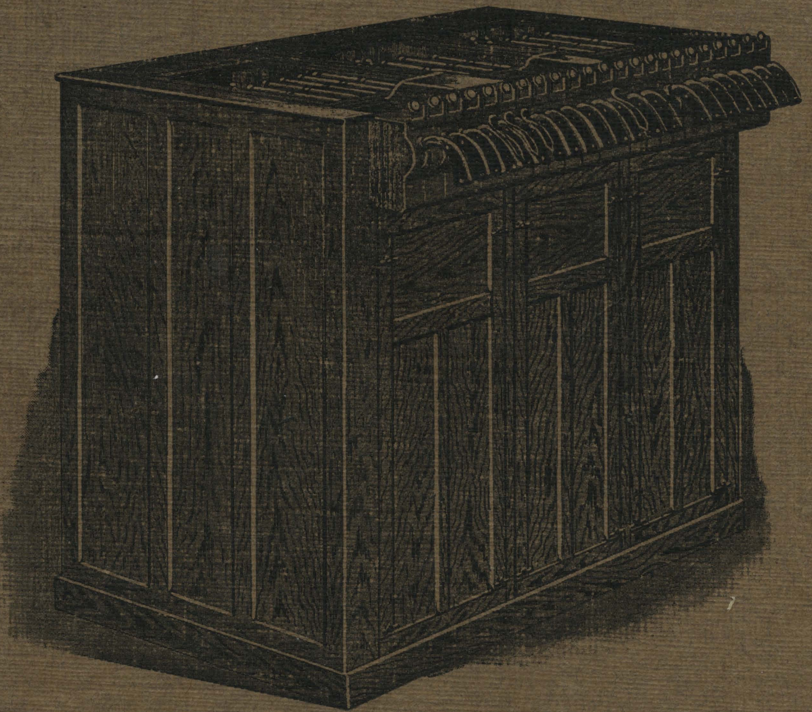
The Union Switch & Signal Co. Swissvale, Pa.

GENERAL OFFICE AND WORKS, SWISSVALE, PA.

DISTRICT OFFICES:

NEW YORK, Hudson Terminal Bldg. CHICAGO, Monadnock Bldg.



Multiple Unit Electric Interlocking System

Bulletin No. 49

Section #2

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8 Way

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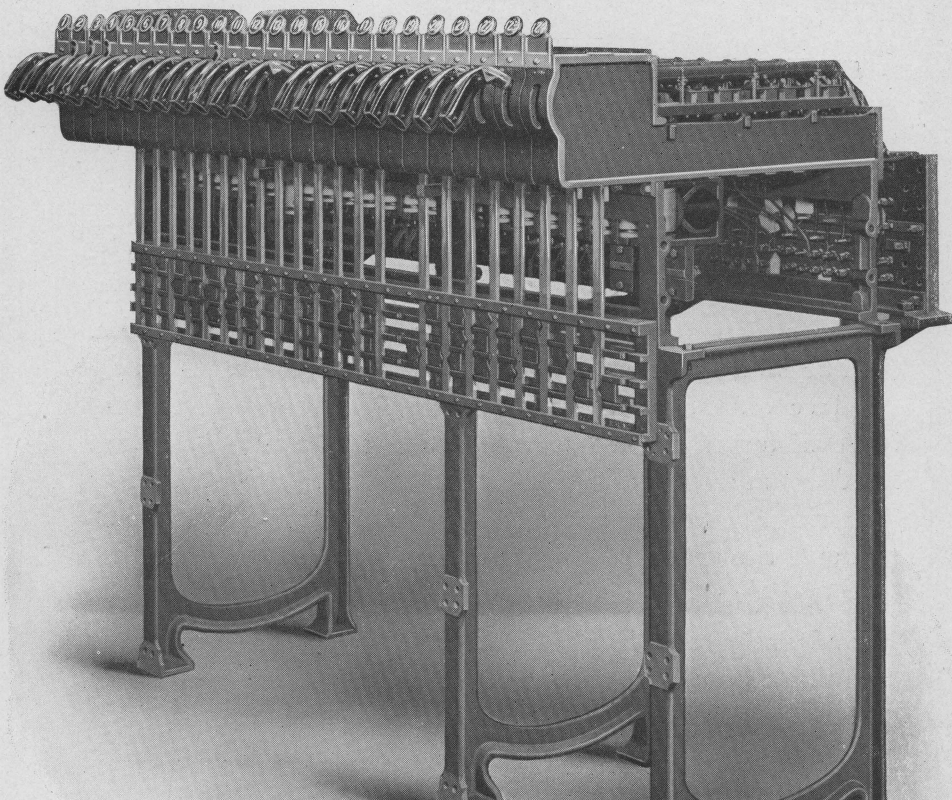
MULTIPLE UNIT ELECTRIC INTERLOCKING SYSTEM.

THE interlocking machine receives its name from the fact that each lever is an independent unit in itself and may be removed from the machine by taking out one screw. The lever movements are novel, the first being a longitudinal movement which actuates the mechanical interlocking in the machine. The intermediate movement is a movement in the arc of a circle and operates controllers for the switch or signal circuits. The final movement is a longitudinal movement, taking place only after the indication has been received and resulting in the release of certain mechanical locking. This movement is automatic and is completed by a spring. It is accomplished only after the operator has made the preliminary and intermediate movements.

All the working parts of the lever are attached to and supported by the frame "A", Fig. 1. The lever and all its connected mechanism may be removed from the machine by simply removing the frame "A". From this it derives its name of *Multiple Unit Electric Interlocking Machine.*

The lever proper "C", comprises a rod provided with a handle. The rod passes through a hole in a pivoted lever "B", the axis of the rod intersecting the axle of the trunnions at a right angle. This method of supporting permits a longitudinal movement of the lever by allowing it to slide through the hole, and an angular movement by permitting it to turn on the trunnions of the lever "B".



Multiple Unit Electric Interlocking Machine,
Case Removed

The spring "b" tends to push the lever inwardly in a longitudinal direction, but has no effect on its angular movement. The inner end of the lever is connected by means of a pin and roller with the link "D", the functions of which are the same as those of the link in the well known mechanical machine. A shouldered plate "P", attached to the frame "A", makes it necessary to pull the lever out to the full extent of its longitudinal movement before a rotational movement can be made. The longitudinal movement turns the link on its pivot and through the bar "E" moves the tappet bar "F", which effects the mechanical locking. The rotational movement has no effect on the link, as the roller moves freely in the slot of the link which is then concentric with the trunnions on which the lever turns. The final inward longitudinal movement produced by the spring "b", moves the link and the tappet still farther in the same direction and effects the release of certain mechanical locking.

The thumb latch "c", is for the purpose of closing the circuit of the magnet "J" to release the detector locking. This is effected through the rod "a" sliding in an axial hole in the lever, the shaft "d" and the contact spring "f". By this means, the magnet "J" may be left on open circuit and only put in circuit when it is necessary for unlocking the lever. This not only saves current, but prevents over-heating of this magnet.

The bar "E" has notches "e" and "e_1" cut in its edges, which form a motion plate for transmitting motion to the indication bar "H". The motions of the indication bar correspond to those of the link, and therefore, to the longitudinal movements of the lever. The indication bar has a notch which comes under the indication latch "O" when the bar is in its middle position.

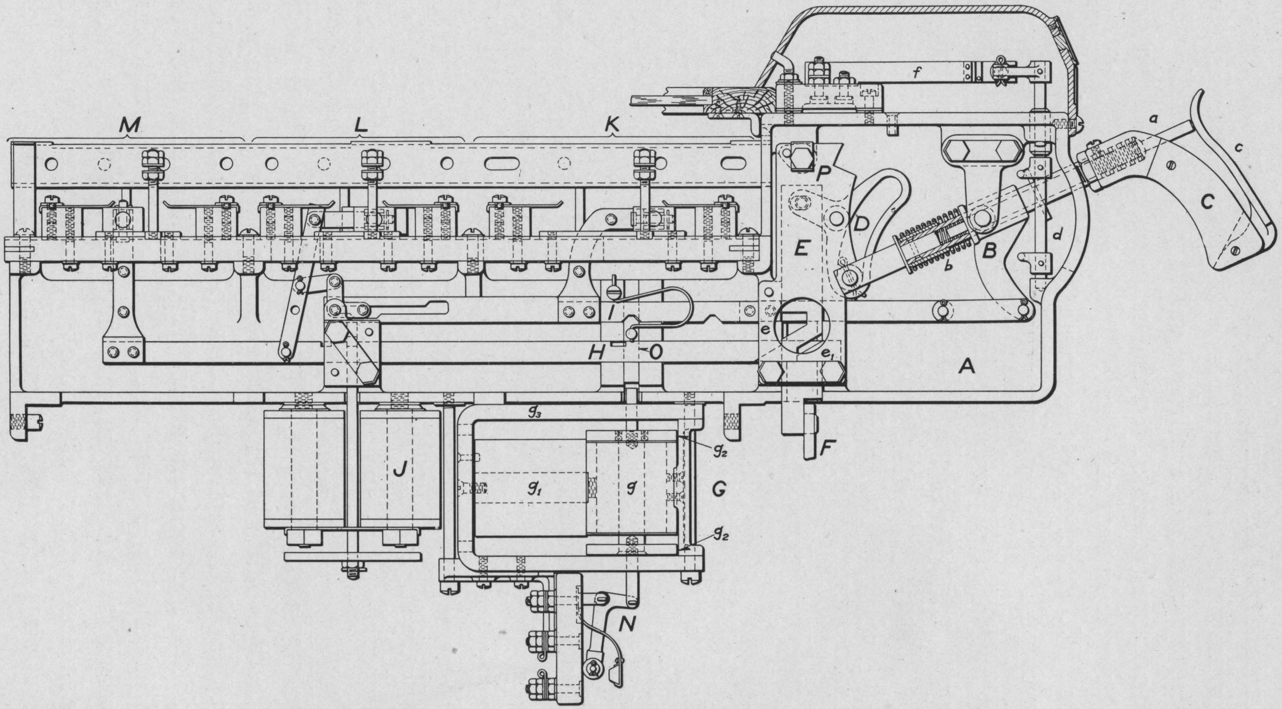


Fig. 1—Switch Lever with Detector Circuit Controller

The latch drops into the notch at the end of the preliminary longitudinal movement of the lever and locks the lever against final movement until the latch is lifted by the indication magnet.

To insure that the latch drops into the notch, a cam formed on the bar "I" will force it down if the spring attached does not perform its function. The bar "I" is connected to the lever "B" which is moved by the rotational movement of the lever, during which movement the indication bar remains stationary. Two "V" shaped notches are cut in the under side of the bar "I", one of these notches coming over the latch in either of the extreme positions of this bar. The uncut part of the bar between the notches forms the cam which forces the indication latch down.

The indication magnets "G" comprises two energizing coils "g" and "g_1." The coil "g" is enclosed within an iron tube or shell which forms one pole of the magnet energized by the coil "g_1". The other pole of the magnet resides at the two ends of the yoke "g_3". Within the coil "g" and free to move in a vertical direction is an iron core having a flat iron disk "g_2" attached to each end. These discs are the poles of another magnet energized by the coil "g". If the direction of the current in the coil "g" is such as to make the upper disc a north pole and the lower disc a south pole, and the direction of the current in the coil "g_1" is such as to make the shell a north pole and the ends of the yoke south poles, the movable core will be pushed upwardly, but, if the current in either coil is reversed, the core will be held down.

The coil "g" consists of a few turns of heavy wire and is energized by the operating current of the switch motor. The coil "g_1" has a large number of turns of wire and is energized by the indication current. The

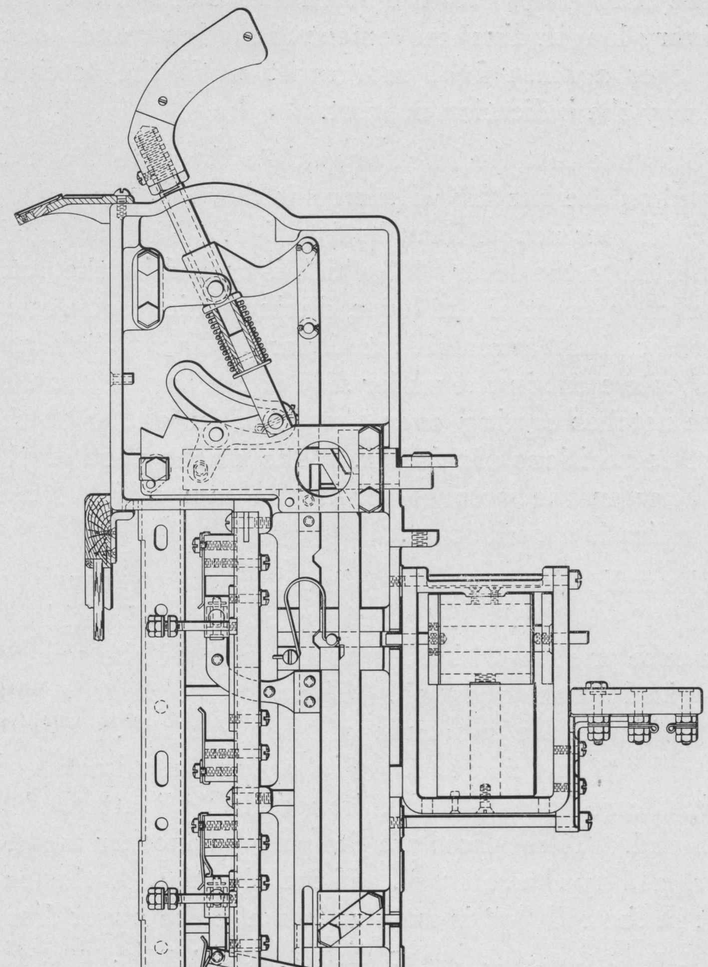


Fig. 2—Signal Lever

operating current through the coil "g" has always the same direction.

During the movement of the switch, a small current flows from the battery, through the coil "g_1" to the motor, but this is in a direction to hold the movable core down. After the switch movement is completed, and the driving current is switched over to one set of armature coils, current flows back in the opposite direction through the coil "g_1", and the core and indication latch are lifted.

The controller "K" comprises four contact springs, two fixed rails, and two movable blocks. This controller is operated by the rotational movement of the lever and controls the operating circuits to the motor. In one of its positions, one of the operating wires is put in connection with positive battery through the low resistance indication coil "g" and the other operating wire is connected to positive battery through the high resistance indication coil "g_1". The current in the latter circuit is limited too much by the high resistance to have any effect on the motor which is governed by the much stronger current in the former. In the opposite position of the controller these connections are reversed.

The controller "L" is similar in construction to the controller "K", but it is actuated by the preliminary and final movements of the lever. Its purpose is to close the motor stopping circuit and open the indication circuit when the lever movement is completed. The stopping circuit is also taken through the controller "N", actuated by the indication magnet. The purpose of this is to close the stopping circuit only when it is needed and leave it normally open.

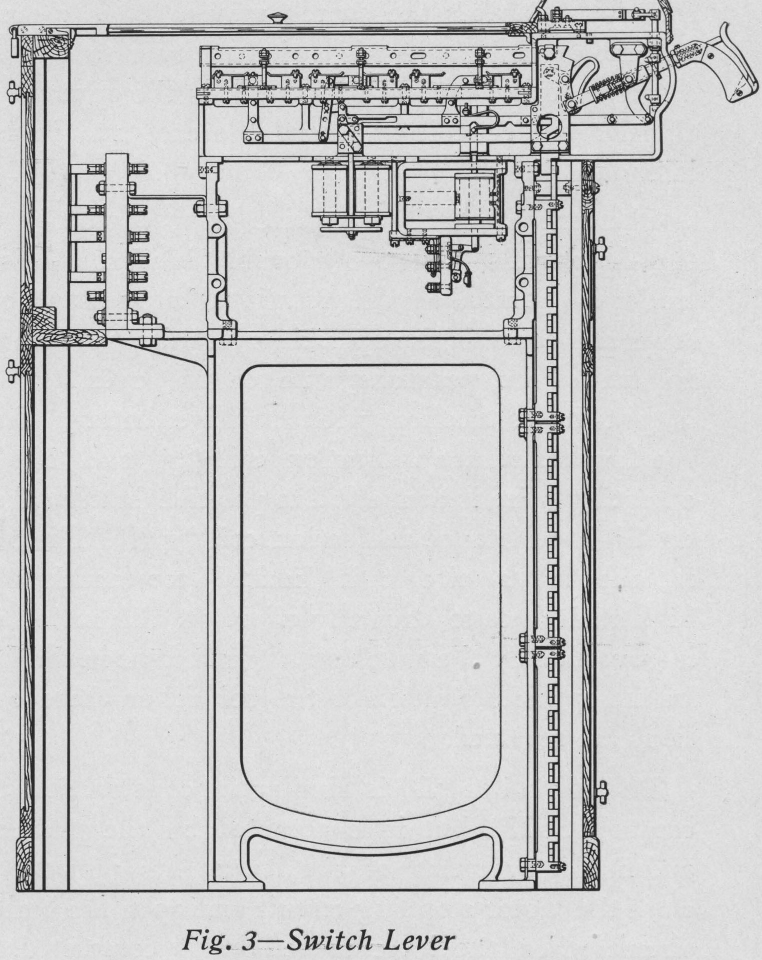


Fig. 3—Switch Lever

The controller "M" is a special and forms no part of the interlocking proper. By means of it, two circuits may be closed in either position of the lever.

The signal lever as shown on Fig. 2 is similar to the switch lever, but it has an indication only in the normal position.

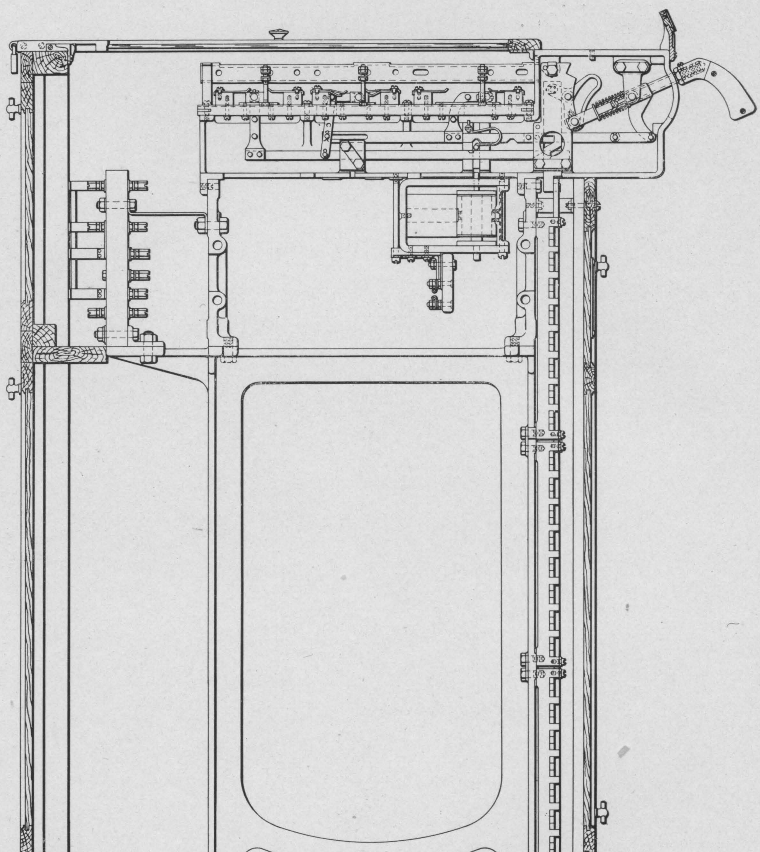


Fig. 4—Signal Lever

Ground Apparatus.

