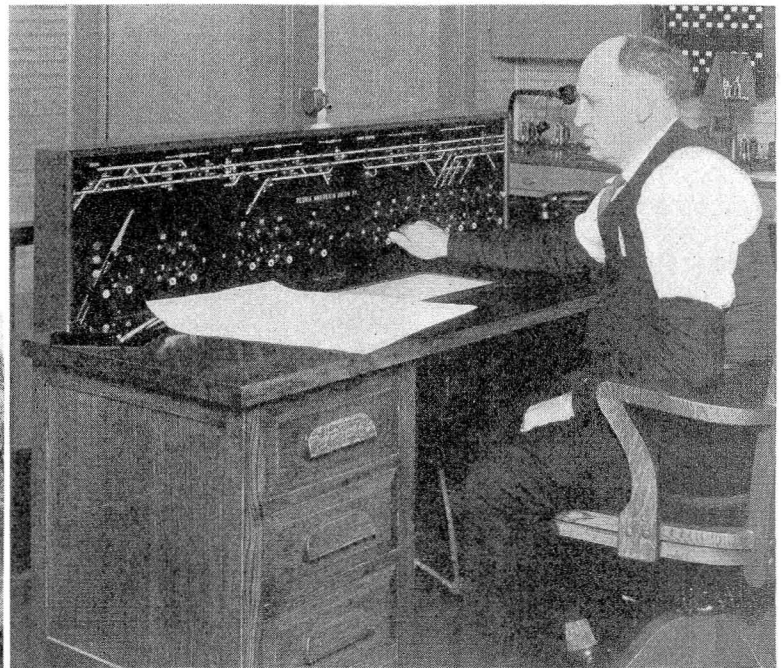
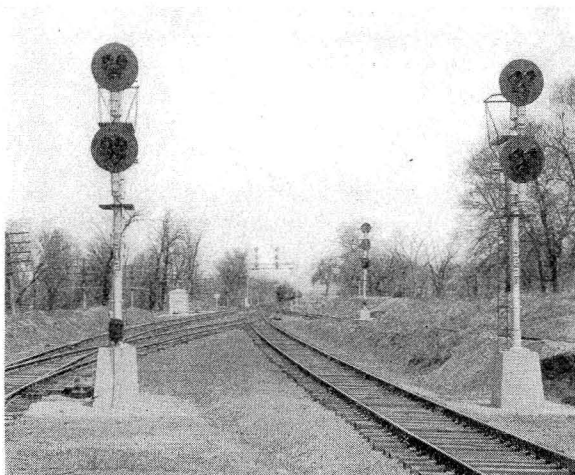


Railway Signaling

Centralized Traffic Control on the Peoria & Pekin Union

Six junctions and 16 track-miles used by 7 carriers controlled from one office — \$19,350 saved annually in operating expenses



Left—View at Grove looking north
Above—The Control machine is of new type

A CENTRALIZED traffic control installation, involving several interesting features from an operating standpoint and including an entirely new type of equipment, has been placed in service recently on the Peoria & Pekin Union between Bridge Junction in Peoria, Ill., and Pekin. This 7.6-mile portion of the line is double track with a third track on 0.7 mile, thus totaling about 16 track-miles in the installation. Twenty power-operated switches and 36 controlled signals in this territory are now controlled by the dispatcher. Train movements in either direction on all tracks are now directed by signal indication and all written train orders as well as rights by class direction and time-table superiority, have been eliminated.

General Layout

The Peoria & Pekin Union is primarily a terminal railroad furnishing passenger station, freight depot, enginehouse, classification yard, and switching facilities for one tenant road and six proprietary carriers—the Illinois Central, the Chicago & Alton, the Pennsylvania, the Nickel Plate, the Big Four, and the Chicago & Illinois Midland. In addition, intermediate switching service is

