

New York Central Re-Signals Track Entering Grand Central Terminal

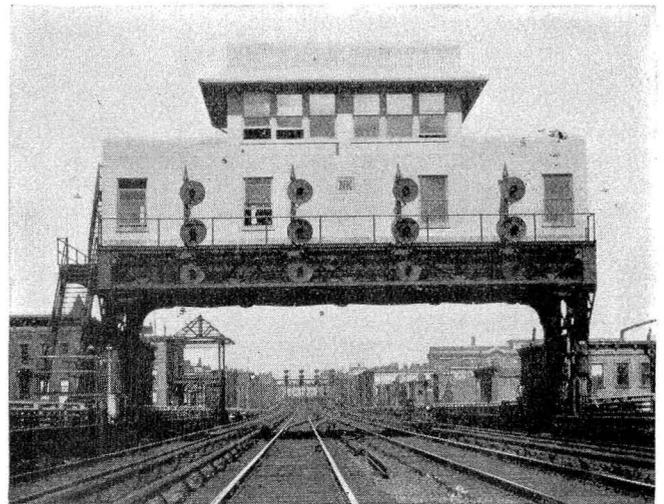
Train operation in either direction on each of four tracks facilitates traffic and increases track capacity

IN ORDER to facilitate movements and increase the track capacity so as to get more trains into and out of the Grand Central Terminal, New York, during the rush hours of the day, the New York Central has revised the track layout and has just put in service a complete re-signaling of the five-mile, four-track throat to the terminal extending north to Mott Haven Junction on the north side of the city.

Track Layout

The track layout at the Grand Central terminal is entirely underground, in two levels, the upper level, with 41 tracks, 31 of which are served by platforms, being used primarily by through trains, while the lower level has 25 tracks, 17 served by platforms, which are used mainly by commuter trains. This layout is located roughly between 42nd and 50th streets, all tracks converging to the north through several interlockings to a four-track line north of 56th street, which extends to Mott Haven Junction. From 56th to 96th street these tracks are in a tunnel under Park avenue and from 98th street to 135th street they are on an elevated structure, beyond which they drop off on an embankment to 140th street, where they enter a depression which continues through Mott Haven. Confined in this manner to a fixed right-of-way, hemmed in on both sides by developed property, the difficulty and impracticability of constructing additional tracks in this territory is readily evident.

At the time the new terminal was built and electrical propulsion provided in this territory in 1907, the four-track territory between 56th street and Mott Haven was equipped with new a-c. signaling, the signals being spaced from 1,100 ft. to 1,300 ft. apart, with one block overlaps. The signals in the tunnel were the two-position color-light type, giving indications similar to lower quadrant



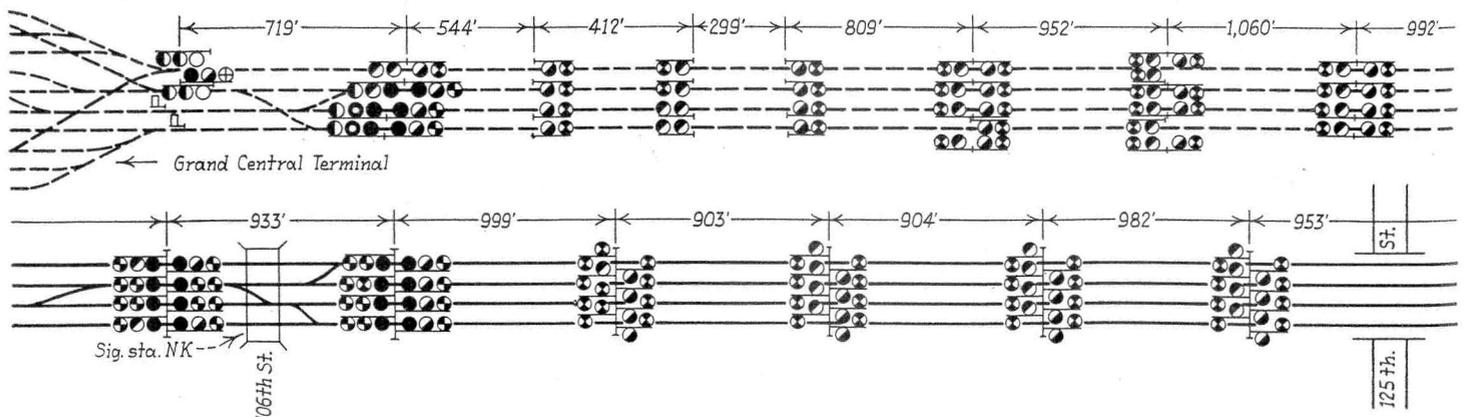
NK interlocking showing westward signals

