This machine in the dispatcher's office at Savannah controls the entire 248 mi. between Savannah and Hamlet

SIGNALING THAT NO WIND CAN HARM

Underground cable on 248-mi. Seaboard project obviates line wire circuits—Two aspect station-to-station signals, normally controlled by the dispatcher, are cut over to automatic block if his control fails

On 248 mi. of main line between Hamlet, N. C., and Savannah, Ga., the Seaboard Air Line has installed a signaling system which, in two respects, is the first of its kind. One new feature is that the control between the dispatcher's office and the power switches and signals at sidings is transmitted on wires in a two-conductor buried cable which is immune to wind storms. A second novel feature is that if this control from the dispatcher's office should fail, the system automatically changes over to a form of station-to-station automatic block signaling, in which, at each siding, an approaching train will automatically "approach clear" the signals for its direction of traffic. When operating under the control of the dispatcher or as automatic block, the blocks are from siding to siding, with no provision for following trains, thus requiring no intermediate signals, except those used also as distant signals for station-entering signals.

This line from Hamlet to Savannah, via Columbia, S. C., is the most direct of two Seaboard single-track lines between these cities, but it includes several heavy grades. A second line, via Charleston, S. C., is 14.5 mi. longer, but is at low grade on the costal plains. Accordingly, through passenger trains are operated

#106

View showing the signaling arrangement at the north end of the power-operated siding at Garnett

Map of C.T.C. territory between Hamlet, N. C., and Savannah, Ga.

via Columbia, and through freights via Charleston.

On the line via Columbia, the year-around passenger trains include the "Sunland," the "Silver Meteor," the "Silver Star," the "Palmland" and an express train daily. In the winter season, December to May, additional passenger trains include the "Orange Blossom" and other trains, making a total of seven passenger trains each way daily. A local freight is operated each way daily also, and, on some occasions, perishable pick-up and extra freights are run over this line. Thus the total number of trains daily may vary from about 14 to 24 or more.

On the 146 mi. south from Hamlet to a curve 2 mi. north of Waynor, the railroad runs through hilly country with rolling grades, ranging up to one per cent. Curves are numerous and range up to four deg. On account of the grades and curves, train speeds are limited at numerous places. South from Waynor, the railroad runs through open country where the line is more nearly straight and level. For example, the track is tangent for 25 mi. between Fairfax, S. C., and Garnett. Accordingly, the 100 mi. between Waynor and Savannah is high-speed territory, the maximum permissible speed being 75 m.p.h. for modern streamlined passenger trains hauled by Diesel-electric locomotives, and 70 m.p.h. for passenger trains of conventional equipment hauled by steam locomotives.

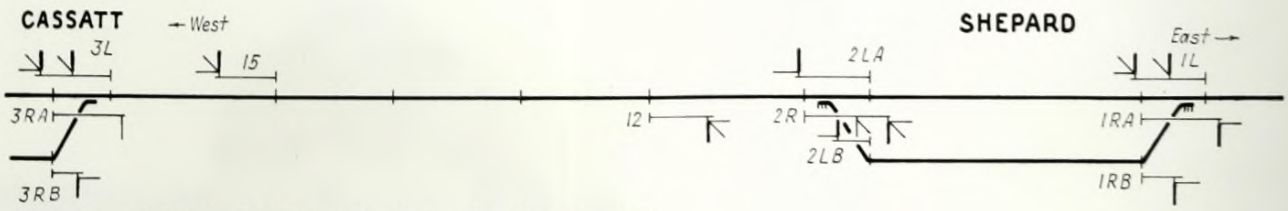
Previously there were 50 sidings between Hamlet and Savannah. Based on experience with earlier installations on the Seaboard, it was decided that 13 of these sidings would not be needed for the meeting and passing of trains after the new signaling was installed. Accordingly, three sidings, at Fulton, S. C., Hyatts and Exley, were retired. Ten other sidings, now used only as house tracks, were left in place, the hand-throw switches being equipped with locks. These tracks are at Kimberly, S. C., McBee, Bethune, Pontiac, Cayce, North, Denmark, Schofield, Sycamore and Scotia. Thus, of the original 50 sidings, only 37 were equipped with power switch machines and signals.

A Block Signal System

Previously, train movements in this territory were authorized by time table, train orders and manual block, no automatic block signaling being in service. The new system of signaling was planned primarily to meet the need for track-circuit-controlled signal protection. The station-leaving signals operate to two positions, and govern from siding to siding. Therefore, in this respect, the system is the equivalent of track-circuit-controlled absolute manual block. The power switch machines and signals at the sidings are ordinarily controlled by coded line equipment from a control machine in the dispatcher's office at Savannah. The aspects of these signals, when controlled by the dispatcher, authorize trains, in the conventional manner, to: (1) continue on the main track; (2) enter the sidings; or (3) leave the siding and go to the next power-equipped siding. In this respect the system is similar to centralized traffic control.

The typical layout of signals is shown in Fig. 2. The station-leaving signal, such as signal 2LA at Shepard, S. C., displays red for Stop, or green for Clear. Similarly, with the switch reversed, the leave-siding dwarf 2LB displays green for Clear. The Clear aspect on either 2LA or 2LB authorizes a train to proceed to Cassatt, S. C. The block is from station-to-station, with no provision for a second westward train to enter the block until first one has gone beyond signal 3RA at Cassatt. Thus, no yellow aspect is needed on signals such as 2LA and 2LB.

