Burlington Completes Automatic Signals Chicago to Denver

2,106 miles of road and 2,914 track-miles now equipped with automatics

Typical signal location on 1927 construction

Latest construction features include parkway and aerial cables

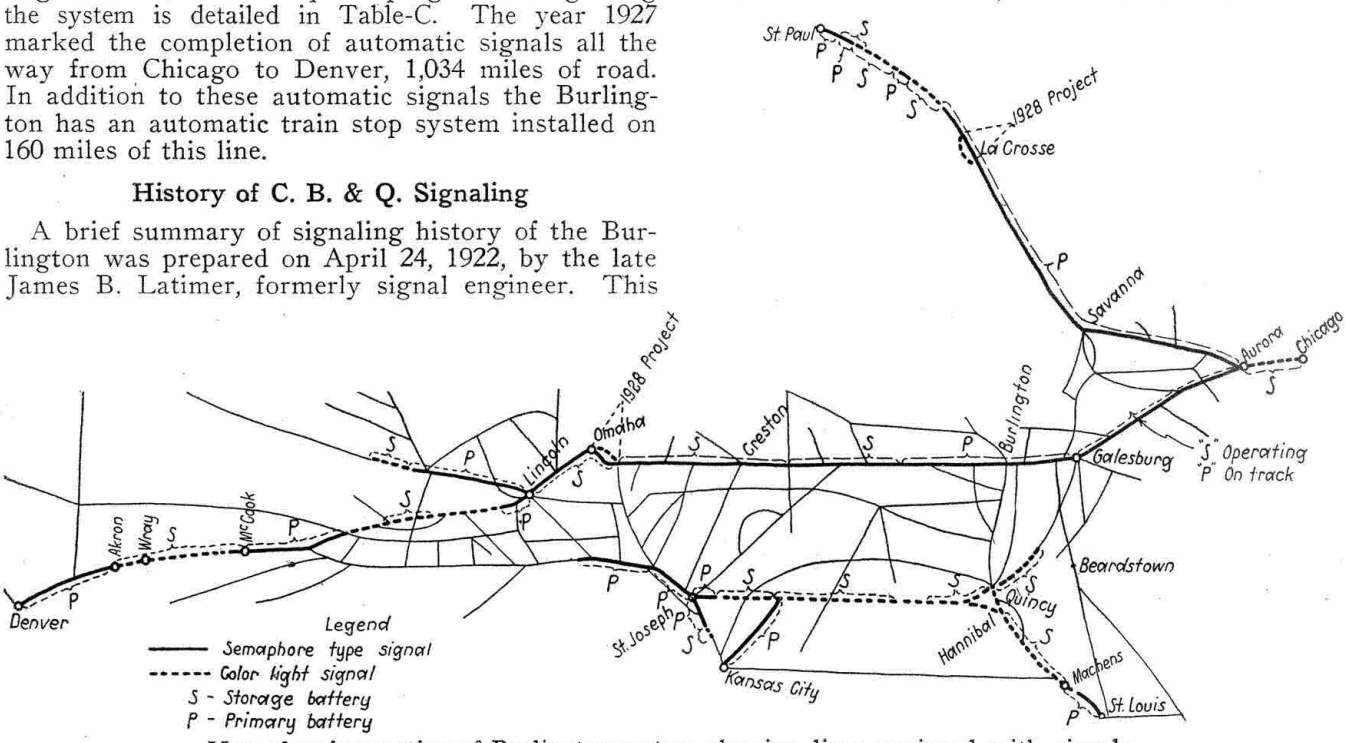
DURING each of the past 16 years the Chicago, Burlington & Quincy has been carrying on an extensive signaling program with the view of providing automatic block signals on all of the main traffic lines, particularly the lines between Chicago and Denver, Colo.; Aurora, Ill., and St. Paul Minn.; St. Louis, Mo., and Kansas City, and Galesburg, Ill., and Kansas City, Mo. Prior to 1911 a few small signal installations were in service in and around large terminals. Subsequent progress in signaling the system is detailed in Table-C. The year 1927 marked the completion of automatic signals all the way from Chicago to Denver, 1,034 miles of road. In addition to these automatic signals the Burlington has an automatic train stop system installed on 160 miles of this line.

History of C. B. & Q. Signaling

A brief summary of signaling history of the Burlington was prepared on April 24, 1922, by the late James B. Latimer, formerly signal engineer. This somewhat condensed report of Mr. Latimer's has a double significance in this instance, for in addition to recording installation of manual and automatic signals on the Burlington it recalls the early development period of what is known as the A. P. B. (absolute permissive block) system of single track signaling. The Burlington has the distinction of having placed in service the first section of A. P. B. signaling in the United States. The report, an abstract of which follows, is in effect a signal department performance record, but it is more than this; it is an interesting example of what one American railroad has accomplished to provide maximum safety and facility of operation in passenger and freight transportation by rail:

"In January, 1903, the Chicago, Burlington & Quincy had no automatic block signals in service except in the Chicago yard from Jefferson street to Crawford avenue, on the two main passenger tracks, a distance of 4.4 miles, and from North Market street, St. Louis, to West Alton, double track main line, a distance of 16.5 miles. The Chicago signals were of the semaphore type and of the electro-pneumatic design of the Union Switch & Signal Company.

"The signals between North Market street, St. Louis, and West Alton were of the Hall Signal Company's disc or "banjo" type and had been installed by the company in 1893 when the line from Old Monroe to St. Louis was completed.



