



INSTRUCTION PAMPHLET

U-5034

INSTALLATION
AND
MAINTENANCE

OF

STYLES "H" and "H-2"
SEARCHLIGHT SIGNALS

with Permanent Magnet
Field Structure



Revised
SEPTEMBER, 1941

UNION SWITCH & SIGNAL CO.
SWISSVALE, PA.

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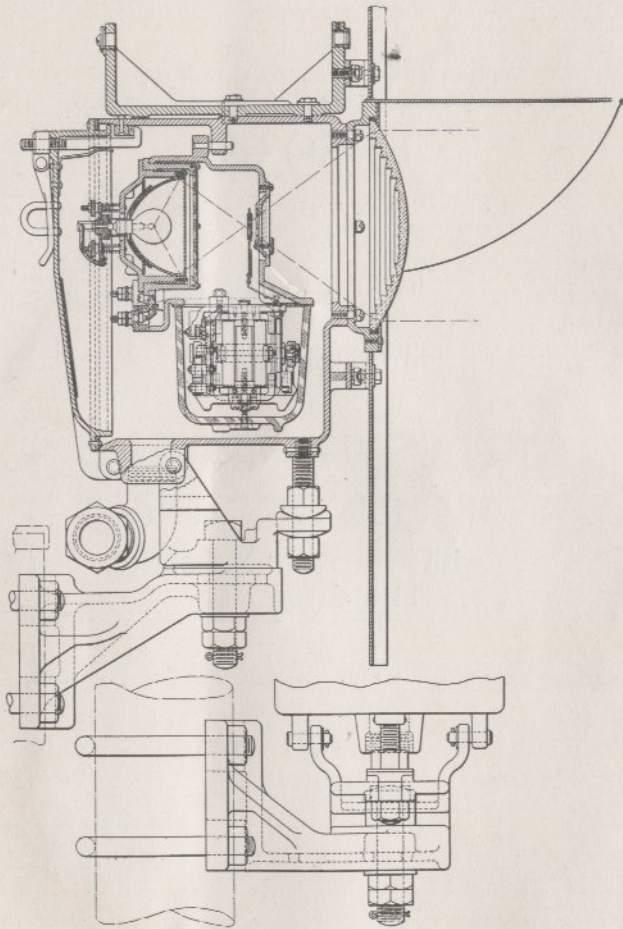


Fig. 1. Sectional View of Style "H" Operating Unit and Case:
Illustrates Optical Principle and "Front of Mast" Mounting.
Lower View Shows "Side of Mast" Mounting

INSTALLATION AND
MAINTENANCE OF
STYLES "H" and "H-2" SEARCHLIGHT
SIGNALS
WITH PERMANENT MAGNETS

1. GENERAL—The searchlight type color light signal consists of an outer case which includes the lens, lens hood and signal support, and an operating unit. The outer case proper is the same for all signals, with the exception of the adapter castings in which the lenses are mounted. Two types of supporting arms are furnished for high signals. One type is designed for side of mast mounting, the center line of the signal being approximately nine (9) inches from the center line of the mast. Another type of supporting arm is furnished providing for front of mast mounting. In this case the signal is located close to the top of the mast, the case door in the open position being horizontal over the top of the mast. High signals are furnished with a background and "U" bolts for fastening the supporting arm to the mast. Each signal is equipped with a sighting device for aligning the signal.

The signal operating unit is shipped in a separate container, being carefully packed to provide against damage to the mechanism in handling. The operating unit is accurately located and fastened in the case by means of a fixed stud and two body-bound bolts. The units are interchangeable in the sense that it is not necessary that a unit be installed in a particular case, provided, of course, that the unit and case are of the same type.

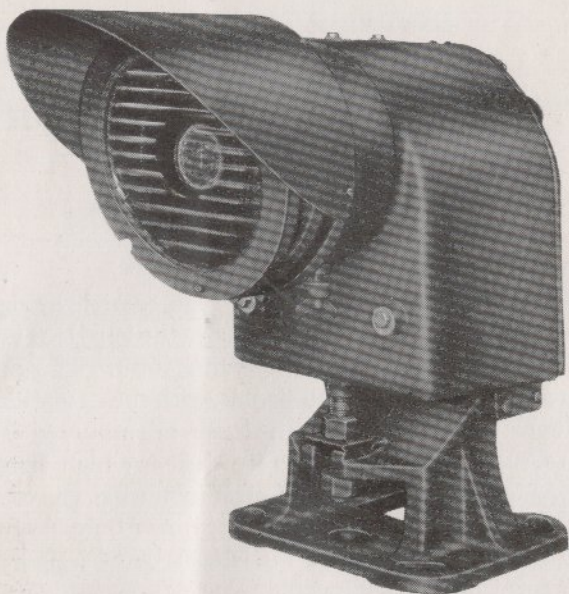


Fig. 2. View of Standard Dwarf Signal, Showing the Alignment Adjustments

The dwarf signal is the same as the high signal except that it is not provided with a background and a sighting device, and is provided with a prism cover glass designed to spread the beam upward. It is fitted with a base suitable for mounting on a flat surface such as a concrete foundation, instead of a supporting arm.

