

## OPEN WIRE

### SUSPENSION TYPE CONSTRUCTION

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#### 1. GENERAL

1.01 This section describes construction methods, tools, and materials for use in erecting a light pole line carrying from one to four open wire circuits attached to suspension type insulators. It covers the placing of suspension insulators and suspension brackets on poles and crossarms and the various arrangements of these items along the lead.

1.02 The suspension insulators and suspension brackets may be used with 109, 109H and 109E steel line wire and 104 copper-steel line wire. The insulators have a hook in which the line wire is held securely by a clamping detail, thereby eliminating wire ties. This feature makes it practicable to use a B Wire Lifter to raise the line wire from the ground and insert it in the hook during the wire placing operations. After the wire has been placed and tensioned along the pole line, the B Wire

Lifter is used to turn the locking screw which tightens the clamp and secures the line wire in the hook.

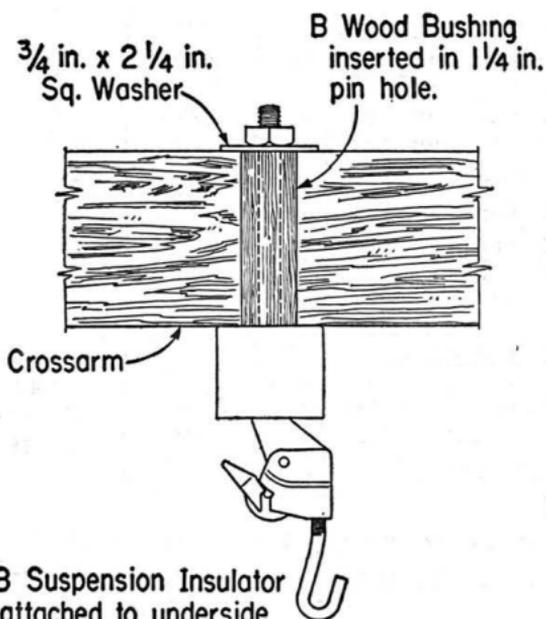
1.03 Suspension insulators and suspension brackets shall be used in open wire construction only when specified on the detail plans.

1.04 All of the recommended wire stringing precautions as outlined in the G10 and G31 divisions of the Practices should be observed during construction of suspension type open wire lines. All workmen handling ropes, wires, reels, wire raising tools, etc., **MUST WEAR RUBBER GLOVES** during the stringing and tensioning operations where the wire is placed on jointly used poles or crosses over or under electric light and power circuits.

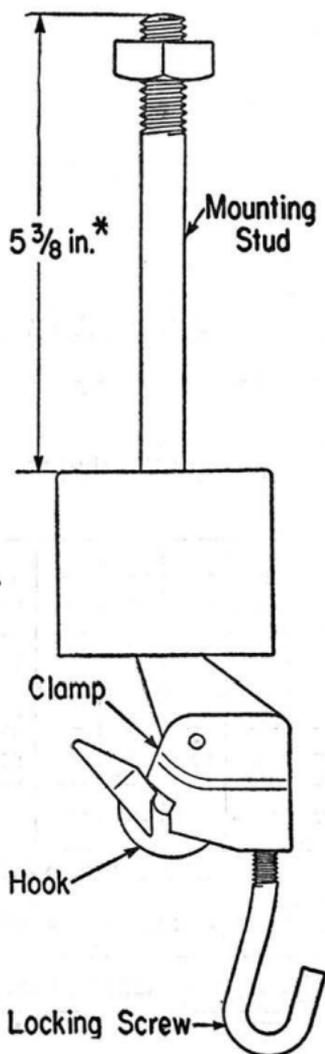
## **2. SUSPENSION TYPE INSULATORS**

2.01 The B Suspension Insulator has a long stud and is attached to the underside of a crossarm. The C Suspension Insulator has a short stud and is attached to a suspension transposition bracket or suspension pole bracket. The following sketch illustrates these suspension insulators and the method of attaching the B Suspension Insulator to a crossarm.

\*Note: The C Suspension Insulator is the same except for a shorter mounting stud which is  $1\frac{1}{8}$  in. long. A  $\frac{9}{16}$  in. mounting hole is provided in each suspension type bracket for attaching the C Suspension Insulator.



B Suspension Insulator attached to underside of wood crossarms with  $1\frac{1}{4}$  in. pin holes.



B SUSPENSION INSULATOR

2.02 The following table indicates the various conditions under which a single insulator will support different kinds of line wire. At locations where the corner pull exceeds those shown in the table it will be necessary to place double crossarms with a suspension insulator attached to each cross-arm. Under special conditions with 109E steel line wire, as indicated in the table, it will be necessary to dead-end the wire.

### LIMITATIONS ON USE OF SINGLE SUSPENSION INSULATORS

STORM LOADING AREA	TYPE OF LINE WIRE	SPAN LENGTH IN FEET									
		150	200	250	300	350	400	450	500	550	600
		MAXIMUM CORNER PULL IN FEET									
HEAVY	109	45	45	40	—	—	—	—	—	—	—
	109H	35	35	35	30	30	—	—	—	—	—
	*109E	—	—	—	30	25	25	20	20	20	20
	104CS	35	35	35	30	30	—	—	—	—	—
MEDIUM	109	50	50	50	50	—	—	—	—	—	—
	109H	50	50	50	45	40	35	35	35	30	30
	109E	—	—	—	40	40	35	30	30	30	30
	104CS	50	50	50	45	40	35	35	35	35	—
LIGHT	109 109H 109E 104CS	NO LIMITATIONS									

\* Dead-end 109E steel line wire at corner poles where the pull exceeds 40 feet and the span is longer than 500 feet.

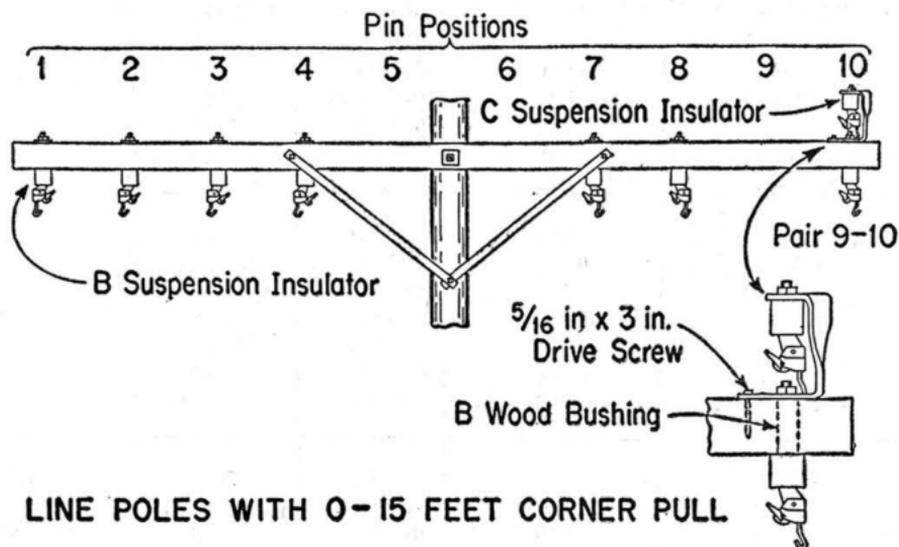
### 3. SUSPENSION TYPE BRACKETS

3.01 Use B or C Suspension Transposition Brackets for attaching C Suspension Insulators to the top of a crossarm at locations where the open wire circuits are to be transposed. The type of bracket to be used depends upon the type of wire, span length and amount of corner pull on the pole. The selection of the B or C Suspension Transposition Bracket for use along the pole line should be made in accordance with the following table.

