

Three-Track Signaling on 13.5 Miles of the C. & N. W.

**Traffic locking for either-direction
operation on center track—Re-
mote control of switches—
Unique part-time interlocking**

By S. E. Noble

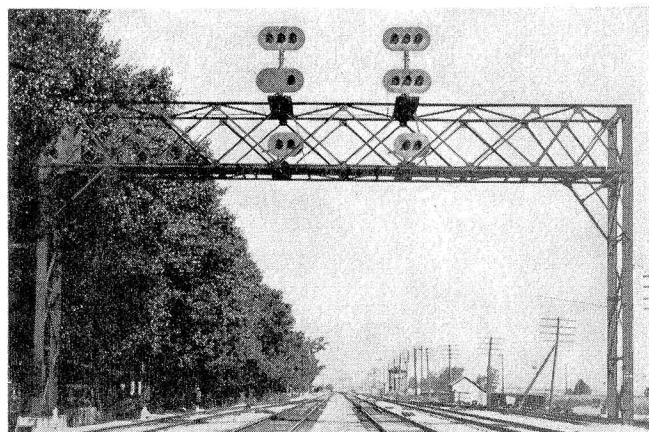
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ON June 22, 1930, the Chicago & North Western placed in service a third-track extension between DeVal interlocking at Des Plaines, Ill., and Barrington, a distance of 13.5 miles. This extension was a continuation of an existing three-track system between Wood Street interlocking, three miles from the North Western Terminal station, Chicago, and De Val interlocking at Des Plaines, making a total of approximately 28 miles of three-track road on this route.

The rapid development of the suburban territory northwest of Chicago and the construction of the Arlington Park race track on this line combined to create congested traffic conditions, which could be relieved only by providing additional track facilities. Two-way traffic on each of the two existing main tracks was considered, but operating conditions required that provision be made for operating two trains in one direction and one in the opposite direction at the same time. To take care of the freight trains and switching movements in this territory, it was apparent that provision should be made to turn over one of the main tracks for three or four hours during the day in one direction, and then one of the main tracks for three or four hours in the other direction for this purpose. The only solution was a three-track system with the center track assigned for traffic in both directions. The installation provided some very interesting problems from a signaling and interlocking standpoint, one of which was the remote control of Tower NY from DeVal interlocking plant, the remote control, from Barrington passenger station, of the west end of the three-track system, and the development of a combination lever- and automatic-control system for Arlington Park.

Automatic Block Signaling Provided

The color-light signal system, which formerly terminated at Des Plaines, was extended to the end of the three tracks, replacing the old Hall disk signals which were formerly on the two-track system. These color-light signals are the three-position horizontal type,



Westward home signal at De Val

mounted on signal bridges and in this territory are spaced approximately 4,000 ft. apart.

Flashing light signals were installed at all highway crossings not previously protected, and an additional wigwag was installed at all crossings having only one wigwag.

The pole line is constructed with an average of 50 poles per mile; with an "H" fixture, at each signal bridge, guyed in both directions; and with the necessary storm guying in between. In general, the wires are on open line except through station grounds, where hand-made cable is used. With the exception of the power wires, which are No. 6 bare copper, all wires on the open line are bare No. 8 iron wire. Hand-made cable is used for all wires required for the operation of the remote control plants. At Arlington Park parkway cable is used through the station grounds.

A 440-volt, 60-cycle a-c. power line is provided to furnish the current for the operation of the signal lights and for charging the storage batteries. Power for feeding this line is purchased at various points approximately four or five miles apart. The power line is sectionalized so that one feed supplies power for approximately five miles of signals but can, in case of an emergency, be fed into the adjoining section.

At each signal bridge five cells of Exide KXHS9 storage battery provide power for the line-control circuits and emergency power for lighting the signals on the bridge in case of a failure of a-c. power. Each track circuit is fed by one cell of Exide KXHS9 storage battery, which is charged by a Balkite rectifier. The 440-volt 60-cycle alternating current is transformed to 110 volts at the junction pole and is carried to the signal location, where an SR-14 Balkite transformer is used to produce the proper voltage for the operation of the rectifier. A LUR lighting unit, used to secure proper voltage regulation for the signal lights, is provided with a power-off relay, which, in case of an a-c. power failure, places the lighting load on the storage battery.