Dwarf signals are equipped as standard with an $8\frac{3}{8}$ " diameter lens.

2. D. C. OPERATING UNIT—The operating mechanism is essentially a three position D. C. motor relay, having an operating or armature coil and a permanent magnet field. The moving element is an iron armature

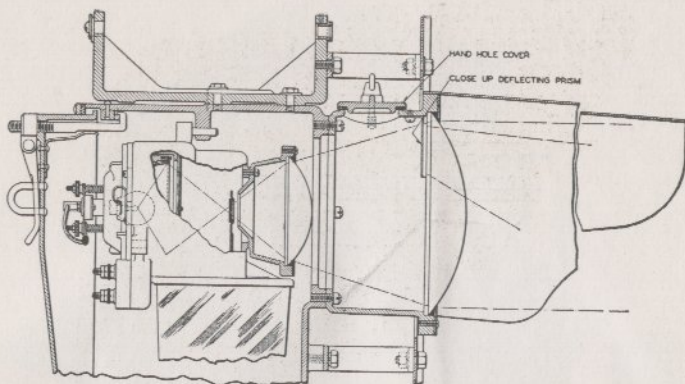


Fig. 3. View Showing Optical Principle and Assembly of the Style "H-2" Signal with Ground Doublet Lens Combination for 3 or 5 Watt Lamps

which rotates approximately thirteen and one-half ($13\frac{1}{2}$) degrees each way from the center position, at which it stands, due to counterweighting, when deenergized. Directly connected to the armature shaft is a small spectacle in which are mounted three colored glass roundels, each of one inch diameter. These roundels are moved into the concentrated light beam, as required, by the movement of the armature. In standard three color light signaling, the red roundel is located in the center and is in the light beam when the armature coil is deenergized.

Current passed through the armature coil in one direction rotates the armature against a stop to bring the yellow roundel into the light beam. Current passed through the armature coil in the other direction rotates the armature in the opposite direction against a stop to bring the green roundel into the light beam. Thus the re-

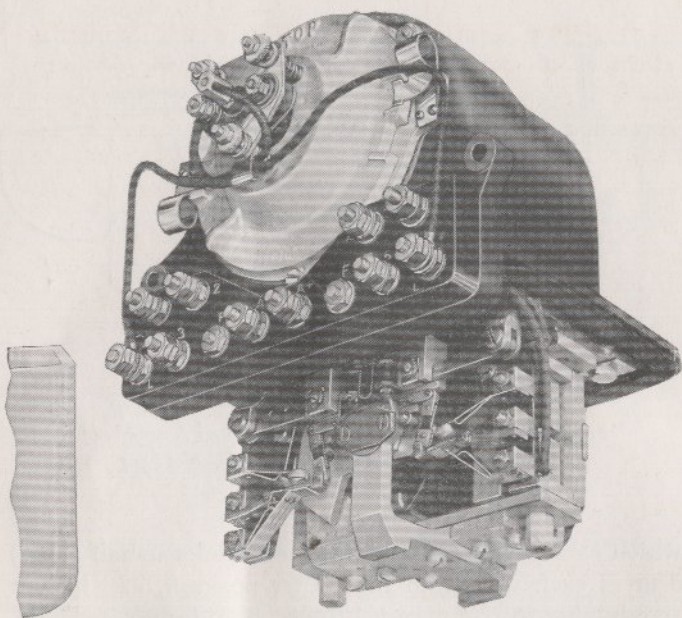


Fig. 4. *Operating Unit with Permanent Magnet Field*

quired change in colors is effected. For two color light signaling the armature is rotated only in one direction.

The light beam is concentrated at the colored roundel location by means of an elliptical glass reflector, which, with the lamp, lamp socket and reflector holder as a unit, is inserted and held in place with spring clips in the back of the unit top case. It is a characteristic of the elliptical reflector that, with the lamp filament located at the focal point of the reflector, the reflected light is concentrated at the other focal point of the complete ellipse, which in this signal unit is approximately the location of the colored

roundel. After passing through the colored roundel, the diverging beam is condensed by the lens or lens system into practically a parallel beam. The lamp socket is adjusted and sealed at the factory and accurately based lamps may be placed in the socket without any readjustment.

For special applications, particularly in connection with 3 or 5 watt lamps, the style "H-2" signal with a doublet combination of ground lenses as shown in Fig. 3 replaces the standard single lens of the moulded or "step" type.

3. LOCATING OF SIGNALS—The best location for high signals is slightly above the engineman's head and as near the rail on his side of the cab as practicable. It is therefore desirable for "side-of-mast" mounting on ground masts, to locate the signal on the track side of the mast. The supporting arm is fastened to the mast at approximately a right angle to the track, and for "front-of-mast" mounting approximately parallel to the track. If the signal is located too low the lens hood interferes with the "close-up" view of the indication. Where a signal is located on a signal bridge it should be mounted as low as practicable and, where convenient, approximately in line with the rail on the engineman's side. The location should be such that no part of the bridge structure interferes with the close-up view of the indication. Dwarf light signals should be located as high as is consistent with clearances and the standard practice of the railroad.

