Coast Line Replaces

Semaphores, controlled by polar track circuits, are replaced by searchlight signals, controlled by coded track—Project includes new interlockings and C.T.C., as well as electric locks on hand-throw main-track switches and crossovers

On an entire engine district of 121 mi. of double track between Richmond, Va., and Rocky Mount, N. C., the Atlantic Coast Line has installed completely new automatic block signaling and interlockings throughout. Old semaphore signaling, controlled by polar d.c. track circuits, has been replaced by modern searchlight signals controlled by coded track circuits, this signaling including electric locks on all main-track hand-throw switches and crossovers. Old electro-mechanical interlockings have been removed, and replaced with new electro-pneumatic or electric plants, some of which are remotely controlled in centralized traffic control territories. Also automatic grade crossing signal installations were improved or replaced as part of the improvements. This territory between Richmond and Rocky Mount is the first engine district on the Atlantic Coast Line's 1,000-mi. through route between Richmond and important cities in Florida.

The through schedules include 20 passenger trains. Seven additional passenger trains are operated in shuttle service on the 27 mi. between Richmond and Petersburg. Approximately 20 freight trains are operated daily so that the total trains daily range from about 40 to 50.

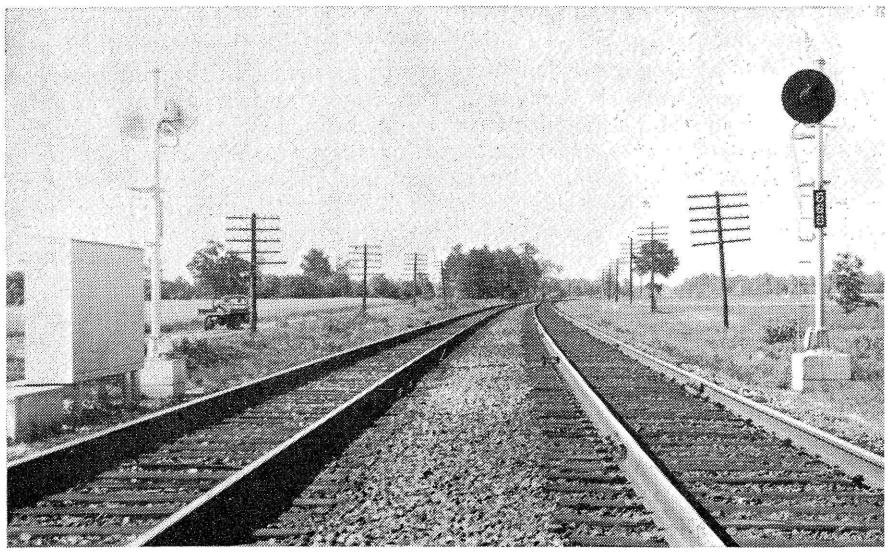
The main line is double track throughout the entire 121 mi. between Richmond and Rocky Mount, with the exception of two single track bridges. Throughout this territory, the railroad traverses the west edge of a coastal plain, with light grades and curvatures. The maximum grade is 0.7 per cent for 1 mi. ascending between Battleboro and Rocky Mount. The curvature is light with relatively few curves, the maximum curvature is 4 deg. on one curve on which the speed for passenger trains is limited to 50 m.p.h. Train speeds are restricted to 25 m.p.h. through two small towns, and to 15 m.p.h. through a third. The maximum authorized speeds are 85 m.p.h. for passenger trains and 60 m.p.h. for freight trains.

