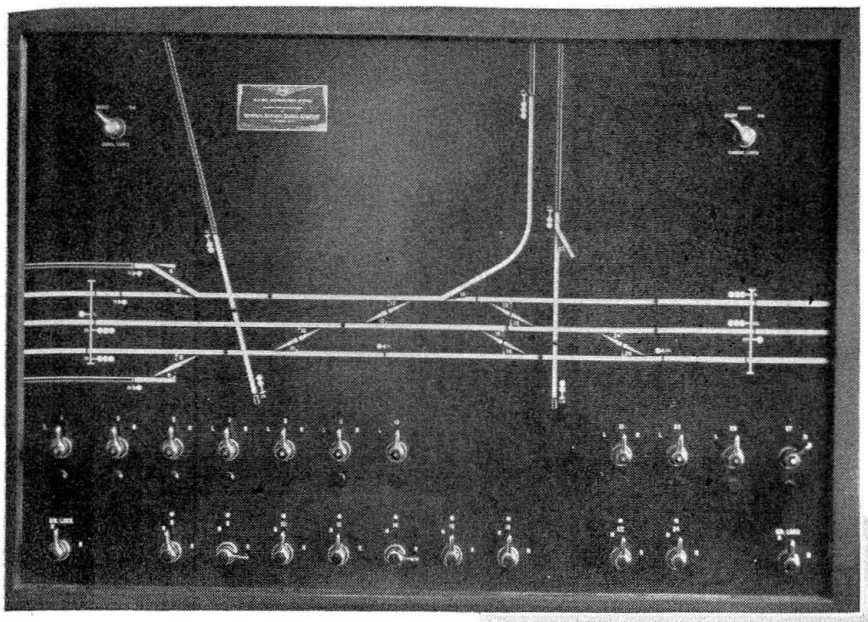
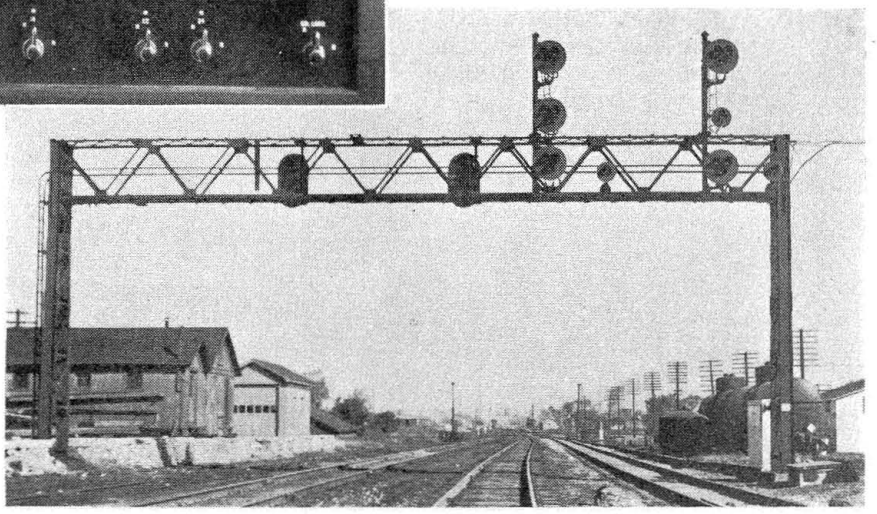


Electric plant at Kankakee, Ill., built in 1903, has been replaced with new switch machines, signals, miniature lever machine, new circuits and plug-in relays



Above—The panel of the new interlocking machine includes the levers, track diagram, and various indication lamps. Right—View looking north at the northward home signal bridge of the interlocking

All-Relay Interlocking on I.C.

THE main line of the Illinois Central south from Chicago is used also by trains of the Big Four for 54.4 miles between Chicago and Kankakee, at which point the Big Four branches off on its line through Indianapolis to Cincinnati. The track layout at Kankakee includes not only the junction between the Illinois Central and the Big Four, but also several crossovers as well as a single-track line of the New York Central crossing the Illinois Central, and a single-track line of the Big Four crossing the Illinois Central. This track layout is shown in the accompanying plan.

