BELL SYSTEM PRACTICES **SECTION G36.120**
Outside Plant Construction **Issue 1, December, 1936**
and Maintenance **AT&T Co. Prov. Std.**

BURIED WIRE

PLACING

Contents **Page**

Location 1
Surveying Route 2
Depth of Placing 2
Splice Points 3
Slack for Future Service 6
Service Connections 8
Test Points 12
Identification of Circuits 12
Culverts and Bridges 12
Protection at Ditch and Stream Crossings 18
Tests During Plowing 18

1. LOCATION

1.01 Buried wire will usually be placed in the shoulder of the road between the driving surface and the drainage ditch, with the possibility of some portions of it being placed on private property depending on which choice is more favorable from a construction and maintenance standpoint. Generally, in highway construction, the most favorable portion of the road shoulder, if available, is that which bears vegetation as the soil is generally more loosely packed and more moist than other portions.

1.02 When placing the wire in highways or across ditches avoid locations which might interfere with natural drainage or locations subject to surface drainage which might result in subsequent washing away of the soil and exposure of the wire.

2. SURVEYING ROUTE

2.01 Shortly in advance of the actual placing of the wire, points at which construction other than straight plowing is to be done should be examined on the ground to decide the sequence of operations.

Example: At a culvert or bridge where the wire is to be threaded through a pipe, a decision as to the necessity for a splice and its location should be made. If the culvert or bridge is within a short distance of a point of termination where the wire must be cut in any event, it may be practicable to eliminate the splice by extending the wire to the terminal uncut after threading the required length through the pipe and back up into the feeding tube of the plow.

2.02 By laying out the work at such locations as far as possible beforehand, many unnecessary delays of the plowing equipment can be avoided. Too much emphasis must not, however, be placed on the avoidance of splices, as it may sometimes be found that the extra work required on the part of the construction crew in eliminating a splice may consume more time than would be required to cut the wire and make the splice.

3. DEPTH OF PLACING

3.01 When plowing along rural highways where it is unlikely that future road improvements will disturb the wire, the plow should be adjusted to place wire at a minimum depth of 16 inches, except in passing over culverts where a minimum depth of 12 inches is satisfactory. If the wire can be placed at greater depth without too great strain on the tractive equipment it is desirable to do so in order to obtain the added protection of increased depth of cover.

3.02 When plowing across tilled ground or across land suitable for placing under cultivation the depth of placing should be increased to 18 to 20 inches.

3.03 In driveways, lawns or pasture land where the wire is not likely to be disturbed by subsequent excavating or cultivating, a depth of 12 to 14 inches is sufficient.

3.04 The shallower the plowing depth the less the effort required to draw the plow. In general, a good practice to follow is always to place the wire at the maximum depth at which the equipment is capable of operating efficiently.

3.05 When placing wire across drainage ditches the wire should be hand placed at a depth of 30 inches and protected as recommended in Part 10.

4. SPLICE POINTS

4.01 At reel ends, loading points and at other locations where the continuity of the wire is broken, slack for splicing should be left at the time of plowing. In order to provide convenient working conditions and allow the splice to be made at the surface of the ground, about 3 feet of excess wire should be provided on each end of the wire.

4.02 When changing reels, the temporary splice, Part 14, Section G36.110, made to pull the wire from the new reel through the feeding tube without raising the plow, should be located by means of the probing hook and pulled above ground as described below.

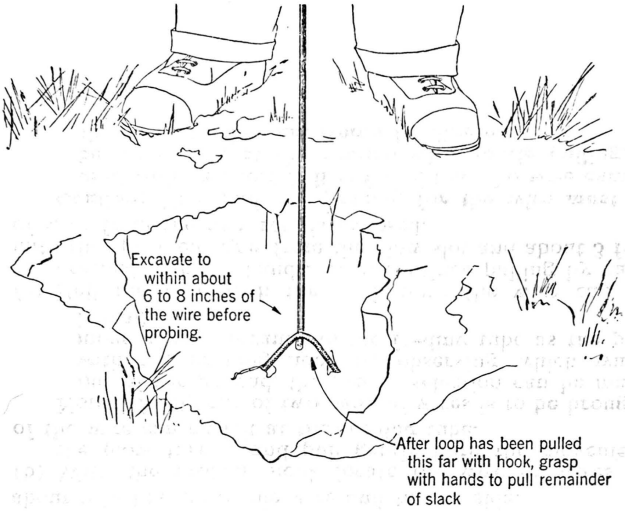
(a) At a point about 3 feet back of where the temporary splice lies in the ground dig a small hole to within about 6 inches above the wire and to one side.

