Report on Economics of Signaling

THE committee submitted reports on: (1) study of economies effected by the installation of signals and interlockings, based on the freight train delay hour on a given railroad; (2) reduction of train delays by the use of spring switches*; (3) economies effected by automatic signaling at railroad grade crossings†; (4) economies effected by a central interlocking station for the control of signals and switches formerly controlled from three interlocking stations‡; (5) economies effected by the use of power operated switches at a hump yard.

Spring Switches Eliminate Delays

The Atchison, Topeka & Santa Fe reports the use on main tracks of switches each fitted with a spring to permit a train to move through them in trailing direction without requiring the train to stop to open the switch and to stop again to close it.

The committee will welcome information from the members of the Signal section as to the economic results and the use of spring switches on their respective roads.

Action taken; acceptance accepted as information.

Automatic Signals at Railroad Grade Crossings

The Great Northern has installed automatic signaling at railroad grade crossings to replace a number of mechanical interlocking plants. These installations have been made at crossings where there are no switches or crossovers within the home signal limits.

The conclusions of the committee are that the economic advantages of automatic signaling at railroad grade crossings are such as to warrant a more extensive use of these time-and-labor-saving devices where traffic is light and delay of superior by inferior trains is not important.

Action taken; accepted as information.

Power Operated Switches at a Hump Yard

At a hump yard it became necessary to add some new classification tracks, including 12 switches, to properly handle the increased traffic.

After the additional tracks and switches were installed, 12 ground switchmen were added to the regular force at the hump yard to operate the switches in a satisfactory manner.

Some time later the 12 switches were connected to an adjacent power interlocking machine and 9 of the 12 ground switchmen were relieved from the hump force at a daily saving in wages of $37.56 or a yearly saving of $13,709.40.

Action taken; accepted as information.

*See *Railway Signaling* for June, 1924, for illustrated article on "Spring Switches Reduce Delays on Santa Fe."

†See *Railway Signaling*, December, 1924, for an illustrated article "Automatic Interlockings on the G. N." Also *Railway Signal Engineer*, April, 1921, for a full discussion of the subject under the title "Non-Interlocking Non-Stop Grade Crossings."

†On the Great Northern Railway, this method of signaling is known as an "Automatic Interlocking System."

‡This plant was described in an article by F. A. Beck, "New Plant on the Pennsylvania," *Railway Signaling*, May, 1924.

Encouraging Remarks by Mr. Basford

G. M. BASFORD, of the G. M. Basford Company, who was the organizer and first secretary of the Railway Signal Club in 1895, gave a brief address. His remarks follow:

It is fitting to celebrate the thirtieth anniversary of this organization by this impressive entrance of signaling into real railroad operation. It is altogether appropriate to bring the signal engineer, as these papers do bring him, into the front ranks of those who are making for more intensive use of track, of equipment, of everything the railroad owns, and for more effective performance of the railroad operating dollar.

This day, with this subject, is a great day for railroad operation, a wonderful day for this organization, a sunrise for signal officers. This is the biggest subject the section has ever discussed; there is more money in it than in anything now being considered in approved railroad operation. Gentlemen, the subject, the improvement, is in safe hands.

Relieving Congestion by Signals

By W. M. POST

Superintendent of Signals and Telegraph, Central Region, Pennsylvania Railroad, Pittsburgh, Pa.

GENERALLY it has not been considered as good practice to operate trains on single track, or against traffic, by signal indication only, unless controlled by track circuit and traffic locking. A system of continuous track circuit and traffic locking was developed by C. C. Anthony of the Pennsylvania, and was first installed on the Renovo division between Huntley, Pa., and Cameron, on January 7, 1907. The original installation consisted of a single track railroad 8.6 miles in length with three interlocking block stations; one located on the east end at Huntley *HY* where the single track led into a double track road with a middle passing siding extending eastward from *HY* and passing siding extending westward from *HY* paralleling the single track.

A second plant was located at Sterling Run *SG* with passing sidings to hold 85 cars east of the interlocking station, and 85 cars west of the interlocking station. A third plant was located at the west end at Cameron *FR* where the single track led into a double track road with a passing siding extending eastward paralleling the single track. During 1917 the single track line between Cameron *FR* and Sterling Run *SG*, 3.5 miles, was double tracked by extending the passing siding at *FR* eastward and connecting it to the west end of the passing siding extending eastward from *SG*, and on October 12, 1917, the controlled manual block system was extended to cover the new westward and eastward tracks in both directions.

