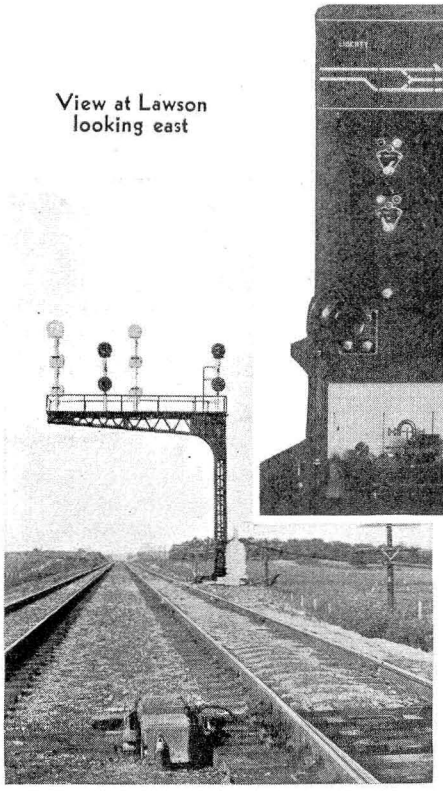
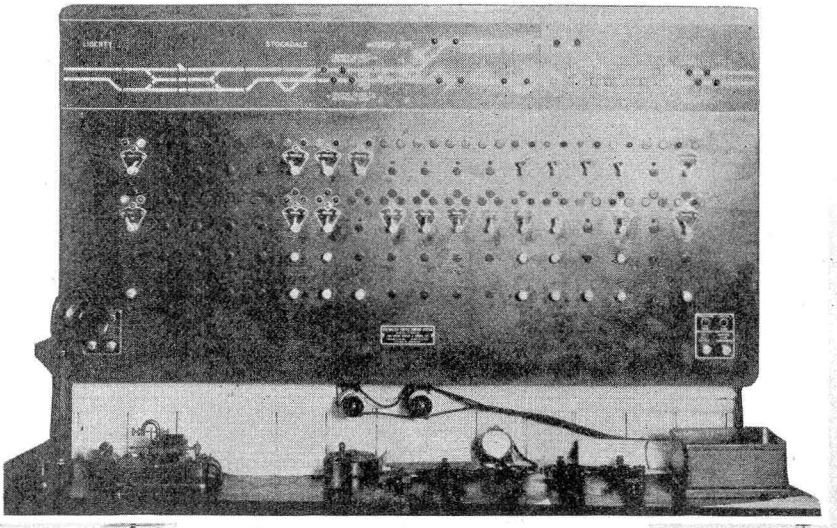
Railway Signaling

Signaling the New Kansas City Line of the Rock Island-Milwaukee

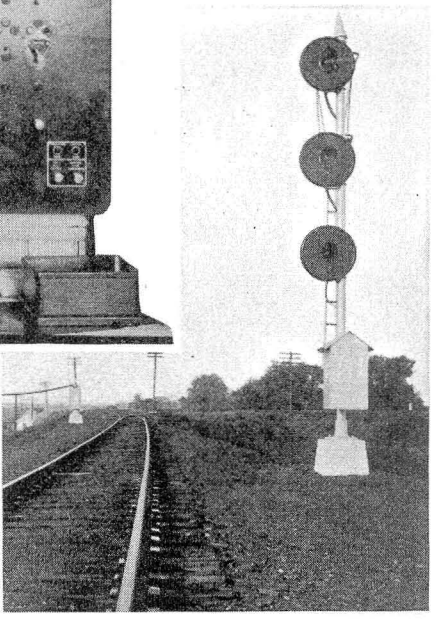
View at Lawson looking east





The centralized control machine

Home signal on the Milwaukee at Moseby



Centralized traffic control, all-relay interlocking, and single and double-track signaling involved

THE signaling is one of the most interesting features of the new line recently constructed jointly by the Chicago, Milwaukee, St. Paul & Pacific and the Chicago, Rock Island & Pacific between Polo, Mo., and Birmingham on the routes of these roads between Chicago and Kansas City.

