# Train Operation Against Traffic

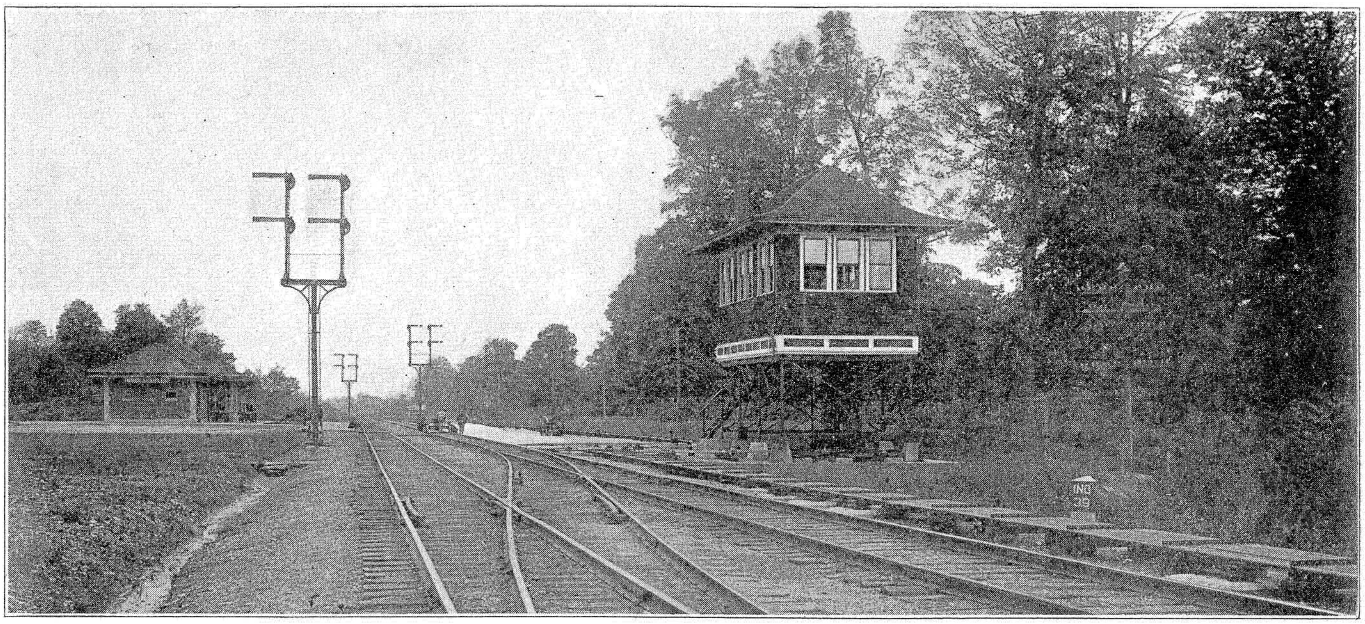
## Signaling Double Track for Movements in Either Direction Allows Idle Stretches to Be Utilized to Advantage

THE Cleveland, Cincinnati, Chicago & St. Louis is one of the few roads which uses its idle stretches of second-track for operating trains against the current of traffic. For the purpose of operating trains in this manner, the double tracks in manual block territory have been signaled as two single tracks by the erection of high signals for both directions. This work was started in 1904. In automatic signal territory, automatic signals have been installed for the operation of trains in the normal direction of traffic and the manual block system has been superimposed on the automatic block system for governing train movements against the current of traffic, the two tracks then being operated as single tracks between the limits where reverse movements are being made.

The greatest change or addition to the signal system required for operating trains in either direction on either track is at the interlocking plants. Here the principal change consists of the use of high signals to govern train movements at locations on the main line where dwarf signals are commonly employed. Thus each track is completely signaled as a single track for movements in either direction. The additional cost for arranging interlocking plants in this manner is approximately $4,000 for the average plant in automatic signal territory. The smaller the plants, however, the greater is the proportionate increase in cost for signaling. This may average approximately 10 per cent higher than on the average plants for signaling the tracks in both directions. In manual block territory the additional cost approximates only about $2,000, which covers the mechanical equipment required and its installation.