How the Controlled Manual System Operates

The controlled manual system is absolute for opposing movements, and permissive for following movements. Continuous d. c. track circuits are provided, and each interlocking is equipped with approach locking with clock work time releases. At each interlocking block station there is a block instrument controlling each block. This instrument consists of two electrically locked semaphore indicators and circuit controllers, each having its own miniature lever standing normally in the vertical position, which can be moved to the right or left. One lever is used to control the block between its block station and the one at the other end of the block, and is known as

the block lever. The other lever is used for the control of the signals and is known as the signal lever. The indicator on the block instrument over the block lever, known as the block indicator, shows whether or not the block lever is unlocked from the next block station, and whether the track is clear from any switch controlled by this block station to the next block station.

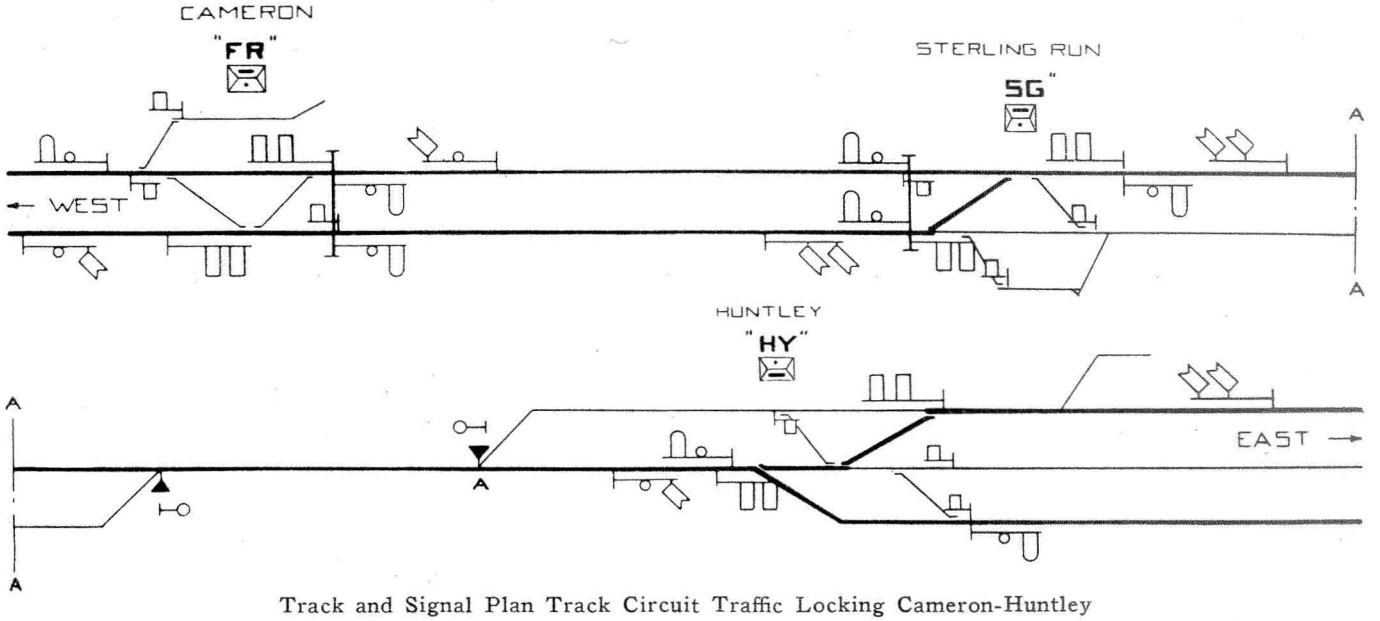
An indicator is provided, known as the *C* indicator, which shows whether or not the track is clear for a distance of about 1,000 ft. (later practice 300 ft.) beyond the block signal. A proceed block signal cannot be given when this indicator is not clear. An indicator, known as the *D* indicator, is provided, which shows whether the track is blocked between the block signal and a point several hundred feet beyond any switch controlled from the block station. This indicator is not necessary where there is no such switch in the block.