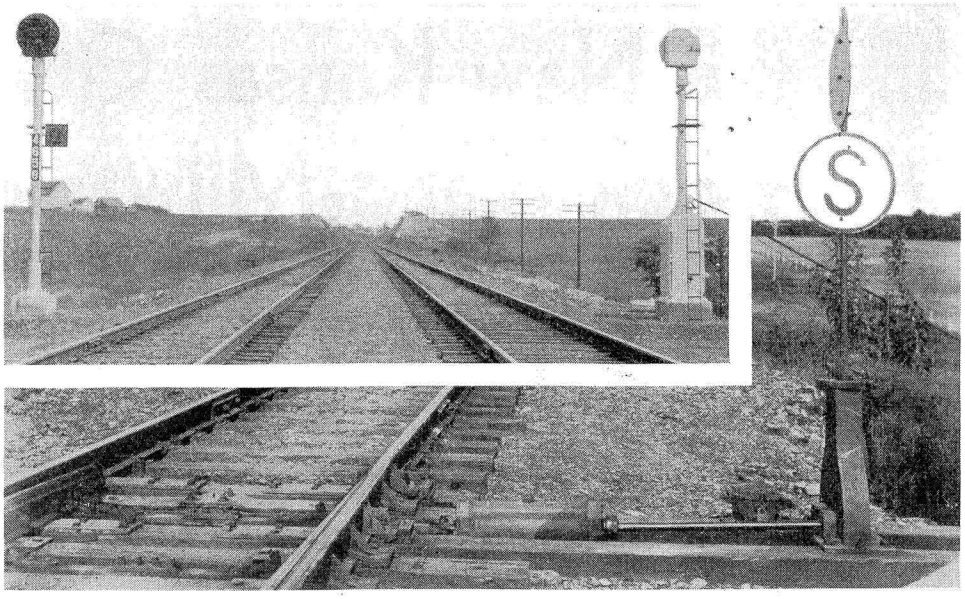
Formerly the Rock Island operated on its own line from Trenton, Mo., to Cameron Junction from which point trains were run over the Chicago, Burlington & Quincy between there and Kansas City. The grades and curvature on the Trenton-Cameron Junction section were excessive. Surveys showed that it was practicable to construct a new low-grade line between Trenton and Kansas City, and it so happened that it was possible to locate the proposed line in the vicinity of an existing section of the Milwaukee's main line between Polo and Birmingham, 36 miles. In this district the grades on the Milwaukee line were not satisfactory and, therefore, the two roads co-operated in a construction program that results in a double-track section for the use of both roads. The Rock Island constructed 40 miles of line from Trenton to Polo. As the Milwaukee single-track line from Polo to Lawson junction, 12.7 miles, was one of excessive grades and curvature, most of this line was abandoned, and the Rock Island constructed a new double-track line in this territory. Between Lawson and Moseby the grades on the existing Milwaukee line were favorable for westward movements. This line was, therefore, retained, but the Rock Island constructed 12 miles of new low-grade single-track line on a different route between these points, for eastward movements, the lines being about 4 mi. apart at Excelsior Springs. From Moseby to Birmingham, 13.5 mi., the Milwaukee constructed a new double-track line, abandoning all of its original track between these points.

By the construction of the new line between Trenton and Birmingham, the Rock Island has eliminated 8.6 mi. of distance and substituted a ruling grade of 0.5 per cent for a maximum gradient of 1.4 in both directions. There is 47.3 miles of double track on the new line as compared with none on the old. The tonnage rating on the new line, for modern freight locomotives now used in this territory, is 5,000 tons, as compared with a rating of 2,250 on the old line.

In order to take advantage of the favorable westbound grades on the original main line between Lawson and Moseby, it was decided to use this as a westbound track for all trains and, therefore, trains are operated on the

left-hand track on the double-track sections. However, all passenger trains in both directions are routed via the old line between Lawson and Moseby so as to serve Excelsior Springs, the new line being about four miles from this station.

to Birmingham, the automatic block signaling being so arranged. However, absolute signals for directing train movements into the several blocks are provided for either-direction operation on either track but no intermediate automatics other than distant signals are pro-



Above—Automatic signals on Rock Island double track
Below—Spring switch layout on Rock Island

Traffic on the Milwaukee in this territory includes two passenger and from six to eight freight trains each way daily, while that on the Rock Island includes five passenger and about five freight trains each way daily. In other words, the total number of train movements is about 34, including 14 passenger and 22 freight trains. As the local freight and passenger trains are all routed over the single track via Excelsior Springs, this means that about 25 train movements are being made daily over this section of track.

The interlocking facilities, to meet the requirements of the train operation, include three interlocking layouts at the junctions, Moseby, Lawson and Polo. At Birmingham the junction switches were included in an existing interlocking. The interlockings at Moseby and Lawson are of the all-electric type, the control being included in a centralized traffic control machine located in the office at Excelsior Springs, this machine also including the control of signals for the direction of train movements on the entire territory between Polo and Birmingham. The interlocking at Polo is, likewise, electric, but is controlled by the all-relay system from a machine of the centralized type located in the Polo telegraph office. Traffic direction locking is used for the direction of train movements on the double-track sections between Polo and Lawson, and between Moseby and Birmingham, levers for this locking being included in the control machine at Excelsior Springs, as well as in the interlocking machines at Polo and Birmingham. As previously explained, trains run on the left-hand track on the double-track sections from Lawson to Polo and from Moseby

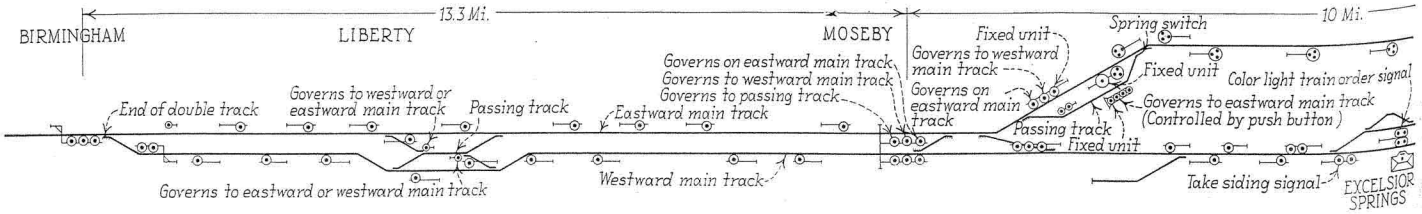
vided for right-hand running. Single-track automatic signaling was installed on both of the two separate lines between Lawson and Moseby.

