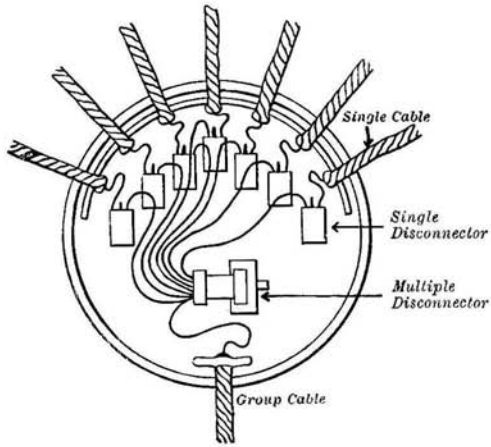
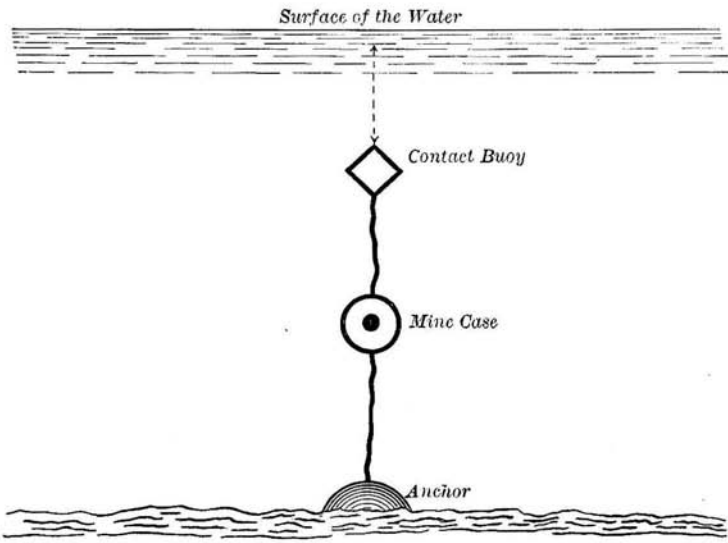
and firing mechanism in a separate buoy called a " contact buoy " which is connected with the mine case and is held a few feet above



JUNCTION BOX. PAR. 13.



MINE WITH CONTACT BUOY. PAR. 16.

the latter, and at the desired distance below the surface of the water, as shown in the sketch.

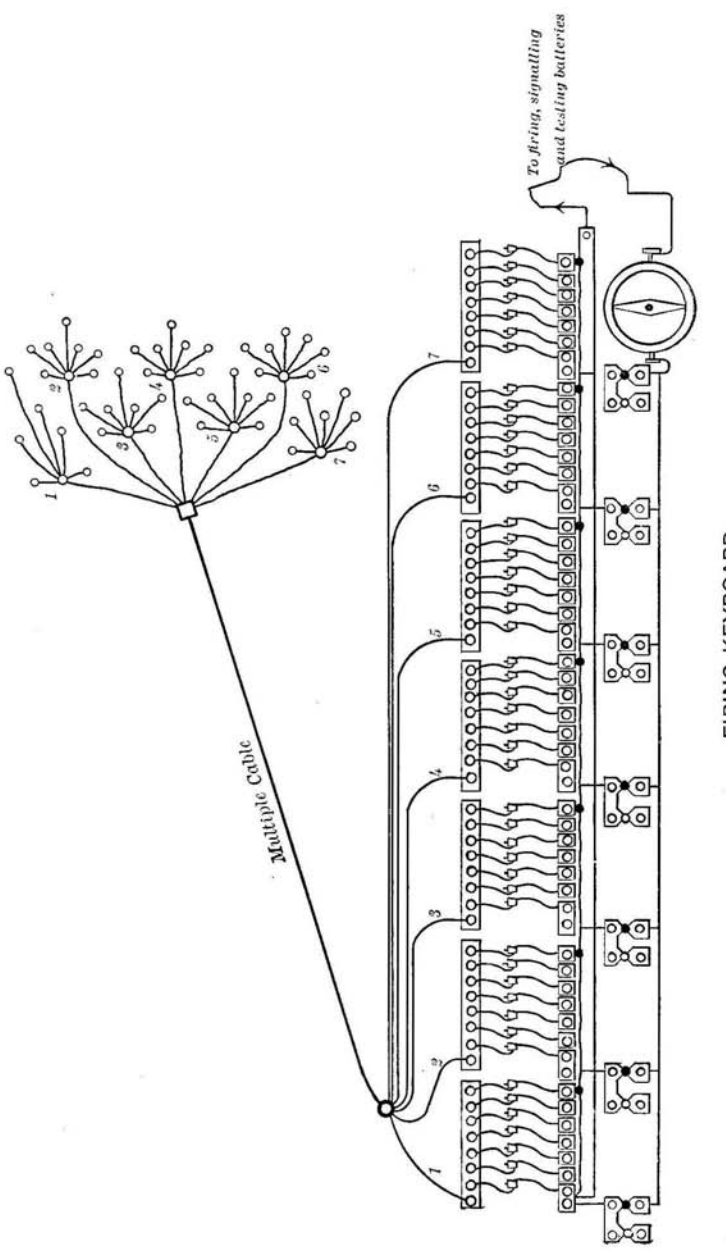
The use of a contact buoy permits a smaller and lighter case for the explosive charge. In electro-contact and electro-mechanical mines a blow upon the contact buoy closes the firing circuit, and the current passes down an electric cable through the primer of the mine and explodes the latter.

17. **Observation Mines.**—Observation mines are so called because each mine may be regarded as an observer which signals to the shore when its contact buoy is struck, and because such mines are completely under the control of an operator or observer at the firing station. This is the standard form of buoyant mine used by all nations for permanent harbor defenses.

Each mine is moored, with its contact buoy above it, in the same general manner as electro-contact mines. But with observation mines there are usually two distinct electric circuits—the signaling circuit and the firing circuit. When the contact buoy is struck, or sufficiently tilted, the circuit closer in the buoy closes the signaling circuit, which rings a bell, lights an electric light, or causes a shutter to drop over a keyboard in a firing station on shore. The operator may then touch the corresponding key beneath the signal, thus closing the *firing circuit* and exploding the mine. It is not necessary that the operator shall see the enemy. The firing station may be underground, quite safe from hostile fire. Thus an enemy striking the contact buoy of an observation mine may signal his own destruction.

18. **Groups of Observation Mines.**—Observation mines are usually moored in groups of about seven. Each mine has its own anchor, mine case and contact buoy. The electric cable for each mine passes from the circuit closer in the contact buoy down through the mine case, then to the anchor and along the bottom to the junction box of the group, from which the main cable leads to one key of the firing station on shore. Disconnector boxes might be interposed between the mines and the junction boxes, as in the case of electro-contact mines.

It is evident that arrangements may be made by which all the mines of a group may be fired simultaneously, or the explosion may be limited to the mine whose contact buoy has been struck. The size of the mines and the general system of laying them will determine whether all or only one mine of a group should be fired.



FIRING KEYBOARD.

Page 392b
BACK of Plate I,
Chapter XXII.

Faces Page 393.

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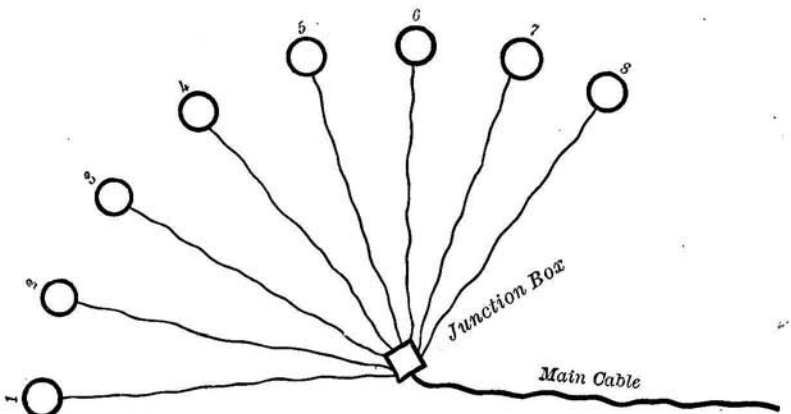
When the mines are large, for instance, only one mine of a group may be expended at a time; if small mines are used, a whole group may be fired simultaneously to insure the destruction of a ship. Some nations use very heavy charges—500 pounds of gun-cotton—in observation mines.

19. The Firing Keyboard.—Plate I will give an idea of the arrangement of a firing keyboard. It is not drawn to scale, but the lead of the cables and the connections are shown for seven groups of mines.



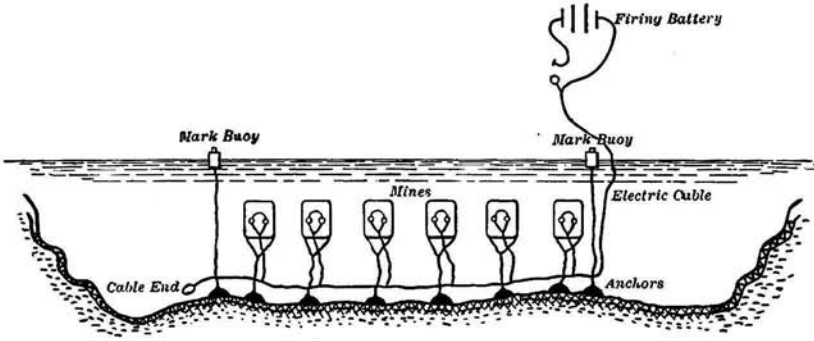
GROUP OF OBSERVATION MINES. PAR. 18.

20. Automatic Firing.—It is possible, in the absence of the operator, or at any time if thought desirable, to so arrange that the shutter which drops by the closing of the signaling circuit when the contact buoy of a mine is struck, may fall upon the firing key and close the firing circuit at the station, thus firing the corresponding mine, or group of mines, automatically.

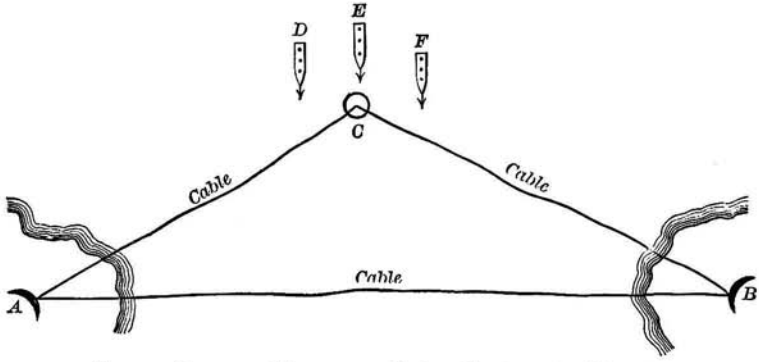
21. Judgment Firing.—The firing station may not be underground, in which case the operator may be so stationed at some convenient point that he may command a good view of the mine field. By the aid of ranges, buoys, etc., he may determine when a ship is in the proper position, and fire a mine or group of mines without the aid of contact buoys or a signaling circuit. This is called "judgment firing." It is evident that it might fail at night, or under some conditions of weather, etc. The operator is liable

to error. But this plan may be resorted to when other facilities are not available.

