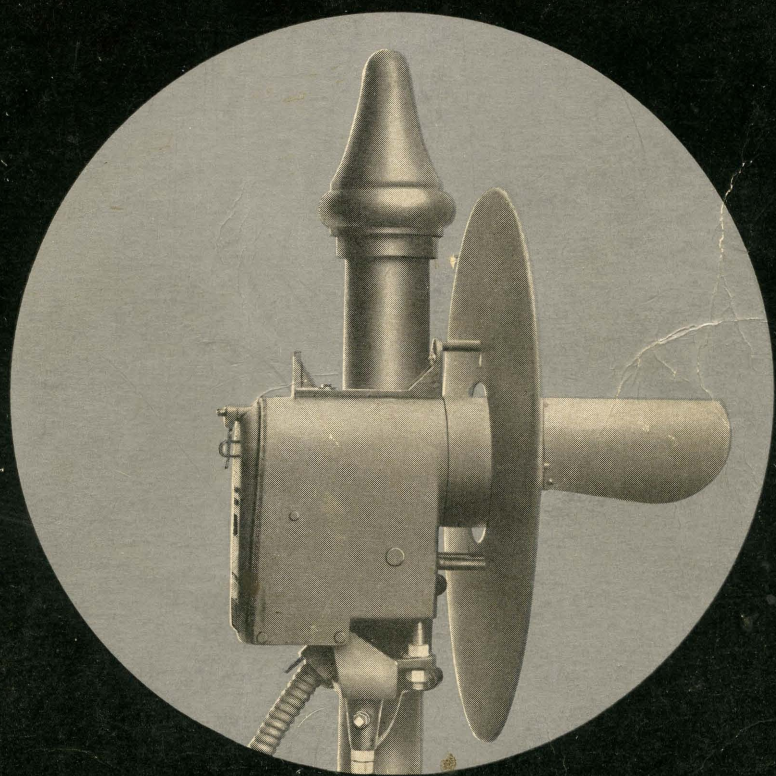


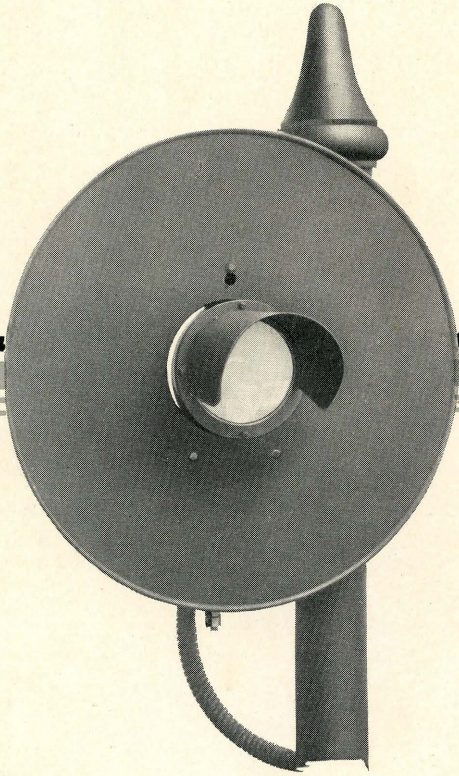
TYPE  
SA SIGNAL



A POWERFUL  
SIGNAL INDICATION

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BULLETIN NO. 163  
FEBRUARY 1932

**A POWERFUL  
SIGNAL  
INDICATION**  
*TYPE SA*  
**SEARCHLIGHT SIGNAL**

**GENERAL RAILWAY SIGNAL COMPANY**

ROCHESTER, N. Y., U. S. A.



SA SEARCHLIGHT SIGNALS INSTALLED  
AT CLEVELAND UNION TERMINAL

# THE SA SIGNAL

## SEARCHLIGHT TYPE

**A**S THE final result from your entire signal system is dependent upon the signal indication, any improvement that can be made in that indication is of paramount importance. To be satisfactory for high speed traffic, especially during adverse weather conditions, this indication must have a powerful and well-controlled beam of light.

The Type SA Signal produces a powerful signal indication at a minimum of energy consumption due to its scientific optical construction. It is equipped with an elliptical reflector which uses approximately 80 per cent of light emitted by the concentrated filament lamp. All three indications are projected through one lens, therefore the beam of light is always in the engineer's line of vision due to the unchanged location of the three indications.

The following features have contributed largely to the rapid adoption of this signal since its introduction in February of 1927. It is now being used by:

- 41 roads in United States
- 5 roads in Canada
- 6 roads in Foreign Countries

## FEATURES OF THE TYPE SA SIGNAL

1. Three indications projected through one lens places the beam of light closer to line of vision and reduces the height of mast.
2. Same housing and relay unit used for high and dwarf signals, thereby reducing the quantity of parts necessary to carry in stock.

3. Alignment is made by hair-line sight. Adjustment is simple and easy.
4. Relay is easily and quickly replaced.
5. No focusing required when replacing lamps.
6. The signal is light in weight. This permits of lighter construction in bridge or other supports.
7. It is compact in design, thereby permitting its use where clearances are limited.
8. The position of the signal spectacle, carrying the miniature colored glass discs, is indicated by its contacts which are actuated directly by the movement of the operating shaft.
9. It can be furnished for d-c. or a-c. operation.
10. It gives a powerful long-range indication on low energy consumption.
11. The signal relay for changing the indications possesses equal reliability in operation to that of other modern relays.
12. Any reflected indication that might be produced by external light would be the true indication of the signal.
13. Due to the fact that lamp failures will usually occur on proceed indications, failures to give the proper stop indication from burnt-out lamps is greatly minimized. Further protection is provided by the true indication given by reflection in case of lamp failure.
14. Its relay simplifies and makes safer the control of light signals:
  - (a) Control of proceed indication is broken through contact on relay of signal ahead instead of through a separate control relay.
  - (b) At interlocking plants the indication employed to check the integrity of operation is through contact on signal relay instead of through de-energized contact of a separate control relay.

15. Stagger of lights is not affected by change of indication.
16. It operates on the closed-circuit principle.
17. Red or stop indication is secured by gravity to produce a stop indication whenever energy is removed from the control, and since the same lamp is employed for three indications a continual check is obtained on the ability of the signal to give its most restrictive indication—a feature which is not obtained on other types of color light signals.
18. Integrity of indication can be directly checked.
19. Cross protection is inherent due to polarized control.
20. Economy of control is secured by eliminating auxiliary control relays.
21. Less maintenance is required to care for one lamp and lens instead of three.
22. Its knife-edge bearings are absolutely free from the effects of vibration and operate in service indefinitely without any signs of wear or deterioration.
23. A permanent magnet, eliminating the local winding formerly employed in d-c. mechanisms, simplifies the control and reduces the energy required to operate the signal.
24. A compound lens has been made available which increases the maximum beam intensity 100 per cent by a more accurate and efficient use of the light input. This outstanding improvement makes possible the use of a 3-watt lamp, thereby making the signal economical for primary battery territory. By using a lamp consuming higher wattage a much more brilliant and powerful indication is produced.
25. Lens combinations of various sizes and light distributions are available.
26. It is universal in application.

## MECHANICAL CONSTRUCTION

**F**IGURES 1 and 2 clearly show both the mechanical and optical construction of the signal. The outer case carries the lens, hood, background, peep sight, and adjustable mounting for aligning the signal, while the other parts of the signal unit are contained in an inner case which may be removed as a unit by simply releasing two locking cams and lifting out.

## SIGNAL RELAY

**T**HE inner case comprises a reflector unit which contains the lamp, and a three-position relay which positions the miniature color discs. Illustrations Figures 3, 4 and 5 show d-c. relays and their application to a signal unit. The relay is contained in a separate dust-proof sealed compartment, the contacts being visible through a moulded glass cover somewhat similar to those used on standard relays. The reflector unit may be removed for changing the lamp or for inspection without exposing the relay to dust. The reflector is made of ground and polished glass to obtain high efficiency in collecting the light from the lamp and to retain this high efficiency in service. A precision lamp is employed, the socket being accurately adjusted at the factory to position the filament on the focal point of reflector so that no subsequent adjustments are required in service.

The same high-efficiency magnetic materials which have so materially improved track and line relays are employed in the SA Relay, and the design of this relay has been so carefully worked out that it equals in dependability the highest quality relays used in any class of signal work.

In both the d-c. and a-c. relays the vane type of construction is used, the magnetic vane being employed in d-c. relays and the non-magnetic vane in the a-c. relays.



