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February 1914

The
Union

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Company



SWISSVALE, PA.



The

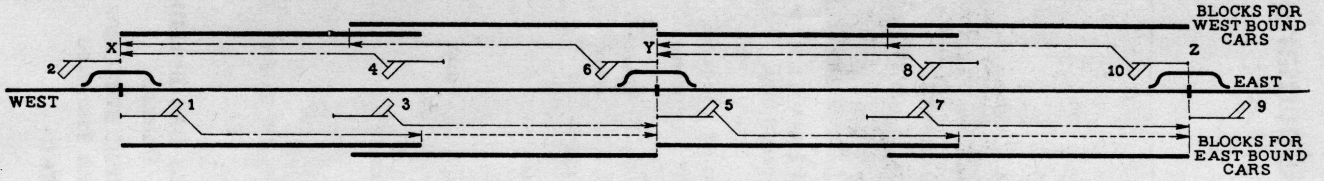
T

D

B

System





LINES LEADING FROM SIGNALS INDICATE SECTIONS OF TRACK GOVERNED AS FOLLOWS

----- = FOR EAST BOUND CARS ONLY - - - - - = FOR WEST BOUND CARS ONLY - . - . - . = FOR EAST & WEST BOUND CARS

NOTE- An east bound car between sidings blocks all west bound cars from same territory, and vice versa
A car on a siding does not affect the signals

Fig. 1. The TDB System. Typical Arrangement of Signals.

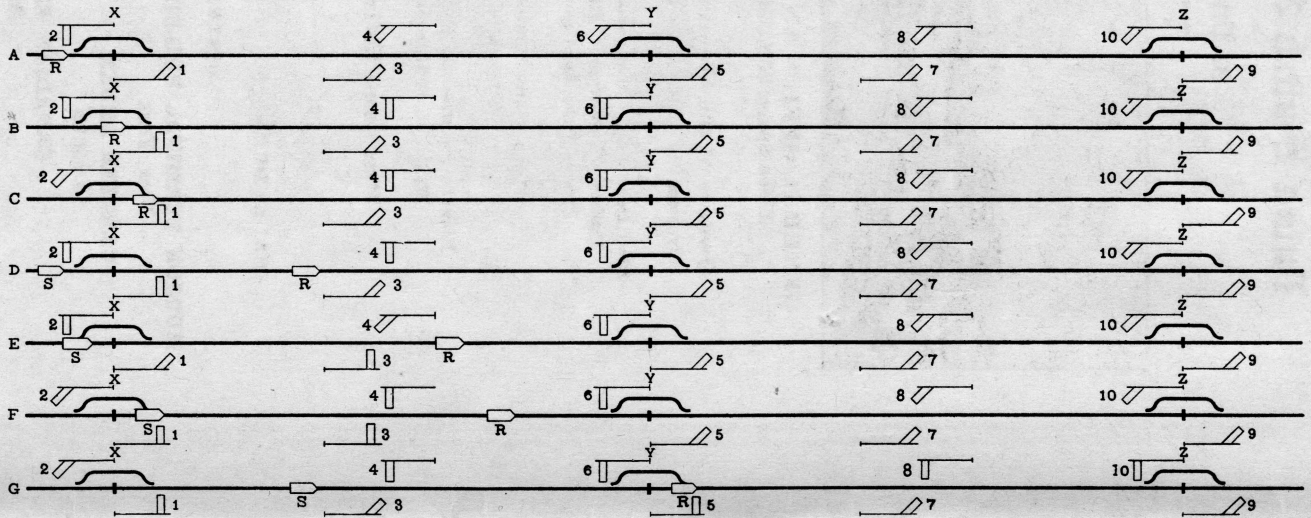


Fig. 2. The TDB System; Showing Effect of Train Movements on Signal Indications.

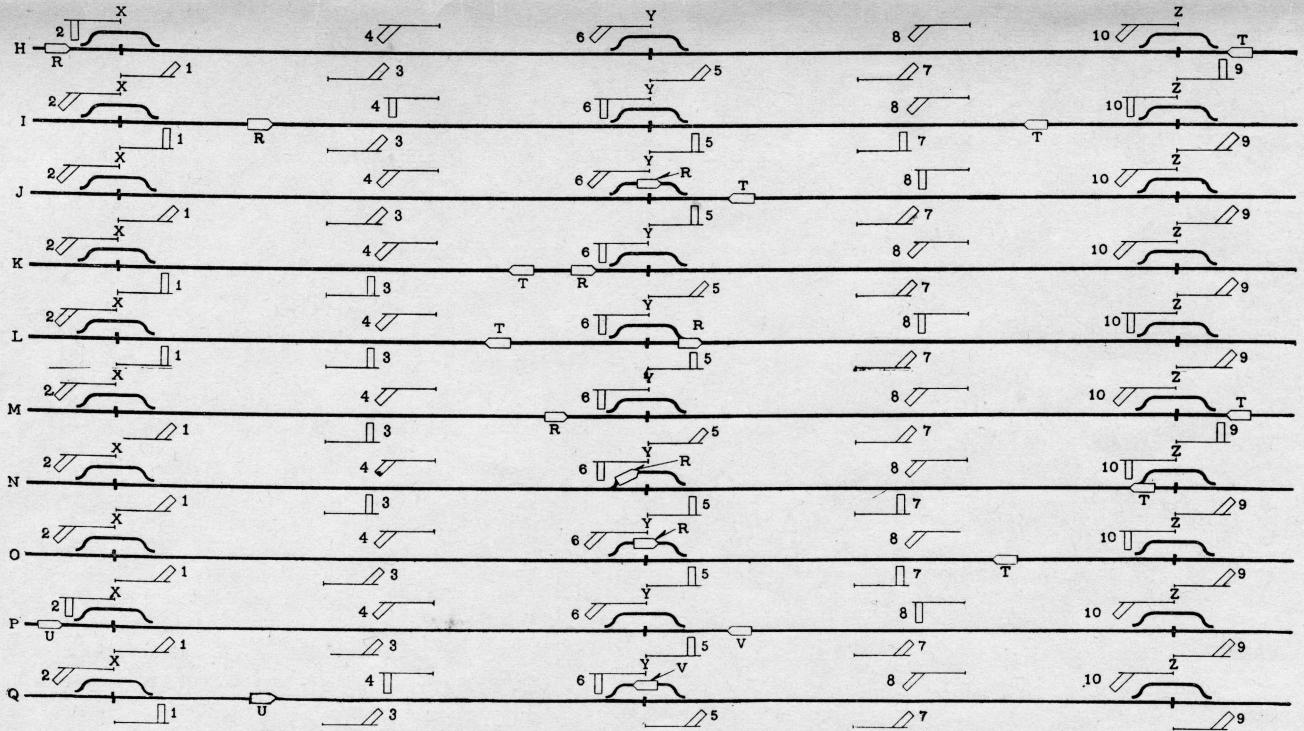
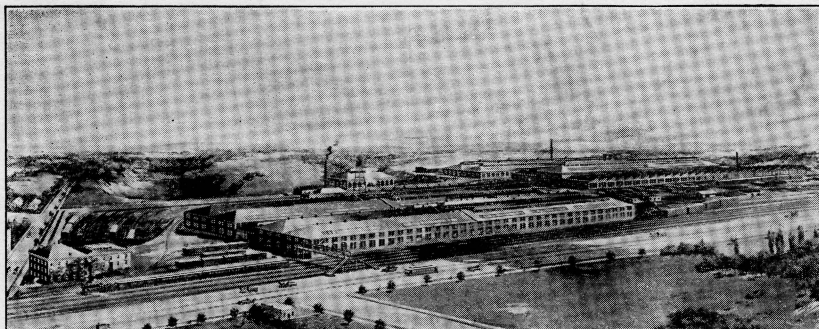


Fig. 3. The TDB System; Showing Effect of Train Movements on Signal Indications.

The
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Style "B" Semaphore Signals at Passing Siding, Proceed and Stop Positions.
Chicago, Lake Shore & South Bend Railway.
The TDB System.

The "T D B" System

Absolute Automatic Block Signaling for Interurban Electric Railways

THE Union Switch & Signal Co. has recently introduced a novel system of automatic block signaling **peculiarly suited to interurban railways**, known as the "TDB" (Traffic Direction Block) System.

Two cars are permitted between sidings, **each in a separate block** and protected head-on and rear by "absolute" signals with a minimum of apparatus;—there is but one track circuit and four signals to each opposing block unit. The blocks for **opposing** cars do not coincide with the blocks for **following** cars, hence the following definitions:

OPPOSING BLOCKS: The section of track from one siding to the adjacent siding;—so called because a car at any point between sidings will block opposing cars at the adjacent siding.

FOLLOWING BLOCK: One-half of the section of track from one siding to the adjacent siding;—so called because there are **two** blocks for **following** cars in **one** block for **opposing** cars.

The simplicity of this system enables the operating rules to be of the simplest kind because but two signal indications, **stop** and **proceed**, are used and there are no preliminaries. In other systems, where track circuit preliminaries are used, the control of the signal at one end of a block is extended past the signal at the opposite end of the block and into the adjoining block, so as to prevent two opposing cars from entering the block simultaneously. The preliminary section is always near a siding. As a result, a car standing within the limits of the preliminary may prevent an opposing car from entering the adjoining block even though this block is clear and the car should be allowed to proceed.

The absence of preliminaries in the system herein described makes each "opposing" block—from siding to siding—a **unit** which allows very flexible operation, as cars which are to meet may advance promptly to the sidings. Another advantage is



The Union Switch & Signal Co.

Universal Switch Circuit Controller and Insulated Switch Rods.
Chicago, Lake Shore & South Bend Railway.
The TDB System.

The Union Switch & Signal Co.

that close headway is permitted for following cars, without complication of apparatus. Under a system using preliminaries, following cars in one direction are spaced a distance apart equal to the length of the block plus the length of the preliminary, which, in such a case, becomes an overlap. Thus, when there are passenger stops within the limits of a preliminary section, the delay to a following car may be prolonged. All apparatus used in this system is of standard design, the amount of material per block unit has been reduced to a minimum and there is no complication of circuits.

Arrangement of Apparatus.

Each "opposing" block, or section extending from siding to siding, is equipped with four signals, two of which are at the ends, or sidings, and two—one for each direction—are near the center of the block. Each signal at a siding governs to the signal at the next siding in the case of opposing movements, but only to the next signal in the same direction of traffic in the case of following movements, whereas the intermediate signals govern to the next signal for the same direction of traffic—the signal at the siding.

The signals, which may be of either the semaphore or light type, are controlled by continuous track circuits and the entire system is operated by alternating current. The use of continuous alternating current track circuits insures that each signal will remain in the stop position so long as the section of track it governs is occupied. The track circuits are of the "double rail" type which permits the use of both rails for the propulsion current return.

