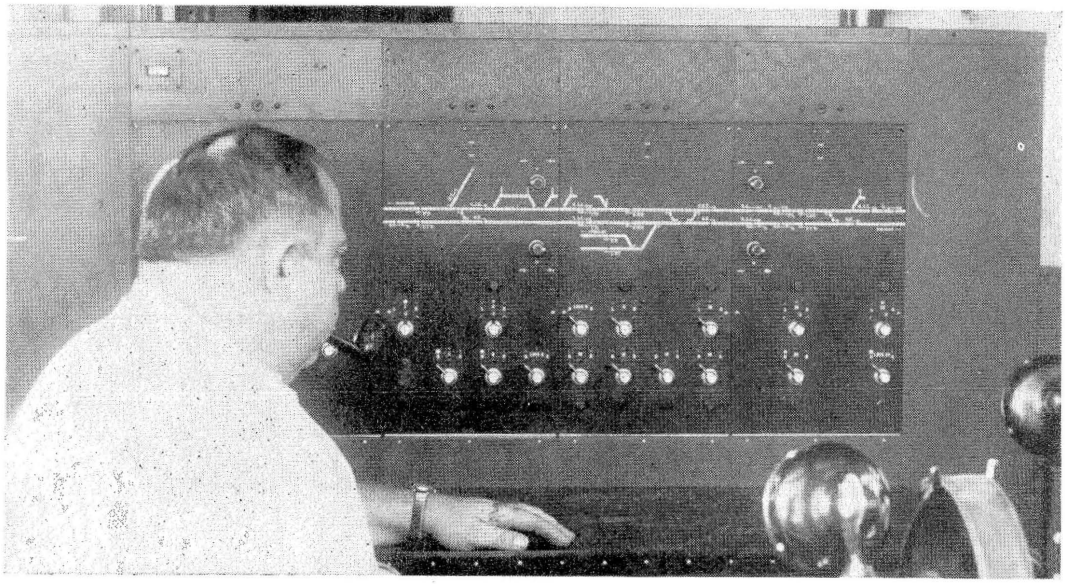


J. E. Hillig, circuit engineer seated at the new C.T.C. control machine in the offices at Lurgan

C.T.C. on the Reading

By J. E. Hillig
Circuit Engineer, Signal Department
Reading Company, Philadelphia, Pa.

Normally-deenergized coded track circuits control traffic locking and signals for train movements in both directions on both tracks

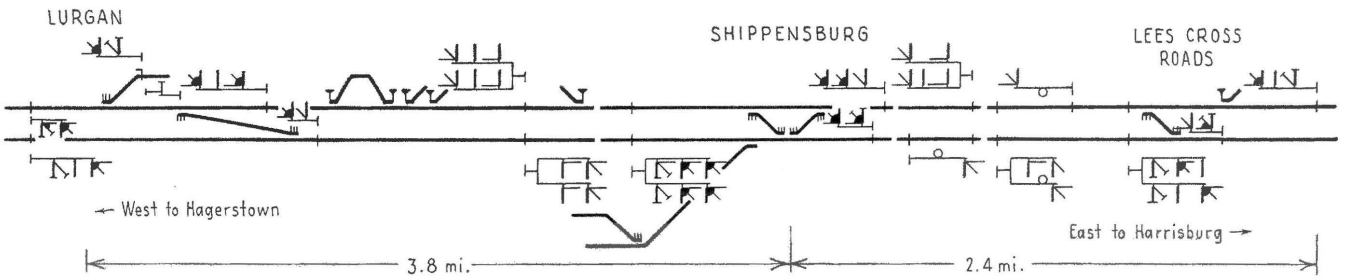
THE Reading has recently completed an installation of centralized traffic control between Lees Cross Roads, Pa. and Lurgan, 6.2 mi., on a section of its Philadelphia, Harrisburg & Pittsburg branch. This is a double-track branch extending 42.7 mi. from Harrisburg west to Lurgan, and is used exclusively by tonnage freight trains. At Lurgan, the west end of this branch, the Reading interchanges traffic with the Western Maryland. Hagerstown, Md., on the W.M., is 30 mi. west of Lurgan, and tonnage freights are operated both directions via Lurgan between Hagerstown and Rutherford yard on the Reading near Harrisburg. Also at Shippensburg, 2.4 mi. east of Lurgan, the Reading interchanges traffic with the Cumberland Valley line of the Pennsylvania. The traffic, all of which is freight, requires numerous trains between Lurgan and the Rutherford yard approximately 42.7 mi.

