

TRENCH WARFARE

A MANUAL FOR OFFICERS AND MEN

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EXPEDITIONARY FORCE



NEW YORK

E. P. DUTTON & CO.

681 FIFTH AVENUE

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TRENCH WARFARE

LOCATION AND CONSTRUCTION OF TRENCHES

In locating the site for a defensive firing line, it must be divided into three sections:—firing line, immediate support and reserves. In doing this several opposing factors should be taken into consideration and their relative importance judged according to the special circumstances and objects in view, keeping in mind the probable lines and manner of defense of the enemy, and whether the trenches are for permanent or for temporary use.

This may be summarized under two heads: first, with the object of attaining the greatest field that can be covered by defensive fire; and, second, the greatest security from offensive fire.

It will even be found that these two constructions will be in conflict. Trenches placed behind the crest of a hill, say fifty to one hundred and fifty yards from the top, will hamper the accuracy of the enemy's artillery fire. Shoot-

ing, to be effective, calls for a high rate of accuracy, and here the only observations possible are from aircraft and balloons; but the enemy side of the hill will be raised ground to the occupants of the trench. At night large numbers of the enemy could collect there, and the dangerous space to them would merely be the distance from your fire trench to the crest of the hill.

The enemy could and would entrench themselves on their side of the crest and by raising their parapet enjoy the advantage of a higher front, which would eventually lead to their entirely controlling the area behind your trenches, which are continually used by the relief and fatigue parties.

It is a principle that grazing rifle fire upon a defensive enemy is more effective than plunging fire, but any entrenched position higher than your own held by an enemy gives them a tremendous advantage. Regardless of what opinion may be held as to the maximum depth of a field of fire required to meet or repel attacks, whether in masse or open order, it should be obvious that the greater the depth of the field of fire and the more extensive the view of the enemy's operations, the better it will be for the defending forces.

Protection from and localization of artillery fire must be provided by the internal construction of the trench rather than by a position that protects but also restricts the field of fire. There are frequently found in front of a firing line small areas of ground which are not covered by direct fire from your trench. A flanking fire frequently can cover these areas, but in spite of this, they must be watched constantly by means of listening posts or concealed observation posts, which may be hidden by the banks of rivers, hedges, ruined houses, or whatever natural existing concealment renders observation possible.

At night, it is a safe principle to support listening posts by automatic rifles, trip wires with noise making arrangements attached to them as common sense under the circumstances dictates. Great care and caution must always be taken to prevent the discovery of these listening posts by the enemy, and when discovered, alternative posts should be made or greater care taken for the protection of the men occupying these posts, such as overhead protection by mesh wire against bombing, and the upkeep of a small supply of bombs and close-range weapons in the post. The important trenches on the front having been located with a view

of protecting the immediate front and with due regard to their relation, tactically, to the other trenches already located, the connecting trenches obviously must be subservient to the more important ones. Every endeavor must be made to avoid enfilade fires in the flanks, to give and to receive mutual support, and in particular to support those flanks which are not protected otherwise.

It is an essential consideration in the location of all these trenches that lateral communications can be established, and that supplies, supports, reserves, ammunition, etc., together with the means of retiring if necessary be taken into account. The distance from the water supplies and the possibility of concealing approaches is a further governing factor, although in many cases an ideal condition cannot be realized.

Then there is the counter attack, in case the fire trench should be taken, and the kind of soil which is so essential to its relation to bad weather and water seepage—these also require thought and study.

These things are main considerations to be kept in mind after a line has been settled on, whether during attack or whether siting trenches under common circumstances. It is not expected and is not necessary, when trying

to obtain a position during attack, to keep all of these conditions in mind, but it is essential that when the attack has been finished and things return to slightly more normal circumstances, that these things be given instant consideration and proper action taken.

Were such a thing as concealment possible, it should be the first thing of importance to be kept in mind. Listening posts, machine gun positions, reserve dugouts, company, battalion and regimental headquarters, and similar things, at some distance behind or on fire lines, may be concealed, but fire-trenches are sure to be observed sooner or later (mostly sooner) by aeroplane and other means of observation, and it is best that one should admit the impracticability of concealment at once and take the proper protective measures. If opportunity for concealment offers itself, as it may do, according to the lay of the land, it should be taken always. It should always be kept in mind that one should try to place himself in the position of having the enemy's point of view, both from his trenches and his aerial observations.

Advantage should be taken and even care given along trenches to the extensive cultivation of the weeds, grasses, etc., that may grow rapidly in the excavated soil.

It is, and always will be, a matter of much argument that trenches should not be dug near hedges, ditches, roads or rows of trees, on account of easy ranging mark given to the enemy artillery. In a country where such things are scarce, the idea may have a leg to stand on, but certainly to the Western Front it does not apply. It does not take artillery a moment to approximate by ranging shot, check by deduction or addition the range of trenches in any area, even if lying along a hedge or road. The ditch or hedge in some cases will provide the starting of a trench and offer fair amount of cover from fire to the troops working. A ditch immediately in front or behind the trench greatly helps to solve the many and varied difficulties of drainage, and when in front of a trench, can be made into a formidable obstacle, generally by throwing in varied lengths of barbed wire. Trenches under the cover of a hedge are very often safe from aerial observation, and even when located, sniping and observation can be carried on from them if the contours of the ground are favorable. It is always possible to do a certain amount of repairing and moving of troops only when unobserved from the enemy's trenches. If advantage is not taken of these natural protections,

such as hedges and trees, then they must be destroyed.

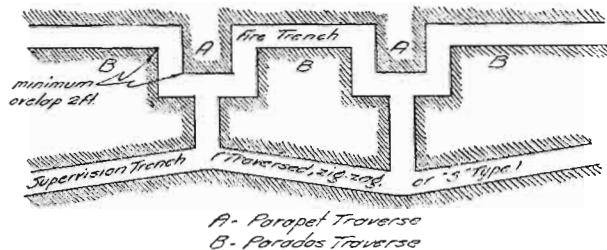
It is obvious that a great deal of labor can be lost and work thrown away if a policy is not adopted and continued. Battalions relieving one another up and down the line may waste a tremendous amount of labor unless the relieved officer's policy is explained. If each commanding officer of a relieving battalion is permitted to air his own theories, duplication of work and lack of continuity will exist. Therefore, it is essential that the officers relieving the trench be thoroughly informed of work going on. With this object in view some of the officers of the relieving battalion should do a tour of duty (about 24 hours) before their troops take over the trench. An Officer and Non-Commissioned Officer are detailed from each relieving company for this duty. In the trench this officer is instructed by the senior officer present, and the non-commissioned officer by the ranking non-commissioned officer, in the policy to be continued. The commanding officer of the occupying company should have a sketch map of his sector of trench which he turns over to the relieving officer. This map should show the work under construction; proposed work; wire defenses; and if possible, the enemies ma-

