



# DATA SHEET

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Sheet #:	<b>D6h</b>
Title:	<b>OVERHEAD TROLLEY STRUCTURE</b>
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Page:	<b>1 of 10</b>
Source Material:	Electric Railway Handbook - Richey McGraw-Hill 1915 AREA Recommended Spec. Number D101-16 EFE North America Inc., Handbook 75 (pgs. 6, 7, 8, 10)
References:	Model Railroad Bluebook, Sept. - Dec. 1960 Trolley Talk, Model Railroader, April 1940, Sept. 1955

## GENERAL

Overhead trolley construction falls into two distinct classes: direct suspension and catenary suspension. In the direct suspension system the trolley wire is attached by suitable devices directly to the supporting device (pole). Catenary suspension may be defined as a system of suspension where the trolley wire is attached to a "messenger" wire which in turn is attached to the supporting structure. Simple catenary uses one messenger; compound catenary, more than one messenger.

Direct suspension systems obviously were the cheapest to erect and therefore interurban lines used them more widely than catenary systems. When finances permitted, and high speeds were a desired end, interurbans resorted to simple catenary. Some, like the North Shore, used compound catenary. The advantage of catenary was the reduction of sag in the contact wire which, in turn, enabled the trolley pole to stay on the wire at higher speeds. It would be proper to use both systems of suspension on the same railroad as this was the case in most prototype situations.

## DIRECT SUSPENSION

This Data Sheet is designed to give the traction modeler a reference for prototype practice in designing direct suspension systems. Data used is taken from technical publications of the 1915-1925 period and should be typical for most properties in the U.S. and Canada. Dimensions given are for the prototype; reference should be made to NMRA Standard S55 for modeling.

Direct suspension can be accomplished in three ways:

1. Support the trolley wire from a span wire suspended from a pole at each side of the right of way.
2. Suspend the trolley wire from a bracket attached to a pole.
3. Support the trolley wire by a span wire attached to eye bolts in buildings. Since this method eliminated the need for poles, it was preferred in many cities with the advantage of a neater looking street. Fig. 1 shows that the span wire system is a possibility for both single and double track. The bracket system is usually found on double track only when the poles are in the center of the right of way with brackets extending over each track.

## CHOICE OF SYSTEM

Bracket support should be used for all single track unless local conditions prevent, except for curves with a radius of less than 300 feet.

Bracket support on central poles may be used on double track where practical.

Span wire suspension should be used on curves with radii of less than 300 feet, and in city streets for single track or for double track where center brackets are not practical.



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## SPACING POLES AND PULL OFFS

Following is a chart showing distances between poles and number of pulloffs for various curve radii.

It may be impossible to put poles at spacing indicated in the following chart. If so, it will be necessary to use compound spans.

## GUYS

Radius of curve (feet)	Spacing of pull overs (feet)	Number of pull overs	Distance between poles (feet)
40	7	4	35
50	8	4	40
60	9	4	45
70	10	4	50
80	11	4	55
90	12	4	60
100	13	4	65
125	14	4	70
150	15	4	75
200-500	20	3	80
750	25	3	100
1000	33.3	2	100
1500-2000	50	1	100
2000+	100	0	100

Guys should be used on wood poles on curves with radii of less than 900 feet. Guys are generally not required on steel poles.

## TROLLEY HEIGHT

Trolley wire should be at least 18 feet above the top of the rail, except that it should be at least 24 feet above the top of the rail where steam trains also operate.

## SPAN INSTALLATION

Eye bolts on wood poles should be at least 12 inches below top of pole. On steel poles span wire may be attached at top of pole.

## FROG LOCATION

Frogs should be temporarily located on the center line of the main track and one-third the distance from track switch points to track frog point back from track switch points.