The storage battery and rectifiers at the signal bridges are located in a wooden battery box mounted on the leg of a signal bridge. At cut-section locations, the storage battery and rectifiers are located in a concrete battery box, which serves also as a foundation for the cable

post on which a four-way relay and terminal box is mounted. At the signal bridge locations, the relays are mounted in a 15-way box located at one end of the signal bridge deck. Wires from the pole line to the relay box are in hand-made cable. Wires from the relay box to the color-light signals are carried in hand-made cable attached to the top girder of the signal bridge.

A light-out relay is installed in series with the green light, the circuit being arranged so that if the green light burns out the yellow light will be lighted. Proper impedances are provided in the yellow and red light circuits to obtain equal voltages at the three lamp sockets.

The signaling for the center track is the same as that provided for the outside tracks, except that the track is signaled in both directions.

Traffic Locking for Either-Direction Operation

A traffic lock circuit controlling traffic-lock levers for governing movements on to the center track is installed between DeVal interlocking and Tower NY, and between Tower NY and Barrington, provision being made at Arlington Park to cut the traffic-lock levers for sections A and B into the circuit. The circuit is selected through each track circuit on the center track in the controlled territory and is energized through the normal contact of the opposing traffic-lock lever. The locks on the lock levers being effective at the reverse indication point, it is impossible to place the lock lever in the full reverse position [to release the locking to allow the signal to be cleared for train movements] unless the opposing lever at the next control point is in the normal position or in position for continuation of the movement, and the track between the two points is unoccupied. In the case of the traffic lock between DeVal and Tower NY, since the two control machines are in the same tower, a lever in the electric interlocking machine is used, which indicates normal and reverse. The indication magnet is controlled by the track circuits between the two points. The lever in the normal position mechanically locks the signals at DeVal governing center-track movements toward NY and feeds current to the signal bus on the NY machine for signals governing center-track movements to DeVal.

The traffic lock circuit is also made use of as an a-c. power-off indicator. When the a-c. power is off in a section, the power-off relay on one of the lighting units

The direction of traffic is scheduled in the time table as follows:

Track No. 1. Westward scheduled and unscheduled movements.

Track No. 2. (Center track). Westward schedules and unscheduled movements between 11:45 a. m. and 11:45 p. m., eastward scheduled and unscheduled movements between 11:45 p. m. and 11:45 a. m.

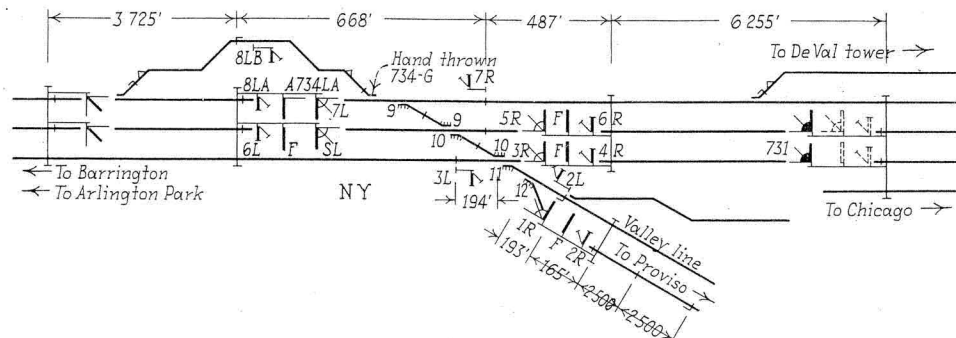
Between DeVal and Tower NY, trains in both directions will move on signal indications on Track 2.

Track No. 3 Eastward scheduled and unscheduled movements.

