New York Commission Recalls Order

Transit Commissioners Revoke Their Requirement for Signaling and Train Control on Elevated System of Interborough

ON January 3, 1923, the Transit Commission adopted a resolution approving a report by their chief executive officer, recommending that the Interborough Rapid Transit Company be required to prepare plans, specifications and estimates of cost to be submitted not later than April 15, 1923, for a complete speed control system of signaling on one mile of local track, with automatic stops designed to safeguard the operation of the trains on local tracks, without reducing the capacity of the existing maximum operation. This order of the Commission is of particular interest because of the impartial investigation which was later made by that body and which, in the form of a report, agreed in substance with the testimony as submitted by the signal engineer of the Interborough Company in his report dated November 13, 1923.

Extensive Plans and Investigation Made by Signal Department

In compliance with the Transit Commission's order of January 3, 1923, the engineers of the railway company prepared an extensive report, based on carefully observed data, and furnished complete with drawings, operating curves, and cost estimates, which showed effectively that under the conditions existing on the local tracks of the elevated system in New York City, the installation of a block signal system or speed control device would greatly decrease the track capacity with a consequent increase in delays and in traffic congestion. To back up the opinion expressed by the company's engineers, the report included three groups of drawings, referred to for convenience as A, B, and C; the first two groups (A and B) pertaining to actual conditions of operation as taken from observed data, and the third group (C) showing the effect, on train operation, of signaling the experimental mile of track. The section of track from 9th street to 42nd street was taken as a typical condition on the elevated system and a place where the result of experimenting would prove of the greatest value. As evidence of the thorough and detailed manner in which the company presented its side of the case, the following list of drawings was submitted as a part of the report of the signal engineer, J. M. Waldron, and in case of those in the first group are based on data received from the car equipment department.

(A) Data and Curves Used in Plotting Train Operation, Braking Distance, Etc.

1. Copy of letter from car equipment department giving car data.
2. Drawing F. 473—Curves of braking distances for various grades for standard Manhattan train.
3. Drawing F. 474—Curves of braking distances for various grades for Composite train.
4. Drawing F 477—Formulae and data for computing accelerations, standard Manhattan train.
5. Drawing F 478—Chart showing different accelerations for different grades and speeds, standard Manhattan train.
6. Drawing F 479—Speed-Distance curves for various grades, standard Manhattan train.
7. Drawing F 480—Time-Distance curves for various grades, standard Manhattan train.
8. Drawing F 481—Formulae and data for computing accelerations, Composite train.
9. Drawing F 482—Chart showing different accelerations for different grades and speeds, light Composite trains.
10. Drawing F 483—Speed-Distance curves for various grades, light Composite trains.
11. Drawing F 484—Time-Distance curves for various grades, light Composite trains.

To obtain a better understanding of the conditions that must be fulfilled or may arise in the signaling of local tracks of the elevated system, several sets of train readings were made. These readings were plotted on drawings in order to present clearly to the layman exactly under what conditions the trains are operating without signals.

(B) Observed Data and Readings of Train Movements at Present Without Signals

1. Drawing F 461—Table of timing of train operation, south of 9th st., to 18th st., station, Third avenue line, northbound local track.
2. Drawing F 462—Table of timing of train operation, north of 42nd st. station to 8th st. station, Third avenue line, southbound local track.
3. Drawing F 463—Table of timing of train operation, south of 23rd st. station to 42nd st. station, Third avenue line, northbound local track.
4. Drawing F 464—Table of timing of train operation, north of 23rd st. station to 9th st. station, Third avenue line, southbound local track.
5. Drawing F 460—Sheet 1. Curves of train operation (readings on drawing F 461), 9th st. to 18th st. station, northbound local track, Third avenue line.
6. Drawing F 460—Sheet 2. Curves of train operation (readings on drawing F 462), 42nd st. to 28th st. stations, southbound local track, Third avenue line.
7. Drawing F 460—Sheet 3. Curves of train operation (readings on drawing F 463), 23rd st. to 42nd st. stations. northbound local track, Third avenue line.
8. Drawing F 460—Sheet No. 4. Curves of train operation (readings on drawing F 464), 23rd st. to 9th st. station, southbound local track, Third avenue line.
9. Drawing F 470—Sheets No. 1 to 10. Table of timing of train operation south of 18th st. station to 42nd st. station, northbound local track, Third avenue line.
10. Drawing F 488—Curves of train operation (readings on drawing F 470, sheets 1 to 10), 18th st. to 42nd st. station, northbound local track, Third avenue line.