The Centralized Traffic Control

The centralized traffic control used on this installation is the Union Switch & Signal Company's two-wire time-code system. The control machine, located at Excelsior Springs, includes 7 switch levers, 9 signal levers and 4 traffic-lock levers. For the Moseby layout there are three switch levers, one for each of the two crossovers and one for the switch at the west end of the passing track, and only two signal levers each of which operates to the left or right to control the respective eastbound or westbound signals, the routes being selected through the switches, etc. For the Lawson layout the control machine includes a switch lever for each of the two crossovers and a lever for the east end of each of the two passing tracks. Three signal levers are for the control of the several signals included in this Lawson layout. The switches for the passing track at Excelsior are of the hand-thrown type but signals are provided for directing train movements including take-siding signals, the four signal levers near the center of the machine being for the control of these signals.

The Milwaukee Construction

Each road installed the signal and interlocking facilities on the sections of line constructed by the respective road, i. e., the Milwaukee installed the interlocking fa-



Track and signal plan of the

cilities at Moseby, the control machine at Excelsior, the single-track signaling from Lawson to Moseby via Excelsior Springs and the signaling on the double track from Moseby to Birmingham. All of the signaling equipment used on the Milwaukee sections of this new installation was furnished by the Union Switch & Signal Company and was installed by the Milwaukee signal department forces under the jurisdiction of L. B. Porter, signal engineer, J. Ellefson being inspector in direct charge.

Automatic Signaling

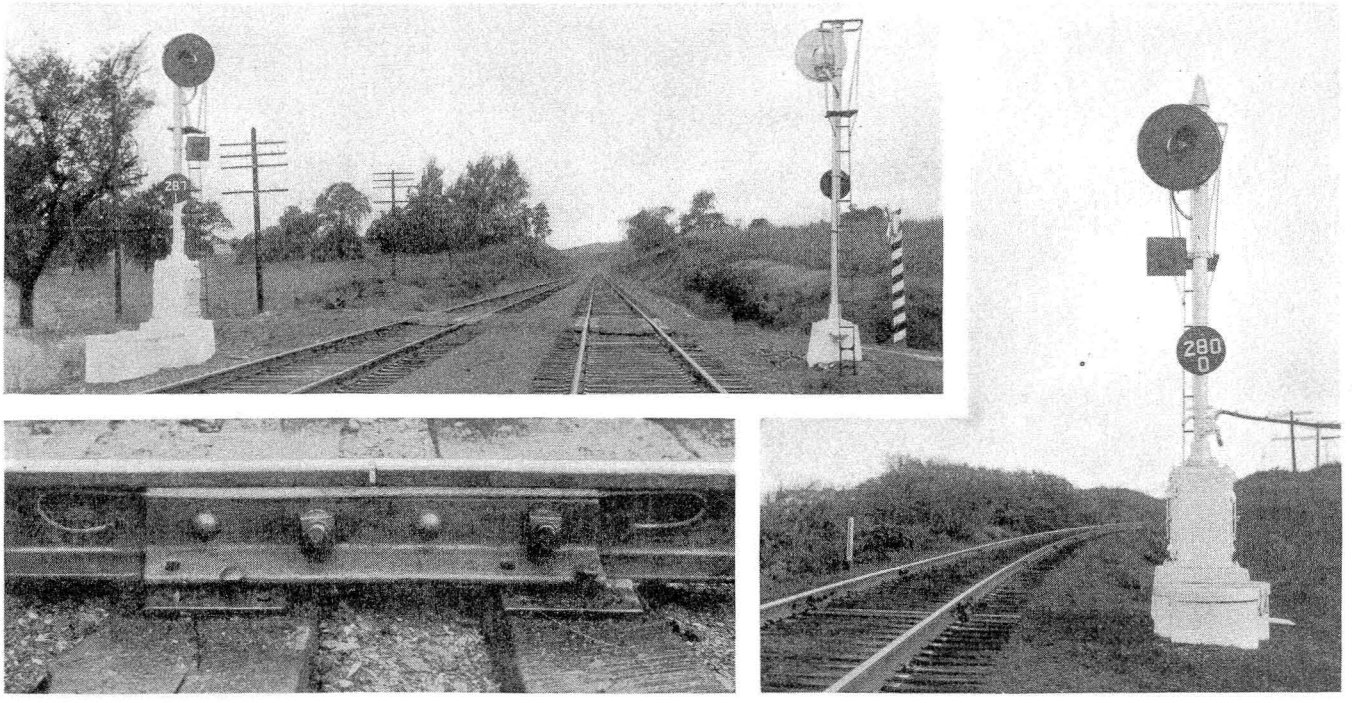
The signals are the searchlight type. Regular absolute-permissive-block control circuits were utilized on the single track, while polar line control circuits were used on the double-track section. The automatic "stop and proceed" signals have only the one signal unit and are further distinguished by a large cast-iron number plate. Where a signal is located on a grade of 0.5 per cent, a large "grade signal" sign is attached to the mast. This sign is 16 in. by 16 in. with a yellow background including a black letter "G" studded with 1-in. reflector buttons. These signs were furnished by the Louisville Frog, Switch & Signal Company, according to Milwaukee signal department standards.

The power supply is the a-c. primary system, with the 220-volt 60-cycle power-line circuit, using No. 6 copper line wire. The territory is cut into four feed sections averaging five miles each, with feeds at Liberty, Moseby, Excelsior Springs and Lawson. With this arrangement the 220-volt line circuit need not be continuous throughout, as a gap the length of one two-track circuit is left between the ends of the feed.

