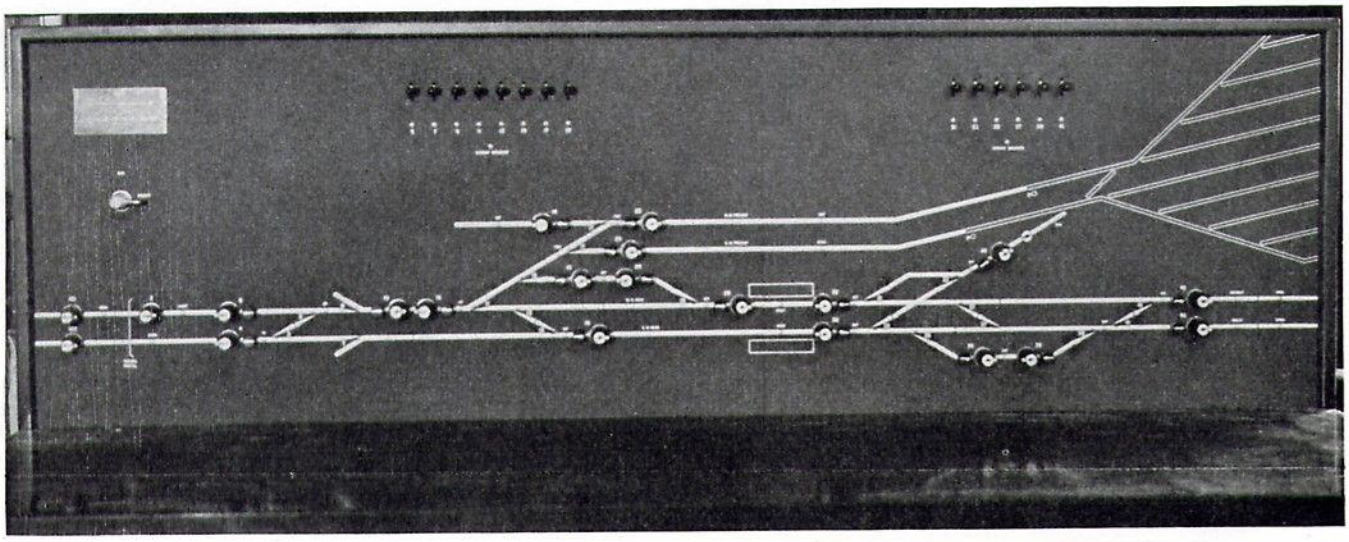


The New NX Interlocking Control Machine Is Located in the Operator's Office in the Windsor Station.

Michigan Central Installs New Interlockings at Windsor, Ont.

Modern entrance-exit and miniature-lever all-relay control systems replace lever-control machines with mechanical locking

THE Michigan Central has extensive track facilities at the east end of the double-track tunnels under the Detroit river at Windsor, Ont., including three main-line crossovers, turnouts leading from the double-track main line to the freight yards, a junction with the Canadian Pacific and special sidings to facilitate changing from steam to electric locomotives. The switches and signals in these track layouts have been controlled from two lever-type interlocking machines. In a new arrangement that was placed in service recently, one new NX entrance-exit type interlocking machine controls the switches and signals on the main line throughout Windsor, while the switches and signals at the east end of the electric freight yard are controlled remotely by a miniature-lever machine, located in an existing interlocking tower at the opposite end of that yard.

The Michigan Central operates 25 passenger trains and approximately 43 freight trains daily through Windsor, in addition to 6 passenger trains of the Canadian Pacific which move daily over the Michigan Central between Windsor and Detroit. The Canadian Pacific line from Toronto, Ont., enters the northeast portion of the Windsor layout and connects with the tracks along the north side of the west end of the Electric Yard. When using the main line tracks for station stops at Windsor, these Canadian Pacific passenger trains are routed over the lead between the yard and the main line east of signals 30 and 32. When the main tracks at the station are occupied, the Canadian Pacific trains use either of the two freight trains north of the north platform, and in such instances these trains move to and from the main line through the turnouts and crossovers west of the platform.

In order to permit a track gang to work on one track or the other inside the tunnels, the track layout and the signaling at Windsor were designed to permit trains to be operated in either direction on either track through the tunnels, traffic locking being provided for the control of the signals, as will be explained later.

