The Type SA Color-Light Signal

Installation, Operation and Maintenance

Handbook No. 8
Third Edition
Revised May 1931

GENERAL RAILWAY SIGNAL COMPANY

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GENERAL RAILWAY SIGNAL COMPANY
ROCHESTER, N. Y.

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INSTALLATION, OPERATION AND MAINTENANCE OF THE TYPE SA COLOR-LIGHT SIGNAL

The object of this booklet is to give instructions for the installation, operation and maintenance of the Type SA Color-Light Signal, manufactured by the General Railway Signal Company.

Installation

To obtain the best results, the signal should be so located with respect to the track, that the lens is as nearly as possible on a level with the eyes of the engineer and as close to the track as clearances will permit. It will be found that this condition normally calls for mounting the signal on the left-hand side of the mast as viewed by the approaching engineer.

Mounting the Signal Housing

Two mountings are available for SA High Signals, one is a bracket for mounting the signal unit 9″ to the right or left of the mast, as shown in Figure 1, and the other a cap for mounting the signal unit on top of the mast, as shown in Figure 2.

Referring to Figure 1, the signal housing A may be assembled either with its mounting bracket B and the whole put in place together, or the bracket may be attached to the mast C and the signal housing then put in place. In the latter case, after

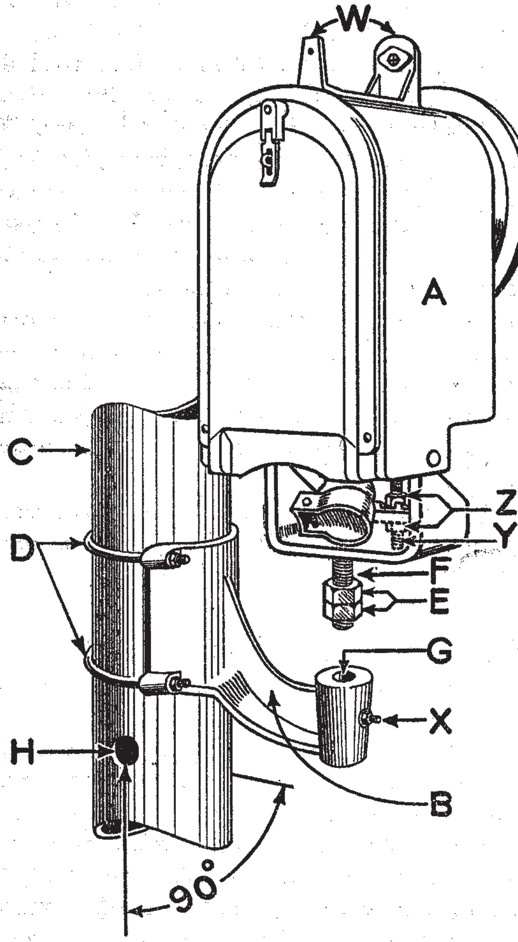


Figure 1. Bracket Mounting the Signal Housing

the bracket has been attached to the mast by means of U Bolts D, all that is necessary to mount the housing is to remove the nuts E from the bottom of stud F, drop the stud through the vertical pivot hole G in the bracket B and replace nuts E.

In cases where flexible conduit is employed for the wires from the mast to the signal, due care must be used in locating the bracket B on the mast C to insure its proper location in relation to the conduit outlet H provided in the mast.

In top-of-mast mounting, illustrated in Figure 2, the signal housing A with cap B is placed on top of the mast, then bracket G is placed so that the stud which is a part of bracket G, fits in hole D in mast thus locking the bracket G in place when the nuts E are tightened.

Care should be taken when mounting the mast to insure that hole D is located correctly in relation to the signal.

Running the Wires to Signal Housing

After the signal housing has been mounted, the next step is to run the operating wires. There will usually be two pairs of wires for the local and line windings of the signal relay, and the lamp circuit together with such additional wires as are necessary for the contacts. It will be found most convenient to run the wires before the signal relay is placed in the case. The wires should be fanned out and laid flat upon the bottom of the housing,

