HOME OFFICE

CIVIL DEFENCE

HANDBOOK No. 2

FIELD CABLE CONSTRUCTION

LONDON: HER MAJESTY'S STATIONERY OFFICE
1954

TWO SHILLINGS NET

HOME OFFICE

CIVIL DEFENCE HANDBOOK No. 2

FIELD CABLE CONSTRUCTION

LONDON: HER MAJESTY'S STATIONERY OFFICE
1954

CONTENTS

CONTENTS—*Cont.*

Chapter I. General

1. Introductory

Telephone communications for the Civil Defence Corps will be based on the telephone system operated by the General Post Office. This system will in fact form the mainstay of all communications required for civil defence purposes, and it is proposed that the C.D. Corps will hold field cable and associated equipment for emergency use only in the event of a major breakdown of G.P.O. lines.

In built-up areas the General Post Office rely mainly on cables buried beneath roadways or pavements ; overhead wires are used to a limited extent. Greater use is made of overhead routes in the less densely populated urban and rural areas. Most telephone subscribers are connected by *exchange line* direct to their local telephone exchange, through which all their calls are made. In exceptional cases there may be direct connections between subscribers (e.g. police or fire stations) ; these are known as *private circuits*. Private circuits are not connected to Post Office telephone exchange switchboards, but they normally pass through equipment (from which the lines may be tested) installed in telephone exchange buildings.

Both underground cables and overhead wires are liable to suffer air raid damage, but it is damage to the telephone exchanges which is likely to cause the greatest disruption of communications. In order to provide greater security for C.D. telephone lines, wherever possible arrangements are made with the G.P.O. for circuits to control centres, etc., to be alternatively routed in order that the risk of all the lines being out of action at one time is reduced. But to meet the contingency, for example, of a control centre being isolated, the H.Q. Section of the C.D. Corps will be provided with field cable and telephone equipment to enable essential point-to-point lines to be quickly re-established.

2. The Fighting Services

The Army is responsible for providing any field cable or field telephone installations required for its own use.

During active civil defence operations in war C.D. Corps line parties may find that Army line routes pass through the areas in which the Corps is working. These routes may have been laid by the Royal Corps of Signals, or by the regimental signallers of other Regiments, or Corps. It is not likely that civil defence line networks will be linked to Army systems but Civil Defence Corps linemen should be able to recognise Army lines by the shape of the line labels. A variety of label shapes are used in order to distinguish between the lines of each formation served. For civil defence purposes an octagonal line label will be used (See paragraph 22).

The main types of Army line construction are :—

(*a*) Assault cable ;

(*b*) D Class cables ;

(*c*) Quad cables ;

(*d*) Aerial cables ;

(*e*) Open wire routes ;

(*f*) Underground cables.

Assault Cable is a light single conductor with a thin but tough sheath. This cable is intended to be quickly laid over the ground to provide temporary communication during action.

D Class Cable is the general purpose field cable. It may be either single, or a twisted pair. Each cable has one or more copper strands, and, to give added strength, several steel strands. The insulation is rubber or P.V.C.

Field and Carrier Quad Cables each consist of two pairs of wires enclosed in a single rubber or plastic sheath of about ⅜-inch diameter. *Aerial cable* (which is also used by the General Post Office) usually has a number of pairs of wires (e.g. 25 or 50) enclosed in a single lead or plastic sheath. The cable is suspended at intervals of about a foot from a separate strong overhead wire supported on poles. This technique is necessary because the cable itself has not sufficient tensile strength to enable it to be supported only at poles. *Open wire routes* (often known as " multi air line ") use either bare or insulated single wires which are suspended on light poles fitted with cross arms and insulators. These resemble miniature versions of the familiar General Post Office telephone poles. *Underground cable* is seldom used by the Army, and will not be used at all by the Civil Defence Corps.

3. Functions of Civil Defence Line Detachments

In the event of a breakdown of G.P.O. telephone lines the Controller, having obtained as much information as possible of the extent to which his communications are affected, will decide which point-to-point circuits are to be established by the use of field cable ; he will direct the field cable detachment accordingly.

In no circumstances will C.D. line detachments connect field cable to G.P.O. lines.

Chapter II. Cable and Equipment

4. Apparatus, Cable-Laying, No. 10 and Reel, Cable, No. 4

The Apparatus, Cable-Laying, No. 10 is used in conjunction with Reel, Cable, No. 4 for laying and reeling-in Assault Cable. Both the Cable Layer and the Reel are manufactured in aluminium alloy, and are sufficiently light to allow the laying of half a mile of Assault Cable by one man. The Reel, Cable, No. 4 is intended to be used with half mile coils of Assault Cable, No. 2. The method of use is as follows :—

(*a*) Separate the halves of the Reel, Cable, No. 4 by unscrewing the knurled knob. Remove the hessian covering from the coil of Assault Cable, No. 2, but leave the ties in place.

(*b*) Lay the coil of wire in position on one half of the reel and re-assemble the reel.

(*c*) To fit the reel to the Cable Layer straighten the toggle plate and insert the spindle in the axial hole of the reel towards the side carrying the knurled knob.

(*d*) When the reel is in position remove the ties from the coil.

Weights are as follows :—

A.C.L. No. 10	8 ozs.
Reel, Cable, No. 4	3 lbs. 8 ozs.
½ mile coil of Assault Cable	11 lbs.
Total weight	15 lbs.

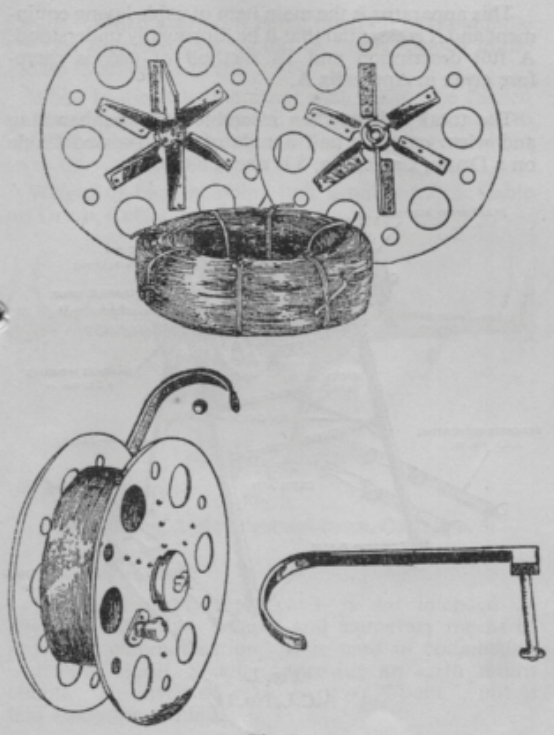

Fig. 1.
A.C.L. No. 10 with Reel, Cable, No. 4 and Coil of Assault Cable.

5. Apparatus, Cable-laying, No. 11

This is a robust, portable, hand-operated, multi-purpose cable layer, used for laying D class cable from Drums, Cable, No. 5. It is suitable either for mounting in a vehicle or for manhandling by two men.

This apparatus is the main item of cable laying equipment and it is essential that it be thoroughly understood. A full description and its method of use, is therefore given in Appendix A.

The total weight when assembled for manhandling and when carrying half a mile of D.3 Twisted Cable on a Drum, Cable, No. 5 is about 88 lbs.

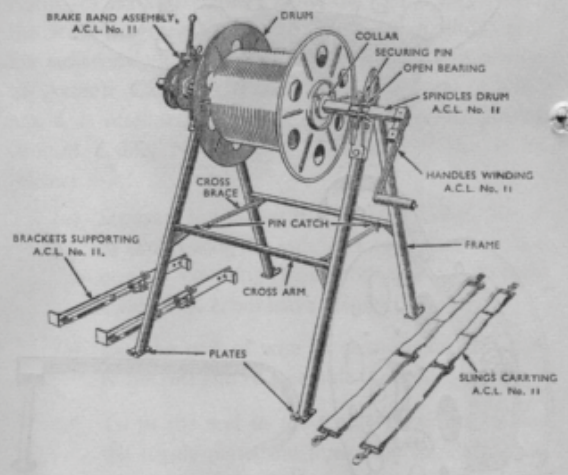

Fig. 2.
A.C.L. No. 11.

