

Duplex Signaling of Fourth Track Solves Grand Central Problem

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WITH the Grand Central Terminal at one end and the two four-track divisions and a large storage yard at the other end of the 5-mile four-track system we find an interesting railroad operation as a basis for this study.

In this 5-mile territory are located a tunnel, a viaduct over the city streets, two important through and suburban passenger stations for the use of the patrons of the New York Central and New York, New Haven & Hartford, an important four-track drawbridge over the Harlem River connects a very important four-track junction and a yard for commissary and classification passenger use. Movements on all of the tracks within this four-track area are handled by signal indication entirely. The trains are operated by direct current electric propelled locomotives and multiple unit equipment for both railroads.

The signal system is designed to meet the train schedules which require a very close headway. The scheme in effect comprises several power interlocking layouts and color-light signals and three-position upper right hand quadrant semaphore signals.

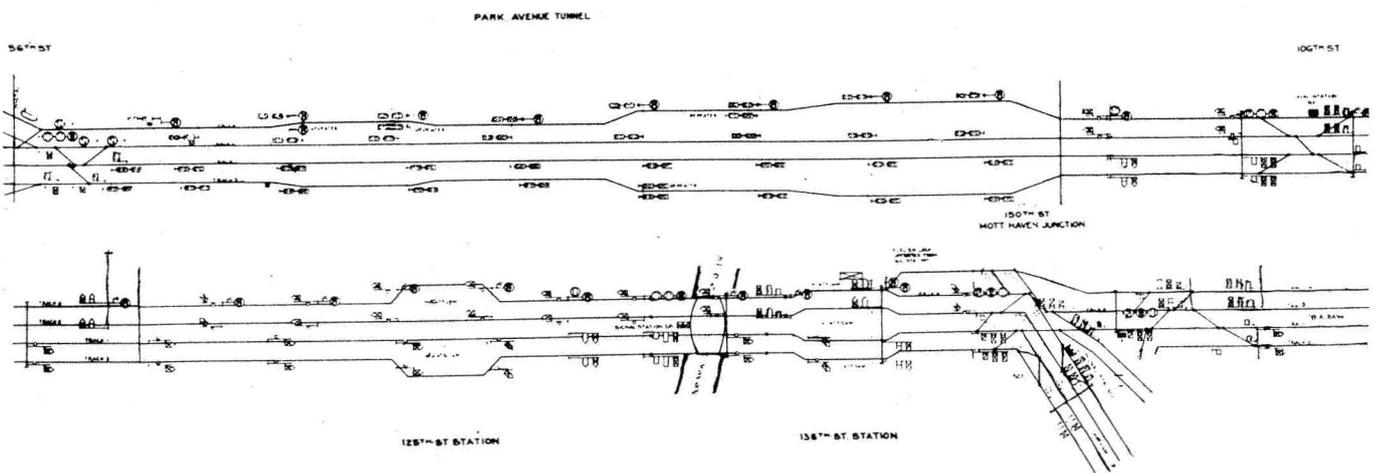
No. 4 Track Now Signaled for Both Inbound and Outbound Moves

Operating conditions have changed so that it was considered prudent to provide ways and means to meet the increase in traffic demands. Studies of the conditions existing on these four tracks brought about the conclusion that one track, viz., the one numbered 4, should

for eastward or inbound passenger service. Trains are operated by signal indications through the medium of traffic locking. The scheme in effect is to traffic-lock from signal station "U" located at 57th street, which is the northern end of the Grand Central Terminal to signal station "NK", 106th street; from "NK" to Harlem River Signal station "BR"; and signal station "DS" to Mott Haven Junction, 150th street, signal station "MO". At "MO" trains may be routed to the four-track system "N" for New York Central trains or N. Y. N. H. & H. trains, also into the storage yards or to "MJ" signal station where trains are advanced to the New York Central for the west over another four-track system.

The selected track provides the most acceptable means of readily avoiding the grade crossing at signal station "MO", and eliminates delays which are naturally encountered. Any one or the other tracks of this four-track system would not have so satisfactorily avoided the conflict in traffic movement over the grade crossing either from four to eight tracks or vice versa. This plan of operation was established in July, 1924.

Considering the large amount of traffic that is moved outbound from the Grand Central Terminal and the congestion which intervenes during certain periods of operation on account of traffic requirements it is necessary to provide methods of handling the public at the intervening passenger stations located on this line without undue confusion so that the revenue traffic is run outbound during certain established hours. This track is also used for trains as required to give relief to move-



Track Plan Grand Central Terminal to Mott Haven Junction

be provided with a signal system for both in and outbound traffic, which method would afford the relief sought.

The clearance problem required careful study and analysis and resulted in the use in the turned areas of colored-light signals giving either two or three indications and in the territory beyond semaphore signals located either over or adjoining the track either to the right or to the left of the track to meet the problem which was normally restricted by the requirement that a limited number of signal bridges only might be used.

Track numbered 4, is used between the points specified

from the Grand Central Terminal at 42nd street to the storage yards at signal station "MO".