Operating Problems

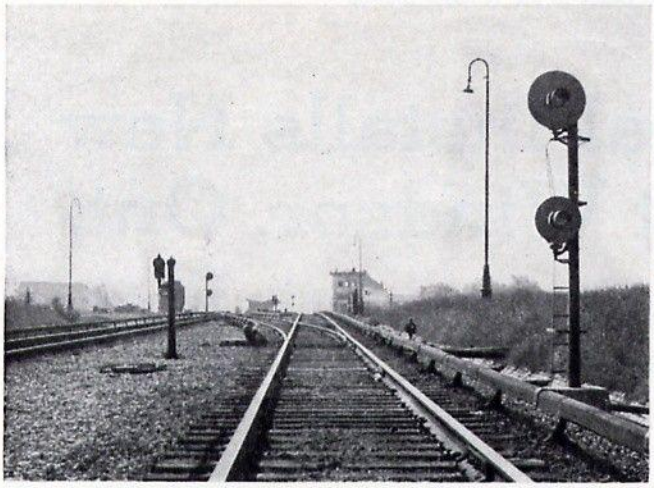
Another important phase of the operations at Windsor is the necessity for changing locomotives. Electric locomotives are used for the 2.7 miles through the tunnels between Windsor and Detroit, and steam locomotives beyond those limits. The locomotives for passenger trains are changed while the trains are standing at the station platform. The siding and switches west of the platforms are used for changing locomotives on westbound trains, and the special locomotive siding east of signal 30 is used when changing locomotives on eastward trains. Numerous extra lineups of the interlocking are required to get the locomotives on and off these sidings, and off and on the passenger trains.

Eastbound freight trains are pulled from Detroit by electric locomotives, and then routed over crossover No. 5 and turnout switch 11 to the freight track and thence into the Electric Yard. From this yard, steam locomotives pull the trains through Tower 3 interlocking to the freight classification yard or onto the main line eastward. Likewise, westbound freight trains are pulled into the Electric Yard by steam locomotives, and electric locomotives then pull the trains through Windsor and to Detroit. An additional complication in the operations is the necessity for all passenger trains to stop at Windsor while customs and immigration inspections are made. The duration of these inspections cannot be de-

termined in advance, and if the delay is too long, other trains may have to be run around. Therefore, cross-over arrangements are provided to permit such moves.

Previous Interlockings

At the time the tunnels were completed in 1907, two General Railway Signal Company lever-control electric interlockings were installed at Windsor to handle the switches and signals. Tower 1, which handled the area from the east end of the tunnel to Windsor station, had 33 working levers to control 5 switches, 5 crossovers, 1 derail, 20 signals and 2 check lock levers. Starting near the west end of the Windsor layout, the tracks descend toward the tunnels on a 1.5 per cent grade. To protect against the possibility that a car might get away and drift back toward the tunnels, a Wharton type derail was installed on the eastward track just east of the eastward home signal. To provide derail protection for



View Looking East With Signal 4 at the Right and Signal 6 at the Left.

the westward track a switch, which was removed during recent track changes, was set normally for the turnout.

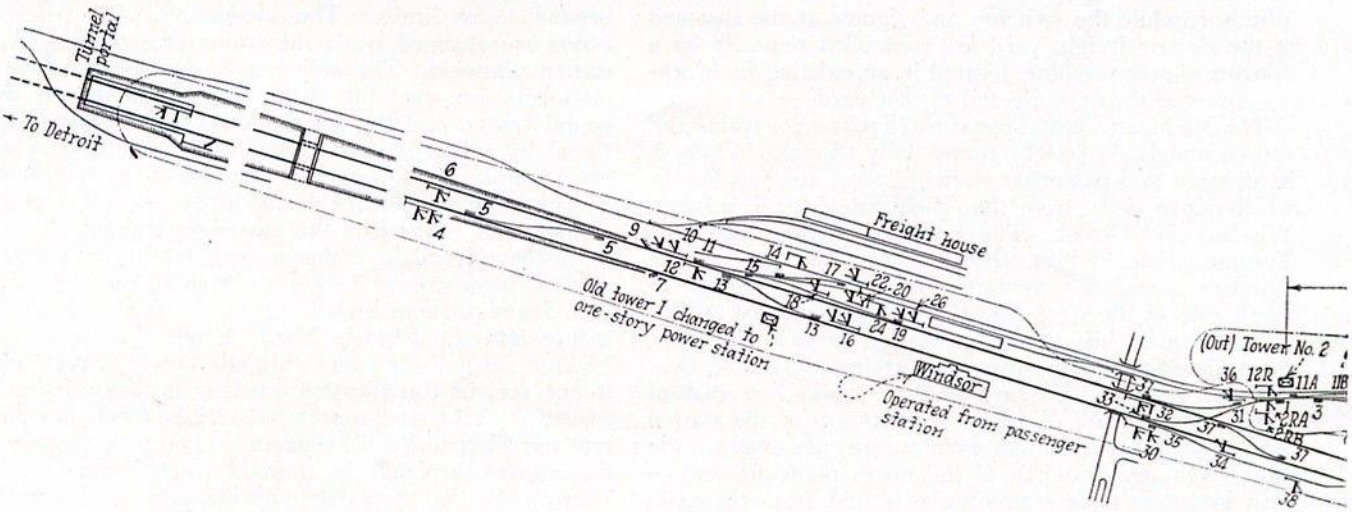
Tower 2, which controlled the area east of the station, including the leads to the yard, had 38 working levers to control 14 switches, 2 crossovers and 22 signals. A mechanical interlocking, Tower 3, was installed at the east end of the Electric Yard to control the switches and signals at that layout.