The apparatus on the ground in its general construction and appearance is very similar to that which has been installed by the U. S. & S. Co., for some time past. The switch and lock movement is the same in all respects, except in the construction of the motor armature. This has two independent series of coils, each connected to a commutator. During the movement of the switch, the two sets of coils are in series and act jointly as a motor to drive the mechanism. At the end of the movement the driving current is switched over to one set of coils, which results in raising the potential of the two sets in series, so that a higher potential is produced at the motor than exists at the battery. This results in a current flowing towards the positive pole of the battery through one coil of the indication apparatus. The other coil of the indication magnet is energized by the current which drives the motor.

Indication.

The indication apparatus comprises a polarized magnet, without permanent magnets, however. The polarization is effected by the driving current to the motor passing through one of the magnet coils. The other coil must then have current in a certain direction relative to the driving current in order to actuate the latch. This coil is also connected to the positive of the battery, and current must flow towards the positive pole of the battery to be in the right direction to energize the magnet. To cause current to flow in opposition to the battery is the purpose of the two sets of coils on the motor armature. As is well known, the counter-electromotive force of a motor, when running light, is nearly equal to that of the source supplying the current. The

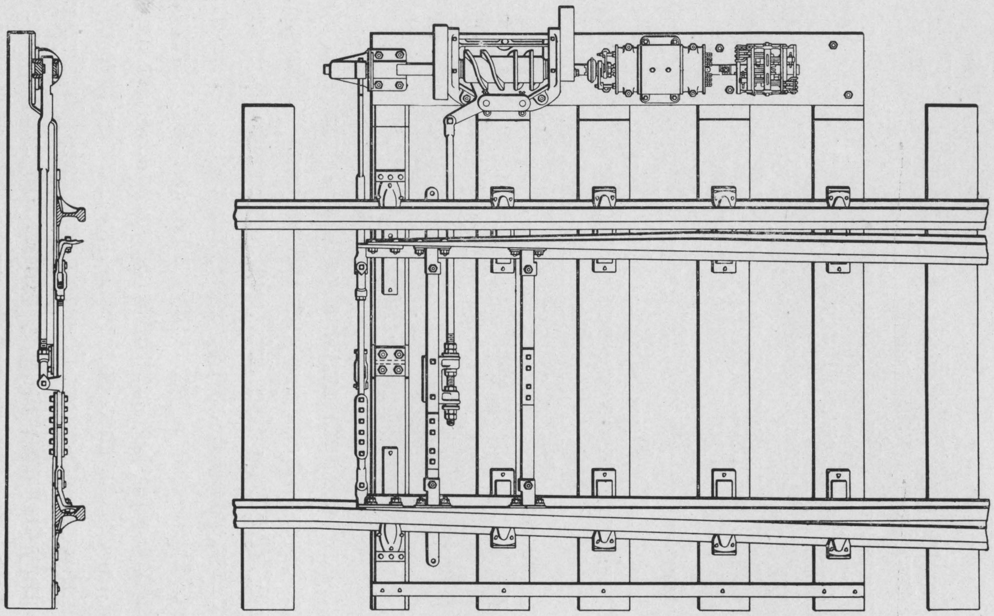


Fig. 5—Layout of Electric Switch and Lock Movement, with Detector Circuits

difference between the two is due to the fall of potential in overcoming the resistance in the circuit. This difference when the motor is running light is not more than ten per cent of the total voltage of the source. When the motor then is driven through one set of coils on the armature, the counter-electromotive force of this set is nearly equal to that of the battery; and since the other set of coils is rotating at the same speed in the same magnetic field, its counter-electromotive force is the same as that in the set driving the motor. The sum of the two then is nearly double that of the battery. The result is that a potential nearly double that of the battery is produced at the motor, so that current can be readily caused to flow towards the positive pole of the battery, or in a direction opposite to that in which the current should come from the battery. This arrangement of the circuits makes the apparatus quite safe against false indications, because the current could not possibly flow through the indication magnet coils in the right direction if it came from a wire which was accidently crossed with the indication wire. A false indication could not result from the wire being crossed with the indication wire to another switch which was in the act of indicating, because unless the switch had completed its movement and a change in circuits been made at the motor, the potential would be held down by the motor which had not reached the proper point for indicating, because the potential at this motor cannot equal that of the battery until after the change in the circuit has been effected by the movement of the mechanical controller at the switch.

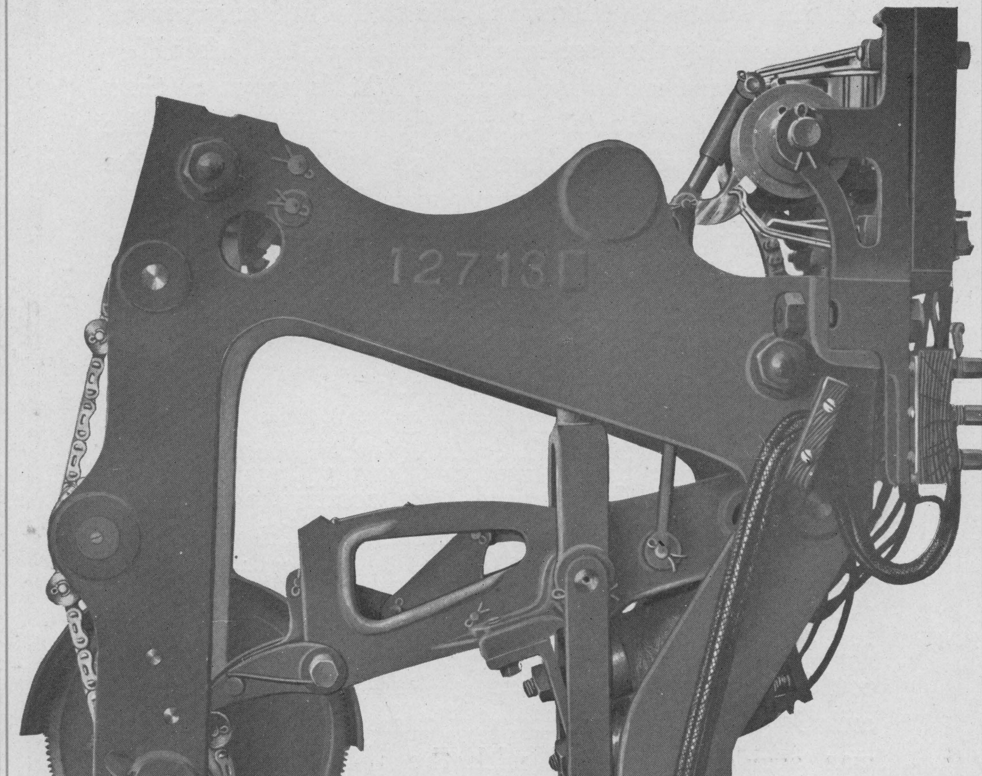


Fig. 6—High Signal Mechanism

High Signal.

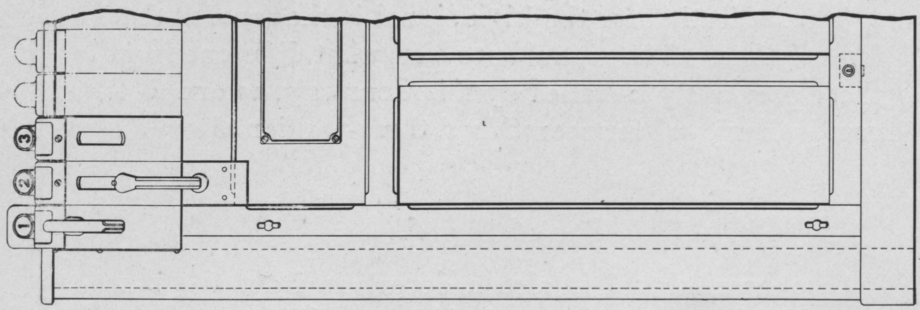
The indication for the high signal is the same as that for switches. The signals are somewhat different from those previously installed by this Company, as one slot-arm is employed for operating a three-position signal.

Dwarf Signal.

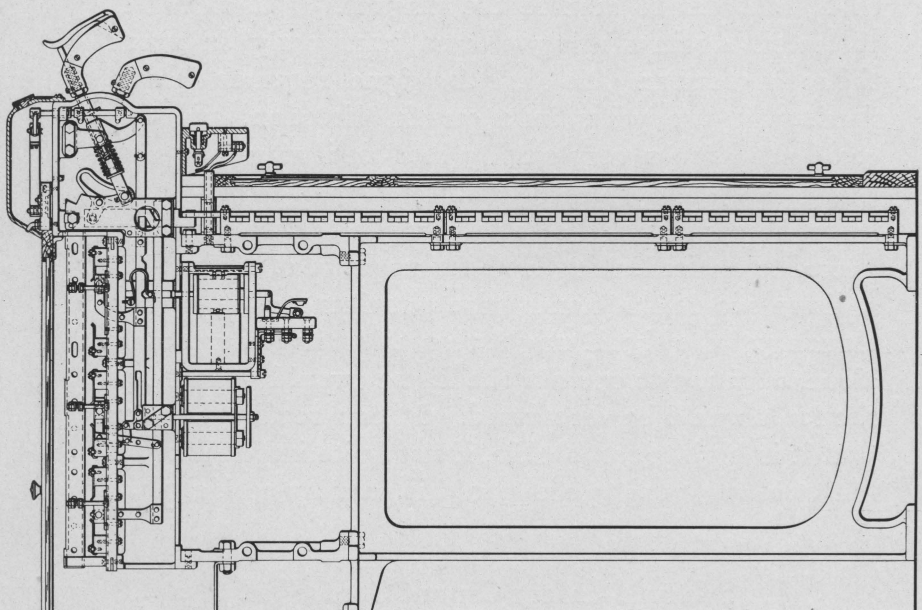
The dwarf signal is also a departure from the past practice of this Company. It is actuated by a solenoid, and the indication is of a type known as battery indication. This is made safe by arranging it so that current must flow in two wires in certain relative direction in each, in order to actuate the magnet. The signal is protected against being cleared improperly in much the same manner. To clear the signal requires current flowing in two wires in a certain direction, and this could not happen very readily because it would require that one of these wires be connected to a wire leading from the positive of the battery, while the other is connected to a wire leading from the negative of the battery. If these two faults could arise simultaneously, a false clearing of the signal might result, but if either occurs alone, a failure to operate the signal would result and the fault would be discovered. It can readily be seen that it is highly improbable, if not quite impossible, for faulty connections to occur in this way by accident.

Solenoid Safety Circuit Controller.

The safety controller which automatically cuts out a switch motor, if the lines become improperly connected, combines in one the functions of two electro-magnetic circuit controllers. The function of one is to open the motor circuit when the lever movement is completed,



PORTION OF FRONT VIEW

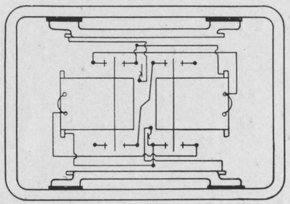


SECTIONAL SIDE VIEW

and of the other to open the next operating circuit when it is energized improperly by connected wires, and thus to prevent a wrong movement.

The instrument which is illustrated in Figs. 8, 9, 10 and 11, comprises two solenoids A and A', fixed to a cast iron base V. Each solenoid has a movable core D, connected by means of a jaw E to a lever F. The lever F is pivoted at its middle to a fixed support G and is connected at its upper end to a rod H, free to move longitudinally. The rod H carries a contact bridge I, which will connect the contacts J and K when the core D is drawn into the solenoid, and will connect the contacts L and M when the core D is drawn outward. The levers F and F' are connected near the lower ends by a spring Z, which causes the bridge I' to connect L' and M', when the core D is drawn into its solenoid A to nearly the full extent. Similarly the contact bridge I is made to connect L and M when the core D' is drawn into the solenoid A'. The contacts J and K are carried by the block N, with springs interposed so that they may be pushed in about 3-16 inch. The contacts L and M are fixed to the block O. The relation of the parts is such that the bridge I touches the contacts J and K, while the core D is still 3-16 inch from its complete inward stroke, and the bridge I' touches L' and M' with the core D about 1-16 inch from its full inward stroke. These clearances are allowed for making good contact. Each solenoid has two coils of wire. The coil C has 100 turns of No. 13 B. & S. G. and the coil B 1100 turns of No. 15 B. & S. G. The resistance coils U and U', each of twenty ohms, are in series with the coils B and B' at the starting of a movement, and the circuits including them may be called the starting circuits. The coil B is connected to terminals P and Q, and the coil C is connected to terminals R and S.

FIG. 8



WIRING DIAGRAM

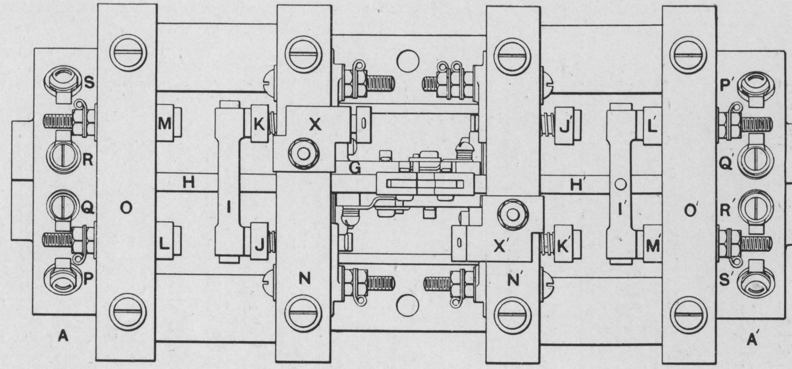


FIG. 10

FIG. 9

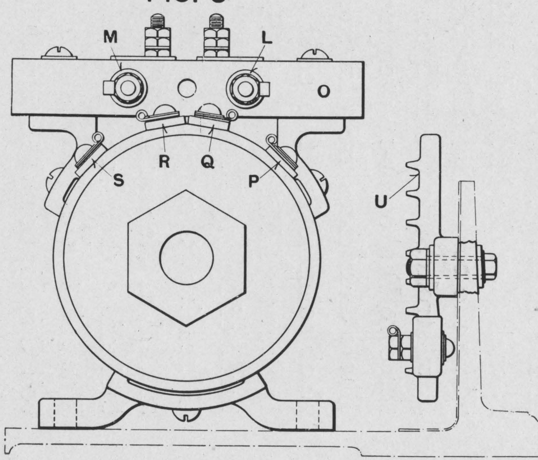
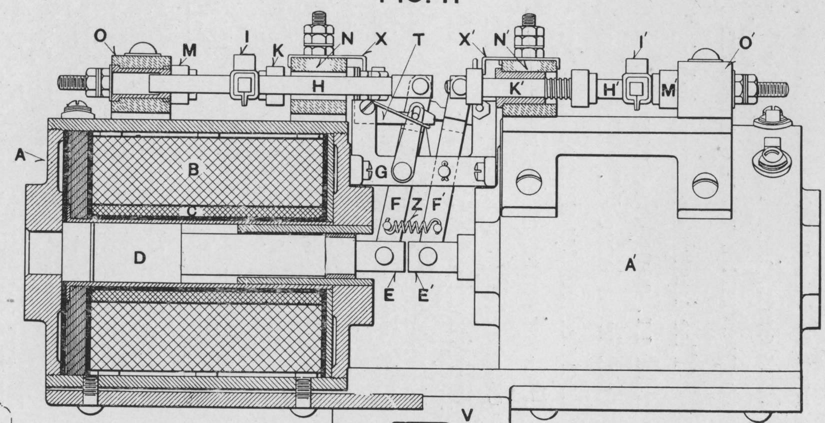


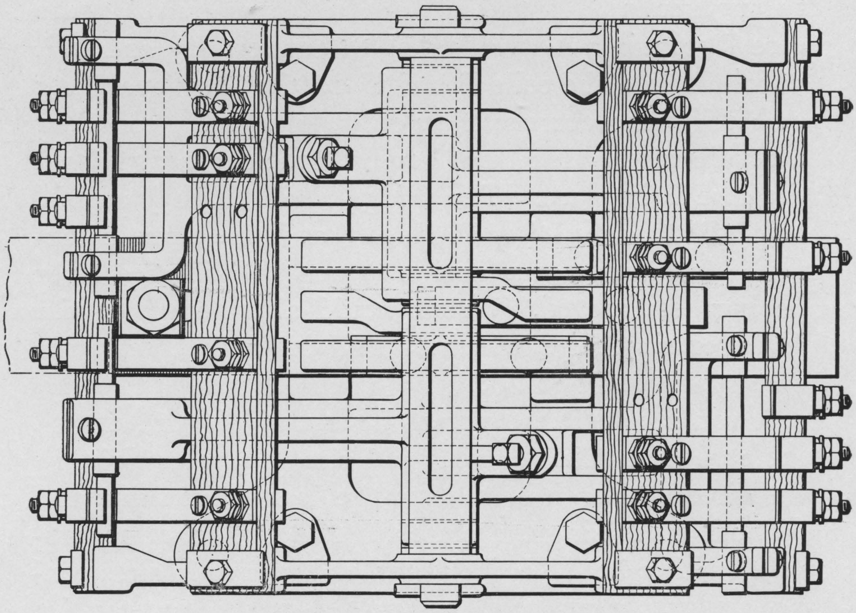
FIG. 11



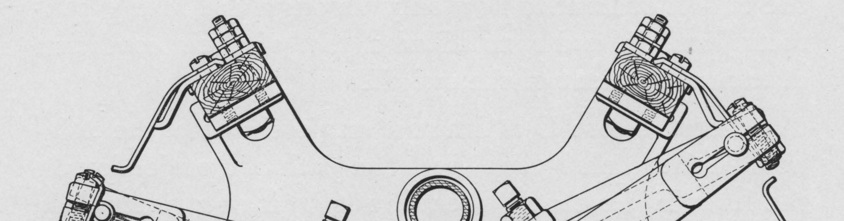
Solenoid Safety Circuit Controller, for Switch Movement

At the beginning of a movement, current flows through coils C, B, and U in series, and draws in the core D, causing the bridge I' to connect L' and M', which shunts the coils B and U, so that the operating and indicating currents flow only through the coil C, of a very low resistance, but having sufficient turns to hold the core D in place. The bridge I will touch J and K before I' touches L' and M', so that if the current happened to come from a foreign source without the lever having been moved, current would also flow from the last operating wire, which is still in connection with battery, through coils C', B' bridge I' and the motor, and would hold I' away from L' and M', by drawing in the cord D'. This current will run the motor light in the direction it ran in making the last movement, and without energizing the clutch. The contact K is provided with a head on its inner end, which makes connection with a contact X, when K is pushed outward by the spring, but when K is pushed in by the bridge I, it is separated from X. The object of this is to cause the cut-off current to flow only through the safety contacts J and K, and thus afford a test of their condition at each movement of the switch.

