American Railway Signaling Principles and Practices

CHAPTER XII

Semaphore Signals

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CHAPTER XII

SEMAPHORE SIGNALS

General

Historical.

About the year 1841, the semaphore type of signal was first designed and erected at New Cross, England, by Mr. C. H. Gregory, and proved to be a very important step in the development of railway signaling.

The first semaphore type signals were mechanically operated; first by levers or handles on the mast; later by wires; and by rods or pipes connected so the signal could be controlled from a remote point. Counterweights were added to the arm or spectacle to cause the signal to assume the Stop position by gravity.

The earlier types of semaphore signal were of the lower quadrant type, the arms being displayed to the left of the mast in England and on the Continent where left-hand running is the practice, and to the right of the mast in America where right-hand running is used.

In 1906 the upper-quadrant semaphore type signal was standardized by the Railway Signal Association and has been used extensively by American railroads.

This chapter will deal with the various types of semaphore signals, their construction, operation and maintenance.

Indications.

The day indications of semaphore signals are displayed by the position of the semaphore arm and the night indications by colored lights. The aspects and indications for upper-quadrant semaphore signals are explained in Chapter II—Symbols, Aspects and Indications.

Blades.

The blades are of wood or enameled steel and are usually red or yellow in color, the ends of the blades being either square, pointed, fishtail or round, depending on the purpose for which the signal is used. Details of standard signal blades are shown on Drawings 1065B and 1548.*

Spectacles and roundels.

The spectacles used in upper-quadrant semaphore signals are shown on Drawings 1040C, 1041C and 1233B. The blades are bolted to these spectacles, and colored glasses or roundels are placed in the openings provided for this purpose. The roundels are shown on Drawing 1414.

A minimum clearance of ¾ inch shall be maintained between the semaphore bearing and spectacle. See Drawing 1093.

Lamp and bracket.

The lamp for the night aspects is mounted on a bracket in such a position that the lens is immediately behind and in the center of a roundel in the spectacle. The bracket is shown on Drawing 1049B.

The lamps may be either oil or electric. Oil lamps are usually fitted with a long time burner and an oil fount with a capacity of 31 ounces.

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* Drawings referred to in this Chapter are reproduced in back pages.

This amount of oil is sufficient for six days burning when a long time burner is used. A special grade of kerosene oil is used, known as "long time burning oil."

A lamp with long time burner and chimney is illustrated in Fig. 1.

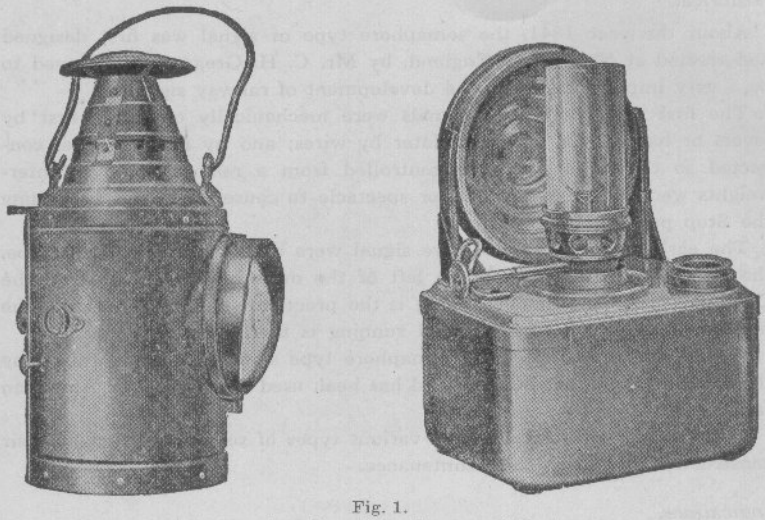


Fig. 1.
Oil Burning Semaphore Lamp and Parts.

Oil burning lamps are sometimes converted to electric lamps by removing the fount and burner and using in their place a socket and electric lamp, or by inserting a specially constructed reflector unit in place of the lens. A converted oil lamp is illustrated in Fig. 2.

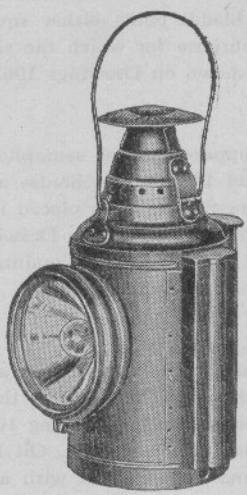


Fig. 2.
Oil Lamp Equipped for Electric Light.

A lamp case designed for electric light only is shown on Drawing 1446B.

The electric lamp used in semaphore signals is designed with filaments suitable for the power supply, ranging from 2.5 to 115 volts. For the lower voltages the filaments are very concentrated and located accurately within $\frac{1}{32}$ inch of a standard light center length and axial alignment. It is further described under "Lamps" in Chapter XIII—Light Signals.

Mechanical Signals

Mechanically operated semaphore signals consist of one arm, or more, supported by a bearing attached to a signal mast and operated, generally, by a rod connection consisting of sections of one-inch pipe extending from a crank attached to the base of the mast to a pin or stud on the semaphore casting or spectacle.

Details of one and two-arm upper-quadrant mechanical ground signals are shown on Drawings 1043D and 1044D.

Dwarf Signals

Dwarf signals are used for movements against current of traffic, and from sidings, at terminals and at other locations where conditions make it impracticable to use high signals. They may be mechanically or power operated similar to high signals of the types described in this chapter.

Due to the low torque of dwarf signal spectacles, a spring attachment is provided in all types except those which are pipe-connected, to return the spectacle to its most restrictive position.

Mechanical dwarf signals are shown on Drawings 1097 and 1545B.

Train Order Signals

Train order signals are used at stations or telegraph offices to indicate to trains when train orders are held at that office for them.

Two spectacles and blades are mounted on one mast as shown on Drawing 1236D and a lamp with two lenses opposite to each other is used for the night indication.

These signals are usually operated mechanically, being connected by pipe to two levers on or near the operator's desk, although some are operated electrically when the signal is located a remote distance from the control point.

Power-Operated Signals

Electric motor.

The early types of motor-driven semaphore signals consisted of a motor, usually operated on 10 volts, which drove the semaphore arm through a train of gears; the connection between the gears and the semaphore being by means of an electromagnet which, when energized, engaged a latch. These types of mechanisms are mounted in a case at the base of the mast, and the motion transmitted to the semaphore arm by means of a rod passing upward through the mast. This type is known as a base-of-mast mechanism, one of which is illustrated in Fig. 3.

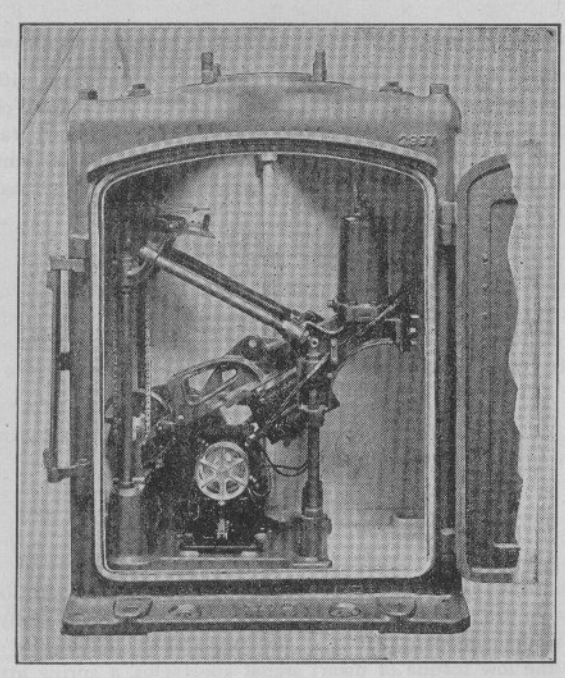


Fig. 3.
Electric Motor Signal, Base-of-Mast Mechanism.

One, two or three arms may be operated by one motor by the application of an electromagnet or slot-arm for each arm to be operated.

As the use of electric motor semaphore signals became more extensive, there was developed a type of mechanism which was self-contained in a case containing the semaphore shaft and operating mechanism, and which could be clamped to the side of a signal mast. This type is known as a top-of-mast mechanism, one of which is illustrated in Fig. 4. These types are known as a "drive-back" type whenever the gears and motor are driven backward by the torque of the semaphore arm and spectacle when returning to the "stop position." The Type 2A and Style T-2 are mechanisms of this character.

This mechanism has the advantage of being readily clamped to an existing signal mast, and has a direct connection between the mechanism and the spectacle.

Mechanisms of the base-of-mast and top-of-mast types are made to operate on either direct or alternating current with slight alterations, the principal difference being in the motor and slot-arm or holding magnets.

The motors used on signals for direct current operation are usually series-connected; that is, their field coils and armatures are connected in series. For alternating current operation, an induction type motor which has no commutator or brushes is used.

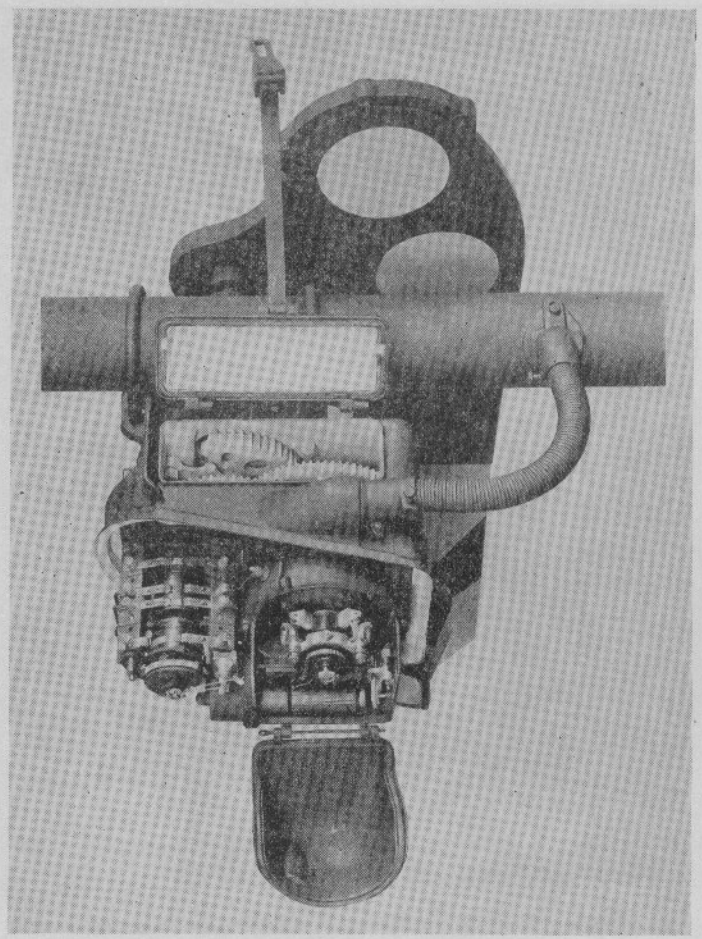


Fig. 4.
Electric Motor Signal, Top-of-Mast Mechanism.

Types of Mechanisms

Style B.

The Style B mechanism is illustrated in Fig. 5.

The operation of a two-arm two-position Style B mechanism is as follows, having reference to Figs. 5 and 6: with the signal in the Stop position and current applied to the home signal, slot coil 7 and motor M (see Fig. 5) in multiple, the motor revolves the gear 3 by means of the large gear 1 and pinion 2. This causes the trunnion 12 on chain 10 to engage the prongs of the fork head 5, and move the slot-arm about G (see Fig. 6) as a center. This clears the signal which is operated by an up-and-down rod attached at K by jaw 6. When the slot-arm has reached the position shown at A (Fig. 5) the lugs S on the fork head 5 engage hooks on the pawl 24 (shown dotted in Fig. 5). This supports the arm in the Clear position. In assuming

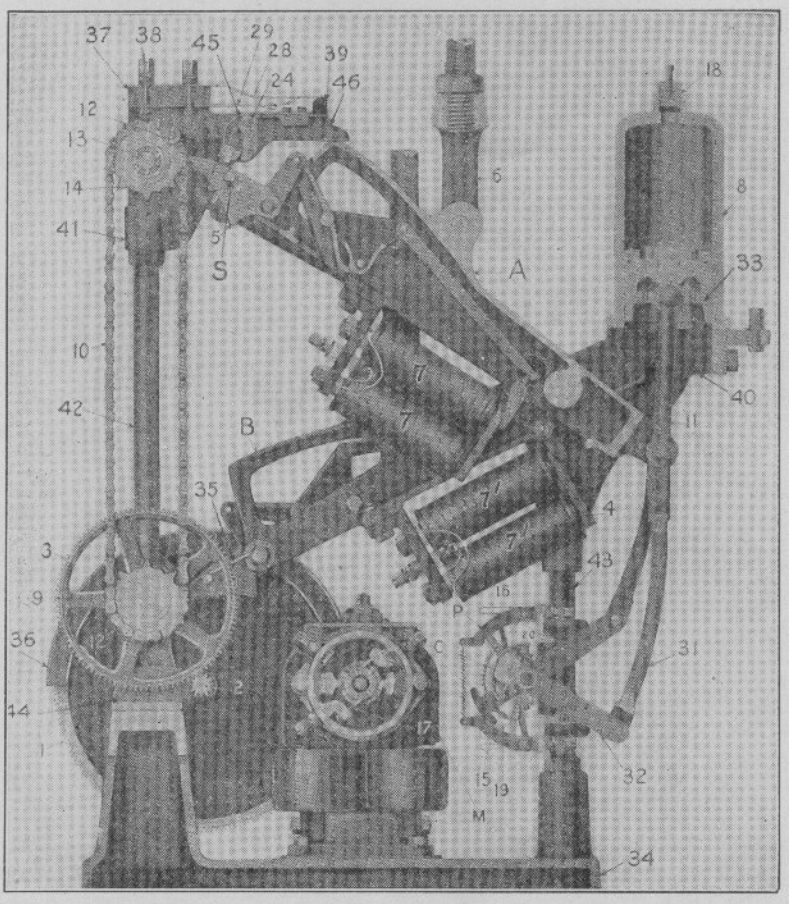


Fig. 5.
Section View of Two-Arm Two-Position Style B
Base-of-Mast Mechanism.

this position, the top of slot-arm strikes against the lever 46. This causes the insulated block 39 to raise contact spring 28 off contact spring 29, thereby opening the motor circuit and stopping the motor. It also closes the contact spring through which the distant signal is controlled. In order that pawl 24 shall be certain to engage lugs S, a spring 45 is fastened to lever 46. Its lower end bears on pawl 24 so that the raising of lever 46 by the slot-arm puts tension on the spring and forces pawl 24 into engagement with the lugs S. When the slot magnet is de-energized the armature 4 falls away by gravity. This releases latch D, permitting link F and fork head 5 to assume the de-energized positions shown in Fig. 6. This allows the signal to go to the Stop position. A dash pot 8 provides an air cushion to absorb the shock incident to the return of the signal to its Stop position. Fork head spring 35 restores the fork head to its normal position after the

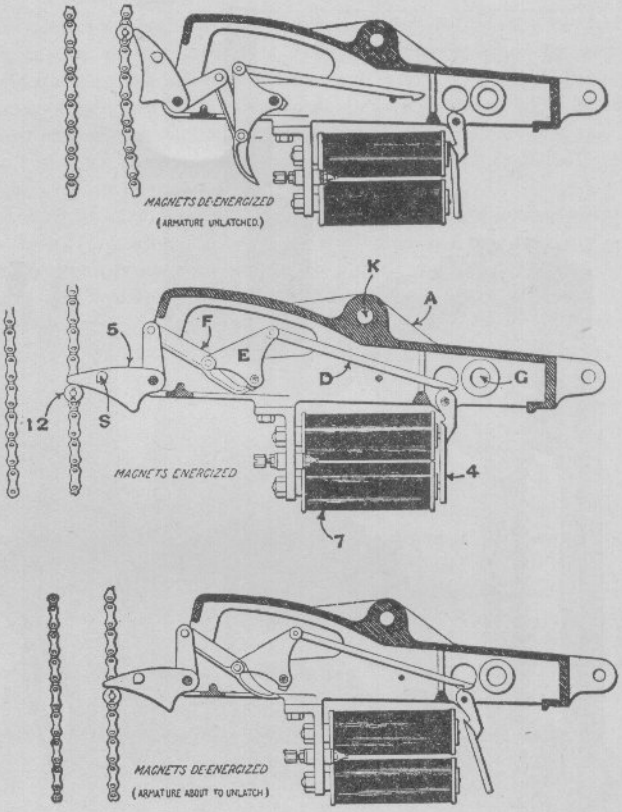


Fig. 6.
Section Through Slot-Arm of Style B Mechanism,
Showing Successive Positions.

slot-arm has passed the holding pawl 24 when returning to the Stop position. One feature of this signal is the arrangement of the parts whereby the slot armature 4 moves both to and away from the pole pieces by gravity. The distant slot 7′ clears the distant signal in exactly the same way as the home signal was cleared, except that it has two windings, one high and one low. The low-resistance winding is generally of 0.1 ohm resistance and is connected in series with the motor so as to provide sufficient holding power while driving the signal to the Clear position. Being in series with the motor, it is cut out when the signal reaches the Clear position. The high resistance winding is generally of 1000 ohms resistance and is used for holding the signal in the Clear position. Connecting link 31 is used to actuate a pole changer P or circuit controller C for the control of outside circuits. Mechanisms of this type for operating one arm only are furnished with one slot-arm, sprocket, chain and dash pot.

