American Railway Signaling Principles and Practices

CHAPTER II

Symbols, Aspects and Indications

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Symbols

In railway signaling, symbols are the characters used on drawings to represent signal and interlocking apparatus, tracks, buildings, bridges and various other parts of the railway structure.

Without the use of symbols, it would be extremely difficult for the engineer to express himself clearly or to design the apparatus, circuits, etc., without much extra labor and the possibility of misunderstanding between the designer and the mechanic building or installing the apparatus or circuits.

Symbols to be of use, however, must be understood by the designer and by him who is to read the plan, thus the necessity for standard symbols in any given field of endeavor. In railway signaling, standard symbols are the work of the Railway Signal Association and its successor, the Signal Section of the Engineering Division of the American Railway Association. The symbols, comprising 14 drawings, were prepared by a committee of signalmen and representatives of the various signal companies.

The portion of this chapter devoted to symbols will describe the symbols and their use; no attempt will be made to describe the signal apparatus, their use or operation, these features being covered in subsequent chapters.

Figure 1 shows the symbols used for signals. These symbols have been in general use for a number of years. The first or upper section of the figure shows the characteristics of the signals. It will be noted the columns have headings to indicate the general type of signal shown, while the headings for the lines indicate the kind of signaling and the various aspects that will be displayed. The first symbol in each column (numbered 1 to 7, inclusive) indicates type of signal, thus a heavy line at the top of the character representing a signal blade (No. 1), indicates a non-automatic, mechanical signal; a heavy line or block at the left end of the blade (No. 4) represents a semi-automatic stick signal, power-operated. The first symbol in each line (lettered A to E, inclusive) indicates whether the signaling is two or three-position, and, if three-position signaling, what positions are used. The various combinations are indicated by vertical and diagonal lines of ordinary width. Where two-position signaling is used these characters are not employed.

Operating.		Characteristics	Non-Automatic. Mechanical	Non-Automatic. Power	Slotted. (Mech.)	Semi-Automatic. (Power) Stick.	Semi-Automatic. (Power) Non-Stick	Automatic (Power)	Special Requires Reference to Notes
			1	2	3	4	5	6	7
Two Position Signaling.	2-Position. 0 to 60-0 to 70 0 to 75-0 to 90	A	A1	A2	A3	A4	A5	A6	A7
Three Position Signaling.	2-Position. 0 to 90	B	B1	B2	B3	B4	B5	B6	B7
	2-Position. 0 to 45	C	C1	C2	C3	C4	C5	C6	C7
	2-Position. 45 to 90	D	D1	D2	D3	D4	D5	D6	D7
	3-Position. 0 to 45 to 90	E	E1	E2	E3	E4	E5	E6	E7

NOTE: Arms should always be shown in normal position.

E24 — Special – 3 Position Non-Automatic, 0 to 45. Semi-Automatic Stick, 45 to 90.

E25 — Special – 3 Position Non-Automatic, 0 to 45. Semi-Automatic Non-Stick, 45 to 90.

Absolute Stop Signal.

Distant Signal.

Permissive Stop Signal.

Train Order Signal.

Ends of blades in symbols are to be of the actual forms used by the road concerned. If not specified the above forms will be used on plans.

Fixed Arm.

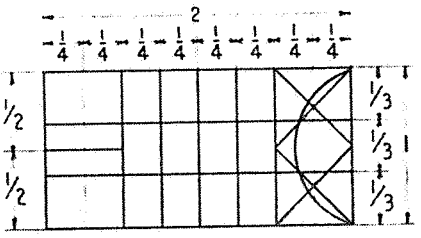
Upper Quadrant Signal.

Lower Quadrant Signal.

Vertical

Staggered

Marker Lights.



Diagrams of proportions for making symbols for signal blades.

Fig. 1.

A two-position, 0 to 60 degree, non-automatic power signal would be shown (as A2) by a block filled in at the right-hand end of the blade. The 0 to 60, 0 to 70, 0 to 75, and 0 to 90 in two-position signaling indicate the number of degrees through which the signal arm moves; usually any railroad having this system uses only one of the four shown.

In three-position signaling, all three positions are not always used as, for instance, "B3" indicates a two-position, 0 to 90 degree slotted mechanical signal.

The letters and numbers shown with the symbols, as "A1," "B2," "C3," etc., are not used on plans, but are placed on the figure for ready reference. The use of the various terms shown on the figure, such as slotted, stick, non-stick, etc., will be explained in following chapters where these features are treated.

The two symbols "E 24" and "E 25" are for a special purpose, signaling of this type being employed on dwarf signals in some of the large terminals.

The third section of the figure covers the outline of the blades to be used with operating characteristics shown in the two upper sections of the figure.

In the lower section the designations for fixed arms, upper quadrant, lower quadrant and marker lights are shown, as well as the proportions to be used in making symbols for signal blades.

These symbols having been in use a number of years are shown on nearly all plans of signals now in service. However, in 1926, a new set of symbols, showing signal characteristics, was adopted by the American Railway Association as recommended practice.

Figure 2 is A.R.A. Sig. Sec. 1571A which supersedes the symbol plate shown in Fig. 1. These new symbols simplify the drafting work and are applicable to all types of signals. With symbols as shown in Fig. 1, it was necessary, in order to designate a light signal, to add some distinguishing mark. This was done by enclosing the blade with a circle as shown in Fig. 3. However, this did not distinguish between the color light, position light or color position light signals, nor provide symbols for the additional aspects which are used with the two latter types of signals; these signals not having come into use when the original symbol drawings were approved.

A detailed explanation of Fig. 2 is not necessary as the same principles used in Fig. 1 are followed.

Figure 3 shows the application of the signal blade symbols to the masts and the relation of the signal to the track and the direction of traffic. Disc and other miscellaneous signals are shown in this figure.

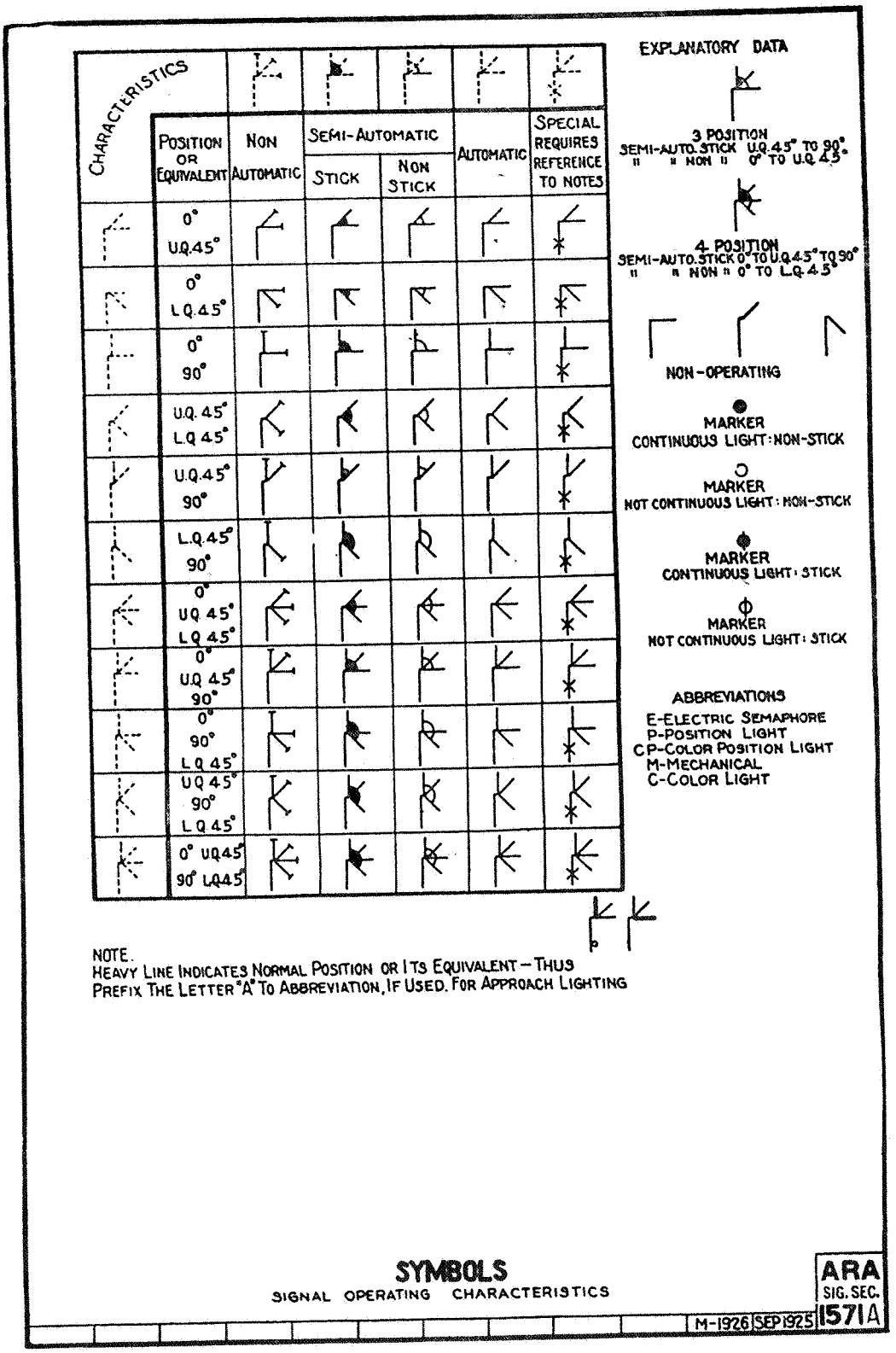

CHARACTERISTICS
POSITION OR EQUIVALENT
NON AUTOMATIC
SEMI-AUTOMATIC
STICK
NON STICK
AUTOMATIC
SPECIAL REQUIRES REFERENCE TO NOTES
0° UQ 45°
0° LQ 45°
0° 90°
UQ 45° LQ 45°
UQ 45° 90°
LQ 45° 90°
0° UQ 45° 90°
0° 90° LQ 45°
UQ 45° 90° LQ 45°
0° UQ 45° 90° LQ 45°
EXPLANATORY DATA
3 POSITION
SEMI-AUTO. STICK UQ 45° TO 90°
" " NON " 0° TO UQ 45°
4 POSITION
SEMI-AUTO. STICK 0° TO UQ 45° TO 90°
" " NON " 0° TO LQ 45°
NON-OPERATING
MARKER
CONTINUOUS LIGHT: NON-STICK
MARKER
NOT CONTINUOUS LIGHT: NON-STICK
MARKER
CONTINUOUS LIGHT: STICK
MARKER
NOT CONTINUOUS LIGHT: STICK
ABBREVIATIONS
E-ELECTRIC SEMAPHORE
P-POSITION LIGHT
CP-COLOR POSITION LIGHT
M-MECHANICAL
C-COLOR LIGHT
P
NOTE.
HEAVY LINE INDICATES NORMAL POSITION OR ITS EQUIVALENT — THUS
PREFIX THE LETTER "A" TO ABBREVIATION, IF USED. FOR APPROACH LIGHTING
SYMBOLS
SIGNAL OPERATING CHARACTERISTICS
ARA
SIG. SEC.
M-1926 SEP 1925
1571A

Fig. 2.

In Fig. 4 are the symbols for various track and roadway appliances, also stations. These symbols are easily understood and no detailed explanation need be given.

An important part of every signal installation is the housings for the batteries and various instruments used with modern signaling. Figure 5 illustrates the symbols used for these shelters. The symbols for highway crossing signals, bells, buzzers and track battery are also shown. The symbol for track battery showing the battery outside the rails connected to the rails with dotted lines is the symbol generally used; the alternatives never have come into common use.

Symbols for interlocked switches and derails are shown on the upper half of Fig. 6. The shaded triangle indicates the position of the switch. On plans, the switches and derails are always shown in their normal positions.

Other symbols in Fig. 6 include those for detector bars, locks and pipe-line parts. The symbols showing the relative position of interlocking or block station operator and track are shown at the bottom of this figure.

The application of the symbols shown in Fig. 6 is made on the double line plan showing interlocked switches, derails, etc., at top of the drawing shown in Fig. 7. The symbols for these units as applied to a single line plan are also shown. Symbols for the various methods used in bringing pipe lines out of the interlocking station are shown on the lower portion of the figure.

The application of a number of the symbols to signal layout plans is shown in Figs. 8a and 8b. Figure 8a employs the symbols shown in Fig. 1, while those in Fig. 2 are used in Fig. 8b. By referring to the figures, it will be seen that the plan shows a single-track railroad running north and south crossing a double-track road running east and west, the single-track road having a passing siding just north of the crossing. The double-track line becomes a three-track road just east of the crossing, the middle track of which is used for running in both directions. The single-track road is not equipped with automatic block signals; the road running east and west is so equipped, the eastward and westward main tracks having automatic signals for movements in one direction only (with the current of traffic), while the middle track is signaled for traffic in both directions.

The signaling at the interlocking on the east and west road is commonly known as three-arm signaling, while that on the single-track line is known as two-arm signaling. The terms two and three-arm signaling are derived from the number of arms used on the

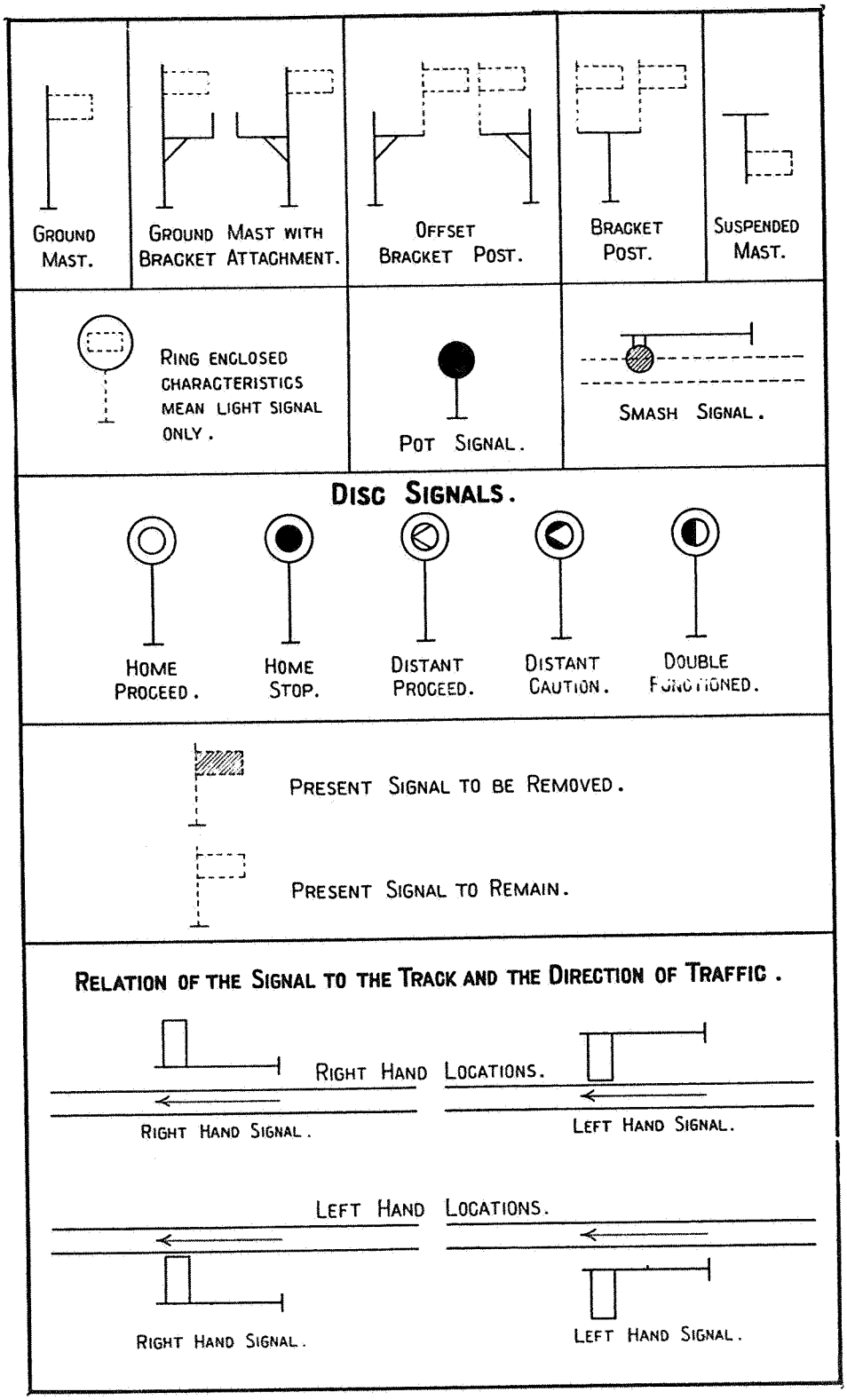

GROUND MAST.
GROUND MAST WITH BRACKET ATTACHMENT.
OFFSET BRACKET POST.
BRACKET POST.
SUSPENDED MAST.
RING ENCLOSED CHARACTERISTICS MEAN LIGHT SIGNAL ONLY.
POT SIGNAL.
SMASH SIGNAL.
DISC SIGNALS.
HOME PROCEED.
HOME STOP.
DISTANT PROCEED.
DISTANT CAUTION.
DOUBLE FUNCTIONED.
PRESENT SIGNAL TO BE REMOVED.
PRESENT SIGNAL TO REMAIN.
RELATION OF THE SIGNAL TO THE TRACK AND THE DIRECTION OF TRAFFIC.
RIGHT HAND LOCATIONS.
RIGHT HAND SIGNAL.
LEFT HAND SIGNAL.
LEFT HAND LOCATIONS.
RIGHT HAND SIGNAL.
LEFT HAND SIGNAL.

Fig. 3.

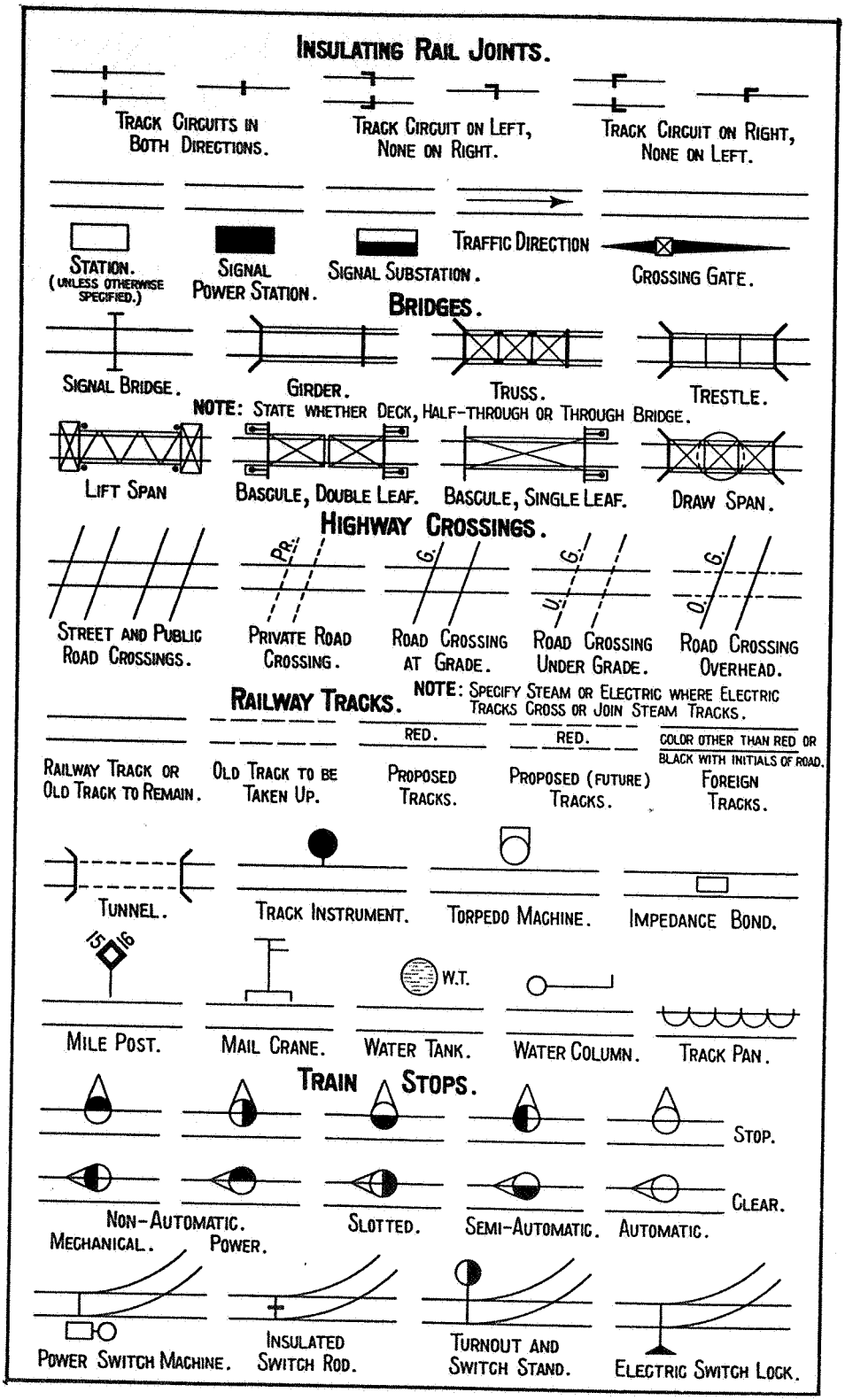

INSULATING RAIL JOINTS.
TRACK CIRCUITS IN BOTH DIRECTIONS.
TRACK CIRCUIT ON LEFT, NONE ON RIGHT.
TRACK CIRCUIT ON RIGHT, NONE ON LEFT.
STATION. (UNLESS OTHERWISE SPECIFIED.)
SIGNAL POWER STATION.
SIGNAL SUBSTATION.
TRAFFIC DIRECTION
CROSSING GATE.
BRIDGES.
SIGNAL BRIDGE.
GIRDER.
TRUSS.
TRESTLE.
NOTE: STATE WHETHER DECK, HALF-THROUGH OR THROUGH BRIDGE.
LIFT SPAN
BASCULE, DOUBLE LEAF.
BASCULE, SINGLE LEAF.
DRAW SPAN.
HIGHWAY CROSSINGS.
STREET AND PUBLIC ROAD CROSSINGS.
PR.
PRIVATE ROAD CROSSING.
G.
ROAD CROSSING AT GRADE.
U. G.
ROAD CROSSING UNDER GRADE.
O. G.
ROAD CROSSING OVERHEAD.
RAILWAY TRACKS.
NOTE: SPECIFY STEAM OR ELECTRIC WHERE ELECTRIC TRACKS CROSS OR JOIN STEAM TRACKS.
RAILWAY TRACK OR OLD TRACK TO REMAIN.
OLD TRACK TO BE TAKEN UP.
RED.
PROPOSED TRACKS.
RED.
PROPOSED (FUTURE) TRACKS.
COLOR OTHER THAN RED OR BLACK WITH INITIALS OF ROAD.
FOREIGN TRACKS.
TUNNEL.
TRACK INSTRUMENT.
TORPEDO MACHINE.
IMPEDANCE BOND.
15
16
MILE POST.
MAIL CRANE.
W.T.
WATER TANK.
WATER COLUMN.
TRACK PAN.
TRAIN STOPS.
STOP.
CLEAR.
NON-AUTOMATIC. MECHANICAL.
POWER.
SLOTTED.
SEMI-AUTOMATIC.
AUTOMATIC.
POWER SWITCH MACHINE.
INSULATED SWITCH ROD.
TURNOUT AND SWITCH STAND.
ELECTRIC SWITCH LOCK.

