INSTRUCTION PAMPHLET

U-5013

MAINTENANCE
OF
STYLE "B"
a-c. and d-c.
SIGNALS

MAY, 1929

UNION SWITCH & SIGNAL CO.
SWISSVALE, PA.

Printed in U. S. A.

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Section I

D-C. SIGNALS

1. GENERAL—All moving parts of the signal must, under all conditions of weather, move with perfect freedom. These parts should not be allowed to get tight through use of unsuitable oil or lack of lubrication.

Precaution should be observed to see that the semaphore spectacle castings rest against the stops provided for that purpose, allowing the slot arms and vertical connections to be free from all downward pressure when in the stop position.

Barring accidents in transit or installation, the signal mechanism should be found ready for satisfactory operation without further adjustment.

Before placing any signal in service, remove all oil, grease and dirt from armature and poles of the slot magnet.

2. LUBRICATION—

General—Avoid using too much oil. Always remove all surplus oil that may flow over the mechanism and collect dust.

"Union" Non-Freezing Lubricating Oil (Spec. 1093) or some other high grade light oil, free from acid, should be used for all lubrication except as otherwise specified in the following instructions.

Before placing the signal in service, lubricate the bearings in the signal head at the top of the pole and in the mechanism, and fill the oil wells on the motor.

Semaphore Shaft Bearings—The semaphore shaft journals should have the lubricant replenished at least once every six months. The journals should be kept well packed with Dixon's Semaphore Lubricant No. 685 or 2 VH Tulc. It is important that the lubricant be kept in a semi-fluid state and to this end it is recommended that a small amount of Spec. No. 1093 oil be applied to the bearings three months after the grease is applied. Care should be taken not to use an excess of lubricant or oil. Lubricant oozing out at the end of the journals indicates that the reservoir is filled.

Previous to 1925 semaphore bearings were equipped with oil cups; since 1925 Alemite Type "A" or Zerk fittings have been furnished.

A pressure gun is recommended for applying lubricant and oil. A gun with a pipe thread tip may be had for use with signals furnished previous to 1925 which can be applied to the pipe taps, in the bearing, provided for the oil cups. This necessitates removal of the oil cups when applying the lubricant.

Bearings with Alemite fittings are best maintained with an Alemite grease gun ($\frac{1}{2}$ pint capacity) equipped with a hose having a check valve. This gun may be used for either the grease or the oil. Alemite or Zerk fittings can be applied to the old bearings not so equipped, providing properly threaded fittings are selected. The oil cups on the earlier signals had a $\frac{5}{16}''$ 32 thread pipe tap.

In case the signal has been equipped with the Zerk fittings, the distinction will easily be noted in that the Alemite is equipped with a bayonet type of attachment for the grease gun. The Zerk fitting is not so equipped, the grease gun being applied merely with a pressure contact which is sufficient to properly force the lubricant into the bearing. The Zerk pressure gun can be used to apply oil as well as grease.

Mechanism and Motor Bearings—Mechanism and motor bearings should be oiled once a month with Spec. No. 1093 oil.

Chains and sprockets should be cleaned periodically with gasoline and coated lightly with any good, light grease such as that used for semaphore bearings.

Commutators—Commutators of motors equipped with copper leaf brushes should be cleaned and then wiped with a cloth slightly moistened with Spec. No. 1093 oil, once a week. Commutators equipped with composition brushes should be kept free from oil at all times.

Circuit Controller—A drop of oil rubbed over the contacting surfaces at frequent intervals will reduce both friction and wear on these parts. By the use of a good, non-freezing oil, troubles from frost on the contacts may be avoided. If the contacting surfaces are kept clean, the oil will be beneficial, but if dirt is allowed to collect so as to form a paste or gum, trouble will develop.

Buffers—Buffer cylinders are thoroughly lubricated with Dixon's Semaphore Lubricant No. 685 before leaving the factory.

To insure that the lubricant remains soft and in proper condition, a few drops of Spec. No. 1093 oil should be inserted into the cylinder once a month by removing the plug containing the vent. The outside of the buffer should be wiped clean before the plug is removed, and special care taken that no dirt or grit enters the cylinder.

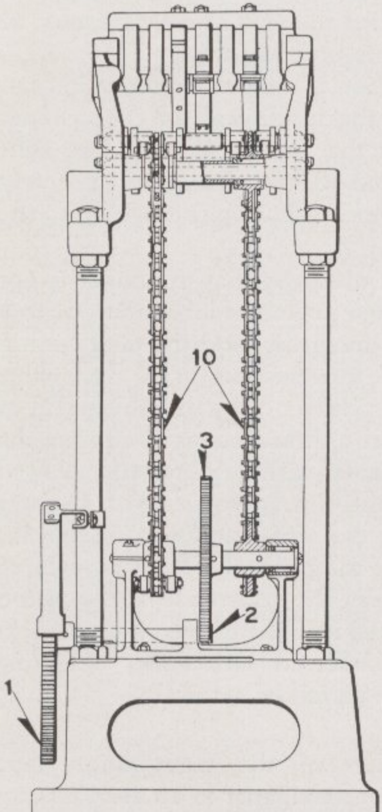
In the earlier designs of Style "B" Signal, the cylinder may be oiled by removing the vent screws and dropping oil in the vent while the signal is being cleared, the suction carrying the oil into the cylinder. Care should be taken here also that no dirt or grit enters the cylinder, and in replacing the vent screw, care must be taken that the buffing is properly adjusted.

A very good indication of the piston lubrication can be had by observing the inside wall of the cylinder when the piston is in the "up" position. The right amount of oil will tend to keep the piston properly lubricated, while too much will drop through on to the mechanism.

