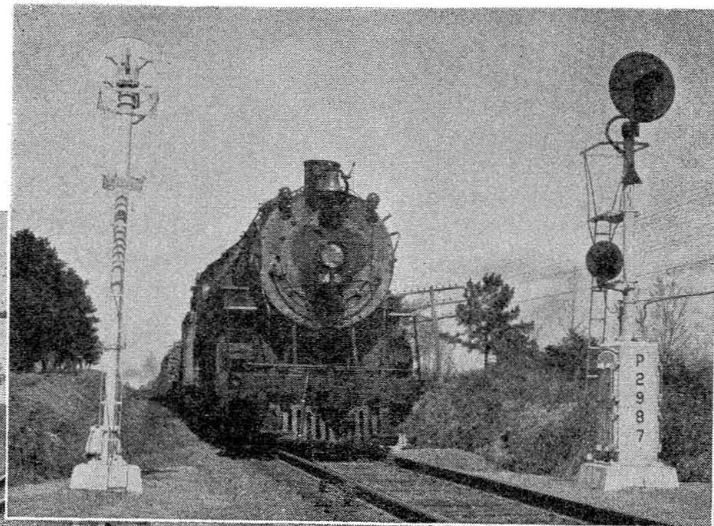
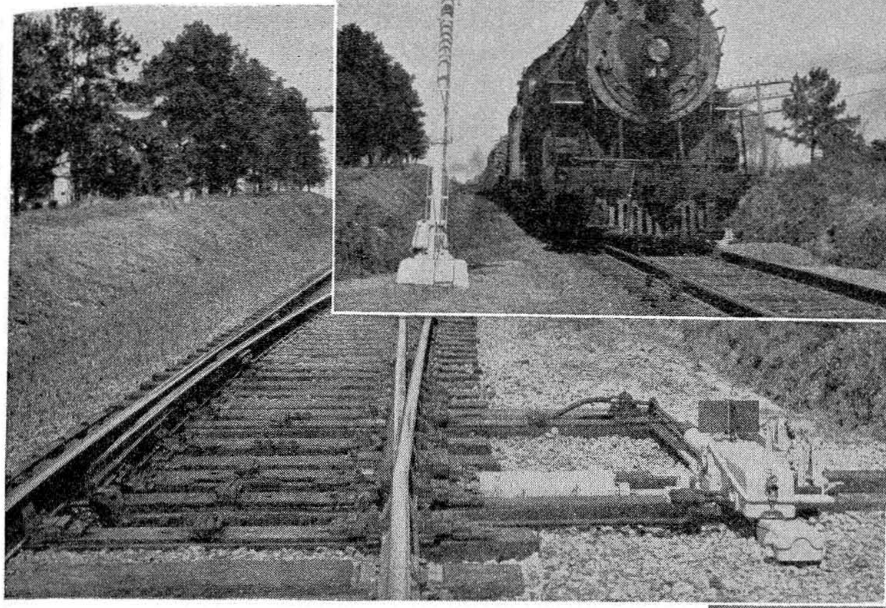
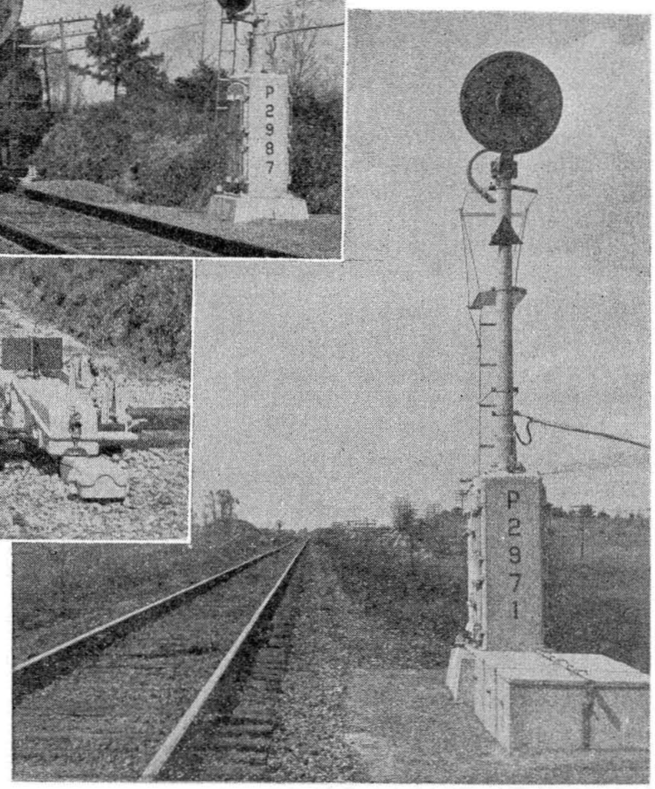


Left—Grade signal on a station - entering signal.



