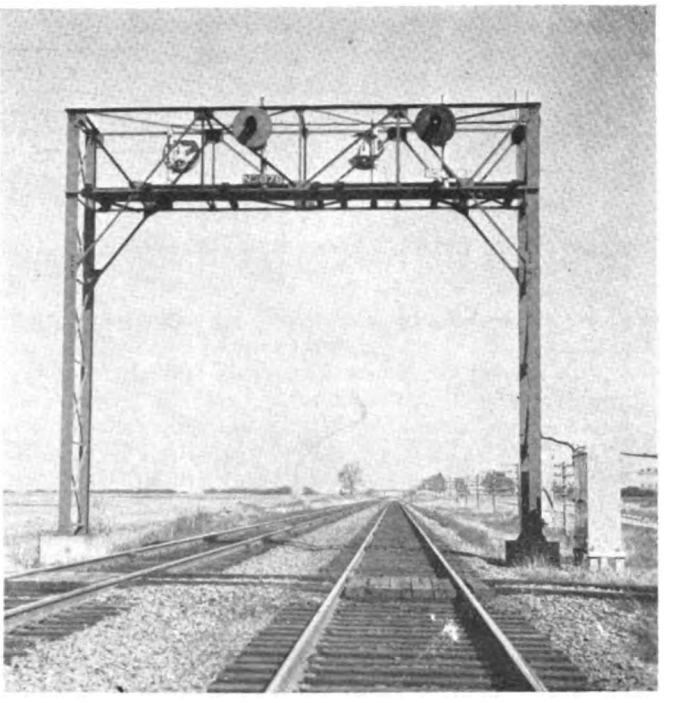


CTC on Single and Double Track

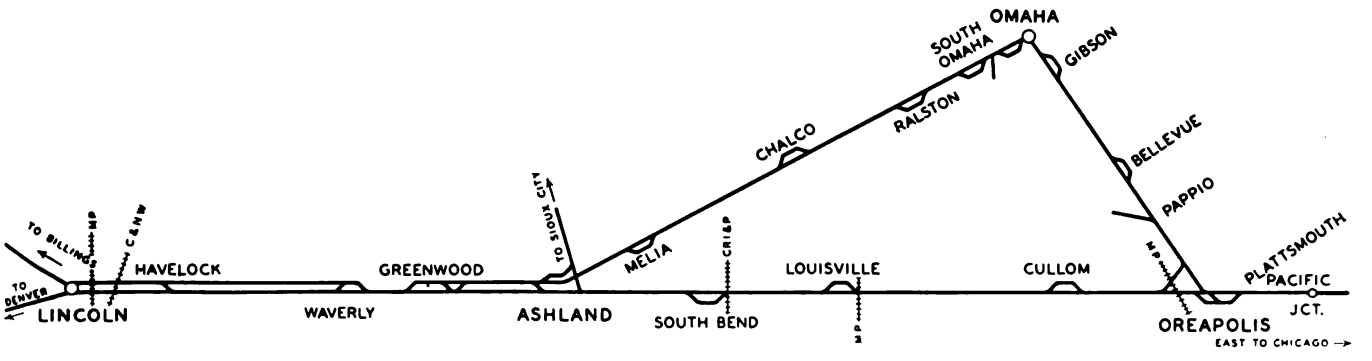
Both ways on both tracks of two-track section, connecting to a 73-mile "loop" of single track—Unique arrangement for switching code carrier if line wires break