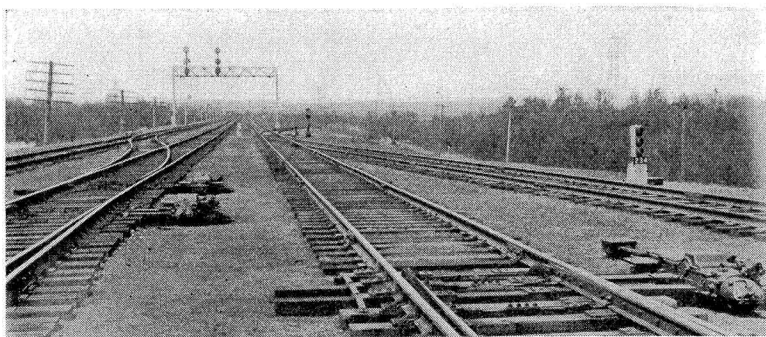
provided between seven other line-haul carriers. The principal classification yard is located on the east side of the river north of Wesley Junction, and the enginehouse is at Bridge Junction. The main line extends from a point about a mile north of the Union station in Peoria, southward through Bridge Junction, where one line, branching off, extends along the north side of the Illinois river to Hollis about 6 miles, where connection is made with the Toledo, Peoria & Western. The second line from Bridge Junction crosses the Illinois river and runs through Wesley Junction, Grove and on to Pekin, which is about nine miles from Peoria Union Station. The total track mileage operated by the P. & P. U. includes 17.5 miles of first main, 10.5 miles of second main, and 137.3 miles of side, yard and industrial tracks.

The second portion of the road—that between Bridge Junction and Pekin—handles the heavier traffic and is the section now equipped with centralized traffic control. Within this territory there are six junctions where other roads connect with the P. & P. U. The C. I. & M., the I. C., and the C. C. C. & St. L. come in at Pekin. The C. & A. line from the south connects at Grove. The N. Y. C. & St. L. and the Pennsylvania enter at Wesley Junction and also at this point the C. & A. line extends

northward. The junction at Wesley connects with the East Peoria classification yard and, therefore, all freight trains leave or enter the main line at this point. At Wesley Junction there are three separate connections to this yard which are used by transfer cuts in and out of the yard, as well as by all light engines moving between the yard and the enginehouse. The P. & P. U. handles all the yard service, breaking up the incoming trains, and delivering the cars to industries or other connecting roads. Likewise, all outgoing trains are made up in this yard.

Naturally, with so many carriers involved and so many junctions included in the territory, the operation of trains is complicated. All passenger trains outbound from Peoria operate through from Bridge Junction to their respective junction, where they leave the P. & P. U., and likewise inbound trains make the opposite move. On the other hand, all freight trains of line-haul carriers depart from the East Peoria classification yard, while likewise, inbound freight trains terminate at this point. However, all the locomotives are serviced at the engine-

Four interlocking plants had been in service in this territory: (1) The Illinois Bridge plant is an all-electric 56-lever interlocking controlling a double-track crossing with the Rock Island, numerous switches for tracks leading to the enginehouse, the operation of the drawbridge, and the end of the third main just east of the river. (2) At Wesley Junction there was a 28-lever mechanical plant controlling the junction with the Nickel Plate, which is also used by the Pennsylvania as well as the three routes leading to the classification yard, which are used by switching and transfer cuts, as well as by light engines. (3) A small mechanical plant had been located in the station at Wesley to handle the crossovers and junction leading from the main line to the classification yard, this being the route used by all inbound and outbound line-haul freight trains. (4) At Grove a 28-lever mechanical plant handled the junction of the C. & A. line from the south, as well as several crossovers and the south end of a passing track. (5) At Pekin, the south end of the new system, a 78-lever mechanical plant



View at Wesley Junction looking north towards Bridge Tower—Switches in foreground equipped for power operation with dual-control—Switch stand in distance equipped for spring operation.

house on the north side of the river and, therefore, this movement of light engines adds to the traffic congestion.

The scheduled train movements in this territory include 34 first-class and 23 second-class trains, totaling 57 movements daily, to which are added about 105 transfer and light-engine moves. The first day the new system was in service, there was a total of 163 train movements in 24 hours, which is an average under present slack business conditions. In order to meet the requirements for service, the schedules are so arranged that the number of trains reach a maximum during three peak periods of the day, i. e., from 6 a. m. to 8 a. m., from noon to 4 p. m., and from 6 p. m. to 9 p. m. Trains arriving on the P. & P. U. property, as well as those ready to depart, must be handled without delay, otherwise complaints may arise implying partiality to certain carriers.

controlled the end of double track, the crossing and junction of the Big Four and the junction of the Santa Fe and the Peoria Terminal.

