

TRENCH PLOW AND ROOTER PLOW

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1. GENERAL

1.01 This section covers the method of laying tape armored cable or its equivalent into the ground by the use of a trench plow and associated equipment.

1.02 Cable can be laid directly in light loam or loose sandy soil with the trench plow. A tractor of the drawbar capacity of the Model 60 Caterpillar should be used. Heavier soil conditions require the use of two of these tractors in tandem.

Where heavier soil is encountered, if roots, shale, rocks or other obstructions may be present, the ground should be first opened by one or more exploring trips with the rooter plow or the trench plow without the cable, before the cable laying trip is made.

1.03 The rooter plow requires the drawbar capacity of one of the above mentioned tractors. The same chassis is used for either the cable laying trench plow or the rooter plow.

1.04 The purpose of this plow is to lay cable in accordance with the instructions covered by Bell System Practices, Section G56.142, entitled, "Buried Tape Armored Toll Cable, Laying Cable."

2. PRECAUTIONARY MEASURES

2.01 Care must be taken when coupling or uncoupling the various units. The hand hook tool should be used when coupling or uncoupling the plow from the cable reel trailer so that the workman will keep clear of the reel during this operation. See Figure 1.

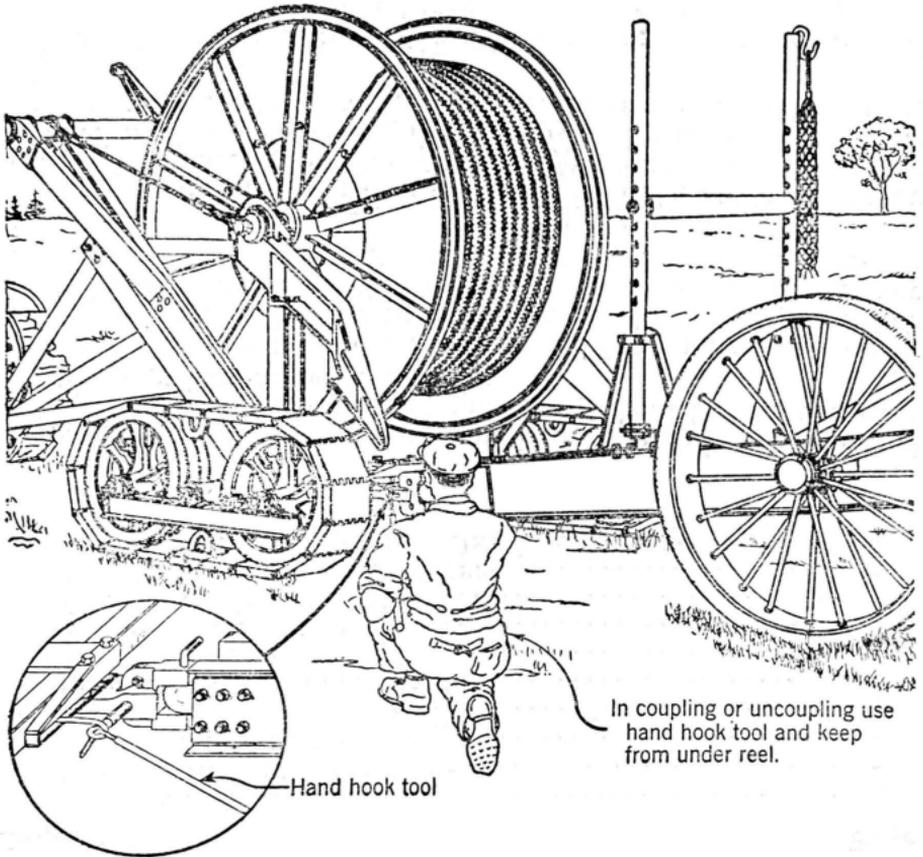
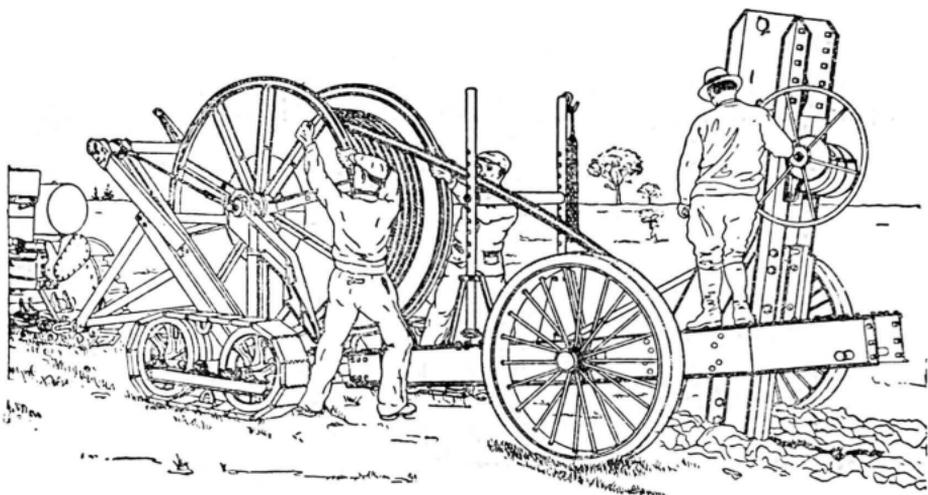