Below—Spring switch with a facing-point lock at end of siding



Below—Triangle marker on intermediate signal

Automatic Block With Spring Switches *on the Central of Georgia*

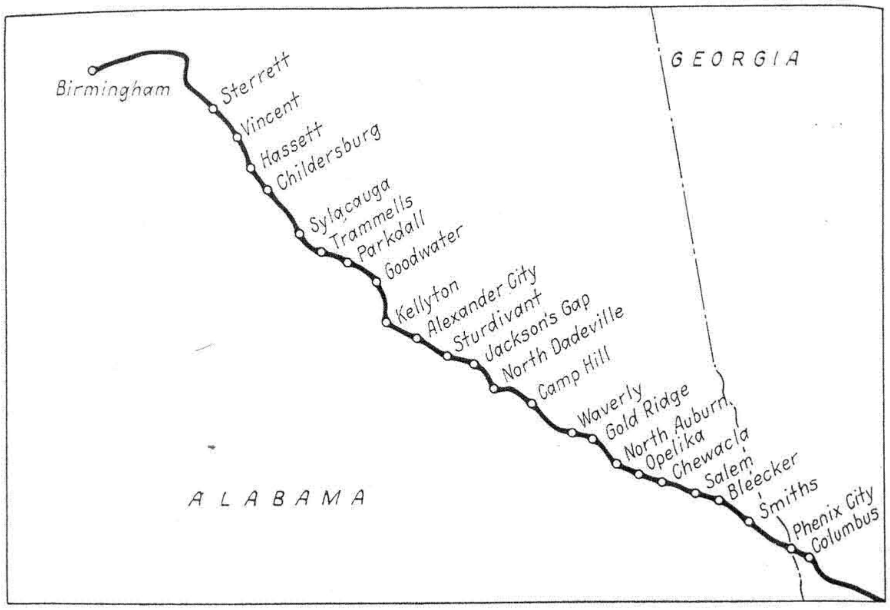
Safety increased and train time saved by signaling on 120-mile single-track engine district including spring switches with facing-point locks at 22 sidings

By including spring switches at all of the 22 principal sidings, the new Central of Georgia installation of automatic block signaling on 120 miles of single track between Columbus, Ga., and Sterrett, Ala., not only improves safety but effects a maximum saving in train time for this form of signaling.

The Central of Georgia has been a pioneer in the design and application of signaling in which train movements are authorized by signal indication rather than by timetables and train orders, such a system having been placed in service in March, 1924, on 4.5 miles of single track between Macon, Ga., and Paynes, and on 23.6 miles of single track and 5.1 miles of double track between Macon and Fort Valley in April, 1927. This was before the term centralized traffic control was first applied to such signaling, and since that time many extensive installations have been made on numerous railroads now totaling more than 6,000 miles of track.

The first proposal for the Columbus-Birmingham territory in 1943 was to include provisions for the dispatcher to control signals at the sidings for authorizing train movements by signal indication, similar to the Macon-Fort Valley section, as well as similar to more modern projects on other railroads. This proposal, however, was not approved by the War Production Board, but approval was granted for straight automatic block signaling.

Accordingly the Central of Georgia decided to plan the automatic block so that it would not only provide safety but also increase track capacity as much as possible. No reductions were made in the number of open offices or hours during which offices were open. Therefore, the maximum that could be expected from timetable and train order operation was retained. Furthermore, spring switch mechanisms were installed at 41 passing track switches to save time for trains when departing from these sidings.

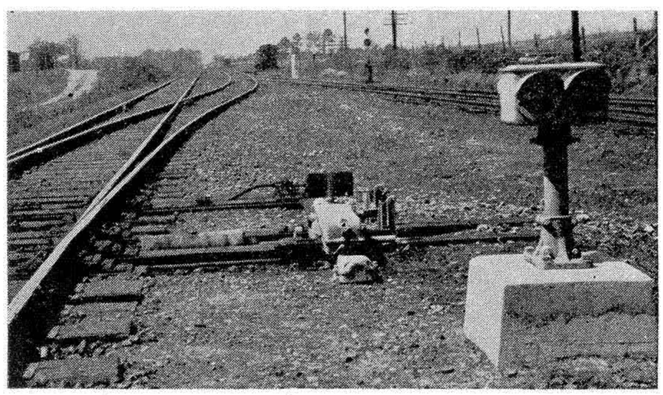


Map of subdivision between Birmingham and Columbus

Characteristics of the Line

Just west of Columbus, the railroad crosses the Chattahoochee river, and the grade ascends westward at varying rates up to 0.85 per cent for about 6 miles. The ruling grade eastward, about 5 miles long, ranging from 1.00 per cent to 1.28 per cent, extends from Sylacauga to Trammells, and includes 15 curves of which two are 4 deg., one is 5 deg., and five are 6 deg. Except for these two grades, the railroad is on rolling grades and comparatively easy curvature for the remainder of the mileage between Columbus and Sterrett, 113 miles. Between Sterrett and Birmingham, 34 miles, the railroad passes through rough mountainous country, including long heavy grades and two tunnels. Automatic block was previously in service on this end of the line so that the entire engine district of 154 miles between Columbus and Birmingham is now equipped.

This engine district is part of two through routes: (1) between Birmingham and Savannah, Ga., via Macon, Ga.; and (2) between Birmingham and Albany, Ga., via Americus, Ga. In connection with other railroads beyond its lines, these parts of the Central of Georgia are links in the operation of through passenger and freight service between Chicago, St. Louis, Kansas City, Memphis and Birmingham on the one hand, and Savannah, Jacksonville, St. Petersburg, Miami and other Florida points on the other hand.



