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FIELD ENGINEERING (ALL ARMS)

MILITARY TRAINING PAMPHLET No. 30

PART III. OBSTACLES

1943

(This pamphlet supersedes the 1940 edition)

Prepared under the direction of
The Chief of the Imperial General Staff

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MILITARY TRAINING PAMPHLET No. 30

FIELD ENGINEERING (ALL ARMS)

PART III.—OBSTACLES. 1943

Note.—This pamphlet includes the detail previously shown in Military Training Pamphlets 21, 21A, and 21B (Barbed Wire Concertinas), which are now cancelled. The detail shown in MTP 21C (High Wire Fence) is also included. No further copies of MTP 21C will be printed, but existing copies should be retained for instructional purposes.

CHAPTER I.—INTRODUCTORY

1. *Object of pamphlet*

This pamphlet is for the use of all arms. It describes the various forms of obstacle for the construction or erection of which units of all arms are responsible.

Reference is also made to the characteristics and limitations of other obstacles which are a RE responsibility.

2. *Object of obstacles*

The object of all obstacles is to assist in the destruction of of the enemy by :—

(*a*) delaying him under fire;

(*b*) disorganizing his plan of attack,

(*c*) restricting his power of manœuvre,

(*d*) forcing him into positions where offensive action can be most effectively used against him,

(*e*) imposing on his AFVs a heavy expenditure of ammunition in clearing a way through the obstacle, or of petrol in making a cross-country diversion.

3. *Essential characteristics*

(*a*) Obstacles must :—

(i) be covered by fire,

(ii) impose delay, the greatest possible, on the enemy,

(iii) withstand to the greatest possible extent enemy attempts to destroy them,

(iv) be concealed as far as possible, either by siting or artificially, in order to achieve surprise.

(*b*) Obstacles must NOT :—

(i) obscure the observation or fire of the defence,

(ii) afford cover to the enemy,

(iii) reveal the exact fire positions of the defence.

4. *Classification of obstacles*

Obstacles are classified as :—

(*a*) *Protective obstacles*, designed to prevent penetration by the enemy into defended localities, posts, or road blocks

(*b*) *Defensive obstacles*, designed to prevent penetration by the enemy between forward defended localities or into an outpost position.

(*c*) *Tactical obstacles*, designed to break up the enemy's attack or movement within and round the flanks of a defended area, or to force his troops into convenient pockets where they can be destroyed by fire.

From the point of view of the difficulty which the enemy finds in surmounting obstacles, they may be classified either as " deterrent " or " delaying."

A " deterrent " obstacle is one which forces the enemy to adopt an alternative means of approach.

A " delaying " obstacle will impede the enemy's progress and expose him to the fire of the defenders.

5. *Siting and concealment*

1. The siting of the main obstacles is described in MTP No. 3, 1943.

2. Gaps or crossing places must be provided in all belts of obstacles to permit the passage of friendly troops and vehicles and should be zig-zagged through the obstacle zone. It is particularly important that the counter-attack plan should not be hindered by obstacles erected by the defence. Gaps and crossing places must be carefully concealed from ground and air view, but properly marked and recorded. Mines and movable obstacles must be provided on the spot for their temporary obstruction.

3. Dummy obstacles should be used wherever possible as an additional measure to mislead and delay the enemy. They are of particular value in confusing his air reconnaissance.

4. When it is impossible to conceal an obstacle, it may sometimes be so screened that the enemy is unable to decide at once what action he must take.

CHAPTER II.—TANK OBSTACLES

6. *General*

(*a*) There are four main types of tank obstacles :—

(i) Anti-tank minefields.

(ii) Permanent obstacles, natural or artificial.

(iii) Those used to close gaps in lines of permanent obstacles.

(iv) Demolitions such as road craters, ditches blown by pipe mines, and bridge demolitions.

All tank obstacles must be covered by fire from anti-tank weapons and small arms as long as possible.

(*b*) All the above types may be used in any system of defence, and, as with any other form of defensive work, should be in as great depth as possible.

(*c*) To restrict reconnaissance by motor cycle or cars, lighter obstacles such as steel wire stretched across roads, or concertina wire, etc., should be sited on the main approaches to defended localities.

(*d*) Except in open country AFVs will tend to advance along roads which they must clear for their supplies and supporting infantry. A series of road blocks, many of which may be dummies, on all probable enemy lines of movement throughout the depth of a defended zone, will not only cause delay, but will weaken the enemy by inflicting casualties on his AFVs and infantry.

(*e*) The tasks of the defenders of all tank obstacles are :—

(i) to destroy as many AFVs as possible ;

(ii) to prevent the enemy's infantry or engineers from destroying or circumventing the obstacles ;

(iii) to separate the AFVs from their supporting infantry ;

(iv) to destroy the enemy as unobtrusively as possible in order that his following AFVs do not halt or take an alternative route before reaching the obstacle.

(*f*) The siting of tank obstacles is dealt with in MTP No. 3, 1943, and some principles for the defence of road obstacles are laid down in MTP No. 42.

7. *Factors governing design of tank obstacles*

A tank will be stopped by :—

(*a*) A gap of half the length of the tank plus 1 ft, and a steep bank, at least 5 ft high, on the home side.

(*b*) A solid vertical face higher than the top of the tank's track where it passes over the leading sprocket or idler wheel.

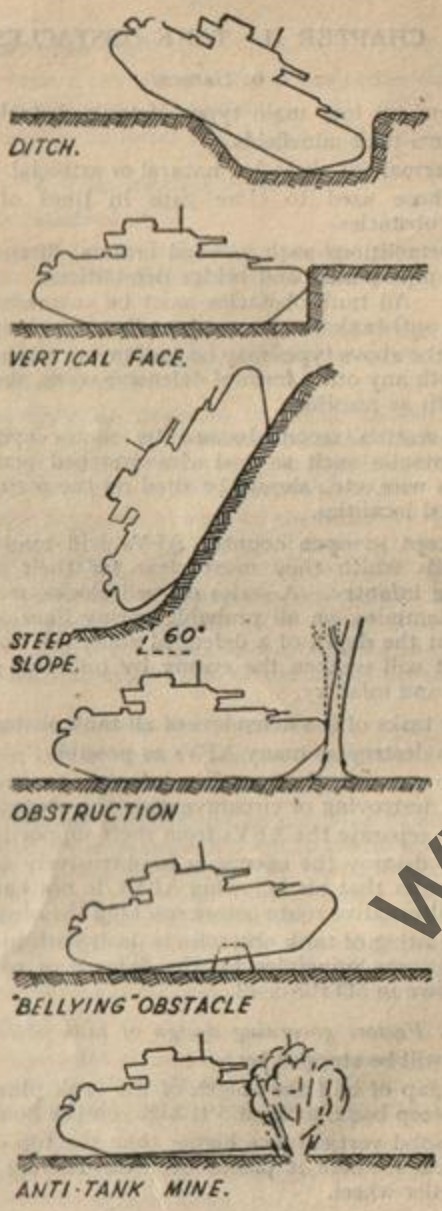


FIG 1.—METHODS OF STOPPING TANKS

(*c*) A slope or obstacle which causes the ground line of the tank to be tilted up to an angle of 60 degrees with the horizontal. A 45 degrees slope will suffice if it has a loose surface or is covered with boulders or trees, or if the tank cannot get a straight run-up.

(*d*) An obstacle which it can neither surmount nor push away, or which so " bellies " it that its tracks cannot grip the ground.

In designing tank obstacles it is useful to know the methods which the enemy may employ in getting over or destroying them.

8. *Anti-tank mines*

Anti-tank mines are the most economical in material and labour of all types of obstacle. They are the most difficult to neutralize, provide the best opportunities for surprise, and have the additional advantage of immobilizing tanks.

They are used in :—

(*a*) Protective minefields, laid to prevent penetration by the enemy into defended localities, posts or road blocks.

(*b*) Defensive minefields, laid to prevent penetration between defended localities or into an outpost position.

(*c*) Tactical minefields, laid to canalize enemy penetration within a defended area or movement round the flank of such an area.

(*d*) Nuisance or scattered mines, laid in small pockets to delay the enemy approach to a position.

They must be covered by fire as long as possible to prevent removal or neutralization.

Anti-personnel mines may be used in conjunction with anti-tank mines and other obstacles to make neutralization of the minefield by the enemy more difficult.

Details of anti-tank mines and their uses are given in MTP 40.

9. *Natural tank obstacles*

(*a*) As the construction of artificial tank obstacles involves a large expenditure of time, materials, and man-power, the fullest use must be made of natural obstacles. Long barrier lines will be sited to coincide as closely as possible with natural obstacles ; isolated blocks will be sited in defiles between them.

(*b*) The following tables give some details of natural obstacles :—

(*a*)	Type (*b*)	Conditions for effective tank obstacles to stop 35-ton tanks (*c*)	Remarks (*d*)
1	Slopes ...	Under perfect conditions : 60 degrees gradient. Surface wet, loose, shrub or tree covered, or boulder strewn : 45 degrees gradient. Minimum length of slope 40 ft, if tank can approach at speed.	For methods of improving, *see* Figs. 2 and 3.
2	Ditches and streams.	At least 14 ft wide with vertical, or nearly vertical face at least 5 ft high on home side.	If too small, may be improved by widening and/or scarping home side bank to vertical height of 5 ft.
3	Water ...	If perfect entry and firm bottom, at least 50 ft wide with minimum depth of 5 ft for 25 ft.	Conditions can be relaxed for soft bottom or bad entry or exit.
4	Banks ...	At least 5 ft high, vertical or nearly so.	May be improved by scarping to vertical and/or deepening.
5	Swamps, bogs, marshes.	No precise specification possible, but a swamp in which a man would sink 2 ft 6 ins is usually effective.	
6	Trees ...	Singly, 24 ins diameter. In depth, min 5 rows, 12 ins diameter, 5 ft to 7 ft apart.	
7	Tree stumps	Five staggered rows, min 18 ins diameter, 2 ft to 2 ft 6 ins high, 5 ft to 7 ft apart, to catch tank under belly and lift tracks off ground.	Not so effective as growing trees.

(*c*) *Water obstacles*

The conditions specified do not apply to amphibian tanks unless the conditions for dry ditches apply.

Water obstacles may be improved by :—

(i) Scarping and revetting the home side to a height of at least 5 ft from bed level ;

(ii) Dredging ;

(iii) Damming to raise the water level.

the first being the most effective.

All large trees should be left standing, but small trees and shrubs may be removed as necessary to obtain the required width and depth. If the home bank has plenty of trees, a barricade may be made of tree trunks placed between existing trees and backed by an earth bank.

As it may remove an otherwise effective obstacle in a nearby area, or flood out defensive positions, damming to raise the water level requires careful control and liaison between neighbouring formations. Accurate information should always be obtained from local sources before flooding is carried out.

Inundations will normally be carried out on the orders of the higher command only. As it will render an area impassable for long periods to any but the lightest traffic, flooding is advisable only when a strategic withdrawal followed by a static defence is intended. In addition, reinstatement of the normal drainage and water control system may be a very difficult task in the subsequent advance.

iv. *Improvement of bank slopes.*

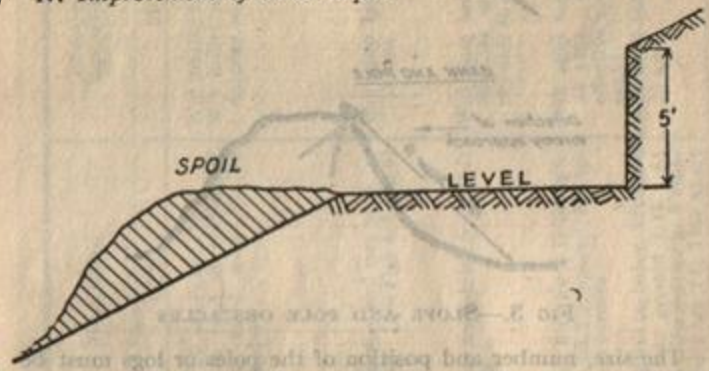


FIG 2.—SCARPED SLOPE

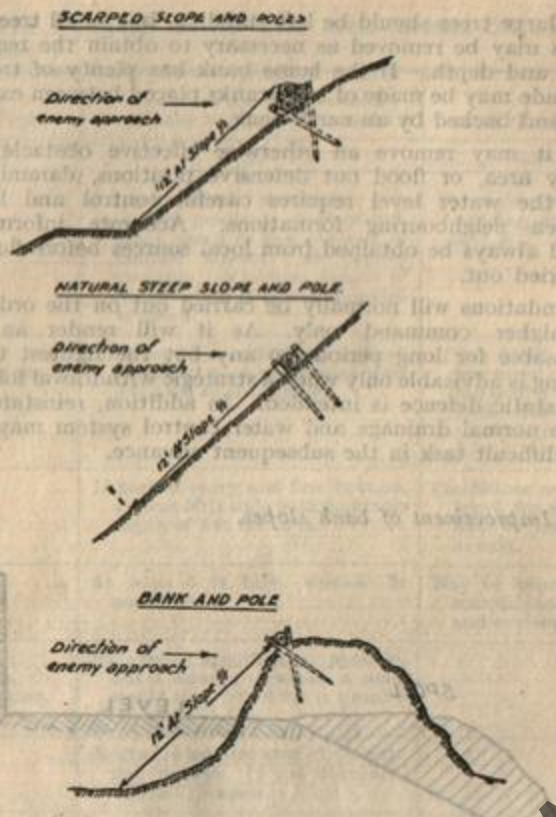


FIG 3.—SLOPE AND POLE OBSTACLES

The size, number and position of the poles or logs must be so chosen as to tilt the ground line of the tank to a slope of 1/1. The poles must be firmly fixed between stout pickets at not more than 5 ft intervals.

To determine the size of log or pole required, a stick 12 ft long should be held at an angle of 45 degrees with its lower end on the ground. The distance between the upper end of the stick and the ground gives the required diameter of the log. Three poles may be fixed together if one of sufficient size is not available.

The scarped face or poles should be sited on the steepest part of the slope and as near the top as possible.