At several intermediate points between DeVal and Barrington, crossovers are provided for movements from Track 1 to Track 3, or vice versa. Crossover movements to track No. 2 are prohibited at intermediate points, except when permission is granted by the train dispatcher through the signalmen at DeVal or the operator at Barrington station. Telephones are installed opposite the center switches of each set of crossovers, for communication with the levermen at DeVal or the operator at Barrington. The cross-over switches on the center track of each set of cross-overs are equipped with a facing-point lock and a circuit controller operated from a ground-throw stand. Unlocking these switches will set at Stop the automatic signals governing this block on the center track in both directions, but will not set the automatic signals at Stop on the outside tracks. Throwing the outside track switch will set the signals on the outside track and on the center track at Stop. Throwing the switch on the center track will set the automatic signals at Stop on the track toward which this switch leads. Switch indicators, located at the facing-point lever stand, indicate the approach of a train on each of the outside tracks. Indicators on the outside-track end of each crossover indicate the approach of trains from each direction on the center track. Operating rules provide that both ends of the crossover must be alined before a movement is started over it.

NY Remotely Controlled from DeVal

At DeVal, which was formerly the western end of the three-track section, a 12-lever section was added to the existing 64-lever electric machine to provide for the control of the 11 units added in this plant due to track



This plant is now remotely controlled from DeVal interlocking tower

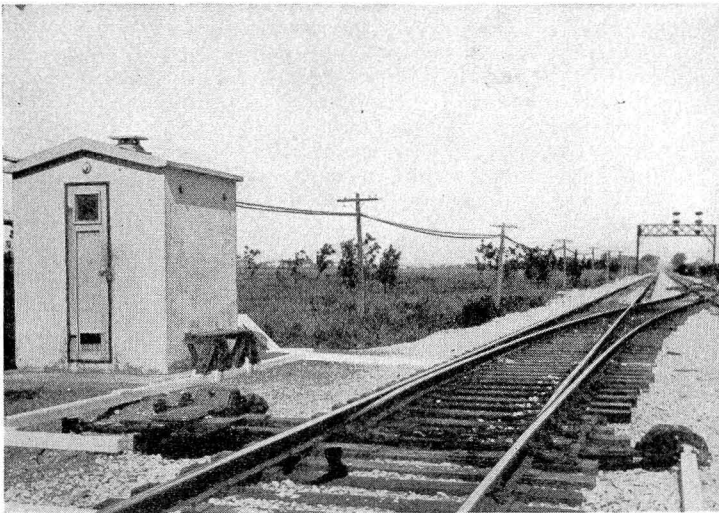
starts a flashing relay, which interrupts the traffic lock circuit, thus causing a single-stroke bell to operate at DeVal or Barrington during a period when the center track is unoccupied. When this occurs the leverman is instructed to call the maintainer. The operation of the bell can be cut out by throwing a switch which lights a lamp. The interruption of the traffic-lock circuit does not interfere with the operation of the traffic lock.

changes occasioned by the extension of the third track. The high home signals on the three-track road were changed from 110-volt, 3-position upper-quadrant semaphore signals to color-light signals as shown in one of the illustrations. The night indication of the dwarf signals was changed from red and red-and-green, to red and yellow.

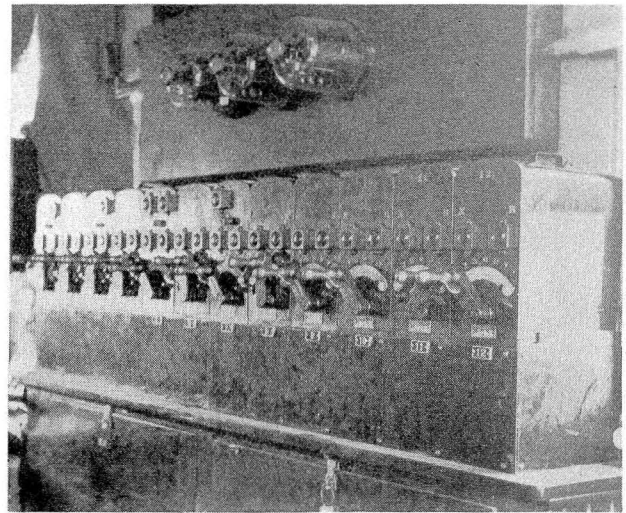
Tower NY, located approximately 6,000 ft. west of

