American Telephone and Telegraph Company

BELL SYSTEM PRACTICES
Outside Plant Construction
and Maintenance

SECTION G31.940
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Long Lines Department
Provisional

OPEN WIRE

CONSTRUCTION OF TEMPORARY LINES

CONTENTS

1. GENERAL

1.01 This practice covers methods of constructing temporary sections of open wire lines with twisted pair H.C. wire or standard drop wire to provide service for not more than a few months in a temporary location due to a line change, storm break or other cause. Carrier as well as voice frequency circuits may be routed over these temporary sections.

1.02 This practice, which supersedes Issue A, is for field trial and if experience shows that other methods or materials should be used, information to that effect should be sent to the Engineer via line of organization.

1.03 The use of temporary line construction should be limited, so far as practicable, both in the number of instances in which it is employed and in the length of time any one installation is permitted to remain in service. This is of particular importance in the case of lines over which carrier telephone systems are operated, especially those on which type J carrier is used.

1.04 In connection with highway work or other work of a similar nature involving J systems, when it is practicable and excessive costs will not be involved, a new section of line of permanent type in a permanent location should be constructed and service cut over to it in preference to using temporary construction during the progress of the work. If this is not practicable, and the work will be in progress for several months, consideration should next be given to a type of temporary light weight pole line using preferably bare wire for the carrier circuits and H.C. wire for voice frequency circuits which, so far as the carrier circuits are concerned, is as nearly as practicable an electrical duplicate of the line to be abandoned. This type is described in Paragraph 7.04. Next in order of desirability is the use of H.C. wire for all circuits and crossarms or other supports for the wires, as described in Paragraph 7.05, and lastly, bunched twisted pair for all circuits. In the case of emergency work on carrier lines requiring immediate installation of the less desirable types of construction, consideration should be given to the later replacement of this construction on the carrier circuits with a more desirable type of temporary line if the conditions warrant it.

1.05 Emergency construction is usually done under adverse weather and transportation conditions. It is essential, therefore, that all materials shipped to the job be in first class condition. Men assigned to the work should be familiar with the methods specified so that the work can be done promptly and with precision. To this end, a definite plan of action should be considered in advance for typical sections of line in the area being maintained. When inexperienced men are concerned, they should practice in advance making joints in the twisted pair wire so that reliable service will result when the work is carried out in the field.

1.06 H.C. twisted pair wire is preferred from a transmission consideration to the other standard drop wires (BP and TP). In line changes,

only H.C. wire shall be used. In emergency storm break work, H.C. wire shall be used up to the limit of available supplies and applied to the more important circuits throughout (carrier circuits first). One type of drop wire shall not be spliced to a different type in the same temporary section of line. When the two wires of the twisted pair are used as a single conductor, the same type of drop wire shall be used for the other conductor of the circuit. The same type and arrangement of wire shall also be used for the two sides of a phantom group. U distribution wire and U bridle wire should not be used in either storm breaks or line changes.

1.07 The temporary section should be so constructed that the twisted pairs clear the ground when installed. If practicable, they should continue to clear the ground when coated with snow or ice. If this is not practicable, the construction should be such that the conductors will again clear the snow covered ground when the ice or snow load has melted from them.

1.08 When only voice frequency circuits are concerned, one pair of H.C. per circuit may be used. For distances greater than ten 130-foot spans, however, if one pair per circuit is used, loading may be required as discussed in Paragraph 4.03. If the temporary route is only about ten 130-foot spans or less in length all voice frequency pairs may be bunched and hung on any suitable available supports. For greater lengths, if phantomed facilities are involved on more than one phantom group, it is desirable, where practicable, that the two pairs constituting one phantom group be bunched together, and that they be separated two or more inches from each other phantom group. Where type C or carrier telegraph systems are involved, in a temporary line, one pair per circuit should be used and all pairs may be bunched for distances up to ten spans. For longer sections where type C or carrier telegraph systems are involved, and in all cases where type J systems are involved, one pair of H.C. per line wire should be used, definite spacings should be provided between

all pairs for these circuits (see Paragraphs 7.04 and 7.05) and the pairs should be hung reasonably parallel between points of support.