The territories over which trains are operated against the current of traffic most extensively, are between Cleveland, Ohio, and Bellefontaine, 140.7 miles; Cincinnati, Ohio, and Springfield, 79.3 miles; Indianapolis, Ind., and Terre Haute, 71.6 miles; Pana, Ill., and Lenox, 70.6 miles, and between Cincinnati, Ohio, and Greensburg, Ind., 62.8 miles. For the purpose of this analysis the districts from Pana to Lenox; Cleveland to Bellefontaine, and Springfield to Cincinnati were studied. Automatic signals are in service over all or part of the last two mentioned territories, while the first mentioned territory is operated under the manual block system. Trains were first operated against traffic as a regular, instead of an emergency, method of procedure on the Cleveland division some time before 1900 and on the St. Louis division in 1900.

The questions naturally asked regarding normal train operation against the current of traffic are: (1) Is the system safe and what precautions are taken to insure safety? (2) How does the system operate; what changes in rules are required and what steps are taken to divert a train from and return it to its right main? (3) What are the results?



At Interlockings, Tracks Are Signaled for Train Movements in Both Directions

### Few Rules Required to Insure Safe Operation

The territory in which the movement of trains against the current of traffic is the rule rather than the exception, includes districts with both single and double track. The train crews, in running between these terminals, handle trains daily on single and double track and are thus familiar with the rules governing both systems of operation. This thoroughly grounds them in operating requirements in double track territory when their trains are moving against the current of traffic, as in such cases rules for running on single track govern.

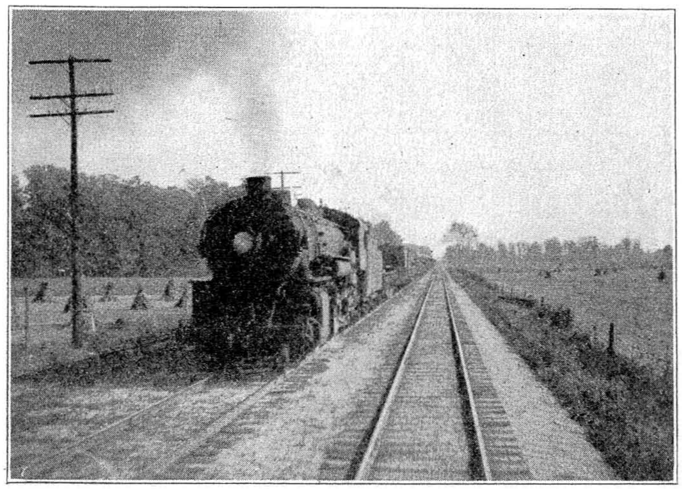
The different division time tables make reference to train operation against the current of traffic under the special instructions covering operations on the particular division. Typical of these instructions is that taken from the St. Louis division time table stating that:

"The automatic block system will be used for movements with the current of traffic between Kingan's (Indianapolis) and Waver. The manual block system will be used for movements against the current of traffic between Mt. Jackson and Waver. Rules 317A* and 331A* will govern when passenger trains are involved, and Rules 317B* and 331B* when trains not carrying passengers are involved.

"Rules S-251 and S-254†, inclusive, will govern on single track, and Rules D-251 and D-254†, inclusive, will govern with the current of traffic on double track between Kingan's (Indianapolis) and Starr, between Karl and Lenox via Short Line, and between Hillsboro and East Alton via Old Line."

In the Cincinnati-Sandusky division time tables under the special instructions one rule states that:

"The automatic block system will be used on single track between West End and Cold Springs. The movement of trains in either direction between West End and Cold Springs will be governed by block signals whose indication will supersede time-table superiority. Signalmen will report the approach of all trains to the train dispatcher, who will instruct what signal to display. Otherwise Rule 509‡ remains in force."

