

Southbound "Rocket" at Curtis junction

C.T.C. and Automatic

Color-light absolute permissive block automatics on 83 miles of single track, centralized traffic control on 8-mile zone between two junctions and 2 miles of manually-controlled signaling facilitate operation

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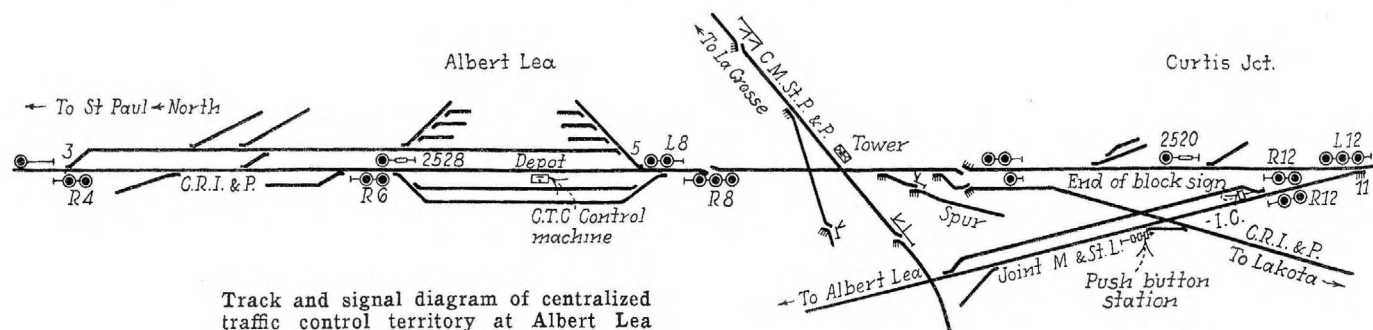
ANOTHER important step in the recent extensive signaling program of the Chicago, Rock Island & Pacific was completed on January 5, when a centralized traffic control installation was placed in service at Albert Lea, Minn.

As described on page 391 of the July, 1938, issue of *Railway Signaling*, the Rock Island, on June 30, 1938, completed the installation of color-light automatic signals on the 467 miles between Herington, Kan., and Tucumcari, N. M. This was a continuation of a large automatic signaling program which was initiated

Rapids division between Minneapolis, Minn., and Manly, the Minneapolis-Chicago and Minneapolis-Kansas City lines diverging to Chicago and Kansas City, respectively, at Manly.

Prior to the installation of the signaling, the train operation between Newport and Manly was handled by train order and manual block in accordance with standard rules, the block stations being approximately five miles apart. The delays caused by this method of operation and the addition of a "streamlined Rocket" passenger train, operated in each direction, were the main factors resulting

permissive-block territory, an unusual layout at Albert Lea required special attention. Within the eight-mile section in the vicinity of Albert Lea passenger station, the Rock Island's Cedar Rapids division from Minneapolis crosses the LaCrosse (Wis.)-Wessington Springs (S. D.) line of the Chicago, Milwaukee, St. Paul & Pacific; forms a junction (facing) with a Rock Island connection extending to Lakota, Iowa, and Sioux Falls, and Watertown, S. D.; forms a junction (trailing) with a jointly-operated Minneapolis & St. Louis and Illinois Central track extending from



Track and signal diagram of centralized traffic control territory at Albert Lea

by the installation, in 1937, of color-light signals on the 46-mile single-track section between Bureau, Ill., and Peoria, on the Chicago-Peoria line. As part of the same general program, work was started in May, 1938, on the application of color-light absolute permissive block signaling on the single-track line between Newport, Minn., and Manly, Iowa. This is a portion of the Rock Island's Cedar

in the authorization of the installation of signaling. The automatic signals were placed in service progressively, starting September 12.

Unusual Layout at Albert Lea

Although the installation of color-light automatics on the greater portion of the Manly-Newport section presented problems typical of absolute-

Albert Lea (M. & St. L. from Minneapolis); and forms a junction (facing) with the Waterloo (Iowa) line of the Illinois Central; from the latter point to Manly the Cedar Rapids division is operated jointly by the Rock Island and the Minneapolis & St. Louis.