FIG. 1

The signal to start the tractor at any time should be given by one man, preferably the foreman, who should see that all men are clear of all of the units in the train.

Care should also be exercised when unloading the cable reel trailer. The reels should be unloaded on level ground so that they will not roll down an incline after they are clear of the trailer.

2.02 The reel of cable on the trailer should always be started to turn by hand power and not by the jerk of the cable when the tractor starts. If this precaution is not taken, the cable will be jerked and damage may result. The position of the men in starting the reel is shown by Figure 2.



When tractor starts, give reel a start by hand to prevent jerking the cable.

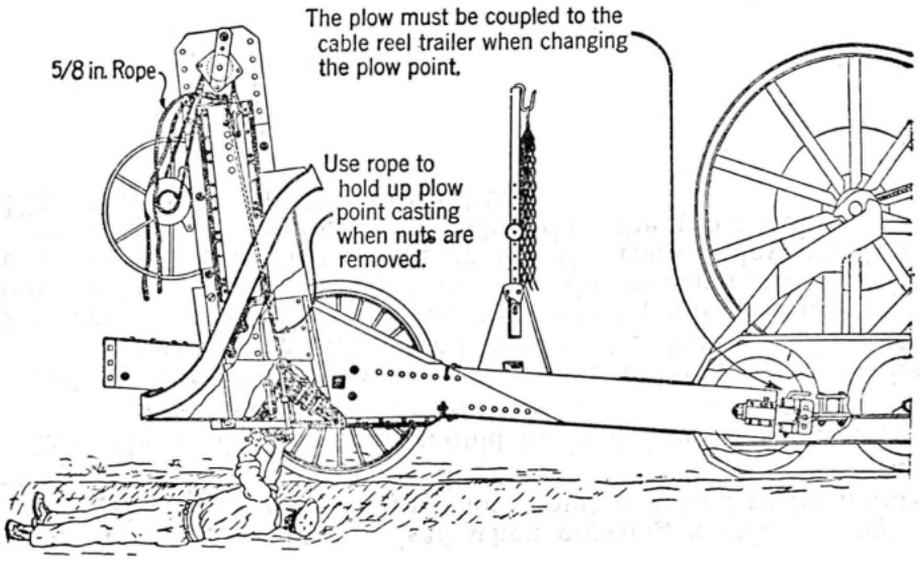
FIG. 2

2.03 Care must be exercised when crossing a railroad right of way to see that the plow point is raised to its maximum height in order to clear the rails.