DeVal interlocking, is the location of a connection to the Valley line leading to Proviso yards. All freight trains operating over this territory to or from Proviso make use of this connection. Formerly, there was a mechanical interlocking plant at NY but in 1917 the freight traffic was not heavy enough to warrant the need

levers, will light when the signal clears. On high-signal levers a second light is installed near the top of the controller and will light when the block is clear. The normal method of operation is to line up the desired route without waiting for an indication from each lever, and when every switch in the route has assumed its proper position



Dual-control switch and relay house at NY controlled from DeVal



The 12-lever table interlocker in DeVal tower, which controls the layout at NY

of an interlocking to operate the switches; therefore, the plant was at that time removed and hand-thrown switches were substituted. The development of Proviso yard and the rearrangement of freight traffic caused this connection to be put into considerable use again and, with the idea of eliminating train stops and delays to trains on account of the crossing over of large freight trains to this connection, it was found advisable to again interlock these switches. DeVal interlocking, being only 6,000 ft. distant, and remote control apparatus having been developed to its present state of dependability, it was decided to place the control equipment in DeVal interlocking tower and make the NY plant a remote-control unit.

The remote-control machine consists of a 12-lever set of desk controllers with mechanical locking sufficient to require the switch levers to be in the proper position for a route before the signal lever can be placed in the reverse, or clear, position. All approach, route and detector locking is effected in the relay house at the NY location. Light indicators are located above the levers, for indication purposes. A light is located above the normal, and above the reverse, position of the switch lever. When the leverman changes the position of the lever, the light over the previous position goes out and the one over the new position is illuminated. When the switch starts to move, the light over the lever flashes and a tap of a bell is sounded. When the switch has completed its movement and locked up, there will be a second flash of the light and a tap of the bell. If, for any reason, the switch fails to go over, and to lock, within a period of 45 or 50 sec., the light over that particular lever will begin to flash and the bell to tap, and they will continue to do so until the lever is placed in the former position. This allows the switch to return to its original position, which action will again be indicated by one flash and a tap of the bell, whereupon the leverman can attempt the operation again in an effort to dislodge the obstruction in the switch point.

Lights, placed above the reverse position of the signal

and the signal has cleared, the light over the signal lever will clear, indicating that the route has been lined up and that the signal has cleared. If a switch has failed to complete its movement, the flashing of the light and the tapping of the bell will indicate which switch is in trouble. The signals are "non-stick" controlled, but can be made "stick" controlled by pressing the button on the controller above the lever. A movement of the lever will eliminate the "stick" control.

The switches are equipped with G. R. S. Model 1-5B dual-control switch machines which operate on 20 volts d-c. Thermal relays are provided, which open the operating circuit in 45 or 50 sec. if the switch fails to lock due to being out of adjustment or due to an obstruction in the points. Polar relays, selected through contacts on the point-detector, repeat the position of the switch. The polar Z relay controlled by the switch lever, and the switch-repeater relay must correspond in position before the signal governing over the route will clear. Switch circuit controllers, operated by the switch point, are used for selection in connection with the route locking. It is not possible to use the switch-repeater relays for this purpose, because the operation of a selector lever on the dual-control machine opens the point-detector contacts, and these will remain in the open position until power is applied to the switch machine. Since the locking is obtained by selection of the switch operating circuit, through a lock-repeater relay, the opening of this circuit would prevent power from being applied to the switch machine.

With a train in the approach circuit, an approach-locking release can be obtained, in the case of a high-speed route, only by the operation of a two-minute clock-work time release by the leverman at DeVal. After a high signal has cleared, and it is desired to change the line up, an interval of five seconds is provided between the placing of the signal in the normal position and the changing of the route. In the case of a dwarf signal, a change in the route requires an interval of 20 to 30 sec.

between the placing of the signal at Stop and the change of the route.

The relays required for the operation of the switches and the necessary electric locking are housed in a concrete house 6 ft. by 6 ft. located on the west side of the plant near the center of the group of controlled switches. The battery, which consists of 12 cells EMGO9 Exide is located in a concrete battery well adjacent to the relay house and is charged by means of a Type-RRG Kuprox rectifier.

