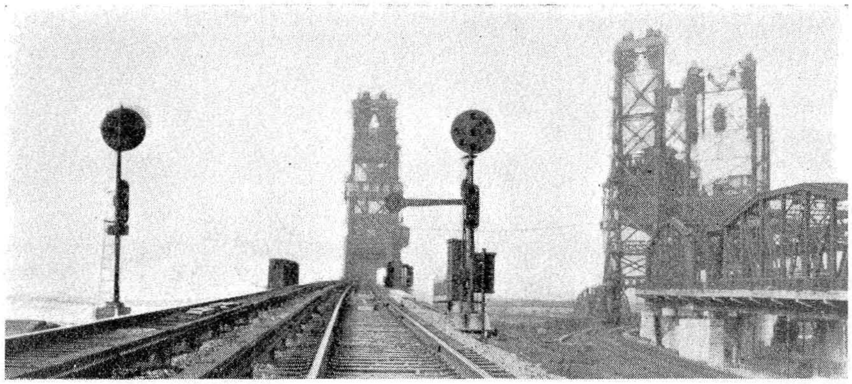
Right—Westward home signal on passenger line; freight line and highway bridges at the right

Below—View of passenger and freight bridges showing cabin and machinery house on the passenger bridge (left)



Movable Bridges and Yard Entrance Layouts Controlled from One Cabin

Installation at Newark on Pennsylvania includes rail-lock levers to interlock signals and lift spans—Smashboards and automatic train stops included—Submarine cables

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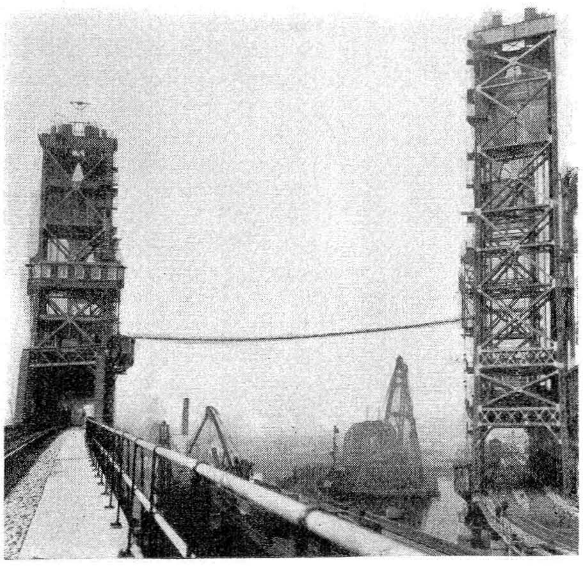
THE Pennsylvania recently installed, at the crossing of its Jersey City passenger and freight lines over the Hackensack river, two double-track movable bridges of the vertical lift type which involved unusual construction features. Both bridges, together with the separate interlocking layouts on the passenger and freight lines, are controlled from one interlocking station called "Hack." The new bridge replaces two of the swing type, the freight bridge having been in use since 1894 and the passenger bridge since 1905. The old bridges had become obsolete for use in this territory, on account of the restrictions they imposed on the use of modern equipment.



The new bridges with their approaches, as located, improve the track and channel alinement and the increased clearance of the new passenger bridge has reduced the number of openings necessary for the passage of river craft. Increased channel depth and width were effected, also. The physical characteristics of the two bridges are shown below:

	Bridge	
	Passenger	*Freight*
Length of lift span	331 ft. 6 in.	200 ft. 10 in.
Closed clearance above mean high water	40 ft.	12 ft. 6 in.
Full open clearance above mean high water	135 ft.	135 ft.

The low closed clearance of the freight bridge was governed by the prevailing elevation of Meadows yard on the west side of the river, the bridge being the connection between this yard and tracks leading to the Jersey City waterfront, as well as interchange tracks and industries in the Jersey City area. The passenger bridge carries the steam traffic to and from Jersey City station at Exchange place, and the electric trains between Park place (Newark), Manhattan transfer and Hudson terminal (downtown, New York).