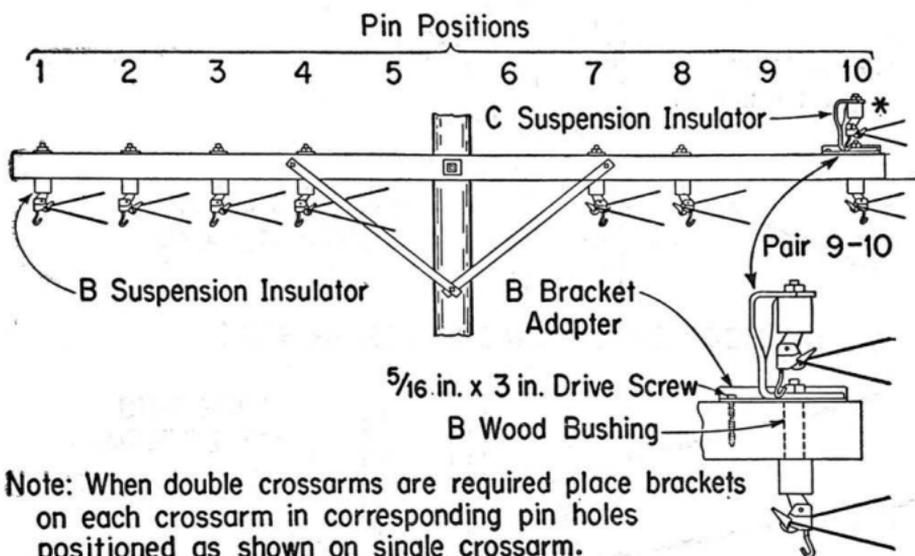
STORM LOADING AREA	TYPE OF WIRE	SPAN LENGTH (FEET)	B SUSPENSION TRANSPPOSITION BRACKET	C SUSPENSION TRANSPPOSITION BRACKET
			CORNER PULL (FEET)	
HEAVY	109	ALL	0-10	Over 10
	109H	ALL	0-5	Over 5
	109E	0-500	0-5	Over 5
	*109E	501-600	0-5	Over 5
	104CS	ALL	0-5	Over 5
MEDIUM	109	ALL	0-10	Over 10
	109H	0-400	0-10	Over 10
	109H	401-500	0-5	Over 5
	109E	0-350	0-10	Over 10
	109E	351-600	0-5	Over 5
	104CS	0-400	0-10	Over 10
	104CS	401-550	0-5	Over 5
LIGHT	109	ALL	0-20	Over 20
	109H	0-300	0-20	Over 20
	109H	301-500	0-15	Over 15
	109E	0-600	0-15	Over 15
	104CS	0-300	0-20	Over 20
	104CS	301-600	0-15	Over 15

\* Dead-end 109E steel line wire at corner poles where the pull exceeds 40 feet and the span is longer than 500 feet, and make transposition in bridle wire.

3.02 Along straight sections of the pole line, and at corner poles with 15 feet pull or less, the suspension transposition brackets are attached to the crossarm by means of the mounting stud of a B Suspension Insulator. The following sketch shows a typical arrangement of suspension insulators and brackets and covers the method of attaching B or C Suspension Transposition Brackets and C Suspension Insulators.



3.03 At corner poles where the pull exceeds 15 feet all suspension transposition brackets are placed on the crossarm so that the line wire pulls away from the back of the bracket. When a transposition bracket is placed in the end pin hole, on the end of the crossarm towards the pull on the pole, place a B Bracket Adapter under the transposition bracket. The following sketch shows a typical arrangement on a 10A crossarm and covers the method of mounting the B or C Suspension Transposition Bracket and B Bracket Adapter.



Note: When double crossarms are required place brackets on each crossarm in corresponding pin holes positioned as shown on single crossarm.

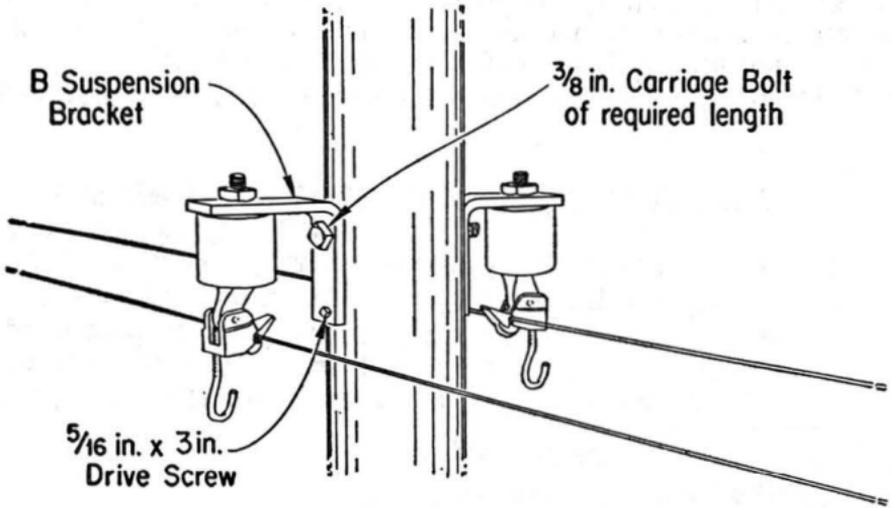
\* When pull is in the opposite direction reverse all brackets, placing the B Bracket Adapter under any transposition bracket placed in pin hole No. 1.

### CORNER POLES WITH PULL EXCEEDING 15 FEET

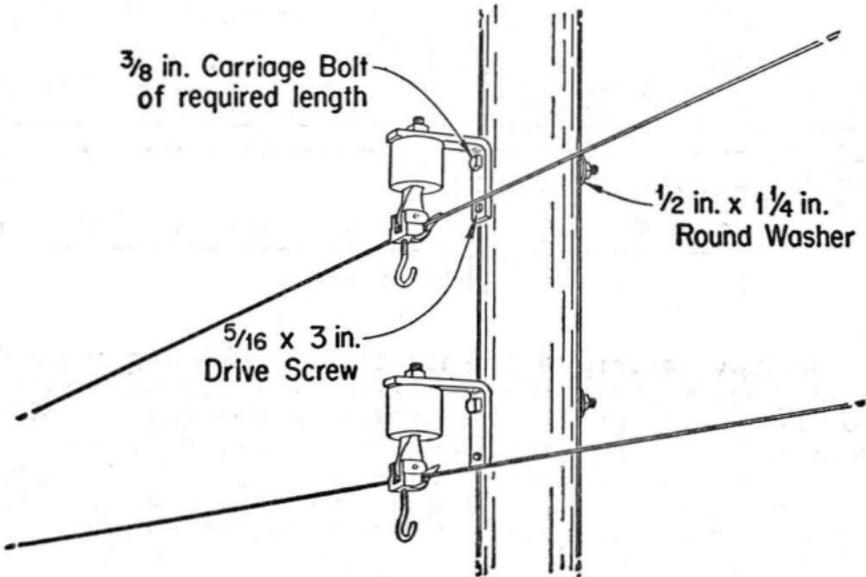
3.04 Use the B Suspension Bracket to attach C Suspension Insulators to the side of a pole along a pole line where only one open wire circuit is to be placed, except at those locations where crossarms are required. It may be necessary to place crossarms in a single circuit lead at poles used jointly with a foreign company or at corner poles where excessive pull, as described in Paragraph 2.02, requires the installation of double crossarms and two insulators for each wire. The follow-

ing sketches show the methods of attaching B Suspension Brackets and C Suspension Insulators on the poles. These items should be placed on the pole before it is set.

