

# AUTOMATIC BLOCK SIGNALING

WASHINGTON, BALTIMORE & ANNAPOLIS ELECTRIC R. R.



The  
Union Switch & Signal Co.  
Swissvale, Pa.

# THE UNION SWITCH & SIGNAL CO.

OF PITTSBURGH, PA.

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

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

**Automatic, Semi-Automatic and Manually Operated  
Block Signals.**

**Electro-Pneumatic, Electric and Mechanical Interlockings  
to suit conditions.**

**Plans and Estimates on Application.**

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**GENERAL OFFICE AND WORKS: SWISSVALE, PA.**

**SALES DEPARTMENT  
Hudson Terminal Building, 30 Church Street, New York.**

## DISTRICT OFFICES

**Hudson Terminal Building  
NEW YORK**

**Candler Annex  
ATLANTA**

**Peoples Gas Building  
CHICAGO**

**Pacific Building  
SAN FRANCISCO**

Style "N" light signals

GO-163810 - Scott St. to N.A. Jct.

-174905-168016 - " " " " - Switch Indicators + Clock Work Released

168000 District Line to N.A. Junction

160450 Shipley + Ordmore - 2- 2-color + Blank - unit 68111

190525 - Bayern River Sawbridge - 3 lever elec. table machine

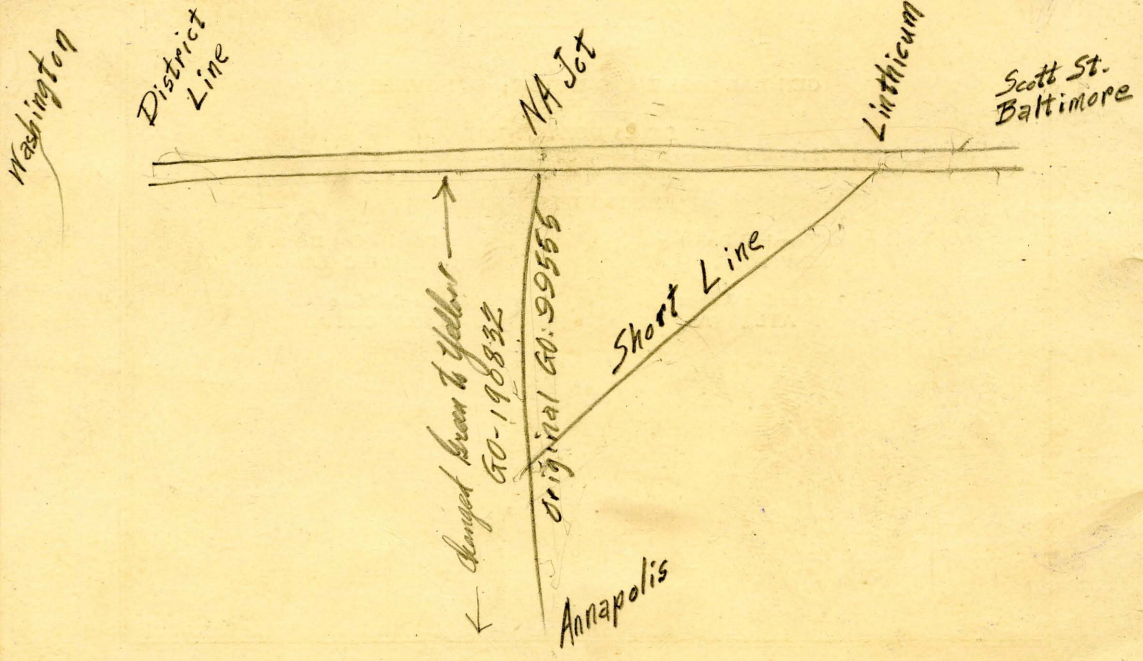
190525 - Short Line Signaling - 68 style "N" signals

189901 - Scott St. to Linthicum + 3 lever table machine  
Bayern River Sawbridge  
B16165 - BM-113141

299050 Waterbury - Camp Parole style "B" w/c no 2nd & clock work release

THE UNION SWITCH & SIGNAL COMPANY'S  
PUBLISHING DEPARTMENT  
Swissvale, Pa.

Press of  
MURDOCH, KERR & Co.  
Pittsburgh, Pa.  
1532



**INTERURBAN AUTOMATIC BLOCK SIGNALING**  
AS INSTALLED ON THE  
**WASHINGTON, BALTIMORE & ANNAPOLIS**  
**ELECTRIC R. R.**  
BETWEEN  
**NAVAL ACADEMY JUNCTION**  
AND  
**ANNAPOLIS, MD.**

*Sema. indicator  
GO-254199*

*GO-99555  
1912.*

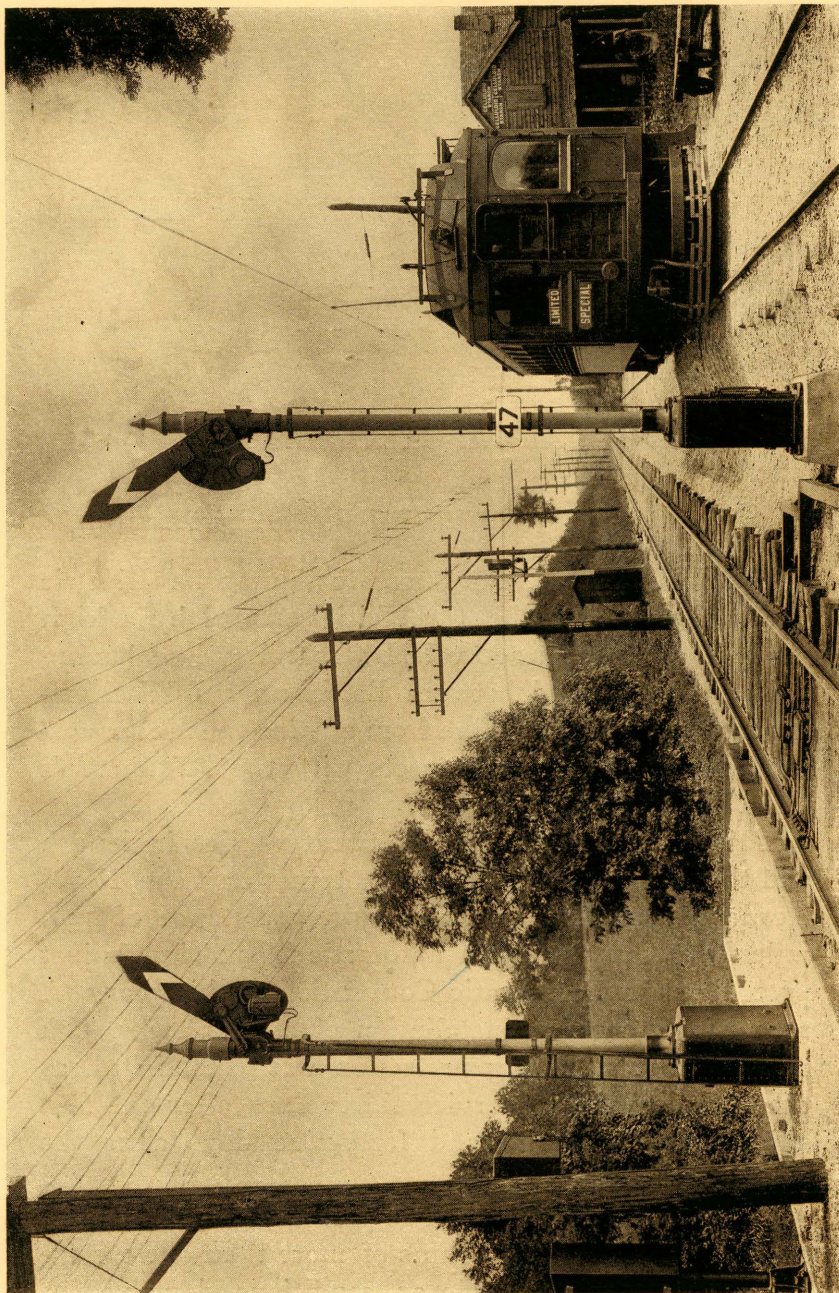
*Style "B" semaphores  
~~Model 15~~ light signals  
Unclassified #13, C 6769-11*

The Washington, Baltimore & Annapolis Electric Railroad connects the three cities named by a high grade, high speed 1,200 volt D. C. trolley line having a double track road between Baltimore and Washington and a single track line from a point called Annapolis Junction, where it connects with the Baltimore & Ohio Railroad, to Annapolis.

