15 DEC 1975

MOLEPLOUGHING CABLE AND DUCT

1 GENERAL This Instruction describes methods of laying cable and PVC duct direct in the ground by using moleploughing techniques.

It is divided into two parts, part one using a Landrover Station Wagon Type 2 and associated winch and part two using a tractor and associated winch, for motive power.

METHODS, OTHER THAN THOSE STRICTLY IN ACCORDANCE WITH THIS INSTRUCTION, COULD BE DANGEROUS, AND MUST NOT BE EMPLOYED UNDER ANY CIRCUMSTANCES.

Moleploughing can be carried out in most soils, the most difficult will be in chalk and soft rock or where the ground is very dry and there is a large proportion of stones packed closely together. In these difficult cases it may be necessary to pre-run the moleplough through the ground before laying duct or cable. Lightly constructed carriageway or farm crossing can be moleploughed by carrying out these pre-runs. A minimum verge width of 460 mm is required for moleploughing.

The nature of the ground will often determine the type of unit to be used. The Landrover winch is limited by an hydraulic cut-out valve to a 24.5 kN direct pull (5,500 lbs). The tractor winch is limited by an externally fitted mechanical fuse to 46.5 kN (9,500 lbs) (see para 6). Generally it will be advantageous to use the Landrover unit on housing estates where comparatively short lengths of armoured cable and 51 mm PVC duct are required quickly. The heavier and more powerful tractor unit should be used for laying long lengths of cables and 89 mm PVC duct (2 x 89 mm max).

The party must be trained in the use of the equipment described before being employed on this work.

Before any moleploughing proceeds road works guarding should be set up in accordance with Road Works Guarding Manual (if working on or near a highway used for vehicles or pedestrians). The position of other plant should also be ascertained before moleploughing commences, any plant near the intended run should be "staked out". The location of plant can be carried out by the use of electrical locating equipment, digging pilot holes, or reference to records. The planning officer should be able to give the approximate position of plant from his early surveys.

PART ONE USING A LANDROVER

CONTENTS

PARA 1 GENERAL

PARA 2 LAYING CABLE POLYETHYLENE, TWIN NO. 3 AT A DEPTH OF 360 mm USING A MOLEPLOUGH NO. 4

PARA 3 LAYING MORE THAN ONE CABLE, POLYETHYLENE, NO. 3 UP TO A MAXIMUM OF 2 x 28 mm DIAMETER CABLE TO A MAXIMUM DEPTH OF 510 mm USING A MOLEPLOUGH NO. 3

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PARA 4 LAYING 51 mm PVC DUCT ALSO DUCT AND CABLE SIMULTANEOUSLY USING A MOLEPLOUGH NO. 3

PARA 5 ORGANISATION OF PARTY

1 A Landrover Party should consists of two men with a Landrover Station Wagon Type 2 and associated winch towing a 30 cwt trailer to carry duct, cable and moleploughs. A 1 ton Utility vehicle will be required to carry the other necessary tools and equipment.

2 To lay a Cable, Polyethylene, Twin No. 3 at a depth of 360 mm a Moleplough No. 4 should be used if site conditions are suitable ie no tree roots, large stones, building materials etc. This Moleplough has a very thin blade and therefore takes less effort to pull, it also causes less surface disturbance than other moleploughs. The armouring wires of the Cable, Polyethylene, No. 3 are attached to the bottom of the moleplough blade by a cable attachment shown in Fig 1.

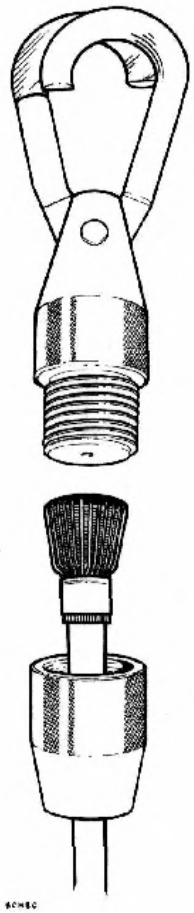

Fig 1 Cable Attachment

A small starting pit is necessary, approximately 360 mm deep 300 mm wide 460 mm long and the moleplough should be placed into this pit with the cable attached. The cable should be immediately behind the pit, mounted on cable jacks, or formed into a figure of eight or laid out along the ground.