1.09 In connecting the temporary section to the main line sections the initial connections should be such as to maintain the same wire count as before at the adjacent offices. Changes may, however, later be required to reduce crosstalk, as discussed in Paragraph 4.04.

2. EMERGENCY SUPPLIES

2.01 Each District Plant Superintendent should designate the location and quantity of emergency supplies to be maintained. These supplies should be inspected by the District Line Supervisor or Section Man in the fall of each year for quantity and condition and should be kept ready for shipment at all times. When any are used and not returned, new items to fill the stock should be obtained promptly.

2.02 These supplies should consist of:

Materials:

-----coils of H.C. drop wire
-----R drop wire clamps
-----drop wire clips
-----064S brass sleeves
-----rolls rubber tape
-----rolls friction tape
-----coils of houseline
-----pounds 20-D wire nails
-----crossarms unequipped
-----crossarms equipped
-----bronze dead-end wires (of sizes required for line wires)
-----DB copper sleeves (of sizes required for line wires)
-----S copper sleeves (of sizes required for line wires)

-----dead-end loops made up with tails of H.C. wire (Fig. 1-A and B)
-----pounds 109 steel construction wire
-----coils of bare line wire (of sizes required for line wires)
-----copper tie wires (flat, round or other types authorized for the area)
-----insulators (of types in service on lines being maintained)
-----pins of types in use on the lines
-----drive hooks

Tools:

-----braid strippers
-----sleeve pressing tools
-----sleeve rolling tools
-----emergency reels
-----6-inch earth augers
-----alligator jaw post hole diggers
-----digging bars

Additional Supplies not Carried in Emergency Stock:

[redacted] drop wire
-----TP " " [redacted]
-----P " " clamps required for [redacted] TP drop wire
-----045-040 S Brass sleeves, required for splicing [redacted] TP drop wire to wire of the same type
-----902 bridging connectors

Note: The foregoing additional supplies are to be used only when sufficient H.C. drop wire can not be had.

2.03 All emergency supplies should be clearly labeled as to kind and quantity and a checking list kept at each storage point.

2.04 HC drop wire placed in emergency stock must be in first-class condition so that it will perform satisfactorily when immersed in water. Coils of length less than 750 feet should not be placed in emergency stock, and in territories where the lines are generally on highways, so that drop wire

may be paid out from moving trucks, it may be advantageous to recoil 1300-1500 lengths of drop wire on standard pay-out reels in anticipation of an emergency. No drop wire in emergency stock should contain hand joints, but pressed sleeve joints covered with DR tape as described in Section G32.102 are permissible. New coils obtained from the supplier will generally be tagged to show the date of manufacture, but if the wire is recoiled or if the coils received are not dated, a suitable tag should be attached to the pull-off end, showing the date the wire was placed in stock.

2.05 HC drop wire which has previously been used in temporary line construction should not be returned to emergency stock unless it is certain that no serious abrasion of the insulation exists, and it is also known that the rubber is in good condition and meets the test outlined below. In practice it is expected that most of the HC drop wire used on an average job will be junked or returned for allowance. Also wire which has never been used but has been stored for 4 years or more may have deteriorated sufficiently to justify replacement. At the annual inspection referred to in Paragraph 2.01 the rubber in drop wire should be tested as follows:

Carefully cut away three inches of the outside braid from the end of a single HC drop wire to expose the rubber beneath. Select a section where the rubber has not been damaged by removing the braid, and with a sharp knife slice off a strip down to the copper; i.e., the strip should be the full thickness of the rubber insulation. On this three-inch strip make two marks one inch apart, lay it on a ruler and stretch it so that the marks are two inches apart. If the strip does not break, the rubber is satisfactory, but if it does break in any one of three tests of rubber taken from the same coil, the HC drop wire should be removed from emergency stock as unsatisfactory.

2.06 The maximum life of DR tape is about 2 years. Each roll is dated and at the annual inspection all rolls more than 18 months old should be junked.