home and distant signals. In the open, three-position upper-quadrant semaphore signals were used. Tracks 1 and 3, the two on the right going west, were signaled for westbound movements and Tracks 2 and 4 were signaled for eastbound movements. An interlocking plant, NK, including five crossovers, was located at 106th street and another plant, DB, protected the drawbridge over the Harlem river at 134th street.

Traffic Heavy

The Grand Central Terminal serves not only the New York Central, but also the New York, New Haven & Hartford, both roads having heavy through passenger and suburban traffic in and out of New York. Under normal conditions, an average of approximately 680 movements are made within the terminal each day, while during holiday seasons, as many as 850 movements have been made in 24 hours. The normal heavy traffic periods of the day are between 7 a. m. and 10 a. m. and between 3 p. m. and 6 p. m., when an average of 155 to 166 trains are handled in and out of the terminal.

A large number of the train movements within the terminal are due to the fact that Grand Central is essentially a dead-end layout with but limited facilities for handling equipment within the terminal. All coach storage tracks, with the exception of a limited number for holding suburban coaches on the lower level directly



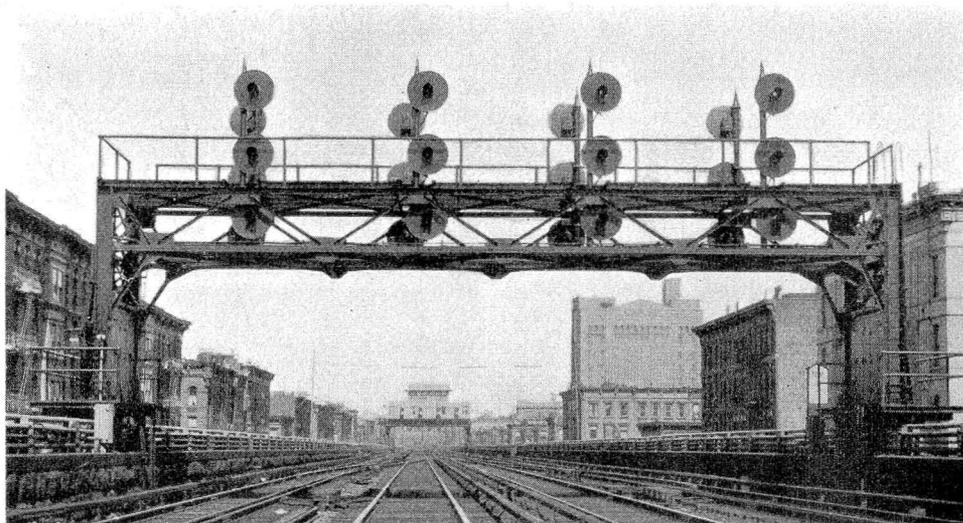
Track and signal plan of

within the terminal, are located in the Mott Haven yard. Therefore, the number of empty train movements in the terminal territory is approximately 20 per cent of the revenue train movements. Further complications are brought about by the fact that the arrival and departure of a number of through trains occurs during the peak of the suburban traffic inbound in the morning and outbound in the evening. Then too, the necessity of the stopping of certain through and suburban trains at the 125th and 138th street stations within this territory, decreases headway and thereby slows up operation. By 1923, with the original layout and signal system within and approaching the terminal still in effect, train movements became so heavy and delays so frequent that something had to be done to increase the track capacity.

four tracks through the installation of a new signal system.