If at any time it is observed that the buffer is not functioning properly due to lack of lubrication or to a stiffened condition of the grease, and the fault cannot be overcome by the introduction of a reasonable amount of oil into the cylinder or by the adjustment of the vent screw, the piston should be removed from the buffer, thoroughly cleaned with gasoline and allowed to dry. Repack the piston ring grooves with Dixon's Semaphore Lubricant No. 685, removing all surplus grease from the top of the piston before it is replaced in the cylinder and from the under side of the piston after it has been inserted into the buffer. This repacking should put the buffer in satisfactory operating condition for another period of service.

3. BRUSHES—Brushes of the composition type can be ground with fine sandpaper to an even seat on the commutator if uneven bearing surface is noted. Do not use emery for this.

Composition type brushes are installed in staggered positions with a slight overlap which results in a con-



END VIEW OF FIG. 1

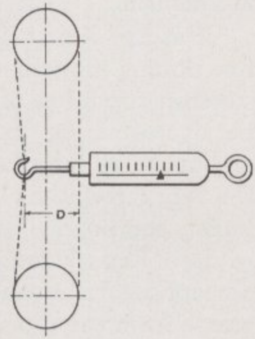


FIG. 2

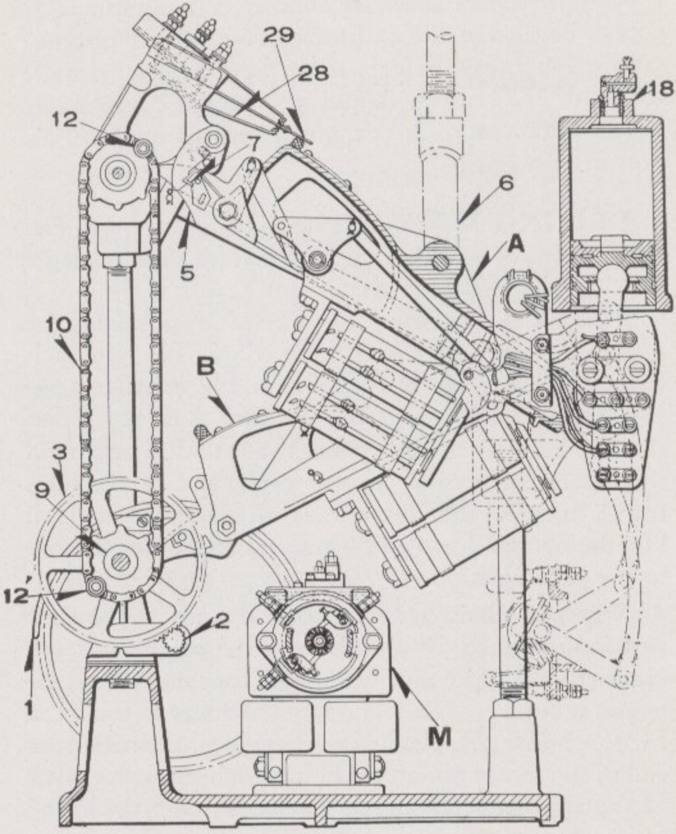


FIG. 1
Central Vertical Section of Mechanism and Frame

tinuous bearing surface across the commutator and prevents the wearing of grooves in the commutator.

Copper leaf brushes are built up of laminations of copper beveled at the end for contact on the commutator. All brush holders must work freely on their studs and the brushes should bear on the commutator with a minimum of 2.0 oz. and a maximum of 4.0 oz. pressure per brush.

4. DRIVING MECHANISM—The Motor M, Fig. 1, by means of a pinion on its armature shaft, engages gear 1. On the same shaft with gear 1 is pinion 2, which engages with gear 3. Sprockets 9 are pinned to the same shaft as gear 3 and drive chains 10. On each chain 10 are two sets of rollers 12 and 12' which engage with the forked end 5 of the slot arm A or B. When the slot magnets are energized, the fork 5 is held rigid through a system of levers and toggle, and as the chain travels upward the slot arm is lifted, which in turn lifts the up-and-down rod 6 and moves the semaphore to the clear position.

When the chain has carried the slot arm to the clear position, contacts 28 and 29 are opened through engagement with the slot arm, and the battery to the motor is cut off. When the motor battery is cut off, a friction brake is applied to a wheel located at the rear end of the motor armature shaft, which stops the roller 12 shortly after it has passed out from under the lifting forks when motor is operated at 8 volts. This roller should not travel more than ½" beyond top of sprocket when the signal is operated at 12 volts. Roller 12' is then in position to engage the slot arm A after it has dropped down ready for the next operation.

When the roller 12 passes out from under the lifting fork of the slot arm, the slot arm drops down about $\frac{1}{16}''$ to $\frac{1}{8}''$ until the lugs 7 rest on latch hooks provided for holding the slot arm in the clear position.

One motor and driving mechanism is used for all arms, with a separate lifting chain for each arm. For a three-arm two-position signal, there is one motor, three chains, and three slot arms, one for each signal blade. In some cases 2 motors are used for operation of a 4 arm mechanism.

Lifting chains shall not be allowed to become too loose. Factory adjustment is checked by using a spring balance attached to the chain at a point midway between upper and lower shaft and with a pull of 5 lbs. as shown in Fig. 12, measuring the distance D between center lines. This distance should be not less than $1\frac{7}{8}''$ or more than $2\frac{1}{16}''$.

About $\frac{1}{32}''$ end play may be expected in sprocket bearings.

5. SLOT ARM—The slot arm is that portion of the mechanism controlled directly by the track or line relay. It is shown as A and B, Fig. 1, and serves to engage the signal semaphore arm with the driving mechanism and holds that arm in the clear position until released, when the signal returns to danger by gravity.

The action of the slot arm and the manner in which its various parts function is shown in Fig. 3.

