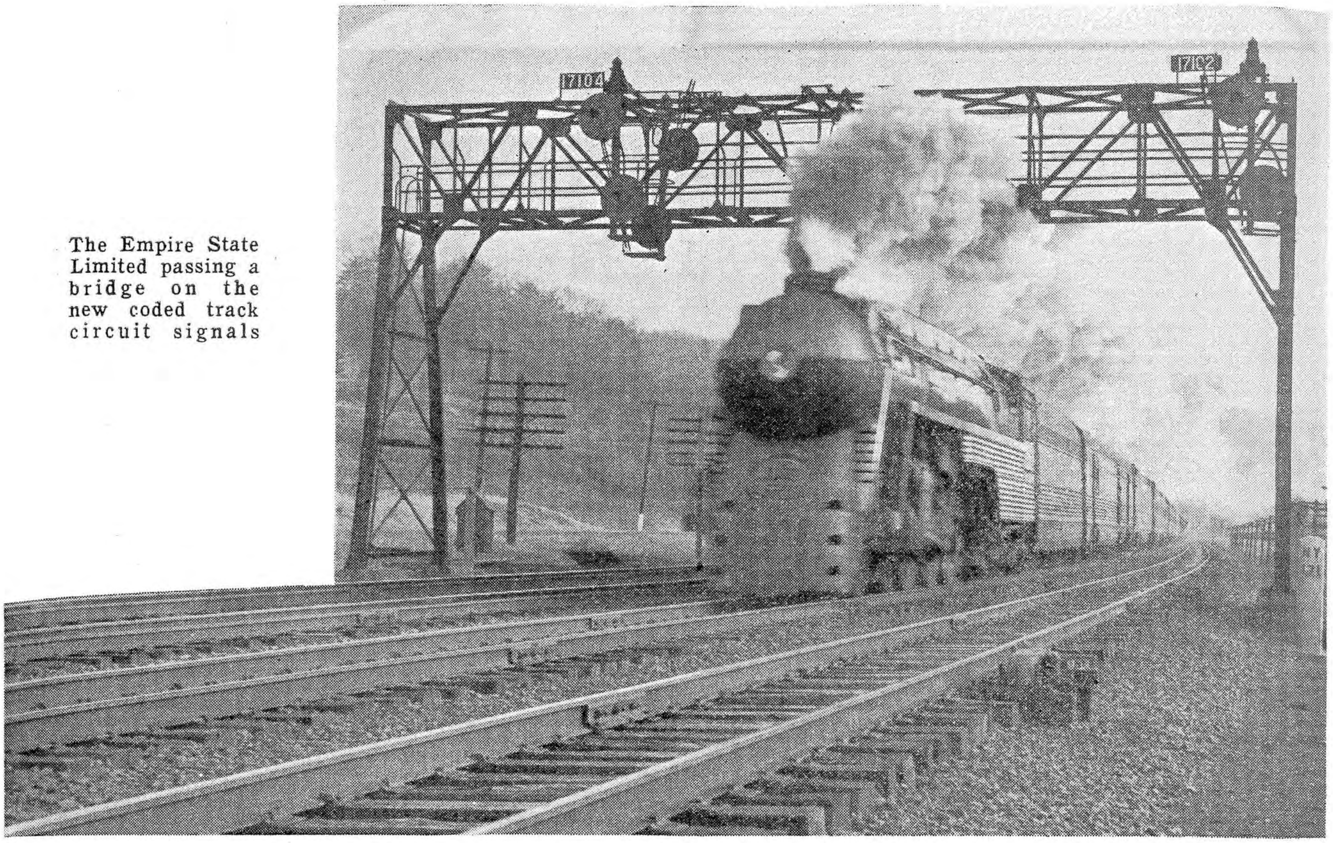


The Empire State Limited passing a bridge on the new coded track circuit signals

New York Central

Installs Coded Track Circuits

Four rates of coding used—An electronic tube spaces feed to prevent burning of contacts

BETWEEN Amsterdam, N. Y., and Hoffmans, N. Y., the New York Central has reconstructed the automatic block signaling on 6.5 miles of four-track main line by installing searchlight-type signals controlled by coded track circuits to replace semaphore signals controlled by conventional d-c. track circuits and line circuits. Also near Weehawken, N. J., on the West Shore line of the New York Central, coded track circuits have been installed for the control of signaling to protect train movements through a tunnel 4,250 ft. long.

