BELL SYSTEM PRACTICES
Outside Plant Construction and Maintenance

SECTION G31.170
Issue 1, March, 1931
Provisional Standard

OPEN WIRE
NON-CATENARY LONG SPAN CONSTRUCTION

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1. STANDARD NAMES OF SUPPLIES

1.01 Standard names of supplies required for use under these instructions are given below in alphabetical order. These items are listed for the convenience of the field forces in ordering and checking supply of materials required for the work covered by these instructions. Only those materials not covered

elsewhere in the Outside Plant Construction and Maintenance Practices are listed below.

Clamp:	**DEAD-ENDING CLAMP.** (For Long Span Use.)
Crossarms:	**SPECIAL STEEL CROSSARMS.** (Dimensions shown in Part 8.)
Eyebolt:	**EYEBOLT FOR LONG SPAN USE.** (A 5/8 in. x 18 in. eyebolt for use in attaching long span suspension insulators to the crossarms on dead end and suspension fixtures.)
Hanger:	**WIRE HANGER.** (For carrying long span wires at suspension fixtures.)
Insulator:	**SUSPENSION INSULATOR.**
Wire:	**165 GALVANIZED STEEL RIVER CROSSING WIRE.**

2. GENERAL

2.01 These practices cover standard methods and materials for use in connection with the construction of long spans of the non-catenary type* in open wire toll and exchange lines excepting rural lines.

*NOTE: It is sometimes necessary to locate transpositions in a long span in which case a crossarm structure is located in the long span and is supported by cable suspension strand. This is known as catenary open wire construction. Where the line wires are given no intermediate support between the crossing fixtures, which is the type of construction covered in these practices, the long span is designated as the non-catenary type.

3. DEFINITION OF LONG SPANS

3.01 A long span is defined for the purpose of these instructions as an occasional span whose length exceeds the average length of the five adjacent spans in each direction by 50 per cent. or more with a minimum length of:

LOADING AREA	MINIMUM LENGTH FOR LONG SPAN CONSTRUCTION
Heavy	225 feet
Medium	250 "
Light	325 "

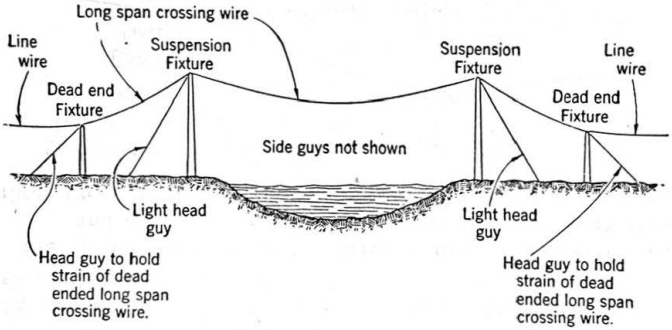
4. TYPES OF LONG SPAN FIXTURES

4.01 All long span fixtures covered by these practices are of the H type except in the case of spans of 325 to 500 feet in length employing 104 copper wire where for dead end fixtures single poles are used.

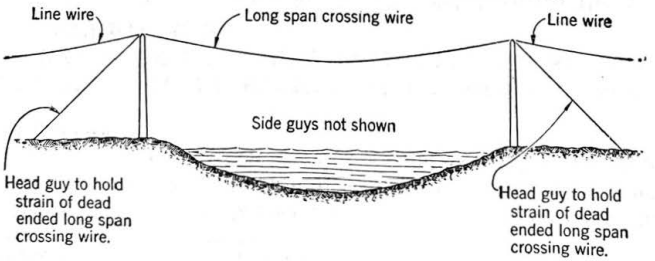
4.02 Dead end fixtures are the fixtures on which the long span wires are dead ended. The head guys to take the strain of the dead ended long span wires are located on the dead end fixtures.

4.03 Suspension fixtures are frequently used in conjunction with dead end fixtures in order to give the wires in the long span greater elevation.

4.04 The general arrangements of long spans constructed both with and without suspension fixtures are indicated below.



Long Span Crossing, Using Both Suspension and Dead End Fixtures.



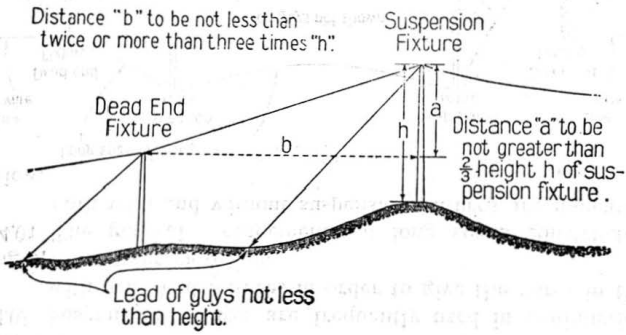
Long Span Crossing Without Suspension Fixtures

4.05 By span length is meant the distance between dead end fixtures when dead end fixtures only are used and between suspension fixtures when they are employed with the dead end fixtures.

5. DIFFERENCE IN ELEVATION OF AND DISTANCE BETWEEN DEAD END FIXTURES AND SUSPENSION FIXTURES

5.01 Make the difference in elevation "a" between the top of the dead end fixture and the top of the suspension fixture not more than two-thirds of the height of the suspension fixture above ground.

5.02 Make the distance "b" between the suspension fixture and dead end fixture not less than twice or more than three times the height of the suspension fixture above ground.



6. SIZE AND TYPE OF WIRE FOR LONG SPANS

6.01 When the size and type of wire is not shown in the detail plans use wire of the following types and sizes. Where two or more types or sizes are shown for the same span length either may be used as the clearance and economy considerations indicate to be desirable, bearing in mind that the wire having the least sag requires, in general, heaviest fixture construction but does not require as long poles to give the same clearance in the span.