10. *Artificial tank obstacles*

	Type	Description	Effectiveness against tanks	Remarks	Responsibility for construction
(a)	(b)	(c)	(d)	(e)	(f)
1	ANTI-TANK MINES:				
2	Tank burster	*See* MTP 40, Part 1, 1943 Hole in road or surface of defile filled with No 75 grenades	Will disable tracks Will inflict major damage on tanks	Number of grenades to give 1 lb of explosives per ton of tank to be destroyed. One No 75 grenade contains 1¼ lb of explosive	All arms
	PERMANENT OBSTACLES:				
3	Tank ditches	V, one-way and two-way types. (*See* Figs 4, 5 and 6)	Will stop tanks up to 35 tons	Ditches with vertical face are more reliable than V-ditch, but must be revetted	RE
4	"Z 1"	Tubular scaffolding fence, 9 ft high	Will stop tanks up to 35 tons unless they are able to charge	When used inland should have a natural or artificial obstacle in front to check speed	RE with assistance of other arms
5	Reinforced concrete cubes	5 ft by 5 ft by 5 ft let into ground, 1 ft spaced, 3 ft between corners	Will stop tanks up to 35 tons. 4-ft cubes effective up to 25-ton tanks	Used where a ditch is impracticable	RE
6	Reinforced concrete "pimples"	3 ft square on bases, 3 ft high, let into ground 1 ft. At 7 ft 6 ins centres in 5 staggered rows 7 ft 6 ins apart	Will stop tanks up to 25 tons	Used for closing detours or gaps where a more massive obstacle would interfere with field of fire	RE

10. ***Artificial tank obstacles*—contd.**

(a)	Type (b)	Description (c)	Effectiveness against tanks (d)	Remarks (e)	Responsibility for construction (f)
7	Reinforced concrete "coffins"	*See* Fig 9	Will stop tanks up to 25 tons	Used for closing detours or gaps where a more massive obstacle would interfere with field of fire	RE
	MOVABLE ROAD BLOCKS:				
8	Reinforced concrete cylinders	2 ft diam, 2 ft 6 ins and 3 ft high, in groups of three, consisting of one large and two small cylinders 9 ft 6 ins between centres of groups	Will stop 25-ton tanks		Construction by RE. Erection by other arms
9	Vertical rails or RSJs	90 lb rails or 8 ins by 6 ins RSJs. 5 rows projecting 3 ft to 3 ft 6 ins. Distance between rows 5 ft, between rails 4 ft	Will stop 25-ton tanks	RSJs more easily bent by tank than rails	do.
10	Bent rails or RSJs	Spaced 7 ft centres, in 4 rows, with 4 ft between peaks when vertical arms are opposed and 8 ft to 9 ft when sloping arm faces sloping arm. Height 2 ft 3 ins to 3 ft 6 ins	Will stop 25-ton tanks and impose greater delay on heavier tanks than vertical rails	RSJs more easily bent by tank than rails	Construction by RE. Erection by other arms
	IMPROVISED ROAD BLOCKS:				
11	Farms carts, cars, etc	Loaded with stones, etc. Wheels removed or damaged, anchored	Will stop 25-ton tanks if effectively constructed	Liable to be scattered by charging tanks unless firmly anchored	All arms
12	Tree barriers	*See* Fig. 15	Will stop 25-ton tanks if constructed of 24-ins diam trees. For 35-ton tanks, trees must be 36-ins diam		All arms
	SUBSIDIARY OBSTACLES:				
13	Concertina barbed wire	As in Fig 16	Will not stop tanks but will stop wheeled vehicles	A series of these blocks will slow down tanks and reduce their performance	All arms
14	Steel wire rope	4 ins circumference stretched across road at height 4 ft 6 ins	Will stop a 25-ton tank if suitably anchored	Easily severed by fire or pulled away by successive charges by tanks	RE
15	Wire stretched taut across road	At height 3 ft 9 ins	Will stop a motor cyclist if he does not see it in time		All arms
16	NECKLACES OR SLEDS	Series of A tk mines or 75 grenades drawn across road in front of advancing tank	Will break tracks		All arms
17	ROAD CRATERS	At least 20 ft wide and 7 ft deep	Will stop 35-ton tanks		RE

To be effective, all the above obstacles MUST be covered by fire and, if necessary, booby trapped or sown with anti-personnel mines where they provide cover to enemy recce patrols or attacking infantry.

11. *Permanent artificial obstacles*

1. Objects

(*a*) To fill the gaps in a natural obstacle line.
(*b*) To produce continuous lines of obstacles.
(*c*) To close immediate detours around blocks.

2. Tank ditches

Tank ditches are dug in straight lengths of about 400 to 600 yards on a zig-zag trace so that enfilade fire can be directed along them.

They are usually dug by the use of excavating machinery, but some hand labour is required to finish off the work.

Vertical faces must be revetted as soon as possible after they have been dug (*See* Appendix II).

(*a*) *V tank ditch*

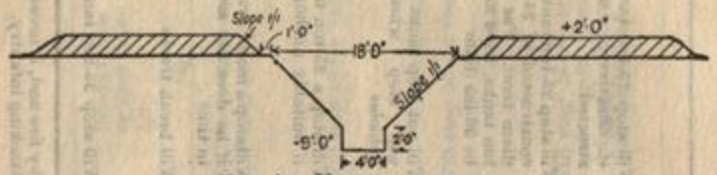


FIG 4.—V TANK DITCH

A " two-way " obstacle.

Not so effective as a ditch with a vertical face, but does not need revetting.

Suitable only for soil which will stand at a slope of 1/1.

(*b*) " *One-way* " *tank ditch*

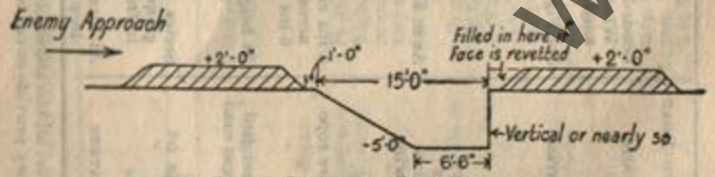


FIG 5.—" ONE-WAY " TANK DITCH

Tank proof in one direction only, and a tank can back out.

Used where V ditch is impracticable owing to nature of soil (i.e., will not stand at slope of 1/1).

(*c*) " *Two-way* " *tank ditch*

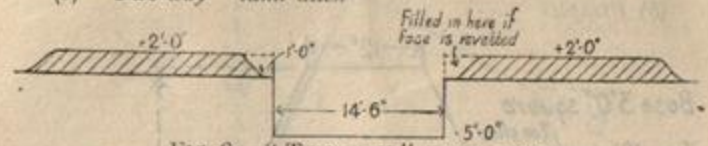


FIG 6.—" TWO-WAY " TANK DITCH

Requires more material and is slow to construct.

Used when an obstacle, tank-proof in both directions, is required in ground too soft for a V ditch.

3. Reinforced concrete obstacles

The construction of reinforced concrete obstacles is a RE responsibility.

All concrete obstacles are vulnerable to gunfire, but a large quantity of ammunition is required to blast a way through, and while a tank is firing at the obstacle, it is itself a stationary target.

The standard types of reinforced concrete obstacle are cubes, " pimples " and " coffins ".

(*a*) *Cubes*

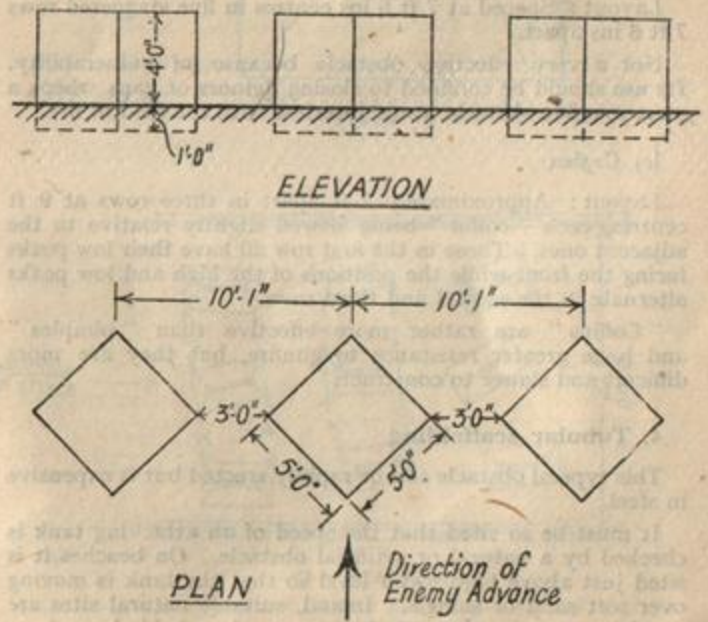


FIG 7.—REINFORCED CONCRETE CUBES

(b) *Pimples*

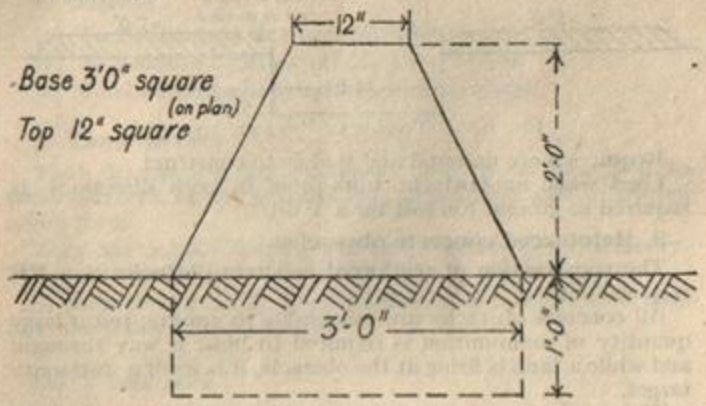


FIG 8.—REINFORCED CONCRETE " PIMPLE "

Layout : Spaced at 7 ft 6 ins centres in five staggered rows 7 ft 6 ins apart.

Not a very effective obstacle because of vulnerability. Its use should be confined to closing detours or gaps where a more massive obstacle would interfere with the field of fire.

(c) *Coffins*

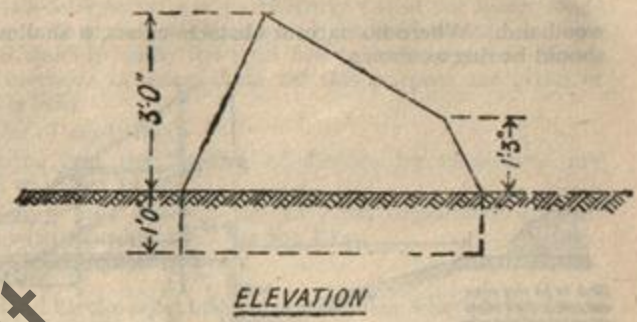
Layout : Approximately 7 ft apart in three rows at 9 ft centres, each " coffin " being slewed slightly relative to the adjacent ones. Those in the first row all have their low peaks facing the front while the positions of the high and low peaks alternate in the second and third rows.

" Coffins " are rather more effective than " pimples " and have greater resistance to gunfire, but they are more difficult and slower to construct.

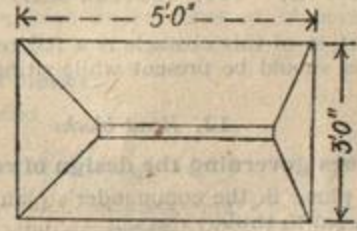
4. Tubular scaffolding

This type of obstacle can be rapidly erected but is expensive in steel.

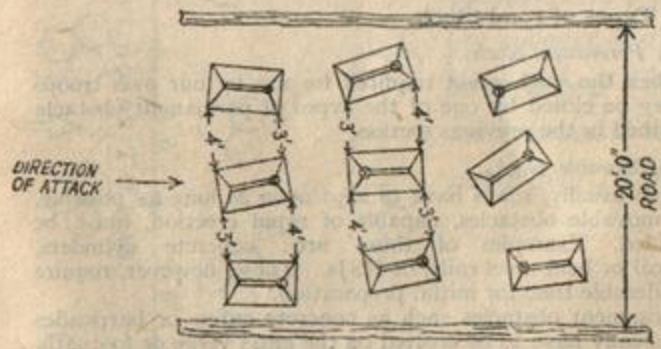
It must be so sited that the speed of an attacking tank is checked by a natural or artificial obstacle. On beaches it is sited just above high water level so that the tank is moving over soft sand or shingle. Inland, suitable natural sites are on slopes greater than 30 degrees, or close behind scrub or



ELEVATION



PLAN



O = HIGH PEAK

LAYOUT

FIG 9.—REINFORCED CONCRETE " COFFINS "

woodland. Where no natural obstacle exists, a shallow ditch should be dug as shown.

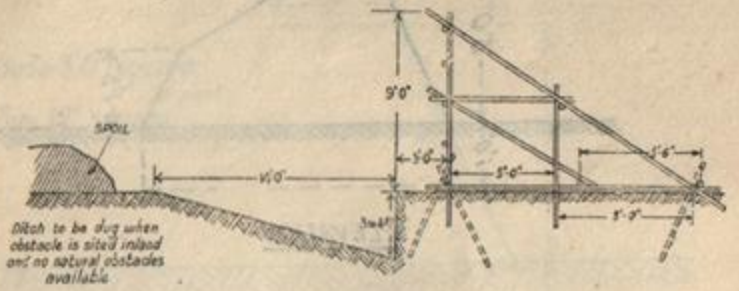


FIG 10.—" Z1 " TYPE TUBULAR SCAFFOLDING OBSTACLE

The erection of this obstacle is a RE responsibility and an RE adviser should be present while siting.

12. *Road blocks*

1. Factors governing the design of road blocks

(*a*) the phase in the commander's plan in which the road is to be closed to traffic ;

(*b*) the time available for preparation ;

(*c*) whether the road may have to be hastily re-opened for counter-attack.

2. Types of road block

(*a*) *Permanent blocks.*

When the road is not required for use by our own troops it may be closed by one of the types of permanent obstacle described in the previous section.

(*b*) *Movable blocks*

More usually, roads have to kept open as long as possible, and movable obstacles, capable of rapid erection, must be provided. Examples of these are : concrete cylinders, vertical or bent steel rails, or RSJs. These, however, require considerable time for initial preparation.

Permanent obstacles such as concrete cubes or barricades will usually have to be erected on the grass verge or footpath.

(*c*) *Improvised blocks*

When there is little time for preparation, full use must be made of local materials to improvise blocks.

(*d*) *Anti-tank mines* are particularly useful for hasty road-blocking. They do little damage to the road surface and can be lifted quickly when the road has to be re-opened. Some special methods of using them for this purpose are given in para. 7 below.

(*e*) *Use of explosives*

Cratering and the blowing of ditches by explosives are referred to in Sec **14.**

(*f*) *Screens and dummies* are of great importance in connection with road blocks. *See* Sec **13.**

3. Siting

(*a*) Road blocks must be located in defiles, where deviation is impossible or difficult.

(*b*) They must be sited to achieve surprise, *e.g.*, just after a bend in the road.

(*c*) They must be kept under constant observation and fire.