When polarized control circuits are used it is necessary to make the home slot magnet slow-acting due to the slot battery being interrupted on

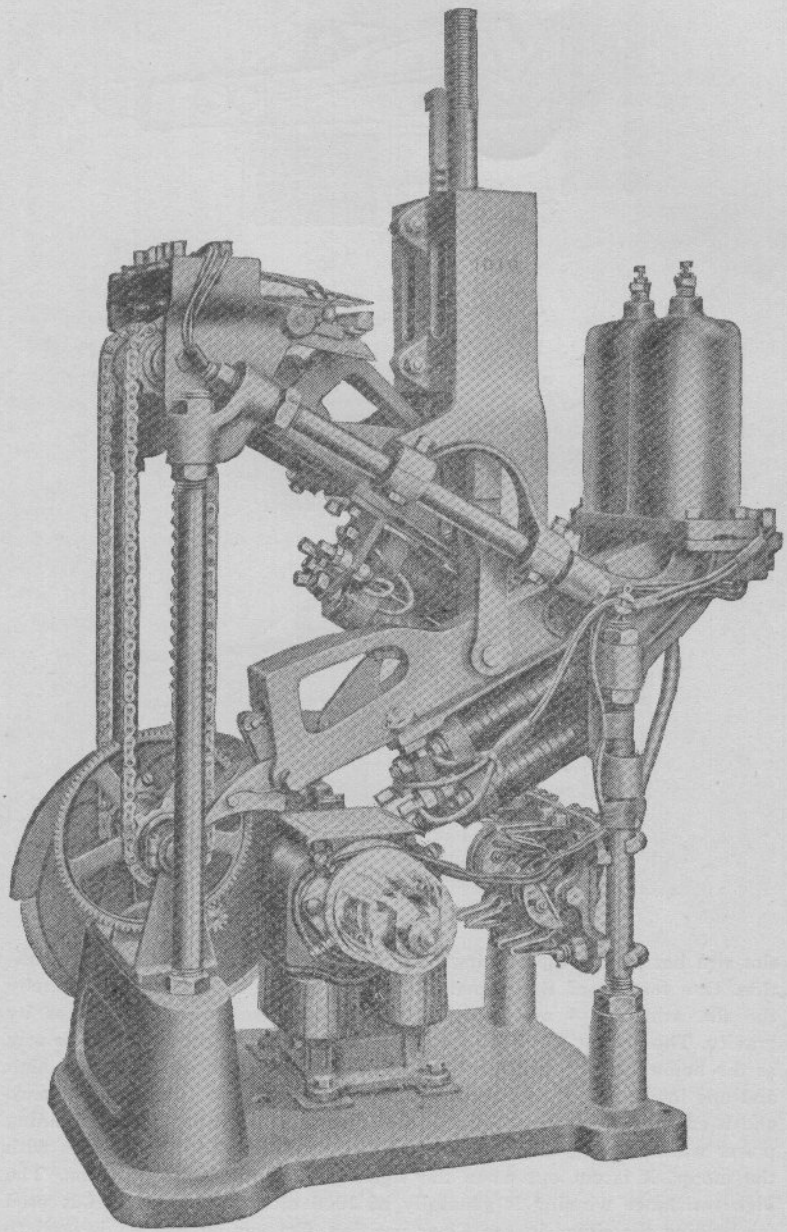


Fig. 7.
One-Arm Three-Position Style B Signal Mechanism.

the home slot-arm at the time of polarity reversal of the control relay. The slow release on the home slot magnet is accomplished by means of a copper sleeve over the core of the magnet inside the coil. This acts as a short-circuited winding of large current capacity, which induces sufficient magnetism in the core to keep it energized a short time after the current has been cut from the coils on account of the current induced in it when the holding circuit is open.

Figure 7 illustrates mechanism equipped to operate a single-arm three-position signal. The up-and-down rod terminates in a jaw carrying a pinion. This pinion engages on each side with a rack operated by each slot-arm. The pinion and two racks are enclosed in a case clamped to the frame of the mechanism. Thus, when one slot-arm is raised its rack revolves the pinion which travels upward on the other rack. This moves the semaphore arm to the intermediate position. Raising of the second slot-arm causes the pinion to travel up the first rack and completes the stroke of the semaphore arm. Dash pot air buffers are attached to each slot-arm as described for two-arm two-position signals.

The motor of the Style B signal is illustrated in Fig. 8. Its brake is controlled by the field magnet and prevents the motor running free after the current is cut off. The commutator is enclosed in a glass case to keep it free from dust and prevent formation of frost.

The Style B mechanism is made to operate on alternating or direct current.

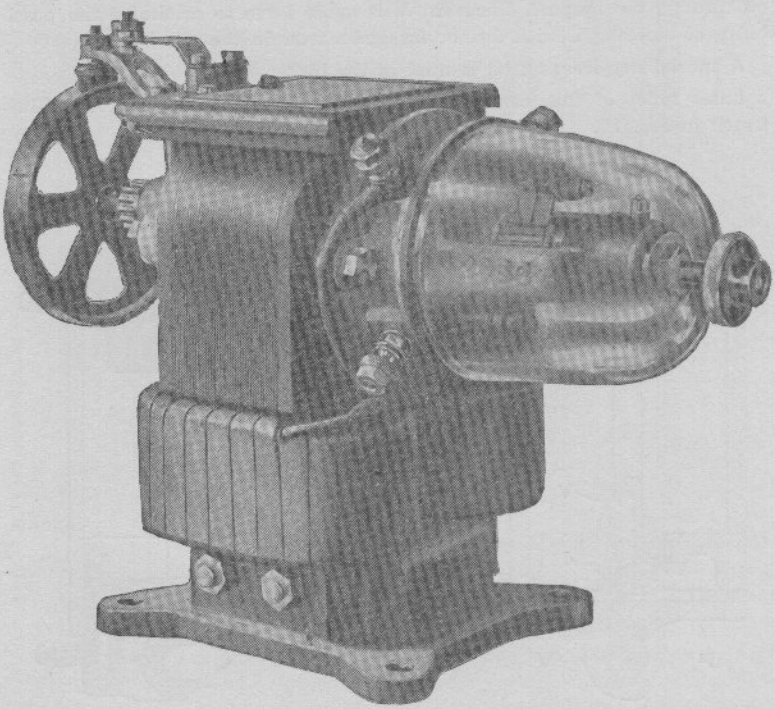


Fig. 8.
Direct Current Motor for Style B Mechanism.

Style S.

The Style S mechanism is a development of the Style B mechanism to meet the requirements of the three-position upper quadrant signal, and is made to operate on direct or alternating current, shaded pole slot magnets and induction motor being used on the alternating current mechanism.

In the Style S three-position signal but one slot-arm with its transmission parts is employed for the operation of each semaphore arm. An air buffer is pivoted to the frame immediately below the point on the slot-arm to which the vertical signal rod is attached.

The upper end of the buffer piston rod and the lower end of the signal rod are fitted with jaws and connect to the slot-arm with one common pin in the same manner as the well-known wide and narrow jaws are connected to a crank in mechanical interlocking practice. This method transmits the shock of the signal arm when returning to Stop position directly to the buffer.

The early mechanisms of this type were equipped with an oil buffer as illustrated in Fig. 9.

A vent V shown in Fig. 9 allows oil to pass upward through the piston rod past the head on the downward or buffing stroke, while on the up stroke the plate P falls away from the lower surface of the piston head and allows the oil to pass through the by-pass shown. On the down stroke the pressure of the oil forces P against the piston ahead and stops the flow of oil through the by-pass. The vent V is made large to minimize the possibility of blocking it with dirt or foreign matter in the oil.

A special non-freezing oil is used in the buffer.

Later types of this mechanism are equipped with air buffers as illustrated in Fig. 10.

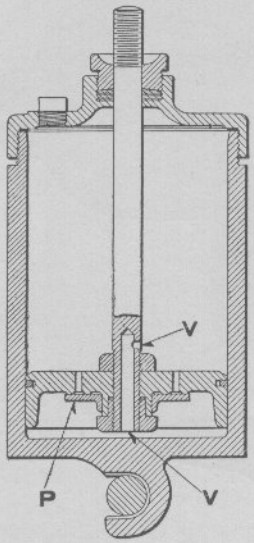


Fig. 9.
Oil Buffer, Style S Mechanism.

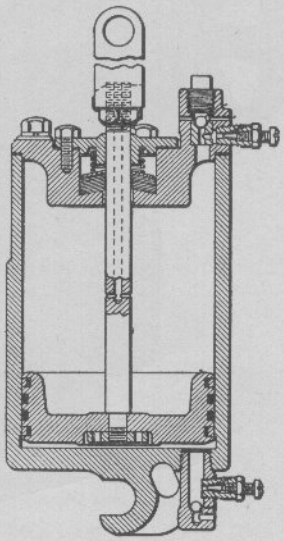


Fig. 10.
Air Buffer, Style S Mechanism.

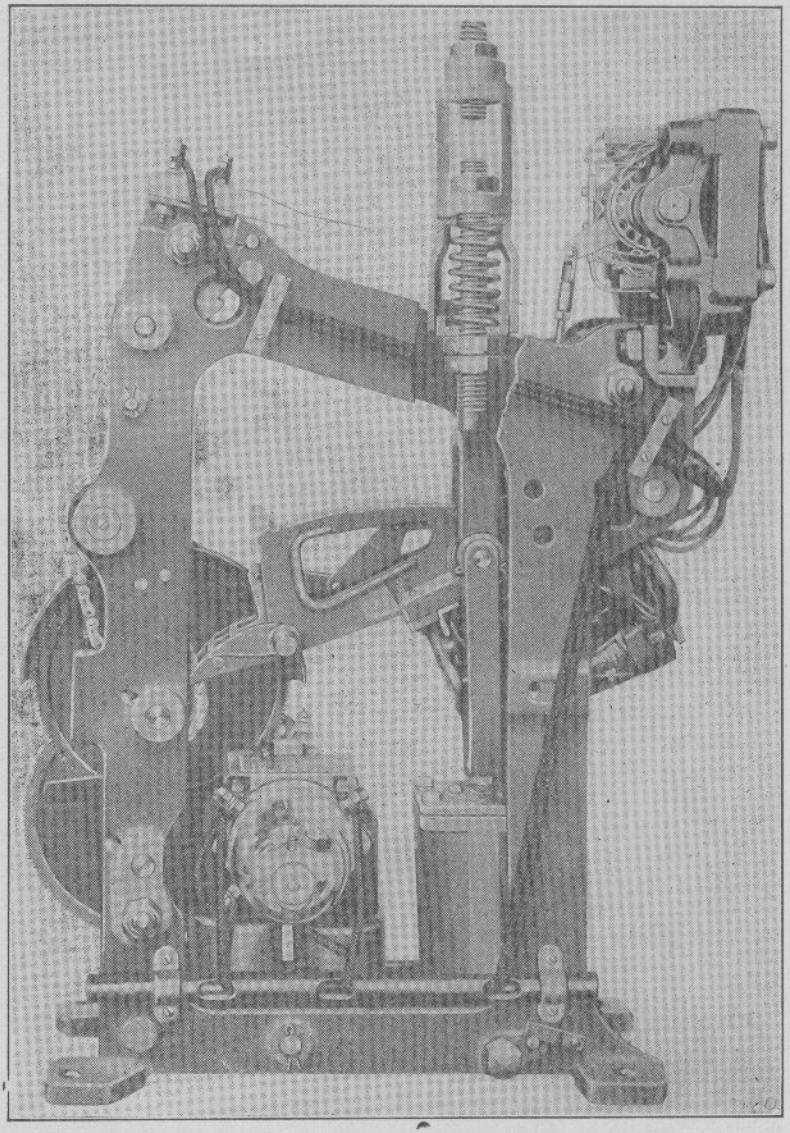


Fig. 11.
Style S Base-of-Mast Mechanism.

This buffer cushions the signal by vacuum as well as compression. The return of the signal from the 90 to the 45 degree position is accomplished almost entirely by the vacuum created in the top portion of the cylinder during the first half of the downward stroke of the piston.

The movement from the 45 to the zero degree position is cushioned by the compression created in the bottom portion of the cylinder during the second half of the downward stroke of the piston.

The main circuit controller to which a pole changer can be applied when required, is located to the right and above the slot-arm, thus providing space for two relays in each mechanism case and keeping the controller contacts out of the way of oil and dirt.

The base of the controller is made of porcelain treated with black insulating varnish. By this means all hidden insulations liable to be charred by lightning, such as bushings and washers, are dispensed with. The controller is equipped with non-turning binding posts and otherwise is designed to comply with Signal Section, A.A.R., requirements.

The circuits for the intermediate or 45 degree position of the arm pass through this controller, which also serves as a main terminal board for the mechanism. Additional circuit controllers are carried on the left-hand upper corner of the mechanism and operated directly by the slot-arm.

The slot-arm is similar in design and principle with that used on the Style B except that the fork head or lifting crank has three prongs.

Two chains are employed, the center lines of which are tangential to the arc described by the slot-arm. The lower chain lifts the slot-arm from the zero to the 45 degree position, and the upper chain from the 45 to the 90 degree position. The chains are staggered with relation to each other, the lower engaging the front and middle prongs of the fork head, and the upper the middle and rear prongs.

The slot-arm rests on hooks in both the 45 and 90 degree positions, thus retaining two of the important features of the Style B signal: *viz.,* (1) the 90 and 45 degree positions are definite and do not depend on the adjustment of circuit controllers; and (2) in both these positions the signal is entirely free from its running gear.

