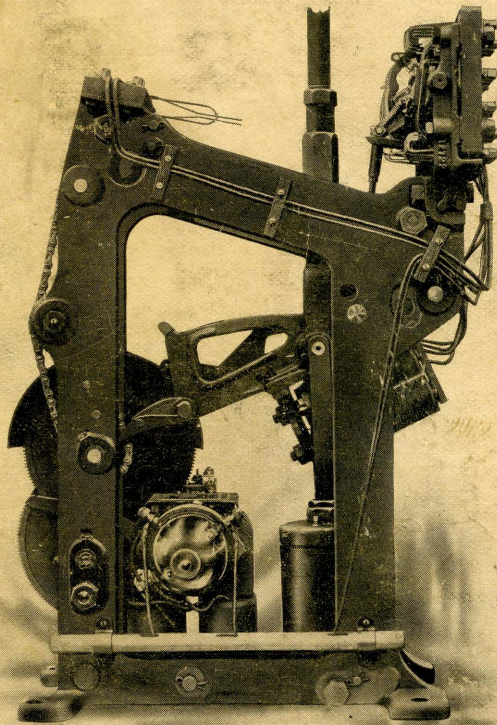


The  
Union Switch & Signal Co.  
Swissvale, Pa.



Union Electric Semaphore  
Equipped With  
Style "S" Mechanism

Bulletin No. 42

## UNION ELECTRIC SEMAPHORE EQUIPPED WITH STYLE "S" MECHANISM

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### Design

**T**HE style "S" signal is a development of our well known style "B" signal along lines that are best adapted to meet the requirements of three-position automatic block signaling.

A number of railroads, while not yet committed to three-position signaling, realize that they may later adopt it, and, with that end in view, naturally desire a signal at a comparatively low price which, while perfectly suited to two-position signaling, can later be transformed into a three-position type at a minimum expenditure of time and money.

In designing the style "S" mechanism to meet these conditions, we were able not only to retain all of the safety features embodied in the style "B", but through a series of exhaustive experiments and tests, were able to *increase* the factor of safety in *both* mechanisms without reducing their efficiency.

The signal has been designed to work with either direct or alternating current, shaded pole slot magnets and induction motor being used in the latter case.

### Three-Position Signal

In the style "S" three-position signal but one slot arm, with its transmission parts, is employed for the operation of each semaphore arm.

