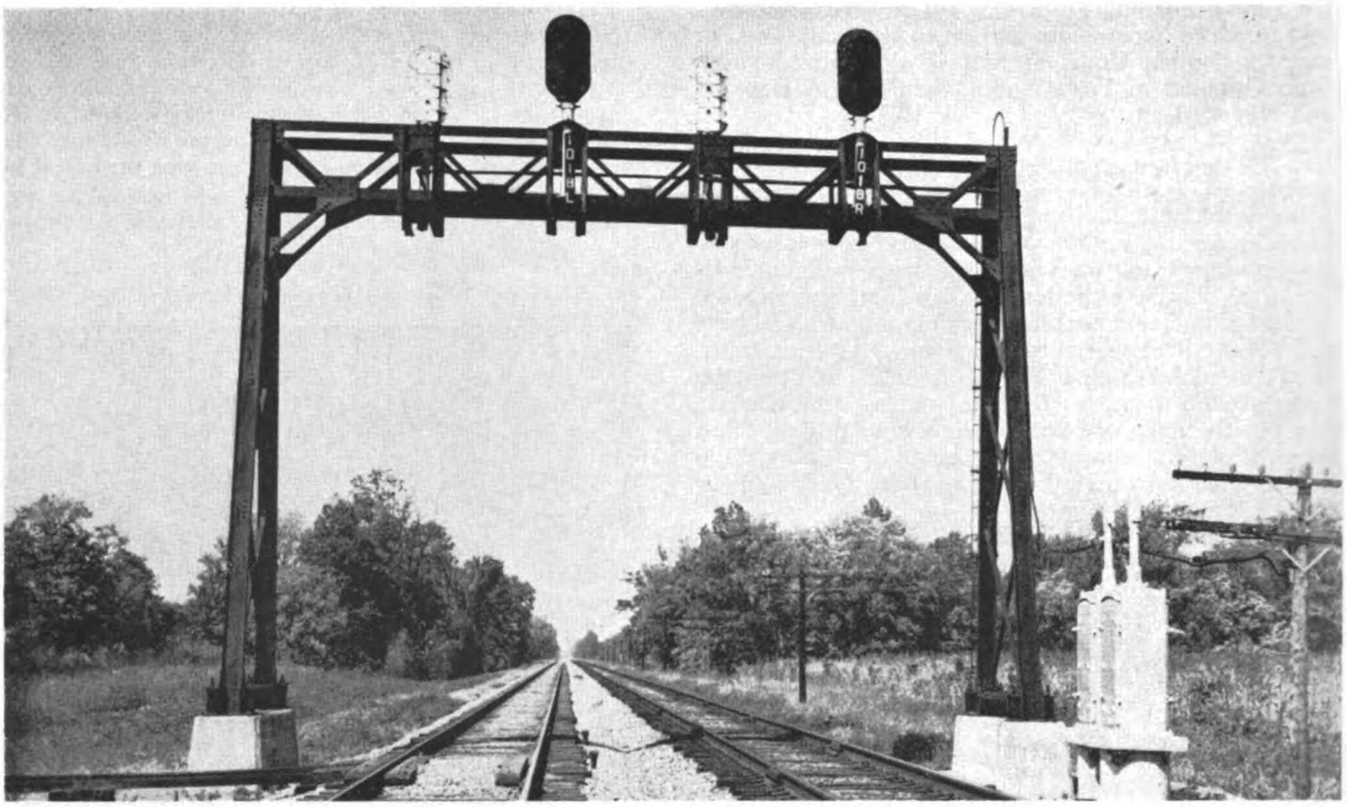


Double-track CTC includes signaling for either-direction running on both tracks

CTC Increases Capacity of Double Track

Missouri Pacific project includes double crossover layouts, spaced about six to eight miles apart, and both tracks are signaled in both directions, so faster trains run around slower ones, thus neither encounters delay on sidings

