

# THE WAY IS CLEAR

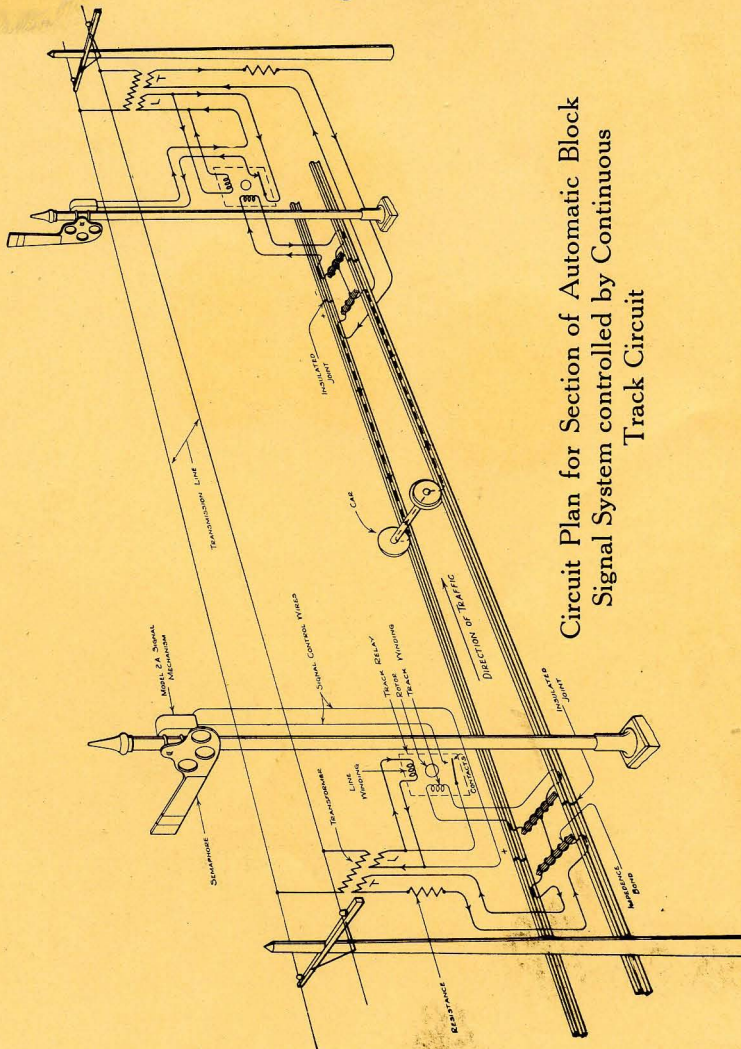


1912 EXHIBIT  
ANNUAL CONVENTION  
A. E. R. A.  
OCTOBER 7 TO 11 INCLUSIVE  
CHICAGO

**GENERAL RAILWAY SIGNAL COMPANY**  
**ROCHESTER, N.Y.**



1912 Exhibit at  
 The Annual Convention of the American  
 Electric Railway Association  
 October 7 to 12 inclusive  
 Chicago, Illinois



Circuit Plan for Section of Automatic Block  
 Signal System controlled by Continuous  
 Track Circuit



**GENERAL RAILWAY SIGNAL COMPANY**

**ROCHESTER, N.Y.**

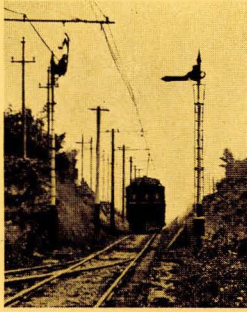


San Francisco,  
 Monadnock Building  
 681 Market Street

Chicago  
 Peoples Gas Building  
 122 So Michigan Avenue

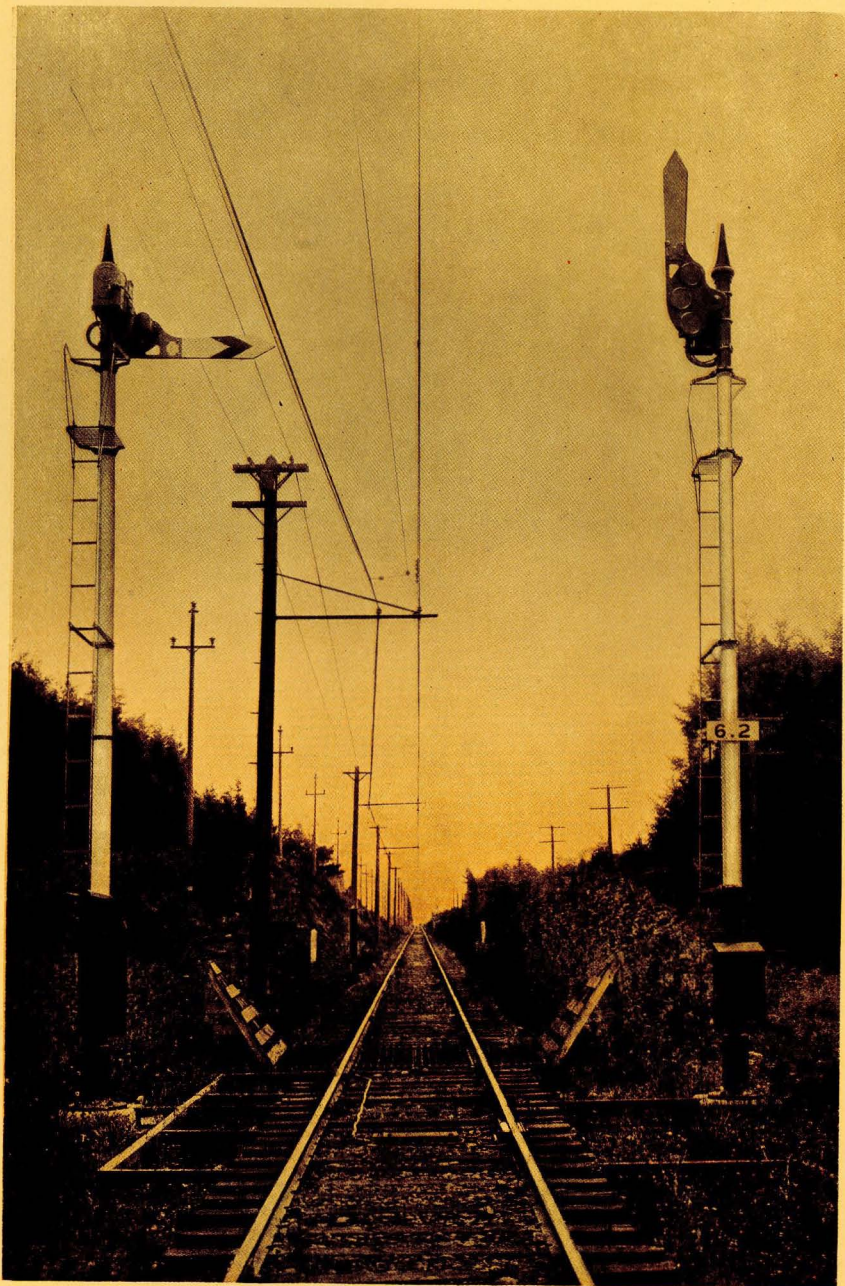
Montreal  
 Eastern Townships Bank Building  
 263 St James Street

New York  
 Liberty Tower Building  
 55 Liberty Street



The Way is Clear





The Way is Clear



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Bulletin 124

October, 1912

**GENERAL RAILWAY SIGNAL COMPANY**

**ROCHESTER, N.Y.**

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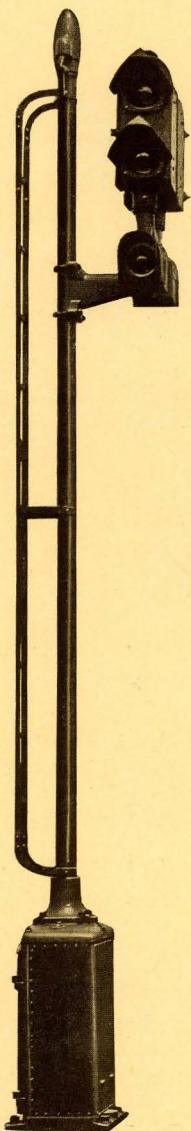
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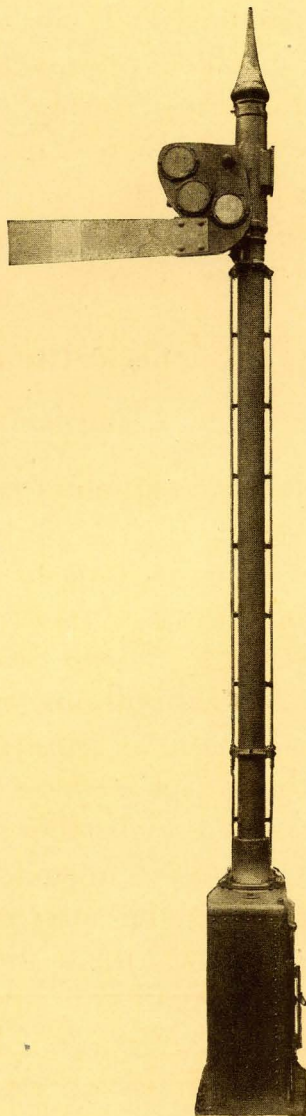




**GENERAL RAILWAY SIGNAL COMPANY**



G. R. S. Double Light  
Signal



Model 2A Semaphore  
Signal





## Preface

**T**HIS bulletin is descriptive of the various automatic block signal systems which have been installed on several interurban and suburban electric lines, during the last two years, by the General Railway Signal Company of Rochester, New York.