An article in the May, 1943, issue of *Railway Signaling* explained in detail an installation of coded track circuits on a section of four-track main line on the New York Central between Batavia, N. Y., and Corfu, N. Y. The purpose for the following article is to discuss the changes and improvements which were installed on the 1943 projects at Amsterdam and at Weehawken, which were not available when the 1942 construction was done between Batavia and Corfu.

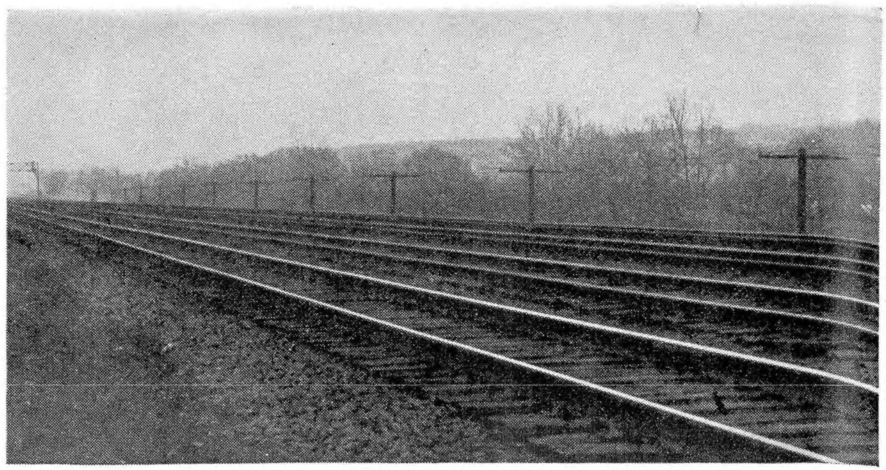
Hoffmans to Amsterdam

Between the eastward rear home signal bridge at Hoffmans and Amsterdam, there are five automatic block signal bridges, each of which has a signal for each of the four tracks, the block lengths from east to west being 4,648 ft., 5,712 ft., 5,800 ft., 5,725 ft., 5,932 ft., and 6,432 ft. Each automatic signal consists of two searchlight mechanisms, the vertical distance between centers being 5 ft. The upper unit is to the left of the mast and the lower one to the right, thus creating a staggered effect which designates these signals as automatic blocks, the most restrictive aspect of which is "Stop, Then Proceed At Restricted Speed." Thus the project involves 40 searchlight signal mechanisms and 24 coded track circuits, with all new relays, instrument cases and wiring.

These new signals regularly display four aspect, and one of the signals in approach to an interlocking display a fifth aspect. A previous practice, still used on some roads, is for the "Clear" aspect to consist of green-over-red. On the New York Central, however, the Clear aspect is green-over-green, thus eliminating red, and thereby obviating the possibility of confusion on the part of the engineman if he should see the red light before seeing the green.

The Advance-Approach aspect is

yellow-over-yellow, indicating proceed preparing to stop at second signal. The Approach aspect is yellow-over-red, indicating proceed preparing to stop at next signal. The Stop, Then Proceed At Restricted Speed aspect is red-over-red.



