(3) *If only single conductor field wire, type W–40, were available, would it be necessary to install only ground return circuits?*

(4) *Would long circuits or short ones work better as ground return circuits?*

(5) *Is a good connection to ground necessary on ground return circuits?*

(6) *How could a good ground connection be made?*

(7) Why should a circuit be grounded at the line terminal strip rather than at the switchboard?

(8) Can more than one ground return circuit be connected to the same ground?

(9) If a metallic circuit were to become shorted, how could it be connected so as to use it with ground return?

(10) If a metallic circuit were to become open, would it still be used as a ground return circuit? Explain.

SIMPLEXING A BUZZERPHONE ON A TELEPHONE TRUNK CIRCUIT

Information.

When employing the buzzerphone, either a full metallic or a ground return circuit may be used. It is usual to make use of existing telephone circuits where possible and by means of "simplexing" to provide a circuit for the buzzerphone without laying an additional circuit. In this way a telephone circuit can be used for buzzerphone transmission at the same time that it is being used for telephone conversations. This is accomplished by inserting a repeating coil at both ends of the circuit as shown in Fig. 48. It can be seen that both sides of the telephone circuit are used as one side of the buzzerphone circuit.

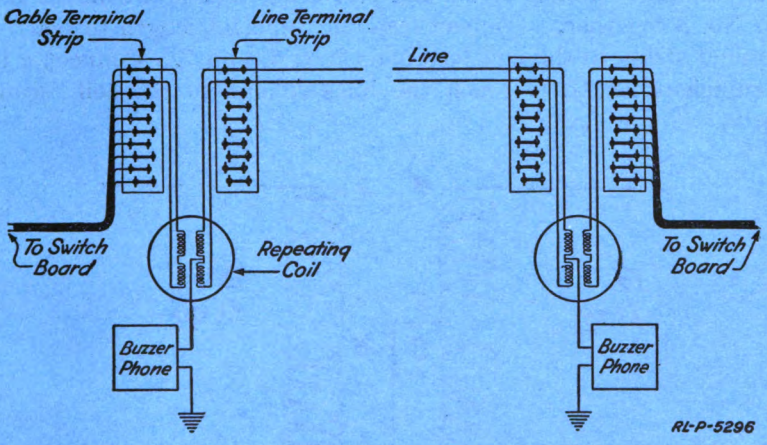

Fig. 48.—Buzzerphone simplexed circuit

The repeating coils consist of two primary and two secondary windings of a one-to-one ratio on a circular iron core, covered with a round cover. The ends of the coils are brought out to terminals numbered 1 to 8 as shown in Fig. 49.

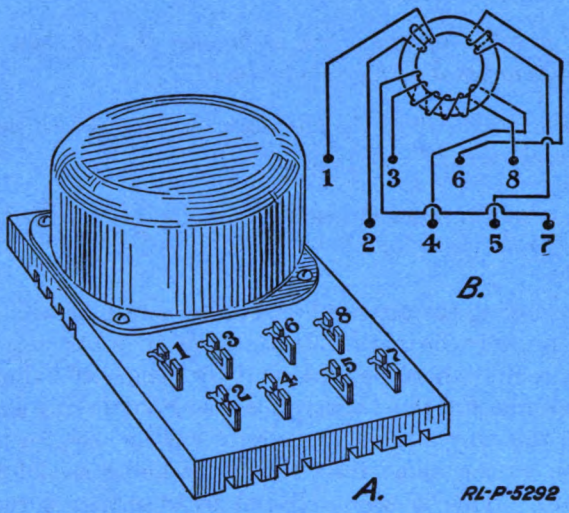

Fig. 49.—Repeating coil

Directions.

2. Mount the repeating coil near the line and cable terminal strips. Connect the terminals No. 1 and No. 6 together and connect No. 3 and No. 8 together. Connect leads of sufficient length to reach the terminal strips to the coil terminals 2, 4, 5, and 7. Connect a lead of sufficient length to reach the buzzerphone to the coil terminal 3 or 8. (See Fig. 50.)

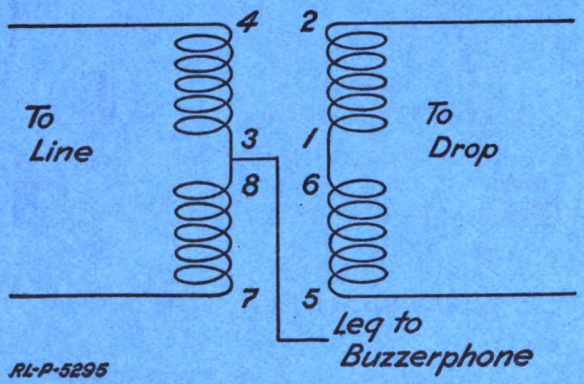

Fig. 50.—Repeating-coil connections

3. Remove the jumper connections between the line and cable terminal strips and connect the Nos. 4 and 7 leads to the line terminal strip and the Nos. 2 and 5 leads to the cable terminal strip. Connect the lead from the No. 3 or 8 terminal to the "Line" binding post of the buzzerphone. (See Fig. 48.)

4. When the same kind of connections for a buzzerphone have been made at the other end of the trunk circuit, proceed to operate the buzzerphone as on a regular ground return or metallic circuit.

Questions.

(*11*) *If a buzzerphone were connected to a simplexed telephone circuit, would it be permissible to use the buzzerphone hand set for testing?*

(*12*) *When connecting a simplexing (or repeating) coil in a telephone circuit, what would happen if the connection were not made as described above?*

(*13*) *Assume that there is one trunk circuit from a regiment to one of its battalions and a telephone circuit from the battalion to an observation point. How could a through buzzerphone circuit be provided from the O. P. to the regiment without interfering with the central at the battalion?*

(*14*) *Why is it unnecessary to have a full metallic circuit for a service buzzer?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Prepare the wire net as shown in Fig. 46 prior to starting the Unit Operation. Provide one trunk circuit and one local circuit for each pair of students.

2. Provide an operator for each switchboard.

3. Divide the class into pairs and assign each pair one trunk circuit and one local circuit. Have one student perform Directions 1 *a* while the other student is performing 1 *b*. When the circuit is installed, have students remove the connections, change places, and repeat operation.

4. Upon the completion of Directions 1 *a* and 1 *b*, direct the students to perform Directions 3, one student of each pair working at each end of their circuit.

5. When the buzzerphones have been simplexed onto the circuit, have each student send several messages.

6. Demonstrate to the class that the operation of the buzzerphone does not interfere with conversation over the telephone circuit.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 20–A (PERFORMANCE)

Equipment.

1 monocord switchboard with cable and terminal strip.
1 terminal strip (extra).
1 buzzerphone.
1 repeating coil.
1 ground rod.
6 leads with Frankel clips attached, 4 feet long.
1 lead with Frankel clips attached, 8 feet long.
100 feet of twisted-pair field or outpost wire.

Procedure.

1. Install the switchboard in advance with cable and line terminal strip in position. Mount the repeating coil below the terminal strips. Drive the ground rod in the ground below the terminal strips. Place the buzzerphone on a box or chair near the ground rod. Connect two 50-foot pieces of twisted-pair wire to the line terminal strip to represent two circuits. Jumper the one of these circuits to the cable terminal strip. Place the leads near by.

2. In making connections have the students use the leads with Frankel clips, merely clipping the leads to the proper terminals, thus

saving the time necessary to make permanent connections. If Frankel clips are not available, the regular connections can be made without clips.

3. Tell the student who is to be tested that there is a short on the first circuit (the one jumpered to the cable terminal strip). Direct him to connect it for use as a ground return circuit.

4. When the student has completed directions under Par. 3, direct him to simplex the other circuit and connect the buzzerphone to the simplexed circuit.

Scoring.

1. The maximum score is 50 points.
2. The score required to pass the test is 40 points.
3. DIRECTIONS FOR SCORING:

	Points
a. If the first circuit is properly connected as a ground return circuit	20
b. If the repeating coil is properly connected into the second circuit	20
c. If the buzzerphone is properly connected	10

No partial score allowed.

INSTRUCTION TEST NO. 20-B (INFORMATION)

Directions.—Below are a number of unfinished statements each followed by several numbered words or phrases, one of which correctly completes the statement. Write the *number* of this word or phrase on the short *dotted line* at the right of each statement.

1. A circuit which uses a wire for one side of the circuit and the earth as the other side is called a
   (1) metallic circuit. (2) simplex circuit.
   (3) field circuit. (4) ground line.
   (5) ground return circuit. ------

2. How many ground return circuits can be made out of two metallic circuits?
   (1) None. (2) Four. (3) Two. (4) One. (5) Three. ------

3. Often when a trunk circuit becomes "shorted" or has an "open" on one side it can then be operated as a
   (1) simplex circuit. (2) phantom circuit.
   (3) ground return circuit. (4) local circuit.
   (5) switching circuit. ------

4. When the two wires of a circuit are used to provide one side of another circuit, it is called a
   (1) phantom circuit. (2) double circuit.
   (3) combination circuit. (4) simplex circuit.
   (5) ground return circuit. ------

5. When arranging a simplex circuit, the following piece of apparatus is used:

(1) Repeating coil. (2) Tuning switch.
(3) Fahnstock clips. (4) Frankel clips.
(5) Variometer. ------

6. A long circuit which uses the earth as one side of the circuit is apt

(1) to be difficult to maintain.
(2) to be difficult to lay.
(3) to be noisy. (4) to become worn out.
(5) to require additional battery. ------

7. Field linemen may be called on to simplex a circuit in order to provide an additional circuit for use with

(1) a service buzzer. (2) a type EE – 65 test set.
(3) a call buzzer. (4) a buzzerphone.
(5) a radio phone. ------

8. When connecting a buzzerphone to a simplex circuit, one terminal of the buzzerphone is connected to the repeating coil and the other terminal is connected to

(1) the line. (2) ground. (3) the switchboard.
(4) the cable terminal strip. (5) the line terminal strip. ------

THE SERVICE BUZZER, TYPE EE – 63

Equipment (for each student).