4. ALIGNMENT—First align the signal horizontally; this is done on high signals by loosening jam nut B and nut A, Fig. 5 and turning the signal on stud bolt C as an axis until the vertical cross-hair in the sighting device lo-

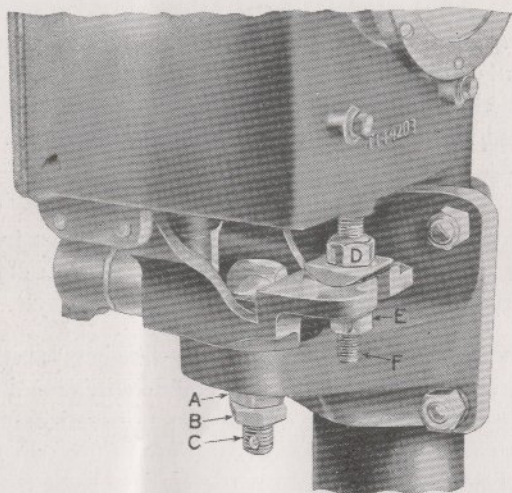


Fig. 5. Adjustable Bracket for "Side-of-Mast" Mounting

cated on the top of the signal case intersects the point on the track where the engineman should first see the indication. With the signal in this position, the nut A and then the jam nut B should be tightened and the adjustment should be checked by means of the sight to make sure that it has not been changed by the tightening of the nuts. The signal should then be aligned vertically. This is done by loosening nut E and adjusting nut D upward or downward until the horizontal cross-hair in the sight intersects the point on the track where the engineman should first see the indication. Nut E should then be tightened and the adjustment should again be checked to insure that the proper alignment has been maintained. As the light beam is parallel to the sighting device on the signal case, the

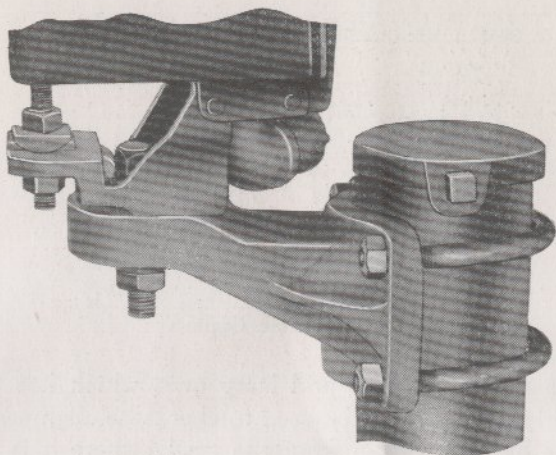


Fig. 6. Adjustable Bracket for "Front-of-Mast" Mounting

center line of the beam will be pointed to the selected location on the track.

As the required range of dwarf signals is comparatively short, accuracy of alignment is not so important and a sighting device is not considered necessary. Foundation bolts should be set to give the approximately correct horizontal alignment. The base casting has slotted holes to provide for some rotation of the signal in the horizontal plane for final horizontal alignment. The vertical adjustment is the same as for high signals. It is customary to point dwarf signals slightly above the horizontal to minimize the interference of the lens hood with the "close-up" view of the engineman.

The operating unit should not be installed permanently in the signal until the wiring is in place and ready to be connected. One operating unit or preferably a unit

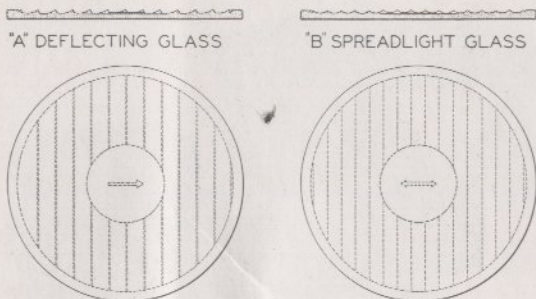


Fig. 7. Cover Glasses

top case with reflector and lamp unit, which has been properly focused, may be used to check the alignment of signals by observation from the track, where it is considered advisable.

Alignment on Curves—Standard Searchlight Signals are designed to produce a concentrated light beam for long range indication on tangent track or track of small curvature. Special cover glasses can be furnished when additional spread of light beam is required to properly signal track of greater curvature.

Two deflecting prism cover glasses similar to "A," Fig. 7, are available for use on curved track, one 10° in one direction only from the center line for moderately curved track, and the other one 20° in one direction only from the center line for use where extreme spread is required. Two spreadlight cover glasses similar to "B," Fig. 7, are available, one for 16° and another for 30° , spread being on each side of the center line.

