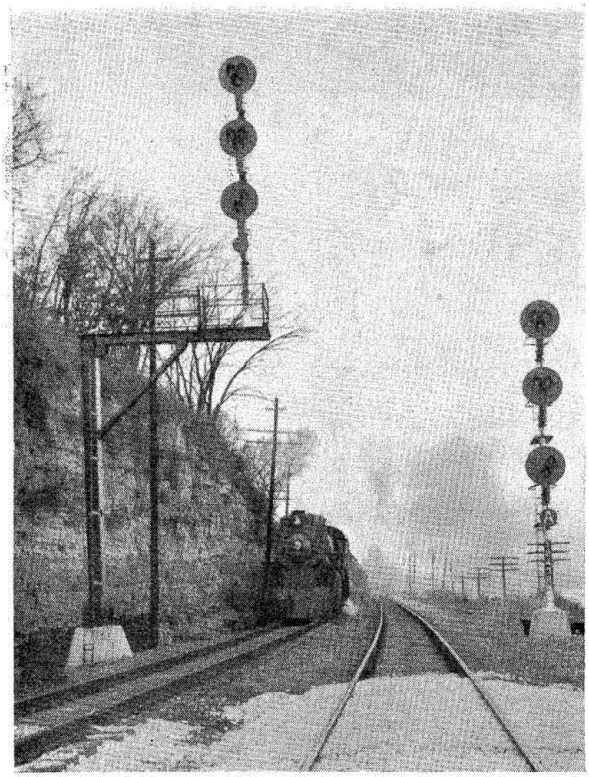


Signals direct train movements in either direction on both tracks on 12.6 miles of line

Centralized Traffic

Installed on the

THE Missouri Pacific has installed centralized traffic control, including power-operated switches and signals for directing train movements, on 12.6 miles of double track between Osage, Mo., and Cole, Mo. The main line has two or more tracks for 116.7 miles from St. Louis, Mo., to an end of double track at East Osage on the east side of the Osage river. Single track extends for 2,600 ft. across a bridge over the Osage river to an end-of-double-track switch at Osage, and from there, two main tracks extend 12 miles through Jefferson City to SR Junction.

Track Layout

From SR Junction, a low-grade single-track line extends northwest in the Missouri River valley to Kansas City, Mo., and a second single-track line from SR Junction extends westward through Sedalia, Mo., and to Kansas City. Through freight trains and two local passenger trains are operated over the River subdivision, while the remainder of the passenger trains, local freight trains and one eastbound red ball freight are operated over the Sedalia subdivision.

Previous Interlockings

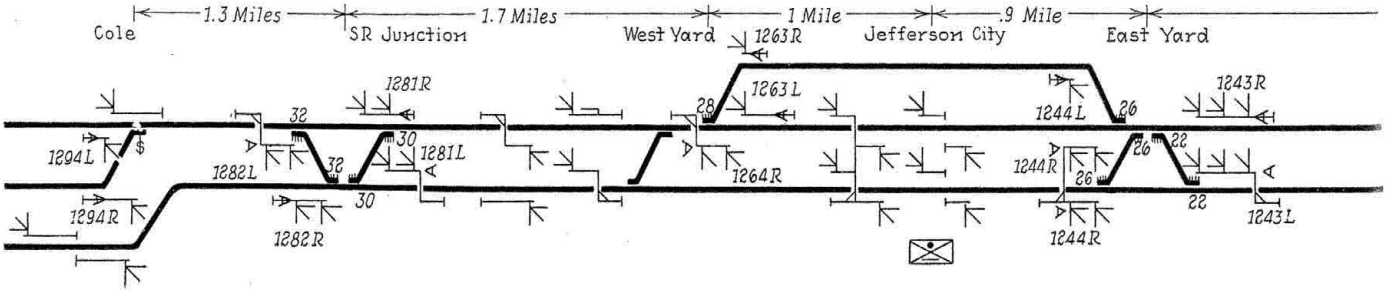
In the previous arrangement, a mechanical interlocking known as MM, located at M.P. 119.1, about 2 miles west of Osage, included two No. 20 crossovers between the two main tracks. The power switches and signals at the two ends of double track on the two ends of the Osage River bridge were controlled remotely from MM tower. Train movements were directed by signal indication between East Osage and MM, with either-direction running on each track between MM and Osage. Right-hand running, using timetables and train orders with automatic signal protection was in effect between MM and Cole Junction. The yard entrance and yard departure switches at Jefferson City were hand operated.

