O-B Catenary Materials Described and Listed in the Section immediately following.

Direct Suspension Line Materials
Described and Listed in the Preceding Section

O-B CATENARY MATERIAL IN SERVICE

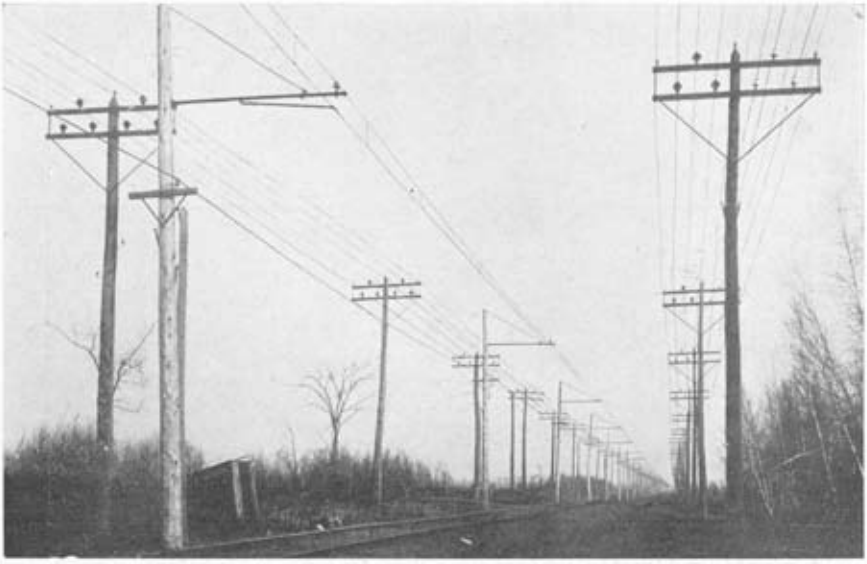


Chicago, Milwaukee & St. Paul Railway

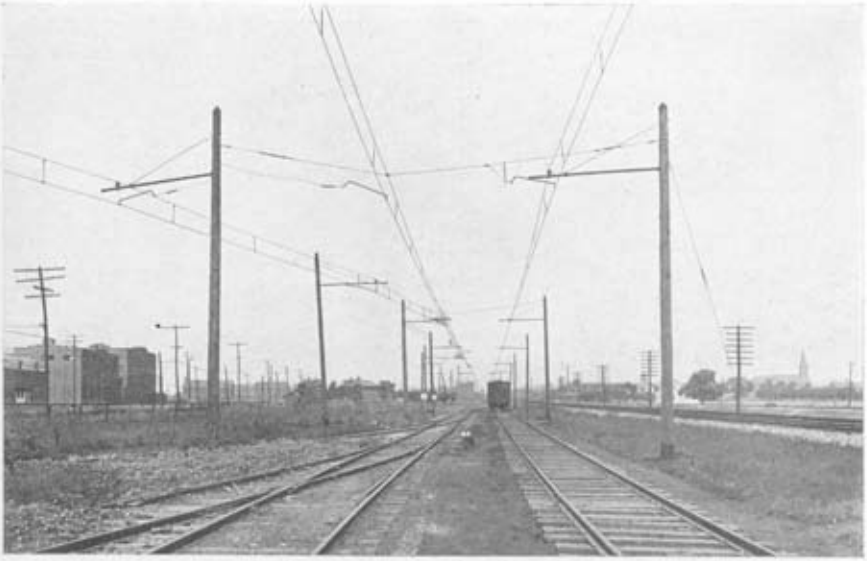


Chicago, Milwaukee & St. Paul Railway

O-B CATENARY MATERIAL IN SERVICE

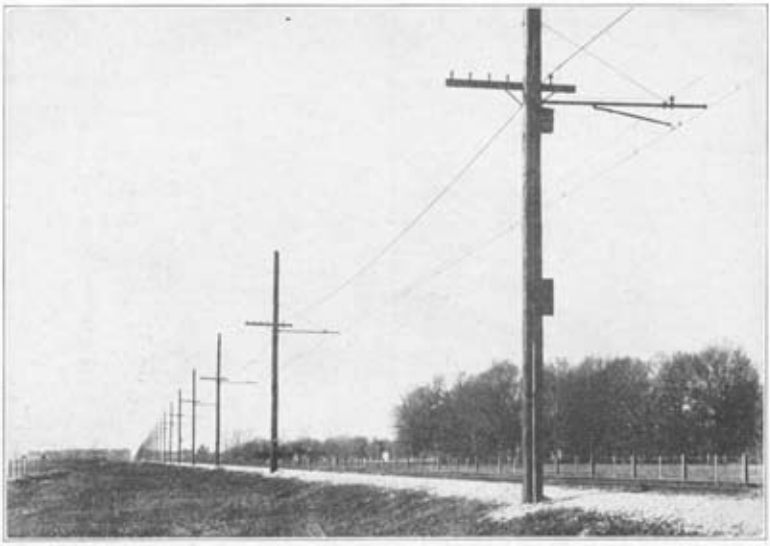


Montreal & Southern Counties Railway

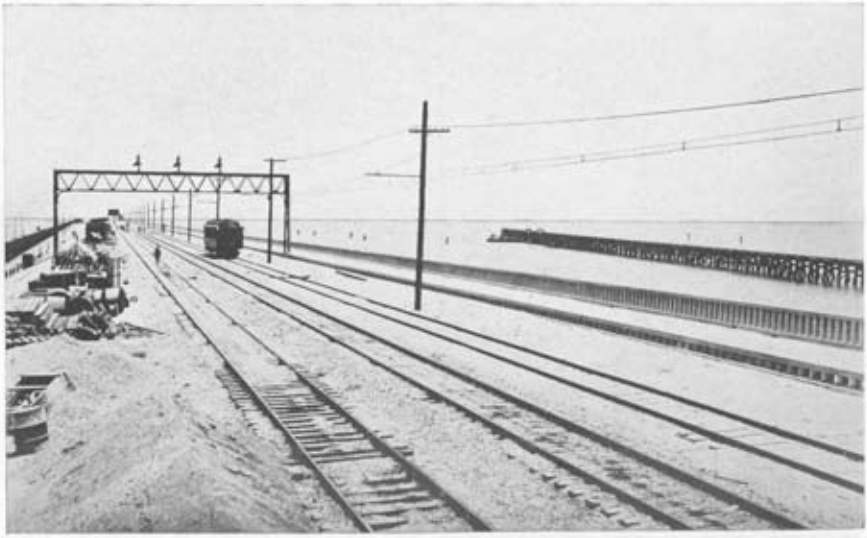


Niagara Junction Railway

O-B CATENARY MATERIAL IN SERVICE

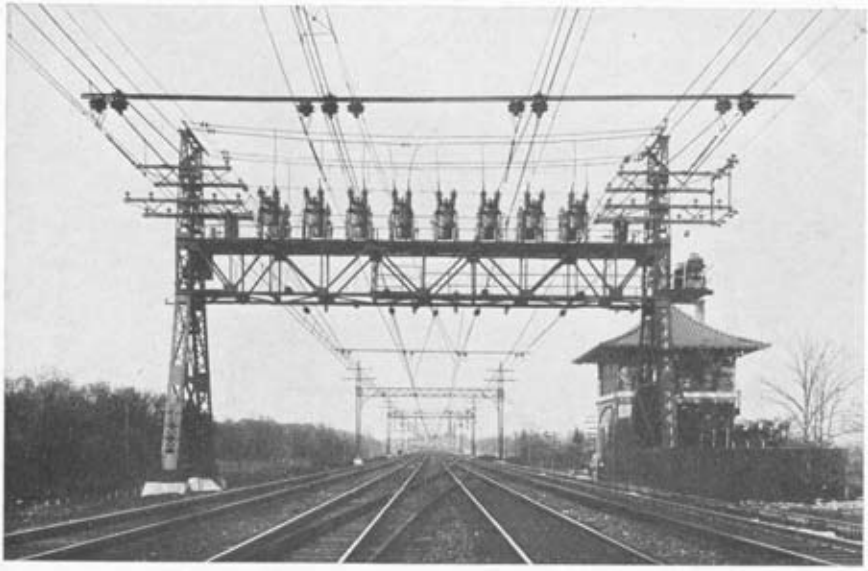


Galveston-Houston Electric Railway Co., Galveston, Texas

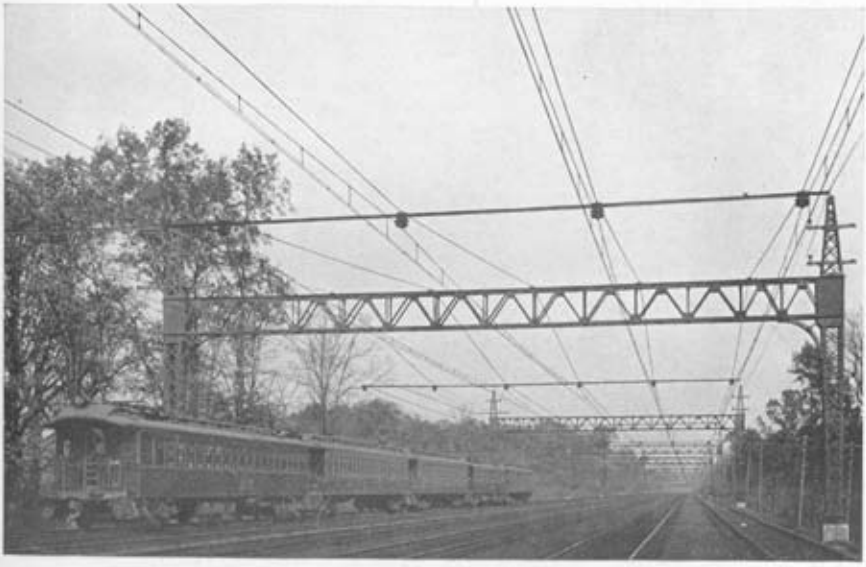


Galveston-Houston Electric Railway Co., Galveston, Texas

O-B CATENARY MATERIAL IN SERVICE

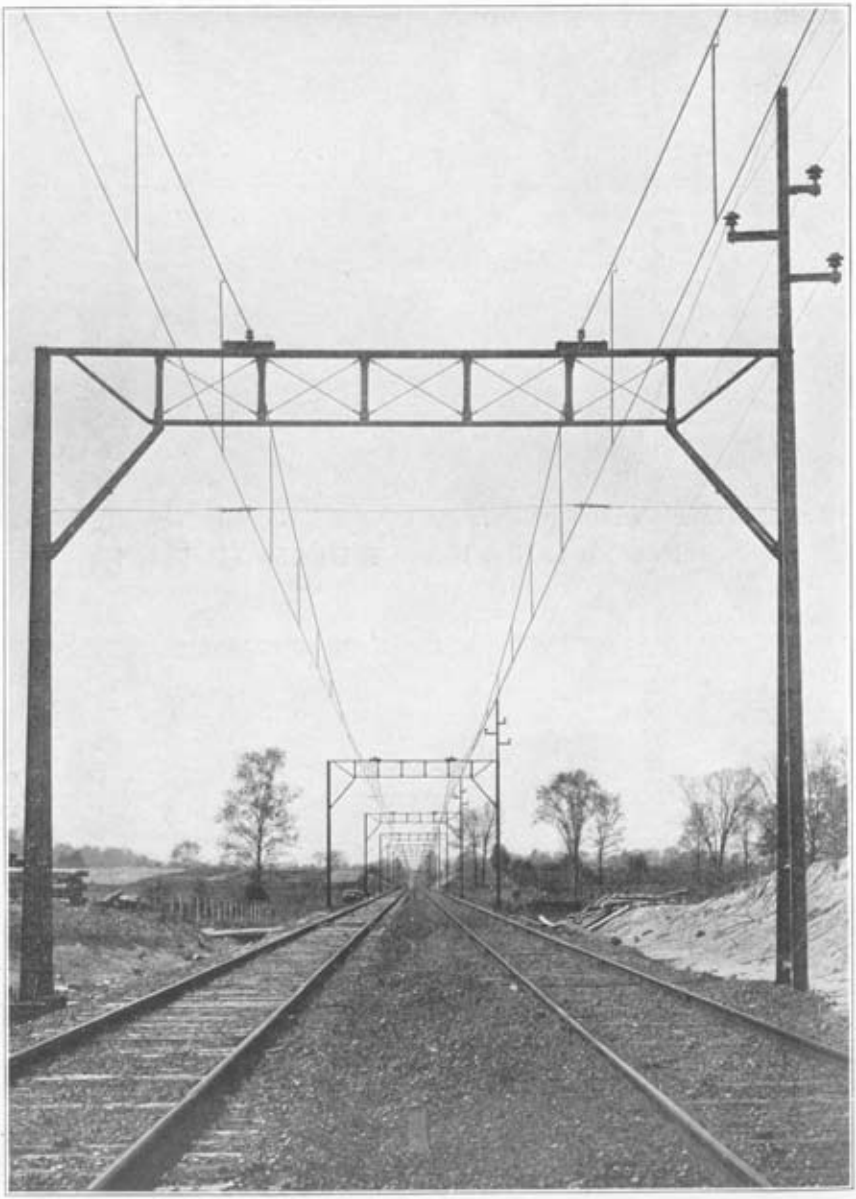


New York, New Haven & Hartford Railroad



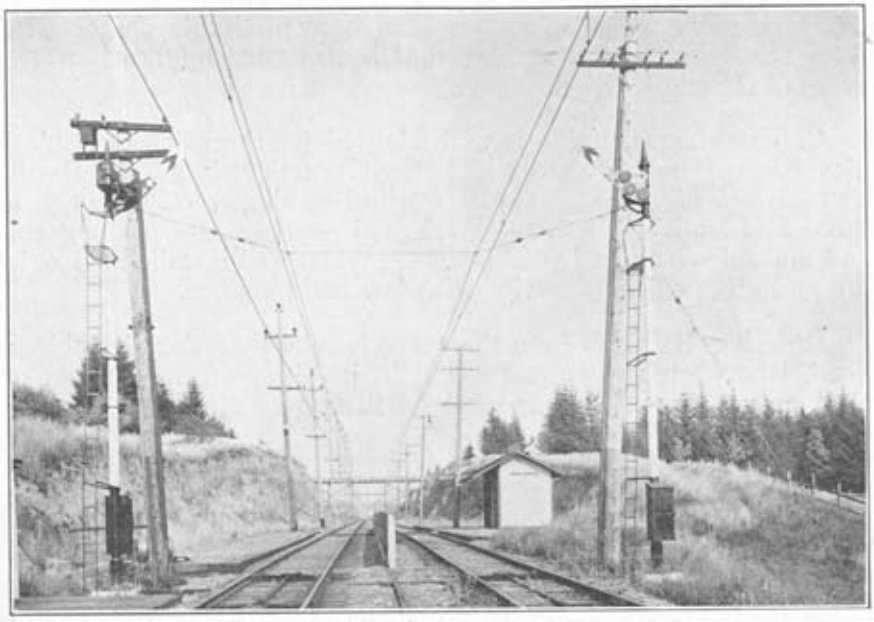
New York, New Haven & Hartford Railroad

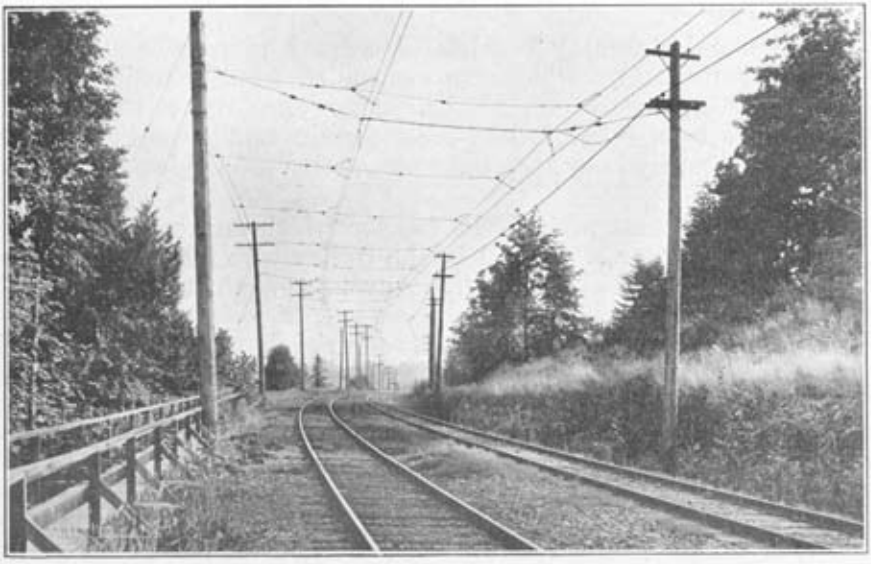
O-B CATENARY MATERIAL IN SERVICE



Northern Ohio Traction Co., Northfield Cut-Off, Akron, Ohio

O-B CATENARY MATERIAL IN SERVICE





Spokane, Portland & Seattle Railway Co., Portland, Oregon

CATENARY CONSTRUCTION

THE Catenary System of line construction, although developed for high voltage roads, possesses so many desirable characteristics from the operating standpoint that it has wide application for all types of electric traction.

Catenary construction is well adapted for the efficient insulation of voltages much in excess of present practice; it affords the best current collection for all types of wheel or slipper collectors at any speed and lends itself to the mechanial requirements of long spans and multiple-track and yard layout. When well installed it has long life and gives efficient service with low maintenance.

It derives its name from the curve formed by a flexible cable suspended between two supports and in its simple form consists of a steel messenger cable supported on insulators and thus forming a catenary curve.

The trolley or slipper wire is suspended below the steel messenger cable by hangers at short intervals and of such lengths that the trolley wire is a straight line without sag. There are various modifications of the simple construction such as the use of a copper or aluminum feeder for the messenger or a steel or alloy slipper wire hung from the copper trolley wire to take the wear and introduce a small degree of flexibility where rigid hangers are used.

Compound Catenary consists of a track messenger strand supported by insulators which are suspended from a main grounded messenger supported on bridges. There are other combinations which have been developed to meet certain conditions but the best practice ordinarily is to keep the construction as simple as possible.

In flexible construction, the hanger which suspends the trolley from the messenger is gripped to the trolley wire and loosely looped over the messenger to permit a free movement of the trolley vertically.

In rigid construction, the hangers are rigidly attached to both the messenger and the trolley. As such construction tends to produce "hard spots" in the trolley at hanger points it is customary to suspend a slipper wire below the trolley at points intermediate of the hangers thus giving just enough flexibility to remove the "hard spots."

Both constructions are in successful use and both have points of merit; in designing a new line care should be used not to have it too rigid or too flexible as both extremes lead to trouble.

CATENARY CONSTRUCTION—Continued

With flexible construction, it is necessary to install at least five flexible bonds per mile between the trolley and messenger to prevent a difference of potential. For steel or alloy trolley wire these bonds must be closer together than for copper.

While it is important to have a small amount of flexibility in the slipper or trolley wire it is equally important to maintain the location of the wire in relation to the track, both on curves and tangents. To this end, anchorages and steady devices must be carefully worked out.

Catenary Construction is well adapted to any voltage, but special consideration should be paid to the design of all insulation in anchorages and strains for the higher voltages. Because of the importance of maintaining the wires in correct location, the tensions in both messenger and trolley are carried higher than in direct suspension systems with the result that all anchorages and strains are under high loading.

For single track lines, wood poles with steel brackets may be used, on double track, cross-spans from wood poles with the poles carefully guyed. For heavy service, the steel bridge or steel poles with cross-span makes a more substantial construction and reduces the amount of guying that is found necessary with wood pole construction. With wood pole bracket construction, the messenger must be free to move longitudinally at the insulated support so as to maintain a uniform tension and thus relieve the bracket of strain. With steel bridge construction, this movement between the insulator and messenger may be prevented and each span designed to take care of its own changes in tension.

Temperature, wind and ice change the tension and sags and must be carefully considered in the design. The construction must be such that the tension in all wires is below their elastic limit when they are subjected to their maximum wind and ice loading and minimum temperature. It is also important that the stringing of the wires be done in accordance with a temperature-tension-sag chart. See pages 400 and 401.

As one of the advantages of catenary construction is the straight trolley without sag, the distance between hangers is important. Hanger spacings vary from 10 to 50 feet but it has become common practice to use a nominal spacing of 15 feet for a pantograph or sliding collector and 30 feet for a pole and wheel collector. Especially on electrifications in cities it is often impossible to maintain a standard pole or bridge spacing, in which cases the hanger spacings may only approximate the standard.

In a catenary line everything depends upon the messenger, which must never fail. For this reason ordinary steel strand is not recom-

CATENARY CONSTRUCTION—Continued

mended. Siemens-Martin steel is the lowest grade that can be depended upon for the messenger or important anchorages and where loading is high it is better to use High Strength or Extra High Strength. For ordinary wood pole construction $\frac{7}{16}$-inch extra galvanized strand is generally used but on long span bridge construction strand as large as $\frac{5}{8}$-inch may be used for the messenger. The correct size to use should be determined by calculation and not assumed from similar practice. For light pull-offs and steady-strains $\frac{1}{4}$-inch strand is strong enough and is easily worked.

Pole spacings as high as 180 feet may be used with wood poles but 150 feet is common practice for tangents. For steel bridge construction spacings as great as 300 feet, on tangent, are in use.

The construction of curves is one that requires considerable study as there are a number of points which must not be overlooked. The trolley is located with respect to the degree of curvature and curve elevation of the track. This must be corrected for the side swing of the pantograph or collector and the magnitude of this side swing depends upon the height of the trolley wire and the spring action of the trucks. The transition at the ends of the curve introduces another correction that requires careful treatment.

There are curve constructions that can be laid out to produce an ideal condition but if the construction is not capable of easy adjustment to accommodate track realignment or changes in supporting structures it will develop troubles in operation and high maintenance. A good curve construction must hold the line in place but be capable of being easily tuned up and provide, at all times, a smooth under-run for the collector.

Where pantographs are used, care must be taken to keep all pull-offs clear of the swing of the collector-pan or roller. The general practice is to have a clearance of 6 inches above the trolley wire at a distance of 3 feet on each side.

On curves, the distance between messenger supports (pole spacing) is reduced to prevent too great a deflection at the center of the span. The deflection at the center of the span or at the center between pull-offs can be found from the formula:

$$D = 12\left[R - \sqrt{R^2 - \frac{S^2}{4}}\right]$$

Where: D = Deflection (middle ordinate) at center of span or between pull-offs in *inches*.

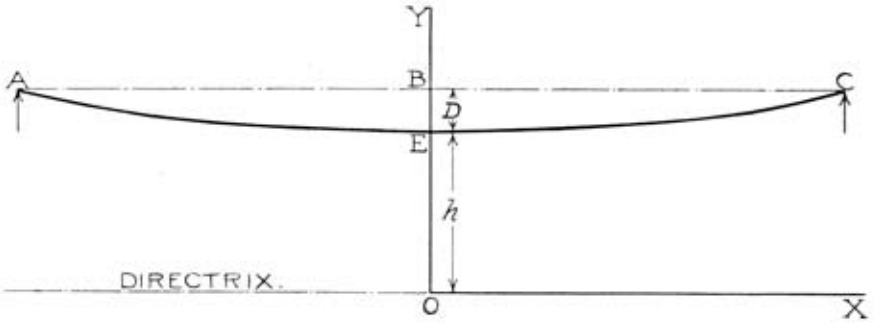
R = Radius of curve in *feet*.

S = Length of span or distance between pull-offs in *feet*.

It is good practice to keep this deflection between pull-offs under 6 inches and the deflection angle for wheel operation under 6 degrees.

CATENARY CONSTRUCTION—Continued

Catenary Formulas



The general equation of the catenary AEC with the origin (O) at a distance (h) below the curve (E) is

$$y = \frac{h}{2}\left(e^{\frac{x}{h}} + e^{-\frac{x}{h}} \right) \quad (1)$$

where "e" is the base of the Naperian (Hyperbolic) System of Logarithms (e = 2.718281828). Where the sag is small in proportion to the length of span, which is usually the case on railway catenary or transmission construction, the curves of a parabola will fill all the conditions of the catenary within practical limits of measurement. Substituting the parabola formula we have

$$y = h + \frac{x^2}{2h} \quad (2)$$

T = Total tension in wire in *pounds*.

W = Load in *pounds* per *linear foot* of span (including weight of wire).

S = Length of span in *feet* = ABC.

D = Deflection or sag at center of span in *inches* = BE.

L = Actual length of wire in *feet* = AEC.

CATENARY CONSTRUCTION—Continued

$$h = \frac{T}{W} \qquad (3)$$

From (2) and (3) the following useful formulas are derived:

$$\text{(Pounds)}\ T = \frac{3}{2}\,\frac{S^2 W}{D} \qquad (4)$$

$$\text{(Inches)}\ D = \frac{3}{2}\,\frac{S^2 W}{T} \qquad (5)$$

The length of the wire in the span is

$$\text{(Feet)}\ L = S + \frac{D^2}{54S} \qquad (6)$$

$$\text{(Inches)}\ D = \sqrt{54S(L-S)} \qquad (7)$$

The length of hangers is y—h+6. Where 6 is the distance in inches the trolley wire hangs below the lowest point of the messenger (E). Six inches is the generally accepted standard but may be changed if desired.

Hanger length in inches =

$$\frac{6\,x^2 W}{T} + 6 \qquad (8)$$

where x is the distance (feet) from the center of the span to the hanger in question. Hanger length is measured from center of messenger to center of trolley wire.

Sag in Spans

The curves on page 400, Fig. 1, show the relation of tension to sag for the spans shown on pages 402 and 403 and also show the effect of temperature changes. These sag curves are plotted from the formula

$$T = \frac{3}{2}\,\frac{S^2 W}{D}$$

W is taken at 1 pound per foot and the temperature curves are calculated for a $\frac{7}{16}$-inch steel messenger having a cross section of .1188

CATENARY CONSTRUCTION—Continued

sq. in. and a modulus of elasticity of 26,000,000. For other conditions it is necessary to plot other curves. The curves in Fig. 1 are all calculated for the same tension at 60 degrees which gives the sags and hanger lengths as shown on pages 402 and 403. It is obvious that all the spans in a given line must have the same tension when at the same temperature; otherwise each span would have to be anchored. The temperature curves show that if the trolley wire is a straight line at 60 degrees it will be curved upward when the temperature falls and sag down when the temperature rises. The changed tensions and sags are shown at the intersections of the temperature and sag curves. These curves are calculated from constants and in practice the results will vary from the calculated quantities. Messenger strand should always be pulled up to the approximate working tension and permitted to take its initial set before anchoring it for the required sag.

Variations in tension and sag due to temperature changes may not be as great as shown in the curves because of the flexibility of poles and anchorages, but when poles and anchorages are rigid the changes shown will take place. The curves, page 401, Fig. 2, show the sags and temperature changes for the same $\frac{7}{16}$-inch steel messenger and spans as Fig. 1 except the messenger is unloaded. Fig. 2 is useful in erecting the line as it shows the tension and sag to pull the messenger to before suspending the trolley wire and hangers. After the trolley wire is suspended the conditions are as shown by Fig. 1.

For spans other than standard it is advisable to make calculations for the stresses caused by wind and ice to be sure that such conditions do not stress the messenger above the elastic limit.

In figuring ice and wind loads it is customary to assume an ice coating $\frac{1}{2}$ inch in thickness and a wind pressure on the ice coated wire of 8 pounds per square foot of projected surface. The weight of ice is figured at .033 pounds per cubic inch. For districts not affected with sleet formation a maximum wind pressure of 30 pounds per square foot of projected surface is frequently used as the limiting condition. In all cases find minimum and maximum temperature from the Weather Bureau. The Bureau of Standards issues publications dealing with the loading of wires.

CATENARY CONSTRUCTION—Continued

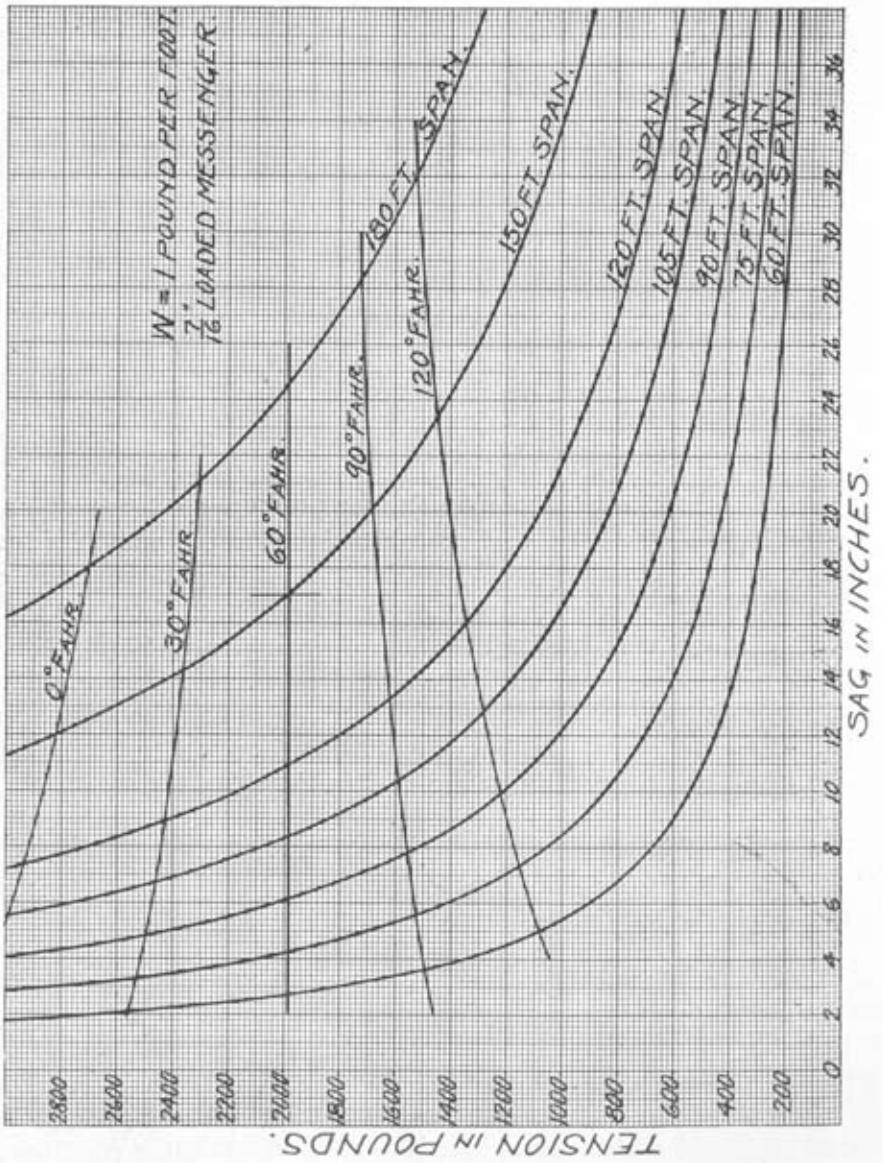


Fig. 1—Tensions and Sags for Loaded Messenger

CATENARY CONSTRUCTION—Continued

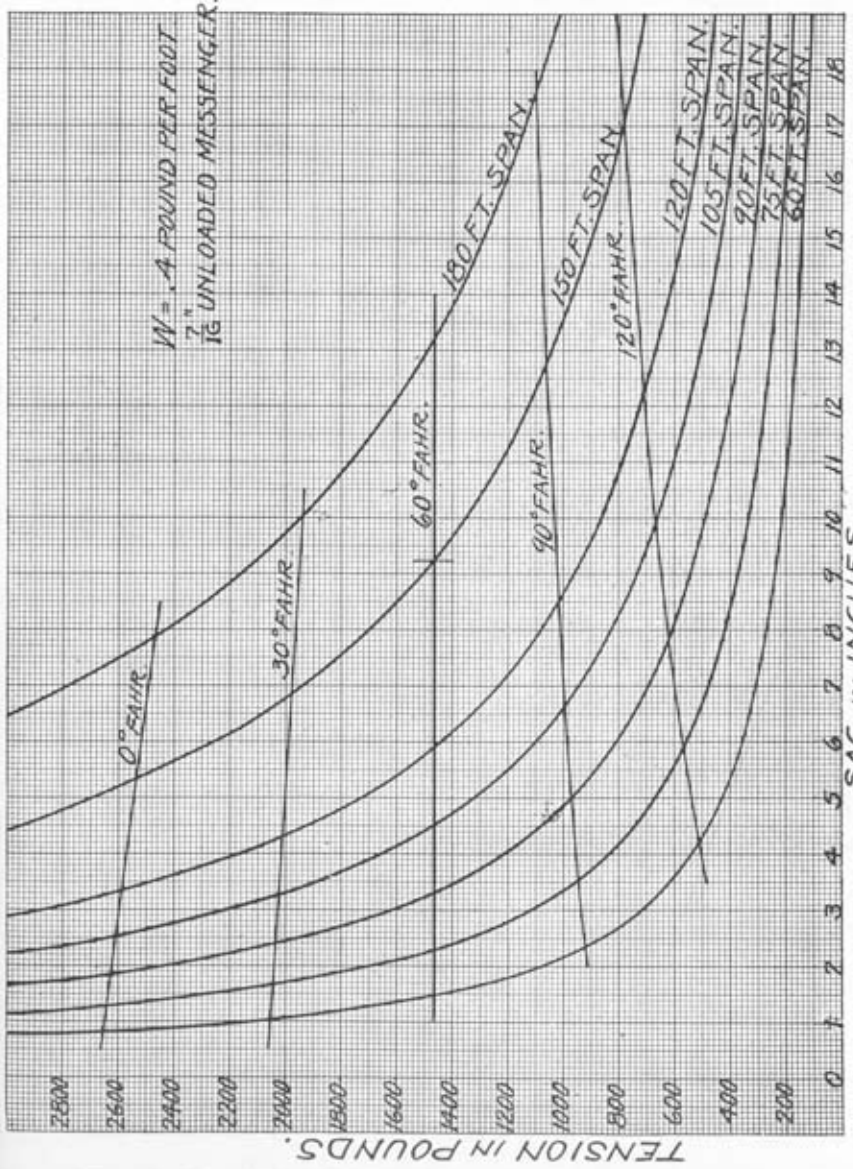
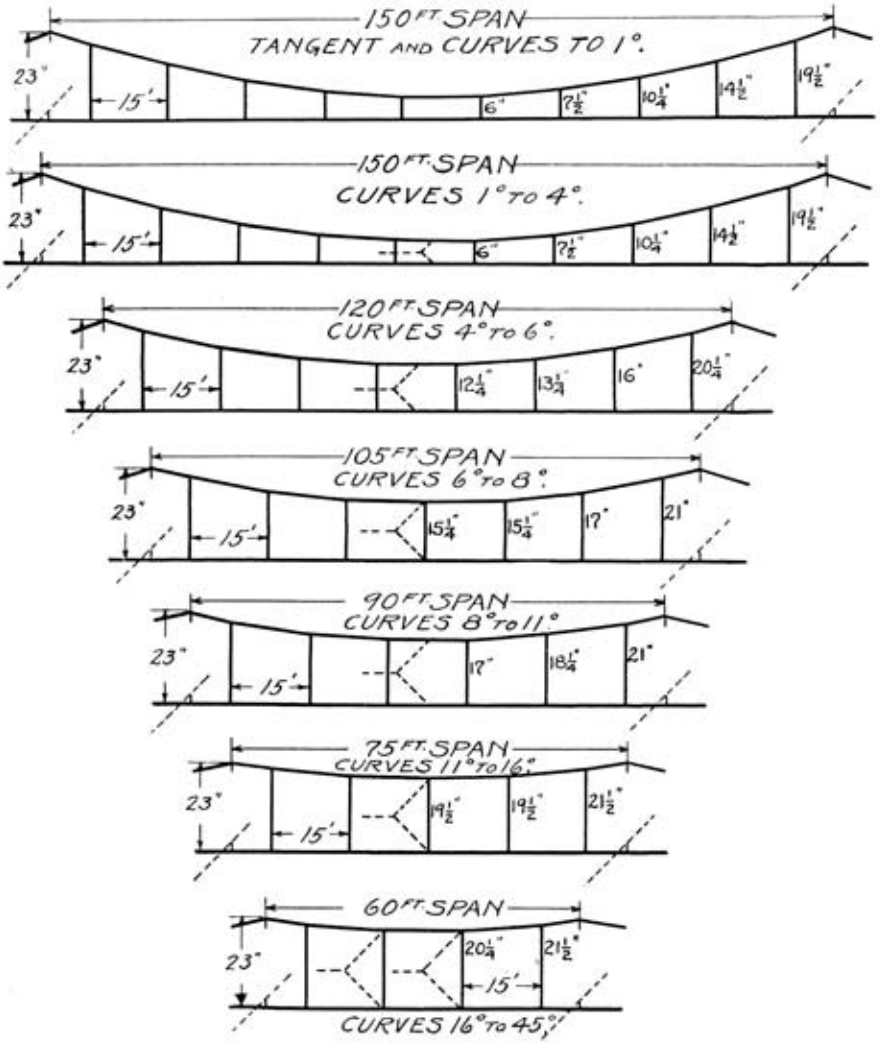


Fig. 2—Tensions and Sags for Unloaded Messenger

CATENARY CONSTRUCTION—Continued

Hanger Lengths—15-Foot Spacing



Hanger lengths given above are for 150-foot pole spacing on tangents and proper shorter spacings and pull-off locations for curves.

Hangers spaced 15 feet for pantograph or wheel collector.

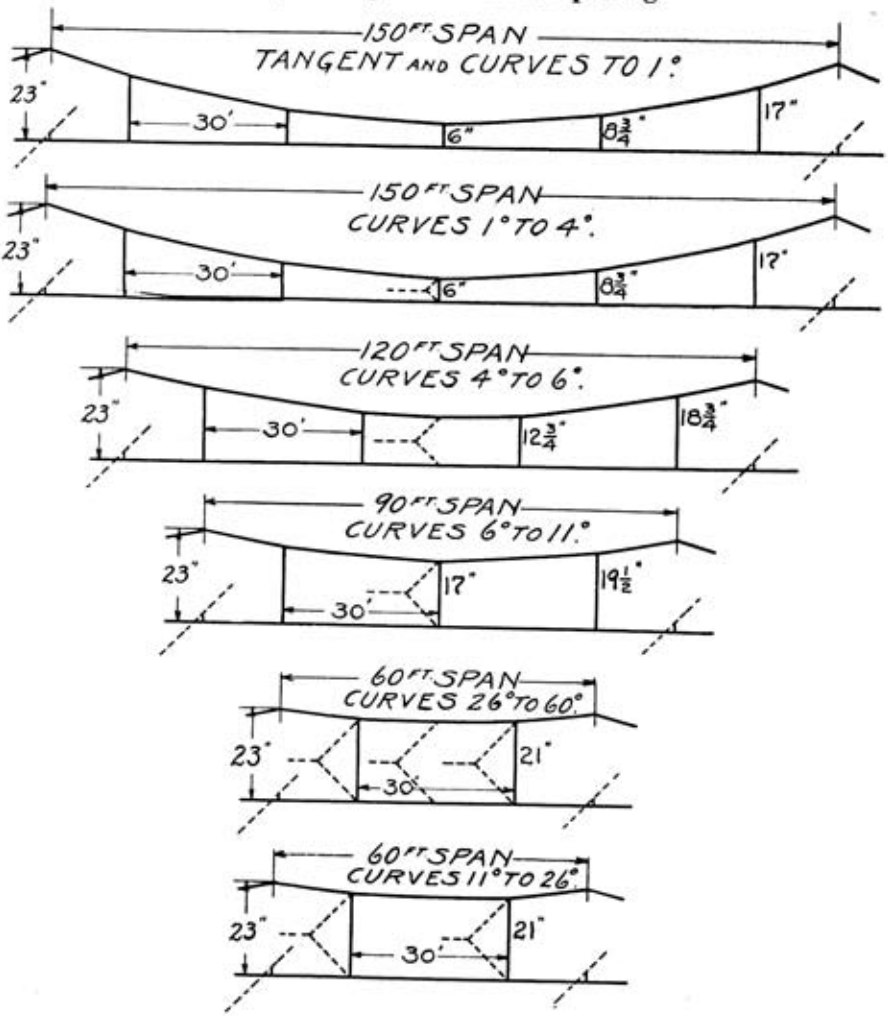
Curves on pages 400 and 401 are calculated for the spans shown above.

Hanger lengths for other tangents with their curve spacings will be given on request.

For table giving relation between degrees and radii of curves, see page in back of book.

CATENARY CONSTRUCTION—Continued

Hanger Lengths—30-Foot Spacing



Hanger lengths given above are for 150-foot pole spacing on tangents and proper shorter spacings and pull-off locations for curves.

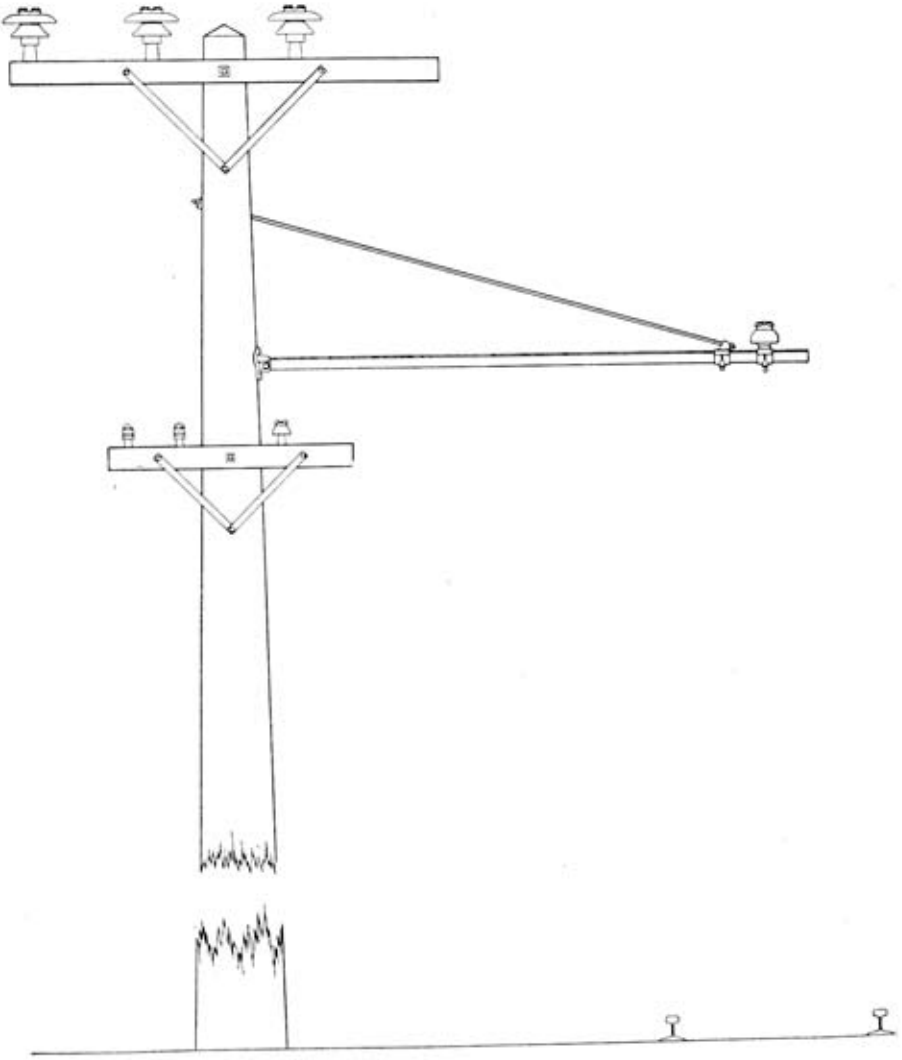
Hangers spaced 30 feet for wheel collector.

Curves on pages 400 and 401 are calculated for the spans shown above.

Hanger lengths for other tangents with their curve spacings will be given on request.

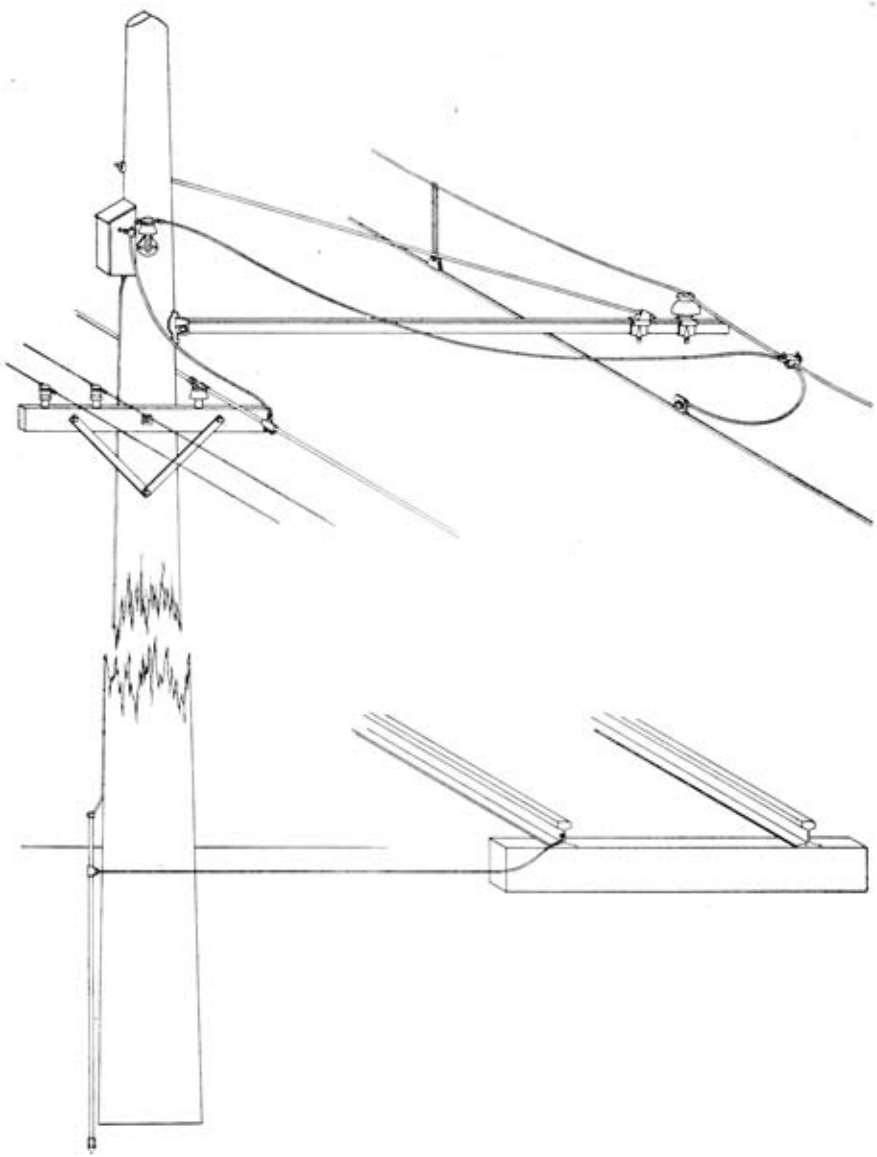
For table giving relation between degrees and radii of curves, see page in back of book.

CATENARY BRACKET CONSTRUCTION



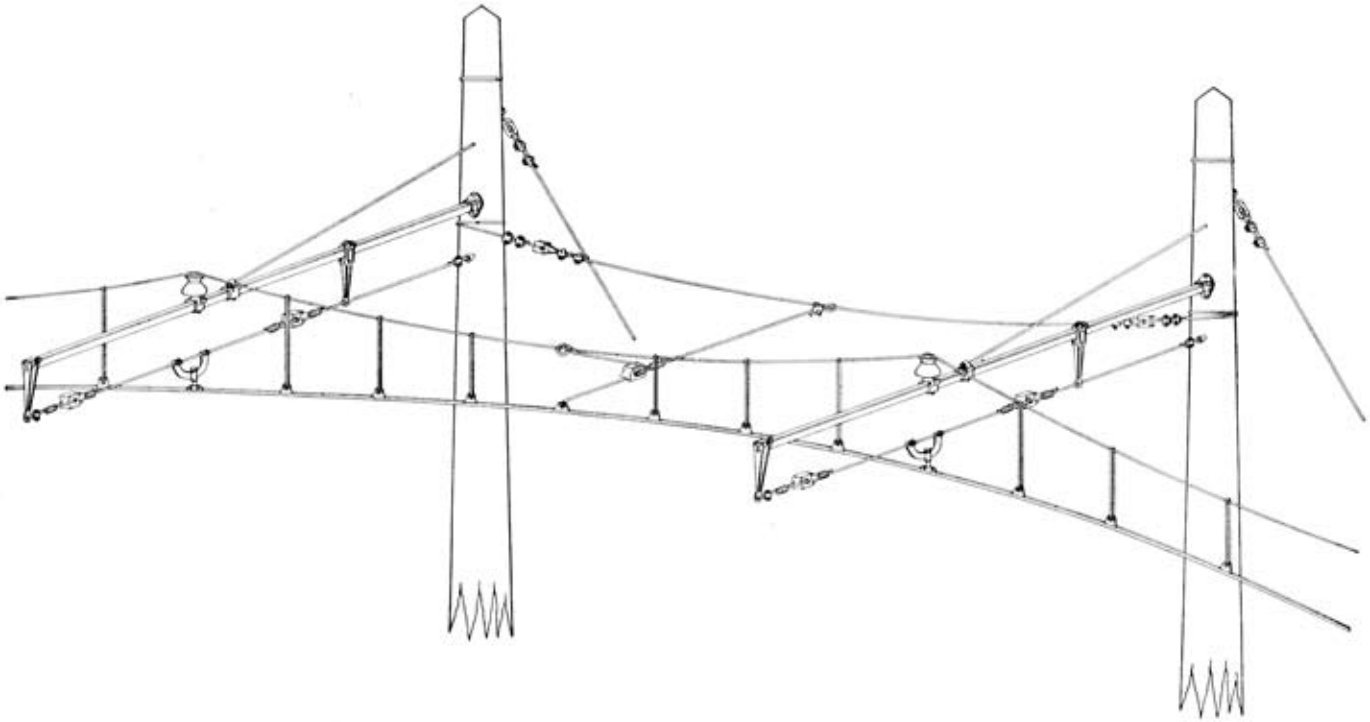
Showing Typical Arrangements Including Transmission Insulators

CATENARY BRACKET CONSTRUCTION



Showing Lightning Arrester and Feeder Tap

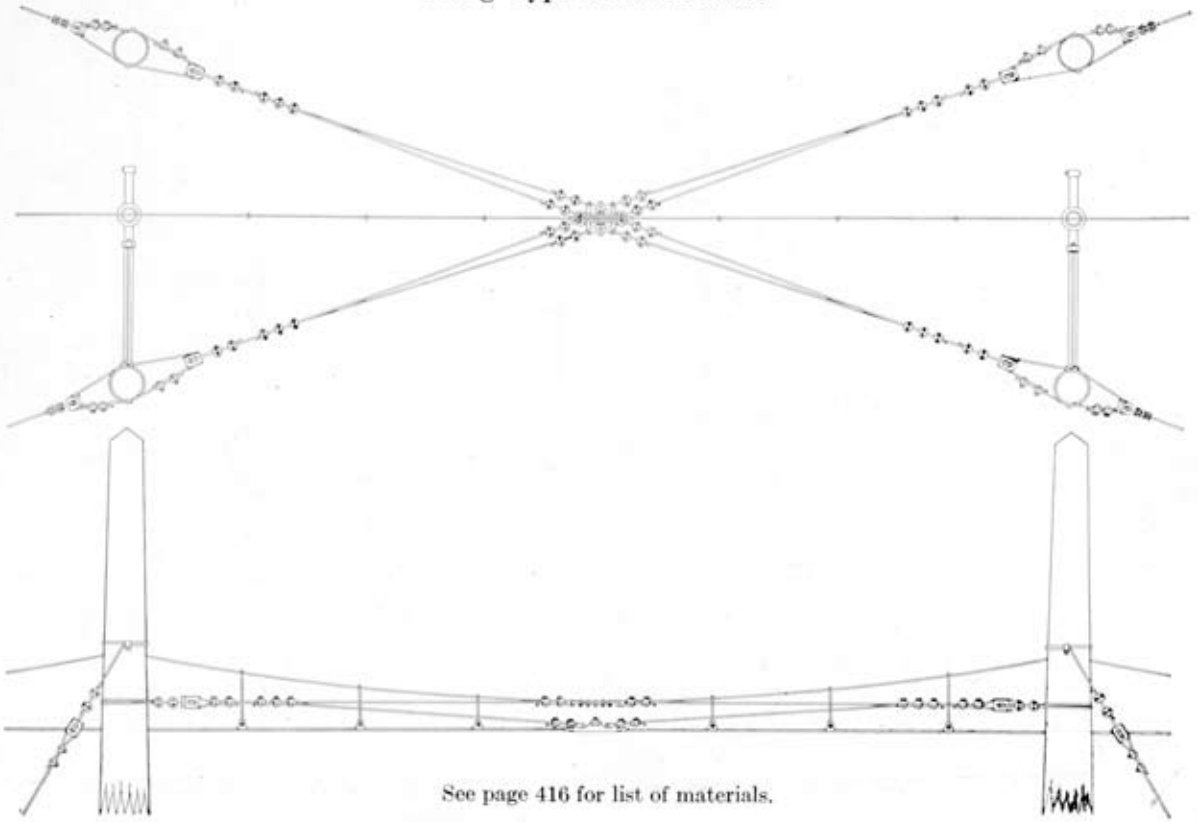
SINGLE TRACK BRACKET CONSTRUCTION ON CURVES



Pull-Off Wires Between Poles

CATENARY LINE ANCHOR CONSTRUCTION

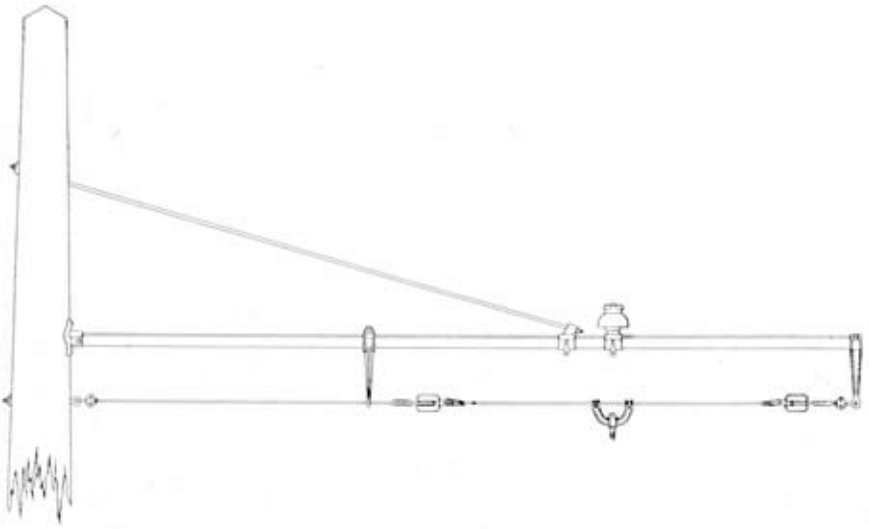
Using Type B Strain Plate



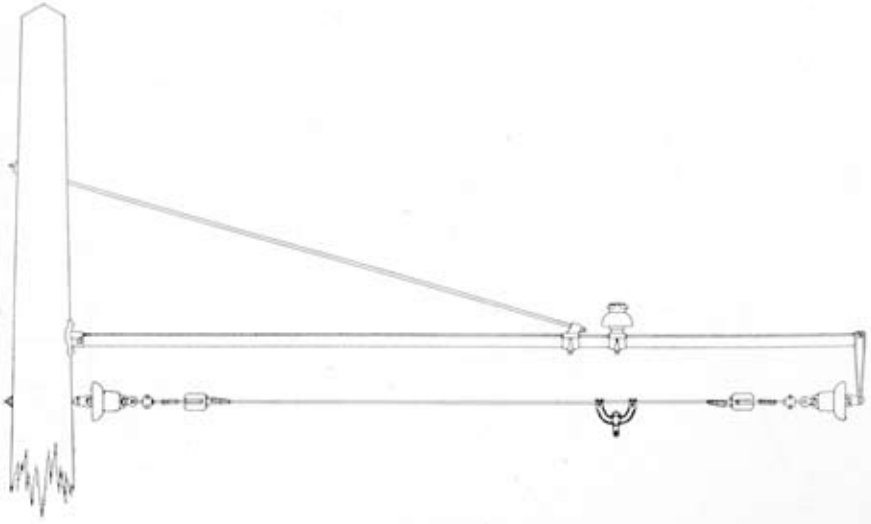
See page 416 for list of materials.

CATENARY STEADY CONSTRUCTION

Tangent or Curve

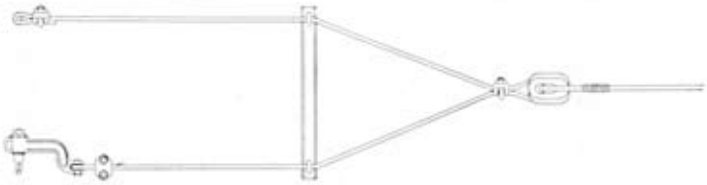


Up to 1,500 Volts



11,000 Volts

CATENARY CURVE PULL-OFF CONSTRUCTION



Pull-Off Spreader with Pull-Over Yoke for Trolley Wheel

See pages 433 and 280 for listing.



Type CA Pull-Off Hanger for Wheel or Pantograph

See page 432 for listing.



Type CB Pull-Off Hanger for Wheel or Pantograph

See page 431 for listing.