Improved Track Layout

These larger changes were authorized early in 1929 and actual field work was started in October of the same year. In order to facilitate the routing of trains in either direction on all of the tracks, certain changes and additions to the track layout were necessary. At the throat entering the Grand Central layout near 56th street a scissors crossing was added and, at NK, 106th street interlocking plant, the five old crossovers were removed and six new ones were provided in a universal layout whereby trains can be routed from any track to any other track within the limits of the plant. All of the

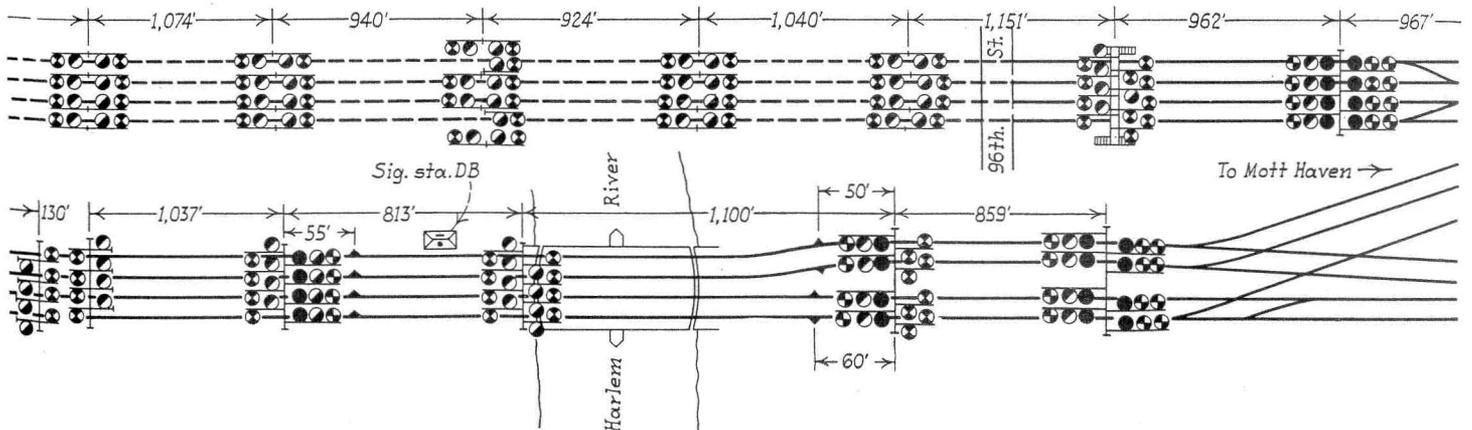


Interlocking signals on bridge at south end of NK interlocking

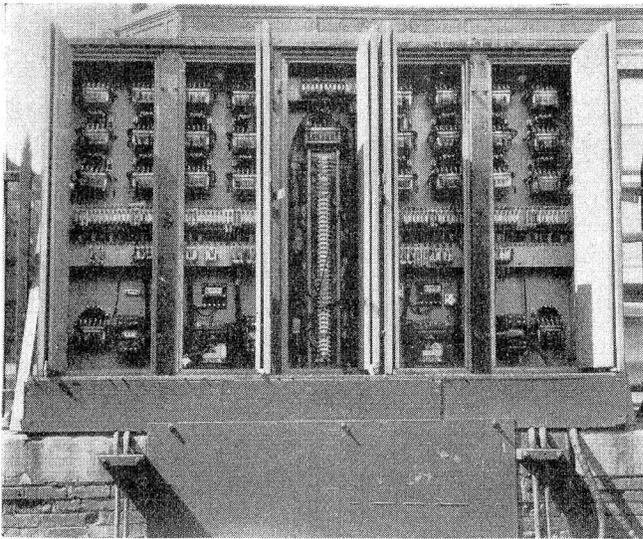
The first improvement, which was completed in July, 1924, was to provide additional three-position signals on Track 4 to permit the movement of trains in either direction on this track the same as on a single-track line. Track 4 was selected for this either-direction operation on account of the track arrangement at Mott Haven being such that trains could be routed to and from this track with minimum conflict with other train movements. During periods when the preponderance of traffic was inbound, this track was used for incoming trains and vice versa. The improvement in train operation afforded by this change was evident at once. Later, however, study was given to the possibility of improving the existing track layout and to either-direction operation on all

new crossovers are No. 18 and about 325 ft. long, which permits crossover movements at 30 m. p. h. with safety and without annoyance to passengers.

