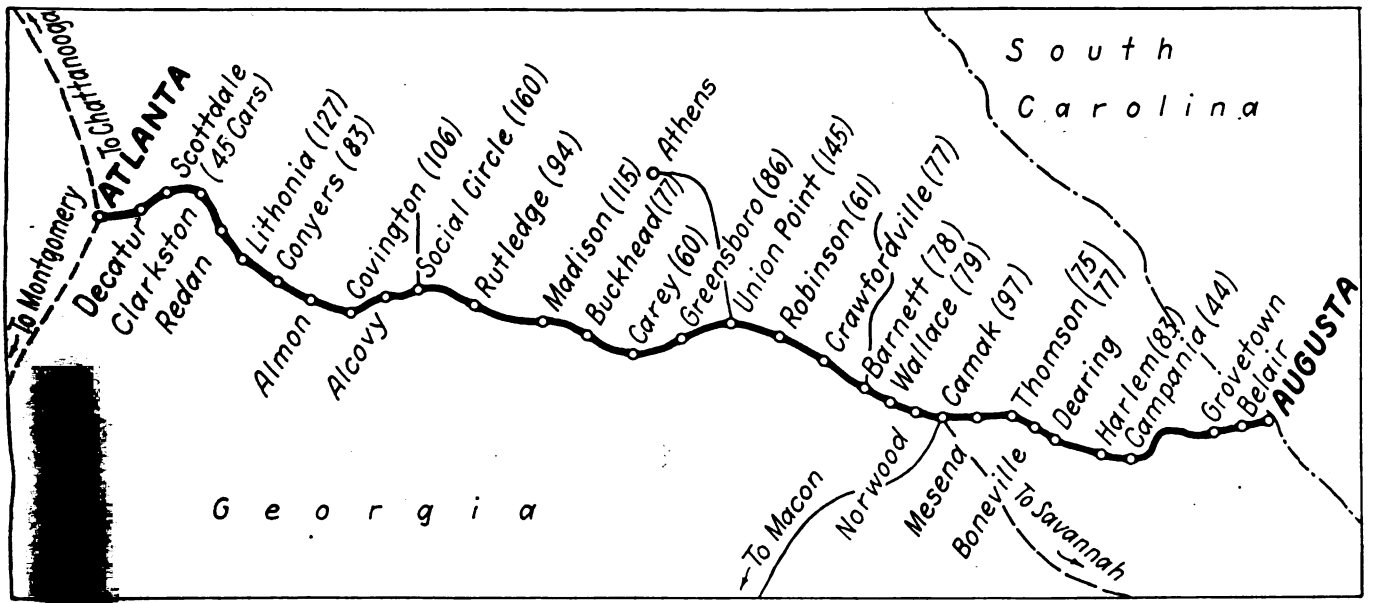


Fig. 1—Map of the Georgia Railroad between Atlanta and Augusta

Automatic Block With Spring Switches

Installed on the Georgia Railroad

On 163 miles of single track handling about 19 trains daily, signaling includes spring switches on 24 passing tracks which are used by the through trains, while 8 were discontinued or were converted to spurs and house tracks

THE Georgia Railroad has recently completed an installation of automatic block signaling and spring switches on 7.4 miles of double track and 163 miles of single track between Augusta, Ga., and Atlanta. This system of signaling was selected after a detailed study of the operations of trains and comparative estimates of the costs and advantages of this system as compared with centralized traffic control including power switches at the sidings and ends of double track. The first section of the new project was completed about April 1, 1946, and the last portion was completed in December.

The Georgia Railroad, the main line of which extends 171 miles between Augusta and Atlanta, is operated in conjunction with the Atlanta & West Point and the Western Railway of Alabama to form an east-and-west connecting line for through traffic in connection with various railroads including the Atlantic Coast Line and the Louisville & Nashville. Augusta is located on the Savannah river at the head of navigation for ocean going ships in the early days. Accordingly, the citizens of Augusta financed the construction of this Georgia Railroad which was built in 1830 to 1835 from Augusta to Athens, Ga., 115 miles, and from Union Point westward 105 miles to a junction with a railroad which was being built by the state of Georgia from Chattanooga, Tenn., southward through Georgia. This junction was the nucleus which grew to be the city of Atlanta..