Alternating current for the operation of the signals is received from one or more substations, in which auxiliary transformers and switchboards are placed. These transformers step up from the available potential to the 2200 or 2300 volts which is the potential generally employed for the signaling mains. If this voltage is already available, the auxiliary transformers are not needed. The entire signal system, including the lighting of the signals, is operated from this 2200 or 2300 volt current, and it is, therefore, independent of the propulsion system. The 2200 or 2300 volt current is distributed over the signaled territory

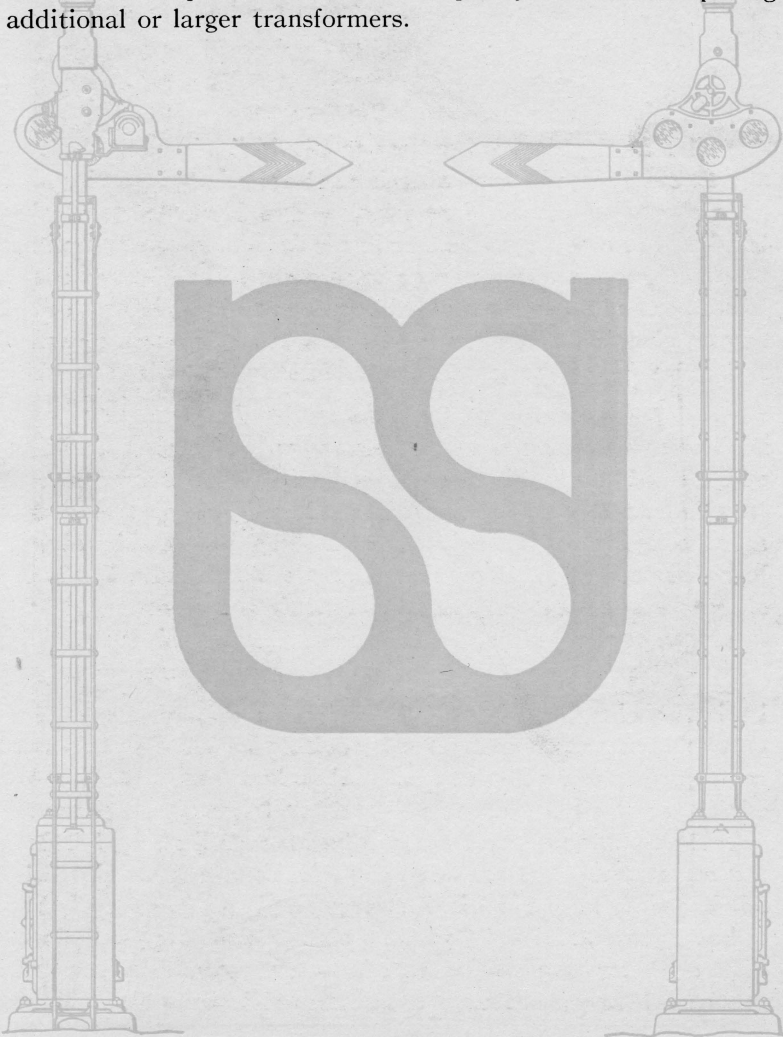


Style "B" Semaphore Signals at Passing Siding, Proceed Position.
Chicago, South Bend & Northern Indiana Railway.
The TDB System.

The Union Switch & Signal Co.

and stepped down where necessary to about 10 volts for track circuits and 110 volts for line and signal circuits. Twenty-five, forty or sixty cycle apparatus is provided, according to the available frequency.

Stations and switches may be lighted from the same 2200 or 2300 volt mains by increasing the capacity of the transformers where necessary. In many cases, the 110 volt signal transformers will provide sufficient capacity without requiring additional or larger transformers.





Style "B" Semaphore Signal Intermediate to Passing Siding, Proceed Position.
Chicago, South Bend & Northern Indiana Railway.
The TDB System

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Operation of the System.

Fig. 1 is a diagram showing the general layout of two opposing blocks with the sections of track controlled by each signal indicated by dotted lines. Figs. 2 and 3 show the indications assumed by each signal as one or more cars proceed through the blocks.

In Fig. 2, at A, there is an east bound car approaching siding X, and opposing signal 2 is at stop.

At B, the car is passing signal 1, which was at proceed at A, setting it at stop. Signal 2 is held at stop until the car has passed. Opposing signals 4 and 6 are also set at stop.

At C, there is no change except that signal 2 has cleared as the car has passed out of the block to the left.

At D, the first car "R" has proceeded to signal 3, and a following car is approaching signal 1. Signal 1 is protecting the rear of car "R" and signals 4 and 6 protect it against opposing movements.

At E, car "R" having passed signal 4, signal 1 has cleared up for car "S."

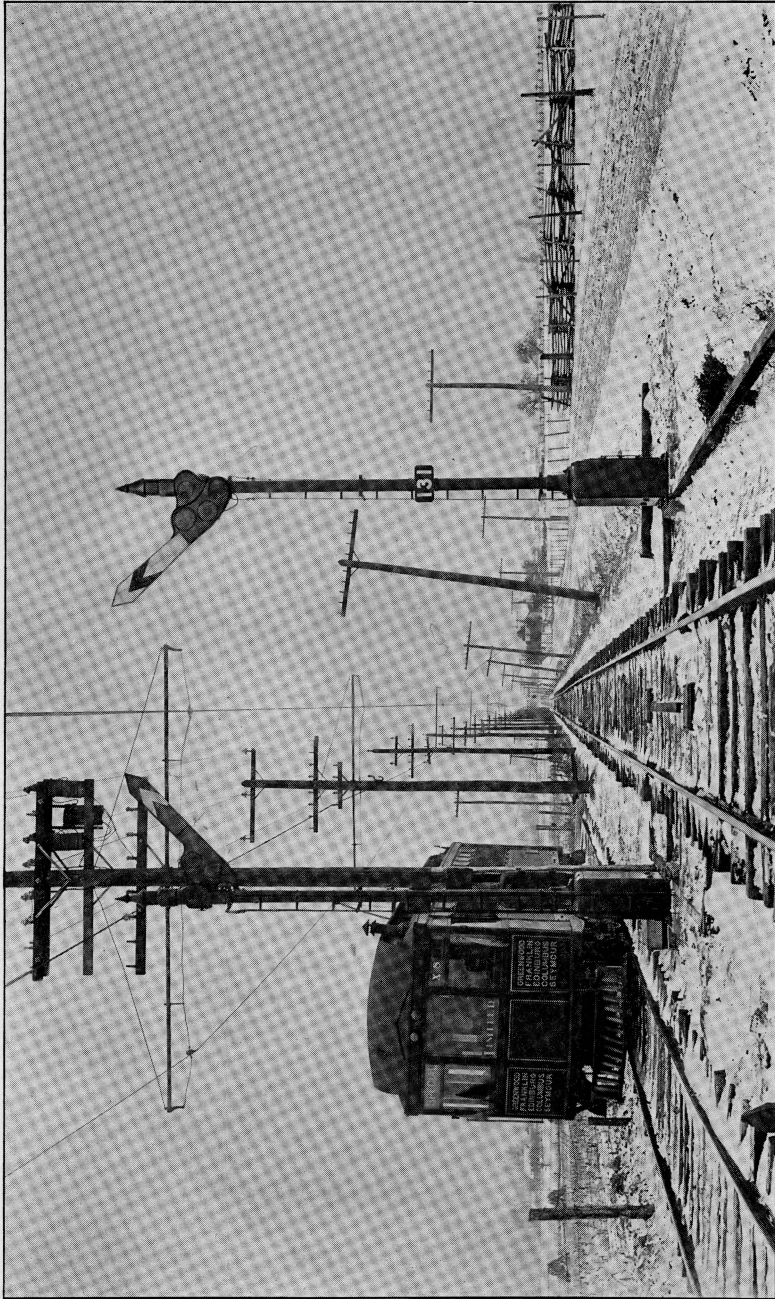
At F, car "S" has entered the first following block while car "R" is in the second following block. Opposing signals 4 and 6 still protect the cars against opposing movements, and signals 1 and 3 protect against following movements.

At G, car "R" has entered the next opposing block while car "S" is following and both are protected rear and head-on.

The operation for west bound cars is similar.

At H, I, J, K, L, Fig. 3, are shown the positions of cars and the indications of signals as a meet is made at siding Y. In this case one car heads in and backs out of the siding, although this particular method of making a meet is not necessary. It will be evident that either car can take the siding because all sidings are shown double ended, and this system of signaling will permit either car to back in and head out, head in and head out, or head in and back out. With stub ended sidings and signals placed opposite the fouling or clearance point of the sidings the cars would be protected equally well by the signals with this system, for a car on a siding does not affect any of the signals in any way.

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Style "B" Semaphore Signals at Passing Siding, Proceed Position.
Indianapolis, Columbus & Southern Traction Co.
The TDB System.

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It will be noted that cars between X and Y do not in any way affect the signals between Y and Z. This is shown at M, N, O, P, Q, Fig. 3. At M, car "R" does not affect the movement of car "T," which, we will assume, is late. At N and O, car "R" is shown proceeding into the siding so as to clear opposing block X to Y for car "T." At P and Q, a west bound car is taking siding without affecting the movement of an east bound car "U".

These diagrams cover all usual car movements. Special movements of any kind are protected equally well, as the broad principle of track circuit control insures that, when the track circuit, or block, is **occupied**, the signals will be in the **stop position**, and when the track circuit, or block, is **unoccupied**, the signals will be in the **proceed position**. No sequence of movements is required to secure complete protection. Therefore cars may leave a block at any point, and the signals will assume the proceed position. Distant signals or marker boards may be used with this system if desired, to regulate the approach of cars to the signals shown in the diagrams. The signals near the center of the block are placed 500 to 1000 feet each side of the center, according to conditions.

