

BELL SYSTEM PRACTICES
Motor Vehicles and
Construction Apparatus

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AT&T Co Standard

BURIED CABLE

CABLE PLACING TRAIN OPERATION

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1. CABLE PLACING SPEEDS

1.01 It is desirable to operate the train at speeds between 2-1/2 and 1-1/2 miles per hour as discussed in routing procedures (Section J6.404).

2. AVOIDANCE OF DAMAGE TO CABLE

2.01 The jute or thermoplastic protective coverings surrounding the lead sheath are provided principally as a safeguard against corrosion. Puncturing or damaging the coverings tend to nullify this protection. It is important, therefore, to avoid damaging the cable when handling it on the job, on the freight car, and during transit from the railroad to the job.

2.02 Excessive pulls on the ends of buried cable should be avoided. The protective coverings are bulky and give an appearance of strength when placed on a cable. These materials are not designed to withstand tension however, and are so placed that only a part of their strength is effective. Buried cables should not be subjected to stresses in excess of those considered safe for lead covered cable having the same diameter as the lead sheath of the buried cable.

2.03 In turning reels, particularly when the lags have been removed, bars should not be used in such a manner that they will press against the cable. Reels should not be dropped since, in addition to damaging the reels if the lags have been removed, the flanges are likely to sink into the ground with the result that the cable may be crushed between the ground and the drum of the reel.

2.04 When it is necessary to roll the reels over soft ground after the lags have been removed, plank tracks should be employed to prevent the flanges from sinking, with possible resultant crushing of the cable. Reels should not be rolled over rocks or other projecting objects that are likely to damage the cable.

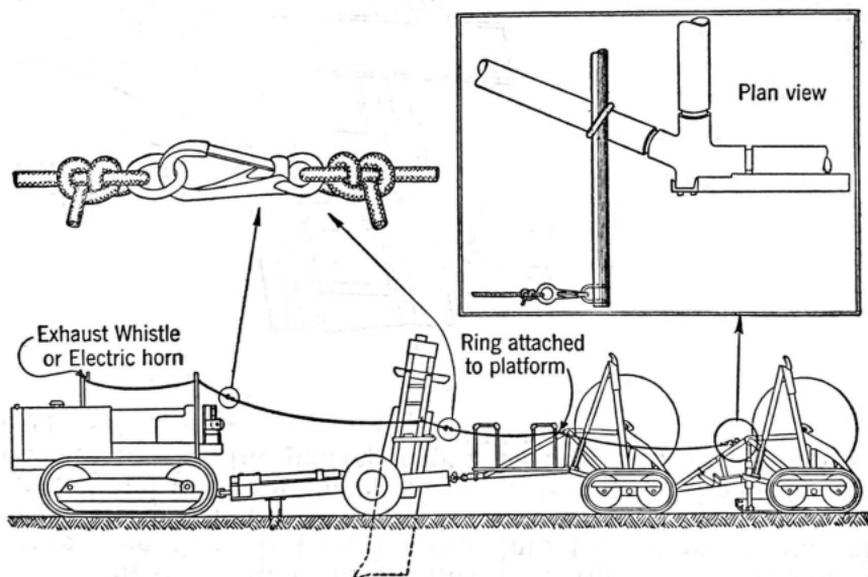
2.05 In handling a heavy reel it should never be permitted to tilt. When uneven ground conditions are encountered, provide a substantial runway of heavy planks leveled by blocking so that tilting of the reel will not occur.

2.06 Where it is necessary to pull the cable over the ground or along the trench, trench rollers or other supporting devices should be used to prevent the cable from dragging over rocks, tree trunks, stumps, etc., which might injure the protective covering.

2.07 Sharp bends should not be made in the cable, since severe bending is likely to crack the lead sheath or separate the protective coverings and expose the metals to corrosive elements.

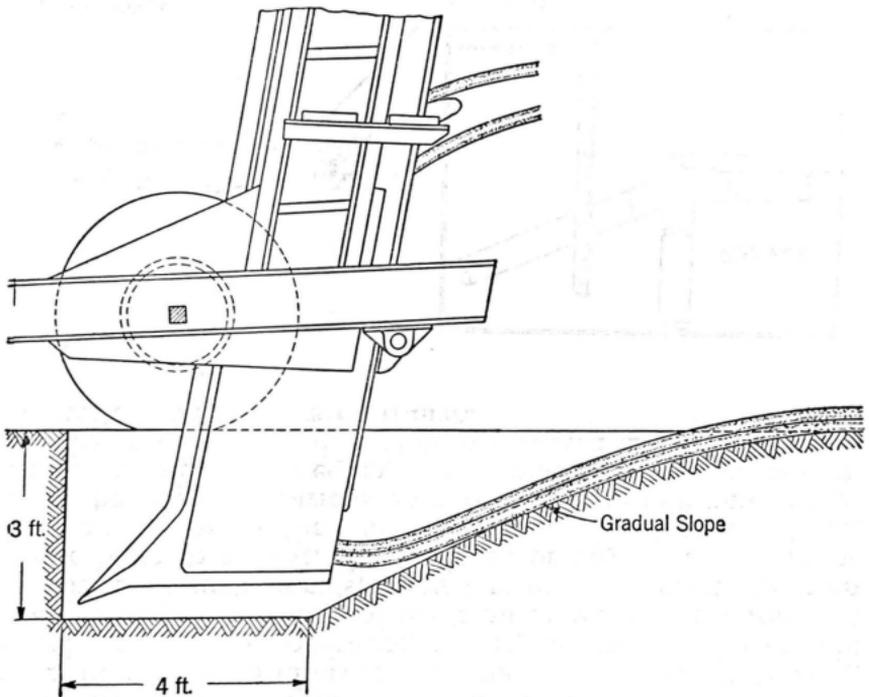
3. SIGNALS

3.01 Due to the noise of machinery it is not practicable to hear verbal orders. A distinctive signaling arrangement which can be heard above the noise is, therefore, necessary. An exhaust whistle or electrically operated horn, mounted on the main tractor has been found satisfactory for this purpose. A hand line to operate this horn can be extended to the rear unit of the train with intermediate attachments. Before starting the train, the person operating the signal must make certain that all employees are clear of the train. In general, the foreman should give all such signals, using two blasts to start the train and one blast to stop it. No employee or any other person or animal should be in the immediate path ahead of the train, walking between the various units or riding on any unit except the tractors and trailers equipped with platforms and back-rests, while the train is in motion. Only designated employees should be permitted on tractors or trailers.