When the core D is drawn completely into the solenoid A, the latch T drops into the path of a projection on the lever F', so that if the magnet A' is energized while A is still holding its core, the core D' will be stopped by the latch T before it puts the bridge I' against J' and K'. A similar latch, T' stops the core D under similar conditions. These latches come into play in the action of the cut-off current last above mentioned. If in that case the bridge I' were allowed to move far enough to touch J' and K', the safety circuit would be temporarily closed and cause sparking at the contacts.



PLAN VIEW



SECTIONAL SIDE VIEW

Fig. 12—Induction Circuit Controller

Indication Circuit Controller.

The indication circuit controller as shown on Fig. 12 consists of operating arms which make and break the operating and indication circuits. The arms are worked by dogs riveted to the slide bar of the switch and lock movement. All contacts are accessible and easily adjusted.

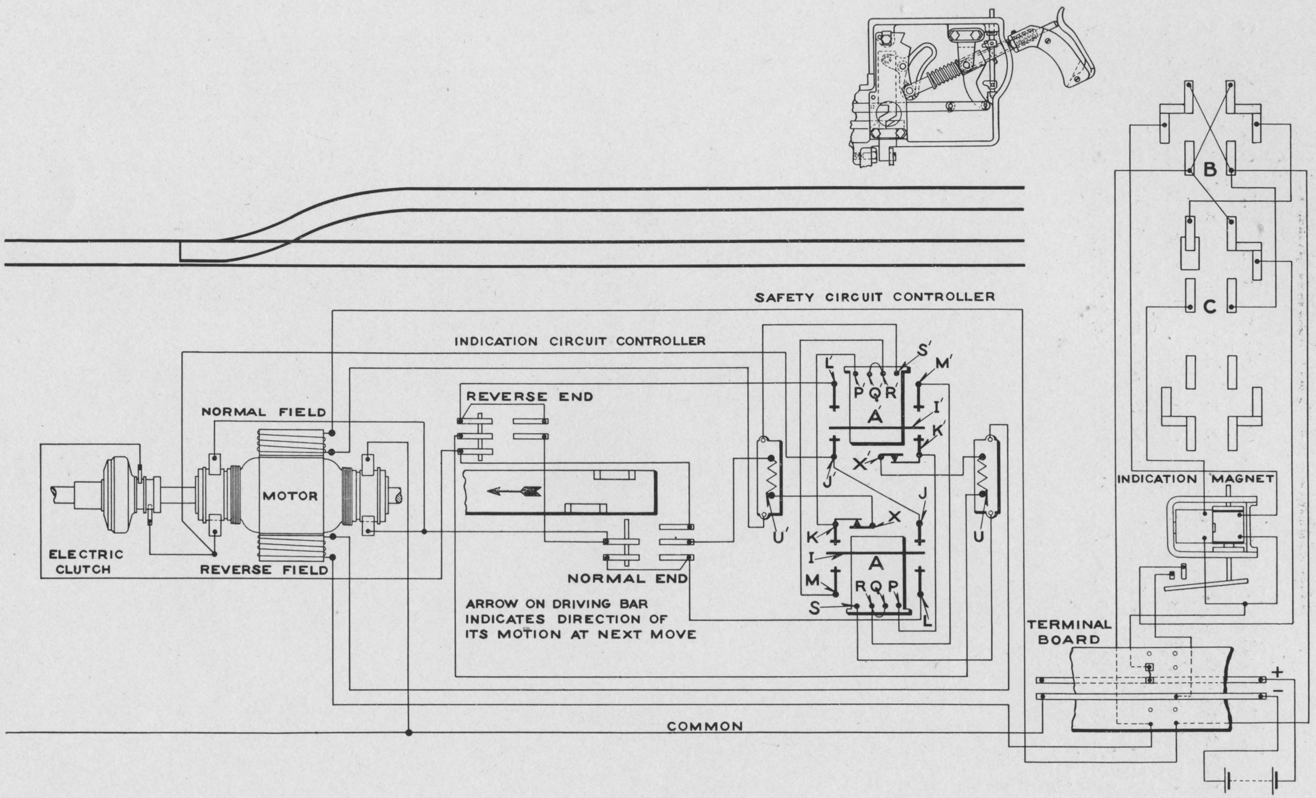

SAFETY CIRCUIT CONTROLLER
INDICATION CIRCUIT CONTROLLER
REVERSE END
NORMAL FIELD
MOTOR
ELECTRIC CLUTCH
REVERSE FIELD
NORMAL END
ARROW ON DRIVING BAR INDICATES DIRECTION OF ITS MOTION AT NEXT MOVE
INDICATION MAGNET
TERMINAL BOARD
COMMON
B
C
A
A'
U
U'
+
−

Plate 1

Plate 1 shows all parts in the normal position.

NOTE—In the following wiring diagram the wires shown in black are not carrying current.

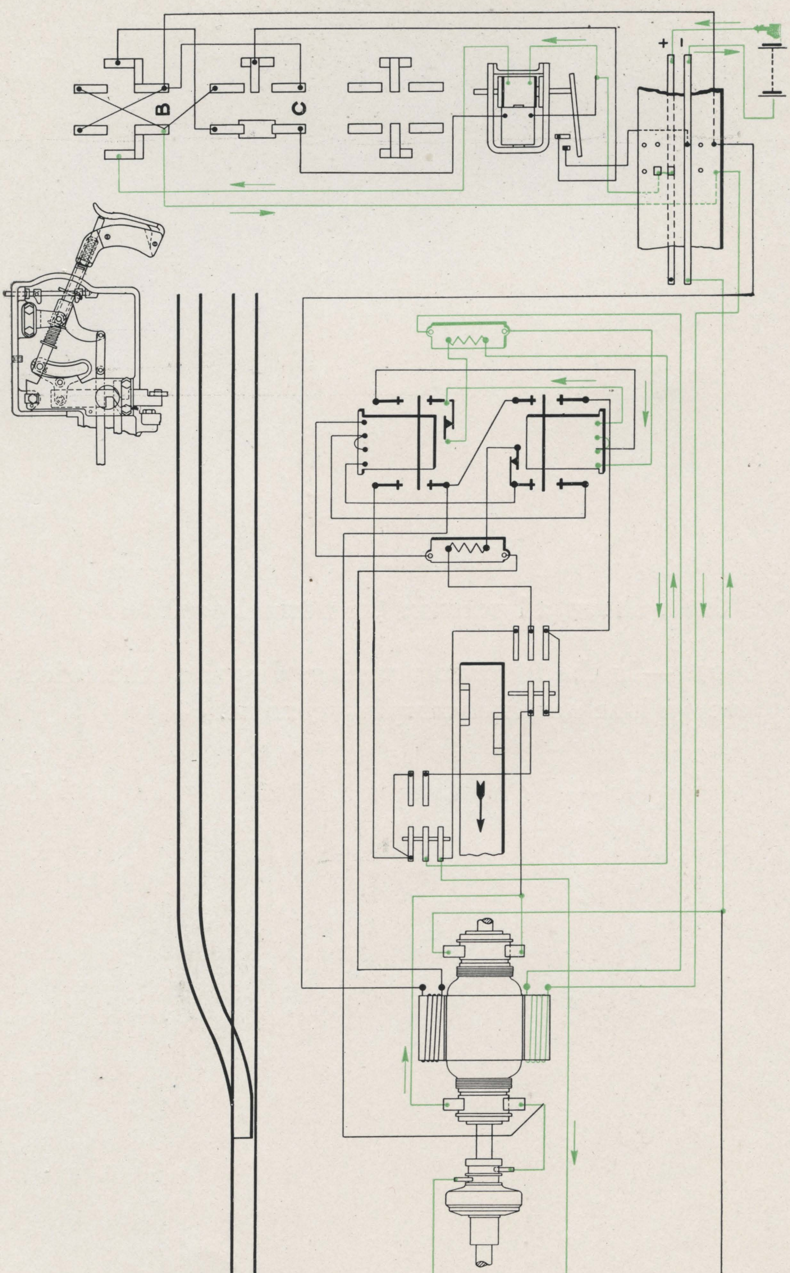


Plate 2

Plate 2 shows the lever thrown to the reverse indication position. Controller "B" working with the lever has closed the reverse operating wires. Controller "C" has bridged one set of contacts and opened another circuit.

The current flows from battery as shown in green. This current does not run the motor, but energizes one set of coils of the safety circuit controller.

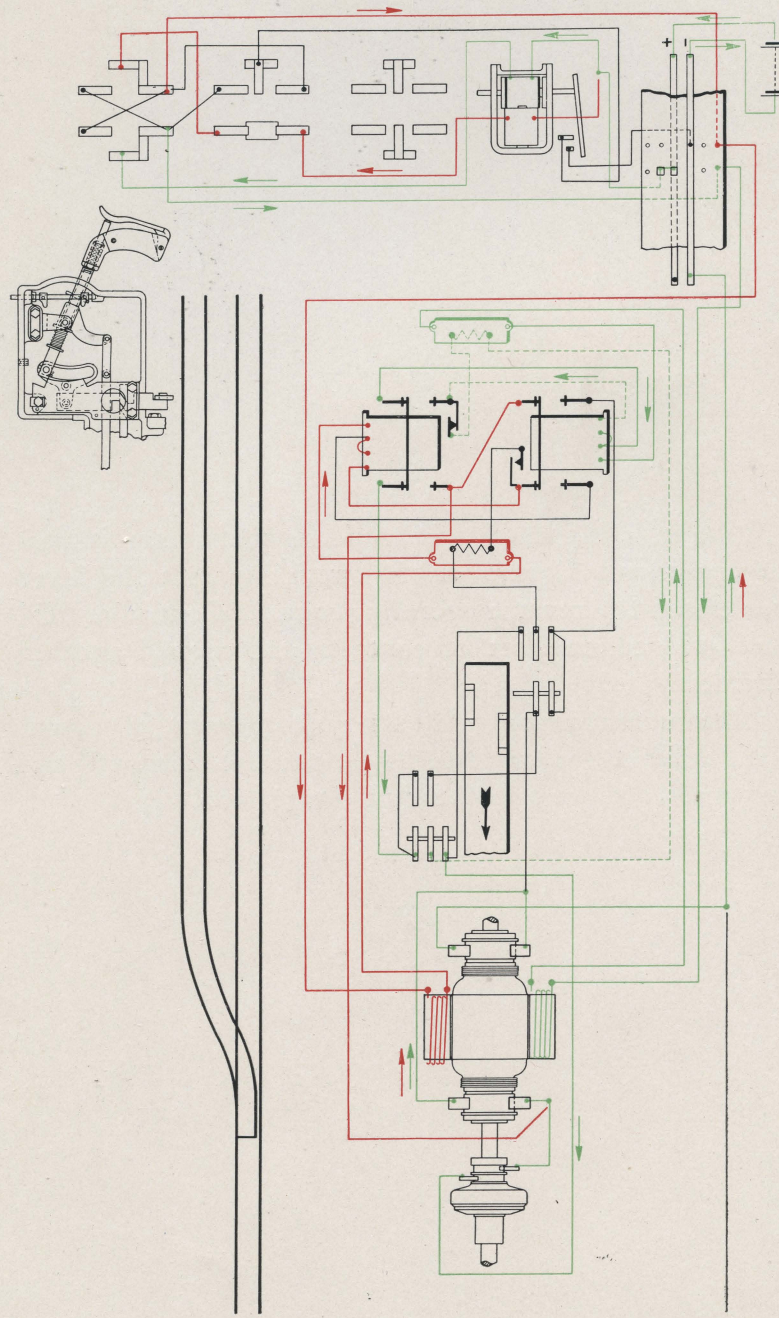


Plate 3

Plate 3 shows the safety circuit controller bridges moved, closing the operating circuit shown in green and another circuit which later becomes the indication circuit, shown in red. The electric clutch is energized, and the movement is started.

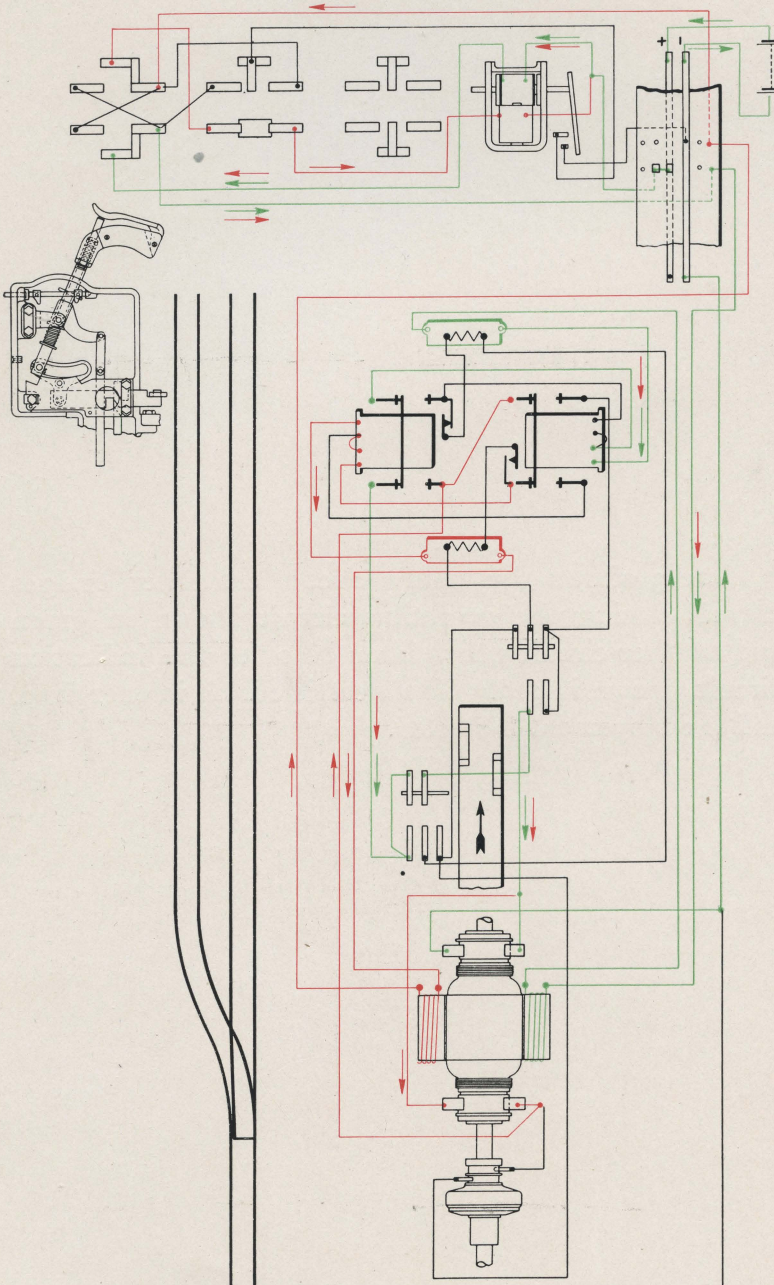


Plate 4

In Plate 4 the movement has been completed at the switch, the indication circuit closed, and the clutch de-energized by the action of the indication circuit controller. This action occurs simultaneously with the locking up of the switch points.

The motor is now operated by the green circuit. The counter-electromotive force generated by the operation end of the armature, added to the electromotive force generated by the other end of the armature, causes a reversal of potential in the red circuit.

During the operation of the switch movement the horizontal and vertical coils of the polarized indication magnets had current flowing through them which tended to hold down the solenoid armature of the vertical coil. The reversal of the current in the horizontal coil magnetizes the poles of the set so that the armature is lifted.

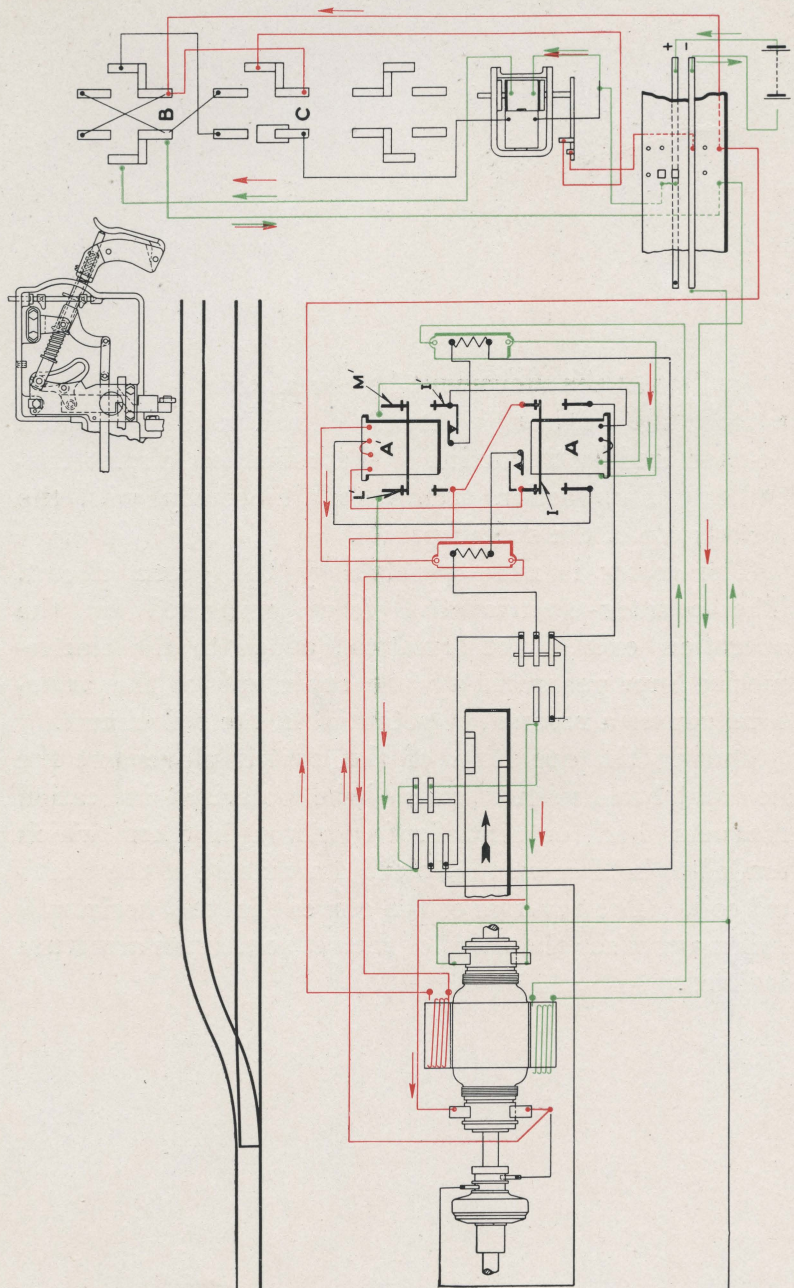


Plate 5

Plate 5 shows the indication latch raised. This action releases the locking on the lever and a spiral spring completes the stroke of the lever, and moves controller "C" to its full reverse position. When the armature is pulled up, two contacts are bridged and a circuit shown in red (stopping circuit) is completed which energizes solenoid A' of the safety circuit controller. The bridge I' of the controller is pulled away from contacts L' and M' thus opening the circuit which energizes A. Then bridge I would resume its central position.