Map of major portion of Burlington system showing lines equipped with signals

"However, a complete manual block system was in operation between Chicago and Burlington, Iowa, Aurora, Ill., and Savanna, Galesburg, Ill., and Quincy, and Galesburg and Peoria. This system was first inaugurated in 1889 between Aurora and Chicago, which at that time was a three-track line to Downers Grove and double track from Downers Grove to Aurora.

"W. B. Throof, then roadmaster of the Aurora division, and L. E. Johnson, superintendent, went over the line on a hand car to locate the block stations. The two-arm signal was used, a red blade above and a green blade below. Both blades down indicated a clear block; the upper blade down and lower blade horizontal was the permissive signal for freight trains, and both blades horizontal was the stop indication. Passenger trains were not allowed to take the permissive signal.

Table A—Lock and Block System Installed Between 1905 and 1910

	Miles
1906 Nodaway, Mo., to Curzons*	11
1906 West Quincy, Mo., to Moody*	4
1907 South Aurora, Ill., to Savanna	107
1907 Savanna, Ill., to Galena Jct.	26
1907 East Dubuque, Ill., to Prescott, Wis.	223
1907 Galesburg, Ill., to Quincy	99
1907 Galesburg, Ill., to Peoria	53
1907 Galesburg, Ill., to Savanna	97
1907 Brookfield, Mo., to Cameron Jct.	67
1907 Cameron Jct., Mo., to Birmingham	45
1907 Armour, Mo., to Block 36*	7
1907 Block 31, Mo., to Beverly*	4
1907 St. Joseph, Mo., to Council Bluffs, Ia.	128
1907 Red Oak to Balfour, Ia.*	24
1908 Omaha, Neb., to South Omaha*	4
1908 South Omaha, Neb., to Lincoln	46
1908 Burlington, Ia., to West Quincy, Mo.	79
1908 Moody, Mo. (now Mark), to Machens	107
1908 Moody, Mo., to Brookfield	98
1908 Cameron Jct., Mo., to Saxton	29
Total miles	1,258

"In 1893 this system had been extended to the lines above mentioned, which meant practically all of what was then the 'Illinois lines,' and there is no question that the system worked remarkably well. Mr. Willard, then general inspector of transportation, used his influence to get the system extended and when he was appointed vice-president in charge of operation we had extended it to cover what is now the LaCrosse division and we were blocking on the old St. Louis, Keokuk & Northwestern from Burlington to St. Louis and on the Hannibal & St. Joseph from Hannibal to St. Joseph and Cameron Junction to Birmingham and on the main line through Iowa with one-arm signals, using a caution card for the permissive movement.

"A lock and block system, automatically controlled was installed in 1900 between Whitebreast Ia., and Troy, three miles of single track of the maximum grade on the subdivion where helping engines are used. The signals were installed in connection with two mechanical interlocking plants, one at Whitebreast, and one at Troy, to handle the ends of double track. No special lock and block instruments were used, the block signals being handled by levers in the interlocking machines and these levers were locked against each other by line circuits and automatically by a track circuit. The arrangement is still in use and has always proved satisfactory.

"Shortly after Mr. Willard took charge we put up two-arm signals on the main line through Iowa wherever there was double track, and between 1905 and 1910 equipped the single-track lines shown in Table A with lock and block machines manufactured by the General Railway Signal Company.

"Items marked (*) in Table A were put in with automatic track circuit control. This track circuit control was complete with electric locks on siding switches. It was from this circuit we designed for this installation that we obtained the idea for our A. P. B. signaling.

"Owing to double tracking and the installation of automatic block signals, much of this lock and block has been abandoned, but it is still in use as indicated in Table B.

"In 1911 electric train staff was installed on two portions of the Beardstown division where helper engines were used between Bader, Ill., and Browning, 3.5 mi. single track, and between Block 107 and Block 104, 3.5 mi. single track. The instruments used are those of the Union Switch & Signal Company. This is still in service and is all of the staff block we ever had.

"In 1914 automatic lock and block was installed between Maxon and Tower 307, a distance of 6.2 miles on the north track. Although this is a double-track line, on account of the passenger station at Albia, which is intermediate between these two points, being some distance away from the regular eastward track, passenger trains were operated between Maxon and Tower 307 in either direction on the north track and it was thought advisable to provide automatic protection. This is the last lock and block that was installed and is still in service.

Table B—Lock and Block System in Service 1911

	Miles
West Quincy, Mo., to Mark (or Moody)*	4
Lytle, Wis., to Prescott	97
Bushnell, Ill., to Quincy	71
Galesburg, Ill., to Peoria	53
Henderson, Ill., to Savanna	92
Brookfield, Mo., to Cameron Jct.	67
Armour, Mo., to Block 36*	7
Block 31, Mo., to Beverly*	4
Napier, Mo., to Council Bluffs, Ia.	94
Burlington, Ia., to W. Quincy, Mo.	79
Mark, Mo., to Machens	107
Mark, Mo., to Brookfield	98
Cameron Jct., Mo., to Saxton	29
Total miles	802