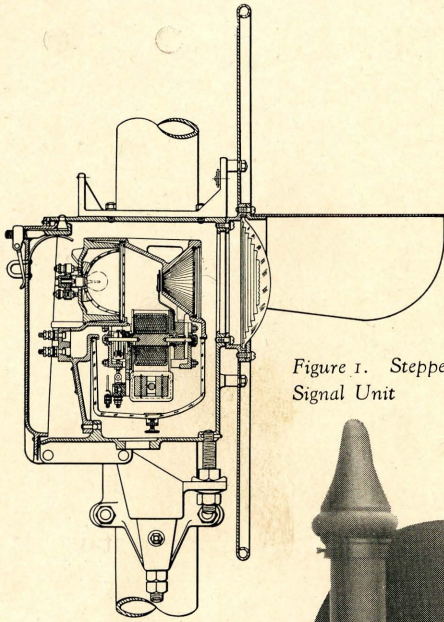


Figure 1. Stepped Lens Signal Unit

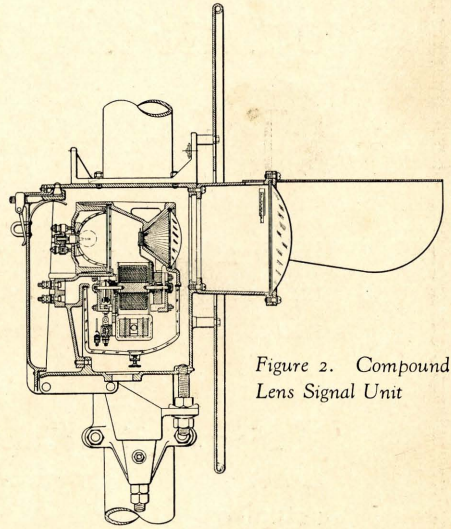


Figure 2. Compound Lens Signal Unit

Figure 3. Rear of SA Signal with Relay in place

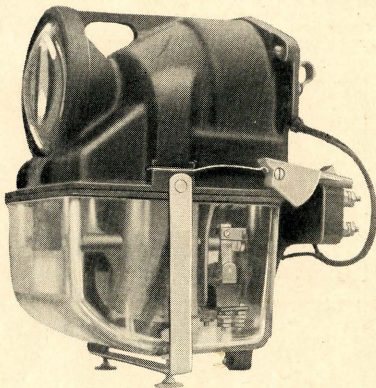
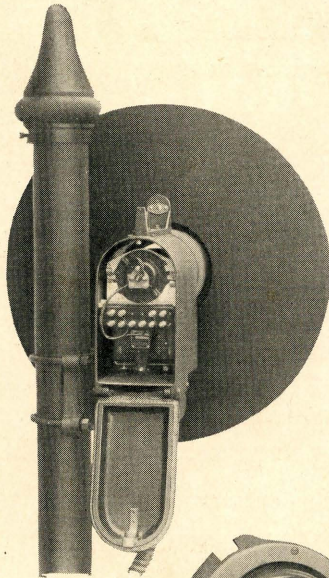


Figure 4. Signal Relay

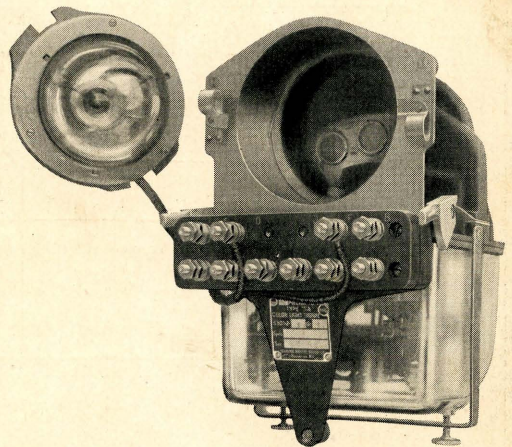


Figure 5. Signal Relay—Reflector Removed

## D-C. RELAY CONSTRUCTION

**T**HE moving element of the d-c. relay, shown in Figure 7, is the core for the line coil with the vanes and miniature spectacle attached. A permanent magnet is employed in this relay in lieu of a local coil.

The gravity bias of the mechanism is far in excess of the actual operating requirements, thereby insuring positive operation. Heavy counterweights are employed with the contacts attached to and operated by these counterweights. Contacts are of standard size and have ample pressure and wipe.

The design is such that when the line coil is de-energized a torque is exerted which tends to move the vanes to a central position; hence the permanent magnet assists the counterweights in restoring the relay to the de-energized position giving an additional safety factor.

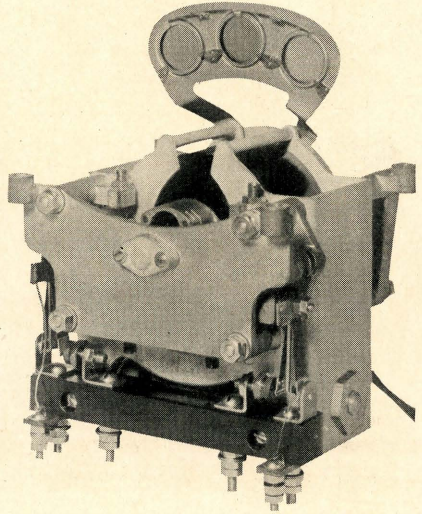


Figure 6. D-C. Relay Structure

### D-C. CONTROL WINDINGS AVAILABLE

Rating		Resistance Ohms	Max. P.U. & Working Amps.	Min. Full Release Amps.
Volts	Amps.			
4.0	0.038	105	0.0328	0.0126
7.5 to 8.0	0.030 to 0.032	250	0.022	0.0085
10 to 12	0.023 to 0.028	430	0.0183	0.007

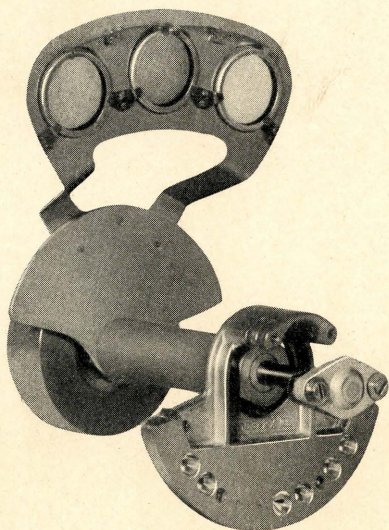


Figure 7. D-C. Relay Field Structure

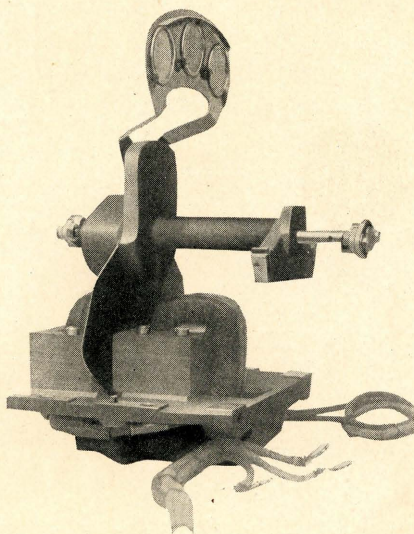


Figure 8. A-C. Armature and Field Structure

## A-C. RELAY CONSTRUCTION

**T**HE moving element of the a-c. relay consists of a shaft which carries a non-magnetic vane and the spectacle as shown in Figure 8. The mounting of shaft on knife-edge bearings, the counterweighting and contact operation, are similar to the construction employed in the d-c. relay. Movement of the non-magnetic vane is produced by the use of a field structure comprising local and line elements similar in design and identical in principle of operation to well-known standard types of three-position vane relays.

### A-C. CONTROL WINDINGS AVAILABLE

Frequency	LOCAL PHASE			LINE PHASE			Maximum Pick-up	Minimum Full Release
	Volts	Amps.	Watts	RATED				
				Volts	Amps.	Watts		
60	11.0	1.54	6.5	110	0.065	7.1	71	25

A-C. Signal Relays will be furnished for operation on other voltages and frequencies as specified or required.