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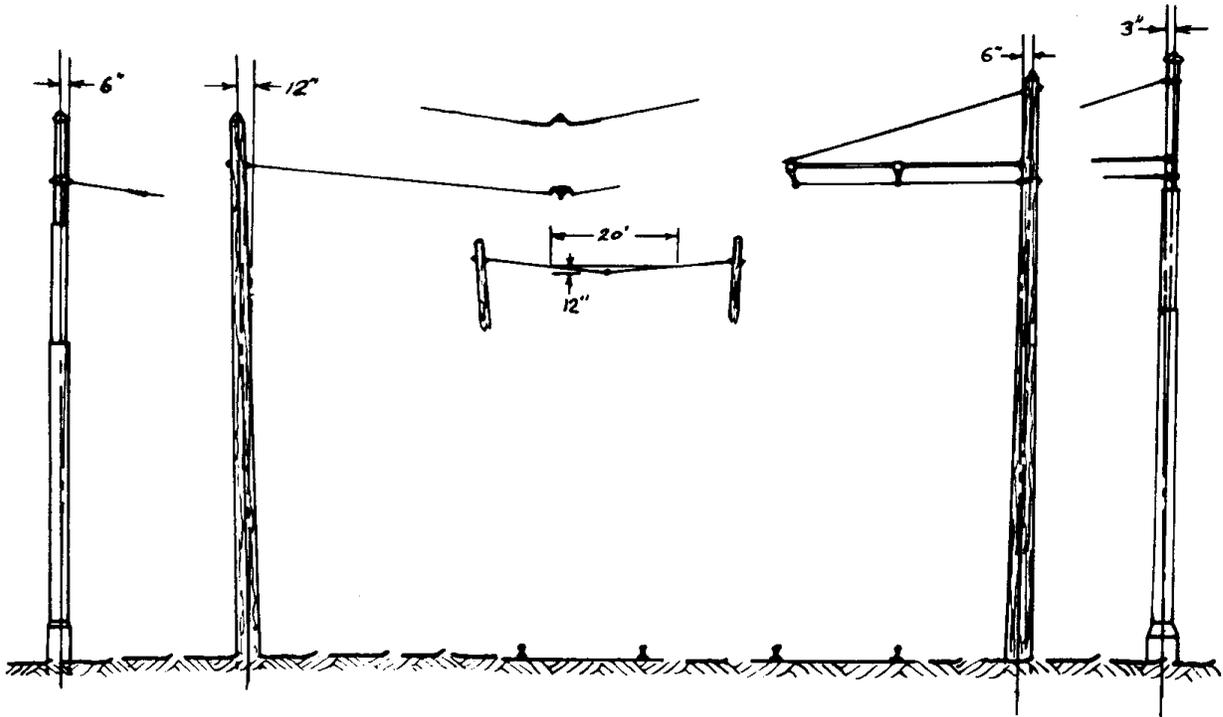


FIGURE 1

Composite drawing showing span wire construction and bracket construction with both wood and steel poles.