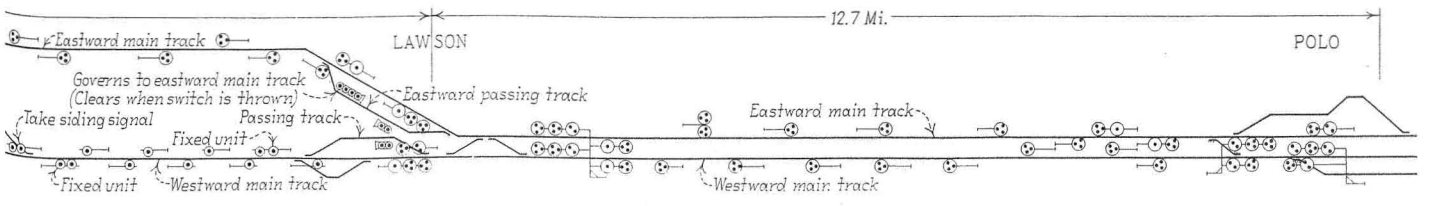
The 220-volt line taps are taken directly from the pole line to arresters in the instrument case and then through 5 amp. fuses to the rectifier transformer. Since the primaries of the WT-10 Union rectifier-transformers are wound for 220 volts, no line transformers are required.

Model-13 2-ohm relays were used on the track circuits, which are fed by 3 cells of Edison 500-a.h. primary battery with an RT5 rectifier, connected across the battery, so adjusted as to carry practically all of the load except when the a-c. power may be cut off in an emergency. The adjustment is such that the primary battery normally discharges at about 12 m.a. The line control relays are Model DN-11 250-ohm slow-release. Each signal line-control battery consists of 16 cells of Edison primary battery which is likewise connected to an RT rectifier and so adjusted that the battery discharges normally at about 4 m.a. This battery also serves as a standby source of energy for the signal lamp which is rated at 13 watts 8 volts. The battery is housed in small circular concrete tubs located adjacent to the signal foundations, parkway cable with No. 9 conductors being used for the runs to these batteries.

The single-conductor insulated wires coming in from the line in cable are terminated on crystal-valve arresters or porcelain-base terminals on the rear wall of the relay case. All the ground rods are Copperweld ½ in. by 8 ft. Flexible insulated wire is used for jumpers to the relays, No. 16 being used for the control circuits and No. 12 for battery feed circuits. The runs from arresters to



Scenes on the Milwaukee—Above, Double track location—Left, Copperweld bond, and—Right, Automatic signal with grade sign



centralized control territory

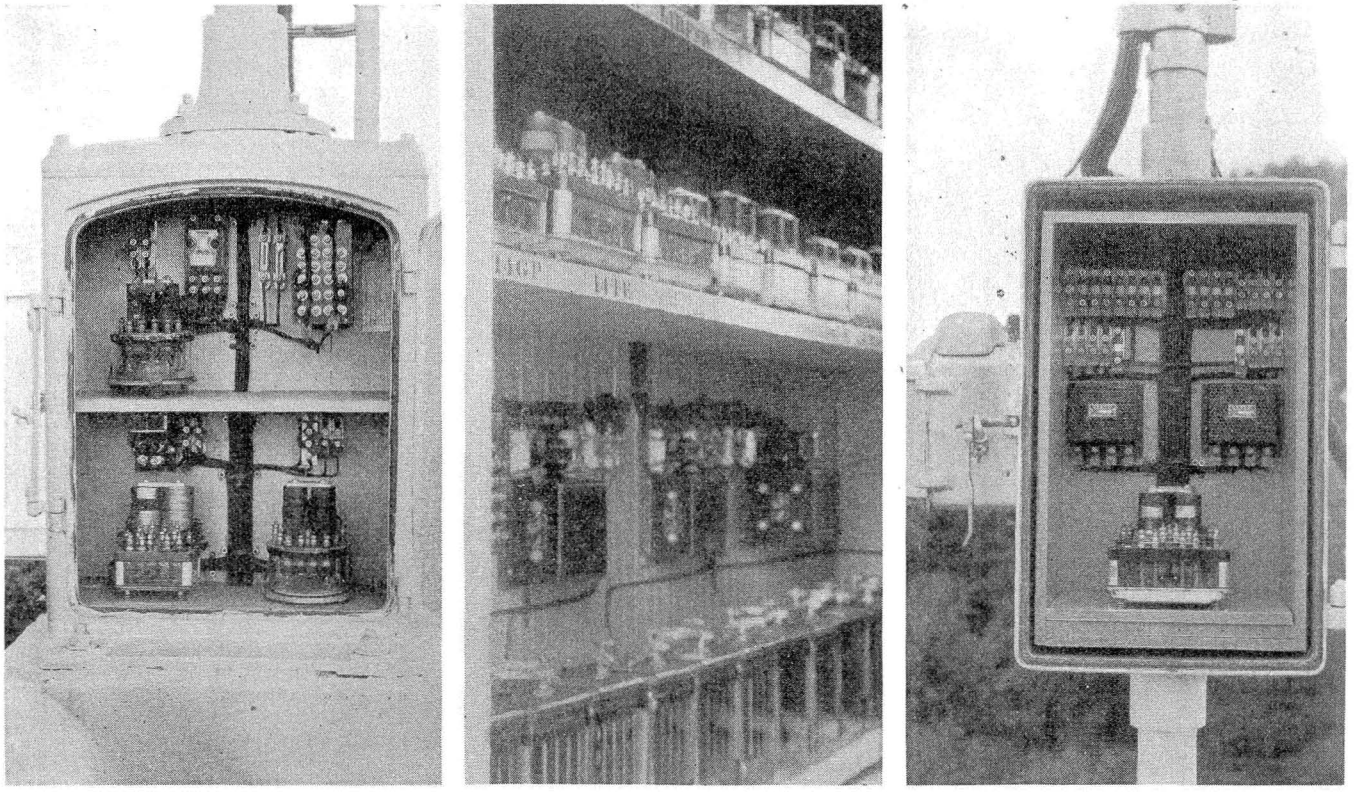
terminals on different shelves are solid insulated wires and these wires, together with wires extending to the line cable or track connections are arranged in a neat straight-lay cable held in place against the rear board of the case by straps. The cables from the signal cases to the line are No. 14 single-conductor, the messenger being No. 9 Copperweld, using Raco cable straps. For runs under the track to the opposite signal, parkway cable is used with five No. 14 conductors for controls and three No. 9 conductors for the battery feed to the lamp. These cables terminate in cast-iron terminal boxes mounted on the signal foundation, No. 14 single-conductor insulated wire being extended up the signal mast to the signal itself. These junction boxes are made of the cases of old-style worn-out switch circuit controllers from which the cranks, cams, etc., have been removed.