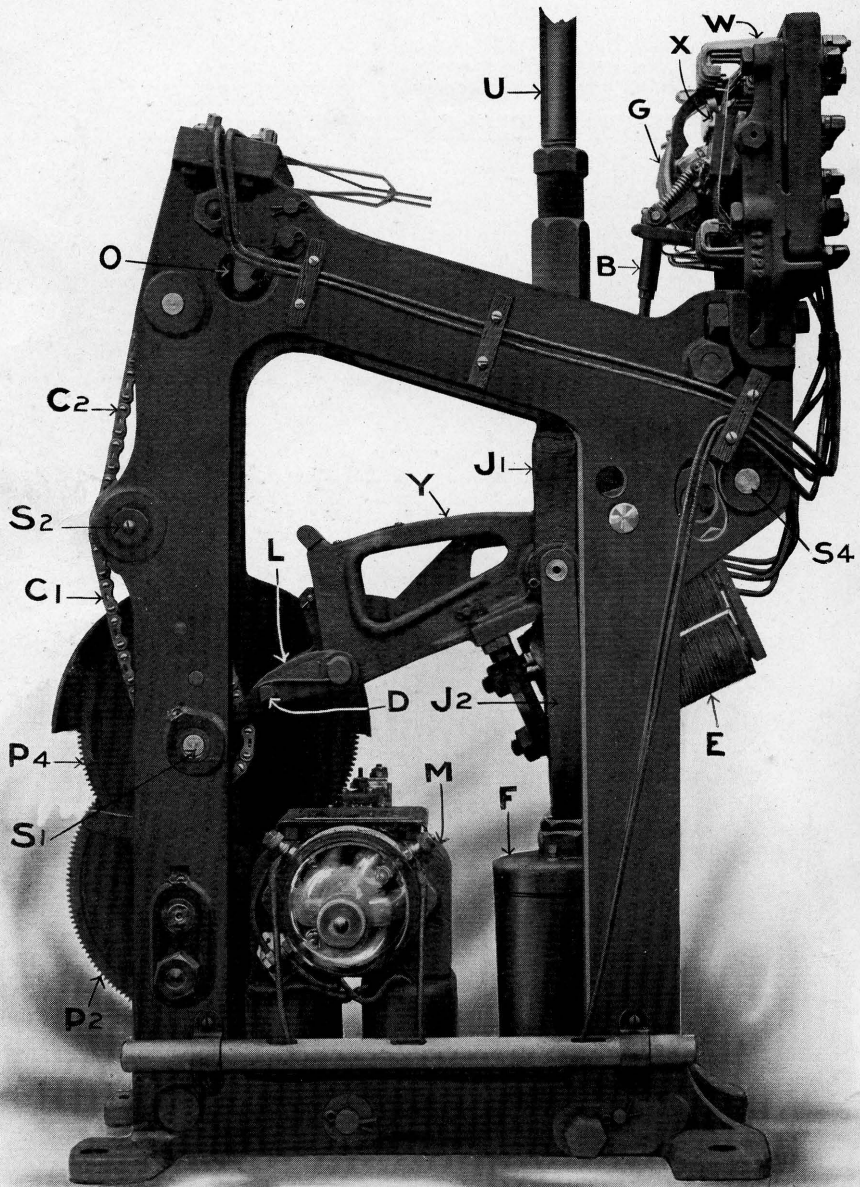


Fig. 1

## **Buffer**

An oscillating liquid buffer of ample dimensions 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", directly to the buffer.

## **Circuit Controller**

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 the highest grade of electrical porcelain dipped in 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 throughout with non-turning binding posts and otherwise is designed to comply with R. S. A. requirements.

The circuits for the intermediate or 45° 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.

## **Slot Arm and Operating Connections**

The slot arm is identical in design and principle with

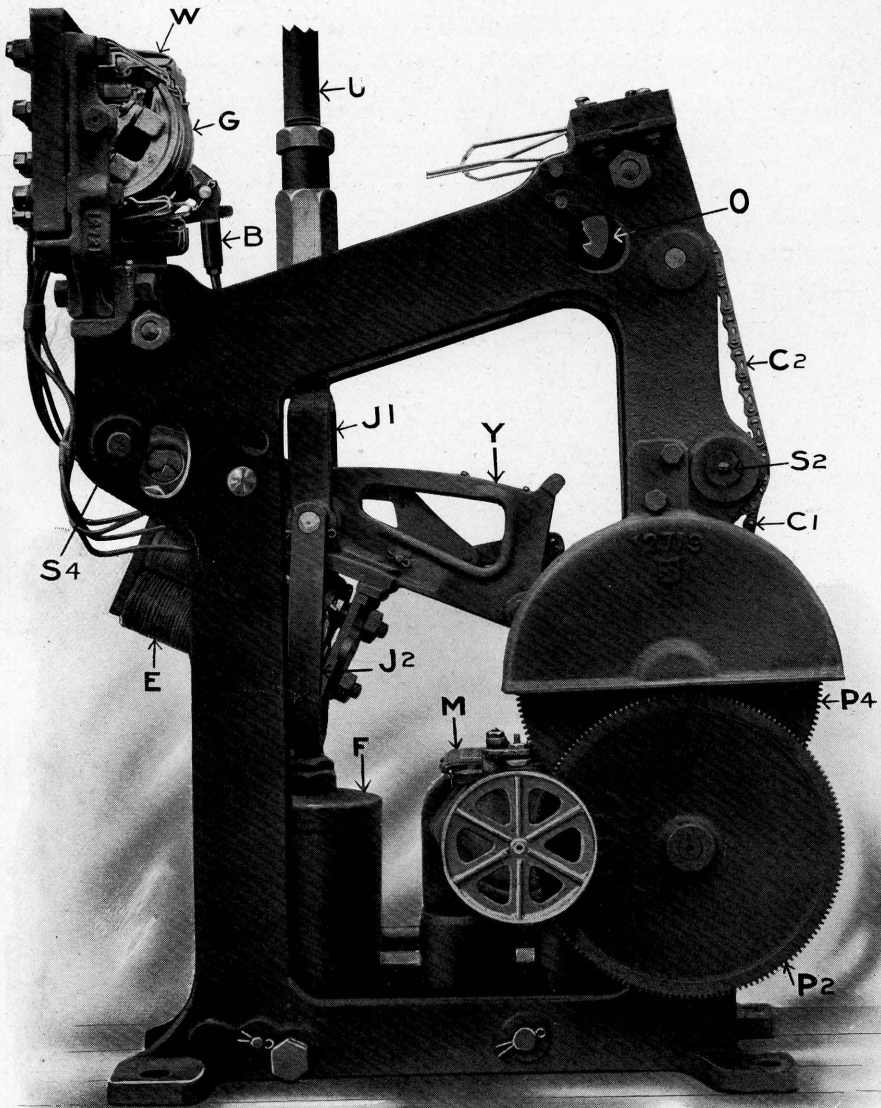


Fig. 2

that used on the style "B", except that the fork head or lifting crank is three pronged.

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 "stop" to the "caution" position, and the upper from the "caution" to the "clear" 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 caution and clear positions, thus retaining two of the important features of our style "B" signal, viz., 1st—the clear and caution positions are definite and do not depend on the adjustment of circuit controllers, and 2nd—in both these positions the signal is entirely free from its running gear.

### **Frames**

The mechanism frames are of cast iron secured to each other by steel bolts and spacers.

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 ready adjustment between the motor pinion and the gears.

