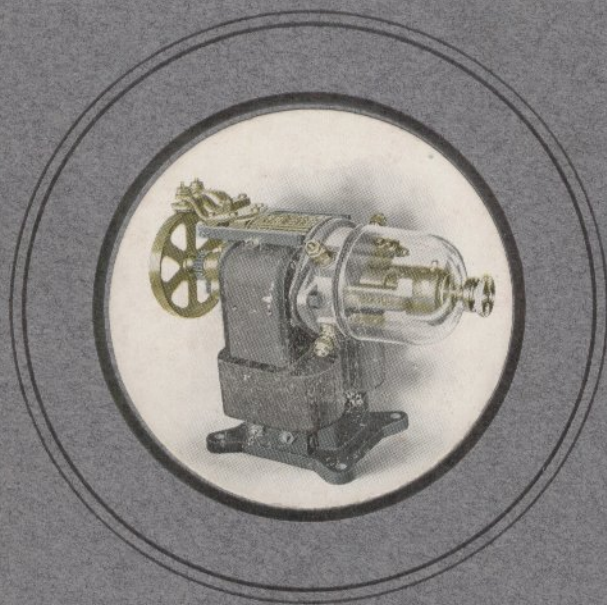


*K. Minn*

The Union Electric  
Semaphore Signal



The Union Switch & Signal Co.  
Swissvale Pa.

Bulletin  
No. 6

THE  
**Union Electric  
Semaphore Signal**

WITH  
STYLE B OPERATING MECHANISM

MADE BY

THE  
**UNION SWITCH & SIGNAL Co.**  
OF PITTSBURGH, PA.

---

Owners of the Westinghouse System of Electro-pneumatic Block Signaling and Interlocking.

Also Designers, Manufacturers and Erectors of Pneumatic, Electro-Pneumatic, Electric, Electro-mechanical, and Purely Mechanical Appliances for Railway Protection.

Automatic, Semi-automatic and Manually Operated Block Signals.

Electro-pneumatic, Electric and Mechanical Interlockings to suit conditions.

Frogs, Crossings, Switches and Hand Devices for controlling them.

Plans and Estimates on Application.

---

General Offices and Works  
SWISSVALE, PA.

---

New York  
Havemeyer Bldg.

Chicago  
Monadnock Bldg.

Boston  
Wentworth Bldg.



## PREFACE.



THE unprecedented demand for a reliable semaphore for automatic block and other signal purposes, resulting in the introduction to service by this Company during the present year of over 1,000 such signals, impresses upon us the necessity for a comprehensive description of the device in detail.

It is not within the province of this bulletin to enter upon all of the situations to which this signal is applicable, nor yet to illustrate the many ways in which it may be controlled.

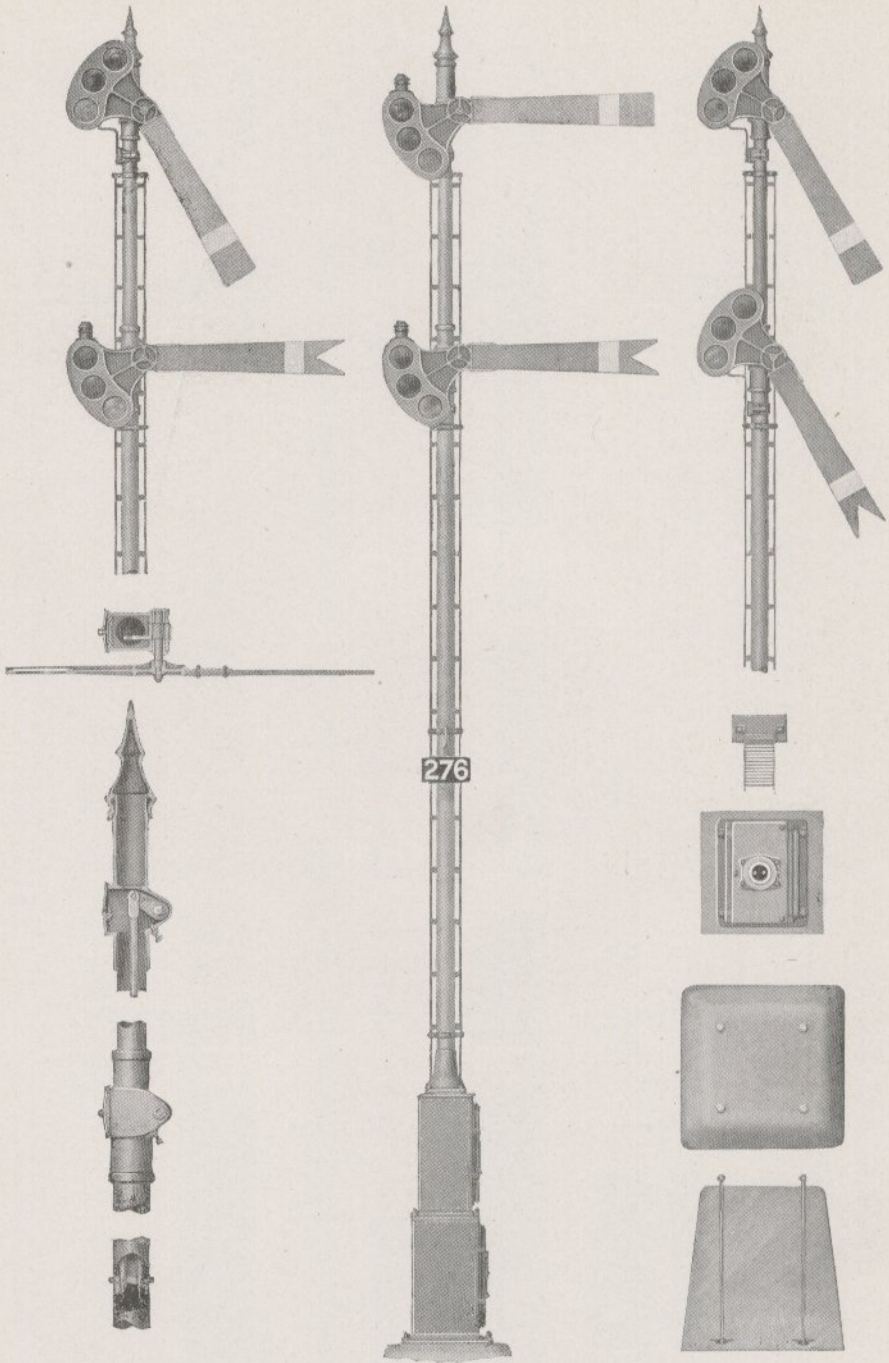
It will suffice to state here that, while especially designed for automatic block work, it has at the same time a more extensive field of usefulness. It is also valuable as a distant signal to interlockings or to outlying switches, and as a substitute for other mechanically operated signals that involve long, expensive and troublesome connections between them and their operating devices.

When applied to these conditions but two wires are required between the signal and the device by which it is controlled. Where the signal is to be automatically controlled by trains, these wires may be discarded and the rails used instead, as in regular automatic block work, the signal being then recognized as "semi-automatic."

Sixteen cells of caustic potash battery are preferably employed for the control and operation of the signal. Their total capacity is 300 ampere hours, and when required to clear both blades of a double arm signal 60 times daily, under the normally clear system, they should last for one year without renewals. When applied to one arm signals similarly controlled and operated, this period of usefulness should cover two years.

We confidently submit this signal to our patrons as the most economical of its type on the market.

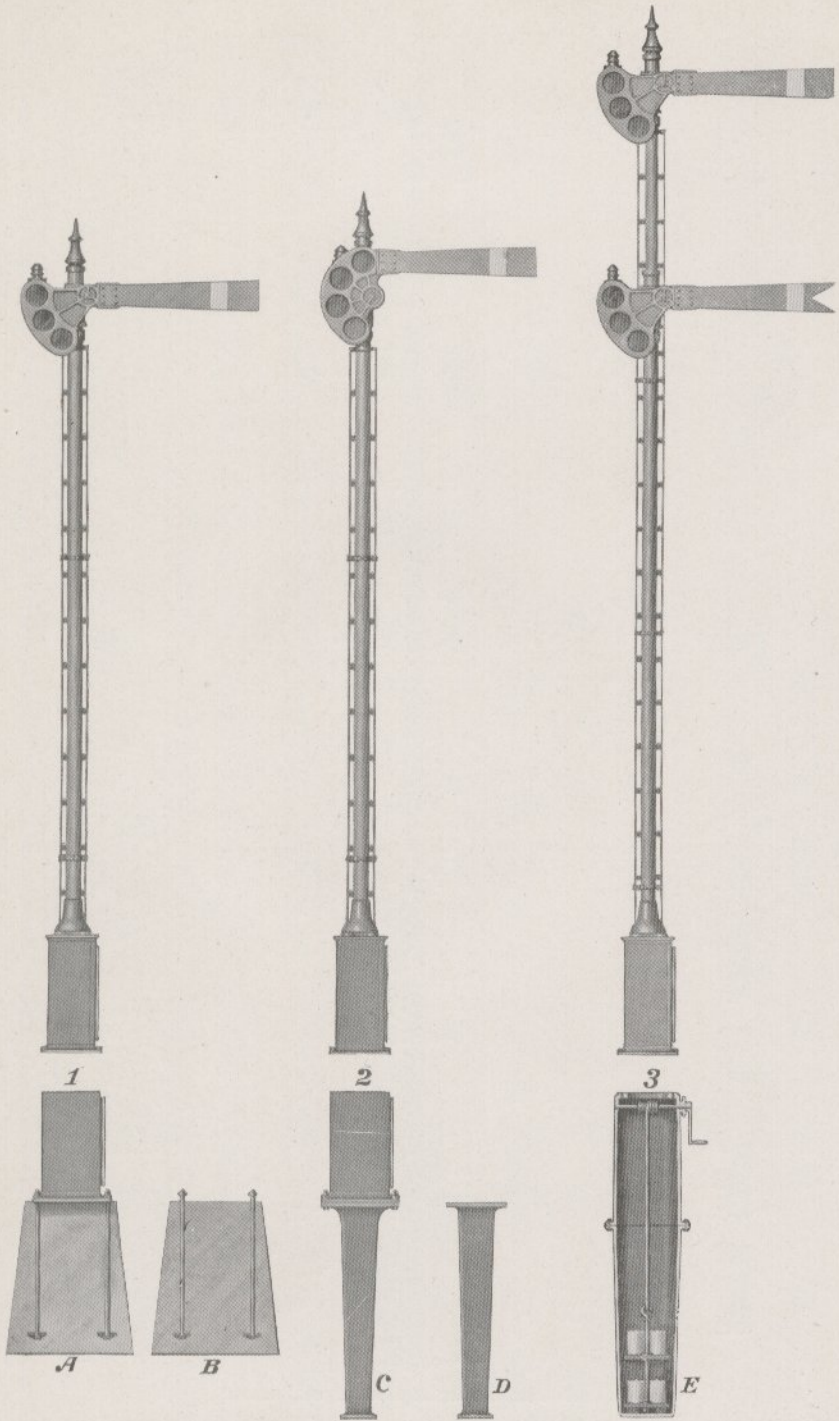
The Union Switch & Signal Co.



**Electric Semaphore Signal.**

General and Sectional Views of Two Arm Signal Post, Showing Internal Operating Rods, Rod Guides, Signal Shaft Bearings and Arms, Foundation and Foundation Bolts.

Also the "Continuous Light" type of Spectacle, designed to permit the use of either Green or White for Clear indication and to avoid the momentary interruption of one night indication while signal moves to display another.



Electric Semaphore Ground Signal.  
Standard Types.