In August, 1939, the 600-volt d-c. traction circuit was accidentally connected to some of the interlocking circuits, and the control machine, wiring and accessory apparatus in Tower 1 were so seriously damaged that the plant was out of service. As a temporary measure, hand-throw switch stands were installed to operate the switches, and the signals for directing routes were controlled by circuits properly selected through switch circuit controllers, signal-repeater relays and a set of knife-switch levers mounted on a panel in the switch-tender's house. Not only because of the damage done by the fire at interlocking Tower 1, but also due to the fact that the old plants needed extensive replacements, a decision was made to reconstruct the interlockings throughout Windsor, and also to provide more modern types of control machines.

An Analysis of Operations

An analysis of the operations showed that the handling of trains through the passenger station area, including the changing of locomotives on passenger trains, as well as the routing of freight trains off or onto the main line, all fell in one operating category, and, therefore, might better be controlled by one man, rather than in part by each of two men. On the other hand, the routing of freight trains into and out of the west end of the Electric Yard had to be co-ordinated with the operation of the east end of this yard which was handled by interlocking Tower 3. The logical solution, therefore, was to provide an entirely different arrangement of interlocking control limits, and to use modern interlocking control machines and systems of circuits.

A new NX interlocking machine in the office of the station at Windsor now controls the switches, derails and signals formerly included in the Tower 1 interlocking, and also the main line crossovers, locomotive interchange track switches, and turnouts leading to the Electric Yard, which were formerly included in Tower 2 interlocking. The remaining switches and signals at the west end of the Electric Yard, which were formerly in Tower 2 interlocking, are now controlled from a miniature-lever interlocking machine in Tower 3 at the east end of the Electric Yard. The upper story of the



Track and Signal Plan of the Entire

old Tower 1 was removed, and the lower story was rehabilitated as a one-story building for housing switching apparatus for the electric traction system. The old Tower 2 was removed.

When changing over to the new interlockings, several minor changes were made in the track layout, the accompanying plan showing the layout now in service. As a part of the improvements, the Wharton type derail on the eastward track was replaced with a Hayes-type derail, and a similar derail was installed on the westward track. The two new derails are operated by switch machines as a part of the interlocking.

New Signals Installed

The old interlocking signals of the semaphore type were replaced with searchlight type signals with quick-detachable plug-in type connections. As the masts for the old high signals were badly rusted where they were clamped in cast-iron bases, the deteriorated sections were cut off, and the masts were set down in concrete foundations which were poured in place. Thus, the new high signals are on masts much lower than the old ones, but are now at the proper height to be approximately in line with an engineman in the cab of a locomotive. At locations where adequate clearance was available, the dwarf signals were mounted on masts high enough to bring the center of the lens 6 ft. above the level of the top of the rail.

Signaling Arrangements

The signaling arrangement for the new plant was designed with two purposes in mind; (a) to provide for all the special train movements and the changing of locomotives, as well as for run-around moves; and (b) when a high "arm" aspect could not be given, to provide other proceed aspects which would authorize train movements at the highest possible speeds consistent with safety in consideration of the occupancy of track sections ahead. In other words, it is not required that a train move at caution-slow-speed through an extended distance when conditions are safe for medium speed or better.

Whereas some of the high home signals on the old plants had three arms, the maximum on the new signals is two "arms." Each high home signal for right-hand running, such as signals 4, 26, 30 and 42, has two operative "arms," the top "arm" governing through moves on straight track while the lower "arm" governs diverging moves. The lower "arms" operate to three aspects so that a green aspect can be displayed if the two "blocks" ahead are unoccupied, thus giving enginemen additional information as compared with a two-aspect "arm." These lower arms can also be used to display a "call-on" aspect, which in all instances is yellow-under-red. This aspect is also displayed when signals govern into non-track-circuited territory.