This new track arrangement necessitated the entire replacement of the interlocking, including a new signal station, new switch machines, signals and the interlocking machine proper, as well as all relays, wiring distribution, etc. One of the most interesting features in connection with these changes is the new signal station, NK, which is a two-story, steel frame, brick face structure mounted directly over the tracks on a specially constructed signal bridge spanning all four tracks. In this new facility, the upper floor is the operators' room, while the lower is essentially a relay and equipment room. The interlocking



territory from Grand Central to Mott Haven



Typical relay case, with terminal board and transformer panel in center, track relays at bottom and signal relays at top

at this point is all-electric, with a 48-lever frame and 44 working levers for the six crossovers and 72 signals involved.

A new interlocking station was also constructed at DB, 134th street, this station including a four-story brick signal station with two stories above the track level and two below. As at NK, the interlocking is all-electric, the machine having a 32-lever frame and 29 working levers.

At Mott Haven Junction the track layout was exten-

sively revised, several new tracks and numerous crossovers being provided to secure complete flexibility of train movements between the four-track approach to the terminal and the tracks of the Hudson and Harlem divisions, which meet at this point. One of the most disadvantageous features at this point was the abrupt angle of meeting of the tracks of the two divisions, with special No. 7½ turnouts which restricted train movements to 10 m. p. h. To overcome this, the junction of the two divisions' tracks was moved approximately 1,600 ft. to the south, toward Grand Central, by extending the three tracks of the Hudson division through this distance. This made possible the use of No. 16 turnouts, permitting a speed of 30 m. p. h., and also made it possible to extend

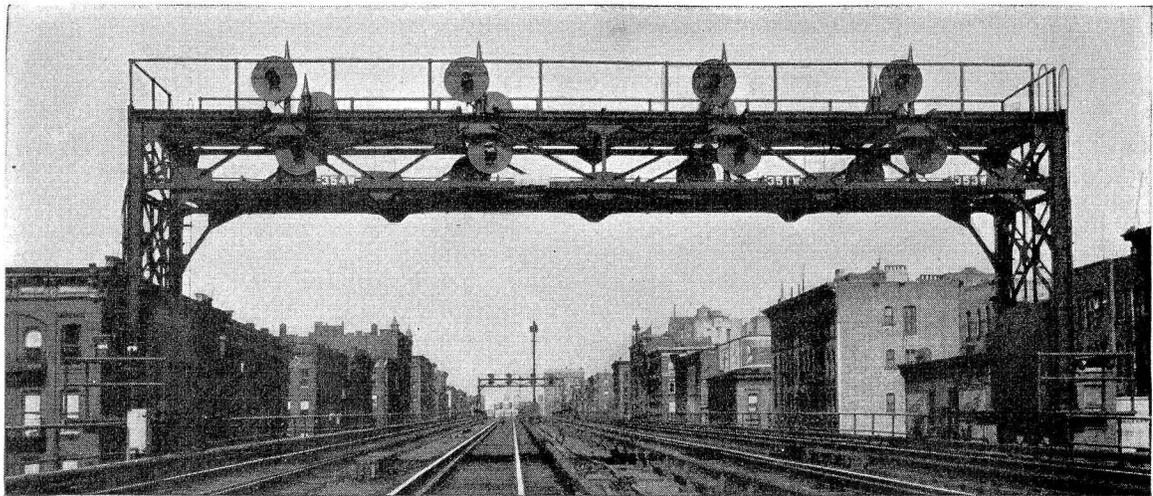
the coach yard leads to Mott Haven yard, which lies in the wye between the tracks of the two divisions, a most desirable improvement. To make these track improvements necessitated the converting of the 144th street viaduct from one crossing five tracks to one crossing nine tracks, the excavation of approximately 2,000 cu. yd. of grading work along the west side of the right-of-way, and the constructing of approximately three miles of new tracks. All of this work had to be carefully programed in order not to interfere with train operation.