4. PRELIMINARY PROCEDURES

4.01 A pit should be dug before the cable placing is started, in order to facilitate threading the cable through the share. The share is later lowered into the pit in starting the plow. The pit should be at the location where the plow is to be started and in line with the proposed trench. It should be deep enough to give the placing depth desired. Usually a pit 3 feet deep is required.



4.02 Lay out a hand line for each cable. These hand lines should extend from the front of the pit, to a point approximately 30 feet to the rear. The use of hand lines is specified in order that a man will not have to crawl under the loaded trailers later in placing the pulling lines.

4.03 Load the trailers, connect the various units of the train and drive over the pit, stopping the train with the plow-share over the pit, the front of the share being slightly back of the front of the pit.

4.04 Feed the cable through the plowshare.

(a) Small cables can usually be thrust down through the cable slot from above, first bending the end (approximately 8" radius) toward the rear of the plow, to assist in feeding the cable around the curves.

(b) To feed larger cables through the slot it is necessary to pull them through, assisting by pushing from above. The operations are as follows. Thread fish tape or wire through the slot. Use hand line to pull winch rope from a convenient truck or tractor or other pulling line, under the trailers. Attach fish line to winch rope and pull winch rope up into share. Place cable grip on cable and attach winch rope to cable grip. Take up slack on winch rope, lubricating the grip and cable as it enters slot. At same time guide cable into entrance of share and start reel or reels turning by hand to relieve strain on cable. After the cable end is pulled through share, train starts to move. The winch line or anchor line holding the cable end must be held, by the truck or by a bar driven in the ground, until about 250-300 feet of cable is laid. Otherwise the cable will be pulled through ground and not through share.

5. LUBRICATION OF CABLE

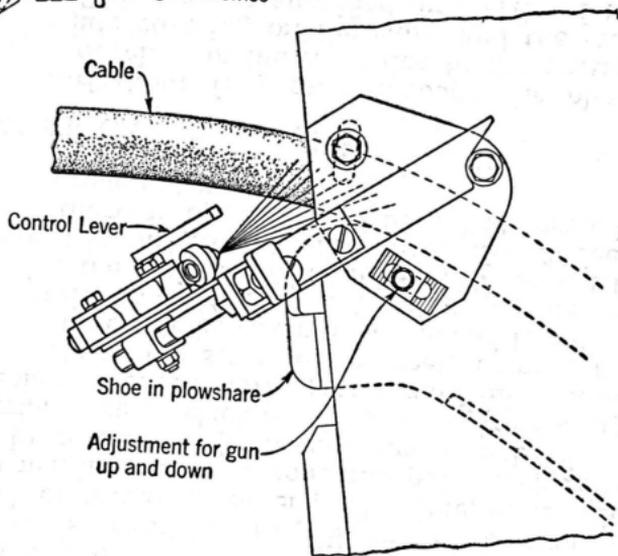
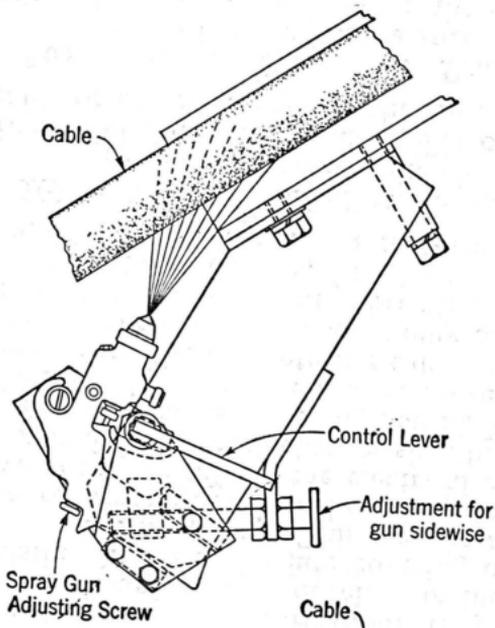
5.01 **Need for Lubrication:** In passing through the plowshare, tension develops in the cable due to the friction existing between the jute covering on the cable and the steel slot in the plowshare. This may be amplified by inertia of the reel or friction of the reel on the spindle. Such tension if excessive adversely affects the electrical characteristics of the cable or may damage conductors or sheath. The above applies whether one or two cables are being placed. When two cables are being placed, one above the other, however, only a slight tension develops in the top entering cable and the tension in the lower cable is about the same as if only one cable were being placed. It has been found that lubrication of the cable surface that contacts the slot shoes, (the bottom entering cable) will materially lessen the tension as it passes through.

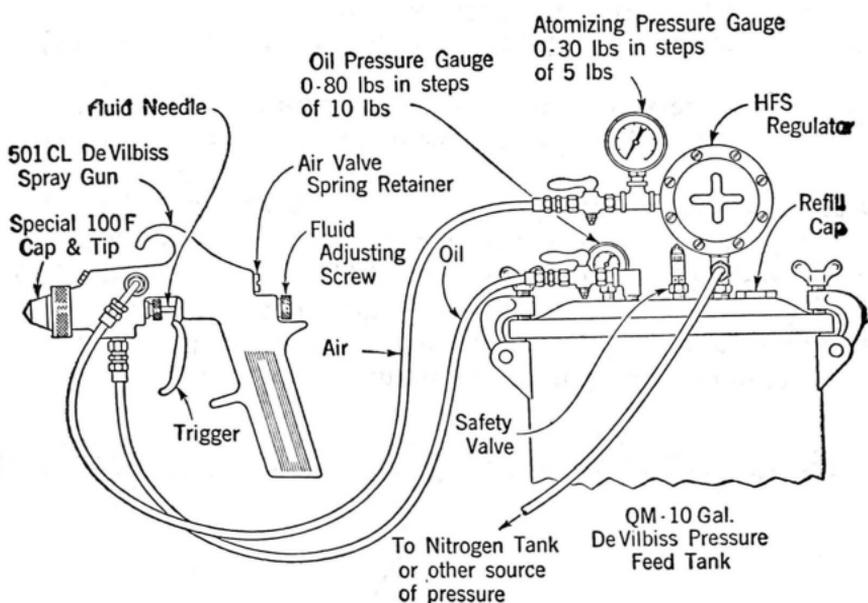
5.02 **Oil lubrication of the cable** shall be provided at the point of entrance at the plowshare by spraying a Winter Black Oil (such as Texas #673) on the under surface of the cable or cables contacting the shoe.

