CONFIDENTIAL—FOR OFFICIAL USE ONLY

NOTES ON
GRENADE WARFARE

COMPILED FROM
DATA AVAILABLE ON FEBRUARY 15, 1917
ARMY WAR COLLEGE

NOTE.

This pamphlet is subject to periodical revision. It is only intended to present in compact form the principles most recently reported from the seat of war, and to suggest methods of training for use in camps of instruction. It should not be quoted in official correspondence, nor should it be used as a textbook for the study of grenade warfare.

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

WAR DEPARTMENT,
Document No. 576.
Office of The Adjutant General.

TABLE OF CONTENTS.

WAR DEPARTMENT,
WASHINGTON, *April 28, 1917.*

The following Notes on Grenade Warfare are published for the information of all concerned.

(2582933–A, A. G. O.)

BY ORDER OF THE SECRETARY OF WAR:

H. L. SCOTT,
Major General, Chief of Staff.

OFFICIAL:

H. P. McCAIN,
The Adjutant General.

NOTES ON GRENADE WARFARE.

INTRODUCTORY.

The exact time of the advent of hand grenades as an instrument of war is uncertain, but is known to date back many centuries. History records their use under the name of "grenades" as early as 1536 at the siege of Arles. The Germans fired grenades from their muskets at the siege of Stettin in 1677. Up to the close of the eighteenth century soldiers were regularly trained in the throwing of hand grenades, and were called "grenadiers." At first, only a few men of long service and marked courage in each regiment were selected as grenadiers; later entire companies of grenadiers were formed; and later still every infantry battalion had its company of grenadiers, which, in the different armies had preference over the other companies at parades and ceremonies, even long after they had ceased to use grenades.

After being obsolete for a century, the use of hand grenades was revived by their employment in large quantities by both sides in the Russo-Japanese war, especially in fighting at close quarters and in assaults on the various forts around Port Arthur. Many of the grenades used in the early part of this war were improvised on the field of battle, but the success obtained by their use led to the invention of many new standard types and their subsequent adoption by all modern armies, including that of the United States.

Modern trench warfare is much like a long siege, with frequent sorties. In the present European war the grenade is a regular part of the equipment of all infantry soldiers, and all nations have established special schools in which officers and men are required to receive instruction in their construction and use.

In a recent address to his troops on the field of a great victory, after six months of fighting by his army, the commanding general said, in effect, that the modern infantryman is more a grenadier than a rifleman, and added that, in all the glorious fighting on this field, the grenade has done more than the rifle. One of this general's division commanders gave it as his opinion

that the rifle as an offensive weapon in trench warfare has been entirely supplanted by the hand grenade, the poniard, and the pistol; and that, in the present methods of attack, the advance should be covered by well-trained grenadiers, abundantly supplied with hand grenades, the following infantry to be armed with grenades as well as with rifles and bayonets.

Grenades have come to be universally regarded as indispensable both in attack and defense. The reason for this is to be found not only in the destructive effect of the grenade but also in that feature of modern warfare which may be described as a tendency to get back to primitive methods of fighting, imposed by the close quarters in which trench warfare must of necessity be conducted. At critical moments in the trenches a man will prefer a bomb or hand grenade which he can throw *toward* his approaching enemy rather than a rifle which he must first aim *at* his opponent. The effect of a hand grenade is much greater and more widespread than that of a rifle or pistol shot. A shower of hand grenades thrown at troops advancing to an attack and exploding with much noise and destroying their lines has a very considerable moral as well as physical effect, and may even stop the attack before it can be pressed home. The attacking troops, in the critical moment just before they reach their opponents, may be thrown into confusion and hence become unable to aim and fire their rifles accurately; in such cases the hand grenade is for them a most efficient weapon. Again, firing the rifle while marching is often impossible, especially for those in rear of the first files when marching in column, as in an advance through communicating or other trenches; but hand grenades may always be thrown. It is also to be remembered that the high-angle fire of hand grenades may be used in the trenches when no target for riflemen can be seen. When artillery fire can no longer be used because of the close proximity of the fighting lines, hand grenades may be used to great advantage.

Grenades are not only thrown by hand, where their limiting range is about 50 yards, but are also fired from the ordinary infantry rifle at ranges from 50 to about 320 yards, and from various projecting devices based on such ancient weapons as the onager, ballista, sling, and catapult, known from the earliest antiquity. The Bible tells us that eight centuries before our era—that is, about 2,700 years ago—Ozias provided the walls of Jerusalem with "machines constructed by a very wise engineer to throw bolts and large stones."

PART I.

SELECTION, TRAINING, AND ORGANIZATION OF GRENADIERS.

GENERAL.

All officers and men of organizations trained to fight on foot should be instructed in the construction and use of hand and rifle grenades. This instruction must be progressive for individuals as well as for organizations.

In the beginning a small number of specially selected officers, noncommissioned officers, and privates of each regiment should be sent to the grenade school to take a 15-day course of instruction, in order to fit them to act as instructors for their several organizations. Upon successfully completing the course at the grenade school and receiving their certificates to this effect, this detachment should immediately be returned to their regiments to begin the selection, organization, and training of gren adiers, as prescribed hereafter.

At Aldershot the course is 10 days for classes composed of 40 officers and 40 noncommissioned officers, who, after graduation, are returned to their battalions as instructors. A proposed syllabus for a course of training is given in Appendix E.

The Canadian Grenade School, at Shorncliffe, England, trains 60 officers, 60 noncommissioned officers, and 300 privates per month in the handling, throwing, and care of grenades; the care and use of explosives; the making of bombs; the use of trench mortars, spring guns, catapults, and other appliances; and in the latest methods of trench fighting. The course of study lasts one month for officers and noncommissioned officers; the first two weeks as pupils and the last two as instructors of the privates in the school. The course for privates is two weeks.

Germany is said to have introduced the grenade into the present war, and both in her recruit depots and her rest billets

behind the lines the men are constantly trained and exercised in bombing. The German ideal is to have every infantry soldier a trained grenadier.

SELECTION OF GRENADIERS.

All efforts should at first be directed to providing one thoroughly trained grenadier squad in each company. Under the supervision of all officers of the company, the men should be assembled and tested in throwing by any straight-arm method the individual chooses to adopt. If no dummy bombs or grenades are available, small sand bags or pebbles weighing about 1.5 pounds may be used as a substitute. The men should be required to throw at a mark, and those who attain the greatest accuracy and distance should be told off for further tests. This party should then be tested in the prescribed methods of throwing hand grenades, and those showing the greatest aptitude should be selected to the number required from each company for training. This number should be about double that needed for service in order to provide for the inevitable eliminations during training and for substitutes to replace casualties in the early periods of service.

The smallest number of men required to carry out an operation with grenades is 6—2 riflemen, 2 carriers, and 2 throwers. The instruction squad should therefore consist of 12 men. There should be 1 noncommissioned officer and 1 spare man for each 6 men, making a complete grenadier squad of 2 noncommissioned officers and 14 men. Each and every man requires individual instruction and supervision, and larger squads would make this difficult, if not impossible.

The number of squads per company must be increased from 1 to about 4, as opportunity offers. The latest reports (1917) indicate that of the 194 men in a French infantry company, 4 noncommissioned officers and 28 men use hand grenades, while 24 men use rifle grenades. Each company of Canadian infantry has 32 men in its grenadier detachment.

The men finally chosen, as indicated above, should be those showing the greatest natural aptitude for the service and duties required, which aptitude it is intended to develop by training. They should, in addition, be intelligent, physically fit for the hard manual labor involved, full of initiative and resource, and cool in emergencies. This latter characteristic can only be dis-

covered when a crisis occurs, and any man failing to meet this crucial test should at once be returned to duty with his company. It will often be found that the most unlikely looking men are those who rise to the occasion in emergencies.

It must be remembered that grenade fighting in the trenches often develops into a duel between single squads or even single grenadiers, and the side which shows the most resource and cunning, and whose grenadiers can throw to the greatest distance and with the most accuracy has the best chance of winning.

TRAINING OF GRENADIERS.

The training of grenadiers must not be too much restricted by hard and fast rules. Instructors must be constantly on the alert for new methods of training and operation, and nothing contained herein is to be construed as limiting in any way the initiative and originality of any officer or man, so long as safety is secured and satisfactory results are obtained.

The general principle to be followed in training grenadiers is to first give the individual a thorough knowledge of his duties and then to teach him by progressive methods to act in combination with his comrades; that is, the course of instruction is divided into two parts: *1. Individual instruction; and, 2. Squad instruction.*

1: INDIVIDUAL INSTRUCTION.

The men selected from each company are grouped into squads of 14 men and 2 noncommissioned officers. The senior noncommissioned officer is in charge of the squad and is responsible for its training, under the supervision of the regimental bombing officer, who is assisted by one of the company officers.

All training is carried out under the strictest discipline. A careless grenadier is a source of danger to himself and to his comrades. Slackness leads to indifferent work in the field, and nothing but discipline and courage can bring to success the work of grenadiers in actual fighting. Any display of carelessness should result in the immediate relief of the individual from the grenadier squad.

All practice must be conducted under service conditions with the men, except the throwers, fully armed and equipped, less

the pack. The throwers do not ordinarily carry the rifle, but are armed with a pistol and a knife for their personal protection. In the case of carriers or other men who carry special apparatus, such as the periscope or a throwing device, the rifles should be slung vertically over and behind the left shoulder.

The instruction is both theoretical and practical, and these two branches should be carried on simultaneously, the one serving as a relief to the fatigue induced by the other. The following is taught by lectures, illustrated at first by photographs and later by actually taking apart the service grenades, and by taking the positions and going through the motions indicated as most suitable for throwing:

(*a*) The precautions to be observed in handling explosives in general, and of grenades in particular.[1]

(*b*) The general principles of detonating explosives.[1]

(*c*) The method of making and using an improvised bomb (tin can, bottle, iron pipe).

(*d*) The classification, mechanism, and use of all the different service models of bombs, hand grenades, and rifle grenades in our own and foreign armies.

(*e*) The mechanics of the throw which gives the greatest accuracy and distance, with the least fatigue.

(*f*) The construction and uses of the periscope in grenade warfare.

In these lectures special emphasis should be laid on the fact that, in the hands of an intelligent and careful man, a grenade is a perfectly safe and efficient weapon; but, in the hands of an ignorant or careless man, it is a danger to himself and to his comrades. Any man doing careless or foolish things with explosives should be returned to his company at once.

The physical condition of the men should be developed to the highest possible degree by suitable exercises related to the work of grenadiers. Among these exercises throwing grenades for distance and accuracy, barricading, and bayonet fighting at close quarters should have a prominent place. At the same time the men should practice correction of the throwing by the use of the periscope, and should be drilled in the movements required in storming and clearing trenches.

[1] See Weaver's Explosives, and Primer of Explosives issued by the Bureau of Mines.

SCOPE OF INDIVIDUAL INSTRUCTION.

(A) The Precautions to Be Observed in Handling Explosives in General and of Grenades in Particular.

