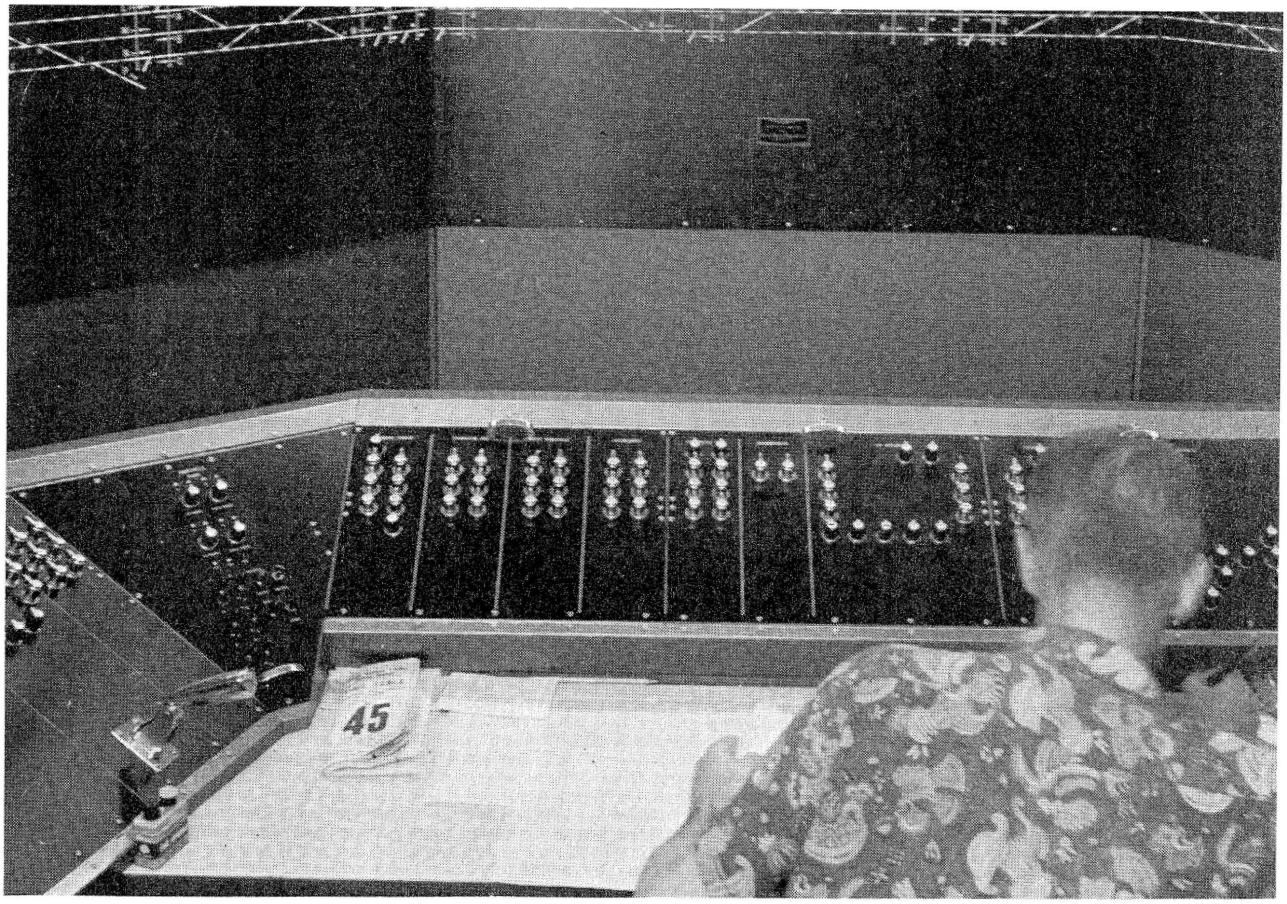


The console is within the dispatcher's reach. The diagram is about 7 ft. from him at a higher level

Burlington Has Compact Control Machine

for Consolidation of 14 Interlockings

Fourteen sizeable layouts on 35.37 miles, mostly three-track handling 122 scheduled trains daily, to be controlled from one console machine all within arm's length of the dispatcher, without leaving his chair

TWO YEARS AGO when the Burlington was starting the plans for consolidated control of 14 interlockings on 35.37 miles, mostly three-track, between Chicago and Aurora, an important objective was to obtain a machine, manufactured to Burlington requirements, by means of which the man in charge could manipulate all the controls without leaving his chair, rather than walking along a machine of the conventional type.

This objective was attained, and the machine is now in the dispatcher's room in the offices of the division superintendent at Cicero, a suburb, about 7.5 miles from the Union Station in Chicago. As of September 1, this machine controls five of the interlockings, and the control of the remaining nine will be brought into this machine as soon as conditions permit.

This consolidated interlocking control is of the all-relay type including entrance-exit system of controls, in which the switches are lined up and the signal for the route is cleared, merely by pushing two buttons on the control console. The first button corresponds with the signal at which the train will enter the home signal limits, and the second button corresponds with the location at which the train will depart from those limits.