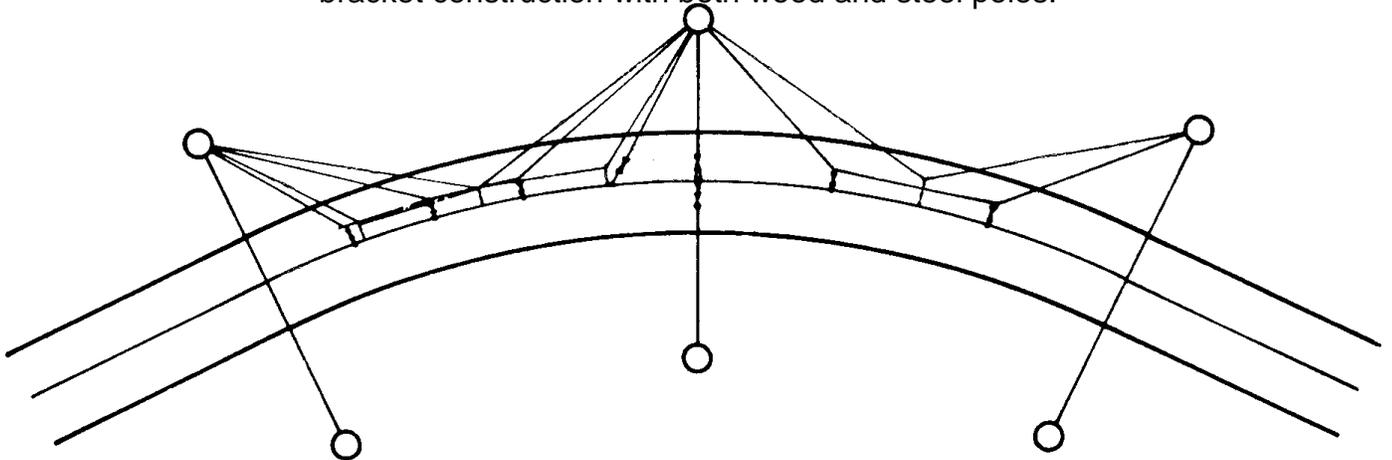


FIGURE 2

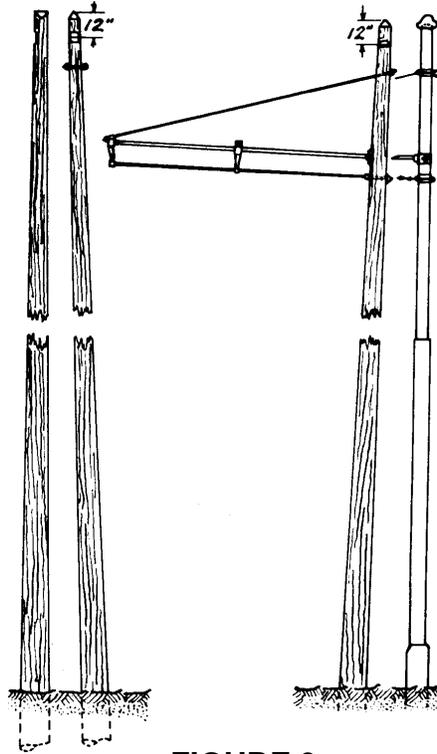
Example of location and arrangements of pull offs trolley wire curves with span wire suspension.



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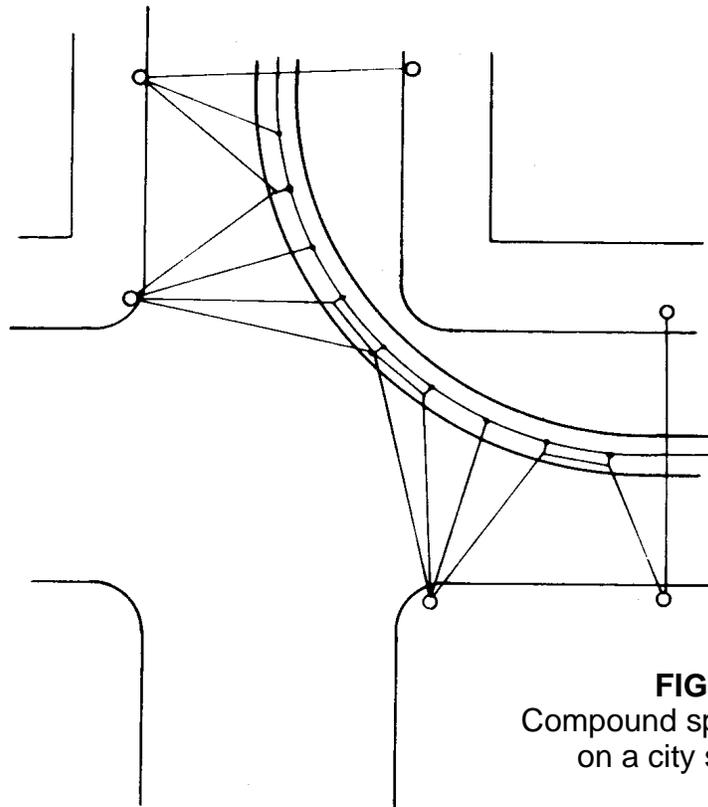
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**FIGURE 3**

Detail of wood and steel poles for both span and bracket suspension.