Character of the Line

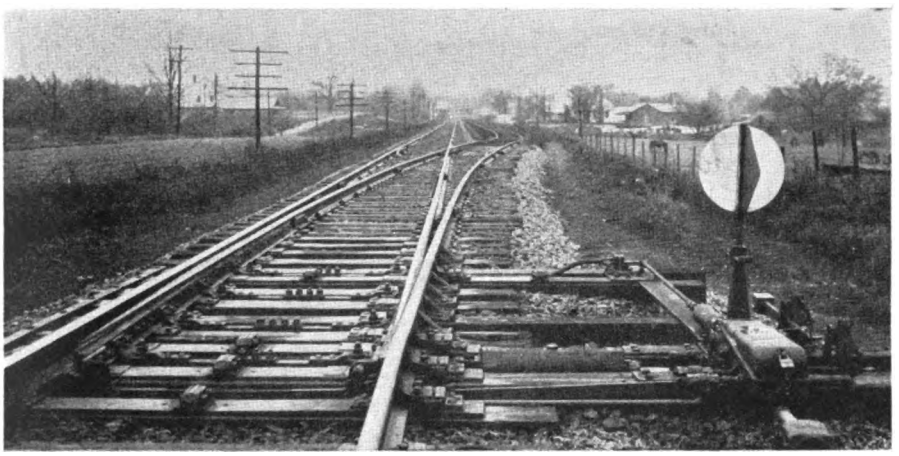
The Georgia Railroad traverses rolling hills and crosses three major rivers, but nevertheless the early engineers constructed the line with a maximum of 0.7 per cent grade and 3 degrees curvature. The elevation above sea level is 115 ft. at Augusta and 1,054 ft. at Atlanta. With only one short break, the grade ascends westward at 0.7 per cent for 13 miles between M.P. 2.5 near Augusta and M.P. 15.5 near Groveton. This grade limits the tonnage rating of the Mikado locomotives to 1,600 tons westbound between Augusta and Camak. Farther west the grades are less, so that the rating is 2,200 tons between Camak and Lithonia, and 2,800 tons between Lithonia and Atlanta. This location of grades to permit increases in tonnage of westbound trains is fortunate, because trains can pick up cars at Camak which is an interchange point with a railroad extending from Savannah. Extensive stone quarries are located at Lithonia and Camak, and the trains can pick up additional cars there to fill out to 2,800 tons.

The grades are more favorable for eastbound trains, and fortunately this is the direction of the preponderance of tonnage. The tonnage rating for

the Mikado locomotives is 2,300 tons eastbound from Atlanta to Union Point, and 2,800 tons between Union Point and Augusta.

On certain sections the curves are numerous, for example, between Harrisonville yards at Augusta and Harlem, 22.5 miles, about 35 per cent of the line is on curves; between Harlem and Camak, 22.7 miles, 25 per cent; and Camak to Atlanta, 120.9 miles, 29 per cent. On account of these numerous curves through hills and woods, the sighting distances are short, which was a factor with respect to the need for signaling, and also an item of importance in locating the intermediate signals to provide maximum view of the signals. With reference to train speeds, the maximum curvature is 3 degrees and accordingly no curves necessitate reductions below the maximum train speeds which are 55 m.p.h. for passenger trains and 45 m.p.h. for freight trains.

The track is well constructed and maintained. The rail is 90-lb. R.E. and 100-lb. R.E. with the exception of a few short stretches of 90-lb. R.A. and 100-lb R.A. The ties are in good condition and there is a deep layer of clean crushed granite ballast throughout the entire length of the railroad. Thus the track, grades, curves and locomotives all contribute to uniformly efficient movement of trains and traffic.



Typical spring switch with facing-point lock

Volume of Traffic

The freight trains stop at Camak and Social Circle for coal and water. The fast through freights are scheduled to make the run in either direction between yards at Atlanta and Augusta in 7 hours. Other trains which set out and pick up cars at junctions are scheduled for 7 hours 30 minutes to 8 hours. The schedules include three through freight trains each way daily, and extra sections of these trains are run as required. A local freight train is operated each direction daily except Sunday, and two passenger trains are operated each way daily. During the first 14 days of January, 1947, there was an average of 18.8 trains daily, including 2 passenger trains each way, 7 freights west and 7.6 freights east. The January, 1947, average of 18.8 trains daily is in excess of 15.5 trains daily in November, 1939, but is somewhat less than an average of 23.7 for November, 1940.