4. Movable road blocks

(*a*) *Concrete cylinders*

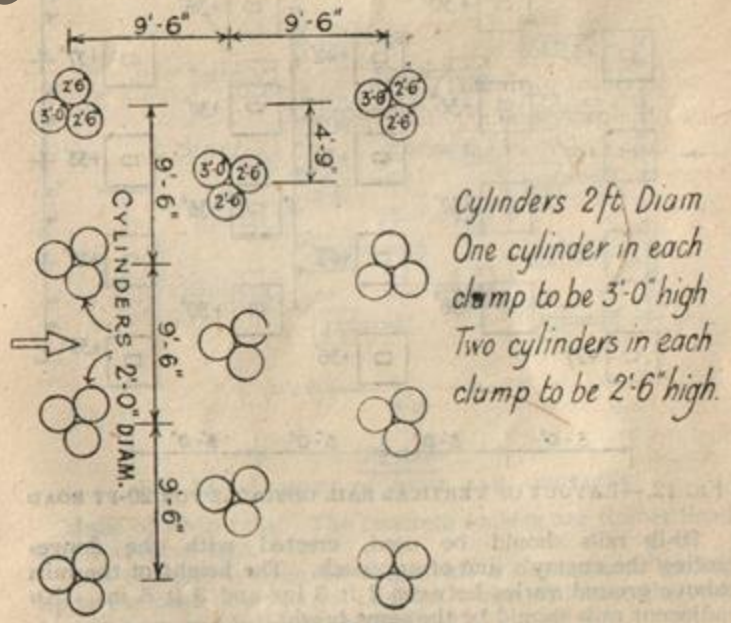


FIG 11.—LAYOUT OF CONCRETE CYLINDERS

Size : diameter 2 ft, height 2 ft 6 ins and 3 ft.

Weight : approximately 10 to 12 cwt.

Layout : at least three rows as shown above, preferably four rows.

The construction of the cylinders is a RE responsibility, but other arms will be required to place them in position.

Erection : Each cylinder requires four men to handle it. The 27 cylinders required for a 30 ft gap can be placed in position in 20 minutes by a team of 8 men.

Cylinders should be used on hard surfaces only, as a tank may push them into soft ground to such a depth that it can cross them. Bricks, stones, or other non-rolling objects should be scattered over the road surface to prevent the cylinders from rolling away if knocked over by a charging tank.

Concrete buoys are obsolete, but existing stocks may be used to impede the run-up to other types of obstacle, particularly on rough surfaces such as gravel roads.

(*b*) *Vertical rails.*

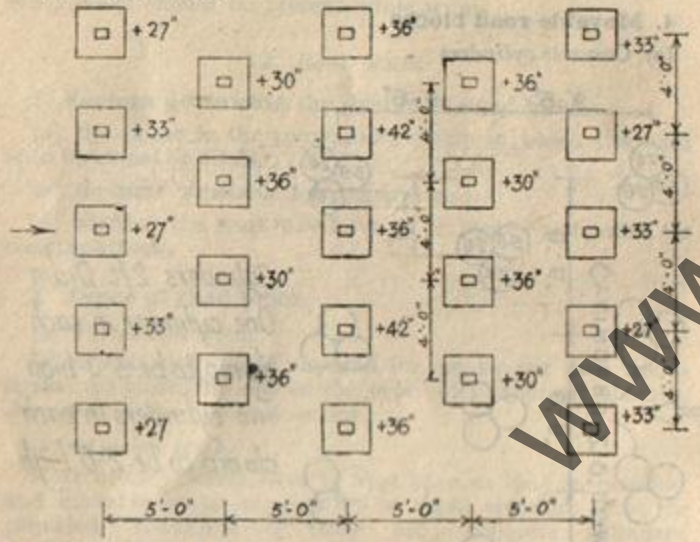


FIG 12.—LAYOUT OF VERTICAL RAIL OBSTACLE FOR 20-FT ROAD

90-lb rails should be used, erected with the flanges facing the enemy's line of approach. The height of the rails above ground varies between 2 ft 3 ins and 3 ft 6 ins. No adjacent rails should be the same height.

The rails are socketed in concrete bases 5 ft 6 ins deep and 2 ft square, lined with timber of minimum thickness 1 in. The length of rail socketed is 4 ft 6 ins.

Erection : Each rail is a two-man load. The 38 rails closing a 30-ft gap can be erected in 35 minutes by a team of 6 men.

The preparation of the rails and sockets is a RE responsibility but other arms will be required to place the rails in positions. This rule also applies to the other rail and RSJ obstacles described below.

(*c*) *Bent rails.*

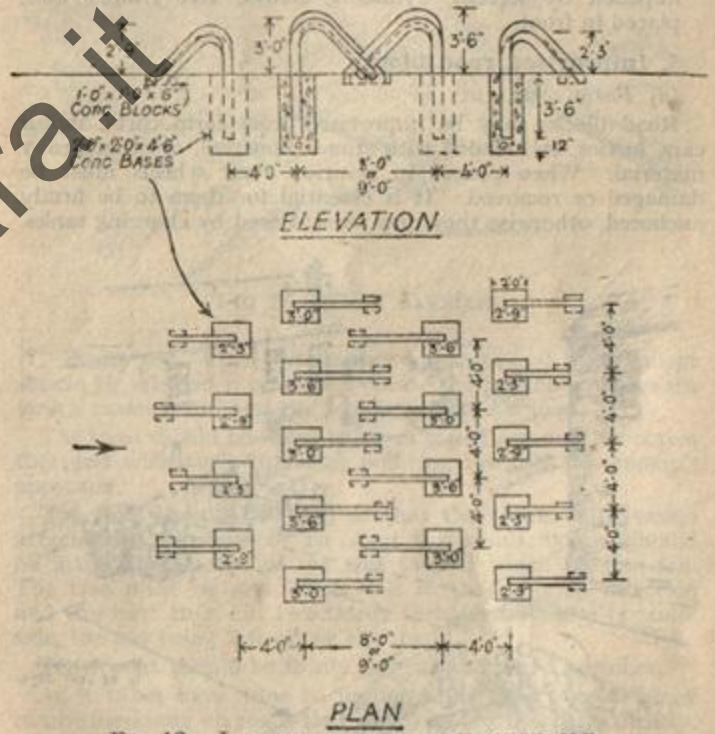


FIG 13.—LAYOUT OF BENT RAIL OBSTACLE

Made of 90-lb rails. The concrete sockets are timber lined as for vertical rails.

This obstacle is designed to provide a sloping arm leading up to the peak of a vertical member which will force the tank to climb up and belly on the peak

Each rail is a four-man load. The 30 rails closing a 30-ft gap can be erected in 45 minutes by a team of 8 men.

(*d*) *RSJ blocks*

When 90-lb rails are unobtainable, rolled steel joists of minimum section 8 ins by 6 ins may be used. The layout, spacing, and bases are similar to those given for 90-ft rails. As RSJs are less brittle than rails there is no need to include timber linings in the sockets. RSJs are bent more easily than rails by charging tanks.

NOTE.—The run-up to all rail and RSJ obstacles should be impeded by screens, cylinders, buoys, tree trunks, etc., placed in front.

5. Improvised road blocks

(*a*) *Farm carts, etc.*

Road blocks may be improvised from farm carts, motor cars, lorries, etc, loaded with stones, concrete, or other heavy material. When placed in position their wheels must be damaged or removed. It is essential for them to be firmly anchored, otherwise they may be scattered by charging tanks.

FIG 14.—LORRY AND BARRICADE BLOCK

Fig 14 shows a suitable arrangement for use where the roadway has to be kept open. The gap can be closed by moving the lorries into the space shown dotted, removing their wheels, and anchoring them. The enemy can quickly deal with farm road blocks by incendiary bullets, and such blocks are, therefore, of temporary use only, *e.g.*, for ambushes.

(*b*) *Tree barriers*

FIG 15.—TREE BARRIERS

"Bushy top" trees with heavy branches and thick foliage should be selected if possible, because the branches reduce the tank's momentum, and the foliage acts as a screen.

The trees should be felled to lie on top of one another across the road with their branches pointing towards the enemy's approach.

The trees should be felled so that the trunks will remain attached to the stump. To effect this result, no cut should be made on the side of the tree toward which it is to fall. The tree must be strained to fall in the required direction and the butt then cut two-thirds through from the opposite side, the cut being 2 ft above the road.

The trunks should be firmly dogged and wired together.

As it takes some time to prepare, this type of road block can be used only on roads that are to be blocked permanently.

All improvised road blocks should be improved by the use of anti-tank and anti-personnel mines and barbed wire.

6. Subsidiary road blocks

(*a*) *Plain wires* stretched across a road at a height of 3 ft 9 ins will unseat and sometimes decapitate motor cyclists. Fencing,

telegraph, or telephone wires may be used, stretched tight and attached firmly to trees, telegraph poles, walls, or fences. The wires should make an angle of between 45 and 90 degrees with the line of the road.

(*b*) *Steel wire ropes* of 4 ins circumference stretched across a road will stop a tank if suitably anchored. As, however, they may be severed by machine gun fire or loosened by two or three repeated charges by the tank, they do not form an effective tank obstacle.

(*c*) *Barbed wire concertinas*

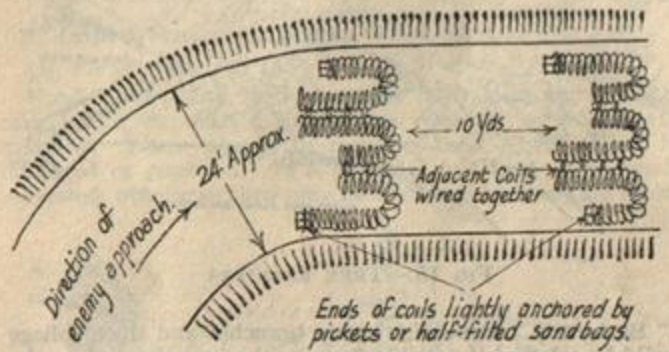


FIG 16.—CONCERTINA ROAD BLOCK

Will stop wheeled vehicles. A series of these blocks in close succession will probably stop the leading tank, but this will have cleared the way for other tanks. The ends of adjacent coils must be wired together, and the obstacle lightly anchored at the sides of the road.

7. Necklaces and sleds

These are devices for drawing a row or rows of anti-tank mines across a road in the path of advancing enemy vehicles. By their use the road can be kept open to friendly traffic, yet is capable of being closed in a few seconds.

They are particularly useful for protecting the flanks of a rapid advance and for checking enemy mechanized raiding columns.

(*a*) *Mine necklace*

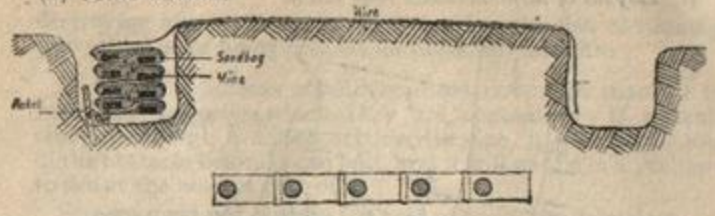


FIG 17.—ANTI-TANK MINE NECKLACE

A necklace is made by sewing or wiring together sandbags, each containing a mine, in such a way as to form a continuous chain. The necklace is folded up and concealed at one side of the road, with its lower end fastened to the ground. To the upper end is fixed a strong wire, which is passed across the road to a man who can draw the mines across the road when required.

No. 75 grenades connected at 2 ft intervals by string can be used instead. The grenades should be wired together so that they lie with their long side at right angles to the direction of pulling wires. Two strings of grenades should be used for each block. In an emergency No. 75 grenades may be thrown on to the road surface as a hostile vehicle approaches.

(*b*) *Mine sled*

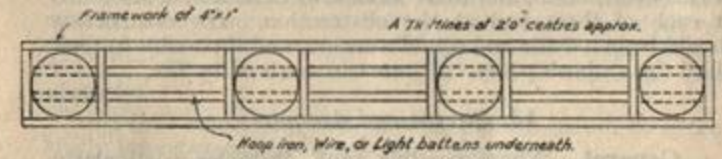


FIG 18.—ANTI-TANK MINE SLED

A sled is a rough framework of wood made to hold mines. It is concealed at the side of the road in such a way that it can be pushed or drawn by a wire into position when required. Alternatively, it may be laid parallel to the roadway at one side and one end anchored down. A wire is fixed to the other end and passed across the road to a man, who can swing the sled across the road when required.

No. 75 grenades may be used in a similar manner by wiring them on to a plank so that their long sides are at right angles to the sides of the planks.

(c) *Lay out of mine necklace road block*

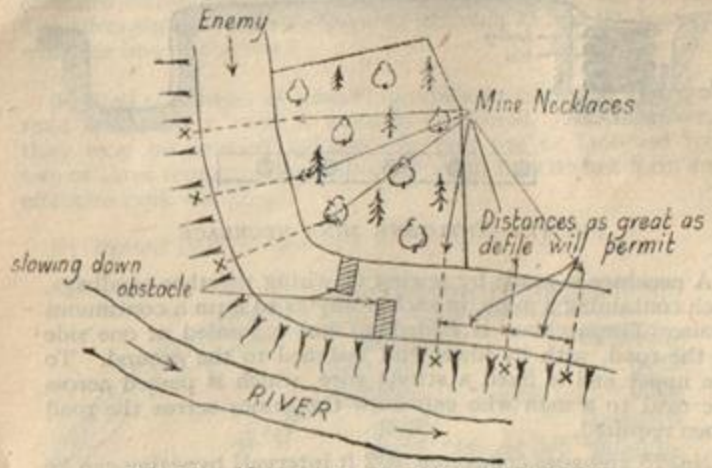


FIG 19.—NECKLACE OR SLED ROAD BLOCK

To ensure that any enemy vehicle approaching the block is recognized in time, some form of obstruction, *e.g.*, farm carts or felled trees, should be made in order that vehicles have to slow down to steer through a very sharp S-bend. There should be at least three necklaces or sleds on either side of this obstruction, and there must always be a man stationed at each of them and at the obstruction. The obstruction should be in a defile and round a corner, and if possible in view of all the ambush party. It must be covered by fire.

13. *Screens and dummies*

1. **General.**—Where possible, tank obstacles, particularly road blocks, should be concealed by screens in order to :—

(*a*) conceal the true nature of the obstacle ;

(*b*) prevent the tank's fire being directed at the most vulnerable part ;

(*c*) confuse the tank's crew and lower their morale.

Screens should also be erected in front of dummy obstacles and at sites where no obstacle exists, causing delay and expenditure of valuable ammunition. The enemy will thus never know with any certainty what form of obstacle or defence opposes him, or whether any real obstacle exists. If he stops to investigate, the defence will be given an opportunity of

destroying him ; if he goes ahead he runs the risk of running into mines or of being held on an obstacle under fire.

2. **Siting.**—Screens should be sited not more than 10 ft from the obstacles which they are concealing. If a tank charges through a screen at this distance, it will be on top of the obstacle before it can halt, and it will not be in a position to fire at the nearest part of it.

Screens must not obscure the field of fire of the defenders.

3. **Construction.**—A form of screen, suitable for concealing a road block, consists of two strips of canvas, garnished netting or blankets, the lower part suspended from wires about 4 ft from the ground, and the upper at a height of 7 or 8 ft. The top half should overlap the bottom half by 6 to 12 ins. When charging, a tank's tracks will tear away the lower half, but the upper part will envelop and blind the observation slits. The wires should be fastened to supports in positions where the tank cannot readily fire at them.

Further details of screens are given in MTP 46, Part 6, 1941.

4. **Dummy obstacles** should be used extensively to confuse and delay tank formations and cause them to waste ammunition.

