BOX 20
NUMBER
658
DATE: DEC 10 19[illegible]
CLASSIFICATION CANC[illegible]
AUTH: Cir 115-50
CM9

[redacted]

NOT TO BE TAKEN INTO FRONT-LINE TRENCHES

ORGANIZATION AND CONSTRUCTION OF BATTERY EMPLACEMENTS

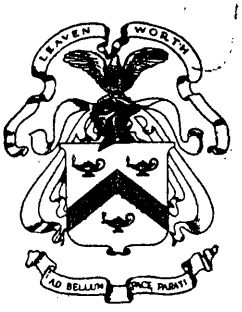
ARMY WAR COLLEGE
August, 1917

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

41886

THE GENERAL SERVICE SCHOOLS

LIBRARY



CLASS NUMBER M 9403-B15

ACCESSION NUMBER 41886

General.

WAR DEPARTMENT,
WASHINGTON, *August 30, 1917.*

The following pamphlet, "Organization and Construction of Battery Emplacements," is published for the information of all concerned.

[662.2, 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.

WAR DEPARTMENT,
THE ADJUTANT GENERAL'S OFFICE,
Washington, June 19, 1917.

To all officers of the Army:

You are advised that this and all subsequent documents of a similar character, which may be furnished to you from this office, are to be regarded as strictly confidential. They are to be kept at all times in your personal possession and are not to be copied, nor are any parts of their contents to be communicated either directly or indirectly to the press nor to any persons not in the military or naval service of the United States. In Europe these documents are not to be carried into the front-line trenches nor farther to the front than the usual post of the officers to whom issued.

Strict compliance with this injunction is enjoined upon every officer into whose hands any of these confidential documents may come.

By order of the Secretary of War:

H. P. McCAIN,
The Adjutant General.

TABLE OF CONTENTS.

Page.

Preface 9

PART I.

Selection and Concealment of Battery Emplacements.

CHAPTER I.—SELECTION OF EMPLACEMENTS.

I. Remarks 11
II. Emplacements bordering roads 11
III. Emplacements in woods 12
IV. Preparation of artificial woods 12
V. Emplacements in former infantry positions 12
VI. Emplacements in villages, ruins, quarries, etc 12
VII. Emplacements on open ground 12

CHAPTER II.—CONCEALMENT OF WORK AT THE BATTERIES.

I. Tracks for artillery wagon traffic 13
II. Organization of supply depot 13
III. Battery camouflages 13
IV. Camouflage material 13
V. Diverse precautions 14

PART II.

Construction of the Different Elements of Battery Emplacements.

CHAPTER I.—GENERAL REMARKS ON CONSTRUCTION.

I. Disposal of water 15
II. Revetments 15
III. Diverse types of cover 15
IV. Roofed emplacement shelters 15
V. Mine gallery shelters or dugouts 16
VI. Descents into the shelter 17

CHAPTER II.—TERREPLEINS AND CASEMATES.

I. Terrepleins 18
II. Casemates 18
III. Light roofing for long "Bange" guns 20

CHAPTER III.—PLATFORMS.

I. Remarks 20
II. "Toul" platforms for 75 mm. guns 20
III. Improvised platforms for 75 mm. guns 21
IV. Platforms for 105 mm. guns 21
V. Improvised platforms for rigid mounts 22
VI. Special dispositions for 90 and 95 mm. guns 22

CHAPTER IV.—BOMBPROOF SHELTERS.

Page.

I. Remarks 23
II. Bombproof in mine gallery 23
III. Roofed bombproofs in open cuts 23
IV. Bombproof on wet ground 23

CHAPTER V.—RECESSES AND SHELTERS FOR AMMUNITION.

I. Storage of ammunition 24
II. Recesses for battery ammunition 24
III. Shelter for conversion of charges 25

CHAPTER VI.—BATTERY COMMAND POSTS.

I. Command post in mine gallery 25
II. Roofed command post in an open cut 25

CHAPTER VII.—ARTILLERY OBSERVATION STATIONS.

I. Advance observation station 25
II. Distant observation station 26

CHAPTER VIII.—COMMAND POSTS OTHER THAN THOSE OF BATTERIES.

I. General remarks 26
II. Description of a battalion command post 26
III. Wireless stations 27
IV. Visual signal stations 27

CHAPTER IX.—REST SHELTERS.

I. General remarks 27
II. Rest shelters in mine galleries 28
III. Roofed rest stations in open cuts 28

CHAPTER X.—AMMUNITION DEPOTS.

I. Battery depots 28
II. Intermediary depots 29
III. Depots of large units 29

PART III.

Construction of Batteries.

CHAPTER I.—PRELIMINARY RECONNAISSANCES.

I. Reconnaissance of battalion commanders 30
II. Reconnaissance of battery commanders 30
III. The outline and the camouflage of the battery 31

CHAPTER II.—ORDER TO BE FOLLOWED IN ESTABLISHING AN ARTILLERY POSITION.

CHAPTER III.—EXAMPLE OF THE ORDER OF WORK IN THE ORGANIZATION OF A FIELD BATTERY POSITION.

I. First step 32
II. Second step 33
III. Third step 33
IV. Fourth step 33
V. Fifth step 33
VI. Sixth step 33
VII. Use of caissons 33
VIII. Appearance of whole finished organization 33
IX. Organization of the position of a heavy battery equipped with trail-spade carriages 33

CHAPTER IV.—EXAMPLE OF ORDER OF WORK IN ORGANIZING A HEAVY BATTERY EQUIPPED WITH RIGID CARRIAGES. (120 AND 155 L.)

Page.

I. First step 34
II. Second step 34
III. Third step 34
IV. Fourth step 34
V. Fifth step 34
VI. Sixth step 35

CHAPTER V.—VARIOUS TYPES OF BATTERIES.

I. Field batteries in roofed emplacement 35
II. Batteries with mine gallery bombproofs 35
III. Field battery completely dug into a mine gallery 35
IV. Heavy batteries 36
V. Heavy battery with rigid mounts in mine galleries 36

CHAPTER VI.—MATÉRIELS AND TOOLS NECESSARY IN THE CONSTRUCTION OF BATTERIES.

I. Casemates 36
II. Extemporized platform for 75 mm. guns 38
III. Extemporized platform for rigid mounts 38
IV. Bombproof shelters, nitches for ammunition 38
V. Battery command posts 39
VI. Observation stations 40
VII. Wireless stations 40
VIII. Visual stations 40
IX. Rest shelters for personnel 40
X. Ammunition depots 41
XI. Field battery in mine gallery 42
XII. Heavy battery in mine gallery 42
XIII. Tool equipment necessary to construct a battery position 42

CHAPTER VII.—DUMMY BATTERIES.

I. Selection and aspect of emplacements 43
II. Organization 44

PART IV.

Trench Artillery.

I. Remarks 45
II. 58 mm. and Van Deuren mortars 45
III. 75 mm. T mortars 46
IV. 150 mm. mortars 47
V. 240 mm. T mortars 47
VI. 340 mm. T mortars 47
DIAGRAM 48

APPENDIX.

British 2-inch and 9.45-inch trench mortar emplacements 87
DIAGRAMS 87

PREFACE.

A battery of artillery generally consists of two, four, or six guns distributed along a narrow and more or less rectilinear front, and spaced irregularly, with no interval between the pieces of less than 20 meters.

The emplacement on which each gun rests is called a terreplein. (T., fig. 1.) Terrepleins may be covered or not by protective casemates. The gun often rests upon a platform (P) of wood or metal, which is superimposed upon the terreplein, and which facilitates the service of the piece. Bombproofs (B) for the personnel are constructed on both sides of each terreplein. Ammunition recesses (M) are constructed in like manner around the terreplein. A command post (C. P. or P. C.), comprising a telephone station, is set up in the battery itself or on one of its flanks. Communication trenches (B) make it possible to circulate in the battery under cover. Ammunition shelters, often of more importance than those of the terrepleins, are prepared in the walls of these trenches.

This preparation, which in its general outline is practically the same for all types of batteries, is completed by a number of shelters or fixed stations outside of the battery emplacement itself. These shelters, or supplementary posts, comprise: Ammunition shelters, constructed a short distance from the batteries, containing the additional battery munition stores; shelters for the personnel, situated back of the batteries at points least exposed to the enemy's fire; observing stations for the use of the batteries, the terrestrial observation service or the sound-locating sections; command posts of battalion commanders or commanders of larger units; signal stations; wireless stations.

ORGANIZATION AND CONSTRUCTION OF BATTERY EMPLACEMENTS.

(Translated from a French official document of December, 1916, by the Army War College, Washington, D. C. Secret and confidential. For official use only. Not to be carried into first-line trenches.)

PART I.

SELECTION AND CONCEALMENT OF BATTERY EMPLACEMENTS.

CHAPTER I.

SELECTION OF EMPLACEMENTS.

I. Remarks.—The artillery commander selects the region to be occupied by batteries called up to perform a certain duty (the position of the battery). The battalion commanders, assisted by their battery commanders, select the exact emplacements which each of their batteries shall occupy (the emplacements of the battery). The battery commanders determine the details of the organization of their respective batteries on the emplacements indicated.

In the choice of battery emplacements, construction facilities must be borne in mind in order to expedite the opening of fire. The lay of the ground itself affords a first protection. In addition, natural cover defilades the battery from terrestrial and aerial view, or at least permits of the easy preparation of artificial screens. A certain number of emplacements favorable to occupation are indicated hereafter as examples.

II. Emplacements bordering roads.—These emplacements especially facilitate circulation; consequently, they permit of rapid construction, occupation, and supply.

Batteries placed on the edge of roads, especially of sunken roads, are easily concealed from the view of enemy aeroplanes, since no special road has to be constructed to supply them. This type of emplacement is particularly advantageous for tractor batteries, which, when placed off the roads, are always subject to inconvenience in bad weather. Figures 2 and 3 show the ground plan and perspective of a battery position on the very edge of the sunken road. Figures 4, 5, and 6 give examples of batteries set up close to roads. The type indicated in figure 6 shows the advantages of a cover which defilades the battery from the enemy's view. Figure 7 shows the disposition of a defiladed battery set up between a road and a narrow railroad, which especially facilitates supply.

III. Emplacements in woods.—Woods provide a certain concealment, but they may be difficult of access. In general, considerable clearing of timber is to be avoided because of its visibility, especially in summer. Small trees (2 or 3 meters high) are particularly valuable in concealing the work, especially when distributed in irregular groups. The interior of the forest is generally reserved for high-angle-fire pieces, as they require very little clearing. The best place for flat-trajectory guns is the forward edge of the wood. (Figs. 8 and 9.) Long guns may also be placed on a steep slope, a little below a very wooded ridge; they will then fire over the tree tops. (Fig. 10 plan and fig. 11 section.)

IV. Preparation of artificial woods.—When a battery has to be set up on practically bare ground sparsely covered with bushes, it is often advantageous to conceal it by means of an artificial wood. This preparation must be made before any other work on the emplacements, so that it may pass unnoticed by enemy aviators whose attention would have been called to this region by work begun upon it. Regions irregularly broken by thickets, ditches, small unevenly defined woods, etc., lend themselves to such preparation. The same is true of natural "thin" forests. Artificial woods must have dimensions distinctly greater than those of the battery they conceal.

V. Emplacements in former infantry positions.—Former infantry positions are very advantageous for the installation of batteries. Considerable changes can be made without altering the aspect of the ground, already very much cut up. Figure 12 shows a battery installed in an old communication trench. General circulation is here interrupted by walls of sandbags (S) placed at the ends. It is reestablished by another route by means of a branch trench carefully camouflaged. Supply wagons stop at a point sufficiently distant from the battery so as not to reveal its position by fresh tracks.

VI. Emplacements in villages, ruins, quarries, etc.—Outskirts of villages, with their gardens or orchards, afford excellent battery positions, because of the facility of concealment by hedges, walls, and isolated trees, and because of the possibility of using streets as supply routes. It is well to plow or harrow the ground as soon as the occupation is completed. Figure 13 gives the perspective view of a battalion position concealed behind the walls of an orchard of a big farm. Ruined villages provide even better positions. Immediate concealment is procured by the color of the ruins, which blends with that of the excavation. Many useful materials are to be found on the spot. Quarries furnish good positions also, especially for howitzers or mortars, with their high-angle fire.

VII. Emplacements in open ground.—Installation in open ground is not undertaken save as a last resort, because of the difficulty of concealment. In this case the general lines of the emplacements must be parallel to the lines of crops, plowing, etc. (See below, Chap. II, "Camouflage.")

CHAPTER II.

CONCEALMENT OF THE WORK BEING DONE IN THE BATTERIES.

The principal indications of activity in the construction of emplacements revealed by aerial photography are the condition of the wagon tracks and the variation in the color of the excavations. Means of concealing the tracks and the work are indicated below.

I. Tracks for artillery wagon traffic.—Tracks must be traversed in one direction only, without allowing the wagons to deviate when the ground is bad. There must be no widening of the track nor track head near the battery. The network of tracks to be followed is determined when the battery position is reconnoitered. It is then picketed and outlined.

A plan of circulation is established which indicates the special arrangements for night circulation and what measures are to be taken for lighting the tracks, if this is possible. It is advantageous for several batteries to share a network of tracks in common. A plan for this will generally be drawn up by the battalion or group commander.

II. Organization of supply depot.—Supply depots, as well as construction works, should be concealed. They are installed at a short distance from the batteries, 200 to 300 meters at the most. All material is unloaded at the supply depot, and carried later to the batteries by hand. When means of camouflage are lacking, supply depots should not be completely concealed; it is better to reserve all means of concealment for the battery emplacements themselves. The material unloaded at the depot is regularly stored, so as to give the appearance of an active work yard. This work yard can eventually be turned into a false battery.

III. Battery camouflages.—The camouflage of the battery work comprises:

(*a*) Camouflage of the terreplein emplacements.

(*b*) Camouflage of the excavated earth carted near by.

(*c*) Camouflage of wheelbarrow tracks and paths for personnel.

The plan of these various camouflages is determined by the battery commander as soon as the project of the preparation is decided. Its execution begins as soon as the trace of the battery is laid out.

IV. Materials for camouflage.—Principal materials for camouflage are painted canvas and metal trellis work, or nets of cordage, with tufts of painted rafia attached. The canvases, trellis, or nets are stretched horizontally above the work to be concealed. If the work is in a wood, this material is fastened to the branches of trees. If the work is in open ground, it is supported by a framework of poles and iron wire (fig. 14). In general, wirework or net covered with rafia is preferable to canvas; it harmonizes better with the color of the ground, and in good weather casts less of a give-away shadow.

V. Diverse precautions.—The blast of the gun traces a clear, characteristic mark in front of the muzzle. To avoid this, screens firmly attached to the ground may be distributed on the ground in front of the guns. These screens, if sprinkled often, will, in spite of the blasts, retain a dark color which makes the effect of the blasts less noticeable. The smoke from the discharge can be rendered less visible by sifting it through a small screen of boughs held over the mouth of the gun immediately after it is fired.

PART II.

CONSTRUCTION OF THE DIFFERENT ELEMENTS OF THE EMPLACEMENTS.

CHAPTER I.

GENERAL REMARKS ON CONSTRUCTION.

I. Disposal of water.—To insure drainage of water, trenches are built all around the works. These receive the surface water and carry it to lower points where the water ditches or waste wells are situated. In addition, the bottom of the trenches are covered with a slightly raised grating (fig. 15).

II. Revetments.—First the excavations of the emplacements and then the ditches must be revetted in order to avoid landslides, by means of metal trellis work, sandbags, fascine work, etc.

III. Diverse cover models.—Shelters are of two types, open emplacement and mine gallery. As a general rule, whenever the ground of the shelter has to be dug below the level to a depth of $2\frac{1}{2}$ meters the construction of a mine gallery is quite as rapid as that of an open emplacement, and it always offers more resistance to artillery fire.

IV. Open emplacements.—Their resistance depends on (*a*) the solidity of the interior framework; (*b*) the construction of the roof.

(*a*) *Interior framework.*—The interior framework (fig. 16) consists of uprights, brought together at the bottom by sills which are clamped to the floor of the shelter. At their top these posts are fitted into cap logs, on which the roof rests. The stability of the whole is assured by diagonal braces, which support the frame longitudinally, and by crossbeams, which support the frame in the transverse direction. This arrangement gives the shelter great resistance. Figure 17 shows the details desired, as well as some defective ones to be avoided.

(*b*) *The roof.*—The roof is constructed of alternate layers of small round logs, of concrete blocks, of rails, of packed earth, or of broken stone. To facilitate the deflection of projectiles it is well to have successive layers of materials of varying resistance. If small logs are used, the successive layers are placed at right angles to each other and joined together in each layer by fastening rods or by solid ligatures of iron wire. The lowest layer rests upon the cap logs of the frame. The ends of the logs of the various layers rest upon solid ground.

The upper part of the roof is covered with an explosion layer of rough material, which causes the fuzes of the shells to operate upon impact. This explosion layer can be made of large stones, of bags of wet cement, of explosive blocks of reinforced concrete (fig. 18a), of rails side by side, or lacking

these, of large logs held together solidly by wire (fig. 18). It must extend 1 meter beyond the shelter on both sides, especially on the side exposed to the greatest fire. On the side exposed to fire it is well to complete it by one or two palisades of round logs side by side and driven into the ground vertically (fig. 18).

The roofs of shelters, built solidly in this fashion, attain a height of about 2 meters above the ceiling of the shelter when they comprise three layers of small logs tied together and separated by layers of hard-packed earth. Well-constructed shelters of this type may be considered proof against the German 15-centimeter shell with delayed-action fuze, but not against the 21-centimeter shell (German) with delayed-action fuze.

(*c*) *Precautions against infiltration of water.*—To insure water-tightness of the roof of an open-emplacement shelter, a layer of corrugated iron or of tarred paper is inserted between some of the layers constituting the roof. The settling of the earth must not be allowed to twist the impermeable layer out of shape, or to make pockets, holes, or crevasses in it. An incline of 1/10 given to the impermeable layer insures a satisfactory flow of water.

The junctures of the various elements of the impermeable layer should be made as indicated in figure 19 in order to keep the water from filtering into the joints.

If the materials used in the impermeable layer are rigid (corrugated iron, for instance, which contributes to the solidity of the roof), it is advantageous to put this layer directly on top of the layer of small logs which forms the ceiling. In this case the proper slant must be given the logs so that the water may drain.

When tarred paper is used, it must first be nailed to a joined lath work. If the paper is in good condition, it may be placed immediately next to the first layer of logs, as in the preceding instance. No pebbles must be in the earth covering the paper. Pliant, corrugated sheet iron in good condition may also be placed directly upon the lower layer of logs, but the logs must be planed with an edge to prevent the iron slipping. When the materials used are in poor condition (sheet iron full of holes or torn paper), it is preferable to put the waterproof covering near the top of the roof so as to diminish the weight of the earth to be supported and to facilitate the flow of water.

V. Mine galleries or dugouts.—The regulation dimensions for mine galleries are given in Instruction in Field Works, of December 21, 1915 (annex V, No. 482 and following). As a rule, the artillery only uses the major gallery or the great gallery. The cave shelter is the only one which assumes effective protection from modern shells of large caliber and delayed-action fuzes. The thickness of the untouched earth to be retained above the galleries depends upon the nature of the soil; it should be at least 6 meters of the hard chalk or 8 meters of clayey soil to assume certain protection against the German 21-centimenter shell with delayed-action fuze.

In mine-gallery construction resistance to shells is especially assured by the mass of earth covering or surrounding the

shelter, and the resistance of the interior sheathing plays a smaller part than in open emplacement shelters. It is, however, not negligible; and it is well to assure the regularity of the shape of the gallery frames by strong angle-iron work which fastens them together and braces them laterally. The sheathing comprises essentially the gallery frames, which are placed meter by meter in the gallery. Their ground sills are sunk into the ground. Figures 20 and 21 indicate the method of assembling the parts of these frames. Overhead planks resting upon the cap logs prevent the roof from caving in. Planks on the sides support the earthen walls (fig. 22). Iron angle braces are fastened by spikes in the corners of the frame to insure its solidity (fig. 21). Longitudinal bracing is obtained either by laths of iron or by cross braces of wood wedged between the frames (fig. 22).

When the mine gallery runs in several directions each change of direction is a right angle. At a right-angle change of direction the corner frames must abut against each other.

Small mine galleries are generally constructed with frames of joined planks. Spiked braces connect adjoining frames as much as possible (fig. 26).

VI. Descent into shelters.—A stairway which gives access to any kind of shelter always starts in an element of a trench (fig. 24). As a rule, every shelter has at least two exits. In the case of mine galleries stairways must be constructed every 10 or 12 meters (fig. 20).

If the stairway is open the walls are supported by a revetment (boards, screens, etc.) held together by an improvised frame (fig. 24). This framework is composed of vertical posts fixed in the ground and supported by longitudinal pieces parallel to the descent. Braces assure the rigidity of the frame (fig. 25).