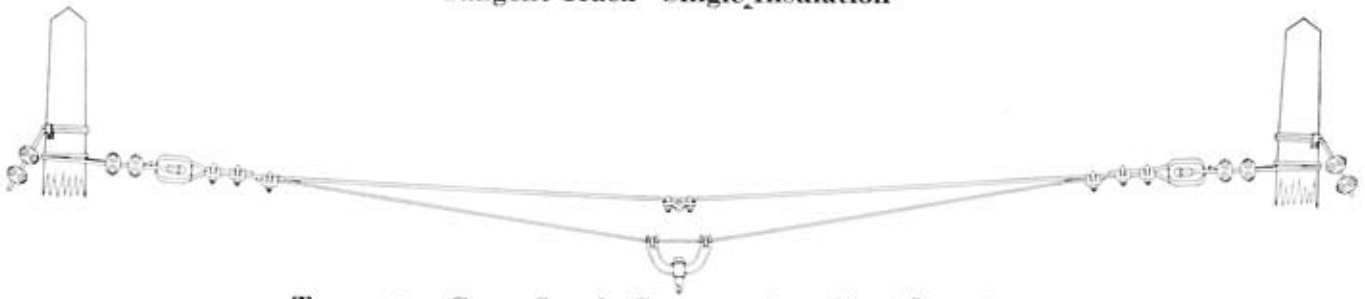
Flexible Pull-Over for Pantograph

See page 433 for listing.

CATENARY CROSS-SPAN FOR SINGLE TRACK



Tangent Track—Single Insulation

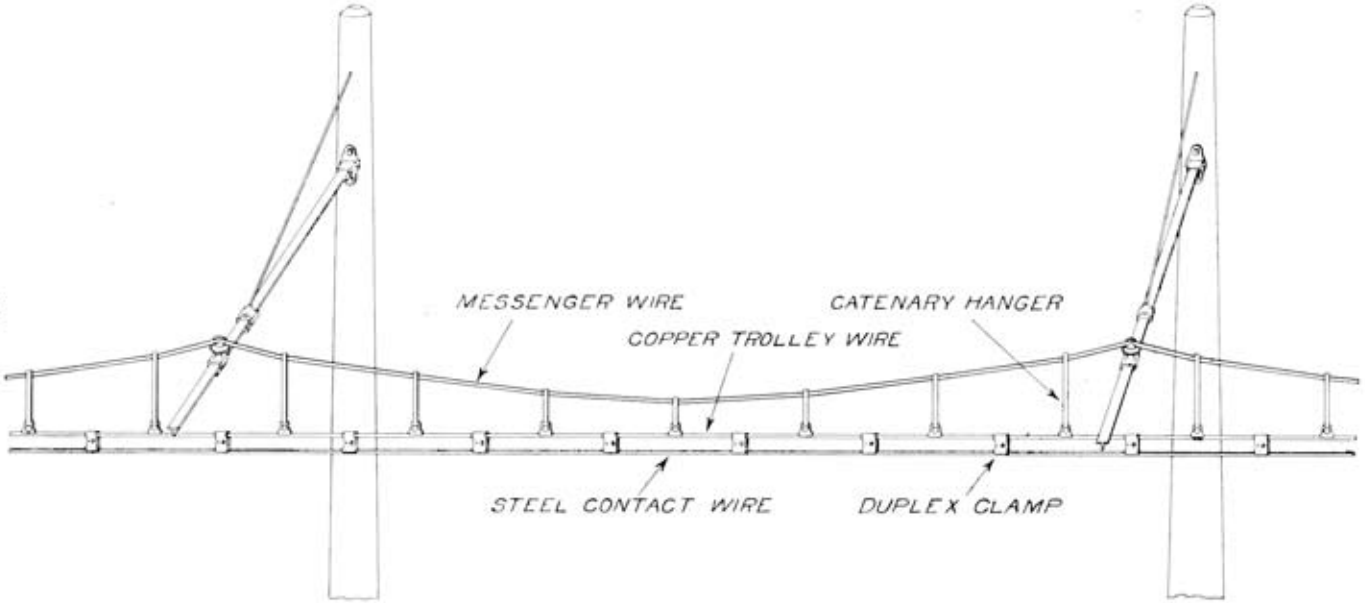


Tangent or Curve Steady Construction—Single Insulation



Curve Pull-Off—Double Insulation

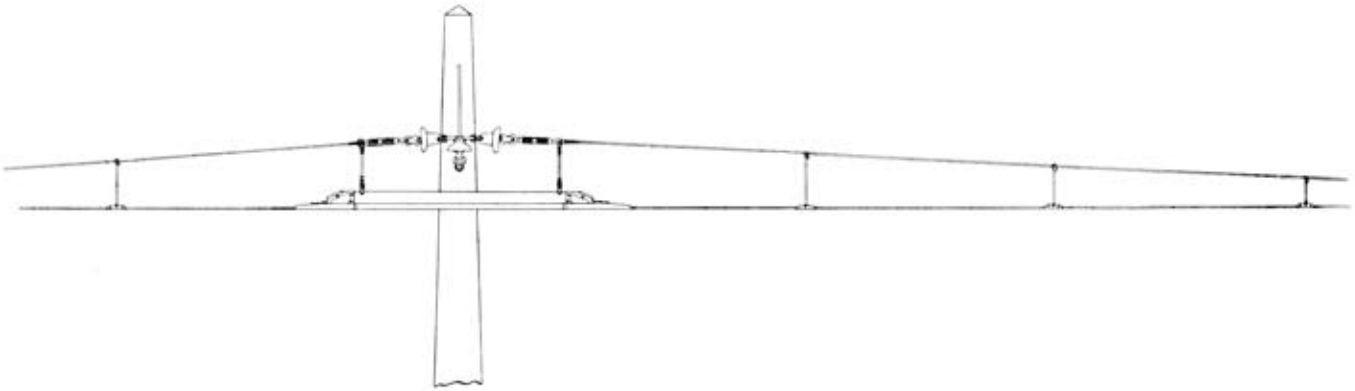
DUPLEX CATENARY CONSTRUCTION



See listing of Duplex Clamps on page 429

METHOD OF INSTALLING CATENARY SECTION INSULATORS

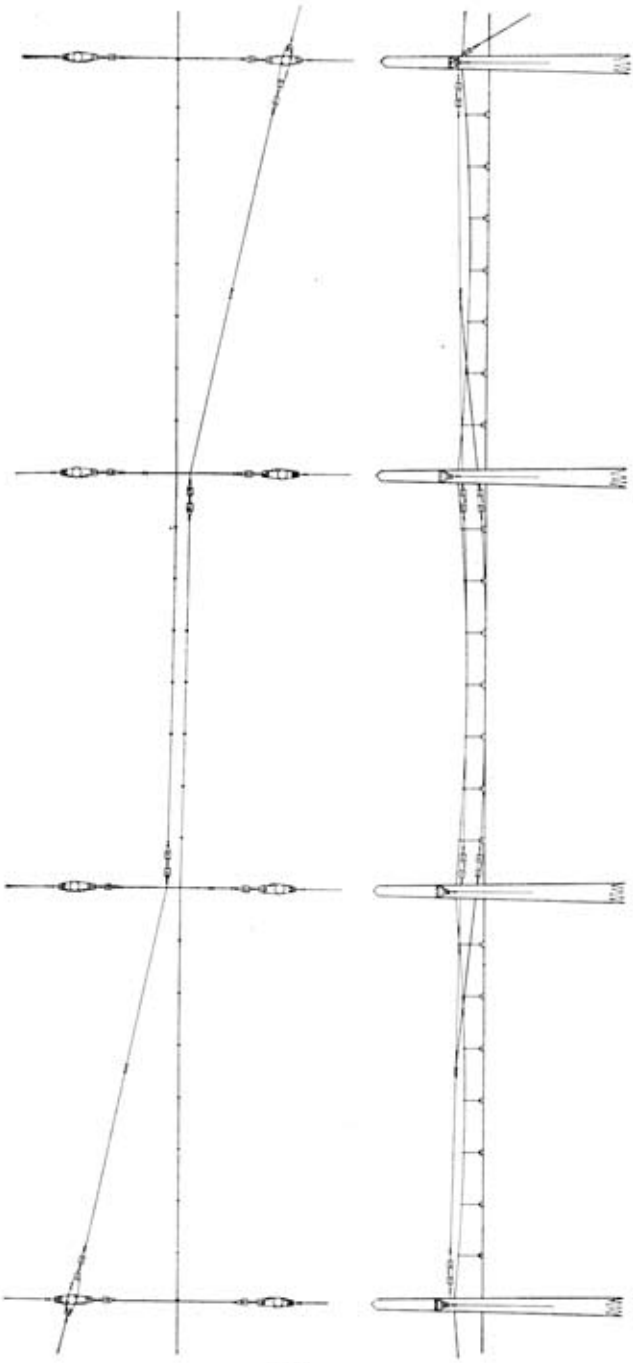
Patented



See page 413 for listing of Section Insulators

METHOD OF SECTIONALIZING LINE

Air-Break Anchor Construction



MATERIALS REQUIRED PER MILE OF TANGENT

Cross-Span Construction

Quantity required for 15-foot hanger spacing, 150-foot pole spacing		Quantity required for 30-foot hanger spacing, 150-foot pole spacing		List of Material
Single track	Double track	Single track	Double track	
72	72	72	72	Porcelain Strain Insulators.
36	72	36	72	Cross Span Messenger Hangers.
576	576	576	576	$\frac{3}{8}$-inch Wire Rope Clips.
72	72	72	72	3 Bolt Guy Wire Clamps.
72	72	72	72	Steel Wire Strand Thimbles
72	72	72	72	Guy Anchors.
72	144	36	72	6 -inch Catenary Hangers
72	144	..	..	$7\frac{1}{2}$ " " "
..	..	72	144	$8\frac{3}{4}$ " " "
72	144	..	..	$10\frac{1}{4}$ " " "
72	144	..	..	$14\frac{1}{2}$ " " "
..	..	72	144	17 " " "
72	144	..	..	$19\frac{1}{2}$ " " "
5,300 feet	10,600 feet	5,300 feet	10,600 feet	American Std. Grooved Trolley Wire.
2	4	2	4	Trolley Wire Splicers.
5,300 feet	10,600 feet	5,300 feet	10,600 feet	Messenger Cable.
8	16	8	16	$\frac{7}{16}$-inch Crosby Rope Clips.
3,000 feet	3,500 feet	3,000 feet	3,500 feet	$\frac{3}{4}$-inch Span or Guy Cable.
75 feet	150 feet	75 feet	150 feet	$\frac{1}{4}$-inch Steel Strand.
10	15	10	15	$\frac{3}{8}$-inch Wire Rope Clips.
5	10	5	10	Trolley Steady.
5	10	5	10	Detroit Trolley Clamp, Form 6.
5	10	5	10	Feeder Connectors.
5	10	5	10	Garton-Daniels Lightning Arresters.
5	10	5	10	Sets Ground Fittings.
5	10	5	10	Socket Terminals.
2	4	2	4	Sets Line Anchor Material (see list, page 416).
360	720	360	720	Rail Bonds.
5	10	5	10	Cross Bonds.

Above list does not include insulators or hardware for transmission, feeder or telephone lines. Extra materials will be required for curves including hangers, pull-offs, back guys, etc. See pages 409 and 410 for suggested construction. Pole spacing must be reduced on curves (pages 402 and 403). List covers single insulation in spans.

The above lists of materials are only suggestive and of use in estimating for the ordinary installations of catenary construction. Higher voltages, curves, crossings, storage yards, etc., introduce many other problems. The services of an engineer will be gladly furnished on request.

MATERIALS REQUIRED PER MILE OF TANGENT

Pole Bracket Construction

Quantity required for 15-foot hanger spacing, 150-foot pole spacing		Quantity required for 30-foot hanger spacing, 150-foot pole spacing		List of Material
Single track	Double track	Single track	Double track	
31	62	31	62	Type CE Pole Bracket, 9 feet long.
5	10	5	10	Type CE Pole Bracket, 12 feet long.
72	144	72	144	½ x 5-inch Lag Screws.
36	72	36	72	Messenger Insulator Pins.
36	72	36	72	Messenger Insulators.
72	144	36	72	6 -inch Catenary Hangers.
72	144	..	..	7½ " " "
..	..	72	144	8¾ " " "
72	144	..	..	10¼ " " "
72	144	..	..	14½ " " "
..	..	72	144	17 " " "
72	144	..	..	19½ " " "
5,300 feet	10,600 feet	5,300 feet	10,600 feet	American Std. Grooved Trolley Wire.
2	4	2	4	Trolley Wire Splicers.
5,300 feet	10,600 feet	5,300 feet	10,600 feet	Messenger Cable.
8	16	8	16	⅞-inch Crosby Clips.
5	10	5	10	Drop Castings.
5	10	5	10	Inner Support Castings.
5	10	5	10	½ x ½-inch Eye Bolts.
10	20	10	20	¼-inch Wire Rope Clips.
75 feet	150 feet	75 feet	150 feet	¼ " Steel Strand.
10	20	10	20	Porcelain Strain Insulators.
5	10	5	10	Trolley Steady.
5	10	5	10	Detroit Trolley Clamp, Form 6.
5	10	5	10	Feeder Connector.
5	10	5	10	Garton-Daniels Lightning Arresters.
5	10	5	10	Sets Ground Fittings.
5	10	5	10	Socket Terminals.
2	4	2	4	Sets Line Anchor Material. (see list, page 416)
360	720	360	720	Rail Bonds.
5	10	5	10	Cross Bonds.

Above list does not include insulators or hardware for transmission, feeder or telephone lines. Extra material will be required for all curves including hangers, pull-offs, back guys, etc. See pages 406 and 409 for suggested constructions. Pole spacing must be reduced on curves (pages 402 and 403).

The above lists of materials are only suggestive and of use in estimating for the ordinary installations of catenary construction. Higher voltages, curves, crossings, storage yards, etc., introduce many other problems. The services of an engineer will be gladly furnished on request.

MATERIALS REQUIRED FOR ONE LINE ANCHOR

See Page 407

Quantity	Material
1	Messenger Anchor Clamp, Type CB.
1	Trolley Strain Plate Type B, Form 2.
*8	Porcelain Strain Insulators, Type XH.
*36	$\frac{7}{16}$-inch Wire Rope Clips.
24	$\frac{3}{8}$ " " " "
4	3 Bolt Guy Wire Clamps.
4	Steel Wire Strand Thimbles.
4	Guy Anchors.
350 feet	$\frac{7}{16}$-inch S. M. Steel Strand.
400 feet	$\frac{3}{8}$ " " " "

*Above is for single insulation. For double insulation use 12-Strain Insulators and 41 $\frac{7}{16}$-inch Rope Clips.

The above lists of materials are only suggestive and of use in estimating for the ordinary installations of catenary construction. Higher voltages, curves, crossings, storage yards, etc., introduce many other problems. The services of an engineer will be gladly furnished on request.

CATENARY POLE BRACKET

Type CE—For Wood Pole



No. 11110

CONSISTS of a Tee Bar Arm with a $\frac{5}{8}$-inch rolled thread support rod. There is included a pole casting, a support rod casting and a beveled cast washer, the latter for use with the support rod at the pole.

Regularly furnished with plain end as illustrated but ornamental end casting can be included if desired.

All bracket arm castings are one piece and completely encircle Tee Bar. Support rod casting is adjustable along the arm.

Bracket can be used for practically any voltage. Messenger insulators for different voltages are listed in the High Tension Insulator section of this catalog.

A clearance of 7 feet 6 inches from the pole face to track center is commonly used on Interurban Construction, and a 9-foot arm is long enough unless poles are given too great a rake.

Bracket with 12-foot arm is intended for use with outer support casting listed on next page. Construction is shown on pages 406 and 408.

Fittings malleable iron, japanned. All fittings can be used with either $\frac{1}{4}$ or $\frac{5}{16}$-inch Tee Bar. Arms and support rods regularly furnished plain but can be japanned on special order.

Holes in pole castings are for $\frac{1}{2}$x5-inch lag screws but lags are not furnished unless specified.

For 9-foot and 10-foot Arms, length support rod is 6 inches less than length arm; for 12-foot Arms it is advisable to use same support rod as used with shorter Arms on tangents.

Code Word	No.		List Each
Ionic.	10163	Pole Bracket, 9-foot Arm, $2\frac{1}{4}$x$2\frac{1}{4}$x$\frac{1}{4}$-inch Tee Bar	$7 60
Ionidium.	10164	" " 10 " " $2\frac{1}{4}$x$2\frac{1}{4}$x$\frac{1}{4}$ " " "	8 20
Pantile.	12806	" " 12 " " $2\frac{1}{4}$x$2\frac{1}{4}$x$\frac{5}{16}$ " " "	11 00
Ipocras.	11110	Ornamental End Casting	48
Refection.	13401	Support Casting with Set Screw	1 15
Referable.	13402	Pole Casting with Bolt	1 05
Referee.	13403	Support Rod, $\frac{5}{8}$ inch x 8$\frac{1}{2}$ feet with Nuts and Beveled Washer	1 40
Refine.	13404	" " $\frac{5}{8}$ " x 9$\frac{1}{2}$ " " " " " "	1 50

CATENARY SUPPORT CASTINGS

For Tee Bar Pole Bracket



No. 13168

Inner Support
For Center of Pole Bracket



No. 11472

Outer Support
For End of Pole Bracket

USED with Tee Bar Pole Brackets listed on preceding page for steadying trolley wire on tangents or for pull-offs on curves as shown on pages 406 and 408.

Inner support has a hinged jaw so that it can be installed on tee bar without disturbing other fittings. Hole for strand is parallel to pole bracket.

Outer support fits over end of tee bar and is held in place by a $\frac{5}{8}$x1-inch set screw. Hole for attaching strand or insulator is at right angles to pole bracket.

Both supports will fit $2\frac{1}{4}$x$2\frac{1}{4}$x$\frac{1}{4}$ or $\frac{5}{16}$-inch Tee Bar.

Distance, top of Tee Bar to center of hole for strand, 12 inches. Holes for strand $\frac{5}{8}$ inch in diameter.

Code Word	No.	List per 100
Pythian.	13168—Inner Support Casting, Malleable Iron, Japanned	$185 00
Marined.	11472—Outer " " " " "	165 00

CATENARY MESSENGER INSULATOR PIN

Type CE



MADE in two sizes and used for mounting porcelain messenger insulators on the Type CE Pole Brackets for Catenary Construction, insulator being cemented to Pin by purchaser at time line is erected.

Made of malleable iron, japanned, and will withstand any side strains that it may be subjected to under most severe curve conditions.

Base of pin completely surrounds tee bar, thus making accidental disengagements impossible. Suitable for a $2\frac{1}{4}$x$2\frac{1}{4}$x$\frac{1}{4}$-inch or $2\frac{1}{4}$x$2\frac{1}{4}$x$\frac{5}{16}$-inch tee bar.

Pin No. 10168 is for use with Messenger Insulators Nos. 12850 and 10636 as listed in the High Tension Insulator section of this catalog.

Pin No. 10644 is for use with Messenger Insulator No. 12852 as listed in the High Tension Insulator section of this catalog.

Code Word	No.		List per 100
Hatted.	10168—	Messenger Insulator Pin, height above Tee Bar $4\frac{1}{4}$ inches.	$140 00
Hatting.	10644—	" " " " " " " $5\frac{1}{2}$ "	155 00

TYPE CU CATENARY HANGER

Patented



Messenger Clip Regularly Furnished



Nos. 13028-13036



Internal Construction



Messenger Clip Furnished on Special Order

CONSISTS of a two-piece malleable iron clamp, held onto the upset lower end of ½-inch steel rod by tightening nut on clamping bolt which is equipped with lock washer.

Upper end of rod is equipped with messenger clip which grips messenger wire tightly. Will fit messenger strand up to ½ inch in diameter.

Installed by placing hooks of clip over messenger wire and then turning rod until upper end engages messenger. Clamp is then tightened on trolley wire.

Will fit 2-0 to 4-0 grooved trolley wire. Length of jaws 2½ inches.

All parts are sherardized.

Lengths as given below are distances between centers of messenger cable and trolley wire.

Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Pantofile.	13028	6	$70 00	*Paraffin.*	13037	16	$79 50
Pantry.	13029	7½	71 50	*Paragon.*	13038	17	80 50
Papboat.	13030	8¼	72 80	*Parapet.*	13039	18¼	81 60
Papery.	13031	10¼	74 00	*Parasol.*	13040	18¾	82 10
Parable.	13032	12¼	76 20	*Parboil.*	13041	19½	83 10
Parade.	13033	12¾	76 60	*Parcel.*	13042	20¼	83 80
Paradigm.	13034	13¼	77 00	*Parcener.*	13043	21	84 40
Paradise.	13035	14½	78 10	*Parcity.*	13044	21½	85 00
Paradox.	13036	15¼	78 80	.....	.....	.....	.....

TYPE CR-1 CATENARY HANGER

Patented



Messenger Clip Regularly Furnished





Messenger Clip Furnished on Special Order

CONSISTS of extruded metal ear, two sherardized malleable iron castings and a ½-inch sherardized steel rod.

Screw threads of boss and rod are set up with white lead.

Permits no vertical movement of hanger on messenger wire.

Ear makes a tight fit upon trolley wire and gives maximum clearance. Will fit 4-0 grooved wire. Length of ear, 5 inches.

Installed by placing hooks of clip over messenger wire and then turning rod until upper end engages messenger. Ear is then clinched upon trolley wire.

Messenger clip takes strand up to ½ inch in diameter.

Lengths given below are distances between centers of messenger cable and trolley wire.

Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Loresman.	11772	6	$75 00	*Lucarne.*	11781	16	$85 50
Loricate.	11773	7½	77 00	*Lucern.*	11782	17	86 60
Lotion.	11774	8¾	77 80	*Lucifer.*	11783	18¼	87 50
Loudful.	11775	10¼	79 60	*Luctual.*	11784	18¾	88 20
Lounger.	11776	12¼	81 60	*Lugmark.*	11785	19¼	89 00
Lovelock.	11777	12¾	82 20	*Lullaby.*	11786	20¼	90 00
Lowbell.	11778	13¼	82 80	*Lumper.*	11787	21	90 60
Loyalist.	11779	14½	84 00	*Lunarian.*	11788	21½	91 20
Lozenge.	11780	15¼	84 80	.....	.....	...	.....

Above Hangers can be furnished to order for all sizes of Round, Figure 8 and Grooved Copper Wires; also for 4-0 Grooved Steel Trolley Wire.

TYPE CR-2 CATENARY HANGER

Patented



CONSISTS of extruded metal ear, a sherardized malleable iron casting and a ½-inch sherardized steel rod.

Screw threads of boss and rod are set up with white lead.

Upper end of rod is formed into a ¾x2-inch loop which permits vertical movement of hanger on messenger wire. Hangers are shipped with loops open for installation.

Installed by clinching ear upon trolley wire and hooking loop of rod over messenger wire. Loop is then closed by a hammer blow.

Ear makes a tight fit upon trolley wire and gives maximum clearance. Will fit 4-0 grooved wire. Length of ear, 5 inches.

Lengths given below are distances between centers of messenger cable and trolley wire.

Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Lunette.	11789	6	$59 40	*Lymphoid.*	11798	16	$69 60
Lungfish.	11790	7½	61 00	*Lyncher.*	11799	17	70 50
Luniform.	11791	8¼	62 00	*Lyrical.*	11800	18½	72 00
Lupercal.	11792	10½	62 60	*Maalin.*	11801	18¾	72 50
Lurdan.	11793	12½	65 70	*Mabble.*	11802	19½	73 10
Luscious.	11794	12¾	66 20	*Macaco.*	11803	20¼	74 00
Lusory.	11795	13½	66 80	*Macarize.*	11804	21	74 80
Lyceum.	11796	14⅛	68 00	*Macaroon.*	11805	21½	75 00
Lycopod.	11797	15¼	68 50	.....	.....	...	.....

Above Hangers can be furnished to order for all sizes of Round, Figure 8 and Grooved Copper Wires; also for 4-0 Grooved Steel Trolley Wire.

TYPE CL CATENARY HANGER

Patented



CONSISTS of extruded metal ear, sherardized malleable iron casting and sherardized steel suspension strap.

Installed by clinching ear on trolley wire and snapping loop over messenger cable. Loop springs shut automatically so it cannot become accidentally disengaged from messenger cable.

Ear makes a tight fit upon trolley wire and gives maximum clearance for trolley wheel. Will fit 4-0 grooved wire. Length, 5 inches.

Strap is $\frac{1}{8}$x$\frac{3}{4}$ inches and loop is $\frac{3}{4}$x3$\frac{1}{2}$ inches, allowing free vertical movement of hanger.

Straps on all hangers are given a twist to decrease wind resisting surface in direction that would cause swaying of trolley wire.

Lengths given below are distances between centers of messenger cable and trolley wire.

Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Lobster.	11473	6	$56 20	*Lockup.*	11482	16	$63 00
Lobular.	11474	7½	57 50	*Locofoco.*	11483	17	63 80
Localism.	11475	8¾	58 10	*Lockulate.*	11484	18¼	64 60
Peeler.	11476	10¼	59 10	*Locusta.*	11485	18¾	65 00
Lockage.	11477	12½	60 50	*Locution.*	11486	19½	65 20
Locket.	11478	12¾	61 00	*Locutory.*	11487	20¼	65 90
Lockjaw.	11479	13¼	61 30	*Lodger.*	11488	21	66 20
Lockman.	11480	14½	62 00	*Lodging.*	11489	21½	66 60
Lockstep.	11481	15¼	62 50	.....	.....	...	.....

Above Hangers can be furnished to order for all sizes of Round, Figure S and Grooved Copper Wires; also 4-0 Grooved Steel Trolley Wire.
Can also be furnished with loop in strap as shown on page 425.

TYPE CM CATENARY HANGER

Patented



MALLEABLE iron jaw castings are fastened to steel suspension strap by a ½x1⅝-inch carriage bolt passing through all three parts.

When hanger is installed, tightening of bolt causes jaws to grip trolley wire. A lock washer prevents nut from working loose.

Suspension strap is ⅛x1 inch and has a ⅝x3-inch loop which allows vertical movement of hanger.

This hanger should be hooked over the messenger wire before the clamp is attached to the trolley wire.

Clamp takes 2-0, 3-0 and 4-0 grooved wire; length of jaws 2½ inches. All parts sherardized.

Lengths given below refer to distances between centers of messenger cable and trolley wire.

Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Macerate.	11490	6	$52 00	*Madbrain.*	11499	16	$60 60
Machete.	11491	7¼	53 50	*Madcap.*	11500	17	61 60
Macilent.	11492	8¼	54 50	*Madden.*	11501	18¼	62 50
Mackerel.	11493	10¼	55 90	*Maddish.*	11502	18¾	63 20
Mackle.	11494	12¼	57 60	*Madeira.*	11503	19½	63 80
Macron.	11495	12¾	58 10	*Madjoun.*	11504	20¼	64 50
Macropod.	11496	13¼	58 40	*Madness.*	11505	21	65 00
Macrucan.	11497	14½	59 40	*Madonna.*	11506	21½	65 20
Macula.	11498	15¼	60 10	.....	.....	...	.....

TYPE CN CATENARY HANGER

Patented



THREE screw clamp of the Detroit type is riveted to steel suspension strap. Clamp takes 2-0, 3-0 and 4-0 grooved wire.

Strap is $\frac{1}{8}$x$\frac{3}{4}$ inch and has $\frac{3}{4}$x3$\frac{1}{2}$-inch loop, allowing vertical movement of hanger. This hanger should be hooked over the messenger wire before the clamp is attached to the trolley wire.

Clamp offers good clearance for trolley wheel. Length, 3$\frac{1}{2}$ inches

Straps on all hangers are given a twist to decrease wind resisting surface in direction that would cause swaying of trolley wire.

All parts are sherardized.

Lengths given below refer to distances between centers of messenger cable and trolley wire.

Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Mainyard.	11755	6	$13 10	*Maltese.*	11764	16	$49 80
Majestic.	11756	7$\frac{1}{2}$	44 10	*Malting*	11765	17	50 40
Majorat.	11757	8$\frac{3}{4}$	45 00	*Maltose.*	11766	18$\frac{1}{2}$	51 00
Malady.	11758	10$\frac{1}{4}$	46 00	*Mammet.*	11767	18$\frac{3}{4}$	51 60
Maledict.	11759	12$\frac{1}{4}$	46 50	*Manacle.*	11768	19$\frac{1}{2}$	52 10
Malkin.	11760	12$\frac{3}{4}$	47 00	*Manakin.*	11769	20$\frac{1}{4}$	52 60
Mallard.	11761	13$\frac{1}{4}$	47 80	*Manchet.*	11770	21	53 10
Malleate.	11762	14$\frac{1}{2}$	48 50	*Manchu.*	11771	21$\frac{1}{2}$	53 50
Mallows.	11763	15$\frac{1}{4}$	49 20	.....	.....	...	.....

Above Hangers can also be furnished with loop in strap as shown on page 423.

TYPE CS CATENARY HANGER



Type CS-1—For Pantograph Operation



Type CS-2—For Wheel Operation

MALLEABLE iron clamp castings are tightened onto trolley wire by a $\frac{7}{16}$x1½-inch carriage bolt passing through both castings and ends of double strap. Lock washer prevents nut working loose.

To eliminate handling of loose parts in installing, castings are riveted to ends of strap.

Suspension strap is $\frac{1}{8}$x$\frac{3}{4}$ inch steel.

Clamp takes 2-0, 3-0 and 4-0 grooved wire. Length of jaws, 2½ inches. All parts sherardized.

Lengths given below refer to distances between centers of messenger cable and trolley wire.

Type CS-1—For Pantograph				Type CS-2—For Trolley Wheel			
Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Reflect.	13283	6	$40 00	*Pardale.*	12612	6	$44 50
Reformade.	13284	7½	41 90	*Pardon.*	12613	7½	46 40
Reformed.	13285	8¾	43 70	*Parental.*	12614	8¾	48 20
Refound.	13286	10¼	45 40	*Parget.*	12615	10¼	49 90
Refractor.	13287	12¼	48 20	*Paring.*	12616	12¼	52 70
Refrain.	13288	12¾	49 00	*Parish.*	12617	12¾	53 50
Refresh.	13289	13¼	49 50	*Paritor.*	12618	13¼	54 00
Refuge.	13290	14½	51 20	*Parley.*	12619	14½	55 70
Refund.	13291	15¼	52 20	*Parodist.*	12620	15¼	56 70
Refutal.	13292	16	53 20	*Parole.*	12621	16	57 70
Regale.	13293	17	54 60	*Parotid.*	12622	17	59 10
Regality.	13294	18¼	56 20	*Parquet.*	12623	18¼	60 70
Regard.	13295	18¾	57 00	*Parrot.*	12624	18¾	61 50
Regarder.	13296	19½	58 00	*Parsley.*	12625	19½	62 50
Regather.	13297	20¼	59 00	*Parson.*	12626	20¼	63 50
Regence.	13298	21	60 00	*Partake.*	12627	21	64 50
Regenerate.	13299	21½	60 80	*Partisan.*	12628	21½	65 30

TYPE CT CATENARY HANGER

Patented



Nos. 12766-12782
Type CT-1—For Pantograph Operation



Installing on Messenger



Nos. 13010-13026
Type CT-2—For Wheel Operation

CONSISTS of two malleable iron castings fastened to the ends of a rod loop by a carriage bolt passing through both castings.

Installed without removing bolt. Unhook one end of rod as shown, slip over messenger wire, install on trolley, then tighten nut on bolt which locks the parts together and, at same time, grips trolley wire.

Rod is $\frac{1}{4}$ inch in diameter. Clamp will accommodate 2-0, 3-0 and 4-0 grooved wire. Jaws $2\frac{3}{8}$ inches long. All parts sherardized.

Lengths given below refer to distances between centers of messenger cable and trolley wire.

Type CT-1—For Pantograph				Type CT-2—For Trolley Wheel			
Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Passable.	12766	6	$32 00	*Patrol.*	13010	6	$41 70
Passage.	12767	7½	32 50	*Patter.*	13011	7½	42 20
Passing.	12768	8¾	33 00	*Paucity.*	13012	8¾	42 70
Passport.	12769	10¼	33 60	*Pauper.*	13013	10¼	43 30
Paster.	12770	12¼	34 60	*Pavement.*	13014	12¼	44 30
Pastime.	12771	12¾	34 80	*Pavesade.*	13015	12¾	44 50
Patamar.	12772	13¼	35 00	*Pawnee.*	13016	13¼	44 70
Patcher.	12773	14½	35 50	*Pawpaw.*	13017	14½	45 20
Paternal.	12774	15¼	36 20	*Paxwax.*	13018	15¼	45 90
Pathless.	12775	16	36 70	*Peabird.*	13019	16	46 20
Pathos.	12776	17	36 80	*Peacher.*	13020	17	46 50
Pathway.	12777	18½	37 20	*Peacock.*	13021	18¼	46 90
Patible.	12778	18¾	37 50	*Peafowl.*	13022	18½	47 20
Patience.	12779	19½	37 80	*Peanism.*	13023	19½	47 50
Patness.	12780	20¼	38 10	*Peanut.*	13024	20¼	47 80
Patrial.	12781	21	38 40	*Pearlish.*	13025	21	48 10
Patriot.	12782	21½	38 80	*Pearmain.*	13026	21½	48 50

TYPE CX CATENARY HANGER

Patented



Messenger Clip Regularly Furnished





Messenger Clip Furnished on Special Order

USED for supporting copper trolley wire when a contact wire is supported under the trolley in duplex construction.

Installed by hooking clip over messenger wire, turning rod until upper end grips messenger tightly, then placing trolley wire in lower clip and tightening nut.

Contact wire is suspended from trolley by Duplex Clamps listed on the following page which are installed midway between Hangers.

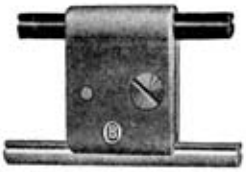
Will take wires up to ½ inch in diameter.

Lengths as given below are distances between centers of wires.

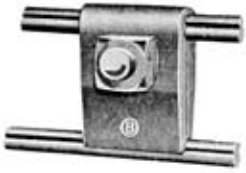
Rod is ½ inch diameter steel; clips are malleable iron; all parts sherardized.

Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Peasant.	13045	6	$56 50	*Pectosic.*	13054	16	$66 00
Peascod.	13046	7½	57 90	*Pedage.*	13055	17	67 00
Peasweep.	13047	8¾	59 20	*Pedalian.*	13056	18¼	68 00
Pebble.	13048	10¼	60 50	*Pedant.*	13057	18¾	68 60
Peccable.	13049	12¼	62 50	*Pedantic.*	13058	19½	69 30
Pectate.	13050	12¾	63 10	*Pedantry.*	13059	20¼	70 00
Pectinal.	13051	13¼	63 50	*Pedary.*	13060	21	70 80
Pectize.	13052	14½	64 50	*Peddler.*	13061	21½	71 50
Pectoral.	13053	15¼	65 30	.....	.....	.....	.....

DUPLEX CATENARY CLAMPS



No. 11111—With Screws



No. 13300—With Bolt



No. 11037—Pull-Off With Eye

USED where it is desired to install two trolley wires—a steel contact wire because of its wearing qualities and a copper wire for feeder, the latter being supported from a messenger in the same manner as when single catenary construction is used.

Installed midway between regular catenary hangers, thus providing greater flexibility.

Clamps completely encircle upper wire but allow longitudinal movement. Length, 2 inches.

No. 11111 gives $2\frac{1}{4}$ inches separation between wires.

Nos. 13300 and 11037 give $1\frac{3}{4}$ inches separation between wires.

Hole for strand in eye of No. 11037 is $\frac{9}{16}$ inch in diameter.

Made of malleable iron; all parts sherardized.

Code Word	No.	List per 100
Isochasm.	11111—Clamp with Screws, for 4-0 Grooved Wires	$34 00
Regible.	13300— " " Bolt, " 4-0 " "	34 00
Maranta.	11037—Pull-Off Clamp with Eye, for 4-0 Grooved Wires	45 00

TYPE CP CATENARY HANGER

For Pantograph Operation

Duplex Trolley



IS of particular advantage where it is desired to use an old, badly-worn copper trolley wire for a feeder and suspend a new steel wire under it.

Consists of a Duplex Clamp similar to that shown on page 429 to which is attached a double strap loop which, when hooked over the messenger wire, gives a flexible support. Strap is $\frac{1}{8}$x$\frac{3}{4}$ inch.

Jaws of clamp are bolted together by a $\frac{3}{8}$x1$\frac{1}{2}$-inch carriage bolt which also passes through ends of strap. In addition each jaw is riveted to one end of the strap loop.

Clamp is malleable iron, sherardized. It completely encircles upper wire, but allows longitudinal movement.

Length of clamp, 2 inches; separation between centers of wires 2 inches. Takes 3-0 Grooved copper upper and 4-0 Grooved copper or steel lower wire.

Hanger lengths given below are distances between centers of messenger cable and contact wire.

Code Word	No.	Length Inches	List per 100	Code Word	No.	Length Inches	List per 100
Mandarin.	11704	6	$47 80	*Mansuete.*	11713	16	$60 80
Mandate.	11705	7$\frac{1}{2}$	49 80	*Mantelet.*	11714	17	62 50
Manful.	11706	8$\frac{3}{4}$	51 40	*Mantilla.*	11715	18$\frac{1}{2}$	64 20
Mangrove.	11707	10$\frac{1}{4}$	53 40	*Mantissa.*	11716	18$\frac{3}{4}$	64 60
Manicure.	11708	12$\frac{1}{4}$	56 00	*Mantling.*	11717	19$\frac{1}{2}$	65 60
Manikin.	11709	12$\frac{3}{4}$	56 80	*Manuary.*	11718	20$\frac{1}{4}$	66 50
Manito.	11710	13$\frac{1}{4}$	57 50	*Manumit.*	11719	21	67 80
Mannerly.	11711	14$\frac{1}{2}$	59 00	*Mappery.*	11720	21$\frac{1}{2}$	68 30
Mansion.	11712	15$\frac{1}{4}$	60 00	.....	.....	...	.....

Above Hangers can be furnished to order for other sizes of Copper and Steel Grooved Wires.

CATENARY PULL-OFF HANGER

Type CB—Patented



Type CB-1—Nos. 13062-13067



Type CB-2—Nos. 13700-13705

USED in curve construction where it is necessary to pull messenger and trolley into position. Construction is shown on page 393.

Consists of a ½-inch steel rod shaped as shown. The upper end is formed into a loop which gives a flexible connection with the messenger and the lower end is equipped with a malleable iron clamp which will fit 2-0 to 4-0 grooved trolley wire or an extruded ear which fits 4-0 grooved wire.

Rod can be installed in a porcelain strain insulator as shown, before clamp is installed.

Lengths as given below are distances between centers of messenger cable and trolley wire.

All iron parts are sherardized.

Type CB-1—With Malleable Iron Clamp

Code Word	No.		List per 100
Peddling.	13062	Pull-Off Hanger, length 6 inches	$95 00
Pedestal.	13063	" " " 14½ "	95 00
Pedigree.	13064	" " " 15¼ "	95 00
Pediment.	13065	" " " 16 "	95 00
Peduncle.	13066	" " " 19½ "	95 00
Peekaboo.	13067	" " " 21½ "	95 00

Type CB-2—With Extruded Ear

Rustler.	13700	Pull-Off Hanger, length 6 inches	105 00
Ruthenic.	13701	" " " 14½ "	105 00
Ruthless.	13702	" " " 15¼ "	105 00
Ruthful.	13703	" " " 16 "	105 00
Rutilate.	13704	" " " 19½ "	105 00
Sabadilla.	13705	" " " 21½ "	105 00

Type CB-2 Hangers can be furnished to order for all sizes of Round, Figure 8 and Grooved Copper Wires; also 4-0 Grooved Steel Trolley Wire.

CATENARY PULL-OFF HANGER

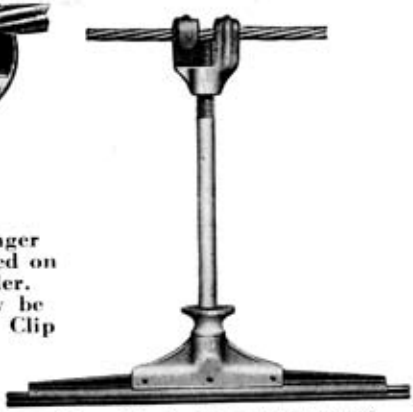
Type CA—Patented



Type CA-1—Nos. 10220-10225



This Messenger Clip Furnished on Special Order. Pull-off may be Attached to Clip



Type CA-2—Nos. 11469-11436

FOR use where it is necessary to hold messenger cable and trolley wire in place on curves by means of pull-off wires.

Clamp on Form 1 will fit 2-0, 3-0 and 4-0 Grooved wire. Ear on Form 2 is for 4-0 Grooved wire.

Malleable iron collar is provided above ear for attaching pull-off wire. Threads on boss and rod are set up with white lead.

Messenger pull-off wire is attached directly to messenger cable at either side of messenger clip.

Malleable iron messenger clip will take strand up to ½ inch in diameter.

Steel rod is ⅝ inch in diameter. All iron parts sherardized.

Hanger lengths given below refer to distances between centers of messenger cable and trolley wire.

Type CA-1—With Form 4, 10-inch Detroit Clamp

Code Word	No.								List per 100
Isiac.	10220—	Form	1	Pull-Off	Hanger,	length	6	inches	$134 00
Isicle.	10221—	"	1	"	"	"	14½	"	147 00
Islam.	10222—	"	1	"	"	"	15¼	"	150 00
Islamism.	10223—	"	1	"	"	"	16	"	151 00
Islamite.	10224—	"	1	"	"	"	19½	"	155 00
Islamitic.	10225—	"	1	"	"	"	21½	"	160 00

Type CA-2—With 12-inch Extruded Ear

Marauder.	11469—	Form	2	Pull-Off	Hanger,	length	6	inches	156 00
Marbling.	11470—	"	2	"	"	"	14½	"	168 00
Marcher.	11471—	"	2	"	"	"	15¼	"	170 00
Marcid.	11434—	"	2	"	"	"	16	"	171 00
Margaric.	11435—	"	2	"	"	"	19½	"	175 00
Margay.	11436—	"	2	"	"	"	21½	"	180 00

Type CA-2 Hangers can be furnished to order for all sizes of Round, Figure 8 and Grooved Wires; also with 10-inch instead of 12-inch Extruded Ears.

CATENARY FLEXIBLE PULL-OVER

For Pantograph Operation



USED in Catenary Construction on curve work. Consists of a ½-inch reinforced pipe shaped to give good clearance for pantograph and formed into an eye at one end and equipped with a malleable iron clamp at the other. Installed as shown on page 409.

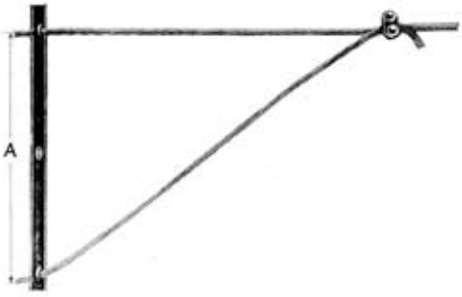
Diameter of hole for strand, ⅝ inch.

Clamp will accommodate 2-0, 3-0 and 4-0 Grooved wire.

Code Word	No		List per 100
Pelican.	12787	Flexible Pull-over, Sherardized, length 3 feet	$158 00
Reindeer.	13301	" " " " 4 "	172 00

Above can also be furnished with clamp for trolley wheel operation.

CATENARY PULL-OFF SPREADER



USED for spreading pull-off wires, one going to messenger wire, the other to strain collar of pull-off hanger as shown on page 409.

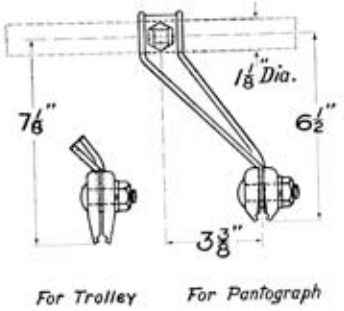
Consists of a ⅞x$\frac{7}{16}$-inch channel iron equipped with two J bolts, which grip the strands.

Lengths as given below are distances between wires as shown by "A" in above illustration.

Code Word	No.		List per 100
Peephole.	12783	Spreader, Sherardized, length 14 inches	$41 60
Peerage.	12784	" " " 17 "	45 00
Peevish.	12785	" " " 20 "	48 50
Pegasus.	12786	" " " 23 "	52 00

CATENARY ADJUSTABLE PULL-OFF LINK





USED to maintain separation between trolley wires at turnouts, etc., preferably with catenary construction. Link Casting slides along pipe and is held in position by ½-inch set screw. With suitable length pipe any desired separation between wires can be obtained. For more than two trolleys, additional castings are added onto pipe.

Fits ¾-inch pipe. Made of malleable iron, sherardized.

Clamp will take 3-0 and 4-0 Grooved wire.

Code Word	No.	List per 100
Punster.	12756—Link Casting with Clamp for Pantograph Operation.....	$125 00
Regicide.	13405— " " " " " Trolley Wheel "	135 00

CATENARY NON-ADJUSTABLE PULL-OFF LINK



USED the same as Adjustable Pull-Off Link listed above but is without adjustable feature.

Separation between wire centers is 8 inches.

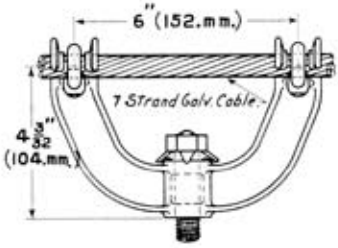
Clamps will take 3-0 and 4-0 grooved wire. All parts sherardized.

Code Word	No.	List per 100
Pupilage.	12757—Link complete with Clamps, for Pantograph Operation....	$137 00
Regiment.	13406— " " " " " Trolley Wheel "	157 00

CATENARY TROLLEY STEADY

For Wheel or Pantograph Operation





USED for steadying trolley wire with cross-span construction or with Type CE Catenary Pole Brackets in conjunction with Support Castings. See pages 406, 408 and 410.

This device is readily installed and adjustable along the support wire without cutting strand. It is hooked over wire and held in place by two "J" bolts. Is applicable to either straight line or curves.

Will fit ½-inch and smaller strand.

Code Word	No.	List per 100
Pupillary.	12764—Trolley Steady, Malleable Iron, Sherardized, ⅝-inch Stud. . .	$120 00

No Trolley Clamps or Ears are included in this listing but any of our regular types may be used. Can be furnished with ¾-inch stud if specified.

CATENARY CROSS-SPAN TROLLEY STEADY

For Wheel Operation



INTENDED for steadying trolley on tangents or pull-off work on curves with cross-span construction.

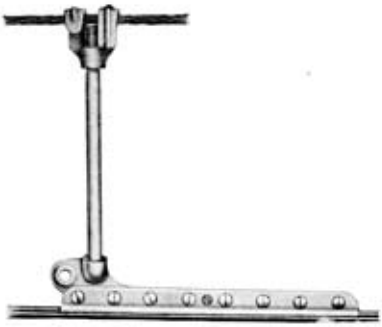
"U" bolts grip cross-span wire firmly and will accommodate strand up to ⅝ inch in diameter.

All parts are sherardized.

Code Word	No.	List per 100
Alibi	10408—Steady for Wheel Operation, ⅝-inch Stud.	$90 00

CATENARY ANCHOR HANGERS

Type CB—Patented



USED for anchoring trolley wire to messenger (see page 413 for anchor scheme).

Provided with 12-inch malleable iron clamp, sherardized, for 2-0, 3-0 and 4-0 grooved wire.

Rod is $\frac{5}{8}$-inch steel, sherardized; messenger clip, malleable iron, sherardized, and will fit strand up to $\frac{1}{2}$ inch in diameter.

Screw threads of boss and rod are set up with white lead.

Hanger lengths given below are distances between centers of messenger cable and trolley wire.

Code Word	No.	List per 100
Ismalize.	10226—Anchor Hanger, length 6 inches	$137 50
Islander.	10227— " " " 10½ "	142 50
Islandy.	10228— " " " 14½ "	150 00
Margent.	11467—Clamp only, Mall. Iron, Sher., for 2-0 to 4-0 Grooved Wire	97 50

TYPE B-2 STRAIN PLATE

For Pantograph Operation—Patented



WIRE is gripped firmly by clamp casting held in place by two $\frac{5}{8}$x1$\frac{1}{2}$-inch standard carriage bolts equipped with lock washers. Renewable bronze tips hold wire in bottom of groove by cam action. Regularly furnished with 2$\frac{1}{2}$-inch tips but can be equipped with 6-inch tips if desired.

Gives smooth under-run and good clearance for trolley wheel. Six holes for guy wire in body casting are $\frac{9}{16}$ inch in diameter. Length overall 15$\frac{1}{2}$ inches. Body malleable iron, sherardized.

Code Word	No.		List per 100
Region.	13399	Strain Plate for 0 Round Wire	$350 00
Register.	13306	" " " 2-0 " and Grooved Wires	350 00
Regius.	13307	" " " 3-0 " " " "	350 00
Reglet.	13308	" " " 4-0 " " " "	350 00

Type B Strain Plate for trolley wheel operation is listed on page 338.
For listing of Renewable Bronze Cam Tips, see page 374.

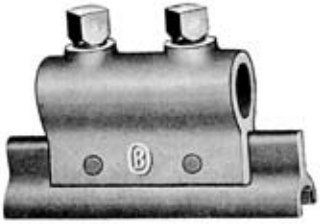
DETROIT FEEDER CLAMP



USED for connecting a feeder wire or a bond from the messenger to the trolley wire. Feeder boss will take up to 4-0 strand. Length, 7$\frac{1}{4}$ inches.

Code Word	No.		List per 100
Regrade.	13302	Feeder Clamp, Bronze, for 2-0 to 4-0 Grooved Trolley	$120 00

EXTRUDED CATENARY FEEDER CONNECTOR



USED for attaching feeder wire to trolley wire or for attaching a bond from messenger wire to trolley wire for the purpose of equalizing the voltage between the two wires and minimizing the passage of current through catenary hangers.

Runner piece is extruded metal, 3 inches long, tinned and soldered to cast bronze boss.

Code Word	No.	List per 100
Marinade.	11432—Connector for 4-0 Cable and 4-0 Grooved Trolley Wire	$54 00

Above Connectors can be furnished to order for all sizes of Round, Figure 8 and Grooved Trolley Wires.

CATENARY FEEDER CONNECTOR



MADE of two bronze castings held together by a bolt equipped with lock washer.

Will accommodate 2-0 to 4-0 grooved trolley wire and 2-0 to 4-0 solid or stranded feeder wire.

Suitable for either wheel or pantograph operation.

Length jaws, 2½ inches.

Code Word	No.	List per 100
Peliom	12765—Connector, Bronze for 2-0 to 4-0 Wires	$55 00

CATENARY CROSS-SPAN MESSENGER HANGER

Type CA



USED to support messenger cable from cross-span cable without insulating one from the other.

Nuts and "U" bolts are of forged steel, body malleable iron, all parts sherardized.

This device avoids the necessity of cutting span wire.

Messenger can be strung along right of way and temporarily held in place below cross-span and after tension in messenger is properly adjusted, messenger and span wire may be clamped together.

Diameter of groove for messenger is $\frac{1}{2}$ inch, "U" bolts take strand up to $\frac{5}{8}$-inch diameter.

Code Word	No.	List per 100
Isoclinal.	10232—Type CA Cross-Span Messenger Hanger, Sherardized	$67 50

CATENARY CROSS-SPAN MESSENGER PULL-OFF



USED in Catenary construction for attaching pull-off wires to messenger, both wires being gripped by tightening two J bolts.

Will accommodate $\frac{5}{16}$ or $\frac{1}{4}$-inch pull-off wires and $\frac{7}{16}$ or $\frac{1}{2}$-inch messenger.

All parts are sherardized.

Code Word	No.	List per 100
Quassia.	13215—Messenger Pull-Off Clamp, Sherardized	$35 50

CATENARY CROSS-SPAN MESSENGER HANGERS

Type CB



No. 13524—Without Eye



No. 13525—With Eye

USED to support messenger cable from cross-span cable, either on single-track or multiple-track construction.

No. 13525, with eye, is intended for use on multiple-track construction. Messengers are suspended beneath the cross-span wire by cables, shorter over the center than the outside tracks. This construction keeps trolley wires at same height over all tracks, despite sag in cross-span.

Hangers are easily installed on both messenger and cross-span. Will fit messenger and cross-span cables up to ½-inch diameter. Made of malleable iron, sherardized.

Code Word	No.		List per 100
Regress.	13524	Type CB Messenger Hanger, without Eye	$57 00
Regret.	13525	" CB " " with Eye	62 50

CATENARY MESSENGER ANCHOR CLAMP

Type CB



USED in Catenary construction for anchoring messenger wires to the poles and also anchoring the trolley to the messenger.

Heavy malleable iron clamp is provided with four $\frac{3}{4}$-inch holes at corners. U bolts will grip $\frac{7}{16}$ to $\frac{1}{2}$-inch strand.

All parts are sherardized.

Code Word	No.	List per 100
Quartet.	10239—Messenger Anchor Clamp	$260 00

CATENARY MESSENGER ANCHOR CLAMP

Type CC



No. 13304

USED for anchor work or dead-ends in Catenary construction. Body casting is malleable iron; all parts sherardized. U bolts will grip $\frac{7}{16}$ to $\frac{1}{2}$-inch strand.

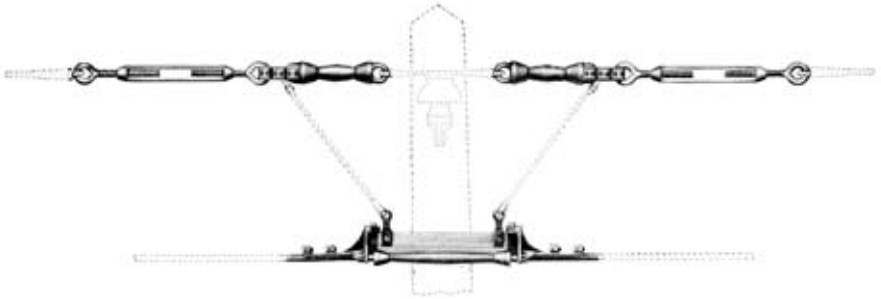
No. 13303 has $\frac{3}{4}$-inch opening in clevis and $\frac{5}{8}$-inch clevis bolt. No. 13304 has $\frac{7}{8}$-inch opening in clevis and $\frac{3}{4}$-inch clevis bolt.

Code Word	No.	List per 100
Regulus.	13303—4-Bolt Anchor Clamp	$220 00
Rehash.	13304—5-Bolt " "	275 00

CATENARY MESSENGER AND TROLLEY SECTION INSULATOR

Type CC—Patented

750-1,500 Volts



USED at pole brackets on 750 and 1,500 volt catenary lines where it is desired to section both messenger and trolley wires.

No. 11112 for 750 volts consists of two ¾x12-inch Turnbuckles, No. 7556, two 1½-inch Wood Strain Insulators, No. 10384 with 5 inches of insulation, two connecting castings and a Section Insulator exactly similar to our Type A, No. 9956 with the exception of having two suspension eyes with ¾-inch openings.

No. 11113 for 1,500 volts consists of two ¾x12-inch Turnbuckles, No. 7556, two 1½-inch Wood Strain Insulators, with 12 inches of insulation, two connecting castings and a Section Insulator exactly similar to our Type A, No. 10409 with the exception of having two suspension eyes with ¾-inch openings.

Messenger cable is fastened to pole bracket at same heights as at points where no section insulator is installed, hence it is unnecessary to provide special length hangers in adjacent spans.

Section Insulator is amply strong to withstand breaking strain of trolley wire without buckling or allowing wire to slip. Will fit 3-0 and 4-0 Grooved Wire. Feeder lugs will accommodate 2-0 to 4-0 feeder wire.

All wood parts are impregnated and varnished; all metal parts except bronze end castings of section insulator are sherardized.

Code Word	No.		List Each
Isography.	11112	Messenger and Trolley Section Insulator for 750 Volts	$30 00
Isolable.	11113	" " " " " " 1,500 "	35 00

CATENARY MESSENGER SECTION INSULATOR

Type CB—6,600-11,000 Volts—Patented



A SIMPLE device for sectionizing messenger cable and insulating it from pole bracket. See page 412.

A $\frac{5}{8}$-inch steel rod designed to be tied into top groove of messenger Insulator, is equipped at the ends with clevises to which are fastened Strain Insulators (7-inch diameter for 6,600 volts and 10-inch diameter for 11,000 volts).

Two $\frac{3}{4}$-inch sherardized turnbuckles are attached to the insulators. Length center to center eyes, maximum 8 feet; minimum, 6 feet.

Code Word	No.	List Each
Isocrymic.	11108—Messenger Section Insulator for 6,600 Volts	$17 00
Isocyanic.	11109— " " " " 11,000 "	19 00

CATENARY TROLLEY SECTION INSULATOR

Type CA—1,500-6,600-11,000 Volts



MADE of selected white oak, impregnated and varnished, and heavy bronze end castings. For installation, see page 412.

Can be used with wheel, sliding or roller contact. Runner piece is renewable.

Openings in suspension eye castings are $\frac{3}{4}$ inch.

No. 13124, 1 foot of insulation, length overall, 4 feet $9\frac{1}{4}$ inches.

No. 10260, 5 feet of insulation, length overall 8 feet, $9\frac{1}{4}$ inches.

No. 10261, 9 feet of insulation; length overall 12 feet, $9\frac{1}{4}$ inches.

Feeder lug will take 4-0 stranded cable. Bolts and suspension castings are sherardized.

Code Word	No.	List Each
Pupipara.	13124—Trolley Section Insulator, 1,500 Volts, 4-0 Grooved Wire	$30 00
Isogonic.	10260— " " " 6,600 " 4-0 " "	33 50
Isogonism.	10261— " " " 11,000 " 4-0 " "	35 00

CATENARY WHEEL-PANTOGRAPH CROSS-OVER

Patented

6,600 Volts AC—1,500 Volts DC



USED where it is desired to insulate two crossing trolley wires, one operating trolley wheel and the other with pantograph.

Adjustable between 45 and 90 degrees.

Runway for trolley wheel drops down 5 inches in the center, at the point of crossing, so as to give good clearance for the ends of the pantograph.

Insulation is afforded by an impregnated hardwood beam.

It is good practice to install section insulators in the high voltage line on each side of the crossing point.