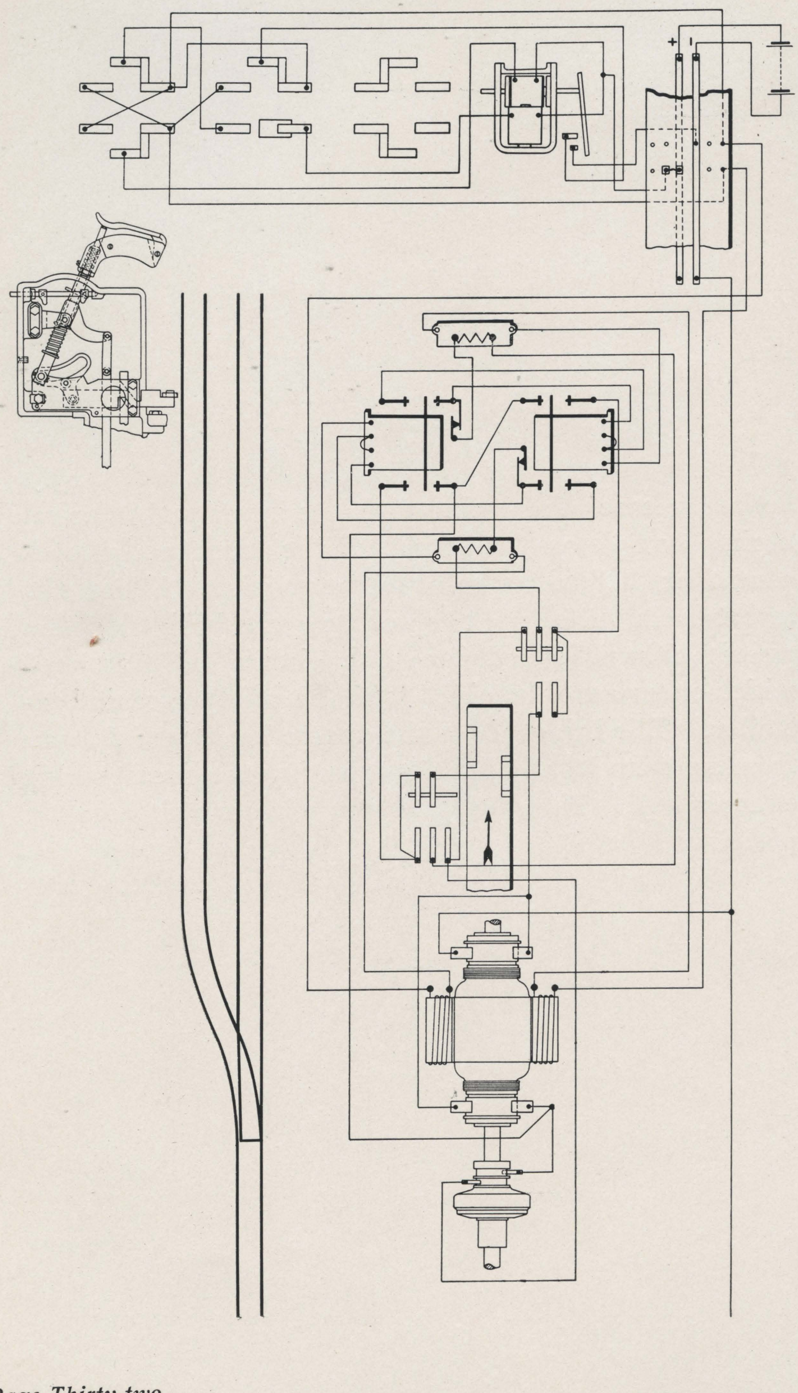


Plate 6

In Plate 6 the lever, switch and indication circuit controller are shown in the reverse position. The safety circuit controller and indication magnets have resumed their normal position.

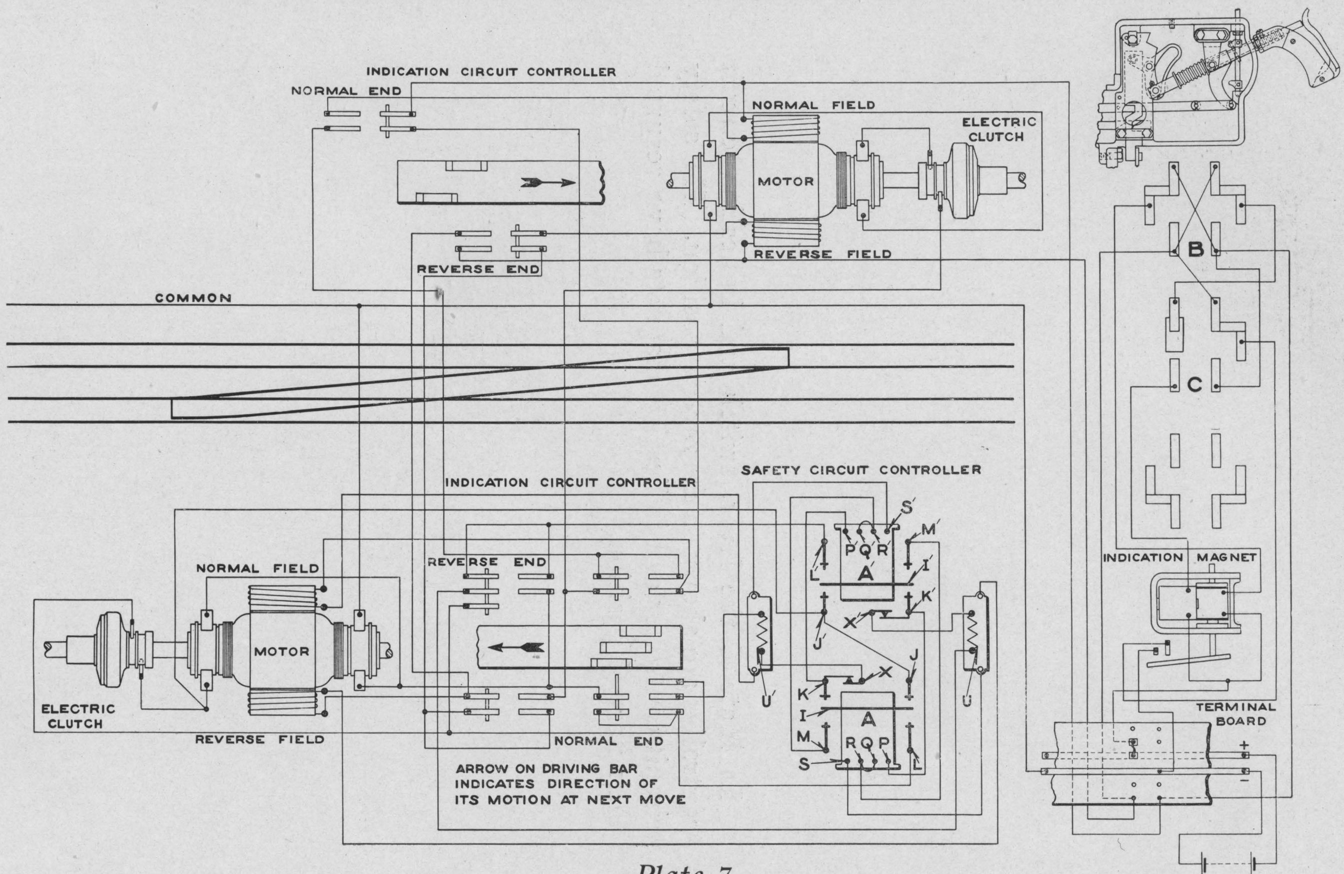

INDICATION CIRCUIT CONTROLLER
NORMAL END
NORMAL FIELD
ELECTRIC CLUTCH
MOTOR
REVERSE FIELD
REVERSE END
COMMON
B
C
INDICATION CIRCUIT CONTROLLER
SAFETY CIRCUIT CONTROLLER
S′
M′
P Q R
A′
L′
I′
K′
X′
J′
U′
J
X
K
I
M
S
A
R Q P
L
U
NORMAL FIELD
REVERSE END
MOTOR
ELECTRIC CLUTCH
REVERSE FIELD
NORMAL END
ARROW ON DRIVING BAR INDICATES DIRECTION OF ITS MOTION AT NEXT MOVE
INDICATION MAGNET
TERMINAL BOARD
+
−

Plate 7

Plate 7 shows the normal positions of a switch lever and two switch movements. The movement having the safety circuit controller is designated as the "far movement," the other the "near movement."

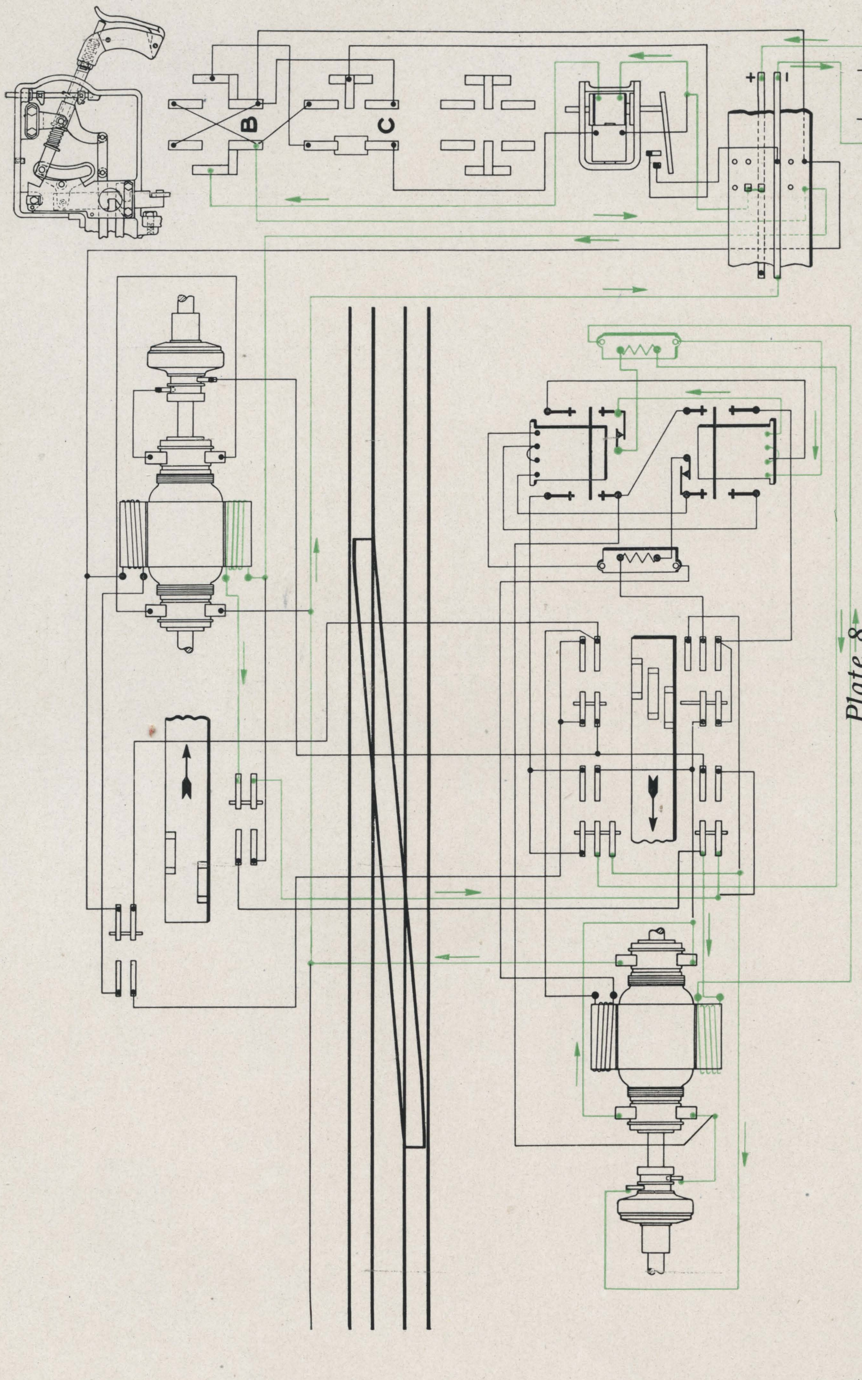


Plate 8

On Plate 8 the lever has been thrown to the reverse indication position, moving the controller "C" half way and "B" its full stroke, thus closing a circuit shown in green which energizes the solenoid magnet A of the safety circuit controller.

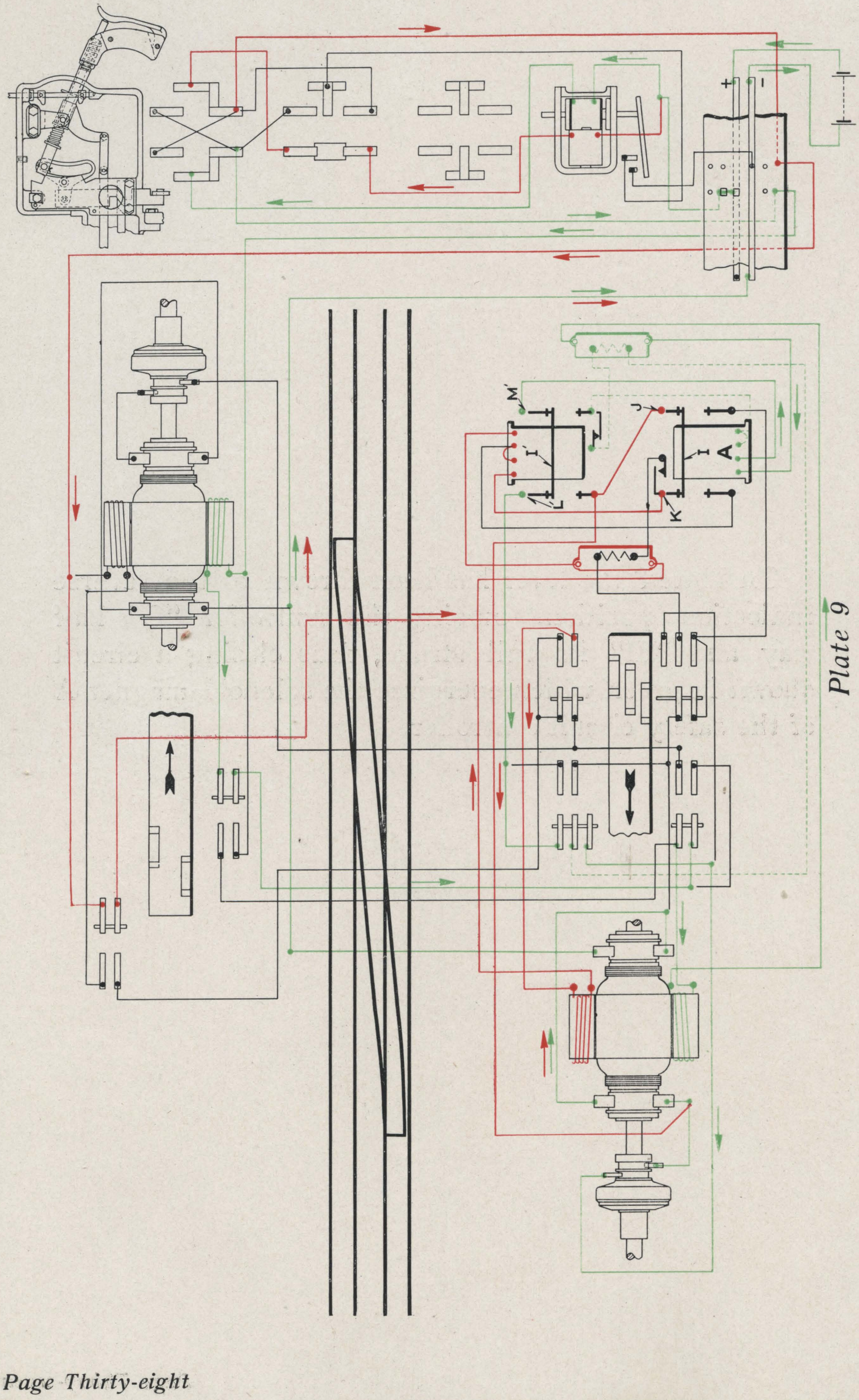


Plate 9

As shown on Plate 9 the bridges I and I' have been moved to close contacts J and K, and L' and M' by drawing the plunger into solenoid A.

The operating circuit is now closed, as is also the circuit shown in red. The current flowing in the red circuit is less that 0.15 ampere, and, therefore, has little or no effect upon the operation of the apparatus.

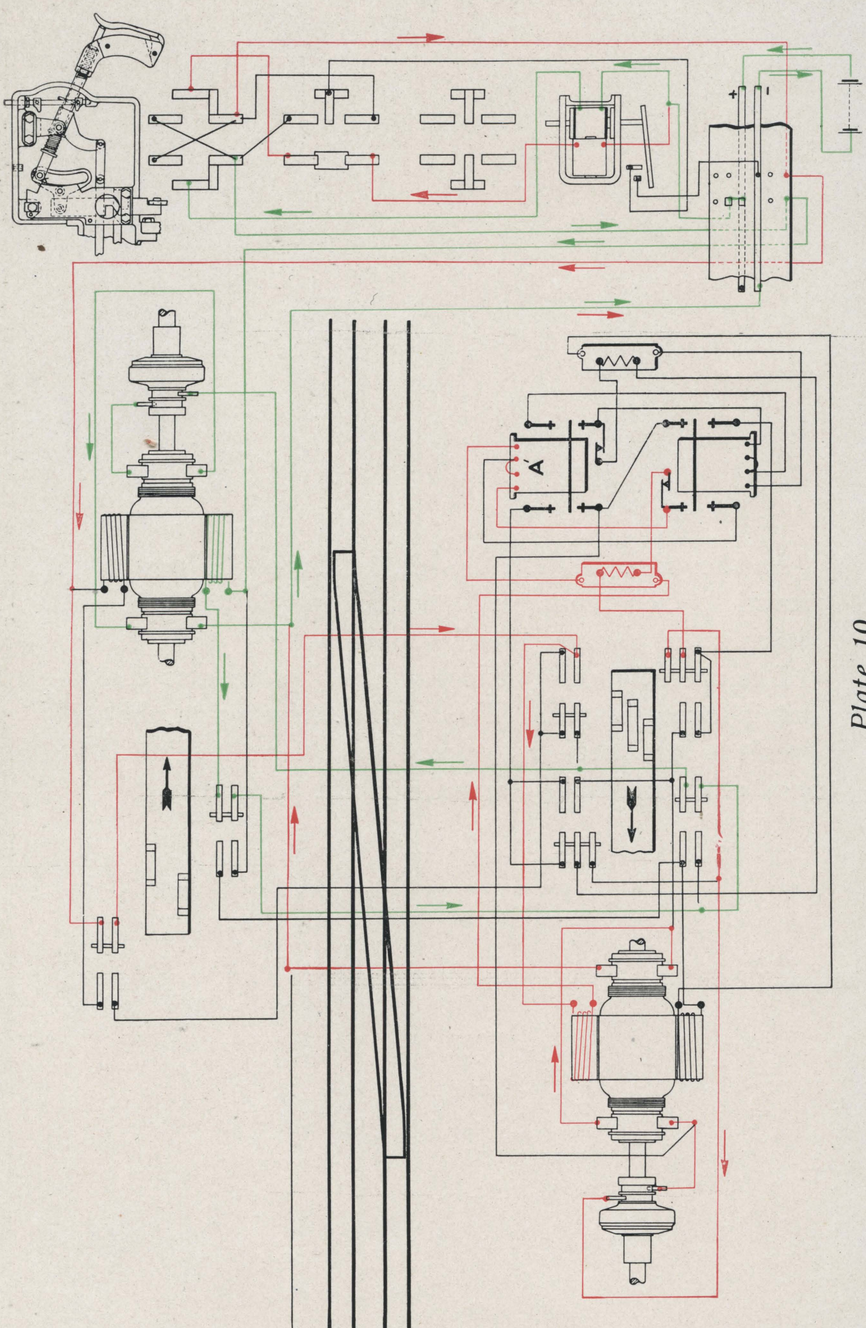


Plate 10

On Plate 10 the far movement has thrown the detector bar on center and at the same time has switched the operating circuit from that end to the near movement. The safety circuit controller returns to its normal position as there is not enough current flowing in the wires shown in red to sufficiently energize A'.