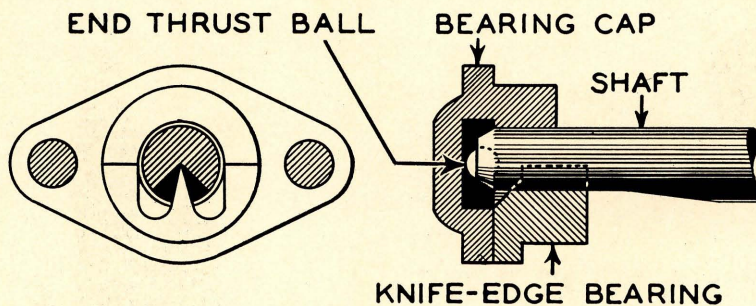


Figure 9. Knife-Edge Bearing

## KNIFE-EDGE BEARING

**T**HE principle of the knife-edge bearing is old and well-known, due to its application in various kinds of scales from those used in the laboratory to types employed in weighing railway cars. Inherent characteristics, such as extremely low and constant friction, freedom from clogging, and ability to stand rough usage without appreciable wear, led to the adoption of this principle in the design of bearings for the Type SA Signal.

The knife-edge bearings developed specifically for the Type SA Signal have been so designed as to take full advantage of these desirable inherent characteristics. The bearings are made of a special grade of material which will not corrode nor break and will operate in service indefinitely. The bearings are absolutely free from the effects of vibration.

Figure 9 shows two views of the bearing, which give a good idea of its construction. The bearing requires no lubrication.

## SIGNAL MOUNTINGS and ALIGNMENTS

**T**WO mountings are available for high signals, one a bracket for mounting the unit with its center 9 inches to the left or right of the center of the mast, as shown by Figure 10, and the other a cap for mounting the unit on top of the mast, as shown by Figure 11. Each signal unit is equipped with a hair-line peep sight which is accurately aligned with the light beam, and separate hori-

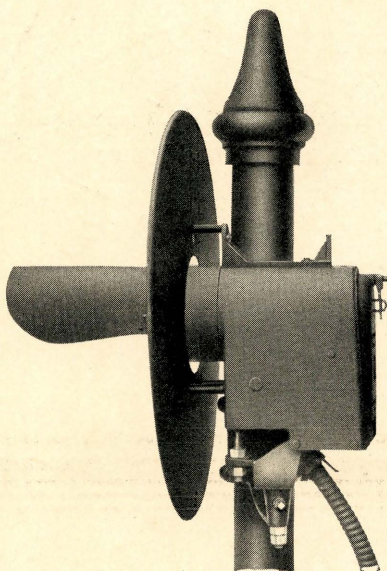


Figure 10. Type SA Signal—Side-of-Mast Mounting

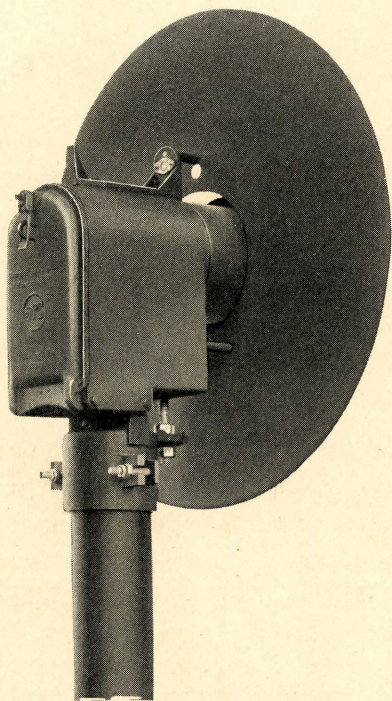


Figure 11. Type SA Signal—Top-of-Mast—Socket Mounting

zontal and vertical adjustments are provided so that one man can easily align the light beam with the track. In the bracket mounting, the signal unit may be turned to the left or right by loosening nuts on bottom of bracket. In the top-of-mast mounting, the unit may be turned to the right or left by loosening nuts on the cap. In either type of mounting the unit is tilted up or down by means of nuts on adjusting stud below front of case.

Figure 13 shows a view of a standard Single-Unit Dwarf Signal. The dwarf signal base has slotted holes for the anchor bolts so that the unit may be turned for aligning the light beam horizontally, the vertical adjustment being the same as for high signal units.

Figure 14 shows a Single-Unit Dwarf Signal mounted on a junction box for parkway cable. The junction box is large enough to house track transformers, fuses and other small apparatus frequently used at dwarf signal locations. Figure 15 is an installation view of a Two-Unit Dwarf Signal. This signal can also be arranged for mounting on a junction box if desired.

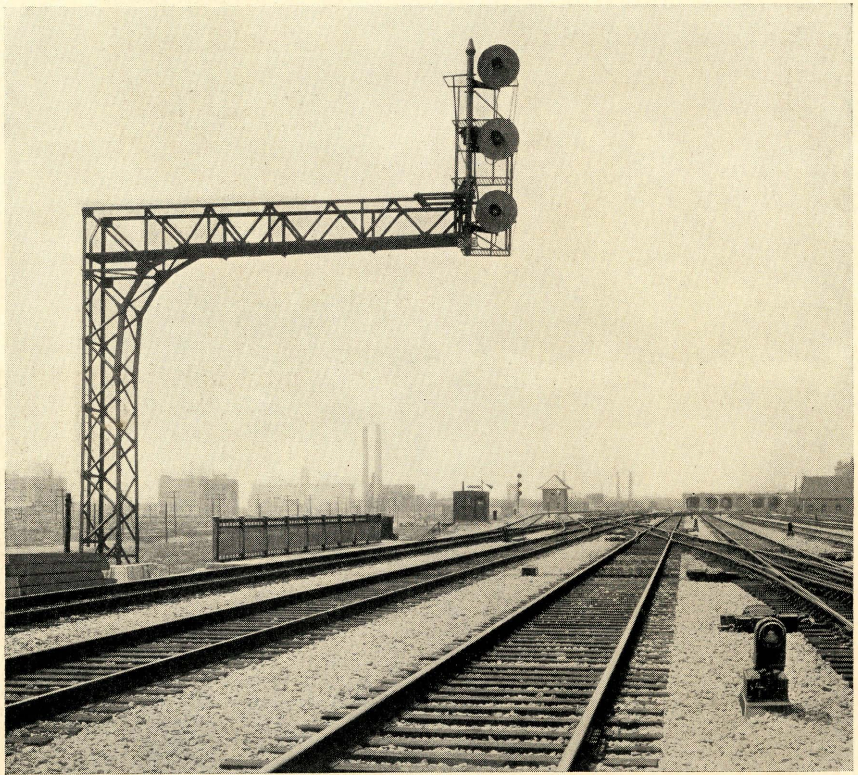


Figure 12. Installation of Type SA Searchlight Signals at Toronto Terminal

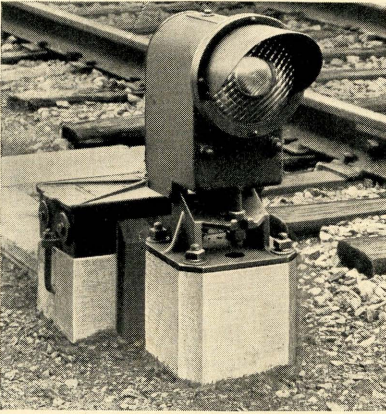


Figure 13. Single-Unit Dwarf Signal

Figure 14. Single-Unit Dwarf Signal Mounted on Junction Box

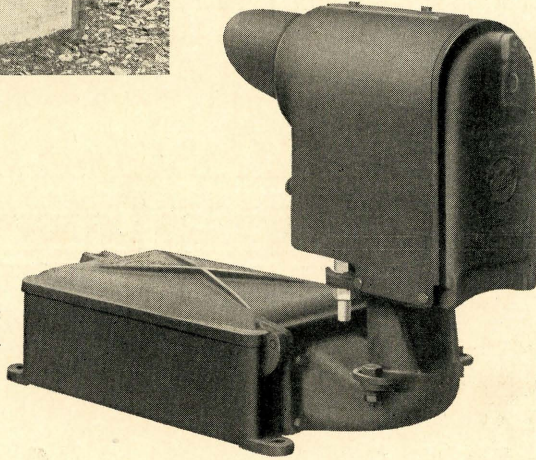
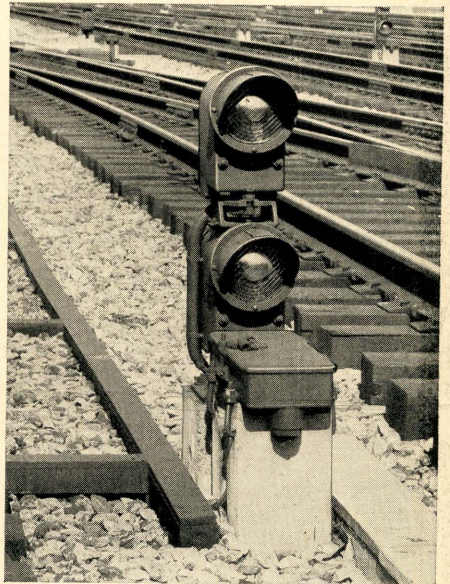