At Cole Junction, a mechanical interlocking included the east switch of a passing track on the River district and a double-slip crossover layout to route trains between the double track to the east and the two single track lines to the west. The junction layout was located on a curve, thus necessitating excessively low train speeds when negotiating the switches and crossovers.

Operating Problems

The daily traffic through this territory includes 12 passenger trains, 2 local freight trains, 8 scheduled freight trains and extra trains as required, thus totaling at least 22 trains daily. Although Jefferson City is a freight district terminal point, the locomotives are run through, but the crews are changed. Rather than running the through freight trains into and out of the yard at Jefferson City, they hold the main tracks. The time required for changing crews and for taking coal and water varies from a minimum of about 10 min. to a maximum of 15 min. If cars are to be taken off and set on, the total time may be from 20 to 30 min. or more. The movements required to take off or set on cars are handled by switch engines. In order to permit the through freight trains to occupy the main tracks while this work is being done, it was necessary to provide an arrangement whereby trains could be operated in either direction on either main track so that other trains, principally passenger trains, could be routed around standing freight trains.

As the principal source of delays was in the vicinity of Jefferson City

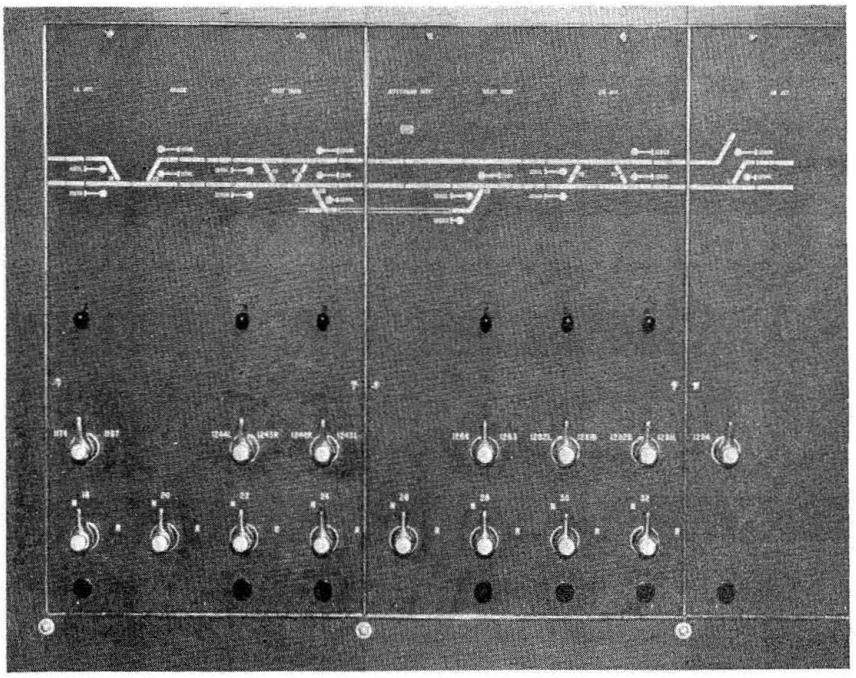


Track and signal plan of C. T. C.