The entrance-exit system of controls has been on the market since 1937, numerous interlockings, using this control, having been installed. However, the conventional entrance-exit machines have each consisted of a large illuminated diagram which included not only the control buttons but also illuminated symbols to represent signals, and engraved track lines with indication lamps to repeat track occupancy, switch position and routes lined up. If these practices had been used to construct a control machine for the 14 interlockings in this Burlington project, the machine would have totaled perhaps 50 ft. or more in length.

What Was Simplified

The solution, as used on this Burlington project, was to place only the control buttons on the control console. On a much larger, more remote track diagram (85 in. from the dispatcher) are panels which include lamps that repeat signal aspects, track occupancy, switch position and routes called for and lined up. This practice, in general, is similar to that used by the Reading on a machine installed in August 1955. However,

in numerous respects, the Burlington machine differs from that on the Reading. An advance model of a section of this Burlington type machine has been in actual service at a different location since January 1954.

The Burlington design for the control console panel omits all indication lamps and lines representing tracks and switches. As applying to the interlocking at Fairview Avenue, including four crossovers and 6 signals, only six control buttons are required, as shown on detail sketch of this section of control panel. These buttons are spaced 1½ in., center, both vertically and horizontally so that the entire control panel for such an interlocking is only 4½-in. wide. Thus 14 interlockings including 17 single switches or derails, 70 crossovers, 131 home signals and electric locks on 15 hand throw switches, are all controlled from this one console type machine.

The buttons for the control of each interlocking are marked by letters as shown in the sketch. Thus, as applying for control of any interlocking, the button "A" is punched first for an eastward train approaching on track No. 1, or button "M" is punched first for a westbound train approaching on track No. 2. No indication lamps, or lines representing tracks are on this control console.

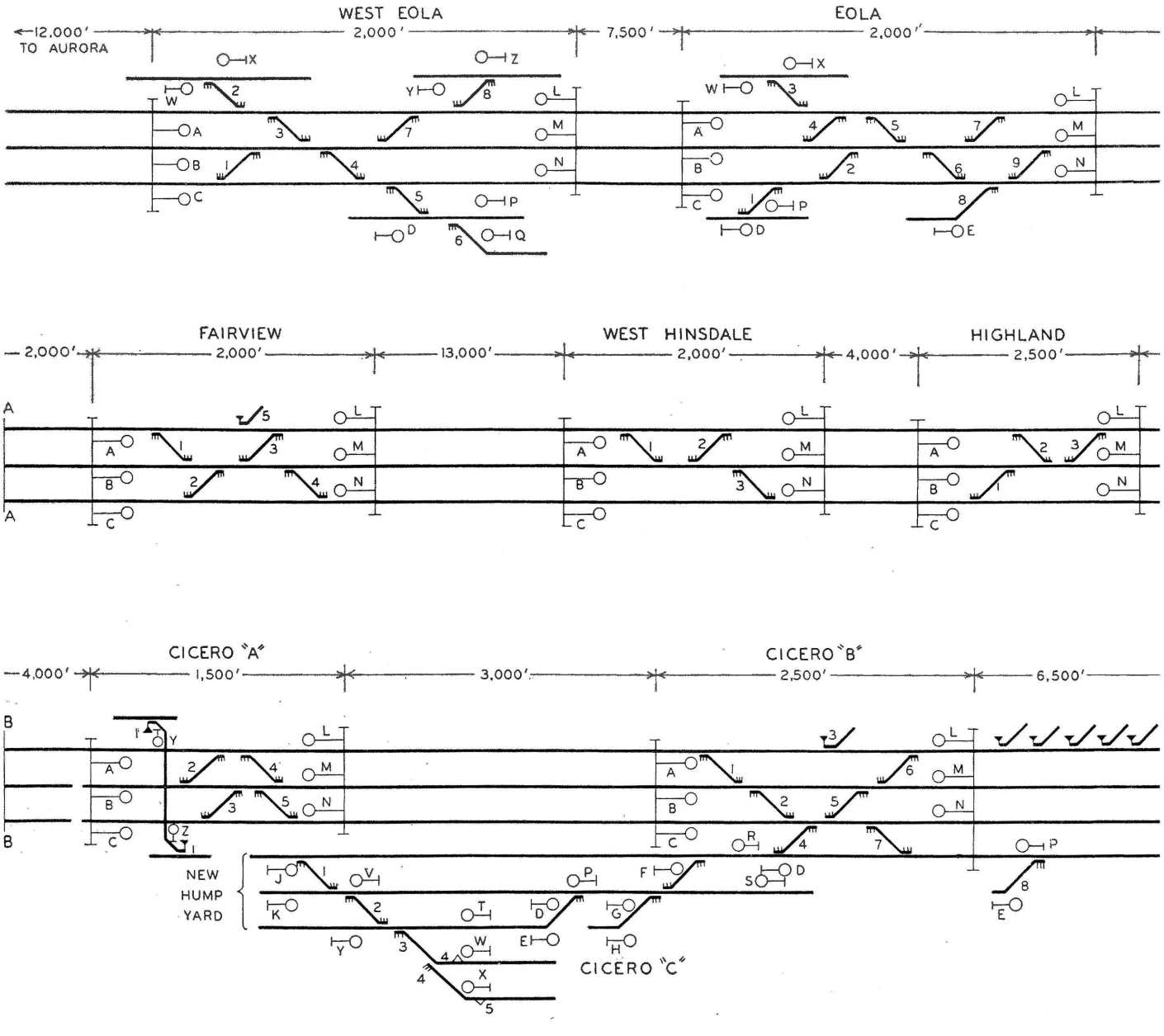
Diagram Seven Feet Away

The large sized separate illuminated track diagram is located at a higher level and about 5 ft. beyond the control console. The panels of this diagram are 24 in. high, the five sections being arranged in a "U" totaling almost 30 ft. length. This diagram is supported on pedestals which place the indications of the board 60 in. from the floor.