The motor straddles a pin passing through both frames, to which it is secured by set screws. A connection between the motor and a cam on the frame permits of adjustment between the motor pinion and the gears. Figure 11 illustrates a Style S mechanism.

Model 2-A.

The Model 2-A signal mechanism is made in both base-of-mast and top-of-mast types, and for any aspect; two or three positions of the semaphore blade, upper or lower quadrant, and right or left-hand of mast, and for alternating current of any voltage or frequency up to 220 volts, and for direct current up to 110 volts.

The mechanism (Fig. 12) is practically the same for the base-of-mast and top-of-mast signals.

The motor (Fig. 13) is directly connected to the semaphore shaft through a train of gears so that the armature revolves with it in either direction. By the use of a high torque, low-speed motor, low reduction

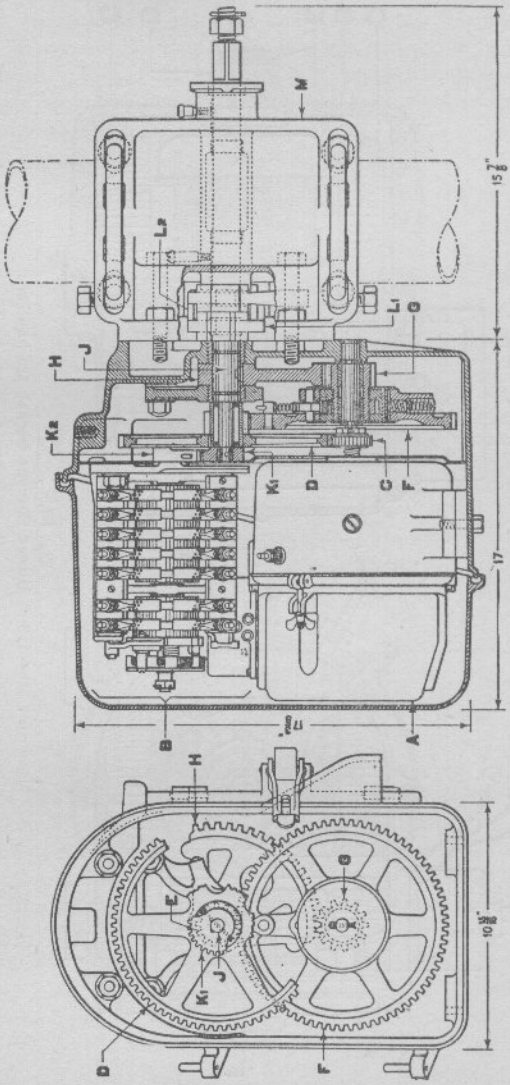


Fig. 12.
Model 2-A Direct Current Signal Mechanism.

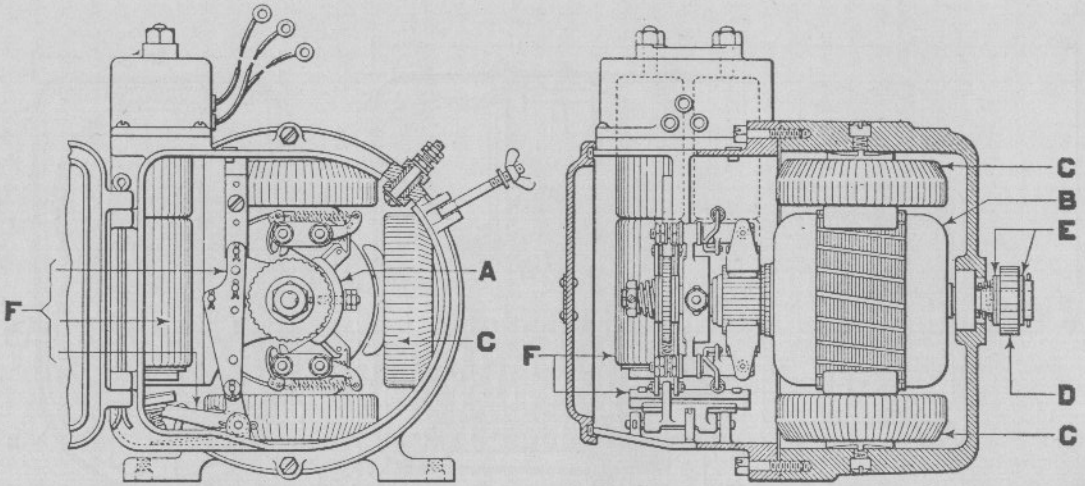


Fig. 13.
Motor for Model 2-A Direct Current Signal Mechanism.

gearing is used, 30 revolutions of the motor being required to clear the signal to the 90 degree position.

The direct current signal is held in the desired 45 or 90 degree position by means of a retaining device (Fig. 14) with which the motor is equipped. It consists of an electromagnet, the armature of which is connected, through a crank and link movement, to a dog designed to engage a toothed disc mounted on the armature shaft of the motor; the design embodies an escapement movement so that when the electromagnet is energized, the motor armature will be held only when it begins its rotation toward the Stop position. An exceedingly high drop-away is procured through having an air gap of 0.020 inch.

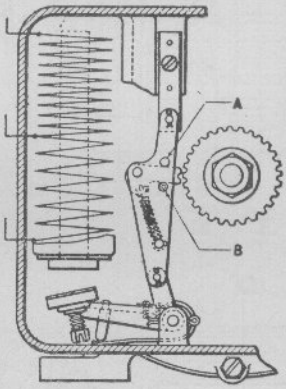


Fig. 14.
Retaining Mechanism for Model 2-A Low-Voltage Direct Current Mechanism.

Due to the motor being driven backward when the semaphore is returning towards the Stop position, electrical means is used for snubbing the movement of the signal blade without the use of a dash-pot or other additional mechanical contrivance. This is accomplished in the last few degrees of movement of the mechanism by shunting the motor, which causes it to generate sufficient current to effectively check the speed of the mechanism so that the signal parts and semaphore arm are brought to rest without shock. A half-wave rectifier is sometimes used instead of the resistance shown in Fig. 21.

The motor used for alternating current operation is of the induction type, having such efficiency that it may operate directly over the line without the intervention of line relays.

The motor unit, illustrated in Fig. 15, includes the hold clear mechanism, also a reactance coil. The hold clear mechanism is a solenoid magnet arrangement and operates in practically the same manner as the direct current low-voltage hold clear device previously described. The essential difference is the substitution of a solenoid for a tractive magnet and a slight difference in the arrangement of the several parts.

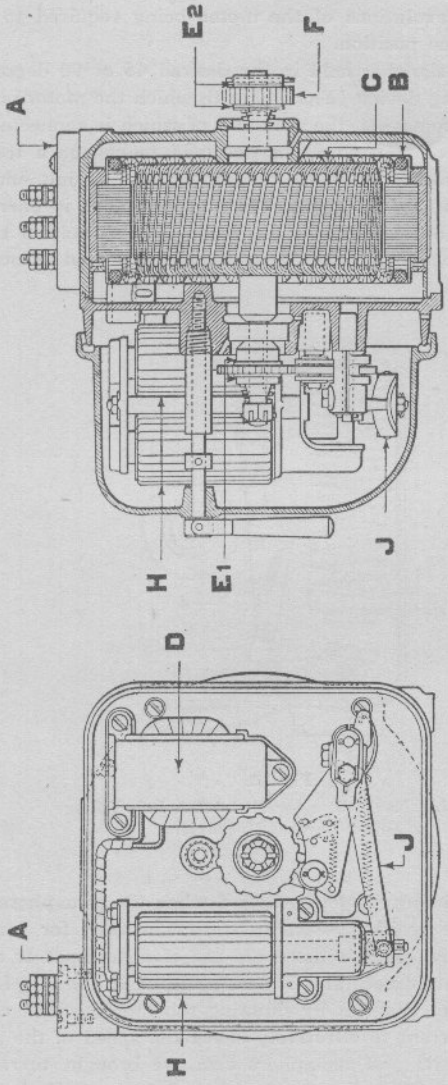


Fig. 15.
110-Volt Alternating Current Induction Motor, 25 and 60-Cycle, for Model 2-A Signal Mechanism.

This motor is known as a split-phase motor; in other words, it is a two-phase motor arranged to operate on single phase by means of the reactance unit which is connected in series with one of the stator windings in order to obtain the necessary phase displacement. Both stator windings are in service while the motor is operating, which eliminates the necessity of contacting devices such as are ordinarily used with single-phase motors to interrupt the current through a starting winding after the motor has developed normal speed.

In the base-of-mast signal the same motor, gearing and circuit breaker parts are used as in the direct-connected type, and the signal arm is operated by means of a mechanical connection. The case is designed to house one or two mechanisms, to operate one or two arms respectively.

The 110-volt direct current Model 2-A signal mechanism is chiefly used as a power interlocking signal in connection with electric interlocking, and is generally operated from a central storage battery located at or near the interlocking station. This mechanism can be made non-automatic or semi-automatic. It is equipped with a four-pole, series-wound motor and differs from the 8, 10 and 20-volt mechanisms in that the signal is held in the 45 or 90 degree position by means of the motor armature. The surface of two of the pole pieces is serrated, and when the holding field windings are energized, the magnetic attraction between these pole pieces and the armature prevents rotation of the armature in either direction thus holding the signal in the position to which it has been operated.

When the Model 2-A signal mechanism is used as a semi-automatic signal and controlled by means of a lever employing the "dynamic" principal of indication, the signal is equipped with a spring attachment located in the gear housing which is used to produce rotation of the motor armature for indication purposes after the signal has reached the Stop position.

The "dynamic" principle of indication is explained in detail in Chapter XIX—Electric Interlocking.

Style T-2.

The Style T-2 signal mechanism (Fig. 16) is made only in the top-of-mast type, and consists of an electric motor driving a train of gears, a circuit controller and a means for holding the semaphore arm in the 45 or 90 degree position. The holding slot controls the 45 degree motor circuit in addition to holding the semaphore arm in the 45 or 90 degree position, and can be inserted direct in a line circuit thereby eliminating the use of a relay at the signal solely for controlling the 45 degree motor circuit.

The semaphore arm, when returning toward the Stop position, drives the motor backward so that it acts as a generator discharging current through a resistance and the frictionless dynamic brake effect thus produced is utilized to check the speed of the mechanism so that the signal parts and semaphore arm are brought to rest without shock, practically in the same manner as previously described in the Model 2-A signal mechanism.

The armature rachet and the holding mechanism are placed in an aluminum case at the outer end of the motor shaft, thus leaving no movable parts of the mechanism exposed except the drum of the circuit controller. The slot magnet is of the iron-clad type and when energized raises the arm 42 (Fig. 17) which carries the steel roller 15 and the contact finger 41 closing the motor circuit at 20. This movement brings the roller into the path of the blades 5 of the stop drum, which is attached to the end of the motor shaft, stopping the rotation but allowing the motor to revolve by means of its rachet. When the motor circuit is opened by the contacts of the circuit controller, due to the semaphore arm having reached the desired position, current is cut from the motor, and the torque of the semaphore arm then tends to rotate the motor backward, and the signal is held in the

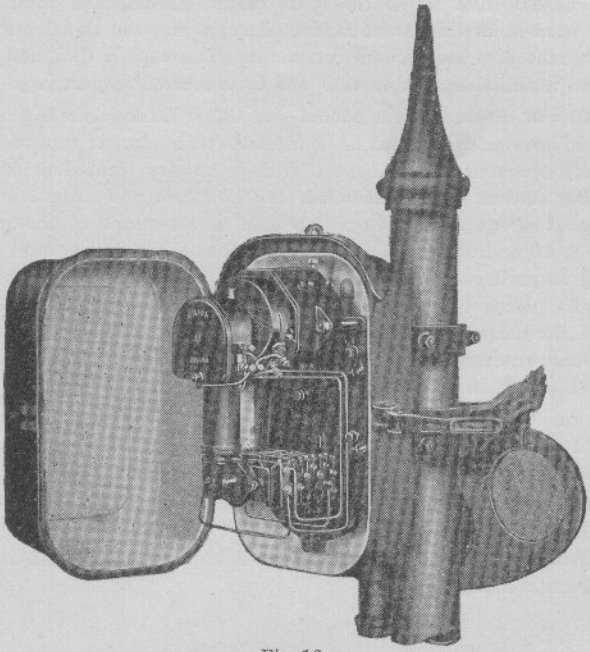


Fig. 16.
Style T-2 Direct Current Signal Mechanism.

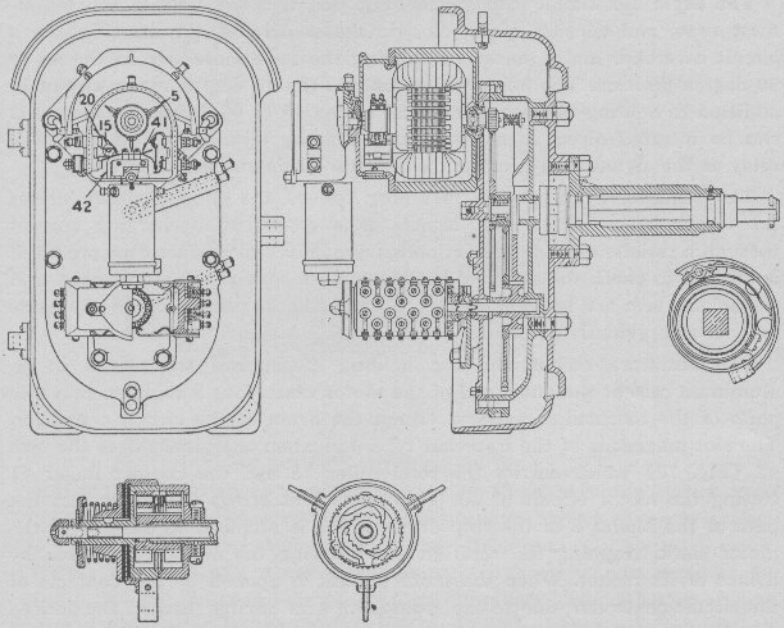


Fig. 17.
Diagram of Style T-2 Direct Current Signal Mechanism and Parts.

position to which it has been driven by means of the rachet on the armature shaft coming into play and the roller 15 being engaged with the blade 5 of the stop drum prevents the backward movement of the motor and holds the signal in position. When the slot magnet is de-energized the arm 42 is released and falls back by gravity.

For alternating current operation the Style T-2 signal is fitted with an alternating current motor into which is built a holding slot which differs from the direct current holding slot in that it is in the form of a rotor and stator, so that all latches or other mechanical holding devices are eliminated. This arrangement is illustrated in Fig. 18.

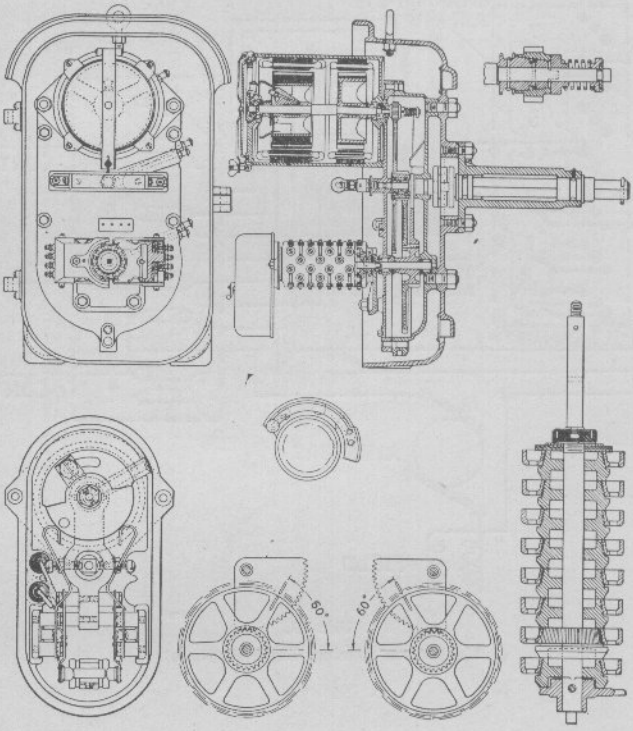


Fig. 18.
Diagram of Style T-2 Alternating Current
Signal Mechanism and Parts.

