



Pedestal type signals display a complete range of aspects

interlocking switches are operated by high-speed electro-pneumatic machines

Pennsylvania Railroad Installs

Large Modern Interlocking

At Passenger Station in Philadelphia

Panel-type control machine uses thumb-type turn-andpush "levers." Turn of signal lever completes route check network, and lights "exit" lamp on track diagram, and the lever is pushed to clear the signal

IN PHILADELPHIA, a large interlocking, employing new practices and the most modern appliances, has been installed at the Pennsylvania Station, Thirtieth Street, which replaces interlocking facilities at the old Broad Street Station. The station at Thirtieth Street was built a number of years ago, at which time only two through tracks were installed, and later modified to include four station tracks, to handle approximately 77 through passenger trains operating on the north-andsouth route between New York and Washington. During this time, approximately 135 passenger trains daily, which originate and terminate at Philadelphia, have been handled in the old Broad Street Station in the main business district, about 0.9 mile east of Thirtieth Street. During this period, the city of Philadelphia has the tracks converge to a doublebeen extending the subway system track mainline south, connecting at

westward, with a subway station at Pennsylvania station, Thirtieth Street. This subway system will provide transportation for passengers to and from various parts of the city.

Ten Tracks in New Station

In preparation for handling, not only 77 north-and-south through trains, but also the greater portion of the trains, other than MU trains, originating and terminating at Philadelphia, the track layout at Pennsylvania Station was expanded to pro-vide a total of 10 through tracks, served by five car-floor-level platforms. The tracks are at ground level, and the station is overhead, with moving stairways extending up from the platforms. These platforms are 1,330 ft. long.

From the south end of the station,

Arsenal interlocking with the four-track line toward Baltimore and Washington. Northward from the station, the tracks converge to two double-track routes, connecting at Zoo interlocking to four-track lines, one east to New York, and the other west to Harrisburg.

New All-Relay Interlocking

The plan herewith shows the track layout and signals of the entire new interlocking at Pennsylvania Station. The interlocking machine is on the fourth floor of the station building, at a location where the leverman has no view of the tracks. The panel of the control machine is 5 ft. 4 in. high and 10 ft. long. The track diagram includes blue trafficdirection lights, amber lamps which are lighted to repeat track occupancy, white exit lights, and red lights to indicate trolley sectionalizing. On the track diagram, each signal is represented by a green lamp which is lighted when the corresponding signal has been cleared to display any proceed aspect.

The levers on this panel are the so-called thumb-button type. The

RAILWAY SIGNALING and COMMUNICATIONS

Digitized by Google

switch levers are painted black, the signal levers red, and the check levers are blue. The switch levers are in a row under the track diagram. A group of three-indication lights is located above each switch lever. An amber lamp, above the normal position of the switch lever, is lighted when the switch is locked in the normal position. A green lamp, above the reverse position, is lighted when the corresponding switch is locked in the reverse position. In the route network circuit to energize a center, above each switch lever, relay that causes a white indication

ward signal. A red indication lamp is located over each signal lever to indicate that the signal is in the stop position.

Exit Lamp Shows Route Set Up

When setting up a route, the leverman operates the switch levers to position the switches for the track line-up required. He then moves the signal lever (to left or right), which closes a contact that completes a signal which is indicated by a green light on the track diagram.

The white exit light is extinguished when the train accepts and passes the signal leading to the route. Then the leverman turns the signal lever back to its normal position. Sectional-route-release locking is in effect, so that the lock lights above switch levers, are extinguished as the rear of the train clears respective release sections. However, none of these lock lights is extinguished until the signal lever is placed normal.



When signal lever is pushed an "exit" lamp is lighted on the diagram, then the lever is turned to clear the signal

there is a red lamp which is lighted when electric locking is in effect to prevent operation of the switch, even if the lever is thrown. There are 42 switch levers to control 45 switches, 19 slip switches, 10 movable-point frogs and 3 derails. These switches, slips, movable-point frogs and derails are operated by a total of 77 electro-pneumatic switch machines.