2.07 Dead-end loops in accordance with Figure 1-A and B should be made up in advance and stored with the emergency stock. These loops should be made so the loop can be spread and slipped over the top of insulators of the types in service to make temporary dead-ends at any point along the lead. The number of each size to be held in emergency stock should be shown in the stock list. Additional dead-end wire, sleeves, etc., should be available, should additional dead-end work be needed at the line.

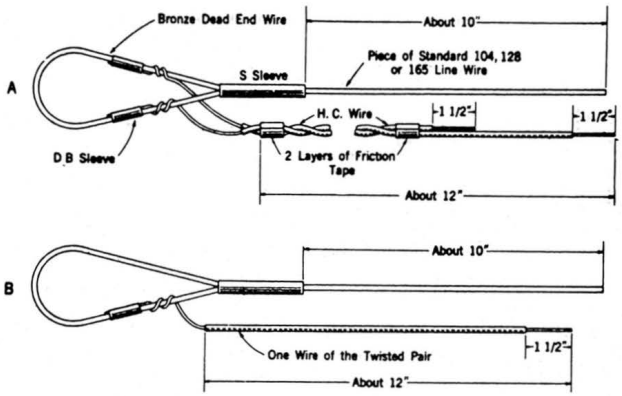


FIG. 1

3. PLAN

3.01 For highway or other relocation work an individual plan should be specified for each job. For storm break work plans should be considered on the assumption that breaks occurred at typical locations in the lines. The possibility of rerouting some of the services should also be taken account of. At time of storm break the testboard will give the field men instructions as to the order in which wires should be made good.

4. TRANSMISSION

4.01 The primary transmission considerations involved in temporary line construction are transmission loss, reduced singing points, and crosstalk.

4.02 Excessive transmission loss will ordinarily be avoided if the methods prescribed in this practice are followed. Variations from these methods may, however, cause serious increases in loss. Excessive losses are particularly likely to occur if considerable lengths of H.C. wire are connected in carrier facilities on a pair per circuit basis. This loss results from the high attenuation of the H.C. wire plus the reflection losses at each end of the temporary section. Where the H.C. wire is connected on a pair per line wire basis and a spacing between the two pairs which constitute a circuit of 4 inches or more is maintained, the loss, even at J carrier frequencies, will not exceed about twice that of normal line facilities.

4.03 The use of H.C. wire on a pair per circuit basis will cause reduced singing points in the voice frequency circuits concerned. When H.C. wire is used in this manner for more than ten 130-foot spans consideration shall be given to loading to increase the singing margins by improving the impedance match. The manner of applying this loading should be specified for each case by the Division Plant Engineer. When H.C. wire is used on a pair per wire basis and the pairs of twist are separated by 4 inches or more, the impedance match at voice frequencies should be satisfactory.

4.04 Even though the methods prescribed herein are followed, excessive crosstalk is to be expected in some cases unless special mitigative measures are applied. This crosstalk results from three major effects; namely, reflections at the ends of the temporary section, cross-induction within the temporary section and transposition unbalances introduced in the main line due to cutting out the

portion of the line replaced by the temporary construction.

(a) Reflection crosstalk usually will be a problem only at carrier frequencies and is minimized by using a pair of H.C. wire per line wire and keeping the pairs separated as indicated.

(b) Cross-induction within the temporary line section is important both at voice and carrier frequencies, particularly where the pairs are bunched. Bunching of two phantom groups for a considerable distance will cause phantom to phantom crosstalk.

(c) If two phantom groups over which type C carrier systems are operated are bunched, crosstalk between systems on the respective groups is likely to be experienced. Bunching of the pairs constituting a single phantom group is not so likely to cause excessive carrier crosstalk as systems of different frequency allocation are usually assigned to the two sides of a group. Phantom to phantom crosstalk and carrier crosstalk between phantom groups can be minimized by separating the groups as indicated. However, sufficient separation between groups will not always be practicable and in some cases crosstalk within phantom groups may be experienced. In these instances, and in certain cases involving non-phantom pairs, special measures, as follows, may be required:

(1) With temporary lines one-half mile or more in length the crosstalk at either voice or carrier frequencies caused by the omission of the corresponding length of main line may be serious. At carrier frequencies this effect may be serious with much shorter lengths of temporary construction. If the temporary line is similar in type to a standard permanent line and the carrier circuits are properly transposed, this effect will be minimized. It is likely to be encountered, however, with any of the other types of construction, including the "crossarm line" shown in Figure 4.