The arrow in "A," Fig. 7, for deflecting prism cover glasses indicates the direction a portion of the light beam

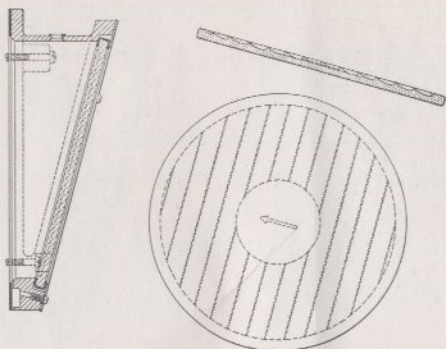


Fig. 7a. Deflecting Cover Glass Assembly

is deflected. It has a definite relation to the prismatic formation on the inside of the cover glass as shown in cross section. It is obvious that the same cover glass can be used to deflect light in the opposite direction by revolving it 180° in its mounting.

The cover glass, with its supporting ring, Fig. 7a is mounted in front of the standard lens by means of two screws threaded into the standard lens ring in place of the dummy screws used to protect the tapped holes.

When Phankill units are furnished in combination with deflecting or spreadlight cover glasses, they are combined with the inclined glass assembly as shown in Ref. B, Fig. 8. This assembly is mounted in front of the standard lens "E" by means of two screws "A," which are threaded into the standard lens ring in place of the dummy screws used to protect the tapped holes. In the application of these assemblies to dwarf signals, the standard arrangement is with a 10° glass deflecting light upward and with the prisms on the outside.

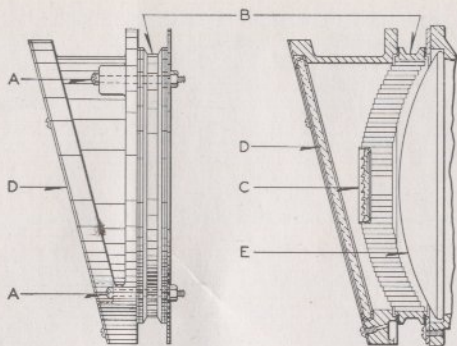


Fig. 8

To align a signal on a moderately curved track, focus the sight on the farthest point of the curve, or on any other point where the indication should be first seen by the engineman. Fig. 9 illustrates how the signal is aligned and the deflecting prism cover glass applied. The signal is aligned on point "X." The main beam is indicated by the full lines. The cover glass is applied to deflect a portion of the beam in the direction of the arrow. The deflected light is indicated by the broken lines. After the signal has been aligned, the indication should be observed from the track to determine whether the point of maximum range has been properly selected so as to utilize the full spread of the signal to best advantage around the curve.

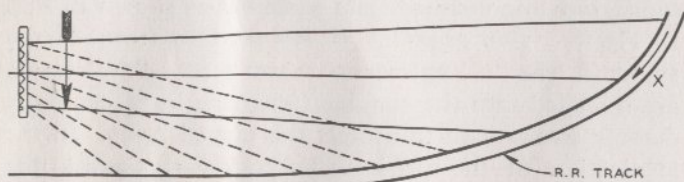


Fig. 9. Diagram Showing Alignment of Light Signal Using Deflecting Cover Glass for Curved Track

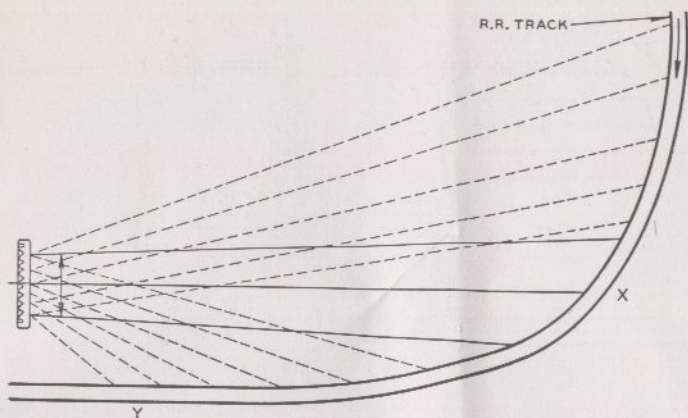


Fig. 10. Diagram Showing Alignment of Light Signal Using Spreadlight Cover Glass for Curved Track

For signals located on extreme curves where greater spread and shorter range are required, the spreadlight cover glass "B," Fig. 7, should be used. The sight is aligned half way across the curve at some point "X," Fig. 10, and the beam should be checked along the curve for close indication at "Y."

Adjustment of Close-up Indication—The Styles "H" and "H-2" Searchlight Signals are equipped with special prisms, known as close-up prisms. These prisms are used to provide an indication in the line of sight of an engineer in a locomotive cab after he has passed out of the limits of the spread of the main beam of the signal as he approaches the signal. Fig. 11 shows a close-up prism and indicates the direction the light is deflected with reference to the prismatic formations on the back side of the glass, the word "top" moulded in the rim of the glass and the arrow on the front face of the prism.