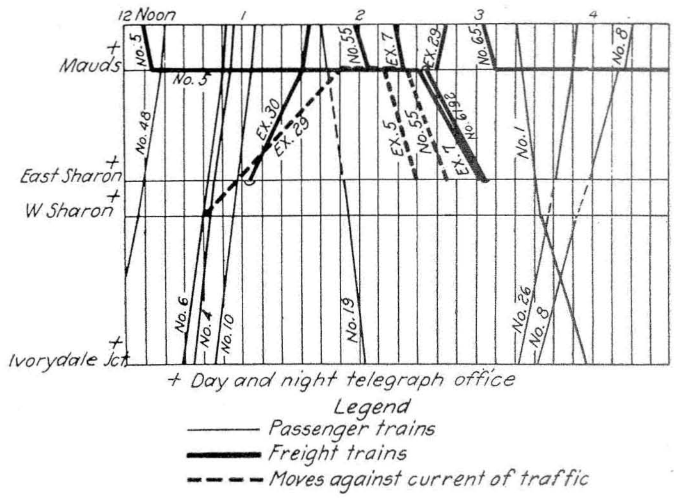


Photograph from Rear of Passenger Train Running on Left Hand Track Around Tonnage Freight Train

This rule has resulted in the elimination of a number of train orders daily.

### How Trains Are Diverted

In diverting trains against the current of traffic the dispatcher puts out a "31" order to opposing first and second class trains at the first open station beyond the point at which the train is to be crossed back to its right main and to the operator at the station where this crossover movement is to be made. The dispatcher also puts out the same order on Form "19" to the operators at the intermediate open stations and to the operator and the trains affected moving in the same direction at the station where the train is to be diverted to the opposite main track. Where the train to be crossed over carries passengers the order must be delivered to it one station in advance of the point of diversion. As an example, a westbound train was diverted to the eastward main at Pana, Ill., with orders to run to Nokomis. The following order




How Utilization of Idle Main Track Saves Delays

was put out as a "31" order to all trains eastbound at Irving, to the operator at Irving and to the operator at Nokomis, while Form "19" was used in sending it to the operator at Rosamond (the only open station) and to the operator and trains at Pana:

"No. 553 has right over opposing trains on eastward track Pana to crossover at Nokomis."

By the addition of the word "crossover" the train has conferred on it the right to the track through the crossover back to its right main as shown at "B" on the track diagram. If the word "crossover" had been omitted from the order the right of the train to the eastward main track would have extended only to the first passing siding switch it approached where it would have headed in as shown at "A" on the diagram. The dispatcher keeps a record of train movements against the current of traffic on his train sheet by entering in red ink the time trains pass the different stations.

### Typical Examples of Time Saved

A typical example of the manner in which operation against the current of traffic reduces running time and prevents delay is shown in the case of eastbound local freight No. 574 on the St. Louis division, which was diverted from the eastbound running main to the westbound main at Livingston, Ill., running against the current of traffic to Joan. This movement was made in manual block territory. If this train had not used the westbound main, which was idle at that time, after finishing its work at Livingston, it would have had to wait at Livingston for one hour and six minutes in order to permit passenger trains No. 16 and No. 522 to pass and clear the block at Joan. By this expedient, No. 574 was enabled to proceed to the next station and do its

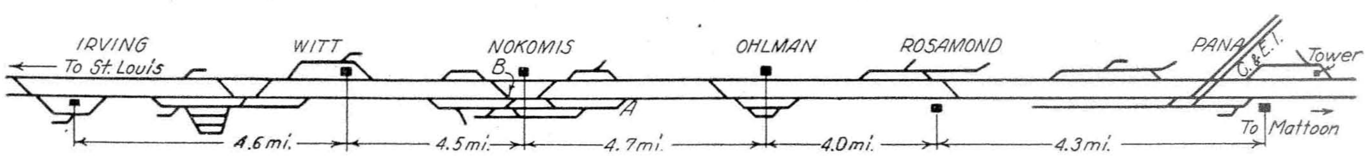



Diagram Illustrating How Dispatchers Divert Trains Against Current

*Standard Code Rules.

†Rules S-251 to S-254, inclusive, govern the movement of trains with reference to other trains in the same direction on single track by block signals. Rules D-251 to D-245, inclusive, govern the movements, of trains with the current of traffic on double track by block signals. These rules state that on portions of the road so specified on the time-table or by special instructions trains are governed by block signals, whose indications will supersede time-table superiority. The movement of trains will be supervised by the train dispatcher, who will deliver instructions to signal men when required.—Editor.