2.04 The cable feed tube should be kept free of asphalt deposits which might cause wedging of the cable.

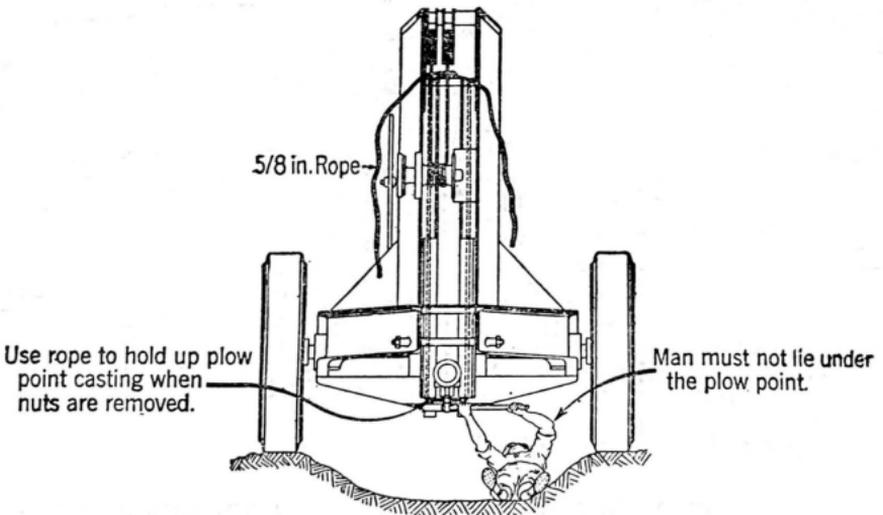
2.05 It is advisable to raise the plow point support to its uppermost position and insert the locking pin (see Paragraph 10.01) before changing a plow point. In order to obviate the possibility of overturning, the trench plow must be coupled to the cable reel trailer and the roter plow must be coupled to the tractor before changing the plow point. See Figures 3 and 4 and Paragraph 8.01.

PRECAUTIONARY MEASURES



Changing Plow or Rooter Point

FIG. 3



Changing Plow or Rooter Point

FIG. 4

3. PREPARATION FOR PLOWING

3.01 Before any cable is laid, the plow should be properly lubricated and the bolts and nuts checked for their tightness.

3.02 The plow point should be inspected to see that it is properly dressed or sharpened, otherwise satisfactory results cannot be obtained.

3.03 The adjustable roller should be placed at the proper height so that the cable will be supported as it passes from the reel to the feed tube. This adjustment is made when the plow point support is set for laying cable at a maximum coverage.

3.04 The following tools, supplies, and spare parts can be carried in the plow tool boxes. (One of the tool boxes is provided with a padlock.)

Tools for sealing end of cable

Solder

Hack saw

Cable dresser

Hammers

Wrenches

Spade (narrow)

Pick

Axe

Spare coupling pins for plow and tractor

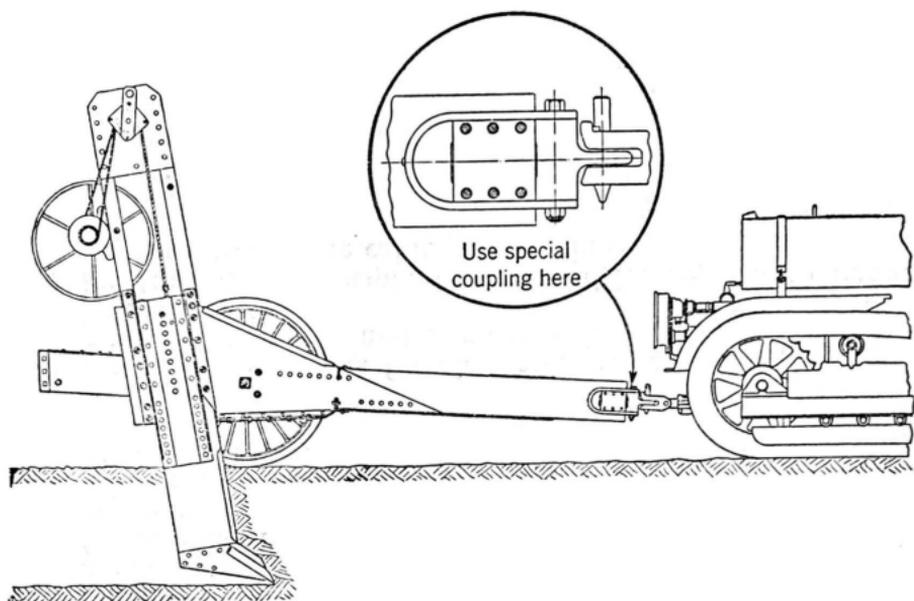
Spare plow points and bolts to suit

Lubricants

Friction tape and asphalt compound for repairing damaged portions of the cable jute serving

4. OPERATION OF ROOTER PLOW

4.01 A tractor of the drawbar capacity of the Model 60 Caterpillar is capable of pulling the roter plow through the ground. If the required depth cannot be obtained at the first pass, it will be necessary to make two or more passes through the soil at increasing depths. It is advisable to explore the soil to a depth approximately three inches greater than the cable is to be laid.