This should be taught by means of simple lectures on the composition, characteristics, uses, packing, shipment, handling, storage, and preservation of all the usual military and commercial explosives, and of grenades, samples of all of which should be shown, with special reference to their advantages for use in improvised and service grenades, and the precautions to be observed in such work. Emphasize the fact that the danger in handling and using explosives and grenades is a direct function of the ignorance or carelessness of the men doing the work.[1]

Instructors are cautioned that the greatest care must be taken in handling explosives, and especially when used in live grenades, and they must use every effort to insure that familiarity with explosives does not lead to carelessness in handling them. Adequate supervision must be insisted upon at all times, and commanding officers will be held responsible that officers competent to act as instructors are present, and that every possible precaution is taken whenever live grenades are being handled.

PRECAUTIONS.

The following precautions are among those which must always be observed:

1. Do not permit the use of live grenades until men are thoroughly trained in handling dummy grenades. Untrained men are very erratic and may injure themselves and the bystanders.

2. If the grenade is "tossed," swinging in a vertical plane, great care must be taken to see that it does not hit the ground or other object during the swing.

3. Do not permit the throwing of a live grenade unless cover is at hand behind which the thrower and spectators may seek shelter before the grenade strikes the ground. It is unsafe to remain in the open when a grenade explodes.

4. In handling live grenades always hold the body of the grenade in the hand, and never lift it by means of the rope or streamer, which sometimes breaks, particularly after the grenade has been thrown.

5. Do not arm the grenade until the moment for firing.

---

[1] See Chapter XXV, Coast Artillery Drill Regulations, 1914; Engineer Field Manual; and Ordnance Pamphlet No. 1741, 1917.

(B) THE GENERAL PRINCIPLES OF DETONATING EXPLOSIVES.

Simple lectures on the various types of military and commercial detonators and firing devices, fuses of all kinds, primers, percussion caps, etc. The instruction should include the method of ignition employed for each class of detonators and their application to the different kinds of explosives described above, together with the precautions to be observed in handling and using each kind of firing device to prevent accidents, as well as failures to fire, especially when used in grenades. Methods of arming and detonating or firing each kind of service and improvised grenades.

(C) THE METHOD OF MAKING AND USING IMPROVISED GRENADES.

Explanation and illustration of making grenades on the field of battle, including containers used (tin cans, bottles, iron pipe, blocks of explosive bound up with nails (see fig. 1), etc.); the explosives most likely to be found available (commercial dynamite, blasting powder, gun cotton, trinitrotoluol); and the fuses which will probably be at hand for firing the same (slow match, percussion caps, fire crackers, toy torpedoes, etc.). Include in this the making of small improvised mines for blowing in trench walls and brief instructions for demolitions. (See Engineer Field Manual.)

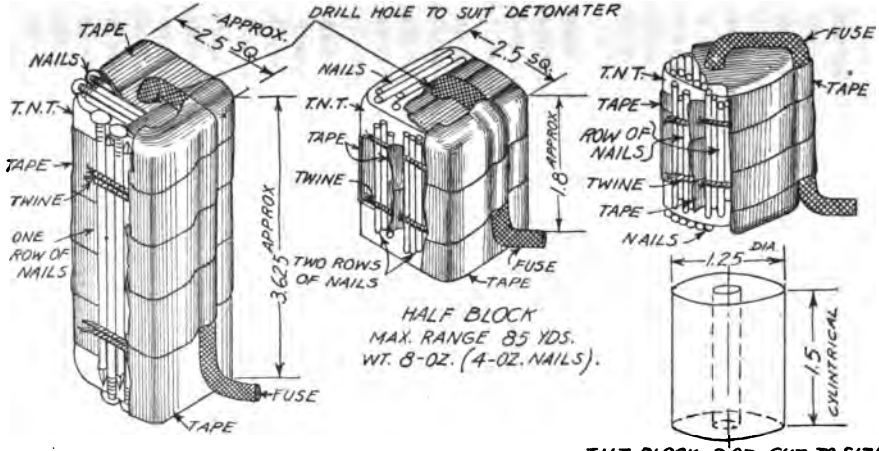
(D) THE CLASSIFICATION, MECHANISM, AND USE OF ALL THE DIFFERENT SERVICE MODELS OF BOMBS, HAND AND RIFLE GRENADES IN OUR OWN AND FOREIGN ARMIES.

This should include a detailed explanation and demonstration of the working of all available models of service grenades, first by showing the photographs and then by taking apart and reassembling the grenade by the instructor and afterwards by each man of the squad.

According to range, grenades may be divided into three classes:

1. Hand grenades, with a maximum range of about 50 yards. Among these we find explosive grenades, poison gas grenades, tear-producing grenades, suffocating grenades, incendiary and smoke-producing grenades.

2. Rifle grenades, with a range of 50 to 320 yards, and of the classes indicated above.



WHOLE BLOCK
MAX. RANGE 55 YDS.
WT. 20-OZ. (12-OZ. NAILS).

TAPE SHOWN PARTLY REMOVED TO SHOW ARRANGEMENT OF NAILS.

T.N.T. BLOCK 2 OZ CUT TO SIZE
MAX. RANGE 85 YDS.
WT. 8 OZ. (6-OZ NAILS).

IMPROVISED HAND GRENADES FROM STD ½ LB. BLOCK OF T.N.T. COPPER PLATED, USED BY ENGR'S FOR DEMOLITION PURPOSES.

Fig. 1.

3. Trench-gun grenades, with ranges from 200 to 800 yards, depending upon the gun, and of the same classes as indicated above.

Hand grenades are in general made up of a body or explosive box containing a certain quantity of explosive and an ignition or detonating device.

On the basis of their tactical employment hand grenades may be divided into two classes—

(1) The *defensive* grenade generally has a cast-iron body, which, when the grenade explodes, breaks up into fragments of sufficient size and weight to seriously or mortally wound a man within a radius of at least 30 yards. With this grenade an impassable barrage can be produced by grenadiers 15 yards apart, but this grenade can only be used when the grenadier is protected by trenches or other cover from the fragments of his own grenades.

(2) The *offensive* grenade generally has a body made of sheet metal or other material, which, when the grenade explodes, does not produce fragments which will cause injuries at close range. These grenades are effective, due to the force of the explosion or blast, within a radius of about 7 yards. An impassable barrage is established if the grenadiers are about 10 yards apart. This grenade can be thrown far enough so that there is no danger to the grenadier throwing it even when without cover.

The British now use only the defensive type of grenade, while the French have both the offensive and defensive types.

On the basis of method of ignition hand grenades may be divided into two types—

(1) The *percussion* grenade is arranged to explode immediately on striking the ground. This type has the disadvantage in trench warfare of being more dangerous to the thrower and his comrades, since the accidental strike or graze on the trench or the clothing or equipment of the thrower may produce an explosion; and besides this, unless the grenade strikes directly in the hostile trench, it may explode without doing any damage; that is, the men in the trench will be protected.

(2) The *time-fuse* grenade is arranged so that the time train is ignited by the striking of a match or the firing of a primer before the grenade is thrown, or at the instant of its departure from the hand. The advantage of this type of grenade lies in the fact that it is safer to use, and also especially because, even if striking in front of the trench or shelter, it may roll

into it before exploding and thus injure the personnel that are under cover.

In order to avoid confusion in joint attacks an agreement has recently been entered into by the French and British Armies that none but time-fuse grenades will be used in either service. Percussion grenades are largely used in the Italian service.

The instruction under this heading should enable each man to use any grenade without danger to himself or to his comrades and should give him the confidence that he can do so.

Special attention should be given to the following points:

1. Every grenade is very dangerous if handled without precaution.

2. The detonator or firing device is dangerous by itself.

3. If the fuse takes fire accidentally, it should be thrown as far away as possible. As soon as a fuse is fixed to a grenade, all rough handling must be avoided.

4. Precaution with live grenades which fail to explode. After each exercise in throwing live grenades, those which fail to explode must be disposed of in such a way as to avoid danger to all concerned.

In the case of grenades with time fuses, at least 10 minutes must be allowed to elapse before any person is permitted on the range to hunt for unexploded grenades. At the end of this period, time-fuse grenades may be considered harmless and will be carefully collected into a small pit in the ground. A small charge of explosive, primed with about 10 feet of time fuse, will be placed in the center of the pile of grenades in the pit. A tamping of dirt will be placed over the pile of grenades, and the charge fired, care being taken to see that a complete detonation of all grenades results. When ready to explode the charge, all the personnel should be under cover, and a noncommissioned officer should light the fuse.

In the case of grenades with percussion fuses, no attempt will be made to move the unexploded grenades, which must be destroyed where they lie. A small charge of explosive should be placed in immediate contact with each grenade to be destroyed, without disturbing the position of the grenade. The charge is fired with a time fuse, after covering the charge and the grenade with a few shovelfuls of earth, without tamping. In case of a misfire of the explosive charge, a wait of 10 minutes is required before making a second attempt to destroy the grenade.

It is expressly forbidden to try to remove the primer from an unexploded grenade by unscrewing the cap.

No grenade which has failed will again be thrown or fired.

(See Ordnance Department Pamphlet No. 1741.)

The description and methods of handling United States grenades will be found in the pamphlets on the different types issued by the Ordnance Department, and these instructions should be carefully studied and accurately followed by all concerned.

(E) The Mechanics of the Throw which Gives the Greatest Accuracy and Distance.

Grenade throwing is the most important branch of grenadier training, and a very high standard of accuracy is required, for, besides the advantage it gives in combat, it diminishes the risks of accidents and the consumption of grenades. The moral effect of a grenade bursting exactly in a hostile trench is added to its destructive effect. Follow accurately the prescribed methods of priming and throwing; work rapidly but without hurry, calmly and coolly.

Careful practice on sound lines is essential to success, and a considerable portion of the time available for training must be devoted to it. The difficulties in throwing are greatly augmented when, as is usually the case, throwing is to be done under complete cover, and according to directions given by an observer. The men throwing must be made to understand clearly at the beginning of their training that nothing can excuse inaccurate throwing, and instructors must not be satisfied until each man can throw from behind cover and in obedience to the directions of an observer, missiles of varying weight and size into a specified trench from any reasonable distance and in any direction.

In all practice involving the use of cover the men must work in pairs, one observing and the other throwing. The training of the observer is of the greatest importance, as he must be able to give distance and direction quickly and accurately. He must give his corrections in positive terms, in the form of short, sharp, clear words of command, and the thrower must be ready and able to understand and obey. The observer must learn to use the periscope, and should operate it throughout the training.

Simple lectures should be given on throwing under different conditions, beginning on open ground and then in trenches, standing, kneeling, and lying down. Special emphasis should

be given to the necessity of taking cover from our own grenades, showing by diagram the radius of action and direction of flight of fragments and balls. Illustrate this talk by moving pictures, photographs, and then by taking up the prescribed positions for throwing; but permit any *safe* method of throwing which promises good results in individual cases.

Methods of throwing vary not only with different individuals but also with different types of grenades. Experience has shown that accuracy is harder to obtain at short ranges than at the maximum range obtainable without undue exertion. It has been found that the accuracy of the throw is surprisingly effected by the presence of an actual wall in place of a hypothetical wall such as may be made by a string or a piece of board. Therefore a large part of the training should be in throwing at ranges of from 15 to 20 yards, and over actual parapets.

Include the method of holding the hand grenade, of arming or setting it for firing, and the precautions to be observed for safety to our own forces, and to secure the greatest damage to the enemy. *The grenade must never be thrown horizontally. Its fire must be plunging. In case ignition is not apparent, consider the grenade ignited, and throw at once, without delay.*

Precision in throwing gives a great advantage, besides reducing the risk of accidents and the consumption of grenades. The normal method of throwing the French hand grenade in the open is shown in the following figures:

Initial position (*fig. 2*).—Aim at the objective with the extended left arm, with the grenade in the right hand and the right arm falling naturally by the side. The shoulders, the extended left arm, and the objective should be in the same vertical plane.