By a modification of the slot arm leverages on both the style "S" and "B" mechanisms, the "mechanical kick-off", or the counterweight effect tending to force the slot armature away from the magnet coils, has been increased 175% without increasing the current consumed for holding the signal at clear or caution.

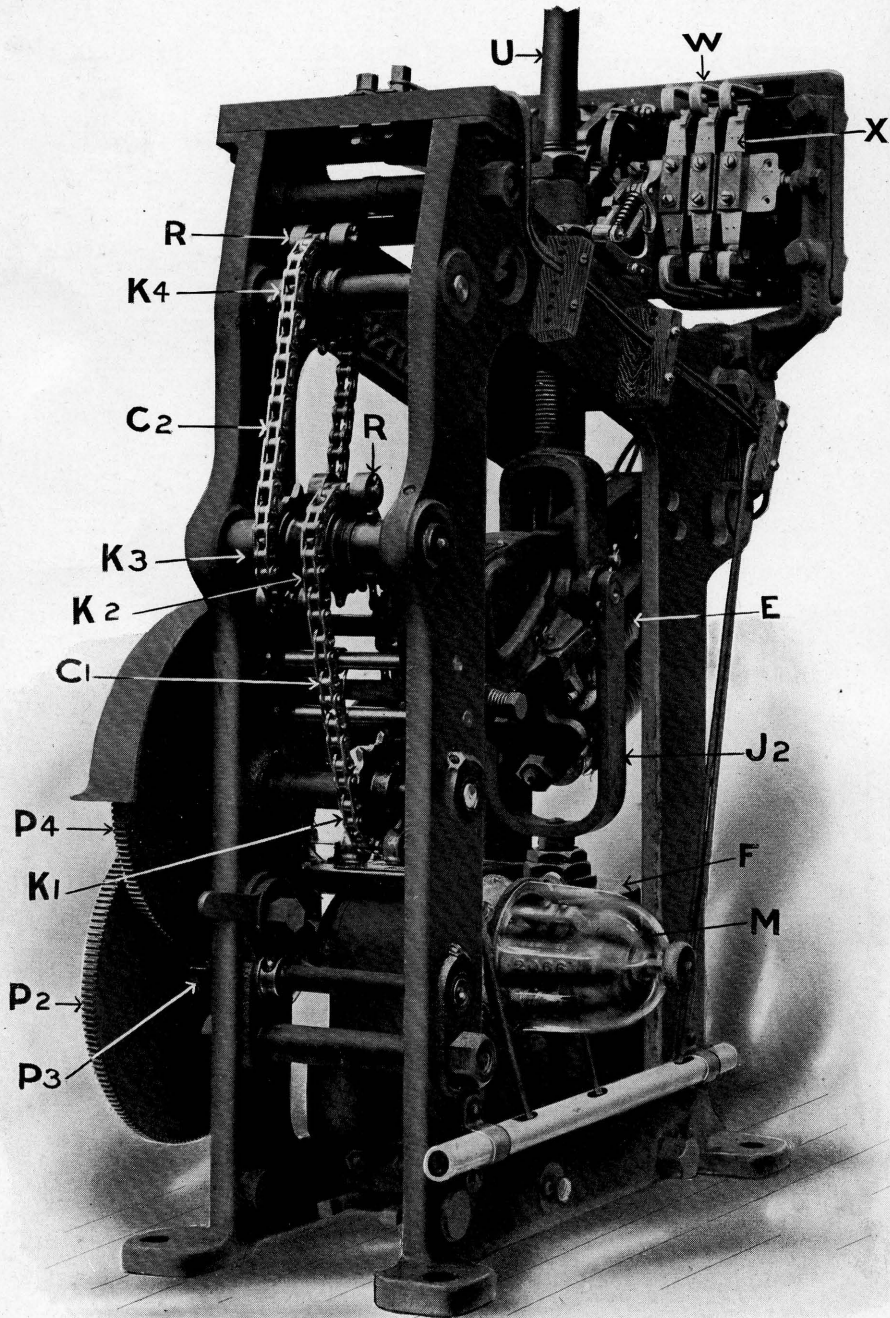


Fig. 3

## Two-Position Signal

While the three-position mechanism will operate a two-position signal through any angle between  $0^\circ$  and  $90^\circ$  without any change in the mechanism or wiring, still if signals are to be installed for two-position work and their change later to three-position is somewhat remote, we suggest the use of our style "S" mechanism arranged for a two-position movement.



