



L. & N. Installs C.T.C. On an Engine District

THE Louisville & Nashville will soon complete the final section of an installation of centralized traffic control on the engine district between Montgomery, Ala., and Mobile. Double track extends 4 miles south from Montgomery to Catoma, from which point the centralized traffic control extends on 110 miles of single-track main line to Welka, which is the north end of a six-mile section of double track through Flomaton, Ala. The south end of this double track is at Miles, from which point centralized traffic control extends on 55 miles of singletrack main line to Sibert Yard which is about two miles north of the passenger station in Mobile.

The power switches and semiautomatic signals on the single track between Catoma and Welka, are con-

trolled from a C.T.C. machine in an office at Georgiana, which is approximately midway in this 110-mile territory. The 56-mile territory between Miles and Sibert Yard at Mobile is controlled from a C.T.C. machine in an office at Mobile. On these two sections of single track, all trains are governed by signals whose indications supersede the superiority of trains for both opposing and following movements on the same track. On the six miles of double track between Welka and Miles, trains are operated under automatic signal protection. Movements into and out of the passing tracks at Flomation, as well as to and from the Myrtlewood branch line at Escambia Junction, are controlled re-motely from a desk-type C.T.C. machine in the office at Flomaton.

Project between Montgomery, Ala., and Mobile includes 172 miles of road – Three - wire local line circuit includes the motor-car indicators

This 178-mile engine district between Montgomery and Mobile is a portion of the Louisville & Nashville through route between Cincinnati, Ohio, and New Orleans, La. Seven passenger trains are scheduled in each direction daily between Montgomery and Mobile, and during the last year, some of these trains have been running in two sections almost every day. The daily schedules include four through freight trains in each direction daily and a local freight each direction daily except Sunday. Extra freight trains are operated as required. On the average about 48 to 52 trains are operated daily.



Middle section and right wing of control machine at Georgiana, Ala.

Throughout most of this territory, the grade is slightly rolling with short sections ranging up to 0.8 per cent. The tonnage rating for the Class J3 locomotives is 2,080 tons, and for the Class J4 the rating is 2,400 tons. The curvature is comparatively light with 3 deg. as a maximum. In general, therefore, the conditions are favorable for handling trains at high sustained speeds, on the territory between Montgomery and Hurricane. The through passenger trains are scheduled to make this 110 miles between Catoma and Welka in about 2 hr. 20 min. The through freights cover this mileage in about 4 hr. 50 min.

Between Hurricane and Sibert, 15 miles, the railroad crosses five drawbridges, the maximum speed limit over these bridges being 15 m.p.h. As a result the average train speeds are low in this section, the time being about 30 min. for passenger trains and about 45 min. for freight trains.

Junctions and Branch Lines

From Georgiana, Ala., a singletrack branch line known as the Alabama-Florida Branch extends southeast 100 miles to Graceland, Fla. The traffic on this line includes one local passenger train and a local freight each way daily except Sunday. From Flomaton, Ala., one branch line extends south 43.7 miles to Pensacola, Fla., where connection is made with a line extending 160.6 miles east to Chattahoochee, Fla. Three firstclass trains and a freight train are operated daily each direction between Flomaton and Pensacola.

A second branch line extends north from Flomaton 112 miles to Selma, Ala. One passenger train is operated each way daily and one freight train is operated each way daily except Sunday. The Foley Branch extends from Bay Minett 36 miles to Foley, on which one mixed train is operated each way daily.

Passing Track Layouts

In the C.T.C. territory, single passing tracks with power switch machines at both switches are located at stations as indicated by the legend on the accompanying diagram. At Greenville all four switches of the two passing tracks are equipped with power machines so that trains in either direction can enter or depart at any switch. In the lap layouts at McGehees, Leto-



Knobs inserted to prevent throwing lever 73 to right or lever 76 to left

hatchie, Calhoun, Wilcox, Evergreen, Castleberry and Hurricane one passing track is used by northward trains and the other is used by southward trains. The trains enter their respective passing tracks at the outlying switches which are equipped with power switch machines, and the trains depart from the passing tracks at the lap switches which are equipped with spring mechanisms. Similar spring mechanisms are used at the ends of double track at Catoma, Welka and Miles, as well as at the yard lead switch connecting to the main line at Aladocks. Considering the C.T.C. territory as a whole, there are 50 electric switch machines and 18 spring switches.