Dummies must be carefully made in order to present a realistic appearance. They may be made of plaster, wood, or asbestos sheeting. Canvas, stretched on frames and covered with cement wash, bellies in the wind and does not produce an effective "concrete" appearance except from a distance. Wooden dummies may be used to represent steel obstacles.

Anti-tank mines and anti-personnel mines should be extensively interspersed between dummy obstacles.

14. *Obstacles made by explosives*

(These are a RE responsibility)

1. **Pipe mines.**—Pipes of 2½-ins internal diameter are pushed under the ground by means of hydraulic jacks. The pipes are then charged with explosives and, when detonated, a ditch is blown. The size of the ditch, which has the general appearance of a V-ditch, varies according to the quantity of explosive used and the lay-out of the pipes.

The effectiveness of this obstacle depends upon the creation of a deep ditch and upon the loosening of the soil when

the ditch is blown. A tank which attempts to cross the obstacle, will churn up the loose soil with its tracks and belly in the centre of the ditch. The value of the ditch as an obstacle is therefore greatly reduced if it is blown too early, and time is allowed for the soil to consolidate.

This method is useful for forming road blocks. It has the advantages that the road can be kept open till the last possible moment, and that the preparations are easily concealed, thus allowing for surprise.

2. **Road craters.**—As time is required for their effective repair, craters, or series of overlapping craters, cause considerable delay. They should be sited where deviation is difficult and where material for filling them is not readily obtainable. Craters are more difficult to repair if so sited that they fill with water.

To form a tank obstacle, craters should be 20 to 25 ft diameter. Two craters, or lines of craters, should be formed at about 80 ft between them along the length of the road.

CHAPTER III.—INFANTRY OBSTACLES

15. *Siting of infantry obstacles*

When siting infantry obstacles :—

(*a*) Full use must be made of natural obstacles, strengthened where necessary.

(*b*) To ensure concealment, artificial obstacles must be sited to conform with the natural features of the ground. Strict track discipline must be enforced during the erection of the obstacle.

(*c*) Obstacles must be under fire from the defenders.

(*d*) Protective obstacles must be far enough from defended posts to prevent the enemy throwing grenades into the posts from the far side of the obstacle, but NOT so far away that they can be destroyed or crossed during darkness or under cover of smoke, unknown to the defenders. A distance of 40 yards is the normal minimum.

(*e*) The position of the defenders must not be indicated by the layout of the obstacles. Dummy fences should be erected to mislead the enemy.

16. *Types of infantry obstacle*

Obstacle	Use and remarks
Natural	Usually requires strengthening by artificial means.
Cattle fences	In districts where wire fences are used by farmers.
Trip wires	For hasty protection ; in conjunction with booby traps and warning devices.
Low wire entanglement	When concealment is essential.
Triple concertina fence Double apron fence	For rapid erection.
High wire fence ...	A very effective obstacle but requires considerable time and material. Difficult to conceal.
Knife-rests	Portable obstacles for blocking roads and gaps.
Anti-personnel mines and booby traps	Used in conjunction with other obstacles. RE responsible for laying.

17. *Barbed wire obstacles*

1. Strengthening of natural obstacles

Deep rivers, canals, bogs, and cliffs form effective delaying obstacles to infantry. Thick hedgerows, fences, and woods, which are only partial obstacles, can be improved by lacing with barbed wire, by the addition of an apron similar to that used in standard wire fences on one or both sides, or by entangling with loose wire.

2. Cattle fences

In districts where wire fences are used by farmers, obstacles in the form of "cattle fences" will harmonize with the landscape. Their design should follow as closely as possible the local custom, usually wooden pickets driven into the ground at about 2 yds interval with four horizontal strands of barbed wire fixed to them. They should be sited along footpaths and edges of fields or crops, where they will not look out of place.

3. Trip wires

Immediately a defensive position is occupied, and before an attempt is made to erect protective wire, trip-wires should be

placed just outside bombing range, that is, 30—40 yards away. They should stretch about 9 ins above the ground and be fastened to pickets at not more than 5 yards interval. They should be concealed either in long grass and crops, or on a natural line, such as the side of a track or the edge of a field.

4. Low wire entanglement

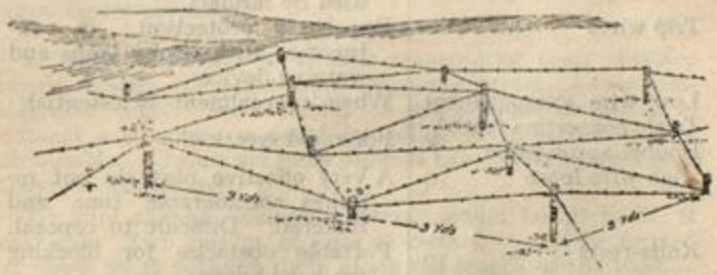


FIG 20.—LOW WIRE ENTANGLEMENT

Used where concealment is essential. At least 5 rows of pickets at 3 yds spacing; height of wire varied between 9 ins and 2 ft 6 ins.

Stores for 100 yds :—
170 pickets.
13 (130-yd) coils barbed wire.

5. Standard barbed wire obstacles :—

(*a*) *Triple concertina fence.*

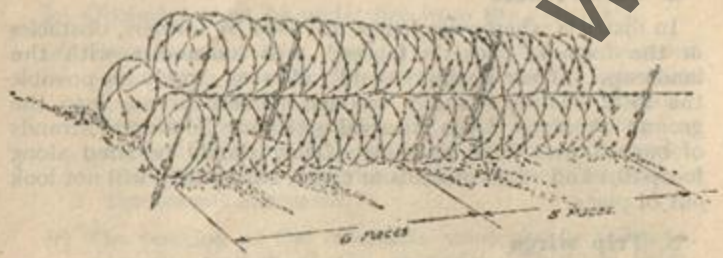


FIG 21.—TRIPLE CONCERTINA FENCE

Stores for 100 yds :
18 concertinas.
52 long pickets.
4 (130-yd) coils barbed wire.
For details of erection *see* Appendix IV, 2.

(*b*) *Double apron fence.*

FIG 22.—DOUBLE APRON FENCE

Stores for 100 yds :
40 long pickets.
82 short pickets.
13 (130-yd) coils barbed wire.
For details of erection *see* Appendix IV, 3.

(*c*) *High wire fence.*

(*See* Figs 33, 34, and 35 in Appendix IV, 4.)
Stores required for 100 yds :
32 concertinas.
19 (130-yd) coils barbed wire.
80 long pickets (NOT screw).
84 short pickets.
100 staples.
For details of erection *see* Appendix IV.

This obstacle should be erected in depth. It is unsuitable for conditions of mobile warfare. Every effort should be made to conceal it by careful siting, because it is very conspicuous and its erection requires more time and materials than the types previously described.

6. Knife rests

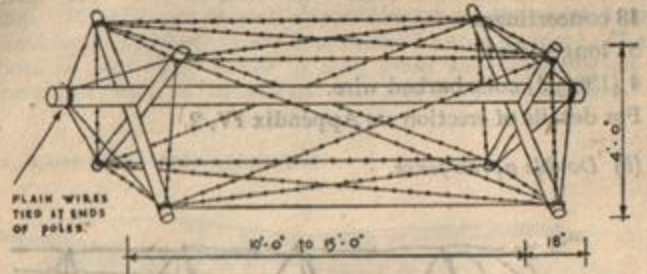


FIG 23

A useful portable obstacle for blocking roads or gaps in wire fences.

Angle-iron pickets, forestry pickets, or squared timber may be used.

The cross members should be firmly lashed to the horizontal member with plain wire, and their ends tied back to it with plain wire as shown.

About 1 ft 6 ins should project at the ends for carrying.

When placed in position, knife rests must be securely fixed.

Stores for one knife rest 10 ft long :—

4 5-ft pickets.
1 13-ft pole.
20 yds plain wire.
1 (130-yd) coil barbed wire.

7. Obstacles for defended buildings

Defended buildings should have an all-round protective obstacle outside bombing range, full use being made of any existing natural obstacles. Another obstacle must be provided close to the house. This should be thickened at the corners of the building to prevent enemy troops from using the corners as cover and to force them into the defenders' field of fire.

Every effort must be made to conceal these obstacles in order not to give away the fact that the house is defended.

Barbed wire concertinas are most suitable for obstacles around buildings. They must be fixed either to the house or to the ground, using pickets where required.

8. Miscellaneous notes

(*a*) *Training.*—Before being instructed in the construction drill, men must learn the use of screw pickets how to fasten the wires to the pickets, and how to handle barbed wire with confidence (*see* Appendix IV).

Appendix V gives instructions for the closing and fastening of concertinas after use for training.

(*b*) *Pickets.*—If available, forestry or angle-iron pickets should be used in the construction of barbed wire fences, as they afford a much stronger obstacle than screw pickets. Screw pickets must be used, however, when wiring has to be carried out in great haste or silently because of proximity of the enemy.

(*c*) *Loose wire.*—All infantry obstacles can be made more effective by the addition of loose barbed wire thrown into the fence or between the rows of fences.

The task of throwing loose wire into an entanglement is made easier by coiling it in a spiral form beforehand.

(*d*) *Gaps.*—Suitable places must be chosen where gaps can be left for counter-attacking troops. Gaps must be carefully concealed from the enemy's ground and air view. They must be adequately marked from the defenders' side. Materials for closing the gaps rapidly must be kept readily available.

(*e*) *Warnings.*—Improvised warning devices, *e.g.*, tin cans filled with stones, should be provided to give warning of enemy approach.

18. EXPLOSIVE TRAPS AND ANTI-PERSONNEL MINES

(*See* MTP 30, Part IV, 1941).

Explosive traps and anti-personnel mines should be used whenever available, either as booby traps or in conjunction with wire fences. In addition to causing casualties, they are useful in giving warning of enemy approach.

The RE are responsible for the laying and setting of these mines and traps. An accurate record of their exact location must be forwarded to formation headquarters and to units concerned.

DETAILS AND CALCULATIONS OF MEN, TIME, AND TOOLS REQUIRED FOR THE ERECTION OF OBSTACLES

NOTE.—Tasks given in this table are those which can be expected from average trained infantry working parties under the following conditions :—

(a) All tracing and marking done beforehand, and materials dumped at site.
(b) Work carried out by day, except where otherwise stated.
(c) It is not raining.
(d) March to work does not exceed 1½ hours.

In conditions less favourable tasks must be correspondingly reduced.

Item No. (a)	Nature of work (b)	No. of Workers (c)	Time (d)	Quantity (e)	Tools for party (f)	Remarks (g)
1	Erecting concrete cylinders (layout as in Fig. 11).	8	20 mins	10-yd length of obstacle (27 cylinders).	—	4 men required per cylinder.
2	Erecting vertical rails or RSJs (layout as in Fig. 12).	6	35 mins	10-yd length of obstacle (38 rails).	—	2 men required per rail.
3	Erecting bent rails or RSJs (layout as in Fig. 13).	8	45 mins	10-yd length of obstacle (30 rails).	—	4 men required per rail.
4	Felling trees.	1	1 min	1 in of diameter of tree up to 12 ins. If over 12 ins diam allow time in minutes $= \frac{d^3}{144}$ where d = mean diam in ins.	1 felling axe or hand-saw.	One man can fell a tree 9 ins. in diam in 9 mins. If only hand axes available, time should be doubled. Over 12 ins diam time required is much greater. Hand axe is not suitable for trees over 15 ins in diam.
5	Wiring tree entanglement in thick undergrowth.	8	40 mins	100 yds	2 billhooks, handaxes, or matchets. 2 pairs pliers.	Stores for 100-yds obstacle : 5 (130-yd) coils barbed wire.
6	Standard triple concertina fence with screw pickets.	1 NCO and 7 men	Day : 2 hrs 4 hrs Night : 4 hrs	100 yds 400 yds 200 yds	1 pair wirecutters 7 windlassing sticks	Stores for 100-yds obstacle : 18 concertinas, 52 long pickets, 4 (130-yd) coils barbed wire.
7	Standard triple concertina fence with angle-iron or forestry pickets.	1 NCO and 7 men	Day : 1 hr 4 hrs Night : 4 hrs	100 yds 250 yds 150 yds	As for Serial 6.	As for 6. Angle-iron pickets and 3 sledge hammers or forestry pickets and 3 mauls required.
8	Standard double apron fence.	1 NCO and 10 men	Day : 1 hr 4 hrs Night : 4 hrs	100 yds 250 yds 150 yds	[illegible] pliers 1 windlass stick	Stores for 100-yds obstacle : 40 long pickets, 82 short pickets, 13 (130-yds) coils barbed wire.
9	High wire fence.	2 NCOs and 14 men	Day : 2 hrs 4 hrs Night : 4 hrs	100 yds 150 yds 75 yds	2 pairs wirecutters 14 windlassing sticks 7 mauls and/or sledge hammers.	Stores for 100-yds obstacle : 32 concertinas, 19 (130-yds) coils barbed wire, 80 long pickets (NOT screw), 84 short pickets, 100 staples.
10	Knife rest.	3	½ hr	One	1 pair pliers.	Stores for knife rest 10 ft long : 4 5-ft pickets, 1 13-ft pole, 20-yds plain wire, 1 (130-yds) coil barbed wire.

NOTES

1. Details of men, time, and tools for earthwork, revetments, etc., are given in MTP 30, Part V, 1942, Appendix III.
2. Load tables for ordnance and engineer stores are given in MTP 30, Part V, 1942, Appendix V.
3. Wiring stores carefully packed can be loaded in correct proportion in a 3-ton lorry as follows :—

	Double Apron	Triple concertina
Wire and screw pickets or wire and angle-iron pickets.	650 yds	300 yds

350 yds of TC fence can be loaded on a 3-ton lorry without superstructure if the coils are roped.
If packed hastily or with used wire, these figures should be halved.

4. Supply of wiring stores in the field :—
2nd line transport of Corps Troops RASC carries 30 tons per division in ten 3-ton lorries.

APPENDIX II

REVETMENT OF TANK DITCHES

1. Materials

(*a*) *Brushwood* may be used loose or in hurdle form for the revetting material. It is also used for interlacing the tops of the revetment pickets. The leaves must be removed from the brushwood before it is placed in position.

(*b*) *Fencing.* Chestnut fencing is effective even in fairly bad ground, but requires to be used double.

(*c*) *Corrugated galvanized iron* (*CGI*) sheets are the most satisfactory form of material in really bad ground.

(*d*) *Expanded metal* (*XPM*) sheets are nearly as good as CGI sheets.

NOTE.—Reinforced concrete panels should NOT be used, as when broken they assist a tank to climb up the face of the ditch.

(*e*) *Revetment pickets* must be strong timber, preferably 6 ins to 8 ins in diameter. They are required 5 ft longer than the depth of the face to be revetted in ordinary ground and an extra foot should be allowed in soft ground.

(*f*) *Anchorage pickets* should be about 4 ins in diameter and 4 ft long.

In ordinary ground one anchorage picket is required for each revetment picket; in bad ground twice as many.