22. Lines of Mines.—A narrow channel may be defended by a simple system of several lines of mines, each line of six or more mines being on one cable.



LINE OF MINES ON ONE CABLE. PAR. 22.



FIRING GROUND MINES BY CROSS BEARINGS. PAR. 23.

Mark buoys, in addition to ranges, may indicate when an enemy approaches the line, and all the mines may be fired simultaneously by the operator on shore. Six 500-pound mines in a line, properly spaced, would thus defend a channel about 700 feet wide, as each mine would be effective at a distance of about 50 feet.

Judgment firing may be used for a line of mines.

23. Ground Mines.—Ground mines rest on the bottom. They may have contact buoys above them and be fired in the same

manner as buoyant mines. If contact buoys are not used "judgment firing," or fire by cross bearings, must be resorted to.

Ground mines are usually placed in shoal water. Sometimes, however, very heavy charges are moored in comparatively deep water, especially when swift currents or a considerable rise and fall of the tide would render buoyant mines ineffective. In such cases there may be two stations on shore to fire by cross bearings, as shown in the sketch. The observers at A and B may have plane tables showing the bearings of the mines, and each may direct a telescope at an approaching ship and close a break in the firing circuit whenever a ship is on the proper bearing. The two stations should be connected by telephone. Unless a ship is on the proper bearing from both stations at the same time, the two breaks in the circuit, one at A and one at B, will not be closed simultaneously, and the mine will not be fired. This would be the case with the ships at D and F, neither of which would pass over the mine. But the ship at E, continuing her course, would pass over the mine, the breaks in the circuit at A and B would be closed simultaneously, the circuit would be completed and the mine fired.

24. Groups of Ground Mines.—In shoal water comparatively small charges, without contact buoys, may be used in ground mines, and they may be planted in groups, or lines, to be fired simultaneously, as described for a line of mines, either by cross bearings or by "judgment firing."

25. Ground Observation Mines.—Ground mines may be supplied with contact buoys and with a signaling as well as a firing circuit, the cables being taken to the shore station, where the mines may be fired, singly or in groups, in the same manner as observation mines. In this case they are called "ground observation mines."

26. Advantages of Ground Mines.—Ground mines, if securely moored, may not be affected by swift currents which would carry down and render buoyant mines quite useless. And if the rise and fall of the tide is not excessive, ground mines especially with large charges, will be effective at all stages of the tide. If contact buoys are not used, friendly vessels may pass over ground mines with no injury either to ships or to the mines.

27. Rise and Fall Mines.—When the rise and fall of the tide

is excessive, buoyant mines which would be effective at high water might be on the surface at low water. Various methods have been

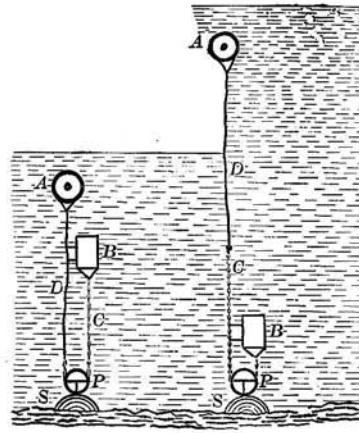


FIG. 1.—RISE AND FALL MINES. PAR. 27.

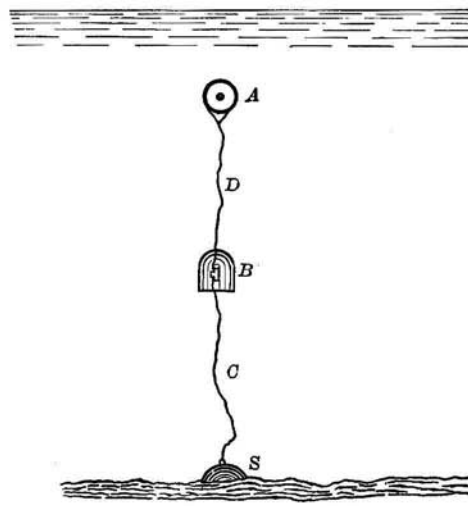
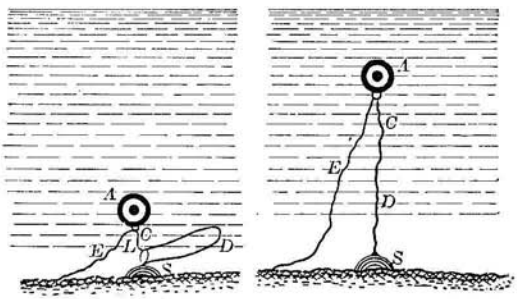


FIG. 2.—RISE AND FALL MINES. PAR. 27.

proposed to keep buoyant mines, automatically, at a constant depth below the surface of the water, and although none of these inven-

tions have been perfect in their action, the subject is of importance. One of the most reliable devices for tidal mines is shown in Fig. 1. A is the buoyant mine case; B is a buoyant counterpoise filled with air; C is a chain made of links varying in weight, the heaviest links being furthest from B; D is a mooring rope attached to the chain; S is an anchor with a pulley attached through which the chain C reeves; to prevent twisting, the counterpoise is attached to the mooring rope by rings, or guides, which permit it to rise and fall along the rope or chain.

The action is as follows: Beginning at low water, as the tide rises the increased water pressure compresses the air in the counterpoise, reducing its buoyancy; B sinks and A rises, therefore,



DORMANT MINES. PAR. 28.

until equilibrium is restored by some of the heavy chain passing around the pulley. When the tide falls, the reverse action takes place.

In another device, shown in Fig. 2, a buoyant regulator, B, contains a spiral wheel and a drum on a single axis, the part of the cable, D, being wound on the spiral wheel and being continuous with the lower part, C, which is wound on the cylindrical drum. The rise and fall of the water inside the regulator, which is open at the bottom, increases or diminishes the air pressure and causes the drum and spiral to turn by the varying tensions on the parts of the cable. The relative buoyancy of the mine case and the regulator, B, determine the diameter of the drum and the varying diameter of the spiral, so that the mine may be kept at a fixed depth below the surface.

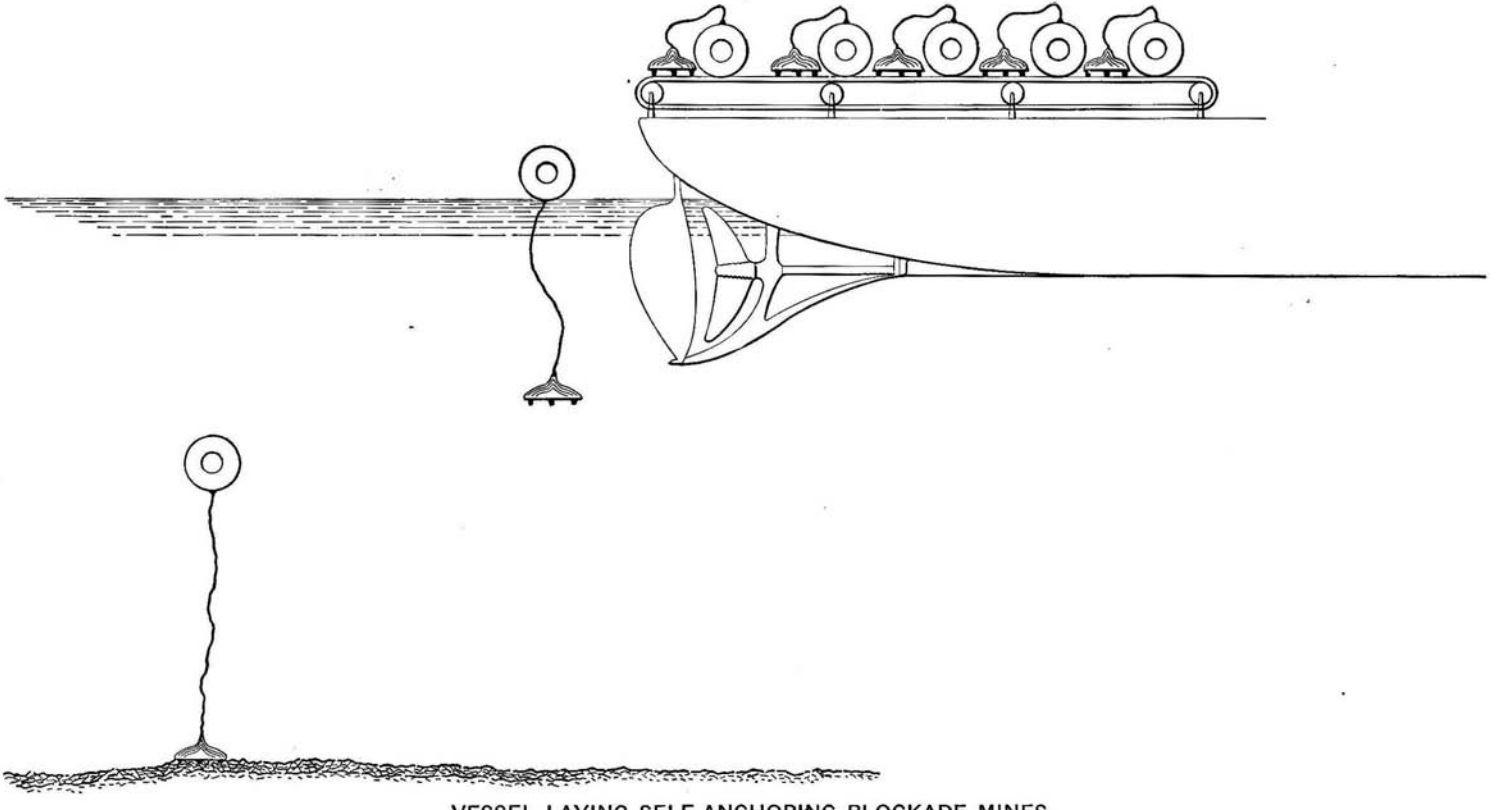
28. Dormant Mines.—In order that friendly ships may use one or more channels with safety in entering or leaving port, the use of dormant mines has been suggested.

The figure shows the general principle of dormant mines. The mine case, A, is held down near the anchor, S, by an explosive link, L, which contains a small charge of explosive. When a hostile force appears, or an attack is anticipated, an electric current may be passed through the link, exploding the charge, destroying the link and permitting the mine to rise and become active. E is the electric cable for firing the mine.

29. Blockade Mines.—Until recent years submarine mines were regarded solely as a feature of the fixed defenses of seaports, and their employment by naval forces in active offensive and defensive warfare was not seriously considered. The practicability of their use by ships or fleets was not admitted until the activity of inventors resulted in such a perfection of mechanical details in the application of electrical, safety and self-anchoring mechanisms that the problem of handling mines—laying them and picking them up—has been greatly simplified. At the present time nearly all navies are being supplied with "naval defense" or "blockade mines," which are to be used by fleets in time of war, and it is reported that in one foreign service all large ships are to carry from 20 to 30 mines of an improved electro-mechanical or electro-contact type, with self-anchoring devices.