These installations may be divided into two general classes, namely:

### Single-track Signaling and Double-track Signaling

Single-track signaling may be further subdivided as follows:

(a) SYSTEMS WHICH PERMIT FOLLOWING MOVES TO BE MADE CLOSER THAN THE DISTANCE BETWEEN PASSING SIDINGS. These closer following moves may be provided for without the use of intermediate signals, or with them, as required. As descriptive of systems which do not employ intermediate signals, we call your attention to the Indiana Union Traction and T. H. I. & E. T. installations. As descriptive of systems employing intermediate signals which permit moves closer than the distance between passing sidings, we call your attention to the Oregon Electric installation. We also call your attention to our Bulletin No. 128, which describes the A. P. Block System, which, using intermediate signals, gives *maximum facility at minimum cost*, and which has been





installed on a number of electric lines as well as on several prominent steam railroads.

(b) SYSTEMS WHICH DO NOT PERMIT FOLLOWING MOVES TO BE MADE CLOSER THAN THE DISTANCE BETWEEN PASSING SIDINGS. Illustrative of systems of this type, we call your attention to the descriptions of the Lehigh Valley Transit Company, Washington Water Power Railway, and Fort Dodge, Des Moines & Southern Railway installations.

The second large division covers *automatic block signaling on double track*. Illustrations of such installations will be found in the Chicago, Rock Island & Pacific Railway, Philadelphia & Western Railway, and the San Francisco, Oakland Terminal Railway installations.

In all of the above-named systems the *Continuous Track Circuit* is employed as the medium of control, the indications being given by either light signals or semaphore signals, as required by the railroad company. Practically all of the apparatus employed is thoroughly standardized.

In addition to the installations above mentioned, this company has installed a number of large signal systems on important steam and electrified steam railroads. A list of these installations will be found on the last page of this bulletin.

GENERAL RAILWAY SIGNAL COMPANY



# Single Track Signaling

## Indiana Union Traction Company

**T**HE Indiana Union Traction Company operates a number of city electric lines as well as an interurban service between Indianapolis, Muncie, Anderson, Marion, Wabash, Logansport, Kokomo, and several smaller towns within the State of Indiana. All the interurban cars are operated by 650 volts continuous current, the power being supplied from a number of substations along the right of way.

On the Anderson Division, between Siding 13 and Siding 22—a single-track interurban line—the Indiana Union Company has installed a system of *Continuous Track Circuit* Automatic Block Signals, which is a typical Absolute Permissive Block Signal Installation, employing the light signal for a day indication as well as a night indication.

The signal system covers 18 miles of single track, including nine blocks, 18 home signals, and 6 distant signals, and is operated from a 2200 volt 25 cycle single phase transmission system which is fed from substation located at Ingalls, Indiana.

A typical layout of this installation is shown in Figure 2, which indicates the zones of control providing absolute blocking for opposing movements but allowing following moves to be made into the same block under a permissive indication. Although all sidings are double end they are only used for stub movements, the rule being to head in, back out, and