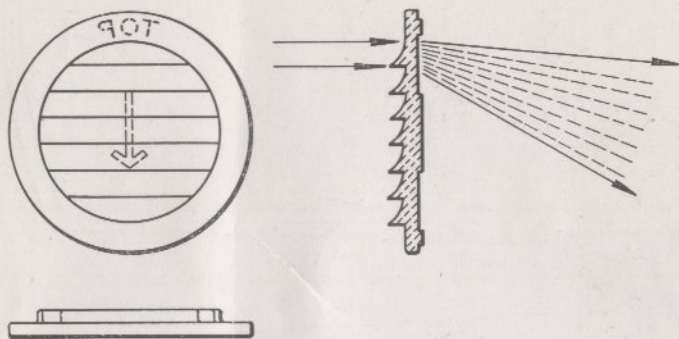
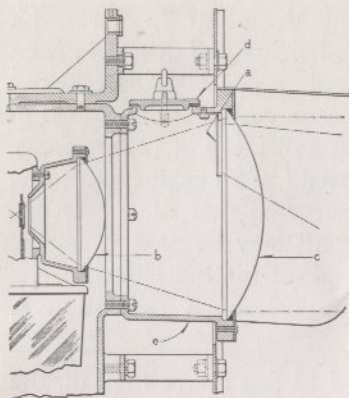


Fig. 11. Close-up Prism

Since signals are located at various heights and distances from the track, it is impossible to adjust the close-up prism at the Factory for all conditions of installation. However, to produce the indication at a point most easily found by installation forces in the field, the prism is adjusted at the Factory to produce the close-up indication vertically downward on high signals, and vertically upward on dwarf signals. The installation forces in the field should readjust the indication to meet local conditions.

In the Style "H" signal, the standard lens has a deflecting prism formation moulded in the center of the lens on the inside; this deflects a portion of the light beam downward at an angle of approximately 40° from the center line of the main light beam, for "close-up" view of the indication, when the signal is located above the engineman's line of sight. The close-up indication of the Style "H" Signal is adjusted by loosening the lens ring which holds the lens in place and rotating the lens in the case. For the Style "H-2" Signal, the close-up prism,



Access to the close-up prism "a," Fig. 12, located between the inner and outer lenses "b" and "c," is obtained by removing the hand hole cover "d" on the lens adapter "e."

Fig. 12. Location of Close-up Prism (H-2 Signal)

which is separate from the lens and mounted adjustably as shown in Fig. 12, is adjusted by removing the hand hole cover and rotating the prism to the angle desired.

In dwarf signals and high signal equipped with cover glass and "Phankill" unit, the close-up prism is located in the center of the "Phankill" screen as shown ("C," Fig. 8). When this assembly is added to a signal, the close-up prism furnished with the signal is removed. In the Style "H" Signal the outer lens with deflecting center is removed and replaced with the plain center lens furnished with the assembly. The close-up prism in the Style "H-2" Signal is removed through the hand hole "d," Fig. 12. To adjust the close-up prism when assembly Fig. 8 is used, loosen, but do not remove, the two screws "A." Rotate the entire "Phankill" unit "B" until the indication is observed at the desired point as described below and then tighten the two screws.

To adjust the close-up indication, an observer should be stationed in a locomotive cab at a distance of 40 feet

from the signal, indicated by the point "X," Fig. 13. Signals are located at various heights and distances from the track. The location selected for point "X" in advance of the signal is satisfactory for all customary locations of signals. Point "X," located at a distance of 12 feet above the rail, is the approximate height of an engineman's eye. A special stepladder so constructed that the observer's eye is located at the point "X" may be used if a locomotive is not available. To adjust the indication, rotate the close-up prism until the maximum indication is observed at the point "X."

For ground signals located 12 feet above the rail, the close-up prism must be turned to direct the indication approximately horizontal in order to be in line with the point "X" as shown in the lower view, Fig. 13. For other signals, located at greater heights such as the upper unit, the close-up prism will not require as much rotation from the factory setting as signals located at a lesser height.

5. OTHER INSTALLATION DETAILS—The high signals are furnished with or without flexible conduit in accord with the requirements of the railroad. The present tendency with the railroads is toward the elimination of the flexible conduit as the heavy rubber covered wire with braid covering can be brought directly to the operating unit terminals. When conduit is not used, the wires to the signal are laced or taped together and trained as desired. It is desirable that the wire entrance to the signal be sealed up after the wires are in place to keep moisture and dust out of the signal. A good way to accomplish this is to fill the space around the wires from the inside of the signal case, with oakum.

