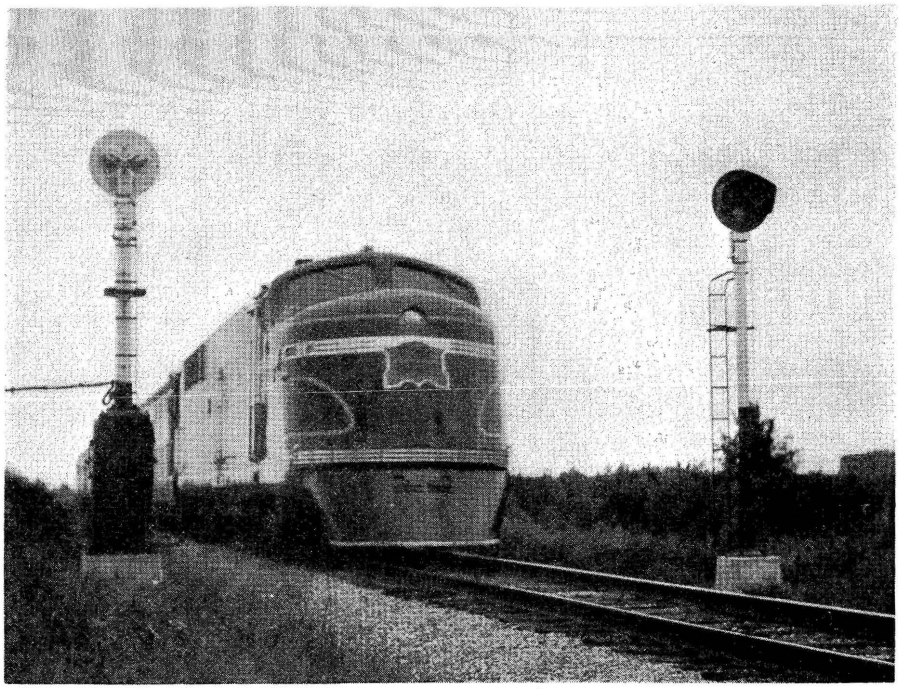


A Rocket train passing the double head-block signal location at west end of Putnam—Instruments housed in case of signal at left.

Rock Island

Color-light signals constructed on 46.5 miles of single track from Bureau, Ill., to Peoria include special control arrangements

THE Chicago, Rock Island & Pacific has installed color-light automatic block signaling on 46.5 miles of single-track line between Bureau, Ill., and Peoria, thus completing this type of protection on the 161-mile Chicago-Peoria territory, where one of the new diesel-propelled Rocket trains is being operated on a high-speed schedule. The main route between Chicago and Rock Island is double track and has been equipped with automatic signaling for years. The line to Peoria diverges from the main route at Bureau and extends 46.8 miles southwest to Peoria. Prior to July 1, this line handled eight passenger trains and about six freight trains daily. The new Rocket train makes two round trips daily between Peoria and Chicago.

In this territory the line is located on the west side of the Illinois river, and although the grade is practically at water level for an extended section, there are some short grades of 0.9 per cent, and a few sections of a mile or more of more than 0.4 per cent grade. Although there are 24 curves in the line, all but two are 1 degree or less, and none are sharp enough to require reductions in normal train speed. The track is constructed with 100-lb. and 90-lb. rail, good ties, and gravel ballast, and is maintained to permit high train speeds with safety. The Rocket is scheduled to make the 161 miles, Chicago to Peoria, in 160 minutes, station to station, averaging 60 miles per hour.

Layout of Track

As shown in the track diagram, there are six intermediate station layouts in this territory, each including a passing siding. In planning the signaling, a double-signal location was placed at the end of each passing track. Where the passing tracks are less than five miles apart, two single locations of staggered intermediate signals are used, as, for example, between Putnam and Henry. Where the distance is not over seven miles, two double locations of intermediate signals were used, as, for example, between Henry and Sporland. Where the distance was over seven miles, three double locations of intermediates were used, as, for example, between Bureau and Putnam. As a general rule, this arrangement results in the blocks being about 10,000 ft. long, and this length allows adequate train-stopping distance. With the present traffic, the trains are so distributed that it is not likely that there will be much delay to trains on account of the long blocks.