The two a-c. power transmission wires are the only signaling line wires

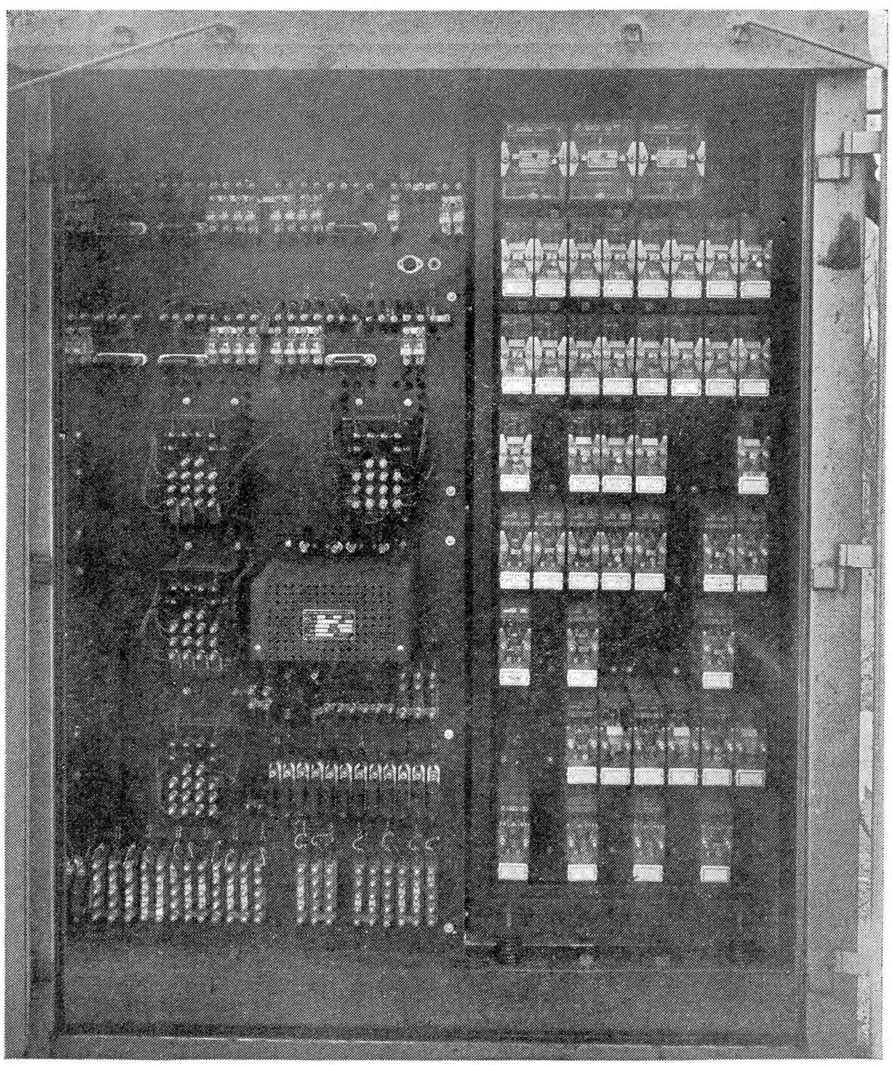
Fourth and Fifth Aspect

When an interlocking home signal displays a Proceed; Medium Speed Within Interlocking Limits aspect for a route over a long crossover or turnout, the first signal in the rear displays the "Approach Medium" aspect, yellow-over-green, indicating "Proceed Approaching Next Signal at Medium Speed," and the second signal in the rear displays the "Advance-Approach Medium" aspect, green-over-yellow, indicating proceed approaching second signal at medium speed.

The controls in the new signaling are all accomplished by coded track circuits, no line controls being used. The coded track circuits operate for the entire automatic block length with no cut section, with the exception of the first block at Amsterdam station in which cut sections were used to provide additional facilities.