The signal levers are in a row below the switch levers. Thirty-one signal levers control 64 home signals. Each signal lever stands normally on center, being thrown to the right 45 deg. to clear a northward signal, or to the left 45 deg. to clear a south-

lamp to be lighted in the track line, on the diagram, at the location where the train will leave the interlocking limits. By looking at the diagram to see this "exit" lamp lighted, the leverman thus has a quick check to know that he has lined up the switches properly for the route required. He then pushes the signal lever. This action closes a circuit to to pick up a lever-repeater relay. This opens the stick-locking relay and places the route locking in effect, which is indicated by lighting a red indication lamp over the center position of each of the levers for the switches so locked, and clears the

When it is desirable to move a train into a section of track occupied by a preceding train, the leverman operates the signal lever in the usual manner. Where a dwarf signal is involved, the restricting indication will be displayed if the first track section beyond the signal is unoccupied. If the first section beyond dwarf signal is occupied or where pedestal signals are involved, the leverman must also push a springreturn pushbutton, located below the signal lever. This causes a stop-andproceed indication to be displayed on the pedestal signal, and a restricting indication to be displayed on a



Track and signal diagram of the new interlocking installed by the

Digitized by Google

MAY, 1952

RAILWAY SIGNALING and COMMUNICATIONS



The relays for the "tower" are the plug-in type mounted in racks made of angle Iron

Rear of relay rack showing terminal power switch down showing rear of relay receptacles

pushbutton is operated, the leverman must return the signal to stop while the train occupies the first track section beyond the signal. Otherwise time locking becomes effective.

Traffic Direction

On some of the routes, the tracks have been laid out so that trains can approach at a fairly good speed, with adequate distance to reduce speed and stop after the locomotive enters the station. Complete track circuit protection is provided through the

controls are provided. For each of the ten station tracks, there is a check lever. These levers are in a group near the center of the panel below the track diagram. The normal position of these levers corresponds to the assigned direction of traffic for the track involved, that is, to the left for southward tracks and to the right for northward tracks. When lining a southward route on track No. 3, for example, the check lever for No. 3 track is thrown to the left. A blue light is lighted in the south arrow on the line representing track

dwarf signal. When this call-on station tracks, and traffic-direction No. 3 on the track diagram, and circuits are established to permit the clearing of a southward signal leading to track No. 3, but not a north-ward signal leading to this track. Having cleared the southward home signal, and after a southward train has entered No. 3 station track and has stopped at the platform, there could be an instance in which a switching move would have to come in from the south end. In order to clear the northward signal for a switch engine to enter the occupied station track, the check lever for that track would be moved to center posi-



Pennsylvania Railroad at 30th Street Station in Philadelphia, Pa.

tion, and after an automatic time relay-set at three minutes-completes its operation, (having started operating when train entered sta-tion track) movement can be made northward by operating the proper signal lever. The best aspect, under these circumstances, is Restricting.

Three Circuit Networks

This all-relay interlocking includes three basic circuit networks: (1) The lever-agreement network, in the



"tower," checks through contacts on levers or lever-repeater relays to determine that the levers of all switches and opposing or conflicting signals are in the proper position; (2) The route check network, also in the "tower," checks to determine that the switches involved are actually in the position required and that opposing signals are in Stop position; and (3) The signal network insures that switches in the route are locked and that stick locking relay releaseschecks track occupancy and is controlled through contacts of switchrepeater relays to select the signal for the route being established.

Track Circuits

All tracks in this interlocking are equipped for electric propulsion, using 11,000 volts, 25 cycle on overhead trolley, with double-rail return on tracks arranged for cab signaling, and single-rail return on all other tracks. Track circuits are operated at 100 cycles a.c., using centrifugal frequency track relays on the doublerail circuits, and single-element, The interior of a sheet-metal case with track relays, code transmitters, and transformers

provide additional protection against momentary loss of shunt. Superimposed on these track circuits is code current which inductively controls cab signaling apparatus on the locomotives. This cab signal code current is in service on the main approach tracks and on track No. 3, No. 4, No. 5 and No. 6 through the station platforms. This coded cab signal energy is not normally fed on the rails. However, when a route is lined up, this coded cab signal energy feeds from the exit end to the entrance end of each track circuit, immediately, when the front wheels of the loco-

single-rail circuits. For each track re-

lay, there is a repeater relay located

in the relay room on the fifth floor of

neutral relays; 800-ohm relays are

used for sections not involving

power-operated switches, and 2,000-

ohm relays for sections where power

switches are involved. The 2,000ohm relays have a retarded pick-up

of about 0.85 seconds at 12 volts, and

the

Plug coupled re-

lays are used in

and home signals

sheet-metal cases at switches

These repeater relays are biased

the station.

vane-frequency track relays on the motive enter each track circuit.