### POLE BRACKETS, NON-TRANPOSED POSITION

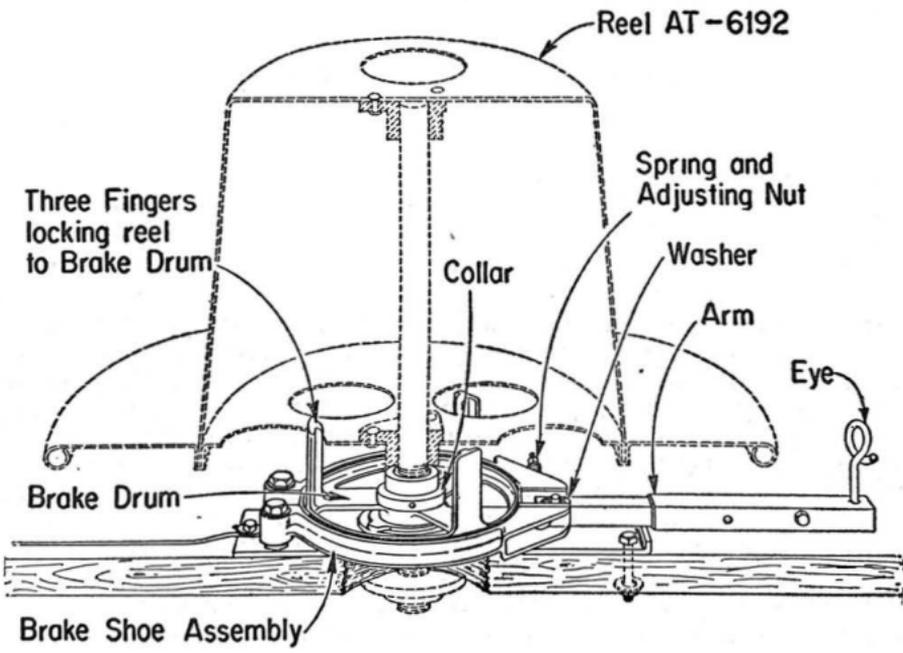
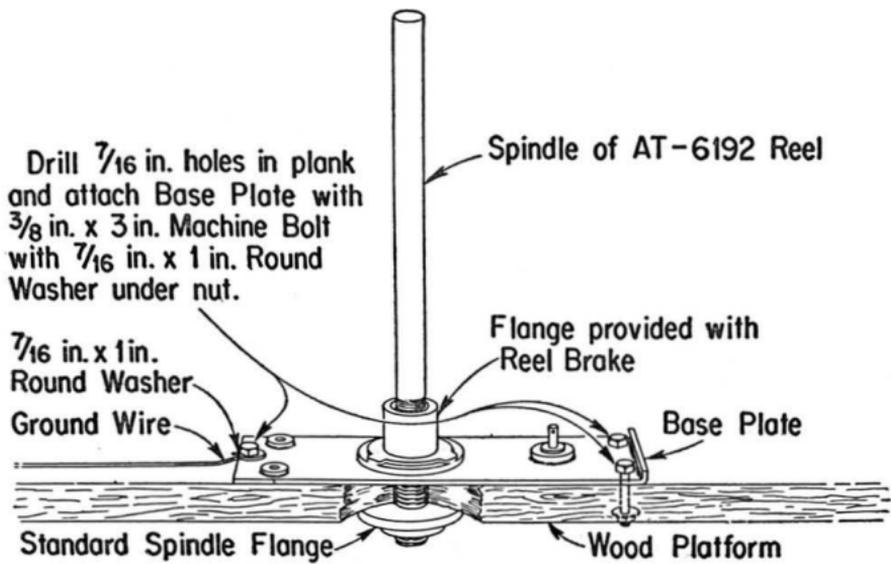


### POLE BRACKETS, TRANPOSED POSITION

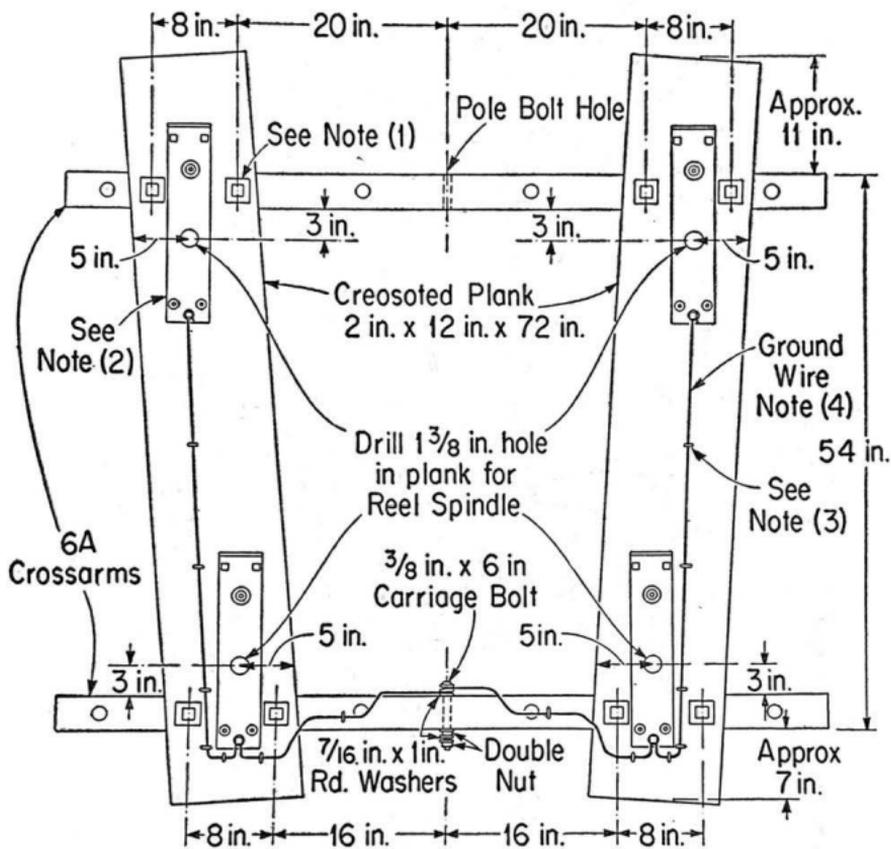


#### **4. B REEL BRAKE**

4.01 The B Reel Brake is used with standard wire payout reels to provide automatic braking during wire placing operations. The following sketch shows the assembly of the brake on the payout reel spindle and the method of mounting the two units for wire placing. Set the brake adjusting screw so that approximately 30 to 40 pounds pull on the wire is required to start the payout reel turning. This pull can be measured by using the 500-pound spring balance described in Part 7 of this section. When making this adjustment, the wire should not be placed through the eye of the brake lever arm. After the brake shoe adjustment has been made the line wire should be inserted through the eye of the lever arm which controls the braking action during wire placing. Wire shall be pulled in at a speed not exceeding approximately 5 miles per hour. The inner end of the coil of line wire should not be attached to the payout reel.



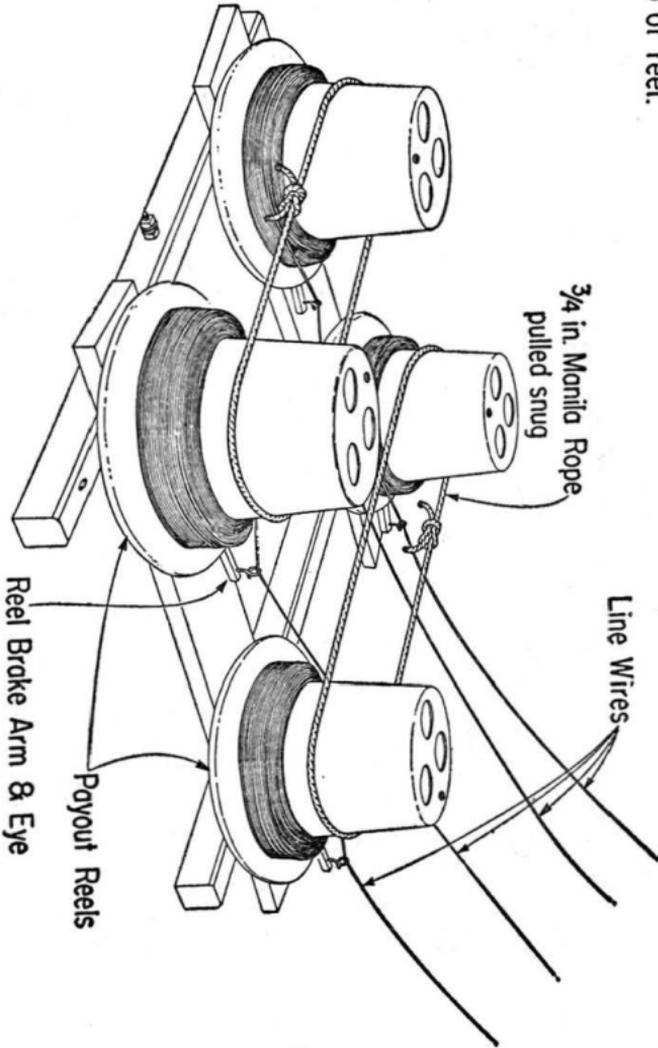
4.02 The following sketch covers the construction of a platform on which four B Reel Brakes and wire payout reels may be mounted. This platform is suitable for use either placed on the ground or mounted on a P3T or P8T Pole Trailer.



- Note: (1) Drill  $\frac{1}{16}$  in. holes in creosoted plank, 2 in. from edge in cross-arms as required. Attach plank to crossarms with 8 inch Crossarm Bolts. Place  $\frac{3}{4}$  in. x  $2\frac{1}{4}$  in. Square Washers under the head and nut of each bolt. Place a B Wood Bushing when crossarm bolt passes through a pin hole.
- (2) Attach Base Plates and assemble the B Reel Brake as shown in the mounting detail.
- (3) Attach Ground Wire with  $1\frac{1}{4}$  in. B Staples—12 in. apart
- (4) Place 104 or 165 Copper Wire to provide for grounding of Payout Reels to effective ground.