SIZE AND TYPE OF WIRE FOR LONG SPANS

Length of Span (Feet)	Heavy Loading Area	Medium Loading Area	Light Loading Area
225	165 copper	.....	.....
250–300	165 copper	165 copper	.....
325–500	165 copper	165 copper	165 copper or 104 copper
550–800	165 R. C.	165 R. C.	165 R. C., 165 copper or 104 copper
850–1000	165 R. C.	165 R. C.	165 R. C., or 165 copper
1050–1600	165 R. C.	165 R. C.	165 R. C.

7. WIRE SAGS FOR LONG OPEN WIRE SPANS

7.01 Place wire in long span crossings constructed under these instructions with the following sags. In the case of additional wire installed in long spans not constructed in accordance with these instructions place the new wire with the same sag as existing wire of the same size and kind except where wire is strung on additional crossarms placed below all existing crossarms. Under these conditions the additional wire should be strung with the sags prescribed in these instructions provided these sags are not less than those in the existing wire. Wire must not be strung with different sags on the same crossarm.

(a) SAGS FOR PLACING 165 STEEL RIVER CROSSING WIRE

HEAVY AND MEDIUM LOADING AREAS

Length of Span In Feet	Temperature In Degrees Fahr. 20	60	100
550	2′ 3″	2′ 5″	2′ 10″
600	2′ 8″	3′ 0″	3′ 6″
650	3′ 4″	3′ 9″	4′ 4″
700	3′ 11″	4′ 6″	5′ 2″
750	4′ 7″	5′ 3″	6′ 1″
800	5′ 6″	6′ 3″	7′ 3″
850	6′ 6″	7′ 6″	8′ 7″
900	7′ 10″	9′ 0″	10′ 4″
950	9′ 2″	10′ 6″	12′ 0″
1000	10′ 9″	12′ 0″	13′ 10″
1050	12′ 6″	14′ 0″	16′ 0″
1100	14′ 6″	16′ 3″	18′ 2″
1150	16′ 7″	18′ 6″	20′ 6″
1200	19′ 0″	21′ 3″	23′ 3″
1250	21′ 7″	24′ 0″	26′ 0″
1300	24′ 10″	27′ 0″	29′ 1″
1350	28′ 0″	30′ 3″	32′ 6″
1400	31′ 6″	33′ 9″	36′ 0″
1450	35′ 2″	37′ 6″	39′ 8″
1500	39′ 0″	41′ 6″	36′ 0″
1550	43′ 0″	45′ 6″	47′ 6″
1600	48′ 0″	50′ 0″	52′ 0″

(b) SAGS FOR PLACING 165 STEEL RIVER CROSSING WIRE

LIGHT LOADING AREA

Length of Span In Feet	Temperature In Degrees Fahr. 20	60	100
550	2′ 3″	2′ 5″	2′ 10″
600	2′ 8″	3′ 0″	3′ 6″
650	3′ 4″	3′ 9″	4′ 4″
700	3′ 11″	4′ 6″	5′ 2″
750	4′ 7″	5′ 3″	6′ 1″
800	5′ 3″	6′ 0″	6′ 10″
850	6′ 0″	6′ 10″	7′ 8″
900	6′ 8″	7′ 6″	8′ 7″
950	7′ 5″	8′ 4″	9′ 5″
1000	8′ 2″	9′ 1″	10′ 4″
1050	8′ 11″	10′ 0″	11′ 2″
1100	9′ 8″	10′ 9″	12′ 1″
1150	10′ 6″	11′ 8″	13′ 1″
1200	11′ 4″	12′ 7″	14′ 0″
1250	12′ 1″	13′ 6″	15′ 0″
1300	13′ 0″	14′ 6″	16′ 0″
1350	13′ 9″	15′ 4″	17′ 0″
1400	14′ 8″	16′ 4″	18′ 0″
1450	15′ 6″	17′ 3″	18′ 11″
1500	16′ 6″	18′ 2″	19′ 11″
1550	17′ 4″	19′ 0″	20′ 11″
1600	18′ 2″	20′ 0″	22′ 0″

(c) SAGS FOR PLACING 165 COPPER WIRE

HEAVY AND MEDIUM LOADING AREAS

Length of Span In Feet	Temperature In Degrees Fahr. 20	60	100
225	1′ 7″	2′ 2″	3′ 1″
250	2′ 0″	2′ 8″	3′ 7″
275	2′ 6″	3′ 4″	4′ 1″
300	3′ 1″	3′ 11″	4′ 10″
325	3′ 8″	4′ 7″	5′ 6″
350	4′ 4″	5′ 5″	6′ 4″
375	5′ 0″	6′ 2″	7′ 2″
400	5′ 11″	7′ 0″	8′ 2″
425	6′ 8″	8′ 0″	9′ 1″
450	7′ 7″	8′ 10″	10′ 1″
475	8′ 7″	9′ 10″	11′ 1″
500	9′ 7″	10′ 11″	12′ 2″

(d) SAGS FOR PLACING 165 COPPER WIRE

LIGHT LOADING AREA

Length of Span In Feet	Temperature In Degrees Fahr. 20	60	100
325	3′ 8″	4′ 7″	5′ 6″
350	4′ 4″	5′ 5″	6′ 4″
375	5′ 0″	6′ 2″	7′ 2″
400	5′ 11″	7′ 0″	8′ 2″
425	6′ 8″	8′ 0″	9′ 1″
450	7′ 7″	8′ 10″	10′ 1″
475	8′ 7″	9′ 10″	11′ 1″
500	9′ 7″	10′ 11″	12′ 2″
550	6′ 1″	7′ 4″	8′ 6″
600	7′ 2″	8′ 6″	10′ 0″
650	8′ 5″	10′ 0″	11′ 6″
700	9′ 10″	11′ 5″	13′ 0″
750	11′ 2″	12′ 11″	14′ 7″
800	12′ 10″	14′ 7″	16′ 5″
850	14′ 5″	16′ 4″	18′ 2″
900	16′ 2″	18′ 2″	20′ 2″
950	18′ 0″	20′ 0″	22′ 1″
1000	20′ 0″	22′ 0″	24′ 2″