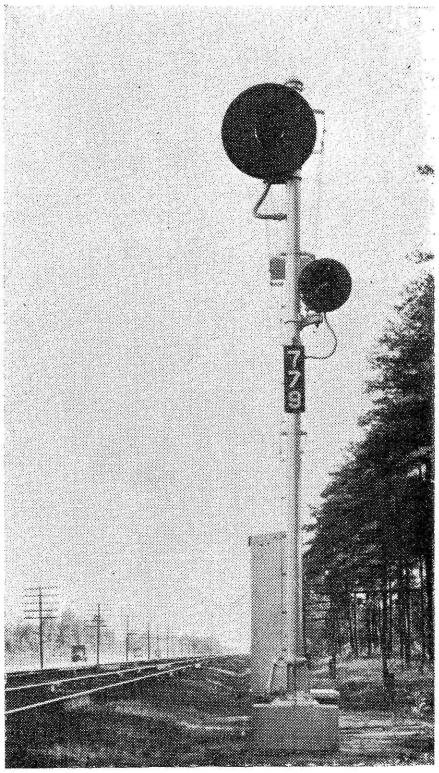
Increase Block Length

In the semaphore automatic signaling, as originally installed in 1913 to 1916, the signals, which were of the three-aspect upper-quadrant type, were spaced for blocks about one mile long. The new searchlight type automatic signals are spaced approximately two miles, which, according to road tests on this territory, is adequate for stopping distances of modern trains at speeds up to 100 m.p.h. for passenger trains and up to 70 m.p.h. for freight trains.

The previous semaphore automatic block signaling, as well as the new light-signal system, includes intermittent inductive train stop, in which a wayside inductor is located 90 ft. in approach to each signal. In this system, the brakes are applied automatically if a locomotive passes a signal displaying a restrictive aspect such as "red" or "yellow," providing the engineman does not acknowledge such an aspect by operating his acknowledgement lever.

The new signals, both automatic and interlocking, display standard code aspects. Each automatic block signal has one "arm" consisting of a searchlight signal head, which can be controlled to display conventional aspects: red, yellow or green. On each distant signal in approach to a home interlocking signal, there is a second "arm" which consists of a lamp





Above—Signal with normally-dark yellow lower lamp unit
Left — Typical double signal location on double track line

Signaling

On Engine District

Northbound home signal at Falling Creek, showing southbound train crossing over to southbound track

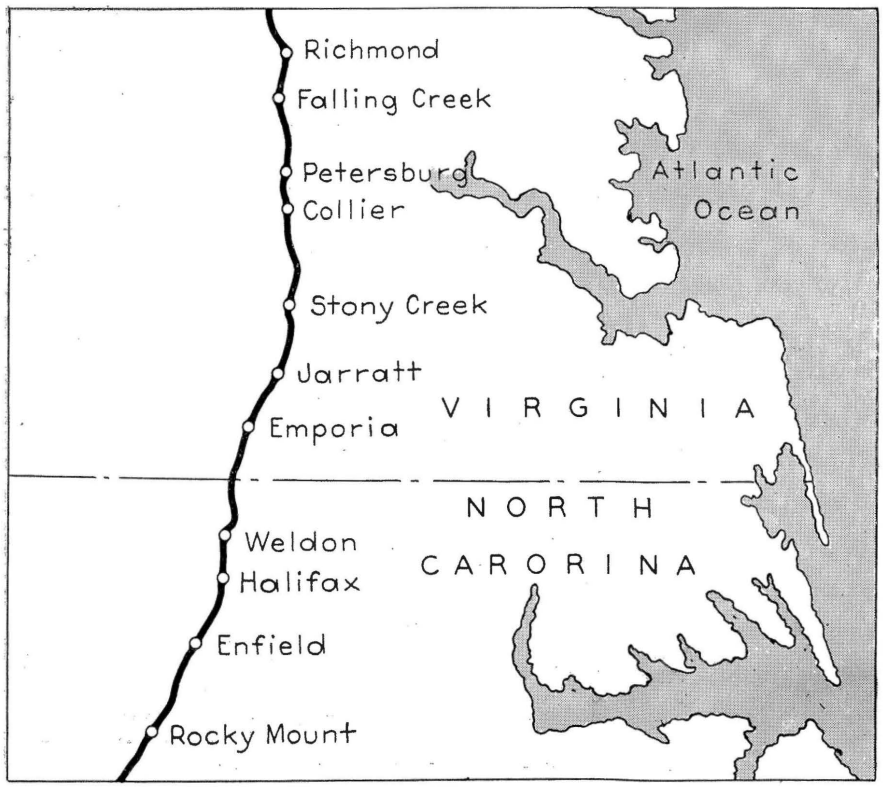
unit with a green glass 8⅜ in. in diameter. The lamp in this unit is normally dark. However, if the home signal is cleared to display the medium-speed aspect for a diverging route over a medium-speed crossover or turnout, then the distant signal displays the Approach-Medium aspect, yellow-over-green. This use of the Approach-Medium aspect on a distant signal, as compared with an Approach aspect, gives enginemen advance information so that they can bring trains up to and through a turnout at the speed for which it was designed, rather than approaching at reduced speed prepared to stop.