AS A MEANS of increasing track capacity and improving the flexibility of train operations, on two sections of double track, the Missouri Pacific has installed centralized traffic control on 38 mi. between Raddle, Ill., and Gale. This is part of the Missouri Pacific's low grade Illinois division from East St. Louis southward along the east side of the Mississippi River to a bridge across the river at Thebes, and thence on the St. Louis Southwestern to Dexter Jct., Mo., and Paragould, Ark., to connect with MP routes to Memphis, New Orleans, Little Rock, Texarkana and points in Texas. The MP uses this Illinois division for freight trains only. The passenger trains, and a limited amount of merchandise freight originating in or destined to St. Louis, being handled between St. Louis and Poplar Bluff on the Iron Mountain line, which is shorter but includes heavy grades and curvature. The St. Louis Southwestern operates its freight trains and one passenger train in each direction over the MP Illinois Division between East St. Louis and Thebes. From the west end of the bridge over the Mississippi at Thebes, the St. L-SW has its own line southwest through Pine Bluff, Paragould, and Texarkana, to Dallas, Tyler and other points in Texas.

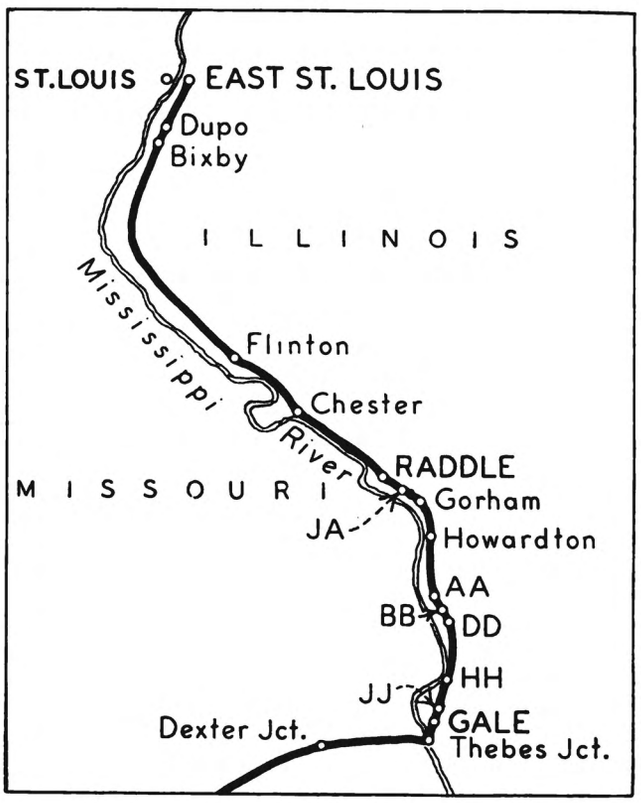
The 117.5 mi. of the Illinois division between East St. Louis (Valley Junction) and Gale, is double track except for two single track sections. On 27 mi. of single track between Flinton and Raddle, extensive line changes are underway to place the tracks above previous highwater. On 4.5 mi. of single track between AA Junction and BB Junction, the railroad crosses the Big Muddy river on a single-track bridge, which is being raised in connection with government levee projects to place the track above previous high water level.

Signaling Program Past and Present

Years ago, no track circuit signaling was in service on this Illinois division. Switches at crossovers and sidings were operated by conventional hand-throw stands, and train movements were authorized by time-

table and train orders, with right-hand running on double track.