The track circuit connections are run from the relay cases to the rail in single-conductor No. 9 parkway cable. At the rail this cable is brought up through an 18-in. riser of Carey Elastite trunking. The parkway conductor is joined to two No. 9 solid insulated wires which are each run to a Saco-Utica terminal bonded one into each side of the rail. The joint is pushed back into the trunking riser which is then poured full of asphaltum.

The switch circuit controllers are the Union Model U-10, the shunt connections being No. 9 single-conductor parkway which is run along the side of the tie and connected to the rail with rail connectors. Two wires extend to each rail. The line circuits breaking through the box are run from the nearest signal or cable post in parkway cable. All insulated wire and cables used on the Milwaukee's part of these installations were furnished by Kerite.

Each rail joint is bonded with a Copperweld stranded bond with 3/8-in. plugs, the bond being so shaped as to lie in place along the upper edge of the angle-iron on the outside of the rail. All the signals, masts, relay cases, switch boxes, etc., were painted with Du Pont Dulux aluminum paint.

Throughout the territory the Western Union built a new pole line, using creosoted pine poles. A 10-pin cross-arm for signal line wires is spaced 30 in. below the top arm. The line wires for the control circuits are No. 10, and the 220-volt a-c. line feed is No. 6 copper, all line wires being protected with weather-proof covering. Porcelain line insulators are used. All the concrete foundations for signals, signal bridges, etc., were poured in place by Milwaukee signal forces using a mixer on a flat car in a work train. On high fills, piles were driven for these foundations to prevent settling.



Typical views of cases and instrument house on the Milwaukee construction

The Centralized Control System

In general, the construction explained above, with reference to the automatic signaling, applied also to the centralized traffic control layout installed by the Milwaukee. However, certain details of power supply and construction were different, described as follows:

The absolute signals for directing train movements each have two signal units and are further distinguished by the absence of a number plate. At Moseby the code receiving apparatus, relays, rectifiers, power batteries, etc., are located in a frame building set on a concrete foundation and covered with sheet iron so as to be protected against fire from an outside source. The battery and coding instruments are located on the bottom shelf, the rectifiers are wall-mounted and the relays with springs under each corner are placed on wooden shelves above.

A battery of 13 Exide DMGO-9 cells, located in this house, is provided for the operation of the five switch machines in this Moseby layout. Four cells of the same type of storage are provided for feeding the line control circuits, etc. Likewise, a set of four cells is located at each signal for line circuits and for signal operation in case of an emergency outage of the normal a-c. power.

The incoming line control circuits all terminate in the

instrument house on Crystal-Valve arresters or porcelain terminals mounted on the rear wall of each shelf above the relays. The jumper wires from these arresters or terminals to the relay are No. 14 flexible and No. 14 solid insulated wire is used for the runs between the terminals or arresters on different shelves, these wires being assembled in straight-lay cables held in place against the wall with pieces of raw hide.

From the instrument bouse the circuits are distributed over the plant in aerial cables made up of single-conductor insulated wires suspended from 3/8-in. stranded Copperweld messenger, using Raco cable straps. On the signal bridge, the wires are run in conduit up to the base of the masts. The runs to the switch machines are in parkway cable which is brought up through a small concrete foundation to a Union cast-iron junction box and from terminals in this box single-conductor insulated wires extend through flexible metal conduit to the switch machine. The switch machines are the Union Style M-22 equipped for dual control. The front rods are the Union Type-6 and the adjusters on the head rods are Bossert type. The lock rods are adjusted to 3/16-in. clearance and in addition the switch detector is adjusted to 3/16-in. opening.