**FIGURE 4**

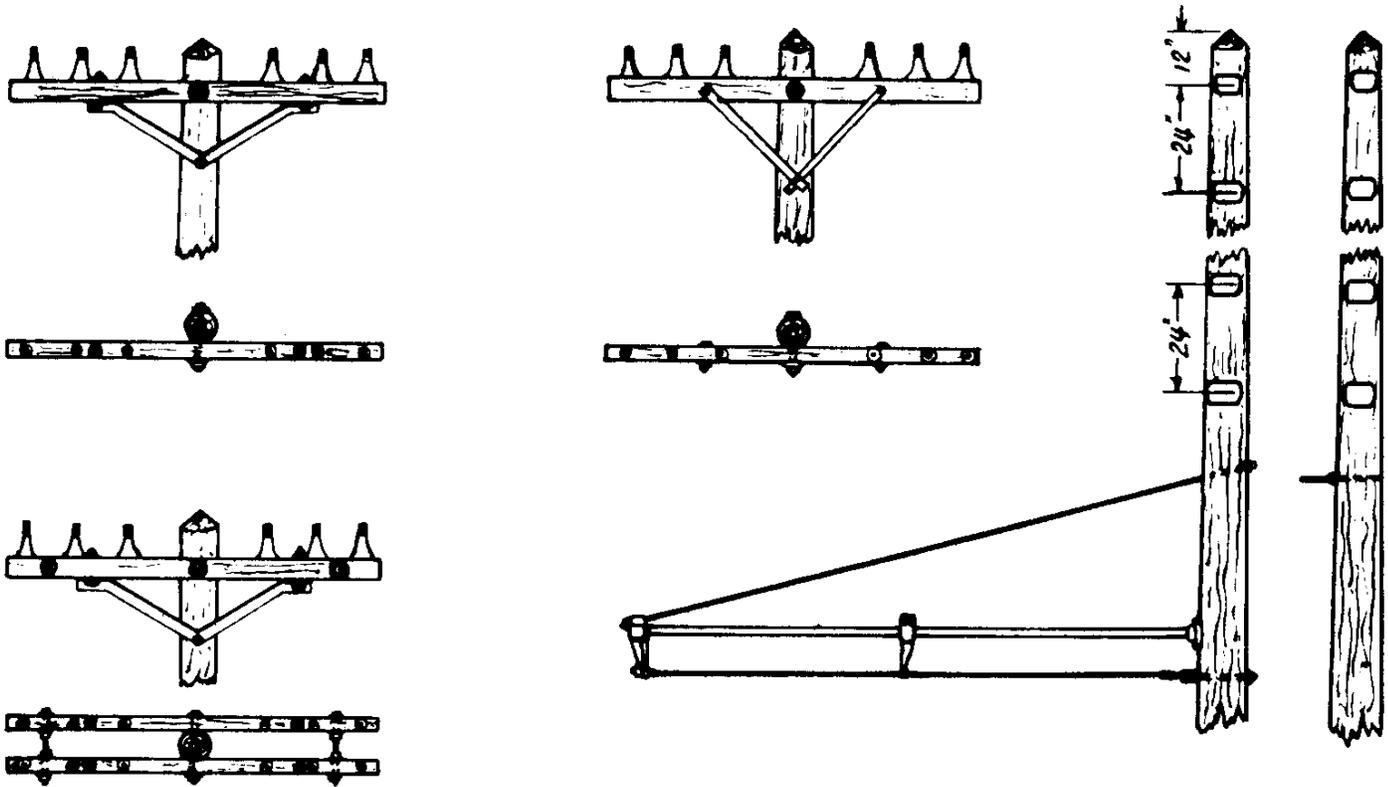
Compound span construction on a city street curve.



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**FIGURE 5: Detail of cross arm location and construction for span and bracket poles.**

NOTE: Preferred practice was to place crossarms on alternate sides of the poles to withstand forces from both directions.



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## THREE TYPES OF CATENARY CONSTRUCTION

The three designs of catenary construction are the simple, compound, and stitched types. All three are variations of the arrangement by which the grooved copper contact wire of the catenary system can be adjusted to a specified distance above the track, providing smooth operation of the current-collecting pantograph.

The supporting member of all three types is known as the primary messenger and is selected for suitable strength over the spans of the system. The difference between types is in the method by which the grooved contact wire or secondary messenger is attached to the primary messenger.

The simple catenary consists of a single messenger cable which supports the contact wire or wires by suitably spaced hangers. Maximum span length is approximately 300 feet. The simple catenary construction is usually associated with comparatively light systems such as single-track operations where wood poles are used for the supporting structures.