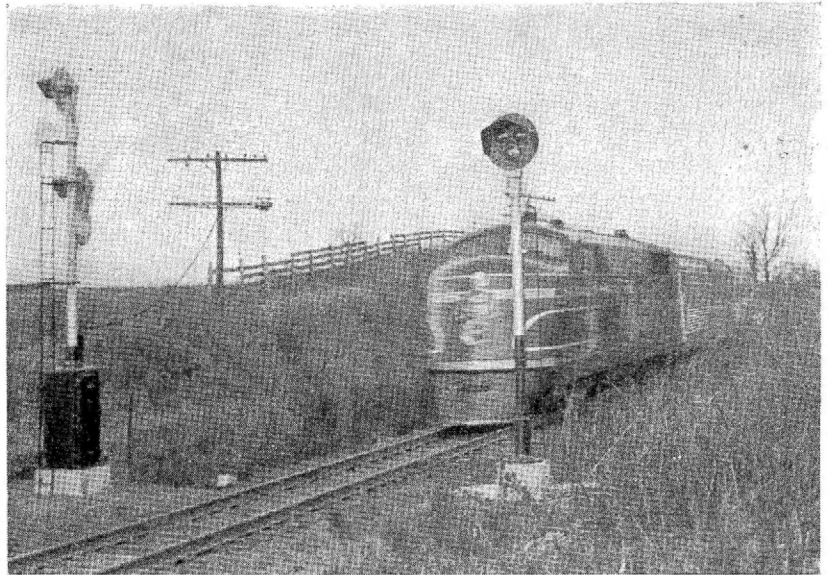
The operation of trains in the Albert Lea area had been handled previously by two mechanical plants, one

Signals

on the Rock Island

at the Milwaukee crossing including control of the Lakota connection junction switch, and another at the junction of the joint M. & St. L.-I. C. track, the switch at the I. C. junction further south having been hand-operated by trainmen. In order to provide more flexible and faster operation, and in order to speed up train movements in keeping with the purposes of the automatic block system installed on either end of the layout, recourse was had to centralized traffic control. The necessity of providing time intervals between trains with manual block operation had several times previously resulted in excessive delays to trains of either one road or the other due to the bottleneck affect of the layout. Another factor in the picture was that the Illinois Central freight trains are all operated as extras and seldom arrived at the same time on successive days, making it difficult to plan regularly scheduled meets and passes. With the centralized traffic control system these delays could be eliminated since trains could be kept moving, spaced only braking distance apart.

The Chicago, Rock Island & Pacific north end freight terminal yard is located at Inver Grove, Minn., south



The signal heads were turned away from the track until placed in service.
Signal R4 at left.

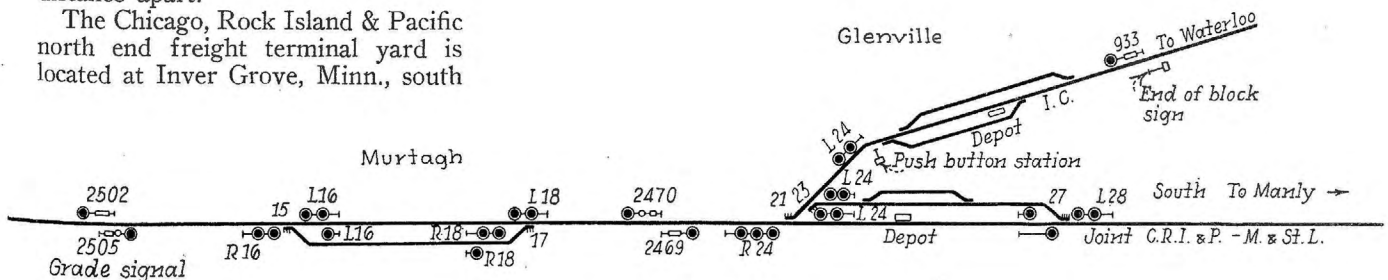
operators at Newport interlocking and the Rock Island station at Inver Grove.