6. Bar, Carrying, Lightweight

This is a two-man, hand cable-laying device used in conjunction with Drums, Cable, No. 5 for laying or reeling-in D. Class Cable. It consists of a mild steel tube 31 inches in length and 2 inches in diameter fitted at each end with a leather-covered steel spade type handle. The spindle on which the drum is mounted is fitted at right angles to the bar at the centre of its length ; it passes through a plain brass bearing in the bar and is fitted with a crank and a wooden

handle. When a drum is being fitted on to the spindle the two square collars should be firmly located in the square holes of the drum.

When in use it is important that the bar be carried so that the spindle is vertical. If an attempt is made to lay with the spindle horizontal the bearing is liable to seize up.

Weight of bar, including half a mile of D.3. Cable on Drum, Cable, No. 5 is 63 lbs.

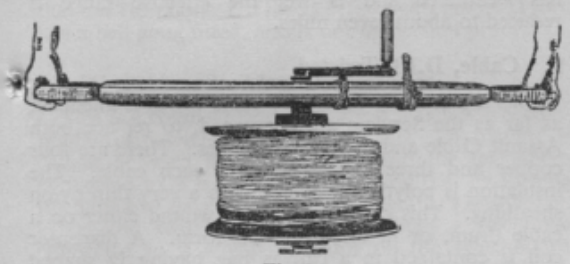

Fig. 3.
Bar, Carrying, Lightweight and Drum, Cable, No. 5.

7. Cable, Assault

This lightweight single cable is *not* intended as anything more than a rapid and temporary means of providing communication. It is used in conjunction with Pins, Earth, Small, to provide an earth return circuit. This type of cable is never " built ", but is laid along the ground.

The speech range of the cable is approximately four miles.

The cable is sometimes supplied already wound on a small drum ; otherwise it is in coil form suitable for use with a Reel, Cable, No. 4.

8. Cable, D.3, Twisted

This will be the cable normally used by the Civil Defence Corps. It consists of two D.3. Single Cables, of different colours to simplify identification, twisted

together. Each cable is made up of one or more copper strands, together with a number of steel strands to give the necessary strength. Earth return circuits should not be used with D.3. Cable except in special circumstances. The Cable is supplied in half mile lengths (weight 44 lbs.) and is carried on Drums, Cable, No. 5 (weight 13 lbs.).

When the cable is in good condition and dry the speech range is about twelve miles; when the cable has weathered and is wet the effective range is reduced to about seven miles.

9. Cable, D.10, Twisted

This is a recently developed cable which is intended, as far as the Services are concerned, to replace both Assault Cable and the D class cables. There are four copper and three steel strands in each cable. The insulation is polythene covered with a very thin nylon sheathing. This cable is provided wound either on a cable drum, or in dispenser coil form. A dispenser coil is contained in a canvas bag having D shaped metal rings by which it may be carried by hand or attached to a lineman's webbing equipment. The cable may then be laid by the simple process of pulling it out of the coil in the same way as string is removed from the centre of a ball. If necessary the bag may be attached to a vehicle and the cable pulled away as the vehicle proceeds.

The weight of a half mile of cable is 25 lbs.

10. Telephone Set, J

This is a portable field telephone built into a metal case having a hinged lid and carrying strap. The instrument is immersion proof.

Operating current is provided either by two Cells, Dry, X, or two Cells, Inert, S, which are housed in the battery box.

A magneto generator, the handle of which projects through the case, is used for calling the switchboard or other telephones to which the instrument may be connected.

No bell gong is provided, the bell hammer being arranged to strike two projections on the case. A " pressel " switch is fitted in the handset and should be depressed when speaking.

The weight of the instrument is about 9 lbs.

11. Telephone Set, L

This is a similar instrument to the Telephone, J. The main differences between the two instruments are that the Telephone, L is heavier (it weights nearly 11 lb.), has a bell gong fitted, and is not immersion proof.

12. Switchboard, Magneto, 10-Line

This is a compact field instrument which will accommodate up to ten field telephone circuits. The method of calling between the switchboard and the telephones connected to it is by magneto ringing (i.e. by turning the handle of the generator of the operator's telephone). When the switchboard is called from a telephone connected to it a flap indicator on the switchboard associated with the particular telephone circuit in use drops. At the end of a call the user of each telephone concerned should turn his generator handle, this will cause the appropriate flap indicator on the switchboard, already restored to its normal position by the operator when answering the call, to drop as an indication that the call has terminated.

A buzzer and external battery may be connected in series with the ALARM terminals to give an audible calling signal. Lightning protectors are connected to the line circuits within the switchboard.

The Switchboard is housed in a mild steel case, having two hinged lids which give access to the front and back panels. A rubber gasket is fitted in each lid to make the instrument water-tight during transit.

The front panel carries the drop indicators, line jacks, operator's jack and single plug-ended cords.

The back panel carries ten pairs of line terminals, two alarm terminals, an earth terminal and a cord for connection with the operator's telephone set.

A five-foot length of copper braid permanently attached to the back of the case is provided for earthing the switchboard. When in use one end of the braid should be connected to the EARTH terminal and the other end connected to the earth pin which should be inserted into the moistened ground.

A spares tray fitted inside the case holds two cords and ten lightning protectors. This tray can be reached by withdrawing the switchboard from the case.

It should be noted that no operator's telephone is provided with this switchboard and a Telephone Set, J (or L) must be used for this purpose.

It is not desirable nor is it easy to connect field cables directly to the switchboard, and use should be made of a Strip, Terminal, 10 pair which has an ebonite base on the front of which ten pairs of brass terminals, suitable for field cable, are fitted. On the back of this terminal block there are small terminals to which 1 pair/12½ lbs. wiring from the switchboard may be connected. (See also paragraph 24.)

Chapter III. Jointing and Terminating Field Cable

13. Jointing—General

All linemen must be able to make good joints in field cable. Badly made joints are responsible for many of the faults which occur on a line and may seriously affect the audibility of speech over the line. Speed in making joints is desirable but is secondary to thoroughness and care. A badly made joint may give satisfactory results for a little while but it will soon become faulty and be the cause of a lot of trouble.

Joints used with field cable may be classified under two broad headings, namely, field joints and permanent joints. The former, as the name implies, are used in the field when constructing a field cable line and may either be " straight " joints or " tee " joints. When cable has been recovered from a route it must be " run through " as soon as possible. " Running through " a cable involves a close examination of the whole length; all field joints, kinks, worn insulation, etc. being cut out and the cable made good by means of permanent joints. Before being put away each drum of cable should be tested by speaking over the length.

14. Methods of Stripping Insulation from Conductors Preparatory to Jointing

Care must be taken not to damage the wire when stripping it. The strands will easily break if nicked with a knife. *The knife must not, therefore, be run round the cable to mark the limits of the portion to be bared.* There are two methods of baring a cable :—

(*a*) Make fast the free end of the cable by standing on it or tying it to a support. Strain it with the left hand and scrape off the insulation with a knife.

(*b*) Hold the cable in the left hand and, using the knife as when sharpening a pencil, scrape away the insulation.

15. Field Joints

A description of the knots used in jointing is given in Appendix B.

A field " straight " joint is made by using either a reef knot (or single sheet bend) or by using a self-soldering sleeve. A field " tee " joint consists of a combination of a thumb knot and a reef knot (or single sheet bend).