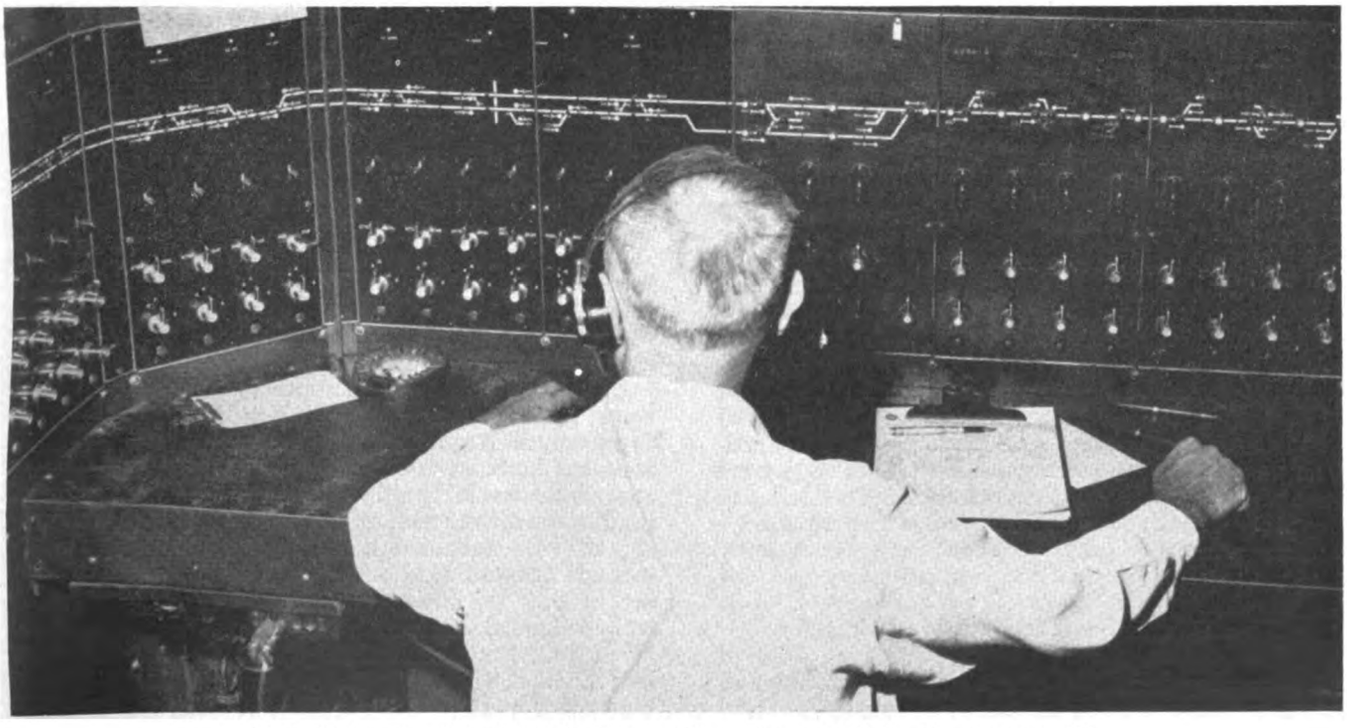
In 1926, automatic block signals were installed on a 4.5-mi. stretch of single track between "AA" and "BB" approximately 90 mi. south of East St. Louis. The switch at end of double track at "BB," as well as the switch entering a center siding between main tracks, were controlled by a mechanical interlocking. The switch at "AA" was remotely controlled from the tower at "BB." In 1929, automatic block signals for right hand running were installed on 8 mi. of double track between East St. Louis (Valley Junction) and Bixby. In 1938, centralized traffic control was installed on 27.2 mi. of single track and 2 mi. of double track between Flinton and Raddle. In 1946, centralized traffic control was installed for train movements in both directions on each of two main tracks between North Dupo and East St. Louis (Valley Junction), a distance of 4.3 mi. In 1950, automatic block signals for right hand running were installed on 39 mi. of double track between Bixby and Flinton. This left 37 mi. south from Raddle to Gale, on which there was no signaling, train movements being authorized by time table and train orders.



Volume of Traffic

On this Illinois division the MP has six scheduled through red ball freight trains southbound daily, and five northbound. Also a local freight is operated each way daily, except Sunday. The St. L-SW has three scheduled through red ball freights southbound daily, and two northbound. Also the St. L-SW has a through passenger train each way daily. Extra trains are operated to haul coal and as second sections of scheduled trains, so that the total number of trains daily may range from 40 to 48 trains during seasons of normal traffic.