# The Union Electric Semaphore.

## STANDARD GROUND TYPES.

PLATE 107 $\frac{1}{2}$

### ORDER BY PLATE AND NUMBER.

- No.
1. Single arm home or distant Signal (no battery case, anchor bolts or foundation).
    - 1-A. No. 1, with battery case and anchor bolts (no foundation).
    - 1-B. No. 1, with anchor bolts (no battery case or foundation).
    - 1-C. No. 1, with battery case and cast iron foundation.
    - 1-D. No. 1, with cast iron foundation (no battery case).
    - 1-E. No. 1, with cast iron battery well and elevators complete.
  2. Single arm three position Signal (no battery case, anchor bolts or foundation).
    - 2-A. No. 2, with battery case and anchor bolts (no foundation).
    - 2-B. No. 2, with anchor bolts (no battery case or foundation).
    - 2-C. No. 2, with battery case and cast iron foundation.
    - 2-D. No. 2, with cast iron foundation (no battery case).
    - 2-E. No. 2, with cast iron battery well and elevators complete.
  3. Double arm Signal (no battery case, anchor bolts or foundation).
    - 3-A. No. 3, with battery case and anchor bolts (no foundation).
    - 3-B. No. 3, with anchor bolts (no battery case or foundation).
    - 3-C. No. 3, with battery case and cast iron foundation.
    - 3-D. No. 3, with cast iron foundation (no battery case).
    - 3-E. No. 3, with cast iron battery well and elevators complete.

The above references are for each Signal complete, including lamps, glass, blades, ladders and fittings; but do not include relays, pole changers, back-lights, or number plates, which should be ordered separately if required.

Order should state character of each signal desired, specifying whether Home or Distant on 1 arm types; or whether 2 Homes or 2 Distant, or 1 Home and 1 Distant on 2 arm types, and also any changes desired from the standard design.

Dimensions of posts, and blades, colors and number of glass discs, arc traversed by arms, design of spectacle, type of lamp, etc., must be clearly stated when differing from standard design.

Unless otherwise specified, Signals will be furnished as follows:

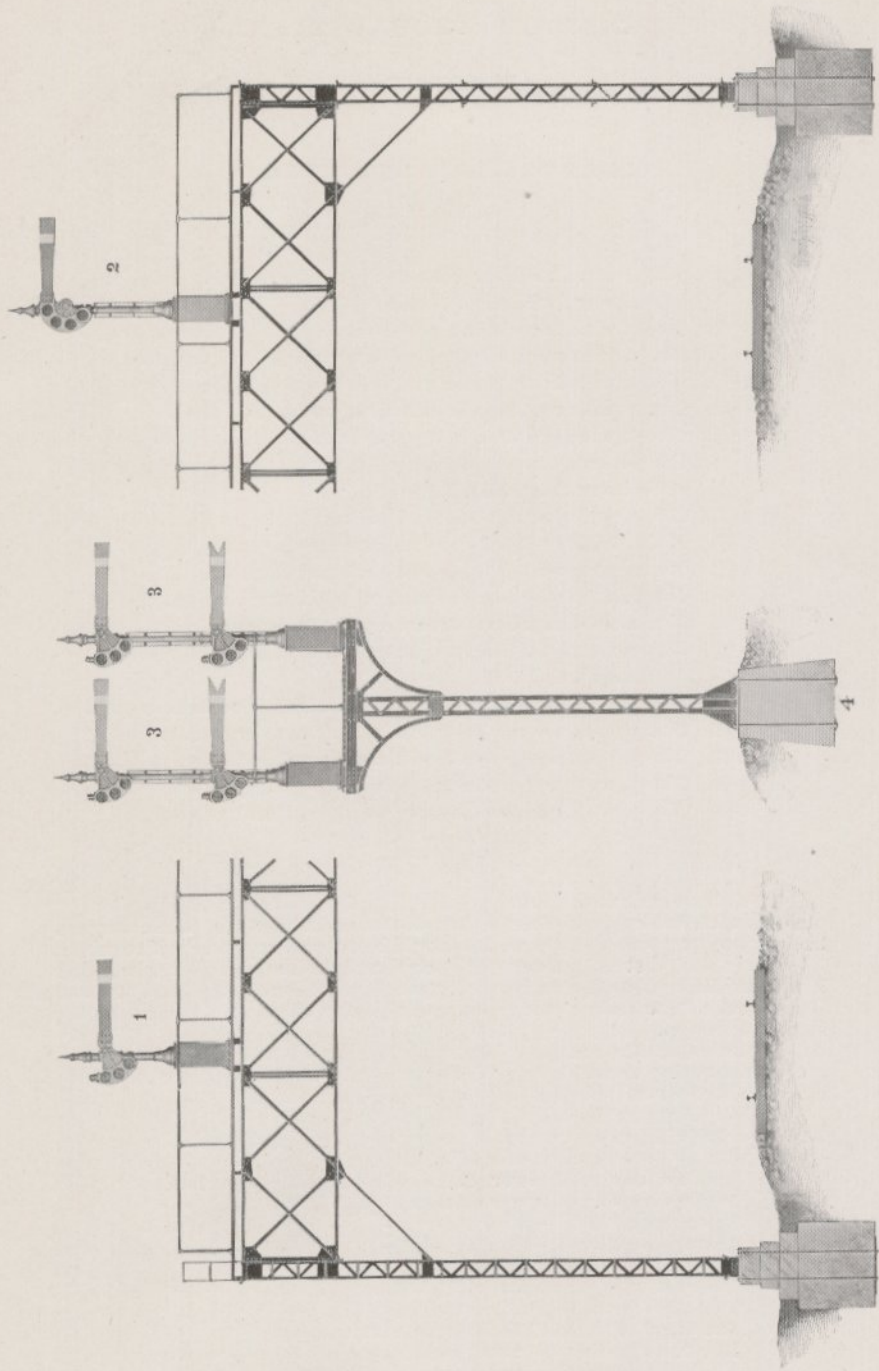
Base of Mechanism case to center of lower signal shaft	21 ft. 1 in.
Center of lower to center of upper shaft, - - -	6 ft. 0 in.
Inside diameter of lower section of pipe post, - - -	5 in.
Inside diameter of upper section of pipe post, - - -	4 in.
Semaphore blades—grip, - - - - -	7 in. x 7 in.
Semaphore blades—length - - - - -	4 ft. 0 in.
Diameter of glasses, - - - - -	8 $\frac{3}{8}$ in.

Colors of glasses; Home, red; Distant, green.

Two glasses with each Spectacle.

Arc of signal arms, Nos. 1 and 3, sixty degrees.

No. 2, forty-five degrees each, between stop and caution, and between caution and clear, total 90 degrees.



Electric Semaphore Signals as applied to Bracket Posts and Bridges.

## The Union Electric Semaphore.

APPLIED TO BRACKET POSTS AND BRIDGES.

PLATE 107 $\frac{1}{2}$ <sub>0</sub>

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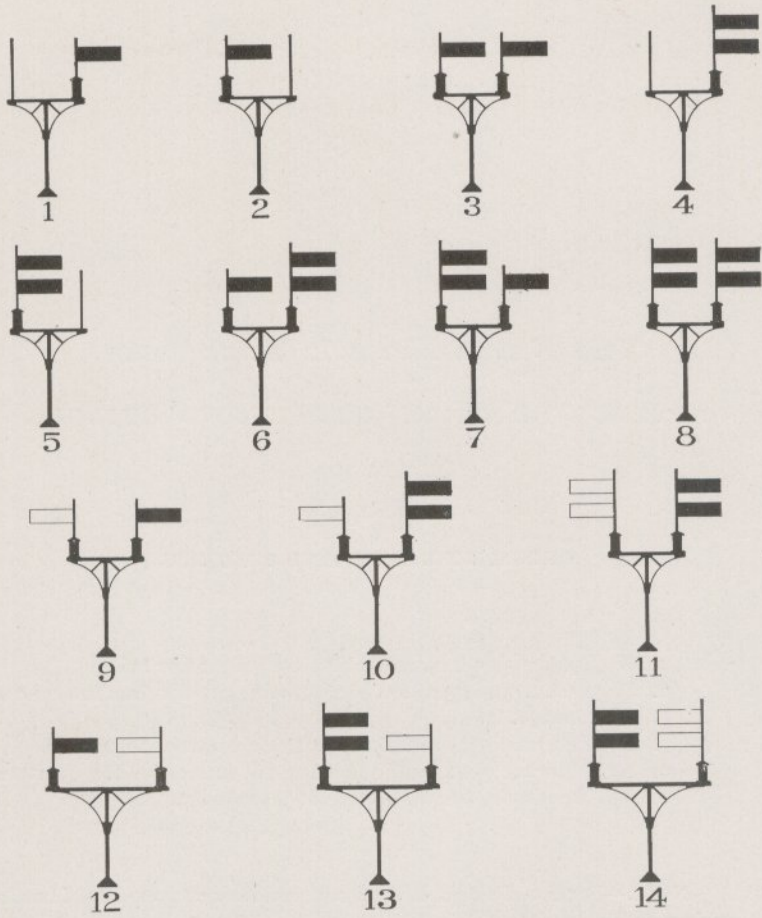
ORDER BY PLATE AND NUMBER.

---

- No.
1. Single arm signal complete for bracket post or bridge.
  2. Single arm three position signal complete for bracket post or bridge.
  3. Double arm signal complete for bracket post or bridge.
  4. Steel bracket post complete with crosstrees, ladder, platform, handrails, anchor bolts, and plates only.
- 

NOTE.—For list of signal bridges and various arrangements of bracket signals see plate 107 $\frac{1}{2}$ <sub>1</sub>.





No. 15, 2 Track Bridge	.....
No. 16, 8 " "	.....
No. 17, 4 " "	.....
No. 18, 3 " "	.....
No. 19, 6 " "	.....
No. 20, 7 " "	.....
No. 21, 3 " "	.....
No. 22, 9 " "	.....
No. 23, 10 " "	.....
No. 24, 11 " "	.....
No. 25, 12 " "	.....

Various arrangements of Bracket Signals and Signal Bridges.

# The Union Electric Semaphore.

## VARIOUS ARRANGEMENTS ON BRACKETS AND BRIDGES.

PLATE 107 $\frac{1}{2}$ <sub>1</sub>

ORDER BY PLATE AND NUMBER.

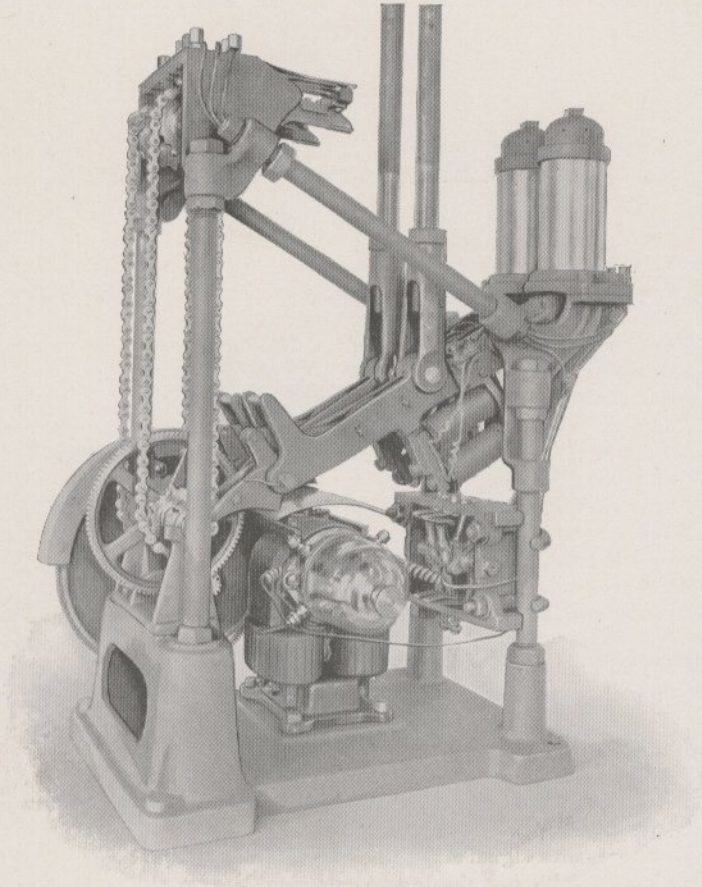
Figures 1 to 8, inclusive, represent arrangements of bracket signals for controlling traffic in one direction only on parallel and adjacent tracks.