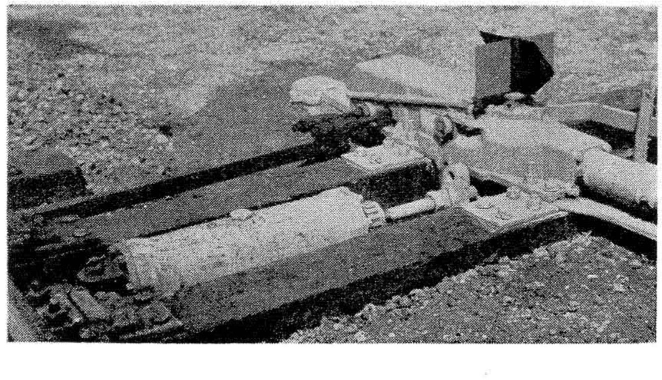
Color - light switch lamp as used at a few special layouts

The City of Miami, a lightweight high-speed passenger train, with a Diesel-electric locomotive, is operated each direction every third day. The Seminole, a passenger train with conventional cars and a steam locomotive, is operated each way daily. The through business on this train requires about 17 cars, and, therefore, a second section, to handle local traffic, is operated each way daily. Another local passenger train each way, brings the total to six passenger trains daily, in addition to the City of Miami every third day.

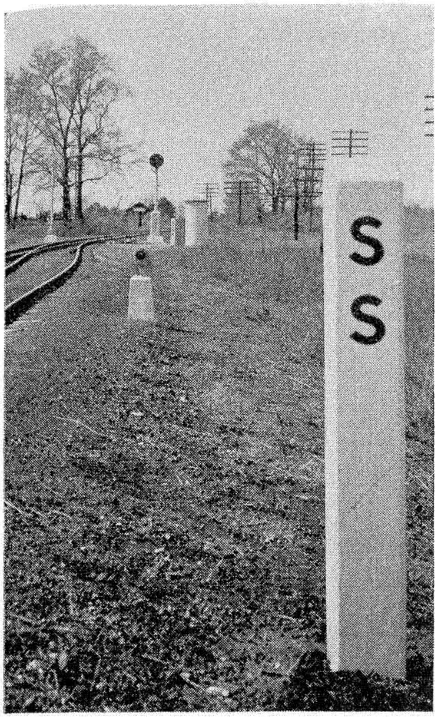
Four scheduled manifest freight trains are operated each direction daily, and a local freight is operated each way daily except Sunday. A local train, to and from the Roanoke branch, operates each way daily over the main line between Columbus and Opelika. Counting extra trains, about 14 freight trains and 6 to 8 passenger trains are operated daily on the section between Columbus and Sterrett. Between Sterrett and Birmingham there are numerous extra moves to handle coal from the mines, and to move extra tonnage over certain grades.

During the first three months of 1946 the movement of ordinary traffic was greater than the same period in 1945. For example, there was more fruit, lumber, merchandise, meat, live stock and coal. On a typical day recently, eight westbound freight trains included 186 loads and 272 empties, and eight eastbound trains included 647 loads and 41 empties.

Prior to the installation of this signaling, train movements were authorized by timetable and train orders, with a minimum spacing of 10 minutes between the departure of following trains from any office, and likewise freight trains for example would have to clear the main track at least 10 minutes ahead of the scheduled arrival of superior trains. As applying to the high-speed City of Miami passenger train, the clearance time and spacing was 20 minutes. Now, with



Switch with target but no switch lamp as in general practice near signals



Red lock lamp on foundation and SS post on turnout

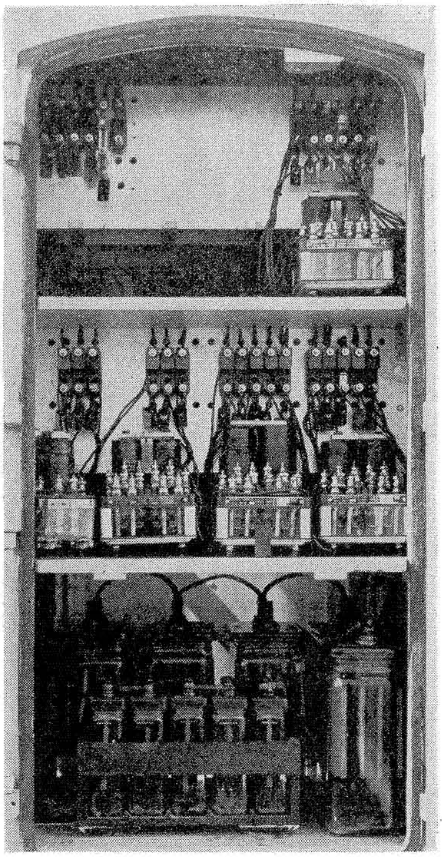
the automatic block signaling, the train movements are still authorized by timetable and train orders but the signaling provides for train movements at closer spacings with safety.

Spring Switch Saves 10 Minutes

Previously, all siding switches between Columbus and Sterrett were operated by hand-throw stands, whereas, as a part of the new signaling project, spring switches were installed at all of the principal sidings used for passing trains. This includes spring switches at both ends of 19 sidings. Also at the lap siding layout at Kellyton, spring switches were installed at the outlying ends of the two sidings. When leaving a siding which is equipped with a spring switch, a train pulls out and departs without stopping or waiting for a trainman to operate the switch. According to tests made on this territory, a freight train with about 40 cars totaling 2,000 tons, saves about 7 minutes to 10 minutes in departing from a siding equipped with a spring switch, as compared with a hand-throw switch. A 4,000-ton train including about 55 to 80 cars would save 10 to 12 minutes or more. The variation in time depends on the local conditions such as grades and curvature.