(b) With the probing hook locate the wire or wires in the plow furrow and pull gently until the movement of the wire can be felt at the feeding tube.

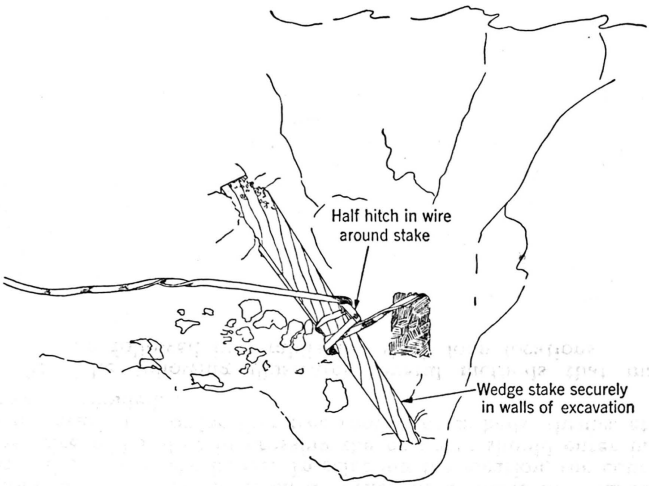
Note: If only one of two pairs of wires is to be brought out of the ground, the proper selection can be made with the probing hook by observing which wires move at the entrance to the feeding tube as the pull is made.

(c) Pull the wire with the hook until the wire can be grasped with the hands. Then continue pulling by hand until the splice emerges from the plow slot and about 3 feet of wire from the new reel is exposed.

Caution: The hook for probing for the wire must be used with care and if it is found that the wire cannot be drawn out of the ground with gentle pulling, it should be further uncovered by digging.



4.03 After sufficient slack has been pulled from the reel, cut out the temporary splice and twist together and tape the conductors of the new reel, as described in Part 3 of Section G36.200. Wind the wire once or twice around a marking stake ending with a half hitch around the stake. Start the plow and allow any excess wire to run into the plow slot until the stake bears against the wall of the hole. Be sure the stake is wedged securely to avoid its being pulled into the channel left by the plow and that sufficient wire remains for the splice.



4.04 Mark the location of the splice on the construction print along with an approximation of the distance to some appropriate fixed point such as a pole, tree, bridge or other landmark. As further identification, the location should be marked by means of a second stake bearing the word "SPLICE" and the distance in feet from the stake to the splice point. The stake should be driven in the ground abreast of the splice point and out of the path of vehicular traffic.

Loading Points

4.05 When slack is to be left for splicing loading coils, the plow should be stopped at a point 8 to 10 feet beyond the point at which the loading is to be inserted. The wire is then located by digging and using the probing hook and a loop of wire is drawn from the slot. Sufficient wire should be drawn to allow 3 feet of slack on each end of the wire after cutting. Do not cut the wire at this time, however, unless it is necessary for test purposes. Secure the wire to a stake, and in the ground to one side drive a second stake bearing the words "Load Point" or the initials "LP" marked plainly on one side.