An all-electric Model-2 General Railway Signal Company interlocking, to protect this junction and two crossings, was installed in 1903, this being one of the early electric plants on the Illinois Central. During the following years, various changes were made in the track layout; for example, in 1922, the Illinois Central extended the third main track through this plant. Several years ago the original semaphores were replaced with color-light signals, and the old Model-2 switch machines were replaced with Model-5 110-volt machines. Through all the 42 years, however, the old wooden frame tower and the original Model-2 interlocking machine had been continued in service far beyond their normal life.

Derails Eliminated

In 1945, when making other track changes, a decision was made to eliminate the derails on the main tracks, with the exception of No. 22 on the Big Four. Rather than revise the old interlocking machine to take care of these changes, a decision was made to change over to an all-relay control scheme with a new miniature lever type interlocking machine, and this led to the replacement of the old frame tower by a one-story brick building to house the control machine as well as relays and other apparatus. Thus the changes and new construction were, for the most part, within the new building.

Color-Light Signals

The signals on this interlocking are the color-light type, the home interlocking signals being the triangular type with three lamp units in one circular background disk 40 in. in diameter, and the automatic block signals are of the type with the three lamp units in a vertical row, using an oblong background. In this manner, there is a distinctive difference between interlocking home signals and automatic signals.

On the Illinois Central three-track territory Track No. 3 is signaled for northbound trains, Track No. 1 is signaled for southbound trains, and the center track, No. 2, is signaled for both directions. The crossover No. 16 is a No. 18 turn-

out, good for diverging moves at 30 m.p.h. for southbound trains from the center track to Track No. 1. For this reason southward signal 5R has a middle unit capable of displaying red, yellow or green, so that the Medium-Clear or Approach aspect can be displayed to authorize a medium speed move over crossover No. 24 reversed. In such an instance, the "distant" signal for signal 5R displays the Approach-Medium aspect, yellow-over-green. Thus with the Approach-Medium and the Medium-Clear or Approach aspects, an engineman can bring his train up to and through the crossover at the speed for which it is designed to be used to an advantage.

The crossovers No. 10, 12 and 24 and the single switch No. 14 are No. 10 turnouts, good for about 15 m.p.h. Movements through these crossovers and turnout are governed by signals displaying Restricting or Slow-Clear aspects as the case may be. The restricting aspect is red-over-red-over-yellow and the slow-clear aspect is red-over-red-over-green.

With No Diverging Route

Northward home signal 7L on Track No. 3, does not govern over any diverging route including a high-speed crossover. Therefore, the middle unit on this signal is fixed, displaying only red. For a northbound diverging move from Track No. 3 over slow-speed crossover No. 12, the signal 7L is controlled to display red-over-red-over-yellow or green dependent on the indication of signal 1L.

On the normally southward Track No. 1, there are two northward dwarf signals, No. 9L and No. 23L. The reason for providing signal 9L in addition to 23L is that the location of 9L permits switching moves to be made in and out of the spur track (switch No. 6) without moving the switch engine all the way south of Signal 23L.

Track Designation for Train Order Signal Aspect

On rare occasions train orders may be issued at this tower and, therefore, a semaphore-type train order signal was installed in front of the tower and is pipe connected to a lever stand in the office. In consideration of the fact that trains may be operated in either direction on the middle track, which is No. 2, there may be a circumstance in which two northbound trains are approaching, one on Track No. 3 and one on the middle track, No. 2. In such an instance, some means is needed to designate the track for which the train order aspect applies. This is accomplished by a single lamp unit with an 8⅜-in. lunar white lens which is mounted on the signal bridge to the right of the base of signal 7L on Track No. 3, and another unit of the same kind is mounted to the right of the base of signal 25L on Track No. 2. These special units are shown in one of the pictures.

When the train orders are for a train approaching on Track No. 3, for example, the leverman throws a toggle switch which causes the lunar white lamp to the right of signal No. 7L to be displayed. This indicates that the orders are for the train on Track No. 3, and the engineman of the train approaching on Track No. 2 is thus informed that the train order signal is not set for him. If the operator has orders for both trains, he can cause the lunar white lamps for both tracks to be lighted.

If the train orders are on Form 31, the train must stop, and in such an instance the train order signal is set at Stop and the lunar white lamp is operated, but the home signal is held at Stop until the train is stopped short of the home signal which is then cleared to direct the train to pull on down to the tower to allow the conductor to get the orders and sign for them. If the orders are on Form 19, they can be picked up without stopping, and in such an instance the train order signal is set at Stop, the lunar white light is displayed and the home signal is cleared. The combination of the lunar white light and the clear home signal gives the engineman advance information that avoids train stops at this interlocking.