At 12 short sidings which are used only by work trains or by the local freight trains when setting out or picking up cars, the hand-throw switch stands were left in service, but electric locks were applied to these switches. Similarly electric locks were applied to 21 other mainline hand-throw switch stands on crossovers or spur tracks. Thus a total of 45 electric switch locks are included in the C.T.C. territory.

C.T.C. Control System

The control of the power switches and semi-automatic signals, as well as the return of indications to the control machines, is accomplished by the General Railway Signal Company's Type-K, Class-M shunt-type line code system using two line wires. One such circuit extends from the control office at Georgiana north to Catoma, and a second circuit extends south from Georgiana to Welka. A third circuit extends from the control office at Mobile to



Map and detail layouts of project as a whole

Miles. These three circuits are carried on new No. 6 AWG 40 per cent Copperweld bare wire put up for the C.T.C. code system. It is so arranged that these three circuits can be coupled together to provide a through circuit for a voice frequency telephone if found necessary or desirable.

Arrangement of Control Machines

As shown in one of the views, the panels of the control machine at Georgiana are set at an angle to form a "U" shape, so that the man in charge can reach any of the levers without leaving his chair. The panel of the control machine at Mobile is in one straight section 100 in. long. Each of these two machines has an automatic train-graph which records the operations of trains when they pass the OS sections at the various power-operated switches.

The machine at Georgiana has 47 levers for controlling semi-automatic signals, and 34 levers for controlling power switches. Similarly the machine at Mobile has 22 levers for signals, and 16 levers for power switches. These machines are equipped with the conventional forms of indications to repeat the operations of switches and signals. In addition to indicating the occupancy of all portions of main track, the illuminated track diagram also has tokens which can be used to indicate occupancy of the passing tracks.

Switch Machines and Spring Switches

The power switch machines are the Model 5D dual-control, equipped with motors for operation on 24 volts d-c. The spring switch mechanisms are the Mechanical Switchman type made by the Pettibone-Mulliken Company.

The switch layouts equipped with switch machines or with spring bolted to the switch machine, thus preventing lost motion.

The electric locks on the handthrow switches are the Model 9A, equipped with indicators and an emergency release device.

Changes in Automatic Signaling

Prior to the installation of centralized traffic control, automatic block signaling had been in service on this division for years. Threeposition upper-quadrant semaphores were in service between Montgomery and Carpenters, and color-light sig-



Switch machine and plates on ties at shop ready to install

switches are reconstructed to provide good ties, heavy plates and adjustable rail braces on four ties. On two ties, the plates extend and are



Train delays are minimized by the new signal system nals were used between Carpenters and Mobile. As a part of the C.T.C. project, the semaphore signals were removed, Type-SA searchlight intermediate automatic signals being installed on the section Catoma to Welka at locations as were required according to present-day braking distances. On the section between Miles and Mobile, the existing colorlight intermediate automatic signals were relocated as required. The semi-automatic signals at the various passing tracks are all new searchlight-type signals.

Changes in Local Controls of Signals

The previous automatic block signaling included conventional absolute-permissive-block controls, using one line wire for each direction in connection with a third wire which was common. Neutral d-c. track circuits were used throughout.

