

# Types S and S A Color-Light Signals

Installation, Operation  
and Maintenance

Booklet No. 8  
January 1929

GENERAL RAILWAY SIGNAL COMPANY

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## INSTALLATION, OPERATION AND MAINTENANCE OF TYPES S AND SA COLOR-LIGHT SIGNALS

The object of this booklet is to give instructions for the installation, operation and maintenance of Types "S" and "SA" Color-light Signals, 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

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 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 stud F, drop the stud through the vertical pivot hole G in the bracket B and replace nuts E.

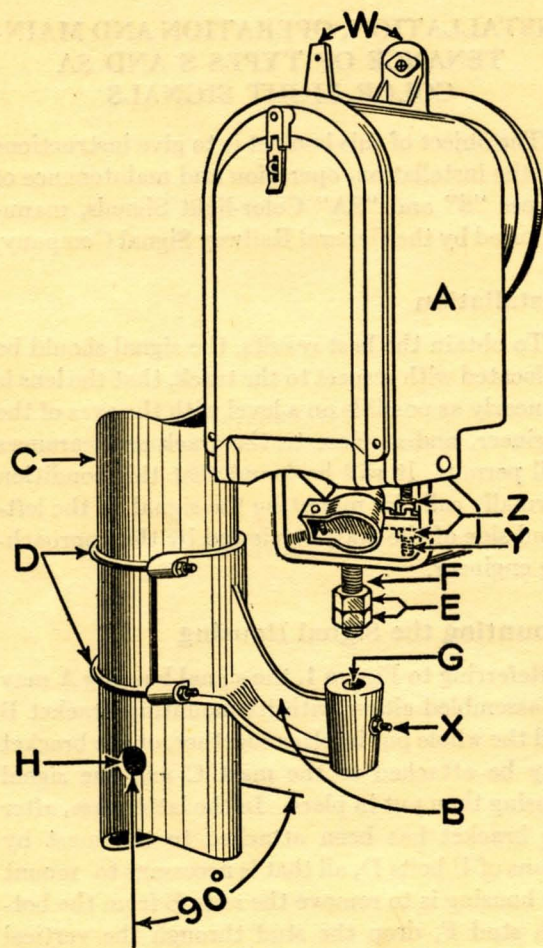


Figure 1. Mounting Signal Housing

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.

### 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 mechanism, 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 relay mechanism is placed in the case. The wires should be fanned out and laid flat upon the bottom of the housing, their loose ends laying along the bottom edge in a row and hanging out of the rear door as shown in Figure 2.

### Inserting the Relay Mechanism

The relay mechanism is carefully packed in a carton and shipped separately from the signal housing. Mechanisms 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 relays.