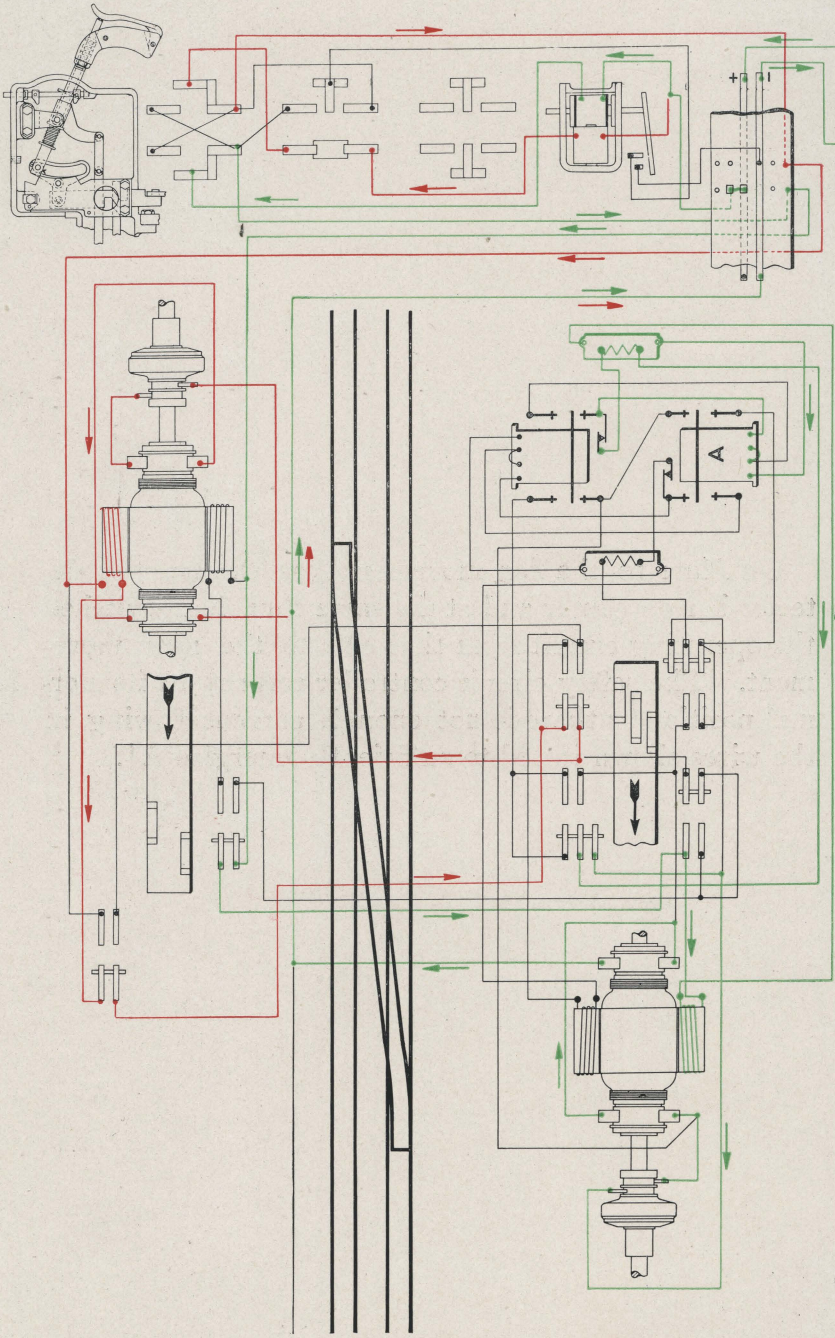


Plate 11

As shown on Plate 11 the near switch points have been reversed, and locked, and the starting circuit of the far movement closed again.

The wires shown in green carry the current which energizes A preliminary to the final closing of the operation circuit.

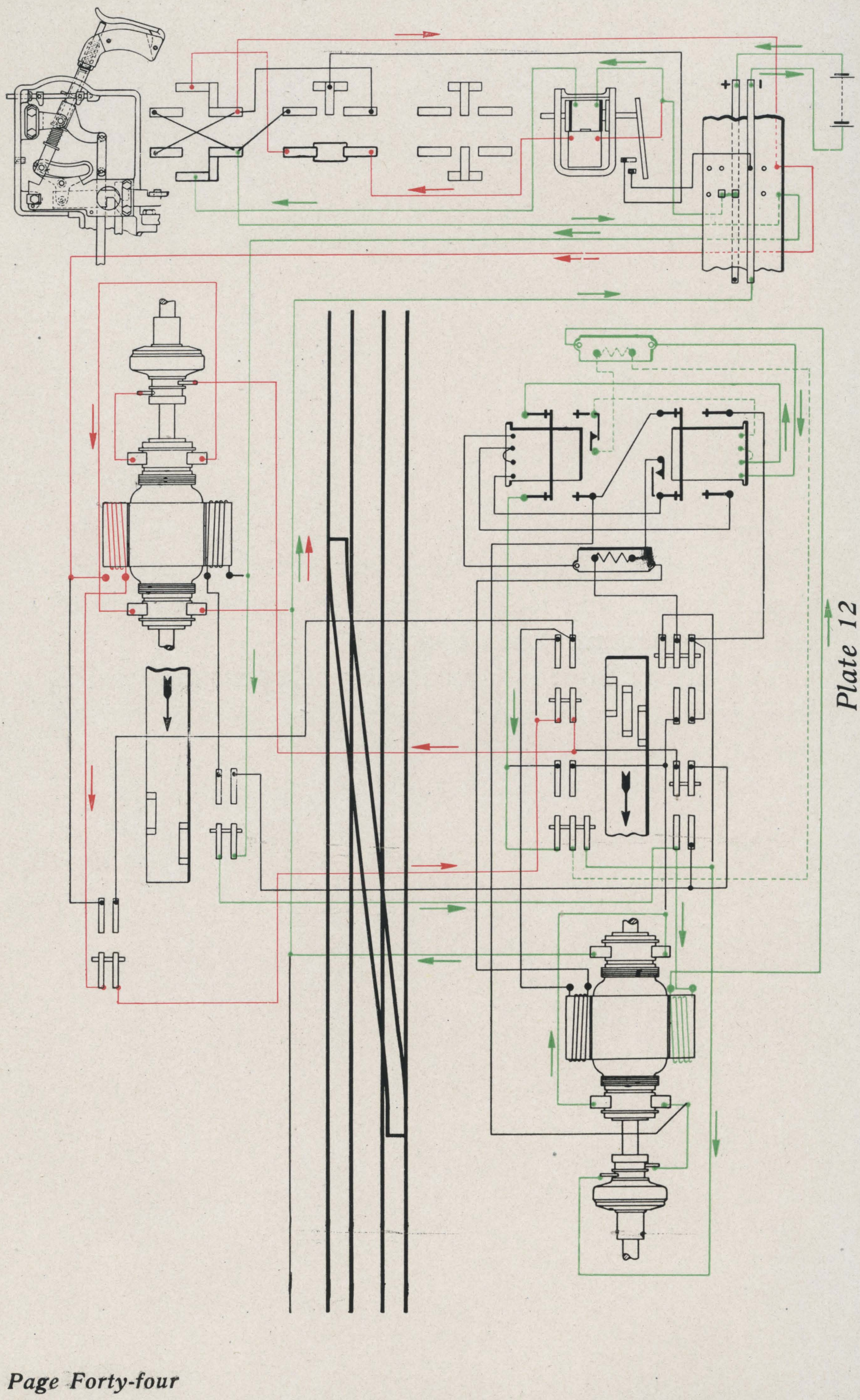


Plate 12

In Plate 12 the current for the final move of the far switch is closed at the safety circuit controller.

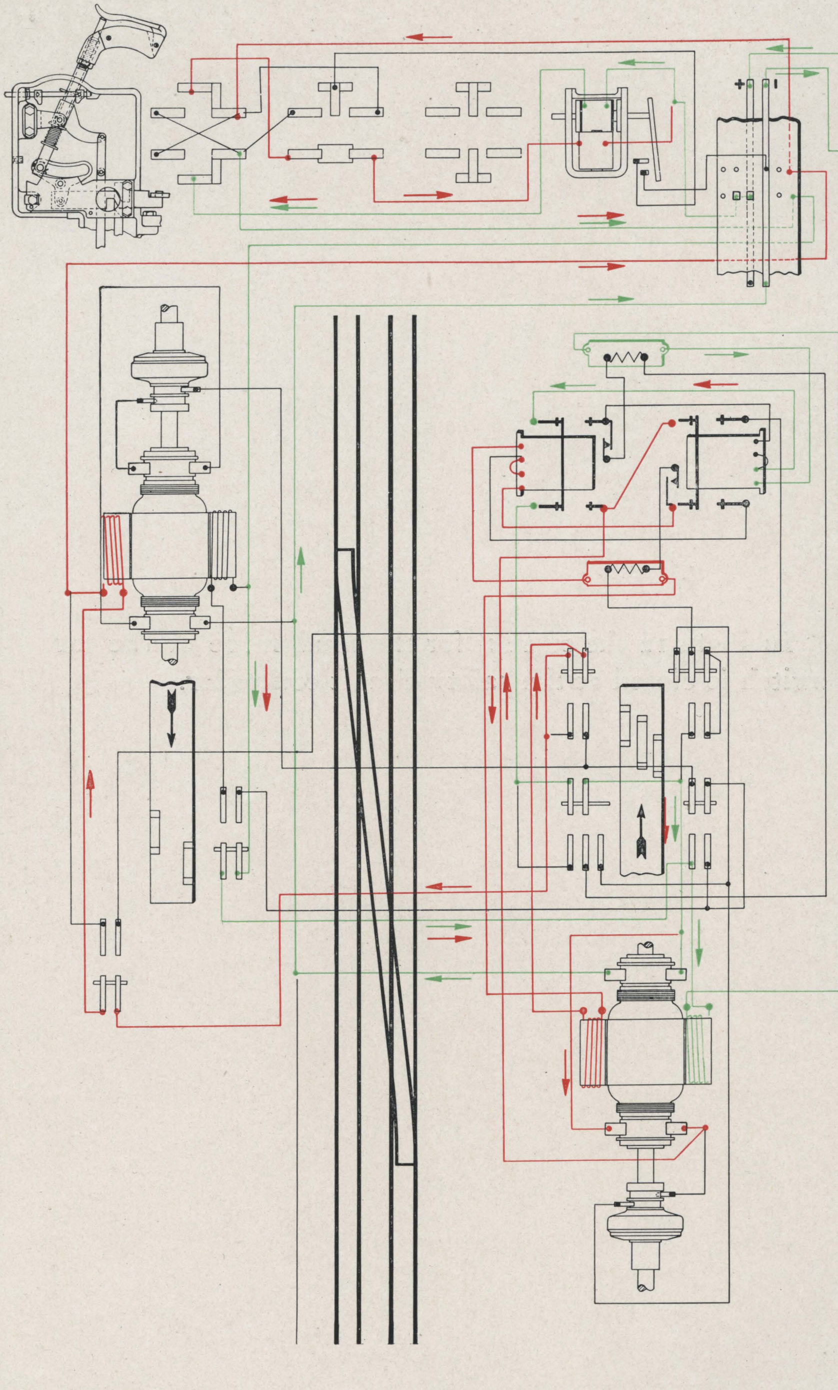


Plate 13

In Plate 13 the far movement has completed its move, and the indication circuit controller has opened the electric clutch circuits and closed the indication wires so that the motor runs free, energized by the current (shown in green) through one end of the armature. The other end of the armature generates a current which opposes and overcomes the battery current so that the direction of flow of current in the wires shown in red is reversed.

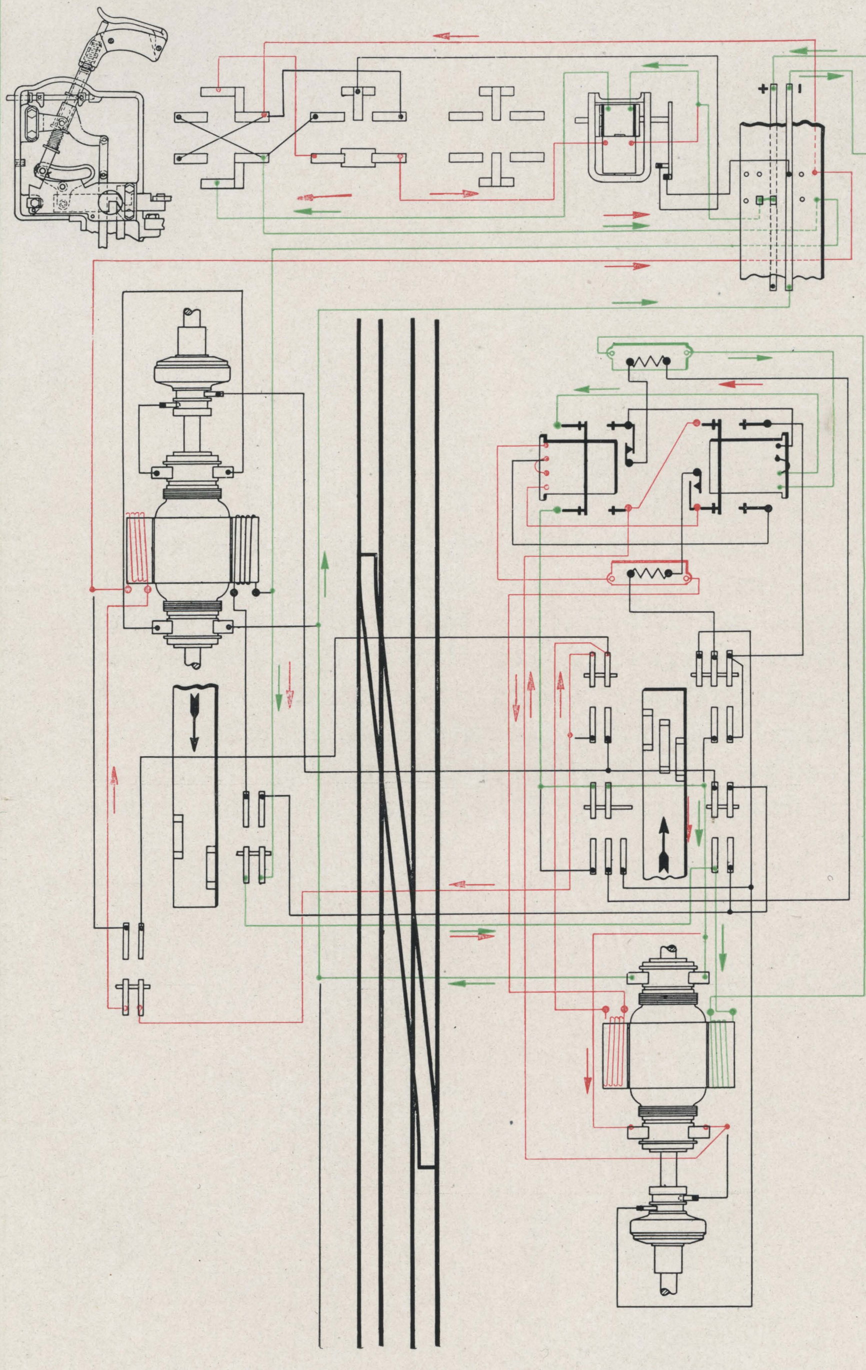


Plate 14

Plate 14. This reversal of current mentioned in the preceding move changes the polarity of the indication magnet and causes the lifting of the armature.

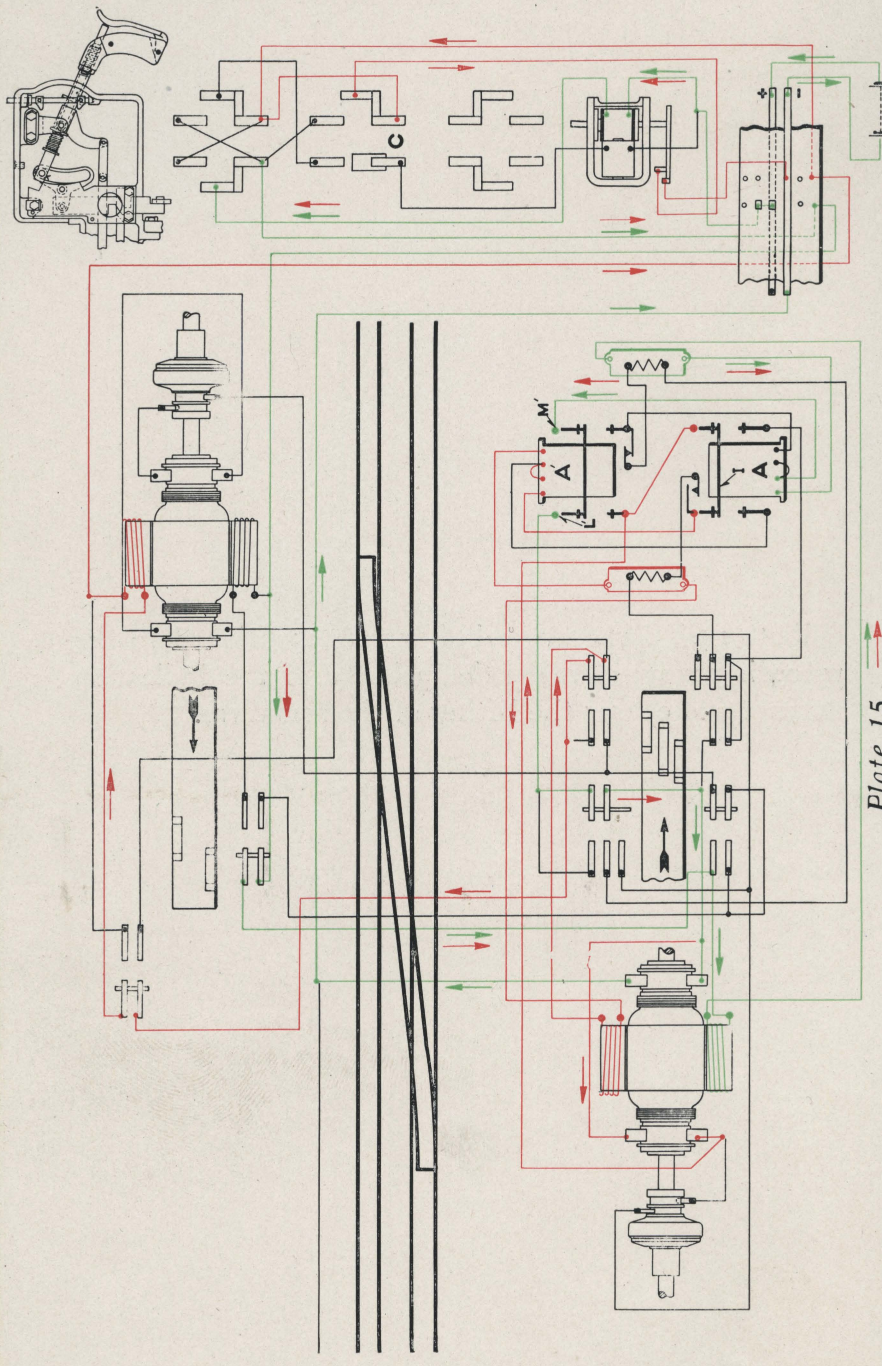


Plate 15

In Plate 15 the indication latch has been raised, causing controller "C" to complete its move, thus closing the stopping circuit through the contacts operated by the indication magnets, which is immediately opened when the magnets are de-energized.