The face of this diagram is made of two-tone laminated phenolic plate. Each track, crossover and turnout is represented by a line which consists of slots ⅛ in. wide and 1 in. long, placed end to end, about ⅛ in. apart. Behind each slot are translucent pieces, backed by units containing two lamps with color filters. This makes four indications available.

If an eastbound train approaching the Fairview Avenue interlocking on the No. 3 track is to be crossed over to the No. 2 track, the dispatcher pushes the "C" button. On the diagram, the 1-in. section of track diagram at each of the possible exits, is illuminated and the lamp in the symbol for signal C is flashed green. When the dispatcher pushes button "M" the section of the track diagram representing the crossover are flashed white until the crossover switches are operated to the reverse portion. Then the track sections for the entire route are lighted steady white, and the lamp in the signal symbol burns steady green, thus indicating the route lined and the signal cleared.

When the train accepts the sig-



nal and enters home signal limits, the green light on the symbol for the signal goes dark, and the lamp sections represent portions of track occupied by the train are changed from white to red light. Then as the rear of the train clears each track circuit, the corresponding track lamp sections (based on sectional route locking) return to normal, which is non-illuminated. As the train departs, no further manipulation by the dispatcher is required. If two or more following trains are to use the same route through an interlocking, "fleeting" control is established by turning the "entrance" button 90 deg., after it is pushed. With this fleeting control in effect, as soon as a leading train clears the interlocking, the home signal will again clear, without further manipulation by the dispatcher. To cancel fleeting control the dispatcher turns the button back to its normal position. To take away a route that has been set up, the dispatcher pulls the entrance button. Lamp sections of the diagram representing turnouts and crossovers, stay lighted white as long as electric locking is in effect.