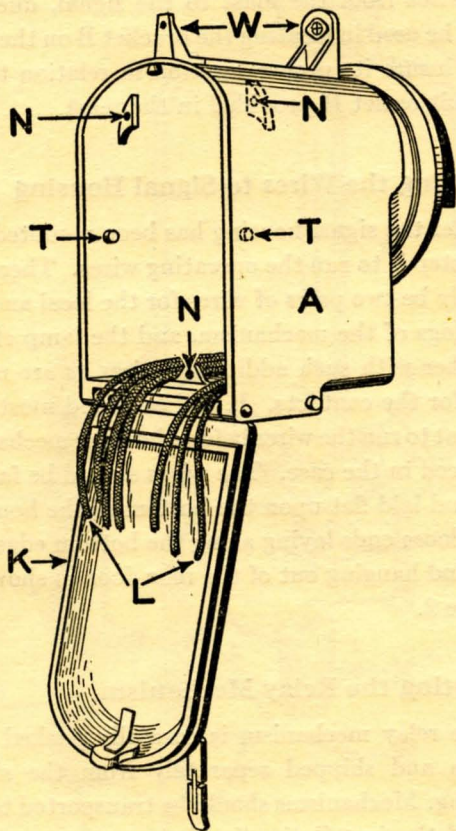


Figure 2. Signal Housing

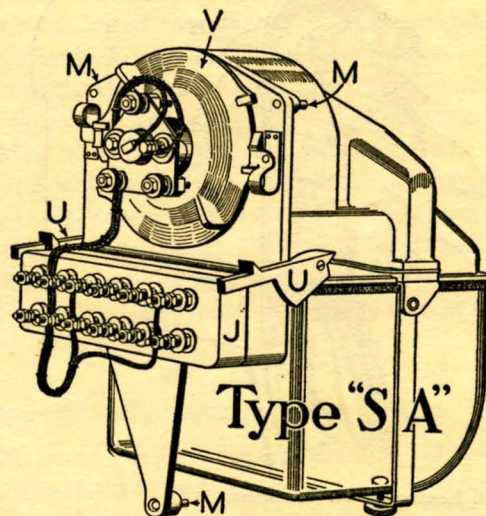


Figure 3. Type "SA" Relay Mechanism

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

### Type "SA" Mechanism

The Type "SA" Mechanism is shown in an isolated view Figure 3 with the parts referred to in the following description designated by letter references. The most convenient way to insert the mechanism into the signal housing is to pick it up by the terminal board, tip the upper part back-

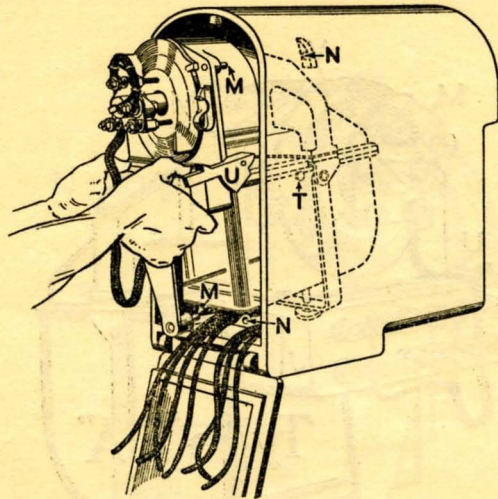


Figure 4. Inserting the "SA" Mechanism

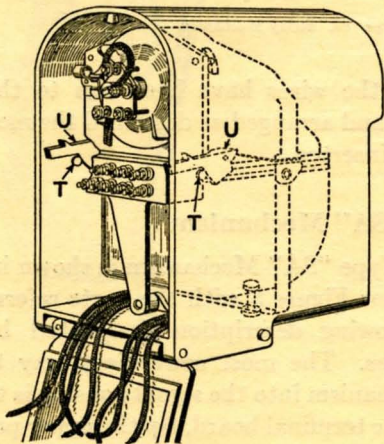


Figure 5. The "SA" Mechanism in Place

ward so that the lower part of the mechanism clears the lug at the bottom of the signal housing as shown in Figure 4. Then shove the mechanism 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 mechanism in place. It is recommended that both locking cams be pressed down at the same time with the fingers to insure that the mechanism is securely locked but in doing this excessive pressure should not be used. See Figure 5.

### Type "S" Mechanism

To insert the Type "S" mechanism in the signal housing, hold it by the reflector holder V and the terminal board J as shown in Figure 6. Then push it into the housing until the three pins M on the mechanism enter the holes N in lugs of the signal housing, Figure 2. The "S" mechanism is locked in place by means of the locking bar P which is applied as shown in Figure 7. Press the plunger Q at one end of the bar P against the "S" relay until the end of the bar passes behind one of the locking pins T, then rotate the bar pressing the other plunger Q against the relay until the other end of the bar passes under the locking pin T, then release allowing the bar P to straddle the two locking pins T. This will firmly lock the relay mechanism in place.