Fig. 4.

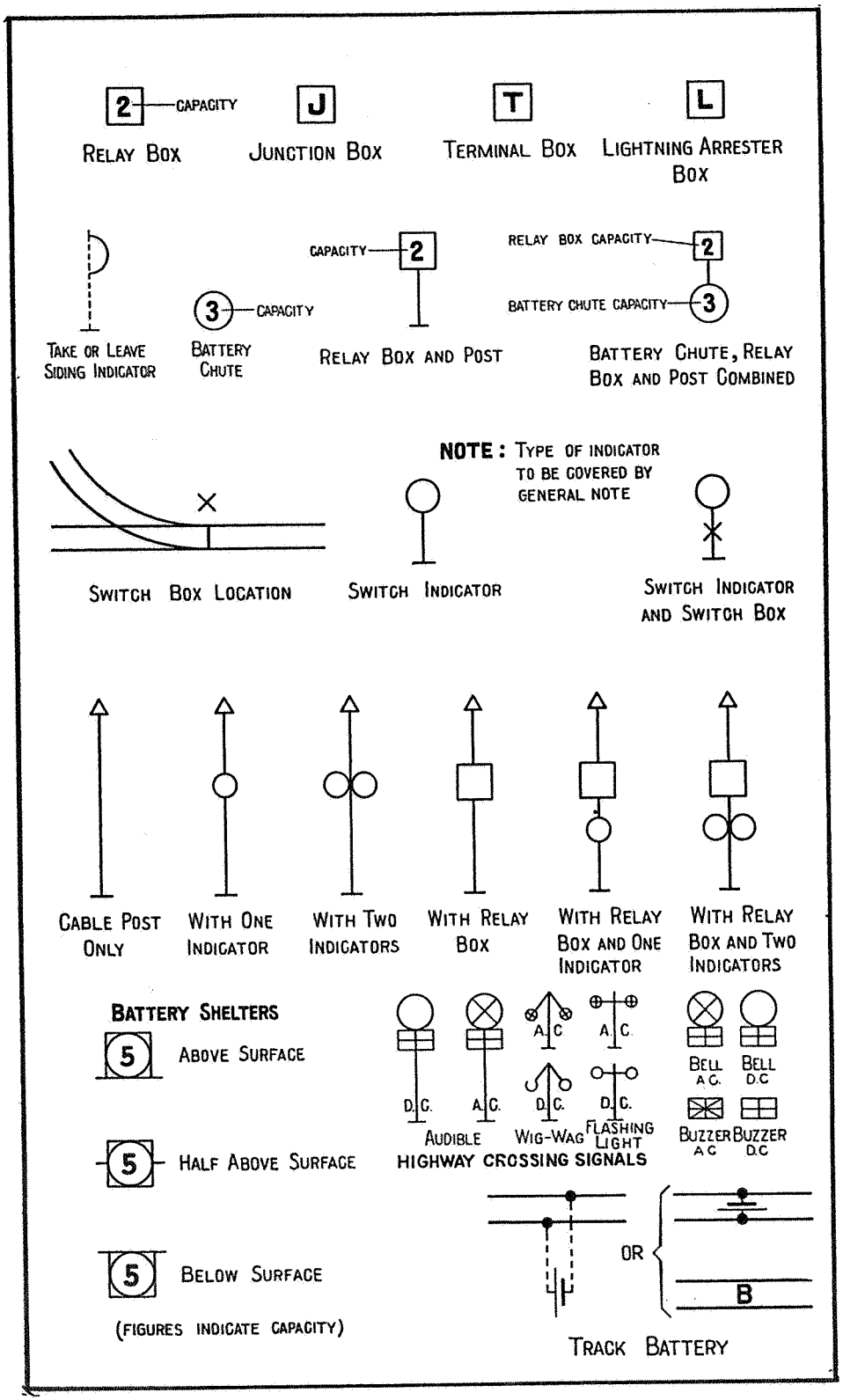

2 CAPACITY
RELAY BOX
J
JUNCTION BOX
T
TERMINAL BOX
L
LIGHTNING ARRESTER BOX
TAKE OR LEAVE SIDING INDICATOR
3 CAPACITY
BATTERY CHUTE
CAPACITY 2
RELAY BOX AND POST
RELAY BOX CAPACITY 2
BATTERY CHUTE CAPACITY 3
BATTERY CHUTE, RELAY BOX AND POST COMBINED
SWITCH BOX LOCATION
SWITCH INDICATOR
NOTE: TYPE OF INDICATOR TO BE COVERED BY GENERAL NOTE
SWITCH INDICATOR AND SWITCH BOX
CABLE POST ONLY
WITH ONE INDICATOR
WITH TWO INDICATORS
WITH RELAY BOX
WITH RELAY BOX AND ONE INDICATOR
WITH RELAY BOX AND TWO INDICATORS
BATTERY SHELTERS
5 ABOVE SURFACE
5 HALF ABOVE SURFACE
5 BELOW SURFACE
(FIGURES INDICATE CAPACITY)
D.C.
A.C.
D.C.
A.C.
A.C.
A.C.
D.C.
D.C.
AUDIBLE
WIG-WAG
FLASHING LIGHT
BELL A.C.
BELL D.C.
BUZZER A.C.
BUZZER D.C.
HIGHWAY CROSSING SIGNALS
OR
B
TRACK BATTERY

Fig. 5.

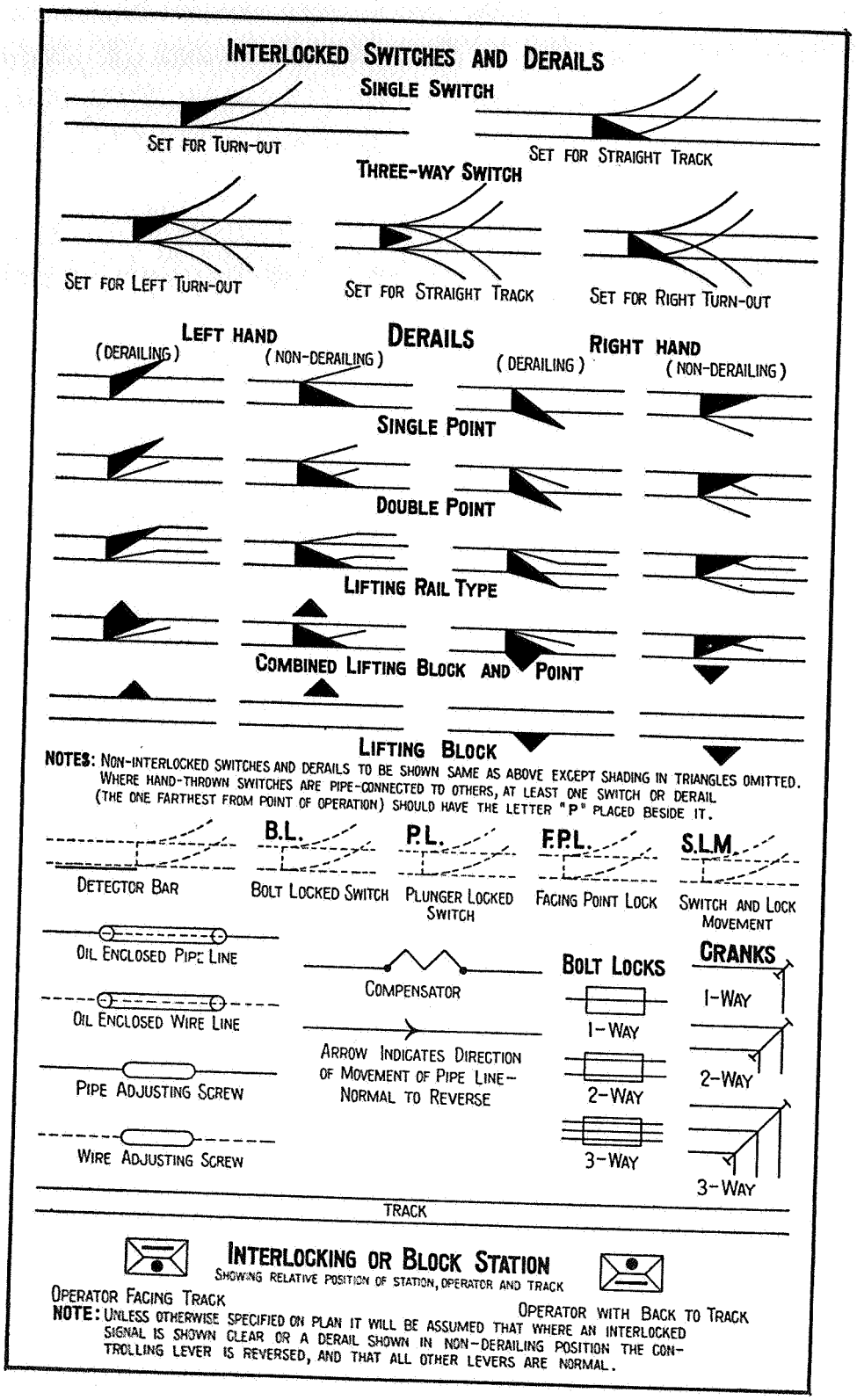

INTERLOCKED SWITCHES AND DERAILS
SINGLE SWITCH
SET FOR TURN-OUT
SET FOR STRAIGHT TRACK
THREE-WAY SWITCH
SET FOR LEFT TURN-OUT
SET FOR STRAIGHT TRACK
SET FOR RIGHT TURN-OUT
LEFT HAND (DERAILING)
(NON-DERAILING)
DERAILS
(DERAILING)
RIGHT HAND (NON-DERAILING)
SINGLE POINT
DOUBLE POINT
LIFTING RAIL TYPE
COMBINED LIFTING BLOCK AND POINT
LIFTING BLOCK
NOTES: NON-INTERLOCKED SWITCHES AND DERAILS TO BE SHOWN SAME AS ABOVE EXCEPT SHADING IN TRIANGLES OMITTED. WHERE HAND-THROWN SWITCHES ARE PIPE-CONNECTED TO OTHERS, AT LEAST ONE SWITCH OR DERAIL (THE ONE FARTHEST FROM POINT OF OPERATION) SHOULD HAVE THE LETTER "P" PLACED BESIDE IT.
DETECTOR BAR
B.L.
BOLT LOCKED SWITCH
P.L.
PLUNGER LOCKED SWITCH
F.P.L.
FACING POINT LOCK
S.L.M.
SWITCH AND LOCK MOVEMENT
OIL ENCLOSED PIPE LINE
OIL ENCLOSED WIRE LINE
PIPE ADJUSTING SCREW
WIRE ADJUSTING SCREW
COMPENSATOR
ARROW INDICATES DIRECTION OF MOVEMENT OF PIPE LINE— NORMAL TO REVERSE
BOLT LOCKS
1-WAY
2-WAY
3-WAY
CRANKS
1-WAY
2-WAY
3-WAY
TRACK
INTERLOCKING OR BLOCK STATION
SHOWING RELATIVE POSITION OF STATION, OPERATOR AND TRACK
OPERATOR FACING TRACK
OPERATOR WITH BACK TO TRACK
NOTE: UNLESS OTHERWISE SPECIFIED ON PLAN IT WILL BE ASSUMED THAT WHERE AN INTERLOCKED SIGNAL IS SHOWN CLEAR OR A DERAIL SHOWN IN NON-DERAILING POSITION THE CONTROLLING LEVER IS REVERSED, AND THAT ALL OTHER LEVERS ARE NORMAL.

Fig. 6.

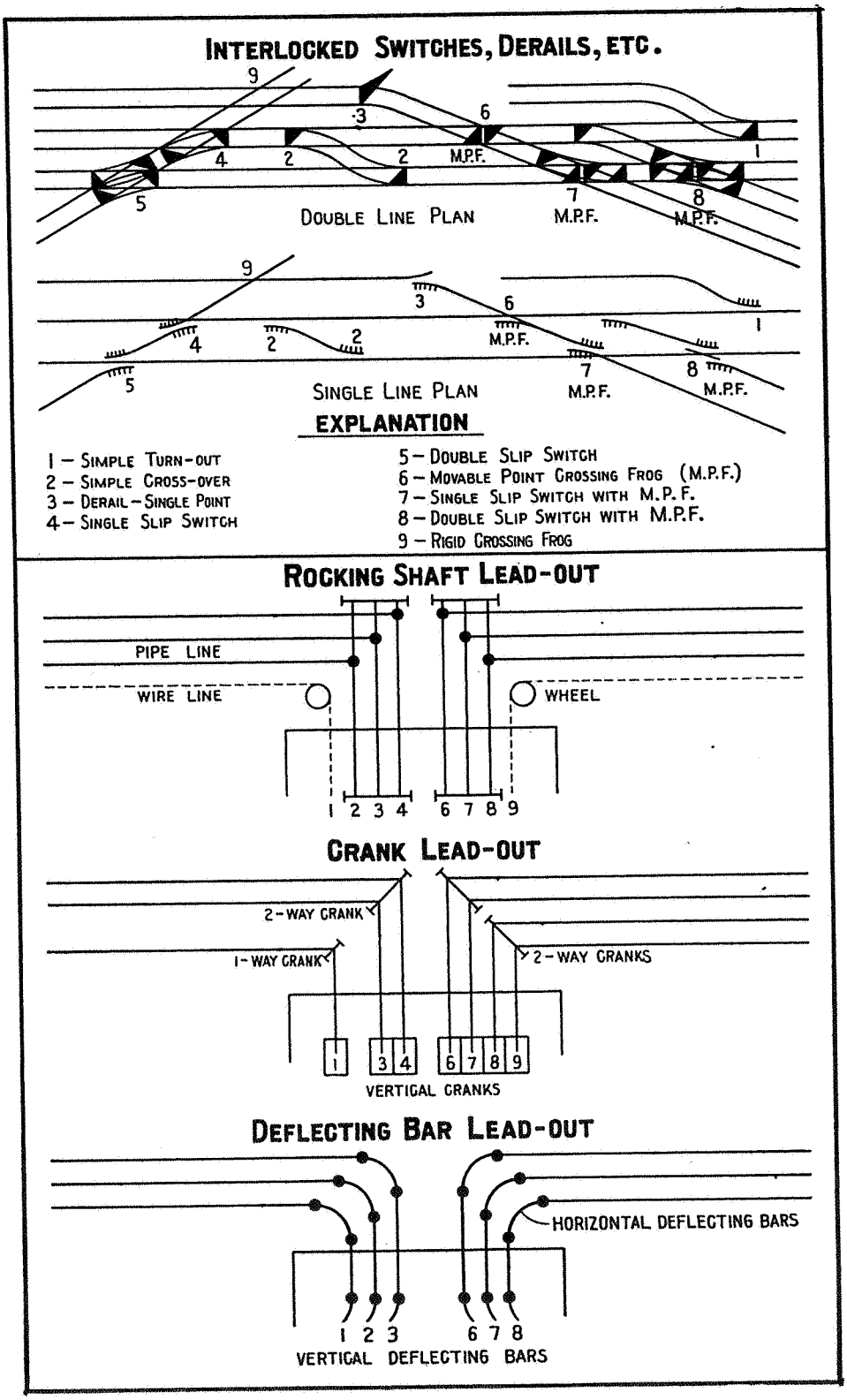

INTERLOCKED SWITCHES, DERAILS, ETC.
DOUBLE LINE PLAN
M.P.F.
SINGLE LINE PLAN
EXPLANATION
1 – SIMPLE TURN-OUT
2 – SIMPLE CROSS-OVER
3 – DERAIL – SINGLE POINT
4 – SINGLE SLIP SWITCH
5 – DOUBLE SLIP SWITCH
6 – MOVABLE POINT CROSSING FROG (M.P.F.)
7 – SINGLE SLIP SWITCH WITH M.P.F.
8 – DOUBLE SLIP SWITCH WITH M.P.F.
9 – RIGID CROSSING FROG
ROCKING SHAFT LEAD-OUT
PIPE LINE
WIRE LINE
WHEEL
1 2 3 4 6 7 8 9
CRANK LEAD-OUT
2-WAY CRANK
1-WAY CRANK
2-WAY CRANKS
VERTICAL CRANKS
DEFLECTING BAR LEAD-OUT
HORIZONTAL DEFLECTING BARS
1 2 3 6 7 8
VERTICAL DEFLECTING BARS

Fig. 7.

high interlocking signals. The principles involved in one, two and three-arm signaling are covered in Chapter III—Principles of Signaling.

The signal symbols may be readily understood by reference to Figs. 1 and 2. For instance, in Fig. 8a the symbols used for the two high signals (one on either side of the crossing) on the north and south road show that each of these signals has two arms, the signaling being three-position, indicated by the vertical and diagonal lines in the blade. The top arms are semi-automatic, stick, power-operated, 0 to 90 degrees. (See B4, Fig. 1). The bottom arms are semi-automatic, stick, power-operated, 0 to 45 degrees. (See C4, Fig. 1).

Both arms of both signals are shown to operate in the upper right-hand quadrant; the small projection at the upper left corner indicates that they are upper-quadrant, and the arms are shown to the right of the mast as they would be installed.

The two signals on the north and south road, having fishtail ends, are distant signals, the symbols for which (D6, Fig. 1) show they are automatically operated and work 45 to 90 degrees.

On the east and west road in addition to the signal symbols thus far described are various others. An arm fixed in the Stop position is shown on the signal at the west end of the middle track. Some of the other arms indicate that all three positions of the arms are used, which is shown by two diagonal lines in the symbols. The diagonal line from upper left corner to lower right corner indicates 0 to 45 degrees (C, Fig. 1) and the line from lower left corner to upper right corner, 45 to 90 degrees (D, Fig. 1).

The symbol for a signal mast is a straight line parallel to the track to which the symbols for the arms are attached. A long line indicates a high signal, a short one a dwarf signal. The dwarf signal on the north and south road is shown as a mechanical, 0 to 45 degree, non-automatic signal (C1, Fig. 1), those on the east and west road as 0 to 45 degree, non-stick, power-operated.

All the high signals on the three-track road shown are located on signal bridges.

It will be noted that some of the signal arms in Fig. 8a are shown with square ends, some with pointed ends and others with fishtail ends. The square end blade indicates home signals whose most restrictive indication is Stop; the pointed end blade indicates an automatic block signal whose most restrictive indication is Stop; Then Proceed; and the fishtail blade indicates a distant signal in non-automatic block system territory. There is, however, a difference in practice on various roads.

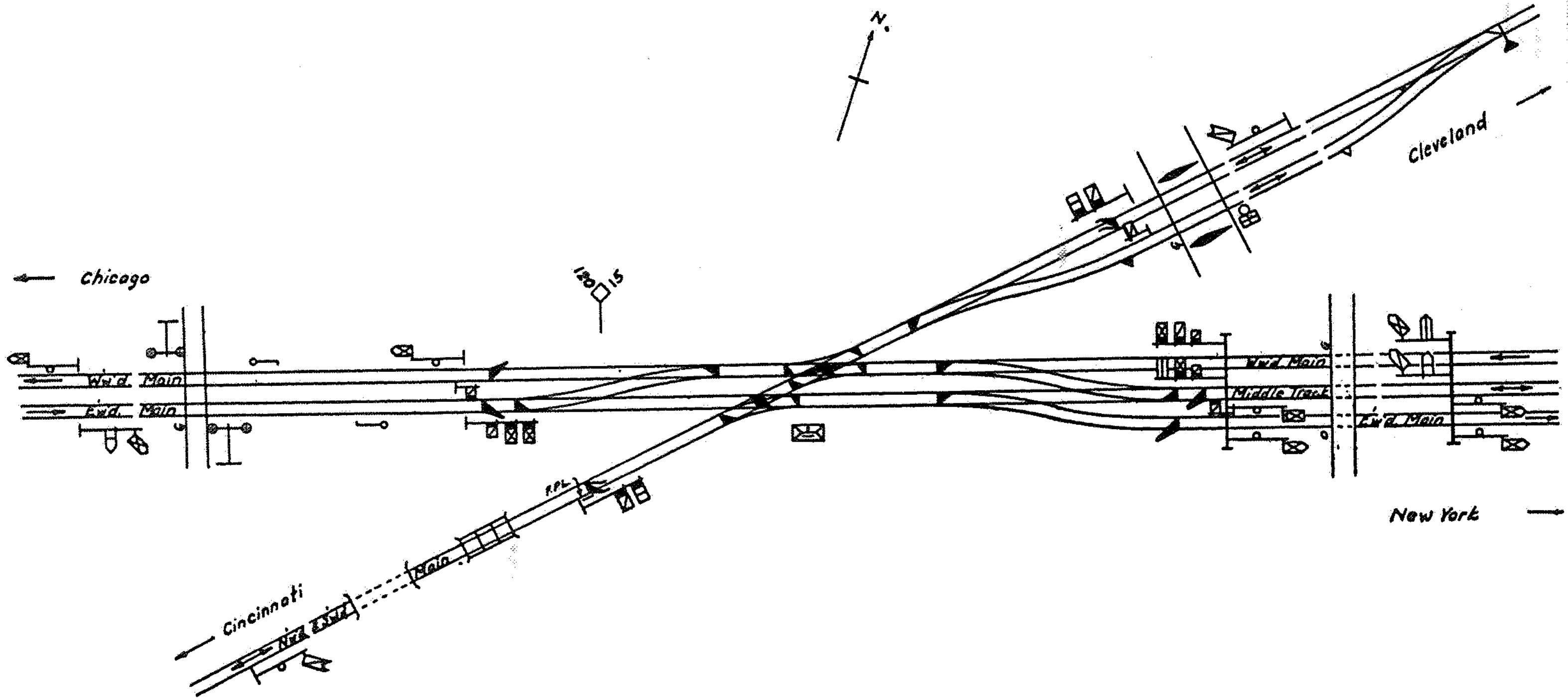

N.
Chicago
Cleveland
New York
Cincinnati
Ww'd. Main
Ewd. Main
Wwd Main
Middle Track
Ewd Main
Main
120
15

Fig. 8a.