(2) Crosstalk due either to induction within the temporary line section or to the omission of the corresponding section of main line can sometimes reduced by turning over one or more of the pairs concerned at one end of the temporary line. In other cases, turnovers within the temporary section, combined possibly with turnovers at the end, may be required. If these measures are ineffective, interchanging cross-connections between circuits at the junctions of the temporary and main lines may accomplish a reduction in some cases. For instance, such an interchange might sometimes be made to increase the separation between carrier systems of like frequency allocation. If such measures fail, it might be necessary to use balancing condensers in a manner similar to their use in reducing capacitance unbalances in cables. If the simpler methods, such as turnovers and cross-connection changes, prove inadequate, the Division Plant Engineer should specify the measures to be applied.

5. DEAD-END CONSTRUCTION

5.01 Temporary dead-ends should be established at the ends of the temporary line, double arming and placing head guys when required. Dead-ends should not be made on transposition drop brackets. They may be made on point side brackets.

5.02 The dead-end loops should be slipped over the tops of the insulators into the wire grooves of the glass to be used for dead-ending and the line wires sleeved to them with rolled joints. The short tails of the H.C. wire fastened to the dead-end loops with DB sleeves should then be spliced to the first run of drop wire to leave the poles (Paragraph 6.01). After this splice is made the drop wire should be hung from the pin with an R drop wire clamp as shown in Figure 2. All the strain from the span of drop wire should be taken through the drop wire clamp and a loop of slack left between the clamp and the point of attachment to the line wire.

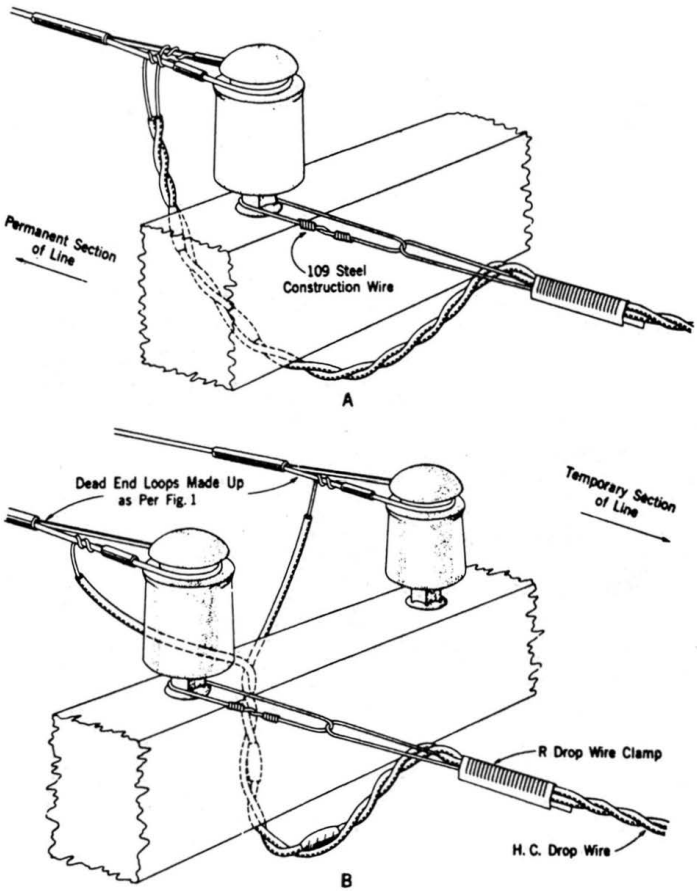

Permanent Section of Line
109 Steel Construction Wire
A
Dead End Loops Made Up as Per Fig. 1
Temporary Section of Line
R Drop Wire Clamp
H. C. Drop Wire
B

FIG. 2

5.03 When it is necessary to use BP or TP drop wire the connection to the line wire must be made with No. 902 bridging connectors as shown in Figure 3.