Semaphore or light signals may be employed, but **semaphore** signals have been more generally used at **sidings** for the following reasons:

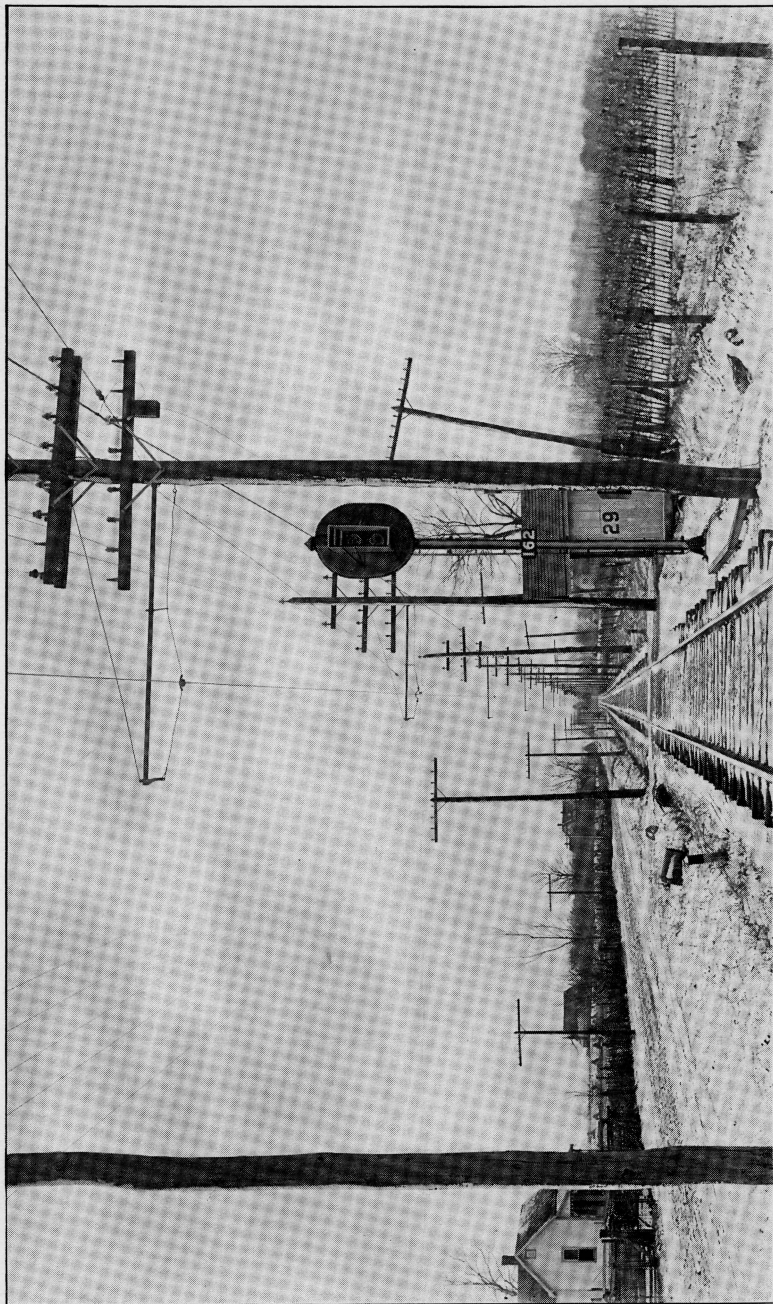
First—They have a much greater advertising value, for their operation may be easily observed by passengers and the general public.

Second—They provide indications which can be clearly seen while making movements into and out of sidings; therefore,

Third—They render unnecessary the use of switch indicators at adjacent switches, and

Fourth—They are of the same general type and give the same indications as signals which have been standard in steam road practice for many years.

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Model "13" Light Signal, Intermediate to Passing Siding.
Indianapolis, Columbus & Southern Traction Co.
The TDB System.

The Union Switch & Signal Co.

Conclusions.

Particular attention is called to the following summary of results to be obtained by the use of this system. This will doubtless appeal to the executive, operating and engineering departments of all interurban railways.

FIRST:—MAXIMUM PROTECTION:—Each car has at all times one or two stop signals protecting it at the rear as well as head-on.

SECOND:—MAXIMUM SPEED:—A proceed signal means that the block is unoccupied.

THIRD:—SIMPLICITY OF OPERATION:—Each signal gives but two indications, **stop** and **proceed**. All apparatus is operated automatically; therefore, trainmen do not need to manipulate any part of the signal system. All cars receive the **same** indication to pass into a block.

FOURTH:—FACILITY OF OPERATION:—A car receiving a clear signal can proceed without delay. Each block is 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. A car may, therefore, at any time proceed promptly to a siding or meeting point.

FIFTH:—SIMPLICITY OF RULES:—There are only two indications, **stop** and **proceed**, which are so easily understood 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:—Opposing or following cars are spaced a minimum safe distance apart. Under a system requiring preliminaries the spacing is increased at certain places by a distance equal to the length of the preliminary without securing additional safety. The fact that the length of the preliminary does not always bear a fixed relation to the length of the block and that the preliminary may be at either end, means that all signals do not give the same information.

SEVENTH:—HIGH EFFICIENCY:—Standard apparatus and simple controlling circuits are used throughout.

EIGHTH:—ADAPTABILITY TO CONDITIONS:—This system may be easily modified to provide for changes in arrange-

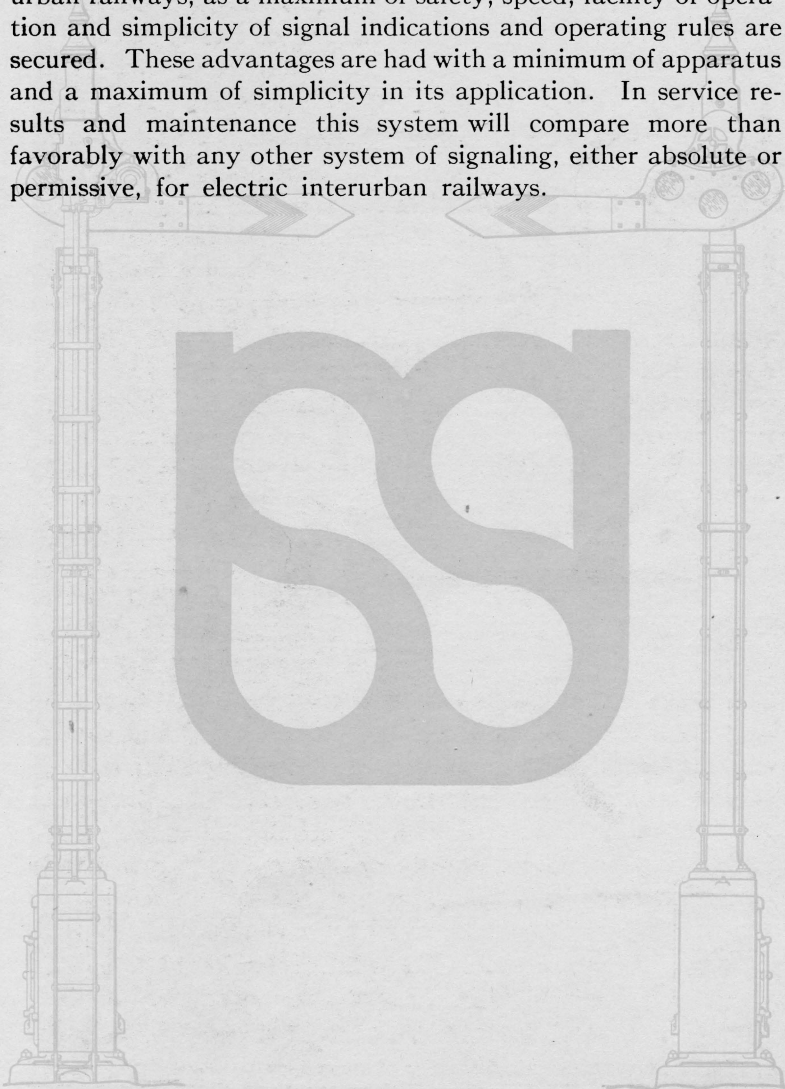


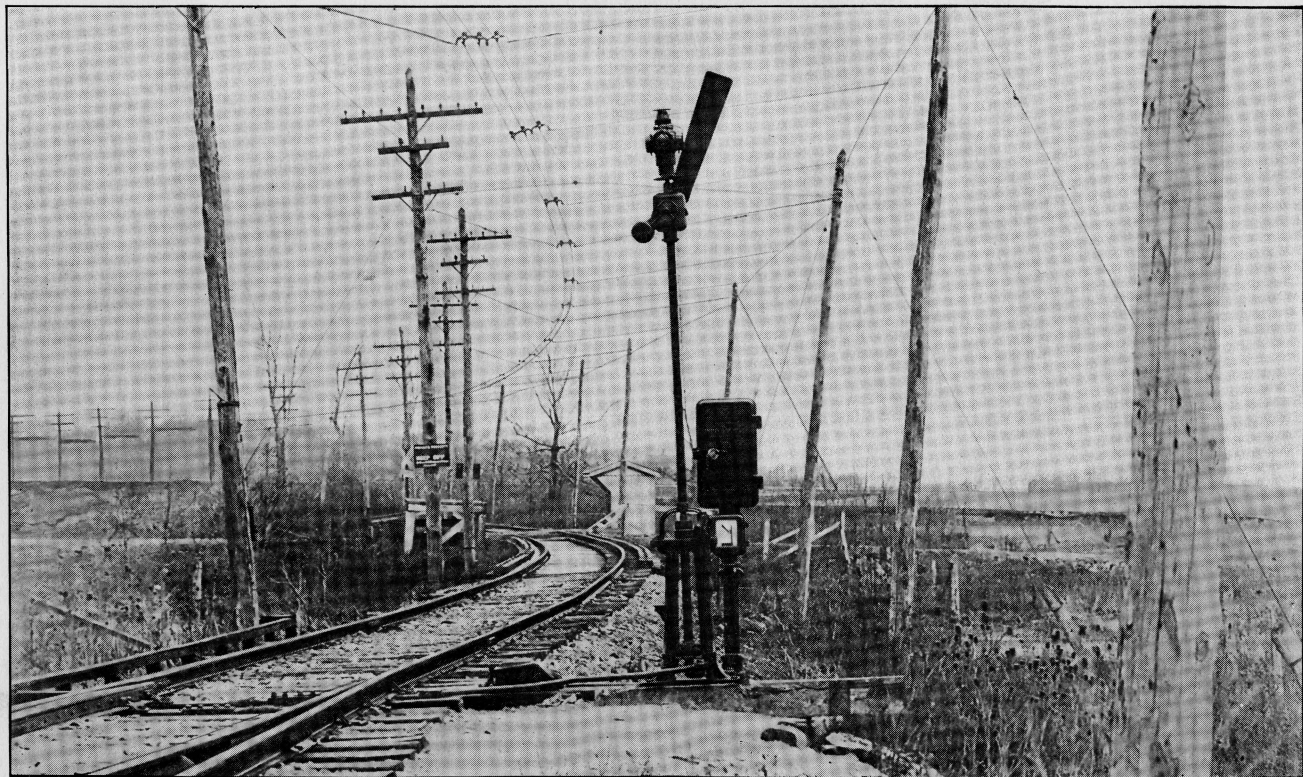
Style "B" Semaphore Signals at Passing Siding, Proceed and Stop Positions.
Louisville & Northern Railway & Lighting Co.
The TDB System.

The Union Switch & Signal Co.

ment of track, traffic, etc. Sidings may be added, double ended, extended or changed to a regular through meeting point with minimum modification in the signaling, and with maximum celerity.

SUMMARY:—This system is peculiarly suited to inter-urban railways, as a maximum of safety, speed, facility of operation and simplicity of signal indications and operating rules are secured. These advantages are had with a minimum of apparatus and a maximum of simplicity in its application. In service results and maintenance this system will compare more than favorably with any other system of signaling, either absolute or permissive, for electric interurban railways.





Universal Switch Circuit Controller and Switch Indicator.
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Engineering Details.

Each opposing block has one track circuit with two track relays—one at each end—and a transformer which supplies current at the center of the block. Each track relay will be shunted by any car which may be on the track circuit between the track relay itself and the transformer feeding it. Also; each track relay will be shunted by a car within a short distance on each side of the transformer. There is, therefore, a territory on each side of the transformer within which a car will shunt **both** relays.