Control Machine

The panel of the new control machine is 36 in. wide and 60 in. high. As shown in one of the pictures, an illuminated track diagram extends across the upper portion of the panel. Red lamps in the lines representing the tracks are lighted when corresponding sections of track are occupied. The crossovers and switches are represented by movable triangular sections of sheet-metal which are operated to show a full-width white line according to the actual position of switches on the ground. For example, for the line up shown in the picture, all the switches and crossovers are normal except that crossover No. 8 and turnout No. 14 are reversed.

The signal levers, which are in the top row under the diagram, normally stand on center, and are thrown to the left to clear a northward signal, or to the right to clear an opposing southward signal. When the corresponding signal clears, a white lamp in the face of the barrel of the lever is lighted. On those signals which are equipped to display a call-on aspect, this call-on is controlled

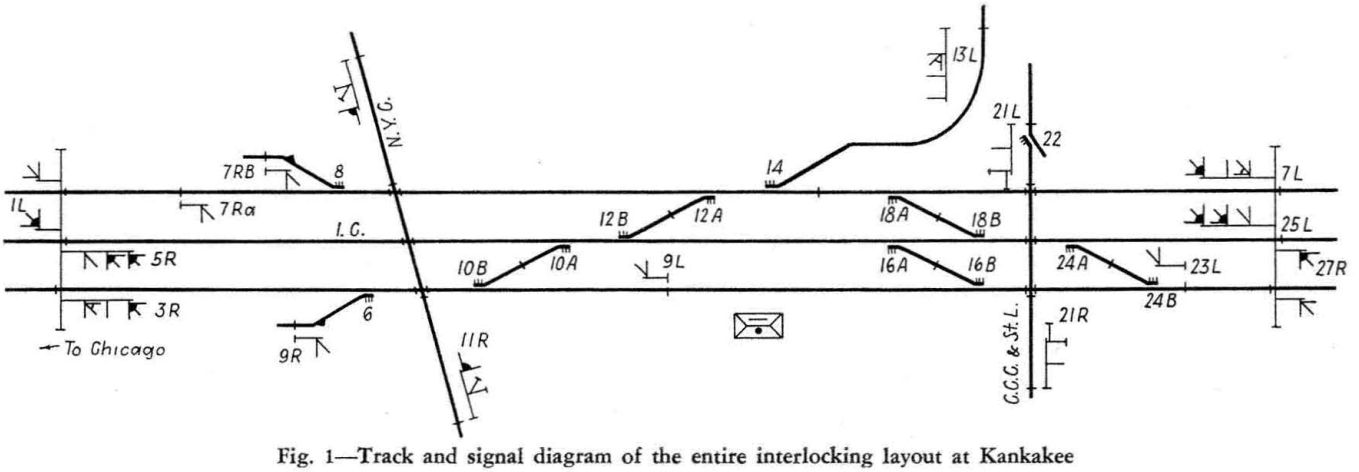


Fig. 1—Track and signal diagram of the entire interlocking layout at Kankakee

by throwing the lever and also pushing a button just below that lever on the panel.

The switch levers, which are in a row at the bottom of the panel, are normally in the vertical position, being thrown 90 deg. to the right to control a switch to the reverse position. Above each switch lever there is a small yellow lamp which is lighted during the time a switch is not over and locked in the position corresponding with that of the lever, thus such a lamp would be lighted when a switch is being operated, or it would stay lighted if the switch did not lock up. In the face of the barrel of each switch lever there is a red lens which is lighted during the time that electric locking is in effect to prevent operation of the switch even if the lever were thrown. In such an instance, the switch would not operate even after the locking is no longer effective, but rather the lever would have to be restored to the position corresponding with that of the switch and then control by the lever would again be effective to operate the switch.