The signals are the color-light type, presenting three aspects, red, yellow and green. Each signal is equipped with 10-volt, 10-watt lamps. 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.

Signal Controls

The signaling is controlled by the absolute permissive block system. The control includes neutral track circuits and polarized line control circuits with the stick relay arrangement to set the opposing signals at stop from head block to head block and to permit signals to clear up behind a train for a following train movement. One line control wire in

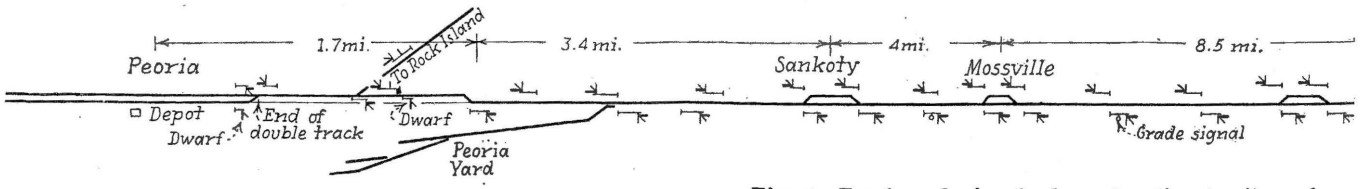


Fig. 1—Track and signal plan of entire territory from

Installs Automatic Blocks

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 circuits are so arranged that a train going from station A to station B will cause the intermediate signal for the opposite direction of traffic, which it passes, to continue to indicate red, so that if the train stops it will not have a clear signal to reverse its movement.

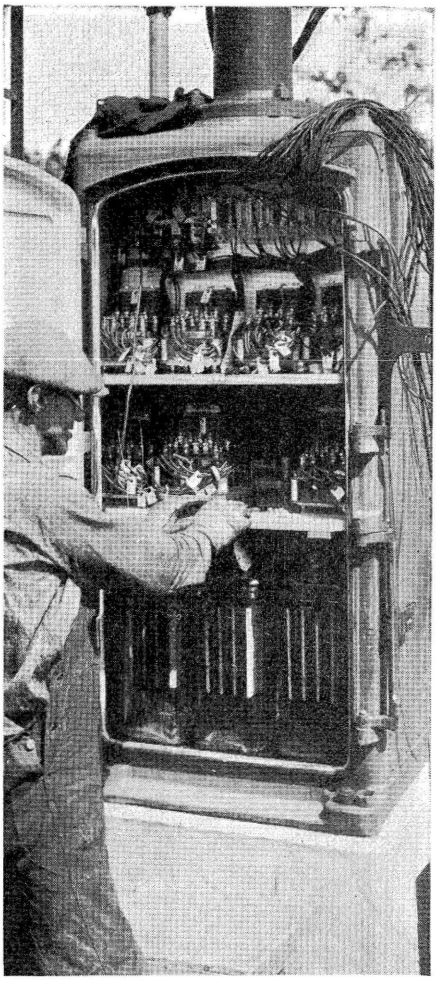
Referring to Fig. 2, when a westbound train passes signal 1, all of the eastward signals between stations A and B, signals 4, 6 and 8, are set to indicate stop and are lighted. When the train enters block Y, signal 3 changes to the stop aspect and signal 4 continues to indicate stop until the train clears block Y, at which time signal 6 continues to indicate stop, but signal 4 changes to the clear aspect. The signal for the opposing direction is held at the stop aspect by controlling, for example, the 4HD relay through a back contact of the 3S stick relay.

In some A.P.B. arrangements it might be possible, if track circuits in blocks X and Y were shunted at the same time accidentally, that the stick relays for signals 3 and 4 would be locked up, and as a result neither signal could clear until the maintainer corrected the condition. To prevent this occurrence, the circuit as used on the Rock Island provides, for example, that the 4H relay and 4S stick relay are each controlled through a separate back contact in 3S stick.