1. Steel bracket post, as per plate 107 $\frac{1}{2}$ <sub>0</sub>, No. 4, with one single arm electric semaphore (Plate 107 $\frac{1}{2}$ <sub>0</sub>, No. 1), and one stub post.
2. As above, with signal arrangement reversed.
3. As above, with two single arm electric semaphores (Plate 107 $\frac{1}{2}$ <sub>0</sub>, No. 1).
4. As above, with one double arm electric semaphore (Plate 107 $\frac{1}{2}$ <sub>0</sub>, No. 3), and one stub post.
5. As above with signal arrangement reversed.
6. As above, with one single and one double arm electric semaphores (Plate 107 $\frac{1}{2}$ <sub>0</sub>, Nos. 1 and 3).
7. As above, with signal arrangement reversed.
8. As above, with two double arm electric semaphores (Plate 107 $\frac{1}{2}$ <sub>0</sub>, No. 3).

Figures 9 to 14, inclusive, represent arrangements of bracket signals for controlling traffic in opposite directions on parallel and adjacent tracks. Figures 9, 10 and 11 represent arrangements for *right* hand and figures 12, 13 and 14 for *left* hand running.

9. Steel bracket post, as per Plate 107 $\frac{1}{2}$ <sub>0</sub>, No. 4, with two single arm electric semaphores (Plate 107 $\frac{1}{2}$ <sub>0</sub>, No. 1).
12. As above, with signal arrangement reversed.
10. As above, with one single and one double arm electric semaphores (Plate 107 $\frac{1}{2}$ <sub>0</sub>, Nos. 1 and 3).
13. As above, with signal arrangement reversed.
11. As above, with two double arm electric semaphores (Plate 107 $\frac{1}{2}$ <sub>0</sub>, No. 3).
14. As above, with signal arrangement reversed.

Should three position signals (Plate 107 $\frac{1}{2}$ <sub>0</sub>, No. 2), be required with any of the above combinations, the fact must be specifically stated in the order.



**General View of Style B Mechanism, Showing Dust Proof Motor, Pole Changing Device, Buffer Cylinders, Slot Arms, and Operating Connections to Signal.**

NOTE.—The Pole Changer is used only when Signal is operated on the Wireless method.



# The Union Electric Semaphore.

## STYLE B MECHANISM.

PLATE 107 $\frac{1}{8}$

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ORDER BY PLATE AND NUMBER.

---

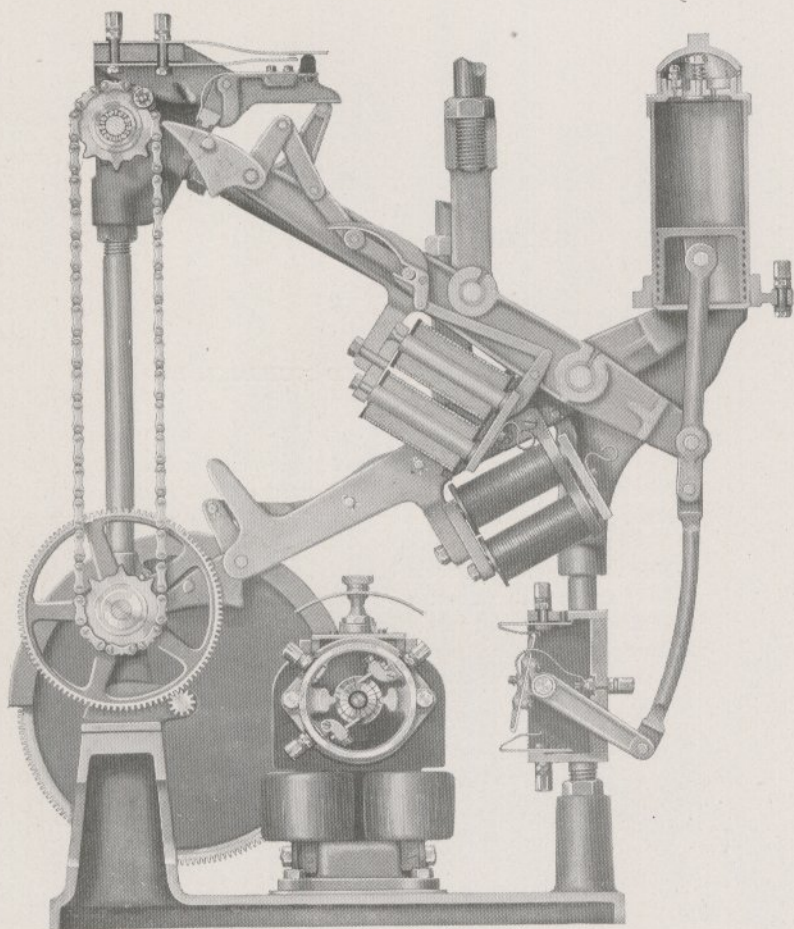
No.

1. Mechanism and motor complete for one arm signal.
2. Mechanism and motor complete for two arm signal.
3. Mechanism and motor complete for three position one arm signal.
4. Mechanism without motor for one arm signal.
5. Mechanism without motor for two arm signal.
6. Mechanism without motor for three position one arm signal.
7. Special attachment complete for operating three position one arm signal from standard mechanism illustrated.

(This attachment is not shown in the illustration.)

NOTE—For combined pole changer and circuit controller illustrated, see plate 107 $\frac{1}{2}$ .

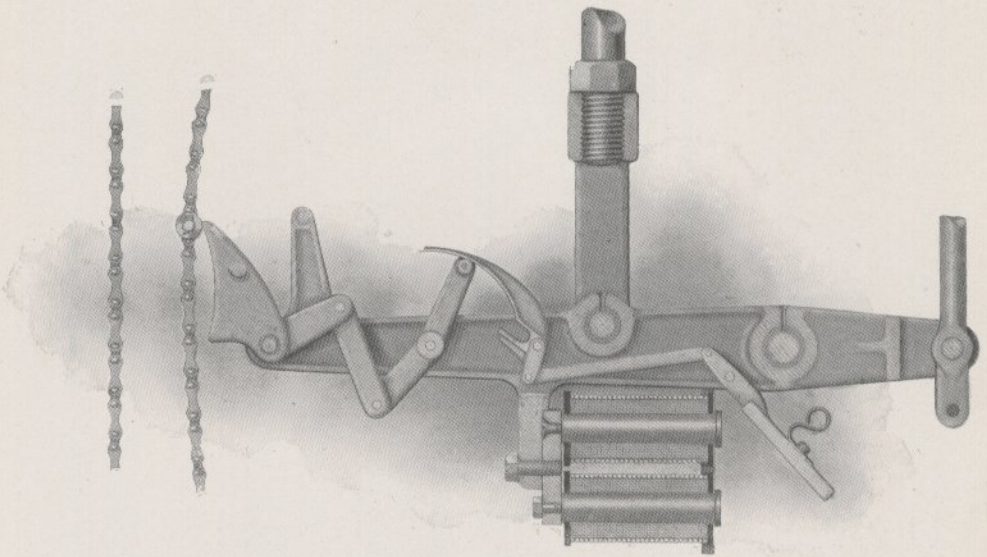
This constitutes a special attachment to the mechanism, furnished only when specifically called for.



**Sectional View of Style B Mechanism through Slot Arm, Buffer Cylinder, Pole Changer and Motor Commutator.**

Sectional Slot Arm is in position occupied when signal is at Safety.

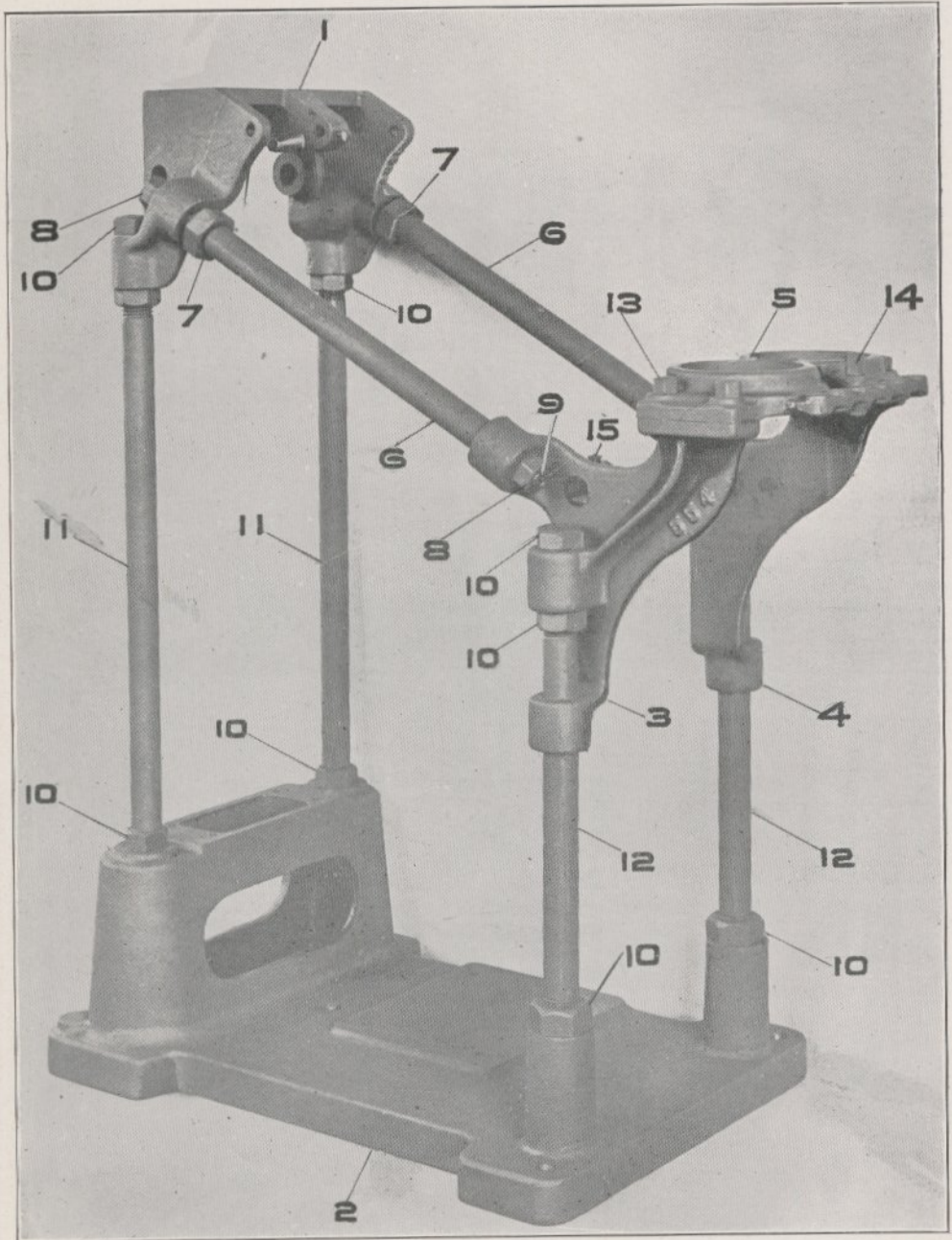
FOR LIST OF COMPONENT PARTS, SEE DETAIL PLATES.