Control

Missouri Pacific

Installation at Jefferson City, Mo., including either-direction operation on two tracks, facilitates train movements through important junction and intermediate terminal



The control machine at Jefferson City

rather than at the east end of the territory, the mechanical interlocking formerly at MM, as mentioned previously. was removed, and the two No. 20 crossovers at that location were reinstalled at East Yard just west of MP 124. Likewise at this location, a new turnout was installed between the westward track and the yard lead, thus forming a new yard entrance switch and leaving some of the old yard lead track as a dead-end tail track for switching moves.

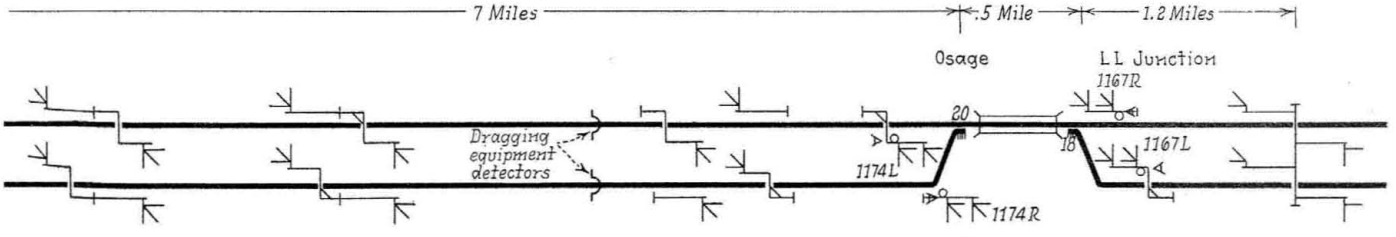
At the west end of the territory, in order to get the junction layout off of curves and onto straight track, the interlocking and crossovers forming the previous junction at Cole Junction were removed, and two new No. 20 crossovers were installed between the two main tracks at a new location on straight track one mile east of Cole. This new track layout, known as SR, now forms the junction of the two single track lines from the west with the double track to the east. At Cole, a spring switch mechanism with an oil buffer was installed at the switch at the east end of the passing track on the River subdivision.

New power switch machines were installed at the two ends of double track on either side of the Osage river, at East Yard, at the east yard entrance and west yard departure switches at Jefferson City, and at SR. These power switch machines as well as signals at these locations for directing train movements by signal indication in either direction on both main tracks, are all controlled from a new centralized traffic control machine in the station at Jefferson City. As a part of the program, changes and additions were made to the automatic block signaling to provide for either-direction train operation on both main tracks.

