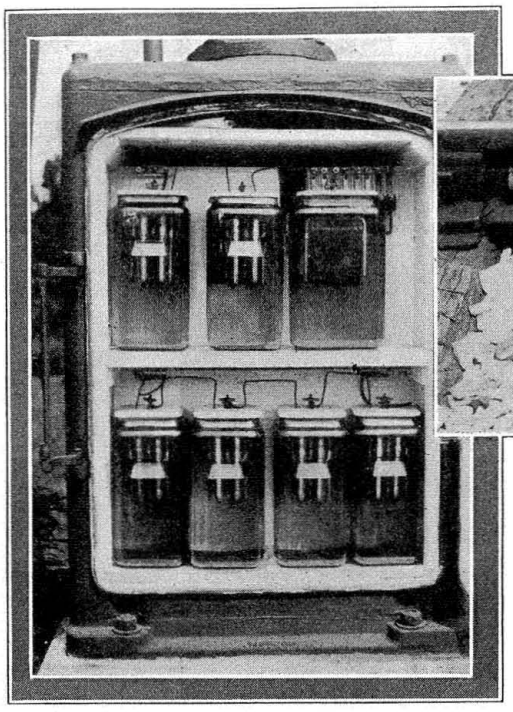
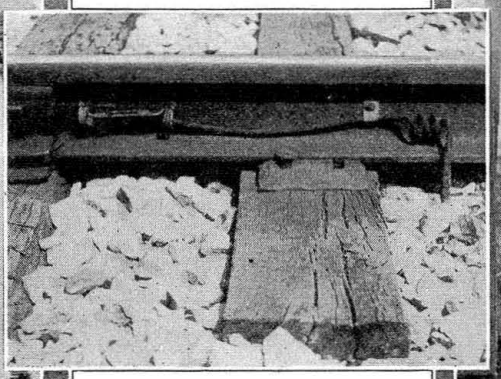
N. C. & St. L. Completes Signaling from Nashville to Atlanta, 288 Miles

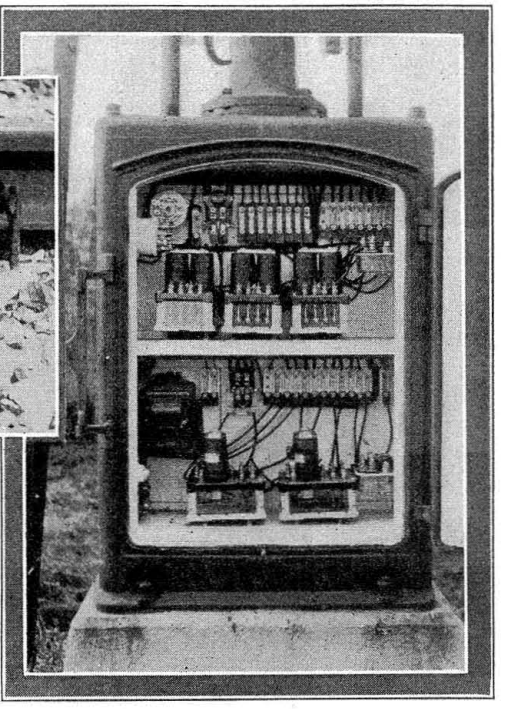
This railroad handles its own construction, including the pouring of foundations in place, pole line work and installation of parkway cables



Left — Primary battery is housed in sheet metal cases.