5.03 **Mounting Spray Gun:** Provision is made on the plowshare for mounting a special spray gun (Section J6.406) with adjustments for directing the spray and a control for turning it on and off.

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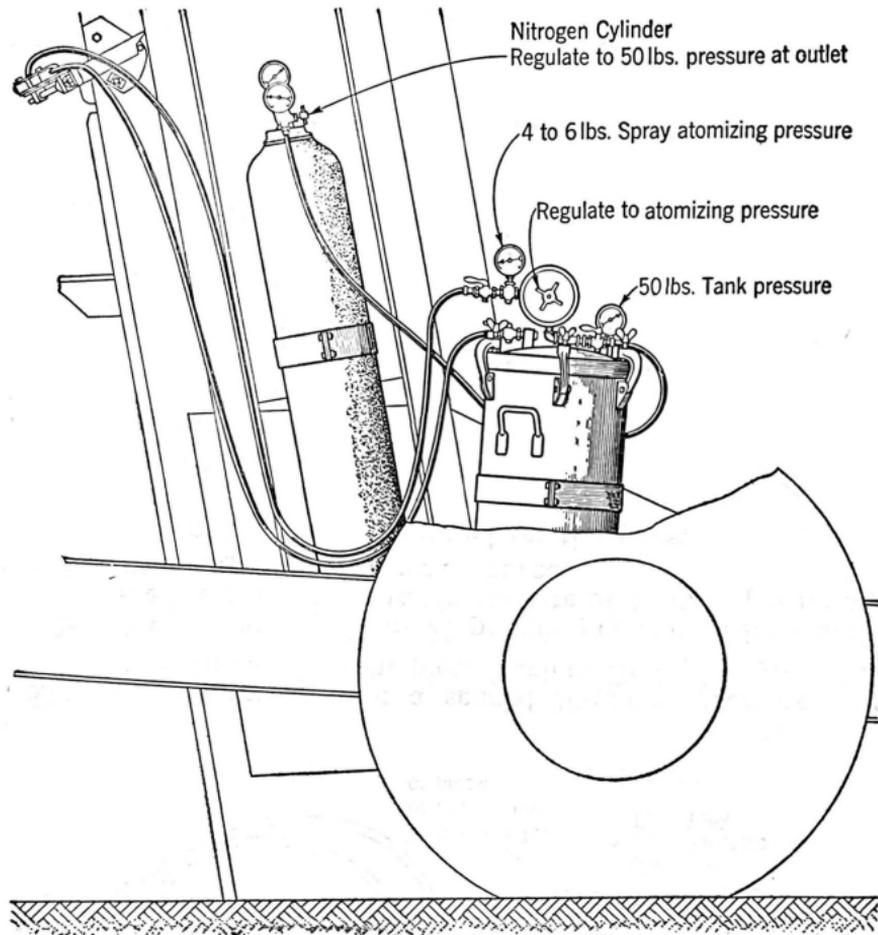


5.04 **Oil supply** is from a special 10-gallon pressure feed tank mounted on the plow (such as DeVilbiss type QM).

5.05 Air or gas supply of 50 pounds per square inch delivered to the tank at minimum rate of .6 cu. ft. per minute can be from any one of several sources.

(a) Nitrogen cylinder mounted on the plow.

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- (b) A compressor mounted on main tractor engine.
- (c) A small capacity gasoline engine driven compressor unit mounted on the plow.

5.06 Regulation of the Spray: When the air or gas supply, oil supply and spray gun are properly connected.

- (a) Open air or gas supply and oil supply valves on pressure tank.
- (b) Remove spray gun from mounting.
- (c) Close spray gun adjusting screw and then open it 2-1/2 full turns.
- (d) Pull trigger on gun and regulate atomizing pressure gauge on tank to read between 4 and 6 pounds.

(e) Deliver oil into a measuring container. The desired quantity is 1 quart in not more than 2-1/2 minutes. Adjust spray gun adjusting screw to give this quantity.

(f) Replace gun in mount on plowshare.

(g) With cable in running position, the oil should spray in a pattern 1 to 1-1/2 inches wide at point where it hits the bottom side of the cable.

5.07 **Oil quantity** desired is approximately 4 to 5 quarts per 1500-foot section. If the plow is being pulled with the winch line or the plow moves slowly, the consumption will be greater than required unless an adjustment of the gun delivery is made.

6. STARTING A REEL TO TURN

6.01 On starting a reel to turn, a slight amount of lubrication of reel spindles is desirable, especially when #420 reels are used, in order to reduce the initial tension on the cables as they enter the plow. An excessive amount of lubricant is objectionable as it tends to cause the reel to overrun when the train is stopped and it makes the parts more difficult to handle.

6.02 In addition, it may be found desirable in starting a reel turning to help it with a push by hand. Also in stopping it may be found desirable to brake reel by hand to prevent overrunning and kinking the cable.

7. CHANGING CABLE REELS—(Twin Cable Job. Omit rear trailer on Single Cable Job.)

7.01 Drop rear trailer when 4 to 6 turns of cable remain on reel.

(a) Stop the train. If on an appreciable up or down grade, set both track locks on rear trailer. (See cut in Section J6.406.)

(b) Lower skids on tongue of rear trailer.

(c) If not already done, attach winch line from main tractor control winch to the left (facing forward) drum of the relay winch on the front trailer.

(d) Disconnect ratchet on small drum of the relay winch by pulling on lever on right side.

(e) Make sure the large and small drums of the relay winch are connected.

(f) Advance train. Winch line from tractor winch will wind on large drum of relay winch and winch line from small drum of relay winch will pay out, permitting the rear trailer to remain stationary while the train moves ahead.

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- (g) Stop train when end of shorter cable is 6 to 10 feet from mouth of cable slot in plowshare. See Paragraph 8.01.
- (h) Pull slack in towing line to rear trailer and pull line to one side to avoid damaging it with tracks of loading tractor and trailer.