The preponderance of traffic is southbound out of East St. Louis between 11:50 a.m. and midnight, and northbound, toward East St. Louis, between 10 p.m. and noon. Furthermore, the St. L-SW passenger train goes south out of St. Louis at 9:02 p.m., and northward, arrives in St. Louis at 7:10 a.m. Although the scheduled red ball freight trains, for the same direction, are timed for departure an hour or more apart, the spacing between trains of the same direction may vary as they proceed, and is further complicated by extra trains and the passenger trains. Therefore, in numerous instances, the dispatcher would encounter a situation in which long sections of the northward main track, for example, would be idle, but congestion and



Controls for the 37-mi. Raddle-Gale section were added to the present CTC control machine at Chester. New controls and panel are at the operator's left

The gage plates on two ties extend under and are attached to the switch machine

delay resulted because all southbound trains could not be handled promptly on the southbound main track.

Studies of train sheets showed that, in numerous instances, fast scheduled freight trains would overtake slower heavy-tonnage trains, such as coal trains, and both such trains would be delayed when getting the faster train around. A conclusion, therefore, was to install a pair of crossovers at each of several locations, about 6 mi. to 8 mi. apart, and to install CTC control for these crossovers, as well as signals to authorize train movements in both directions on each of the two main tracks, just the same as two single-track main lines, side by side. With this arrangement, during the period each day when the preponderance of traffic is one way or the other, a faster train can be diverted to the idle second main track to run around a slower train, or the slower train can be diverted to the second track, while faster one goes around.

Increased Average Train Speed

Thus, in each such instance, both trains are kept moving at practically normal speed, rather than one train losing 15 min. to 45 min., entering, leaving and waiting on, a siding. Since this project was placed in service, R. W. Parker, division superintendent, states that such operation is reducing train hours daily, not only by making run-around moves, but also it expedites train movements by eliminating numerous train stops and delays because train moves are now authorized by signal indication. The track-occupancy indication lamps, on the control machine, show the location of, and progress being made by every train, so that the power switches and CTC signals can be controlled to keep trains moving. A further important factor is that the signaling protection has improved safety of train operation, so that, logically, the maximum permissible train speeds are to be increased from 50 m.p.h. to 55 m.p.h. for freight trains. This 5 m.p.h. increase is important on this division, where the grades and curvature are easy, so that trains consistently maintain maximum speed for long distances.

Thus Further Time Savings are Realized

A secondary benefit is the increased utilization of expensive power track maintenance machines and crews. By means of the new C.T.C. system, all trains can be handled on one track between two crossover layouts for an entire eight-hour period. This leaves the other track available for the exclusive use of the track maintenance machines. The saving is appreciable. Thus, as expressed by Mr. Parker, the superintendent, everybody concerned is well pleased with the new C.T.C. between Raddle and Gale.

New Track Layouts

The layout at Raddle, including the junction of single track, from the north, to double track to the south was included in the C.T.C., in service since 1938. In the 1953 project, the first layout of two crossovers between main tracks is at "JA," which is 5 mi. south of Raddle.

At Gorham, 5 mi. south of "JA," a branch line of the Illinois Central crosses the MP. This crossing was previously protected by an automatic interlocking. In the new C.T.C. system, the interlocking home signals, on both roads, normally indicate Stop. When an IC train approaches, the home signal for this train will clear. However, when a train approaches on the MP, its home signal will not clear until the man at the C.T.C. control machine sends out a control to clear it. The advantage of lever control for the MP signals, is that these signals can thus be used to hold trains, if necessary to do so. This layout at Gorham also includes C.T.C. controlled power switch machines on MP crossover and the switches at both ends of an MP siding. Gorham is also a junction of the East-west subdivision, which serves numerous coal fields in the territory.