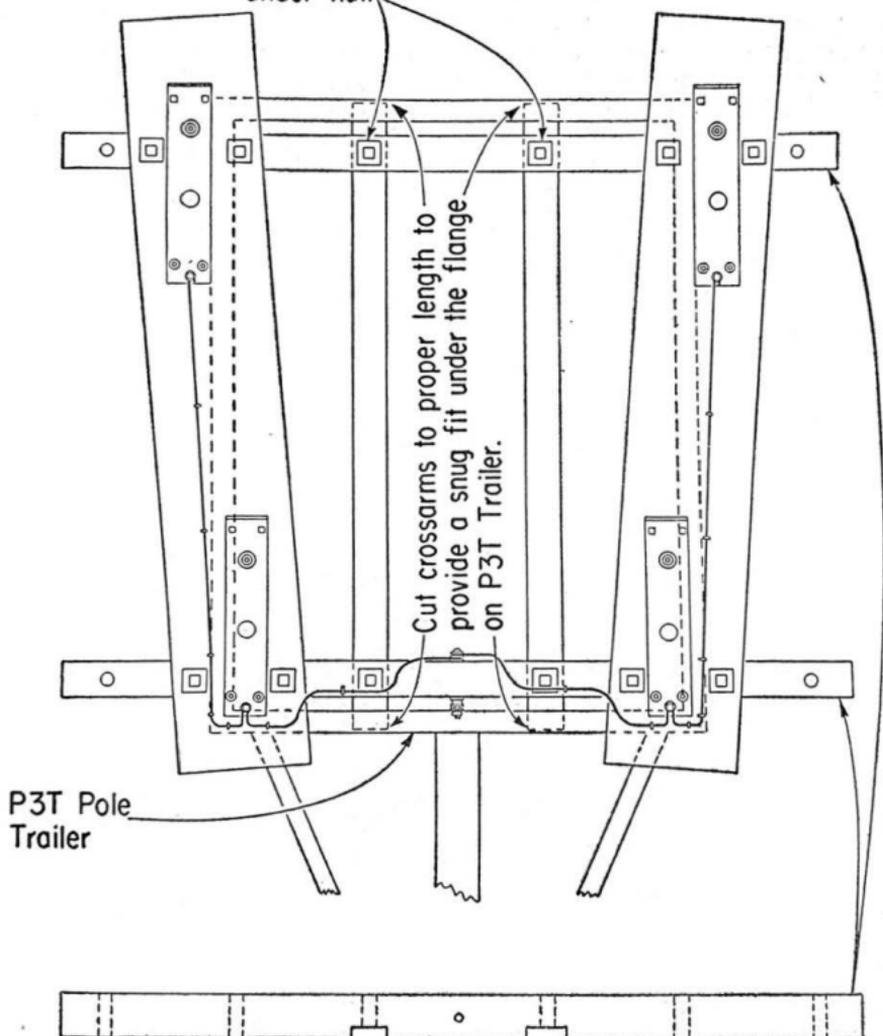
4.03 The following sketch shows the complete assembly of B Reel Brakes and payout reels mounted on the platform for wire placing operations.

Place ropes as shown to keep any loose wraps of wire from flipping over top of reel.



4.04 The platform may be mounted on the pole trailers as shown in the following sketch.

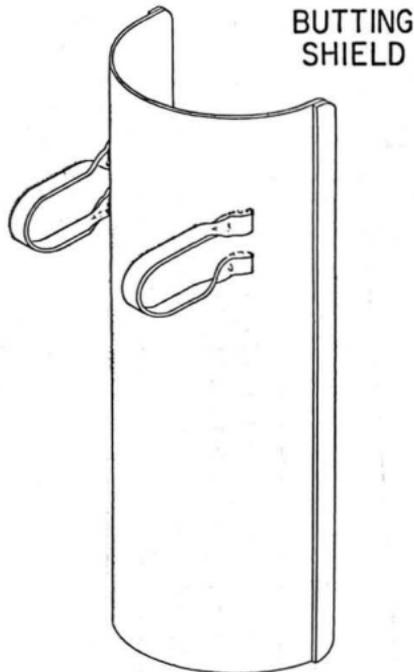
10 in. Crossarm Bolts with  $\frac{3}{4}$  in. x  $2\frac{1}{4}$  in. Sq. Washers under head of bolt and under nut.



Place gain in crossarms  $3\frac{1}{2}$  inches wide and  $1\frac{1}{4}$  inch deep for mounting on Pole Trailers

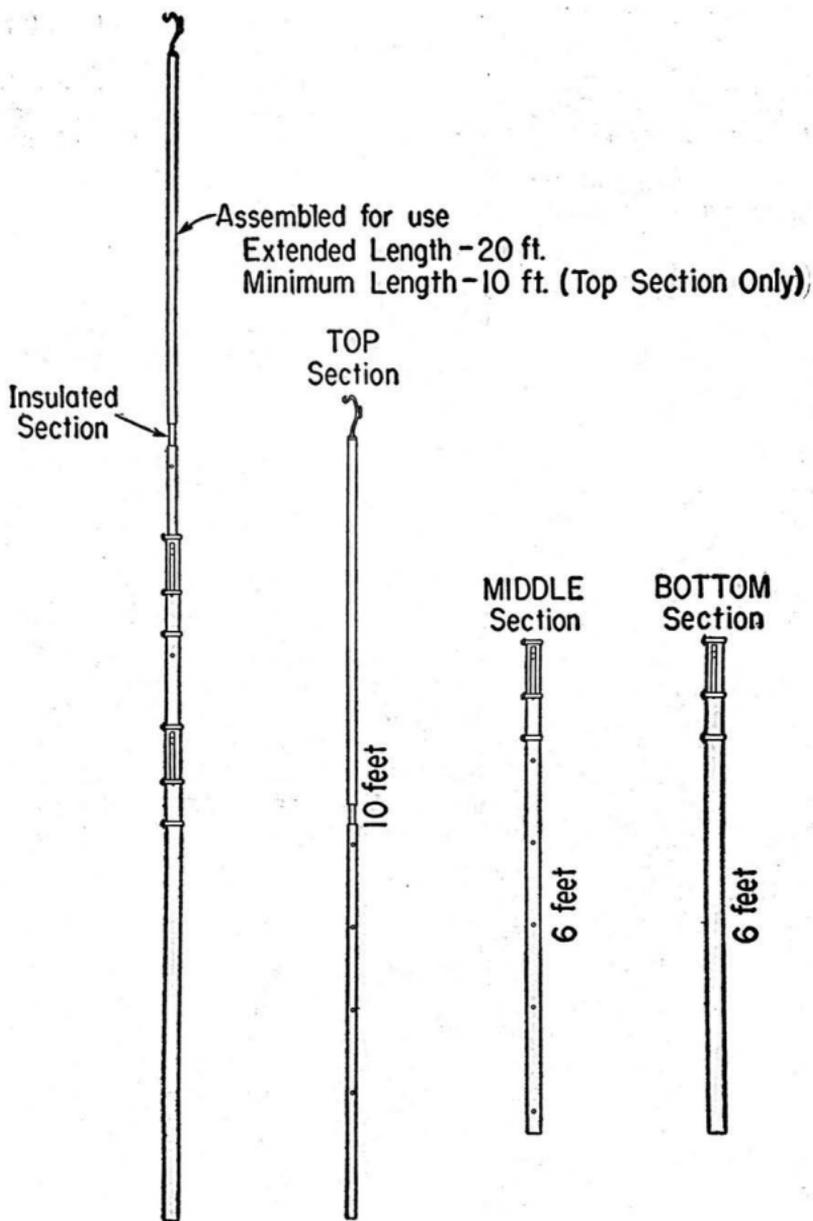
## 5. BUTTING SHIELD

5.01 The C Butting Shield shall be used when setting Class 7 or smaller poles manually to prevent slippage of the pole butt away from the pole hole and to guide the pole into the pole hole. The following sketch illustrates the C Butting Shield.



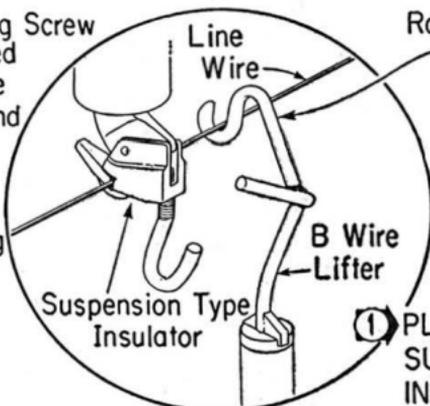
## 6. B WIRE LIFTER

6.01 The B Wire Lifter is used for raising line wire into the clamp of suspension insulators and for tightening the clamp after the line wire has been tensioned. The tool has an insulated section to protect the workman in case of accidental contact between the line wire and power supply conductors. The B Wire Lifter should be assembled for use as shown in the following sketch.