Above—The parkway bootleg
Right—The relays in the side of the case opposite the battery



By J. H. Schubert

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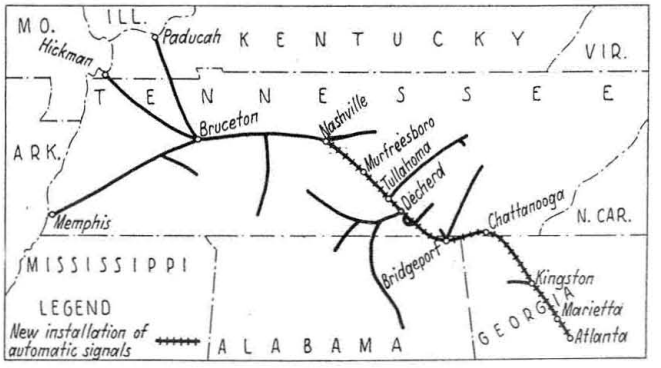
DURING the last three years, the Nashville, Chattanooga & St. Louis, known as the "Dixie Line," has carried on an active signaling program, constructing color-light automatic block signals on the main line from Nashville, Tenn., to Atlanta, Ga., so that the entire route, 288 miles, between these cities, is now signaled.

In the line from Nashville to Atlanta, about 238 miles is single track and 50 miles, double track. This is the route of Dixie Flyer and Dixie Limited as well as other fast trains, making a total of 16 passenger trains and 14 freight trains over most of the line. In addition to this traffic, the Louisville & Nashville operates about 39 trains over this line on the 48 miles of single track between Junta, Ga., and Atlanta, making an average total of about 65 trains a day on this section. The major portion of the line traverses rather rough country with numerous curves, so that automatic signals are of decided benefit in promoting safety of train operation as well as increasing track capacity.

With such heavy traffic, it was decided that some method of power supply for the signals should be used that would render continuous service, in spite of outages of the alternating current supply. The a-c. primary system was therefore adopted as the power supply for the signal system. Normally the current for the light signals is furnished from the alternating current supply, but in case of an outage of the a-c., a relay cuts the signal operation over to a set of Edison 1,000-a. h. primary batteries. These primary batteries are also used for the line control circuits. Three cells of the same kind of primary battery are used in each track circuit.

The signals are the Union Switch & Signal Company's Style-P color-light type mounted on the top of the masts, which in turn are set on top of sheet metal instrument cases for housing the batteries and relays. The entrance block signals are lighted continuously with 8-volt, 18-watt lamps, and have vertical lunar-white marker lights, with 6-8 volt lamps.



Map showing territory equipped with automatic signals

The intermediate signals are approach-lighted with 8-volt, 18-watt lamps, and have diagonal lunar-white marker lights with 6-8 volt lamps. The signals are normally lighted from the 440-volt a-c. line, through a transformer stepping down to 110 volts, which in turn is connected to the combined lighting transformer and relay, and thereby further transformed to the necessary voltage for the lamps.

Track Layout and System of Signaling

The track arrangement consists of 10 lap-passing sidings at 10 stations in the first 48 miles north of Atlanta, Ga., 5 lap-sidings between Nashville and Chattanooga, and 29 straight sidings at stations on the balance of the mileage. At the lap-sidings, trains enter the outer ends and leave at the inner ends, where a repeater signal to the entrance block signal at the outer end of passing siding is located. All entrance block signals are located at the outer ends of passing sidings, and the head-on protection extends from the outer end of one passing siding to the outer end of the next passing siding, the space between being provided with intermediate block signals for following movements, the spacing between signals being approximately 4,800 ft., regardless of the distance between the ends of passing sidings. Cut sections are provided between signal locations. On double track the signals are approximately one mile apart.