Typical mechanism wiring.

Figures 19, 20, 21 and 22 show typical mechanism wiring as installed by the manufacturers.

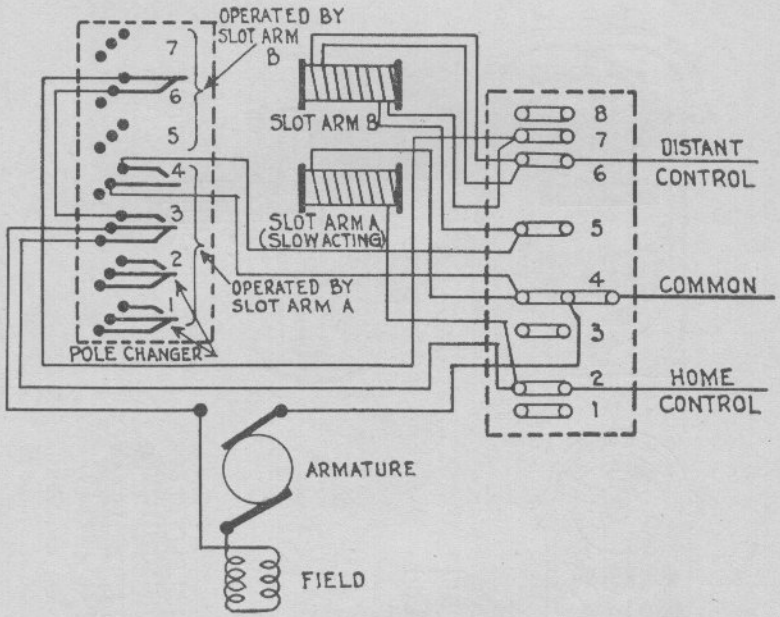


Fig. 19.
Mechanism Wiring, Style B Signal.

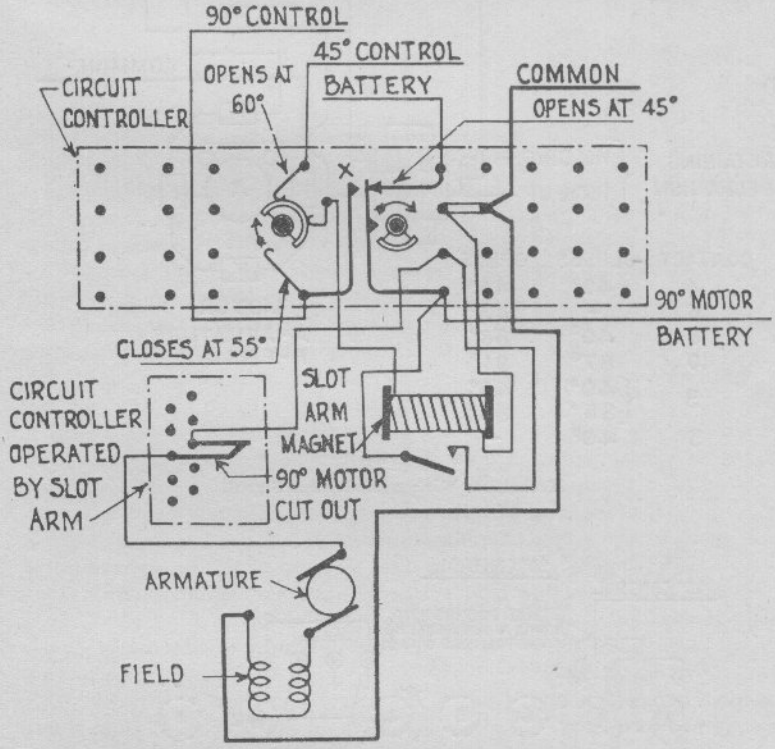


Fig. 20.
Mechanism Wiring, Style S Signal.

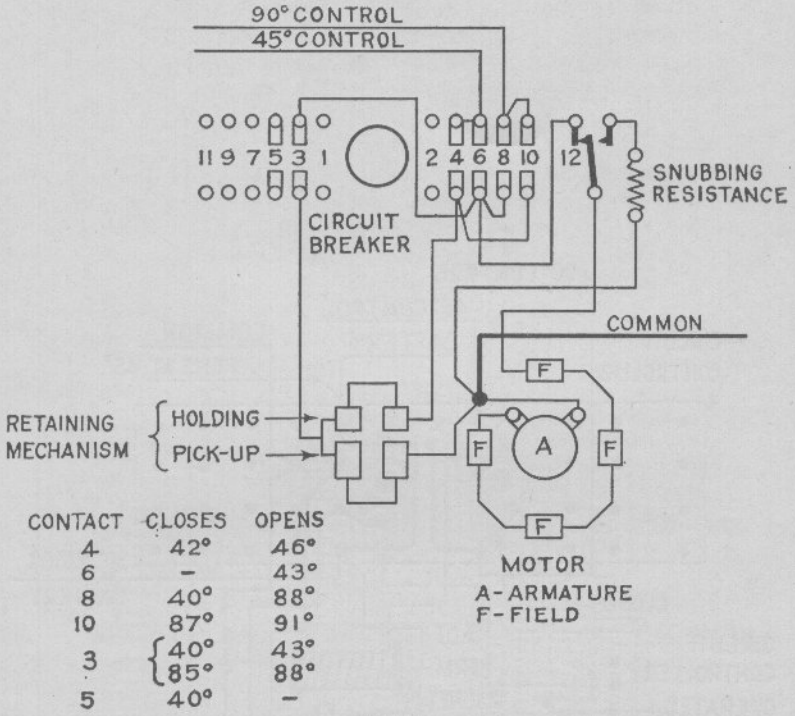


Fig. 21.
Mechanism Wiring, Model 2-A Signal.

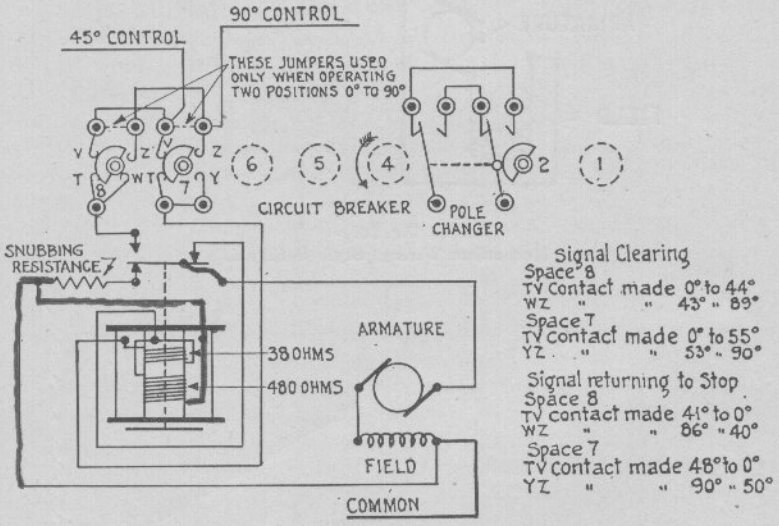


Fig. 22.
Mechanism Wiring, Style T-2 Signal.

Instructions

Semaphore signals should be maintained and tested in accordance with the following A.A.R. Signal Section Instructions:

General.

1. Mast must be vertical, mounted on suitable support, signal aligned to display the best possible indication for approaching trains, and securely fastened.

2. Signal blade, lens, reflector, roundels, glass and lamps must be cleaned as necessary to insure good indications. Reflectors must be cleaned with a dry soft cloth free from lint and abrasives.

3. Defective reflectors, lenses, roundels or glass must be replaced.

4. Ladder, hand railing and platform must be kept in good condition and securely fastened.

5. Doors, covers and fastenings must be kept in good condition, with suitable gaskets in place, so as to keep out moisture and dirt.

6. Housings must be kept clean and must not be used for storing material, tools or supplies unless special provision is made. They should not be opened in severe or stormy weather, except when conditions require.

7. Electric lamps must be maintained and tested in accordance with Instructions for Incandescent Electric Lamps.

8. Bolts, nuts, pins and cotters of proper size must be kept in place, nuts kept tight and cotters properly spread.

9. When movable parts are worn to such an extent as to create excessive lost motion, they must be replaced.

10. Maintenance and repair work which may interfere with safe movement of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments when required must be made in such manner that safety of operation will not be impaired.

11. Tags must be made of insulating material and wires and tags must be so arranged as not to interfere with moving parts of apparatus.

12. Circuits, other than track circuits, should be kept free of grounds.

13. Tests must be made and recorded as instructed, and values maintained in accordance with the Table of Operating Characteristics for the type of signal tested.

14. When making test of apparatus proper instruments must be used, and it must be known that no unsafe conditions are set up by the application of testing equipment.

15. Manufacturer's instructions must be followed unless they conflict with general or detailed instructions, in which case proper authority must be consulted for correct procedure.

16. Operating mechanisms, when placed in service, must meet shop requirements specified in Table of Operating Characteristics for the particular type of signal.

17. Operating mechanisms not meeting field requirements must be removed from service as promptly as possible and defects noted on repair tag, Form 7018, Fig. 23.

Motor semaphore signals.

18. Lamp bracket must be securely fastened and all parts of lamp must clear any passing part of the spectacle not less than 1 inch.

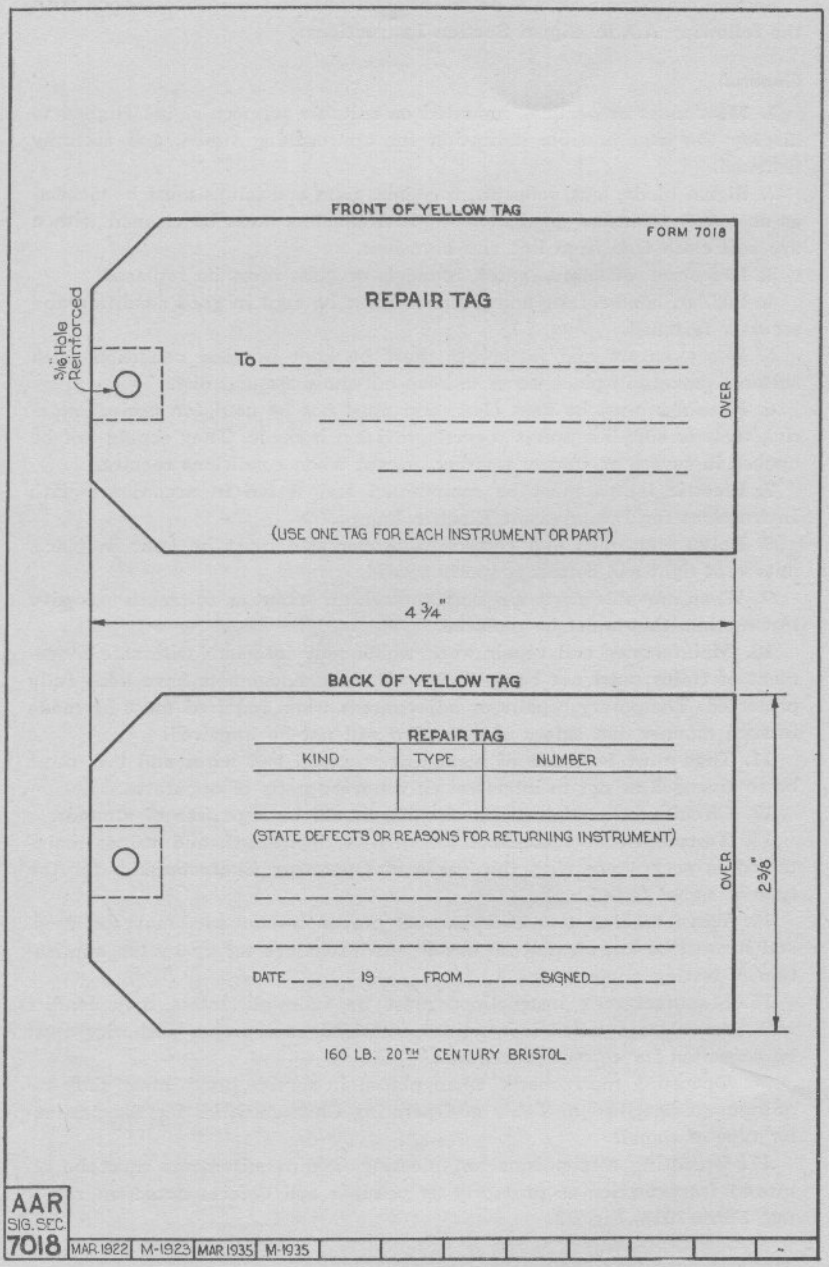

FRONT OF YELLOW TAG
FORM 7018
REPAIR TAG
5/16" Hole Reinforced
To
OVER
(USE ONE TAG FOR EACH INSTRUMENT OR PART)
4 3/4"
BACK OF YELLOW TAG
REPAIR TAG
KIND
TYPE
NUMBER
(STATE DEFECTS OR REASONS FOR RETURNING INSTRUMENT)
OVER
2 3/8"
DATE ____ 19 ___ FROM ____ SIGNED ____
160 LB. 20TH CENTURY BRISTOL
AAR
SIG. SEC.
7018
MAR. 1922
M-1923
MAR 1935
M-1935

Fig. 23.

19. Movable parts of the signal must move freely under all weather conditions.

20. Semaphore spectacle casting must rest against the stop provided for that purpose, allowing slot-arms and vertical connections to be free from downward pressure when in the most restrictive position.

21. A minimum clearance of 3/4 inch must be maintained between the semaphore bearing and any passing part of the semaphore spectacle (except hub).

22. Semaphore signals must not be placed in service until bearings have been cleaned, and all oil, dirt and grease removed from the armature and poles of slot magnets and gears, all parts lubricated, and electrical torque tests made when practicable.

23. Bearings must be lubricated and kept free from grit and dirt.

24. Semaphore shaft bearings must be packed with lubricant specified by the manufacturer, which must be kept in a semi-fluid state by the addition of a small amount of Specification 102 or 103 oil when necessary.

25. Clutch between motor shaft and pinion gear on signals so equipped must be lubricated in accordance with instructions for the particular type of signal.

26. Bearings and movable parts except those covered in Instructions 24 and 25 must be lubricated with Specification 102 or 103 oil, in accordance with instructions for the particular type of signal.

27. Signal mechanism must be inspected to insure that it is in proper adjustment and suitable for service.

28. Slot or equivalent device must release on voltage not less than that specified in the Table of Operating Characteristics for the particular type of signal.

29. Air gap between movable and fixed members of slot or retaining device must be not less than that specified in the Table of Operating Characteristics for the particular type of signal. Movable and fixed member of slot or retaining device must be kept free from grease, oil and dirt.

30. Circuit controller contacts must be kept clean and in proper adjustment. Lintless cloth or chamois should be used for cleaning and must be free from abrasives.