Keeps Trains Rolling

In addition to checking track occupancy for trains ahead, the signaling checks other items. For example, during the first six months in service the signals detected six broken rails and two main-track switches that were open part way. As expressed by one engineman, "The signals are just like somebody out ahead telling me to come on, 'the way is safe'." With this confidence in the protection provided by the signals, the enginemen can keep their trains rolling at speeds which are nearer to the maximums allowed. For example, prior to the installation of signalling, the heavier passenger trains such as the Seminole had difficulty in making the scheduled running time, often losing 20 to 30 min-



Extra battery where common is cut

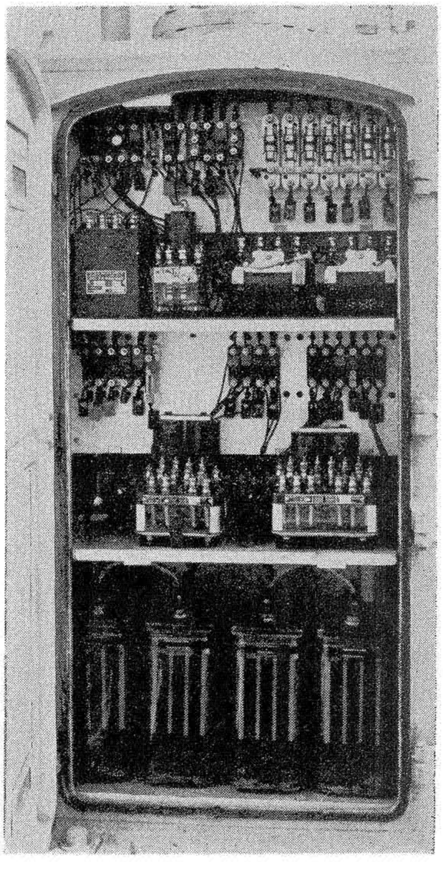
utes between Columbus and Birmingham. Now these trains can hold to the schedule easily, and if necessary, make up 30 to 45 minutes if they are late.

Similarly the fast through freight trains, if given a clear track, can make fast time. In numerous instances when the dispatcher can get the first section of eastbound freight train No. 38 out of Birmingham 30 minutes ahead of passenger train No. 2, he keeps the freight rolling ahead of the passenger train all the way to Columbus. Without the signaling, the freight trains would have to take siding to let the passenger train by, so that the freight would lose 30 to 45 minutes.

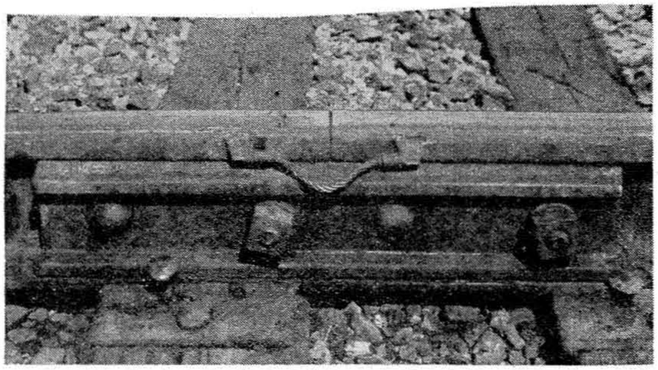
The through freight trains are received from and delivered to connecting railroads for operation in through schedules, such as from St. Louis to Jacksonville the third morning. Therefore, the C. of G. must operate these trains over the Columbus-Birmingham district in the allotted time, as well as make-up time if received late. In this respect, the new automatic block signaling and spring switches have been a great help. For example, the first section of No. 29, the fast westbound freight, must be in Birmingham before 5 p.m. On numerous occasions this train leaves Columbus from 45 minutes to an hour behind schedule. Since the new signaling was completed in July, 1945, this train has made up all the time needed so that it has not missed connection at Birmingham a single time. Similar good reports apply to other through trains. Prior to the installation of signaling and spring switches, the freight trains handling regular tonnage would ordinarily require 8 hours or more for the run either way between Columbus and Birmingham, and time of 7 hours was exceptional. Now the 2,000-ton trains make the run in about 5 hours 30 minutes, and the 4,000-ton trains in about 6 hours 5 minutes.

Intermediate Signals Arranged for Maximum Track Capacity

These automatic signals are controlled by conventional absolute permissive block circuits which provide



Interior of typical case



Gas-welded bonds were installed on all the territory

absolute stop protection to prevent opposing train movements between sidings, and to permit following train movements between sidings. The distance between passing tracks varies from a minimum of about 3 miles to a maximum of about 6.5 miles. In all cases there is double stopping distance so that no special circuit is required. Several of the passing tracks are shorter than stopping distance, but the entering signals are both overlapped one track circuit in any event, so that no special circuit is required on that account. Because of this overlap, the first track sections away from a headblock location is generally kept to about 2,500 ft. Maximum length of other track circuits is 6,000 ft., although many alongside passing sidings are much shorter, as will be explained later. Where the distance between sidings is less than 4 miles, there is only one set of intermediate signals. For longer distances between sidings there are two sets of intermediate signals. Because of grades and curves it was not always practical to have the intermediate signals opposite each other, and where there are two sets, it was found advantageous, in some instances, to "back stagger" one set to afford longer preliminary view.