1 service buzzer.
250 feet of single conductor field or outpost wire.

Information.

The service buzzer is an instrument used in connection with field-wire communication systems. It may be used for telephone communication, but its primary purpose is for the transmission of International Morse code signals.

The principal value of the service buzzer is its dependability for buzzer signals. If for any reason the transmission over a telephone circuit becomes too poor for talking, it is very often the case that the buzzer signals can be transmitted over the circuit without difficulty. Messages can even be transmitted at times when there is an actual break in the wire.

The instrument is contained in an aluminum case inclosed in a leather container. It is arranged for operation with the cover closed, this being accomplished by having a piece of flexible pigskin just over the key and an opening for receiver and transmitter cords.

Directions.

1. Open the leather case. Throw the BT switch to the right to the T position. Place the plug in the jack and see that it is firmly seated. Connect the test clamp to the ground rod. Then hold the receiver to the ear and at the same time push the transmitter button and blow in the transmitter. If the battery is O. K., the sound should be heard in the receiver. Due to faulty connections in the set, a good many sets have the BT switch connected in reversed. If this test fails to work, throw the BT switch to the B position and repeat the test. It may not be necessary to short the line and ground leads in order to make this test, since in some sets the receiver is so connected in the circuit that this is not necessary.

2. Press the key and the buzzer should work but should not be heard in the receiver. If it is heard in the receiver, the key is not breaking contact underneath when the key is depressed, and it should be adjusted by increasing distance at the main contacts or by bending the spring contacts.

3. If the battery and key are in working order but the buzzer fails to operate when the key is depressed, it probably needs adjustment. Adjust the screw nearest the spring (or tongue) seat so that the buzzer gives the proper tone. Then loosen the locking screw

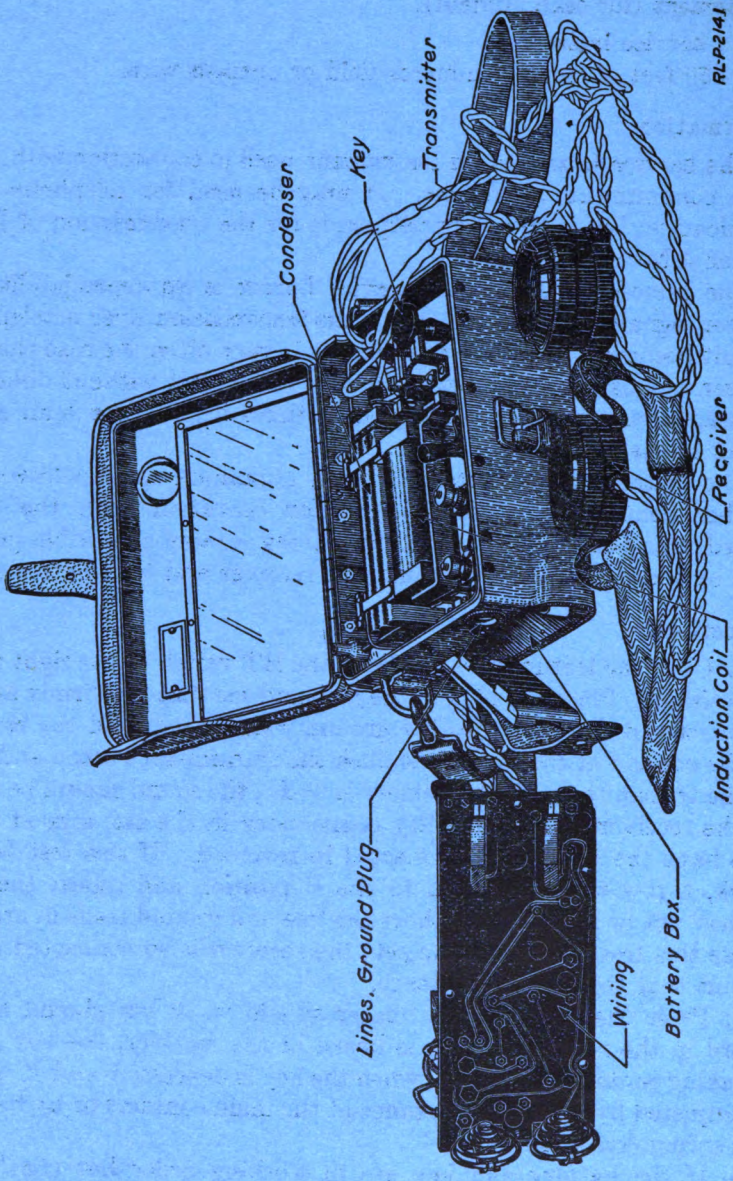

Fig. 51.—The service buzzer, type EE – 63

and adjust the screw in the split post so that the buzzer responds with the greatest efficiency and lock it in position. If the buzzer sparks excessively at the contacts, the trouble is probably an open circuit in the bridging condenser. Remove this condenser (the one farthest from the induction coil). Replace this condenser with one of the other condensers and note if the trouble is remedied. If so, leave the condensers as they are. If the tongue of the buzzer sticks on the induction coil side, the trouble is probably a short in the bridging condenser. Replace this condenser as described above, and, if this remedies the trouble, leave the condensers as they are. Replace the defective condenser at the first opportunity.

4. Place the connecting plug into the line jack. Connect the test clamp to the line wire and drive the ground rod into the ground. Call the distant station in the approved manner and proceed to transmit any messages on hand.

5. If at any time it is necessary to "break" the transmitting operator, make several long dashes with the key. The transmitting operator will hear these in his receiver whenever this key is up on its top contact and he will know that he is being "broken."

Questions.

(1) *Is the service buzzer primarily a buzzer or telephone instrument?*

(2) *Can telephone and buzzer communication be carried on simultaneously on the same circuit?*

(3) *What is the result if the BT switch is operated to the T position while buzzer signals are being transmitted?*

(4) *In what way would a service buzzer be of use to a central which had only telephone circuits connected to it?*

SERVICE-BUZZER OPERATION

Information.

Due to its high induction, the service buzzer interferes with near-by telephone, telegraph, buzzerphone, and radio systems and therefore is usually employed only on separate buzzer circuits which are not in close proximity to any other circuits. As a telegraph instrument it is the most efficient yet developed for use over leaky lines, and for use over long lines of field wire, over which it is impossible to operate telephones, buzzerphones, or ordinary telegraph.

The procedure used in service-buzzer operation is the same as that used for buzzerphone. (See Unit Operation No. 19.) However, service buzzers are seldom operated with more than two instruments on a circuit.

Directions (for each pair of students).

6. Lay out the 500 feet of wire and connect a service buzzer at each end.

7. A number of messages will be provided by the instructor to each student. Transmit the messages provided, taking turn about in transmitting with the student on the other end of the circuit.

8. Be careful to use correct procedure and make sure that each message is checked and necessary repetitions made before it is acknowledged for.

Questions.

(5) *Could a buzzer be used to test out a circuit for shorts, opens, and grounds?*

(6) *In what way would it be advantageous to use a service buzzer between two points a great distance apart?*

(7) *How many men does it take to operate a service buzzer efficiently?*

(8) *What advantages has a service buzzer over a telephone?*

(9) *What are the disadvantages of a service buzzer?*

SUGGESTIONS FOR THE INSTRUCTOR

1. Test the service buzzers to be used and see that there is nothing seriously wrong with them.

2. Place various faults on the service buzzers that can be tested for by the student, such as bad batteries, breaking contact out of adjustment, buzzer out of tone, condenser removed, etc.

3. When a student finds a fault, allow him to remedy it and put the buzzer in proper working order.

4. Repeat this procedure until all students have had experience with removing the various faults of the service buzzer.

5. Assemble the class and go over the "Procedure Signs" as given under Unit Operation No. 19.

6. Divide the class into groups of two men each and assign them call letters; for example, XF–1 and XF–2. Require the groups to connect to the ends of a 500-foot circuit.

7. Give each pair of students several messages and message blanks with instructions to send these messages to each other in turn.

8. At intervals the instructor or his assistant should connect on to one of the circuits, call the students and transmit a message in the prescribed manner. The instructor should intentionally make errors and correct them. He should also garble words or groups so as to necessitate calls for repeats, etc.

9. Continue this operation until the students are proficient in operating the service buzzer in the prescribed manner.

SUGGESTIONS FOR CONDUCTING INSTRUCTION TEST NO. 21–A (PERFORMANCE)

Equipment.

Six service buzzers (for each group of six students).

Procedure.

1. Prepare in advance six service buzzers for each group, each with one of the following faults:

   a. Poor battery.
   b. Breaking contact out of adjustment.
   c. Bad condenser.
   d. Buzzer out of tone.
   e. Key out of adjustment.
   f. One O. K.

2. Tag these buzzers as follows: "Service Buzzer A," "Service Buzzer B," etc.

3. Divide the class into groups of six students and assign each group to one set of equipment. Assign each man in the group to a service buzzer.

4. Instruct the group to test service buzzers for faults and to record on a slip of paper their results, keeping these results to themselves.

5. Allow three minutes per service buzzer, then rotate the men in the group.

6. Repeat until each student has tested each service buzzer.

7. Assemble class and collect record slips, making sure students have signed their names to their slips.

Scoring.