The plant at Wesley Junction had been taken out of service during Federal control and had never been restored to service. The accompanying list shows the number of employees that were required for the operation of these facilities.

Train dispatchers at office near Bridge Junction..	3
Levermen at Bridge Tower.....	3
Switchmen at Wesley Junction.....	3
Operator-levermen at Wesley.....	3
Operator-levermen at Grove.....	3
Levermen at Pekin tower.....	3
Operators at Pekin, joint with another road.....	3

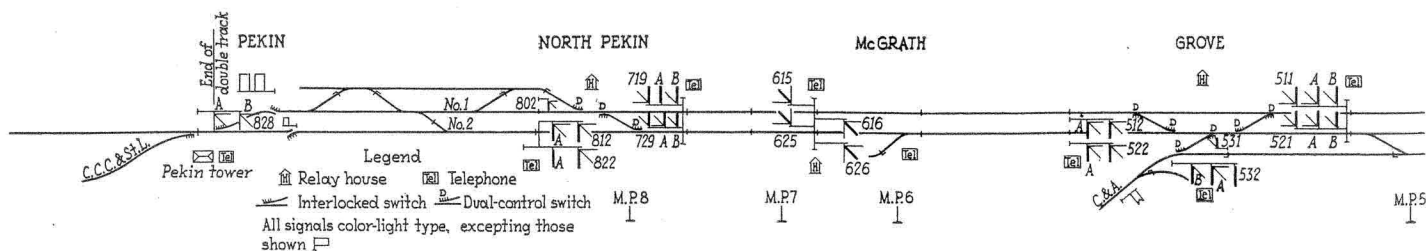
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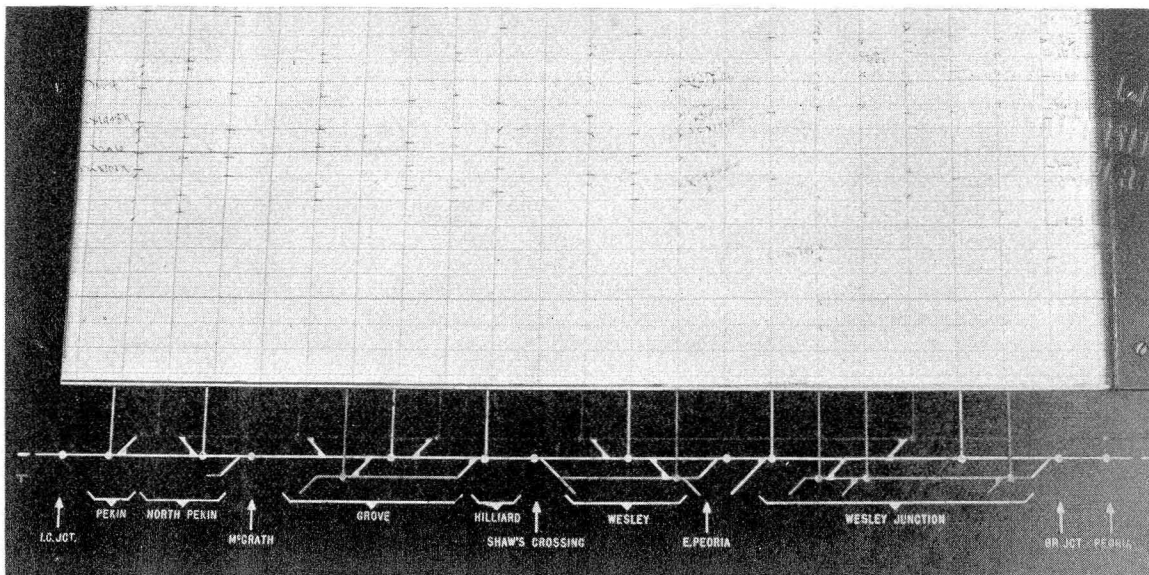
Previous Method of Operation

Train movements in this territory were formerly directed by train orders and manual block, block stations being located at Wesley, Grove and Pekin. The train dispatcher was located in the superintendent's office building which is one-fourth of a mile north of the tower at Illinois Bridge. During the peak traffic periods each day, trains were run close together, thus resulting in numerous delays on account of the manual block system.