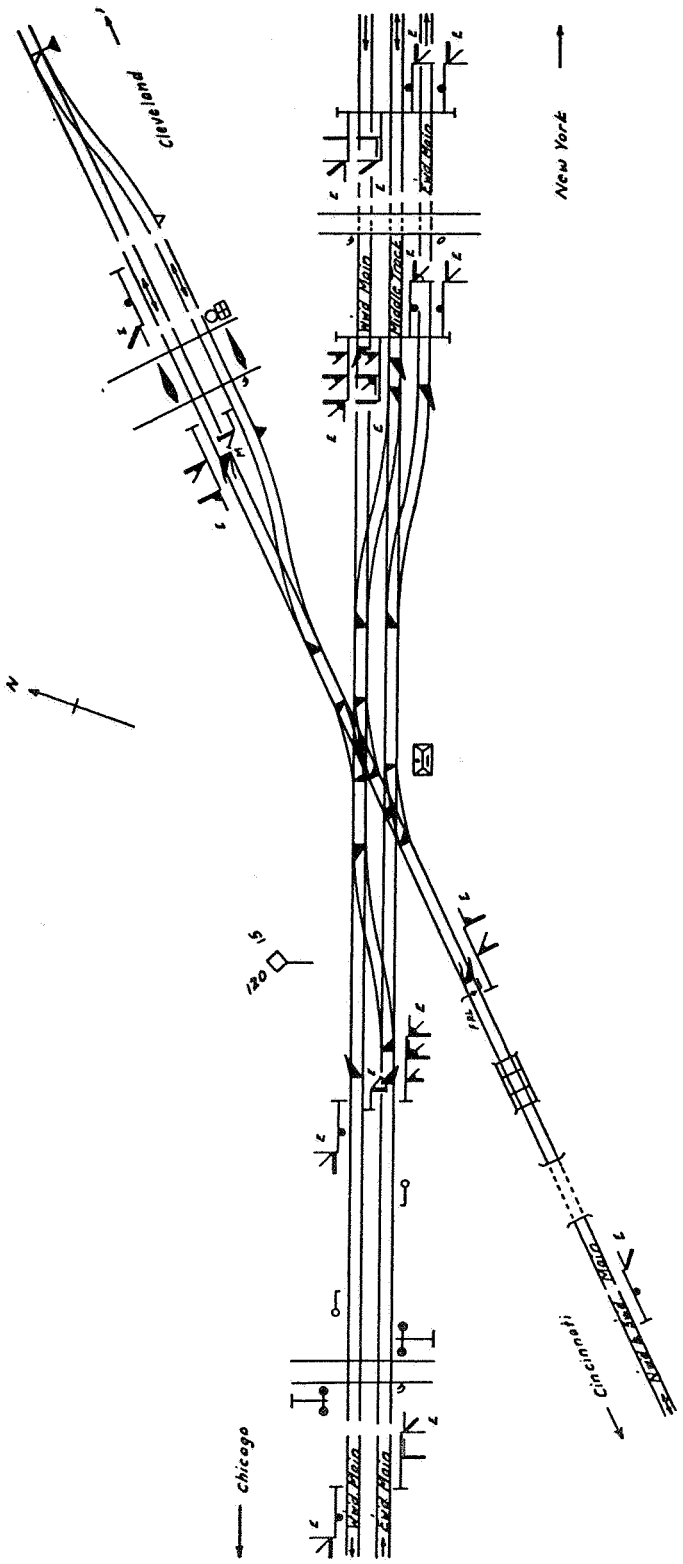

Cleveland
New York
West Main
Middle Track
East Main
West Main
East Main
Chicago
Cincinnati
120

Fig. 8b.

The application of the symbols shown in Fig. 2 is made to the layout shown in Fig. 8b.

All one-arm signals are shown with a marker light, this being the practice on many roads. Where the marker light is shown to right of the mast it is in a vertical line with the active or semaphore light, and where it is shown to the left of the mast it is said to be staggered; that is, on the opposite side of the mast from the semaphore lamp.

The letters "E" and "M" placed near the signals, indicate the type; for instance, "E" indicates the signal is electric semaphore, while "M" indicates a mechanical semaphore signal. For other types of signals, other letters as shown in Fig. 2 would be used.

The aspects and indications are explained later in this chapter.

The various switch and derail symbols should need no further explanation here, as they are in accordance with Figs. 6 and 7 and the explanation given with them. It will be seen, however, that the double-slip switch with movable point frogs is used where the north and south road crosses the westward main track of the east and west road, and a single-slip switch and movable point frogs at the crossing in the eastward main track. The movable point frogs are necessary due to the angle of the crossing. The double-slip switch permits train movements to be made from one road to the other as follows:

Northward movements from the single-track road to the westward main track of the other road or vice versa.

Southward movements from the single-track road to the westward main track of the other road or vice versa.

The single-slip switch provides for northward train movements from the single-track road to the eastward main track of the other road or vice versa.

The switches in tracks of the east and west road also permit these movements to be made to and from the middle track.

Other symbols such as highway crossing signals, water columns, mileposts, grade crossings, bridge, tunnel, etc., are used. By referring to Figs. 1 to 7 these symbols are readily understood.

Symbols for relays, indicators and electric locks are shown in Figs. 9 and 10 as are also the symbols for contacts on such instruments. Figure 9 shows the elements of symbols for the various instruments and Fig. 10 shows examples of various combinations of the symbols.

In Fig. 9 the solid lines are the elements of symbols; the dotted symbols are given to show the relation between the element given and an element previously shown. It will be noted that a rectangle denotes an electromagnet or the coils of an instrument. Two diagonal lines intersecting in the rectangle indicate an alternating current instrument, while a direct current instrument is a rectangle without diagonal lines. The armature or other contact carrying member is shown as a straight line with a dot on one end to represent the pivot end, this symbol being placed below the coil or magnet. When a coil is energized the symbol for the armature is shown in the horizontal position, and when de-energized is inclined downward. A small arrow which represents a contact is shown above the armature symbol for a front contact and below for a back contact. A closed contact is represented by the arrow touching the symbol for the armature, and not touching it for an open contact. Polar and three-position armatures are represented by the same symbol as is used for the neutral armature, except they are shown in the vertical or nearly vertical position. The normal and reverse contacts for both the polarized relay and the three-position relay are the same and similar to the contacts for neutral relays except they are shown to the right and left of the armature instead of above and below. The de-energized contact for the three-position relay is shown below the armature and makes contact when the armature is in center position. Other features also have symbols which are readily understood such as the high current contact, bell, slow-acting feature, indicators, etc.

In the symbols for the electric locks, the segment is always shown with cuts representing the position in which the lever or other device will be locked. The symbol at the left of the figure shows the lock is effective when the lever is in the normal position; the next with lever in midstroke position going normal; the next with lever in reversed position, and the one on the right with lever in either the normal or reversed position.

Example of combinations of symbols for relays, indicators and locks as explained for Fig. 9 are shown in Fig. 10.

In Chapter VI—Direct Current Relays, and Chapter X—Alternating Current Relays, further explanation is made of certain special contacts and contact combinations.

Figure 11 illustrates the written method of designating the circuit controllers operated by levers. The symbols for levers with extreme position as normal are shown on the left of the figure; the symbols for levers with middle position as normal are shown on the right of the figure. The letter symbols are represented by a letter

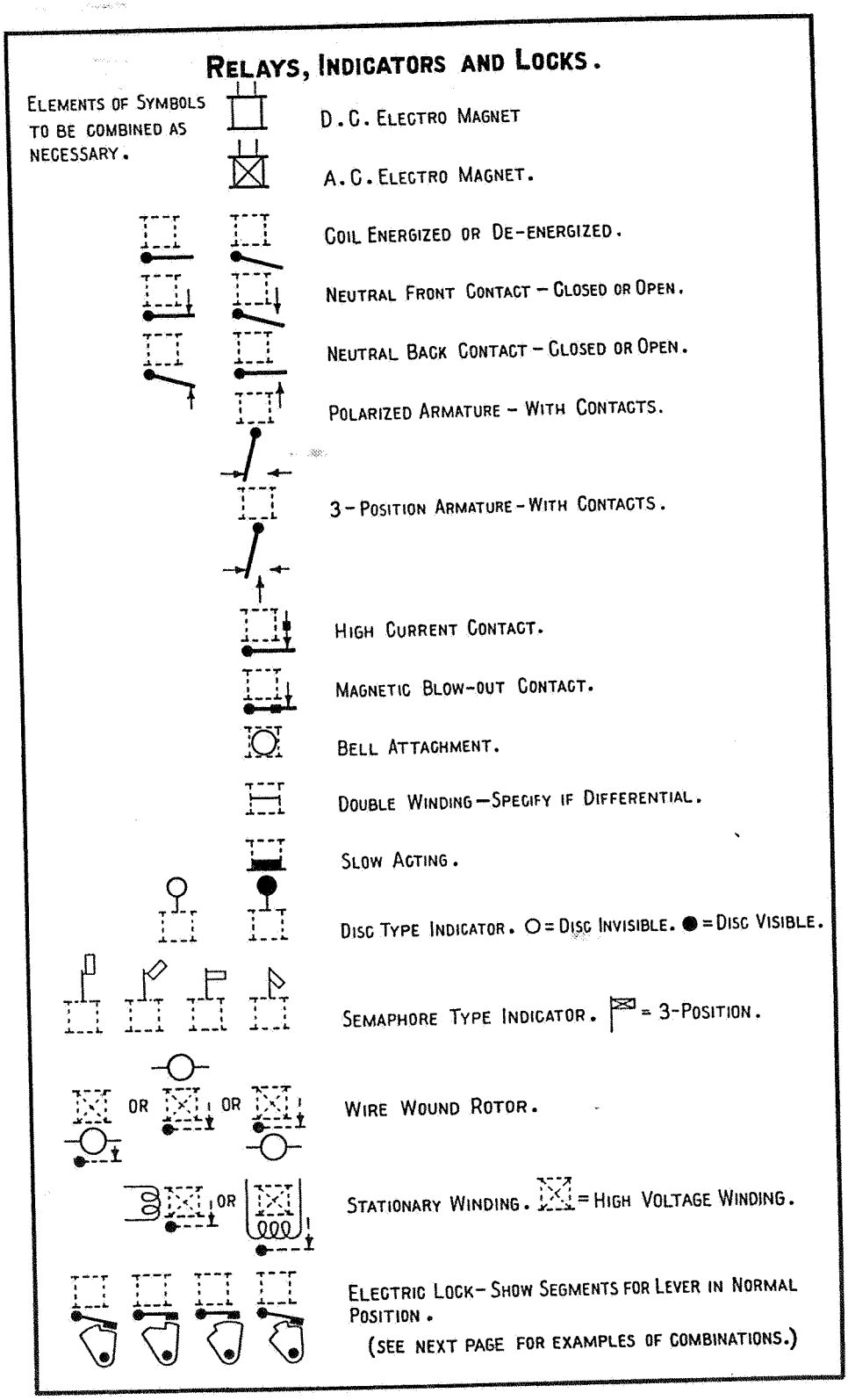
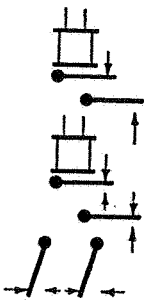

RELAYS, INDICATORS AND LOCKS.
ELEMENTS OF SYMBOLS TO BE COMBINED AS NECESSARY.
D.C. ELECTRO MAGNET
A.C. ELECTRO MAGNET.
COIL ENERGIZED OR DE-ENERGIZED.
NEUTRAL FRONT CONTACT – CLOSED OR OPEN.
NEUTRAL BACK CONTACT – CLOSED OR OPEN.
POLARIZED ARMATURE – WITH CONTACTS.
3 – POSITION ARMATURE – WITH CONTACTS.
HIGH CURRENT CONTACT.
MAGNETIC BLOW-OUT CONTACT.
BELL ATTACHMENT.
DOUBLE WINDING – SPECIFY IF DIFFERENTIAL.
SLOW ACTING.
DISC TYPE INDICATOR. ○ = DISC INVISIBLE. ● = DISC VISIBLE.
SEMAPHORE TYPE INDICATOR. = 3-POSITION.
OR
OR
WIRE WOUND ROTOR.
OR
STATIONARY WINDING. = HIGH VOLTAGE WINDING.
ELECTRIC LOCK – SHOW SEGMENTS FOR LEVER IN NORMAL POSITION.
(SEE NEXT PAGE FOR EXAMPLES OF COMBINATIONS.)

Fig. 9.

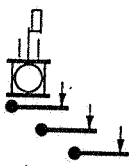
RELAYS, INDICATORS AND LOCKS.

EXAMPLES OF COMBINATIONS.

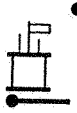


D.C. RELAY – NEUTRAL – ENERGIZED –
ONE INDEPENDENT FRONT CONTACT CLOSED –
ONE INDEPENDENT BACK CONTACT OPEN.

D.C. RELAY – POLARIZED – ENERGIZED –
TWO COMBINATION FRONT AND BACK NEUTRAL CONTACTS –
TWO POLARIZED CONTACTS CLOSED –
TWO POLARIZED CONTACTS OPEN.



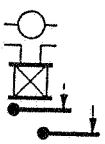
D.C. INDICATOR – SEMAPHORE TYPE – ENERGIZED –
THREE FRONT CONTACTS CLOSED –
BELL ATTACHMENT.



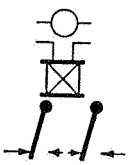
D.C. INDICATOR – SEMAPHORE TYPE – ARM HORIZONTAL –
ENERGIZED – WITHOUT CONTACTS.

NOTE: INDICATORS (OR REPEATERS) WITHOUT CONTACTS SHOULD BE SHOWN WITH ARMATURES TO INDICATE WHETHER ENERGIZED OR DE-ENERGIZED.

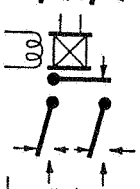
A.C. RELAY – ONE ENERGIZING CIRCUIT TYPE (SINGLE PHASE)
ENERGIZED – ONE FRONT CONTACT.



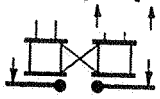
A.C. RELAY – TWO ENERGIZING CIRCUIT TYPE – ENERGIZED –
WIRE WOUND ROTOR –
TWO NEUTRAL FRONT CONTACTS.



A.C. RELAY – TWO ENERGIZING CIRCUIT TYPE – ENERGIZED –
WIRE WOUND ROTOR –
TWO POLARIZED CONTACTS.



A.C RELAY – TWO ENERGIZING CIRCUIT TYPE – ENERGIZED –
STATIONARY WINDINGS –
ONE NEUTRAL FRONT CONTACT –
TWO 3-POSITION CONTACTS.



D.C. INTERLOCKED RELAY.

D.C. ELECTRIC BELL.

DESIGNATE RESISTANCE IN OHMS OF ALL D.C. RELAYS, INDICATORS AND LOCKS.

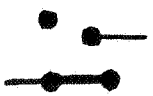
Fig. 10.

enclosed within a circle. The letter indicates the position of the lever when the circuit is closed. The graphic symbols consist of one or more short lines intersecting at various angles, the horizontal line represents a wire, and the angle as indicated represents a position of the lever where the circuit is closed. Where the circuit is closed during a considerable portion of the movement of the lever, the extremities of the short lines are connected by either straight lines or arcs. In the case of the graphic symbols, the levers with center position as normal are distinguished from the levers with the extreme end position as normal by a circle. Contacts when shown thus:

indicate the circuit as closed when lever is in the normal position. The heavy horizontal lines in Fig. 11 indicate portion of cycle of lever through which circuit is closed.

The upper section of Fig. 12 illustrates the symbols for circuit controllers operated by signals. The symbols on the left are for upper-quadrant signals, those on the right are for lower-quadrant signals. The symbols for controllers on upper-quadrant signals are shown in the upper right-hand quadrant, those for controllers operated by lower-quadrant signals in the lower right-hand quadrant. The dot at the vertex is the pivot point. The dots on the arc of the quadrant represent the various positions the signal may assume. The heavy horizontal line represents the contact arm and moving through arc of the quadrant closed the circuit at points desired, thus:

circuit closed 45 to 90 degrees:



circuit closed at 45 degrees.

The lower section of Fig. 12 illustrates symbols for switch circuit controllers, pole changing circuit controllers, etc. These symbols are easily understood and a detailed explanation is not necessary.

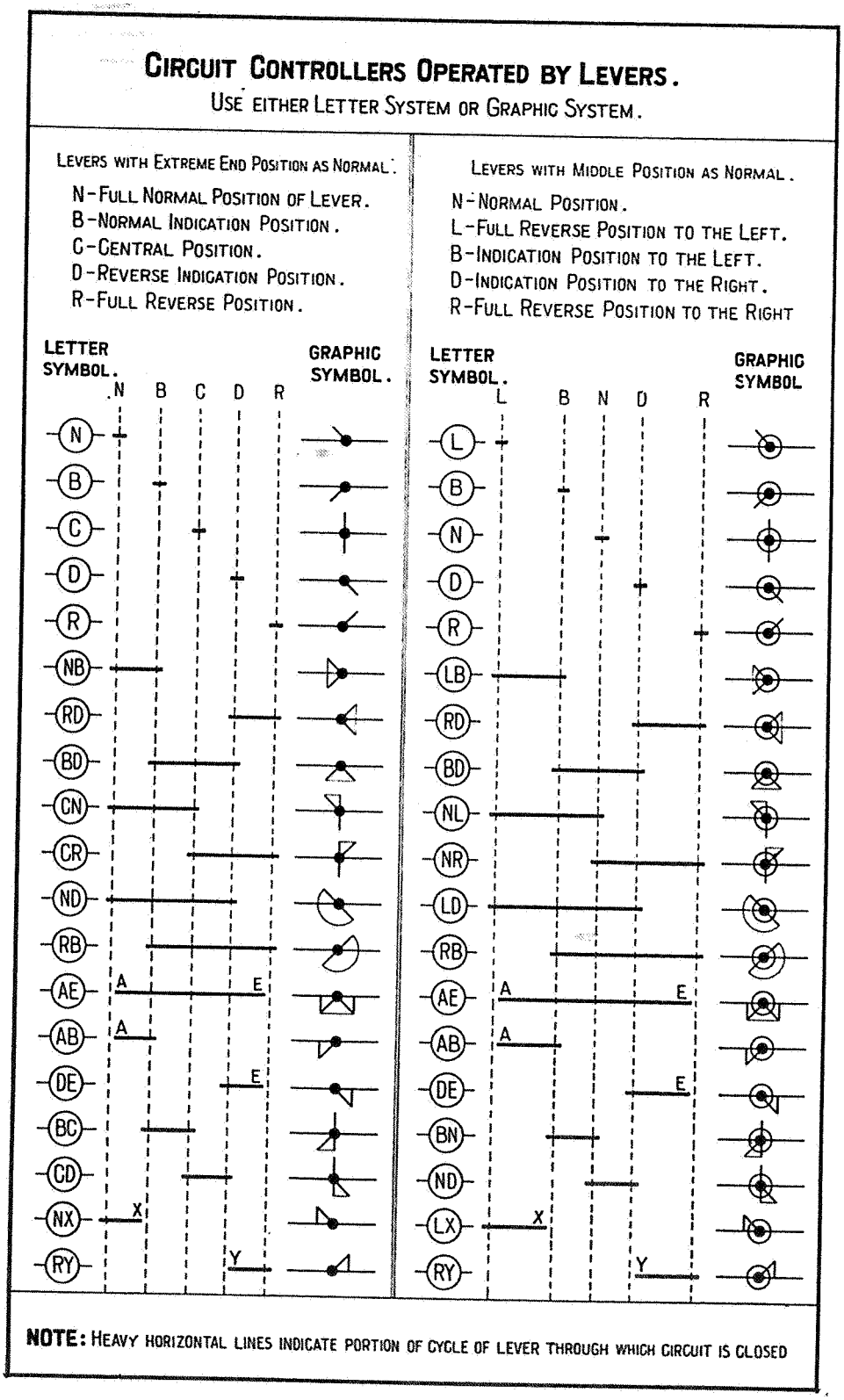

CIRCUIT CONTROLLERS OPERATED BY LEVERS.
USE EITHER LETTER SYSTEM OR GRAPHIC SYSTEM.
LEVERS WITH EXTREME END POSITION AS NORMAL.
N-FULL NORMAL POSITION OF LEVER.
B-NORMAL INDICATION POSITION.
C-CENTRAL POSITION.
D-REVERSE INDICATION POSITION.
R-FULL REVERSE POSITION.
LETTER SYMBOL.
GRAPHIC SYMBOL.
N B C D R
N
B
C
D
R
NB
RD
BD
CN
CR
ND
RB
AE
AB
DE
BC
CD
NX
RY
A
E
A
E
X
Y
LEVERS WITH MIDDLE POSITION AS NORMAL.
N-NORMAL POSITION.
L-FULL REVERSE POSITION TO THE LEFT.
B-INDICATION POSITION TO THE LEFT.
D-INDICATION POSITION TO THE RIGHT.
R-FULL REVERSE POSITION TO THE RIGHT
LETTER SYMBOL.
GRAPHIC SYMBOL
L B N D R
L
B
N
D
R
LB
RD
BD
NL
NR
LD
RB
AE
AB
DE
BN
ND
LX
RY
A
E
A
E
X
Y
NOTE: HEAVY HORIZONTAL LINES INDICATE PORTION OF CYCLE OF LEVER THROUGH WHICH CIRCUIT IS CLOSED

Fig. 11.