Traffic

The traffic in the zone between Inver Grove and Curtis junction consists of two regular passenger trains, the "streamlined Rocket" and three scheduled freight trains each way daily or a total of 12 trains. In the zone between Curtis junction and Glenville, the traffic is increased by one passenger train and one freight train each way daily operated by the Minneapolis & St. Louis, and by four freight trains operated by the Illinois Central each way daily, giving a total of 24 trains. The Albert Lea-Manly

Company two-wire time-code centralized traffic control system was installed to control train movements by signal indication without time-table superiority or train orders in the section between signal R4 on the north end and signal L28 on the south end. The miniature-lever type machine, with 8 levers for the control of signals and 8 switch levers, was placed in the ticket and block station office in the Albert Lea station building.

With the new layout, the I.C. junction and the Rock Island passing siding on the south end were completely protected with color-light home signals, while Union Style M-22 dual-control electric machines were installed in place of the hand-thrown switches previously in service. Both



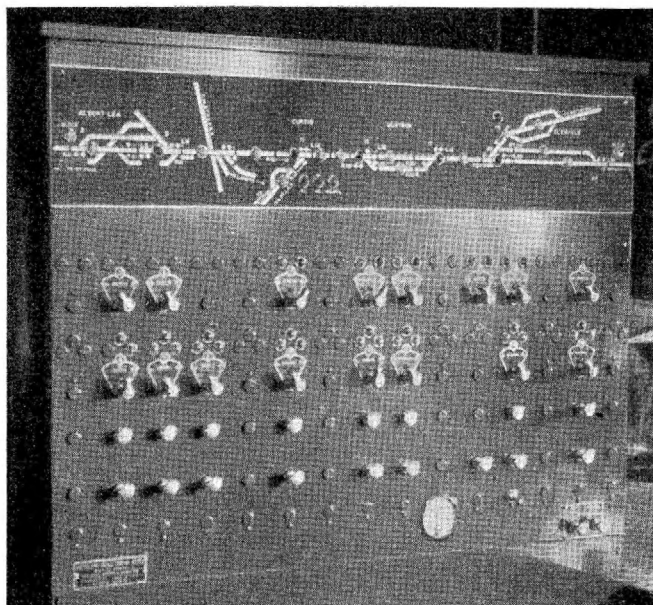
of Newport, and freight traffic is handled by transfer train crews from Inver Grove to the South St. Paul freight yard. To facilitate the handling of the numerous transfer train movements, on the single track between Inver Grove and Newport, where the Rock Island connects with the double track jointly-operated line of the Chicago, Burlington & Quincy and the Chicago, Milwaukee, St. Paul & Pacific, it was necessary to control the signaling manually. Train operation by signal indication in this two-mile zone is under the control of the

traffic consists of a Rocket, two regular passenger, and three freight trains operated by the Rock Island, and one passenger and one freight operated by the Minneapolis & St. Louis, in each direction daily. Maximum speeds are 45 m.p.h. for freight, and 60 m.p.h. for regular passenger, the limit on the Rocket streamliners being 80 m.p.h.

C. T. C. Layout

The layout in the vicinity of Albert Lea is indicated in the accompanying diagram. A Union Switch & Signal

ends of the passing siding at Murtagh were equipped with dual-control M-22 switch machines and typical passing siding signal protection established. The mechanical plant previously used at the M. & St. L.-I. C. joint track junction switch location at Curtis was eliminated and all functions placed under the control of the Albert Lea centralized traffic control operator, the junction switch being equipped with an M-22 movement, and all signals being color-light. The mechanical plant at the Milwaukee crossing was retained in service; how-



A track diagram, complete with indication lights, is above the control levers on the C.T.C. machine

ever, the Rock Island home signals, previously of the mechanical upper-quadrant semaphore type, were replaced with color-light units and provision was made in the control circuits to require co-operation between the Milwaukee crossing towerman and the Albert Lea C.T.C. operator before signal R8 could be cleared.

In laying out the zone to be controlled by C.T.C. for operation of trains by signal indication, it was necessary to extend the signaled zone from the north passing track switch at Albert Lea, about 4,000 ft. north of the station, to the south passing track switch at Glenville about 3,200 ft. south of the station, in order to dispense with operation by time-table rights or the necessity of train orders within this territory. Signals R4, R6, and L8 were installed, therefore, as home signals, and serve as a means of controlling trains within the Albert Lea station limits; these signals, and also signal R8, are controlled by direct wire because of their proximity to the control machine; the passing siding switches No. 3 and No. 5 are equipped with hand-throw switch stands which are operated by trainmen; the control of signals R4 and L8 is directly under the C.T.C. operator, the position of the switch in each respective instance determining the aspect actually displayed; all signals and power switches on the Rock Island south of signal R8 are controlled by code.