Power Supply and Signal Control Wires Placed on Existing Pole Line

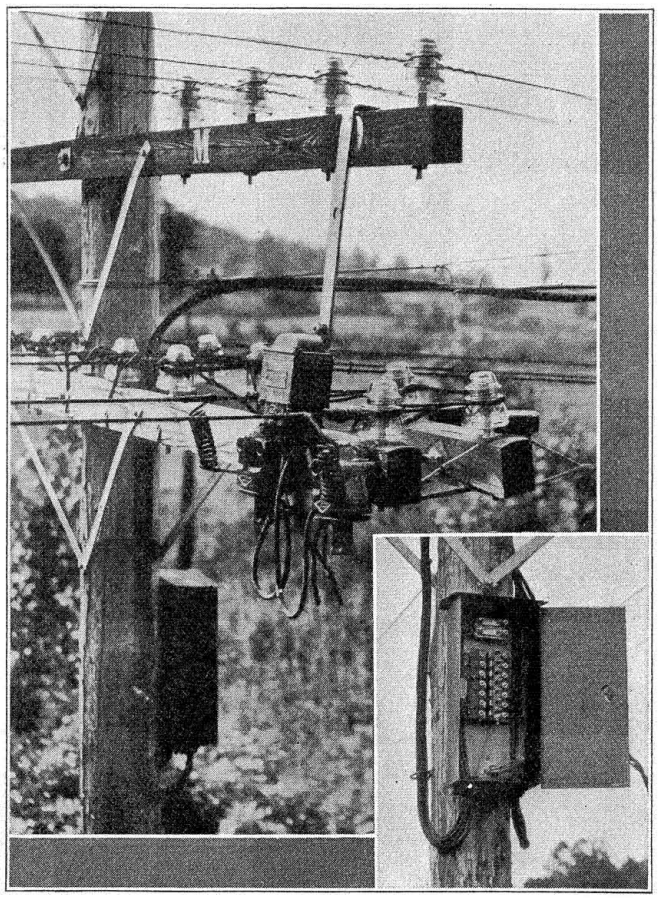
Throughout the line from Nashville to Atlanta, the railroad has its own pole line for communication circuits. A 10-pin cross-arm was added to this line for the signal control and power wires. All line wires are triple braid weather-proof solid copper, the signal control wires being No. 10, but the power supply wires are of various sizes, depending on the length of the feed sections. Power is purchased locally from public utility companies and is fed in each direction at 440-volts a-c., the longest feed being about 8 miles each way from the power connection. In view of the fact that the power line feeders go only to the signals and not to the cut sections, it was possible to eliminate the power line between signals in the gaps between the ends of two adjacent feed sections. This method saved at least a mile of power line wires, insulator, etc., between the ends of adjacent feed sections.

On account of the characteristics of the load, and on account of the fact that the power lines are relatively short, there has been no necessity to transpose the line to eliminate inductive interference with the communication circuits, nor has any such interference been experienced.

Parkway Cable Used Extensively

No trunking was used on this signal installation, all underground circuits being in Hazard parkway cable, made up with insulated solid copper conductors covered with jute, with two wraps of steel tape and an outer covering of jute and twine. The rail connections are No. 9 solid copper single-conductor cable. The control circuits, running under the track from one signal to another, are in No. 9 solid copper 10-conductor cables. All cables are buried 18 in. below the ties and are surrounded by a thick layer of clay.

Two different methods have been used to connect the wires to the rail. The method which has proved most satisfactory, as shown in the illustration, consists of joining a four-foot piece of No. 8 flexible insulated wire to the solid conductor of the parkway cable at a point that will leave this joint above the surface of the ground. This joint is soldered, covered with P. & B., taped and painted again with P. & B. The flexible conductor is then extended through a rail clip to a double cage made of a bond wire, the ends of which are bonded into the rail with channel pins. This method of construction permits ready inspection of all joints and connections, and permits any movement of the rail to be taken up in the flexible section, without transmitting vibration to the solid conductor in the parkway. A coil of four



Line transformer and fuses on cross-arm—Arresters mounted in sheet metal case attached to pole