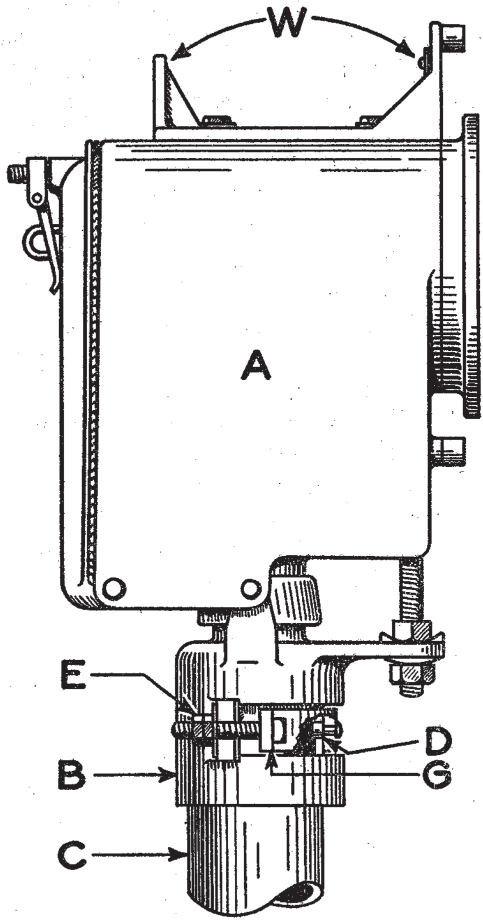


Figure 2. Top-of-Mast Mounting the Signal Housing

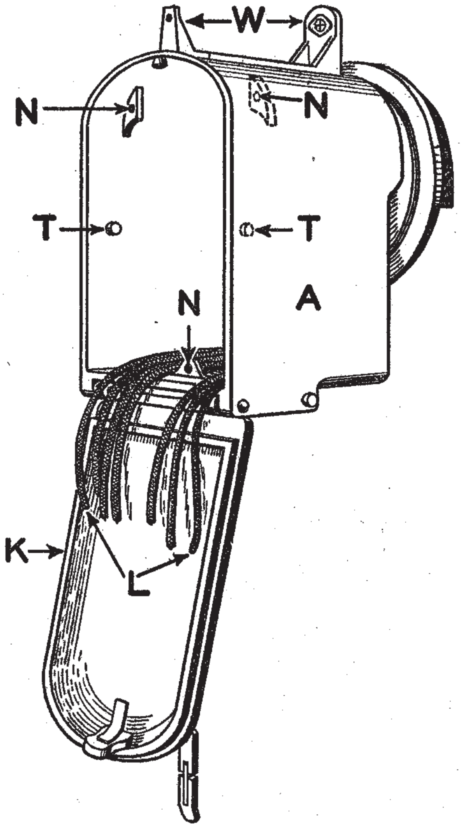


Figure 3. Signal Housing

their loose ends laying along the bottom edge in a row and hanging out of the rear door as shown in Figure 3.

Inserting the Signal Relay

The signal relay is carefully packed in a carton and shipped separately from the signal housing. Signal relays should be transported to the site of the installation in their cartons and the same care used in unpacking and handling as would be used in the handling of any other relays.

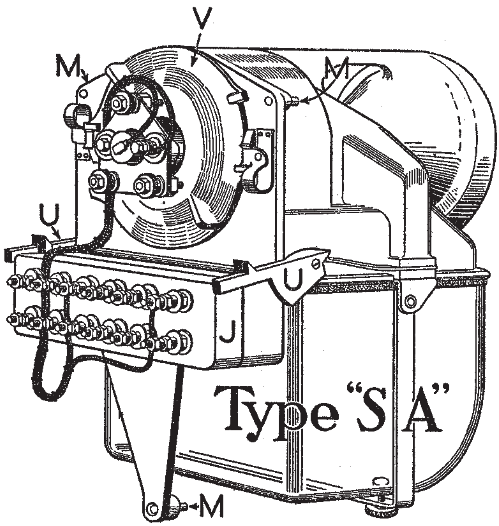


Figure 4. Type SA Signal Relay

After the wires have been run to the signal housing and arranged as described the signal relay may be inserted.

Type SA Signal Relay

The Type SA Signal Relay is shown in an isolated view Figure 4 with the parts referred to in the following description designated by letter references. The most convenient way to insert the relay into the signal housing is to pick it up by the terminal board, tip the upper part backward so that the lower part of the relay clears the lug at the bottom of the signal housing. Then lower the relay until it clears under studs T, as shown in Figure 5.