Three-position signals are used for the backup dwarfs,

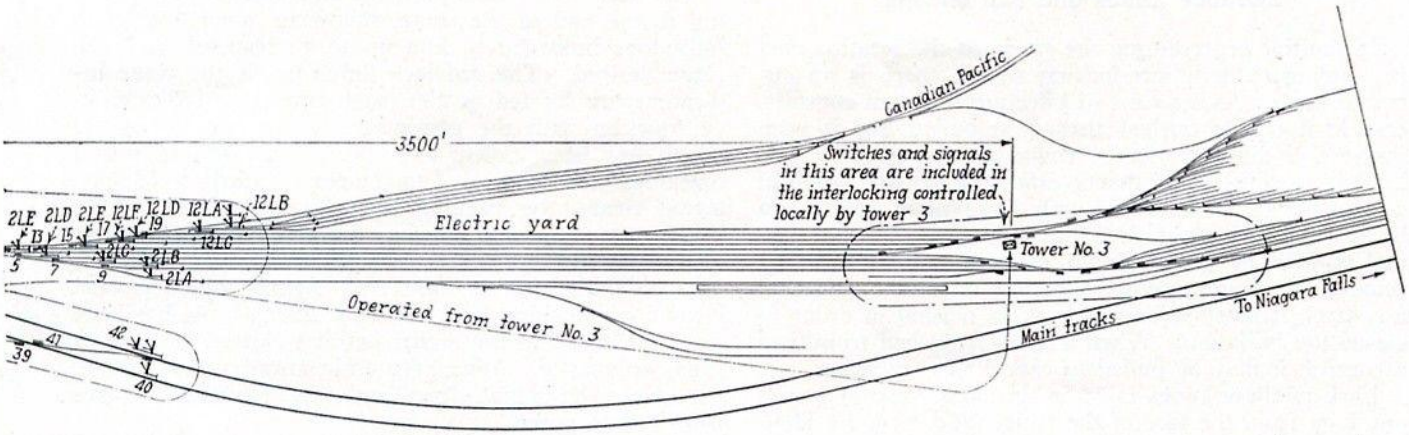
Model-4 Electric Switch Machine After Being Rebuilt.

such as signals 6 and 12, which govern reverse running moves on a route over a crossover to the other main track for right-hand running into automatic block territory beyond the plant. The use of the green aspect on such a signal permits trains to pick up speed and get under way, rather than operating at slow speed for longer distances. The same statement regarding the use of three aspects applies to signal 36, governing movements from the yard to the main line, and also to dwarf signal 22, which governs movements from the westward freight train which also is used frequently by Canadian Pacific passenger trains when making the station stop.

Signal 32, which governs reverse running moves from the normal westward main track into the yard or over the crossover to the eastward main track, has a fixed top "arm" and a three-position lower "arm." Dwarfs displaying only two aspects, red or yellow, are used to govern short routes confined to interlocking limits or up to other interlocking signals, such as leading out of a locomotive parking siding or out of a yard track.

The New Windsor Control Machine

The new NX control machine in the Windsor station has 19 entrance knobs and 19 exit buttons to control 6



Interlocking Layout at Windsor

single switches, 6 crossovers, 2 tunnel protection derails and 19 signals. The panel of the control machine is 18 in. high and 60 in. long. For the area within home signal limits and the approach sections on the main lines, each track is represented on the diagram by white lines 3/16 in. wide, which stand out in contrast with the dull black finish of the panel. Small lamps mounted in the lines representing the track are normally extinguished, but are lighted to show white when each corresponding track circuit is occupied by a train, thus outlining the route being used.