Disposing of Slack at Splice Points

4.06 The work of temporarily burying the wire at splicing and loading points is done after the plowing crew has resumed placing the wire. At splice points the ends of the wire

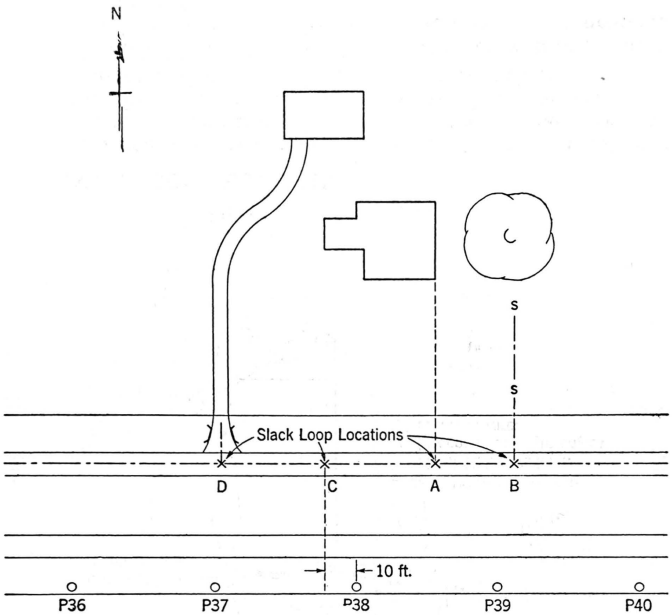
should be pulled clear and the excavation enlarged to a depth of about 15 inches. The wire should then be formed in a flat loop and inserted in one end of a 12 inch length of single 3-1/4" vitrified clay or 3" creosoted wood conduit. The conduit should then be set in an upright position in the excavation with the wire entering the lower end of the conduit and the upper end of the conduit setting about 3 inches below the ground surface.

4.07 Plug the end of the duct with a wad of paper or wooden conduit plug and backfill the excavation around and over the end of the conduit. Restore the ground surface as near as possible to its original condition. Directly alongside the conduit drive a marking stake leaving about 2 inches of its length exposed above ground. To the end of the stake tack a small piece of red cloth to increase its visibility.

5. SLACK FOR FUTURE SERVICE

5.01 Where a prospect of future service exists, slack may be left in the main line of the wire at locations as indicated on the construction prints. The slack left in the wire will have to be located at some later date after all evidence of its position will have disappeared and therefore it is important to identify the location by referring it to some fixed point, such as a pole, driveway, or house. A good practice is to select for the location of the slack wire a point directly along a line extended from a corner of a house and parallel with the side of the house. In selecting the location, the course the wire will follow in crossing the property should enter into consideration in order that tree roots, flower beds, shrubs, etc., may be avoided.

5.02 The following illustrates several methods that may be followed in establishing slack loop locations

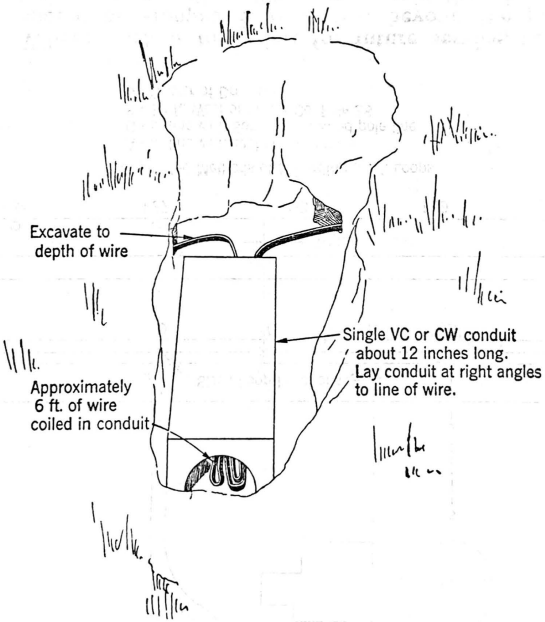


Suggested Methods of Recording Slack Loops

A - In line with East side of house
B - In line with Subscriber owned pole line
C - 10 ft. West of Power Co. Pole 38
D - Center of Driveway

5.03 Where slack is to be left for future service, the plow should be stopped 8 to 10 feet beyond the point at which slack is to be pulled. The wire should then be located with the probing hook and a loop of wire drawn from the plow channel. A total length of 6 feet of wire should be pulled from the reel so that 3 feet of slack will be available on each end when the loop is cut at the time of installing service. Secure the slack to a stake and resume plowing. The length of slack wire left should be marked on the construction print for future reference in connection with testing or for other record purposes.