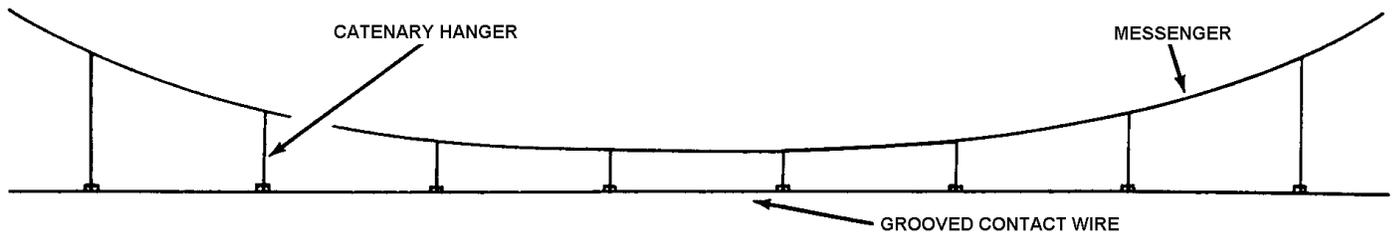


FIGURE 6: SIMPLE CATENARY CONSTRUCTION

The compound catenary has a main messenger similar to that of the simple catenary; but, instead of directly supporting the contact wire, the main messenger supports a secondary messenger at intervals of 20 feet or less from which the contact wire or wires are suspended by short clamps or clips of equal length. The compound catenary is ordinarily used for low-voltage direct-current systems with comparatively heavy catenary construction.

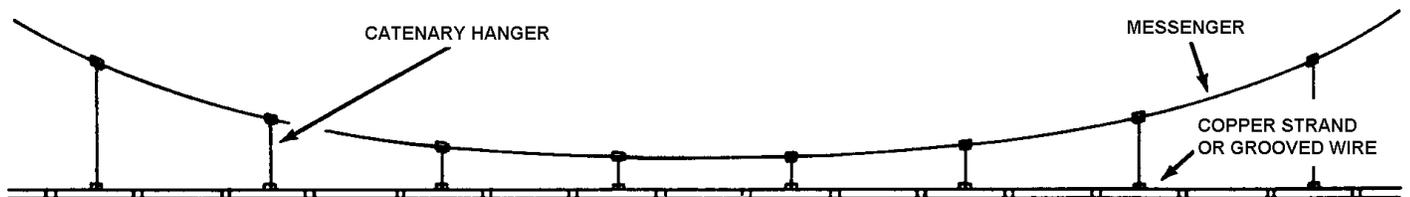


FIGURE 7: COMPOUND CATENARY CONSTRUCTION (STANDARD)



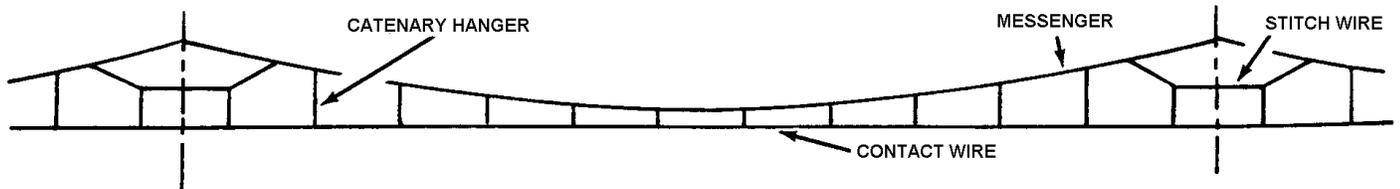
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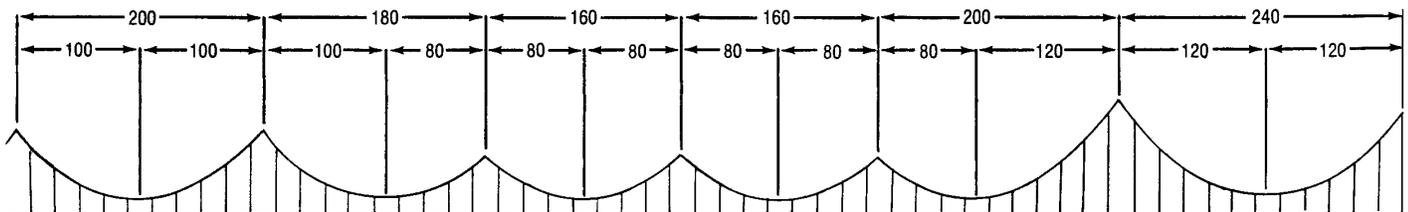
## CATENARY CONSTRUCTION - continued

The stitched catenary is used on many of the later electrification projects in Europe. It has the advantage of presenting a more uniform reaction to the upward thrust of the pantograph, offering better collection at the higher speeds.