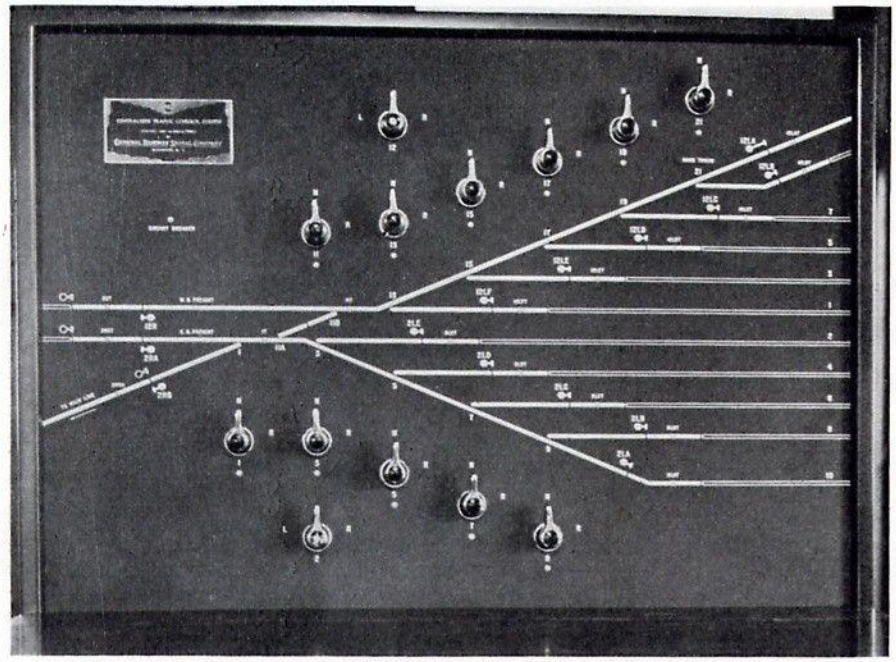
The switches and crossovers are represented by small, movable sections of the track which are called route indicators. The movable sections are operated by magnets mounted behind the control panel, and are actuated to positions which outline the route as soon as the towerman pushes the exit button. An indication whether each switch is locked is given by a small lamp with a red lens, mounted behind the track lines adjacent to each route indicator. Each such lamp is lighted to show red when electric locking, including the equivalent of mechanical locking, has taken effect at the corresponding switch, and the switch is, therefore, not free to move. Thus these lamps are known as "lock lights."

Entrance Knobs and Exit Buttons

In the line representing the track, at the location corresponding to each interlocking signal, there is an entrance knob. As a means of effecting different controls, each knob can be pushed, turned, or pulled, and in each instance a different set of contacts is operated. The knob is so constructed that it cannot be pressed while in a turned position; therefore, only one type of control can be initiated. When pushed, the knob returns to the normal position by spring action, as soon as the towerman removes his finger. When the knob is turned to initiate a control, it must be turned back to normal in order to cancel the initiation. When a knob is pushed to initiate a control, it may be pulled to cancel that initiation.

Each of these knobs is 3/4 in. in diameter, and stands out 1 in. from the face of the panel. To facilitate identification, the number of the signal is etched in white, adjacent to each knob. The knob is hollow and surrounds a separately-supported round disk of Lucite, which fits in the face of the knob. A white glass arrow in the face of the knob points in the direction in which the corresponding signal controls, and maintains this position. A small round white marker, on the outer rim of the knob, indicates the position of the knob, this marker normally being in line with the track and at the base of the arrow in the face of the knob.

An exit button is mounted in the line representing the track at each point where a train leaves the section of track over which a signal governs. Each exit button is 9/16 in. in diameter, and normally stands out from the panel 5/16 in. A white arrow on the face of each exit button points in the direction a train is going when leaving the end of a route controlled by that button.



The Lever Type Interlocking Machine for Controlling the Switches and Signals at the West End of the Electric Yard.

These exit buttons are operated by pushing, and do not turn; they return to normal position by spring action as soon as the towerman removes his finger.

In normal operation, when a route is to be lined up, the towerman pushes the entrance knob corresponding with the signal for the track on which the train is to enter the plant. This action causes a red light to flash behind the arrow in the face of the knob, as an indication that the lining up of a route has been initiated.

The next action is to push the exit button corresponding to the end of the route, following which the route indicators immediately line up to correspond with the route desired. The red lock lights under the route indicators are lighted at the same time and indicate, in conjunction with the continuous white line, the route which has been called for. After the various switch machines have responded to the route called for and the signal clears, the flashing light in the entrance knob changes to a steady burning green or red indication. The green indication shows that the signal has cleared. The red indication is used with signals which govern beyond interlocking limits to show that a route has been lined up, but that the signal has not cleared because of track occupancy. When the train ahead moves out of the block, the signal clears and the indication changes from red to green.

If the towerman initiates a movement by pushing or

turning the entrance knob and the route desired is not available, the pushing of the exit button has no effect, and the lamp in the entrance knob continues to flash. In this case the operator may cancel the initiated condition as described above, or may wait for the route desired to be available and again press the exit button. The non-availability of a route is indicated to the operator by following the desired route across the panel and noting whether the red lock light is lighted under any of the route indicators which must be operated in order to secure the desired route. As the train travels over the route, the signals go to Stop and remains at Stop until the towerman again sets up the route (stick signal). This is known as "automatic route restoration."

When lining up a route including several intermediate signals, the push operation of the entrance knob and the exit button at the end of the complete route causes the switches to operate and all of the several intermediate signals, as well as the one at the entrance, to clear. This control feature is known as end-to-end control, and eliminates the necessity of operating entrance knobs and exit buttons for each of the intermediate sections.