These track changes necessitated the construction of an entirely new interlocking plant at Mott Haven Junction, called MO, which replaces four existing plants in this vicinity. The new plant, which is the largest and most interesting involved in the work, is all-electric throughout and contains a 260-lever machine. A complete description of this plant will be covered in a subsequent issue.

An Entirely New Signaling System

In order to realize the full benefit from either-direction operation on all four tracks, it was necessary to go beyond the track changes and to install a complete new layout of signaling, re-arranging the block lengths to reduce the spacing between trains. In order to effect the results desired, that is, maximum speed with safety, four-block signal indications are provided. Excepting where interlockings or other local conditions prevent, the new blocks are from 810 to 1,000 ft. long, as compared with 1,000 to 1,300 in the previous arrangement.

The re-arrangement of the length of the blocks and the introduction of the four-block indication necessitated



Automatic signal bridge at 112th street. Note relay cases located between legs of bridge

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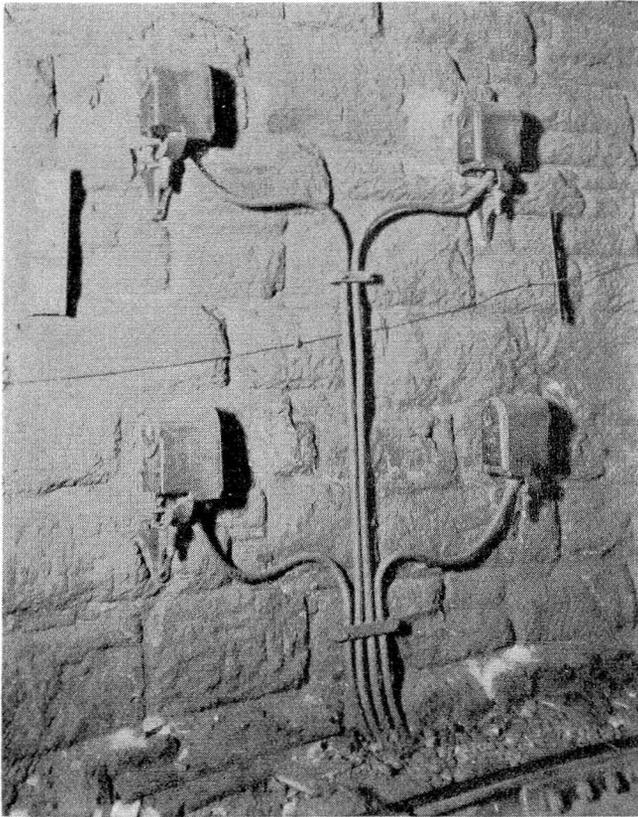
practically an entire replacement of the track circuit equipment, as well as the control circuits. In all cases new signals of the SA searchlight type were provided. In the tunnel the signals are attached to the side or curtain walls, but in the open all signals are mounted on overhead bridges. Altogether, 26 new signal bridges and one cantilever bridge were constructed, two new sets of signal brackets were provided on the lengthened 144th Street bridge, and alterations were made at two of the existing bridges.

Details of Construction

In view of the fact that the electrification system operates on 660-volt direct current, the signaling system