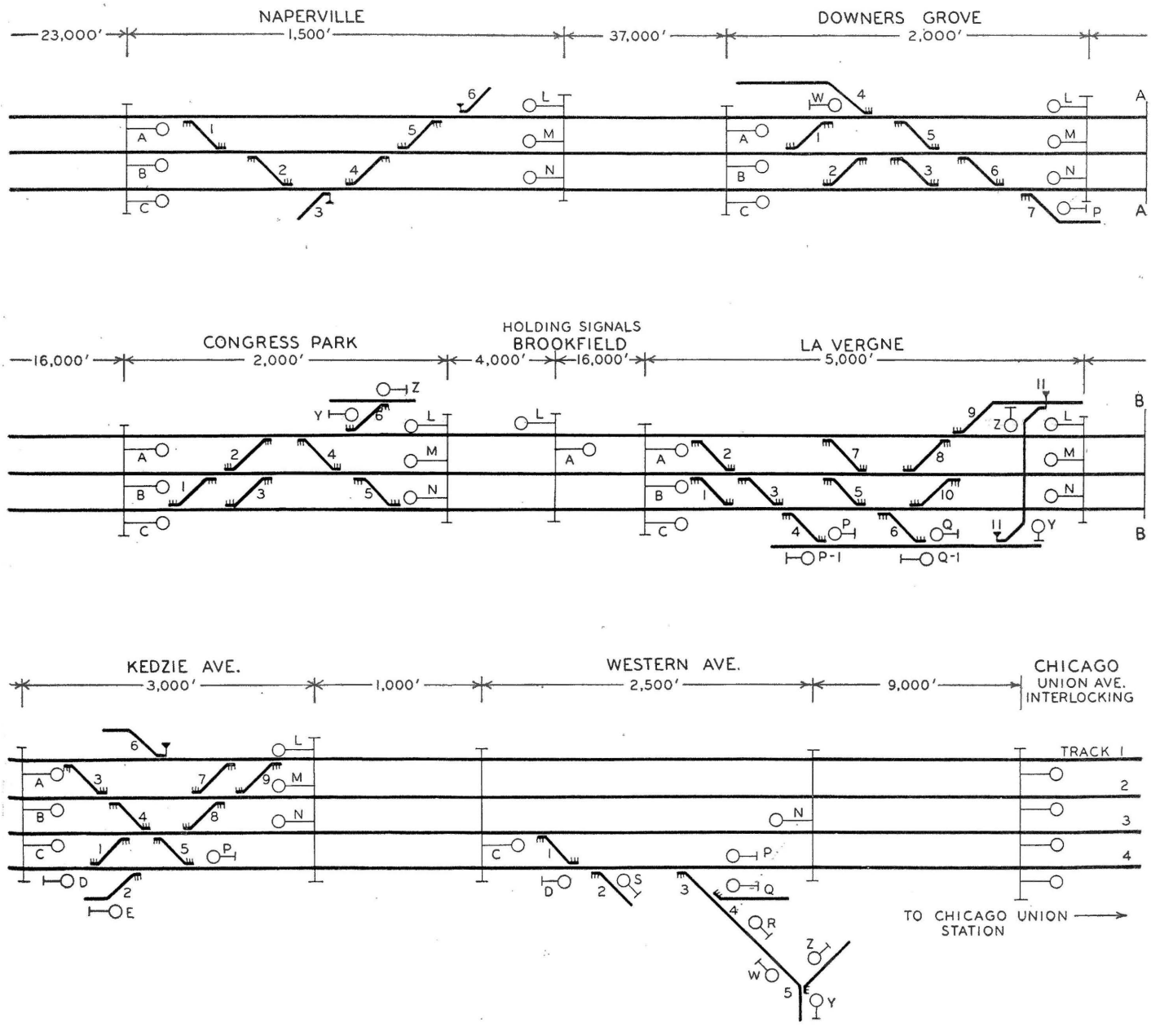
Hold-Out Signals

On the main track No. 1 between interlockings at LaVergne and Congress Park hand-throw switches lead to yard tracks. In order to give the local freight more time to continue switch operation at these yard tracks, while a westbound suburban train or other local train is proceeding west on track No. 1, a special pair of dispatcher controlled stop signals A and L were installed at Brookfield. When the local freight is working at the yard tracks the dispatcher controls eastward signal at Brookfield to stop. Then he can clear the westbound home signal at LaVergne to let a suburban local train makes its station stops at five stations. When the local freight gets in the clear for the time of the passenger, the dispatcher clears westward signal at Brookfield for the passenger train, which proceeds on west without stopping.

On the control console, the buttons on lines representing the main tracks are smooth finished chrome plated metal, with a short lever handle normally pointed up; whereas the buttons for signals on other than main tracks are black plastic knurled knobs, with no lever handle.

Train Graph, Too

On the track diagram, in addition to the lamp sections indicating track occupancy in interlocking limits, there is also a lamp section that indicates occupancy of each automatic block. The automatic train graph, counter sunk in the desk top of the control console, has a pen corresponding with occupancy of each automatic block adjacent to an interlocking but no

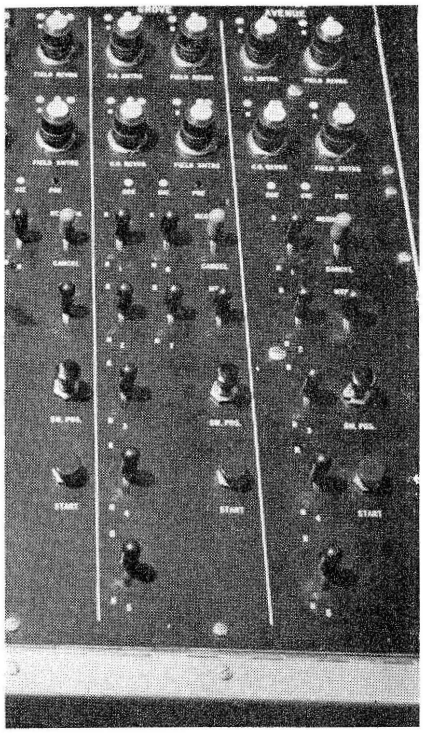


pens for other track sections. Thus adequate information is indicated on the chart, without the complications involved in providing pens for the home signal limits.

Test Panel is by Itself

On separate sections at the two ends of the "U" shaped console, there are small test panels, one such panel 6 in. wide and 18 in. high to correspond with each of the interlockings in the field.

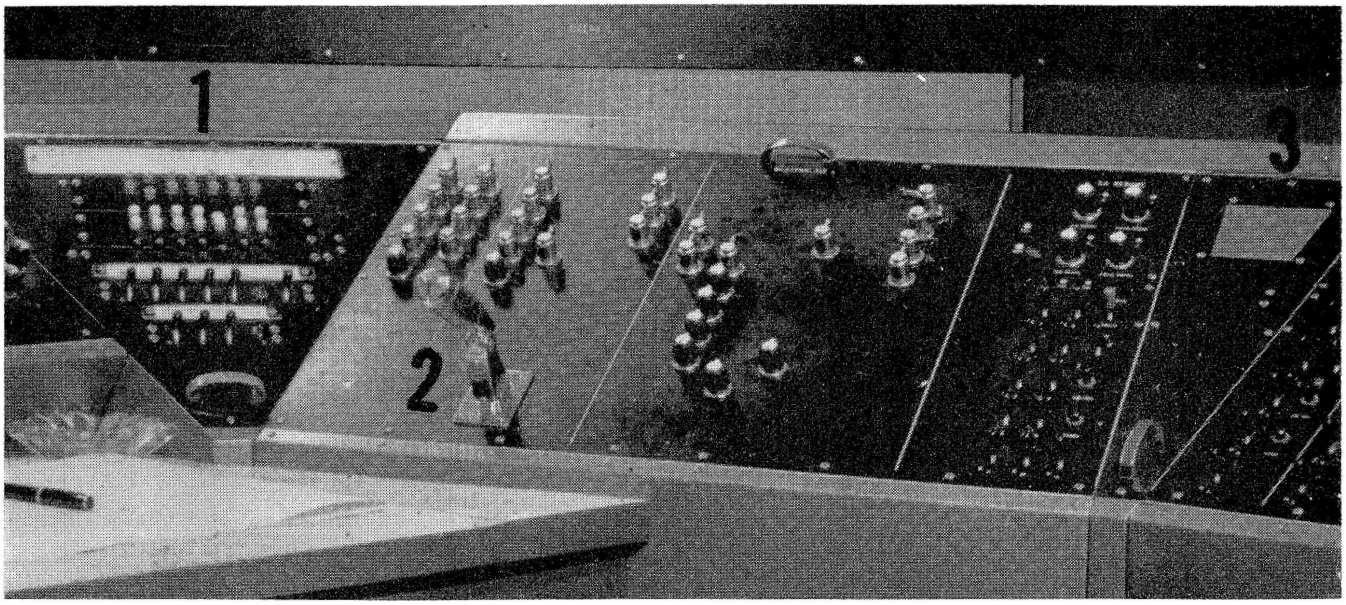
At the top of such a test panel there are four rotary type knobs, about 1 in. in diameter and 1 in. high, which are for manual control of the changeover from normal carrier to standby carrier equipment. The carrier equipment of the code line system is in duplicate, and ordinarily if any carrier fails, the cut over to standby is automatic. However, the knobs on the test panel are for making tests. Above each knob are small lamps which are lighted to indicate whether the normal or standby carrier equipment is in service on any corresponding circuit. Below the carrier knobs and at the left side of a test