Cabin Is Advantageously Located

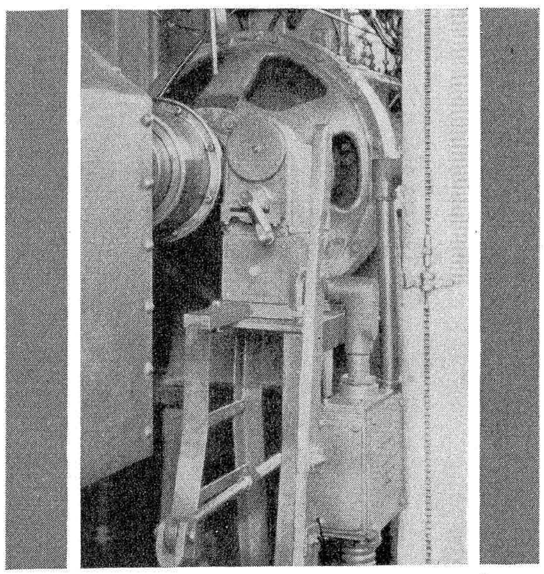
In order to give the operator the best possible view of the river traffic and rail-freight traffic, the cabin (10 ft. by 43 ft., outside dimensions) was mounted on the east side of the east tower of the passenger bridge, approximately 120 ft. above water level. The operator's table is in the end of the cabin projecting beyond the north side of the bridge, as shown in the accompanying photograph.

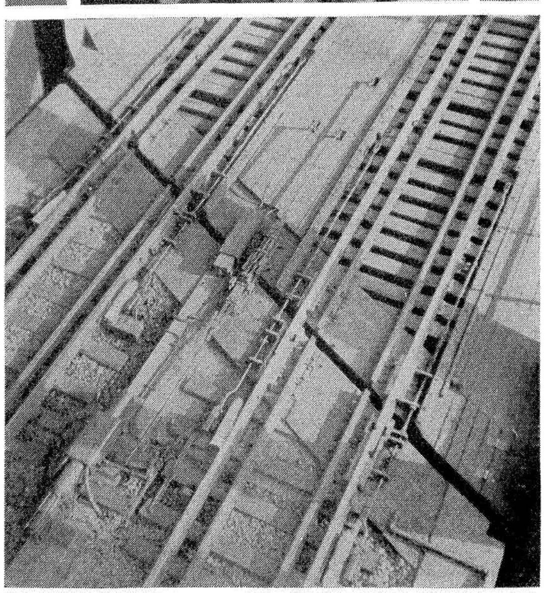
On account of the exposed location of the cabin, the walls are filled with a heat-insulating material. The floor consists of a 6-in. concrete slab on which is supported a maple floor with a 2-in. space intervening, likewise filled with heat-insulating material. Both the machinery house and the cabin are heated by a hot-water plant located in the machinery house. A toilet room is incorporated in the cabin.

A 27-lever Model 14 electro-pneumatic Union Switch & Signal Company interlocking machine was installed, with 19 working levers operating 23 signals, 9 switches, 4 smashboards, 2 train stops and 16 rail locks. The four levers controlling signals, smashboards, train stops and rail locks on the passenger track are grouped together in the low-numbered end of the machine, leaving seven spare spaces on the high-numbered end for expansion on the freight layout. Push-buttons on the interlocking machine control three emergency whistles on the track level. Time releases are partially recessed in the wall in the rear of the interlocking machine.

A layout model suspended from the ceiling above the interlocking machine is inclined, in order to make it visible from the operator's chair, as well as from in front of the interlocking machine and control desks. Indicating lights are provided on the track model for each track circuit within the interlocking plant and the approach limits, supplementing the lever and approach lights on the machine, in order to provide more definite information concerning the location of trains, particularly during the foggy weather which is so prevalent in this district. Lights are provided also to repeat the positions of each smashboard in order to detect readily any faulty operation of an individual board.

The desk for controlling the operation of the lift spans is placed in line with the interlocking machine. A power-transfer panel, included in the desk layout, is equipped with miniature bus bars and indicating lights which indicate the controlled operation of the power sources, motor-generator sets, bridge operating machinery, lighting, etc. Spring-return switches on the desk operate a coding siren on each bridge for signaling river traffic. A "Selsyn" indicator, mounted above each control desk, shows the height of each lift span at all times.





Interior of cabin

Electro-mechanical lock applied to clutch-lever in emergency house on lift span

West end of lift span on freight bridge

Three sources of electrical energy are available for the operation of the bridges: A 4,400-volt, 3-phase, 60-cycle commercial tap; 650-volts d-c. from the eastward third rail; and 650-volts d-c. from the westward third rail. Any one of three 500-hp. 350-kw. motor-generator sets delivers power at 575-volts d-c. for the operation of the lift spans. Two 260-hp. motors drive the passenger lift span and two 135-hp. motors drive the freight lift span. An emergency gasoline engine is provided on each lift span for use if the electrical operation should fail.

