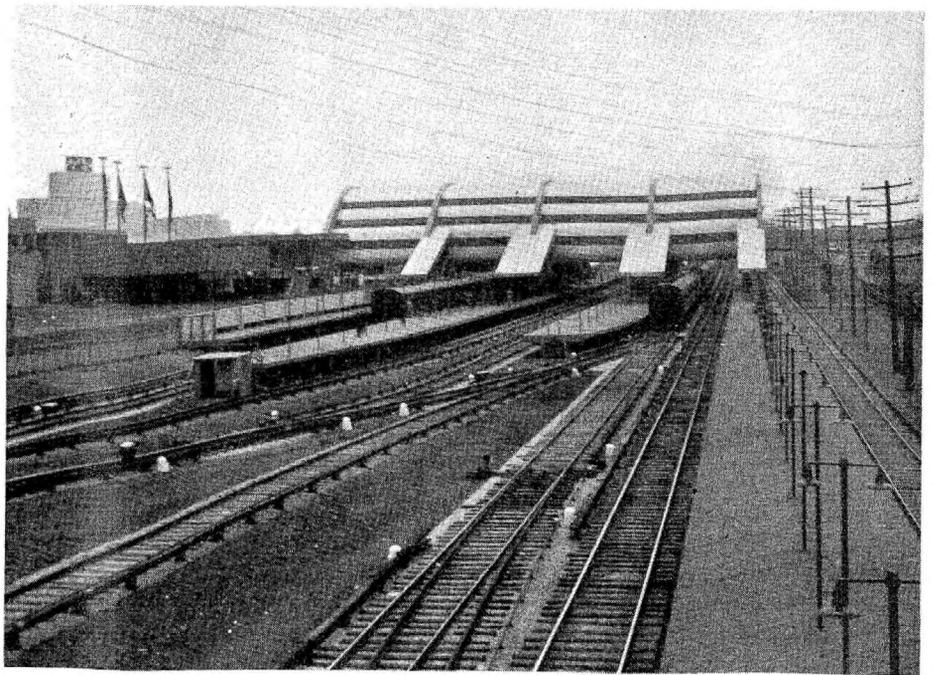


View of World's Fair station and track layout included the new Fair interlocking to expedite handling of special passenger service



Signaling the Pennsylvania to New York World's Fair

Automatics in East River tunnels are respaced; changes made at two plants, and temporary interlocking installed

EIGHT miles in ten minutes for ten cents, and always a train ready to depart, is the advertising slogan concerning the operation of special train service on the Pennsylvania between Pennsylvania Station in New York City and the World's Fair near Flush- ing on Long Island. The Long Island railroad, a subsidiary of the Pennsyl- vania, has various lines serving differ- ent parts of Long Island. These lines converge at Long Island City and

enter New York through tunnels approximately 3 miles long, extending under the East River from Long Is- land City to Pennsylvania Station in New York.

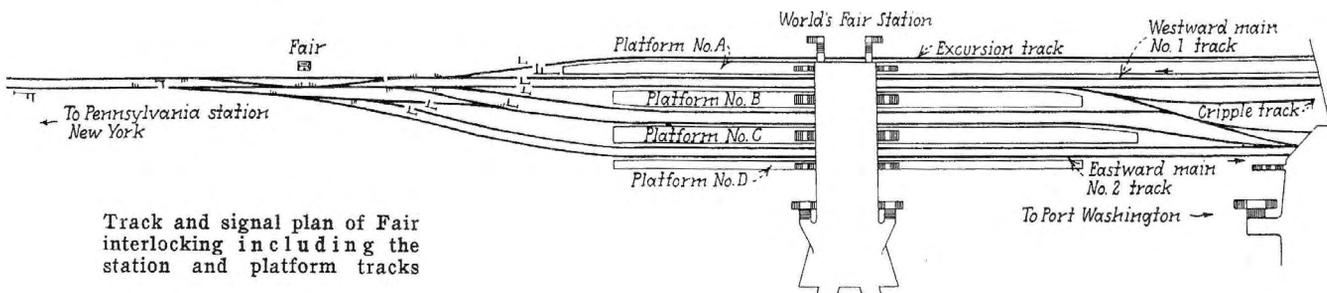
The double-track Port Washington branch of the Long Island is located along the north side of the Fair grounds, and a new track layout and station, known as World's Fair, was constructed at that point to handle the loading and unloading of passengers and the reversal of trains. These lines are equipped for electric traction, and service is handled by standard mul- tiple-unit cars of the coach type.