6.02 The B Wire Lifter should be used for placing or removing line wire as shown in the following sketches.

CAUTION: Locking Screw must be loosened so that line wire rests in Hook and is held in place by the Clamp without binding during tensioning operations.

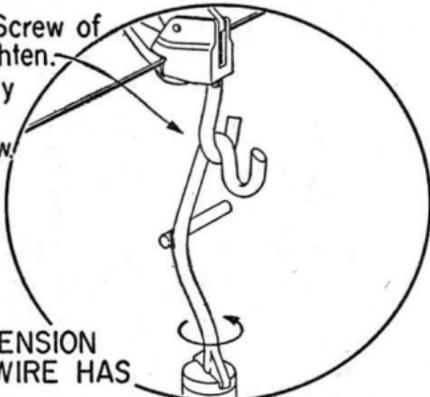


Raise line wire with B Wire Lifter and insert wire in the hook as shown.

① PLACING WIRE IN SUSPENSION TYPE INSULATOR.

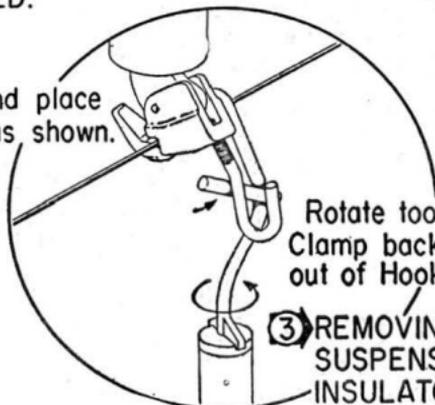
Insert B Wire Lifter into Locking Screw of Clamp and rotate as shown to tighten.

CAUTION: Workman should use only one hand to turn B Wire Lifter when tightening the Locking Screw. Hold the tool as nearly vertical as practicable during the tightening operation.



② TIGHTENING CLAMP OF SUSPENSION TYPE INSULATOR AFTER LINE WIRE HAS BEEN TENSIONED.

Loosen Clamp and place B Wire Lifter as shown.



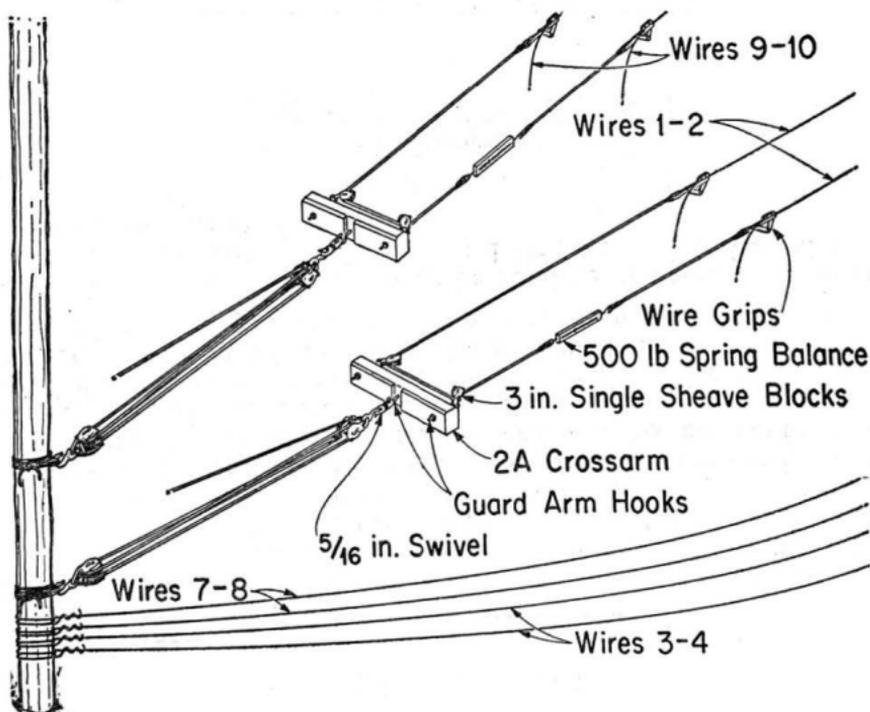
Rotate tool to move the Clamp back and raise wire out of Hook.

③ REMOVING WIRE FROM SUSPENSION TYPE INSULATOR.

## 7. TENSIONING TACKLE

7.01 Wire sags in suspension type construction are most readily determined by pounds pull on the line wire instead of sag in inches. To determine line wire tensions during installation it is recommended that a 500-pound capacity No. 180 "Iron Clad" spring balance manufactured by J. Chatillon and Sons be used. Tables showing recommended tensions for different types of line wire under various conditions are provided in Part 13 of this section.

7.02 In general it is practicable to tension two wires at a time using 3-inch Double Sheave Tackle Blocks reeved with 3/8-inch rope with an equalizing arrangement to ensure the same tension in both wires. When two or more circuits are to be tensioned, two sets of tensioning tackle should be used to tension pairs of wires on opposite sides of the crossarm so that an unbalanced load is not imposed on the dead-end crossarm. The following sketch shows a recommended arrangement of rope blocks and equalizing tackle which may be used to tension open wire circuits.



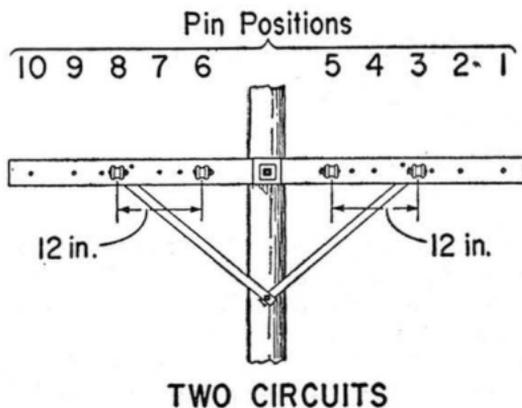
TENSIONING TACKLE—TWO PAIRS OF WIRES

7.03 Other arrangements of rope blocks and equalizers which may prove satisfactory for tensioning two or more wires are shown in Section G85.800.

## 8. EQUIPPING AND PLACING CROSSARMS

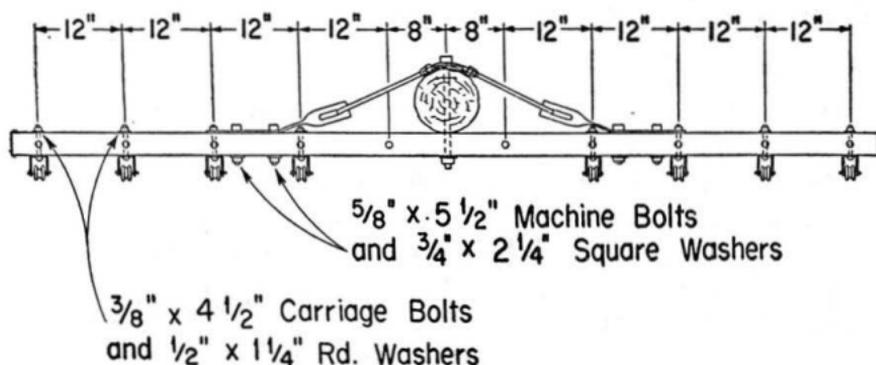
8.01 In general all crossarms should be fully equipped and attached to the pole before the pole is set. The following paragraphs cover the recommended usage of different types of crossarms and the arrangement of attaching suspension type insulators and brackets along the pole line. At dead-end crossarms, where tensioning operations are not to be performed, short lengths of line wire long enough to be reached from the ground should be terminated on the B Deadend Brackets. The line wire may then be spliced to these short lengths of line wire during wire placing operations by a workman on the ground.

8.02 (a) The DE crossarm may be used to dead-end two open wire circuits with B Deadend Brackets placed as shown in the following sketch.

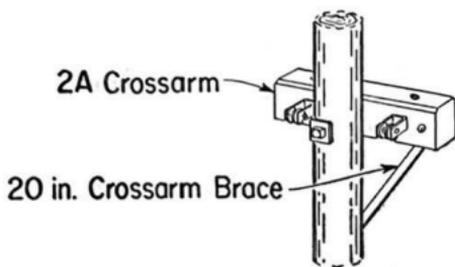


Note: Place DE Crossarms on the pole and attach B Deadend Brackets, B Back Brace and 30 in. Crossarm Braces in accordance with instructions provided in other sections of the Practices.

(b) A 10A crossarm, equipped with B Deadend Brackets and a B Back Brace is used for dead-ending 4-pair lines, as illustrated.