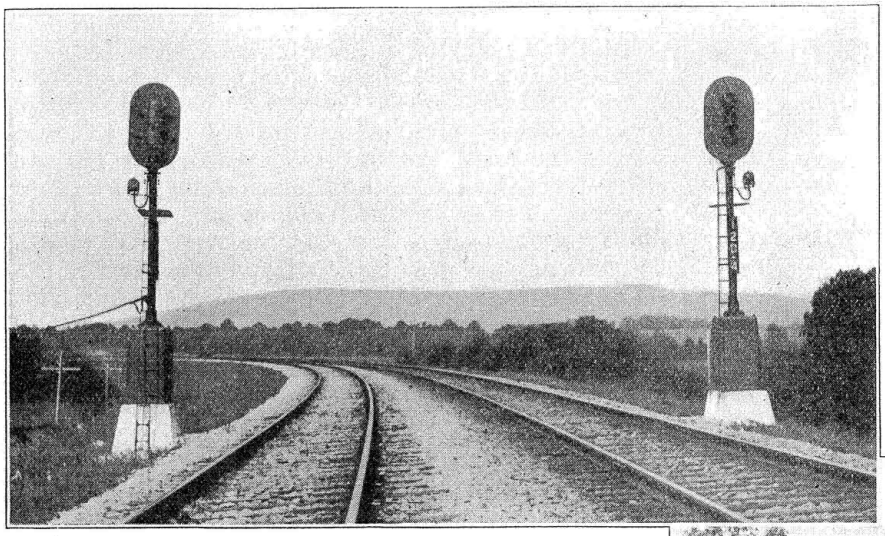
feet of slack is buried in the trench at each place where the parkway rises to the rail. This slack is available in case the joints are moved when the rails are changed.

When making the signal foundations, a wire chase is made with the outside entrance about 18 in. below the ground, and with the top hole under the relay case. This chase is about 5 in. in diameter, being large enough to take 8 or 10 cables of the size used. The outer covering of the parkway cable and the steel wrappings are stripped off of the insulated wire to a point above the bottom shelf of the relay case, and the end of this protective covering is painted with P. & B. and taped, while the insulated conductors extend to the terminal board.

Line Drop Construction

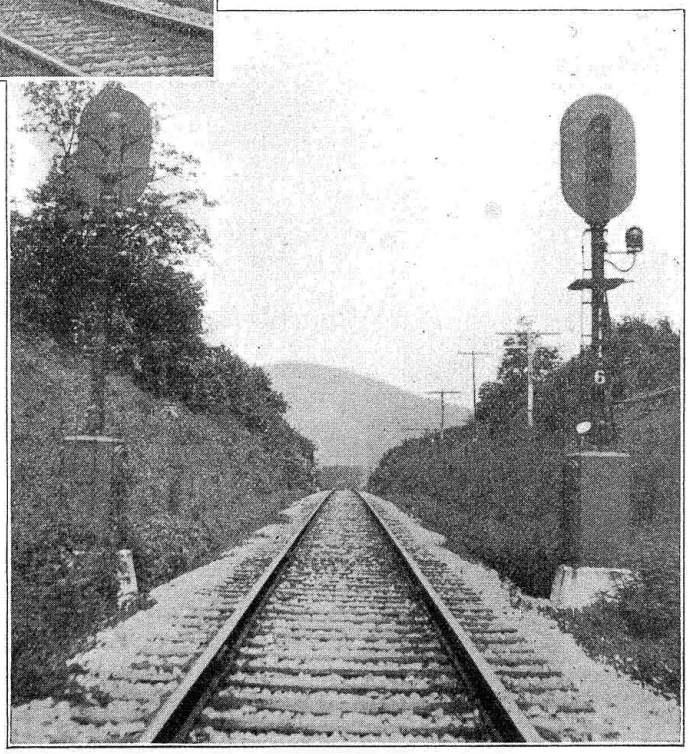
At each signal location a 440 to 110-volt G. E. air-cooled 100-watt transformer (except at locations

where stations are lighted from the same transformer, in which case a 1,000-watt transformer is used) is mounted on the cross-arm. The taps to each side of this transformer are connected from the 440-volt line wires to a porcelain fused cut-out plug mounted on the cross-arm. The 110-volt taps, as well as the taps from the line control wires, are taped to arresters which are mounted in a sheet-iron box on the pole below the cross-arm. From these arresters, the wires run in manufactured cable to the terminals in the relay cases, a separate cable being used for the two 110-volt wires. Mounted in the relay case is a G. E. combined low-voltage transformer and cut-over relay. Taps on this transformer are available to provide 8 to 10 volts for the signal lamp circuits for normal lighting.