The Rock Island Construction

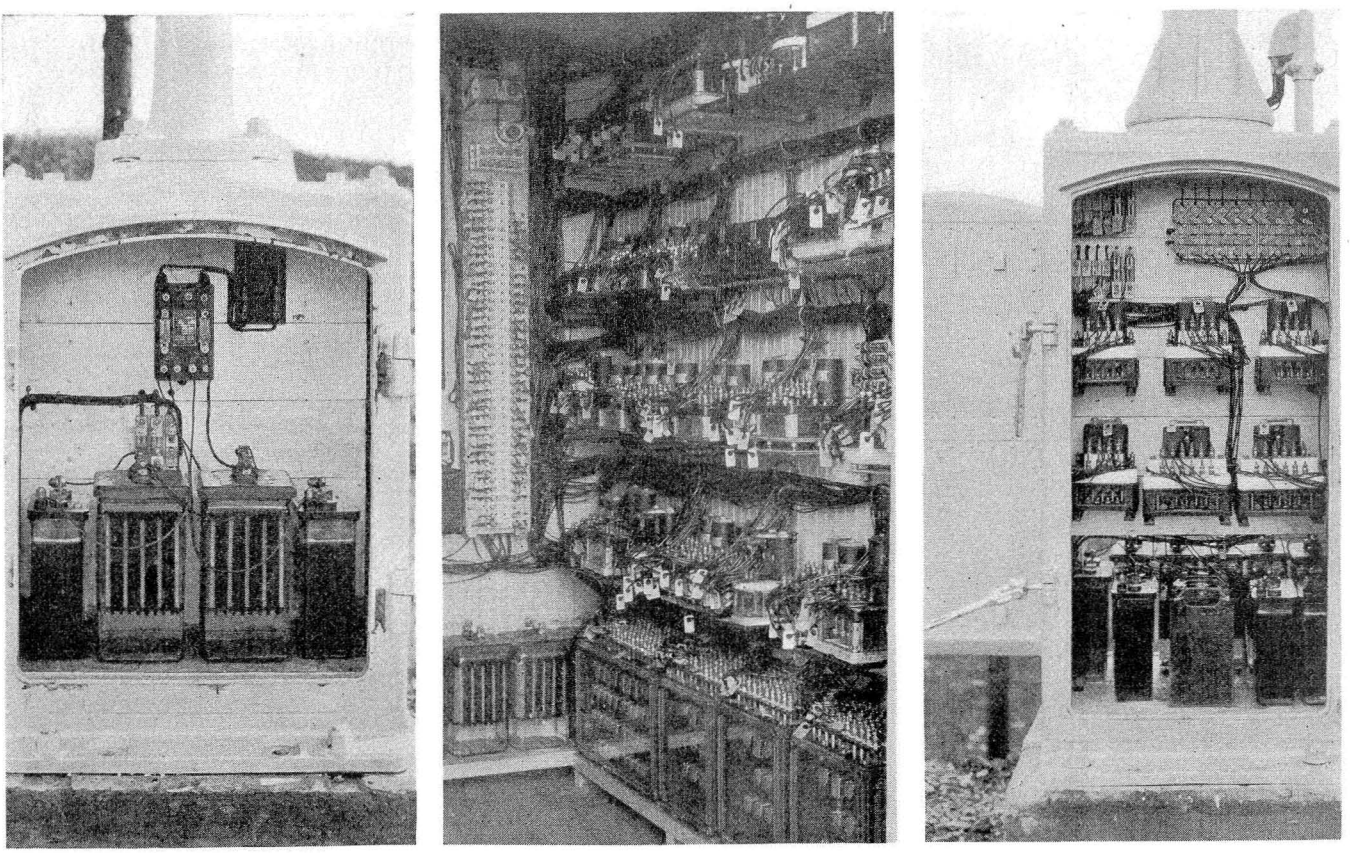
The signal department forces of the Rock Island installed the automatic block signaling on the double track between Polo and Lawson and on the new single-track line between Lawson and Moseby, as well as the interlocking equipment at Lawson including the switch machines, signals and attendant local control facilities which in turn are remotely controlled from the centralized machine at Excelsior Springs as previously mentioned. The all-relay interlocking at Polo, which was also constructed by Rock Island forces, will be described in a later article.

The Rock Island Automatic Signaling

The signals, relays, switch boxes, etc., on the Rock Island sections of this installation were furnished by the Railroad Supply Company and installed by Rock Island signal department forces under the jurisdiction of Leroy Wyant, signal engineer, E. L. Bartholomew being the field engineer in direct charge of the construction.

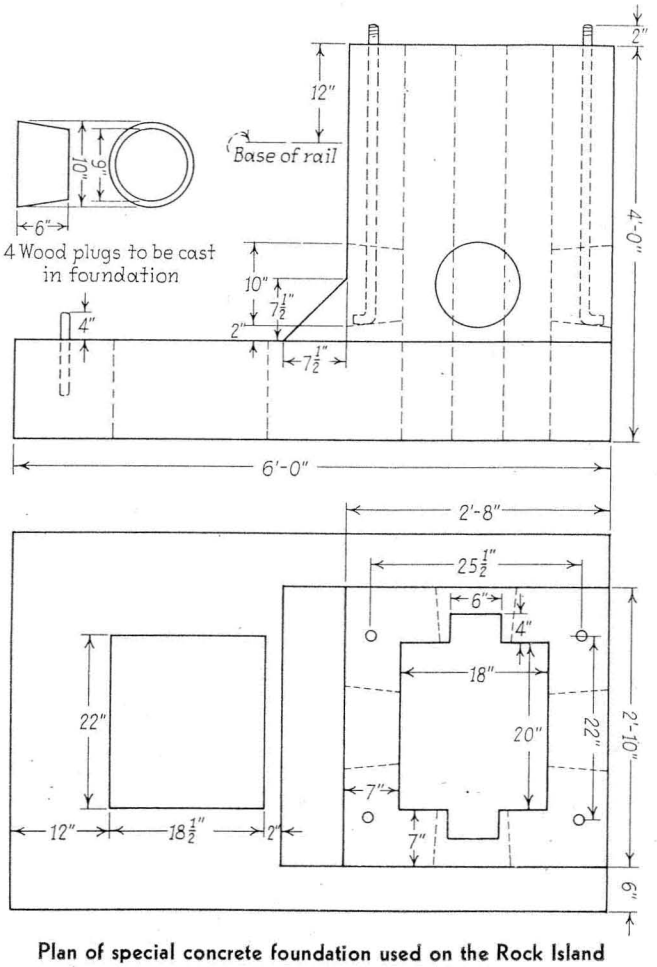
The signals are of the three-lens triangular type, using 10 and 18-watt 10-volt lamps, the 18-watt lamps being used on curves and signal bridges. A feature of special interest is the use of spring switches on the passing tracks at Moseby and Polo, the Pettibone-Mullikan Mechanical Switchman type of machines being used. Eastbound train movements from this passing track are governed by a dwarf signal normally indicating red. When an eastbound train on this siding is ready to leave, the engineman or conductor must call the operator in charge of the centralized control machine at Excelsior Springs to obtain instructions. If there are no westbound trains in the Lawson-to-Moseby zone, and the Lawson levers for westbound movements via this line are normal, the engineman or conductor is instructed to press a push button located in a box on the side of the signal. The pressing of this button will break down the westbound controls, after which the eastbound signal and the siding dwarf signal will clear, if the block is clear.