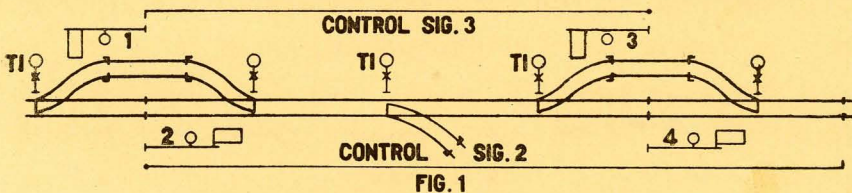


FIG. 1

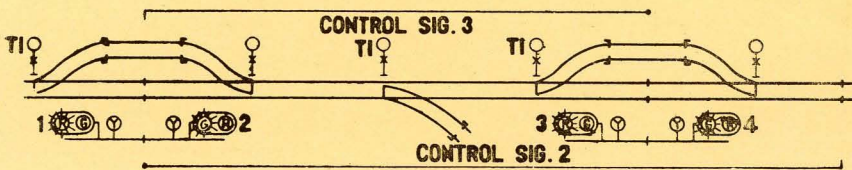


FIG. 2





Figure 3—A. P. Block System, Indiana Union Traction Company



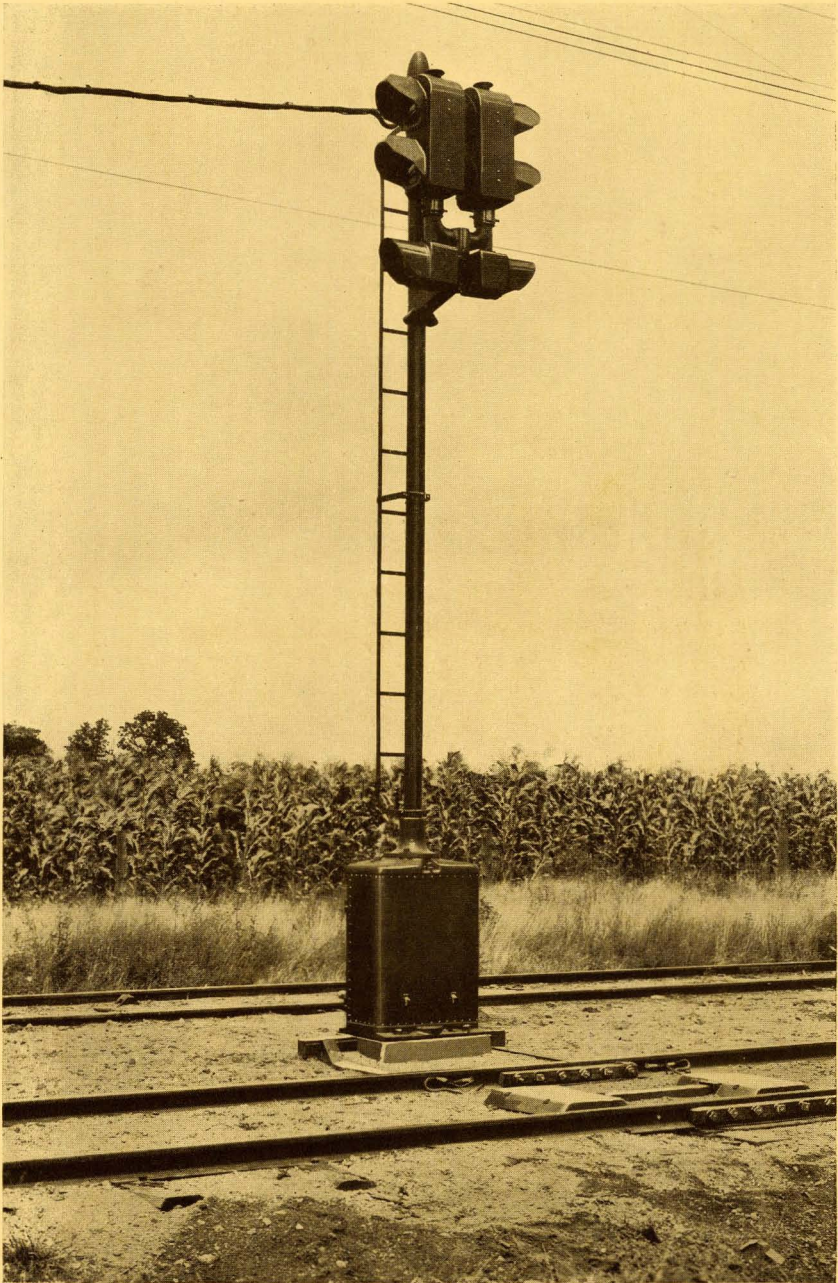


Figure 4—Double Light Signal, Indiana Union Traction Company



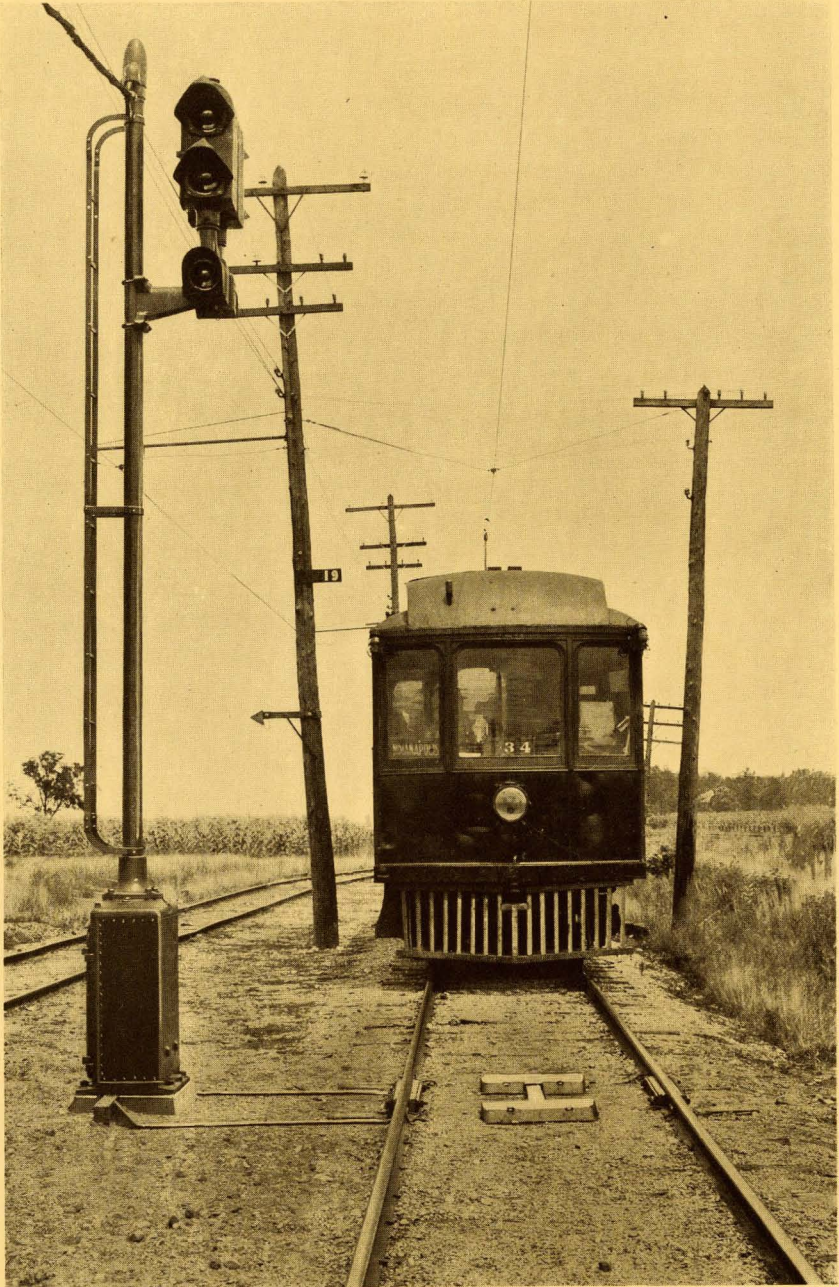


Figure 5—A. P. Block System, Indiana Union Traction Company





proceed in all cases. From the 2200 volt a. c. line a transformer (Figure 3) at each signal location steps the voltage down to 55 volts for the signal and 2 to 8 volts for track operation. A general construction of the light signal is shown in Figure 4; the two upper lights constitute the main signal, the lowest light being the permissive indication. All the apparatus at each location is housed in an apparatus case at the base of the signal. In order to retain two rails for the return of the d. c. propulsion current and at the same time divide the track into blocks controlling the various signals, it was necessary to provide double reactance bonds, as shown between the tracks in Figure 4.

A unique feature of this system consists in the use of but two line wires for the control of opposing signals. Both the absolute and permissive indications having been given, neither of the proceed signals into said block can be given until the permissive light has been extinguished. Switch indicators are used at a number of locations to repeat the indication of the signals. In certain cases, time elements are used with the switch indicators to prevent a movement from a siding simultaneously with a train entering the block at the other end, thus serving practically the same purpose as a preliminary track circuit. The time-element indicators are interconnected with the system in such a manner that when a switch has been thrown they will go to stop and will not clear until after a predetermined time has elapsed, and provided a train has not entered the far end of the block in the meantime.

This installation represents a system applicable to a large number of single-track interurban lines, and by the Absolute Permissive Block (A. P. B.) System of Control an increased facilitation of train movement is secured while the entire territory is safeguarded.

### Terra Haute, Indianapolis & Eastern Traction Company

**T**HE city of Indianapolis, Indiana, is connected to Terre Haute, Richmond, La Fayette, Danville, Crawfordsville, Martinsville, and several smaller towns by the Terre Haute, Indianapolis & Eastern Railway, which is a high-speed



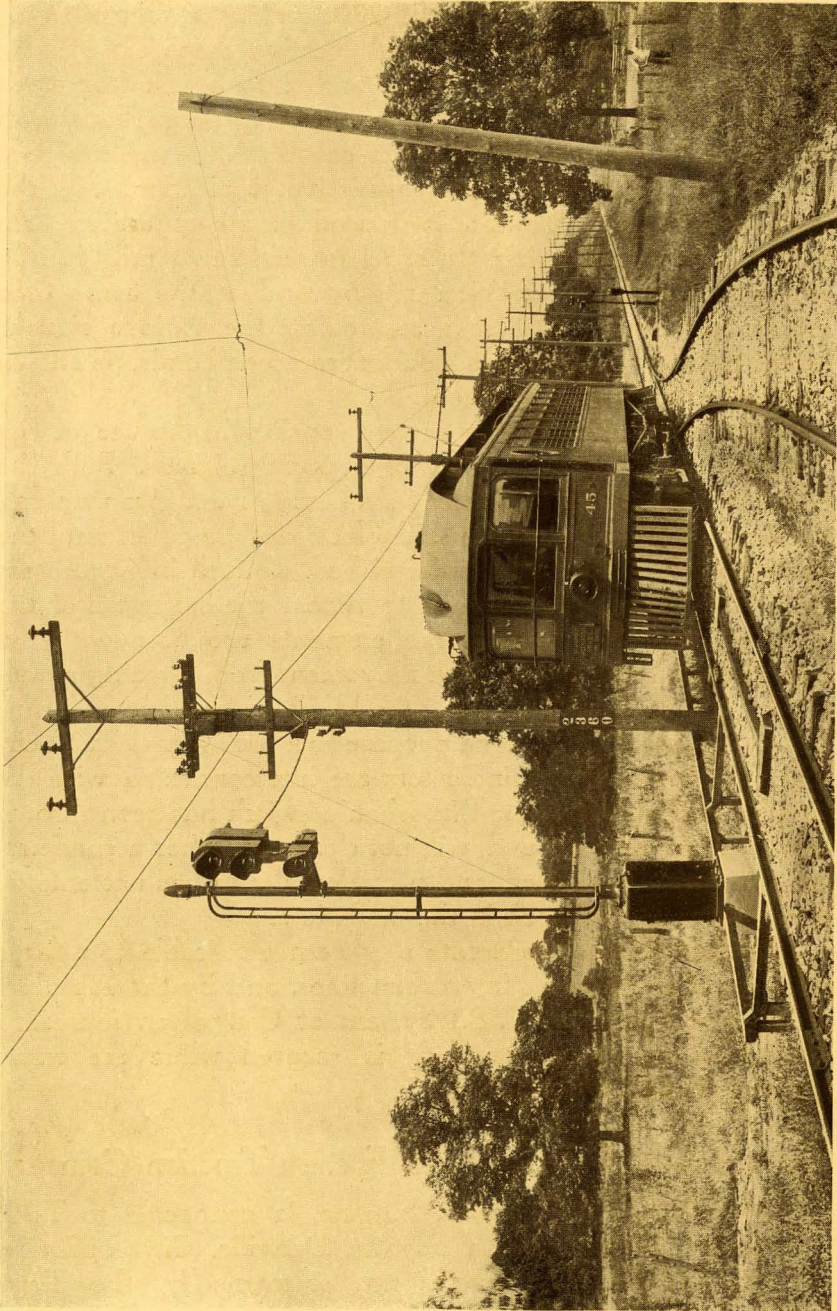


Figure 6—A. P. Block System, T. H. I. & E. T. Co.





Figure 7—Apparatus Case, T. H. I. & E. T. Co.



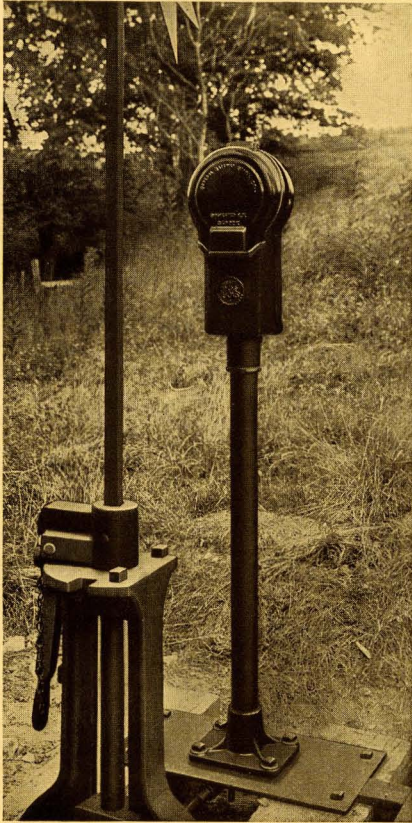


Figure 8—Time-Element Switch Indicator,  
T. H. I. & E. T. Co. .