Left—The new N. C. & St. L. signaling includes 50 miles of double track from Chattanooga, Tenn. to Bridgeport, Ala.

Below—About 238 miles of the route on which automatic signaling was recently completed is single track. Note the absence of trunking which was made possible by the use of parkway



Pilot Signals Facilitate Switching

At several special locations, where switching movements must be made across or onto the main tracks, when through trains may be approaching, special "pilot" signals have been installed which are not exactly switch indicators, but which serve a special purpose. A pilot signal consists of two single color-light units mounted on the lower part of a signal mast. When no through trains are on the approach section, the yellow light shows, but when a train is coming, the yellow light is extinguished and the red light shows. Train crews switching on the main line or preparing to do so, watch this pilot signal. In other words, this special signal serves the function of a switch indicator, but for a number of switches at the end of the yard lead track where it joins the main track. Instructions governing the use of these indicators are as follows:

Directions for Use of Switch Indicators

"Switch indicators are directional and are marked N. B. for northbound and S. B. for southbound. They will have two red and two yellow lamps, normally not burning, and a push-button.

"To secure information as to whether or not the main track may be occupied, push the button which should cause two lights to appear. If two red lights appear, it means the block is occupied in both directions from the point where the switch indicator is located. If two yellow lights appear, it means the block is clear in both directions from the point where the switch indicator is located, and train movement may be made in either direction under caution to the first signal.

"If one red and one yellow light appear, it means the block is clear only in the direction indicated by the yellow light, and train movement may be made only in that direction under caution to the first signal.

"The opening of the switch will cause the automatic signals on each side of the switch to indicate stop.

"The switch indicator should be observed until the switch is opened, and if the yellow light indicating the block is clear in the direction in which movement is to be made, goes out, or a red light is displayed for that direction, the switch must not be opened.

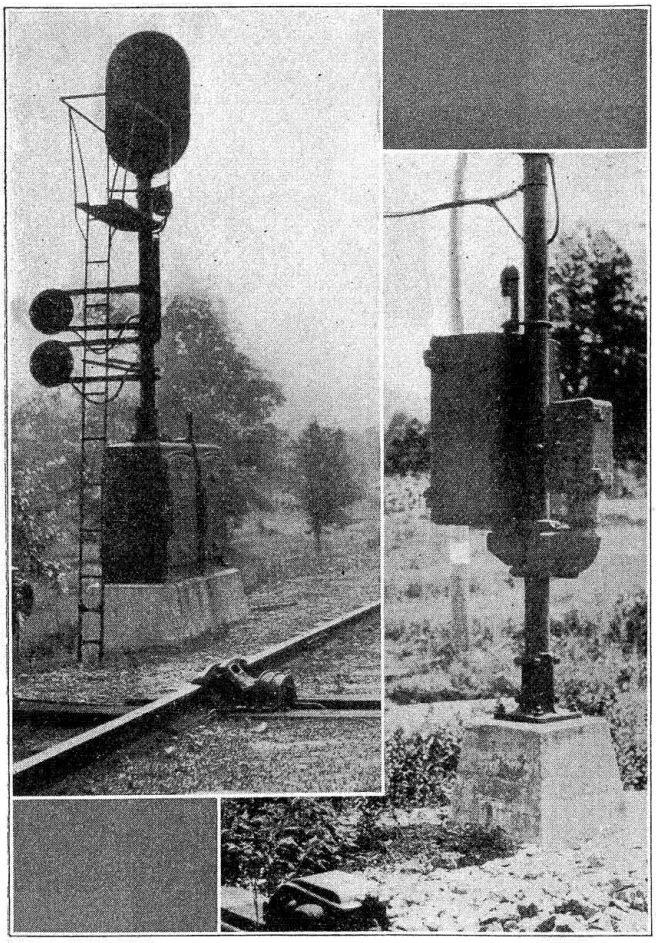
"If the yellow light fails to appear to indicate the block is clear in the direction in which movement is to be made, or a red light is displayed for that direction, wait two minutes, but if a train is seen approaching, or has passed, wait until such train has had time to pass the first signal, before again pushing button. In either case, if the yellow light again fails to appear, or the red light again appears, the telephone may be

used to ask the train dispatcher for permission to occupy the main track under caution to the first signal.