	Points
Total score possible	30
Score required to pass test	20
For each service buzzer's fault correctly located	5

No partial score allowed.

NOTE.—For testing service buzzer operation use Instruction Test No. 19–A with service buzzers instead of buzzerphones.

INSTRUCTION TEST NO. 21–B (INFORMATION)

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the short *dotted line* in the right margin. If what it says is not true (incorrect), place a minus sign (−) on the dotted line.

1. The service buzzer can be used only for the transmission of International Morse code signals. ------
2. If transmission over a telephone circuit becomes too poor for talking, it is very often the case that service buzzer signals can be transmitted without difficulty. ------
3. The service buzzer can be operated with the cover of its case closed. ------
4. When the service buzzer key is pressed, the buzzer should operate and the sound should be heard loudly in the telephone receiver. ------
5. If the buzzer sparks excessively at the contacts, it is probably not adjusted tight enough. ------
6. If there should be an open circuit in the bridging condenser, this can be remedied by changing it with one of the other condensers. ------
7. The service buzzer, due to its high inductive effect, will disturb nearby telephone circuits if it is operated on a circuit through a telephone switchboard. ------
8. The service buzzer will work over leaky lines. ------

9. To "break" the transmitting operator, the receiving operator on a buzzerphone transmits three long dashes. ------

10. The service buzzer and the buzzerphone each require a different kind of procedure. ------

11. The service buzzer uses one BA – 2 battery. ------

12. Telephone and buzzer transmission can be carried on simultaneously with a service buzzer. ------

13. The service buzzer is an excellent instrument to use for testing telephone circuits. ------

14. Service buzzer communication cannot be made secret. ------

15. As a telegraph instrument, the service buzzer is the most efficient yet developed for use over leaky lines. ------

16. It requires two men to operate a service buzzer. ------

PROFICIENCY TEST NO. 1

This Proficiency Test is arranged in three parts as follows:

Part I (for Infantry and Field Artillery).

Part II (for Infantry only).

Part III (for Field Artillery).

The questions in Part I are of a general nature and most of them will apply to any unit using the Manual.

If the test is to be used for an Infantry unit, Part I and Part II are used. If it is to be used for a Field Artillery unit Part I and Part III are used. If it is to be used for a unit of any other arm, the instructor should go through the test carefully and pick out the questions that apply and use only those questions.

PART I

INFANTRY AND FIELD ARTILLERY

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the *dotted line* in the right margin. If what it says is not true (incorrect), place a minus sign (−) on the dotted line.

1. It is never possible to talk over a circuit which is crossed with another circuit ----------
2. The body should be held well away from the pole when climbing ----------
3. Service buzzer communication is secret ----------
4. When a central closes, the cable and line terminal strips are usually removed and the circuits are spliced through ----------
5. Subscribers' telephones are sometimes connected on the ends of trunk circuits ----------
6. Circuits are numbered according to the units they connect ----------
7. When a lineman is descending a pole the safety should be allowed to hang by one end until the ground has been reached ----------
8. Test stations are operated by the construction detail ----------
9. The service buzzer will not work over ground return circuits ----------
10. The wire pike is used by dismounted linemen when recovering wire with a wire cart ----------
11. When a circuit is being laid it is connected into the line terminal strip by the switchboard operator ----------

12. If, when locating trouble on a circuit, a lineman finds that the trouble is in the switchboard, he notifies the switchboard operator. The operating detail then clears the trouble ----------

13. A circuit when it is laid should be tied in or anchored securely near the initial terminal strip ----------

14. Field or outpost wire should be laid with plenty of slack ----------

15. A test station on a trunk line consists of one or more terminal strips with the circuits connected into them ----------

16. Climbers should be put on with the spurs on the inside of the feet. ------

17. A "cross" is often reported as such by the switchboard operator because he can hear "cross talk" on the circuit. ------

18. Tie wires are used when tying in field or outpost wire to knobs. ------

19. The lineman's belt should be worn tight around the waist. ------

Directions.—The following questions can be answered by a single word or phrase. Write the answer on the *dotted line* at the right of each question.

20. For what kind of communication is the service buzzer used primarily? ----------

21. What is the meaning of the buzzerphone or service buzzer procedure sign I M I? ----------

22. Who is responsible for locating and clearing trouble on trunk lines? ----------

23. What instrument should be carried by field linemen when going out on trouble? ----------

24. What is the strap called which a lineman uses, when on a pole, in order that he may have both hands free to work? ----------

25. When two or more circuits are laid along the same route what is the installation called? ----------

26. What is the meaning of the service buzzer or buzzerphone procedure sign K? ----------

27. What is apt to be the condition of long ground return circuits? ----------

28. What is the map or diagram called on which is shown the routes of trunk lines which are already laid or are to be laid? ----------

29. What is a circuit called which connects two centrals? ----------

30. What is the meaning of the buzzerphone or service buzzer procedure sign G? ----------

31. A test station is arranged so that it can be converted into what? ----------

32. What is the meaning of the buzzerphone or service buzzer procedure sign V? ----------

33. What kind of tie is used when tying in the end of a field wire circuit before connecting it to the terminal strip? ----------

34. When fitting linemen's climbers on the leg the upper end of the shank should rest about how far below the joint of the knee? ----------

35. By what means are circuits marked so that linemen can identify them? ----------

36. What is the map or diagram which shows the numbers assigned to circuits for identification purposes? ----------

37. Who is responsible for the upkeep of local circuits? ----------

38. What kind of circuit is one which consists of a single conductor, the instruments on either end being grounded? ----------

39. What code is used for the transmission of service buzzer signals? ----------

40. What is a circuit called which connects a subscriber and a central? ----------

41. What does a lineman require in order to test the condition of the wire on a spool? ----------

42. When locating trouble on a local circuit, what is tested first? ----------

43. What is done to a splice in field or outpost wire to prevent it from causing shorts or grounds? ----------

Directions.—Below are a number of unfinished statements each followed by several numbered words or phrases, one of which correctly completes the statement. Write the *number* of the word or phrase on the *dotted line* at the right of each question.

44. When splicing twisted-pair field or outpost wire
    (1) the joint is soldered.
    (2) a Western Union splice is used.
    (3) the wires that have the tracer thread are spliced together.
    (4) a clove hitch is used.
    (5) a staggered splice is never used. ------

45. If a single circuit running from Brigade to Regiment were numbered 301, the circuit running from Regiment to one of its battalions might be numbered
(1) 401. (2) 302. (3) 310. (4) 351. (5) 301. ------

46. When a trunk circuit is being laid it is tagged at the initial terminal strip by
(1) the switchboard operator. (2) a lineman.
(3) the communication officer.
(4) the chief of the wire section.
(5) a record clerk. ------

47. A central which has trunk lines connected to it but no local subscribers is called a
(1) trunk central. (2) switching central.
(3) primary central.
(4) secondary central.
(5) telephone communication center. ------

48. When the conversation on one telephone circuit can be heard on another circuit, the trouble is most likely
(1) a ground. (2) an open. (3) a short.
(4) a cross. (5) a return. ------

49. The kind of tie used by a field lineman when tying in to trees, along the route, when laying outpost wire is called a
(1) clove hitch. (2) timber hitch.
(3) bowline tie. (4) double half hitch.
(5) square-knot tie. ------

50. Linemen at test stations
(1) switch calls.
(2) make tests and patch circuits during trouble.
(3) supervise calls. (4) prevent trouble occurring.
(5) connect subscribers. ------

51. The greatest advantage of the service buzzer lies in its
(1) ability to work over poor circuits.
(2) ability to work over telephone circuits without interference.
(3) speed of operation. (4) accuracy. (5) secrecy. ------

52. The spurs on a pair of climbers should be sharpened by
(1) grinding or filing the half round or outer side
(2) by grinding the flat or inner side.
(3) by heating and hammering to a point.
(4) by filing the point only.
(5) by placing in a lathe. ------

53. The construction detail, when laying a circuit, is responsible for nothing further than that the circuit
(1) is laid. (2) is laid and tested.
(3) is laid, tested, and tagged
(4) is laid, tested, tagged, and connected to the line terminal strip.
(5) is laid, tested, tagged, connected to the line terminal strip, and jumpered to the switchboard ------

54. The small upper curved prong or hook on the pike is used for
(1) placing wire overhead. (2) tying in.
(3) riding the loop.
(4) picking up wire from the ground. (5) testing. ------

55. When crossing over a road with a field circuit, the wire should clear the road by at least
(1) 5 feet. (2) 10 feet. (3) 8 feet.
(4) 40 feet. (5) 18 feet. ------

56. A line having a field telephone connected to it is in trouble if when blowing in the transmitter, this sound can be heard in the receiver, the trouble is
(1) a capacity. (2) a ground. (3) a cross.
(4) a short. (5) an open. ------

57. Twisted-pair field or outpost wire is attached to an empty spool or reel by
(1) splicing the wire to the spool.
(2) a clove hitch around the spool.
(3) placing the ends through the hole in the side of the spool and tying a knot.
(4) means of connectors. (5) a square knot tie. ------

58. If a ringing test is made with a type EE – 5 telephone on a shorted circuit
(1) the buzzer will sound and the crank will turn hard.
(2) the buzzer will not sound and the crank will turn hard.
(3) the buzzer will sound and the crank will turn easily.
(4) the buzzer will not sound and the crank will turn easily.
(5) the crank will turn easily. ------

59. The switchboard operator gets into communication with a lineman at a test station by
(1) calling him on a special circuit.
(2) by messenger.
(3) by ringing three rings on the control circuit.
(4) buzzer. (5) waiting until the lineman reports in. ------

60. When a circuit is being laid, it should at turns or corners always be
(1) tested. (2) tagged. (3) placed overhead.
(4) tied in. (5) placed under ground. ------

61. The kind of splice used in field or outpost wire is
(1) Western Union. (2) three wire. (3) square knot.
(4) clove hitch. (5) sleeve.