In a few instances, due to local circumstances, the block lengths are less than maximum train-stopping distances. In each such instance, the signal for the block in approach to the short block has a second "arm" which is a single lamp unit with a yellow glass. The lamp in this unit is normally dark, but if the short block, i.e., the second one ahead, is occupied, the aspect displayed is yellow-over-yellow, Advance Approach Aspect, Rule 282A.

In the new signaling, the track circuits are the coded type, one advantage being that they can be operated successfully for greater length; in most instances, extending throughout each automatic block ranging from 1.7 mi. to 2.0 mi. in length. The signals are controlled by codes at different rates. Code at the rate of 180 per minute controls a signal to the green aspect; 75 to the yellow; and 120 for the yellow-over-yellow, or the yellow-over-green. There is no occasion for any signal to display both of the latter aspects.

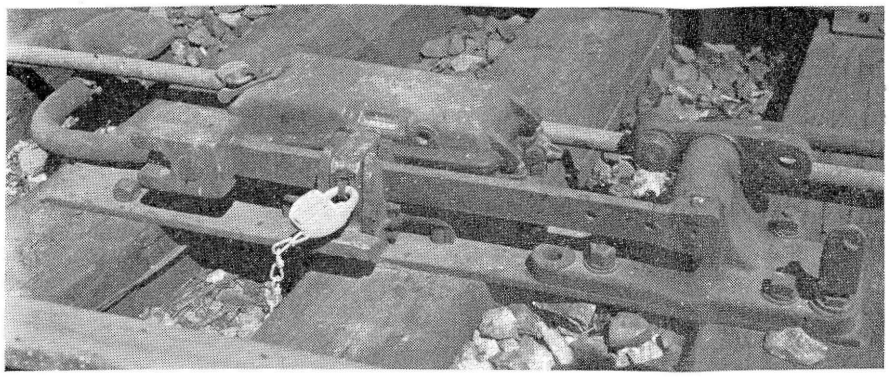
In each track circuit, the code feeds through a block in the direction opposite to the train movement, and, at the same time, impulses of energy feed in opposite directions to form the reverse code which is used to control the approach lighting of signals, as well as to control approach locking. Thus, with the exception of special circuits, no line wires are required for controls of signals. The relays for the automatic signaling are of the shelf type, and are equipped with plug couplers, so that a relay can be replaced quickly by changing the coupler, and without changing wires.

In interlockings, the dwarf signals on routes leading to main tracks can be controlled to display a flashing-yellow aspect when one block is unoccupied, thus authorizing a train to proceed preparing to stop at next signal, as compared with 15 m.p.h. maximum permitted by a steady yellow aspect.



Signals at Spring Switches

Sidings, which are remote from interlockings, are equipped, on the leaving end only, with spring switch



Lever stand at center of crossover

mechanisms and automatic mechanical facing-point locks. Ordinarily trains are operated right-hand running on this double-track line. However, as facing-point protection for trains operated reverse running, there is a two-aspect color-light "spring switch indicator" dwarf signal at each spring switch which normally displays yellow with the switch in the closed position and locked. If the switch is not fully closed, and locked, the dwarf displays red instead of yellow. Rules require trains to approach this indicator signal prepared to stop.

Electric Locks on Hand-Throw Switches

At each hand-throw main-track switch for a turnout, the old hand-throw stand was replaced by a T-21 manually operated switch and lock mechanism, each of which is equipped with an electric lock, which locks the hand-throw lever when in the normal position. These electric locks are released by two methods. First, immediately if block conditions permit and secondly, straight time locking. The type of control used is determined by the importance of the switch in question. Contacts, actuated by removing the padlock, set the signals at red and start operation of a time-element relay. When the time has expired, the lock is released. Then the switch can be thrown. A pipe-connected derail at clearance point on the turnout is removed from the track when the switch is thrown.