The power supply is arranged on the a-c. floating system. The 550-volt 60-cycle line feed is carried on two No. 6 copper wires with weather-proof insulation on porcelain insulators. General Electric Type-TC air-cooled 575-115-volt distribution transformers are mounted on the crossarm and are protected by two G.E. compression-chamber type arresters, and the feed circuit to



Interior views of cases and instrument house on the Rock Island territory

the primary is broken through porcelain plug-type fused cut-outs. The line transformers are of several different capacities ranging from 75 v.a. to 500 v.a., depending on the load at the respective location. The 115-volt a-c. circuit is extended from the line transformer to the relay case where a double-pole knife-switch with cartridge fuses is connected into the circuit feeding the rectifier-light transformer. Balkite rectifiers are used for charging all the automatic signal and track circuit batteries. Each signal battery consists of a battery of five Exide DMGO-7 cells. About half the storage batteries used on track circuits are Exide DMGO-9 and the remainder are Edison Type BH4. The storage battery is housed in the lower part of the instrument case, this compartment being open from front to back, the case having a door on both the track and field sides. Above the battery section, a wooden partition extends to the top of the case, the relays being located on the track side and the rectifier transformers, etc., on the field side. The wires of the line cable terminate on R.R.S. three-way arresters mounted at the top of the board. Wall-mounted brackets are used for the relays, a coil spring supporting each corner of the relay. The jumpers are made of No. 16 Pullman special flexible wire, run directly from arrester or terminal to relay terminal. Porcelain enameled insulated bridle rings, screwed into the partition, are used to hold these jumpers in place. The track relays are Style-R 4-ohm and the polar line relays are Style-S2 500-ohm.



Plan of special concrete foundation used on the Rock Island

The cables from the line to the relay cases are made up of No. 14 single-conductors with 3/64-in. insulation except for the 115-volt a-c. circuit which is No. 9 with 5/64-in. insulation. The messenger is No. 8 Copperweld wire using ties made of scrap pieces of No. 14 insulated wire. The circuits extending under the track to the signal on the opposite side are in six-conductor No. 14 cable with a lead protection and two wraps of steel tape. Each insulated conductor is covered with braid. The track connections from the relay case to the rail are single-conductor No. 9 parkway with two wraps of steel tape but no lead. No braid is used on these conductors. At the rail, the parkway cable is brought up through a riser made of second-hand boiler flues or two-inch pipe and is joined to a piece of No. 6 Copperweld bond wire which is bonded into the rail. The joint is pushed back into the riser which is then filled with asphaltum. Each rail joint is bonded with two No. 8 galvanized iron bond wires using single 9/32-in. channel pins, the bonds being placed behind the angle bars. The insulated wire and parkway cable were purchased according to Rock Island specifications.

The Centralized Control

The same type of construction, as explained with reference to the automatic signals, was used also for the interlocking facilities at Lawson, constructed by the Rock Island. The switch machines are the Union Switch & Signal Company Style-M22 equipped for dual control, and the relays used for the code control of switches and signals were furnished by the same company.

The relays, code equipment units, rectifiers, batteries, etc., are housed in a frame structure located near the center of the layout. The controls of all the signals and switches of the entire plant, together with the control of the signals for directing train movements out of the plant into the several blocks, are all concentrated in this house, where their controls in turn are connected into the code instruments controlled by the Union two-wire time code system controlled by the centralized machine at Excelsior Springs.

In the Lawson instrument house the main battery and coding instruments are located on a shelf near the floor. Wall brackets are used to support the relays which are each supported by a coil spring at each corner. The wires coming into the house all terminate on arresters or terminals mounted in vertical rows on the wall at each side of the window at the rear of the house. Pullman special, No. 16 and No. 12 flexible wire is used for all jumpers from arresters to relay terminals or between the terminals of various instruments. These jumpers are held in place by porcelain-insulated bridle rings screwed into the wall. Every wire is tagged at every terminal.

The main battery for operation of the switches consists of 16 Exide DMGO-9 cells, which is on a-c. floating charge from Union RT rectifiers, mounted on the rear wall. The circuits are distributed from the instrument house over the layout in aerial cables made up of single-conductor insulated wires. The messenger is 3/8-in. stranded Copperweld, using Copperweld Blackburn cable rings spaced 18 in. apart. The wire for the control circuits is No. 14 with 3/16 in. rubber with braid; that for the switch operating circuits is No. 4. The runs to the switch machines are in parkway cable which is brought up out of the ground on a slant to the switch machine to prevent wire breaking due to vibration of the machine. Greenfield flexible duct is used to protect the cable from a point below the ground line to the machine. On the signal bridges the wires are in parkway cable run directly to the signal heads.