The Problem

The railroad was faced with the necessity of constructing a new interlocking at Wesley Junction, where switchmen had to be employed since the old interlocking was taken out of service. Likewise, the old plant at Grove was obsolete and worn out. The construction of modern interlockings at these two points would not have permitted any reduction in operating expenses nor would it





The automatic train recorder operates on the principle of an automatic typewriter

have facilitated the movement of trains to any extent. Investigations showed that a complete system of centralized traffic control could be installed for approximately the same investment as would have been required for the two new interlockings and replacement of several automatic signals. Further, the centralized control would not only facilitate train movements, but would also permit a saving in operating expenses by reason of the reduced number of levermen and operators required.

The New System

The interlocking at Illinois Bridge and at Pekin were continued in service, the centralized traffic control system replacing all the block offices, interlockings and ground switch layouts between the plants mentioned. As the new system is tied in with the Bridge and the Pekin plants, trains are directed by signal indication throughout 7.8 miles of line, involving 16 track-miles on which there are 20 power-operated switches, 36 controlled signals and 6 automatic signals.

In order to facilitate movements by running trains in either direction on either track, it was necessary to make some changes in the track layout to permit routing trains from one track to the other. Changes were made in the crossover at the south end of the Grove layout, and a crossover was added at North Pekin. The main line derails formerly included in the junction plants were eliminated.

In order to provide the additional space that was needed, a new tower was constructed at Illinois Bridge. The new centralized control machine is now located near the regular interlocking machine in this tower, and the dispatchers, who were formerly in the superintendent's office, were moved to the Bridge tower where they now operate both machines, excepting that a leverman is retained for the present to assist during the rush hours from 1 p. m. to 9 p. m. The services of the remaining

14 operators, levermen and switchmen formerly required in this area have been dispensed with.

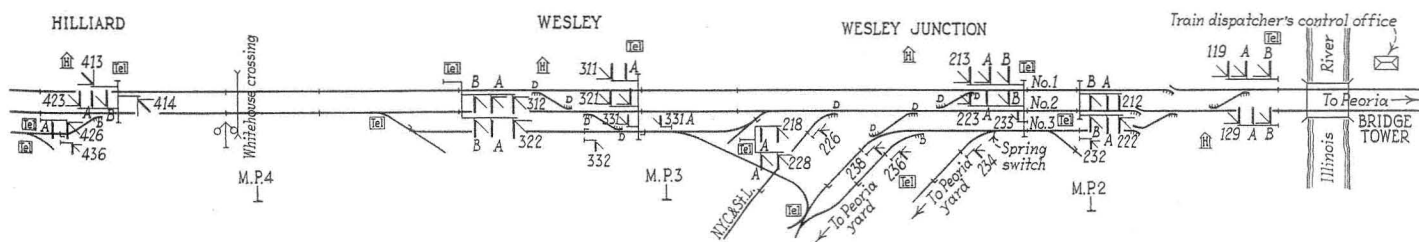
The pay-roll saving, not including the wages of the one leverman who will eventually be removed, nor giving any consideration to the wages of the joint operators at Pekin, amounts to \$19,347 annually.

The new improvements, including the centralized traffic control system, a dispatcher's telephone system with 20 telephones and a loud speaker equipment, additional flashing-light crossing signals, and the construction of a new tower at the Illinois River plant, all totaled a charge of \$96,709 to capital account. The pay-roll saving explained above is 20 per cent of this investment. No increased charge is made for maintenance as the maintenance force formerly required for the interlockings is maintaining the new system.

The installation has not as yet been in service long enough to determine the benefits of the greater facility of train movements as compared with the previous method of operation, but comparison of the train sheets before and after the system was placed in service shows that numerous train stops and delays are being eliminated.