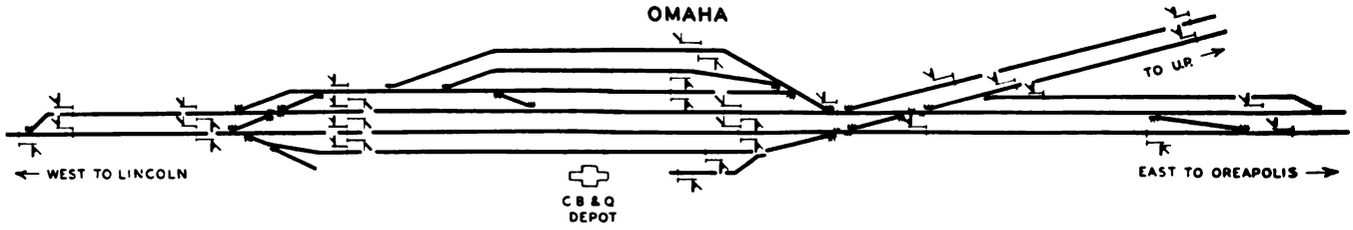
THE CHICAGO, BURLINGTON & QUINCY has installed centralized traffic control in an area shown in the map. Starting at Pacific Junction, Iowa, single track extends across the Missouri river, 3.48 miles to Plattsmouth, with double track 3.85 miles to Oreapolis, from which point there are two lines. One extends north 16.88 miles to Omaha, Neb., and then southwest 29.96 miles to Ashland, Neb. The second single-track line from Oreapolis extends west along the Platte river 26.1 miles to Ashland. From Ashland to Greenwood, 7.61 miles is double track; from Greenwood to Waverly, 4.96 miles is single track; and from Waverly to Lincoln, 11.32 miles it double track.

The route from Oreapolis through Omaha to Ashland is 46.84 miles which is 20.74 miles longer than the 26.1 miles from Oreapolis directly west through Louisville to Ashland. Furthermore, this short line through Louisville is along the Platte river at maximum grade of about 0.4 per cent for one mile, with the remainder of line having an average grade of about 0.15 per cent. The longer route includes rolling grade the maximum being 1.25 per cent in several places both eastward and westward between Omaha and Melia.

Freight trains, which are to set out or pick up cars at Omaha, are operated on the longer route via Omaha. The remaining through freight trains, about four each way daily, are operated via the low grade shorter line through Louisville thus handling more tonnage and saving about 1 hour. Local freight trains are operated over both lines. The 16 scheduled passenger trains daily are routed through Omaha. Special through passenger trains can be routed via Louisville, thus saving about 30 min. An average of about 58 trains are operated daily on this territory as a whole.

Previously, automatic block was in service from Pacific Junction through Oreapolis to Omaha and from there to Lincoln, with CTC on the 4.95 miles between Pacific Junction and Plattsmouth, and 8.12 miles Greenwood to Waverly. The double crossover at Ashland was in an inter-





THIS LAYOUT AT OMAHA is controlled by a separate interlocking machine

locking controlled by a machine in the office at Ashland. Manual block was in service between Oreapolis through Louisville to Ashland.

On the Double Track

On the sections of double track between Lincoln and Ashland, the new CTC system includes signals for authorizing train movements in both directions on both tracks, the same as two single tracks side by side, except that no intermediate automatic block signals are in service for left-hand running except at controlled points. At the east end of Ashland, a wye connection extends from the Louisville line across the Omaha line to connect with a single track line to Sioux City. The wye switches are in the CTC. Previously these two switches were hand-thrown but they are now power operated and are controlled in the CTC.

On the line via Louisville, the new CTC includes power switches and signals at both ends of sidings at South Bend, Louisville and Cullom. On the line from Ashland to Omaha, CTC power switches and signals are located at both ends of sidings at Melia, Chalco, Ralston, South Omaha, and Omaha, and also a power junction switch at South Omaha leads to a yard. Between Omaha and Oreapolis, CTC power switches and signals are located at the end of double track at Gibson, at a junction switch at Pappio, and at both ends of sidings at Gibson and Bellevue. Three junction switches, a crossover and end-of-double-track switch, with signals, are included in the CTC at Oreapolis. All of the power switches and signals outlined above are controlled by a CTC machine in the dispatcher's office at Lincoln.