Signal Routing at Albert Lea

All of the new signals at Albert Lea are of the Union Style TP-5 type. The controls of signals R4 and L8 are arranged similarly so that a description of the control of R4 will be typical of both. Assume switch No. 3 to

be in the normal position on the ground. When the operator turns signal lever No. 4 to the right, with switch lever No. 3 in the normal position, signal R4 displays either a yellow or green light in the top unit, depending upon block occupancy ahead and the aspect displayed by signal R6. However, if the operator reverses switch lever No. 3 and turns signal lever No. 4 to the right, signal R4 will display an illuminated letter "S" in the lower unit; this authorizes the trainman of an approaching train to line switch No. 3 for a move into the siding.

The controls for the yellow aspect of the lower unit are controlled through the switch so that reversal of the switch causes the yellow lower unit aspect to be displayed and thus authorizes the train to proceed at slow speed. The lower unit yellow slow-speed aspect may also be displayed when lever 3 is normal and the block is occupied to advance a southward main-track movement.

The top unit of signal R6 authorizes southward main-track movements while the lower unit displaying yellow authorizes southward movement at slow speed. Intermediate station signals R6 and 2528 were installed to permit the advancement of a train on the main track to the station while another train at the opposite end of the yard is entering the passing track.

On signal R8, the top unit governs main-track movements toward Manly, the middle unit governs westward movement to Lakota, and the bottom unit authorizes southward movement to the spur track or main-track movement at slow speed. The C.T.C. operator was given joint control with the Milwaukee crossing towerman over signal R8, because certain of the

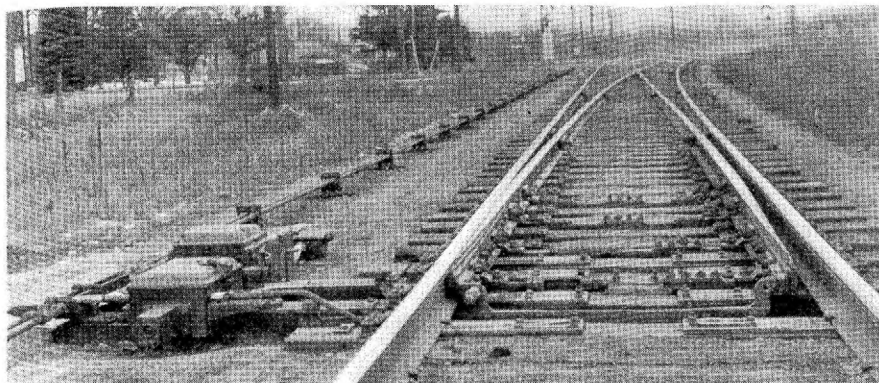
aspects govern train movements into the Curtis-Glenville section of the centralized traffic control territory. When lever 8 on the C.T.C. machine is operated to the right, a light is displayed on the track diagram at the Milwaukee crossing tower which indicates to the towerman that the C.T.C. operator has picked up a relay controlling the interlocking signal, R8, and that he is authorized to clear the signal by reversing interlocking signal lever 19. If the block is unoccupied, the top unit will clear. When the block is occupied, the lower, slow-speed signal unit will clear. However, the lower arm may be displayed for spur track movements by the Milwaukee crossing towerman merely by reversing mechanical lever 17. The middle unit of signal R8 is likewise controlled independently by the Milwaukee crossing towerman, except that he operates lever 18 for this purpose. The northward home signals at the Milwaukee crossing are controlled directly from the mechanical machine at the crossing by the Milwaukee towerman.