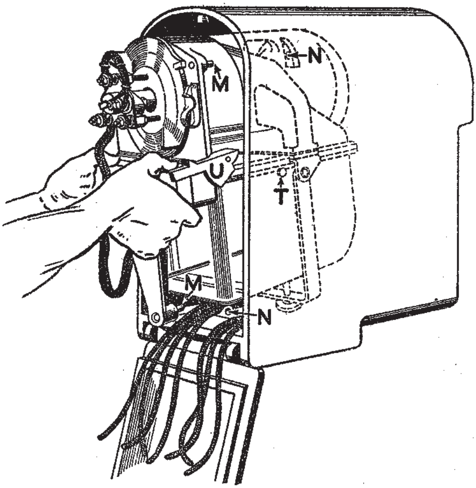


Figure 5. Inserting the SA Signal Relay

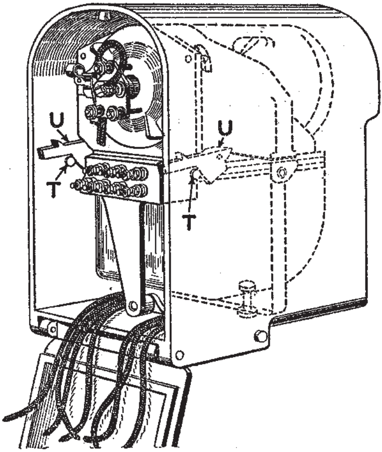


Figure 6. The SA Signal Relay in Place

Then push the relay in until the three pins M on the relay housing enter the holes N in the lugs of the signal housing. The locking cams U will then automatically snap down behind locking pins T and lock the relay in place. It is recommended that both locking cams be pressed down at the same time with the fingers to insure that the relay is securely locked but in doing this, excessive pressure should not be used. See Figure 6.

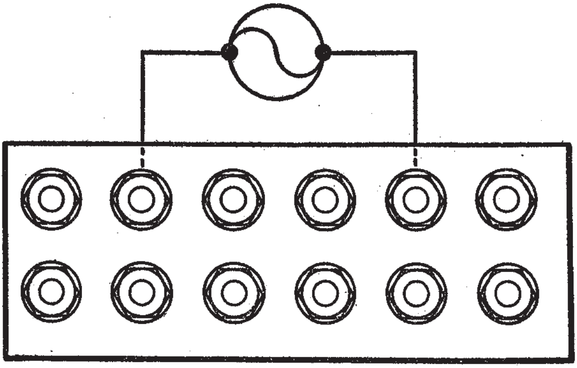


Figure 7. Terminal Block. The two center posts in the upper row are used only when local winding is required.

Connecting Control Wires

After the relay has been securely locked in place, the wires may be cut to length and connected to their respective binding posts. The control wires should be connected to the two center binding posts in the lower row and on A.C. signal relays the local wires should be connected to the two center posts in the upper row, see Figures 7, 10 and 11, due care being taken to maintain the proper relative polarity of these connections.

The D.C. signal relay has no local winding since a permanent magnet is employed and the center posts in the upper row are omitted, see Figures 8 and 9. The lamp is connected to the two posts in the upper row, as shown in Figure 7. Where a separate source of supply is used for the lamp, the supply wires should be connected to these posts.

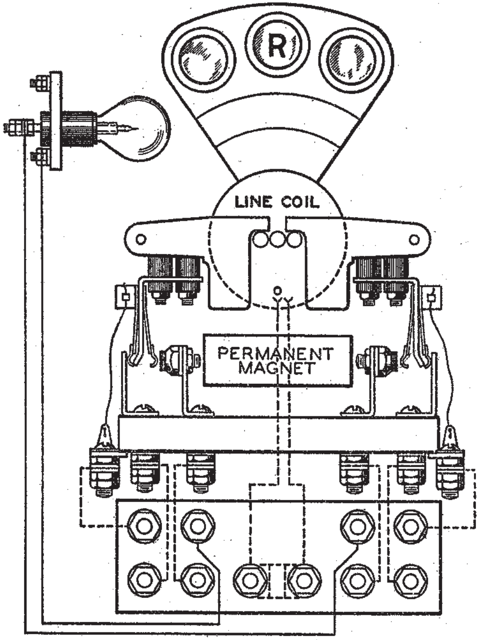


Figure 8. Internal Connections, D.C. Signal Relay

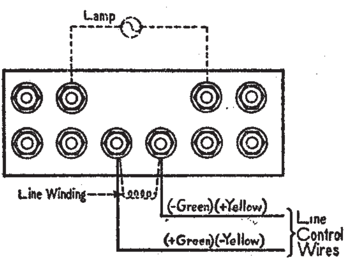


Figure 9. Typical External Connections, D.C. Signal Relay

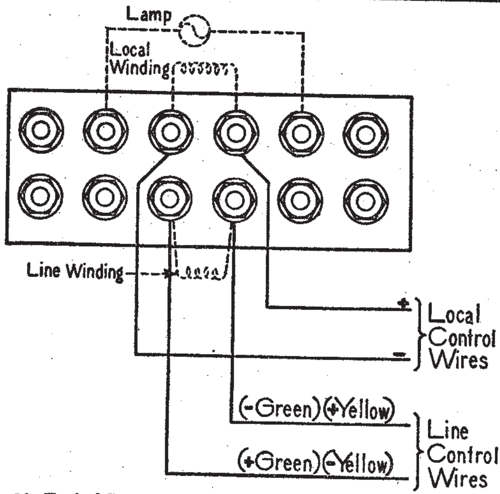


Figure 10. Typical External Connections, A.C. Signal Relay. Lamp on Independent Circuit

When the Type SA Alternating Current Relay is supplied with the local winding designed to operate independently of the lamp, the external connections are made as shown in Figure 10. When the relay is supplied with the local winding designed to operate in series with the lamp, the external connections are made as shown in Figure 11.

