

Type SC
COLOR-LIGHT
SIGNAL



DESCRIPTION
OPERATION
INSTALLATION
MAINTENANCE

HANDBOOK 23

GENERAL RAILWAY SIGNAL COMPANY

L. W. W. W.

11/18/76.

Type SC
COLOR-LIGHT
SIGNAL

Searchlight Type

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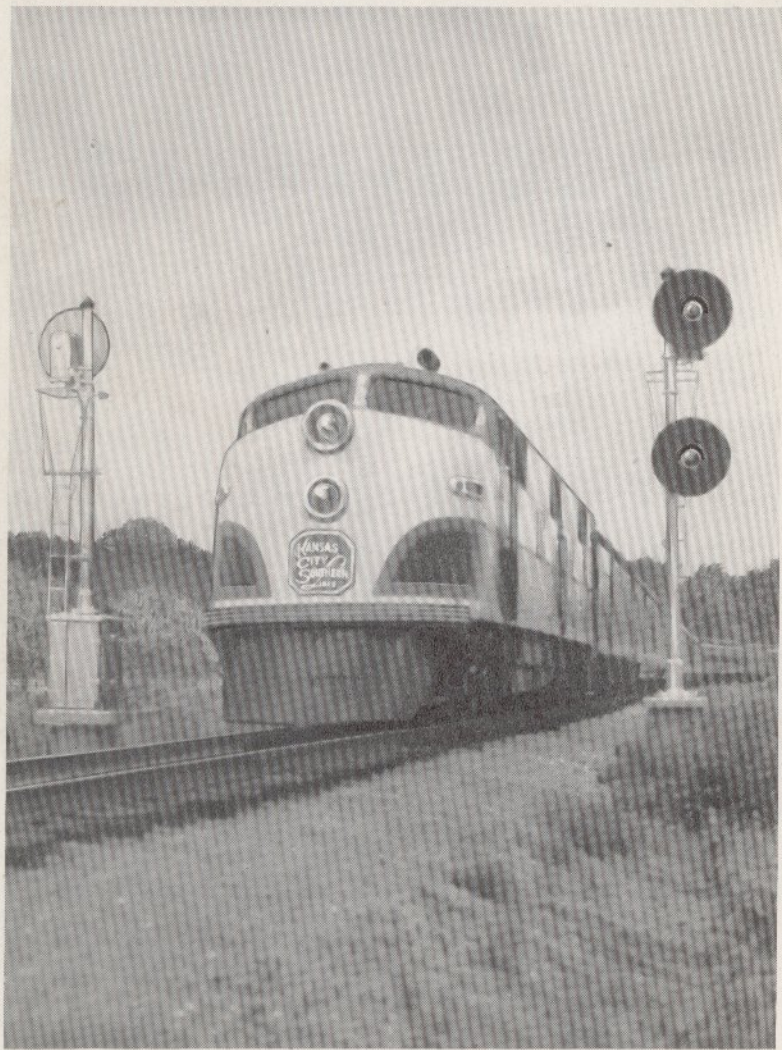
HANDBOOK 23

September 1946



GENERAL RAILWAY SIGNAL COMPANY

ROCHESTER 2, N. Y., U. S. A.



Type SC signals on the Kansas City Southern Lines.

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Side view of Type SC signal mounted on side of mast with resilient mounting bracket.

INTRODUCTION

The object of this handbook is to explain the general features and operation of the Type SC color-light signal, and to give instructions for its installation and maintenance.

GENERAL DESCRIPTION

The Type SC signal, Figure 1, is a color-light signal with one optical system through which are projected three color aspects. The signal has two principal parts:

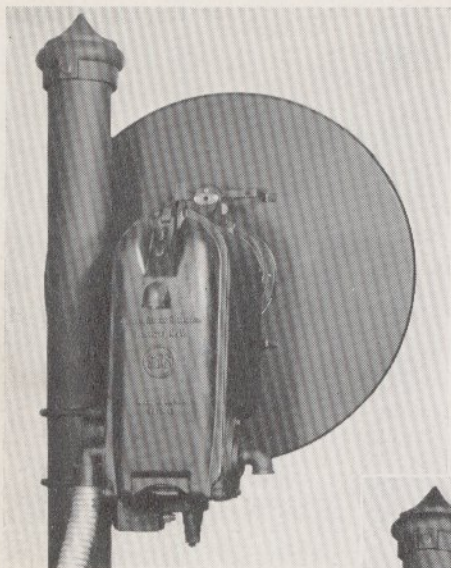
1. The signal housing, which is bolted to a signal mast or bridge as a high signal or to a foundation as a dwarf signal.
2. The signal mechanism, which can be removed from the housing. The mechanisms are interchangeable with other mechanisms bearing the same circuit number on the name plate.

A. The Signal Housing

The signal housing, Figure 1, protects the mechanism and provides facilities for terminating the field wires. It carries a plugboard, terminal board, outer lens and deflecting roundels, and the various fittings for high or dwarf use.

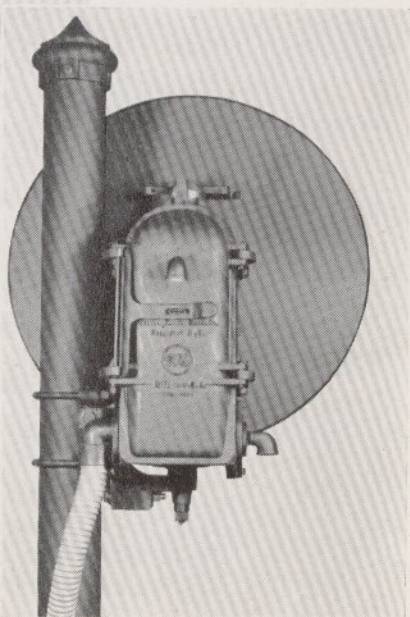
As shown in Figure 1, the housing is equipped for side-of-mast mounting. Other mounting brackets are furnished for top-of-mast, bridge, or dwarf mounting. See under "Installation and Maintenance". All Type SC operative signals are resiliently mounted.

Housings are available with the door hinged at the bottom, as shown in Figure 2a, or with the door hinged at the side, as shown in Figure 2b. Hinge and latch fittings on the side-opening door may be trans-



a. Rear view shows bottom-hinged housing door.

b. Type SC signal equipped with side-hinged housing door. Hinges and latch fittings may be transposed to have door left-hand or right-hand opening as desired.



posed in the field to make the door either right-hand or left-hand opening, as desired.

When used as a dwarf signal, the signal is furnished without the black background and the sighting device (on top).

Overall dimensions of the housing alone (without the sighting device) are:

Height (including mounting stud) 29 inches

Width (measured at lens bezel ring) 10 inches

Depth (compound lens, less hood and ventilator) $21\frac{1}{2}$ inches.

Weight (with sighting device and compound lens, but without mechanism, hood, background, and mounting bracket) 137 pounds.

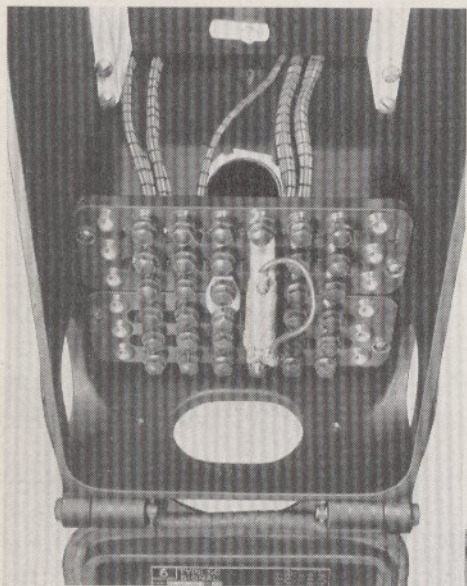
The background is 35 inches in diameter; the hood is 12 inches long for high signals; $6\frac{1}{2}$ inches long for dwarf signals.

The door of the housing, when opened, describes an arc having a clearance radius of $23\frac{1}{2}$ inches (bottom-hinge type) and $11\frac{1}{2}$ inches (side-hinge type).

Several options are available on couplings, both for flexible conduit and parkway cable. A flexible conduit coupling is shown in Figure 2 bolted to the side of the housing. Others are shown in Figure 27, and are discussed more fully under "Installation and Maintenance," page 44. The couplings are threaded to take 2-inch flexible conduit. The mast couplings for 2-inch conduit or parkway, are furnished for either clamping to or screwing into the mast.

Four wire inlets, Figure 3a, are available—on the bottom, sides and the 45-degree slope near the bottom of the housing. The last is furnished only on top-of-mast housings.

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a. Four wire inlets are available. Inlet shown just above terminal board is supplied only in top-of-mast housing.

b. Interior of housing with mechanism removed showing terminal board with adjustable lamp resistor and lighting arrester, track on which mechanism slides, leaf springs which lock mechanism in place, and plugboard. Circles on plugboard locate raised pads against which the mechanism plugboard bears.

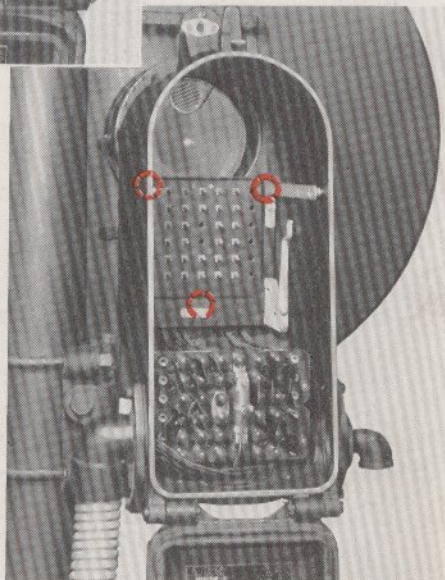


Figure 3

The rear view of the housing with the door open, Figure 3b shows (from top to bottom), the 40-degree deflecting close-up roundel, the outer lens, the plugboard, the tracks on which the mechanism slides, the terminal board, the wire inlets, and lower ventilator. The sighting device with the crossed hair-lines is bolted to the top of the case.

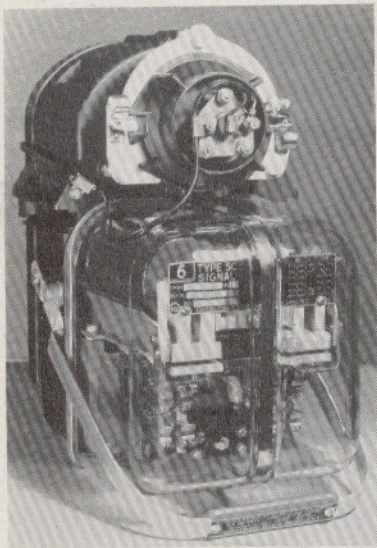
In the compound-lens signal a small 40-degree deflecting roundel is provided inside the housing to deflect a portion of the main beam of light downward (or upward for dwarf signals) at 40 degrees so that enginemen may see the signal aspect if stopped at the signal. The roundel is adjustable through a hand hole provided in the lens barrel.

The plugboard is bolted to the housing and consists essentially of one piece of molded plastic with contact plugs protruding at right angles from the surface against which the mechanism seats. On this surface there are three molded pads (encircled in Figure 3b) which butt against the mechanism plugboard to insure accurate positioning in the housing. See Figure 6, page 14.