(*a*) *Method of making a knotted " straight " joint*

Strip the insulation on each cable for about 1½ inches leaving 6 inches of insulation on the ends to prevent the strands from unlaying while the knots are being made.

Join the bared portion of each cable with a reef knot (or where cables are of unequal size with a single sheet bend). The knots should be pulled tight. Now strip the insulation from the ends, unlay a copper strand back to the knot and cut off the remaining strands to within a quarter of an inch of the knot.

(A simple way to locate the copper strands is to bend the bared wires sharply and then release them. The steel strands will spring back to their original positions leaving the copper strands still bent.)

Starting as close as possible to the knot use the copper strand to bind down the steel ends tightly, continuing for about half an inch along the standing part of the cable. Twist off the end of the binding wire. Repeat on the other side of the knot.

Strip off about a quarter of an inch of the braiding on each side of the knot, exposing the insulation.

Cover the joint and the exposed insulation with a layer of rubber jointing tape.

Cover the whole joint with a layer of insulating tape commencing and finishing half an inch beyond the rubber jointing tape.

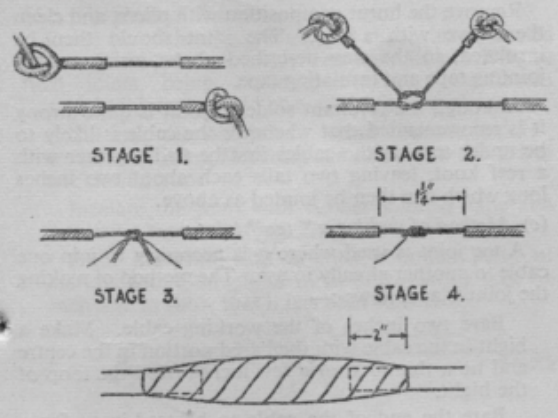

Fig. 4.
Stages in Making a Knotted " Straight " Joint.

(*b*) *Method of making a self-soldered " straight " joint* :—

" Sleeves, self soldering " are copper sleeves partly filled with solder and having a layer of solid fuel on the outside which is ignited by striking on the box in which the sleeves are packed.

Taking care to keep the strands together remove the insulation from each cable for a length of quarter of an inch greater than the length of the sleeve. The wire must be freshly stripped to ensure that the conductors are clean.

Insert the conductors into opposite ends of the sleeve as far as they will go.

Holding the sleeve, " strike " the side of the box across the red spot on the sleeve.

As the solder softens press the bare conductors home into the sleeve, pushing them together to make a good joint.

Maintain steady inward pressure until the joint has cooled.

Remove the burnt composition with pliers, and clean the sleeve with a rag. The joint should then be insulated, in the way described above, using rubber jointing tape and insulating tape.

Although the resultant soldered joint is quite strong it is recommended that whenever the cable is likely to be under tension the cables first be tied together with a reef knot, leaving two tails each about two inches long which can then be jointed as above.

(*c*) *Method of making a " tee " joint :—*

A tee joint is used where it is necessary to join one cable to another already in use. The method of making the joint is as follows :—

Bare two inches of the working cable. Make a bight in the cable with the bared portion in the centre and tie a thumb knot a few inches from the loop of the bight.

Bare the end of the cable to be teed-in as for a knotted " straight " joint.

Pass the end of the teeing-in cable up through the bight, down and behind both legs of the bight, then up and through thus forming a reef knot. Where the cables are of an unequal size, a single sheet bend should be used. (See Fig. 5.)

Complete as for a " straight " joint. When binding, only the side nearest the teeing-in cable need be bound down.

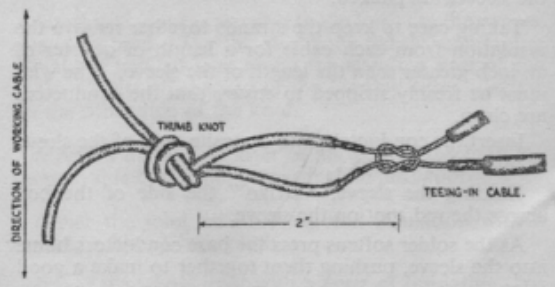

Fig. 5.
Tee Joint.

16. Permanent Joints

Cable which has been used and subsequently reeled in should be " run through " as early as possible, all field joints being made permanent. Permanent " straight " joints should be made as follows :—

Cut out the old joint ; clean the conductors ; remake the joint, soldering the knot with the aid of a soldering iron.

Insulate the joint with rubber jointing tape and insulating tape as before.

Paint the joint with brightly coloured paint or mark it with a couple of turns of insulating tape on each side to show that it has been soldered.

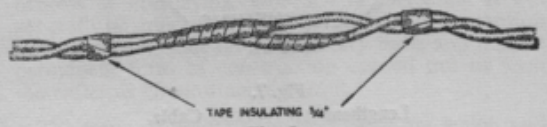

Fig. 6.
Marking of Soldered Joint.

17. Lengthening a Working Cable

For various reasons it may become necessary to insert a new length of cable into an existing cable, e.g. if the insulation is badly damaged. This is done, *without interrupting communications*, as follows :—

On the existing cable, strip off 1½ inches of insulation at the two points where the ends of the new length of cable will come. Make sure the conductors are clean.

Prepare both ends of the length of cable to be inserted as for a normal "straight " joint.

Then, using the method adopted for tee joint but without making thumb knots in the existing cable, join the ends of the length of new cable to the two points bared on the existing cable.

Cut out the unwanted portion of the standing cable, leaving the ends long enough for binding with insulating tape.

Complete as for a " straight " joint.

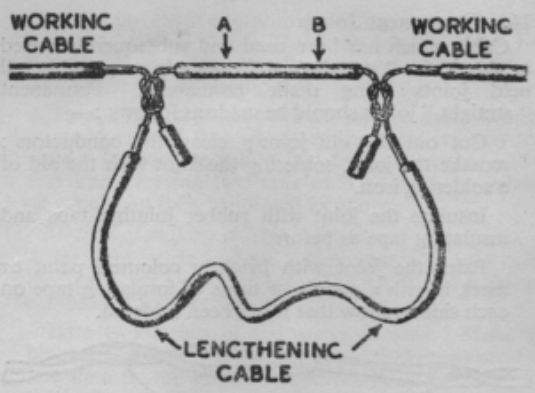

Fig. 7.
Lengthening a Working Cable.

18. Connecting Field Cable to Telephone Apparatus

The method of connecting field cable to the terminals of telephone apparatus is shown below :—

If short circuits, contacts and loose connections are to be avoided, the cable should *never* be stripped at its end.

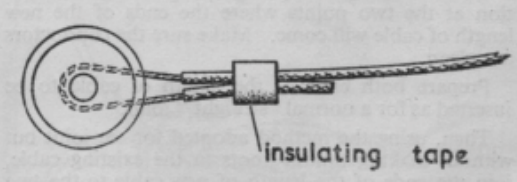

Fig. 8.
Connecting Field Cable to Apparatus Terminals.

Chapter IV. Securing, Labelling, and Leading in Field Cable

19. General

It is extremely unlikely that any field cable line laid for civil defence purposes will be so situated that it can be safely left lying on the ground throughout its whole length. It may be taken as a general rule that a line will require to be suspended over the greater part of its length and that it will require securing in some way or another at frequent intervals. It will be found that much of this will have to be done during the actual process of line laying, although in this event it will generally be sufficient if the initial securing or suspension of the cable is done on a temporary basis and a more permanent form of construction carried out as soon thereafter as circumstances permit.

The types of holdfast for field cable are legion and Field Cable Detachments with average ingenuity should have little difficulty in exploiting the resources available in the area over which they are required to operate. There are, however, one or two restrictions which, in the interests of safety and good line construction, should be strictly observed :—

Care must be taken that no sharp edge which would damage the insulation can chafe the cable.