Figure 9—Time-Element Switch Indicator,  
T. H. I. & E. T. Co.



Figure 10—Time-Element Switch Indicator,  
T. H. I. & E. T. Co.



**GENERAL RAILWAY SIGNAL COMPANY**





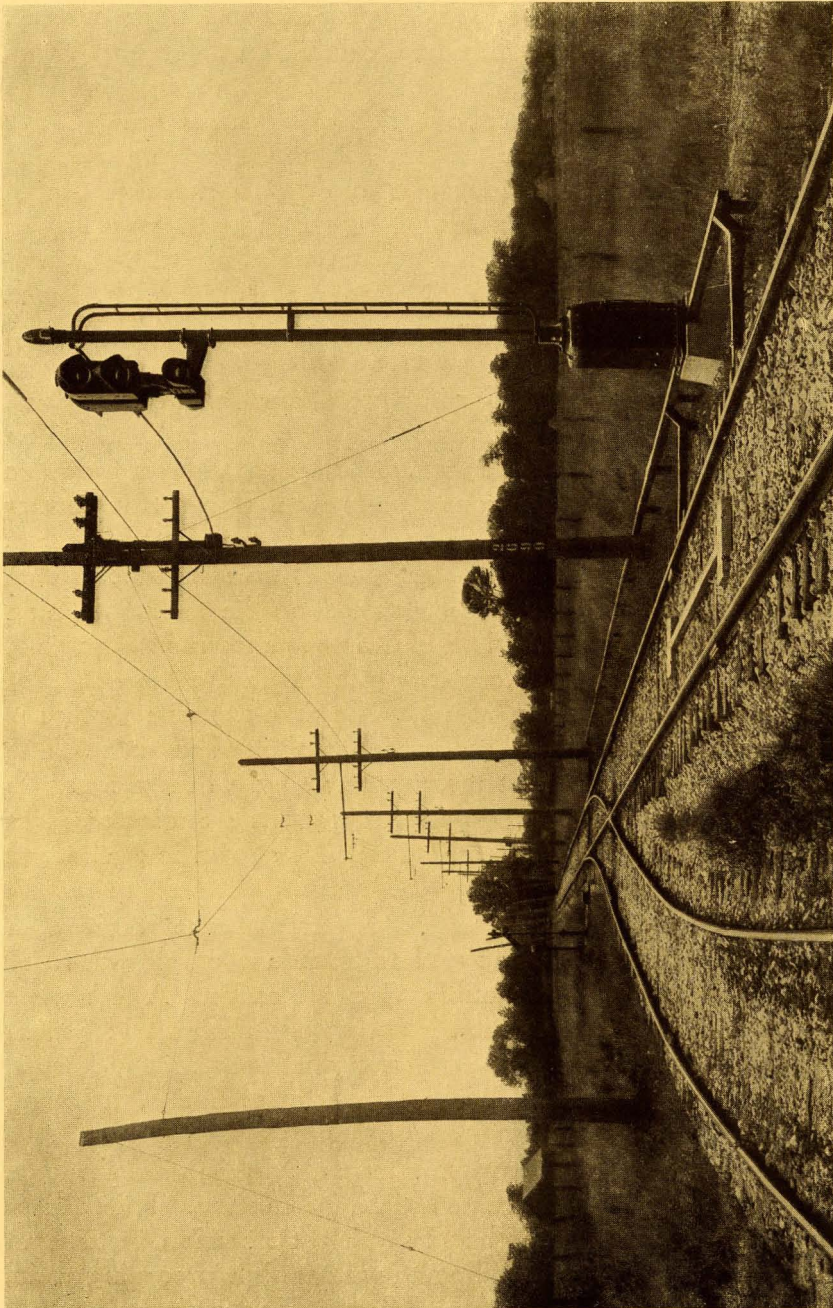


Figure 11—A. P. Block System, T. H. I. & E. T. Co.





interurban electric system, operating by 600 volts direct current.

On the Brazil and Terre Haute Divisions, between Duffs and Junction, the General Railway Signal Company have installed for the T. H. I. & E. T. Ry. a *Continuous Track Circuit* Automatic Block Signal System of the Absolute Permissive Block control; this system covers 15 miles of single track, including 6 blocks and 12 light signals, which give a light indication by day the same as at night. A typical layout shown in Figure 2 illustrates the A. P. Block System employed, and shows the zone of controls, sidings, and indicators.

This installation is similar in general arrangement, voltages, control, and method of operating signals to the Indiana Union installation previously described. A diagonal view of a double light signal with cable connections to a signal transformer located on a transmission and trolley pole is shown in Figure 6. On account of staggered rail-joints, the double reactance bonds are farther apart than those installed on the Indiana Union Line. A time-element switch indicator is shown in Figures 8, 9, and 10, and is similar to that referred to in the description of the Indiana Union Installation. The time-element feature is controlled by mechanical connection to the switch point. The indicator glass and blade are protected by a heavy cover, in order to prevent malicious breaking of the indicator glass (Figure 9). The time-element device is shown in the bottom of the indicator case (Figure 10).

An interior view of the signal apparatus case is given in Figure 7, showing the line and track relays employed, fuses and connections for a double signal location. A complete typical double signal location is presented in Figure 11, which clearly shows the signal transmission line, transformer, cutouts, cable connections, double signal, reactance bonds, trunking runs, switch box, and time-element indicators.

In this installation all opposing train movements are absolute, while the following movements are permissive. This allows one train to follow another in quick succession instead of requiring a train at one siding to wait until a preceding train, moving in the same direction, clears the next siding.





Lehigh Valley Transit Company

THE Lehigh Valley Transit Company is a 600 volt single-track trolley line extending north from Philadelphia through the thickly populated section of the State of Pennsylvania, and connecting Philadelphia with Chestnut Hill, Norristown, Landsdale, Souderton, Quakertown, Emaus, Allentown, and Slatington.

In connection with the recent improvements made upon this property, in order to provide high-speed limited service between Allentown and Philadelphia, is the installation of G. R. S. Automatic Block Signals from Emaus Junction, which is five miles south of Allentown, to Norristown, Pa.

The installation consists of A. C. Automatic Block Signals covering 41 miles of single track, including 38 Model 2A Semaphore Signals and 18 Blocks. Twelve of the passing points are stub-end sidings and six are passing sidings. Semaphore signals operating in two positions  $0^\circ$  to  $90^\circ$  in the upper left-hand quadrant are controlled by *Continuous Track Circuit*; these signals are provided with *single phase induction motors*. A typical layout of this signal system is shown in Figure 12. The signal transmission line is 2300 volts, single phase, 25 cycles and takes energy from several substations within the territory. Energy for the operation of the signal system is stepped down by type H Transformers at all track feed and signal locations from 2300 volts to 110 volts for the signals, and