Hand-Throw Crossover Protection

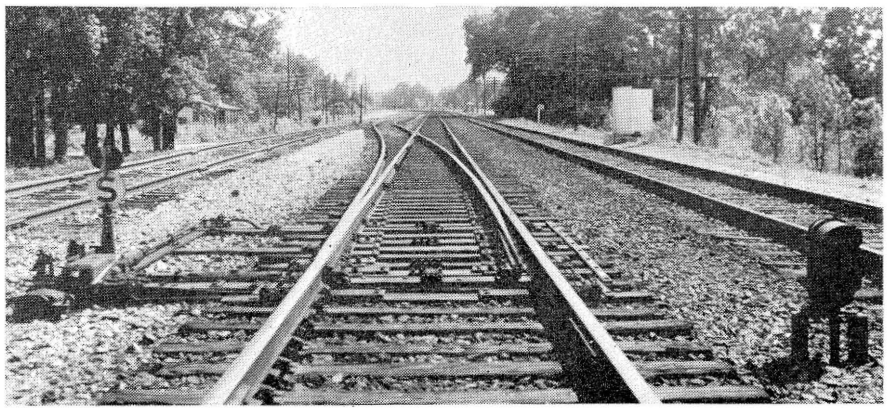
The hand-throw crossovers are protected to prevent the switches from being placed normal with a car or locomotive on the crossover. This is accomplished by special equipment. Each switch is equipped with a T-21 manually-operated mechanical switch and lock movement. The lock plungers of the two machines are pipe connected to and operated by a lever-stand which is located on the ties between the rails at the middle of the crossover, as shown in one of the accompanying pictures. This lever stand is equipped with an electric lock which locks the lever in the normal position.

Under normal conditions, the two switches are in the closed position and locked with the facing-point locks. When a crossover is to be used, a trainman goes to the center lever stand, and removes the padlock. This sets the signals at stop and starts the time-element relay. When the time locking period has elapsed, the lock is released, as is shown by an indicator on the lock. Then the lever can be thrown to pull the facing-point locks so that the switches can be reversed. After the crossover has been used, the switches are placed normal, and then the lever stand can be returned to normal. If a car or locomotive is standing on the crossover, it will be above the lever stand so that the lever cannot be placed normal. In order for the signals to clear, the switches must be normal and locked by placing the lever stand normal. The protection is maintained by shunting the track circuits through point-detector contacts and lock-plunger contacts in the T-21 mechanisms. The track shunt connections from the rails to the controllers on the T-21 hand-throw switch and lock machines are No. 6 stranded bare Cadweld conductors which are welded to the rails.

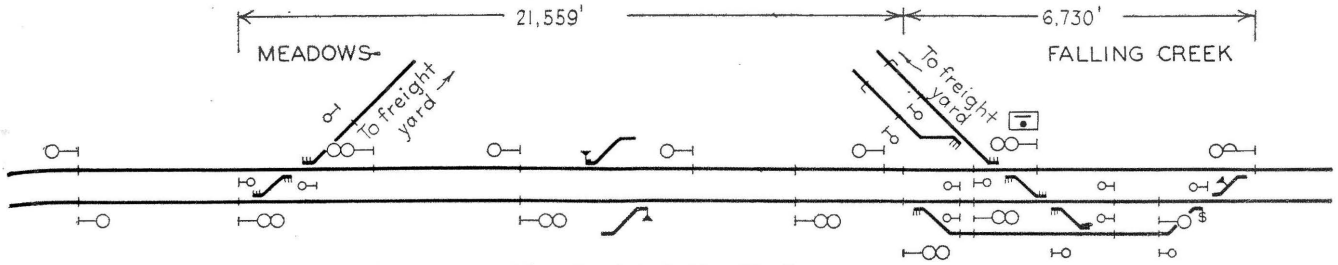
All of the automatic signaling is of the d.c. type. The normal direction control codes in each track circuit are fed from a 120-a.h. Exide lead cell of battery, and the reverse codes are fed by a cell of the same type, rated at 60 a.h. These track batteries are on floating charge from rectifiers. The signal lamp is fed a.c. normally from the low-voltage transformer. These transformers and rectifiers are fed from a 440-volt two-wire a.c. power distribution circuit on the pole line. If the a.c. power fails, the storage cells continue to feed the track circuits. Energy required for the 8-10 volt apparatus, including the 250-ohm signal head relay, is normally supplied from a full-wave copper oxide rectifier of the constant potential type. In case of an a.c. power failure, all of the 8-10 volt apparatus, including the approach-lighted signal lamp are fed from a set of 15 cells of Edison 1,000-a.h. primary battery, which normally is on open circuit with no discharge. In order to keep such a set of primary battery active, it is discharged once every two weeks for 5 min. by placing a ½-ohm shunt across its terminals.