When a "closing-in" move is to be made, as, for example, to move a locomotive back onto a train that is standing within the interlocking limits, a "call-on" signal aspect, consisting of red-over-yellow, is used on a two-arm signal; or a single yellow may be displayed on a dwarf signal. In order to prevent the operator from inadvertently allowing such a move, he is required to use a distinctive type of manipulation by which he *rotates* the entrance knob so that the white dot or marker on the knob turns downward through 90 deg. He then presses the exit button as before.

A flashing red indication is displayed in the entrance knob until the route is lined up. When the signal clears, the indication changes to a flashing green. In this case the signal will not go back to stop when the train accepts it. The flashing green serves to remind the operator that he must rotate the entrance knob back to normal as soon as the train has passed the signal.

Special Control of Derails and Traffic Locking

The two derails, 7 and 9, on the two main tracks are set normally to derail cars so they cannot drift down into the tunnels. When establishing a route including one of these derails, the derail is controlled to clear the track the same as a switch is controlled in the NX system. After a train uses a route and passes beyond the home signal limits, the switches remain as they were until another route is established. However, to return the derails to the derailing position to provide the protection for which they were installed, the controls are so arranged that when the rear of a train clears the track circuit including a derail, that derail automatically returns to the derailing position without any action on the part of the operator.

The two knobs at the left, on the lines representing the tracks through the tunnels, are for the control of traffic-direction locking for the control of signals to direct train movements by signal indication in either direction on each track between the Windsor interlocking and the 15th Street interlocking in Detroit. Normally the traffic-direction locking is set up for right-hand running, but if no train is within the traffic-locking section or approaching it, the direction of traffic may be reversed on either track by co-operative action on the part of the operators at the two ends of the tunnels.

The 14 signals, 10 single switches and 1 crossover at the west end of the Electric Yard are controlled by a miniature-lever interlocking machine on the operator's desk in Tower 3, which is located about 2,800 ft. east of this track layout. The face of the panel is 18 in. high and 26 in. wide. The main track sections are represented by white lines ⅛ in. wide in the panel. Each section has a translucent round spot which is illuminated when the corresponding track circuit is occupied. Cars are left standing on the yard tracks for extended periods, and, therefore, track-occupancy indications would be of no use. In order that the operator may know when a train is ready to pull out of a yard track, a track circuit 100 ft. long was installed in the approach to each signal governing a move out of a yard track. Occupancy of each of these sections is indicated on the diagram by a small white illuminated spot in the track line.

The crossover and the 10 single switches are each controlled by a two-position lever, these levers being arranged in two diagonal rows, one above and the other below the track diagram so that each lever is adjacent to that portion of the diagram which represents the corresponding switch. Switch 21 leads to a yard track which is used primarily for storing cars, and, therefore, the installation of a power switch machine was not justified. This switch is operated by a hand-throw stand but a lever, No. 21, is provided and must be operated to line up the signal selections for a move over this switch when it is reversed by hand throw. A telephone is provided at this switch so that trainmen can inform the operator when they want to use this switch.

Switch 1 is normally lined for through moves on the straight track of the eastward freight track. The crossover between the two freight main tracks is normally open. The switches leading from the two ladder tracks to the various yard tracks are normally lined for through moves on the ladder tracks. With this set-up, no yard track switch has to be moved to line up for a Canadian Pacific passenger train when moving over the north ladder track.

The switch levers stand normally in the vertical position, thus controlling the corresponding switches to their normal position. When a switch is to be operated to permit a train movement into or out of a yard track, the corresponding lever is thrown 90 deg. to the right. A white lamp below each switch lever is illuminated when the lever is thrown and continues to stay lighted until the switch moves to the corresponding position and is locked; then the indication lamp is extinguished. This indication is known as the out-of-correspondence lamp, and, in case the switch does not follow the lever control, the operator thus has this information at once.

A red lamp in the face of each switch lever is illuminated when the switch is electrically locked and not free to be thrown. Since pre-conditioning is prohibited, this light constitutes a "Hands Off" light. If the operator should throw the switch lever when this light is lighted, the switch will not operate, even though electric locking is subsequently released. Both the lock light and the out-of-correspondence light will remain lighted. The operator is obliged to return the switch lever to the last position, and, if the lock light is extinguished, he is then free to throw the switch.

An analysis of this layout showed that only a limited number of routes could possibly be used simultaneously, and, therefore, only two signal levers are required to control a total of 14 signals which direct trains on a total of 54 different routes. Normally each signal lever stands on center with its handle pointing upward, thus controlling the corresponding signals to display the Stop aspect. When a signal lever is thrown 90 deg. to the right, one eastward signal clears, depending on the position of the switches in the route lined up. When the lever is thrown 90 deg. to the left a westward signal is cleared for a route. When a signal lever is thrown

and the corresponding signal clears, a white lamp in the face of the signal lever is lighted. Since the yard signals are not track circuit controlled, the lamp remains lighted until the operator puts the signal to Stop by placing the signal lever normal.