First motion (*fig. 3*).—With the left arm pointed in the direction of the objective, carry the right hand up to the left, for the purpose of arming or igniting the grenade, if necessary, and for starting the swing.

Second motion (*fig. 4*).—With the left arm pointed in the direction of the objective, swing the right arm downward and backward, as far as possible, in a vertical plane, keeping the eyes on the grenade to avoid hitting the ground or wall, at the same time extending the left leg and bending the right knee.

Third motion (*fig. 5*).—Cast the eyes at the objective, or at the aiming point, if throwing from a trench.

Fourth motion (*fig. 6*).—With the right arm describe the arc of a circle in a vertical plane, the right shoulder and the body

FIG. 4.

FIG. 3.

FIG. 2.

FIG. 7.

FIG. 6.

FIG. 5.

following the movement of the arm, extending the right leg and bending the left knee. The left arm is swept vigorously downward and backward, following the left shoulder, which is sharply "refused."

The finish (*fig.* 7).—Finish with the entire weight of the body in the throw. The grenade thrown under these conditions should fly in the direction in which the left arm was pointed, and the maximum range should be obtained. The right arm acts like a catapult. The time of the throw is about two seconds.

(F) The Construction and Use of the Periscope in Grenade Warfare.

Describe and illustrate by diagrams, photographs, and actual service periscopes the principles of construction and the use of the trench periscope in correcting the throwing of grenades in order to place them accurately on the target. Show how to improvise simple but effective periscopes and trench mirrors from the material likely to be available on the field of battle, and how to make simple repairs to all periscopes.

Give each man in turn practical instruction in the use of the periscope in correcting first for direction; then for distance; then for both combined, or for accuracy. This should be continued until each man is thoroughly proficient, and the best men should be selected for permanent observers or range correctors. Keep in mind that in emergency any man in the squad must be able to replace any other man.

PHYSICAL INSTRUCTON OF GRENADIERS.

To develop the physical condition of the men, the day's work should begin with calisthenic exercises and short talks on personal hygiene. This should be followed by exercises in throwing, climbing out of and running along trenches, bayonet fighting, and other movements relating to grenade fighting.

NOTES ON THROWING.

Fix the eyes intently in the direction in which the grenade is to fall; judge the distance carefully, as upon that depends the trajectory of the grenade in flight.

Throwing practice for distance and accuracy should be made progressive, starting in the open with dummy or improvised

dummy grenades. Accuracy is considered of first importance, and the distance lengthened as the training is continued. The live grenade should be used in practice only where cover is available and by skilled and careful men. Men should be instructed to hold the grenade in such a manner that it is not necessary to change the hold after the grenade is set for firing. This practice should always be given on the instruction field laid out as described hereafter.

Throw only a few yards, say 10 yards, at first, using this distance 10 or 15 times in order to teach the man to let go of the grenade properly. If he throws with full force the first time, he will handle the grenade so convulsively that he will let go of it at the wrong instant, and hence will throw it too high or too low. This is a very bad habit, and one which is hard to eliminate. Let the grenade go when the hand is at the highest point, allowing it to leave the hand without a shock, and be sure to follow through with the body.

Throwing practice should be given in short periods, and the intervals used to give talks on other subjects of grenade instruction.

Many men hesitate to use grenades, and care must be taken to give them confidence; for this reason begin with dummy grenades, then use grenades with fuses only, and finally use live grenades. At first long-time fuses should be used, say, 7-second fuses, and the men should be required to count while throwing; thus, 1, 2, 3 (throw the grenade), 4, 5, 6, 7 (the grenade explodes). Later on the fuse should be cut to 4 seconds; the standard throw in the open occupies about 2 seconds.

BAYONET FIGHTING.

Special instruction in the use of the bayonet is essential for grenadiers. The usual bayonet instruction given to all soldiers will accustom them to the use and balance of the weapon and teach the necessary movements. This, however, is not sufficient for the training of a grenadier, but must be supplemented by practice in narrow trenches against living opponents. In trench warfare grenadiers will fight in inclosed and narrow spaces, where shock tactics are impossible. Methods in bayonet fighting similar to those of a swordsman are required, with a perfect combination of eyes, hands, and feet. Practice must be designed to develop ability and speed at close quarters. Contests should be arranged between men of the grenadier squad, and the most

proficient men should be selected as bayonet men. The men must be reminded that the rifles should always be loaded and that shooting is often possible and may be the best means of acting effectively in certain circumstances.

BARRIER AND BARRICADE MAKING.

Men must be skilled in the rapid making and filling of sandbags, and must be able to quickly construct bomb-proof barriers with any available material. Instructors will indicate the best positions and train their men to block up a trench, using available cover and working against time. In building with sandbags, which must always be properly tied, the bags should be laid in alternate layers of headers and stretchers, and the structure made as solid as possible. The following exercises are suggested:

1. Filling sandbags against time with large and then with small tools.
2. Filling a trench with sandbags.
3. Building a partial barrier, leaving a small space for a passage.

EXERCISES IN TRENCHES.

Make use of simple lectures, illustrated by diagrams, photographs, moving pictures, and by actual trenches on the ground, on the methods of obtaining a lodgment in the hostile trenches by means of the grenade; and practice running along and climbing out of fire and communication trenches with full equipment, including bags or baskets of grenades. As a basis for subsequent squad instruction, include explanations of the best points of attack; the means of supply of grenades, methods of carrying, and depots established; necessity of silence during the operation, communicating by signals, etc. Extend this instruction and practice to the methods of clearing the enemy out of trenches by means of grenades, after a lodgment has been effected; the methods of examining shelters; the advance from traverse to traverse; barricading; blowing in trench walls, etc.

INSTRUCTION OF "EXPERT GRENADIERS."

In addition to the instruction given to all men of the grenadier squad, expert grenadiers receive a special course and follow a more thorough training. This special course comprises:

1. The making up of explosive charges.
2. The making of dummy grenades.
3. Utilization of foreign grenades and detonators.

4. The use of trench mortars of low power.

The special objects of the course for expert grenadiers is to make expert throwers with confidence in their skill; to provide men capable of organizing a grenade combat and carrying it to a successful outcome; and to provide leaders among the men to serve as examples to be imitated by their comrades.

TESTS FOR APPOINTMENT AS GRENADIERS.

At the completion of the individual training period company commanders will apply the following tests to determine the fitness of the men for appointment as grenadiers:

FIRST TEST.

Eliminating; object, verification of accuracy in throwing.

1. *On open ground.*—Throw 10 dummy grenades to each distance.

Position: Standing, 35 yards; kneeling, 25 yards; prone, 15 yards.

Objective: Trench 1 yard wide, 1 yard deep, and 3 yards long.

Requirement: Not less than 50 per cent of hits.

2. *From a trench.*—Throw 10 grenades, plunging fire.

Position: Any; throwing trench 6 feet deep.

Objective: Trench 1 yard wide, 1 yard deep, and 3 yards long; distance 30 yards; objective not seen by thrower.

Requirement: Not less than 50 per cent of hits.

3. *Over traverses.*—Throw 12 grenades in a fire trench.

Position: Standing.

Objective: First 6 grenades over 1 traverse; then 6, over 2 traverses; trench 6 feet deep, 3 feed wide; traverses 6 feet high, 9 feet wide, and 25 feet apart.

Requirement: 5 hits out of each series of 6 throws.

SECOND TEST.

1. *Observing.*—The men work in pairs, one throwing and the other observing; 10 dummy hand grenades are thrown, inaccurately at trenches, at distances up to 30 yards. The observer, using a periscope, announces the corrections after each throw.

Requirement: The observer's corrections after each throw must be such that the next grenade, if thrown as directed, would strike in the objective trench.

2. *Knowledge of mechanism of grenades.*—Take apart one grenade of each service model; ask 6 questions on the char-

acteristics of grenades, detonators, fuses, and primers; 6 questions on the care and preservation, supply and handling of grenades; 6 questions on the tactics of grenade fighting.

Requirement: Not less than 50 per cent of correct answers.

3. *Throwing exercises as in paragraph 2 of the first test, but using live grenades.*—Throw 6 grenades.

Requirement: Not less than 50 per cent of hits.

To qualify as a grenadier the candidate must make a general average of not less than 65 per cent on the entire examination. The first test, which is elementary, may be repeated; a second failure results in sending the candidate back to the instruction squad.

The candidate for "expert grenadier" must have qualified and have the rating of grenadier, and must successfully pass an examination consisting of 10 questions on each of the four subjects prescribed in the special course for "expert grenadiers," with an average of not less than 65 per cent. In addition to this he must, in the opinion of the examining board, have the necessary physical and mental qualities to successfully perform the responsible duties of "expert grenadier."

Grenadiers and expert grenadiers should wear a special chevron denoting their rank, and receive extra pay on the basis prescribed for similar qualifications in small-arm practice.

2. SQUAD INSTRUCTION.

All foot troops should receive sufficient instruction to enable them to pass readily and quickly to the status of grenade combat, and the special instruction given to the grenade squad should enable it to carry out any of the special technical operations for which grenade fighting is suitable.

After the men have received a thorough training in the individual instruction prescribed above, the necessary teamwork will be secured by squad training.

ORGANIZATION OF THE SQUAD.

The men of the grenadier squad are divided into *riflemen, throwers,* and *carriers,* according to the duties each is to perform; but each man must understand thoroughly the duties of each of the others, so that he may quickly replace any of his comrades in case of emergency. There is probably no other operation in life where so much depends on efficient teamwork.

DUTIES OF THE DIFFERENT MEMBERS OF THE SQUAD.

The squad commander.—The commander of the squad is responsible for its organization, training, discipline, and leading in combat. He assigns the men to duty according to their aptitudes, directs their operations in combat, organizes the relief of throwers and carriers, and supervises the supply of grenades.

If the squad be acting alone, the general rule for the squad commander is to act aggressively, seizing every opportunity to press forward; if this is impossible, he defends the ground held, foot by foot, piling up barricades.

The riflemen.—The riflemen must be chosen from the men who are most aggressive and alert, and must be good shots and handy with the bayonet. Their duty is, in general, to protect the throwers.

In a frontal attack in the open they move on both flanks and protect the throwers by rifle fire.

In the communication trenches the riflemen precede the throwers and move around the angles of the trenches and the traverses, ready to stop any counter attack by use of rifle fire or the bayonet, or both. They also assist in determining the fall of grenades, help to correct the fire of the throwers, and signal when an advance is possible. When a further advance has become impossible the riflemen notify the squad commander. Without further orders a barricade of sandbags is built by all available men and the riflemen post themselves behind it, ready to fire.

In street fighting the riflemen watch especially doors and windows.

The throwers.—The throwers should, as far as possible, be expert grenadiers. They should have both hands absolutely free so as to be able to handle grenades with ease and safety. The throwers should not carry a rifle except when the grenade attack is but a prelude to some further enterprise in which rifles will be required; if the rifle is carried, it should be slung over the back during the grenade fight. The throwers should be provided with pistols and knives for their personal defense.

The carriers.—The carriers, one of whom is attached to each thrower, assure the supply of grenades, which they carry in baskets or bags, and which they pass to their throwers one at a time. The carriers replace the throwers when the latter fall.