(Continued on page 387)

far as track circuit operation is concerned. The results are based on the actual power consumption with the track circuit unoccupied, and an allowance of 20 per cent is made for losses in the transformer, rectifier and line. The readings are given on a watt and dollar basis in an accompanying table.

From the above it is plainly seen that the current cost for a track circuit equipped with Z.M.A. treated ties is much less than for one equipped with zinc chloride treated ties, when compared in the same territory and under the same ballast and climatic conditions. This differential in costs would be the same for either primary or storage battery installations, except that the cost of maintaining primary batteries would be approximately 20 per cent higher than for storage batteries.

As a means of further considerations, tables were prepared showing the current consumption for five of the Z.M.A. track circuits on which the current consumption was the greatest, as compared with the five track circuits on which zinc chloride treatment was used. And, conversely, the five Z.M.A. circuits with the least drain of current are compared with the same five zinc chloride circuits.

Table Showing Comparative Costs of Track Circuit Operation

Track Circuit	Treatment	Kind of Wood	Current from Battery	Watts Consumed	Cost Per Year for Current for Track Circuit
A	Z.M.A.	Oak	.280 Amp.	7.00	$3.68
B	Z.M.A.	Oak	.220 "	5.5	2.89
C	Z.M.A.	Gum	.290 "	7.25	3.81
D	Z.M.A.	Gum	.280 "	7.00	3.68
E	Z.M.A.	Gum	.200 "	5.00	2.62
F	Z.M.A.	Gum	.210 "	5.75	2.76
G	Z.M.A.	Pine	.230 "	5.75	3.02
H	Z.M.A.	Pine	.440 "	11.00	5.78
*I	Z.C.	Oak	.600 "	15.00	7.88
*J	Z.C.	Oak	.530 "	13.25	6.96
*K	Z.C.	Oak	.525 "	13.13	6.90
*L	Z.C.	Oak	.500 "	12.50	6.57
*M	Z.C.	Oak	.400 "	10.00	5.25

*These sections are track circuits with ties treated by the Card Process using zinc chloride and creosote oil. The ties were treated at the same time and installed at the same time as the Z.M.A. treated ties were.

Z.M.A. Circuits with the Greatest Drain

Track Circuit	Cost Per Year
A	$3.68
C	3.81
D	3.68
G	3.02
H	5.78
Cost per year	$19.97

Zinc Cloride Circuits

Track Circuit	Cost Per Year
I	$7.88
J	6.96
K	6.90
L	6.57
M	5.25
Cost per year	$33.56
Cost per year zinc cloride	$33.56
Cost per year Z.M.A.	19.97
Saving in favor of Z.M.A.	$13.59

Z.M.A. Circuits with Less Drain

Track Circuit	Cost Per Year
B	$2.89
D	3.68
E	2.62
F	2.76
G	3.02
Cost per year	$14.97
Cost per year zinc chloride	$33.56
Cost per year Z.M.A.	14.97
Saving in favor of Z.M.A.	$18.59

This test is being continued and will not be completed for a considerable time, as the preservative qualities of the Z.M.A. treatment have not as yet been fully determined. However from the view point of the signal engineer the test has progressed far enough to develop electrical and economic results that are favorable, as well as to prove that Z.M.A. is not corrosive or injurious to metal parts of signal fittings or track fittings, and that it is free from galvanic or electrolytic action.

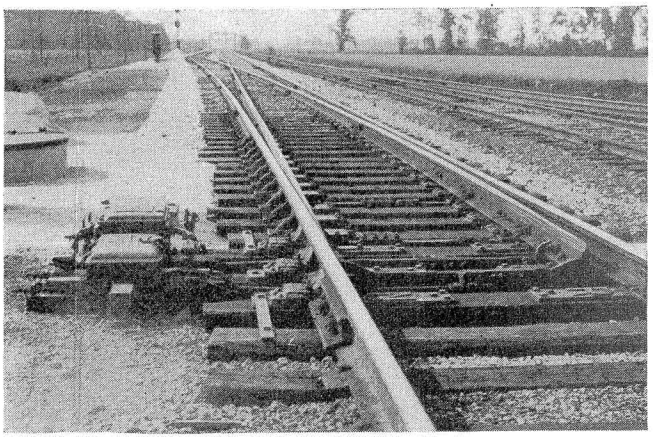
Signaling the New K. C. Line of Rock Island-Milwaukee

(Continued from page 370)

When constructing the new line, the grades were separated at most of the important highways. However, at the request of the Missouri Commission, the Rock Island installed automatic crossing signals at several highway crossings of secondary highways. These signals are the standard A.R.A. Signal Section flashing-light type, the vertical illuminated Stop sign being added at one crossing.

The concrete signal foundations were pre-cast, being made at a central point. These foundations are of Mr. Wyant's special design to meet the requirements brought about by the new fill conditions. It will be noted that the toe of the foundation extends toward the track and that there is an open space in the toe, as well as in the main section, which has a tendency to grip the dirt and prevent the foundation from sliding.

The signal cases were all wired at a central point. Five-foot cases were used at the signal locations, and three-foot cases at all cut sections. The foundations and cases were set in place by a work train using two ditcher machines, one handling the foundations and the other the cases.



Power operated switches eliminate train delays