62. The kind of tie used by a field lineman when tying in to a knob while laying twisted-pair field wire is
(1) a clove hitch. (2) a Western Union tie.
(3) a three-wire tie. (4) a square-knot tie.
(5) a bowline tie. ------

63. Wire is attached to a partly filled spool or reel by
(1) splicing it to the wire on the spool.
(2) putting the ends through the hole in the side of the spool.
(3) making a clove hitch around the spool.
(4) tying it to the wire on the spool.
(5) means of connectors. ------

64. The ends of the wire on a spool are placed through the hole in the side of a spool to provide for
(1) Securing the ends. (2) tagging the wire.
(3) identifying the wire. (4) testing the wire.
(5) refilling the spool. ------

65. If two circuits from Brigade to Regiment were numbered 501 and 502, a lateral circuit from Regiment to a regiment on its flank might be numbered
(1) 601. (2) 515. (3) 610. (4) 01. (5) 650. ------

66. When a lineman, who has been ordered to lay a circuit, completes his job, he reports the circuit installed to the
(1) chief lineman. (2) chief of construction detail.
(3) communications officer. (4) message center.
(5) switchboard operator. ------

67. A lineman at a field test station should be equipped with
(1) a testing bridge. (2) a wire cart.
(3) a monocord switchboard.
(4) a wire chief's testing equipment.
(5) a type EE – 5 telephone.

68. Test stations are located
(1) on trunk lines. (2) on bare wire lines only.
(3) on local circuits.
(4) only between sections of the wire net.
(5) at centrals. ------

69. The code used in service buzzer or buzzerphone telegraph communication is the
(1) International Morse Code. (2) telephone code.
(3) Division Field Code. (4) telegraph code.
(5) Radio Service Code. ------

70. Field or outpost wire should always be
(1) strung overhead. (2) laid taut. (3) laid slack.
(4) tied into knobs on posts. (5) placed underground. ------

Directions.—Below are a number of problems. Read the directions pertaining to each and perform the exercise required.

71. The figure below represents a test station on a trunk circuit with the connections incomplete. Draw the necessary lines to show how the circuit should be connected into the terminal strip.

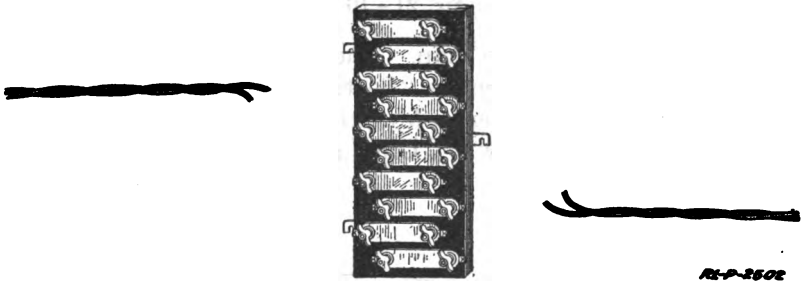

Fig. 19 – IG

72. The figure below is a circuit diagram showing three circuits between MAGIC and MOBILE centrals. All three circuits are out of order due to faults as indicated in the figure. Draw the necessary lines to show how the circuits could be patched through at the test stations in order to provide one through circuit.

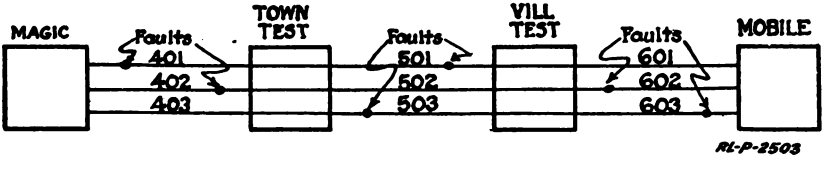

Fig. 20 – IG

73. The figures below represent lineman's climbers on which the spurs have been sharpened. Indicate by drawing a circle around it, which one of these has been sharpened correctly.

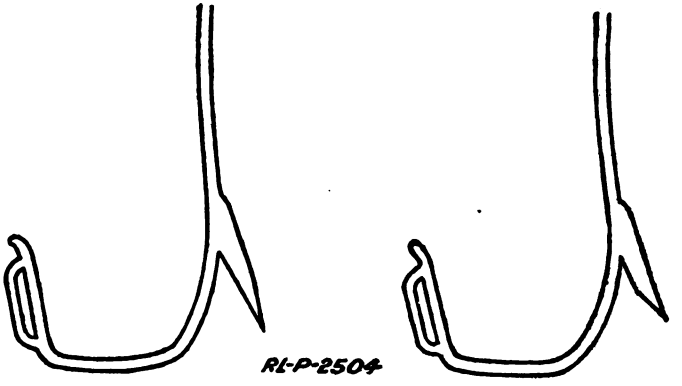

Fig. 21 – IG

74. Below is a line route map. The section of the wire net between Brigade and Regiment is "Section 3." The code names of units is as follows: Regiment—MODERN, right Battalion—MOGUL, and left Battalion—MOHAWK. Draw a circuit diagram of the net.

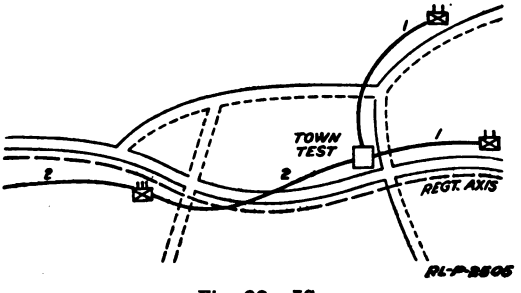

Fig. 22 – IG

75. Complete the diagram below showing how the local telephone should be connected into the switchboard on a ground return circuit.

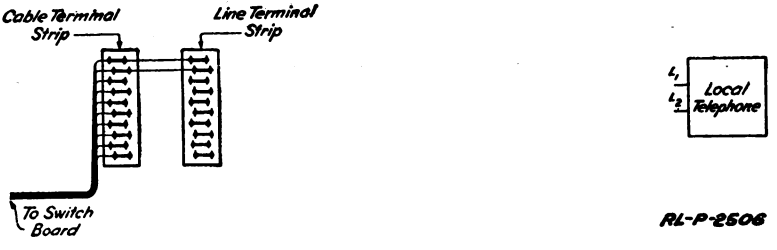

Fig. 23 – IG

76. What kind of tie is shown in the figure below?

(.....)

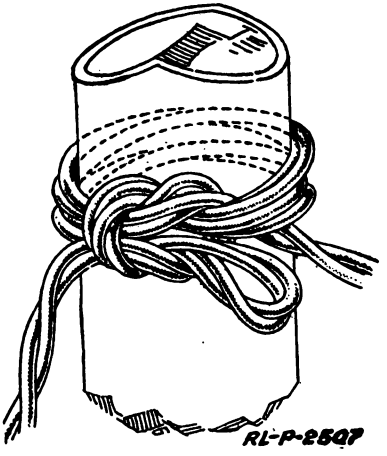

Fig. 24 – IG

77. What kind of tie is shown in the figure below?

(.....)

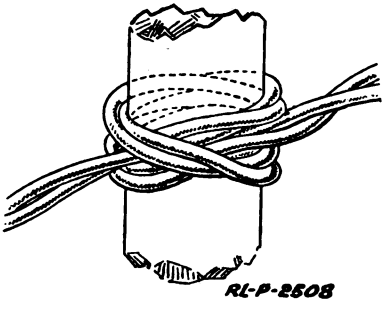

Fig. 25 – IG

78. The figure below represents a splice in a twisted-pair wire. Is the splice made properly? If not, what is wrong with it?

(.....)

Fig. 26 – IG

79. The diagrams below represent two splices made in a piece of outpost wire seized with copper wire with the tape omitted. Draw a circle around the splice which is made correctly.

Fig. 27 – IG

80. The diagram below is a circuit diagram showing a Brigade and two Regiments. Is this diagram correct? If there are any errors, what are they? (.....)

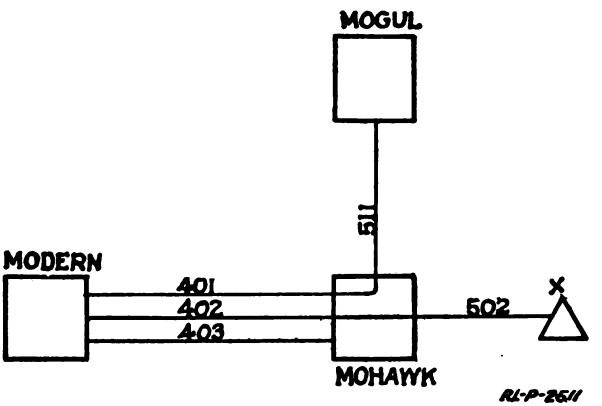

Fig. 28 – IG

PART II

INFANTRY ONLY

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the *dotted line* in the right margin. If what it says is not true (incorrect), place a minus sign (−) on the dotted line.

81. The buzzerphone is primarily a telephone instrument. .....
82. If the buzzerphone does not work, the microphones should be adjusted. .....
83. The universal test set can be used to measure the voltage of a battery. .....
84. When a spool on the pack reel cart is emptied, it can either be refilled or replaced with a full spool. .....
85. When recovering wire with a wire cart, a loop of the wire must always be kept behind the cart. .....