A switch indicator is located at each switch in the block, and is cleared to permit a train to leave the siding by movement of the signal lever to the left, and is cleared for a train to enter the siding from the main track by the movement of an auxiliary circuit controller lever in when *HY* has the block, the *D* indicator is clear, and the block signal is in the stop position. Moving this signal lever to the left locks the block lever and prevents *SG* from obtaining the block or displaying a signal for the block. After the train has passed far enough beyond the switch to allow the *D* indicator to clear, *HY* can, if necessary, move his signal lever to the right to give a permissive signal for a following train.

If it should be necessary to let a train leave the siding and return toward *HY*, this can be done as described in preceding paragraph, but while such train is moving from switch *A* to *HY*, no other train can be admitted to the block at either *HY* or *SG*.

In the same way a train may leave the siding and return to *HY* after a train moving from *SG* has passed switch *A*. No train can be admitted to the block at *SG* under these conditions until the train let out of the siding has cleared the block at *HY*.

If it is necessary for a train moving from *SG* toward *HY* to enter siding at switch *A*, *HY*, by moving his auxiliary circuit controller lever to the left, will clear the switch indicator and unlock the switch when the train



Track and Signal Plan Track Circuit Traffic Locking Cameron-Huntley

the block station, provided the short releasing track circuit ahead of the switch is occupied by a train.

When a train is approaching *HY* moving toward *SG*, *SG* will move his block lever for that block to the left. If the block is clear, this will clear the block indicator at *HY*. *HY* will then move his block lever to the right which will release mechanically the signal lever in the block instrument. This signal lever can then be moved to the right thereby releasing the signal lever in the interlocking machine and permitting the block signal to be cleared. The movement of the signal lever in the block instrument to the right locks its block lever and prevents *SG* from obtaining the block, or displaying a signal for the block. The train as it enters the block will return the signal to the stop position, and cause the *C* and *D* indicators to show that a train is in the block. Following movements under permissive signal may then be made provided the preceding train has passed far enough beyond the block signal to allow the *C* indicator to clear.

If a train on the siding controlled by *HY* is to enter the main track at switch *A* following a train admitted at *HY* on the main track, *HY* will move his signal lever in the block instrument to the left to clear the switch indicator and unlock the switch. This can be done only occupies the short track circuit ahead of the switch. After *HY* has unlocked switch *A* for this movement, *SG* can only display signal for permissive movement, and *HY* cannot obtain the block for movements from *HY* to *SG* until switch is again locked in the normal position, block is clear, and auxiliary circuit controller lever is restored to the normal position.

Territory and Traffic Handled

This controlled manual block system covers the "neck of a bottle" between the Driftwood, Pa., freight yard and the junction of the low grade branch of the Allegheny division on the east, and the Emporium Junction, Pa., freight yard and the junction of the main line of the Buffalo division on the west. During the month of October, 1924, there were handled through this controlled manual block territory eastward, 247 regular passenger trains, 22 extra passenger trains, 325 freight trains; westward, 249 regular passenger trains, 21 extra passenger trains, and 310 freight trains, an average of 42 trains per day. During this period there were 36 movements against the traffic made between *FR* and *SG*, the double track portion, by signal indication and without train orders.

During the depression of 1923, at which time a num-

ber of block stations in manual block territory were closed, it was suggested that possibly some saving could be effected by closing one of the three interlocking plants in the controlled manual block territory. It was found that if Cameron *FR,* the least important plant was closed, it would increase the cost of operation in this territory by $87 per day, so, of course, the interlocking was not closed.

The need for a double track was urgent in 1907. The installation of a controlled manual block system postponed the necessity of double track on 3.5 miles until 1917 (ten years), and the second track has not yet been installed over the remainder 5.1 miles.

Success of Operation Led to Many Other Installations

Since the installation between Huntley, Pa., and Cameron, Pa., there have been 45 similar installations, a few of which in terminal territory are not controlled by track circuit. Most of these installations are over short stretches of track where it is necessary to move trains in both directions frequently. It is difficult to determine the money saving, due to facilitating traffic, but there is no doubt it is considerable in each case. The description of the installation between Huntley and Cameron, together with descriptions of the installations between South Fork and Sheridan on the Pittsburgh division, and between Spruce Creek and Tyrone Forge on the Middle division, which follow, will be quite typical of all.