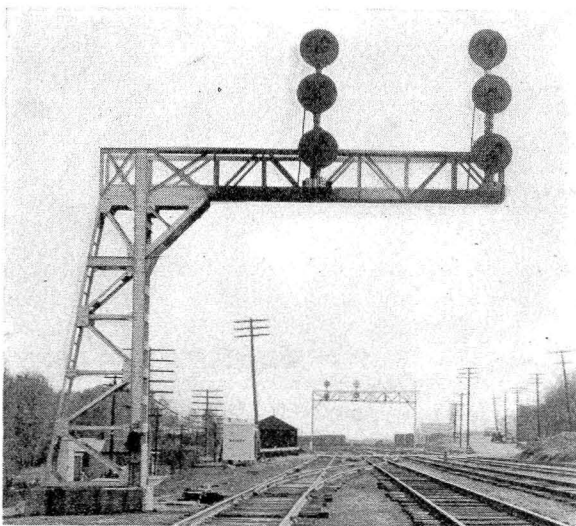
Communication System

An out-door telephone was installed at each controlled signal and also at each hand-operated main-line switch in the centralized control territory. The phones are so located that a trainman, riding the head end of a train which has been stopped at a signal, will in each instance be within 100 ft. of a phone. A line connecting these phones extends to loud-speaker apparatus in the control office. The rules require that when a train is stopped at a signal, a trainman get in communication with the dispatcher at once. Likewise, when any irregular movements are to be made, the trainmen call the dispatcher for information.



The Centralized Control System

The centralized traffic control equipment is of the latest type developed by the General Railway Signal Company. It is known as the Duplex system, this name being applied because the system provides for the simultaneous transmission of controls to, and the receipt of indications from, the same or different stations. Only three line wires are required, these forming two circuits, one for outgoing controls and the other for incoming indications. In the operation of the system, stations can be called one at a time, or several can be called, the control codes being transmitted to the stations one at a time in predetermined order according to preference previously es-



A view at Wesley looking north toward connections to the classification yard

tablished as to the more important, irrespective of the geographical location. Likewise, no lockout is used for the incoming indications; if several stations have indications to transmit at the same time, the several stations send in the indications to come in on successive operating cycles in a predetermined order which is based on the superiority of the impulse combination assigned to the different stations.

At a field station the receipt of controls and the sending in of indications is accomplished by so-called relay cabinets. Each of these cabinets is 10 in. by 12 in. by 21 in. and contains 24 small relays. All of the 16 such cabinets used on the installation are connected identically the same and the wiring terminates on plugged connectors so that in case of a failure any cabinet can be replaced quickly by a spare cabinet. At field stations, these cabinets, as well as the other relays, batteries, etc., are housed in sheet-metal houses. The relay apparatus used in connection with the control office is located in large steel cabinets on the first floor of the tower.

New Type Control Machine

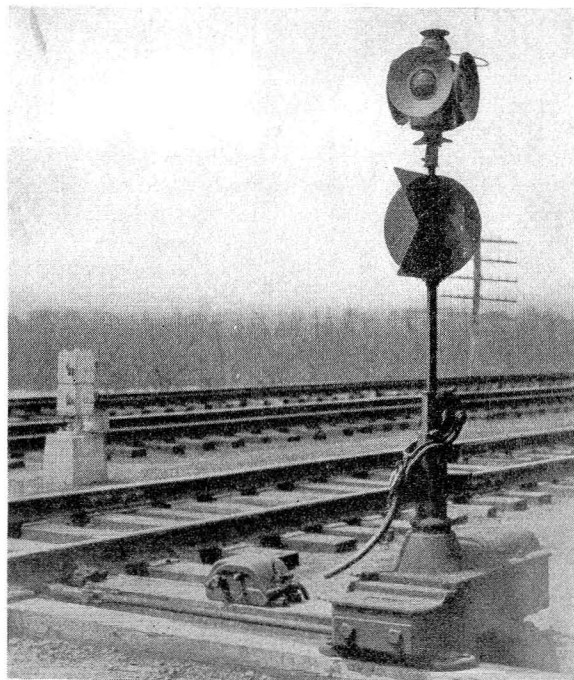
The control machine includes several important improvements and is the first of this type to be placed in service. The machine itself is only 42 in. high and 55 in. long, being mounted on an ordinary flat-top desk. An illuminated track diagram of the entire system extends across the top of the machine panel. The signal levers are arranged in a row below the diagram, and the switch levers are in a row just beneath the signal levers. These levers are of a new rotary-knob-type design, having the same general appearance as the knobs on an

ordinary radio receiving set. The automatic graphic train-recorder is recessed in the top of the desk.

Red lights, located directly in the lines representing the tracks on the diagram, are lighted when the corresponding section of track is occupied by a train, and, in addition, a single-stroke bell rings when a train enters an OS section. The signals are represented on the diagram by small green lights which are lighted when the corresponding signal is indicating Proceed. Small switch-point devices in the tracks on the diagram are mechanically connected to and are operated by the corresponding switch lever.