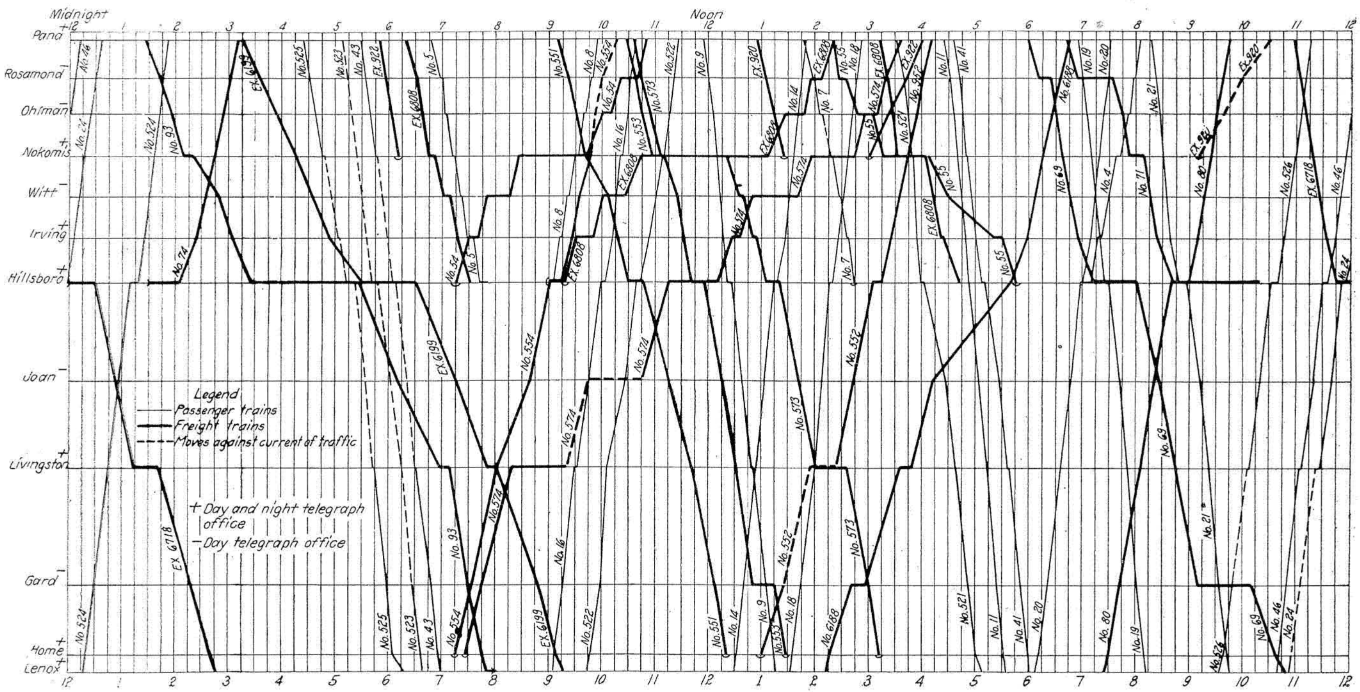
‡Standard Code Rule.

station work at that point while waiting for the passenger trains to pass.

As an example of what is done in automatic signal territory, eastbound extra 29*, was run from West Sharon, Ohio, to Mauds, against the current of traffic in order to save a delay of 17 min. at West Sharon, waiting for eastbound passenger trains No. 6, No. 4 and No. 10 to pass. Reference to the small diagram will illustrate an interesting move which it was necessary to make in connection with the use of the westward main by the eastbound extra. This extra took from 12:40 p. m. to 1:50 p. m. to run from West Sharon to Mauds. Before this extra arrived at Mauds, westbound passenger train No. 19 was approaching Mauds and in order to prevent what would have amounted to a delay of 8 min. to this passenger train waiting for the extra to get in the clear, the dispatcher diverted No. 19 to the eastward main, which was then clear, running the passenger train against the current of traffic from Mauds to East Sharon where it allow these three passenger trains to clear the block (manual block territory) at Irving. Had extra 6199 been delayed this additional time, it would have exceeded the 16 hour limit. The large diagram shows the train movements involved.