Supported in slots near the top of the plugboard at one end and attached to the sides of the housing at the other are the two tracks on which the mechanism slides. Below these tracks are the long leaf springs which hold the mechanism tight against the plugboard when the carrying handle is in the "locked" position.

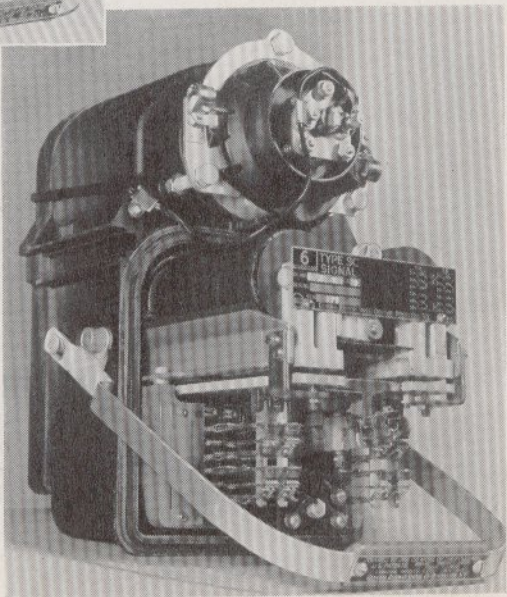
The plugboard is positioned with a master mechanism and locked in the housing before leaving the factory. This insures that mechanisms shall be interchangeable, yet give equal optical performance.

The plugboard in the housing is permanently



a. Mechanism, contact end.

b. Mechanism with glass cover removed, contact end.



wired to the terminal board. As shown in Figure 3b, space is provided for two terminal boards so that ample terminal space is available. Some mechanisms require only one terminal board, as they are furnished with fewer contacts.

An adjustable lamp resistor is mounted on the terminal board. On polar-neutral mechanisms, the terminal board is also provided with a replaceable carborundum shunt gap arrester, which is connected across the windings of the mechanism. All terminals have insulated heads for protection against short circuits. They fit standard $\frac{1}{2}$ -inch wrenches. Fittings for various mountings are described under "Installation and Maintenance." Horizontal and vertical adjustments are provided for all signals so that the beam can be directed as required.

B. The Mechanism

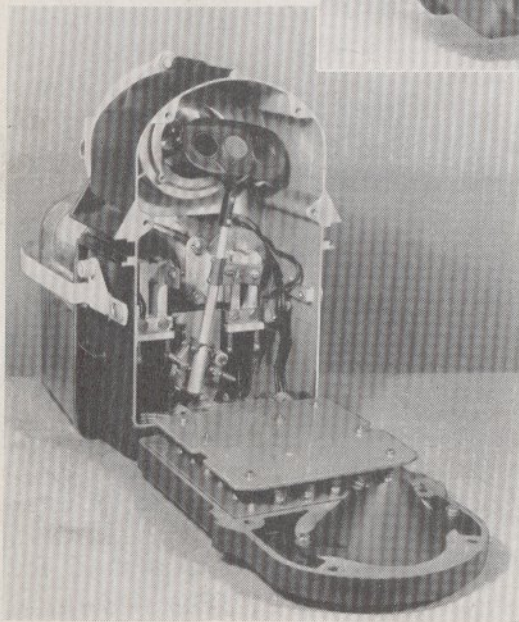
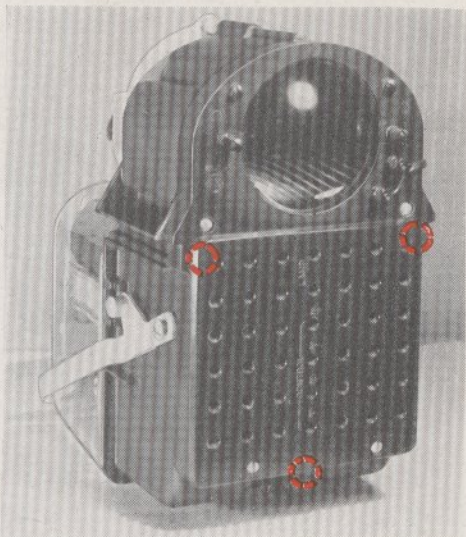
The mechanism, Figure 4, consists of two relays with horizontal tractive armatures which operate contacts below them. The contacts and the relay windings are permanently wired to a plugboard on the front of the mechanism.

A beam carrying the three colored discs is actuated by the movement of the armatures, thus controlling the aspect of the signal (Figure 11, page 23).

All the working parts are totally enclosed against dust and mechanical injury; contacts, air gaps, etc. are visible through the glass case.

The mechanism also carries parts of the optical system, such as the reflector and an inner lens or plain cover glass. Figure 4a shows the reflector unit, the two relays enclosed in the gasketed glass case, and the carrying handle, which is also used for locking the mechanism in the housing. Figure 4b

a. Mechanism, plug-board end. Circles locate pads against which pads on housing plug-board bear.



b. Mechanism with plugboard removed to show interior.

Figure 5

shows the mechanism with glass cover removed to give a clearer view of the contact structure.

The overall dimensions of the mechanism are:

Height $14\frac{3}{4}$ inches

Width $8\frac{1}{2}$ inches

Depth (exclusive of the handle) . . . $12\frac{1}{4}$ inches

The polar-neutral mechanism weighs approximately 45 pounds. The neutral-neutral mechanism weighs approximately 42 pounds.

Figure 5a shows the "inner" lens of the compound-lens signal. When a stepped-lens signal is specified, this inner lens is omitted and a plain cover glass substituted.

The plugboard and lens frame are made of one piece of molded plastic. This plugboard is the receptacle portion of the complete coupler. The plug portion, part of the housing, is described on page 9.

Three molded pads or raised surfaces on the plug portion of the coupler, Figure 3b, touch at three points (shown encircled in Figure 5a) on the receptacle portion to insure accurate positioning of the mechanism in its case.

The plugboard presents a smooth surface. It is screwed to the metal frame to protect the interior of the mechanism, and is sealed to prevent unauthorized opening. By removing the plugboard, the front of the relays and the spectacle are exposed, Figure 5b.

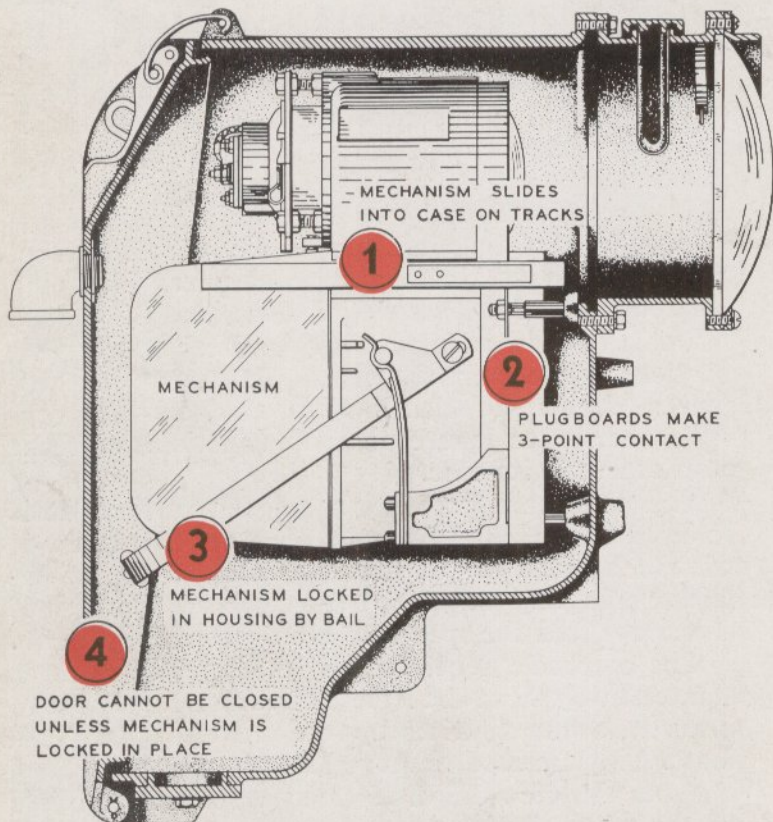
The spectacle, where it carries the color discs, is slanted away from the lens. The reason for this is to prevent beam dilution by extraneous light. This feature is described on page 19.

From this view, Figure 5b, can be seen the bearings of the relay armatures. These bearings are long, needle-shaped roller bearings under several pounds

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pressure. They have been adopted after successful operation in such constantly moving parts as armatures of code-responsive relays used in coded track circuits.

Wires showing are from the relay windings and contacts. They are permanently connected to the



Mechanism is accurately positioned, insuring optical precision.

Figure 6

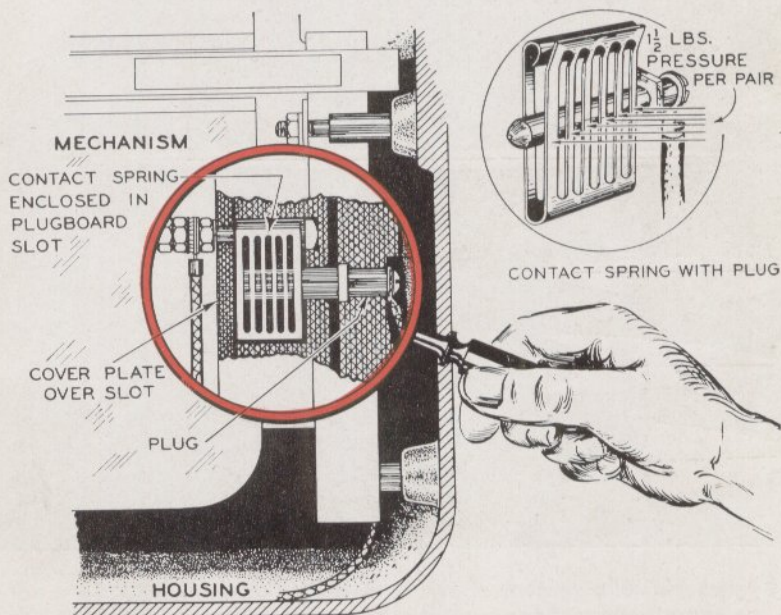
back of the plugboard, which encloses the contact springs shown in Figure 7.

C. The Plug-in Feature

The plug-coupling feature is standard on all Type SC mechanisms. With this feature faster, simpler change-outs are possible. Inserting the mechanism is described on page 46.