5.04 Slack left for future service will be buried permanently as soon as practicable after the plow has passed. Hold the slack loop clear and make an excavation to the depth of the wire and laterally for a distance of about 15 inches beginning at the point where the wire leaves the slot. Insert the loop in one end of a 12 inch length of vitrified clay or creosoted wood conduit and lay the conduit in the excavation in a horizontal position at right angles to the line of the wire as shown below. Backfill over the conduit and restore the ground surface as near as possible to its original condition.



6. SERVICE CONNECTIONS

6.01 Service branches will be constructed in several different ways depending on the circumstances at each location. In general, however, access to the subscriber's property will be made in one of the three ways described below.

(a) A buried loop of wire will be extended without splicing from the main line directly to the terminal or protector at the subscriber's house.

(b) A loop of wire will be buried from the main line to a terminal mounted on a subscriber's pole line without splices and from there a pair of wires will be extended aerially to the subscriber's premises.

(c) A loop of wire will be buried from the main line to a terminal mounted on a post without splices and from there a single buried pair will be run directly to the subscriber's premises or to a subscriber's pole line to connect with aerial construction to the house.

6.02 In all cases a loop of wire will be pulled from the plow after the plow has passed the point at which the service connection leaves the main line. Depending on the circumstances of the job, the work of burying the service loop to the house, pole or stub, etc., may be done immediately or, after leaving the necessary slack, the plowing may be continued to the end of the line after which the equipment is brought back and the entrance completed.

6.03 If the entrance is to be made immediately, the procedure followed in completing the service entrance is as outlined below:

(1) Excavate a hole in front of the plow at the point where the service leaves the main line and at the depth of placing the wire along the road.

(2) Pull the plow standard into the excavation and disconnect the plow from the towing hitch.

(3) Pull out from the lower end of the feeding tube a loop of wire long enough to reach to the terminal and cut it at the terminal, laying it aside temporarily. Reel back onto the reel the free end of the wire.

(4) Back the plow as close to the point of termination as possible. Thread up into the feeding tube a length of 109 steel wire long enough to reach from the terminal to the branching point and hook the wire over the upper end of the feeding tube.

(5) Pulling the plow with a winch line, plow the steel wire into the ground from the terminal to the excavation at which the plow was originally halted. **Avoid stepping on or running vehicles over the slot left by the plow.**

(6) Remove the 109 wire from the feeding tube. Thread the U Distribution Wire from the reel down into the feeding tube. Strip about 4 inches of insulation from the end of this wire and that of the other leg which was measured off under (3) and twist these around a loop made in the end of the 109 wire.

(7) By pulling on the steel wire at the terminal end pull the two legs of the U Distribution Wire by hand into the slot left by the plow and through the slot up to the point of termination.

(8) Reset the plow in the excavation, connect to the towing hitch and resume plowing in the main line. Backfill the excavation and restore the ground surface.

6.04 If the service entrance is to be completed after the main line plowing is finished the plow is stopped 8 to 10 feet beyond the point selected for taking off the service loop. Using the probing hook locate the wire in the plow slot and pull up a loop long enough to reach to the point of termination. Secure the plow end of the wire to a stake, form the wire into a circular coil about 12 inches in diameter and resume plowing.

6.05 As the wire is not to be exposed to weathering the service loop must be buried temporarily if more than a few hours will elapse before it is installed. Holding the wire clear, make a shallow excavation large enough to accommodate the coil when laid flat and deep enough to afford about 6" cover above it. Remove the nails from 8 or 10 lags from the wire reels. Place the coil of wire in the excavation, cover it completely with the lags and fill in with earth over the lags. Mark the location by driving near the coil the stake originally used to hold the wire during plowing.