Roter plow connected to tractor.

FIG. 5

4.02 When the plow is to be used for rooting purposes, or when it is to be trailed in moving, it will be necessary to replace the universal coupling at the front end of the tongue with a fitting provided for that purpose. The plow can then be coupled directly to the tractor as shown by the Figure 5.

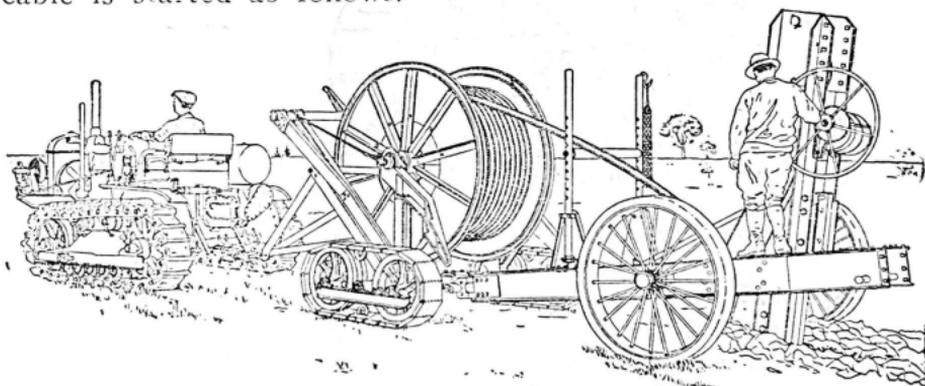
4.03 The method of adjusting the depth of the roter plow point is the same as that given for the cable laying plow. See Paragraph 5.02 and Figure 7.

4.04 When contact with a solid buried object occurs, its exact nature should be ascertained by digging with hand tools after the plow has been moved.

- 4.05 Large rocks can be removed by means of the tractor or it may be necessary to use dynamite.
- 4.06 When the cable right of way traverses territory containing shelf rock, limestone formation, or slate deposits, it may be necessary to loosen the formation before exploring with the rooter plow. To do this, follow the route, placing charges of dynamite at the desired depth or use mud capping, depending on the conditions encountered, approximately 18 inch spacing, and firing in accordance with the standard dynamite practices.
- 4.07 If the buried object is found to be small in extent and difficult to remove, a slight detour of the cable route can be made.
- 4.08 Roots or other vegetable matter can be removed by means of an axe and shovel.

5. OPERATION OF TRENCH PLOW

5.01 With the cable laying trench plow, cable reel trailer, a tractor coupled as shown by Figure 6 the laying of cable is started as follows.



Cable laying train in operation. Two tractors may be required for some conditions.

FIG. 6

5.02 The plow point is adjusted to the required depth by means of the hand winch mounted on the plow frame. Turning the winch wheel in one direction raises the plow point and the counter direction lowers the plow point.

5.03 The plow point is adjusted to the desired depth at which the cable is to be laid by turning the hand wheel until the locking pin is placed in the corresponding hole. One or both of the plow wheels will then be lifted from the ground. See Fig. 7.