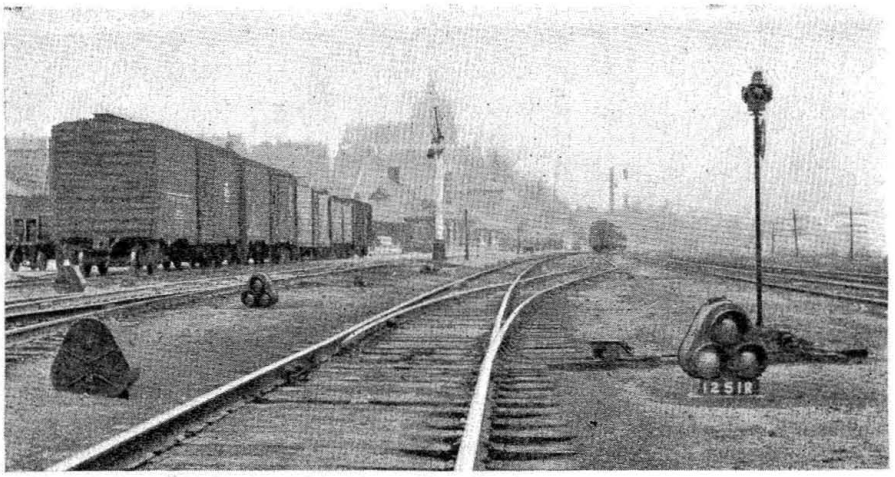
How the New Facilities Are Used

Thus the new track arrangement includes three locations, Osage, East Yard, and SR, at any one of which the trains can be diverted from one main track to the other. The centralized traffic control and signaling provides for direction of train movements by signal indication which supersede timetable superiority and take the place of train orders. With these facilities, run-around moves can be made as required. For example, if a westbound through freight train is holding the main line at Jefferson City, a westbound passenger train on the north track can be diverted to the south track at Osage or at East Yard, and, after making its station stop at Jefferson City, can be diverted to the River subdivision at SR or can continue on the south track to the Sedalia subdivision. If an eastbound through freight train is occupying the south track, an eastbound passenger train from the Sedalia subdivision can be diverted to the north track at SR, and, after making the station stop, it can be diverted to the south track at East Yard or it can be run through to Osage on the north main, providing a second eastbound freight train is occupying the south main between Jefferson City and Osage. Thus the flexibility, with which train movements can be made, eliminates train delays and congestion through Jefferson City.

The turnouts and crossovers are No. 20 with 30-ft. points, thus permitting diverging moves at train



territory between Cole and LL Junction



Dwarf signals at east end of the station platform at Jefferson City obviate signal bridges

speeds of 30 m.p.h. In order to direct trains to approach and pass through these turnouts or crossovers at the speeds for which they are designed, extra signal aspects were provided, this being the first installation of this character on the Missouri Pacific. An absolute home signal normally displays the red-over-red, Stop aspect, and the distant signal displays the yellow, Approach aspect. When a through route on straight track is lined up, the home signal displays the green-over-red, Clear aspect, and the distant signal displays the single-light green Clear aspect. When a No. 20 turnout or crossover is reversed and block is not occupied, the red-over-green, Clear-Medium aspect is displayed on a home signal, indicating that a diverging route good for 30 m.p.h. is lined up. With this lineup, the distant signal displays the yellow-over-green, Approach-Medium aspect, directing a train to approach the next signal at medium speed.

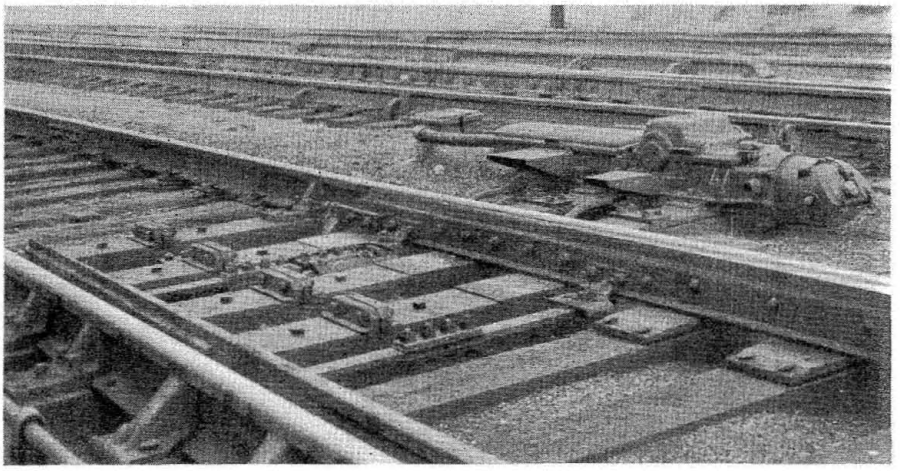
A point of importance with reference to the new four-aspect distant signals as adopted on the Missouri Pacific is that the previous practice of using one lamp, red for Stop, yellow for Approach and green for Clear, has been continued in so far as the distant signal is concerned, and the second lamp, normally extinguished, is lighted green only when required to complete the yellow-over-green, fourth aspect. If the filament in the lower unit fails, the remaining single-yellow lamp is a more restrictive aspect. If the filament in the yellow lamp in the top unit fails, a relay is released which, in case an Approach-Medium aspect is intended, the lower unit green lamp also is extinguished, thus leaving a dark signal which is considered as displaying its most restrictive aspect. Other than the distant signals for the home signals at switches, the intermediate automatic block signals display the standard single-lamp aspect, red, yellow or green. Four of the automatic block signals, 1251R, 1251L, 1252R and 1252L, at the east end of the Jefferson City station platform, are of the three-aspect dwarf type. The use of these dwarf signals obviated the necessity for overhead signal bridges and the throwing of tracks to provide clearance for the bridge supports.