6.06 At the time of completing the service entrance, remove the earth and lags, uncoil the wire and lay it clear. The remaining steps in completing the installations are as follows:

(1) Enlarge the excavation to about 2 feet square and 18 inches deep.

(2) Back the plow to the terminating point and plow in a length of 109 steel wire as described under Paragraph 6.03.

(3) Pull the plow into the excavation and remove the steel wire from the feeding tube.

(4) Straighten the legs of the entrance loop until both are equal and twist the 109 wire to the end of the loop.

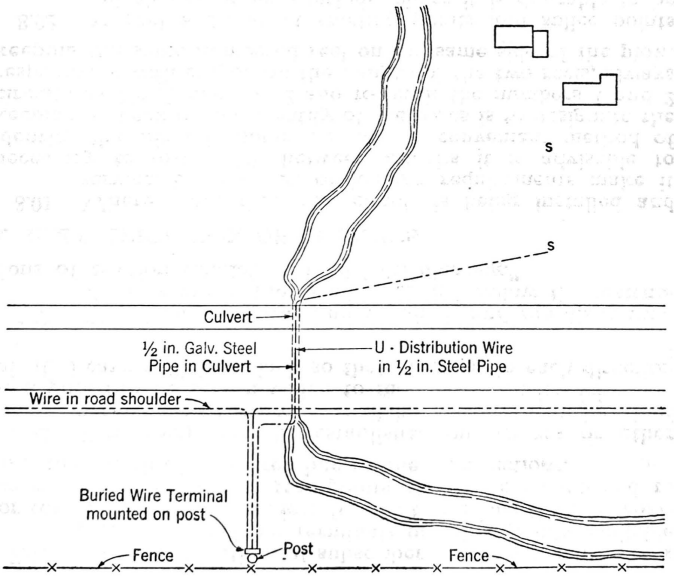
(5) By means of the 109 wire pull the loop into the plow slot and up to the point of termination.

(6) Backfill the excavation and restore the ground surface.

6.07 Where the distance from the line to the point of termination is short, as at a post or subscriber pole, or where steep banks or other difficult terrain is encountered

it may not be practical to follow the plowing method for installing loops. In such cases the wire can be laid in a hand dug trench of the required depth.

6.08 On occasion the terminal to which connection is to be made as described above will also be the terminating point of a second loop or a single pair branching off to another line or to a subscriber's premises as illustrated below. In a case such as that shown, the loop in the main line would be pulled out during the plowing of the main line. At the time of burying the loop, the amount of wire necessary to reach from the terminal to the subscriber's line would be cut from a reel and threaded through the steel pipe. One end would then be laid to the terminal along with the main line loop. For the other end, the truck could be placed to pull the plow toward the subscriber's pole, using the winch line. In this case the plow would be set up at the culvert end with the wire threaded into the lower end of the feeding tube and pulled out at the top. Then as the plow moved forward the wire would be fed into the tube at the top, by hand.



7. TEST POINTS

7.01 When terminations at subscriber's premises, subscriber's pole lines, bridging terminals or other points available for test purposes occur at less frequent intervals than approximately one mile, special test points should be established to limit the length of unbroken line to one mile sections.

7.02 Test points can be established on bridges or other permanent structures if available at convenient locations or a post can be set on which to mount the buried wire terminal. Leave sufficient slack so that all wires in each direction can be carried into the terminal.

7.03 The placing of posts and terminals and the disposition of the wires in the terminal should follow the instructions of Section G36.130 entitled "Terminating."

8. IDENTIFICATION OF CIRCUITS

8.01 Where more than one circuit is being installed and service, branch line, or loading requirements make it necessary to distinguish between circuits it is advisable to identify the wires in some manner. A convenient method of keeping a check on the identity of the wires is to designate the circuits as No. 1 and No. 2 and to mark the numbers 1 and 2 respectively with crayon on the flanges of the two reels, always keeping the same numbered reel on the same side of the plow.