Heavy Traffic Eastbound

The preponderance of freight traffic is eastbound, including an average of about 150 loaded cars daily for the entire run, with numerous additional loads picked up at stations and junctions for shorter hauls. Average loads daily eastbound on the main line is 225. An average of about 80 loaded cars of stone are shipped daily from Lithonia and Camak.

The passenger trains make local stops. For example, on a recent day the westbound passenger train No. 1, with 9 cars, made 31 stops, 6 of which were for passengers only, 5 for passengers and mail, and 20 for passengers, mail and express. This train met eight freight trains and one passenger train, and passed one freight train. The run of 171 miles between Augusta and Atlanta was made in 5 hours 35 minutes, arriving on time.

Sidings Well Arranged

The double track at Augusta begins 0.5 mile west of the Union Station and extends 1.2 miles to 15th street. The freight yard extends west from 15th Street to a west switch near M.P. 3. Also double track extends six miles eastward from Atlanta to Decatur.

Prior to the consideration of signaling, there were 31 passing tracks on the 162 miles of single track between the west yard switch at Harrisonville yard and the end of double track at Decatur. An important benefit from the studies with reference to train operation by centralized traffic control was that the passing tracks were not spaced uniformly, and furthermore that several of them could be removed or discontinued for meeting and passing of through trains. Accordingly, several changes were made in passing tracks before proceeding with the installation of automatic signaling and spring switches.

Passing tracks were removed at Clarkston, between Scottdale and Stone Mountain, and at Mesena between Camak and Boneville. The old passing track at Thomson is in a congested area involving the passenger station, house tracks and three street crossings. The two daylight passen-

Intermediate location with battery boxes

ger trains meet here, and thus there was no chance to get a freight train in the clear at Thomson at this time of day. For these reasons, and also to secure uniform spacing, a new 70-car

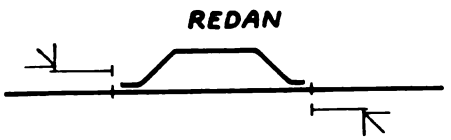


Fig. 2—Layout at Redan

passing track was constructed in open country just east of Thomson, thus making two at this town.

At 4 towns, Redan, Norwood, Alcovy and Campania, the old short passing tracks were left in place to be used by work trains and the local freight trains. No head-block signals were installed at these towns but intermediate signals were located to provide protection for trains when departing. At two other towns, Almon and Boneville, where old short passing tracks had been in service, one switch was removed thus leaving a spur to serve industries or house tracks. Thus of the original total of 31 passing tracks, 2 were removed, 4 were left in place to be used by the local freight trains, and 2 were converted to spurs. This left 23 of the original passing tracks plus 1 new one at Thomson plus 1 at Scottdale which are equipped with head-block signals arranged to be used regularly for the meeting and passing of trains. The foresight in thus reducing the number of passing tracks was an important factor in reducing the installation costs as well as maintenance expenses of the signaling. The accompanying plan indicates the locations and car capacities of these passing tracks.

As part of the improvements, new 100-lb., No. 12 turnouts with 22-ft. reinforced switch points were installed at both ends of these 22 passing tracks which are to be used for meets and passes. At 21 of these, excluding Camak and Scottdale, both switches are equipped with spring switch mechanisms. No spring switches were installed at Campania because this passing track is seldom used by freight trains. No spring switches were installed at the west end of Scottdale because westbound trains do not use this siding. No spring switch was installed at the east end of Camak because all trains stop here. Spring switches are also in service at the ends of double track at Decatur and at 15th street in Augusta.

The spring switch mechanisms are the mechanical switchman type made by the Pettibone-Mulliken Company. Also at each of these layouts, the old switch stand was replaced with a Union Switch & Signal Company Type S-21 switch stand which, in fact, is a hand-operated switch-and-lock movement including lock rods and plungers which provide the same protection as at an interlocked switch, and, as applied at these spring switches, special connections are arranged to unlock the switch automatically when a locomotive starts to make a trailing movement from the siding to the main track. If the plunger is out of adjustment, so that it might not be pulled far enough, a set of contacts in the circuits hold the signal at its most restrictive aspect thereby warning the enginemen not to trail through.