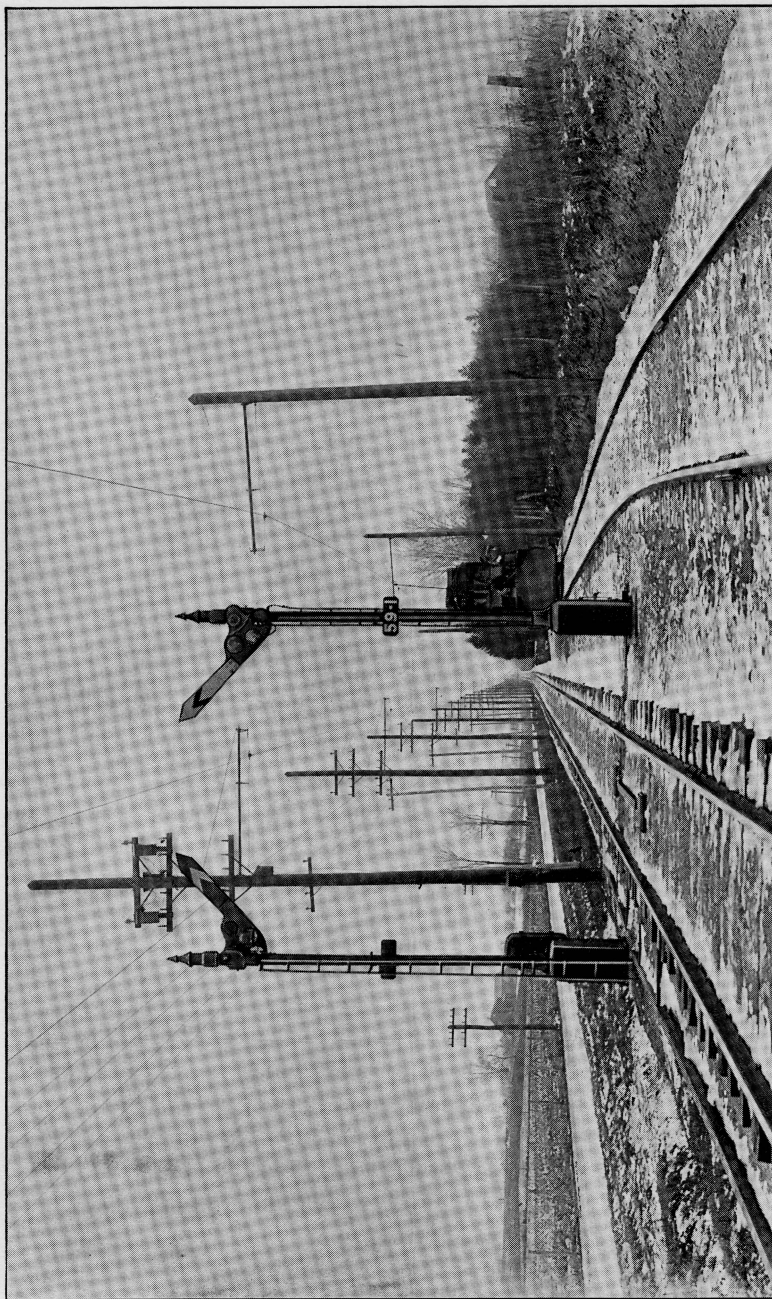
Referring to Figs. 1, 2 and 3; in the block between X and Y there will be one track relay at signal 1, and another track relay at signal 6. Normally, signals 1 and 6 are controlled by both track relays or the entire section of track between signals 1 and 6. Signal 3 is controlled by the track relay at signal 6, and signal 4 is controlled by the track relay at signal 1.

An eastbound car entering the block X-Y at X will de-energize the track relay at signal 1, and thereby set signals 1, 4 and 6 at stop. As signal 3 is controlled by the track relay at signal 6, it will not be set at stop until the car reaches the point where it affects this track relay.

The car in setting signal 4 at stop, energizes a line relay which is used to clear signal 1 after a car has passed signal 4. This line relay cuts out the control of signal 1 from the track relay at signal 6. As the car proceeds, passing signal 3, the track relay at signal 6 is de-energized, setting signal 3 at stop and still holding the other three signals at stop. When the car passes signal 4, the track relay at signal 1 is again energized and signal 1 is cleared. Incidentally, signal 4 is cleared because the track relay at signal 1 is energized, but this has no effect on east bound movements. When the car has passed signal 6 all signals and relays again assume their normal positions unless a second car has entered the block at signal 1 before the first car passed signal 6. The operation for west bound cars is similar.

The line relay is active only in connection with east bound movements; west bound movements have no effect upon it. Therefore a west bound car will set signal 1 at stop when signal

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Style "B" Semaphore Signals at Passing Siding, Proceed Position.
Ohio Electric Railway.
The I.D.B. System.

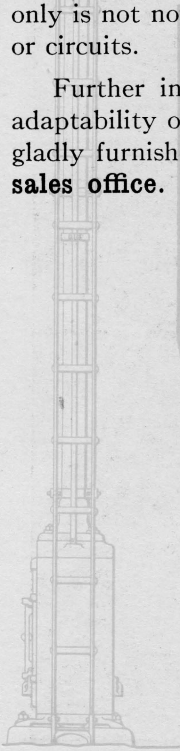
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6 is passed. Another line relay is used to limit the control of signal 6 in a similar manner for west bound movements.

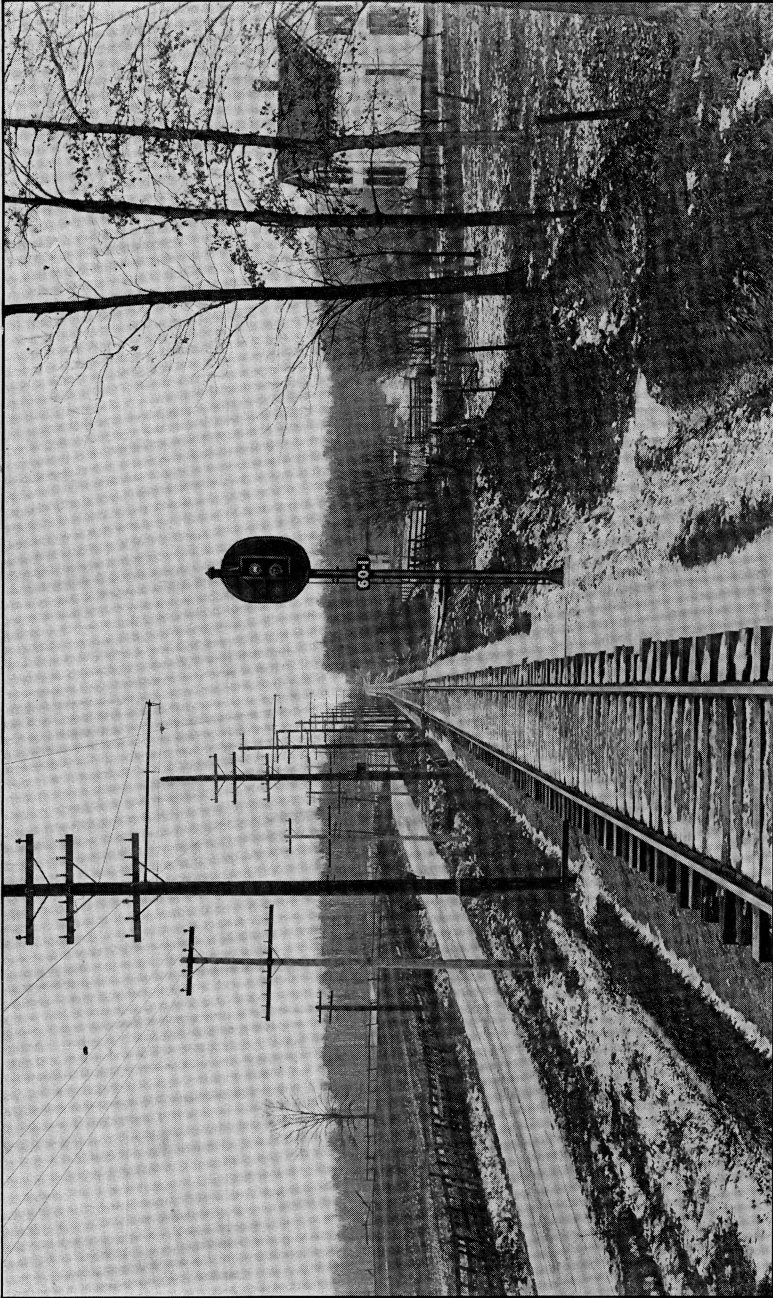
The circuits are so arranged that but one of the two line relays can be energized at any one time. It will be evident that if an east bound car should pass signal 1 at the same time that a west bound car passed signal 6, signals 3 and 4 being directly controlled by the track relays, would afford positive protection.

From the foregoing description of the "T D B" System of signaling it may appear to require a certain sequence of car movements. **But this is not the case.** An east bound car could proceed past signal 1 and afterward back out of this block instead of proceeding through, and all apparatus would again become normal when the car had left the block. The same would happen if a west bound car should enter at signal 6, and then back out. The arrangement of circuits in conjunction with a standard relay so that it will be active for one direction of traffic only is not novel, nor does it involve complication of apparatus or circuits.

Further information regarding apparatus, circuits and the adaptability of this system to your operating conditions will be gladly furnished on application. **Please address our nearest sales office.**



The Union Switch & Signal Co.



Model "13" Light Signal, Intermediate to Passing Siding.
Ohio Electric Railway.
The TDB System.

The Union Switch & Signal Co.

Installations.

Inasmuch as concrete examples are always worth more than abstract discussion, we give below short descriptions of several installations of the "T D B" Signal System now in service or being installed on the following interurban railways.