Cable must not be made fast directly to a metal holdfast such as a gutter or pipe, but should, in such cases, be tied back with spun yarn and, where necessary to prevent chafing, bound with spun yarn.

Power poles carrying high or medium voltages must *never* be used for suspending field cable. *Where no other form of support is available* cable may be attached to low tension power poles (i.e. below 250 volts) for short distances. If the pole is of iron, a wooden batten, either slotted or with bobbins attached to it, must be fastened to the pole. With wooden poles the bobbins may be fixed directly to the poles. The cable should be slung below the power wires, leaving a clearance of 4 feet between the

lowest power wires and the cable. Rubber gloves must be worn by the linemen when they are working on power poles, crossings, etc.

The General Post Office is opposed to use being made of its permanent line poles for field cable construction, and cables should not normally be attached to these without prior consent.

The length of span between two points of support should not exceed 150 feet.

It will frequently be necessary to construct road crossings and the various methods of doing this are dealt with fully in Chapter VII. It cannot be over-emphasised that the various drills are the outcome of considerable experience on the part of Royal Corps of Signals and Regimental Signals personnel and that familiarity with them will do much to ensure well constructed crossings erected in the minimum of time.

20. Temporary Methods of Making Fast Cable

A cable may be secured in the following ways :—

(*a*) By making a clove hitch in the cable and slipping it over a holdfast. (See Fig. 9.)

(*b*) Where a holdfast has no free end; by forming a bight in the cable, passing it round the support and tying with two half-hitches round the standing part of the cable. (See Fig. 10.)

N.B.—In methods (*a*) and (*b*) each leg of the cable should be secured separately to avoid risk of short circuiting.

(*c*) By making a barrel-hitch with spun yarn round the cable and tying the spun yarn to the holdfast. (See Fig. 11.)

Where the cable is suspended, two or three loops should be made in it and placed together, the barrel hitch being formed around the group of loops on the side having the standing end. (See Fig. 12.)

(*d*) By using the weave tie method. Attach a short length of twisted cable to a support by means of a clove hitch ; the free ends should be about 18 inches long. The ends of the

twisted cable are then freed and, starting at the centre and working outwards, the wires are weaved along the line for about eight inches in each direction. Each weave is tied off with a reef knot and the surplus ends removed. (See Fig. 13.)

The advantages of this method are :—

Chafing on the working cable is reduced to a minimum.

It may be used with any type of support.

It is quickly and easily done.

The line can be taken down for inspection and replaced with the same tie.

The strain of suspension is evenly spread.

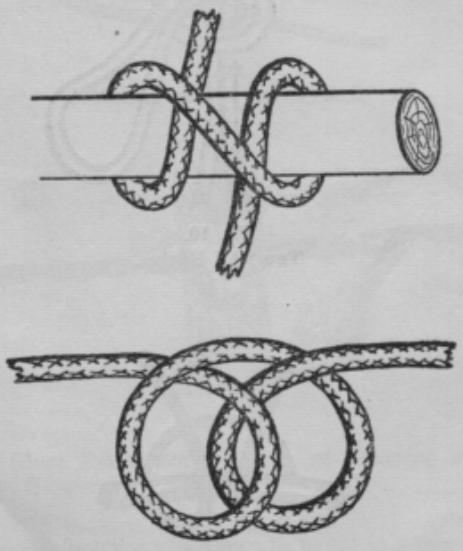

Fig. 9.
Clove Hitch.

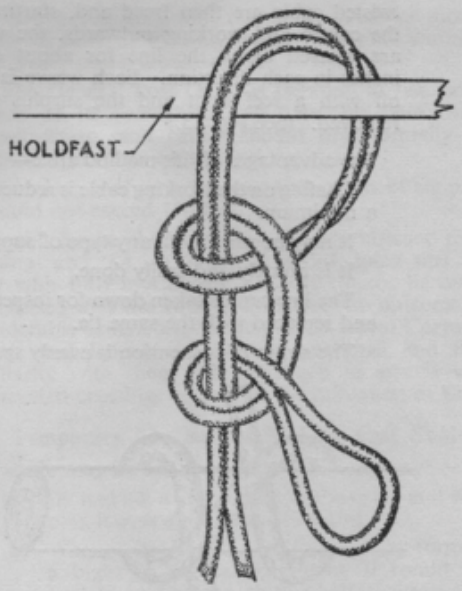

Fig. 10.
Two Half Hitches.

Fig. 11.
Barrel Hitch.

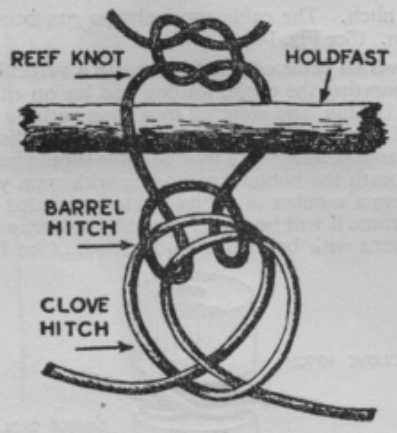

Fig. 12.
Cable Suspended by Barrel Hitch.

Fig. 13.
Weave Tie.

21. More Permanent Methods of Securing and Supporting Cable

(*a*) *Bobbins*

Wooden bobbins which may be nailed to a support are a quickly erected and reliable support for a cable. A single cable may be fastened to a bobbin using a

clove hitch. The cable must always run beneath the bobbin. (See Fig. 14.)

A twisted cable can be fastened to a vertical bobbin by separating the cable, leading one leg on either side of the bobbin, and securing by a spun yarn tie on each side of the bobbin. (See Fig. 15.) When the bobbin is horizontal, however, a twisted cable should be secured underneath the bobbin by binding with spun yarn.

Where a number of cables are to be erected along a given route it will be found useful to prepare a number of battens with bobbins already fitted. (See Fig. 16.)

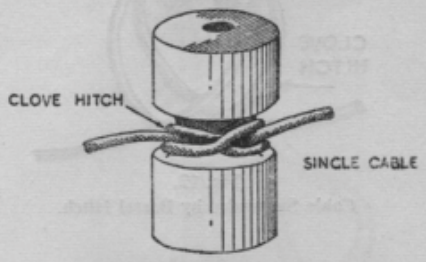

Fig. 14.
Fastening a Single Cable to a Bobbin.

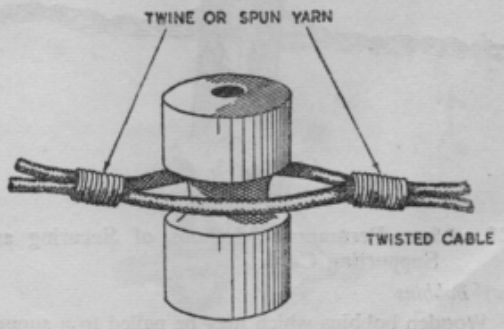

Fig. 15.
Fastening Twisted Cable to a Vertical Bobbin.

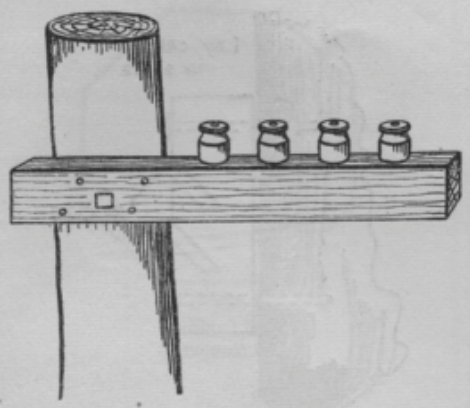

Fig. 16.
Use of Battens.

(*b*) *Screw-eyes Spiral*

These are excellent supports for rapid construction work and can be screwed into poles, trees or other wooden supports. The open end of the eye must always be at the bottom so that the cable can be easily lifted in or out with a crookstick.