Having cleared a signal, all of the switches involved are automatically locked. After a train accepts and passes the signal, all the switches involved are automatically locked by the detector locking. Therefore, even though the operator might inadvertently throw a switch lever, no action of the switch would take place. If the operator clears the signal for a train on any approach circuit, and then "takes the signal away" by moving the lever, no switch in the route can be moved and no opposing or conflicting signal can be cleared for 15 sec., which allows time for the train to stop short of the signal or to enter the home signal limits and thereby maintain the locking on the switches and lock out opposing and conflicting signals.

These new interlockings were planned and installed by signal forces of the Michigan Central, under the direction of R. E. Green, assistant signal engineer. L. Rupert, circuit engineer, was assigned to this project to develop the plans and inspect the construction and installation. F. M. Brown, signal supervisor, had general supervision of the construction. The new control machines, signals, relays, rectifiers and replacement parts for the switch machines were furnished by the General Railway Signal Company.

Cantilever Introduced in This Simple-Truss Bridge

(*Continued from page 948*)

quired, first, to permit driving the hanger pins for connecting it to the adjoining simple span and, second, to bring the westerly end of the new steel to the desired elevation for its position in the camber diagram of the completed structure. However, all of these operations were completed practically within the allotted time, and adequate supports for the new steel were introduced to cause it to act temporarily as a continuous structure, so that the afternoon passenger train could cross the bridge with only a slight delay.

After the operations described above had been completed, the 300-ft. span that had been rolled out was placed on longitudinal roll beams and shifted in a westerly direction 721 ft. to a point opposite its new position in the structure, after which it was moved laterally into its final alinement. Meanwhile erection of the remainder of the new steel was taking place in the clear around a gap left in the north truss for the detour track. Subsequently, this gap was closed and traffic was diverted permanently on to the new structure, without interruption to train service. In its new position at the westerly end of the bridge, the relocated simple span is supported at one end on the new pile pier, while the other end is suspended from the westerly projection arm of the new fixed span.

As a part of this project, it was necessary to relocate a number of the railroad's buildings and other facilities, including the bridge controls for the swing span. These were formerly located on land in the bridge gateman's house, but in carrying out the project it was necessary to remove them to the powerhouse on the swing span. It was also necessary to raise the track west of the bridge to meet the level of the bridge extension, this being accomplished in part by building a new timber approach trestle extending as far as the government's new levee, a distance of 240 ft. from the end of the steel.

C. S. Kirkpatrick, chief engineer, and R. Owen, construction engineer, of the Gulf Coast Lines, had supervision over this project for the railroad. During the progress of the work Lieutenant Colonel Wm. F. Tompkins was district engineer of the Second New Orleans district, Corps of Engineers, U. S. Army. The Missouri Valley Bridge & Iron Company was the general contractor on the project at a contract price of $723,779, the superstructure work being sub-let to the Mt. Vernon Bridge Company. Paul H. Galbraith was the superintendent on the project for the general contractor; while Otto F. Sorgenfrei served as resident engineer for Modjeski and Masters and the J. F. Coleman Engineering Company, who prepared the plans for, and supervised the execution of, the bridge alterations.

Two Western Trains Christened

FURTHER bids for more passenger traffic in the west have been made by the Chicago, Milwaukee, St. Paul & Pacific which placed its "Midwest Hiawatha" in daily service between Chicago and Omaha, Neb., and Sioux Falls, S. D., on December 11 on a schedule of 480 minutes for the 488 miles, and the Chicago, Rock Island & Pacific-Southern Pacific which placed its "Arizona Limited" in operation between Chicago and Phoenix, Ariz., on December 15 on a schedule of 39⅔ hr. westbound and 38½ hr. eastbound. Besides reducing the time between terminals, these trains offer an improved service and modern equipment.

The Midwest Hiawatha joins a fleet of sister trains which have an enviable record. During the period from June 1, 1935, when the first Hiawatha was placed in service between Chicago and the Twin Cities, to October 31, 1940, all Hiawathas, including the Morning, the Afternoon, the North Woods and extra sections carried 1,895,815 revenue passengers with a total revenue, excluding that from mail, dining and buffet cars, amounting to $9,295,166. Out-of-pocket expenses, including depreciation, amounted to $3,629,263, leaving a net revenue of $5,665,903 for the period. Afternoon and North Woods Hiawathas carried 1,606,701 revenue passengers with a revenue of $7,510,933 for this period. Out-of-pocket expense, including depreciation, amounted to $2,745,020 leaving a net of $4,765,913 for the period. Morning Hiawathas began operation on January 21, 1939, and up to October 31, 1940, carried 289,114 revenue passengers with a total revenue of $1,784,233, expenses of $884,243 and a net of $899,990.