At a reasonable distance away up to a maximum of 70 metres the Landrover should be set up as described in J2 A8001 paras 7 to 10, facing the plough.

A Rope Sisal 3" should be run out from the Landrover over the proposed route and one end attached to the loop at the front of the Moleplough No. 4 by means of a spliced eye and shackle No. 10. At the other end three turns of the rope should be taken round the capstan of the winch and the winch brought into operation in accordance with para 11, sub paras (a) to (d) in J2 A8001. Sufficient weight should be exerted by one man on the free end of the rope at the capstan to allow the rope to grip and so pull the moleplough along and the cable into the ground. A handle is provided with the moleplough to maintain in an upright position. Any tendency for it to rise out of the ground can be counteracted by the operator standing on the footplate whilst holding onto the handle. At the end of a pull the moleplough is stopped by releasing the weight on the rope. The operation can then be repeated for further lengths up to a maximum of 150 metres. When longer lengths are desirable (to reduce joints) the starting pit can be dug at a maximum of 150 metres from the beginning of the run and cable moleploughed in both directions. The first 150 metres can be fed directly off the drum, the other 150 metres taken off into a figure of eight formation and attached to the moleplough.

The moleplough can be lifted out of the ground by two men lifting carefully at the front end of the plough until the blade pivots out of the ground. This can be done with a cable attached.

Another method of increasing the length is by removing the plough and cable from the ground at the end of a 150 metre run, excavating a small pit and pulling the moleploughed cable through the ground laying it out into a figure of eight formation so that a succeeding length can be drawn in.

This method can only be used if the cable is pulled immediately after ploughing, before the ground has had time to settle around the cable.

At road crossings the cable should be released from the moleplough and sufficient pulled with the winch to pass through the crossing duct. The moleplough can then be set up on the other side of the road and the operations continued when the cable has been passed through the duct. For farm and other entrances the cable should be protected by laying at greater depth and or by concrete or other cover.

3 A No. 3 moleplough should be used for cable laying in the following circumstances:-

(a) When the ground and site conditions prohibit the use of the No. 4 moleplough.

(b) To lay more than one cable up to a maximum of 2 x 28 mm diameter or to lay at depths greater than 360 mm up to a maximum of 500 mm.

A pit 600 mm long 300 mm wide and as deep as the cable depth requires should be dug at the commencement of the run. The cable to be ploughed should be laid out along the route by pulling off a mounted drum or rolling the drum along the ground. If there are any road crossings the cable should be passed through these in advance.

The cables to be ploughed should be passed down the guide box of the moleplough and the moleplough placed into the pit, the ends of the cable being secured to a stake. The winch should be operated as described in para 2.

If the safety valve on the winch operates with any regularity during ploughing, without there being any obstruction to the plough, the Double pull method should be used by putting down the "Crows foot anchors" at the rear of the vehicle keeping the rope in line with the plough and attaching one end to this anchor and passing through a single block which is attached to the moleplough, back to the bollard of the winch. Shackles No. 10 should be used to attach the rope to the anchor and the block to the moleplough (see Fig 2).

Fig 2 Double Pull Method (Moleplough No. 4)

The No. 3 moleplough can be removed from the ground by withdrawing the lower pin securing the moleplough to the frame and pulling the plough forward, using the winch; this will cause the blade to pivot on the top end and come out of the ground.

At road crossings the cable can be released from the guide box by removing the back plate of the guide. At the other side of the road the cable can be laid into the guide box, the back plate refitted, and moleploughing continued.