In the instrument cases, the incoming wires from rails for track circuits are connected to rare gas type lightning arresters made by the Western Railroad Supply Co. The 110-volt a.c. line circuit and the line controls and indication circuits, where used, are protected by Clearview type arresters made by Raco.

On the new signaling, the line wires are on a bottom arm which was added to the existing pole line used also for communications circuits. These line wires are all weatherproof. The two wires for the 440-volt a.c. power distribution are No. 6. The wires for the line code in C.T.C. sections are No. 9, as also are the line wires used for lock circuits where required. The underground cable from instrument cases to track connections is single-conductor No. 6, brought up through W.R.S. Co. bootleg outlets with Cadweld stranded conductors welded to the



Spring switch with mechanical facing-point lock



Track and signal plan of layout at Falling Creek including Meadows

rail. The rail joints in this territory are bonded with Cadweld bonds.

New Interlockings and C.T.C.

At Falling Creek, 6 mi. south of Richmond, a double track line branches off to the north and east to an industrial freight yard in South Richmond. Also from the north end of this yard, a line connects with the main track at Meadows, 1 mi. from Richmond. Northbound freight trains with cars to set out in this yard leave the main line at Falling Creek and enter again at Meadows. Southbound trains to pick up at this yard follow the corresponding reverse route. Formerly there was an electro mechanical interlocking at Falling Creek and the junction switch and crossover at Meadows were operated by hand-throw stands. The mechanical plant was replaced by a new electro-pneumatic interlocking controlled by all-relay circuits and a C.T.C. type machine. This interlocking includes home signals at the switch at the south end of the siding, this switch being equipped with a spring switch mechanism. At the junction at Meadow, electro-pneumatic switch machines and associated home signals were installed to form an interlocking which is controlled remotely from the machine in the tower at Falling Creek. The north end of pass track is also remotely controlled from Falling Creek tower.

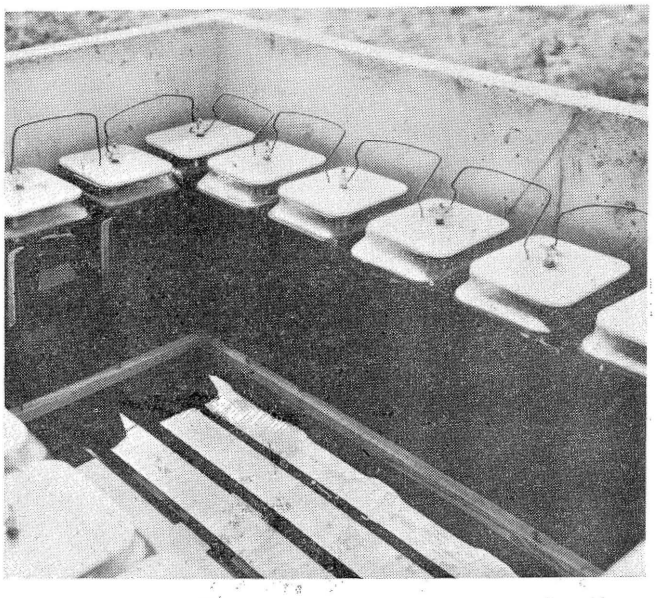
New Interlockings and C.T.C. at Petersburg

The original main line passed through the city of Petersburg, 27 mi. south of Richmond. In later years, a belt line, now used by all main-line trains, was constructed west of the city, connecting with the old main-line at Dunlop, 4 mi. north of Petersburg, and at "BX," 2 mi. south. Electro-mechanical interlockings were in service at Dunlop and at "BX," and single track main line on the belt line extended between these plants. As part of the improvements during the last few years, second main track was added between Dunlop and "BX" with the exception of single track on the bridge over the Appomattox river. A new passenger station was constructed at North Petersburg near River Road crossing. To increase the flexibility of train movements in the vicinity of this station, a pair of power-operated crossovers were installed at MP 22 about 2,500 ft. north of the station.