31. Buffing or snubbing of signal must be effective to eliminate undue strain on mechanism.

32. Buffers where used must be disassembled, cleaned and repacked as instructed. Piston rings and grooves must be packed and piston washers treated with lubricant specified by manufacturer. If washers are worn they must be replaced with new washers properly treated. Total thickness of washers must not exceed 5/16 inch. Remove surplus lubricant from bottom of piston before placing in cylinder and from top of piston after it is in place.

33. Where snubs are used tests must be made to insure that snub is effective. Signal should travel from the 90 to the zero degree position in approximately 8 seconds when control circuit is opened. The ratchet dog where used on main gear should click several times after signal has reached its most restrictive position.

34. Armature of signal motor must not have excessive lost motion in bearings and the clearance between rotating and stationary parts must be adequate to insure proper operation. Segment wires must be securely fastened to segments.

35. Commutator must be smooth, clean and have a glossy appearance. To clean, lift brushes from commutator and use chamois or cloth free from lint and abrasives, moistened, if necessary, with Specification 102 or 103 oil, and then wipe commutator dry with dry chamois or cloth. Abrasives or files must not be used on commutators.

36. Brushes must be kept clean, fitted to commutator, free in brush holder or brush holder free on stud. Springs must be in place and so maintained that brushes will have proper bearing and pressure. When installing new brushes they should be placed in position and carefully seated on the commutator by placing No. 000 or finer sandpaper under the brush with smooth side against the commutator and while pressing brush oscillate sandpaper with commutator. Burrs must be removed from the brush. When finished, all sand and dust must be removed.

37. Counters, when used, must be adjusted to correctly register operation of mechanism. Counters must not be oiled.

38. Chains and sprockets where used must be cleaned when necessary and coated lightly with a light grease.

39. Motor clutch where used must be adjusted to slip in accordance with instructions for the particular type of signal.

40. Tooth disc on motor armature where used or the pawl on retaining mechanism which has become worn or burred must be replaced.

Method of making service test of motor semaphore signals.

41. Connections for instruments are shown in Fig. 24.

42. In starting tests the signal must be in its most restrictive position and motor circuit open. Connections must be made and motor circuit closed, allowing motor to operate and hold clear device to become effective.

43. Motor must be tested while signal is clearing by reducing voltage until armature rotates slowly. If motor does not run smoothly at slow speed, it is evidence of a faulty condition which must be corrected.

44. Test for minimum clearing values must be made by reducing voltage until signal just clears and holds.

45. Test for release values of hold clear device must be made by increasing voltage until normal operating value is obtained, then reduce voltage gradually until hold clear device releases.

46. In making tests on 45 degree position of three-position signals, the 90 degree operating circuit must be opened to prevent the signal clearing beyond the 45 degree position.

47. In making tests on 90 degree position of three-position signals, the 45 degree operating circuit must be closed and the instruments connected in the 90 degree circuit.

Method of making shop and field electrical torque tests of motor semaphore signals in which the motor is operated backward by the semaphore torque.

48. For direct current signals Styles T-2 and 2-A, connect an adjustable resistance and ammeter in series with the motor, gradually reduce the resistance until the motor will just move the arm upward. Just before the arm reaches the 45 degree position, quickly insert sufficient resistance to permit the motor, with snubbing circuit open and moved by the arm, to start backward. With Style T-2 signals, hold clear armature must be fixed in the de-energized position.

(a) The current which will permit it to start backward from a given position should be not less than 50 per cent of the current required to move it to that position. If this current is less than 50 per cent, inspection must be made to determine that brush pressure is not excessive, that proper clearance exists between motor armature and pole faces, that shaft and gears are lubricated and working freely and that there is no binding in circuit controller.

(b) The same test must be made starting just before arm reaches the 90 degree position.

(c) Variations in readings may be caused by wind pressure on blade.

49. For alternating current signals Styles T-2 and 2-A, supply sufficient voltage to the motor, for any given semaphore position, to just cause the motor rotor to revolve one or two times, then reduce the voltage until the rotor turns back one or two times. The percentage of the latter voltage to that of the first should be not less than 80 per cent for Style T-2 signals and 65 per cent for Model 2-A signals. Care must be taken to see that these readings are taken at approximately the same semaphore position.

(a) Readings at several angular positions of the semaphore must be made in order to determine actual friction of the mechanism.

(b) Variations in readings may be caused by wind pressure.

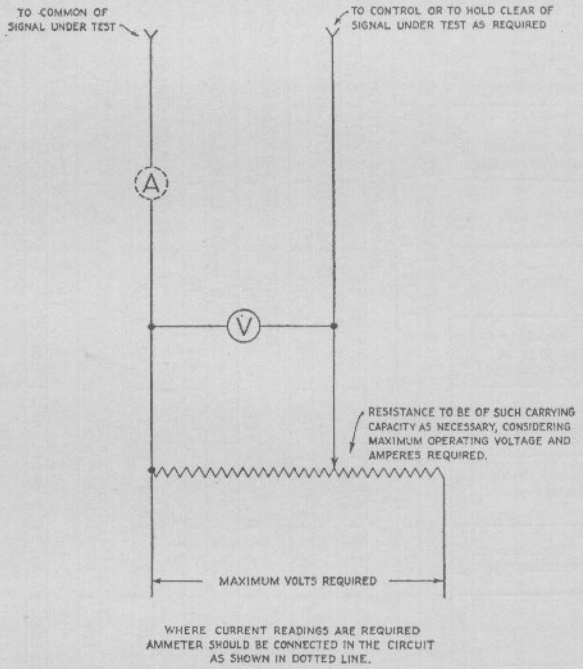


Fig. 24.
Connection for Making Service Tests of Motor Semaphore Signals.

TABLE OF OPERATING CHARACTERISTICS OF STYLES S AND B SIGNALS

Shop Requirements											Field Requirements						
Rating of motor	Volts at motor	Maximum to just clear and latch signal	Maximum motor current	Maximum time clearing	Minimum release at 45 degrees or clear	Charge	Slot current	Minimum hold clear armature air gap forged core hex. pole	Minimum hold clear armature air gap old type round pole	Minimum hold clear armature air gap	Maximum to just clear and latch signal	Maximum motor current	Maximum time clearing	Minimum release at 45 degrees or clear	Minimum hold clear armature air gap forged core hex. pole	Minimum hold clear armature air gap old type round pole	Minimum hold clear armature air gap
Volts	Volts	Volts	Amps.	Secs.	Volts	Volts	Amp.	Inch	Inch	Inch	Volts	Amps.	Secs.	Volts	Inch	Inch	Inch
S—SLOW RELEASE 500 OHM SLOT COILS 5/32 INCH TOGGLE																	
10	10	7	3	13	1.5	12				0.015	7.7	3.3	15	1			0.011
S—1000 OHM SLOT COILS 5/32 INCH TOGGLE																	
10	10	7	3	13	3.75	12		0.020	0.017		7.7	3.3	15	2.5	0.015	0.013	
S—3500 OHM SLOT COILS 5/32 INCH TOGGLE																	
110	110	75	0.75	6	35	120				0.030	82	0.82	7	28			0.024
B—SLOW RELEASE 500 OHM SLOT COILS 1/4 INCH TOGGLE																	
10	10	7	3	10	1.6	12				0.020	7.7	3.3	11	1			0.015
B—1000 OHM SLOT COILS 3/8 INCH TOGGLE																	
10	10	7	3	10	3.2	12				0.015	7.7	3.3	11	2			0.011
B—3500 OHM SLOT COILS 1/4 INCH TOGGLE																	
110	110	75	0.70	5	30	120				0.036	82	0.77	6	24			0.028
S—60 CYCLE 5/32 INCH TOGGLE																	
110	110	87	3.7	8	35		0.90			0.020	96	4.1	9	28			0.015
S—25 CYCLE 5/32 INCH TOGGLE																	
110	110	80	3.4	10	45		0.35			0.015	88	3.7	11	36			0.011
B—60 CYCLE 1/4 INCH TOGGLE																	
110	110	75	2.1	8	50		0.45			0.020	83	2.3	9	40			0.015
B—25 CYCLE 1/4 INCH TOGGLE																	
110	110	75	2.1	8	50		0.26			0.020	83	2.3	9	40			0.015
55	55	40	3.8	8	25		0.44			0.020	44	4.2	9	20			0.015

TABLE OF OPERATING CHARACTERISTICS OF MODEL 2-A SIGNALS

SHOP REQUIREMENTS

VOLTAGE RATING OF MOTOR	VOLTAGE AT MOTOR	MAXIMUM MOTOR CURRENT	MAXIMUM MOTOR CURRENT INCLUDING HOLD CLEAR PICK-UP CURRENT	CLEARING TIME WITH MOTOR VOLTAGES AS IN COL. 2	MINIMUM WORKING VOLTAGE OF MOTOR	MINIMUM WORKING VOLTAGE OF HOLD-CLEAR	HOLD-CLEAR DROP-AWAY ADJUSTED FOR	RESISTANCE OF HOLD-CLEAR HOLDING CIRCUIT	RESISTANCE OF HOLD-CLEAR PICK-UP CIRCUIT
VOLTS	VOLTS	AMPS.	AMPS.	SEC.	VOLTS	VOLTS	VOLTS	OHMS	OHMS
10	10	2.1	2.4	10.0	5.0	5.0	4.2	630	26
8	8	2.6	2.9	10.0	4.0	5.0	4.2	1000	26
8-10	8	2.5	2.8	10.0	3.5	4.5	3.6	1000	26
8-10	10	2.5	2.8	7.5	3.5	4.5	3.6	1000	26
8-10	10	2.5	2.7	7.5	3.5	1.0	0.75	60	60
20	20	1.1	1.2	10.0	8.5	13.0	11.0	5000	138
110	110	0.85	2.00	6.0	40.0	90.0	40.0	420	
110	85	0.85	1.40	8.0	40.0	90.0	40.0	450	
110	110	0.65	2.00	3.0	40.0	80.0	40.0	420	
110	90	0.65	1.40	4.0	40.0	80.0	40.0	450	
CYCLES			WATTS					VOLT-AMP.	WATTS
110-25	110	3.40	260	11.0	90.0	90.0	70.0	22	7.5
CYCLES			WATTS					VOLT-AMP.	WATTS
110-60	110	3.75	260	10.0	90.0	90.0	65.0	50	6.5

FIELD REQUIREMENTS

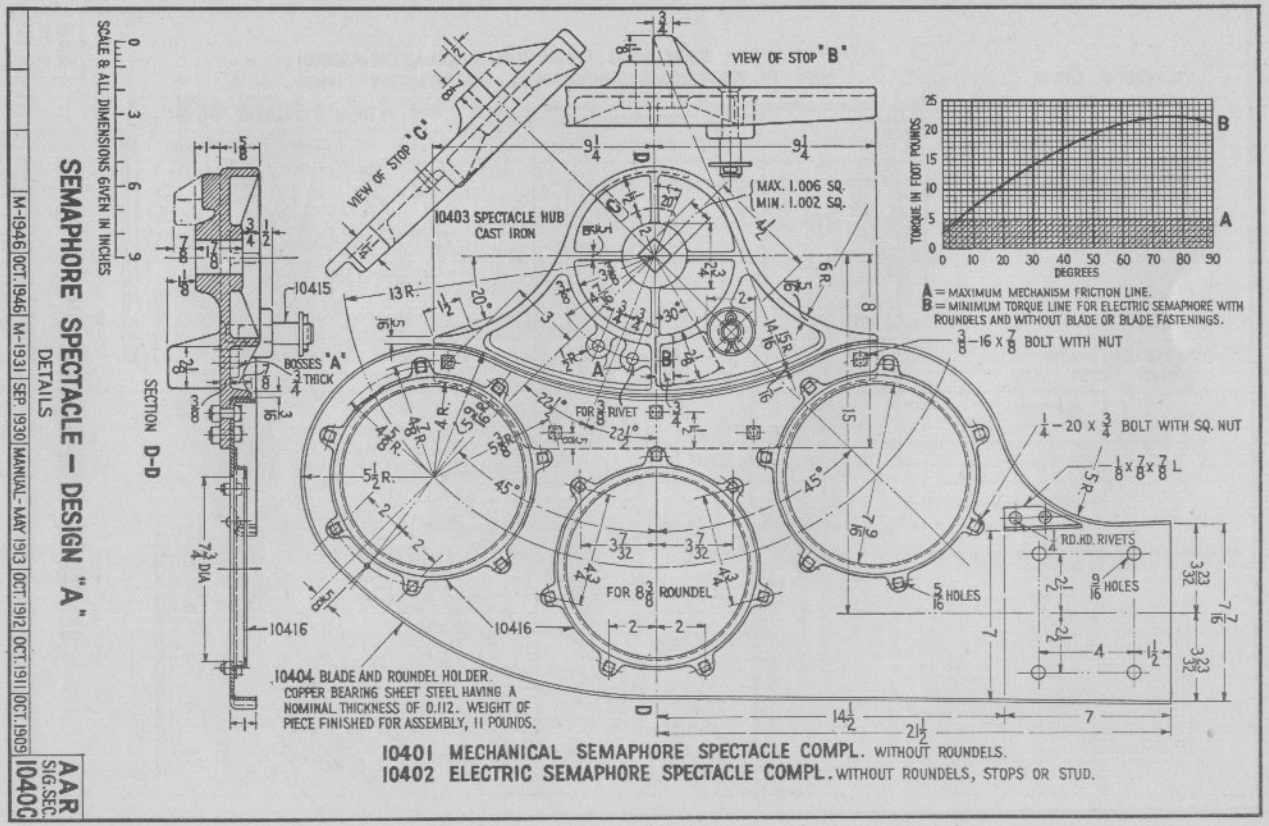
VOLTAGE RATING OF MOTOR	VOLTAGE AT MOTOR	MAXIMUM MOTOR CURRENT	MAXIMUM MOTOR CURRENT INCLUDING HOLD-CLEAR PICK-UP CURRENT	CLEARING TIME WITH MOTOR VOLTAGES AS IN COL. 2	MINIMUM WORKING VOLTAGE OF MOTOR	MINIMUM WORKING VOLTAGE OF HOLD-CLEAR	HOLD-CLEAR DROP-AWAY ADJUSTED FOR	RESISTANCE OF HOLD-CLEAR HOLDING CIRCUIT	RESISTANCE OF HOLD-CLEAR PICK-UP CIRCUIT
VOLTS	VOLTS	AMPS.	AMPS.	SEC.	VOLTS	VOLTS	VOLTS	OHMS	OHMS
10	10	2.3	2.64	11	5.5	5.5	3	630	26
8	8	2.86	3.2	11	4.4	5.5	3	1000	26
8-10	8	2.75	3.06	11	3.86	4.95	2.54	1000	26
8-10	10	2.75	3.06	8.25	3.86	4.95	2.54	1000	26
8-10	10	2.75	3.0	8.25	3.86	1.1	.53	60	60
20	20	1.21	1.32	11	9.35	14.3	7.75	5000	138
110	110	.94	2.2	6.6	44	95	28	420	
110	85	.94	1.54	8.8	44	95	28	450	
110	110	.72	2.2	3.3	44	95	28	420	
110	90	.72	1.54	4.4	44	95	28	450	
CYCLES			WATTS					VOLT-AMP.	WATTS
110-25	110	3.4	260	12	90	90	50	22	7.5
CYCLES			WATTS					VOLT-AMP.	WATTS
110-60	110	3.75	260	11	90	90	46	50	6.5