The two outside posts in the upper row are for use in making connections to the heels of the contact fingers of the relay and the two outside posts in the lower row are for use in making connections to the back contacts, while the posts directly next to these posts in the lower row are for use in making connections to the front contacts of the relay. See Figure 8.

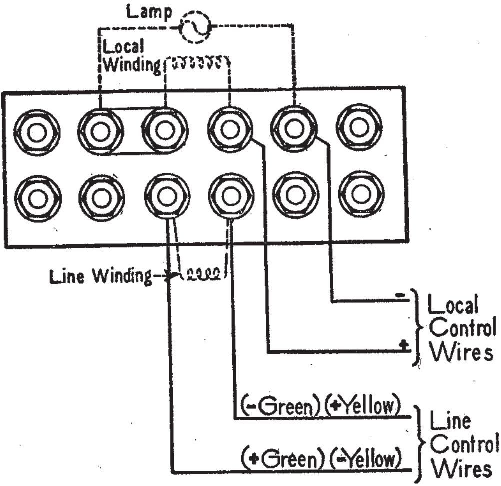


Figure 11. Typical External Connections—A.C. Signal Relay. Lamp in Series with Local Winding

Inserting the Lamp

To insert the lamp in the signal, rotate the reflector holder V, Figure 4, to the right until it unlatches, then withdraw it. This will expose the reflector and socket. Be sure that the reflector is clean, that the label has been removed from the bulb and that lamp is properly seated in its socket before replacing reflector holder. Then turn the reflector holder to the left to lock in place.

Checking Operating Voltage

After making sure that the wires to the signal have been properly connected, power should be applied and careful checks made to be sure that all operating currents are normal, and that polarities are correct. The current applied to the line coil should be approximately 25% above the specified rating. The latter increase is recommended to insure a working margin to allow for voltage drop which may occur during operation due to various extraneous causes. Current applied to the signal relay should not exceed 50% of the rated current on the line winding as this may cause the moving member to slam against its stops and produce unnecessary wear.

It is our present practice to give the operating values in amperes of each signal relay on a tag which is tied on the outside of the relay.

One of the greatest contributing factors toward the successful operation of any light signal is the maintenance of proper and constant voltage. The candle power of the lamp is greatly influenced by voltage changes and in order to secure a satisfactory indication the voltage must be correctly adjusted. Excessive voltage will greatly reduce the burning life of the lamp. Under voltage will materially reduce the candle power and consequently the range of the signal.

The lamps should be burned as nearly as possible at the voltage recommended by the signal manufacturer in order to obtain the most satisfactory signal indication commensurate with long life. See table in Appendix A to this handbook.

Aligning the Signal with the Track

The final step in the installation of the signal is to align it with the track. Each signal housing, except when used as a dwarf signal, is equipped with an individual sighting device adjusted at the factory. This device should not be removed or readjusted in the field. By sighting through this hair line peep-sight along the top of the signal housing and by manipulating the separate horizontal and vertical adjustments as follows, the light beam is aligned with the track.

For bracket mounting, the signal should first be slightly loosened on its vertical stud F. See Figure 1. This will permit it to be swung in a horizontal plane. By looking through the sight W, the signal may be swung and set so that the vertical cross-line in the sight bisects the point at which it is desired to project the axis or most intense part of the main beam. It should then be locked by means of the set screw X in the mounting bracket after which the two nuts E on stud F should be drawn up. The signal should then be tipped up or down by means of the adjusting stud Y and nuts Z under the front end until the horizontal cross-line in the sight bisects the desired point. It should then be locked in place by tightening up both nuts Z.

When the signal is top-of-mast mounted the four nuts E, see Figure 2, should be loosened for adjusting horizontally, then tighten the adjusting nut on the side towards which it is desired to rotate the signal. When the vertical cross-line in the peep-sight bisects the point desired, the signal is clamped in place by drawing up the nut E on the opposite side, after which both adjusting nuts should be locked by tightening up their jam nuts. For vertical adjusting proceed exactly as stated in bracket mounted signals.