March formation of grenade squads.—Grenade squads on the march make use of the usual formations for patrols and reconnaissances.

The squad commander takes the position from which he can best direct the movement of his squad.

The riflemen are disposed so as to cover the forward movement, the flanks, and to protect the grenadiers in case of an encounter with the enemy.

In the march on open ground the squads are in skirmish line, with the riflemen distributed along the line, but particularly grouped in the wings so as to protect the grenadiers. In case the enemy is encountered the riflemen who are scouting to the front take their places in the line.

In marching in communicating trenches, the squads move in single file, the order of march being as follows: Riflemen, throwers, carriers.

SQUAD EXERCISES.

In general, squad training may be said to consist of rehearsals of the various operations which grenadiers may be called upon to undertake in actual war. These exercises should always be carried out under conditions identical, as nearly as possible, with those to be expected in actual service; trenches should always be provided for instruction purposes. Instruction should be given at night as well as by day and under all conditions of weather.

In the European war zone all successful operations in grenade warfare will be found to have been rehearsed for several days. The most important grenade fight of which we have authentic accounts was rehearsed for about 10 days at a point some miles behind the lines, where special comforts were provided for the grenadier detachment, and where exact copies of the hostile trenches and nearby terrain were made from data obtained from aeroplane photographs and from two or three months of personal reconnaissance. The attack, which was preeminently successful, was not undertaken until every man could go through his part in it by day and by night without hesitation.

Squad exercises are carried out on a terrain specially prepared for the purpose. (See Appendix A.)

The squad will be instructed to divide itself rapidly into riflemen, throwers, and carriers, and will be taught the proper steps to take in the different circumstances of combat.

The men must always work in the greatest silence, communicating as much as possible by gestures and signals.

PART II.

TACTICAL EMPLOYMENT OF HAND GRENADES.

There are no set rules for the tactical employment of grenades, and, from the very nature of the case, no such rules can be formulated. Every problem must be considered separately, the terrain and the enemy carefully studied, and most careful and detailed preparations must be worked out in advance. The men must be well trained in throwing grenades and must be daring and resourceful. Most of the work must be done under cover of darkness.

Theoretical and practical instruction should be given in the following:

Defensive.—Defense of a trench by grenades, including the location and construction of emplacements for grenadiers, niches for grenade depots, and barricades against grenades.

Offensive.—1. Advance in, and step by step defense of, communication trenches.

2. Assault of a trench with grenade preparation of the assault.

3. Cleaning up of a trench, taking it by the flank, including measures of security during the operation.

4. Execution of sorties.

The instruction should also include formations for marching in open terrain by night and by day; methods of making a rapid approach to hostile trenches after preparation by artillery and trench engines; surprise attacks at night.

The organization of grenade supply should be part of each exercise.

DEFENSIVE.

Defense of a Trench by Grenades.

The grenadiers are divided into small groups of two or more squads along the line; their number is increased along the most exposed fronts, such as salients, parts very close to the enemy's

trench, etc. It is well in this case to double these trench elements by other trenches very close to the first, so as to form, to a certain extent, two ranks of grenadiers at these points.

In order to avoid the daily losses where the trenches are very close together, superiority in grenade throwing must be obtained and maintained so as to make it impossible for the enemy to stay in his trench.

Emplacements for grenadiers and depots for grenades will be provided in the "double" trench, at the entrance to the communicating trenches, and in shelters along the course of the communicating trenches in such a way as to permit an exit in case the trench is invaded by the enemy.

The different groups must be exercised in the rapid organization of counterattacks with the grenade so as to retake any part of the trench which may be lost.

OFFENSIVE.

General.

The dispositions taken for combat in trenches must be such as to avoid piling the men up. Only a minimum number of men must be exposed to hostile grenades, and these must have sufficient room for freedom of movement. This kind of fighting is very onerous, for which reason frequent relief must be provided; besides this, the group commander must be able to replace instantly all men put out of action and, when necessary, to reenforce the leading squad by new riflemen or throwers.

The most profound silence must be maintained, so as to hear all sounds coming from the enemy which may serve as indications; hence, communicate by gestures and signals.

Groups must not "bunch up"; not more than three men should be in a single element of the trench at any one time. Advance prudently, keeping a sharp lookout for traps, fougasses, etc. The long straight portions of the trench are generally enfiladed by rifles or machine guns placed in the traverses. The enemy also often hides at the end of a blind lateral communicating trench, of which the entrance is sometimes masked, for instance, by a piece of painted canvas. If the advance is made too rapidly, the enemy may come out of his hiding place behind the group of grenadiers and cut it off.

1. Advance in, and Step by Step Defense of, Communicating Trenches.

Figures 8 and 9 indicate, in a general way, the disposition and movements of the grenadiers in operations of this nature, which are about the same as in cleaning up a fire trench.

The type method of operation is based on the following principle: The enemy must be driven back, step by step, and due precaution must be taken to minimize the losses that may be caused by his grenades. Progress will therefore be attempted under the following conditions (fig. 9):

1. Organize a forward group composed of—

(*a*) A rifleman (f^1) who acts as a point, stops the enemy grenadiers, and protects our own. Reserve rifleman at (f^2).

(*b*) Two grenadiers (l^1, l^2) who methodically throw grenades to points 1, 2, and 3, then to points 1′, 2′, and 3′, always beyond the defilated spaces, so as to insure a constant and progressive cleaning out.

(*c*) A chief of group (Ch) who directs the combat, corrects the fire, organizes the relief of the grenadiers and of the carriers, superintends the ammunition supply, and holds himself ready to defend his ground, foot by foot, if further progress becomes impossible.

2. Organize an ammunition replenishment chain composed of—

(*a*) Three ammunition bearers, or carriers (p^1, p^2, p^3), placed somewhat apart so as to have freedom of movement. They pass up grenades in baskets, haversacks, or bags.

(*b*) A series of relays, proportional in number to the constantly increasing distance which separates the combatant group from the principal grenade depot.

3. Organize a group of pioneers (P) close to the advance group of carriers, which should always be ready to construct a barricade or to demolish those of the enemy. The pioneers should be supplied with shovels, picks, empty sandbags, bombs loaded or ready to be loaded with explosive charges. They may also have rifle grenades to hinder the enemy's supply system, and one or two automatic riflemen to defend their barricades.

All men are required to preserve the most profound silence and to observe attentively all sounds coming from the enemy.

The grenadiers, supplied without interruption by the carriers, throw grenades continuously, one thrower upon the nearest enemy and another as far forward as possible, so as to prevent

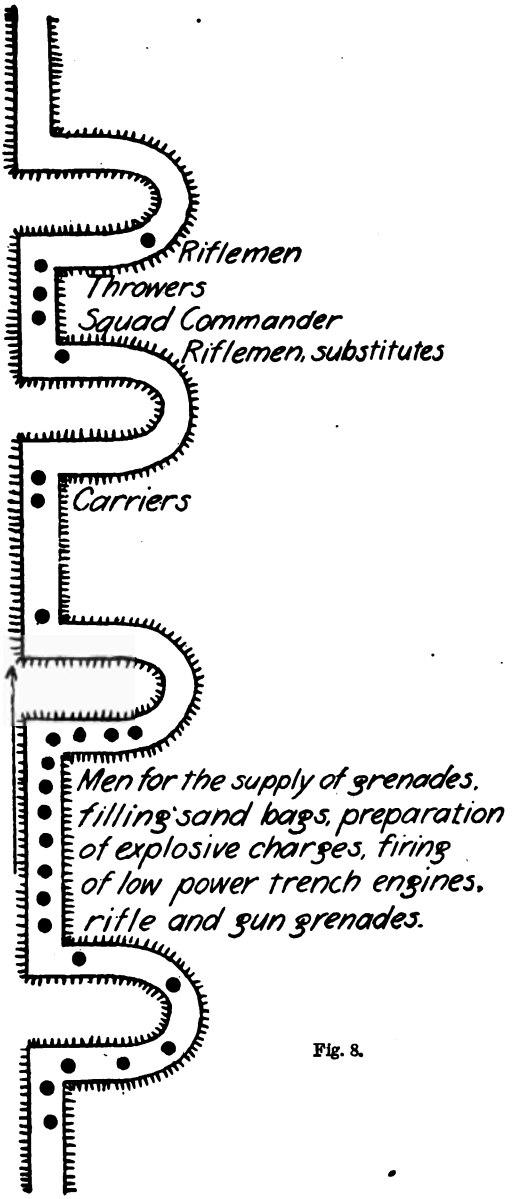

Riflemen
Throwers
Squad Commander
Riflemen, substitutes
Carriers
Men for the supply of grenades,
filling sand bags, preparation
of explosive charges, firing
of low power trench engines,
rifle and gun grenades.

Fig. 8.

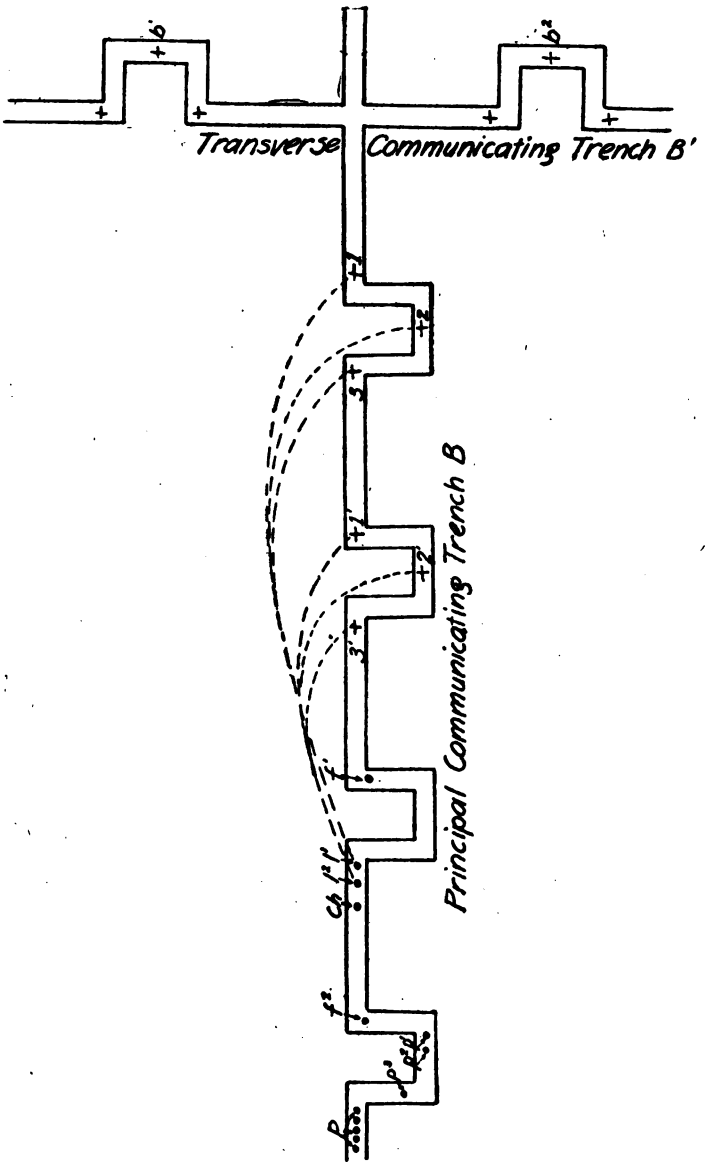

Transverse Communicating Trench B'
Principal Communicating Trench B

Fig. 9.

the enemy from bringing up grenades. Hostile barricades are destroyed as far as possible by charges of explosives.