chine gun emplacements, observation posts, snipers and work in progress. The notes accompanying the map should give the general conditions concerning the work—depth to which it is safe to dig, nature of soil, conditions regarding drainage, and all information in regard to the enemies' activities during the period of occupancy. In addition, the relieving officer has the trench diary showing all the information covering every minute detail of the happenings during that company's stay in the trenches. This diary is a continuous record of that particular sector and remains with the occupying company until it is relieved and then passes into the possession of the relieving half company, and so on, forming a continuous running record of the policy applying to the upkeep and methods employed therein. This diary, unless it is buried to avoid falling into the hands of the enemy, will continue until the end of the war. So every half company inherits one from his predecessor in the line upon its assuming the obligations previously assumed by its fore-runner, thus preventing a duplication of work and assuring continuity of endeavor.

There are certain obvious requirements that have to become rules. When required to fill sandbags, always look for the nearest excava-

tion being made and fill from there, if distance permits.

As a matter of fact, in every trench there is a continuous revetting, widening of communications or control trenches, or driving of a tunnel to a listening post.



TRAVERSED & RECESSED TRENCH.

Inasmuch as the time for filling sandbags is never ending, if work is being done and the earth is not absolutely needed for parapet or parados, the earth, if dry, should be put in sandbags, and, if necessary, stored until it is needed. The repair work that is most necessary takes precedent and is about as follows: Any damage to parados or traverses should be immediately attended to. During the night any damage to the wire entanglements must be repaired. Drainage comes next in order of im-

portance, and this involves the digging of sumps and deepening of the drainage bottom. These are the repairs, but improvements must continually be made in the dugouts and communication trenches.

The ultimate design of a fire-trench depends upon its closeness to the enemy. When the latter are within 150 yards, the traversed fire-trench shown in sketch should be employed, as it provides adequate accommodation and protection for men who may at any moment be called upon to make use of bomb, bayonet and bullet; but if the enemy trenches are more than 150 yards distant, the ultimate design would depend upon the number of machine guns and automatic rifles available. Each of these guns has a firing capacity of about 25 rifles. Each gun therefore gives a reduction in the number of men required to hold the line, and in consequence reduces the amount of trench needed to protect these men.

A design, known as the "T" shaped fire-trench, makes an adaptable basis for entrenching under these conditions. Many lengths of a continuous traversed trench have no great field of fire, and yet, having been dug, they must be held, and unless properly held and kept in

repair, they naturally become a source of danger.

As shown in the sketch, a traversed trench consists of a series of fire-bays interrupted by a series of traverses. The object of these being to localize the effect of shells or bombs landing in a fire-bay, and preventing enfilade fire down the length of the trench, as well as localizing any entry of the enemy into your line.

Dimensions vary up and down the line. Sometimes according to the lay of the land, sometimes according to the opinions, whims or fancies of the regiments making them, but the following dimensions should be kept in mind, and it will be found that they show the average of the whole general line on the Western Front.

Fire-bays generally are from 12 to 18 feet long (defendable by 4 to 6 men, but accommodating 8 to 12, when necessary) plus a 2-ft. covered sentry-box recessed into the traverse and giving room for one more man; this depending entirely on the energy and initiative of the men occupying the section.

Every traverse averages 9' x 9' which includes a fairly liberal allowance for wear and tear, and is the minimum allowance for stopping enfilade fire and localizing fire. As the width from front to rear varies, depending on

the amount of shell fire, it should be wide enough to allow a certain amount of lateral traffic without interfering with those who may be firing. Three feet may be taken as the maximum width at the bottom of the trench, that is, $1\frac{1}{2}'$ for traffic and $1\frac{1}{2}'$ for those firing, with a slope to the sides of from 10 to 15 degrees from perpendicular, thus lessening the tendency of the walls, whether revetted or otherwise, to slide in.

The depth of the trenches varies also, for the same reasons that cause the width to vary. Recesses should also be dug at various and favorable places for the storing of ammunition and bombs.

When digging entrenchments without regard to concealment, the excavated soil is first of all thrown to the front or enemy's side of the trench, thus temporary cover is obtained. When the entrenchment has reached the proper depth the artificial raising of the ground is leveled. The artificially raised portion is known as the parapet. On the completion of the parapet, the soil is thrown to the rear side of the trench, thus forming the *parados* which gives a protection from the rear. It is not a good policy to excavate in front of the parapet, but to get additional height and thickness as quickly

as possible this is often done. Unless carefully watched, men will dig this dirt from places as near the parapet as possible, resulting in the weakening or total undermining of the parapet or trench wall. The more gradual the forward slope of the parapet, the more does it approximate as it should to the glacis of a fort, consequently giving less cover to an attacking enemy. Make use of the ditch or holes from which the dirt was obtained, as a strong obstacle immediately in front of your trench, where the enemy at the last moment may be held up to go under a very severe rifle and bombing effort. In normal circumstances, by which I mean when not exposed to an unduly vigorous machine gun or artillery fire, the soil should not be taken from in front of the trench in the manner described above, closer than 10 to 15 feet from the actual parapet, unless the holes are adequately protected by trip wire, as well as barbed wire. Cases have occurred when valuable information has been obtained by the enemy lying in holes thus dug and not properly protected.

The parapet should be kept as low as possible and made to blend with its surroundings as much as possible. This is done by taking great care to cover any signs which show that fresh work has been done, even to the extent of ac-

tually planting grasses, weeds and roots, such as grow in the immediate neighborhood, and giving every encouragement to those that already grow. This greatly hinders the enemy's artillery, as it changes positions up and down the line; interfering with and hindering the observations and accurate ranging by their forward observing officers, checking charts turned over by relieved batteries.

Bullet-proof nature of a parapet naturally depends on the soil of which it is composed. Although it is not necessary to memorize the minimum of safety, you should keep a general rule in your head. The parapet should not be less than five feet, regardless of the kind of soil. When the trench has been carefully sited for the actual field of fire from a ground level, this thickness is best obtained by raising the ground level artificially as little as possible and getting the necessary depth by digging, unless prevented by moisture.