**Sectional View of Slot Arm in Mechanism, showing system of levers through which Counterweight of Signal is supported by Magnet.**

The illustration shows the positions assumed by these levers when the magnets are de-energized during operation of the signal by the motor.





General View of Style B Mechanism Frame.

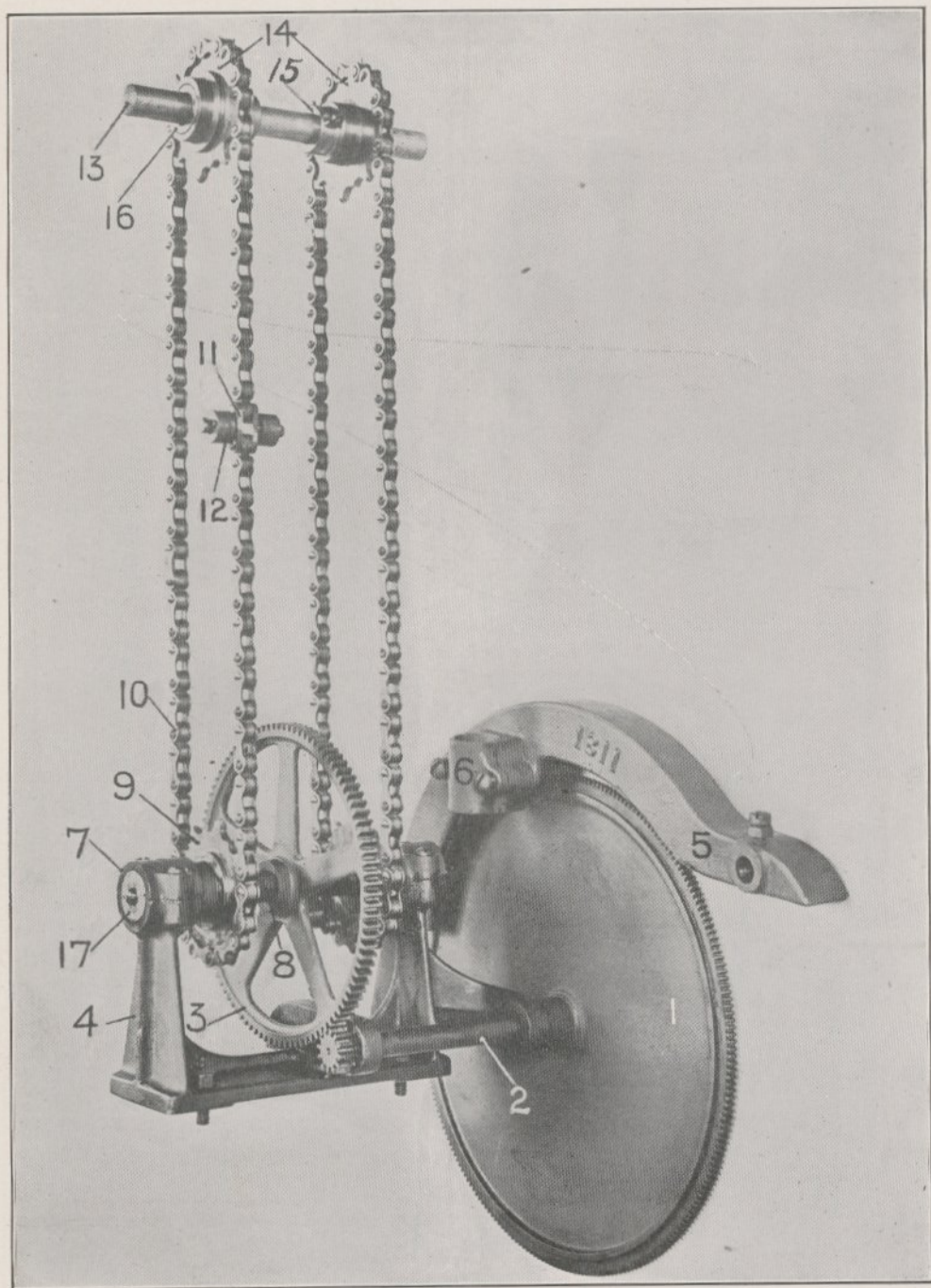
## The Union Electric Semaphore.

### STYLE B MECHANISM, FRAME DETAILS.

PLATE 107 $\frac{1}{8}$

ORDER BY PLATE AND NUMBER.

- No.
1. Bearing bracket for upper sprockets and contact springs.
  2. Mechanism bed plate.
  3. Right hand bracket supporting slot shaft and buffers.
  4. Left hand bracket supporting slot shaft and buffers.
  5. Buffer base plate.
  6. Diagonal outer tubing of frame.
  7. Adjustable bushing for same.
  8. Lock nuts for diagonal inner tubing.
  9. Diagonal inner tubing of frame.
  10. Nuts for frame uprights.
  11. Long frame, uprights.
  12. Short frame, uprights.
  13. Tap bolts securing buffer base plate.
  14. Binding post complete with insulation, for mechanism terminals.
  15. Set screw securing sprocket shafts.



General View of Mechanism, Running Gear and Shield.



# The Union Electric Semaphore.

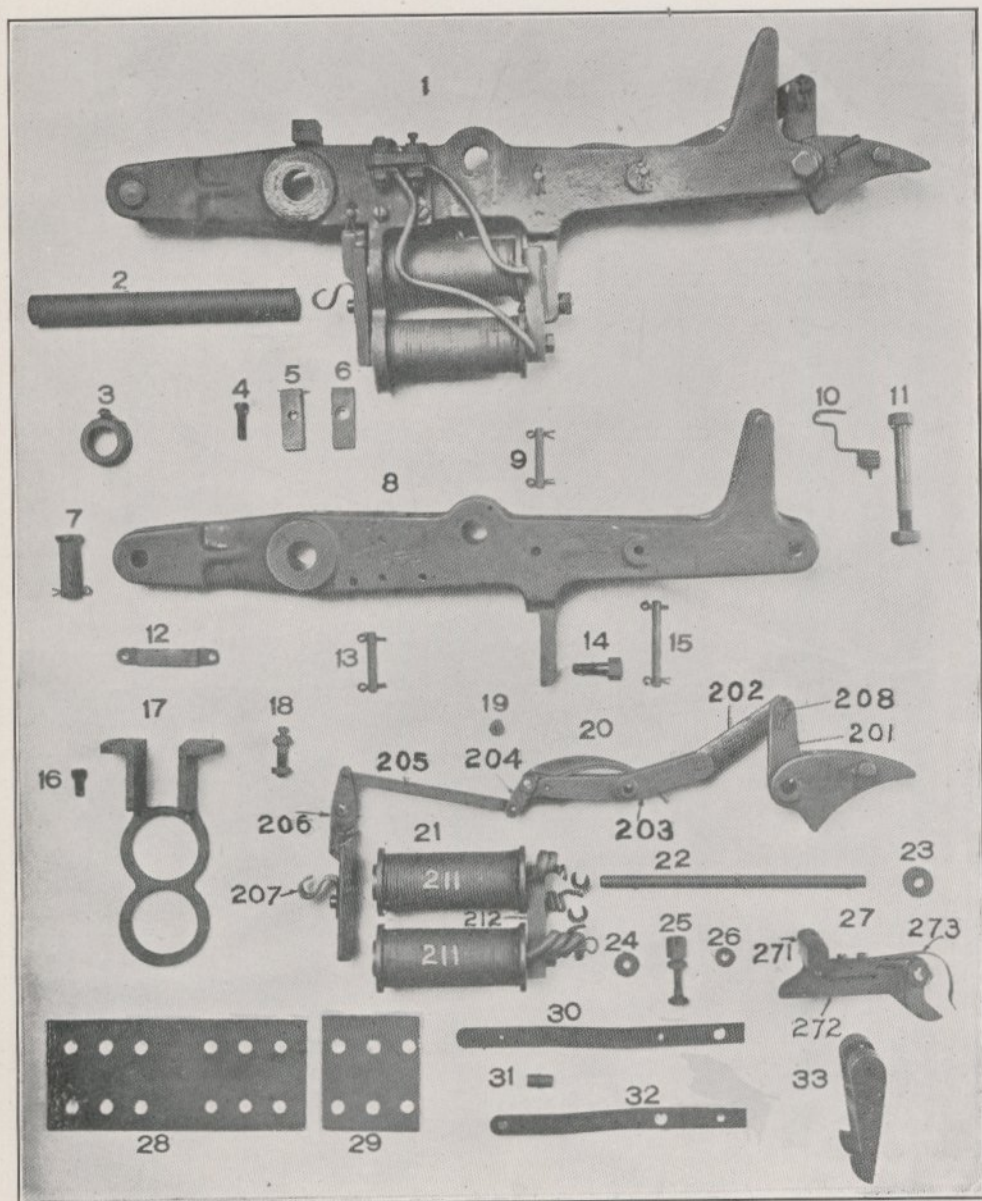
## STYLE B MECHANISM RUNNING GEAR AND SHIELD.

PLATE 107 $\frac{1}{18}$

### ORDER BY PLATE AND NUMBER.

No.

1. Main gear wheel.
2. Counter shaft and pinion.
3. Intermediate gear wheel.
4. Bearing bracket for counter shaft.
5. Main gear shield with set screw and nut.
6. Clamp cap for gear shield, with screws.
7. Bearing cap and screw.
8. Lower sprocket shaft.
9. Lower sprocket with bushing.
10. Chain, Morse Pattern.
11. Trunnion link for chain.
12. Roller for trunnion link.
13. Upper sprocket shaft.
14. Upper sprockets.
15. Collar for upper sprockets, with set screw.
16. Roller bearing for either shaft.
17. Retaining washer for roller bearing, with screw.



Slot Arm and Details.