The installation from South Fork *SO* to Sherdian *SG,* 11.2 miles on the Pittsburgh division, is on the westward passenger track of a four-track system. All eastward freight trains stop at Conemaugh, the foot of a 24 mile grade up the Allegheny mountain, to take helping engines and have fires cleaned. Whenever freight trains cannot be taken care of on the pit tracks, the trains are moved to the ash pits on No. 1 and 2 main tracks, making it necessary to move passenger trains east on the westward passenger track. Previous to the installation of the eastward signals on the westward passenger track in 1916, it was necessary to issue train orders which resulted in delay to passenger trains. Whenever tonnage freight trains arrive faster than they can be taken care of on the pit tracks and No. 1 main track, it results in trains laying out on No. 1 eastward freight tracks west of *C* Conemaugh. Under such conditions the preference freight trains are run on No. 2 eastward passenger track at *SG* Sheridan, and around the tonnage trains on No. 1 track, and passenger trains are run east on No. 3 westward passenger track from *SG* Sheridan to *AO,* and often to *SO* South Fork. Automatic signals are provided for following movements both with and against the traffic on No. 3 westward passenger track.

Alternating current track circuits are used on all tracks in this territory.

The following are the types of interlockings:

SO South Fork—Electro-mechanical with switch and lock movements. Power semaphore high signal and position-light dwarf signals.

AO Bridge No. 6—Mechanical with position-light signals.

C Conemaugh—Electro-pneumatic with Position-light signals.

At the present time trains move with little delay through this territory, and there is an average of only six eastward passenger trains per day using No. 3 westward track. During periods of freight congestion there have been as high as 29 passenger trains per day run against the traffic, and 19 preference trains per day run on No. 2 eastward passenger track around slow freights.

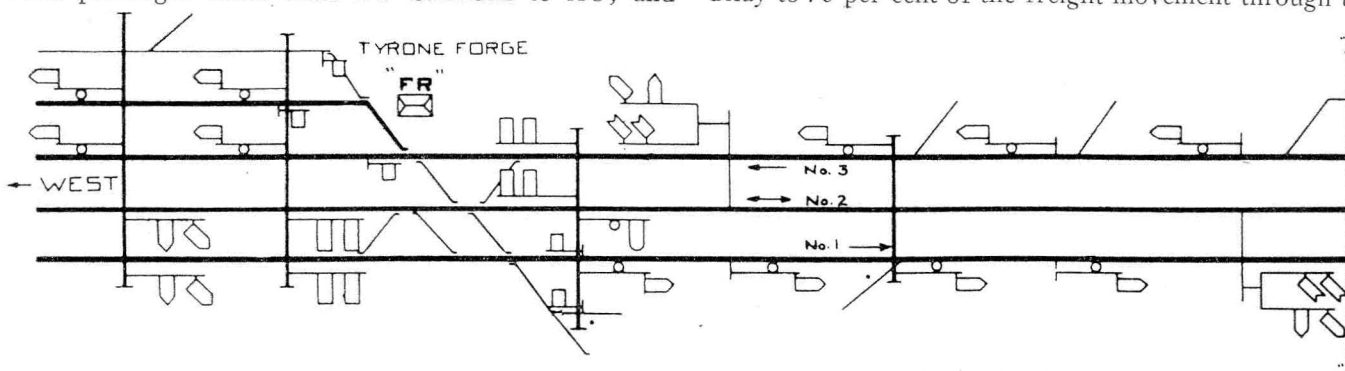
Delays Eliminated Between Spruce Creek and Tyrone Forge

The main line of the Pennsylvania between Harrisburg and Altoona, known as the Middle division, is four track, with the exception of the territory between Spruce Creek and Tyrone Forge, a distance of 6.8 miles, where the road winds in and out around the base of the hills, following the course of the Juniata river, which it crosses 17 times between these two points over stone arch bridges. Here the railroad is limited to 3 tracks, on account of the expense which would have been involved in the construction of larger bridges, and in the making of deeper cuts and fills.