(e) SAGS FOR PLACING 104 COPPER WIRE

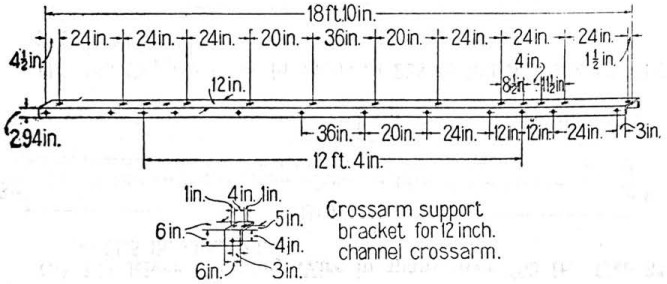
LIGHT LOADING AREA

Length of Span In Feet	Temperature In Degrees Fahr. 20	60	100
325	2′ 7″	3′ 4″	4′ 2″
350	3′ 1″	3′ 11″	4′ 11″
375	3′ 7″	4′ 6″	5′ 6″
400	4′ 1″	5′ 1″	6′ 2″
425	4′ 9″	5′ 9″	6′ 11″
450	5′ 4″	6′ 6″	7′ 8″
475	6′ 0″	7′ 2″	8′ 5″
500	6′ 8″	8′ 0″	9′ 4″
550	8′ 6″	9′ 10″	11′ 2″
600	10′ 0″	11′ 6″	13′ 0″
650	12′ 0″	13′ 6″	15′ 0″
700	13′ 11″	15′ 7″	17′ 2″
750	16′ 2″	17′ 11″	19′ 6″
800	18′ 7″	20′ 5″	22′ 1″

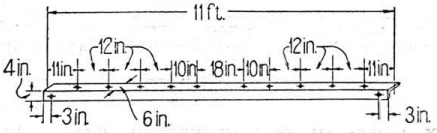
8. TYPES OF CROSSARMS

8.01 Crossarms of the following types will be used on DEAD END FIXTURES to carry the kind of wire shown and for the span lengths indicated below. Where a suspension fixture is employed in conjunction with a dead end fixture the type of crossarm used on the dead end fixture will be that shown for the shortest span length of the particular kind of long span wire being used.

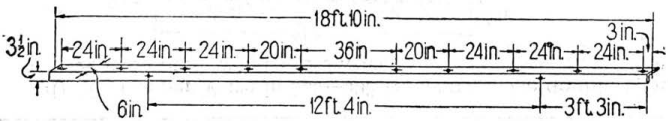
(a) 165 River Crossing Wire. Use 12"—20.5 lb. channel.



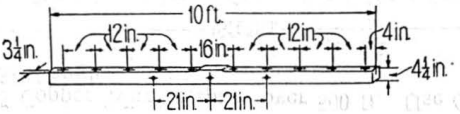
(b) 165 Copper Wire 225'—500' spans. Use 6" x 4" x 1/2" angle.



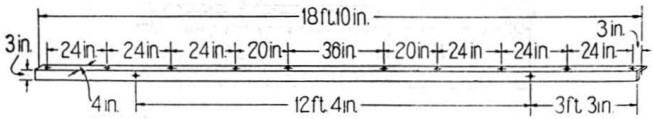
(c) 165 Copper Wire in spans over 500 ft. Use 6" x 3-1/2" x 3/8" angle.



(d) 104 Copper Wire in 325—500 ft. spans. Use double type A creosoted wood crossarms.

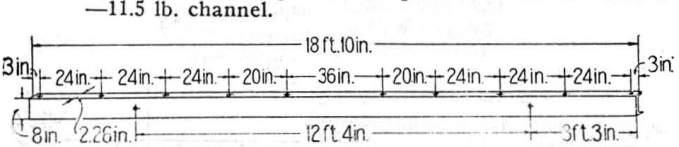


(e) 104 Copper Wire in spans over 500 ft. Use 4" x 3" x 3/8" angle.

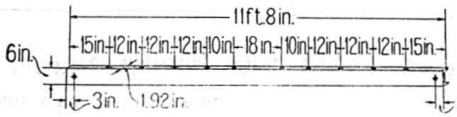


E.02 Crossarms of the following types will be used on SUSPENSION FIXTURES.

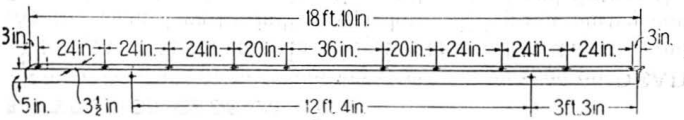
(a) 165 River Crossing Wire in spans over 500 ft. Use 8" —11.5 lb. channel.



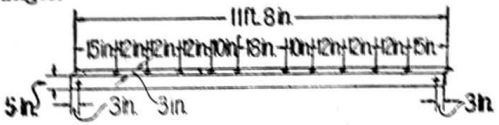
(b) 165 Copper Wire in spans of 225 to 500 ft. Use 6"—8.0 lb. channel.



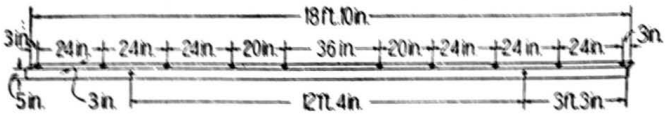
(c) 165 Copper Wire in spans over 500 ft. Use 5" x 3-1/2" x 3/8" angle.



(d) 104 Wire in spans of 325—500 ft. Use 5" x 3" x 5/16" angle.



(e) 104 Copper Wire in spans over 500 ft. Use 5" x 3" x 5/16" angle.