# The Union Electric Semaphore.

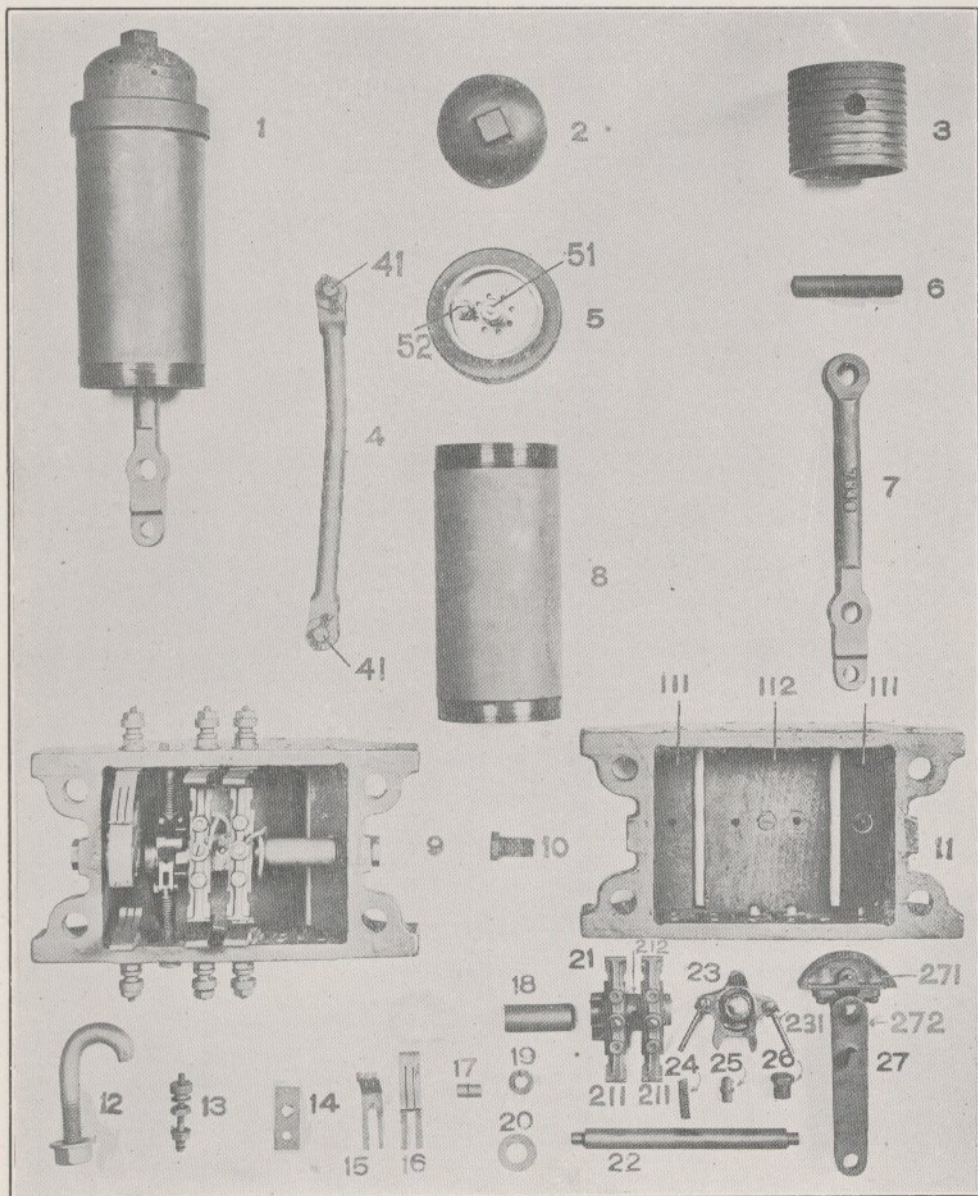
## STYLE B MECHANISM SLOT ARM AND DETAILS.

PLATE 107  $\frac{1}{10}$

### ORDER BY PLATE AND NUMBER.

- No.
1. Slot arm, complete as shown.
  2. Main shaft supporting slot arm.
  3. Collar for main shaft with set screw.
  4. Screw for fibre wire cleats.
  5. Lower fibre wire cleat.
  6. Upper fibre wire cleat.
  7. Pin and cotter for buffer connecting link.
  8. Slot arm, casting only.
  9. Pin and cotters for alligator crank pivot.
  10. Coil spring for fork-head of slot arm.
  11. Stud and nut for fork-head.
  12. Copper "jumper" for slot binding posts.
  13. Pin and cotters for armature pivot.
  14. Tap bolt for securing slot magnets.
  15. Pin and cotters for differential lever pivot.
  16. Screw for securing magnet spectacle.
  17. Spectacle for slot magnets.
  18. Binding posts complete, for slot magnets.
  19. Steel roller for end of differential lever.
  20. Armature, fork-head, and intermediate members of slot mechanism.
  201. Fork-head of slot arm.
  202. Link connecting fork-head and differential lever.
  203. Differential lever.
  204. Alligator crank.
  205. Link connecting alligator crank and armature.
  206. Armature.
  207. Recoil spring, with screw for armature.
  208. Pin and cotters for connecting fork to link.
  21. Slot magnets complete with back strap as shown.
  211. Electro-magnets.
  212. Back strap for electro-magnets, with tap bolts.
  22. Pawl pivot pin.
  23. Steel washer for pawl pivot pin.
  24. Brass washer for binding post.
  25. Binding post with nuts.
  26. Fibre bushing.
  27. Circuit closing lever complete, with spring and screws as shown.
  271. Hard rubber strip on circuit closing lever, with screws.
  272. Circuit closing lever only.
  273. Phosphor bronze spring, with screws for circuit closing lever.
  28. Long mica insulation strip.
  29. Short mica insulation strip.
  30. Long contact springs.
  31. Rubber bushing.
  32. Short contact spring.
  33. Pawl for supporting slot arm.





Buffer Cylinder and Details.  
Pole Changer and Details.

# The Union Electric Semaphore.

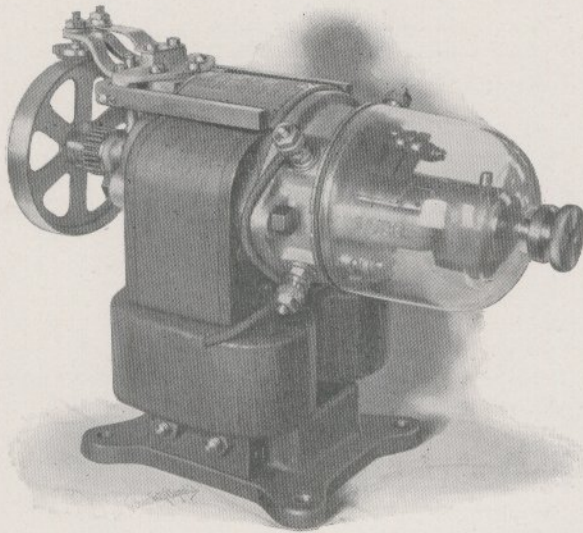
## STYLE B MECHANISM, BUFFER CYLINDER AND POLE CHANGER.

PLATE 107 $\frac{1}{2}$

### ORDER BY PLATE AND NUMBER.

- No.
1. Buffer, with piston and piston link, complete as shown.
  2. Cap for buffer cylinder head.
  3. Buffer piston.
  4. Pole changer connecting link, with pins and cotters.
  - 4I. Pins and cotters for pole changer connecting link.
  5. Buffer cylinder head, with valves, spring, nuts and cotter.
  - 5I. Check valve, spring, nut and cotter.
  52. Adjustable release valve complete.
  6. Piston pin securing link 7.
  7. Buffer piston connecting link.
  8. Buffer cylinder.
  9. Pole changer, complete as shown.
  10. Trunnion screw for pole changer shaft.
  11. Pole changer box with back boards.
  - 11I. End boards for pole changer box.
  112. Center board for pole changer box.
  12. Hook-bolt, nut and washer, for securing pole changer box to mechanism frame.
  13. Binding post, complete.
  14. Mica insulation strip for phosphor bronze springs.
  15. Phosphor bronze spring for pole changing contacts.
  16. Phosphor bronze spring for circuit controller.
  17. Rubber bushing for binding post.
  18. Brass bushing for pole changer shaft.
  19.  $\frac{5}{16}$  inch brass washer for pole changer shaft.
  20.  $\frac{1}{2}$  inch brass washer for pole changer shaft.
  21. Pole changer contacts, with screws, washers and bracket complete as shown.
  - 21I. Contact pieces, with screws and washers for pole changing contacts.
  212. Bracket for above contact pieces.
  22. Pole changer shaft.
  23. Toggle, with spring rods and screws, complete as shown.
  - 23I. Spring rod and screw for toggle.
  24. Spring for toggle.
  25. Brass bushing for toggle spring.
  26. Trunnion screw for spring rod bushing.
  27. Pole changer arm and contact piece for circuit controller, complete as shown.
  - 27I. Contact piece of above.
  272. Pole changer arm.





**General View of Mechanism Motor, Showing Field Actuated  
Brake and Transparent Shield over Commutator.**

NOTE—This shield completely overcomes the serious troubles formerly experienced from frost or dust accumulating on the commutator.

For Details of Motor See Plate 107  $\frac{1}{11}$



# The Union Electric Semaphore.

MECHANISM MOTOR.

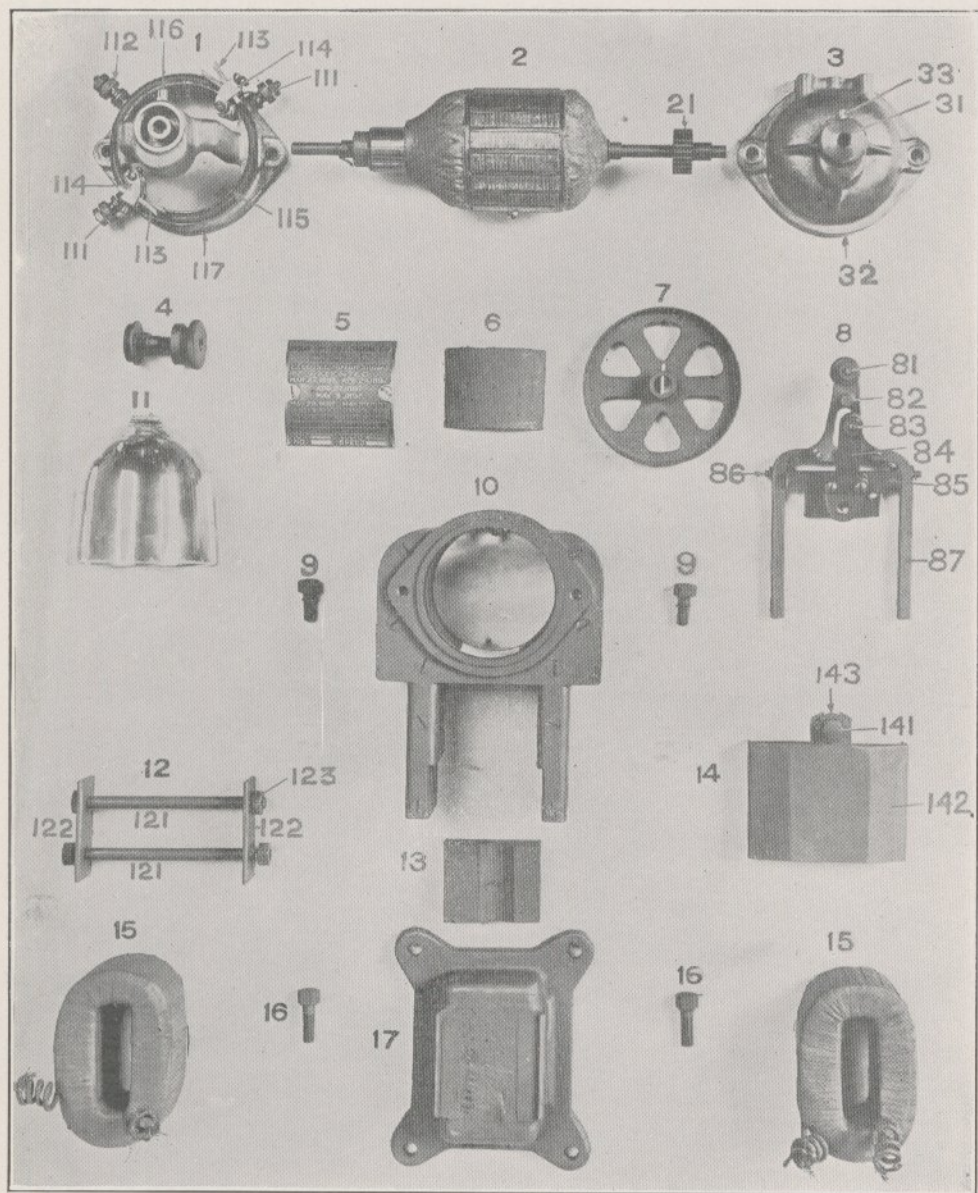
PLATE 107½

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ORDER BY PLATE AND NUMBER.

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No. 1. Electric Semaphore Signal Motor with Brake and Commutator  
Shield as shown.



Motor Details.