Figure 15. Two-Unit Dwarf Signal



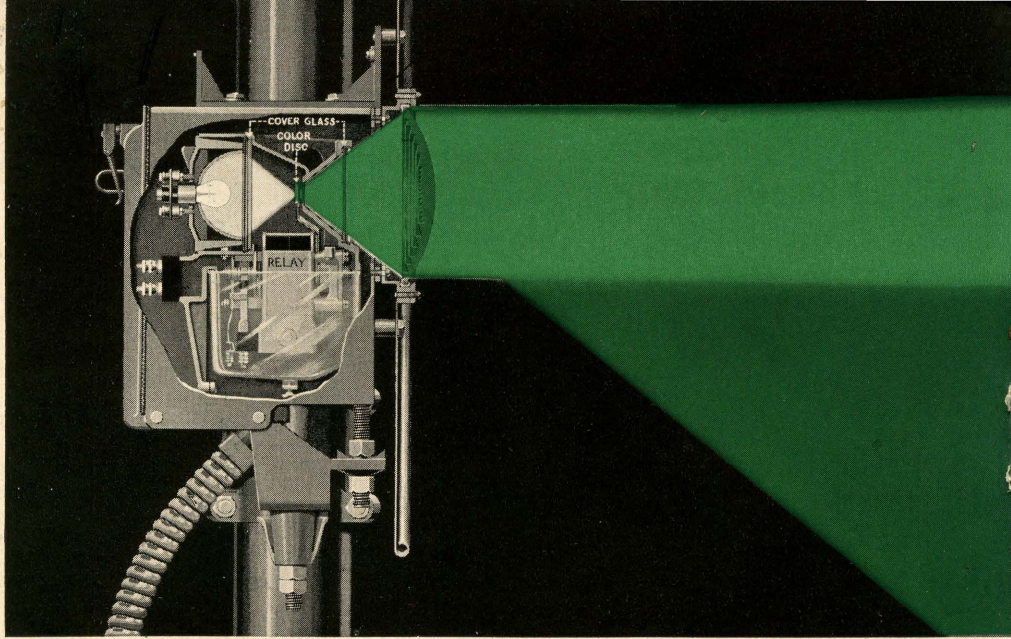


Figure 16. Optical Construction of SA Stepped Lens Signal

## THE TYPE SA SIGNAL

### OPTICAL CONSTRUCTION

**T**HE optical construction of the Type SA Signal, illustrated in Figures 16 and 17, is described as follows:—A concentrated filament lamp is placed with its filament at the focal point of an elliptical reflector which collects a large percentage of the light rays emitted from the lamp, concentrates and projects them at the second focal point of the reflector. At this second point, which is coincident with the focal point of a clear lens system, the light rays pass through a miniature color disc, fill the lens and emerge in a colored beam. Three of these miniature color discs are supported by the moving member of a three-position relay, the position of the relay determining the color of the disc through which the light passes—hence the color of the signal indication.



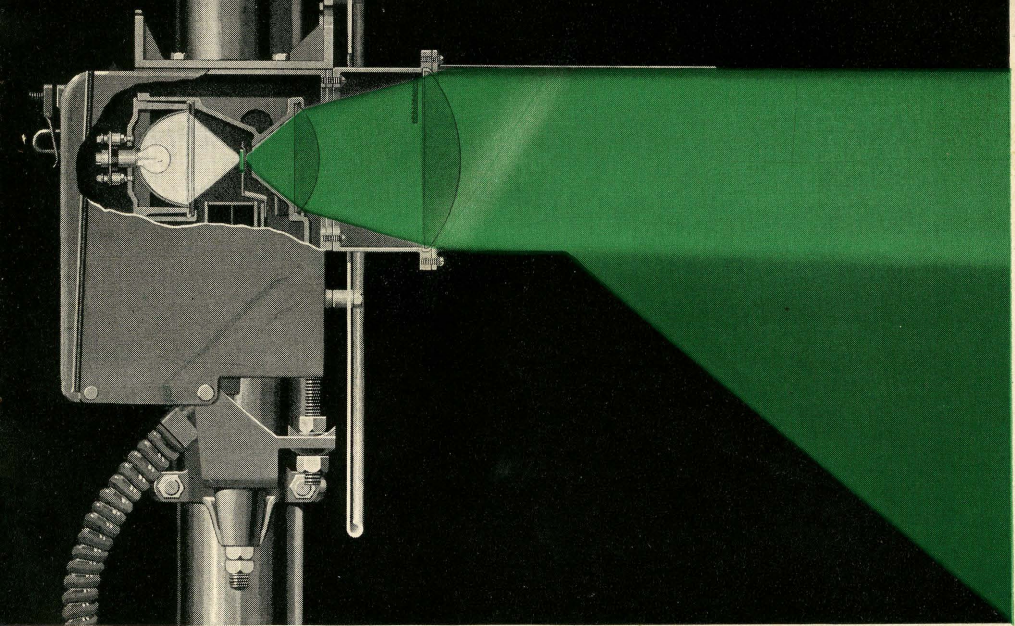


Figure 17. Optical Construction of SA Compound Lens Signal

With this construction, approximately 80 per cent of the light emitted from the lamp is collected, which is considerably more than is collected by the optical system of any other type of color-light signal. The shape of the lamp filament has much to do with the shape and uniformity of the beam produced by any light signal. Theoretically, the light filament should give a concentrated point of light. Due to mechanical construction of filaments, a point source of light can only be approached. Therefore, the projection of a multitude of images of the lamp filament at the focal point of the lens system instead of a single concentrated filament forms a substantial source of practically solid light resulting in a beam of very uniform intensity throughout.

By using an accurately ground and polished compound lens in lieu of the Fresnel or Stepped type, the intensity of light on the axis of the beam is increased by approximately 100 per cent, while the total amount of light projected into the beam is increased approximately 20 per cent.

This development, in combination with the optical construction employed, has accomplished two noteworthy objectives:

- 1st. It has made this type of color-light signal economical for use in primary battery territory, since a 3-watt, 4-volt lamp produces an indication of 11000 beam candle power.\*
- 2nd. By using a lamp which consumes only 12 watts of energy, an indication of 37500 beam candle power\* may be produced, thus a very brilliant and powerful indication in color-light signaling becomes economically feasible.

By projecting three indications from one lens through the use of one lamp,  $\frac{2}{3}$  of the lenses and lamps otherwise required are eliminated, and there is constant check on the ability of the signal to give its most restrictive indication. The compactness obtained in the signal unit is of great advantage in locating signals where clearance is limited, and also, signal units may be located to better advantage with respect to the view of the engineer in the cab.

Practically all of the light which can enter the signal from the outside must pass through the color disc which is determining the color of the indication before it can be reflected into the beam, hence the indication produced will be the true indication of the signal.

*\*NOTE—The relation between beam candle power and range is shown by curve Figure 31.*

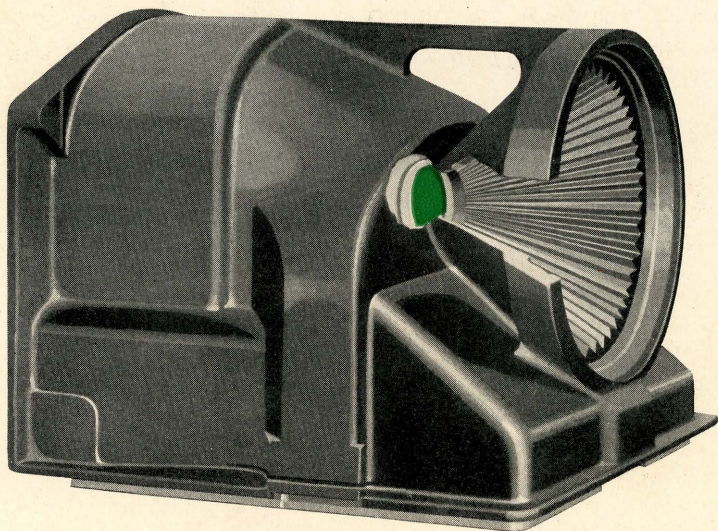


Figure 18. Serrated Cone

To preclude the possibility of reflected white light diluting the color of the indication, the cover glass for the relay case is placed well away from the focal point of the lens, so that any light reflected by the surface of the glass will be diffused and not returned to the beam. The cover glass is supported in this position by a cone which converges to the diameter of the color disc, as shown by Figure 18.