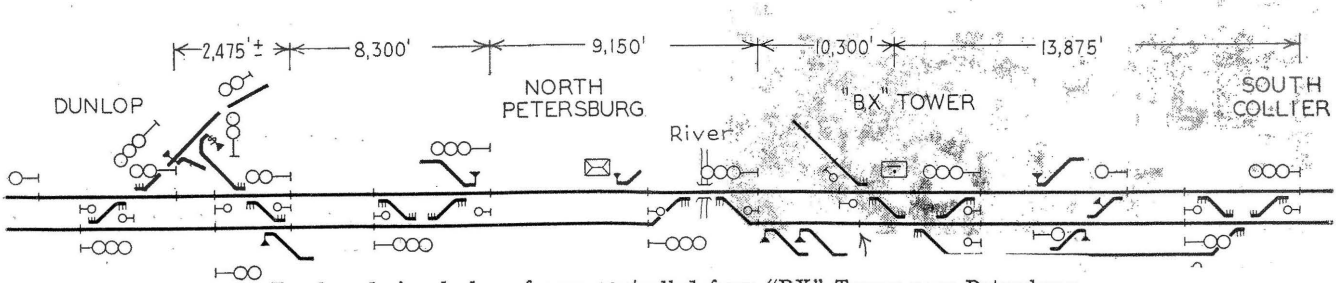
The new centralized traffic control, with the control machine in a tower at "BX," includes the entire territory from Dunlop through North Petersburg and "BX" to South Collier about 10 mi. This C.T.C. includes power switches and signals to replace the old electro-mechanical plant at Dunlop; and to power operate the crossover and wye switch south of Dunlop, which were formerly hand-throw, and to power operate two new crossovers at North Petersburg; the end of double track switches at both ends of the bridge; all the switches at "BX," which were previously in the old electro-mechanical interlocking, and the siding switch and two crossovers at South Collier which were formerly hand thrown.

C.T.C. at Weldon

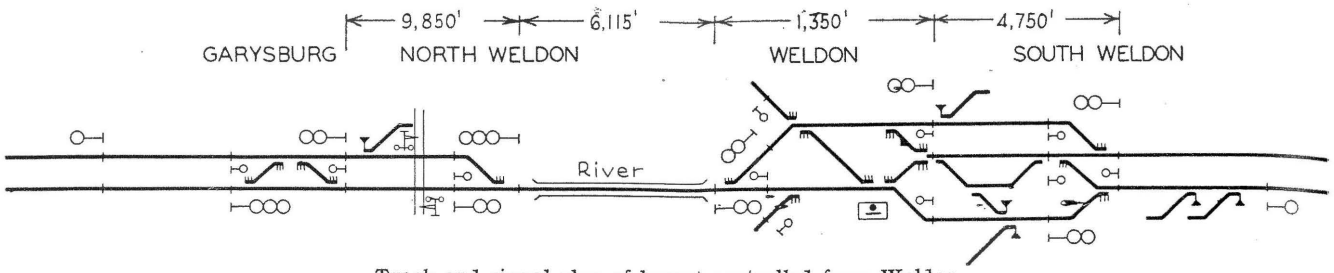
At Weldon, 88 mi. south of Richmond, there was formerly an electro-mechanical interlocking which included crossovers and switches at the



Set of 15 cells of 1,000-a.h. primary battery at each signal acts as standby feed for line circuit and signal lamp



Track and signal plan of area controlled from "BX" Tower near Petersburg



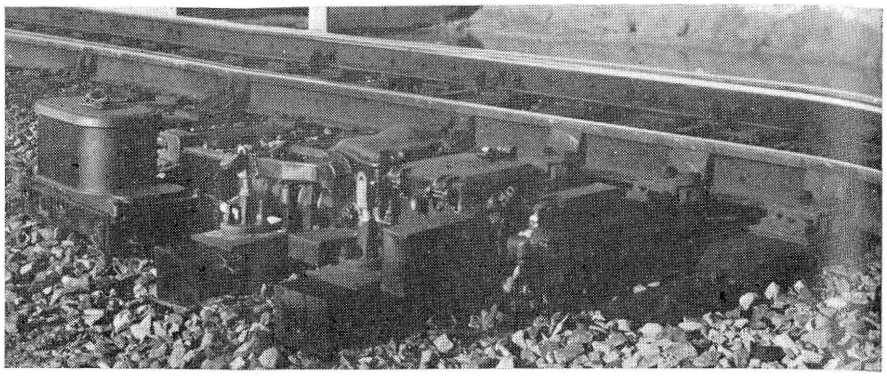
Track and signal plan of layout controlled from Weldon

north end of a siding and a small storage yard, as well as the switch at the south end of single track over the Roanoke river bridge, the switch at the north end being power operated and controlled remotely from the Weldon tower.