OPERATION OF TRENCH PLOW

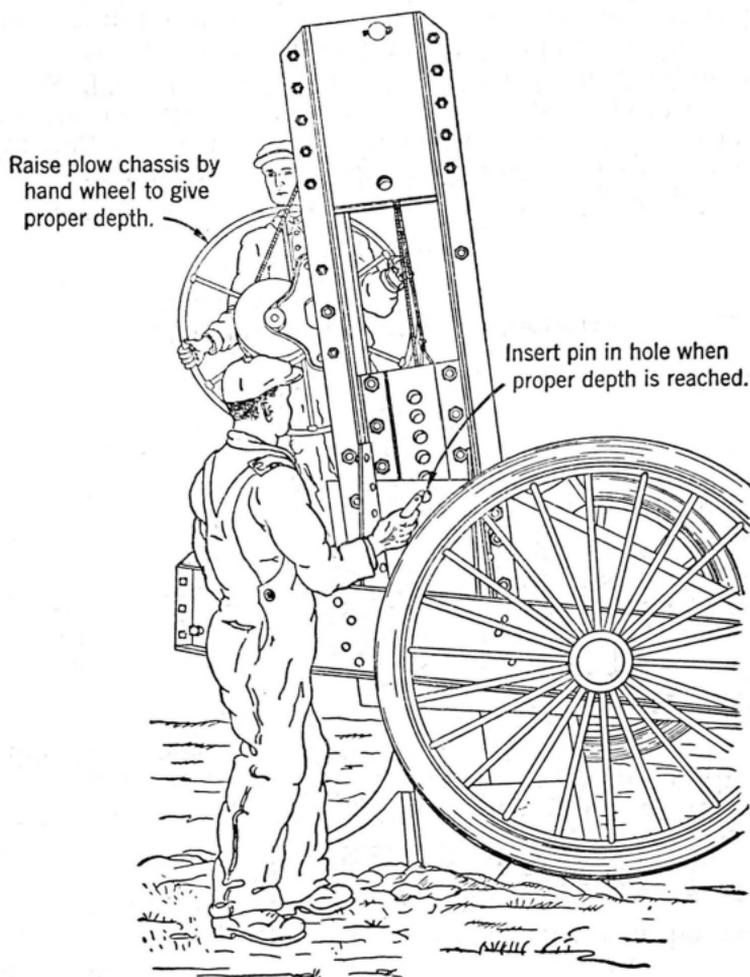
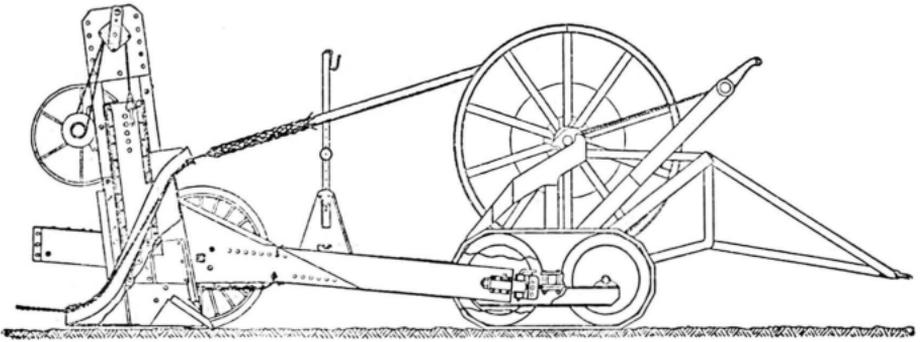


FIG. 7

5.04 The outer end of the cable is unclamped from the reel and a standard underground cable grip is placed in position. The chain is passed through the cable feed tube and connected to the cable grip by means of a double ended connecting link. The lower end of the chain is connected similarly to the winch rope of a tractor or truck which is located approximately 100 feet behind the plow. The winch is started, pulling the cable through the feed tube until the end of the cable reaches a point that will provide the necessary overlap for splicing. This requires a pull of about 1,000 pounds. See Fig. 8.



Set up for pulling cable end through tube.

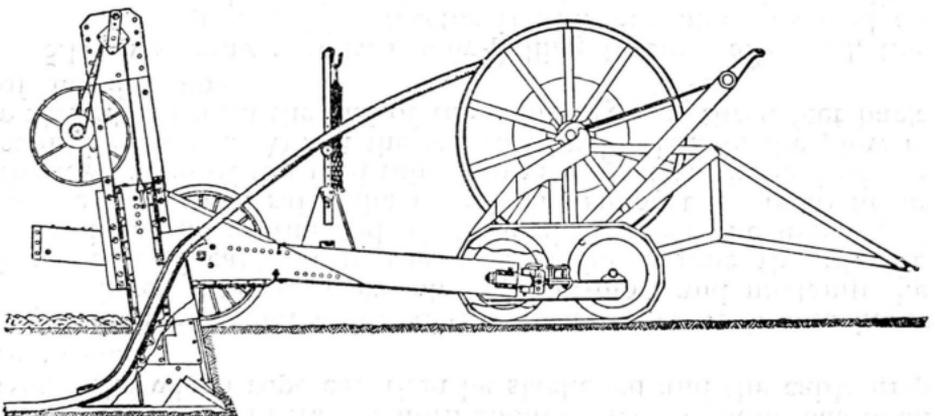
FIG. 8

5.05 A small tractor equipped with a winch is desirable for pulling the cable through the feed tube. This tractor can be used for other work on the job such as moving empty reels.