The interior surface of the cone is serrated so that any light which impinges on its surface is absorbed by internal reflection and is not returned to the beam.

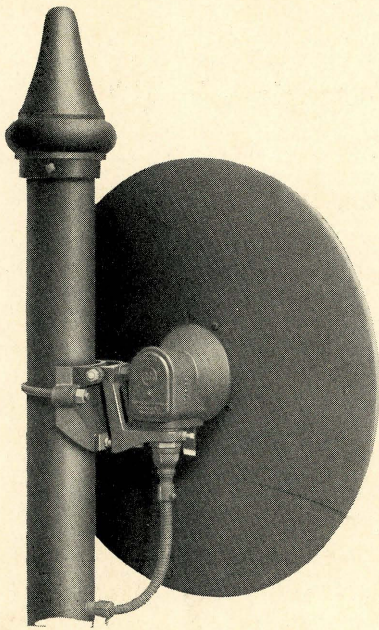


Figure 19. Type W Signal Unit

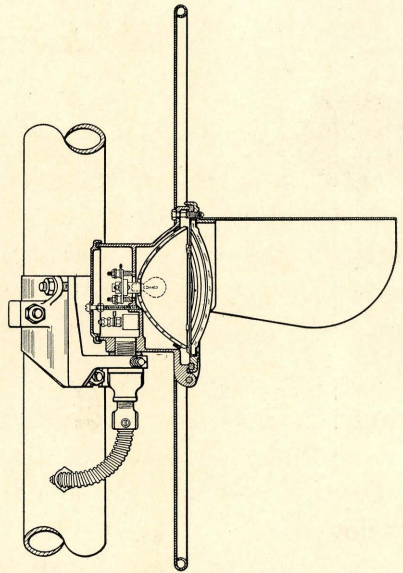


Figure 20. Sectional View

## THE TYPE W SIGNAL UNIT FOR FIXED INDICATION

**I**N PROVIDING standard aspects at interlocking plants, the fixed indication is often required. For this use the Type W Unit is available with background and mounting to match the SA Signal Unit, as shown in Figure 19. The mounting provides separate horizontal and vertical adjustments for aligning the light beam. Figure 20 is a sectional view of the Type W Unit. The bracket provides for mounting the center of the unit directly in front of the mast or 9 inches to the right or left of the center of the mast. The Type W Unit is frequently used with or without background as a vertical or staggered marker.

## LENSES AND LENS COMBINATIONS

**A**S EXPLAINED under the heading *Optical Construction*, two types of lenses are used, the Fresnel or Stepped type which has a smooth, convex outer surface with concentric circular steps on the concave inner surface, and the compound lens composed of two plano-convex lenses, each having smooth surfaces on both sides.

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. However, 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, 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.

Light may be diverted out of the main beam, for the purpose outlined, by either modifying the surface of the lens or by the use of deflecting roundels in combination with the lens. With the Fresnel type of lens both methods are employed, while with the compound lens deflecting roundels are used exclusively.

The following paragraphs describe typical lenses and lens combinations employed to meet the various track conditions usually encountered. Other combinations, not described, are available for unusual conditions. Continual development is taking place in this field of endeavor, which naturally will affect future practice in the use of lenses in color-light signaling.



Figure 21.  $8\frac{3}{8}$  inch diameter Hot-Spot Lens

## STEPPED LENSES and LENS COMBINATIONS

### HOT SPOT LENS $8\frac{3}{8}$ INCH DIAMETER

**T**HE hot-spot lens projects a light beam having approximately  $1\frac{1}{2}$  to 2 degrees spread all around the axis, and a secondary beam downward through an angle of 40 degrees from the axial center. Parallel curved prisms are moulded on the inner surface of the central portion of the lens to divert a part of the light downward. The small amount of light diverted from the main beam to produce the close-up indication does not appreciably affect the range, yet the close-up indication given by the secondary beam is good throughout the 40 degree angle.

In most cases 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.

Figure 21 shows a view of the light beam produced by an  $8\frac{3}{8}$  inch diameter hot-spot lens.

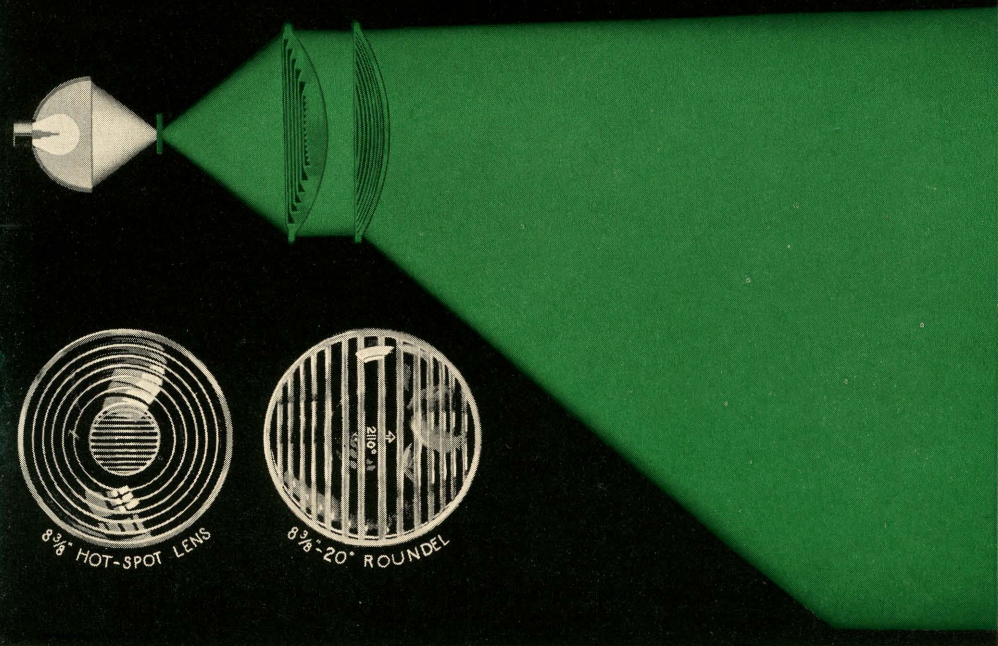


Figure 22.  $8\frac{3}{8}$  inch diameter Lens in combination with 20 degree Deflecting Roundel

## 20 DEGREE DEFLECTING ROUNDDEL ● ●

### $8\frac{3}{8}$ INCH DIAMETER

**T**HIS 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 degrees.

To deflect the beam to the right or left, position the roundel so that the arrow moulded on the inside surface points in the direction desired. This roundel is for use on average curves.

Figure 22 shows the light beam produced when the  $8\frac{3}{8}$  inch diameter hot-spot lens is used in combination with the  $8\frac{3}{8}$  inch diameter roundel. This combination spreads the light over six times the original area which causes approximately 70 per cent reduction in the maximum candle power, which means a reduction in range\* of approximately 45 per cent.

\*NOTE—The relation between beam candle power and range is given by curve Figure 31.

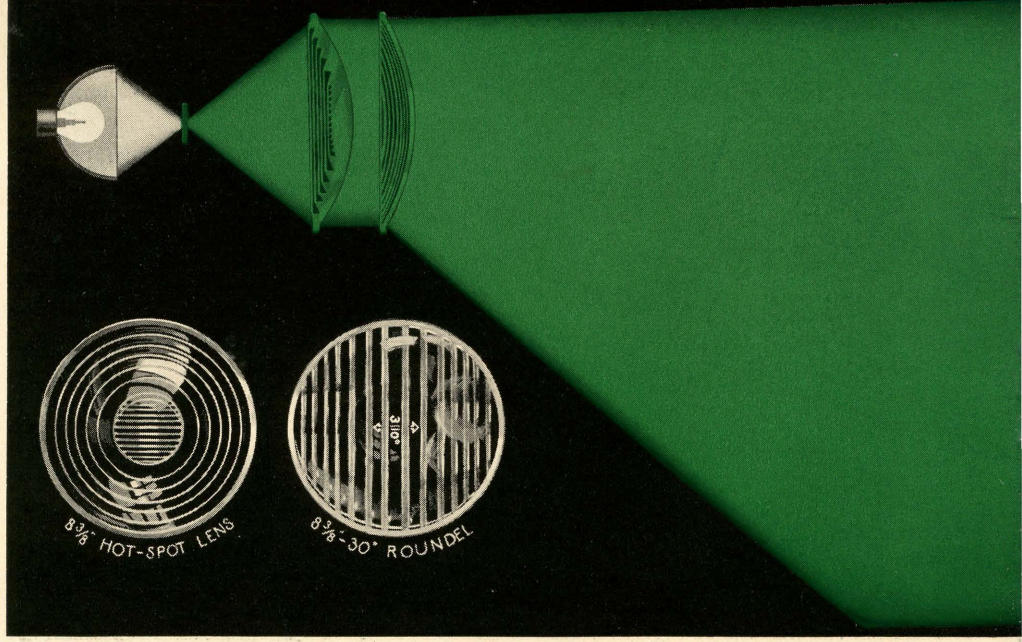


Figure 23.  $8\frac{3}{8}$  inch diameter Hot-Spot Lens in combination with 30 degree Spredlite Roundel