There is one hand-throw switch, 734-G, within the plant limits. Telephones are located at each home-signal bridge and a trainman desiring to make movements out of this track must first call the leverman at DeVal and secure permission to make the movement. After securing permission, he must open the switch and the leverman will clear the side track signal for the route desired.

Special Instruction for Dual Control Switches

The dual-control switch machine provides a flexible unit for use in emergency. Special instructions are provided which govern operation over these switches in case of failure of power operation or the assignment of a certain track or tracks for switching by hand, the NY plant being too far away from the point of control for

5. After the movement has been completed, the switch or switches must be set in the position in which they were found unless otherwise instructed by the leverman, and the selector lever returned to the "Power or switch machine" position and locked in that position.

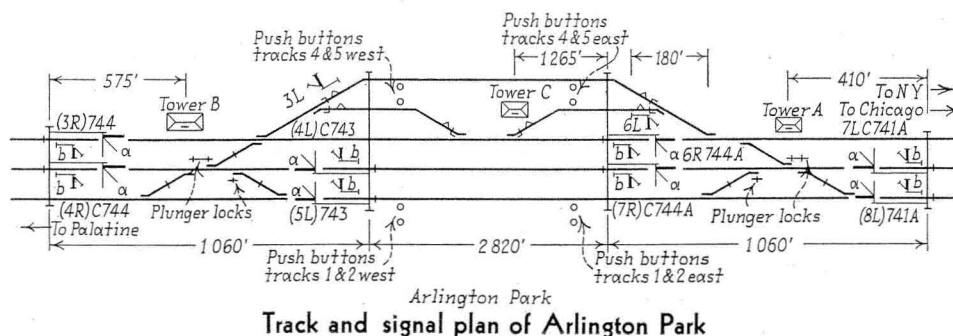
6. The leverman must be notified and given the location of the train or engine.

When permission is given by the leverman to operate a dual-control switch by hand, no part of a train or engine must move on tracks not designated by the leverman, and if movement beyond such designated tracks is necessary, further communication must be had with the leverman to secure proper authority for such movements.

Enginemen and trainmen, when making switching movements, must not accept hand signals as against fixed signals, in moving over a dual-control switch, unless they have been informed that the selector lever is in the "Hand" position.

Unique Part-Time Interlocking at Arlington

At Arlington Park it was necessary to provide a track layout which would facilitate the unloading of passenger trains from the city and getting them out of the way of the following trains, and which would enable at least four 10-car Chicago-bound trains to be in the process of loading at the same time. The illustration shows the track layout which was devised. On heavy-traffic days,



Track and signal plan of Arlington Park

the leverman to operate the switches for such switching movements. A copy of these instructions follows:

Instructions for Hand Operation of Dual-Control

When a train or engine has been stopped by a Stop signal, the conductor or engineman must at once communicate with the leverman by telephone, and then be governed by the instructions received. The instructions must be repeated to insure correct understanding. When given oral permission to pass a Stop signal, a train or engine must not move over a dual-control switch until after the switch has been thrown to the required position by means of the hand-throw devices.

If the switch is already in position for the movement, it must first be thrown to the opposite position and then back to the position required for the movement. All dual-control switches that the train will pass over must be operated by hand. Dual-control switches must not be operated by hand except on instructions from, or by permission of the leverman.

TO OPERATE A DUAL-CONTROL SWITCH BY HAND

1. The selector lever must first be thrown from the "Power or switch machine" position to the "Hand" position.
2. Operate the switch by means of the hand-throw lever the same as an ordinary switch.
3. If the switch cannot be thrown completely by means of the hand-throw devices, it must be spiked securely before the movement is made over it.
4. Whenever a switch has been operated by hand, the selector lever must be left in the "Hand" position until after the train movement has been completed.

trains are loaded on Track 2, the center main track, as well as on Tracks 4 and 5. The race track is located on the west side of the railroad, and passengers are enabled to reach the platform for Tracks 4 and 5 by means of a subway running underneath the three main tracks. Gates are provided at the exit of the subway to prevent the platform from being overcrowded.