When the leading squad judges that the enemy is overcome (as shown by slackening or cessation of his grenade fire, indications given by noises, etc.) the riflemen slide forward in the smoke, glance around the corner, and signal to their comrades; and so the forward movement continues from turn to turn or from traverse to traverse.

When a rifleman sees a lateral communicating trench (B^1), he signals to the throwers, who place a series of three grenades in each direction (at b^1 and b^2). The trench is at once explored so as to avoid surprises. If no movement is to be made in this new direction, a barricade is established at some distance from the principal communicating trench, so as to place it out of range of hostile grenades. This barricade should be built of sandbags and guarded.

A detachment is specially charged with filling sand bags, so as to permit the rapid building of barricades.

It is well to use gun grenades, or mortars of low power to interrupt at long range the enemy's supply of hand grenades.

If the advance is temporarily checked, the ground already gained must be defended foot by foot until the advance can be

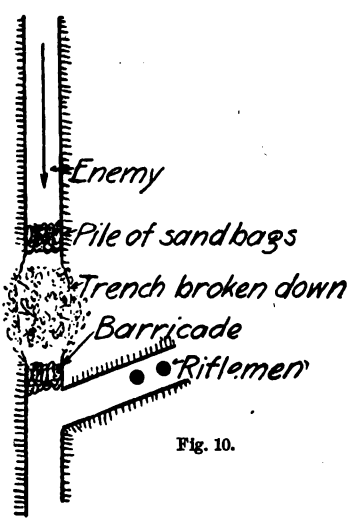


Fig. 10.

resumed. In this case impede the enemy's advance by increasing the number of barricades, obstructing the trench by piling up sandbags or by breaking down the sides of the trench, so as to force the enemy to expose himself to rifle fire. (Fig. 10.)

It may be possible and advisable to draw the enemy on to a point where he will be outnumbered in grenadiers and where he may be decisively defeated. (Fig. 11.)

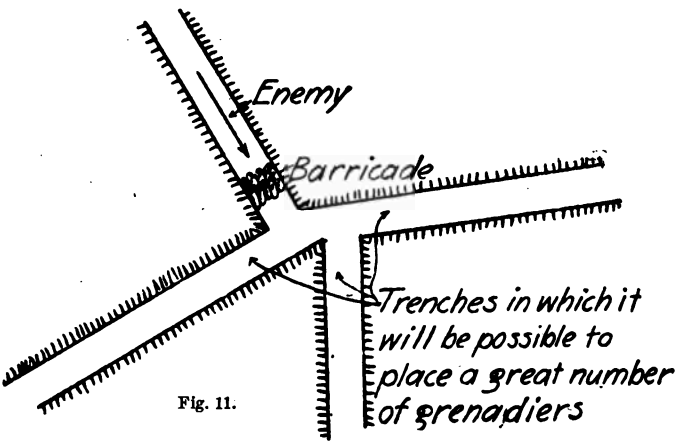


Fig. 11.

2. Assault of a Trench, Prepared by the Grenade.

The assault of a trench is, in general, a combined action which is executed under the protection of powerful bursts of Artillery fire. But sometimes during the combat the lines are so close together in certain sections that the Artillery preparation can not be made. An effort will then be made to overcome the enemy by grenades so as to fall on him thereafter with the bayonet. A few riflemen, armed with grenades (expert grenadiers if possible), approach the enemy, utilizing all the accidents of the ground. Meanwhile the rest of the group wait behind cover for the moment to assault. The grenadiers overwhelm the enemy with a hail of well-directed grenades, and oblige him either to evacuate the position or to take to the shelters. At this moment the assault should be made.

The assault is sure to be followed by a struggle in the interior of the hostile position, which can be prepared for

beforehand, thanks to our information of the hostile defensive organization.

Well-defined missions may then be assigned to certain squads of grenadiers, such as advancing through the communicating trenches toward the intermediary position or the second position; cleaning up the trenches and communicating trenches, etc.

The groups to which these various missions are assigned are specially trained for the purpose in advance.

3. Cleaning up a Trench.

The cleaning up of the trenches comprises two distinct parts, which must be assigned to different squads:

First. The cleaning up, properly so called, which consists in assuring the fact that no enemy remains in the captured trenches or shelters.

The organization of "clearing" or "mopping-up" parties requires very careful prearrangement. The strength of these parties and their position in the assaulting column must depend on the circumstances. Their strength has amounted in some cases to 25 or 30 per cent of the assaulting force.

If the first waves of the assault are to push forward over a line or lines of hostile trenches to some further objective, they must be accompanied by small parties of bombers, whom they will drop in these lines to prevent the enemy from issuing from his dugouts and shelters, till the arrival of the larger parties farther back in the assaulting column, who are detailed for the systematic clearing up of the line.

The most effective weapon for clearing dugouts is the suffocating grenade, which drives out or suffocates the occupants, and has sometimes set fire to the woodwork. The ordinary explosive grenade is comparatively ineffective against a large dugout with several rooms and passages.

German dugouts have usually more than one entrance, and when clearing up dugouts a sentry should invariably be posted at all entrances to each dugout. One of his duties is to see that the dugout is not bombed by another party while our men are in it.

In wood and village fighting, care should be taken that each dugout is discovered and dealt with. It may also be necessary in some cases to drop parties to clear up the shell holes in front of and behind a line of hostile trenches or to search a field of long grass or crops for concealed machine guns.

The importance of such clearing-up operations is very great, and neglect to provide for them has had most unfortunate results on more than one occasion. Special precautions are necessary to insure that men detailed for such work do not push on with the advancing line.

The squads charged with the cleaning up of the trenches, properly so called, follow a fixed itinerary. They run along the trenches and the communicating trenches and do their work so that *no part of the trenches is overlooked.* They strew grenades along their passage, their attention being especially directed to the shelters, whose openings, often concealed or closed by the bombardment, are not always apparent. The prisoners are collected and rapidly sent back by the noncommissioned officers in command of the cleaning-up squads.

Second. The destruction of hostile detachments which continue to resist in certain places.

The squads intended to overcome any possible resistance are composed of expert grenadiers. They march with the second line, and, always on the alert, they rush upon the points where the enemy still resists, following the trenches, as far as possible, so as to attack from the side least defended.

4. Sorties.

GENERAL.

The grenade is continually employed in the execution of sudden enterprises (coups de main) or sorties, which are attempted by small groups of chosen men, having mutual confidence in each other, and especially trained in grenade work; or by a unit, likewise selected and sometimes given a stronger proportion of noncommissioned officers, and which leaves uncertain members behind.

Sorties have for their object the throwing of grenades into an occupied portion of the enemy's trench, the attack of a sap head, the occupation of a crater, the capture of a listening post or trench, or to bring back prisoners.

The success of such an operation depends essentially upon the care with which it has been prepared by minute reconnaissance and by the thorough rehearsal of all phases of its execution under conditions as near as possible to those actually existing.

PREPARATION.

The preparation must be made with the most minute care.

The special rôle of the officer who is to carry out the enterprise is:

First. To see to all the necessary reconnaissances (terrain, accessory defenses, hostile trenches, etc.).

The terrain must be studied from the double point of view of avenues of approach and of shelter which will permit lodgment for the grenadiers within grenade range of the enemy's position.

The defensive arrangements of the enemy can be advantageously studied on photographs taken from the avions.

Second. To study the conditions under which the operation will be carried out (weather, hour, etc.).

Third. To assign to each squad a well-defined task.

Fourth. To arrange the best system of supply.

Fifth. To put the infantry and artillery who are to support the operation in touch with the manner in which he proposes to carry out his mission.

The officer in charge of the sortie personally conducts the squad charged with the principal operation. He should hold one of his subordinates responsible for the supply of grenades.

After the preparation for the sortie, made on the spot in the trench, in front of the hostile position, the troops charged with its execution should be taken to the rear for some time so as to prepare themselves by rehearsal of the appropriate exercises.

ATTACK OF A TRENCH BY A SORTIE.

The group which is to carry out the attack approaches the enemy's trench silently; if there has been artillery preparation the approach must be very rapid.

When the group is close to the points chosen for crossing the accessory defenses (supposed to be destroyed in front of the point of attack), a shower of grenades is thrown into the enemy's trench. Immediately after the burst of grenades the men leap into the trench.

Such an operation usually requires two groups, who, once in the trench, proceed to the cleaning up thereof, one to the right and the other to the left.

All precautions should be taken to avoid the enemy's grenades. A position prepared a few yards in rear of the first line may have been arranged by the enemy, and this must be taken into consideration.

Sometimes it is well to choose a very dark night or very bad weather. An understanding must then be arranged between the garrison of the line of departure and the group of grenadiers. For instance, a few shots fired in a certain manner warn the grenadiers that a light rocket is going up. The grenadiers lie on the ground and profit by the light to study their terrain. As soon as the rocket goes out they rush forward.

During the cleaning up the riflemen keep watch on any special objectives, according to orders given them before the departure.

NOTES.—It must be realized by all ranks that the rifle and the bayonet is the main infantry weapon. Grenades are useful for clearing small lengths of trench and for close fighting after a trench has been rushed; but no great or rapid progress will ever be made by bombing, and an assault across the open after adequate preparation will usually be a quicker and, in the long run, a less costly operation than bombing attacks on a large scale.

There is a tendency in bombing operations for more grenades than necessary to be thrown, thus tiring out the throwers prematurely and wasting grenades. This is due partly to neglect of throwing discipline, and also in some cases to the bombers having been overloaded with grenades and hastening to get rid of part of their load; 120 grenades per bombing squad of 8 men is as large a quantity as can be carried. Reserve supplies for immediate use can be formed, when the objective has been reached, by collecting the two grenades per man, which should be carried by all infantry.

PART III.

MECHANICAL METHODS OF THROWING GRENADES.

Mechanical methods of throwing hand grenades have the advantage of enabling a hostile trench to be made uncomfortable without exposing our own men, and of operating at a greater distance than is possible when throwing by hand. It also permits grenades to be methodically thrown on critical points of the enemy's trenches at intervals throughout the day or night. The mechanical grenade throwers in general use consist of ordinary rifles, special devices, and trench guns or mortars.

RIFLE GRENADES.

The construction and uses of the rifle grenade should be carefully taught in the manner indicated for hand grenades, and with the same painstaking care.

The rifle may be held in the hand, the firer kneeling, the rifle butt on soft ground, a piece of turf, or a bundle of rags. It may be fired from a rack or rest (see figs. 12, 13, 14), which insures greater accuracy and rapidity, and also permits the accurate laying of the rifle from behind shelter by means of a level with a jointed leg or some similar device.

Rifles using grenades may be fired from a rest by a lanyard attached to the trigger, with a small pulley to give direction to the lanyard. From four to six rifles may be fired by the same operator, by the simple device of using the proper number of lanyards and pulleys attached to a crossbar.

Precautions.

1. Do not permit the firing of a rifle grenade unless cover is at hand behind which the firer and spectators may seek shelter before the grenade strikes the ground. The stem of the grenade is sometimes thrown several hundred yards to the rear and would make a dangerous if not fatal wound even at that distance.