As part of the new project, a pair of power crossovers, with signals, all controlled by C.T.C., was installed at "CC," which is 3 mi. south of Gorham crossing. At Howardton, 3 mi. south of "CC," the double track, from the north, connects with the single track to the south. A power switch and C.T.C. signals were installed here. At "BB," 4.5 mi. south of Howardton, the single track, from the north, connects with the double track to the south. A power switch and C.T.C. signals were installed here. From BB, double track extends 22.5 mi. on south to Gale. As part of the project, a pair of power crossovers, with C.T.C. controlled signals, was installed at each of three locations; (1) at DD, 3 mi. south of BB; (2) at HH, 10 mi. south of DD; and (3) at JJ, 7.5 mi. south of DD. The JJ layout is 2 mi. north of the office at Gale. All this new C.T.C. from Raddle South to Gale, is controlled from an office at Chester, new machine sections being added

to the previous machine which controlled the C.T.C. between Flinton and Raddle, installed in 1938.

Signals and Signal Aspects

Between the power switch layouts, intermediate signals are spaced approximately 2 mi. apart, plus or minus, as necessary to make the automatic blocks about the same length. These signals serve also as approach signals for the home signals at the crossovers and ends of double track.

All main track signals are high signals mounted either on masts or on overhead bridges. The home signals are the type G, with the three color units in a triangle arrangement, with a circular background 30 in. in diameter. Thus, these home signals are distinctly different from the intermediate signals which are the Type D, with the color units in a vertical row, and with an oblong background. For further distinction, the home signals have an "A" marker to designate them as absolute signals, and they have number plates. The intermediate signals also have number plates.

The new crossovers between main tracks are No. 16, good for 30 m.p.h. for a diverging move. When lined for such a diverging move, the home signal displays green-under-red aspect,. and the signal in approach displays flashing-yellow aspect. Thus, an engineman has advance information that he can bring his train up to and through the crossover at the speed for which it was designed, i.e., 30 m.p.h. This saves train time, as compared with only a steady yellow aspect on the approach signal, which would require an engineman to reduce speed, prepared to stop at the home signal.

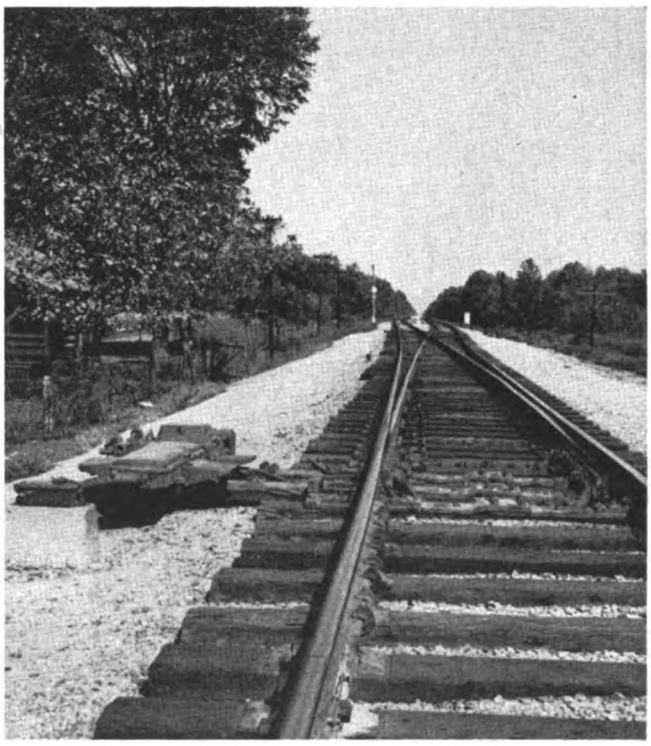
Where single track leads to double track at Howardton, for example, there is a No. 20 equilateral turnout, so that half the divergency is each way. This reduces the curvature, so that freight trains can make such diverging moves at normal speeds up to 50 m.p.h. Accordingly, for a move through Howardton, with two or more blocks ahead clear, the home signal aspect is the high green, the same as for straight track.