(*c*) *Slotted Battens*

Wooden battens, with ends slotted to take the number of cables likely to be required, may be fixed to a suitable support. The slots must be cut diagonally as viewed from the front of the batten. The portions of the cable which pass through the slots should be bound with spun yarn to protect the insulation and provide a grip. (See Fig. 17.)

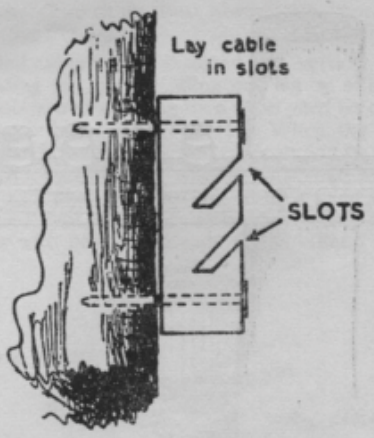

Fig. 17.
Slotted Battens.

22. Labelling

To avoid any possibility of confusion with other routes all lines must be clearly labelled, otherwise line-tracing and maintenance becomes much more difficult than need be, particularly in darkness. In addition, labelling makes the task of handing over lines very much easier. The detachment leader must, therefore, ensure that all lines laid by his detachment are properly labelled.

A label of octagonal shape will be used to identify civil defence lines. (See Fig. 18.)

Wood and metal are the most satisfactory materials for labels, since they are comparatively weather-proof. Plywood, except the resin bonded variety, should be avoided.

Wooden labels should be marked with an H.B. pencil pressed firmly into the wood. Tin labels should be painted. *Do not use indelible pencil for labelling since the writing will run when wet.*

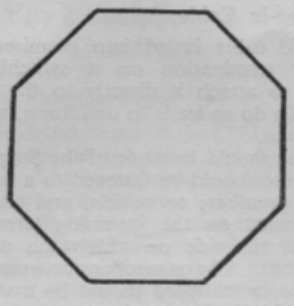

Fig. 18.
Octagonal Label.

Labelling must be done as lines are laid and labels must be used at the following points :—

Where cable routes cross.
Road, track or tramway junctions.
Inside and outside control centres, depots, etc.
Both sides of buried crossings.
One side of overhead crossings.
Terminal strips (most terminal strips have a white ivorine labelling panel for each pair of terminals).
Teeing-in points.
Joints.
Coils of slack.

Labels should be fixed securely to the line, using a single strand of spun yarn about three inches long. Tie the label with a half-hitch and secure to the cable with a reef knot, making sure that the label is close to the cable. Never use bare wire to attach labels to field cable ; the wire will cut through the insulation of the cable and cause faults.

23. Records

A record should be kept of every line that is laid, giving details of the route taken, major stores used, time and date when the line was through, etc.

24. Leading-in Cable

When field cable is led into premises, or into a vehicle, for termination on a switchboard it is undesirable to attach it directly to the switchboard terminals. To do so leads to untidiness, and difficulty in maintenance.

Instead, use should be made of the Strips, Terminal, 10 pair. These should be fastened to a suitable point outside the premises, or vehicle, and the field cable pairs terminated on the incoming terminals (those terminals on the side on which the white ivorine labels are fitted). The connections between the terminal strip and the switchboard should be made by means of suitable 12½ lb. insulated copper wire. (See also paragraph 12.)

There should, of course, be no strain on that section of cable which terminates on telephone equipment or Strips, Terminal. Cable should be made fast at a suitable point in the vicinity.

Chapter V. Principles of Field Cable Construction

25. General Considerations

Field Cable detachments of the Civil Defence Corps will be concerned in the main with laying cable in built-up areas. The type of area and the time available for the construction of the route will dictate the method of construction to be used. It may be possible to lay the cable along the ground, but where it is likely to suffer damage it should either be raised on poles, hung in trees, or attached to the eaves, etc. of buildings. In any case, cable must be raised at road-crossings to a height sufficient to permit vehicles to pass beneath ; normally a minimum of fifteen feet will give sufficient clearance but it will be necessary for field cable parties to check, before laying commences, whether any abnormally high vehicles will be traversing the route. Where a raised crossing of sufficient height is not practicable, the cable may be buried in a shallow trench.

Maintenance of a line is as important as its construction and the line should therefore be built with an eye to the time that will be involved in maintaining it.

26. Safety

The safety of a field cable line implies the avoidance of damage by :—

(*a*) Traffic ;
(*b*) Construction or demolition works by civil defence services of all kinds ;
(*c*) Weather.

It is clearly desirable for civil defence lines, when required, to be laid as quickly as possible. The speed factor, however, is closely linked with that of safety, and in order to cater for both it is nearly always necessary to compromise. However quickly a line is laid it is useless if the linemen find it out of action on reaching their destination. Similarly, a line is of no value unless it can be *kept* " through." As a general rule it can be said that a line must be made safe, at least from the effects of traffic, as it is built. When the necessity

for quick communication demands a neglect of safety, the line once through should be improved without delay.

27. Faults

These will usually result from interference by traffic, bomb damage, etc., but may develop through lack of thoroughness in construction and maintenance. Obviously, cable laid upon the ground is most likely to suffer damage, but its accessibility permits quick repair. Cable raised on trees, poles, etc. is not very liable to faults provided that care is taken during the laying and building of the route ; the location and repair of any faults that do occur, however, take somewhat longer than for corresponding faults in cable laid upon the ground.

28. Reconnaissance

As much information as possible about the area through which lines are to be laid will be collected in the control centre. Close liaison must be maintained with the Police and Fire Service in order that it may be known which roads are accessible, and the maximum height of vehicles likely to cross the route. In addition there should be close contact with the G.P.O. in order to obtain as much advice and assistance as may be available. On the information received the route to be followed will be decided and the conditions the line detachment must expect to meet will be known ; e.g., where hand laying only is possible.

The line detachment leader will then be briefed and he will be responsible for a detailed examination of the route, but, as time will be short, he will probably have to do this by moving ahead of his detachment while the line is being laid, returning to the detachment to detail the next part of the route to be followed, and to assist with crossings, etc.

29. Testing

A telephone should be connected to the line at the starting point and left in charge of a responsible person. During construction frequent tests should be made

with the starting point to ensure that the line remains " through."

When the line reaches the terminal station it should be tested and, if satisfactory, handed over for use. If the circumstances permit the cable detachment will then return along the route and where necessary consolidate the construction.

Chapter VI. The Field Cable Detachment

30. Composition and Duties of Field Cable Detachment

The normal cable-laying detachment will consist of a detachment leader (mounted on a motor cycle to enable him to reconnoitre the route ahead of his party), one lineman/driver and two linemen. The linemen/driver, in addition to driving the vehicle, will assist in certain phases of laying and construction work. The vehicle provided for the detachment's use will be a Landrover with trailer.

This team of four is adequate for laying from the vehicle using Apparatus, Cable-Laying, No. 11, or for hand-laying, using Apparatus, Cable-Laying, No. 11 or Bar, Carrying, Lightweight. (See Appendix A).

For ease in describing the various drills, etc., the members of the team, with the exception of the detachment leader, are known by numbers, as follows :—

No. 1 }
No. 2 } Two Linemen.

No. 3 Lineman/driver.

In addition to the duties listed below all members of the detachment will take part in the various drills detailed in Chapter VII.

31. Duties of the Detachment Leader

The stores carried by a cable-laying detachment must *always* be ready, checked, and loaded in the vehicle. The detachment leader is responsible for seeing that this is done. Failure to ensure that stores are ready and in good working order may result in unnecessary delays.

Before setting off with his detachment to carry out a task the detachment leader must make certain that he has complete instructions and as much information about the proposed route as can be obtained. This will enable him to decide on the method of laying and construction.

He must ensure that each man in the party knows his job.