The stairway of a mine gallery has a frame of joined planks, joined two by two by iron braces or supported by vertical frames placed at 1-meter intervals (fig. 26). These frames have solid lateral braces and are joined like those in a horizontal gallery. The last frame is solidly braced against the wall of the shelter which faces the opening of the gallery. Planks placed vertically hold the earth above the frame in place (fig. 26).

Stairways in general, and mine-gallery descents in particular, are the weak spots in resisting an artillery attack. This weakness may be partially remedied by having as many descents as possible. The interval between two descents, however, must be such that the same shell can not demolish or obstruct two adjacent entrances (cir. 10 meters). The shelter entrance must always be protected by one or more obstacles to cause the explosion of a shell (flagstones or logs) offering the largest possible resistance. (For details of construction see Instruction in Field Works for all Branches of the Service, in preparation.)

11378°—17——2

CHAPTER II.

TERREPLEINS AND CASEMATES.

I. Terrepleins.—Terrepleins must never be built on made ground.

Their dimensions vary according to the type of gun and according to the required lateral field of fire. This is generally 90°. Terrepleins which are trapezoidal in shape fulfill these requirements and have approximately the following dimensions:

Materials.	Trapeze dimensions.		
	Large base.	Small base.	Height.
	Meters.	*Meters.*	*Meters.*
75	4	2	3
120 long "Bange" guns	7	2½	6½
155 long "Bange" guns	12	5	7½
220 (metal platform)	6	4	5

It is advantageous from the point of view of protection to sink the terrepleins below the natural level of the ground; moreover, this sinking facilitates the making of the casemate. It is usually sunk so that the trunnions are on the level of the ground, and may be sunk even more provided that this does not interfere with the gun at its minimum range. Sinking the terreplein is especially advisable in the case of field guns and howitzers. It has the disadvantage of consuming much time and requiring much work, especially in the case of long guns of the Bange type on old-fashioned mounts.

II. Casemates.—(*a*) *General plan.*—A light casemate, such as a row of round logs or a sheet of corrugated iron covered with earth, is sufficient to protect from shell splinters. It can be constructed quickly and should be placed without delay over all guns equipped with trail-spade carriages.

A casemate proof against percussion fire can be obtained by reinforcing light casemates; but this is not done unless time and material are plentiful.

Even light casemates for long-range guns on recoil carriages are difficult to make, and requires a great deal of time.

(*b*) *Casemate accessories.*—First, embrasure shutters: It is advantageous to equip the front of the casemate with shutters. They diminish the danger of hits through the embrasure by protecting it from fragments. Figure 34 shows an arrangement consisting of panels of thick planks or joined logs sliding upon transverse rails. Figures 27 and 28 give another type of embrasure shutter. It is composed of similar parts in juxtaposition, which rest against the upper part of the embrasure and pivot about a horizontal axis perpendicular to the casemate

axis when it is desired to open the embrasure. Each part is formed by a piece of squared wood (about 25 centimeters on each side) or by three planks bolted together. The operation of opening and shutting is effected from inside the casemate by means of handles attached to each part. It must be remembered that when this system is installed in a casemate already constructed the let-down portions raise the lower part of the embrasure about 25 centimeters, which results in an increase in the minimum range obtainable.

Second, rear splinter-proof shields: Protection from splinters from projectiles which fall slightly behind the casemate must also be provided. The casemate entrance is therefore masked by two stockades made of joined logs. (Figs. 30, 31.) Rear splinter-proof shields may sometimes be made of mobile panels of joined planks supported by two braces and a wide base. (Fig. 29.) These shields may be considerably reinforced by a light backing of earth or gabion.

(*c*) *Casemate for field gun.*—"Instruction in Field Works, December 21, 1915," gives a model of an earth-and-log casemate which assumes a lateral field of fire of 90°. Figures 30 and 31 show a variation of the casemate model, provided with side openings that permit of rapid access to the bombproofs. The framework of these different casemates is made according to the principles laid down for the building of open emplacement shelters (Part II, Chap. I, par. 4); but, because of the large dimensions of the casemates, it is even more essential that rigidity and uniformity of the framework be assumed. The vertical posts (25 centimeters in diameter if possible) should rest upon transverse sills bedded in the ground of the casemate. The posts are fastened to the sills by means of angle irons and bolted hound straps. (Fig. 31*a*, drawing No. 1.)

When the framework of a casemate is lightly bedded in the ground, it is necessary to make the ground sills overlap and to fasten them to the uprights by external braces. (Fig. 31*a*, drawing No. 1.)

The longitudinal cap logs must be embedded and bolted to the heads of the uprights; likewise the beams of the roof must be embedded and bolted into the cap logs.

If squared timber and trained woodworkers are to be had, the different parts can be joined, as indicated by figure 31*a*, drawing No. 2. If only timber with the bark on is at hand, joining and squaring may be done as indicated in figure 31*a*, drawing No. 3.

Figures 32 and 33 give the details of a second type of casemate, which may be used when there is more time and material. The lateral earth filling is made by tightly packing earth between two walls of round logs placed side by side between the posts. The first roof covering is made of a layer of concrete and small metal beams.

A third type is shown in figure 34. Here the posts are thick planks placed side by side and bolted every 70 centimeters. The beams are double **T**-rails set in the posts. The first layer of the roof is made of rails side by side, joined by cement. In front

embrasure shutters are arranged to slide upon rails. The interior slope is notched to make a place for the gun wheels. This arrangement procures a very extensive lateral field of fire (1,300 mils), in spite of the small dimensions of the embrasure.

Whatever type of casemate is adopted, it is indispensable to line the strong outside face of the roof above the embrasure with a solid explosion layer, so as to prevent projectiles which hit this region from slipping between the horizontal layers of logs of the roof and producing, by explosion, irreparable destruction.

(*d*) *Casemates for field howitzers.*—The types of casemates described above may be easily adapted to field howitzers. Especially when they have to fire at great angles from behind high slopes, and when the lateral field of fire is not very great, it is well to use arc sheet iron (called "toles metro") for the casemates. It is easily set up. Figure 35 gives an example of this kind of casemate, built of arc sheet iron, logs, and earth, which protects from fragments and from small-caliber fire. Figure 36 gives a variation in arc sheet iron and cement.

III. Light roofing for long "Bange" guns.—The dimensions of terreplein makes casemates for this matériel difficult. It will be sufficient to cover these guns with a light roofing, properly concealed, which will protect from rain. This roofing consists of light-weight corrugated-iron sheeting, supported by improvised frames made of tied boards and iron wire.

The anterior part of the terreplein is left open to allow for the recoil. It is covered by a concealment canvas which may be opened and closed like a fan (figs. 37 and 38).

CHAPTER III.

PLATFORMS.

I. Remarks.—The platform facilitates the placing and handling of the gun, accelerates the fire, and diminishes the gunners' fatigue. It is generally indispensable for medium and high-calibre guns, especially when they are not equipped with "cirgoli," but it may be more or less simplified. During periods of immobility, its use is advantageous for all calibers. Platforms are constructed of selected materials or of whatever is at hand. In the first instance, they are constructed in the parks in the rear and brought up to the batteries, which have only to put them together and set them up. In the second instance, they are constructed by the batteries themselves of whatever material is at hand.

II. "Toul" platform for 75 mm. guns.—The parks prepare the material for the platform. It comprises (fig. 39) a wheel platform and a trail platform, placed separately.

The wheel platform is formed by a floor laid on three stringers resting on the ground. Two guides for the wheels may be placed on the floor. Their stability is assured by braces and collars. The guides can be fixed in two different positions

on the floor; the rear position for a small angle of fire (less than 18 degrees), the forward position for larger angles.

The trail platform comprises two traverse circles of hardwood fastened to four radial sills by means of bolted clamps. The rear circle is for a low angle of fire, and the forward circle for higher angles.

To set up the platform, ram down the earth at the emplacement of the wheel platform, then set the three transverse stringers in the ground. Place the floor on it and set up the wheel guides in the rear position. Make a circular excavation back of the wheel platform, concentric with the arc of the wheel platform. This excavation is 70 centimeters in depth and between 2 and 2⅜ meters in radius.

Ram down the bottom of this excavation and set the four radial sills in it. Put the traverse circles in place on the sills and fasten them by the bolted clamps. Set short planks edgewise between the sills as a retaining wall to hold the earth. Fill in earth back of the planks and ram it down hard to act as support for the traverse circles. Set the gun in place, with the trail resting on the rear traverse circle. For fire at great angles move the trail from the rear circle by shifting the gun slightly forward and then 30 centimeters to the rear; raise the wheel guides and fasten them in their front position; push the gun forward and set its trail on the forward traverse circle.

III. Improvised platform for 75 mm. guns.—The improvised platform, like that just described, comprises a wheel platform and a trail platform.

The wheel platform is formed by a plank floor resting on several pieces of wood bedded in the ground. A circular wheel guide (fig. 40) is nailed on this floor.

The trail platform comprises a hardwood trail-traverse circle, bolted to a plate which is firmly anchored in the ground by cramping irons in front and strong stakes behind. The trail platform is more or less sunk in the ground, depending on the highest angle of fire anticipated.

It is best to have the parks make the trail-traverse circles and the metal parts of this platform.

Figure 34 shows another model of improvised platform for 75 mm. guns. Like the Toul platform, it has two positions by which it is possible to fire at will at either small or large angles.

On the terreplein a wood floor is laid, at the front of which two wheel guides are nailed, one in front of the other, and at the rear is fastened a trail-traverse circle, made of whatever material is at hand. The part of the floor between the circle and the rear wheel guide can be raised like a trapdoor, uncovering a lower floor bearing a second traverse circle.

IV. Platform for 105 mm. guns.—Figures 41 and 42 give the plan and cross sections of a terreplein provided with an improvised platform for a 105 mm. gun similar to the platform just described.

The trail-traverse circle is formed simply by a circular ditch, carefully made and with hard packed walls. This simple ar-

rangement, which requires no metal parts, can be used to advantage for all small and medium caliber guns which are provided with trail spades (among others, the 155-mm. gun and howitzer); it has no parts which require to be made in the rear.

V. Improvised platforms for rigid mounts.—Rigid mounts, especially those of medium caliber (120 mm. gun and 155 mm. Bange gun) can hardly do without platforms. When supplied with platforms, the rapidity and precision of their fire is much increased.

These platforms are made of squared timber brought from the rear, or, if this is impossible, of round logs on which two parallel flat sides have been adzed at the emplacement; the rounding of the logs and the crevices between them are filled with earth, which is solidly rammed during the construction.

Each platform comprises a wheel platform and a trail platform, placed separately, sometimes joined and sometimes not.

The wheel platform, in general, comprises two crossed layers of timber (fig. 43), and sometimes three layers, if time and material permit. The bottom layer, made of timbers laid in the direction of fire and bedded in the natural ground, which has first been rammed down, must be particularly firm immediately under the wheels. The upper layer is made of rough-hewn logs or of planks nailed together side by side, perpendicular to the direction of fire. The whole platform is held firm by strong stakes about it.

The construction of the trail platform is similar to that of the wheel platform. Its bottom layer need not be so strong, but it is indispensable that the different layers be held by strong stakes like those of the wheel platform.

The trail platform is generally wider than the wheel platform, to give great width to the lateral field of fire (fig. 44). In case of fire at high angles (over 28° for the 120 mm. and the 155 mm. guns), it is well to have the trail platform slope toward the rear (fig. 45). It is also possible in this case to put the trail platform at a lower level than the wheel platform and keep it horizontal. This arrangement is of easier construction than the inclined plane, but it leaves a sharp drop from the platform, which may cause accidents during fire if the wedges for returning the gun into battery are not well placed.

VI. Special arrangements for 90 and 95 mm. guns.—The platform arrangements described above for rigid mounts of 120 and 155 mm. guns also apply to 90 and 95 mm. guns mounted on omnibus mounts. In this case, the wheels recoil on wedges for return into battery, which are similar in outline to the wedges for 120 or 155 mm. guns; the trail also slides in a slideway engaged in the lunette of the trail. The dimensions of these wedges and guideway are shown in figures 46 and 47.

Fire of 90 and 95 mm. guns mounted on field mounts can be accelerated by the use of more perfect platforms made in the artillery parks. Figures 48 and 49 show an arrangement of this kind.

On an improvised platform, bedded in the ground, a wheel of a 90 mm. gun is laid flat and fastened with cramping irons to serve as wheel guide. The trail of the mount slides in a guideway formed of angle irons, which pivots on the hub of the wheel serving as king-pin. A spring placed at the bottom of the guideway limits the recoil and assures the automatic return of the gun to battery position. The rear spring can be omitted, and wedges used for this purpose.

In other arrangements the mount is supported with its wheels on a frame with a guideway (fig. 50). The back of each side of the frame, as well as the back of the guideway, are set in an inclined plane, so as to assure automatic return into battery. The frame turns about a forward pivot on a stationary platform (fig. 51).

CHAPTER IV.

BOMBPROOFS.

I. Remarks.—Bombproofs are built near the terreplein. They must have great solidity and be easy of access. Figure 52 gives the plan generally adopted. As a rule, these shelters are constructed in mine galleries. It is only when the possibilities for getting below ground are limited that they are made in the form of an open emplacement. The shelters are generally connected two by two to increase the number of outlets. (See Part III, "Construction of batteries," Chaps. III, IV, V.)

II. Bombproofs in mine galleries.—The entrance trench which leads from the terreplein is a stairway, covered if possible, which descends from a depth of 2 meters. The descent into the mine gallery (fig. 53) runs down at right angles and by a steep descent (45 degrees), so as to gain the protection of a layer of untouched earth at least 6 meters in thickness as soon as possible. The descent has the interior dimensions of a grand gallery (height, 2 meters; width, 1 meter). It has a framework sheathed with joined boards, or else it is well constructed of ordinary gallery frames spaced at 1-meter intervals and well braced laterally. The roof and side are sheathed with netting or planks.

The gallery proper opens perpendicularly upon the descent, and has the same dimensions. It is supported by gallery frames at 1-meter intervals, which support the roofing and the boards of the lateral sheathing. This bombardment gallery should first have a length of 3 meters. It should subsequently be connected with the neighboring shelter.

III. Roofed bombproofs in an open cut.—The plan is identical with the preceding one. A branch trench leads from the terreplein perpendicularly to the descent, which runs down at right angles, etc. The shelter itself is in the form of a passage, so as to increase the resistance of its roof. Figure 54 shows one of these bombproofs common to two terrepleins.

IV. Bombproofs in watery soil.—When the condition of the subsoil does not permit of sinking the shelters (surface water, for instance), cement must be used if well-protected shelters are

to be constructed. Figure 35, representing a casemate for howitzer made of arc sheet iron and cement, furnishes a model for a shelter of this type, provided that the entrances are protected by walls, also of cement. When only small logs are to be had, a superstructure shelter can be built (see figs. 55 and 56) which provides ample protection. The shelter comprises a central passage with elbows made of mine-gallery frames carefully squared at the elbow angles and embedded side by side in the ground. A gabion revetment filled with hard-packed earth surrounds this passage on all sides. The roof is likewise covered with packed earth or gabions. Earth and gabions are packed in together between vertical rows of logs embedded in the earth, the tops of which are united by a roof of fitted logs. The whole is in turn covered by packed earth, supported by a second series of logs arranged in the same way. A pile of sand bags and earth, with an explosion layer on the outside, if possible, covers the whole on the side exposed to the greatest fire.

CHAPTER V.

RECESSES AND SHELTERS FOR AMMUNITION.

I. Storage of ammunition.—Ammunition (shells, cartridge chests, fuzes, primers, etc.) must be kept free from mud. Fixed ammunition should be kept in cases (chests) as long as possible. Recesses and shelters for cartridges should be equipped with pigeonholes. Heavy artillery shells are placed standing up in the recesses. When space is lacking they are piled in horizontal layers separated by strips and laths. The ogive should be turned to the accessible side. Ammunition recesses must be reveted on the interior with planks or fascines to prevent their falling in. Fuzes and primers are kept in special cases in dry places. All ammunition storage places must be airy. Ammunition storage places are divided into small units, so as to avoid total loss by explosion or fire. Cartridge and fuze chests, boxes of primers, and shells are stored separately. Primed shells, incendiary shells, and special shells are put by themselves. This arrangement holds even when the ammunition is placed in bombproof shelters.

In depots ammunition is placed on benches to keep it off the ground (fig. 57) and covered with thin boards, boughs, tarpaulin, etc., to shield it from the direct rays of the sun.

II. Recesses for battery ammunition.—When feasible, a cartridge recess and a shell recess should be prepared on the terreplein. Other recesses are established in the communicating trenches.

Figure 58 shows a recess constructed in this manner in the side of a trench (approximate dimensions given). Terreplein recesses are of more restricted dimensions. Intervals between contiguous recesses must not be less than 1 meter between two shell recesses or 4 meters between a cartridge recess and any other. When there is no time to build recesses in the communicating trench walls, projectiles are placed on end in communicating trenches, which have a width of 1 meter on the

bottom. These communicating trenches are covered with small logs and light sheet-iron shutters, or, if these are not to be had, with canvas (fig. 59).

III. Shelter for the priming of projectiles.—Priming takes place in a shelter at some distance from the terreplein (10 meters, approximately). The shelter must be well ventilated to prevent accidents due to the inflammation of ether gas, which escapes from the cartridge chest. Where there is only one priming shelter to a battery it should preferably be placed in the center. The shelter is excavated to a depth of 3½ meters. Its walls are reveted with light boards and it is approached by two stairways, which start from a communicating trench. Its interior dimensions are 4 by 1½ meters (fig. 60).

CHAPTER VI.

BATTERY COMMAND POSTS.

Battery C. P. receives the same protection as bombproofs. There must be easy communication with the terrepleins to insure haste in the transmission of orders. A command post comprises, as a rule, three compartments which serve as fire station, telephone station, and the officer's room.

I. Command post in mine gallery (fig. 61).—It consists of an element of the major gallery, is provided with two exits, and has a length of at least 8 meters (head of the stairway included). The gallery is divided into three adjoining rooms by interior board partitions.

II. Roofed command post in an open cut.—The shelter comprises three compartments of 3 by 2.40 meters each, separated by passageways of 2 meters by 80 centimeters (fig. 62). A separate stairway leads to each of these compartments. The timber work and roof (earth and round logs) are constructed as described in Part II, Chapter I, section 4. Sometimes corrugated-iron sheeting (called "metro") and round logs may be used to advantage (figs. 63, 64). In this case the three compartments are either in the same gallery (with board partitions separating them), or else distinct and connected by covered galleries. This second method offers greater safety.

CHAPTER VII.

ARTILLERY OBSERVATION STATION.

Artillery observing stations are established within the infantry lines (advance observation station), and behind the lines (distant observation station). In both cases, the concealment of the observing station is of more importance than its protection.

I. Advance observation stations.—When established on the first line, the O. S. resemble lookout posts, some models of which are described in Instruction in Field Works of December 21, 1915 (Chap. III, p. 115 and following). Armored molehills and armored sentry boxes on molehills, concealed by camouflages,

may also be used. First-line observation station must be placed near a subterranean infantry shelter. Observation stations in lines other than the first may be constructed more substantially. The entrance trenches of O. S. must always connect with the general network of neighboring trenches, but in a way that will not attract attention. They must not terminate in a blind alley at the observation station. They may, for example, be run beyond the observation station into a wooded region where they appear to be continued. Figure 65 shows this arrangement.

Figures 66 and 67 show an advance observation station with a mine gallery shelter close by. The station itself and the gallery are connected to a neighboring communication trench of the general network.

In some cases the entrance to the observation station from the shelter is made vertically by means of a shaft and ladder (see figs. 72 and 73, which represent a visual station constructed on these lines). This method of construction is more substantial than the one preceding, but evacuation of the observation station is more difficult.

II. Distant observing stations.—Figure 68 gives the plan of an observation station of extended outlook established on the top of a ridge. This observation station follows the general type of such shelters. It is covered with a roofing of small logs and earth, which is prolonged toward the front by a long overhang. It is approached by covered trenches.

Big trees can be used for observation stations. They are reached by an improvised or ready-made ladder. Figure 69 gives an example of the arrangement. The entrance ladder is made of parts of a Durand ladder, joined end to end and put up against the tree. Wooden supports and guy ropes hold the ladder in place. An improvised seat is built at the top. A front and side camouflage conceals from observation and prevents dizziness.

CHAPTER VIII.

COMMAND POSTS OTHER THAN THOSE OF BATTERIES.

I. General remarks.—Command posts for commanders of battalions, of larger units, of divisional or heavy artillery, etc., are constructed in the same way as battery command posts, either in mine galleries or in roofed shelters in open cuts. The length of the mine gallery and the number of shelters depend upon the number of the personnel to be sheltered. Wireless and optical signal stations (which require supplementary installation) are often a part of command posts. Battalion command posts are often established beside an observation station. As these different elements are installed outside of the batteries, they may be easily concealed by natural covers or by camouflage.