The speed limits for passenger trains operated by steam locomotives is 75 m.p.h., and 55 m.p.h. for freight trains. The light-weight streamlined "Eagle" trains which are hauled by diesel-electric locomotives are limited to 90 m.p.h. The speed limit for all trains through Jefferson City station platform limits is 45 m.p.h. All signals are spaced properly to provide adequate braking distances for trains, the minimum spacing, on territory where maximum speeds are permitted, is 8,000 ft.

The Control Machine

The centralized traffic control machine panel includes an illuminated track diagram with sections which are lighted to indicate the locations of trains on all portions of the main tracks. The signal levers, in the upper row near the bottom of the panel, normally stand on center and are operated to the left or east to clear eastward signals and to the right or west to clear westward signals. A lamp in the face of each signal lever is lighted when the corresponding signal clears.

The switch levers, in the bottom row, stand normally in the vertical position to control the switches to the normal position, and are thrown to the right to reverse the switches. The indication lamp in the face of each switch lever is an out of correspondence light, normally out, but is lighted from the time the lever is thrown until the switch operates and is locked in the position corresponding to that of the lever. The controls for switches and signals as well as the return of indications are all handled by the coding system using only three line wires. Codes can be sent out and indications can come in simultaneously.



Adequate plates and braces are used on the switches

Switch Layouts Well Equipped

The power switch machines are of the electric type Model 5D equipped for operation on 24-volts d-c. These machines are all equipped for dual-control, so that they can be operated manually if necessary when making special switching moves. The use of dual-control machines is standard practice for all power switches on remote control or centralized traffic control projects on the Missouri Pacific. These switch layouts are equipped with the standard arrangement of facing-point lock rods and lock-out point detectors.

In order to insure proper operation of the 30-ft. switch points, a second operating rod is provided at the midpoint of the switch points, and this rod is pipe connected to the main operating rod. Four 1-in. by 9-in. insulated gage plates are provided under each switch, one of these plates being on the tie ahead of the points. On two ties, ½-in. by 6-in. plates are attached to the ends of the gage plates and extend on top of the ties under the switch machine. The switch machine is held by steel blocks welded to the gage plates. This type of construction prevents lost motion between the switch machines and the switch. Fixed rail braces are used on seven ties. On the tie ahead of the points, rail braces are used on the gage side as well as on the outside of the rails, in order to prevent "rolling" of the stock rails. When installing these fixed braces, they are fitted individually on the job to insure a tight fit when driven in place by a maul.

Power Supply

As a part of the previous automatic signaling, a new pole line was constructed exclusively for the signaling system. This line includes a single-phase, 4,400-volt power distribution line carried on two No. 4 stranded aluminum conductors with steel core.