Joint Track Operation

The joint M. & St. L.-I. C. track from Albert Lea joins the Rock Island at the Curtis junction; this junction is protected by signals R12 and L12. Signal L12 authorizes northward Rock Island movements when the top unit is cleared; the middle unit authorizes northward Minneapolis & St. Louis or Illinois Central movements; the bottom unit is inoperative. There is considerable switching at Curtis on the M. & St. L.-I. C. track by Rock Island, M. & St. L., and I. C. switch engines or road crews; in order to facilitate



Typical automatic color-light signal



Junction switch at Curtis before removal of old pipe line

operation and to give the C.T.C. operator definite information relative to what railroad is occupying the approach section, a push button arrangement was installed near the entrance signal. The arrangement consists of three push buttons and three lights, one for each railroad, the operation, for instance, of the M. & St. L. button will cause a lamp marked M. & St. L. to be lighted on the C.T.C. machine; simultaneously a lamp at the push button will also be lighted, indicating that the request for permission to enter the C.T.C. zone has been displayed on the C.T.C. machine. The clearing of the signal will cause both of these lights to be extinguished.

The passing siding at Murtagh, equipped with power switches No. 15 and No. 17, is completely track circuited, giving track-occupancy indication on the C.T.C. control machine, and is protected by signals 16 and 18. The lower arm on either signal R16 or L18 authorizes movements to or from the siding.

At Glenville, the Illinois Central

diverges from the Rock Island, being operated under manual block to the south. The top unit of signal R24 authorizes Rock Island or Minneapolis & St. Louis southward main-track train movements; the middle unit authorizes the diverging Illinois Central train movements to the Illinois Central track; and the bottom unit authorizes Rock Island or M. & St. L. train movements to the siding—or, if a toggle switch is thrown by the operator on the C.T.C. machine, authorizes an I. C. train to proceed at slow speed onto the I. C. track; the latter indication is used only when the southbound I. C. train is to meet a northbound I. C. train at the I. C. passing siding or to close trains in on the I. C. tracks and free the Rock Island main line.

C. T. C. Construction Features

Four concrete houses, one at Curtis, two at Murtagh, and one at Glenville, house the outlying code, switch, and signal control apparatus. The code line and direct wire circuits extend from the station building in No. 10 weatherproof line wire. Lead-covered steel-armored cable was used for all underground local runs. The storage battery at each control house consists of 13 cells of Exide Type DMGO-7, 5 cells being used for control of relays and the lights at one signal, 8 cells for operation of code-controlled relays, and the entire 13 cells for switch machine operation, a 6-cell, 12-volt, Exide BTMP-3 battery being used for local operation of the control machine equipment. The central station batteries and the indicating relays are housed in two double cast-iron instrument cases sheltered behind the building, five 10-conductor No. 14 underground ar-

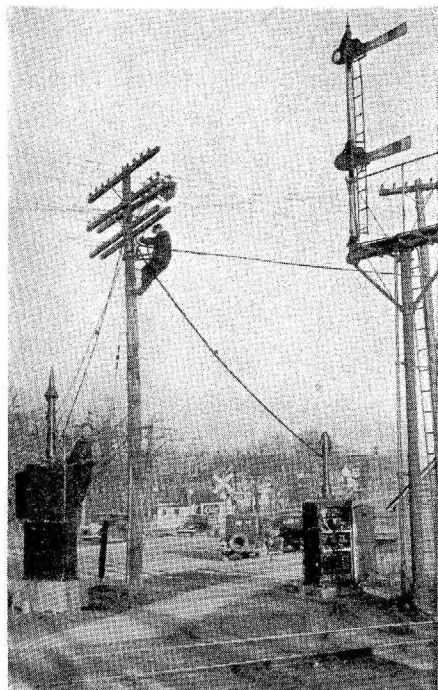
mored cable being run from this point under the station floor to the control machine.