Signals — Smashboards — Train Stops

The signals are of the position-light type, the 17-ft. ground signal providing ample clearance and good visibility for future overhead electrification. The signals on the passenger line through this territory are spaced approximately 3,000 ft. apart and display three-block indications. As there are no switches in the passenger tracks in the limits of "Hack" interlocking, and very few lifts are made by the passenger bridge, this spacing was retained between the home and advance automatic signals to provide uniform headway in the daily operation of the 425 trains on this line, the majority of which are concentrated in the so-called "rush hours." The home signals on the passenger line are semi-automatic non-stick, and as no block record is kept, at "Hack," of train movements on this line, lever manipulation is required only for bridge operation and for infrequent rail movements against the current of traffic.

Pneumatically-operated train stops, effective for electric trains only, and working in conjunction with the smashboards, are located at the home signals on the passenger line. Side-of-pole smashboards, pneumatically operated, are used on both the passenger and freight lines. Flashing yellow-light train-order signals are located midway between the top and bottom units of home signals governing movements over the freight drawbridge.

A-C. Track Circuits

As the freight tracks through this territory are used in multiple with the passenger tracks for the propulsion return-current, 1,500-amp. impedance bonds are used between the track circuits on both lines, excepting through the interlocking limits on the freight line where a single rail in each track is used for the return current. All track circuits more than 2,000 ft. long are double-rail and center-fed by ½-kv.a. adjustable filler-type oil-cooled transformers which are connected directly to the 2,200-volt 60-cycle power line. The double-rail circuits less than 2,000 ft. in length, as well as the single-rail circuits, are fed by 300-v.a. air-cooled transformers connected to a 110-volt bus. Union Switch & Signal Company centrifugal frequency track relays are used on all track circuits.

Two track circuits on the passenger line have a third impedance bond connected across the rails of each circuit approximately 600 ft. from the feed ends. The neutral connections of these and adjacent impedance bond layouts in the opposite tracks are connected to a 2,000,000-c.m. submarine cable laid across the channel. Had these third bonds not been installed, neutral cables, extending to the home signal locations, would have been necessary, and at much greater expense. A second 2,000,000-c.m. submarine cable across the channel connects the rails on the tower spans of the freight bridge, which are used for return current. Wherever possible, the track-circuit apparatus has been selected to operate under conditions which will be imposed by the future installation of the 25-cycle overhead a-c. electrification and the installation of 100-cycle power for cab- and wayside-signal operation.

Switches and Rail Locks

The switches on the freight line are operated by Union Style A-1 switch-and-lock movements controlled by Style-CP valves, the use of the latter eliminating the necessity for quick switches on controlling levers, and, under most conditions of switch failure, permitting the restoration of the lever and the switch to the original position.

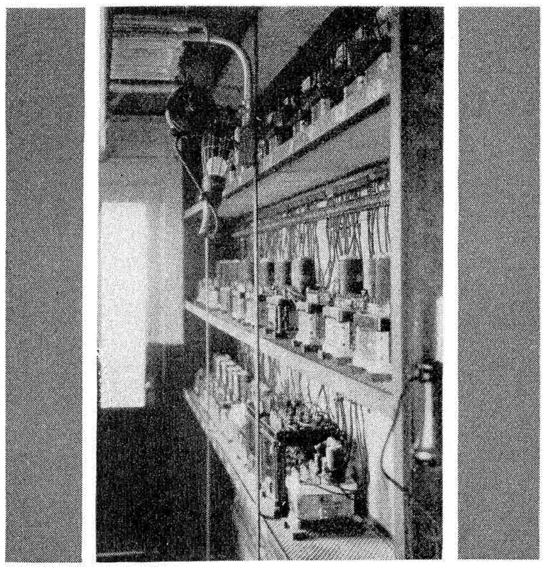
The rail locking, illustrated in the accompanying views, is operated by a Style A-1 switch-and-lock movement controlled by a Style-CP valve, located on the track level of each tower span. Each movement is pipe-connected through a mechanical coupler to a rocker shaft on the lift span, which in turn is connected to the four locking plungers (one for each rail), and to a T. Geo. Stiles Company Model-C four-way electric coupler which connects the track circuits. Each of the four locking plungers actuates a spring-return indication plunger on the tower span. The normal and reverse, or, respectively, the unlocked and locked, positions of the locking plungers are indicated to the lever over contacts on these indication plungers.