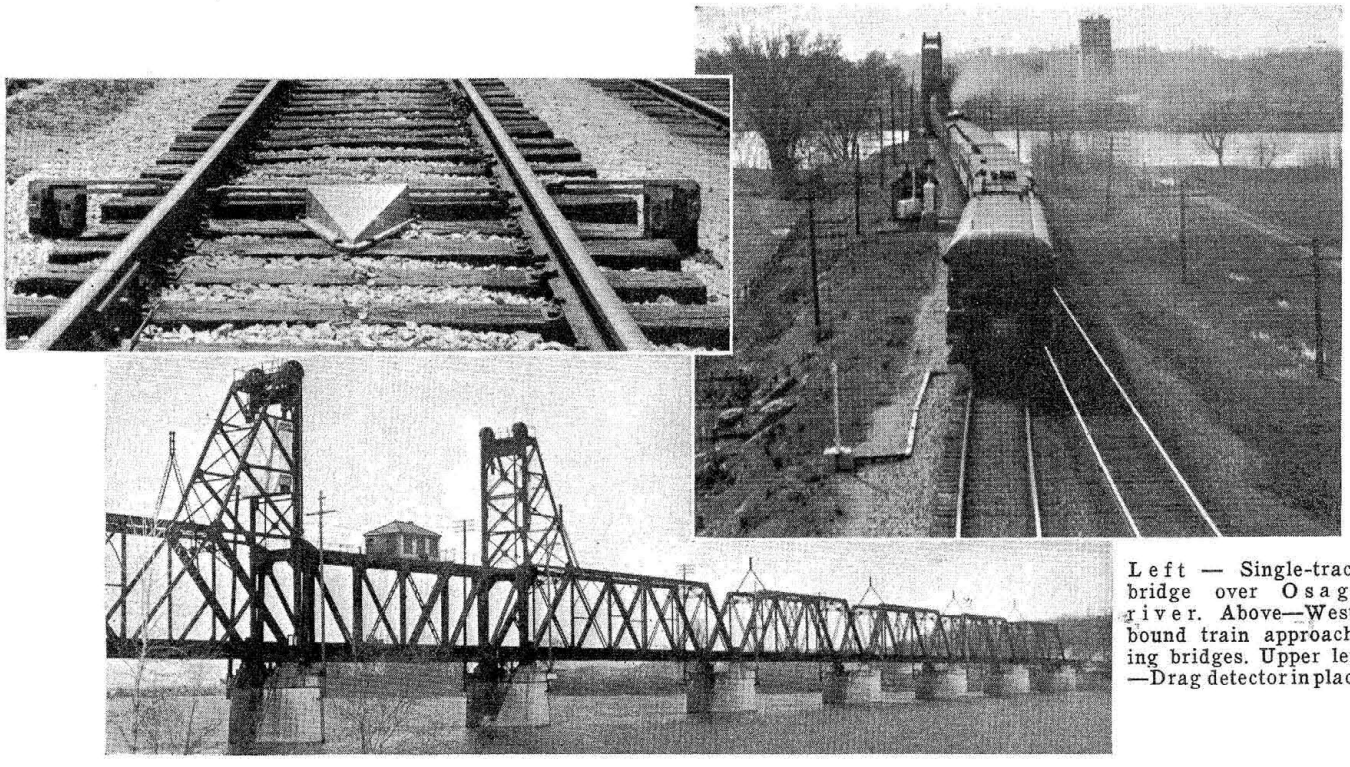
At each location a battery consisting of 12 DMGO-7 cells was provided for operating the switches. This battery serves to operate the switches as well as being used to feed the local code relays. Each signal has a set of five cells of the same type, and a similar cell feeds each track circuit. At the control office at Jefferson City, there are two sets of storage cells, a 40-volt battery for the control code includes 20 cells type BMT; a 40-volt battery for the indication code consists of 20 cells of the same type, and the local 24-volt split battery includes 12 cells of type DMGO-7. All of these batteries are of the Exide Chloride Accumulator type, and are on floating charge through G.R.S. dry-plate rectifiers. The code line wires are No. 10 bare copper and are located on pins 4, 8 and 10, counting from the track side, this separation being made to reduce the chances for crosses.

Sheet-Metal Instrument Housings

In the vicinity of each group of power switches and signals, a cabin is provided for housing the relays, coding apparatus, battery and charging apparatus. These houses are of various sizes, ranging from 6 ft. by 6 ft. to 8 ft. by 8 ft., depending on the space requirements at each location. The cabins or houses are of welded sheet-metal construction and are lined with ⅜-in. celotex insulation, being constructed by the General Railway Signal Company. The instruments are of the wall-type mounting and are attached to 1½-in. by 8-in. boards attached to angle-iron uprights set 4 in. from the wall to allow wiring space at the rear.