In some cases, due to commercial variations in lamp bulbs, the axis of the projected light beam will not be exactly parallel with a line from the sight on the signal to the point along the track to which it is sighted. If this condition occurs the indication may be improved by making a compensating adjustment to the signal after viewing it from the track to determine in which direction the beam has been thrown out of line. By viewing the signal from both sides of the point along the track to which it has been sighted and from points in advance of and behind this point, it can readily be determined in which direction the signal should be moved to bring the axial center of the beam to its proper place. The lamp filaments are inspected for accuracy within certain specified limits, therefore, once the signal has been aligned by means of the sighting device, it should seldom be necessary to re-align the signal to compensate for bulb inaccuracy. Adjustment of the lamp receptacle should never be attempted in the field as it will most likely result in throwing the adjustment out of focus. All signals are carefully focused in the factory before shipment and should require no change in the field.

Signal Lenses

There are a variety of different lens combinations furnished with Type SA Signals, each combination being adapted to take care of some specified track condition. It is important when installing the signals to see that the proper lens or lens combination is employed at each location to suit the particular track condition encountered.

Fundamentally, it can be stated that the greater the curvature of the track to be signaled, the greater will be the spread required; and that the greater the spread of the optical system, the lower will be the beam candle power. Consequently the range will be less because as the light is spread over a greater area it is less intense. Each installation presents its own peculiar problems in this respect and in some cases subsequent changes in lens combinations may be found to better meet the particular conditions involved. This should be borne in mind when installing the signals. General information as to the lenses and lens combinations available for the Type SA Signal is included as Appendix A in the back of this handbook.

Due to clearance requirements high signals are usually mounted above the eye level of the engineer in the cab and either a "half-toric" or "hot-spot" lens is employed to deflect a part of the main beam downward to improve the close-up indication. In some cases, depending upon the relative location of signal and track, it will be found beneficial to rotate the lens so that the short range beam is projected at an angle across the track, thus enabling the engineer to hold the indication for a longer period.

In Compound Lens Signals a small deflecting roundel mounted between the inner and outer lenses, see Figure 20, may be rotated to compensate for any change in the direction of the short range beam. This is also described more completely in Appendix A.

After the signals are in service, the lenses should be cleaned periodically in order to maintain a first-class indication.

In Conclusion:

1. Be sure that operating currents and polarities are right. Check these before putting signals in service.
2. Be sure that reflector and lens are clean.
3. Be sure that bulb is clean and free from labels.
4. Be sure that bulb is properly seated in socket.
5. Be sure that signal is properly aligned. Check both horizontal and vertical adjustments.

6. Be sure that all adjustments are properly tightened to avoid subsequent movement of the signal.
7. Be sure that the proper lens combination is employed for the particular track conditions at the location.
8. Be sure that glasses in relay housing are clean.
9. Be sure that signal relay is properly inserted and locked in housing and that reflector unit is in place and properly locked.

Don'ts

1. Don't tamper with reflector or socket adjustment. (This has been factory adjusted and should never be touched.) If the indication is not satisfactory, the trouble may be due to one or more of the following causes, which should be investigated:
   - (a) Low-voltage at lamp terminals.
   - (b) Signal improperly aligned with respect to track.
   - (c) Wrong lens combination (or adjustment) for particular location of signal.
2. Don't open signal relay on right-of-way. Seals on the relay should not be broken nor the relay opened except where adequate facilities are available for relay repairs.

3. Don't attempt to oil the signal relay at any time. It is equipped with bearings which require no lubrication whatever.

4. Don't check voltage at source of supply—there is always a line drop which makes such a check useless. Measure voltage at lamp terminals and operating currents through relay coils.

5. Don't burn lamp at a lower voltage than recommended by manufacturer of signal.

6. Don't burn lamp at excessive voltage; as a general rule never exceed recommended voltage by more than one-half volt.

7. Don't apply such excessive current to the relay as to cause it to slam.

8. Don't try to compensate for low current in line winding by boosting the current in the local winding, or vice versa. The input ratings are properly balanced to give maximum efficiency with proper operation.

9. Don't expect a lens projecting a concentrated beam to cover a curved track.

10. Don't expect a beam with wide spread to have the same brilliancy as a concentrated beam.

11. Don't remove or re-adjust the sighting device. (This has been factory adjusted and should never be tampered with.)

APPENDIX A
Incandescent Lamps
and
Lenses for Type SA Color-Light Signals

INCANDESCENT LAMPS FOR TYPE SA SIGNALS

The following table gives the 1000 hr. ratings, our recommendations and other information relative to the lamps which are available for use with Type SA Color-Light Signals. The lamps are the 2 pin, candelabra bayonet base type, with the S-11 or S-10 bulb and single filament. The reduced voltage, at which we recommend the higher wattage lamps be burned, greatly increases the life of the filament without reducing the range of the signal excessively. In other words, with the reduced voltage, the lamps will last more than twice as long and the range of the signal will be ample to meet average conditions.