**FIGURE 8: STITCHED CATENARY CONSTRUCTION**

Conditions may sometimes prohibit spotting poles to standardized span lengths, but experience indicates that the great majority of spans can be plotted to provide the benefits of standardized hanger lengths. In this system the brackets change elevation as the span length changes. Conversely, when all brackets are installed at the same elevation, many different hanger lengths are required, some only a fraction of an inch different in length, and problems of identification and stocking are compounded. This system requires all brackets at the height suitable to the longest span, which in turn means that extra-length hangers are required in all shorter spans.



**FIGURE 9: EQUALLY SPACED HANGERS**

Catenary hangers of standardized lengths are a definite advantage during construction and maintenance of a catenary system, simplifying identification and reducing stock requirements to a relatively few different lengths. The distance from the low point of one span to the low point of the next span is called the equipoise span (sometimes also called the weight span or vertical span). Note that the low point elevation is the same in all spans and the span length equals the sum of the equipoise half spans in each span. Hangers at any given distance from the low point are of the same length in all "standard spans", a standard span being one in which the length is an exact multiple of the hanger spacing. In Figure 9, hangers are spaced 20 feet apart



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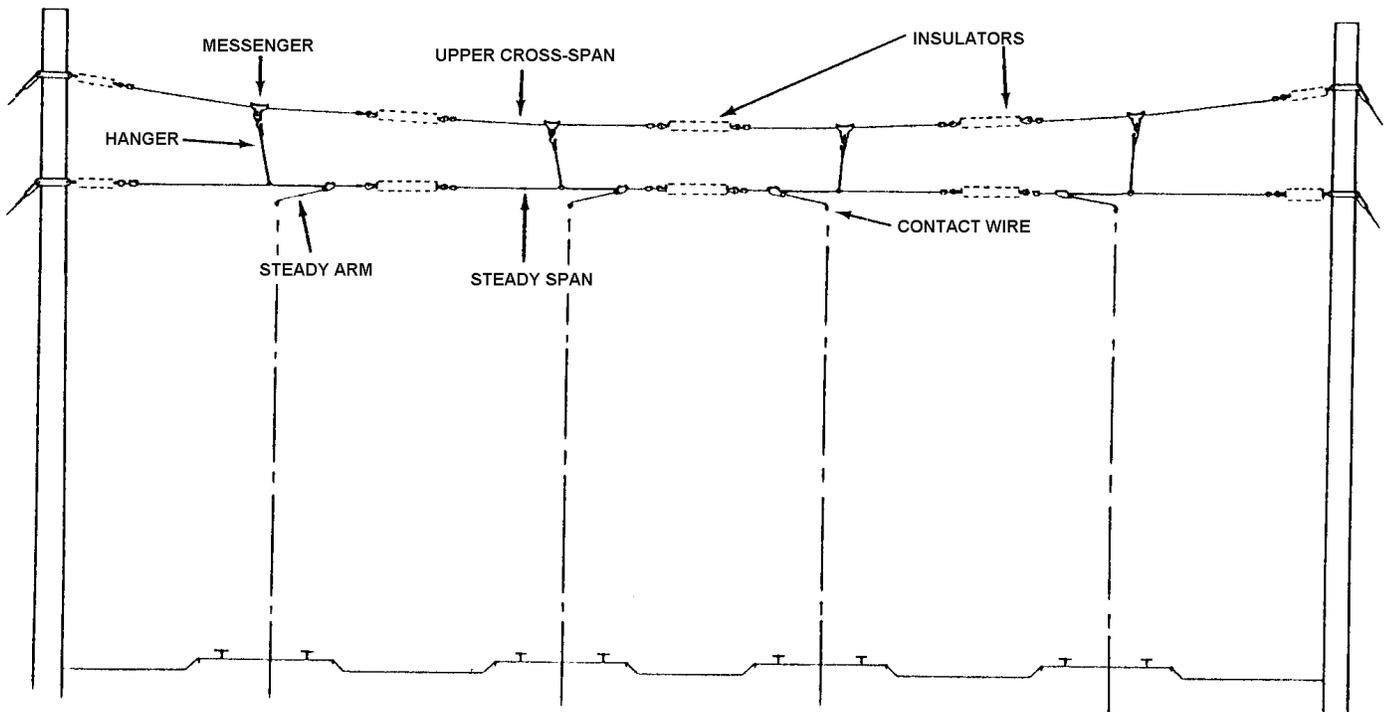
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## CATENARY CONSTRUCTION - continued



**FIGURE 10: 4-TRACK CROSS SPAN CATENARY**

Figure 10 is a simplified illustration of a cross-span catenary for a multiple track system. The upper cross-span takes a catenary sag, supporting both the main messenger and the lower steady span. The lower steady span is maintained at an even elevation and controls the steadies. The steady span and steadies may be eliminated when not required in short tangent catenary spans. The placement of insulators is optional, depending on the degree of isolation desired between each line.