9. CROSSARM SPACING

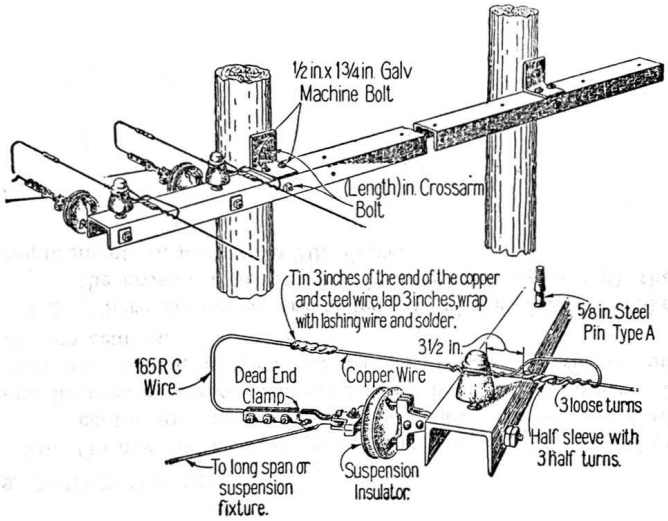
9.01 On new fixtures the crossarm spacing shall be 36 inches center to center on both suspension fixtures and dead end fixtures where 24 inch pin spacing is required. Where 12 inch pin spacing is used the crossarms shall be spaced on 24 inch centers.

9.02 Where crossarms are added on existing fixtures make the crossarm spacing for the new arms agree with the requirements of paragraph 9.01 above.

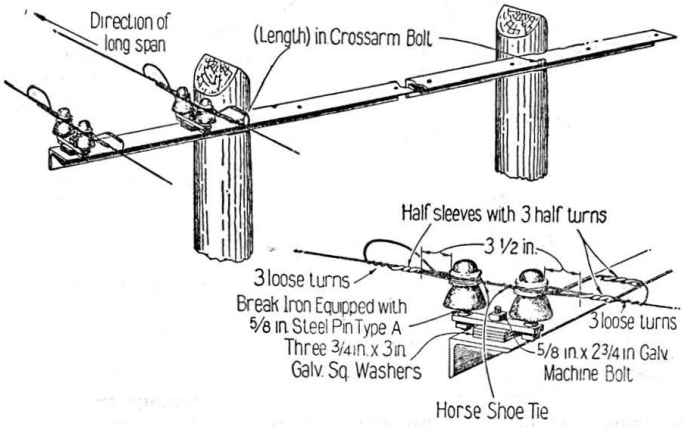
10. CROSSARM AND INSULATOR ARRANGEMENTS

10.01 At dead end fixtures the crossarm, insulator and wire dead ending arrangements shall be as follow:

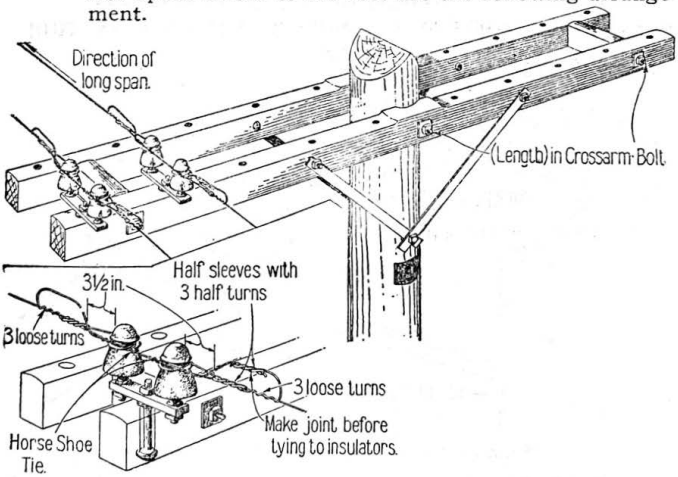
(a) 165 River Crossing Wire.
Where 165 river crossing wire is used the arrangements shall be as shown.



(b) 165 Copper Wire.
Use the following arrangement except that for spans of from 225 to 500 feet line fixture poles will be located at the ends of the crossarm.

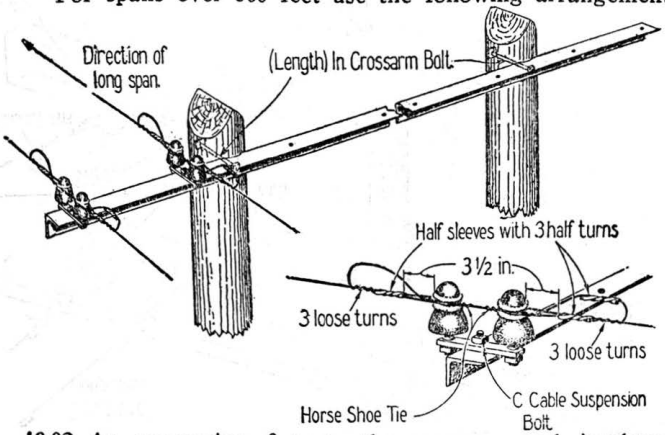


(c) 104 Copper Wire.
For spans of 325 to 500 feet use the following arrangement.



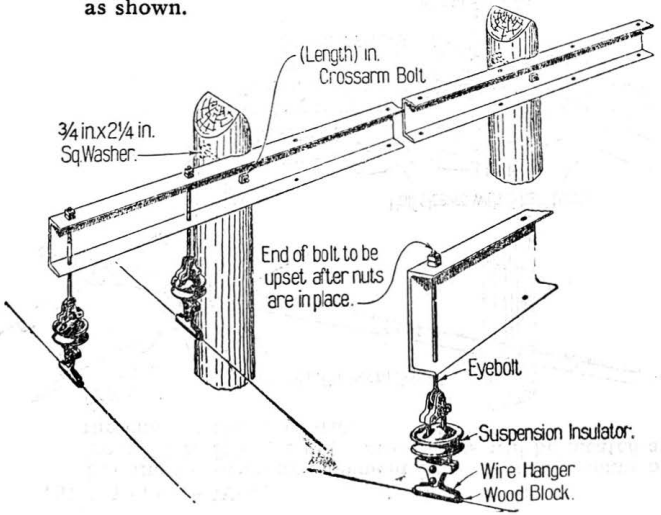
NON-CATENARY LONG SPAN CONSTRUCTION

For spans over 500 feet use the following arrangement.