II. Description of a battalion C. P.—Figure 70 gives the complete organization of a battalion command post. It is situated in front of the batteries on the slope of a ridge giving an outlook over the battle field. The various details belonging to the C. P. are installed in a mine gallery. This gallery opens toward the

front upon a shaft in which there is a ladder giving access to an observation station. Toward the rear the gallery opens upon a stairway which leads to a communicating trench in which there is a visual signal station for signaling to the batteries. Figure 71 gives the plan of a roofed battalion C. P. in an open cut, equipped with near-by wireless and visual signal stations.

III. Wireless station.—A single shelter, roofed in an open cut after the model of C. P. shelters, generally suffices for a wireless station. It must have an easy entrance and exit to facilitate the use of the signal flags. The emplacement is essentially dependent upon the position of the wireless aerial and of the terrain where the signaling is to be done. It may be at some distance from the C. P. it serves. Telephone communication between the wireless station and the C. P. must be absolutely dependable. If possible, it should be underground.

IV. Visual signal stations.—Visual signal stations, like observation stations, are placed to advantage near the C. P.; but the topography of the locality will not always permit of this proximity.

Figures 72 and 73 give the plan and cross section of an isolated visual signal station constructed according to models of observation stations previously described. The signal chamber is connected by a shaft with the bombproof gallery, which serves both as telephone station and bombproof. Telephone communication between the visual signal station and the C. P. must be assured; to this end, a subterranean line is used as much as possible.

CHAPTER IX.

REST SHELTERS.

I. General remarks.—As a rule, only the personnel on duty with the guns should be in the battery. Rest shelters are built outside of the battery. Disguised paths or communication trenches lead from the shelters to the battery. Rest shelters should be constructed in the battery itself only when the shelters are established in mine galleries and the personnel off duty is not numerous, or when barrage fire is frequently called for at night, as is often the case with field batteries. In case of a long bombardment the shelters should be placed near the places where food supplies are stored.

Figure 74 gives an example of personnel shelters established in a bombardment gallery common to two guns. When rest shelters are inside of the battery, all necessary precaution must be taken against suffocating gases (oiled cloth covering the doors, gas masks constantly at hand). When they are outside of the battery, but within range of the enemy's artillery, they should be established in bombproof mine galleries; they may then be of great capacity. When this is not feasible, they are roofed in open cuts; in this case, the capacity of one shelter must not exceed eight men and one officer. If the rest shelters are beyond the range of the enemy guns they consist of portable shacks (Adria type) or of improvised shacks.

II. Rest shelters in mine galleries.—These consist of a gallery of the type called "major gallery," with descents every 8 or 10 meters. To insure greater comfort for the personnel, a double tier of individual bunks line one side of the gallery. The other side serves as a passageway and as a place for equipment. Folding bunks are of advantage in procuring greater space by day.

The shelter dimensions are calculated by allowing one running meter of gallery for each man to be sheltered. If the space is lacking, double tiers of bunks are built on both sides of the gallery. This doubles the shelter capacity (two men to the running meter).

III. Roofed rest station in open cuts.—Figure 75 gives a type of shelter for eight men built into an excavation and covered by a roofing composed of three layers of round logs. A row of posts placed on end along the axis of the shelter increases the resistance of the frame work. The right-hand side of the shelter is occupied by two double tiers of bunks, perpendicular to the axis of the shelter. The left-hand side is left free for a table or for packs. Figure 76 gives a cross section of a rest shelter having a roof of thin arc sheet iron, round logs and earth.

CHAPTER X.

AMMUNITION DEPOTS.

Ammunition depots are subdivided into battery depots, intermediary depots, and large unit depots.

I. Battery depots.—They are established near the batteries. and contain the stores that can not be accommodated in the ammunition recesses. They must be as solidly built as the rest shelters for personnel; they are generally made by roofing open cuts. Each depot comprises several shelters, from 10 to 20 meters distant from each other. Each shelter should be able to hold about 500 75 mm. projectiles, or from 250 to 300 155 mm. shells. The models described below correspond approximately to this capacity.

Figure 77 represents an ammunition depot shelter constructed by roofing an open cut with round logs and earth. The timber work is reinforced by a row of posts placed in the axis of the shelter. A passage for circulation runs around the ammunition stored in the center of the shelter, and facilitates its inspection. At the same time the passage assures better ventilation and less risk of water vapor condensation.

Figure 78 gives another model for a shelter. It is roofed with earth and round logs, and has the same capacity as the preceding one, but it may be constructed more rapidly. The ammunition is stored on both sides of the central passage. Its inspection and ventilation are not so well arranged for as in the other type. In addition, this figure shows an arrangement for 75 mm. projectiles with superimposed pigeon holes, a single row of cartridges to each pigeonhole.

Figure 79 represents a third type of ammunition shelter, roofed with arc sheet iron, earth, and round logs.

II. Intermediary depots.—Intermediary depots contain the first reserve of ammunition kept behind the batteries. They are held in common by several batteries or battalions. As they are installed in relatively quiet regions, they do not ordinarily have bombproof shelters.

The ammunition is distributed in small lots, properly concealed and protected from bad weather. Means of circulation must be easy. The ammunition is stacked on benches erected as indicated by figure 57 and covered by tarpaulins, or else it is stored either under light lean-tos or under camouflaged arc sheet iron (fig. 80).

Figure 81 shows an important intermediary depot established in a wood at a short distance from a road. The ammunition can be rapidly placed on the two parallel rows of benches and withdrawn from them, thanks to the circulation passage surrounding the benches. These passageways must only be used in one direction.

III. Large-unit depots.—They are installed according to the principles governing intermediary depots; but their dimensions are greater. The circulation routes must permit of the simultaneous use of narrow gauge track, automobile trucks, and wagons drawn by horses, all transporting ammunition.

PART III.

CONSTRUCTION OF BATTERIES.

The following directions can be completely carried out only when there is a sufficient extent of time and material. But, in any case, even in open warfare, they can be partially applied by making the most of the time and means in each particular case.

CHAPTER I.

PRELIMINARY RECONNAISSANCES.

I. Reconnaissance of the battalion commander.—The battalion commander, aided by his battery commanders and his battalion detail, decides on the ground the position of each battery, ammunition depot, false battery, battalion commander post, rest shelters of the personnel, ammunition depots outside of batteries, observing stations, and (if necessary) the intermediary depot. He arranges the telephonic, visual, and wireless communication of the group, and also indicates the positions and methods of construction for their station. He divides among the batteries the work affecting the general service of the battalion (construction of command post, observation station, intermediary depot, false batteries, etc.), and indicates the method of construction of each. He decides with his range officer upon the procedure of general range finding of the batteries and the first aiming points of the guns. He decides on the route and construction of roads; he gives orders concerning traffic of wagons, especially during the construction and armament of the batteries; he determines the immediate steps to be taken for the camouflage of the position; he draws up a general plan of the organization, work, hauling, armament, and supply of the batteries.

II. Reconnaissance of battery commanders.—As soon as he receives the necessary orders from the battalion commander, each battery commander makes a reconnaissance of the battery position which is assigned to him. He decides first on the location of the main features of his position, keeping in mind tactical necessities, character of the ground, natural cover, and approaches. He locates the terrepleins of the guns and his command post. He reconnoiters localities for his supply depot, the rest shelters of the personnel, the supply depot outside the battery, and those elements of the battalion which have been turned over to him by the battalion commander. He studies the means of natural timber concealment, and decides, without delay upon the arrangement of camouflage to complete this concealment. He completes the orders concerning traffic on the position by

regulating the interior traffic in his battery (footpaths, wheelbarrow paths, etc.).

These orders are summed up for benefit of the subordinate personnel of the battery in an order comprising (*a*) A sketch of the whole of the battery (terrepleins, bombproofs, command post, munition niches, communication trenches, rest shelters, munition depots, etc.), with approximate dimensions in double paces; (*b*) General provisions on the construction of different parts of the battery, with indication as to the order of the work; (*c*) Sketches of routes for vehicle and pedestrian traffic, with résumé of the orders concerning them; (*d*) Information relative to the armament and to the supply of ammunition and food; (*e*) Steps to be taken immediately for the camouflage of the work and of the paths.

III. The outline and the camouflage of the battery.—The outline of the battery follows immediately the reconnaissance of the battery commander, and consists of the following operations: (*a*) Staking out the center of each of the terrepleins; (*b*) Laying out the direction of fire of each gun;[1] (*c*) Staking out of the terrepleins, shelters, posts, and communication trenches, etc., seen on the summary sketch of the battery commander;[2] (*d*) Pickaxing the outline of the contours indicated by this staking out; (*e*) Surveying rapidly but exactly the dimensions of the above outline; (*f*) Staking out and enclosing of traffic routes and footpaths inside the battery; (*g*) Staking out of the supply depot and determining the system of issue of these supplies.

The camouflage of the battery is undertaken as soon as the main features of the battery have been fixed. Use is made either of regular camouflage material, ordered by the battery and brought up during reconnaissance, or of material found on the position or near by. The battery commander estimates what camouflage material he will need and puts in a requisition for it.

The laying out of the battery position being completed, the battery commander (*a*) marks a stretch of the earthwork to be done, (*b*) draws up a statement of necessary materials for the construction of different parts, (*c*) writes out a requisition for the necessary digging tools if the regulation supply proves insufficient.

---

[1] To trace correctly the direction of fire of a battery, use a compass and plumb line in the following manner: Before leaving for reconnaissance, determine on the battle map the angle formed by the magnetic north and the direction prescribed for the battery; make a note of this angle. On arrival at the terrain, put the compass on the ground, horizontally, and have it mark the above angle exactly. With the plumb line lay off this angle O of the compass and set up two stakes along the vertical plane of the plumb line. (See fig. 82.)

[2] This staking out must be done carefully or errors will be made which will be difficult to correct in the course of construction. Make use of a surveyor's square as much as possible, or of a right-angle triangle made of twine (sides of 3, 4, and 5 meters) to erect perpendiculars. To measure length, use a surveyor's chain or a carefully measured off cord. Exceptional care must be taken in this staking out when a mine gallery is to be constructed.

He then takes up the organization of the working squads.

The requisitions for materials and tools are transmitted by the battalion to the Engineers' depot.

CHAPTER II.

PRIORITY ORDER OF WORK IN ESTABLISHING AN ARTILLERY POSITION.

In a general way the work should be organized so as to (*a*) permit the most rapid opening of fire possible; (*b*) assure from the beginning, first for the personnel, then for the matériel, protection sufficient to permit them to accomplish their mission; (*c*) render possible a progressive and uninterrupted improvement.

The priority order given below can be more or less followed in every case, and fulfills the above requirements:

LIST OF FIRST PRIORITY.

Hasty camouflage of the position.

Rudimentary organization of command post and observing stations.

Organization of liaisons (telephone, wireless, visual, signaling).

Mounting the guns.

Rudimentary preparation of bombardment trenches.

LIST OF SECOND PRIORITY.

Improvement of above work.

Hasty casemating of guns.

LIST OF THIRD PRIORITY.

Preparation of ammunition recesses.

Construction of rest shelters and ammunition depots.

CHAPTER III.

EXAMPLE OF ORDER OF WORK IN ORGANIZATION OF FIELD BATTERY.

The following example is given as a suggestion: Each case will have its peculiarities, which must be considered without adhering too closely to a set formula.

I. First step (fig. 83).—The guns are brought up rapidly to the position as soon as the reconnaissance has been made, the outline of the battery begun, and a hasty camouflage constructed.

Two portions of trench, serving as the beginnings of bombproof shelters, are dug on either side of the terrepleins and toward the rear of them. An ammunition recess is made in the slope of each of these trenches.

The excavated earth is thrown on both sides of the guns, forming a protecting slope right up to the gun shield. It is best to use excavated earth in the form of sand bags.

The cases of ammunition are stored in the excavations of the prepared niches.

A special squad digs at the center or flank of the battery an embryo trench for the command post.

II. Second step (fig. 84).—The gun is slightly withdrawn and the terreplein is sunk to the height of the trunnions.

The lateral trenches are deepened. The ammunition niches receive further attention. Mine gallery descents or a roofed shelter in an open cut for the battery C. P. are begun.

III. Third step (fig. 85).—One bombproof in a mine gallery or a roofed shelter in an open cut for each platoon is begun.

A simplified casemate (a layer of round logs) is placed above each gun.

The munition recesses are covered.

Work on the C. P. is continued.

IV. Fourth step (fig. 86).—The bombproofs of the platoons (two per platoon) are finished and the stairways leading to them are covered.

The gun casemates are reinforced.

The C. P. is completed.

V. Fifth step (fig. 87).—A rear communication trench is built for circulation in the battery.

A new series of ammunition niches is established in this trench.

VI. Sixth step.—Rest stations and ammunition depots are constructed outside of the battery.

New bombproof shelters may be begun in the battery.

VII. Use of caissons.—In open warfare the 75 caisson is generally brought up and put into position at the same time as the guns. The means of immediate protection in this case in trench warfare are practically those previously described. The caisson is kept in position a certain time and may then be withdrawn. If the caisson is left in the battery, a double casemate will be required. It presents no special difficulties. Figures 88 and 89 give an example of the work of construction begun with the caissons in position.

VIII. The whole of the completed construction.—The series of successive steps described above leads to the execution of the whole, as shown by figure 92. This diagram refers only to a construction of roofed work in open cuts. The battery position may ultimately be completed (fig. 93) by mine-gallery shelters, starting from the bombproofs and carried 8 meters underground. Air shafts are provided immediately above each stairway.

IX. Organization of a heavy battery equipped with trail-spade carriages.—In the installation of a battery of heavy guns on trail-spade carriages, the same principles are observed as in the case of field batteries, only the terreplein dimensions vary according to the type of matériel used.

11378°—17——3

CHAPTER IV.

EXAMPLE OF ORDER OF WORK IN ORGANIZING A HEAVY BATTERY EQUIPPED WITH RIGID CARRIAGES (120 L, 155 L).

With this matériel, the excavation of terrepleins necessitates the removal of a considerable volume of earth. This can not be accomplished as a rule, especially when fire has to be opened promptly. On the other hand, the establishment of platforms is of great advantage in executing precise fire, increasing the rapidity of fire, and diminishing the fatigue of the personnel.

The following example of the order of work is planned with these considerations in mind; it is only offered as a suggestion:

I. First step (fig. 94).—Platforms are put in place as soon as reconnaissance is completed,[1] the trace of the battery laid out, and a hasty camouflage put up.

The guns are brought up without delay.

Two trenches, which will serve as the beginnings of future bombproofs, are dug on both sides of the terrepleins.

The excavated earth is thrown up in front of the terrepleins and on the sides to form a protective parapet. It is better to place this earth in sandbags.

The ammunition is distributed in the trenches, and the surplus is placed on the outskirts of the battery in small-spaced piles covered with canvas.

A special working party digs an embryo trench for the battery C. P. in the center or on a flank of the battery.

II. Second step (fig. 95).—The lateral trenches are deepened and lengthened. An ammunition niche is dug in the walls of each of the trenches.

A revetment of round logs is prepared in front of the gun. Sandbags are carried to both sides of the terrepleins, and form a prolongation of the revetment in which ammunition recesses are established.

Stairways leading to the mine gallery, or a roofed shelter in an open cut for the battery C. P., are started.

III. Third step (fig. 96).—The protective walls surrounding the terrepleins are completed.

Munition recesses are arranged.

A bombproof for each section is begun.

The C. P. is continued.

IV. Fourth step (fig. 97).—The bombproofs for the sections are finished; the descents leading to them are covered.

A rear communication trench for circulation in the battery is begun, as well as a shelter for priming charges, which leads off from this communication trench.

The C. P. is finished.

V. Fifth step (fig. 98).—The rear trench is completed and a series of ammunition recesses established in it.

---

[1] Materials for platforms must be placed at the disposition of the batteries immediately upon their arrival.

The shelter for the priming of charges is completed.

VI. Sixth step.—Rest shelters and the ammunition depot are constructed outside the battery.

Additional bombproof shelters (in mine gallery) may be started in the battery.

CHAPTER V.

VARIOUS TYPES OF BATTERIES.

The successive steps described in Chapters III and IV result in a plan for the whole, which will be useful in many instances.

A certain number of variations in battery types are described below:

I. Field batteries in roofed emplacements.—When it is impossible to dig below 2½ meters, either for lack of time or because the soil will not stand a deeper excavation, all shelters must be of the roofed type.

Figure 99 shows the right section of a battery so constructed. A single general trench connects the C. P. on the right with the bombproofs.

In addition to bombproofs, three ammunition recesses to each gun are established in the communication trench, one on each side of the terreplein (100 projectiles), and a more important one beside the bombproof (250 projectiles).

Figure 100 gives the diagram of a field battery established with the guns in echelon and at large intervals.

The length of the communication trench which unites the bombproofs permits of a great number of munition recesses. In this case another communication trench in rear is unnecessary.

II. Battery with mine gallery bombproofs.—If the soil will stand excavation, it is advisable to establish bombproofs in mine galleries. This has been done in the battery given in figures 101 and 102.

Casemates of arc sheet iron and cement, with an explosion layer of round logs, are constructed, making use of a wall along the battery's front. They are long enough to shelter ammunition cases (100 projectiles in each) in their rear ends.

Behind the terrepleins runs a communication trench, from which run the descents (of framework sheathed with boards), leading to a mine gallery (part of which is major gallery and part grand gallery), where quarters for personnel and storage for additional ammunition cases are found.

Two sections of the grand gallery starting in the longitudinal gallery give access to the C. P.

III. Field battery completely dug into mine galleries.—This battery (fig. 103) comprises four casemates of one of the types previously described. The earth of the terreplein is excavated to a depth of 1½ meters, with the terrain sloped toward the front.

The descents into the bombproofs form at a depth of 4½ meters a small section of a grand gallery, which serves as a place for an additional ammunition recess and a passing place.

These descents come together finally at a depth of 7 meters (5 meters of earth ceiling). At their point of junction circulating galleries branch off, parallel to the axis of the casemates, and leading to a major gallery in the rear (fig. 104) which runs the whole length of the battery at a depth of 8 meters.

Air shafts are sunk above the major gallery, immediately underneath the terrepleins and above the intersection of the circulating galleries with the descents.

The major gallery is used for additional supplies of ammunition, for C. P., and personnel stations. It is therefore partitioned off on the inside (fig. 105).

This battery position can hold 8,000 75-mm. projectiles.

The order and time of the work are given in the diagrams of figure 106.

IV. Heavy batteries.—The diverse plans for field batteries positions cited above are suitable for heavy batteries whose terreplein dimensions are nearly the same.

V. Battery of heavy guns on rigid carriages, with mine galleries.—The terrepleins are not excavated; the matériel is protected by an embankment of filled earth, 2½ meters deep, supported by a revetment of round logs (fig. 107). The gun is covered with a light roofing camoufléd with painted grass woven into wire mesh.

Descents to the mine gallery start on either side of each terreplein. They come together two by two. Circulation galleries start from their points of junction and lead to a major gallery in the rear (fig. 108).

Air shafts open into the major gallery in the extension of the axis of the terrepleins. Three other shafts are sunk immediately under the intersection of the descents with the circulation gallery (fig. 109).

A section of the major gallery is used by the C. P. in the center of the battery.

The battery position can hold 4,000 155-mm. projectiles.

The construction of rest shelters for the personnel are provided for outside of the battery.

CHAPTER VI.

MATÉRIELS AND TOOLS NECESSARY IN THE CONSTRUCTION OF BATTERIES.

I. Casemates.—(*a*) *Casemates* (figs. 30, 31).—Roof of two layers of round logs, splinter-proof shields in the rear.

Round logs, 4½ meters	14
Round logs, 4 meters	35
Round logs, 3 meters	50
Round logs, 2½ meters	44
Round logs, 2 meters	106
Corrugated sheet iron, square meters	24
Sandbags	500

Strong iron wire, nails, bolts.

(*b*) *Casemate* (figs. 32, 33).—Roof of metal joists, cement, and round logs.

Round logs, 1⅘ meters (posts)	24
Round logs, 2⅔ meters (posts)	22
Planks 22 by 8 or bastings 18 by 6 (tie beam), square meters	80
Boards for sheathing sides and ammunition recess, square meters	52
Lining roof planks, under concrete	40 square meters
Planks about 12 centimeters by 0.027 centimeter by 2 meters (framing brace)	30
Bolts and nuts, 30 centimeters long, for brace	80
I rails (casemate covering):	
4 meters long	9
5 meters long	3
6 meters long	4
Iron rods: 0.015 to 0.018 centimeter, to arm the concrete	600 meters
Cement	5 tons
Gravel (concrete for roofing)	10 cubic meters
Sandbags	400
Logs, 3 meters long, for covering (two layers) and for lateral protectors	400
Planking for floors	16 square meters
Strong iron wire and staples.	

(*c*) *Casemate* (fig. 34).—Roof of rails and logs.)

Planks, 8/23, 4 meters long (posts)	50
I rails (ground plate and shelter embrasure):	
4 meters	8
6 meters	8
Rails, 5 to 6 meters (first layer of roof)	60
Planks (for the walls)	30 square meters
Planking for floor	12 square meters
Logs, 3 meters and 4 meters, for roof	60
Cement and gravel	-----
Explosion slabs	30 square meters
Or logs (explosion layer)	60 square meters
Sandbags	500
Logs (for embrasure and splinter proof in rear)	40
Strong iron wire and staples.	