Rates of Codes

Absence of energy or steady flowing energy in a track circuit causes a signal to display the "Stop, Then Proceed" aspect. Code at 75 per minute controls the Approach aspect. As explained on page 250 of the May, 1943, issue, on the Batavia-Corfu project, code at the rate of 120 per minute with one rail positive was used to control the "Advance-Approach aspect," and code at the same rate but with negative to the same rail was used to control the "Advance-Approach-Medium aspect," green-over-yellow. Thus polarity of track circuit code was used to accomplish selection. In contrast, on the Hoffmans-Amsterdam project, polarity of code is not used. The 240 code is for the control of the Clear aspect on the one signal with five aspects, 180-code being used for the green-over-yellow on this signal. The 180-code is used for clear aspect on all other signals, and code of 180 is for the control of the "Advance-Approach-Medium aspect." This practice of using the 240 code required an extra code transmitter for the 240-code and a "240"-decoding unit at the receiving end, but these additions are offset by the elimination of two neutral relays for polarity selection at the feed end and three neutral relays at the receiving end.



Interior of sheet metal case at a signal bridge

In all instances, on the Hoffmans-Amsterdam project, the approach lighting control is accomplished by the use of inverse code, whereas on the Batavia territory, unless inverse coding was provided for the other purposes, the approach lighting control was effected by a relay in multiple with the feed to the track circuit in approach to the signal to be lighted. One difference is that, with inverse code, the signals are lighted for a full block, whereas, with the multiple relay, the control is less than block length under adverse conditions.

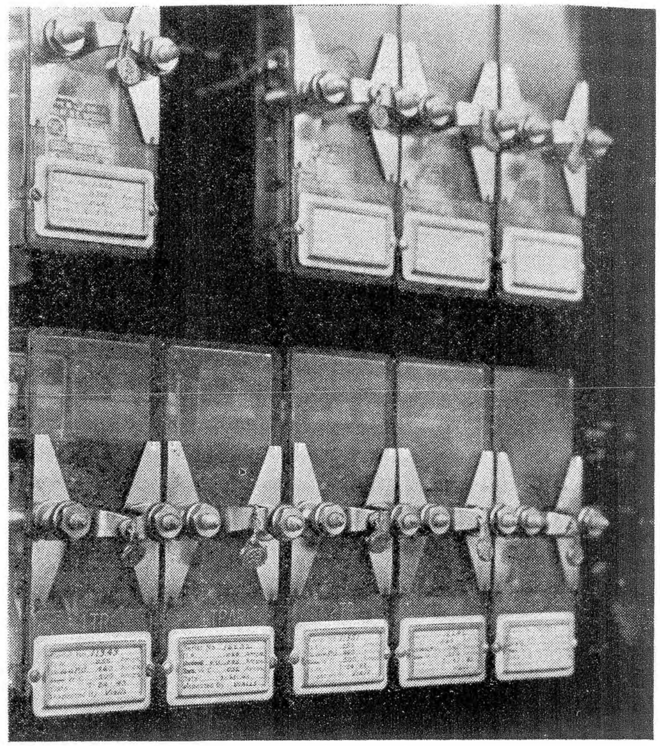
On the Batavia-Corfu territory, the relays were of the conventional type of construction, provided with plug couplers, mounted on spring hangers in wooden instrument cases. In contrast, on the Hoffmans-Amsterdam section, the relays are of the quickdetachable plug-in type, which are mounted in racks arranged in sheet-steel cases, as shown in the accompanying illustrations. The panels which form the rear of these cases can be removed to give access to the wiring at the rear of the relay racks.