The coding equipment in each cabin is contained in a sheet-metal cabinet 11¾ in. deep, 23 in. high and 19 in. wide, which is located in the center of the cabin. The face of the cabinet is fitted with transparent fibestos which is not subject to breakage like glass. The entire case is practically dustproof. The operation of the relays can be observed through the transparent cover. If any of the relays are not operating correctly, the cover can be removed and the individual relay replaced readily, as each relay is a standard unit fitted with plug-and-jack connections so that any relay can be replaced merely by pulling it out and plugging in a new one.

As a means of reducing the chances for crosses in circuits extending underground from the instrument cases to signals and switch machines, each wire is run as a single conductor No. 9 or No. 6 cable depending on necessity of reducing voltage drop. The outer protection on even cable includes lead sheath and two wraps of steel tape armour. Six such cables are run to each switch machine, and four to each three-position signal. The same type of cable is used for runs to rail connections. At each switch machine, the underground cables are brought up into a cast-iron junction box where soldered joints are made to flexible insulated conductors extending through flexible conduit to the switch machine. As originally installed, the wires were attached to standard A.A.R. terminals in the cast-iron junction boxes. When making insulation resistance tests with a Megger instrument, a low resistance reading was located between



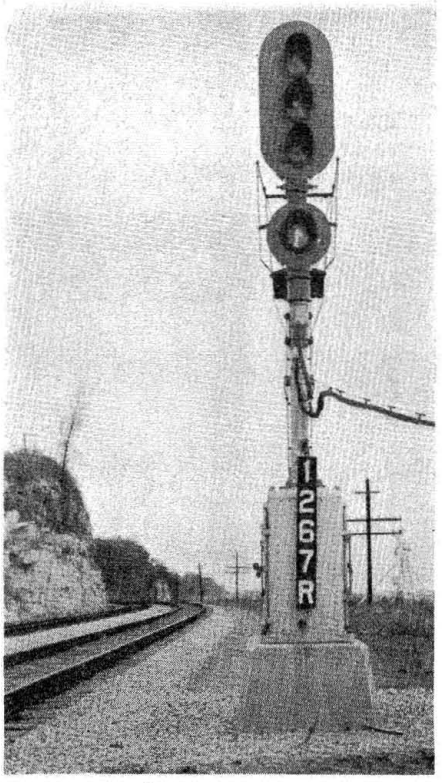
Left — Single-track bridge over Osage river. Above—Westbound train approaching bridges. Upper left —Drag detector in place

these terminals, this being caused by dampness and dust. The terminals were removed and the wires jointed together, as explained above.

Dragging Equipment Detectors

The single-track bridge over the Osage river is a vital portion of this division. If this bridge is damaged or a train is derailed in the bridge or on the approaches, the line would be out of service for an extended period before repairs could be made. For this reason, detectors are in service on both tracks in approach to this bridge from each direction, so that if any equipment is dragging, signals will display aspects to indicate the defective condition, and the train can be stopped before the dragging equipment arrives at a switch or the bridge where a derailment most likely would be caused.

As shown in the illustration, each detector location includes brackets mounted on each side of both rails, and so arranged that brake beams or other defective equipment, which is hanging or dragging below standard clearance, will strike and break one of the brackets. These brackets are made of very brittle cast-iron so that they are easily broken by a sharp blow; even a dragging truck chain will break them. Each bracket is made in the form of a loop, and the four loops of a detector are connected in series in an electrical circuit which includes a battery and a normally-energized relay. If any one of the brackets is broken, the relay is released and signals, which are controlled through the relay, are set to display special aspects.