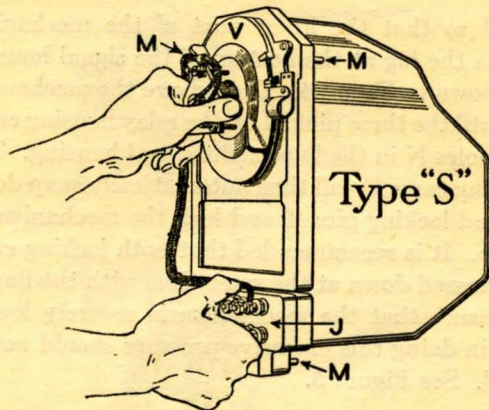


Figure 6. Type "S" Mechanism

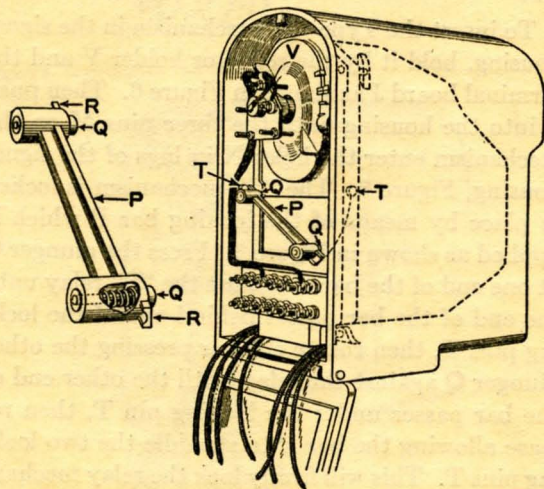


Figure 7. Type "S" Mechanism being locked in place

### 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 L and M in the lower row and the local wires to the two center posts O and J in the upper row (see Figures 8, 9, 10, 11 and 12), due care being taken to maintain the proper polarity of these connections.

The two posts E and F in the upper row, adjacent to local posts, are for the lamp and where a separate source of supply is used for the lamp, the supply wires should be connected to these posts. On D.C. Relays, Types "S" and "SA" where the same source of supply is used for both local and lamp, the lamp binding posts E and F should be jumped to the local posts O and J, thereby placing the local winding and lamp in multiple. (See Figure 10.)

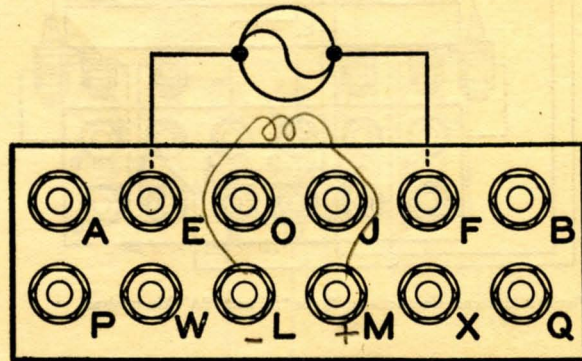


Figure 8. Terminal Board

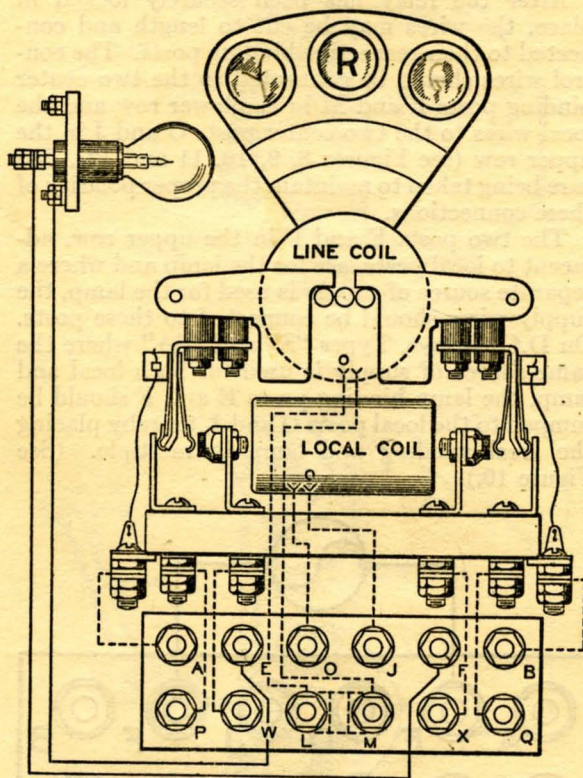


Figure 9. Internal Connections, Types "S" and "SA" Mechanisms

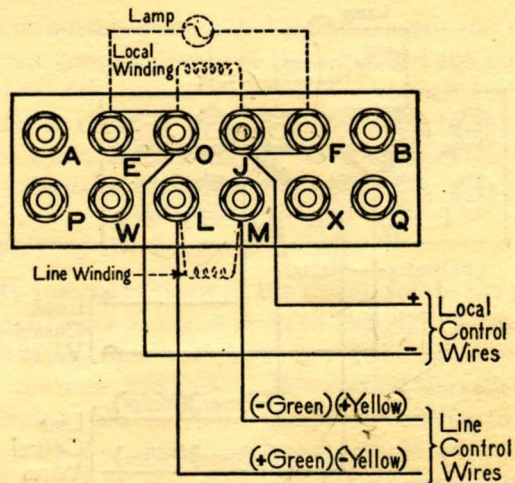


Figure 10. Typical External Connections, D-C and A-C Signals, Lamp in multiple with Local Winding