When in the clear position, both lugs of the slot fork should rest evenly on the faces of the supporting pawl, insuring an even distribution of weight on the slot fork.

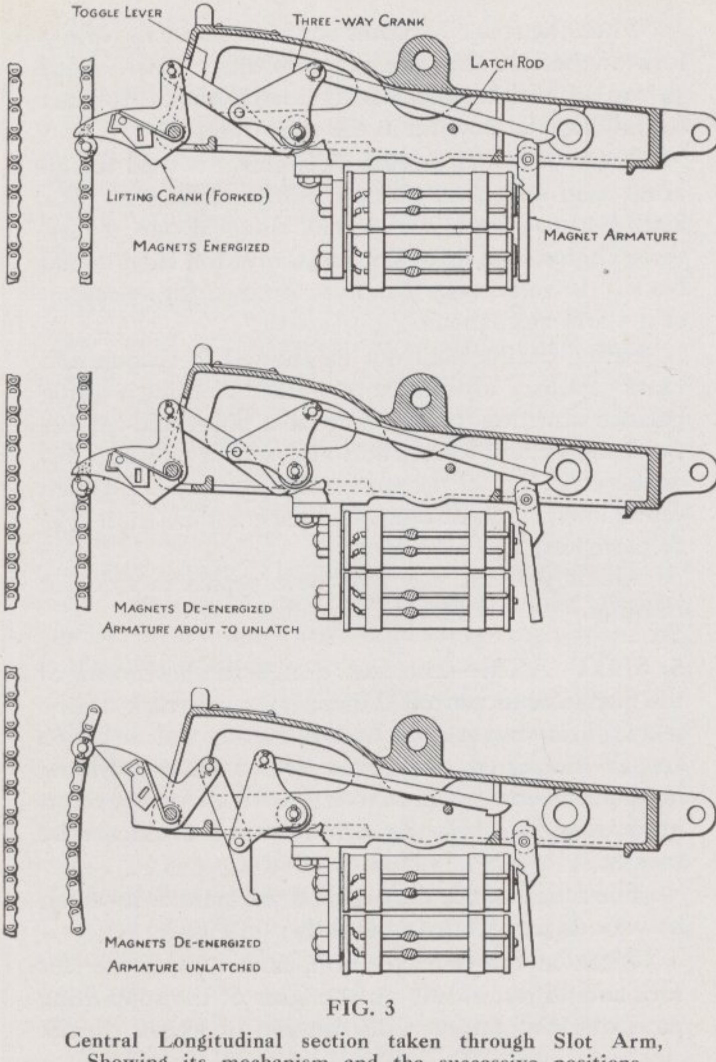


FIG. 3

Central Longitudinal section taken through Slot Arm, Showing its mechanism and the successive positions the latter assumes prior to, and at the moment of, releasing the signal mechanism.

The coil spring on the slot fork should have a tension equal to one-quarter turn, to be determined by releasing spring and noting that released end takes a position at right angles to slot arm, and should restore the fork quickly to its normal position after the slot arm has kicked off.

The springs on the supporting pawls should have ample tension to force the pawl sharply against the lugs on the slot fork.

The operation of the signal depends a great deal upon the adjustment of the toggle, latch rod, armature, and magnet. In order to more clearly understand proper adjustment, Figs. 5 to 14 inclusive are shown. These views show correct and incorrect conditions and are self-explanatory.

Always keep the armature and the pole faces clean and free from oil or grease.

Toggle—The length of the slot arm toggle is the distance T in Fig. 13. This is always adjusted at the factory and the value stamped on link E, Fig. 13, such as 1, 3, or 5, meaning $\frac{1}{4}''$, $\frac{3}{8}''$ or $\frac{5}{32}''$ toggle, respectively. These parts should never be altered by filing the arm E or the brass stop B, as changes in the toggle produced thereby seriously affect the safety of the signal.

Armature Trunnion—The clearance between the armature fulcrum pin and the bushing in the armature and the supporting trunnions is very small. Because of this, there is not more than $\frac{1}{32}''$ side play at the lower end of the armature when signals are new. Excessive wear of these parts will distort the magnetic air gap and permit the upper stop pins to ride on the pole face when they should be free at all times.

When excessive wear is present, the release values of the slot arm will be erratic and renewals should be made of the worn parts.

Slot Magnets—The slot magnet on the front slot arm is usually wound to 500 ohms resistance and is slow acting so as to retain sufficient energization to keep the armature attracted during a change of polarity on polarized relays. The rear slot arm controlling the distant semaphore blade, or the 45 deg. to 90 deg. operation on three-position signals, does not have to take care of any open circuit period in polar relays when polarity changes and hence is usually 1000 ohms resistance and ordinary acting with a special motor winding to furnish extra power during the clearing operation.

When used at interlockings or for neutral line control, a slot contact is sometimes provided. This contact is actuated by the magnet armature so that the slot magnet must be energized to close the contact which supplies current to the motor.

6. BUFFER—With the buffer exhaust port open, the slot arm should of its own weight without up-and-down rod connection, settle freely from the clear to the stop position, thereby indicating that excess friction does not exist in the buffer or connections.

7. CIRCUIT BREAKER—Contact fingers should be adjusted so that they bear firmly and evenly on their respective segments and springs.

The contacts on the circuit controller located above the sprocket shaft that are open when the slot is down, should be adjusted so that the contact opening is from $\frac{3}{32}''$ to $\frac{1}{8}''$ and should close when the bottom of the lug on the slot arm fork is $\frac{1}{2}''$ below the face of the supporting latch.

The springs that are closed when the slot arm is down should have not less than $\frac{1}{16}''$ contact opening when the lugs are resting upon the latch.