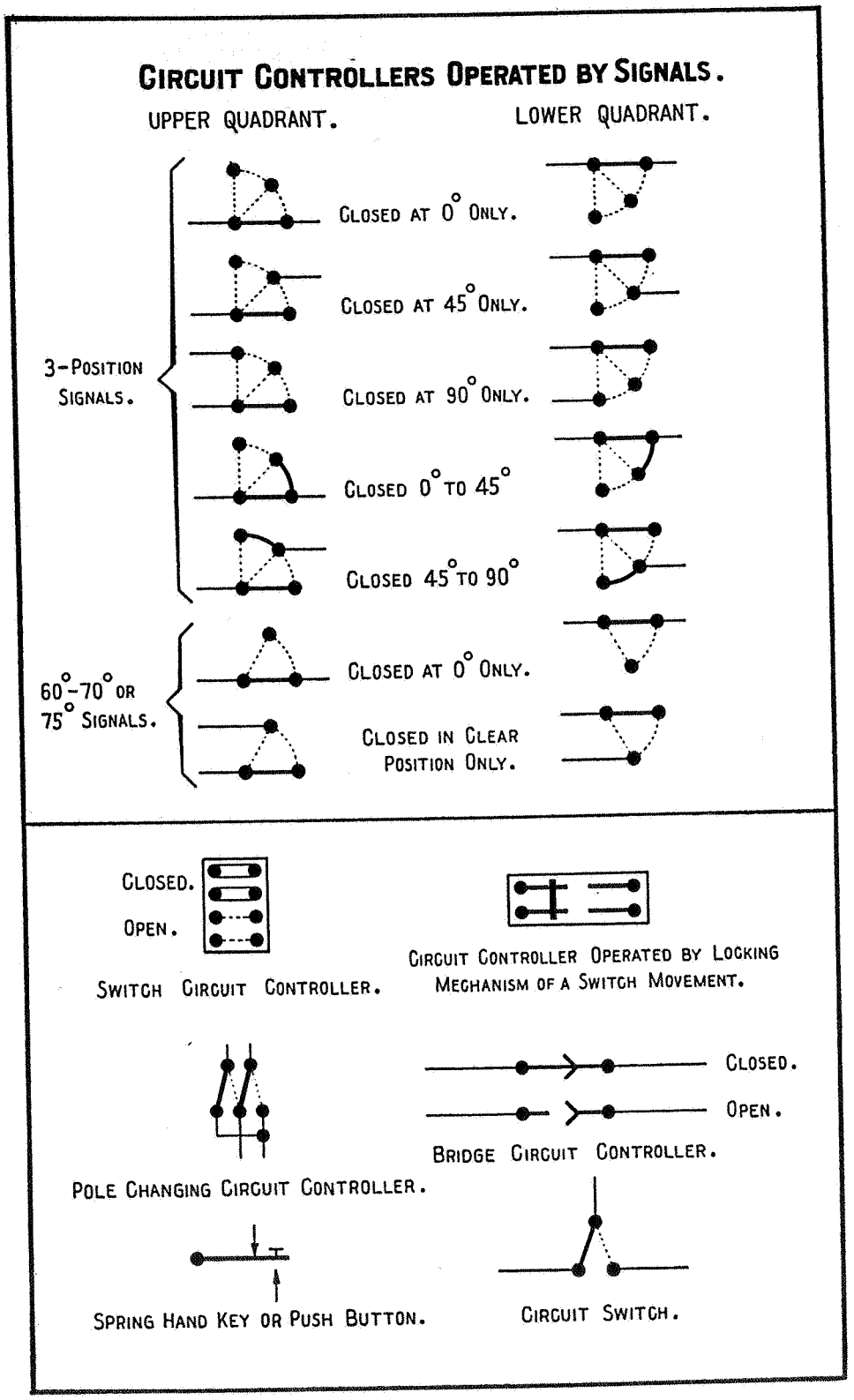

CIRCUIT CONTROLLERS OPERATED BY SIGNALS.
UPPER QUADRANT.
LOWER QUADRANT.
3-POSITION SIGNALS.
CLOSED AT 0° ONLY.
CLOSED AT 45° ONLY.
CLOSED AT 90° ONLY.
CLOSED 0° TO 45°
CLOSED 45° TO 90°
60°-70° OR 75° SIGNALS.
CLOSED AT 0° ONLY.
CLOSED IN CLEAR POSITION ONLY.
CLOSED.
OPEN.
SWITCH CIRCUIT CONTROLLER.
CIRCUIT CONTROLLER OPERATED BY LOCKING MECHANISM OF A SWITCH MOVEMENT.
POLE CHANGING CIRCUIT CONTROLLER.
CLOSED.
OPEN.
BRIDGE CIRCUIT CONTROLLER.
SPRING HAND KEY OR PUSH BUTTON.
CIRCUIT SWITCH.

Fig. 12.

Figure 13 illustrates circuit symbols for releases, knife switches, etc. The symbol for a release consists of a combination of heavy lines, arrows and dots. The heavy horizontal lines represent the contact arms, the dots on the ends of these lines are the pivot points. When a heavy horizontal line and an arrow touch, the circuit is closed. The dots on the arrows and heavy horizontal lines represent terminals to which the lines representing wires are connected.

The symbols for floor push, latch contact, track instrument contact, rheostat and knife switches are easily understood.

The symbol for fixed resistance is represented by a series of connected diagonal lines. The variable resistance is similar to the fixed resistance, except that an arrow is employed to indicate the variable connection.

The symbol for a fuse is a wave line between two dots. The symbol for an impedance (without iron core) is a series of connected loops, while that for an impedance (with iron core) has a horizontal line through the loops which represents the core.

The symbol for a condenser consists of four parallel lines, two connected to each side of the circuit. The parallel lines represent the plates of the condenser; the space between them is the dielectric.

In Fig. 14 the symbol for an electric cell consists of a long light line as the negative terminal parallel to a short heavy line which represents the positive terminal. The symbol for a battery consists of a number of cells connected either in multiple or series. When cells are in multiple the short heavy lines (positive terminals) are connected and the long light lines (negative terminals) are connected. A battery in series is represented by a group of alternate long light lines and short heavy lines. Of the two extreme lines one is a short heavy line representing the positive terminal of the battery; the other is a long light line representing the negative terminal of the battery.

The symbol for a rectifier consists of a wave line bisected by a horizontal line. This represents the alternating current side of the rectifier. The direct current side is represented by a horizontal line.

Transformers are represented by two parallel series of connected loops. The upper series represents the primary coil and the lower the secondary coil.

The symbol for a direct current motor consists of an "M" enclosed in a circle, which represents the commutator, and two lines tangent to it representing the brushes. The symbol for a direct current generator is similar to that for a direct current motor, except that a "G" is enclosed in the circle. The symbol for an alternating current motor consists of two concentric circles, an "M"

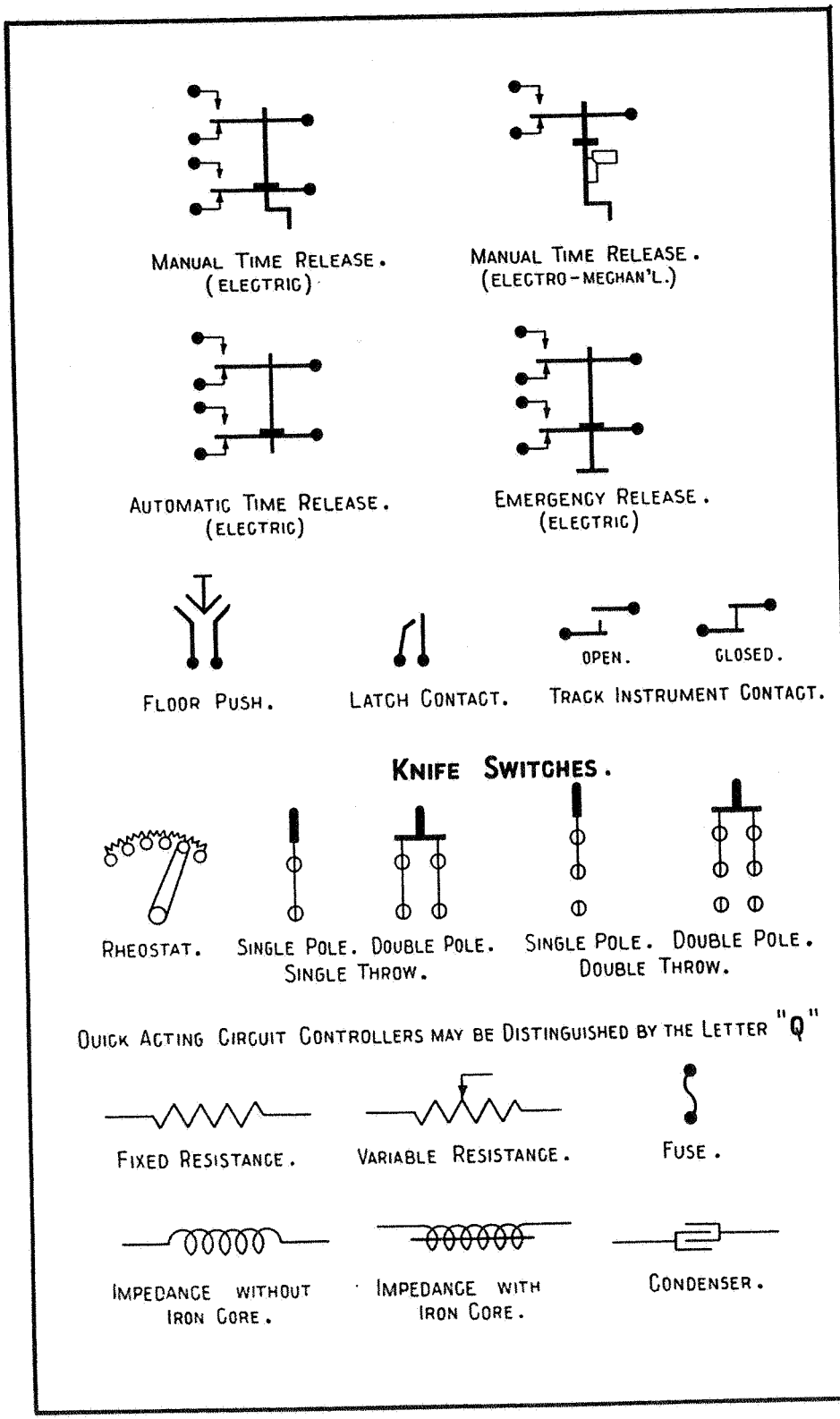

MANUAL TIME RELEASE. (ELECTRIC)
MANUAL TIME RELEASE. (ELECTRO-MECHAN'L.)
AUTOMATIC TIME RELEASE. (ELECTRIC)
EMERGENCY RELEASE. (ELECTRIC)
FLOOR PUSH.
LATCH CONTACT.
OPEN.
CLOSED.
TRACK INSTRUMENT CONTACT.
KNIFE SWITCHES.
RHEOSTAT.
SINGLE POLE. SINGLE THROW.
DOUBLE POLE. SINGLE THROW.
SINGLE POLE. DOUBLE THROW.
DOUBLE POLE. DOUBLE THROW.
QUICK ACTING CIRCUIT CONTROLLERS MAY BE DISTINGUISHED BY THE LETTER "Q"
FIXED RESISTANCE.
VARIABLE RESISTANCE.
FUSE.
IMPEDANCE WITHOUT IRON CORE.
IMPEDANCE WITH IRON CORE.
CONDENSER.

Fig. 13.

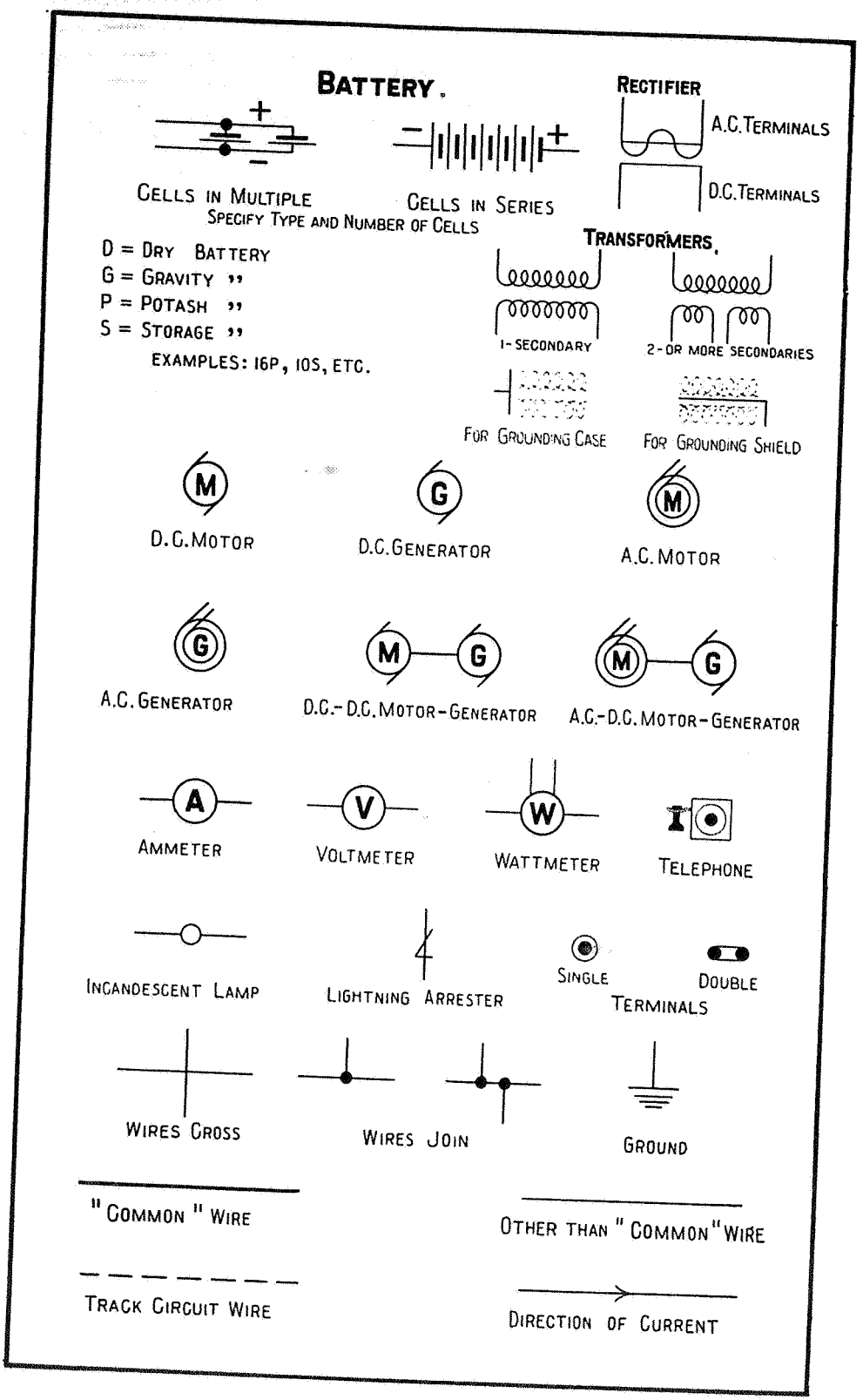

BATTERY.
CELLS IN MULTIPLE
CELLS IN SERIES
SPECIFY TYPE AND NUMBER OF CELLS
D = DRY BATTERY
G = GRAVITY ,,
P = POTASH ,,
S = STORAGE ,,
EXAMPLES: 16P, 10S, ETC.
RECTIFIER
A.C. TERMINALS
D.C. TERMINALS
TRANSFORMERS.
1-SECONDARY
2-OR MORE SECONDARIES
FOR GROUNDING CASE
FOR GROUNDING SHIELD
D.C. MOTOR
D.C. GENERATOR
A.C. MOTOR
A.C. GENERATOR
D.C.-D.C. MOTOR-GENERATOR
A.C.-D.C. MOTOR-GENERATOR
AMMETER
VOLTMETER
WATTMETER
TELEPHONE
INCANDESCENT LAMP
LIGHTNING ARRESTER
SINGLE
DOUBLE
TERMINALS
WIRES CROSS
WIRES JOIN
GROUND
" COMMON " WIRE
OTHER THAN " COMMON " WIRE
TRACK CIRCUIT WIRE
DIRECTION OF CURRENT

Fig. 14.

within the inner circle and two lines, one tangent to each circle, representing the collector ring brushes. The symbol for an alternating current generator is similar to that for an alternating current motor, except that a "G" is enclosed in the inner circle.

An ammeter is represented by an "A" enclosed in a circle. A voltmeter is represented by a "V" enclosed in a circle. A wattmeter is represented by a "W" enclosed in a circle.

The symbol for a telephone consists of a dot enclosed in a circle within a square; on the left of the square is a representation of the receiver hanging in the hook.

A number of explanatory diagrams are shown in Fig. 15. These symbols, with the exception of those showing contacts and the lever and latch diagrams, are for use on signal layout plans. The contacts are for circuit plans, while the lever and latch diagrams are merely to illustrate the positions the lever or latch are in to correspond to the position as shown in the symbols in Fig. 11. This concludes the description of the various symbol drawings.

However, a desire to provide a scheme to make it easier for the drafting forces to design and draw circuit plans led to a simpler method known as Written Circuits. The symbols for written circuits are shown in Figs. 16 and 17.

The forms of written circuits are shown in Figs. 18 and 19. The written circuits in Fig. 18 employ standard symbols throughout, both on the track plan and in the circuit diagrams.

The written circuits illustrated in Fig. 19 employ standard symbols on the track plan, but in the circuit diagrams make use of a straight line for the circuit with contacts and other symbols written on it. These symbols are known as Symbols for Written Circuits.

In speaking of the two forms of written circuits, the circuit diagrams illustrated in Fig. 18 will be referred to as written circuits using standard symbols, and those shown in Fig. 19 will be referred to as written circuits using symbols for written circuits.

In the case of the written circuit diagrams using standard symbols some attempt is made to show clearly how each unit in the circuit closes and opens it. On the other hand, written circuit diagrams using symbols for written circuits are represented by a straight unbroken line upon which the various symbols representing contacts, circuit controllers, etc., with their designating numerals and letters, are placed. No attempt is made to show how each unit in the circuit closes and opens it.

Written circuits, using standard symbols, number the line representing the wires to the unit controlled, giving each branch circuit and cut-around a distinct number, and showing the point at which

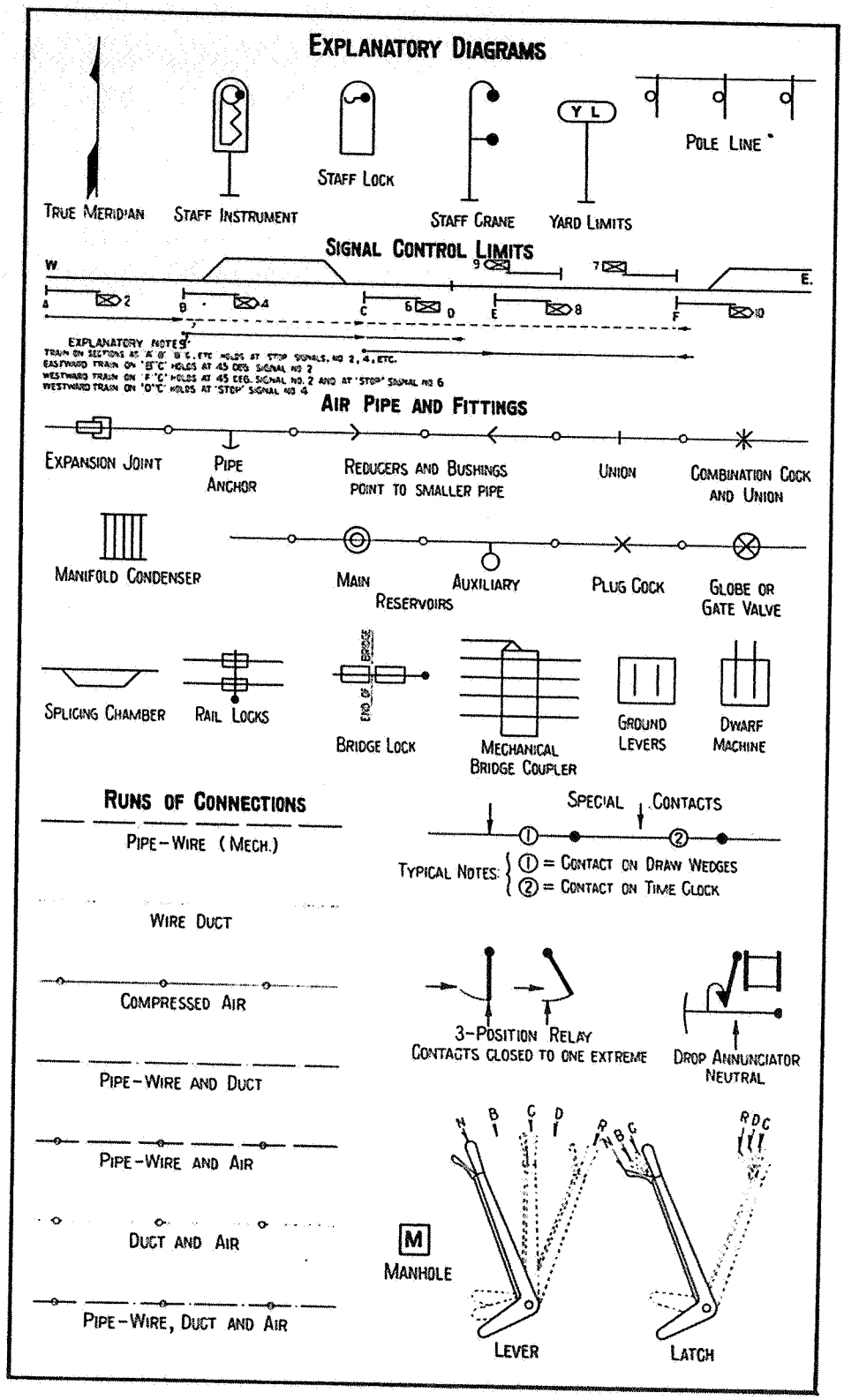

EXPLANATORY DIAGRAMS
TRUE MERIDIAN
STAFF INSTRUMENT
STAFF LOCK
STAFF CRANE
Y L
YARD LIMITS
POLE LINE
SIGNAL CONTROL LIMITS
W
E.
EXPLANATORY NOTES
AIR PIPE AND FITTINGS
EXPANSION JOINT
PIPE ANCHOR
REDUCERS AND BUSHINGS POINT TO SMALLER PIPE
UNION
COMBINATION COCK AND UNION
MANIFOLD CONDENSER
MAIN RESERVOIRS
AUXILIARY
PLUG COCK
GLOBE OR GATE VALVE
SPLICING CHAMBER
RAIL LOCKS
END OF BRIDGE
BRIDGE LOCK
MECHANICAL BRIDGE COUPLER
GROUND LEVERS
DWARF MACHINE
RUNS OF CONNECTIONS
PIPE-WIRE (MECH.)
WIRE DUCT
COMPRESSED AIR
PIPE-WIRE AND DUCT
PIPE-WIRE AND AIR
DUCT AND AIR
PIPE-WIRE, DUCT AND AIR
SPECIAL CONTACTS
TYPICAL NOTES: ① = CONTACT ON DRAW WEDGES
② = CONTACT ON TIME CLOCK
3-POSITION RELAY
CONTACTS CLOSED TO ONE EXTREME
DROP ANNUNCIATOR NEUTRAL
M
MANHOLE
LEVER
LATCH

Fig. 15.