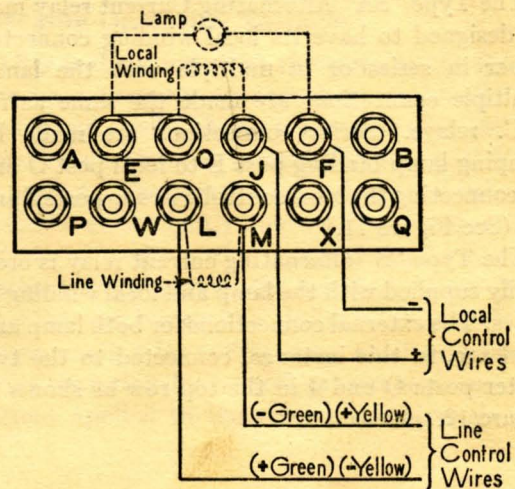


Figure 11. Typical External Connections, A-C Signal, Lamp in Series with Local Winding



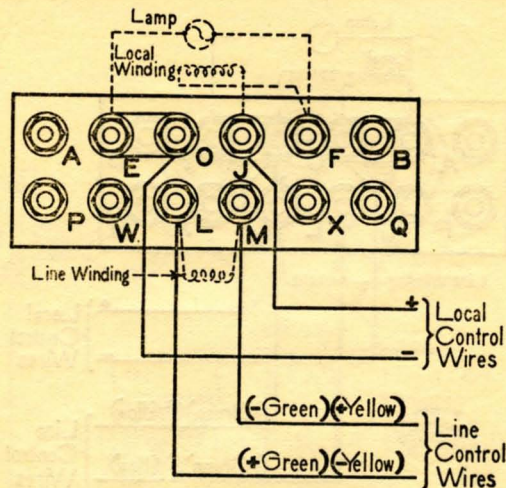


Figure 12. Typical External Connections, Type "S"—A-C Signal

The Type "SA" Alternating Current relay may be designed to have its local winding connected either in series or in multiple with the lamp. Multiple connections are made the same as for D.C. relays. Series connections are made by jumping lamp binding post E to local post O and by connecting the local control wires to posts J and F. (See Figure 11.)

The Type "S" alternating current relay is ordinarily supplied with the lamp and local winding in series. The external connections for both lamp and local are, in this instance, connected to the two center posts O and J in the top row as shown in Figure 12.

The outside posts A and B in the upper row are for the contact fingers of the relay and the posts immediately beneath, W and P on the left and X and Q on the right are for their co-acting front and back contacts respectively. See diagram Figure 9 for internal connections of the relay.

### Inserting the Lamp

To insert the lamp in the signal, rotate the reflector holder V, Fig. 3 or 7, 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 Voltages

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 local coil should be at or slightly above the specified rating and the current in 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 relay mechanism should

not exceed 25% of the rated current on local and line windings as this may cause the moving member to slam against its stops and produce unnecessary wear.

It is our present practice to give the working values of each relay mechanism on a label which is pasted on the inside of the glass cover, the same as on other relays.

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 kept where it belongs. 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 booklet.)

### Aligning the Signal with the Track

The final step in the installation of the signal is to align it with the track. By sighting through the 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:

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.

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, very little movement of the signal is required to compensate for bulb inaccuracy. Adjustment of the lamp receptacle should not be attempted in the field as it will most likely result in throwing the adjustment out of focus. All mechanisms are carefully focussed 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 the "S" and "SA" type signals, each combination being adapted to take care of some specific 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 signalled, 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 par-

ticular conditions involved. This should be borne in mind when installing the signals. General information as to the lenses and lens combinations available for the "S" and "SA" type signals is included as Appendix A in the back of this booklet.

Due to clearance requirements high signals are usually mounted above the eye level of the engineer in his 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.

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 relay mechanism 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 relay mechanism on right-of-way. Seals on the relay should not be broken nor the mechanism opened except where adequate facilities are available for relay repairs.
3. Don't attempt to oil the relay mechanism 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.