(*d*) *Casemate* (*arch iron and logs*), figure 35.—

One-half arch iron	6
Logs, 4 meters	4
Logs, 3½ meters	40
Logs, 3 meters	8
Sandbags	500

(*e*) *Light shelter for "Bange" gun* (figs. 37, 38).—

Logs, 3½ meters	24
Planks	125

(*e*) *Light shelter for "Bange" gun*—Continued.

Light corrugated iron plate	80 square meters.
Bolts, 0.15 to 0.20 centimeter	60
Binding wire	400 meters.

II. Extemporized platform for 75 gun (fig. 40).

Sills, 2.3 meters	4
Thick plank, 2½ meters	8
Logs for wheel guides	10 meters.
Circular crosshead:	
Hardwood	5 meters.
Thick plank	5 meters.
Metal plate	
Eyebolts	16
Metal staples	8
Stakes, large	8
Stakes, small	12

III. Extemporized platform for rigid mounts.

(*a*) *Platform* (fig. 43)—

Sills, 2 meters, 70 centimeters	13
Sills, 3 meters	6
Thick planks, 4 or 5 meters	12
Thick planks, 3 meters	25
Stakes	40

(*b*) *Platform* (fig. 45)—

Sills, 2 meters	6
Sills, 2 meters, 70 centimeters	6
Thick planks, 3½ meters	20
Stakes (small)	25

IV. Bombproof shelter and ammunition niche.

(*a*) Shelter in large gallery (6 meters long), containing two descents (fig. 53):

Exterior casing for grand gallery	48
Iron staples	92
Planks to hold back earth (25 centimeters wide)	100 meters.
Casing for grand gallery	7
Angle iron for casing	28
Square iron braces	760
Diagonal wooden braces	12
Ties, 2 meters	12
Roofing planks	6 square meters.
Lining planks	24 square meters.

(*b*) *Shelter 7 meters long, with roof in layers* (3 layers of logs and exploding layers) and 2 covered stairways (fig. 54):

Logs, 4 meters	30
Logs, 3 meters	120
Logs, 2½ meters	40
Logs, 2 meters	80

(*c*) *Shelter in wet ground* (figs. 55, 56):

Interior casing for grand gallery	30
Angle irons for casing	120

(*c*) *Shelter in wet ground*—Continued.

Logs, 5 meters	20
Logs, 4½ meters	12
Logs, 4 meters	70
Logs, 3½ meters	15
Logs, 3 meters	130
Logs, 2 meters	10
Square braces	850

(*d*) *Niches for battery ammunition* (fig. 58):

Square frames, 1 meter each side	3
Log, 3 meters long	15
Corrugated iron	4 square meters.
Revetment batten	5 square meters.

(*e*) *Shelter for converting charge* (roof, three layers of logs and exploding layer in broken stone), two stairways (fig. 60):

Logs, 4 meters	30
Logs, 3 meters	80
Logs, 2½ meters	12
Logs, 2 meters	38
Corrugated iron	15 square meters.

V. Battery command post.

(*a*) Complete post in major gallery; total length, 8 meters; two stairways (fig. 61):

Casing for large gallery	48
Iron clamps	92
Frames for major gallery	9
Angle irons for casing	36
Square iron braces	800
Diagonal wooden braces, 80 centimeters	16
Ties, 2 meters	16
Lining planks	36 square meters.
Roofing plank	17 square meters.
Batten for floors, doors, descents	52 square meters.

(This quantity of batten allows, in addition, 2 partitions to be made in the post.)

(*b*) *Shelter for post* (roof with 3 layers of logs and an exploding layer, stairway, 1 meter of trench communicating with neighboring shelter; fig. 62):

Logs, 4 meters	40
Logs, 3 meters	144
Logs, 2 meters	12
Light corrugated iron	16 square meters.
Revetment batten	20 square meters.

Multiply the above quantities by the number of shelters which the post is to comprise.

(*c*) *Shelter for post* (roof with layers, iron arches, and logs, 3 layers and exploding layers; stairway and one covered trench communicating with neighboring shelter; figs. 63, 64):

One-half section, iron arch	6
Logs, 4 meters	50

(*c*) *Shelter for post*—Continued.

Logs, 3 meters	50
Logs, 2 meters	100
Broken stone, for exploding layer, or 3-meter logs	60
Revetment batten	15 square meters.

Multiply the above quantity by the number of shelters which the post is to comprise.

VI. Observation station.

(*a*) *Observation station, with telephone post* (fig. 68):

Logs, 4 meters	18
Logs, 3 meters	52
Logs, 2 meters	30
Thick planks, 4 meters	12
Corrugated iron	24 square meters.
Revetment batten	15 square meters.

As a reminder, connect with bombproof shelter in grand gallery or with layered roof.

(*b*) *Elevated observation station* (fig. 69):

Parts of ladder (type, Dirand ladder)	6
Rope for support	50 meters.
Iron stakes	4

Improvised seat.

Connect telephone station with shelter of C. P.'s type.

VII. Wireless station.

(*a*) *Station in grand mine gallery.*—Same material as for bombproof shelter. Additional revetment battens, 14 square meters.

(*b*) *Roofed shelter in open cut, with layers.*—Same material as C. P. shelter.

VIII. Visual signaling station.—*Sheltered station or telephone station in mine gallery* (figs. 72, 73).

Room for apparatus (roof with two layers of logs) and shafts:

Logs, 4 meters	10
Logs, 3 meters	56
Logs, 2½ meters	10
Logs, 2 meters	22
Revetment planks	36 square meters.

For the material necessary for a mine-gallery shelter, refer to quantity used for the shelter in mine gallery, C. P., or bombproof shelters.

IX. Rest shelter for personnel.

(*a*) *Shelter in major gallery for 100 men* (50 meters of length of gallery; 6 descents):

Frames for grand gallery	145
Iron braces	280
Frames for major gallery	52
Angle irons for casing	210

(*a*) *Shelter in major gallery for 100 men*—Continued.

Square iron braces	3,200
Diagonal wooden braces, 80 centimeters	100
Ties, 2 meters	100
Roofing planks	100 square meters.
Lining planks	200 square meters.
Shelving and stairway planks	150 square meters.

(*b*) *Roof shelter in open cut*, roof with layers (three layers of logs and an exploding layer), with two stairways, for eight men (fig. 75):

Logs, 3½ meters	30
Logs, 3 meters	105
Logs, 2 meters	100
Broken stone, for exploding layer, or 3-meter logs	70
Corrugated iron	20 square meters.
Revetment and interior shelving planks	36 square meters.

(*c*) *Roofed shelter in an open cut*, roof with layers of corrugated iron and logs (two layers and an exploding layer), two stairways, for eight men (fig. 76):

One-half section iron arch	5
Logs, 3½ meters	30
Logs, 3 meters	65
Logs, 2 meters	55
Broken stone, for exploding layer, or 3-meter logs	70
Revetment and shelving planks	30 square meters.

X. Ammunition depot.

(*a*) *Roofed shelter in an open cut*, roof with layers (two layers of logs and an exploding layer), two staircases, for 600 rounds of 75 mm. (fig. 78):

Logs, 4 meters	38
Logs, 3 meters	90
Logs, 2½ meters	10
Logs, 2 meters	45
Corrugated iron	12 square meters.
Revetment and shelving planks	55 square meters.

(*b*) *Roofed shelter in an open cut*, roof with layers of corrugated iron and logs (two layers and an exploding layer), two staircases, for 700 to 800 rounds of 75 mm.:

One-half section of iron arch	3
Logs, 4 meters	18
Logs, 3½ meters	18
Logs, 3 meters	65
Logs, 2 meters	50
Revetment and shelving planks	18 square meters.

(*c*) *Depot in major mine gallery* for 6,000 rounds of 75 mm. (20 m. of gallery, including 3 descents):

Exterior casing for grand gallery	72
Iron braces	140
Cases for major gallery	22
Angle irons for casing	88
Square iron braces	1,500
Diagonal wooden braces 80c	40
Ties, 2 m	40
Roofing planks	40 square meters.
Lining and stairway planks	120 square meters.

Logs and planks in quantity varying according to the way ammunition is stored.

XI. Field battery in mine gallery (figs. 103, 104, 105, 106):

Exterior casing for grand gallery, 6 stairways	160
Iron braces	310
Frames for grand gallery	30
Frames for major gallery	80
Angle irons for casing	525
Square iron braces	5,600
Diagonal wooden braces, 80 centimeters	260
Ties, 2 m	260
Frames for shafts (7 shafts)	35
Logs for timbering shafts	200 meters.
Planks and battens for lining galleries and shafts	950 square meters.

Matériel for casemates and adjoining ammunition niches.

XII. Heavy battery in mine gallery (figs. 107, 108, 109):

Logs, 3-meters for casemates	800
Sandbags	4,000
Exterior frames for grand gallery (8 stairways)	220
Iron braces	440
Frames for major gallery	120
Frames for grand gallery	50
Angle irons for frames	680
Square iron braces	7,400
Diagonal wooden braces (80 centimeters)	340
Ties, 2 meters	340
Frames for shafts (7 shafts)	35
Logs for timbering shafts—meters	200
Planks and battens for lining galleries, shafts, C. P—square meters	1,300

XIII. Tool equipment necessary to construct a battery position.

(*a*) *For the trace of the battery:*

10-meter tapes	2
Carpenter mallets	6
Iron sledge hammers	6
Meter rules	10
Line—meters	200
Plummet lines	4

(*b*) *Excavating tools:*

	Field battery.	Heavy battery.
Round shovels	30	50
Spades	10	10
Picks	30	50
Rock picks	6	12
Claw hand spikes	2	4
Boring bars	4	6
Borer	1	1
Rammers	6	10
Wheelbarrows (to carry away excavated earth)	10	20
40-centimeter railroad (to carry away excavated earth)	300	300
Baskets (to carry away the earth from the shafts of the mine galleries by means of improvised winch)	6	6
Rope, 12 meters long (to carry away the earth from the shafts of the mine galleries by means of improvised winch)	10	10

(*c*) *Carpenter's tools:*

Felling axes	4	6
Crosscut saws	4	6
Ordinary saws	2	2
Adz	4	4
Hammers	4	4
Saw files	3	6
Carpenter's chisels	2	4
Quoins (iron)	4	6
Pincers	2	2
Worms	4	6
Wheelwright planes	2	2

(*d*) *Miscellaneous tools:*

Braces, with bits	2	2
Wire pliers	3	3
Pincers	2	2
Mason's levels	2	4
Mason's trowels	2	2
Portable forge	1	1
Millstone	1	1

CHAPTER VII.

DUMMY BATTERIES.

I. Selection and appearance of emplacements.—It is valuable to have a number of dummy batteries. They must therefore be easy of construction. It is best to start several dummy batteries simultaneously, giving each one of them a stability of con-

struction apparently equivalent to that of a real battery. Dummy batteries must not be too plainly visible lest they fail to deceive the enemy. Above all, indications of activity in their neighborhood must be maintained.

They must not be too far away from real batteries nor between them. The intervals may vary between 200 and 500 meters approximately.

Dummy batteries should be organized on the very edge of the general network of tracks which supply one or several real batteries. The width of the tracks should be increased near them. They should not contain either real or false matériel which is too much in evidence. Old store depots of real batteries should be transformed into dummy batteries.

II. Organization.—Excavate two, three, or four terrepleins to a depth of 30 or 40 centimeters and conceal them imperfectly with discarded camouflage canvas. Transport the excavated earth some distance away and partially conceal it with boughs. Make wheelbarrow tracks all around the dummy batteries. Construct a bombproof shelter for the personnel charged with the lighting of the false flares. Establish visual or telephone communication between the dummy battery and the corresponding real battery, so that the false flares and the guns may go off simultaneously. If labor is scarce, the work of embanking the dummy battery should be minimized by superficially scraping the earth. Over the parts thus scraped burlap may be thrown to roughly represent terrepleins, C. P., shelters, and communication trenches. Extend this fictitious work over the length of time necessary for real work.

PART IV.

TRENCH ARTILLERY.

I. Remarks.—Trench mortars are especially built for vertical fire (high angle of fire of more than 45°), the gun emplacements should be established in view of that kind of fire.[1]

These pieces may be placed in shell craters or deep emplacements, which insure them a satisfactory defilade even when they are obliged to use an exposed terrain.

The sinking of the terreplein is only limited by the dimensions of the angle of fire. The length and breadth of the terreplein are about equal to the depth.

Because of the possibility of premature explosions, all such accidents should be borne in mind in constructing batteries. Each emplacement must be equipped with two escape trenches with traverses, which permit of the rapid departure of the gunners and of the localization of the effect of the explosion in case of accident.

The construction of trench battery emplacements follows the rules pertaining to the construction of other emplacements, and particularly this rule—however hasty the first work it must be organized with ultimate improvement in mind in the way of protection and concealment.

The regulations for trench artillery drawn up during the war give types of organization conforming to the principle of the regulations which may be adapted in every case to the lay of the terrain and the requirement of the situation.

The installation of a battery of trench mortars comprises the following work—mortar emplacements with platforms (P), personnel shelters (B), ammunition recesses for bombs (M) and charges (A), and command post (C. P.), including a telephone station (P. T.).

II. 58 mm. and Van Deuren mortars.—The mortars of one section (fig. 110) may be either—

(1) Distributed on the ramification of an infantry communication trench (roofed or not roofed) perpendicular to the lines ("tree distribution").

(2) In echelon, along a communication trench parallel to the lines ("parallel distribution.")

---

[1] The 75 mm. and the 150 mm. mortars are exceptions to this rule. In order to make use of all their ballastic capacity it is best to establish emplacements permitting a more rapid and precise flat trajectory fire. These emplacements should be close to the emplacements for vertical fire, which afford maximum protection.

(3) Grouped under favorable cover ("circular distribution.")

Parallel distribution should be given the preference every time it is practicable, for it affords the personnel maximum protection from the premature explosion of neighboring pieces.

Figures 111 to 114 show the successive steps in the construction of a position for a section of two guns.

Figure 111 gives a plan of rapid installation which may be used when the mortars are accompanying infantry. The pieces are set up some 20 meters apart, using what shelter exists on the terrain as much as possible. A section of trench having a traverse between the two guns serves as shelter for personnel. Ammunition depots are placed on the flanks of the battery, slightly below ground, either in parts of trenches or in shell craters, in order to protect the bombs from infantry fire.

Figure 112 indicates improvements that may be added to the preceding plan. The shelter trench is deepened; one part of it is made bombproof against projectiles of small caliber (cross-section C–D), to serve as C. P. Nitches for signal rocket (G) are dug in the parapet. The gun emplacements (P) and the communication trenches leading to the nitches for the signal rockets (G) are lightly roofed. The ammunition recesses (M) are made proof against splinters (cross-section E–F). This procures the type of installation desirable before opening fire.

Figure 113 shows the final installation which should be realized when tactical conditions permit. A bombproof (B) is dug in the mine gallery. Ammunition recesses and gun emplacements are made proof against small-caliber shells (fig. 114). The walls of the mortar emplacements are protected by a hurdle revetment or by one of planks. Painted canvas may be used to advantage in concealing the opening of the embrasure. Cross section A–B shows how the canvas may be easily handled.

Figure 115 gives a platoon emplacement, the shelters of which are constructed entirely in a mine gallery under 6 or 8 meters of untouched earth. The guns are set up in simple craters in the shape of shell holes and covered with painted canvas. The earth taken from the crater has been carried away and scattered on the neighboring trench parapets. Sandbags reinforce the crater walls. The construction of such a position by the personnel of the platoon will require two months.

III. 75 mm. T. mortars (fig. 116).—A communication trench (B_o) is constructed for circulation in the battery and the service of the pieces. In front are platform emplacements for flat trajectory fire (P), sunk to a depth of 50 centimeters, and communicating with the communication trench by means of two stairways. Sometimes the communication trench is left uncovered to give it the appearance of an infantry trench. When the first installation is completed, deep emplacements for vertical fire (P2) and bombproofs in the mine gallery (B) are constructed.

Figure 117 gives the details of the installation of the pieces and of an ammunition recess. To conceal the embrasure, a

painted canvas stretched horizontally may be used, as in the case of the 58 mm.

IV. 150 mm. mortars.—Figure 118 gives a diagram of an emplacement for a section. The installation is begun in an infantry trench whose trace is followed to avoid attracting attention from aviators. The communication trenches and shelters opening into the main trench are roofed. The bombproof is in a mine, main gallery.

Figure 119 gives the cross section along the axis of the pieces and the details of the shelters.

V. 240 mm. T. mortars.—Figure 120 gives a plan of the installation of a piece. The terreplein of platform (P) is sunk 4 meters below the ground surface. Ammunition shelter (M) is sunk 7 meters in a mine gallery. The personnel shelter is sunk 8 meters.

Figure 121 gives a cross section along the axis of the piece. A part of the platform's emplacement is sunk in the mine gallery. The embrasure should be very carefully sheathed, owing to the effects of the blast. Cement revetment gives the best results. It may be put up as follows: The earth at the sides and rear is supported by a frame of metal laths 15 mm. diameter, sunk in the ground, to which are fastened bars placed horizontally and vertically 30 cm. from each other. A first revetment of pebbles and cement mortar is placed on the inside of this latticework. Then a roll of wire trellis is stretched over the framework, sunk 20 cm. into the ground. A coating of mortar covers this network. The sloping portion of the embrasure is coated with cement mortar spread over the wire trellis work, which is held firmly in the ground by hooks. Drying takes five days, at the end of which time fire may be opened.

VI. 340 mm. T. mortars.—Figure 122 gives the whole of the installation of a platoon of 340 mm. T. mortars.

Figure 123 gives the details of an ammunition shelter supplied by a track 60 cm. in width.

ABBREVIATIONS USED IN THE FIGURES TO INDICATE THE DIFFERENT PARTS OF A BATTERY.

T	Terreplein.
P	Platforms.
B	Bombardment shelter.
M	Recess or shelter for ammunition.
G	Cartridge recess.
P. C. (or C. P.)	Command post.
P. T. (or T. S.)	Telephone station.
B	Communication trench.

Fig. 1.

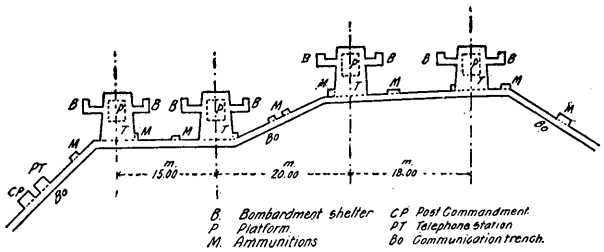


Fig. 2.

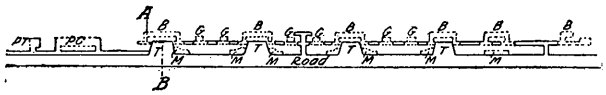
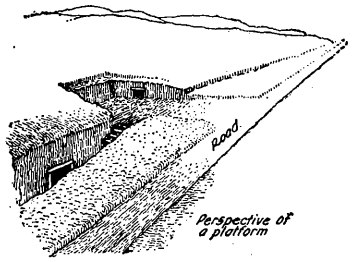


Fig. 3.





Longitudinal section.



Gross section on line A-B of Fig. 2.

Fig. 4.

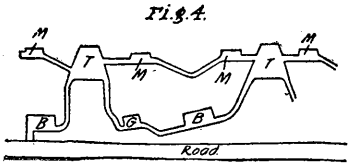


Fig. 5.

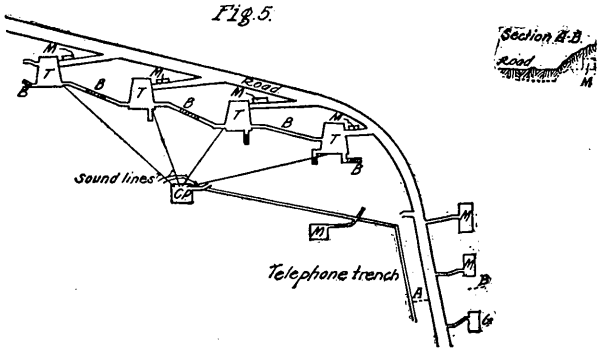


Fig. 6.

