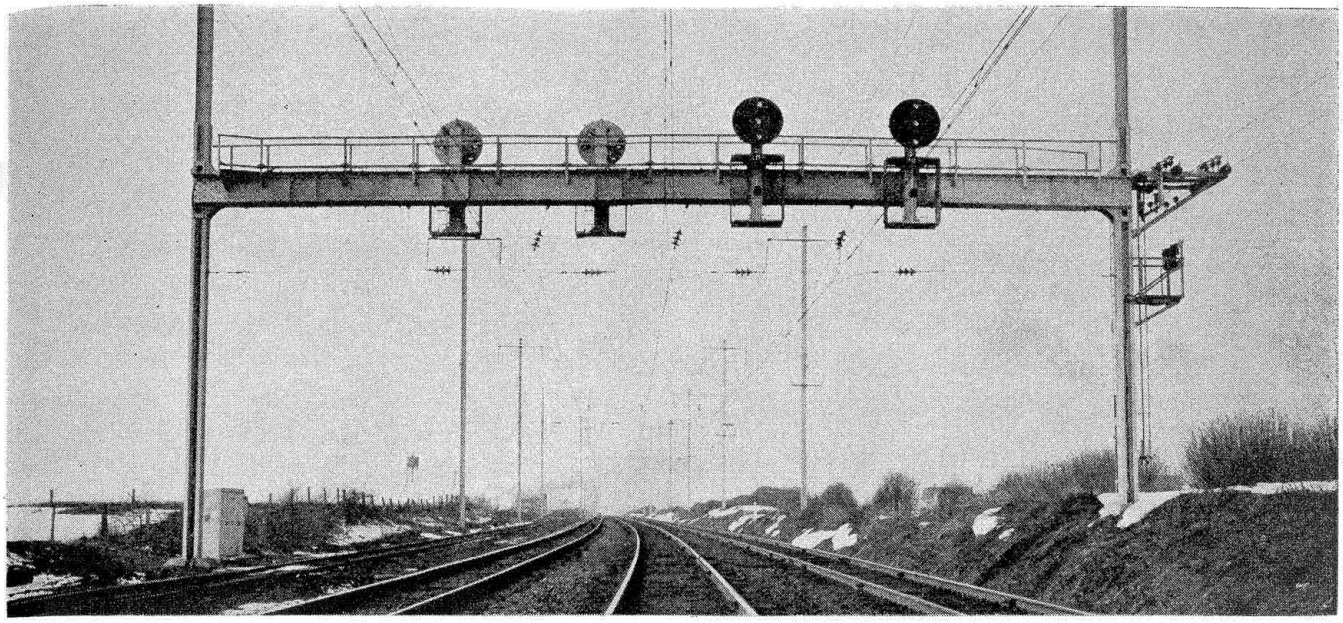


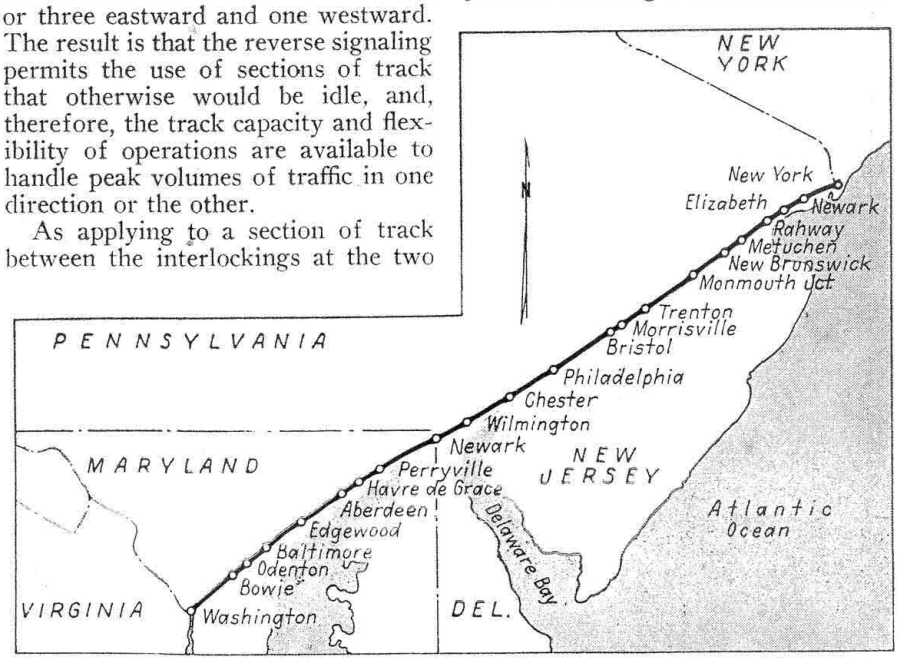
Typical intermediate automatic location in three-track territory with the center track signaled for reverse running