"In 1912-1913 four temporary block stations in Illinois, which had been maintained since 1893, were replaced, at Clarion (between Mendota and Arlington), at Sadler (between Kewanee and Galva), at Enox (between Galva and Altona), and at County Line (between Wataga and Galesburg) with what we called 'split block,' which was an arrangement of semi-automatic signals operated by the block operators at Mendota, Arlington, Kewanee, Galva, Altona, Wataga and Galesburg, and did away with the expense of block operators at the four intermediate points. It had been the practice to close these block stations whenever business fell off and open them again when it picked up, but so much delay always occurred before authority to open them could be secured that I was appealed to help out with something more permanent, and as a result designed this split block, which worked excellently, if I do say

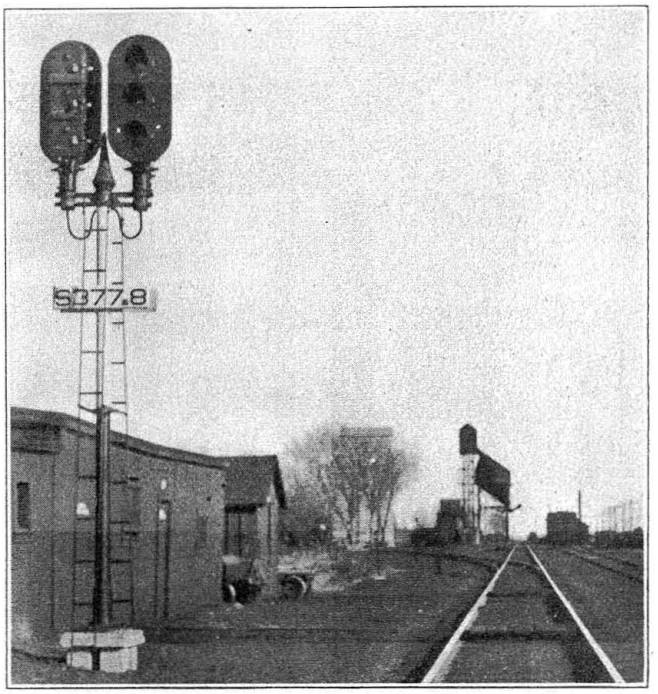
Table C—Installation Data—C. B. & Q. Automatic Signals

		Miles Double Track	Miles Single Track
1903	(In service) Chicago Terminal	4.4	0
	St. Louis, Mo., to West Alton	16.5	0
1907	(Installed) West Alton, Mo., to Machens	6.5	0
1909	Chicago Terminals	4.7f	0
1910	St. Croix Jct., Minn., to Newport	11.9*	0
1911	Cameron Jct., Mo., to Murray	8.2*	44.32
1912	Galesburg, Ill., to Brick Yard Switch	2.2	0
1913	LaVergne, Ill., to Aurora	28.32t	0
1914	Akron, Colo., to Denver	0	111.42
	St. Louis, Mo., to Machens (Banjo signals replaced with semaphores, no increase in mileage)		
1915	Savanna, Ill., to Portage	28.46	0
1916	Montgomery, Ill., to Mendota	43.61	0
	East Dubuque, Ill., to Crawford, Wis.	51.93	0
	Omaha, Nebr., to Lincoln	16.89	36.0
	Indianola, Nebr., to McCook		.11
	Holdrege, Nebr., to Oxford	9.0	23.01
	Union Depot K. C., Mo., to St. Louis Ave.	0.4	0
1917	Galesburg, Ill., to Ottumwa, Ia.	117.36	0
	St. Joseph, Mo., to Napier	34.1	0
	Crawford, Wis., to Lytle	65.97	0
	Lincoln, Nebr., to Dorchester	0	27.96
	Gibson, Nebr., to Omaha	1.92	0
	Holdrege Jct., Nebr., to Holdrege	0	1.16
	Council Bluffs, Ia., to U. P. Transfer	0	0.84
1918	Mendota, Ill., to Wataga	72.83	0
	Wataga, Ill., to Galesburg	7.15t	0
1919	Creston, Ia., to Gibson, Nebr.	63.6	44.31
	Dietz, Wyo., to Ranchester	0	11.79
1920	Aurora, Ill., to Savanna	8.49	95.7
	Oxford, Neb., to Arapahoe	0	14.58
	Cushman Jct. (Lincoln, Nebr.) to Gr. I.	0	96.32
1921	Osceola, Ia., to Creston	33.2	0
1922	Lytle, Wis., to E. Winona		15.2
	Napier, Mo., to Pawnee, Nebr.	3.3	51.95
	Arapahoe, Nebr., to Indianola		27.7
	St. Joseph, Mo., to Saxton		5.1
	So. St. Joseph, Mo., to Block 36	13.7	9.8
	Hannibal, Mo., to Louisiana		27.7
1923	Macon, Mo., to Cameron Jct.		101.2
	East Winona, Wis., to Purdy		12.5
	Alma, Wis., to Stockholm		21.3
	Diamond Bluff, Wis., to St. Croix Jct., Minn.		14.2
	Guernsey, Wyo., to Wendover		8.4
	McCook, Nebr., to Culbertson		11.2
1924	Alma, Wis., to Purdy	13.36	
	Stockholm, Wis., to Diamond Bluff		23.9
	Casper, Wyo., to Brookhurst		4.6
1925	Ottumwa, Ia., to Osceola	19.4**	10.7
	Hannibal, Mo., to Monroe City		31.1
	Louisiana, Mo., to Clarksville		9.9
	Machens, Mo., to Old Monroe		24.7
1926	Newport, Minn., to St. Paul		10.0†
	Harvard, Nebr., to Kenesaw		29.3
	Grand Island, Nebr., to Ravenna		31.4
	Wray, Colo., to Akron		53.3
	Clarksville, Mo., to Old Monroe		32.4
	Hannibal, Mo., to Mark		13.9
	Ewbank, Ill., to Golden		20.5
	Cameron, Mo., to Saxton		28.5
	Beverly, Mo., to Block 36		9.1
1927	Mark, Mo., to Palmyra		8.7
	Kenesaw, Nebr., to Holdrege		38.8
	Dorchester, Nebr., to Harvard		52.6
	Culbertson, Nebr., to Wray, Colo.		78.5
	Purdy, Wis., to Bluff Sdg.	10.	
	Diamond Bluff, Wis., to Prescott	10.7	
	Totals	728.0	1,325.8