Where there is only one set of intermediate signals, the circuits are arranged so that a yellow indication will be displayed at each of the opposing headblocks when opposing trains approach these locations simultaneously. This, of course, requires an extra line wire. In an endeavor to keep the number of successive restrictive indications as low as is considered safe practice, the change from green to yellow at an absolute headblock signal, where there is only one set of intermediates, occurs when an opposing train enters the track circuit aproaching the opposing headblock signal. To illustrate by referring to diagram 1. Eastbound signal 2 at the east headblock of A, will change from green to yellow when a westbound train shunts the relay of track circuit 6E at B. For following moves, however, signal 2 goes green when signal 4 changes from red to yellow after an eastbound train. In the same manner, signal 5 changes from green to yellow when an eastbound train shunts the relay of track circuit 1W at A. This is the reason for some of the cut sections that make short track sections alongside passing sidings.

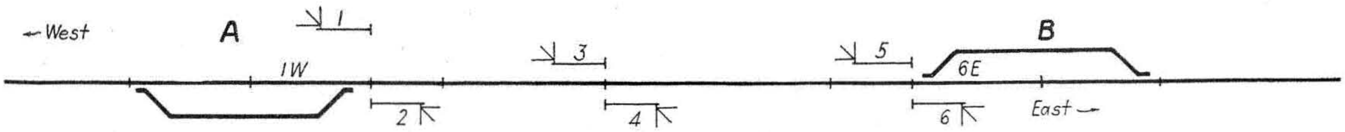


Diagram No. 1 showing overlaps to include extra track circuit in station limits

Tonnage Grade Signals

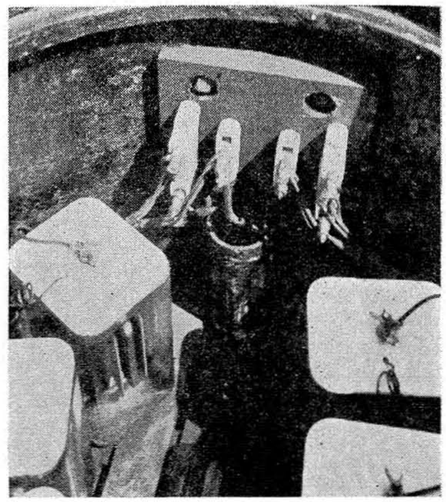
The signal numbers are painted on the signal masts or on the relay cases on all signals. The Stop-and-Then-Proceed permissive signals are designated by a three cornered piece of sheet-metal, painted black, and mounted on the signal mast below the signal head. The station-leaving absolute Stop signals are so designated by the absence of any such triangular marker.

Formerly a second light showing red only was used to denote the absolute signal. The use of the triangular marker not only saves this extra light but has the advantage of having the distinguishing marker attached to the permissive signals, so that if it should be removed by any cause, the indication would be more restrictive. The distinguishing marker need not be readily identified at high speed, as it is of value only after a stop has been made at that signal.

Where permissive signals are on ascending grades on which heavy trains would have difficulty in starting, a tonnage signal is attached to the left of the mast and 5 ft. below the center of the signal unit, as shown in the accompanying picture of signal P2987. This tonnage signal is an 8-in. yellow unit with the lamp normally extinguished. It is displayed in conjuction with the red in the signal head. The indication of this combined aspect is "Proceed at Slow Speed prepared to stop short of train or obstruction." This rule applies to all trains, both passenger and freight.

Lamp-out Control

If the filament in the lamp of the signal head is burned out, so that the red in the signal is not displayed, then the lamp in the tonnage unit will not be lighted. At intermediate



Primary battery on track circuits

signals, the control of this tonnage unit is through the traffic stick relay, as well as the front contact of the relay of the track section immediately beyond the signal. This means it is displayed only for following moves, and then only when the preceding train has cleared one track circuit. This tonnage signal is also used in some cases at station-entering signals, such as P-2987, at the east end of Smiths, where the grade is heavy. At such passing tracks, the intention, in the majority of cases, is to have the train on the descending grade take the siding, and this tonnage signal avoids stopping a train on the heavy grade in case of a close meet. At such locations, the tonnage light is not cut through a directional stick relay, but is cut through the front contact of one track relay. This is another reason for some of the cut sections that make short track sections along side passing sidings.