4 When laying 51 mm duct the pit needs to be a minimum of 1200 mm long and 300 mm wide and as deep as necessary tapering to the surface. The duct should be laid out behind the pit up to a maximum of 70 metres, the spigot end towards the pit and a 8 mm SWR threaded through the whole length as the ducts are joined together. Jointing the ducts can be achieved by driving the spigot into the socket using a paving mallet or a block of hardwood and a hammer. The front end of the wire is then joined to the wire in the metal sleeve using a small shackle and the sleeve is then passed over the spigot end of the duct. The length of

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duct is then placed under tension using a duct tensioner. This is carried out by placing the wire in the clamps on the tensioner and operating the handle, finally placing the handle back into its holder and fitting the cover. Correct tension will be observed when the ducts tend to bend slightly. At the moleplough end the chain on the front of the sleeve is attached to the moleplough guide box using a 12 mm high tensile bolt and nut (see Figs 3 and 4). Two crow bars should be driven into the ground at the rear of the pit, taking care to avoid known services, and the length of duct allowed to feed through the crow bars into the pit. If the safety valve operates on the winch the double pull method as described in para 3 should be used.

When the length of tensioned duct has been pulled in remove the tensioner from the duct, by first removing the cover and then rotating the tensioner on the duct, using the handle, until it is in a convenient position for working. The hole in the handle is pushed onto the pin of the rear clamp and turned anti-clockwise knocking the clamp off the wire, remove the wire from the clamp and deal with the centre clamp in the same way. The third clamp is levered off by placing the other end of the handle into the small metal tube on the tensioner and turning in an anticlockwise direction. After removing the tension the handle should be returned to its holder. A brush, mandrel and draw-rope should then be attached to the wire. (See Fig 3).

The moleplough is now pulled forward pulling the metal sleeve off the duct, and the moleplough removed from the ground as described in para 3. The hole should then be dug for ploughing in the next section of duct and making the joint. This hole should be approximately 1 metre long 300 mm wide and to the necessary depth. The wire should then be pulled out of the duct pulling the brush, mandrel and draw-rope in. The wire will then be ready for the next section of duct. The complete operation being repeated for any further lengths required. To joint the pulled in lengths together cut the overlapping duct in the centre of the excavating hole to make a butt joint, by passing a Collars Duct 56A over one end of the duct. Clean both ends of duct and then paint with Compound No. 21 for a distance of 75 mm, slip the collar over the butting ends of the duct ensuring the duct joint is in the centre of the collar.

To lay duct and cable simultaneously feed the cable down the cable guide, attach the duct to the moleplough and proceed as described above. The cable should not be cut at each pit when joining up the pulled lengths of duct.

5 Only two men are necessary for moleploughing using the Landrover. It is important that a planned procedure should be adopted to avoid wasted effort and achieve safe working.

A sequence of operations is suggested below:-

1 Attend to Road Works Guarding.

2 Establish the position of other services.

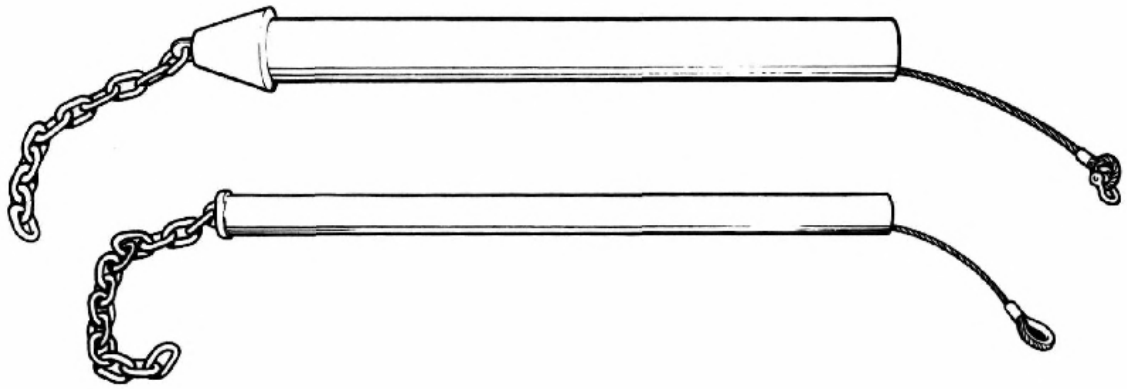
3 Dig any pilot holes that may be necessary if possible at positions where they can be used for starting pits.