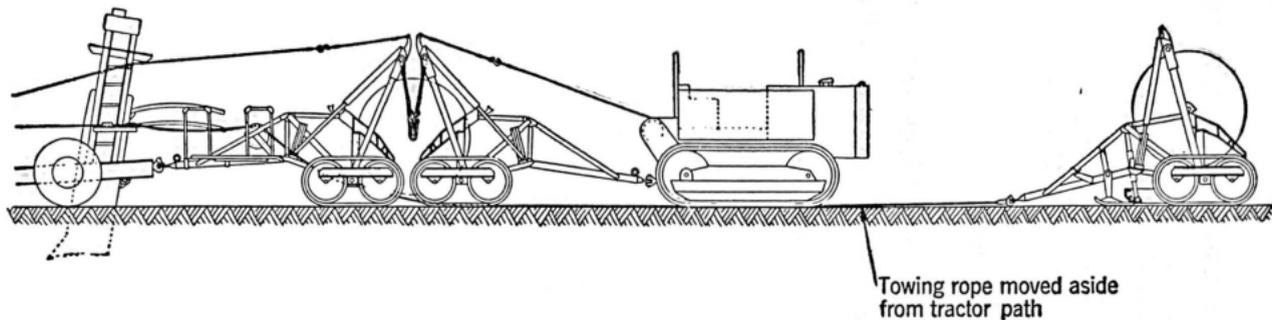
7.02 Unload empty reel from front trailer by lowering trailer boom.

- (a) Take up on winch line between main tractor and front trailer boom pulling spindle to stop on trailer.
- (b) Release latches on spindle locks.
- (c) Slack off on tractor winch until reel reaches ground.
- (d) Remove loops from ends of spindle.
- (e) Remove spindle from reel.
- (f) Roll reel to side of right of way and block securely.

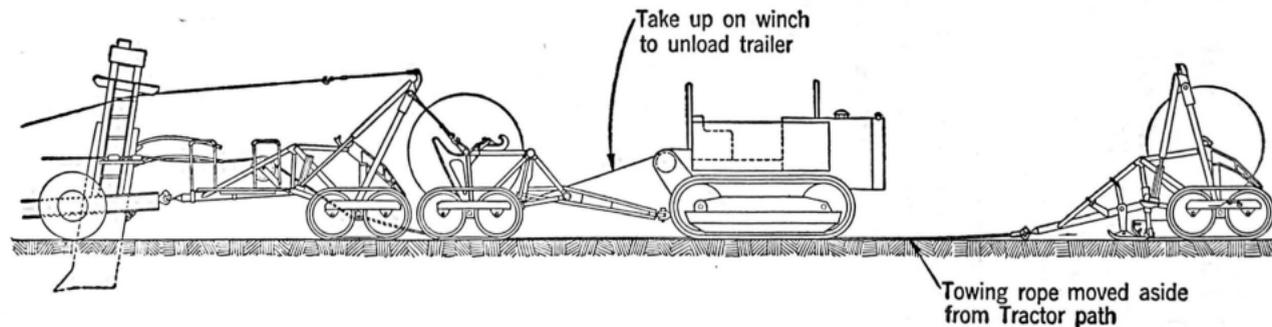
7.03 Load new reel on front trailer.

Note: In figures and descriptions below, the new reel of cable is carried to the front and rear trailer in the train by an extra trailer pulled by an auxiliary tractor. As indicated in Section J6.406, the new reel can also be moved by lifting it with a special framework and winch operated sling at the rear of the auxiliary tractor. Where this method is employed the reel should be held from sidesway by brackets projecting from the rear of the tractor. This method is suitable for fairly level firm ground. It is not suitable for work in marshy ground where it may be necessary to pull the reel on a trailer over soft places, using the winch line in extremely bad locations. Also it should not be used on steep grades.

- (a) Back loading trailer into position behind front trailer.
- (b) Lower loaded reel part way until wire rope loops from front trailer can be placed over ends of spindle.
- (c) Take up on winch line to boom of front trailer.
- (d) As reel is raised by front trailer boom, release winch line to WL loading trailer boom or jack-knife TL trailer, if the latter is used.
- (e) Take up on front trailer boom until spindle reaches stop on trailer ramp.
- (f) Lower spindle latches into slots making sure that they drop back to locked position.
- (g) Release winch line to front trailer boom permitting spindle to roll back to rest against latch.



USING WL TRAILER FOR LOADING FRONT TRAILER



USING TL TRAILER FOR LOADING FRONT TRAILER

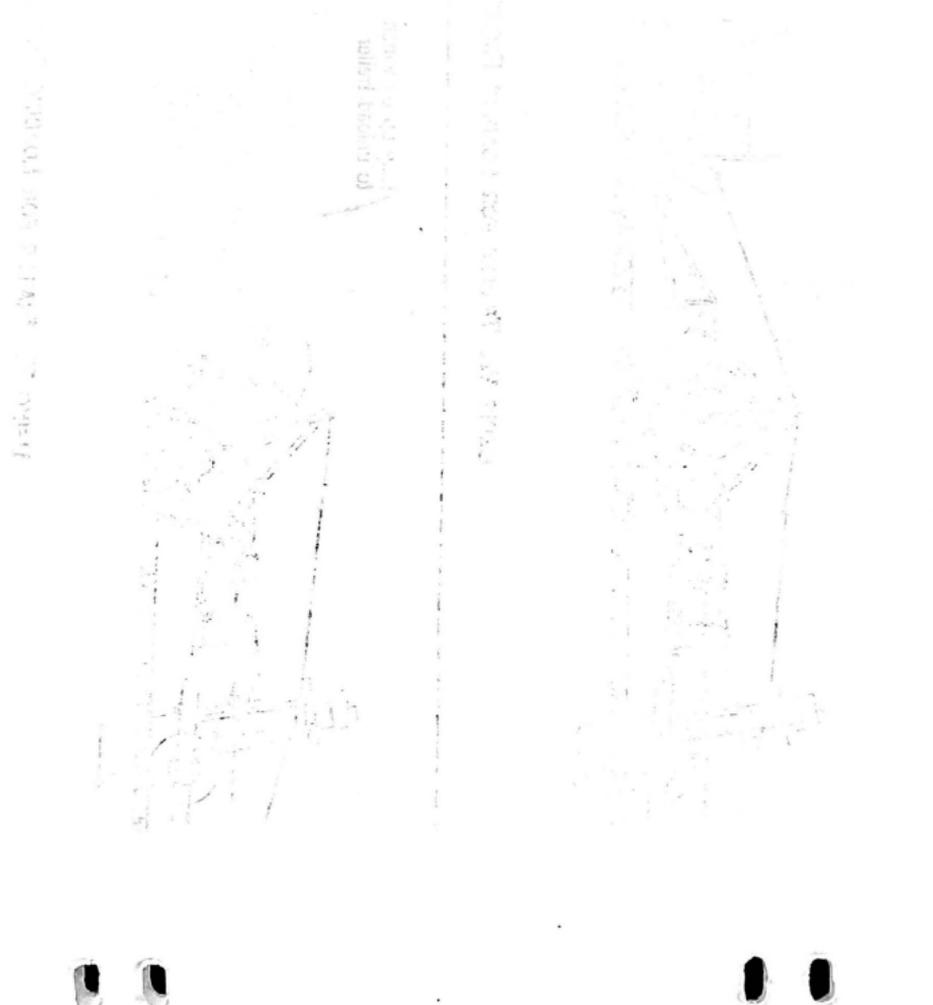
7.04 Reconnect rear trailer.