A small lamp mounted in the switch lever itself is lighted when a lever is operated; it continues to be illuminated until the switch has completed its movement and is locked up in the position corresponding to the position of the lever. Therefore, the entire board is normally dark, no light appearing unless a train is occupying a track section, a signal is at proceed, or a switch in operation.

The switch levers operate to two-positions, the normal position being to the left, as indicated by an arrow point on the face of the knob. The signal levers operate to five positions, standing normally on center with the arrow pointing up, in which case the corresponding signals are all at stop. By rotating a signal lever to the right, the northbound signals at the corresponding layout are cleared, and if rotated to the left the southbound signals are cleared. If the lever is revolved so that the arrow is 45 deg. from the normal position, the signals are



One switch is equipped for spring operation

cleared "non-stick" so as to permit the signal to clear again for following moves. However, if the lever is turned through 90 deg. from normal, i. e., to the full right or left position, then the signals are cleared "stick" and will not return to the clear position following the passing of a train unless the dispatcher again operates the lever.

New Type Automatic Train Recorder

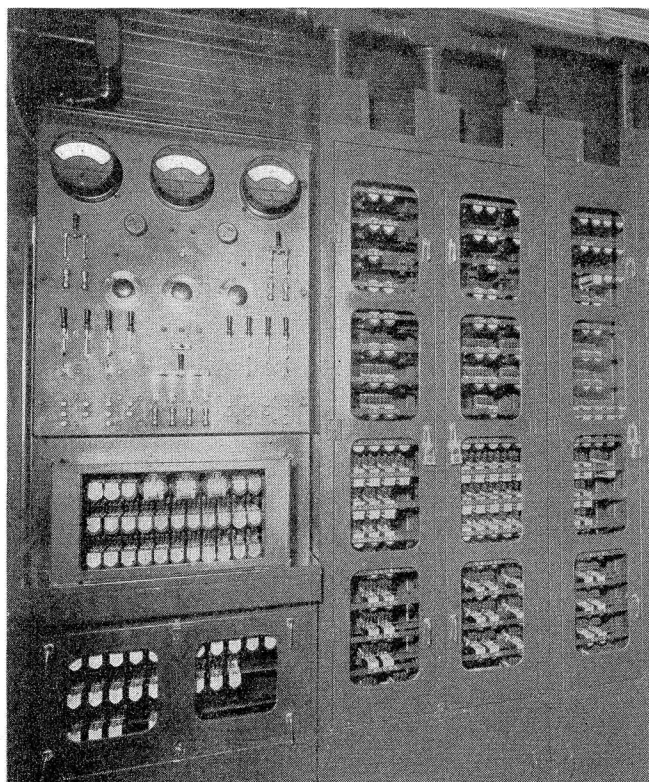
The automatic train recorder is a distinctly new style, operating somewhat on the principle of an automatic typewriter, the impressions on the graph being made by

metal type striking through a typewriter ribbon. A different character is used for each of the three tracks, that for the southbound track being \perp , for the northbound \neg , and for the third track \neg . When a train passes through an OS section, the main or base portion of mark made on the graph is horizontal. If the train crosses over from one track to another, or if it leaves the main track at a junction, the mark is turned 45 deg. diagonal. Thus the record is complete and can be followed quite readily.

The Signals and Power Switches

The signals are the triangular color-light type and are normally lighted. Three of the high signals are on ground masts and the remaining are on bridges. In order that all high signals might be similar, the same number of heads were used over both main tracks at each controlled location, thus eliminating markers. Three indications, red, yellow and green, are provided on all high signals, yellow being used as a call-on indication in certain instances. The 6 straight automatic signals are designated by a sign showing the letter "P" for permissive at a "stop and proceed" signal. Dwarf signals are used to direct movements out of a side track.