	MILES	BLOCKS
Chicago, Lake Shore & South Bend Railway . . .	55	20
Indianapolis, Columbus & Southern Traction Co.	22	13
Chicago, South Bend & Northern Indiana Ry. . .	9.5	5
Louisville & Northern Railway & Lighting Co. . .	3.5	2
Ohio Electric Railway	4.2	2
Scranton & Binghamton Railroad	10.1	9
Kansas City, Clay Co. & St. Joseph Ry.	70.1	25
	174.4	76

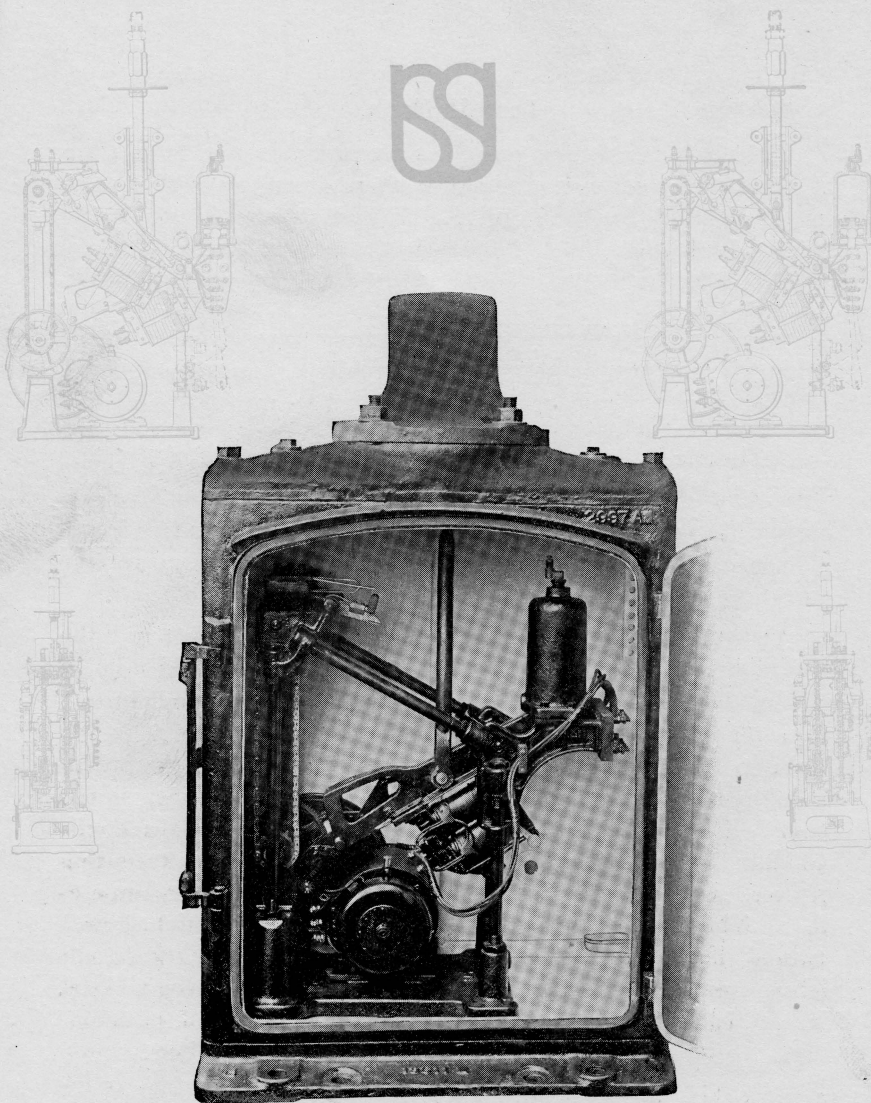
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In this table the blocks constitute the territory from siding to siding.

On these lines the semaphore signals are of the well known Style "B" type, electrically lighted, two position, working in the upper left hand quadrant, Fig. 4. They are equipped with induction motors and the mechanisms are at the bottom of the posts. On the Chicago, Lake Shore & South Bend and the Chicago, South Bend & Northern Indiana, all signals are semaphores. On the other roads light signals are used between sidings. These light signals are Union Model "13" equipped with two 8" lenses each, Fig. 5. They carry hoods to screen the lenses from sunlight and backgrounds to increase the visibility. Behind each lens are two 25 watt, 16 c. p., tungsten lamps.

Each block—siding to siding—has but one track circuit with a track relay at each end. Current is supplied by transformers at the center of each block. Galvanometer track relays, Fig. 6, are used on the six D. C. propulsion roads, and centrifugal frequency relays, Fig. 7, on the Chicago, Lake Shore & South Bend which operates on alternating propulsion current at 6600 volts, 25 cycles. The semaphore signals are directly controlled by the track relays, whereas the light signals on the Indianapolis, Columbus & Southern Traction, Louisville & Northern Rail-

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Style "B" A. C. Automatic Block Signal Mechanism.

The Union Switch & Signal Co.

way & Lighting, Scranton & Binghamton, Kansas City, Clay County & St. Joseph, and the Ohio Electric require line relays which operate on 110 volt circuits controlled by the track relays.

All signal apparatus is designed for 60 cycle operation except on the Scranton & Binghamton, the Ohio Electric Railway and the Kansas City, Clay County & St. Joseph, where 25 cycle current is used. The signal slot coils are controlled by line wire circuits through the track relay contacts, whereas the signal motor circuits receive their current from transformers at the sidings. They are on purely local circuits. Transformers with two secondaries, one for the track circuits and one to deliver 110 volts, supply current at the center of the block for the track and to line and intermediate signal circuits. Other transformers with one 110 volt secondary each, placed at the turnouts, supply current for the siding semaphore signals and line circuits. These transformers are provided with taps as required, and all receive current from the 2200 volt A. C. mains.

The Indianapolis, Columbus & Southern Traction, the Chicago, South Bend & Northern Indiana, the Louisville & Northern Railway & Lighting, the Scranton & Binghamton, the Ohio Electric and the Kansas City, Clay County & St. Joseph, are D. C. propulsion roads. On the first six the potential is 600 volts, on the last 1,200, and the impedance bonds have a capacity of 500 amperes per rail. The impedance bonds on the Chicago, Lake Shore & South Bend, where alternating current at 6,600 volts is used, have a capacity of 200 amperes per rail. Circuit controllers connected to the switch points require the switches to be set for the main line before the signals at the sidings can assume the clear position. All relay boxes are of iron, mounted either on separate iron posts or on the semaphore signal cases. The 110 volt lightning arresters of the Union "spark gap" type are mounted in wooden boxes on the trolley poles.

The foregoing description covers certain features common to the seven railways. What follows has to do with details peculiar to each installation.

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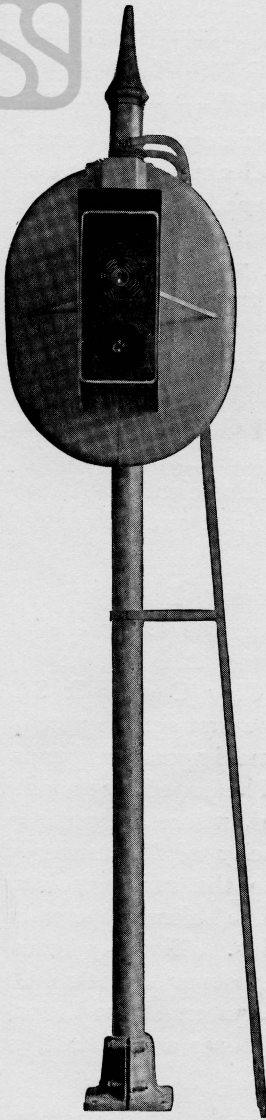


Fig. 5. Model "13"
Electric Light
Signal Complete.

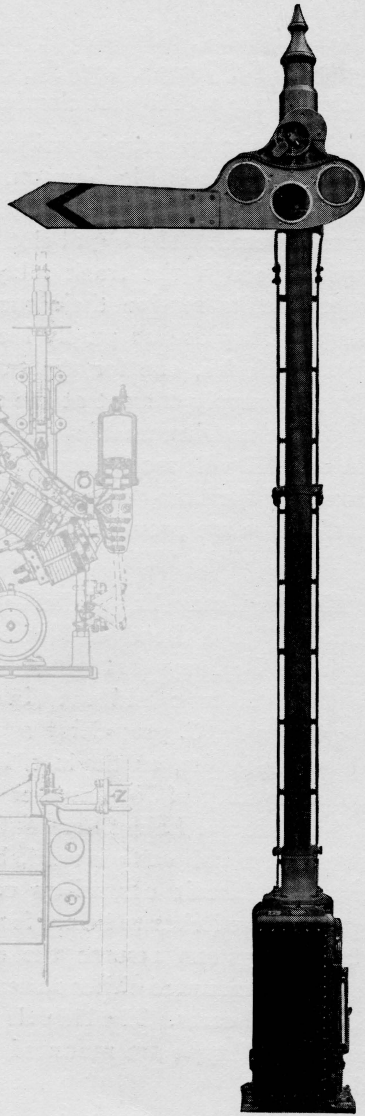
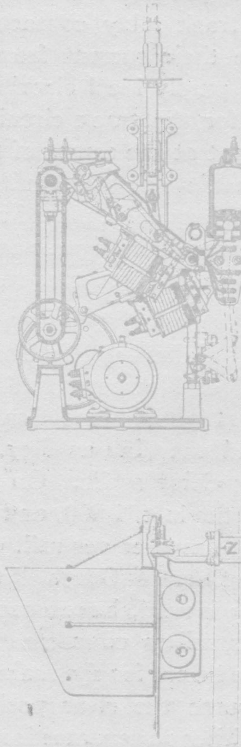


Fig. 4. Style "B"
Automatic Block
Signal Complete.



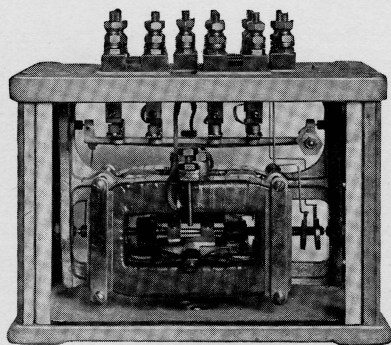


Fig. 6. Galvanometer
Track Relay for D. C.
Propulsion Roads.

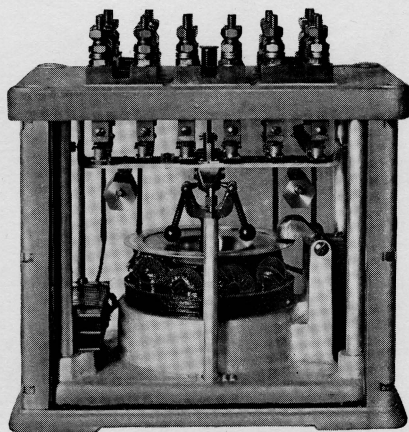


Fig. 7. Centrifugal
Frequency Track
Relay for A. C.
Propulsion Roads.



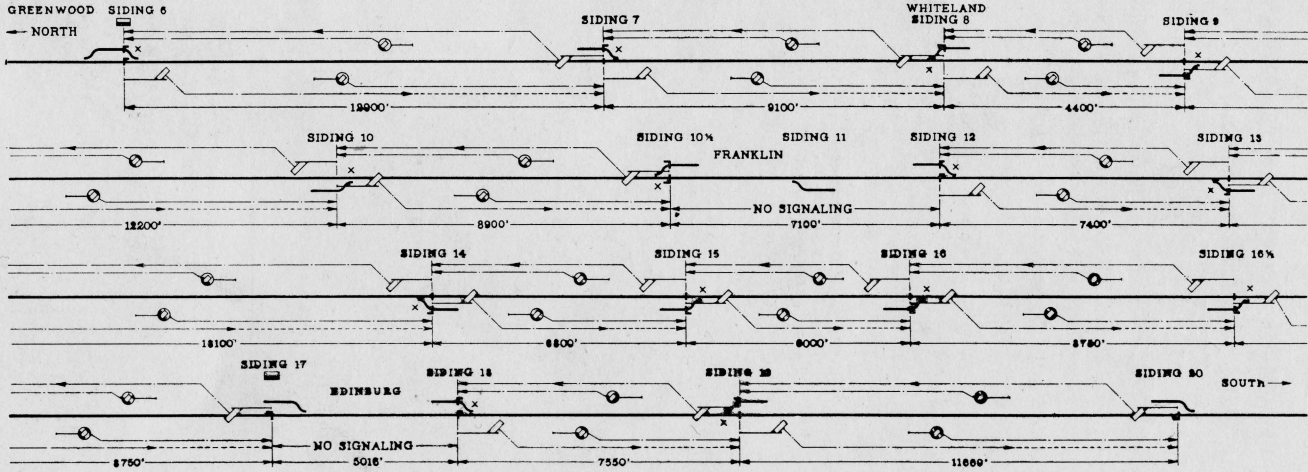


Fig. 8. The TDB System. Indianapolis, Columbus & Southern Traction Co.