Lamps	Volts	Watts	B.C.P. 8⅜″ Stepped Lens	B.C.P. 8⅜″ Compound Lens	Drawing Number
1000 hr. Rating	11.3	14.4	17500	37500	34866-32
Recommended Use	10.0	11.9			
1000 hr. Rating	9.0	15.3	16000	34000	34866-34
Recommended Use	8.0	12.8			
1000 hr. Rating	4.0	3.0	Not Recommended	11000	34866-35
Recommended Use	4.0	3.0			
1000 hr. Rating	10.0	5.0	Not Recommended	19000	34866-38
Recommended Use	10.0	5.0			

The 3 and 5 Watt Lamps are for use with the compound lens only.
Note: The table shows the average axial B. C. P. (Beam Candle Power) obtained with lens combinations for tangent track, for each lamp when burned at its recommended voltage.

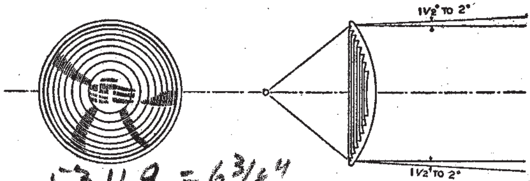
LENSES AND LENS COMBINATIONS FOR TYPE SA SIGNALS

By concentrating all of the light emanating from a signal lens into a conical beam having very little spread, the most brilliant indication, and consequently the greatest range, is obtained. However, due to the necessity of locating signals either above or below the natural eye level of the engineer in the cab or due to the necessity of viewing signals from an approaching curved track, such a beam of light can seldom be used, since a comparatively small angular movement takes the observer out of the beam. Therefore, a lens or a lens combination must be employed which will deflect a part of the main beam downward for high signals, or upward for dwarf signals, and if signals are located on curved track, the beam must be spread to one or both sides of the curve so that the signal can be seen at all required points within its range.

Since the stepped optical lens projects a conical beam such as described above and since most of the lenses employed in signal work are modifications of this lens, it will be described first.

Stepped Optical Lens

The stepped optical lens, as illustrated in Figure 12, has a smooth convex outer surface with concentric circular steps on the concave inner surface and projects a concentrated conical beam of light having approximately 1½° to 2° spread



5-3119 = 6 3/8"

Figure 12. Stepped Optical Lens

around the axis. Beam spread is understood to mean the angle from the axis at which 50% of maximum beam intensity (candle power) is obtained. This lens is available in all sizes employed in Type SA Signals. It is regularly supplied in dwarf signals only when it is used in combination with a deflecting roundel which deflects a part of the beam upward to give the necessary close-up indication.

Hot-Spot Lens—8⅜″ Diameter

The hot-spot lens, shown in Figure 13, is a stepped optical lens having a central portion or bull's-eye with a modified inside surface. Parallel curved prisms are moulded on the inside of the

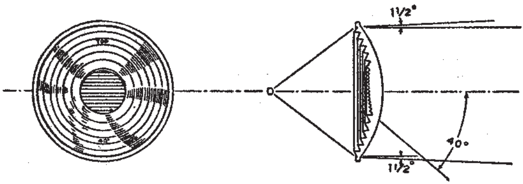


Figure 13. Hot-Spot Lens

36733-7 = 8 3/8"

bull's-eye to divert part of the light passing through this portion of the lens downward through an angle of 40° from the axial center of the main beam. This lens provides a very satisfactory means for obtaining a good close-up indication. A very small amount of light is diverted from the main beam and yet the close-up indication given by the secondary beam is good throughout the 40° angle.

In assembling the signals at the factory, the lenses are usually placed with the parallel prisms of the bull's-eye set at an angle of 30° with the vertical to deflect the secondary beam downward and to the left across the track. When the signal is in place, it is sometimes beneficial to rotate the lens to increase or decrease this angle, the amount of the change, of course, depending upon the relative locations of signal and track.

20° Deflecting Roundel—8⅜″ Diameter

This roundel is for use on average curves. It has parallel flutes moulded on the inner concave surface of the lens which deflect part of the main beam to one side through an angle of 20°, which reduces the range of the signal approximately 45%; the amount and direction of deflection is indicated by the figure and arrow moulded on the inside of the roundel as shown in Figure 14. To deflect the beam to the right or left the roundel should be positioned so that the arrow points in the direction desired.