8.03 The 2A crossarm should be used when double crossarms are required at corner poles in a non-joint pole line supporting one open wire circuit. It may also be used to dead-end one circuit of open wire when clearance requirements prevent the use of B Deadend Brackets mounted on the pole and the average span length does not exceed 250 feet in the Heavy and Medium Loading Areas and 350 feet in the Light Loading Areas. The method of equipping and placing 2A crossarms along the lead and at dead-end poles are shown in the following sketches.



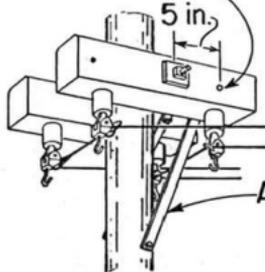
Note: Drill  $\frac{7}{16}$  in. hole in crossarm at center of pin holes and attach B Deadend Brackets with  $\frac{3}{8}$  in. x 4 in. Carriage Bolts with a  $\frac{1}{2}$  in. x  $1\frac{1}{4}$  in. Round Washer under the nut.

### DEAD-END POLES.

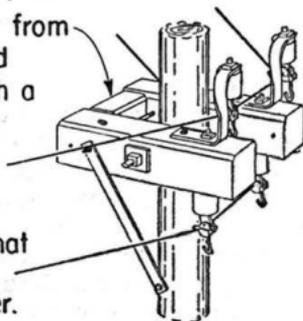
Drill  $\frac{7}{16}$  in. hole 5 in. from center and attach crossarm braces with  $\frac{3}{8}$  in. x 4 in. Carriage Bolt.

Face the brackets and insulator hooks towards the pole.

Spacer block cut from old crossarm and held in place with a 30d wire nail through each crossarm.



Attach braces so that they are located on inside of corner.



### DOUBLE CROSSARMS AT NON-TRANSPOSITION POLES

### DOUBLE CROSSARMS AT TRANSPOSITION POLES

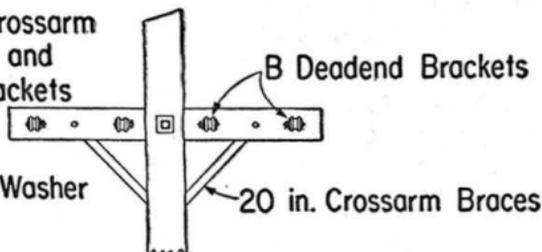
#### Notes

- (1) Fasten all crossarms to the pole with a crossarm bolt of proper length. Place  $\frac{3}{4}$  in. x  $2\frac{1}{4}$  in. Sq. Washer under head and nut of bolt.
- (2) Use 20 in. crossarm braces attached to the pole with  $\frac{1}{2}$  in. x  $4\frac{1}{2}$  in. Drive Screw and to the crossarm with  $\frac{3}{8}$  in. x 4 in. Carriage Bolt.
- (3) When spacer is placed, two  $\frac{7}{16}$  in. holes should be drilled in the crossarms at center of pin holes. Join the two crossarms with a carriage bolt and attach crossarm braces to the carriage bolt.

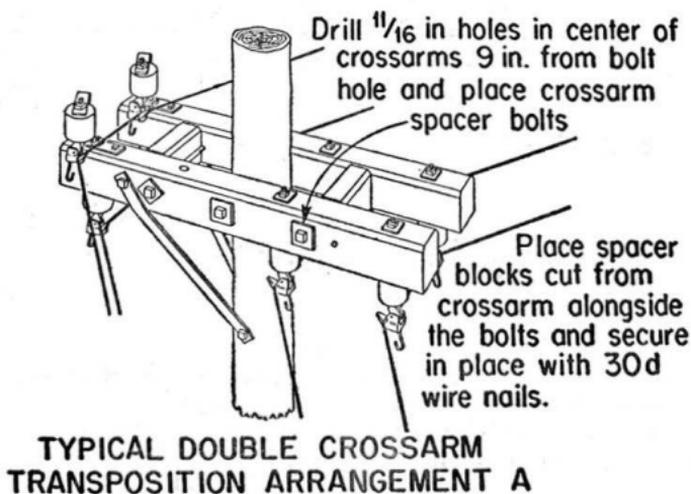
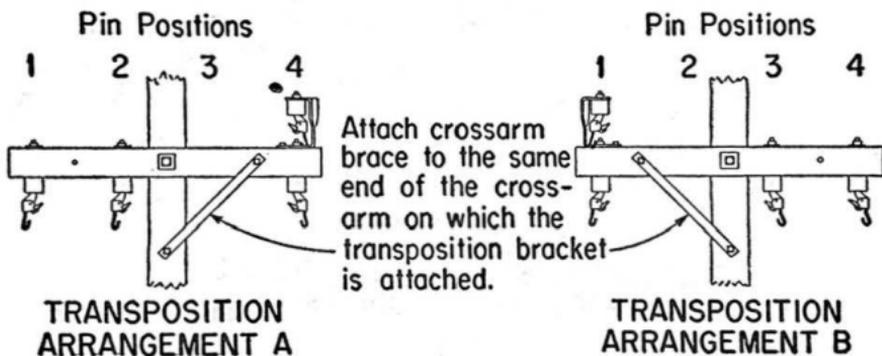
8.04 The 4A crossarm should be used along a nonjoint pole line which supports two open wire circuits. It may also be placed on a joint use pole located in a pole line supporting one open wire circuit, to provide adequate climbing space, or to dead-end two pairs of wire when the average span length does not exceed 250 feet in Heavy and Medium Loading Areas

and 350 feet in the Light Loading Areas. The following sketches show the different arrangements and methods of equipping 4A crossarms for use along the line and at dead-end poles.

Drill  $\frac{7}{16}$  in. holes in crossarm at center of pin holes and attach B Deadend Brackets with  $\frac{3}{8}$  in. x 4 in. Carriage Bolts with a  $\frac{1}{2}$  in. x  $\frac{1}{4}$  in. Round Washer under the nut.

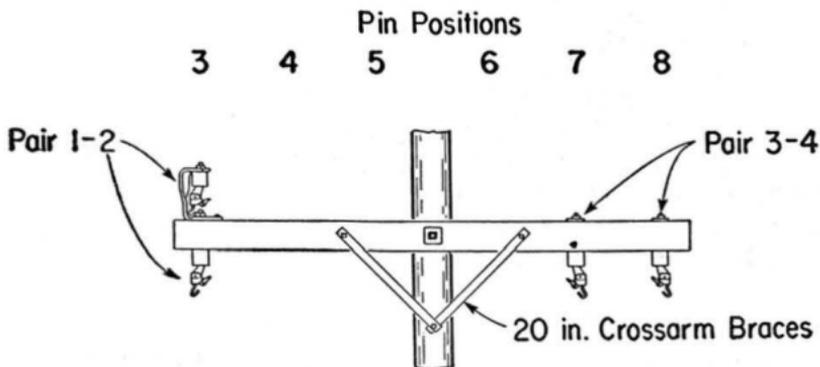


DEAD-END POLES

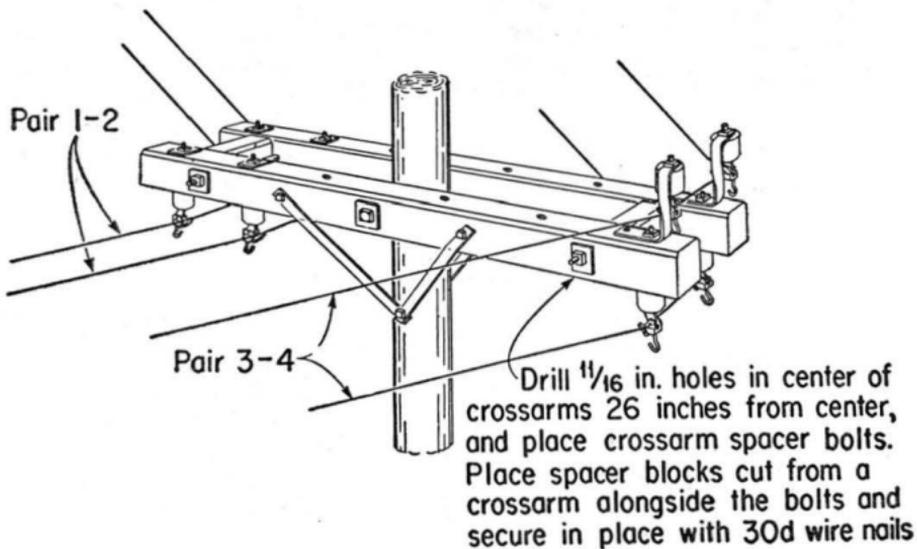


TYPICAL DOUBLE CROSSARM  
TRANSPPOSITION ARRANGEMENT A

8.05 The 6A crossarm should be used along a pole line which supports two open wire circuits at jointly used poles where greater climbing space is required. The methods of equipping and placing 6A crossarms on poles along the line are shown in the following sketches.