Four-aspect signal

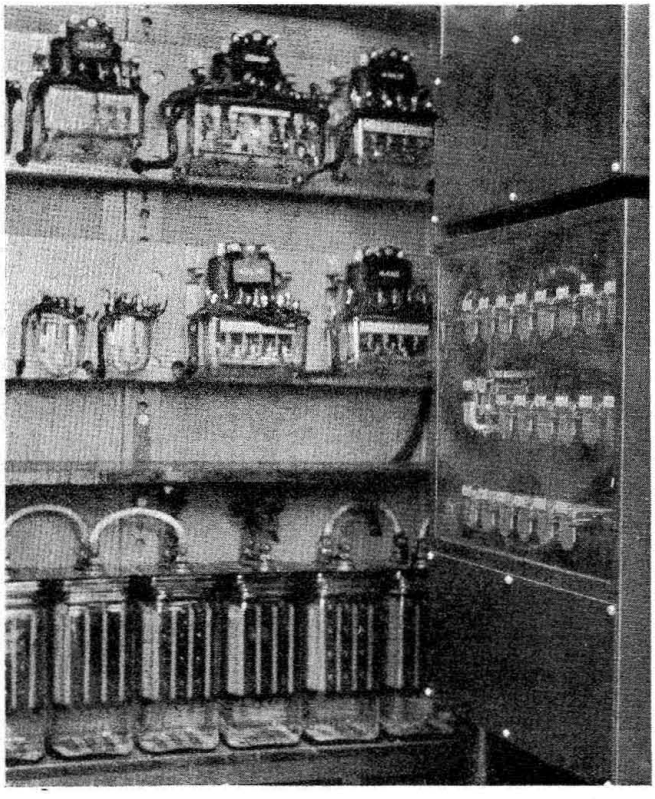
In consideration of the fact that equipment may be dragging on a car near the rear of a train, the detectors are located a sufficient distance from the bridge so that if a detector is operated by defective equipment on any car, the engineman receiving a change in signal aspects would have adequate time and space to stop before the defective part of the train reaches the switch or the bridge. The freight trains of maximum length include 125 cars, and, therefore, eastward detectors are located 9,505 ft. west of the eastward home signals, and the westward detectors are 9,635 ft. east of the westward signal.

Special Detector Signal Aspects

The Missouri Pacific does not approve of a practice which might cause the aspect of a signal to be changed from Clear to Stop in the face of an approaching engineman. To do so, might result in the engineman using the emergency application of the brakes, which, in the case of a freight train, might result in an accident. In order to obviate such a circumstance, the Missouri Pacific uses an additional signal unit and a special aspect to indicate that a dragging-equipment detector has operated. The addition consists of a single lamp unit, similar to that used as half of a highway crossing signal. This unit is mounted below and slightly to the left of the other signal units on the home signal mast. The electric lamp in the special unit is normally extinguished.

If a home signal is displaying the Proceed aspect for an approaching train, and a detector is operated by defective equipment on that train, the aspect of the home signal is changed from "Proceed" to "Restricted Speed," and also the special unit at the lower left is operated to display a flashing red light. This complete aspect indicates to the engineman that no change has been made in the position of the switches and that no conflicting train has fouled the established route, but that the only change is the operation of a dragging equipment detector. With this knowledge, the engineman brings his train to a stop as quickly as practicable, consistent with safe handling, knowing full well that the route and length of unoccupied track ahead is available. If the filament in the lamp of the extra unit fails, red lights are displayed in the remaining units.

The major items of signaling equipment for this installation were furnished by the General Railway Signal Company, and the dragging equipment detectors were furnished by the Western Railroad Supply Company. The construction was handled by the Missouri Pacific signal forces, supervised by L. S. Werthmuller, assistant signal engineer, and R. M. Spillman, signal foreman, under the direction of P. M. Gault, signal engineer.



Interior view of a steel instrument house showing relays, batteries and code equipment