The deflecting roundel is most frequently used in combination with the hot-spot lens, being mounted in front of the lens by means of an adapter.

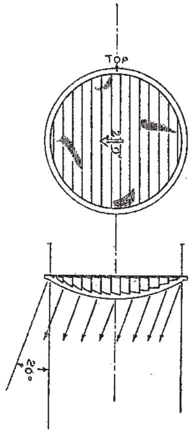


Figure 14. 20° Deflecting Roundel

9238-38 = 8 3/16

30° Spredlite Roundel—8⅜″ Diameter

This roundel, illustrated in Figure 15, is similar to the 20° deflecting roundel, previously described, except that the parallel flutes on the inner concave surface are arranged to spread the main beam through an angle of 15° to each side of the axis, giving a total spread of 30°. It is intended for use in combination with the 8⅜″ hot-spot lens, but should not be employed except on reverse curves or severe curves since it reduces the range of the signal approximately 65%.

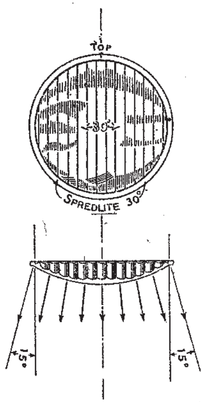


Figure 15. 30° Spredlite Roundel

53142-1-8 3/8

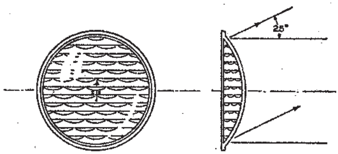


Figure 16. 25° Deflecting Roundel

25° Deflecting Roundel—6⅜″ Diameter

Figure 16 illustrates the 25° deflecting roundel which is employed on dwarf signals in combination with the stepped optical lens. It is somewhat similar to the 20° deflecting roundel, previously described. It is used to provide the close-up indication and is so positioned as to direct the secondary beam upward. In some cases, it is beneficial to rotate the roundel so that the parallel flutes are at an angle with the horizontal, thus projecting the beam sideways across the track as well as upward.

Half-Toric Lens—10½″ Diameter

In the earlier development of lenses the close-up indication was secured by modifying the concentric circular steps of the optical lens through a sector of approximately 90°, as shown in Figure 17. This changed portion gives the lens its name—"*Half-Toric.*" The modification is largely a matter of changing the curvature of the steps in the 90° sector. The half-toric section of the lens diverts

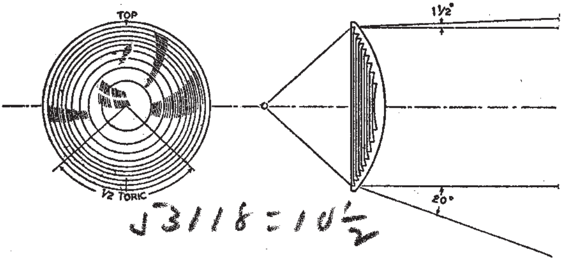


Figure 17. Half-Toric Lens

light from the main beam in a fan-shaped downward secondary beam which is visible downward through an angle of 20°. The lateral spread of the downward beam is usually sufficient to permit the lens to be mounted with the center of the half-toric sector at the bottom and still have the track covered by the beam at close range. However, the location or height of the signal may be such that the close-up indication can be improved by turning the lens sufficiently to direct the sec-

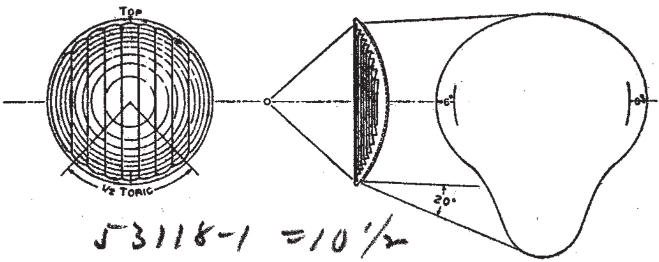


Figure 18. Spredlite Half-Toric Lens

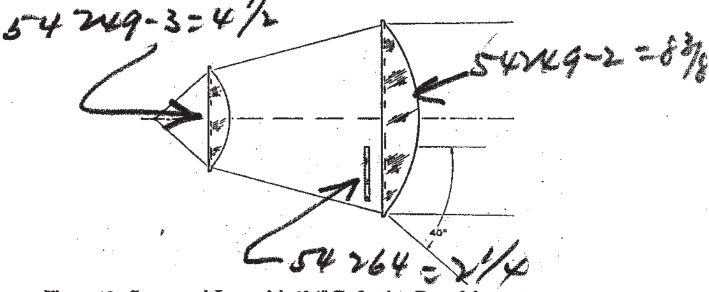


Figure 19. Compound Lens with 2¼″ Deflecting Roundel

ondary beam downward at an angle across the track. This lens is regularly employed on tangent tracks where the larger size 10½″ diameter stepped lenses are used.