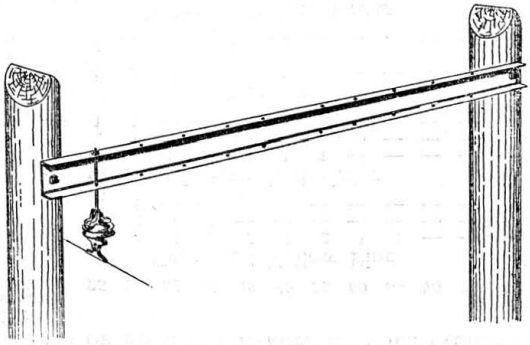


10.02 At suspension fixtures the crossarm and insulator arrangements shall be as follow:

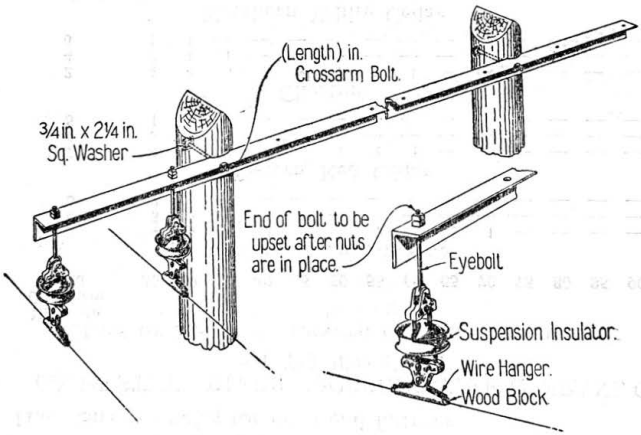
(a) 165 River Crossing Wire.
For 165 river crossing wire the arrangements shall be as shown.



(b) 165 Copper Wire in spans of 225 to 500 feet. Use the arrangement illustrated below.



(c) 165 Copper Wire in spans over 500 feet and 104 copper wire in spans of all lengths. Use the following arrangement except that with 104 copper wire in spans of 500 feet or less the fixture poles will be located at the ends of the arms.



11. SIZES OF POLES FOR FIXTURES

11.01 The class of pole required for a fixture depends on the height of pole and the load to be carried. Where the

class of the poles to be used is not shown in the detail plans use poles of the class shown below:

11.02 Sizes of poles for dead end fixtures.

(a) 165 STEEL RIVER CROSSING WIRE IN SPANS OF 501 TO 1000 FEET

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Crossarm Load	25	30	35	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine														
2	4	4	4	3	3	2	2	2	1	1	—	—	—	—
4	3	3	2	1	1	—	—	—	—	—	—	—	—	—
6	2	1	1	—	—	—	—	—	—	—	—	—	—	—
Western Red Cedar														
2	4	4	3	3	2	1	1	1	—	—	—	—	—	—
4	3	2	1	—	—	—	—	—	—	—	—	—	—	—
6	1	1	—	—	—	—	—	—	—	—	—	—	—	—
Chestnut														
2	4	4	3	2	2	1	1	1	—	—	—	—	—	—
4	2	1	1	—	—	—	—	—	—	—	—	—	—	—
6	1	1	—	—	—	—	—	—	—	—	—	—	—	—
Northern White Cedar														
2	4	4	3	3	2	2	1	1	—	—	—	—	—	—
4	3	2	1	1	—	—	—	—	—	—	—	—	—	—
6	2	1	—	—	—	—	—	—	—	—	—	—	—	—

(b) 165 STEEL RIVER CROSSING WIRE IN SPANS OF 1001 TO 1600 FEET

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Crossarm Load	25	30	35	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine														
2	4	4	4	3	3	2	2	1	1	—	—	—	—	—
4	3	2	1	1	—	—	—	—	—	—	—	—	—	—
6	2	1	—	—	—	—	—	—	—	—	—	—	—	—
Western Red Cedar														
2	4	4	3	2	2	1	1	—	—	—	—	—	—	—
4	2	1	1	—	—	—	—	—	—	—	—	—	—	—
6	1	1	—	—	—	—	—	—	—	—	—	—	—	—
Chestnut														
2	4	3	3	2	1	1	—	—	—	—	—	—	—	—
4	2	1	—	—	—	—	—	—	—	—	—	—	—	—
6	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Northern White Cedar														
2	4	4	3	2	2	1	1	—	—	—	—	—	—	—
4	3	2	1	—	—	—	—	—	—	—	—	—	—	—
6	2	1	—	—	—	—	—	—	—	—	—	—	—	—

(c) 165 COPPER WIRE IN HEAVY AND MEDIUM LOADING AREAS

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Wire Load	25	30	35	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine														
2	4	4	4	4	4	4	4	3	3	3	2	2	2	1
4	4	4	3	3	2	2	1	1	1	—	—	—	—	—
6	4	3	2	2	1	1	—	—	—	—	—	—	—	—
Western Red Cedar														
2	4	4	4	4	4	3	3	3	2	2	2	1	1	1
4	4	3	3	2	2	1	1	—	—	—	—	—	—	—
6	3	2	2	1	—	—	—	—	—	—	—	—	—	—
Chestnut														
2	4	4	4	4	4	3	3	2	2	2	—	—	—	—
4	4	3	3	2	1	1	—	—	—	—	—	—	—	—
6	3	2	1	1	—	—	—	—	—	—	—	—	—	—
Northern White Cedar														
2	4	4	4	4	4	4	3	3	—	—	—	—	—	—
4	4	4	3	2	2	1	1	—	—	—	—	—	—	—
6	4	3	2	1	1	—	—	—	—	—	—	—	—	—