This single track line is twenty miles in length and the Eastern Division, or that portion from Naval Academy Junction to Annapolis, a distance of 13.2 miles, was equipped with automatic block signals just preceding the Democratic Convention of this year. A record for the quick installation of a complete system of automatic signaling protection was established, as the signals were in service thirty days after the first shipment of material and forty-nine days after the award of the contract.

The traffic over this road is passenger, local freight, and through freight. Trains of more than one car are used for passenger traffic as conditions demand. A

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SEMAPHORE SIGNALS—PROCEED POSITION

shuttle or city service is also maintained between Annapolis and Camp Parole. On special occasions regular steam trains of the Baltimore & Ohio Railroad and the Pennsylvania Railroad convey over this signaled section a large number of passengers to the Naval Academy exercises at Annapolis.

This section was built about 1836 and retains the many original curves, almost all of which, being in cuts, or bordered by woods allow only a short view of the road.

The layout of tracks and signals, with the signal controlling limits, is shown in diagram in the back of the book.

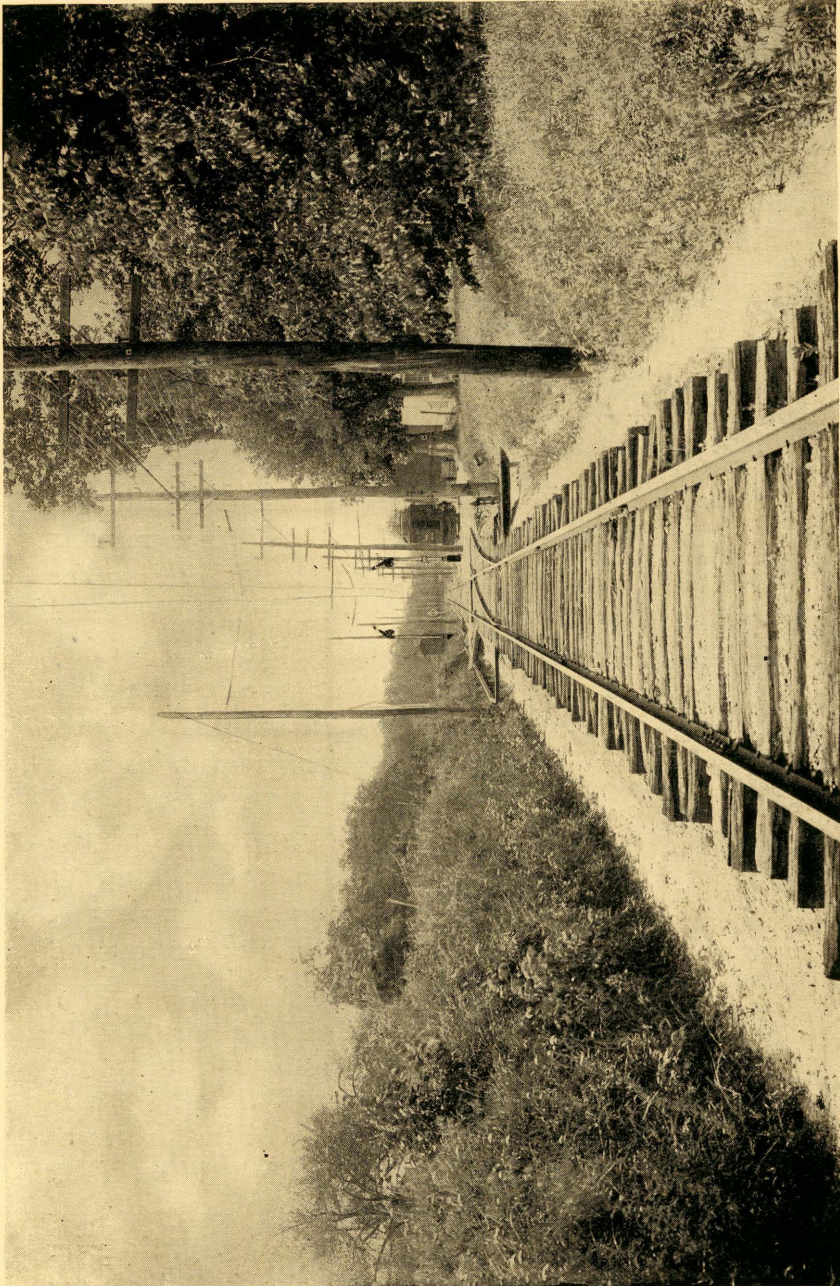
There are four stub and three double ended sidings on this line, one of which, "Best Gate," is a regular meeting point for scheduled cars. At this siding the switches are set for all cars to take the right hand track and trail through the exit switch. At other double ended sidings cars proceed at speed on the main line if they have no meets. Whenever possible these double ended sidings are used for meets with long freight trains.

The signal installation comprises 13.2 miles of protected track, 8 standard single track blocks and 1 special block (Best Gate), 17 semaphore signals and 16 light signals. The longest block is 11610 feet and the shortest is 5430 feet, an average of 8680 feet.

The signaling is controlled by *continuous* track circuits which insure the signals remaining on the danger position so long as the block which they govern is occupied, and each car is fully protected in the rear as well as head on, i. e., but one car is allowed in a block at any one time.

All schemes for single track automatic signals prior to this installation employed a track circuit preliminary

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SEMAPHORE SIGNALS IN DISTANCE—PROCEED POSITION

at one or both ends of the block in order to prevent two opposing cars from simultaneously entering a block under clear signals. This, under normal conditions, operates perfectly, but with a deranged schedule on an interurban road, may cause either further delay to a car already late or require additional signals or indicators at the entrance to the preliminary to minimize such delay.