### Results in Dollars and Cents

An analysis of a typical day's movements on the territory where trains are moved most frequently against the current of traffic shows that 42 out of 97 passenger trains, and 21 out of 104 freight trains used the opposite main tracks for varying distances. The operation of these trains against the current of traffic prevented five trains from being tied up under the 16-hour law, while the total train time between terminals was shortened 1,880 min. This saving in time alone, capitalized on the basis of 40 cents per minute of delay, represents a total of $752 for the day or $274,480 a year, in the territory on which the study was based. The figure of 40 cents a




**Train Movement Chart on District of St. Louis Division Showing Movement Against Current**

was diverted back to the original main. In this case two trains in opposite directions running between adjacent stations were moving on their respective contra-normal mains.

To illustrate how reversing the operation of the main tracks prevented a train from being tied up under the 16 hour law, westbound extra 6199 left Pana, Ill., at 3:15 a. m., arriving at Lenox, at 9:16 a. m., a distance of 70.6 miles. It was in this territory that passenger train movements were made against the current of traffic which allowed this extra to proceed on the westbound main without having to take a siding to permit three westbound passenger trains to pass. This extra was on the road 13 hours 45 min. from East St. Louis, Ill., to Mattoon, while the crew had been called 55 min. before the train departed from East St. Louis. Westbound passenger trains No. 525 and No. 43 were operated against the current of traffic from Nokomis, Ill., to Livingston, a distance of 34.8 miles and a third passenger train, No. 523, ran from Pana to Gard on the eastbound main to prevent delay to this extra 6199 at Nokomis, which would have been incurred to

*Arbitrary number assigned as engine number was not recorded in this study.—Editor.

minute is based on repairs, depreciation, fuel, water, lubricants, other supplies, engine house expense, wages of enginemen, interest on engines, overhead expense, interest on facilities, maintenance of facilities, depreciation of facilities, wages of trainmen, train supplies and expenses, caboose expenses and overhead expense. The saving in time between terminals is, of course, largely to the freight trains.

In arriving at the dollars and cents value of the locomotives released for service sooner, the following results are shown, basing the calculations on the formula developed by the Committee on Economics of the Signal section, A. R. A.

LOCOMOTIVES SAVED PER DAY DUE TO SAVING TRAIN HOURS

(1) 1,880 min. = 31.33 hr. saved in moving equipment.

(2) 31.33 × 365 = 11,435.5 hours a year.

(3) Locomotives saved = $\frac{31.33}{24\text{ hr.}}$ = 1.3

(4) Locomotives at, average, $66,000 × 1.3 = .........$85,800

Savings per Year on locomotives saved:

| | |
|---|---|
| Interest on first cost at.................... | 6% |
| Maintenance, repairs and depreciation charge | 20% |
| | 26% |

(5) Locomotives at 26% of $85,800 amount saved a year =......$21,308

Coal Saved a Year Due to Saving Train Hours
(Based on one ton saved per train hour)

(6) \$3.68 × 31.33 hr. = \$115.29 a day
(7) \$115.29 × 365 days = ........................................ \$42,080

\$63,388

CARS SAVED PER DAY DUE TO SAVING TRAIN HOURS
104 freight trains involved

(8) Freight cars per train, average number, 50

(9) $\text{Cars saved} = \dfrac{\text{Train hours saved} \times \text{cars}}{24 \text{ hours}} = \dfrac{31.33 \times 50}{24} = \dfrac{1{,}566.5}{24}$

(Car hours) = 65.3

(10) Cars at, average, \$2,800 × 65.3 = ................ \$182,840
Savings per year on cars used:

| | |
|---|---|
| Interest on first cost at .................... | 6% |
| Maintenance, repairs and depreciation........ | 10% |
| | 16% |