Automatic Signal Program

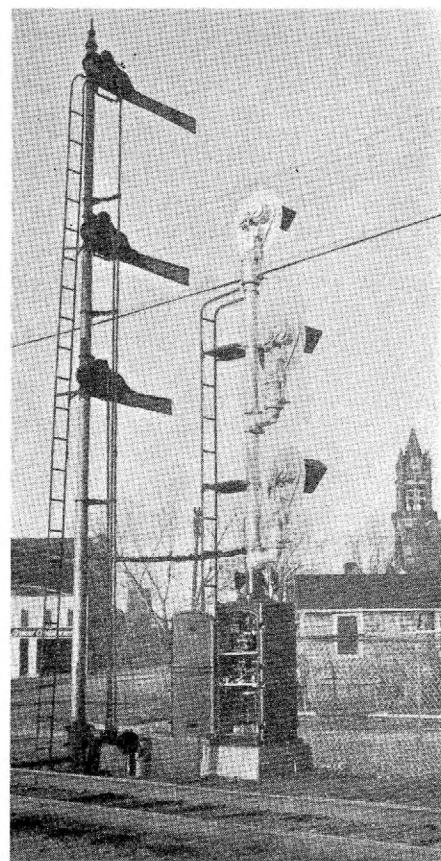
A total of 93 miles of single track was equipped with Union Style TP-5 color-light automatic signals, operated on the absolute permissive block system; the signals, spaced on the average of $2\frac{1}{2}$ miles, display either red, yellow, or green. The only interlocking involved, excluding the Albert Lea layout, was an automatic interlocking at a crossing with the Chicago Great Western at Fairbault, Minn., 46 miles south of Newport; this plant had previously been equipped with color-light signals. The signaling was tied into an existing interlocking at Newport as previously described.

A total of 13 passing sidings were involved in the automatic signaling. In planning the signaling, a double-signal location was placed at the end of each passing track. Where the passing tracks are from 5 to 7 miles apart, 2 single locations of intermediate signals are staggered about 6,500 ft. Where the distance is more than seven miles, two double locations of intermediate automatic block signals were used.

The control includes neutral track circuits and polarized line control circuits arranged to set the opposing signals at stop from head block to head block, and to permit signals to



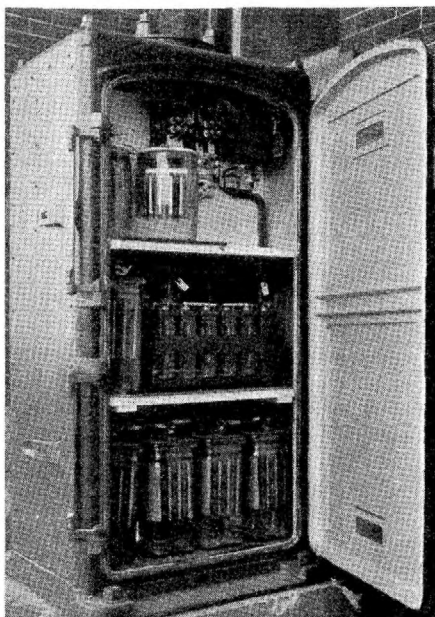
Left—P. E. Poulsen and A. C. Violanti (on pole) make a few line changes. Right—Color-light signal R8 and mechanical semaphore it replaced (before in-service date)



clear up behind a train for a following train movement. One line control wire in connection with the common line is used for each direction, thus making a total of three line control wires. The common is cut at one intermediate location between each set of sidings. The absolute head-block signals are so designated by the absence of a number plate, whereas each permissive signal is equipped with a number plate.

The leaving signals at each end of the station layouts are lighted continuously to provide an indication for trains on a siding when pulling out, and to give information to operators and to crews of trains on a passing track concerning the approach of trains. The lamps in the remainder of the signals are normally extinguished, being lighted by approach control. However, this control, as used on the Rock Island, has several special features. As a means of giving information as to the approach of trains for the benefit of maintainers, track forces and others on motor cars, the control is so arranged that when a train leaves a station, all of the signals for both directions are lighted throughout to the next station. In most instances, 10-volt, 10-watt lamps are used, but where the background interferes with the signal aspect, 10-volt, 18-watt lamps are used. The signals are mounted on pipe masts to bring the center of the red lamp 13 ft. above the level of the rail, so as to be approximately in line with the engineman in the cab of a locomotive.

The signal lamp is lighted for the red aspect by a circuit made when the local HP relay is down, which, of course, lights the lamp at all times when the control is set up for the red aspect. At a double signal location, the lamp is lighted, when either the yellow or green aspect is set up, by extending the lamp control circuit through a back contact of the home



Batteries in case at central station

relay for the signal governing movements in the opposite direction.