Half-Toric Spredlite Lens—10½″ Diameter

This is the half-toric lens, previously described, modified by a fluted surface on the convex side arranged to spread the main beam through an angle of approximately 6° to each side of the axis, giving a total spread of approximately 12°. See Figure 18. The half-toric sector of the lens gives the 20° downward spread as before. The lens is used on curved track. It reduces the range of the signal approximately 40%.

Compound Lens—4½″ and 8⅜″ Diameters

The compound lens comprises two plano-convex lenses; an inner lens 4½″ in diameter and an outer lens 8⅜″ in diameter as shown in Figure 19.

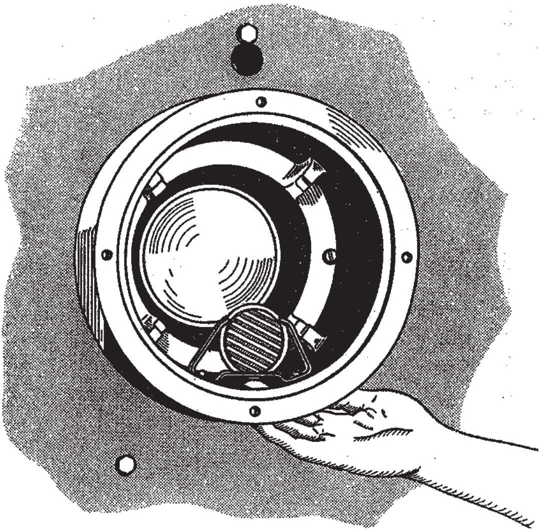


Figure 20. Means of Rotating 2¼″ Deflecting Roundel

To incorporate close-up indication with the compound lens a small 2¼″ deflecting roundel is mounted directly behind the 8⅜″ diameter lens, as shown in Figure 19. This diverts light from the main beam to a secondary beam downward through an angle of 40°, and is very similar to the secondary beam of the hot-spot lens.

By removing a small plate at the bottom of the adapter which supports the outer lens, the deflecting roundel may be rotated in its mounting to direct the secondary beam at an angle across the track where this is desired, without disturbing the outer lens. In Figure 20 the outer lens has been removed to show more clearly how the deflecting roundel is rotated.

Summary of Lenses

The preceding descriptions with illustrations should enable those installing signals to identify the lenses and lens combinations usually applied on Type SA Signals so that the proper arrangement may be installed to meet the needs of each location.

GENERAL RAILWAY SIGNAL COMPANY
Rochester, New York

District Offices

NEW YORK OFFICE
230 Park Avenue, New York City

CHICAGO OFFICE
PEOPLES GAS BUILDING
122 South Michigan Avenue, Chicago, Illinois

ST. LOUIS OFFICE
RAILWAY EXCHANGE BUILDING
611 Olive Street, St. Louis, Missouri

MONTREAL OFFICE
512 DRUMMOND BUILDING
Montreal, Quebec, Canada

Affiliated Companies' Offices

GENERAL RAILWAY SIGNAL COMPANY, LTD.
512, Australia House, Strand, London, W. C. 2

METROPOLITAN-VICKERS AUSTRALIA PTY. LTD.
84 William Street
Melbourne, C. I., Australia

METROPOLITAN-VICKERS ELEC. CO. LTD.
Vickers House, Woodward St.,
Wellington, New Zealand

METROPOLITAN-VICKERS ELEC. EX. CO. LTD.
Colonial Mutual Chambers,
Johannesburg, South Africa

METROPOLITAN-VICKERS ELEC. EX. CO. LTD.
Avenida de Mayo 580
Buenos Aires, South America

ASSOCIATED ELECTRICAL INDUSTRIES, INDIA, LTD.
Hongkong House, 9 Council House St.
Calcutta, India

COMPAGNIE FRANCAISE THOMSON-HOUSTON
Signaux et Enclenchements
14 Rue Vasco de Gama, Paris XV^{e}, France

GENERAL RAILWAY SIGNAL IBERICA—S.A.E.
Via Layetana, 18, Barcelona, Spain

NIPPON SHINGO KABUSHIKI KAISHA
No. 6, 3-Chome Higashi-Nakadohri
Tsukijima, Kyobashiku
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