Ordinarily the C.T.C. controlled signals at the crossovers and ends of double track are controlled so that, after one train accepts and passes a signal, the signal goes to Stop, and will not clear again for a second train, until the leverman operates the lever again. It several trains are following one another in a "fleet," the leverman can establish "fleet" control, so that the corresponding signal will clear automatically for a second train. This special control is set up by "keying" the signal lever. This keying is done by bypassing the signal start button through the key switch and signal lever contacts with the "OS" track indication relay down, thus sending a signal control to position the field code relays so the signal will clear for the following move when the first train clears the block. Track circuit controlled approach locking is in service on this project, so that if a train has not entered the locking section in approach to the signal which has been cleared for it, the signal can be taken away, and route changed without waiting for a time release. This approach locking requires more line wire circuits than ordinary time locking but the approach locking gives the C.T.C. leverman more flexibility to change line ups and thereby save train stops and delays.

For the Raddle to Gale Section, the C.T.C. line coding is done by the GRS Type K equipment, on a two-wire line circuit. At the Chester office, this line circuit is fed at 50-volts, from a set of 25 cells of Exide 8-a.h. storage battery.

Each local signal line control circuit has two wires

Runarounds can be made on idle second track to save time

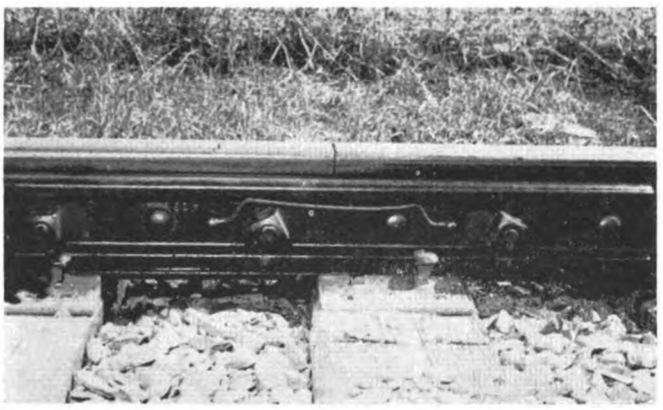


No. 20 equilateral turnouts used at ends of double track

that control biased neutral line relays. The track relays are the conventional d.c. type, using 2-ohm relays. Each track circuit is fed by one cell of Exide, 60-a.h. storage battery. The relays on line circuits that check occupancy of several track sections of control of approach locking and track-occupancy indication, are the retained neutral type, so that they will not release during a pole change of the line circuit.

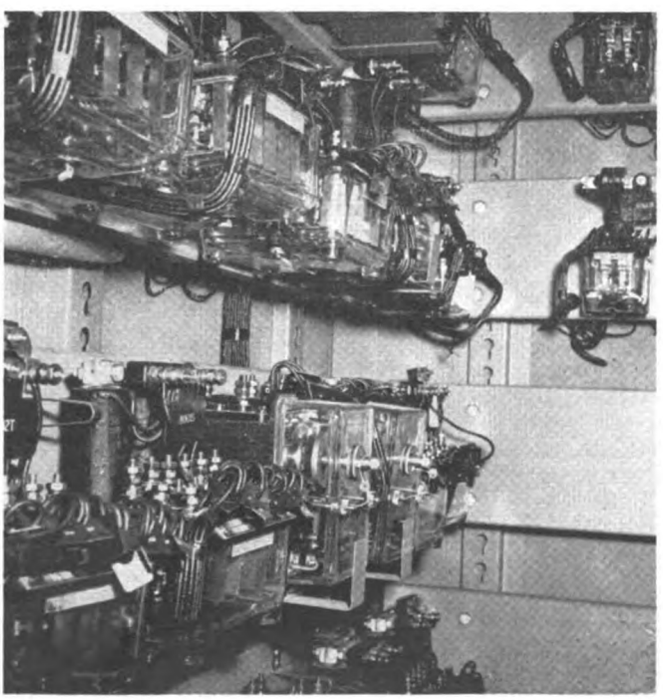
Before the C.T.C. program was started, the Western Union pole line was rebuilt throughout this entire territory, using about 90 per cent new poles. This rebuilt pole line carries the communications wires and also the signaling wires. The C.T.C. code is on two No. 6 weatherproof copper line wires, and the 550-volt a.c. power distribution circuit is on a pair of the same kind of wires. The local signal line circuits are on No. 10 weatherproof Copperweld wires.