Throughout the major portion of each 24-hr. period, a train is scheduled

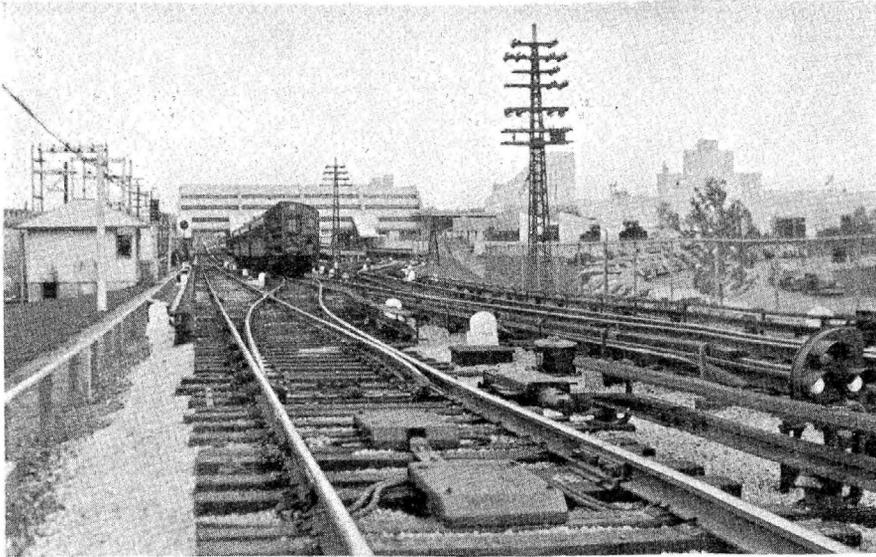
to leave New York every 10 min. Likewise, a train leaves World's Fair on schedule every 10 min. However, during rush periods, as soon as a train is loaded at Pennsylvania Station or at the World's Fair, it pulls out promptly, and extra trains are placed in service as fast as necessary to handle the traffic promptly.

Number of Trains

At Pennsylvania Station, one en- tire platform, with Track 15 on one side and Track 16 on the other side, is used exclusively for trains depart- ing for the World's Fair. The stair- ways leading down to this platform



Track and signal plan of Fair interlocking including the station and platform tracks



View showing the "Fair" interlocking station at left, and a general view of the track layout looking toward the World's Fair passenger station

are plainly designated, thus eliminating any confusion. Trains arriving in Pennsylvania Station from the Fair pull in on Tracks 20 or 21 and passengers then pass up stairways into the station. The trains are then moved into a small yard, and again run back to Track 15 or 16 ready for departure to the World's Fair. A period of 17 min. is allowed from the time a train arrives in Pennsylvania Station until it is scheduled to depart.

On arrival at World's Fair, passengers pass up stairways and enter the station through turnstiles, where a dime must be inserted by each person. Likewise, when going from the World's Fair station to a departure platform, each person deposits a dime to operate a turnstile. Thus, the selling of tickets is eliminated, and fares are collected with minimum delay. Quite obviously, it would be impracticable to provide enough collectors to work trains while en route only 10 minutes.