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INDIANAPOLIS, COLUMBUS & SOUTHERN TRACTION COMPANY.

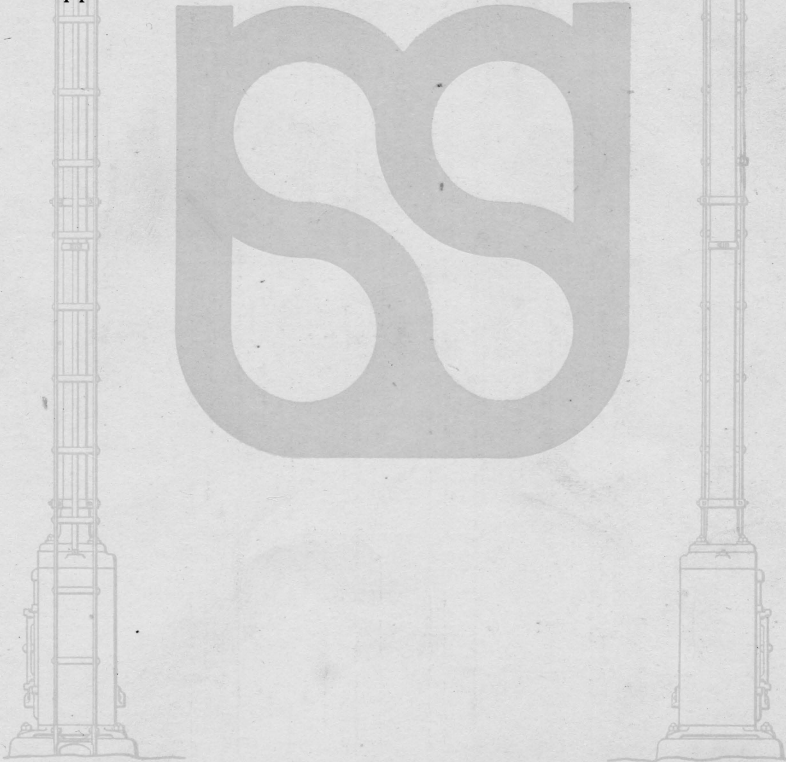
Siding 6 to Siding 20, Indiana.

" 20 " 1 33.

GO-110502
" 123294

This road operates trains between Indianapolis and Seymour, Ind., a distance of 62 miles. There is an Indianapolis-Louisville limited and a local service, and the traffic near the northern end between Siding 6 and Siding 20, is such that a headway less than the distance between sidings is necessary.

The territory signalled is between Siding 6 and Siding 20. The actual distance is 22.2 miles, divided into 13 blocks—siding to siding—with a total of 26 semaphore and 26 light signals. This installation—the initial one on this road—is shown in the diagram, Fig. 8. All sidings are single-ended and the opposing blocks average 9000 feet in length. Power for this installation is supplied from a commercial line at Franklin.



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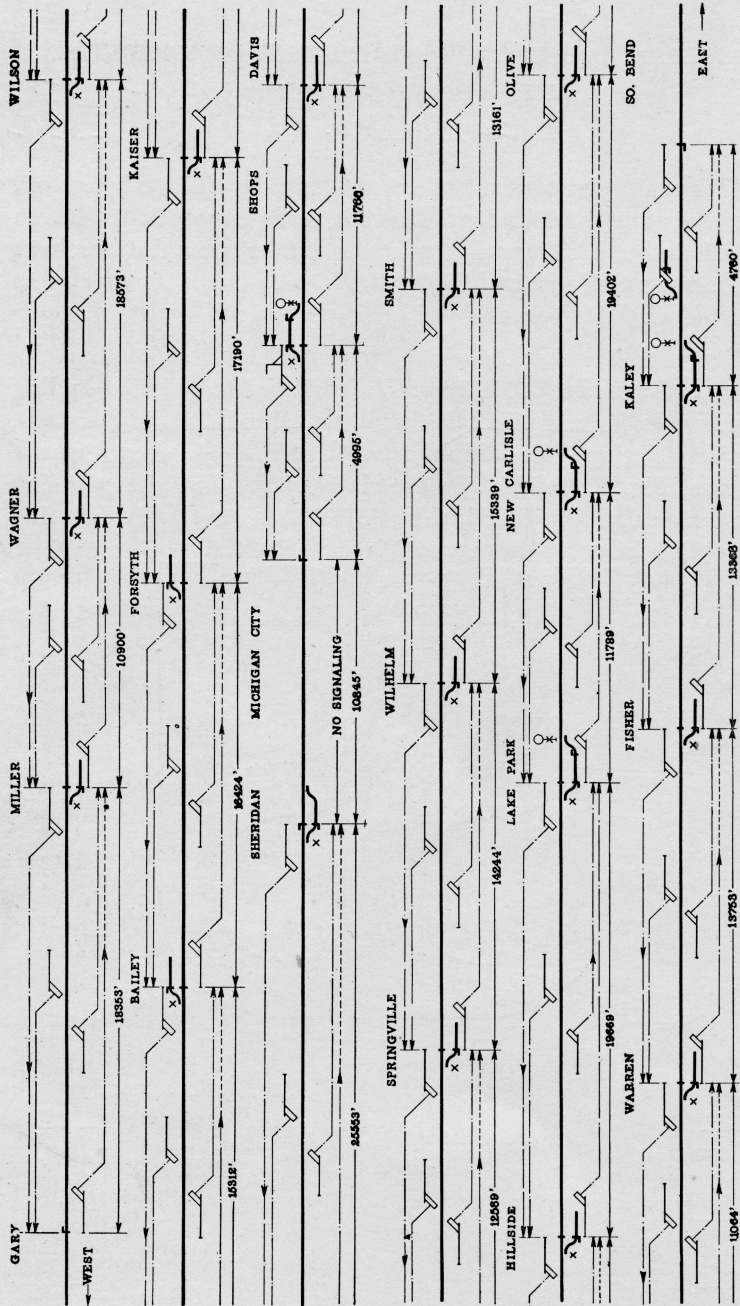


Fig. 9. The TDB System. Chicago, Lake Shore & South Bend Railway.

The Union Switch & Signal Co.

CHICAGO, LAKE SHORE & SOUTH BEND RAILWAY.

Gary to South Bend, Indiana.

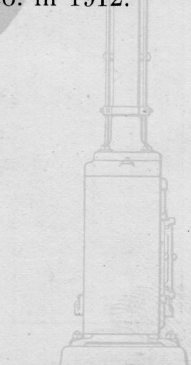
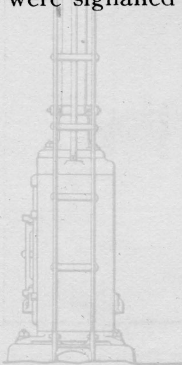
90-110400

The Chicago, Lake Shore & South Bend extends from Pullman, Illinois to South Bend, Indiana. From Pullman to Gary the road is double track, and from Gary to South Bend it is single track. The entire single track line, with the exception of a short stretch through Michigan City and in the city of South Bend, a distance of about 55 miles, is signalled.

The installation includes 20 blocks—siding to siding—having an average length of 14,400 feet, protected by 80 semaphore signals. The layout of tracks and signals is shown in Fig. 9. Most of the sidings are single-ended, and so arranged as to favor westbound traffic connecting with the Illinois Central at Pullman. Certain of the sidings are double-ended, and the ends farthest from the signals are equipped with semaphore switch indicators, so as to permit cars to enter the main line only when the block is unoccupied and no cars approaching.

As this road is operated by alternating current at 6,600 volts, 25 cycles, the track relays are so designed as to be affected only by 60 cycle current; therefore they are not influenced by the propulsion return. These relays are of the centrifugal frequency type shown in Fig. 7.

The power for this installation is secured from the power house at Michigan City. The power line leading north towards Gary is extended to supply current also for two gauntlets which were signalled by The Union Switch & Signal Co. in 1912.

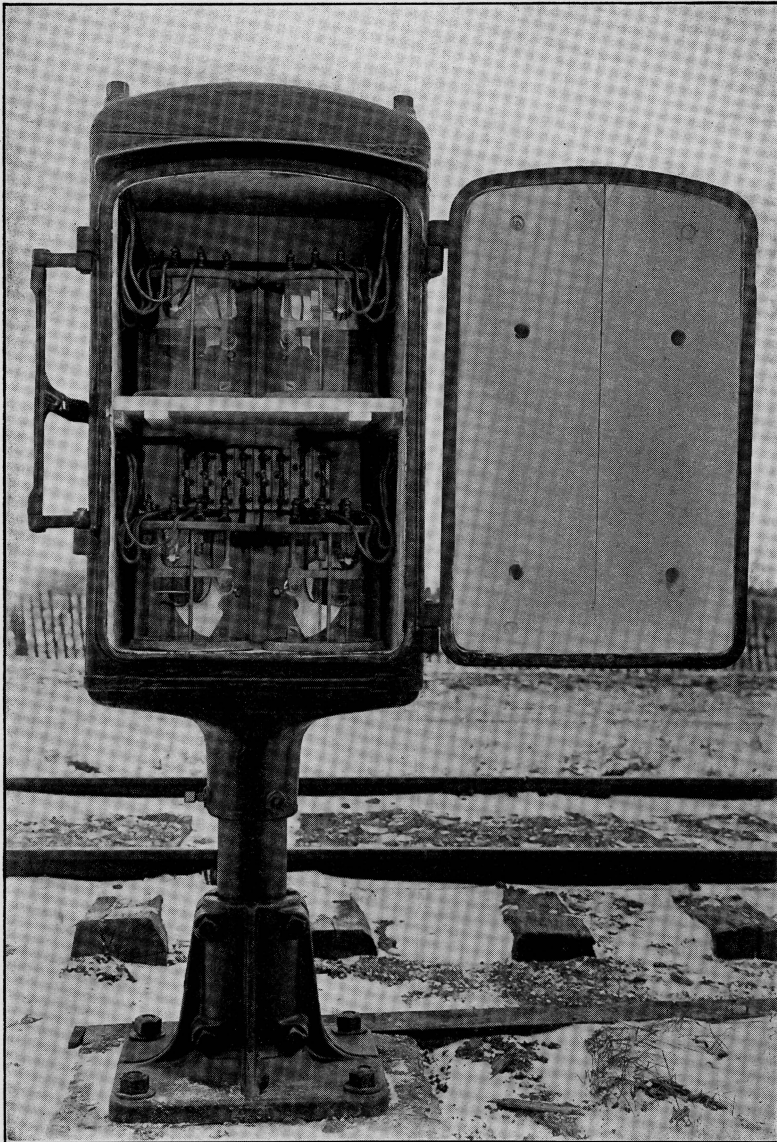


The Union Switch & Signal Co.