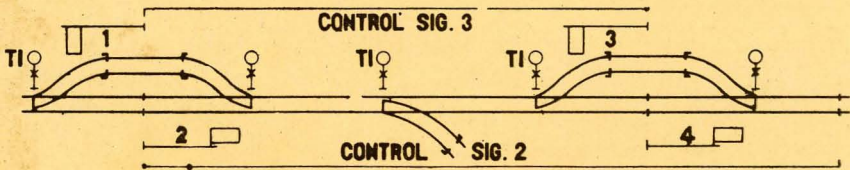


FIG. 12

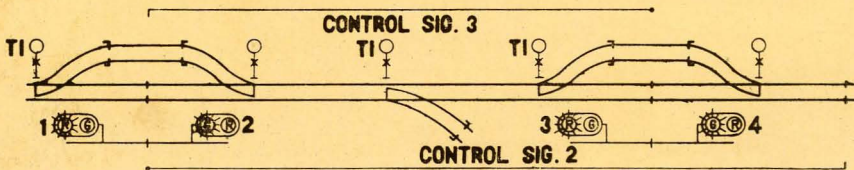


FIG. 13



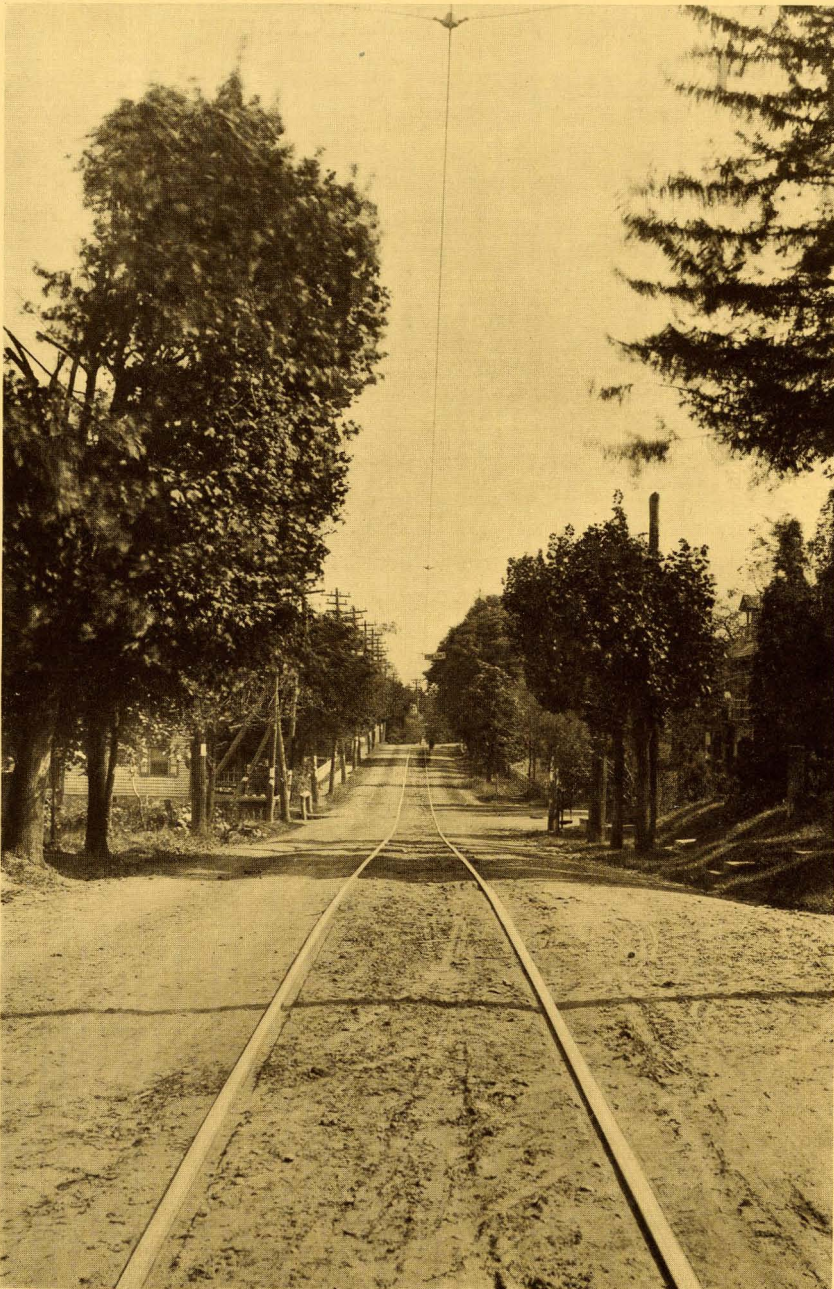


Figure 14—Track Circuit Through Street, Lehigh Valley Transit Company.



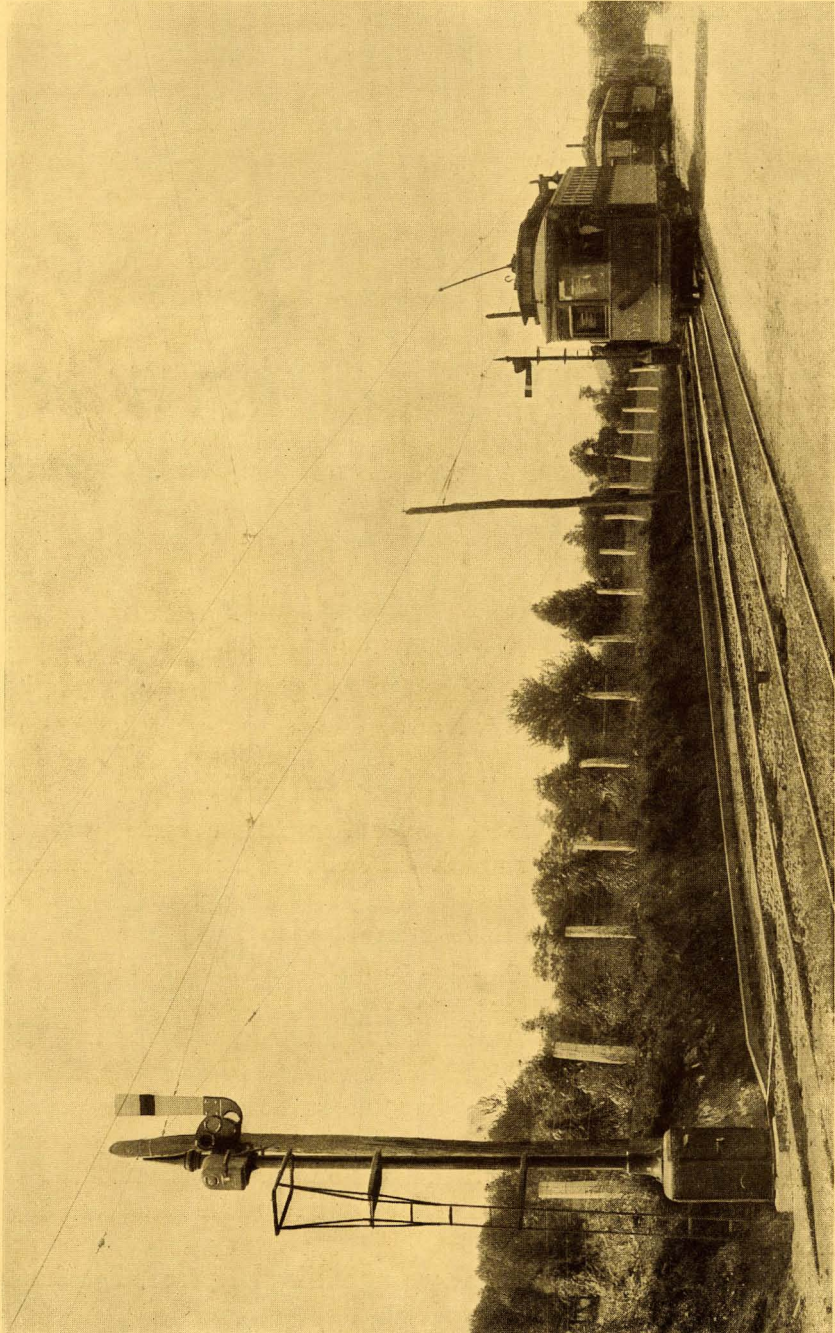


Figure 15—Lehigh Valley Transit Company





from 2 to 8 volts for the various track circuits. The line and track relays are of the G. R. S. Model 2, Form A Universal Polyphase Type. The efficiency of this relay has been demonstrated in several instances in this installation; on one center-fed track circuit two miles long, this relay required but 4 volts and 10 amperes (40-volt amps.), the section having dirt banked up nearly to the top of one rail throughout its entire length and up to the top of both rails at twenty odd road crossings within the section; in another location, as shown in Figure 14, the center-fed track circuit is operated 4,000 feet long under the most adverse conditions, as the illustration clearly shows.

Double rail track circuits using iron reactance bonds are installed between sidings, and single rail circuits on the shorter sections through the passing sidings. Two-rail return is provided by bonding the power rails of the two tracks within siding limits.

Figure 15 shows two cars passing at Siding 75.

This installation of automatic signals is supplementary to an installation completed a short time ago and is now included within the 41 miles.

### Washington Water Power Company

**T**HE Washington Water Power Company operates a high-speed interurban railway connecting Spokane, Medical Lake, and Cheney in the State of Washington.

On their single-track line from Garden Springs, which is a short distance from Spokane, to Medical Lake and Cheney, a total distance of 20 miles, the General Railway Signal Company has installed an Automatic Block Signal System. This installation includes 29 Model 2A semaphore signals, 24 of which are home signals operating automatic stops. The control of all signals is absolute and by means of *Continuous Track Circuit*.

A detail description with illustrations of this installation is given in Bulletin 115 B, a copy of which will be mailed to any address upon request.

Figure 16 shows a semaphore signal in the proceed position with the automatic stop reversed.