Left—The test panel for each interlocking is 6 in. wide and 18 in. high

panel there is a small telephone key type lever for each single power switch or power crossover in the interlocking; for example in the Downers Grove test panel there are seven such levers. Each of these levers is for the individual manual direct control of the corresponding switch or crossover (independent of NX control), when making tests or when lining switches for a track motor car. Similar key levers on these test panels are for control of electric locks on hand-throw switches in interlocking limits. For example to release electric locks No. 6 in the Kedzie interlocking, the dispatcher at the control machine would use the key levers in the Kedzie test panel to place crossovers 3, 7 and 9 normal. Then, with signals displaying Stop aspect, he would throw the No. 6 key lever on the Kedzie test panel to reverse, which would release the electric locks on the two No. 6 hand-throw switches provided field safety circuits will permit.

In any instance, no control goes out from a test panel until the "start" button is depressed, which is at the right on the test panel. Other buttons at the right, on each



(1) Communication keyboard, (2) Slim dynamic microphone, (3) Loudspeaker, recessed in console panel

Voice Circuits Terminate in Console

The dispatcher's communications circuits are at his fingertips. A triangular portion of the interlocking console, at his right, contains 7 keys, one indication lamp and 3 spare key positions, for circuit control, as well as the pushbutton panel of a 62A telephone selector.

A slim dynamic type microphone is mounted at the bottom of the first panel at the right of the desk portion of the dispatcher's machine, and a second microphone is at the left end of this desk. The two microphones are connected to the same circuit except they have independent footswitches. The use of the two microphones makes it easier for the dispatcher to answer calls, and as mounted on the panels they eliminated the use of microphone boom, which would have obstructed his view of portions of the track diagram.

A 5-watt loudspeaker is recessed into the upper portion in a triangular section of the console panel at the dispatcher's right, and a second loudspeaker is mounted at the corresponding location at his left. These speakers are connected in parallel. These loudspeakers, at the left and right of the dispatcher,

test panel, are for checking switch position, and for cancel or recheck of code.

This practice of placing all the auxiliary controls and test controls on a panel, separate and remote from the NX buttons, is another factor in making the manipulation compact and simple.

This is Heavy Traffic Territory

This section between Chicago and Aurora carries a large volume of traffic. The scheduled traffic includes 32 through passenger trains, 66 suburban passenger trains, about 24 through freights, and 90-100 transfer cuts and switching moves, thus totaling 222 moves daily. One of the through passenger trains has a regular stop at Naperville, and 8 have conditional stops at La Grange. Local suburban passenger trains stop at all the 25 stations. Express suburban trains stop only at certain stations. Trains must be on the outside track between Downers Grove and Cicero when making station stops. This necessitates extra crossover moves in interlockings.

Some of the inbound through trains are scheduled during the morning peak of inbound suburban trains. Therefore, these through trains must be run around the suburban trains. In the evening, the highball Chicago-Kansas City through freight scheduled to leave Clyde yard at 6 p.m., goes west with the evening suburban trains.

In order to secure track capacity to handle these peaks, either one way or the other, and to make run-around moves, interlockings including crossovers are located as shown on the plan, and main tracks are signaled for train movements in both directions the same as on single track.

The track on the north is track No. 1; the center one is track No. 2; and the one on the south is track No. 3.

Why So Many Interlockings

The Western Avenue interlocking includes switches leading to the west end of the Western Avenue yard. At this point the Burlington has a line extending south to numerous industries, and for interchange with 12 other railroads. A fourth main track, used by freight transfers both directions, extends from Union Avenue, Chicago, to Cicero, which is the east end of a new classification yard. Kedzie Avenue interlocking includes one single switch, seven crossovers, nine signals and electric locks on two hand-throw switches. This layout is used primarily to route trains from one main track to another.

Cicero B interlocking has to do primarily with main track moves at the east end connection to the new gravity classification yard. Cicero C interlocking deals primarily with yard lead connections at the east end of the yard which is on the south side of the main tracks in the area westward from Cicero C to La Vergne.