(d) 165 COPPER WIRE IN LIGHT LOADING AREAS

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Wire Load	25	30	35	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine														
2	4	4	4	4	4	4	4	4	4	4	4	4	3	3
4	4	4	4	4	4	4	4	3	3	2	2	2	1	1
6	4	4	4	3	3	3	2	2	1	1	1	—	—	—
Western Red Cedar														
2	4	4	4	4	4	4	4	4	4	4	3	3	3	3
4	4	4	4	4	3	3	3	2	2	2	1	1	1	—
6	4	4	3	3	2	2	1	1	—	—	—	—	—	—
Chestnut														
2	4	4	4	4	4	4	4	4	4	2	—	—	—	—
4	4	4	4	4	3	3	3	2	2	1	—	—	—	—
6	4	4	3	2	2	1	1	1	—	—	—	—	—	—
Northern White Cedar														
2	4	4	4	4	4	4	4	4	—	—	—	—	—	—
4	4	4	4	4	4	3	3	3	—	—	—	—	—	—
6	4	4	4	3	2	2	1	1	—	—	—	—	—	—

(e) 104 COPPER WIRE

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Wire Load	25	30	35	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine														
2	4	4	4	4	4	4	4	4	4	4	4	4	3	3
4	4	4	4	4	4	4	4	4	3	3	2	2	2	1
6	4	4	4	4	4	3	3	2	2	2	1	1	—	—
Western Red Cedar														
2	4	4	4	4	4	4	4	4	4	4	4	4	3	3
4	4	4	4	4	4	3	3	3	2	2	2	1	1	1
6	4	4	4	3	3	2	2	1	1	1	—	—	—	—
Chestnut														
2	4	4	4	4	4	4	4	4	4	2	—	—	—	—
4	4	4	4	4	4	3	3	3	2	2	—	—	—	—
6	4	4	4	3	3	2	2	1	1	1	—	—	—	—
Northern White Cedar														
2	4	4	4	4	4	4	4	4	—	—	—	—	—	—
4	4	4	4	4	4	4	3	3	—	—	—	—	—	—
6	4	4	4	4	3	3	2	2	—	—	—	—	—	—

11.03 Sizes of poles for suspension fixtures.

(a) STEEL RIVER CROSSING WIRE IN SPANS OF 501 TO 1000 FEET

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Crossarm Load	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine											
2	4	4	4	4	4	3	3	3	2	2	2
4	3	3	2	2	1	1	1	—	—	—	—
6	2	1	1	1	—	—	—	—	—	—	—
Western Red Cedar											
2	4	4	4	3	3	3	2	2	2	1	1
4	3	2	1	1	1	—	—	—	—	—	—
6	1	1	—	—	—	—	—	—	—	—	—
Chestnut											
2	4	4	4	3	3	2	2	—	—	—	—
4	2	2	1	1	—	—	—	—	—	—	—
6	1	1	—	—	—	—	—	—	—	—	—
Northern White Cedar											
2	4	4	4	3	3	—	—	—	—	—	—
4	3	2	2	1	1	—	—	—	—	—	—
6	1	1	—	—	—	—	—	—	—	—	—

(b) STEEL RIVER CROSSING WIRE IN SPANS OF 1001 TO 1600 FEET

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Crossarm Load	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine											
2	4	4	4	3	3	3	2	2	2	1	1
4	3	2	2	1	1	1	—	—	—	—	—
6	1	1	—	—	—	—	—	—	—	—	—
Western Red Cedar											
2	4	3	3	3	2	2	2	1	1	1	—
4	2	1	1	—	—	—	—	—	—	—	—
6	1	—	—	—	—	—	—	—	—	—	—
Chestnut											
2	4	3	3	2	2	2	1	—	—	—	—
4	2	1	1	—	—	—	—	—	—	—	—
6	1	—	—	—	—	—	—	—	—	—	—
Northern White Cedar											
2	4	4	3	3	3	—	—	—	—	—	—
4	2	1	1	1	—	—	—	—	—	—	—
6	1	—	—	—	—	—	—	—	—	—	—

(c) 165 COPPER WIRE IN HEAVY AND MEDIUM LOADING AREAS

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Crossarm Load	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine											
2	4	4	4	4	4	4	4	4	4	3	3
4	4	4	4	3	3	2	2	2	1	1	1
6	3	3	3	2	2	1	1	1	—	—	—
Western Red Cedar											
2	4	4	4	4	4	4	4	4	4	3	3
4	4	3	3	2	2	2	1	1	1	—	—
6	3	2	2	1	1	—	—	—	—	—	—
Chestnut											
2	4	4	4	4	4	4	2	—	—	—	—
4	4	3	3	2	2	2	1	—	—	—	—
6	2	2	1	1	1	—	—	—	—	—	—
Northern White Cedar											
2	4	4	4	4	4	—	—	—	—	—	—
4	4	4	3	3	2	—	—	—	—	—	—
6	3	2	2	1	1	—	—	—	—	—	—

(d) 165 COPPER WIRE IN LIGHT LOADING AREAS

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Crossarm Load	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine											
2	4	4	4	4	4	4	4	4	4	3	3
4	4	4	4	4	4	4	4	3	3	3	3
6	4	4	4	4	3	3	3	2	2	2	1
Western Red Cedar											
2	4	4	4	4	4	4	4	4	4	3	3
4	4	4	4	4	4	3	3	3	3	2	2
6	4	4	3	3	3	2	2	2	1	1	1
Chestnut											
2	4	4	4	4	4	4	2	—	—	—	—
4	4	4	4	4	4	3	2	—	—	—	—
6	4	4	3	3	3	2	2	—	—	—	—
Northern White Cedar											
2	4	4	4	4	4	—	—	—	—	—	—
4	4	4	4	4	4	—	—	—	—	—	—
6	4	4	4	3	3	—	—	—	—	—	—

(e) 104 COPPER WIRE

CLASS OF POLE FOR LENGTH OF POLE INDICATED

Ultimate Crossarm Load	40	45	50	55	60	65	70	75	80	85	90
Creosoted Yellow Pine											
2	4	4	4	4	4	4	4	4	4	3	3
4	4	4	4	4	4	4	4	4	4	3	3
6	4	4	4	4	4	4	4	3	3	3	2
Western Red Cedar											
2	4	4	4	4	4	4	4	4	4	3	3
4	4	4	4	4	4	4	4	4	4	3	3
6	4	4	4	4	4	3	3	3	2	2	2
Chestnut											
2	4	4	4	4	4	4	2	—	—	—	—
4	4	4	4	4	4	4	2	—	—	—	—
6	4	4	4	4	4	3	2	—	—	—	—
Northern White Cedar											
2	4	4	4	4	4	—	—	—	—	—	—
4	4	4	4	4	4	—	—	—	—	—	—
6	4	4	4	4	4	—	—	—	—	—	—

12. LEAD OF GUYS

12.01 Make the lead of all head guys as nearly as practicable 1-1/4 times the height of the guy and the lead of all side guys not less than the height of the side guy.