Both live and insulated runways are equipped with renewable bronze cam tips having lips 6 inches long.

Cross runner piece is easily removed by taking out two bolts and pantograph wire is installed without cutting.

Ends of insulated wire are clamped by strong U-bolt clamps.

Length overall, insulated member, 8 feet; live member, 37 inches.

Code Word	No.	List Each
Rehearse.	13282—Wheel-Pantograph Cross-Over for 4-0 Round and Grooved Wires	$57 00

For listing of Renewable Bronze Cam Tips, see page 374.

O-B Rail Bonds and Bonding Tools

Described and listed in the section immediately following

O-B Catenary Materials

Described and listed in the preceding section

O-B RAIL BONDS

Patented



Concealed Type Bond on Web of Tee Rail

See pages 474-481 for listing.



Exposed Type Bond on Web of Tee Rail Around Splice Plate

See pages 482-491 for listing.



Mechanically Applied Type Bond on Ball of Tee Rail

See page 471 for listing.

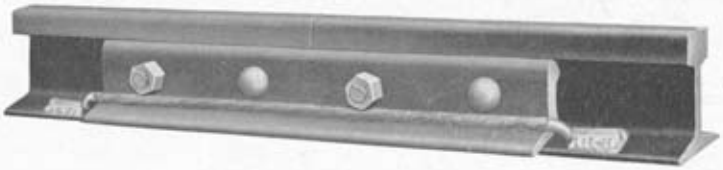
O-B RAIL BONDS

Patented



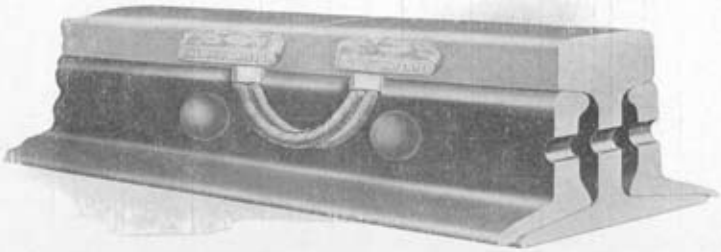
O-B Electric Arc-Weld Bond Applied on Ball of Tee Rail

See pages 458-459 for listing.



O-B Electric Arc-Weld Bond Applied on Base of Tee Rail

See page 457 for listing.



O-B Gas-Weld Bond Applied on Ball of Tee Rail

See pages 464-466 for listing.

DIMENSIONS OF STANDARD TEE RAILS

A. S. C. E. Section

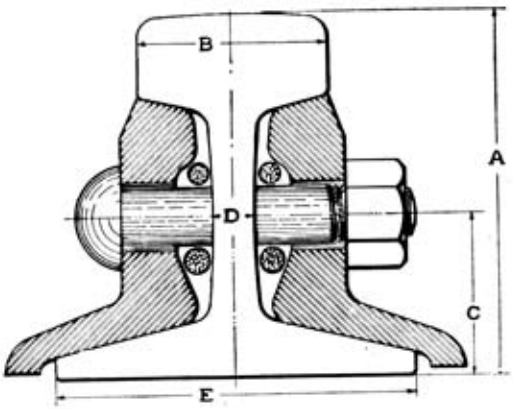


Figure 1

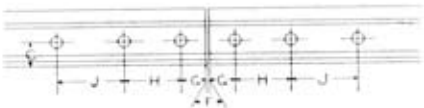


Fig. 2—Rail Drilling

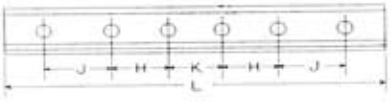
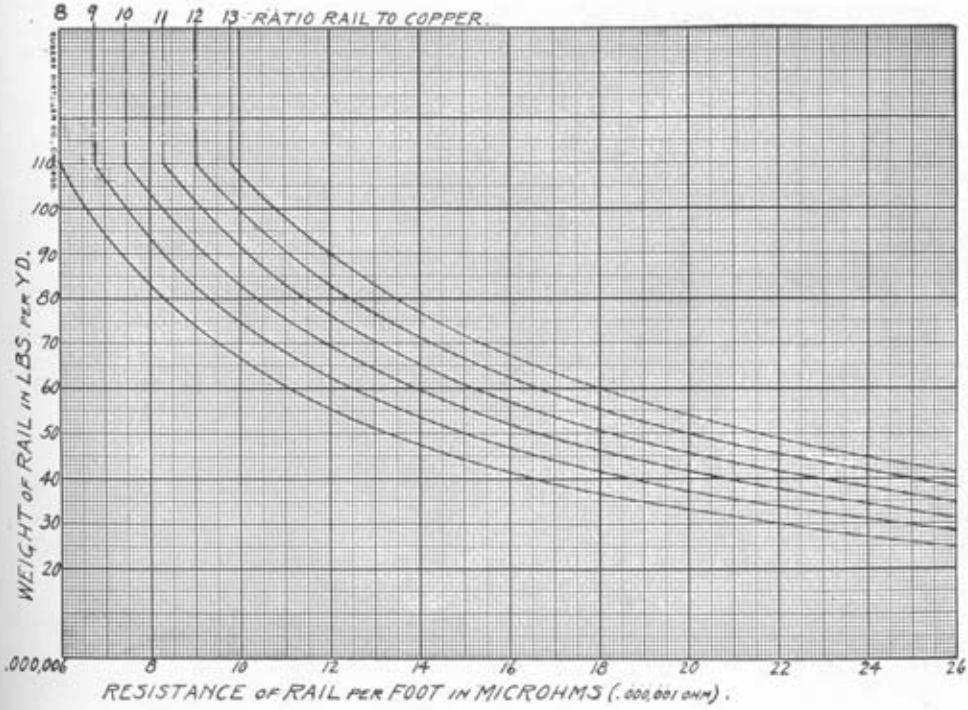


Fig. 3—Splice Bar Punching

Weight of Rail per Yard in pounds	Dimensions of Rail Sections in Inches See Figure 1					Rail Drilling and Splice Bar Punching in Inches See Figures 2 and 3						Size Hole in Rail
	A	B	C	D	E	F	G	H	J	K	L	
16	2 3/8	1 11/64	1 7/128	7/32	2 3/8	1/8	2	4	..	4 1/8	16 1/8	5/8
20	2 3/8	1 11/64	1 11/64	1/4	2 3/8	1/8	2	4	..	4 1/8	16 1/8	5/8
30	3 1/8	1 11/16	1 25/64	21/64	3 1/8	1/8	2	4	..	4 1/8	16 1/8	5/8
40	3 1/2	1 3/4	1 7/8	23/64	3 1/2	1/8	2	5	..	5 1/8	20	5/8
45	3 11/16	2	1 31/64	25/64	3 11/16	1/8	2	5	..	5 1/8	20	5/8
50	3 7/8	2 1/8	1 29/64	27/64	3 7/8	1/8	2	5	..	5 1/16	24	1
55	4 1/16	2 1/4	1 1 1/32	29/64	4 1/16	1/16	2	5	..	5 1/16	24	1
60	4 1/8	2 1/2	1 1 1/32	31/64	4 1/8	1/16	2	5	..	5 1/16	24	1
65	4 7/16	2 13/32	1 1 1/32	1/2	4 7/16	1/16	2	5	..	5 1/16	24	1
70	4 5/8	2 7/16	2 1 3/64	33/64	4 5/8	1/16	2	5	6	5 1/16	34	1
75	4 13/16	2 1/2	2 1 5/128	17/32	4 13/16	1/16	2	5	6	5 1/16	34	1 1/8
80	5	2 1/2	2 1 3/64	35/64	5	1/16	2	5	6	5 1/16	34	1 1/8
85	5 3/16	2 9/16	2 1 7/64	9/16	5 3/16	1/16	2	5	6	5 1/16	34	1 1/4
90	5 3/8	2 5/8	2 1 9/128	19/32	5 3/8	1/16	2	5	6	5 1/16	34	1 1/4
95	5 9/16	2 11/16	2 1 5/64	39/64	5 9/16	1/16	2	5	6	5 1/16	34	1 1/4
100	5 3/4	2 3/4	2 1 3/128	5/8	5 3/4	1/16	2	5	6	5 1/16	34	1 1/4
110	6 1/8	2 7/8	2 1 3/64	41/64	6 1/8	1/16	2	5	6	5 1/16	34	1 1/4

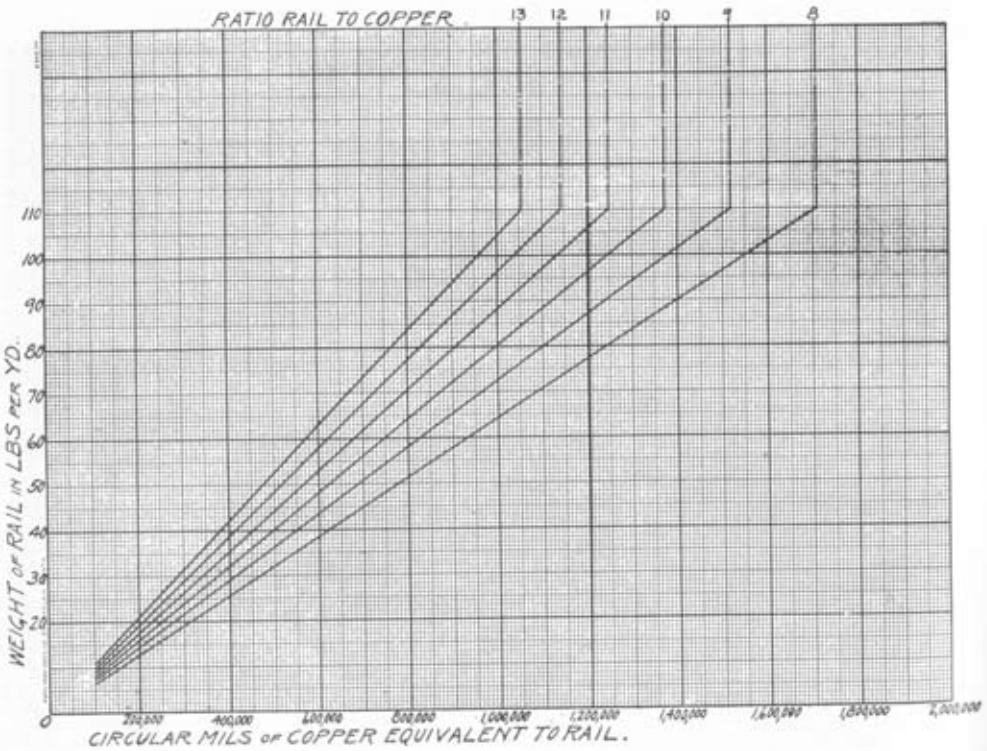
RESISTANCE OF STEEL RAILS



THIS chart shows the resistance of 1 foot length of rail in microhms (.000,001 ohm) for different weights of rail and ratios of rail to copper.

EXAMPLE: What is the resistance per foot of a 70-pound per yard rail for a ratio of 11 to 1? Follow the horizontal line through 70, at the left, to the right until it intersects the curve marked 11, then follow the vertical line through the intersection downward and read .000,013 ohm per foot.

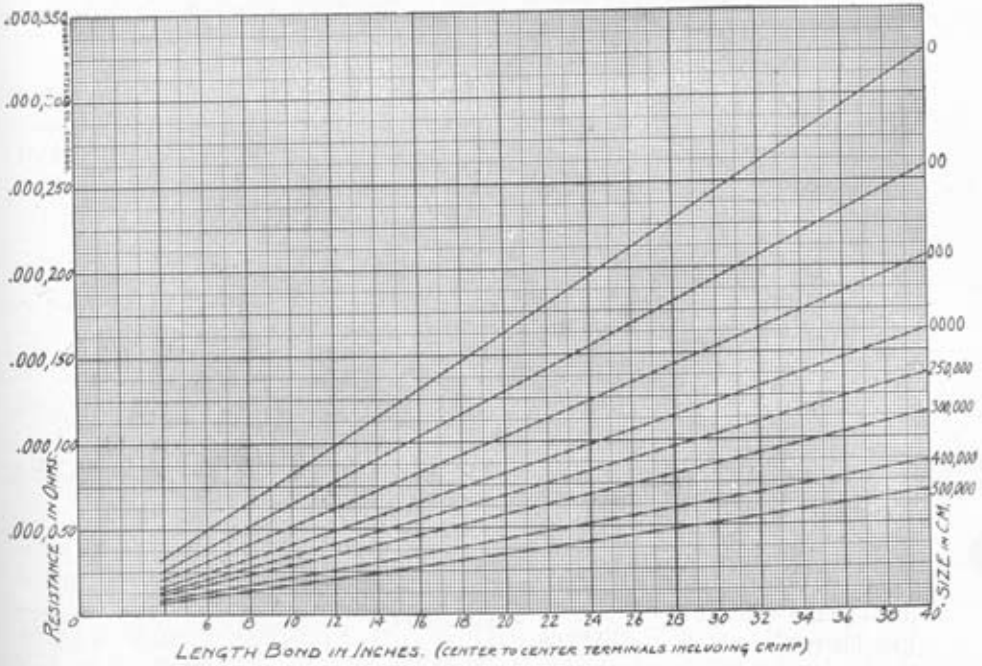
COPPER EQUIVALENT OF STEEL RAILS



THIS chart shows the equivalent section in copper of different weights of rail for various ratios of the resistance of the rail to that of copper.

EXAMPLE: What is the equivalent cross section of copper for a 60 pound per yard rail having a ratio of 11 to 1? Follow the horizontal line through 60, at the left, to the right until it intersects the curve marked 11, at the top, and follow down on the vertical line through this intersection and read 680,000 circular mils, the equivalent of the rail in copper.

RESISTANCE OF RAIL BONDS



THIS chart shows the resistance of different capacities and lengths of rail bonds. The length is the unformed length between centers of terminals.

EXAMPLE: What capacity of bond 24 inches long will have a resistance of .0001 ohm? Follow horizontal line through .000,100, at left, to the right until it intersects the vertical line through 24 inches—and the nearest curve is that marked 0000, the capacity of the required bond.

ELECTRICAL RAIL BOND TESTING

ONE of the best methods of finding the resistance of a bonded joint is to use two millivoltmeters and determine the number of feet of rail equivalent to the bonded joint. A duplex millivoltmeter is preferable to two separate instruments and should be connected as shown in Fig. 1.

There must be sufficient current flowing in the rail to give a fair deflection on the instruments.

The contact "C" should be moved along the rail until the two needles give the same reading. The drop along the joint is now equal to the drop along "Y" feet of rail. As the current is the same in both sections the resistance of the bonded joint AB equals the resistance of "Y" feet of rail. The resistance of rail per foot is given on page 449.

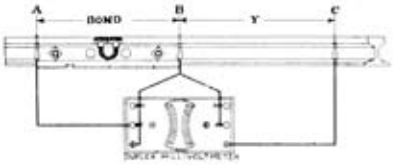


Fig. 1

The added resistance of the bonded joint is therefore equal to Y - AB feet of rail.

Where the current flowing in the rail is not great enough to give good deflections on the millivoltmeters it is customary to operate a line car close to the tester to produce the current flow. On alternating current systems, an independent direct current, furnished by a portable generator or storage battery, should be passed through the joint and section of rail "Y" during the test.

It is highly important to know how much resistance is added to the joint in feet of rail equivalent when the bonding is in good condition. The old rule that a joint should test three feet of rail or better has no significance and in many cases is entirely wrong.

Fig. 2 is a chart which gives the added resistance expressed in equivalent length of rail equal to the bonded joint for various capacities and lengths of bonds and weights of rail when the bond is in the best condition.

The actual unformed length of the bond, the capacity of the bond and the weight of the rail per yard, must be known. Follow the vertical line through the actual length of the bond (shown at

ELECTRICAL RAIL BOND TESTING

Continued

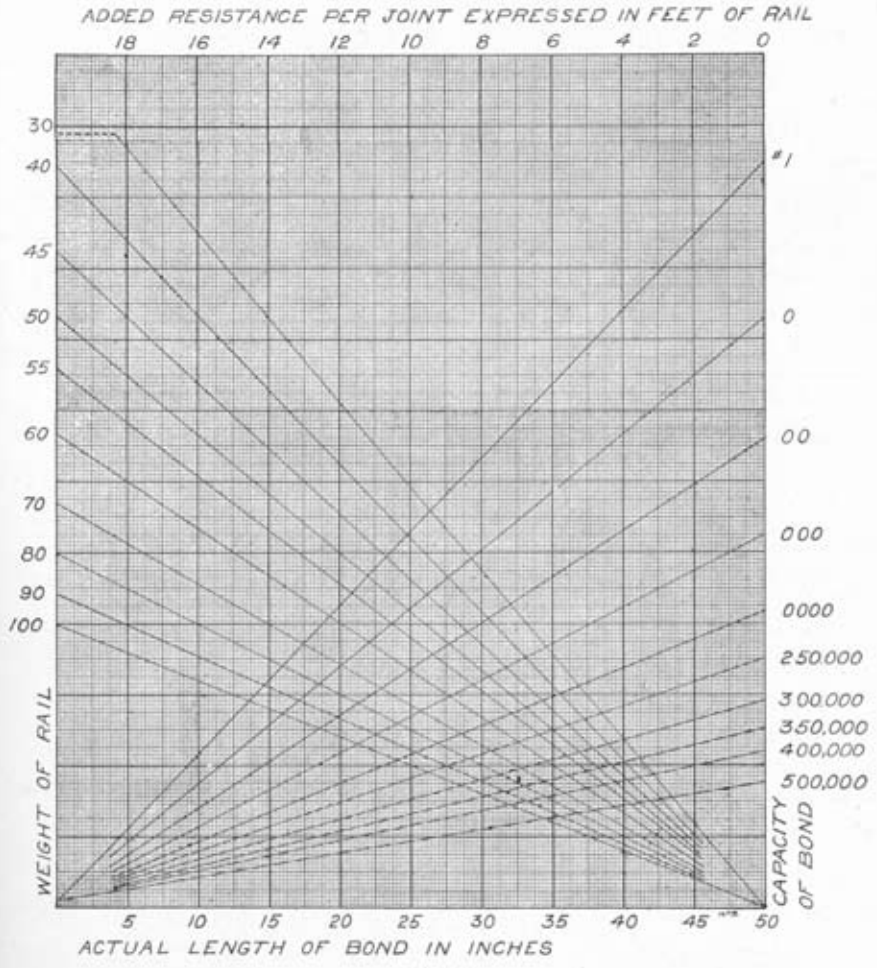


Fig. 2

the bottom) until it intersects the diagonal representing the capacity of the bond (shown at the right). Follow the horizontal line through this intersection until it cuts the diagonal representing the weight of rail (shown at the left). Follow the vertical line through this point upward and read the added resistance per joint expressed in feet of rail (shown at top). This chart shows the standard for a given bonded joint with which its actual condition may be compared.

O-B RAIL BONDS

Cable Data

Double Strand Balanced Bonds

Types F-3, F-3-T, F-5, F-7, GW, ST-1, ST-2, AW-1, AW-3, M, J

Capacity of Bond, B. & S. Gauge	Capacity of Each Strand		No. of Wires in Each Strand	Diameter of Each Strand, Inches
	B. & S.	Cir. Mils		
0	3	52,640	27	.276
2–0	2	66,370	37	.297
3–0	1	83,690	37	.333
4–0	0	105,500	61	.375

Double Strand Unbalanced Bonds

Types F-4, F-6, F-8

Capacity of Bond, B. & S. Gauge	Capacity of Strands		No. of Wires in Strands	Diameter of Strands, Inches
	B. & S.	Cir. Mils		
2–0	3	52,640	27	.276
	1	83,690	37	.333
3–0	2	66,370	37	.297
	0	105,500	61	.375
4–0	1	83,690	37	.333
	2–0	133,100	37	.420

Single Strand Bonds

Types E-1, E-2, AW-2, HL, N, Signal

Capacity, B. & S. Gauge	Capacity Circular Mils	Number of Wires	Diameter of Strand, Inches
1	83,690	37	.333
0	105,500	61	.375
2–0	133,100	37	.420
3–0	167,800	37	.472
4–0	211,600	37	.529
250,000	250,000	61	.576
300,000	300,000	61	.639
400,000	400,000	75	.785

O-B RAIL BONDS

Patented

ON the following pages are shown the many standard types, forms and sizes of O-B Rail Bonds. Other types and sizes to meet special conditions will be furnished as ordered.

A number of O-B engineers, who are experts on Rail Bonds are available to assist in solving the more difficult bond problems. You are invited to consult with these engineers, and thereby get the benefit of their long experience and special study of the subject.

Directions for Ordering

Always state the type, form, length, capacity and diameter of terminals if a stud terminal bond. If it is desired to take advantage of O-B Engineering Assistance, give the maker's name, and section number of the rail and the splice bar. Also specify the track bolt spacing and the diameter of the track bolts. If the holes for bond terminals have been drilled, state location of these holes.

ELECTRIC ARC WELDING

THERE are two methods of arc welding in common use; the carbon arc process and the metallic arc process.

The carbon arc process is the older and employs a carbon pencil which is used to draw the arc from the welding surface. Metal is then fed into this arc where it melts and unites with the fused surface, forming the weld. Owing to the tendency of the carbon arc to add carbon to the weld, causing hard spots, this method has been superseded largely by the metallic arc process in which a metal rod is used as the electrode to draw the arc which, in turn, melts off the end of the electrode, the molten metal uniting with the fused surface of the work forming the weld.

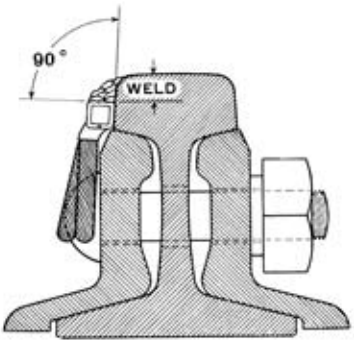


Fig. 1—O-B Arc-Weld Bond on Ball of Rail

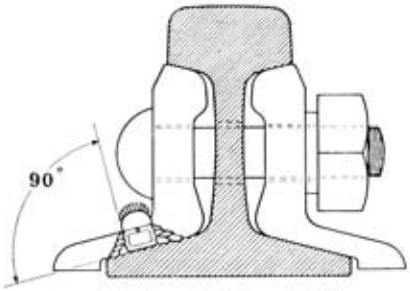


Fig. 2—O-B Arc-Weld Bond on Base of Rail

In welding, the best results are obtained with a 90° angle between the surfaces to be welded together, and in the application of the process to rail bonding, this fundamental principle has been employed. Fig. 1 and Fig. 2 illustrate O-B ball-of-rail bond and base-of-rail bond applied, showing the 90° angle between the welding surfaces. The ball-of-rail bond is best employed on rail of 50 or 60 pounds weight per yard or over. For lighter rails, the base-of-rail type is better adapted, particularly where there is a tendency for the locomotive wheels to form false or double flanges.

A booklet describing the arc-weld bonding process in detail will be mailed on request.

O-B RAIL BONDS

Type AW-2—Armored Terminal—Patented

For Application by Metallic Arc-Weld Process



WELDED to base of rail as shown on page 447. May be used either in electric railway or mine service. Can be applied with any electric arc welding machine now on the market. O-B Arc Welding Machines are described on pages 460-461.

An armor of sheet steel completely encircles the copper terminal and is welded to it at the factory. In application the operator welds "steel to steel with steel"—the easiest type of electric welding.

The Bond terminal makes a ninety degree angle with the rail—another requisite for a successful weld.

Soft steel welding rod is used. About 25 pounds of rod should be ordered with each 100 bonds.

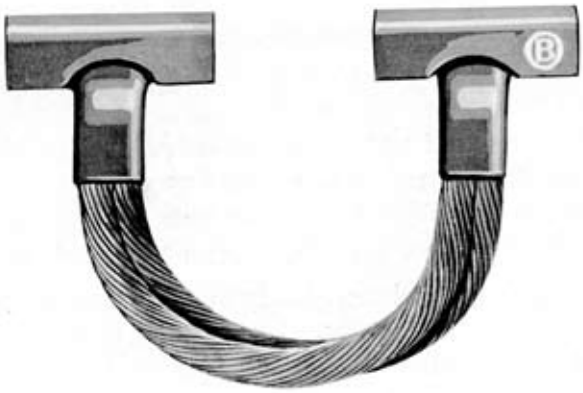
Code Word	No.								List per 100
Sleepless.	13649—Type AW-2 Bond, length 11¼ inches, capacity							2-0	$ 57 15
Rickrack.	13650—	"	"	"	"	11¼	"	" 4-0	77 15
Ricochet.	13651—	"	"	"	"	22	"	" 2-0	75 70
Rictal.	13652—	"	"	"	"	22	"	" 4-0	109 30
Ricture.	13653—	"	"	"	"	24	"	" 2-0	79 30
Riddance.	13654—	"	"	"	"	24	"	" 4-0	114 70
Riddle.	13655—	"	"	"	"	26	"	" 2-0	82 90
Ridgelet.	13656—	"	"	"	"	26	"	" 4-0	120 10
Ridicule.	13657—	"	"	"	"	28	"	" 2-0	86 50
Riding.	13658—	"	"	"	"	28	"	" 4-0	125 50
Rifler.	13659—	"	"	"	"	30	"	" 2-0	90 10
Rifling.	13660—	"	"	"	"	30	"	" 4-0	130 90
Rigadoon.	13661—	"	"	"	"	32	"	" 2-0	93 70
Rigation.	13662—	"	"	"	"	32	"	" 4-0	136 30
Rigger.	13663—	"	"	"	"	34	"	" 2-0	97 30
Riggish.	13664—	"	"	"	"	34	"	" 4-0	141 70
Righten.	13665—	"	"	"	"	36	"	" 2-0	100 90
Rightful.	13666—	"	"	"	"	36	"	" 4-0	147 10
Residuous.	13549 Soft Steel Welding Rod, ⅜-inch diameter, per 100 lbs.								30 00

Above Bonds can be furnished in any length over 11¼ inches.
For listing of Welding Machines, see pages 460–461.

O-B RAIL BONDS

Type AW-3—Armored Terminal—Patented

For Application by Metallic Arc-Weld Process



WELDED to ball of rail as shown on page 447. May be used either in electric railway or mine service on rail of 40 lbs. per yard or heavier. Can be applied with any electric Arc-Welding machine now on the market. O-B Arc Welding Machines are described on pages 460-461.

An armor of sheet steel completely encircles the copper terminal and is welded to it at the factory. In application the operator welds "steel to steel with steel"—the easiest type of electric welding.

The Bond terminal makes a ninety degree angle with the rail—another requisite for a successful weld.

When completed the terminal is beveled from the rail. This reduces the possibility of injury from car wheels, etc.

Soft steel welding rod is used. About 25 pounds of rod should be ordered with each 100 bonds.

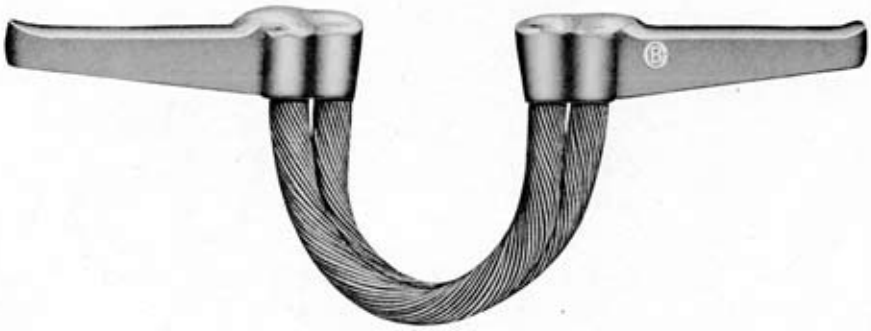
Code Word	No.	List per 100
Rightly.	13667—Type AW-3 Bond, length 7 inches, capacity 2-0	$48 20
Rimple.	13668— " " " " 7 " " 4-0	59 00
Residuous.	13549—Soft Steel Welding Rod, $\frac{3}{16}$-inch diameter, per 100 pounds	30 00

For listing of Welding Machines, see pages 460–461.
For listing of Clamp, see page 462.

O-B RAIL BONDS

Type AW-1—Steel Terminal—Patented

For Application by Metallic Arc-Weld Process



THIS Bond is applicable to both railway and mine service. Can be welded to the ball or the base of the rail successfully with any of the electric arc welding machines now on the market. The machines listed on the following pages are especially designed for this work.

The Bond consists of copper cables, the ends of which are fused and welded to steel terminals in our factory thereby forming the electrical and mechanical connection between the strands and terminals.

In application, the steel terminals are welded to the rail by the addition of metal from the steel electrode which is fused in the arc. When completed, the terminal has a beveled surface which eliminates the possibility of injury from car wheels, etc.

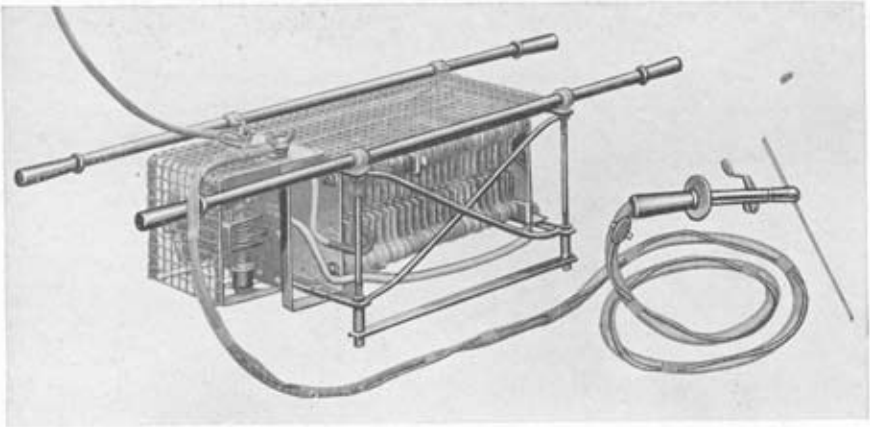
Soft steel welding rod is used; about 25 pounds of rod should be ordered with each 100 Bonds.

Code Word	No.	List Price
Residence.	13538—Type A-W Bond, capacity 4-0, per 100	$60 25
Residuous.	13549—Soft Steel Welding Rod, $\frac{3}{16}$-inch diameter, per 100 pounds	30 00

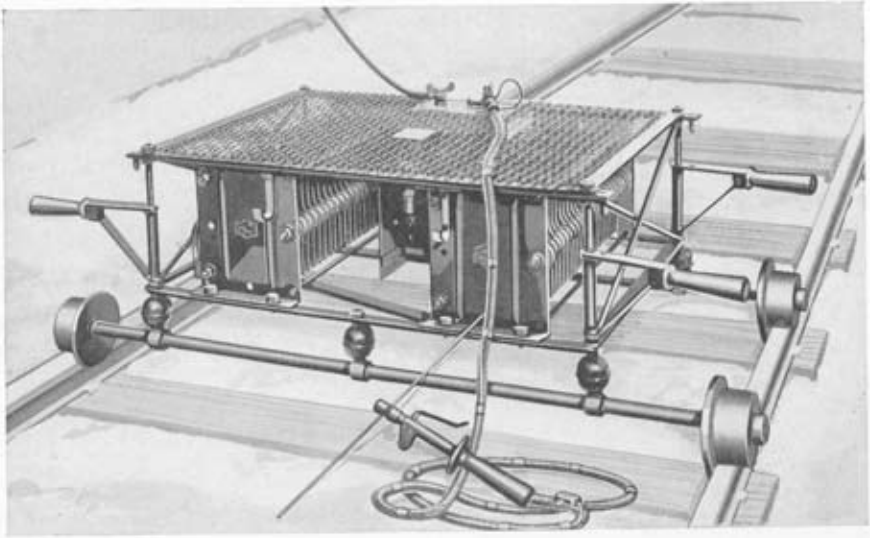
For listing of Welding Machines, see pages 460–461.
For listing of Clamp, see page 462.

ELECTRIC ARC WELDING MACHINES

Resistance Type—Patented



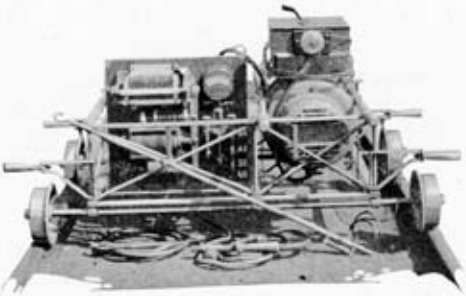
NO. 13541—250 volts. Length, not including handles, 40 inches; width, 19 inches; height, 20 inches. Net weight, 160 pounds.



NOS. 13672–13675—500–600 volts. Length, not including handles or axles, 43 inches; width, 28 inches; height, 19 inches. Net weight, 320 pounds.

For listing, see opposite page.

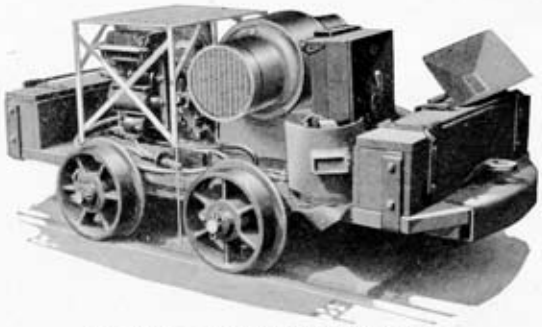
WILSON Plastic-Arc RAIL BOND WELDERS



Machine mounted on Flanged Wheel Truck



Machine mounted on Auto Trailer



Machine mounted on Mine Car Truck

THE Wilson machines were designed and are built by the Wilson Welder and Metals Company of Brooklyn, N. Y.

These machines are of the dynamotor type using the metallic arc process and with the exception of the trailer type are built for two voltage ranges; 350 to 650 Volts DC and 175 to 350 Volts DC. The trailer type is built for 350 to 650 Volts only.

The remarkable feature in these machines is the method of controlling the current, producing a short arc with uniform heat in the weld.

WILSON PLASTIC ARC RAIL BOND WELDER AND ACCESSORIES

WILSON Plastic Arc Rail Bond Welder complete includes starting box, dynamotor, control panel, rheostat, welder's eye shield, wire brush, trolley contact pole, fuse, 30 ft. trolley contact cable, 70 ft. electrode cable, 12 ft. ground cable with clip and electrode holder.

Machines for 150 to 350 volt service are furnished with 30 ampere fuse; those for 350 to 650 volt service, 20 ampere fuse.

Code Word	No.	List Each
Skedaddle	13969—Machine for 150 to 350 volt service, not mounted, but with frame for mounting.	
Skeleton	13970—Machine for 350 to 650 volt service, not mounted, but with frame for mounting.	
Skeptic	13971—Machine for 150 to 350 volt service mounted on mine car truck. (Specify track gauge and buffer height when ordering)	
Skepticism	13972—Machine for 350 to 650 volt service mounted on mine car truck. (Specify track gauge and buffer height when ordering)	
Sketchbook	13973—Machine for 150 to 350 volt service mounted on flanged wheel truck, dynamotor removable (Specify track gauge when ordering)	
Sketcher	13974—Machine for 350 to 650 volt service mounted on flanged wheel truck, Dynamotor removable, specify track gauge when ordering.	
Skillet	13975—Machine for 350 to 650 volt service mounted on auto trailer, standard automobile gauge, solid or pneumatic tires as specified.	
Skinflint	13976—Motor Brush for 150 to 350 volt machine, (4 required for set)	
Skipper	13977—Motor Brush for 350 to 650 volt machine, (4 required for set)	
Skullcap	13978—Generator Brush (6 required for set)	
Slander	13979—Carbon Plates for carbon pile (19 required for complete set)	
Skimming	13980—Copper cooling flange, with retainer, for carbon pile, (19 required for set)	
Slangy	13981—Carbon end plates (2 required for set)	
Slanting	13982—Trolley contact pole complete, with hook contact	
Slapjack	13983—Trolley contact pole complete, with under-run contact.	
Slapper	13984—Extra Flexible electrode cable, per foot	
Slashed	13985—Electrode extension and ground cable, per foot	
Slattern	13986—Electrode Holder	

PLASTIC ARC WELDING METALS

Code Word	No.	List Per 100 lbs.
Sister	13945—Grade 4 Metal—.148" Dia. For building up cam or wearing surfaces on steel work	$65.00
Sisterly	13946—Grade 8 Metal—.148" Dia. Useful for building up worn places where high tensile strength is not required. Can be readily machined. Steel parts, less than .15 C	12.00
Sitting	13947—Grade 9 Metal—.148" Dia. For use on all cast steel parts requiring high strength in the weld. Standard with many R.R. and shipyards for this purpose. Steel engine frames; engine axles; rolled steel (over .25C); propeller shafts; crankshafts; cast steel parts; solid axles; filling blow-holes in steel castings; locomotive wheel tires; frogs; crossings; switch points; bearing surface of shafts; rolling mill machinery (steel parts); steel rails (for strength); steel valves; ship rudder supports; ship rudder shafts; rail bonds; rail welding	14.00
Situate	13948—Grade 12 Metal—.148" Dia. For cast iron welding without studding	95.00
Sixfooter	13949—Grade 17 Metal—.148" Dia. For use in filling blow-holes in steel and gray iron castings and all work where parts are not subject to undue strains or where tensile strength is not an important factor. Blow-holes in cast iron and cast steel; farming machinery (cast iron parts); worn spots on propeller blades; rail bonds	9.00
Sixpenny	13950—Grade 20 Metal—.148" Dia. Bronze alloy for bells and all brass, copper and bronze work; pipes; valves; propeller blades; submarine brass and copper parts; kettles; telescope tubes; periscope sleeves; filling bronze castings; filling bronze rolls; filling car bearings; filling core support holes in bronze statues; rail bonds and rail welding where high conductivity is essential.	60.00
Sixteenth	13951—Grade 30 Metal—.148" Dia. This is an exceptionally easy and fast flowing electrode and lays relatively flat where deposited; of medium tensile strength; specially designed for welding thin cast iron. Thin cast iron (less than ¼"); cast iron electric motor frames; sheet steel (¼" approximately); cast iron automobile cylinders; farming machinery (malleable parts); rail bonds; rail welding	12.00
Sizzle	13952—Grade 31 Metal—.148" Dia. High tensile strength and conductivity combined with very smooth flowing specially designed for overhead welding with deep penetration.	15.00
Skater	13953—Grade 33 Metal—.148" Dia. Exceptionally smooth flowing qualities. Specially designed for overhead welding deep penetration.	16.00

Number 13949, covering Grade 17 Metal is the one we propose to furnish for rail bonding. Grades 4 and 12 are wrapped in five pound packages in addition to fifty pound and one hundred pound packages. Grade 8, 9, 17, 20, 30, 31 and 33 are sold in packages fifty or one hundred pounds each. All metal is cut and straightened in 14" lengths and treated with a rust proof coating which improves the welding quality. The above metal regularly furnished in .148" Dia. (about 5-32") but can also be furnished in .120" Dia. (about ⅛").

ELECTRIC ARC WELDING MACHINES

Resistance Type—Patented—Continued

THESE machines are especially designed for Arc-Weld Bonding. They are safe, simple and easy to use.

Consist of a resistance grid and two switches, the latter being the only moving parts. The main switch, which controls the arc circuit, is operated by a push button on the electrode holder, controlled by the operator. In addition, it is automatically opened in case of overload.

Can be set to deliver current from 125 to 175 amperes. Several taps are provided to take care of different voltages.

250 Volts, Direct Current

For Mine Service

Code Word	No.	List Each
Resign.	13541—Welding Machine, 250 volts, complete with Electrode Holder, 12 feet Electrode Cable, 12 feet Trolley Contact Cable, Helmet and Wire Brush	$500 00

500-600 Volts, Direct Current

For Mine or Railway Service

Ripple.	13672—Welding Machine, for mines, complete with Electrode Holder, 12 feet Electrode Cable, 12 feet Trolley Contact Cable, Helmet and Wire Brush	$800 00
Riprap.	13675—Welding Machine, for electric railways, complete with Electrode Holder, 12 feet Electrode Cable, 30 feet Trolley Contact Cable, Helmet and Wire Brush	825 00

In ordering 500–600-volt machine specify track gauge, and maximum operating voltage. Machine can be furnished for over 600 volts on special order.

Accessories for 250-Volt and 500-600-Volt Machines

Code Word	No.	List Price
Ripsaw.	13676—Electrode Holder, complete with 12 feet Cable and Push Button Switch, each	$ 50 00
Rescribe.	13542—Electrode Holder only, each	20 00
Rescue.	13543—Push-Button Switch, each	1 20
Research.	13544—Electrode Cable, extra flexible, per foot	2 00
Resemble.	13545—Trolley Contact Cable, per foot	1 80
Resiant.	13548—Wire Brush, each	1 50
Seamstress.	13802—Resistance Element complete, each	100 00
Seaport.	13803— " Grid only, each	1 30
Residuous	13549—Soft Steel Arc Welding Rod, $\frac{1}{16}$-inch diameter, per 100 pounds	30 00
Searcher.	13550—Bronze Arc Welding Rod, .204-inch diameter, per 100 pounds	150 00

WELDER'S HELMET AND EYE SHIELD

For Arc Welding Operators



Helmet with Door, Containing Colored Glass, Open



Eye Shield No. 13546

HELMET is constructed of aluminum and vulcanized fiber resulting in both durability and minimum weight. The design is such that it is almost impossible for any light or reflection to reach the eye from side or back and fire proof apron protects operator's chest.

Operator can easily open or close the door, containing colored glass. When the door is open a clear glass protects his eyes from flying particles.

Helmet is adjustable for any size. No metal touches the face. Glass can be removed and replaced without tools.

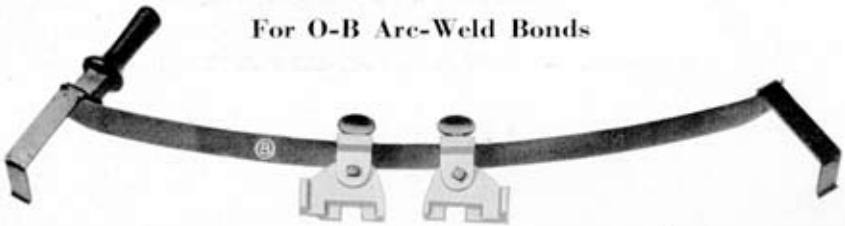
Helmet permits absolutely free use of hands and arms.

Shield is made of fiber and is light in weight. Glass is interchangeable with helmet.

Code Word	No.	List Price
Ringed.	13635—Welder's Helmet	$18 00
Resent.	13546—Welder's Eye Shield	16 00
Ringer.	13669—Complete set lenses only for Welder's Helmet or Shield	2 00

BONDING CLAMP

For O-B Arc-Weld Bonds



USED to hold O-B Arc-Weld Bonds on the ball of the rail during welding.

Code Word	No.	List Each
Reseige.	13539—Clamp for Type AW-1 Bond	$6 00
Rindle.	13648— " " " AW-3 Bond	6 00

O-B GAS-WELD BONDING PROCESS

General Description

BOND terminals are welded to rail by oxy-acetylene flame such as is ordinarily used in other welding operations. The application of an intense heat to a limited area fuses the metals together forming a molecular union between them. A thorough, permanent contact is obtained at a low cost for installation.

Welding equipment is low in cost and easy to operate. The necessary tanks of compressed oxygen and dissolved acetylene are obtained by the user direct from the gas manufacturers who have warehouses and charging plants distributed generally over the country, thus insuring prompt service.

Each tank is equipped with a pressure regulator and set of gauges which are changed from tank to tank, as empties are replaced. Two lengths of hose and blow-pipe complete the welding equipment.



Three Types of Trucks

Various types of trucks for carrying the entire welding equipment can be purchased or made by the user.

O-B Bonds for application by this process are listed on pages 464 to 469 inclusive.

O-B RAIL BONDS

Type ST-2—Steel Armored Terminal—Patented

For Application by Gas-Weld Process



STRANDS are formed into terminals which are surrounded and protected by pressed steel sleeves.

In application, by the addition of flux metal, the steel sleeves as well as the copper terminals, are welded to the rail. This gives added mechanical strength and protection to the individual strands of the Bond.

When installation is completed the terminal has a beveled surface which eliminates the possibility of injury by car wheels, wagon wheels, etc.

Length, unformed, 7 inches.

Flux wire affords the metal for building up the terminal and contains the flux needed for the welding operation. About 15 pounds of wire should be ordered with each 100 Bonds.

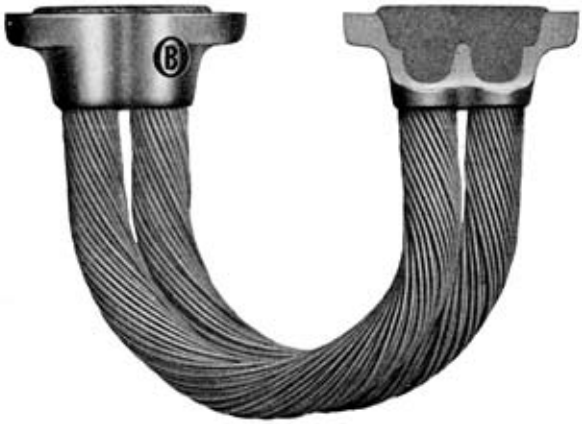
Code Word	No.	List Price
Repoach.	13537—Type ST-2 Bond, capacity 4-0, per 100	$ 59 00
Pancake.	12630—Flux Wire, per 100 pounds	105 00

For general description of Gas-Weld Process, see page 463.
For listing of Clamps, see page 467.

O-B RAIL BONDS

Type ST-1—Steel Armored Terminal—Patented

For Application by Gas-Weld Process



Right Terminal Sectioned to Show Construction

STRANDS are headed over on the ends to form terminals which are surrounded and protected by forged steel sleeves.

In application, by the addition of flux metal, the steel sleeves as well as the copper terminals, are welded to the rail. This gives added mechanical strength and protection to the individual strands of the Bond.

When installation is completed the terminal has a beveled surface which eliminates the possibility of injury by car wheels, wagon wheels, etc.

Length, unformed, 7 inches.

Flux wire affords the metal for building up the terminal and contains the flux needed for the welding operation. About 20 pounds of wire should be ordered with each 100 Bonds.

Code Word	No.	List Price
Ragout.	13199—Type ST-1 Bond, capacity 4-0, per 100	$ 59 00
Pancake.	12630—Flux Wire, per 100 pounds	105 00

For general description of Gas-Weld Process, see page 463.
For listing of Clamps, see page 467.

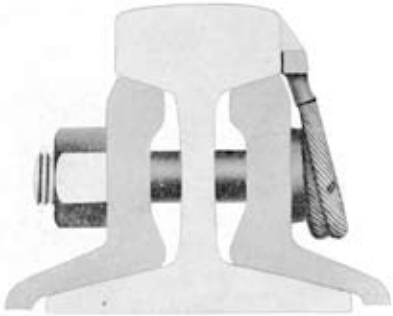
O-B RAIL BONDS

Type G-W—All Copper—Patented

For Application by Gas-Weld Process



No. 12629



No. 12629 Installed



No. 13172



No. 13172 Installed

TERMINAL is solid copper and is well adapted for application by the Gas-Weld Process. When completed by the addition of flux metal during application, terminal has a beveled surface, which eliminates chances of injury from car wheels, wagon wheels, etc.

No. 13172 is laid on top of Weber joint in a horizontal position and terminals are welded to ball of rail by the addition of flux metal.

Length, unformed, No. 12629 and No. 13172, 7 inches.

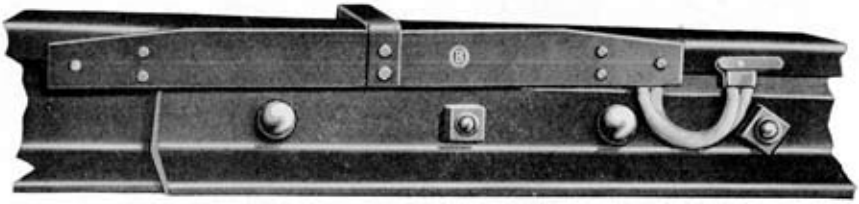
Flux Wire affords the metal for building up the terminal and contains the flux needed for the welding operation. About 25 pounds of wire should be ordered with every 100 Bonds.

Code Word	No.	List Price
Panary.	12629—Type G-W Bond, Standard, capacity 4-0, per 100	$ 61 50
Ragweed.	13172— " " " for Weber Joints, capacity 4-0, per 100.	61 50
Pancake.	12630—Flux Wire, per 100 pounds	105 00

For general description of Gas-Weld Process, see page 463.
For listing of Clamps, see page 467.

BONDING CLAMPS

For O-B Gas-Weld Bonds



No. 13198—Holding Type G-W Bond in Position for Welding

USED for holding O-B Gas-Weld Bonds in position for welding first terminal to the rail. When one terminal is welded, clamp is removed and the second terminal then welded.

Made of substantial spring steel provided with a cast iron pocket at each end for holding the bond terminal. Either end of the clamp is used depending upon which terminal the operator prefers to weld first.

Arm attached to center hooks over top of rail and holds Clamp in place.

Code Word	No.	List Each
Ragwort.	13197—Clamp for Type ST-1 Steel Armored Terminal Bond	$3 00
Reprobate.	13551— " " " ST-2 " " " "	3 00
Raider.	13198— " " " G-W All-Copper Terminal Bond	3 00

O-B SIGNAL BONDS

Patented

For Application by Gas-Weld Process



No. 13692—O-B Signal Bond



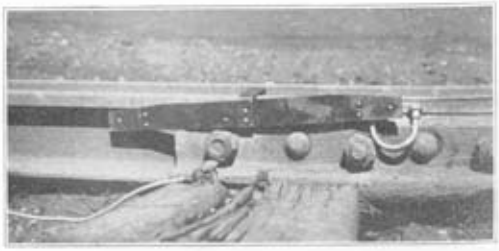
Nos. 13804-13805—O-B Switch Bond



No. 13876—O-B Boot-Leg Connector



No. 13692 Installed on Ball of Rail



Clamp No. 13693 Holding O-B Signal Bond in Position for Welding

See description and listing on the opposite page

O-B SIGNAL BONDS

Patented

For Application by Gas-Weld Process

Continued

DESIGNED for application in the track circuit of steam railroad automatic signal systems.

Bonds are welded to the rail with an oxy-acetylene flame. The result is a signal track circuit of permanently low resistance.

Bonds are made of No. 1 B. & S. gauge stranded copper cable of 37 wires, with pressed steel sleeves at the terminals.

No. 13692 is intended for installation on the ball of the rail at joints.

Nos. 13804 and 13805 are for bonding switches. Ordinarily furnished in the lengths listed below, but may be had in any other lengths desired.

No. 13876 is a boot-leg connector intended for connecting battery and relay leads to the rails. It has a terminal on one end for welding to the rail and a sleeve on the other end for welding to the lead wire. Can be furnished in other lengths than listed.

Clamp No. 13693 is a flat steel spring provided with a strap hook for attaching to the rail ball. At each end is a pocket which fits the bond terminal.

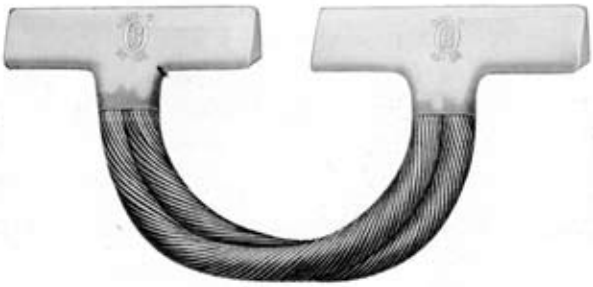
Clamp can be kicked off the rail. Only a thin steel strap is over the rail ball.

The flux rod is a special bronze alloy. About twelve or thirteen pounds are required per 100 bonds.

Code Word	No.	
Sabbath.	13692	O-B Signal Bond, No. 1 B. & S., 7 inches long
Shadowing.	13804	O-B Switch " " 1 " 21 " "
Shaggy.	13805	O-B " " " 1 " 28 " "
Shaken.	13876	O-B Boot-Leg Connector, No. 1 B. & S., 18 inches long
Saccade.	13693	O-B Signal Bond Clamp
Pancake.	12630	Flux Wire, Bronze

O-B RAIL BONDS

Type M—Soldered Terminal—Patented



INTENDED for use on outer face of ball of rail. Terminals are tapered with thin edge at top and contact faces are $2\frac{3}{4}$ x $\frac{9}{16}$ inches.

Center to center of terminals is $3\frac{1}{4}$ inches and distance from upper edge of terminals to lower edge of loop is $2\frac{13}{16}$ inches.

Code Word	No.	List per 100
Lancer.	11114—Type M Bond 4-0 capacity	$62 75

Above Bond can be furnished in other capacities if desired.
All inquiries or orders should give complete specifications as called for on page 455.

O-B RAIL BONDS

Type HL—Soldered Terminal—Patented



DESIGNED for use in bonding around splice bar or for cross-bonding and special work.

Each terminal is 3 inches long and, as overall lengths are given in listing below, a bond of this type should be 6 inches longer than a compressed terminal bond for use under the same conditions.

Code Word	No.	List per 100
Glassful.	8439—Type HL Bond, length 30 inches, capacity 4-0	$118 75
Glazen.	8441— " " " " 36 " " 4-0	134 95
Gleamy.	8443— " " " " 42 " " 4-0	151 15

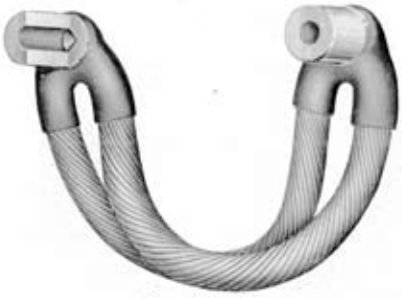
Above Bonds can be furnished in any length and capacity desired.
All orders or inquiries should give complete specifications as called for on page 455.

O-B RAIL BONDS

Type J—For Ball of Rail—Patented



Annular Hole in Rail



No. 11439



Sectional View Installed in Rail

THIS Bond possesses distinctive features in the shape of terminals and the method of making contact with the rail. It is installed in an annular hole milled in the ball of the rail with a hollow cutter which leaves a stud (B) in the center of the hole. This stud is an integral part of the rail and makes contact with the inside of the bond terminal.

Contact surfaces C, D and E, as shown in sectional view, are ample for the capacity of the bond.

Bond is installed by driving terminal in hole with an ordinary hammer, the force of the blows being sufficient to expand the copper into intimate contact with the rail.

Two holes in rail necessary for each bond are milled simultaneously by the Motor Driven Milling Machine listed on page 472. Operation is very rapid.

Hollow Milling Cutters are listed on page 473.

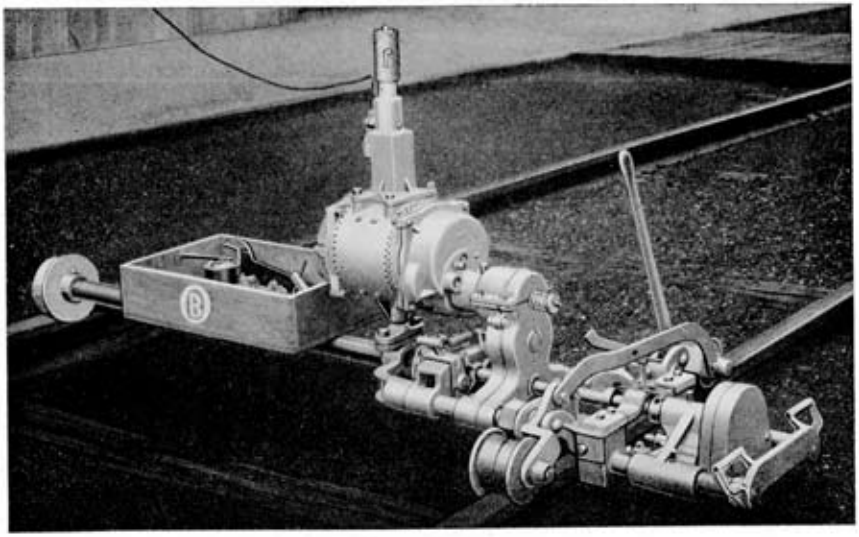
Hole in rail is $\frac{5}{8}$ inch in diameter and $\frac{5}{8}$ inch deep. Type J Bond terminal has $\frac{1}{4}$-inch hole for reception of stud. Capacity of Bond, 4-0; unformed length, 7 inches.

Code Word	No.	List per 100
Nutting.	11439—Type J Bond, capacity 4-0	$66 50

MOTOR DRIVEN MILLING MACHINE

Patented

For Type J Bonds



MILLS simultaneously two holes in the rail for installing the Type J Bond. Operation is very rapid. The cutters listed on the preceding page are fed in automatically and backed out without stopping the motor. Two men can operate the machine while a third cleans the holes, installs Bonds, etc. Machine is mounted on truck and can be quickly moved from joint to joint.

Machine is furnished complete with motor, rubber cover for motor, wrenches, reamer for brightening holes in bond terminals and a spray can with rubber tubing attached, for cleaning chips and oil out of holes in rail.

Motor operates on 600 volts D. C. and is especially designed for this service. Switch is on top of machine within easy reach of operator.

Code Word	No.	List Each
Nymphean.	11440—Milling Machine with Motor	$1000 00

MILLING CUTTER

For Type J Bonds



USED in Milling Machines listed on the preceding page for milling annular holes in ball of rail for installing Type J Bonds.

Made of high speed steel. May be reground easily by means of Grinder, fitted with a special jig, as listed below.

Code Word	No.	List Each
Nymphal.	11441—Milling Cutter	$4 50

CUTTER GRINDER WITH JIG

For Type J Bonds



EQUIPPED with jig for accurately grinding both face and flute of Milling Cutter listed above. Jig holds Cutter firmly and permits of fine adjustment in grinding.

Code Word	No.	List Each
Princely.	12754—Cutter Grinder with Jig, complete	$80 00
Incoach.	10646—Alundum Wheel, 8-inch diameter, 1-inch face	4 80

O-B RAIL BONDS

Type F-3—Compressed Terminal—Patented



INTENDED for installing on web of rail under splice bar, as shown on page 446. Can be used singly to span one or more bolts or can be combined for double or quadruple bonding.