The west end of Ashland includes the junction switch connecting to a line north to Sioux City, and one main track crossover, with space for a second crossover. At Ashland station the double set of crossovers and signals formerly in the interlocking are now in the CTC. At Waverly, the new CTC includes not only the end-of-double-track switch but also both ends of a center siding. At Greenwood the end of double track, and also a double set of crossovers 1.55 miles east of Greenwood, are included in the CTC.

New Interlocking at Omaha

At Omaha, the Burlington passenger station layout includes six through tracks and several spurs as well as a junction with two main tracks connecting with the Union Pacific. This entire station area includes 7 single switches, 1 crossover, 2 double-slip switch layouts, and 26 home signals, all of which are controlled by a panel-type control machine located in an office in the Burlington passenger station building. This installation is all new, the switches in this area having been operated previously by hand-thrown stands.

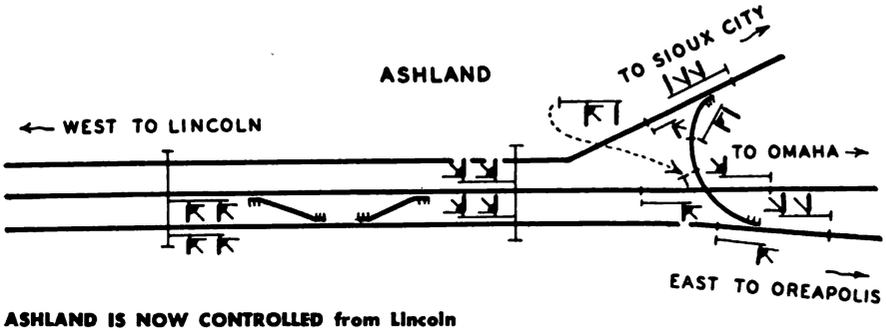
Six Interlockings at Railroad Crossings

In this overall territory six single-track lines cross the Burlington CTC tracks. In the layout at Oreapolis a north-and-south single-track line of the Missouri Pacific crosses the east-and-west Burlington track and also the single track of the left leg of the Burlington wye connection. The crossing of the east-and-west line with the MP was formerly protected by a mechanical interlocking, which, as part of the CTC project was replaced by an automatic interlocking that includes automatic control of the MP signals, and combined automatic control and CTC lever control for clearing the Burlington signals.

The crossing of the MP and the left leg of the Burlington wye connection was previously protected by manually-controlled gates which were normally in the clear position for the MP. This crossing is now protected by a new automatic interlocking with automatic clearing for MP, and combined automatic control and CTC lever control for clearing for the Burlington. At South Bend a single-track main line of the Rock Island crosses the Burlington, this crossing being protected previously by an automatic interlocking which was revised to include CTC lever control in the clearing of the Burlington signals. At Louisville, where another single-track line of the Missouri Pacific crosses the Burlington, an old mechanical interlocking was replaced by an automatic plant which includes CTC lever control for the Burlington signals.

In the layout at Ashland, a connection from the Louisville line crosses the Omaha line and connects with the line to Sioux City. This crossing was previously protected by gates operated by trainmen. As part of the new work, interlocking was installed at this crossing, including CTC lever control for Burlington signals.

At 27th Street, 2.18 miles east of the station at Lincoln, a single track of the Chicago & North Western crosses the Burlington double track. This crossing was previously protected by an automatic interlocking. As part of the new project this interlocking was rebuilt, and the controls were revised, so that the Burlington signals will not clear until the dispatcher sets his levers and sends out a code to clear them.