As a part of the construction, new insulated gage plates were installed with T. Geo. Stiles adjustable braces on four ties, one ahead of the points, the first two ties under the points, and on the sixth tie. The plate on this sixth tie extends out under the crank base for the pipe connection which pulls the plunger. Thus these switch layouts are well constructed with good ties, adequate plates and adjustable braces so that the adjustments can be set accurately and will hold in place, thereby obviating unnecessary train stops.

With the exception of the section between Scottdale and Decatur, the signaling on the single track is controlled by the absolute permissive block system. Because of the numerous switching movements made in the section between Decatur and Scottdale, the overlap system of signal controls was applied so that through trains would not be held back for the full station-to-station block if the switch engines did not clear the main track.

At each of the 22 sidings to be used for meeting and passing trains, a head-block double signal location was installed near the switch in the conventional manner. At the short sidings which were retained for occasional use by the local freight, such as at Redan, two intermediate signals were arranged to afford protection when a train is to depart from the siding, as shown in Fig. 2.

The head-block signals are lighted continuously and the crews of the local

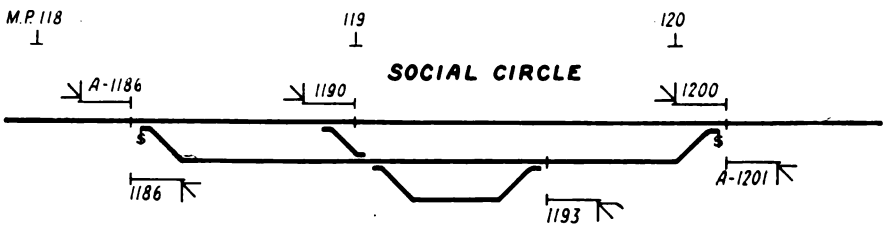


Fig. 3—Extra signals at Social Circle

trains watch these signals, to determine whether through trains may be approaching from the next town, before a switching move is made from a spur track to the main line. At Social Circle, an important coal and water station, the tracks are on a grade and curve so that the signals at the ends of the siding cannot be seen from the vicinity where much of the switching is done. In order to save delays while waiting for a trainman to walk down around the curves to see the head-block signals, two extra signals, 1190 and 1193, were installed, as shown in Fig. 3. When a westbound train leaves the next town, which is Rutledge, signal A1186 changes to the red aspect

Typical station-entering signal at end of a passing track

and signal 1190 to the yellow aspect, thus indicating to the local freight crew that they should not make a movement out onto the main track, or if they are on the main track they should clear the main track as soon as practicable. In these respects, signal 1190 is similar in control and purpose to an indicator to indicate the approach of trains.

Spacing of Intermediate Signals

In all instances the automatic block is more than long enough for train-stopping distance. Where no special circumstances are involved, the intermediate signals are spaced approximately as shown in Fig. 4, which is a plan of the territory between Wallace and Barnett. The feature of interest is that the blocks adjacent the passing tracks are about one half as long as the block between the two intermediate locations. For example, if an eastbound freight train is waiting on the passing track at Barnett for an eastbound passenger train to pass, the freight can pull out of the passing track sooner due to the fact that the block between signal A-576 and 566 is as short as practicable. Similarly, if an eastbound freight train is just pulling into the passing track at Wallace, the fact that the block between signal 546 and 538 is short, allows maximum time for the freight to get in the clear without delaying a following passenger train that is to pass.

The overall station-to-station distance between Camak and Wallace is 5 miles, this being cut into four intermediate blocks which are approximately the same length, about 6,250 ft. This arrangement provides an eastward automatic signal 504 just east of the short siding at Norwood, and a westward signal 507 just west of the siding. The purpose of this arrangement is to provide protection and a signal for a work train or local freight when departing from this passing track.

On the Double Track

On the 6 miles of double track between Decatur and the Union Station in Atlanta, each track is signaled for right-hand running. In much of this territory the main tracks are parallel with yard tracks and industry tracks, which are so close that there is not sufficient space to install high signals. For this reason, dwarf signals of the searchlight type were installed at several of the locations.

In this territory there are numerous turnouts to yard tracks as well as crossovers between the two main tracks. Switching movements are under way all the time, and a problem has been to clear the main tracks when passenger trains are approaching. As an aid in this respect the new signaling system includes indicators located between main tracks in the vicinity of the principal crossover layouts, which are lighted as a warning that a train is approaching on the main track, and accordingly, yard crews stay in the clear. These indicators are actually type N-2 dwarf color-light signals which are of course distinctly different from the searchlight dwarfs used as automatic block signals.