Reverse Running on the Pennsylvania

On 226 miles of multiple track between New York and Washington, certain sections of track between interlockings are signaled for train movements in both directions, thus increasing track capacity and reducing many of the train delays

BETWEEN New York, Philadelphia, Baltimore and Washington, 226 miles of multiple-track territory ranging from two tracks to six tracks, the Pennsylvania has installed reverse signaling on some sections of track between certain interlockings, so that where trains could run by signal indication in only one direction on a track previously, they can now be operated by signal indication in either direction on the same track. With this arrangement, when the preponderance of movement of trains is in a certain direction, traffic can be established in that direction on more tracks, thus all trains can be kept moving. For example, on a three-track section 13.6 miles long between Winans and Anderson, two tracks can be used northward and one southward; or two tracks southward and one northward. Between Elmora interlocking at South Elizabeth, N. J., and Lane interlocking at Newark, N. J., two of four tracks are signaled in both directions, so that, for example, three tracks can be used westward and one eastward, or three eastward and one westward. The result is that the reverse signaling permits the use of sections of track that otherwise would be idle, and, therefore, the track capacity and flexibility of operations are available to handle peak volumes of traffic in one direction or the other.

As applying to a section of track between the interlockings at the two ends, the operation of trains is the same as on a section of single track equipped with centralized traffic control where train movements are authorized by signal indication, thus superseding timetable authority and train orders. An important point is that, on this Pennsylvania multiple-track territory, each track was previously signaled for train movements in one direcction only and, therefore, the practice of using a track in the other



Map of the route between New York, Philadelphia, Baltimore and Washington

direction also was termed "reverse" running. This change from single-direction to either-direction running on multiple track is covered by A.A.R. Standard Code Rule No. 261, which reads as follows: "On portions of the railroad, and on designated tracks so specified on the timetable, trains will be governed by block signals whose indications will supersede the superiority of trains for both opposing and following movements on the same track."

Main-Track Switches and Crossovers Included in Interlockings

In the territory between New York and Washington, all of the main-track switches and crossovers used ordinarily in routing through trains are included in interlockings, so that, in each instance, any section of track used in both directions extends between two of the interlockings. The home signals at these interlockings govern not only through the interlockings, but also the indications of these signals authorize train movements as specified in the rule quoted above.