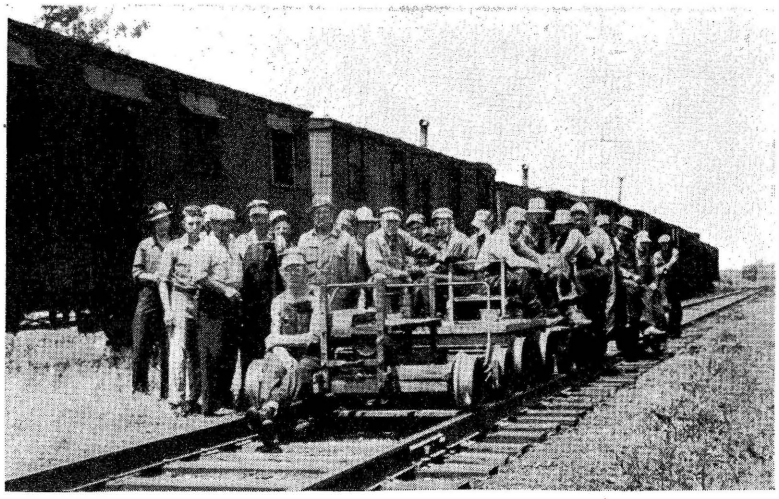
Special Control of Signal Lights

The leaving signals at each end of the station layouts are lighted continuously to provide 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 (see Fig. 2) when a train leaves a station, all of the signals for both directions are lighted throughout to the next station.

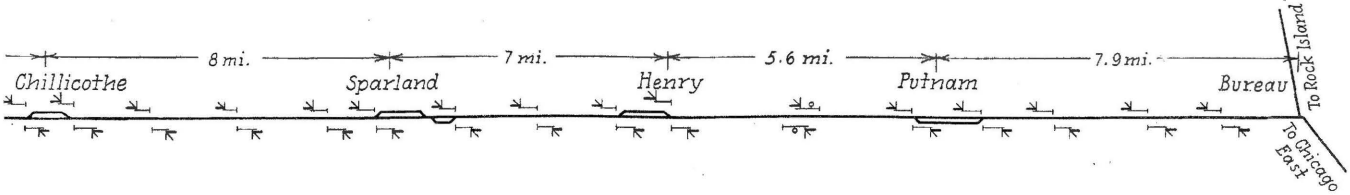
The signal lamp is lighted for the red aspect by a circuit made when the local HP relay is down, which of course lights the lamp at all times when the control is set up for the red aspect. At a double signal location the lamp is lighted, when either the yellow or green aspect is set up, by extending the lamp control, as for signal 3, through a back



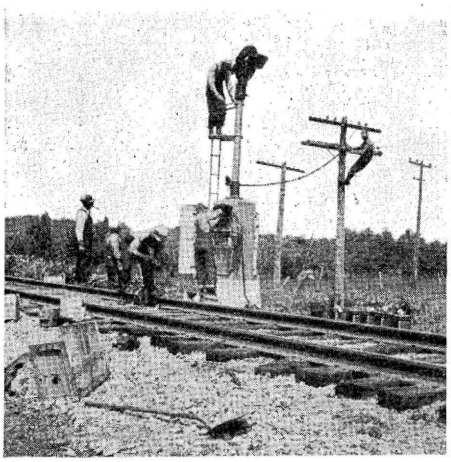
The only wiring done in the field was to connect up the line cables



A crew of about 40 men handled the field construction

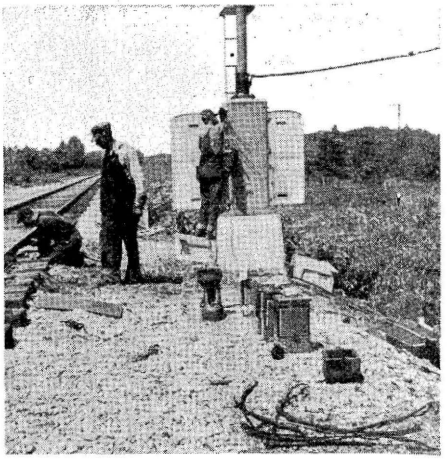


Bureau to Peoria showing distances between stations



The signal assembly work and track wiring

Parkway outlet and tools used



Installing line cables and parkway

contact of 4HD, the home relay for the signal for the opposite direction.