Heavy Grade

On account of a 0.47 per cent ruling grade eastward, pusher locomotives are required on eastbound tonnage trains from Lurgan east to Lees Cross Roads, 6.2 mi. Formerly at Lees Cross Roads, there was a hand-throw crossover between the two main tracks. When a pusher was cut off of a train at this location, the fireman got down from his cab, walked to the east end of the locomotive to close the angle cock; then he went to the hand-throw crossover to throw the switches. After waiting the required three minutes, protection was provided while the engine made the crossover movement, after which the crossover switches were restored to normal. All this consumed about 10 min.

Survey of Train Movements

A survey of a three-month's period indicated that an average of 219 pusher engines made this crossover



Track and signal plan of the entire C.T.C. territory between Lurgan and Lees Cross Roads

move monthly. Study indicated that an appreciable saving could be effected in engine hour expense if interlocking operation and control were applied at this crossover layout. This led to a decision to install centralized traffic control throughout between Lurgan and Lees Cross Roads to include power switches at the crossover at Lees Cross Roads, as well as to replace the old mechanical interlockings at Lurgan and Shippensburg, and to include signals for authorizing train movements in both directions on both tracks. This was planned not only to facilitate movements of the helper engines, but also to permit tonnage trains to be operated in either direction on both tracks, under signal indication, without prohibitive loss in time as was inherent in the previous train-order operation.

At Lurgan, the old mechanical interlocking, "GN," included a trailing-point crossover, a hand-throw turnout with an electric lock, and semi-automatic signals. In the new C.T.C., electric switch machines were installed on this crossover and also on the turnout, signals being arranged as shown in the plan.

The layout in the old mechanical interlocking, "SX", at Shippensburg, include a double-track junction to the interchange, a trailing-point crossover between the main tracks, a facing-point switch on the westward main, a double-slip and movable-point frog, and a trailing-point turnout from the eastward interchange track. This track layout was changed to a single-track junction, thus eliminating the slips and movable-point frogs, and by installing a trailing-point crossover between the main tracks, a facing-point crossover, a trailing turnout on the eastward main, and a trailing turnout at the end of double track on the connection. In the C.T.C., switch machines and signals were installed at Shippensburg as shown in the plan. At Lees Cross Roads, the old crossover was replaced by a new longer crossover to permit crossover moves at higher speeds that would not necessitate reductions in the speed of tonnage trains. Switch machines and signals were installed at this crossover. On the entire C.T.C. territory, the new power switch machines are the dual-control type, the high signals are the color-light type and the four-aspect dwarfs are the searchlight type.