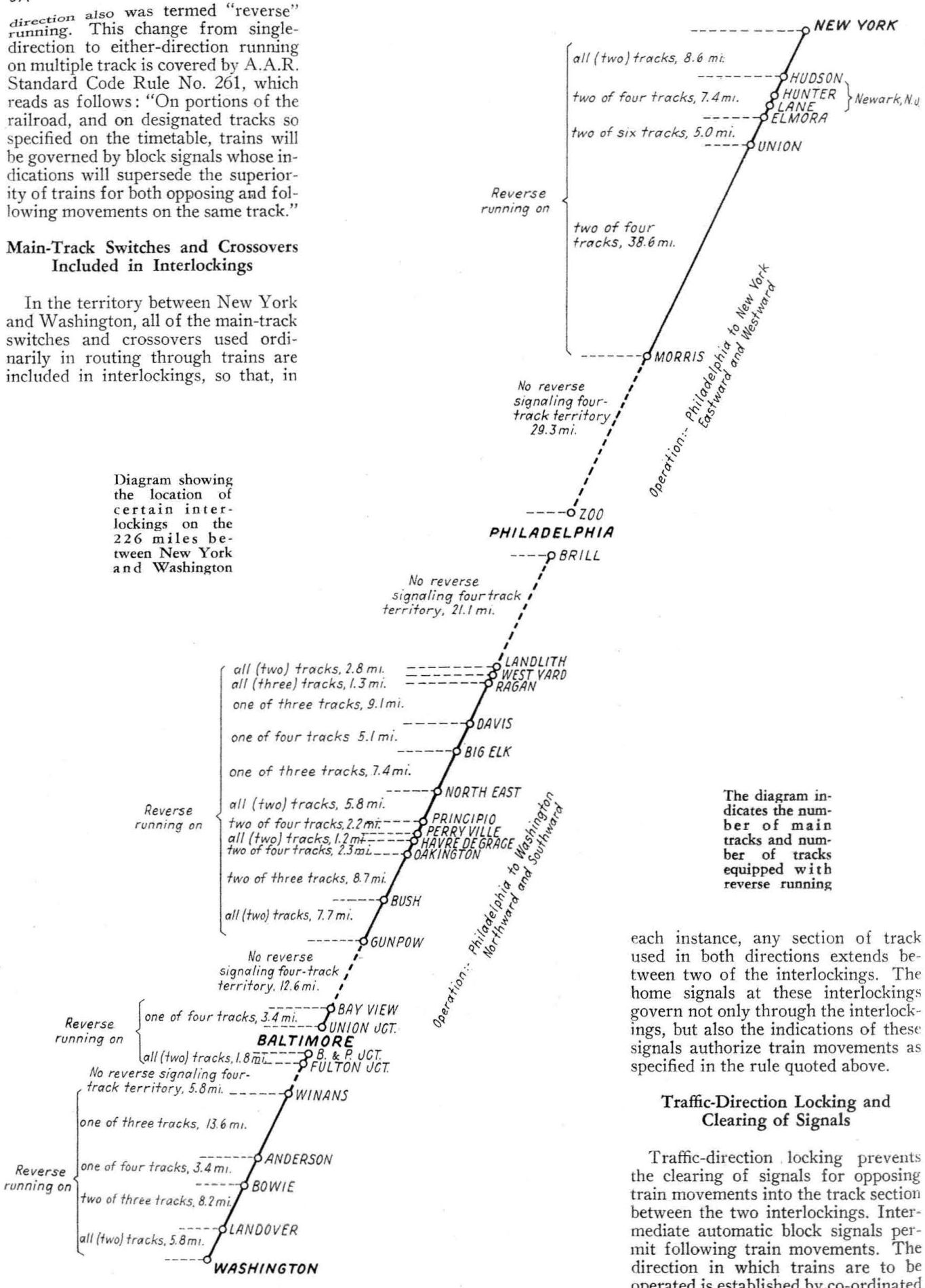


Diagram showing the location of certain interlockings on the 226 miles between New York and Washington

The diagram indicates the number of main tracks and number of tracks equipped with reverse running

Traffic-Direction Locking and Clearing of Signals

Traffic-direction locking prevents the clearing of signals for opposing train movements into the track section between the two interlockings. Intermediate automatic block signals permit following train movements. The direction in which trains are to be operated is established by co-ordinated action of the operators in the in-

Southbound train at Iron Hill, Md. One of four tracks is reverse signaled

terlocking towers at the two ends of the section of track. These men work under the direction of the train dispatcher, and the train movements are thus authorized by signal indication without the use of train orders.

Why the Extensive Use of Reverse Running Was Necessary

Reverse running under authority of signal indication had been in service at a number of locations on the Pennsylvania prior to 1941, so that the benefits of increased track capacity were well known. Soon after the United States entered World War II, the traffic between New York and Washington increased rapidly, and continued to increase as the war developed. There are numerous important junctions at which many trains enter or leave the line between New York and Washington, and therefore the number of trains operated may vary widely on the different sections. A 24-hour traffic count, made April 20, 1945, at Lane tower, 13.6 miles west of New York, showed 223 westward and 224 eastward trains. Of these, 325 were passenger, 95 freight, 23 light engines and four work trains. Between Philadelphia and New York the preponderance of traffic is eastward in the morning, and westward in the evening. On a typical day in 1945, the maximum traffic eastward in one hour was 18 trains, counted at Newark, N. J., between 8 a.m. and 9 a.m. Between 4 p.m. and 5 p.m. that day, there were 18 trains westward.