Unnecessary casualties are caused by the practice of putting a single row of sand bags along the top of a parapet for temporary purposes of concealment, as it gives a faulty idea to the men in the trench as to the real height of the parapet.

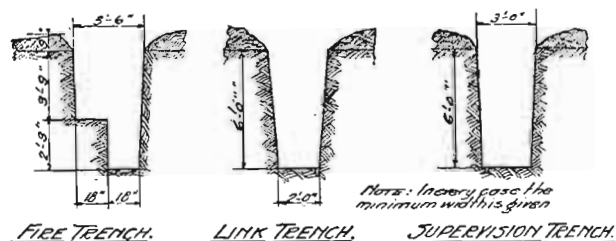
The parados gives protection from the effect

of shell fire bursting behind the trench, and should be made fire-proof as soon as possible, although it is not necessary unless concealment is possible to level it down in a similar manner to the parapet. As a matter of fact, it should be at least a foot higher than the parapet, thus providing a background for the parapet. It has been known to happen that when the occupants of a trench have been reached by the enemy they have vacated their trench and used the parados as a parapet, much to the surprise and disgust of the enemy. In a high and irregular parados, places could even be found which when not used steadily provide unexpected and safe observation and sniping posts, but care must be taken that they are not used too often.

If a trench were used merely for firing, $4\frac{1}{2}$ feet from bottom of trench to top of parapet would be a sufficient depth. During attack, however, when fire from loopholes is too restricted, exposure of head and shoulders over the parapet becomes necessary, but it is not necessary to expose men moving along the trench and not actually firing. If the trench should be 7' or 8' deep, you must provide a platform at the bottom of the front wall $1\frac{1}{4}$ ' wide and $4\frac{1}{2}$ ' from the top of the parapet. This is called a fire-step. The rest of the trench can

be deepened to any desired depth, depending on the energy displayed. If of an extraordinary depth, steps must be cut to the fire platform.

In a great many different parts of the Western Front, especially Belgium, it was found that after digging to a depth of one to three feet water was encountered to such an extent that it



became impossible to dig any sort of a trench which would give adequate protection to the men involved.

When these conditions are run into, breast work parapets must be artificially built up above ground level with soil, sods and sandbags, supported by sandbags, hurdles or close wire netting, revetment and stakes. The same principles of thickness, depth, width, slopes, and in fact everything that applies to a dug-in trench, applies to breast works.

The "T" trench has many more advantages

than the few mentioned in the opening of this chapter. T fire-bays may be single, double or treble (that is with one, two or three bays). Fire-bays in any length up to 15 feet with 8 feet traverses are for firing purposes only, and the control trench, sometimes known as the lateral communication trench, as its name im-



plies, giving lateral communications, is used for that purpose only. Therefore, the fire-bays and control trenches can be narrower than trenches which have to be used for both purposes, thus lessening the amount of repair and revetment work required. And the intervening ground between these fire-bays gives the same result as a traverse used in a traversed trench system, and saves the labor of digging a more intricate system. The control trench gives an officer or N. C. O. in charge of the T bays a

chance to handle his men and fire in these bays without struggling around innumerable traverses and wasting time very often when a minute lost or gained means lives lost, or part of a trench system in the hands of the enemy.

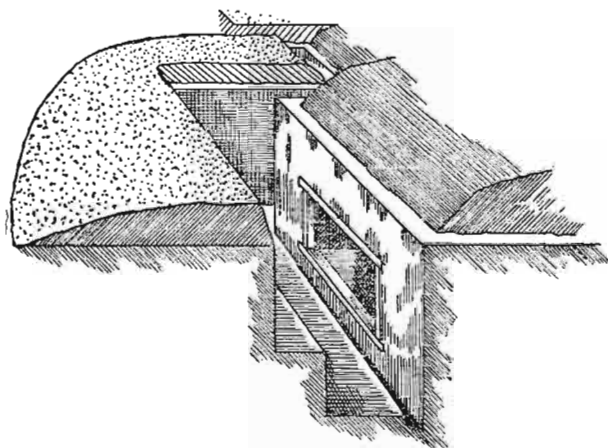
T bays may be sited with due and careful consideration while facing the enemy in an existing trench system. Thus it gives you the advantage of being able to take into consideration all the requirements of the field of fire, control of isolated areas, and the obtaining of maximum results from enfilade fire. These T trenches may be dug out from the old system without undue exposure of your men and if distance between the lines permits, and it is entirely possible to construct a new and generally more favorable line of trenches within 100 to 200 yards of the enemy's trenches. Intervening ground between these T bays must be completely controlled by entanglements and mobile machine guns, or automatic rifles, able to operate from different alternating recesses in the control trench. Fire platforms should be placed in recesses at intervals in the control trench from which covering fire can be given. Artillery fire to damage a T trench, must be very accurate. In a traversed trench a shell destroys not only lateral communication, but

the defenders as well, whereas with a T shape, both fire-bays and control trench have to be ranged and hit. The success of the enemy is entirely local when capturing one of these T-bays, and he may be shelled by your own artillery without any danger or risks to those defending their T-bays. Control trenches should be dug first and zigzagged with the longer stretches facing the enemy. This gives you another fire-trench as well as a communication trench, and is also ready for use at any time needed before the T-bay is completed. On the completion of the T-bay, the corners of the zigzagged trench must be rounded off to make it easier and quicker for the movement of troops and carrying of stretchers.

DUGOUTS

It is only under very exceptional circumstances that under-cutting a trench wall is allowed, and then the shelter should be cut in the rear wall only. These shelters must be carefully supervised and watched by the officer, as men are very often careless, with the result that the shelters are dug in a hurry and poorly. Then it rains, the shelter falls in, and the men are no

more. It should be high enough for a man to sit up straight, and long enough for him to lie down in, and deep enough for two men to lie side by side. It should be raised at least a foot



FIRE TRENCH, SHOWING ENTRANCE TO SHELTER

The shelter is of use only in a narrow or deep trench. Note that the floor is above the bottom of the trench.

above the floor level in the trench to prevent water from the trench floor coming in. A shelter smaller than these dimensions is useless. It has a demoralizing effect, destroying all activity, mental and physical. These shelters can

only be properly made by cutting into the rear trench wall the necessary depth and length and right to the top. Then, with any material which is convenient, such as corrugated iron, brush wood, old rubber sheets,revet the sides and back. A corrugated iron roof is supported on posts at a depth of about a foot to a foot and a half below the normal level of the ground. Then, when possible, cover this with rubber sheets. If not possible to procure rubber sheets, simply cover with dirt excavated from shelter, taking care that it does not rise higher than your parados.