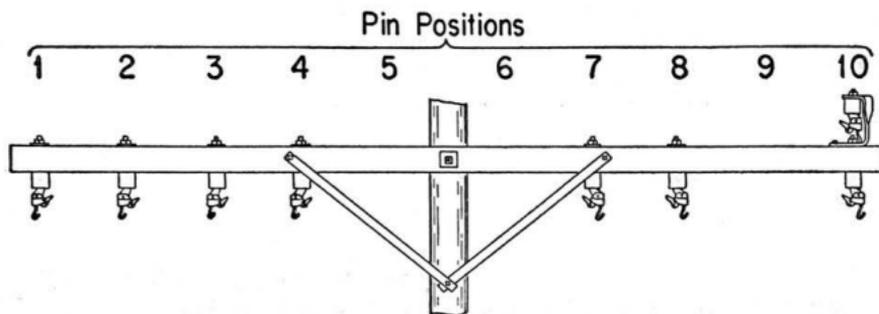


**STRAIGHT LINE POLE  
TRANSPOSITION ARRANGEMENT B**

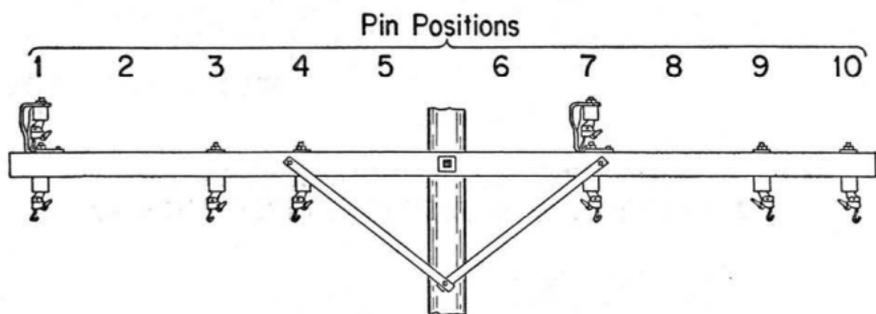


**TYPICAL DOUBLE CROSSARM  
TRANSPOSITION ARRANGEMENT A**

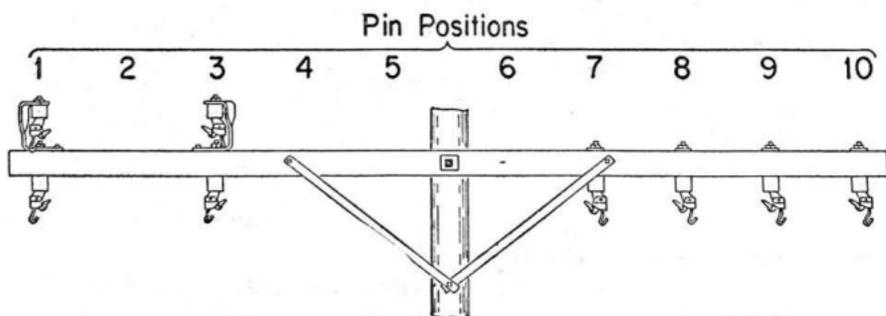
8.06 The 10A crossarm should be used along a pole line which supports three or four open wire circuits. When only three open wire circuits are to be placed, they shall be placed in pin holes 1-2, 3-4, and 9-10. The following sketches show the methods of equipping and placing 10A crossarms along the line.



TRANSPPOSITION ARRANGEMENT A

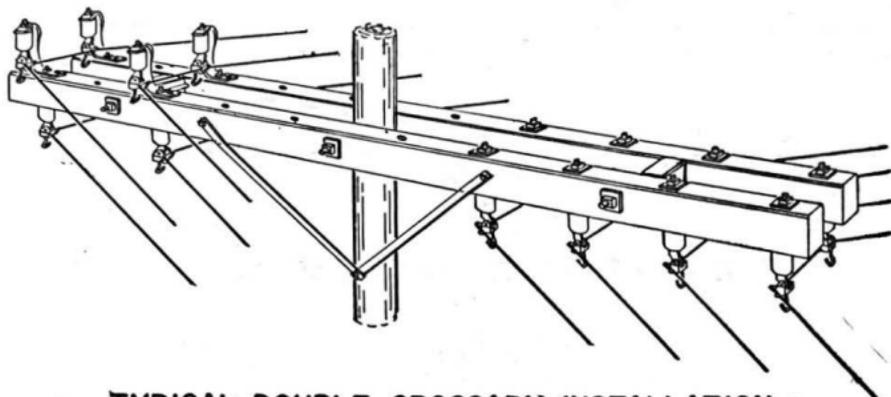


TRANSPPOSITION ARRANGEMENT B



TRANSPPOSITION ARRANGEMENT C

Drill  $\frac{1}{16}$  in. holes in center of crossarm 38 inches from bolt hole and place crossarm spacer bolts. Place spacer block cut from crossarm alongside the bolts and secure in place with 30d wire nails.

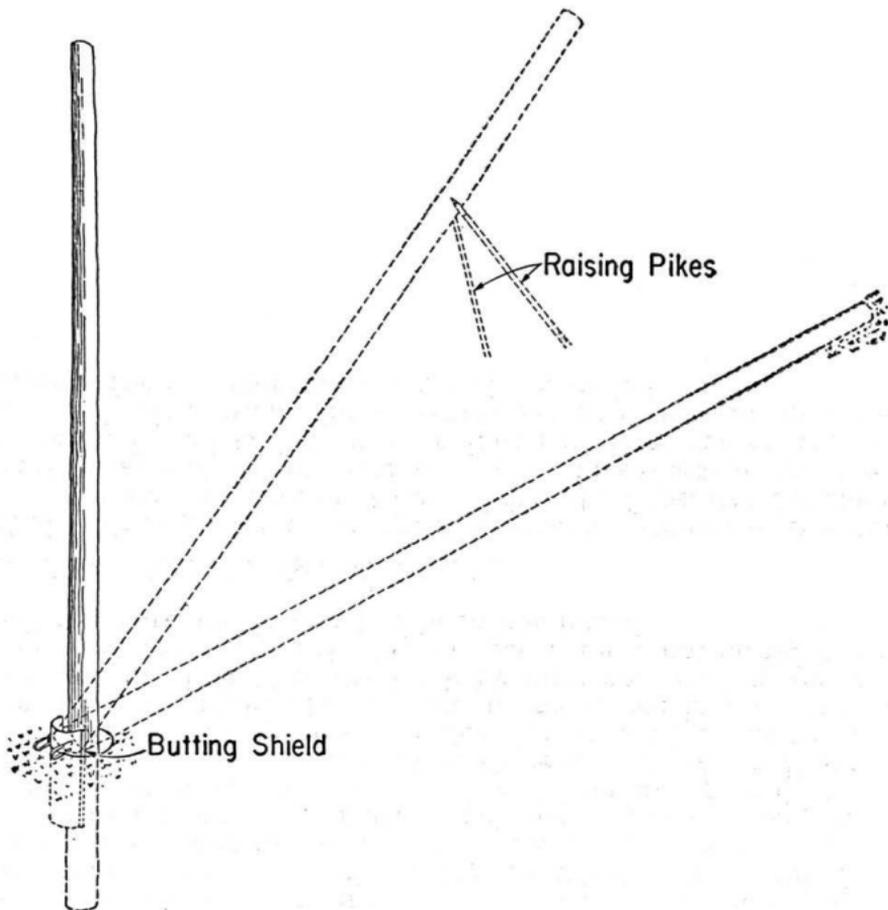


**TYPICAL DOUBLE CROSSARM INSTALLATION  
TRANSPOSITION ARRANGEMENT C**

## 9. SETTING POLES

9.01 Fully equipped crossarms and guys should whenever practicable be attached to the poles before the poles are set in the ground. All poles along the line, except at dead ends, should be set so that the crossarm is facing towards the central office. At dead-end poles the position of the crossarm depends upon the location of the dead-end pole and the dead-end arrangement which is used.

9.02 When poles are set manually a butting shield should be used to insure greater safety. The following sketch shows the use of a butting shield.