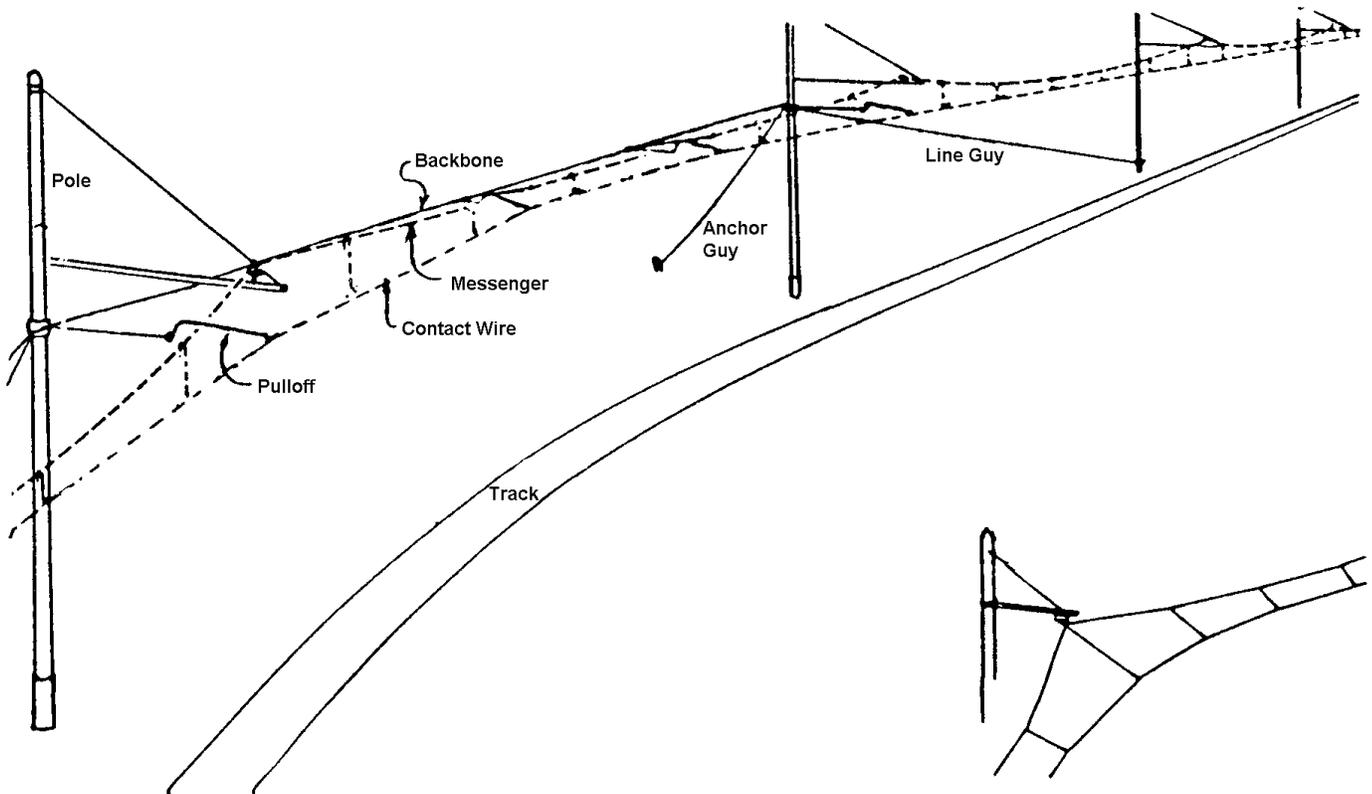


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## CATENARY CONSTRUCTION - continued