When no trains are approaching on the main tracks, the indicators display yellow, but as soon as a train approaches, the yellow is extinguished and a red light is displayed. These indicators are located in strategic positions and between the main tracks where they can be seen readily by the yard crews but not so they can be mistaken for automatic signals by enginemen on the main tracks.

Signal Control Circuits

The automatic block signals on the single track are controlled by d.c. neutral track circuits and polar line circuits using three line wires, one of which is common. Ordinarily the track circuits range up to about 4,000 ft. in length, but in the territory between Atlanta and Stone Mountain the track circuits are 2,000 ft. to reduce chances for induction from an electric railroad. One reason for using conventional d.c. track circuits rather than coded track circuits was because the track circuits had to be cut on account of numerous highway crossing signals and because of short track circuits made necessary to locate intermediate signals where they could be seen the maximum distance on curves. Another consideration was that elimination of line control circuits was not a controlling factor because the pole line was in good condition to install line wires cheaply. The total cost for all line work including materials and labor was only $53,750.

The track relays are the DN-11 type, rated at 4 ohms. Each track circuit is fed by two cells of Edison 1,000-a.h. primary battery in multiple, the average life being about 8 months.

The head-block signals are normally energized and the lamps in these signals are lighted constantly so that train crews on sidings and other railroad men can watch these signals to know when approaching trains have passed the next town. At all the sid-

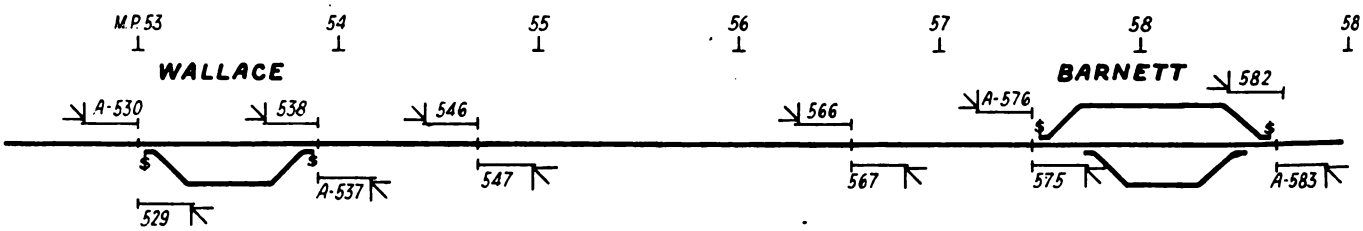
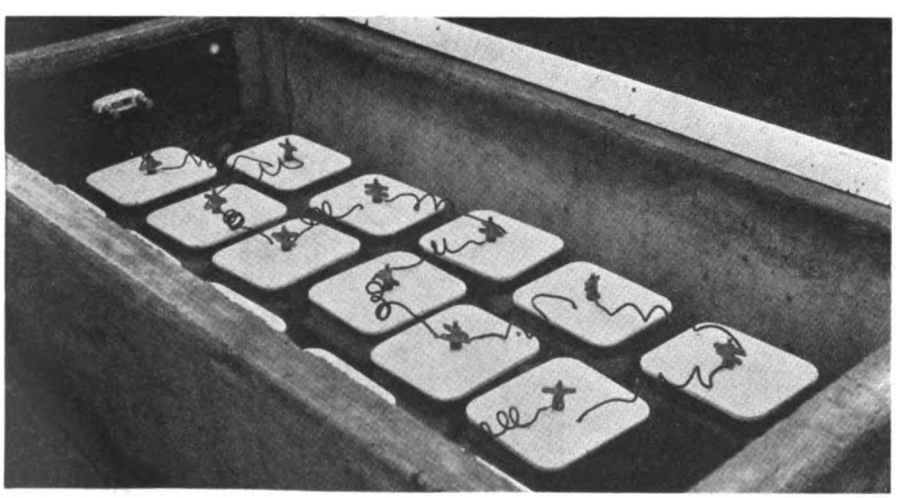


Fig. 4—Track and signal layout between Wallace and Barnett



Primary battery in box at intermediate signal

ings a.c. power is available to feed through rectifiers to charge storage batteries which feed the signal lamps and line circuits. The rectifiers are the RT-21 type rated to charge the battery at 1.7 amp. Each of these batteries consist of five Exide 80-a.h. cells. The signal lamps in these head-block signals are the double-filament type, 5 + 3.5 watt, 10 volt. The operating coils of these signals are normally energized directly by the signal line control circuit.