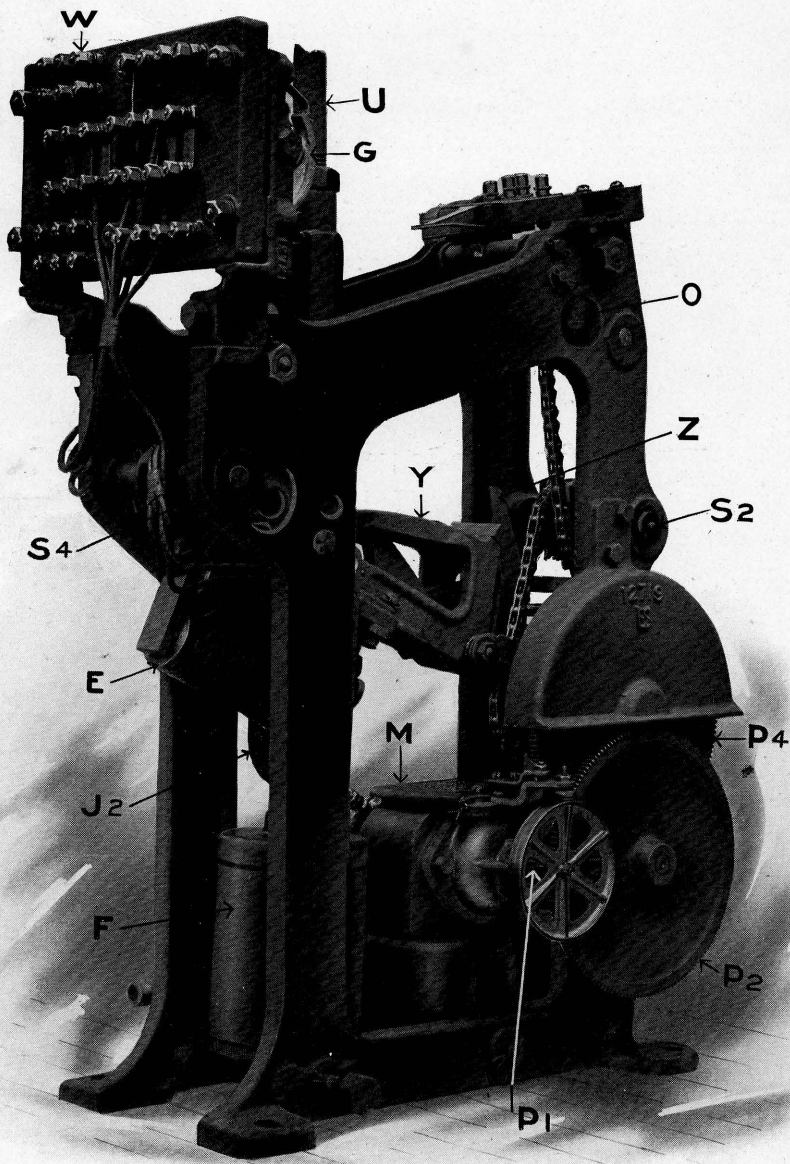


Fig. 4

## Method of Operation and Detailed Description

### I. METHOD OF OPERATION.

#### A. General Scheme.

(See Figs. 1, 2, 3 and 4.)

The style "S" mechanism consists of a motor M which, by means of pinion P<sub>1</sub> on its shaft, drives gears P<sub>2</sub>, P<sub>3</sub> and P<sub>4</sub>, the latter turning shaft S<sub>1</sub> and sprocket K<sub>1</sub>. Chain C<sub>1</sub> runs over sprockets K<sub>1</sub> and K<sub>2</sub> while chain C<sub>2</sub> runs over sprockets K<sub>3</sub> and K<sub>4</sub>, K<sub>2</sub> and K<sub>3</sub> being made in one piece. The slot arm Y, carrying the vertical rod U on jaw J<sub>1</sub>, is swung upward about S<sub>4</sub> when the lifting crank L, held rigidly through a toggle mechanism and electro magnet E, engages the rollers R on the chains. The rotating segments G and the pole changer X of the circuit controller W are operated by a link B connected to the slot arm. When the circuit controller opens the motor circuit for the 45° position the projecting lugs D come to rest on the stops Z for the caution indication. The 90° stops are shown through the hole at O. When the magnets E are de-energized the slot arm and the vertical rod are forced downward by gravity, the oil buffer F, connected by jaw J<sub>2</sub>, insuring a gradual and easy down stroke.

#### B. Circuits.

(See Fig. 5.)

When the neutral armature of the controlling relay is picked up, current flows through the 45° control wire to terminal 1. From thence there are two paths: one from upper to lower spring across circuit breaker A to terminal 2 and then through the motor to the negative side of the battery at terminal 4; the