ASHLAND IS NOW CONTROLLED from Lincoln

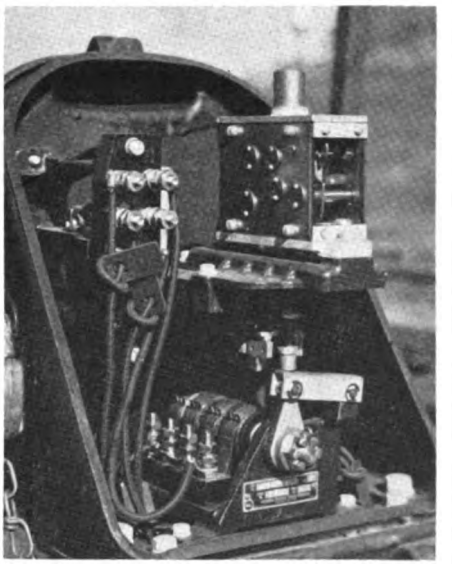
About 3,800 ft. east of the passenger station at Lincoln, a Missouri Pacific industry track crosses the Burlington double-track mains. Previously, this crossing was protected by gates, normally across the MP, which controlled normally-clear home signals on the Burlington. As part of the new work, this protection was improved by installing new color-light signals on the Burlington, and a new gate with a controlled electric lock on the MP. If the gate and lock are normal, the Burlington signals will clear if the dispatcher has sent out a control to clear them. When a MP switch crew is to make a move over the crossing, the conductor phones the dispatcher for permission to unlock the electric locks on gates. Then he opens the lock case. When he makes the preliminary move of the lock crank, the Burlington signal is held at Stop. After the lock release has been obtained he can swing the gate for his train to move over the crossing.

Locks on Hand-Throw Switches

As part of the CTC project, automatic electric locks were installed at the main-track, hand-throw switches which connect to house tracks, industry spurs and gravel pits that are frequently used, and mechanical-type locks installed where switches are less frequently used.

The mechanical-type locks are controlled locally by a mechanical-type time release. When the conductor of a train crew has permission from the dispatcher to use such a switch, he unlocks the padlock and opens the front door of the lock. This action shunts the track thus causing signals in each direction to display a red aspect. Then he moves the lever to the preliminary position, (about 7 deg.). This starts the operation of the mechanical timing device. After the time has expired, the mechanical device lifts a toggle thereby effecting a mechanical release, as is indicated by display of "Unlock" to the conductor. Then he can complete the operation of the crank which pulls the plunger out of the lock rod.

When the switch is returned to its normal position, the conductor operates the crank to push the plunger through the lock rod. In so doing he also rewinds the mechanical-type time release device.