8.02 At reel ends, as at starting points and splice points and also at other locations where it is desirable to be able to distinguish between the pairs, temporary identification can be had by wrapping a few turns of friction tape around one pair, it being understood which circuit is to be so marked. If all wires are cut at one location the circuit to be marked should be taped on both sides of the cutting point.

8.03 Where a more permanent means of identification is required as at locations where slack has been left for future service, lead cable tags stamped with an identifying number should be wired to one or both of the pairs.

9. CULVERTS AND BRIDGES

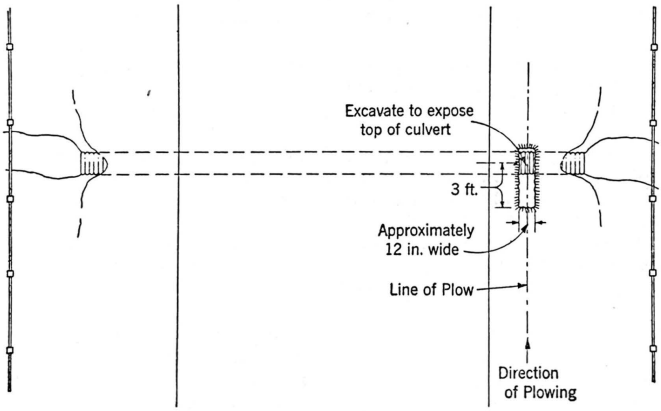
Culverts

9.01 In general the culverts encountered in highway plowing are of two types—those built of pipe, such as corrugated iron, clay sewer pipe, or concrete pipe usually not exceeding 18 inches in diameter and larger rectangular culverts of the box type constructed of concrete or heavy masonry. If a depth of 12 inches or more of earth covers the culvert and

it is not evident that the depth will be materially decreased in the future the wire can be placed across the culvert without protection.

9.02 One man should precede the plowing equipment to uncover the culverts shown by the construction prints to have less than the minimum cover necessary to allow the plow to pass at normal depth. In line with the position being followed by the plow a narrow excavation about 3 feet in length and to the depth of the culvert should be made on the side of the culvert from which the plow is approaching. When the plow reaches the location the point should be raised and the plow pulled over the culvert as described in Part 13 of Section G36.110. Remove any sharp rock particles between the wire and the culvert and backfill the excavation.

EXCAVATION TO EXPOSE SHALLOW PIPE CULVERT



9.03 If the depth of cover over the culvert is less than 12 inches the crossing may be made in one of the following ways:

(a) If the culvert is of pipe and the end of the pipe is not more than 3 or 4 feet from the line being followed by the plow the wire may be passed under the culvert by looping it around the exposed end. On approaching the culvert, the plow should be lifted out of the ground,

pulled across the culvert and started in the ground on the far side after pulling from the reel enough wire to enable it to be laid in a trench dug around the end of the culvert. The wire should, of course, be wrapped around a stake to hold the slack. After passage of the plow, the wire should be laid aside and a trench dug under the end of the culvert. Draw the wire well under the end of the culvert to prevent its being exposed by scouring and backfill the trench.

(b) If the culvert is of pipe and the end of the pipe is more than 3 or 4 feet from the line of the trench cut the wire, excavate, and pass one end under the culvert, leaving slack for a splice. Secure the slack wire, record and stake the location, and, after plowing has been resumed, dispose of the slack as described under Part 4.

(c) If the culvert is of the box type the earth should be removed from the surface by digging a narrow trench across the culvert and about 3 feet each side of it in the line of plowing. Cut the wire, raise the plow and draw it over the culvert. Pull from the plow enough slack wire to reach across the culvert and allow for a splice, record and stake the splice location and resume plowing. Complete the crossing as follows:

(1) Ream the ends and joints of a length of galvanized steel pipe of the proper size (see table below) and long enough to extend about 3 feet beyond each side of the culvert.

(2) Thread the wire through the pipe leaving a little slack at the pipe end where the wire is uncut. Wrap the wire at the ends of the pipe with a double layer of friction tape for a distance of about 8 inches and draw part of the taped portions into the pipe so that the wire is protected against cutting on the ends of the pipe.