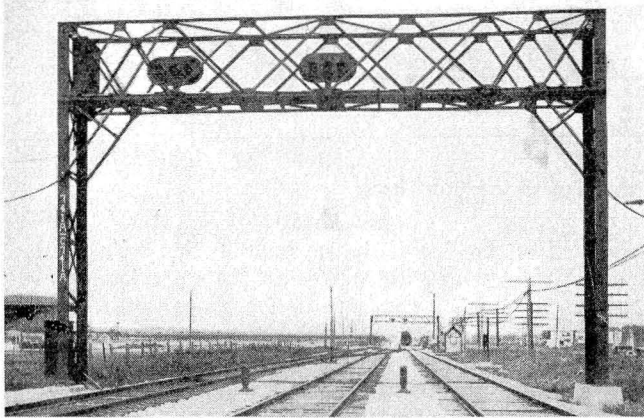
Considering the fact that the race track would be in operation only one month or possibly two months in the year, the installation of an interlocking machine at some point such as Cabin C to operate the system of crossovers and turnouts at each end of the station grounds was not warranted. These switches are, therefore, hand-thrown, requiring that a conductor be assigned, for this purpose, to Section A and Section B.

It was thought necessary to control train movements by signal indication, and especially movements to the center track. The signal system had to be one which during the period of operation could be lever controlled but during the rest of the day would allow the main-track signals to operate automatically. With this in mind the following system of signaling was installed.

The home signals on the main tracks consist of a C. & N. W. standard three-position color-light signal unit mounted on a signal bridge with a color-light two-position dwarf signal located on the ground to the right of the track. These signals are bulletined as Stop signals during the racing season. At the close of the season all the dwarf signals, including the one governing movements out of Tracks 4 and 5, are removed and stored

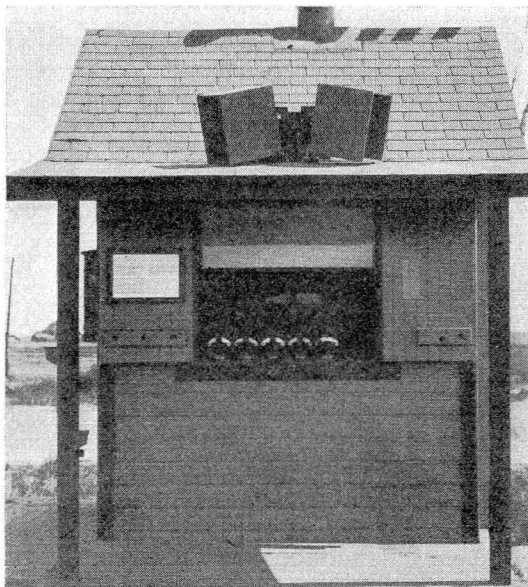
until the next year. The home signals then become automatic "Stop and Proceed" signals. No reverse movements are made on Tracks 1 or 3, except in emergency, and no signaling has been provided for this purpose.

The signals are manually controlled by means of desk-lever controllers. A group of five levers is required for each of the two sections and these groups are mounted as shown in the illustration of Cabin A, so that they can



Westward home signals at Cabin A, Arlington Park

be operated from outside the cabin. There is no mechanical locking between levers. One (two-position) lever is designated as the "In Service" lever, and it must be in the full service position before manual control of the signals is obtained. An electric lock on this lever compels the other levers in the group to be in their normal positions, the traffic-lock lever in one or the other of the next adjacent center-track traffic control points to be in the normal position, and the track in between to be unoccupied. This is done to prevent the possibility of two adjacent center-track traffic-control points having their traffic-lock levers reversed at the same time and



Cabin A—Open during certain hours only

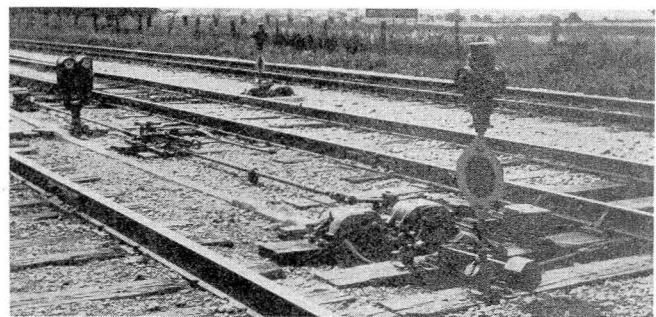
thereby allowing the signals to be cleared for opposing trains to enter the center-track section.