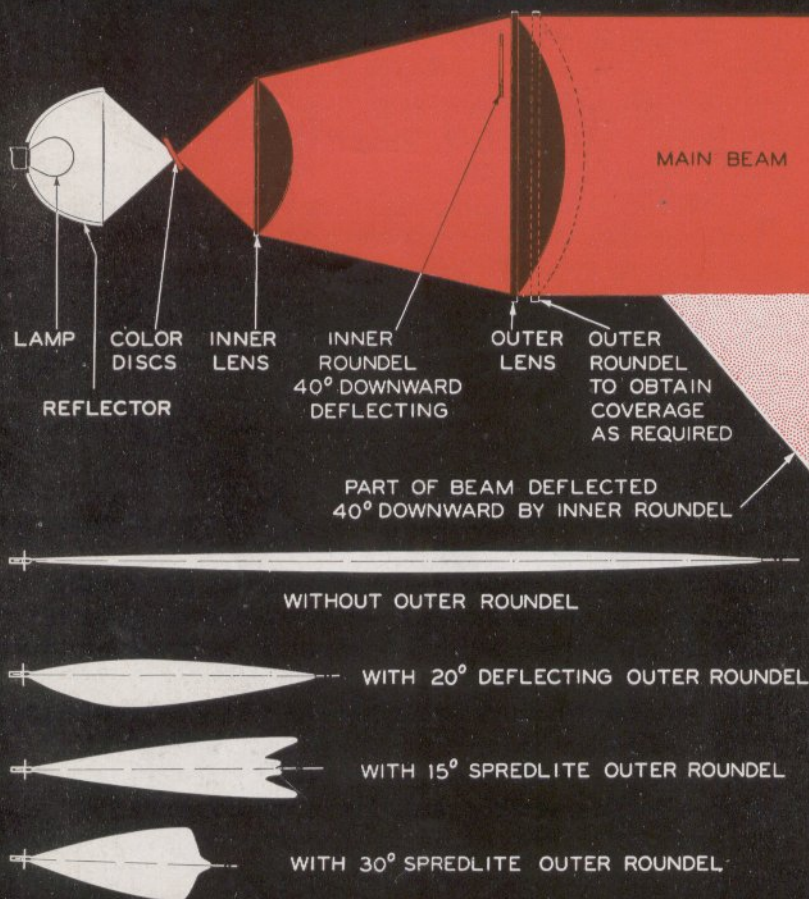
To insure positive, low-resistance contacts in the coupler and to make it easy to pull the plugboards apart, a new type of plug contact was devised. See Figure 7.

A typical receptacle in the mechanism plugboard consists of a beryllium-copper spring, shaped as in Fig-



There is twelve-point contact between plug and spring.

Figure 7



Compound lens system showing beam coverages with different lens combinations. Lens system shown viewed from side of signal; beam coverages shown looking down on track.

Figure 8

ure 7, bolted to a cover plate. The spring lies in a narrow slot in the plugboard.

The spring has slotted sides. Slotting has the effect of dividing the spring into several similar springs, each one gripping the plug in a different place with a pressure of approximately $1\frac{1}{2}$ lbs., as shown.

D. The Optical System

The optical system of the compound-lens signal, Figure 8, consists of:

1. The lamp.
2. The reflector unit.
3. Color discs: red, yellow, green, or any other standard signal color.
4. The inner lens.
5. The outer lens.

Spreader and deflector roundels are added as required to shape the beam to the topography of the railroad. See Figures 8 and 9.

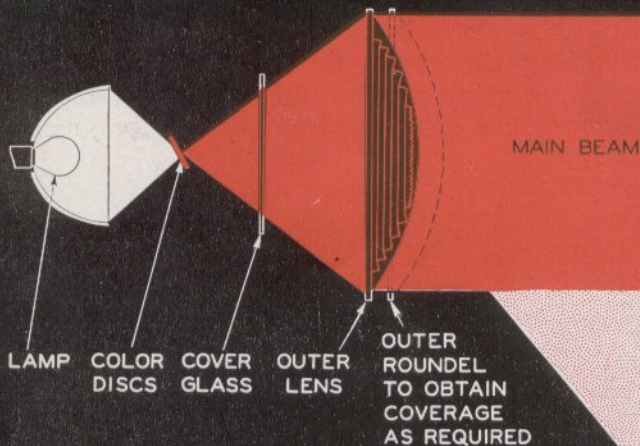
The stepped-lens signal, Figure 9, has the same units in the optical system, with the exception of the inner lens, which is replaced by a plain cover glass. The solid outer lens is replaced by a stepped lens. Outer lenses are $8\frac{3}{8}$ inches in diameter.

The plugboard in the housing is adjusted in the factory so that the inner lens or cover glass is at the proper distance from the outer lens to produce a parallel beam from the signal.

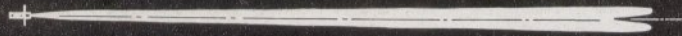
E. Lens Systems

Two basic lens systems are available:

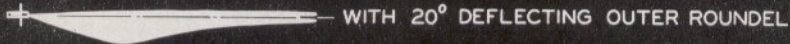
1. The compound-lens system, consisting of two plano-convex lenses, having smooth surfaces on both sides, Figure 8.
2. The stepped-lens system, consisting of a single



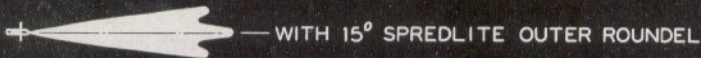
PART OF BEAM DEFLECTED
40° DOWNWARD BY CENTER
PORTION OF OUTER ROUNDL



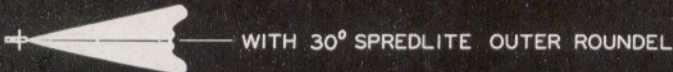
WITHOUT OUTER ROUNDL



WITH 20° DEFLECTING OUTER ROUNDL



WITH 15° SPREDLITE OUTER ROUNDL



WITH 30° SPREDLITE OUTER ROUNDL

Stepped lens system showing beam coverages with different lens combinations. Lens system shown viewed from side of signal; beam coverages shown looking down on track.

lens, which has a smooth, convex outer surface and concentric circular steps on the concave inner surface, Figure 9.

With the same wattage lamp the compound-lens system gives a beam of longer range. It is particularly effective for primary-battery operation, for which 8- or 10-volt, 5-watt lamps are available. This lens system is also frequently used with higher voltage lamps on storage battery supply.

Outer roundels are added as required to spread the beam to suit the curvature of the tracks.

The compound-lens system is provided with a small inner roundel which deflects a part of the main beam 40 degrees downward (upward for dwarf signals) for close-up aspects. The stepped lens has a modified center which does the same thing.

F. Why the Color Discs Are Slanted

It has been found that under certain conditions the signal light has been diluted by the light from the approaching engine's headlight. To create this condition it was necessary to have the headlight, signal, and the engineman's eyes on the same level.

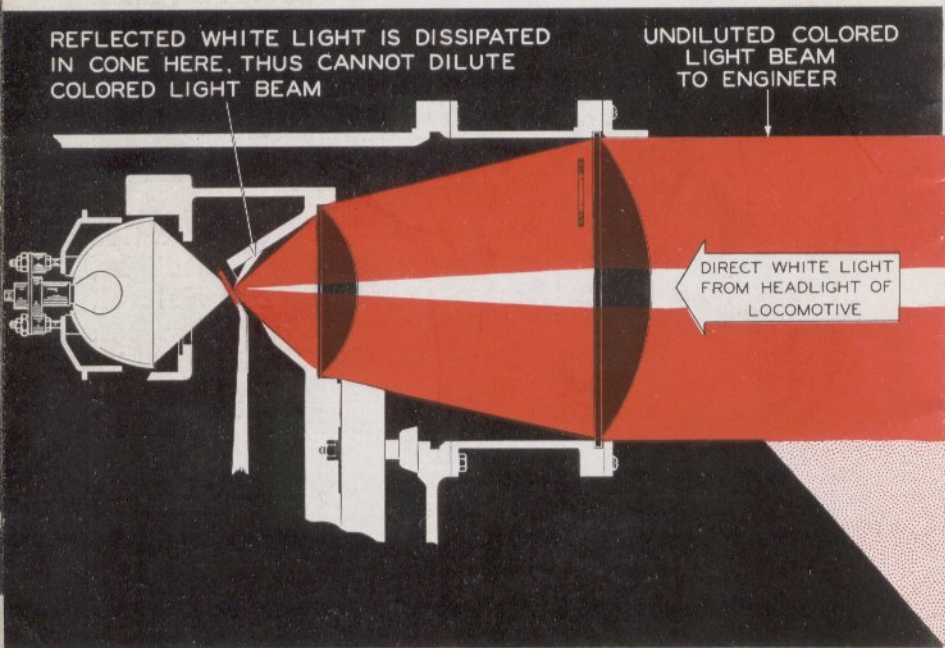
This dilution created a weaker, paler aspect. Laboratory experiments proved that the direct white light from the headlight of a locomotive was concentrated on the mirror-like surface of the vertical color discs and was reflected to the engineman, mixed in with the signal beam, thus diluting the color.

In the SC signal the color discs are slanted away from the vertical so that extraneous light is now reflected upwards and into the serrated cone where it is absorbed. Thus the undiluted color beam is transmitted from the signal, Figure 10.

G. Mechanical Operation

The two relays in the mechanism are mounted side by side and have tractive armatures which are pivoted at the plugboard end of the mechanism and can be furnished for operation on polar or neutral line circuits.

The horizontal spectacle beam, which carries the spectacle and color discs, is supported on needle bearings and is free to rotate in a clockwise direction (as viewed when facing the mechanism contacts) when changing the aspects from RED to YELLOW to GREEN.



The color discs are slanted to eliminate dilution of the color beams.

Figure 10

The mechanical details of the action which moves the spectacle may be easily followed by referring to Figure 11, page 23.

The following should be borne in mind:

1. In the polar-neutral relay arrangement, the HG (YELLOW) relay will pick up on energization at either polarity. The DG (GREEN) relay will pick up on energization only at the polarity predetermined to give the green aspect.
2. In the neutral-neutral relay arrangement, the control of the DG (GREEN) relay is broken through front contacts of the HG (YELLOW) relay. In this way, a green aspect cannot be displayed unless the HG relay is energized.

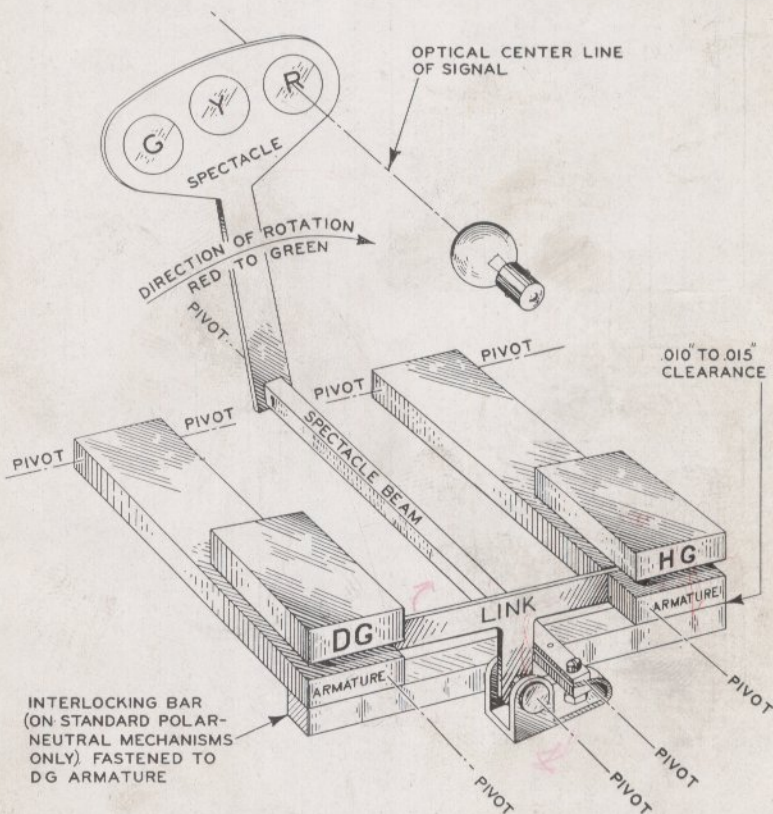
When the HG ARMATURE is picked up, one end of the LINK is raised, imparting a clockwise rotating motion to the SPECTACLE BEAM and moving the SPECTACLE far enough to the right to place the YELLOW color disc on the optical centerline of the signal, squarely in front of the lamp.