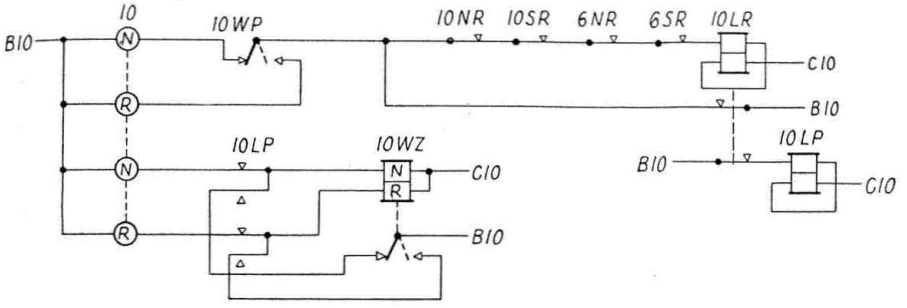


Fig. 2—Diagram of typical switch control circuit

Switch Lock Lever

The lever at the left and in the same row as the switch levers is for the control of an electric switch lock on hand-throw switches outside of home signal limits north of the tower, and the lever at the right end in this row is for the control of an electric lock on hand-throw switches south of the interlocking.

Circuit Locking

In this new project, the interlocking is accomplished by inter-connections of circuits rather than as previously by mechanical locking between levers and by electric lever locks. The circuit interlocking is all confined in the instrument room in the new tower, thus simplifying the networks to use single-wire selection circuits. In order to confine these circuits to the tower, a 900-ohm d-c. neutral repeater relay was provided in the tower for each track circuit. Also in place of the previous dynamic indication for switches new 900-ohm d-c. polar relays were installed to repeat the position of switches, and this required the installation of additional wires for switch repeater circuits. All of the relays in the tower, including the motor-driven time-element relays, are of the plug-in type, as shown in the pictures.

Typical Switch Circuit

Each switch lever controls a corresponding polar relay which has two independent windings, one to control the relay to the normal position and one for the reverse. As shown in Fig. 2, relay 10WZ is the lever-repeater relay for switch lever No. 10. The circuit for 10WZ includes a front contact of repeater relay 10LP, which is a repeater of lock relay 10LR. The control of 10LR is through polar contacts of the switch-repeater relay 10WP, the corresponding polar points being connected through N and R lever contacts. As long as the lock relay 10LP is released, the circuit for relay 10WZ is polar locked and, therefore, operation of the lever has no control of 10WZ. In order for lock relay 10LR to be energized, the lever must be placed in the position corresponding to the then position of the switch as evidenced by the position of the polar contacts of the switch-repeater relay 10WP. A conclusion, therefore, is that if the switch lever is thrown while the lock relay is down, the position of 10WZ cannot be changed because 10LR is down and 10LR cannot be picked up until the lever is returned to the position corresponding to that of the switch. Thus pre-conditioning is prevented.

Route and Signal Network

The circuits in this interlocking include the checks for opposing signals and signal lockouts as well as the selections of routes through switches all in one network. The diagram Fig. 3 shows portions of the network for signal levers 7 and 13. For example, if the Big Four junction switch No. 14 is reversed, then the normal-switch-repeater relay 14NWC is released and 14RWC is picked up which completes the circuit between point A and B on Fig. 3. An item of interest is that this portion of the circuit between A and B is now available to control route relays as well as signal lever repeater relays. For example, if signal lever 13 is thrown to the L position, the lever contact 13L is closed which completes the circuit to energize lever-repeater relay 13GZ and route relay 7RRR in a series circuit. Relay 7RRR sticks up through its own