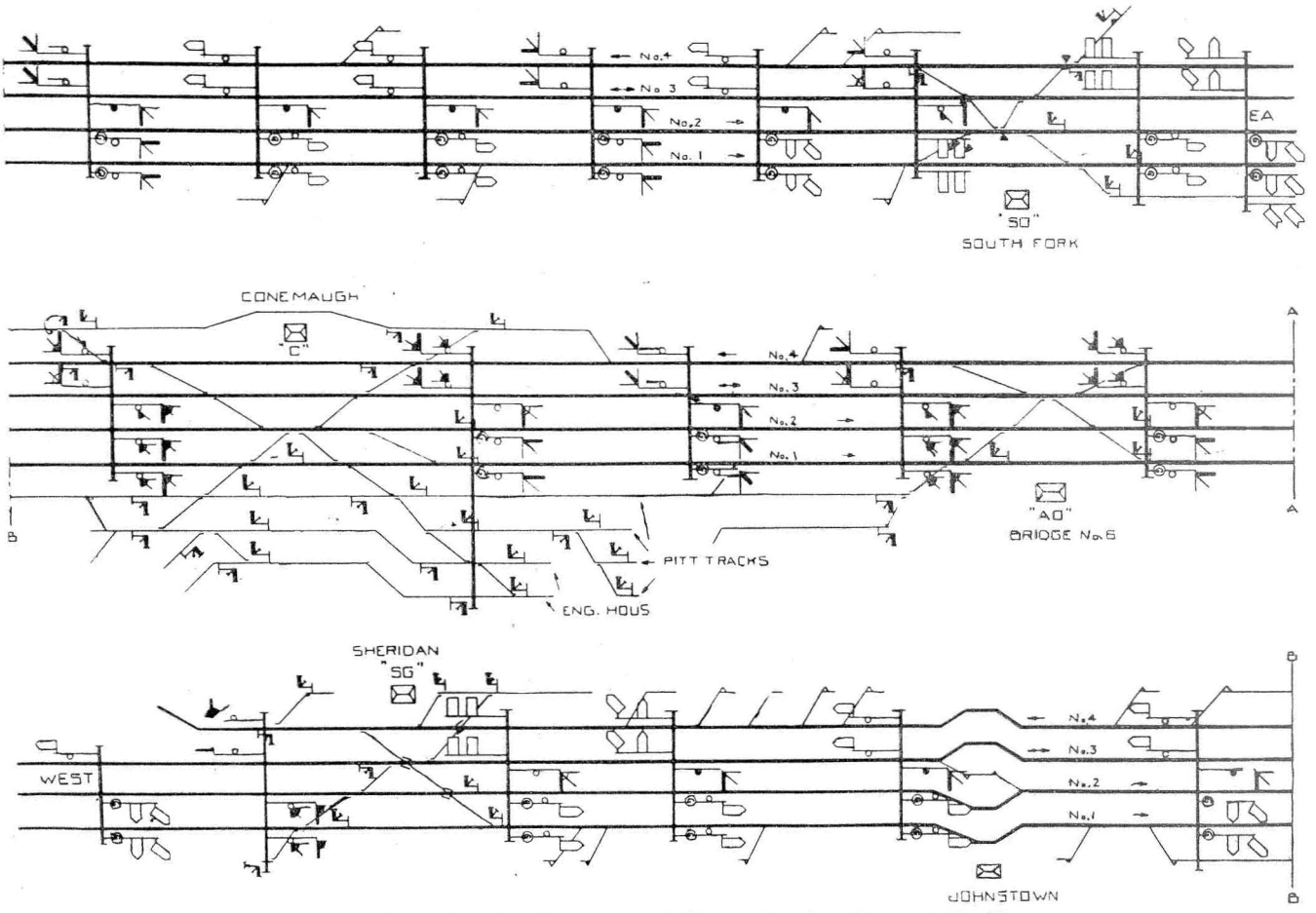
The three-track territory originally consisted of: No. 1 eastward passenger and freight track; No. 2 westward freight track; No. 3 westward passenger track. There were four block stations: *FR*—Tyrone Forge; *UE*—Birmingham; *QY*—Union Furnace; *SC*—Spruce Creek.