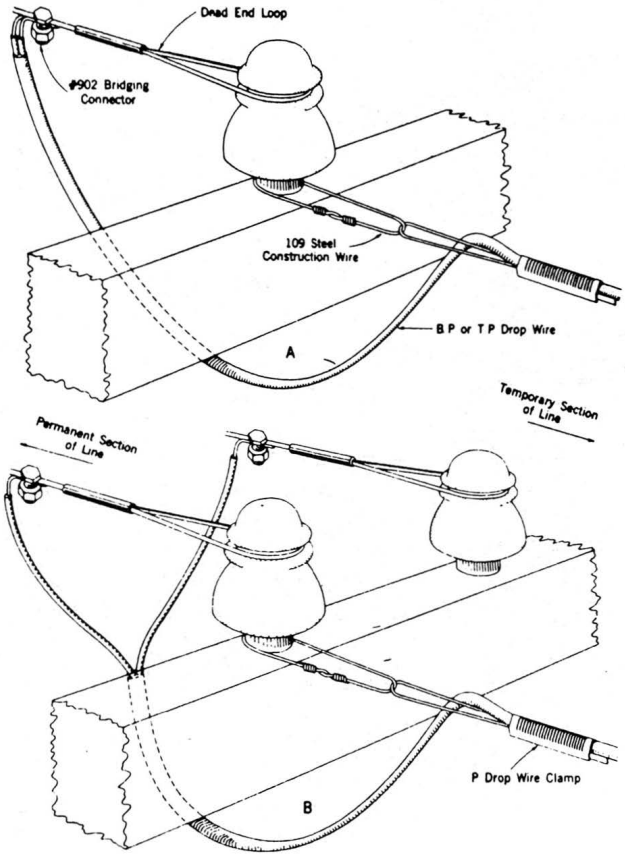


FIG. 3

5.04 When the drop wires in the temporary run are to be bunched together this should be done at a convenient point between the terminal pole and next point of support by wrapping the bunched wires with several layers of friction tape. Tie wire, line wire, or construction wire shall not be used for this purpose or to fasten drop wire directly to a point of support. Where the wires in the main run are not to be bunched, each pair should be extended directly from the dead-end pole to the first temporary support, carefully avoiding any crossing contacts or bunching in this span.

6. SPLICING DROP WIRE

6.01 Drop wire should be spliced with pressed on S brass sleeves as shown in Section 032.102. Care shall be taken to properly tape all joints as shown in that practice.

7. CONSTRUCTION OF TEMPORARY LINES

7.01 The location of the temporary line should be selected to be as direct as practicable and provide protection from interference by persons, workmen, animals and traffic. There should be as few crossings with highways as practicable. Where possible, the free spans of drop wire should not exceed 200 feet. At rivers and similar points a messenger strand or strands may be used and bunched wire lashed to it with houseline wrapped on with about a one-foot lay. The strand should be fastened securely to firm suitable supports at the ends of the long span.

7.02 Individual twisted pairs should be attached to supports in straight sections with drop wire clips and at corners or dead-ends with drop wire clamps as shown in Section 032.105. They should not be hung over metal supports such as nails or hooks. When clamps or clips are not available the drop wire may be tied to points of support with houseline applied so that the drop wire can not rub against the metal support. At dead-end points and corners drive hooks may be used on poles, posts or trees. The pull on the hook shouldbeat right angles

to the direction in which it is driven. In straight runs hooks or nails should be used, depending on the type of support and load to be carried.

7.03 When the drop wires are bunched they should be wrapped at convenient intervals with three layers of friction tape to hold them together. This tape should also be applied at points of support. Four close wraps of houseline should be applied over the friction tape, pulled reasonably tight and tied in place with a square knot. The ends of the houseline should then be used to tie the rope of twisted pairs to the support.