Four 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 consisting of a circular metal disk 24 in. in diameter, painted black with white letter "G" attached, with an 8⅜-in. yellow lens mounted in the center, this marker being mounted on the mast 5 ft. below the main signal unit. The rules specify that if the signal indicates red and the yellow marker lamp is lighted, all trains can pass the signal without stopping, at restricted speed not exceeding 10 m.p.h. Obviously such a rule is applicable only for following trains but not for opposing movements. Therefore, this yellow grade marker is lighted only when the signal has been controlled to the stop aspect by a leading train proceeding in the same direction. This result is accomplished by controlling the yellow grade marker lamp through a front contact of the local stick relay and a back contact of the track relay of the track circuit occupied by the following train.

Power Supply System

Power is distributed over the territory at 550-volt, 60-cycle, being carried on two No. 6 copper weatherproof wires. One power feed is located at Henry and another about three miles east of Mossville. Thus each power connection feeds about 11 miles in each direction. A General Electric air-cooled line transformer 550-110 volts, rated at 100 v.a., is provided at each signal location, and a 75 v.a. transformer of the same type, at each track-feed location. These transformers are protected by G. E. pellet type arresters. The local transformers in the cases are the W-10 type.

The battery at each signal location consists of five cells of Exide lead type on floating charge through an RX-21 rectifier. In a layout of signals between two passing tracks where all are double locations, as shown, for example, in Fig. 2, only one set of battery is required for the two signals at each double location, with the exception of one location where the common line wire is cut, i.e., at the location for signals 5 and 6, where a separate battery is used for each signal. At each of the signals where one battery is used to feed the line circuits in both directions, the circuits are so arranged through contacts of the relays and the pole-changers, that there is no interference of the circuits in securing proper connection to the common line wire.

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 transformer, with a power-off relay used to switch 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. At the intermediate locations the lamp-feed circuits are connected directly to the battery with no power-off relay required. At such locations the DMGO-7 type of battery, rated at 60 a.h. was used.

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 of the same type with an RT-10 rectifier connected.

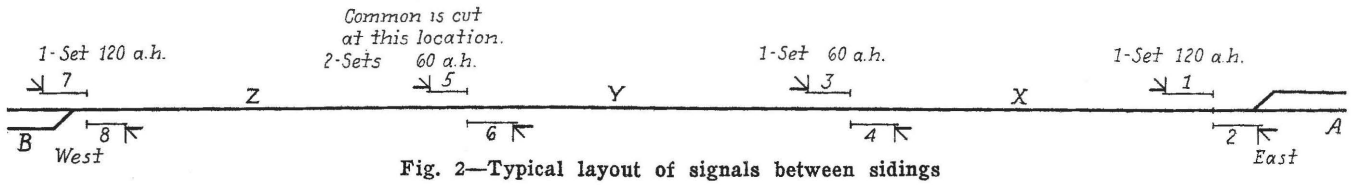


Fig. 2—Typical layout of signals between sidings

Instrument and Battery Housings

At each signal location the instruments and batteries are housed in a large-sized sheet metal 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, for housing the battery.

On one side of the case the upper shelf, 18 in. high, includes the lightning arresters, porcelain-based terminals, resistance units, etc., on the board, and the two track relays on

the shelf. The upper shelf on the other side houses the 110-volt line switches and fuses, the W-10 transformer, the RX-21 rectifier and resistance units in the line-feed circuits. The second shelf, 11 in. high, includes the three control relays for the signal for one direction, while the three relays for the signal in the opposite direction are located on the second shelf on the other side of the case. The polar HD relays are the DP-14 type, 500 ohms; the stick relays are the DN-11 neutral type, 500 ohms. The home-repeater HP relays are the DN-18 type neutral, 350 ohms, and operate slow-release, slow pick-up. The advantage of using a relay with these operating characteristics is that it prevents other signals from being affected by pole-changer operations at a signal changing from caution to proceed indication. The power-off relays are the a-c. type ANL-30 rated at 10 volts.

Limiting Resistances

With the use of storage battery to feed the lamps and the line control circuits, an accidental short across two terminals might cause enough current to flow to burn out the ribbons on the relays. To prevent this, Ward Leonard fixed resistances of 20 ohms were used in all relay battery feeds; a resistance of 70 ohms is used for 500-ohm relays. A 4-ohm unit is used in series with each of the lamp-feed circuits.