During laying work he must continually reconnoitre the route ahead of his detachment. He will supervise the laying of the cable, detailing the types of crossings to be used and ensuring that the line is being properly labelled. He will indicate when laying from the vehicle is impracticable and give orders for hand-laying.

It is emphasized that the detachment leader is responsible for seeing that the line is properly constructed. He must therefore decide what is to be made good at once and what may be left for later building. To this end he must see that sufficient slack is allowed at appropriate points.

When the destination is reached he must ensure that the line is through before handing over.

Unless given instructions to the contrary, he will return with his party along the route improving its safety and building it where necessary.

He will keep a record of the route taken, major stores used, time when line was through, etc.

When cable is being reeled in the detachment leader is responsible for general supervision of the work and also, where required, will give assistance in clearing the line.

32. Duties of No. 1

No. 1 understudies the detachment leader.

When cable is to be laid he must acquaint himself with the destination, route, time available, labelling details and any other special instructions.

When laying is being done from the vehicle he will be responsible for co-ordinating the speed of the vehicle with the speed of laying. He will walk behind the vehicle guiding the cable into the required position by use of a crookstick. At points where building is to be carried out he must draw off such slack as may be required.

During hand-laying he will follow Nos. 2 and 3 who will be manhandling the Bar, Carrying, Lightweight, or Apparatus, Cable-Laying, No. 11.

During reeling-in of cable his main task will be to guide the cable evenly on to the drum, protecting his hands with hedging gloves. He will also assist in the dismantling of crossings (during which operation reeling-in ceases).

33. Duties of No. 2

When laying from the vehicle, No. 2 will stand by the layer in the vehicle and control the paying out of the cable, using the brake on Apparatus, Cable-Laying, No. 11. He must watch No. 1 carefully and must be ready to halt the vehicle by whistle signal (see paragraph 35) before any strain comes on the cable due to a hitch. He will also halt the vehicle as required by No. 1 for the drawing off of slack, erecting of crossings, etc.

During hand-laying he will be responsible, with No. 3 for manhandling the Bar, Carrying, Lightweight or the Apparatus, Cable-Laying, No. 11. If Apparatus, Cable-Laying, No. 11 is being used he will be the rear man and be responsible for seeing that the drum does not over-run and snag the cable. Similarly, when the Bar, Carrying, Lightweight is being used he will be responsible for controlling the speed of the drum.

During reeling-in of cable, No. 2 will operate the layer. If reeling-in is being done using a vehicle he will adjust the speed of reeling-in with the speed of the vehicle so that the bight is kept at least fifteen yards behind the vehicle. He must halt the vehicle immediately by whistle signal if the cable becomes caught up in any way, or if knots or kinks are seen.

Reeling-in must cease and the vehicle halted during dismantling of crossings.

When reeling-in is being done on foot, Nos. 2 and 3 will walk down the route until a reasonably long bight of free cable is formed. They will then halt and reel in the bight, No. 2 operating the winding handle.

34. Duties of No. 3

No. 3 is the lineman/driver and he will assist in the line construction as required.

When hand-laying is being done he will assist No. 2 in manhandling the cable-layer.

During cable laying and reeling-in operations using the vehicle he will adjust the speed of the vehicle in accordance with signals made by No. 2. He must be prepared to halt the vehicle immediately when required.

When a crossing is to be constructed, or dismantled, he will halt the vehicle beyond the crossing.

Chapter VII. Cable Laying Drills

35. Drill for Controlling Vehicle Speed

The following whistle signals will be used :—

2 short blasts to move off or to increase speed by a pre-arranged amount.

1 short blast to decrease speed by a pre-arranged amount.

1 long blast to halt.

36. Drill for Changing Drums

When a drum becomes empty :—

No. 2 will halt vehicle by a whistle signal.

No. 1 will order the change of drums and will then connect a telephone and prove the line back to the starting point.

No. 2, assisted by No. 3, will remove the empty drum and replace with a full drum.

The empty drum shall be placed at the side of the route. A clove hitch should be made around the barrel of the drum with each cable end. The two ends should then be jointed. If necessary the drum can be recovered later by releasing the turns of each clove hitch without disturbing the joint ; sufficient slack must be left to allow for this.

37. Notes on Crossings

Before describing the construction of crossings, it should be noted that the following rules apply :—

(*a*) *General*

The vehicle will be halted just beyond the place where the crossing is to be constructed.

The " farside " is used to indicate the side of the crossing farther from the vehicle, and the " near side " to indicate the side nearer to the vehicle.

Use natural supports where available and make certain that all parts of the crossing are clear of traffic.

Where intermediate poles are used, the poles must be guyed along the line of the cable.

When the supports of the crossings differ, e.g. a pole and a tree, the crossing will be described by naming first the support on the near side.

If it is necessary for reasons of urgency to cross a road by laying the cable on the surface, the cable should be secured on either side of the road and protected by a covering of earth or sand. Such a crossing will not last very long when traffic is using the road and as soon as possible a "built" crossing should be erected.

(*b*) *Railways*

Where no suitable bridge is available across which the cable may be taken the normal method of crossing the railway will be to pass the cable under the railway lines, making sure that the cable is secured each side of the crossing.

When an electric railway which uses the third rail feeder system is encountered an overhead crossing must be made, care being taken to ensure that the construction is really sound.

(*c*) *Power Lines*

When it is necessary to cross power lines, trolley bus routes, etc., the cable must clear the feeders by at least four feet and must be securely fastened at each side of the crossing.

Rubber gloves must be worn by the linemen engaged in erecting the crossing.

A length of sash line should be used when building the crossing. The sash line is passed over the feeders by two men standing on ladders on either side of the crossing, and using crooksticks. The cable is attached to one end of the rope and pulled across. The man on the ladder on the side from which the cable is being paid out should keep the cable in tension to avoid it sagging on to the line.

38. Drill for Constructing a Pole Crossing

(*a*) The detachment leader will :—

Indicate to Nos. 2 and 3 where holes are to be jumpered.

Assemble far pole, picket and guy line.

Hand picket to No. 2 when he is ready.

Hold pole between legs, so that top is immediately over hole with pole at right angles to line of route.

Tie cable to top of pole with clove hitch, allowing enough slack to reach the bottom of the pole, with about two yards to spare.

Attach guy to top of pole ; withdraw jumper from hole ; signal "ready" to No. 1.

When No. 1 says "Up" raise pole and place firmly in hole.

Direct Nos. 2 and 3 to adjust guys to make poles vertical.

Coil slack and tie to foot of pole with spun yarn.

Check stability and alignment of crossing.

(*b*) No. 1 will :—

Draw off twenty to thirty yards of slack.

Assemble picket and guy line near pole.

Hand picket to No. 3 when he is ready.

Withdraw jumper from hole.

When detachment leader signals "Ready" pull cable tight from detachment leader's pole and fasten to top of pole with clove hitch, allowing enough slack to reach the bottom of the pole, with about two yards to spare.

Attach guy to top of pole.

Shout "Up" and raise pole at same time as detachment leader and place firmly in hole.

Make a coil of two yards of slack and tie to the foot of the pole with spun yarn.

(*c*) No. 2 will :—

Take hammer and jumper and make a hole on the far side.

Ease the jumper so that the detachment leader can withdraw it easily.

Take picket from detachment leader and drive it into the ground eight feet behind crossing in line with the two jumpers.

Take end of guy and make it off to the peg.

Adjust guy as ordered by the detachment leader.

(*d*) No. 3 will carry out the same sequence of operations as No. 2 but on the near side with No. 1.

39. Drill for Constructing a Tree Crossing (or Crossing Using Permanent Fixtures etc.)

(*a*) The detachment leader will nominate the fixtures to be used and will then make a coil of two yards of slack at the foot of the tree or pole at each side of the crossing, starting on the far side.

(*b*) No. 2 will pay out 20-30 yards of cable. He will remain on the vehicle.