Also at Garysburg

The improvements included the installation of a set of two crossovers at Garysburg, 3 mi. north of Weldon. New interlocking power switches and signals were installed at the new crossovers at Garysburg, at both switches at the ends of the bridge, and throughout Weldon to replace the old electro-mechanical plant, as well as at South Weldon to operate the crossover and switches which were formely hand-thrown. All these facilities in the 4.5 mi. between Garysburg and South Weldon, inclusively, are now controlled by a panel type C.T.C. machine in the tower at Weldon.

At Emporia, 68 mi. south of Richmond, a mechanical interlocking, at a crossing with the Southern, was replaced with a new electro-pneumatic interlocking. At these new interlockings and C.T.C. control offices, including Falling Creek, "BX" at Petersburg, at Weldon and at Emporia, new one-story interlocking towers were constructed. Each building is on a concrete foundation, with brick walls and a flat roof, all of fireproof construction. The operating room in each tower is about 14 ft. by 14 ft. and a separate room for relays is 14 ft. by 10 ft. In these interlockings, the relays are the plug-in type which can be replaced without changing any wire connections.



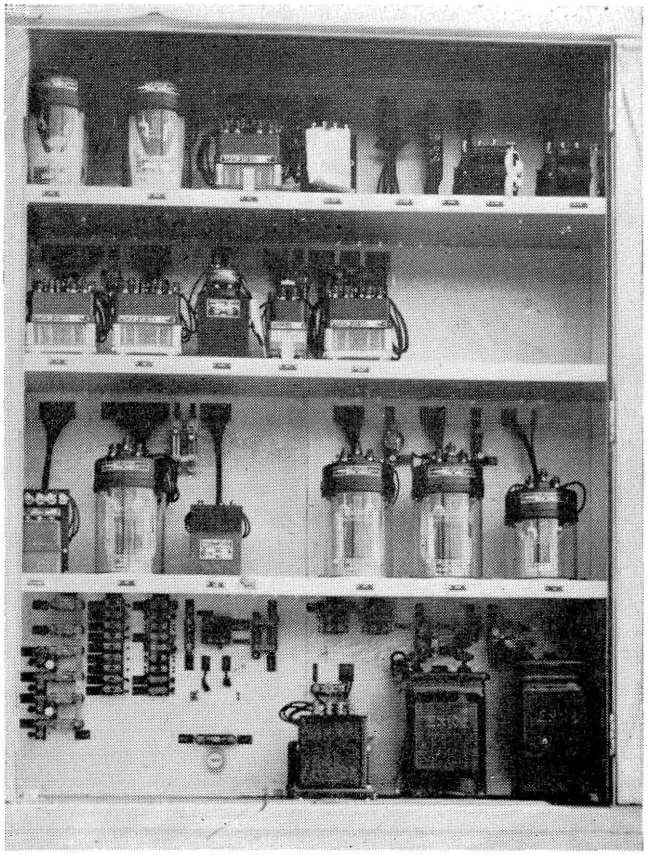
An A21 electro-pneumatic switch machine at remote control switch

The signals on all these new plants are the searchlight type, and the majority of switch machines are electro-pneumatic. The type A5 machines are used in the general vicinity of towers and the A21 type with dual control are used at remote places, such as at the south end of Weldon siding, Garysburg and Meadow.

At each interlocking layout, the compressed air for operating switch machines is furnished by small electric motor-driven compressors, two of which are mounted in a sheet-metal case.

These air compressors are rated at 4.2 cu. ft. per min., and are driven by 2 h.p. a.c. motors. Both compressors are set to cut in at 55 lb. pressure; a thermal relay prevents both motors from starting simultaneously. They both cut out at 70 lb.

This new signaling was planned and installed by signal forces of the Atlantic Coast Line, under the direction of J. S. Webb, chief engineer communication and signaling. Construction work was carried out under the supervision of S. J. Davis, Jr., supervisor signal construction. The major items of signaling equipment were furnished by the Union Switch & Signal Company and the insulated wires and cables by the Kerite Company.



Interior of case at a signal showing relays with plug couplers on three shelves and on lower shelf a storage cell for a track circuit