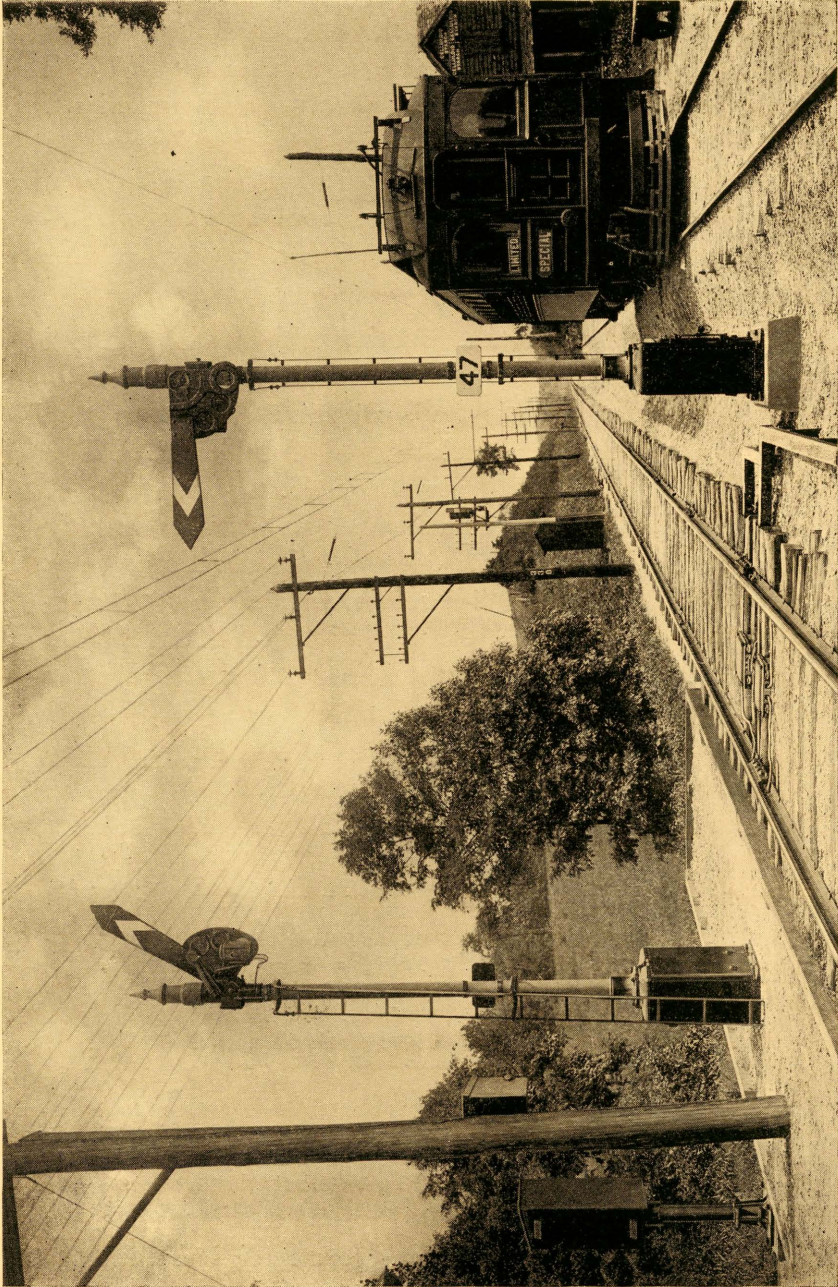
An explanation of the function and disadvantage of preliminaries can be secured by reference to The Union Switch & Signal Company's Bulletin No. 57, or the 1911 report of the Block Signal Committee of The American Electric Railway Engineering Association. The elimination of preliminaries is unquestionably desirable if the substitute does not introduce unsafe or undesirable features. Therefore, with a view to overcoming the objection to preliminaries, The Union Switch & Signal Company designed an arrangement of signaling in which their elimination was accomplished. Instead of preliminaries, the arrangement employs two signals of the light type. Signals of the semaphore type are located at the ends of the block. This scheme of signaling was adopted by The Washington, Baltimore & Annapolis Railroad, after a careful study of all systems and arrangements of signals then on the market, by its General Manager, Mr. J. J. Doyle, and Engineer Maintenance of Way, Mr. E. W. Weinland.

This being the first installation of its kind, a detailed description will be of interest.

Each signal is numbered according to the miles and nearest tenth, from Annapolis. East bound signal numbers end in an odd tenth because east bound trains are odd numbered, whereas west bound signal numbers correspondingly end in an even tenth.



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SEMAPHORE SIGNALS—PROCEED AND STOP POSITIONS

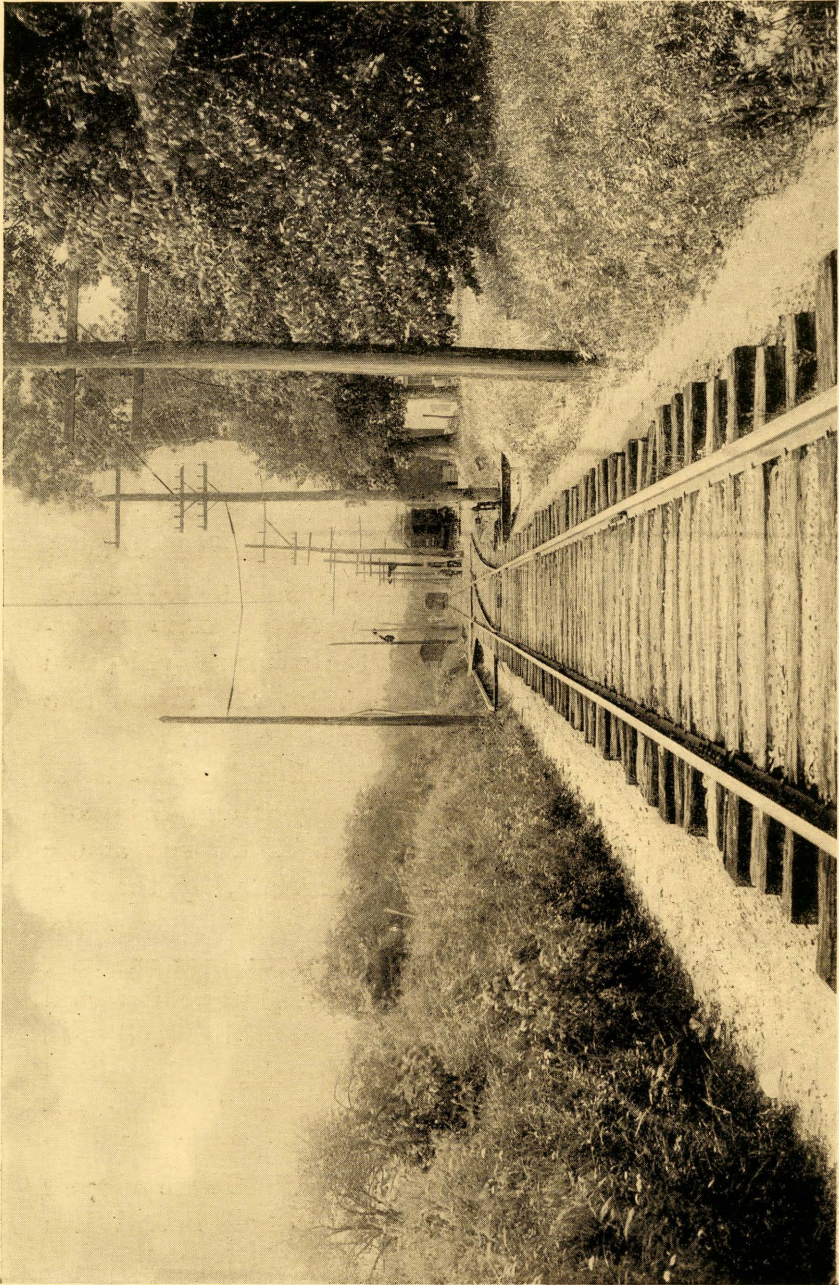
The blocks extend from siding to siding and each has four signals, two of which are semaphores, located one at each end of the block; the other two are light signals, each about 1,000 feet or more in advance of a semaphore signal. Referring to Fig. 1, the block between Gambrills and Millersville has semaphore signals No. 115 (for east bound cars only) and No. 102 (for west bound cars only) with light signals No. 113 (east bound) and No. 104 (west bound) respectively, in advance of the semaphores.

The minimum of track sections is employed in this system, one to each block, and the transformer, or source of energy for each track section, is in the center and operates two track relays. Referring to the above mentioned block from Gambrills to Millersville, one of the relays, located at Signal No. 115 is controlled by the track to a point "Y," about 1,000 feet or more *east* of the center of the block, and the other relay, located at Signal No. 102, is controlled from this signal to a point "X" about 1,000 feet *west* of the center.