8. THREE-POSITION SIGNALS—When style "B" mechanisms are used to operate three-position signals, two slot arms are required, one for zero to 45 deg. and one for 45 deg. to 90 deg. operation. The up-and-down rod is provided at the lower end with a pinion meshing with two vertical racks projecting upwards between guides. Each slot arm lifts a rack and when the front slot arm reaches the top of its stroke, its rack has carried the pinion to lift the up-and-down rod through half its total travel, thus bringing the semaphore to the 45 deg. or caution position. When the rear slot arm lifts, it completes the upward stroke of the up-and-down rod so that the signal indicates 90 deg. or full proceed.

9. CIRCUITS—Fig. 15 illustrates a typical circuit for the control of a two-arm, two-position home and distant automatic signal or a one-arm, three-position automatic signal.

Fig. 16 illustrates a typical circuit for interlocking or line control where the slot magnet functions as a relay and operates a contact for the motor battery.

10. ELECTRICAL INSPECTION

Test—Measure the release voltage (shunt) periodically. Tabulate the results in a form permitting of ready comparison. A gradual change in the release voltage from time to time indicates a changing condition of the signal. Use a standard voltage for all tests.

Intervals—Electrical tests should be made every six months where signals operate under average conditions. Signals located in dense traffic zones should be given a test every *four months.*

Apparatus—1. Tests should be made with an E. M. F. of 12 volts d-c. at the terminals of coils. Connect a sufficient number of cells (dry cells may be used) in series with the signal battery to give approximately 14 volts on open circuit.

2. Voltmeter with a scale reading 0-15 volts.

3. Adjustable slide resistance for potentiometer connection.

Method—1. Comparative results can be obtained only by following exactly the same procedure in all tests.

2. Remove the slot coil leads from the terminals and connect to testing circuit per diagram. Fig. 4.

3. First drive the signal to the position at which the release (shunt) is to be taken and then open the circuit. This is to be done at least twice before taking readings so as to produce normal conditions.

4. Adjust to 12 volts with switch "S" open, then close the switch, clear the signal and adjust the voltage if necessary. Do not exceed 12 volts on the slot coils after closing switch "S." If exceeded, release slot and repeat the operation before taking the release value. An overcharge will lower the release.

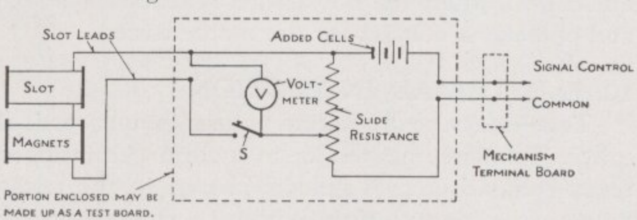


FIG. 4

5. Before taking the release, be sure that the trunnions have passed from under the lifting crank.

To obtain the release, reduce the voltage *slowly* by moving the slide connection on the resistance unit until the slot magnet releases.

Points to be Observed—1. The release voltages should be within values given below:

	Slow Acting		Ordinary Acting	
	500 Ohm Air Gap	¼″Toggle Rel. Volts	1000 Ohm Air Gap	⅜″Toggle Rel. Volts
Shop Test......	.020	1.6-1.8	.015	3.2-3.4
Min. Service....	.015	1.0	.011	2.0

This data is for style B signals producing 120 lbs. thrust on slot arm.

2. If the release voltage is less than the *Minimum Shop Values* specified in the tables above, the signal should be watched closely and adjustments made before the *Minimum Service Value* is reached.

3. All slow acting slots of round pole face type should hold without tripping when the circuit is opened 0.6 second with energy at 8.0 volts. This is with slot arm in clear position. Under the same conditions, the slow acting slots having magnets with hexagon pole faces should hold 0.9 second.

4. Signals releasing below minimum shop values indicate either one or more of the following conditions:

a. Excessive friction exists in the moving parts such as the toggle, up-and-down rod, slot arm bearing, buffer, semaphore bearings or head gear bearings.

b. Insufficient torque due to improper semaphore equipment.

c. That the magnetic air gap has been decreased through wear of stop pins in armature. Stop pins should not be allowed to wear beyond a point giving 0.004″ less air gap than marked on data plate of slot arm. The air gap can be measured by leaf or a stop pin gauge. (This measurement should be made with magnet deenergized.)

When stop pins need renewing, the slot arm should be sent to the shop for repairs and re-adjustment of air gap.

5. If signals release at values higher than specified in the foregoing table, the safety factor is increased by that amount, but if they do not operate properly at the higher release values, this would indicate either one or more of the following:

a. Excessive torque produced by improper semaphore equipment.

b. Latch hook not seated to full depth in armature notch.

c. Latch rod too long, allowing toggle to droop when latched.

d. Latch hook or armature notch worn and not permitting proper engagement.

e. Toggle links and connection worn sufficient to increase the toggle.

f. Stop pins longer than specified in data plate.

g. Upper stop pins in armature engaging with pole face.

With lower pins engaging pole face, there should be about .003″ clearance between upper pins and pole face. This means that the upper pins should always be .003″ shorter than the lower pins and the air gap adjusted to be parallel and the same across both pole faces.

Air gap should be as noted in preceding table.

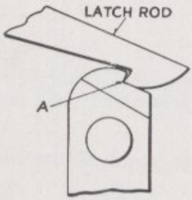


FIG. 5

Correct adjustment of lever latch. Point of contact at "A" (bottom of notch).

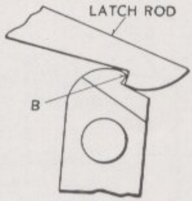


FIG. 6

Incorrect adjustment of lever latch. Point of contact at "B" (top of notch) increasing pull on armature.

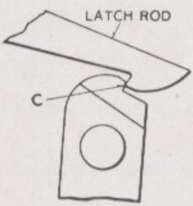


FIG. 7

Lever latch not properly seated to full depth in armature notch. Point of contact at "C" increases leverage pulling armature away from pole pieces.