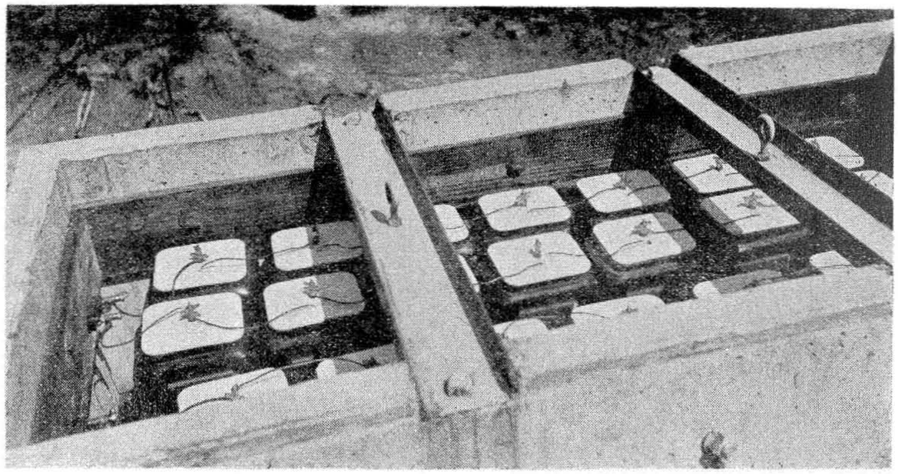
Signaling at Spring Switches

At the 41 locations where spring switch mechanisms were to be installed, the switches were reconstructed. Most of the turnouts are No. 10, on which a speed restriction of 15 m.p.h. is in force when making a diverging move. A few are No. 14 with a 20 m.p.h. restriction. The switch points for No. 10 turnout are 16 ft. 6 in. in length, and those for the No. 14 turnouts are 18 ft. in length. All spring switches have special heavy reinforced switch points to prevent too much flexing when being trailed through. They are also equipped with three switch rods instead of the two used on hand-thrown switches. This has been standard practice on the C. of G., starting with the first spring switch installed on this road in August, 1925.

Insulated gage plates, ¾ in. thick and 7 in. wide, were installed on four ties, the one ahead of the points, the first two ties under the points and the fourth tie, on which the crank base for the facing-point lock is located. Adjustable rail braces made by the T. Geo. Stiles Company are used on these four ties, a special feature being the use of these braces on the gage side of the rail on the tie ahead of the point, which prevents "rolling" of the rail. These braces are adjusted carefully when installed, and then, after several days with heavy traffic, the braces are tightened up again. Then the switch stays in place for a long time, with very little attention.

Switch and Lock Movements

At each location where a spring switch was to be installed, the old switch stand was replaced by a Union Switch & Signal Company Type S-21 switch movement which in reality is a hand-thrown switch and lock mecanism including a lock rod and plunger which locks the switch just the same as at a switch in an interlocking plant. The oil-buffer spring mechanisms are the Mechanical Switchman type made by the Pettibone-Mulliken Corporation. These devices take the place of a regular connecting rod for the switch. As applied to a spring switch the S-21 switch stand also includes an arrangement and pipe connection so that when a train starts to pull out of the siding to trail through the switch, the lock plunger is automatically withdrawn from the lock rod so that the switch can open to allow the train to trail on through.



At certain intermediate signals, primary battery is used

If changes in temperature, running rail or other local conditions have changed the adjustments so that the switch does not return to its normal position with the plunger through the lock rod, then the circuits through the device hold the main-line high signals to display the red aspect to approaching trains, and, after having stopped, the enginemen must inspect the switch before proceeding over it in the facing-point direction.

Special Type of an Overthrow Warning

If temperature variations have changed adjustments so that the plunger goes too far through the lock rod, it might not be pulled out far enough, when a train starts to trail out through the switch from the siding. Experience proves that this overthrow occurs very rarely, but nevertheless the device is designed with contacts which detect this overthrow condition and cause a red lamp to be lighted on a small concrete foundation located opposite the fouling point on the siding. When such a warning lamp is lighted, this indicates to the engineman of a train on the siding that he must not trail his train out through the spring switch, but rather the switch must be thrown by hand by a trainman. Also, as a reminder to enginemen of trains ready to depart from a siding equipped with a spring switch, there is a special marker post, with letters "SS," which is located along the siding near the clearance point, as shown in one of the pictures.

For example, with a train on a siding ready to go, the engineman looks to see that he has a green in the station-departure head-block automatic signal, then he is reminded by the SS sign that he has a spring switch which he can trail through without stopping, providing the little red lamp is not lighted on the small foundation beyond the SS sign. This combination of information as proven to be effective in giving the enginemen confidence to pull out promptly and thereby save time.

The switches are equipped with small rectangular targets showing green when the switch is normal, or red when reversed. With a few exceptions, the spring switches are within 50 ft. of the head-block double signal location, and, therefore, no lamps are used on the switches. In some towns the location of the passenger station, house tracks and other local conditions are such that the head-block signal location is perhaps 1,000 ft. or more from the end of the siding equipped with the spring switch device. In such instances an electric color-light switch lamp is mounted near the switch. The green lamp is lighted when the switch is normal and locked, otherwise the green is extinguished and the red is lighted. These lights show only in the facing-point direction.

Signals and Relays

The signals are the H-2 searchlight type with plug connections. The operating coils are rated at 250 ohms and these coils are connected directly to the line circuits thus saving a line relay. Each signal has a 350-ohm type DN18 slow-release, slow-pick up relay, which is used to polarize the line circuit to the rear. The slow operation prevents flips of the signals. Another advantage of using this repeater relay is that it saves running several wires from the relay case up to the signal head. The stick relays are the DN-11 type rated at 1,000 ohms. The light-out relays are the DN-22L type rated at 0.185 ohms and are connected in series with the lamps. The track relays are the DN-11 type rated at 4 ohms. The power off relays are the DN-22P type rated at 150 ohms.