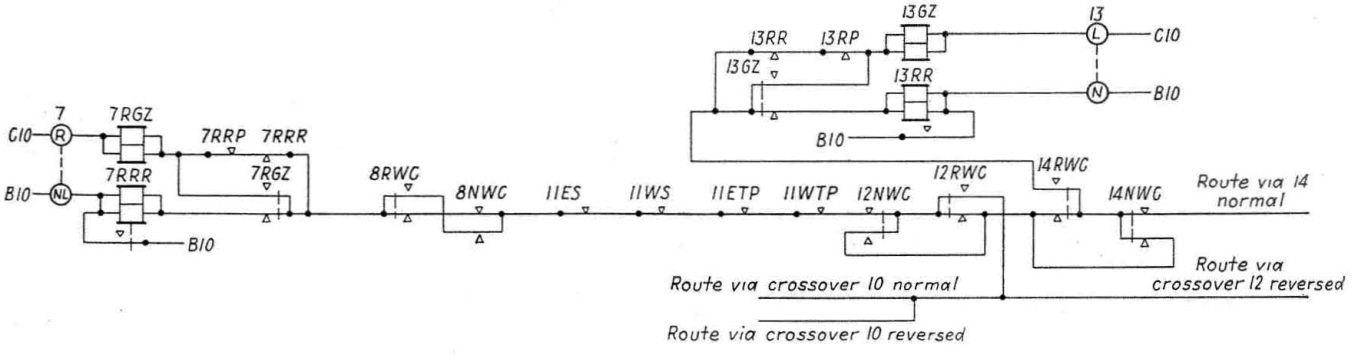
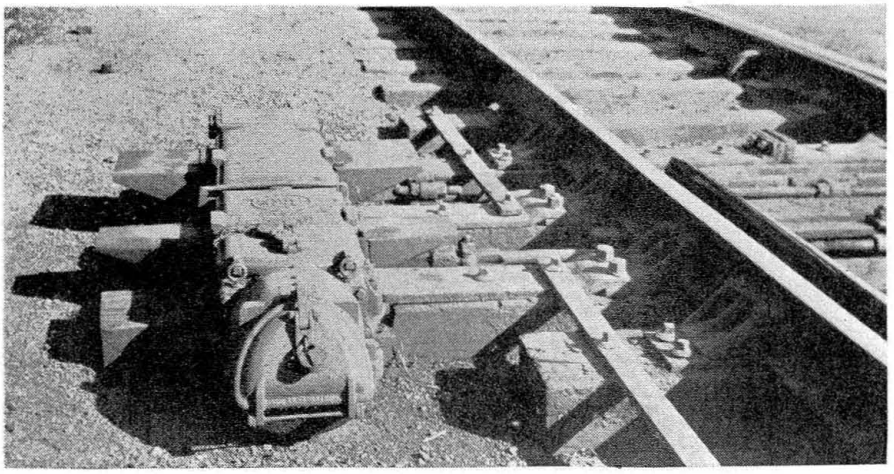


Fig. 3—Portion of the network for signal lever 7



Modern switch machines were a part of the improvement program

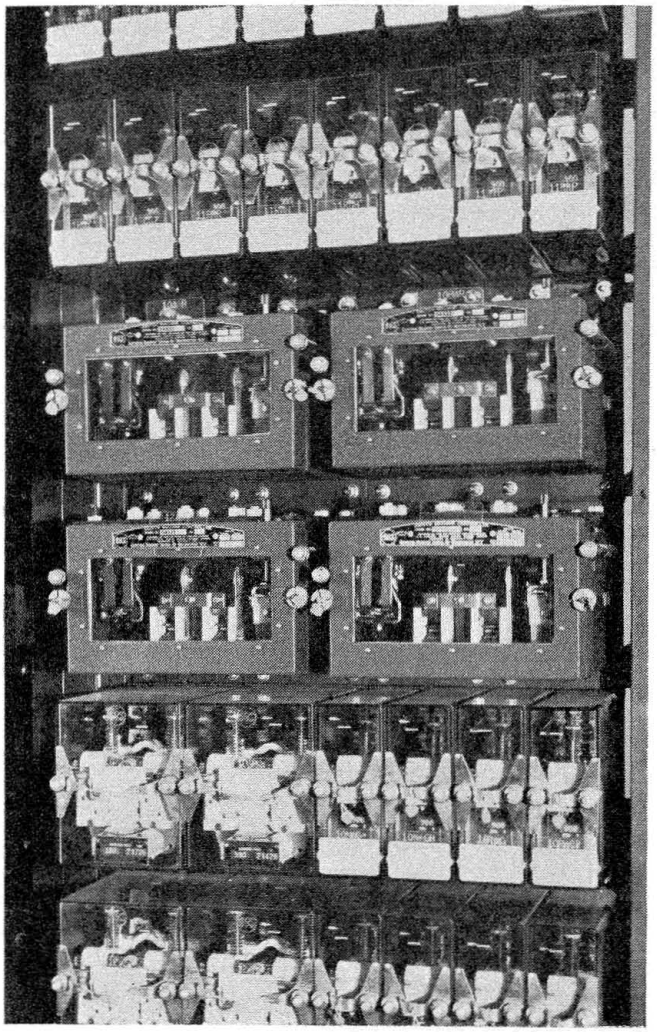
contact independent of the 7NL lever contact. Thus, as shown in the diagram, the signal-lever-repeater relay is in the end of the network toward the lever contact, and the route relay is in the other end near the lever contact of the lever for the opposing signal of the track line-up.

When the route relay 13GZ is energized, contacts are opened to release lock relays which lock the switches and lock out opposing as well as conflicting signals. Front contacts of lever-repeater relay 13GZ, back contacts of the lock relays and contacts of switch-repeater relays are used to complete signal control circuits.