From a close study of these drawings the following facts and data were found: (1) That light and road trains do not follow each other in any definite order; they are grouped in almost every conceivable combination. (2) That the average station stop is approximately 20 sec. (3) That traffic is grouped, due to delays, to drawbridge interference, and to local and express trains not arriving at Chatham Sq. at the proper time. (4) The effect of signals on train movements can be observed by studying the 34th street interlocking, where the interlocking signals have slowed down and in many cases held trains. (5) That if these trains were not held at signals, the running time would be reduced. (6) A study of headway existing on the Third avenue line between 9th and 42nd street stations, as taken from the sheets F-460 (58.5, 53, 62, 53, 57, 58, 53.5, and 56 seconds) formed the basis for later comparisons with calculated headways with signals installed.

To show the effect of signaling on train operation; such as, running time, and minimum headway that is possible with signals installed on a one-mile section from 18th street to 42nd street; the report includes three drawings and an estimate of cost as follows:

(C) Computed Data, Curves and Effect of Signaling on Train Operation

1. Drawing F 489—Study of train operation, minimum headway and running time possible, with and without signals, northbound local track.
2. Drawing D 970—Sheets No. 1, 2 and 3. Signal apparatus and location of signaling on one mile of northbound

local track, 18th to 42nd st., Third avenue line, based on drawing F 489.

3. Drawing D 971—Layout of circuits from north of 34th st. station, including 42nd st. station, typical of signaling for one mile of northbound local track between 18th st. and 42nd st., Third avenue line, based on drawing F 489.

4. Estimate of cost of construction for "experimental mile" of signaling, 18th st. to 42nd st. and cost of signaling one mile of track other than the "experimental mile."

In drawing F 489, an 8-car train is used as a basis, because all of the Manhattan stations will take 8-car trains and all present signaling of the elevated lines has been laid out for 8-car trains. In preparing this drawing station stops of 20 sec. were used and the signals were laid out to give protection of braking distance plus ten per cent for the maximum speed, from the signal to the rear end of the train. In the proposed scheme of signaling, all signals have an overlap so that there is at least a braking distance plus ten per cent between trains, except in cases of speed control, in which case if the following train has reduced its speed to a safe operating value, it is allowed to come closer to the rear end of the preceding train. On entering the station the last signals have overlaps beyond the signal leaving the station; as a light train does not stop in the station, it is necessary to protect the preceding train by using overlaps throughout. While the overlapping at the entering signal is not used in the subway, yet in that case the last signal entering is over 500 ft. from the signal at the leaving end; or in most every case more than the braking distance. However, on the elevated lines the last signal entering is only about 200 ft. from the signal at the leaving end and the braking distance for Manhattan trains is greater than for the subway or composite trains. It was found by calculation that the higher speeds obtainable by the composite trains were compensated for by the longer braking distances required for the Manhattan standard train with relatively lower speeds. The speed control feature is taken care of by allowing a portion of the controlled section to be cut off when the timing device operates, that is to say, when the following train has reduced its speed to a safe operating value, the signal control is cut back and the train is allowed to close in on the preceding train. These operating curves are built upon years of experience and study in train operation and have been developed to such an extent that in practically all cases, train operation is identical with the predetermined curve.

Results of Study

Considering first the question of headway we have from the drawing F 489, showing train operation with signals on the local track, the following average values:

Forty-second street station	64.8 sec.
Thirty-fourth street station	65.9 sec.
Twenty-eighth street station	67.7 sec.
Twenty-third street station	68.9 sec.
Eighteenth street station	69.7 sec.

The proposed operation does not take into consideration any gap in traffic, whereas those headways actually observed and reported have included gaps in traffic. These gaps in some places amount to over three minutes. The signal layout as proposed does not provide a free running condition for any train, that is, every train is operating only on the caution signal and not on the clear signal. This condition is not for the best of service but to operate under the green indication would mean a corresponding increase in headway. Keeping in mind the above conditions, on comparing the calculated average headway as above with the headway as actually observed, it is impossible to fulfill that condition of the Transit Commission's order—to signal one mile of local track without reducing headway.

Another factor of importance in the signaling of the local track is the reduction of speed and the consequent increase in running time. Also, the proposed operation is for straight track and straight operation and does not take into account the slower speeds necessary at curves, neither does it consider the delays at operating interlockings. With overlapping of signal controls to give absolute protection around curves, the operation would be much slower because of the longer section of track controlled and due to the limited vision of the motorman.