SYMBOLS FOR WRITTEN CIRCUITS

OPERATED UNITS

An operated unit is represented by a rectangle with the numerical and alphabetical designation indicated therein; as:-

RELAY AND INDICATOR CONTACTS

10HRV / 3 — Front contact of 2 position relay, closed.

10HRV / 3 — " " " " " " open.

10HR / 3 ^ — Back " " " " " " closed.

10HR / 3 ^ — " " " " " " open.

10HR / 3 — Polarized and 3 position relay contact closed when normal.

10HR / 3 — Polarized and 3 position relay contact closed when reversed.

10HR / 3 — Polarized and 3 position relay contact closed when de-energized.

B — V — C Battery flows from heel to point (2 pos. relay)

B — V — C " " " point to heel " " "

Arrow indicates direction of current through polarized and 3 position contacts.

NOTE:- Figure 3 above indicates third contact of relay counting from left to right.

CIRCUIT CONTROLLERS OPERATED BY LEVERS

Use R.S.A. symbols as shown on Plate 9 thus:- 10 — or 10 (N)

CIRCUIT CONTROLLERS OPERATED BY SIGNALS

10 ← Signal number
0 — Closed at 0° only.

10 / 45 — Closed at 45° only.

10 / 90 — Closed at 90° only.

10 / 60 — Closed at 60° only.

10 / 0-45 — Closed between 0° and 45°.

10 / 45-90 — Closed between 45° and 90°.

CIRCUIT CONTROLLERS OPERATED BY SWITCH POINT

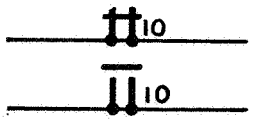
10 ← Switch number.
Closed when switch is normal.

10 — Closed when switch is reversed.

Fig. 16.

SYMBOLS FOR WRITTEN CIRCUITS

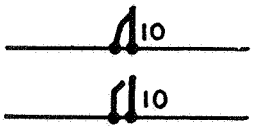
CIRCUIT CONTROLLERS OPERATED BY LOCKING MECHANISM OF SWITCH MOVEMENT.



Closed.

Open.

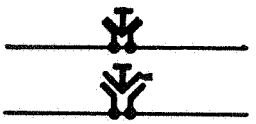
LATCH CONTACTS



Normally closed.

Normally open.

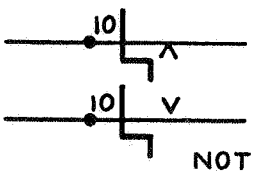
FLOOR PUSH.



Normally closed.

Normally open.

TIME RELEASE CONTACTS

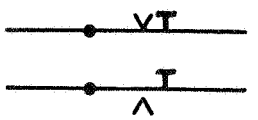


Normally closed.

Normally open.

NOTE:- 10 indicates number of Signal whose route is released.

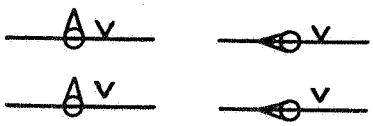
PUSH BUTTON AND STRAP KEY.



Normally closed.

Normally open.

TRAIN STOP CONTACTS



Closed.

Open.

Fig. 17.

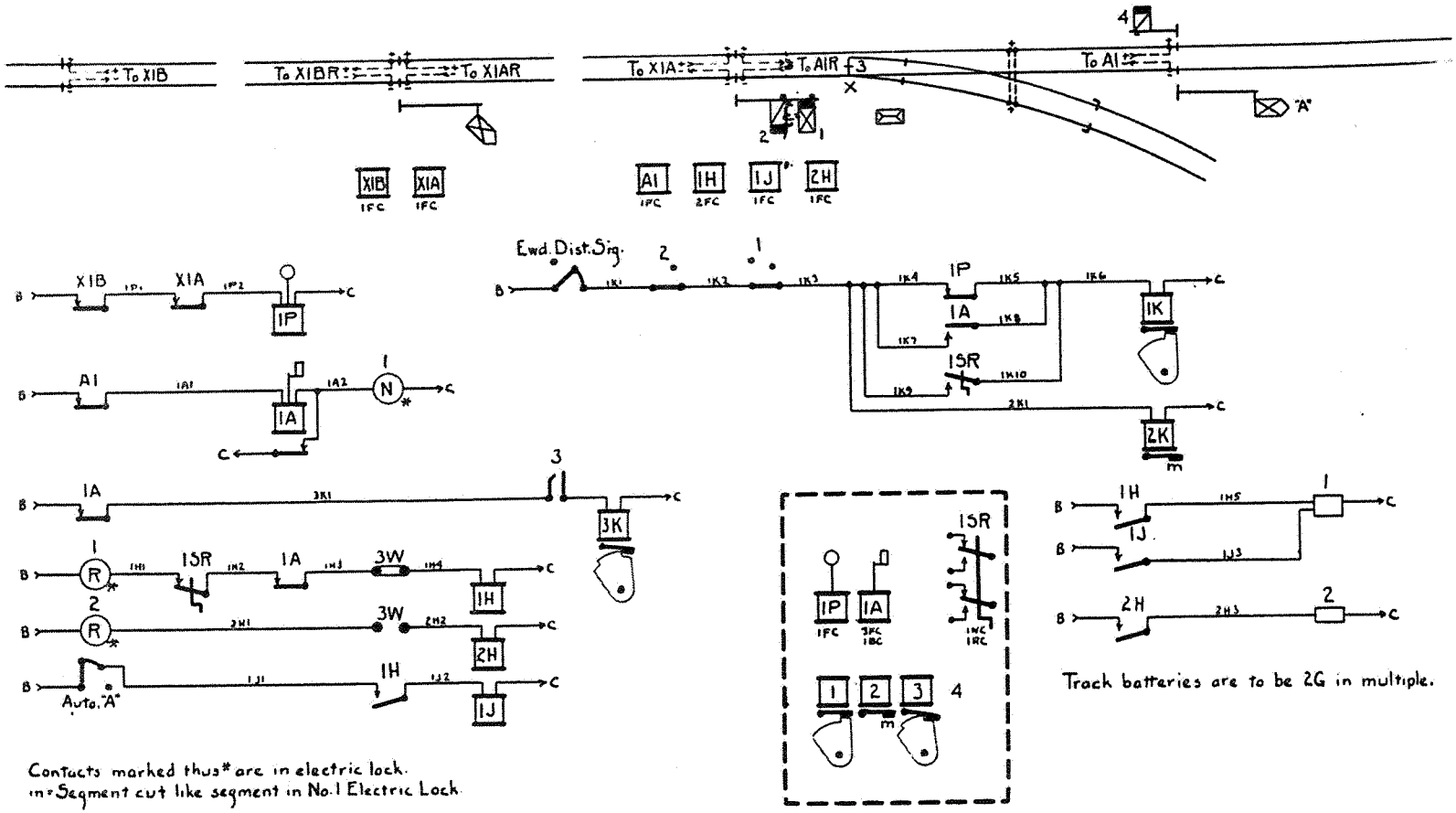

To X1B
To X1BR
To X1AR
To X1A
To A1R
To A1
"A"
X1B 1FC
X1A 1FC
A1 1FC
1H 2FC
1J 1FC
2H 1FC
Ewd. Dist. Sig.
X1B
X1A
1P
A1
1A
N
3K
1H
1SR
3W
2H
1J
Auto. "A"
1K
2K
Contacts marked thus* are in electric lock.
m=Segment cut like segment in No.1 Electric Lock.
Track batteries are to be 2G in multiple.

Fig. 18.

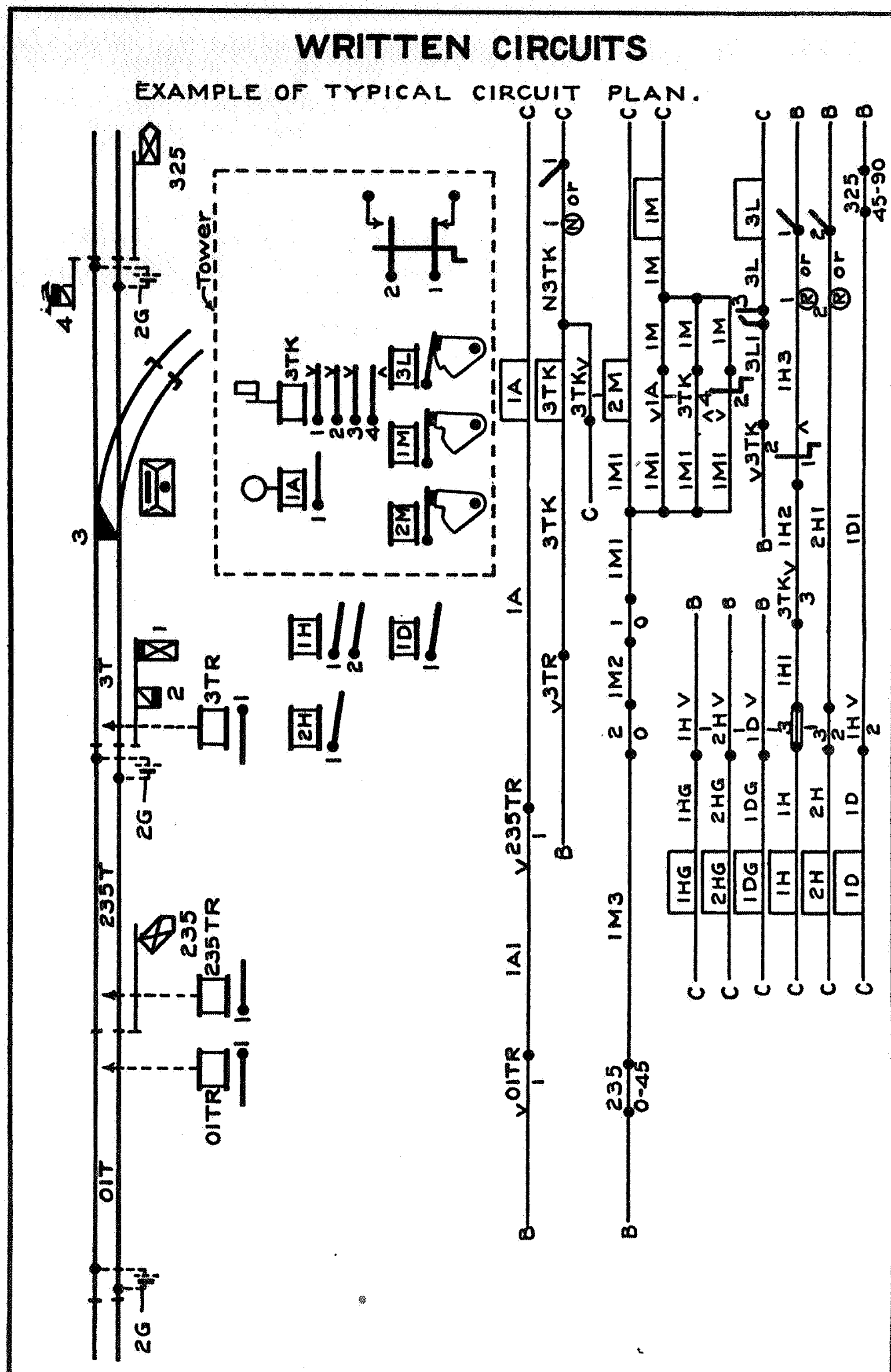

WRITTEN CIRCUITS
EXAMPLE OF TYPICAL CIRCUIT PLAN.
01T
235T
3T
3
2G
01TR
235TR
3TR
235
2
1
4
325
Tower
2H
1H
1D
1A
3TK
2M
1M
3L
1A1
1A
N3TK
N or
IM3
IM2
IM1
IM
1HG
2HG
1DG
1H
2H
1D
1H1
1H2
1H3
2H1
1D1
3L1
R or
0-45
45-90
C
B

Fig. 19.

each branch and cut-around circuit connects. Written circuits, using written circuit symbols, number the line representing the wires from the unit controlled; branch and cut-around circuits are not given a distinct number, nor does this form of written circuit attempt to show the point at which the branch and cut-around circuit connect.

The difference in the nomenclature of these two methods of drafting circuits may be quite marked. This may readily be seen by the nomenclature used in Figs. 18 and 19. The nomenclature used in Fig. 19 is A.R.A. recommended practice for written circuits. The one used in Fig. 18 is one of the many schemes used by various railroads not using A.R.A. recommended practice.

In Fig. 18, "1P" is the designation for the approach circuit on No. 1 track, while in Fig. 19, "1A" is the nomenclature for approach circuit on No. 1 track.

The track indicating indicator circuit in Fig. 18 is designated as "1A," while in Fig. 19 it is designated as "3 TK." "1K" and "3K" in Fig. 18 are the designations for the signal lever lock No. 1 and switch lever lock No. 3. These same lever locks are designated "1M" for signal lever lock No. 1, and "3M" for switch lever lock No. 3 in Fig. 19. The few examples given above show the difference in the nomenclature of the two methods.

Written circuits as illustrated in Fig. 19 are an attempt to save as much time as possible in drafting the circuit plans. Circuits will be covered in subsequent chapters.

Signal Aspects and Indications

Signal aspect is defined by the Signal Section, A.R.A., as: The appearance of a signal conveying an indication as received from the direction of an approaching train.

Signal indication is defined by the Signal Section, A.R.A., as: The information conveyed by the aspect of a visual signal.

In other words, "aspect" is the picture conveyed to the mind by the eye and "indication" is the meaning this picture or aspect has for the engineman and upon which he acts.

The following definitions are taken from the Standard Code of the A.R.A. as revised January 17, 1928:

"Medium Speed.— .....miles per hour.
"Slow Speed.— .....miles per hour.

"Restricted Speed.—Proceed prepared to stop short of train, obstruction, or anything that may require the speed of a train to be reduced."

Medium speed is quite generally designated as 30 miles per hour. Some roads use one-half authorized speed not exceeding 30 miles per hour. Slow speed is usually 15 miles per hour.

In previous issues of the Standard Code "medium speed" was known as "restricted speed" and "slow speed" covered what is now known as "slow speed" and "restricted speed."

Aspects and indications.

The Standard Code, revised January 17, 1928, sets forth signal aspects and indications for use with the Block Signal and Interlocking Rules.

The aspects and indications as approved are designed to cover the requirements of all American railways and, consequently, show many more aspects than are necessary on any one railroad: for instance, aspects and indications are given for the one-arm scheme of signaling as well as those for the two and three-arm schemes. A name is given to each set of aspects having the same indication.

With semaphore signals the signal indications are given by positions of arms and color of lights. With light signals the indications are given by color, the position of lights, or both.

The Standard Code rules are shown in Figs. 20 to 32, inclusive, except Fig. 22. In these typical signal aspects

R = Red
Y = Yellow
G = Green

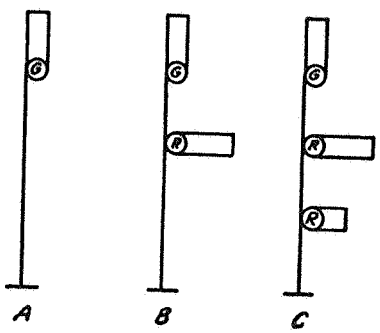


Fig. 20.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Day and night aspects for position light signals shall have the same positions as the day aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Proceed.
Name—Clear.

Many roads use other aspects: for instance, the round end blade used by some roads to mark distinctively their manual and controlled manual block signals, and the fishtail blade used by some roads as distant signals outside of automatic block system territory. The same thing may be accomplished by night by a different combination of lights.

In Fig. 20 are the various aspects of signals indicating Proceed.

These signals indicate the block or route is clear, and when the distant indication is displayed to another signal they will be at Approach or Clear.

The Approach-Medium signal as shown in Fig. 21 requires at least two arms and/or lights. This signal was known for many years as the Approach-Restricting signal.

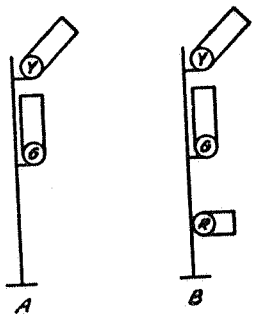


Fig. 21.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Day and night aspects for position light signals shall have the same positions as the day aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Approach Next Signal at Not Exceeding Medium Speed.

Name—Approach-Medium.

The aspects and indications are used to give approach information where medium speed is required at the next signal. It indicates that a block or route governed by a signal displaying this indication is clear, but next signal limits the speed at that point. The next signal may be displayed for a movement over a turnout, crossover or other medium speed route. This indication is also used with what is known as three-block indication. Three-block indication may be used in automatic block system territory where there is less than braking distance between signals, in which case the aspects displayed behind a train are shown in Fig. 22. Thus it will be seen that a train receiving the Proceed indication has three clear blocks. This subject will be treated fully in Chapter XV—Automatic Signals.

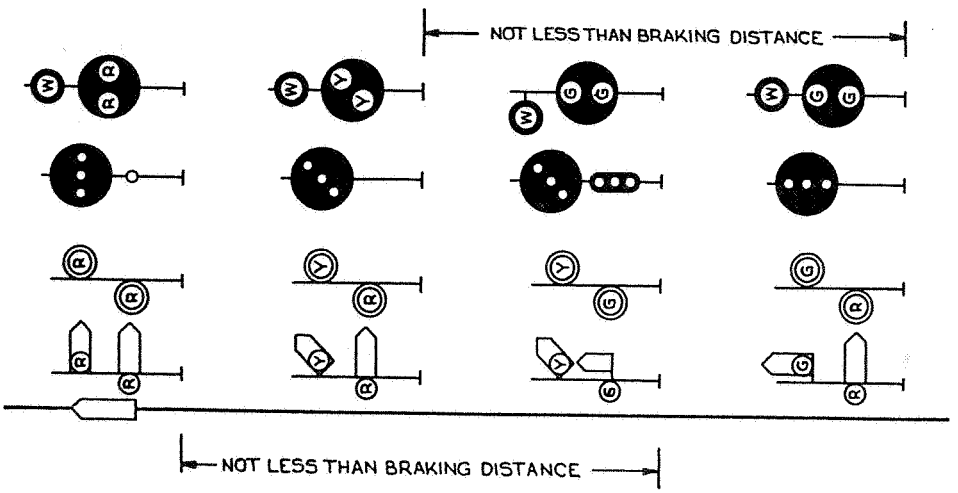


Fig. 22.

The Clear-Medium signal shown in Fig. 23 also requires at least two arms and/or lights to display the aspects shown.

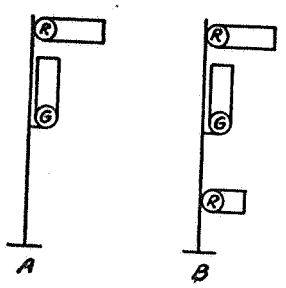


Fig. 23.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Day and night aspects for position light signals shall have the same positions as the day aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Proceed at Not Exceeding Medium Speed.
Name—Clear-Medium.

This signal indicates the block or route is clear, the movement is over a medium speed route and, where approach information is also given, that the next signal displays one of the aspects shown in Figs. 20, 21, 25, or 26.

The Approach-Slow signal shown in Fig. 24 is only given on a three-arm signal and indicates that the block or route governed by a signal displaying this indication is clear, but that slow speed restriction will be effective at the next signal.

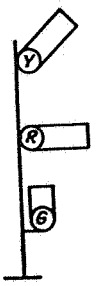


Fig. 24.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Day and night aspects for position light signals shall have the same positions as the day aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Approach Next Signal at Not Exceeding Slow Speed.
Name—Approach-Slow.

Distant (as formerly used) or Approach (as now used) is necessary to govern the approach of a train to a signal indicating Stop. The aspects and indication requiring a train to be prepared to stop at the next signal are shown in Fig. 25.

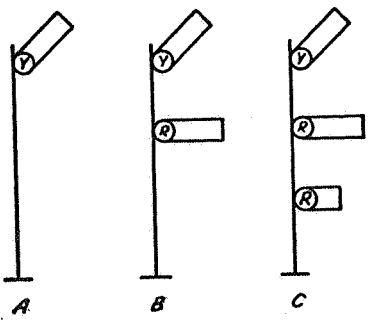


Fig. 25.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Day and night aspects for position light signals shall have the same positions as the day aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Prepare to Stop at Next Signal. Train Exceeding Medium Speed Must at Once Reduce to That Speed.
Name—Approach.

These aspects indicate the block in advance is clear but train must be prepared to stop at the next signal. Formerly this was the only requirement, thus permitting the engineman to use his own judgment as to the speed. However, experience has demonstrated that it is desirable for the engineman to take some action on receiving such an indication and the requirement for a train to have its speed re-

duced to not exceeding medium speed at point involved has been added. This indication may be given by signals of the "stop and stay" type as well as by those of the "stop and proceed" type.

The Medium-Approach signal shown in Fig. 26 is only given on a three-arm signal and indicates a medium speed route is clear but that the engineman must be prepared to stop train at the next signal.

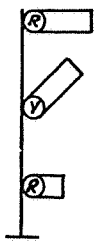


Fig. 26.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Day and night aspects for position light signals shall have the same positions as the day aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Proceed at Not Exceeding Medium Speed Prepared to Stop at Next Signal.
Name—Medium-Approach.

As shown in Fig. 27, the indication Proceed at Not Exceeding Slow Speed may be given on three-arm signals, or on dwarf signals. The Clear-Slow signal indicates a slow speed route is clear, and where it also gives approach information, that the next signal is displaying one of the aspects shown in Figs. 20, 21, 23, 24, 25, 26, 27, 28, or 30.

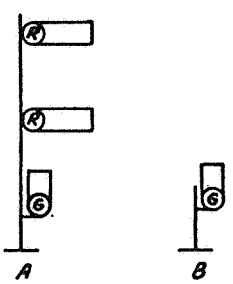


Fig. 27.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Day and night aspects for position light signals shall have the same positions as the day aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Proceed at Not Exceeding Slow Speed.
Name—Clear-Slow.

The Slow-Approach signal shown in Fig. 28 is used by a few roads in terminal territory where the signal indications are given by dwarf signals. It may be used for other slow speed purposes.