4 Unload moleplough, cable, duct etc where they are going to be used.

5 One man digs the starting hole while the other man prepares the Landrover for moleploughing.

6 Both men run out cable required and/or prepare first section of duct.

7 Both men lift plough into hole.



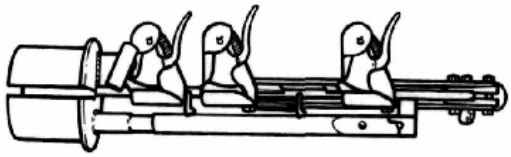


Fig 3 Sleeves and Tensioner

8 One man operates winch while the other man attends to the moleplough and cable or duct.

9 On completion of the operations the Landrover is repositioned for further lengths to be pulled in.

10 If duct laying is being undertaken the man with the moleplough walks back to release the tensioner and attach the brush, mandrel and draw-rope to the wire. After the tensioner is released the winch operator can draw the moleplough forward pulling the sleeve off the duct, remove the pin from the moleplough and then pull the moleplough out of the ground.

11 The winch can now pull the wire out of the duct pulling a draw-rope in and then the man at the tensioner end can make the duct joint and fill in the hole. While the joint is being made the second man should prepare the next section of duct.

12 Both men should then be ready to repeat the operation to lay further lengths of duct.

Fig 4 follows

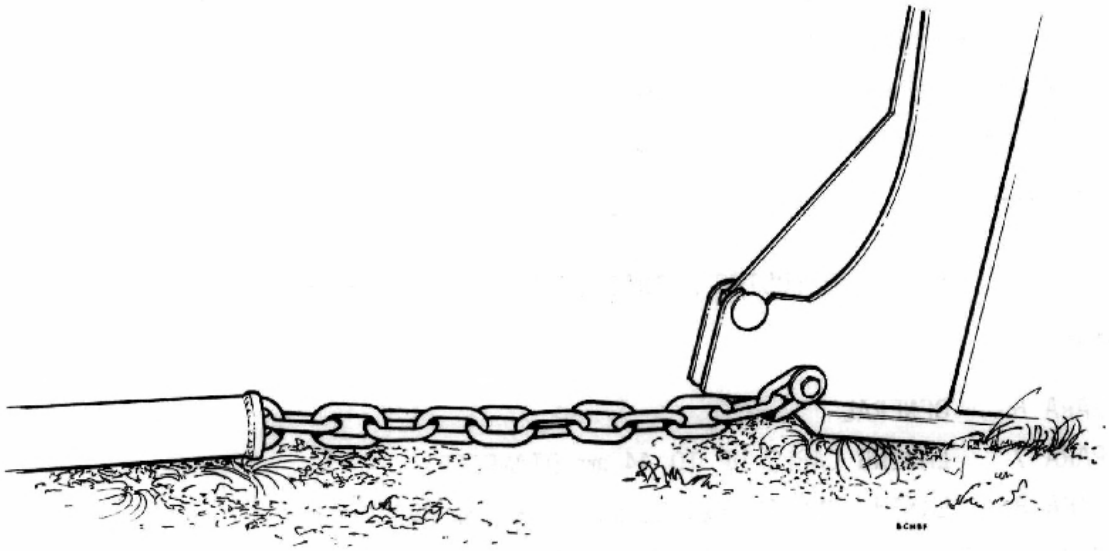


Fig 4 Duct Attached to Moleplough

TOOLS AND TRANSPORT 2-MAN PARTY

One ton Utility Vehicle	
Landrover Station Wagon Type 2 and 30 cwt Trailer	
Moleplough No. 3	1
" No. 4	1
Cable attachment for Moleplough No. 4	2
Sleeve duct Moleplough No. 1 (Duct 56)	2
Tensioner Duct	2
Anchors Crows feet Small	1 set†
Blocks Snatch	1
Rope Sisal	150 yds in 2 coils
Shackles No. 10	12
Crowbars	4
Hammers Sledge Double faced 10 lb	1
Brush Cylindrical 57 mm dia	1
Mandrel 43 mm dia x 200 mm	1
Digging Tools - as required	2 sets