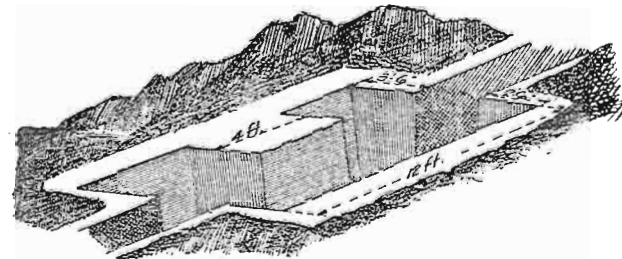
A fire-trench, however, is not a proper place for shelters, and they are generally better as a weather protection than a shell-proof shelter. Even this should not be favored too much, as it tends to cause obstruction, delay and inconvenience in the passing of troops. The real dugouts for the accommodation of men holding a line are generally behind the fire-trenches in an immediate support line, or as in the case of T-bays, in the control trench and communication trenches leading to and from them. These are large dug-outs, having a depth of 30 and 40 feet, and in some cases capable of holding 100 to 250 men, generally having from 5 to 10 exits and entrances. Here the men stay during bom-

bardments and are generally safe from any caliber shell which may light on top, unless a half dozen should light in the same particular spot.

This work is generally of a very skilled and technical kind. Plans, drawings and labor are supervised by the engineers, expert tunnelers being used in constructing work, although the infantry supplies working parties to dispose of the dirt, etc., resulting from these excavations and to carry the materials and tools needed and required in the construction.

The design and general scheme of a small dugout which can be made by the infantry under the supervision of an officer, without the aid of an engineer, are here given. The dugout should be approximately 6 feet from floor to roof and about 8 feet wide, with an approximate length of 12 feet, thus allowing men to lie down and yet leave room for passage through. The width depends upon the number you intend to have occupy it. Each man requires 18". Depth to be dug below ground depends entirely to what extent you may raise the roof upon the ground without making an unduly exposed hump which will at once tell the enemy a dugout is there. The thickness of the roof should be approximately 6 feet, constructed with side

posts, cross beams, corrugated iron, water proof oilcloth, sandbags and soil. Sandbag revetments should be used in the strengthening of side posts. When possible, although hardly ever so, walls should be lined with waterproof



DUG-OUT WITH ROOF REMOVED.

Dimensions variable. Note the wide berms permitting the use of strong roof supports. A layer of large stones to cause early shell burst should form part of the roofing.

oilcloth and entrances so placed that they get as much sun as possible.

Great care and attention must be given to these dugouts, and even though taking a little longer than seems necessary, care must be taken to see that they are substantially constructed, otherwise they are in a constant source of danger of cave-ins during heavy shelling and bad

weather. Not more than 10 men should occupy one of these dugouts. Then, if accidents happen, your casualties are not so great.

The roof of these dugouts should be prepared in a manner tending to withstand as high shell shock as possible, and for this purpose the following table would be of some use, any part of which, or a combination of all, will give some idea of what is required.

RESISTANCE OF ROOFING MATERIALS

(a) Shrapnel bullets—Stout planks suitably supported and covered with corrugated iron and 12" of earth or 3" of shingle.

(b) Ordinary guns of 3" caliber—Strong timber supporting 4 ft. of earth with a top layer of heavy stones or broken bricks to cause early shell burst.

(c) Field howitzers (of less than 6" caliber)—12" logs, supporting 8 ft. of earth with top layer of heavy stones or broken brick and lightly covered over with some earth.

(d) "Jack Johnsons"—20 ft. of earth or 10 ft. of cement concrete, reinforced with steel and covered over with a covering of heavy stone or broken brick.

It is very often the case that there is a line of trenches with very few dugouts. Those that exist are mainly occupied by first aid stations with a medical officer in charge, and officers' headquarters. When such is the case, very narrow, deep trenches, known as retirement trenches, are dug roughly from 20 to 50 yards behind the firing line, so that every one, except those on sentry duty, may retire there during the heavy shelling. It is very obvious that excellent communication must be kept up between this trench and the firing line.

DUMPS

Sandbags, corrugated iron, floor boards, ladders, pails, brushes, rubber boots, periscopes, barbed wire, etc., are what are known as "trench stores." These are generally brought up by carrying parties during the night and taken to some convenient spot picked out by whosoever may be commanding that particular section of trench, ready for distribution in the morning. This place is known as a "trench dump." Here every morning each junior officer goes to his company commander with a request for his stores for the day. When this has

been handed in and approved by his company commander, he then has a party detailed to go and collect his stores. These are again placed in his particular little sector of the lines and he receipts for their care and proper use; all stores not used are turned over to the relieving troops and a receipt taken for same. These dumps must be made in a central location, both as regards the company dump and the platoon. The company dump is not a permanent home for the stores or utensils brought up, but is merely what might be called the distributing center. When a company commander turns over his trench stores and utensils to the relieving commander, the fact that he has all his stores and utensils in the company dump does not show merit, but merely inefficiency, that the distribution, which should have taken place, has not been carried out, and, therefore, that some of the men under his command probably have not the required tools to work with or the material that is necessary to the small units to carry on their daily lives. Stores should not remain in their center dumps. But each platoon commander should know exactly how much he has in hand, and how much he needs. It is also plainly evident that in a scattering of dumps in this manner, any captured by the enemy do not consti-

tute a "knock out" as far as the trench stores are concerned.

LATRINES

The cleanliness of the trenches and latrines requires the closest supervision of all officers and non-commissioned officers. The bucket system of latrines is entirely unsatisfactory. The ground where the buckets are in use becomes unsanitary, and so does the ground in which the contents are buried. Double labor and carriage is involved, and as often as not a polluted soil is sooner or later to be found in the line of a proposed communication trench. The method used in the French armies is very good and by far the cleanest. It involves no unpleasant labor and is satisfactory. A pit about 12 feet deep, 3 feet wide and 12 feet long is dug in some place which is fairly easy to get at by those who are to use it. Generally thirty to forty feet behind the fire-trenches and off one of the communication trenches. The pit is boarded over, the boards being laid across the width, that is from front to rear; every other board space being omitted. A pail of disinfectant is kept standing nearby, and the deeper the pit is, the better and longer it will remain in use,

but should be filled in when contents are within 6 feet of the top. This makes subsequent unpleasantness very unlikely. Care must be taken that men using these places have some protection from stray shells, and are out of sight of the enemy.