30. Mine-laying Vessels.—Although it is expected that each ship, with its own boats and resources, may lay its supply of blockade mines in case of necessity, special mine-laying vessels have been suggested to accompany each fleet for the purpose of handling the mines with greater ease and expedition. Plate II will give an idea of one method of fitting a mine-laying vessel for this work.

The mines may be placed upon an endless traveling platform, similar to the floor of a treadmill, which will carry them with their anchors successively to the stern of the ship, where they may be permitted to drop off and anchor themselves at intervals and at a certain distance below the surface of the water, the ship moving at high speed. It is claimed that such a ship can anchor a large number of mines and pick them up again with ease—lay them in the forenoon and pick them up in the afternoon.



VESSEL LAYING SELF-ANCHORING BLOCKADE MINES.

Page 398b
BACK of Plate II,
Chapter XXXII.

Faces Page 399.

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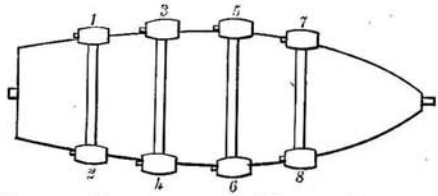
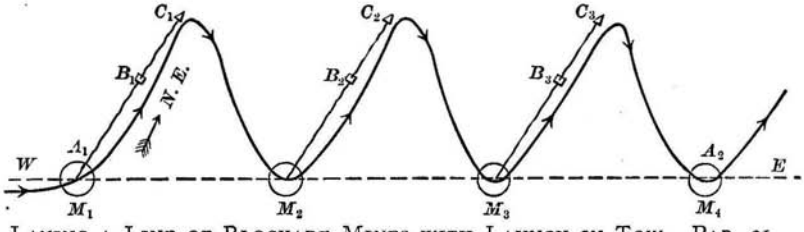
31. Laying Blockade Mines with a Launch.—In case a cruising ship is required to lay a number of blockade mines with its own resources, there are several methods which may be adopted. The mines, with their anchors, batteries and safety breaks, may be placed in a ship's launch at the ends of the thwarts as shown in the sketch, each being ready to slip at short notice. A steam cutter may then take the launch in tow.



LAUNCH LOADED WITH MINES. PAR. 31.

Suppose the mines are to be laid in a line, A_1, A_2, from west to east, M_1, M_2, M_3, etc., being the mines, B_1, B_2, B_3, the batteries, and C_1, C_2, C_3, the safety breaks for the several mines. Arriving at A_1, the first mine, M_1, with its anchor, is slipped, and the tow steers N. E. until B_1 and C_1 are dropped successively.

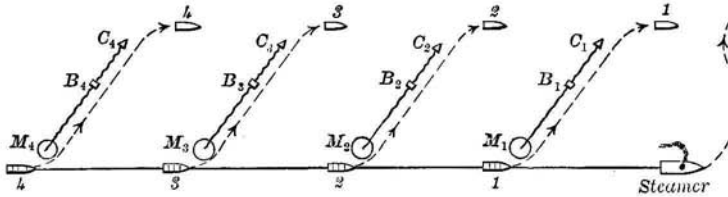


LAYING A LINE OF BLOCKADE MINES WITH LAUNCH IN TOW. PAR. 31.

The helm is then put hard over and the tow returns to the E and W line where M_2 is dropped, and continues to steer a zigzag course until all the mines are laid.

32. Laying Blockade Mines with Several Boats in Tow.—Another method, which would be preferable under some circumstances, is to place each mine with its battery and safety break in a separate boat, the mine and its anchor slung over the stern ready for slipping, and the crew seated on the thwarts ready to get

up oars. Take all the boats in tow of a steamer, the lengths of the tow lines or painters being equal to the distances at which the mines are to be spaced when anchored. The tow then proceeds, as before, to the point where the mines are to be laid and steers along the line, the crew of each boat being ready to slip its mine. When in position the towing boat makes a signal and all the mines are slipped simultaneously and *all tow lines are cast off*. If the mines are dropped promptly, it will not be necessary for the boats to anchor. In case of a hitch, however, a boat may anchor in position until its mine is dropped. All boats then get up oars and pull on parallel courses at 4 or 8 points from the line of mines and drop their respective batteries and safety breaks as before. The steamer may then take the boats in tow again and return to the ship, if necessary, for another lot of mines.



LAYING BLOCKADE MINES WITH BOATS IN TOW. PAR. 32.

In this manner each ship of a squadron may quickly lay a line of mines in accordance with a plan previously decided upon, and each ship's force, knowing exactly how and where its mines were planted, may pick them up without delay. The sketch illustrates this method, the boats, mines, batteries and safety breaks being numbered as before.

33. **The Future of Blockade Mines.**—If the claims of inventors are even approximately realized, submarine mines may play an important part in future naval wars. A squadron, or a single ship, may protect itself from attack by quickly mining the approaches to a harbor in which it takes refuge; or an inferior naval force may successfully blockade an enemy in port by laying lines of mines across the entrance, and then protecting the mine field from countermining operations. With such a system of blockade mines, Cervera's squadron might have been effectively blockaded

in the harbor of Santiago, leaving the greater part of Admiral Sampson's fleet free to engage in other operations. The subject is one of growing interest and importance.

34. Plan of Mine Defense.—The plan of mine defense to be adopted for any particular seaport can only be decided upon after a careful study of the conditions peculiar to that port—the character of the channels, the depth of the water, strength of currents, rise and fall of the tide, etc. All these points having been carefully noted, the positions of the mines, or groups of mines, are laid down on the chart. As a general rule, ground and contact mines, singly or in groups or lines, are placed in shoal water, the former being preferred wherever the currents are strong. Groups of observation mines, or electro-contact mines, are usually placed in deep water and at outlying points, and the groups are so spaced that a ship passing between the groups of one line will pass over those of the line next inside. The mines are all numbered and a table of angles is given to the officer who lays the mines, so that they may be laid in accordance with the plan.

35. The Mine Field.—The whole space occupied by mines is called the "mine field." It should be swept by the fire of small guns to protect it from countermining operations, and by electric searchlights to guard against night attacks upon the mine cables. Plate III, Figs. 1, 2, and 3, shows the general plan of a mine field and the group formations used for observation and electro-contact mines.

36. Spacing of Mines.—If the plan of the mine defense does not contemplate that all the mines in one group, or line, are to be fired simultaneously, it is evident that care must be used to plant the mines at such intervals that the explosion of one may not cause those adjoining it to explode, or even to signal in the case of observation mines. It is not easy to give a rule for this distance, but one authority states that mines containing 100 pounds of gun-cotton should be spaced about 100 feet apart. The larger the mines the less desirable will it be to fire more than one mine at a time, and the greater must be the distance between them. Mines containing 500 pounds of gun-cotton should be spaced about 320 ft. apart. For these reasons it is obviously wise to distribute the mines over a wide area and in many different lines. The com-

Page 401a
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Chapter XXXII.

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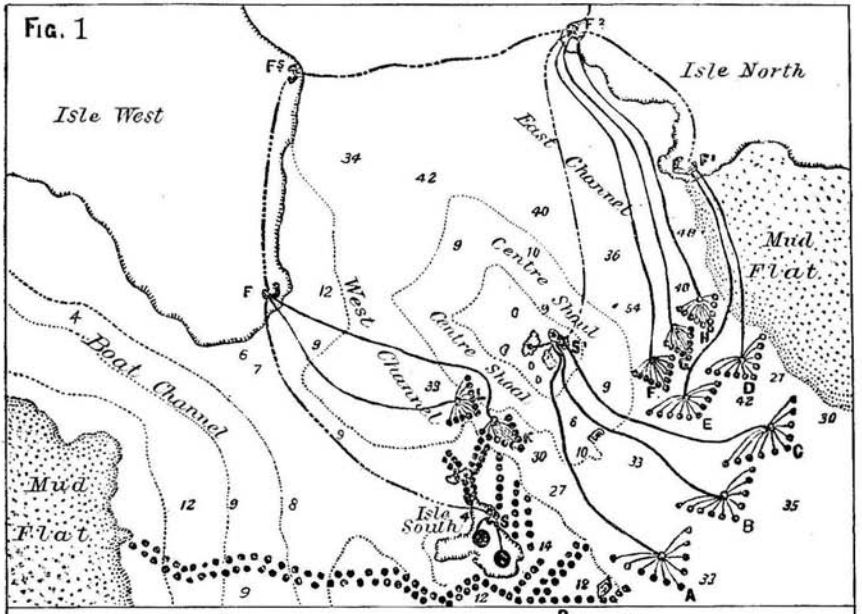
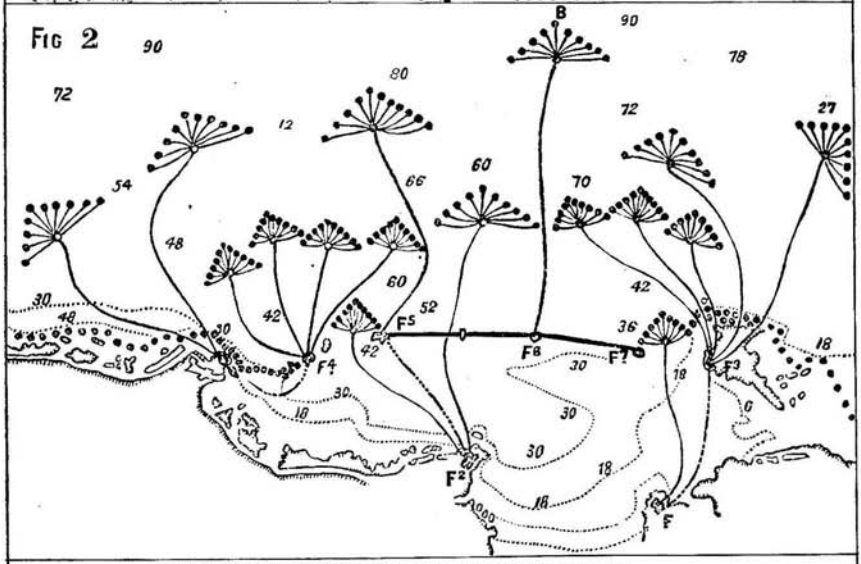
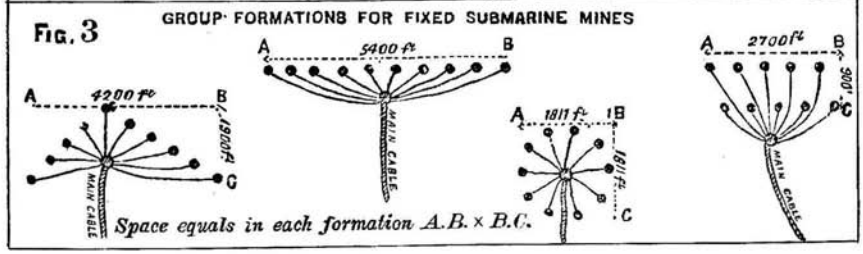






PLANS OF MINE FIELDS.

plete removal of the mines by an attacking force will thus be rendered more difficult, and the expenditure of a few mines to beat off one attack may not destroy the whole mine field, leaving the entrance open to a second attack. An enemy would prefer to pass over a limited field thickly planted with mines, because the leading ships might clear the way for those in rear. But he will dread the passage over a field of great extent where each mine acts singly—where no ammunition is wasted.