When the DG ARMATURE is picked up, the opposite end of the LINK is raised, imparting a further clockwise rotating motion to the SPECTACLE BEAM, moving the SPECTACLE further to the right to place the GREEN color disc on the centerline of the signal, squarely in front of the lamp.

If the DG ARMATURE drops away, and HG ARMATURE remains picked up, the SPECTACLE is rotated counterclockwise to produce a YELLOW aspect.

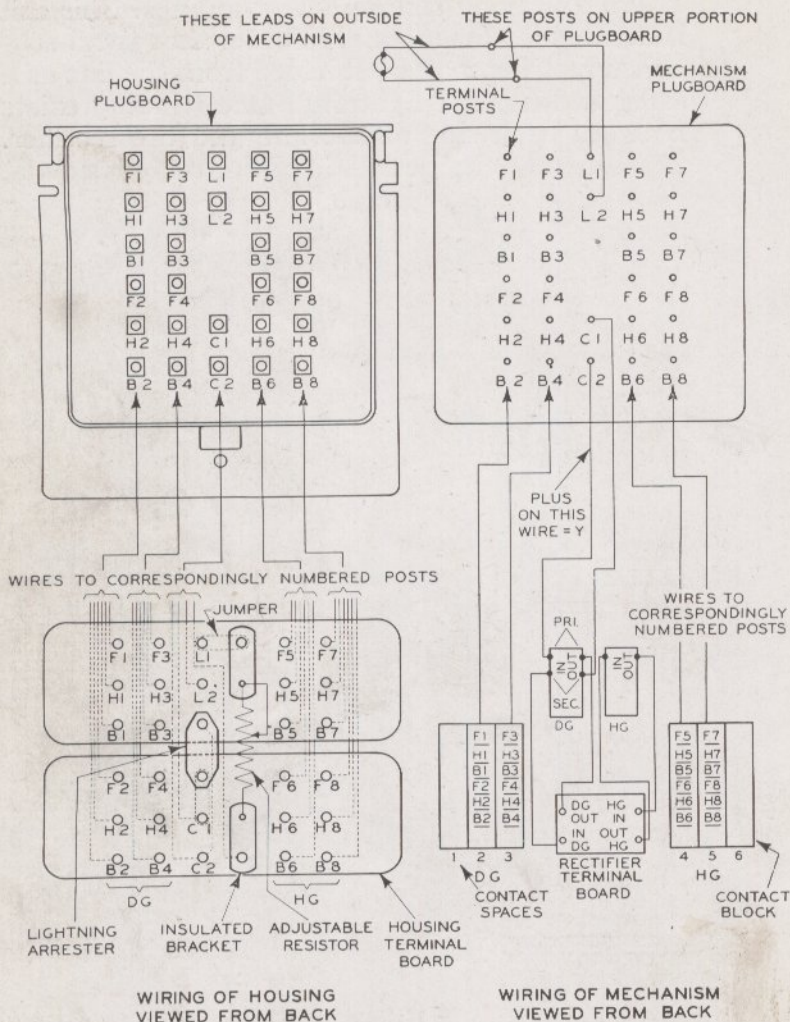
In the polar-neutral arrangement, both relays are energized by the same control circuit and, therefore, the HG ARMATURE drops only upon deenergiza-

The DG relay coil has two windings. This coil is divided in this manner in order that the mechanism rectifier may be shielded from the line as a safeguard against lightning. One winding exists between each side of the line and the rectifier. The inherent characteristic of this relay is partial



Simplified operational diagram of spectacle drive. Mechanism shown in RED (deenergized) position.

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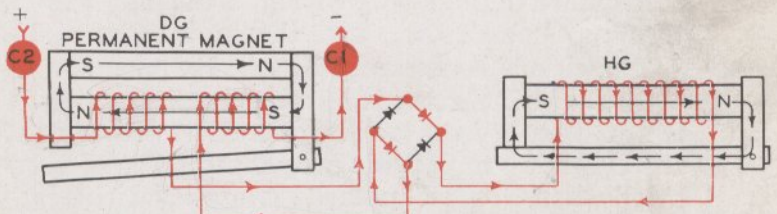


Signal wiring diagram for standard polar-neutral mechanism.

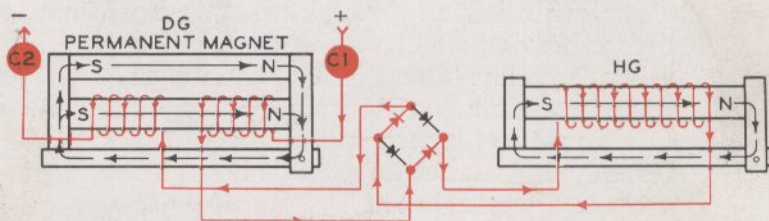
slow-acting. It is polarized by means of a permanent magnet incorporated in its magnetic structure.

Upon initial energization, with (+) applied on plugboard terminal C1, see Figure 13b, the flow of current is from terminal C1, through the secondary winding of the DG relay, through one path of the rectifier, through the HG relay winding, through another path of the rectifier, through the primary winding of the DG relay to terminal C2 and back to line (-).

This permits the HG relay to pick up, but, owing to the fact that an interlocking bar is attached to the DG armature, Figure 11, the DG relay is prevented from closing its front contacts



a. Polarity applied to display YELLOW aspect.



b. Polarity applied to display GREEN aspect.

Schematic diagrams of rectifier circuit for standard polar-neutral mechanism.

before the HG armature has picked up. With both relays picked up, the GREEN aspect is displayed.

With negative energy applied on C1, Figure 13a, the direction of the flow of current through the HG winding remains the same, but the direction of current flow through the DG winding is reversed. When current flow in this direction exists, the HG armature responds to energization, but the DG armature remains down or drops, as the case may be, and the signal displays YELLOW.

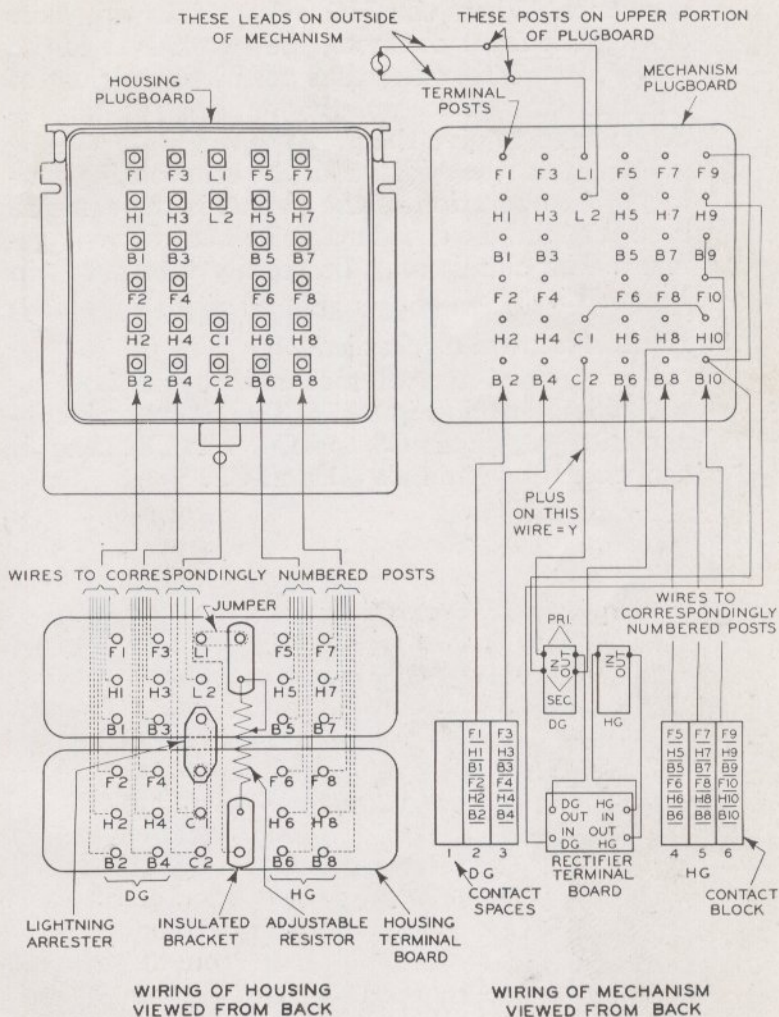
2. Polar-neutral mechanism with slow-pickup and slow-release HG relay.

The polar-neutral arrangement can also be furnished designed for slow pickup and slow release of the HG relay. For this arrangement the mechanism and housing wiring, coils, plugboards, terminal board, etc., are shown in Figure 14.

The circuit is shown in Figure 15, page 29.

Since the DG relay is relatively quick acting, it is necessary to interlock its operation with that of the HG relay to provide proper sequence of operation when GREEN polarity is applied with windings deenergized. The interlocking bar of the standard polar-neutral arrangement is supplanted by an electrical interlock through an extra set of make-before-break pole-changing contacts on the HG relay, so that the pickup timing of the HG relay is not influenced by the quicker action of the DG armature. These contacts are connected internally and do not have leads brought out separately to the plugboard.

When the pole-changing contacts are made in the back position only, the two halves of the DG coil buck each other, preventing pickup of the



Signal wiring diagram for polar-neutral mechanism with slow-pickup and slow-release HG relay.

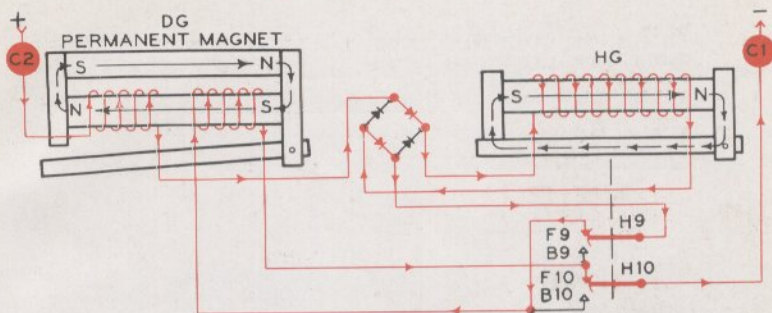
Figure 14

armature. When the HG relay picks up, thus closing the front contacts, the two halves of the DG coil work together thus permitting pickup of the armature (if the polarity applied is that predetermined to give the green aspect).