86. The detail for a pack reel cart should be increased by one man for testing purposes when the circuit does not begin at a switchboard. ------

87. The buzzerphone will work well over "leaky" lines. ------

88. When recovering wire with a wire cart, the wire should be wound on the reel loosely. ------

89. The buzzerphones can be used on a telephone circuit in addition to straight telephone communication. ------

90. One circuit can be laid and another recovered simultaneously with the pack reel cart.

91. One circuit could be laid and another recovered simultaneously with the two-horse wire cart. ------

92. The reels on a wire cart operate independently of each other. ------

93. The pike is used by pike men for tying in field or outpost wire. ------

94. If the reels on a wire cart get to spinning too fast when laying wire, they are braked by throwing them in gear. ------

95. A good method of filling a reel on the two-horse wire cart from a commercial spool is to raise one wheel of the cart from the ground, throw the reel in gear, and turn the cart wheel, winding in the wire. ------

96. When filling a reel on a two-horse wire cart, the reel is turned so that the wire goes on from the bottom. ------

97. The universal test set can be used to measure the inductance of a circuit. ------

98. The spools of a pack reel cart are mechanically rotated. ------

99. Only one circuit can be laid at a time with the pack reel cart. ------

100. The universal test set can be used to measure the resistance of a circuit. ------

Directions.—Each of the following questions can be answered by a single word or phrase. Write the answer on the *dotted line* at right of each question.

101. What piece of wire-laying equipment is so built that it can be "knocked down" for packing on an animal for transportation? ----------

102. How many spools on a type RL – 16 reel cart? ----------

103. What can a buzzerphone be used for in addition to being used for telegraph communication? ----------

104. What do mounted men use to guide wire on the reels or drums of a wire cart? ----------

105. How are the reels of a wire cart rotated when recovering wire? ----------

106. How many reels are there on the two-horse wire cart? ----------

107. The inside ends of a spool of twisted-pair wire are shorted together and a type EE – 4 telephone is connected to the other end. What is the trouble when a ringing test is made and the bell rings, and the crank turns easily? ----------

108. How many pikemen in the two-horse wire-cart detail? ----------

Directions.—Below are a number of unfinished statements each followed by several numbered words or phrases, one of which correctly completes the statement. Write the *number* of this word or phrase on the *dotted line* at the right of each question.

109. The quality which buzzerphone communication has that makes it suited for use in forward areas is
(1) speed. (2) secrecy. (3) accuracy.
(4) simplicity. (5) brevity. ------

110. In order to simplex a circuit, the piece of apparatus required is a
(1) terminal strip. (2) simplexing telephone.
(3) double pole switch. (4) repeating coil.
(5) double transmitter. ------

111. The advantage of simplexing a circuit is that
(1) noise is eliminated. (2) transmission is better.
(3) communication is quicker.
(4) service buzzers can be used on telephone circuits.
(5) another channel of communication is provided. ------

112. The detail which includes men equipped with a pike is
(1) the pack reel-cart detail. (2) breast-reel detail.
(3) operating detail. (4) test-station detail.
(5) the wire-cart detail. ------

113. When a buzzerphone is connected to a telephone circuit by means of a repeating coil so that the circuit can be used for telephone and buzzerphone at the same time, the circuit is said to be
(1) grounded. (2) phantomed. (3) simplexed.
(4) repeated. (5) double connected. ------

114. On the two-horse wire cart each of the pedals which are located at the center of the footboard acts as a
(1) clutch for one of the reels only.
(2) brake for one of the reels only.
(3) gear shift for one of the reels.
(4) clutch and brake for one of the reels.
(5) brake for the cart wheel. ------

115. The spools on a pack reel cart
(1) are mechanically rotated. (2) are removable.
(3) operate independently of each other.
(4) hold about 2 miles of wire.
(5) are normally kept in gear. ------

116. When completely filled with outpost wire, the pack reel cart holds approximately
(1) ¼ mile. (2) 5 miles. (3) 1 mile.
(4) 2 miles. (5) ½ mile. ------

117. The number of men in the two-horse wire-cart detail for laying a single circuit is
(1) four. (2) seven. (3) two. (4) six. (5) five. ------

118. The reels on a two-horse wire cart are thrown out of gear by means of
(1) the pedals on the footboard. (2) the clutch pedal.
(3) the foot-brake lever. (4) the hand crank.
(5) levers in the rear of the cart. ------

119. The approximate amount of outpost wire that a two-horse wire cart will hold is
(1) 2½ miles. (2) 4 miles. (3) ½ mile.
(4) 3½ miles. (5) 10 miles. ------

120. The number of keys on a universal test set is
(1) one. (2) two. (3) three. (4) four. (5) five. ------

121. The number of men in the detail for operating a pack reel cart is
(1) 2 linemen and 1 N. C. O. (2) 2 linemen.
(3) 1 lineman and 1 N. C. O.
(4) 3 linemen and 1 N. C. O.
(5) 2 linemen and 2 N. C. O.'s. ------

122. The number of men in the two-horse wire-cart detail for recovering a circuit is
(1) four. (2) two. (3) seven. (4) five. (5) six. ------

PART III

FIELD ARTILLERY ONLY

Directions.—Below are a number of sentences. Read each sentence carefully and if what it says is true (correct) place a plus sign (+) on the *dotted line* in the right margin. If what it says is not true (incorrect), place a minus sign (−) on the dotted line.

81. Signal Corporal No. 1 is in charge of the reel cart. ------

82. When a drum on the artillery reel is emptied, it can be replaced with a full drum. ------

83. The drums on a artillery reel can be filled by using a hand crank to turn the drums. ------

84. The drums of an artillery reel recover wire independently of each other. ------

85. The drum of a battery reel can be braked while the drum is in gear. ------

86. When filling a drum on the artillery reel cart, the drum is turned so that the wire goes on from the bottom of the drum. ------

87. Only one circuit can be laid at a time with a battery reel cart. ------

88. The drums of a battery reel cart are mechanically rotated. ------

89. One circuit could be laid and another recovered simultaneously with an artillery reel cart. ------

90. The drums on an artillery reel operate independently of each other when laying wire. ------

91. The pike is used by lineguards for tying in field or outpost wire. ------

92. If the nets on a reel cart get to spinning too fast, when laying wire, they are slowed up by throwing them in gear. ------

93. A good method of filling a drum on the artillery reel cart from a commercial spool is to raise the right wheel of the reel from the ground, throw the drum in gear, and turn the cart wheel, reeling up the wire. ------

94. When recovering wire with a reel cart, a loop of the wire must always be kept behind the cart. ------

95. The detail for an artillery reel should be increased by one lineguard when laying two wires simultaneously. ------

96. The breast reel carries one mile of twisted-pair outpost wire. ------

97. When recovering wire with a reel cart, the wire should be wound on the drum loosely. ------

98. Two circuits can be laid simultaneously with the breast reel. ------

99. Two circuits can be laid simultaneously with the battery reel cart. ------

100. Only one man is required to lay a circuit with a breast reel, type RL – 9. ------

101. The spool on the breast reel is removable. ------

102. When recovering wire, the breast reel is carried on the back. ------

Directions.—The following questions can be answered by a single word or phrase. Write the answer on the *dotted line* at the right of each question.

103. When recovering wire with a reel cart, with what is the wire guided onto the drum? ----------

104. When recovering wire with an artillery reel, how are the drums rotated? ----------

105. When the inside ends of a spool of twisted-pair wire are shorted together and a type EE – 5 telephone connected to the outside ends, if the magneto crank turns easily, what is the trouble on the wire on the spool? ----------

106. How many drums on a battery reel cart? ----------

107. How many wiremen in a reel cart detail? ----------

108. When a breast reel is adjusted on the back, on which side should the crank be? ----------

109. When laying wire, the breast reel is carried where? ----------

Directions.—Below are a number of unfinished statements each followed by several numbered words or phrases, one of which correctly completes the statement. Write the *number* of this word or phrase on the *dotted line* at the right of each question.

110. When completely filled with twisted-pair outpost wire, the battery reel holds about
(1) 2½ miles. (2) 1¼ miles. (3) 4 miles.
(4) 5 miles. (5) 10 miles. ------

111. In order to recover wire with an artillery reel cart, the
(1) clutch handwheel must be turned counterclockwise. ------
(2) clutch handwheel must be turned clockwise.
(3) drum clutch rod must be thrown out.
(4) foot pedal must be pressed down.
(5) drum must be turned by hand. ------

112. The number of men, exclusive of drivers, necessary to recover a circuit with an artillery reel is
(1) four. (2) seven. (3) three. (4) ten. (5) five. ------

113. The number of men, exclusive of drivers, used in laying wire with a battery reel cart is
(1) three. (2) four. (3) seven. (4) ten. ------

114. The approximate amount of twisted-pair outpost wire that an artillery reel will hold is
(1) 1½ miles. (2) 4 miles. (3) 6 miles.
(4) 2½ miles. (5) 10 miles. ------

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Page

115. The drums on an artillery reel are thrown out of gear by means of the

(1) foot pedal. (2) clutch. (3) hand lever.
(4) crank. (5) guide.

116. The number of men, exclusive of drivers, used in laying a single circuit with an artillery reel is

(1) four. (2) seven. (3) three. (4) ten. (5) two.

117. The approximate amount of outpost wire that a breast reel, type RL – 9, will hold is

(1) 300 feet. (2) 600 feet. (3) ¼ mile.
(4) 50 feet. (5) 1,000 feet.