A large freighthouse and various warehouses and industries are located north of the main tracks. In order to move cars quickly in either direction between the yard and the freighthouse area, with minimum interference to main track trains, two single-track lines were constructed, at grade, from the yard across the three-track main to the freighthouse area. The crossing at the east end is included in inter-

(*Continued on page* 32)

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give better results than loudspeakers in front of him. The dispatcher says "regardless of which way I am facing, I get the impression that I am facing the person who is calling."

Of the seven keys, six are on voice circuits and one is a 20-cycle ring key. The six circuits are: (1) signal maintainer's circuit; (2) yard radio; (3) end-to-end radio frequency; (4) dispatcher's circuit; (5) yard line; and (6) loudspeaker line between interlocking towers. The indication lamp is for radio transmitter "on."

Three loudspeakers are mounted on the wall at the right side of the room. Each of these speakers monitors one circuit: (1) the dispatcher's line; (2) end-to-end radio; and (3) the tower loudspeaker line. When the dispatcher is called on one of these monitor speakers, he operates the key for that circuit, which cuts out the monitor speaker and transfers the call to the two console speakers. He answers by stepping on his footswitch and speaking into his microphone.

Dispatcher's Circuit

The dispatcher's telephone circuit extends over the territory between Chicago and Aurora. To make a call on this circuit, the dispatcher operates the dispatcher key and when signaling is necessary operates the 62A selector. When the operator answers, his voice comes in on the two console speakers. The dispatcher replies using his footswitch and microphone. For standby, all dispatcher circuit equipment can be switched to a message line which likewise is connected to all the phones. The yard line is a telephone circuit, 20-cycle ringing, that connects the interlocking towers. When the interlocking consolidation is completed, this line will probably be used as a standby circuit. The same will apply to a loudspeaker line that connects all interlocking towers, which also terminates on the dispatcher's console.

Talk-Back Circuit to Maintainer

When the dispatcher desires to call the signal maintainer, he operates his signal maintainer circuit key and calls in the conventional manner, his voice being reproduced on a wall speaker in the relay and equipment room. This is a talk-back speaker, so that the maintainer need only talk toward it to answer. If he is working near the signal equipment racks, he takes a portable talk-back speaker with him and plugs it into one of the jacks on the talk-back circuit. The dispatcher's call is also reproduced on this speaker. To signal the dispatcher, the maintainer presses a button on the speaker, which actuates a buzzer at the dispatcher position. To hold a conversation, the dispatcher must answer, the maintainer can only signal that he wants to talk to the dispatcher.

Standby operating equipment, such as amplifiers and pre-amplifiers for the dispatcher are in duplicate. Each voice circuit that has a monitor speaker has its own receiving amplifier, and when the dispatcher operates a key to "get on" the circuit, the input is switched over to an operating amplifier. Switching is done at zero level. Receiving amplifiers including the pre-amplifiers have automatic volume control, and band-pass filters for noise elimination. The speakers in the console have volume control which can be adjusted by the dispatcher. Design and engineering of these communications facilities were performed by E. F. Hutchinson, communications engineer, under the jurisdiction of T. W. Wigton, general superintendent communications.

CB&Q Interlocking

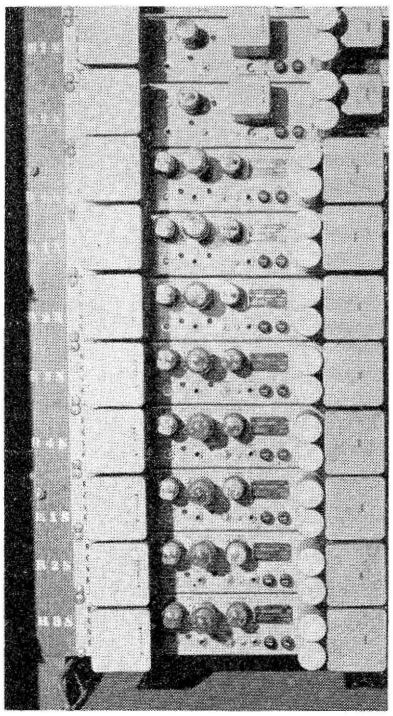
(Continued from page 21)

locking Cicero A which also includes four main track crossovers. The crossing at the west end is in La Vergne interlocking which also includes nine crossovers at the west end of the classification yard.