Five of the intermediate signals are so located that if a tonnage freight train stopped at such a location, there might be difficulty in starting. Each of these signals is equipped with a grade signal made according to A.A.R. drawing No. 1612A. The rules specify that if a grade signal indicates red, all trains can pass the signal without stopping, at restricted speed not exceeding 10 m.p.h. Grade signals are not provided on any signal opposing one that is so equipped.

Power Supply

Power is distributed over the territory at 550-volts, 60-cycle, single-phase, being carried on two No. 6 copper weatherproof wires on the field side of the pole line. Power is obtained from local power companies

at Inver Grove, Fairbault, Albert Lea, and Manly. An air-cooled line transformer 575/115 volts, rated at 100 v.a., is provided at each signal location, and a 20-v.a. transformer of the same type at each track-feed location. These transformers are protected by General Electric pellet-type arresters. The local transformers in the cases, when required, are of the W-10 type.

The battery at each signal location consists of five cells of Exide lead type on floating charge through a rectifier, EMGS-7 being used at station locations and the DMGO-7 at all intermediates except where common is cut.

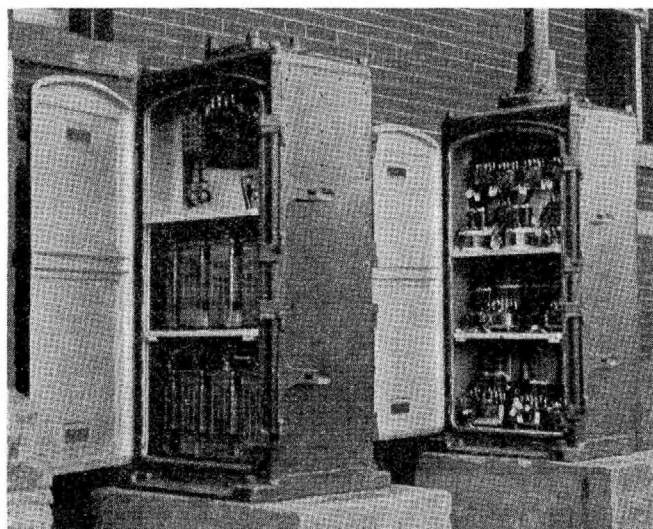
At each of the signals where one battery is used to feed the polarized line circuits in opposite directions, the common line wire from each direction is separated and the circuits are arranged through contacts of the pole-changing relay so as to permit the use of polarized circuits from one set of battery.

As mentioned previously, the lamps in the leaving signals are lighted continuously and at these signals the lamps are normally fed from the a-c. supply through the W-10 transformer, with a power-off relay used to transfer the lamp circuit to the battery in case of an a-c. power outage. At such locations, a set of EMGS-7 cells, rated at 120 a.h., was used. The power apparatus at such a location includes a W-10 transformer with two secondaries, one of which is controlled through a power-off relay for feeding the lamps, and the other secondary feeds an RX-21 rectifier for charging the batteries. At the intermediate locations, the lamp-feed circuits are connected directly to the battery and no power-off relay is used. At such locations the DMGO-7 type of battery, rated at 60 a.h., is used, and is charged by an RT-21 rectifier.