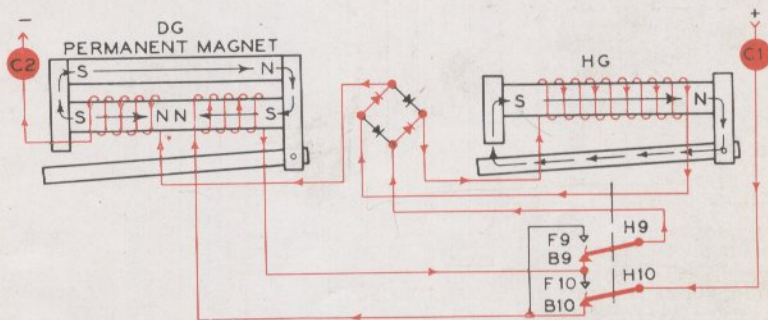
Except for the addition of the interlocking contacts, the operation of the circuit is the same as described for the standard polar-neutral arrangement. The circuit may be readily traced out in Figure 15.

3. Neutral-neutral mechanism

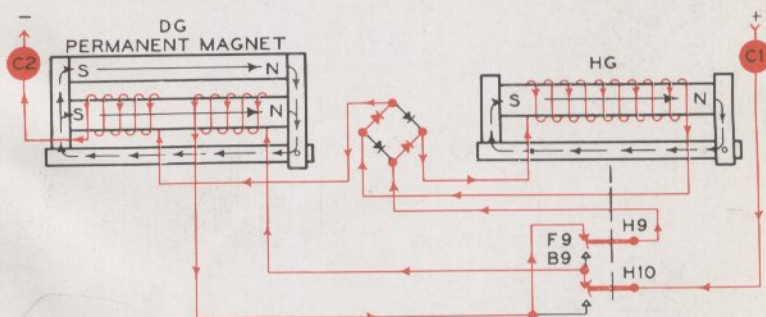
The neutral-neutral mechanism and housing wiring is shown in Figure 16. The HG relay is connected to terminals C3 and C4. The DG relay is connected to terminals C1 and C2.



a. Polarity applied to display YELLOW aspect, HG relay up.



b. Polarity applied to display GREEN aspect, HG not yet up.

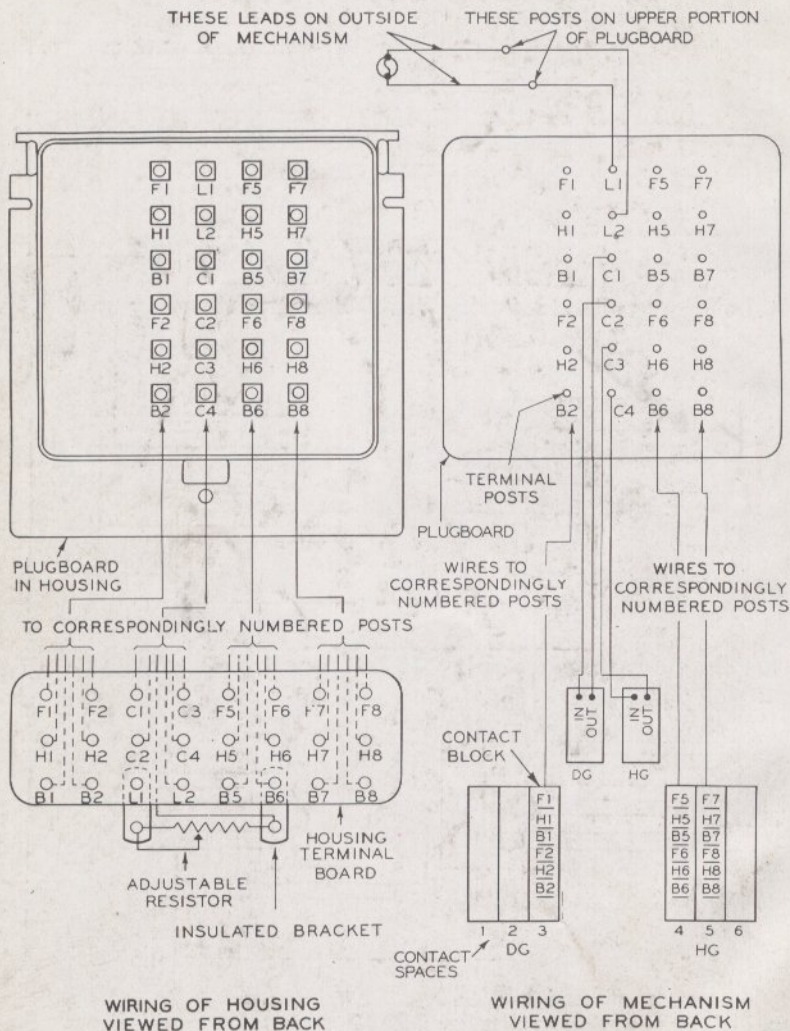


c. Polarity applied to display GREEN aspect, HG and DG up.

Schematic diagrams of rectifier circuit for polar-neutral mechanism with slow-pickup and slow-release HG relay.

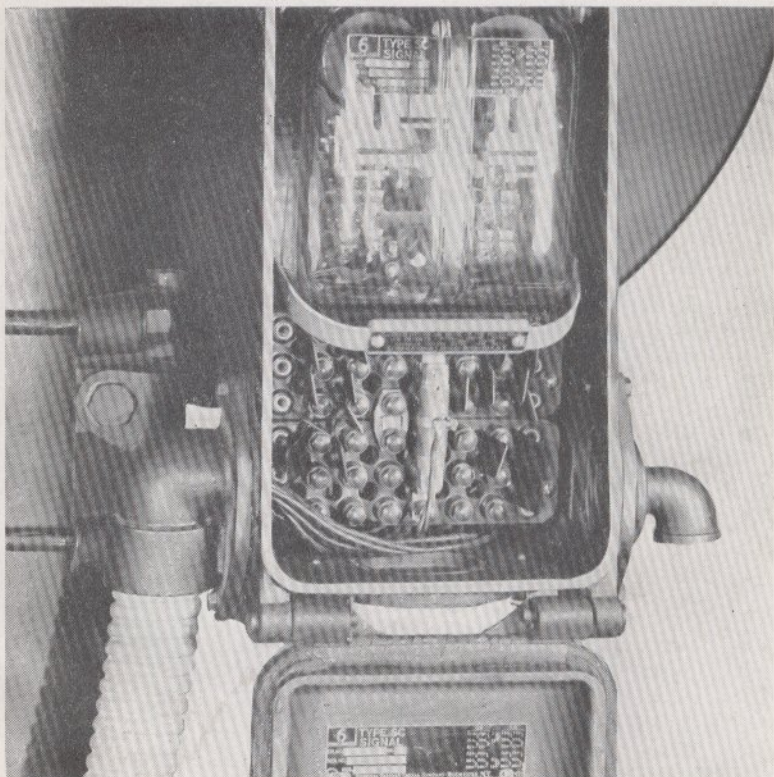
Figure 15

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Signal wiring diagram for neutral-neutral mechanism.

It is obvious that the mechanism wiring and housing wiring must agree, hence, a number appears in the upper left-hand corner of the name plate attached to each mechanism and housing. When inserting a mechanism in a housing, it should be ascertained that these numbers agree, as illustrated in Figure 17.

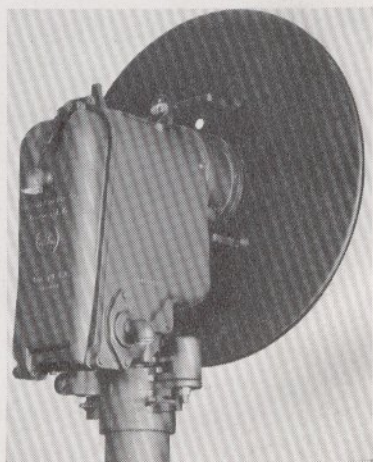


Circuit numbers on mechanism and on housing name plates must agree.

Figure 17

INSTALLATION AND MAINTENANCE

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 engineman 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 engineman.

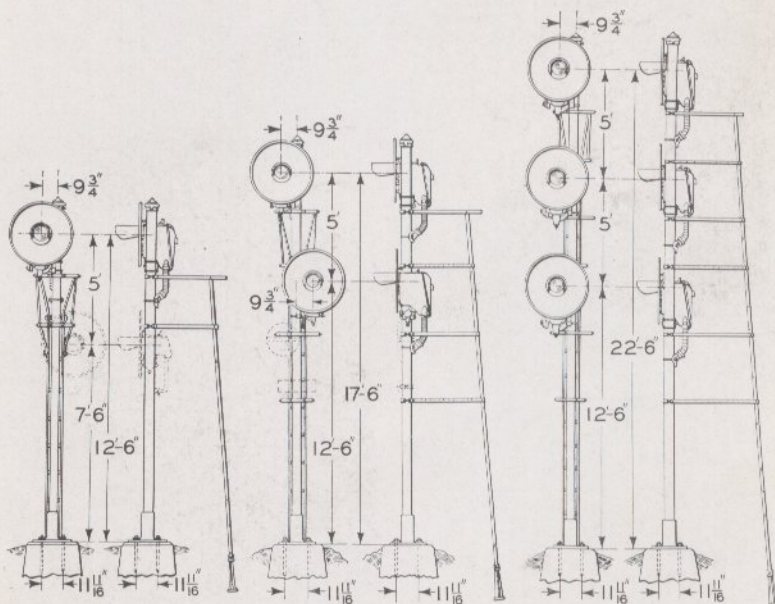


Side and rear views of Type SC signal mounted on top of mast with resilient mounting.

Before mounting the signal housing, a check should be made to determine if the signal has the required outer roundel to cover track curvature. The effect of these roundels is shown in Figures 8 and 9. They are described fully in Pamphlet 530, "How to Select the Proper Optical Combination for any Given Condition."

A. High Signals

Type SC signals can be mounted on the side of a 5- or 6-inch mast, as shown in Figure 1, or on top, as shown in Figure 18. When mounted on the side, the centerline of the lens is $9\frac{3}{4}$ inches from the centerline of a 5-inch mast ($10\frac{1}{2}$ inches for a 6-inch mast).



Some typical arrangements of Type SC signals. $9\frac{3}{4}$ -inch distance shown from center of lens to centerline of mast is for 5-inch mast; with 6-inch mast, this distance is $10\frac{1}{2}$ inches.