Each semaphore signal is controlled by *both* track relays or the entire block. Each light signal is controlled by one track relay only, i. e., the one at the opposite end of the block and, therefore, by the two-thirds of the block at that end.

Considering the operation, an east-bound car entering the block under clear signal No. 115, places this signal as well as No. 102 and No. 104 at Millersville, to "Stop." As it passes No. 113 at clear, and reaches "X," this signal is also placed to "Stop." When the car is in the center of the block, between "X" and "Y," all *four* signals are held to "Stop." These signals protect the car in the rear as well as head on. When signal No. 102 is passed all the signals for this block assume the clear position and it may again be entered

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SEMAPHORE SIGNALS IN DISTANCE—PROCEED AND STOP POSITIONS

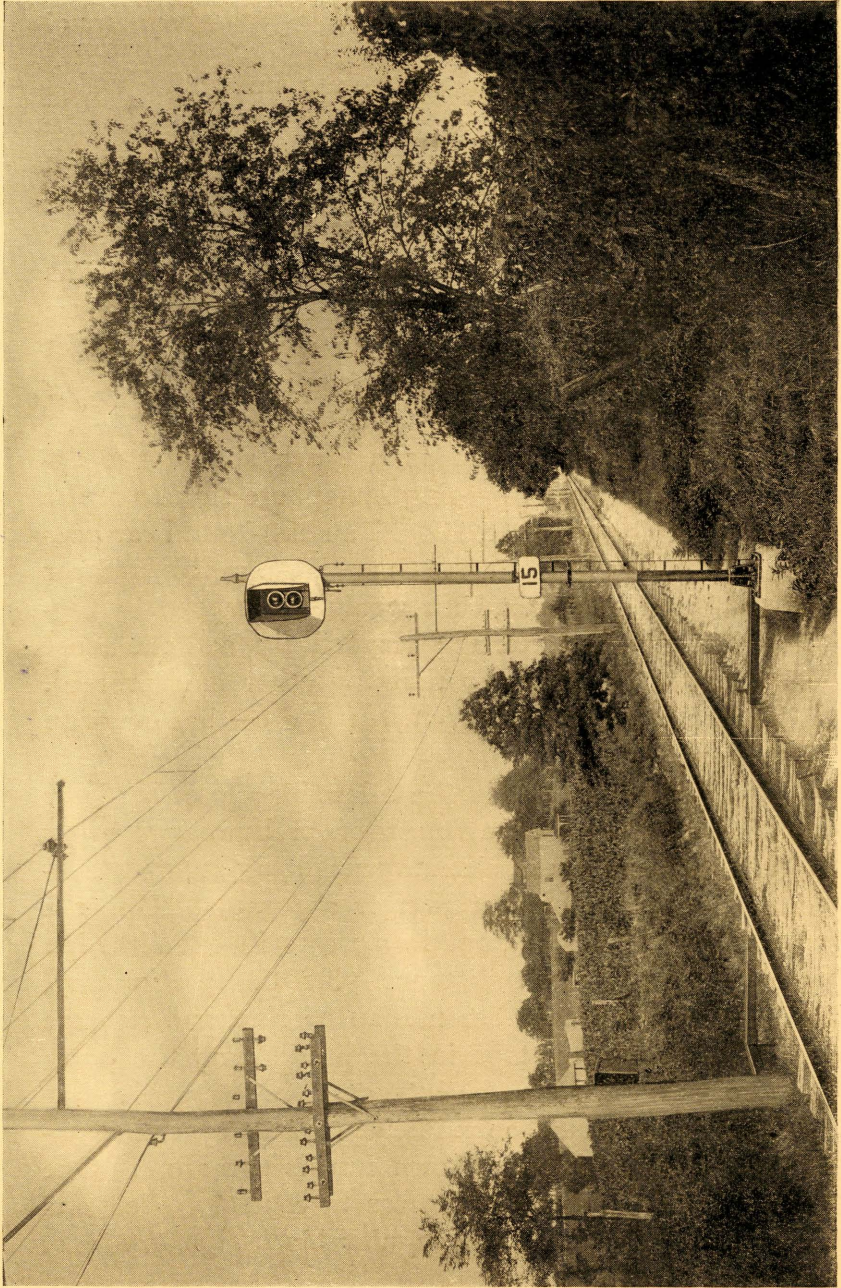
at either end. Except at Best Gate Siding, cars standing on stub sidings back of the fouling or clearance point, and between fouling points on double ended sidings, do not affect the signals.

A great advantage of this scheme is the facility with which "meets" can be made, as opposing cars can proceed to a meeting point, such as Gambrills, without delaying each other or being subject to special rules as in systems having preliminaries. This is true because *each block is a unit* and a car in one block does not affect the movements of a car approaching an *adjoining* block.

The light signals act as a check should two approaching cars pass opposing semaphore signals at the same time; for example, should an east-bound car pass Signal No. 115 at the same time that a west-bound car passes Signal No. 102, both would be stopped by Signals No. 113 and No. 104 respectively, and one must back out of the block so that the other may proceed. This condition *arises only* when one car has over-run its orders.

Another advantage is the allowable close headway for following cars on account of preliminaries being eliminated and these eliminations being secured without complication of operation or apparatus. Under a "preliminary" system, following cars in one direction are spaced the block distance plus the preliminary, which in such a case becomes an overlap, and as there may be passenger stops in the preliminary the delay to a following car may be extended.

This scheme is also flexible as regards special conditions, two of which are shown in this signaling. One is the use of switch indicators to control movements out of sidings where the regular block signals cannot govern.



LIGHT SIGNAL

Switch indicators are miniature unlighted semaphore signals mounted in iron cases set on four foot iron posts, and are generally employed to indicate when switches can be thrown to allow a movement from the siding to the main line. They do not apply to movements into the siding from the main line.

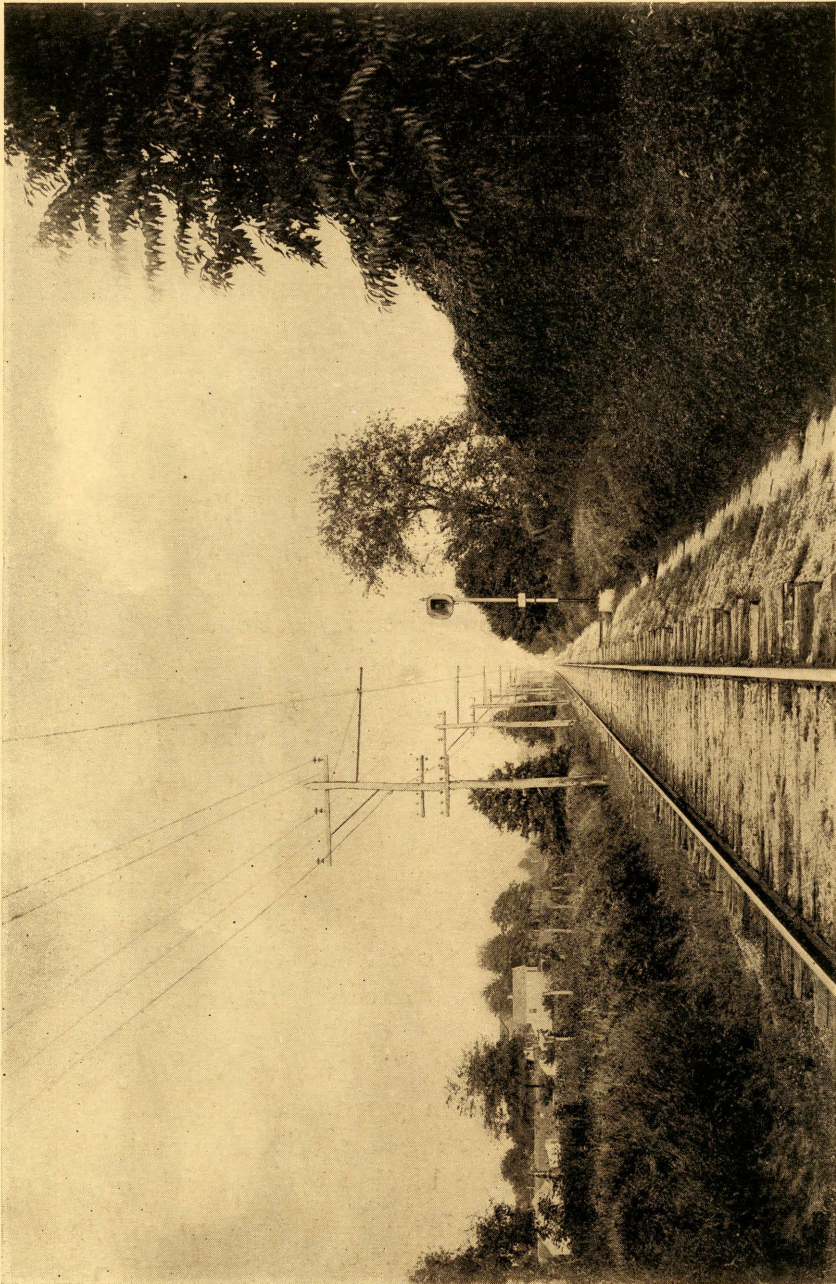
It will be evident that under this system switch indicators are unnecessary at a siding such as Gambrills, because a car desiring to enter the main line can be governed by the regular block signal No. 116.