The cutting out of the high resistance indication magnet allows enough current to flow through A^1 to pull in its solenoid plunger. This will open the contacts L^1 and M^1 which will open the circuit to A. When A is de-energized the bridge I resumes its middle position thus opening all circuits carrying current.

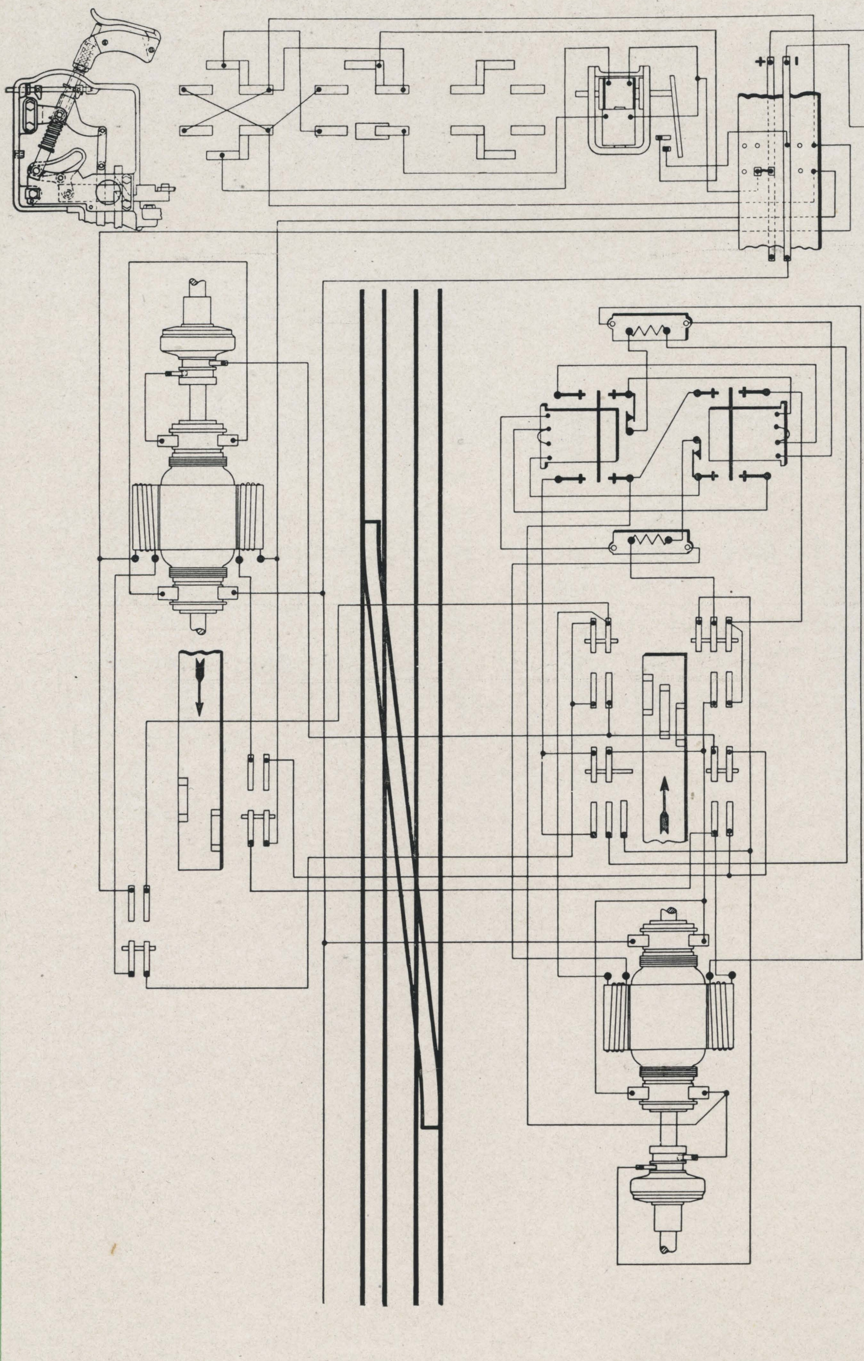


Plate 16

Plate 16 shows the lever and two switches in their reverse position.

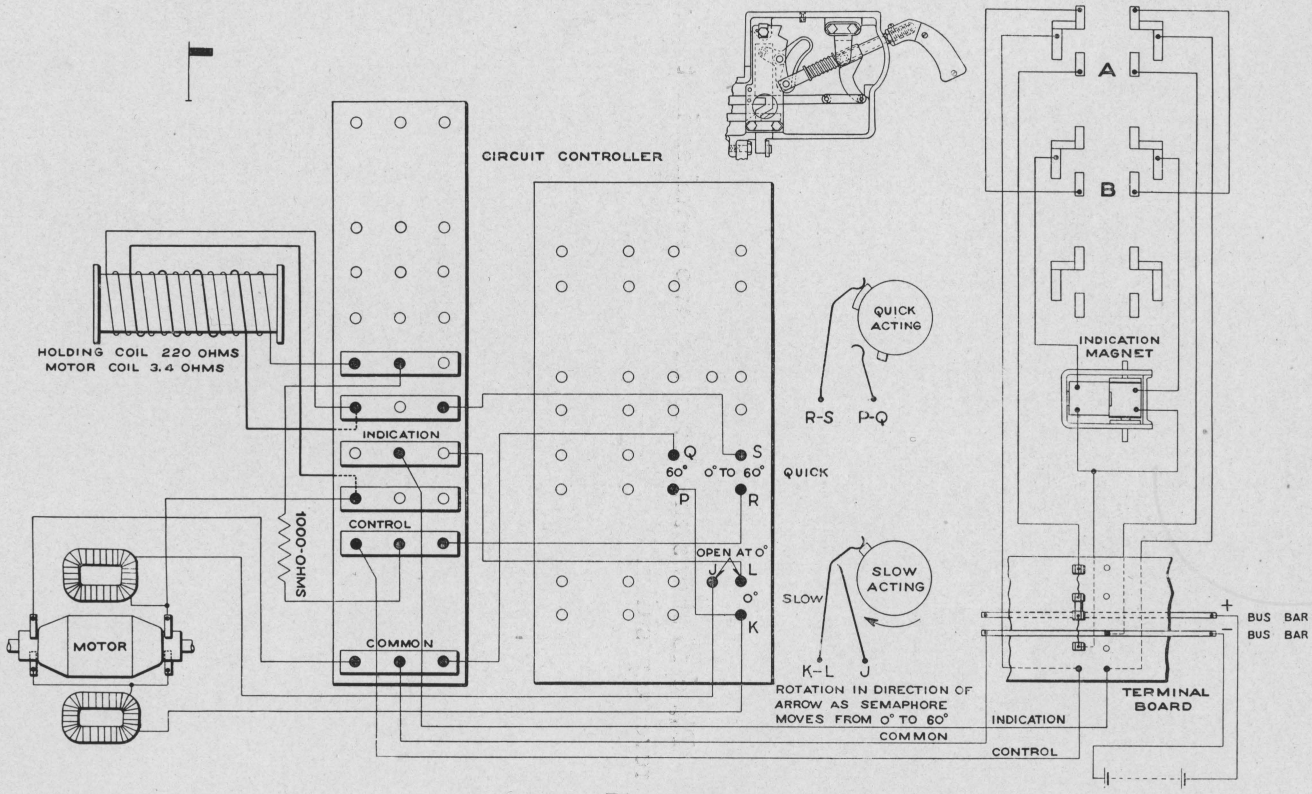

CIRCUIT CONTROLLER
HOLDING COIL 220 OHMS
MOTOR COIL 3.4 OHMS
INDICATION
CONTROL
COMMON
1000-OHMS
MOTOR
Q
S
60°
0° TO 60°
QUICK
P
R
OPEN AT 0°
J
L
0°
K
QUICK ACTING
R-S
P-Q
SLOW ACTING
SLOW
K-L
J
ROTATION IN DIRECTION OF ARROW AS SEMAPHORE MOVES FROM 0° TO 60°
A
B
INDICATION MAGNET
+
BUS BAR
−
BUS BAR
TERMINAL BOARD
INDICATION
COMMON
CONTROL

Plate 17

High Signal Operation.

Seven cuts are here used to show the various changes of circuits which result during the move of the lever and signal from the normal to the clear position and back to normal. We use an example of a 60° signal to introduce simple circuits.

Plate 17 shows all parts in the normal position.

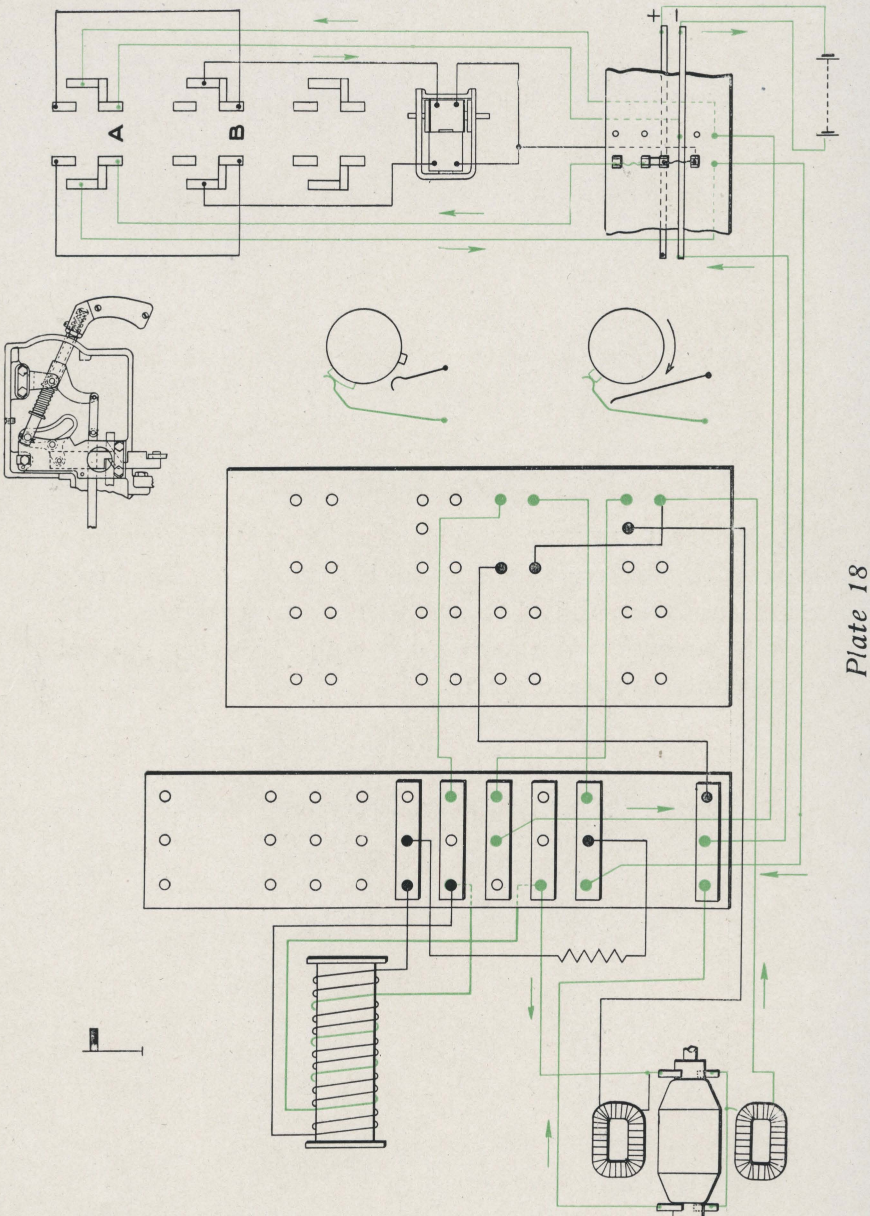


Plate 18

As shown on Plate 18 the lever has been moved to the full reverse position and circuit controller A has closed the operation circuit. Controller B has moved to the reverse position, closing contacts preparatory to the normal stroke of the lever.

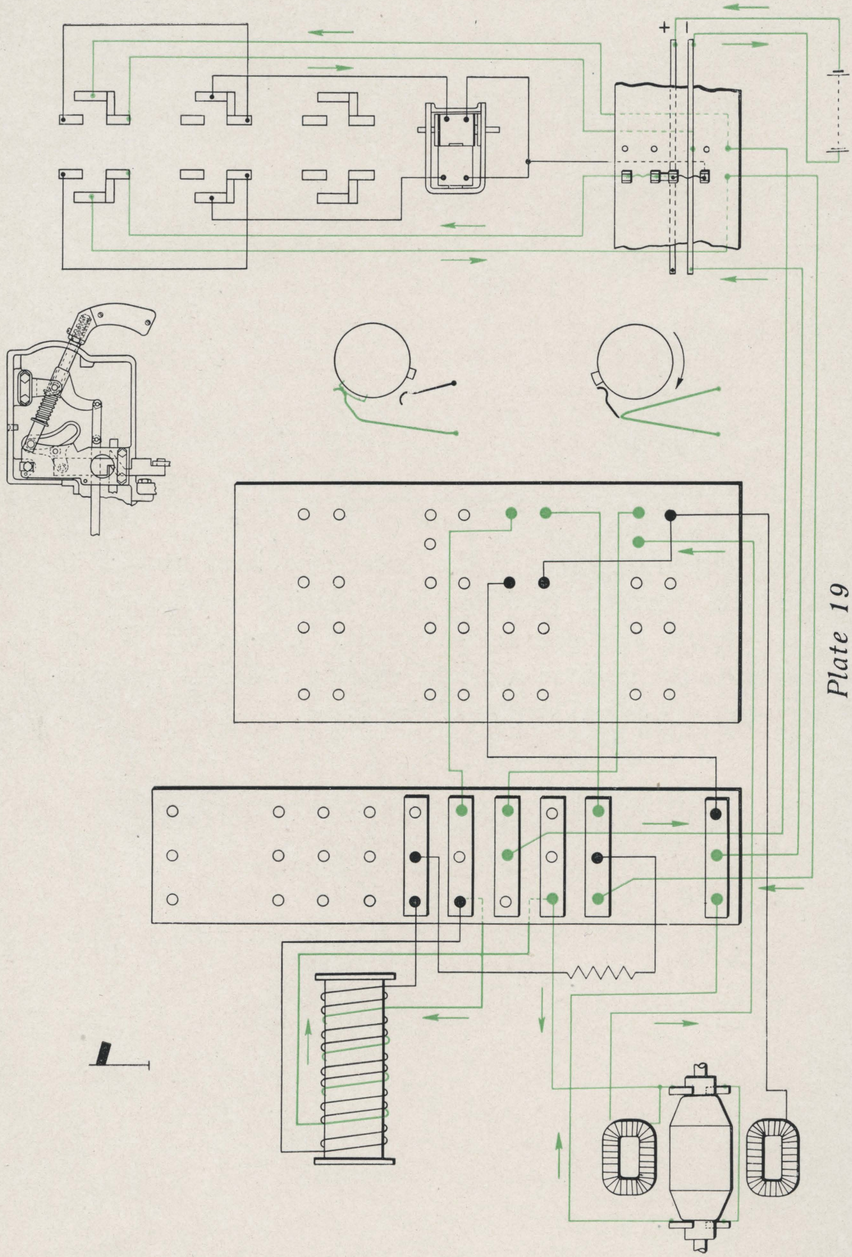


Plate 19

In Plate 19 the signal has started to clear. The slow acting circuit controller working directly with the slot-arm, has opened the circuit to the starting field and closed a circuit through a shunt field winding.