# Wiring Design

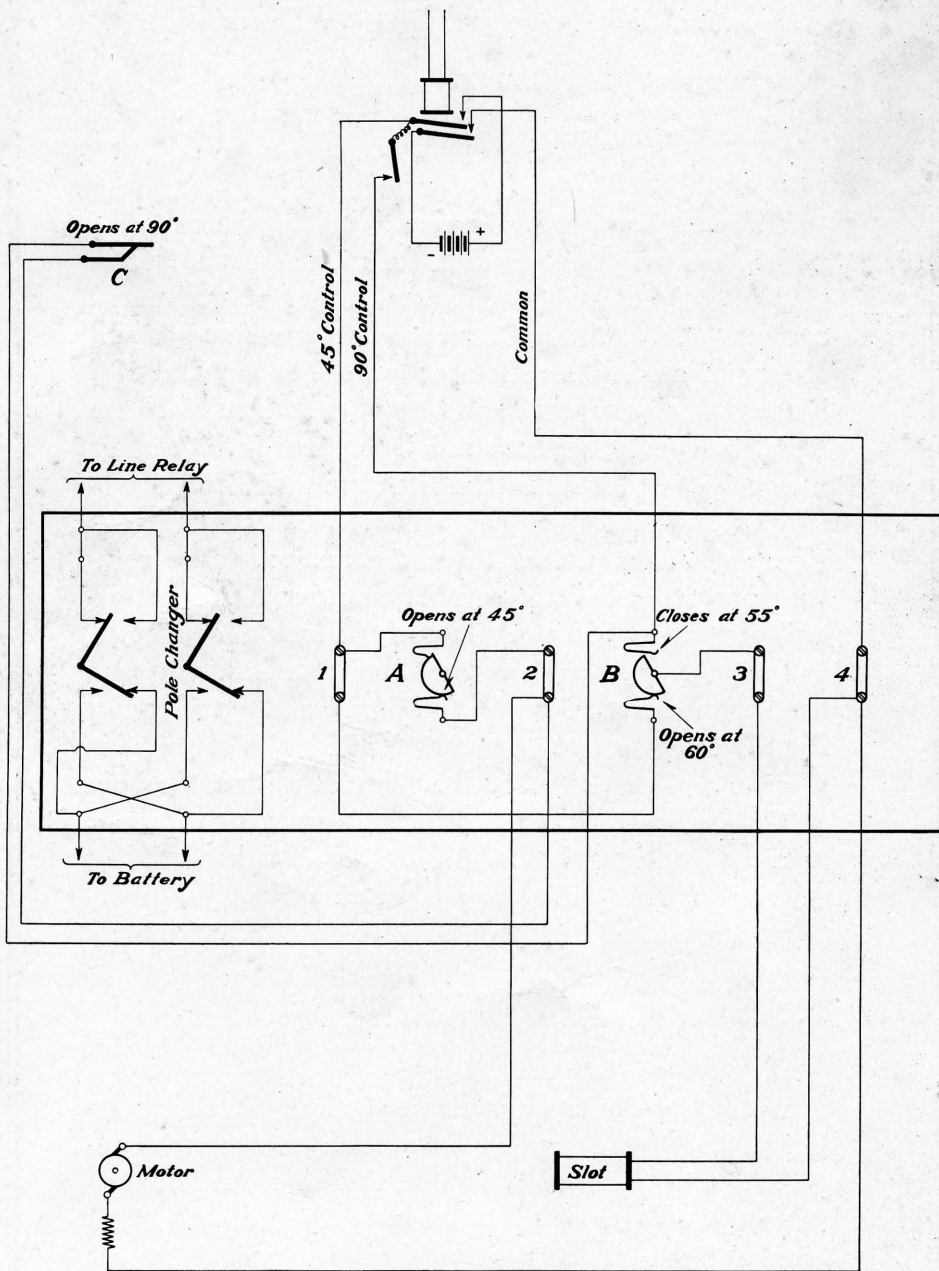
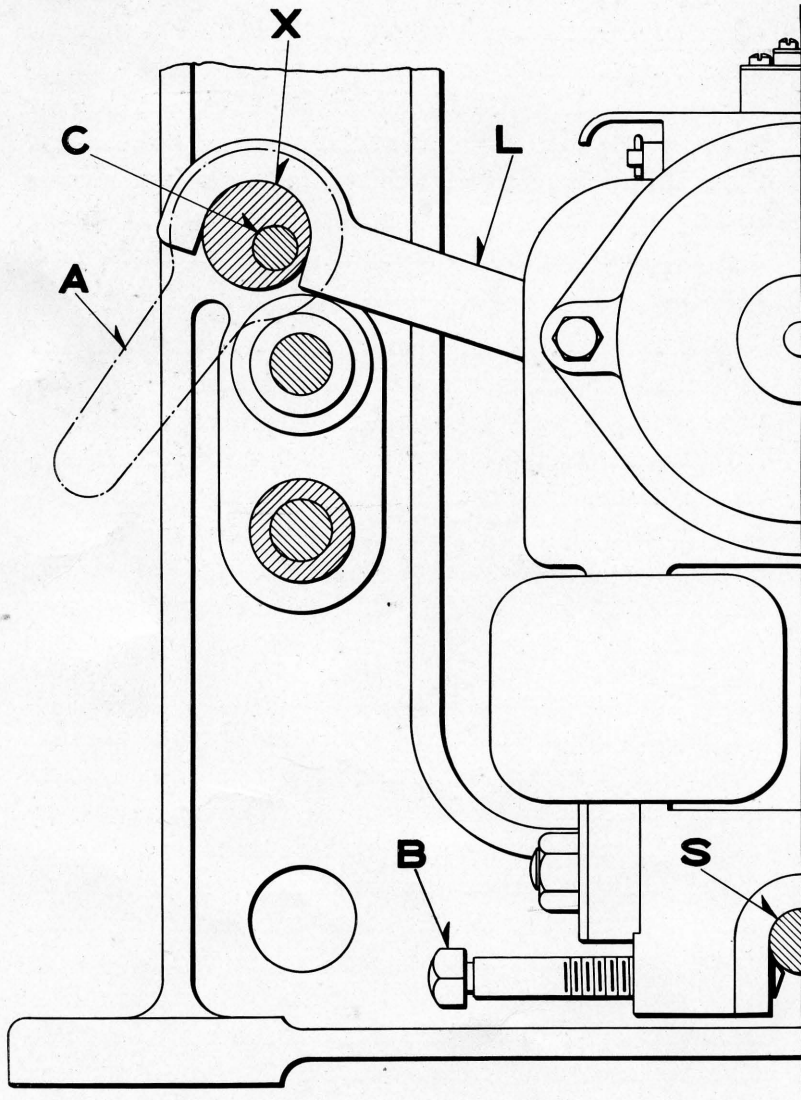