Wire Duct 8 mm 100 metre coil	2

Paviers Mallet (Local Purchase)	1
Hand Tools as required	
Jacks Cable Drum Small	1 pair
Bars Operating Small	1
Drum Spindle and Collars as required	1 set
Guarding equipment as required	

†In addition to the set supplied with the Landrover

PART TWO (USING A TRACTOR AND A WINCHED MOLEPLOUGH)

CONTENTS

PARA 6 GENERAL
PARA 7 LAYING CABLE UP TO 44 mm DIAMETER
PARA 8 LAYING ONE OR TWO 51 mm OR 89 mm PVC DUCTS
PARA 9 LAYING CABLE AND DUCT SIMULTANEOUSLY
PARA 10 USE OF GUIDING BAR
PARA 11 ORGANISATION OF WORK
PARA 12 TOOLS

6 For these operations a 3-man team is required, including the tractor driver.

Except for a few early models the 10 ton Boughton mechanical winch is the standard winch fitted to all PO tractors.

Normally a Moleplough No. 2 will be used with the tractor winch and this is capable of burying plant with up to 610 mm of cover for cable and single ducts and 460 mm for two ducts laid one above the other.

A mechanical fuse must be used at all times when pulling a moleplough through the ground with a steel wire rope. The purpose of the fuse is to break at a pre-determined load to prevent damage to the steel hawser or moleplough. The fuse bypass is to prevent the hawser flying when the fuse breaks. (See Fig 5). A check should be made that the fuse is correct and that correct pins are fitted to the plough.

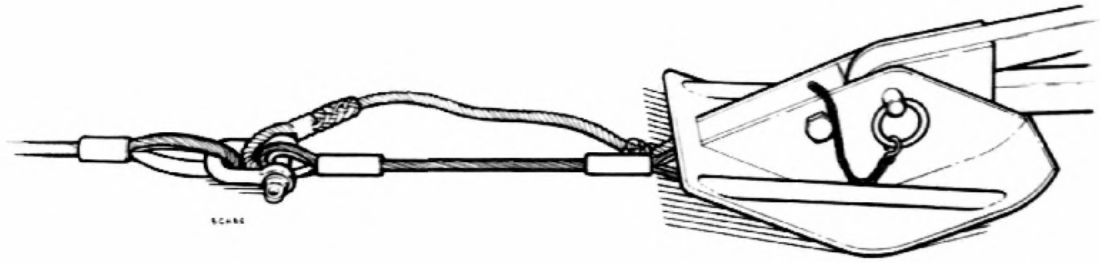


Fig 5 Mechanical Fuse

7 The cable should be laid out along the line of route by setting up the drum on jacks and pulling the cable off or rolling the drum along the ground. A starting pit should be dug 1 metre long 300 mm wide and as deep as necessary. The moleplough should be set about 75 mm deeper than the required depth and the cable fed down the cable guide box of the moleplough and firmly secured to stake.