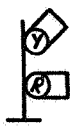


Fig. 28.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Proceed at Not Exceeding Slow Speed Prepared to Stop at Next Signal.
Name—Slow-Approach.

The Permissive signal shown in Fig. 29 is used in manual and controlled manual block system territory where a train is admitted to an occupied block by a fixed signal.

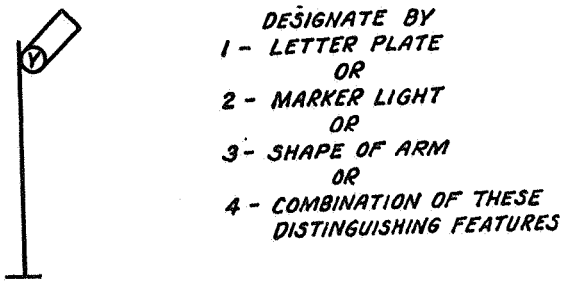


Fig. 29.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Block Occupied, Proceed Prepared to Stop Short of Train Ahead.
Name—Permissive.

It is also used in the one-arm signaling scheme at interlockings and in automatic block system territory for all purposes where it is desired to display a more favorable indication than Stop, or Stop; Then Proceed but less than Proceed (Fig. 20). Thus, in one-arm signaling this indication means that the route or block may be occupied, or a switch open, or next signal at stop, or any condition requiring caution.

Where used as a Permissive signal in manual or controlled manual block it is used to admit other than a passenger train to a block occupied by other than a passenger train.

To display the indication Proceed at Restricted Speed (Fig. 30) requires a two-arm, a three-arm or a dwarf signal. This indication is used for slow speed routes at interlockings which may be occupied, for "calling-on" movements and, on automatic signals, for movements of trains by such signals at Stop; Then Proceed without stopping. "Calling-on" signal, as this signal is frequently called, may be used at interlockings to advance a train to the block or interlocking station for orders or may be used to admit a train to a main track or other route that is occupied.

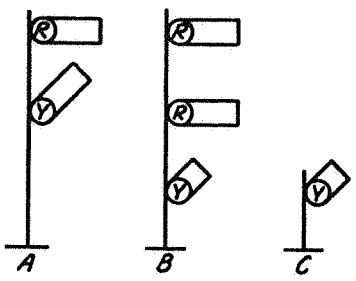


Fig. 30.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Proceed at Restricted Speed.
Name—Restricting.

In Fig. 31 is shown a signal giving the Stop; Then Proceed indication.

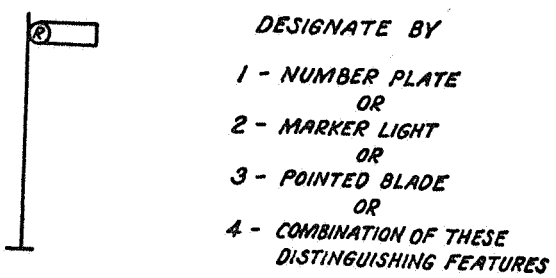


Fig. 31.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Day and night aspects for position light signals shall have the same positions as the day aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Stop; Then Proceed in Accordance with Rule 509B.
Name—Stop and Proceed.

While the aspect may be designated by the schemes indicated in the A.R.A. Rule, the most generally used schemes are:

Where semaphore signal is used—pointed blade and staggered lights.

Where color light signal is used—staggered lights.

Where position light signal is used—marker light.

Where color position light signal is used—white marker light.

Various aspects of signals indicating Stop are shown in Fig. 32.

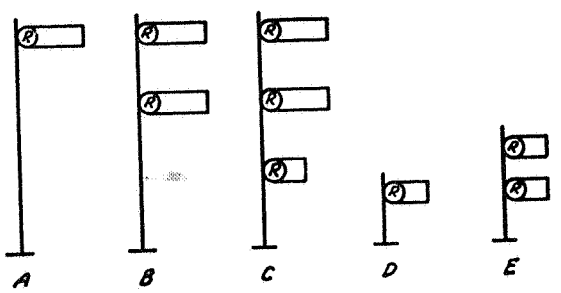


Fig. 32.

Day and night aspects for color light signals shall have the same colors as the night aspects of the semaphore signals. Day and night aspects for position light signals shall have the same positions as the day aspects of the semaphore signals. Aspects shown are typical. Each road should show the aspects and colors of lights it uses.

Indication—Stop.
Name—Stop.

Trains receiving Stop indication must stop and stay until a more favorable indication is received or until authorized to pass the Stop signal by train order, clearance form or other method in vogue on the railway involved.

Where two or more lights are used on semaphore and color light Stop signals, they are vertically arranged. Purple in lieu of red is used by some roads on dwarf signals to indicate Stop.

Stop and Proceed indication, Fig. 31, is closely allied with the Stop indication shown in Fig. 32. The indications given by each rule require the train to stop, those in Fig. 32 requiring the train to stay until a more favorable indication is displayed or authority received to pass it, while those in Fig. 31 permit the trains to proceed after having stopped, expecting to find a train in the block, broken rail, obstruction or switch not properly set.

The signal aspects in Fig. 32 are those ordinarily used at interlockings and block stations, or other points where it is necessary to hold trains. The signal aspects in Fig. 31 are those used as automatic block signals where stop and stay until authorized to proceed

is not required. Where two lights are used they are diagonally arranged, or staggered.

On some roads automatic block signals are equipped with number plates, and, on some of these, the number plate is used in connection with the signal aspect to distinguish a signal whose most restrictive indication is more favorable than the Stop signal. For example, some roads use a square end blade on all semaphore signals and apply the number plate on Stop and Proceed signals only.

There are in service a large number of fishtail signals as shown in Fig. 33, for which there is no A.R.A. rule, and there are no color light or color position light signals giving a corresponding indication although same could be provided safely for color light signals having two lights.

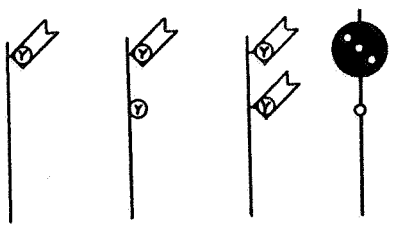


Fig. 33.
Indication—Approach Home Signal With Caution.
Name—Caution Signal.

These signals are used on some roads to govern the approach of trains to block and interlocking signals outside of automatic block system territory; some roads use an automatic signal with pointed arm or its equivalent light signal for this purpose. This practice, however, may require a train to stop at a signal for which no Caution or Approach signal was displayed. The signal, having a fishtail arm, displays no indication as to whether or not the track is occupied. The aspect shown for Caution signal, Fig. 37, is used with the position light signal when the track is occupied or a switch is open. The Approach signal, Fig. 25, is used when the track is clear, switches properly set, and home signal is at Stop.

Grade signals.

The grade or tonnage signal is used, on some roads, in automatic block system territory, where for various reasons it is not desired to arrange the signal system to display Permissive or Slow Speed. It is used primarily to permit heavy tonnage freight trains, on ascending grades, to proceed at restricted speed by a Stop and Proceed signal without stopping. However, on some roads all freight trains may pass these signals without stopping, while on other roads all

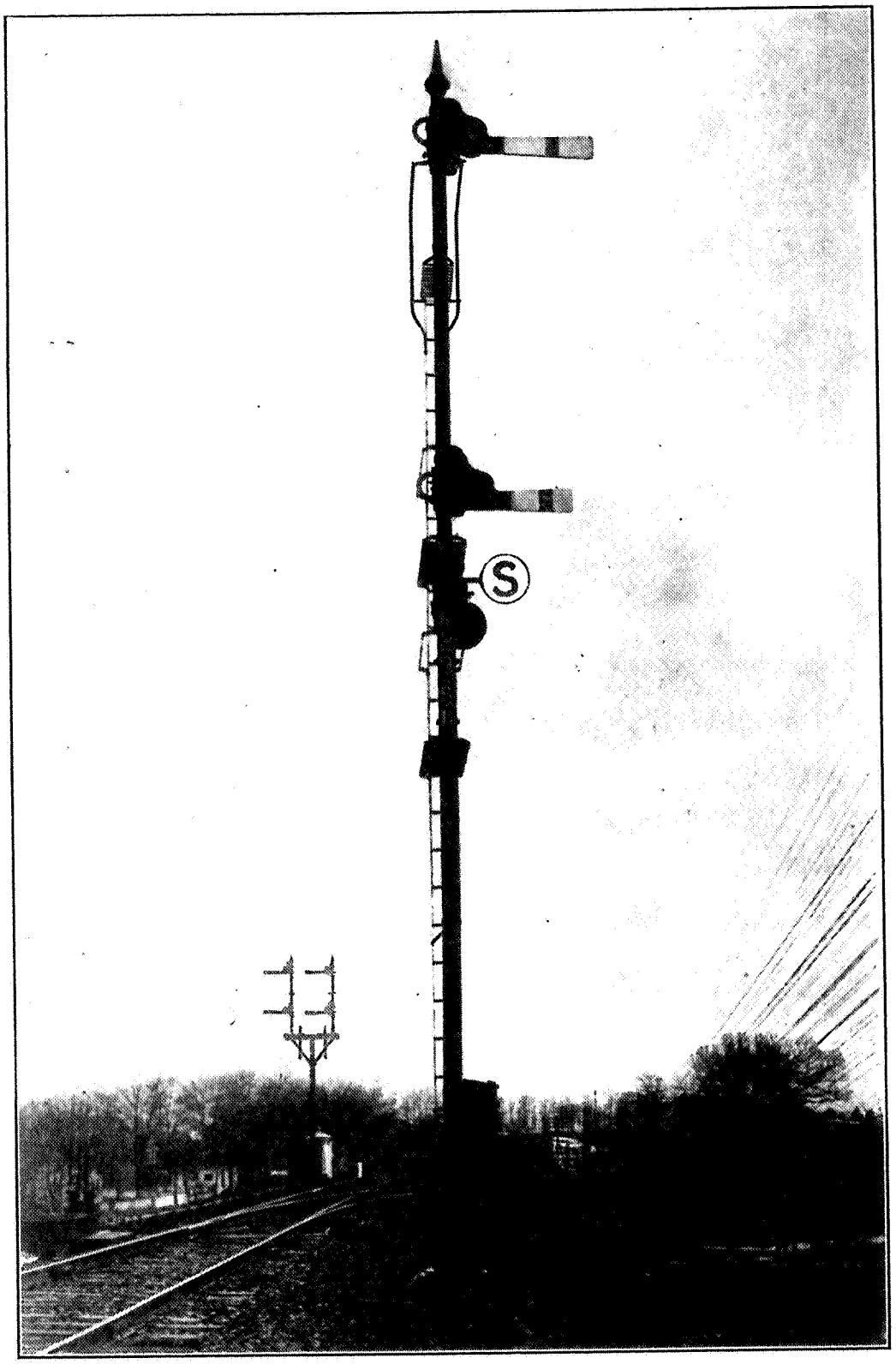


Fig. 34.
Example of Application of Take Siding Indicator.

trains may do so. This signal is used generally on ascending grades; however, it is also used at other points where it is desired to eliminate the stop at an automatic block signal.

All roads permitting trains to pass Stop and Proceed signals without stopping, provide some sort of distinctive aspect for the purpose.

Some of the aspects employed are as follows:

1. Short semaphore arm 45 degrees, pointed arm, night aspect yellow; arm located below block signal arm on same mast. The arm with a light shining on it is also used for the night aspect.
2. A yellow disc, displaying the letter "G," mounted on the signal mast is the aspect on several large roads. On some roads the "G" is illuminated for the night aspect; a yellow instead of a red marker light is also used as a night aspect.
3. On some roads where the block signals have red arms, a yellow arm is substituted for the day aspect, and a yellow light in place of the usual red light for the night aspect.

Take siding indicators.

There is no "take siding indicator" in the Standard Code; however, there is one illustrated in the Signal Section Manual which is reproduced in Fig. 34. Other forms are in use, such as the position light type, aspect and indication shown in Fig. 37 and the short semaphore arm below the regular arm.

Semaphore signals.

The semaphore signal is the type most generally in use on the American railways today although in many of the new signal installations light signals are being used and on some roads when renewals are necessary.

The aspects for semaphore signals shown in Figs. 20 to 33, inclusive, are those for upper-quadrant signals, which is the type most generally installed for new work and renewals. There are, however, many lower-quadrant signals in service. Three-position lower-quadrant signals give the same indications for corresponding positions as upper-quadrant signals.

Two-position lower-quadrant signals were in use many years before the three-position signals were developed. This type of signal requires two arms to give the three indications which may be given with one three-position signal arm.

In Fig. 35 are shown some of the lower-quadrant, two-position signal aspects and indications. No attempt is made to show a complete set of such aspects as there are so many possible combinations. Those shown illustrate the principles involved. Three-position signaling simplifies the signaling as fewer aspects are necessary to convey the various indications.

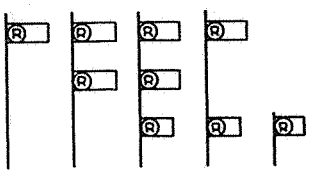
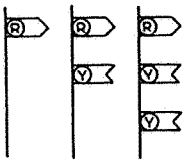
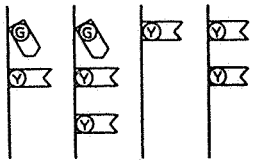
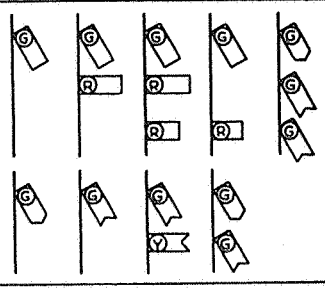
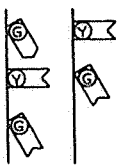
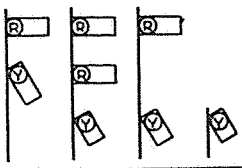
INDICATION	NAME	ASPECT
STOP	STOP	
STOP-THEN PROCEED	STOP AND PROCEED	
PREPARE TO STOP AT NEXT SIGNAL. TRAIN EXCEEDING MEDIUM SPEED MUST AT ONCE REDUCE TO THAT SPEED.	APPROACH	
PROCEED	CLEAR	
APPROACH NEXT SIGNAL AT NOT EXCEEDING MEDIUM SPEED	APPROACH-MEDIUM	
PROCEED AT MEDIUM SPEED	MEDIUM-APPROACH	
PROCEED AT RESTRICTED SPEED	RESTRICTING	

Fig. 35.

Lower-Quadrant Semaphore Signals.

Color light signals.

As previously stated, the aspects of light signals are the same both day and night, using the same colors as the night aspects of the semaphore signal, except as stated in connection with Fig. 33, no aspects corresponding with those of the semaphore signal using fish-tail blades are being used.

While the practice thus far in America has been to follow the night aspects of semaphore signals, a system of color light signals reducing the number of aspects could be worked out. In England, a system known as "four-aspect color light signals" is being used by some railroads. This system is based on the same principles as three-block indication which is illustrated in Fig. 22. In this system, one red light is used for stop; one yellow light, caution—be prepared to stop at next signal; two yellow lights, attention—run at medium speed; one green light, proceed. In automatic block system territory this scheme would agree with the principles and practice of the American roads, but at interlockings where more than one route is involved, complications arise. An attempt is made to so signal the routes that it will not be necessary for a train to pass a red light; this, however, cannot be done except by the use of route indicators and other auxiliary devices used in connection with the four-aspect signal. The system generally uses one four-aspect signal, regardless of the number of routes, and an indicator to designate the route to be taken.

The color light signal aspects, Figs. 20 to 32, are based on the night aspects of three-position semaphore signals. The aspects and indications for color light signals were not, prior to the revision of January 17, 1928, referred to in the Standard Code. This, probably, has been one of the main reasons for the wide difference in practice on various railroads in the use of color light signal aspects and indications. Figure 36 shows some of these aspects and indications not covered by Figs. 20 to 32.

Position light signals.

The aspects and indications of this type of signal are given by positions day and night. The positions are given by rows of lights (all the same color), the high signals having three lights per row and the dwarf signals two lights per row. The position light signal is more flexible than the semaphore or color light signal in that four positions may be secured from each arm while three positions or colors is the maximum with the semaphore, and with the color light signals, except by use of color combinations, as, for instance, the "four-aspect color light signal" being used in England.

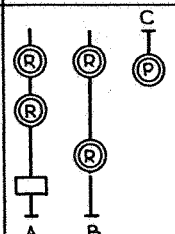
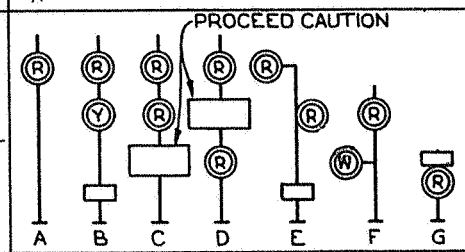
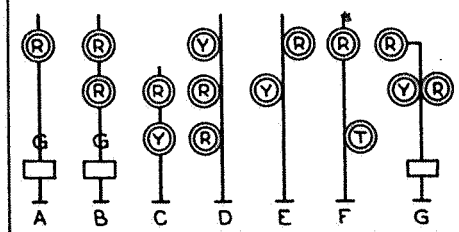
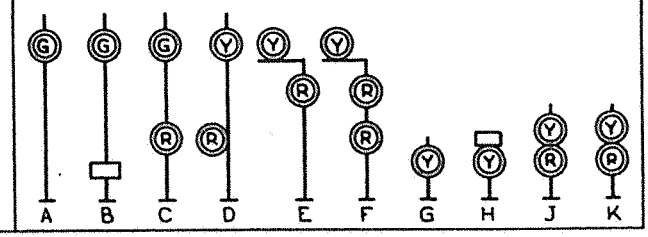
INDICATION	NAME	ASPECT
STOP	STOP SIGNAL	
STOP	SIDING INDICATOR STOP SIGNAL	
STOP	SWITCH MAY BE OPENED	
STOP-THEN PROCEED	STOP AND PROCEED SIGNAL	
STOP AND PROCEED	GRADE SIGNAL	
APPROACH NEXT SIGNAL PREPARED TO STOP	APPROACH SIGNAL	

Fig. 36. (Sheet One)
Color Light Signals.

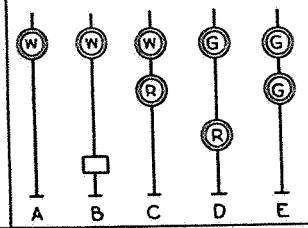
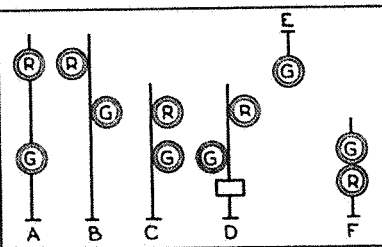
INDICATION	NAME	ASPECT
PROCEED	PROCEED (OR CLEAR) SIGNAL	
APPROACH NEXT SIGNAL AT RESTRICTED SPEED	APPROACH RESTRICTING SIGNAL	
PROCEED AT RESTRICTED SPEED	CLEAR RESTRICTING SIGNAL	
PROCEED AT RESTRICTED SPEED PREPARED TO STOP AT NEXT SIGNAL	RESTRICTING SIGNAL	
PROCEED TO NEXT SIGNAL AT RESTRICTED SPEED	RESTRICTING SIGNAL	
PROCEED AT SLOW SPEED	CLEAR SLOW SPEED SIGNAL	

Fig. 36. (Sheet Two)
Color Light Signals.

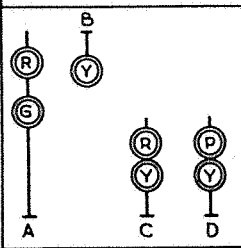
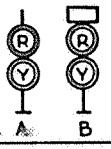
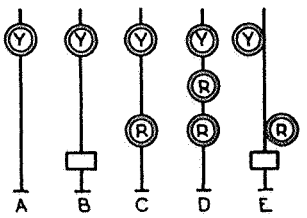
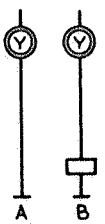
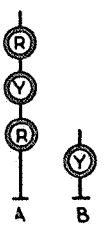
INDICATION	NAME	ASPECT
PROCEED AT SLOW SPEED PREPARED TO STOP	SLOW SPEED SIGNAL	
PROCEED AT SLOW SPEED PREPARED TO STOP SHORT OF TRAIN OR OBSTRUCTION	PERMISSIVE SIGNAL	
PROCEED WITH CAUTION	CAUTION SIGNAL	
PROCEED WITH CAUTION AT RESTRICTED SPEED	CAUTION RESTRICTING SIGNAL	
PROCEED TO NEXT SIGNAL PREPARED TO STOP	PROCEED SIDING SIGNAL	
PROCEED FROM MAIN LINE TO SIDING AT SLOW SPEED PREPARED TO STOP SHORT OF TRAIN OR OBSTRUCTION	PERMISSIVE SIGNAL	

Fig. 36. (Sheet Three)
Color Light Signals.

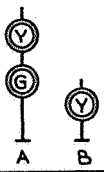
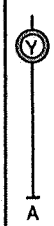
INDICATION	NAME	ASPECT
PROCEED WITH CAUTION ON MAIN ROUTE		
PROCEED WITH CAUTION ON SECONDARY OR DIVERGING ROUTE		
PROCEED WITH CAUTION END OF BLOCK SYSTEM	END OF BLOCK SIGNAL	
PROCEED AT SLOW SPEED INTO YARD TRACK		
PPOCEED ON SECONDARY OR DIVERGING ROUTE		

Fig. 36. (Sheet Four)
Color Light Signals.

Position light signal aspects, indications and names as generally used are shown in Fig. 37. By referring to this figure, it may be seen that it is the practice in using position light signals to display only the various arms, or rows of lights, as necessary: for instance, the Stop signal displays only one horizontal row of lights as it is unnecessary to light additional arms to indicate Stop.