Fig. 5

other from terminal 1 through the lower spring of circuit breaker B to terminal 3 through the slot winding to terminal 4. The lower spring of circuit breaker A opens the motor circuit at the caution position and the slot circuit being still complete through the lower spring of B, the projecting lugs come to rest on the  $45^\circ$  latch when the rollers on the lower chain pass from under the lifting crank.

When the polarized armature of the control relay is picked up, current flows through the  $90^\circ$  control wire to the upper spring of circuit breaker B, and a tap from thence leads through circuit breaker C to terminal 2, to the motor and the negative side of the battery at terminal 4. The slot circuit for the caution position is broken by the lower spring of circuit breaker B at  $60^\circ$ , while that for the clear position is made through the upper spring of B at  $55^\circ$ .

Now when a train enters the section in advance of the signal the control relay opens and breaks the slot circuits for both the caution and clear positions, so that the signal returns to danger. If, however, the polarized armature alone shifts, as will be the case when the signal in advance goes to the danger position on account of a train backing into the block, a switch being opened in said block, or from any other cause, then current ceases flowing through the slot coils from the upper spring of circuit breaker B, the armature releases and the slot arm and vertical rod are forced down until the lifting crank rests on the  $45^\circ$  latch, the slot circuit having been made by the lower spring of B at  $60^\circ$ . The slot coil is thus energized a little before the  $45^\circ$  position, so that the magnetic flux has time to build up to enable the slot armature to hold when the lifting crank strikes the latch for the caution position.



*Fig. 6*

## II. DETAILS.

### A. Motor.

(See Fig. 6.)

The motor, a direct current bi-polar series wound machine of ample power, is remarkable for its efficiency and dependability. The armature and field structures are made up of annealed soft iron laminations, the armature is balanced exactly and its shaft runs in self-oiling bearings, the copper losses are small on account of the low resistance of the field and armature windings, and the brushes, being made up of sheet copper stampings, offer little contact resistance. The armature and field coils are very carefully insulated, and after being wound are dried out under vacuum and then impregnated at a high temperature with an absolutely waterproof insulating compound. All parts of the motor pass a ground test of 3000 volts A. C.

The motor base is slotted and extends down over shaft S, to which it is held by the set screws in Fig. 6. The frame of the motor is connected by link L to the eccentric arrangement X, so that by shifting arm A up and down, the motor is tilted on shaft S, the hole in link L and the pivot of arm A being off center. By this means the pinion on the shaft of the motor may be brought exactly into mesh with its gear, the adjustment being retained by tightening the set screws B and C.

### B. Sprockets, Chains and Bearings.

(See Figs. 1, 2, 3 and 4.)

The sprockets K<sub>1</sub> and K<sub>4</sub> are steel forgings, while K<sub>2</sub> and K<sub>3</sub> are turned out of one piece of cold rolled