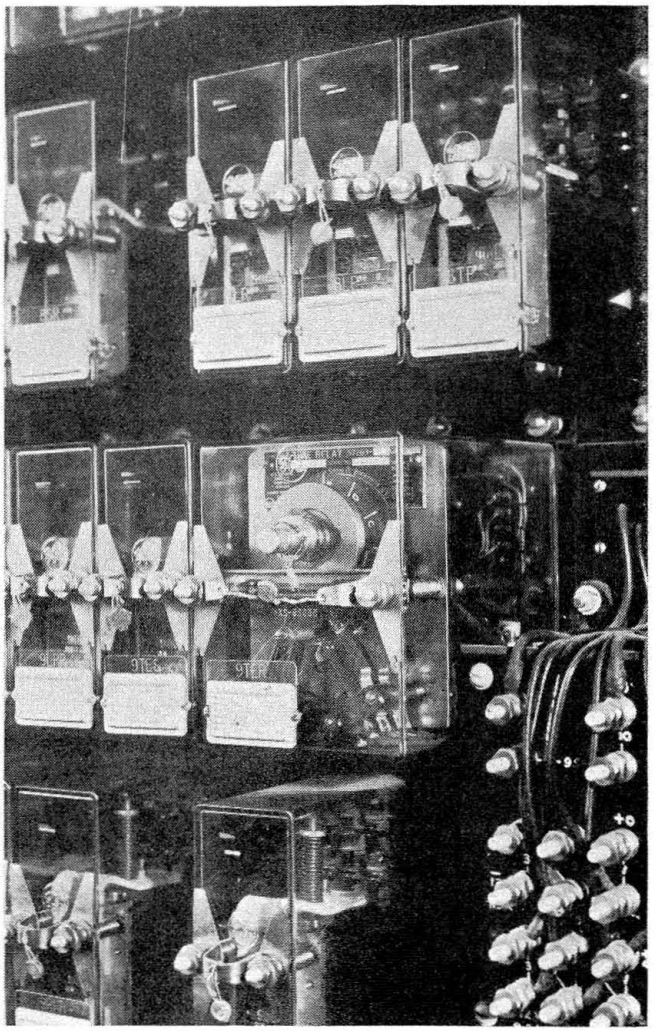
When relay 7RRR is energized, a back contact is opened in the circuit for relay 7RGZ, which prevents this relay from being energized if lever 7 is thrown to the right. Thus this prevents pre-conditioning of signal lever 7R, as well as excluding interference with an established route if lever 7 should accidentally be thrown. This is the reason for relays such as 7RRR and 13RR.

Individual Cross Protection

As applying to this Kankakee project, the General Railway Signal Company switch controllers are not out in the switch machines or in cases nearby but rather they are all in the new tower, and these controllers, in effect, accomplish the same functions as did the contacts on switch levers in the previous Model-2 interlocking machine. The switch machines are the General Railway Signal Company Model-5 or 5A, operated by 110-volt d-c. motors, the 110-volt power being from storage batteries in the tower. For the operation of each switch machine a new three-wire 110-volt d-c. circuit extends from the corresponding controller relay in the tower to the switch machine, thus providing individual commons and individual



Typical section of plug-in relays



The time-element relays are also the plug-in type

cross-protection with the cut out and restoring features incorporated in each of the controller relays in the tower. These controllers are the plug-in type the same as the relays.

The main battery for operation of the 110-volt switch machines consists of 56 cells of 80-a.h. Exide Type DMGO-9 storage battery, and the relay circuits in the tower are fed from a set of 5 cells of 160-a.h. battery. Each track circuit is fed by one cell of DMGO-9 battery.

This interlocking was planned and installed by signal department forces of the Illinois Central, under the direction of H. G. Morgan, signal engineer, the major items of new equipment, such as the switch machines, interlocking machine and new relays, being furnished by the General Railway Signal Company.