This is a balanced Bond, the two cables being of the same size.

Code Word	No.	Length, Center to Center of Terminals, Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head, Inches	List per 100
Mucigen.	11974	8	0	1-2	17-32	$46 00
Mucilage.	11975	8	0	5-8	17-32	48 50
Mucksy.	11976	8	2-0	1-2	17-32	51 40
Mucocele.	11977	8	2-0	5-8	17-32	51 40
Muconate.	11978	8	2-0	3-4	3-4	56 90
Mucosity.	11979	8	3-0	3-4	3-4	63 80
Muculent.	11980	8	3-0	7-8	3-4	65 80
Mudarin.	11981	8	4-0	3-4	3-4	66 50
Muddle.	11982	8	4-0	7-8	3-4	69 00
Reiterant.	13348	8	4-0	1	3-4	74 00

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.

O-B RAIL BONDS

Type F-3—Compressed Terminal—Continued

Code Word	No.	Length Center to Center of Terminals in Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Mudfish.	11983	9	0	1-2	17-32	$47 50
Mudsill.	11984	9	0	5-8	17-32	50 00
Mudwort.	11985	9	2-0	1-2	17-32	53 00
Muezzin.	11986	9	2-0	5-8	17-32	53 00
Muffetee.	11987	9	2-0	3-4	3-4	58 50
Muffle.	11988	9	3-0	3-4	3-4	66 20
Muffler.	11989	9	3-0	7-8	3-4	68 20
Muggard.	11990	9	4-0	3-4	3-4	69 50
Mugiloid.	11991	9	4-0	7-8	3-4	72 00
Rejoice.	13349	9	4-0	1	3-4	77 00
Mugwump.	11992	10	0	1-2	17-32	49 00
Mulberry.	11993	10	0	5-8	17-32	51 50
Muleteer.	11994	10	2-0	1-2	17-32	54 60
Mullein.	11995	10	2-0	5-8	17-32	54 60
Muller.	11996	10	2-0	3-4	3-4	60 10
Mullock.	11997	10	3-0	3-4	3-4	68 60
Multeity.	11998	10	3-0	7-8	3-4	70 60
Multifid.	11999	10	4-0	3-4	3-4	72 50
Mumble.	12000	10	4-0	7-8	3-4	75 00
Rejoin.	13350	10	4-0	1	3-4	80 00
Mundify.	12004	11	2-0	5-8	17-32	56 30
Muntjac.	12008	11	4-0	3-4	3-4	75 60
Murexan.	12009	11	4-0	7-8	3-4	78 10
Rejudge.	13351	11	4-0	1	3-4	83 10
Pomade.	12812	12	2-0	5-8	17-32	58 00
Pomatum.	12813	12	4-0	3-4	3-4	78 70
Muriate.	12010	12	4-0	7-8	3-4	81 20
Reland.	13352	12	4-0	1	3-4	86 20
Pomfret.	12814	13	2-0	5-8	17-32	59 70
Pommel.	12815	13	4-0	3-4	3-4	81 80
Muriform.	12011	13	4-0	7-8	3-4	84 30
Relapse.	13353	13	4-0	1	3-4	89 30

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.

O-B RAIL BONDS

Type FP-3—Pin Driven Terminal—Patented



INTENDED for installing on web of rail under splice bar, as shown on page 446. Can be used singly to span one or more bolts or can be combined for double or quadruple bonding.

This is a balanced Bond, both cables being of the same size.

Bonds are furnished complete with Steel Expansion Pins.

Code Word	No.	Length, Center to Center of Terminals, Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head, Inches	List per 100
Nephew.	12121	8	0	1-2	17-32	$46 00
Nepotic.	12122	8	0	5-8	17-32	48 50
Neptune.	12123	8	2-0	1-2	17-32	51 40
Nereid.	12124	8	2-0	5-8	17-32	51 40
Neroli.	12125	8	2-0	3-4	19-32	56 90
Nerved.	12126	8	3-0	3-4	19-32	63 80
Nervine.	12127	8	3-0	7-8	19-32	65 80
Nervous.	12128	8	4-0	3-4	19-32	66 50
Nestful.	12129	8	4-0	7-8	19-32	69 00
Relate.	13354	8	4-0	1	19-32	74 00

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.
For listing of Steel Expansion Pins, see page 494.

O-B RAIL BONDS

Type FP-3—Pin Driven Terminal—Continued

Code Word	No.	Length, Center to Center of Terminals, Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head, Inches	List per 100
Nestling.	12130	9	0	1-2	17-32	$47 50
Netfish.	12131	9	0	5-8	17-32	50 00
Netting.	12132	9	2-0	1-2	17-32	53 00
Nettles.	12133	9	2-0	5-8	17-32	53 00
Network.	12134	9	2-0	3-4	19-32	58 50
Neural.	12135	9	3-0	3-4	19-32	66 20
Neurism.	12136	9	3-0	7-8	19-32	68 20
Neurotic.	12137	9	4-0	3-4	19-32	69 50
Neuter.	12138	9	4-0	7-8	19-32	72 00
Relation.	13355	9	4-0	1	19-32	77 00
Nevadite.	12139	10	0	1-2	17-32	49 00
Newcomer.	12140	10	0	5-8	17-32	51 50
Newness.	12141	10	2-0	1-2	17-32	54 60
Newsboy.	12142	10	2-0	5-8	17-32	54 60
Newsroom.	12143	10	2-0	3-4	19-32	60 10
Nexible.	12144	10	3-0	3-4	19-32	68 60
Nibble.	12145	10	3-0	7-8	19-32	70 60
Niblick.	12146	10	4-0	3-4	19-32	72 50
Nicene.	12147	10	4-0	7-8	19-32	75 00
Release.	13356	10	4-0	1	19-32	80 00
Nicotic.	12151	11	2-0	5-8	17-32	56 30
Niggard.	12155	11	4-0	3-4	19-32	75 60
Nighly.	12156	11	4-0	7-8	19-32	78 10
Relagate.	13357	11	4-0	1	19-32	83 10
Ponder.	12824	12	2-0	5-8	17-32	58 00
Pondfish.	12825	12	4-0	3-4	19-32	78 70
Nightcap.	12157	12	4-0	7-8	19-32	81 20
Relent.	13358	12	4-0	1	19-32	86 20
Pongee.	12826	13	2-0	5-8	17-32	59 70
Poniard.	12827	13	4-0	3-4	19-32	81 80
Nighted.	12158	13	4-0	7-8	19-32	84 30
Reliant.	13359	13	4-0	1	19-32	89 30

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.
For listing of Steel Expansion Pins, see page 494.

O-B RAIL BONDS

Type F-3-T—Compressed Terminal—Patented



INTENDED for installing on web of rails where space under splice bar is not sufficient to give clearance for bonds with round cables.

Can be used singly to span one or more bolts or can be combined for double bonding.

This is a balanced bond, the two cables being of the same size.



Code Word	No.	Length Center to Center of Terminals in Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Pomona.	12816	8	2-0	17-32	5-8	$51 40
Pompano.	12817	8	2-0	3-4	3-4	56 90
Overwary.	12485	8	4-0	7-8	3-4	69 00
Overwell.	12486	9	4-0	7-8	3-4	72 00
Overwise.	12487	10	4-0	7-8	3-4	75 00
Overwork.	12488	11	4-0	7-8	3-4	78 10
Overworn.	12489	12	4-0	7-8	3-4	81 20
Ovidian.	12490	13	4-0	7-8	3-4	84 30

A variation of $\frac{1}{2}$ inch in length of terminal under head is allowed.

Above Bonds can be furnished in any desired length, capacity and size of terminal.

In ordering, give full information as called for on page 455.

O-B RAIL BONDS

Type FP-3-T—Pin Driven Terminal—Patented



INTENDED for installing on web of rails where space under splice bar is not sufficient to give clearance for bonds with round cables.



Can be used singly to span one or more bolts or can be combined for double bonding.

This is a balanced Bond, both cables being of the same size.

Bonds are furnished complete with Steel Expansion Pins.

Code Word	No.	Length Center to Center of Terminals in Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Pontage.	12820	8	2-0	5-8	17-32	$51 40
Pontoon.	12821	8	2-0	3-4	19-32	56 90
Owenite.	12491	8	4-0	7-8	19-32	69 00
Owllight.	12492	9	4-0	7-8	19-32	72 00
Oxacid.	12493	10	4-0	7-8	19-32	75 00
Oxalan.	12494	11	4-0	7-8	19-32	78 10
Oxalate.	12495	12	4-0	7-8	19-32	81 20
Oxaline.	12496	13	4-0	7-8	19-32	84 30

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.
For listing of Steel Expansion Pins, see page 494

O-B RAIL BONDS

Compressed or Pin Driven Terminal—Patented



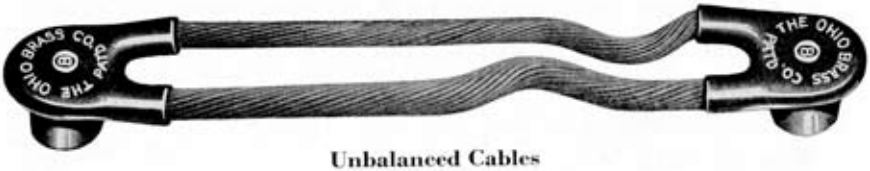
Unbalanced Cables

Type F-4 (Compressed Terminal) or FP-4 (Pin Driven Terminal)



Balanced Cables

Type F-5 (Compressed Terminal) or FP-5 (Pin Driven Terminal)



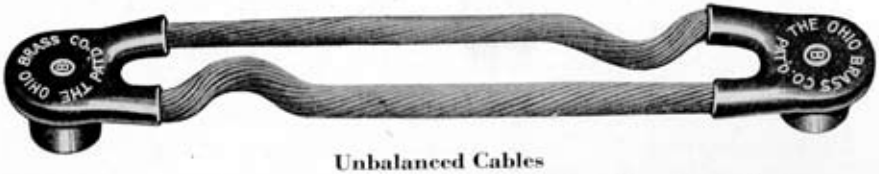
Unbalanced Cables

Type F-6 (Compressed Terminal) or FP-6 (Pin Driven Terminal)



Balanced Cables

Type F-7 (Compressed Terminal) or FP-7 (Pin Driven Terminal)



Unbalanced Cables

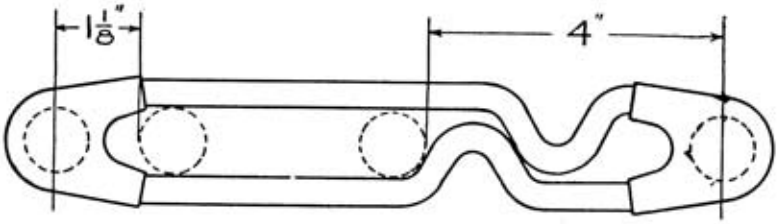
Type F-8 (Compressed Terminal) or FP-8 (Pin Driven Terminal)

Above Bonds can be furnished in any size and capacity.

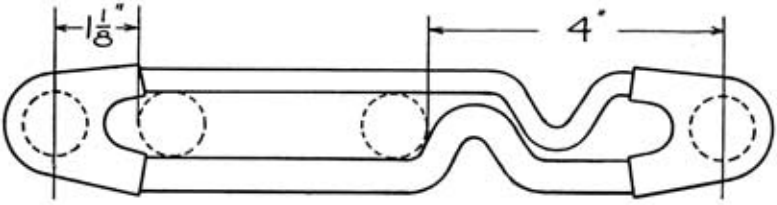
O-B RAIL BONDS

Compressed or Pin Driven Terminal—Patented

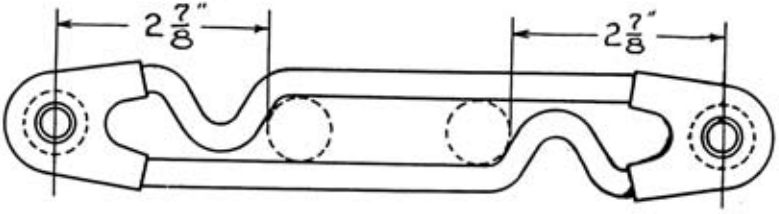
Clearance for Splice Bolts



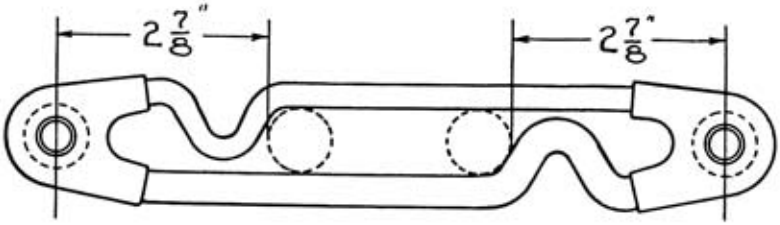
Type F-5 or FP-5—Balanced Cables



Type F-6 or FP-6—Unbalanced Cables



Type F-7 or FP-7—Balanced Cables



Type F-8 or FP-8—Unbalanced Cables

Above dimensions show minimum distance from center of terminal to near side of track bolt with standard crimping of bonds. Special crimping can be furnished on order.

O-B RAIL BONDS

Type E-1—Compressed Terminal—Patented



USED either for bonding around splice plates as shown on page 446, or cross bonding.

Can be installed without removing splice plates.

Bonds should be at least 6 inches longer than splice plates; distance, center to center of holes, should be at least 4 inches greater than length of splice plates.

Code Word	No.	Length, Center to Center of Terminals, Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head, Inches	List per 100
Muscatel.	12018	22	0	1-2	17-32	$ 68 10
Muscid.	12019	22	0	5-8	17-32	70 60
Muscle.	12020	22	2-0	1-2	17-32	75 70
Muscular.	12021	22	2-0	5-8	17-32	75 70
Useful.	12022	22	2-0	3-4	3-4	81 20
Musette.	12023	22	3-0	3-4	3-4	98 10
Mushroom.	12024	22	3-0	7-8	3-4	100 10
Musical.	12025	22	4-0	3-4	3-4	109 30
Musket.	12026	22	4-0	7-8	3-4	111 80
Relief.	13320	22	4-0	1	3-4	116 80
Musketry.	12027	24	0	1-2	17-32	71 10
Muskrat.	12028	24	0	5-8	17-32	73 60
Muskwood.	12029	24	2-0	1-2	17-32	79 30
Musquito.	12030	24	2-0	5-8	17-32	79 30
Mussel.	12031	24	2-0	3-4	3-4	84 80
Mussite.	12032	24	3-0	3-4	3-4	102 70
Mustache.	12033	24	3-0	7-8	3-4	104 70
Mustard.	12034	24	4-0	3-4	3-4	114 70
Mustily.	12035	24	4-0	7-8	3-4	117 20
Religion.	13321	24	4-0	1	3-4	122 20
Mutable.	12036	26	0	1-2	17-32	74 10
Mutage.	12037	26	0	5-8	17-32	76 60
Mutandum.	12038	26	2-0	1-2	17-32	82 90
Mutation.	12039	26	2-0	5-8	17-32	82 90
Mutilate.	12040	26	2-0	3-4	3-4	88 40
Mutiny.	12041	26	3-0	3-4	3-4	107 30
Mutuary.	12042	26	3-0	7-8	3-4	109 30
Muzarab.	12043	26	4-0	3-4	3-4	120 10
Muzzle.	12044	26	4-0	7-8	3-4	122 60
Relish.	13322	26	4-0	1	3-4	127 60
Mycology.	12045	28	0	1-2	17-32	77 10
Mycose.	12046	28	0	5-8	17-32	79 60
Mylodon.	12047	28	2-0	1-2	17-32	86 50
Mynchery.	12048	28	2-0	5-8	17-32	86 50
Myogalid.	12049	28	2-0	3-4	3-4	92 00

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.

O-B RAIL BONDS

Type E-1—Compressed Terminal—Continued

Code Word	No.	Length, Center to Center of Terminals, Inches	Capactiy, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Myolin.	12050	28	3-0	3-4	3-4	$111 90
Myosis.	12051	28	3-0	7-8	3-4	113 90
Myotome.	12052	28	4-0	3-4	3-4	125 50
Myriad.	12053	28	4-0	7-8	3-4	128 00
Relucent.	13323	28	4-0	1	3-4	133 00
Myricin.	12054	30	0	1-2	17-32	80 10
Myronic.	12055	30	0	5-8	17-32	82 60
Myrtle.	12056	30	2-0	1-2	17-32	90 10
Mystery.	12057	30	2-0	5-8	17-32	90 10
Mystical.	12058	30	2-0	3-4	3-4	95 60
Mystify.	12059	30	3-0	3-4	3-4	116 50
Mythical.	12060	30	3-0	7-8	3-4	118 50
Nacarat.	12061	30	4-0	3-4	3-4	130 90
Nacreous.	12062	30	4-0	7-8	3-4	133 40
Relume.	13324	30	4-0	1	3-4	138 40
Nagging.	12063	32	0	1-2	17-32	83 10
Nainsook.	12064	32	0	5-8	17-32	85 60
Namation.	12065	32	2-0	1-2	17-32	93 70
Nameless.	12066	32	2-0	5-8	17-32	93 70
Namesake.	12067	32	2-0	3-4	3-4	99 20
Napery.	12068	32	3-0	3-4	3-4	121 10
Napiform.	12069	32	3-0	7-8	3-4	123 10
Napoleon.	12070	32	4-0	3-4	3-4	136 30
Narcotic.	12071	32	4-0	7-8	3-4	138 80
Remain.	13325	32	4-0	1	3-4	143 80
Narrable.	12072	36	0	1-2	17-32	89 10
Narrowly.	12073	36	0	5-8	17-32	91 60
Narwhal.	12074	36	2-0	1-2	17-32	100 90
Nasalize.	12075	36	2-0	5-8	17-32	100 90
Nascent.	12076	36	2-0	3-4	3-4	106 40
Nasiform.	12077	36	3-0	3-4	3-4	130 30
Nataloin.	12078	36	3-0	7-8	3-4	132 30
Natant.	12079	36	4-0	3-4	3-4	147 10
Natantly.	12080	36	4-0	7-8	3-4	149 60
Remand.	13326	36	4-0	1	3-4	154 60
Nathmore.	12081	38	4-0	7-8	3-4	155 00
Remanent.	13327	38	4-0	1	3-4	160 00
Natica.	12082	40	4-0	7-8	3-4	160 40
Remark.	13328	40	4-0	1	3-4	165 40
Nativism.	12083	42	4-0	7-8	3-4	165 80
Remedy.	13329	42	4-0	1	3-4	170 80
Nativity.	12084	48	2-0	5-8	17-32	122 50
Natrium.	12085	60	4-0	7-8	3-4	214 40
Remiform.	13330	60	4-0	1	3-4	219 40
Naturist.	12086	66	4-0	7-8	3-4	230 60
Remind.	13331	66	4-0	1	3-4	235 60
Nauscopy.	12087	70	4-0	7-8	3-4	241 40
Remiss.	13332	70	4-0	1	3-4	246 40
Nauseate.	12088	72	4-0	7-8	3-4	246 80
Reproduce.	13333	72	4-0	1	3-4	251 80

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.

O-B RAIL BONDS

Type E-2—Compressed Terminal—Patented



HAS longer sleeves than Type E-1 Bond listed on preceding pages. Can be used for bonding around splice plates, as shown on page 446, or cross bonding. Installed without removing splice plates.

Bonds should be at least 6 inches longer than splice plates; distance, center to center of holes, should be at least 4 inches greater than length of splice plates. Cross bonds should be at least 10 inches longer than the track gauge.

Code Word	No.	Length Center to Center of Terminals in Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Poorness.	12656	22	0	1-2	17-32	$ 68 10
Popedom.	12657	22	0	5-8	17-32	70 60
Popgun.	12658	22	2-0	1-2	17-32	75 70
Oxamic.	12498	22	2-0	5-8	17-32	75 70
Poplar.	12659	22	2-0	3-4	3-4	81 20
Poppied.	12660	22	3-0	3-4	3-4	98 10
Populous.	12661	22	3-0	7-8	3-4	100 10
Porcine.	12662	22	4-0	3-4	3-4	109 30
Oxanilic.	12516	22	4-0	7-8	3-4	111 80
Porifera.	12663	24	0	1-2	17-32	71 10
Porism.	12664	24	0	5-8	17-32	73 60
Porkwood.	12665	24	2-0	1-2	17-32	79 30
Oxbane.	12499	24	2-0	5-8	17-32	79 30
Porpoise.	12666	24	2-0	3-4	3-4	84 80
Porridge.	12667	24	3-0	3-4	3-4	102 70
Portage.	12668	24	3-0	7-8	3-4	104 70
Portal.	12669	24	4-0	3-4	3-4	114 70
Oxford.	12517	24	4-0	7-8	3-4	117 20
Portend.	12670	26	0	1-2	17-32	74 10
Porter.	12671	26	0	5-8	17-32	76 60
Portfire.	12672	26	2-0	1-2	17-32	82 90
Oxhead.	12500	26	2-0	5-8	17-32	82 90
Porthole.	12673	26	2-0	3-4	3-4	88 40
Portico.	12674	26	3-0	3-4	3-4	107 30
Portly.	12675	26	3-0	7-8	3-4	109 30
Portman.	12676	26	4-0	3-4	3-4	120 10
Oxheart.	12518	26	4-0	7-8	3-4	122 60

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.

O-B RAIL BONDS

Type E-2—Compressed Terminal—Continued

Code Word	No.	Length Center to Center of Terminals in Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Postpone.	12677	28	0	1-2	17-32	$ 77 10
Portrait.	12678	28	0	5-8	17-32	79 60
Posied.	12679	28	2-0	1-2	17-32	86 50
Oxidate.	12501	28	2-0	5-8	17-32	86 50
Postboy.	12680	28	2-0	3-4	3-4	92 00
Postdate.	12681	28	3-0	3-4	3-4	111 90
Postfact.	12682	28	3-0	7-8	3-4	113 90
Postil.	12683	28	4-0	3-4	3-4	125 50
Oxidator.	12519	28	4-0	7-8	3-4	128 00
Posting.	12684	30	0	1-2	17-32	80 10
Postman.	12685	30	0	5-8	17-32	82 60
Postmark.	12686	30	2-0	1-2	17-32	90 10
Oxindol.	12502	30	2-0	5-8	17-32	90 10
Posture.	12687	30	2-0	3-4	3-4	95 60
Potable.	12688	30	3-0	3-4	3-4	116 50
Potash.	12689	30	3-0	7-8	3-4	118 50
Potassa.	12690	30	4-0	3-4	3-4	130 90
Oxiodic.	12520	30	4-0	7-8	3-4	133 40
Potation.	12691	32	0	1-2	17-32	83 10
Potato.	12692	32	0	5-8	17-32	85 60
Potence.	12693	32	2-0	1-2	17-32	93 70
Oxonian.	12503	32	2-0	5-8	17-32	93 70
Potpie.	12694	32	2-0	3-4	3-4	99 20
Pottage.	12695	32	3-0	3-4	3-4	121 10
Pouched.	12696	32	3-0	7-8	3-4	123 10
Poultice.	12697	32	4-0	3-4	3-4	136 30
Oxonic.	12521	32	4-0	7-8	3-4	138 80
Poultry.	12698	36	0	1-2	17-32	89 10
Pounce.	12699	36	0	5-8	17-32	91 60
Poundage.	12700	36	2-0	1-2	17-32	100 90
Oxshoe.	12504	36	2-0	5-8	17-32	100 90
Poverty.	12701	36	2-0	3-4	3-4	106 40
Powder.	12702	36	3-0	3-4	3-4	130 30
Powdike.	12703	36	3-0	7-8	3-4	132 30
Powerful.	12704	36	4-0	3-4	3-4	147 10
Oxtongue.	12522	36	4-0	7-8	3-4	149 60
Oxyacid.	12523	38	4-0	7-8	3-4	155 00
Oxygen.	12524	40	4-0	7-8	3-4	160 40
Oxygenic.	12525	42	4-0	7-8	3-4	165 80
Oxynel.	12505	48	2-0	5-8	17-32	122 50
Oxytone.	12526	60	4-0	7-8	3-4	214 40
Oyster.	12527	66	4-0	7-8	3-4	230 60
Ozonic.	12528	70	4-0	7-8	3-4	241 40
Ozonizer.	12529	72	4-0	7-8	3-4	246 80

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.

O-B RAIL BONDS

Type EP-1—Pin Driven Terminal—Patented



USED either for bonding around splice plates as shown on page 446, or cross bonding. Can be installed without removing splice plates.

Bonds should be at least 6 inches longer than splice plates; distance, center to center of holes, should be at least 4 inches greater than length of splice plates.

Bonds are furnished complete with Steel Expansion Pins.

Code Word	No.	Length, Center to Center of Terminals, Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head, Inches	List per 100
Ninefold.	12165	22	0	1-2	17-32	$ 68 10
Ninepins.	12166	22	0	5-8	17-32	70 60
Nipper.	12167	22	2-0	1-2	17-32	75 70
Nipping.	12168	22	2-0	5-8	17-32	75 70
Nitency.	12169	22	2-0	3-4	19-32	81 20
Nitrate.	12170	22	3-0	3-4	19-32	98 10
Nitrify.	12171	22	3-0	7-8	19-32	100 10
Nitrosyl.	12172	22	4-0	3-4	19-32	109 30
Niveous.	12173	22	4-0	7-8	19-32	111 80
Remodel.	13334	22	4-0	1	19-32	116 80
Noachian.	12174	24	0	1-2	17-32	71 10
Nobilify.	12175	24	0	5-8	17-32	73 60
Nobleman.	12176	24	2-0	1-2	17-32	79 30
Noctuary.	12177	24	2-0	5-8	17-32	79 30
Noctuid.	12178	24	2-0	3-4	19-32	84 80
Nocturn.	12179	24	3-0	3-4	19-32	102 70
Nocuous.	12180	24	3-0	7-8	19-32	104 70
Nodated.	12181	24	4-0	3-4	19-32	114 70
Nodding.	12182	24	4-0	7-8	19-32	117 20
Remora.	13335	24	4-0	1	19-32	122 20
Nodical.	12183	26	0	1-2	17-32	74 10
Nodose.	12184	26	0	5-8	17-32	76 60
Noduled.	12185	26	2-0	1-2	17-32	82 90
Noemics.	12186	26	2-0	5-8	17-32	82 90
Noggen.	12187	26	2-0	3-4	19-32	88 40
Noiseful.	12188	26	3-0	3-4	19-32	107 30
Noisily.	12189	26	3-0	7-8	19-32	109 30
Nolleity.	12190	26	4-0	3-4	19-32	120 10
Nomadic.	12191	26	4-0	7-8	19-32	122 60
Remorse.	13336	26	4-0	1	19-32	127 60
Nomadism	12192	28	0	1-2	17-32	77 10
Nomancy.	12193	28	0	5-8	17-32	79 60
Nombril.	12194	28	2-0	1-2	17-32	86 50
Nominate.	12195	28	2-0	5-8	17-32	86 50
Nominee.	12196	28	2-0	3-4	19-32	92 00

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.
For listing of Steel Expansion Pins, see page 494.

O-B RAIL BONDS

Type EP-1—Pin Driven Terminal—Continued

Code Word	No.	Length, Center to Center of Terminals, Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head, Inches	List per 100
Nomology.	12197	28	3-0	3-4	19-32	$111 90
Nonacid.	12198	28	3-0	7-8	19-32	113 90
Nonagon.	12199	28	4-0	3-4	19-32	125 50
Nonelect.	12200	28	4-0	7-8	19-32	128 00
Remove.	13337	28	4-0	1	19-32	133 00
Nonius.	12201	30	0	1-2	17-32	80 10
Nonjuror.	12202	30	0	5-8	17-32	82 60
Nonplane.	12203	30	2-0	1-2	17-32	90 10
Nonplus.	12204	30	2-0	5-8	17-32	90 10
Nonsame.	12205	30	2-0	3-4	19-32	95 60
Nonsense.	12206	30	3-0	3-4	19-32	116 50
Nonuser.	12207	30	3-0	7-8	19-32	118 50
Noonday.	12208	30	4-0	3-4	19-32	130 90
Norian.	12209	30	4-0	7-8	19-32	133 40
Rendible.	13338	30	4-0	1	19-32	138 40
Normalcy.	12210	32	0	1-2	17-32	83 10
Norman.	12211	32	0	5-8	17-32	85 60
Norroy.	12212	32	2-0	1-2	17-32	93 70
Nortelry.	12213	32	2-0	5-8	17-32	93 70
Norther.	12214	32	2-0	3-4	19-32	99 20
Northing.	12215	32	3-0	3-4	19-32	121 10
Nosebag.	12216	32	3-0	7-8	19-32	123 10
Nosegay.	12217	32	4-0	3-4	19-32	136 30
Nosing.	12218	32	4-0	7-8	19-32	138 80
Rendrock.	13339	32	4-0	1	19-32	143 80
Nostoc.	12219	36	0	1-2	17-32	89 10
Notable.	12220	36	0	5-8	17-32	91 60
Nostril.	12221	36	2-0	1-2	17-32	100 90
Notching.	12222	36	2-0	5-8	17-32	100 90
Noteless.	12223	36	2-0	3-4	19-32	106 40
Notional.	12224	36	3-0	3-4	19-32	130 30
Notornis.	12225	36	3-0	7-8	19-32	132 30
Notwheat.	12226	36	4-0	3-4	19-32	147 10
Noumenal.	12227	36	4-0	7-8	19-32	149 60
Renege.	13340	36	4-0	1	19-32	154 60
Nounize.	12228	38	4-0	7-8	19-32	155 00
Rennet.	13341	38	4-0	1	19-32	160 00
Nourish.	12229	40	4-0	7-8	19-32	160 40
Renounce.	13342	40	4-0	1	19-32	165 40
Novator.	12230	42	4-0	7-8	19-32	165 80
Renovate.	13343	42	4-0	1	19-32	170 80
Novelist.	12231	48	2-0	5-8	17-32	122 50
Novene.	12232	60	4-0	7-8	19-32	214 40
Renown.	13344	60	4-0	1	19-32	219 40
Novercal.	12233	66	4-0	7-8	19-32	230 60
Rental.	13345	66	4-0	1	19-32	235 60
Novice.	12234	70	4-0	7-8	19-32	241 40
Reordain.	13346	70	4-0	1	19-32	246 40
Novity.	12235	72	4-0	7-8	19-32	246 80
Repartee.	13347	72	4-0	1	19-32	251 80

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.
For listing of Steel Expansion Pins, see page 494.

O-B RAIL BONDS

Type EP-2—Pin Driven Terminal—Patented



HAS longer sleeves than Type EP-1 Bond listed on preceding pages. Can be used for bonding around splice plates as shown on page 446, or cross bonding. Installed without removing splice plates.

Bonds should be at least 6 inches longer than splice plates; distance, center to center of holes, should be at least 4 inches greater than length of splice plates. Cross bonds should be at least 10 inches longer than the track gauge.

Bonds are furnished complete with Steel Expansion Pins.

Code Word	No.	Length Center to Center of Terminals in Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Powwow.	12705	22	0	1-2	17-32	$68 10
Poyntel.	12706	22	0	5-8	17-32	70 60
Practive.	12707	22	2-0	1-2	17-32	75 70
Ozonous.	12506	22	2-0	5-8	17-32	75 70
Prairie.	12708	22	2-0	3-4	19-32	81 20
Praise.	12709	22	3-0	3-4	19-32	98 10
Prancer.	12710	22	3-0	7-8	19-32	100 10
Prankish.	12711	22	4-0	3-4	19-32	109 30
Pabular.	12530	22	4-0	7-8	19-32	111 80
Prattle.	12712	24	0	1-2	17-32	71 10
Preamble.	12713	24	0	5-8	17-32	73 60
Precinct.	12714	24	2-0	1-2	17-32	79 30
Pabulous.	12507	24	2-0	5-8	17-32	79 30
Precious.	12715	24	2-0	3-4	19-32	84 80
Precise.	12716	24	3-0	3-4	19-32	102 70
Preclude.	12717	24	3-0	7-8	19-32	104 70
Predate.	12718	24	4-0	3-4	19-32	114 70
Pabulum.	12531	24	4-0	7-8	19-32	117 20
Predict.	12719	26	0	1-2	17-32	74 10
Preface.	12720	26	0	5-8	17-32	76 60
Prefix.	12721	26	2-0	1-2	17-32	82 90
Pacane.	12508	26	2-0	5-8	17-32	82 90
Prejudge.	12722	26	2-0	3-4	19-32	88 40
Prelacy.	12723	26	3-0	3-4	19-32	107 30
Prelude.	12724	26	3-0	7-8	19-32	109 30
Premier.	12725	26	4-0	3-4	19-32	120 10
Pacation.	12532	26	4-0	7-8	19-32	122 60

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.
For listing of Steel Expansion Pins, see page 494.

O-B RAIL BONDS

Type EP-2—Pin Driven Terminal—Continued

Code Word	No.	Length Center to Center of Terminals in Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Premium.	12726	28	0	1-2	17-32	$ 77 10
Premorse.	12727	28	0	5-8	17-32	79 60
Prender.	12728	28	2-0	1-2	17-32	86 50
Pacify.	12509	28	2-0	5-8	17-32	86 50
Presage.	12729	28	2-0	3-4	19-32	92 00
Preserve.	12730	28	3-0	3-4	19-32	111 90
Presider.	12731	28	3-0	7-8	19-32	113 90
Presser.	12732	28	4-0	3-4	19-32	125 50
Packfong.	12533	28	4-0	7-8	19-32	128 00
Pression.	12733	30	0	1-2	17-32	80 10
Presto.	12734	30	0	5-8	17-32	82 60
Pretend.	12735	30	2-0	1-2	17-32	90 10
Packman.	12510	30	2-0	5-8	17-32	90 10
Preterit.	12736	30	2-0	3-4	19-32	95 60
Pretext.	12737	30	3-0	3-4	19-32	116 50
Prettily.	12738	30	3-0	7-8	19-32	118 50
Pretzel.	12739	30	4-0	3-4	19-32	130 90
Paction.	12534	30	4-0	7-8	19-32	133 40
Prevene.	12740	32	0	1-2	17-32	83 10
Previse.	12741	32	0	5-8	17-32	85 60
Pricker.	12742	32	2-0	1-2	17-32	93 70
Padder.	12511	32	2-0	5-8	17-32	93 70
Pricking.	12743	32	2-0	3-4	19-32	99 20
Prickle.	12744	32	3-0	3-4	19-32	121 10
Prideful.	12745	32	3-0	7-8	19-32	123 10
Pridian.	12746	32	4-0	3-4	19-32	136 30
Paddling.	12535	32	4-0	7-8	19-32	138 80
Primacy.	12747	36	0	1-2	17-32	89 10
Primage.	12748	36	0	5-8	17-32	91 60
Primary.	12749	36	2-0	1-2	17-32	100 90
Paddock.	12512	36	2-0	5-8	17-32	100 90
Primer.	12750	36	2-0	3-4	19-32	106 40
Priming.	12751	36	3-0	3-4	19-32	130 30
Primness.	12752	36	3-0	7-8	19-32	132 30
Primrose.	12753	36	4-0	3-4	19-32	147 10
Padelion.	12536	36	4-0	7-8	19-32	149 60
Padlock.	12537	38	4-0	7-8	19-32	155 00
Pagandom.	12538	40	4-0	7-8	19-32	160 40
Paganize.	12539	42	4-0	7-8	19-32	165 80
Pageant.	12513	48	2-0	5-8	17-32	122 50
Pailful.	12540	60	4-0	7-8	19-32	214 40
Painable.	12541	66	4-0	7-8	19-32	230 60
Painless.	12542	70	4-0	7-8	19-32	241 40
Painture.	12543	72	4-0	7-8	19-32	246 80

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.

Above Bonds can be furnished in any desired length, capacity and size of terminal.

In ordering give full information as called for on page 455.

For listing of Steel Expansion Pins, see page 494.

O-B SOLID WIRE RAIL BONDS

Type S—Compressed Terminal



CAN be used around splice bars or for cross bonding where flexibility is not essential.

Bonds should be at least 6 inches longer than splice plates. Distance, center to center of holes, should be at least 4 inches greater than length of splice plates. Cross bonds should be at least 10 inches longer than track gauge.

Code Word	No.	Length, Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Neoplasm.	12117	22	0	1-2	17-32	$ 68 10
Neorama.	12118	22	2-0	5-8	17-32	75 70
Repast.	13413	22	2-0	3-4	3-4	81 20
Neotoric.	12119	22	4-0	3-4	3-4	109 30
Nepenthe.	12120	22	4-0	7-8	3-4	111 80
Geognost.	10515	24	0	1-2	17-32	71 10
Geology.	10516	24	2-0	5-8	17-32	79 30
Repeal.	13414	24	2-0	3-4	3-4	84 80
Geometry.	10517	24	4-0	3-4	3-4	114 70
Geranium.	10518	24	4-0	7-8	3-4	117 20
Germanic.	10519	26	0	1-2	17-32	74 10
Germless.	10520	26	2-0	5-8	17-32	82 90
Repeat.	13415	26	2-0	3-4	3-4	88 40
Getter.	10521	26	4-0	3-4	3-4	120 10
Ghastful.	10522	26	4-0	7-8	3-4	122 60
Ghastly.	10523	28	0	1-2	17-32	77 10
Giantly.	10524	28	2-0	5-8	17-32	86 50
Repent.	13416	28	2-0	3-4	3-4	92 00
Giblet.	10525	28	4-0	3-4	3-4	125 50
Giddily.	10526	28	4-0	7-8	3-4	128 00

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.

Above Bonds can be furnished in any desired lengths.

In ordering give full information as called for on page 455.

O-B SOLID WIRE RAIL BONDS

Type SP—Pin Driven Terminal



CAN be used around splice bars or for cross bonding where flexibility is not essential.

Bonds are furnished complete with Steel Expansion Pins.

Bonds should be at least 6 inches longer than splice plates. Distance, center to center of holes, should be at least 4 inches greater than length of splice plates. Cross bonds should be at least 10 inches longer than track gauge.

Code Word	No.	Length Center to Center of Terminals in Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head in Inches	List per 100
Nubble.	12236	22	0	1-2	17-32	$ 68 10
Nubian.	12237	22	2-0	5-8	17-32	75 70
Repetend.	13417	22	2-0	3-4	19-32	81 20
Nubilate.	12238	22	4-0	3-4	19-32	109 30
Nubilose.	12239	22	4-0	7-8	19-32	111 80
Nucament.	12240	24	0	1-2	17-32	71 10
Nuchal.	12241	24	2-0	5-8	17-32	79 30
Repine.	13418	24	2-0	3-4	19-32	84 80
Nuciform.	12242	24	4-0	3-4	19-32	114 70
Nucleate.	12243	24	4-0	7-8	19-32	117 20
Nuclein.	12244	26	0	1-2	17-32	74 10
Nucleole.	12245	26	2-0	5-8	17-32	82 90
Replenish.	13419	26	2-0	3-4	19-32	88 40
Nucleus.	12246	26	4-0	3-4	19-32	120 10
Nuddle.	12247	26	4-0	7-8	19-32	122 60
Nudicaul.	12248	28	0	1-2	17-32	77 10
Nugatory.	12249	28	2-0	5-8	17-32	86 50
Replete.	13420	28	2-0	3-4	19-32	92 00
Numbfish.	12250	28	4-0	3-4	19-32	125 50
Numbness.	12251	28	4-0	7-8	19-32	128 00

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired lengths.
In ordering give full information as called for on page 455.
For listing of Steel Expansion Pins, see page 494.

O-B STUB END TERMINALS

Types E-1 and EP-1—Patented

USED for making up extra long bonds for use around special work or for connecting lightning arresters and other ground wires to the rail.

Consists of a single terminal, length 12 inches.



Type E-1—Compressed Stub End Terminal

Code Word	No.	Length of Cable, Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head, Inches	List per 100
Nautical.	12089	12	0	1-2	17-32	$35 55
Navajoes.	12090	12	0	5-8	17-32	36 80
Navigate.	12091	12	2-0	1-2	17-32	39 65
Nayward.	12092	12	2-0	5-8	17-32	39 65
Nearctic.	12093	12	2-0	3-4	3-4	42 40
Nearhand.	12094	12	4-0	3-4	3-4	57 35
Nearness.	12095	12	4-0	7-8	3-4	58 60
Replevin.	13361	12	4-0	1	3-4	61 10



Type EP-1—Pin Driven Stub End Terminal

Complete with Expansion Pins

Neatherd.	12096	12	0	1-2	17-32	35 55
Neatify.	12097	12	0	5-8	17-32	36 80
Neatness.	12098	12	2-0	1-2	17-32	39 65
Nebular.	12099	12	2-0	5-8	17-32	39 65
Nebulose.	12100	12	2-0	3-4	19-32	42 40
Nebuly.	12101	12	4-0	3-4	19-32	57 35
Neckband.	12102	12	4-0	7-8	19-32	58 60
Replica.	13360	12	4-0	1	19-32	61 10

A variation of $\frac{1}{32}$ inch in length of terminal under head is allowed.
Above Bonds can be furnished in any desired length, capacity and size of terminal.
In ordering give full information as called for on page 455.
For listing of Steel Expansion Pins, see page 494.

O-B SOCKET TERMINALS

Compressed and Pin Driven Terminal



Compressed Socket Terminal



Pin Driven Socket Terminal

Will take either solid or stranded wire of the size specified. Holes for cable are tinned for soldering.

Compressed Socket Terminal

Code Word	No.	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	Length of Terminal Under Head, Inches	Diameter Drilling for Cable, Inches	List per 100
Nectary.	12103	0	1-2	17-32	27-64	$20 00
Negation.	12104	0	5-8	17-32	27-64	25 00
Negligee.	12105	2-0	1-2	17-32	15-32	20 00
Negoce.	12106	2-0	5-8	17-32	15-32	25 00
Negritic.	12107	2-0	3-4	3-4	15-32	30 00
Report.	13362	3-0	3-4	3-4	33-64	37 50
Reporter.	13363	3-0	7-8	3-4	33-64	42 50
Negroid.	12108	4-0	3-4	3-4	37-64	37 50
Nemesis.	12109	4-0	7-8	3-4	37-64	42 50
Reposal.	13364	250,000C.M.	7-8	3-4	21-32	42 50

Pin Driven Socket Terminal—Complete with Expansion Pins

Nemoral.	12110	0	1-2	17-32	27-64	20 00
Nenuphar.	12111	0	5-8	17-32	27-64	25 00
Neocene.	12112	2-0	1-2	17-32	15-32	20 00
Neocracy.	12113	2-0	5-8	17-32	15-32	25 00
Neogen.	12114	2-0	3-4	19-32	15-32	30 00
Reposit.	13365	3-0	3-4	19-32	33-64	37 50
Reprehend.	13366	3-0	7-8	19-32	33-64	42 50
Neology.	12115	4-0	3-4	19-32	37-64	37 50
Neophyte.	12116	4-0	7-8	19-32	37-64	42 50
Represent.	13367	250,000C.M.	7-8	19-32	21-32	42 50

For listing of Steel Expansion Pins, see page 494.

O-B STEEL EXPANSION PINS

For O-B Pin Driven Bonds



STANDARD Expansion Pins should be used under ordinary conditions. Oversize Pins are for use where bond holes in rail are drilled oversize or where it is desired to get a still greater expansion of the bonds than is possible with Standard Pins. Oversize Pins are also used for a second installation of bonds that were previously applied with Standard Pins.

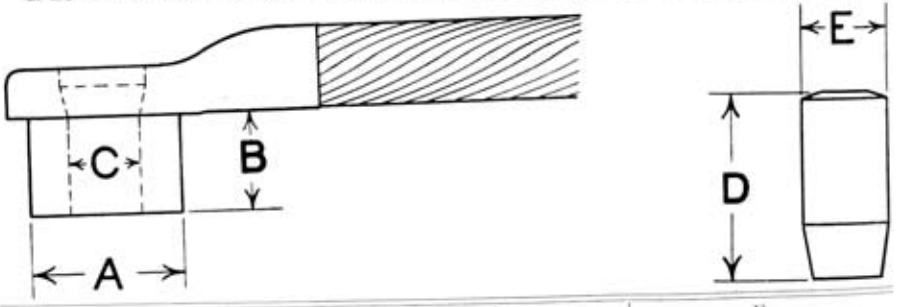
Standard Pins

Code Word	No.		List per 100
Numeric.	12252—	Standard Expansion Pin for $\frac{1}{2}$-inch diameter Bond Terminal	$80 50
Nunchion.	12253—	" " " " $\frac{5}{8}$ " " " "	50
Nunciate.	12254—	" " " " $\frac{3}{4}$ " " " "	1 00
Nunnery.	12255—	" " " " $\frac{7}{8}$ " " " "	1 00
Repress.	13372—	" " " " 1 " " " "	1 00

Oversize Pins

Reprieve.	13368—	Oversize Expansion Pin for $\frac{1}{2}$-inch diameter Bond Terminal	$80 50
Reprimand.	13369—	" " " " $\frac{5}{8}$ " " " "	1 00
Reprint.	13370—	" " " " $\frac{3}{4}$ " " " "	1 00
Reprise.	13371—	" " " " 1 " " " "	1 00

DIMENSIONS OF PIN DRIVEN BOND TERMINALS



A Diameter of Bond Terminal, Inches	B Length of Bond Terminal Under Head, Inches	C Diameter of Hole in Terminal, Inches	D Length of Expansion Pin, Inches	E Diameter of Expansion Pin, Inches	
				Standard Pin	Oversize Pin
$\frac{1}{2}$	$\frac{11}{16}$	.2	$1\frac{3}{32}$	$\frac{1}{4}$	$\frac{9}{32}$
$\frac{5}{8}$	$\frac{11}{16}$	.2	$1\frac{3}{32}$	$\frac{11}{32}$	$\frac{25}{64}$
$\frac{3}{4}$	$\frac{11}{16}$	.2	$1\frac{3}{32}$	$\frac{13}{32}$	$\frac{29}{64}$
$\frac{7}{8}$	$\frac{11}{16}$	.2	$1\frac{3}{32}$	$\frac{15}{32}$	$\frac{33}{64}$
1	$\frac{11}{16}$	.2	$1\frac{3}{32}$	$\frac{17}{32}$	$\frac{37}{64}$

TAPER PUNCHES

For Pin Driven Bonds



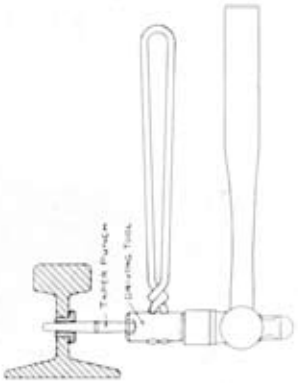
ALTHOUGH these Tools are not absolutely necessary to install Pin Driven Bonds, better results are secured by their use. When driven through the holes in the bond terminals before Expansion Pins are inserted, they eliminate any chance of the pin shearing the hole as it is driven home. Made of steel.

Code Word	No.		List Each
Nuptial.	11690	Taper Punch, diameter $\frac{7}{32}$ inch, for $\frac{1}{2}$-inch Terminal	$0 75
Nursery.	11691	" " " $\frac{5}{16}$ " " $\frac{5}{8}$ " "	75
Nutant.	11692	" " " $\frac{11}{32}$ " " $\frac{3}{4}$ " "	75
Nutgall.	11693	" " " $\frac{3}{8}$ " " $\frac{7}{8}$ " "	75
Nuthatch.	11694	" " " $\frac{7}{16}$ " " 1 " "	75

DRIVING TOOL

For Taper Punches





USED for driving all sizes of Taper Punches listed above as the punches are hardened and may chip if struck directly with a hammer.

Driving Tool is hardened only on the end that holds the Taper Punch, the end that receives the hammer blows being soft.

One man can easily handle both Driving Tool and hammer.

Code Word	No.	List Each
Overtake.	12497—Driving Tool for Taper Punches	$2 75

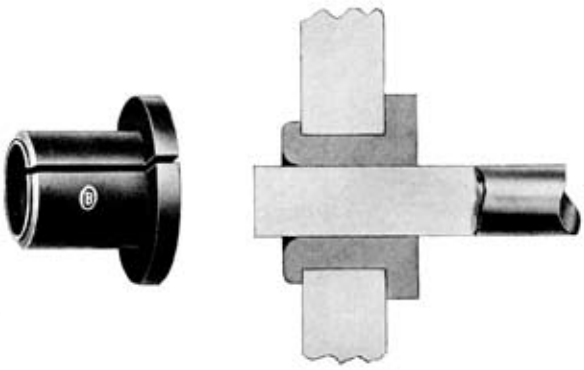
CHANNEL PINS



MADE of steel, carefully machined to dimensions and copper plated.

Code Word	No.	Size of Bonding Wire B. & S. Gauge	Diameter of Pin Inches	Diameter of Hole in Rail Inches	List Per 1000
Grouper.	1272	0	19-32	9-16	$38 40
Grouser.	8765	0	21-32	5-8	42 10
Growable.	2684	2-0	19-32	9-16	38 40
Grower.	7546	2-0	21-32	5-8	42 10
Grudge.	1861	2-0	3-4	23-32	48 60
Gruffly.	8767	2-0	25-32	3-4	51 00
Grunter.	8769	4-0	3-4	23-32	48 60
Guardage.	4500	4-0	25-32	3-4	51 00

COPPER BONDING SLEEVES



USED for holding bonding wire in rails and installed with the aid of the tools shown on the following page.

Code Word	No.	Size of Bonding Wire B. & S. Gauge	Diameter of Sleeve Inches	Diameter of Hole in Rail Inches	List Per 1000
Guttate.	3160	0	19-32	9-16	$114 80
Gusher.	3158	0	21-32	5-8	134 00
Gurgle.	4498	2-0	19-32	9-16	114 80
Gunster.	3156	2-0	21-32	5-8	134 00
Gunner.	3149	4-0	25-32	3-4	165 80

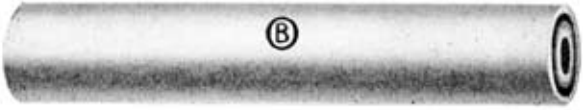
COPPER SLEEVE BONDING TOOLS



Drift Punch—Nos. 11379-11381



Driving Tool—Nos. 11382-11384



Upsetting Tool—Nos. 11385-11387

USED for installing Copper Bonding Sleeves listed on the preceding page.

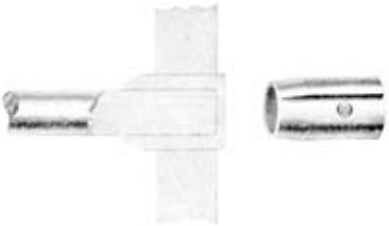
Drift punch is driven lightly into the rail from the side that the bonding sleeve is to enter. It removes any burrs around the edge of the hole.

Driving Tool is used for driving the Bonding Sleeve in place in the rail. One end of the Tool is slotted to clear the bond wire.

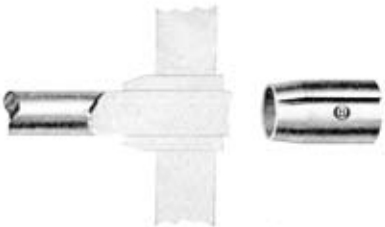
Upsetting Tool is used to form a shoulder on the Bonding Sleeve after the latter has been driven into place.

Code Word	No.		List Each
Latinist.	11379	Drift Punch for $\frac{5}{16}$-inch Hole in Rail	$2 50
Latinity.	11380	" " " $\frac{11}{32}$ " " " "	2 50
Laudable.	11381	" " " $\frac{3}{8}$ " " " "	2 50
Laughing.	11382	Driving Tool for 0 Bonding Wire	3 00
Laughter.	11383	" " " 2-0 " "	3 00
Launder.	11384	" " " 4-0 " "	3 00
Laundry.	11385	Upsetting Tool for 0 Bonding Wire	2 50
Laureate.	11386	" " " 2-0 " "	2 50
Lavaret.	11387	" " " 4-0 " "	2 50

STEEL BONDING CAPS



Regular Caps
Nos. 1260-1850 Inc.



Cross-Connecting Caps
Nos. 11378-11374 Inc.

USED for fastening bonding wires into holes drilled in web or base of rail. Made of soft steel.

Cross Connecting Caps are open at both ends allowing the wire to pass entirely through them for cross bonding.

Regular Caps

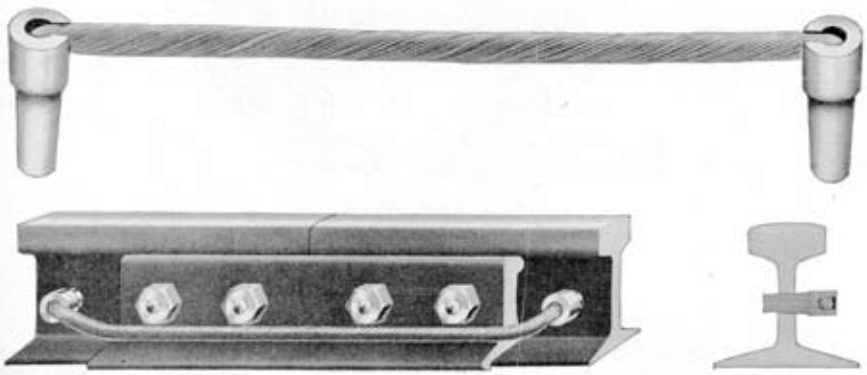
Code Word	No.	Size of Bonding Wire B. & S. Gauge	Diameter of Cap Inches	Diameter of Hole in Rail Inches	List per 1000
Guitar.	1260	0	15-32	7-16	$39 40
Guinea.	1853	0	17-32	1-2	43 00
Guiltily.	1852	0	19-32	9-16	47 40
Guileful.	4491	0	21-32	5-8	51 80
Guidable.	1259	2-0	17-32	1-2	43 00
Guesser.	1851	2-0	19-32	9-16	47 40
Gudgeon.	4490	2-0	21-32	5-8	51 80
Guardian.	1850	4-0	5-8	19-32	49 80

Cross-Connecting Caps

Lasket.	11378	0	19-32	9-16	59 00
Lascar.	11377	0	21-32	5-8	63 00
Larynx.	11376	2-0	19-32	9-16	59 20
Larvated.	11375	2-0	21-32	5-8	63 20
Larkspur.	11374	4-0	5-8	19-32	61 20

O-B REMOVABLE MINE BOND

Type N



DESIGNED for use in bonding temporary tracks only.

Made of flexible copper cable soldered into tapered steel terminals, heavily tinned.

Installation and removal easy—merely driven in or out with hammer—without injury to bond terminals.

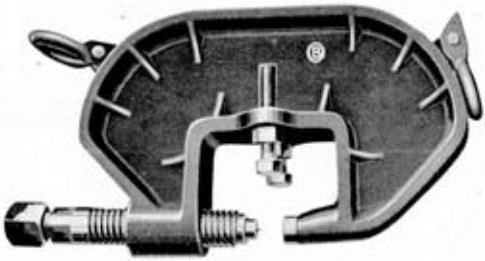
Can be taken out of rails and reinstalled when tracks are moved from one entry to another.

Code Word	No.	Length, Center to Center of Terminals, Inches	Capacity, B. & S. Gauge	Diameter of Terminal in Inches	List per 100
Raffle.	12759	22	0	5-8	$70 60
Rafter.	12760	24	0	5-8	73 60
Ragged.	12761	26	0	5-8	76 60
Ragman.	12762	28	0	5-8	79 60
Nuthook.	12256	22	2-0	5-8	75 70
Nutlet.	12257	24	2-0	5-8	79 30
Nutmeg.	12258	26	2-0	5-8	82 90
Nutrient.	12259	28	2-0	5-8	86 50

Above Bonds can be furnished in any desired length.
In ordering Bonds give full information as called for on page 455.

RAIL BOND COMPRESSOR

For Tee and Girder Rails



Nos. 12451-12484



No. 5437



No. 9982

IS of compound screw type, outer screw serving to press terminal of bond tightly against web of rail, after which inner screw is tightened up by means of a long wrench, thus expanding terminal in rail.

Both screws are made of best quality steel and ends are hardened.

Nos. 12451 and 12484 are equipped with carrying handles and leveling screws. No. 5437 has leveling screws but no handles, while No. 9982 has neither leveling screws nor handles.

No. 9982 can be used with bond terminals up to and including inch in diameter only; other compressors with any size terminal up to and including 1 inch diameter.

One wrench supplied with each compressor unless otherwise specified.

See listing on the opposite page.

RAIL BOND COMPRESSOR

For Tee and Girder Rails

Continued

Code Word	No.	List Each
Glorify.	9982—Extra small size, for Tee Rails only, 3 inches or less in height	$70 00
Glosser.	5437—Small " " " " 5 " " "	110 00
Prismoid.	12451—Medium size for Tee or Girder Rails, 7 " " "	130 00
Prison.	12484—Large " " " " " over 7 inches in height	140 00
Glumly.	5209—Wrench, for extra small Compressor, only	6 00
Pristine.	12593— " " small, medium and large Compressors	8 00

Prices for Compressors given above include Wrench.

Extra Parts

Inner Screws



No. 11196

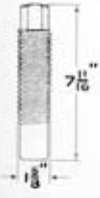


No. 11198

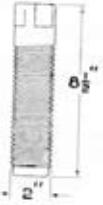


No. 11200

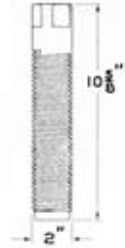
Outer Screws



No. 11197



No. 11199



No. 11201

Code Word	No.	List Each
Landlord.	11196—Inner Screw for Extra Small Compressor No. 9982	$23 00
Landman.	11197—Outer " " " " " " 9982	24 00
Landtag.	11198—Inner " " Small Compressor, No. 5437	30 00
Langate.	11199—Outer " " " " " 5437	33 00
Langued.	11200—Inner " " Medium and Large Compressors Nos. 12451-12484	36 00
Languish.	11201—Outer Screw for Medium and Large Compressors Nos. 12451-12484	39 00

See description on preceding page.

MOORE TRACK DRILLS

Nos. 1, 2 and 3—For Tee and Girder Rails



Nos. 1 and 2 Drill



No. 3 Drill

MADE with detachable upright or standard which is quickly erected and rigidly secured to frame by shifting of one lever. Upright and rail hooks can be removed to allow trains to pass and quickly replaced, to continue drilling, without disturbing drill.