**APPENDIX A**  
**Incandescent Lamps**  
**and**  
**Lenses for Types S and SA**  
**Color-Light Signals**

## INCANDESCENT LAMPS FOR TYPES "S" AND "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 the types "S" and "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 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	Approx. Aver. Range Feet	Drawing No.	Type of Service
1000 hr. Rating Recommended Use	13.5	17.0	4800	34866-25	For A.C. lighting with D.C. or A.C. Mechanism. May be connected in series with A.C. Mechanism.
	10.5	11.5			
1000 hr. Rating Recommended Use	5.4	12.1	6000	34866-27	For use with 8-volt storage battery with resistance in series.
	5.0	10.7			
1000 hr. Rating Recommended Use	11.3	14.4	6000	34866-32	For use with 10-volt storage battery with or without trickle charge. For A.C. lighting with D.C. or A.C. Mechanism. May be connected in series with A.C. Mechanism.
	10.0	11.9			
1000 hr. Rating Recommended Use	9.0	15.3	6000	34866-34	For use with 8-volt storage battery with or without trickle charge.
	8.0	12.8			

NOTE: The approximate average ranges shown in the table are for signals with  $\frac{3}{8}$ " diameter lenses without deflecting roundels or spredlite lenses and are the distances at which the indications are clear and distinct in bright sunlight.

## LENSES AND LENS COMBINATIONS FOR TYPES "S" AND "SA" SIGNALS

By concentrating all of the light emanating from a signal lens into a cylindrical beam having very little spread, the most brilliant indication and consequently the greatest range is obtained. The standard optical lens does this but due to the necessity of locating signals either above or below the natural eye level of the engineer in his 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, practically all lenses employed in high signals are modified to deflect a part of the main beam downward and, if the signals are located on curved track, still further modifications must be made to deflect a part of the beam to one or both sides of the curve so that the signal can be seen at all required points within its range. Since all lenses are modifications of the standard optical lens, this lens will be described first.

### Standard Optical Lens

The standard optical lens, as illustrated in Figure 13, has a smooth convex outer surface with concentric circular steps on the concave inner surface and projects a concentrated cylindrical beam of light having approximately  $1\frac{1}{2}^{\circ}$  to  $2^{\circ}$  spread all around the axis. Beam spread is understood to

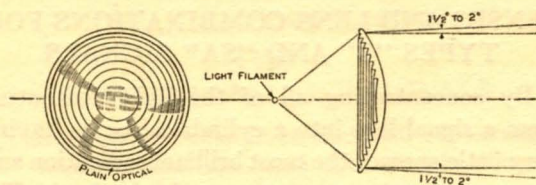


Figure 13. Standard Optical Lens

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 types "S" and "SA" signals. It is regularly supplied in dwarf signals only in which 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— $8\frac{3}{8}$ " Diameter

The hot-spot lens, shown in Figure 14, is an 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 bull's-eye to divert part of the light passing through this portion of the lens downward through an angle of  $40^\circ$

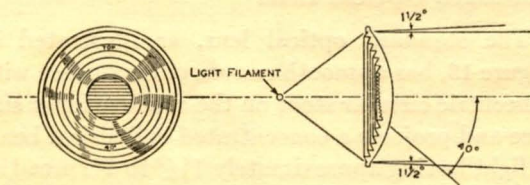


Figure 14. Hot-Spot Lens

from the axial center of the main beam. This lens is a comparatively recent development and provides the most satisfactory means yet made available for obtaining a good close up indication. A very small amount of light is diverted from the main beam consequently its range is not appreciably affected and yet the close up indication given by the secondary beam is good throughout the  $40^\circ$  angle.

All "S" and "SA" Signals intended for mounting as high signals are regularly supplied with the  $8\frac{3}{8}$ " diameter "hot-spot" lens. 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  $45^\circ$  with the horizontal 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.