Transformer, High Tension Lightning Arresters, Lightning Arrester Box and Relay Box.
Indianapolis, Columbus & Southern Traction Co.
The TDB System.

The Union Switch & Signal Co.



**Relay Box with Vane Relays and Fuses.
Indianapolis, Columbus & Southern Traction Co.
The TDB System.**

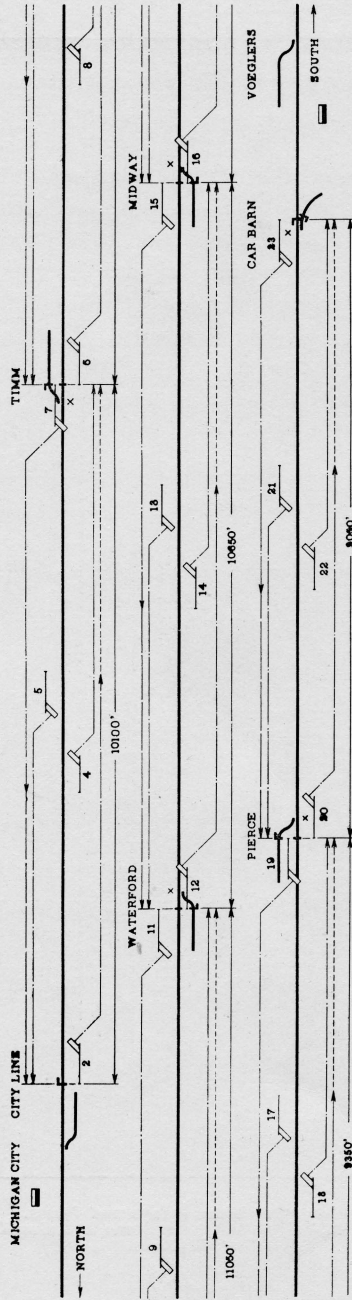


Fig. 10. The TDB System. Chicago, South Bend & Northern Indiana Railway.

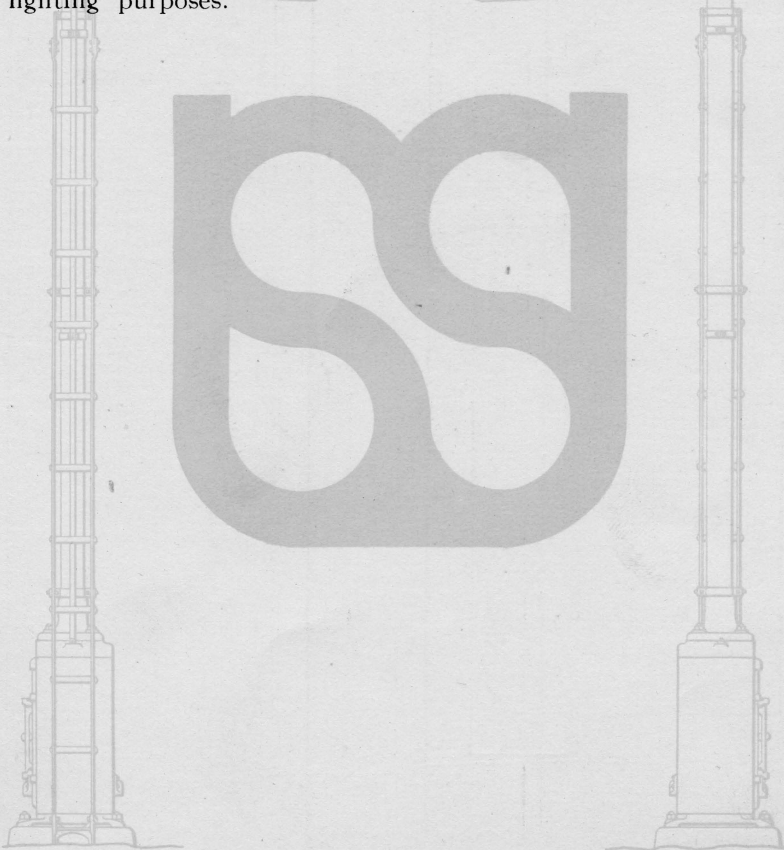
The Union Switch & Signal Co.

CHICAGO, SOUTH BEND & NORTHERN INDIANA RAILWAY.

Michigan City to Car Barns, Indiana.

110766

This road is signalled for 9.5 miles between the outskirts of Michigan City and the railroad company's car barns near La Porte, Ind. The installation, the initial one on this road, consists of five blocks—siding to siding—protected by 20 semaphore signals. Opposing blocks average 10,000 feet in length, and all sidings are single-ended. The layout of tracks and signals is shown in Fig. 10. The 2200 volt current for the operation of the signals is secured from a power line running along the road and otherwise employed for manufacturing and lighting purposes.



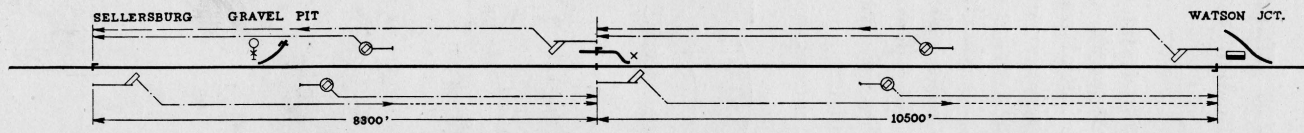


Fig. 11. The TDB System. Louisville & Northern Railway & Lighting Co.

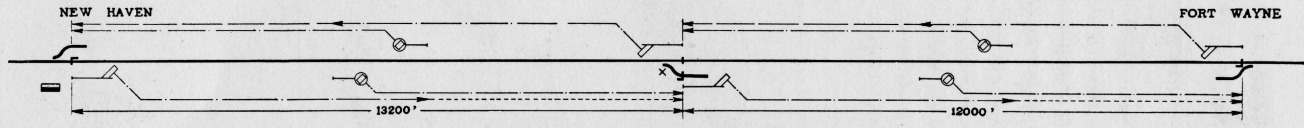


Fig. 12. The TDB System. Ohio Electric Railway.

The Union Switch & Signal Co.

LOUISVILLE & NORTHERN RAILWAY & LIGHTING COMPANY.

Sellersburg to Watson Junction, Ind.

90-110501

This road is the southern link in an Indianapolis-Louisville limited service, and also operates a local service. This, the initial track circuit signal installation for the road, protects 3.5 miles of single track and includes two blocks with a total of four semaphore and four light signals.

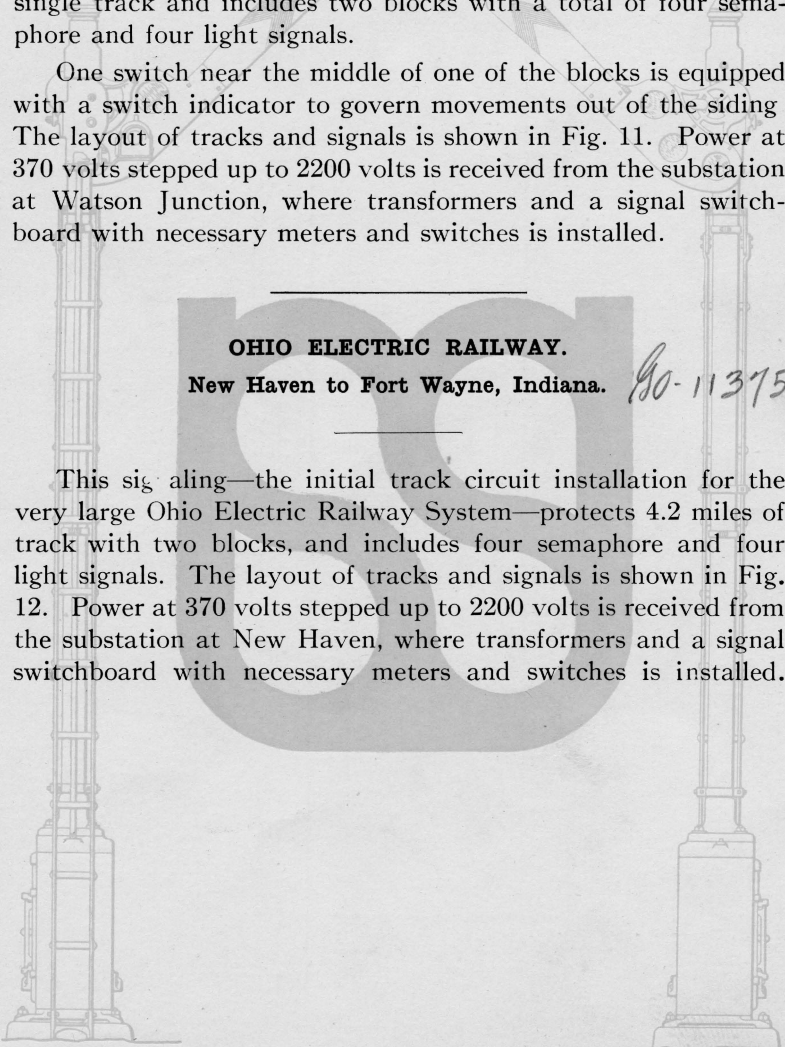
One switch near the middle of one of the blocks is equipped with a switch indicator to govern movements out of the siding. The layout of tracks and signals is shown in Fig. 11. Power at 370 volts stepped up to 2200 volts is received from the substation at Watson Junction, where transformers and a signal switchboard with necessary meters and switches is installed.

OHIO ELECTRIC RAILWAY.

New Haven to Fort Wayne, Indiana.

90-113750

This signal—the initial track circuit installation for the very large Ohio Electric Railway System—protects 4.2 miles of track with two blocks, and includes four semaphore and four light signals. The layout of tracks and signals is shown in Fig. 12. Power at 370 volts stepped up to 2200 volts is received from the substation at New Haven, where transformers and a signal switchboard with necessary meters and switches is installed.



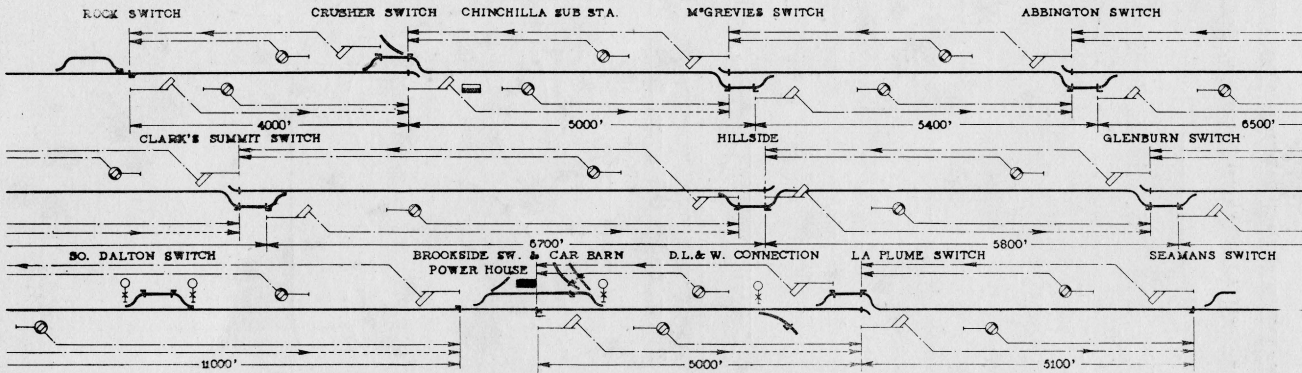


Fig. 13. The TDB System. Scranton & Binghamton Railway.