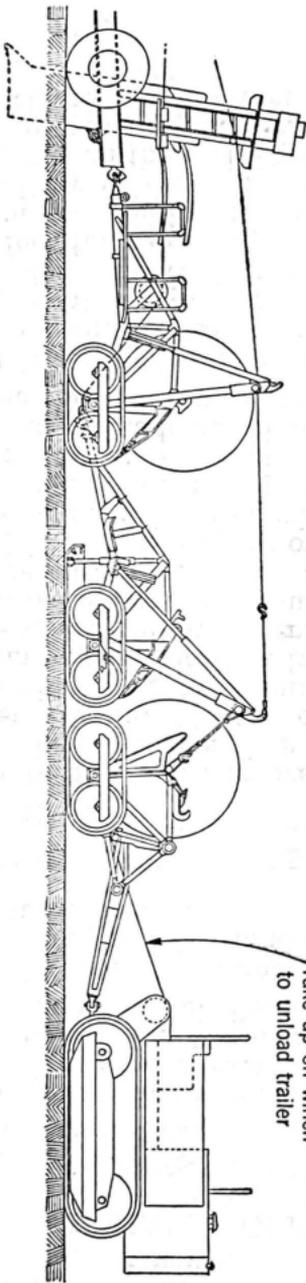
- (a) Take up on winch line from main tractor to left drum of relay winch drawing up rear trailer to its position in the train.
- (b) Ratchet handle should be free and ratchet clicking.
- (c) As bullet nose on connecting device enters socket on axle of front trailer, slow up on winch line pull. See cut in Section J6.406.
- (d) Make sure that bullet nose engages in its socket but lacks 1/2" to 1" of pulling tight, and that ratchet on relay winch is holding properly.

7.05 Unload empty reel from rear trailer.

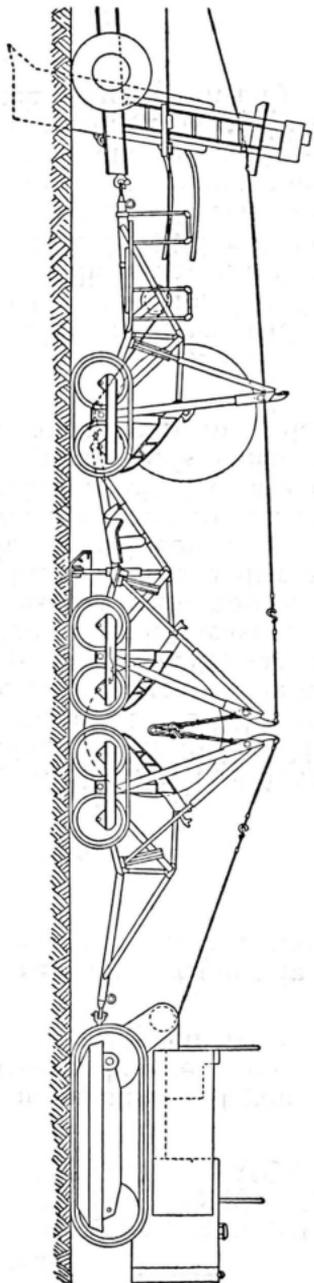
- (a) Proceed as in Paragraph 7.02.
- (b) Roll reel to side of right of way and block securely.

7.06 Load new reel on rear trailer as in Paragraph 7.03.





USING TL TRAILER FOR LOADING REAR TRAILER



USING WL TRAILER FOR LOADING REAR TRAILER

Take up on winch
to unload trailer

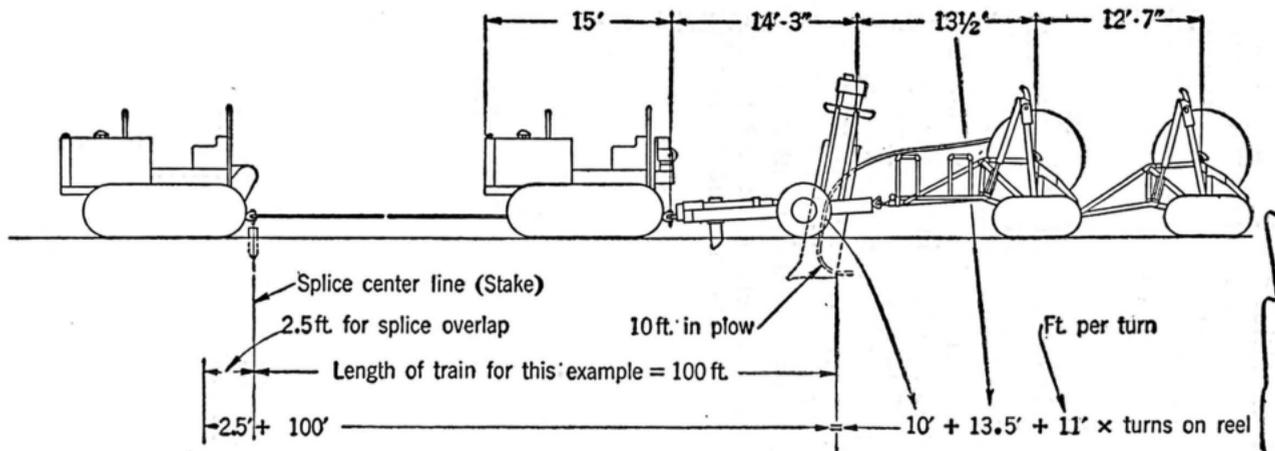
7.07 Precautions when loading and unloading reels.

- (a) Keep all persons away from the back of trailer so as to avoid injury if unexpected movement of the reel occurs or if winch line should break.
- (b) KEEP HANDS OFF WINCH LINES EXCEPT WHEN PERFORMING ASSIGNED OPERATIONS WITH THESE LINES. NEVER TAKE HOLD OF A MOVING WINCH LINE.
- (c) In handling reel spindle locks, make sure that you have signal from tractor winch operator before latching or unlatching. Latches must be handled only when there is no movement of spindle.
- (d) Before attempting to load a reel on a trailer in the train, any ice, mud or other debris on the reel flanges must be removed.