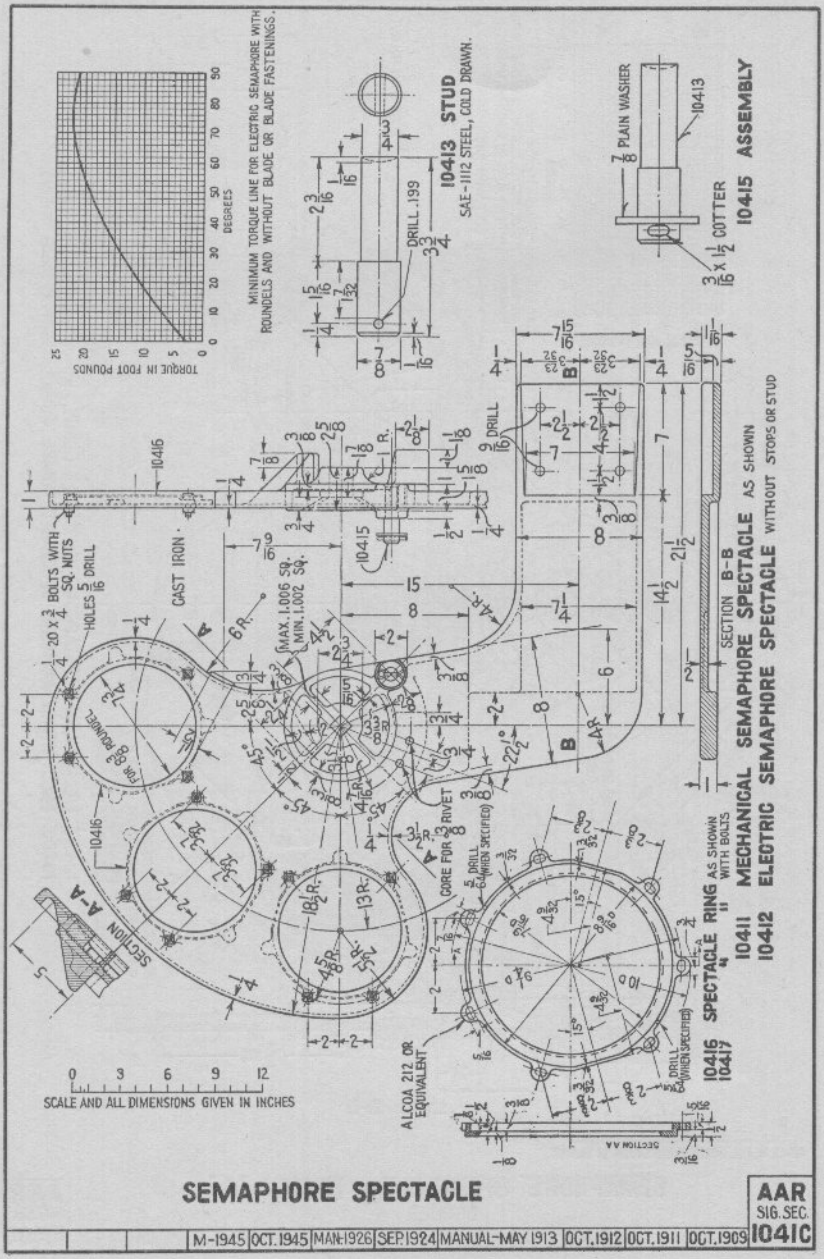
TABLE OF OPERATING CHARACTERISTICS OF STYLE T-2 SIGNALS

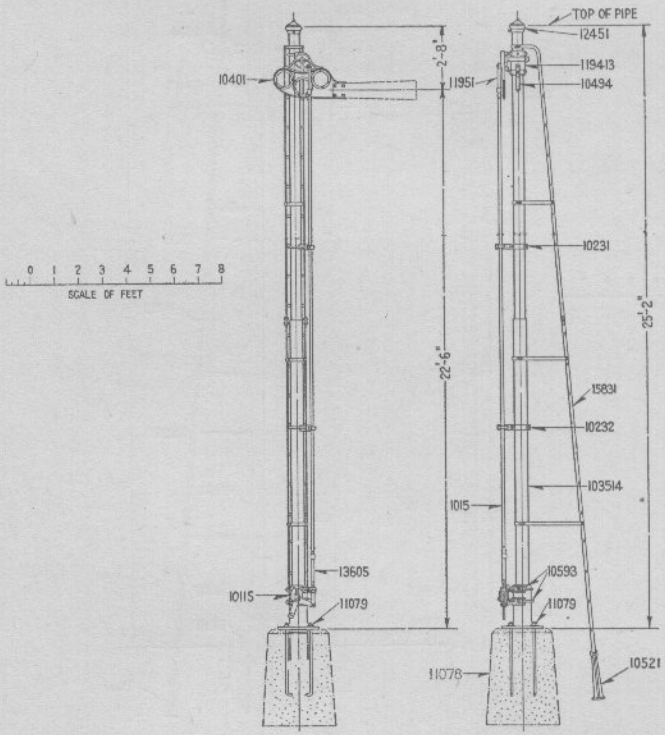
SHOP REQUIREMENTS												FIELD REQUIREMENTS						
MOTOR					SLOT							MOTOR			SLOT			
RATING OF MOTOR	VOLTS AT MOTOR	MAX. TO JUST CLEAR AND LATCH SIGNAL	MAX. CLEARING 0°-90°	MAX. TIME CLEARING 0°-90°	PICK-UP WINDING	HOLDING WINDING	CHARGE	MAX. PICK-UP	MIN. RELEASE AT 45° OR 90° WITH SPRINGS	MIN. RELEASE AT 45° OR 90° WITHOUT SPRINGS	MIN. ARM. AIR GAP	MAX. TO JUST CLEAR AND LATCH SIGNAL	MAX. CLEARING 0°-90°	MAX. TIME CLEARING 0°-90°	MAX. PICK-UP	MIN. RELEASE AT 45° OR 90° WITH SPRINGS	MIN. RELEASE AT 45° OR 90° WITHOUT SPRINGS	MIN. ARM. AIR GAP
VOLTS	VOLTS	VOLTS	AMPS.	SECS.	OHMS	OHMS	VOLTS	VOLTS	VOLTS	VOLTS	INCHES	VOLTS	AMPS.	SECS.	VOLTS	VOLTS	VOLTS	INCHES
D.C. EQUIPPED WITH SLOT MAGNETS AND CONTACTS FOR PICK-UP AND HOLDING WINDINGS IN SERIES																		
10	10	7	2.5	10	38	480	12	6.5	3	2	.015	7.7	2.75	11	7.15	2.4	1.6	.012
8	8	6.5	2.9	9	38	480	12	6.5	3	2	.015	7.15	3.2	10	7.15	2.4	1.6	.012
110	110	75	.50	5	1500-3000	** NOTE			35	30	.040	82	.55	5.5		28	24	.030
D.C. EQUIPPED WITH INDEPENDENT PICK-UP AND HOLDING WINDINGS - PICK-UP WINDING IN SERIES WITH MOTOR																		
10	10	7	2.5	10	.25	27				.75	.018	7.7	2.75	11			.6	.015
8	8	5	2.9	9	.25	27	* NOTE			.75	.018	5.5	3.2	10			.6	.015
10	10	7	2.5	10	.25	460				3.7	.020	7.7	2.75	11			3	.017
8	8	5	2.9	9	.25	460				3.7	.020	5.5	3.2	10			3	.017
10	10	7	2.5	10	.25	670				4.6	.020	7.7	2.75	11			3.7	.017
8	8	5	2.9	9	.25	670				4.6	.020	5.5	3.2	10			3.7	.017
10	10	7	2.5	10	.25	1000				3.85	.015	7.7	2.75	11			3	.012
8	8	5	2.9	9	.25	1000				3.85	.015	5.5	3.2	10			3	.012
NORMAL - 60 CYCLE																		
					VOLTS	AMPS												
110	110	94	3.4	9.5	110	.7				33	.025	100	3.75	11			26.5	.020

* FOR A 270HM SLOT WHERE AN INDEPENDENT BATTERY IS USED FOR ENERGIZATION, THE SLOT SHOULD PICK UP WITH ONE VOLT ACROSS THE HOLDING WINDING AND THE MINIMUM OPERATING VOLTAGE ACROSS THE MOTOR - OTHER SLOTS ARE USED WITH A COMMON BATTERY FOR SLOT AND MOTOR OPERATION AND THE SLOT PICKS UP ON VOLTAGE EQUAL TO OR BELOW MAXIMUM OPERATING VOLTAGE TO JUST CLEAR SIGNAL.

** HIGH VOLTAGE SIGNAL HOLDS CLEAR WITH THE TWO WINDINGS IN SERIES MAKING A TOTAL OF 4500 OHMS. - SOME HIGH VOLTAGE T-2 SIGNALS ARE EQUIPPED WITH 1000 OHM SLOT WINDING WITH AN EXTERNAL RESISTANCE OF 3500 OHMS TO WHICH THE ABOVE VALUES ALSO APPLY.


SEMAPHORE SPECTACLE — DESIGN "A"
DETAILS
SCALE & ALL DIMENSIONS GIVEN IN INCHES
M-1946 OCT. 1946 M-1931 SEP. 1930 MANUAL - MAY 1913 OCT. 1912 OCT. 1911 OCT. 1909
AAR SIG.SEC. 10400
VIEW OF STOP "B"
VIEW OF STOP "C"
10403 SPECTACLE HUB CAST IRON
MAX. 1.006 SQ.
MIN. 1.002 SQ.
10415
BOSSES "A" THICK
SECTION D-D
FOR 3/8 RIVET
10416
10404 BLADE AND ROUNDEL HOLDER. COPPER BEARING SHEET STEEL HAVING A NOMINAL THICKNESS OF 0.112. WEIGHT OF PIECE FINISHED FOR ASSEMBLY, 11 POUNDS.
FOR 8 3/8 ROUNDEL
TORQUE IN FOOT POUNDS
DEGREES
A = MAXIMUM MECHANISM FRICTION LINE.
B = MINIMUM TORQUE LINE FOR ELECTRIC SEMAPHORE WITH ROUNDELS AND WITHOUT BLADE OR BLADE FASTENINGS.
3/8 - 16 x 7/8 BOLT WITH NUT
1/4 - 20 x 3/4 BOLT WITH SQ. NUT
1/8 x 7/8 x 7/8 L
RD.HD. RIVETS
5 HOLES
10401 MECHANICAL SEMAPHORE SPECTACLE COMPL. WITHOUT ROUNDELS.
10402 ELECTRIC SEMAPHORE SPECTACLE COMPL. WITHOUT ROUNDELS, STOPS OR STUD.

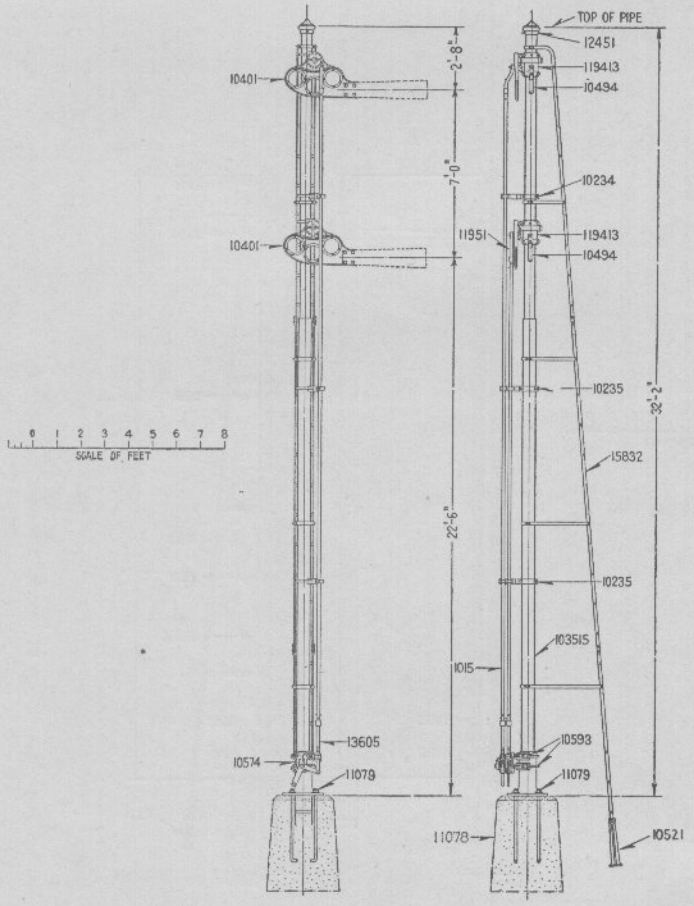

SEMAPHORE SPECTACLE
AAR SIG. SEC. 1041C
M-1945 OCT. 1945 MAN-1926 SEP. 1924 MANUAL-MAY 1913 OCT. 1912 OCT. 1911 OCT. 1909
10411 MECHANICAL SEMAPHORE SPECTACLE AS SHOWN
10412 ELECTRIC SEMAPHORE SPECTACLE WITHOUT STOPS OR STUD
10416 SPECTACLE RING AS SHOWN WITH BOLTS
10417
10413 STUD
SAE-1112 STEEL, COLD DRAWN.
10415 ASSEMBLY
MINIMUM TORQUE LINE FOR ELECTRIC SEMAPHORE WITH ROUNDELS AND WITHOUT BLADE OR BLADE FASTENINGS.
TORQUE IN FOOT POUNDS
DEGREES
SECTION B-B
SECTION A-A
SECTION A A
CAST IRON
ALCOA 212 OR EQUIVALENT
SCALE AND ALL DIMENSIONS GIVEN IN INCHES



ONE-ARM MECHANICAL GROUND SIGNAL

AAR SIG. SEC. 1043D

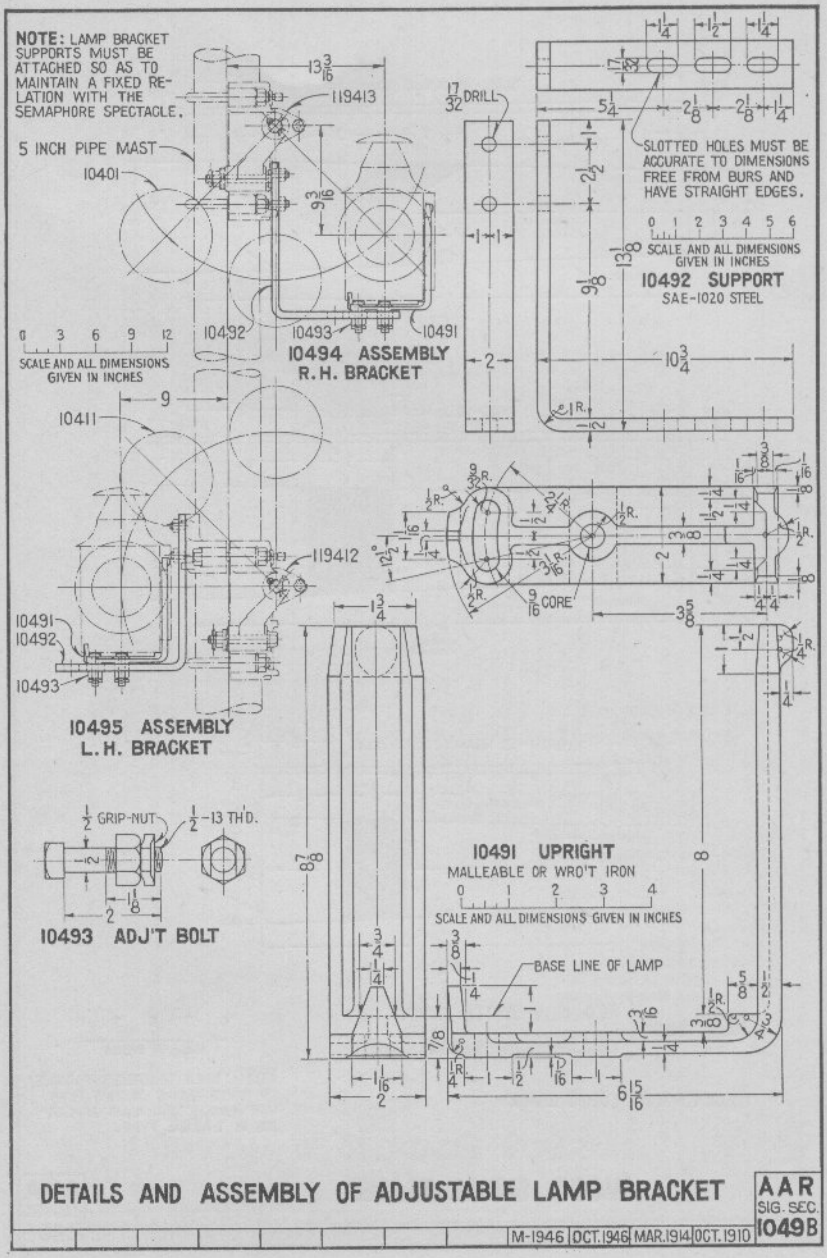
M-1938 | APR.1938 | M-1935 | MAR1935 | M-1926 | SEP.1925 | SEP. 1915 | DEC.1910