(*c*) No. 3 will :—

Take the ladder from the vehicle first to the far side and hold it for No. 1 when he is fixing the cable. Label line.

(*d*) No. 1 will :—

Climb tree or other fixture on the far side and attach cable where directed by the detachment leader. Repeat this drill on the near side.

40. Drill for the Construction of a Tree Crossing Using a Long Crookstick

(*a*) The detachment leader will order which trees are to be used. He will then tie back the cable on the far side, making a coil of two yards of slack.

(*b*) No. 2 will pay out 10–15 yards of cable. He will remain on the vehicle.

(*c*) No. 1 will :—

Stand in the middle of the crossing, maintaining the required strain on the cable whilst No. 3 works on the far side.

Take a long crookstick from No. 3 and go to the near side, placing the cable over suitable branches as directed by the detachment leader.

Tie back cable on near side and make a coil of about two yards of slack.

(*d*) No. 3 will :—

With long crookstick go to far side and place cable over suitable branches as directed by the detachment leader.

Hand the crookstick to No. 1.

Stand in the middle of the crossing, maintaining the required strain on the cable whilst No. 1 works on the near side.

Label line.

41. Drill for the Construction of a Buried Crossing

This method should not be used except where no suitable alternative means exist. The cable must be buried to a minimum depth of eight inches.

(*a*) The detachment leader will :—

Indicate position of trench.

Secure cable to pegs with spun yarn and lay it in the trench when dug.

Make off cable on both sides of the crossing, far side first.

(*b*) No. 2 will pay out five yards of cable. He will remain on the vehicle.

(*c*) No. 1 will :—

Take two pegs from the vehicle : drive them in at each end of the crossing, each sloping inwards towards the crossing and thus giving greater support against any pull on the unburied line on either side.

Pick out trench with mattock.

Label line.

(*d*) No. 3 will :—

With spade clear trench picked out by No. 1.

Fill in trench after cable has been laid.

42. Drill for the Construction of a Mixed Crossing

When a pole is used on one side only of a crossing it must be erected *before* the cable is finally secured to the support on the other side.

The drill to be used will depend on the type of crossing as special instructions will probably have to be issued. Normally Nos. 1 and 3 will work on the far side and the detachment leader and No. 2 on the near side.

43. Drill for Reeling In

When two parties can be used, one party will be detailed to go ahead and clear the line of obstructions,

allowing the cable to lay freely by the roadside. The other party will return along the route, reeling in the cable. The duties of the various members of the reeling-in party have been described in paragraphs 31–34.

Where only one party is available it will have to clear the line in sections and reel in each section as it goes along. The work of dismantling will be done by the detachment leader, assisted where necessary by No. 1.

The work involved in clearing the line consists of :—

Removing all spun yarn ties, except at tree crossings.

Removing all labels.

Digging up buried crossings.

Retrieving all spun yarn and pegs, except guy pegs which will be collected when the crossings are dismantled.

Clearing cable of all obstructions.

When a line has been recovered and the detachment returns to its headquarters the used cable should be carefully "run through", all field joints made permanent, and any damaged cable cut out and jointed. No cable should be put away in store until this work has been done.

Chapter VIII. Maintenance of Field Cable

44. General

Whilst C.D. Corps field cable routes are not intended to be in continuous use for long periods, and should be required only to meet an immediate need until G.P.O. lines can be re-connected, it is essential that such routes be properly maintained during the time that they are in service.

Many faults that arise can be avoided if, before a detachment sets out to lay a line, the detachment leader has made certain that all the cable he carries is in first class condition. This can only be ensured by careful inspection and testing when the cable is " run through " whilst the detachment is resting.

45. Maintenance Lineman

The lineman responsible for maintenance will be provided with a Landrover and should carry with him the following items :—

A pair of pliers, lineman, 8 inch (together with a light pair if available).
A jack knife.
Insulating tape.
Rubber tape.
Spun yarn.
Spare lengths of D.3 cable for weave ties.
Bobbins and nails.
Self soldering sleeves.
Screws, eye, spiral.
A coil of cable.
Jumper wire for leading in, etc.
A telephone, L or J and an earth-pin.
Two safety pins, each soldered to a short length of cable.
Spare labels.
A mattock.
Notebook and pencil.
Ladder (when necessary).
Test Set, Portable, No. 2.
Rubber Gloves.

The Lineman should undertake all maintenance and repair work with which he can deal, noting down particulars of any work he cannot do without assistance.

When inspecting a line the maintenance lineman should :—

Improve safety of line where necessary.
Examine cables for poor insulation and replace any faulty lengths.
Check insulation and joints.
Replace broken spun yarn, split battens, etc.
Check labelling.
Check overhead crossings for clearance and security of stays.
Note any changes in the ground necessitating re-routing.

46. Fault Localisation

The lineman localises a fault in the following manner :—

He goes to a point about midway along the route and makes a test call to each end of the line. This will indicate in which half of the line the fault has occurred. He repeats this process at the midpoint of the faulty portion, and so on until the fault is localised to a short section of cable when the actual position of the fault can in most cases be discovered by inspection.

In order to tee into a line for testing use is made of the safety pins soldered to the short lengths of cable. Each pin should be pushed through the middle of one leg of the cable to be tested so as to make electrical contact with the core and fastened to hold it in place. The other ends of the leads are attached to the terminals of a field telephone.

When the pin is removed from the cable the insulation can be easily closed by rubbing the pin holes with the fingers. The use of insulating tape is not necessary, nor is it recommended as moisture will tend to collect between the tape and the braiding.

APPENDIX A

Apparatus, Cable-Laying, No. 11

1. Constructional Details

(*a*) *Frame*

This consists of two H-shaped sections of pipe hinged together. Directly above the hinged joint of each section is an open bearing in which the spindle carrying the drum is held by means of a securing pin. For mounting on the floor of a vehicle, the frame can be opened to form a double A, two pivoted braces preventing the sections from spreading.

The plates forming the feet of the frame are drilled for screwing to a vehicle floor. When the layer is man-handled by two men, the snap-fasteners of the carrying slings are clipped into these holes in the plates. When the layer is mounted on the tailboard of a vehicle two of the plates fit on to the lower part of the supporting brackets. (See Fig. 19A.)

(*b*) *Drum Spindle*

This is of square section except for the two parts which fit into the open bearing of the frame. Holes are drilled at the end of the spindle to take the split pin for securing the winding handle. The reel is located on this spindle by two adjustable collars held in place by set screws. (See Fig. 19B.)

(*c*) *Winding Handle*

This fits either end of the spindle and consists of a steel arm with a wooden handle. Two square sockets are provided to give a choice of crank leverage. (See Fig. 19C.)

(*d*) *Brake Band Assembly*

This is used to prevent the drum from overspinning when the cable is being paid out rapidly or when the cable is given a sudden tug. Braking is by friction between a fixed collar in the body of the brake and a metal cylinder which turns with the drum spindle. The wing nut gives an adjustable braking pressure. The lever varies the set pressure to allow for changes

in the speed of the vehicle, or can stop the drum completely if required to do so.

The assembly can be fitted over either end of the spindle, and is located by a spigot which engages with a hole below the open bearing of the frame. (See Fig. 19D.)

(*e*) *Carrying Slings*

These are two slings, used when the apparatus is manhandled, and are fitted with snap fasteners to clip into the holes in the feet of the frame.

2. Installation on the Floor of a Landrover

(*a*) *Frame*

Open frame to form a double A.

Push pin catches upwards.

Swing out cross-braces at right-angles.

Adjust frame until spring catches snap into place in lugs on opposite cross-arm.

Make certain that the cross-braces are secure, if they swing free they may snap off.

The feet of the frame can then be bolted to the floor of the vehicle using $\frac{3}{8}$ inch nuts, bolts and washers.

(*b*) *Drum and Spindle*

Remove one of the adjustable collars.