The situation at Camp Parole, a double ended 1,000 ft. siding, required an arrangement whereby cars could safely and promptly enter the main line via the switch at the east end. As this siding is located on a curve and as a view of the block signal No. 17 would be impossible, at night in any event, a switch indicator was installed to provide the required indication.

The situation at Crownsville is the same as at Camp Parole.

Each indicator is controlled by the block in which the switch is located and a preliminary (track circuit) extending beyond the west end of the block. This "preliminary" control is secured without an additional cut section in the track. The "preliminary" control is installed; for example, at Camp Parole to prevent the switch being opened to let a car out of the siding after an east bound car has approached within 3,000 ft., more or less, of the block.

This, in reality, is a selective means whereby the regular car, running within 3,000 feet of the block on the main line, possibly at speed, receives and retains a right of way to enter the block when a car is on the siding. If, however, the main line car was over 3,000 ft. from the block the siding car crew would receive the right to the block, throw the switch and block the



LIGHT SIGNAL IN DISTANCE

main line car at Signal No. 17. Without the track circuit preliminary control the siding car would in all cases have the preference and delay the main line car.

By the use of Signal No. 15 no preliminary is required for this indicator at the east end of the block, for should a west bound car pass Signal No. 106 as the switch is thrown, the car in the siding would be stopped by the west bound car having placed Signal No. 15 to stop.

Attention is called to the fact that a car leaving this east Camp Parole Switch has clear Signal No. 15 in advance for its further information and assurance that the block is clear.

Cars on a siding may proceed *promptly* into the block when the block signal or switch indicator is clear. The action of each is wholly automatic and therefore requires no action on the part of the trainmen other than to stay or proceed according to the indication received.

Switches located at any point in the signaled territory may be equipped with switch indicators so as to protect traffic and only permit of movements to the main line when the block is clear.

The other special situation is the regular meeting point and passenger stop at Best Gate Siding. Here it will be noticed that signals No. 18 and No. 27 are controlled by the track sections between signals No. 18, No. 26 and No. 27, and signals No. 47 and No. 28 by the section between signals No. 47, No. 28 and No. 27, whereas the track section on the siding controls Signal No. 26 only. If a west bound car reaches the siding first and passes Signal No. 26, Signal No. 27 will clear for an east bound car. When the east bound car passes Signal No. 27 the west bound car may proceed promptly under clear Signal No. 28. Should the *east*



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LIGHT SIGNAL IN POLE LINE

*bound* car arrive first it will be held at Signal No. 27 until the west bound car passes Signal No. 26. A passenger stop is located at Signal No. 27 and the east bound car discharges passengers *east* of the signal, if the west bound car is ready to proceed, but if the west bound car has not arrived the passengers are discharged *west* of the signal.

Signal No. 26 was provided to allow a west bound car to pass Signal No. 18 and still protect a car standing on the Best Gate Siding.

The previously mentioned shuttle service between Annapolis and Camp Parole is protected by signals No. 06 and No. 17, as the car does not proceed west of Signal No. 17 and is, therefore, protected by the two signals mentioned. This signal displaced a hand operated light signal arrangement between Camp Parole and Annapolis.

The signals at the sidings were located at the fouling point instead of at the switch point, in order to better protect movements into the sidings and also to cause minimum delay to cars approaching the switch.

For example: Movements in or out of the switch at Gambrills do not affect the signals of the Gambrills-Millersville block, and also do not prevent a west bound car proceeding safely to Signal No. 116, which will be at stop if the switch is open or a car is fouling the main track. This switch will, of course, control signals No. 137 and No. 135 as well as No. 116.

If the signals were located at the switch point, an east bound car taking the siding would necessarily hold Signal No. 102 at stop, and if a west bound car had passed this signal there would be danger of having it hit the car at the siding.

Each switch, except the two at Best Gate Siding which are traileed through, is equipped with circuit con-



BLOCK SIGNAL MARKER

trollers so arranged as to hold to "stop" all signals governing the block in which the switch is located when the points are not correctly set for the main line.

On this road cars head in and back out of siding, except when this is prevented by special conditions.

At present there are no distant signals; marker boards stating "Block Signal 1,000 ft.", are used instead.

No propulsion or other than the regular signaling current is employed for signaling purposes. The current for the signal system is distributed by means of separate mains, thereby making the signaling independent of interruptions and low voltage conditions which would be incidental to its supply by the propulsion system.