7.04 In the case of highway changes or similar work in type J carrier lines, and of considerable lengths of type C carrier lines, a temporary line to support the carrier circuits in a similar manner to that of a standard permanent line should be constructed when practicable and time permits, particularly if it is to remain in service for a considerable period. For such a line small poles with standard crossarms with capacity for the carrier circuits should be built or regulation size poles at greater than normal spacing (not to exceed 200 feet) and any voice frequency circuits carried in bunched H.C. wire. In no case should bare wires be strung at less than six-inch separation between wires of a pair and twelve-inch separation between nearer wires of different circuits. The wire should be strung on standard pins and insulators and the transpositions made at the same relative positions as in the original line on standard transposition brackets. Where clearance to ground or other objects would make the continuity of service over bare wires unreliable, standard tree wire or a pair of H.C. wire can be used for each bare wire and tied to the insulators at the same position as bare wire at both straight line and transposition points.

7.05 Where J carrier lines or lengths of type C carrier or carrier telegraph lines greater than 10 - 130-foot spans are concerned and the type of line described in Paragraph 7.04 is not practicable, a line built with crossarms for support or its equivalent should be built as shown in Figure 4.

The crossarms should be placed like small poles set in the ground 18 inches to two feet with the earth auger, post hole digger or digging bar. They may be side guyed or corner guyed, where necessary, with 109 galvanized construction wire, using pegs for anchorage and wrapping the wire around the crossarm and when terminated served on itself for at least three wraps. The crossarms should be placed so the top and bottom faces face across the line and the sides along the line to obtain the greater separation between the individual twisted pairs used for the carrier circuits which will be attached on either side. Twisted pairs for the voice frequency circuits in one or more bunches should take the lower positions.

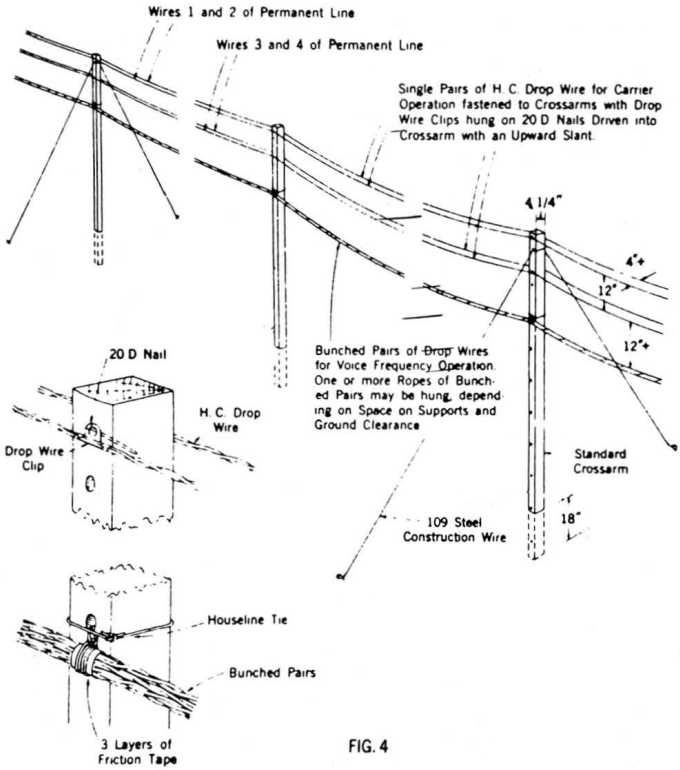
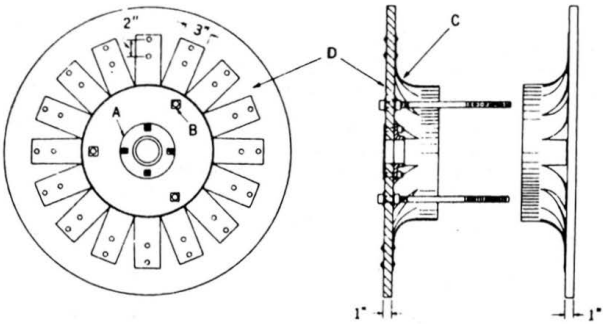