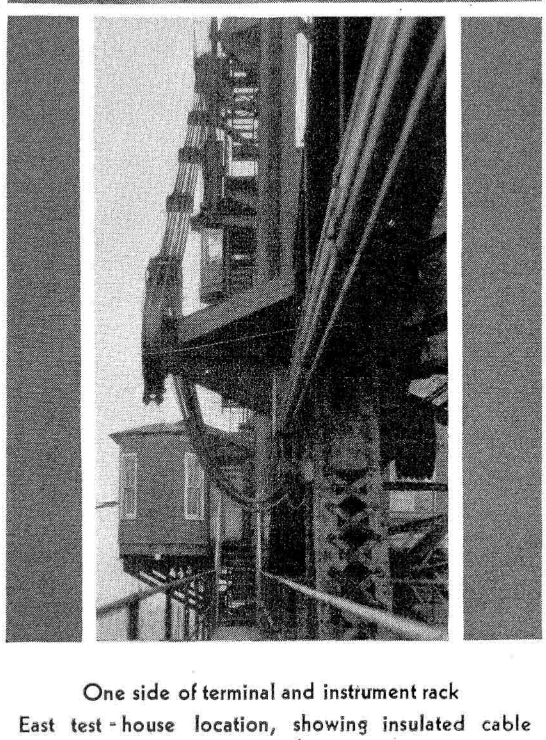
Interlocking Between Signals and Lift Spans

The lever controlling the rail-locking on each bridge is also the medium through which the interlocking features between the bridge-operating machinery and the signaling are accomplished. A relay repeating the normal position of each rail-lock lever controls the 125-volt d-c. supply to the corresponding bridge-operating control desk, which permits electrical operation of the lift span only when the lift span is unlocked and the lever is in full normal position. An electrically-locked circuit controller, applied as an electro-mechanical lock to the clutch-operating lever between the emergency gasoline engine and the lift-span driving gears, is controlled also over this normal lever-repeating relay. The open position of the contactors controlling the lift-span operating motors, and the locked position of the electrically-locked circuit controller, which locks, in the "disengaged" position, the clutch-operating lever between the emergency gasoline engine and the lift span driving gears, are checked by circuits that control locks which prevent full reversal of the rail-lock lever unless all driving energy is disconnected from the lift span.

A variety of conditions was met in the installation of the rail-locking on the two bridges.

(Continued on page 174)





One side of terminal and instrument rack

East test-house location, showing insulated cable supports

Power and signal cables on lift span

Movable Bridges on the Pennsylvania

(Continued from page 163)

The ends of the passenger lift span are square, while the ends of the freight lift span are on a 29-deg. skew. This necessitated three different designs of rail shoes. The passenger tower and the lift spans are timber decked throughout, while on the freight bridge the west tower span has a separate concrete deck for each track, with a parapet wall between tracks; the east tower span has a single concrete deck and the lift span is timber decked. In all cases the operating movements were located between tracks. On a similar bridge previously installed the valves were first mounted between tracks, but rapid wear of the pin valves resulted from vibration caused by traffic. Therefore at "Hack" the valves were mounted directly on a member of the bridge truss.

Air is distributed for all purposes in this district from a 3-in. air line connected to large steam-driven compressors at the Jersey City engine terminals. Normally, a pressure of approximately 90 lb. is carried. The main 3-in. line is run on the freight bridge to the ends of the lift span, and connected across the channel with two 3-in. submarine lines. Two-inch lines are run on the approaches to the ends of the lift span on the passenger bridge. Two-inch emergency lines are laid across both lift spans, outlets being provided for cleaning purposes at convenient intervals throughout the length of the bridges.

Power for signal operation through this district is supplied from a 2,200-volt 60-cycle underground line. Due to the relocation of tracks, a portion of the line was renewed with metal-taped cable without lead sheath. The local buses are energized at 110 volts by transformers connected to this line, with switching arranged to provide reserve sources if line or transformer failures should occur, which could be isolated by sectionalizing. Copper-oxide rectifiers provide the d-c. energy required, with storage batteries at cabin and home-signal locations only, where there is an appreciable continuous load on the d-c. bus, or where the reserve provided by a storage battery is desired during a power failure.