Grand total (D. T. and S. T.)=2,053.8 road-miles.

it myself, until we put in automatic block signals. In 1912-1913 we put in this split block on the single-track line between Indianola, Neb., and McCook, and between Wray, Colo., and Eckley. The former was converted into A. P. B. automatics in 1917 and the latter in 1927.

"During most of this time there were no eight-hour laws and we were at liberty to work block operators 12 hr. Our train movement was being so well regulated by this block system that Mr. Rice was much opposed to the installation of automatic block signals, and I am free to admit I fully agreed with him. The consequence was that we continued to operate in this way until eight-hour laws were passed, which



The "Gold Spike" of Burlington signaling from Chicago to Denver—Signal S-377.8 at Wray, Colo., placed in Service, December 21, 1927

made the expense of this sort of operation so great that we began to consider seriously the installation of automatic block signals.

Burlington Installed First A. P. B. Signaling

"Having decided that the operation of manual block was too expensive, we put in automatic block signals between Cameron Junction, Mo., and Murray Tower in 1911. These were the first A. P. B. signals ever installed in the United States as far as I know. They were put in according to a circuit designed by W. F. Zane and T. C. Seifert, and I feel that we can claim to be pioneers in the A. P. B. single-track block system. The idea of A. P. B. block was first brought out by the General Railway Signal Company who patented a circuit for this type of signal and the Chicago & North Western was installing about 50 miles of this circuit at the same time we were installing ours, but we got ours in service first and, therefore, claim priority.

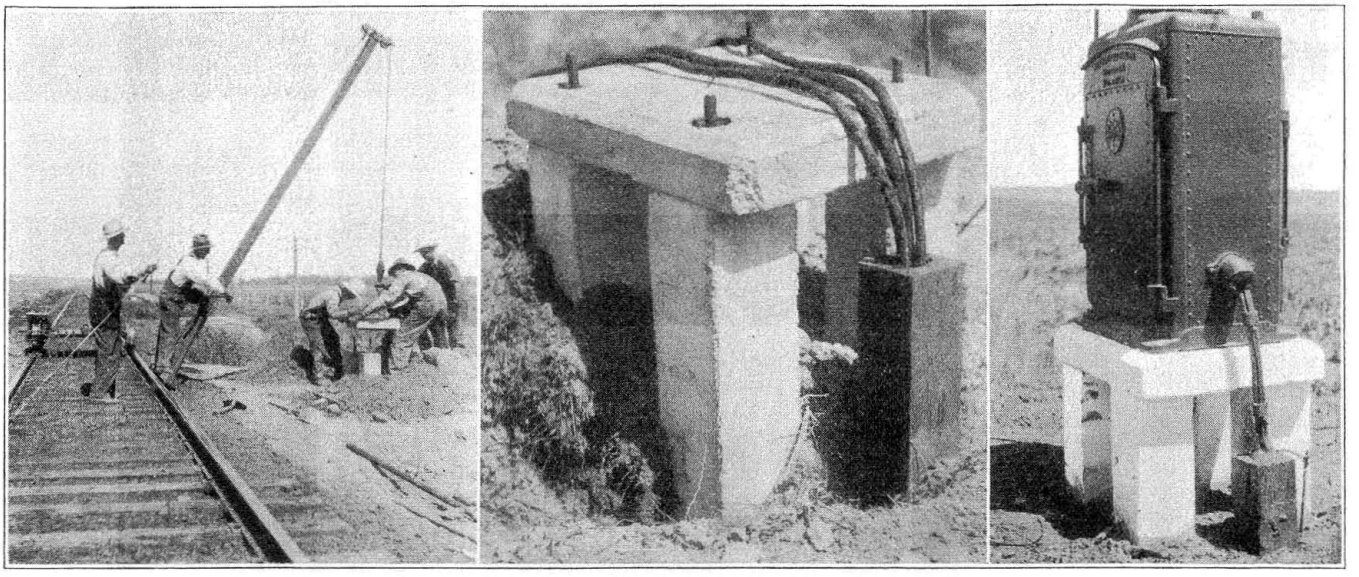
"I did not like the G. R. S. circuit, as it required trainmen to push buttons in order to clear the sig-

*Mileage marked thus is one side of a joint double-track arrangement between St. Croix Jct. and Newport, Minn., and between Birmingham and Murray, Mo.

†Mileage marked thus is C. B. & Q. side of joint track arrangement between Newport and Hoffman Ave., St. Paul, Minn.