# The Union Electric Semaphore.

## MECHANISM MOTOR DETAILS.

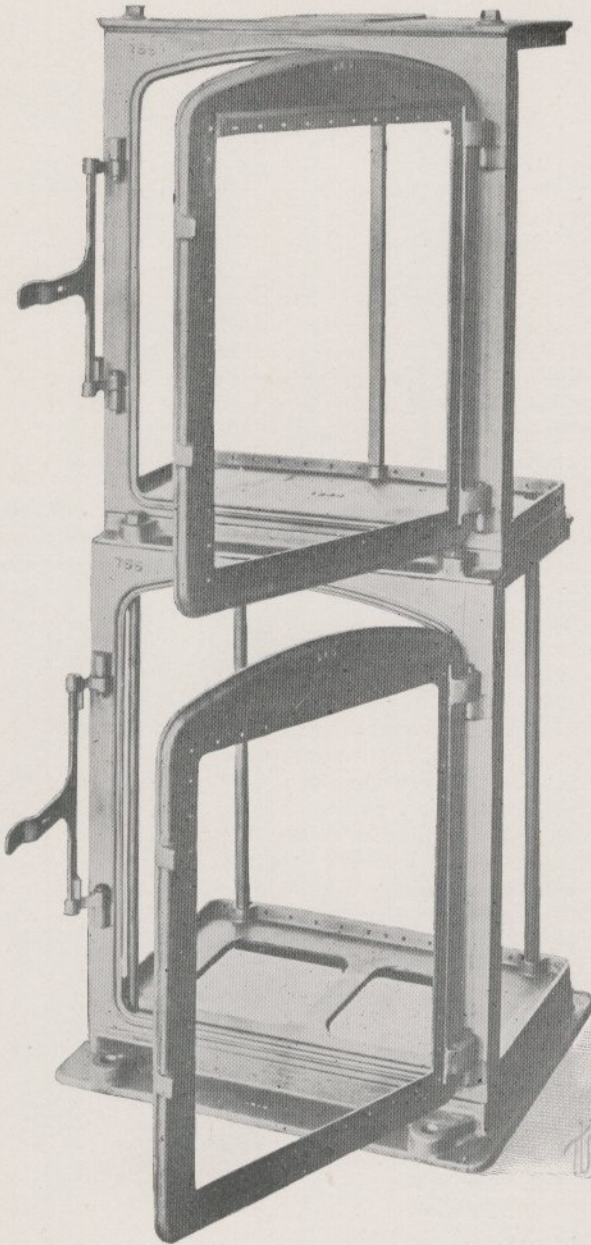
PLATE 107  $\frac{1}{11}$

### ORDER BY PLATE AND NUMBER.

No.

1. Armature shaft bearing (commutator end) complete as shown.
111. Brush holder binding posts.
112. Field terminal binding post.
113. Commutator brushes.
114. Brush holders complete, without brushes and binding posts.
115. Leather gasket for glass commutator shield.
116. Oil cup for shaft bearing (commutator end).
117. Armature shaft bearing, casting only (commutator end).
  21. Motor armature complete, with pinion, as shown.
  21. Pinion only.
  3. Armature bearing (gear end), complete as shown.
  31. Journal cap.
  32. Armature bearing, casting only (gear end).
  33. Oil cup for shaft bearing (gear end).
  4. Brass stud with nut and washer for securing glass commutator shield.
5. Name plate and screws.
6. Top wooden filler under name plate.
7. Brake wheel and pin.
8. Motor field brake, complete, as shown.
81. Brake shoe, nut and washer.
82. Brake shoe bracket with screws.
83. Adjusting screw and nut for brake spring.
84. Brake spring and screws.
85. Brake shaft bearing bracket, and screws.
86. Brake shaft and cotters.
87. Brake armature.
  9. Tap bolts for securing motor shaft bearings.
  10. Motor fields, complete as shown.
  11. Glass commutator shield.
  12. Field stay-bolts and plates, complete as shown.
121. Field stay-bolts.
122. Field stay-bolt plates.
123. Field stay-bolt nuts.
  13. Bottom wooden filler under motor armature.
  14. Shield for field brake armature, complete as shown.
141. Tap bolt for above.
142. Shield only for above.
143. Washer for above.
15. Field coils.
16. Tap bolts for securing motor base.
17. Motor base.





General View of Mechanism and Battery Case Frame.  
For Details of Parts, see Plate 107  $\frac{1}{18}$

# The Union Electric Semaphore.

## MECHANISM AND BATTERY CASES.

PLATE 107 $\frac{1}{17}$

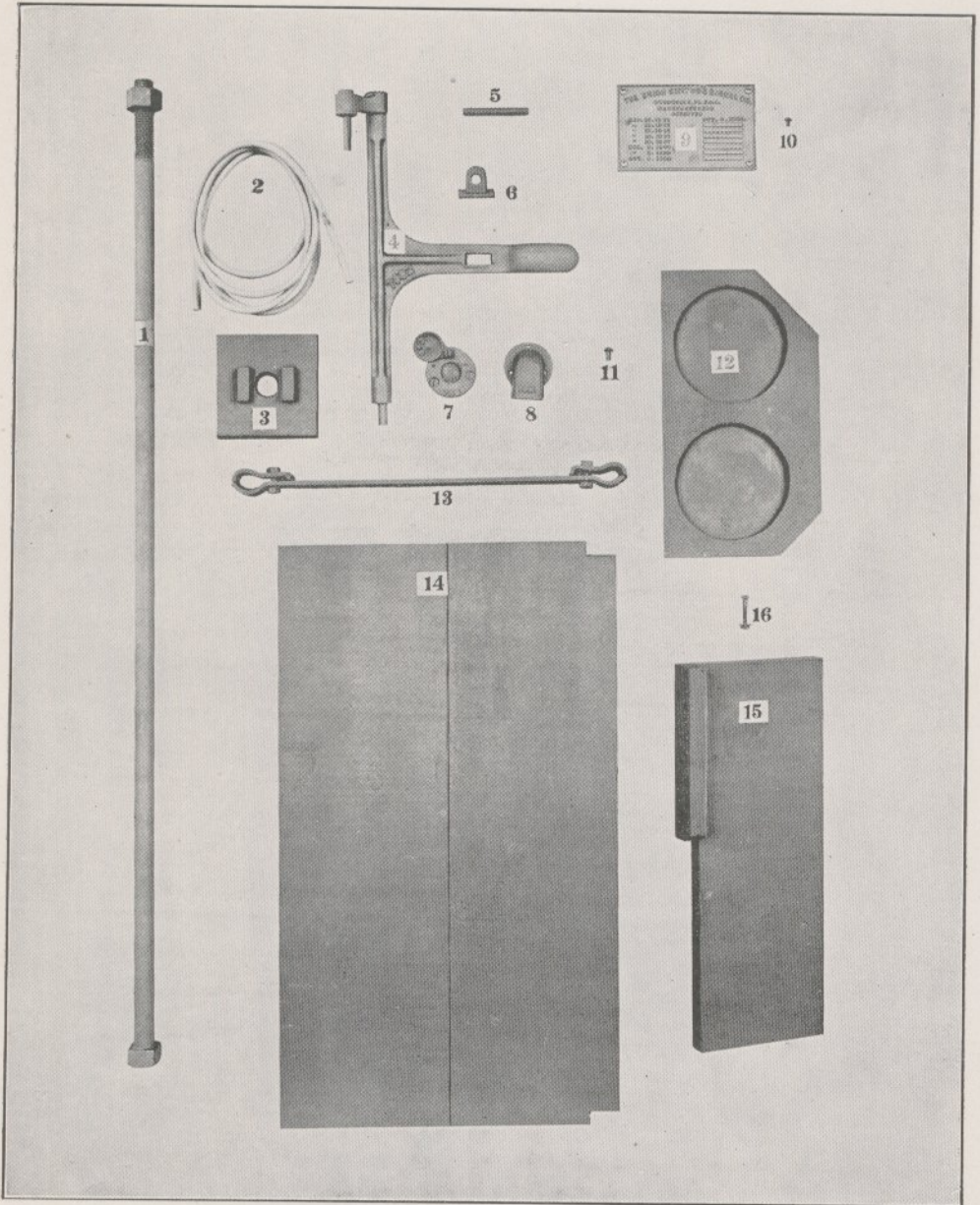
---

ORDER BY PLATE AND NUMBER.

---

No.

1. Combined mechanism and battery case, complete.
2. Mechanism case only, complete.
3. Door complete for either case.



Details of Mechanism and Battery Case Fittings.



## The Union Electric Semaphore.

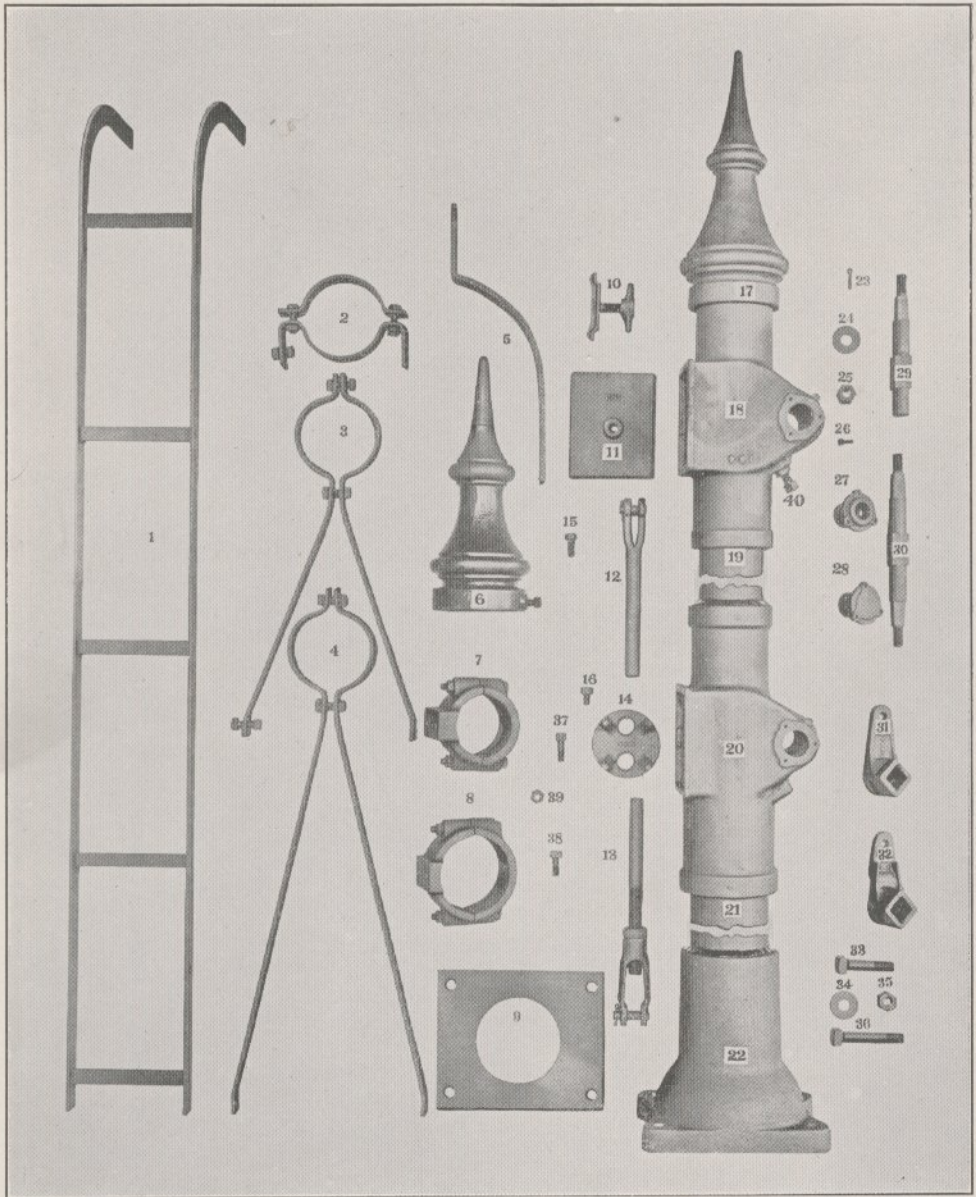
### MECHANISM AND BATTERY CASE FITTINGS.