Two fire-proof angle-iron and asbestos-board terminal and instrument racks are located in a compartment of the machinery house, located 40 ft. below the cabin. Single wires are used in the cabin between a metal terminal case and the interlocking machine, time releases, model board, etc. A 3 in. by 12 in. duct was cast in the under side of the 6-in. concrete floor of the cabin between the terminal case and the interlocking machine, and wires pass through the floor to the spring combination through a series of short lengths of 3½-in. Bermico duct. These ducts extend one inch above the maple flooring to prevent damage to wiring by any liquids which may be used on the floor. Two-inch fiber duct, embedded in the floor, carries the wires to the approach lights. Train-order-signal control switches and push-buttons, which control the signal lights in the lift spans, are all located conveniently above the operator's table. Metal conduit above the ceiling carries the wires to the model board and time releases. All buildings are of fireproof construction and the ends of all ducts and wire-ways, and floor slots in the buildings are sealed with asbestos cement to minimize the fire hazard.

From the terminal case in the cabin to the terminal rack in the machinery house, and from the terminal rack to the concrete test house on the east shore, circuits are carried in aerial bronze-taped cables, supported on bronze messengers which are anchored to and supported by insulating brackets attached to the bridge structure. Bronze was used on account of the corrosive effect of the atmosphere in this vicinity due to the presence of salt water in the river, the salt marshes of the Meadows and exhaust from steam locomotives.

The metal sheaths of the cables are entirely insulated from the bridge structure to avoid possible damage to or interference with signal and communication circuits that might result from stray currents existing in this territory by reason of the extensive use of d-c. power for propulsion. The advent of overhead a-c. electrification will create a further hazard because of the possibility of inductive interference and the falling of high-voltage wires.

The signal circuits to the lift-span houses are carried in 12-conductor No. 12 A.W.G. cables, supported with the control cables. Each wire in the signal cable consists of 37 strands and the cable is covered overall with a copper braid, resulting in combined mechanical strength and flexibility.

A 6 ft. by 8 ft. concrete test house, mounted above a large man-hole, is located on each shore. Separate telephone- and signal-terminal frames are mounted in these houses, to which frames are connected the submarine and duct-line cables, cables to the instrument rack in the machinery house, and parkway cables to locations on the tracks and to the ground level at each end of the bridge. Sliding panels of asbestos board cover the signal frames to prevent terminals being crossed by metal tools or other objects exposed on the clothing of employees working on the telephone frame.

The following submarine cables carry all telephone and signal circuits across the river: Four 37-conductor No. 14 A.W.G. stranded wire cables for the signal conduits; one 2-conductor No. 4 A.W.G. stranded wire cable for the 2,200-volt power; three 66-pair cables consisting of 3 quads No. 10 A.W.G. and 30 quads No. 13 A.W.G. for telephone circuits, and one single-conductor No. 4/0 A. W. G. stranded cable for the electrolysis bond.

Telephone Equipment

Fourteen telephone circuits are connected to a table unit mounted on the operator's table. These circuits include the passenger and freight line dispatchers; the Movement Bureau; a P.B.X. connection to the Jersey City exchange; block, yard and signal location lines; and a separate line for each bridge, to which lines are connected 'phones in the machinery house, lift span house and 'phones at each end of the lift spans. A loudspeaker is provided with the operator's desk set.

The passenger bridge was placed in service Sunday, November 2, 1930. The change required approximately three hours, involving the re-arrangement of tracks, third rails and signal circuits. One track was changed at a time, leaving the other available for traffic in both directions. The freight bridge was placed in service Monday, November 3, 1930, and the change required approximately three hours, which was consumed principally in shifting and re-arranging tracks at the west end of the bridge where a complete change of the switch layout was made on the ground occupied by the old tracks.

The average daily number of trains over the passenger bridge is 425, and over the freight bridge 98. This number for the freight bridge does not include the shifting movements made at the west end of the bridge. All traffic is handled with a daily average of only 770 lever movements.

A week's record indicates a daily average of 26 boats passing, requiring 22 lifts on the freight bridge and 2 on the passenger bridge, the difference in number of lifts made by the 2 bridges being due to the different closed clearances of 12.5 ft. and 40 ft. above mean high water.