The moleplough is lifted into the starting pit by using the hydraulic arms on the tractor. The hawser is attached to the front of the moleplough via a mechanical fuse having a breaking strain of 46.5 kN (9,500 lbs), by means of a Shackle No. 10 and, with the winch lever in the pay off position, the tractor is driven off in the direction of the pull until the required distance is reached or until one complete layer of hawser is left on the winch drum.

NOTE: This layer of hawser is left on the drum to help layering the hawser as it is being winched in.

If the tractor can be positioned on level ground so that it is in a straight line with the moleplough it will only be necessary to let down the sprags on the tractor, engage the winch to pull in and start winching. The sprags will dig into the ground and hold the tractor steady as the moleplough is winched towards it.

IF THERE IS ANY DOUBT ABOUT THE TRACTOR STANDING LEVEL OR IT NOT BEING IN A STRAIGHT LINE WITH THE PLOUGH THE SPRAGS SHOULD NOT BE USED TO HOLD THE TRACTOR STATIONARY. A "CROWS FOOT" ANCHOR SHOULD BE PUT DOWN IN FRONT OF THE TRACTOR AND ATTACHED TO IT IN LINE WITH THE PULL BY A HAWSER, TO HOLD THE TRACTOR STEADY WHILE WINCHING IS PROCEEDING.

One end of each of the crows feet hawsers should be attached to the angle iron at the same point, and the other end to one of the lugs situated under the winch by means of a Shackle No. 10. The angle irons are joined together as required using Shackles No. 10, and then the pin driven into the ground. Care should be taken when driving in the pins to ensure they are clear of other services. (See Fig 6).