FIG. 12.

FIG. 13.

THE ABOVE ILLUSTRATIONS SHOW TWO IMPROVISED FRAMES FOR HOLDING A SINGLE RIFLE.

FIG. 14.—THIS ILLUSTRATION SHOWS A MODERN RIFLE REST AND GRENADE THROWER COMBINED.

2. Do not remove the safety wire until the moment of firing.

The best results are obtained by placing the rifle in a rest or holder. This is especially necessary when it is desired to fire on a critical point of the hostile trenches at intervals throughout the night. A simple rest or frame may be devised on the spot, and it may also be arranged so that one rifleman may fire four to six rifles at the same time.

Tactical Employment of Rifle Grenades.

The well-directed employment of rifle grenades demoralizes the enemy and inflicts upon him much more serious losses than the artillery bombardment. As an illustration of this, a battalion of infantry on the western front in Europe is reported to have received a bombardment of 3,000 shells in one day without one man being touched. In the evening, while the men were at supper, laughing about the inefficient work of the hostile artillery, a rifle grenade fell into a group of twelve men, killing four, and wounding eight, two of them fatally.

Enemy trenches should be minutely studied, to find the points where an adversary is likely to be located, such as sentry posts, shelters, crossings of communication trenches, etc. Rifles clamped in racks or rests should be kept laid on these points in order to shoot a grenade at once on any indication of movement at that point. Such a continuous fire, by night and by day, on well-chosen points will cause the enemy appreciable losses, and adversely affect his morale.

Well-directed rifle fire of grenades by small, perfectly trained detachments on an enemy assembling for attack, or upon known and registered points of communication trenches during the hour of changing reliefs, should give excellent results.

In assaults the employment of rifle grenades is closely connected with the action of other units constituting the waves of assault.

In cleaning up communication trenches the fire of rifle grenades should be carefully executed by the supporting groups which follow immediately in rear of the first line of grenadiers, in order to hinder the enemy's supply and to bar his line of retreat.

Grenades fired from infantry rifles at a range of about 200 yards, with an angle of departure of about 45 degrees, give a good angle of fall for reaching the enemy in his trenches.

NOTE.—As a corollary of this method, it is suggested that a table of elevations be constructed for use in high-angle fire of ordinary infantry bullets from rifles and machine guns.

GUN GRENADES.

The intelligent employment of gun grenades demoralizes the enemy and inflicts upon him losses much heavier than those due to bombardment.

The hostile trench must be studied minutely in order to know the points where the enemy may be caught (such as in lookout posts, shelters, the crossings of communicating trenches, etc.). The grenade guns should be kept accurately laid on these vulnerable points, so as to be able to send a grenade upon them at any moment of the day or night.

Notwithstanding the almost complete invisibility of the enemy in his trenches, his small density and his quick disappearance into shelters, it is still possible to cause him considerable losses by sending a ceaseless rain of gun grenades on certain judiciously chosen points.

The chief of a bombardier section has a very important rôle to play. He must be constantly on the watch, his vigilance is perpetual, in order to cooperate to the fullest possible extent in giving the garrison of his sector an aggressive attitude, which should always characterize the periods of calm. Each of his subordinates shares his responsibility in this respect, and this small unit must cultivate and maintain a value in morale which makes it a veritable "corps d'elite."

PROJECTING APPARATUS FOR GRENADES.

I. Organization.

Projecting apparatus or trench weapons are divided into two classes:

(*a*) High-power weapons, used by the artillery bombardiers, and which are described under the head of artillery.

(*b*) Low-power weapons, comprising mortars or bomb throwers whose propelling force is powder, compressed air, or springs. (See figs. 15, 16.)

Low-power weapons are used by the infantry and are organized into batteries of four to six pieces, attached to battalions. The assignment of the weapons of this kind among the different battalions is not uniform, but depends upon the terrain and the

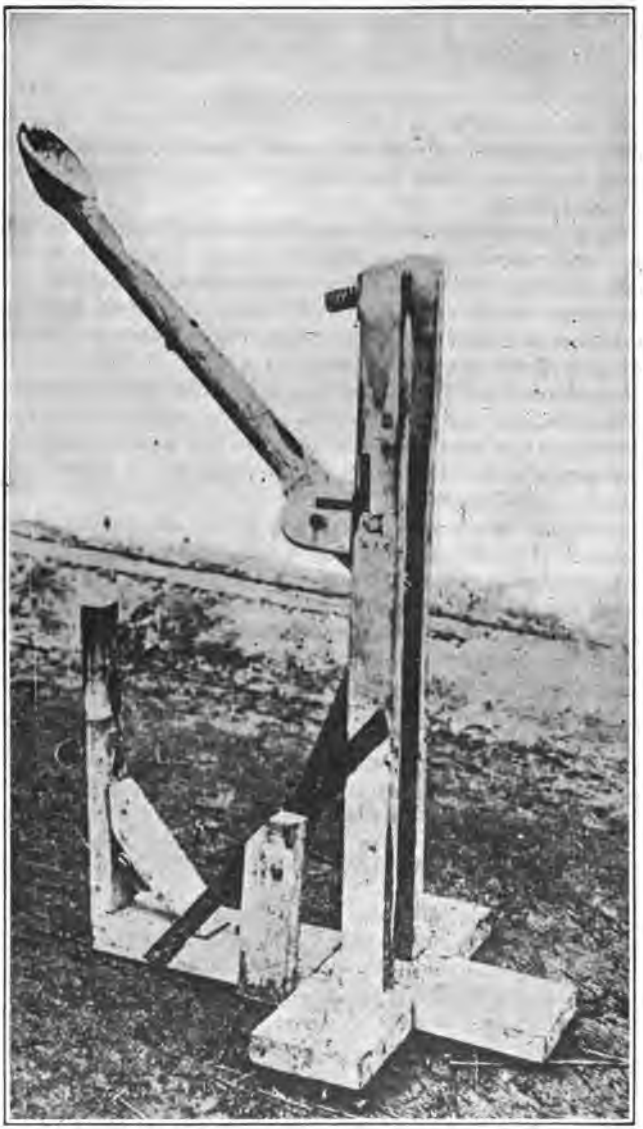


FIG. 15.—THIS DEVICE FOR CASTING GRENADES OR BOMBS IS OF VERY ANCIENT DESIGN, BUT IS BEING USED EFFECTIVELY FOR DROPPING BOMBS ON HOSTILE TRENCHES IN THE EUROPEAN WAR.

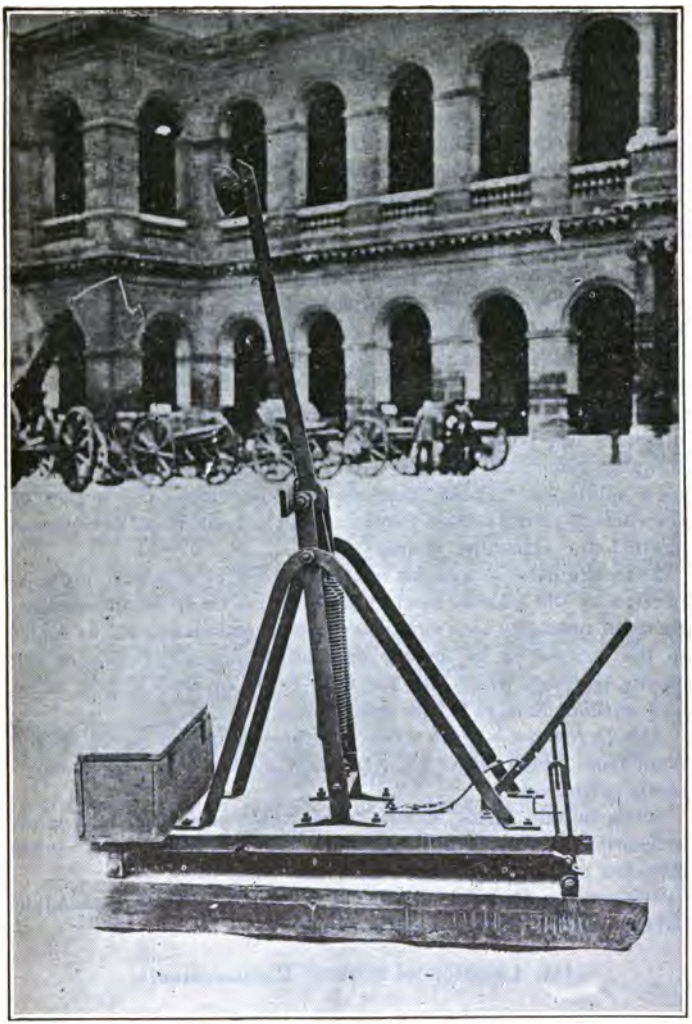


FIG. 16.—A MODERN GRENADE THROWER WITH ITS MUNITION CASE.

specific object to be attained, with a view to concentrating at the most important points the maximum means of this nature.

II. Tactical Employment.

Low-power weapons have a range, depending upon the propelling charge and the length of the time fuse, of from 50 to 350 yards. Their effect is small against material objects, but they are very efficient against personnel behind shelter which protects them from rifle fire.

Their use is particularly valuable in the following cases:

(*a*) *Offensive.*—1. Against enemy works, such as shelters for machine guns, which are demolished or nearly demolished by artillery fire, but in which the enemy has reestablished himself after having withstood the artillery fire in his deep bombproofs.

2. In parts of the front adjacent to those from which our offensive has been started, with a view to cooperate with the infantry remaining on this front, which has now been reduced to a minimum. These weapons can neutralize the action of the corresponding hostile front and can prevent flank movements against our attacking troops.

3. In the defense against counter attack of a newly captured portion of the hostile front. In this case these weapons move forward promptly and organize battery emplacements to assist in the defense or to operate against adjoining portions of the enemy trenches which are too near to be covered by our artillery without danger to our own troops.

(*b*) *Defensive.*—1. To assist in the defense of parts of the front from which most of the infantry garrison has been temporarily withdrawn.

2. To defend parts of the front which are especially close to hostile listening posts, small posts, or advance works which threaten our front line.

3. Near the second or third line in order to render untenable parts of our first line taken by the enemy.

III. Location of Battery Emplacements.

A battery produces its maximum effect when firing obliquely at its target, but observation is easier, and consequently fire is more effective, from the first-line trenches. For this reason batteries intended for destructive and offensive fire are generally

placed in or near the first line. The parts of the line most difficult for the enemy to reach, such as reentrants, defiladed points, etc., are selected, if possible, and three or four emplacements for each battery on successive lines are established beforehand. Each emplacement is divided into two half batteries, separated by a traverse.

IV. Employment of Fire.

Four kinds of fire are distinguished:

1. *Destructive fire.*—To be used against listening posts, small posts in course of construction, and blockhouses and machine-gun shelters already damaged, as, for instance, by artillery fire.

2. *Offensive fire.*—To be added to the fire of high-power weapons in the preparation for attack.

3. *Defensive fire.*—Heavy fire on the parallels of departure of the enemy preparing an attack; heavy fire at critical moments on trenches or communication trenches captured by the enemy. This fire should be violent, unforeseen, and sudden.

4. *Fire in periods of calm.*—Violent fire at any moment when the enemy appears to be negligent, such as when a fatigue party arrives in a trench, during a calm following an attack, during the warm hours of the day, a storm, or on dark, silent nights, etc.