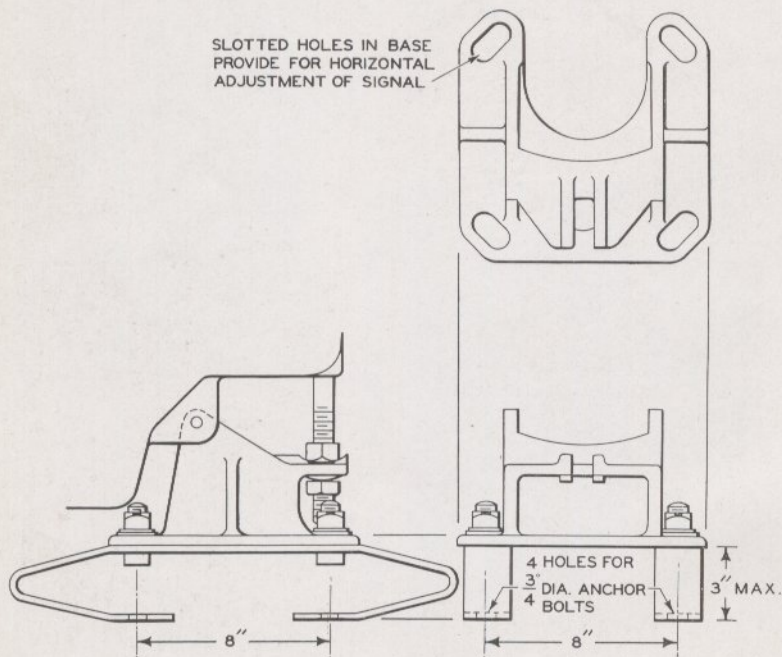
Figure 19

TYPE SC COLOR-LIGHT SIGNAL

The height above the top of the foundation may vary on different railroads. Typical dimensions are given in Figure 19.

The side-of-mast mounting bracket is shown in Figure 24, page 40. The top-of-mast socket is shown in Figure 25, page 41.

The high signal complete with its mechanism and bracket for top-of-mast mounting weighs approximately 230 pounds, with side-of-mast mounting bracket, approximately 240 pounds.

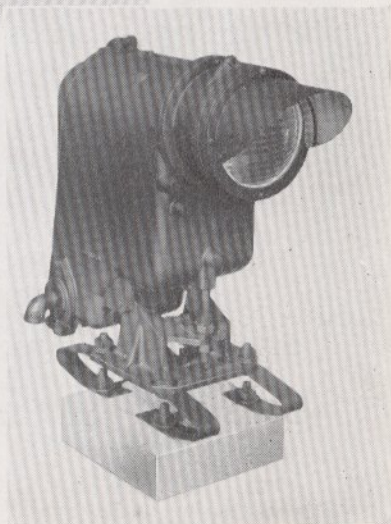


Spring-mounted base for dwarf signal or for bridge signal.



a. Type SC bridge signal as arranged for bolting to bridge plate.

b. Type SC one-arm dwarf signal with outer deflecting roundel.



B. Bridge Signals

Type SC bridge signals are either fastened to the bridge girders or to masts which are anchored to the girders. In the latter case the brackets shown in Figures 24 and 25 can be used.

When the signals are mounted on the girders, a spring-mounted base, Figure 20, is furnished. Holes are slotted in this base to provide some lateral adjustment when aligning the signal. Figure 21a shows the spring-mounted bridge signal complete.

The bridge signal complete with mechanism and spring-mounted base weighs approximately 220 pounds.

C. Dwarf Signals

Type SC dwarf signals are of the one-arm and two-arm types. The one-arm signal is shown in Figure 21b; the two-arm in Figure 22. These signals are provided with spring-mounted bases as shown.

D. Heights of Dwarf Signals

1. One arm:

From top of foundation to top of housing $28\frac{1}{2}$ inches

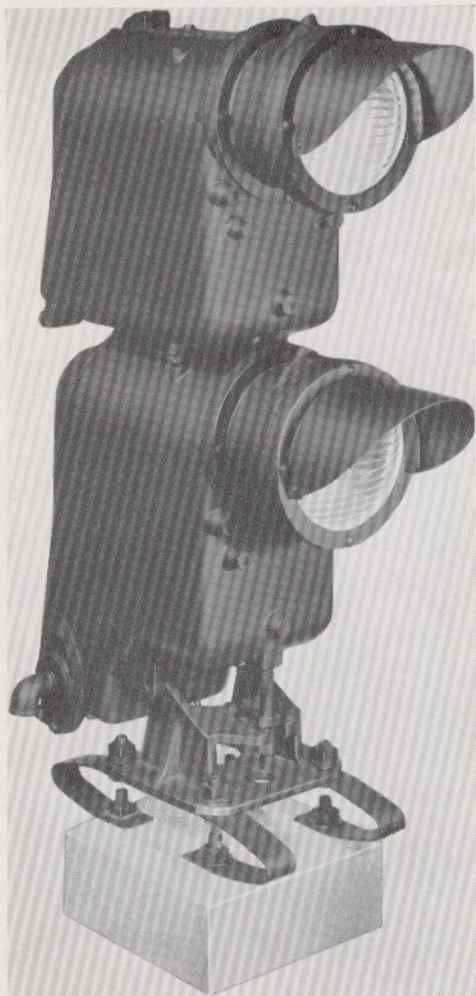
From top of foundation to center of lens $23\frac{3}{16}$ inches

2. Two-arm:

From top of foundation to top of housing $46\frac{3}{16}$ inches

From top of foundation to center of lower lens $23\frac{3}{16}$ inches

From top of foundation to center of upper lens $41\frac{3}{16}$ inches



Dwarf signals are usually equipped with outer roundels to deflect the beam upward to the engineman. An arrow cast in the roundel indicates the direction in which the beam is deflected.

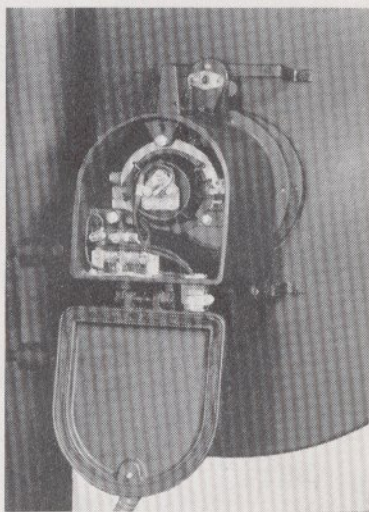
The one-arm dwarf signal with its mechanism and spring-mounted base weighs approximately 200 pounds. The two-arm signal complete with its mechanism and spring-mounted base weighs approximately 355 pounds.

Type SC two-arm dwarf signal with outer deflecting roundels.

E. Fixed Signals

Type SC fixed signals, Figure 23, are used to provide an aspect of one color only. They are equipped with either the compound lens (as shown) or the stepped lens and are furnished for mounting on bridge or mast, as specified. Resilient mountings are not required for fixed signals.

The rear view of the signal shows the cover open. A single fixed slanted color disc is used; otherwise



Type SC fixed signal, side and rear views. Rear view shows terminal board, adjustable lamp resistor, and detachable lamp socket and reflector unit.

the optical system is the same as that used in the Type SC operative signals, Figures 8 and 9, pages 16 and 18. The rear door can be opened with a standard $\frac{1}{2}$ -inch socket wrench.

The fixed signal complete with background and mounting bracket as shown weighs approximately 123 pounds.

F. Mounting the Signal Housing

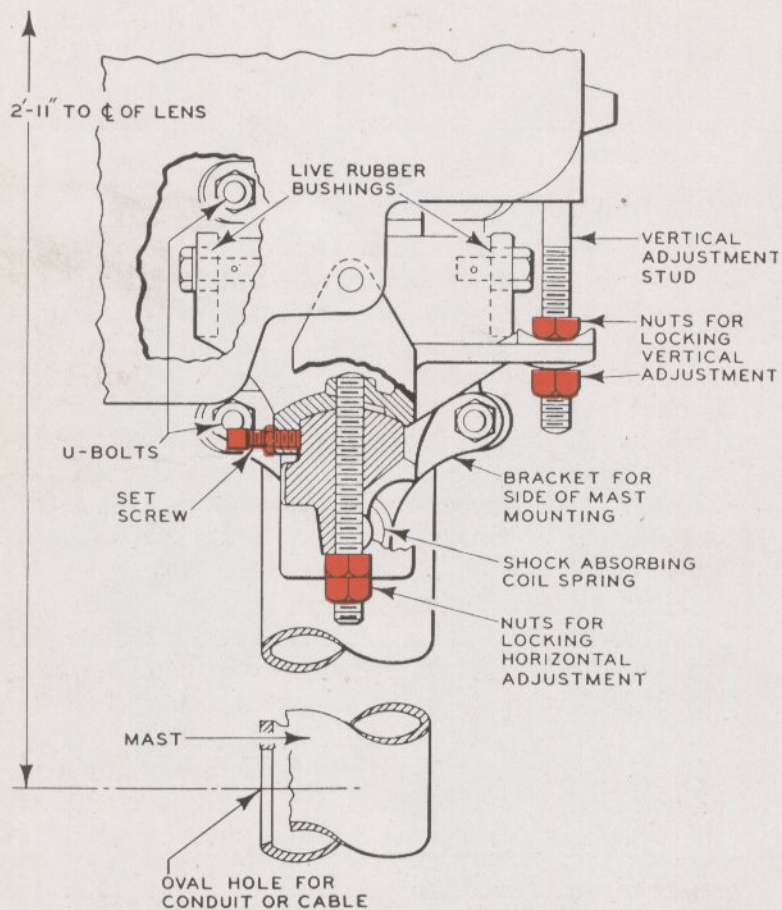
The side-of-mast signal, as illustrated in Figure 24, may be mounted with its mounting bracket already attached; or the bracket may be attached to the mast first, and the signal housing can then be attached to the bracket. In the latter case, after the bracket has been attached to the mast by means of the U-bolts, all that is necessary to mount the housing is to remove the nuts for locking horizontal adjustment from the bottom of the stud, drop the stud through the vertical pivot hole in the bracket, and replace the nuts.

In cases where flexible conduit is used for the wires from the mast to the signal, care must be used in locating the bracket on the mast to insure its proper location in relation to the conduit opening in the mast.

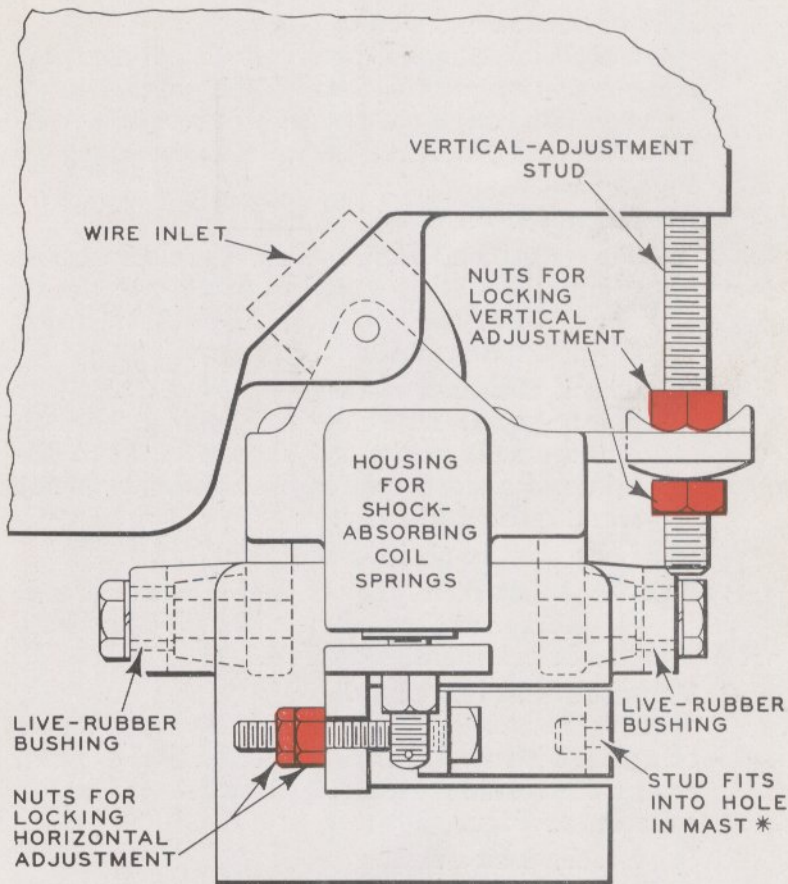
For top-of-mast mounting, illustrated in Figure 25, the signal housing with the socket is placed on top of the mast. Then the clamp is placed so that the stud, which is a part of the clamp, fits into the hole in the mast, thus locking the clamp in place when the nuts are tightened.