"If the switch indicator and the telephone are both out of order, the main track may be occupied under flag protection to the first signal indicating proceed or caution."

Color-Light Signals Used

The signal units are the long range Style-P, manufactured by the Union Switch & Signal Company, and are mounted on poles and cases supplied by the same company, which also supplied the relays, switch boxes, D. N. L. relays, cut-section relay boxes, cable posts, etc. Two-ohm relays are used on track circuits, 670-ohm polarized relays for line operation, and slow-acting relays of approximately 300-ohms resistance for retardation during the change of line circuit polarity. The line and standby battery consists of 15 cells of 1,000-amp. hr. Edison primary cells in series; the track battery is of the same type with 3 cells in multiple. The insulated joints are of the continuous type, furnished by the Rail Joint Company, the rail being of 90-lb. and 110-lb. section, the latter being the present standard.



Left—A pilot signal on a signal mast. Right—Color-light switch indicators are used at a few industry sidings

Line materials were furnished by the Western Electric Company, the F. D. Lawrence Company and the Chicago Insulated Wire & Manufacturing Company, jointly. Lighting arresters were furnished by the L. S. Brach Manufacturing Company. Duplex copper-clad bond wires and channel pins were furnished by the Railroad Accessories Corporation, and the signal number plates, by the Southern Signal Company. Line transformers, combined signal and lighting relays and multigap arresters were furnished by the General Electric Company.

All cables were supplied by the Hazard Manufacturing Company, steel-taped cable being used, in place of trunking which had heretofore been used throughout.

Railroad Handles Its Own Construction

This 288 miles of automatic block signaling was installed completely by the signal construction forces of the railroad. The forces were organized in three separate outfits equipped and trained to do a certain part of the work, starting at one end of the job and going through to the other. Each outfit had its own tool cars, living cars and dining cars, which were moved from town to town as the work progressed. The line crew, consisting of about 15 men and a foreman, placed the new crossarms, strung the line wire, installed the additional guys, etc. This line construction crew covered an average distance of about three miles a day.

The concrete signal and cable posts and foundations were poured in place from a train. Two 4½-cu. ft., power-driven mixers were mounted on a flat car, with adjacent cars loaded with stone and sand along with a water tank car and camp cars for the men. The sand and stone was handled to the mixer in wheelbarrows handled on overhead plank-ways constructed over the cars.

About 12 men and a foreman were required to operate this train. An average of 22 signal foundations were poured daily. The mixers were started in operation when on the way to a location, and concrete was poured into the forms upon arrival, then another batch was prepared in about two minutes to fill the other forms. The average cost for a foundation in place was about $2.40 for labor and $6.10 for materials, including the forms.

When finished with the foundations, the concrete crew was organized into an erecting crew, consisting of a foreman and 10 men. They did all the bonding, installed the insulated joints and pipe-connected derails, erected the signals and all other apparatus on the foundations. When finished with the line work, the line gang was organized into a parkway crew consisting of a foreman and 10 men. This crew laid all parkway cables in the ground and ran the ends to the cases or boxes. The wiring crew consisted of a foreman and 10 men, who wired all cases and apparatus in the field, as well as the electrically lighted switch lamps. A crew of signalmen and laborers was organized to do all painting of apparatus. The final testing and placing in service of the signaling was carried out by the general signal inspector, assisted by wiremen taken from the wiring gang.

Maintenance Well Organized

This territory of 288 miles is divided into 18 maintenance sections. On account of these automatics cutting through 14 interlocking plants, the sections assigned to each maintainer vary in length from 7 to 22 miles, depending on the amount of interlocking work involved. The average length of automatic signal mileage assigned to each maintainer is approximately 20 miles.