(11) Cars at 16% of \$182,840, amount saved a year.............. \$29,254

SUMMARY OF SAVINGS

| | |
|---|---|
| On cost of locomotives saved ............................ | \$21,308 |
| On cost of coal, account train hours saved.................. | 42,080 |
| On cost of cars saved .................................... | 29,254 |
| Total ............................................ | \$92,642 |

ST. LOUIS DIVISION

Table to Illustrate Time Saved by Trains Operated Against Current of Traffic (See Train Movement Diagram)

EAST BOUND

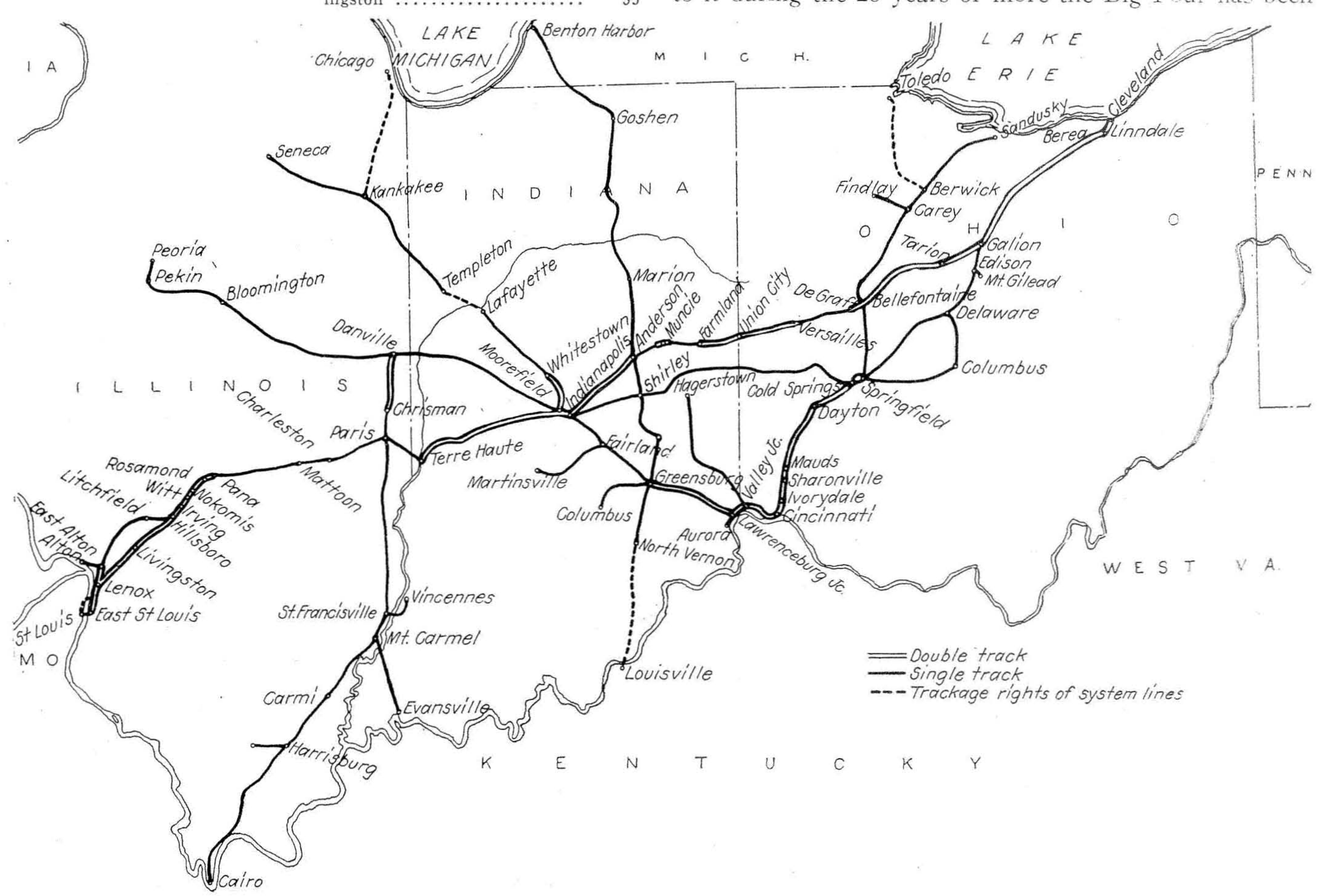
| Train No. | Between | Cause | Time saved, min. |
|---|---|---|---|
| No. 554 | Nokomis to Pana........ | From 9:46 a. m. to 10:15 a. m. account No. 54 ahead. If No. 554 had followed No. 54 it would have been delayed 10 min. between Nokomis and Ohlman .................... | 10 |
| Ex. 920 | Nokomis to Pana........ | From 9:10 p. m. to 10:30 p. m. to prevent delay to No. 80.... | 55 |
| No. 24 | Home to Livingston..... | From 10:55 p. m. to 11:22 p. m. as No. 46 was in the block. No. 24 would have been delayed at Home 10 min. for No. 46 to clear the block at Livingston.. | 10 |
| No. 552 | Gard to Livingston...... | 1:25 p. m. to 1:53 p. m. in order to prevent delay to itself of 35 min. waiting at Gard for No. 18 to clear the block at Livingston .................... | 35 |
| No. 574 | Livingston to Joan...... | 9:20 a. m. to 9:45 a. m. in order to prevent delay waiting at Livingston for passenger trains No. 16 and No. 522 to clear the block at Joan............ | 66 |
| | | WEST BOUND | |
| No. 525 | Nokomis to Livingston... | From 4:48 a. m. to 5:42 a. m. to prevent delay to Ex. 6199 and to No. 93.................. | |
| No. 43 | Nokomis to Livingston... | 5:47 a. m. to 6:28 a. m. to prevent delay to Ex. 6199 and to No. 93 by running No. 523 from Pana to Gard, No. 525 and No. 43 from Nokomis to Livingston against the current of traffic. This saved a delay of 102 min. to Ex. 6199 at Nokomis to allow these three passengers to clear the block at Irving. A delay of 61 min. was saved No. 93 at Hillsboro by running the three passenger trains against the current of traffic to clear the block at Livingston .............. | 102 |