(3) Lay the pipe in the trench with the ends projecting about equally over each side of the culvert and bend the ends of the pipe down to the normal plowing depth.

(4) Backfill the trench and dispose of the slack wire for the splice and mark as directed under Part 4.

SIZES OF GALVANIZED STEEL PIPE FOR BURIED WIRE AND STRAPS FOR ATTACHING PIPE

Number of Pairs	Size of Pipe (Inches)	Size of Cable Strap
1	½	No. 16
2	½	No. 16
3	¾	No. 20
4	¾	No. 20
5	1	No. 24

9.04 When the plowing reaches a point where a culvert is to be utilized to carry buried wire under a paved crossroad the wire should be cut and the plow lifted out of the ground and pulled across the intersecting road. Sufficient wire to reach across the road and allow for a splice should then be pulled from the plow, the splice recorded and staked and plowing resumed. A hand dug trench should then be excavated from the plowing line to the culvert. The operations of placing the wire through the culvert are as follows:

(1) Sufficient pipe (see table of sizes above) to reach through the culvert with an overhang at each end long enough to carry the pipe out of the ditch and into the trench in solid ground should be placed through the culvert.

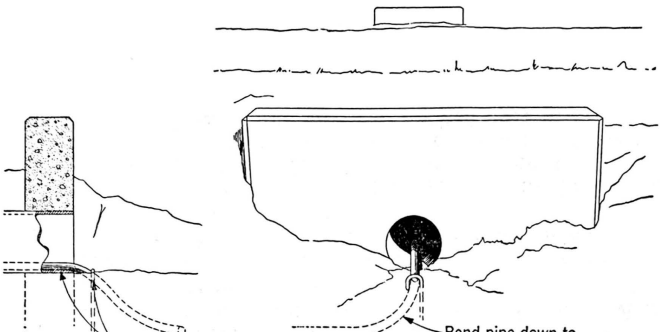
(2) Form the pipe at the culvert ends so the pipe lies flat in the bottom of the culvert and so that no more of the pipe than necessary is exposed or buried in the ditch.

Note: If numerous small radius bends must be made in the pipe, it may be advisable to thread the wire through the pipe before bending.

(3) Using 109 steel wire, thread the wire through the pipe and tape the wire with two layers of friction tape where it leaves the pipe at both ends.

(4) Backfill the trench and restore the ditch to its original condition. Dispose of the slack wire for splicing and mark as explained in Part 4.

(5) As a means of holding the pipe securely to the bottom of the culvert a 4-foot length of 3/8" or 1/2" round reinforcing bar formed into a hook at one end may be driven in the ground beside the pipe and hooked over it.



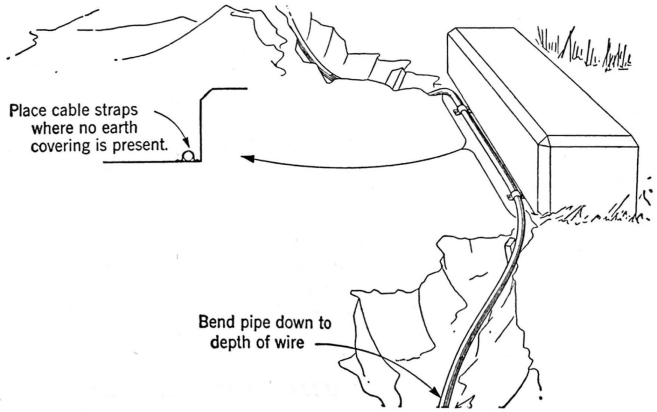
9.05 Where a culvert is employed for the purpose of carrying wire across the highway to reach a subscriber on the side of the road opposite that in which the main line is being placed, the construction is similar to that described above with the exception that such work will generally be done after the main line plowing is completed.

9.06 Where the wire passes through a box culvert, the pipe should be attached to the side walls of the culvert with cable straps.