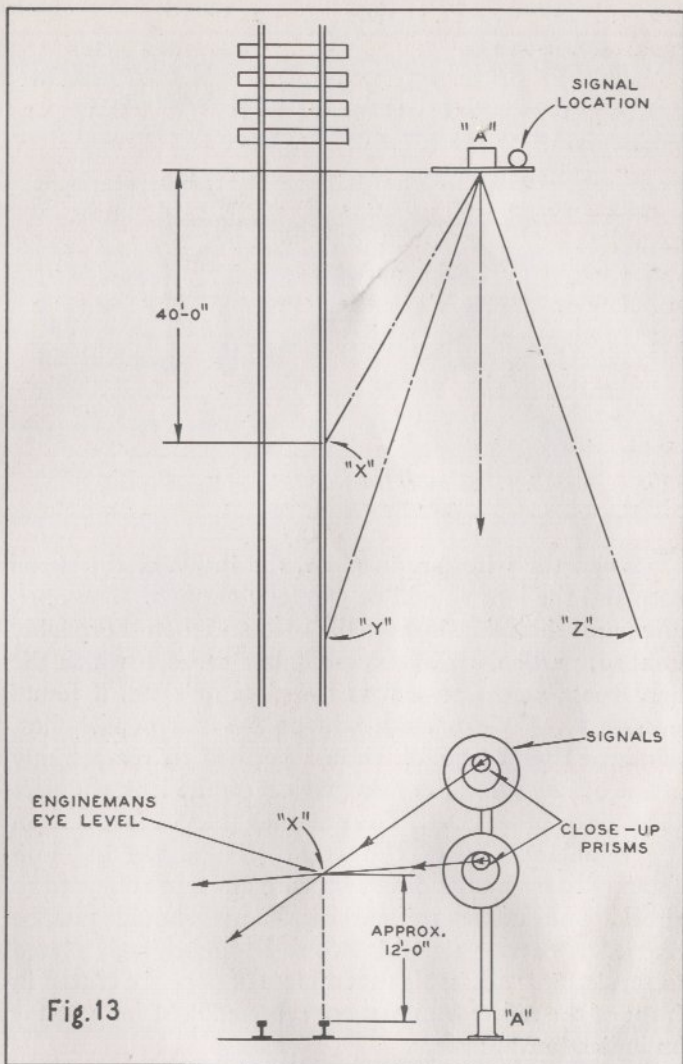


Fig.13

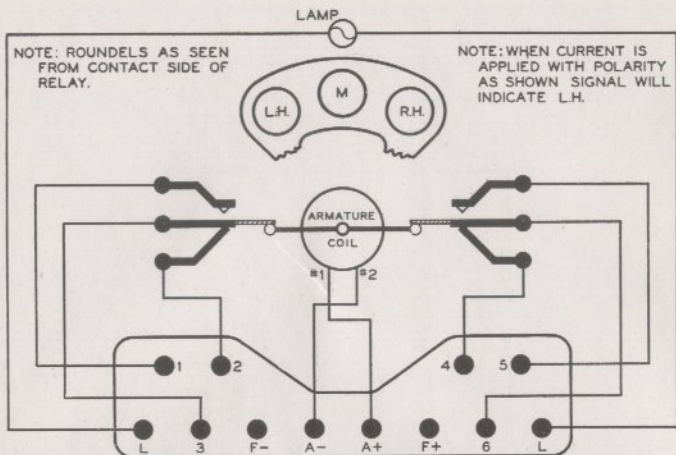


Fig. 14. Diagram of Internal Wiring of Signal with Permanent Magnets

When the wires are in place, the inside of the signal case and the lens should be carefully cleaned. The operating unit should be inspected, tested and then thoroughly cleaned, particularly all exposed glass through which the light beam passes as well as the glass reflector, if found necessary. A clean cloth which does not deposit lint, dampened with alcohol, should be used to remove any grease or oily substance that may get on the lens, the glass reflector or other glass. The unit may then be fastened on the signal and wires connected. The operating unit should always be handled with care and not subjected to shock, and under normal conditions should not be opened. Where a signal is not to be immediately placed in service, it is advisable that a piece of paper be placed in front of the reflector to prevent reflected light from giving an indication.

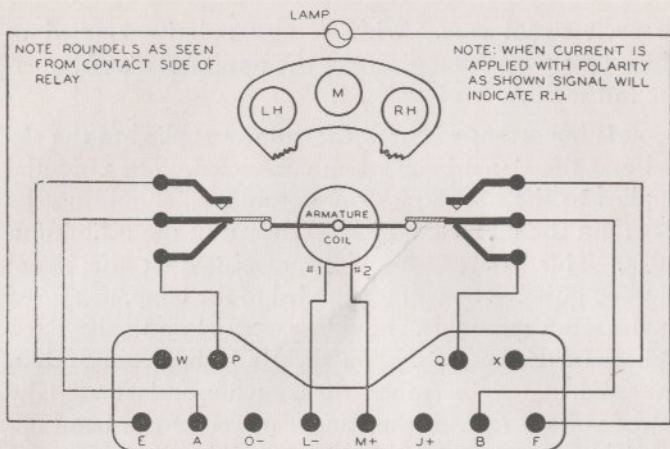


Fig. 15 Diagram of Internal Wiring of Signal with Permanent Magnets. (Differs from Fig. 14 in terminal designation and relative direction of armature rotation.)