MECHANICAL TIME LOCK on switch

BATTERIES ARE IN instrument house

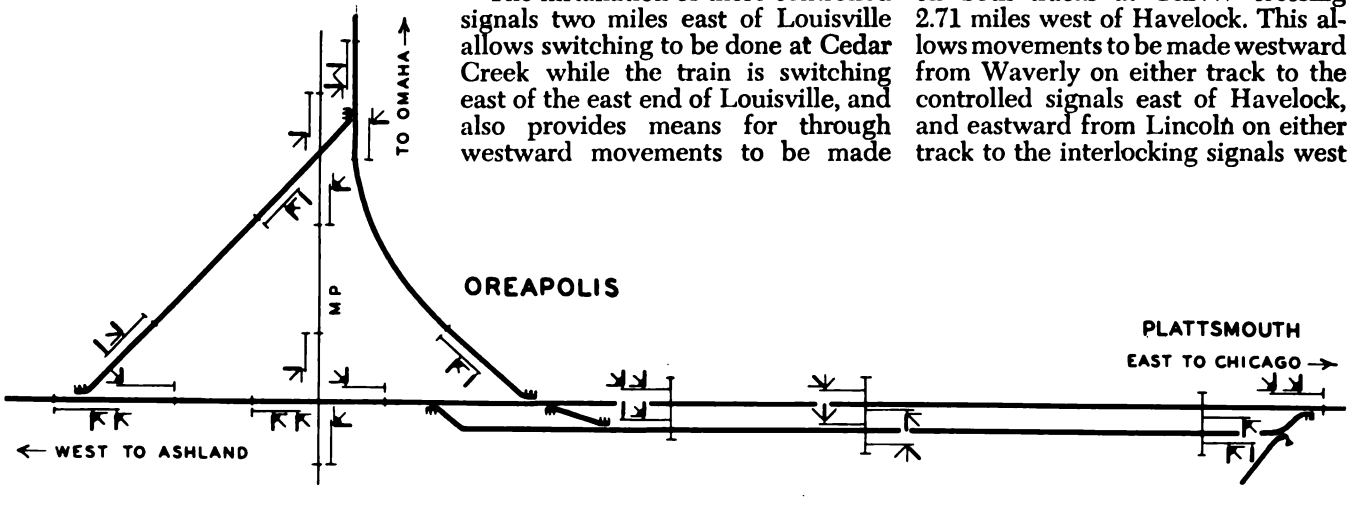
Controlled Intermediate Signals

During certain periods of the year there is a considerable amount of switching done from sand and gravel pits and rock quarries on the line between Ashland and Oreapolis. To facilitate the switching movements, as well as through train movements, controlled intermediate signals in each direction were installed at a point about two miles east of Louisville and about 2.2 miles east of Ashland, which shortens positive blocks in this territory.

The installation of these controlled signals two miles east of Louisville allows switching to be done at Cedar Creek while the train is switching east of the east end of Louisville, and also provides means for through westward movements to be made from Cullom to the controlled signals east of Louisville, with a minimum delay to the through movements as well as to the switching at Louisville.

Between South Bend and Louisville, there is considerable quarry switching to be done. The controlled signals east of Louisville will allow these quarries to be switched, while at the same time movements can be made around the wye at Ashland. Also, movements around the wye at Ashland may be made while westward movements are being made from South Bend to the controlled signals.

At Havelock there is a hand-throw crossover between the main tracks and six main-track, hand-throw switches. To provide a short positive block in this territory, to facilitate switching movements, controlled intermediate signals were installed in each direction on both tracks 1.19 miles east of Havelock, and supervisory control was provided on both eastward and westward automatic interlocking signals on both tracks at C&NW crossing 2.71 miles west of Havelock. This allows movements to be made westward from Waverly on either track to the controlled signals east of Havelock, and eastward from Lincoln on either track to the interlocking signals west



of Havelock, with a minimum delay to both the switching and the through train movements.

Switching of CTC Code Lines

The CTC code line is a pair of Neoprene jacketed No. 6 Copperweld wires with 30 per cent conductivity of copper. This code line is divided in four sections: the "A" lines extend from Lincoln to Ashland, the "B" line from Ashland to Oreapolis via Omaha; the "CA" line extends from Ashland to Oreapolis via Louisville, and the "CB" line from Oreapolis to Pacific Junction.

The conventional d.c. code is used on the "A" line for control of the functions between Lincoln and Ashland, and for the transmission of the indications from the field locations to the control machine, and for control of converter equipment located at Ashland. Carrier is used over the "A" and "B" lines to Oreapolis where it is converted, and controls functions Oreapolis to Ashland on the "B" line. Indications from the field locations on this line are transmitted to Oreapolis where they are converted to carrier and sent to the control machine.

Carrier is used over the "A" and "CA" lines Lincoln to Oreapolis where it is converted, and controls functions Oreapolis to Ashland on the "CA" line, and Oreapolis to Pacific Junction on the "CB" line. Indications from the field locations from these two lines are transmitted to Oreapolis where they are converted to carrier and sent to the control machine.

In event of a break in either the "B" or "CA" lines, the carrier on the line in trouble may be transferred to the other line and transmitted to Oreapolis where it will be converted in the regular manner and operate the line up to the break. So as to have control of the functions beyond the break, a converter was installed at Ashland which may be operated by the dispatcher at the control machine and control the functions and pick up indications on the part of the line between Ashland and the break. This can be done on either the "B" line or the "CA" line.