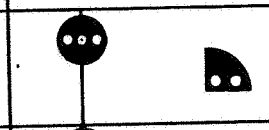
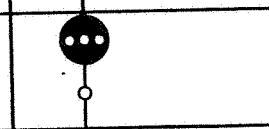
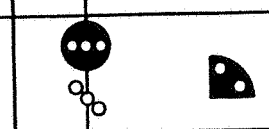
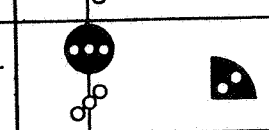
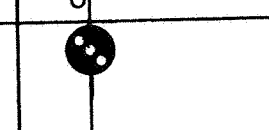
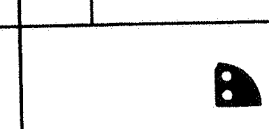
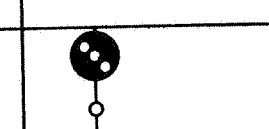
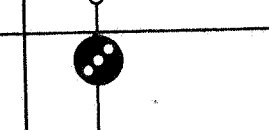
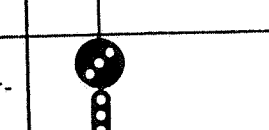
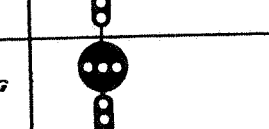
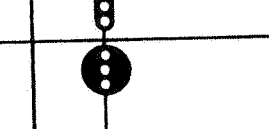
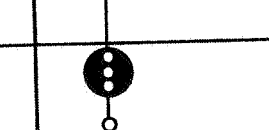
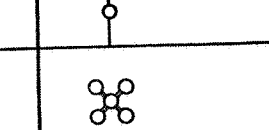
INDICATION	NAME	ASPECT
STOP	STOP SIGNAL	
STOP - THEN PROCEED	STOP AND PROCEED SIGNAL	
PROCEED AT SLOW SPEED WITH CAUTION PREPARED TO STOP	CAUTION SLOW SPEED SIGNAL	
PROCEED AT SLOW SPEED PREPARED TO STOP AT NEXT SIGNAL	SLOW SPEED SIGNAL	
PROCEED WITH CAUTION PREPARED TO STOP SHORT OF TRAIN OR OBSTRUCTION	PERMISSIVE BLOCK SIGNAL	
PROCEED AT SLOW SPEED	CLEAR SLOW SPEED SIGNAL	
APPROACH NEXT SIGNAL PREPARED TO STOP WHERE A FACING SWITCH IS CONNECTED WITH THE SIGNAL, APPROACH THAT SWITCH PREPARED TO STOP. A TRAIN EXCEEDING ONE-HALF ITS MAXIMUM AUTHORIZED SPEED AT POINT INVOLVED MUST AT ONCE REDUCE TO NOT EXCEEDING THAT SPEED	CAUTION SIGNAL	
APPROACH NEXT SIGNAL PREPARED TO STOP. A TRAIN EXCEEDING ONE-HALF ITS MAXIMUM AUTHORIZED SPEED AT POINT INVOLVED MUST AT ONCE REDUCE TO NOT EXCEEDING THAT SPEED	APPROACH SIGNAL	
APPROACH NEXT SIGNAL AT RESTRICTED SPEED	APPROACH RESTRICTING SIGNAL	
PROCEED AT RESTRICTED SPEED	CLEAR RESTRICTING SIGNAL	
PROCEED	CLEAR SIGNAL	
PROCEED - MANUAL OR CONTROLLED MANUAL BLOCK CLEAR.	CLEAR BLOCK SIGNAL	
TAKE SIDING	TAKE SIDING INDICATOR	

Fig. 37.

Position Light Signals.

The aspect for the Permissive block signal, Fig. 29, is the same as one of the aspects of the Approach signal, Fig. 25, in the Standard Code for semaphore and color light signals; with the position light signals there is a distinctive aspect for each of these indications, the lower right-hand quadrant position being used for the permissive. On some roads this feature on semaphore signals is covered by using a differently shaped blade by day and a different combination of lights at night. A distinction is also made with the position light signal between a clear manual or controlled manual block signal and any other clear signal by the addition of a marker light. With the semaphore this distinction may be made by a differently shaped blade and a different combination of lights.

Color position light signals.

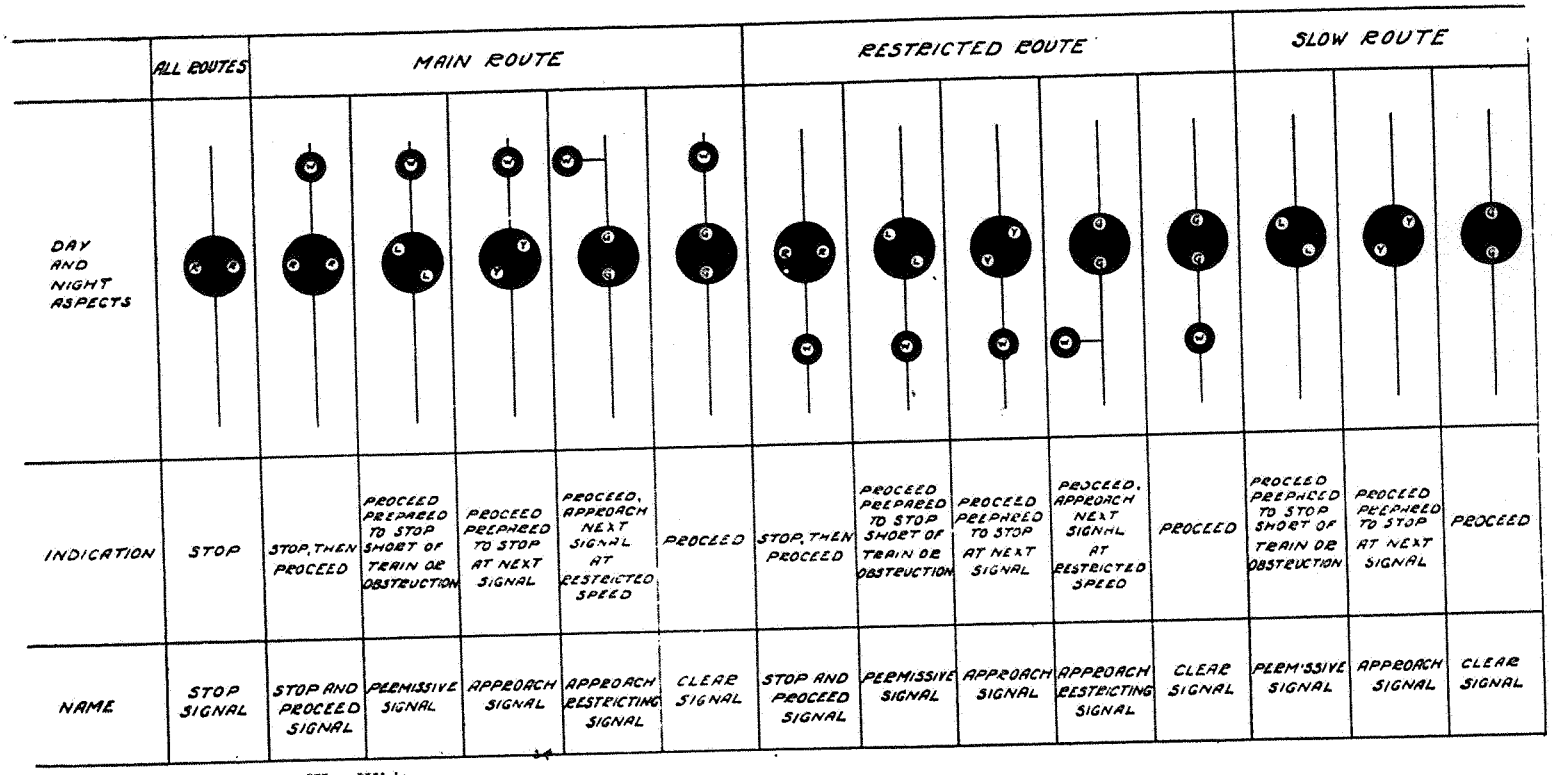
The aspects and indications of this type of signal are given both by colors and positions, day and night. The positions are given by two lights in a row on both high and dwarf signals, each row having a distinctive color. There is but one arm used and its positions are the same as those used with the position light signal. Red, yellow and green as used with semaphore and color light signals are used as is also lunar white; red being used in the stop row, yellow in the approach row, green in the clear row and lunar white in the lower-quadrant or permissive row. The different speeds or routes are indicated by a white marker light above or below the arm or the absence of a marker light. The white marker above the arm indicates authorized speed or main route; below the arm, medium speed route, and no marker lights, slow speed route. The marker light is in line with the mast or center of signal for all indications, where used, except the Approach-Restricting signal, in which case it is to the left of the mast as seen from an approaching train.

The aspects, indications and names for the color position light signals are shown in Fig. 38, and with the explanations of the aspects and indications given above no detailed explanation is necessary.

The system as now used is based on three-arm scheme of signaling, and, like the position light signal, the indications can be given with fewer aspects than with semaphores.

The aspects and indications in Fig. 38 are as in use. The dwarf signals are not shown in this figure as they are the same as the high signals without the marker light, except for height and size.

The indications of the position light signals are given by positions corresponding with the positions of the arm of the semaphore signal. The indications of color position light signals are also given by positions and in addition by the three colors generally used with



W—White.
L—Lunar White.

Fig. 38.
Color Position Light Signals.

semaphore and color light signals for the giving of three, and lunar white for the fourth or the Permissive indication; the marker light is white.

General.

Reference is made in some of the indications to medium, slow and restricted speed. Generally, where no speed is mentioned, authorized speed for that portion of the road being used is permitted.

Until the Railway Signal Association (now the Signal Section, American Railway Association) adopted its principles of signaling (1912) there was a great variety of aspects and indications. These have been reduced to a scientific basis as shown above. There are 28 semaphore aspects, exclusive of the two-position lower-quadrant, shown in the various figures, and these cover the three schemes of signaling: namely, one, two and three-arm. One road some years ago had on its lines over a hundred semaphore aspects; the adoption of a scheme of uniform signaling has reduced its standard semaphore aspects to 39, including the distinctive aspects used for grade signals and for manual and controlled manual block signaling. When the hundred aspects were in service many of them had more than one meaning or indication.

While much uniformity has been attained in the use of semaphore signals, such uniformity has not been attained in the installation of light signals, as many such installations have added aspects not previously used or given different indications for aspects already in use as well as having an aspect give two or more indications until the color light signal aspects and indications are in much the same state as the semaphore aspects and indications were prior to the time the Railway Signal Association adopted its principles of signaling. Some examples may be seen by referring to Fig. 36. This state of affairs has been recognized by the Signal Section which has, in conjunction with the Operating Division, prepared the aspects and indications shown in Figs. 20 to 32. These aspects and indications will, no doubt, be a guide for future color light signal installations as well as provide a basis for the revision of the color light signal aspects and indications now in service, to the end of greater uniformity between the various roads and the removal of conflicting aspects on the same road.

There are two basic principles in the use of aspects and indications which should never be overlooked: first, the undesirability of using one aspect to give two or more indications, and second, the undesirability of providing a multiplicity of aspects which would be confusing to the engineman. The picture received by the mind should have only one meaning and thus avoid the possibility of con-

fusion arising in the engineman's mind which may cause hesitation when prompt action should be taken, or the taking of the wrong action.

The principles involved in the determination of the various aspects and indications are covered in Chapter III—Principles of Signaling, while the details of the various kinds of signals are covered in Chapters XII—Semaphore Signals, and XIII—Light Signals.

Cab signals and cab indicators.

Cab indicators of the audible type were used in Europe as early as 1880, some of which were placed in service on the Northern Railway of France in that year. Other roads in the European countries have used similar cab indicators. Trial installations of visual cab indicators also have been made. However, most of these installations made use of the cab indicator only in connection with distant signals, and this primarily on account of dense fogs experienced.

On the American continent cab signals and cab indicators did not receive serious consideration until the era of automatic train stop and automatic train control in the United States of America. Both audible and visual signals are now in use.

With the intermittent automatic train stop the cab indicator is usually an audible one produced by an air whistle, a bell, or both. In some systems the whistle or bell indicates that the receiver on the locomotive has passed over an open inductor, providing the acknowledging lever is manipulated, while in other installations, the whistle is used for the above purpose and the bell acts as a check on the proper functioning of the wayside inductor. When an engineman acknowledges prior to passing a restrictive signal indication, the bell rings when the receiver passes over an open inductor. If an engineman acknowledges the indication and the bell fails to ring, he knows there is something wrong either with the engine equipment or inductor. In addition to this, on one road there is in use an indicator in the cab with a white light displayed when the train-stop apparatus is in working order and cut in. On another road a red light is displayed in the cab at the instant an automatic application is received; this in addition to the audible signal. When the locomotive circuits are set up for free running, no light is shown and no audible signal is sounded.

With the continuous automatic stop or with speed control, a cab signal (designated by one road, "Visual indicator") is used; however, the practice on various roads differs. The practice of one road is cited:

On this road, bell, whistles and a visual indicator were used and the following appears in a small booklet which contains information and instructions for handling automatic train speed control apparatus:

"Bell

This is a single stroke gong mounted on the inside back wall of the cab on the engineer's side.

When this 'gong' sounds it indicates that the low speed restriction is removed.

"Warning Speed Whistle

This is a Soft-Toned Chime Whistle mounted over the boiler in the cab.

When this whistle is sounded it indicates that the speed of the train is within the warning speed limits.

This whistle will stop blowing as soon as the speed has been properly reduced.

"Acknowledging Whistle

This is a Sharp-Toned Whistle mounted over the boiler in the cab.

When this whistle sounds the engineer should immediately acknowledge same by means of the acknowledging lever later described.

When properly acknowledged this whistle will immediately stop blowing.

"Visual Indicator

This is a box mounted on the inside front wall of the cab on the engineer's side containing two lights:

GREEN—Indicating *'Proceed.'*

YELLOW—Indicating *'Proceed at Slow Speed Prepared to Stop.'*

"The change from Green light to Yellow light will precede the whistle indications by 175 to 200 feet when the speed of the train is over 20 miles per hour and will precede the whistle indications ¼ mile when the speed is under 20 miles per hour. Acknowledgment should not be made until the acknowledging whistle blows but if done it should be repeated when acknowledging whistle blows.

"The change from Yellow light to Green light will be accompanied by a single stroke of the bell.

"When passing over short sections of track where current may not be picked up for a distance of less than 175 feet such as staggered joints at the end of a track circuit or at a railroad

crossing, the light may flash from green to yellow and back to green without the whistles or bell sounding. No attention need be paid to these flashes.

"When either indication light is lit it indicates that the current on the engine is 'cut in' for train control operation and the actuator can then be cut in.

"The train control should not be cut out on account of a failure of either or both lights if device is otherwise operating properly as this may only be due to failure of bulb."

Since the issuance of the booklet, electric horns have been substituted for the whistles without changing the meaning of the indications.

Some roads use two-aspect cab signals, while others use three or four aspects. On some roads where continuous automatic stop or speed control is in service all wayside signals except Stop signals at points where trains may be held are eliminated. One road is now installing four-aspect cab signals without the automatic stop or train control. The wayside signals are being retained.

The two-aspect cab signals are shown in Fig. 39. Indication (B) is generally used where wayside signals are in service and indication (C) is generally used where wayside signals, except Stop signals, are eliminated.

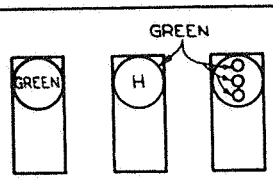
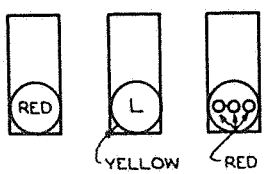
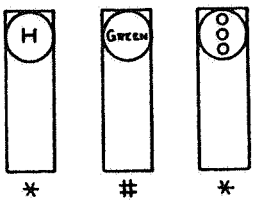
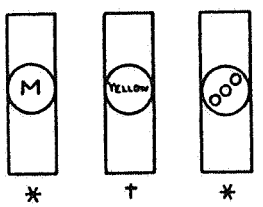
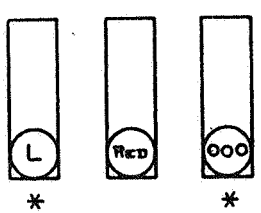
	SIGNAL	INDICATION	ASPECT
(A)	CLEAR CAB SIGNAL	PROCEED	
(B)	LOW SPEED CAB SIGNAL	APPROACH NEXT SIGNAL PREPARED TO STOP	
(C)	RESTRICTING CAB SIGNAL	PROCEED AT RESTRICTED SPEED	

Fig. 39.
Two-Aspect Cab Signals.

The general practice where three-aspect cab signals are used is as shown in Fig. 40.

On some of the recent installations four-aspect cab signals have been installed, the aspects displayed by the various roads are shown in Fig. 41.

	Signal	Indication	Aspect
(A)	Clear cab signal	Proceed	
(B)	Approach cab signal	Approach next signal prepared to stop	
(C)	Medium speed cab signal	Proceed at medium speed	
(D)	Low speed cab signal	Observe Figs. 27, 28, 30 or 31 as displayed by wayside signal	
(E)	Caution slow speed cab signal	Proceed at not exceeding fifteen miles per hour with caution. Prepared to stop short of train or obstruction	

* Generally displayed with white lights, some roads use green, yellow and red respectively
\# One road uses white
† One road uses green

Fig. 40.
Three-Aspect Cab Signals.

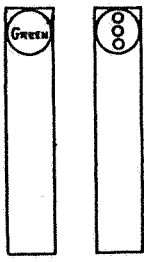
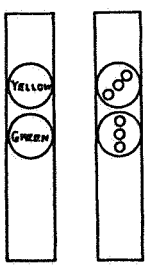
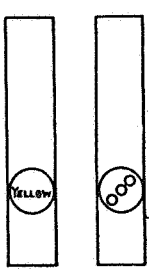
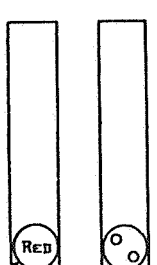
	Signals	Indication	Aspect
(A)	Clear Cab Signal	Proceed	
(B)	Approach Restricting Cab Signal	Observe as indicated by wayside signal :- Approach next signal at restricted speed OR Proceed at restricted speed.	
(C)	Approach Cab Signal	Proceed at speed reduced to not exceeding one half the maximum authorized (not exceeding 30 miles per hour) Prepared to stop at the next signal.	
(D)	Caution slow speed cab signal when passing wayside signal. Figs. 27,28 & 30	Proceed at low speed prepared to stop	 One road uses Lunar White.
(E)	Within interlocking limits, if cab signal changes to caution slow speed after entering such limits, excepted as authorized by Figs. 27,28,& 30	Stop	
(F)	Caution slow speed cab signal at entrance to automatic train control territory, when passing wayside signal Fig. 31.	Observe Fig 31	
(G)	Caution slow speed cab signal that appears between wayside block signals.	Observe Fig. 31	

Fig. 41.

Four-Aspect Cab Signals.

Audible signals are sometimes used with visual cab signals, usually a whistle, although single stroke gongs have been used. The whistle or bell sounds to advise the engineman of a change of his visual cab signal to a more restrictive indication and, in case of the whistle, blows continuously from the time the indication changes until an automatic application occurs or until the engineman takes proper action.

In the application of the cab signals, the general principles which apply for wayside signals have been followed as far as practicable.

This chapter deals only with aspects, etc.; the details of construction, control, etc., will be covered in subsequent chapters.

American Railway Signaling Principles and Practices

QUESTIONS ON

CHAPTER II

Symbols, Aspects and Indications

QUESTIONS ON CHAPTER II

SYMBOLS, ASPECTS AND INDICATIONS

Symbols

1. What are symbols as used in railway signaling?
2. What difficulty would be met in designing apparatus, etc., without the use of symbols?
3. What is the necessity for standard symbols in any given field of endeavor?
4. In Fig. 1, showing symbols used for signals, what does the first or upper section show?
5. What do the headings of the columns indicate?
6. What do the headings of the lines indicate?
7. What does the first symbol in each column (numbered 1 to 7, inclusive) indicate? Give two illustrations.
8. What does the first symbol in each line (lettered A to E, inclusive) indicate?
9. How are the various combinations in three-position signaling indicated?
10. Are these characters employed in two-position signaling?
11. How is a two-position, 0 to 60 degree, non-automatic power signal shown?
12. What does 0 to 60, 0 to 70, 0 to 75, and 0 to 90 in two-position signaling indicate?
13. Usually, does any railroad having two-position signaling use more than one angle of movement of signal arm?
14. Are all three positions always used in three-position signaling?
15. Are letters and numbers shown with the symbols used on plans?
16. Where is signaling employed as shown by symbols "E24" and "E25"?
17. What does the third section of Fig. 1 cover?
18. What designations are shown in the lower section of Fig. 1?
19. Are symbols shown in Fig. 1 standard and now used by the Signal Section, A.R.A., as recommended practice?
20. What are the advantages of the present Signal Section, A.R.A., symbols over those previously used?
21. How was a light signal designated with the old symbols?
22. Are the same principles followed in the old and new symbols?
23. What is the symbol generally used for track battery?
24. In what position are switches and derails always shown on plans?
25. From what are the terms two and three-arm signaling derived?

26. Draw the symbol for a two-arm high signal, system of three-position upper-quadrant signaling, top arm semi-automatic, stick power-operated, 0 to 90 degrees, bottom arm semi-automatic, stick, power-operated, 0 to 45 degrees.

27. Draw the symbol for a distant signal having forked or fishtail end, automatically operated and working 45 to 90 degrees.

28. Draw the symbol for an interlocking home signal arm fixed in the Stop position.

29. Draw the symbol for an interlocking home signal operating 0 to 45 degrees.

30. Draw the symbol for an automatic signal operating 45 to 90 degrees.

31. What is the symbol for a high signal mast?

32. What is the symbol for a dwarf signal mast?

33. What kind of signals do square end blades indicate and what is their most restrictive indication?

34. What kind of signals do pointed end blades indicate and what is their most restrictive indication?

35. What kind of signals do fishtail blades indicate?

36. What is the practice on many roads in regard to the use of marker lights?

37. What do the letters "E" and "M" placed near signal symbols indicate?

38. Draw the symbol for an audible highway crossing signal.

39. Draw the symbol for a wig-wag highway crossing signal.

40. Draw the symbol for a flashing light highway crossing signal.

41. Draw the symbol for a water column.

42. Draw the symbol for a milepost.

43. Draw the symbol for a road crossing at grade.

44. Draw the symbol for a signal bridge.

45. Draw the symbol for a tunnel.

46. How is an electromagnet or the coils of an instrument shown?

47. How is an alternating current instrument shown as compared with a direct current instrument?

48. How are contacts shown:
    (a) Energized?
    (b) De-energized?

49. Draw the symbol for a direct current electromagnet.

50. Draw the symbol for an alternating current electromagnet.

51. Draw the symbol for a neutral relay with coils energized.

52. Draw the symbol for a neutral relay with coils de-energized.

53. Draw the symbol for a polarized relay contact.

54. Draw the symbol for a three-position relay contact.

55. Draw the symbol for a high current contact.

56. Draw the symbol for a magnetic blow-out contact.

57. Draw the symbol for a bell attachment.

58. Draw the symbol for a double winding.

59. Draw the symbol for a slow-acting magnet.

60. Draw the symbol for a disc type indicator with disc visible and disc invisible.

61. Draw the symbol for a semaphore type indicator, two-position and three-position.

62. Draw the symbol for a wire wound rotor.

63. Draw the symbol for a stationary winding.

64. Draw the symbols for electric lock showing segments cut to lock normal, normal indication, reverse, normal and reverse.