The question of flexibility of operation within this territory has been discussed from several angles. It is difficult to institute more tracks on account of the physical conditions prevailing. Probably a fifth track will be of sufficient benefit. No estimates are produced as to the approximate cost. The signaling on track 4 costs approximately \$90,000. No increase in maintenance or operating forces was required. The only additional costs that are involved are those which will accrue for the current to operate the control circuits and light the signals.

The advantages gained by this installation are: (1) Making available track 4 for run around movements; (2) The saving of accumulated delays during peak load

periods on the existing two outbound tracks; (3) The schedules have been made more flexible by this arrangement and the delay to certain trains eliminated.

Train Operation by Signal Indications— Especially by Cab Signals

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IN my paper on the results of the test installation of train control on the Sunbury and Williamsport Divisions of the Pennsylvania Railroad, presented at the Meeting of the Signal section, September, 1924, a statement was made which was, in part, as follows:

"The wayside signals are two-position position-light and indicate Stop or Go. Combination of the cab and wayside signals gives us, therefore, Authorized, Restricted, Slow and Stop.

"The cab signals give good service and are as reliable as the wayside signals and it is my personal opinion that, if any additional safeguards are required or justified, in order to handle our traffic safely, expeditiously and economically, as required by law and desired by every one, the addition of these cab signals will, with the type and character of men who run our trains, provide as much protection as the complicated apparatus required for any system of train control and more protection than the straight stop with the permissive feature, excepting in the case of a train with an engineman gone suddenly crazy and the fireman not knowing it, and in the case of either control or stop, an engineman and fireman both absolutely incapacitated, a contingency less likely to occur than a failure of the apparatus to apply the brakes."

We are continuing the development of the three-speed continuous train control on the Lewistown branch, and we are proceeding with the installation of an automatic block system on the Baltimore-Harrisburg line, "using signals without moving parts spaced for future installation of continuously controlled cab signals and for trains running with closed throttle at maximum authorized speed . . . controlled by alternating current track circuits to reduce foreign current interference to a minimum, and including in the installation flashing lights . . . indicating the approach of trains" at many grade crossings. On this we are superimposing cab signals giving three indications and arranging for a straight stop with forestalling feature on the locomotive, the latter in accordance with the requirements of the Interstate Commerce Commission revised in July, 1924.

The cab signal will be the same as that in use on the Lewistown Branch, and will operate so as to show "A"—Authorized—when train is running in a clear block under clear signals; forestalling being required to avoid brake application on each change to a less favorable indication, so that, if one train is following another, and the engineman does not forestall, a stop will result: (1) when it passes an approach signal back of the leading train, having had an "A" cab indication before reaching the signal; (2) when it passes a stop signal and enters the block occupied by the leading train, having had an "R" cab signal before reaching the stop signal. In case No. 1, if the leading train clears the block ahead before the following train reaches the signal protecting that block, that signal will, of course, change to an approach signal and the cab signal on the following

train will at once change from "R" to "A," and, when passing the signal, back to "R." In case No. 2, as soon as the leading train clears the block occupied by both trains, the cab signal on the following train will change from "S" to "R" and, on passing the signal ahead indicating stop, back to "S." Should a rail ahead of a train be broken, or a switch open, or the track short-circuited in any way, the cab signal would immediately change to "S," and a stop result unless the engine man is very alert.

Records of Performance

An analysis of cab signal performance, separated from train control performance, on the Lewistown Branch, during the 18 months from July 11, 1923, when the apparatus was placed in service, to January 10, 1925, inclusive, 5,337 trips, shows approximately 384 irregularities. That is one for every 14 trips, one in every 700 miles, one in every 840 sections. For the first nine months, there were 233, and the second nine months 151, showing that we have progressively developed and improved the apparatus and eliminated failures.

Of these failures, the roadside apparatus was responsible in the first nine months for 125 and in the second nine months for 72, a total of 197; the engine equipment in the first period for 108, and in the second period for 79, a total of 187.

The cab signal in service on the Lewistown Branch will regularly change momentarily when passing over the insulated joints between adjacent track circuits, the duration of this "flip" depending on the speed of the train, but, in any case, it is not of sufficient duration to be interpreted as a change in indication, it is thereby self checking. Only when it continues after the joints have been passed would it be observed by the engineman as a change in indication. This change is most noticeable on single track lines where direction must be established by the moving train as it shunts the successive track circuits.

The smaller number of failures during the last half of the 18 month period is explained by the fact that the "bugs" always present in a new development are gradually being eliminated. Improved methods of engine wiring and better grade of wire, as well as a better knowledge of what must be most closely watched in maintenance, are items responsible for this reduction. Improvements in the headlight generator, which are expected to result in a more uniform voltage, should still further reduce this trouble. Broken filaments or other defects in amplifier tubes and ballast lamps are inevitable but regular tests and improved knowledge of what service to expect will keep this trouble at a minimum.

Advantages of Cab Signals

Many of the fixed signal units now display four aspects and, by combination of two units, additional ones are provided. The cab signal as at present developed gives only three. It may be substituted for the ordinary three-