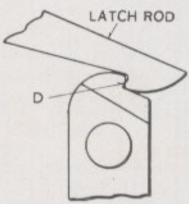
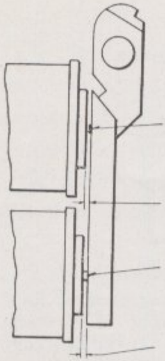


FIG. 8

Wear of point of lever latch raises the point of contact, increasing leverage pulling armature away from pole pieces.



Safety stop pins (.003″ shorter than working stop pins) free from pole face.

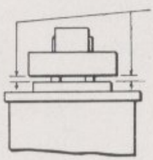
Parallel air gap same dimension as lower pole face.

Working stop pins.

Parallel air gap.

FIG. 9

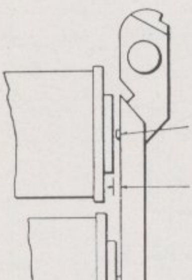
CORRECT adjustment of air gap—Side View. Both magnets exactly in line.



Air gap must be same on both sides.

FIG. 10

CORRECT adjustment of air gap—End View. Both magnets exactly in line.



Safety stop pins same length as working stop pins.

Upper air gap larger than on lower pole face.

Lower air gap smaller than on upper pole face.

FIG. 11

INCORRECT air gap adjustment. Air gap distorted due to setting of magnets to make upper stop pins free when all four stop pins are the same length.

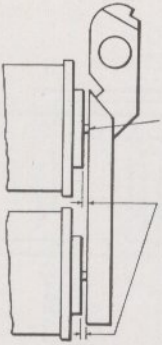


FIG. 12

INCORRECT air gap adjustment. All four stop pins same length and riding on pole faces.

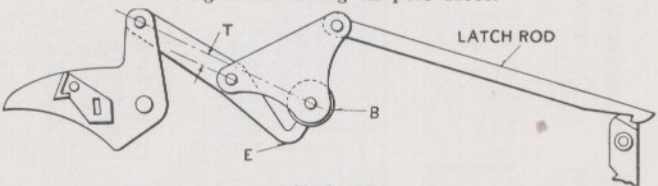


FIG. 13

Toggle is distance "T" measured when E is tight against brass stop B.

When signal is in clear position E should drop slightly away from B, but when E is pushed up tight against B, the latch rod should not move outwards more than $\frac{1}{64}''$.

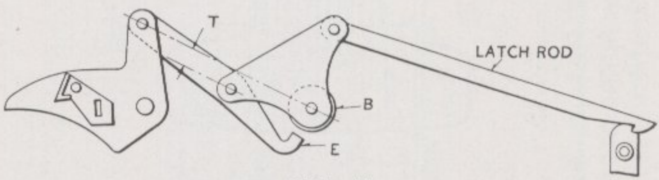


FIG. 14

Incorrect adjustment when signal is clear. Toggle is increased by drooping as shown and when pushed up against brass stop, the latch rod will move outwards more than $\frac{1}{64}''$. Condition is due to wear of parts or to long latch rod and causes high release and kicking off.

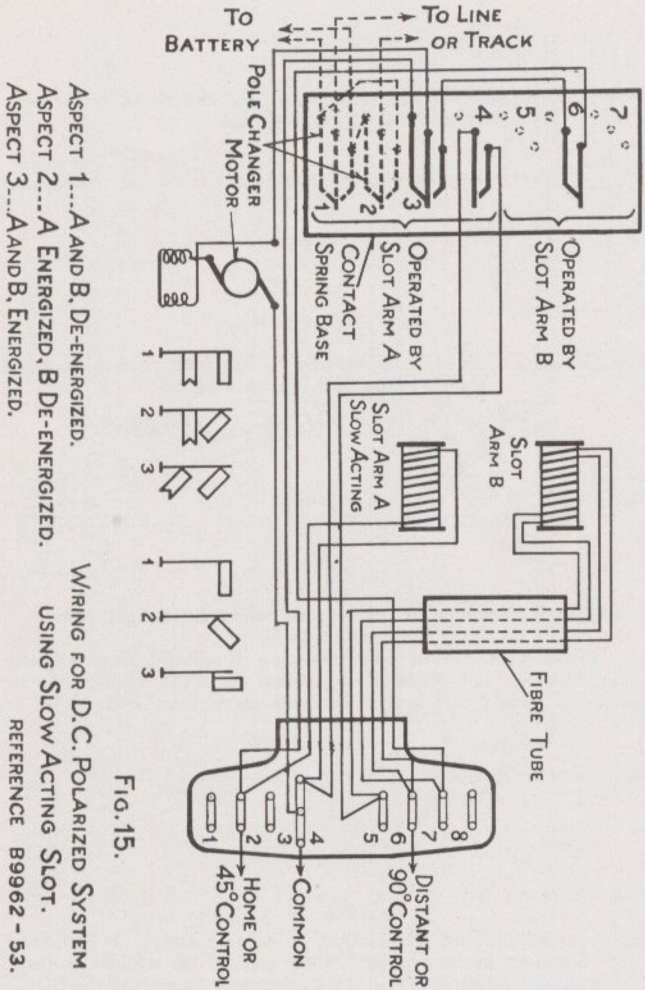

To Battery
To Line or Track
Pole Changer Motor
Contact Spring Base
Operated by Slot Arm A
Operated by Slot Arm B
Slot Arm A Slow Acting
Slot Arm B
Fibre Tube
Home or 45° Control
Common
Distant or 90° Control
Fig. 15.
Wiring for D.C. Polarized System using Slow Acting Slot.
Reference B9962 - 53.
Aspect 1...A and B, De-energized.
Aspect 2...A Energized, B De-energized.
Aspect 3...A and B, Energized.