Power Supply

From various commercial sources, 110-volt a.c. power was available at all of the sidings. This power is extended on two No. 10 bare copper wires out to one intermediate location. Thus at all signals at sidings and some of the intermediate signals, this a.c. power is fed through transformers and rectifiers to charge five cells of DMGO-7 Exide storage battery which feeds the line circuit, the searchlight signal coils, the relays, and to act as a standby for feeding the lamps which are normally fed from the transformer. At each of the other signals, a set of 16 cells of 1,000-a.h. Edison primary battery is provided to feed the signal coil, lamps and line circuits. Each track circuit is fed from a set of three cells of 500-a.h. Edison primary battery.

The signal line control circuits are of the type which each use one line wire in connection with common. In order to localize grounds and other line circuit troubles, the common wire is cut at the east end of every siding. This requires a second battery at these locations to feed the line circuit, and this extra battery consists of five cells of Exide Type BTMP3, 16-a.h. battery.

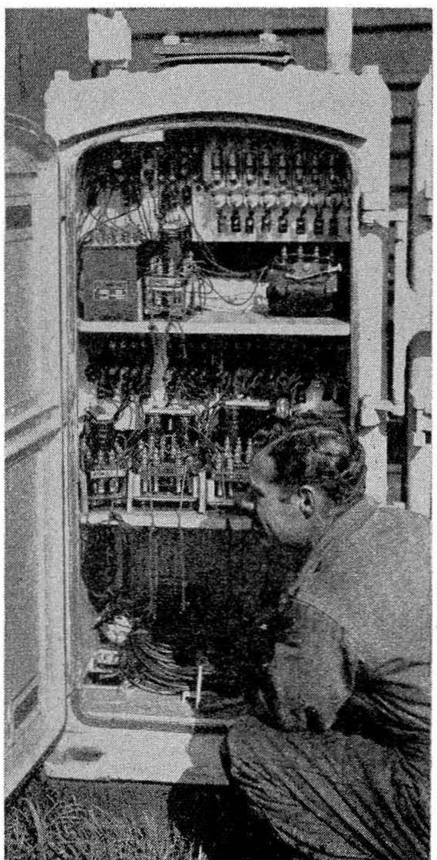
The signals fed from a.c. are normally lighted and are, therefore, a help to maintainers and trackmen in watching for the approach of trains. When the a.c. power fails and the lamps are cut over to feed from the battery, the controls are switched to approach lighting in order to conserve the battery charge. During such periods, if a track foreman wants to light the signal so he can check for approaching trains, he pushes a button which is mounted in a box on the relay case. At signals fed from straight primary battery, approach lighting is in effect at all times and, therefore, in any instance the button would have to be pushed to light the signal for a man on a motor car.

Construction Organization

The preparation of circuit plans for this signaling was simplified in the signal engineer's office by adopting a scheme of simplified numbering. In order to take advantage of the scheme of typical plans, an arrangement was devised to use single-digit numbers for signals so far as circuits are concerned. This method provides for numbering of signals to start with numbers 1 and 2 at each east headblock location, and continuing eastward to the next east headblock, using an even number for eastbound and an odd number for westbound signals. Number 3 is the first westbound intermediate east of a passing track, and number 4 is first eastbound intermediate east of a passing track. If there are two pairs of intermediates, the next pair are numbers 5 and 6. If there is only one pair of intermediates, then the west headblock signals are numbers 5 and 6.

Since the main difference is circuits depended upon the number of intermediate signals between two passing tracks, the differential was made on detail wiring plans by adding the letter D (Indicating that D circuits were involved) to the single-digit signal number. For example: typical detail wiring plans for an opposite intermediate location would be 3-4 where there are more than two intermediate signals, and 3-4D where there are only two intermediate signals. This arrangement eliminated the difficulty of previous typical detail wiring plans because in each instance the signal number for the circuits could be inked-in on the tracing instead of being added after prints are made.

The number of tracings for detail wiring plans were reduced 60 per cent and in addition, a very large number of man hours was saved in having to letter-in only one digit for signal numbers on all tracings of both circuit and detail wiring plans, instead of the usual four figures plus one District prefix thus totaling a five character signal number. For example, 2H1 instead of P 3244 H1. Time saving was also realized in making up the several thousand tags for circuit identification.



H. F. Ferguson wiring a case

Construction headquarters was located at Goodwater, Ala., where all materials were assembled. The cases are all wired according to a standard so that a construction man or maintainer knows the location of relays and wiring as applying to the signals at which he is working. The backboards were removed from the cases, placed on a rack, as shown in one of the pictures, and all terminals, arresters and wiring were applied. This practice makes the work easier than if the boards are left in the cases. When the wiring is finished, the boards are returned to the cases. The relays are set in place and connected. Cardboards and packing are placed over the relays and are strapped down.

The ladders and signals, except for the searchlight mechanisms and backgrounds, were applied to the masts; then these masts and relay cases were loaded on flat cars ready for a work train. All concrete foundations were bought pre-cast from the Massey Concrete Products Corporation, which also furnished the battery boxes. As these were all made in the Birmingham plant, arrangements were made locally to ship just as needed in small quantities for distribution by a work train. A work train, including a small power crane, would then set all foundations, relay cases, battery boxes, and erect the signals for a stretch varying from 15 to 20 miles.