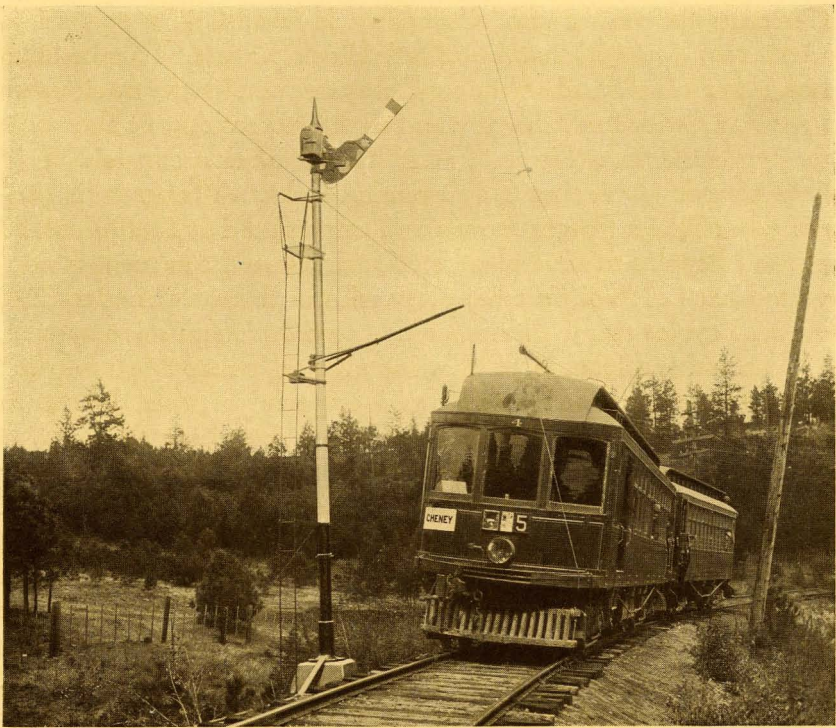


Figure 16—Signal at Proceed, Washington Water Power Co.

Various reports and statements from the Washington Water Power Company show that this installation is operating in a highly satisfactory manner. The percentage of efficiency being 99.997% to 99.998%, or nearly perfect.

### Fort Dodge, Des Moines & Southern Railway

**T**HE Fort Dodge, Des Moines & Southern Railway, which was formerly steam operated, has been changed to a 1200 volt high-speed interurban line. This railway connects Fort Dodge and Rockwell City with Newton, Boone, Des Moines, and several smaller cities within the State of Iowa, and serves a combined agricultural and mining district in the center of the State.

On 18 miles of single track from Boone to Niles and Roberts to Fort Dodge, a total distance of 43 miles, the





General Railway Signal Company is installing a system of *Continuous Track Circuit* Automatic Block Signals. This installation is typical of an absolute control system on single track using light signals for both the day and night indications, as shown in the typical layout (Figure 13). The installation consists of 18 light signals governing 8 automatic blocks. All current is generated at Fraser Power House and transmitted at 22,000 volts 3 phase 25 cycles to several substations, where the current is converted into 1200 volts d.c. for propulsion and transformed to 2200 volts 25 cycles single phase for the signal transmission system.

The unique feature of this installation consists of the fact that a single line wire is used for the opposing signals, the return being over the rails. Both line and track relays are the G. R. S. Model 2 Form A universal polyphase type, which are immune to the effects of direct current. The control of the signals is absolute and is by means of *Continuous Track Circuit*, two rails being retained for the return of the 1200 volt propulsion current by means of double reactance bonds. The reactance bonds are the sloping cover design and of 1000 ampere capacity per track, similar to those illustrated on the T. H. I. & E. T. Co.'s installation in Figures 6 and 11. The capacity of these bonds is sufficient to conduct the return current from two 40-ton locomotives, each drawing a 1600-ton train.

## Oregon Electric Railway

**A** VERY important electric line of the Pacific Coast section is the Oregon Electric Railway, which operates between Portland and Salem, 50 miles, and Hillsboro and Forest Grove, 20 miles, located in the State of Oregon. Cars are operated by a 600 volt direct current catenary trolley line supported by poles on each side of the single-track railway. The daily passenger movement over the district of this division of the Oregon Electric Railway is about 36 trains, exclusive of several freight and work trains.

Passenger trains consist of 2 to 4 cars each, while 15 to 40 cars compose the usual freight train.

Between Portland and Garden Home, the General Railway Signal Company have installed a *Continuous Track Circuit*