The low-voltage lightning arresters are the Railroad Accessories Corporation multiple-path type with five posts. One wire from the line is brought to the upper post and a jumper from this post extends to the terminal of the line relay. The bottom post is used in the same way for another line circuit. The center post is connected to the ground, and wires from rail connections are attached to each of the other two posts, with jumpers extending to the wires leading to rails. Copperweld ground rods, 5/8 in by 8t ft., are used in connection with Copperweld clamps held in place by a set-screw.

Tags Lettered

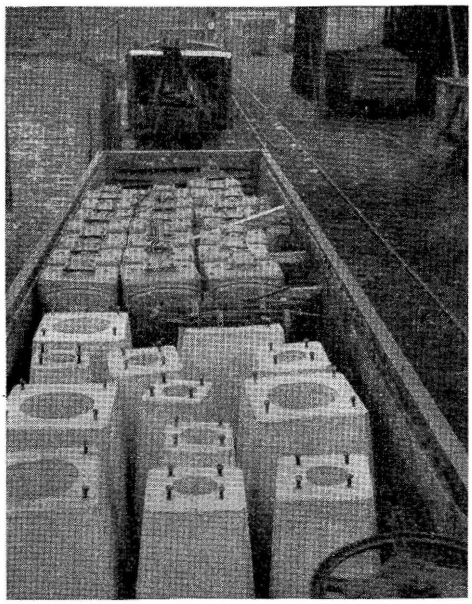
The wire for the jumpers inside the cases is No. 14 flexible, insulated with double braid, 9/32-in. solder tipped eyelets being used. White fibre identification tags are used, but instead of using the slow process of stenciling the tags, the identification is lettered on each tag with a pen, using indelible, waterproof ink such as is used in laudries and hotels for marking linen.

As a general rule, the feed end of the track circuits are located at the cut sections. Therefore, at such locations a 4-way sheet metal case cable post is used to house the local transformer, rectifiers and primary battery for the track feeds.

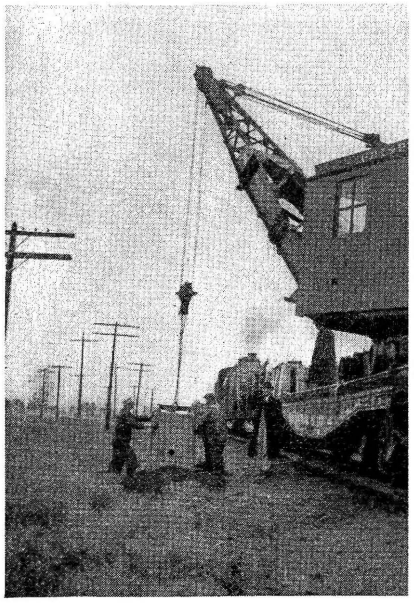
In order to secure uniformity and standardization, arrangements were made to wire up all the instrument cases in the signal shop at Moline, Ill. As soon as a car load of cases arrived, they were set up in the shop. The first work was to install the porcelain-based terminals, arresters, rectifiers, and transformers. Then the jumpers were installed complete with fibre identification tags. The relays were then set in place and connected. The relays are the shelf type with spring mounted bases. As a means of holding the relays in place during shipment, a clamp was made of No. 9 copper wire fitting over the relay and held down at each side by a screw set in the wooden shelf.