Numbers 1 and 2 Drills are exactly similar except that the No. 2 is of heavier construction throughout. Both No. 1 and No. 2 Drills are equipped with an automatic flexible feed mechanism which has a range of from 1 inch advance of spindle for every 50 revolutions to 1 inch advance for every 650 revolutions.

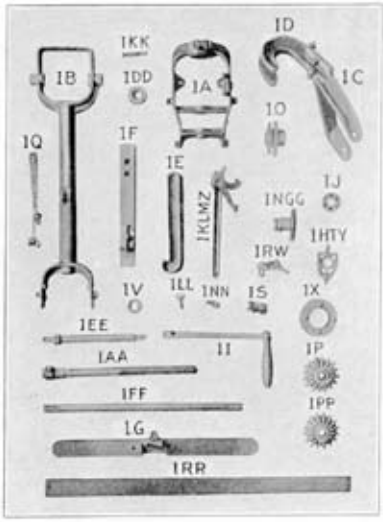
No. 3 Drill is strong and compact, and has a much smaller number of working parts than the Nos. 1 and 2. The feed mechanism permits three changes as follows: 120 turns of crank to 1 inch advance of drill bit; 180 turns of crank to 1 inch advance of drill bit and 360 turns of crank to 1 inch advance of drill bit.

Code Word	No.		List Each
Gnarled.	10133—No. 1 Drill, weight 60 lbs.	for Tee Rails	$27 00
Gnawer.	10134—No. 1 " " 65 "	Girder Rails	32 00
Impedite.	10717—No. 2 " " 80 "	Tee Rails	30 00
Impellent.	10718—No. 2 " " 85 "	Girder Rails	35 00
Olivine.	12341—No. 3 " " 60 "	Tee Rails	27 00
Olympic.	12342—No. 3 " " 65 "	Girder Rails	32 00

See List of Parts on the following pages.

MOORE TRACK DRILLS

List of Repair Parts for No. 1 Drill

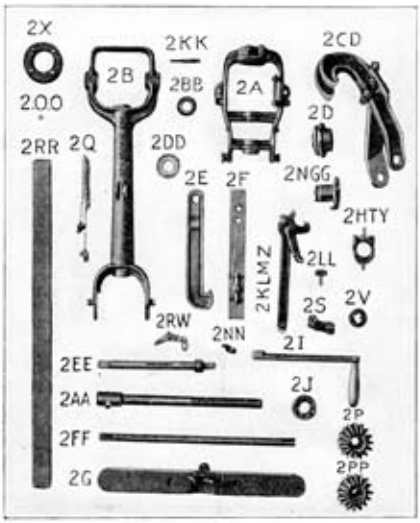


For No. 1 Drill Nos. 10133-10134

Code Word	No. Part		List Each
Gobbler.	10135—1A	Base with Feed Bracket Pin and Bolt	$3 00
Goblet.	10136—1B	Upright Frame	4 60
Goblin.	10137—1C	Rail Hook Arm, R. and L. (2 per set)	2 25
Goggled.	10138—1D	" " for Standard Rail	80
Granule.	10161—1D1	" " for Girder Rails	1 00
Reptile.	13432—1E	Underclutch Hook, R. and L. (2 per set)	2 00
Republic.	13433—1F	" Eye Bar (2 per set)	1 00
Gondola.	10139—1G	Foot Plate	1 15
Goodly.	10140—1HTYV	Shifting Lever, complete	1 50
Goodness.	10141—1I	Crank with Wood Handle and Bolt (2 per set)	75
Gopher.	10142—1J	Ball-Bearing Adjusting Nut	1 00
Gorged.	10143—1KLMZ	Back Brace, complete	1 50
Gorgeous.	10144—1NGG	Clutch Flange and Spring	1 25
Gosling.	10145—1O	Feed Nut	2 00
Gossip.	10146—1P	Gear for Spindle with Key, $1\frac{1}{16}$-inch Bore	75
Reprove.	13434—1Q	Underclutch Lugs with Chain	50
Gothic.	10147—1RW	Feed Lever with Link and Pin	65
Gowned.	10148—1S	" Bracket with Roll and Stud	60
Gracious.	10150—1X	" Nut Case	1 00
Gradely.	10151—1AA	Spindle with Set Screw	4 75
Gradient.	10152—1DD	Ball-Bearing Complete	1 00
Graduate.	10153—1EE	Crank Shaft with Collar	1 30
Grainer.	10154—1FF	Vertical Shaft, Keyseated	1 00
Graining.	10155—1KK	Clutch Collar Spring and Bolt	15
Grammer.	10156—1LL	Feed Adjusting Screw	25
Granary.	10157—1NN	" Dog	50
Grandly.	10159—1PP	Gear, $\frac{3}{8}$-inch Bore, Keyseated (3 per set)	75
Repudiate.	13435—1RR	Underclutch Cross-Bar, Steel	1 00
Grange.	10160—1GG	Feed Dog Spring	10

MOORE TRACK DRILLS

List of Repair Parts for No. 2 Drill

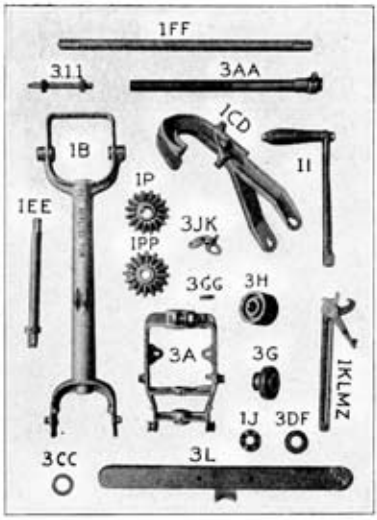


For No. 2 Drill Nos. 10717-10718

Code Word	No.	Part	List Each
Impeople.	10719	—2A Base with Feed Bracket Pin and Bolt	$4 00
Implead.	10720	—2B Upright Frame	7 00
Implore.	10721	—2C Rail Hook Arm, R. and L. (2 per set)	3 00
Imporous.	10722	—2D " " for Standard Rail	1 10
Inclip.	10746	—2D2 " " for Girder Rails	1 25
Repulsive.	13436	—2E Underclutch Hook, R. and L. (2 per set)	2 75
Repulse.	13437	—2F " Eye Bar (2 per set)	1 20
Imposer.	10723	—2G Foot Plate	1 60
Imposing.	10724	—2HTYV Shifting Lever, complete	2 00
Impost.	10725	—2I Crank with Wood Handle and Bolt (2 per set)	1 00
Imposter.	10726	—2J Ball-Bearing Adjusting Nut	1 00
Impotent.	10727	—2KLMZ Back Brace, complete	2 00
Imprison.	10728	—2NGG Clutch Flange and Spring	1 65
Impudent.	10729	—2O Feed Nut	2 50
Impugn.	10730	—2P Gear for Spindle with Key, 1¼-inch Bore	90
Repugn.	13438	—2Q Underclutch Lugs with Chain	60
Inaction.	10731	—2RW Feed Lever with Link and Pin	80
Inanity.	10732	—2S " Bracket with Roll and Stud	70
Inboard.	10734	—2X " Nut Case	1 00
Inburst.	10735	—2AA Spindle with Set Screw	5 50
Incanton.	10737	—2DD Ball-Bearing, complete	1 25
Incense.	10738	—2EE Crank Shaft with Collar	1 75
Inceptor.	10739	—2FF Vertical Shaft, Keyseated	1 50
Incertum.	10740	—2KK Clutch Spring with Bolt	15
Incident.	10741	—2LL Feed Adjusting Screw	25
Incisor.	10742	—2NN " Dog	50
Inclasp.	10744	—2PP Gear, 1-inch Bore, Keyseated (3 per set)	90
Repute.	13439	—2RR Underclutch Cross-Bar, Steel	1 20
Incliner.	10745	—2GG Feed Dog Spring	10

MOORE TRACK DRILLS

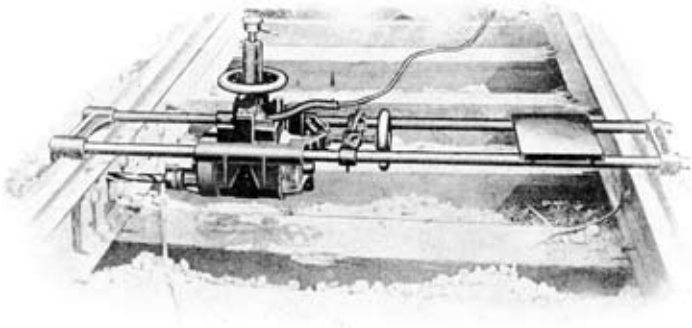
List of Repair Parts for No. 3 Drill



For No. 3 Drill Nos. 12341-12342

Code Word	No. Part		List Each
Omegoid.	12343—3A	Base with Bolt	$3 00
Omelet.	12344—1B	Upright Frame	4 60
Omened.	12345—1C	Rail Hook Arm, R. and L	2 25
Ominous.	12346—1D	" " for Standard Rail	80
Granule.	10161—1D1	" " for Girder Rails	1 00
Omissive.	12347—3DF	Friction Washer	30
Omitter.	12348—3G	Feed Nut, 36 teeth	1 50
Omniety.	12349—3H	Assembled 33, 34 and 35-tooth gear	2 50
Omoplate.	12350—1I	Crank with wood handle and bolt (2 per set)	75
Oncidium.	12351—1J	Ball-bearing Adjusting Nut	1 00
Oneidas.	12352—3JK	Shifting Gear Bracket and Lever	1 25
Oneness.	12353—1KLMZ	Back Brace, complete	1 50
Oneself.	12354—3L	Foot Plate	1 15
Ongoing.	12355—1P	Gear for Spindle with Key $1\frac{1}{16}$-inch bore	75
Ontogeny.	12356—3AA	Spindle with Set Screw	4 75
Opacity.	12357—3CC	Fiber Washer	15
Opalesce.	12358—1EE	Crank Shaft with Collar	1 30
Opalize.	12359—1FF	Vertical Shaft, Keyseated	1 00
Opelet.	12360—3GG	Feed Dog Spring	10
Opener.	12361—3II	Gear Shaft, 12 teeth on each end	1 00
Operand.	12362—1PP	Gear, ½-inch bore, keyseated (3 per set)	75

LITTLE GIANT ELECTRIC TRACK DRILL



AN efficient tool for rapidly drilling holes for bonding in web of either tee or girder rails.

Frame does not bolt to track, being merely hooked over one rail. Operator holds down the other end by sitting on the seat which places him in a convenient position to operate feed nut.

Spindle is at bottom, permitting drilling holes close to ties without using an angle attachment. Holes are located vertically by means of adjusting screws.

Cross bar carrying feed nut is located on the horizontal rods by means of eye pins which may be easily withdrawn for quick removal of drill.

A series of holes in the horizontal rods permits adjustment for varying lengths of drill bits.

Drill may be removed from frame and used as an independent tool by removing four cap screws.

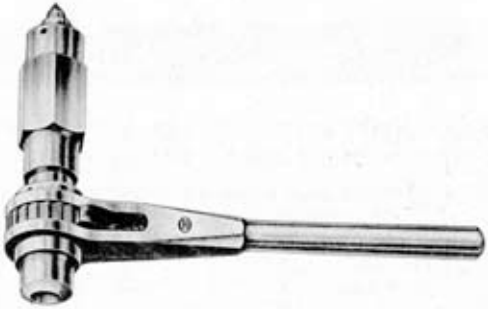
Drilling capacity No. 2 Drills, $\frac{3}{4}$-inch holes; No. 3 Drills, 1-inch holes.

Weight: No. 2 Drills, 90 pounds; No. 3 Drills, 140 pounds.

Code Word	No.						List Each
Requiem.	13317—	No. 2	Drill,	250	Volts,	No. 2 Morse Taper Socket	$238 00
Requital.	13318—	" 2	"	250	"	$\frac{3}{4}$-inch Uniform Round Shank Socket	238 00
Oliver.	11635—	" 3	"	600	"	No. 3 Morse Taper Socket	305 00
Reredos.	13319—	" 3	"	600	"	$\frac{3}{4}$-inch Uniform Round Shank Socket	305 00

Special Chucks can be furnished to order.

HAND RATCHET DRILL



THE socket of No. 1300S is $\frac{3}{8}$x$\frac{5}{8}$x1$\frac{1}{2}$ inches and takes drills $\frac{1}{8}$ to 1$\frac{1}{2}$ inches in diameter with No. 1 square shanks. Length handle, 13 inches. Weight, 7 pounds.

The socket of No. 13009 is standard No. 2 round taper and takes drills from $\frac{32}{64}$ to $\frac{49}{32}$-inch diameter with No. 2 round taper shanks. Length handle, 13 inches. Weight, 6$\frac{1}{2}$ pounds.

Code Word	No.		List Each
Privacy.	13008	—Drill with No. 1, Square Taper Socket	$13 50
Prizable.	13009	—" " No. 2, Round " "	16 00

HIGH SPEED TWIST DRILLS



Nos. 13187-13191



Nos. 13192-13196

FOR use with Hand Ratchet Drill listed above. Length overall, square taper shank drills, 5 inches; round taper shank drills, 5$\frac{5}{16}$ inches. Made of high speed steel.

No. 1 square shanks $\frac{3}{8}$ to $\frac{5}{8}$ inch square, 1$\frac{1}{2}$ inches long.

No. 2 round shanks $\frac{9}{16}$ to $\frac{11}{16}$ inch diameter, 3$\frac{1}{8}$ inches long.

Code Word	No.								List Each
Railing.	13187	—Twist Drill, Diameter	$\frac{1}{2}$	inch,	No. 1	Square	Taper	Shank	$2 50
Raiment.	13188	—" " "	$\frac{9}{16}$	"	"	"	"	"	2 60
Rainbow.	13189	—" " "	$\frac{5}{8}$	"	"	"	"	"	2 70
Raindeer.	13190	—" " "	$\frac{3}{4}$	"	"	"	"	"	3 10
Raindrop.	13191	—" " "	$\frac{7}{8}$	"	"	"	"	"	3 90
Rainfall.	13192	—" " "	$\frac{1}{2}$	"	No. 2	Round	"	"	1 80
Rainless.	13193	—" " "	$\frac{9}{16}$	"	"	"	"	"	2 00
Rakehell.	13194	—" " "	$\frac{5}{8}$	"	"	"	"	"	2 20
Rakish.	13195	—" " "	$\frac{3}{4}$	"	"	"	"	"	2 70
Rallier.	13196	—" " "	$\frac{7}{8}$	"	"	"	"	"	3 40

UNIFORM ROUND SHANK TWIST DRILLS



SHANK 2¼ inches long, approximately ⅝ of an inch in diameter (actual diameter .647 of an inch). Length overall, 6 inches.

Code Word	No.								List Each
Grapple.	2953—	Twist	Drill,	Carbon	Steel,	Diameter	1/2	inch	$1 10
Grasper.	2955—	"	"	"	"	"	9/16	"	1 20
Gratuity.	2957—	"	"	"	"	"	5/8	"	1 30
Greaser.	2961—	"	"	"	"	"	11/16	"	1 70
Greenery.	2965—	"	"	"	"	"	3/4	"	2 10
Grenade.	2969—	"	"	"	"	"	1	"	2 50

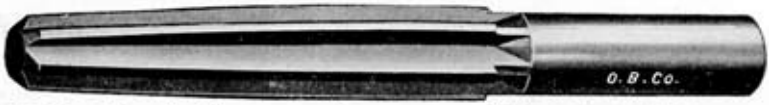
UNIFORM ROUND SHANK FLAT DRILLS



SHANK, 2¼ inches long, approximately ⅝ of an inch in diameter (actual diameter .647 of an inch). Length overall, 6 inches.

Code Word	No								List Each
Lapidary.	11202—	Flat	Drill,	High	Speed	Steel,	Diameter	1/2	inch $0 95
Lapidate.	11203—	"	"	"	"	"	"	9/16	" 1 00
Lapidify.	11204—	"	"	"	"	"	"	5/8	" 1 05
Lapper.	11205—	"	"	"	"	"	"	11/16	" 1 20
Lapping.	11206—	"	"	"	"	"	"	3/4	" 1 40
Lapsable.	11207—	"	"	"	"	"	"	1	" 1 55

BONDING REAMERS



MADE with six flutes, and are especially adapted for reaming high carbon steel rails.

Provided with a straight shank approximately ⅝ inch in diameter and 2¼ inches long. Length overall, 5½ inches.

Code Word	No.								List Each
Grewsome.	8160—	3/4	-inch	Reamer	for	Reaming	9/16	-inch holes	$4 50
Impaint.	10707—	21/32	"	"	"		5/8	"	4 75
Griddle.	8164—	3/4	"	"	"		11/16	"	4 90
Impalsy.	10708—	23/32	"	"	"		3/4	"	5 15
Gridiron.	8225—	3/4	"	"	"		13/16	"	5 35
Imparter.	10709—	25/32	"	"	"		7/8	"	5 55
Laputan.	11210—1		"	"	"		15/16	"	5 95
Lapwork.	11211—1 1/32		"	"	"		1	"	5 95

O-B Third Rail Insulators

Described and Illustrated in the Section immediately following.

O-B Rail Bonds
In the Section Preceding

O-B THIRD RAIL INSULATORS

THE third rail system of current distribution has been used for many years, the earliest records dating back to 1893 when installations were made almost simultaneously in the United States and England. The former was on the Intramural Railroad at the Chicago World's Fair and the latter on the Liverpool Overhead Railway.

Years of service and experiment have since developed many varying types, also demonstrated that, under certain well defined conditions, the third rail system possesses marked advantages over the overhead trolley system.

The early forms of insulators used for supporting the third rail consisted of wood blocks. While these gave satisfactory service when first installed, their efficiency as an insulating medium decreased after a time, and leakage once started, the rate of depreciation increased rapidly.

Stoneware, reconstructed granite and semi-porcelain were later used with varying degrees of success. Then the porcelain used in O-B Third Rail Insulators was developed particularly for this class of service. This porcelain has a solid homogeneous body which is thoroughly vitrified and practically non-absorbent, but at the same time is amply tough mechanically for the most severe service.

Owing to the wide range of service requirements, it is not possible to list in this catalog a complete line of even the standard types of O-B Third Rail Insulators but only a few of the more popular types are illustrated and described. It is suggested that those interested take advantage of our experience in this line and permit us to offer the type best suited to their particular conditions.

To enable us to make a study of your conditions with the idea of recommending the type of Third Rail Insulator best adapted to these conditions, we should have information as to the maker's name, the section number and weight of rail, also information as to the maximum and minimum height allowable for the third rail support.

O-B THIRD RAIL INSULATORS IN SERVICE



New York Central Railroad



Michigan Central Railroad, Detroit River Tunnel

O-B THIRD RAIL INSULATORS IN SERVICE



New York Central Railroad



Baltimore & Ohio Railroad

O-B THIRD RAIL INSULATORS IN SERVICE

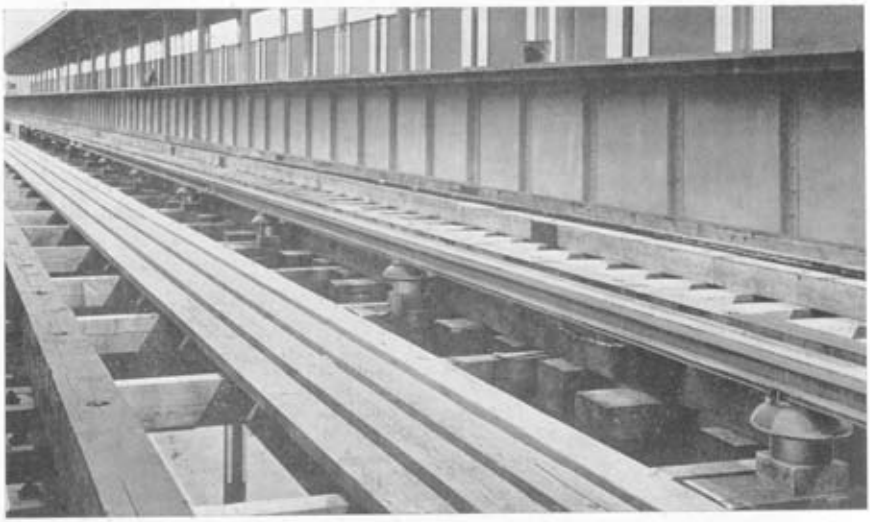


Michigan Railway Co., Kalamazoo, Mich.



Michigan Railway Co., Kalamazoo, Mich.

O-B THIRD RAIL INSULATORS IN SERVICE

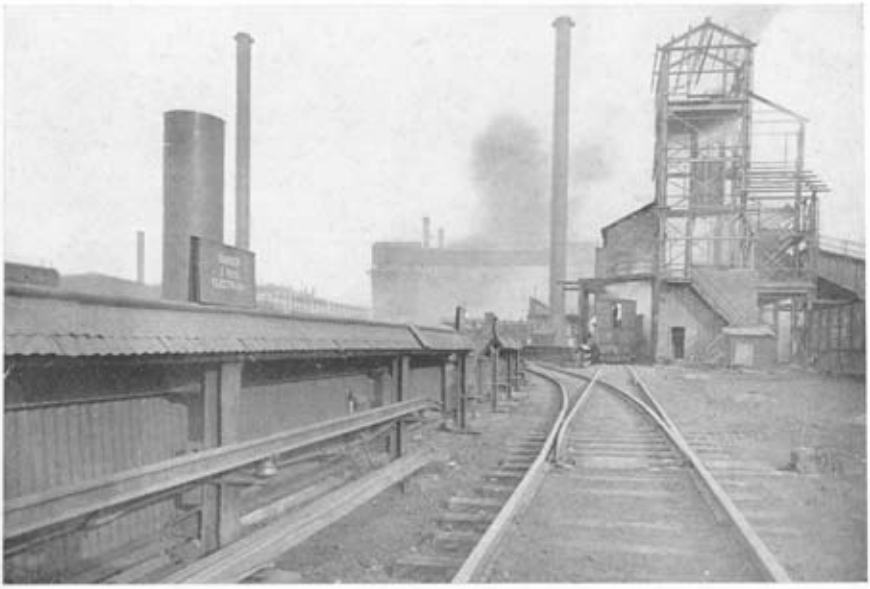


New York Municipal Railway Corporation, New York

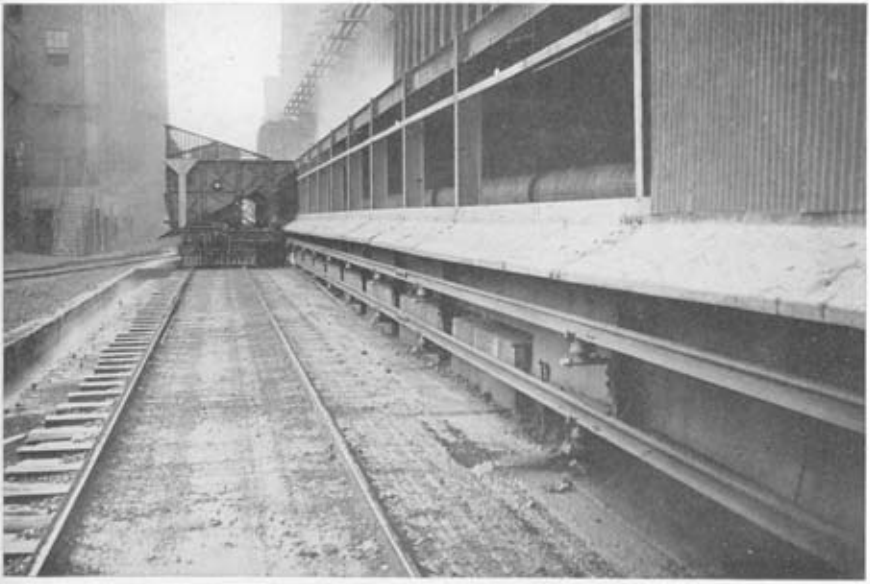


West Jersey and Seashore R. R., Camden, N. J.

O-B THIRD RAIL INSULATORS IN SERVICE

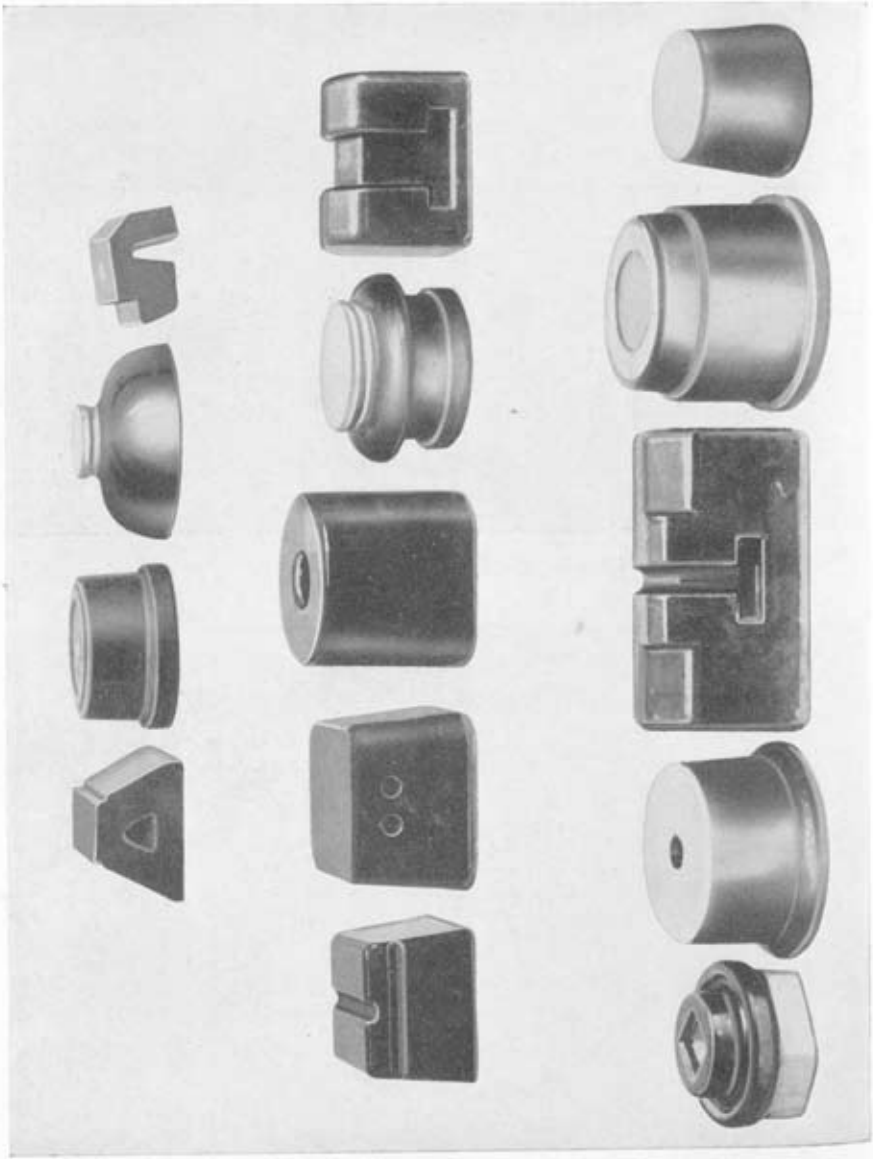


Illinois Steel Co., Gary Works



The Youngstown Sheet & Tube Co.

O-B THIRD RAIL INSULATORS

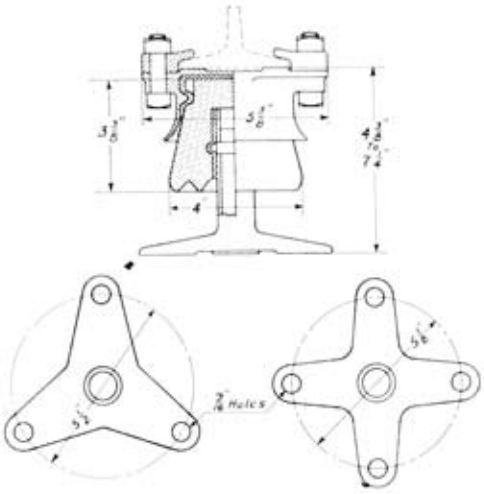


See following pages for description and listing.

O-B THIRD RAIL INSULATOR

Type A—Form 1





THIS Insulator is suited for the lighter weight rails and is extensively used by industrial properties. It has the advantage of being obtainable in any height from $4\frac{3}{8}$ to $7\frac{1}{4}$ inches, measured from top of tie to base of rail.

Suitable for A. S. C. E. rails from 20 to 55 lbs. weight.

Furnished with 3-hole or 4-hole base plate as shown.

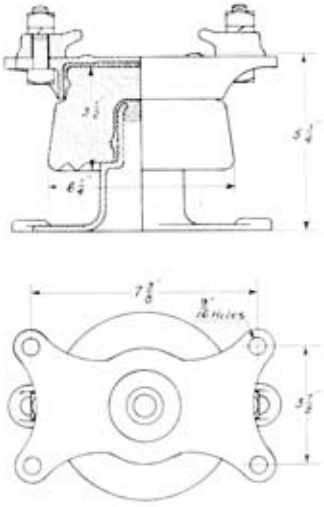
Metal cap and base are both cemented to the porcelain block.

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type A—Form 2





SUITABLE for the heavier weights of rail and is used by many industrial properties.

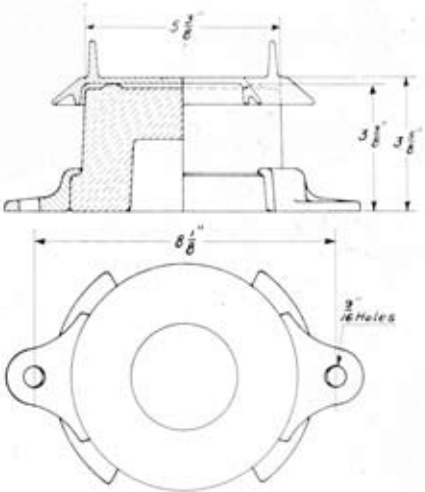
Can be furnished with different clamping lugs to fit A. S. C. E. rails of from 50 to 100 lbs. weight. All lugs are adjustable so that any set will clamp several sizes of rail.

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type B





USED on industrial properties and is particularly desirable where vertical clearance is limited. Height is only $3\frac{3}{8}$ inches from top of tie to base of rail.

Suitable for rails of from 45 to 100 lbs. weight.

Porcelain block rests directly on tie and is held in place by two clips lagged to the tie.

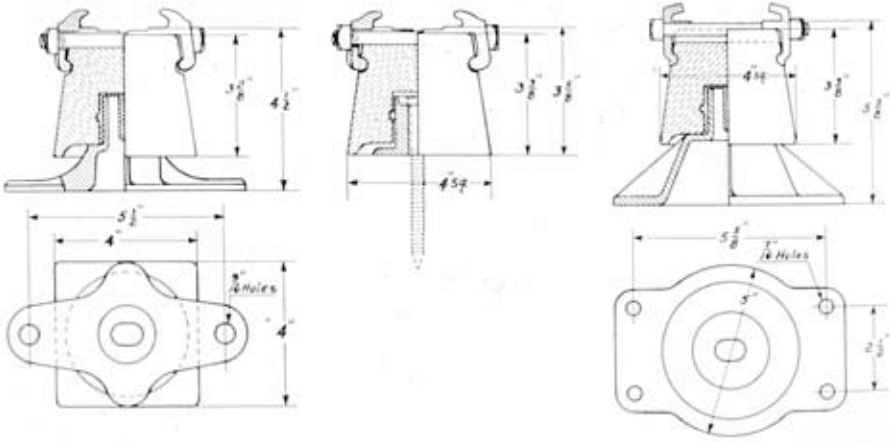
Cap casting rests loosely on block.

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type D—Form 1





A PARTICULARLY rugged insulator for the lighter weight rails. Used largely for industrial work.

For rails from 16 to 40 lbs. weight.

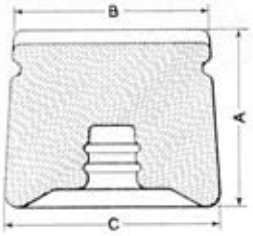
Can be furnished with any of the three bases shown above.

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type D—Form 2





THIS is a type of Insulator used extensively by the Interboro Rapid Transit Company, both in subway and on elevated, and by the Scioto Valley Traction Company.

Dimensions in Inches

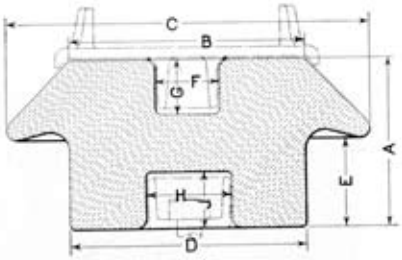
Size No.	A	B	C
1	$3\frac{1}{2}$	$5\frac{1}{2}$	6
2	$3\frac{15}{16}$	$4\frac{1}{2}$	$5\frac{1}{4}$
3	$4\frac{7}{16}$	$5\frac{1}{2}$	6
4	$4\frac{7}{8}$	$5\frac{1}{2}$	6

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type C





PORCELAIN block rests directly on tie over a cup casting which is lagged to tie.

Rail rests on a malleable cap casting provided with vertical lugs for holding rail in proper alignment, and circular lug at center projecting downward to hold cap in position on block.

A canvas or felt pad should be used between cap casting and porcelain block.

Projecting skirt affords protected leakage surface which increases electrical efficiency.

This type is used by the Philadelphia & Western Railway Co. and the Long Island R. R. Co.

Dimensions in Inches

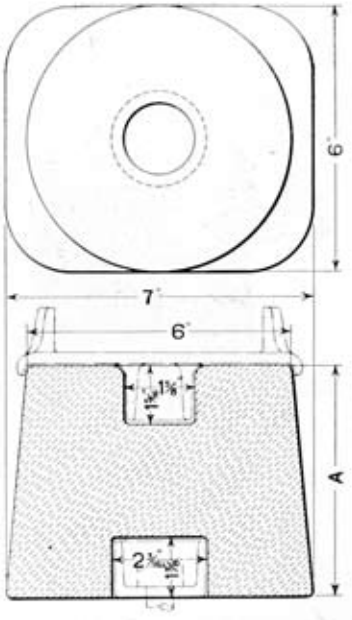
Size No.	A	B	C	D	E	F	G	H	J
1	$4\frac{1}{4}$	6	$9\frac{1}{4}$	6	$2\frac{1}{4}$	$1\frac{5}{8}$	$1\frac{3}{8}$	$2\frac{3}{16}$	$1\frac{7}{16}$
2	$4\frac{7}{16}$	6	$9\frac{1}{4}$	6	$2\frac{1}{4}$	$1\frac{5}{8}$	$1\frac{3}{8}$	$2\frac{3}{16}$	$1\frac{7}{16}$
3	5	$5\frac{7}{32}$	8	5	$3\frac{1}{4}$	$1\frac{5}{8}$	$1\frac{3}{8}$	$2\frac{3}{16}$	$1\frac{1}{2}$
4	$5\frac{1}{4}$	6	$9\frac{1}{4}$	6	$3\frac{1}{4}$	$1\frac{5}{8}$	$1\frac{3}{8}$	$2\frac{3}{16}$	$1\frac{7}{16}$

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type E





PORCELAIN block rests directly on tie over a malleable cup casting, which is lagged to tie. The malleable cap casting is provided with vertical lugs to prevent lateral movement of rail and a circular lug at the center, projecting downward to hold cap in position on block.

A canvas or felt pad should be used between cap casting and porcelain block.

Among those using this type are the Pennsylvania Tunnel & Terminal Co., The Long Island R. R. Co. and the Philadelphia & Western Ry. Co.

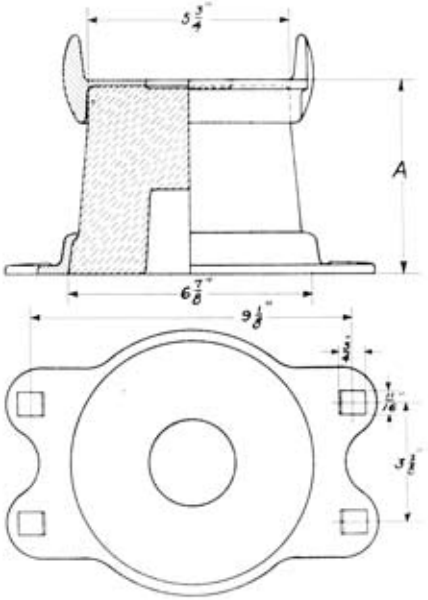
Dimension	Size No. 1	Size No. 2	Size No. 3	Size No. 4
A	$4\frac{7}{16}$"	$4\frac{11}{16}$"	$5\frac{1}{4}$"	$5\frac{7}{8}$"

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type F





CONSISTS of a porcelain block, which rests directly on tie and which may be held in place by a malleable clamping ring, as shown above, extending entirely around the block and with projecting lugs by which it is lagged to the tie, or the block may rest over a malleable cup casting as shown for the Type E Insulator on page 523. Cap casting is provided with vertical lugs for holding rail in proper alignment and should rest on a canvas or felt pad.

Can be furnished with castings suitable for A. S. C. E. rails of from 70 to 100 lbs. weight.

Among those using this type are the Aurora, Elgin & Chicago Railway Company and the Puget Sound Electric Railway Co.

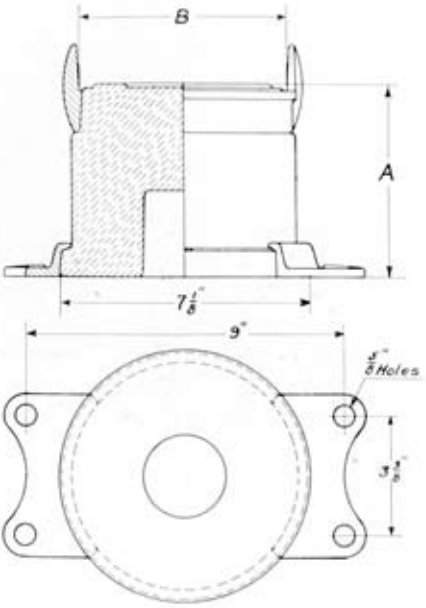
Dimension	Size No. 1	Size No. 2
A	$5\frac{5}{16}$"	$6\frac{5}{16}$"

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type G





CONSISTS of a porcelain block which rests directly on tie and which may be held in place by two clamp castings as shown above, or the block may rest over a cup casting as shown for the Type E Insulator on page 523.

Malleable ring casting is provided with vertical lugs to hold rail in proper alignment.

Dimensions in Inches

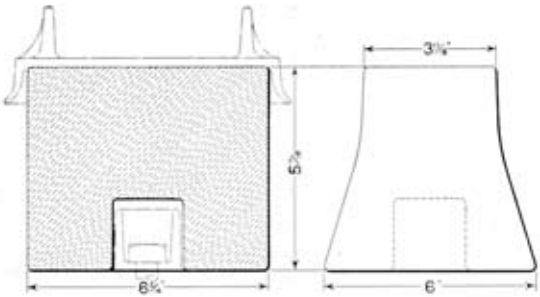
Size No.	A	B
1	5 1/2	5 3/8
2	5 1/2	5 1/16
3	6 3/8	4 3/8

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type H





PORCELAIN block rests directly on tie over a malleable cup casting which is lagged to the tie. Cup casting is square in section; the hole in bottom of block is 2 x 2 x 2 inches.

The malleable cap casting is provided with vertical lugs to prevent lateral movement of rail.

A canvas or felt pad should be used between cap casting and porcelain block.

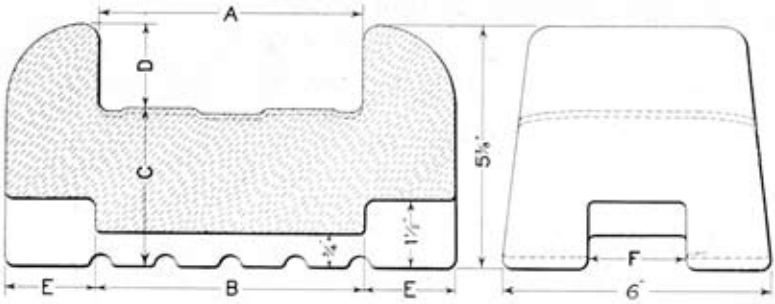
This Insulator is used by the Michigan Railway Company.

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type K—Patented





PORCELAIN block rests directly on tie and is held in position by a bar iron forging which fits in the slot running across bottom of insulator.

Slot is recessed at each end to provide clearance for the heads of lag screws which fasten forging to tie.

Block is provided with porcelain lugs to hold rail in proper alignment.

The forging may be extended to provide a support for third rail protection board, if desired.

Used by West Jersey and Seashore Railroad Company and Lackawanna and Wyoming Valley Railroad Company.

Dimensions in Inches

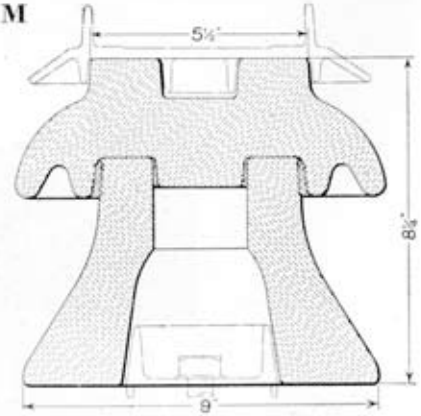
Size No.	A	B	C	D	E	F
1	$5\frac{7}{8}$	$5\frac{3}{4}$	$3\frac{1}{2}$	$1\frac{7}{8}$	$2\frac{1}{8}$	$2\frac{3}{16}$
2	$4\frac{13}{16}$	$5\frac{5}{16}$	$3\frac{3}{4}$	$1\frac{5}{8}$	$1\frac{7}{8}$	$2\frac{5}{16}$

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type M





PORCELAIN block is made up of two pieces, cemented together, and rests directly on the tie over a malleable cup casting which is lagged to the tie.

Cup casting is rectangular in section as is also the hole in bottom of block.

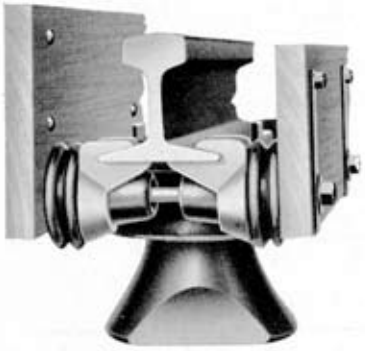
Four short lugs extend downward from bottom of cup casting which serve to prevent it from turning on tie.

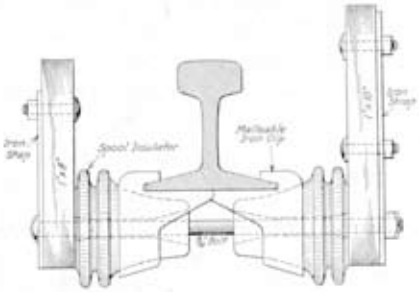
Rail rests on a malleable cap casting provided with vertical lugs for holding rail in proper alignment and circular lug at center projecting downward to hold cap in position on block.

A canvas or felt pad should be used between cap casting and porcelain block.

This Insulator has considerable protected leakage surface and is designed for 2,400 volt D. C. operation.

It is used by the Michigan Railway Company with protection boards supported and insulated as shown below.



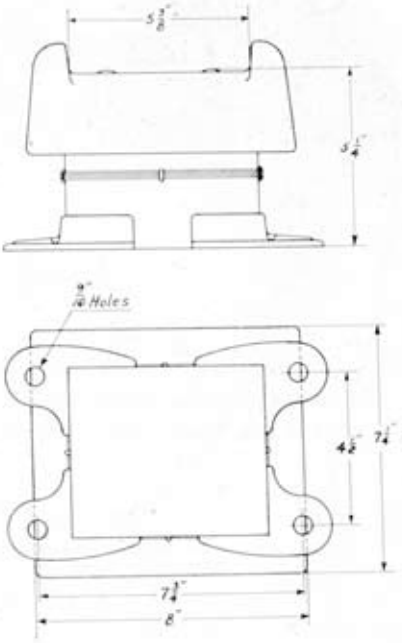


See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type L





PORCELAIN block rests on a treated wood block which is held in position on tie by four foot castings lagged in place.

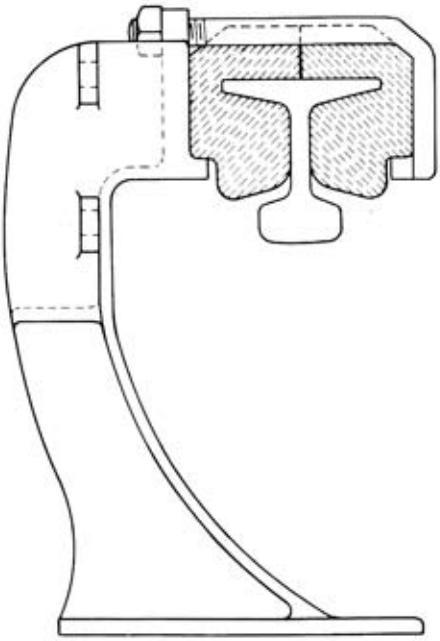
A canvas or felt pad is placed between the porcelain and wood blocks.

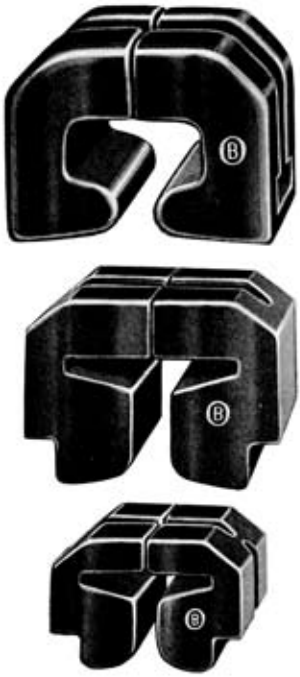
This Insulator is used by the Wilkesbarre and Hazelton Railway.

See page 510 for general description.

O-B THIRD RAIL INSULATOR

Type N





DESIGNED to suspend a bullhead or an inverted tee rail for an under-running contact system. Consists of a pair of porcelain blocks, a malleable support casting and a strap, or bolt. The manner in which they are assembled is shown in the illustration.

Can be furnished in a number of sizes; full data given on request.

Prominent among the users of this type are the following: Central California Traction Co., New York Central R. R., Michigan Central R. R., Philadelphia Rapid Transit Co., New York State Railways and many industrial plants.

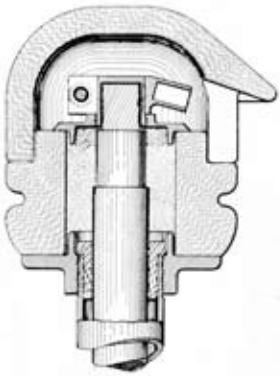
See page 510 for general description.

O-B CABLE TERMINAL INSULATORS

Types A-1 and A-2



Type A-1



Type A-2—No. 12367



Type A-2

USED on third rail systems to insulate the cable terminal where it leaves the underground conduit and provides means for making flexible connection with contact rail. Insulator base and cap are made of porcelain.

Terminal casting is provided with lugs to receive stub ends of bonds used for making connection with contact rails.

Space between insulator support flange and cable support flange which rests on top of porcelain base should be filled with insulating compound.

Type A-1

Code Word	No.			List Each
Ophelic.	12363—	Type	A-1 Insulator, complete, for 1,000,000 C. M. Cable..	$16 00
Lavender.	11311—	"	A-1 Porcelain Cap and Base only, for 1,000,000 C. M. Cable.....	5 00
Ophiuran.	12364—	"	A-1 Metal Fittings only, for 1,000,000 C. M. Cable..	11 00
Opiate.	12365—	"	A-1 Insulator, complete, for 2,000,000 C. M. Cable..	20 00
Laverock.	11312—	"	A-1 Porcelain Cap and Base only, for 2,000,000 C. M. Cable.....	6 00
Outpace.	12366—	"	A-1 Metal Fittings only, for 2,000,000 C. M. Cable..	14 00

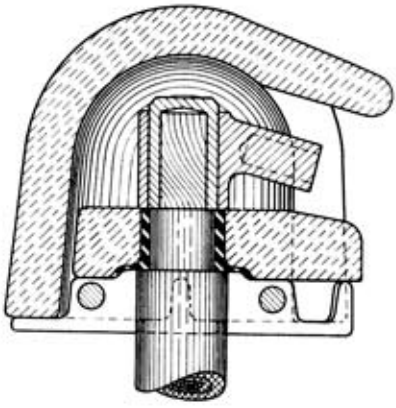
Type A-2

Opiface.	12367—	Type	A-2 Insulator, complete, for 1,000,000 C. M. Cable..	18 00
Lavisher.	11313—	"	A-2 Porcelain Cap and Base only, for 1,000,000 C. M. Cable.....	7 00
Opinator.	12368—	"	A-2 Metal Fittings only, for 1,000,000 C. M. Cable..	11 00

O-B CABLE TERMINAL INSULATOR

Type B





SERVES the same purpose as the Type A Insulator listed on the preceding page but is a simplified design, lighter in weight and is used with smaller cables.

Terminal casting is provided with lugs to receive stub ends of bonds used for making connection with contact rails.

Code Word	No.	List Each
Prizing.	12960—Type B Insulator, Complete, for 500,000 C. M. Cable	$15 00
Probate.	12961— " B " " " 1,000,000 C. M. "	18 00
Probator.	12962—Porcelain Cap, only	3 00
Probity.	12963—Porcelain Ring only, 500,000 C. M. Cable	2 00
Procere.	13007— " " " 1,000,000 C. M. "	2 50

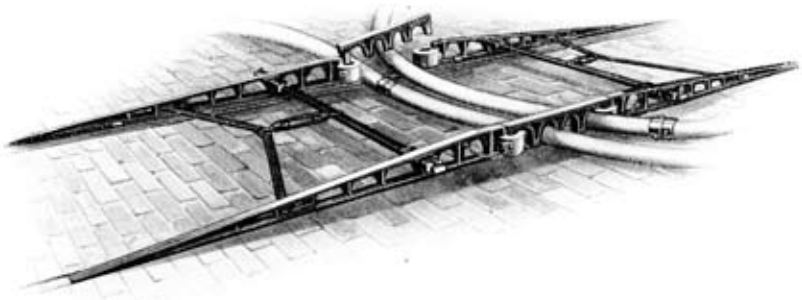
O-B Car Equipment Materials

Described and listed in the section immediately following.

O-B Third Rail Insulators in the section preceding

EMERGENCY HOSE BRIDGE

Improved Design



THIS Bridge enables cars to run over tracks crossed by fire hose. It consists of two parallel trusses, provided with openings through which several lines of hose may be passed, and so arranged that the trusses are rigidly connected by brace rods, which are placed high enough to clear the pavement. The trusses are secured on top of the rails by lugs which project downward, and engage the side of the rail head.

The Hose Bridge can be assembled or taken apart quickly, and when "knocked down," can be readily carried on a trouble or emergency wagon. The running surfaces have ample strength to carry any electric cars with perfect safety and the slope toward either end is gradual. Where the Hose Bridge is in use, there can be no blockades or holding of cars on account of fires and often it is not necessary to even break the regular schedule.

Made for either four or six lines of 3-inch hose.

Length of approach is 5 feet 3 inches, maximum height $4\frac{3}{4}$ inches.

Code Word	No.	List Each
Faddle.	9989—Steel Bridge for four lines of Hose, length overall 14 feet.	$260 00
Fadedly.	10473— " " " six " " " " " 15 "	280 00

In ordering Hose Bridges, state the gauge of track on which they are to be used and when for use with cars having rigid pilots, give clearance between top of rail and pilot, also the distance from a point on the pilot which is immediately over rail, to the center of front wheels and distance between wheel centers on truck.

O-B TROLLEY WIRE PICK-UP

Patented



Showing Pick-Up in Use

INTENDED for picking up the broken end of live trolley wire and for pulling it up out of the way and suspending it.

Wooden handle is 14 inches long. A pull on the rope grips the wire. Rope passes through hole in handle at "A" and is formed into a permanent half-hitch which will not let go even though strain on rope is accidentally released.

Will grip all sizes of trolley wire tightly, from a badly worn 1-0 size up. All metal parts are sherardized.

Code Word	No.	List Each
Imagery.	10633—Pick-Up, complete with 50 feet of ¾-inch Manila Rope	$5 00

TRAILER CONNECTOR

Patented



No. 11023—One Half Broken Open to Show Construction

A SIMPLE and efficient form of Connector for coupling trailer and motor car lighting circuits and for similar work.

Internal construction eliminates possibility of burning. When uncoupled all exposed parts are "dead."

Each end of the Connector is supplied with 3 feet of No. 12 flexible insulated cable, securely soldered in place.

Code Word	No.	List Each
Interrer.	11023—Trailer Connector	$3 00

IMPERIAL HEADLIGHTS

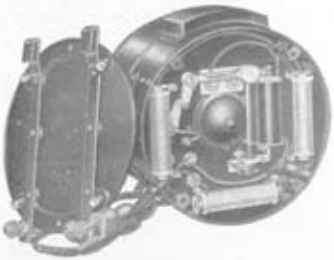
Luminous Arc for Railway Service



Type LAA
Combination Arc and Incandescent



Type LAA with
Front Door Open



Type LAA with
Rear Door Removed

COMPLETE listing of the entire line of Imperial Headlights—Luminous Arcs, Carbon Arcs and Incandescents for both railway and mine service—together with accessories, is given in separate complete Headlight catalog.

Copy on request.

IMPERIAL HEADLIGHTS

Carbon Arc for Railway Service



Type A
Combination Arc and Incandescent



Type B
Arc Only

COMPLETE listing of the entire line of Imperial Headlights—Luminous Arcs, Carbon Arcs and Incandescents for both railway and mine service—together with accessories, is given in separate complete Headlight catalog.

Copy on request.

IMPERIAL HEADLIGHTS

Incandescent for Railway Service



Type SDP—Portable



Type SDS—Stationary

For Suburban or Interurban Service

WITH all Imperial Incandescent Headlights for suburban and interurban service, there is a choice from three kinds of light beam depending upon the reflector selected.

Crystal Ray—Clear glass mirror reflector.

Sterling Ray—Nickel-plated copper reflector.

Gold Ray—Yellow glass mirror reflector.

Complete listing of the entire line of Imperial Headlights—Luminous Arcs, Carbon Arcs and Incandescents for both railway and mine service—together with accessories, is given in separate complete Headlight catalog.

Copy on request.

IMPERIAL HEADLIGHTS

Incandescent for Railway Service



Type W



Type Z

For City Service



Type WDS
Surface Mounting



Front View



Type WDF
Flush Mounting

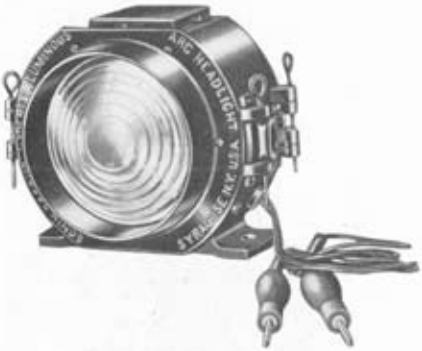
For City or Suburban Service

COMPLETE listing of the entire line of Imperial Headlights—Luminous Arcs, Carbon Arcs and Incandescents for both railway and mine service—together with accessories, is given in separate complete Headlight catalog.

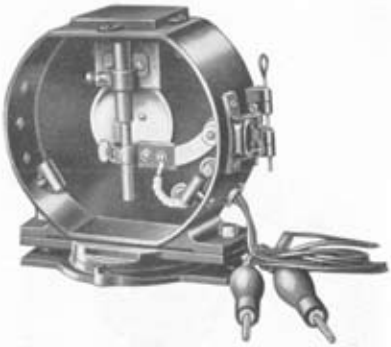
Copy on request.

IMPERIAL HEADLIGHTS

Luminous Arc and Carbon Arc for Mine Service



Type MLK
Rigid Base



Type MLK
Turret Base
Front Door Removed to Show
Partition in Case

Luminous Arc



Type M
Turret Base



Type M
Rigid Base

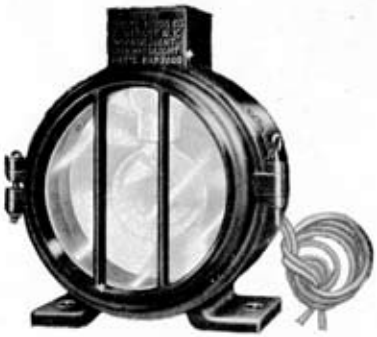
Carbon Arc

COMPLETE listing of the entire line of Imperial Headlights—Luminous Arcs, Carbon Arcs and Incandescents for both railway and mine service—together with accessories, is given in separate complete Headlight catalog.

Copy on request.

IMPERIAL HEADLIGHTS

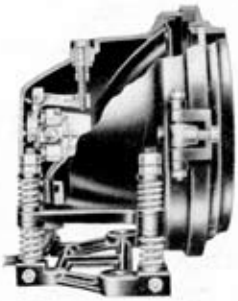
Incandescent for Mine Service



Type I—Cast Iron Case



Type MD—Cast Iron Case



Type MH—Sectional View



Type MH—Spring-Hinged Suspension

COMPLETE listing of the entire line of Imperial Headlights—Luminous Arcs, Carbon Arcs and Incandescents for both railway and mine service—together with accessories, is given in separate complete Headlight catalog.

Copy on request.

O-B TROLLEY CATCHER

Patented



Nos. 13141-11628



Phantom View



No. 11628

USED to catch trolley pole when wheel jumps and prevent damage which would result if pole caught in overhead.

Operation is positive. Three dogs fastened to back of reel are thrown outward when trolley jumps. One dog slides over guide (A-B) and engages stop at (C) preventing further flight of pole. Dog will not release accidentally because guide (A-B) prevents it being pulled toward center by spring until rope is reeled in farther than it will be on the rebound; hence, there is no "stepping up" of pole.

All parts are ruggedly constructed. Springs attached to dogs are worked through a short distance only and, therefore, will give long service. They are enameled to prevent rusting.