**FIGURE 11: TANGENT CHORD  
SIMPLE CATENARY**

**FIGURE 12: INCLINED  
SIMPLE  
CATENARY**



## HARDWARE FOR TANGENT CHORD CATENARY

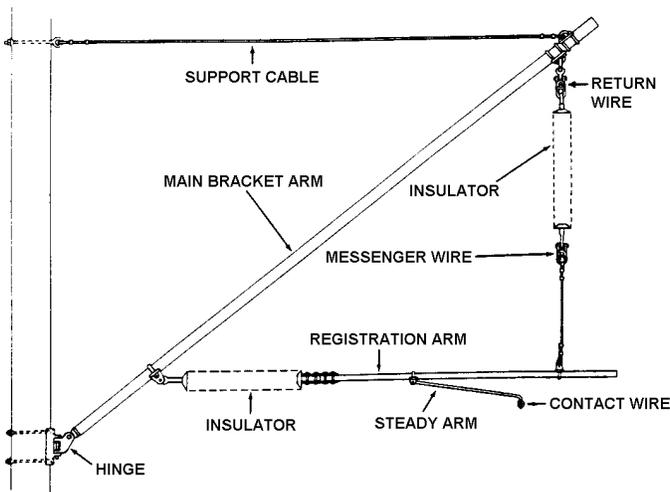


FIGURE 13: GROUNDED BRACKET STRAIGHT PIPE

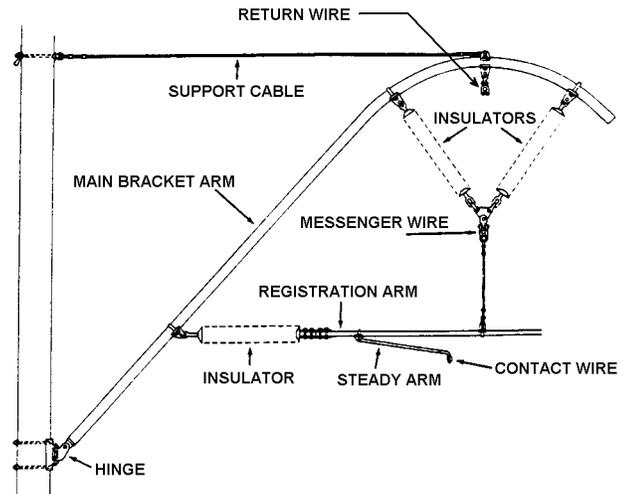


FIGURE 14: GROUNDED BRACKET CURVED PIPE

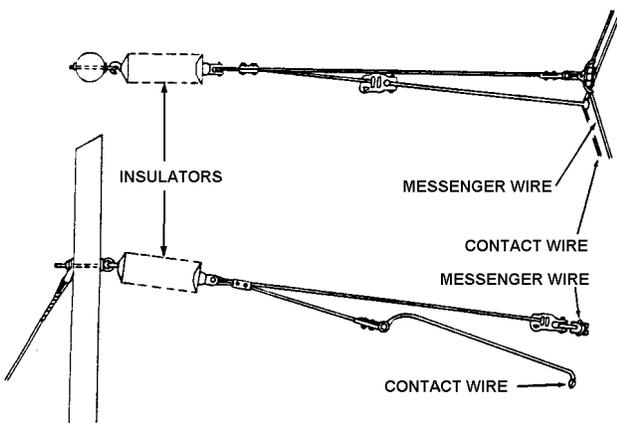


FIGURE 15: MID-SPAN PULLOVER ASSEMBLY

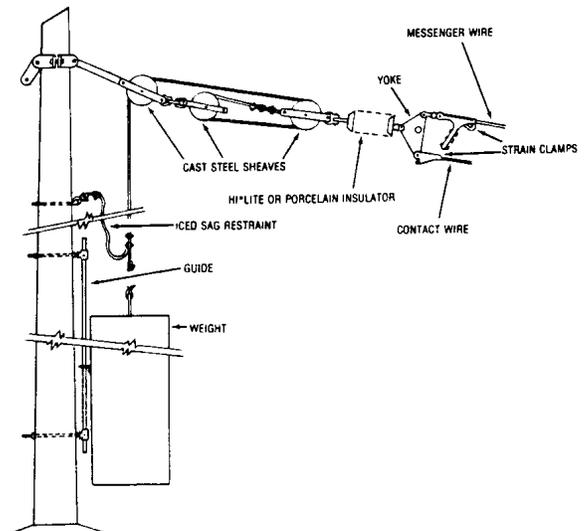


FIGURE 16: CONSTANT TENSION ASSEMBLY