8. OVERLAPPING ENDS

8.01 General.

- (a) In the manufacture of cable, ordinarily, reel lengths slightly longer than those specified are furnished. However, occasionally the cable may be shorter or the stake marking the splice point may have been moved accidentally from original location. In order, therefore, to make sure that the splices fall at designated locations, certain measurement approximations are usually made as the train approaches these locations. These are in addition to those discussed in (c). When the rear of the leading tractor comes opposite the splice stake, the cable turns on the drum of the front reel are counted. A previous calculation will indicate how many turns are required at this point. This calculation should be made as follows for the particular train to determine the number of turns.
- (b) Measure length of train from towing hook of leading tractor to rear of plowshare. This will vary with the length of the towing line between the tractors. Add 2-1/2 feet for extra cable required beyond splice center. Subtract 10 feet for cable in plowshare and 13-1/2 feet for distance from plow entrance to center line of front reel. Divide result by 11 and this figure should be the minimum number of turns on the reel. The figure 11 represents the number of feet of cable in one turn on the reel drum. (This is approximately correct for reel with 42-inch diameter drum.)

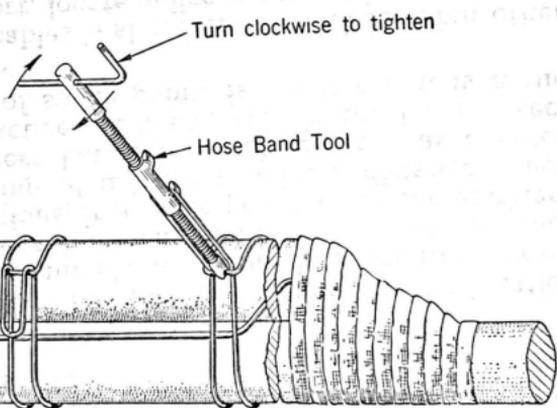
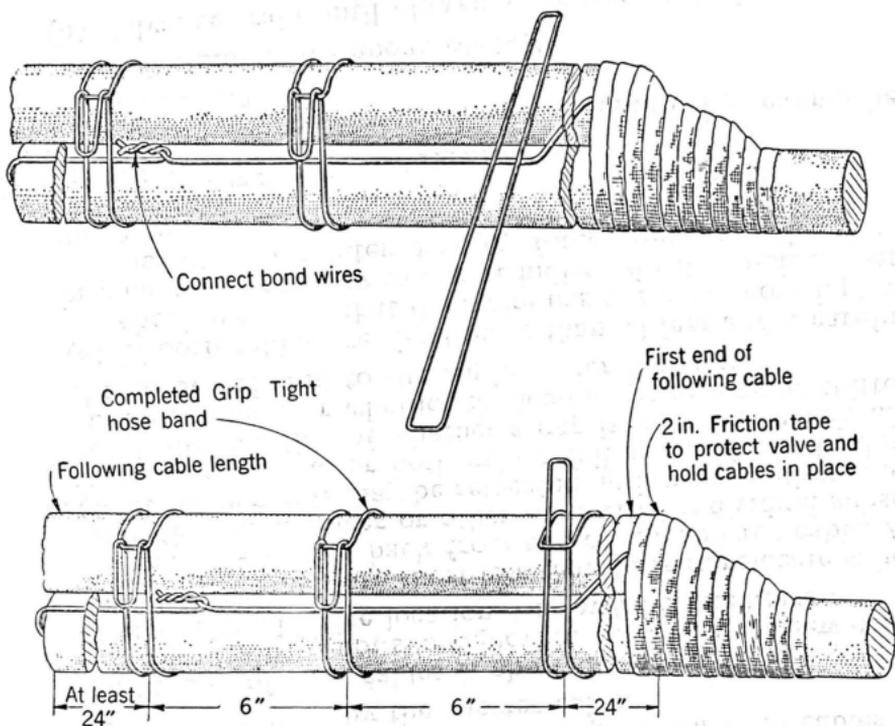


$$\frac{2.5 + 100 - 10 - 13.5}{11} = 7.2 \text{ turns (approx.) on first trailer}$$

(c) After train has advanced to point where reels are to be changed and cable ends are to be overlapped, the train is stopped. The point where center of splice will occur on cable end protruding from rear of plowshare can now be determined as follows: Measure distance from stake marking splice center, to point opposite rear of share. From this subtract 10 feet representing amount of cable in share and the remainder measured from the rear of share out on protruding cable end will locate point on cable where splice will later be made.

8.02 **When reels are of correct length** the reel ends of the same size cable should ordinarily be overlapped approximately 5 feet unless special overlaps are specified on the detail plans. If longer overlaps are required at loading points, the detail plans will so specify, giving desired length. Secure the overlapped ends using Grip Tight type of hose bands. The length of the hose band should be approximately equal to the sum of the circumferences of the cables plus 2 inches. Apply 3 hose bands with hose band tool and wrap 2-inch friction tape around the end of the new cable binding it to the previous section, including the tire valve and about 2 inches beyond it.

Twist the bond wires together, cut off excess length and lay along cable so they will pass into plow smoothly.



8.03 Procedure when cable is longer than needed to reach the splice point.

- (a) If excess is not more than 13 feet, plow in. In this case the end will extend beyond the splice and will be cut off by splicers.

(b) If excess is greater than about 13 feet and less than 50 feet, cut off to required length and junk the short piece. Solder seal the cable end to be buried, adding a valve at the same time and apply nitrogen gas pressure at 9 lbs. for 5 minutes. Suitable notations should be made on the gas history record of such reels.

(c) If the length of cable cut off is in excess of 50 feet, proceed as in (b), except seal end of cut-off piece and save it for possible use.

8.04 If Cable is Too Short.

(a) When the cable is too short, no change in the location of the loading point should be made from that shown on the detail plans without engineering approval. Depending upon the conditions, it may be possible for the engineer to permit the moving of a loading point a distance which would fall somewhere between 0 and 120 feet, as covered in Bell System Practice AB23.195. Within the loading section some shifting of splice points is possible if it is found to be advantageous.

(b) If one of twin cables is short less than 10 feet, but other cable is not short, locate splice point for both cables at the point reached by the shorter cable.