37. Friendly Channel.—A special channel across a mine field is sometimes designated for the use of friendly vessels. It may be planted with ground or dormant mines to prevent its use by an enemy, while friendly vessels may pass over such mines with safety.

38. Testing Mines.—It is most important that a mine field should be kept in an efficient condition by providing all facilities at the observing station on shore for testing, daily, the firing circuits of all electrical mines.

39. Mine Destroying.—The quickest way to put a mine field out of action would be to cut, near the shore, the cables that lead to the observing stations. This of course would only be possible at night under peculiarly favorable conditions and in the absence of a defending force. If this plan of attack is impracticable, there are three other methods that may be resorted to:

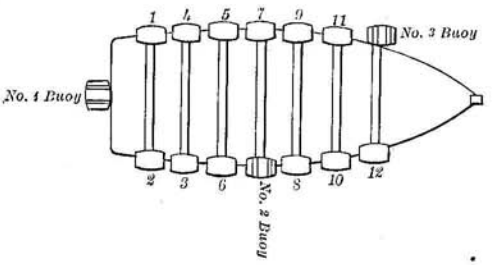
(1) Creeping.
(2) Sweeping.
(3) Countermining.

All these methods of removing or destroying mines to clear a passage for ships are difficult and dangerous, inasmuch as the force engaged in the work may be under the fire of guns that command the mine field, or may be attacked by vessels specially assigned to protect the mines from destruction. As a rule, such operations should only be attempted at night.

40. Creeping.—This consists in supplying boats with grapnels with which to drag the mine field for cables, junction boxes and disconnectors. Sometimes explosive grapnels are used with which to destroy the cables or connections. This method is used in shallow water and as near the shore as possible in order to get hold of the cables.

41. Sweeping.—This consists in dragging a weighted rope, chain or long iron bar between two boats some distance apart. Grapnels and explosive charges are sometimes attached to the sweep. If cables, or junction boxes, are brought to the surface they may be cut or destroyed. Anchors may be pulled up so that the mines will come to the surface and float away.

42. Countermining.—This method consists in running lines of mines across the field and then exploding them in order to destroy the connections or cause the defending mines to explode by shock. Countermines sometimes contain very heavy charges—500 pounds of gun-cotton. All the mines in one line are attached to a single cable so that all may be fired simultaneously as soon as the last mine is dropped.



COUNTERMINING LAUNCH. PAR. 43.

43. Countermining Boats.—Ships may be supplied with countermining boats specially designed for the work. It is important that each boat should carry from eight to twelve mines and that arrangements should be made to run out a line of mines quickly. When special boats are not provided, a heavy sailing launch may be fitted for the purpose, as shown in the sketch.

The mines with their sinkers are slung over the sides of the launch at the ends of the thwarts. For a long line of mines three buoys are provided, which, with their separate anchors may remain in position at the extremities and middle of the line after the explosion to mark the ground that has been cleared. All the mines are attached to one strong cable, and are spaced according to the weight of the charges. The cable is coiled clear in the launch and the bights pass under the boat from one mine to another on the opposite side. One end of this cable is carried in a battery

boat which is towed astern of the launch and which anchors before the first buoy is dropped; the other end of the cable is taken on board the steamer, or gunboat, which takes the countermining launch in tow. The mines and buoys are held by slip stops so that they may drop automatically when a strain comes on the cable. It should not be necessary to have a crew in the launch.

44. Running a Line of Countermines.—All being in readiness, the tow starts at full speed for the point of attack. At the proper time the battery boat in rear of the launch slips its tow line, at the same time anchoring and also slipping No. 1 buoy at the stern of the launch. The launch continues on, towed at full speed, the cable being paid out until it tautens and slips No. 1 mine. The other mines and buoys are slipped in turn when the strain comes on the cable, and finally No. 3 buoy drops. The towing steamer then makes a signal and closes the firing battery at its end of the cable; the battery boat, seeing the signal, also presses the firing key and the line of mines explodes. The lines of countermines may be laid with a view to clearing only one channel—that is, lengthwise and near the middle of the channel. In case the channel is wide, two parallel lines may be run at a certain distance apart to insure a safe passage for ships. A channel having once been cleared, the defenders should not be permitted to plant new mines. They may seek to re-mine a channel by using simple contact mines to prevent delay, dropping them at night or in thick weather. This operation will be easier than that of countermining. It is far simpler to defend or replace, than to attack or destroy a mine field.

CHAPTER XXXIII.

FIELD FORTIFICATIONS AND INTRENCHMENTS.

NOTE.—Ingersoll's Text-book of Ordnance and Gunnery and the Manual of Military Field Engineering, by Captain Wm. D. Beach, U. S. Army, were consulted in the preparation of this chapter.

1. **A Judicious Use of Fortifications** may enable the weaker body of men (from whatever cause) to become equal to, or stronger than, a superior force; a knowledge of its principles assists in occupying a position to the best advantage, the artificial construction being so combined with the natural features of the ground as to produce from a minimum of labor a maximum of strength.

All works are made up of two parts, the profile, and the plan or outline.

2. **Trenches and Ditches.**—A trench is an excavation in rear of the covering mass; a ditch is one in front of it.

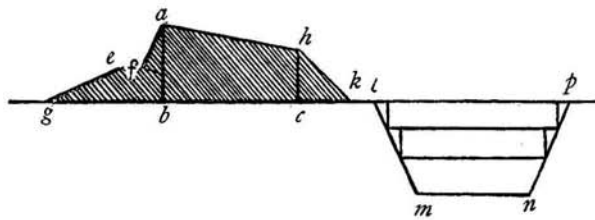
Cover is more rapidly gained by the use of a trench, as it will be obtained by the excavation plus the height of earth thrown immediately in front.

A ditch might provide the earth for the parapet in works of a more important nature, and at points which are purely defensive. The bottom of a ditch may be formed in a V shape with advantage, in order to prevent the attack from accumulating there.

3. **Profile.**—The profile is a section shown by a vertical plane at right angles to the direction of the work. The profile selected will depend upon the object the work has to fulfill, upon the projectiles it may have to withstand, and upon the nature of the surrounding ground.

The profile may be formed also of a trench and a ditch, the men working on each side of the parapet and throwing the earth upon the intermediate space. By these means a considerable thickness of parapet may be obtained in a short time; but in such a case the ditch does not become deep enough for a sufficient

obstacle, but may be subsequently deepened, the earth being thrown upon the crest of the counterscarp and forming a sloping surface called a *glacis*.

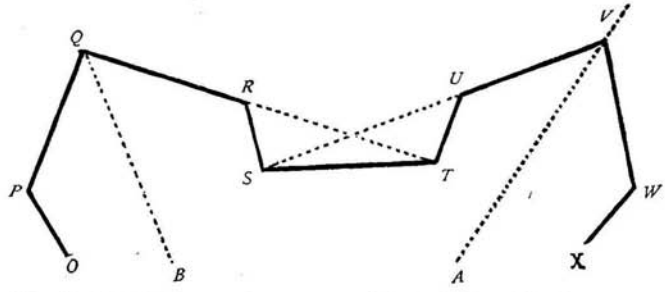


PROFILE. PAR. 3.

The above profile is that of a parapet and ditch. The dimensions are obtained by the following considerations: The *command, a b,* by the amount of cover required to screen the interior of the work and the position of the enemy; the *thickness, b c,* by the nature of the projectiles likely to be used against it, for field artillery, 12 feet to 15 feet, and for rifles, 4 feet (these dimensions may be lessened, except for rifles, for the rear faces of works); *e f,* the *banquette,* is to enable riflemen to fire over the parapet, and is made 3 feet wide for a single rank of men, and 4 feet 6 inches for a double rank; *e g,* the slope leading to the banquette, has a base equal to double its height; *a f,* the *interior* slope, is *revetted* (it being so steep as to require artificial support); *a h,* the *superior* slope, is sufficiently sloped to enable the defenders to see the top of the *counterscarp,* and, upon level ground, is as 1:6; *h k,* the *exterior* slope, is an angle of 45°; *k l,* the *berm,* is made sufficiently wide to relieve the escarp from the pressure of the parapet; *l m,* the escarp, usually slopes about 2:1 if the soil be strong, and as much as 45° in sandy soil; *p n,* the counterscarp, is made as steep as the earth will allow, as it has no weight to bear like the scarp. The ditch is from 6 feet to 12 feet deep, and should be at least 12 feet wide at the top. The slopes of the ditch are obtained by excavating it in steps, as shown in the sketch, the depth and base of the steps being in proper proportions; these steps are subsequently cut away.

4. Outline.—The outline is the general arrangement, or trace, of works upon the ground. As much direct and flanking fire as

possible must be brought to bear upon points of attack. In very uneven ground, where direct fire cannot be given, there will always be found some points from which flanking fire may be obtained. The three points to be considered are: 1st, the object of the work, that fire may be given in the required direction; 2nd, that its own ditches shall not be dead, that is, unseen by the fire of the defenders, and that the ground over which the attack must be made shall be under fire from the work; 3d, that those defending the work shall be protected from oblique, enfilade or raking, and reverse fire.



P Q R and *U V W*, Advanced Parts.
R S T U, Retired Parts.
P Q, *Q R*, *U V*, *V W*, Faces.
R S, *T U*, Flanks.
S T, Curtain.

Q T, *S V*, Lines of Defence.
P Q R, *U V W*, Salient Angles.
R S T, *S T U*, Re-entering Angles.
V A, *Q B*, Capitals.

OUTLINE. PAR. 4.

The outline, therefore, will depend upon the object of the work and the natural features of the ground.

5. Definitions.—The following definitions and simple rules will be found useful:

The extent of the work will be determined by the number of men required for its defense. Two men per lineal yard of the parapet, with half that number in addition as a reserve, were formerly considered an ample garrison in most cases; but in the present day, taking into consideration the greater use of curved fire of shells, the precision of rifled artillery, and the rapidity of fire with breech-loading small-arms, it would be inexpedient to crowd men together. One man per running yard, and half that number in addition as a reserve, will probably be sufficient for most positions. Field guns will each occupy a length of 15 feet

upon the faces of works, and 40 feet (20 feet on each side) at the salient angles.

Splinter-proof Traverses, 4 feet wide at top and 6 feet wide at bottom, may be placed between field guns, and to give protection from enfilade or oblique fire. Those of similar construction, to give cover from reverse fire, are called *parados traverses;* within such traverses magazines may be conveniently formed. When the interior space is limited in a field work, the magazine may be placed under the parapet.

A Salient Angle is formed by two faces projecting outwards, towards the enemy. Such angles, being points of attack, should be as few and as prominent as possible, so that the points of attack may not be doubtful, and may be well prepared for defence. They should be as obtuse as possible, and not less than 60 degrees, in order that a greater extent of ground may be seen from the parapet, and they should be situated upon the higher points of ground, in order that the interior of the work may be the better screened. See P Q R in the sketch.