Care should be taken when erecting the mast to insure that the hole is located correctly in relation to the track.

TYPE SC COLOR-LIGHT SIGNAL



Horizontal and vertical adjustments for side-of-mast mounting bracket.



* $\frac{5}{8}$ " DIAMETER HOLE LOCATED IN FRONT OF MAST $2\frac{1}{2}$ " BELOW TOP OF PIPE

Horizontal and vertical adjustments for top-of-mast mounting bracket.

Figure 25

G. Adjustment of Resilient Mountings

1. Side-of-mast, Figure 26a.

After the housing has been installed on the pole complete with mechanism, hood, background, and conduit coupling attached, adjust the resilient mounting bracket as follows, referring to Figure 26a:

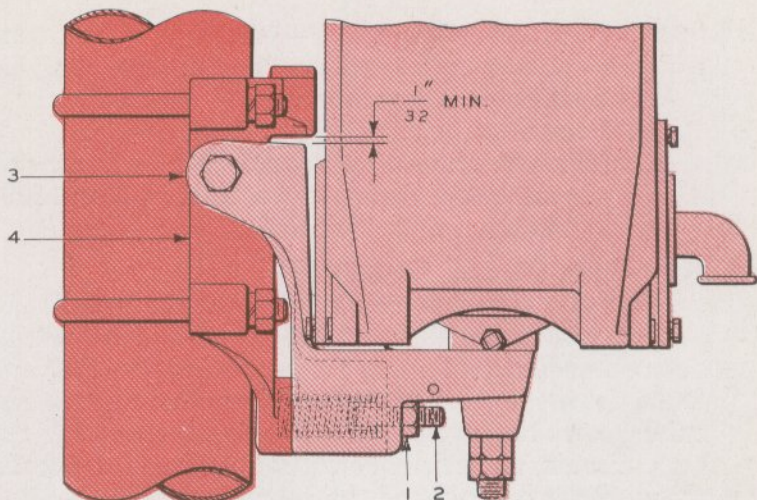
- (a) Loosen lock nut 1.
- (b) Turn stud 2 clockwise or counterclockwise as required to align signal housing parallel to pole. Holes are provided in stud to insert $\frac{1}{8}$ -inch rod or nail for turning.
- (c) Check clearance between castings 3 and 4 at point shown. This clearance must be $\frac{1}{32}$ inch minimum. If necessary, back off stud to obtain clearance, even if signal housing does not stand quite vertically.
- (d) Lock stud in position with nut 1.

NOTE: Adjustment may be sealed with car seal threaded through hole in stud 2 and hole in casting 3, if desired.

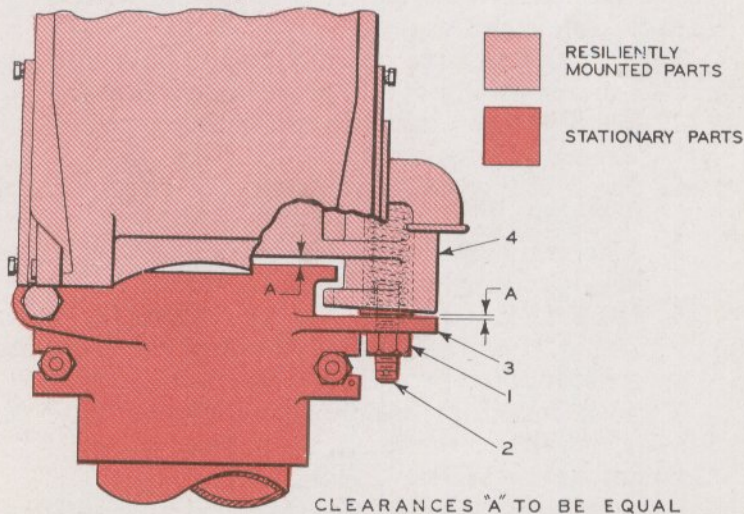
2. Top-of-mast, Figure 26b.

After the housing has been installed on the pole complete with mechanism, hood, and background, adjust the resilient mounting bracket as follows, referring to Figure 26b:

- (a) Loosen lock nut 1.
- (b) Turn stud 2 clockwise or counterclockwise as required to align signal housing with pole. Holes are provided in stud to insert $\frac{1}{8}$ -inch rod or nail for turning.
- (c) Check clearances between castings 3 and 4 at points shown. These clearances shall be ap-



a. Adjustment of resilient mounting on side-of-mast mounting bracket (view facing door).



b. Adjustment of resilient mounting on top-of-mast mounting bracket (view facing door).

proximately equal. If necessary, adjust stud to obtain equalized clearances, even if signal housing does not stand quite vertically.

(d) Lock stud in position with nut 1.

NOTE: Adjustment may be sealed with car seal threaded through hole in stud 2 and hole in casting 3, if desired.

H. Wire Conduits and Couplings

After the signal housing has been mounted, the next step is to run the operating wires. There will be one or two pairs of wires for operating the HG and DG relays (depending on whether the control circuits are polar or neutral), a pair of wires for the lamp circuit, and several additional wires for circuits through the contacts of the relays.

A 2-inch flexible conduit is standard on SC operative heads. The fixed signal is furnished with a $\frac{3}{4}$ -inch flexible conduit.

When using flexible conduit and fittings such as shown in Figure 2, page 6, proceed as follows:

1. Screw the conduit into the fitting provided on the signal housing.
2. Screw the mast fitting onto the other end of the conduit.
3. Attach the conduit to the mast, inserting a gasket between the fitting and the mast.
4. Pack oakum around the conduit in the mast fitting, then seal with a non-hardening sealing compound to produce a waterproof joint.

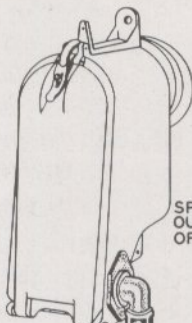
Various couplings are shown in Figure 27, both for the signal and the mast, for wire or cable.

J. Connecting the Wires

The terminal board for the standard polar-neutral SC mechanism with 4FB contacts on the HG relay

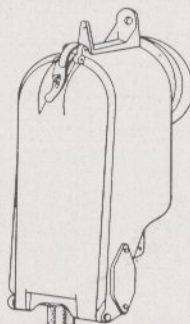


SIDE FOR 2-INCH
CONDUIT

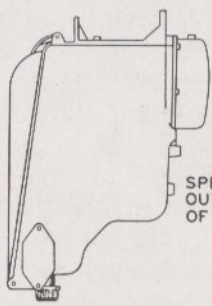


SIDE FOR PARKWAY

SPECIFY
OUTSIDE DIA.
OF PARKWAY



BOTTOM FOR 2-INCH
CONDUIT



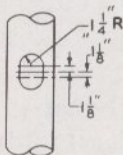
BOTTOM FOR PARKWAY

SPECIFY
OUTSIDE DIA.
OF PARKWAY

SPECIFY
INSIDE DIA.
OF MAST

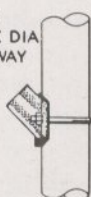


FOR 2-INCH
CONDUIT

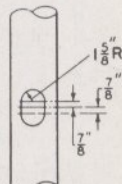


DRILLING

SPECIFY
OUTSIDE DIA.
OF PARKWAY



FOR
PARKWAY



DRILLING

Signal and mast couplings.

Figure 27

and 4FB contacts on the DG relay is shown on page 24. Page 27 shows terminal board for the polar-neutral SC mechanism with 6FB contacts on the HG relay and 4FB contacts on the DG relay. Page 30 shows the terminal board for the neutral-neutral SC mechanism with 4FB contacts on the HG relay and 2FB contacts on the DG relay.

The wires should be fanned out and laid flat upon the bottom of the housing, their loose ends lying along the bottom edge in a row and hanging out of the door.

The incoming wires, after being identified, should be passed behind the terminal board and threaded through the holes adjacent to the terminals to which they are to be connected. The wires should then be cut to the proper length and eyelets applied. The terminals are insulated and can be unscrewed by a standard G-R-S $\frac{1}{2}$ -inch hex. socket wrench.

K. Inserting the Mechanism

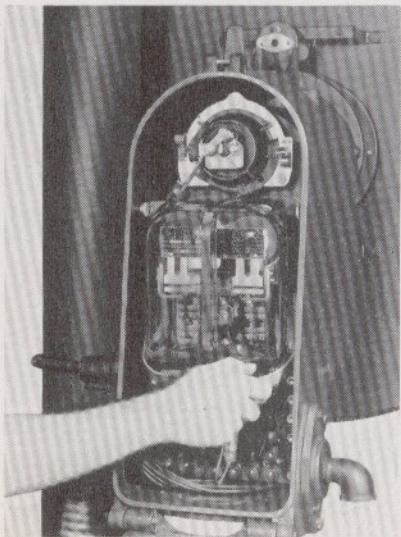
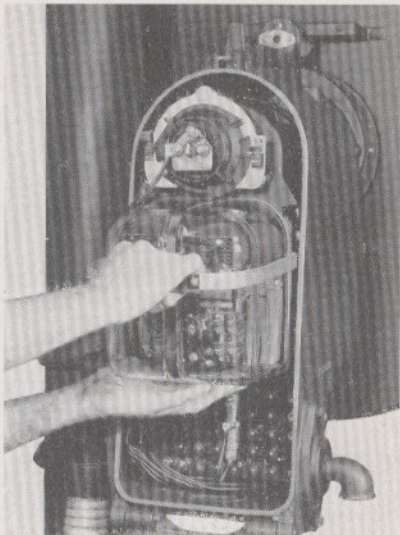
The mechanism is carefully packed in a carton and shipped separately from the signal housing. It should be stored in a dry place until ready for use.

Mechanisms should be transported to the site of the installation in their cartons, and the same care should be used in unpacking and handling as would be used in the handling of any other relays.

After the mechanism has been removed from its carton, examine it for any breakage that may have occurred in shipment, clean the lens or cover glass, and blow off any dust or particles of shipping materials that may have accumulated. See that the plug-board holes are clear. Check the housing also for dust and foreign substances.

Before plugging the mechanism into the housing,

a. Inserting the mechanism in the signal housing.



b. After mechanism has been thrust forward to engage plugboards, press handle down as shown to lock mechanism in housing.

Figure 28

make sure that the circuit number on the mechanism name plate agrees with the circuit number on the housing name plate as shown in Figure 17, page 31.