## 30 DEGREE SPREDLITE ROUNDEL

### $8\frac{3}{8}$ INCH DIAMETER

**T**HE 30 degree Spredlite Roundel, as shown in Figure 23 for the  $8\frac{3}{8}$  inch hot-spot lens, is similar to the 20 degree 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 degrees to each side of the axis, giving a total spread of 30 degrees. It should not be employed except on reverse curves or severe curves, since it reduces the beam candle power approximately 90 per cent which means a reduction in the range of the signal of approximately 65 per cent.



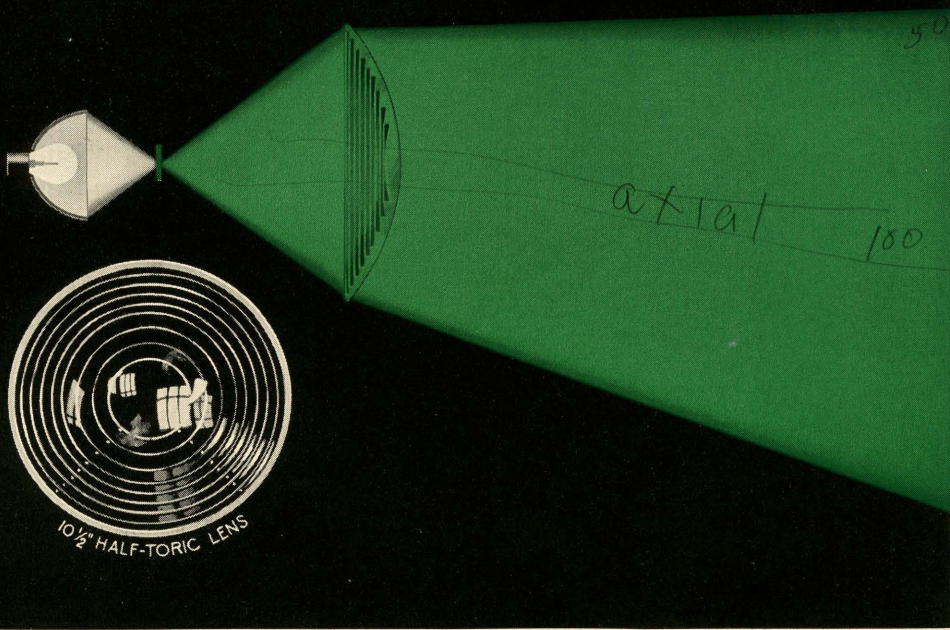


Figure 24. 10½ inch diameter Half-Toric Lens

## HALF-TORIC LENS

10½ INCH DIAMETER, 6 INCH FOCAL LENGTH

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 degrees. 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 degree 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 degrees. The main beam has a spread of approximately 3 degrees. The half-toric lens is regularly employed on tangent track where the larger size (10½ inch diameter) lenses are used.

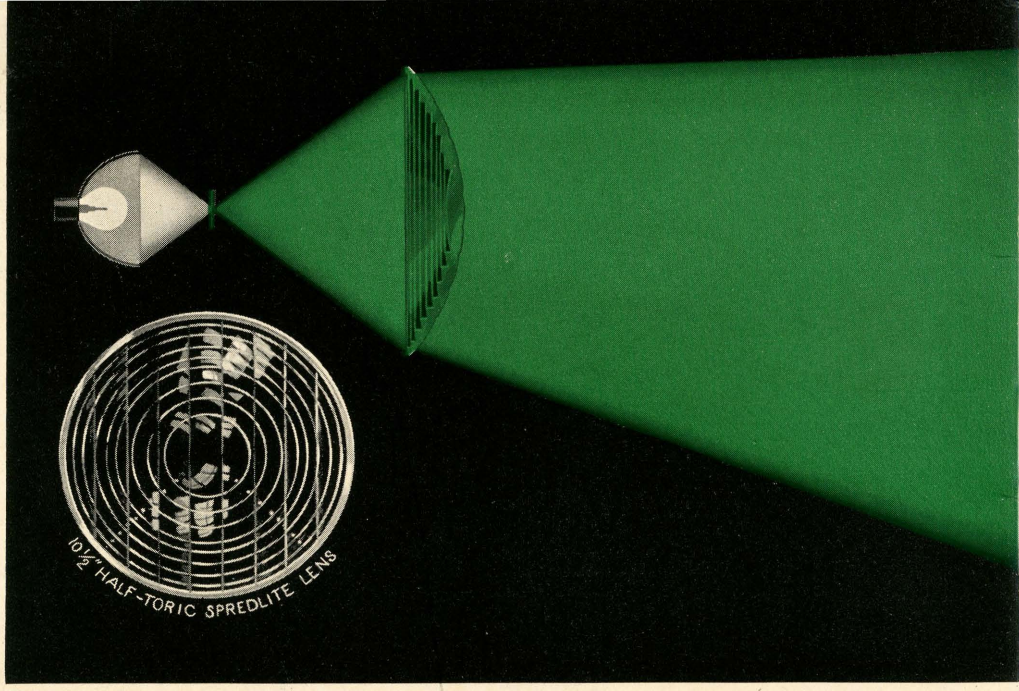


Figure 25.  $10\frac{1}{2}$  inch diameter Half-Toric Spredlite Lens

## HALF-TORIC SPREDLITE LENS

$10\frac{1}{2}$  INCH DIAMETER, 6 INCH FOCAL LENGTH

**T**HIS is the half-toric lens, as described under Figure 24, modified by a fluted surface on the convex side arranged to spread the main beam through an angle of approximately 6 degrees to each side of the axis, giving a total spread of approximately 12 degrees. The half-toric sector of the lens gives the 20 degree downward spread as before, and is used on curved track. It reduces the range of the signal approximately 40 per cent.

# THE COMPOUND LENS AND LENS COMBINATIONS

**T**HE compound lens comprises two plano-convex lenses, an inner lens  $4\frac{1}{2}$  inches in diameter and an outer lens  $8\frac{3}{8}$  inches in diameter, the focal length of the combination being  $2\frac{3}{8}$  inches. While this lens projects 20 per cent more light into the beam than the Fresnel (stepped) lens, as explained under *Optical Construction*, its great advantage is due to the more accurate control of the light, thereby increasing the intensity in the center of the beam by 100 per cent. The indication produced by the compound lens with a 3-watt, 4-volt lamp has a beam candle power of 11000\* which is sufficient for ordinary use, while a 5-watt, 10-volt lamp produces an indication having a beam candle power of 19000\*.

The close-up indication is produced by mounting a small  $2\frac{1}{4}$  inch diameter deflecting roundel between the inner and outer lenses, as shown by Figures 26 and 27. The secondary beam has very little lateral spread, extends downward through an angle of 40 degrees from the axis of the beam, and is very similar to the secondary beam of the hot-spot lens. By removing a small plate on the top of the adapter which supports the outer lens, the deflecting roundel may be turned in its mounting so that the secondary beam can be directed downward or at an angle across the track, where this is desirable.

\*NOTE—The relation between beam candle power and approximate range is given by curve Figure 31.