**Maxon—Tower 307 signals one track only.

nals before leaving a station and had other objectionable features which the circuit designed by Mr. Zane and Mr. Seifert eliminated. However, our circuit did require the use of interlocking relays in order to make the selection between a train going in one direction and one going in the other. The interlocking relay is a special piece of mechanism and, protection against failure, required a stock of interlocking relays to be kept on hand, which, al-



Sectional foundations placed by portable crane

Parkway protected at ground line by pump log

Finished location with cable sealed in

though not a serious objection, was one to be avoided.

"In 1914 we contracted with the Federal Signal Company to install single track A. P. B. automatics between Denver, Colo., and Akron, using the same circuit that we had used between Cameron Junction and Birmingham. However, during the progress of this work, the Federal Signal Company bought the business of the bankrupt American Signal Company of Cleveland, Ohio, which concern had an unfinished contract with the Nickel Plate for an installation of A. P. B. single-track automatics somewhere in Indiana, and the American Signal Company had designed an ingenious circuit which eliminated the use of interlocking relays and used a stick relay instead. This, of course, gave us the advantage of being able to eliminate the interlocking relay, and since that time all of our single-track A. P. B. signals have been put in with the stick relay circuits, and we have also changed the two installations (between Cameron Junction and Birmingham, and between Akron and Denver) so as to remove the interlocking relay.

"Mileage marked thus (*) in Table D is one side of a joint double-track arrangement between St. Croix Junction and Newport, Minn., and between Birmingham and Murray, Mo., as explained above. All single-track automatics are A. P. B. Double-track automatics, Montgomery to Mendota, installed in 1916, and those from Mendota to Wataga, installed in 1918, are arranged to protect movements in either direction on each track under A. P. B. circuits. The middle track from Wataga to Galesburg is A. P. B. The middle track LaVergne to Aurora is not A. P. B.

"Signals from Akron, Colo., to Denver, were installed by the Federal Signal Company under contract. All others now in service were installed by our forces. This totals 1,134.15 miles of road, and 1,789.15 miles of track equipped with automatic block signals of our own, in addition to joint double track with other roads."

Subsequent Signaling on the Burlington

Mr. Latimer's report brought the history of signaling on the Burlington down to 1922. A supplemental report prepared last year continues the story to date. Still further reductions have been made in the list shown in Mr. Latimer's report until the lock and block situation now is as follows:

	Miles
Bushnell to Golden	50
Galesburg to Peoria	53
Henderson to Savannah	92
Napier to Council Bluffs	94
Burlington to West Quincy	79
	368

Since 1922 considerable headway has been made and the progress since that time is depicted in Table D.

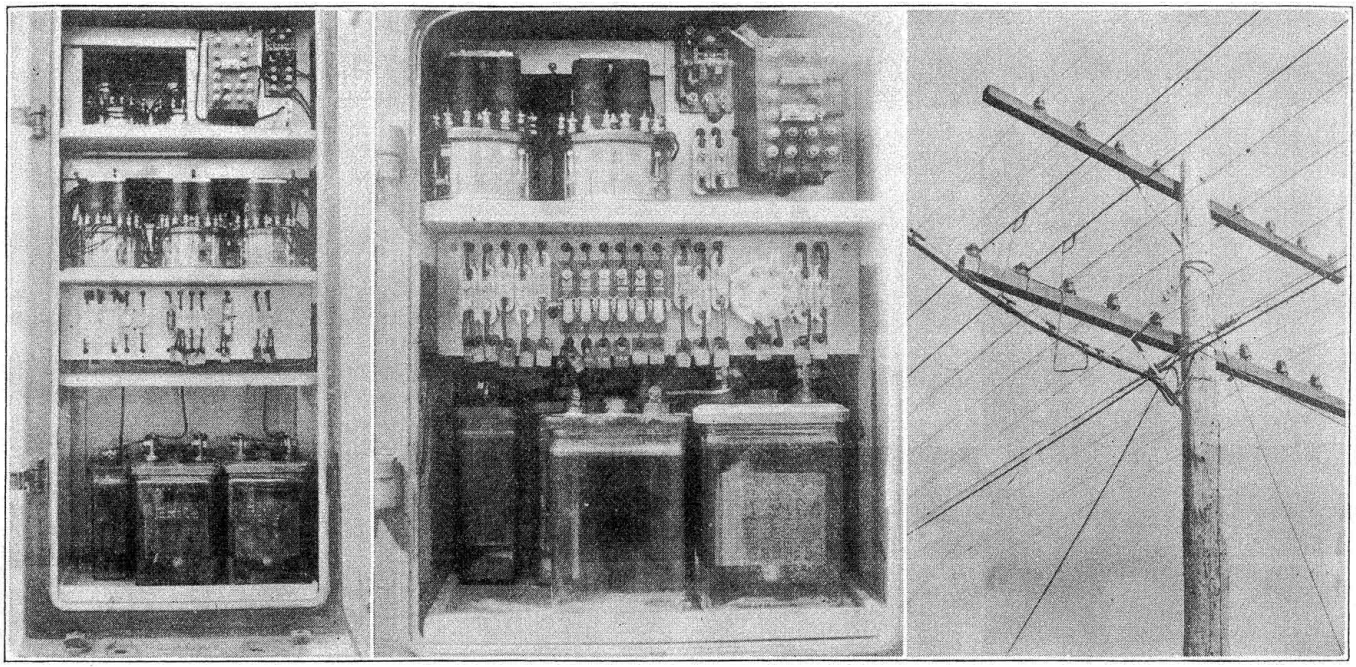
In 1925 the semaphore automatic block signals between Aurora, Ill., and Chicago were replaced with light signals of the color-light type and the semaphore signals were completely worked over and installed between Ottumwa, Ia., and Osceola. During the years 1922 and 1923 it was found expedient to contract for the installation of certain of the signals.