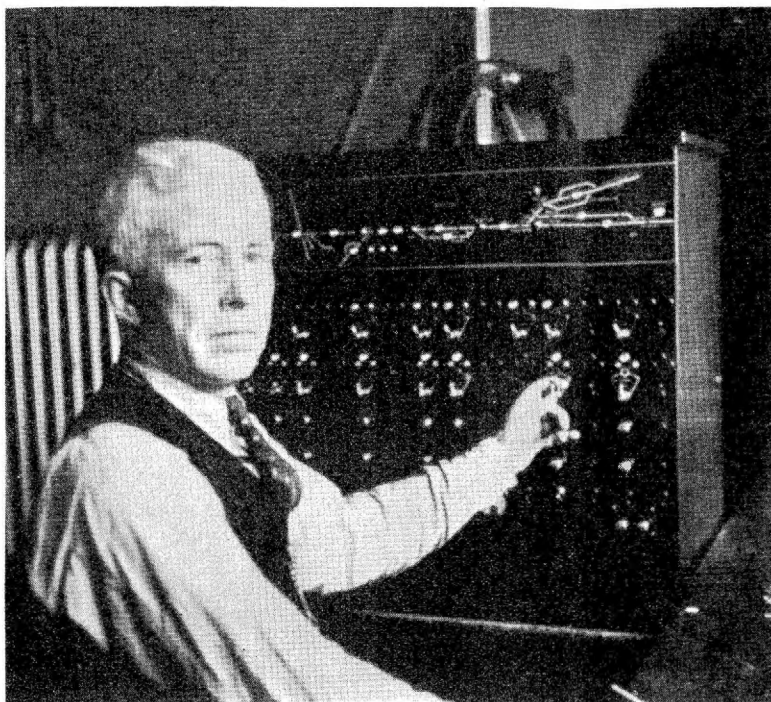
Track Circuits

The a-c. primary system of power supply is used on the track circuits. Each of the end-fed track circuits is energized by one Edison HA-500-a.h. primary cell, across which an RT-5 rectifier is connected. Each center-fed track circuit is energized by two primary cells, in multiple, of the same type with an RT-10 rectifier connected. For the purpose of testing the battery discharge, a McKen test switch was placed in the positive lead from the battery. The rectifier delivers practically all of the normal current flow and the battery serves mainly as a reserve in case of power failure.

At each signal location, the instruments and batteries are housed in a large-sized copper-bearing sheet-metal



Central station batteries and indicating relays are housed in two cast-iron cases behind the station building



The control machine is at the left of the operator's desk

case (A.A.R. Style C), measurements inside the wood lining being 52 in. high, 28 in. wide, and 22½ in. deep. There is a door on the track as well as the field side, the case being made according to Signal Section Drawing 1628. This case is located on the pole line side of the track. A partition divides the upper part of the case into two compartments, one open to the track side and the other to the field, the bottom section, 20 in. high, for the battery being open throughout from door to door.

The housing used for track circuit intermediate locations for battery, rectifiers or relays consists of a Union Switch & Signal Company 4-way sheet-iron box, with cable post top, mounted on a ground post. Only three concrete battery boxes were used on the entire installation, these being at outlying points, away from the main line, beyond the limits of the power line.

As a preliminary step in the construction program, a bonding crew consisting of 14 men started bonding of the track and installing fouling connections in May, 1938. The two bond wires at each joint are No. 6 AWG Copperweld wires, 44 in. long, with single-channel 9/32-in. pins at each end. The bonds were placed on the inside of the angle bars on the gage side of the rail. The bonds were shaped on a bending form before being distributed in the field. Raco power drilling machines were used.

The major construction work was started on July 5, two gangs being used, one consisting of approximately 24 men doing the line work, and another consisting of approximately 23

men handling the actual signal construction. Each gang was housed in regular Rock Island system construction crew trains, consisting of four bunk cars, one kitchen-diner, one material car, and one tool car. The cross-arms and line wire were distributed by motor car and push-car. The 10-ft. cross-arms, with pins and insulators, pole-stepping and guying, were installed throughout on the existing communication pole line. Glass insulators were used for the line control circuits; and brown porcelain in-

sulators for the 550-volt circuit. After completing this work, the line wire was put up. It was pulled off the reels, using a team for the wires to go on the field side of the poles, and a motor car for those on the track side. This construction was handled at the rate of from three to five miles a day. The line wire is copper with weatherproof covering, No. 6 being used for the two wires of the 500-volt a-c. power distribution circuit and No. 10 for the signal line controls, at least three of these wires being required throughout the territory.

Cases Pre-wired

All instrument cases were pre-wired in the system signal shops at Moline, Ill., and shipped to the nearest suitable points in gondola cars. Likewise, all the signal foundations were pre-cast and shipped in open cars. Two days before the work train was scheduled, a crew dug the holes for the foundations at all locations where there would be no hazard to train crews. As a means of picking up the foundations and cases out of the cars and setting them in place, a steam-operated crane was used. The signal masts were erected with the use of gin-poles.

The signal department forces of the Rock Island designed the installation and carried the construction program through to completion, the principal items of signaling material being furnished by the Union Switch & Signal Company.

The batteries and c.t.c. control apparatus at Curtis is housed in this concrete house