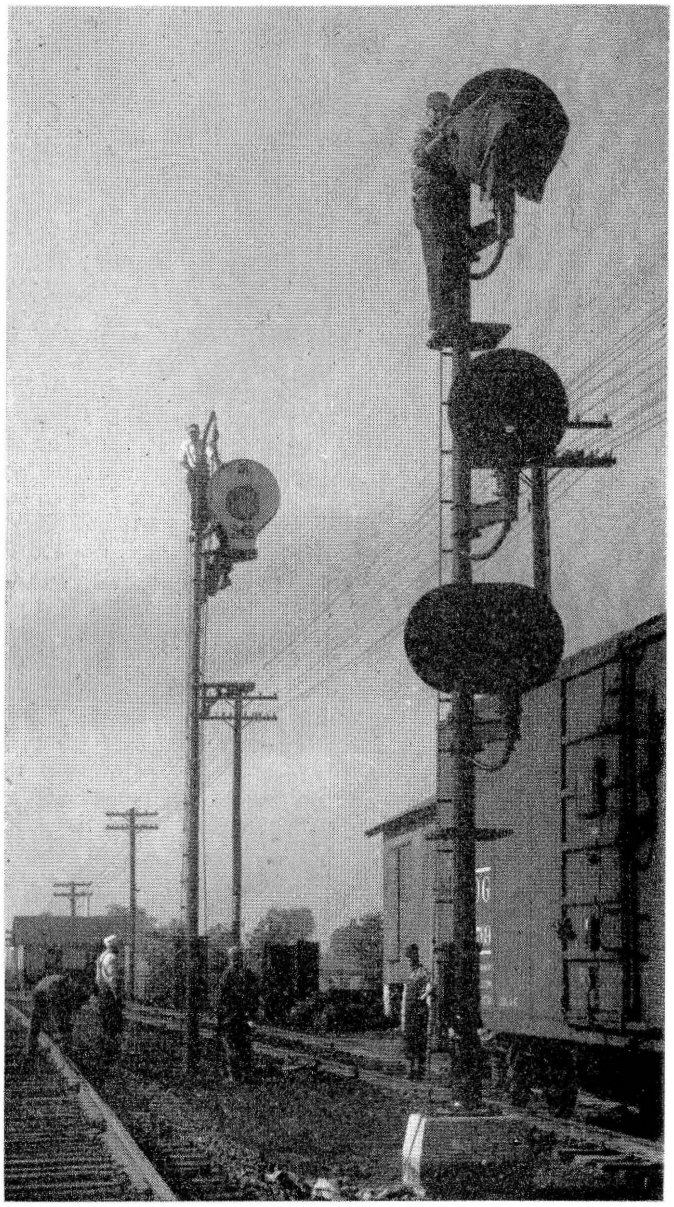
On hand-throw industrial turnouts, the derails are electrically locked, the hand-throw switches are equipped with pipe-connected bolt locks, actuated by movement of the derail. To enter or leave a spur track, a member of the train crew must contact the operator of the C.T.C. machine to release the electric lock, which can be released when the opposing signals routing into that section where the lock is located, are at Stop.

The machine for controlling the C.T.C. between Lurgan and Lees Cross Roads was located at Lurgan because this is an office where interchange reports are maintained and a train-order office for movements on the Western Maryland west of Lurgan. The C.T.C. machine, as shown in an accompanying picture, is the conventional type. This machine is in the operating room of a new one-story brick building which has two other rooms, one for relays and another as a restroom for train crews. The operating room and crew room are heated by a radiant type oil heater. This has an advantage of eliminating dust and dirt ordinarily present with coal-fired heating plants.

The power switches and signals at Lurgan are controlled by direct-wire circuits, while those at Shippensburg and Lees Cross Roads are controlled by C.T.C. line-code equipment on a two-wire line circuit. In order to prevent confusion to the operator of the control machine, starting buttons were used in connection with the levers of the direct-wire layout as well as the line code layouts.

Traffic Locking

As a part of the new project, the old disc-type automatic signals were replaced by new color-light signals, and both tracks are now signaled for train movements in either direction—all under the control of the C.T.C. machine. Normally-deenergized coded track circuits are used between Lurgan and