No data were obtainable as to the number of stops eliminated, consequently no savings are shown to cover cost of coal saved or the savings on wear and tear of equipment. The amount of overtime saved was not developed and as a consequence no saving in overtime pay is included.

In addition to providing for more flexible train operation and the elimination of delays by making use of either idle track, savings may be made by other departments. For example, the maintenance of way department on the St. Louis division in laying new steel was given the exclusive use of the one track during the day, cutting the labor cost of this work in half.

## Conclusions

That this method of train operation is safe is evidenced by the fact that but one serious accident may be charged to it during the 23 years or more the Big Four has been




The Big Four System Showing Double-Track Territory Where Trains Are Operated Against Current operating trains against the current of traffic as a regular practice. Essentially the operation is the same as if two single track railways were being operated between the places trains are operated against the current of traffic. Therefore, this method of operating trains is as safe as is single track operation as the Standard Code rules for single track movements are in force. No changes in rules are required. The results in time saved and delays eliminated on the three districts on which the study was made have proved the advantage in expediting traffic resulting from this method of operation. When reduced to a dollars and cents basis substantial savings yearly result. It should be borne in mind that this analysis is based on but three districts and does not cover all districts where this mode of operation is used.

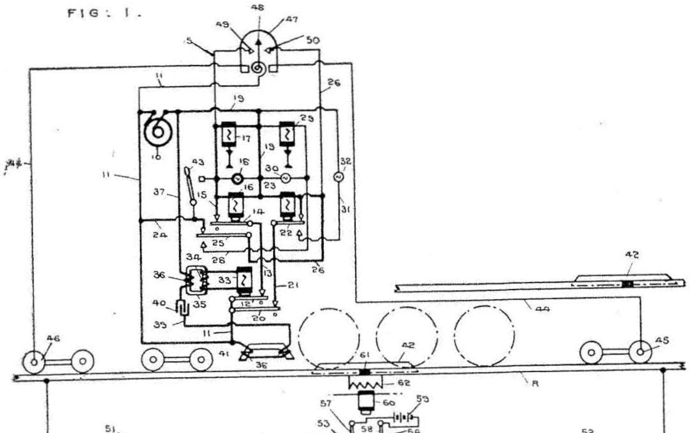
Proportionate savings also are made on the other districts which, if added to the result obtained here, show that this method of operation is well worth while.