### $20^\circ$ Deflecting Roundel— $8\frac{3}{8}$ " Diameter

This roundel is used in combination with the "hot-spot" lens, being mounted in front of the lens by means of an adapter. It has a smooth convex outer surface with parallel flutes moulded on the inner concave surface to deflect a part of the main beam to one side through an angle of  $20^\circ$ . The

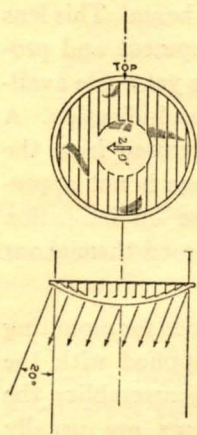


Figure 15. 20° Deflecting Roundel

flutes do not extend across the circular area in the center and, therefore, the close up indication produced by the bull's-eye of the hot-spot lens is not interfered with. The amount and direction of deflection is indicated by figures and an arrow moulded on the inside of the roundel. The roundel may be used to deflect the beam to the right or left by positioning it so that the arrow points in the desired direction.

The 20° deflecting roundel is used on average curves. It reduces the range of the signal approximately 40%.

### 30° Spredlite Roundel— $8\frac{3}{8}$ " Diameter

This roundel, illustrated in Figure 16, 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

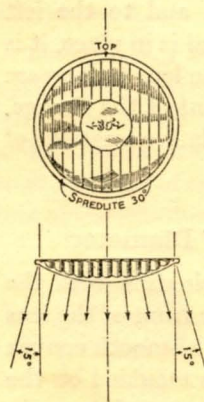


Figure 16. 30° Spredlite Roundel

of 30°. It is intended for use in combination with the  $8\frac{3}{8}$ " 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%. This roundel may be identified by the double-direction arrow and degrees of spread moulded in the plain circular area.

### 20° Deflecting Roundel— $6\frac{3}{8}$ " Diameter

Figure 17 illustrates the 20° deflecting roundel which is employed on dwarf signals in combination with the standard optical lens. It is similar to the 20° deflecting roundel, previously described, except that the flutes are omitted from a band or area extending entirely across the roundel. 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.

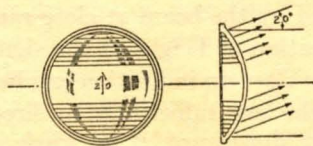


Figure 17. 20° Deflecting Roundel



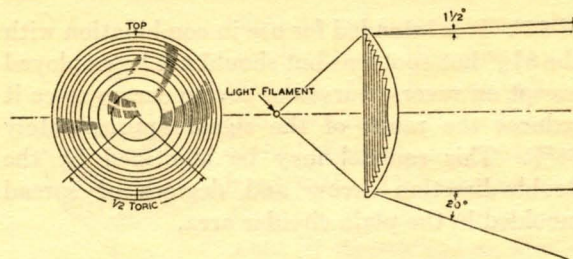


Figure 18. Half-Toric Lens

### Half-Toric Lens— $10\frac{1}{2}$ " 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  $90^\circ$  as shown in Figure 18. 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  $90^\circ$  sector. The half-toric sector of the lens diverts light from the main beam in a fan-shaped downward secondary beam which is visible downward through an angle of  $20^\circ$ . 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 secondary beam downward at an angle across the track. This lens is regularly employed on tangent

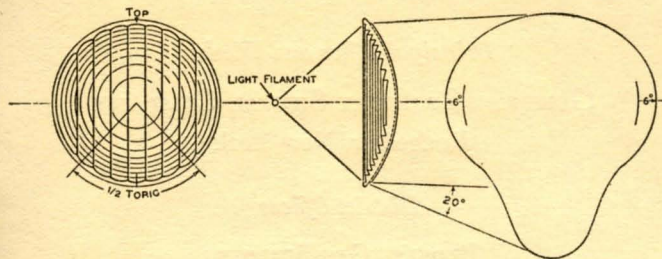


Figure 19. Spredlite Half-Toric Lens

tracks where the larger size  $10\frac{1}{2}$ " diameter lenses are used.

### Half-Toric Spredlite Lens— $10\frac{1}{2}$ " Diameter

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

### Summary of Lenses

The above description with illustrations should enable those installing signals to identify the lenses and lens combinations usually supplied on Types “S” and “SA” Signals so that the proper arrangement may be installed to meet the needs of each location.

*Principal Office and Works*

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Rochester, New York

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512 Drummond Building  
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COMPAGNIE FRANCAISE THOMSON-HOUSTON  
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GENERAL RAILWAY SIGNAL COMPANY, PTY. LTD.  
Melbourne, Australia