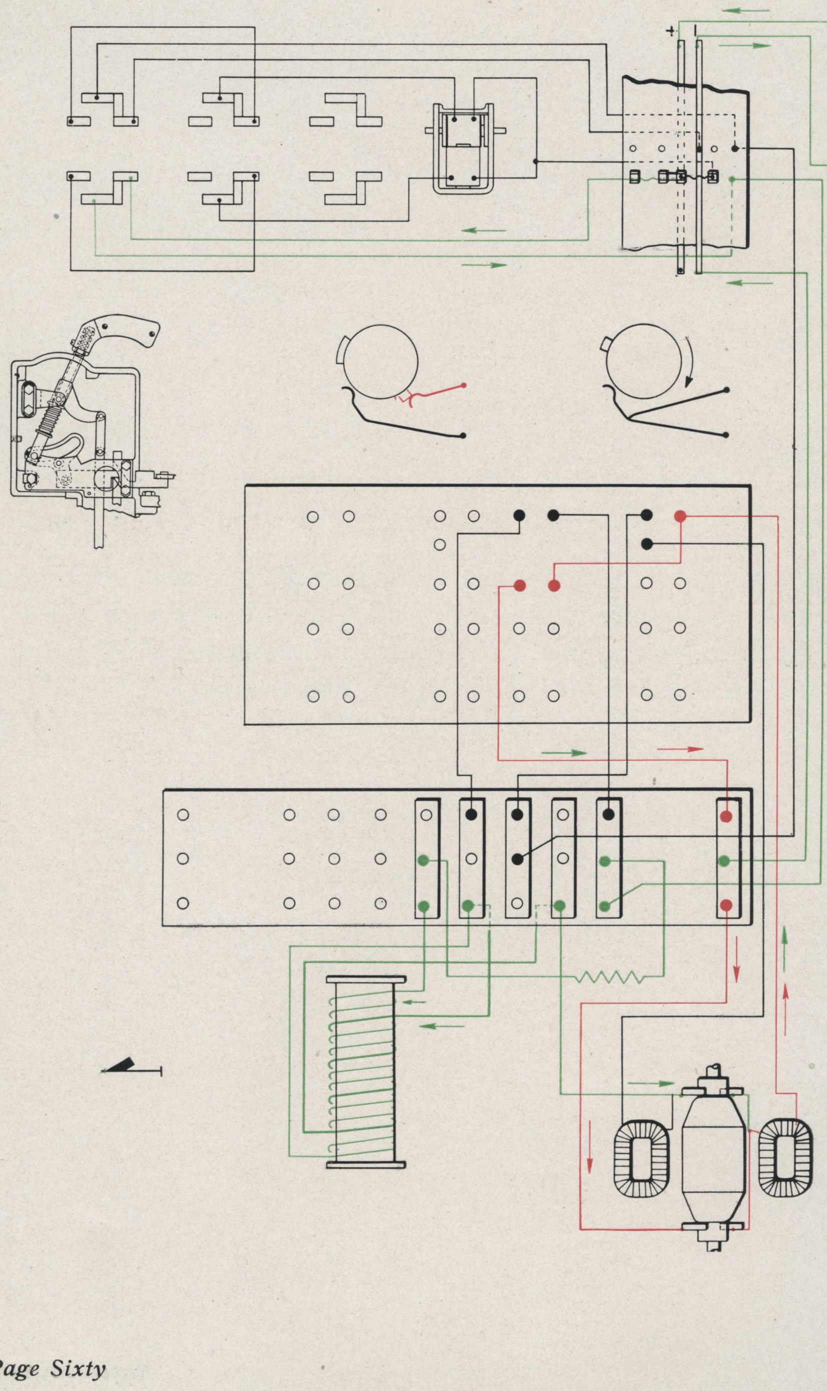


Plate 20

Plate 20 shows the signal cleared, the quick acting circuit controller has opened the operating circuit and closed a short circuited stopping circuit shown in red which instantly stops the rotation of the motor armature, thus holding the trunnions on the chain in a position to engage immediately with a slot-arm at the next clearing of the signal. The slot magnet, being energized by the circuit shown in green, holds the signal clear.

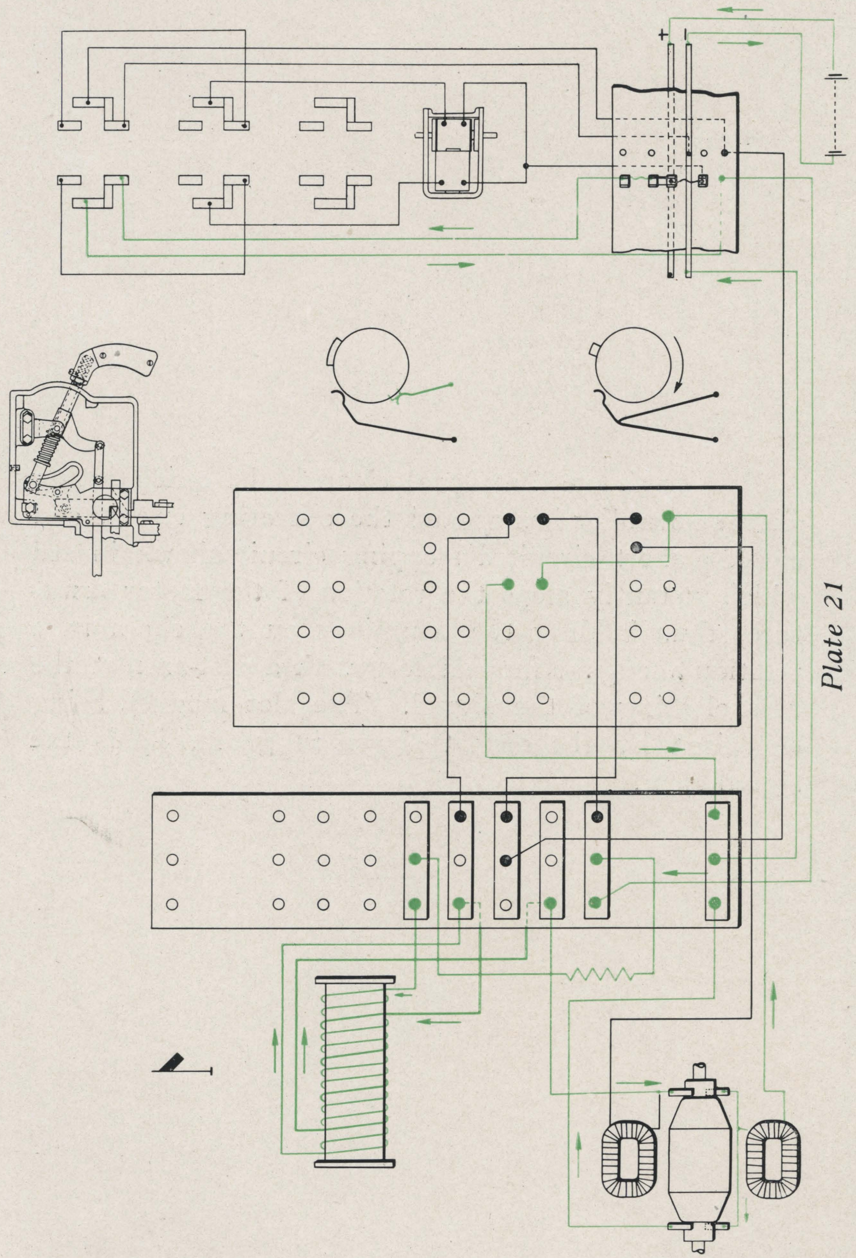


Plate 21

In Plate 21 the motor has been stopped and the holding clear circuit only is shown.

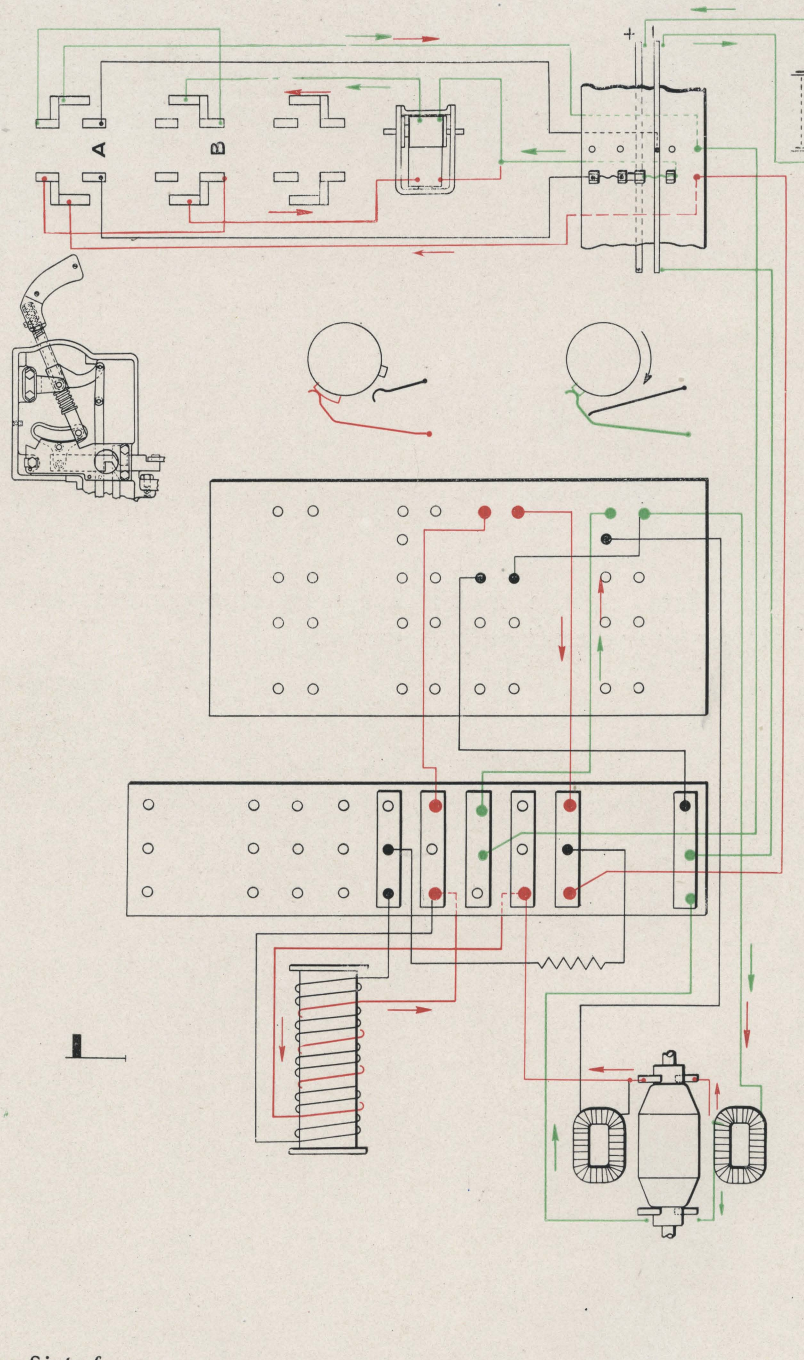
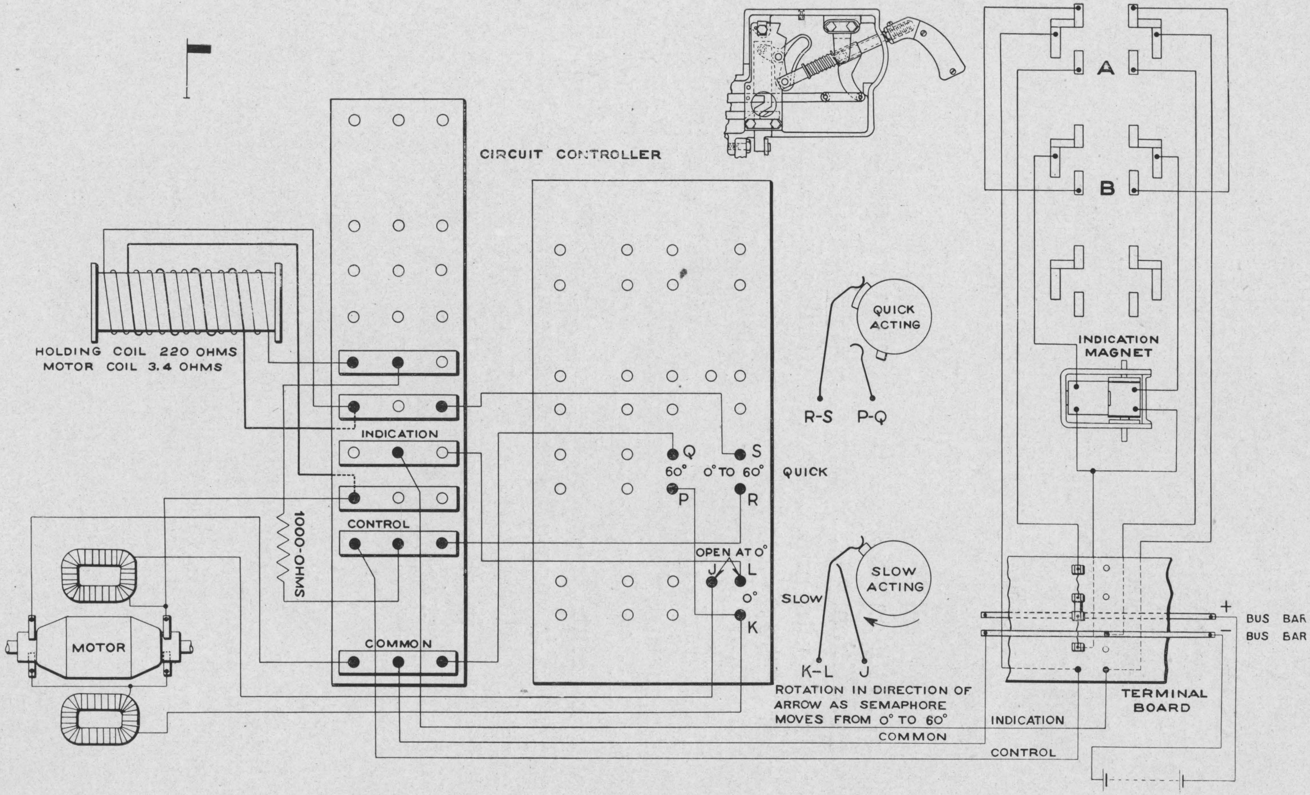


Plate 22

In Plate 22 the lever is shown on the normal indication position. Controller A has opened the holding clear circuits and closed the indication wires at the lever. The signal has returned to danger, closing the indication wires at the signal.

The circuit shown in green causes the rotation of the armature in the reverse direction to that taken while clearing. The wires colored red show the path of a current generated by the other set of armature coils. This current flows in opposition to the battery current and causes a reversal of the current in the horizontal indication magnet. The armature of the indication set is then lifted.



CIRCUIT CONTROLLER
HOLDING COIL 220 OHMS
MOTOR COIL 3.4 OHMS
INDICATION
CONTROL
COMMON
1000-OHMS
MOTOR
Q
S
60°
0° TO 60°
QUICK
P
R
OPEN AT 0°
J
L
0°
K
SLOW
QUICK ACTING
R-S
P-Q
SLOW ACTING
K-L
J
ROTATION IN DIRECTION OF ARROW AS SEMAPHORE MOVES FROM 0° TO 60°
A
B
INDICATION MAGNET
+
BUS BAR
−
BUS BAR
TERMINAL BOARD
INDICATION
COMMON
CONTROL

Plate 23

Plate 23 shows all parts returned to their normal position. The energization of the magnets in the preceding operation lifted the indication latch and the lever actuated by a spring completes its stroke and at the same time controller B opens the circuits carrying current.

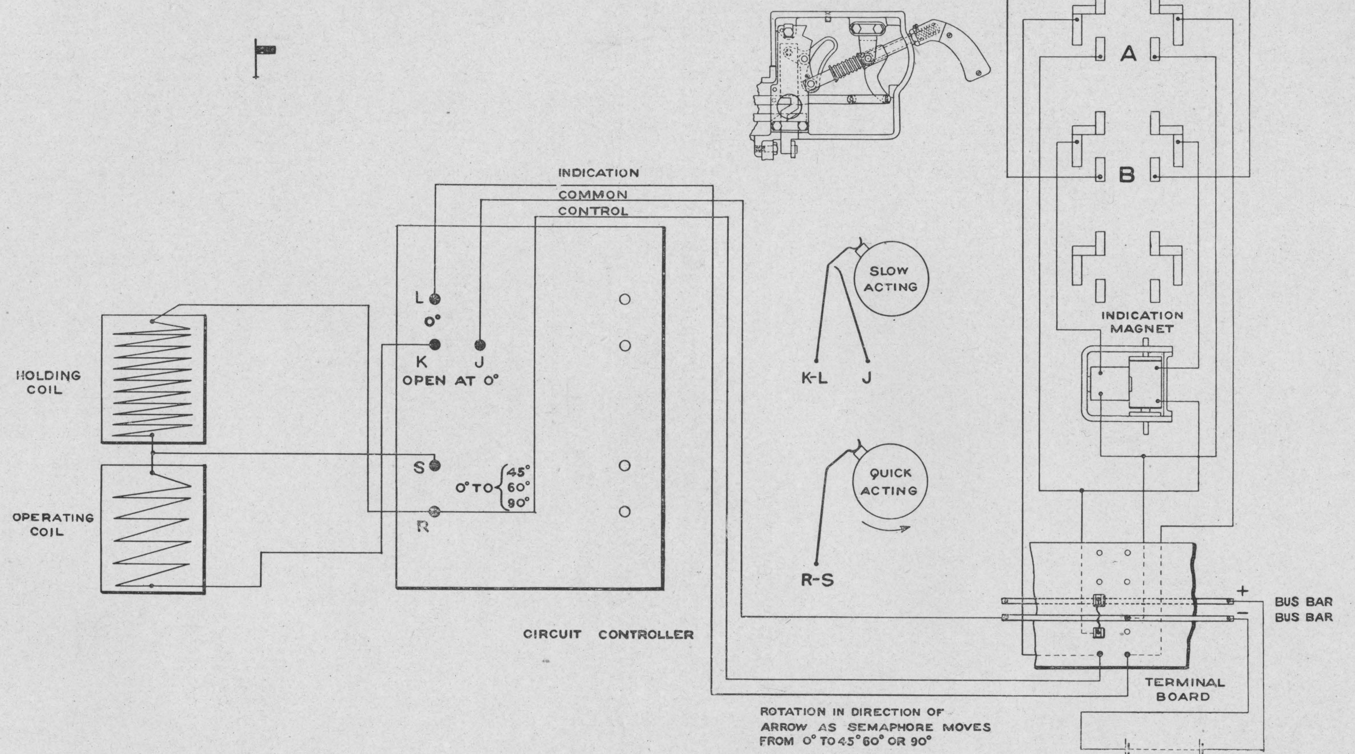

INDICATION
COMMON
CONTROL
L
0°
K
J
OPEN AT 0°
HOLDING COIL
OPERATING COIL
S
0° TO 45° 60° 90°
R
CIRCUIT CONTROLLER
SLOW ACTING
K-L
J
QUICK ACTING
R-S
A
B
INDICATION MAGNET
+
−
BUS BAR
BUS BAR
TERMINAL BOARD
ROTATION IN DIRECTION OF ARROW AS SEMAPHORE MOVES FROM 0° TO 45° 60° OR 90°

Plate 24

Dwarf Signal Operation

The solenoid dwarf signal consists of a clearing and holding coil through which a plunger acts, and a circuit controller. The semaphore may be operated through 45°, 60° or 90° with different arrangements of leverage.

The lever circuit controller consists of two working controllers, A and B on Plate 24. The bridge of A works with the lever as it moves up or down the quadrant. The bridge of B moves only with the final inward stroke of the lever.