When possible, there should be a refuse pail for every section of men, and care should be taken to impress on the men that they must throw in all tea leaves, dregs, all scraps of food, and refuse in general, and should be covered over with disinfectant. If this is not done, thousands of flies and insects are attracted, with the inevitable rats, and disease and unsanitary conditions will follow. Tin cans, etc., should under no circumstances be thrown over the parapets as the same results will occur there.

REVETMENTS

When fire trenches are to be occupied for any length of time it is necessary to revet them. By that I mean the walls, and especially front walls, have to be faced or strengthened by sandbags, boards, corrugated iron or other material that is needed. This work to be of any use at all must have solid foundations and be thor-

ough from top to bottom. Careless revetment work is of no use and a source of endless labor and trouble. All such work should be supervised by officers or N. C. O.'s who have a thorough understanding of such things, and they will be amply repaid if they take an active part in the work with their own hands. There are several forms of revetment, according to the materials available and the conditions of the walls to be revetted, but the usual materials are the sandbags, corrugated iron, stakes, boards, wire netting, etc., and these can be used either separately or in a combination. All these materials are generally kept in engineer dumps, some little way behind the firing line. Requisitions are made during the day by the officer commanding the sector of trench which requires revetting, and at night the men are detailed in carrying parties to go down to the engineer dumps and carry these things up for work the next day.

SANDBAGS. Sandbags are usually available in large quantities, but it is well to remember that generally only half the number indented for reach the indentor. The rest generally go around the men's feet and legs to keep them warm at night, and very often are used as a sort of mattress in the dugouts. This

should not be allowed as it creates a tremendous wastage. The sandbags should only be about three-quarters filled, thus allowing for the choke or neck end, after tied, being turned under the back when laid in position. This also gives something to catch hold of when laying and brings the weight to something manageable, about sixty pounds. A bag three-quarters filled measures approximately 20" x 10" x 5". Laid sand bags are called headers, when laid with bottom of the bag facing the center of the trench, and stretchers, if laid with the side facing the trench as per sketch. The neck end should always be tucked well in the bag in the case of the stretcher; the side seam, which is a weak spot in the sand bag, should be kept from exposure, that is, should be turned from the center of the trench.

When the front wall of a trench is to be revetted and only sandbags are available, the wall should first be cut to a slope of from 10 to 15 degrees from the perpendicular, and the loose soil obtained, if dry, placed in the sandbags. When there is an unrevetted fire platform, this should be also cut away and put, if dry, in the sand bags. A bed should then be dug about 6 inches into the solid bottom of the trench (disregarding the soft mud which for

foundation purposes is of no use) and sloping down into the parapet at right angles to the slope of the front wall. Into this bed place a row of headers. On this row place a double row of stretchers. Joints must always be the same manner as brick-laying; that is, care taken that the joint where the ends of the stretchers



meet does not come immediately over the joint between the headers and the lower row. Sand bags should now be beaten down flat, generally with a wooden mallet provided for this purpose; then alternate rows of headers and stretchers laid; each layer being flattened out with the mallet until the top of the parapet is reached. The top layer should always come out as headers.

Twenty-five headers or twelve stretchers, or sixteen mixed, is the average required for revetting every superficial yard of trench.

The slope of a front trench wall, even when from 10 to 15 degrees from perpendicular, is apt gradually to assume the perpendicular, and then fall in, owing to the sinking of the trench bottom or the actual thrust of the earth in front. This can, however, be checked by using 6' to 8' stakes driven well into the front wall foundation, and at the same angle as the front wall. Then, wiring the head of these stakes to what is known as an anchor-stake driven about 10' into the ground in front of the trench.

Sandbags come in bales of 250, which are again divided into bundles of 50 each. On a carrying party it is an average rule that each man carry 100 sand bags.

CORRUGATED IRON. Generally, when lengths of corrugated iron and plenty of floor boards and stakes are available, this material is used for revetting the lower half of a trench wall, as it removes a great many difficulties, such as looking over substantial foundations for sandbag revetments. It makes it unnecessary to fill sandbags, etc., thus saving a great amount of time and labor. In revetting with corrugated iron and stakes or hurdles, cut the slope or wall from 10 to 15 degrees from the perpendicular, putting the soil in the sandbags and leaving it in some handy place for any future use. Then,

drive 6' to 8' stakes well into the trench foundation and approximately 4' apart, thus giving adequate protection to each piece of corrugated, having the stakes at an angle of 15 degrees at least, from the perpendicular, and 6" or 8" away from the trench wall. Then, slide the corrugated, hurdles, or boards on their sides down behind the stakes, overlapping slightly the ends and ramming them well down into the mud or soil in the bottom, and filling in the space behind with soil.

The bottom third or half of the front wall is thus substantially, easily and quickly revetted, and the upper half or remainder is generally revetted with the sandbags, a bed being dug so that the first layer of headers is about half its depth below the top of the corrugated. If stakes shorter than 6' or 8' have been used in the revetting, half should be cut off to where the sandbag revetting commences and wired to anchor stakes, driven into the parapet end of the bed, and not wired over the top of the parapet, as it tends to gradually pull them upwards. Then cover this wiring with your first layer of headers. When hurdles or floorboards are used instead of corrugated iron, empty sandbags or similar material must be hung behind them to prevent the soil crumbling through and thus

weakening the foundation of the sandbag revetments. Corrugated should not be used for revetting the front wall higher than 2', which is the width of one sheet, as the supply is generally limited and can be put to more valuable use as dealt with later.

Corrugated iron comes in bundles of about 24 sheets to the bundle, averaging 6' by 3'. Two sheets is the average load for any one man in a carrying party.

A front wall constructed in the manner shown, if prompt and immediate attention always be given to repair if damage is done, will give very little bother. It is the usual custom to construct your fire platform after this revetting work has been done.

A trench should be dug no deeper than will afford protection to the firer, a deeper passage-way necessitating a fire platform, a subsequent work, and by first revetting the whole front wall from bottom to top then adding the fire platform, each gets the benefit of the foundation of the other. Until this fire platform is constructed, emergency methods may be used and improvised in a moment with ammunition boxes, loose sandbags and the various other junk which accumulates in a trench.

FIRE PLATFORMS. Now that the front wall

has been revetted, either with corrugated or sandbags, the construction of the fire platform should be at once started. To start this, short stakes should be driven well into the trench bottom about 36" from the front wall and parallel to the slope of the front wall, averaging from 2' to 3' apart and generally as substantial as the large revetment stakes, although this is not of absolute necessity.