Insert spindle into drum.

Replace collar and tighten set screw.

Place spindle evenly in open bearings.

Insert securing pin to close the bearings.

(*c*) *Winding Handle*

The appropriate socket on the winding handle is fitted on the spindle and secured by a split pin.

(*d*) *Brake Band Assembly*

Slide assembly on to opposite end of spindle from the winding handle.

The spigot should engage with the hole drilled in the open bearing of the frame.

Adjust the wing nut to regulate the braking pressure.

The completely assembled layer is shown in Fig. 2.

3. Assembly for Use by Two Men (See Fig. 19E)

(*a*) Open out frame to form one straight framework.

(*b*) The cross braces should be folded flat against the cross arms and held there by the pin catches.

(*c*) Lay frame on ground open bearings facing upwards.

(*d*) Remove one of the collars from the spindle and insert spindle through the drum. Replace the collar and tighten screw.

(*e*) Place the drum on ground so that spindle is immediately above open bearings.

(*f*) Remove securing pins and raise frame so that the spindle bearings engage with the open bearings on the frame.

(*g*) Replace securing pins.

(*h*) Fit winding handle and brake band assembly.

(*i*) Adjust slings (if required) to correct length and clip the snap fasteners into the holes in the " feet " of the frame. The slings are then placed on the shoulders.

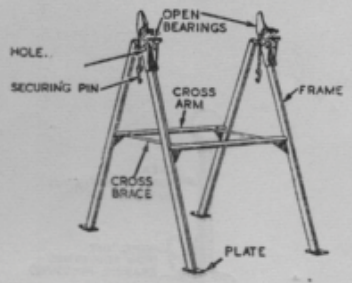

Fig. 19A.
Frame.

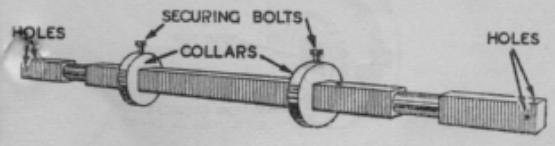

Fig. 19B.
Drum Spindle.

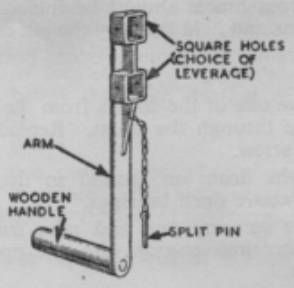

Fig. 19C.
Winding Handle.

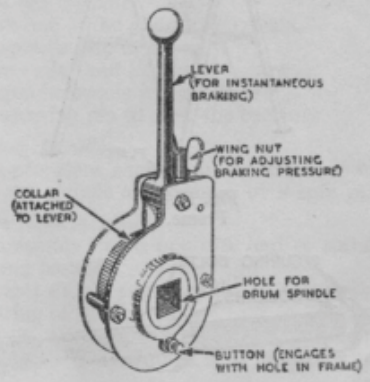

Fig. 19D.
Brake Band Assembly.

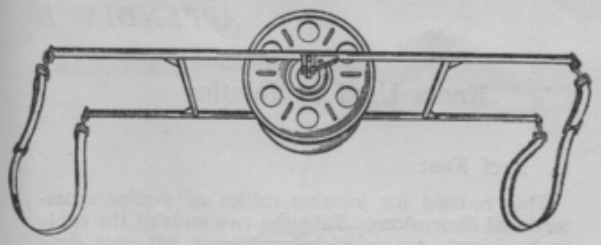

Fig. 19E.
Assembly for Use by Two Men.

APPENDIX B

Knots Used in Jointing

1. Reef Knot

This is used for jointing cables of similar cross-sectional dimensions. Take the two ends of the cable to be joined, one in each hand, pass left over right with a thumb twist, then right over left with another twist, and pull tight. Care must be taken not to tie a " granny " knot. (See Fig. 20.)

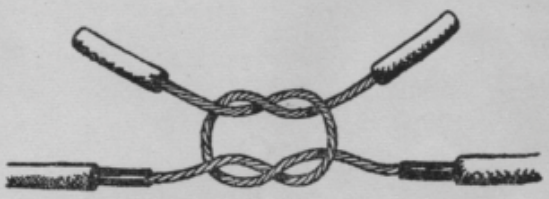

Fig. 20.
Reef Knot.

2. Single Sheet Bend

This is used for jointing cables of unequal cross-sectional dimensions. Since normally D3 Cable only will be used, the knot will be rarely, if ever, required. For the sake of completeness, however, it is described.

Take a bight of the larger cable about 1 inch long in the left hand, pass the end of the smaller cable up through the bight, over and under it and over again between the two cables and pull tight. (See Fig. 21.)

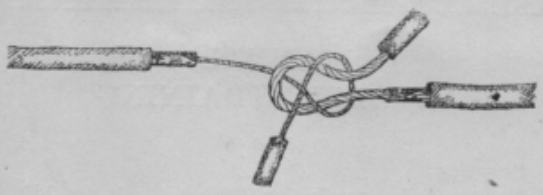

Fig. 21.
Single Sheet Bend.

3. Thumb Knot

See Fig. 22 for method of tying.

Fig. 22.
Thumb Knot.

Printed in Great Britain under the authority of HER MAJESTY'S STATIONERY OFFICE by The South Essex Recorders, Ltd., Ilford.

(1162) Wt. 3498/363 K100 2/54 S.E.R. Ltd. Gp. 562

MANUAL OF BASIC TRAINING

Volume I

Pamphlets

No. 1. Ambulance Section (1951) 1s. (1s. 2d.)
No. 2. Welfare Section (1952) 1s. 3d. (1s. 4½d.)
No. 2a. Welfare Section. Emergency Feeding (1952) 1s. 9d. (1s. 10½d.)
No. 2b. Welfare Section. Improvisation of Large Scale Cooking Equipment (1952) 1s. 3d. (1s. 4½d.)
No. 3. Warden Section (1951) 1s. 3d. (1s. 4½d.)
No. 4. Headquarters Section (1953) 1s. 6d. (1s. 7½d.)
No. 6. Organisation of Civil Defence and Allied Services (1952) 1s. (1s. 1½d.)
No. 8. Principles of Damage Control (1951) 1s. (1s. 1½d.)
No. 9. Reconnaissance and Reporting (1952) 1s. 6d. (1s. 7½d.)

Volume II

No. 1. Basic Chemical Warfare (1951) 1s. (1s. 2d.)
No. 2. Basic Firefighting (1952) 1s. (1s. 2d.)
No. 3. Basic First Aid (1951) 1s. 3d. (1s. 4½d.)
No. 4. Basic Rescue (1951) 1s. 6d. (1s. 8d.)
No. 5. Basic Methods of Protection against High Explosive Missiles (1952) 1s. (1s. 1½d.)
No. 6. Atomic Warfare (1953) 1s. 9d. (1s. 10½d.)

Binders for these pamphlets are available, price 1*s.* 6*d.* (1*s.* 8*d.*)

Priced amendments are issued from time to time; when the pamphlets are reprinted these amendments are incorporated in the revised text. The date given in brackets is that of the most recent issue.

Prices in brackets include postage

HER MAJESTY'S STATIONERY OFFICE
at the addresses on cover page iv
or through any bookseller

PUBLISHED BY HER MAJESTY'S STATIONERY OFFICE

To be purchased from

York House, Kingsway, LONDON, W.C.2 423 Oxford Street, LONDON, W.1
P.O. Box 569, LONDON, S.E.1
13a Castle Street, EDINBURGH, 2 1 St. Andrew's Crescent, CARDIFF
39 King Street, MANCHESTER, 2 Tower Lane, BRISTOL, 1
2 Edmund Street, BIRMINGHAM, 3 80 Chichester Street, BELFAST
or from any Bookseller

1954

Price 2s. 0d. net

S.O. Code No. 34-359-2*