FIG. 15

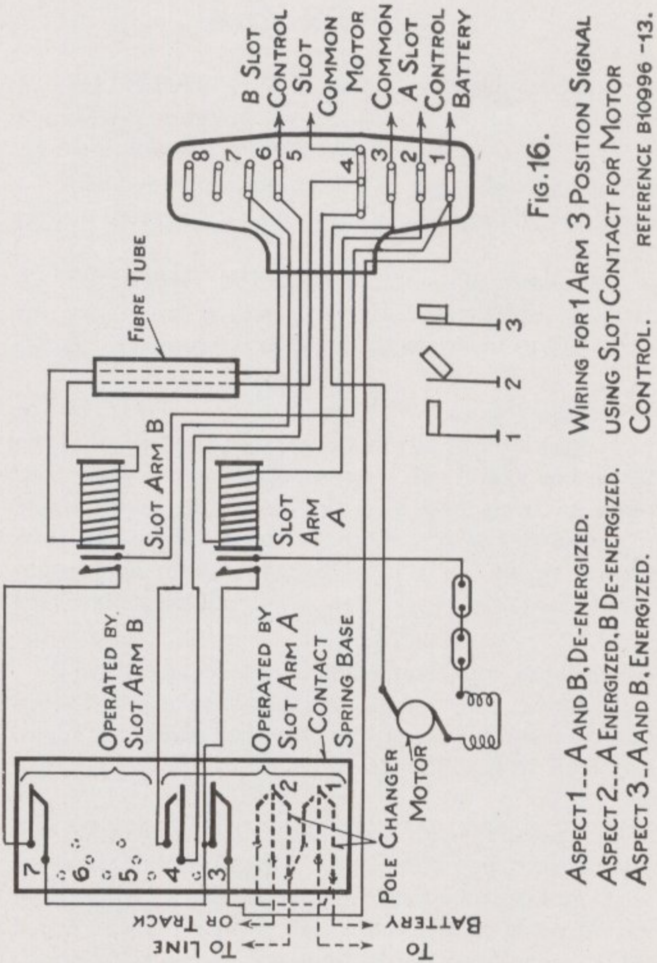

Fibre Tube
Slot Arm B
Slot Arm A
Operated by Slot Arm B
Operated by Slot Arm A
Contact Spring Base
Pole Changer
Motor
To Line or Track
To Battery
B Slot Control
Slot Common
Motor Common
A Slot Control
Battery
Fig. 16.
Wiring for 1 Arm 3 Position Signal using Slot Contact for Motor Control.
Reference B10996 -13.
Aspect 1.. A and B, De-energized.
Aspect 2.. A Energized, B De-energized.
Aspect 3. A and B, Energized.

FIG. 16

Section II

A-C. SIGNALS

1. **GENERAL** — The same general precautions should be observed for a-c. signals as for d-c. signals. These points are outlined in Section I.

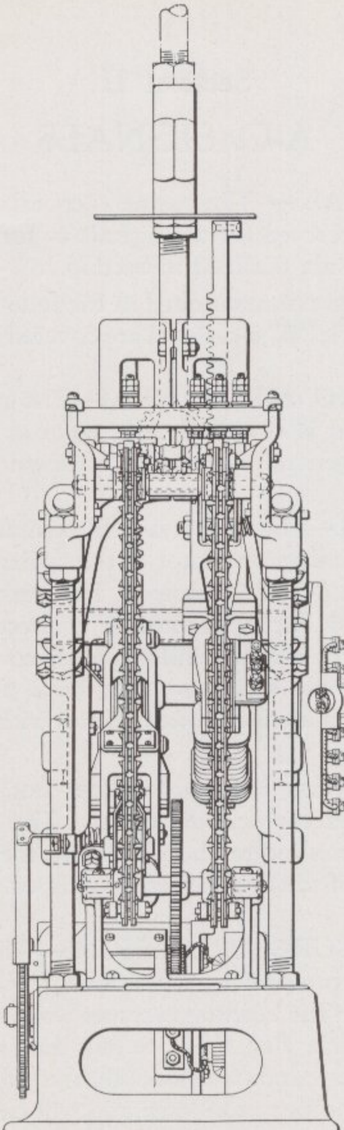
Any points not mentioned in the following description of the style "B" a-c. signal are covered by Section I.

2. **DRIVING MECHANISM**—The mechanism of the a-c. signal is essentially the same as for the d-c. signal. The general appearance is shown in Fig. 17.

3. **MOTOR**—The a-c. style "B" signals are driven either by an induction motor of the squirrel cage rotor type or by an a-c. series motor. The brake coil of the single phase induction motor is connected in series with one of the motor windings and acts as a reactor to provide phase splitting. For the 2 phase motors two brake coils are used, one in series with each motor winding.

The induction type motor does not require any special care except periodic oiling. The commutator of the a-c. series motor should receive the same attention as that of the d-c. motor as outlined in Section I.