Equipment Used

Eight trains of 12 cars each are assigned to this special service, and each such train seats 944 passengers. During light traffic hours, each train uses only ten cars. These cars, which were completely overhauled and painted prior to the inauguration of this service, are all equipped with electro-

Train bound for the World's Fair passing through "F" interlocking at the east end of the tunnels. Position-light signals are used

pneumatic braking equipment, by means of which the brakes on all cars of the train are applied simultaneously.

In addition to the shuttle train service as explained above, excursion trains on one-day roundtrips from Philadelphia and other cities are being operated through New York directly to World's Fair, where the trains are held until departure. Thus, all of this extra traffic must be handled in addition to regular trains ordinarily operated on the lines between Pennsylvania Station and World's Fair.

Problem in Tunnels

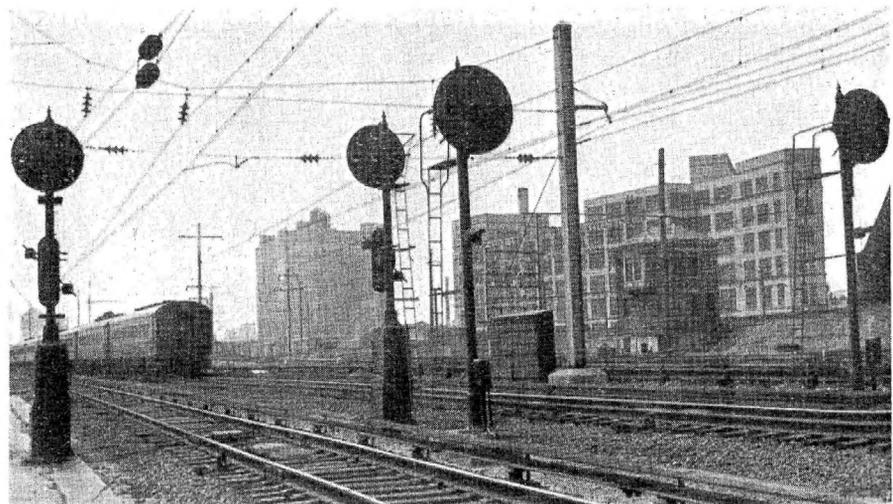
Digressing for a moment, it may be well to explain that all through Pennsylvania passenger trains operated in or out of New York are cleaned in Sunnyside yard on Long Island, which means that these empty trains, as well as all regular Long Island trains, World's Fair trains, 10 Lehigh Valley trains, and about 12 New Haven trains which use Pennsylvania Station, pass through the four tracks under the East River.

Each of the four tracks is in a separate tunnel, all tracks being signaled for traffic in both directions. Track 3 is for eastward and Track 4 for westward Long Island trains, normally. Only in rush hours is it necessary to diverge from this operating arrangement to run some Long Island trains through Tracks 1 and 2 which are normally used as Pennsylvania tunnels.

Increased Track Capacity

Thus, the additional traffic between Pennsylvania Station and the World's Fair brought up a serious problem concerning the track capacity on the tracks in the tunnels under the East River. Based on recent train braking tests, the signals on these four tracks were relocated to reduce the spacing between signals, thereby reducing the headway between trains and thus increasing the track capacity. The maximum train speed in the tunnels is 50 m.p.h. On westward Track 4 the signals were respaced in the section near the west end, one signal being added. The lengths of the blocks in this section were reduced from a minimum of 1,335 ft. to 1,080 ft. In this section, which is on an ascending grade of 1.5 to 0.8 per cent, the trains are reducing speed to enter the terminal; therefore, reduced spacing between trains was needed.

Likewise, on eastward Tracks 1 and 3, in the section just east of the ter-



minimal, the trains are not as yet up to normal speed; therefore, closer spacing is desirable. In this section, the signals were respaced and one signal added. For example, on Line 1 two former blocks, 1,238 ft. and 1,897 ft., were cut into three blocks 900 ft., 950 ft., and 1,283 ft. long, respectively.