Code at 75 impulses per minute controls the Approach aspect, code at 120 impulses controls the Approach-Medium aspect, and code at 180 impulses controls the Clear aspect, in the cab of a locomotive. No code or steady energy causes the Restricting aspect of the cab signal. When an interlocking signal is displaying the Stop aspect, no code exists in the track circuit for a distance of approximately 1,000 ft. immediately in approach to that signal. This results in the cab signal changing from approach to restricting, about 1,000 ft. in approach of a Stop signal.

Two-Arm Pedestal Signals

All the signals on this interlocking are the position-light type. Many of the home signals are of the pedestal type, the upper lamp unit of these signals being about 7 ft. above the base of the rail. These pedestal sig-



nals have two "arms," and, therefore, display a complete range of aspects, the same as a high signal. The back-ground on these pedestal signals is only 16 in. wide, and the overall height is 4 ft.; therefore such a signal can be located, with adequate clearance, between tracks spaced on 15-ft. centers. An advantage is that such a signal can be located exactly where required to be most effective, and to utilize track length efficiently.

The interlocking machine is on the fourth floor of the station building and the relay room is on the fifth floor directly above the machine.

Digitized by Google

MAY, 1952

RAILWAY SIGNALING and COMMUNICATIONS



Panel on station platform for controlling train starting indicator

Twenty-two 61-conductor cables run from the machine to the relay room. A terminal board, built in the relay room, has terminals arranged to correspond with the arrangement of the terminals at the rear of the machine, an exception being that there is much more space between terminal blocks on the board in the relay room. Because of limited space on the board at rear of machine, and be-cause of sharp turns and limited space in ducts; special cable, with No. 16 flexible wire and 3/4-in. insulation, was used for the circuits between the machine and the board in the relay room. Solderless connectors are used in terminating this cable.

The relays in this relay room are the plug-in type, mounted on angleiron racks. Jumper wires, soldered to the fixed plug-in receptacle contacts, extend down to terminal boards on each rack. From these terminals to

other similar terminals, the wire is No. 14 solid with $\frac{5}{44}$ -in insulation. Approximately 210,000 ft. of wire was used in this relay room. This wire runs in troughs, made of $\frac{3}{4}$ -in. asbestos boards, supported on frameworks made of $\frac{3}{6}$ -in. by 1½ by 1½ angle-iron, bolted together.

From the relay room the cables (going outdoors) extend down a vertical concrete duct for approximately 194 ft. to basement level below ground line. These cables, 61 and 91 conductor, are No. 14 solid insulated wire. In this vertical duct, each cable is tied by marline ties to a %-in. stranded galvanized steel messenger, which at the top is attached to heavy angle-iron cross beams. From cable vaults in the basement the principal cables extend in underground concrete ducts to manholes and instrument housings. From there, buried cables extend to switch machines and signals. The gage of wire in these cables, for control circuits, is practically all No. 14.

Train Starting System

As part of the interlocking project, a train-starting signal system was installed to save time by coordinated action of all persons concerned when trains are ready to depart. On several of the posts along the platforms, there is a panel having a lamp and several pushbuttons. Over each track, near the north and south end of the platform, there is a special indicator which has two 3%-in. lenses, one yellow and the other green, visible in either direction.

About 15 seconds before the time that a train is due to depart, a station attendant presses a button in the stairhead in the concourse, illuminating an amber light on the platform panel. On receipt of this amber



Left—the front, and right—the rear of the terminal board in relay room



A train starting indicator is mounted over each track

light, and after observing that passengers in his vicinity have boarded the train, the flagman then goes to the nearest post and pushes the "flagman" button. This lights the yellow lamp in the indicators, above the track. The conductor observes the indicator, then checks to see that passengers are loaded on the re-mainder of the train, and that mail and baggage are all loaded; after which he goes to the nearest post and pushes the "Conductor" button, which lights the green light in the indicator over the track, so that both the green and yellow lamps are lighted, indicating to the train crew that the train is ready to depart. With the yellow and green indicator lights, and the amber light on the panel, illuminated, the conductor pushes button marked "Penn" Tower causing a light to be displayed in an indicator on the interlocking machine. If the signal for the train has not already been cleared, this "train starting" indicator is a reminder to the towerman to clear the signal.

Fire Alarm System

An automatic fire alarm system is in service in the relay room of this interlocking. A small metal tube, about the size of No. 8 wire, is supported by a tight wire extending the length of the room above the relay racks. These tubes are spaced 8 to 10 ft. apart. The tubes contain gas under pressure. If a flame warms the tube, the gas expands and operates a pneumatic relay, thus sounding an alarm.

This interlocking was planned and installed by signal forces of the Pennsylvania Railroad.

MAY, 1952

Digitized by Google

315