Rear-End Accident Leads to Show-Cause Order

On November 11, 1945, there was a rear-end collision between a freight train and a passenger train on the Western Pacific near Carbona, Cal., which resulted in the death of 1 train-service employee, and the injury of 105 passengers, 1 Pullman employee, 1 traffic agent, 4 dining-car employees and 7 train-service employees. This accident was investigated in conjunction with a representative of the Railroad Commission of California. An abstract of the report of the Interstate Commerce Commission is as follows:

Location and Method of Operation

This accident occurred on that part of the Western division extending between Stockton, Cal., and Chestnut Junction, 87.95 miles, a single-track line in the vicinity of the point of accident, over which trains are operated by timetable and train orders. There is no block system in use. At Carbona, 22 miles west of Stockton, a siding 5,175 ft. in length parallels the main track on the south. The east switch of this siding is 0.81 mile east of the station. The accident occurred on the main track 0.60 mile east of the east siding-switch at Carbona. The track is tangent throughout a distance of 3 miles east of the point of accident and a considerable distance westward. The grade is 0.63 per cent ascending westward.

Description of Accident

Second 53, a westbound second-class freight train, consisting of engine 309, 63 cars, a caboose and engine 17, in the order named, passed Lathrop, the last open reporting station, 13.4 miles east of Carbona, at 4:21 a.m., 6 hours 41 minutes late, passed S.P. Crossing, 2.2 miles east of Carbona, about 4:47 a.m., and stopped on the main track about 4:51 a.m., with the rear end 3,156 ft. east of the east siding-switch at Carbona. About 1 minute later, while it was preparing to enter the siding to clear for an opposing superior train, the rear end was struck by Extra 177 West.

Extra 177 West, a westbound passenger train, consisted of engines 81 and 177, six Pullman sleeping cars, seven troop sleeping cars, one dining car, one kitchen car and a caboose, in the order named. This train passed Lathrop at 4:31 a.m., passed S.P. Crossing about 4:50 a.m., and while moving at an estimated speed of 25 m.p.h. it struck the rear end of Second 53. The weather was clear at the time of the accident, which occurred about 4:52 a.m. During the 30-day period preceding the day of the accident, the average daily movement in the vicinity of the point of accident was 29.4 trains.

Discussion

As Extra 177 West was approaching the point where the accident occurred, the speed was about 35 m.p.h. No train order restricting the authority of this train to proceed at maximum authorized speed had been issued. The engineman of the first engine saw the rear end of the preceding train about 400 ft. distant, and he immediately moved the brake valve to emergency position, but the collision occurred before the train could be stopped.

The flagman of Second 53 said that he dropped a lighted 10-minute fusee from the rear platform of the caboose when the speed of the train was being reduced about 1 mile east of the point of accident. At that time he did not see or hear a train approaching from the east. After the accident, two partly burned fusees were found in the vicinity of the point where the flagman of Second 53 said he dropped a lighted fusee. Examination of these fusees indicated that one had burned about 30 seconds and the other about 3 seconds. Both had been extinguished when they struck the ballast of the roadbed. Since no burning fusee was seen by the members of the engine crew of Extra 177, it is evident that the fusee dropped by the flagman of Second 53 did not remain lighted after it was dropped.

In this territory, trains are operated by timetable and train orders only. The only provision for spacing following trains is by the time-interval method, enforced by operators at open stations, and by flagman's signals. The rules require that a following train must be spaced at least 10 minutes behind a preceding train. In this case the preceding train passed Lathrop, the last open office, 13.4 miles east of Carbona, 10 minutes before the following train departed from that station. However, the time-spacing method in use does not provide means for spacing trains except at open offices, and the collision occurred before the trains reached Carbona, the next open office, 1.41 miles west of the point of accident. These trains passed the interlocking tower at S.P. Crossing, 0.79 mile east of the point of accident, about 3 minutes apart. However, the operator-leverman at S.P. Crossing is not required to report the passage of W.P. trains, or to space trains of this carrier. The operator-leverman said when he observed that the preceding train was stopping, he held the westward home signal of the interlocking in stop position for Extra 177 until the speed of that train had been considerably reduced. If an adequate block system had been in use in this territory, the crew of the following train would have received definite information that the preceding train was occupying the main track in the same block.

Show-Cause Order

As a result of a previous accident which occurred on the line involved, the Commission issued an order calling upon this carrier to show cause, if any, why it should not be required to install an adequate block-signal system on this line. This order will be set for hearing in San Francisco, California, on April 1, 1946.

Cause

It is found that this accident was caused by failure to provide adequate protection for the preceding train.

Dated at Washington, D. C., this eighth day of January, 1946.

By the Commission, Commissioner Patterson.

W. P. Bartel,
Secretary.