4. **ARMATURE TRUNNIONS**—The bushing in the armature prevents excessive side play on the trunnion shaft. If the bushing becomes worn so that there is too much side play, the core pins may strike on the copper shading bands instead of on the pole face. This will make the air gap too large and will cause the trac-



END VIEW OF FIG. 17

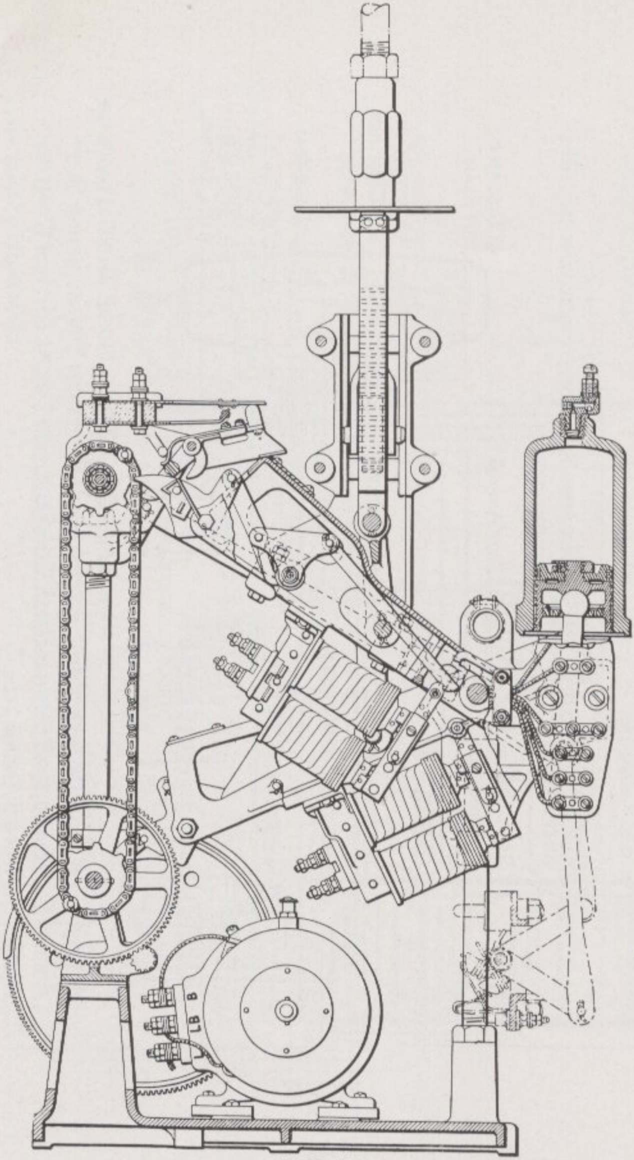
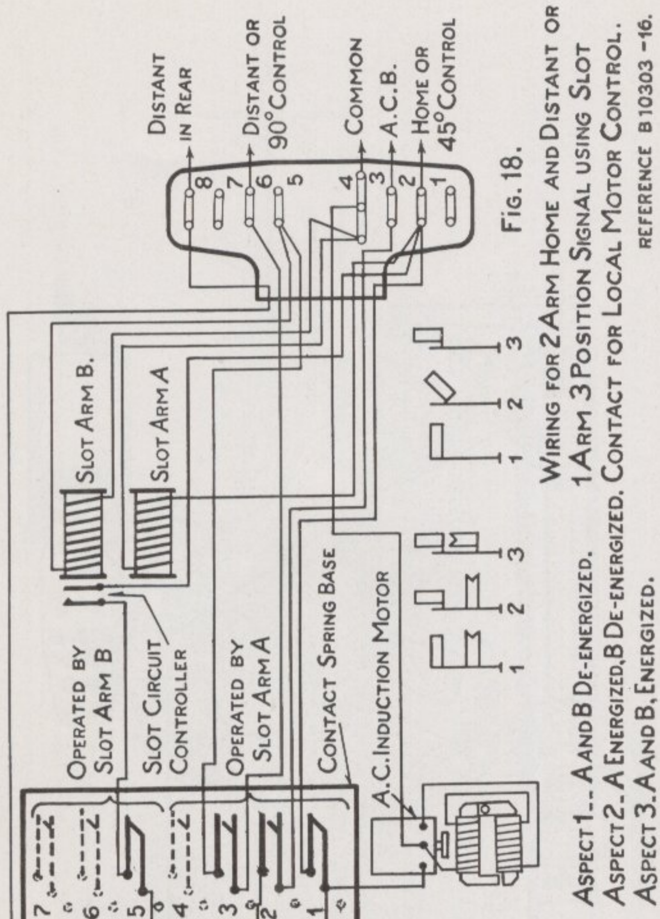


FIG. 17
Mechanism with Induction Motor for One-Arm Three-Position 90 Deg. Upper Quadrant Style "B" a-c. Signal



Distant in Rear
Distant or 90° Control
Common
A.C.B.
Home or 45° Control
8 7 6 5 4 3 2 1
Slot Arm B.
Slot Arm A
Operated by Slot Arm B
Slot Circuit Controller
Operated by Slot Arm A
Contact Spring Base
A.C. Induction Motor
7 6 5 4 3 2 1
1 2 3
1 2 3
Fig. 18.
Wiring for 2 Arm Home and Distant or 1 Arm 3 Position Signal using Slot Contact for Local Motor Control.
Reference B10303 -16.
Aspect 1... A and B De-energized.
Aspect 2.. A Energized, B De-energized.
Aspect 3. A and B, Energized.