5.06 The winch brake and the tractor brake on the small tractor are now applied.

5.07. The signal is given to the drivers of the one or two plow-pulling tractors to start. Two men, one on each side of the reel (see Figure 2), should start it to turn as the tractor starts to move so that the cable will not be jerked.

5.08 The weight of the plow point support, chassis assembly, and the rake of the point are such that both plow wheels will come into contact with the ground quickly and permit the plow point to attain its working depth. Coverages up to 30 inches can be obtained. See Fig. 9.



Feeding cable into ground.

FIG. 9

OPERATION OF TRENCH PLOW

5.09 It is necessary to hold the cable by means of the winch on the small tractor until about 40 feet of cable has been laid. The winch rope can then be slackened and the cable grip removed.

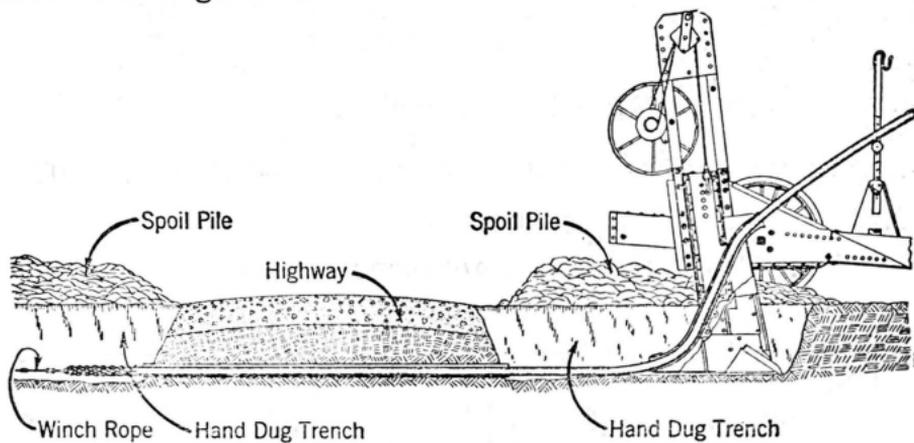
5.10 When all but a few of the turns of cable in the inner layer have been placed, stop the plow and unclamp the inner end of cable from the reel. Then resume the placing operations and as the end of the cable reaches the upper end of the feed tube, raise the plow point support so as to bring the lower end of the feed tube into view, just as the end of the cable is reached. When the length of cable is laid, the plow is pulled ahead until the end of the cable is about three feet back of the feed tube.

5.11 Assuming that two plow-pulling tractors are used, the front plow-pulling tractor is now uncoupled as well as the plow from the cable reel trailer and the second plow-pulling tractor is used for pulling the cable reel trailer with the empty reel, to a point where the next reel of cable is spotted. The empty reel is replaced by a full one and the trailer moved back to its original position for cable laying. The head tractor and the plow are again coupled in their respective locations. The use of the hand winch will greatly facilitate the coupling of the plow to the cable reel trailer by using it to raise or lower the front end of the plow tongue. The small winch equipped tractor is now brought into position to pull the cable from the new reel through the feed tube. This completes the cycle of operations.

5.12 The splicers' pit is dug by hand after the cable is laid.

5.13 If in laying cable it is found that there is insufficient coverage at certain points, these locations should be marked by means of stakes and the proper depth secured later by hand digging.

5.14 When a highway or railroad right of way is crossed by the cable right of way, the following method should be used. See Figure 10.



Pulling cable from reel through plow tube and under roadway.

FIG. 10

A trench of the proper depth should be dug by hand in line with the pipe under the highway or railroad right of way. The plow should be set up on the far side of the highway or railroad right of way and the cable pulled back by means of a winch rope through the pipe until the proper splice overlap is obtained. The cable is held at this point with the winch rope, the plow started and the remainder of the section of cable is laid in the usual manner.

5.15 When pipe lines having coverages of not less than 36 inches are crossed, the cable should pass over them with a minimum clearance of 12 inches. The method given for crossing the highway or railroad right of way can be used when passing under a pipe line. When the coverage over the pipe line is less than 36 inches, the cable should pass under it with a minimum clearance of 12 inches.