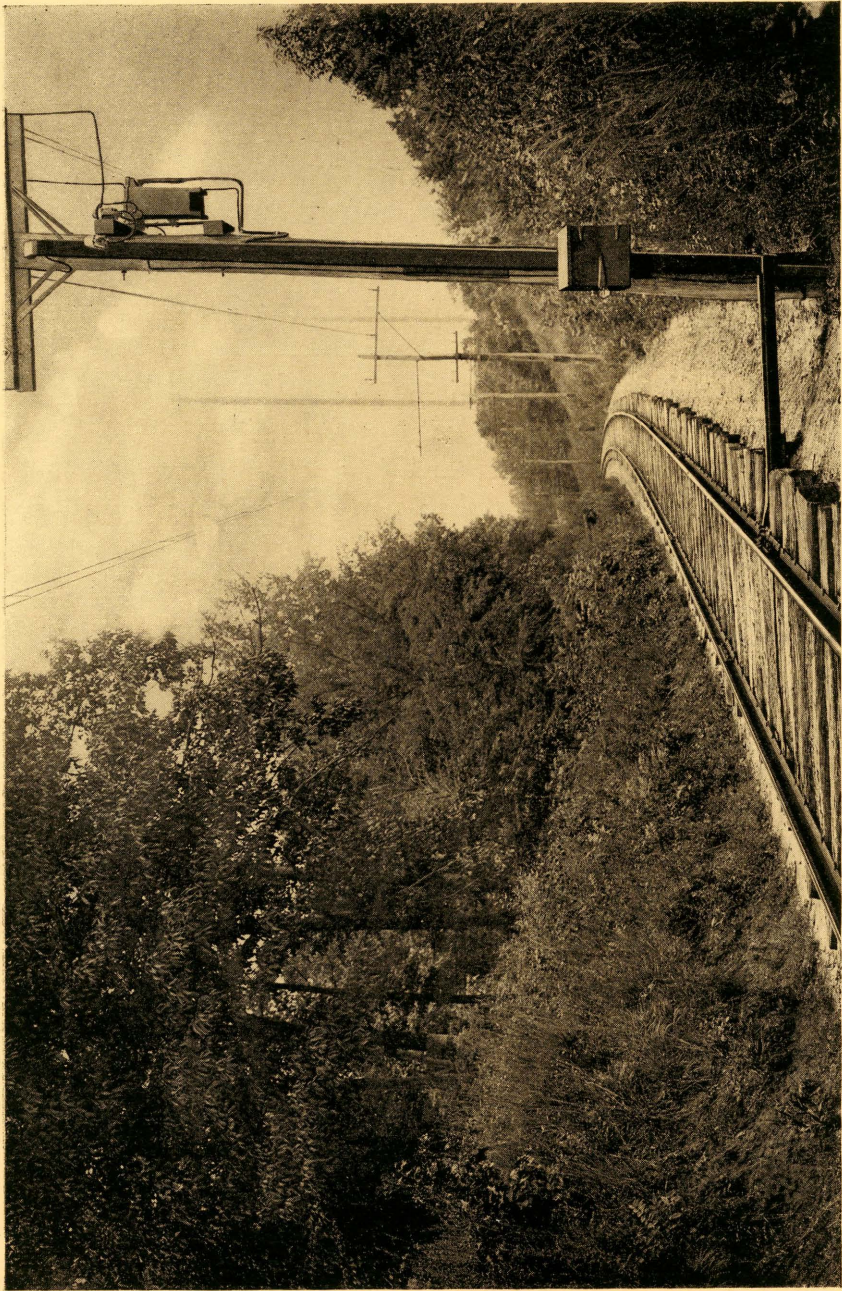
Power for this installation is taken from a sub-station located at Naval Academy Junction where available 370 volt, 25 cycle current is transformed to 2,200 v. for distribution over the signaled territory. A separate General Electric Co. one-panel switchboard with ammeter and switches is included in the sub-station equipment.

The line wire equipment consists of two 2,200 volt and three or four 110 volt line wires extending the length of the signaled territory. Transformers, high tension plug cutouts and high tension lightning arresters are mounted on additional short arms located on the regular trolley poles.

Transformers located in the center of each block and tapped to the 2,200 volt line supply current through one secondary at about 10 volts for the track circuits and through another secondary at 110 volts for the signal circuits.

The light signals are constructed of cast iron and provided with hoods and shields to improve the day-

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TRANSFORMER LOCATION

light indication by offsetting the effect of the sun. These signals have two 5 inch lenses, one red and one green, and behind each are located two lamp bulbs wired in multiple. It is assumed that only one lamp will burn out at a time.

No reflectors are employed.

Exhaustive tests showed conclusively that arc headlights have no effect on the distinctness of the indication of this light signal. These light signals give distinctive indications at about 1,600 feet under the most unfavorable daylight conditions.

The lamps employed in these signals are of the Tungsten type and the energy required for one entire signal is less than that required for one 16 c. p. carbon lamp.

Each light signal is controlled directly by a 110 volt line relay, which is in turn controlled by the galvanometer type track relays.

The lamps behind the green lens are controlled by the front contact (closed with the relay energized) of the line relay and the red lens lamps are controlled by the back contact (closed with relay de-energized) of the same relay.

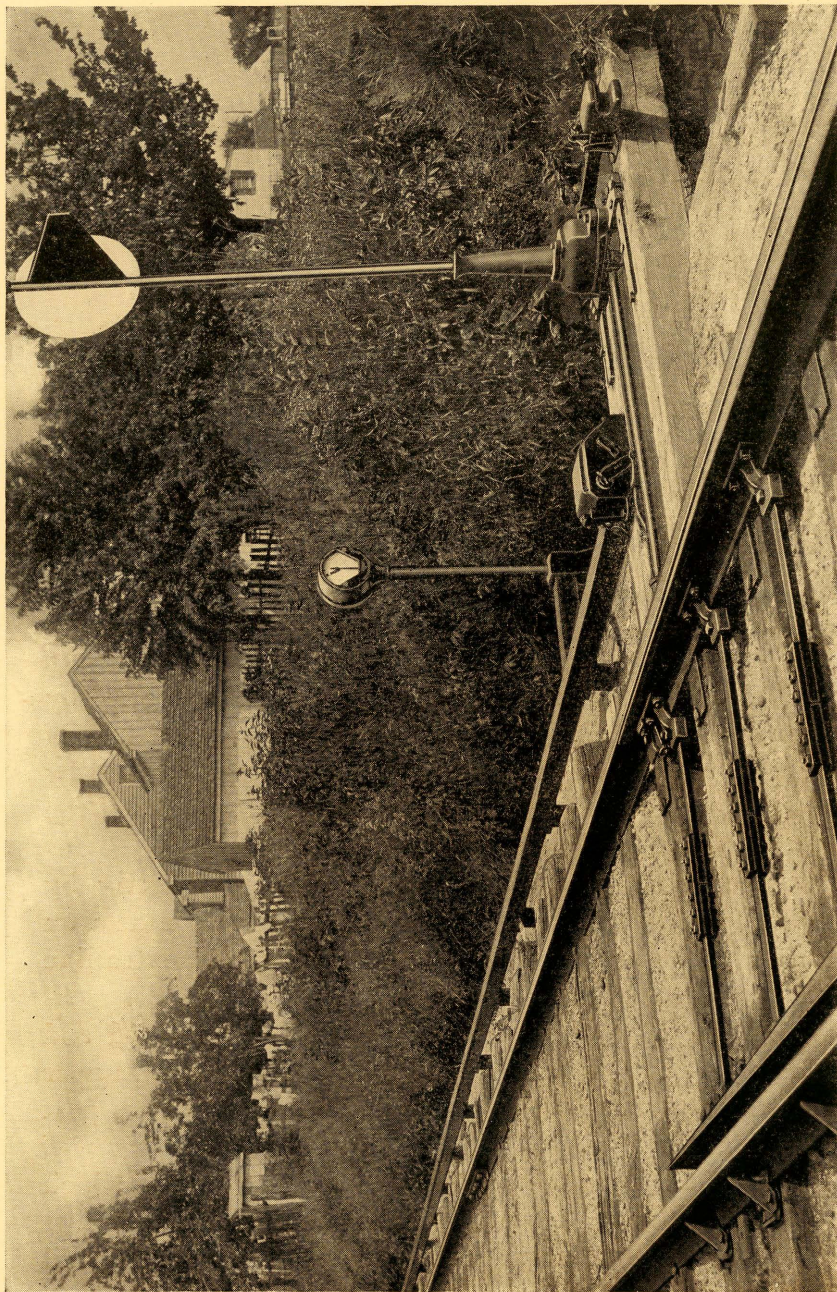
The semaphore signals are controlled directly by contacts on the track relays and also by contacts on the light signal line relay, without the use of extra line relays.

The semaphore signals are electrically lighted and are of the two position, horizontal to 60 degree, upper left hand quadrant, well known Style "B," bottom post mechanism type.

All track circuits are of the "double rail" type which provides a two rail return for the propulsion current.

Alternating Current track circuits require better rail joint bonding than is generally maintained on electric

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SWITCH INDICATOR, SWITCH BOX AND INSULATED SWITCH RODS

roads but as improved bonding saves propulsion current the net result is distinctly beneficial. It has been demonstrated that the power saved by the increased efficiency of the bonding will, in most cases, be several times greater than the power required for the signal system.