# Schweyer Induction Train Control

THE Schweyer automatic train control system illustrated here is of the intermittent non-contact, inert roadside element type. Early types of this equipment were described on page 120 of the *Railway Signal Engineer* for March, 1922.

The newest development of this system eliminates the insulation on the engine by using a low resistance voltage drop relay which picks up the clear and caution indications from the track while the vehicle is in shunt across the relay. New developments in the circuit and apparatus have brought out the so-called "super capacity circuit." When running normal, where there is no unusual amount of steel along the track, the current is about 1.28 amp. When the coil comes over an extra rail, such as at a switch turnout, the current raises to 1.5 amp., but when the coil passes over the inert armature located on the ties, the amperage falls to a value of 0.43 amp., causing the relay to open. With former circuits an extra rail caused lower current in the coil, whereas the new circuit now causes a higher current, eliminating false operations.

FIG. 1.



Circuit Diagram of Schwyer Induction Type Train Control

## Explanation of Wiring Diagram

The track apparatus consists of an inert armature located along the outside of the running rail and may be connected in series with the running rail so that the removal of the armature will cause the signal in the rear to go to stop position. The signal relay controls the polarity of the current at the running rails which reverses its direction under clear and caution conditions and opens the circuit under stop conditions. The track may be insulated near the armature with a resistance coil shunted around the insulation or this insulation may be omitted under certain conditions, depending upon the voltage drop relay used on the engine.

The locomotive apparatus consists of a choke coil suspended from some convenient part of the engine in such a manner that it passes over the inert armature. This choke coil is in series with the generator, condenser and the primary winding of a step-up transformer, energizing the control or actuating relay. This relay controls two holding relays so that each time it passes a signal the stick circuit of the holding relays are broken. The voltage drop relay in shunt with the locomotive picks up energy from the rail under clear or caution conditions, so as to selectively energize the external circuit of the clear or caution holding relays. As shown, the clear or caution relays control an electro-pneumatic valve, as well as visual or audible indications.

An a. c. generator 10, supplies current continuously to the engine induction coil 41 which is in series with condensor 40, and primary transformer winding 36 and produces a "super capacity" circuit causing the secondary winding 34 of transformer 35 to energize control relay 33.

This control relay 33 controls the internal circuits of holding relays 16 and 23. When choke coil 41 passes over the inert armature 42, it causes a large increase in the impedance, causing relay 33 to open, stopping the train. The caution holding relay 23 is a stick relay, and when in its raised position, is energized by the alternator 10, the circuit being from connection 11, armature 20, connection 21, armature 22, and winding of relay 23, back to generator, via connection 19. The clear holding relay 16 is energized by the circuit from connection 11, armature 12, connection 13, armature 14, winding of relay 16, and connection 19 back to generator. Pick up or voltage drop relay 47 is connected on the one side at the last wheel of the tender and on the other side at the front wheel of the locomotive by connections 44 so that when the rail is energized by the local battery 59 through the signal mechanism. Armature 48 of pick up relay 47 moves to the right or left, depending on the polarity of the current in the rail between the front and rear end of the locomotive. As shown, clear electro-pneumatic valve 17 and visual signal 18 are in parallel with clear hold up relay 16, and caution electro-pneumatic valve 29, and caution visual signal 30 are in parallel with hold up relay 23. The stop visual signal 32 is energized through armature 22, making back contact with connection 31.

## When Passing a Clear Signal

In starting, the engineman closes the clearing switch 43, causing energy from the alternator to pick up the clear holding relay 16, thus energizing the clear electro-pneumatic valve 17, and the visual or audible indication 18 which is in parallel. This action allows the train to proceed because the armatures 12 and 20 (of the control relay) are in a raised position due to the circuit from alternator, including the choke coil 41, condensor 40 and primary winding 36, being near a state of resonance, in