The backgrounds were not put in place until the signals were put in service. As the work progressed, and short stretches were put in service, the placing of the background, just like the attaching of a blade to a semaphore signal, was of assistance to enginemen in keeping posted as to just how far the new signals were in operation. This also made it possible to focus the signal before it was put in service. When the units were put in place, a piece of cardboard was placed inside the unit to prevent reflected light.

The rail joints were bonded with Ohio Brass Company O-Balloy type bonds, which were applied with gas welding. The welding torches were operated by three men, one being a swing man. Two men held the bonds in place, and two men took care of the motor cars, push cars and gas tanks. One man supervised the work and kept in touch by telephone with the dispatcher so that the crew could clear the track when trains were approaching. The crew that applied the rail bonds also attached the cross arms and strung the line wire. Another crew with 12 to 15 men installed the underground cables and the line drop cables from the pole line to the relay cases. This crew made all the wiring connections in the cases, put in and connected the operating units, installed the battery, set and adjusted switch boxes, and in general completed the work including testing and putting in service.

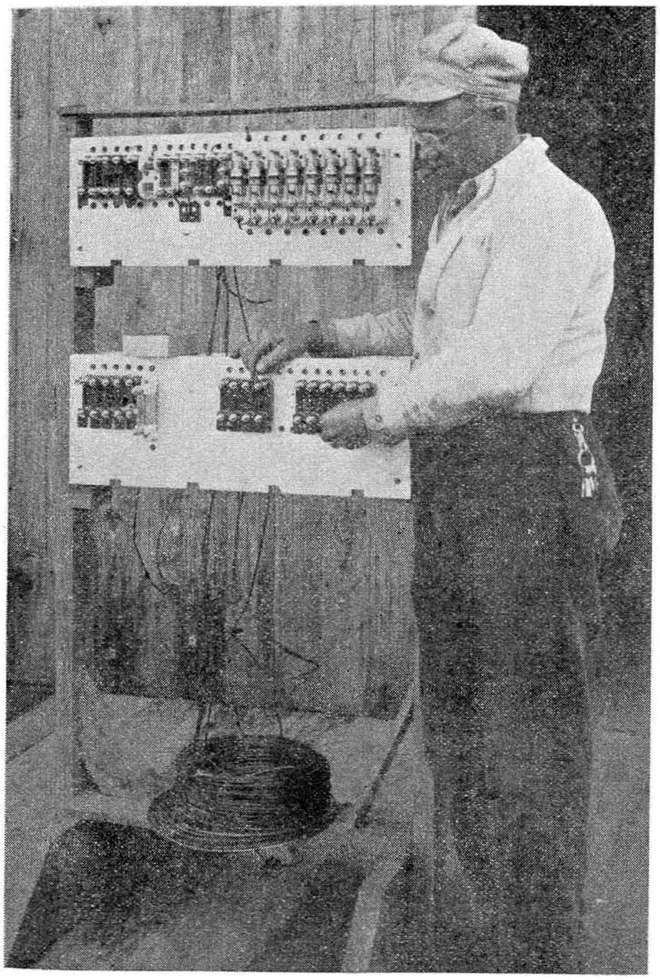
The single-conductor underground cable for track connections is No. 9. A 7-conductor No. 14 cable extends from the relay cases under the track and up to a junction box at the base of the mast on the other side of the track. From this box, stranded No. 14 extends up the mast and out through flexible metal conduit to the signal head. The jumper wiring in the cases is No. 16 flexible. The cables from the cases to the line poles are No. 14 solid, these cables being made up in the field. The insulated wires and cables were furnished about half by the Okonite Company and the other half by the Simplex Wire & Cable Company.

The signal lamps are the two-filament type rated at 8 volts, 5 + 3.5 watts. Where signals are on curves, a special deflecting lens is required, and more light is needed, thus requiring a 10-volt 13 + 3.5-watt lamp. In order to reduce the lamp burnouts due to lightning and static, the common side of the 110-volt a.c. is grounded and a No. 275 neon gas type Western Railroad Supply Company arrester is connected across the lamp circuit. The arresters on the signal line control circuits are the No. 111 neon gas type made by the same company. The line control circuits are on No. 10 Copperweld wire with weatherproof covering, run on Ohio Brass Company porcelain insulators. These wires are on a crossarm which was added to the existing Western Union pole line.

The automatic signaling, not including the spring switches, was constructed on the 92 miles between Trammells and Columbus in 6 months and 12 days. After finishing the signaling, two smaller crews with eight men each were organized to go back over the territory to install the spring switches. The insulated gage places were all made up and drilled at the signal shop at Goodwater. Each crew installed about two spring switches per week.

This installation of automatic signaling and spring switches was planned and installed by the forces of the Central of Georgia under the jurisdiction of E. B. DeMeritt, signal engineer, and the field work was under the direct supervision of D. McCaleb, general signal foreman. The major items of signaling equipment, including the type S-21 switch stands and facing-point locks, were furnished by the Union Switch & Signal Company, and the oil-buffer spring mechanisms for the spring switches being furnished by the Pettibone-Mulliken Corp.

Right—D. McCaleb, the general signal foreman, and George Clifford, the leading signalman, at one completed case



Mr. Clifford shows how back boards are placed on the rack while applying the terminals, arresters and wire