A-C. Floating System Adopted

During the year of 1922 the first color-light signal installation with the so-called trickle charging of storage batteries was installed. Considerable early investigation and use in a small way of the principle of charging storage batteries with rectifiers had proved that it was feasible to consider its use in a signal installation with a power transmission line of low-voltage to light signals and charge batteries. The installation between Hannibal, Mo., and Louisiana was so installed with light signals and while considerable trouble was encountered at first, the trouble was gradually overcome until today this principle is used throughout in new installations.

The automatic signals constructed in Nebraska and Colorado during 1927 represent the latest types

of construction and the description following applies to these installations. The signals are laid out on the standard Burlington system, using home and distant signals, the distant signals being located 4,000 ft. from the home signals. One set of intermediates is used where the stations are up to seven miles apart and two or more sets for greater distances. The signals are controlled by the overlap method. The track circuits average 2,500 ft., the maximum being 3,200 ft., and are relayed between the home and distant signals. Two-light, color-light signals are used except for short blocks such as around stations where the home and distant signal for the next home signal are combined into a three-light signal. The home signals indicate either red for *stop* or green for *clear*, while the distant signals indicate either yellow for *caution* or green for *clear*. The General Railway Signal Company's assembled type signals are used with a doublet lens combination using a 10-volt, 18-watt single filament bulb with bayonet base. The signal masts are at the height needed to bring the center of the top lens 16 ft. above the top of the rail.



Interior of instrument cases and view of pole showing cable drop and line circuit cable

Efficient Material Distribution Eliminates Delays in Construction

All materials are ordered well in advance of the construction season and for Lines West are assembled at the storehouse at Havelock, Neb. Several box cars assigned for general overhauling are given light repairs to fit them for material handling service when hauled at the rear of trains. These cars are set in at the platforms of the storehouses and materials are loaded according to directions given on requisitions. As each part of the work is handled by separate crews, each crew is assigned a number and material to be used by a certain crew on a particular stretch of signal work is loaded in one or more separate cars and shipped to this crew. The cars are held until the material is used. This method eliminates the cost of temporary storehouses located on the line and gives the crew an advantage of having a moving storehouse with materials always near the point of installation.

The Burlington keeps a clean right of way with uniform embankments around signals. From past experience it was found that it was unsatisfactory and expensive to build embankments for signals by hand or by hauling dirt on push cars. Local teamsters were employed at the rate of 71 cents an hour with a driver. Three or four teams with scrapers and a couple of extra men all under the direction of a foreman can easily build up the extra embankments ahead of the signal construction forces and the cost is not over $40 a mile. The result is a uniform bank around signal locations which meets the approval not only of the signal department but of all other officers as well.

Crew No. 2 includes 16 men and a foreman, working three sub-gangs. Six men dig the holes and set the foundations, pre-cast assembled foundations being used. These foundations are made in the Burlington concrete plant at Hannibal, Mo., and are loaded and shipped as directed by requisition. Cars loaded with foundations are hauled in the way freight over a district to be signaled and the section crews under the direction of the general signal foreman unload enough foundations at each station as are required for signals half way to each station in either direction. When the foundation crews come along they distribute these foundations on push cars pulled by motor cars.

Hand Derrick Used to Advantage

When a hole is dug, the sections of the foundation are picked up by the hand derrick as shown in the illustrations and set in place. The use of the derrick eliminates all lifting by hand. After the top is in place the nuts are tightened quickly by large 24-in. ratchet wrenches so that a foundation can be set in about 10 to 15 min. by three or four men. It should be noted that this method eliminates distribution of loose concrete materials and concrete mixing on the job as well as work train service, and provides that any type of freight car can be used in transport. With a little experience a foreman can size up the local ground conditions and level up the bottom of

the hole to provide an allowance for settling that will bring the signal in a true vertical position. Adjustments can be made later after the signals are in service to bring them to the exact position. This sub-screw of six men set an average of eight to ten such foundations a day.

As soon as the foundation is set the foreman measures the runs of parkway cable from the rail connections to the relay case on the line side and from the relay case to the opposite signal. These lengths are carried six feet beyond the top of the foundation to allow enough length to reach the terminals in the relay case. These measurements are made within close limits and about a foot at the relay case is allowed for frost heaving and 10 in. at each bootleg connection to care for track raising. A tag is made out and attached to the parkway runs required at each location to distinguish the location where it will be installed.

A Good System for Installing Parkway

A sub-crew of three or four men work in or near the supply cars to make up the parkway according to these tags. The parkway cable for the track connections is two-conductor No. 12 solid copper with 3/8-in. insulation on each conductor, one covering of lead sheath 3/64 in. thick and two wraps of steel tape 0.02 in. thick with jute filler and wrapper. The parkway cable used is Okonite.