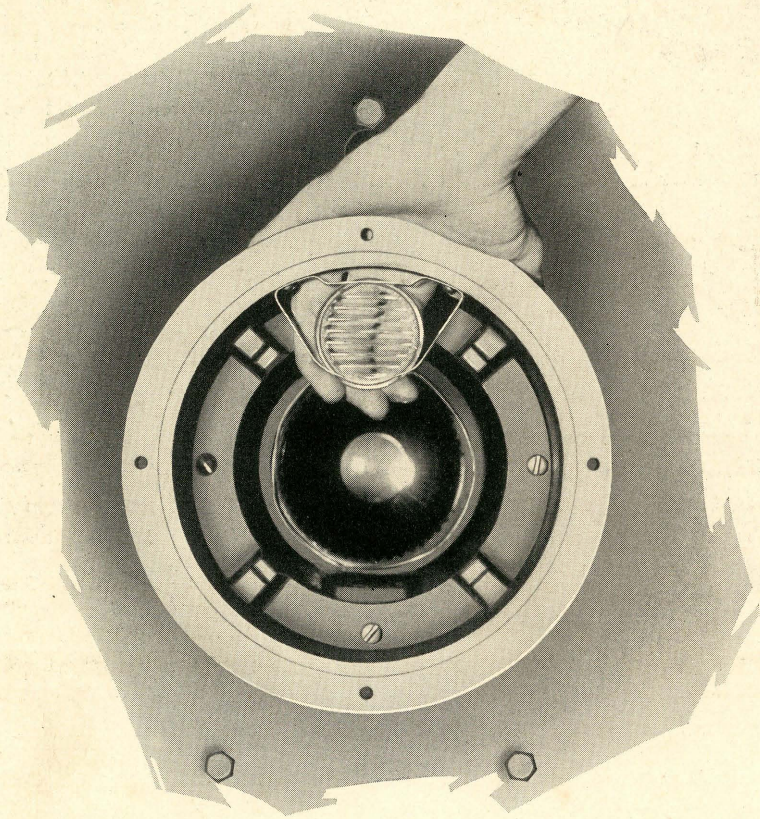


Figure 26.  $2\frac{1}{4}$  inch Deflecting Roundel and method of adjusting

Figure 26 shows the front of the signal with the outer lens removed to show the mounting of small deflecting roundel and method of rotating. The advantage of being able to adjust the secondary beam to meet the requirements of the location without disturbing the lens mounting is a desirable feature.

Figure 27 illustrates the optical arrangement using the compound lens and shows the side view of the light beam.

The same deflecting roundels are employed with the compound lens as have already been described and illustrated with the hot-spot lens. The 20 degree deflecting roundel spreads the light over an area  $6\frac{2}{3}$  times as great as the beam produced by the lens without the roundel, while the 30 degree spreadlite roundel increases

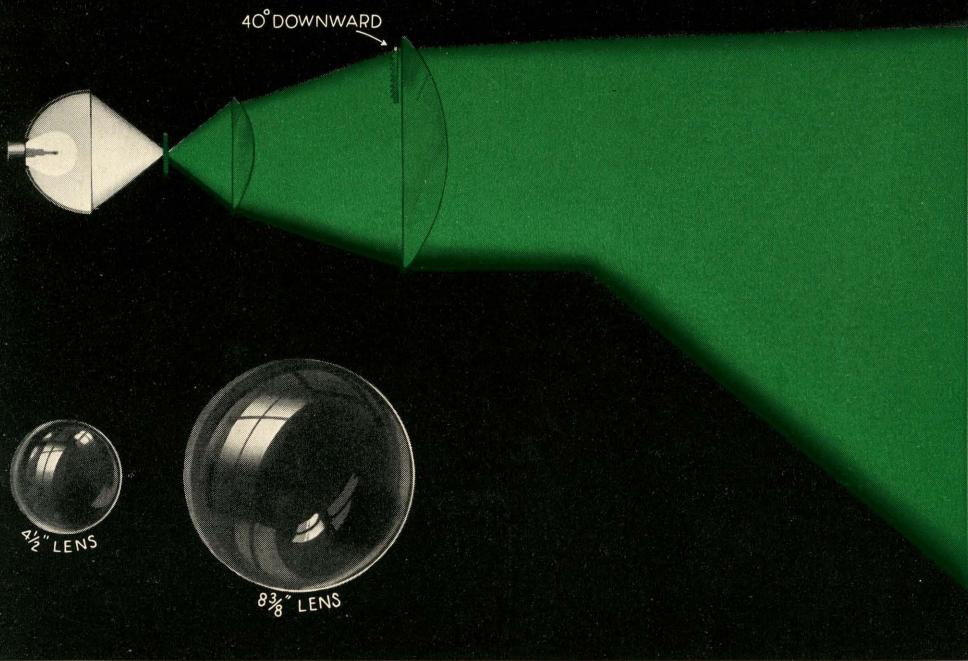


Figure 27.  $8\frac{3}{8}$  inch diameter Compound Lens

the area covered by the beam 10 times, consequently the intensity of light or beam candle power is greatly reduced. With the compound lens the per cent reduction in beam candle power is slightly greater than given for the stepped lens due to the greater concentration of light at the center of the beam. However, since the compound lens actually transmits 20 per cent more light into the beam it provides a means of improving the signal indication on curves. For example, the combination, including a 5-watt, 10-volt lamp, a compound lens and a 20 degree deflecting roundel gives an indication having a beam candle power of 4000 which means a range of 2830 feet. This is more than ample for average curves.

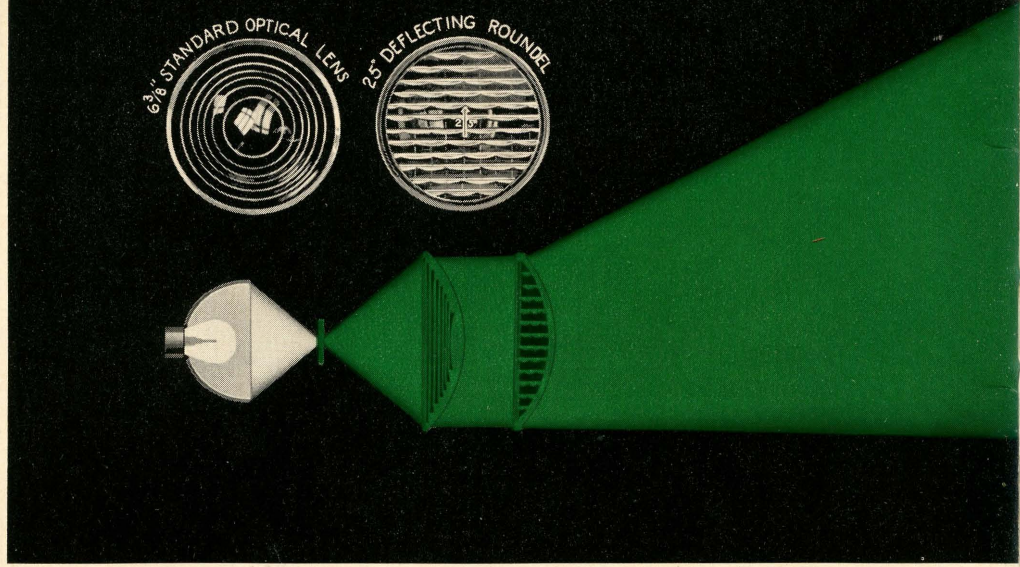


Figure 28.  $6\frac{3}{8}$  inch Dwarf Signal Stepped Lens with 25 degree Deflecting Roundel

## DWARF SIGNAL LENSES

**D**WARF signals may be equipped with the  $8\frac{3}{8}$  inch diameter lenses and deflecting roundels previously described, or they may use the  $6\frac{3}{8}$  inch diameter Stepped Optical Fresnel Type of lens with  $6\frac{3}{8}$  inch diameter deflecting roundel, as shown in Figure 28. The Stepped optical lens gives a conical beam having approximately  $1\frac{1}{2}$  degree spread around the axis and the deflecting roundel, which is mounted in front of the lens by means of an adapter, deflects a part of the main beam upward at an angle of 25 degrees for the close-up indication. In some cases it is beneficial to rotate the roundel to project the beam at an angle across the track as well as upward. Figure 28 shows the side view of the beam produced by the  $6\frac{3}{8}$  inch diameter lens combinations.