13. HEAD GUYING DEAD END FIXTURES

13.01 Head guy dead end fixtures away from the long span as follows:

(a) With 165 steel river crossing wire place one 10M strand above each crossarm on each pole of the fixture.

(b) With 165 copper wire place one 6M strand above each crossarm on each pole of the fixture except in the case of spans not over 500 feet in length in the light loading area, in which case place one 6M strand between the first and second, third and fourth and fifth and sixth crossarms on each pole of the fixture.

(c) With 104 wire in spans not over 500 feet in length place one 6M guy between the first and second, third and fourth, and fifth and sixth crossarms. Where the span is more than 500 feet in length place on each fixture pole one 6M guy between the first and second crossarms for loads up to forty wires. Where more than four crossarms are carried place one 6M guy on each fixture pole between the first and second and between the fourth and fifth crossarms.

14. HEAD GUYING SUSPENSION FIXTURES

14.01 Head guy suspension fixtures away from the long span as follows:

(a) With 165 steel river crossing wire, 165 copper or 104 copper wire, place one 6M guy under the second crossarm position on each pole of the suspension fixture.

15. SIDE GUYING DEAD END FIXTURES

15.01 When no suspension fixture is used side guy dead end fixtures in both directions as follows:

(a) Spans up to 500 feet in length.

(1) With 165 copper wire in the heavy and medium loading areas place on 6M guy between the first and second arms for loads up to two arms and for loads greater than two arms place one 6M guy below the first and fourth crossarms.

(2) With 165 copper and 104 copper in the light loading area place one 6M guy below the first arm.

(b) Spans from 501 to 1000 feet in length.

(1) With 165 RC wire in the heavy and medium loading areas place one 10M guy between the first and second arms for loads up to two arms and for loads greater than two arms place a 10M guy below the first and fourth crossarms.

(2) With 165 RC wire in the light loading area place one 6M guy between the first and second arms for loads up to two arms and for loads greater than two arms place a 6M guy below the first and fourth crossarms.

(3) With 165 copper wire place one 6M guy between the first and second arms for loads up to 4 arms and for loads greater than this place a 6M guy below the first and fourth crossarms.

(4) With 104 copper wire place one 6M guy below the first arm for loads up to 6 arms.

(c) Spans from 1001 to 1600 feet in length.

(1) With 165 RC wire in the heavy and medium loading areas place one 10M guy between the first and second, third and fourth and fifth and sixth crossarms.

(2) With 165 RC wire in the light loading area place one 6M guy between the first and second arms for loads up to two arms and for loads greater than two arms place a 6M guy below the first and fourth crossarms.

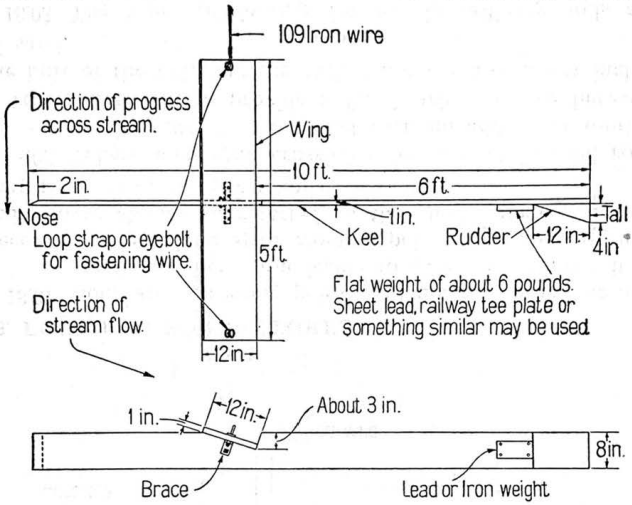
15.02 When a suspension fixture is used side guy the dead end fixture in both directions using one 6M guy attached beneath the first arm.

16. SIDE GUYING SUSPENSION FIXTURES

16.01 Side guy suspension fixtures as prescribed in part 15.01 for dead end fixtures when no suspension fixture is used.

17. ESTABLISHING CONNECTION ACROSS STREAMS

17.01 Where a line cannot be gotten across a stream having a rapid current flow, by ordinary means, as for instance when a stream is in flood the device shown below may be used.



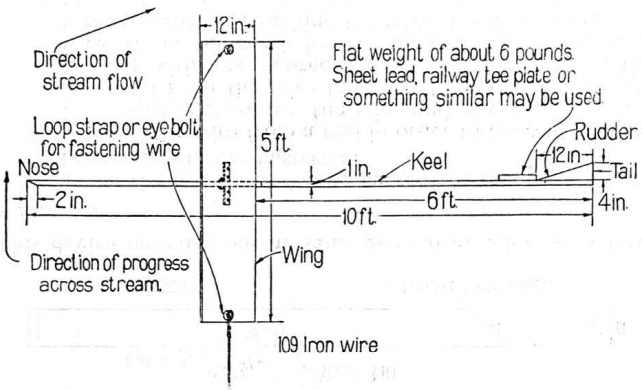
This device operates on the same general principle as a kite. To operate.

(a) Place the apparatus in the current of the stream with the nose pointing upstream.