The track runs are made up with a duplex cable, run from the relay case to a point near the end of the cross-tie at which point each single-conductor is joined to a short section of the same kind of duplex cable that is long enough to go to a point near the rail where it is joined to an 8-ft. piece of No. 8 soft-drawn bare copper bent at the middle, the ends extending for bonding into the rail. All the joints are soldered and wrapped with rubber and friction tape. Two methods are used to protect these joints, one using a pump log and the other a cast-iron case.

In the pump log method, the finished joint from the main run to the two branches is slipped into a piece of pump log, 18 in. long and 6 in. by 6 in. with a 3-in. round hole. One end is stuffed with jute and the log filled with molten R. S. A. Parolite. The joint of the cable and the bare copper wire for rail connection is slipped into a pump log 4 in. by 4 in. with a 1½-in. hole. After stuffing some jute around the hole where the two bare wires come out of the notch in the cover, the log is turned upside down and filled with molten Parolite. A wood block had been used for a top, but on account of splitting, a small square of galvanized sheet iron has been used on later work. These pump log sections are made in the Burlington plant from scrap pieces of Southern pine and are treated with creosote by the pressure method. For a part of the work, cast-iron junction boxes and risers are used. In addition to several holes 1 in. in diameter, a 2-in. hole is left to pour in the Parolite sealing compound.

The Midwest Signal Supply Company cast-iron parkway bootleg outlet used on the Burlington consists of a tubular riser with a special top, and flanges on the side for nailing it to an oak stake. The cable is brought up through the bottom and a fiber ring slipped over it to make a close fit at the bottom. The joint is made and the two No. 8 bare wires slipped out through holes in a fiber section in the cap. The riser is then filled with Parolite and the lid fastened on with cotter keys.

For the runs from the relay case on the pole line side to the opposite signal, 3-conductor, No. 12 solid parkway cable is used for a two-light signal and 4-conductor for a three-light signal. A section of this cable as called for on the tag is cut off and together with the finished track runs is bundled up and tagged ready for the field forces. It should be noted that with this method of making up the cables no time is lost handling heavy cable reels in the field. No cable is wasted and no time is lost in the field by the men digging trenches waiting for the wireman to complete the joints.

The parkway sub-crew of six men haul out and install the finished cables. The trenches are dug to a depth of 2 ft. below the bottom of the ties. When digging trenches, the ballast is thrown to one side and the bottom dirt to the other and then the dirt is thrown around the cable first and the ballast last. The bootleg risers are set on the outside of the rail with the top about 1 in. from and about 1 in. above the edge of the base of the rail. Where the cables come up out of the ground at the signal foundation to enter the case, a section of the larger pump log is slipped down over the cables to protect them at the ground line. This log is filled with Parolite.

The fouling shunt connections are made up of two separate two-conductor No. 8 parkway cables with bootlegs constructed as described above. For the connections from the switch circuit controllers to the rail a two-conductor No. 8 parkway runs from each rail to the switch box. The ground rods are copperweld ½ in. by 7 ft. with No. 8 insulated copper ground wires wrapped and soldered to the rod. The connecting wires are made up at the cars and the rods are installed by the crew that installs parkway. This sub-crew of six men install enough parkway cables for about eight locations a day.

The Bonding Is Handled by Contract

In view of the fact that a unit basis for piece work is readily established for track bonding, this work is handled by contract at five cents a joint. A separate crew is employed, directed by an experienced ex-Burlington signal foreman. Two Everett power drilling machines and two men bonding form a crew. Two No. 8 copperweld bond wires 40 in. long are placed outside the angle bar on the inside of the rail above the bolts and are bonded with duplex 3/8-in. channel pins. After considerable experience these men have become skilled with these power machines and a crew of four men have been able to drill and bond as high as 1,295 joints per 8-hr. day on 90-lb. rail. The average, taking into account weather conditions, moving headquarters, lost time, etc., is about 2.5 mi. a day on single track.

Signal Erecting Crew

The signal erecting crew includes 10 men and a foreman, their work being arranged so that they work in three sub-crews. The signals are unloaded and the poles and ladders assembled on the ground at the locations. These poles, relay cases and signal heads are assembled complete as a unit with all fittings in place at the location where the derrick is used to set the relay case, and the signal mast with signal head (all in one unit) in place. Before setting the case or pole the nuts on the anchor bolts are loosened and the holes down through the foundations filled with molten Parolite and after the nuts are again tightened the hole over the nut is filled. After the case or pole base is in place this hole is also filled. No work train service is required.

The other six men in this erecting crew are divided into two sets of three men each. They tie in the cables from the pole line to the signal, bringing the parkway cable into the case, clean back the steel tape and lead so that it terminates in the wire entrance hood and bring the parkway cables in. When this work is done they paint the signals and relay boxes and install the number boards, leaving the locations complete except for the wiring.

The Two Line Crews

One line crew guys the poles and puts up the two line wires for the 220-volt a-c. feed circuit which are No. 6 hard-drawn copper with triple braid weatherproof covering. Poles at signal locations are guyed four ways and at cut sections or other cable drops, two ways. The two-power wires are placed on the two pins on the track side of the existing lower crossarm, using No. 22 Hemingray glass insulators with steel pins. This crew of 11 men install about 2.5 road-miles of this circuit per day.