The station-entering signals, such as signal 2R at Shepard, display an aspect of green-over-red as Clear, if the station-leaving signal 1RA has been cleared; or signal 2R displays the yellow-over-red as an Ap-



Typical arrangement of two-aspect, station-to-station signaling

proach if 1RA is indicating Stop. Also, if the siding switch is reversed, station-entering signal 2R can display the aspect red-over-yellow to authorize a train to enter the siding.

In order to give advance information concerning the aspects displayed by station-entering and leaving signals, distant signals are provided. For example, signal 15 is the distant signal in approach to station-entering signal 3L. When signal 3L displays green in the top arm, the distant signal 15 displays the green aspect. If station-entering signal 3L displays either the red-over-red or the red-over-yellow aspect, than distant signal 15 displays the yellow aspect. When a train occupies the track section between signals 3L and 15, signal 15 is set to display the red aspect.

In all instances the distance between a station-entering signal and its distant signal is more than train-stopping distance. The track circuits are the coded type, and one such circuit extends between each station-entering signal and its distant signal. As a general rule, therefore, the distance from a station-entering signal to its distant signal is about 9,000 ft. Thus, as applied to various station-to-station blocks, the remaining distance between the two distant signals would vary. For example, as shown in Fig. 3, the distance between the sidings at Lugoff, S. C., and Blaney is 8.7 mi. One distant signal is out 8,725 ft. and the other 9,125 ft. This leaves 4.6 mi. intervening between the two distant signals.

Change-Over to Automatic Block

The coded line control circuit from the dispatcher's office to the field stations is in a two-conductor buried cable for the entire 248 mi. If the circuit on this cable fails, the controls in the field are changed over automatically so that an approaching train will automatically "approach clear" the signals for its direction of traffic in each successive station block and each station-to-station block.

When the system is operating as automatic block, the power switch machines at the sidings are each controlled locally by trainmen. On the instrument house near each power switch is a small cast-iron controller case in which there is a panel with two key holes that fit standard switch padlock keys. To cause the switch to operate from normal to reverse, a key is placed in the "right" hole and turned clockwise. Or, to operate the switch from the reverse to the normal position, the key is used in the "left" hole.

A feature of this project is the two-conductor underground cable extending the entire 248 mi. This cable, which was made by the General Electric Company, has two No. 10 solid copper wires, each wire having a 3/16-in. thickness of polyethelene, and these insulated conductors are enclosed in an overall layer of Flamenol, 4/64 in. thick. The cable was buried 18 to 22 in. deep by a cable plow, which was pulled by a steel wire cable connected to a 12-in. steel I-beam, extending out from a flat car at the floor level. With favorable conditions, the cable was plowed in at a speed of about five m.p.h. About 60,900 ft. were laid in one day when the work train was out on the main line a total of 6 hr. 20 min.

The two wires in the 248 mi. of buried cables are used for telephone carrier as well as for the d.c. codes and carrier for centralized traffic control. Three-channel Western Electric Type-C carrier equipment, used primarily for telephone service, is designed for modulation of the channel frequency by voice frequencies. Therefore, the Union Switch & Signal Company carrier apparatus, employed for the transmission of C.T.C. codes, is in the voice range.

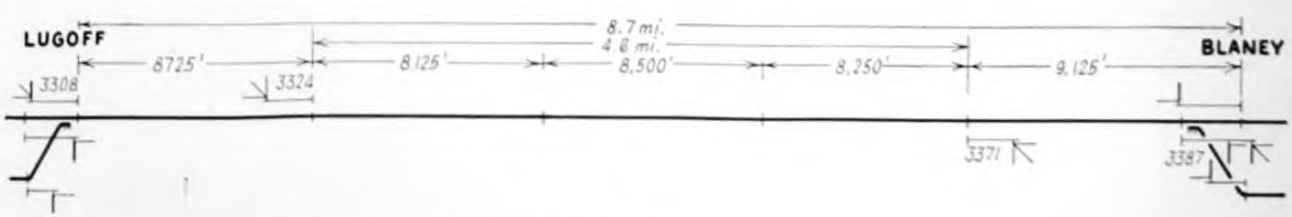
No Line Wires for A. C. Power

At the power switch locations storage batteries supply the energy to feed control circuits and operate the switch machines. These batteries are on floating charge from rectifiers which are fed from local commercial sources of a.c. At these locations, the storage batteries will keep the switches and signals in operation even if the commercial a.c. power fails.

However, the carrier equipment for C.T.C. line coding and for communications circuits requires a.c. power constantly. Accordingly, at the nine field stations which are also carrier repeater stations, an emergency standby source of a.c. was required. At each of these stations there is a small-size gasoline engine-driven generator, rated at 1,500 watts, 110 volts. If the incoming a.c. commercial power fails at any of these nine field stations, the gas-engine generator is started automatically and takes over the load quickly. These machines are the lightweight portable type made by Onan & Sons, Minneapolis, Minn.

On the sections of track between sidings the track circuits and distant signals are normally deenergized, being set in operation as a part of the controls when a line-up in a station-to-station block is being established under control of the dispatcher. Accordingly in the station-to-station blocks, the track circuits and signal are fed directly from primary battery and, therefore, no line wires are required for an a.c. power distribution circuit.

The installation was under the jurisdiction of J. R. DePriest, superintendent communications and signals, and J. E. Barker was general signal construction supervisor. The principal items of signaling equipment on this project were furnished by the Union Switch & Signal Company.



Typical spacing of distant signals in a station-to-station block

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