Power Feed Indication by Carrier Current

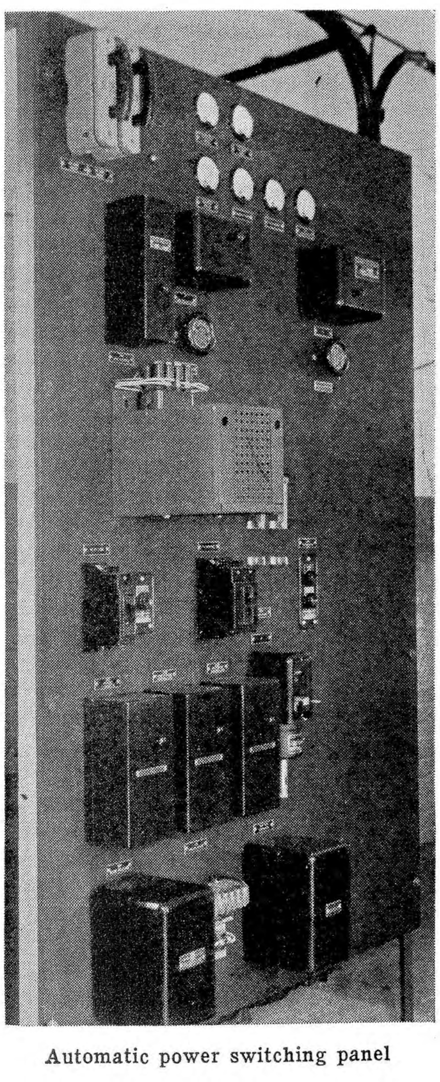
The use of coded track circuits between Hoffmans and Amsterdam dispensed with all the line wires formerly used in signal control circuits, thus leaving only the two No. 4 wires for the 550-volt a-c. power distribution.

At each signal location, line transformers feed the signal lamps and the rectifiers which produce d-c. energy to operate code transmitters, to feed signal relays, signal coils and track circuits. Therefore, no batteries are required at the signals. Thus operation of the signaling depends on continued service of the a-c. supply.

The 550-volt line is normally fed at Amsterdam from a commercial source of a-c. When commercial source of power fails, an automatic cut-over panel connects the 550-volt line to a 1.5 K.V.A. dynamotor which is operated from a set of storage batteries. If such a cut-over occurs, the towerman at Hoffmans must be warned so that he can call the maintainer. As a means for conveying this information, 5,000-cycle carrier current energy is superimposed on the 550-volt power line as long as the original normal a-c. source is in service. The operation of this carrier current sending set requires an input of only 9 watts. At the Hoffmans end, this carrier is detected by a receiving set which controls a relay that keeps a green lamp lighted on the interlocking panel. However, when the original a-c. source at Amsterdam fails, the carrier is cut-off, the green lamp at Hoffmans is extinguished and a bell rings to warn the towerman. There is also a second source of commercial a-c. power at Hoffmans, which can be used to feed the 550-volt line. Hoffmans' is also equipped with a dynamotor and in addition a 5 K.V.A. gasoline engine driven alternator supplying 110-volt 60-cycle power. The 550-volt line can be fed at Hoffmans from a 1.5 K.V.A. dynamotor, which is operated from a set of storage batteries. A further standby source of 550-volt a-c. is from a 5-K.V.A. gasoline engine driven set at Hoffmans.



Plug-in relays are used in the new signaling



Automatic power switching panel

In Weehawken Tunnel

In the Weehawken Tunnel the ballast resistance is very low, dropping below 0.24 ohms per 1,000 ft. of track. The track circuits are 3,000 ft. long and the train shunting is difficult because of the sand and cinders present on the rails. Therefore, to obtain proper operation at minimum ballast and yet maintain sufficient inter-rail voltage for proper train shunting, excessive energy must be fed into these track circuits.

An engineering study of this case showed that this energy would be greater than that which could be handled in the conventional manner, therefore, the polar-stick type relays, driven in each direction were used for the main and inverse track relays. Even this required energy in excess of that that could be properly handled in the conventional manner. Therefore, half-wave energy was fed to the track through a relay controlled by electronic tubes so that this relay would close and open during the "off" periods of the half-wave energy, never making or breaking the circuit while current is flowing. Limit of current is determined by the current-carrying capacity of the contacts, thus never making or breaking any current and, therefore, placing no restrictions on the amount of current that the relay can carry.

The three conventional codes, 75, 120 and 180 are used for the signal aspect control, and a 240 code for the check-locking control with inverse at each of these codes, for approach locking.

These signaling projects were planned and installed by signal forces of the New York Central Lines Buffalo and East, under the jurisdiction of R. B. Elsworth, Signal Engineer, the major items of signal materials were furnished by the General Railway Signal Company.