Intermediates Normally De-energized

At the intermediate signals no a.c. power is available and, therefore, the signals, lamps and line circuits at each signal are fed from a set of 16 cells of 1,000-a.h. Edison primary battery. In order to lengthen the life of these batteries at the intermediate signals, the circuits are arranged so that the signal operating coil and the signal lamps are normally de-energized. These signal lamps are the single-filament type, rated at 10 volts 5 watts, and are fed, with approach control, from the set of 16 cells of primary battery at the signal.

The approach control of the signal operating coil and the lamp is accomplished by a 150-ohm DN-22A relay, in series with the line control circuit. The line control relays are the DP-21 retained neutral polar type rated at 670 ohms. The retained-neutral feature eliminates the need for a slow-pick up slow-release signal repeater relay. The use of the line relay and approach control makes the signal coil normally de-energized, therefore, this leaves only the 670-ohm line relay, in series with the 150-ohm approach relay, as the normal line load. On the basis that the line relay will be energized 22.5 hours daily, and the signal lamp and directional stick relay energized 1.5 hours daily, the average life of a set of 16 cells of 1,000-a.h. primary battery is estimated at about 30 months. In comparison, the battery life is estimated as about 15 months if the circuits and equipment had been arranged to normally energize a 250-ohm signal coil with a 40-ohm approach relay in series, and a 350-ohm signal-repeater relay.

In 1936 a heavy sleet storm partially destroyed the pole line on this territory, and during that year the pole line was largely replaced, using new creosoted pine poles. The line is, therefore, in excellent condition, and with poles high enough to add an arm without interfering with proper clearances. When installing the signaling, new six-pin arms were added. The three wires for the signal line circuits are No. 10 bare copper, and the same kind of wire is used to feed 110 volts a.c. from each station out to the signal locations at the ends of the sidings.

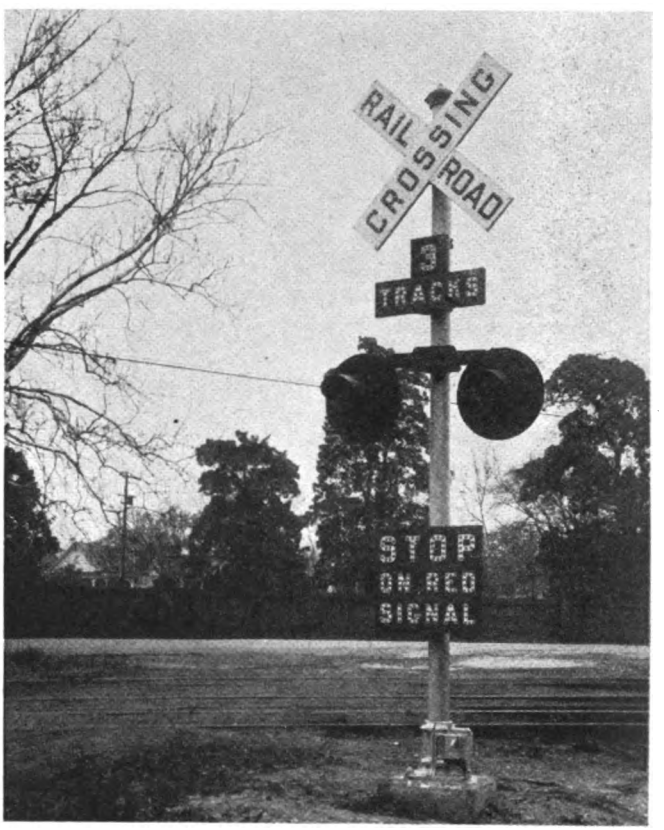
Constructed by Railroad Forces

This automatic signaling was installed by forces of the Georgia Railroad. Field forces were organized in two crews, each of which was provided with camp car outfits including tool cars, sleeping cars, dining cars and kitchen cars, complete with a cook. One crew of 12 men dug the holes for signal foundations, buried the cables, installed the bootleg outlets and insulated joints. A second crew made the line cables, did the field wiring, installed the relays and batteries, and did the painting.