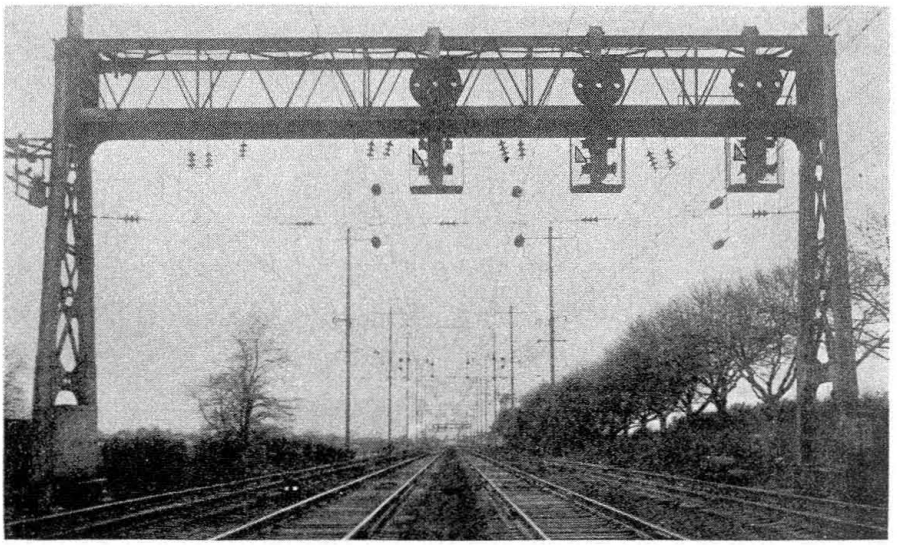
Delays occurred at times when there were too many trains in one direction and tracks in the opposite direction were not being used to capacity over sections between certain interlockings. On account of the war-time restrictions on material, the construction of additional tracks was limited to a few short sections. Therefore, in order to increase the utilization of the existing tracks, the practice of reverse running was applied on numerous sections between New York and Washington. In some instances, certain track changes, and additional switches and crossovers were required. For the most part the new signaling material was limited to traffic locking circuits and additional intermediate signals for the reverse direction. Therefore, much, in terms of benefit to train operation, was accomplished with very little materials, thereby aiding the war program.

Extent of Reverse Running

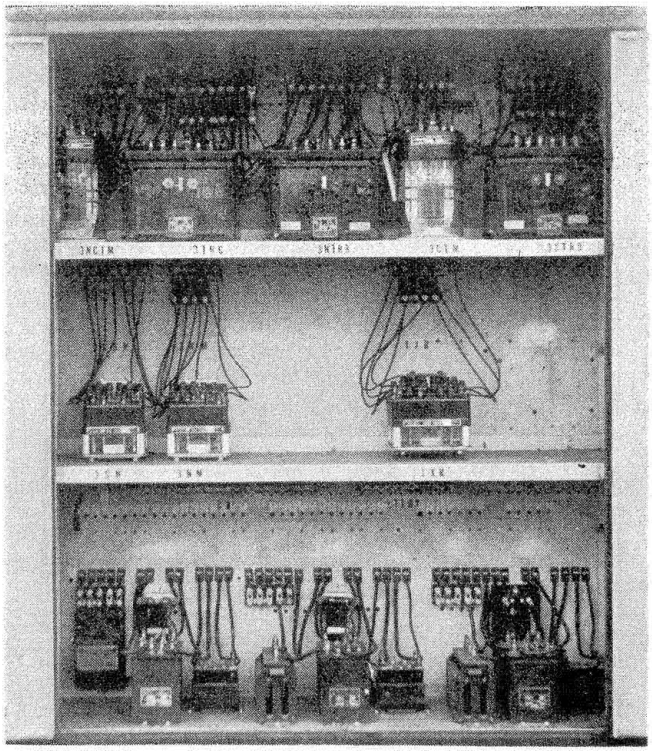
The sketch herewith indicates the location of certain interlockings on the 226 miles between New York and Washington, with notations to indicate the number of main tracks as well as the number of tracks equipped with reverse running between those interlockings. For example, northward from Washington to Landover, Md., is 5.8 miles of two-track with both tracks equipped for reverse running. Between Landover and Bowie is 8.2 miles of three tracks with two tracks equipped for reverse running, and next, between Bowie and Anderson is 3.4 miles of four-track with one track equipped. On other sections are numerous variations of the number of tracks and the number equipped, but in brief, the reverse running under signal indication is in service on one or more tracks on 149.4 miles of road including 258.1 track miles. Of the entire route between New York and Washington, the only major section without reverse running is 29.3 miles of four-track between Morris interlocking at Morrisville, Pa., and Zoo interlocking at Philadelphia. The longest section of four-track with reverse running on two tracks is 38.6 miles between Morris and Union.

Signaling for High-Speed Crossovers

As ordinarily applied on the Pennsylvania, the Approach-Medium aspect on a distant signal and the Medium-Clear aspect on the corresponding home signal, indicates that an engineman is to bring his train up to and through an interlocking at 30 m.p.h. However, the new No. 20 crossovers and turnouts in the interlockings are designed and constructed for train speeds at 45 m.p.h. when making diverging moves. At such locations, a special marker is applied to the distant signal and the home signal which, when the Approach-Medium and the Medium-Clear aspects are displayed on the respective signals, authorizes the enginemen to bring



Northward home signals with special markers at Davis on the Maryland division



Interior of instrument case at signal location

their trains up to and through the interlockings at 45 m.p.h. The marker consists of a sheet-metal triangle 13 in. wide at the bottom and 17½ in. high. The triangle is yellow with a 1-in. black border, and is mounted to the left of the second "arm" of the signal.