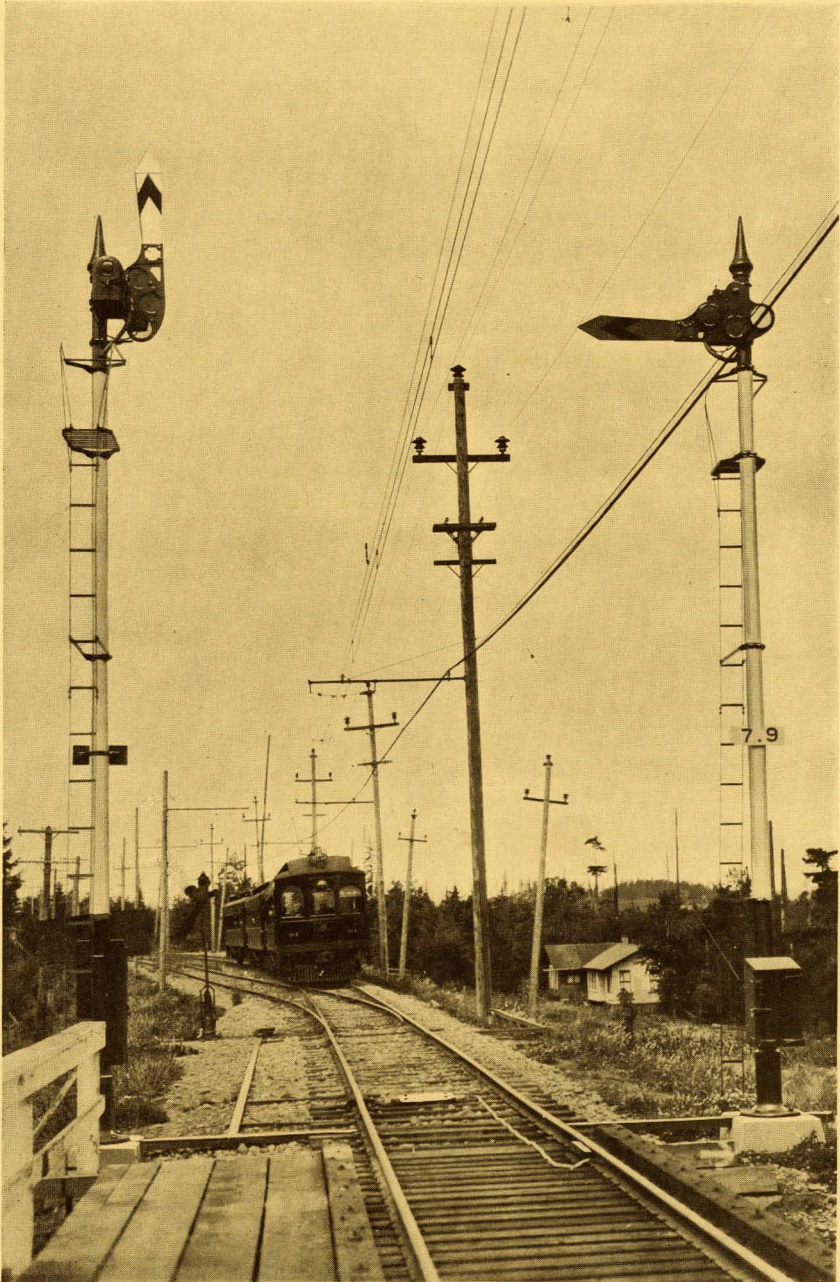


Figure 17— A. C. Automatic Block Signals, Oregon Electric Railway



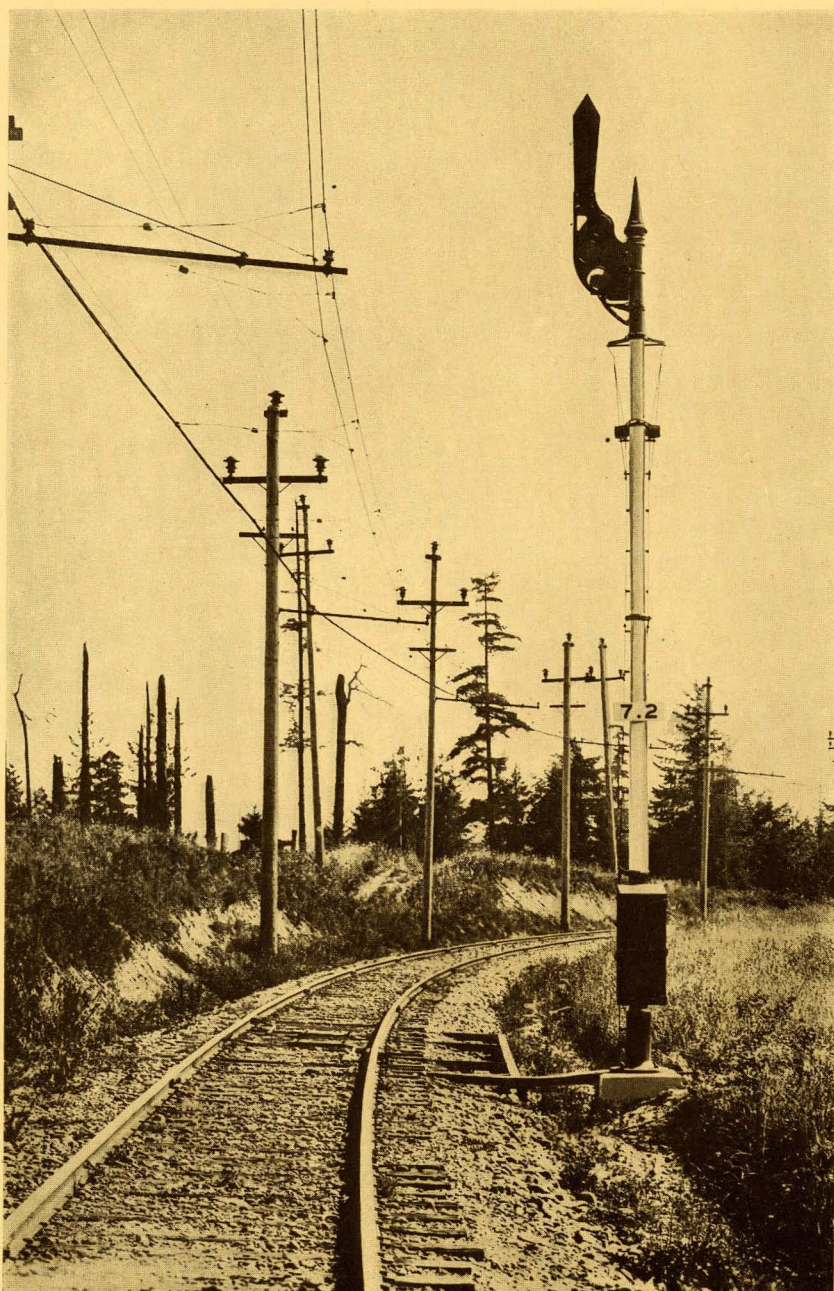
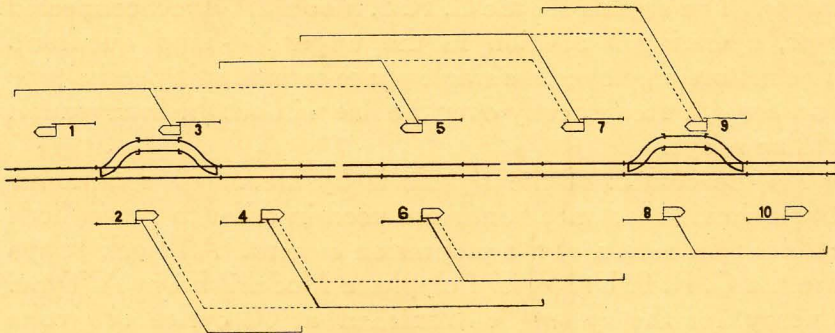


Figure 18—A. C. Automatic Block Signals, Oregon Electric Railway





Automatic Block Signal System, covering 7 miles of single track and including 22 Model 2A Semaphore signals operating 3 position in the upper left-hand quadrant. The typical layout shown in Figure 19 gives the zones of control and shows the intermediate signals. Energy for the system is transmitted at 2200 volts single phase 60 cycles, and is stepped down by the G. R. S. Type H transformers to 110 volts for signal operation and 2 to 6 volts for the track cir-



**FIG. 19**

cuits. As the track circuit is continuous, two rails are retained for the return of the propulsion current.

Interesting views of this installation are shown in the frontispiece and Figures 17 and 18.





## Double-Track Automatic Block Signaling

### Aurora, Elgin & Chicago Railway

**T**HE Aurora, Elgin & Chicago Railway is a high-speed third-rail system composed of single and double-track lines. The double-track portion extends through Bellewood, Illinois, where an installation of automatic block signals has been made to protect a crossover between the main-line tracks. The signals are the G. R. S. Model 2A direct connected type, operating 3 position in the upper left-hand quadrant. The motors employed are single phase commutating series type and are operated directly over the line without the intervention of line relays.

As the control of the signals is by means of continuous track circuit, reactance bonds are used in order to retain both rails for the return of the propulsion current. All track relays are the G. R. S. Universal Polyphase Model 2 Form A Type. Energy for the system is furnished at 60 cycles 110 volts transformed from a 2200 volt transmission line.

### Chicago, Rock Island & Pacific Railroad

**T**HE necessity for the signaling practice as used by electric traction railways to conform to the general signal practice of steam railroads is forcibly shown by a recent installation of alternating current automatic block signals between Des Moines and Altoona on the main line of the Chicago, Rock Island & Pacific Railroad. The work consisted in changing over two miles of direct current signaling to alternating current operation, in order that the Fort Dodge, Des Moines & Southern Railway, which is a 1200 volt electric traction system, could operate their cars over the main line of the Rock Island Railroad, giving the former road a shorter and faster entrance into Des Moines.

The signal material for the changes in this installation was furnished by the General Railway Signal Company, and was installed by the Signal Department forces of the Rock Island Lines. The signals consist of Model 2A base of mast mech-





anism, installed into cases formerly used to house direct current mechanisms. The operating current for the signals is 550 volts 60 cycles, while the trains of the Fort Dodge, Des Moines & Southern Railway operate on 1200 volts direct current. Two rails are retained for the return of the propulsion current by the use of Type C reactance bonds. G. R. S. Polyphase relays, Model 2, Form B, are used throughout this installation.

It is believed that the use of the same track by steam and electric traction roads will become more and more common in the future, and where signals are employed in such cases the signaling practice must be common to both steam and electric traction roads.

### Philadelphia & Western Railway

THE Philadelphia & Western Railway is a double-track, high-speed, interurban line, extending westward from Union Station at 69th Street, Philadelphia, to Strafford, Pa., a distance of 11½ miles, with a branch from Villa Nova to Norristown, making a total of 21 miles of line. The original signal installation on this road between Philadelphia and Strafford was made by the General Railway Signal Company in August, 1907, governing approximately 12 miles of double track. To this system the Philadelphia & Western Railway have recently added an installation from Villa Nova to Norristown, governing 6 miles of double track, and including 7 blocks with as many signals. This installation was also performed by the General Railway Signal Company, and comprises semaphore signals operating 3 position upper quadrant 0° to 90°. The signals are of the G. R. S. Model 2A direct connected type, operated by 25 cycle *single phase induction motors*. A typical layout of this signal system is shown in Figure 20.