Bomb-throwing weapons use either special projectiles or the ordinary hand grenades (explosive, incendiary, asphyxiating, etc.). They are divided into three classes, according to the propelling force used:

1. Spring apparatus, using the force of unbending springs.
2. Mortars, using the force of gunpowder.
3. Pneumatic guns, using the force of compressed air.

PART IV.

SUPPLY OF GRENADES.

The supply of grenades must be the constant care of the commanders of all groups. The most minute precautions must be taken to prevent the grenadiers running short of grenades, and arrangements should be made to start *two* grenades forward for every *one* that is expected to reach its destination.

The supply comprises, both on defensive and offensive:

1. The carrying by all the men of a certain number of grenades. The expert grenadiers and the men forming part of the squads designated to fight with grenades receive a more plentiful supply, carried in special haversacks.

2. The building of well-sheltered depots, whose position should be known to all grenadiers. It is well not to have too many of these depots.

3. Organization for transporting the grenades from the depots to the combatants.

On the defensive, the first condition for assuring the supply is that the depots should be near the combat posts of the grenadiers and placed in good shelters.

The personnel charged with the supply must know perfectly the places of the combat posts and of the different depots; this personnel should be placed under the orders of a noncommissioned officer specially detailed for this work.

On the offensive the supply detachment must not only consider the grenades needed by the combatants, but also the establishment of advance depots, built as the advance progresses.

As a rule depots will be established as follows: Near the communicating trenches which are to be built to connect the departure trench with that of the enemy when taken, in the forward part of the communicating trenches of the enemy, and near the flanks of the objective attacked.

The grenades must be sent forward in sacks or baskets, ready for use.

APPENDIX A.

TRAINING FIELDS.

A practice field for each regiment should be constructed promptly by the personnel of the regiment near its rest camp or billets. Such a field for throwing *dummy grenades only* may be made a very simple affair. A sketch of a suitable arrange-

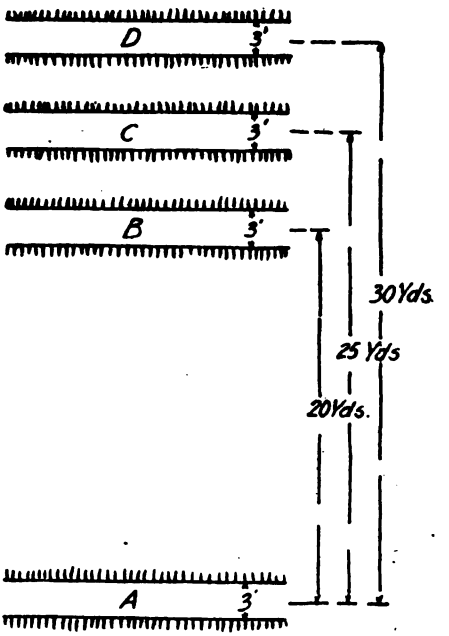


Fig. 17.

ment is shown in figure —. This is intended only as a suggestion, and any other arrangement answering the same purpose is permissible.

The trenches may be actually constructed or simply indicated by lines marked on the ground; a traverse or screen should

always be provided in order to insure that grenades are thrown at high angles so as to give a plunging fire.

The throwers take a position in trench A and practice throwing dummy grenades into trench B, afterwards increasing the distance so as to reach C, and then to reach D. The men may be divided into two parties, throwing to each other from opposite ends of the practice ground, in friendly contest, so as to increase the interest as well as to save time. Targets may be constructed or outlined so as to give practice in throwing for

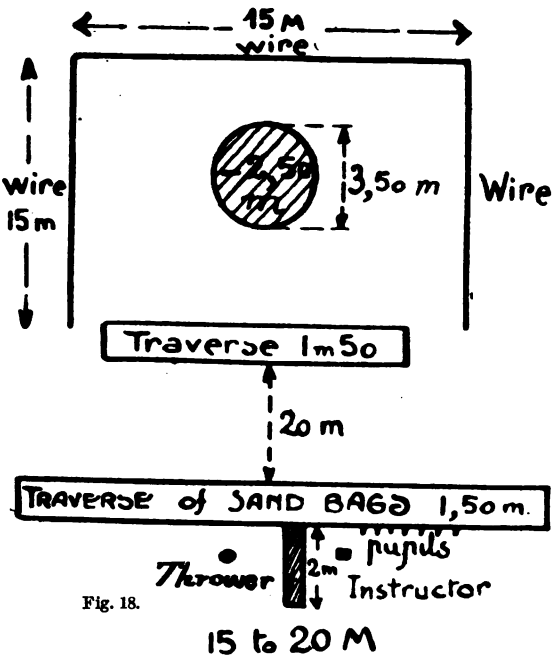


Fig. 18.

accuracy. The men must be required to throw from different positions—standing, kneeling, and lying down.

The regular form of instruction field should be constructed when troops are to remain some time in any place, and such a field is absolutely necessary if practice is to be had in throwing live grenades. This involves the building of fire and communicating trenches, machine-gun emplacements, shelters, traverses, barbed-wire entanglements, barricades, protecting screens, etc.

The establishment of an instruction field requires the construction of:

1. About 200 yards of trenches with traverses, communicating trenches, and shelters.

2. A hole to serve as a target for throwing live grenades. This hole should be about 8 feet deep and 12 feet in diameter. It is also well to surround it with barbed-wire entanglements, about 18 to 20 yards on a side, so as to prevent the handling of unexploded grenades by men not skilled in their manipulation. At some distance from this hole and on the same side as the trench from which the throwing is to be done, a 6-foot traverse should be built. The throwers should be sheltered in a trench or behind a wall with traverse. (Fig. —.)

3. About 30 yards of trench, in zigzag form, with circular traverses.

4. Two shelters to protect against humidity, 100 yards apart, one for grenades, the other for detonators.

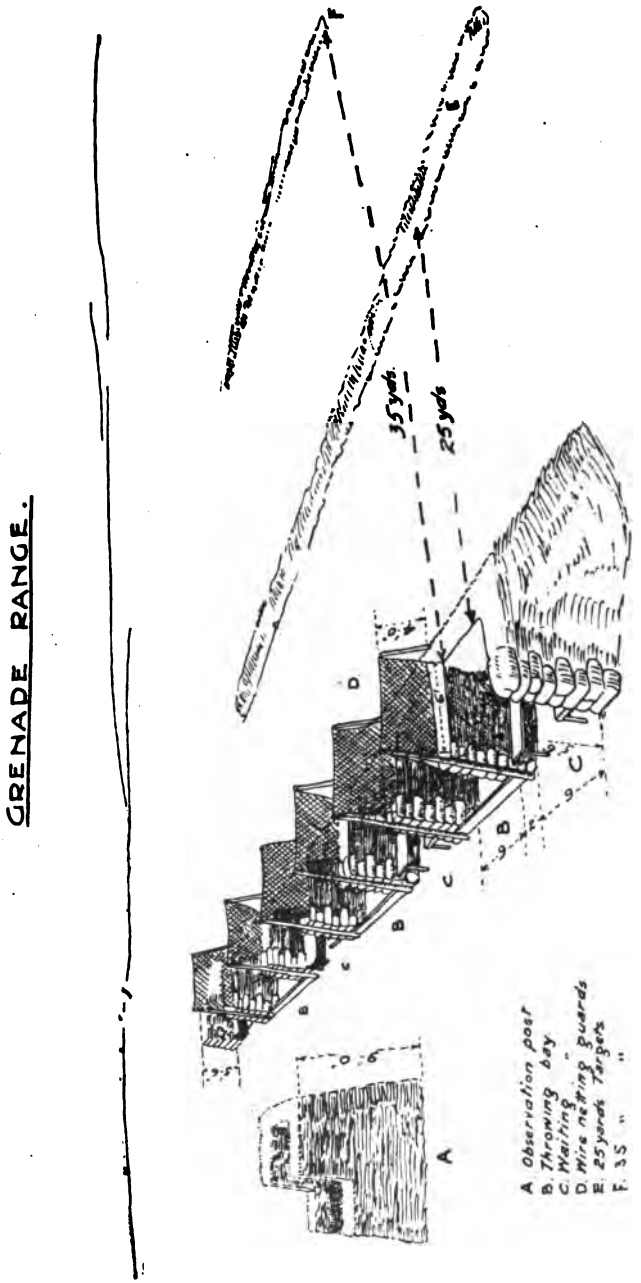

GRENADE RANGE.
35 yds.
25 yds
A Observation post
B. Throwing bay
C. Waiting "
D. Wire netting Guards
E. 25 yards Targets
F. 35 " "

Fig. 19.

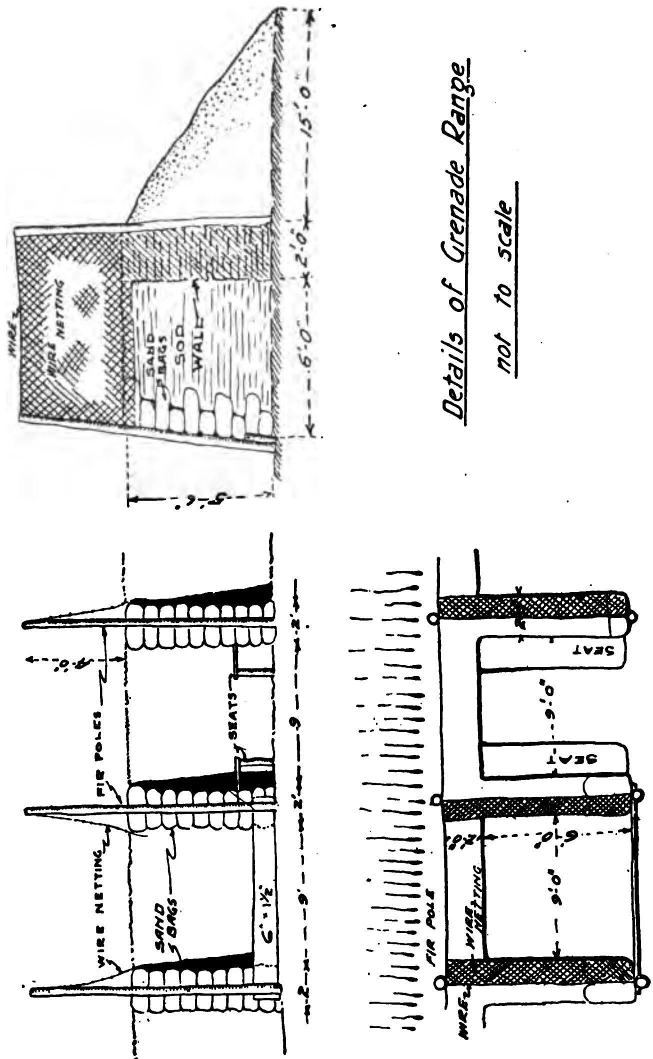

Details of Grenade Range
not to scale
WIRE
WIRE NETTING
SAND BAGS
SOD WALL
15'0"
2'0"
6'0"
FIR POLES
SEATS
SAND BAGS
WIRE NETTING
SEAT
SEAT
9'0"
6'0"
FIR POLE
WIRE NETTING
WIRE

Fig. 20.

APPENDIX B.

PROTECTION AGAINST GRENADES.

The method of making a device for protection against the explosion of percussion grenades and gun bombs is indicated in figures 21 and 22. The apparatus is simple and easily constructed wherever needed. The surface of the screen on which the projectile strikes must yield on the shock of impact; hence the use of timber or other rigid material on this surface should be avoided or minimized as much as possible.