65. Draw the symbol for a direct current interlocked relay.

66. Draw the symbol for an alternating current interlocked relay.

67. Describe the letter symbol used for circuit controllers operated by levers.

68. What does the letter used in the letter symbol represent?

69. Describe the graphic symbols used for circuit controllers operated by levers.

70. With the graphic symbols where the circuit is closed during a considerable portion of the movement of the lever, how is this represented?

71. With graphic symbol, how are levers with the center position as normal, distinguished from those with the extreme end position as normal?

72. Draw the letter symbol for levers with extreme end position as normal, in the following positions:

(a) Normal.
(b) Normal indication.
(c) Center.
(d) Reverse indication.
(e) Reverse.
(f) Circuit closed from normal to normal indication position.
(g) Circuit closed from reverse to reverse indication position.
(h) Circuit closed from normal indication to reverse indication position.
(i) Circuit closed from normal to center position.
(j) Circuit closed from center to reverse position.
(k) Circuit closed from normal to reverse indication position.
(l) Circuit closed from normal indication to reverse position.
(m) Circuit closed through the entire stroke except at full normal and full reverse position.
(n) Circuit closed from normal indication position to just before normal.
(o) Circuit closed from reverse indication position to just before reverse.
(p) Circuit closed from center position to normal indication position.
(q) Circuit closed from center position to reverse indication position.

(r) Circuit closed from normal to just before normal indication position.

(s) Circuit closed from reverse to just before reverse indication position.

73. Draw the graphic symbols for lever with extreme end position as normal, in the following positions:

(a) Normal.
(b) Normal indication.
(c) Center.
(d) Reverse indication.
(e) Reverse.
(f) Circuit closed from normal to normal indication position.
(g) Circuit closed from reverse to reverse indication position.
(h) Circuit closed from normal indication to reverse indication position.
(i) Circuit closed from normal to center position.
(j) Circuit closed from center to reverse position.
(k) Circuit closed from normal to reverse indication position.
(l) Circuit closed from normal indication to reverse position.
(m) Circuit closed through the entire stroke except at full normal and full reverse position.
(n) Circuit closed from normal indication position to just before normal.
(o) Circuit closed from reverse indication position to just before reverse.
(p) Circuit closed from center position to normal indication position.
(q) Circuit closed from center position to reverse indication position.
(r) Circuit closed from normal to just before normal indication position.
(s) Circuit closed from reverse to just before reverse indication position.

74. Draw the letter symbols for levers with middle position as normal, in the following positions:

(a) Circuit closed in the left position.
(b) Circuit closed in the indication position to the left.
(c) Circuit closed in the normal position.
(d) Circuit closed in the indication position to the right.
(e) Circuit closed in the right position.
(f) Circuit closed from left to left indication position.
(g) Circuit closed from right to right indication position.
(h) Circuit closed between right indication and left indication position.
(i) Circuit closed from normal left.
(j) Circuit closed from normal right.

(k) Circuit closed from left to right indication position.
(l) Circuit closed from right to left indication position.
(m) Circuit closed through the entire stroke except in the full normal and full reverse positions.
(n) Circuit closed from left indication position to just before the full left position.
(o) Circuit closed from right indication position to just before the full right position.
(p) Circuit closed from normal to left indication position.
(q) Circuit closed from normal to right indication position.
(r) Circuit closed from left to just before the left indication position.
(s) Circuit closed from right to just before the right indication position.

75. Draw the graphic symbols for levers with middle position as normal, in the following positions:
(a) Circuit closed in the left position.
(b) Circuit closed in the indication position to the left.
(c) Circuit closed in the normal position.
(d) Circuit closed in the indication position to the right.
(e) Circuit closed in the right position.
(f) Circuit closed from left to left indication position.
(g) Circuit closed from right to right indication position.
(h) Circuit closed between right indication and left indication position.
(i) Circuit closed from normal left.
(j) Circuit closed from normal right.
(k) Circuit closed from left to right indication position.
(l) Circuit closed from right to left indication position.
(m) Circuit closed through the entire stroke except in the full normal and full reverse positions.
(n) Circuit closed from left indication position to just before the full left position.
(o) Circuit closed from right indication position to just before the full right position.
(p) Circuit closed from normal to left indication position.
(q) Circuit closed from normal to right indication position.
(r) Circuit closed from left to just before the left indication position.
(s) Circuit closed from right to just before the right indication position.

76. Draw the symbols for circuit controllers operated by upper-quadrant three-position signals closed in the following positions:
(a) Circuit closed at 0 degree only.
(b) Circuit closed at 45 degrees only.
(c) Circuit closed at 90 degrees only.
(d) Circuit closed at 0 to 45 degrees.

(e) Circuit closed at 45 degrees to 90 degrees.

77. Draw similar symbols for lower-quadrant signals:

(a) Circuit closed at 0 degree only.
(b) Circuit closed at 45 degrees only.
(c) Circuit closed at 90 degrees only.
(d) Circuit closed at 0 to 45 degrees.
(e) Circuit closed at 45 to 90 degrees.

78. Draw the symbols for circuit controllers operated by two-position upper-quadrant signals:

(a) Closed at 0 degree only.
(b) Closed in Clear position only.

79. Draw the symbols for circuit controllers operated by two-position lower-quadrant signals:

(a) Closed at 0 degree only.
(b) Closed in Clear position only.

80. Draw the symbols for the following:

(a) Switch circuit controller with open and closed contacts.
(b) Circuit controller operated by locking mechanism of a switch movement.
(c) Pole changing circuit controller.
(d) Bridge circuit controller open and closed.
(e) Spring hand key or push button.
(f) Circuit switch.

81. Draw symbols for the following:

(a) Manual time release (electric) with open and closed contacts.
(b) Manual time release (electro-mechanical) with open and closed contacts.
(c) Automatic time release (electric) with open and closed contacts.
(d) Emergency release (electric) with open and closed contacts.

82. Draw the symbols for the following:

(a) Floor push.
(b) Latch contact.
(c) Track instrument contacts, open and closed.
(d) Rheostat.
(e) Single pole, single-throw knife switch.
(f) Double pole, single-throw knife switch.
(g) Single pole, double-throw knife switch.
(h) Double pole, double-throw knife switch.
(i) Fixed resistance.
(j) Variable resistance.
(k) Fuse.
(l) Impedance without iron core.
(m) Impedance with iron core.
(n) Condenser.

83. In the symbol for a condenser, what do the parallel lines represent and what do the spaces between the parallel lines represent?

84. Draw symbols for the following:

(a) A battery of two cells in multiple indicating positive and negative terminals.

(b) A battery of seven cells in series indicating positive and negative terminals.

85. What letters are used to designate, respectively:

(a) Dry battery.

(b) Gravity battery.

(c) Potash battery.

(d) Storage battery.

86. In the symbol for an electric cell, how is the negative terminal indicated and how is the positive terminal indicated?

87. Draw symbols for the following:

(a) Rectifier indicating which are the alternating current terminals and which the direct current terminals.

(b) Single-phase transformer indicating which are the primary and which the secondary windings.

(c) Single-phase transformer with two secondary windings.

(d) Transformer with case grounded.

(e) Transformer with grounding shield between windings.

(f) Direct current motor.

(g) Direct current generator.

(h) Alternating current motor.

(i) Alternating current generator.

(j) Direct current—direct current motor-generator.

(k) Alternating current—direct current motor-generator.

(l) Ammeter.

(m) Voltmeter.

(n) Watt-meter.

(o) Telephone.

(p) Incandescent lamp.

(q) Lightning arrester.

(r) Single terminal and double terminal.

(s) Wires crossing without being connected.

(t) Wires joined.

(u) Ground.

(v) Common wire.

(w) Other than common wire.

(x) Track circuit wire.

(y) Direction of current in a conductor.

88. Draw explanatory diagrams for the following:

(a) True meridian.

(b) Staff instrument.

(c) Staff lock.

(d) Staff crane.

(e) Yard limits.

(f) Pole line.

(g) Diagram of a short section of track with automatic signals.

(h) Air pipe and fittings showing an expansion joint, pipe anchor, reducer, union, combination cock and union, manifold condenser, main reservoir, auxiliary reservoir, plug cock, globe or gate valve.

(i) Splicing chamber.

(j) Rail locks, bridge locks, mechanical bridge coupler, ground levers, dwarf machine.

(k) Runs of connections showing pipe—wire (mech.); wire duct; compressed air; pipe—wire and duct; pipe—wire and air; duct and air; pipe—wire, duct and air.

(l) Special contacts on draw wedges and on time clocks.

(m) Three-position relay contacts closed to one extreme.

(n) Drop annunciator neutral.

(o) Manhole.

(p) Lever similar to that in Style A mechanical machine indicating positions N, B, C, D, R.

(q) Latch and lever similar to that in Saxby and Farmer mechanical machine indicating positions N, B, C, and R, D, C.

89. What are written circuits, and in general how are they arranged?

90. Draw the following symbols for written circuits:

(a) An operated unit designating the home control of signal No. 10.

(b) An operated unit designating electric lock on lever No. 10.

(c) An operated unit designating the distant control of signal No. 10.

(d) Front contact of two-position relay, closed.

(e) Front contact of two-position relay, open.

(f) Back contact of two-position relay, closed.

(g) Back contact of two-position relay, open.

(h) Polarized and three-position relay contact closed when normal.

(i) Polarized and three-position relay contact closed when reversed.

(j) Polarized and three-position relay contact closed when de-energized.

(k) Battery flowing from heel to point of two-position relay.

(l) Battery flowing from point to heel of two-position relay.

(m) Graphic symbol for circuit controller operated by lever.

(n) Letter symbol for circuit controller operated by lever.

(o) Circuit controllers operated by signals closed at the following positions of blade:

1. 0 degree only.
2. 45 degrees only.

3. 90 degrees only.
4. 60 degrees only.
5. From 0 to 45 degrees.
6. From 45 to 90 degrees.

(p) Circuit controllers operated by switch point closed when switch is normal.

(q) Circuit controllers operated by switch point closed when switch is reversed.

91. Draw the following symbols for written circuits:

(a) Circuit controllers operated by locking mechanism of switch movement shown in the closed and open positions.

(b) Latch contacts normally closed and normally open.

(c) Floor push normally closed and normally open.

(d) Time release contacts normally closed and normally open.

(e) Push button and strap key normally open and normally closed.

(f) Train stop contacts closed and open.

92. Using the standard symbols, draw a track circuit and signal diagram showing home and distant signals with approach and detector circuits necessary to interlock a single turnout.

(a) Indicate the location of insulated joints, jumpers, connections to track batteries, and track relays.

(b) Draw circuits for track repeaters and for electric locks on one signal lever and one switch lever.

93. Using symbols for written circuits, make a similar drawing to that required in Question 92.

Signal Aspects and Indications

94. How is a signal aspect defined?

95. How is a signal indication defined?

96. What definitions, for speed, are shown in the Standard Code of the American Railway Association, as revised January 17, 1928?

97. What is the definition for restricted speed?

98. At how many miles per hour is medium speed generally designated?

99. At how many miles per hour is slow speed generally designated?

100. In previous issues of the Standard Code, what was medium speed known as?

101. In previous issues of the Standard Code, what were slow speed and restricted speed known as?

102. What is the purpose of signal aspects and indications, as set forth in the Standard Code?

103. What are the aspects and indications designed to cover?

104. What schemes of signaling are the aspects and indications given for?

105. How are each set of aspects, having the same indications, identified?

106. How are indications given with semaphore signals?

107. How are indications given with light signals?

108. How do the day and night aspects for color light signals compare with the night aspect of semaphore signals?

109. How do the day and night aspects for the position light signal compare with the day aspect of the semaphore signal?

110. Make a sketch of a one, two and three-arm Clear signal, showing a Proceed indication.

111. Why do many roads use other aspects such as:

(a) Round end blades?

(b) Fishtail blades?

112. How may the aspects covered by the round end or fishtail blades be accomplished by night?

113. How many arms and/or lights does the Approach-Medium signal require?

114. What was the Approach-Medium signal known as for many years?

115. Make a sketch of a two and three-arm Approach-Medium signal showing an indication Approach Next Signal at Not Exceeding Medium Speed.

116. Why is the Approach-Medium aspect used, and what does it indicate?

117. For what movements may the next signal be displayed?

118. For what other indication is the Approach-Medium signal used?

119. Where and why may three-block indication be used?

120. In three-block indication territory, how many clear blocks does a Proceed indication indicate?

121. Make a sketch showing the aspects displayed behind a train, in three-block indication, automatic block system territory, with three clear blocks.

122. What are the least number of arms and/or lights required to display a Clear-Medium aspect?

123. What is the indication of a Clear-Medium signal?

124. Make a sketch of a two and three-arm Clear-Medium signal.

125. What does a Clear-Medium signal indicate?

126. How many arms are used on a signal that indicates Approach-Slow?

127. What does the Approach-Slow signal indicate?

128. What is the indication for the Approach-Slow signal?

129. Make a sketch of the Approach-Slow signal.

130. Why is the Distant (as formerly used) or Approach (as now used) necessary?

131. What is the indication for the Approach signal?

132. Make a sketch showing a one, two and three-arm Approach signal.

133. What does the Approach signal indicate?

134. How does the indication of the Approach signal differ from the former indication and why was the change made?

135. What two types of signal may the Approach indication be given from?

136. How many arms are used on a signal from which a Medium-Approach signal is given and what does it indicate?

137. What is the indication for a Medium-Approach signal?

138. Make a sketch of a Medium-Approach signal.

139. What signals may the Clear-Slow signal be given from?

140. What does the Clear-Slow signal indicate?

141. What is the indication for the Clear-Slow signal?

142. Make a sketch of the Clear-Slow signal.

143. Where is the Slow-Approach signal used, and for what other purpose may it be used?

144. What is the indication for the Slow-Approach signal?

145. Make a sketch of the Slow-Approach signal.

146. Where and when is the Permissive signal used?

147. What is the indication for the Permissive signal?

148. Make a sketch of a Permissive signal.

149. What signal is required from which to display the Restricting signal and what is it used for?

150. What is the indication for Restricting signal?

151. Make a sketch of Restricting signals.

152. What is the indication for the Stop and Proceed signal?

153. Make a sketch of the Stop and Proceed signal.

154. What schemes are most generally used to designate the Stop and Proceed aspect where:

(a) Semaphore signal is used?
(b) Color light signal is used?
(c) Position light signal is used?
(d) Color position light signal is used?

155. What is the indication for the Stop signal?

156. Make a sketch of Stop signals.

157. What are the requirements of trains receiving Stop signals?

158. Where two or more lights are used on semaphore and color light Stop signals, how are they arranged?

159. What color is used on dwarf signals on some roads in lieu of red, to indicate Stop?

160. What indication is closely allied with the Stop indication, and in what respect are they alike, and how do they differ?

161. Where are the Stop aspects ordinarily used?

162. Where are the Stop and Proceed aspects used, and where two lights are used how are they arranged?

163. What is used on some roads with automatic block signals, in connection with the signal aspect to distinguish a signal whose most restrictive indication is more favorable than the Stop signal?

164. What is the indication for the Caution signal?

165. Make a sketch of Caution signals.

166. Why are Caution signals used by some roads?

167. What do some roads use instead of the Caution signal for the same purpose?

168. What is the objection to using the pointed blade, or its equivalent light signal, to govern the approach of trains to block and interlocking signals, outside of automatic block system territory?

169. What information is not given by the fishtail signal?

170. What aspect is used for the position light signal when the track is occupied or a switch is open?

171. What signal is used when the track is clear, switches properly set, and home signal is at Stop?

Grade signals.

172. Where and why are grade or tonnage signals used?

173. How do the requirements in regard to proceeding at restricted speed by a Stop and Proceed signal vary on different roads?

174. When roads permit trains to pass Stop and Proceed signals without stopping, what provision is made?

175. What are some of the aspects used for grade signals?

Take siding indicators.

176. What is a take siding indicator and for what is it used?

Semaphore signals.

177. What type signal is most generally in use on American railroads today, and to what extent are they being superseded?

178. What type signal is most generally installed for new work and renewals?

179. How do the indications for three-position lower-quadrant signals compare with corresponding upper-quadrant signals?

180. Were the two-position lower-quadrant or the three-position signals developed first?

181. How many arms are required with the two-position signal to give the same indications as a three-position signal arm?

Color light signals.

182. What semaphore does not have a corresponding aspect in the color light signal?

183. In what country is the system known as the four-aspect color light signals being used by some railroads?

184. Is this system based on the same principle as three-block indication?

185. What lights are used with the four-aspect color light system and what do they indicate?

186. With what method of signaling in this country does the four-aspect color light system compare?

187. Where would complications arise if the four-aspect color light system was used in America?

188. In order to signal the route so trains will not have to pass a red signal what is necessary to use in connection with the four-aspect color light system?

189. How is the system using route indicators generally arranged?

190. What are the color light signal aspects in Figs. 20 to 32 based upon?

191. Were the aspect and indications for color light signals referred to in the Standard Code prior to January 17, 1928?

192. What is the probable main reason for the wide difference in practice on various railroads in the use of color light signal aspects and indications?

Position light signals.

193. How are the day and night aspects and indications of the position light signals given?

194. How many lights in a row have high signals?

195. How many lights in a row have dwarf signals?

196. Why is the position light more flexible than the semaphore or color light signal?

197. In using position light signals what is the practice in regard to displaying the various arms, or rows of lights?

198. With what signal in the Standard Code does the aspect for the Permissive block signal, Fig. 29, compare?

199. How do the aspects and indications compare in the position light signal?

200. What quadrant position of lights is used for Permissive?

201. How is the Permissive feature covered, by some roads, on semaphore signals?

202. How is a distinction made with the position light signal between a clear manual or controlled manual block signal and any other clear signal?

203. How may the distinction be made with the semaphore signal?

Color position light signals.

204. How are the aspects and indications of the color position light signal given?

205. By how many lights and what arrangements are the positions given on the high and dwarf signals?

206. How many arms are used and how do the positions compare with the position light signal?

207. What are the colors of lights used and how are the colors arranged?

208. How are the different speeds or routes indicated?
209. What does the white marker above the arm indicate?
210. What does the white marker below the arm indicate?
211. What does no marker light indicate?
212. Where is the marker placed with respect to the signal for the various indications?
213. What scheme of signaling is the color position light signals, as now used, based upon?
214. How do the number of aspects necessary for indications compare with semaphores?
215. How do dwarf signals compare with the high signals?
216. How are the indications of position light signals given compared to the position of the arm of the semaphore signal?
217. How are the indications of color position light signals given compared to the position of the arm of the semaphore signal?

General.

218. Where no speed is mentioned for a portion of track, what speed is generally permitted?
219. Prior to the time the Signal Section adopted its principles of signaling, how did the aspects and indications compare with those now in use?
220. How many semaphore aspects, exclusive of the two-position lower-quadrant, are there and what three schemes do they cover?
221. How do the aspects and indications of light signals compare with the uniformity obtained in the use of semaphore signals?
222. What do the aspects and indications shown in Fig. 36 represent?
223. Why were the aspects and indications as shown in Figs. 20 to 32 prepared?
224. What two basic principles in the use of aspects and indications should never be overlooked?
225. Why should the picture received by the mind of the engineman have only one meaning?

Cab signals and cab indicators.

226. What type, and when were cab indicators first used in Europe?
227. To what extent have visual cab indicators been used in Europe?
228. What type of indicator did most of the installations in Europe make use of and how was it used, and why?
229. When did cab signals and cab indicators receive serious consideration in America and what type is now in use?
230. What type of cab indicator is usually used with the intermittent automatic train stop and how is it produced?
231. What does the whistle or bell indicate in some systems?

232. When an engineman acknowledges prior to passing a Restrictive signal indication what happens when the receiver passes over an open inductor?

233. If an engineman acknowledges the indication and the bell fails to ring what does he know is wrong?

234. In addition to the audible signal, what is used by one road as an indication the train-stop apparatus is in working order and cut in and on another road at the instant an automatic application is received?

235. When the locomotive circuits are set up for free running how does the light or indicator perform?

236. How does the practice compare on various roads in regard to the use of a cab signal with the continuous automatic stop or with speed control?

237. As pointed out in the chapter, on one road using bell, whistles and visual indicator with continuous automatic stop or speed control:

(a) What type bell is used and where is it mounted? When the gong sounds what does it indicate?

(b) Describe the warning speed whistle and explain where it is mounted. When the whistle sounds what does it indicate? When will the whistle stop blowing?

(c) Describe the acknowledging whistle and explain where it is mounted. When this whistle sounds what action should the engineman take? When will the whistle stop blowing?

(d) Describe the visual indicator and explain where it is mounted. What does the green light indicate? What does the yellow light indicate?

238. By what distance will the change from the green light to the yellow light precede the whistle indications, when the speed of the train is over 20 miles per hour, and by what distance when the speed is less than 20 miles per hour?

239. When should the acknowledging whistle be acknowledged?

240. What action does the bell take when the change from the yellow light to the green light takes place?

241. When passing over short sections of track where current may not be picked up for a distance of less than 175 feet such as staggered joints at the end of a track circuit or at a railroad crossing, what may happen to the lights and what attention should be paid to the change?

242. When either indication light is lit what does it indicate and what can be done with actuator?

243. Should the train control be cut out on account of a failure of either or both lights if the device is otherwise operating properly?

244. What may cause the lights to fail?

245. Since the issuance of the booklet what substitution has been made for the whistles and what effect did it have on the meaning of indications?

246. What is the practice on different roads in regard to using different aspect cab signals?

247. To what extent are wayside signals eliminated on some roads where continuous automatic stop or speed control is in service?

248. To what extent is the four-aspect cab signals without the automatic stop or train control being used and what is being done with the wayside signals?

249. In Fig. 39 what indication is generally used where automatic block signals are used and what indication where automatic block signals are dispensed with?

250. What signals are sometimes used with visual cab signals?

251. When the whistle or bell sounds what does it indicate?

252. In the case of the whistle, how long does it blow?

253. In the application of cab signals, how do they compare with wayside signals?