Train-Stop System in Tunnels

At each signal in the tunnels there is an automatic train-stop trip mechanism operated in conjunction with the signaling system. These trips are normally in the "down" position where they will not encounter the air brake cocks on cars. When in the "raised" position, a trip will contact a lever on a car or locomotive which opens the air brake pipe and causes the brakes to be set. The control circuits for the signaling are arranged to provide a full block overlap; in other words, there are always two successive signals in the rear of a train which display the stop aspect. Referring to the diagram, if a train is

up too quickly to clear the valve arms on certain types of cars and locomotives. The control as explained, therefore was used.

In brief, the signaling in the tunnels is arranged for trains to be operated on 105 to 112-second headway at running speeds up to 50 m.p.h. maximum or at reduced speeds as dictated by operating conditions when ascending or descending grades, or when entering or leaving the Pennsylvania Station. In normal operation, trains are scheduled on a two-minute headway, which allows leeway for slight delays when passing through interlockings.

Changes at Two Interlockings

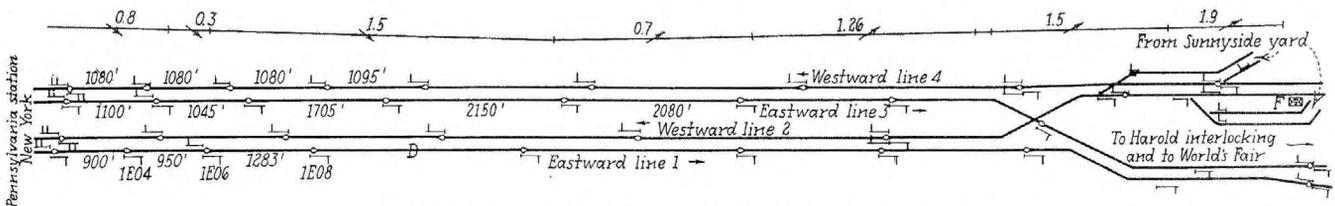
At "F" interlocking, located at the east end of the East River tunnels, the four East River tracks connect to a six-track layout extending 0.7 miles to "Harold" interlocking, at which point two tracks diverge to the north side and extend 4.8 miles to the World's Fair and 11.4 miles beyond to Port Washington. Four tracks ex-

in "F" interlocking. Three crossovers were added to provide facilities for engine interchange to permit reversal moves on westward special trains operated from the World's Fair through Pennsylvania Station to points south and west, and to be made more quickly to and from the yards. Certain signals were moved and other signals were removed to facilitate train moves.

Changes at Harold

At "Harold" interlocking, one crossover was added to handle trains for the North Side route and thus permit parallel eastward movement through the interlocking. Several changes were made to relocate signals and also to introduce certain holding signals as a means of facilitating reversal moves to or from yards. Four automatic signals were moved and two automatic signals added to improve train operation.

Between "F" interlocking and "Harold" interlocking, the World's Fair trains are handled on the six-



Track and signal plan of the four tracks in East River tunnels

occupying Block D on the eastward Track 1, then Signal 1E08 will display a "stop and proceed" aspect, Signal 1E06 will also display the "stop and proceed" aspect, and Signal 1E04 will display the "approach" aspect. The trip at Signal 1E06 is raised and the trips at the other two signals are down. In all instances each block is long enough for a train to be brought from normal speed to a stop within the block. The trip at the signal at the entrance of an occupied block is purposely held in the "down" position. If the trip were raised when the head end of a train entered the block, the trip would stop that train. If the control were arranged to raise the trip when the rear of a train cleared the track circuit in approach to the signal, the trip in some instances might come