PLATE 107 $\frac{1}{18}$

ORDER BY PLATE AND NUMBER.

No.

1. Anchor bolt and nut.
2. Rubber tubing for gaskets in mechanism and battery case doors.
3. Cast iron anchor plate.
4. Hasp with link and pin.
5. Cold rolled steel pin for hinges.
6. Staple.
7. Ventilator complete with screws.
8. Ventilator apron.
9. Name plate.
10. Name plate rivet.
11. Ventilator apron rivet.
12. Relay base board.
13. Wrought iron strap with clamps and bolts supporting shelving
14. Shelving for battery case.
15. Board and cleat for lightning arrester and terminals.
16. Carriage bolt and nut for above.



General view of Signal Post, Ladder and Fittings.

# The Union Electric Semaphore.

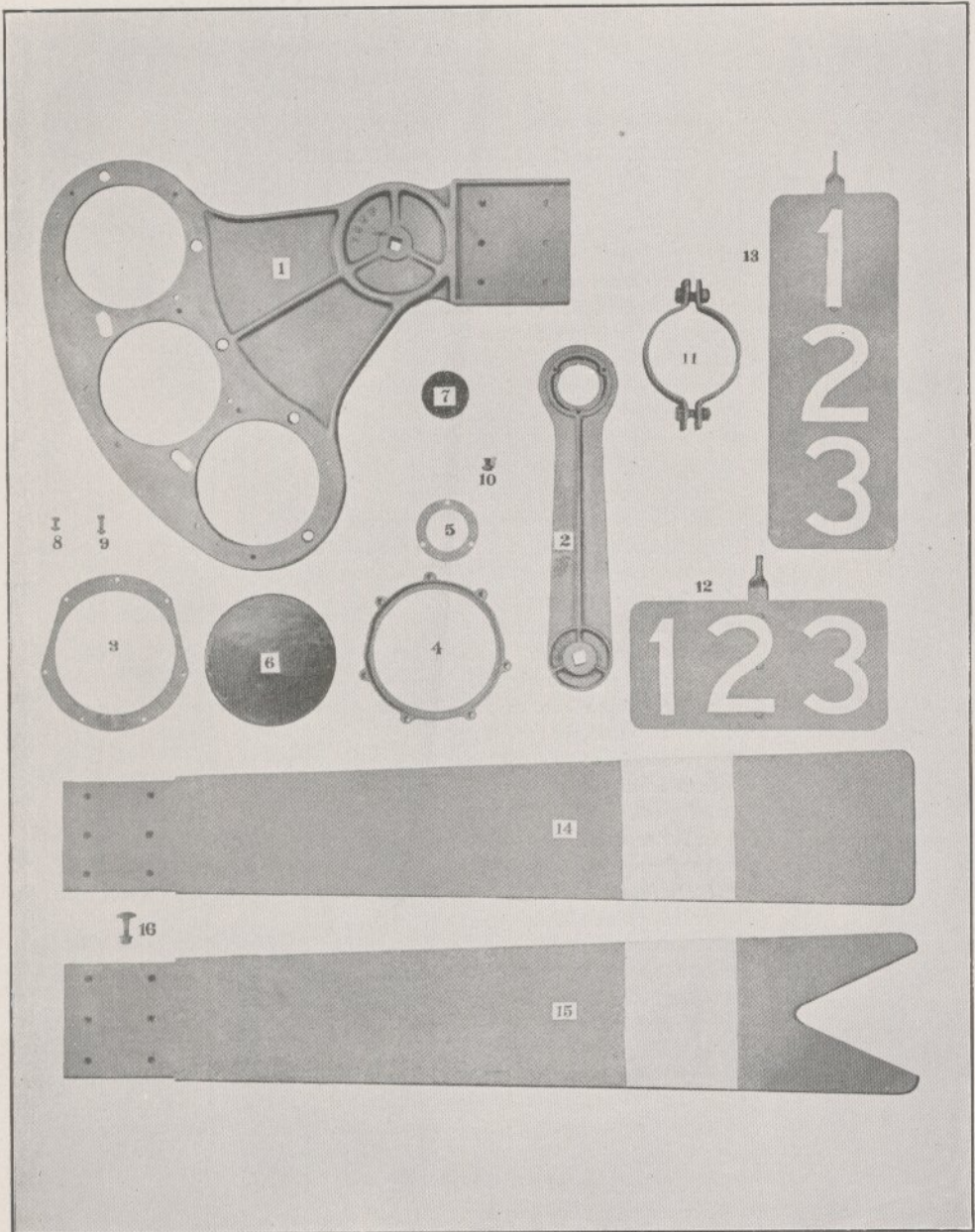
## POST, LADDER AND FITTINGS.

PLATE 107  $\frac{1}{4}$

ORDER BY PLATE AND NUMBER.

- No.
1. Ladder only ( give total length in ordering).
  2. Top ladder brace and bolts.
  3. Intermediate ladder brace and bolts.
  4. Bottom ladder brace and bolts.
  5. Lamp bracket.
  6. Pinnacle with set screw for one arm signals.
  7. Lamp bracket clamp and bolts for 4 inch pipe.
  8. Lamp bracket clamp and bolts for 5 inch pipe.
  9. Rubber gasket for base of post.
  10. Clamp and nut for hand hole cover.
  11. Hand hole cover for semaphore bearings.
  12. } Up and down rods, with pins and cotters (give length in
  13. } ordering).
  14. Guide for up and down rods.
  15. Tap bolt for lamp bracket.
  16. Tap bolt for guide.
  17. Pinnacle for two arm signal.
  18. Upper semaphore bearing with set screw and nut.
  19. 4 inch section of pipe post.
  20. Lower semaphore bearing.
  21. 5 inch section of pipe post.
  22. Base of post.
  23. Cotter for semaphore shafts.
  24. Washer for same.
  25. Nut for same.
  26. Tap bolt for shaft bushings.
  27. Shaft bushing.
  28. Rear shaft bushing (used when no back light is required).
  29. Semaphore shaft (used when no back light is required).
  30. Semaphore shaft (used with back light).
  31. Straight arm for semaphore shaft.
  32. Offset arm for semaphore shaft.
  33. Short bolt for base of post (two required).
  34. Cupped washer with lead gasket for same.
  35. Nut for same.
  36. Long bolt for base of post (two required).
  37. Bolt for clamping ladder brace to post.
  38. Bolt for securing ladder brace to ladder.
  39. Nut for same.





General view of Standard Spectacles, Blades, Number Plates and Details.

## The Union Electric Semaphore.

### STANDARD SPECTACLES, BLADES, NUMBER PLATES AND DETAILS.

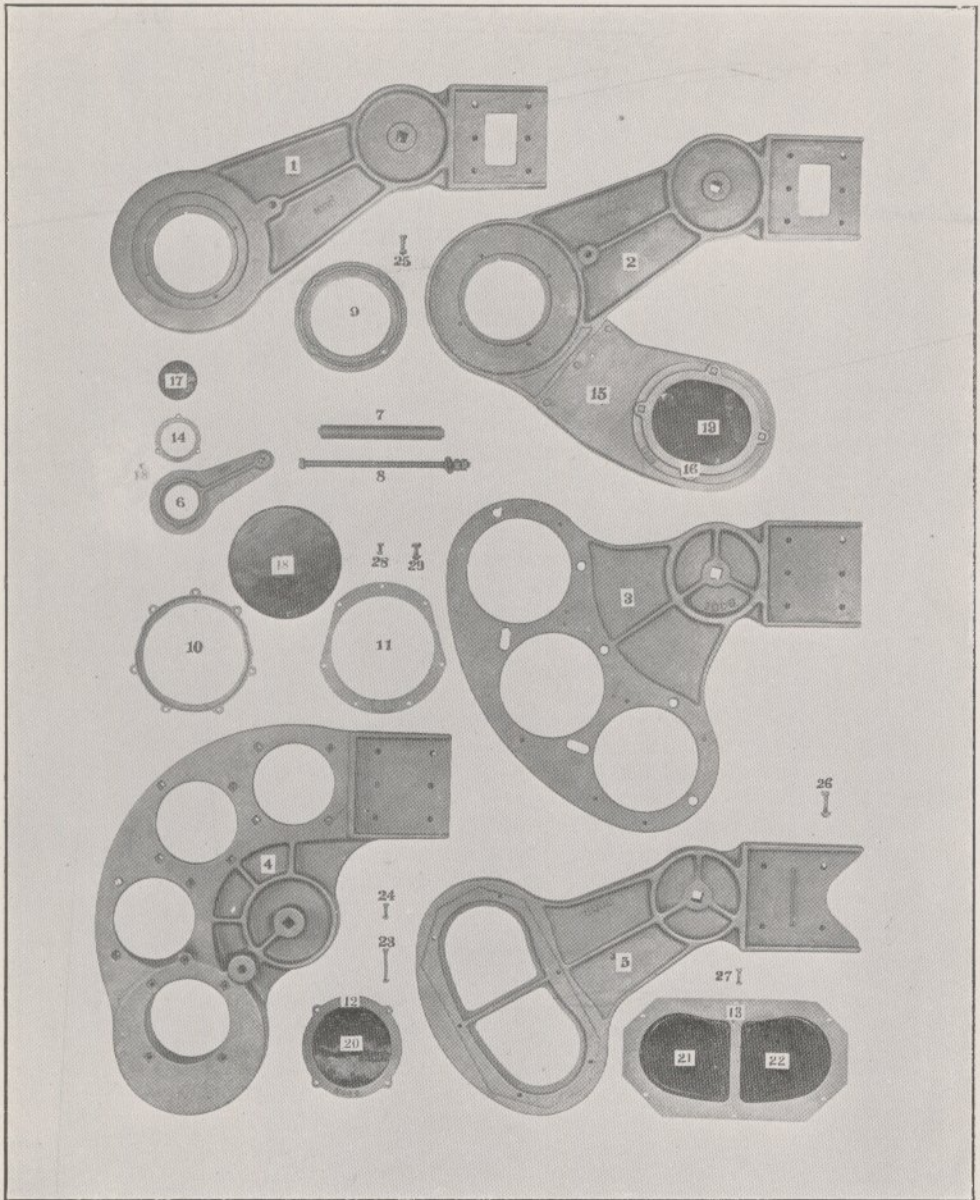
PLATE 107 $\frac{1}{15}$

ORDER BY PLATE AND NUMBER.

No.

1. Standard 60° continuous light spectacle.
2. Back light spectacle.
3. Sheet iron ring for glass.
4. Cast iron ring for glass.
5. Cast iron ring for backlight.
6. Glass for spectacle. (Specify color in ordering.)
7. Glass for backlight. (Specify color in ordering.)
8. Bolt and nut for securing glass in rings.
9. Bolt and nut for securing rings to spectacle.
10. Bolt and nut for securing ring to backlight.
11. Number plate clamp with bolts.
12. Horizontal number plate. (Specify figures in ordering.)
13. Vertical number plate. (Specify figures in ordering.)
14. Home signal blade.
15. Distant signal blade.
16. Bolt and nut for signal blades.





General view of special Spectacles, Glass, and Details.



# The Union Electric Semaphore.

## SPECIAL SPECTACLES AND DETAILS.

PLATE 107 $\frac{1}{16}$

ORDER BY PLATE AND NUMBER.