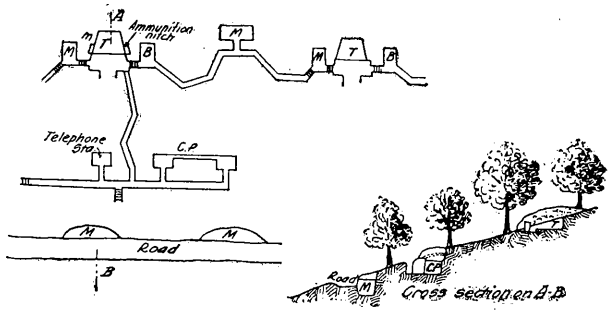
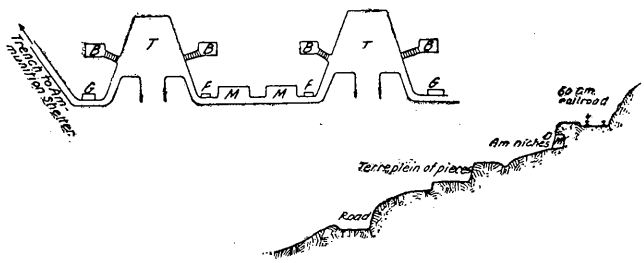
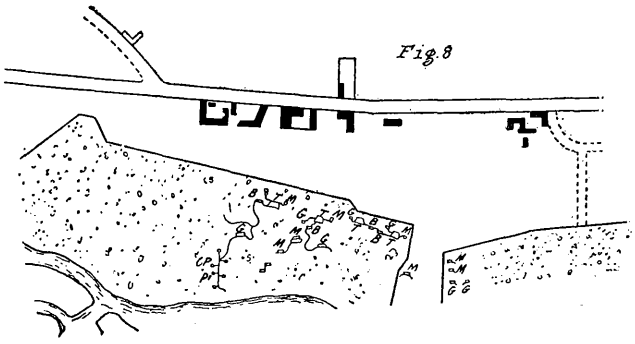


Fig. 7.




Fig. 8

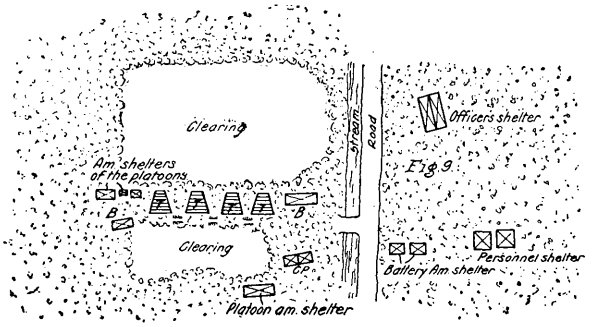

Clearing
Am. shelters of the platoons
Stream
Road
Officers shelter
Fig. 9
Clearing
Battery Am shelter
Personnel shelter
Platoon am. shelter

Fig 9.

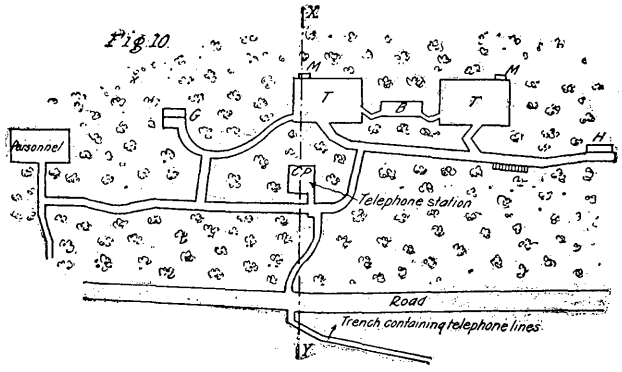
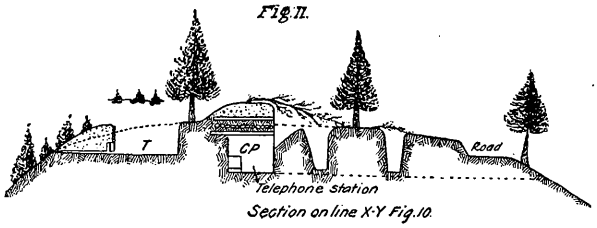
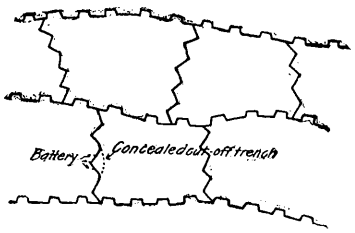

Fig. 10
Personnel
Telephone station
Road
Trench containing telephone lines

Fig. 11.



Section on line X-Y Fig. 10.

Fig. 12.



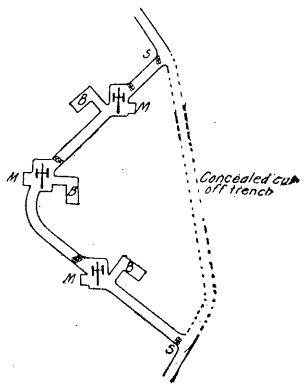


Fig.13.

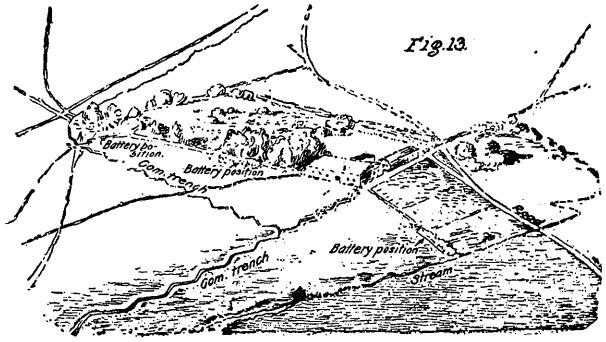




Fig.14.

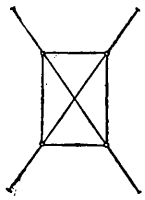
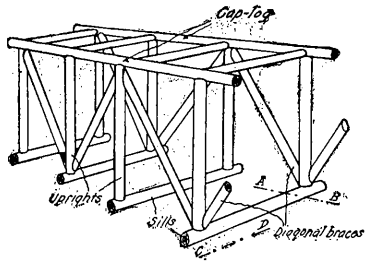


Fig.16.



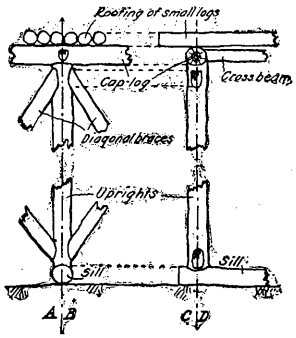


Fig.15.

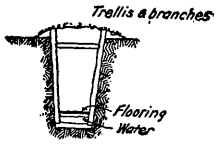


Fig. 17.

Proper joints.

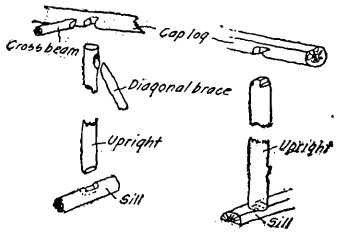


Fig. 18.

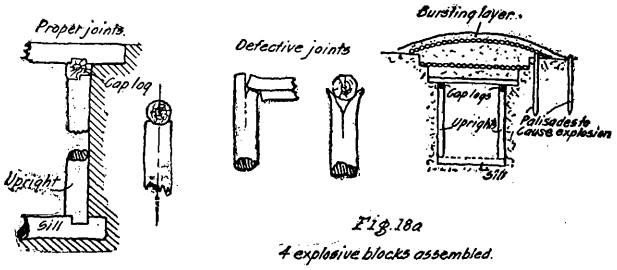


Fig. 18a

4 explosive blocks assembled.

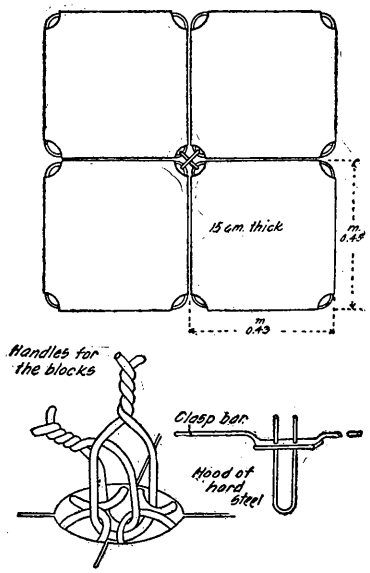


Fig. 19.

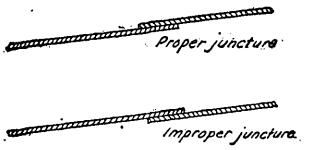


Fig. 20.

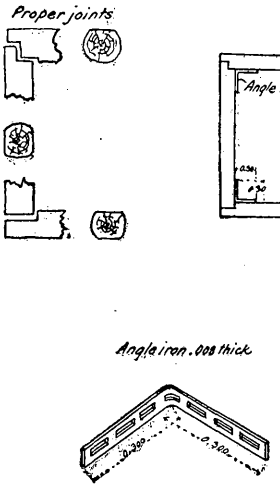


Fig. 21.

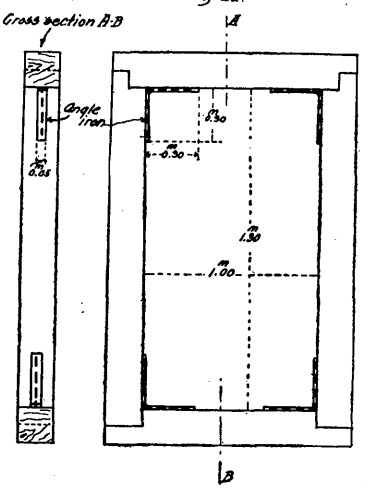


Fig. 22.

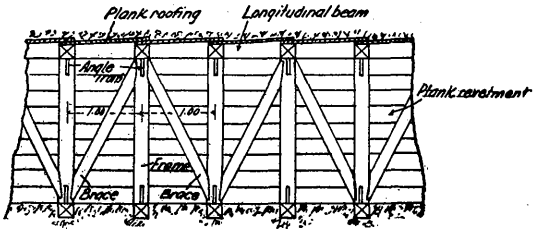


Fig. 23.

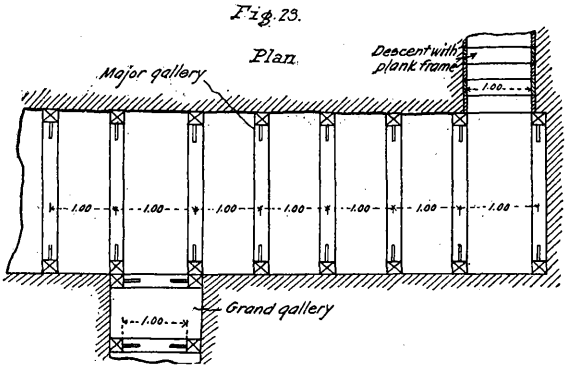


Fig. 24.

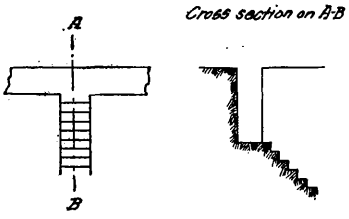


Fig. 25.

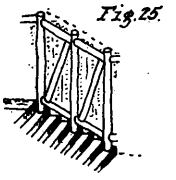


Fig. 26.

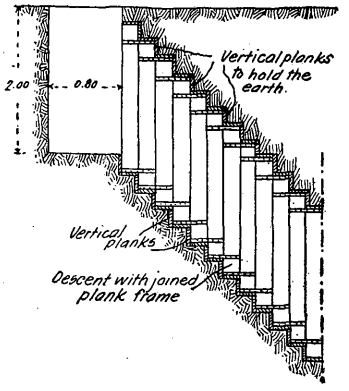
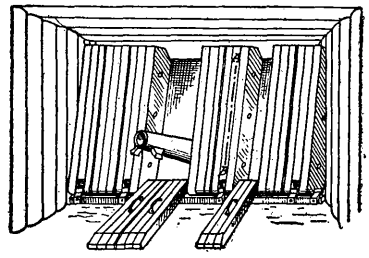
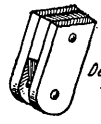


Fig. 27.

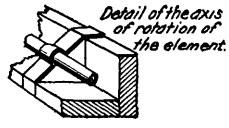
Fragment proof embrasure of a casemate.





Detail of one of the elements.

Fig. 28.



Detail of the axis of rotation of the element.

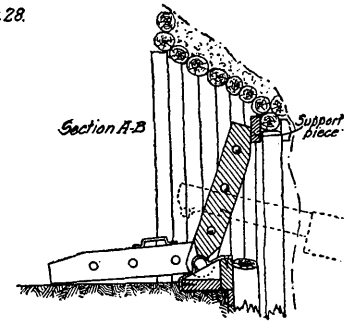
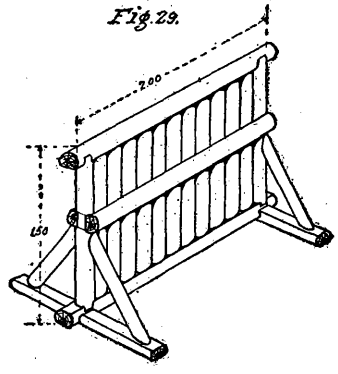


Fig. 29.



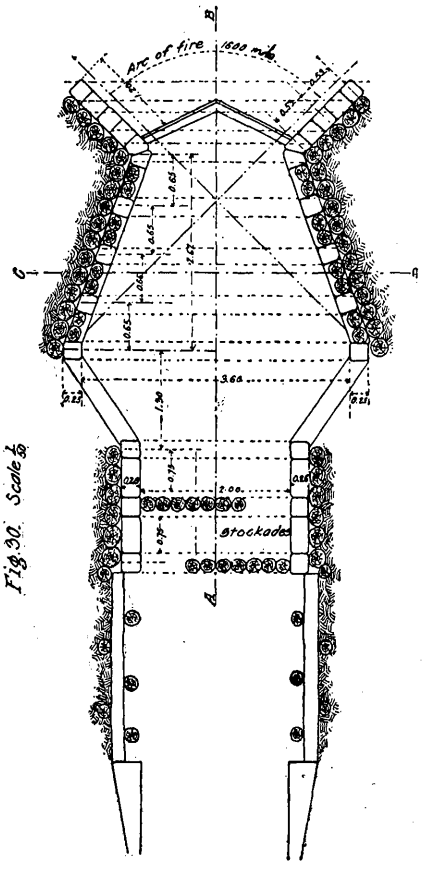
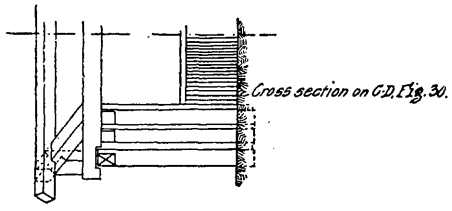


Fig. 30. Scale $\frac{1}{50}$

Fig. 31.



Cross section on A.B. Fig 30.

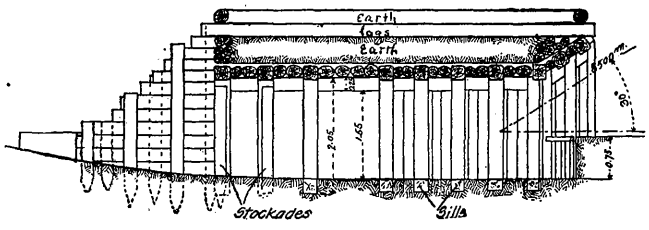


Fig. 31a.

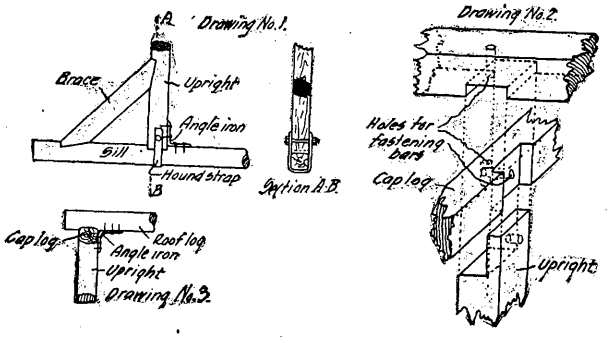


Fig. 32.

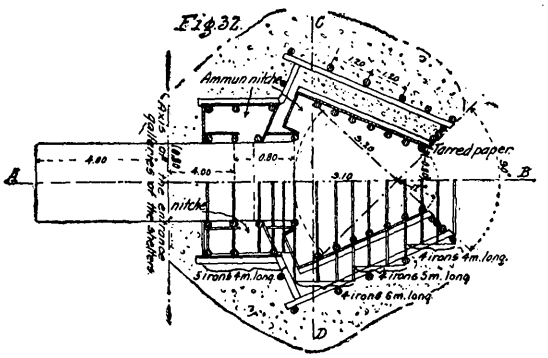

C
Ammun nitche
Parapet 10.80 high & 2.00 thick for Machine guns
4.80
4.00
0.80
3.10
tarred paper
B
A
nitche
4 irons 4m. long.
5 irons 4m. long
4 irons 5m. long
4 irons 6m. long
3.
D

Fig. 33.

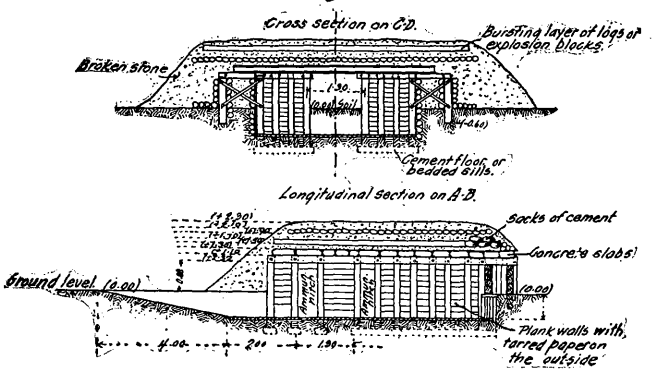

Cross section on C-D.
Bursting layer of logs or explosion blocks.
Broken stone
1.30.
Cement floor or bedded sills.
Longitudinal section on A-B.
sacks of cement
concrete slabs
Ground level (0.00)
(0.00)
Plank walls with tarred paper on the outside
4.00
2.00
1.90

Fig. 34.

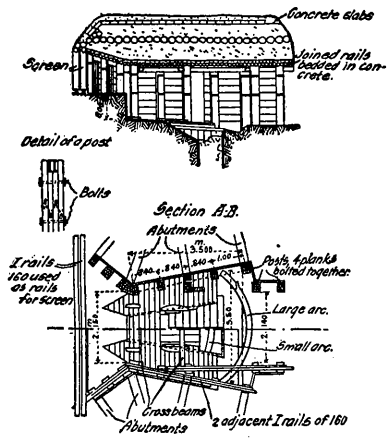


Fig. 35.

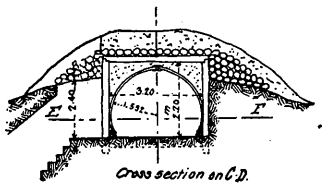
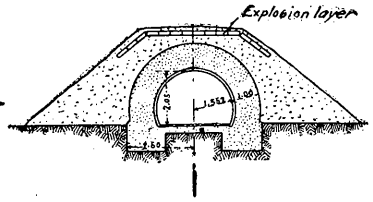


Fig. 36.



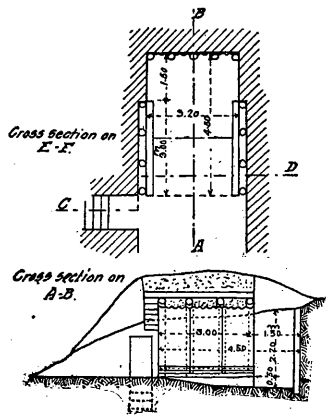


Fig. 37.

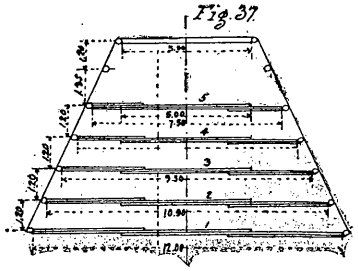


Fig. 38.

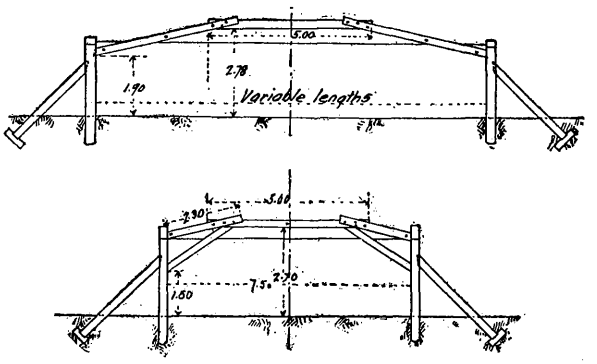


Fig. 39

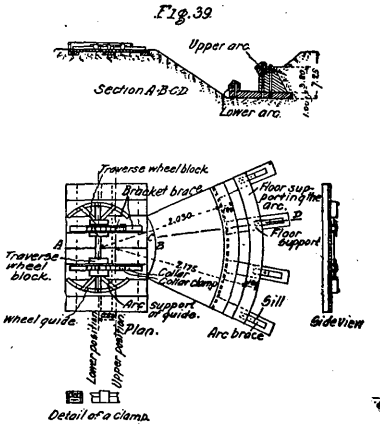


Fig. 40.