Prior to 1913, trains were moved over the division under manual block control, with the permissive signal for freight movements. Traffic at that time had increased to a point where the delay caused by this method of operation made some change necessary, which would speed up the movement and increase the capacity of the tracks. The delays in the three-track territory were even more serious. To remedy these conditions it was decided to install automatic signals with the current of traffic over the four-track portion of the main line, and in three-track territory it was decided to install automatic signals for movements with the current of traffic on No. 1 and 3 tracks, and to install controlled manual block with the permissive signals for freight movement on the middle track, so that this track could be used for the movement of trains in both directions without the issuance of train orders.

Prior to the change it is estimated that there was a delay to 75 per cent of the freight movement through the three-track section. A great deal of this delay applied to eastward freight movement at Tyrone Forge during periods when eastward passenger trains were moving at frequent intervals. The train dispatcher occasionally advanced freight trains by moving them against the current of traffic on No. 2 track, when conditions would



Track and Signal Plan Spruce Creek to Tyrone Forge With the



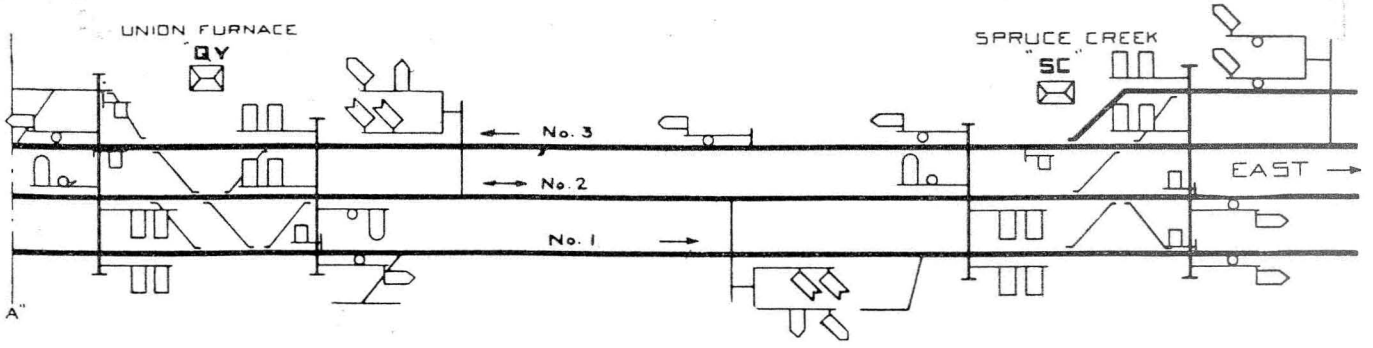
Plan of Signaling for Run Around Moves Against Normal Traffic

permit. However, it required so much time in starting an eastward freight train by means of a train order, and in crossing them from the four-track to the three-track system, that freight trains were often held rather than chance the delay to passenger trains.

The installation of the signaling on the three-track territory was completed July 21, 1913. This installation not only eliminated most of the delay, but it is estimated that the capacity of the tracks was increased to such an extent that the three-track system would be able to take care of an increase of at least 23 per cent in traffic. Occasionally some delay is still experienced with eastward freight during the period of the day when eastward passenger trains are frequent. Consideration is now being given to the installation of automatic signals for eastward movements on No. 2, the middle track, which it is felt will relieve this condition. The capacity of No. 2 track can be further increased by the installation of automatic signals for westward movements. With these two proposed improvements it is felt that a considerable increase in traffic can be handled in this territory before consideration will have to be given to the construction of the fourth track, which it is estimated would cost approximately $900,000.

There is an average of 78 passenger and 70 freight trains per day, many of the freight trains being 100 car trains. It is estimated that this installation, which included automatic signals on No. 1 and 3 tracks, also controlled manual block on No. 2 track, cost in 1913 approximately $60,000. The interest on this investment was almost wholly covered by the abandonment of *UE* block station at Birmingham, making any saving incident to the elimination of delay to 75 per cent of the freight movement in this territory a clear profit. It also saved the expenditure of approximately $900,000 for the construction of a fourth track.

It is probable that with an average increase in traffic, and the two improvements proposed for the future, consideration need not be given to the construction of the fourth track for 10 or possibly 20 years.



Middle Track Signaled for Movements in Both Directions Without Orders