Main operating spring is well protected in back of case.

Gravity-operated Reel Latch affords a convenient means of locking the reel for rope renewal.

Catcher is attached to bracket by a snap latch. A bracket can be mounted on each end of car and one catcher used for double end operation.

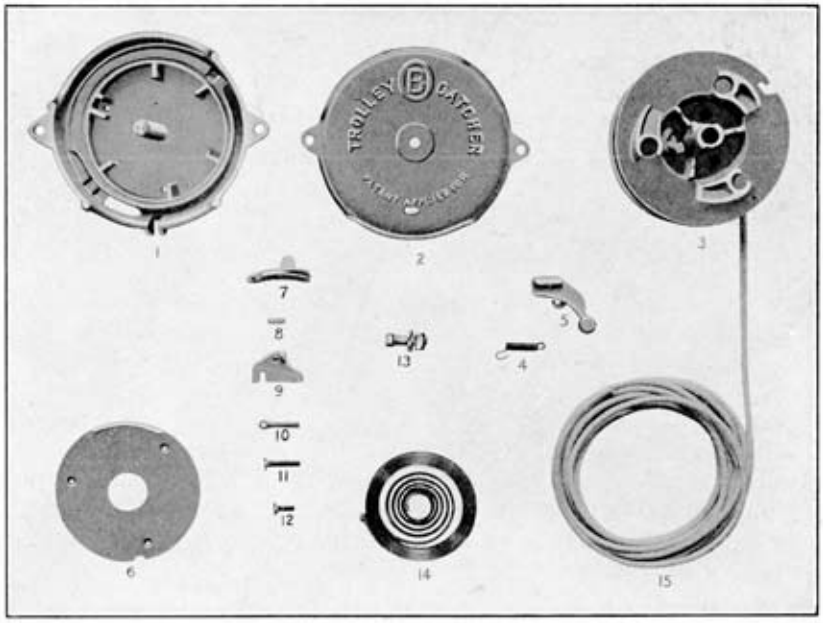
Holes in bracket are $\frac{3}{8}$ inch in diameter; vertical spacing 8 inches, horizontal spacing $4\frac{1}{2}$ inches.

Weight, without bracket, $15\frac{1}{2}$ pounds. Case and bracket are malleable iron, enameled.

Catcher is furnished with 22 feet of $\frac{1}{4}$-inch trolley rope.

Code Word	No.	List Each
Ralline.	13141—O-B Trolley Catcher for O-B and Ideal Brackets	$20 50
Ordainer.	11628—O-B Bracket only, for O-B and Ideal Catchers	1 40
Shallow.	13900—O-B Trolley Catcher for Keystone Bracket	20 50
Shameful.	13901—Bracket for O-B No. 13900 and Keystone Catchers	1 40
Shampoo.	13902—O-B Trolley Catcher for Earll Bracket	20 50
Shamrock.	13903—Bracket for O-B No. 13902 and Earll Catchers	1 40
Shapely.	13904—O-B Trolley Catcher for Wilson Bracket	20 50
Shatter.	13905—Bracket for O-B No. 13904 and Wilson Catchers	1 40

O-B TROLLEY CATCHER PARTS



Code Word	No.	Part No.		List Each
Ramiform.	13142	1	Case with Center Stud installed for Catcher No. 13141	.85 50
Shaving.	13906	1	" " " " " " " " 13900	5 50
Shearer.	13907	1	" " " " " " " " 13902	5 50
Shearling.	13908	1	" " " " " " " " 13904	5 50
Pythonic.	13143	2	Cover	1 90
Ordinant.	12389	3	Reel	5 00
Orectic.	12392	4	Throw-Out Dog Spring	10
Quackery.	13173	5	Throw-Out Dog	30
Organdy.	12394	6	Partition Plate	50
Organic.	12395	7	Case Latch	20
Organist.	12396	8	Case Latch Spring	10
Quackish.	13145	9	Reel Latch	15
Quadrille.	13146	10	Reel Latch Cotter Pin	05
Orgeat.	12397	11	Partition Plate Screw	05
Oriency.	12399	12	Case Latch Screw	05
Quadrin.	13147	13	Cover Attachment Bolt with Nut and Lock Washer	20
Orient.	12400	14	Main Spring	3 00
Oriental.	12401	15	Trolley Rope, ¼-inch Diam., 22 feet long	1 50

O-B TROLLEY RETRIEVER

Patented



Nos. 13119-13120-11628



No. 11628

USED to catch a flying trolley pole and automatically pull it down so as to clear the overhead construction. Upward travel of pole is stopped quickly and a powerful retrieving action instantly follows.

After the retrieving operation, resetting of the mechanism is quickly accomplished by simply pulling out the rope until a positive stop is reached. Rope should then be slackened a trifle which action unlocks the reel from the rewound retrieving spring, the Retriever being again in operating condition.

Retriever is attached to bracket by a snap latch.

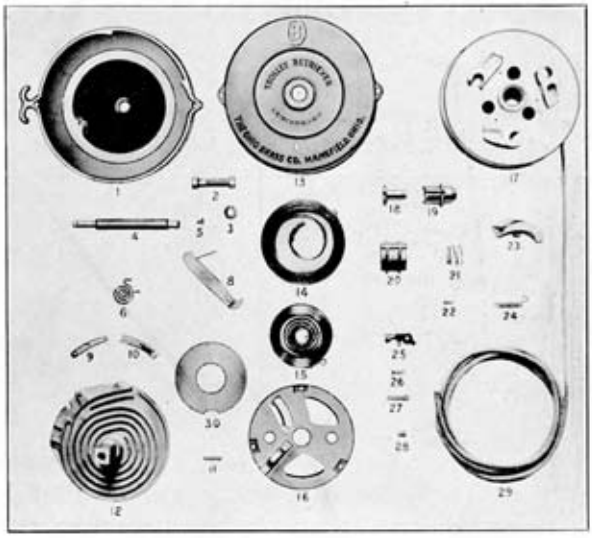
Holes in bracket are $\frac{3}{8}$ inch in diameter; vertical spacing is 8 inches; horizontal spacing, $4\frac{1}{2}$ inches. Case is malleable iron, enameled. Retriever is furnished with 22 feet of $\frac{5}{16}$-inch trolley rope. Net weight No. 13119, 32 pounds; No. 13120, 33 pounds.

No. 13119, equipped with medium spring, is designed for rope tensions of 35 pounds or less; No. 13120, with heavy spring, is for rope tensions of over 35 pounds. It is important that the trolley pole tension be given when ordering.

Code Word	No.	List Each
Puffer.	13119—Retriever, Medium Spring, with Rope, without Bracket	$42 00
Pugging.	13120— " Heavy " " " " " "	42 00
Ordainer.	11628—Bracket only, Malleable Iron, Enameled	1 10

O-B Retriever can be used on cars equipped with Knutson Bracket.

O-B TROLLEY RETRIEVER PARTS



Code Word	No.	Part No.		List Each
Pugilism.	13121	1	Case	$6 00
Pannose.	12605	2	Cover Attachment Bolt with Nut and Lock Washer	10
Orisont.	12405	4	Center Stud	40
Orleans.	12406	6	Latch Dog Spring	10
Ornate.	12408	8	Floating Lever, Forged Steel	1 20
Oroide.	12409	9	Winding Stop Dog	70
Orotund.	12410	10	Main Latch Dog	70
Orphan.	12411	11	Dog Pin (Used with Nos. 9 and 10)	05
Orphean.	12412	12	Retrieving Disc	9 00
Pannage.	12604	13	Cover	5 20
Pugnacity.	13122	14	Medium Retrieving Spring, for Retriever No. 13119	7 50
Pugnose.	13123	14	Heavy " " " " " 13120	9 00
Puissance.	13125	15	Service Spring	3 00
Orthid.	12415	16	Partition Plate	1 50
Orthodox.	12416	17	Reel	6 00
Orthoepy.	12417	18	Winding Ratchet, Male Half	80
Orthogon.	12418	19	" " Female Half	90
Ortolan.	12419	20	Retrieving Spring Core	40
Osages.	12420	21	Winding Ratchet Spring	10
Oscinian.	12421	22	" " Pin	05
Paling.	12585	23	Throw-Out Dog	20
Orectic.	12392	24	" " " Spring	10
Oscitant.	12422	25	Case Latch	20
Oscule.	12423	26	" " Spring	05
Osmius.	12424	27	" " Cotter Pin	05
Osmose.	12425	28	Partition Plate Screw	05
Osmund.	12426	29	Trolley Rope, $\frac{5}{16}$-inch diameter, 22 feet long	2 50
Ramadan.	13169	30	Reel Washer, Sheet Steel	50

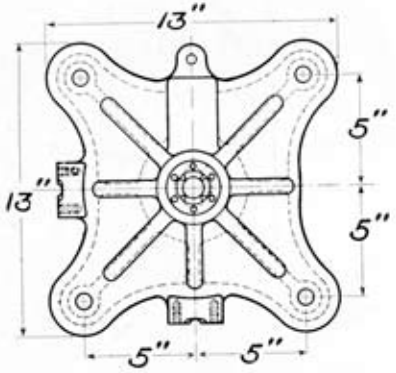
O-B TROLLEY BASE

Patented

Form 1



End View Showing Renewable Bearing Bushings



Plan View Showing Spacing of Bolt Holes



Form 1 Base

See following page for description and listing.

O-B TROLLEY BASE

Patented

Form 1—Continued

THIS Base combines light weight and construction features that mean satisfactory operation under all conditions of service.

Roller bearings are set in an improved type of cage which keeps rollers upright and prevents jamming.

Bearings are easy of access at all times.

All working bearings are provided with steel bushings which may be renewed when worn and thus greatly increase life of Base.

Hook is provided for holding fork down for pole renewal in car barn.

Tension springs are closed at the ends over drop forgings, thus minimizing spring breakage, and are provided with special bearing sleeves which prevent excessive wear between spring eye and fork.

A buffer spring prevents bending of trolley poles.

No. 11398, as listed below, is equipped with two low and two medium tension springs; No. 11399 is equipped with four medium tension springs, and No. 11934 is equipped with two medium and two high tension springs. In other respects the three bases are identical.

Always specify tension on trolley pole and length of pole used. Socket will accommodate poles 1½ inch outside diameter at butt.

Height overall, with trolley pole horizontal, 6⅝ inches. Castings are malleable iron. All parts are painted; threaded parts are sherardized. Net weight, 120 pounds.

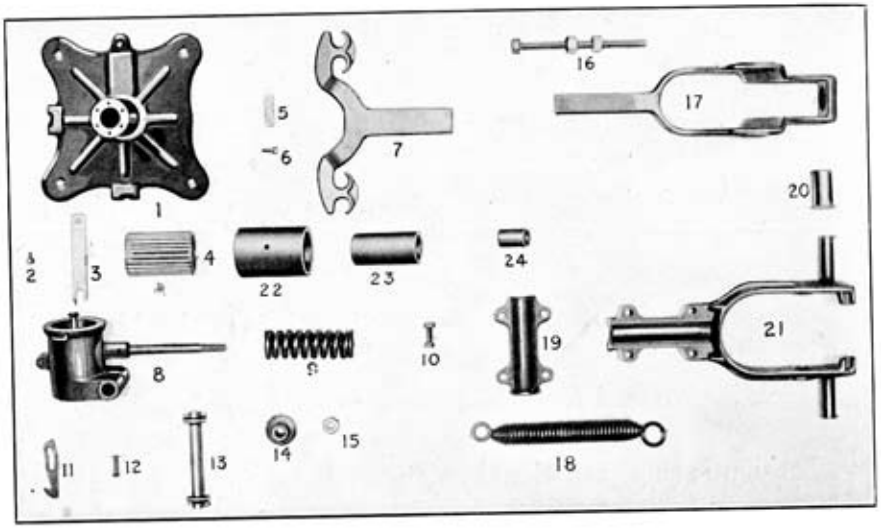
Code Word	No.					List Each
Limbate.	11398—	Form	1	Base for	City Service	$74 00
Limbous.	11399—	"	1	"	Interurban Service	74 00
Opinicus.	11934—	"	1	"	Extra Heavy "	76 00

Always specify tension on trolley pole and length of pole used

Above Bases can be furnished for trolley poles 2 inches outside diameter at butt.

O-B TROLLEY BASE PARTS

For Form 1 Base



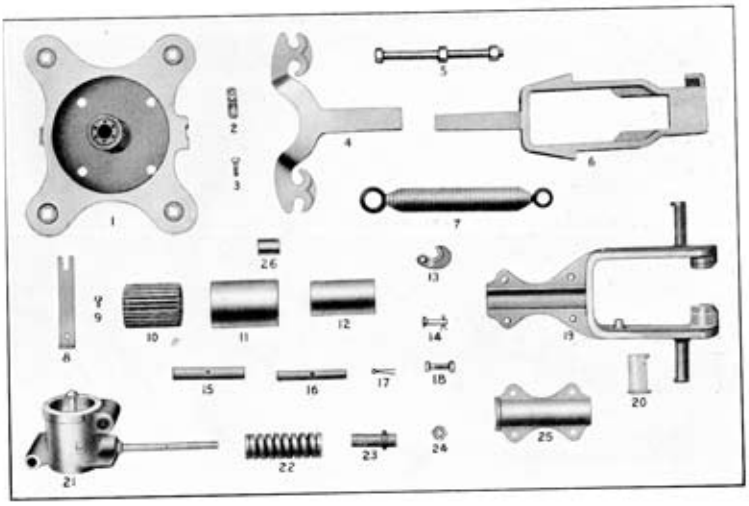
The listing below refers to a single part in each case, and if more than one part of the same kind is wanted, state quantity desired.

Code Word	No.	Part No.		List Each
Legioned.	11400	1	Stem Casting with Bushing	$14 00
Leisure.	11401	2	Retaining Fork Screw	10
Lemming.	11402	3	Retaining Fork	50
Lendable.	11403	4	Roller Bearing, complete	3 00
Leniency.	11404	5	Cable Clamp	25
Lenitude.	11405	6	" " Cap Screw	10
Lenticel.	11406	7	Spring Adjusting Casting	4 25
Lentil.	11407	8	Turret, complete	12 00
Lentous.	11408	9	Buffer Spring	1 40
Leonese.	11409	10	Trolley Pole Clamp Bolt with Nut	10
Leopard.	11410	11	Hold Down Hook	30
Lepidoid.	11411	12	" " " Pin with Cotter	10
Leperize.	11412	13	Main Fork Pin with Washers and Cotters	1 10
Leporine.	11413	14	Buffer Spring Washer	60
Leprosy.	11414	15	" " Post Nut	10
Lethargy.	11415	16	Tension Bolt with Nuts	40
Lettuce.	11416	17	Yoke	11 50
Levant.	11418	18	No. 9 Low Tension Spring (see Note below)	3 20
Leucite.	11417	18	" 10 Medium " " " " "	3 00
Oppilate.	11935	18	" 11 High " " " " "	3 70
Levator.	11419	19	Trolley Pole Clamp	1 70
Levesel.	11420	20	Spring Bearing Sleeve	40
Levitate.	11421	21	Fork	14 00
Mobbish.	11444	22	Turret Bearing Bushing	1 30
Mobile.	11445	23	Stem " "	1 30
Pantheon.	12449	24	Fork " "	50

NOTE—Base No. 11398 is equipped with two No. 9 and two No. 10 springs; Base No. 11399 is equipped with four No. 10 springs and Base No. 11934 is equipped with two No. 10 and two No. 11 springs.

O-B TROLLEY BASE PARTS

For Form 2—Low Base



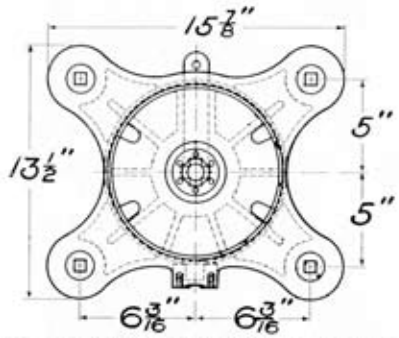
Code Word	No.	Part No.		List Each
Optical.	12372	1	Stem with Bushing	$19 00
Leniency.	11404	2	Cable Clamp	25
Lenitude.	11405	3	" " Cap Screw	10
Lenticel.	11406	4	Spring Adjusting Casting	4 50
Lethargy.	11415	5	Tension Bolt with Nuts	40
Optician.	12373	6	Yoke	11 50
Levant.	11418	7	No. 9 Low Tension Spring (See Note below)	3 20
Leucite.	11417	7	" 10 Medium " " " " "	3 00
Oppilate.	11935	7	" 11 High " " " " "	3 70
Lemming.	11402	8	Retaining Fork	50
Leisure.	11401	9	" " Screw	10
Optimate.	12374	10	Roller Bearing, complete	2 80
Optimism.	12375	11	Turret Bearing Bushing	1 20
Oquassa.	12376	12	Stem " "	1 10
Oracle.	12377	13	Hold Down Hook	25
Orangery.	12378	14	" " " Pin with Cotter	10
Orangite.	12379	15	Main Fork Pin	75
Oretress.	12380	16	Yoke Pin	40
Orbate.	12381	17	Retaining Cotter (used with Nos. 15 and 16)	05
Leonese.	11409	18	Trolley Pole Clamp Bolt with Nut	10
Orbical.	12382	19	Fork	13 50
Levesel.	11420	20	Spring Bearing Sleeve	40
Orbity.	12383	21	Turret, complete	12 00
Orcein.	12384	22	Buffer Spring	1 00
Orchard.	12385	23	" " Sleeve	45
Orchid.	12386	24	" " Post Nut	10
Levator.	11419	25	Trolley Pole Clamp	1 70
Panther.	12450	26	Fork Bearing Bushing	50

NOTE—Base No. 12369 is equipped with two No. 9 and two No. 10 springs; Base No. 12370 is equipped with four No. 10 springs; Base No. 12371 is equipped with two No. 10 and two No. 11 springs.

O-B TROLLEY BASE

Patented

Form 2—Low Base



Plan View Showing Spacing of Bolt Holes

FOR use where minimum overall height is desired. Possesses all the desirable features of the Form 1 Base described on page 547.

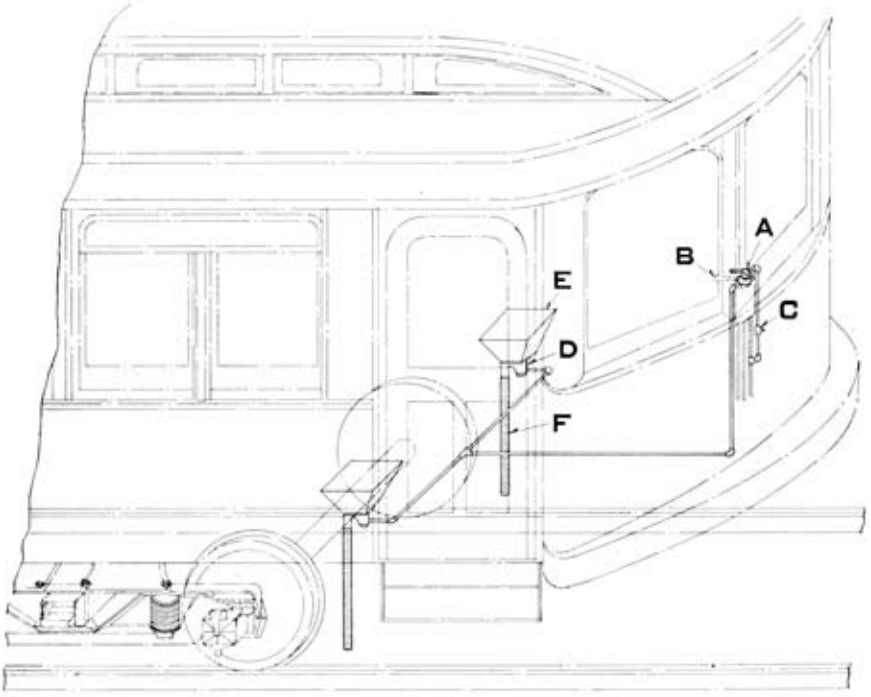
No. 12369 is equipped with two low and two medium tension springs; No. 12370 with four medium tension springs, and No. 12371 with two medium and two high tension springs. In other respects the three bases are identical.

Height, overall, above running board is 3⅜ inches. Outside diameter of dished portion is 9⅞ inches; extends 2⅛ inches below running board. Castings malleable iron; all parts painted; threaded parts are sherardized. Net weight, 120 pounds.

Code Word	No.					List Each
Opponent.	12369—	Form	2	Base for	City Service	$78 00
Oppress.	12370—	"	2	"	Interurban Service	78 00
Oppugner.	12371—	"	2	"	Extra Heavy "	78 00

O-B AIR SANDER EQUIPMENT

Method of Mounting



THIS diagram refers particularly to the mounting of Forms 1 and 2 Diaphragm Valves.

Sander Valve "A" is mounted so that handle is in convenient position just above engineer's valve handle "B."

Reducing Valve "C" is cut into the pipe on inlet side of Sander Valve.

The sand is blown from a chamber in Trap "D" into Wire Hose "F" falling by gravity through the hose to rail.

Sand Hoppers "E" can be made any shape to fit the space they must occupy. They should be placed in vestibule, baggage compartment, or under seats far enough back, if possible, so that the hose will guide the sand to spots on the rails immediately in front of the wheels.

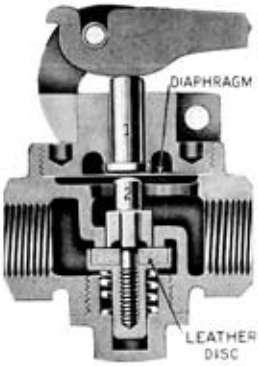
See following pages for description and listing of O-B Air Sander Devices.

O-B AIR SANDER VALVE

Patented

Diaphragm Type—Form 1





POSSESSES an exclusive feature in the flexible bronze diaphragm between the valve stem (2) and the plunger (1) which opens the Valve, making it absolutely impossible for air to leak around the plunger stem (1) when it is being operated and avoiding the necessity of packing and therefore making the Valve easier to operate.

Leather disc makes it difficult for small particles of dirt to cause leakage and eliminates regrinding.

Clevis to which the handle is attached can be rotated with respect to the valve body so that it is possible to install the Valve at either side of the engineer's valve and turn the operating handle immediately over the engineer's valve handle.

Made from high grade bronze and neatly finished. Inlet and outlet openings are tapped for ½-inch standard pipe. Width of valve over faces of pipe connections is 2⅝ inches.

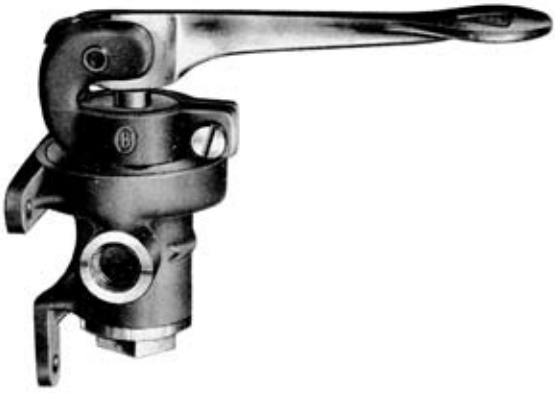
Code Word	No.	List Each
Flutter.	10568—O-B Air Sander Valve, without handle	$4 00
Ossific.	11438—Operating Handle only	60
Sheath.	13887—Handle Clamp Casting with Screw and Pin	70
Sheetfold.	13895—Plunger	30
Shekel.	13896—Diaphragm, Bronze	10
Shelly.	13897—Valve Stem	20
Shelter.	13898—Leather Disc	05
Shepherd.	13899—Disc Holder	30
Sherbert.	13894—Spring	10

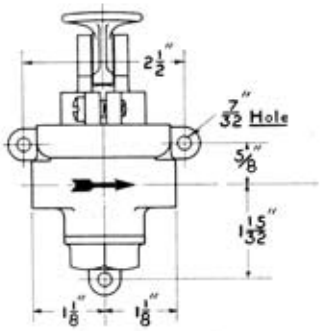
For installation diagram, see page 551.

O-B AIR SANDER VALVE

Patented

Diaphragm Type—Form 2—Bracket Mounting





POSSESSES the same popular diaphragm feature and other internal construction of the Form 1 Valve listed on preceding page.

A bracket, cast integrally with the body, offers means of fastening valve to car panels or a block or bracket, if such is necessary to locate the handle over engineer's valve.

Horizontal distance between centers of top screw holes is $2\frac{1}{2}$ inches; vertical distance between bottom hole and center line of top holes is $2\frac{3}{32}$ inches. Holes are $\frac{7}{32}$ inch in diameter.

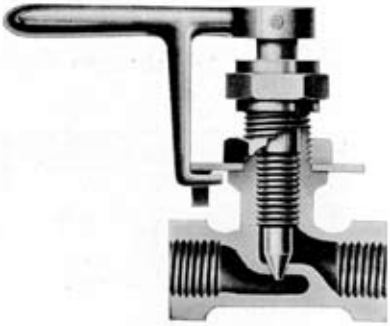
Inlet and outlet openings are tapped for $\frac{1}{4}$-inch standard pipe. This is smaller than that used with the Form 1 Valve where a heavier pipe is necessary in order to support the valve.

Code Word	No.		List Each
Osseter.	11437	Sander Valve, Bracket Mounting, without Handle	$4 00
Ossific.	11438	Operating Handle only	60
Sheath.	13887	Handle Clamp Casting with Screw and Pin	70
Sheepfold.	13895	Plunger	30
Shekel.	13896	Diaphragm, Bronze	10
Shelly.	13897	Valve Stem	20
Shelter.	13898	Leather Disc	05
Shepherd.	13899	Disc Holder	30
Sherbert.	13894	Spring	10

For installation diagram, see page 551.

INDEPENDENT AIR SANDER VALVE





USED in connection with the O-B Air Sand Trap when it is not desired to locate Sander Valve immediately over Brake Valve.

Tapered valve seat as shown in sectional view permits flow of air to be regulated as desired and insures a tight seat when closed. Handle is removable for double end operation.

Locking plate has a projecting lug which acts as a stop for valve handle and may be adjusted to any desired point. Locking plate also makes it impossible to remove handle except when valve is closed.

Valve should be connected up so that flow of air will be in direction indicated by arrow on valve body.

Code Word	No.	List Each
Fabulist.	8280—Independent Sander Valve, without Handle, for ½-inch Standard Pipe	$4 00
Facete.	8281—Operating Handle for Independent Valve	90

AIR REDUCING VALVE



THIS Valve is used in the air line of air sander equipment as a throttle and can be adjusted so that only sufficient air can pass to cause the proper flow of sand when the sander valve is wide open.

Code Word	No.	List Each
Hurlbat.	8282—¼-inch Reducing Valve	$0 50
Hurlwind.	10648—½ " " "	60

For installation diagram, see page 551.

O-B AIR SAND TRAPS



No. 10038



Internal Construction



No. 13797

TRAP is very compact, thus economizing space where it is often needed, can be placed in any convenient location on car where hose or pipe will reach the wheels, cannot release sand except by an application of air, and has no moving parts to get out of order.

Consists of a one-piece casting fitted with a 2-inch pipe plug, sherardized to prevent its rusting fast in Trap.

By removing pipe plug it is easy to remove caked or frozen sand.

The curved surfaces inside the Trap offer a minimum resistance to flow of sand when under air pressure and facilitate cleaning.

Width of flanged top of Trap $4\frac{5}{8}$ inches, length $6\frac{5}{8}$ inches. Height of Trap overall from flanged top to end of hose connection $4\frac{3}{4}$ inches, weight 6 pounds. Hole for air blast pipe is threaded for $\frac{1}{4}$-inch pipe.

Two Traps listed below are similar except that Form 2 has outside of spout threaded to take 1-inch standard pipe coupling, while Form 1 has spout fitted with studs to hold Wire Sander Hose 2 inches inside diameter.

Code Word	No.	List Each
Facingly.	10038—Form 1 Air Sand Trap, Malleable Iron, Japanned	$3 50
Sheriff.	13797— " 2 " " " " " "	3 50

WIRE SANDER HOSE

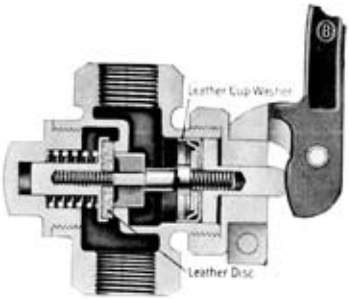


USED with the Form 1 Sand Trap shown above and should be attached on the outside of the spout of the trap.

Code Word	No.	List Each
Ostend.	11557—Wire Hose, 42 inches long, 2-inch inside diameter	$3 50

O-B WHISTLE VALVE





THE valve stem is fitted with a leather disc similar to that used in the O-B Air Sander Valve but the opening around the stem is equal in area to a ½-inch pipe and permits a volume of air to pass that is sufficient to operate the largest size of air whistle.

Leakage of air around the operating plunger is effectually prevented by means of a cup-shaped leather washer in the top of the Valve which expands against the inner wall of the body under the air pressure when the Valve is being operated. The cup washer is subjected to air pressure only when the Valve is open.

The handle can be rotated with respect to the body so that the Valve can be located in any desired position. The flow of air must be in the direction indicated by the arrow on the body.

The Valve is made of high grade bronze and the handle is malleable iron, sherardized.

Both inlet and outlet are tapped for ½-inch standard pipe.

Code Word	No.	List Each
Hurden.	10861—Whistle Valve, with handle	$4 50
Sherry.	13886—Handle	30
Shield.	13887—Handle Clamp Casting with Screw and Pin	70
Shifting.	13888—Piston with No. 14 Machine Screw	30
Shiftless.	13889—Leather Cup Washer	10
Shipmate.	13893—Copper " "	10
Shilling.	13890—Valve Stem	20
Shimmer.	13891—Leather Disc	05
Shipman.	13892—Disc Holder	30
Shipwreck.	13894—Spring	10

O-B CHIME WHISTLE



THE O-B Chime Whistle is designed for operation by compressed air on Interurban Electric Roads.

It is made of bronze throughout and is neat in appearance and very compact. The parts are few in number and minimize chance to get out of order.

No. 10759, having a 10-inch bell, produces a deeper toned warning than No. 10642 which has a 4-inch bell. However, the warning from either whistle can be heard from a great distance.

Bells of both whistles are 2 inches in diameter.

Lower end is tapped for ½-inch standard pipe.

Code Word	No.		List Each
Hummer.	10642—	Chime Whistle, length of Bell 4 inches	$5 00
Hunch.	10759—	" " " " 10 "	7 50

COUPLER SELECTION

SATISFACTORY coupler operation is governed by certain fixed laws of simple mechanics. No operator or coupler manufacturer can modify these laws however much circumstances may demand. It is the purpose of this article to emphasize this fact and outline briefly the conditions under which these laws will not clash with car design and modern improved methods of train operation. More detailed discussion of coupler mounting will be found on page 561.

The selection of ideal coupler equipment is nearly always limited by at least three conditions existing at the time train operation is adopted. The first and most vital is the presence of one or more short radius track curves somewhere on the system; the second is the existence of abrupt changes in track grade; and the third condition is the type, construction and dimensions of existing cars which are to be equipped.

A track curve once installed is expensive to change and often street clearance or other considerations will not permit an increase of curve radius. No single factor, however, so vitally affects coupler selection or design of cars for train operation and hence the following points are worthy of attention: (a) The center line radius of track curves should be as great as conditions permit—40 feet or greater if possible and never less than 35 feet if satisfactory train operation of double truck cars is to be achieved. (b) If short radius curves must be used, spiralled approaches offer effective corrective possibilities as it is at the ends of curves that a short radius imposes the greatest coupler swing. Spiral approaches may be applied to a 35 foot curve which will make it equivalent to a 40 foot curve from a coupler operation standpoint. (c) The shortest radius curve on a system dictates the selection of couplers and one short radius curve may prove as effective a handicap as a dozen.

The effect of abrupt changes in track grade is perhaps less often a limiting condition and hence the danger that it may be overlooked in considering train operation. The amount of change in grade is of little importance if sufficient distance is available for making the change. It is the change of grade, perhaps not great, which must be made in a short length of track that affects coupler clearance.

Such conditions usually obtain at railroad crossings where street and railroad grades are permanently established at different levels, at the approaches to some bridges, and at points where streets dip below

COUPLER SELECTION

Continued

railroads or other overhead structures. Other special or temporary conditions must not be neglected such as temporary cross-overs, emergency hose bridges used at fires or transfer tables with short approaches. The settling of cars under load and the turning of the worn car wheels are final points to be considered.

In considering the vertical movement of couplers between two cars, two fixed points or anchorages located one below each car platform form the end fastenings of a continuous rigid bar representing the coupled draw bars. As one platform rises or falls with respect to the level of the adjacent platform, its anchorage lifts or depresses that end of the coupling bar and the all important fact is that this movement has a pronounced effect upon the clearance between coupler head and car buffer. The straight line between anchorages must be maintained at all positions the two cars assume in passing over the change in grade.

The length between truck centers, the length from truck center to buffer and the possible variation in height of cars are the important car dimensions affecting coupler mounting, but length of couplers, their distance below car buffers and the mechanical provisions for their free vertical movement are points of vital importance.

Usually the practical way to assure satisfactory operation is to plot coupled cars to scale on profile drawings of actual track grades. It is frequently found that the existing track conditions are more favorable than the grade drawings indicated, due to the tendency of traffic to iron out vertical curves in the track.

That coupler selection is dependent upon car dimensions and design is self evident. The fact of chief importance in this discussion is that cars are usually designed and often constructed beyond the point where modification can be readily made before the coupler and its requirements receive attention.

Coupler equipment demands certain space under the car platform and the nature and importance of its service requires that this clearance space may not be invaded even by such important items as car steps, brake apparatus, fenders or door operating mechanism.

With a given track curve and overall length of car, the remaining factors which determine the coupler swing are spacing of truck centers, length of coupler and coupler anchorage position. Usually truck center spacing, as well as the length of car, is fixed and the only two

COUPLER SELECTION

Continued

variables left are coupler length and anchorage position. This leaves small opportunity to secure a favorable maximum swing of couplers or entirely acceptable clearance space for car steps. The usual result is a compromise involving a coupler shorter than desirable in order to obtain required step clearance. The relationship between car dimensions and maximum coupler swing on curves is discussed in greater detail on page 563. It is always advisable to limit the coupler swing on either side of car center line to 60 degrees or less.

Another point in car design affecting train operation which is frequently overlooked is the buffer radius or contour of car ends. For several reasons it is important that coupled cars be separated as little as possible. This is impossible with flat end cars. The buffer radius should approximate the coupler length and preferably be slightly less than the length of coupler. Such platforms not only permit close spacing of cars, but improve corner clearance on curves and afford better opportunity for proper coupler mounting.

Car design for train operation should consider more than mere coupler clearance and mounting. The stresses on car under-frames when coupled in trains differ from those of single car operation. Center sills for anchorage mounting should be capable of withstanding and transmitting the loads imposed in normal operation and the shocks incident to coupling. Reduction of weight in these important members should be thoughtfully considered as it may prove false economy.

An operator considering coupler equipment should insist upon a coupler having the following qualities: (1) Automatic coupling. (2) Simple and safe means of uncoupling. (3) Ample vertical and horizontal pickup or aligning ability of coupler heads in making a coupling. (4) No loose parts subject to loss or misplacement. (5) Ability to operate under all weather conditions. (6) Freedom from relative movement at coupler faces. (7) Strength to withstand abnormal operating conditions. (8) Provision for free vertical as well as horizontal swing of coupler. (9) Provision for limited torsional movement to permit trains to travel over curves having outer rail elevated. (10) Simplicity of construction. (11) Ease of repair.

Unless interchange of traffic or other important reasons demand a coupler of the M. C. B. or steam road type, the following points should also form essential requirements in a modern coupler: Automatic coupling of air brake pipe lines and provision for attachment of automatic electric couplers.

COUPLER MOUNTING

THIS article deals with the actual methods used in determining coupler dimensions and approved mounting of coupler equipment on cars. The preceding article on coupler selection should be read as it not only forms an introduction to the present discussion but contains some general statements of importance not repeated here.

The problem of coupler mounting cannot be solved until the following data are available: (1) Track conditions over which trains are to operate, particularly curves and breaks in grade. This track investigation should include all yards, work track, special work at car barns, and in fact all sections of track over which cars may be required to operate. (2) General dimensions of all types of cars to be equipped for intercoupling. (3) General dimensions of couplers in the several lengths available.

The track survey aims to find the curve of shortest radius, any reverse curves or cross-overs of short length, and abrupt breaks in grade. Too much dependence should not be placed upon the completeness of information available from track drawings and in all questionable cases the actual track conditions should be checked by careful measurements. The radius of the center line of track on curves is used in coupler layouts and if radius of either rail be given, it should be corrected accordingly. A very simple means of checking curve radius is to use a straight edge or piece of strong string ten feet long. Stretch this across the center of curve as a chord along inner or outer rail, locating each end of the ten foot length directly over the tread of the rail. Next measure the perpendicular distance from the center of the ten foot chord to the tread of rail. The radius is calculated from the following formula in which all measurements are in inches:

$$R = \frac{C}{2} + \frac{A^2}{8C}$$

R equals radius of rail curve; A equals chord length (120 inches commonly used) and C is the measured distance from chord to rail. The radius thus secured must be corrected to show the radius of center line of track. The following table gives the measurement from a ten foot chord to rail, taken on both inner and outer rails, for center line track curves of short radius. Track gauge of 4 feet, $8\frac{3}{4}$ inches, is used as being common practice on curves:

COUPLER MOUNTING

Continued

Center Line Track Radius, in Feet	C in Inches, Inside Rail	C in Inches, Outside Rail
30	5.473	4.663
35	4.625	4.033
40	4.004	3.554
45	3.531	3.176
50	3.158	2.872
60	2.608	2.409

Having secured the center radius of the shortest track curve, the next step is to determine the maximum swing of couplers on cars of a given type when operating in trains around this curve. To do this, the curve should be plotted to convenient scale such as $\frac{3}{4}$-inch =1 foot. One-half of a complete circle is sufficient length. Draw a chord to this arc, the length of chord being equal to the truck center spacing of the car to be equipped. Extend this chord and, using it as the car center line, draw in the outline of the car underframing. It is now necessary to assume a trial length of coupler and a trial anchorage position. A standard length of coupler such as 4 foot, 4 foot 6 inches, or 5 foot is usually employed, depending upon the buffer radius of car. The anchorage position on the car center line should be taken at a point which will keep the coupler face two inches or more beyond the buffer at all operating angles of horizontal swing. Now with assumed anchorage position as a center, describe an arc having a radius equal to double the trial coupler length. Where this arc cuts the curve of track center line, a point should be marked representing the anchorage position on the adjacent car. A line drawn between the two anchorage positions represents the center line of the coupler at its maximum swing from the center line of the plotted car.

It is a common mistake to assume that couplers swing furthest to one side when the coupled cars are both fully upon the curved section of track. This position of cars should also be plotted to assure proper clearance of vestibule corners but it does not give extreme coupler travel. The greatest coupler swing on a given car and curve is when the car is fully within the curve and the coupler anchorage of the adjacent car is directly over the point of tangency of the track curve. This position of cars is shown in Fig. B, while Fig. A shows the same train plotted completely within the curve to check corner clearance.

COUPLER MOUNTING

Continued

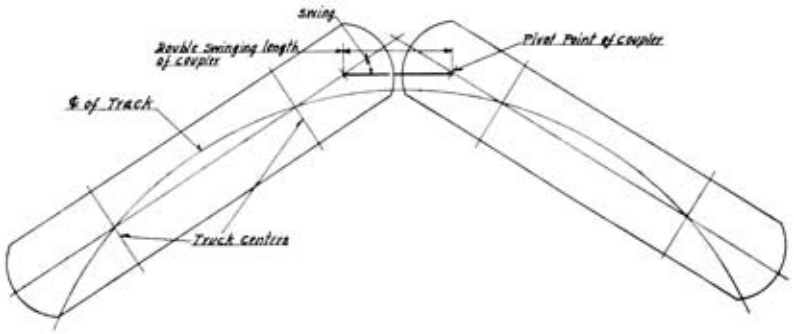


Fig. A—Both Cars on Curve

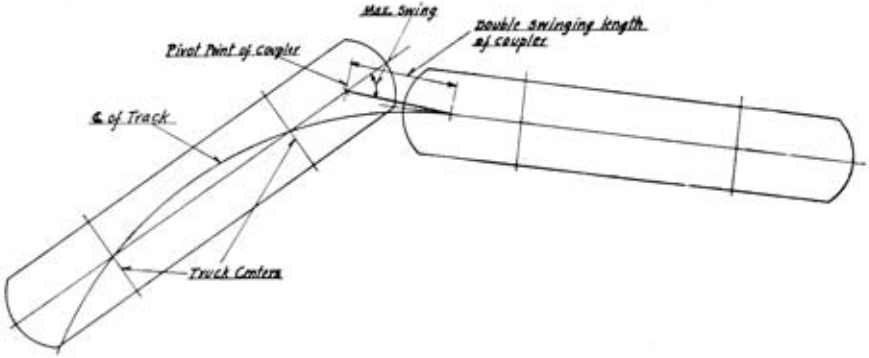


Fig. B—One Car on Curve and One with Anchorage at Point of Tangency

By extending car and coupler center lines it is easy to determine the coupler swing by means of a protractor. A moment's thought will convince that the maximum swing thus secured is the greatest that it is possible to secure on this car, regardless of car to which it may be coupled, unless it be coupled to a car equipped with a shorter coupler. This maximum swing should be held to 60 degrees or less on either side of car center line to prevent undue stresses upon cars and couplers, particularly when pushing cars around curves.

COUPLER MOUNTING

Continued

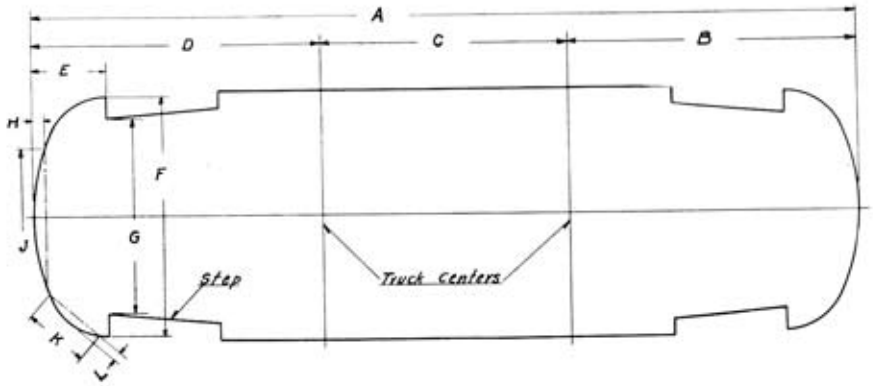


Fig. C—Showing necessary Car Plan Dimensions for Mounting of Coupler. If Front and Rear Platforms are Different, Two Diagrams should be made.

After coupler swing has been determined, the coupler equipment in outline should be drawn in to larger scale upon the car platform, drawing with coupler head in extreme position, as shown in dotted outline on pages 573, 577 and 599. This is necessary to check the coupler and spring carrier clearance of car steps, fenders, hand brake, door operating levers and any other mechanism under the platform. It is not often that the first assumed condition proves entirely satisfactory. Frequently several lengths of couplers and anchorage positions must be tried. Very often car platform changes become necessary before a satisfactory solution is possible.

It should be observed that, with a given car, the shorter the coupler used (a) the greater the swing will be on a given curve; (b) the greater the step clearance will usually be; (c) the greater the operating stresses will be upon coupler and car framing in traveling curves.

In special cases, such as short reverse curves or cross-overs, the conditions do not permit such simple treatment. The safest method is to plot the center lines of complete track layout, try paper templets of cars in all possible positions on the layout and thus by trials determine the greatest coupler swing. This same templet method applied to spiralled track curves will sometimes show a practicable coupler mounting which would be impossible on simple circular curves.

Fig. C is shown to indicate the car measurements to be made for coupler layout purposes where car drawings are not available.

COUPLER MOUNTING

Continued

Dimensions C, D, E and G are of greatest importance. Dimensions H, J, K and L are for calculating radii of buffer.

The projection of coupler beyond car buffer when in center line position should always be sufficient to keep hood rims of coupled cars separated at the bottom of most abrupt track grade and should never be less than one and one-half times the coupler draft gear travel. This projection must also be sufficient to keep corners of cars separated when in Fig. A position on curve; but at the extreme limit of travel, Fig. B, the coupler face may frequently be permitted to swing under the corner of car platform due to the nearly center line position of its companion coupler which insures safe platform clearance between cars. It is often possible to take advantage of this last mentioned fact and be able to fasten uncoupled couplers in a concealed position under the corner of cars. The corner position of idle coupler is often enforced by the fender mounting at the front end of a car or train and in such cases a projection of the coupler beyond the side of vestibule corner may interfere with passing traffic.

After a suitable coupler mounting has been achieved with reference to horizontal curves, it is necessary to consider its operation in the vertical plane. Here also only the extreme conditions need checking. The diagrams on page 586 show the manner in which convex and concave vertical track curves affect coupler clearance under car buffers and the vertical travel of spring carriers. The best method in doubtful cases is to resort to the plotting of cars on profile drawings of actual track conditions. One of the worst conditions to meet is the temporary cross-over, hose-bridge or transfer table where short approaches frequently permit coupled cars to assume parallel positions on sections of track of different elevation. The effect of car loading and turning of car wheels should not be overlooked.

It has been found that under the average conditions existing on most systems a coupler mounted not less than 7½ inches below car buffer will negotiate all track grades.

The following points are worth remembering in considering this phase of coupler mounting. Vertical movement of coupler heads is: (a) reduced by increasing the distance between truck centers of cars, (b) reduced by reducing end overhang of cars, (c) slightly reduced by increase of truck wheel base, (d) increased with a reduction of length of coupled draw bars between anchorage pivots for vertical movement. The spring carrier travel is always proportional to the vertical travel at coupler end or face and depends in magnitude upon the position of carrier along the vertically swinging portion of the coupler.

COUPLER MOUNTING

Continued

Moving carrier backward toward anchorage reduces its travel but increases the load carried by carrier and slide bar supports. Carrier position is usually determined by considerations of car clearance and its travel is rarely in excess of three inches.

A coupler equipment properly selected for operating cars over a given system must be securely mounted in an approved manner if the best service is to be obtained. General mounting diagrams for various types of couplers are shown on pages 573, 577 and 599. These should be followed as closely as circumstances permit. Particular attention should be given to the following points: (1) The coupler height from track should be the same on all cars and this standard height is usually determined by the lowest type of car. Coupler pickup is sufficient for variations in car loading, turning of wheels, etc. (2) Coupler heads should be horizontal in normal uncoupled position. (3) Coupler anchorages should be securely fastened to car sills of adequate strength by not less than fourteen $\frac{3}{4}$-inch bolts or rivets or their equivalent. (4) The flexible air hose connection between coupler and car body piping should be of ample length and so disposed as to permit full and free coupler movement without undue stress or distortion of hose. It is particularly important that hose unions or other pipe fitting directly back of pipe supports on the anchorage should be located at least two inches back of such supports to provide for necessary pipe movement when draft gear springs compress under pulling load.

Proper coupler mounting should be followed by periodic inspection and careful maintenance the same as with other important equipment. Abusive treatment and failure to observe oiling instructions will in time reduce the efficiency of any coupler.

Where electric couplers are added to the mechanical equipment, certain additional points must be considered. The electric coupler proper occupies space on one or both sides of the coupler head and in some cases of extreme horizontal coupler swing this affects car step clearance. The disconnecting switch must be mounted in some accessible space convenient for air piping connections and the attachment of switch handle operating rods. The electric couplers must be wired to the disconnecting switch through properly supported protecting conduits having flexible sections at the anchorage to permit horizontal and vertical coupler swing and the longitudinal movement due to draft gear travel. The most important features of electric coupler equipment, however, are not in connection with its mounting but refer to the number, character and connections of the various electric circuits and hence do not properly belong to this discussion.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Patented

General Description

THE Tomlinson Coupler shown on the following pages is absolutely automatic in its performance. Always ready for action, there is no necessity of entering between cars to set any parts for coupling or uncoupling operation. Each Coupler is self contained—no loose parts.

Safety, convenience and rapidity when coupling are the essential features of this Coupler. A slight impact establishes a secure coupling; a jerk on either uncoupling chain disengages the hooks and permits separation of the cars.

The Tomlinson Coupler will intercouple with the various standard radial couplers now in use without removing or deranging any of the parts of the Coupler. This is shown clearly on the following page.

The efficiency of the Tomlinson Coupler is best proved by its extensive use on large city and interurban systems.

The spring draw bar carrier listed on pages 587, 588, 590 and 603 is an exclusive feature of Tomlinson Couplers which is necessary for successful operation over abrupt changes in grades.

The electric couplers listed on pages 578-579, as the name implies, serve to establish automatic electric circuit connections between cars. Attached to the standard Tomlinson Coupler head they perform their function simultaneously with the mechanical and air line coupling, requiring no additional time or attention of the train crew. There are no loose parts or exposed jumper cables liable to loss or injury.

These electric couplers are listed in different sizes appropriate to the requirements of various signal and control systems.

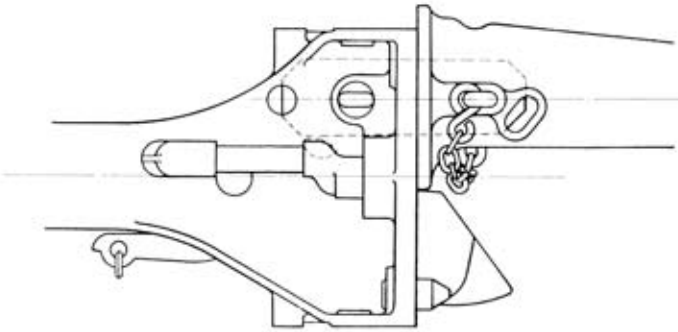
A specification blank giving full data for ordering will be furnished upon request.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

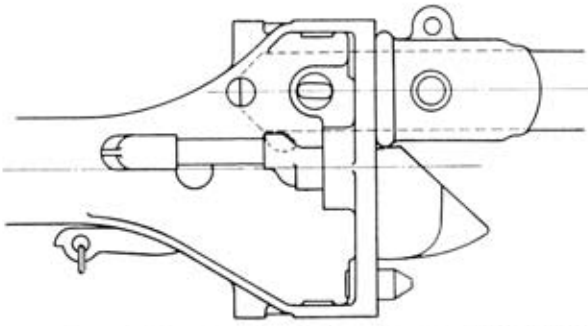
Patented—Continued

Inter-Coupling Feature

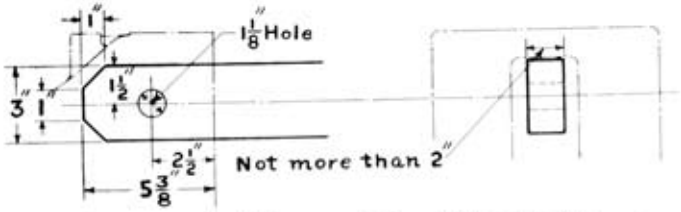
No adjustment or change necessary in Tomlinson Coupler. Note the "face to face" contact of coupler heads.



Tomlinson, Form 8 Coupler Coupled to Van Dorn Coupler



Tomlinson, Form 8 Coupler Coupled to Standard "Pocket" Coupler



Recommended Shape and Size of Shackle Bar

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Patented

Form 8—Air Connecting

THE Form 8 Coupler shown on the following pages is the popular medium capacity coupler used in city train service and for light interurban duty. It is automatic in action, provided with two air brake pipe line connections and machined at each side of the head for electric coupler mounting.

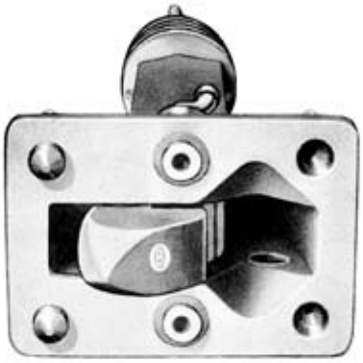


Fig. 1

An ample flat machined face absorbs the impact and compression forces while two steel dowel pins, projecting from this face and entering close-fitting holes in opposing coupler, assure perfect alignment of air connections and prevent any vertical or lateral movement between heads. A heavy steel forging in the form of a hook, hardened and ground, forms the interlocking member.

This automatic coupling of air lines is effected by means of flat faced rubber gaskets (J), Fig. 2, seated into the head of the bronze sleeves (H), which screw into malleable offset fittings (L-M) seating upon leather gaskets (K).

When coupled, opposing gaskets are forced together by the coiled springs (T) making absolutely air-tight joints regardless of whether the coupler heads are under pushing or pulling strains.

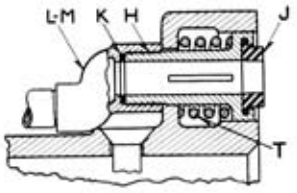


Fig. 2

Offset fittings (L-M) connect to air pipe lines, arrangement of which is shown on following pages.

To remove air gasket sleeve (H) insert end of a $\frac{1}{4}$ x $\frac{5}{8}$-inch bar through rubber gasket (J) until lugs on inside of sleeve are engaged and then unscrew sleeve from offset fitting (L-M).

In coupling, the hooks and guide pins bring the coupler heads into perfect alignment before the gaskets engage, thus preventing gaskets from being distorted by rubbing against each other and also insuring a full unrestricted air passage.

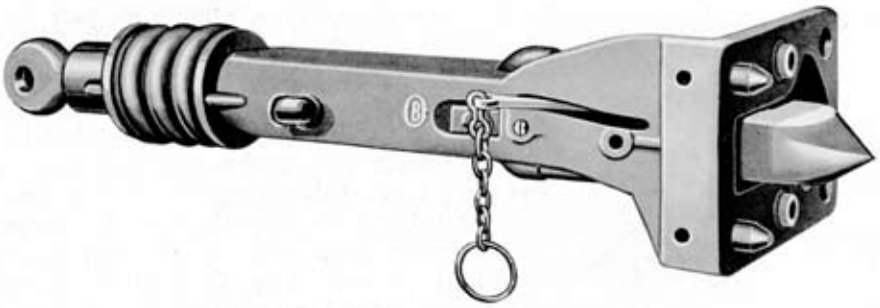
The same structural elements similarly align the contact points of electric coupler before actual contact is made and maintain this correct spacing and alignment of contact points during operation.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Patented

Form 8—Air Connecting

Continued



USED for all classes of city and suburban service where any of the various air brake systems are in operation.

Greater saving in time of making up trains and increased safety for employes afforded by automatic air and electric circuit connecting features are especially valuable where it is necessary to make up trains under extremely short headway.

Coupler head is machined, drilled and tapped on both sides for mounting of electric couplers shown on pages 578 and 579.

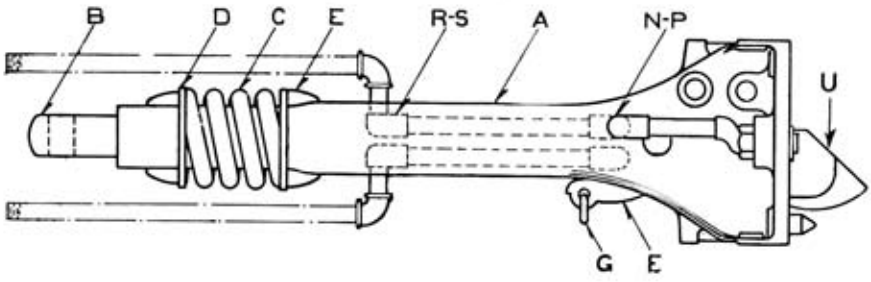
Body and tail piece are cast steel. Hook is forged steel, hardened and ground. Uncoupling cam is steel. Weight: No. 13271, 185 pounds; No. 13272, 200 pounds and No. 13273, 207 pounds.

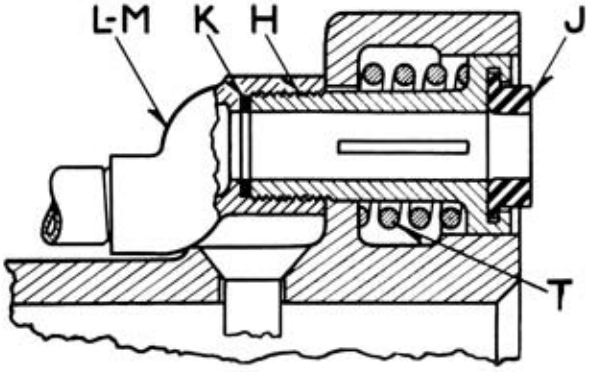
The coupler length as listed below refers to dimension (A) of outline drawing, page 572. The total effective length of coupler, when used with Forms 1 or 3 anchorage, is obtained in each case by adding 6 inches to include the working length of these anchorages shown on pages 592 and 593.

Code Word	No.												List Each
Resister.	13271—	Form	8	Coupler,	complete,	length	(A)	3	feet	6	inches	.....	$125 00
Resolute.	13272—	"	8	"	"	"	(A)	4	"	0	"	.....	125 00
Resolve.	13273—	"	8	"	"	"	(A)	4	"	6	"	.....	125 00

See general description on pages 567 and 569 and other data on pages 572 and 573.
See listing of Repair Parts on opposite page.