When changing over to C.T.C., coded track circuits were installed between stations, the objective being to utilize the increased lengths of coded circuits to eliminate cut sections, and also to use these coded track circuits to provide track-occupancy indications for each stationto-station block as a whole, without requiring any line wires for this purpose. A special feature was to provide means for warning men on motor cars concerning the approach The switch machines are of the dual-control type. Note adjustable rail braces on five of the crossties.

of trains. This objective was accomplished in two ways: (1) By arranging that lights on all intermediate signals be normally extinguished, but when a line-up is made, these signals are lighted; proceed aspects, i.e., yellow or green being displayed on the signals for the direction of traffic established, and the red aspect being displayed on the signals for the opposite direction; (2) The head-block signals are normally lighted, therefore, these signals cannot be used as information to men on motor cars.

Motor Car Indicators

At the head-block locations special lamps with 83%-in. lunar white lenses and 191/2 in. backgrounds are mount-



Spring switch at Hurricane

ed on the sheet-metal instrument house near the switch. These motor car indicator lamps are located so that they display an indication into the block toward the next passing siding and are lighted as long as no line up is in effect for a train to proceed from the adjacent stations to the station at which the said indicators are located.

With this system of information, a man on a motor car watches the signals when between stations. When departing from or approaching a passing track he observes the motor car indicators. With such an arrangement, the man in charge of the C.T.C. control machine is instructed not to line up for trains any sooner than necessary; otherwise the men



in the field could not figure closely on the time at which trains may be expected at the various locations.

How the Three Line Wires Were Used

The three No. 10 bare copper line wires, formerly used for the A.P.B. line circuits of the automatic signaling, were utilized in a new and novel circuit scheme to do these three things: (1) As local line controls for the intermediate signals to clear in one direction or the other when the direction of traffic is established by C.T.C. control between any two sidings; (2) to cause the signal lamps in all intermediate signals between said two sidings to be lighted when a line up is being established for a train; (3) control the motor car



Electric lock with emergency release

indicators at the passing track switches at the end of a station-tostation block.

In so far as clearing the signals for one direction or the other is concerned, this new circuit accomplishes nothing more than a circuit using two line wires, as has been installed on several roads including the Louisville & Nashville between Winchester and Irvine, Ky., as discussed on page 628 of the October, 1943, issue of *Railway Signaling*.

The important new objective attained by the new circuit, using three line wires, is to provide means for warning men on motor cars of the fact that the man in charge of the C.T.C. control machine has lined up the signals for a train. As considered from another standpoint, the new circuit scheme eliminates special relays and circuits to control approach lighting on intermediate signals. The lamps in intermediate signals are lighted when C.T.C. line code control from the office is effective in establishing control for a stationleaving signal. The semi-automatic C.T.C. controlled signals at the switches are constantly lighted.

The new circuits use three line wires between any two locations of intermediate signals, or between a station-leaving head-block signal and the first intermediate location. The circuits remain energized for the direction used by the last previous train, as, for example, in the typical circuit, Fig. 1, the line relays 101HD and YHD and signals 111 and 121 are shown energized. With these relays energized, and with no C.T.C. code control in effect, a corresponding set of relays are energized, thus preventing the lamps in the intermediate signals from being illuminated. For this reason, at intermedi-



ate signal location 111 relay NBK is energized, at signal 121 relay NBK is energized, etc. As long as these NBK relays are energized, the lamps in the signals at the respective locations are extinguished because the light circuits are through back contacts of these relays.

The NBK relay at signal 111 is energized by a circuit starting from positive battery through the contacts in the circuit controller in searchlight signal 112 to check that signal in the stop position, then through a front contact of relay 111YGP, and this relay would not be up unless searchlight signal mechanism 111 is in the yellow or the green position; then the circuit goes through front contacts of relays 112TPP, 8TP, 7RAS, back contact of 7RGZP, front contact of 101HDP, then back over common through front contacts of 112TPP and 111YGP to negative battery.