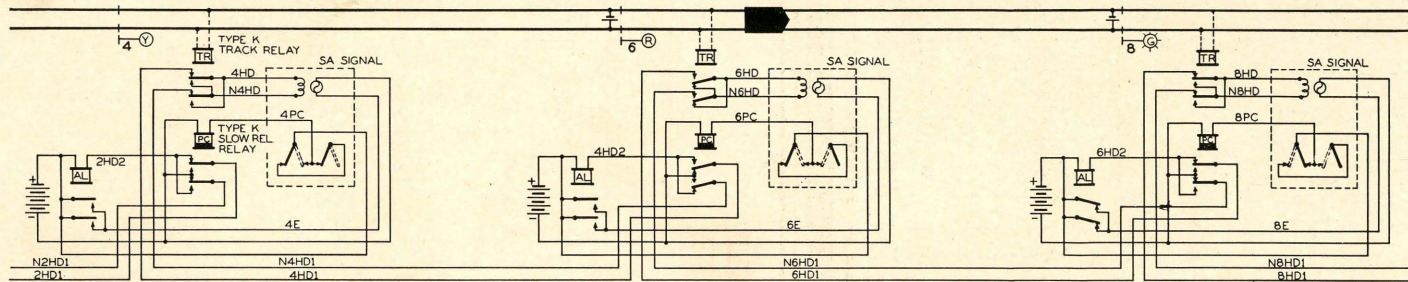


Figure 29. A modern double-track automatic block circuit. All signal relay mechanisms are in correct position, but signals are approach-lighted

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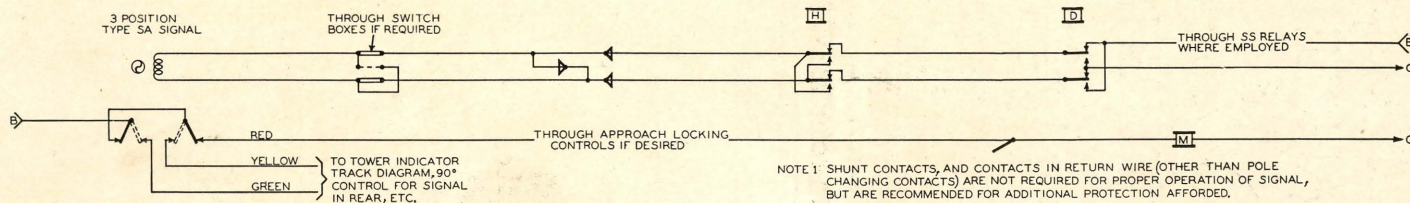


Figure 30. A typical circuit for interlocking control of SA Signals

# RELATION BETWEEN BEAM CANDLE POWER and RANGE

**A**S APPLIED in this bulletin, beam candle power is the measure of the maximum light intensity in a beam of light by comparison with the standard candle. Beam candle power can be accurately determined in the photometric laboratory and, for a given lamp and lens combination, becomes a definitely known quantity.

As applied to light signals, range is usually understood to mean the distance on a tangent, in bright sunlight, at which the indications are clear and distinct to a person of average eyesight. Unless the range can be expressed in terms which will be equivalent to some known quantity, for example beam candle power, and accepted generally, it is a very unsatisfactory means of drawing comparisons between different types of signals and various lamp and lens combinations.

An empirical formula, namely:— $\text{Range} = \sqrt{2000 \times \text{B.C.P}}$  has been found to work out very satisfactorily as a means of expressing beam candle power in terms of range in feet. The formula is based on visibility in bright sunlight using the green indication. Red gives about the same visibility and yellow somewhat better. The formula does not apply to purple.

The range of the Type SA Signal for any known beam candle power may be quickly ascertained by referring to the curve on the opposite page which has been plotted from calculations using the above formula. Beam candle power was accurately measured in our photometric laboratory and averages used which were the result of a number of tests. In making the measurements, beams of white light were used, the color disc being omitted, since the formula takes care of the transmission factor through color.



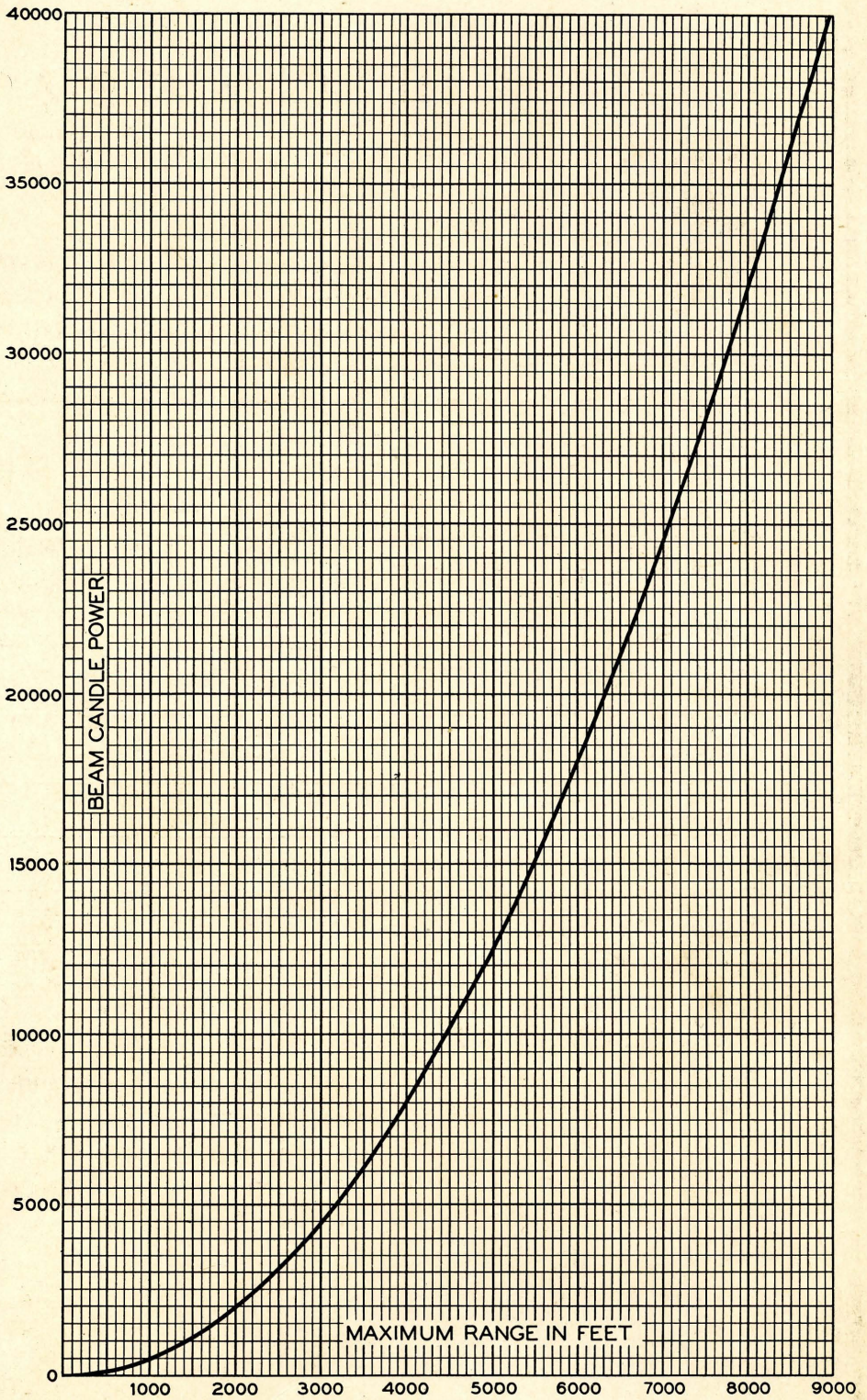


Figure 31. Curve showing relation between Beam Candle Power and Maximum Range

# INCANDESCENT LAMPS

**T**HE following table gives the 1000-hour ratings, service ratings and other information relative to the lamps which are available for use with Type SA Color-Light Signals. The lamps are the precision, 2-pin, candelabra bayonet base type. The higher wattage lamps produce beams of high candle power even when burned at the recommended reduced voltage, thereby obtaining average life well in excess of 1000-hours. The lower wattage lamps cannot be burned under their 1000-hour average life rating without seriously reducing the beam candle power of the indication produced. We recommend that the voltage be maintained very close to the rated voltage when the 3 and 5-watt lamps are used.

As with lenses, there is a continual development taking place in the production of incandescent lamps for color-light signals which will undoubtedly affect future practices.

Lamps	Volts	Watts	B.C.P. 8 3/8" Stepped Lens	B.C.P. 8 3/8" Compound Lens	Drawing Number
1000-hr. Rating Service Rating	11.3 10.0	14.4 11.9	17500	37500	34866-32
1000-hr. Rating Service Rating	9.0 8.0	15.3 12.8	16000	34000	34866-34
1000-hr. Rating Service Rating	4.0 4.0	3.0 3.0	Not Recommended	11000	34866-35
1000-hr. Rating Service Rating	10.0 10.0	5.0 5.0	Not Recommended	19000	34866-38

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.

NOTE—In order to maintain uniformity in rating, all lamps are factory rated and marked on a basis of 1000-hours average burning life. These lamps should be burned at the voltage recommended under "Service Rating."

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