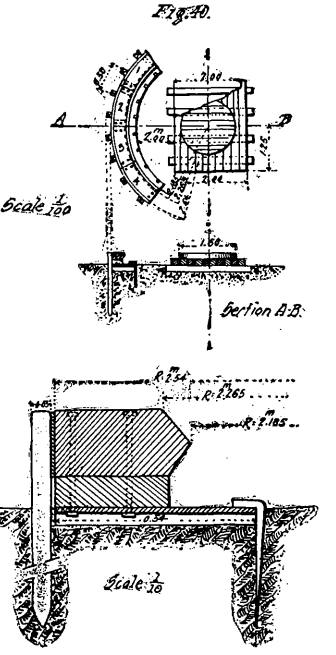


Fig. 41.

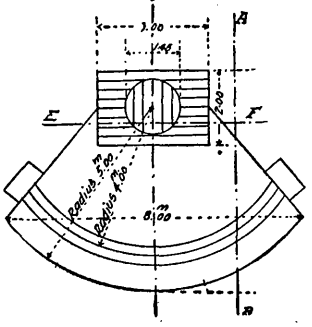


Fig. 42.

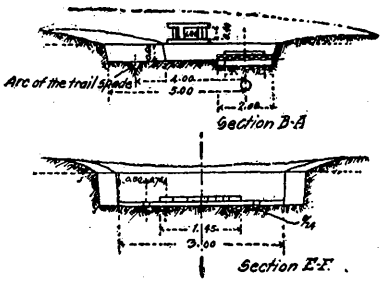


Fig. 43.

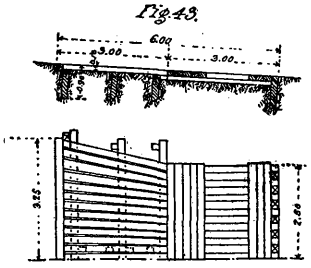


Fig. 44.

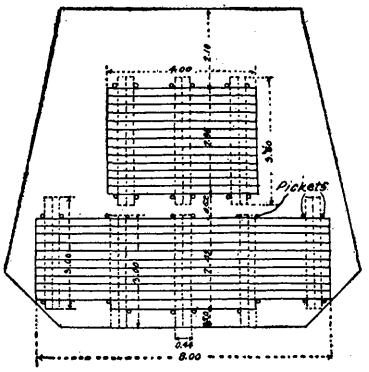


Fig. 45.

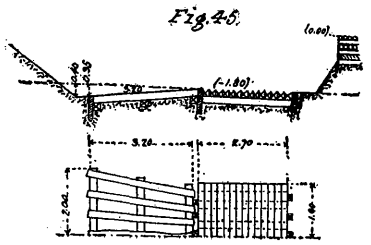


Fig. 46.

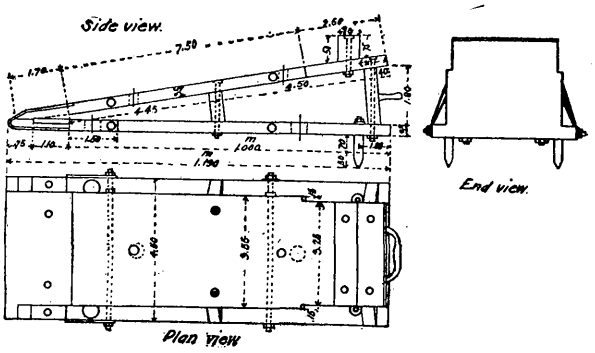


Fig. 47.

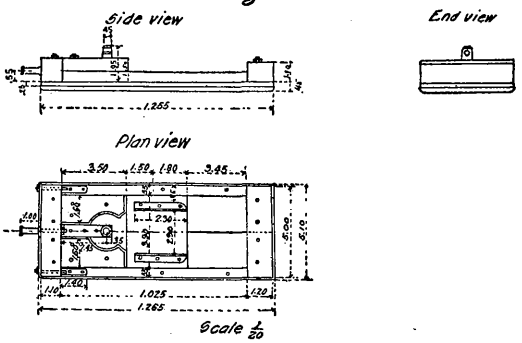


Fig. 48

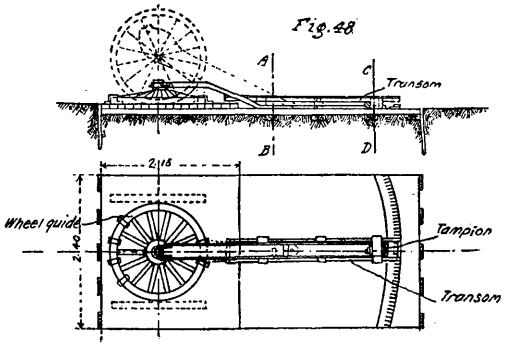
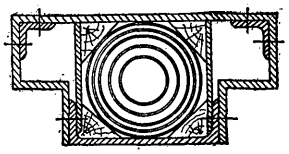


Fig. 49.

Section on A-B



Section on C-D.



Stop against return in battery

Fig. 50.

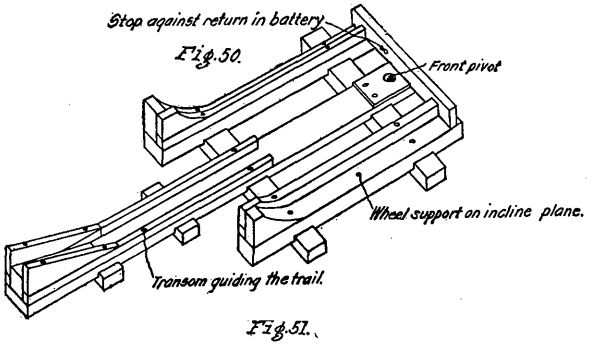
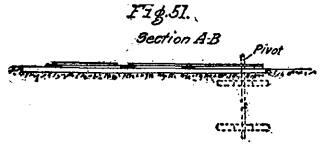


Fig. 51.

Section A-B



Plan view.

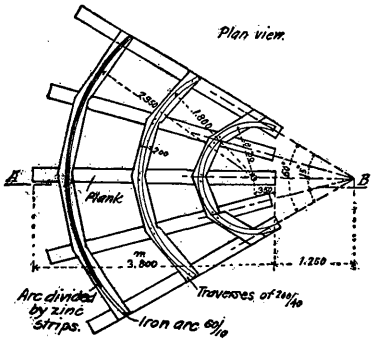


Fig. 52.

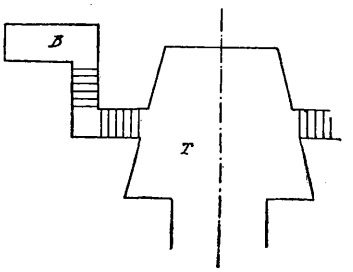


Fig. 53.

Cross section on A-B.

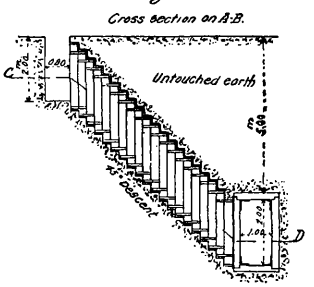
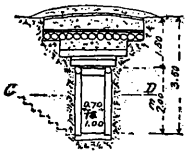
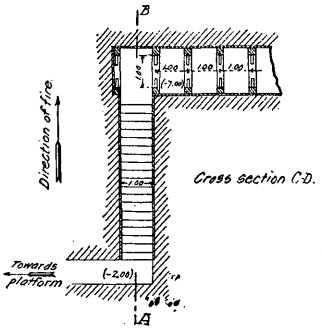


Fig. 54.

Cross section on A-B.





Cross section on C-D.

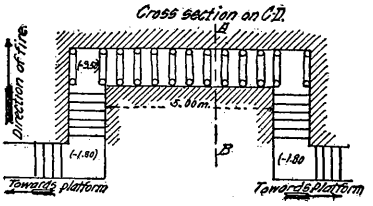


Fig. 55.

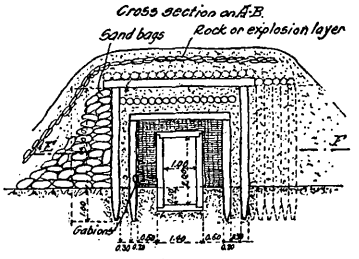
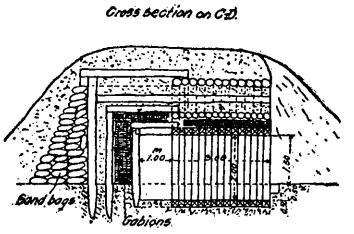


Fig. 56.



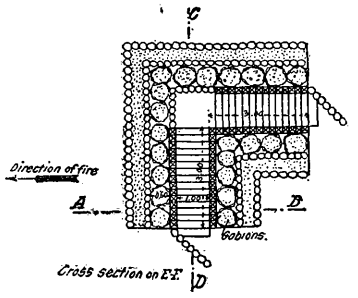


Fig. 57.

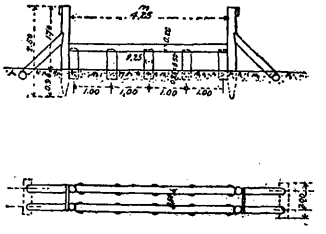


Fig. 60. Cross section on A-B.

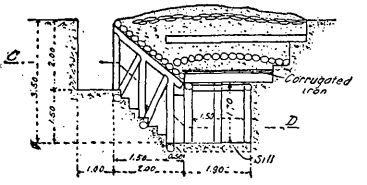
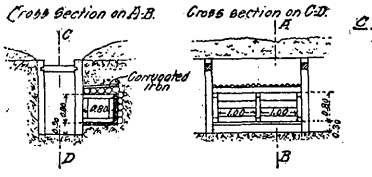


Fig. 58.



Cross section on C.D.

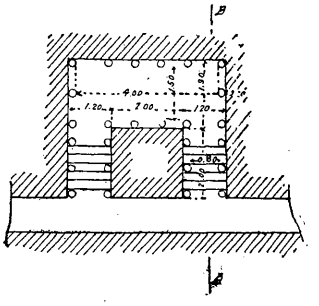


Fig. 59.

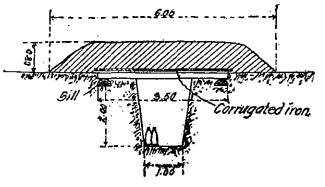


Fig. 61.

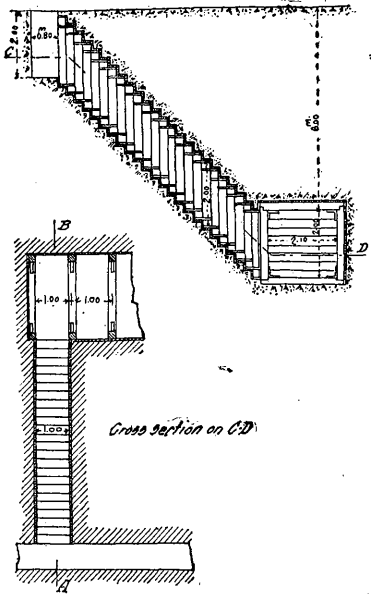


Fig. 62.

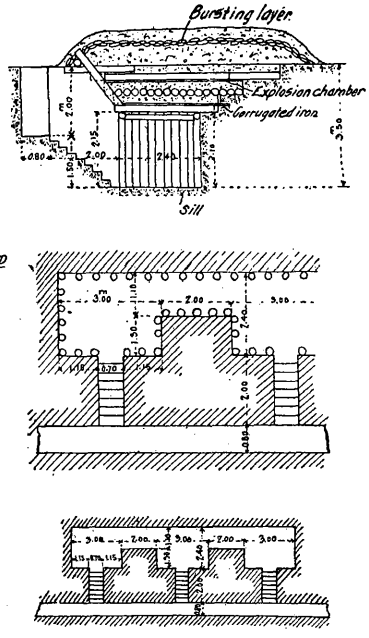


Fig. 63.

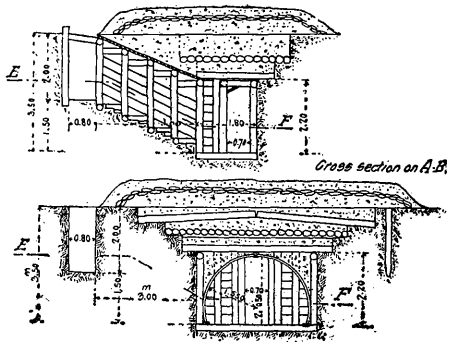


Fig. 64.

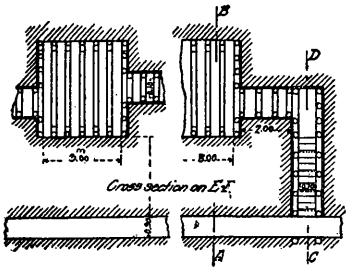


Fig. 65.

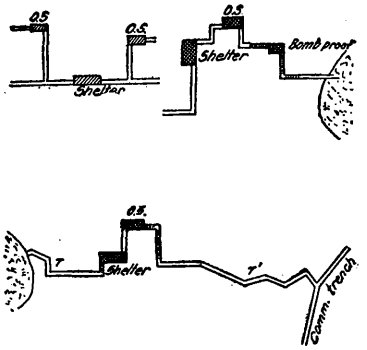


Fig. 66.

Cross section on A-B.

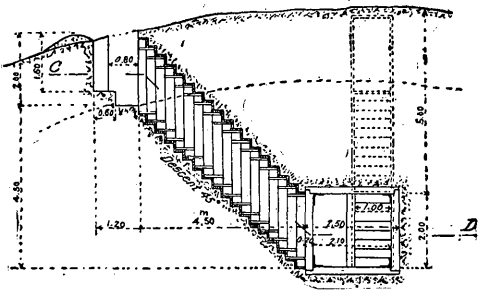


Fig. 67.

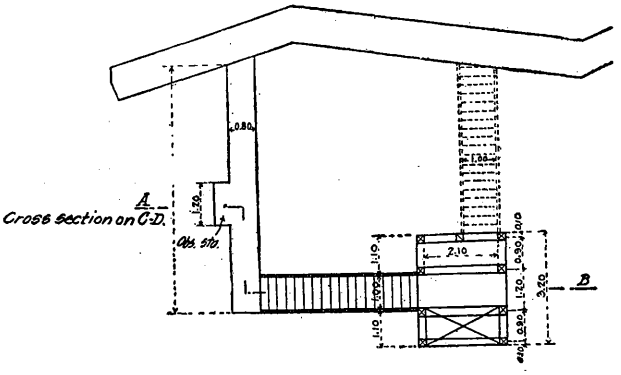
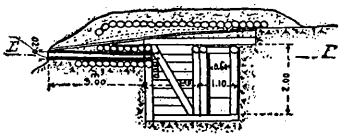
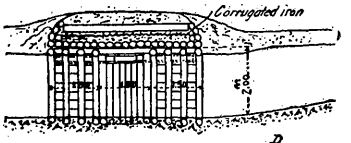


Fig. 68.

Cross section on A-B.



Cross section on C-D.



Cross section on E-F.

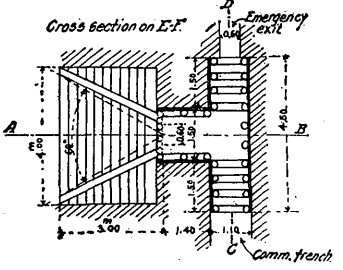


Fig. 69.

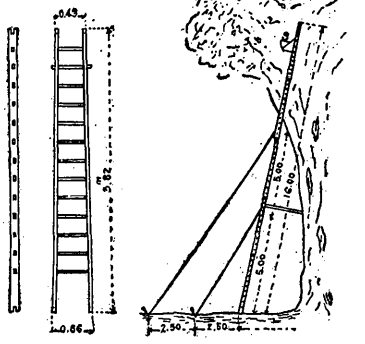
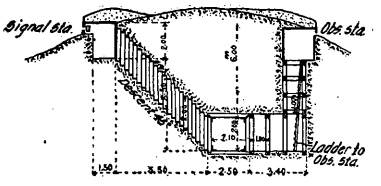


Fig. 70.

Vertical cross section.



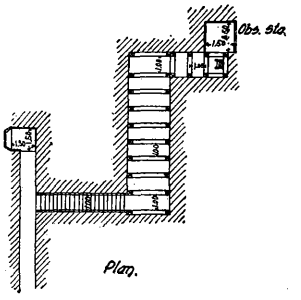


Fig. 71.

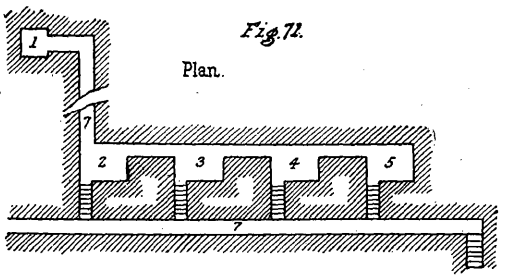


Fig. 72.

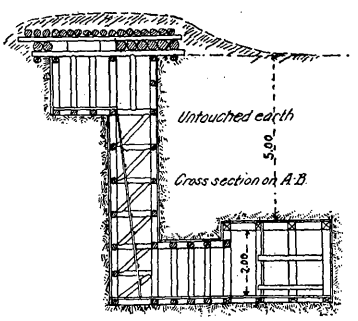


Fig. 73.

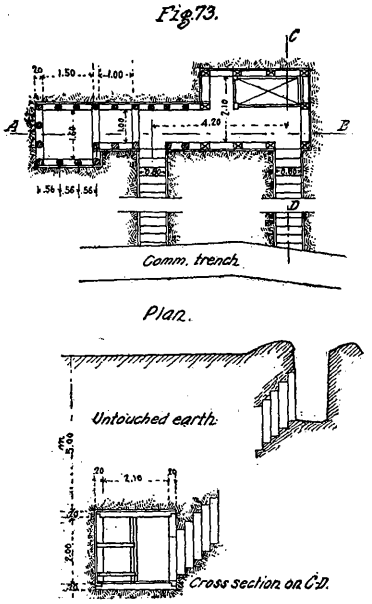


Fig. 74.

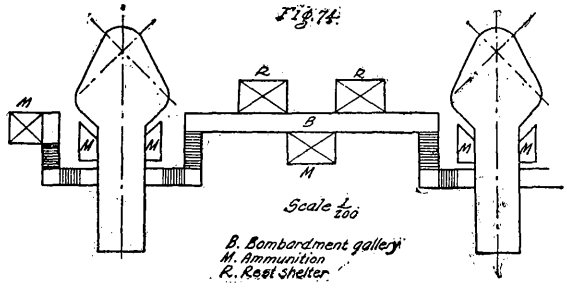


Fig. 75.

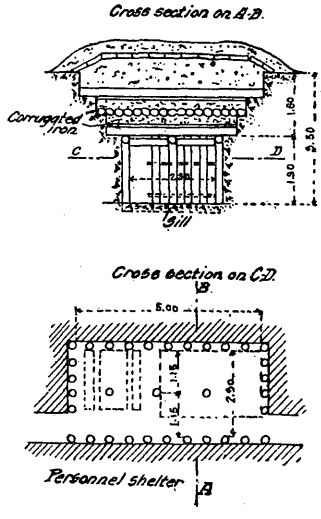
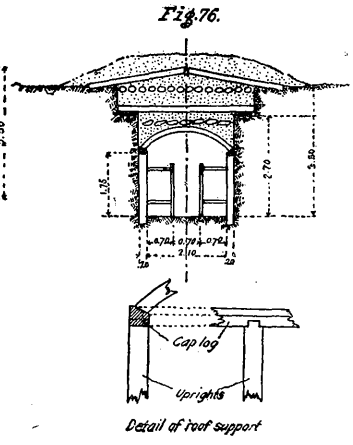


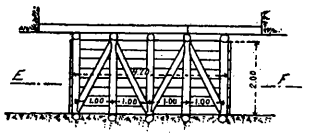
Fig. 76.



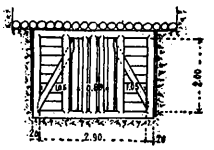
Detail of roof support

Fig. 77.

Cross section on A-B.



Cross section on C-D.



Cross section on E-F.

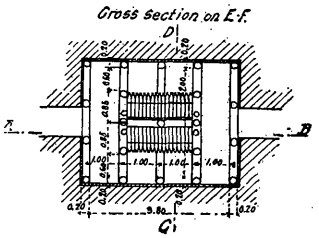
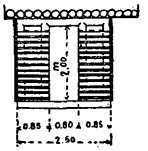
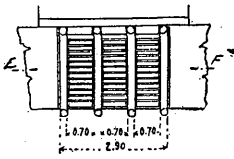


Fig. 78.

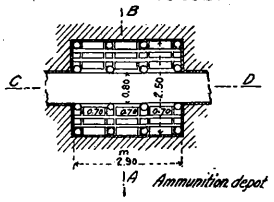
Cross section on A-B.



Cross section on C-D.



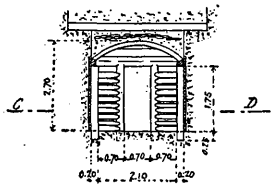
Cross section on E-F.



Ammunition depot

Fig. 79.

Cross section on A-B.



Cross section on C-D.