FIG. 18

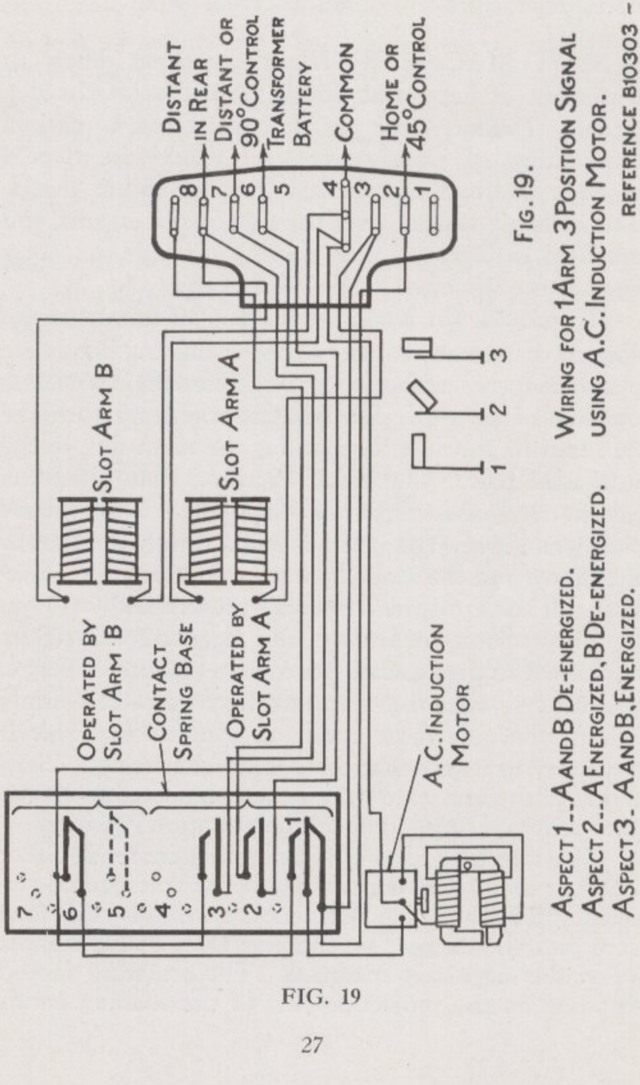

Distant in Rear
Distant or 90° Control
Transformer Battery
Common
Home or 45° Control
Slot Arm B
Slot Arm A
Operated by Slot Arm B
Contact Spring Base
Operated by Slot Arm A
A.C. Induction Motor
Fig. 19.
Wiring for 1 Arm 3 Position Signal using A.C. Induction Motor.
Reference B10303 -
Aspect 1.. A and B De-energized.
Aspect 2.. A Energized, B De-energized.
Aspect 3. A and B, Energized.

FIG. 19

tive power of the slot magnet to be lowered below that necessary for proper operation of the signal.

5. SLOT MAGNETS—The slot magnet differs in a number of important details from that of the d-c. signal. The magnetic circuit consists of U shaped laminations of transformer steel which are riveted together and to a bracket at the closed end of the U. The coils are slipped over the legs of the magnet and are held in place by pins passing through the outer ends of the legs close to the head of the coil.

To provide for a continuous flow of flux from the core to the armature, heavy copper shading bands are placed in the pole faces so as to surround approximately one-half of the area. These bands or ferrules cause the flux passing through them to lag the main flux in the unshaded part. The result is, then, that when the flux in the unshaded part of the pole face is zero at the time when it reverses, there is still a certain amount of flux flowing in the shaded part of the pole face. Chattering of the armature is thereby prevented.

The armature of the a-c. slot magnet is not rigidly connected to the bracket. A certain amount of play is provided so that the armature may be seated firmly against the pole faces under all conditions. This is necessary to insure that there is no chattering. Chattering of the armature will, in time, hammer down the core pins and cause wear on the armature bearings.

The core pins for a-c. slot magnets are made either .020″ or .025″ long depending on the voltage and frequency for which the magnets are wound. All four core pins should bear on the pole faces of the magnet when the magnet is energized. The armature should not ride on the projecting part of the shading bands nor should the core pins strike the shading bands. In either case the armature position should be re-adjusted, or, if necessary, a new armature should be installed to get the correct adjustment. The shading bands should project 0.015″ beyond the pole faces.

Unlike the d-c. slot magnets, the a-c. magnets cannot be made slow acting. It is therefore necessary when three position Style "B" a-c. signals are used to provide a slow acting relay which will keep energy on the 45 degree slot arm during the open circuit period which occurs when the three position track relay is being reversed.

6. CIRCUITS—Typical circuits for a-c. signals are shown in Figs. 18 and 19.

7. ELECTRICAL INSPECTION—Periodic tests should be made of the release values of the slot magnets. The results should be tabulated so that comparison may be made from time to time to determine whether or not the condition of the signal is changing.

The release of a-c. slot magnets should not be allowed to drop below 40% of the normal rated voltage.

The circuit for testing release of slot magnets is shown in Fig. 20.

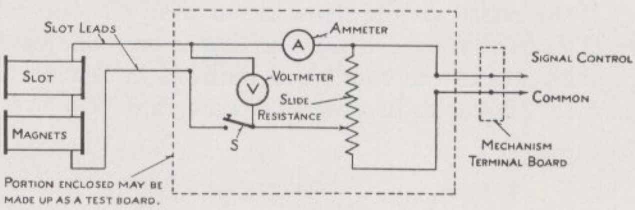


FIG. 20

The apparatus required for these tests is as follows:

1—90 ohm adjustable resistance slide, 2 Amp. Capacity (U. S. & S. Co. Dwg. 65525-B9954, Sh. 7).

1—a-c. Ammeter 0-1.0 ampere.

1—a-c. Voltmeter 0-150 and 0-75 volt scales.

It should be noted that the armature will hold in the clear position of the signal, without humming or chattering on 80% of the normal operating voltage. Any tendency to chatter indicates improper adjustment and the cause should be located and removed.

Chattering may be caused by:

a. Upper corepins not resting on the pole face. This may be corrected by moving the magnet toward the armature.

b. The two corepins on one side of the armature not touching the pole face. The magnet should be twisted sideways until all four corepins rest on the pole face.

c. Core pins resting on copper shading bands. The magnet should be adjusted until the core pins clear the shading bands and rest on the pole faces.

d. Improper toggle adjustment in the slot arm. Proceed as described in Section I for adjusting the toggle under "Points to be observed" 5a, 5b, 5c, 5d and 5e.

If the release of the signal is less than 40% of the rated normal voltage it may be due to any one or a combination of the conditions outlined in Section I, page 15, "Points to be observed" paragraph 4.

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