In so far as the present consideration is concerned, the reason for the circuit for NBK being closed is that signal mechanism 111 is in the clear position, thus holding repeater relay 111YGP energized, thereby keeping the front contacts of 111YGP closed in the circuit for NBK. Searchlight signal mechanism 111 is in the clear position because the coil is being fed over the line wires from signal location 121, the lower line wire as drawn being positive and the middle one of the three wires being the connection to negative. Similarly the coil of searchlight signal 121 is energized by a line circuit from signal location 132, and relay XHD at that location is energized by a similar line circuit from signal location 9R. Thus in the set up as shown, the mechanisms in the southward signals are energized by line circuits using the lower wire in connection with the center wire, and the NBK relays are energized by line circuits using the upper wire in connection with one of the other two wires.

Now, if southward station-leaving signal 7RA is to be cleared, coded line control from the office causes relay 7RGZ to be energized which closes the circuit to energize relay 7RGZP. This opens a back contact in the "upper" line wire which causes relay NBK at signal 111 to be released, and the lamps in both the signals 111 and 112 are lighted by a circuit through back contacts of NBK and SBK.

Also the opening of a front contact is NBK at signal 111 opens the "upper" line wire to the right, releasing NBK at signal 121, thus lighting the lamp there, and similarly all the lamps at intermediate signals are lighted.

In the meantime when relay 7RGZP was energized, signal 7RA was cleared in the conventional manner, the details of these local circuits not being shown on the diagram.

Assume that a train accepts signal 7RA and progresses through the block. The train moves on to 8T and then to 112T. Signal 7RA will go to stop when 8T is dropped and 101HD will drop when 112T is occupied. Then when the train moves towards 111 signal, it reaches a point where 111AP relay picks up. This drops 111YGP relay and picks up 111S which remains up until 111YGP is again picked up. With 111S up and when the rear end of the train leaves 112T, relay 101HD will pick up reverse and permit following moves as in usual A.P.B. practice. Since 111YGP is still down, the NBK relay at 111 will remain down also. When the train moved on to B132T, it caused 111 signal to go to red, and when the train reaches a point where 121AP picks up, then 121S comes up. And when the rear end of the train passes 121 signal, signal 111 will clear to yellow. This causes 111YGP to pick up, thus dropping 111S and closing the circuit for the NBK relay at 111 location. The NBK up breaks the light energy for 111-112 signals. Thus it will be seen that the YGP relays control the time that the sig-



nal lights are on in back of a train unless a following train movement has been initiated. When the rear of the train passes beyond signal 9R, 121YGP picks up, 121S drops, NBK at 121 location picks up, YHD and YHDP at 132 signal location pick up and energize the NBK at this location. The NBK relays up remove light energy for 121 and 132 signals.

To Change Traffic Direction

With the circuits as left by a departing southward train, if the next train is to be northward, a C.T.C. control is sent out from the office to energize relay 9LGZ at signal location 9 and this energizes relay 9LGZP. A back contact of 9LGZP in the "lower" line wire opens the line circuit for YHD at signal 132, and then the southward signal line circuits are opened in cascade so that final relay 101HD at signal 7RA is released. Then repeater 101HDP releases and back contact 1 of 101HDP completes the circuit for a connection for the "upper" line wire through this back contact through a back of 7LAYGP to negative battery. In the meantime positive battery feeds through the other back of 7LAYGP over the "middle" line wire through front of 112TP the coil of searchlight signal 112 back of 111S, back of 111YGP, etc., thus clearing signal 112. Similarly the northward signal line circuits are energized in cascade until relay 142HD at signal 9L is energized. Thus traffic direction has been reversed.

Right half of Fig. 1, circuit diagram

At the time the southward signal line controls, such as 121 and 111, were released in cascade, these signals were released and their YGP repeater relays were released which released the NBK relays at the respective signals which in turn completed the circuits to light the signal lamps.

A northward train causes the same sequence of operation as previously described for the southward train.