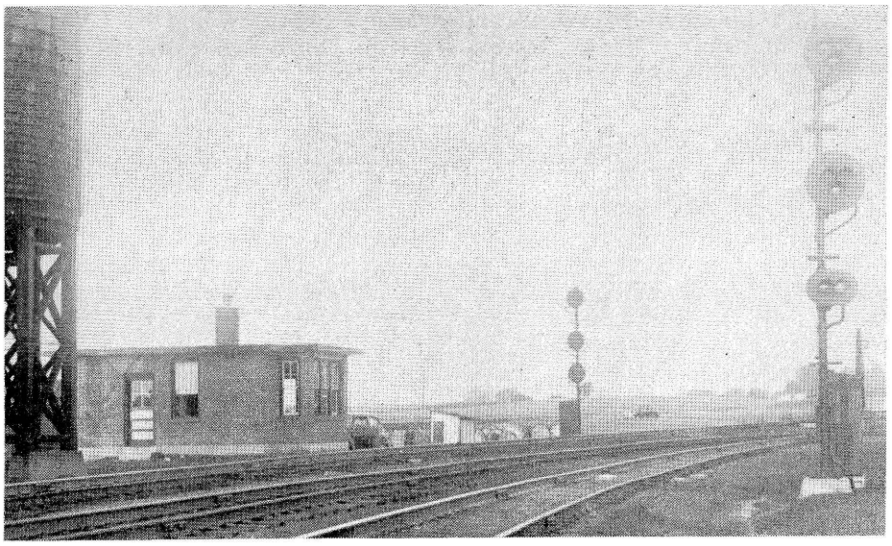
View during the change to remove old disc signal and install new colorlight signal

Shippensburg, and between Shippensburg and Lees Cross Roads. These track circuits control the signals and traffic locking, no line wires being required other than the two for the C.T.C. code and two for a.c. power distribution.

Traffic control and coded track circuit starts are initiated in both directions between Lees Cross Roads and Shippensburg and in the westward direction on both tracks between Shippensburg and Lurgan by C.T.C. codes; whereas in the eastward direction between Shippensburg and Lurgan they are initiated by direct wire. To initiate a start, the operator actuates the traffic lever and signal lever to the positions required, and depresses the starting button. The traffic lever for the section to which it obtains must be in correspondence with the signal lever when the start is initiated, otherwise incomplete C.T.C. control cycle will be transmitted, causing a buzzer to sound. This cycling will continue until cancelled or the traffic lever actuated to the proper position.

The following will briefly describe the various phases required to permit a westward train movement on the westward track between Lees Cross Roads and Shippensburg. The first step is to initiate a start at Lees Cross Roads. This is accomplished by a C.T.C. control code being transmitted from Lurgan to Lees Cross Roads conveying the information to clear L23 signal. After this control code has been received and decoded at Lees Cross Roads, a C.T.C. function relay L23GZR is picked up which in turn picks up a repeater L23GZPR. The second phase is to insure that traffic has not been established in the opposite direction, automatic signals indicate stop, track circuits are unoccupied, switches are in correct position for the particular movement and no broken rails obtain, etc.

This is accomplished first by the picking up of the 3LTCZPR relay which checks that conditions as required obtain within the limits of the interlocking, and second when the 23ECPR picks up to apply a steady energy to 23 track circuit. When the steady energy is received at the east end of the track circuit,



View at Lurgan showing new one-story office at the left

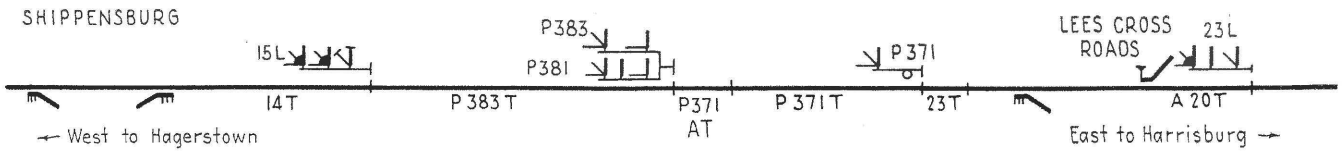
the 23ETR will pick up the ECPR for the adjacent track circuit if the conditions required obtain. The ECPR will apply a steady energy to its track circuit to pick up the ETR. This application of steady energy continues until all the ET relays have been cascaded up between Lees Cross Roads and Shippensburg on the westward track.