When brushwood is procurable, it should be used as a foundation, putting it in after the short stakes are driven and ramming it down behind them. This gives you as nearly as possible a dry and compact foundation for your first row of headers. Then this may be covered with another lot of brushwood, and that again by a row of headers, and from then the layer should be alternate headers and stretchers. Sand bags do not offer a good platform after a heavy rain, as they become wet and slippery and the material quickly rots, then they break open and the top of your fire platform is gone. To avoid this, it is necessary to use whatever material may be at hand in the covering of the top layer.

One good way of providing this top covering when the material is procurable, is a wire netting used in a double thickness. It should be

placed behind and up against the stakes before the foundation is laid. Then when the fire platform is built to its proper height, bend the wire from the top of the fire platform and fasten it down on the sides by whatever means are handy. Using this double wire netting makes it possible to use brick and all sorts of general trash in the construction of the fire platform and gives a very good dry footing. When doing that the face of your platform should be either corrugated sheets or boards.

Very often what are known as sentry-boards, or small floor boards about 36" square and with additional cross pieces underneath, giving them a height of about a foot, thus raising them well out of the mud, are used, and are very handy before a fire platform is made, and in some cases have to be used for small men after the fire platform is made.

TRAVERSES

All the walls of the traverses must also be revetted, generally with the sandbags and in exactly the same manner as the front walls of a fire-bay, care being taken to keep it well sloped. This leads to a lessening of protection afforded

the occupants by making a greater width at the top of the trench, but it is absolutely necessary unless you wish your whole traverse to gradually fall in, when you are in a position of having no protection at all. The top of the traverse may be and is often several feet higher than the parapet, if the fire-bay it protects is exposed to enfilade fire from the enemy trench at a higher level. But when this is not the case, the traverse should not be higher than the parapet or parados, and should slope down towards the enemy to give the appearance of being merely a continuation of the parapet.

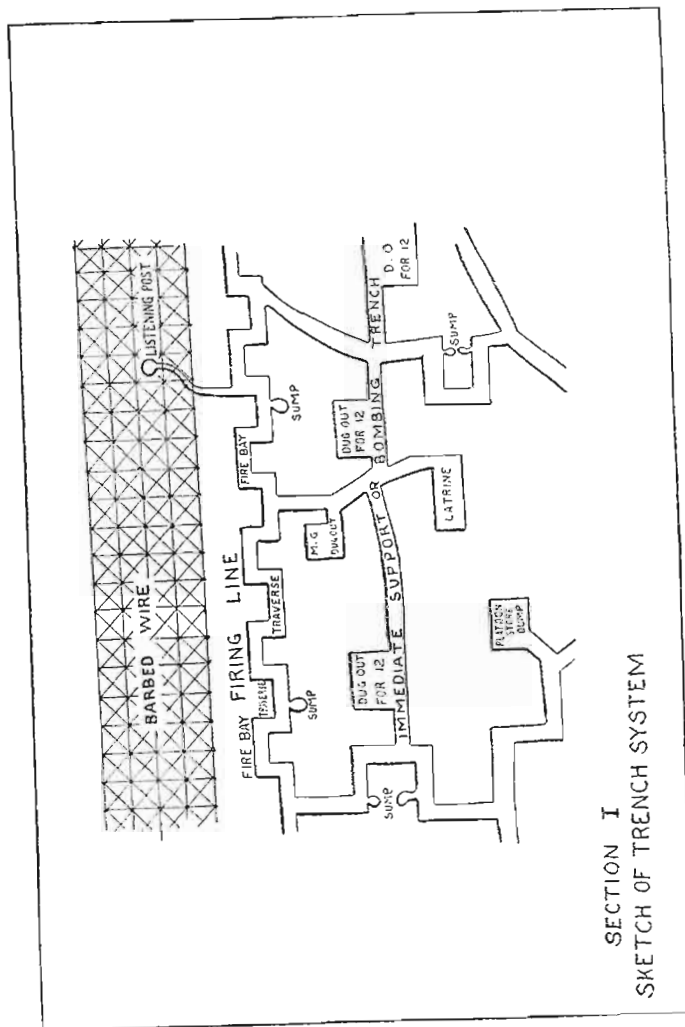
The traverse should never be less than 9' wide, allowing 2' for a sentry box, although this sentry box is no longer generally in use.

What are known as overhead traverses are made generally in a communication trench leading up to the front line, and which in certain parts the enemy are able to look into. These overhead traverses give to this particular place the protection which is necessary. They are quickly and easily made by placing corrugated iron, logs or strong branches, or floor boards, across the top of the trench and putting sand bags on the top of these. When the trench walls are weak, or even on general principles, the

SKETCH OF TRENCH SYSTEM

This sketch shows a double-traffic communication trench leading (5 ft. wide) from reserves and H. Q. to a loopholed island-traverse about 30 yards behind the support line. At this island-traverse, single-traffic C. T. branches off to various sectors of the support line; the main C. T. leading on (from 3 to 4 feet wide) uninterrupted through the support line to loopholed island-traverse "E," about 30 yards behind the firing line. At this island-traverse the main C. T. breaks off into single-traffic C. T. 3 feet wide. Each leads to various sectors of the firing line.