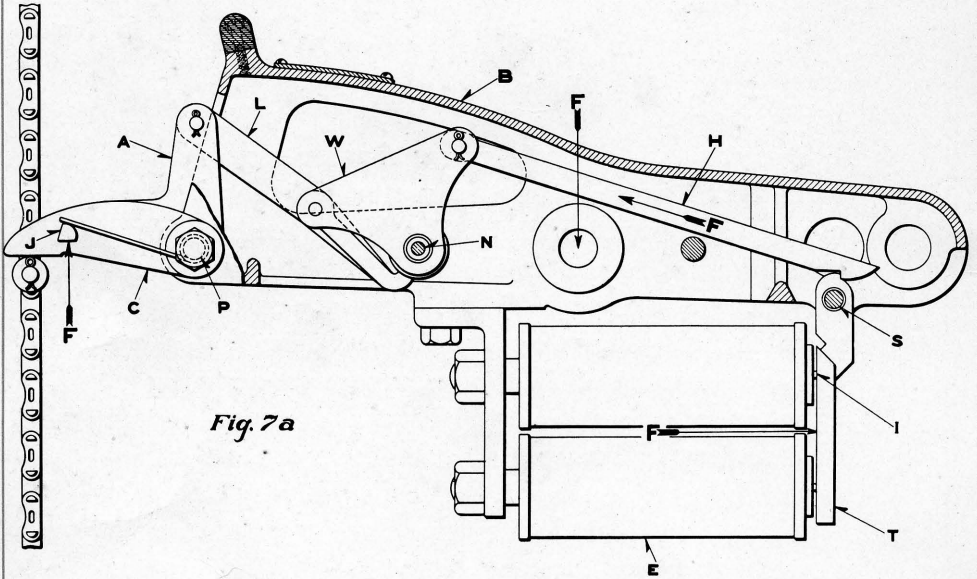


Fig. 7a

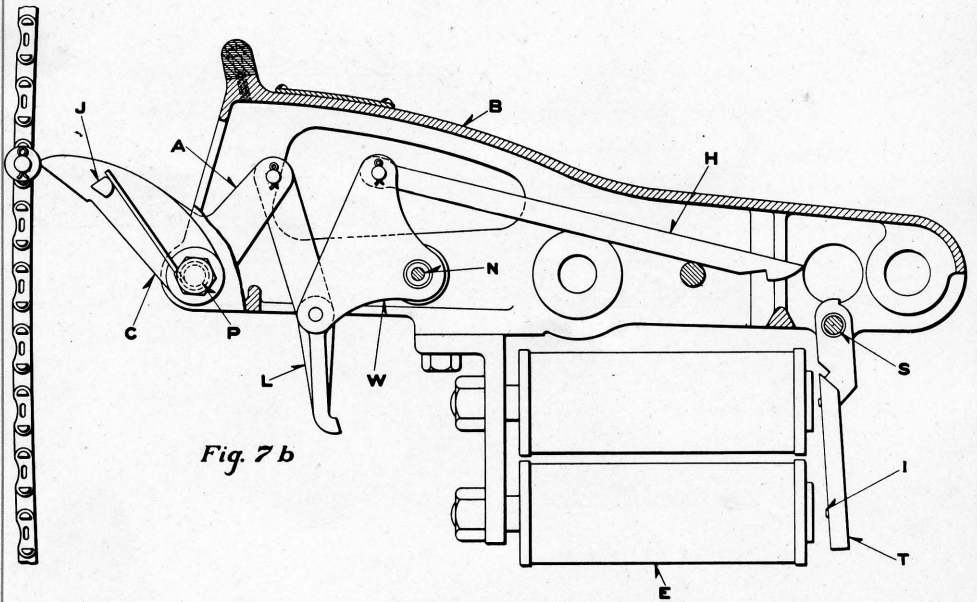


Fig. 7b

Fig. 7

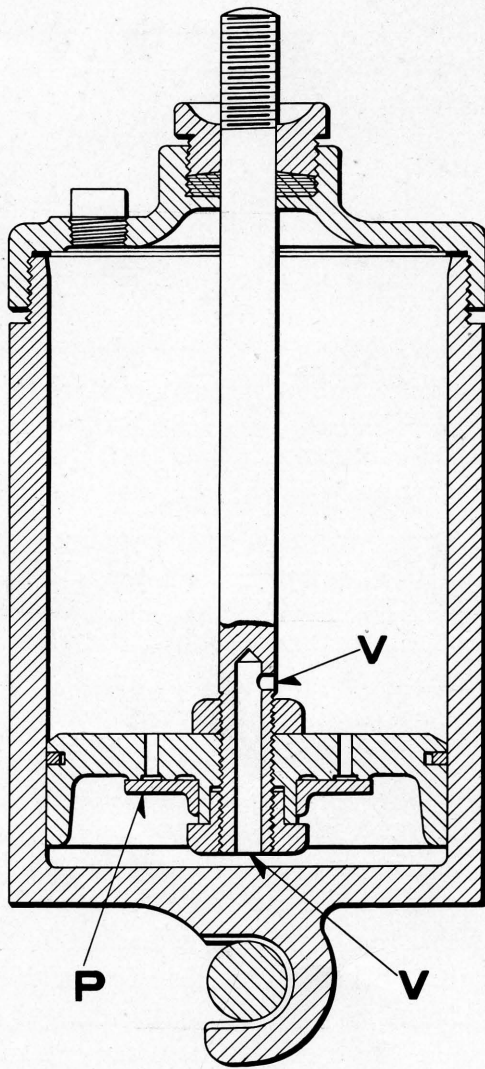
steel. Each chain passes a tension test of 1200 pounds. All the shafts are made of cold rolled steel and the middle one, S<sub>2</sub>, runs on special roller bearings to minimize friction.

### C. Slot Arm.

(See Fig. 7, a and b.)