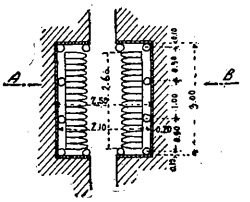
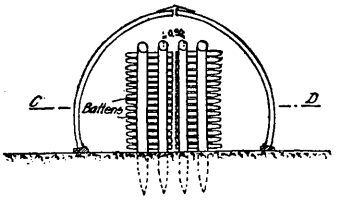


Fig. 80.

Cross section on A-B.



Cross section on C-D.

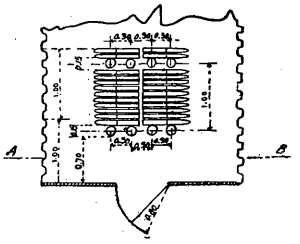


Fig. 81.

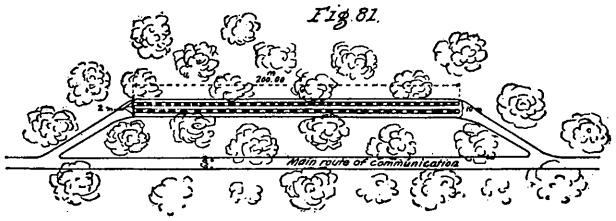


Fig. 82.

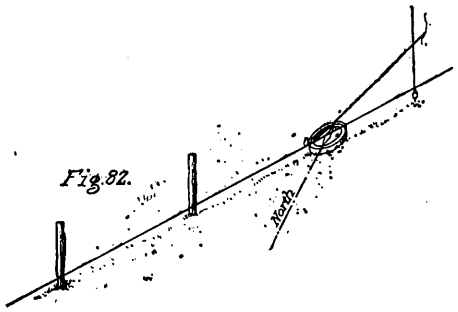


Fig. 83.

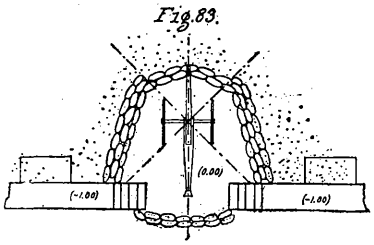


Fig. 84.

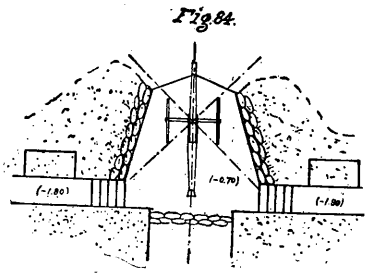


Fig. 85.

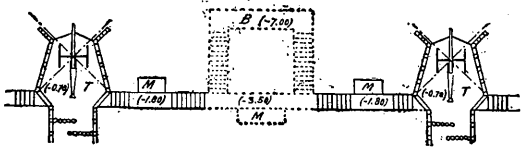


Fig. 86.

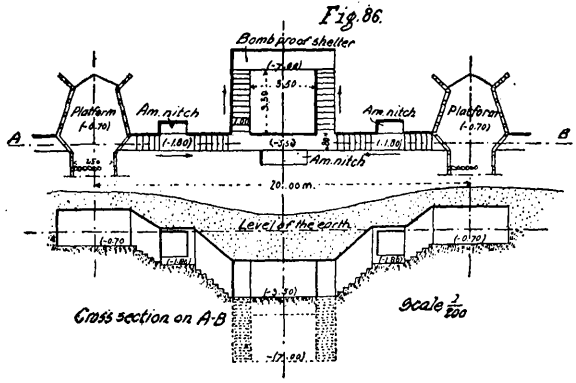


Fig. 87

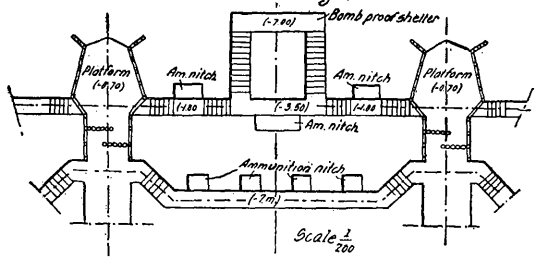


Fig. 88.

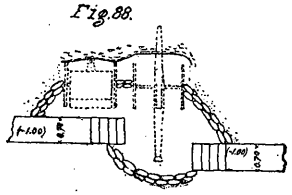


Fig. 89.

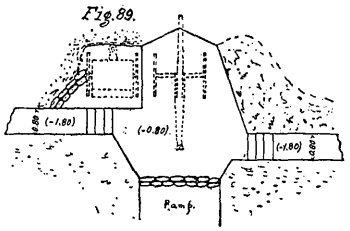


Fig.90.

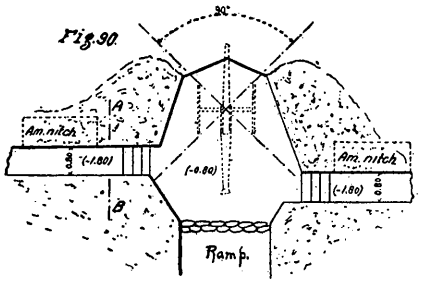


Fig.91.

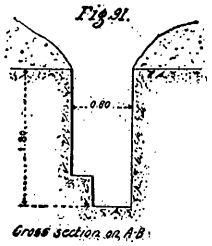


Fig.92.

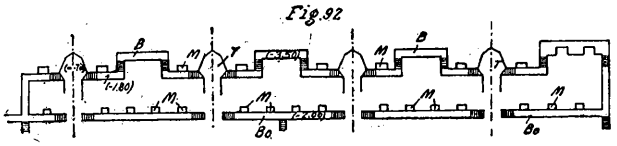


Fig.93.

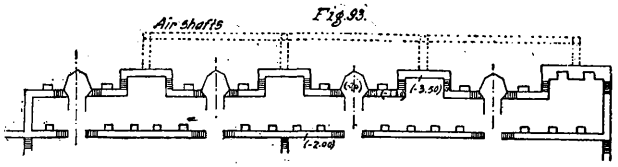


Fig.94.

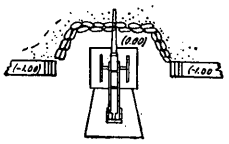


Fig.95.

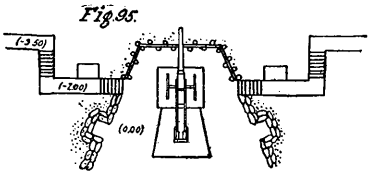


Fig.96.

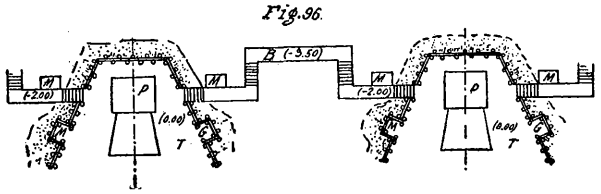


Fig. 97.

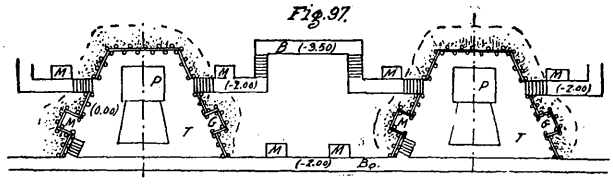
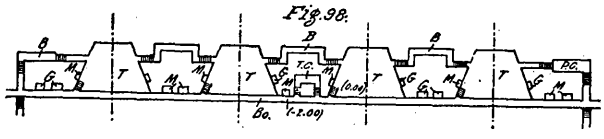


Fig. 98.



B. Bomb proof.
P. Platform.
M. Ammunition.
P.C. Command post.
P.T. Telephone station.
T. Terre plein.
Bo. Communication trench.

Fig. 99.

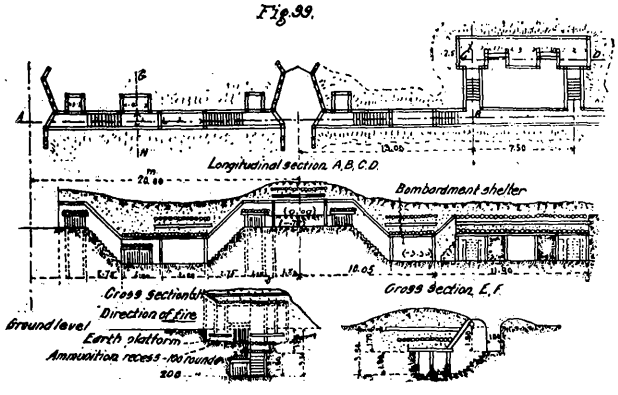


Fig. 100.

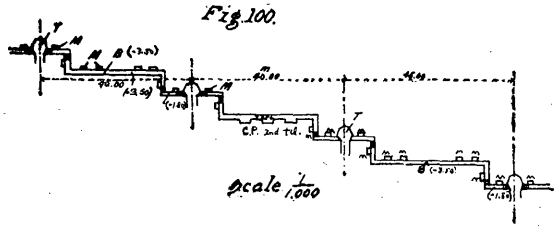


Fig. 101.

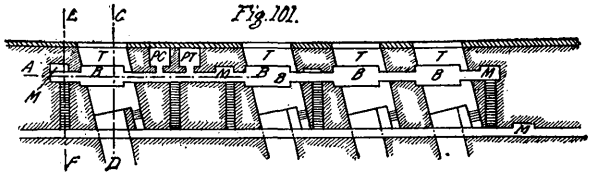


Fig. 102.

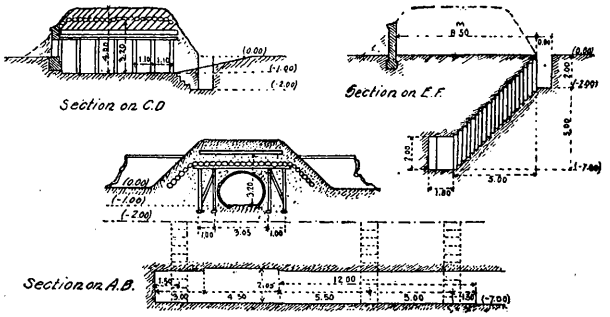


Fig. 103.

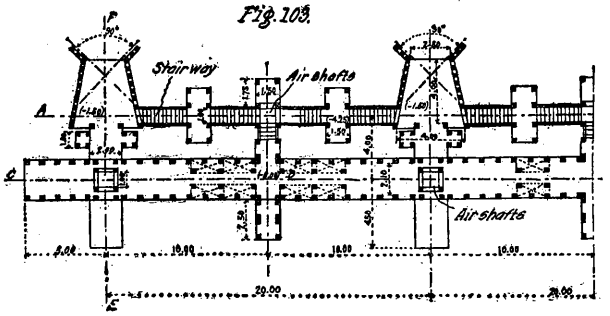


Fig.104

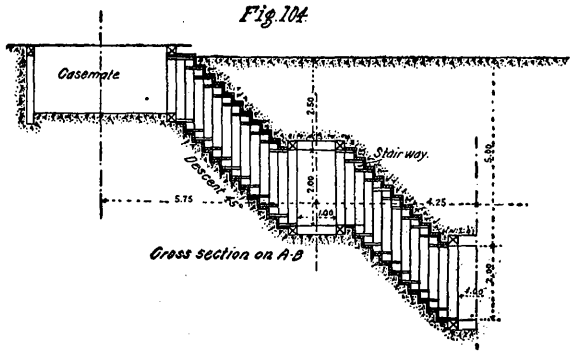


Fig.105

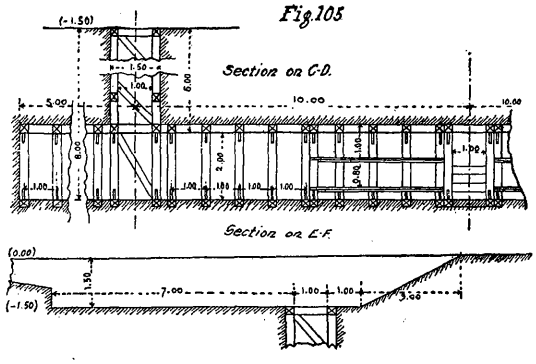


Fig. 106.

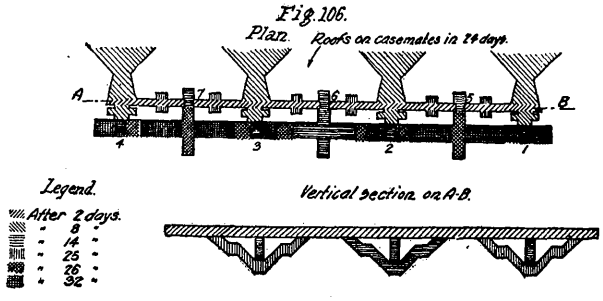
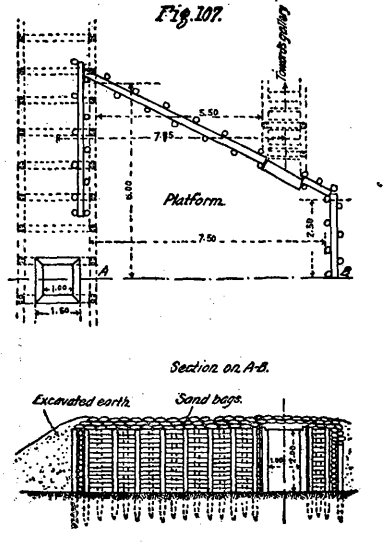


Fig. 107.



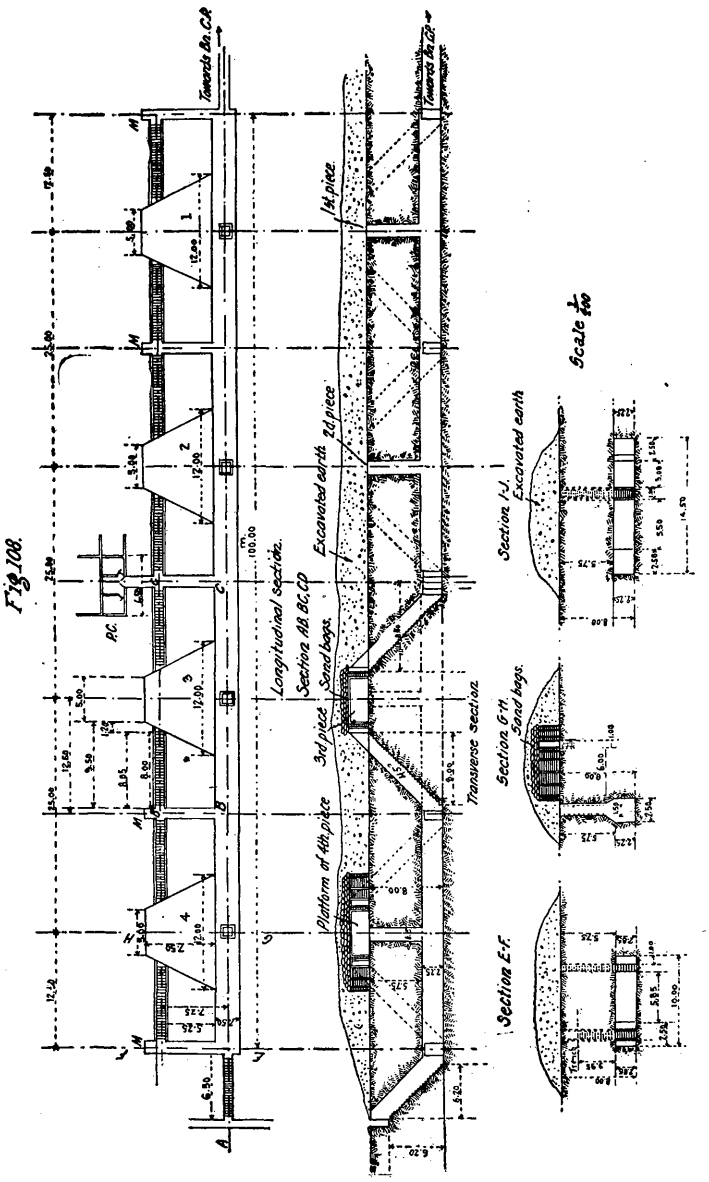

Towards Bn. C.R.
Towards Bn. C.R.
1st piece
2nd piece
Excavated earth
Longitudinal section.
Section AB BC CD
Sand bags.
3rd piece
Platform of 4th piece
Transverse section.
Section I-J
Excavated earth
Section G-H
Sand bags.
Section E-F.
Scale 1/100
P.C.

Fig 108.

Fig. 109.

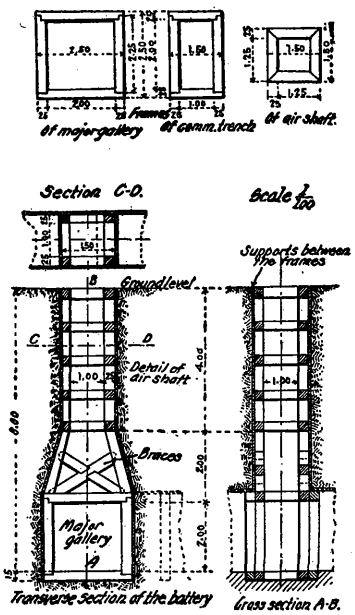


Fig. 110.

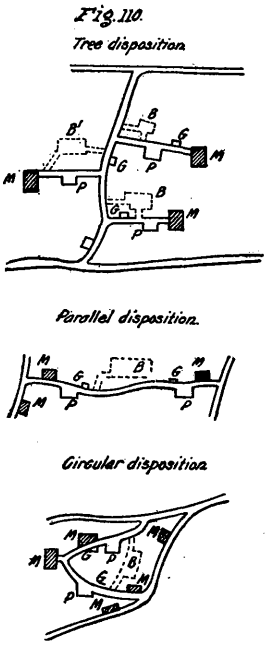


Fig. 111

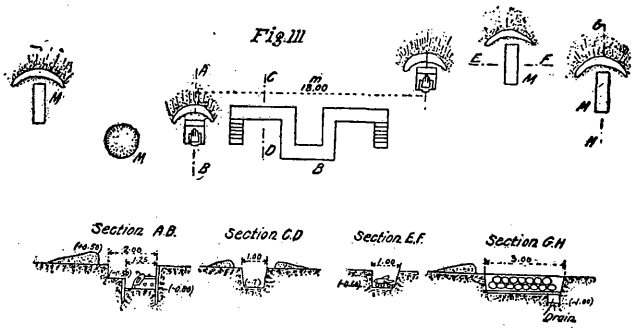


Fig. 112.

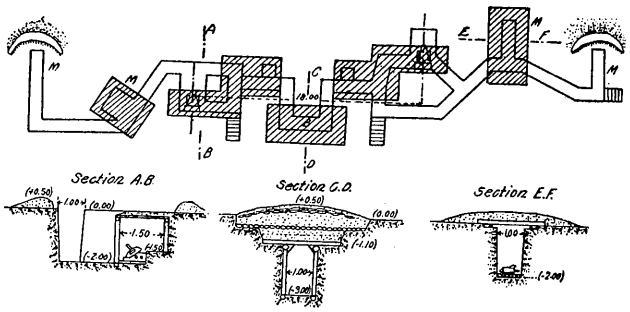


Fig. 113.

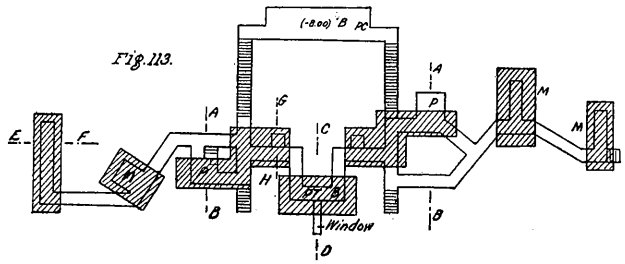


Fig. 114.

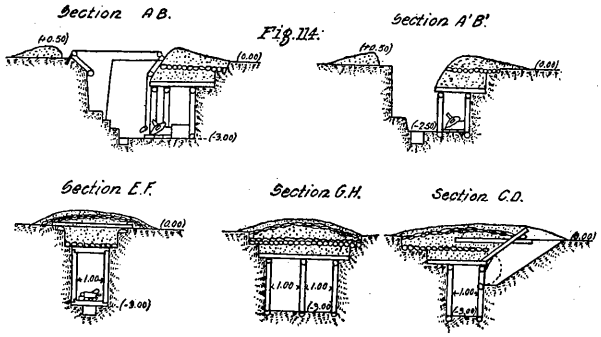
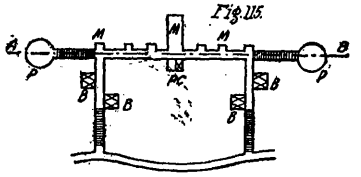
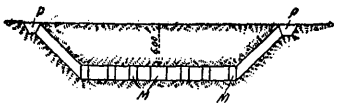


Fig. 115.



Section on A.B.



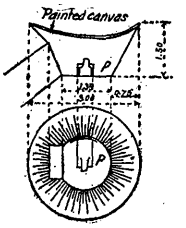


Fig. 116.