Foundations Precast

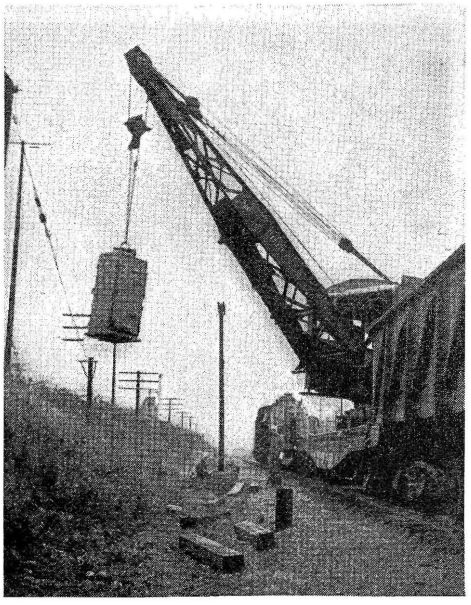
The concrete signal foundations were also made at the signal shop at Moline. A gas-engine-driven mixer of 1/8-yd. capacity was used. Platforms were constructed so that the mix could be handled in wheelbarrows from the mixer and poured directly into the sheet-metal forms set up on planking on the ground. As this work was started in February, it was necessary to heat the water used, this being accomplished by using a coil of pipe suspended over a coke fire in a steel drum. Ten steel forms were available, and this many foundations were made each day. Three or four men were used to wheel the sand and gravel, as well as the mix; one man operated the mixer, regulated the water and put in the cement; and one man tamped the mix in the forms. When the 10 foundations were complete, these men were assigned to other work handling material, assisting case wiremen, etc. A cover of plaster board was placed over and around two groups of five foundations each, over night, and the surrounding air was kept warm by using charcoal burners such as are used in winter to keep lading warm in freight cars. The requirement for the Bureau-Peoria job included 36 large-sized foundations for signals with cases, 30 foundations for single-mast signals and 51 foundations for cases at cut sections. These foundations were made at a relatively low



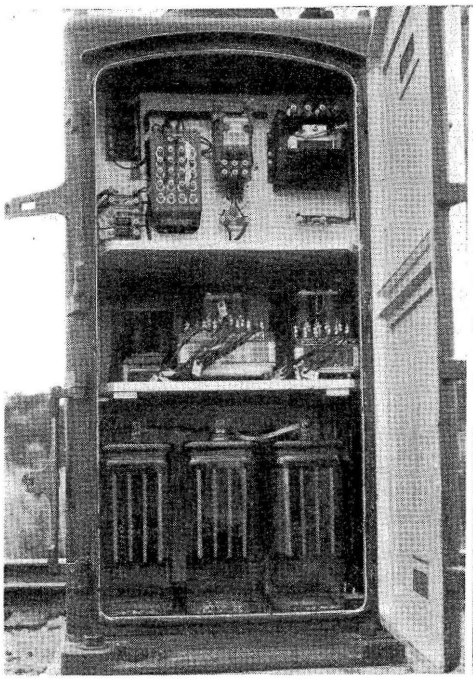
Foundation and cases as loaded at shop



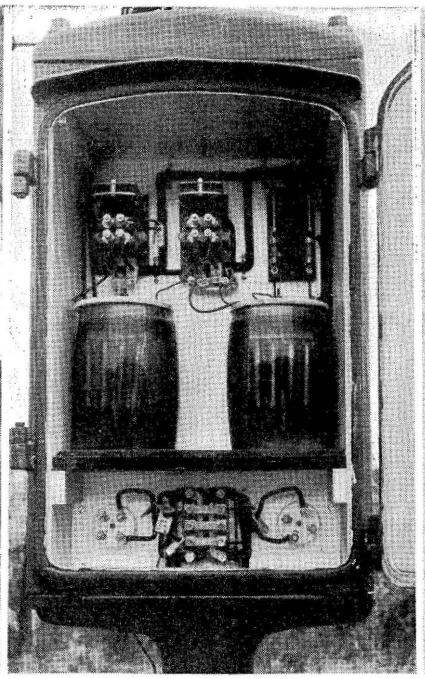
Power ditcher crane for setting foundations



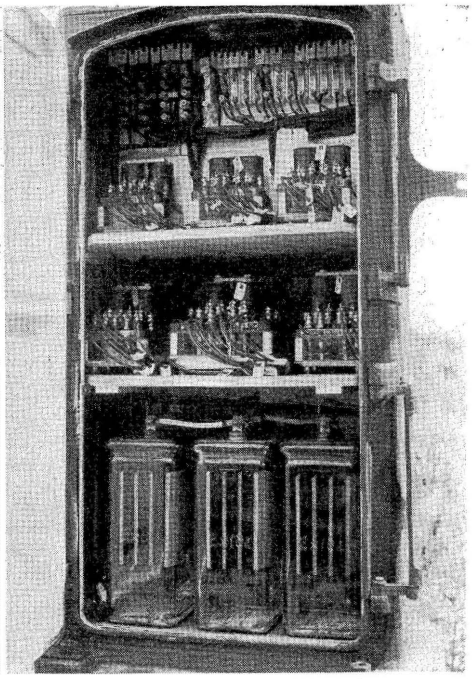
Crane was used also to set cases



Field side of a typical signal case



Battery-rectifier feed at track circuit cut



Track side of case at double signal

cost. There were about 300 more foundations made at the same time for a large job in Kansas.