9.03 All crossarm arrangements and insulators should be inspected before the pole is set so that changes or replacement of damaged insulators can be made without climbing the pole. Locking screws must be backed off completely so that the clamps will open to permit seating of the wire in the hook.

9.04 The loose ends of wires or guys attached to the crossarm or pole should be secured before setting the pole to prevent injury which might be caused by the swinging ends of the wires or guys.

## 10. WIRE STRINGING

10.01 The wire stringing operations should be completed in accordance with the instructions provided in other sections of the Practices except that the wire should not be pulled in over the top of the crossarms.

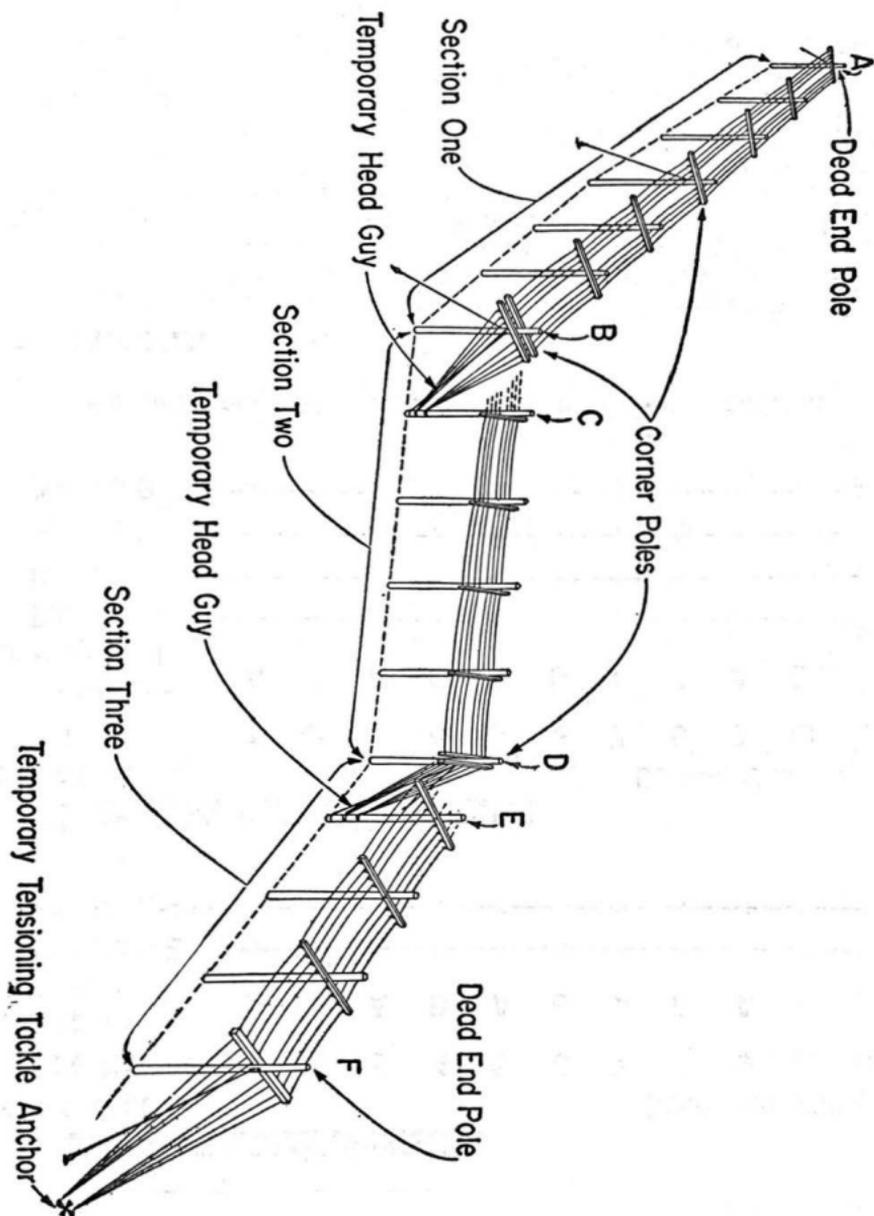
**Caution: Wire sleeves will not pass suspension insulator hooks, hence sleeve locations in the wire should be noted, so that sleeves will not be pulled against the insulator hooks during the wire sagging operations.**

10.02 Line wires may be placed along the lead by paying the wires out on the ground from reels mounted on a moving trailer or by pulling the wires in on the ground from a stationary reel setup. Both of these methods are described in the other sections of the Practices. As the wire is laid on the ground along the lead, or after such operations are completed, it should be raised with the B Wire Lifter and placed in the hook of the suspension insulator. Place a B Vibration Damper on each line wire in each span before it is raised into the suspension insulator hook. The wire should be seated in the hook so that the wire is held in the hook by the clamp during the tensioning operations but the locking screw must not be tightened until the wire tensioning has been completed.

## 11. TRANSPOSITION SYSTEMS

11.01 Transpositions in suspension type open wire construction should be made left-over-right. The Crossarm Arrangements A and B for the two pair line and Crossarm Arrangements A, B and C for three or four pair lines are covered in Part 8 of this section. The following sketch shows transposition patterns for one-pair, two-pair, and four-pair lines.





- (a) Splice the line wires to the short lengths of line wire attached to the dead-end crossarm at Pole A.
- (b) Attach the tensioning tackle to the base of Pole C or to a tree, anchor rod, or other safe anchorage in line with the lead which will support the load imposed during tensioning operations.

- (c) Hand tension the line wires in Section One and attach to the wire grips of the tensioning tackle.
- (d) Pull the line wires with the tensioning tackle until they are over-tensioned. Shake the tackle vigorously so that the line wire tension will equalize itself through the spans and between each wire. Slack off the tensioning tackle until the recommended wire tension is indicated on the 500-pound spring balance. Shake the line wires again to provide equalized wire tensions along the lead and check the wire tension as indicated on the spring scale. Adjust the tension as necessary with the rope blocks.
- (e) Tighten the clamps of the suspension insulators supporting the line wire in Section One.
- (f) Place a temporary head guy on Pole B to support Section One of the lead when the tensioning tackle is removed.
- (g) Remove the tensioning tackle and splice the line wires in Section One to the line wires in Section Two.
- (h) Move to Pole E and complete the operations in Steps (b) to (d) as outlined above and place a temporary head guy on Pole D. As the pairs of wire in Section Two are pulled to final tension the insulator clamps holding the pair of wires on the last two poles of Section One should be loosened. This will remove any slack in the wires that may have resulted from wire slippage through the clamps. Tighten all clamps of the suspension insulators supporting line wires which have been tensioned.
- (i) Remove the tensioning tackle at Pole E and splice the line wires in Section Two to the line wires in Section Three.
- (j) Attach the tensioning tackle to a tree, anchor rod, or other safe anchorage in line with the lead out from Pole F.
- (k) Pass the line wire over the dead-end crossarm at Pole F and complete the tensioning operations for Section Three outlined above.
- (l) Snub the line wires at Pole F and attach them to the B Deadend Brackets with appropriate dead-end terminations for the type of line wire being placed as covered in other sections of the Practices.
- (m) The temporary head guys at poles B and D should be removed when no longer required.

### 13. WIRE TENSIONS

- 13.01 Line wire should be pulled to the tension indicated in the following table.

## WIRE STRINGING TENSIONS

Type of Line Wire	Storm Loading Area	Average Span Length (Feet)	TEMPERATURE — DEGREES FAHRENHEIT													
			0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°	
			WIRE STRINGING TENSIONS IN POUNDS													
109 Steel	Heavy and Medium Areas	100-250	140	129	117	107	98	89	82	76	70	66	61	58	54	
	Light	100-300	164	152	141	130	119	110	101	94	87	81	76	71	67	
109H Steel	All	100-250	184	170	158	147	136	126	116	108	100	93	87	82	77	
	Heavy	251-350	257	243	231	218	205	193	181	170	159	149	140	131	123	
	Medium and Light Areas	251-450 451-600	293 328	280 314	267 302	254 289	241 277	229 265	218 254	206 242	196 231	186 221	176 211	167 201	158 192	
109E	All Areas	All Spans	388	374	359	344	330	315	303	288	275	262	249	238	226	
104 Copper- Steel	All Areas	201-250	251	236	223	209	196	182	170	157	146	134	124	114	105	
	Heavy	251-350	245	231	218	205	193	180	169	158	147	137	128	119	112	
	Medium and Light Areas	251-450 451-600	276 311	263 299	250 286	238 273	226 261	214 249	203 237	191 226	181 216	170 205	161 195	152 185	144 177	