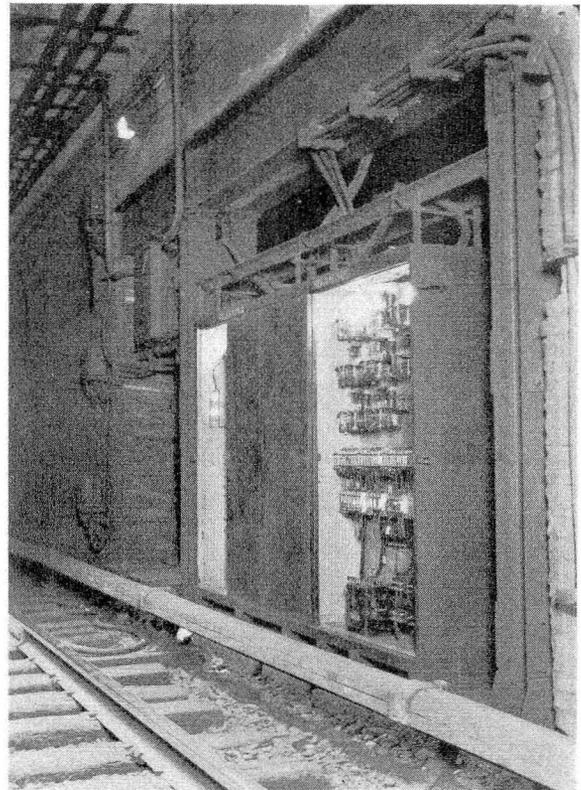
is operated on alternating current, supplied from step-down transformers from 11,000 to 2,200-volt, 25-cycle, single-phase current. Other step-down transformers afford the desired voltages for control circuits, signals and track circuits. The supply line is provided in duplicate in two-conductor No. 0 cables run in exposed pipes or underground conduits on each side of the right-of-way. Both lines are energized at all times and the load on each is equally divided normally. Each line is capable of carrying the full load, however, and power-off relays automatically take care of any breakdown in either source of supply.

The control circuits extending between signal locations in the Park Avenue tunnel are carried in aerial cables, consisting of 37 to 50 conductors, No. 12 A. W. G. solid copper wire, insulated and braided in accordance with New York Central specifications. These cables are supported on $\frac{1}{2}$ -in. copperweld, 7-strand messenger wires along the curtain walls between Tracks 1 and 3 and 2 and 4. From the tunnel portal at 96th street, to the Harlem river drawbridge, two 50-conductor No. 12 A. W. G. solid copper wire, insulated and braided in accordance with New York Central specifications, were run in



Signal location in tunnel using SA signals for both eastward and westward operation

$3\frac{1}{2}$ -in. wrought iron pipes on top of the outside viaduct girders. Three 60-conductor, No. 12 A. W. G., 19-strand submarine cables, in accordance with A. R. A. specifications 9020, were installed at interlocking MO. Lead-covered cable, varying in size from 19 to 60-conductor No. 12 to No. 6 A. W. G., 19-strand copper wire, in accordance with A. R. A. Signal Section specifications No. 9120, were run in an underground duct system employing $3\frac{1}{2}$ -in. and 4-in. Birmco fibre pipe encased in concrete. This system consists of 6 to 32-way on the run from 140th street to MO, 6 to 20-way for the Hudson division tracks, and 6 to 20-way for the Harlem division



Instrument housing in tunnel

tracks, making a total of 72 ducts entering signal station MO.

Ten and 12-conductor cable, No. 12 A. W. G. solid copper wire was used from relay boxes to signals, each wire insulated and braided with circular loom braid for outside covering of the cable in accordance with New York Central specifications. Parkway cable is used on runs from switches and dwarf signals to main cables.

A-c. double-rail track circuits were used, equipped with G. R. S. size one reactor bonds, 1,500 amperes per rail capacity, located on outside of track rails and connected to the rails with 2,500,000 c. m. stranded cable, rubber insulated and braided.

Track relays are the a-c. two-position, Type-D poly-phase vane type, with four independent front, two dependent front and back contacts; the local element being rated at 55 volt, 25 cycles. Track transformers are the air-cooled, Type K2 of 300 v. a. capacity. Connections between reactor bonds, transformers and relays are made with two-conductor No. 6 A. W. G. solid copper wire insulated and braided with circular loom covering, for tunnel and viaduct. Parkway cable, where necessary, was run under ground. Direct-current, Type K, 450-ohm line relays, with four dependent front and back contacts were used and are fed from the a-c. supply feeds from 55-volt rectifiers placed in the circuit at the relay end. The control circuits are two-wire being energized by one-to-one insulating transformers.

Results Obtained

The new system of either-direction signaling was completed and cut into full service the latter part of April, 1931. The results in expediting train movements have been entirely satisfactory as is evidenced by a reduction in the delay to trains at Mott Haven Junction and in their running time between Grand Central and the Junction.