(b) Pay out the wire from a reel in order to prevent fouling. Keep steady strain on the wire and pay out no faster than will keep the wire taut. In the case of a stream flowing with any appreciable speed the strain on the wire will be too much for one man to handle and some arrangement for snubbing the wire should be used.

(c) Keep wire out of water. If the bank is not high enough, set a pole temporarily on the bank and feed the wire over the pole.

The apparatus as set up above is designed for crossing a stream in the direction indicated by the arrow. To make it suitable for crossing in the opposite direction reverse the keel, rudder and point of attachment of the wire as shown below.



18. FOOTINGS FOR FIXTURES

18.01 Long span crossing poles shall not be set in swampy locations where practicable to avoid it. Where it is necessary to set long span crossing poles in swampy ground the matter should be referred to the chief engineer's office for design of the proper foundations.

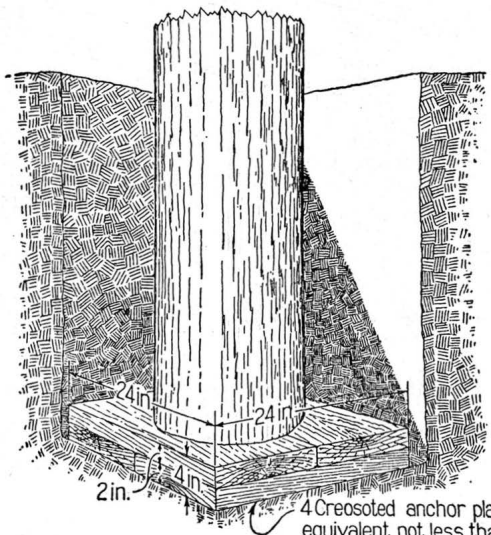
18.02 Where long span crossing poles are set in solid rock or the butts rest on solid rock no additional footing is required except to provide a flat bearing surface between the butt of the pole and the rock using a pad of a few inches of sand.

18.03 The types of footing for use in ordinary soils are shown below and the type of footing to be used for a particular kind of crossing is indicated in the following tables.

TYPE OF FOOTING FOR OPEN WIRE LONG SPAN CROSSING POLES

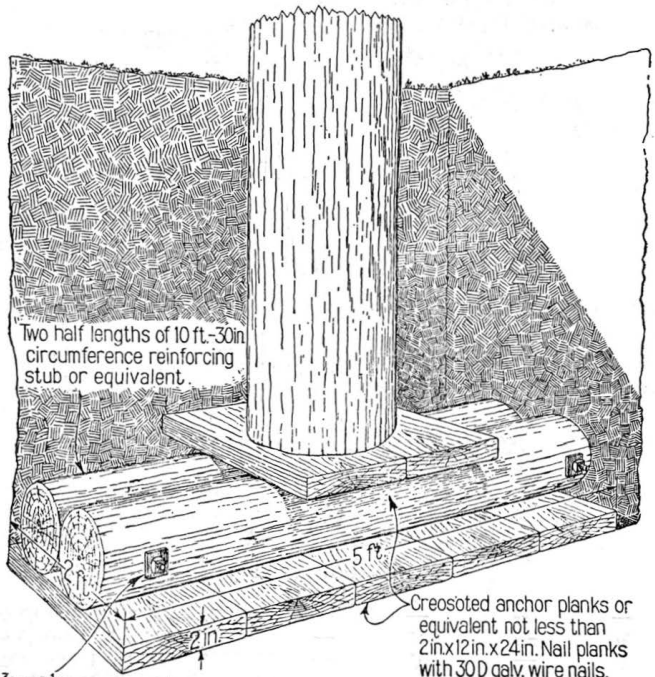
	TYPE OF FIXTURE			
	DEAD END		SUSPENSION	
CHARACTER OF CROSSING	Compact Gravel Sand or Loam	Pure Clay	Compact Gravel Sand or Loam	Pure Clay
165 River Crossing Wire, 21 to 60 Wires	A	B	A	B
165 River Crossing Wire, 20 Wires or Less	—	A	—	A
165 Copper	—	A	—	A
104 Copper	—	—	—	—

TYPE A FOOTING



Non-Catenary Long Span Construction

Type B Footing



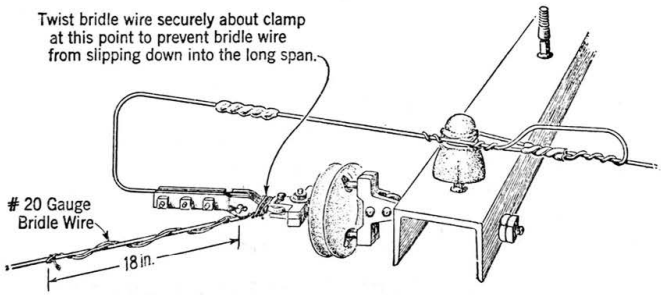
19. WIRE VIBRATION DAMPENER

19.01 It sometimes happens that wire in long spans, particularly 165 steel river crossing wire will vibrate excessively. This vibration may occur with only mild wind and it may be found that only certain wires vibrate to any great extent, the other wires in the crossing being relatively free from vibration. The individual vibrations of the wire are too rapid to be seen but badly vibrating wire can be readily detected in two ways.

(a) When looking at the wire about 18 inches outside of the clamp the edges of the wire will have a hazy appearance.

(b) When the thumb and forefinger are closed slowly and gently about the wire at a point about 18 inches outside the clamp the vibrations can be felt long before the fingers are actually closed on the wire. As the fingers are closed the vibration will be found to die down and practically disappear when the wire is firmly held in the fingers. When the wire is released the vibration will immediately begin to build up again.

19.02 To reduce the vibration in any wires which are vibrating badly a vibration dampener made of No. 20 gauge bridle wire may be applied as indicated below.



Wrap bridle wire (without untwisting) about the line wire making about three complete wraps in 18 inches. Bend outer end of bridle wire back so that it will not become unwrapped but do not twist tightly about the line wire.