The most convenient way to insert the mechanism is to grip the handle in one hand, placing the other under the mechanism's glass case. Raise it on to the tracks on either side of the housing, Figure 28a, and slide it forward until both plugboards engage. The sliding movement should be accompanied by force sufficient to insure that the plugboard surfaces meet. Lower the handle as far as it will go, as shown in Figure 28b. This action applies the additional pressure exerted by the leaf springs on either side of the housing, and squeezes the plugboards into close contact.

When removing a mechanism, raise the handle to the horizontal position and pull it towards you. Ease the plugboards apart by a steady pull on the handle accompanied by a sidewise rocking motion. As the mechanism slides out, support it with one hand under the glass case.

The mechanism can be carried by the handle, Figure 29. When setting a mechanism down, place it on the plugboard surface, first making sure that there are no rough raised surfaces which might scratch the lens or cover glass.

L. Inserting or Replacing the Lamp

To insert the lamp in the signal, turn reflector unit clockwise until it unlatches and then withdraw it. If it is raining or snowing, protect reflector surface if hot, as sudden cooling may crack it. Be sure that lamp is properly seated in its socket before replacing reflector unit; then turn it counterclockwise to lock in place.



The mechanism can be carried by the handle.

M. Cleaning Reflector and Lenses

The reflector, lenses, and cover glasses should be cleaned periodically with a chamois skin or a soft, lint-free cloth. To avoid scratching the lens, gritty substances must not be allowed to accumulate in the chamois skin or cloth. Alcohol or lacquer thinner will help in removing incrustations from the outer lens.

N. Checking Lamp Voltage

After making sure that the wires to the signal have been properly connected, the light energy should be applied. The candlepower of the lamp is greatly affected by voltage changes. The lamp voltage should be checked at the time of installation and at any time thereafter when alterations have been made in the power supply that cause a change in voltage at the signal. Excessive voltage greatly reduces the burning life of the lamp. Under-voltage materially reduces the candlepower, and, consequently, the range of the signal.

Connect the voltmeter across the lamp terminals on the reflector unit and adjust the voltage by varying the lamp resistor on the terminal board below the mechanism.

In general, it is recommended that lamps be burned at 10 per cent under rated voltage to increase the average life. For low-wattage lamps, it will be found necessary to burn them at or close to the rated voltage in order to obtain adequate daylight range. It is also recommended that nothing lower than a 10-watt lamp should be used in a stepped-lens signal.

P. Checking Operating Voltage

The operating voltage or current, whichever is being measured, should be enough above the specified working values to insure a margin in case of volt-

age drop which may occur if batteries are drained during a power outage. Current should not exceed 50 per cent of the rated values, as it is wasteful and does not provide any better operation of the mechanism.

Q. Sighting the Signal

On all signals, except dwarfs, a sighting device is provided on top of the housing. This device has been adjusted in the factory and should not be removed or readjusted in the field. By sighting through the hair-line peep sight and by manipulating the separate horizontal and vertical adjustments, the light beam is aligned with the track.

For side-of-mast signals, proceed as follows:

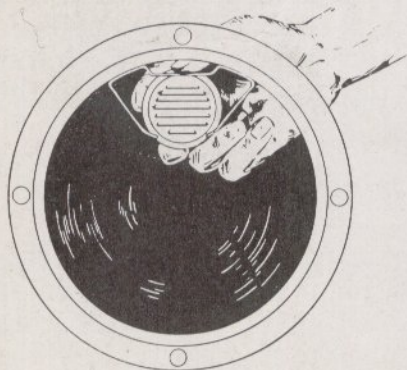
1. Before sighting a resiliently mounted signal, the resilient mounting bracket should be adjusted as explained on page 42.
2. With a fine wire clean the peep-hole in the rear of the sighting device. It sometimes gets clogged with paint and dirt.
3. Loosen the signal slightly on its vertical stud, Figure 24. This will permit it to be turned in a horizontal plane. By looking through the sight you can set the signal so that the vertical hair line in the sight bisects the point at which it is desired to project the most intense part of the main beam.
4. Lock the horizontal adjustment by means of the set screw in the mounting bracket, Figure 24, page 40.
5. Draw up tight the two nuts on the vertical stud.
6. Tip the signal housing up or down by turning the nuts on the adjusting stud under the front end of the signal until the horizontal hair line in the sight bisects the desired point.

7. Lock the vertical adjustment by tightening both nuts.

When the signal is mounted on top of the mast, page 41, the four nuts (two not shown) should be loosened for adjusting horizontally. Tighten the adjusting nut on the side towards which it is desired to rotate the signal. When the vertical hair line in the peep-sight bisects the point desired, the signal is clamped in place by drawing up the nut on the opposite side, after which both adjusting nuts should be locked by tightening up their jam nuts. For vertical adjusting proceed as for bracket-mounted signals.

The bases of bridge signals which are mounted on the girders, page 35, have slotted holes, page 34, for horizontal adjustment. The same type of base is provided for dwarf signals, Figures 21b and 22, pages 35 and 37, which, however, are not adjusted by peep-sight. When the two-arm dwarf signal is aligned with the track, the lower arm is adjusted first and locked before the upper is aligned.

R. Adjusting the Close-up Beam



Adjusting roundel.

Signals are equipped with small 40-degree deflecting roundels to provide a close-up aspect for the engineman who stops under a signal. The roundel can be turned in its support to throw the beam across the track. To reach roundel, remove handhole cover, Figure 30.

S. Replacing a Broken Lens or Roundel

1. Make sure that the replacement lens or roundel is of the same design as the original. This is particularly important as concerns the lens. The Type SC signal stepped lens has a 5-inch focal length, the designation for which is molded in the rim of the lens, for example: $8\frac{3}{8}D$ x 5F etc. Make certain that the term "5F" appears in the designation.
2. Before installing the new lens or roundel, apply a sealing compound (such as Vulcatex) on the surface of the bezel ring to prevent water from entering.
3. Tighten screws evenly around the bezel ring to avoid the possibility of cracking the glass.

T. Changing Signal from Straight Track to Curved Track Application

As shown on pages 16 and 18, various outer roundels are available to cover the many topographical conditions encountered in railroad practice. When changing a Type SC signal from a straight to a curved track application, the proper deflecting roundel should be selected in accordance with directions given in Pamphlet 530, "How to Select the Proper Optical Combination for Any Given Condition." In addition to the roundel with its gasket, the following will be required:

Quantity	Description	Drawing Reference
1	Adapter Ring	43983-46
4	Screws (for compound lens)	33287-8
4	Screws (for stepped lens)	33287-13

When these materials have been secured, proceed

as follows (Figure 21b, page 35, shows a signal with these parts installed):

1. Remove outer rim on which sheet-metal hood is mounted. Be careful that lens does not fall out of its bezel ring.
2. Assemble adapter ring 43983-46 after first applying sealing compound to machined surfaces.
3. Assemble roundel in position to direct the deflected or spread beam in the required direction. An arrow molded in the glass of the deflecting roundel indicates the direction in which it deflects the beam. A spreadlite roundel has the word "TOP" molded in the glass.
4. Place outer ring over roundel and fasten with the four longer screws, tightening the screws evenly around the ring.

U. A Final Check

Check these before placing signals in service:

1. Be sure that the operating voltages and polarities are right.
2. Be sure that the reflector and lenses are clean.
3. Be sure that the lamp is clean and properly seated in its socket.
4. Be sure that resilient mounting is properly adjusted.
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 used for the particular track conditions at the location.

8. Be sure that the mechanism is properly locked in the housing and that the reflector unit is in place and locked.

DON'TS

1. Don't change the reflector or socket adjustment. This has been factory adjusted and should never be touched. If the aspect is not satisfactory, the trouble may be caused by:
 - (a) Low voltage at lamp terminals.
 - (b) Signal improperly aligned with respect to the track.
 - (c) Wrong lens combination for the location.
2. Don't open the signal mechanism on the right-of-way. Seals on the mechanism should not be broken, nor the mechanism opened, except where adequate facilities are available for repairs.
3. Don't oil the signal mechanism at any time. It is equipped with bearings which require no lubrication whatever.
4. Don't check voltage at the source of supply - there is always a line drop in potential which makes such a check useless. Measure voltage at the lamp terminals and measure operating currents through the relay coils.
5. Don't burn the lamp at a lower voltage than that recommended.
6. Don't burn the lamp at excessive voltage; as a general rule never exceed recommended voltage by more than half a volt.
7. Don't force excessive current through the relay coil.
8. Don't expect a lens projecting a concentrated beam to cover a curved track.

9. Don't expect a beam with wide spread to have the same range as a concentrated beam.
10. Don't remove or readjust the sighting device. This has been factory adjusted and should not be changed.

ORDERING REFERENCES

A. Lamps

Order new lamps by sending us the catalog ordering reference and drawing number of the lamp as listed in G-R-S Catalog Section H, Part 39.

B. Adjustable Lamp Resistance

Order by giving the drawing number stamped on mechanism name plate.

C. Reflector Unit

If the reflector is broken, send us reflector unit, and we will replace the reflector and refocus it. Give us the drawing number on the mechanism name plate and the drawing number of the lamp.

D. Lenses and Roundels

Should you wish to replace a broken lens or roundel, give us the drawing number stamped on the housing or mechanism name plate for which it is intended.

E. Coils

Order coils by giving the drawing number stamped on mechanism name plate. State on which relay the coil is to be assembled, the HG or DG relay.

F. Rectifier

To order a rectifier for polar mechanisms, give the drawing number stamped on name plate of the mechanism for which it is intended.

G. Contacts

Order contacts by giving the drawing number stamped on mechanism name plate and state on which relay the contacts are to be used. Since contacts are molded in blocks and there are three spaces under each relay armature for a maximum of three contact blocks, it will be necessary to state in which space the block of contacts is to be used. These spaces may be numbered 1, 2, 3, 4, 5 and 6 for convenience, from left to right across the mechanism, looking at it from the side from which the contacts can be seen. Spaces 1, 2 and 3, therefore, are directly under DG relay. Spaces 4, 5 and 6 are under HG relay.

H. Arrester

The shunt gap lighting arrester on the terminal board in the housing of a polar-neutral signal should be ordered as follows:

“one shunt gap lightning arrester for Type SC signal—drawing reference 59134 Gr. 1.”

J. Glass Case

Should glass case protecting working parts of the mechanism be broken, order a new one as follows:

“one glass case for Type SC signal—drawing reference 37380-27.”

K. Other Parts

In the absence of a catalog, and until one is issued on the Type SC signal, it is recommended that the drawing number stamped on the name plate of the mechanism or housing or both be given whenever parts are ordered. Name the part as clearly as possible, or call on our nearest district office for assistance in ordering.

DISTRICT OFFICES

NEW YORK OFFICE

230 Park Avenue, New York 17, New York
Telephone: MUrray Hill 9-7533

CHICAGO OFFICE

122 South Michigan Avenue, Chicago 3, Illinois
Telephone: HARrison 2361 and 2362

ST. LOUIS OFFICE

611 Olive Street, St. Louis 1, Missouri
Telephone: Main 4696

EASTERN CANADIAN OFFICE

William S. Henry, P. O. Box 600, Rochester 2, New York
Telephone: Genesee 1483

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