The power switch machines are the G. R. S. Model-5D equipped for dual control. The ordinary approach,



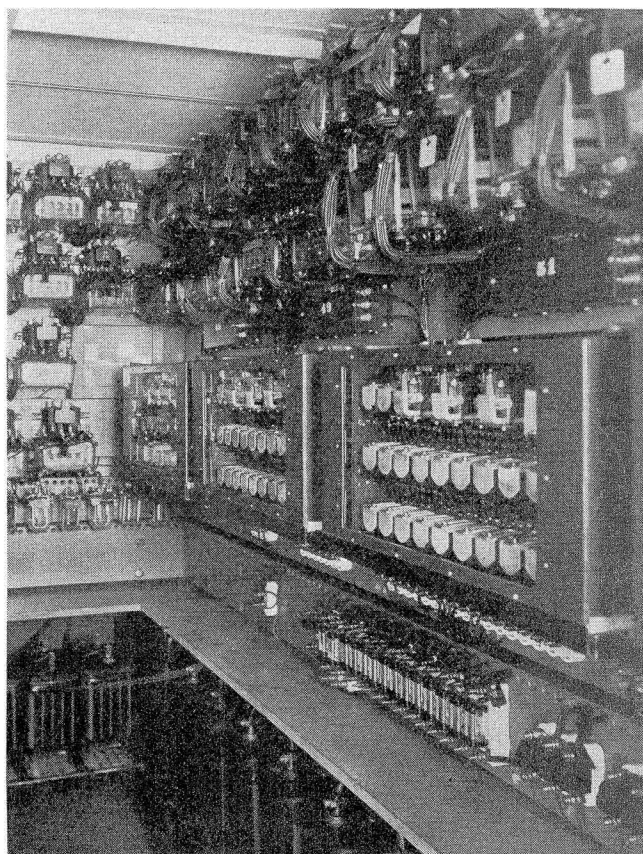
Front view of master and lever cabinets on ground floor of control office

time, route and sectional, and indication locking is provided in each case to protect the operation of these switches.

The switch marked SS on the diagram near Wesley Junction is equipped with a Racor Model-100-A spring switch stand. This switch is used principally by light engines and transfer cuts going from the classification yard to Bridge Junction. As these moves were predominately in the trailing direction, a spring switch serves adequately.

Battery and Power Supply

A battery of 16- 160-a.h. storage cells is provided at each of the field houses for the operation of switches, relays, code system, etc., as well as to serve as a reserve supply for the signal lamps in case the a-c. power is cut off temporarily. One 80 a.h. cell is provided for each track circuit. Two sets of 50 cells of 6 a.h. line battery are located in the control station for the operation of the centralized control line circuits. One set of 20 cells of 80 a.h. battery is used for the low-voltage station control circuits. All batteries are the Exide lead type and are on a-c. floating charge from a 220-volt, a-c. supply line fed at four points on the installation.



Interior of apparatus house at Wesley Junction

All underground connections from the instrument houses to the signals, switch machines and to rail connections are run in trenchlay cable, manufactured by the General Cable Corporation. A 7-conductor cable extending from a house to a switch contains two No. 6 conductors for the motor feed and five No. 14 conductors for the WP circuits. A five-conductor No. 14 cable extends to each three-position signal head from a box on the ground. Larger cables are used between these boxes and the instrument housings. Track connections are No. 9 single conductor cable; the cable conductor is joined to a long bond wire which has been doubled and this joint, after being taped, etc., is pushed down in an 18-in. piece of 2-in. pipe set vertically 3 in. from the rail. The pipe is filled with asphaltum and a wooden plug with a hole for the bond wires is driven down and then the top is filled with asphaltum.

Spare conductors in an existing submarine cable were used to extend the three special control wires from the tower under the river to the south shore. The fact that only three wires were required for the control eliminated the requirement for a new expensive submarine cable.

A 10-conductor No. 14 lead-covered cable is used from this point to Wesley Junction and open line wire, No. 10 weather-proof Copperweld is used from there to Pekin.

One of the most interesting features of the program was the construction of the new tower at the Bridge interlocking. The old tower was located in exactly the spot where the new one was wanted. Since it was necessary to keep the Bridge plant in service during the change, the chief engineer of the P. & P. U. conceived the idea of building the new tower around the old one. First the foundation and frame work of the new tower were constructed. The interlocking machine was supported by chains from the new rafters while the old second floor was being torn out and the new one being built. The battery and charging apparatus, relay cabinets, etc., on the first floor were supported from the joints above while the new concrete floor was built. In the meantime, the old tower building was removed in pieces. All during this period the interlocking plant was continued in service without a failure or train delay, which can be considered as a worthwhile accomplishment considering that approximately 400 train moves are made over this plant daily and the drawbridge is opened frequently for the passage of boats.