The signal foundations are of the precast type, made in one piece. A hole 1 ft. square extends down through the center to reduce weight and also to provide an entrance for underground cables in the larger foundations. At the intermediate locations the primary batteries are in reinforced concrete boxes. A special feature of these boxes, made at the suggestion of the Georgia Railroad, is a 2½-in. pipe 20 in. long, which is set vertically with the lower end cast into the bottom of the box when being made. This pipe is used as the entrance for incoming underground cables. The advantage is that no part of the cable is exposed outside the box, and the pipe is so long that water cannot enter the box through the pipe. The foundations and battery boxes were made in Birmingham, Ala., by the Massey Concrete Products Company. Having dug the holes on a territory of about 30 miles, the foundations and boxes were set in place from a work train including a power driven crane. On days when there were not too many trains to interfere, this work could be done on about 30 miles in 8 to 10 hours.

The drilling for the installation of the Ohio-Brass Company Hammerhead bonds was done by a twin-spindle drilling machine purchased from the Ohio-Brass Company. The drills were sharpened on a micrometer type precision grinder located in the signal shop at Atlanta. On the old 90-lb. rail which is to be replaced as soon as practicable, each joint was bonded with two No. 8 galvanized iron bond wires using ⅜-in. double grooved channel pins.

For the most part, the installation of terminals, arresters and jumpers in the instrument cases was done at the camp car headquarters, this being accomplished by removing the boards from the cases to do this work, and then installing the boards in the cases in the field. The lightning arresters on line circuits are the Western Railway Signal Company spark gap arresters. A neon arrester furnished by the same company is connected across each signal lamp. The ground rods are ¾-in. by 8 ft., Copperweld.



As a part of the new project the highway crossing protection at 26 street crossings was modernized

The cables from line poles to signals were made up of single-conductor No. 14 insulated wire, using No. 8 galvanized iron messenger, and ties made of pieces of No. 12 insulated wire. In order to allow vertical clearance above motorized roadway equipment operated on the right of way, each cable is attached to the mast about 10 ft. above the level of the rail.

The underground cable, which goes from the case under the track to a junction box on the base of the mast of the other signal, is seven-conductor No. 14, two of these being spares. The wires from the box up inside the mast to the searchlight signals are single-conductor No. 14. The track connections are single-conductor No. 9 from the case to bootleg outlets which are of two types, the Raco and the Union. The insulated wire and cable on this project was furnished by the Okonite Company. The connections from the bootlegs to the ⅜-in. plug in the rail are strands of seven No. 10 Copperweld.

As a part of the project, the highway crossing protection at a total of 26 crossings was modernized or installed new so that up-to-date flashing-light signals are now in service at all locations. Eight of these crossings are on the double track between Augusta station and 15th street.

The signaling as a whole between Augusta and Atlanta, 171 miles, is maintained by six maintainers, who have no helpers. Each maintainer has a new Model 19 Fairmont motor car, and a complete set of tools, meters and lamps.