Fig 6 follows

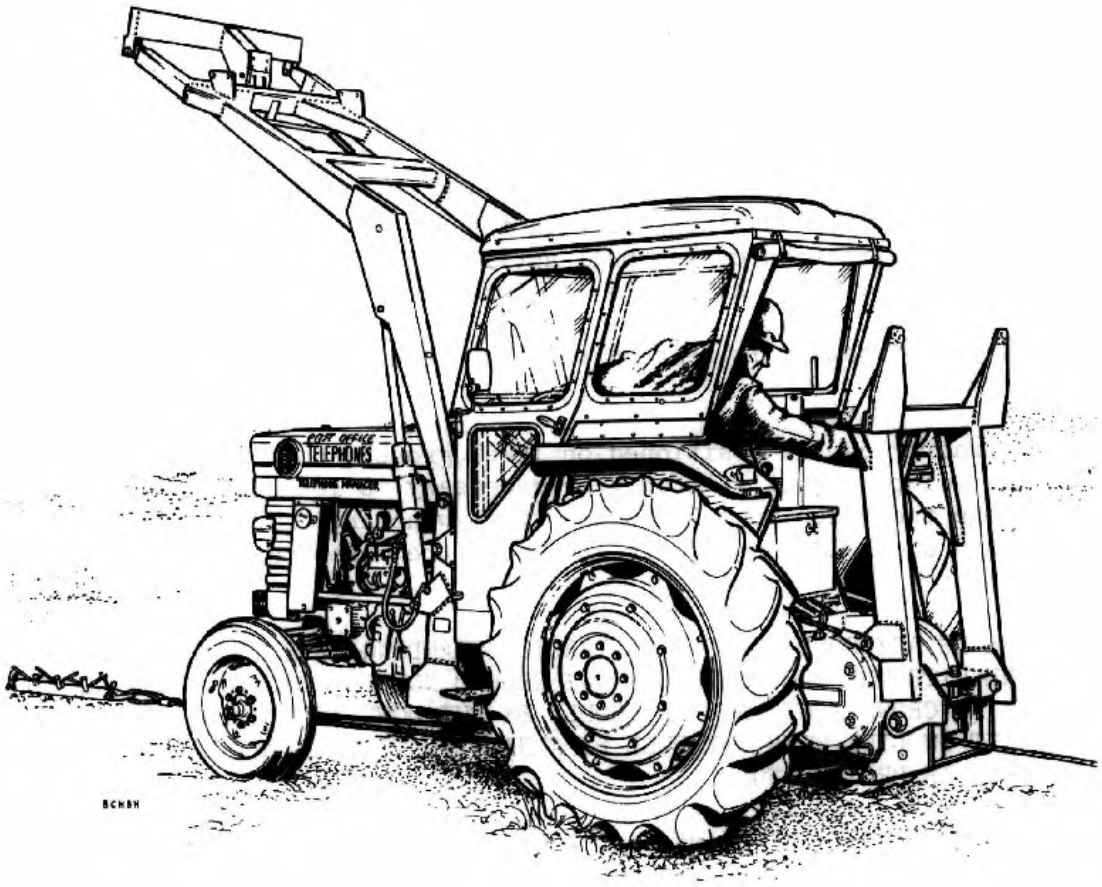


Fig 6 Crows Feet Anchors

Should the mechanical fuse break with any regularity and the moleplough not be obstructed the double pull method should be used to reduce the tension in the hawser. The hawser should go round a single block attached to the moleplough and be anchored to a crows foot anchor placed in front of the tractor in line with the pull. The mechanical fuse is then fitted between the end of the hawser and crows foot anchors.

The moleplough can be kept upright by using the moleplough guiding bar in a horizontal position. It can be pulled out of the ground when necessary by inserting the guiding bar into a vertical position and using it to pull the moleplough on to its side while the moleplough is being winched forward.

The tractor should be moved and the winching repeated until the required length of cable has been pulled in.

8 The duct should be laid, tensioned and tested as described in para 4 using a Sleeve Duct Moleplough No. 2, and brushes and mandrels when laying 90 mm duct. The starting pit should be 1.6 metres long and the maximum length of duct tensioned should be 100 metres. The tensioned length of duct is attached to the moleplough by inserting the chain of the moleplough sleeve in the clevis of the duct attachment at the front of the moleplough guide box and screwing down the duct attachment rod. (See Fig 7).

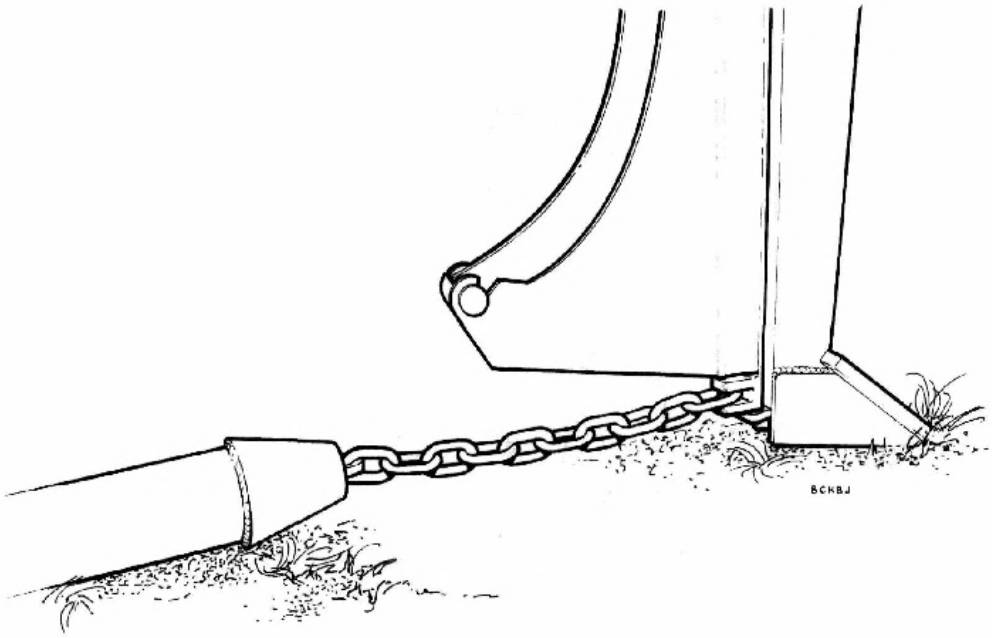


Fig 7 Attachment of Duct to Clevis

When it is necessary to lay two ducts the same operation should be carried out as for one duct, the chains of the two duct sleeves being inserted into the clevis of the cable guide. Winching proceeds as described in para 6. The ducts are kept in vertical formation by the use of crowbars.