Wires 1 and 2 of Permanent Line
Wires 3 and 4 of Permanent Line
Single Pairs of H.C. Drop Wire for Carrier Operation fastened to Crossarms with Drop Wire Clips hung on 20 D Nails Driven into Crossarm with an Upward Slant.
4 1/4"
4"+
12"
12"+
20 D Nail
H.C. Drop Wire
Drop Wire Clip
Bunched Pairs of Drop Wires for Voice Frequency Operation. One or more Ropes of Bunched Pairs may be hung, depending on Space on Supports and Ground Clearance
Standard Crossarm
18"
109 Steel Construction Wire
Houseline Tie
Bunched Pairs
3 Layers of Friction Tape

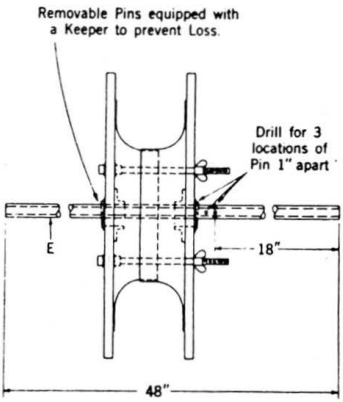
FIG. 4

7.06 Where carrier circuits are involved care shall be taken to give all individual pairs used for carrier about the same sag in the same span so that the wires will hang approximately parallel. Care shall also be taken to hang any ropes of bunched pairs so as to maintain at least the minimum separation to the carrier drop wires.

7.07 In crossing highways and at other points where clearance is a feature and carrier circuits are involved, a crossarm should be fastened or hung horizontally and the wires spaced off on it, retaining the same configuration and separations between drop wires that are specified in Figure 4. In long spans crossarms can be hung from two strands one attached near each end of the arm at about 200-foot intervals and the drop wires strung between these arms at the required spacings at as nearly equal sags as practicable.

7.08 In laying out the drop wire the emergency reel (Figure 5) may be used. This reel is in two halves designed to take any size standard coil of drop wire that has not been recoiled to fit the pay out reel. The reel can be threaded on the four-foot pipe spindle furnished with it and carried by two men into right of way. The pull off end of wire should be fastened in position to a support with a drop wire clamp, or spliced to a length of wire that has been run out and the wire laid out as the reel is carried. Where conditions are favorable the reel can be hung in a sling and the wire pulled off. The holes in the reel sides are large enough to permit threading one or more of these reels on the spindle bar of the standard construction truck and the wire laid out by the travel of the truck or the wire pulled off from this support. When desirable the reel can be rolled into right of way by hand or with a drag line, or several reels mounted on the same spindle, each with a coil of wire, may be rolled a short distance to a point of use in that manner. In doing this, care should be taken not to damage the drop wire with rocks or similar projections from the ground. The reel should also facilitate taking up drop wire when the temporary line is dismantled.





A. Flange on inside, round washer on outside, 2 1/2" dia. hole, attached with countersunk F. H. bolts. Make 2

B. 14" x 5/8" Double end bolt. Round washers under each nut and head upset on fixed end. Wing nut for other end. Make 3

C. 1/16" Sheet iron cylinder 9" long 14 3/4" diameter. 16 cuts 7 inch deep giving ribbons approx. 3" wide bent to form drum as shown, riveted to wood flanges with 3/16" rivets round washers under wood and heading done on outside of reel. Two drums to telescope as shown.

D. Discs of good quality 3 ply light weight white pine or similar wood 32" dia. make true circle paired to roll evenly.

E. 1 1/2" dia. light weight steel pipe drilled for 1/4" spacing pins as indicated.

FIG. 5

7.09 When BP or TP drop wire is used it is desirable from a transmission standpoint to place a few twists in it in each span to reduce crosstalk. When paying it out from the emergency reel the reel should be turned over at right angles to the spindle two or three times in each 100 feet or the wire twisted at least to the same extent when it is pulled from the reel. In laying out this wire directly from the coil, the coil may be held with its axis in line with the run of wire and the wire pulled straight from it. This places one twist in it for each loop of the wire in the coil.

7.10 Special care should be taken in laying out all types of drop wire to avoid sharp bends, kinks, or loops pulled out tight, as these may result in broken conductors.