TWO-ARM MECHANICAL GROUND SIGNAL

AAR SIG. SEC. 1044D

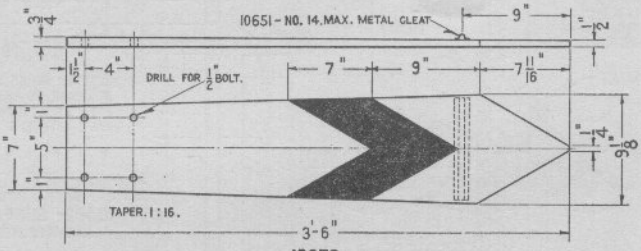
				M-1938	APR. 1938	M-1935	MAR 1935	M-1926	SEP. 1925	SEP. 1915	DEC. 1910



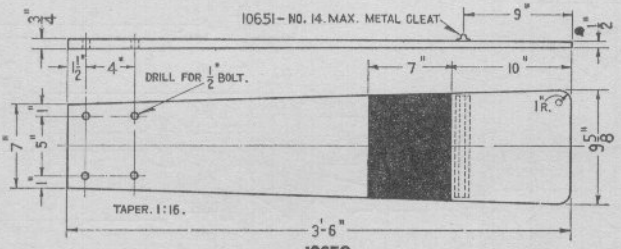
DETAILS AND ASSEMBLY OF ADJUSTABLE LAMP BRACKET

AAR SIG. SEC. 1049B

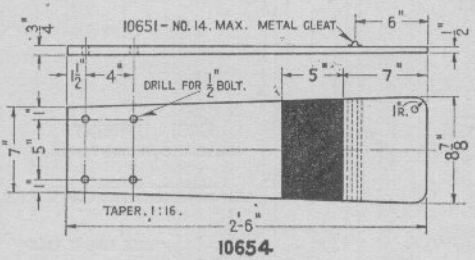
M-1946 | OCT. 1946 | MAR. 1914 | OCT. 1910



10652



10653



10654

COLOR FRONT { **RED** WITH **WHITE** STRIPE / **YELLOW** WITH **BLACK** STRIPE

COLOR BACK AND EDGES BLACK

0 3 6 9 12
SCALE OF INCHES

NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN **LARGE** TYPE.

WOOD SIGNAL BLADES

ARA SIG. SEC. 1065 B

			M-1931	SEP. 1930	MAN'L 1924	MAR. 1923	MAR. 1918	SEP. 1915	MAY 1915	M-8-1914	OCT. 1911

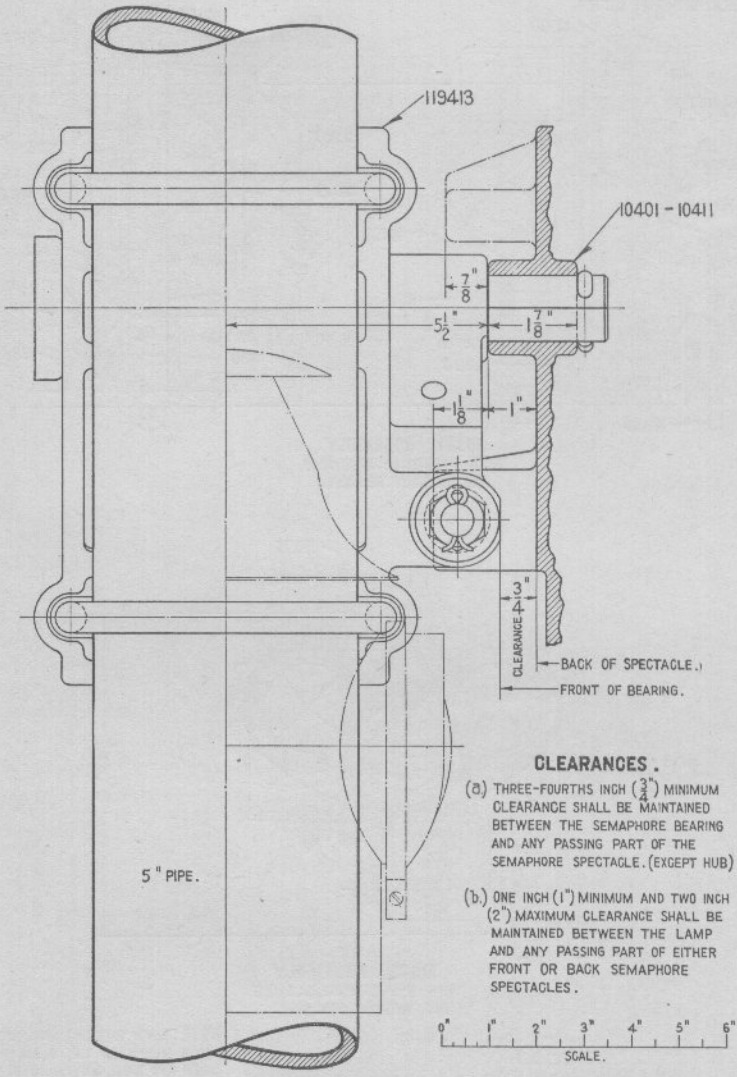
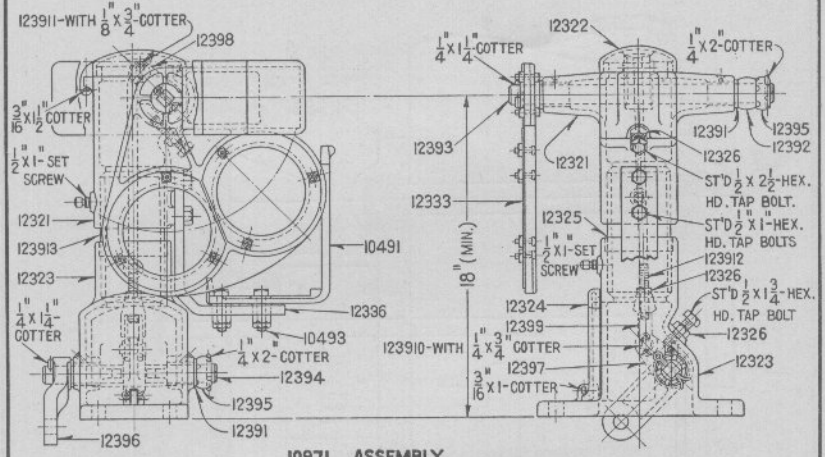


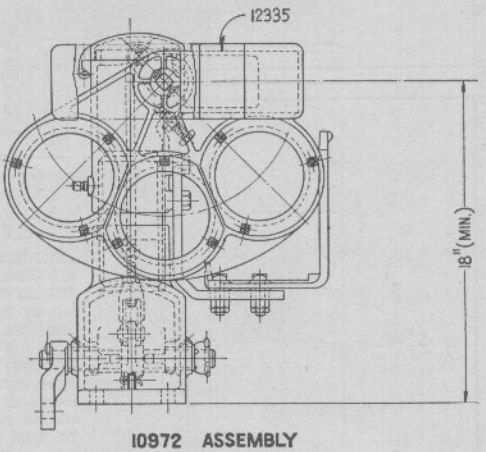
DIAGRAM OF SPECTACLE CLEARANCE

RSA 1093

MANUAL-DEC. 1913 OCT. 1911



10971 ASSEMBLY
WITH 2-POSITION SPECTACLE
AND WITHOUT ROUNDELS



10972 ASSEMBLY
WITH 3-POSITION SPECTACLE
AND WITHOUT ROUNDELS

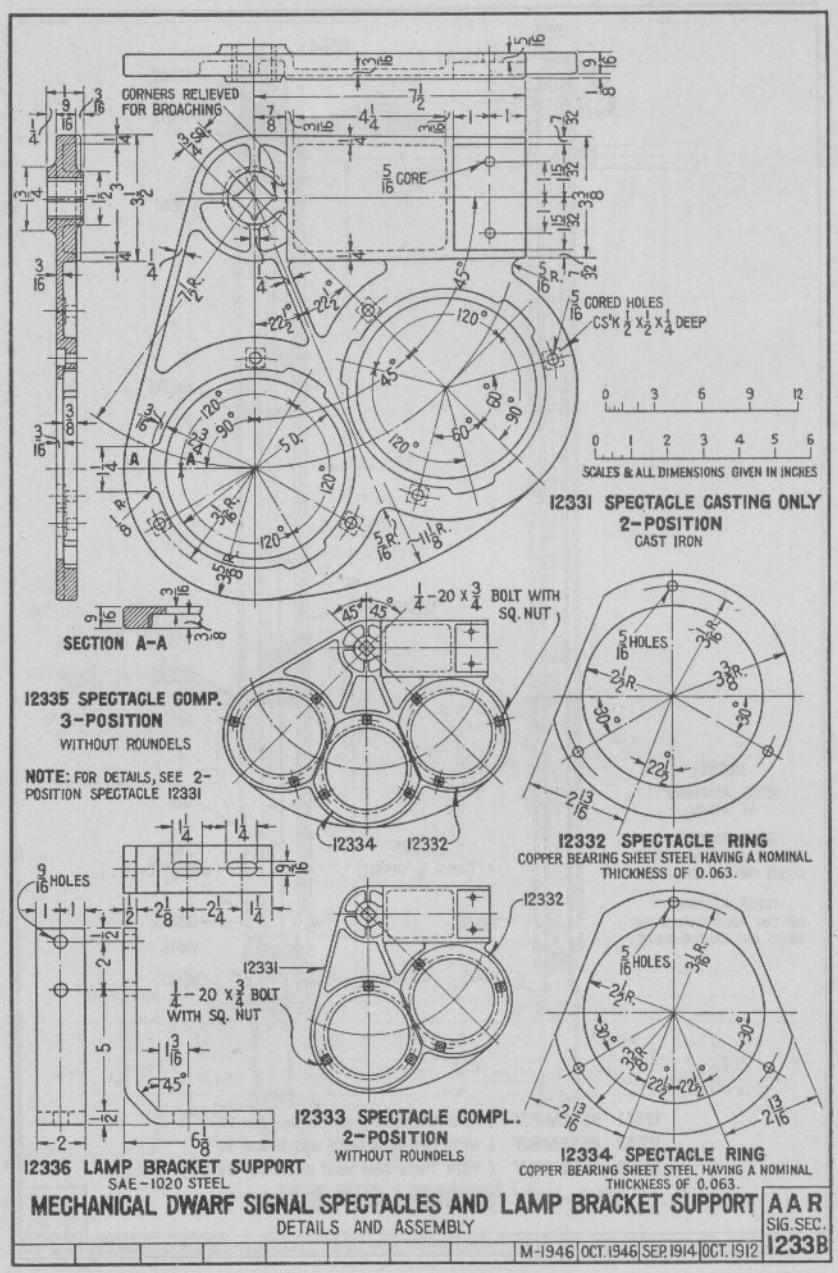
0 3 6 9 12
SCALE OF INCHES

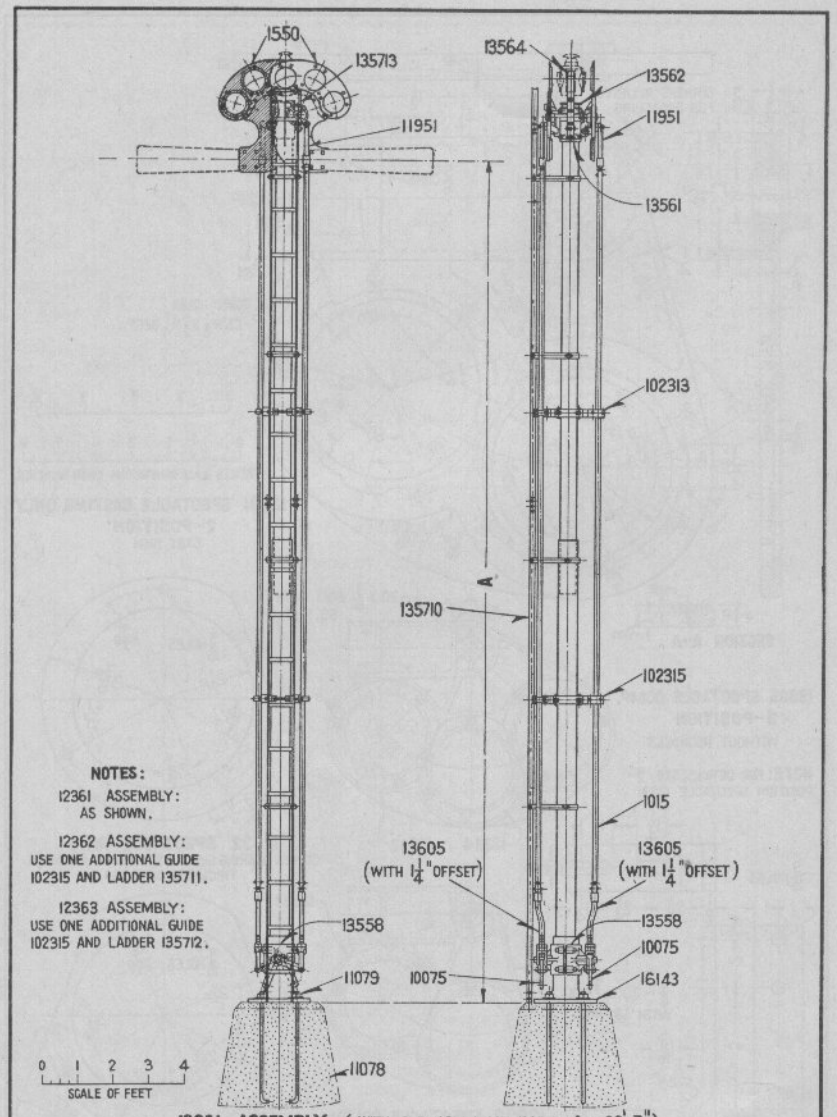
NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN **LARGE** TYPE. (SEE R.S.A. 1232-1233-1239)

MECHANICAL DWARF SIGNALS
(ASSEMBLY)

RSA 1097

SEP. 1914 OCT. 1912 OCT. 1911


CORNERS RELIEVED FOR BROACHING
CORE
CORED HOLES CS'K ½ X ½ X ¼ DEEP
SCALES & ALL DIMENSIONS GIVEN IN INCHES
12331 SPECTACLE CASTING ONLY
2-POSITION
CAST IRON
SECTION A-A
¼-20 X ¾ BOLT WITH SQ. NUT
12335 SPECTACLE COMP.
3-POSITION
WITHOUT ROUNDELS
NOTE: FOR DETAILS, SEE 2-POSITION SPECTACLE 12331
12334
12332
12332 SPECTACLE RING
COPPER BEARING SHEET STEEL HAVING A NOMINAL THICKNESS OF 0.063.
9/16 HOLES
12331
¼-20 X ¾ BOLT WITH SQ. NUT
12333 SPECTACLE COMPL.
2-POSITION
WITHOUT ROUNDELS
12336 LAMP BRACKET SUPPORT
SAE-1020 STEEL
12334 SPECTACLE RING
COPPER BEARING SHEET STEEL HAVING A NOMINAL THICKNESS OF 0.063.
MECHANICAL DWARF SIGNAL SPECTACLES AND LAMP BRACKET SUPPORT
DETAILS AND ASSEMBLY
A A R SIG. SEC. 1233B
M-1946 OCT. 1946 SEP. 1914 OCT. 1912



NOTES:

12361 ASSEMBLY:
AS SHOWN.

12362 ASSEMBLY:
USE ONE ADDITIONAL GUIDE 102315 AND LADDER 135711.

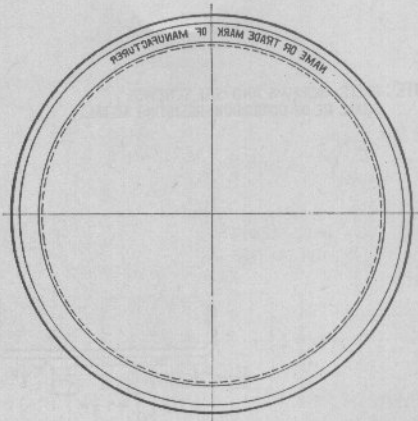
12363 ASSEMBLY:
USE ONE ADDITIONAL GUIDE 102315 AND LADDER 135712.