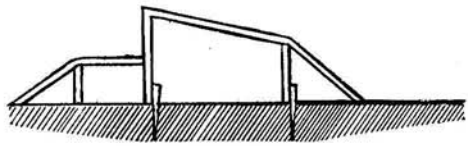
A Line of Defence is the face of a work, which, together with its ditch, receives flank defence. In detached works which mutually flank each other, it consists of the portion which is flanked, together with its distance from the flanking work. For the close flanking of ditches, lines of defence should never be greater than 300 yards. The distance between detached works, in order that the ground in front of them may be defended by the artillery fire of the collateral works, may extend to 1500 or 2000 yards. Faces of works will usually average from 40 to 60 yards, and should be directed clear of a raking fire from the front; this will usually be the case when the salients are obtuse; the prolongations of all faces of works should, if possible, be directed upon points where it is impossible to establish batteries, such as marshes, etc. See Q T, S V, in the sketch.

An Angle of Defence is the angle contained by the flanking portion and the line of defence. The limits are from 90 degrees to 120 degrees: about 100 degrees is best.

The Capital of an Angle is the imaginary line bisecting it, along which the enemy advances. That portion of the capital under fire should be made difficult by the use of obstacles. See V A.

As a corollary to the rule that salient angles should occupy the higher points of ground, re-entering angles will necessarily occupy the lower points. The openings or communications through works, which may be necessary, are formed near the re-entering angles.

Flanks should never be less than 12 yards long, otherwise the ditch will not be seen, much of this space being occupied by the slopes of the portion which is flanked. When it is advisable to flank with artillery, not less than three guns should be used.



RIGHT PROFILE. PAR. 6.

6. Construction of Single Field Works.—Pickets are to be driven at the salient and re-entering angles, and tape or string passed round them. The lines traced are the crest line (or highest part of the work) and the lines marking the excavation for trenches or ditches. With ditches these lines will be the crest of the work and the edge of the escarp and counterscarp; if with trenches, it will be sufficient to mark the front line of the trench only. "Profiles," or skeletons of the work, are then set up, formed of slips of deal or other wood, secured to pickets driven into the ground; or they may be formed with wood, cut to the proper lengths, for the heights of the various slopes, connected at their ends with rope yarn.

The berm is generally left rough, and dressed upon the completion of the work.

Upon long faces at least three profiles should be set up. At the angles of the work oblique profiles are erected, whose dimensions will, of course, vary with the sides of the angles.

It is advisable to divide the working party into squads of 25 men, each squad having a responsible overlooker. With trenches it is best to place the men at intervals of 6 feet along the tracing line, each man having a pick and shovel. When all is ready, the

work is commenced simultaneously, each digger beginning at the *left* of his task, and getting cover to the required depth as quickly as possible, and then extending the excavation to his right.

With ditches, place the diggers along the escarp line, facing the work, each with a pick and shovel, at intervals of 6 feet. *Shovelers* are placed upon the ground to be occupied by the parapet, in the proportion of two to each set of three diggers (the whole number being, therefore, one-third less than that of the diggers); these have shovels only. *Rammers* are placed in the proportion of one to each pair of shovelers, in order to consolidate the earth; they should not allow more than 6 inches in depth to accumulate without ramming it well. Suitable instruments for their use are of very easy construction. The ramming is not done with a view of resisting projectiles, as loose earth will do this better, but with the object of solidifying the work.

7. **Revetments.**—Earth newly dug up will not stand at the steep slopes required for some portions of the work; the means used to effect this are called *revetments; hurdles* or mats, 6 feet long and 2 feet 9 inches high, and made of brushwood with vertical pieces called pickets may be readily formed; 10 pickets will be a good number for each hurdle. A *gabion* is a cylindrical hurdle, filled with earth when placed in revetment; gabions are 2 feet in diameter and about 3 feet high; *fascines,* or bundles of brushwood, from 7 to 9 inches in diameter, and of various lengths, are very good for this purpose; they are bound together by tough twigs, at intervals of about 18 inches; this revetment is built as the parapet is raised, and secured to it by means of pickets driven into it at angles of 45°, each row of fascines being also picketed to the row beneath; the joints of the rows of fascines should be broken; it is necessary to use revetments for the interior slopes and cheeks of embrasures; if fascines cannot be procured, planks, casks or sand bags may be used for this purpose. Magazines are frequently constructed on the unexposed sides of traverses, as follows: Place strong splinter-proof timbers at an angle of 45° against a well-revetted traverse, strengthened by bags of earth and sods, the whole being covered with tarpaulins.

8. **Obstacles.**—Obstacles have for their object the holding of an enemy under fire while checking his advance and breaking up his formation.

1. They must be within the effective range of the defender's fire.

2. They should not be visible to the attacking party until the latter is at close range.

3. They should be difficult of removal under fire.

4. They must afford no shelter to an enemy.

To hinder the approach of the enemy, keep him under the fire of the intrenchments, and render an assault as difficult as possible, are most important points in the defense of field works; and it must especially be borne in mind that obstructions should always be placed in the unflanked ditches. *Palisades* made of young trees, or of large ones split into two or three pieces of a triangular shape and pointed, 10 feet long and 6 or 8 inches thick, are very useful when placed either upright in the middle of the ditch, or at the foot of the escarp inclining outwards; they are planted 4 or 5 inches apart, and buried 3 or 4 feet in the ground. The lower ends under ground are connected by a riband or cross piece to prevent them from being torn up separately; another riband is also used to connect them at about 1 foot from the top.

9. **Abattis** are constructed of trees or stout branches having their ends pointed or fastened to the ground with strong pickets, the branches being turned toward the enemy; for putting a village into a state of defence, trees bordering the road can easily be turned into a serious obstacle by sawing half through their trunks and fixing their heads to the ground.

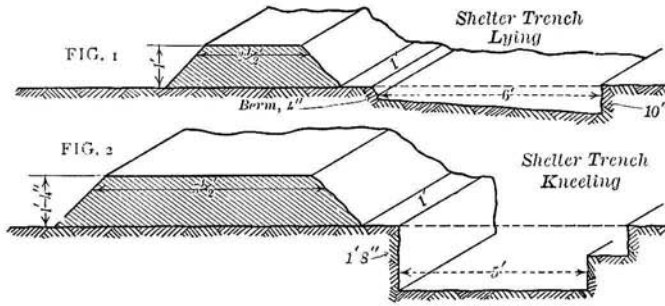
10. **Trous de Loup** are also very useful placed in front of the counterscarp, especially at the salient angles; they are pits of either 3 feet in width and depth, or of double these dimensions; a sharpened palisade is placed in the center, the point is not to project above the mouth of the pit; on no account should the pits be made 4 or 5 feet deep, as the enemy might then turn them into rifle pits.

11. **Barbed Wire.**—Barbed wire fences have been used in recent wars to check an attack. Wire entanglements, both high and low, made by driving stakes into the ground and connecting them by stout wire are also used. All such obstacles are particularly useful at night.

12. **Hasty Intrenchments.**—Hasty intrenchments are such as

may be made with little delay after occupying a position in the field; they consist of cover or shelter trenches for the men, and gun pits or epaulments for artillery.

13. **Shelter Trench Lying.**—The shelter trench for skirmishers lying down is shown in Fig. 1. It gives a protection of 2½ feet of loose earth, which will stop small-arm bullets under ordinary circumstances. The time required for one man to make 5 feet of this trench with a small intrenching spade is about 25 minutes. Ordinarily two men may use 5 feet of this trench, though three may occupy five feet by lying on their left sides. In firing, the left elbow rests on the berm.



SHELTER TRENCHES. PARS. 13 AND 14.

14. **Shelter Trench Kneeling.**—To get cover kneeling, deepen the lying down trench to 1 foot 8 inches, and make it 5 feet wide with an embankment in front having a height of 1 foot 4 inches with a resulting thickness of about 5½ feet (Fig. 2). The time for one man to deepen the trench in this manner, with a small intrenching tool, is about 45 minutes.

Men may fire from this trench kneeling in double rank, four rifles for each 5 feet of trench. Four men could make 5 feet of this trench from the beginning in about 20 minutes.

15. **Cover for Artillery.**—Cover for guns may be obtained by means of gun pits made by digging a hole of a size sufficient to partially conceal the gun and its crew, and forming an embankment in front with the excavated earth. The "Austrian Gun Pit" is often used.

16. **Gun Epaulments.**—Instead of placing the gun in the

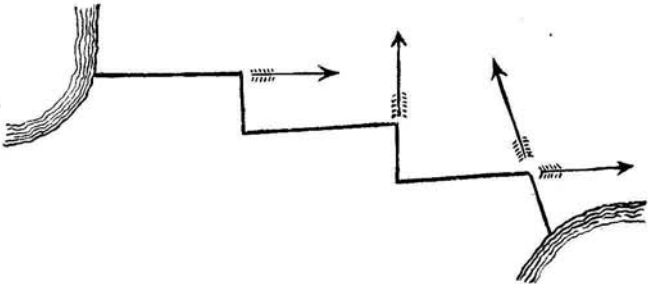
bottom of the pit, it may rest on the natural surface of the ground and be covered by an embankment in front, made by digging two pits, one on each side of the gun. The crew may find cover in these pits.

17. **Advantages and Disadvantages of Shelter Trenches.**—The advantages are:

1. They stop rifle bullets.
2. They offer a small target.
3. They are quickly and easily made.

The disadvantages:

1. The embankments being low, the field of fire may be limited by small folds in the ground unless care is taken in selecting the position.



INDENTED LINES. PAR. 18.

2. In wet weather they may become untenable by reason of mud and water.

Gun pits have practically the same advantages and disadvantages as shelter trenches.

18. **Lines of Works.**—A line of works may have *intervals*, or it may be *continuous*. A line with intervals has the following advantages:

1. It involves less labor.
2. The garrison may be smaller.
3. It allows greater freedom of movement for counter attacks

Such works are usually so placed as to mutually flank each other; that is, in echelon.

In the case of continuous works the line may be an *indented line*, or a *right line*. From the latter only a direct fire can be

obtained, while from the indented line both a front and flank fire may be practicable as will be seen from the sketch.

19. A Defensive Position.—A position of perfect defence may not always be possible, but the following general advantages should always be sought:

1. The position should conform to the tactical requirements of the occasion and should favor the effective use of the principal weapon of the defenders.

2. The flanks should be as secure as possible against a turning movement.

3. It should be impossible for the enemy to obtain natural cover during his advance; that is, the defenders should have a free field of fire.

4. The defenders should be protected from the fire and view of the enemy by cover, natural or otherwise, which will not interfere with counter attacks.

5. The position should be such that the defenders may move readily from one part of the line to another.

6. The advance of the enemy should be delayed by obstacles and entanglements.

It was formerly the function of engineers and pioneers to lay out and construct defensive works. It is no longer their exclusive province. It is now accepted as a principle that the men who are to defend a position must prepare it for defense. Cover is of greater importance than ever before in the history of warfare. Modern weapons and smokeless powder have emphasized the importance of cover.