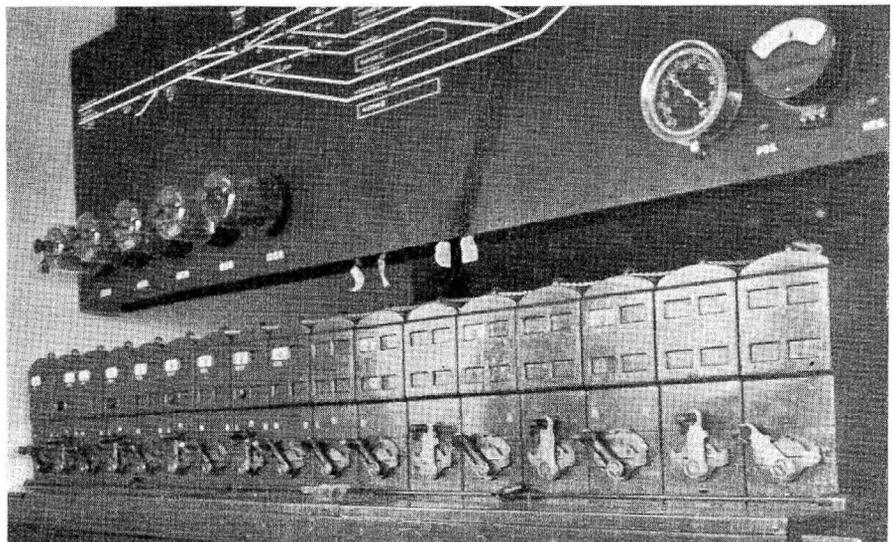
tend east of Harold to Jamaica, L.I., for the Long Island main line trains, and two tracks for New Haven trains over the Hell Gate Bridge.

Also at "F" interlocking, connections from the two Pennsylvania tunnels extend to the Pennsylvania Sunnyside coach yard, to Borden Avenue yard and to various industries. In view of the increased number of through trains to be handled, certain track and signal changes were made

track layout, but from "Harold" interlocking eastward, two tracks are used exclusively for the line extending east through World's Fair to Port Washington. In the section between Harold and World's Fair, the automatic block signaling already in service was adequate to handle the traffic without changes or additions. This line is equipped with continuous cab signaling, which necessitated that

(Continued on page 452)

The desk-lever control machine and illuminated track diagram in the "Fair" interlocking tower



3-channel circuit operating at this frequency is only 5.25 points, which is not sufficient to give efficient, reliable operation. A similar calculation for eastbound transmission would indicate that the range in this direction is also inadequate. Therefore, consideration must be given to reducing the transmission losses and increasing the operating ranges if we desire to operate the circuit at 60 words.

From an examination of the data included in Table 1, we learn that the excessive loss is in the Reno-San Francisco section and is due to the high breakover current rather than to excessive repeater section length. Since this section is equipped with anti-induction sets which minimize the crossfire, further measurements are advisable to determine the cause of the high breakover.

Therefore, the repeater section should be carefully analyzed by the method previously described to determine the magnitudes of each of the various components of interference.

Table 2

	At	
	San Francisco	Reno
Total breakover	32	28
Crossfire	14	14
Power induction, 60 cycles	11	8
Power induction, 180 cycles	8	6
Earth currents	2	2

Let us assume that this analysis has been made and that the results are as tabulated in Table 2.

The 180-cycle currents indicated here may be most economically eliminated by applying resonant reactors to the telegraph circuits. The 60-cycle induction, as previously discussed, may be reduced by the installation of two supply line transpositions.

With the interference level reduced by these measures, the operating ranges between Ogden and San Francisco would be increased to 6.8 points.

Thus we see that, in the co-ordination of power and communication lines, consideration must be given not only to the components of power induction present, but also to the other types of extraneous current, and to the characteristics of the line wires as well. This complete picture must be obtained, not only within the exposure limits, but throughout the entire length of the communication circuits affected. Only when all of this information is available can we visualize the effect of an increase or decrease in any of the components, and it is only with this information that the best engineering solution can be reached.

Signaling to the New York World's Fair

(Continued from page 437)

equipment be installed at the World's Fair to test the car equipment before each train departs.