The slot arm consists of the frame B, the lifting crank C pivoted at P, the stop link L connecting the three way crank W swinging on N with the arm A of the lifting crank, the latch H which hooks over the armature T pivoted at S, and the electro-magnet E. When the latch is hooked over the armature as shown in Fig. 7a, the magnets being energized and the armature attracted, the toggle mechanism just described is held immovable, so that when the rollers on the chain engage the lifting crank, the slot arm is lifted and comes to rest on the 45° or 90° stops which hook about the projecting lugs J on the lifting crank. The entire counterweight of the semaphore casting and blade is transmitted through the up and down rod to the slot arm, and, as there is no intervening mechanism, a large force tends to thrust the lifting crank upward when hooked in the 45° or 90° positions. This force F, acting in the direction shown by the arrows, is reduced through the links and levers in the slot arm and transmitted to the armature where it acts to force it away from the poles of the electro-magnets, which are separated from the armature by an air gap equal to the length of the stop pins I. Therefore, the moment the slot circuit is opened, the armature is forced away from the poles and the latch H is released. See Fig. 7b.





**Fig. 8**

The mechanical and electrical construction of the slot arm embodies the practical experience gained in twelve years of service conditions. The lifting crank is made of malleable iron, and the fingers for engaging with the rollers of the chain, as well as the projecting lugs that rest on the hooks in the caution and clear positions, are case hardened to prevent wear; the faces of the hooks themselves are also hardened for the same reason. The stop link L is a steel forging, the three way crank is made of cold rolled steel, and the latch of a special high grade of Bessemer steel, the hook end being hardened in a mercury bath. The armature and cores are made of the best Norway iron obtainable, carefully annealed after machining.

The slot magnets are insulated in the same careful manner as the motor, slow releasing slots being subjected to a ground test of 3000 volts A. C. and quick acting slots to 5000 volts A. C.

#### D. Circuit Controller:

(See W, Figs. 1, 2, 3 and 4.)

The circuit controller shown at W in Figs. 1, 2, 3 and 4 is built in a very substantial manner. A shaft, pivoted horizontally and turned by a crank and a link B connected to the slot arm, carries a number of rotating brass sectors which bridge the springs shown in the illustrations at the proper points in the stroke. The springs are made of stiff phosphor bronze and the sector is a single brass casting, so that there is little to get out of adjustment. A quick acting pole-changer is also provided for polarized work. The parts are assembled on a block of high grade electrical porcelain, thus doing away with insulating bushings.

## E. Oil Buffer.

(See Fig. 8.)

The oil buffer has been very carefully designed to make it absolutely safe as well as effective. A vent V shown in Fig. 8 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, known as Pale Semaphore Oil, is used in the buffer. Actual tests show that it does not begin to thicken until a temperature of 40° F. below zero is reached. No other oil should be used.

## III. INSTRUCTIONS FOR MAINTAINERS

1. Unless damaged by accident in transit or installation, the mechanism should be ready for operation without adjustment. The stop screw at the semaphore bearing should, however, be adjusted to engage the stop on the operating gear when the signal is at danger in order to relieve the vertical connections from the weight of the semaphore.

2. The mechanism should be kept clean and be frequently inspected at regular intervals. THE ARMATURE AND POLES OF SLOT MAGNETS MUST BE KEPT FREE FROM OIL, GREASE AND DIRT. The journals and bearings must work freely, and be oiled

at least once a month, care being taken to see that they do not get gummed from the use of unsuitable oil. Surplus oil should be wiped off. Any light non-freezing lubricating oil may be used, but the best results will be secured with "Pale Semaphore Oil" obtained from this Company.

3. The motor commutator and circuit controller contacts should be cleaned with a cloth moistened with oil. The motor brushes should be staggered 1-32 inch and should bear on the commutator with sufficient pressure to give good contact.

4. The buffer (Fig. 8) must be kept full of oil. Under no circumstances should any oil other than "PALE SEMAPHORE OIL" be used without first consulting the Company. In filling, extreme care must be taken that no dirt, cinders nor other foreign matter are admitted. We recommend that once a year, preferably before cold weather, the buffer be removed from the mechanism by taking out the pin in the slot arm and the pin in the frame to the right of the buffer support. It should then be washed with gasoline or benzine, particular care being exercised to insure that the vents and parts are thoroughly cleaned and the packing ring free in the piston. The buffer should then be refilled with fresh oil, the oil removed being retained for lubricating purposes.

5. By loosening the set screws the motor can be turned on the shaft "S" (Fig. 6) and its pinion brought into mesh by adjusting the arm "A" of the eccentric mechanism shown at "X" after loosening set screws "B" and "C." After the proper adjustment has been secured, the set screws must be screwed down to prevent play.

6. The batteries should be inspected at regular intervals, including a voltmeter test to judge of their condition and life.

7. The length of the core pins in the slot magnets and armature, and the adjustments of the internal levers and links, must never be changed except under the direction of some responsible person.



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645