(*g*) *Wire* used for tying back revetment pickets may be from 8 to 14 gauge, 4 to 8 strands being used according to the thickness of the wire.

Barbed wire is not very satisfactory, but may be used if there is no plain wire. Four strands of barbed wire are required.

2. Method of revetment

The face of the ditch must be revetted as soon as possible after it has been dug, particularly in soft ground or in wet situations (Fig 24).

The revetting material is held tight against the earth face by pickets and any voids behind it should be filled in and rammed during the progress of the work.

The revetting pickets must be driven 3 ft into the ground and tied back by wire to the anchorage pickets. They should be placed not more than 3 ft apart in ordinary ground. In bad ground they should be 2 ft apart.

The strands of wire between the revetment pickets and anchorage pickets must be windlassed with a short stick to increase the pressure on the revetting material.

The anchorage pickets should be driven 3 ft into the ground. They should not be in a straight line, as this tends to form a line of cleavage in the ground, but staggered, alternate pickets being about 2 ft to 3 ft behind the general line. They must not be nearer to the revetted face than twice its depth in ordinary ground. In bad ground this distance should be increased. In very bad ground it may be necessary to use a pair of anchorage pickets for each revetment picket, the two anchorage pickets being driven one behind the other in line with the pull and about 6 ft apart. Each pair of anchorage pickets is joined with 4 to 6 strands of wire which should be windlassed.

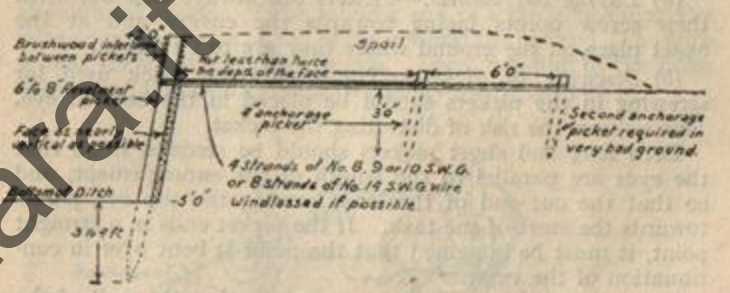


FIG 24.—TANK DITCH REVETMENT

The wires must be in a straight line between the revetment pickets and the anchorage pickets, and must be as near ground level as possible.

If the ditch has already been dug and some of the spoil deposited on the home side of it, channels must be dug through the spoil so that the anchorage pickets and wires can be put in position.

To obviate the necessity for this extra digging the anchorage pickets may be driven before the excavation of the ditch is begun, and the required number of turns of wire taken to a small picket driven temporarily on the line of the face of the ditch. This small picket will be dislodged when the ditch is dug, but will keep the turns of the wire in approximately the right place whilst the spoil is being deposited on top of them.

After the revetting pickets have been driven the loops of the wires are passed over them, and the wires are drawn as tight as possible and the end made fast behind the revetting picket.

If excavating machinery is being used to dig the ditch, the revetting pickets may conveniently be driven into the ground with the bucket of the excavator.

APPENDIX III

GENERAL NOTES ON PICKETS AND WIRE FASTENINGS

1. Pickets

There are three types of pickets, screw, angle-iron, and forestry pickets. Screw pickets are used when work must proceed in proximity to the enemy, as they can be erected without noise. In other circumstances, angle-iron or forestry pickets should be used.

2. Erecting screw pickets

(*a*) *Laying out pickets.*—Pickets are always laid out with their screw points facing towards the enemy and at the exact place on the ground where they are to be put in.

(*b*) *Screwing in pickets.*—The windlassing stick used for screwing in the pickets should be placed in the bottom eye. This reduces the risk of distorting the picket.

Both long and short pickets should be screwed in so that the eyes are parallel to the length of the entanglement, and so that the cut end of the loop forming the top eye points towards the start of the task. If the picket ends in a straight point, it must be imagined that the point is bent over in continuation of the twist.

Short screw pickets must be so put in that the pull of the fence comes in the direction of their length, *i.e.* they must lean towards the fence not away from it, thus :—

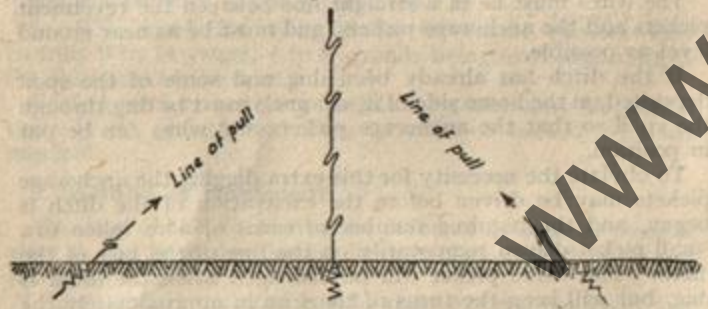


FIG 25.—ANCHOR PICKETS

3. Fixing wires to screw pickets

(*a*) *General.*—Wires should be just taut enough to prevent them from being easily pressed down by a trench board or similar article thrown across the top of a fence. If wires are strained too taut they are more easily cut by splinters. Although

any firm fastening will do, provided that each wire in the fence is secured at least once in every bay, the following are standard methods which will be taught in training.

The fastenings described can be made whether the pickets are put in correctly or not. In order that men may not be upset in practice by pickets incorrectly put in, they should, during the latter stages of training, be taught to fix the wires to pickets in any position, the turns being made when necessary with the standing part of the wire instead of with the running end.

(*b*) *To fix the wire to an anchorage picket.*—Seize the running end of the wire and slip the wire into the eye. Continue the upward motion of the running end in a circle bringing the wire down between the top of the eye and the cut end. The wire is now threaded through the eye. Then, winding in the same direction, take a turn round the picket below the eye.

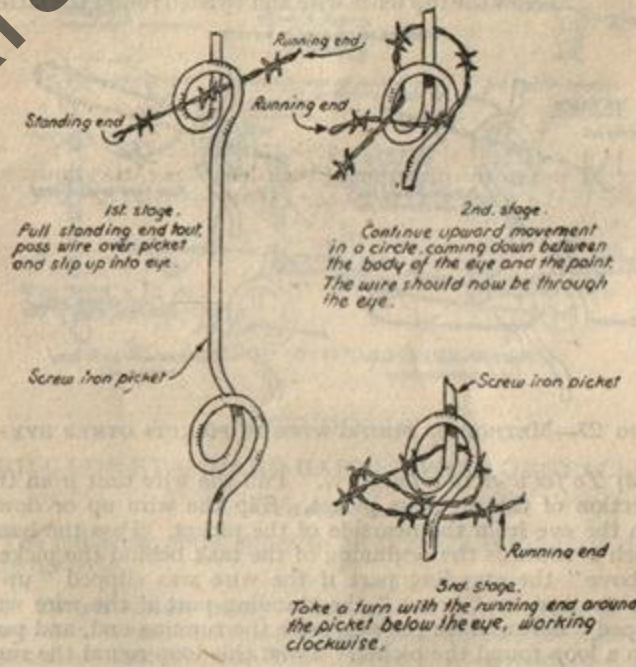


FIG 26.—METHOD OF FIXING WIRE TO PICKETS TOP EYE

(c) *To fix wires in top eye of a long picket.* (Double apron fence.)

(i) The front diagonal is pulled upwards into the eye, the wire having, if necessary, been first passed over the picket. The running end (that nearest to the coil) is then passed over the point of the picket and brought down again. The wire will then be found to be threaded through the eye. Then, winding in the same direction, take a turn round the picket below the eye.

(ii) *The top horizontal fence wire* is laid in the top eye. A bight is then formed in the running end and is twisted round the front diagonal wire close to the picket.

(iii) *The rear diagonal.* A bight is formed in the wire and is passed over the top fence wire and down between the two front diagonal wires. It is then brought to the side of the picket away from the start of the task below the top fence wire and twisted round the latter.

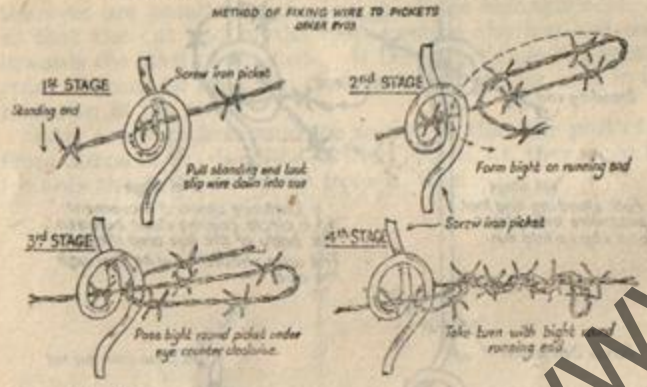


FIG 27—METHOD OF FIXING WIRE TO PICKETS OTHER EYES

(d) *To fix wire in a lower eye.* Pull the wire out from the direction of the previous picket. Slip the wire up or down into the eye from the nearside of the picket. Pass the hand which is towards the beginning of the task behind the picket, "above" the standing part if the wire was slipped "up" into the eye, or "below" the standing part if the wire was slipped "down" into the eye, seize the running end, and pull it in a loop round the picket. Twist this loop round the running end of the wire, *i.e.*, in the direction in which the work is progressing.

(e) *Erecting forestry or angle-iron pickets.* Angle-iron pickets are laid out with their points directed towards the enemy and in the exact place where they are to be driven. They should be driven in with a 7-lb sledge until firm: two men are necessary, one to hold the picket, the other to use the sledge.

Angle-iron pickets should be driven with the apex or point of the V facing the home side of the fence.

Forestry pickets should likewise be driven until firm, using a maul instead of a sledge.

Short or anchorage pickets must be driven in at right angles to the direction of the pull.

(f) *Fixing wires to forestry or angle-iron pickets.* The methods of fastening wire to forestry pickets are shown in Fig 28. The same fastenings are used with angle iron pickets, though care must be taken to ensure that the wire engages in the notches cut in the angle iron.

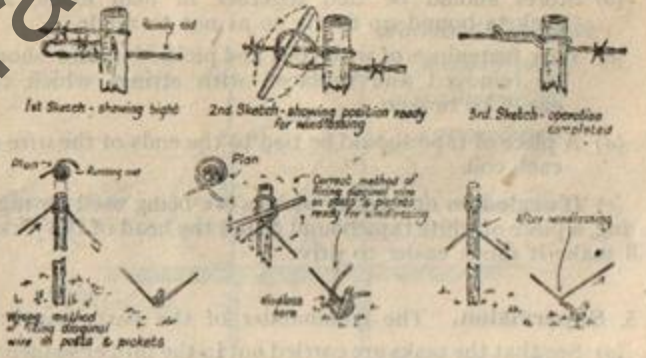


FIG 28.—METHOD OF FIXING WIRE ON POSTS

APPENDIX IV

DRILL FOR STANDARD BARBED WIRE OBSTACLES

1. General notes

The following notes apply to all types of standard barbed wire obstacle.

1. **Construction party.** The size of party given is the most suitable one, and this number should be used for training.

Provided that the men know the proper sequence of work, the drill is suitable for larger or smaller parties; there are no special jobs for special members.

2. **Direction of work.** A fence is usually constructed from left to right, facing the enemy. It may, however, be necessary to work from right to left, and men must, therefore, be taught to work in either direction. In the detailed drills which follow, it will be noted that the triple concertina fence is described as beginning at the left hand end and the high wire fence at the right hand end.

3. **Casualties.** The NCO will decide, in the event of heavy casualties, what wires, if any, are to be omitted. Otherwise men will automatically carry on the work despite casualties, in order that the work should proceed in proper sequence.

4. **Preparation**

(*a*) Tracing tapes should be laid from the stores dump to the site of work and then along the line of fence.

(*b*) Stores should be tied together in man loads, and pickets bound up firmly so as not to rattle.

(*c*) Wire fastenings of wire coils and picket bundles should be removed and replaced with strings which can easily be broken.

(*d*) A piece of tape should be tied to the ends of the wire on each coil.

(*e*) If angle-iron or forestry pickets are being used for night wiring, a piece of white tape bound round the head of the picket will make it much easier to drive.

5. **Supervision.** The commander of the party must :—

(*a*) See that the tasks are carried out in the proper sequence.

(*b*) Prevent bunching or overcrowding.

(*c*) See that wires are strained and spaced correctly.

(*d*) Check that windlassed connections are being made correctly and at the right points.

6. **Precautions when working in close proximity to the enemy.**

(*a*) No noise.

(*b*) No working on enemy side of fence unless absolutely necessary.

(*c*) Use screw pickets, if available.

(*d*) Men not working must lie down near start of work until they can continue their work.

2. Triple concertina fence

1. The triple concertina fence consists of a pyramid of three concertinas supported by two rows of long pickets, with a strand of barbed wire along the top of each of the bottom concertinas.

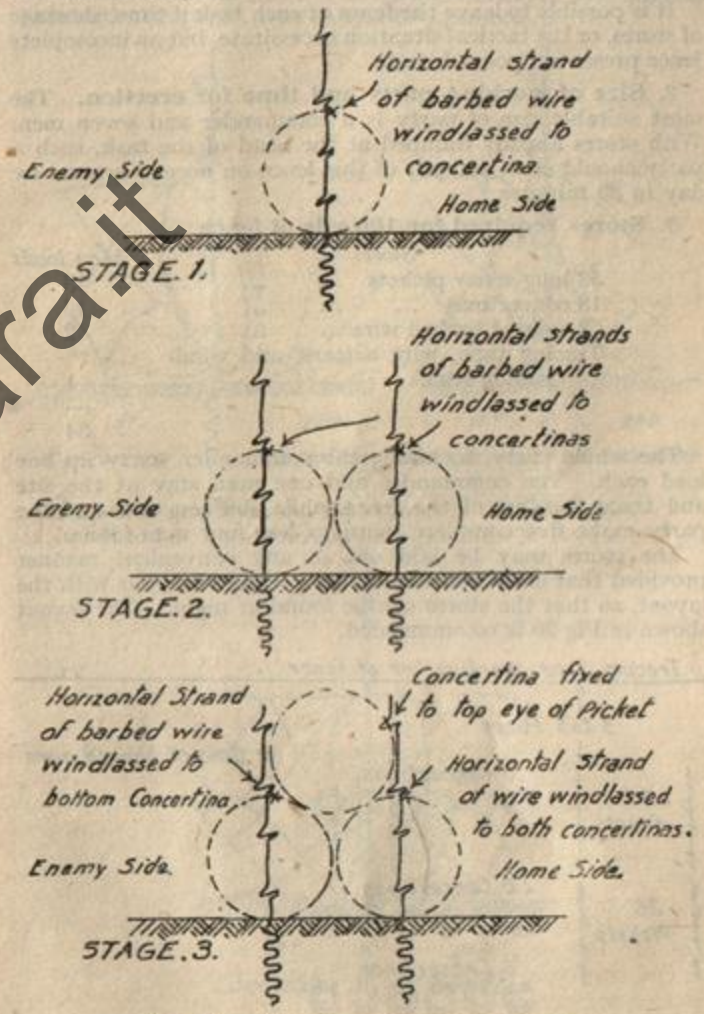


FIG 29.—TRIPLE CONCERTINA FENCE

The fence is erected in three tasks :

1st task. One row of long pickets, one row of concertinas, horizontal strand of barbed wire.