Controls for Reverse Signaling

The direction in which trains are to be operated on a given track between two interlockings is controlled by two line circuits which are set up by coordinated action of the operators by operating traffic-direction levers and push-buttons in the two towers at the ends of said section of track. When a train has accepted a signal and entered the block between interlockings, the direction of traffic cannot be changed until the train departs from that block. Thus protection is maintained to prevent opposing trains from entering that block. With traffic direction established, following trains can be operated at intervals determined by the intermediate automatic signals, which ordinarily are the three-aspect type, spaced for train speeds of 90 to 100 m.p.h.

In addition to the wayside signals, this territory, including the locomotives, is equipped with continuous inductive type cab signaling, which necessitates that the track circuits, in a block between interlockings, must be feeding in the direction opposite the train movement to be made. For this reason, the controls include means for changing the direction of feed for the track circuits in a block between interlockings, one two-wire line circuit, with a polar relay at each track circuit feed point, being used for this purpose and also for selecting the direction in which automatic block signals are operative. The second two-wire line circuit, extending between the two interlockings, breaks through front contacts of the track relays, through lever contacts and push-buttons, to control neutral locking relays at the towers.

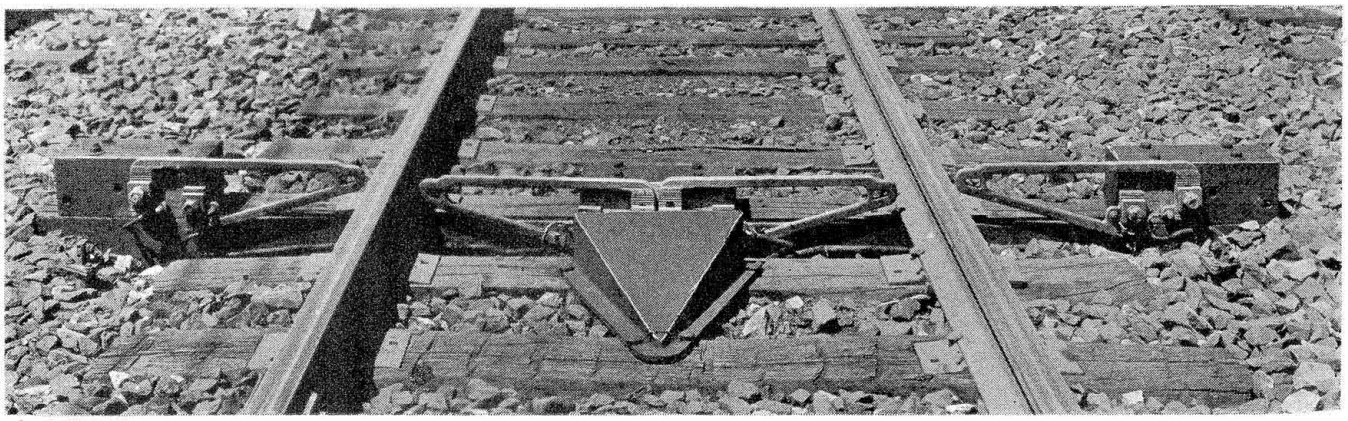
Code Change Point

A new feature included in the recent changes was to install a "code-change" point 1,000 ft. in approach to each interlocking home signal so that if the signal is displaying an indication less favorable than Approach, the cab signal aspect on an approaching locomotive will change from Approach to Restricting at the "code-change" point 1,000 ft. from the signal, rather than holding the Approach aspect until reaching the home signal. The code-change point employs a bridging transformer. When a wayside signal is less favorable than Approach, steady energy is fed back to the change point, and a 75 code is sent from the code-change point to the next signal in the rear to control that signal to the Approach aspect.

Dragging Equipment Detectors

Dragging equipment detectors are in service on main tracks in the approach to interlockings on this entire territory, the average spacing between detectors on any route taken by a train is about seven miles. Equipment dragging from a train will break an element in the detector and cause signals to display aspects to direct the engineman to stop his train at the interlocking home signal, so that it can be inspected. A detailed explanation of the construction and operation of these dragging equipment detectors was published on page 583 of *Railway Signaling* for September, 1945.

The reverse signaling between New York and Washington was planned and installed by the signal forces of the Pennsylvania.



Dragging equipment detectors are in service on main tracks in approach to interlockings on the entire territory