5.16 When the cable right of way crosses a bog or swamp which will not support the cable laying equipment, one of the following alternatives should be used:

- (a) The cable can be laid with proper coverage up to the swamp and then laid out on the ground around the edge of the swamp in a large radius so that it can be carried into the swamp by hand.
- (b) The plow can be set up across the swamp and the cable pulled back to the previously laid section by means of the winch on the tractor.

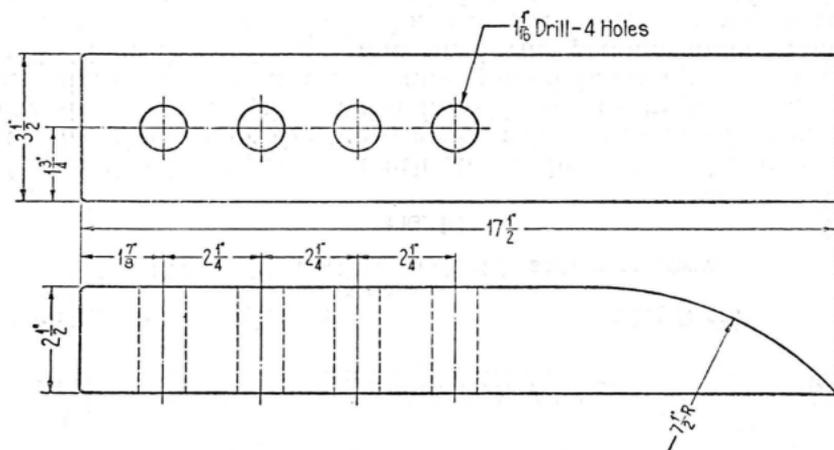
OPERATION OF TRENCH PLOW

5.17 When the cable crosses unimproved highways, it may not be necessary to pull the cable through a pipe under them. It may be practicable to plow or dig a trench across the highway. When cable is laid across these highways, care should be taken that sufficient coverage is obtained at the drainage ditches and under the traveled portion.

6. PLOW MAINTENANCE

6.01 The plow point is made of heat treated Colonial well bit steel. This material has been found to be very durable and to maintain a sharp edge when properly heat treated. In ordinary soil, distances of 50 miles can be plowed without the necessity of replacing or resharpening the plow point.

6.02 When the cutting edge of the plow point becomes dull it can be sharpened as shown by the accompanying profile drawing. See Figure 11.



Drawing of Trench Plow or Rooter Point (New)

FIG. 11

6.03 The heat treatment as recommended by the steel manufacturer is as follows:

FORGING:—When forging, heat the steel slowly and uniformly to approximately 1600-1650° F. (bright cherry red to salmon) and forge with a number of light blows rather than a few heavy ones. Do not finish forging at a temperature below a red heat. Reheat if necessary. When forging is completed, bury the piece in mica, lime or some slow cooling medium.

ANNEALING:—If it is desired to perform machine work on the forged part, it is suggested that the forgings be heated to a temperature of 1430° F. (cherry red) and held at the heat until uniformly heated through, after which they are permitted to cool down in the furnace overnight or removed from the furnace and immediately buried in mica, lime, or any other insulating material.

HARDENING:—To harden the piece, heat slowly, and uniformly to a temperature of 1450° to 1480° F. (cherry to bright cherry red), then quench in cold water.

DRAWING:—Draw the parts for wearing surface only at a temperature of 480° F. (brown) for one hour at heat. Draw the parts in which toughness is desired at 725° F. (red visible in dark) for one hour at heat. Cool in air.

6.04 The cable laying plow root cutter is of the same material as the plow point and can be sharpened with a portable electric or air driven carborundum grinding wheel. This operation should be repeated as required by the cable laying conditions. The heat treatment of the root cutter is the same as that given for the plow point.

6.05 The surfaces of the plow point support casting and the lower end of the feed tube, which become worn due to abrasion from the soil, can be surface-hardened by adding a coating of Stellite or other similar alloy.

6.06 The universal drawbar coupling on the forward end of the plow tongue is made of heat treated alloy steel in order to resist wear and upsetting. This part should be replaced when the holes become elongated so that the drawbar cannot withstand the pull of the tractor.

6.07 The cable feed tube should be cleaned at the completion of the day's work and a location free of inflammable material should be selected for this purpose. Particularly in hot weather asphalt will be deposited from the cable on the inside of the tube. Heat is directed into the lower end of the feed tube which will cause the asphalt to melt and flow from the tube.