The service performed by the Midwest Hiawatha is not confined to the line between Chicago and Omaha and Sioux Falls, but extends to Rockford, Ill., Dubuque, Iowa, Cedar Rapids, Des Moines and Rapid City, S. D. Westbound this Hiawatha leaves Chicago at 12:45 p. m. and splits at Manilla, one section going to Omaha where it arrives at 8:45 p. m. and the other to Sioux Falls, where it arrives at 11:55 p. m. On the return trip, these two sections, leaving at 12:35 p. m. and 9:10 a. m. respectively, unite at Manilla and arrive in Chicago at 8:35 p. m. At Davis Junction the west and eastbound Hiawatha is met by a bus which carries passengers to and from Rockford on a 35-min. schedule. On the westbound trip, a steam train carries passengers from Dubuque to Savanna and on the eastbound trip from

(*Continued on page 958*)

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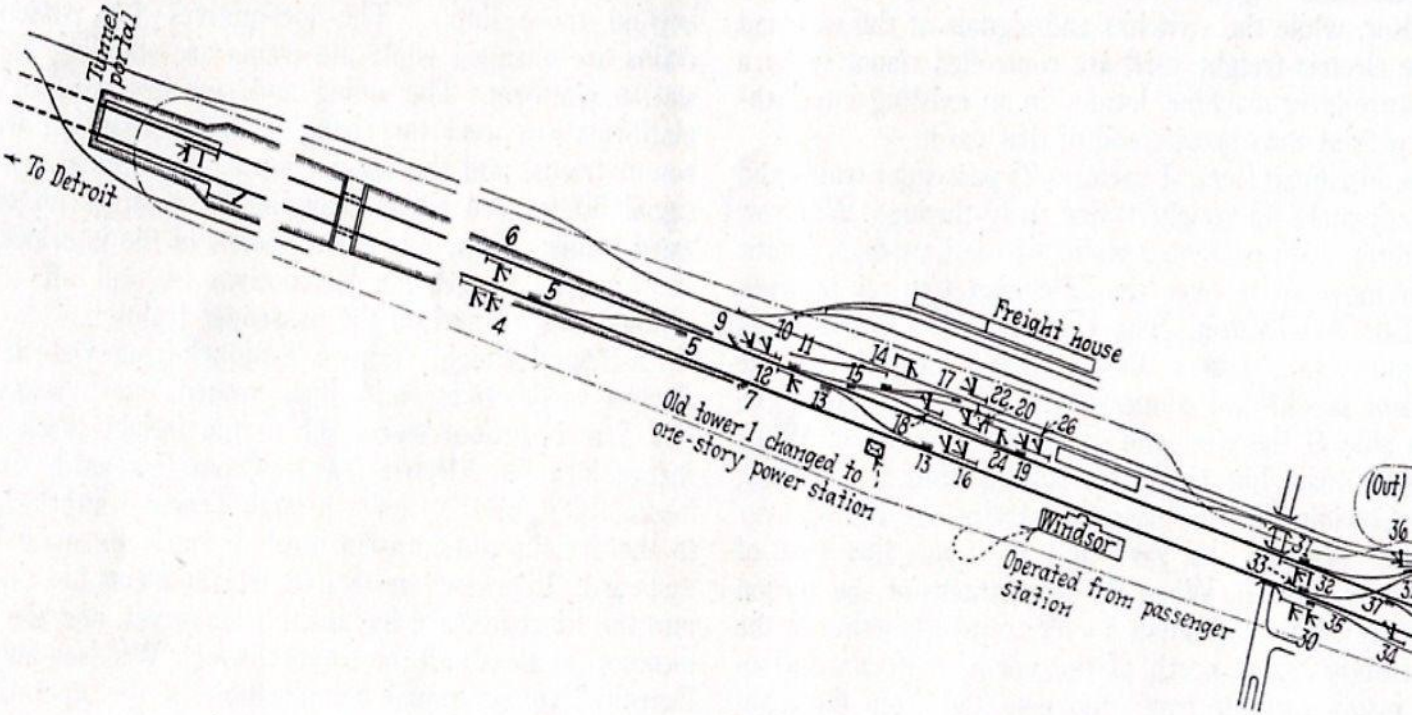

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