The next phase is to remove the steady energy from all the track circuits involved. When the last track relay P383 ETR had picked up from steady energy a circuit was completed to pick up the 3LTCR which initiates a C.T.C. indication code to Lurgan, conveying the information that steady energy has been received at Shippensburg. Had an unsafe track condition existed such as broken rail, track occupied, switch in wrong position, steady energy would not have been received at Shippensburg, thus traffic could not be established.

When this indication code is received at Lurgan, it is indicated by a lighted traffic indication and it automatically starts a C.T.C. control code to Lees Cross Roads conveying the information to remove the steady energy from the first track circuit. After the control code has been received and decoded at Lees Cross Roads, the function relay 3LTCZR picks up to release the 3LTCZPR which in turn releases the 23ECPR to remove steady energy from 23 track circuit which releases the 23ETR, steady energy is removed from each following track circuit until all ET relays are cascaded down.

The last phase of applying coded track energy to the rails is obtained when the last track relay P383ETR was released to pick up the 3LTCPR, which together with 3LTCR stuck up, completes the necessary circuits to energize the code transmitters and the P383-WCPR which applies a coded energy to the track circuit at a frequency selected over relays actuated and dependent upon the indication displayed by 15L signal at Shippensburg.

When the coded energy is received at the west end of the track circuit the P383WTR will follow the code being received. This code rate is decoded and will allow the signal to indicate as required. When the P383WTR picked up on the first code pulse it picked up the P383WFPR relay (which is made slow release so to bridge the off time of the coded track energy) which will apply coded track energy to the next track circuit at a frequency dependent on the position of signal P383. This coded track energy is cascaded through all track circuits in the same manner as the steady energy was. When coded track energy is received at the last track circuit 23T, the final traffic control stick relay 3LTCSR is picked up and will remain stuck up until traffic has been cancelled by a C.T.C. control code. This with



Plan of westward track only to explain control by normally-deenergized track circuits

the final traffic relay picked up and the 23WTR coding circuits are completed in conjunction with the L23GZR to allow L23 signal to indicate.

The following explanation will briefly describe how the system is automatically restored to normal by a train movement.

When the OS track relay is released the stick circuit for the L23GZR is opened to release the GZR and the GZPR which causes the signal 23L to indicate stop. When 23 track circuit is occupied 23WTR and 23WTPR are released (not coding), consequently the 23W decoding transformer has no alternating output and the decoding relays are released. As the train movement progresses through the system, the various code frequencies are received and decoded at Lees Cross Roads. When the train movement has cleared P383 track section, 180 code is received and decoded to pick up the 23WACR (180 decoding relay). It may be well to point out at this time that the first time 180 code was received at Lees Cross Roads, the GZPR relay was picked up and there was no circuit to pick up the 3LTCZPR but with the WACR up and the GZPR down a circuit is completed to pick up the LTCZPR which picks up the 23ECPR to apply steady energy to 23 track circuit. (Had the operator initiated a control code to again pick up the 23GZR, traffic control would have remained established). The steady energy is applied to the successive traffic circuits as previously described.

When the train movement has cleared P383 track circuit, the steady energy will pick up P383-ETR to release the P383WCPR, the 3LTCR and stick the 3LTCPR up at Shippensburg. The 3LTCR down starts a C.T.C. indication code to Lurgan which when received at Lurgan releases the 3LTCKR relay and starts a control code to Lees Cross Roads conveying the information to release the 3LTCZR.

When the 3LTCZR picks up it opens the stick circuits for the 3LTCZPR and the 3LTCSR. The 3LTCZPR down releases the 23-ECPR to remove the steady energy from the track circuit. After the steady energy has been removed from the last track circuit, the P383-TR releases to remove the stick circuit from the 3LTCPR and with the 3LTCPR down the system is restored to normal.