The next adjacent lever, the traffic-lock lever, is three-position and is equipped with an electric lock. It is cut into the traffic-lock circuit between Tower NY and Bar-

rington when the "In-Service" lever is in the service position. The normal position of the lever is on center. The lever must be placed in the full left position for westward movements toward the left on the center track and must be placed in the full right position for eastward movements toward the right on the center track; otherwise the governing signal will not clear for the movement. The electric lock permitting the movement of the lever to the full-left or full-right position is energized only under the conditions stated in the description of the traffic-lock circuit.

The other three desk-lever controllers are three-position and are used for controlling the signals. One is assigned to each of the three tracks. The normal position of the signal levers is at the center. The lever placed in the full-right or full-left position with the proper line-up of switches will clear the signal for movements in the direction the lever is thrown. Indication lights are placed above the left and right positions of the signal levers and they are illuminated when the signal clears.

The high signals are "non-stick" and the circuits are so arranged that if the block is occupied the dwarf signal



Facing—point locks on center track switches

below will clear with the proper line-up and the lever in the clear position. During the period of the day when the manual control is out of service these dwarf signals become automatic and will clear when the high signal indicates "Stop."

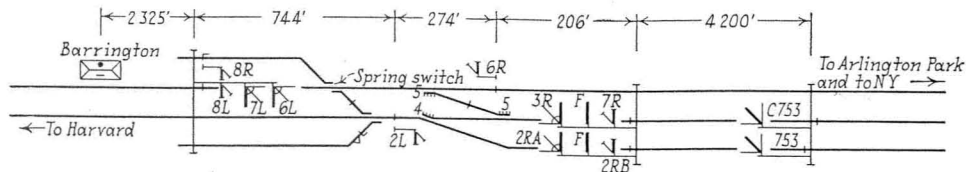
An auxiliary control of the eastward signals on Tracks 3, 4 and 5 at Section A is placed at Cabin A-1. When the traffic is inbound (to Chicago), the junction switches of Tracks 3, 4 and 5 are the only ones operated at this end, and it would be practically impossible for the conductor to reach Cabin A to operate the signals without causing considerable delay. The trains are loaded on Track 2, the center track, and they continue on that track, all other trains being routed down the outside track. All that is necessary at Cabin A is that the "In-Service" lever be in the service position, that the traffic-lock lever be in position for center-track traffic toward Tower NY and that the signal levers be in the clear position for inbound movements on Tracks 2 and 3 and out-bound movements on Track 1.

A director is stationed at "C," which is an elevated tower, to dispatch trains and supervise the operation. A loud-speaker system was installed to provide communication between Cabins A, A-1, C and B, so that this man could, without delay, advise the conductors at Sections A and B of the desired train movements.

Information as to the loading of trains is provided at C by means of a track diagram having illuminated bull's eyes and push-buttons located on the tracks on which the loading is done. When the train is loaded and ready to start an attendant on the platform pushes the button for that particular track and location and the correspond-

ing bull's eye on the diagram lights up. The director, when the train has started, pushes the button adjacent to the bull's-eye and the light goes out. The director governs the number of people allowed on the platform between Tracks 4 and 5 during the loading of trains by signaling the attendants at the subway gates by means of an electric gong and push button.