Operating units are usually equipped with two dependent front and back contacts, and with an arrangement of binding posts, binding post designation figures, and wiring in accord with diagram shown in Figure 14. Both back contacts are closed when the armature is deenergized. The other contacts are closed only at the "yellow" and "green" positions of the relay respectively. This unit is also furnished, when so specified, with the binding posts designated with letters as shown in Fig. 15. The operating unit is also furnished without contacts. The wiring diagram furnished with this unit is the same as Figs. 14 or 15, but the wires from the contacts to the terminal board are omitted, and the binding post holes in the terminal board for the contact wires are closed up with dummy screws. A wiring diagram in accord with the particular unit to be used is placed on the inside of the door

of each signal case. With voltage polarity applied as shown on the wiring diagram, the armature should operate in the direction indicated.

It is important to check the voltage applied to the signal and the signal lamp when connected. The potential applied to the operating or armature coil, should not be less than the maximum pick-up shown in the calibration table. This voltage should be measured at the signal binding posts. The voltage applied to the lamp, measured at the lamp terminals, should be very close to the rated voltage of the lamp. Even a slightly higher voltage than the rated, materially reduces the lamp life, and a materially lower voltage reduces the candle power of the lamp appreciably.

6. INSPECTION AND TEST OF OPERATING UNIT—The operating unit should be given a visual inspection to see that it has not been physically damaged in shipment. Check to see that the glass cover is not cracked or disturbed or that the glass reflector or any of the glass parts are not cracked or broken. Exert outward pressure on the reflector holder, and check to see that the holding springs have sufficient tension to properly seat the reflector holder. By visual observation through the glass cover, see that the counterweight arms and connections to the contacts are properly in place, and that clear armature air gaps of approximately 0.050" exists. Rock the unit gently sideways and see that the armature rotates freely.

The pick-up and release of the unit should then be taken to see that these operating values are in practical accord with the limits given in the table following, for the particular type of unit. The figures given in the table are the values specified for our shop test.

Release—Apply voltage to the armature coil terminals equal to twice the maximum pick-up value shown in the table and then gradually reduce this voltage until the armature returns to the central position. The value of the voltage at which the counterweight just touches the bottom stop is the release, and should not be less than the value given in the table.

Pick-up—Immediately after measuring release, the circuit should be opened for one second and then voltage applied in the same direction and gradually increased until the unit picks up, and the counterweight arm just touches the top stop. This value of the voltage is the pick-up, and should not exceed the value given in the table.

The polarity of the voltage on the armature should then be reversed and the release and pick-up taken in the same way in the reverse direction.

It is desirable in taking the pick-up and release that the voltage applied to the armature terminals be varied very gradually to aid in detecting any friction or mechanical resistance to the movement of the armature. The best method of varying the voltage is by means of an adjustable resistance connected in accord with the potentiometer method.

TABLE OF OPERATING VALUES

Permanent Magnet Type of Unit	Resistance Ohms Armature	Armature Volts	
		Minimum Release	Maximum Pick-up
With Contacts	250	2.0	5.2
With Contacts	500	3.0	7.6
Less Contacts	250	2.6	5.2
Less Contacts	500	3.8	7.6

7. **MAINTENANCE**—The first essential of maintenance of the signal is cleanliness. The case door should be kept tightly closed, except when necessary to open it, to keep all dust, rain, snow, etc. out of the signal. It will therefore usually be only necessary to clean the outside surface of the lens occasionally as the conditions of the atmosphere, etc. require. If dust or foreign material collects on the reflector or glass through which the light beam passes or on the inside of the lens for any reason, it should, of course, be cleaned off. Cleaning of glass should be done as outlined under Installation Details (Section 5). To clean the inside of the lens or the glass on the lens side of the unit, it is necessary to remove the unit from its mounting and tip it forward.

Except in cases of emergency, we recommend that the operating unit not be opened in the field. If, for any reason, the unit is thought not to be in proper operating condition, we recommend that it be replaced by a spare operating unit and sent to the railroad repair shop or to our factory for investigation and repair.

Periodical inspection should be made of the colored glass roundels to see if they are properly in place or broken. Inspection of the colored roundels may be made by removing the reflector holder and observing the roundels through the glass at this location. Occasionally a roundel will crack due to a strain set up in the glass on account of the intense heat of the concentrated light beam. The roundels, however, are made from special heat resisting glass to withstand this heat. A simple crack through the glass is not considered objectionable as the small retaining ring around the edge of the glass will hold the parts in place. If, however, a double crack should occur or a small

piece break out, allowing white light to pass through, the roundel should be replaced. In order to overcome this difficulty with the green roundels which have more tendency to crack due to higher absorption of heat than with the other colors, the operating units come from the factory equipped with special green roundels, in two parts to prevent undesirable double fracture of the roundel when used in service. If in emergency, it is found necessary to change a roundel in the field, this may be done without disturbing the working parts of the unit, by removing the ring in which the reflector holder is seated. This ring is held in place by three screws entering the unit top case, one of which is sealed with a lead seal. The joint between this ring and the top case is sealed with a thin coating of a special black sealing compound, and should be resealed when the ring is replaced, care being exercised in handling so that no particles of sealing compound or other foreign matter gets into the unit. White lead may be used in the field to seal this ring to the case, however, more care must be exercised when disturbing a ring having a white lead seal, since the white lead seal has a greater tendency to chip when dry than does the black sealing compound. Care should also be taken, in replacing roundels, not to bend or distort the small spectacle which supports the roundels, as clearance between this movable element and other parts is important.