For example, if the "B" code line became open between Ralston and Chalco, the dispatcher would switch the carrier from the "B" line to the "CA" line, and the line would continue to function normally from Oreapolis to and including Ralston. If he desired to send any controls to either Melia or Chalco, or pick up indications from either of these points, he would then cut in the converter for the "B" line at Ashland, which would provide normal operation from Ashland to and including Chalco, but would cut out the line from Oreapolis to Ralston. After he had transmitted any controls he desired, and received indications wanted, he would then cut out the "B" line converter at Ashland, at which time the converter at Oreapolis would automatically cut in and give normal control of the functions between Oreapolis and Ralston.

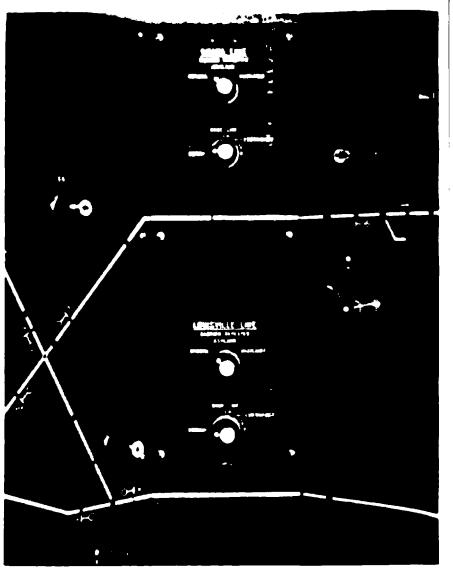
Switch Layouts Well Built

New switch layouts with No. 15 frogs were installed at the ends of CTC controlled sidings. Racor adjustable rail braces and three Racor vertical-pin type rods were installed in these switches, as shown in the pictures. As one of the rods, a GRS roller bearing was installed in each switch.

The switch points are 30 ft. long, and, in order to insure that the entire length moves over properly, a helper connection, made of pipes and cranks, extends from the switch machine to a second operating rod 15 ft. 6 in. from the point. A special switch circuit controller checks the operation of the middle section of the points.

Power Supply

On this territory a.c. power at 220 volts is distributed from various locations on a pair of No. 6 copper wires. Low-voltage transformers feed through rectifiers to charge storage batteries. At each power switch, there is a set of 12 cells of 80-a.h. battery, and at each intermediate signal there is a set of 5 cells of 60-a.h. battery. Each track circuit is fed by one 60-a.h. battery. At the control office the code line is fed by a set of 35 cells of 8-a.h. battery. Two sets of 12 cells each of 280-a.h. battery feed the local circuits at the office. All these batteries are the lead type made by Exide.



SPECIAL BUTTONS FOR code lines

At each field station, such as at the end of a power siding, there is a 6 ft. by 9 ft., or 8 ft. by 10 ft.—depending upon the requirements—Massey concrete house for relays, code equipment and batteries. These houses were wired complete with relays in place, in the signal shop at Aurora, Ill. The relays were strapped down during shipment. Sheet-metal cases, also wired in the shop, are used at intermediate locations.

The wire for the battery circuit to switch machines is No. 6 ordinarily, but if the run is more than 500 ft., No. 4 wire is used. The cables from a house to a switch machine ordinarily include an eight-conductor No. 12; and one two-conductor No. 6. From a house to a two-arm signal, the cables include one two-conductor No. 8 for lamp circuits; one six-conductor No. 12; and one four-conductor No. 12. The track connections are single-conductor No. 8.

On this project a large percentage of the trenches for buried cable were dug with a Barber-Greene self-propelled power trenching machine. At locations where it was necessary to cross tracks, a power boring machine was used to drill a 4-in. hole through the dirt fill under tracks, and then the cable was pulled through. This avoided unnecessary disturbance of ballast. Where the ground was not firm enough for boring, a pusher was used to push pipe through fills.

This CTC was planned and installed by railroad forces under the direction of A. L. Essman, chief signal engineer, Chicago. The major items of signal equipment were furnished by the General Railway Signal Company.