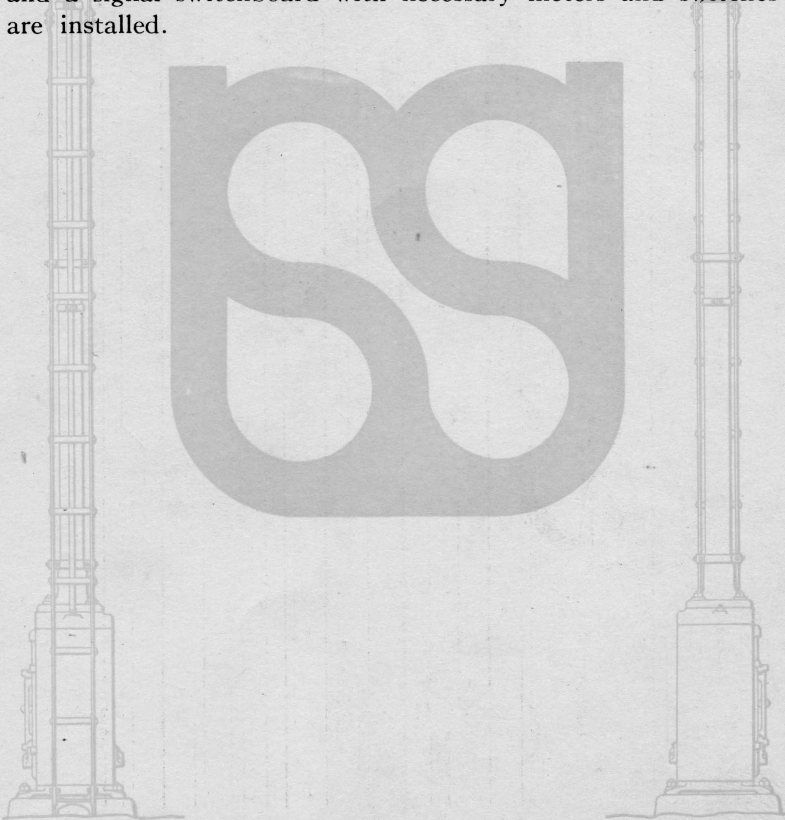
The Union Switch & Signal Co.

SCRANTON & BINGHAMTON RAILROAD.

Rock Switch to Factoryville Junction.

118050?
126000

This is the initial installation for a road having a large passenger, park and express traffic. Ten miles are protected by nine opposing blocks, and it will be noted from the layout in Fig. 13 that all cars turn out at each siding; this is required because of the many meets. On account of the large number of shifting movements at the power house at Brookside this territory will, for the present, be treated as yard limits. Certain switches intermediate to the sidings are provided with switch indicators. Power at 370 volts stepped up to 2200 volts is received from the power house at Brookside where transformers and a signal switchboard with necessary meters and switches are installed.



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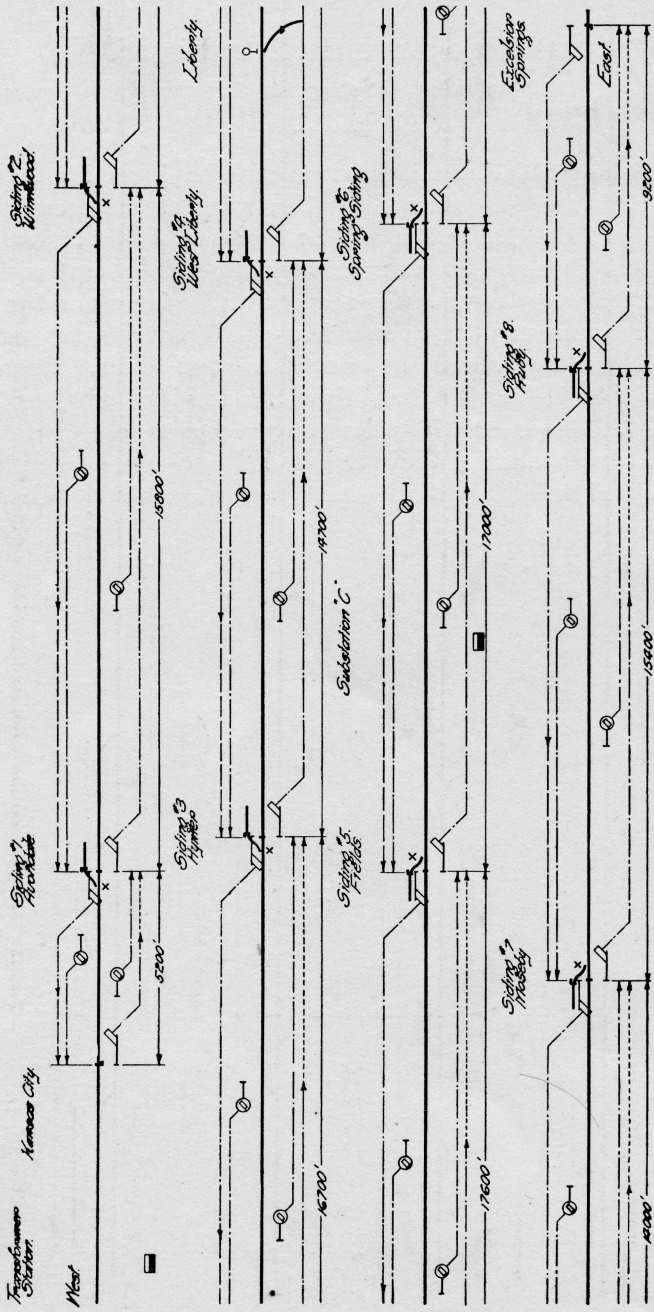


Fig. 14. The TDB System. Kansas City, Clay County & St. Joseph Railway.

The Union Switch & Signal Co.

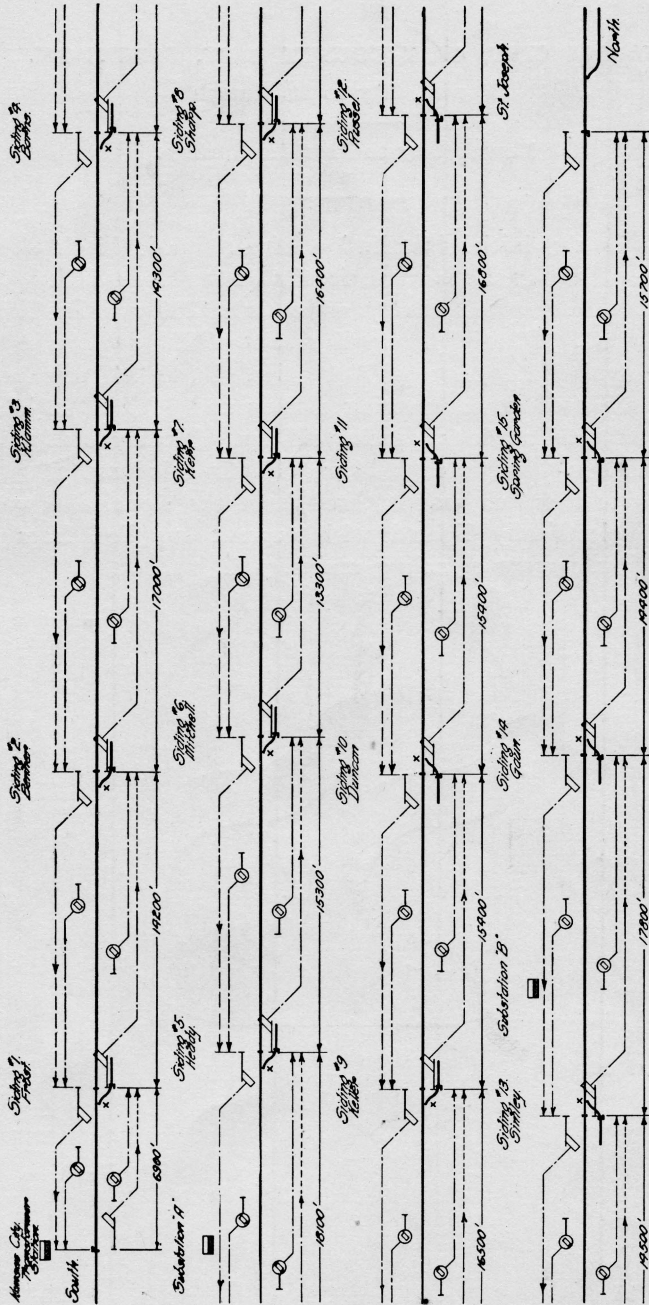


Fig. 15. The TDB System. Kansas City, Clay County & St. Joseph Railway.

The Union Switch & Signal Co.

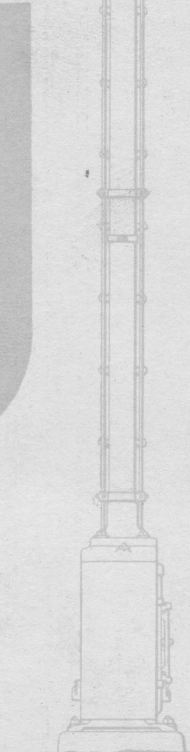
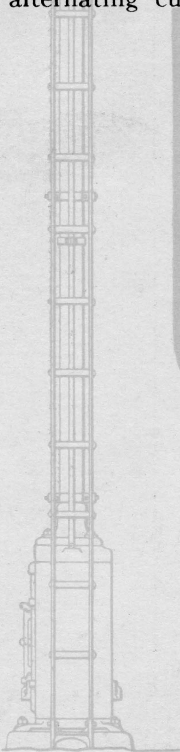
KANSAS CITY, CLAY COUNTY & ST. JOSEPH RY.

Kansas City to St. Joseph

Kansas City to Excelsior Springs.

GO-120333

This is the initial installation of automatic block signals controlled by continuous track circuits on the Kansas City, Clay County & St. Joseph Railway, which is a 1200 volt D. C. propulsion road. The signaling will consist of 25 opposing blocks, extending over a distance of 70.1 miles. Style "B" semaphore signals are used at the passing sidings and Model "13" light signals intermediate to the passing sidings. The layout of tracks and signals is shown in Figs. 14 and 15. In this installation the stations and switch stands throughout the signaled territory will be electrically lighted with current supplied from the alternating current signaling mains.





The Union Switch & Signal Co.
Publicity Department.
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