Once traffic has been established, the system can be restored to normal by the operator starting a C.T.C. control code calling for a Stop signal, this control code when received at Lees Cross Roads releases the GZR and GZP, thus clearing the system as mentioned in the foregoing.

Account of the system being automatically restored to normal when the 180 code again is received at the starting point, a condition obtains when a train movement is made into a spur clearing the main track, which restores the system to normal, thus when the train movement is ready to return to the main track, it is necessary to re-establish traffic so that the intermediate automatic signals will be clear and as mentioned previously, it is not possible circuitwise to release the electric lock when the opposing signals are clear, traffic must be re-established when a C.T.C. code is transmitted to release the electric lock on the spur where the movement is to be made.

Track circuit occupancy is indicated on the modelboard by a lighted lamp indication and as the track circuits are normally deenergized, circuits were designed so that the track circuit indication lamps are unlighted when the system is at rest, even though the track relays are deenergized.

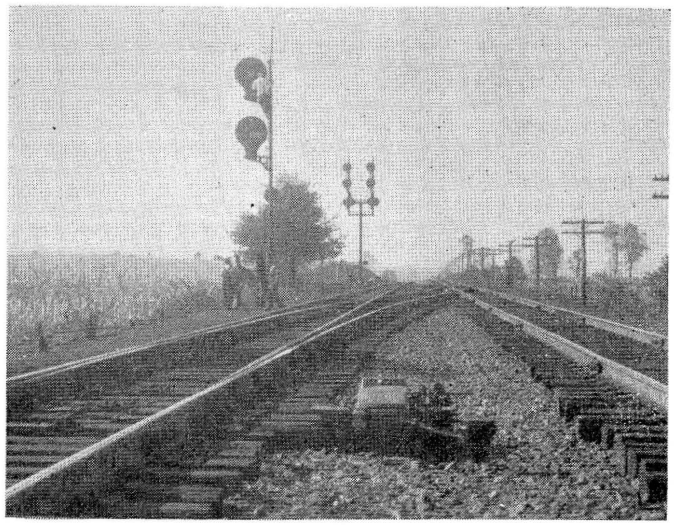
Non-coded normally energized d.c. track circuit are used within the limits of the interlockings and on the approach track circuits used for starting highway crossing protection account of their comparatively short length. Continuity of the coded track circuits through the short approach track circuits is obtained by line circuits which are checked through the approach track circuit relays.

Whereas railroads have for a number of years recognized the economic advantages and improved safety inherent in C.T.C. or operation under signal indication on single track lines, there is a wide field for the application of similar type signaling for the operation of trains on multiple track lines, more particularly in the approaches to interchange point such as described in this article and in like manner the signaling of main tracks for operation in either direction in the approaches to yards with the facilities to yard the train without delay when trains arrive under close headway.

The installation herein described is rather unique in that it combines the use of normally deenergized coded track circuits controlled both by direct wire and by code starts from a single machine; coded track circuits are used both to effect traffic locking and for control of intermediate automatic signals. Line wire requirements are held to an absolute minimum and while the coded track circuits offer the advantages of improved shunting, the deenergized feature saves wear and maintenance on contacts, as well as to hold power requirements to an absolute minimum.

With the occupancy of track sections indicated at the control point and with traffic locking following the operation of a traffic lever to a final setup, the operator's attention is directed to irregularities which may exist in the track structure, such as broken rails, before an attempt is made to clear a signal into the territory.

The system was planned and installed by railroad forces under the jurisdiction of W. L. Scott, Supt. Telegraph & Signals, and J. E. Hillig, Circuit Engineer of the Reading Company. All signaling apparatus was purchased from the General Railway Signal Company. The C.T.C. apparatus is the Type K Class M.



Scene during the construction showing new switch in foreground, and an old disc signal at the left which is being taken down