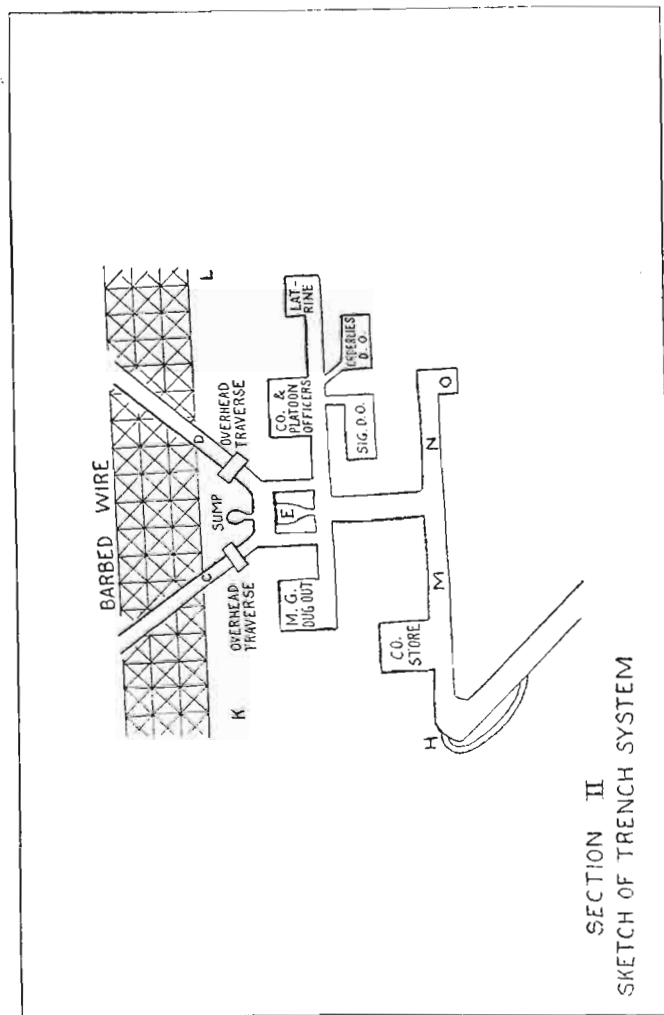
SECTION I. C. T. should start behind one of the fire-trench traverses and not from a fire-bay. Every yard should be contestable for approximately the first 15 to 20 yards. This can be effected, and at the same time the effect of hostile artillery and rifle fire and bombs localized, by a series of traverses 9 feet square, the trench being approximately 7 feet deep and 2 feet wide at the bottom. Cut into the rear of a few of these traverses is a narrow recess through which one of the defending bombing party may take up a position in the



center of the traverse and fire, kneeling or standing, through a loophole at the advancing enemy. The recess gives him ample protection, including head cover, and is so cut that the entrance is out of alignment with the trench behind him and he will be unaffected by a bomb exploding there. At the same time he may work with, and direct, the bombers behind him who are bombing over the traverse, and if it becomes necessary, they can also take cover in the entrance to the recess. The loophole should not be placed so high that it becomes possible for the enemy to come forward under it.

The most dutiable arms for the members of the defending bombing party detailed for this traverse work are what are known as "close-contact weapons," generally including revolvers, bombs, trench knives, and very often a bayonet carried by pushing it down in the puttee.

SECTION II. The time and claims of rapid transit will not allow the traverse system as employed in Section I to be continued, the narrow single-traffic C. T.'s, from wear and tear and shell fire, soon become wider, and as the width would allow rapid transit to friend and foe alike, it is of the utmost importance that some means be adopted to deprive the enemy of this

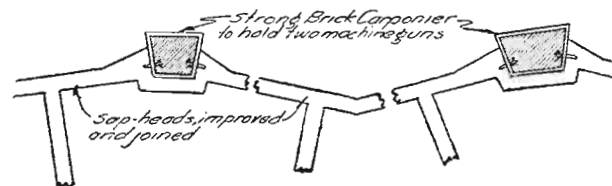


SECTION II
SKETCH OF TRENCH SYSTEM

advantage. Moreover, the enemy may have successfully advanced down on traversed C. T., say, at "C," and our own bombers might still be fighting in another traversed C. T., say, at "D," and their needs demand protection. This may be obtained if, before the single C. T.'s merge into the double, each of them be quite straight for approximately 15 yards, and island-traverse, "E," be placed at the junction. In the rear of this island, "E," is a large and substantial recess, into which one or two Lewis guns or automatic rifles can be placed, firing through loopholes and rendering hostile advance down both "C" and "D" communication trenches almost impossible. The recess in "E" must allow ample room in which to operate. Overhead cover is provided, and one rifle would require one long loophole, so that it could fire along either C. T. without more than a moment's interruption. In the case of two rifles being available, there could be two such long loopholes, each covering both C. T.'s, one for kneeling and one for standing. The lower loophole gives the advantage of it being impossible for any of the enemy to get out of danger beneath it. The fact that the traverse is an island one, with passageway either side, would allow friends to advance round the traverse and up

"D" to the support of friends still fighting there, and without obstructing the fire directed from the traverse at enemy advancing down "C."

An island-traverse so constructed and manned should be unapproachable along either trench "C" or "D," but precautions must be



ISLAND TRAVERSE.

A type used to control long, straight stretches of trench.

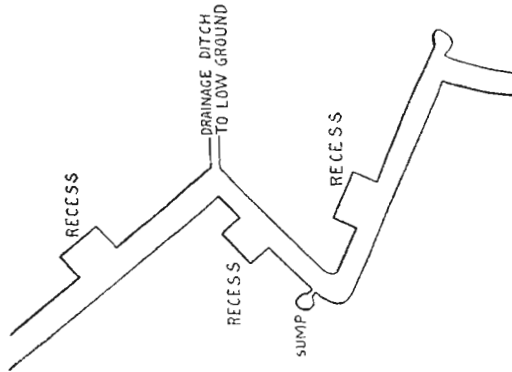
taken to prevent the enemy avoiding it by coming out into the open, as in active moments C. T.'s become as mutilated as fire trenches and the enemy may leave the C. T. before reaching the 15-yard stretch and approach the traverse from above or flank. In anticipation of this, the position "H" is selected slightly in rear and to flank of the traverse, and in this position one of the automatic rifles may take up, either originally or by retirement from "E," and deliver the required traversing covering fire across the

front of "E" and giving adequate protection to the garrison manning the island-traverse. Barbed wire is also generally placed in open ground such as this described, say, for instance, between "K" or "L" on either side of the 15-yard stretches to impede hostile exit and advance. The overhead traverse just in front of the island gives protection against bombs thrown down on C. T.

When covering fire is not required, the position "H" will form an alternative position should the island-traverse be destroyed by shell fire or taken by the enemy; but the latter will be of little use to the enemy as their progress passed it is blocked by a loophole placed at "H" and covering the trench "M" down which they must advance. It also covers a dummy trench, shown as "N," down which there is a fair chance that the enemy would naturally go if a misleading notice were placed at the junction of "M" and "N." The slight turn at the end, "O," will prevent premature knowledge as to the real nature of this trench. The enemy's progress may also be blocked for a short time by having rolls of looped wire, sometimes known as concertina wire, so placed in recesses in the side of the trench, and so arranged that when a man retiring down a trench can catch

hold of the roll as he passes a recess, uncoils it as he runs, leaving it in the trench in a badly tangled mass.