118. The pike is used when

(1) laying wire with the breast reel
(2) splicing outpost wire. (3) placing wire overhead.
(4) tying in. (5) testing wire.

119. If a type EE – 5 telephone is connected to a shorted circuit,

(1) blowing in the transmitter can be heard in the receiver.
(2) blowing in the transmitter cannot be heard in the receiver.
(3) the magneto handle turns easily.
(4) the circuit is grounded. (5) the bell will ring.

120. The foot pedal on the artillery reel operates the

(1) clutch. (2) brake for the right drum.
(3) brake for the reel cart.
(4) brake for the left drum. (5) gear shift.

INFORMATION TOPICS

DEFINITIONS

NOTE.—The definitions given below are the common meanings of words *as used in this Manual.*

Anchor.—To fix firmly, as guy wire of telephone pole.

Aparajo.—A form of pack saddle used for the transportation of material.

Artillery pair.—Two horses equipped as team to draw an artillery vehicle.

Automatic.—Self moving or self acting.

Axis.—A route along which circuits are laid.

Battery, external.—A battery which is not part of an instrument.

B. B. (Best Best).—A quality designation for galvanized iron wire; second quality.

Bridging.—A method of placing a piece of electrical apparatus in parallel or in shunt with another piece of electrical apparatus.

B. & S. (Brown & Sharpe).—Name of the standard American wire gauge or system for indicating the size of wire.

Buzzer, Telephone.—An electric signaling device such as is used on the EE-5 telephone.

Buzzerphone.—A combination telegraph and telephone instrument. (See Fig. 44.)

B. W. G. (Birmingham wire gauge).—The standard British wire gauge.

Central.—Any point at which a switchboard is installed.

Central, switching.—A central located at the junction of two or more trunk lines.

Choke.—To hinder the flow of current.

Circuit.—The course or path followed by an electric current passing from its source through a succession of conductors and back again to its starting point.

Circuit, control.—A circuit used exclusively for signal communication service messages.

Circuits, lateral.—Those circuits connecting with organizations located on the right or left of the wire axis.

Circuit, open.—A circuit, the continuity of which, has been interrupted.

Circuit, phantom.—A third metallic circuit obtained by simplexing two existing metallic circuits.

Circuit, trunk.—A line connecting telephone centrals with one another as distinguished from a line connecting a subscriber to a central.

Climbers.—Equipment worn by a lineman to enable him to climb poles. (See Fig. 1.)

Clove hitch.—A tie used to fasten wire to a support. (See Fig. 15.)

Condenser.—A piece of apparatus used to accumulate electrical charges. Usually composed of layers of tinfoil separated by paraffined paper, and sealed in a container.

Connector.—A device for holding in electrical contact the ends of conducting wires in such a manner that they may readily be released when it is desired to disconnect them again.

Cotter pin.—A split pin placed crosswise in a hole in the end of a bolt or shaft to prevent the accidental removal of the bolt or shaft.

Cross.—An accidental contact between the conductors of neighboring circuits.

Cross connecting.—The system of connecting circuits by means of jumper wires between terminal strips or between terminals on a terminal strip.

Cross talk.—Conversation over a telephone circuit which is overheard in a telephone of a neighboring circuit.

Cut in.—To connect a line to a terminal strip at a test station or central.

Drop.—(*a*) The electromagnet with its armature and catch which permits the shutter on a switchboard unit to fall for the purpose of attracting the attention of an operator.

(*b*) Sometimes used to mean the shutter.

Facilitate.—To increase ease of operation or movement.

Filter.—A combination of condensers and inductance coils which permits the easy flow of alternating current of a given frequency, and at the same time offers a high resistance to the flow of all other frequency currents.

Frame, test.—A board for permitting the ready introduction of testing instruments into any line entering a central.

Frankel test clip.—A spring contact device so constructed that it may be quickly attached to a conductor to complete a circuit.

Gauge.—(*a*) The instrument used for measuring sizes or dimensions, as of wire.

(*b*) A standard system of measuring, as the B. & S. or B. W. G.

Ground leakage.—Leakage current returning to its source by means of the earth, rather than by means of the conductor provided for its return.

Identify a circuit.—To determine which conductors of a group or cable form a particular circuit.

Inductance coil.—A coil of wire with an iron core used to choke alternating current.

Initial.—Of, or pertaining to, the first stage of anything.

Install.—The act of setting up a piece of electrical equipment for operation.

Insulation, leaky.—The condition of insulation which permits the escape of electric current.

In the clear.—The location of a wire or line such that it will be free from obstruction or damage.

Inverse.—Opposed in order; inverted.

Jack.—(*a*) A type of metallic spring contact on a switchboard, forming the terminals of a circuit.

(*b*) A mechanical lifting device.

Knocked down.—The method of constructing a piece of apparatus whereby it may be readily taken apart and reassembled.

Knot, granny.—An imperfect square knot. It differs from the true square knot in that it has the second tie crosswise. (See T. M. No. 20.)

Lagging.—A wrapping placed around coils or spools of wire to protect the wire from damage.

Leads (pronounced leeds).—Conductors, by means of which, an instrument is connected to a circuit.

Lines, high tension.—Electrical circuits operated at a voltage sufficient to cause damage to field telephone lines, should contact be made between a field line and such a circuit.

Localizing trouble.—The process of determining the specific section of a line in which trouble exists.

Loop.—A metallic circuit.

Marker.—A flag, post, or other object used to designate a particular location.

Message center.—The agency at each headquarters or command post which is charged with the receipt, transmission, and delivery of all dispatches pertaining to that headquarters or command post.

Microphone.—A very sensitive telephone transmitter.

Packed transmitter.—That condition of a transmitter in which the granules of carbon adhere to each other.

Patching.—A method of cross connecting at a central or test station for any temporary purpose.

Paying out.—Releasing wire from a reel or coil.

Pike.—A tool used by a pikeman to facilitate handling wire. (See Fig. 26.)

Repeater.—A device by means of which signals in one circuit are transferred to another circuit.

Repeating coil.—A form of telephone repeater. (See Repeater; also see Fig. 49.)

Reel, breast.—An article of equipment used to lay or to recover wire. (See Figs. 17, 18, and 19.)

Ringer.—A call bell of the type used on the EE – 4 telephone.

Safety.—A strap carried by a lineman snapped to his belt, and used to hold him in position while he is working on a pole.

Set, test.—A telephone or other device used to determine the electrical condition of a circuit.

Set, universal test.—A special instrument used to determine the condition of circuits. (See Fig. 41.)

Simplex.—(See Unit Operation No. 20, page 3.)

Simultaneously.—Occurring or existing at the same time.

Splicing clamps.—A tool used in making splices.

Spool, commercial.—A wooden spool upon which wire is wound at the factory for delivery.

Station, repeating.—A point at which messages or signals are transferred from one circuit to another, usually automatically.

Subscriber.—A unit or individual that is furnished with telephone service from a central.

Switchboard, monocord.—A switchboard having a single cord as a part of each unit. (See Fig. 13.)

Tapping in.—A method of inserting an instrument into a telephone or telegraph line for the purpose of listening to messages passing over the line.

Taper.—To make gradually smaller toward one end, as of a shaft or spindle.

Telephone, magneto or local battery.—A telephone in which the transmitter current is furnished by a battery within the instrument, and signaling is accomplished by means of a magneto also located within the instrument.

Tension.—The condition or state of a body under stress or when stretched taut.

Terminal strip.—A piece of apparatus to facilitate cross connecting. (See Fig. 33.)

Terminate.—To end.

Test, continuity.—A test made for the purpose of determining whether a circuit is completely closed.

Tone signal.—A musical note sometimes heard in the buzzerphone when the instrument is not properly adjusted.

Tracer thread.—A thread or strand, forming part of the insulation of a wire and different in color or texture from the remainder of the insulation. It is used to distinguish a given wire from others in a group or cable.

Traffic.—(*a*) Vehicles moving along a road.

(*b*) Telephone calls.

"Tying in."—The process of fastening wires to a permanent object for support.

Unlimbered.—Without means of propulsion, as the wire cart with team removed.

Wheatstone bridge.—A device for measuring resistance.

Winding, primary.—The input winding of a transformer or repeating coil. (See Fig. 50.)

Winding, secondary.—The output winding of a transformer or repeating coil. (See Fig. 50.)

Wing nut.—A threaded binding post nut having wing-shaped projections for ease in turning by hand.

Wire, field.—Wire composed of 10 steel wires each 10 mils in diameter, twisted about a copper wire 28 mils in diameter. The insulation is rubber covered by paraffined cotton braid.

Wire, line.—The conducting wire between stations in a telephone or telegraph system.

Wire, outpost.—Wire composed of 3 bronze and 3 steel wires, each 13 mils in diameter, cabled about a bronze wire 14 mils in diameter. The insulation is rubber covered by paraffined cotton braid.

Wire, outside distributing.—An insulated twisted-pair wire, size No. 17, B. & S., having a single copper-plated steel conductor.

Wire, seizing.—A small-sized annealed copper wire used to bind a splice in field or outpost wire.

Wire, tie.—A short piece of wire used to fasten a line wire or wires to a support.

Wire, twisted pair.—Two insulated wires twisted together. (See Fig. 29.)

WIRE SYSTEMS

DEFINITION

1. *a.* A wire line consists of a single circuit or two or more circuits installed on the same supports, laid on the ground along the same route, or buried in the same trench.