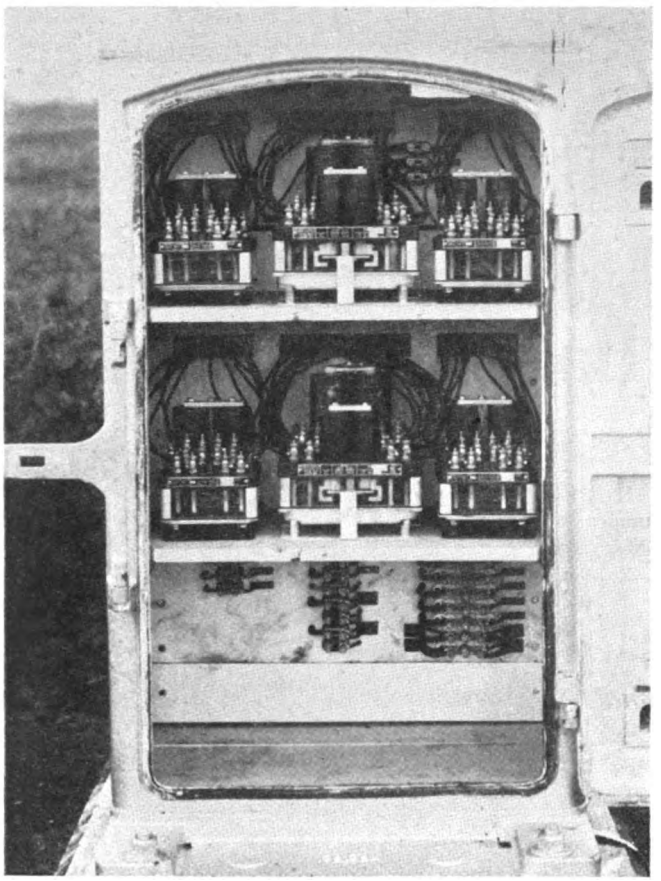
Timetable and Train Orders

With the automatic signaling the train movements are authorized by timetable and train orders, the same as previously. A part of the signaling program was to install new three-position upper-quadrant semaphore type train-order signals to replace older two-position lower-quadrant signals at 12 stations. The dispatcher is located at Atlanta. Operators or agent-operators are on duty all three tricks daily at 8 stations, and on two tricks daily at 2 stations, and on duty one trick only at 12 stations. Six of the offices are closed on Sunday.

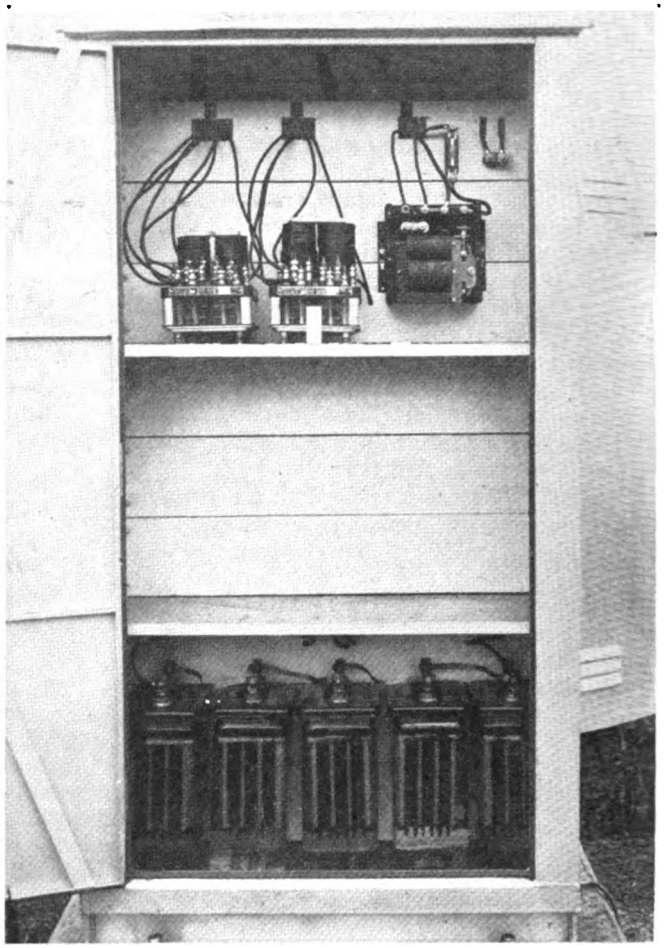
Although this installation has been completed for only a few months, numerous benefits are apparent. When the signals display green aspects, the enginemen know that the track is clear and that the switches are normal, therefore, they have confidence to operate their train around the curves at the authorized speed, rather than reducing speed in case of uncertainties concerning the locations of other trains.

Especially on account of the grades and curves, the spring switches are a great benefit in saving train time when departing from sidings, and the operating officers estimate a saving of six to eight minutes for each such move as compared with stops to operate hand-throw stands. At Rutledge the grades are such that prior to the installation of the spring switch, an eastbound tonnage freight could not depart through the east end but rather had to back out in order to be in a location to start up the grade.

This installation was planned under the jurisdiction of S. R. Young, assistant general manager, G. K. Williams, superintendent transportation, F. W. Graf, assistant engineer telephone and signals, and C. S. Coggins, supervisor telephone and signals. Supervisor Coggins and Inspector J. D. Bateman were in direct charge of the field forces. The major items of signal equipment were furnished by the Union Switch & Signal Company.



Left — Track side of relay case at an intermediate automatic signal



Right — Interior of the case at a head-block signal