20. To Occupy and Defend a Town.—A town when properly prepared and defended may have the following advantages:

1. It may be rapidly placed in condition for defense.

2. It conceals the strength of the defenders.

3. It provides a certain amount of cover from fire.

4. It affords shelter from the elements.

On the contrary, it has the following disadvantages:

1. The garrison is scattered and not easily controlled.

2. When under artillery fire, splinters and fragments may cause casualties.

3. It may be set on fire by shell fire.

A town may be held for the following reasons:

1. As a supporting point in the main line.
2. As an advanced post in front of the main line.
3. As an independent post.
4. As a reserve station, or rallying point, in rear.

The following are some of the preparations to be made for the defense of a town:

First select some suitable and substantial building as a stronghold, and determine whether it would be best to occupy the whole village, or a part only. Avoid wooden houses and thatched roofs, and prefer brick houses to those of stone, selecting such as mutually flank each other. Take care that the amount of ground occupied be not in excess of the number of men available for the defense. Salient points must be strengthened as much as possible; all houses not occupied by the defense which may be of the least use to the attack must be demolished. *Outside* the defenses destroy all walls, thick hedges, and any cover which may be parallel generally to the place, and leave such as may be perpendicular to it, and which will therefore be enfiladed and cause obstruction. *Inside* the place, reverse this rule; *wet* ditches, palings, and thin hedges outside the place may all be left. Hedges, walls, etc., may be incorporated with the general line of defense. Long walls may receive flank defense by means of *tambours* or projecting small angular works or stockades; communications may also be thus covered. The streets may be barricaded and the houses loopholed; great care must be given to the communications with the stronghold, and also that barricades be not in positions to be taken in reverse; in this case other barricades must be formed in rear. Field guns must be placed in commanding and retired positions difficult of access.

A sufficient garrison for a building will be at the rate of 1 man for every running 4 feet of the lower story, 1 man for every 6 feet of the second story, and 1 man for every 8 feet of the upper story, should there be one. All windows and doors of the lower stories should be well barricaded and secured, and ditches cut around the house. Doors may be barricaded by heavy furniture filled with earth or filled sand bags; doors should, if possible, be made bullet-proof by nailing upon them additional planking. The

glass in all windows should be at once demolished, and the window frames filled up with rolled blankets, carpets, etc. If there be no time to destroy all the glass, blankets secured by forks within the window frames will prevent splinters. Loopholes should be made in the walls and at the angles. The upper windows need not be barricaded throughout, but must be so to a height of 6 feet from the flooring. Balconies may be strengthened and made bullet-proof, being loopholed at the base in order to give fire from beneath to the foot of the wall; suitable overhanging constructions of a similar nature may be formed by means of timber, these being passed through the wall and secured inside to the joists of the flooring; it would be advisable to construct them over outer doors. Especial care must be given to the communications inside the building, staircases being partially removed and ladders substituted. If the outer wall be liable to be weakened by artillery fire, the flooring inside should be supported in addition by stanchions. Plenty of water must be available, in casks, etc., within the building.

Loopholes should be made as small as possible, the width at the neck never being more than 3 inches.

21. Hedges and Walls.—Hedges and walls serve as screens, and with ditches on either or both sides, the earth being thrown against them, they may afford more or less cover. To prevent their being used by the enemy in case they are abandoned or captured, the ditch on the enemy's side should be so deep that he cannot fire through or over them.

22. Concealment of Trenches and Gun Positions.—It is of the utmost importance that all trenches and gun pits, or gun positions, should be covered with branches, weeds, sod, etc., in order that their position and extent may not be discovered. The old rule "fire draws fire" is now changed to "visibility draws fire," and all problems in attack and defense must consider this principle first of all. Smokeless powder is a great aid to the defender in that it does not betray his position.

23. Defensive Tactics of the Boers.—The success of the Boers on the defensive was due not only to the judgment displayed in the selection of a position, but to their skill in concealing it. Their trenches were usually without embankments. After dig-

ging the ditch the earth was leveled off. There was nothing to betray their position. Their artillery was usually dispersed, and every gun carefully screened. The English often found themselves under fire without knowing from what point the fire came. There being no smoke, and the enemy being completely screened, or having burrowed in the ground, the fire could not be returned. It must be evident that such conditions would be extremely trying and demoralizing to the attacking force.

The Boers often occupied widely separated positions, and their trenches were seldom continuous but were placed at all advantageous points where a clear field of fire could be obtained, and sometimes in several lines which would be occupied in turn as they fell back. Their plan was to conceal every rifle and every gun and utilize the full power of every weapon by appealing to the individuality and marksmanship of their men.

24. Successful English Tactics.—Against these tactics of the Boers the English finally won their greatest successes by the adoption of extended order formations at all times. Instead of concentrating and massing their men while on the march from point to point, they often swept over the country in long lines of skirmishers—they marched in extended order. Brigades kept in touch with each other, and battalions of eight companies marched in column, each company deployed as skirmishers at five paces interval, and the companies following each other at distances of about 200 yards. Thus a battalion would be about a mile deep. When one part of this long, thin line would find itself seriously opposed, or under fire, it would usually halt, take cover, and hold its ground until the distant parts of the line, continuing the march, would threaten the flanks and rear of the Boers and force the latter to leave their position. The English line would then resume the march and regain touch. This formation was known as "awaiting shell." It minimized the effect of the Boer's artillery and infantry fire, and reduced the chances of a disastrous surprise.

25. Field Intrenchments and Tactics.—It is laid down that the question of fortifications and intrenchments is essentially tactical. The examples of the Boer War demonstrate the truth of this statement. The location and the nature of field fortifications or intrenchments depend primarily upon tactical situations.

26. Naval Brigades on Shore.—It is not to be expected that purely naval forces will be called upon to construct permanent fortifications or to engage in independent operations on shore requiring an extensive knowledge of field engineering. The brief discussion of the subject in this chapter may suffice for most situations in which a naval officer may find himself.

Naval landing forces may be required to man permanent fortifications already constructed, to seize and hold towns or other positions, or to attack the same. The lessons of the Boer War, which have been briefly referred to, both as regards offensive and defensive tactics, should not be forgotten. But it will of course be apparent that the open order formations, and the tactics used against the Boers, who were expert marksmen armed with modern magazine rifles using smokeless powder, may not be practicable against another enemy differently armed.

Formations in mass, for mutual support, both on the march and in action, may be required against an uncivilized or semi-civilized enemy whose tactics are to surround and come to close quarters with his opponent. Such were the squares used by the British in the Soudan.

The officer must choose the formations and make the disposition of his force which may be required by the existing conditions. There is range enough in the Drill Regulations to cover most cases if an officer applies them in a practical manner.

CHAPTER XXXIV.

PRACTICAL NAVAL GUNNERY.

Prepared by Lieutenant-Commander W. S. Sims, U. S. Navy, and Lieutenant Ridley McLean, U. S. Navy.

1. **Definition.—Ordnance** is a term ordinarily applied to heavy weapons of warfare, such as great guns, howitzers, artillery, etc. In naval parlance, however, it has grown to be a general term which includes all material used on board a naval vessel for firing projectiles at the enemy.

2. **Gunnery** is the art of using the ships' guns to the best advantage; that is, in such a manner as to make the greatest possible number of hits in a given time.

Principles of Gunnery.

3. **Excellence in Gunnery** is measured by the rapidity of hitting the point of aim. It is evident that however large a percentage of hits a gun may make, if these hits are not made with the greatest possible rapidity, the gun will have failed to attain its highest degree of usefulness. Similarly, the very highest degree of rapidity of fire, with inaccurate pointing, is entirely useless. Excellence in gunnery may therefore be regarded as the product of its two essential elements: 1. Accuracy of fire, and 2. Rapidity of fire.

4. **Accuracy of Fire.**—This depends on:

1. The accuracy with which the gun is pointed at the target or the enemy, or briefly, *accuracy of pointing.*

2. The correctness of the position of the sight each time the gun fires, or briefly, *correct sight setting.*

5. **Accuracy of Pointing** depends on:

1. *The individual skill of the pointer,* which is developed:

(a) By continued preliminary practice at his own type of gun.

(b) By pointing at the horizon, or at floating objects when the ship is rolling, and

(c) In actually firing his gun at target practice.

2. *The condition* in which the sight, the gun, the mount, and the various appurtenances which affect accurate shooting are kept.

Unless the gun, the gun gear, gun mount, and gun sights are maintained in such a condition that the mechanical difficulty experienced by the pointer in aiming and firing the gun is a minimum, the accuracy of pointing will be affected. This applies not only to the condition as regards cleanliness, but particularly to the condition as regards facility of operation, and to the proper functioning of each individual part. A neglected gun mount renders pointing difficult, and hence conduces to inaccuracy. Neglected sights always invite disaster; if they are actually out of adjustment when firing begins they insure a string of misses; if they are weak and liable to derangement they are apt to jar out of adjustment during a string of shots and thus invite disaster in action. Neglected firing connections, locks, etc., invite either hangfires, missfires, or prolonged firing intervals, all of which are serious hindrances to accuracy of fire.

6. Correct Sight Setting depends on:

1. The accuracy of the orders given by the divisional officer, or the gunnery officer, to the sight setter, concerning the setting of the sights. This depends upon the accuracy with which the sight-bar range has been determined, which may be regarded as the most difficult problem in naval gunnery.

2. The promptness and accuracy with which these orders are obeyed.

It is manifest that however perfect the gun, the mount, the crew, and the ammunition, unless the sights are correctly set at the moment each shot is fired the projectile will certainly miss.

7. The Accuracy of the Orders Given to the Sight Setter may for convenience be subdivided under the headings:

(a) When firing guns singly at measured ranges.

(b) When firing guns singly at unmeasured ranges.

(c) When firing all guns of a ship's broadside together at unmeasured ranges.

(a) *Firing Guns Singly at Measured Ranges.*—This is the most elementary stage of target practice. In this case (which is the case under which ordinary record target practice is held) the

entire responsibility for the correct setting of the sights falls upon the divisional officer; he must keep himself informed as to the true distance from the target at every instant of time, and by observation of the fall of the shot he must so correct these varying distances that the sight-bar ranges which he gives to the sight setter will insure that any shot which is accurately aimed at the center of the target, will hit it.

(b) *Firing Guns Singly at Unmeasured Ranges.*—In this case the ranges are determined by the range finding party, by such means as exist on board ship, and are transmitted by the gunnery officer to the battery, by the range indicators, or by such other means as may be provided. In this case the observations of the fall of the shot are made by the gunnery officer and his assistants, and the necessary corrections to the distances determined by the range finding party are applied by this officer, because from an elevated position such corrections can be more accurately estimated, especially at long ranges, than by the division officer from his station near the gun.

(c) *Firing all Guns of a Ship's Battery together at Measured Ranges.*—In this case the range is determined by the range finding party, and transmitted by the gunnery officer to the battery in the same manner as above described. The correction to the various distances would be determined by the gunnery officer from the average center of impact of the various trajectories, and this would be applied by him, and included in the various ranges which are transmitted, so that nothing remains to be done but set the sight to the range and lateral compensation that are transmitted.