WIRE-LINE CIRCUITS

2. *a.* The circuits of a wire line may be metallic or ground return. Ground return circuits are inferior to metallic circuits in that earth currents and cross talk interfere with communication and the messages can be easily picked up by enemy listening-in sets. A single circuit may provide one or more channels for telephone or telegraph communication. Additional channels are obtained by such electrical expedients as simple, phantom, composite, and line radio.

b. Military wire circuits are classed as to use as either trunks or locals. Trunks are those circuits connecting one switchboard to another. Locals are circuits which connect switchboards to subscribers.

CONDUCTORS

3. *a.* Bare wire, insulated wire, and cables are used for conductors in installing wire circuits.

BARE WIRE

4. *a.* Bare wire is used for permanent installation in rear areas, and for semipermanent installation in the forward areas up to the zone affected by enemy shelling. Semipermanent construction is used in front of army and corps headquarters when time permits.

b. The transmission range of bare wire used in semipermanent construction is ample for all normal distances within the Army. If especially long circuits are desired, special construction is necessary.

c. The principal types of bare wire employed in the zone of operations are:

(1) Hard-drawn copper, No. 12, B. & S. gauge.
(2) Galvanized iron, grade B. B., No. 14, B. W. G.
(3) Phosphor-bronze, No. 17, B. & S.

d. Bare hard-drawn copper wire, No. 12, B. & S., 81 mils diameter, weighing about 59.4 pounds per 1,000 yards or 104.5 pounds per mile, and coming in mile or half-mile coils, is suitable for practically all bare aerial lines constructed by the Signal Corps. For splicing purposes, in the absence of copper sleeves, the splicing wires, and

likewise the tie wires, must be of soft copper. They are simply made by heating pieces of the hard-drawn wire in a fire, which gives it the necessary pliability.

e. Bare galvanized wire, No. 14, B. W. G., 81 mils diameter, weighing about 56.2 pounds per 1,000 yards or 99 pounds per mile, and coming in mile or half-mile coils, is extensively employed for telegraph lines in the rear of the zone of operations. It should not be employed for permanent or semipermanent lines more than 8 miles in length.

f. Bare phosphor-bronze wire, No. 17, B. & S., 45 mils diameter, and weighing about 19 pounds per 1,000 yards or 33 pounds per mile, has recently been advocated for certain bare wire circuits of semipermanent construction in the field. It is noncorrosive to gas. A type of wire such as this is classified by the Signal Corps as type W – 47.

g. Four circuits of light galvanized iron or phosphor-bronze wire on light poles and cross arms, can be installed by corps signal troops at the rate of from one-half to 4 miles per day, according to the personnel and transportation available for the work. During a rapid advance, however, it is often impossible for the corps to keep up with its divisions in this construction. It is then necessary to lay hasty field lines first, to be followed by bare wires when time permits.

INSULATED WIRE

5. *a.* Insulated wire (sometimes called "field wire") is used for installations forward of the area of semi-permanent bare wire construction. The wire employed is flexible and of considerable tensile strength. It is issued in the form of twisted-pair and single conductor.

b. The principal types of insulated wire issued for line construction are:

(1) Field wire, type W – 40.
(2) Heavy outpost wire, type W – 44.
(3) Outside distributing wire, type W – 38.
(4) Buzzer wire, type W – 45.

(*a*) Field wire, Type W – 40, is a twisted-pair wire, each conductor being composed of 10 steel wires each 12 mils in diameter, twisted about one copper wire 28 mils in diameter and covered with rubber insulation and cotton braid. It has high tensile strength, good insulation, and will lie flat on the ground. Its limit for good telephone transmission is from 12 to 15 miles. This wire is intended for use from brigade back to the zone of semipermanent bare-wire construction. It weighs about 110 pounds per 1,000 yards or 195 pounds per mile. It is issued wound on wooden spools, each spool carrying about 1 mile of wire.

(*b*) Heavy outpost wire, type W – 44, is a twisted pair of which each conductor is composed of three bronze and three steel wires, each 13 mils in diameter, wrapped around one bronze wire 14 mils in diameter and covered with rubber insulation and paraffined cotton braid. It will lie flat on the ground, but it has less tensile strength and poorer insulation than field wire. Its limit for good telephone transmission is from 7 to 9 miles. This wire is intended for use from the brigade forward. It weighs about 68 pounds per 1,000 yards or 119 pounds per mile. It is issued on steel spools which fit a hand drawn reel cart; each spool carries about one-half mile of wire.

(*c*) Outside distributing wire, type W – 38, is a twisted pair, of which each conductor is a nonstranded copperclad steel wire, 45 mils in diameter (No. 17, B. & S.), covered with rubber insulation and weather-proof cotton braid. Commercially it is known as outside distributing wire 17–2. It has less tensile strength and less rugged insulation than field wire, but can be more easily spliced. It was used in great quantities by the U. S. Army in the World War in place of field wire and will probably be used in future operations because of its extensive manufacture for commercial purposes. It weighs about 112 pounds per 1,000 yards or 199 pounds per mile. It is issued in coils of about 1,000 feet each.

(*d*) Buzzer wire, type W – 45, a single conductor of two steel and one soft copper wire, each strand 12 mils in diameter, insulated with cotton and insulating compound, weighing 5.6 pounds per 1,000 yards or 9.9 pounds per mile, comes in half-mile lengths on metal spools which fit various hand and breast reels. It is chiefly employed for use with the service buzzer, less frequently with the buzzerphone, and occasionally during rapid movements in the forward areas, for rapid temporary changes of short terminal telephone leads from a switchboard. For the service buzzer it is quite satisfactory in all kinds of weather, but for the buzzerphone and telephone, it is dependable only for short distances and in dry weather or when the insulation has not been damaged by traffic or rough handling.

(*e*) Effort is being made to develop a light outpost wire, an extra-light, twisted-pair wire of high tensile strength, good insulation and small bulk, suitable for use where it is impracticable to employ wire carts or reel carts. Transmission qualities to permit conversation up to 3 miles and sufficient insulation to withstand adverse weather conditions for several hours are desired. Issue on one-half-mile spools is contemplated.

CABLES

6. *a.* Cables are of two general classes: Submarine cables and land cables. The land cables usually used for military purposes are 10, 25, 40, 50, and 100-pair, paper insulated, lead covered. They are

used for overhead and buried cable construction. Overhead cables are used at the larger headquarters for permanent or semi-permanent installation. Cables (usually 10-pair) are buried in forward areas to furnish circuits protected from shell fire. Buried cables are a development of long periods of stabilization. A great amount of time and labor is necessary for their original construction and for their repair when broken. For proper protection, cables should be buried in a trench seven feet in depth, with properly drained manholes or junction boxes at intervals of about 1,000 yards.

INSTALLATION

7. *a.* Within a combat unit wire lines are not installed until actual hostile contact has been gained or is imminent. During marches wire communication is normally maintained over existing nonmilitary wire systems. The established commercial telegraph and telephone systems ordinarily provide sufficient facilities for the necessary wire communication for a marching body to fixed headquarters. Within brigades and lower units wire communication is not normally established on the march. On the march arrangements may be made for subordinate commanders to report to higher headquarters when passing local telephone and telegraph stations.

b. In camp, when the units are separated by considerable distances, telegraph and telephone circuits for long-distance intercommunication may be connected to near-by local telegraph offices or commercial telephone centrals, the necessary arrangements being made with the local officials of the commercial company. However, circuits between stations are never cut, unless permission is first obtained from higher authority.

c. In hostile territory, when commercial systems have not been destroyed, the same methods are followed as described in the preceding paragraph, except that the local offices are taken over and operated by signal personnel until the necessity for their use passes. To seize and operate hostile wire lines and to interrupt wire communications into hostile occupied territory, are functions of the signal personnel accompanying advanced elements of cavalry or other arms. In rearward movements the destruction of wire systems is carried out under the authority directing other demolitions.

d. Within combat units, wire lines are installed just prior to or upon deployment for combat.

e. Responsibility for installations is as follows:

(1) The superior unit is responsible for wire communication from its command post to the command posts of the next subordinate units. A unit is also responsible for the wire communication from its system to all railheads in its area. For example, the Army con-

nects all railheads situated in the Army service area to the most convenient exchange of the Army wire system. Corps and division obtain the necessary communication over the Army system. In a similar manner the corps connects all railheads and its regulating unit is normally maintained over lines pertaining to the regulating unit.

(2) A supporting unit is responsible for wire communication from its command post to the command post of the supported unit.

(3) A superior unit is responsible for lateral wire communication between adjacent subordinate units. Lateral wire communication between adjacent units may be obtained through a switching central of the superior unit. When adjacent units are flank units of different superior units, lateral wire communication is established to the left.

8. *a.* The routes of field wire lines are chosen with a view to avoiding shell fire and traffic. Highways are particularly subject to enemy shell fire, and in addition, military traffic causes frequent breaks in roadside field wire lines. However, it is usually impracticable to avoid following highways in laying field lines, due to the inability of vehicles to operate efficiently off the road while laying and recovering field wire and to the necessity of the prompt establishment of telephone service between command posts. When time and means permit, lines should be laid off the road, so as to parallel it at not less than one hundred yards. Road crossings are avoided by at least two hundred yards. When field wire lines must cross highways they are laid under the road at culverts, bridges, or in trenches or put overhead.

b. Field wire lines are recovered, and made available for future use by the unit laying them, when no longer required by that unit, unless a superior headquarters directs otherwise.

c. It is the duty of every military person to guard against interfering with wire lines. Drivers of transportation, road repairers, tanks, etc., are held responsible for carelessness in this regard.

d. Field wire lines are laid (1) from motor transportation, (2) from specially constructed animal-drawn wire and reel carts, when motor transportation is not practicable, and (3) by hand when the first two methods are impracticable. During movement of units in combat, wire is laid hastily. During this hasty construction, wires are kept off the ground whenever possible, and placed high enough to clear traffic. Existing pole lines, fences, rows of trees, and sides of buildings are utilized, and whenever possible, the wires are fastened to small wooden or porcelain knobs which are provided for the purpose. Every care is taken to see that the insulation is not broken. As stabilization occurs and continues, wire lines are

rerouted if necessary, and more stable construction adopted. In accordance with the degree of stabilization the following methods of construction are adopted:

(1) *Short-stake construction.*—Short stakes, about four and a half feet in length, are driven into the ground at intervals of about 15 to 20 feet. Small insulating knobs, usually of wood or porcelain,are fastened to the stakes. To these knobs the wires are attached. This type of construction, due to its vulnerability, should be discouraged in favor of one of the following.