At signal 7RA the 25-ohm relay SCK is in series with the signal line control circuit feeding southward to feed the searchlight coil of signal 112; therefore, relay SCK is up. Through a front of SCK the line circuit feeding north on the "middle" and "bottom" line wire is connected to energize relay SBK at signal 7RA. Through a front contact of SBK the lamp in the motor car indicator is lighted thus affording information that no line up for a northward train is in effect.

These circuits may be summarized as follows: When the 'upper' wire in connection with common is being used for control of northward signals, the 'bottom' wire in connection with one of the other two wires is being used to energize SBK relays which, when energized, extinguish the signal lamps and light the motor car indicator at the other end. On the other hand, the 'lower' wire in connection with common is used to control southward signals while the upper wire in connection with one of the other two wires is used to control NBK relays to extinguish the signal lamp and to light the motor car indicator at the far end of the station-to-station block.

Station-to-Station Track Occupancy

Referring to the circuit diagram, 75 code is fed in both directions from signal 121. As long as no train is occupying track circuit A132T, then 180 code is fed southward on track circuit B142T, but if A132T is oc-



The C.T.C. machine at Mobile controls the section from there to M iles, Ala., 55 miles

cupied then 75 code is fed southward on B142T. Only when 180 code is received on B142T at signal 9R is the block occupancy relay 9LBP energized.

Similarly with track circuits B132T and 112T unoccupied, then relay 7RBP is energized. With both 9LBP and 7RBP energized and repeated in the C.T.C. office, a stationto-station track occupancy lamp is extinguished. Thus the track occupancy indication of each stationto-station block is obtained without requiring any local line wires.

Control of Outlying Switch Locks

Outlying switch locks were installed on hand-throw switches leading from the main line. The method



Primary battery on track circuit

of control for these locks, while varying depending on the particular location, followed a general pattern.

Typical circuits Fig. 1 shows a short siding, with the switches at both ends protected by switch locks, located between signals 111 and 132. Briefly stated the control for these two locks is as follows: (1) The door of the lock must be open to energize the lock. (2) For a train movement out of the siding a time element is provided to furnish a definite time interval before the lock can be energized. (3) For moves into the siding a short "release" track circuit is provided. The train pulls up to the switch and stops with the engine on this release track. A crew member opens the lock door and the lock may be operated at once. The opening of the lock door also drops the lock repeater relays 8ALP at locations 111 and 132. Assume a train movement out of the siding and the following conditions are set up when the 8ALP relays drop. B132TP at location 111 will be de-energized and in turn opens the line circuits to put the protecting signals to stop. Relay B132TPP down also causes a block occupied indication for this section to show on the control machine panel. The LP relays at both 111 and 132 locations control the respective stick relays also.

Power Supply

On most of this C.T.C. territory 550-volt a-c. single-phase power is distributed on a circuit of two No. 6 copper line wires. This power is fed about 10 to 15 miles in both directions from certain towns with a gap of one automatic block between the end of one feed and the end of the next, thus saving line wire. The 550-110 volt transformers at the power switch locations are rated at 300 v.a., and at intermediate signal locations at 100 v.a.

At each power switch location there is a set of 12 cells of 80-a.h.



Storage battery at switch location

Exide storage battery for operation of the switch machine and for feeding the line coding apparatus. Another set of 5 cells of 60-a.h. battery is used to feed the local relays and signal line relays and a similar set of battery is provided at each intermediate signal location.

Each of the coded track circuits is fed by one cell of Edison-B4H type storage battery, and each of the conventional d-c. track circuits in station limits is fed by three cells of 1,000-a.h. Edison primary battery.

When installing the centralized traffic control, the previous automatic signaling was changed to the extent that construction was required throughout. New signals at new locations were required at the switches, and practically all the intermediate signals were relocated and reconstructed. New underground cables were installed throughout, this cable being of Okonite manufacture. The construction methods and field organization on this project were about the same as used on previous Louisville & Nashville jobs. as were explained in detail in an article entitled "Signal Construction

Organization on the L. & N." on page 688 of the December, 1942, issue. A special feature is the mounting of the switch machines, plates, braces, etc., on ties, at construction headquarters, and the installation of these assemblies as units.