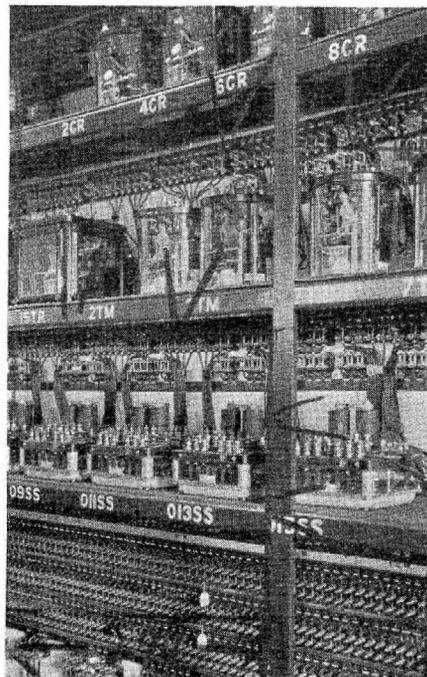
Track Layout at World's Fair

At World's Fair station, the eastward main track was moved south to allow space for four new station tracks and four new platforms, as shown in the diagram. Ordinarily, trains arriving from New York are routed to one of the tracks served by Platform C. Trains depart from one of the tracks served by Platform B. However, the switches and crossovers are arranged so that trains can arrive at or depart from either of these platforms; therefore, in rush periods, as soon as a train is unloaded, it can be loaded and depart.

Eastward trains to Port Washington use Platform D and westward trains from Port Washington to New York use the south side of Platform A. The track on the north side of Platform A is used by Pennsylvania one-day excursion trains from and to points such as Philadelphia, Wilmington, Baltimore, Washington, Harrisburg, and Pittsburgh.

World's Fair Interlocking

The track layout at the west throat of World's Fair includes 5 single switches, 3 crossovers, two 2-arm high signals, and 7 dwarf signals. These switches and signals are controlled



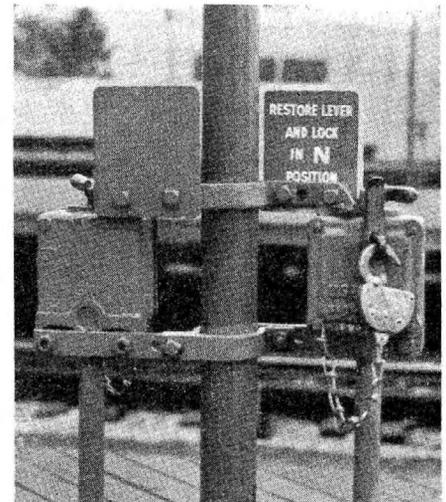
The relay rack is constructed of angle-iron and asbestos boards

and operated by an electro-pneumatic interlocking, using an interlocking machine consisting of desk-type control levers. Five levers control signals and eight levers control switches or crossovers.

The control lever units are assembled on a bed which includes mechanical locking. The levers are equipped with electric locks, and the standard arrangement of electric locking is provided. Each signal lever is equipped with a block indication lamp which is lighted when the route is clear, in other words, when the lever can be operated to clear a signal. On the illuminated track diagram, a green lamp, representing a signal, is lighted to indicate when the corresponding signal clears. On switch levers, the indication lamp is extinguished when route locking is in effect.

Instrument Racks

The relays, rectifiers and other control instruments are located in a rack along the wall of the building at the rear of the control machine. Control circuits are fed from a set of storage battery on floating charge from a



Switches located on the station platform are used to test cab signaling

copper-oxide rectifier. The track relays are of the a-c. vane type.

The switch machines are the Model A-5 with C.P. valves, and each switch is equipped with a point detector. Compressed air for operating the switch machines is furnished from a set of duplicate compressors which are operated from the 650-volt d-c. propulsion line feed. The interlocking station is of sheet metal construction on a concrete foundation which forms a basement.

The signaling and interlocking explained in this article was planned and installed by signal forces of the Long Island Railroad.