Considerable accuracy is required in the adjustment of the lamp socket with respect to the reflector to insure that maximum efficiency and proper alignment with the sighter are obtained. Replacement of the reflector alone, in signals where the reflector has been broken, does not insure that best results will be obtained and for this reason

only two methods of replacement are recommended. Replacement of the reflector holder complete with a reflector holder adjusted at the factory, or returning the complete operating unit to our factory where the lamp socket can be re-adjusted.

The unit armature is pivoted on specially constructed knife-edged bearings. As no oil should ever be used on these bearings or other pivots of the unit, there is normally no occasion to open the unit.

We recommend that the pick-up and release of the operating unit be taken and recorded periodically, approximately every six months. This should be done as outlined herein under "Inspection and Tests," (Section 6). As the iron structure of this unit is made of a special non-aging iron, very little variation may be expected from the operating values given in the table, on account of residual magnetism. The principal purpose of the electrical test, therefore, is to determine whether any friction is developing in the armature bearing or other moving parts. A "jerky" movement of the armature when the armature current is varied gradually, is an indication of friction, roughness or foreign particles in the bearings or pivots of the moving parts. When this test is made, the operation of the contacts, when used, should be observed to see that they are closing properly with a slide of approximately $\frac{1}{32}$ " on the front contact and $\frac{1}{64}$ " on the back contact. An increase in pick-up value or a decrease in release of over 20%, in our opinion, would indicate undue friction and would justify sending an operating unit to the shop for investigation and repair.

8. LAMPS—Lamps furnished by the Union Switch & Signal Co. for the searchlight type signal are based with the filaments accurately located with respect to the pins in the base. It is obvious that when such a lamp is installed for replacement, the signal indication will remain the same as before. If non-precision lamps, having filaments appreciably off the true location, are used, not only will the signal indication be impaired, but the alignment of the light beam may not be parallel to the sighting device on the signal and therefore not pointed in the direction indicated. For best results, therefore, it is desirable that accurately based lamps be used.

The lamps used in the Style "H" Searchlight Signals are of the S-11 bulb, candelabra bayonet base, C-2 filament, single contact, $\frac{1}{64}$ " precision type. Some of the lamps suitable to this service are:

Volts	Watts	Volts	Watts
**4	3	**10	5
**8	5	10	10
8	10	10	18
* 8	10	* 10	18
		11	11

* Double Filament type.

**For use with Style "H-2" Signal only.

There are also available some special double filament lamps rated at 8 volts and 10 volts with the main filament 13 watts and the secondary 3.5 watts.

The filaments are connected in multiple and it is recommended that they be burned at about 7.25 volts for the 8 volt lamp and 9.0 volts for the 10 volt lamp. These values are sufficiently below the rating of the main

filament to give it a long life, while the secondary filament is assured an extremely long life due to its being burned at a voltage considerably below its rating.

The time that lamps may be used consistent with minimum lamp failures varies with several other factors. Some railroads continue the use of signal lamps until the lamp fails. Most of the railroads, however, replace the lamp at regular intervals with a view of anticipating the larger percentage of lamp failures.

For information on lamps and handling of lamps see Instruction Pamphlet U-5037 on "Life, Installation and Replacement of Railway Light Signal Lamps."

POINTS TO BE OBSERVED IN MAINTENANCE

1. Replacement of broken lenses in the field should be avoided if at all possible. Due to variations in lenses, proper results in efficiency and alignment are obtained only by returning the signal to the factory or to a specially equipped railroad shop for optical adjustment. The glass reflector, if damaged, should not be replaced, but the entire reflector assembly may be replaced without much loss in alignment or efficiency.

2. Using a lintless cloth, clean both surfaces of each of the lenses by removing the operating unit and hand-hole cover, being careful not to disturb the adjustment of the close-up prism. Clean the windows in the operating unit, and clean both the reflector and lamp bulb, without removing the lamp.

3. To install a lamp in the lamp socket, insert the lamp base into the socket as far as it will go, then turn the lamp clockwise as far as possible, then pull out until the pins in the lamp base are properly seated in the pin seats in the socket.

4. Lamp voltage should be checked periodically and re-adjusted, if necessary. For further information on lamps, see Instruction Pamphlet U-5037 on "Life, Installation and Replacement of Railway Signal Lamps."

5. A periodic test should be made of the operating unit to determine pick-up and release values, and to detect any improper operation. In case of trouble, replace the unit, and send the defective unit to the Repair Shop for inspection and test per Service Specification 2377.