TOMLINSON FORM 8 COUPLER PARTS





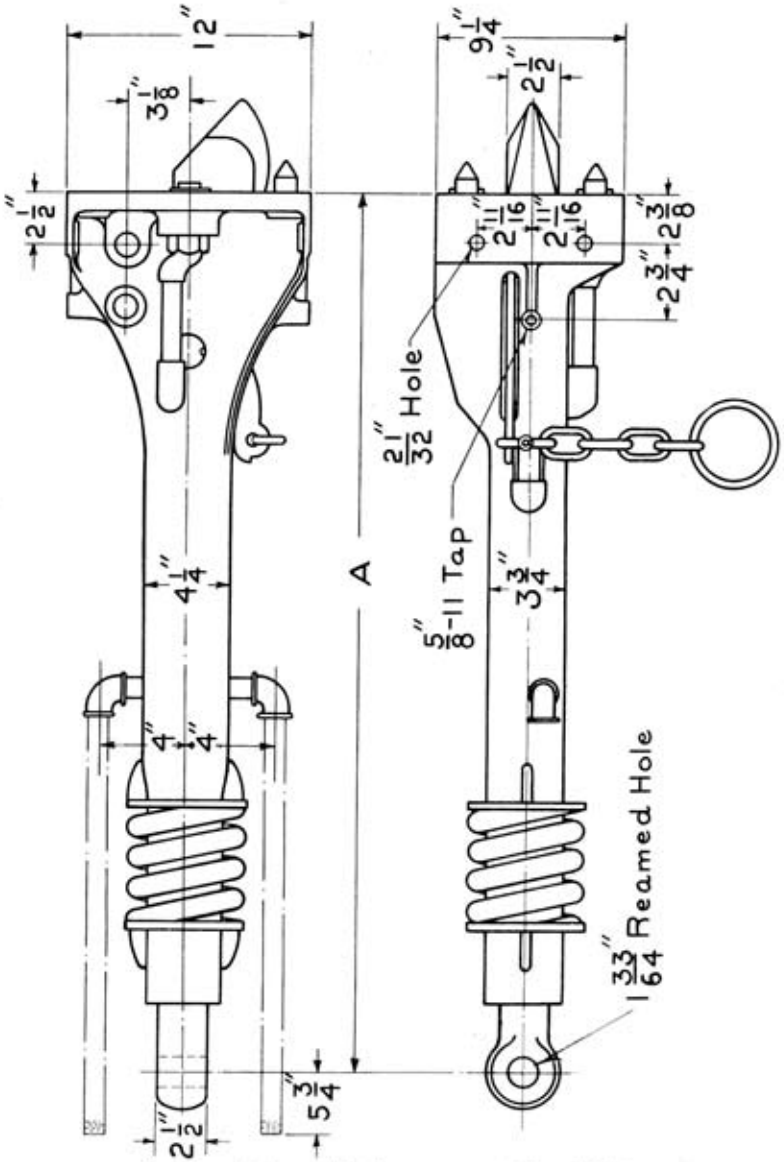
Code Word	No.	Part		List Each
Resonant.	13274—	A	Body only, with Guide Pins for 3 ft. 6 in. Coupler.	$75 00
Resort.	12989—	A	" " " " " " 4 " and 4 ft. 6 in. Couplers	75 00
Resound.	13458—	B	Tail Piece for 3 ft. 6 in. and 4 ft. Couplers	11 00
Respect.	13459—	B	" " " 4 " 6 " Coupler	13 00
Respite.	13460—	C	Draft Gear Spring	3 70
Restful.	13461—	D	" " " Collar	1 20
Restitute.	13462—	E	" " Key	70
Restless.	13463—	F	Uncoupling Cam	1 40
Restore.	13464—	G	" Chain with Repair Link	30
Restrain.	12991—	H	Air Gasket Retaining Bushing	1 00
Restrict.	12992—	J	" Coupling Gasket	40
Resurgent.	13465—	K	Seating Washer for Gasket Retaining Bushing	25
Resurrect.	13466—	L	Air Connection Offset Fitting for ¾-in. Air Piping	60
Retaliate.	13467—	M	" " " " " ½- " " "	60
Retard.	13468—	N	Special Exterior Elbow for ¾-in. Air Piping	50
Retepore.	13469—	P	" " " " ½- " " "	50
Reticent.	13470—	R	" Interior " " ¾- " " "	50
Reticule.	13471—	S	" " " " ½- " " "	40
Rewake.	13559—	T	Retaining Bushing Spring	25
Shrinking.	13875—	U	Hook	15 00

For listing of Form 8 Coupler, complete, see opposite page.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Form 8—Air Connecting—Patented

Continued

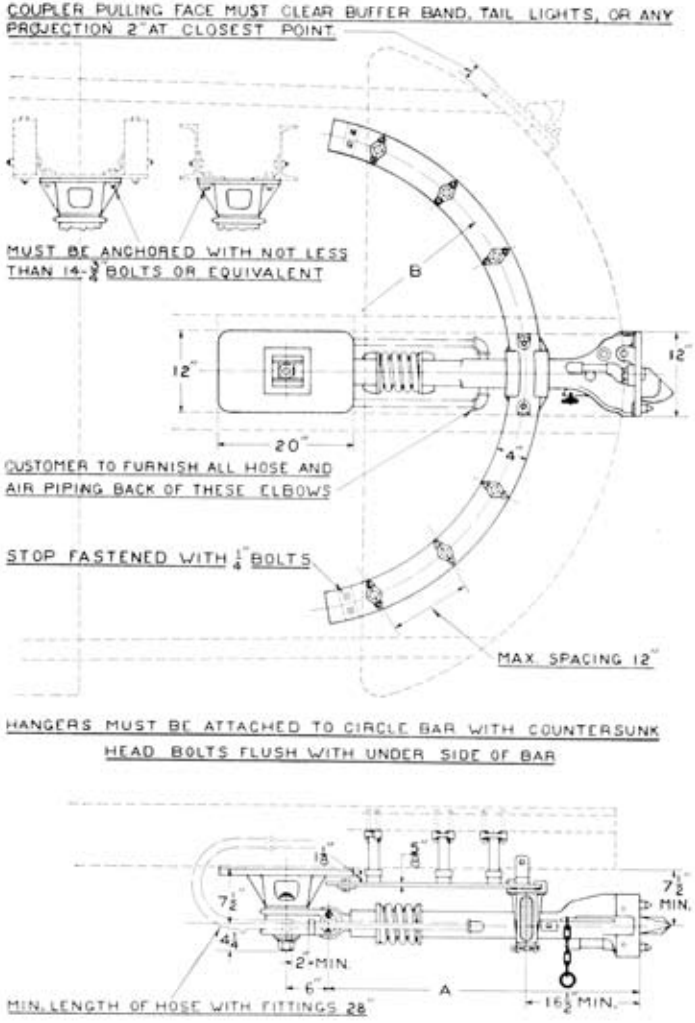


See description and listing on pages 569 and 570.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Form 8—Air Connecting—Patented

Continued

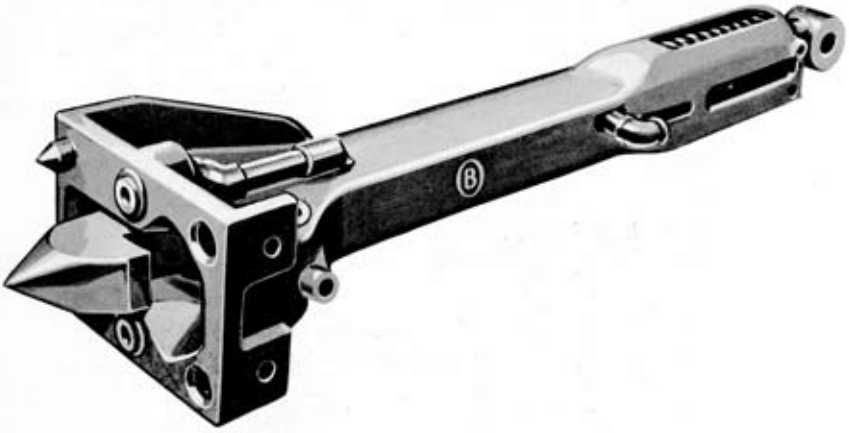


See description and listing on pages 569 and 570.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Patented

Form 9—Air Connecting



WILL intercouple with Form 8 Coupler listed on preceding pages and has same operating characteristics as that coupler. Form 9, however, is made for slightly heavier and more severe service.

Draft gear of Form 9 has a convenient adjustment to compensate for wear.

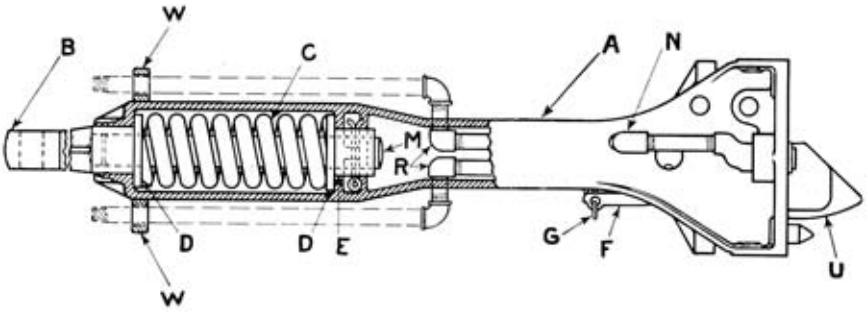
Coupler head is machined, drilled and tapped on both sides for mounting of electric couplers shown on pages 578 and 579.

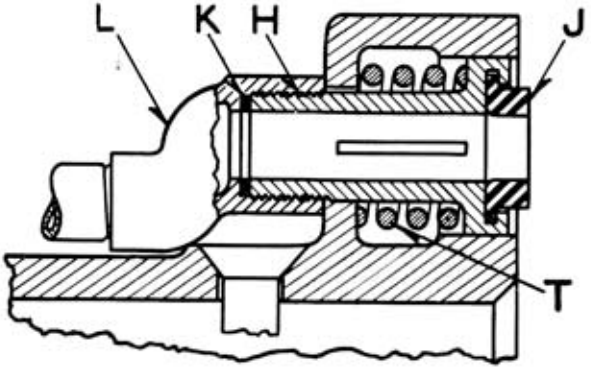
Body and tail piece are cast steel. Hook is forged steel, hardened and ground. Uncoupling cam is steel. Weight: No. 13866, 250 pounds; No. 13867, 255 pounds.

Code Word	No.		List Each
Shrouded.	13866—	Form 9 Coupler, complete, length (A) 4 feet 6 inches	$135 00
Shrubbery.	13867—	" 9 " " " (A) 5 " 0 "	135 00

For data on Form 9 Couplers and listing of repair parts, see following pages.

TOMLINSON FORM 9 COUPLER PARTS





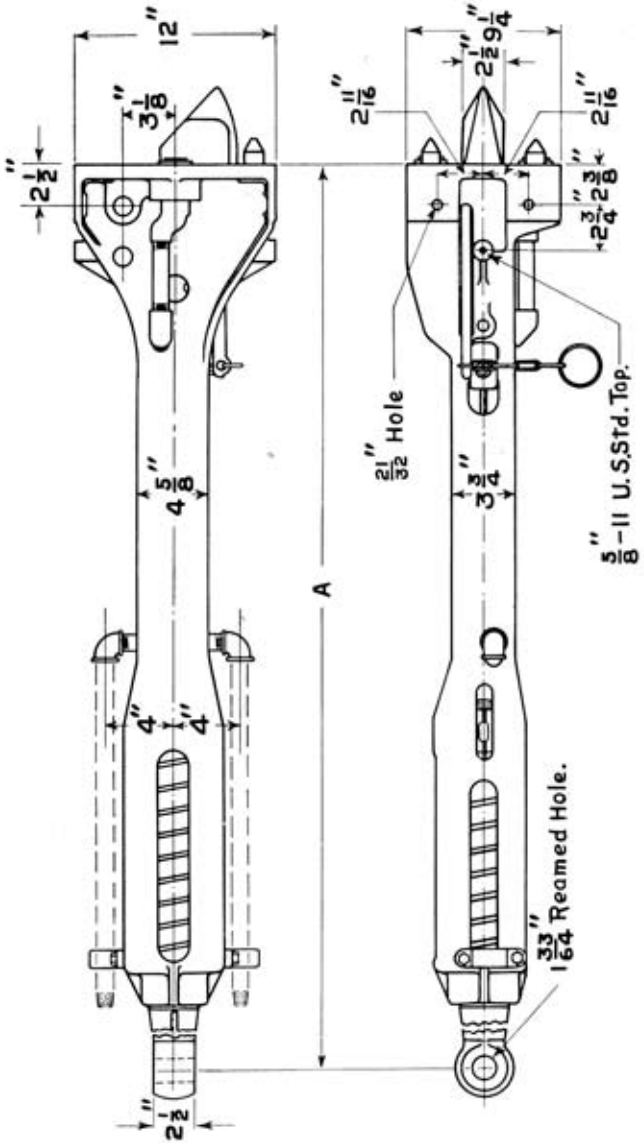
Code Word	No.	Part		List Each
Shrubless.	13868—	A	Body only, with Guide Pins for 4 ft. 6 in. and 5 ft. Couplers	$81 00
Sibylist.	13869—	B	Tail Piece for 4 ft. 6 in. Coupler	11 00
Sickness.	13870—	B	" " " 5 " Coupler	13 00
Sideboard.	13871—	C	Draft Gear Spring	4 00
Sidebone.	13872—	D	" " " Collar	1 50
Sidehill.	13873—	E	" " Adjusting Nut	1 50
Restless.	13463—	F	Uncoupling Cam	1 40
Restore.	13464—	G	" Chain with Repair Link	30
Restrain.	12991—	H	Air Gasket Retaining Bushing	1 00
Restrict.	12992—	J	" Coupling Gasket	40
Resurgent.	13465—	K	Seating Washer for Gasket Retaining Bushing	25
Resurrect.	13466—	L	Air Connection Offset Fitting for ¾-in. Air Piping	60
Sidelong.	13874—	M	Tail Piece Stud	10 00
Retard.	13468—	N	Special Exterior Elbow for ¾-in. Air Piping	50
Reticent.	13470—	R	" Interior " " ¾- " " "	50
Rewake.	13559—	T	Retaining Bushing Spring	25
Shrinking.	13875—	U	Hook	15 00

For listing of Form 9 Coupler, complete, see opposite page.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Form 9—Air Connecting—Patented

Continued

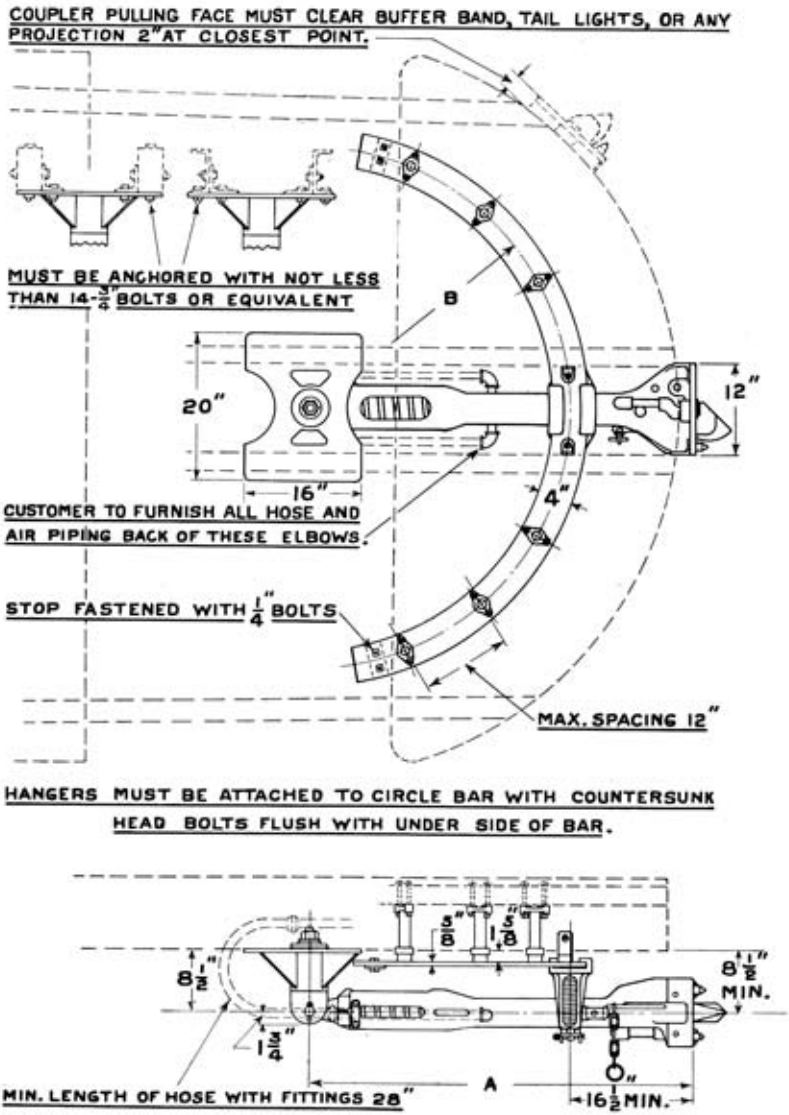


See description and listing on page 574.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Form 9—Air Connecting—Patented

Continued



See description and listing on page 574.

O-B ELECTRIC COUPLER

Patented

General Description

AN efficient device for establishing electrical circuit connections between cars is an essential feature of modern coupler equipment.

The most simple conditions of motor car and trailer train operation require the extension of buzzer and single stroke bell circuits from the motor car for signalling purposes as well as a lighting and heater circuit. Usually door signal circuits are added to increase speed and safety of operation while the extension of special electric tail light and other circuits is a simple matter with electric couplers.

The operation of multiple unit motor cars in trains always required some form of hand operated multiple conductor jumper cables which are unnecessary with electric couplers.

The sizes of electric couplers listed on the following pages differ in capacity to suit various classes of service but are similar in design.

A full appreciation of the hazards surrounding pioneer development of this character, combined with long experience in coupler manufacture, dictated the push-button principle of operation free from all delicate adjustments and complicated construction. All electrical contact parts are of generous strength and capacity, thoroughly insulated in molded composition blocks which are mounted in strong metal cases.

All electric couplers are made for bolting directly to the machined side faces of the Tomlinson coupler head and their proper operation is assured by the perfect preliminary alignment and straightforward coupling movement of these mechanical couplers. This method of mounting has proved to be the most practical as it combines easy accessibility for installation and inspection with maximum track clearance.

The Form 2 electric couplers are designed for accommodating a maximum number of circuits in the limited space available for this purpose on most installations. Except in single-end operation, these units are generally mounted in pairs, one on each side of coupler head. Disconnecting switches of the type shown on pages 582-583 are installed between the electric coupler and the car circuits to disconnect the contact points which are normally alive. This form of electric coupler is peculiarly adapted to multiple unit motor car train service.

TRAMWAY WORKSHOPS

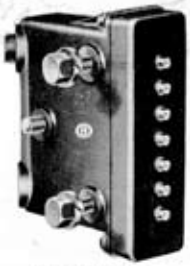
O-B ELECTRIC COUPLER

Patented

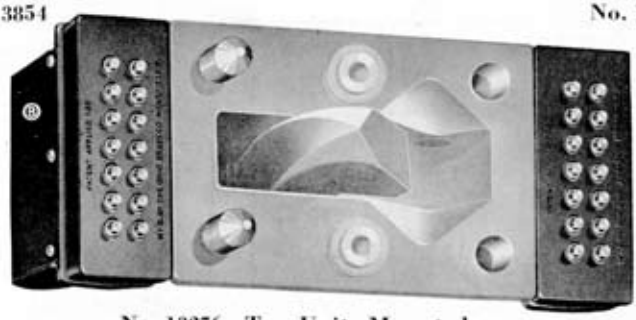
Form 2



No. 13854



No. 13275



No. 13276—Two Units Mounted on Form 8 Coupler Head

INTENDED primarily for coupling the train line and signal circuits employed in train service, From 2 electric couplers are designed for mechanical simplicity and maximum number of circuits.

They are made in three sizes, 5-point, 7-point and 14-point, and all units of the same size are similar, there being no male and female construction.

The electric couplers are bolted in position on the machined sides of Forms 8 and 9 coupler heads listed on pages 570 and 574. Usually one unit is required on each side of the coupler head.

Their operation is entirely automatic and involves no additional duties for the train crew.

For disconnecting electrical circuits and rendering exposed coupler contacts dead, drum switches of the type described on page 583 are employed. Proper operation of these switches is enforced by mechanically interlocking them with the air brake cut-out cocks.

Electric coupler cases are provided with tapped outlet for conduit connection (1 inch on the 5-point and 7-point and 1¼ inch on the 14-point) but conduit is not supplied.

The usual method of conduit mounting is shown on page 581.

Code Word	No.		List Each
Sidereal.	13854—	Form 2 Electric Coupler, 5-point size	$32 00
Revere.	13275—	" 2 " " 7- " "	36 00
Reverent.	13276—	" 2 " " 14 " "	42 00

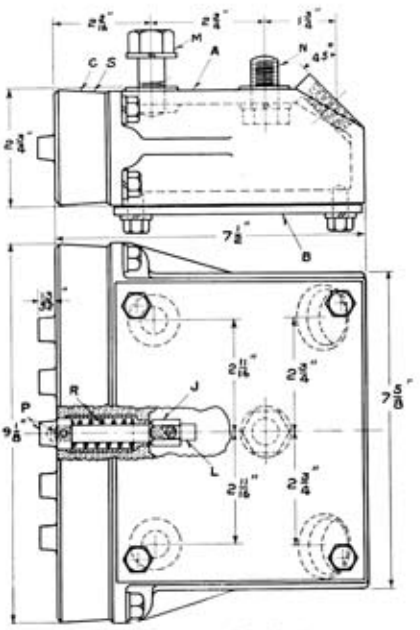
For general description, see opposite page.
For dimensions and listing of parts, see following page.

£9-70 each

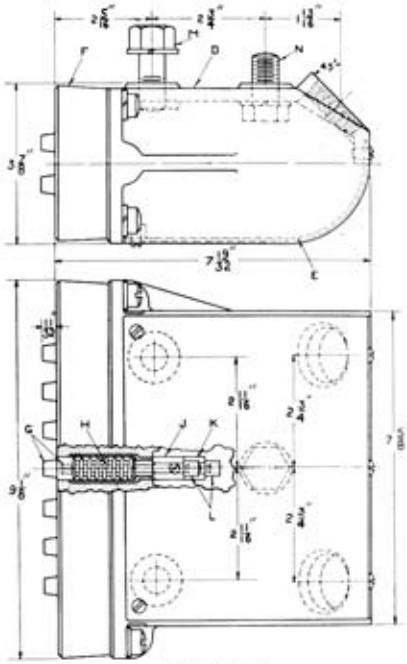
O-B ELECTRIC COUPLER

Patented

Form 2—Continued



5-Point and 7-Point
General Dimensions



14-Point
General Dimensions

Parts for Form 2 Electric Couplers

Code Word	No.	Part		List Each
Slaughter.	13855—	A	Case for 5-point and 7-point sizes	$ 5 00
Slavery.	13856—	B	Cover with Gasket for 5-point and 7-point sizes	1 00
Slayer.	13857—	S	Composition Face Block for 5-point size	14 00
Review.	13488—	C	" " " " 7 " "	14 00
Revile.	13489—	D	Case for 14-point size	5 00
Reviler.	13490—	E	Cover for 14-point size	1 00
Reviling.	13491—	F	Composition Face Block for 14-point size	17 00
Sleeper.	13858—	P	Contact Tip with Stud attached for 5-point size	1 50
Revival.	13492—	G	" " " " " " 7 " and 14-point sizes	1 00
Sleepish.	13859—	R	Contact Tip Spring for 5-point size	20
Revive.	13493—	H	" " " " 7 " and 14-point sizes	20
Revoke.	13494—	J	Short Terminal Nut with Screw for all sizes	50
Revolver.	13495—	K	Long Terminal Nut with Screw for 14-point size	50
Revulse.	13496—	L	Terminal Wire Connecting Sleeve for all sizes	10
Revenge.	13497—	M	Front Attachment Bolt, $\frac{5}{8}$x1$\frac{1}{2}$ in. with Lock Washer for all sizes	10
Reward.	13498—	N	Special $\frac{5}{8}$-in. Rear Attachment Bolt with Lock Washer for all sizes	10

For description and listing of Form 2 Electric Coupler, see preceding page.

CONDUIT HOUSING AND SUPPORTS

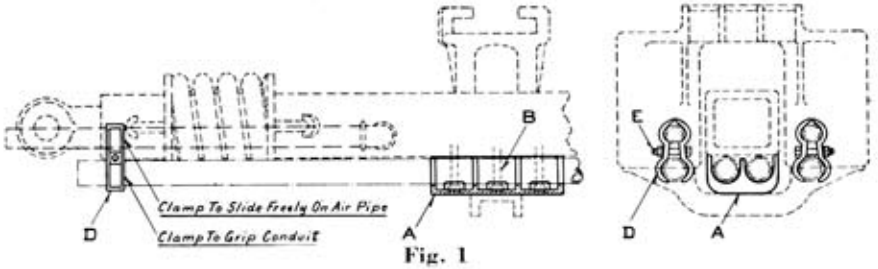


Fig. 1

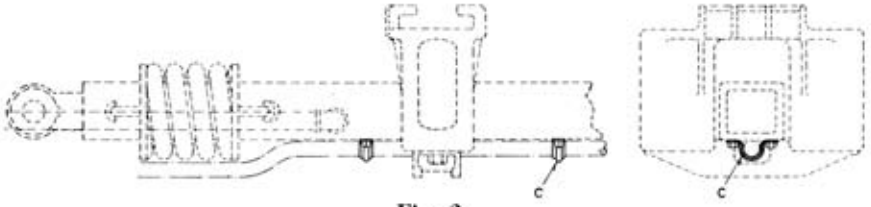


Fig. 2

THE conduit housing block (A) is required as a conduit protection and coupler support in the carrier yoke on installations employing Form 7 carriers. Its mounting is shown in the illustration.

The conduit supporting clips are of two types. The Form 1 (C, Fig. 2) is a simple pipe clip attached by screws to the coupler body as shown. Two of these clips are used on each coupler. The Form 2 (D, Fig. 1) consists of two double cleat castings with clamping bolt and is used to support conduit from the coupler air pipe. These hangers are applied so they do not grip the air pipe but slide freely upon it.

Code Word	No.	Part		List Each
Reword.	13531—		Conduit Housing Block complete with Attachment Bolts	$ 5 00
Rewrite.	13532—	A	Conduit Housing Block only	4 50
Reynard.	13533—	B	Attachment Bolt and Lock Washer for Conduit Block	30
Rhapsode.	13534—	C	Form 1 Clip for ¾-inch Conduit complete with two ¾-inch Attachment Screws and Lock Washers	30
Shipyard.	13674—	C	Form 1 Clip for 1-inch and 1¼-inch Conduit complete with two ¾-inch Attachment Bolts, Nuts and Lock Washers	40
Rhematic.	13535—	D	Form 2 Cleat Casting only, two required per Hanger, for 1-inch and 1¼-inch Conduit	20
Rhesus	13536—	E	¾-inch Clamping Bolt with Nut and Lock Washer, for Form 2 Conduit Hanger	10

O-B DISCONNECTING SWITCHES

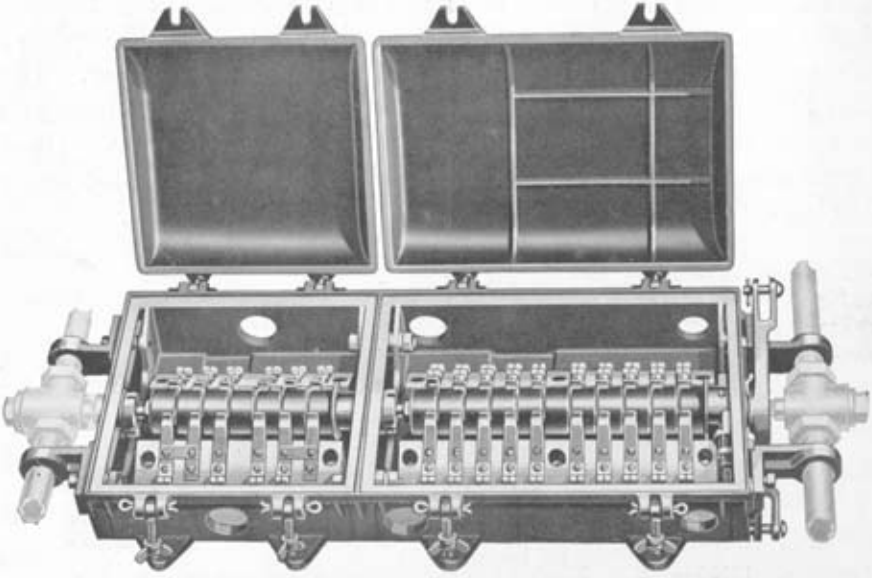
Patent Applied For



No. 13910—6-Point
without Magnetic Blowout



No. 13911—8-Point
with Magnetic Blowout



No. 13914—16-Point without Magnetic Blowout

O-B DISCONNECTING SWITCHES

Patent Applied For—Continued

USED for simultaneous connection and disconnection of various electrical circuits leading to electric couplers described on the preceding pages. Also completes the necessary circuits for single car operation.

The switch is of multiple circuit drum type. At each end of the drum the shaft is connected with a standard ¾-inch air cock in the air brake line running to the coupler. Normal operation of air brakes enforces proper switch position and insures that all exposed electric coupler contacts are dead at the uncoupled ends of cars or trains.

The iron case has 1¼-inch tapped outlets for conduit connections at convenient points. The switch handle has clevis connections at each end to permit operation from either side of car.

Angle cocks, air pipe and electrical conduit and wire are not furnished with switches.

Switches can be supplied in other combinations than listed below and with special circuit connections.

Code Word	No.		List Each
Sieur.	13909	Switch, 4-point, with Magnetic Blowout	$55 00
Sightless.	13910	" 6 " without " "	50 00
Sightly.	13911	" 8 " with " "	75 00
Sightseer.	13912	" 10 " without " "	70 00
Signal.	13913	" 14 " with " "	95 00
Signalman.	13914	" 16 " without " "	90 00
Signate.	†13915	Small Case Casting only, without Ends or Cover	10 00
Signboard.	†13916	Large " " " " " " "	12 00
Significant.	13917	Case End Casting, Handle End, complete, with Drum Latch	3 00
Signior.	13918	" " " End without Handle	2 50
Signora.	13919	" Partition Wall Casting	1 00
Signorina.	*13920	Cover for Small Case, without Hinge Bolts	2 00
Silhouette.	*13921	" " Large " " " "	2 50
Silken.	13922	Hinge Bolt Forging, complete, with Nuts, Lock Washer and Cotter	60
Silkworm.	13923	Latch Bolt Forging, complete, with Wing Nut and Cotter	70
Similar.	13924	¾-inch Pipe Bracket with Set Screw for Handle End of Case	50
Simile.	13925	¾-inch Pipe Bracket with Set Screw End without Handle	50
Simmer.	13926	Operating Handle, complete, with Set Screw and End Bolts.	70
Simpleton.	13927	Switch Drum Segment, Composition Insulation	70
Simplicity.	13928	Drum Contact Stamping, Light Brass, for Control Fingers.	10
Sinapine.	13929	" " " Heavy " " Blowout "	15
Sincerity.	13930	Wood Finger Board, 6-finger length	1 00
Sinecure.	13931	" " " 4 " "	1 00
Sinewless.	13932	" " " 10 " "	1 50
Sinewous.	13933	" " " 7 " "	1 50
		Above Finger Boards furnished complete with Finger Attachment Plates.	
Singing.	13934	Bronze Control Contact Finger	40
Singleness.	13935	" Blowout Contact Finger for Finger Board Mounting	50
Singletree.	13936	" " " " " Coil Yoke Mounting	60
		Above Fingers furnished with Bronze Backing Plate, Mounting Screws and Terminal Clip.	
Sinister.	13937	Magnetic Blowout Unit, complete, with Base Plate and Mounting Screws	6 00

†No. 13915 is small case and No. 13916 is large case for Switches Nos. 13913 and 13914.
*No 13920 is small cover and No. 13921 is large cover for Switches Nos. 13913 and 13914.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Patented

Form 16—Air Connecting



USED in subway, elevated and heavy interurban service. Greater saving in time of making up trains and increased safety for employes afforded by automatic air connecting feature will be appreciated and is especially valuable where it is necessary to make up trains under extremely short headway.

Body and tail piece are cast steel, japanned.

Hook is forged steel.

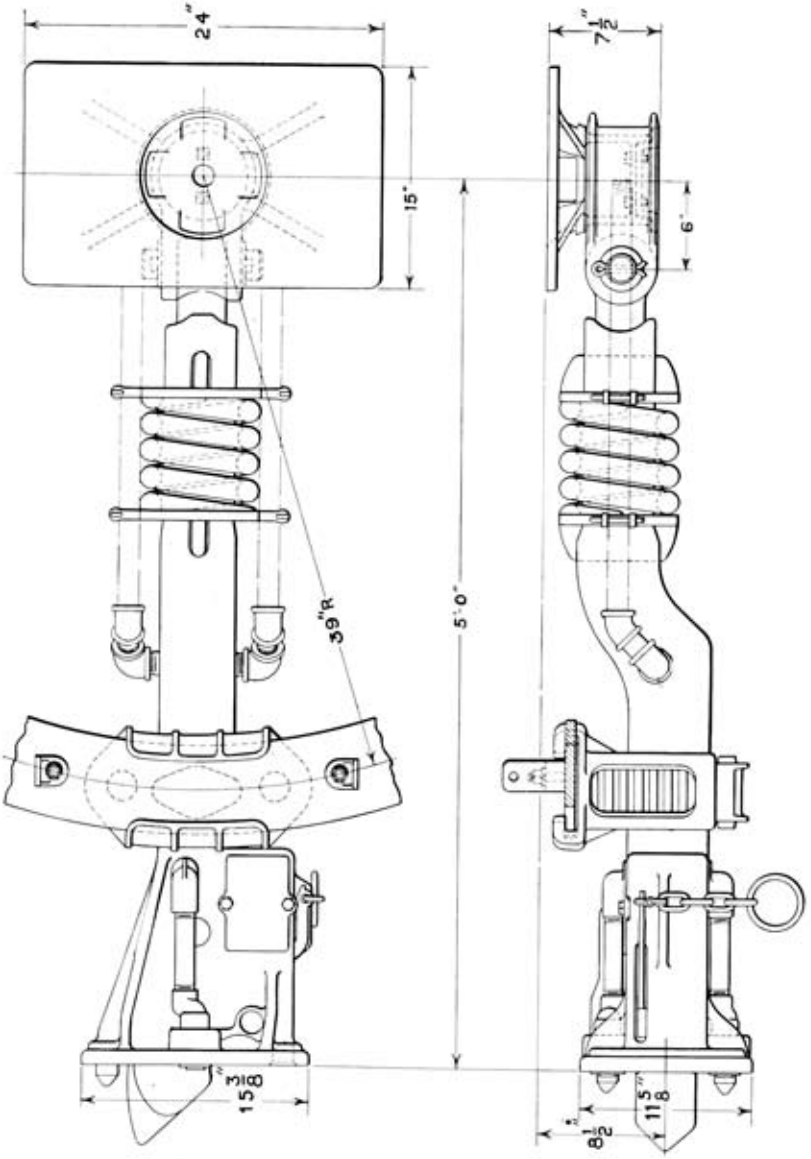
Code Word	No.	List Each
Publish.	12599—Coupler Head and Draft Gear, complete	$220 00
Puccoon.	12600—Anchorage, Form 16	64 00
Puckerer.	12601—Spring Draw Bar Carrier, Form 16	44 00
Pudding.	12602—Carrier Slide Bar, ¾x6-inch steel, bent to 36 inches inside radius, length 160°	32 00
Shirker.	13880—Coupler Hook, Forged Steel	24 00
Shocking.	13881—Air Coupling Gasket	50
Shooter.	13882—Gasket Retaining Bushing	1 50
Shoplifter.	13883—Retaining Bushing Spring	30

For listing of Carrier Slide Bar Supports, see page 596.
See dimensions and mounting details on following page.

TOMLINSON AUTOMATIC RADIAL CAR COUPLER

Patented

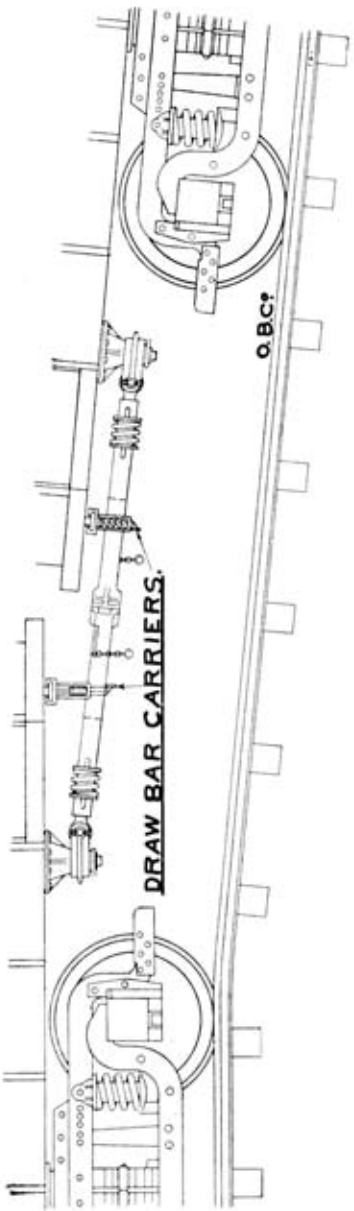
Form 16—Air Connecting—Continued



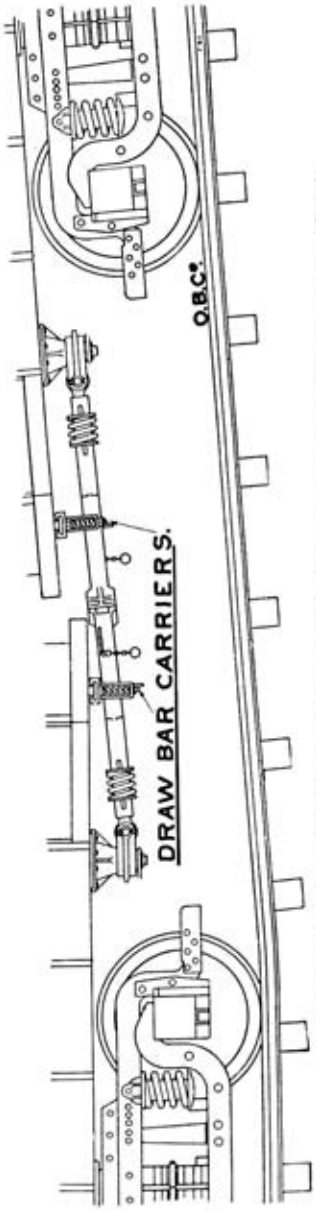
See preceding page for description and listing.

SPRING DRAW BAR CARRIER

Patented



Showing Action of Spring Draw Bar Carriers on a Downward Break in Grade



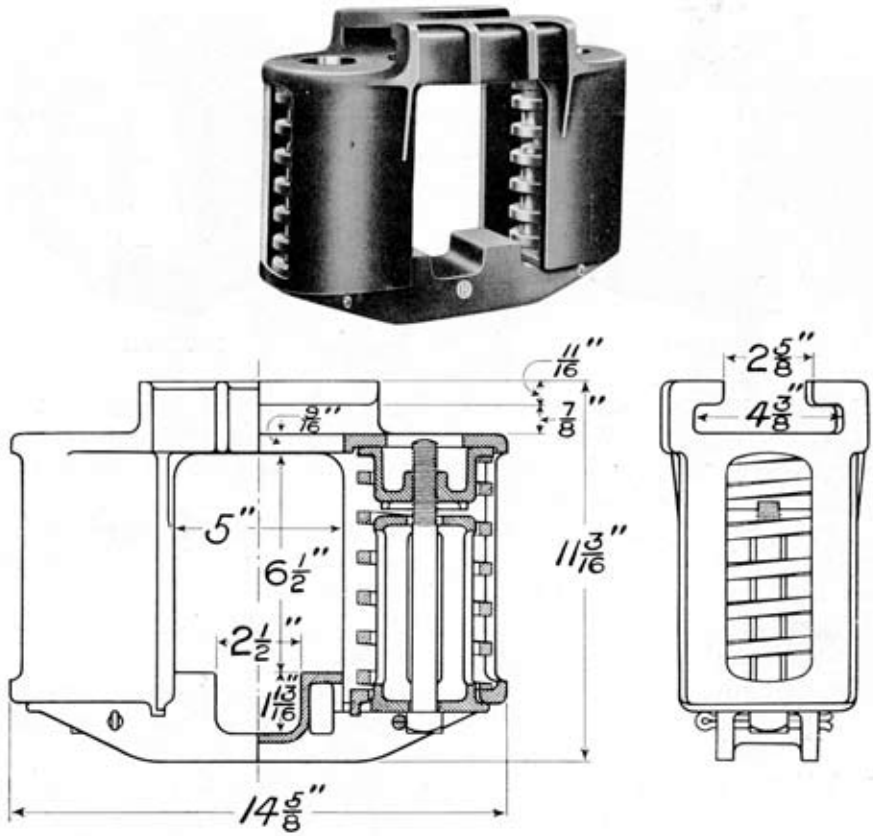
Showing Action of Spring Draw Bar Carriers on an Upward Break in Grade

See description and listing on following pages.

SPRING DRAW BAR CARRIER

Patented

Form 5



SIMILAR to Form 6 Carrier listed on the following page, but has single coil springs and is intended for use with Forms 8 and 9 Couplers without electric couplers.

Castings are malleable iron, japanned. Weight, 50 pounds.

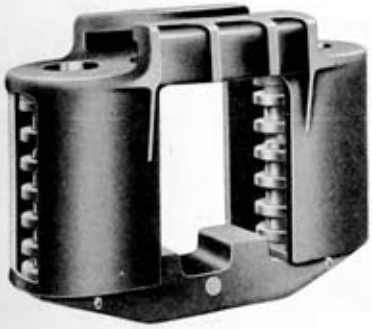
Code Word	No.	List Each
Ligule.	11428—Form 5 Carrier with Single Coil Spring	$31 00
Rhetoric.	13526—Body Casting for Form 5 Carrier	18 00
Rhubarb.	13527—Yoke " " " 5 "	7 00
Rhythm.	13529—Large Coil Spring for Form 5 Carrier	2 00

See opposite page for diagrams showing operation of Spring Carrier.

SPRING DRAW BAR CARRIERS

Patented

Forms 6 and 7



No. 13204



No. 13421

USED with Forms 8 and 9 Couplers to give a yielding support so that abrupt breaks in grade can be passed over without straining the car platforms (see diagrams on page 586). Also serves to hold the couplers level under normal conditions.

Provided with double coil springs and intended for use when the vertical strain, due to added weight of electric couplers, is greater than that for which Form 5 Carrier is designed.

Support member or yoke has a vertical adjustment for maintaining a uniform height of couplers on all cars.

Groove in bottom yoke of Form 6 Carrier provides means for supporting electric cable conduit when electric coupler requirements do not exceed a single 1¼-inch standard conduit.

Yoke of Form 7 Carrier will accommodate two electric conduits, 1¼-inch or smaller with Housing Block as shown on page 581.

Installation is clearly indicated on diagrams of Coupler mountings shown on preceding pages.

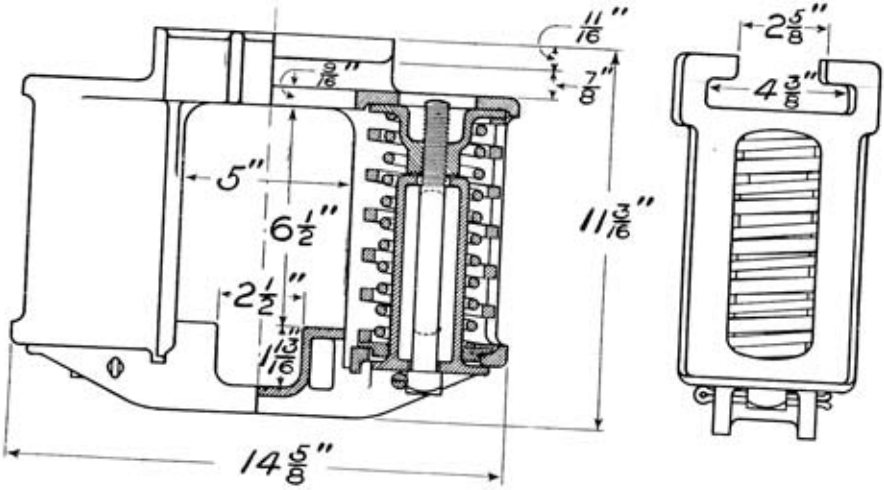
Code Word	No.	List Each
Ramenta.	13204—Form 6 Carrier	$35 00
Ribless.	13421— " 7 "	35 00
Rhetoric.	13526—Body Casting for Forms 6 and 7 Carrier	18 00
Rhyolite.	13528—Yoke " " Form 6 Carrier	6 00
Ribwort.	13522— " " " " 7 "	5 50
Rhythm.	13529—Large Coil Spring for Forms 6 and 7 Carrier	2 00
Ribbon.	13530—Inner " " " " 6 " 7 "	1 10

See page 586 for diagram showing operation of Spring Carrier.

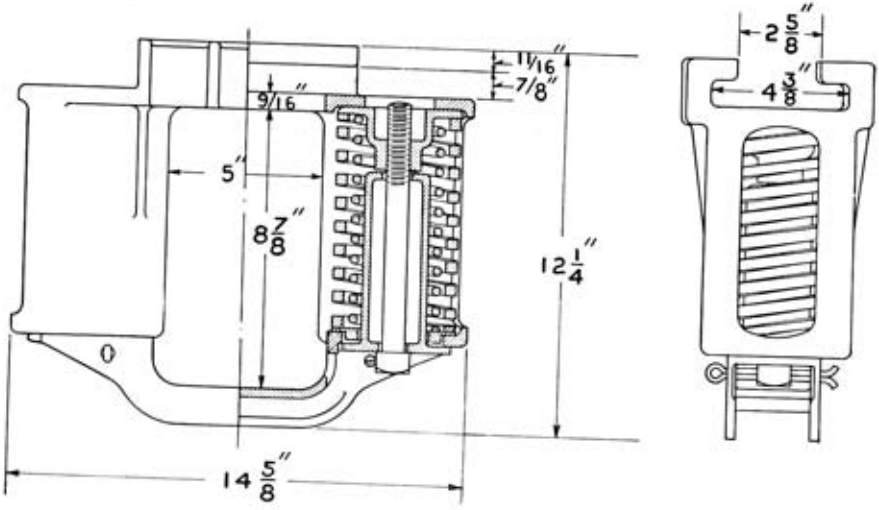
SPRING DRAW BAR CARRIERS

Patented

Forms 6 and 7



No. 13204—Form 6 Carrier



No. 13421—Form 7 Carrier

See description and listing on the opposite page.

SPRING DRAW BAR CARRIERS

Patented

Forms 8 and 9



Form 8



Form 9

THE Forms 8 and 9 Carriers correspond in general dimensions to the Forms 6 and 7 respectively listed on preceding pages. However the springs are so arranged as to permit greater vertical travel of the coupler within the carrier.

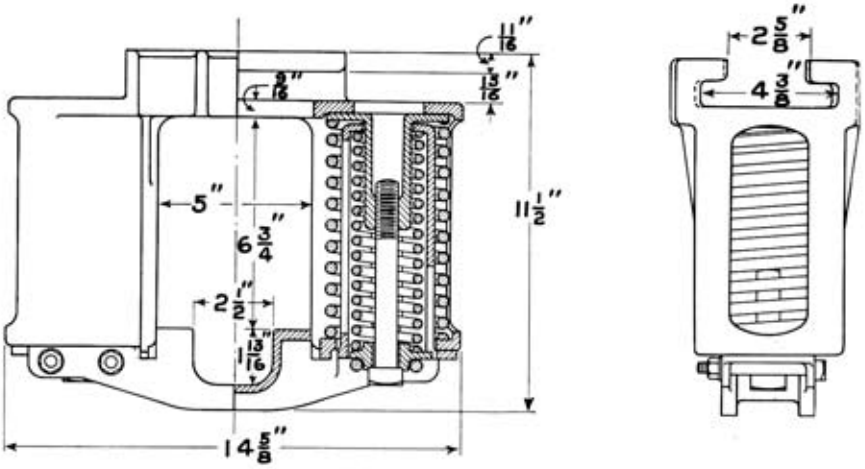
Code Word	No.	List Each
Shopkeeper.	13860—Form 8 Carrier	$40 00
Shorthand.	13861— " 9 "	40 00
Rhetoric.	13526—Body Casting for Forms 8 and 9 Carriers	18 00
Shopper.	13862—Yoke " " Form 8 Carrier	6 00
Shotgun.	13863— " " " " 9 "	6 00
Shoreless.	13864—Outer Coil Spring for Forms 8 and 9 Carriers	2 50
Shortcake.	13865—Inner " " " " 8 " 9 "	1 10

See page 591 for dimensions and page 586 for diagrams showing operation of Spring Carrier.

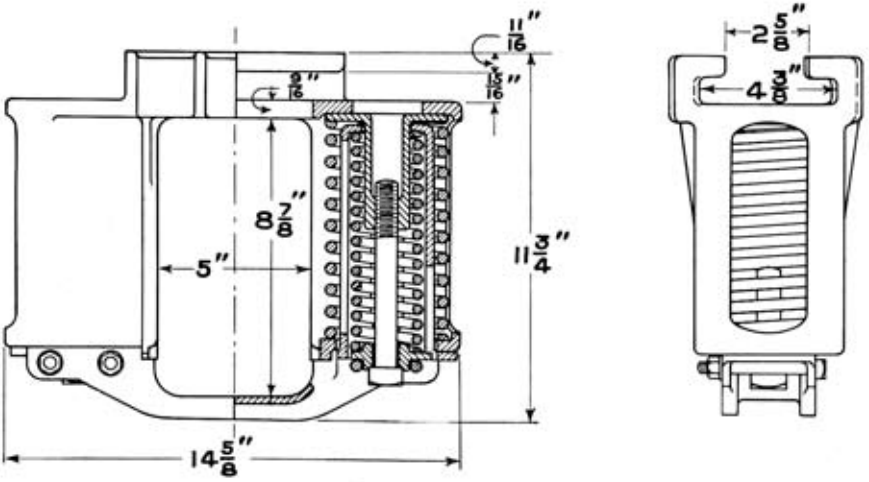
SPRING DRAW BAR CARRIERS

Patented

Forms 8 and 9



Form 8 Carrier



Form 9 Carrier

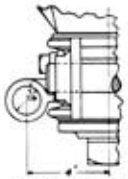
See description and listing on preceding page.

DRAW BAR ANCHORAGE

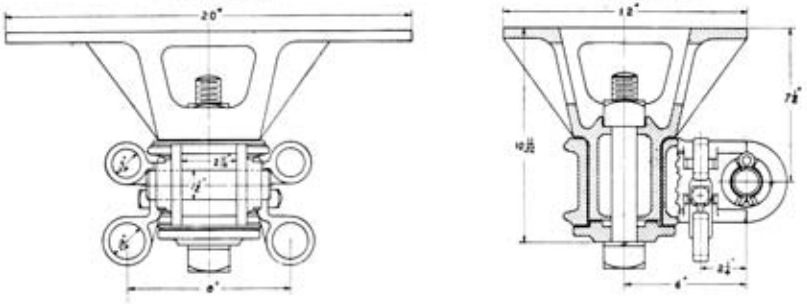
Form 1



No. 13575



Single Eye Bracket of No. 13574



No. 13575

FOR use with Forms 8 and 9 Couplers. Permits unrestricted horizontal and vertical movement of Coupler and secures maximum benefit from action of Spring Draw Bar Carrier on abrupt breaks of grade.

Machined fit between tail piece and clevis pin, also between collar and body, eliminates lost motion and excessive wear on parts.

Top plate is bolted directly to sills. Furnished undrilled so customer can drill to suit conditions.

Distance from pivotal center of Anchorage to center of tail pin is 6 inches, hence effective overall length of Coupler is increased 6 inches and this fact should be borne in mind when determining length of Coupler required.

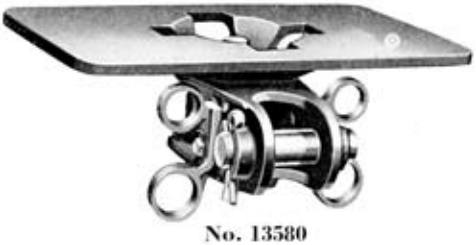
Castings steel, japanned; tail pin, steel. Weight, 80 pounds.

Code Word	No.	List Each
Shoulder.	13574—Form 1 Anchorage with Single Eye Bracket	$42 00
Shower.	13575— " 1 " " Double " "	42 00
Revolt.	13552—Body Casting for Form 1 Anchorage	27 00
Shrapnel.	13576—Anchorage Clevis with Single Eye	14 00
Shrewdly.	13577—Single Eye Pipe Bracket	50
Shrill.	13578—Double " " and Cable Bracket	70

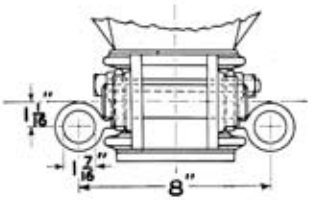
M. C. B. Anchorage is listed on page 602.

DRAW BAR ANCHORAGE

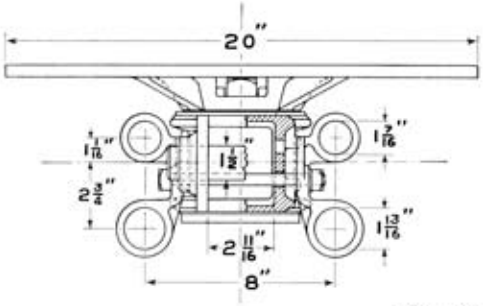
Form 3

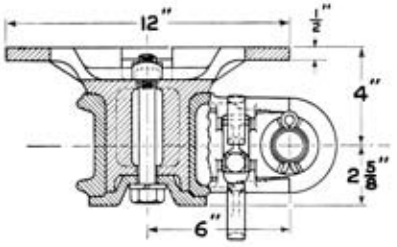


No. 13580



Single Eye Bracket of No. 13579





No. 13580

FOR use with Forms 8 and 9 Couplers when car sills do not permit Anchorage to be mounted on same plane as slide bar.

Similar to Form 1 Anchorage listed on preceding page except that it is 3½ inches less in height from center of tail pin to top of Anchorage.

Permits unrestricted horizontal and vertical movement of Coupler and secures maximum benefit from action of Spring Draw Bar Carrier on abrupt breaks of grade.

Machined fit between tail piece and tail pin, also between collar and body, eliminates lost motion and excessive wear on parts.

Top plate is bolted directly to sills. Furnished undrilled so customer can drill to suit conditions.

Distance from pivotal center of Anchorage to center of tail pin is 6 inches, hence effective overall length of Coupler is increased 6 inches and this fact should be borne in mind when determining length of Coupler required.

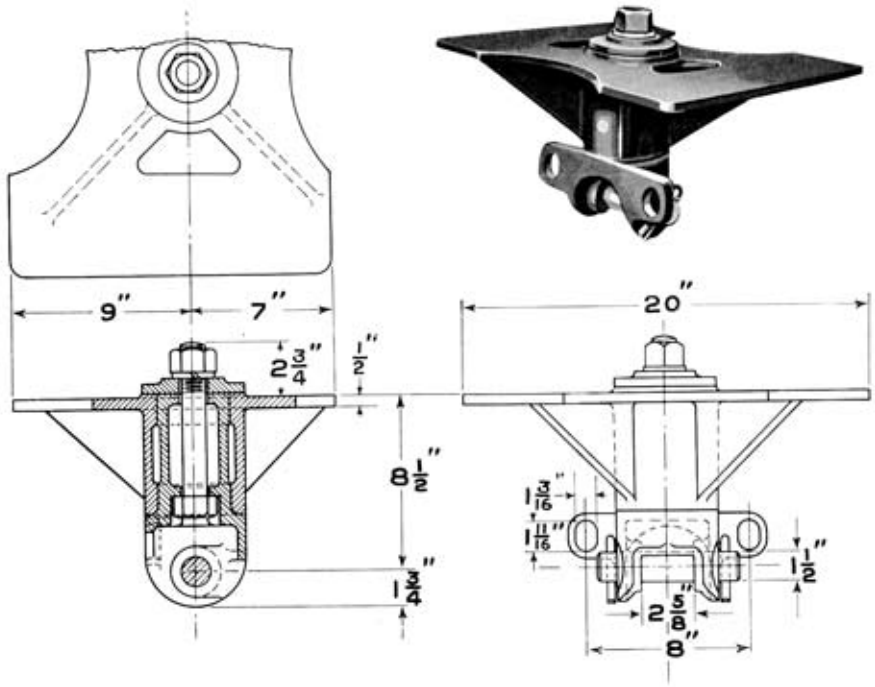
Castings steel, japanned; tail pin, steel. Weight, 80 pounds.

Code Word	No.	List Each
Shrillness.	13579—Form 3 Anchorage with Single Eye Bracket	$40 00
Shrine.	13580— " 3 " " " Double " "	40 00
Richly.	13553—Body Casting for Form 3 Anchorage	23 00
Shrapnel.	13576—Anchorage Clevis with Single Eye	14 00
Shrewdly.	13577—Single Eye Pipe Bracket	50
Shrill.	13578—Double " " and Cable Bracket	70

M. C. B. Anchorage is listed on page 602.

DRAW BAR ANCHORAGE

Form 4



USED with Forms 8 and 9 Couplers in the same manner as Form 1 Anchorage listed on page 592.

An advantage for the Form 4 Anchorage is that the clevis for coupler tail piece is at the pivotal point of the anchorage.

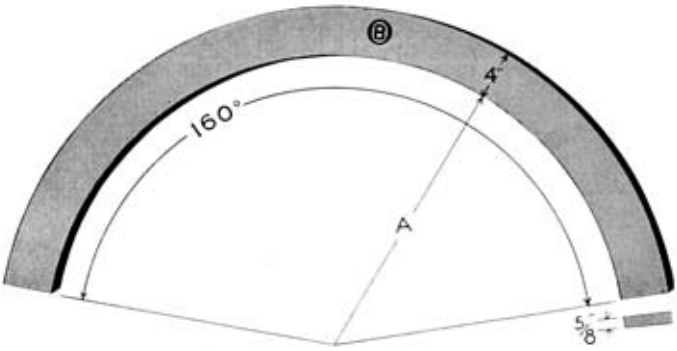
Castings steel, japanned; tail pin, steel. Weight, 93 pounds.