- No.
1. Single light spectacle.
  2. Single light spectacle with lugs for attaching second light.
  3. Michigan Central R. R. standard 70° continuous light spectacle.
  4. Continuous light spectacle for 45° and 90° blade movements.
  5. Pennsylvania R. R. standard 60° continuous light spectacle.
  6. Back light casting for Nos. 1 and 2.
  7. Bolt bushing for back light.
  8. Bolt, nut and washer for securing back light to spectacle.
  9. Ring for Nos. 1 and 2.
  10. Cast iron ring for No. 3.
  11. Sheet iron ring for No. 3.
  12. Ring for No. 4.
  13. Glass retaining plate for No. 5.
  14. Ring for No. 6.
  15. Second light attachment for No. 2 with bolts.
  16. Oval ring for No. 15.
  17. Glass for back light (specify color in ordering).
  18. Glass for No. 3 (specify color in ordering).
  19. Oval glass for No. 15 (specify color in ordering).
  20. Glass for No. 4 (specify color in ordering).
  21. Upper glass for No. 5 (specify color in ordering).
  22. Lower glass for No. 5 (specify color in ordering).
  23. Long bolt and nut for No. 4.
  24. Short bolt and nut for No. 4.
  25. Bolt and nut for securing rings to Nos. 1 and 2.
  26. Bolt and nut for securing P. R. R. blade to spectacle.
  27. Bolt and nut for securing glass retaining plate to No. 5.
  28. Bolt and nut for securing No. 10 to No. 11.
  29. Bolt and nut for securing Nos. 10 and 11 to No. 3.

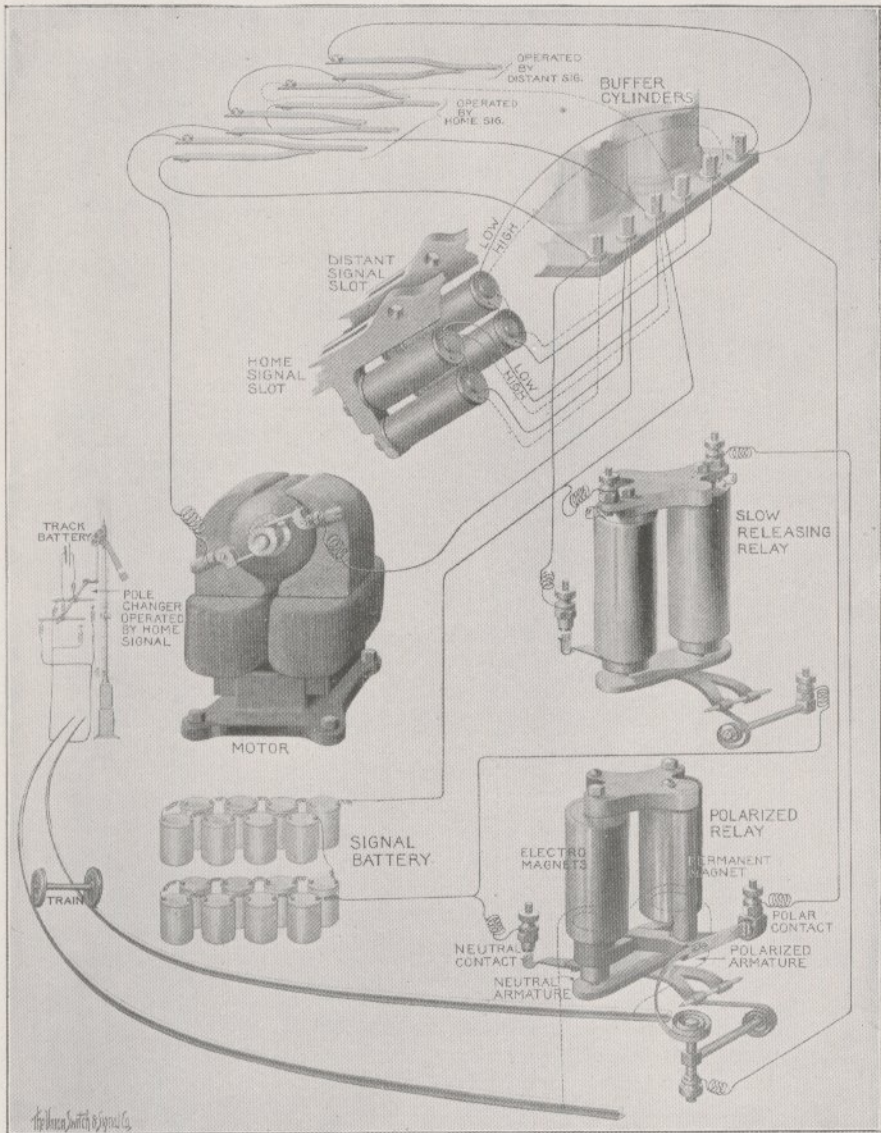


Diagram illustrating Polarized Track Circuit System adapted to the control of Union Automatic Electric Block Signals.



# The Union Electric Semaphore.

## A METHOD OF AUTOMATIC CONTROL.

Plate 103 $\frac{1}{4}$  illustrates the internal and external connections peculiar to the control of this signal by the Polarized Rail Circuit, which has come to be the only recognized method of eliminating line wires between home and distant block signals on double track work.

Each track circuit includes the magnets of a relay, having a "neutral" and a "polar" armature, which control, respectively, the home and distant arms of the signal marking the entrance of the block whose rails form the track circuit. Normally, when all blocks are unoccupied and when all switches therein are properly set for main line traffic, signals indicate the fact by displaying safety.

The movement of a switch from the main line, or the presence of a train within the block, short-circuits the relay and thus depriving it of current energy, causes the neutral armature to drop and to open the circuit of the signals, which immediately assume the horizontal position by gravity.

Each home signal is fitted with a pole changing device, which, as the signal moves to danger, changes the direction of the current in the track circuit preceding it and causes the polar armature of the relay at the other end of that circuit to shift and open the circuit of the distant signal there located, whereupon this signal assumes the caution position.

In the non-polarized system, two line wires are required between each home and its distant signal for the control of the latter by the former the rails of the block section controlling the home signals only by non-polarized relays and track circuits of constant current direction.

The reversal of the track circuit, in the polarized system, besides causing the shifting of the polar armature of the relay, causes an instantaneous release and return of the neutral armature also. The momentary interruption of the home signal circuit thus produced would cause it, from the nature of the mechanism holding the signal at safety, to assume danger, were it controlled *directly* by the neutral armature of this relay.

Instead, the home signal is controlled by means of an intermediate relay of special design having sufficient self induction to cause a slow release of its armature when the current controlling it is interrupted.

As before stated, this interruption occurs for a fraction of a second only, during reversal of current in the track circuit, and therefore has no effect upon the home signal.

## ECONOMY OF OPERATION.

While 16 cells of caustic potash battery are recommended for operating and controlling this signal, half that number may be employed, by modifying motor and magnet windings to correspond with the requirements of the smaller number, but we do not advise the use of less than 16 cells for the following reasons:

FIRST. Primary batteries of the type employed develop in service a higher rate of efficiency under a moderate than under a heavy discharge. The greater the number of cells employed the less the discharge required for a given amount of work performed in a fixed time.



SECOND. The low temperatures to which batteries are subjected in winter increase their internal resistance considerably. This is accompanied, during motor operation, by a reduction in e. m. f. which falls rapidly as the number of cells employed is reduced.

THIRD. The imperfect contact of motor brushes with commutators during cold weather, which results from congealed lubricants thereon and, in exposed types of motors, from frozen atmospheric condensation, renders high voltage desirable in the operating batteries.

FOURTH. Motors in general become more efficient as the e. m. f. of their operating energy is increased. Resistances external to signal motors (such as that in relay contacts and batteries), absorb a smaller percentage of the energy consumed during operation when the e. m. f. of the generator is highest and the resistance of the motor is, in consequence, permitted to be greatest.

In support of our assertion that the signal herein illustrated is more economically maintained in service than any other type on the market, we present the following data in relation to the energy consumed by a two-arm signal operated upon the normally clear principle.

When in the clear position, the magnets of the signal slots and that of the slow releasing relay, all of which are normally in parallel circuit with the battery, entail a total current discharge of but .016 amperes.

The current drawn from these cells during motor operation is slightly under 2 amperes—allowing for the initial discharge occurring at the instant the motor starts and before its counter e. m. f. is developed.

Were the batteries employed solely for the purpose of holding the signals at safety and not for their operation as well, the current discharge from the 16 cells would represent .384 ampere hours daily.

As the cells have a capacity of 300 a. h. they should for this purpose alone last for 780 days or slightly over 2 years, without renewals.

To arrive correctly at their capacity for the double duty to which they are put, a knowledge of the traffic involved is necessary.

As an average this traffic may be assumed to represent 60 trains daily and hence 60 operations of the home and distant signals at the entrance of each block.

Assuming also that trains, by holding open the home and distant signal circuits while within their respective blocks, prevent any discharge of the battery for a period of 3 minutes each, sixty trains would then cause the batteries to remain on open circuit 3 hours out of every 24, and the daily current discharge through the magnets only would represent .336 ampere hours.

The average time required by the motor to clear *each* signal is 7.5 seconds or .25 minutes for both; 60 trains would therefore cause the motor to operate for .25 hours daily.

The average motor current being 2 amperes, .5 a. h. represents the daily output from the batteries for *operating* purposes only.

To this should be added the .336 a. h. formerly mentioned as that required for *holding clear* purposes, thus making .836 a. h. the total daily output of the batteries. This represents a service of practically 360 days without renewals, or virtually 1 year.

On a lesser traffic the batteries should last longer, and when applied to *one-arm* signals operated by about 40 trains daily, they have in a number of instances continued to operate the signal and to hold it at safety normally for 2 years without renewals. It is rare, however, that batteries even on open circuit can be relied upon during such an extensive period. In general, one year's service is possibly as much as can, under any conditions, be reliably maintained without renewals.

#### SOME FEATURES OF DESIGN.

It was not alone to secure a signal capable of operation by commercial batteries while in prime condition, that so much time and money were spent in the development of this one. It was also our desire to place upon the market a signal capable of utilizing advantageously virtually the full rated energy of such batteries; to draw so moderately from them and under such favorable conditions as to never overtax them until their full rated capacity for work had been fully reached.

In our efforts we have been quite as successful as anticipated, and records show a number of instances in which one-arm signals of our early construction—less efficient than our present design—have, in two years of continuous service without renewals of battery, permitted the latter to exceed their rated capacity by virtue of the moderate demand for current made upon them, and these are operated on the normally clear principle.

Owing to the small number of cells permissible on each signal, and to the low e. m. f. of each cell, ( 7 volt) signal motors are necessarily of low resistance and hence entail a relatively heavy discharge momentarily from the cells, until their speed, by developing a counter e. m. f. reduces it.

During this instance of heavy discharge the e. m. f. of the battery falls considerably and so remains during motor operation. This naturally decreases the current energizing the slot or clutch magnets, and, were it not for a valuable feature peculiar to our signal, these magnets would fail under such conditions to perform their functions if wound of high resistance, or, if not so wound, would entail an unwarranted drain of the battery normally. This is true only when in both cases the same battery is used for energizing these magnets as is employed for motor operation—a method desirable on account of its simplicity and other virtues.

To secure the economy resulting from high resistance in slot magnets and to render them capable of performing their duty during motor operation they are compound wound. The inner or primary winding is of high resistance and energizes the magnets under normal conditions when battery e. m. f. is highest. The outer or secondary winding consists of a relatively few convolutions of low resistance, and is included in the motor circuit. The loss in energy caused by the fall in e. m. f. at the terminals of the primary winding during motor operation is thus compensated for by the influence of the motor circuit in the secondary winding of the magnets.

It is this feature of the signal which renders *one set of batteries* thoroughly practicable as a common source of energy for its *operation* as well as for its *control*, and which by thus unifying elements and concentrating energy makes its maintenance and inspection both simple and economical of performance.



Arranged and Illustrated  
by  
The Union Switch & Signal Co.