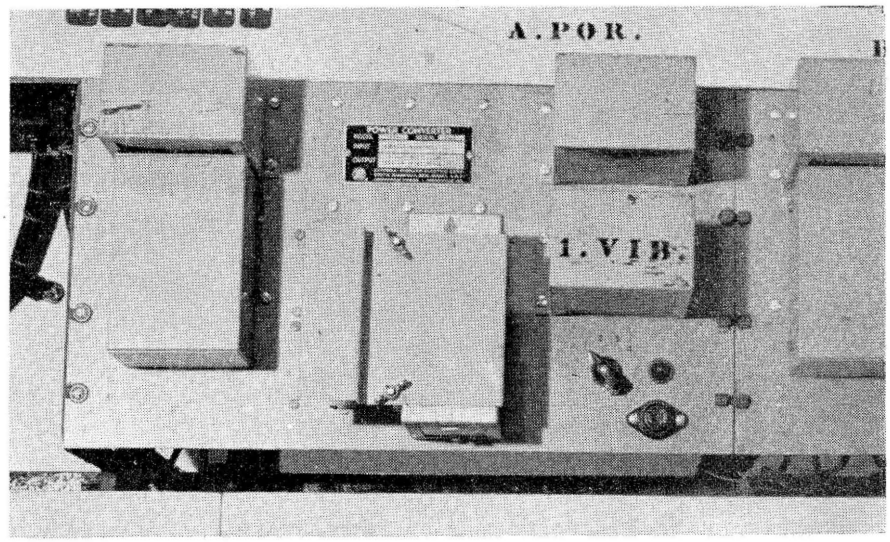
Congress Park interlocking includes five main track crossovers and a crossover to a yard track that extends to an interchange connection with the Indiana Harbor Belt. The interlockings at Highlands, West Hinsdale, Fairview Avenue, Downers Grove and Naperville are primarily crossover layouts. Eola interlocking includes the connection to the east end of Eola yard as well as interchange connection with the EJ&E. West Eola interlocking includes a connection from west end of the yard to the main tracks.

When this project is completed, all of the 14 interlockings controlled from the dispatcher's machine will include modern 110-volt electric switch machines and color-light signals.

Mechanical interlockings each controlled locally were in service at Congress Park, Eola and West Eola. Electric interlockings each controlled locally were in service at Western Avenue, Kedzie, Cicero B, La Vergne and Downers Grove. Electric interlockings at Highlands and West Hinsdale were controlled



Rack-mounted carrier equipment



Tuned alternator power converter, 48 volt d.c. to 115-volt a.c.

remotely, since January 1954, from Congress Park using a machine which was an advance model of the practices used in making the consolidated control machine at Cicero.

The interlockings at Fairview Avenue and Naperville are not as yet constructed but will be new electric plants.

Furthermore, signals at these interlockings, all controlled by the dispatcher, serve also to authorize train movements through an interlocking, and through the block to the next interlocking. Thus this entire multiple-track terminal territory, 35.37 miles long including 110.25 miles of main track, is actually centralized traffic control, all controlled from the dispatcher's machine.

Line Code Operates Quickly

Early in the planning, the Burlington signal engineers realized that the success of the control of these 14 interlockings from one office, would depend primarily on much faster handling of outgoing controls and incoming indications, than had been known previously in conventional practice. The specification set up by the Burlington was that a separate independently operated coding system be used between the office and each of the 14 interlockings so that the line coding system between the office and any or all of the interlockings can operate simultaneously without interference. Furthermore, controls can be sent to any interlocking and indications can be returned from any interlocking simultaneously. One requisite was that, as applying to any of the interlockings, the system must provide for controls to go out and indications be returned within a total maximum of 3 seconds. The entire system operates on one pair of line wires and the system is arranged so that the control office could be located at any place on the territory, or remote therefrom.

Basically, the system known as Quikode made by the General Railway Signal Company, uses conventional relay stepping code apparatus. To reduce code time, station selection coding is eliminated by using certain carrier frequencies as applying for controls and indication to and from each interlocking. Further reduction in code time is accomplished, as for example as applying to La Vergne, by using one outgoing carrier frequency to control switches "normal" and signals at "stop," and a second frequency for switch "reversed" and signal "clear." By this means, controls to any interlocking involving a maximum of 16 controls (32 bits of information) can be sent out in 0.70 seconds. La Vergne has 32 controls, including 5 spares, requiring 1.26 seconds. Including 5 spares, a total of 90 indications can be sent in from LaVergne. Three carrier frequencies and one monitor frequency are used to handle any or all of these indication codes in 1.26 seconds. Thus the total of two times 1.26 equals 2.52 which is less than the specific 3.0 second maximum. The carrier frequencies are in the range between 5 kc and 35 kc. For La Vergne the outgoing carriers are 16.8 and 16.3, and the incoming are 28.1, 28.7, 29.3 and 29.9. The minimum separation is 0.5 kc. For the project as a whole, there are 64 line frequencies and, for each frequency, the carrier transmitter and receiver equipment in the office and at the field locations, is in duplicate. The carrier is

normally energized. If the receiver of any frequency fails to receive for a pre-determined time, a checking relay automatically changes connections to cut in the standby carrier equipment at the office and at the field locations, and an indication to this effect is shown on the dispatcher's machine. Thus the vacuum tubes in the carrier equipment may be allowed to remain in service until they fail, or show evidence of possible failure.

The line coding carrier is on one pair of line wires which are No. 6 Copperweld with a tape and neoprene covering. These wires are on two track side pins on the top arm of the pole line. This circuit is transposed for 30 kc. A duplicate standby line circuit of the same construction is provided. If the normal line circuit should fail, change over to the standby line circuit is automatic around interrupted sections of the code line.