In both this and the preceding case, the great importance of every gun pointer being a trained expert, of every pointer aiming directly at the center of the target, and of all sights being set exactly alike (i. e. at exactly the range and lateral compensation ordered by the gunnery officer) is apparent. This will cause the shots to be bunched somewhere, and the gunnery officer can then quickly alter the sights of the battery so that this bunch will fall on the target, whereas, were this not the case, the shots from the battery would be so dispersed that no deductions could be made by the gunnery officer to guide him in the determination of the error existing between the distances determined by the range finder and the actual sight-bar range which should be used.

8. Promptness and Accuracy with which Orders Regarding the Setting of the Sight are Obeyed.—Regardless of the accuracy with which the ranges may have been determined, or of the skill of the gunnery officer in fire control, unless the sights are promptly and accurately set to conform to the ranges given (in the first of the above cases by the divisional officer, in the second and third cases by the gunnery officer) all excellence in other features affecting gunnery are nullified.

Whatever the method employed in carrying out the practice, the sight setter's duty remains the same: it is to set the sight as accurately and as quickly as possible both laterally and in elevation each time a new range or a change in lateral compensation is ordered; and as the pointer always aims at exactly the same place, and as all errors are corrected by altering the sights, it is impossible to attach too great importance to this feature of naval gunnery.

9. Rapidity of Fire.—This depends on:

1. The rapidity with which the gun is loaded after it has been fired, or briefly, *rapidity of loading*.

2. The promptness with which the pointer fires after the gun is "ready," or briefly, *rapidity of pointing and firing*.

10. Rapidity of Loading depends on:

(a) The rapidity with which each member of the gun crew performs his allotted duty.

(b) The "team work" of the gun crew. That is, on each member of the gun crew performing his own duty in the service of the gun at exactly the proper time and in exactly the proper sequence, and then getting out of the way so as not to interfere with the other members of the crew.

(c) The *precision* with which each member of the gun crew performs his allotted portion of the drill.

Accuracy and thoroughness in every detail, even though it may require slightly more time, is an absolute requisite to real rapidity of *continuous* loading, because in the commendable eagerness for excessive rapidity, many serious delays are caused by interference, confusion, and casualties that can be avoided only by precision in every movement; and it must be remembered that some of these delays, such as the raising of one single burr, or the jamming of

one cartridge case, may more seriously interfere with rapidity of fire than the maximum deliberation necessary to surely avoid them.

11. **Rapidity of Pointing and Firing** depends, like accuracy of pointing, on:

(a) The skill of the pointer.

(b) The condition of the gun, gun mount, sights, etc., but particularly on the condition of the mount and firing connections.

A really skillful pointer will keep a gun of an intermediate calibre, which is mounted on a modern gun mount, continuously pointed at the target, provided the mount is maintained in a perfect condition. In this way the gun is aimed and prepared to fire the instant the pointer is notified that the gun is "Ready." If to this degree of skill and excellence of mount is added a firing mechanism in such thoroughly efficient condition that the gun will fire with certainty at the earliest possible moment after the pointer wills to fire, the rapidity of *aimed* shots is made practically to equal the rapidity with which *unaimed* shots may be fired. So long as this degree of rapidity is possible with any gun, it is evident that any time which elapses between the word "Ready," and the firing of the gun is a clear loss, and its cause must be due either to—

(a) The lack of skill of the pointer in not having his gun accurately aimed before the word "Ready," or,

(b) The inefficient condition of the mount, or of the firing mechanism which prevents him from pointing and firing the gun with facility and certainty.

General Remarks on Naval Gunnery.

12. From the above it is apparent that skill in gunnery—measured by the rapidity of hitting the point of aim—depends not on the pointer alone, but on every person actually participating in the practice; on the gunnery officer, in case he is controlling the fire of the ship, on the divisional officer, the gun captain, both pointers, the sight setter, and on each individual member of the gun crew.

13. The greatest rapidity of hitting can be attained only by the united efforts of each person concerned, working as in an

athletic team, in complete harmony with every other member of the crew. A failure in the slightest detail on the part of any one participant may materially reduce the rapidity of hitting, and thus nullify the greatest possible excellence on the part of the others.

14. In the following epitome of the duties of the various persons participating in the firing of a great gun, attention is confined to the gun crew as a fighting unit. Whether one gun, or all guns, are firing, whether the ranges are determined by the divisional officer himself, as in record target practice, or are transmitted to the divisions by the gunnery officers, the range and lateral compensation are given to the sight setter by the divisional officer (or by some person appointed to assist him in doing this), and the duties of the members of the gun crew remain in all cases the same.

The Divisional Officer.

15. It should be the divisional officer's ambition to obtain from each gun in his division, at each practice, the greatest number of hits per minute possible with his particular types of guns. Having trained his division to this degree of excellence, it is ready to be used as a unit by the senior officers of the ship in the more advanced fighting efficiency practices, simulating action, in which all divisions of a ship are exercised together with a view to bringing the ship itself to its highest degree of excellence as a unit of the fleet. It is evident that until the subdivisions of a ship's force (the gun divisions) have attained a high degree of individual skill, it would be fruitless to attempt to develop a high degree of excellence in the ship as a whole. Therefore a divisional officer's chief duty is the development of his gun division, which in turn requires the development of each individual gun crew in it to the highest possible degree of excellence, and then to use this division to the best advantage as a unit, in the exercises for the development of the efficiency of the ship. In training his division up to a high degree of excellence at record practice, there is not a single feature of naval gunnery, as enumerated above, that a divisional officer can afford to overlook or neglect. Guns, gun crews, ammunition, and the necessary authority are given to him, and with these he is expected, after a limited period of training, to hit the target rapidly.

The duties of a divisional officer in connection with great guns naturally divide themselves into two classes:

1. Duties necessary during the course of training prior to target practice.

2. Duties necessary during target practice.

16. Duties Prior to Target Practice.—These may be divided into the headings:

(a) The acquirement of a thorough knowledge of, and the maintenance of, his ordnance material in perfect condition.

(b) The intelligent training of his gun crews.

17. Knowledge of, and Maintenance of, Perfect Condition of Ordnance.—The very best results can be attained only by an officer who has a thorough and complete practical knowledge of all of the ordnance material under his charge. This does not mean a general knowledge of how the guns and appurtenances are rigged and used; it means the most complete knowledge, especially practical, that it is possible for him to obtain. Needless to say, he should know more about every detail of his guns, mounts, sights, ammunition, or other ordnance supplies than any other person in the ship. He should ascertain and record the initial velocity for which each of his sights are graduated; the kind and amount of powder required to give this initial velocity; the normal pressure; the pressure to which the gun has been tested; the length of the gun in calibres; the permanent angle of the sight, etc. He should construct for each gun a table showing, for the various ranges: (a) The angle of elevation. (b) The angle of fall. (c) The time of flight. (d) The "danger space" for 19 feet (the height of the top of the target). (e) Drift remaining uncorrected. (f) The lateral distance corrected by one division on the sliding leaf. (g) The lateral effects of the apparent force of winds of various strengths on the projectile. (h) The vertical distance at various ranges, corresponding to changes of 100 yards in the sight bar. (i) The effect on the trajectory of a variation of 1 per cent in the density of the air.

He should render himself thoroughly familiar (both practically and by a study of descriptive pamphlets, or other literature) with the construction, use, and means of manipulation of every piece of the mechanism of the gun, mount, or accessories. He should

thoroughly familiarize himself with the regulations for the care, preservation, and precautions to be observed with the ordnance outfit, and should assure himself that these regulations are strictly observed by the members of his division. He must assure himself by frequent inspections that the ordnance and all appurtenances under his charge are always kept in the most efficient possible condition; and if the guns and mounts do not then work with the required facility, it is his duty to take such steps toward their modification as will insure their efficient operation. He must see that the sights are, when at point blank, in adjustment with the bore sights, and not only that they are maintained in as good a condition as when supplied, but also that they are sufficiently secure to withstand the shock of discharge without jarring out of adjustment. Similarly, he must see that his firing connections are strong, and well secured; that the firing mechanism and the batteries are in efficient condition, and that the circuits are complete.

Immediately before a target practice, he should critically examine all ammunition that is to be used, and should assure himself of its perfect cleanliness, good condition, and when practicable (by actual trial in the gun) of its proper size. In all practices, faults in any of the above mentioned items seriously retard the rapidity of fire, and very seriously detract from the efficiency of the division. All delays in firing, caused by faults such as weakness of lanyards, raising burrs, sights out of adjustment, etc., or delays caused by the inherent weakness or delicacy of any device or appliance which has been duly supplied, but the weakness of which could reasonably have been anticipated and remedied by the force on board, are considered faults of the crew, and time occupied in their rectification during a string of shots, counts against the crew. In such cases the fault clearly lies with the divisional officer.

18. **The Intelligent Training of his Gun Crews.**—To train intelligently the crews of the various guns to the highest degree of efficiency, the divisional officer must himself know each individual duty of every member of the gun crew, and how such duties can best be performed. He must, in all exercises with the various devices for training the gun crews, as well as at actual drill at the gun, insist on the careful observance of all of the

minor details of the drill, bearing in mind that any drill that is carried out without observing every detail which it would be necessary to observe in actual firing, or without striving to attain as great a degree of rapidity as will be sought in target practice or action, *is actually detrimental to the gun crew.*

Owing to the number of gun crews which may be under the command of one divisional officer, each officer should consider as a most important feature of his own duties, the development of the gun captains of the various guns so that they can efficiently drill and, so far as necessary, instruct their own gun crews.

19. Duties during Target Practice.—Assuming that the above duties have been efficiently performed prior to target practice, the score made by the division, or by any single gun crew, depends as much on the efficiency displayed by the divisional officer in the performance of his duties during target practice, as on the efficiency of the pointer, or any other man in the gun crew. These most important duties are:

(a) The accurate determination of the distance of the target at each particular instant during the actual firing.

(b) The display of care and judgment in applying to these distances, corrections based on the observed fall of the shot.

The data obtained by the observation of the fall of the first shot of a string should be adequate to insure the remainder of the shots hitting the target, provided the pointers are well trained, the ordnance in good condition, and the divisional officers well informed as to the trajectory of his gun.

In addition to the training of his division in great guns, it may be well to specify briefly the—

20. Duties of Divisional Officers in Small Arm Practice.—Small Arm Firing Regulations fully explain the general duties of the divisional officer in connection with this form of practice.

The divisional officer is responsible for the strict observance of all regulations laid down for the safety of the men of his division and of other persons who may expose themselves while firing is in progress.

He should see that all regulations are strictly obeyed, and he should attempt to bring his division to a high degree of efficiency in all of the prescribed methods of firing. He should seize every

opportunity to carry out the supplementary forms of practice which are permitted, though not absolutely required by the regulations.

In all "instruction practice," he should bear in mind that the purpose is to *teach his men the correct methods,* and to *teach them the art of using small arms* to the best advantage; not to obtain the highest possible score.

Turret Captains.

21. **A Turret Captain,** as the name implies, is second only to the officers, in his authority in a turret.

This position was created in order that our turret crews might be so organized that their efficiency in action would not depend too much on the presence of the officer of the turret; that is to say, in order to provide some leading man in each of our turrets who could be relied upon to perform the vitally essential duties of receiving orders, adjusting sights, directing the setting of sights, and particularly who could be trusted to carry out the very important regulations in the drill book for insuring safety in all operations during loading, firing, or in the case of missfires, hangfires, or unforseen casualties.