6.08 The root cutting edge of the rooter plow is surface-hardened by means of Stellite or other similar alloy. These surfaces should be built up as required and can be ground to the proper cutting edge by means of a portable electric or air driven carborundum grinding wheel. Wear can be arrested on other surfaces of the rooter plow point support by the application of Stellite or other similar alloy.

7. PLOW LUBRICATION

7.01 The pressure lubricator, such as supplied with the Model 60 Caterpillar tractor, can be used to lubricate the plow wheels, the universal drawbar coupling, and hand winch bearings.

7.02 The plow point support guides should be kept well lubricated with transmission oil.

7.03 The wire rope sheave wheels and the hand winch parts can be lubricated with engine oil by means of an oil can.

8. CHANGING PLOW POINTS

8.01 A set of socket wrenches and extensions are supplied with each plow for the purpose of changing the plow point. In order to support the weight of the casting to which the plow point is bolted, it is advisable to employ a piece of 5/8 inch manila rope as shown. Figures 3 and 4 show the method by which the plow points are removed or installed.

8.02 It is advisable to raise the plow point support to its uppermost position and insert the locking pin (see 10.01) before changing a plow point. The trench plow must be coupled to the cable reel trailer and the rooter plow must be coupled to the tractor before changing the plow point.

9. CHANGING PLOW POINT SUPPORT

9.01 The plow point support of either the cable laying plow or rooter plow can be changed by one of the four methods given below.

(a) The wire ropes connected to the plow point support should be removed. If this work is done in a shop equipped with an overhead hoist or crane the plow chassis can be raised allowing the plow point support to rest on the floor. When the plow chassis is sufficiently high the plow point support can be moved to some other position in the shop and the plow chassis lowered to the floor.

(b) The plow wheels can be removed, the axle withdrawn and the main right and left hand members of the chassis separated by removing the bolts which hold them together. The chassis members can be removed so that the plow point support assembly is left standing.

- (c) With the wheels and axle removed the chassis can be laid on its side and the plow point support pulled from its guides.
- (d) If a trench or deep pit is available, the plow can be placed astride the trench or pit and the plow point support lowered into it.

9.02 The plow point support can be installed by reversing the order of the above mentioned operations.

10. MOVING THE PLOW FROM ONE LOCATION TO ANOTHER

10.01 The hand winch is operated until the plow point support is raised to its uppermost position. The locking pin should then be inserted through the holes provided in the lower edge of the tower side plates. A new cotter-pin should be placed in position in the locking pin so that it cannot fall out of place accidentally. See Fig. 12.

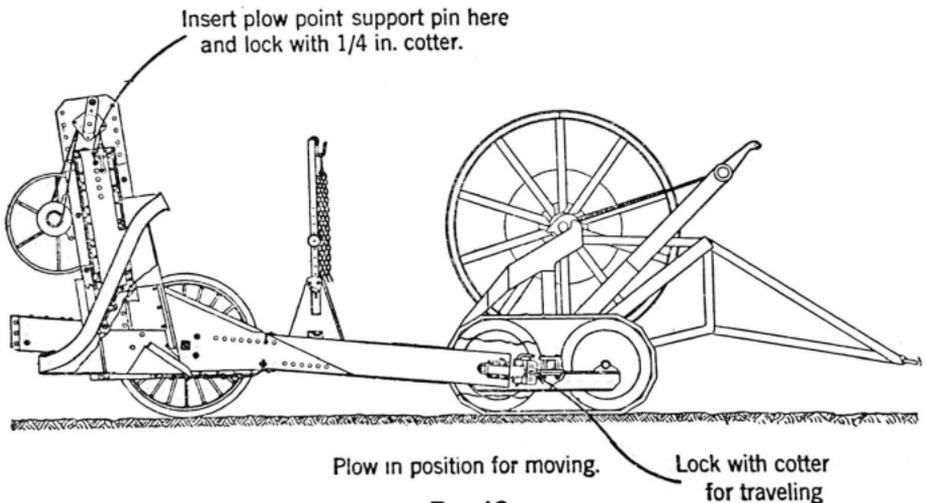


FIG. 12

10.02 If required, additional clearance under the roter plow point support can be obtained by removing the plow point when traveling.

10.03 A new cotter-pin should be placed in the end of the plow coupling pin for traveling.