These foundations are of a special design developed on the Rock Island, for the purpose of reducing the amount of materials required, as well as to reduce the weight, and yet secure a foundation that will stay in place. A circular hole extends down through the center of the foundation, this hole being about 18 in. in diameter for the large-sized foundations, the result being that the foundation, 4 ft. high, 30½ in. by 33½ in. at the top and 38½ in. by 41½ in. at the base, has a cubic content of only 0.94 cu. yd. In the single-mast foundations the hole is 12 in. in diameter. This hole is used to bring the underground cable up to the case, an entrance to the foundation being made by a 6-in. hole cast in the wall at a point below the ground line.

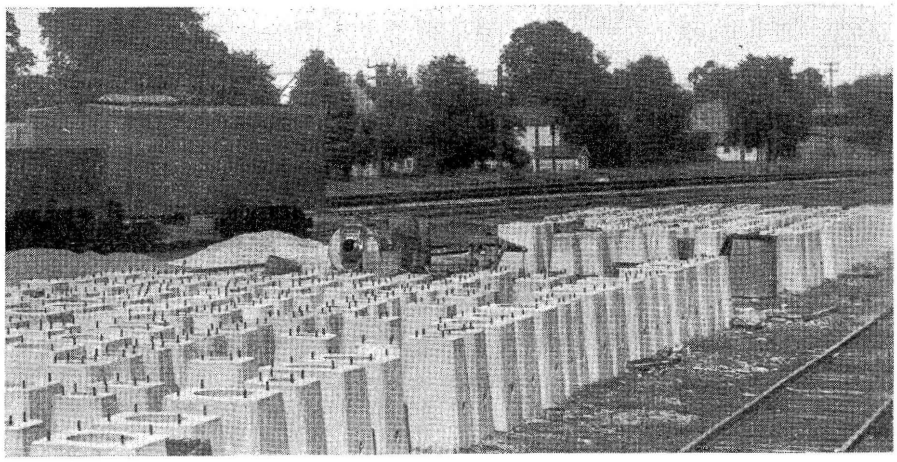
When the cases were all wired and the foundations ready, a work train was loaded, a power crane being used. The cases were loaded in a gondola car and about 43 foundations were loaded on each flat car. The illustration showing cases and foundations in one car happens to be the odds left over after loading full cars. The 4-way cases for the cut-sections were loaded in a box car and were unloaded by hand, using skids, and then were set on the stub masts. The signal masts, ladders, signal heads, etc., were not received in time to be handled by the work train, and therefore were hauled out to the locations on push cars pulled by motor cars.

Bonding and Turnout Connections

While the work explained above was under way at the shop, other forces were busy in the field. One crew of six men and a foreman installed the bonding and turnout fouling connections on the 46.5 miles of single track. 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. Three Raco power drilling machines were used.

Construction of the Line

The line construction was handled by a crew averaging 15 men. First, the 10-ft. crossarms, with pins and insulators, were installed throughout on the existing communication pole line. Glass insulators were used for the line control circuits, and porcelain insulators for the 550-volt circuit. The line wire is copper with weatherproof covering, No. 6 being used for the two wires of the 550-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. The line wire was pulled off



The concrete foundations were made at the signal shop at Moline, using a power mixer and sheet steel forms

the reels, using a team of mules for the wires to go on the field side of the poles, and a motor car for the wires to go on the track side. Four men distributed and pulled in the wire, while six men placed the wires on the pins and tied them in. This construction was handled at the rate of from three to five miles a day.

One Work Train Used

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 ditcher crane was used, the bucket, of course, being removed. This crane operates under its own power on a set of rails laid on a flat car, the advantage being that with one spotting of the train, the crane can be run forward or backward to pick up and set the foundations and cases at a location, without moving the train as a whole. An important factor is that the crane

Wooden riser and metal cap at parkway outlet

can be spotted exactly as required to set the foundation or case so that very little pushing one way or the other is required on the ground.