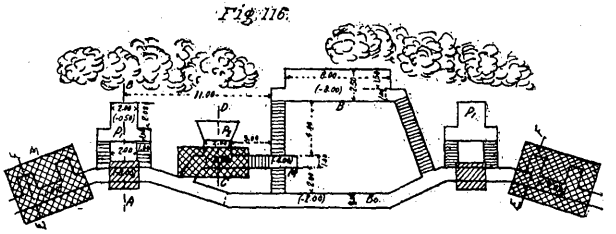
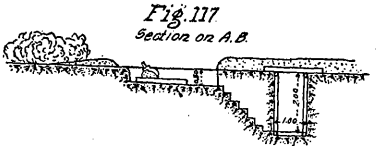
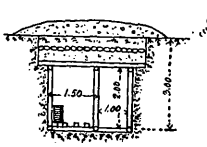


Fig. 117

Section on A.B.



Section on E.F.



Section on C.D.

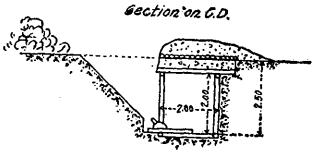


Fig. 118.

Plan view.

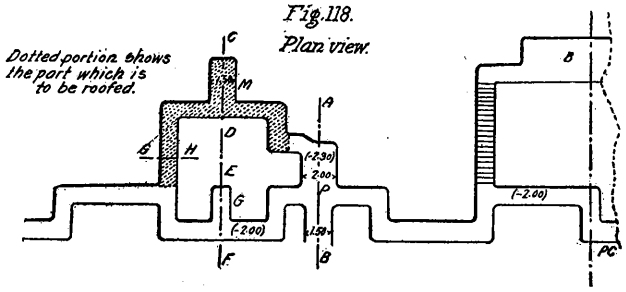


Fig. 119.

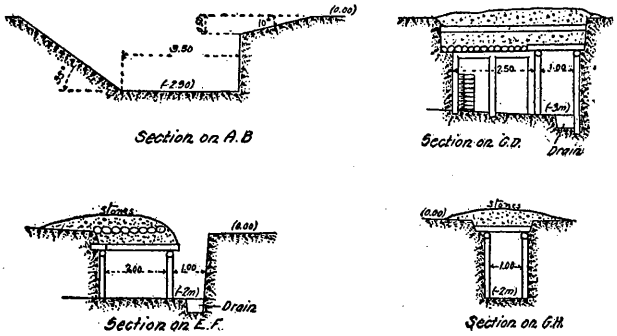
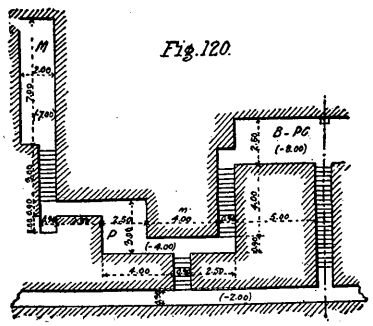


Fig. 120.



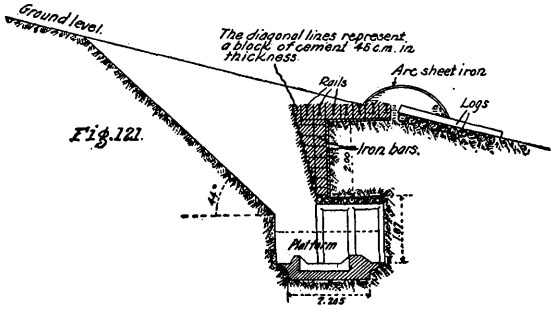


Fig. 121.

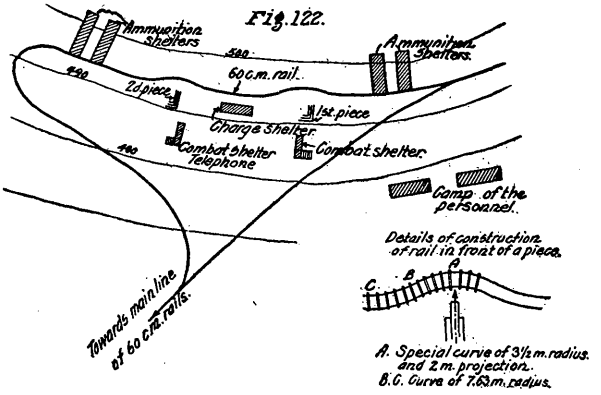


Fig. 122.

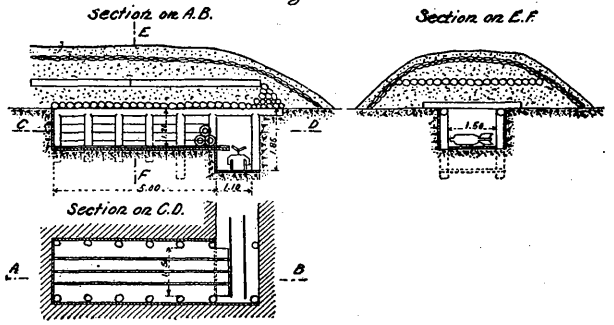


Fig. 123.

APPENDIX I.

BRITISH 2-INCH TRENCH MORTAR EMPLACEMENTS, 9.45-INCH TRENCH MORTAR DECAUVILLE R. R. MOUNTINGS, AND 9.45-INCH TRENCH MORTAR EMPLACEMENTS.

The following diagrams show the above mentioned British emplacement constructions.

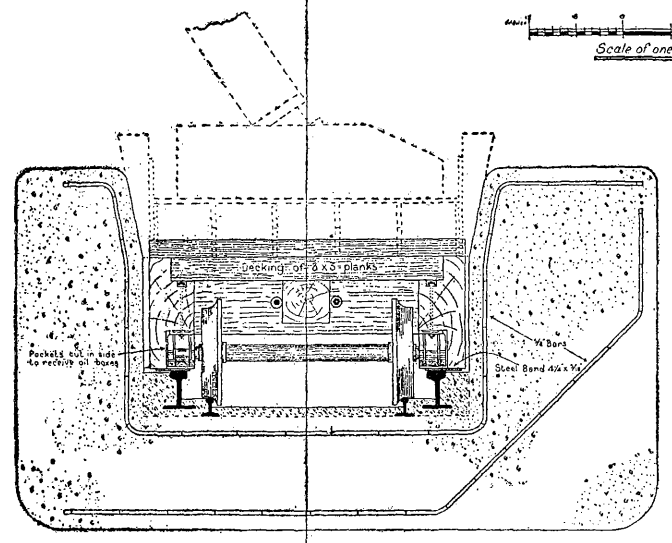
9·45 Inch T.M. Decauville Railway Mounting

No 1

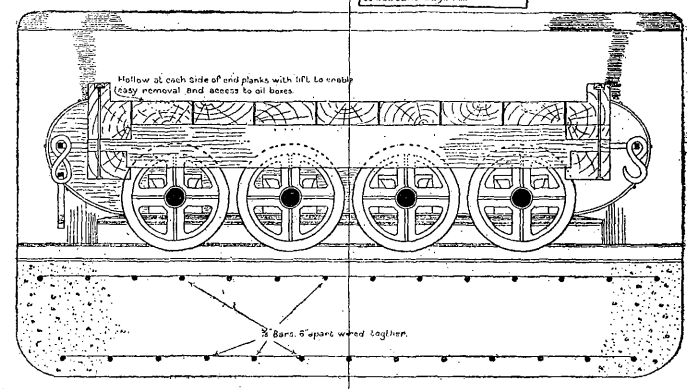
Third Army

Scale of one and a half inches to a foot

List of Materials Req^d for the Concrete Emplacement	
Material	Quantity
Concrete composed of:	
4 parts Broken Stone or Gravel	33 Tons 15c.
1 part Cement	18 Cwt.
½" Steel Bars	No 14 - 12'0" long
Do "	18 9'0" "
Plain Wire	113 yds run
Rail Heavy	No 2 - 3.4 long
Co. Decauville ½	According to size
Concrete required will be from 250 to 300 sand bags full	



Cross Section



Longitudinal Section

NOTE –
In the construction of the concrete emplacement the concrete surrounding the rails (seen in end and side) should be laid with the rails in position after the side walls and bottom have perfectly set.

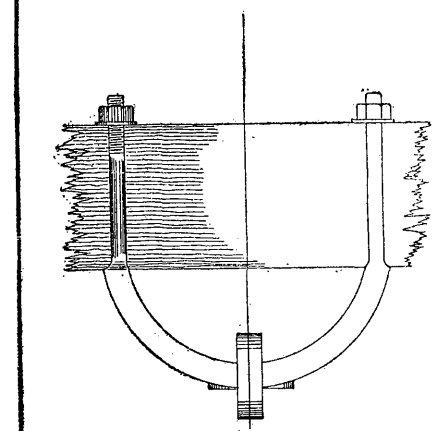
End Elevation of Wagon

Side Elevation of Wagon

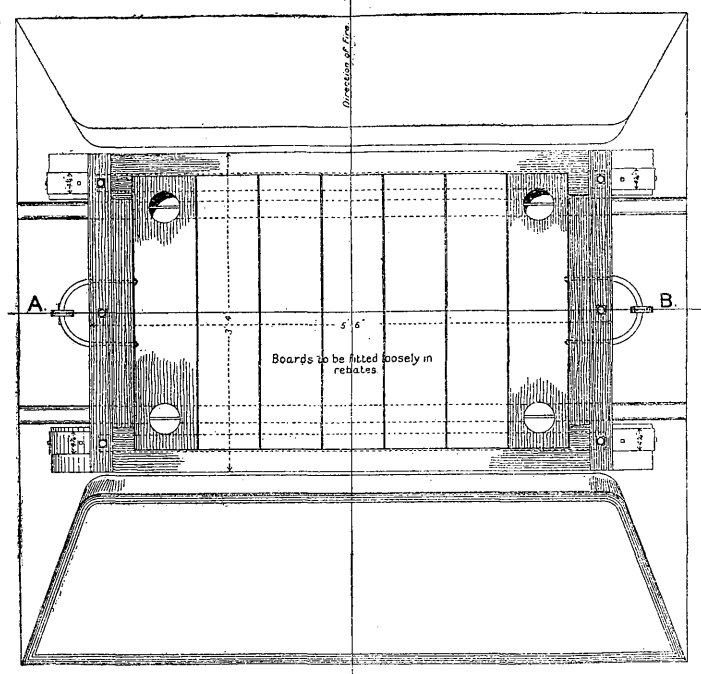
PLAN AND DETAILS.

No. 2.

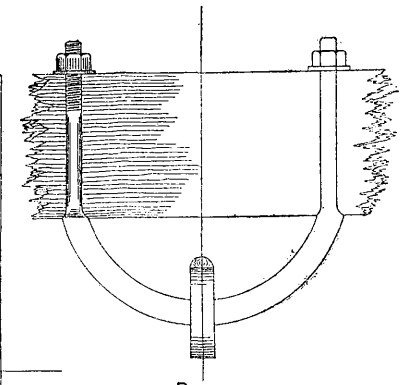
Plan to Scale of ½" to a Foot.
Details ¼ = 1". One Half Full Size.



PLAN.

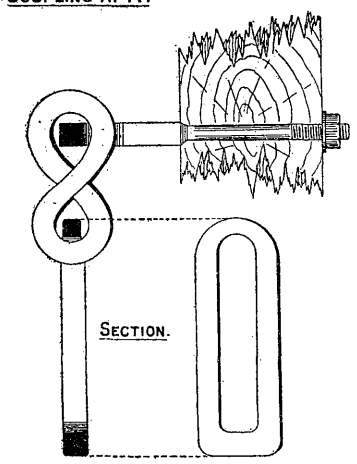


PLAN.



PLAN.

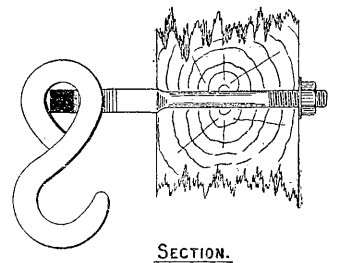
COUPLING AT A.



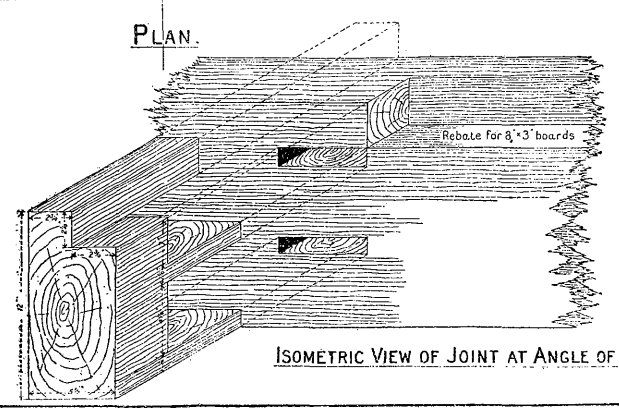
SECTION.

ELEVATION OF EYE.

COUPLING AT B.



SECTION.



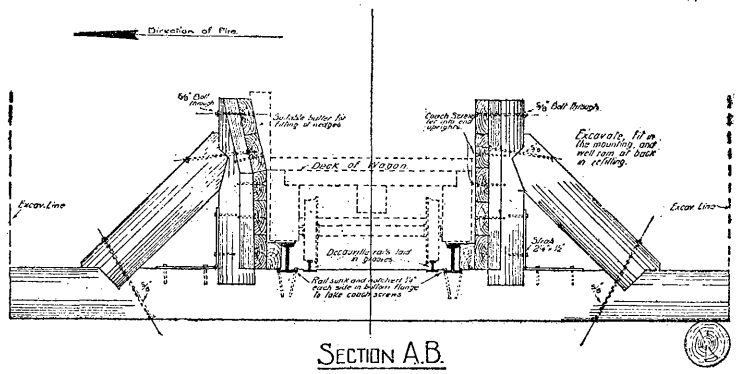
ISOMETRIC VIEW OF JOINT AT ANGLE OF FRAME

No. 3.

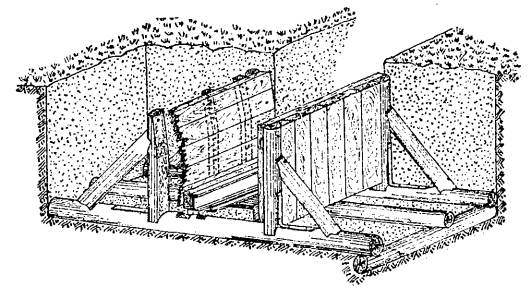
9·45 Inch T.M. Decauville Railway Mounting. (Revised)

THIRD ARMY.

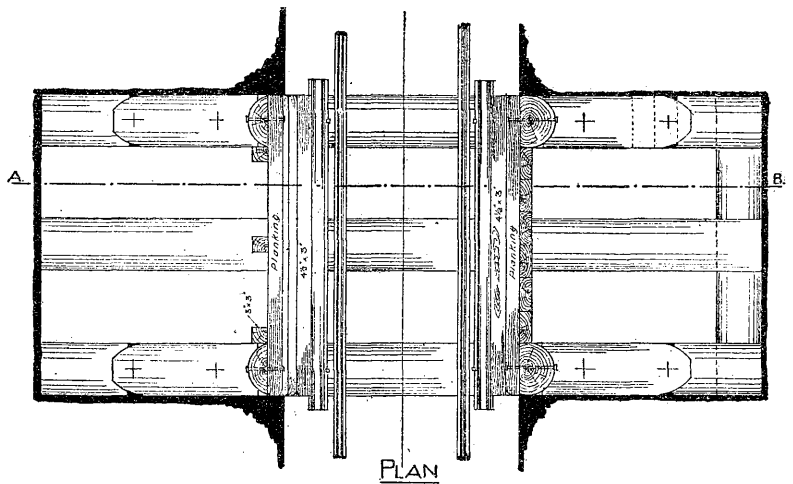
Scale of ¾" to One Foot.



Section A.B.



VIEW



PLAN

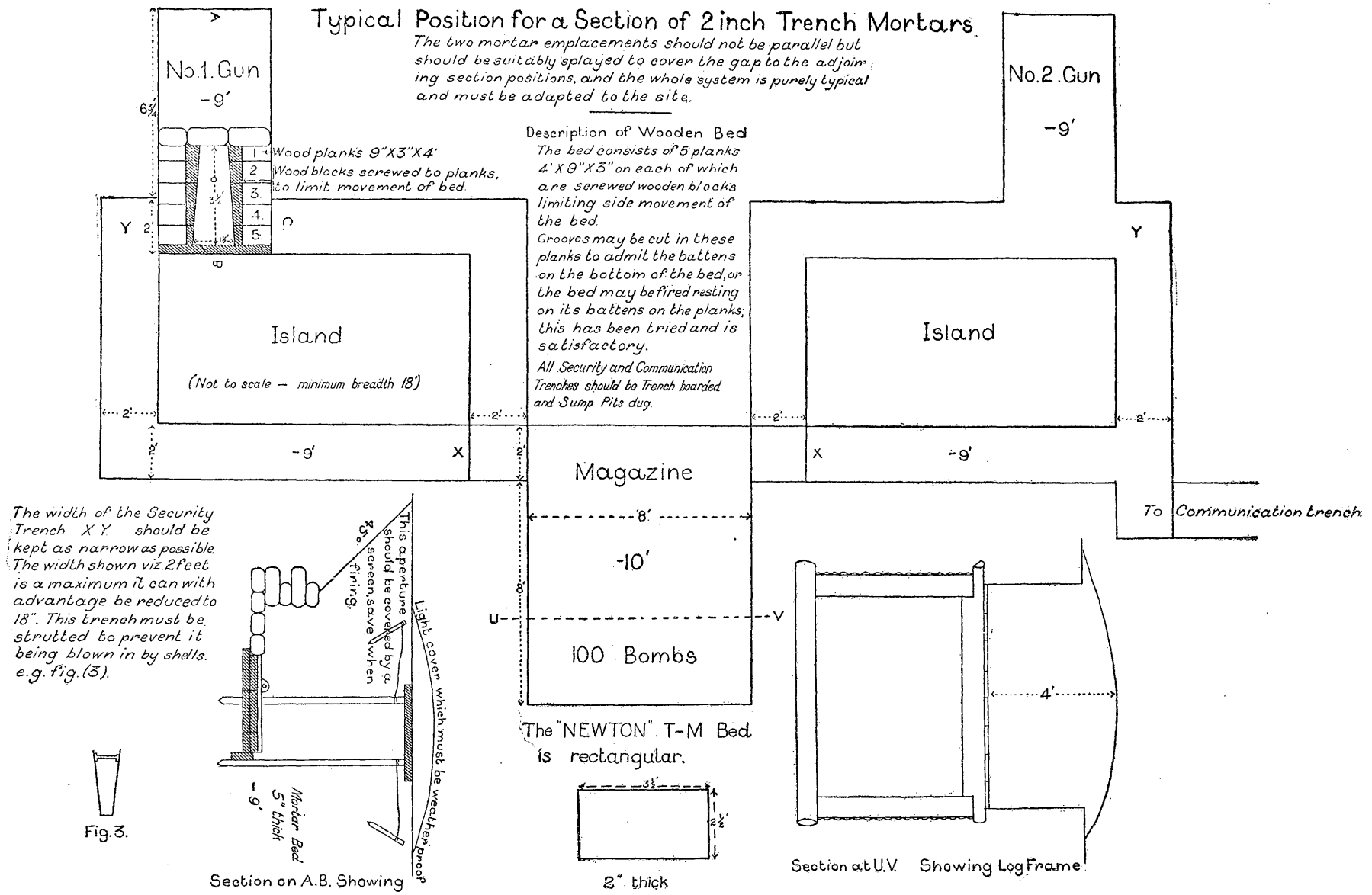
List of Materials Required

Material.	Quantity.
5" or 10" Pitprops	No 3. 12'0" long, Sills.
D°	" 1 5'0" " End Bearers
D°	" 4 3'6" " Struts.
D°	" 4 3'3" " Uprights.
Timber 7"×3½"	67'0" run.
D° 4½"×3"	10'0" "
D° 3"×3"	9'0" "
Iron Angle Straps	24"×6"×6"
Heavy Rail.	No 2. 5'6" long.
Decauville Rail.	According to Site.
Bolts, ½" sq head with nuts & washers	No 4 " 18" long.
D°	" 2 13" "
D°	" 4 10" "
D°	" 2 8" "
Coach Screws ½"	No 20. 6" "
Fire Nails. 3"	7 Lbs.

Drawn by Sgt W.D. Evans, RE
Chief Engineers Office
Third Army
A. H. 16

Typical Position for a Section of 2 inch Trench Mortars.

The two mortar emplacements should not be parallel but should be suitably splayed to cover the gap to the adjoining section positions, and the whole system is purely typical and must be adapted to the site.



Description of Wooden Bed

The bed consists of 5 planks 4' X 9" X 3" on each of which are screwed wooden blocks limiting side movement of the bed.

Grooves may be cut in these planks to admit the battens on the bottom of the bed, or the bed may be fired resting on its battens on the planks; this has been tried and is satisfactory.

All Security and Communication Trenches should be Trench boarded and Sump Pits dug.

1st Printing Co. R.E. 3rd Army (925).

11378°—17. (To follow page 87.) No. 4.