The other line crew installs the line cable, all line control circuits being in a Hazard manufactured cable made of No. 16 solid copper insulated wires with a triple twine braid. Either 5 or 7-conductor cable is used according to the wires required between locations. This cable is supported from a ⅜-in. stranded galvanized iron messenger attached to the poles by single bolt suspension clamps. National Junior cable hangers, 1½ in., located 18 in. apart, support the cable, which was pulled in from reels in lengths of about 2,500 ft. The rings are placed on the messenger from the ground and both messenger and cable are raised together and pulled taut. The aerial cables are brought in at each signal location, no terminals or arresters being located on the line poles. This line crew of 11 men put up an average of 1½ miles of messenger and cable a day.

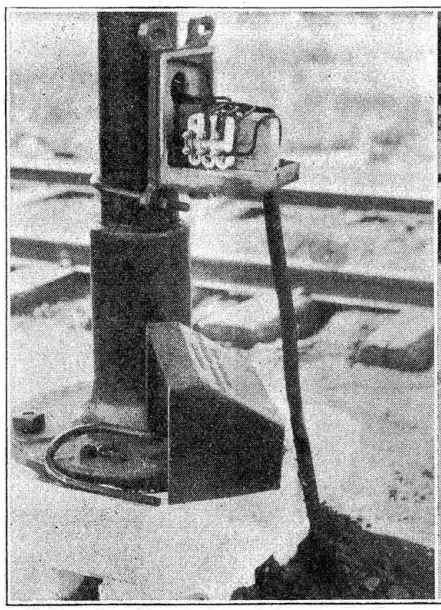
Wiring Crew Completes the Job

The wiring crew includes 10 men and a foreman. Four men make up jumpers from No. 14 flexible Pullman special, and distribute them together with the necessary number of relays, battery rectifiers, terminals, arresters, tags, screws, etc., to each case, together with a blueprint of the case wiring. Two men ring out the wires and cables and tag everything according to the print. Four case wiremen, working independently, complete the job and test circuits for correct operation. When one of these wiremen arrives at a case, everything is in the case ready for him to mount the arresters, terminals and connect the wires.

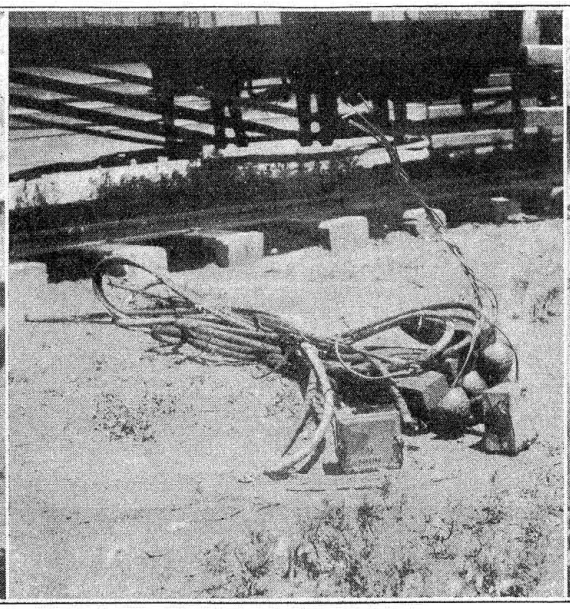
The 220-volt, a-c. circuit is brought in from the line on two No. 12 insulated wires tied up along with the line cable. These wires drop off the cable below the line wires and go directly to the line without going over to the pole, this construction leaving a clear climbing space for linemen. These 220-volt wires are brought into the case to a Brach No. 25-c. arrester and from there to a duplex plug fuse block with 3 amp. fuses before going to the transformer. Brach No. 20 arresters are used for line circuits and Railroad Supply Company spark gaps are placed across track terminals.

One set of four cells of storage battery is used for the line circuit and reserved for signal operation. One cell is used for each track circuit, each set of battery being charged by the a-c. floating method using a Balkite rectifier cell and transformer. The signal light circuit is fed normally from the 8-volt tap of the rectifier transformer and in case the a-c. power is interrupted, a cut-over relay switches the light circuit to the storage battery. All storage batteries are 75 a.h. capacity.

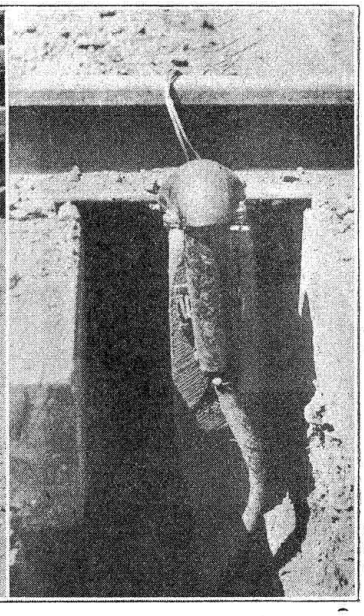
Two sections of this terirtory have the a-c. furnished to the transmission line from a d-c. motor, a-c. generator set located in local d-c. power plants.



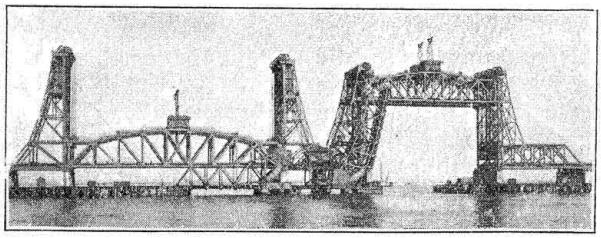
Parkway terminal box at signal



Parkway runs with junction boxes made up



Parkway outlet at rail



The C. R. R. of N. J. Newark Bay drawbridge