Rail joint bond testing becomes a simple matter where alternating current track circuits are installed, as a direct current ammeter across a joint produces a vibration of the needle if the bonding is poor and vice versa, no effect if the joint is good. It will be evident that this permits a very rapid testing.

Adjoining track circuits are separated by impedance bonds having a capacity of 500 amperes per rail and all insulated rail joints are of the "Keystone" type. The track circuits are carried into the sidings to the fouling or clearance points.

All circuits are fused and provided with lightning arresters connected to a deep ground.

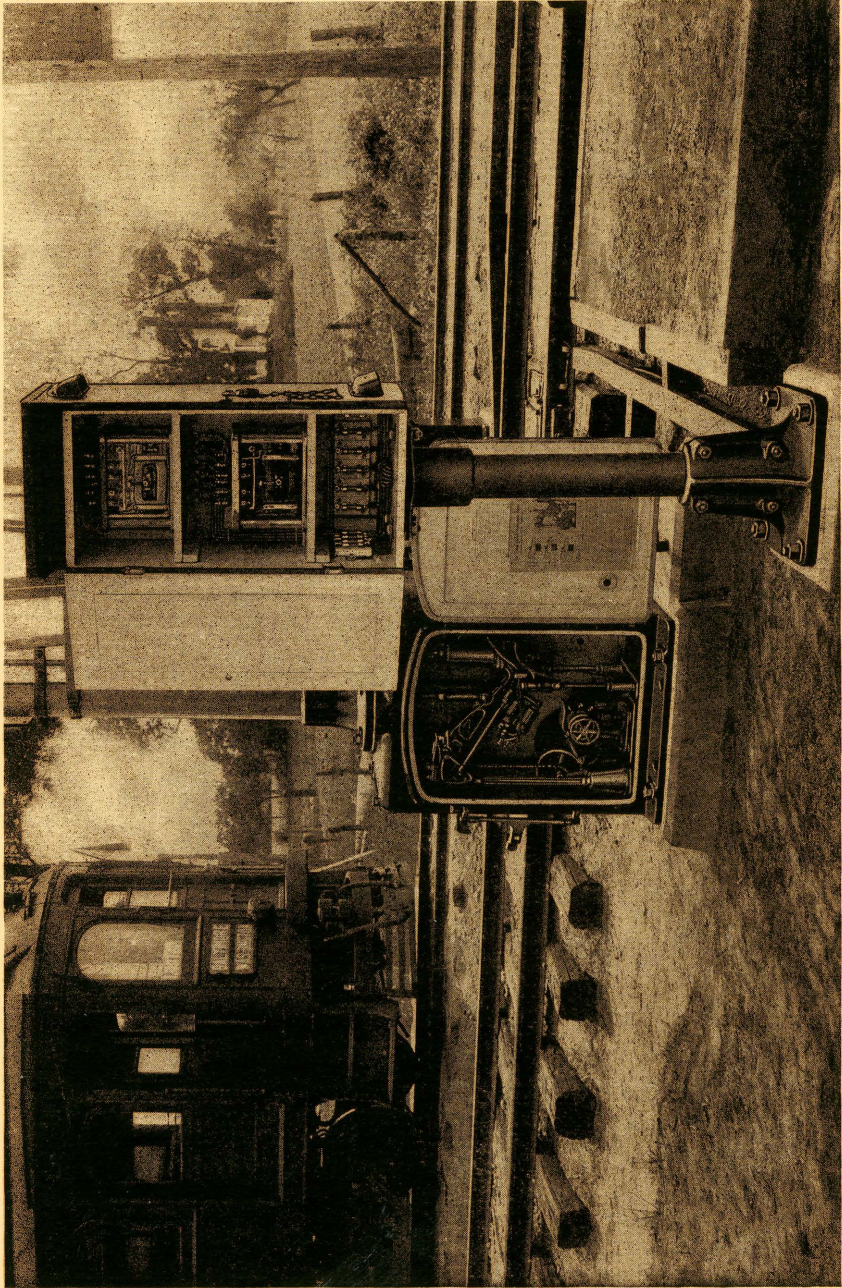
An existing ground wire protecting the propulsion feed and high tension wires is grounded to the rails by connection to the neutral of the impedance bonds located at each siding.

The relays and low tension lightning arresters are located in wooden boxes which are mounted on the trolley poles or on separate iron posts.

Seven months operation under this signaling has fully demonstrated that it is well adapted to electric interurban conditions and therefore merits the attention of all interested in securing signaling protection.

The material for this installation was furnished and installed by The Union Switch & Signal Company under the direction of Mr. J. J. Doyle, General Manager, and Mr. E. W. Weinland, Engineer Maintenance





RELAYS, RELAY BOX AND SEMAPHORE MECHANISM

of Way, of the Washington, Baltimore and Annapolis Electric R. R.

The enclosed views of the signals and other apparatus will give the reader a very good idea of the appearance, construction and method of installation.

Particular attention is called to the following facts in connection with this system, which facts will doubtless appeal to the management, operating department and engineering department of all interurban railroads.

FIRST: MAXIMUM PROTECTION:—because each car has at all times a full stop, or danger, signal in the rear as well as head on.

SECOND: FULL SPEED:—because a proceed signal means that the block is unoccupied.

THIRD: SIMPLICITY OF OPERATION:—because there are but two indications, *stop* and *proceed* to each signal or indicator. All apparatus being operated automatically, trainmen are not required to manipulate or handle any part of the signal system.

FOURTH: FACILITY OF OPERATION:—because a car receiving a clear signal or indicator can proceed without delay.

Each block being a unit with clearly defined limits, the absence of preliminaries insures that a car in one block does not affect other cars in or approaching adjoining blocks and may, therefore, at all locations proceed promptly to a siding or meeting point.

FIFTH: SIMPLICITY OF RULES:—because of only two indications, stop or proceed, and therefore so brief and clear that trainmen are favorably impressed and appreciate the fact that they can be observed without difficulty or confusion.

SIXTH: SHORTEST POSSIBLE HEADWAY UNDER FULL PROTECTION:—because opposing or following cars are spaced just one block apart. Under a system requir-