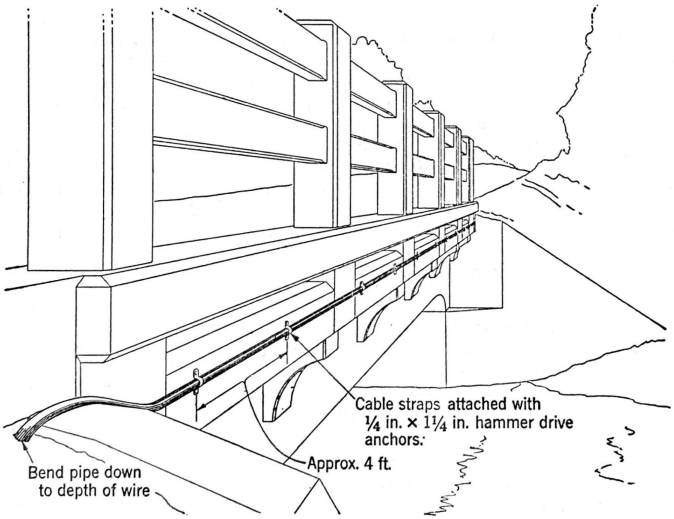
Bridges

9.07 Depending on the construction of the bridge, crossings over such structures should be made by pipe either laid across the floor slab of the bridge or attached to the side.

9.08 Where the bridge is short and there is a shallow fill of earth over the floor slab the construction is similar to that followed for box culverts as described in (c) of Paragraph 9.03, except that the pipe should lie in the angle formed by the floor slab and the guard curb as shown below. If the bridge carries no earth covering it is advisable to clamp the pipe with cable straps using 1/4 inch x 1/4 inch hammer drive anchors to hold the pipe in place. (See table on Pg. 15 for pipe and strap sizes.)



9.09 On bridges where a position on the floor slab is not available, the pipe can be attached to the side of the floor slab as illustrated below. The attachment should be made with 1/4 inch x 1-1/4 inch hammer drive anchors and cable straps. (See table on Pg. 15 for pipe and strap sizes.)



9.10 Long lengths of pipe should be fished with a length of 109 steel wire for pulling in the U Distribution Wire. The insulation should be stripped from the buried wire for a distance of about 6 inches and the connection made with the bare wire to a small loop formed in the steel wire. Always ream each length of pipe individually before coupling and wrap the wire at the ends of the pipe with friction tape as described under (c-2) of Paragraph 9.03. Bend down the ends of the pipe where it leaves the bridge so that the buried ends lie at about the normal plowing depth.

10. PROTECTION AT DITCH AND STREAM CROSSINGS

10.01 Where the buried wire crosses ditches, as in running from the road shoulder to a post at the fence line, it should be placed in a hand dug trench of sufficient depth (see 3.05) to ensure that the wire will not be exposed by the scouring action of the drainage water or injured by men or machines cleaning the ditch. As additional protection the wire should be covered by a length of split wood conduit before backfilling, using half the piece to lay over the wire. If there is any question as to the adequacy of this protection the wire should be threaded through a galvanized steel pipe of sufficient length to span the ditch.

10.02 At shallow streams the wire can be plowed across the bed if sufficient depth can be obtained by this method. If the stream bed is unstable or the possibility exists of the wire being exposed it should be placed in galvanized steel pipe and buried across the stream by hand.

11. TESTS DURING PLOWING

11.01 During the plowing in of the wire, tests for continuity and insulation resistance should be made at the end of each length of wire and at the end of each reel as described in Part 3 of Section G36.200. In addition these tests should be made at any time during the course of the plowing when there is an indication that the wire may have been injured, as in striking rocks, binding of the wire, etc.

11.02 Faults disclosed as a result of these tests should be uncovered and marked by means of a location stake so that the splicer can make repairs to the wire. Where necessary, slack should be left in case a length of wire must be cut out and spliced.

11.03 Splices should not be made until each section or reel length of wire has been tested and found to be free of faults.