(c) If one of twin cables is short in excess of 10 feet, but other cable is not short, plow in end and start new cable at the original splice location. Gap will be filled later.

(d) If both cables are short less than 60 feet, relocate splice point 2-1/2 feet back from end of the shorter cable. At discretion of engineer or other authorized individual subsequent splice points may be relocated until next loading point is reached. If one or both cables fall short of the loading point, the question of whether a gap is to be left which will be filled in later or whether the loading point may be shifted should be referred to the engineer for decision.

(e) If both cables are short more than 60 feet and a careful check indicates that the stake has not been moved, plow in ends and start new cables at indicated splice points. Gap will be filled at a later date by forces following the placing gang.

9. PROCEDURES AT OBSTACLES

9.01 If a subsurface obstacle is encountered which cannot be plowed past:

(a) Raise plowshare above obstacle.

(b) Advance train until plowshare passes obstacle.

- (c) Lower plowshare to desired depth.
- (d) If plowshare cannot be raised, excavate behind the share, back up plow slowly while taking up the slack cable through the share.

DO NOT BACK PLOW WITHOUT EXCAVATING AS CABLE MAY BE DAMAGED.

- (e) If practicable remove obstacle and lower cable to desired depth. If much time is required do not hold plow train.
- (f) If impracticable to remove obstacle, dig trench around it and place cable in this trench which should be toward the near edge of the right of way to avoid interference with future cable.

9.02 Swamp or Marsh Land: In general little tractive power can be developed when operating in such locations and the equipment may become mired if conditions are worse than anticipated. Several choices of procedure are available, the choice being dependent upon the conditions encountered.

(a) Take auxiliary tractor around the swamp or through the swamp, preferably over a route to the side of the proposed cable route. Anchor the auxiliary tractor on firm ground and winch the remainder of the train through the swamp. Usually a two to one pull through a wire rope block attached to the main tractor is desirable as a precaution against breaking the winch line. However, when the swampy section is long a single line pull may be necessary. Precautions should be taken to safeguard all persons in the event of the winch line breaking whether single or double line pulls are made.

(b) If it is necessary to provide additional bearing surface for the tractor to negotiate a swamp it can be obtained by using 4-inch by 6-inch or 4-inch by 4-inch oak lags about 36 inches long bolted with two bolts to each or every other link in the tractor tracks. These lags will not appreciably increase the pulling power on very soft ground but the additional bearing surface may permit the tractor to proceed with a trailing load (without pulling with its tracks) across marshes too soft for the regular tracks. These lags should not be used on solid ground since a load on their protruding ends may break them or damage the track.

(c) In some conditions it is impracticable to take even the main tractor attached to the plow, through the swamp. All tractors should then be detoured around the swamp. For this condition it is necessary to support the tongue of the plow on a special skid (Drawings PR319-320). The tractors are anchored on firm ground and pulls made as in (a).

9.03 **Foreign Subsurface Structure Crossings:** (See Section G56.130). At crossings the relative levels, protection, and separations between buried cables and foreign structures should be as follows:

- (a) Buried cables may be placed either above or below gas, water, or oil mains, etc., or ducts carrying power cables. However, buried telephone cables should be placed above buried power cables, where practicable.
- (b) Where buried telephone cable crosses gas, water, oil mains or power cables the telephone cable should be protected from future digging operations by a concrete cap or by treated wood planking at least $\frac{3}{4}$ in. x $3\frac{1}{2}$ in., for at least three feet each way from the point of crossing. If the power cable is in the top position at the crossing, the power cable should also be protected from digging operations in a similar manner. At crossings, any work protecting power cables, gas, water, or oil mains shall be done by the respective owners. Advance arrangements should be made.
- (c) Separations from foreign structures, such as gas, water, or oil mains shall be at least 6 inches of well-tamped earth or 3 inches of concrete of at least as rich as a 1:3:6 mixture.
- (d) Separations from ducts containing power cables shall be at least 12 inches of well-tamped earth or 3 inches of concrete.
- (e) Separations from buried power cables with or without metallic sheath shall be at least 12 inches of well-tamped earth or 3 inches of concrete. Where concrete is used at crossings it shall be at least 3 inches by 4 inches in cross-section and shall extend along the power cable on both sides of the point of crossing to points at least 12 inches beyond the crossing.
- (f) Excavating operations at the location of other subsurface structures should be carried on in a manner that will avoid accidental contact of the digging tools with such structures. This applies particularly to buried power cables, due to the element of danger involved in such contacts.
- (g) If any foreign structure is damaged, it should be reported immediately to the company involved. Temporary repairs should be made immediately to structures other than those of Electric Companies. Permanent repairs should not be made unless the consent of the owner has been obtained and no repairs should be made to electric structures.

9.04 **Railroad and Paved Highway Crossings:** In general, pipe should be pushed under these crossings and the cable pulled through the pipe. The pipe is left in place for the added protection it affords if agreeable to the authorities involved. If freezing is anticipated at such crossings the detail plans should cover the procedure to be followed. In rock formations where it is necessary to drill a hole for the cable, ordinarily the pipe protection is omitted. Appropriate barricades and flagmen shall be used to halt and direct traffic on the highway if required.

9.05 **Procedures on hills** are similar to those described for rooting in Section J6.404.

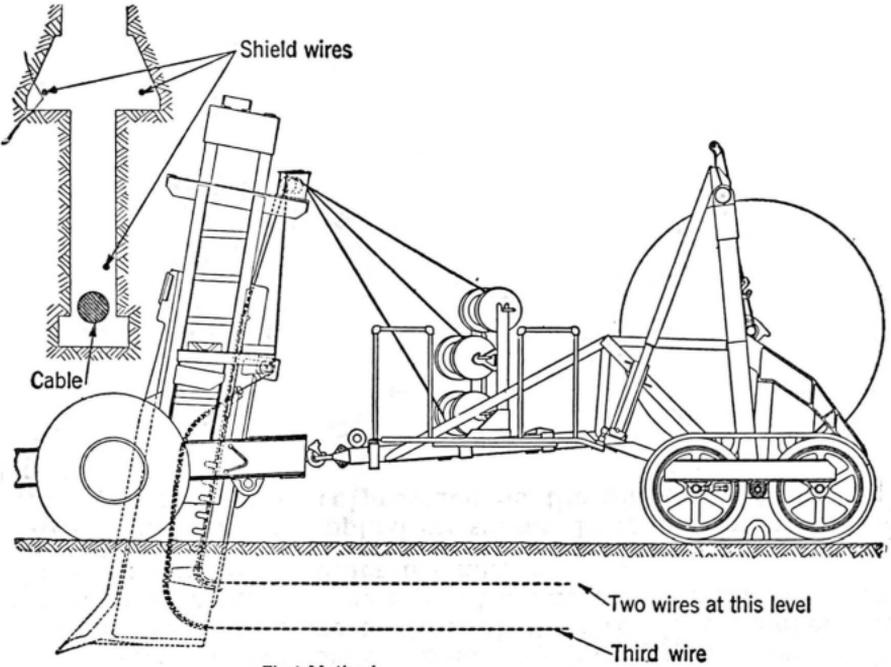
9.06 **Rooting across unpaved roads** and moving tractors on any highways should be with permission of proper authorities and in accordance with local regulations.