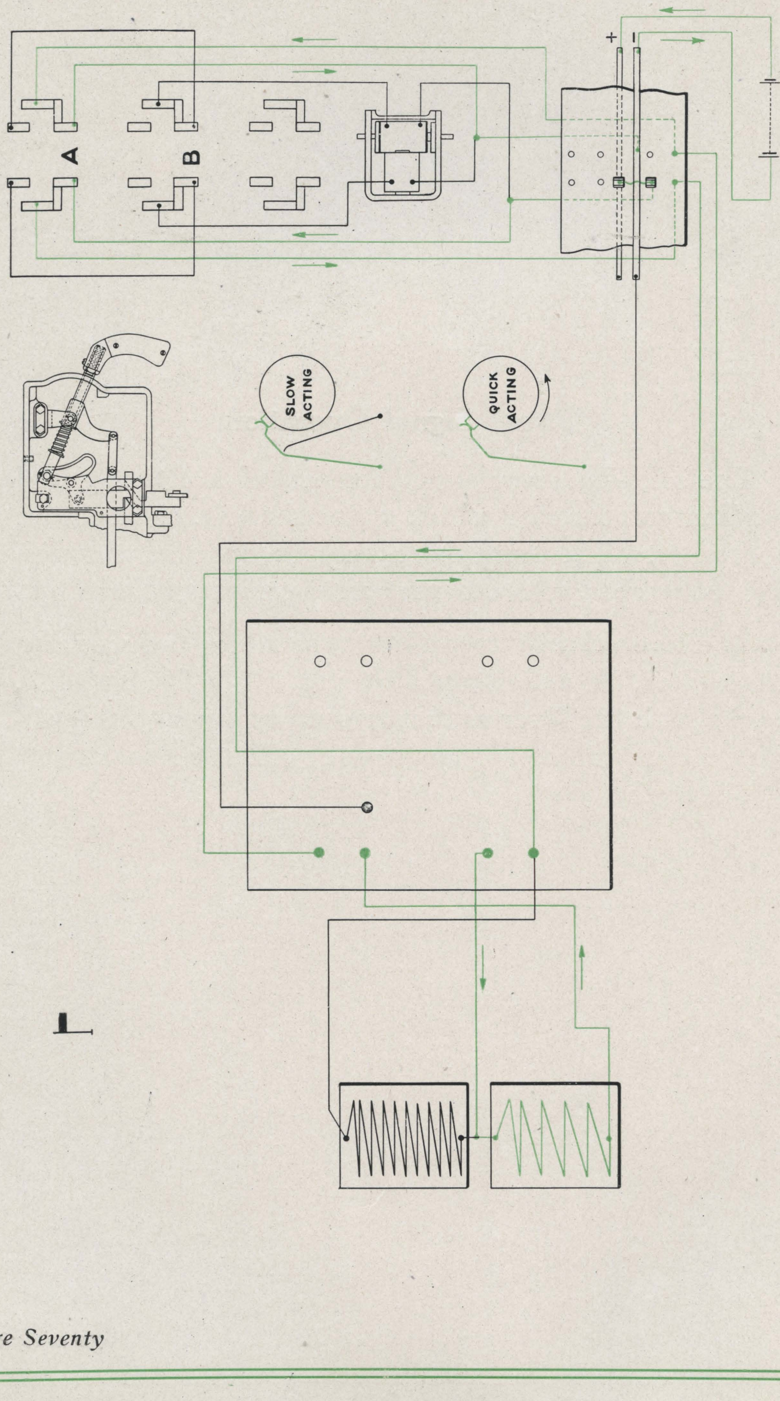


Plate 25

Plate 25 shows the lever moved through a complete reverse stroke, there being no indication position on the reverse throw of a signal lever.

The bridges of controllers A and B have moved. The A controller has closed the clearing circuits and B, the indication wires for the normal throw. The operation current then flows through the path shown in green.

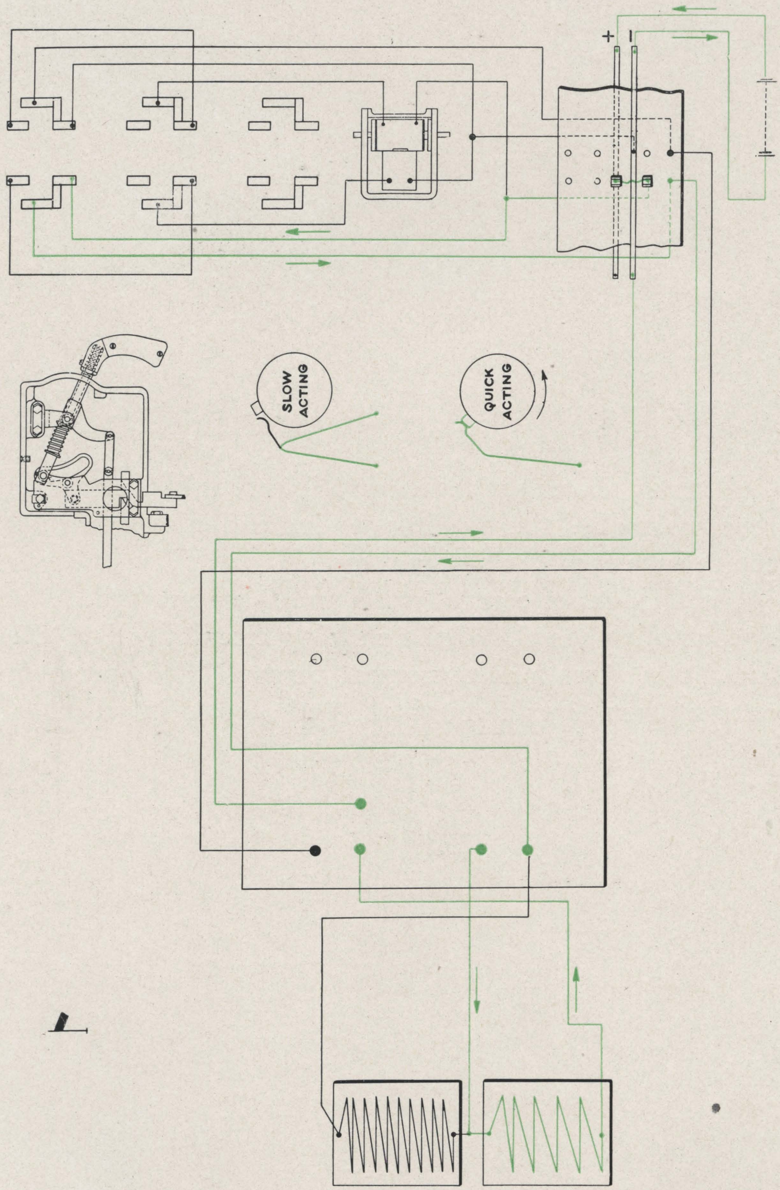


Plate 26

Plate 26 shows the lever in its former position. The signal has cleared far enough for the signal controller to open the indication wire through which the operating circuit starts and close the operating circuit to common.

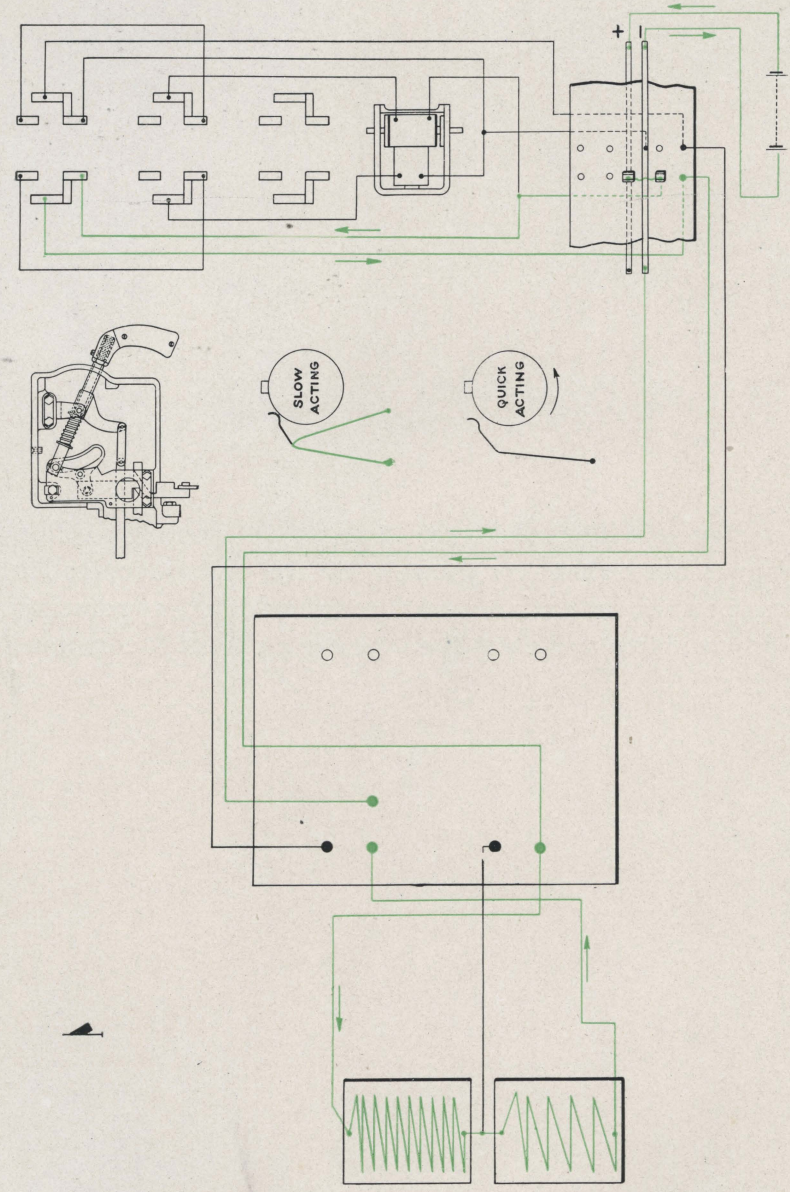


Plate 27

Plate 27 shows the signal cleared, the quick acting controller on the signal having removed the shunt on holding coil, thus putting both coils in series.

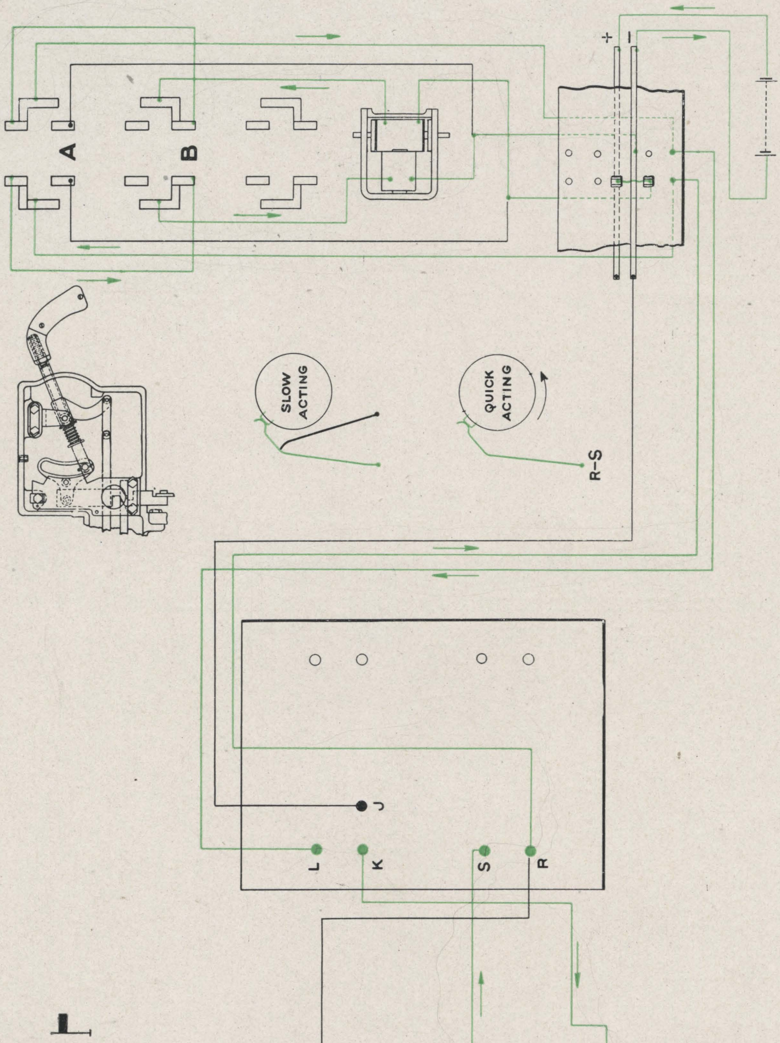


Plate 28

Plate 28 shows the lever on the normal indication position and the signal and parts returned to danger.

The controller, A, has moved, closing the indicating circuits. B remains in its former position.

Battery now flows out through the vertical indication magnet through RS on the signal controller, operating coil, L K the indication contacts on the signal and back to common over the indication wire and through the horizontal magnet.

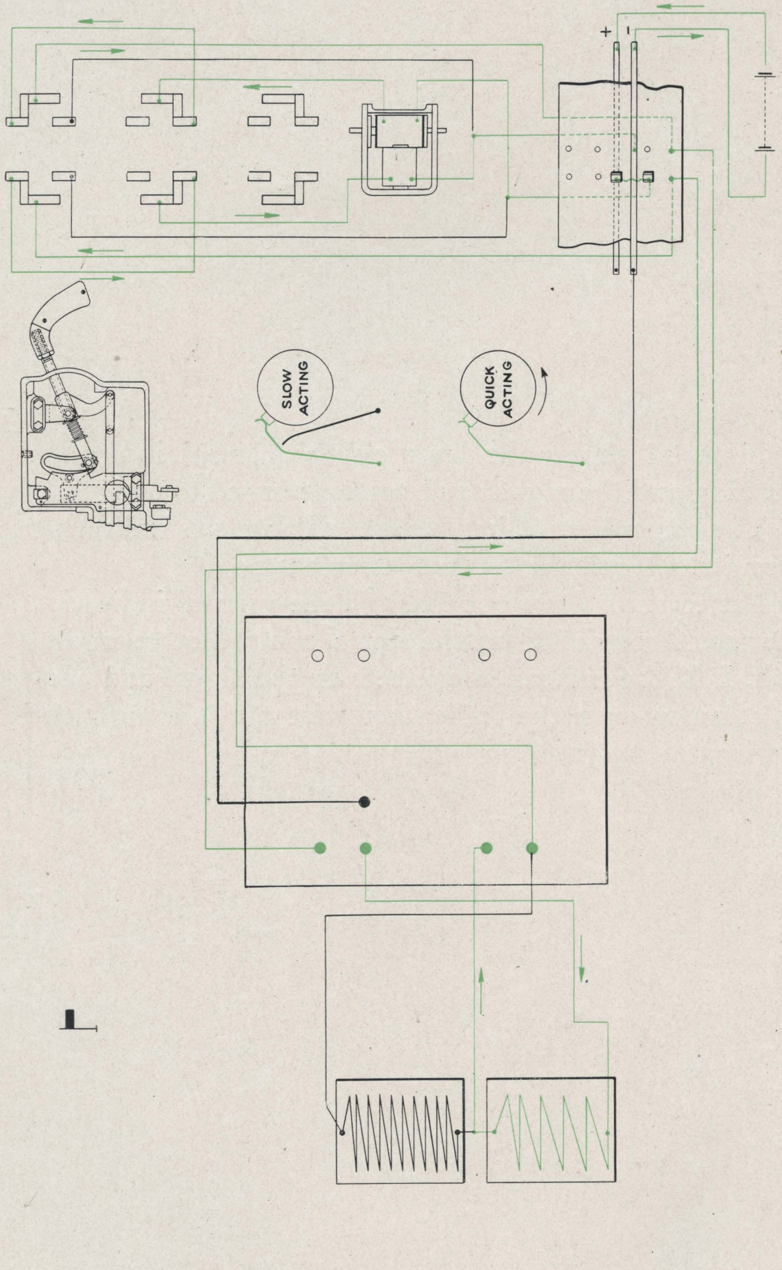
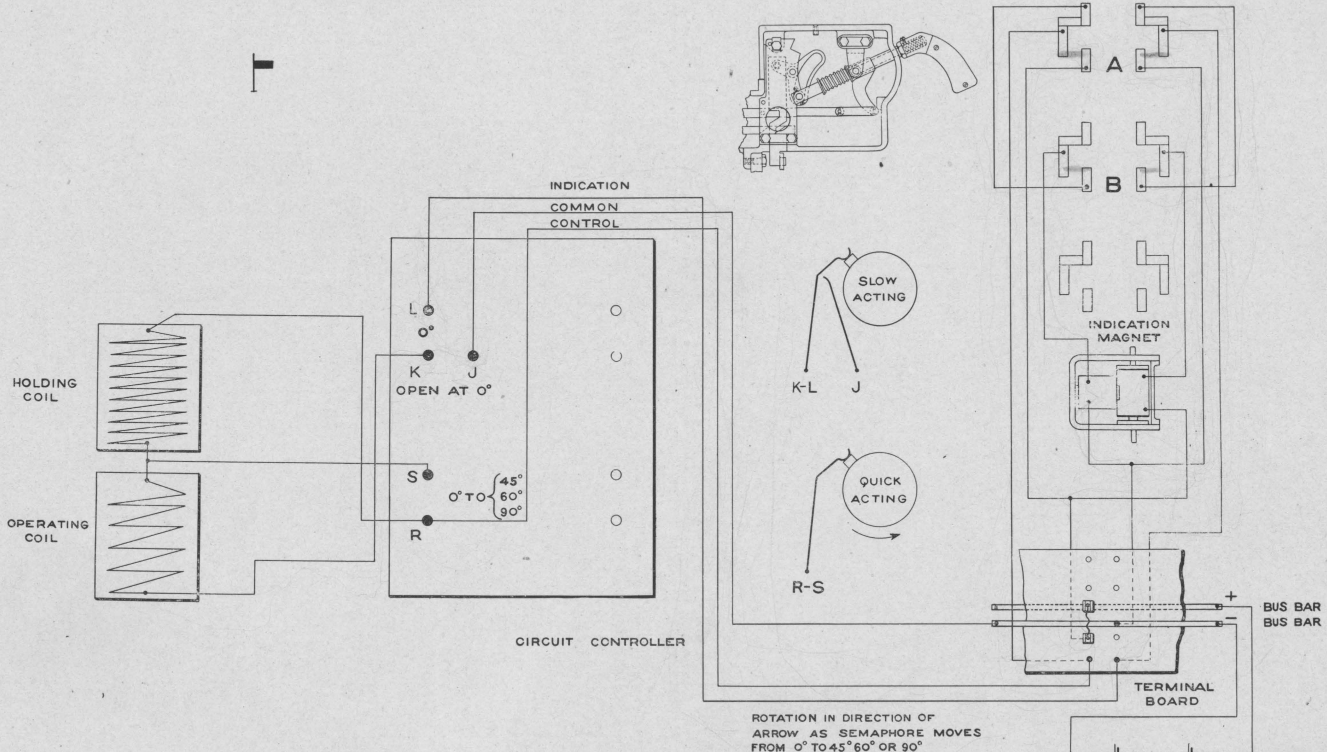


Plate 29

Plate 29 shows the indication magnets energized, and the latch raised.



A
B
INDICATION MAGNET
INDICATION
COMMON
CONTROL
SLOW ACTING
QUICK ACTING
K-L
J
R-S
L
0°
K
J
OPEN AT 0°
HOLDING COIL
OPERATING COIL
S
R
0° TO {45° 60° 90°
CIRCUIT CONTROLLER
+
−
BUS BAR
BUS BAR
TERMINAL BOARD
ROTATION IN DIRECTION OF ARROW AS SEMAPHORE MOVES FROM 0° TO 45° 60° OR 90°

Plate 30

Plate 30 shows the lever after the indication is received, and the controller B moved to the open position.

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