Code Word	No.		List Each
Sidesaddle.	13877	Form 4 Anchorage	$42 00
Sidewalk.	13878	Body Casting for Form 4 Anchorage	27 00
Sideways.	13879	Clevis " " " 4 "	14 00

M. C. B. Anchorage is listed on page 602.

CARRIER SLIDE BAR

For Forms 5, 6, 7, 8 and 9 Spring Carriers



USED as a support for the Forms 5, 6, 7, 8 and 9 Spring Draw Bar Carriers listed on pages 587, 588 and 590. Bar is attached to car sills by means of countersunk head bolts with properly spaced washers, or preferably with Slide Bar Supports, listed on page 596.

Slide Bars are shipped not drilled, as holes must be located to conform to under-framing of car platform.

Slide Bar is $\frac{5}{8}$ x 4 inches and is furnished in either of two different inside radii to suit the requirements of different length couplers. Weight: No. 11431, 69 pounds; No. 13422, 58 pounds.

Code Word	No.		List Each
Linnet.	11431—	Slide Bar, Steel, dimension A 35 inches	$16 00
Richweed.	13422—	" " " " A 29 "	16 00

M. C. B. Carrier Slide Bar is listed on page 604.

SLIDE BAR SUPPORTS

Forms 1, 2 and 3



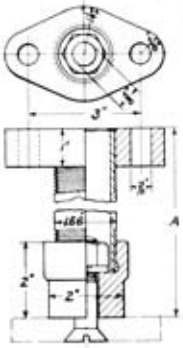
Form 1—No. 13218

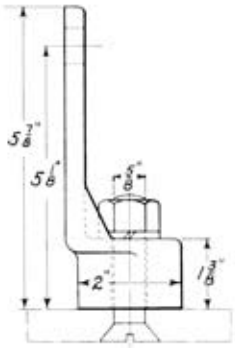


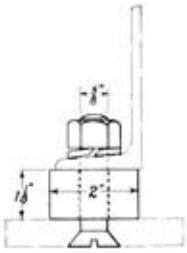
Form 2—No. 13219



Form 3—No. 13220







THESE supports provide a full complement for varying conditions of platform underframing.

The Form 1 Support will be supplied in various lengths to suit the requirements of particular installations. In ordering this support, dimension A should always be specified.

Used for supporting all types of Carrier Slide Bars employed in Tomlinson Coupler installations.

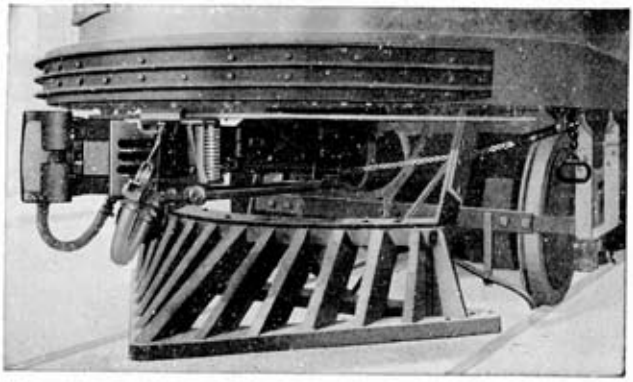
The same size of bolt is used for attaching all three forms of support to the circle bar; the head of this bolt must be completely countersunk in the lower face of circle bar to insure unrestricted movement of spring carrier.

Code Word	No.		List Each
Ramage.	13218—	Form 1, Slide Bar Support, with bolt, nut and washer	$2 50
Ramble.	13219—	" 2, " " " " " " " "	1 10
Ramean.	13220—	" 3, " " " " " " " "	50

TOMLINSON M. C. B. CAR COUPLER

Patented

Form 12



Showing Complete Tomlinson Equipment Mounted on Car

THE Tomlinson Form 12 Coupler is a successful adaptation of the standard M. C. B. type of Coupler to comply with all Electric Traction requirements.

It is recommended for use upon cars which at any time are coupled with steam road cars or with Electric Traction cars having any type of M. C. B. coupler mounted upon them. When installing couplers, in places where there is no immediate need of this type, it is well to consider what "inter-traffic" arrangements may be made in the future that would make this type necessary.

This coupler will intercouple with any coupler built upon standard M. C. B. contour lines.

The standard steam road coupler will not operate successfully on most electric roads because of its excessive buckling on curves and the possibility of vertical disengagement on breaks in grade.

The Tomlinson, Form 12, overcomes these objections by having the heads of engaging couplers positively interlocked.

TOMLINSON M. C. B. CAR COUPLER

Form 12—Patented

Continued

THE diagram drawing on the following page shows a recess in the face of the Knuckle, also the Sliding Lock.

When two Couplers are connected and the Sliding Locks are seated in the recesses, there cannot be any vertical uncoupling, neither can there be appreciable buckling.

The Sliding Lock is limited in its vertical movement within the recess provided for it in the knuckle face, but when it reaches its limit the Spring Draw Bar Carrier (an exclusive feature of the Tomlinson Coupler) provides for all additional movement required on maximum breaks in grade.

By referring to the illustrations it will be seen that there is an offset in the Draft Gear of the Coupler which provides maximum clearance below the Coupler and reduces the size and weight of anchorage required.

The Body, Knuckle, Tail Piece, Sliding Lock, Draft Spring Plates and Anchorage are made of cast steel. All other castings are malleable iron.

Weight of complete single end equipment is about 825 pounds.

Code Word	No.		List Each
Ricinic.	13555	Complete M. C. B., Form 12, Equipment for single end including Coupler, Draft Gear, Anchorage, Unlocking Chain with Fittings, Spring Draw Bar Carrier, Carrier Slide Bar and S Slide Bar Supports	$310 00

For listing of parts of above equipment, see following pages.

TOMLINSON M. C. B. CAR COUPLER

Form 12—Patented—Continued

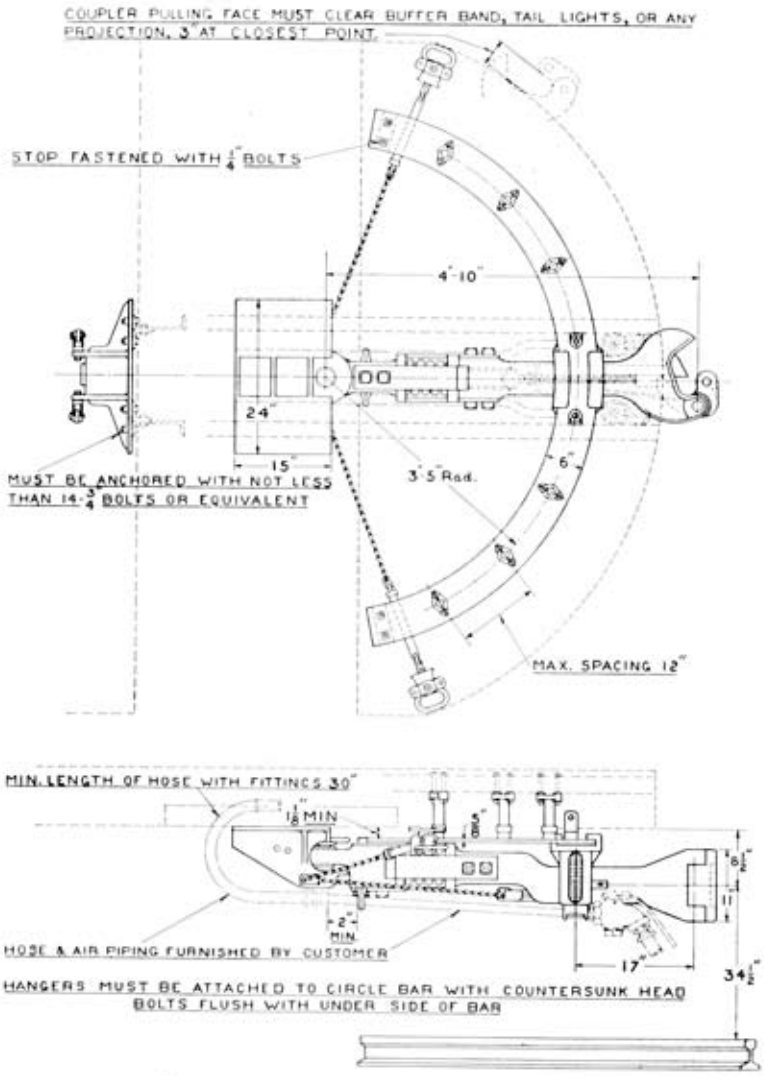


Diagram showing method of mounting

See pages 597 and 598 for description and listing.

TOMLINSON M. C. B. CAR COUPLER

Form 12—Patented—Repair Parts



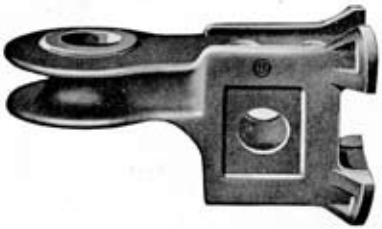
No. 12828—Body Casting, Machined, with Knuckle Opening Spring Installed



No. 10673
Split Knuckle



No. 12829
Sliding Lock Casting



No. 12831—Tail Piece



No. 13884—Sliding Lock Pull Rod



No. 13885—Sliding Lock Spring



No. 12832—Draft Gear Yoke



No. 12833—Double Coil Draft Spring

See listing on following page.

TOMLINSON M. C. B. CAR COUPLER

Form 12—Patented—Repair Parts—Continued



No. 12834 Draft Spring Follower Plate



No. 12835—Double Sliding Clevis with Sheave Wheels, Pins, Cotters and Attachment Bolt



No. 12836—Chain Guide with Sheave Wheel, Pin, Cotter and Attachment Bolts



No. 12833—Uncoupling Hook with Enclosed Tension Spring



No. 13277—Uncoupling Bracket with Cross Pin and Cotters



No. 12840—Uncoupling Handle Casting



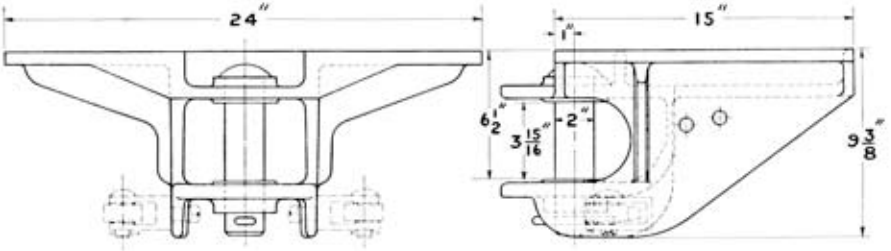
No. 13108 Pipe Support Casting

Code Word	No.	List Each
Provect.	12828—M. C. B. Coupler Body	$64 00
Humble.	10673—Split Knuckle	23 00
Proverb.	12829—Sliding Lock Casting	9 00
Sierra.	13884— " " Pull Rod	1 20
Siesta.	13885— " " Spring	60
Proviso.	12831—Tail Piece	21 00
Provoke.	12832—Draft Gear Yoke	12 00
Prowess.	12833—Double Coil Draft Spring	5 50
Prowling.	12834—Draft Spring Follower Plate	5 50
Proximal.	12835—Double Sliding Clevis	5 50
Proximo.	12836—Chain Guide with Attachment Bolts	2 00
Prudence.	12837—Unlocking Chain, 13 feet long, for Single End Equipment	3 50
Prudery.	12838—Uncoupling Hook with Spring	3 00
Rickety.	13277— " Bracket with Pin	2 50
Psalmist.	12840— " Handle Casting	80
Publican.	13108—Pipe Support Casting	1 40

M. C. B. DRAW BAR ANCHORAGE

Form 12





USED with M. C. B. Coupler listed on page 598. Is furnished not drilled so that user can drill to suit any conditions.

Made of steel.

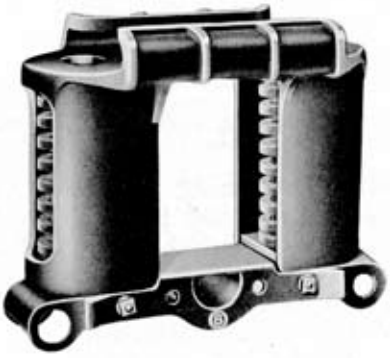
Weight 125 pounds.

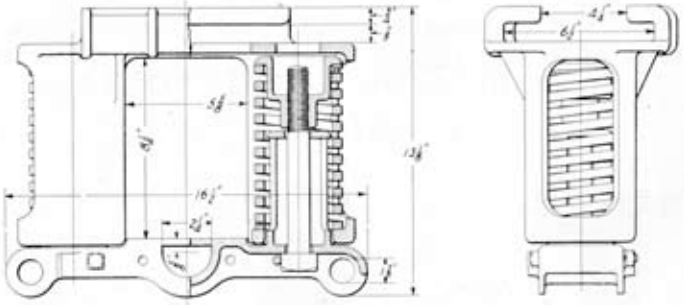
Code Word	No.	List Each
Huffish.	10671—Form 12 Anchorage for use with M. C. B. Coupler.....	$44 00

M. C. B. SPRING DRAW BAR CARRIER

Patented

Form 12





USED with M. C. B. Coupler listed on page 598. Offers a yielding support so that abrupt breaks in grade can be passed over as shown on page 586.

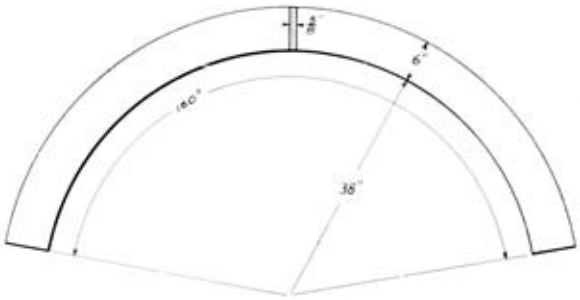
Lugs on ends of yoke are intended for carrying air lines.

Casting can be sawed out above opening in center of support, thus allowing space for $1\frac{1}{4}$-inch conduit.

Castings are malleable iron. Weight 96 pounds.

Code Word	No.					List Each
Interposer.	10985—Form 12 Carrier for use with M. C. B. Coupler					$39 00
Ricinine.	13556—Body Casting for Form 12 Carrier					19 00
Ricker.	13557—Yoke	"	"	12	"	10 00
Ricketa.	13558—Coil Spring	"	"	12	"	2 50

M. C. B. CARRIER SLIDE BAR



SUPPORTS the M. C. B. Spring Draw Bar Carrier listed on the preceding page and is fastened to car by supports listed below. Supports should be spaced so that distance between them is not greater than 12 inches.

Slide Bars are shipped not drilled, as holes must be located to conform to underframing of car platforms.

Made of steel. Weight 107 pounds.

Code Word	No.	List Each
Hostelry.	10034—Carrier Slide Bar, Steel, for M. C. B. Carrier	$30 00

M. C. B. SLIDE BAR SUPPORTS

Forms 1, 2 and 3



Form 1



Form 2



Form 3

SUPPORTS the M. C. B. Slide Bar listed above and allows Spring Draw Bar Carrier to slide along bar.

Unless otherwise specified, the equipment is furnished with 6 Form 1 and 2 Form 2 Supports.

Orders should specify dimension A of Form 1 Support and whether Form 3 Center Supports are to be substituted for Form 2.

The Supports are listed on page 596.

Tables and Data

In the Section Immediately Following

Indexes

Page 618

TABLES

For Conversion of American and Metric Systems

Measures of Length

1 Millimeter	=	0.001	Meter	=	.03937	Inch or	.0032808 Foot.
1 Centimeter	=	0.01	Meter	=	.3937	Inch or	.032808 Foot.
1 Meter	=	1	Meter	=	39.37	Inches or	3.2808 Feet.
1 Kilometer	=	1000	Meters	=	1093.61	Yards or	.62137 Mile.
1 Inch	=	25.4	Millimeters	=	2.54	Centimeters.	
1 Foot	=	.3048	Meter.				
1 Yard	=	.9144	Meter.				

Measures of Surface

1 Square Millimeter	=	.00155	Square Inch.		
1 Square Centimeter	=	.155	Square Inch.		
1 Square Meter	=	10.764	Square Feet	=	1.196 Square Yards.
1 Square Kilometer	=	.386109	Square Miles	=	247.11 Acres.
1 Square Inch	=	6.452	Square Centimeters.		
1 Square Foot	=	.0929	Square Meter.		
1 Square Yard	=	.836	Square Meter.		

Measures of Volume

1 Cubic Centimeter	=	.061	Cubic Inch.	
1 Liter	=	.001	Cubic Meter	= 61.023 Cubic Inches.
1 Cubic Meter	=	35.314	Cubic Feet	= 1.308 Cubic Yards.
1 Cubic Inch	=	16.387	Cubic Centimeters.	
1 Cubic Foot	=	.02832	Cubic Meter.	
1 Cubic Yard	=	.7645	Cubic Meter.	
1 American Gallon (231 cubic inches)	=	3.785	Liters.	

Measures of Weight

1 Gram	=	15.432	Grains		=	.0022	Pound.
1 Kilogram	=	2.2046	Pounds (Avoirdupois)				
1 Metric Ton	=	.9842	Ton (2240 pounds)	=	2204.6	Pounds.	
1 Grain	=	.0648	Gram				
1 Pound (Avoir.)	=	453.6	Grams		=	.4536	Kilograms.

Table of Multiples

1 Mil = $\frac{1}{1000}$ part of an Inch = .001 Inch.
Circular Mils = Diameter in Mils Squared.
1 Circular Mil = .7854 Square Mil.
1 Square Mil = 1.2732 Circular Mils.
1 Millimeter = 39.37 Mils.
Circumference of Circle = Diameter × 3.1416.
Area of Circle = Diameter Squared × .7854.
Diameter of Circle = Circumference ÷ 3.1416.
Diameter of Circle = $\sqrt{\text{Area}} \div .7854$.
Diameter of Circle × .8862 = Side of Square of equal area.
Area of Ellipse = Product of two diameters × .7854.
Surface of a Sphere = Diameter Squared × 3.1416.
Volume of a Sphere = Diameter Cubed × .5236.
Volume of a Cone (round, square, triangular) = Area of Base × ⅓ Altitude.

CENTIMETER EQUIVALENTS

Of Inches and Fractions of an Inch

Fractions——> Inches–v	0	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
0	0	.159	.318	.476	.635	.794	.953	1.111	1.270	1.429	1.588	1.746	1.905	2.064	2.223	2.381
1	2.54	2.70	2.86	3.02	3.18	3.33	3.49	3.65	3.81	3.97	4.13	4.29	4.45	4.60	4.76	4.92
2	5.08	5.24	5.40	5.56	5.72	5.87	6.03	6.19	6.35	6.51	6.67	6.83	6.99	7.14	7.30	7.46
3	7.62	7.78	7.94	8.10	8.26	8.41	8.57	8.73	8.89	9.05	9.21	9.37	9.53	9.68	9.84	10.00
4	10.16	10.32	10.48	10.64	10.80	10.95	11.11	11.27	11.43	11.59	11.75	11.91	12.07	12.22	12.38	12.54
5	12.70	12.86	13.02	13.18	13.34	13.49	13.65	13.81	13.97	14.13	14.29	14.45	14.61	14.76	14.92	15.08
6	15.24	15.40	15.56	15.72	15.88	16.03	16.19	16.35	16.51	16.67	16.83	16.99	17.15	17.30	17.46	17.62
7	17.78	17.94	18.10	18.26	18.42	18.57	18.73	18.89	19.05	19.21	19.37	19.53	19.69	19.84	20.00	20.16
8	20.32	20.48	20.64	20.80	20.96	21.11	21.27	21.43	21.59	21.75	21.91	22.07	22.23	22.38	22.54	22.70
9	22.86	23.02	23.18	23.34	23.50	23.65	23.81	23.97	24.13	24.29	24.45	24.61	24.77	24.92	25.08	25.24
10	25.40	25.56	25.72	25.88	26.04	26.19	26.35	26.51	26.67	26.83	26.99	27.15	27.31	27.46	27.62	27.78
11	27.94	28.10	28.26	28.42	28.58	28.73	28.89	29.05	29.21	29.37	29.53	29.69	29.85	30.00	30.16	30.32
12	30.48	30.64	30.80	30.96	31.12	31.27	31.43	31.59	31.75	31.91	32.07	32.23	32.39	32.54	32.70	32.86

Decimal Equivalents
of Fractions of an Inch

Fractions——>	0	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
Decimals——>	0	.0625	.125	.1875	.25	.3125	.375	.4375	.5	.5625	.625	.6875	.75	.8125	.875	.9375

Inches and Fractions of an Inch
In Decimals of a Foot

Fractions——> Inches–v	0	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
0	0	.0052	.0104	.0156	.0208	.0260	.0312	.0365	.0417	.0469	.0521	.0573	.0625	.0677	.0729	.0781
1	.0833	.0885	.0938	.0990	.1042	.1094	.1146	.1198	.1250	.1302	.1354	.1406	.1458	.1510	.1562	.1615
2	.1667	.1719	.1771	.1823	.1875	.1927	.1979	.2031	.2083	.2135	.2188	.2240	.2292	.2344	.2396	.2448
3	.2500	.2552	.2604	.2656	.2708	.2760	.2812	.2865	.2917	.2969	.3021	.3073	.3125	.3177	.3229	.3281
4	.3333	.3385	.3437	.3490	.3542	.3594	.3646	.3698	.3750	.3802	.3854	.3906	.3958	.4010	.4062	.4115
5	.4167	.4219	.4271	.4323	.4375	.4427	.4479	.4531	.4583	.4635	.4688	.4740	.4792	.4844	.4896	.4948
6	.5000	.5052	.5104	.5156	.5208	.5260	.5312	.5365	.5417	.5469	.5521	.5573	.5625	.5677	.5729	.5781
7	.5833	.5885	.5937	.5990	.6042	.6094	.6146	.6198	.6250	.6302	.6354	.6406	.6458	.6510	.6562	.6615
8	.6667	.6719	.6771	.6823	.6875	.6927	.6979	.7031	.7083	.7135	.7188	.7240	.7292	.7344	.7396	.7448
9	.7500	.7552	.7604	.7656	.7708	.7760	.7812	.7865	.7917	.7969	.8021	.8073	.8125	.8177	.8229	.8281
10	.8333	.8385	.8437	.8490	.8542	.8594	.8646	.8698	.8750	.8802	.8854	.8906	.8958	.9010	.9062	.9115
11	.9167	.9219	.9271	.9323	.9375	.9427	.9479	.9531	.9583	.9635	.9688	.9740	.9792	.9844	.9896	.9948
12	1.0000	1.0052	1.0104	1.0156	1.0208	1.0260	1.0312	1.0365	1.0417	1.0469	1.0521	1.0573	1.0625	1.0677	1.0729	1.0781

THE OHIO BRASS COMPANY, MANSFIELD, OHIO

OHM'S LAW FOR DIRECT CURRENT

The strength of a continuous current is directly proportional to the difference of potential (electromotive force) in the circuit and inversely proportional to the resistance of the circuit.

The above is known as Ohm's law and is expressed as follows:

$$I = \frac{E}{R} \qquad (1)$$

$$\text{or } R = \frac{E}{I} \qquad (2)$$

$$\text{or } E = IR \qquad (3)$$

where I = Current in Amperes.
E = Electromotive Force in Volts.
R = Resistance in Ohms.

Amperes per Generator

Kilo Watts	Approx. H. P.	125 Volts	250 Volts	600 Volts	Kilo Watts	Approx. H. P.	125 Volts	250 Volts	600 Volts
1	1.3	8	4	1.7	30	40	240	120	50
2	2.7	16	8	3.3	35	47	280	140	58
3	4.0	24	12	5	40	54	320	160	67
5	6.7	40	20	8	50	67	400	200	83
7.5	10	60	30	12	60	80	480	240	133
10	13	80	40	17	75	100	600	300	125
12.5	17	100	50	21	100	134	800	400	167
15	20	120	60	25	125	167	1000	500	208
20	27	160	80	33	150	201	1200	600	250
25	34	200	100	42	200	268	1600	800	334

Amperes per Motor

H. P.	Efficiency Per Cent	Kilo Watts Input	110 Volts	220 Volts	500 Volts
¾	70	.8	7	4	2
1½	70	1.6	14	7	3
3	75	2.98	27	14	6
5	80	4.66	42	21	9
7½	85	6.58	60	30	13
10	85	8.78	80	40	18
15	85	13.2	120	60	26
20	85	17.6	160	80	35
25	85	21.9	199	100	44
30	90	24.9	226	113	50
40	90	33.2	301	151	66
50	90	41.4	375	188	83
60	90	49.7	451	226	99
70	90	58.0	527	264	116
80	90	66.3	602	302	133
90	90	74.6	677	339	149
100	90	82.9	752	377	166
120	90	99.5	902	452	199
150	90	124	1125	563	248

STEEL STRAND DATA

Galvanized steel strand in the sizes used in catenary or overhead construction is usually composed of 7 or 19 wires. The wires may have a strength anywhere from 60,000 pounds to 350,000 pounds per square inch. The breaking weight of a galvanized strand is about 90 per cent of the sum of the breaking weights of the individual wires. The breaking weight of the individual wires depends on their treatment and drawing and as a general rule the smaller the wire the higher the breaking strain per square inch of metal. It is always a good investment to buy double or extra galvanized wire, owing to its longer life.

Regular Grade (ordinary) single or double galvanized steel strand has a breaking weight of 15 to 20 times its weight per 1000 feet. Used for short spans and guys where great flexibility is not needed and a strand of moderate strength and reliability will meet the requirements.

Siemens-Martin double galvanized strand has a breaking weight of 20 to 30 times its weight per 1000 feet. Composed of soft pliable wire of considerably higher strength than the ordinary. Used for messenger and span wires, heavy guys and ground wires on high tension transmission lines. High Strength double galvanized strand has a breaking weight of over 30 times its weight per 1000 feet. Used where a stronger strand than Siemens-Martin is required. It is consequently stiffer and more difficult to handle but has great reliability. Extra High Strength double galvanized strand has a breaking strength of over 50 times its weight per 1000 feet. It has the same properties as High Strength only to a more pronounced degree. As the breaking weight of steel strand varies considerably, depending on the mill at which it is drawn, the quantities in the table are approximate only. For important work calculations should be based on actual tests of the strand to be used.

Galvanized Steel Strands

Nominal Diameter of Strand	Pounds per 1000 Feet	Cross Section Sq. In.	Wires		Breaking Weight in Pounds			
			Number	Diameter in Mils	Ordinary	Siemens-Martin	High Strength	Extra High Strength
½	1565	.4570	19	175	23000	38000	58000	87000
⅜	1150	.3358	19	150	17000	28000	44000	66000
⅜	800	.2332	19	125	12000	20000	32000	47000
¼	525	.1533	7	167	8300	12000	19000	28000
7/16	400	.1172	7	146	6300	9300	15000	23000
⅜	295	.0859	7	125	4800	7000	12000	18000
5/16	205	.0595	7	104	3600	5000	8200	13000
¼	130	.0379	7	83	2200	3200	5200	8000

Breaking weights in above table are taken from average values of several wire mills.

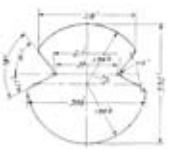
TROLLEY WIRE

Weight, Resistance and Strength of Copper, Phono-Electric and Iron Trolley Wire

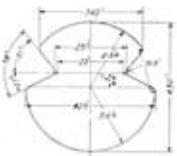
American Wire Gauge (B. & S.)	Weight Pounds per 1000 Feet			Resistance Ohms per 1000 Feet at 20° C. (68° F.)			Breaking Load in Pounds		
	Copper (Hard)	Phono-Electric	Iron (Galv.)	Copper (Hard)	Phono-Electric	Iron (Galv.)	Copper (Hard)	Phono-Electric	Iron (Galv.)
0000	641	641	562	.0504	.1182	.3635	8125	11450	9500
000	508	508	446	.0636	.1494	.4577	6700	9100	7900
00	403	403	354	.0802	.1899	.5774	5500	7400	6000
0	320	320	281	.1011	.2385	.7276	4500	6300	4800

Elastic Limit of Copper (Hard Drawn) and Phono-Electric = 75% of Ultimate Strength.
Elastic Limit of Iron (Galvanized) = 60% of Ultimate Strength.
Resistance Iron (Galvanized) Trolley = 7.2 x Resistance Hard Drawn Copper.
Phono-Electric Trolley = 2.3 x Resistance Hard Drawn Copper.
Furnished in Round or American Standard Grooved Sections.
Iron Trolley Wire in Grooved Sections frequently oversize, especially when galvanized.

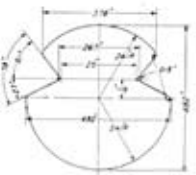
American Standard Grooved Wire



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000



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Drawings include dimensions added at Chicago Convention of The American Electric Railway Association in October, 1912.
Purchasers of Grooved Wire should insist that it conform to these standards.
O-B materials are designed to fit these standard sections.

COPPER WIRE

(1a) At a temperature of 20°C., the resistance of a wire of standard annealed copper, one meter in length and of a uniform section of one square millimeter, is 1/58 ohm or 0.017241 ohm.

(1b) At a temperature of 68°Fahr., the resistance of a wire of standard annealed copper, one foot in length and of a uniform section of one circular mil (one mil in diameter), is 10.3712 ohms.

(2) At a temperature of 20°C. (68°Fahr.), the density of standard annealed copper is 8.89 grams per cubic centimeter or .3212 pounds per cubic inch.

(3a) At a temperature of 20°C., the "constant mass" temperature coefficient of resistance of standard annealed copper is 0.003,93 per degree Centigrade.

(3b) At a temperature of 68°Fahr., the "constant mass" temperature coefficient of resistance of standard annealed copper is .002,183 per degree Fahrenheit.

(4) The coefficient of linear expansion of annealed copper is .000,017 per degree Centigrade, or .000,009,44 per degree Fahrenheit.

Values adopted by International Electrotechnical Commission of 1913 and endorsed by Bureau of Standards in 1914.

Conductivity of Copper Wire

		Ohms per mil foot
Soft or Annealed Copper	98.2%	10.565
Medium Hard 4/0 to 1/0 B&S	97.7%	10.619
Medium Hard No. 1 to No. 18 B&S	96.7%	10.729
Hard Drawn or Unannealed 4/0 to 1/0 B&S	97.2%	10.674
Hard Drawn or Unannealed No. 1 to No. 18 B&S	96.2%	10.785
Standard Values	100.0%	10.371

The elastic limit of 4/0 to 1/0 hard drawn copper wire averages 55% of the ultimate breaking strength.

Properties of Bare and Insulated Solid Copper Wire

American Wire Gauge (B & S)	Diameter in Mils Bare Wire	Area		Diameter Over Insulation Inches		Weight Pounds Per 1000 Feet			Resistance Ohms Per 1000 Feet at 20°C. (68°Fahr.)		Breaking Load in Pounds		Diameter Bare in Millimeters	American Wire Gauge (B & S)
		Circular Mils	Square Inches	2 Braid	3 Braid	Bare	Insulated 2 Braid	Insulated 3 Braid	Standard Annealed 100%	Hard Drawn	Hard Drawn	Annealed		
0000	460.0	211,600	.1662	.609	.640	640.5	723	767	.04901	.05042	8125	5320	11.68	0000
000	409.6	167,800	.1318	.562	.593	507.9	587	629	.06180	.06358	6700	4220	10.40	000
00	364.8	133,100	.1045	.500	.515	402.8	467	502	.07793	.08017	5500	3340	9.266	00
0	324.9	105,500	.08289	.468	.500	319.5	377	407	.09827	.10110	4500	2650	8.252	0
1	289.3	83,690	.06573	.422	.453	253.3	294	316	.1239	.1288	3675	2100	7.348	1
2	257.6	66,370	.05213	.390	.437	200.9	239	260	.1563	.1625	3000	1670	6.544	2
3	229.4	52,640	.04134	.359	.406	159.3	185	199	.1970	.2048	2425	1325	5.827	3
4	204.3	41,740	.03278	.328	.359	126.4	151	164	.2485	.2583	1950	1050	5.189	4
5	181.9	33,100	.02600	.306	.337	100.2	122	138	.3133	.3257	1575	880	4.621	5
6	162.0	26,250	.02062	.296	.328	79.46	100	112	.3951	.4107	1275	700	4.115	6
7	144.3	20,820	.01635	.278	.308	63.02	84	95	.4982	.5179	1025	550	3.665	7
8	128.5	16,510	.01297	.250	.296	49.98	66	75	.6282	.6530	825	440	3.264	8
9	114.4	13,090	.01028	.236	.282	39.63	54	62	.7921	.8234	660	340	2.906	9
10	101.9	10,380	.008155	.203	.234	31.43	46	53	.9989	1.038	525	270	2.588	10
11	90.74	8,234	.006467	.....	.....	24.92	.....	.....	1.260	1.310	420	210	2.305	11
12	80.81	6,530	.005129	.172	.203	19.77	30	35	1.588	1.651	330	170	2.053	12
13	71.96	5,178	.004067	.....	.....	15.68	.....	.....	2.003	2.082	260	130	1.828	13
14	64.08	4,107	.003225	.156	.187	12.43	20	25	2.525	2.625	210	105	1.628	14
15	57.07	3,257	.002558	.....	.....	9.86	.....	.....	3.184	3.310	170	85	1.450	15
16	50.82	2,583	.002028	.125	.172	7.82	16	20	4.016	4.175	135	65	1.291	16
17	45.26	2,048	.001609	.....	.....	6.20	.....	.....	5.064	5.264	105	55	1.150	17
18	40.30	1,624	.001276	.109	.156	4.92	12	16	6.385	6.637	85	40	1.024	18

For weight or resistance per mile multiply values per 1000 feet by 5.28. Weight and resistance of actual wire may vary from calculated quantities in table.

PROPERTIES OF BARE AND INSULATED STRANDED COPPER WIRE

American Wire Gauge (B & S)	Area		Number of Wires in Strand	Diameter in Inches			Weight in Pounds per 1000 Feet			Resistance Ohms per 1000 Feet at 20°C. (68° Fahr.) Standard Annealed	Area in Square Millimeters	American Wire Gauge (B & S)
	Circular Mils	Square Inches		Bare	Over Insulation		Bare	Insulated				
					2-Braid	3-Braid		2-Braid	3-Braid			
	2,000,000	1.5708	91	1.630	1.875	2.000	6205	6690	7008	.005,289	1013.5	
	1,750,000	1.3744	91	1.526	1.781	1.906	5429	5894	6193	.006,045	886.8	
	1,500,000	1.1781	91	1.412	1.656	1.781	4654	5098	5380	.007,052	760.1	
	1,250,000	.9817	91	1.289	1.531	1.656	3878	4264	4508	.008,463	633.4	
	1,000,000	.7854	61	1.152	1.406	1.531	3100	3456	3674	.010,578	506.7	
	900,000	.7069	61	1.094	1.312	1.437	2790	3127	3332	.011,753	456.1	
	800,000	.6283	61	1.031	1.250	1.375	2480	2799	2992	.013,223	405.4	
	750,000	.5891	61	.998	1.218	1.343	2325	2635	2822	.014,104	380.1	
	700,000	.5498	61	.964	1.187	1.312	2170	2471	2650	.015,112	354.7	
	600,000	.4712	61	.893	1.109	1.234	1860	2093	2235	.017,631	304.0	
	500,000	.3927	37	.813	1.000	1.109	1548	1765	1894	.021,157	253.4	
	450,000	.3534	37	.772	.937	1.062	1393	1601	1724	.023,508	228.0	
	400,000	.3142	37	.728	.906	1.031	1239	1436	1553	.026,447	202.7	
	350,000	.2749	37	.681	.843	.968	1083	1248	1345	.030,225	177.4	
	300,000	.2356	19	.629	.796	.921	926.0	1083	1174	.035,262	152.0	
	250,000	.1963	19	.574	.750	.875	771.7	907	985	.042,315	126.7	
0000	211,600	.1662	19	.528	.687	.812	653.1	745	800	.049,99	107.2	0000
000	167,800	.1318	19	.470	.671	.734	512.1	604	653	.063,04	85.04	000
00	133,100	.1045	7	.413	.625	.687	407.0	482	522	.079,49	67.42	00
0	105,500	.08289	7	.368	.578	.640	322.4	388	424	.100,24	53.48	0
1	83,690	.06573	7	.328	.531	.593	255.5	303	328	.1264	42.41	1
2	66,370	.05213	7	.292	.468	.531	202.5	246	270	.1594	33.63	2
3	52,640	.04134	7	.260	.421	.468	160.6	190	206	.2009	26.67	3
4	41,740	.03278	7	.232	.390	.437	127.4	155	170	.2535	21.15	4

For weight or resistance per mile multiply values per 1000 feet by 5.28.
Weight and resistance of actual strand may vary from calculated quantities in table.
Due to twist in strand weight and resistance increase about 2% over solid wire.

THE OHIO BRASS COMPANY, MANSFIELD, OHIO

ALUMINUM WIRE

(1a) At a temperature of 20°C. the resistance of an aluminum wire, one meter in length and of a uniform cross section of one square millimeter is .02828 ohm.

(1b) At a temperature of 68°Fahr., the resistance of an aluminum wire one foot in length and of a uniform section of one circular mil (one mil in diameter), is 17.0112 ohms.

(2) At a temperature of 20°C. (68°Fahr.), the density of aluminum wire is 2.70 grams per cubic centimeter or .0975 pounds per cubic inch.

(3) At a temperature of 20°C. (68°Fahr.), the "constant mass" temperature coefficient of aluminum wire is .0039 per degree Centigrade or .00217 per degree Fahrenheit.

(4) At a temperature of 20°C. (68°Fahr.), the coefficient of linear expansion of aluminum wire is .000,023,1 per degree Centigrade or .000,012,8 per degree Fahrenheit.

Weight of aluminum wire can be found by multiplying weight of same size copper wire by .303712.

Resistance of aluminum wire can be found by multiplying resistance of same size of copper wire by 1.64024 based on copper of 100% conductivity.

For equal resistance, aluminum wire compares with copper as follows:

Weight of	Aluminum	= weight of	100%	soft copper x	.498172
Weight of	Aluminum	= weight of	97%	hard copper x	.483227
Diameter of	Aluminum	= diameter of	100%	soft copper x	1.28
Diameter of	Aluminum	= diameter of	97%	hard copper x	1.26
Section of	Aluminum	= section of	100%	soft copper x	1.64
Section of	Aluminum	= section of	97%	hard copper x	1.59

Comparative Weights and Resistances of Solid Aluminum and Copper Wire

American Wire Gauge (B & S)	Diameter in Mils	Area		Weight Pounds per 1000 Feet		Resistance Ohms per 1000 Feet at 20°C. (68°Fahr.)		Diameter Bare Millimeters	American Wire Gauge (B & S)
		Circular Mils	Square Inches	Aluminum Hard Drawn	Copper Annealed	Aluminum Hard Drawn	Copper Annealed		
0000	460.0	211,600	.1662	195	641	.0804	.0490	11.68	0000
000	409.6	167,800	.1318	154	508	.101	.0618	10.40	000
00	364.8	133,100	.1045	122	403	.128	.0779	9.266	00
0	324.9	105,500	.08289	97.1	320	.161	.0983	8.252	0
1	289.3	83,690	.06573	77.0	253	.203	.124	7.348	1
2	257.6	66,370	.05213	61.1	201	.256	.156	6.544	2
3	229.4	52,640	.04134	48.4	159	.323	.197	5.827	3
4	204.3	41,740	.03278	38.4	126	.408	.249	5.189	4
5	181.9	33,100	.02600	30.4	100	.514	.313	4.621	5
6	162.0	26,250	.02062	24.2	79.5	.648	.395	4.115	6
7	144.3	20,820	.01635	19.2	63.0	.817	.498	3.665	7
8	128.5	16,510	.01297	15.2	50.0	1.03	.628	3.264	8
9	114.4	13,090	.01028	12.1	39.6	1.30	.792	2.906	9
10	101.9	10,380	.008155	9.55	31.4	1.64	.999	2.588	10
11	90.74	8,234	.006467	7.57	24.9	2.07	1.26	2.305	11
12	80.81	6,530	.005129	6.00	19.8	2.61	1.59	2.053	12
13	71.96	5,178	.004067	4.76	15.7	3.29	2.00	1.828	13
14	64.08	4,107	.003225	3.78	12.4	4.14	2.53	1.628	14
15	57.07	3,257	.002558	2.99	9.9	5.22	3.18	1.450	15
16	50.82	2,583	.002028	2.38	7.8	6.59	4.02	1.291	16
17	45.26	2,048	.001609	1.88	6.2	8.31	5.06	1.150	17
18	40.30	1,624	.001276	1.50	4.9	10.50	6.39	1.024	18

Based on hard drawn aluminum and standard annealed copper. For weight or resistance per mile multiply values per 1000 feet by 5.28. Weight and resistance of actual wire may vary from calculated quantities in table.

Dimensions, Weight and Resistance of Equivalent Aluminum and Copper Strand

American Wire (B & S) Gauge or Circular Mils		Weight Pounds per 1000 Feet		Resistance Ohms per 1000 Feet at 20°C. (68°F.) (Copper 97% Conductivity)	Diameter in Inches		Number of Strands Aluminum	Strength in Pounds			
								Breaking Load		Elastic Limit	
Aluminum Hard Drawn	Equivalent Copper Hard Drawn	Aluminum	Copper		Aluminum	Copper		Aluminum	Copper	Aluminum	Copper
1,590,000	1,000,000	1491	3100	.0109	1.454	1.152	61	30,000	47,100	17,500	23,500
1,431,000	900,000	1343	2790	.0121	1.380	1.094	61	27,000	42,400	15,700	21,200
1,272,000	800,000	1193	2480	.0136	1.301	1.031	61	24,000	37,600	14,000	18,800
1,192,500	750,000	1121	2325	.0145	1.257	.998	37	22,500	35,300	13,100	17,600
1,113,000	700,000	1047	2170	.0156	1.215	.964	37	21,000	32,900	12,200	16,400
954,000	600,000	894	1860	.0182	1.124	.893	37	18,000	28,200	10,500	14,100
795,000	500,000	746	1548	.0218	1.026	.813	37	15,000	23,500	8,750	11,700
750,000	472,000	704	1463	.0231	.994	.791	37	14,100	22,100	8,250	11,000
715,500	450,000	672	1393	.0242	.974	.772	37	13,500	21,200	7,870	10,600
636,000	400,000	596	1239	.0271	.918	.728	37	12,000	18,800	7,000	9,400
556,500	350,000	520	1083	.0311	.856	.681	19	10,500	16,500	6,120	8,250
500,000	314,500	469	975	.0347	.810	.645	19	9,420	14,700	5,500	7,350
477,000	300,000	447	926	.0363	.793	.629	19	9,000	14,100	5,240	7,050
397,500	250,000	372	772	.0435	.724	.574	19	7,490	11,700	4,370	5,850
336,440	0000	316	653	.0514	.657	.528	7	6,350	9,970	3,700	4,980
300,000	188,800	282	585	.0578	.621	.498	7	5,650	8,870	3,300	4,430
266,800	000	250	512	.0648	.586	.470	7	5,040	7,910	2,940	3,950
211,630	00	197	407	.0816	.522	.413	7	3,970	6,270	2,330	3,130
167,750	0	157	322	.1026	.464	.368	7	3,180	4,970	1,845	2,480
133,070	1	125	256	.1294	.414	.328	7	2,520	3,940	1,465	1,970
105,530	2	98.9	203	.1639	.368	.292	7	1,990	3,130	1,160	1,560
83,700	3	78.7	161	.2070	.328	.260	7	1,580	2,480	920	1,240
66,370	4	62.6	127	.2610	.293	.232	7	1,250	1,970	730	980

For weight or resistance per mile multiply values per 1000 feet by 5.28. Actual strand may vary from calculated quantities in table.
Due to twist in strand weight and resistance increase about 2% over solid wire.

Dimensions, Weight and Resistance of Steel Reinforced Aluminum Strand

American Wire (B & S) Gauze or Circular Mils		Diameter Outside in Inches	Weight Per 1000 Feet in Pounds	Resistance Ohms per 1000 Feet at 20°C. (68°F.) (Copper 97% Conductivity)	Strength in Pounds		Stranding	
					Breaking Load	Elastic Limit		
Aluminum Hard Drawn	Equivalent Copper Hard Drawn						Aluminum	Steel Core
500,000	314,500	.904	776	.0347	23,800	17,100	30 x .1291	19 x .0775
336,440	0000	.741	528	.0514	16,200	11,700	30 x .1059	7 x .1059
266,800	000	.635	344	.0648	9,460	6,510	6 x .2120	7 x .0705
211,630	00	.564	290	.0816	8,450	5,950	6 x .1880	1 x .1880
167,750	0	.501	231	.1026	6,660	4,690	6 x .1670	1 x .1670
133,070	1	.447	184	.1294	5,310	3,740	6 x .1491	1 x .1491
105,530	2	.398	145	.1639	4,210	2,960	6 x .1327	1 x .1327
83,700	3	.355	116	.2070	3,340	2,350	6 x .1182	1 x .1182
66,370	4	.316	91.9	.2610	2,640	1,860	6 x .1052	1 x .1052
41,740	6	.250	57.5	.4155	1,640	1,150	6 x .0834	1 x .0834
26,250	8	.198	35.1	.6606	1,040	730	6 x .0661	1 x .0661

For weight or resistance per mile multiply values per 1000 feet by 5.28. Actual strand may vary from calculated quantities in table.

TEST OF GALVANIZING

The most common test applied to galvanized iron or steel is the copper sulphate test sometimes called the "Blue Vitriol," "Western Union" or "Preece Test."

The samples must be cleaned before testing, first with carbona, benzine or turpentine, and cotton waste (not with a brush), and then thoroughly rinsed in clear water and wiped dry with clean cotton waste.

The standard solution of copper sulphate consists of commercial copper sulphate crystals dissolved in cold water, about in the proportion of 36 parts, by weight, of crystals to 100 parts, by weight, of water (3 pounds crystals in 1 gallon water). The solution must then be neutralized by the addition of an excess of chemically pure cupric oxide (CuO) (about ¼ pound). The presence of an excess of cupric oxide will be shown by the sediment of this reagent at the bottom of the containing vessel.

The neutralized solution must be filtered before using by passing through filter paper. The filtered solution must have a specific gravity of 1.186 at 65 degrees F. at the beginning of each test. If the filtered solution is high in specific gravity clean water may be added to bring it to 1.186 at 65 degrees F., or if it is low, filtered solution of a higher gravity may be added. An excess of cupric oxide shall always be kept in the unfiltered stock solution.

The temperature of the solution must be maintained between 62 degrees and 68 degrees F. during the test.

The galvanized articles to be tested, after being cleaned, are immersed in this solution *four times* for periods of *one minute each*. After each immersion the article is covered with a black scum which should be carefully cleaned off with a clean bristle brush in clean water. After brushing, the surface should be wiped perfectly dry with clean cotton waste.

The coating is said to have broken down or failed when a bright salmon colored spot of copper remains after the brushing and wiping operations are completed.

Zinc has the ability to displace copper from solutions of copper salts. Consequently, after the zinc coated article is dipped into the solution a certain amount of zinc is removed from the article and a corresponding amount of copper from the solution. It is this loose copper that is brushed off after each immersion and each immersion makes the coating of zinc thinner. Iron also displaces copper from solutions of its salts and the bright salmon spots, which are a sign of breakdown, are copper spots on iron. They differ from the copper that the zinc displaces in that they hold tenaciously to the iron and cannot be brushed off.

In testing sherardized articles, the zinc iron compound which is formed in the sherardizing process displaces copper, and most of the copper is easily brushed off, but a thin dark film may remain on the surface. This does not indicate breakdown but is often mistaken for it. Experience will teach one to distinguish between this thin dark red film and the salmon colored copper spots which indicate actual breakdown.

TABLES
STANDARD AND EXTRA HEAVY PIPE

Butt and Lap Welded

English and Metric Systems—Standard Pipe

Nominal Inside Diameter		Actual Inside Diameter		Actual Outside Diameter		Thickness of Metal		Weight	
Inches	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters	Pounds per Foot	Kilograms per Meter
¼	3.174	.269	6.83	.405	10.28	.068	1.727	0.24	.355
⅜	6.349	.364	9.24	.540	13.71	.088	2.235	0.42	.621
½	9.524	.493	12.52	.675	17.15	.091	2.311	0.56	.828
¾	12.700	.622	15.79	.840	21.33	.109	2.768	0.84	1.243
1	19.050	.824	20.93	1.050	26.67	.113	2.870	1.12	1.657
1	25.400	1.047	26.59	1.315	33.40	.134	3.403	1.67	2.471
1¼	31.749	1.380	35.05	1.660	42.16	.140	3.556	2.24	3.315
1½	38.099	1.610	40.89	1.900	48.26	.145	3.683	2.68	3.966
2	50.799	2.067	52.50	2.375	60.32	.154	3.911	3.61	5.342
2½	63.499	2.467	62.66	2.875	73.02	.204	5.181	5.74	8.495
3	76.199	3.066	77.87	3.500	88.89	.217	5.511	7.54	11.159
3½	88.898	3.548	90.12	4.000	101.60	.226	5.740	9.00	13.320
4	101.600	4.026	102.26	4.500	114.30	.237	6.019	10.66	15.776
4½	114.300	4.508	114.50	5.000	127.00	.246	6.248	12.49	18.485
5	127.000	5.045	128.14	5.563	141.30	.259	6.578	14.50	21.460
6	152.400	6.065	154.05	6.625	168.27	.280	7.111	18.76	27.764
7	177.800	7.023	178.38	7.625	193.67	.301	7.645	23.27	34.439
8	203.200	7.981	202.71	8.625	219.07	.322	8.178	28.18	41.706
9	228.600	8.937	226.99	9.625	244.47	.344	8.737	33.70	49.876
10	254.000	10.018	254.44	10.750	273.05	.366	9.296	40.00	59.200

Extra Heavy Pipe

1	25.400	.951	24.155	1.315	33.40	.182	4.623	2.17	3.229
1¼	31.749	1.272	32.309	1.660	42.16	.194	4.927	3.00	4.464
1½	38.099	1.494	37.947	1.900	48.26	.203	5.156	3.63	5.402
2	50.799	1.933	49.098	2.375	60.32	.221	5.613	5.02	7.470
2½	63.499	2.315	58.801	2.875	73.03	.280	7.112	7.67	11.413
3	76.199	2.892	73.456	3.500	88.89	.304	7.722	10.25	15.252
3½	88.898	3.358	85.293	4.000	101.60	.321	8.153	12.47	18.556
4	101.600	3.818	96.977	4.500	114.30	.341	8.661	14.97	22.276
4½	114.300	4.280	108.712	5.000	127.00	.360	9.144	18.22	27.113
5	127.000	4.813	122.250	5.563	141.30	.375	9.525	20.54	30.565
6	152.400	5.750	146.050	6.625	168.27	.437	11.099	28.58	42.529
7	177.800	6.625	168.275	7.625	193.67	.500	12.700	37.67	56.056
8	203.200	7.625	193.675	8.625	219.07	.500	12.700	43.00	63.988

STANDARD Iron Pipe is known to the trade by its *nominal* inside diameter, which, however, is not its *actual* inside diameter. A pipe known as 1¼-inch pipe will measure 1.38 inches diameter inside, while an extra strong pipe will measure 1.272 inches, the outside diameter of both styles being the same, 1.66 inches.

Pole brackets used for the suspension of trolley wires are usually made from what is known as standard steam gas and water pipe, the sizes in most general use being 1¼, 1½ and 2-inch pipe (see Table on opposite page), the 1½-inch being used in the majority of cases.

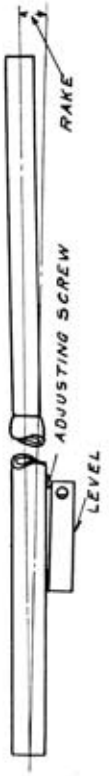
Standard Trolley Poles are made from both the ordinary and the extra heavy pipe.

TABLES
STRUCTURAL STEEL TUBING AND PIPE

Styles A and C

STRUCTURAL Steel Tubing is now employed extensively in the construction of pole brackets, two styles being used, which are known as Styles A and C respectively. This Tubing is made of a high grade of steel and is stronger and stiffer than welded pipe, and also has considerably more elasticity. The Style C Tubing is of the same weight and dimensions as standard welded pipe, while the Style A Tubing is considerably lighter in weight.

Nominal Inside Diameter Inches	Actual Outside Diameter		Thickness of Metal				Weight			
	Inches	Millimeters	Inches		Millimeters		Pounds per Foot		Kilograms per Meter	
	A & C	A & C	A Tubing	C Tubing & Pipe	A	C	A	C	A	C
1¼	1.66	42.16	.098	.140	2.49	3.550	1.50	2.2	2.231	3.275
1½	1.90	48.26	.161	.145	2.56	3.685	1.87	2.6	2.782	3.719
2	2.375	60.32	.107	.154	2.72	3.910	2.50	3.6	3.719	5.210



SETTING STEEL POLES WITH A UNIFORM RAKE

IN city construction it frequently becomes necessary to set long stretches of steel poles and it is necessary that the poles shall all be set with the same rake so as to insure a uniform and pleasing appearance. The diagram shows a method of accomplishing this with the aid of a mason's level equipped with a wood screw or other projection.

For a rake of 6 inches in 24 feet, which is the A. E. R. A. standard in cross-span work, the wood screw or projection is allowed to project so that the top of a 30-inch level is ⅝ inch from the pole. By simply holding the level against pole and shifting the pole until the bubble in the level is in the center, the correct rake will be obtained.

The projection of the wood screw for other rakes can easily be determined by the following proportions:

$$\frac{A \times 12}{B} = \frac{C}{X} \qquad \text{or } X = \frac{B \times C}{12 \times A}$$

Where A = Height of pole in feet
B = Rake in inches
C = Length of mason's level in inches
X = Projection in inches of wood screw

Where the standard rake of 6 inches in 24 feet is used, the formula is simplified to the following:

$$X = \frac{C}{48}$$

RADII AND DEGREES OF CURVES

The Degree of a Curve is the Angle at the Center Subtended by a Chord of 100 Feet

Degree of Curve	Radius in Feet	Degree of Curve	Radius in Feet
0° 30′	11459	14°	410.3
1°	5730	14° 30′	396.2
1° 30′	3820	15°	383.1
2°	2865	16°	359.3
2° 30′	2292	17°	338.3
3°	1910	18°	319.6
3° 30′	1637	19°	302.9
4°	1433	20°	287.9
4° 30′	1274	21°	274.4
5°	1146	22°	262.0
5° 30′	1042	23°	250.8
6°	955.4	24°	240.5
6° 30′	882.0	25°	231.0
7°	819.0	26°	222.3
7° 30′	764.5	27°	214.2
8°	716.8	28°	206.7
8° 30′	674.7	29°	199.7
9°	637.3	30°	193.2
9° 30′	603.8	31°	187.1
10°	573.7	32°	181.4
10° 30′	546.4	33°	176.1
11°	521.7	34°	171.0
11° 30′	499.1	35°	166.3
12°	478.3	36°	161.8
12° 30′	459.3	37°	157.6
13°	441.7	38°	153.6
13° 30′	425.4	39°	149.8

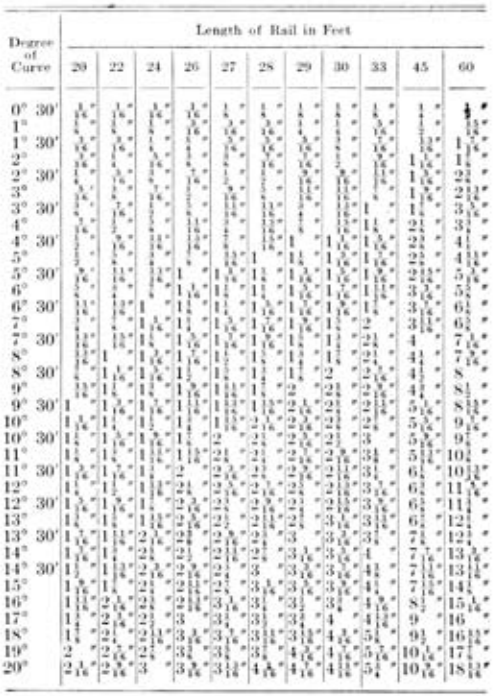
Formula:

$$\frac{50}{R} = \text{Sin } \tfrac{1}{2} \ \varnothing$$

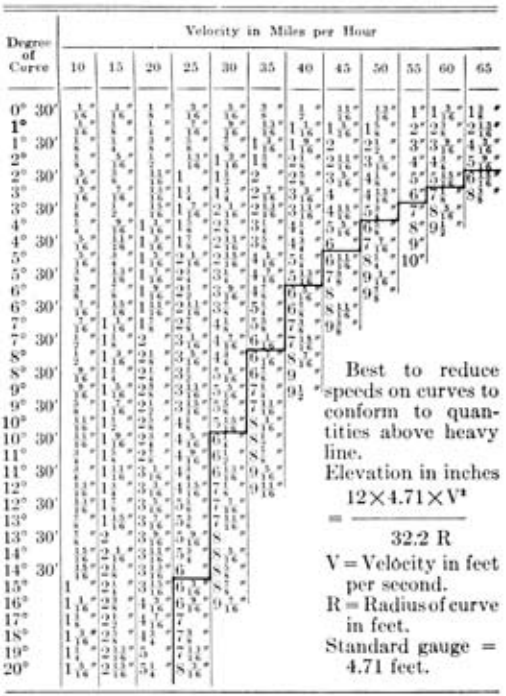
$\varnothing$ = Degree of curve.

R = Radius of curve in feet.

MIDDLE ORDINATES FOR CURVING RAILS



ELEVATION OF OUTER RAIL ON CURVES



Best to reduce speeds on curves to conform to quantities above heavy line.

Elevation in inches

$$= \frac{12 \times 4.71 \times V^2}{32.2 \ R}$$

V = Velocity in feet per second.

R = Radius of curve in feet.

Standard gauge = 4.71 feet.

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