10. SHIELD WIRE PLACING PROCEDURES

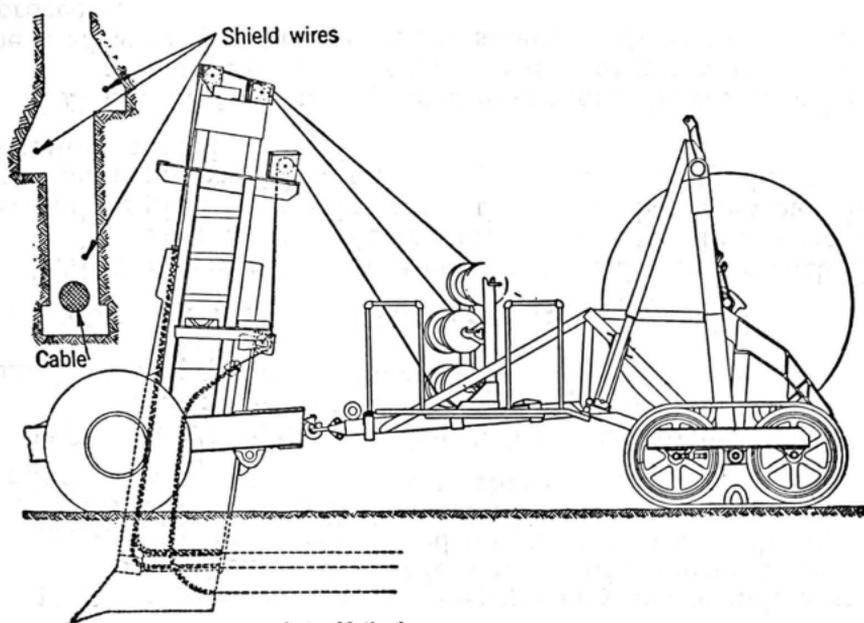
10.01 In certain sections protection from lightning is necessary and is usually provided by burying, simultaneously with the cable, from one to three shield wires. The number and size of these wires and the type of connectors for splicing them will be specified on the detail plans.

10.02 The wire is supplied on spools. Brackets for mounting these spools are provided on the platform of the first trailer.

10.03 Two designs have been used for guiding the wires through the plowshare from the ducts as shown on the sketches. See Section J6.404 for information on wire spacing.



First Method.
Two shield wires along outsides of share.
Third shield wire feeds inside share
to bottom position.



Later Method.
 Two shield wires inside front of share.
 Third shield wire feeds inside share
 to bottom position.

10.04 While the wires are being placed, careful watch should be maintained for breakage or entanglements. Assign one man to ride the platform directly back of the spool mounting bracket to do this job.

11. BACKFILLING AND TAMPING

11.01 As soon as practicable after the cable has been placed the trench should, where necessary, be backfilled and tamped sufficiently so that animals cannot injure themselves or a sudden rainfall will not wash out the loose dirt in the trench.

11.02 An inverted V plow has been used under the rear trailer of the train to act as a backfiller in mounding up the loose earth over the trench.

11.03 After delivering reels at each splice point the loading tractor proceeds to tamp the earth in the open trench by running over it with its tracks. On the trip away the tracks are run on one side of trench center and, on the return trip, on the other side of the trench center. On fairly level ground this is all that is required in most cases. Ground conditions determine whether additional trips are necessary.

11.04 If the coverage over the cable is 24 inches or less and the soil contains large or medium size stones, they may be forced into the cable sheath and damage it. For this condition special protection should be considered.

11.05 Any excavations such as those at splice points, which are to be left open overnight shall, when in the judgment of the foreman it is desirable, be protected by suitable planking or a woven wire fence.

(a) If such excavations are near highways, streets or other accessible locations, warning lights shall be placed as required.

11.06 **At Road Crossings:** Trench shall be backfilled and tamped promptly to meet the requirements of the local authorities. The roadbed shall be restored to its original condition, or as nearly so as practicable. Paving material, where practicable should be kept separate from other excavated material and reused in restoring the road surface.

11.07 **At irrigation ditches** seepage may occur unless steps are taken to prevent it. The use of a substance such as Bentonite should be considered for this purpose. Such material expands to more than 20 times its original volume when water is added. It is mixed with earth to stop seepage.

11.08 Backfilling and tamping shall conform to any local regulations and should be done in a manner which will minimize future maintenance.

12. SOIL EROSION PRECAUTIONS

12.01 **Seeding:** Where the character of the soil is such that erosion is probable at a later rainy season consideration should be given to seeding after the trench has been backfilled and tamped. Grass, alfalfa, rye or similar seed suitable for the territory should be used.

12.02 **On hillsides** extra precautions should be taken to insure a thorough tamping job. Rip-rap of heavy stone should be used when practicable on the steeper hills as the backfilling proceeds.

(a) On side hills care should be taken that the earth is not mounded on the trench as such a mound would divert the water from the entire hillside above the trench. Planks or shallow ditches placed transversely across the area of loosened earth, at intervals depending upon the slope, to divert any water that might gather and run down the trench, are useful in controlling surface drainage. In the more serious cases it may be necessary to build a series of retaining walls extending down to the cable.

(b) When the trench is straight down the hill diversion can be made at less frequent intervals depending upon the grade.

13. RESTORING FENCES AND OTHER PRIVATE PROPERTY

13.01 In general it is desirable from a maintenance viewpoint to leave the gates for future use. However, if the property owners require it the fences should be restored and the gates removed. This work as well as any other fence restoration required by the property owner should be done after the cable work has been completed.

13.02 Repair any damage to private roads, tile drains, and drainage or irrigation ditches.