SECTION III. Supporting trenches may be at any distance from 30 to 300 yards behind the firing trenches. The C. T. in this section is constructed on the same lines, or may be constructed on the same lines, as Sections I and II, into whatever proportions local conditions and practical considerations, and particularly dangerous places, may dictate. The zigzag plan shown in the sketch is generally safe to adopt, as it allows rapid transit with a certain amount of concession to the claims of protection, more so as it approaches the fire trenches. These C. T.'s generally should be a series of straight stretches, zigzagging at acute or obtuse angles, the length and angles governed by local conditions, the extent and direction from which each stretch might be enfladed, and the gradient and distance from danger. It has been shown before that the shorter the stretches and the more acute the angle at the turn, the less is the danger from enflade fire, but the C. T. with this advantage requires a greater length of time and labor in digging, as well as taking a great deal more time and effort to pass through it. In order to lessen these things as much as possible,

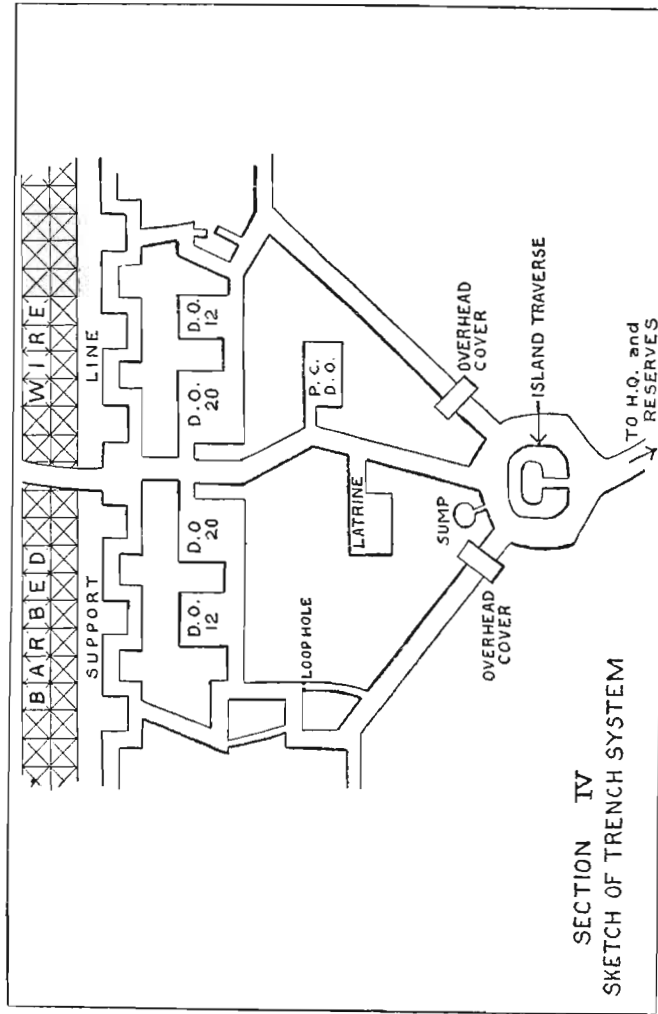


SECTION III
SKETCH OF TRENCH SYSTEM

it is always considered best to adopt longer stretches and more obtuse angles as soon as possible.

The excavated soil is naturally thrown up on the side facing the enemy, and thus forming a parapet. It can at times be used as an actual fire trench. The parapet should fulfill the same conditions as the parapet of a fire trench, and where necessary, overhead traverses should be placed. The more of these overhead traverses used, the longer can the straight run of trench be. When running up-hill, facing the enemy, it is clearly obvious that acute turns and short stretches are necessary, or, if it is not found advisable to use these and more time can be gained by digging the straight runs, then they should be dug deeper and a great deal of care taken in placing the overhead traverses.

Generally, the farther the C. T. from the enemy, the less necessity to take measures for stopping hostile advance down it, but it is a safe thing when time permits to loophole the traverses facing the long straight stretches either in an ordinary traverse or when time permits the building of island-traverses, especially at junctions. Such loopholes command the straight stretch in front and are reached by narrow trenches very similar to a drainage



trench, as indicated at "II." Here again, as well, the loopholes for at least one or two should be for kneeling fire.

Hostile attacks may also be hampered here by using the rolls of looped wire previously mentioned, or by frames of barbed wire placed at the side of the trench just behind the parapet, so that a man retiring down the trench can easily pull them down into the trench after him. Great care must be taken that C. T.'s running from firing line to support trenches do not obstruct the fire from the supporting trenches.

SECTION IV. Behind the support trenches the C. T. should be constructed on the traverse principle of *Section I*, so that the same defensive features existing for the support trenches as should exist for the firing line. In doing this, however, it should be kept in mind to provide rapid transit for troops behind these supporting lines. This is best done by continuing the zigzag system right through support trenches as shown. When necessary, this C. T. can be blocked.

It is always a possibility that support trenches may be lost, but not a probability. Therefore, undue weight should not be given against the convenience of adopting as soon as possible again the zigzag C. T. of *Section II*, the

latter supplying all requirements of rapid transit and allowing the introduction of straight stretches in loophole traverses wherever required.

TELEPHONE LINES

It is generally found that artillery telephone lines are laid on the north and west side of a C. T.; infantry lines on the south and east. Lines are generally laid about two feet from the bottom of the trench, picketed inter-grooves being cut into the side of the trench. These lines must be given absolutely every protection possible by the infantry and by any one using the trenches. Far too much carelessness has at times existed which destroyed communication with artillery and infantry when it was of vital importance that it should be open.

Infantry in the trenches depend for immediate support upon their artillery, and if, through lack of supervision on the part of the officers in charge, these lines are destroyed or temporarily torn down by careless men not understanding their significance and importance, then that officer or officers is guilty of a very serious crime.

RECESSES

These are usually made in C. T. to allow for the passing of troops or bearers of stretchers, or parties passing up and down to the line carrying the many things that are necessary for the upkeep of that line.

It is advisable that these should always be placed in the same corresponding place in each stretch, as shown in SECTION III, just before the turn, so that men know where they are to be found. The first man of a party coming up having arrived at a turn, and seen or heard others coming down, can give necessary protection to his party, and a great deal of unnecessary and very exasperating and fatiguing movements, and sometimes retracing of steps, is avoided. It is also often the cause of a great many casualties in a trench where these recesses are not made, as parties of men coming and going very often, while struggling to get past one another with their loads, are caught by heavy shell fire.

The recesses should be about 8 feet long and at least 2 feet wide, and the soil excavated from these recesses could be used for strengthening the parapets of the C. T.'s at these turns. Gen-