There are 1,290 operating units of apparatus on the 18th to 42nd street section of proposed signaling. Each of these units consists of several parts which are delicate and need to be supported on springs or pads to overcome vibration. The control circuits would be very complicated and hard to maintain and in the section from 18th to 42nd street; the total number of "breaks" in circuits would be 725, each of which is a potential source of trouble, requiring constant attention. Considering the amount of apparatus and the delicate operating conditions of the apparatus, it can be easily understood that the cost of signal maintenance would be greatly increased without any corresponding increase in revenue. In fact with the greater running time, delays, etc., the revenue per mile would be greatly decreased.

The cost of power per train mile would be greatly increased, due to the fact that with signals on the local track it would not be possible for the motorman to keep moving. Also due to the increased running time a train could not make as many trips in the same time, thereby increasing the cost of train operation per mile.

It is estimated that the cost of the "experimental mile" of signaling would be $126,000. The cost per mile of track other than the "experimental mile" is placed at $105,000. Or for the total 82.78 miles of local track on the Manhattan elevated structure, the approximate cost would be $8,700,000. The general overhead, engineering and interest during construction, amounting to 20 per cent, would be $1,740,000; making the grand total $10,440,000.

To sum the matter up it is found from this study that by signaling of the local track; (1) train headway is increased; (2) train speed is decreased (3) running time between points is increased; (4) track capacity is decreased; (5) delays are increased; (6) cost of power is increased; (7) amount of apparatus is greatly increased; (8) cost of signal maintenance is increased; (9) cost of train operation is increased; and (10) number of passengers carried is reduced.

Commission Reviews Testimony at Hearing

THE foregoing report which had previously been entered as testimony was considered at a hearing held on February 13, 1924, before the State Transit Commission in the City of New York, at which time counsel for the Commission and also for the Interborough Rapid Transit Company and the New York Rapid Transit Corporation were present. At this hearing a memorandum dated January 24, 1924, was submitted by counsel for the Commission which had been prepared by Gibbs & Hill, consulting engineers of the commission, after a careful study and examination of the testimony presented. Following is the substance of the memorandum as presented at this hearing:

The testimony in the hearing on this question showed that it was physically possible to signal the elevated tracks by installing a very elaborate and complicated continuous speed control system, similar in principle to that used approaching stations on the express tracks of the subway. In order to get the maximum possible capacity of the tracks it is necessary, however, to provide for very close train spacing, which means that signals must be placed very close together over the entire railway, in some places only 70 ft. apart. Even with this elaborate installation, it appears impossible to secure the track capacity which is today required during the rush hours on the tracks which are used to return jointly, light and revenue movement. While the exact degree of reduction in capacity may be open to dispute, it is evident that it would at times, be quite serious. A feature which is not susceptible to accurate analysis, and connected with the very close spacing of signals (such as proposed) is that the motorman must observe each signal and must carefully control the speed of his train at all points throughout the run. This means very great mental strain of long continued duration. If he allows his attention to waver, from fatigue or otherwise, traffic will be delayed, congestion will occur, and track capacity will be further reduced. We have endeavored to suggest an alternative signal system which would be sufficient as well as simpler and less costly; but in no way have we been able to satisfy ourselves that requisite track capacity can be obtained with the complete protection desired. For partial protection it has been suggested that cautionary signals might suffice, but this would not fulfill the purpose of requiring obedience to the indication. We have also considered the suggestion that the signals might be thrown out of service on the return movement during heavy hours; but this we do not believe would be good practice and it is certain that the operating company would strenuously object to any such idea.

The railway company estimated the cost of installation of the signal system would be in the neighborhood of $10,000,000; this may be an over-statement in some degree, but it is evident that the first cost must be high and of this order. The maintenance cost of this complicated system would also be a very burdensome item. Again, as any piece of apparatus is subject to derangement, a multiplication of delicate parts means multiplication of failures; consequently Mr. Waldron states that, based on his experience in the subway, he would expect at least 4,500 cases of derangement per year in the proposed elevated railway installation. A failure, of course, means a more or less serious disorganization of movement each time it occurs, and this is, obviously, a serious matter to contemplate.