The line and track relays are Model 2, Form A, similar to

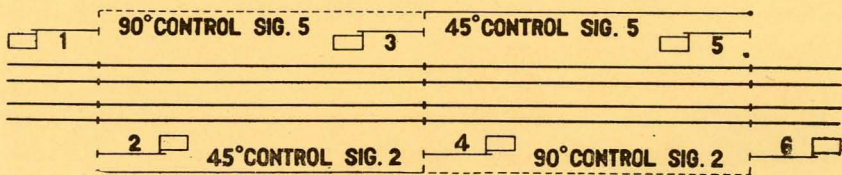


FIG. 20



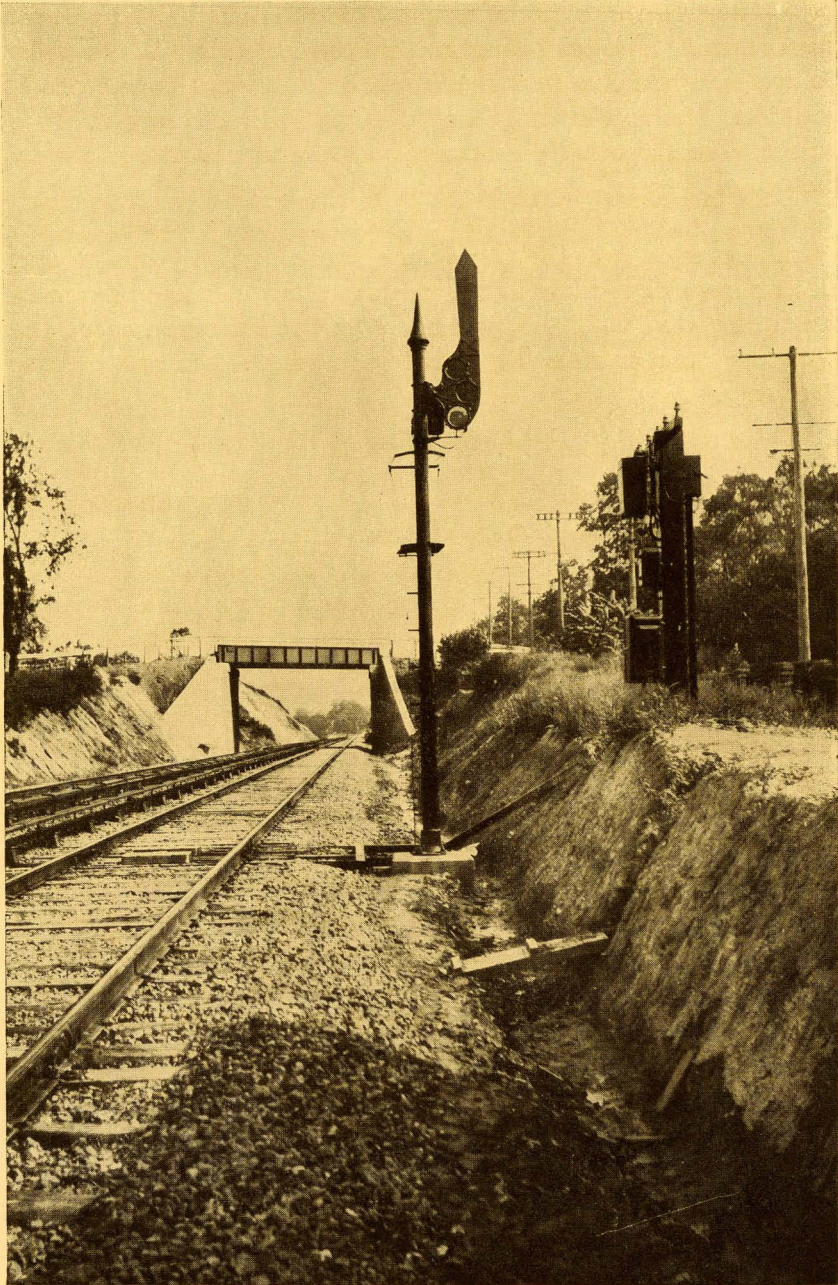


Figure 21—A. C. Automatic Block Signals, Philadelphia & Western Railway





those used on the majority of alternating current installations. The reactance bonds are used in order to provide two rails for the return of the propulsion current.

### San Francisco, Oakland Terminal Railway

**T**HE San Francisco, Oakland Terminal Railway operates 30 miles of double-track line terminating at the end of a pier which extends 3 miles westward into San Francisco Bay from Oakland.

The trains at this pier terminus connect with ferry steamers of this company which operate to and from San Francisco, 2.7 miles distant across the bay from the end of its electric railway pier. About 575 trains, consisting of four to eight large cars, are operated daily. The train service schedules are designed to provide very close connections with the ferry steamers, which arrive at and depart from the terminal every 15 minutes during the rush hours and every 20 minutes during the remainder of the day. Each boat as it arrives is met by 4 or 5 trains which have come into the terminal from the pier approach under as close headway as is operable. The passengers from these trains transfer to ferry steamers and those that have arrived by steamer, in turn, go directly to the waiting trains, which leave promptly for the 3-mile run over the pier to the shore and over a 1-mile double-track line to a junction where the route divides.

On account of the exceedingly dense traffic on the pier and approach to the junction points and because of the comparatively high speeds and the foggy weather encountered at certain seasons of the year, the San Francisco, Oakland Terminal Railway contracted with the General Railway Signal Company for a complete system of Automatic Block Semaphore Signals including automatic train stops. The signaling as installed provides for operating trains at full speed under 45 seconds headway, each train being protected by a full block overlap. Automatic stops provide for service application of the brakes whenever a train passes a signal set at stop. The complete installation includes 75 Model 2A semaphore signals, operating 3 position upper left-hand quadrant, covering approximately



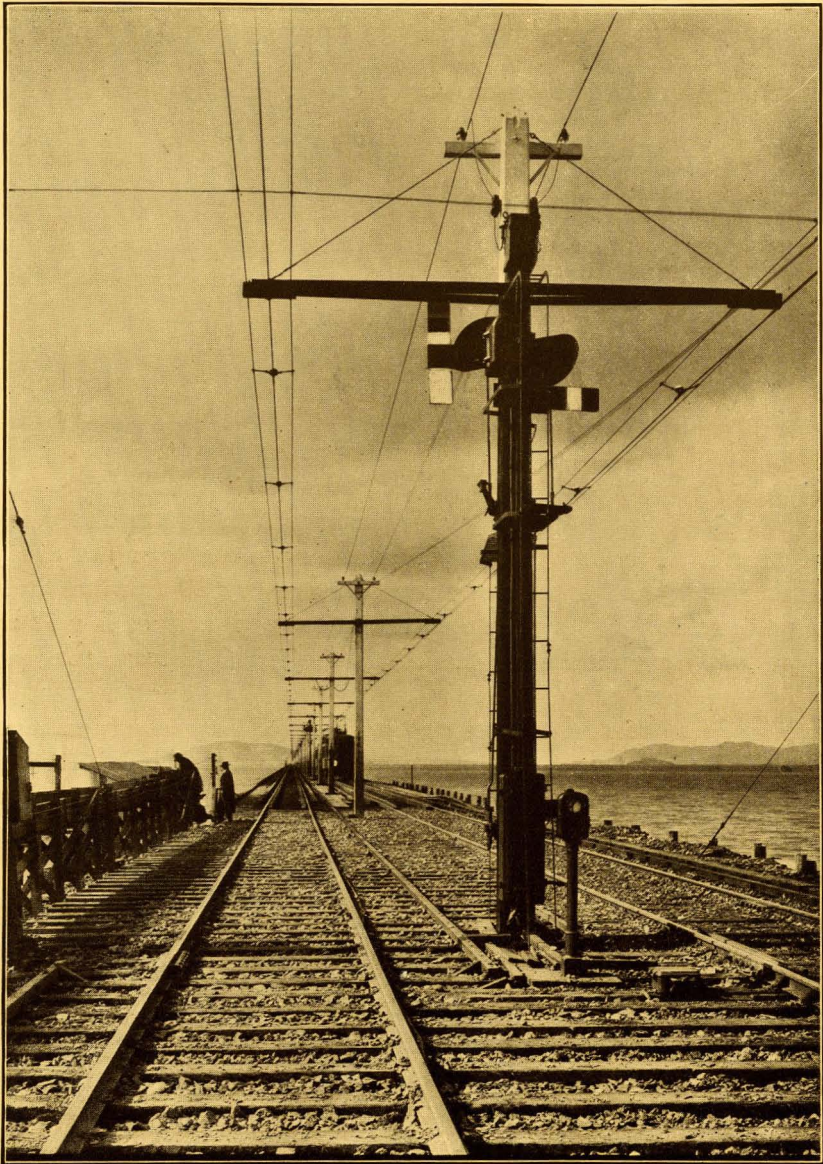


Figure 22—Model 2A A. C. Signals Mounted on Trolley Pole.  
The Key Route, S. F. O. T. Ry.





4 miles of double track and controlled by *Continuous Track Circuit*. A typical signal layout is shown in Figure 22, although the spacing of the signals vary according to the speed maintained throughout the system.

The signal system requires about 10 K. W., which is supplied from Yerba Buena power station at 1100 volts single phase 25 cycles and is stepped down by G. R. S. Type H transformers to 55 volts for signal operation and 2 to 8 volts for the track circuit.

On account of the short track circuits only one rail is used for the return of the propulsion current which is supplemented with a negative return line to the power house. The automatic stop feature is provided by a stop arm operated by the signal mechanism which, when the signal is in the stop position, engages the trip arm of a special-designed valve mounted on the top of all motor cars. This automatic stop valve, which is shown in Figure 23, is restored to normal position, after it has made a service application of the brakes, through the control of the motorman's air valve.

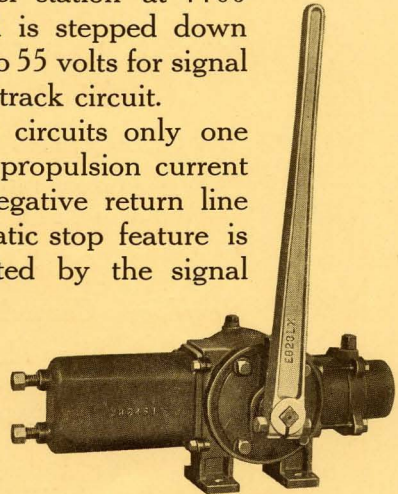


Figure 23— Automatic Stop

The various reports on the efficiency of the system show an average of over 200,000 blade movements per failure. This is a remarkable performance when one realizes that a train could travel eight times around the earth at the equator under *Continuous Track Circuit* signaling, the signals being placed one mile apart, and would only be stopped once due to a signal failure.

In conclusion, this system is operating in a highly satisfactory manner; is facilitating and safeguarding the traffic of one of the most congested electric railways in the world.





List of Installations on  
Steam and Electrified Steam Railroads  
Using our A. C. Appliances

Chicago, Rock Island & Pacific Railroad.  
Cumberland Valley Railroad.  
Fort Dodge, Des Moines & Southern Ry.  
Great Northern Railroad.  
Long Island Railroad.  
Nankai Ry., Japan.  
New York Central Railroad, Electric Zone.  
New York, New Haven & Hartford Railroad.

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List of Installations on  
Electric Traction Railways Using  
Our A. C. Appliances

Hudson Tunnels, Hudson & Manhattan Railroad.  
Indiana Union Traction Co.  
Lehigh Valley Transit Railroad.  
Oregon Electric Railway Co.  
Philadelphia & Western Railroad.  
San Francisco, Oakland Terminal Ry.  
Spokane & Inland Empire Railroad.  
Terre Haute, Indianapolis & Eastern Traction Co.  
Washington Waterpower Company's Railways.



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