(2) *Wire-trench construction.*—The short stakes are driven into the bottom of a small wire trench at intervals of about 8 to 10 feet, and the wires are attached as indicated above. The wire trench is approximately 10 inches deep with the necessary width.

(3) *Construction in communication trenches.*—The wires are fastened on the sides of communication trenches.

9. In routing wire special care must be taken in its protection as follows:

a. Across roads wire will be raised and securely fastened to some substantial object on each side of the road. These fastenings must be of such a height that the wire will clear the highest point (crown) of the road at least 18 feet. When dirt roads can not be crossed aerially, fasten the wire securely on the near side of the road at some culvert or drain. Cut and leave free end long enough to thread under road to opposite side. On the opposite side of road fasten the free end of the wire on the reel cart, leaving ample wire for a splice to the wire that is threaded under the road. If no drains or culverts are available, fasten as before, dig a small trench about 3 inches deep across the road and bury the wire. Tamp the replaced earth good. It is not necessary to cut the wire. In the case the highway is paved and there are no culverts, drains, trees, or poles that can be used, fasten the wire on each side of the highway, make a protection for the wire by taking planks or boards and cleat them together so as to allow a space for the wires to lie in. The above principles also apply when crossing in front of private driveways.

b. Around corners wire will be securely fastened on each side of the corner so as to take all side pull off the wire.

c. Under tracks wire will be securely fastened on the near side of track and cut, leaving enough free end to thread under the track. The cart is then taken over the tracks and the free end of the wire on the reel cart securely fastened, leaving the free end long enough to make a staggered splice with the wire that is threaded under the tracks.

d. Across creeks fasten the wire securely and high enough to avoid any danger of high water. Proceed on across the creek, making

another fastening on the opposite bank and pulling the span across as tight as practicable by hand. If the creek can not be crossed with the reel cart at the point where the wire must cross, fasten the wire securely and cut, leaving enough free end to cross the creek. The reel cart is sent to the opposite bank by the shortest practicable route. The free end of the wire is then taken across by throwing a hand line or by being carried across by a swimmer. When the reel cart arrives on the opposite bank the wire is securely fastened, leaving enough free end to make a good splice with the span across the river. Care must be taken to fasten both ends of the span high enough to make a proper clearance of the river.

WIRE LINE ROUTES

10. *a.* Efficiency and economy of wire and labor demand a system of installation and maintenance of wire lines by which the maximum use may be obtained from each line laid before it is discarded or salvaged.

b. The route of the line must be so chosen that as a circuit its usefulness will not terminate with its first assignment. If located with an eye to future needs, many circuits or parts of them may be reassigned and used during each successive step of the advance, until the lines can be rebuilt in a more permanent manner during a period of stabilization or "back area" conditions.

c. If wire lines, installed forward of the command post of a unit, pass through subsequent locations of the command post of that unit they will provide communication to the rear after a forward movement.

d. The route of advance of a command post is designated as its "axis of signal communications." Each successive location of a command post can not be definitely located at the beginning of an operation, but its route of advance can be foreseen and is published in field orders.

e. Consequently, the principal wire lines of a unit are established, in general, along the prescribed axis of signal communication, or along routes which are accessible to points which have been used in designating the axis.

f. Further than this, the general layout of the lines of each subordinate unit should be so directed that they build into the general scheme of their superior unit. This means close coordination between all officers in charge of this work and necessitates following closely the general plan laid down by the superior unit.

g. During forward movement in combat the wire systems of all units are as simple as possible, consistent with necessary requirements.

The initial wire installation, or in other words the wire installation of a unit established before or upon deployment, is taken as the basic form, and serves as the framework upon which the system is extended during forward movement or stabilization.

h. The wire systems of auxiliary or supporting units are connected to the systems of controlling or supported units at suitable switching centrals or at a command post.

i. The command post of a unit may advance from its initial location to points along the axis at which switching centrals are established. In such cases the switching central and the through lines are already established at the new location, and only the local telephones required for the command post need be connected.

CONVENTIONAL SYMBOLS

Often it is necessary for some officer to draw a map and mark on it the location of the various headquarters. Since there are so many different kinds of troops within a division, if it were necessary to write out the name of each unit the map, if small, would soon be unreadable. Therefore symbols have been adopted to be used instead of names. These symbols are called conventional signs. Fig. 52 shows the most important symbols.

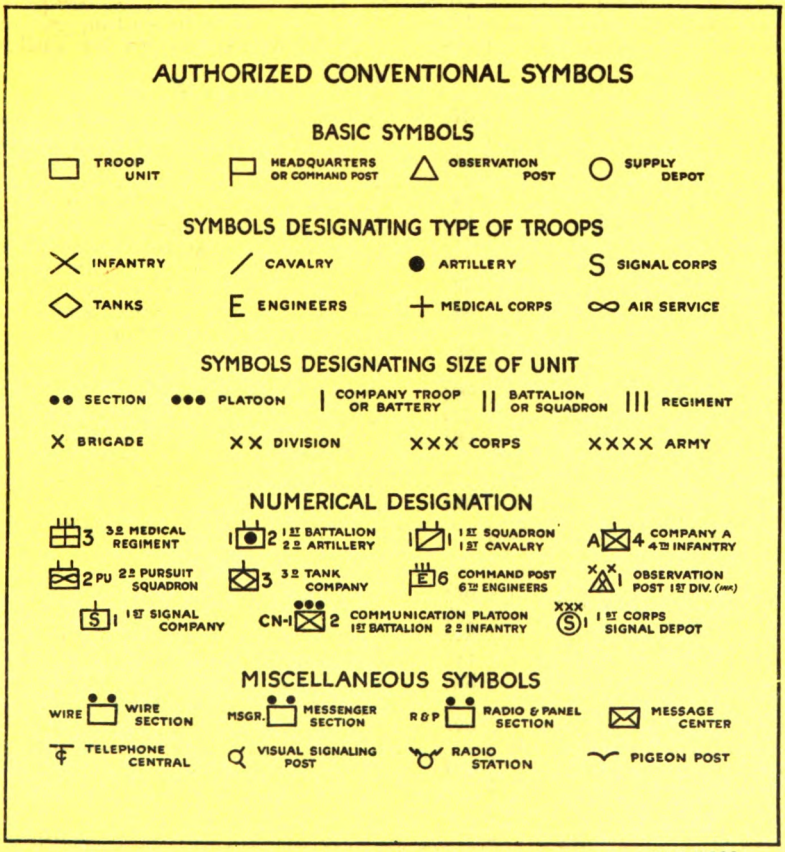
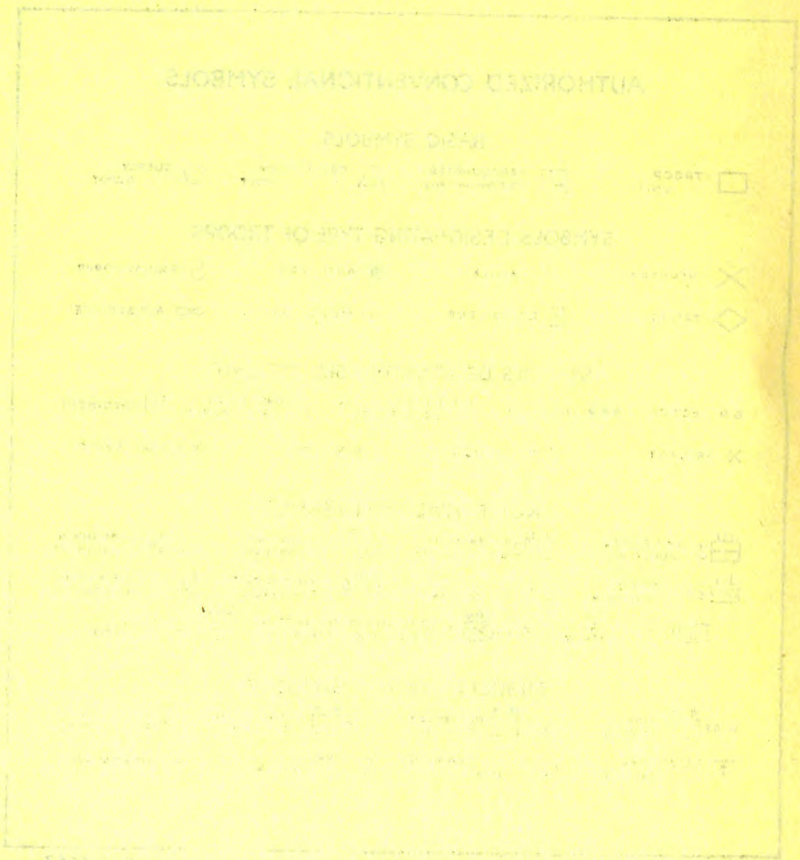


Fig. 52.—Authorized conventional symbols



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