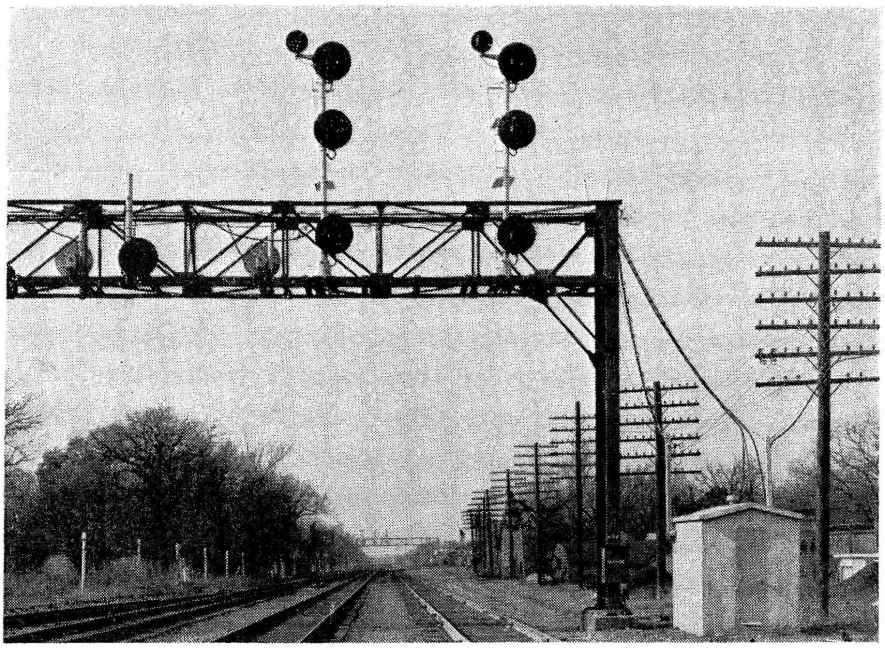
In the equipment room adjacent to the control office there are 12 sets of storage battery to operate all circuits and equipment. The office coding equipment is operated by four 48-volt sets of battery. Separate fused busses connect to the coding equipment for each interlocking. Eight sets of 24-volt battery are used to feed the NX circuits. The 115-volts for operation of the carrier equipment is normally fed from commercial a.c. If this fails a power-off relay automatically cuts in two Cornell-Dubilier tuned alternators fed from the 48 volt battery, to supply a.c.

At each of the interlockings in the field the switch machines are fed by one set of 110 volt battery. The 10-volt local controls are fed by two sets of 10 volt battery. The carrier equipment is normally fed from commercial a.c. but if that fails a motor generator is fed from the 48 volt code battery. These storage batteries are the lead type made by Exide.

Four Aspect Signaling

All three main tracks throughout this territory are equipped with automatic block wayside signals. Between Chicago and La Vergne the blocks are about 3,500 ft. long; between La Vergne and Downers Grove, about 4,000 ft. long; and between Downers Grove and Aurora, about 6,000 ft.

The crossovers between main tracks, used for diverging trains, are No. 20 with 30 ft. points, good for diverging moves at 50 mph. When a route through an interlocking is lined up for a train to make a



diverging move over a turnout or crossover, good for 30 mph or more, the interlocking home signal displays the Diverging-Clear aspect, red-over-green, and the automatic signal, in approach, displays the Approach-Medium aspect, flashing yellow. In this instance, the cab signal displays the corresponding Medium-Speed aspect, not only throughout the automatic block approaching the home signal, but also while the locomotive is passing through the diverging route.

A list, in the time-table, gives the maximum speed for each diverging route in the interlockings which are used for routing trains between main tracks. For example, "Downers Grove Track No. 1 to No. 2, good for 50 mph by passenger trains handled by diesel locomotives, operated with electro-pneumatic straight air brakes; 40 mph for other passenger trains; and 35 mph for freight trains." Thus the Diverging-Clear aspect indicates that the diverging route lined up is good for 30 mph or more, and the engineer knows how much more, according to the type of his train and the route in the particular interlocking, as listed in the time table, for example 50 mph as explained above. Thus the signaling, and timetable, aid the enginemen in bringing their trains up to and through the crossovers at the speeds for which they are designed. This saves much time.

The aspect of the home signal is governed, not only by the lineup of the route through interlocking limits, but also by track occupancy of the automatic block extending from the leaving end of the interlocking to the next governing signal. If the route through interlocking limits is lined up, but the home signal is held at the red aspect because a preceding train has not as yet left the automatic block, a lunar light mounted 22½ in. to the left of the top aspect will be lighted. This aspect, lunar over all red, indicates stop short of home signal, and then proceed through the interlocking, and enter automatic block beyond, at restricted speed, prepared to stop short of train of obstruction. Thus the lunar, in combination with the red, converts the absolute Stop aspect to a Stop-and-Proceed aspect. The benefit of the special lunar unit is to avoid delay to trains under the circumstances discussed. In such instances, the cab signal aspect is red-over-yellow, restricting, while the locomotive is in interlocking limits. When the preceding train clears the automatic block, the cab signal aspect in the second train changes at once from Restricting to a more favorable aspect. The restricting aspect might have been caused by a broken rail; therefore, the rules require that in case of a change from Restricting to a more favorable cab signal aspect, the engineman is to continue at restricted speed for the length of his train before increasing speed.

This project was planned and constructed by Burlington signal department forces under the direction of A. L. Essman, chief signal engineer. The new console type control machine, track diagram and line coding equipment in the office, as well as new switch machines and signals where required, were furnished by the General Railway Signal Company.