In his daily duties the turret captain is charged with the care, preservation, and efficient condition of everything belonging to the turret to which he is assigned. He should give the necessary orders to the captains of the respective guns and ammunition crews, or to the gunners mate of the turret as the case may be. He will see that such orders are promptly executed, superintending and assisting with the work as may be necessary. Any duty in connection with the turret devolving upon the gunners mate, or the gun or ammunition crews, whether repairs, cleaning, overhauling, general work, or drill, is under his general charge, and he is responsible to the turret officer for the efficiency and thoroughness thereof.

In the absence of the turret officer, the turret captain assumes charge, carries out the regular drills, the training with mechanical targets, actual target practice, or commands the turret in action in the same manner as the divisional officer would do were he present. In addition to the knowledge and ability necessary to

drill the turret crews and, in the absence of the turret officer, to direct the fire of the guns in action, the turret captain must have the mechanical knowledge and ability necessary to overhaul all parts of the turret and gun gear, and to keep them at all times in efficient condition. His general duties are, therefore, such as to render it indispensable that he acquire a thorough knowledge of the ordnance of his turret, and he should make every effort to obtain and read the detailed instructions describing the various features thereof.

Gun Captains.

22. Each gun crew has a gun captain, who besides his duty in his individual station at the gun is in charge of that gun and gun crew.

During all drills and exercises with the gun, the gun captain must be in a position to superintend and direct the movements of the members of the gun crew; for this reason he is not stationed as pointer (except in guns of the secondary battery), nor can he ever become the pointer so long as he remains gun captain. He can generally best perform his duties as gun captain when stationed as plugman. The fewer men in the crew of a secondary gun, together with the position of the pointer in the rear of the breech, enables the pointer of such guns to act as gun captain.

A gun captain must not be allowed to regard his duties as merely perfunctory. He receives extra pay to act as captain of that gun and gun crew, and he has the same relation to his gun and gun crew as a coxswain has to his boat and boat crew. He is responsible to his divisional officer for the care of his gun, and for the drill of his particular gun crew.

23. While his duties in the instruction and development of his crew have to do very much more with the development of its practical skill in serving the gun, than with its theoretical instruction, he should be thoroughly familiar with his gun, mount and appurtenances, and be able to explain such essentials to the crew as will enable them to gain the best practical results from their exercises. He has immediate charge of all of the exercises with the mechanical devices provided for training the crew, and should therefore clearly understand the purpose, and the object to be

attained by each exercise. As he is responsible to the divisional officer for the practical development of his crew, he should always bear in mind that it is his duty to get the very highest performance out of the crew that it is capable of. The principle cannot be too strongly impressed upon either gun captains or gun crews that every movement at gun drill should be made *quickly,* no matter how much time may be then available. This is always necessary at gun drill because the gun crew is being trained for the one great emergency of battle, and at such a time every second, every fraction of a second counts; and the only way to obtain a gun crew which will utilize advantageously every fraction of a second in battle, is to train it to do so in time of peace. When the crew is finally engaged in actual battle, it should be so accustomed to using intelligent speed at drill that it will then do so *mechanically.* Every instant saved in action increases the "hits per minute"; to save instants in action, the crew must be *trained* at saving these instants beforehand. In other words, the crew must be *trained at rapidity* of *fire,* rather than simply *instructed in it,* and every effort of a gun captain should be directed to that end. It should at all times be remembered that drill is but a preparation for action. Never for a moment permit slouchiness, or inattention on drill. If a crew is permitted to drill slowly or carelessly, it will do so in action unless it is *then made to hurry,* and on being *suddenly hurried* true rapidity will not be attained. Remember always, that a drill is as much for the purpose of instructing men how to serve a gun *quickly,* as how to serve it at all.

24. For the purpose of assisting in the training of gun crews, a certain course of training has been prescribed for pointers and gun crews. The gun captain has the immediate supervision of these exercises, and should see that they are at all times carried out in accordance with the instructions, otherwise the best results will not be attained.

An efficient gun captain will therefore have:

(a) A thorough practical knowledge concerning his gun, mount, accessories, ammunition, etc.

(b) The ability to take charge of, drill and instruct his gun crew in practical details concerning his gun, without the supervision of an officer.

(c) The executive ability to handle a crew of men, make them perform every detail of the drill, and maintain their parts of the gun and mount in excellent condition.

Gun Pointers.

25. **The Gun-Pointer Group** consists of the first and second pointer, and the sight setter, and each of these men must be carefully trained to acquire skill in accuracy and rapidity of pointing. A gun pointer must remember that he has a most important position. A ship is built for the purpose of using her guns, and therefore the pointer is a man of vital importance to the ship. A ship may never be engaged in action more than a few minutes during her whole career, and if in this few minutes a pointer, through over confidence or neglect of any of the details of training, fails to fire accurately or as quickly as possible after the gun is loaded, he fails in his duty to his ship in that he has occupied one of her important positions of offense without doing the enemy the greatest possible injury.

26. Pointers must not, however, misunderstand their duties. It is a pointers duty to fire the gun as soon after it is loaded as he can get his crosswires, or his line of sight, to bear accurately on the *middle* of the target, or on the portion of the enemy that may be designated as the point of aim. He has nothing to do with the correction of his sights; that is done by the sight setter under the orders of the divisional officer. In all cases the pointer must aim exactly as he is directed, otherwise nothing can be determined from the fall of the shot, and corrections made by the divisional officer, based thereon, will be erroneous.

27. The firing pointer must control the pointing of the gun. The training pointer will keep his sight set roughly for the range, but exactly for the lateral compensation ordered, and, unless otherwise directed by the firing pointer, will keep the gun trained continuously on the center of the target. If in the opinion of the firing pointer, the gun is not trained exactly "on," he will give the orders "right," "left," or in the case of an apparently moving target, "a little faster" or "a little slower," and the training pointer must obey the command even though he thereby throws his own sight off. Both pointers will, at all times, keep their

eyes pressed firmly against the rubber guards on the eye pieces of the telescopes, and keep the cross wires or the line of sight constantly on the target when it is practicable to do so.

28. *Skill in pointing* is shown in *bunching the shots* when the sights and the points of aim remain unchanged. If a pointer, firing under the orders herein laid down, bunches his shots in a small area when the sights remain unchanged, it shows that he is a skillful pointer whether the shots hit or miss, as it is the duty of the divisional officer to order the alteration of the sights so as to bring the bunch on the target. A bunched string of shots simply shows that the pointer aims alike each time, and fires each shot at the same corresponding moment in each roll, and if he does this, and does it quickly, it is all that can be required of him. The divisional officer must do the rest.

Skill is required to point the gun in exactly the same manner for each shot, and especially is this the case when the ship is rolling or pitching. In this case the fall of the shot will be so affected by the motion of the ship, that an inexperienced and untrained pointer cannot hit the target. If the wires are "on" when he makes up his mind to fire, they are "off" when the projectile leaves the gun, and in such cases he will fire over, if the ship is rolling away from the target, or short, if rolling towards it. This, the greatest error of naval marksmanship is avoided (1) in heavy guns, by training men to allow for the "firing interval," that is, to judge correctly the proper moment to fire so that the wires will be "on" when the projectile leaves the gun; and (2) in all guns capable of doing so, by keeping the wires "on" during the "firing interval," so as to eliminate the effect of the roll. Much skill and constant practice are essential with either method.

The quickness with which a pointer can aim and fire his gun is a most important factor in his excellence, but a pointer should always remember, in his zeal for rapidity, that if the wires are not *exactly* "on" when the projectile leaves the gun he will surely miss, and he will have actually thrown away the entire time required to load, aim and fire that shot; therefore accuracy must never be sacrificed to rapidity.

The Sight Setter.

29. **The Sight Setter** must keep the sight set exactly as he is ordered (both the lateral and the vertical setting being done by him), and he must keep the training pointer notified as to how the firing pointers sight is set. He must carefully watch the sight during firing to see that it is not jarred out of adjustment by the discharge of the gun. He must realize that unless at each shot the sight is accurately set, the pointer must certainly miss. This most important element in accuracy of fire is too often neglected, the pointer having almost invariably a disposition to correct small changes of range, or small errors both vertically or laterally, by altering his point of aim. This is now absolutely forbidden, therefore all the greater care is required of the sight setter and divisional officer. As previously stated a good pointer will bunch his shots somewhere, if he aims always at the same place. While this is all that can be required of the *pointer,* it is not enough for the *gun;* the gun is for the purpose of hitting the point of aim, therefore when the gunnery or divisional officers observe that the shots are being bunched *off the target,* the range and lateral correction are so changed that the shots are made to hit, the pointer continuing to aim at the same point as before. If, when a change of range or lateral correction is ordered, the sight setter does not promptly and accurately set the sight to conform thereto, he may be, himself, wholly responsible for a series of misses. It should be borne in mind that when sights are not correctly set, the more expert a pointer is the less chance he has for hitting, because *were he a perfect shot he would* NEVER *hit the point of aim with sights which were incorrectly set.*

While the amount and direction in which to move the sliding leaf will always be given to the sight setter by the divisional officer, it is important that both the gun captain and the members of the gun pointer group thoroughly understand the direction the sight must be moved to correct errors made. The rule is so simple that every one can understand it. It is simply necessary to remember that the shot always falls in the direction the rear sight (or the eyepiece of the telescope sight) is moved. Everyone knows that if we raise the rear sight, we fire higher; if we lower it we

fire lower; similarly, if we move it to the right we shoot further to the right, and if to the left we shoot to the left.

Rapidity of Loading.

30. Having now considered the pointing and sight setting, the rapidity and precision of serving the gun follows.

No pointer can make a high score in hits per minute unless the gun crew is capable of continuous rapid loading; and no gun crew will be capable of loading a great number of times in a minute unless the members of that crew have been trained, as a team, to do their individual duties quickly, thoroughly, and in such a manner as to in no way interfere with each other.

Gun crews, when at drill, are too apt to regard small matters as of no consequence, but these are always the causes of the delays when it comes to actual firing. Therefore every small detail in the gun drill should be zealously practiced by each member of the crew.

Every man should feel that in practicing the small details that are mentioned in the drill book, he is learning to avoid what some one else learned by actual experience.

Summary.

31. Summarizing the above instructions:

1. *Turret captains and gun captains* have complete charge of their guns or turrets under their divisional officer, and their knowledge should be such that they can in action, drill, or target practice, efficiently take the position of that officer in controlling the exercise or fire from their particular gun.

2. *The pointers* sole duty in firing is to keep the cross wires as constantly on the target as possible, and to fire as soon after the gun is loaded as he can hold them accurately "on." He should be oblivious to his surroundings, as his only duty is to point and fire the gun. He has nothing to do with correcting the errors made through incorrect sight setting, except when no sliding leaf is provided, in which case he must alter his point of aim as directed by the divisional officer.

3. *The sight setter* watches the sight constantly to see that it remains at the correct position; alters the setting of the sight as