Typical Work-Train Day

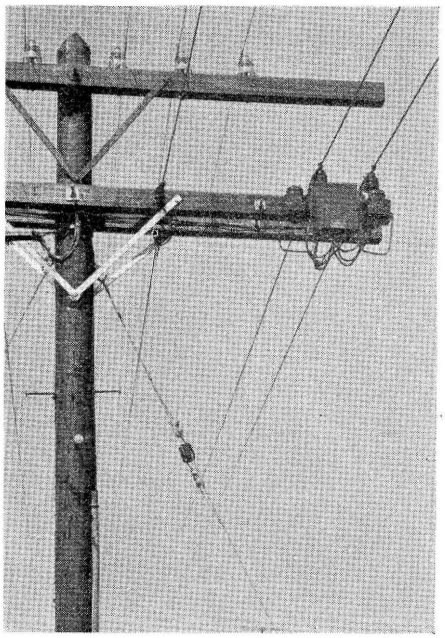
The work train was operated on May 15 and 16. Two men on a motor car went ahead to inspect the holes and also to dig a few holes around switches, etc., which could not be dug in advance. On Monday, May 15, the foundations and cases were set on the first 21 miles. The train left Bureau at 8:50 a.m., lost one hour in getting out of the way of other trains, and stopped unloading at 4:38 p.m. On the second day the work was completed to Peoria. The average time required to run from one location to the next, set the two signal foundations and one case, unload the masts, ladders, etc., and leave for the next location, was 12.5 min. To make such a move for a track-cut location, set the foundation, case, and unload the material from the box car was 9 min. The force on the work train included seven signal department men, a foreman, one crane operator and the usual train crew.

After the foundations and cases were in place, the forces were organized by assigning certain men to do a particular class of work throughout the entire territory, enough motor cars being available so that each unit could work independently if necessary. However, by asisting each other in handling materials, etc., the entire force progressed uniformly from Bureau to Peoria.

Completion of Field Work

First a crew of about seven men erected the signal masts and ladders and placed the signal heads. Tackle, and a gin pole made of a section of 3-in iron pipe, was used at some locations but it was soon determined that the erection work could be handled quicker without using the gin pole. After the signals were erected, four men were assigned to install the underground cable and bootleg connections. The track wiring is in No. 9 single conductor cable, made up with protection including jute and steel tape but no lead. The run from the case under the track and to the signal on the other side is 6-conductor No. 14 made up with the same outer protection, with the exception that a lead sheath is included. The bootleg risers are made of 4-in. by 4-in. creosoted pine pump log, 18 in. long with a 2-in. round hole through lengthwise. These were made at the railroad company's treating plant. A metal cover which fits over and is screwed to the top of the pump log is equipped with a vertical bolt connector, to which are attached the end of the cable wire and the two No. 6 Copperweld connectors, which extend to 9/32-in. channel pins in the rail. A cast-iron cap fits over the connections on the top of the bootleg. The bootleg caps were furnished by the O. S. Flath Company. An interesting feature of the cable as used on the Rock Island is that the insulated conductor has a braid covering throughout the length of the cable so that this braid protects the insulation on the section of each single conductor extending from the terminal to the place where the outer covering is ended. The underground cable is of Hazard manufacture.

Two men made up and installed the line drop cables. For this, No. 14 wire with 3/64-in. insulation tape and braid is used for the control circuits and the same type of make-up except that 5/64-in. insulation is



Line transformer, arresters and plugs on crossarm

used for the 110-volt circuit. The messenger is No. 8 AWG bare Copperweld wire and short pieces of scrap No. 14 insulated wire is used to wrap the cables and attach them to the messenger. This crew mounted the line transformers and the 550-volt arresters, made the line taps and extended the wires into the cases, but did not connect them.

Wiring and Testing

This gang was followed by three small crews, each consisting of a wireman and helper, who made the connections to the terminals and arresters, installed the battery and made all final connections. The wireman and foreman then made a complete detail check and operation test before the signals were ready for service. The signal cases and base castings and ladders are painted red, the masts and the rear of the signal head are painted aluminum, and the face of the backgrounds and the hood are black. The painting conforms with the coloring of the new Rocket trains.

This installation was planned and installed by the signal forces of the Rock Island, the principal items of signaling material being furnished by the Union Switch & Signal Company.