The power switch machines are the Model 5D, with dual control, and equipped with point detectors. Two



Short bonds are driven through hole in angle bar into rail

Storage batteries feed switch machines and track circuits



biased neutral relays (rather than one polar relay) is used for the control of each switch, and the switch controller is enclosed in the machine case. Each switch layout is constructed with 1-in. by 9-in. insulated gage plates on 4 ties, including the No. 0 tie. Rail braces are used on these ties. Also on the No. 0 tie, rail braces are used on the gage side of the rail to prevent "rolling" of the rail. The gage plates on two ties extend under, and are attached to the switch machine, thereby maintaining exact position of the machine and rail. Tie straps, bolted to the ends of ties, assist in maintaining the relative position of 11 ties in a No. 20 turnout. AGRS roller bearing is used in place of one switch rod in each power switch layout. Also two Ramapo Ajax, vertical type rods are used in each switch.

At each power switch layout there is a set of 12 cells of 60-a.h. Exide storage battery which feeds the switch motor and also local code equipment. For each signal there is a set of 5 cells of the same type. As a means of reducing the chances for crosses in circuits extending underground from instrument housings to signals and switch machines, each wire is run as a single conductor, No. 9 cable. Buried cables run to each switch machine. The two power wires for each switch machine are single-conductor No. 6 underground cable. The same type of cable is used for runs to rail connection bootlegs. This cable is manufactured according to Signal Section Specifications No. 161-50.

Specially-Designed Bootlegs

The bootleg outlets are of a type designed for the Missouri Pacific and made by the Western Railroad Supply Company. Each bootleg consists of a cast iron box on a pipe riser with a cast iron flare base. The cable is brought up through the riser, which is equipped with a clamp to hold the cable. The strand is brought into the box through a sleeve which is threaded to hold it in place with insulation in the hole through the side of the box. The parkway cable is soldered to the $\frac{3}{16}$-in. rope strand connector which extends to a plug in the web of the rail. The bootleg for both rails is on the field side of the track, about 6 in. from the end of the ties so as to minimize interference with track work. The strands extend from the box through staples on the side and 2 in. from the top edge of the ties. The connectors are Tiger-weld Type S-8 stud end bonds, having $\frac{3}{16}$-in. rope strand. The same strand is used for switch shunt connections.

A picture herewith shows the special Missouri Pacific type of angle bars and short bonds used on rail joints. During manufacture, the two extra $\frac{15}{16}$ by 1-¼ in. oblong holes are punched through the angle bars. Holes ⅜-in. in diameter are drilled through the web of the rail in the area of the holes through the angle bar. Pin type bonds, 14 in. long, are then applied by driving the pins in the holes in the web of the rail. By thus shortening the bond, broken rail protection is improved as compared with pin type bonds applied in the web of the rail beyond the ends of the angle bar. A second objective of the design of these bonds is to minimize damage to bonds caused by dragging equipment.

This C.T.C. was planned and installed by Missouri Pacific forces, under the direction of the signal engineer. R. M. Spillman, assistant signal engineer was in charge of field construction forces. The major items of signal equipment on this project were furnished by the General Railway Signal Company.