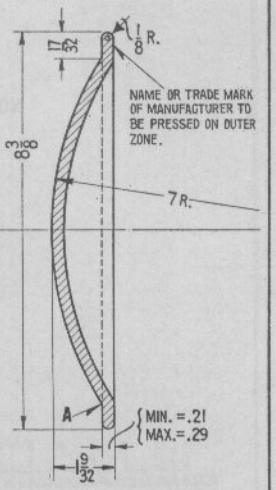
12361 ASSEMBLY (WITH ONE-ARM MAST 103514 – A = 23'-7")
12362 ASSEMBLY (WITH TWO-ARM MAST 103515 – A = 30'-7")
12363 ASSEMBLY (WITH THREE-ARM MAST 103516 – A = 36'-7")

TWO-WAY SINGLE-LAMP SIGNAL

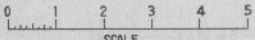
AAR SIG. SEC. **1236D**

			M-1943	OCT. 1943	M-1936	MAR 1936	MAN-1926	SEP 1924	NOV. 1923	MAR. 1916	MAR. 1914





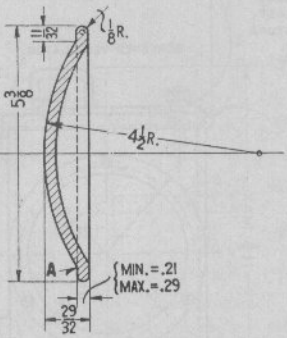
8 3/8 CONVEX ROUNDEL
HIGH TRANSMISSION GLASS



NOTES:
SCALE AND ALL DIMENSIONS ARE GIVEN IN INCHES.

REINFORCING BEAD MAY BE USED AT 'A'.

WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN **LARGE** TYPE.



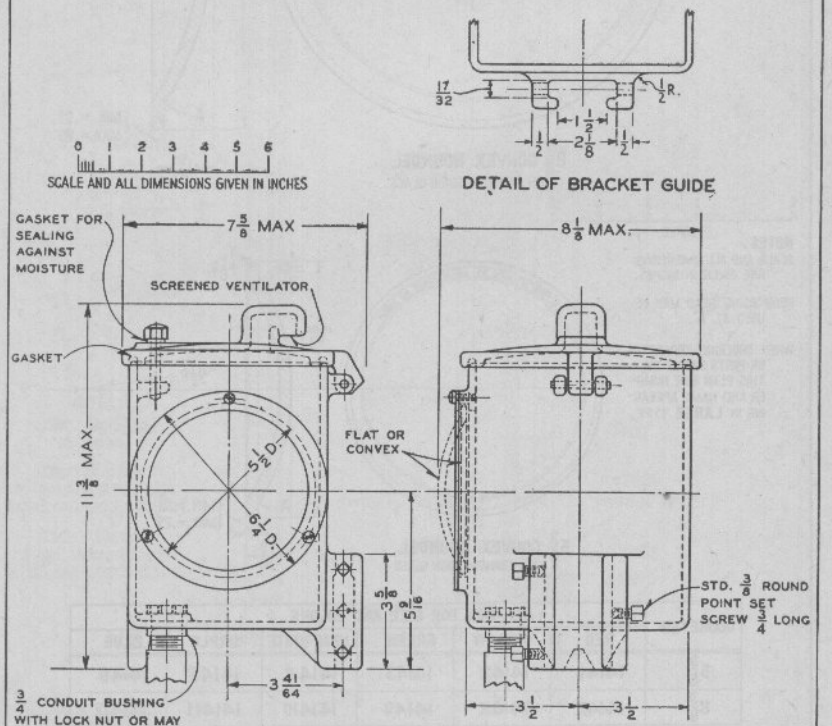
5 3/8 CONVEX ROUNDEL
HIGH TRANSMISSION GLASS

DIAMETER	REF. NOS. FOR SIZE AND COLORS					
	RED	YELLOW	GREEN	LUNAR WHITE	PURPLE	BLUE
5 3/8	14141	14142	14143	14144	14145	14146
8 3/8	14147	14148	14149	14140	141411	141412

ROUNDELS FOR SIGNALS

JUL. 1920 | 1414

NOTE: BOLTS, SCREWS AND SET SCREWS SHALL BE OF CORROSION-RESISTING METAL.

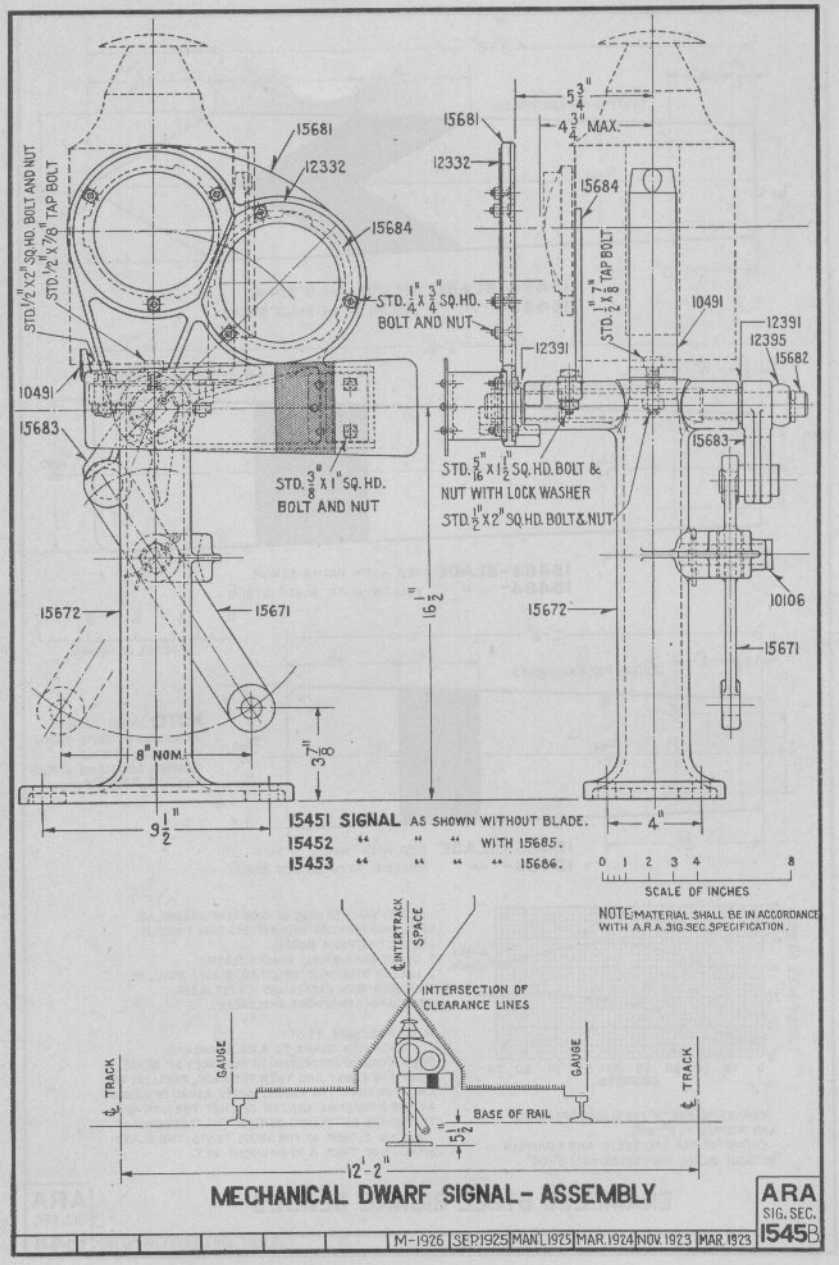


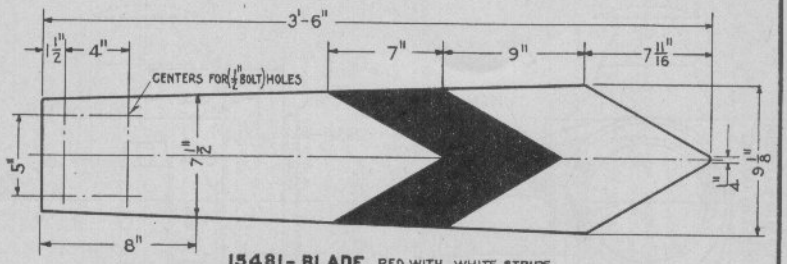
14461 LAMP CASE WITH CONVEX ROUNDEL
14462 LAMP CASE WITH FLAT ROUNDEL
(CAST IRON)

ELECTRIC LAMP CASE
FOR SEMAPHORE LIGHTING

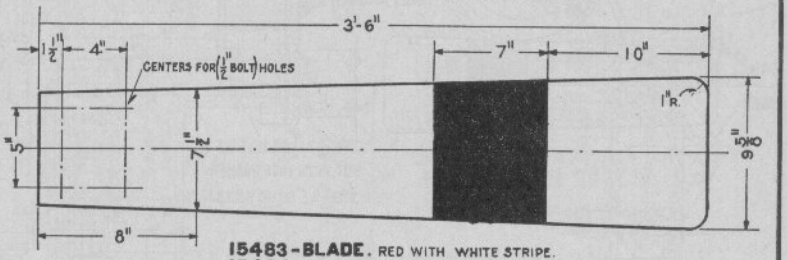
AAR SIG.SEC. 446B

								M-1941	SEP. 1941	M-1937	MAR 1937

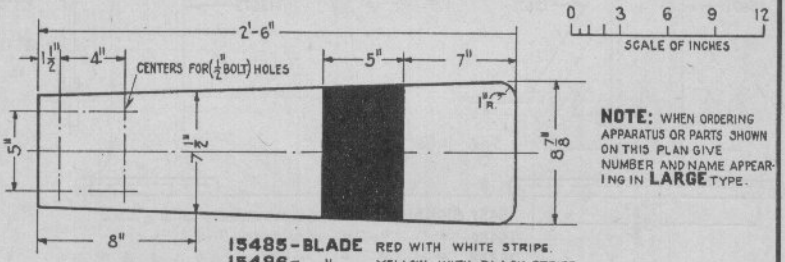

15681
12332
15684
STD. 1/2" X 2" SQ. HD. BOLT AND NUT
STD. 1/2" X 7/8" TAP BOLT
10491
15683
STD. 3/8" X 1" SQ. HD. BOLT AND NUT
STD. 1/4" X 3/4" SQ. HD. BOLT AND NUT
12391
STD. 5/16" X 1 1/2" SQ. HD. BOLT & NUT WITH LOCK WASHER
STD. 1/2" X 2" SQ. HD. BOLT & NUT
5 3/4"
4 3/4" MAX.
STD. 1" X 7/8" TAP BOLT
12395
15682
10106
15672
15671
16 1/2"
8" NOM.
3 7/8"
9 1/2"
4"
15451 SIGNAL AS SHOWN WITHOUT BLADE.
15452 " " " WITH 15685.
15453 " " " " 15686.
0 1 2 3 4 8
SCALE OF INCHES
NOTE: MATERIAL SHALL BE IN ACCORDANCE WITH A.R.A. SIG. SEC. SPECIFICATION.
℄ INTERTRACK SPACE
INTERSECTION OF CLEARANCE LINES
℄ TRACK
GAUGE
BASE OF RAIL
5 1/2"
12'-2"
MECHANICAL DWARF SIGNAL - ASSEMBLY
ARA SIG. SEC. 1545B
M-1926 SEP. 1925 MAN. 1925 MAR. 1924 NOV. 1923 MAR. 1923



15481-BLADE. RED WITH WHITE STRIPE.
15482- " . YELLOW WITH BLACK STRIPE.

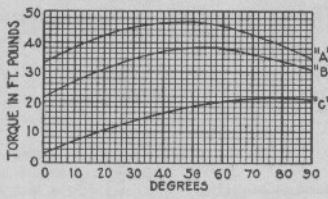


15483-BLADE. RED WITH WHITE STRIPE.
15484- " YELLOW WITH BLACK STRIPE.



15485-BLADE RED WITH WHITE STRIPE.
15486- " YELLOW WITH BLACK STRIPE.

NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN **LARGE** TYPE.



CURVES "A" AND "B" FOR BLADE, SPECTACLE AND ROUNDELS, 0°-90°.
CURVE "C" FOR SPECTACLE AND ROUNDELS (WITHOUT BLADE AND FASTENINGS) 0°-90°.

1. BLADES SHALL BE MADE OF OPEN HEARTH ENAMELING STEEL AND ENAMELED WITH NOT LESS THAN THREE (3) COATS OF VITREOUS ENAMEL.
2. COLOR BACK OF ALL BLADES BLACK.
3. UNLESS OTHERWISE SPECIFIED, BLADES SHALL BE FURNISHED WITH FASTENINGS TO FIT A.R.A. STANDARD SEMAPHORE SPECTACLE.

WIND PRESSURE TEST:
ATTACH THE BLADE TO A.R.A. STANDARD SEMAPHORE SPECTACLE; WITH SURFACES OF BLADE, FIRST THE FRONT AND THEN THE BACK, PARALLEL TO AND TOWARDS THE FLOOR. APPLY A LOAD OF 60 LBS. AT THE GEOMETRIC CENTER OF THAT PORTION OF THE BLADE EXTENDING BEYOND THE FASTENINGS.
DURING EITHER OF THE ABOVE TESTS, THE BLADE SHALL NOT TAKE A PERMANENT SET.

ENAMELED STEEL SIGNAL BLADES

ARA SIG. SEC. 1548

MAN'L 1925 | MAR 1924 | NOV. 1923