A part of the construction including the bonding, concrete foundations, bridge erection, etc., was handled by the signal department forces of the P. & P. U. and the remainder of the construction of the centralized traffic control system was performed by the General Railway Signal Company. The entire installation was made under the supervision of E. H. Thornberry, chief engineer of the Peoria & Pekin Union.

Passenger and Transfer Trains Collide

ON MARCH 19, 1931, there was a head-end collision between a transfer train and a passenger train on the Michigan Central at West Detroit, Mich., which resulted in the injury of 39 passengers and 1 employee. The report of the Bureau of Safety of the Interstate Commerce Commission is given in abstract below:

This accident occurred within the territory known as Detroit yard, at the southern end of interlocking limits. Approaching from the eastern end of the interlocking limits, there is a four-track main line. There are two sets of crossovers, herein referred to as the north and south crossovers, respectively, which connect these tracks and extend toward the left or south of the double-track line of the Toledo division. The accident occurred on a switching lead at a point approximately 650 ft. south of the tower and about 21 ft. outside the western or southern end of the interlocking limits, at a switch connecting the lead track with the yard tracks.

The interlocking signals involved are home signal 2 and dwarf signal 85. The interlocking plant is equipped with approach route locking and route indicator lighting, which enables an operator to note the route actually lined up as soon as a train enters the route.

Description

The transfer train, consisting of yard engine 8951 and 27 cars, headed north was standing on a yard track at a point about 404 ft. south of dwarf signal 85, fouling

the switching lead and with the switch open, and was prepared to move through the interlocking plant as soon as the route could be obtained; it had been standing at that point about 9 or 10 min. when it was struck by train second No. 309.

The latter train in charge of Engineman Knitter, passed signal 2, displaying a caution indication on the calling-on arm, and was routed over the south crossovers to the northbound Toledo division track. Instead of continuing on the northbound track to crossover 91, where it was to be diverted back to the southbound track, it passed dwarf signal 85, which was displaying a caution indication, passed through the open crossover leading to the lead track, entered the open yard track switch, and collided with transfer 8951.

Summary of Evidence

Towerman Schemehorn stated that at the time train second No. 309 came upon the annunciator circuit he was moving a train of 55 cars over track 6, the eastbound freight main track, through the north set of crossovers to track 3, which made it necessary for train second No. 309 to be routed through the south crossovers and over the northbound track of the Toledo division for a short distance. Transfer train 8951 had been standing in the south yard about 10 min., prepared to move out of the yard through the switching lead to the northbound track; Towerman Schemehorn had opened the switches for this movement to be made after the passage of train second No. 309, but no signal had been given. He then lined the route for train second No. 309 through the south set of crossovers, over the northbound track, and through crossover 91 which led back to the southbound track, but overlooked crossover 87, which was open and led to the switching lead. If he had looked at the route indicators he could have seen that the route was lined for a movement into the south yard, but he was quite busy, the telephones were ringing and he expected the 55-car train moving on track 6, which was on short time ahead of two other scheduled trains, to become stalled, and in the confusion he overlooked the position of crossover 87 and also the light indication.

Conclusions

This accident was caused primarily by the failure of Towerman Schemehorn properly to line the route for the passage of train second No. 309 within interlocking limits.

The indications displayed by the calling-on arm on home signal 2, and at dwarf signal 85, required that a train be operated at low speed, and Engineman Knitter understood that they governed movements to any route and that such movements should be made expecting to find the track occupied, a broken rail, or other obstruction in the block, and that the maximum speed allowed for diverging movements is 10 m.p.h. He said he was operating his train at a speed of approximately 10 m.p.h. upon passing dwarf signal 85, and when he saw that his train was being diverted from the main track through crossover 87, he made a 10-lb. brake-pipe reduction, followed by an emergency application at a point about 200 ft. beyond and about two car-lengths from transfer 8951 train having come practically to a stop when the collision occurred. The statements of the other members of his crew, however, indicated that their train was traveling at a speed of 10 or 12 m.p.h. at the time of the accident, and the occurrence of the accident itself is evidence that Engineman Knitter was not prepared to stop short of an obstruction.