2nd task. Second row of concertinas as above.

3rd task. Top concertina.

It is possible to leave the fence at each task if time, shortage of stores, or the tactical situation necessitate, but an incomplete fence presents a poor obstacle.

2. **Size of working party and time for erection.** The most suitable size of party is a commander and seven men. With stores already dumped at the head of the task, such a party should erect 100 yds of this fence on normal ground by day in 30 minutes.

3. **Stores required for 100 yds of fence**

Stores	*Man loads*
52 long screw pickets	13
18 concertinas	18
2 coils of barbed wire	2
Tracing tape, wire cutters, and wind-lassing sticks	1
	34

The whole party, including the commander, carry up one load each. The commander and one man stay at the site and trace the line of the fence while the remainder of the party make five complete journeys less four man loads.

The stores may be laid out in any convenient manner provided that each man knows and becomes familiar with the layout, so that the stores can be found at night. The layout shown in Fig 30 is recommended.

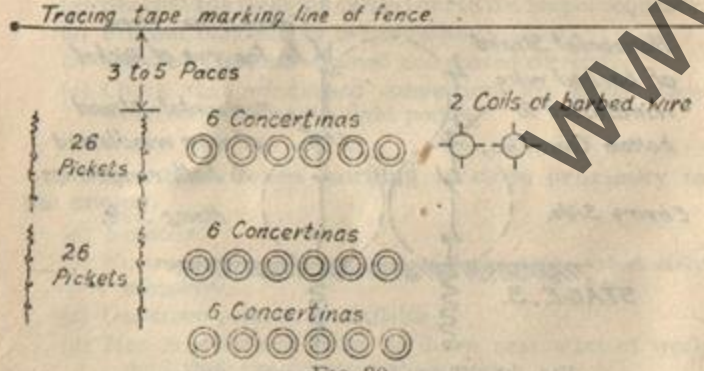


FIG 30

LAYOUT OF STORES FOR 100 YDS TRIPLE CONCERTINA FENCE

4. **Drill for 100 yds of fence**

1st task. The commander paces along the tracing tape followed by the party in single file. Each man, other than the commander, carries a windlassing stick and four pickets, except the last man, who carries two pickets.

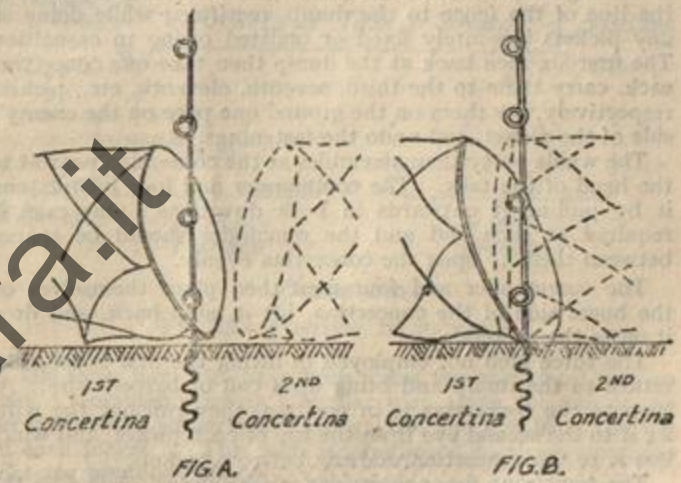


FIG 31.—FIXING CONCERTINAS TO PICKET

The commander indicates at 5-pace intervals the positions for the pickets. The leading man lays down his four pickets in turn at the points indicated and screws in the fourth, third, second, etc., in that order. Each man in turn acts similarly.

Having screwed in all his pickets, each man returns along the line of the fence to the dump, rectifying while doing so any pickets insecurely fixed or omitted owing to casualties. The first six men back at the dump then take one concertina each, carry them to the third, seventh, eleventh, etc., pickets respectively, lay them on the ground one pace on the enemy's side of the picket, and undo the fastenings.

The whole party then assembles at the concertina nearest to the head of the task. The commander and four men extend it by pulling it outwards in both directions. One man is required at each end and the remainder should be spaced between them to open the concertina evenly.

The commander and four men then place themselves on the home side of the concertina, lift it, step back, and drop it on to the pickets.

The three men not employed in lifting the first concertina return to the dump and bring up a coil of barbed wire. As soon as the concertina is in position, they run out the wire, fix it to the second eye from the top of each picket, and windlass it to the concertina midway between pickets.

The remaining five concertinas are extended, placed on the pickets, and wired in the same way. The ends of adjacent concertinas are fixed to the picket in the following manner :—

The bottom portion only of the end coil of the first concertina is placed over the picket. Both the top and bottom of the end coil of the second concertina are then placed over the picket and finally the top portion of the first concertina is placed over the picket above all the others. (Fig 31.)

2nd task. This will start before the three men fixing the horizontal strand have finished, hence the commander and four men only will be available at first. These four men return to the dump where each man collects four pickets. The pickets are then laid out and screwed in on a line parallel to that of the pickets of the 1st task and 3 ft from it on the home side. The four men return to the dump, carry out the remaining ten pickets, and screw them in.

Each picket of task 2 must be placed opposite the centre of the gap between pickets of task 1. The left hand picket of task 2 must overlap 2½ paces to the left of the left hand picket of task 1.

Having screwed in the pickets, the four men carry six concertinas up to the third, seventh, eleventh, etc. picket respectively, and remove the fastenings. The commander

and all four men then extend the left hand concertina and drop it on to the pickets exactly as in task 1. They repeat this process with each of the remaining concertinas.

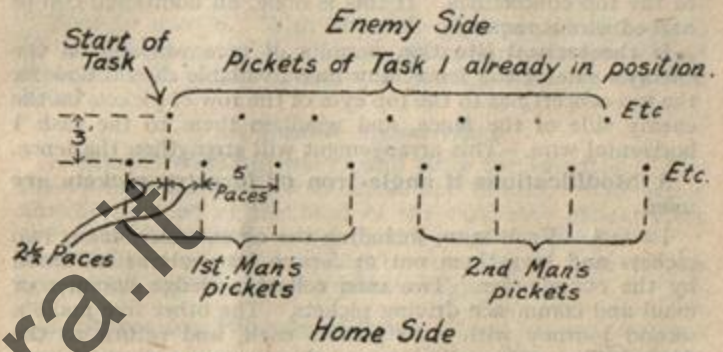


FIG 32.—POSITION OF PICKETS

The three men who have been fixing the horizontal wire on task 1, commence fixing a similar wire along the top of the second row of concertinas through the 2nd eye from the top of each picket. This wire is windlassed to the concertinas midway between pickets.

3rd task. When the commander and four men have finished placing the concertinas of task 2, they return to the dump, collect the remaining concertinas, extend them on the home side of the fence, and lift them over the home line of pickets on to the top of the two lower concertinas. As soon as it is placed in position each concertina is fixed to the top eyes of the home line of pickets as follows :—

Two adjacent wires of the concertinas (or with pickets where the ends of two concertinas meet, the outside wire of each concertina) are grasped together in both hands, which should be about 15 ins apart. These two wires are then drawn upwards into the eye of the picket, care being taken that the hand grasping the lower part of the wires is on the same side of the picket as the double portion of the eye. The *lower portion* of the wires is then *carried up and over* the cut end of the picket. Both wires will now be found to pass through the eye. In some instances it will be necessary to pull the two wires over the picket to the nearside before they can be passed up into the eye. The remaining three men meanwhile continue running out and fastening the horizontal wire of task 2. When they have finished, they return and windlass this horizontal wire to the top concertinas.

Instead of securing the top concertinas to the home line of pickets as above, another horizontal strand of barbed wire may be fixed to the top eyes of the home line pickets and windlassed to the top concertinas. If this is done, an additional coil of barbed wire is required.

If the tactical situation permits of men working on the enemy's side of the fence, any men available should now fix the top concertinas to the top eyes of the row of pickets on the enemy side of the fence, and windlass them to the task 1 horizontal wire. This arrangement will strengthen the fence.

5. Modifications if angle-iron or forestry pickets are used.

1st task. Each man, including the commander, takes two pickets and lays them out at 5-pace intervals as indicated by the commander. Two men collect a sledge hammer or maul and commence driving pickets. The other five make a second journey with two pickets each, and return to the dump. Two pairs collect two sledge hammers or mauls and also drive pickets, while the remaining man begins to carry out concertinas. When the pickets have been driven, the commander and four men extend the concertinas and lift them over the pickets, and two men run out the horizontal barbed wire strand. This is fastened to the pickets just above the height of the concertinas and is windlassed to the concertinas midway between the pickets.

2nd and 3rd tasks. The commander lays out the first two pickets of the home line and four men carry out the remainder in three journeys. They then drive all the pickets, working in pairs. Meanwhile the man who carried out the concertinas for task 1 carries out the remainder of the concertinas, laying them out in pairs behind the appropriate pickets. After driving the pickets, the four men will, if necessary, help to carry concertinas.

The commander and four men assemble at the first pair of concertinas, extend one of them, and place it over the first five pickets of the 2nd task. They next extend the second concertina of the pair and place it on top of the two concertinas already in position, and then continue with the other pairs.

The two men who fixed the front horizontal strand are joined by the seventh man, and the three work together to fix the rear horizontal strand. This is fastened to the pickets at about the level of the top concertina. Before windlassing to the standing part, the loop in the barbed wire is passed round a strand of the concertina so as to secure it. The horizontal strand is also windlassed to the top concertina midway between the pickets.

If another coil of wire is available and if men may work on the enemy side of the fence, another horizontal wire may be run along the enemy side pickets and fixed to the top concertina as just described.

Time for erection. With stores already dumped at the head of the task, a party of a commander and seven men should erect 100 yds of this fence on normal ground by day in 1 hour.

3. Double apron fence

1. Size of working party and time for erection.—The most suitable party is a commander and 10 men. With stores already dumped at the head of the task they should erect 100 yds of fence on normal ground by day in 1 hour.

As this fence will normally be constructed close to the enemy, the drill using screw pickets is given.

2. Stores for 100 yds of fence

	No.	*Man-loads*
Pickets, screw, long	40	10
,, ,, short	82	10
Barbed wire (28-lb) coils ...	13	13
Wire cutters, pairs	2	
Windlassing sticks	one per man	
Total		33

All stores are carried to the start of the task and laid out. The stores may be laid out in any convenient method, provided that they can be found in the dark and that the working party knows how they are to be laid out. The following is found to be a suitable method :—

About 5 yds behind the trace of the task and in line with the head of the task lay all the long pickets in bundles of four, screw points towards the enemy. Next (farther away from the trace of the task) lay out one pair of short pickets and the remainder of the short pickets in bundles of four in two equal groups. Next the barbed wire coils in any neat arrangement.

3. Drill for 100 yds of fence

1st task—Long pickets

The commander takes the two anchorage pickets of the isolated pair, places one at the start of the task and the other at the end of the task when it is reached. He is followed by the party in single file, each man carrying four long pickets. The long pickets are laid out by men in succession, three paces apart as indicated by the commander. Having laid out his pickets each man screws in his own, beginning with the last

laid out. When all his pickets are screwed in he returns to the dump along the line of the long pickets and screws in any left on the ground, either by mistake, or as a result of casualties. If necessary, men will make further journeys with four long pickets and carry out the above procedure until no long pickets remain. The first man screws in the first anchorage picket. The commander himself screws in the last anchorage picket. When all the long pickets have been taken the second task will at once be started.

2nd task—Short pickets

Each man as he gets back to the dump takes four short pickets from the front dump and lays them half-way between the long pickets and two long paces from the centre line of the fence on the enemy's side of it. He then screws in his short pickets, beginning with the last one. When all his pickets are screwed in he returns to the dump along the line of the short pickets and screws in any left on the ground. When the front dump is emptied, the short pickets from the rear dump are taken and fixed in a similar manner on the home side of the fence.

3rd task—Wire

As the men return to the dump they combine and erect the wire as follows :—

First three men		Front diagonal to top eye of picket and to short pickets.
Next pair	...	Bottom wire on front apron.
,, ,,	...	Centre ,, ,, ,,
,, ,,	...	Top ,, ,, ,,
,, ,,	...	Bottom fence wire to bottom eye of picket.
,, ,,	...	Centre ,, ,, next to bottom eye of picket.
,, ,,	...	Top fence wire to top eye of picket.
,, three men		Rear diagonal to top eye of picket and rear short pickets.
,, pair	...	Top wire on rear apron.
,, ,,	...	Centre wire on rear apron.
,, ,,	...	Bottom ,, ,,

4. **Modifications for use of angle-iron or forestry pickets.**—The man-loads of stores will be increased to 46, as the long pickets are 20 man-loads and 5 sledge hammers or mauls are 3 man-loads.

In tasks 1 and 2, men work in pairs, one carrying two long or four short pickets and the other a maul or sledge hammer according to the type of pickets.

4. High wire fence

1. This fence will not be constructed in the immediate proximity of the enemy, and a minimum of work on the enemy side is therefore permissible. As shown in Figs 34 and 35, it consists of two single apron fences with four concertinas between. It is erected in six tasks, namely :—

1st task—front apron pickets.
2nd task—wiring front apron.
3rd task—triple concertina.
4th task—rear apron pickets.
5th task—top diagonal strand, top horizontal strand and top concertina.
6th task—wiring rear apron.

2. **Size of working party and time for erection**

The most suitable party is 2 NCOs and 14 men. They should erect 100 yds of this fence on normal ground in 2 hours, assuming all stores have been laid out at the site.

3. **Stores for 100 yds of fence :—**

		Man-loads
Pickets, long (angle-iron or forestry) ...	80	40
Pickets, short (angle-iron or forestry) ...	84	10
Coils, barbed wire, 28 lb	19	19
Concertinas, barbed	32	32
Staples	100	1
		102

In addition, each member of the working party carries a windlassing stick and the commander and assistant commander a pair of wire cutters each.

Each alternate member of the working party also requires either a maul or a sledge hammer, depending on the type of picket to be used. If alternate angle-iron and forestry pickets are being used, both hammers and mauls are needed.

Tracing tapes are laid on the line for the pickets of the front apron.

All stores are carried up and laid out at the dump. The second-in-command and each member of the working party make seven journeys; on their first journey the second-in-command and the first two men carry up the tools, windlassing sticks, and mauls or hammers. The commander carries a load on the first journey only, and thereafter directs the dumping of stores.

The stores may be laid out in any convenient method, provided that they can be found in the dark and that each member of the party knows the method of layout. A suitable layout is shown in Fig. 33.