IMPEDANCE BONDS

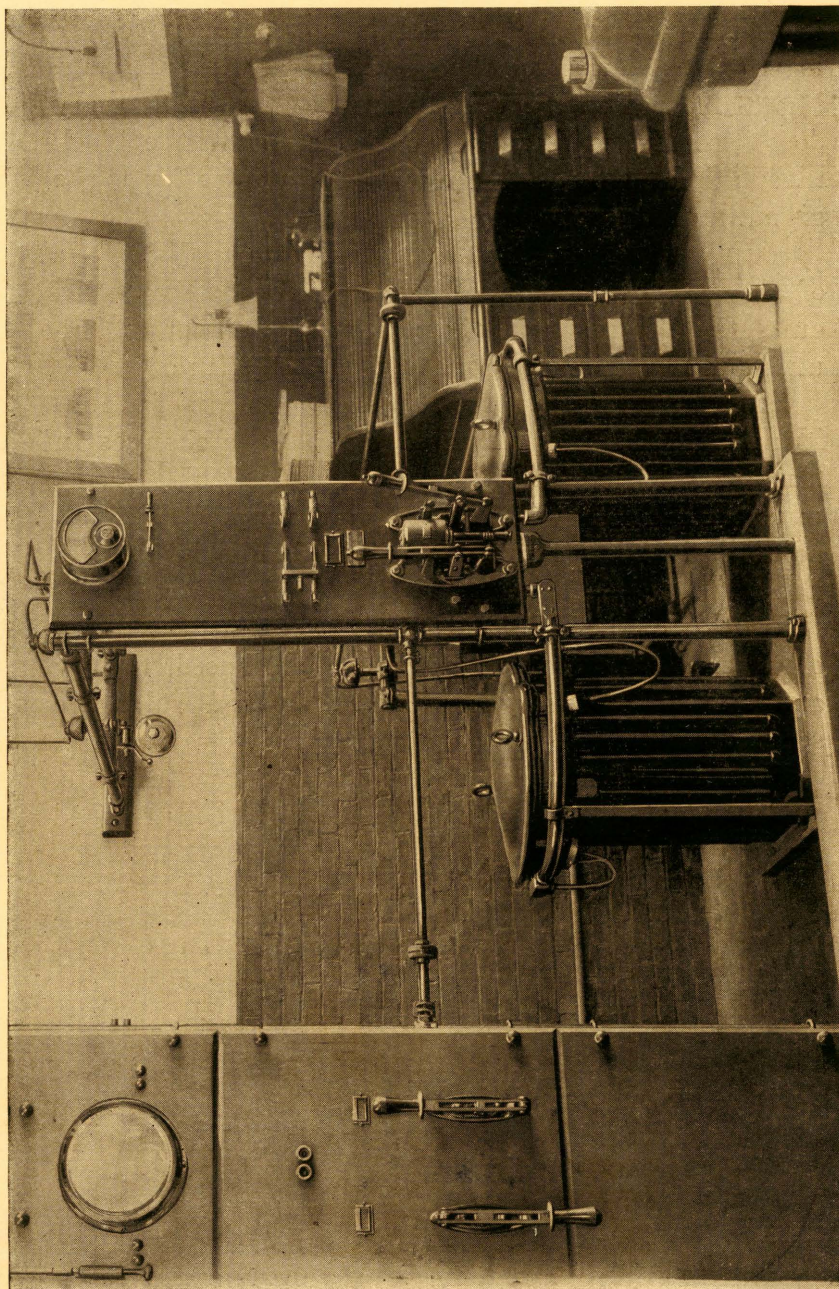
ing preliminaries the spacing is increased, at certain locations the length of the preliminary, without securing additional safety. The fact that the preliminary does not always bear a fixed relation to the block means that all blocks are not uniform in so far as the signaling indications are concerned.

SEVENTH: HIGH EFFICIENCY:—because of the use of the standard apparatus and simple controlling circuits, thereby insuring the minimum number of failures and minimum time loss due to one failure.

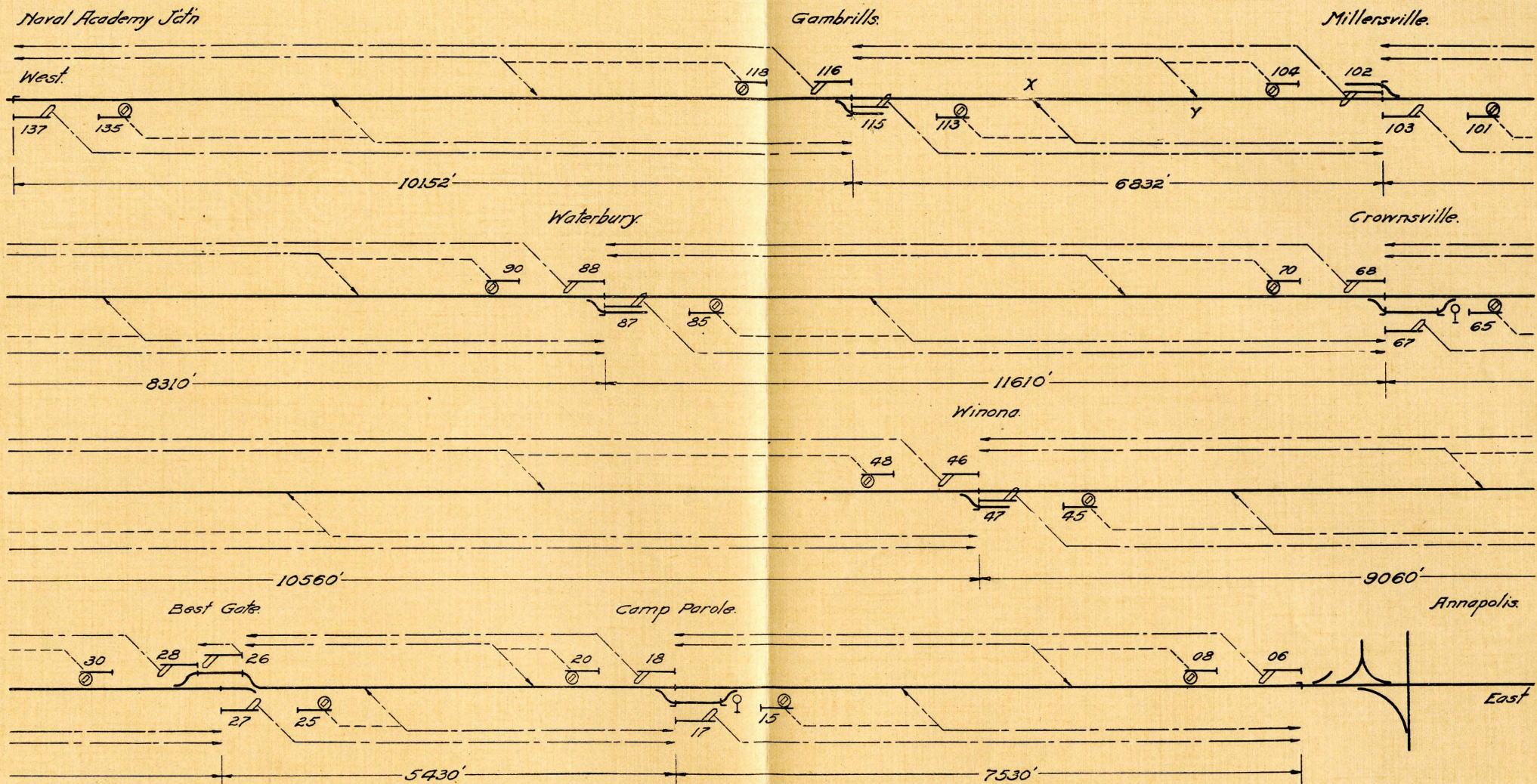
EIGHTH: ADAPTABILITY TO CONDITIONS:—because it may be easily modified to provide for changes in track, traffic, etc. Sidings may be added, double ended, extended or changed to a regular through meeting point with a minimum and quick change in the signaling.

SUMMARIZING:—This system is peculiarly adapted to interurban operation as protection, speed, facility and simplicity of signal indications and rules are secured with a minimum and a simplicity of apparatus.

Further information regarding apparatus, circuits, and its adaptability to your conditions will be furnished on application.



SIGNAL SWITCHBOARD AND TRANSFORMERS IN NAVAL ACADEMY JUNCTION SUB-STATION



Automatic Block Signaling With Continuous Track Circuits.

<p>9 Blocks (8 Single Track - 1 Double Track), Average Length 8685 Feet          33 Signals (17 Semaphore - 16 Light)          Time of Installation - 30 Days.          Furnished &amp; Installed By The Union Switch &amp; Signal Co 1912.</p>	<p>Washington, Baltimore &amp; Annapolis Electric Ry.          Naval Academy Jct'n to Annapolis, Md.          A.C. Track Circuits - Home Semaphore and Light Signals.          13.2 Miles of Track Protected.</p>
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LAYOUT OF TRACKS AND SIGNALS



THE UNION SWITCH & SIGNAL COMPANY'S  
PUBLISHING DEPARTMENT  
Swissvale, Pa.