Two crosses or "sawbucks" are constructed of wood, with the ends of the crosspieces joined by a stout wire, and a heavy nail or a bolt serving as a pivot. The two crosses are then connected longitudinally with a board, and the corresponding ends of the crosses are joined by a heavy wire. The frame thus constructed is covered with any convenient form of metallic trellis, such as chicken wire.

This grenade screen is placed over the firing or communicating trench, resting on traverses or other points of support, as indicated in figures 23, 24, and 25. It is balanced in position by a sandbag resting on the connecting board. By displacing the center of gravity of the sandbag, the apparatus is easily adjusted to any desired position. Experience has demonstrated the efficiency of this device.

In practice it is found that grenades do not burst as they strike the wire of the screen, but are thrown back by the rebound far enough to be harmless. These screens are used in parts of the trench which are especially exposed to grenade fire. The pivot of the device permits it to be displaced slightly from the normal position, so that lookouts may put their heads out of the trench, and by lifting the apparatus off its supporting points it may be used as an auxiliary defense, especially as an obstacle in a communication trench.

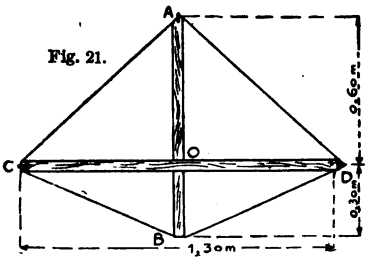


Fig. 21.

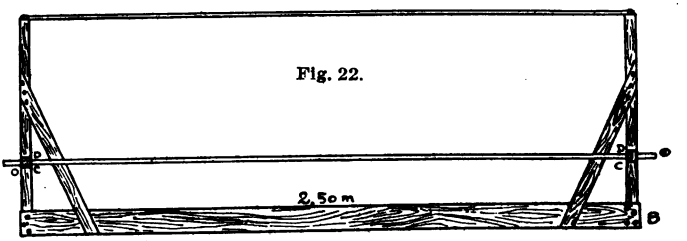


Fig. 22.

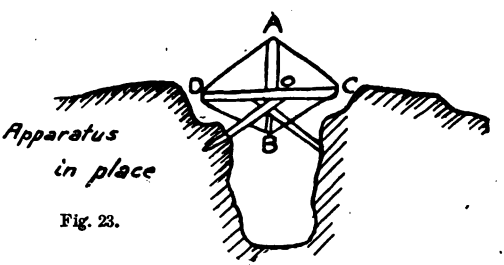


Fig. 23.

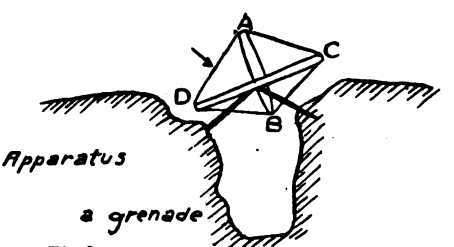


Fig. 24.

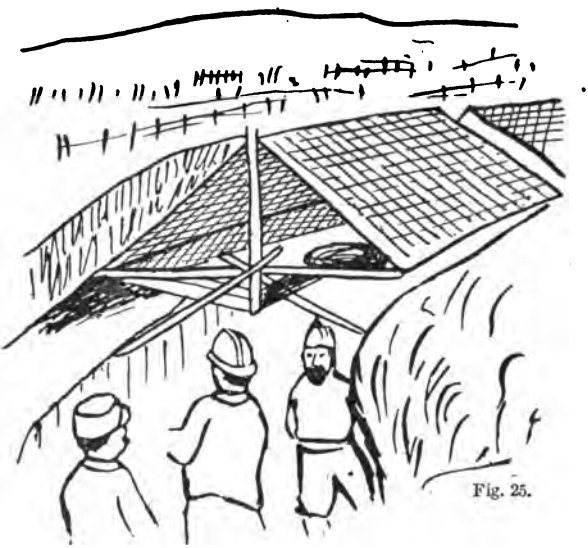


Fig. 25.

APPENDIX C.

SUGGESTED TACTICAL PROBLEM FOR GRENADIERS.

Situation.—Red (caps) has effected a lodgment in a front-line trench of Blue (hats), and is now driving Blue down a communication trench toward Blue's second-line trench.

NOTE.—Actual trenches should be constructed, and umpires should conduct the problem, making decisions on the spot, such as ruling men out as killed, requiring one side or the other to fall back, permitting them to advance, etc.

Solution.—Red is preceded by two riflemen with fixed bayonets, whose duty it is to occupy the angles of the trench in successsion, so as to sweep straight sections and prevent the grenadiers from being rushed. Red also brings up machine guns and riflemen to the front-line trench just captured from Blue to cover the advance; but the grenadiers do not carry rifles.

For grenades use small sandbags with an ordinary firecracker to simulate explosion. Each thrower should be followed by a carrier with a basket or gunny sack filled with grenades (40 to 50), which are passed to the thrower one at a time; and a supply detachment should be bringing up grenades from the depots in rear. Men in the captured Blue trench, provided with periscopes, should coach the throwers, correcting the fall of grenades.

When Red is halfway down the communicating trench the umpire decides that his advance is checked. Red then passes up sandbags and builds a barricade at the farthest point reached. While his riflemen are holding this barricade, assisted by the throwers, a second barricade is erected about halfway back to the captured front-line trench. The first barricade is solid across the communicating trench; the second is in two parts, each extending a little over halfway across the communicating trench, and not opposite each other, so as to leave a passage for the throwers to run through, throw their grenades, and run back to shelter.

While these barricades are being built, mine the walls of the communicating trench between the barricades with half a dozen small mines (2 pounds), and set them off with a slow match. This blows in the trench walls, and makes a place which the enemy (Blue) must cross unprotected from rifle fire, if he attempts a counterattack.

Red now drives Blue out of the supporting (second line) trench by the use of rifle grenades or gun bombs, etc.

NOTE.—The first and second line trenches are about 100 yards apart.

As a variation, for expert grenadiers put dummy figures in the Blue trenches and use live grenades in the attack.

APPENDIX D.

DIVISION BOMBING SCHOOL.

Suggested syllabus of course of instruction (11 working days), based on British schools.

Day and hour.	Place.	Work.
MONDAY.		
6.00 p. m.....	Lecture hall.....	Organizing class into squads.
TUESDAY.		
8.45 to 11.30...	Lecture hall.....	Introductory lecture. Explosives, fuses, detonators, etc.
11.45 to 12.30...	Trenches.....	Demolitions.
2.00 to 3.00...	Throwing field.....	Assembling detonators, fuses, etc.
3.00 to 4.00...	Lecture hall.....	Lecture: Hand grenade.
4.00 to 4.45...	Throwing field.....	Throwing practice.
WEDNESDAY.		
8.45 to 10.00...	Lecture hall.....	Lecture: Tactics.
10.00 to 10.30...	Trenches.....	Demonstration of trench storming.
10.45 to 12.30...	Lecture hall.....	Lecture: U. S. grenades.
2.00 to 3.00...	Range.....	Nos. 1 to 6 squads—live-throwing practice.
	Trenches.....	Nos. 7 to 12 squads—inspection of trenches.
3.00 to 4.00...	.....do.....	Nos. 1 to 6 squads—inspection of trenches.
	Range.....	Nos. 7 to 12 squads—live-throwing practice.
4.00 to 4.45...	Throwing field.....	Dummy-throwing practice.
THURSDAY.		
8.45 to 11.00...	Lecture hall.....	Lecture: Defense.
11.15 to 11.45...	.....do.....	Lecture: Projecting apparatus.
11.45 to 12.30...	Throwing field.....	Dummy-throwing practice.
2.00 to 3.15...	Range.....	Nos. 1 to 6 squads—firing projecting apparatus.
	Trenches.....	Nos. 7 to 12 squads—trench-storming practice.
3.15 to 4.30...	Reverse places.....	Reverse squads.
FRIDAY.		
8.45 to 10.45...	Lecture hall.....	Lecture: Attack.
11.00 to 11.45...	Range.....	Nos. 1 to 6 squads—live-throwing practice.
	Throwing field.....	Nos. 7 to 12 squads—practical work.
11.45 to 12.30...	Reverse places.....	Reverse squads.
2.00 to 2.30...	Lecture hall.....	Lecture: Crater fighting.
2.30 to 4.15...	Throwing field.....	Squads at disposal of instructors.
4.15 to 4.45...	.....do.....	Dummy-throwing practice.
SATURDAY.		
8 45 to 10.15...	Lecture hall.....	Lecture: Patrols.
10.30 to 12.15...	.....do.....	Lecture: Foreign grenades.

Suggested syllabus of course of instruction (11 working days), based on British schools—Continued.

Day and hour.	Place.	Work.
MONDAY.		
8.45 to 9.45...	Lecture hall.....	Lecture: Barricading.
9.45 to 11.00...	Range.....	Nos. 1 to 6 squads—firing rifle grenades.
	Trenches.....	Nos. 7 to 12 squads—trench-storming practice.
11.15 to 12.30...	Reverse places.....	Reverse squads.
2.00 to 3.15...	Range.....	Nos. 1 to 6 squads—firing percussion rifle grenades.
	Trenches.....	Nos. 7 to 12 squads—trench-storming practice.
3.15 to 4.30...	Reverse places.....	Reverse squads.
6.00 to 8.00...	Range.....	Night operations—live throwing.
TUESDAY.		
8.45 to 10.45...	Trenches.....	Practice barricading.
11.00 to 12.30...	Lecture hall.....	Nos. 1 to 6 squads—lecture: Trench-defense scheme.
	Trenches.....	Nos. 7 to 12 squads—traverse throwing.
2.00 to 3.30...	Reverse places.....	Reverse squads.
3.30 to 4.30...	Trenches.....	Trench-storming competition.
WEDNESDAY.		
8.45 to 10.45...	Lecture hall.....	Lecture: Attack and defense scheme.
11.00 to 11.30...	.....do.....	Lecture: Gas.
11.30 to 12.30...	Throwing field.....	Helmet drill.
2.00 to 2.45...	.....do.....	Demonstration of night signals, flares, etc.
2.45 to 3.45...	Trenches.....	Rehearsal for night operations.
6.00 to 11.00...	Lecture hall (outside).	Night operations.
THURSDAY.		
8.45 to 10.00...	Range.....	Nos. 1 to 6 squads—live-throwing competition.
	Throwing field.....	Nos. 7 to 12 squads—oral examination.
10.00 to 11.15...	Reverse places.....	Reverse squads.
11.30 to 12.30...	Throwing field.....	At disposal of instructors.
2.00 to 4.30...	.....do.....	Firing rifle grenades; throwing tests.
FRIDAY.		
8.45 to 9.15...	Lecture hall.....	Explanation of scheme.
9.15 to 11.00...	Trenches.....	Rehearsal for scheme.
11.00 to 12.30...	Throwing field.....	Recapitulation.
2.00 to 4.30...	Trenches.....	Officers' demonstration.
SATURDAY.		
8.45 to 11.30...	Lecture hall.....	Nos. 1 to 6 squads—written examination for officers.
	.....do.....	Nos. 7 to 12 squads—written examination for officers.
	Throwing field.....	Noncommissioned officers at disposal of instructors.