TYPICAL STORES LAYOUT FOR 100 YARDS OF HIGHWIRE FENCE

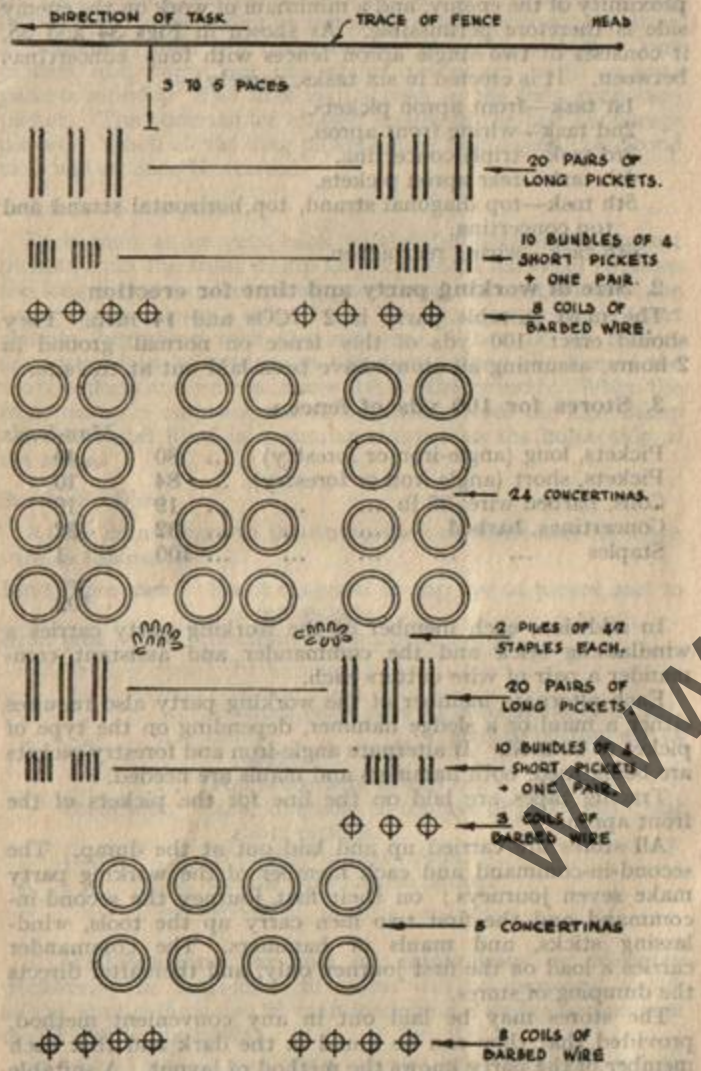
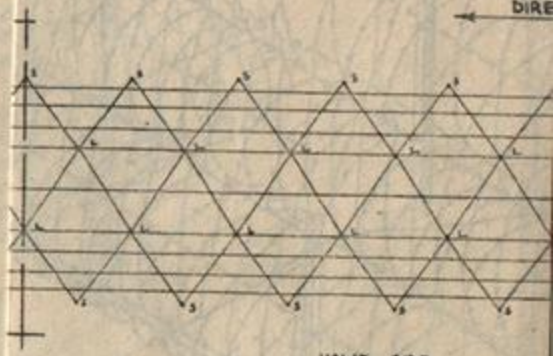


FIG 33

VIEW OF CO

HIGHWIRE FENCE CONSTRU

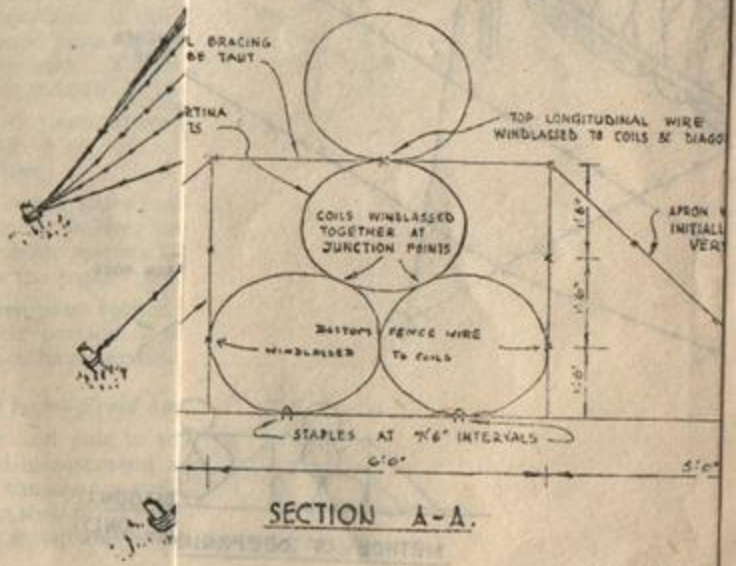
ENEMY SIDE



HOME SIDE

PLAN OF OBSTACLE.

CONCERTINAS OMITTED FOR CLEARNESS

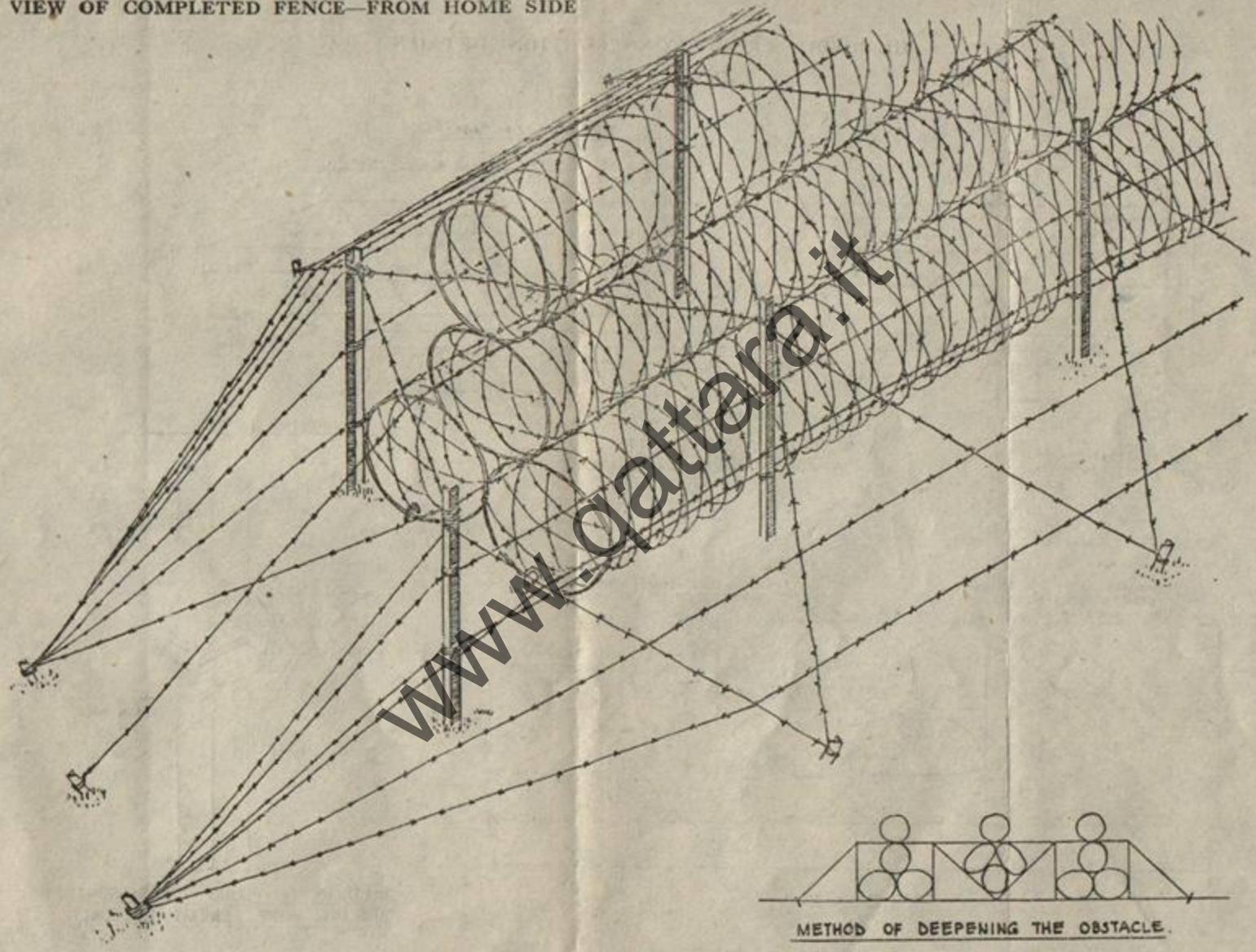


SECTION A-A.

FIG 35

[To face page 50

VIEW OF COMPLETED FENCE—FROM HOME SIDE

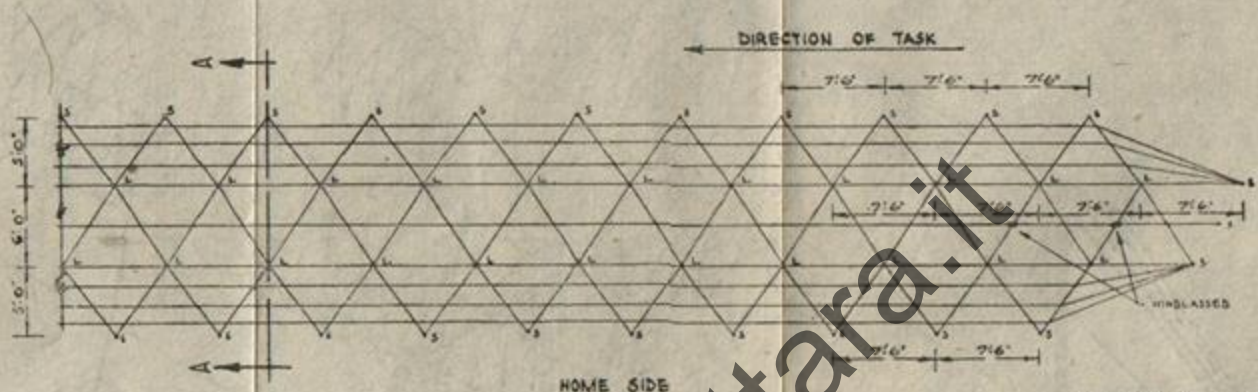


METHOD OF DEEPENING THE OBSTACLE.

FIG 34

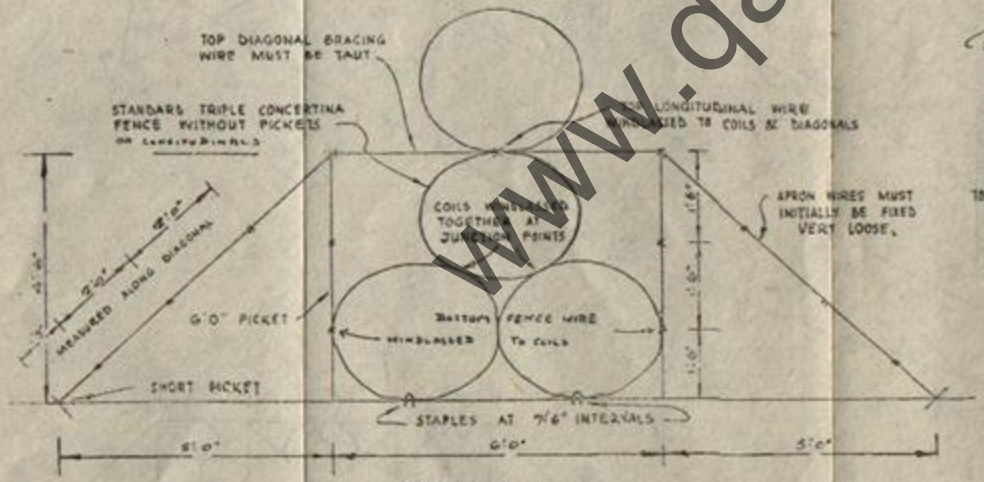
HIGHWIRE FENCE CONSTRUCTION DETAILS

ENEMY SIDE

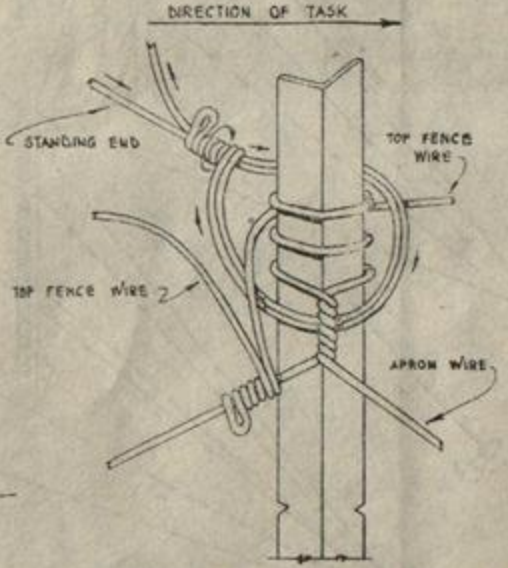


NOTE :-
6'-0" LONG PICKETS SHOWN THUS 'L'
5'-0" SHORT PICKETS SHOWN THUS 'S'

PLAN OF OBSTACLE.
CONCERTINAS OMITTED FOR CLEARNESS



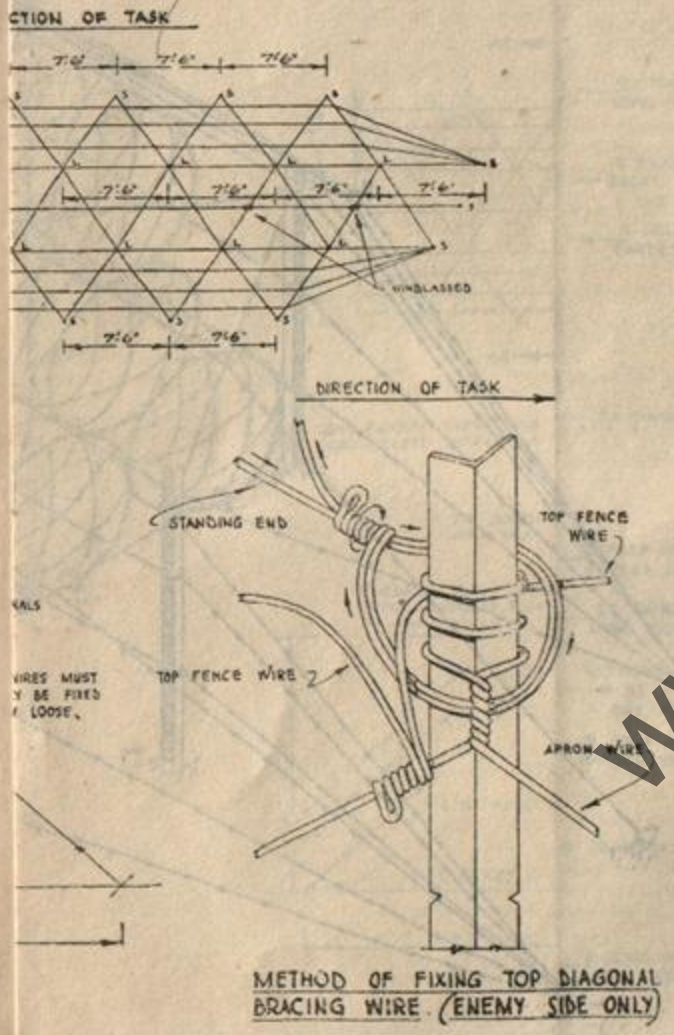
SECTION A-A.