The first section of this C.T.C. project between Mobile and Bay Minette was placed in service on May 31, 1943, and various other sections were brought into service when completed. This C.T.C. was planned and installed by signal forces of the Louisville & Nashville under the direction of W. H. Stilwell, signal engineer, the major items of equipment being furnished by the General Railway Signal Company.

Accident at Crossover

ON November 26, 1943, there was a side collision between a Union Pacific passenger train and an Atchison, Topeka & Santa Fe engine on the line of the Atchison. Topeka & Santa Fe at Devore, Cal. An abstract of the report of the Interstate Commerce Commission concerning this accident is as follows:

Location of Accident

Trains of the Union Pacific were of the railroad. This is a doubletrack line over which trains moving with the current of traffic are operated by an automatic block-signal system, the indications of which superseded timetable superiority. The current of traffic is to the left. At Devore the westward siding is south of the westward main track, and its west switch is 3,486 ft, west of the station. The east switch of a crossover 207.6 ft. long, which connected the main tracks. is 14.3 ft. west of the west switch of the westward siding, and is facing-point for movements from the westward main track to the eastward main track. The accident occurred at the fouling point of the eastward main track and

From the west on the eastward main track there was a 3-deg. curve to the right 1,925 ft., which was followed by a tangent 182 ft. to the point of accident and 935 ft. beyond. From the east on the westward siding there were, in succession, a tangent 1,718 ft., a 3-deg. curve to the right 1,009 ft., a tangent 671 ft., a No. 10 turnout 200 ft. to the westward main track, a

tangent 14.3 ft., and a No. 10 turnout about 50 ft. to the point of accident and 157 ft. beyond. Throughout a distance of more than 1 mile immediately west of Devore the grade for eastbound trains varied between 2.06 per cent and 2.25 per cent ascending, and at the point of accident it was 2.2 per cent ascending.

A derail was located on the south rail of the siding about 200 ft. east of the west switch. This derail was connected to the west siding-switch and operated in conjunction with it. When the west siding-switch was lined for movement from the siding to the westward main track, the derail was in non-derailing position.

The switch-stand for the west siding-switch was on the south side of the westward main track and was of the low-stand, hand-throw type. The switch-stand for the east switch of the crossover was of the highstand, hand-throw type and was located south of the westward main eastward main track, was 1,723 ft. west of the point of accident. This signal was of the two-unit, two-indication, searchlight type.

First 208, an eastbound first-class U.P. passenger train, was passing through Devore on the eastward track at a speed of about 25 m.p.h. when the eighth car was struck by Extra 3778 West at the fouling point of the crossover.

Discussion

Extra 3863 West, a westbound siding switches at Devore. Extra 3778 West entered the westward siding to pass Extra 3863 West, and switch for movement of Extra 3778 main track, and gave proceed siggine 3778. He said he thought the first switch was for operating the derail only, and that the second switch was for operating the west sidingswitch. He was not aware that a crossover was located in this vicinity. It was dark, 9:55 p.m., and he was carrying a lighted white lantern. never been instructed regarding the conjunction with siding switches.

If the switches of the crossover at Devore had been equipped with electric-locking, it would not have been possible to operate the switches to permit movement on the crossover when a train was moving on the eastward main track in the vicinity of the crossover, as in this case, and the accident would not have occurred.

It is found that this accident was caused by the unintentional throw-



Track layout in the vicinity of the accident

track. When the west siding-switch was lined for movement to the westward main track, and when the east crossover-switch was lined for movement to the eastward main track, the switch lamp of each switch displayed a red aspect.

Automatic signal 712, which governed eastward movements on the ing of a switch immediately in front of an approaching train.

It is recommended that the Atchison, Topeka & Santa Fe install electric switch-locking at main-track hand-operated switches in automatic block-signal territory.

By the Commission, Chairman Patterson.