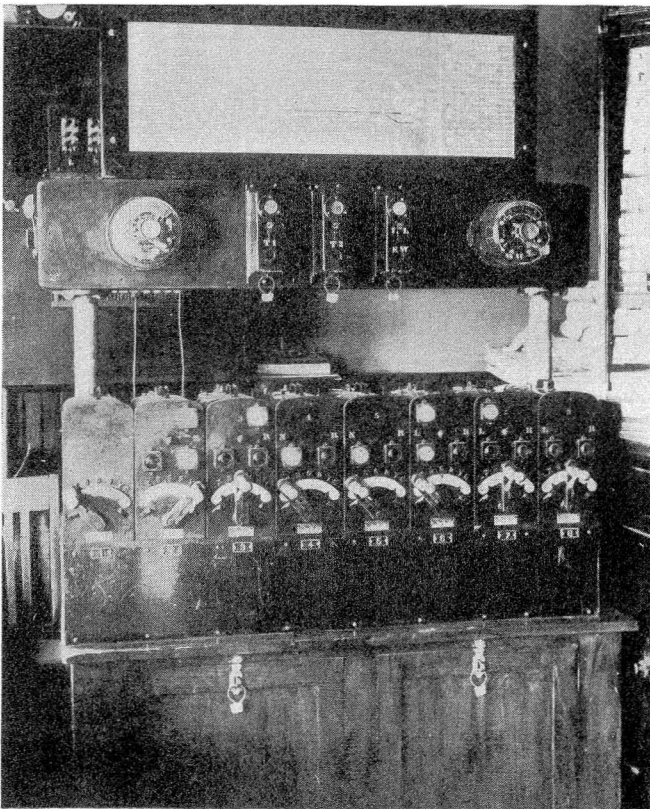
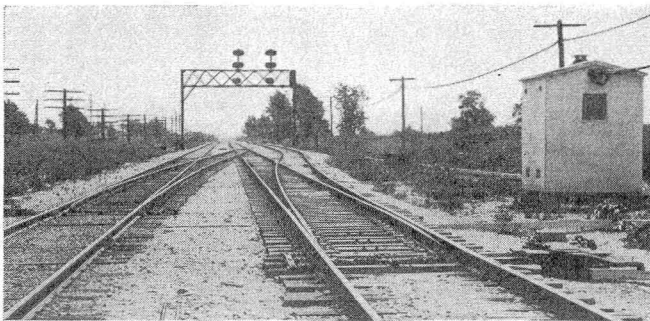
filled as described in the method of placing the lever in the service position and for the same reason. The doors enclosing the opening in which the desk lever controllers are mounted in the cabin are so constructed that they cannot be closed unless each lever is in the proper normal or out-of-service position. This is accomplished by means of blocks of wood which are



Remotely controlled plant at the end of the third track

At the close of the "race track" period for the day, the manual control of the signal system at each section is cut out of service by placing the "In Service" lever in the out-of-service position. The electric lock on the

mounted on the inside of the door in line with the lever handles, and which are drilled to accommodate the lever handles only when they are in the proper position.



Switches and signals at end of third track (above) are controlled by an eight lever table interlocker

lever prevents the lever from being placed in the out-of-service position unless the same provisions are ful-

Another Remotely-Controlled Plant at Barrington

At the west end of the three-track system at Barrington, the remote-control interlocking plant is similar to that at NY. The Barrington layout is smaller, having only one crossover, one turnout and one spring switch within the home-signal limits and is operated from the passenger station one-half mile west of the plant. The control machine consists of a group of eight interlocked desk circuit controllers mounted on a cabinet in the ticket office of the station with the annunciators, time releases and track diagram mounted above. The cabinet houses the OS relays and terminals. The illustration shows the light indicators above the levers referred to in connection with the discussion of Tower NY.

The circuits are arranged so that the call-on signal will clear if the block of the high arm is occupied. The result is that the operator, after securing a line-up, need not touch the levers again for following trains unless a change in route is desired. The signals can be made stick controlled by pushing a button on the desk controller above the signal lever. The operation of the signal lever eliminates the stick control.

If traffic becomes such that three-track operation is not required during certain hours of the night, the plant can be lined up for the desired two-track operation and the office closed for that period.

Results of Three-Track Operation

The results obtained from this three-track installation have been very satisfactory. Previous to its installation there was difficulty in maintaining the schedule. Freight trains starting over this line during certain periods of the day were required to pull into sidings for passenger train movements, thereby losing a surprising amount of time. The schedule between Chicago and Barrington in some instances has been reduced from three to five minutes. Trains in this territory are invariably on time. The running time for the race-track trains between Chicago and Arlington Park was scheduled as 35 min. but, due to congestion, was liable to require 50 or 60 min. Now it is possible to start two or more trains at one time at Arlington Park and operate on two main tracks to Wood street, Chicago. During the operation of the race track this year, there was not a minute delay to any of these trains.