METHOD OF FIXING TOP DIAGONAL BRACING WIRE (ENEMY SIDE ONLY)

FIG 35

CTION DETAILS



4. Drill for 100 yds of fence

1st task—Front apron pichets. (Fig. 35.)

The commander takes two anchorage pickets and places one at the start of the task and the other at the end of the task when it is reached. He is followed by the party in single file.

For this task the party works in pairs; five pairs, under the commander, constitute the party for long pickets and two pairs, under the second-in-command, the party for short pickets.

One man in each of the seven pairs carries a maul or a sledge hammer, or both, depending on the pickets to be used. The second member of each of the first *five* pairs carries two long pickets. If alternate angle-iron and forestry pickets are to be used, he carries one of each. The second member of each of the last *two* pairs carries four short pickets.

The commander indicates the positions, at 3-pace intervals, for the long pickets. Each man carrying the long pickets lays down his two pickets where indicated and, with the other member of his pair, commences driving his second picket. On completion, each pair return to their first picket and drive that.

Meanwhile, the two pairs carrying short pickets work similarly, driving their fourth picket first and working back. The positions of the pickets are indicated by the second-in-command, two paces in front of and centrally between the long pickets. The first pair also drive the picket placed by the commander at the head of the task.

As all pairs return to the dump after driving their pickets, they drive any pickets which have been forgotten or left by casualties.

All seven pairs make further journeys with the same sized pickets as before, until all pickets have been driven. The pair which reaches the end of the task, driving short pickets, drives the picket placed there by the commander.

When pairs return to the dump and find that all the pickets of their particular first task have been taken, they dump mauls or hammers and immediately start the second task.

2nd task—Front apron

The first pair to start on the second task are joined by the second-in-command and the three take one barbed wire coil from the dump and erect the diagonal wire of the apron, *leaving it slack*. When this first coil is finished, one man returns to the dump and brings a second coil to complete the diagonal.

Subsequent pairs take one barbed wire coil and erect the remaining wires in the front fence in the following order, drawing them as taut as possible :—

Second pair to finish	1st task	...	bottom apron wire
Third	,,	,,	,,	,,	...	middle ,, ,,
Fourth	,,	,,	,,	,,	...	top ,, ,,
Fifth	,,	,,	,,	,,	...	bottom fence wire
Sixth	,,	,,	,,	,,	...	middle ,, ,,
Seventh		,,	,,	,,	...	top ,, ,,

3rd task—Triple concertina

(*a*) On completion of the second task, the first eight men (under the second-in-command), carry one concertina each to the fence. The concertinas are laid immediately on the home side of the line of long pickets, successively midway between the

Third and fourth long pickets.
Eighth and ninth ,, ,,
Thirteenth and fourteenth long pickets.
Eighteenth and nineteenth ,, ,,
and so on

The first five men available, after completing their 2nd task or having carried up a concertina, move to the first concertina, extend it to 37½ ft (that is to say from the 1st to the 6th picket) and place it in position against the back of the apron pickets. The sixth man available, as soon as the concertina is in place, begins to windlass it to the bottom strand of the apron fence, once between each pair of pickets. He also windlasses together the ends of adjacent concertinas.

The next five men available extend and place the second concertina.

Of the remaining three men, the first available begins to windlass the second concertina as soon as it is placed. The remaining two men return to the dump, collect 50 staples, and, beginning at the head of the task, staple the concertinas to the ground opposite each long picket.

The task then proceeds on the same plan, two parties of five extending and placing concertinas, one man with each party windlassing, and two men fixing the staples. During this stage, the commander controls the allocation of the members of the party and the extension and placing of concertinas while the assistant commander controls the windlassing and placing of staples.

(*b*) As the men complete the first line of concertinas they proceed, in the same sequence, to erect the second line, except that the only windlassing needed is between the ends of adjacent concertinas. Each man of the first eight to finish

carries up and places one concertina between the same pickets as for the first line. The working party then divides into two parties of five extending and placing concertinas, each party assisted by two men placing staples and windlassing together the ends of the concertinas. Staples are placed midway *between* those on the first line of concertinas.

(*c*) When the second line is in place, the third line of concertinas is carried up and laid down between the same pickets as in (*a*) above, and, as soon as all eight are in place, extension and erection begin. Again two parties, each of five men, place the concertinas. The two men assisting each party, both working on the home side of the fence, windlass the third concertina to the lower two. One man of each pair windlasses, once between each pair of pickets, the top concertina to the lower one on the enemy side, and also windlasses together the ends of the concertinas. The other works slightly behind him to avoid impeding him, and windlasses the top concertina to the lower one on the home side.

4th task—Pickets of home side fence.

On completing the third task, each man returns to the dump, and the party is formed into pairs organized as for the 1st task. The commander carries *four* short pickets. He places one of them as an anchorage picket at the head of the home side fence, 6 ft behind the line of the long pickets of the enemy side fence, and midway between the end anchorage picket and first long picket of that fence. He then places his second short picket in line with the two end anchorage pickets, and midway between them.

The remaining two he places similarly at the finish of the task.

Five pairs drive the long pickets and two the short. The first pair of the latter, after driving their four pickets, drive the two placed by the commander at the head of the fence.

The pair driving the last four pickets drive the last *two* pickets left by the commander before beginning on their four.

The task continues until all the pickets are driven.

5th task—Top diagonal strand—Top horizontal strand and top concertina.

(*a*) The first two pairs to finish driving pickets return to the dump, collect one coil of barbed wire and begin to erect the diagonal strand. One of the four men works on the enemy side.

The diagonal strand starts at the short picket at the head of the home side fence, goes to the top of the first long picket of the enemy side fence, and then backwards and forwards between the two rows of long pickets. Of the three men

working on the home side, one carries the coil, the second makes fast to the home side pickets, and the third passes the wire in a loop about 2 yds long to the man on the enemy side. The latter takes the strain on the standing end of the wire and then makes fast to the appropriate picket on his side.

To do so, he lays the loop *over* the top fence wire beyond the picket, away from the head of the task, and then takes it round the picket, under the apron wires, and under the top fence on the side towards the head of the task (Fig. 35). He then windlasses the loop to both the standing and running ends of the diagonal strand.

The second man on the home side takes the strain on the standing end, and makes fast by the standard method for fixing apron diagonals to angle-iron pickets. When the first coil is exhausted, the man who carried it returns to the dump and collects another.

(*b*) The next two pairs to complete the 4th task return to the dump, collect one coil of barbed wire and begin placing the top longitudinal strand. Two men carry the coil, one windlasses the strand to the centre of the diagonal strand at alternate points of intersection, while the fourth strains the wire. The strand is first attached to the centre and anchorage picket and windlassing begins at the first point of intersection. The strand is finally attached to the centre short picket at the end of the task.

(*c*) The remaining six men on completion of their 4th task, return to the dump and carry up the remaining eight concertinas, placing them behind the line of the rear long pickets and between the same pickets as for all previous concertinas. The first two men make two journeys.

All six then extend the first concertina to 37½ ft, lift them over the home side pickets and lay them on top of the longitudinal strand. They then stand, one man opposite each of the six covered by the concertina. Nos. 1, 3, and 5 of the six hold the concertina in position, while Nos. 2, 4, and 6 windlass it to the longitudinal strand and the diagonal strand. This is carried out in one windlass embracing all three strands of barbed wire and is done on the opposite leg of the diagonal wire to that already windlassed to the longitudinal strand. When Nos. 2, 4, and 6 have completed windlassing, they hold the concertina while Nos. 1, 3, and 5 do the same on the strands immediately in front of them.

As the original first four pairs become available, three of the pairs commence extending, lifting, and windlassing the remaining concertinas and the two parties of six continue until the task is completed.

The remaining pair return to the dump and begin the 6th task.

6th task—Rear apron.

The pair not engaged on placing the top concertinas, begin to construct the bottom wire of the rear fence. They are accompanied by the second-in-command who windlasses the wire to the bottom concertina on the home side once between each pair of pickets.

Again, all wiring must be as taut as possible.

Subsequent pairs, as they complete the 5th task, return to the dump and commence wiring the fence in the following order:—

1st pair—middle fence wire.
2nd pair—top fence wire.

The top fence wire is attached immediately *below* the top diagonal fastening. The windlassing bight is passed *over* and round one leg of the diagonal wire before being windlassed to the standing end.

The next *three men* available erect the apron diagonal wire, fastening it in the standard way above all the other fastenings on each picket.

The next two erect the top apron wire.

The next two erect the middle apron wire.

The remaining man waits until another man becomes available and the two then complete the fence by erecting the bottom apron wire.

APPENDIX V

INSTRUCTIONS FOR CLOSING AND FASTENING BARBED WIRE CONCERTINAS AFTER USE ON TRAINING

1. Barbed wire concertinas used for training lose their shape quickly, and become difficult to handle, particularly in darkness, unless care is taken in closing and fastening the concertinas after use.

The following instructions should always be followed before a concertina is returned to store.

2. The concertina is first stretched out on the ground and any kinks in the wire removed so far as is possible. Loose clips should be refixed, or replaced by binding with plain wire.

3. In order that the concertina may be supported in a convenient manner for handling, a "horse" should be constructed of two X-shaped supports with a horizontal member resting on their crutches.

Long-angle-iron pickets are suitable for both uprights and cross-piece.

The cross pickets should be bound with a few turns of wire to secure them.

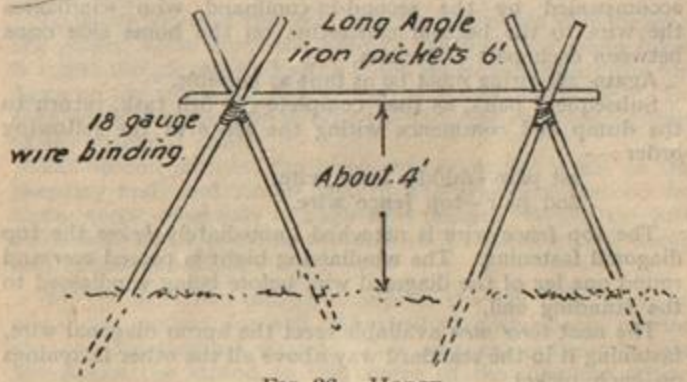


FIG 36.—HORSE

4. The concertina is then closed and hung on the horizontal picket with the *carrying handles* at the sides, thus :—

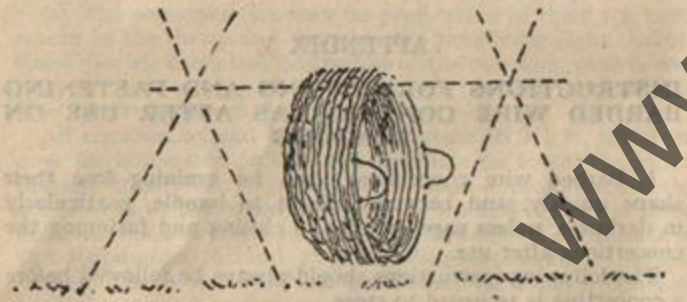


FIG 37

5. If a new concertina is examined, it will be seen to have two wire *carrying handles*. These are fixed opposite to one another on the outside turn of wire at one end of the concertina.

At each carrying handle is a special *wire fastening* made of thinner wire than the carrying handle.

These *fastenings* are designed for rapid release (*see* para 10), and should on no account be cut with wire cutters.

Any intermediate bindings of wire should be removed and replaced by spunyarn or tape which can easily be removed in the field.

6. Each *fastening* consists of two loops of wire, one fastened to the end of the concertina at the *carrying handle* and the second fastened in a corresponding position at the other end of the concertina.

These loops are wound around the closed turns of the concertina in opposite directions and are then interlocked to secure them (*see* detail in para 11).

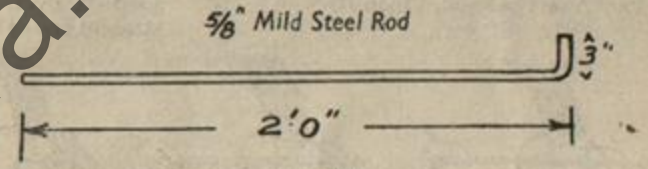


FIG 38

7. When the concertina is closed after use, the corresponding *fastening wire* loops for fixing the concertina should be level, or nearly level, with the *carrying handles*.

If it is not possible by twisting the concertina to bring the loops level with the handles, the loops at the end farther from the handles must be taken off and refixed so that they are level.

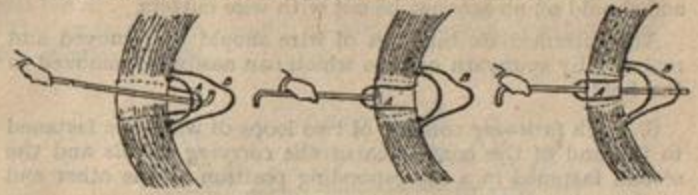
The *carrying handles* themselves should be repaired if necessary.

8. To consolidate the turns in the concertina and fasten the wire loops around them, a bar or other suitable implement is used. Such a bar should be about 2 ft long with one end turned at right angles to form a hook of about 3 ins.

9. The fastening on the other side is made in the same manner, starting by passing the bar through the carrying handle and the loop on that side. The direction of rotation of the bar will be opposite to that shown in each figure.

10. The fastening is released by straightening the end of loop B and disengaging loop A from it.

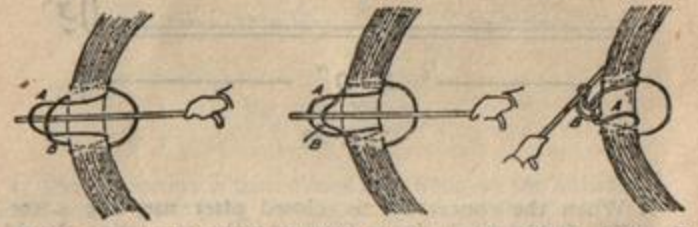
11. The method of making the fastening is as follows :—



1. Pass the hooked end of the bar through both loop B and the carrying handle and pick up loop A on the hook.

2. With a clockwise motion pull loop A around the turns and through the carrying handle and loop B.

3. Continue to use the bar as a lever in a clockwise direction until it is possible to slip loop B over the straight end of bar.



4. Reverse the direction of rotation of the bar and pull loop B around the concertina in a counter clockwise direction until it is possible to slip loop A off the end of the bar over loop B.

5. Pull loop B through loop A and using the bar as a lever in a clockwise direction draw loop B back upon itself.

FIG 39.

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APPENDICES

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