On account of reduction in capacity caused by the signals, there would be a resulting increase in congestion, and this in turn means an increase in the amount of discomfort to passengers, and probably a considerable actual increase in the number of minor accidents and injuries. It might be noted, as of interest, that in 1922 the Interborough Rapid Transit Company reported 13,091 accidents from all causes, of which 5,402 were to passengers boarding or alighting from trains; doubtless very many of these were caused by overcrowding, so that increased congestion would tend to add to the number of these accidents.

While, of course, every one is seeking to promote safety by every possible means and device, yet, while this is a most laudable object, it is interesting to see how closely this object is aimed at and attained in respect to other phases of city life. We have drawn off from the Board of Health records, the following memorandum of deaths in greater New York, resulting yearly from accidents of various kinds. It will be seen that these total in the year 1921, 2,733 and in 1920, 2,792, of which only 35 occurred on the elevated and subway in 1921 and 39 in 1920, and of these only two resulted in death in railway collisions in 1921 and three in 1920. Analyzing these fatalities, it is seen that a very large number of them should have been preventable and yet no particular attention has been directed to this enormous death toll.

Now coming to the question of what the signal system might be expected to accomplish, the records for the 15-year period from 1908 to 1923, inclusive, show that on the Manhattan Elevated an average of .87 persons was killed per year by collision, and that the number injured per year in this way is about 68. While we cannot segregate in the companys' reports, the number injured on the Manhattan Railway from causes other than collision, it was doubtless many thousands; therefore it follows that the number injured in collisions on the elevated was a very small fraction only of those injured by other causes. In fact, on the whole Interborough system, only .8 of one per cent of the total injured reported were in collisions. It seems not impossible to assume that if we increase the congestion seriously by introducing a signal system that we would **add**, by this reason alone, as many killed and injured as we seek to **save** by avoiding collisions.

Lately, the records cited above seem, at least to raise the question whether or not it is wise or would be really helpful to the transit situation in the city, to insist upon a so-called safety provision at enormous cost and difficulty, in the face of an undoubted effect of adding to the congestion and causing added inconvenience to the public. It raises the question whether $10,000,000 could not be more profitably devoted to other safety provisions and to extensions in transit lines, which are so urgently needed.

As referred to in the report, there were included several tables of accidental deaths as drawn from the records of the Board of Health of the City of New York. At the conclusion of the reading of the report, and after a short discussion as to whether or not the report as submitted was intended to cover both the Interborough and the New York Rapid Transit Lines, the hearing was closed on the motion of counsel for the Commission.

Report on Inspection of Pennsylvania Train Control

THE Interstate Commerce Commission has made public a letter addressed by E. H. De Groot, Jr., director of the Bureau of Signals and Train Control devices, to Samuel Rea, president of the Pennsylvania, with a copy to G. A. Blackmore, vice-president of the Union Switch & Signal Company, referring to the recent inspection by the commission's engineers of the installation of the Union Switch & Signal Company's three speed continuous inductive system of automatic train control on the Lewistown branch of the Pennsylvania Railroad. This inspection was similar in character to the preliminary inspections of permanent installations under the commission's order authorized in its circular of June 9, 1924. The letter says:

1. It is our understanding that the older pneumatic apparatus with which the majority of the locomotives assigned to this branch are still equipped, is considered obsolete and will be replaced with the later type as rapidly as possible. With this understanding this older type will not be further discussed here.

2. In the later type of pneumatic equipment, as installed on locomotive 4142, diagramatically illustrated by Westinghouse drawing C 41722, the type which it is our understanding you propose to adopt, it was determined that, when employed in combination with the No. 6 ET locomotive brake equipment, it will cut off the main reservoir air supply to the application cylinder of the distributing valve in a manual emergency application made while the automatic apparatus is applying the brake, or while the application valve of the automatic apparatus is in application position. This is at variance with that portion of requirement No. 8 of the specifications of the Commission's order No. 13413, reading:

"The apparatus shall be so constructed as not to * * * impair the efficiency of the air brake system."

3. It is understood that difficulty has been experienced with this installation as a result of the presence of foreign current. Effective means should be provided to overcome this.

4. The cut-in feature at the beginning of train control territory in this installation is designed and operated upon the open circuit principle, and while the wayside and cab signals are intended to apprise the engineman of a failure of the device to automatically cut-in, this method involves reliance upon the human element.

5. No provision is made in this installation for reacknowledgement at successive stop signals.

The object of this and similar inspections, is that of constructive criticism; the pointing out of such matters as may be helpful to the carrier in checking an installation against the specifications and requirements of the commission and such other related points as our necessarily brief inspection may develop. The foregoing criticisms and comments are offered accordingly.