When joining together pulled in lengths of 90 mm duct, Collars Duct 54A should be used. The method being the same as described in para 4 for a 51 mm duct except with the ends of the duct should be painted with compound No. 21 for 110 mm.

9 To lay duct and cables simultaneously feed the cable down the guide box, secure the cable to stake, attach duct to cable guide and proceed as described in paras 7 and 8. The cable should not be cut at each duct jointing point.

10 When it is required to deviate slightly from a straight line between the moleplough and the tractor a Bar Guiding should be used with a single block as shown in Fig 8.

Fig 8 follows

Fig 8 Guiding Bar

11 Only 3 men will be required for most duct laying operations. The following sequence of operations is suggested.

1 Attend to Road Works Guarding.

2 Establish the position of other services.

3 Dig any pilot holes that may be necessary if possible in positions where they can be used for starting pits.

4 Unload moleplough, cable, duct etc where they are going to be used.

5 One man digs the starting hole while the other two men prepare the cable and /or duct.

6 When the starting pit has been dug the 3 men should work together in positioning the moleplough using the hydraulic arms of the tractor.

7 The hawser should then be attached to the moleplough to allow the tractor driver to position the tractor ready for moleploughing; while this is being done the men with the moleplough should operate it.

8 If cable laying is being undertaken 2 men attend to the moleplough while the third man operates the tractor. If the Bar Guiding is needed then one of the men with the moleplough should operate it.

9 If duct is being laid one man should remain with the tensioner and walk towards the starting pit as ploughing proceeds leaving one man with the moleplough.

10 On completion of a run the man at the tensioner end should release the tensioner and attach the brush, mandrel and drawrope.

After the tensioner is released the tractor driver should pull the moleplough forward pulling the sleeve off the duct. The 2 men at the tractor end should then work together, pulling the wire out of the moleplough lengths of duct and the drawrope in, and prepare the next section of duct.

When the wire has been removed the man at the tensioner end should joint the end of the drawrope to the end of the proceeding lengths, make the duct joint and fill in the hole; it is not necessary to retest the length with a mandrel after the joint has been made. He should then go to the tractor end and prepare the hole for the next section of duct.

12 TOOLS AND TRANSPORT FOR 3 MAN PARTY 4 ton cabling vehicle or vehicle capable of towing a 4 ton trailer and having facilities to lift drums of cable of 1 ton gross weight on and off the vehicle and a personal compartment and lockers for tools etc.

4 ton Trailer for carrying tractor	1
Tractor No. 3	1
Moleplough No. 2	1
" " 3	1
Sleeves Duct Moleplough No. 1 (Duct 56)	2
" " " " 2 (Duct 54)	2
Tensioner Duct	3
Anchor Crows Foot Large	2 sets
Blocks Snatch	2
Crowbars - as required	6
Shackles No. 10	24
" " (small)	6
Hammers Sledge Double faced 10 lb	1
Brush Cylindrical 57 mm dia	1
" " $3\frac{1}{8}$" x $2\frac{1}{8}$"	1
Mandrel 43 mm dia x 200 mm	1
" 83 mm dia x 240 mm	1
Digging Tools	3 sets
Wire Duct 8 mm 100 metre coil	3
Paviers Mallet (Local Purchase)	1
Jacks Cable	1 set
Drum Spindle and Collars	1 set
Guarding Equipment - as required	
Hand Tools - as required	

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