Simplified Interlocking Installed

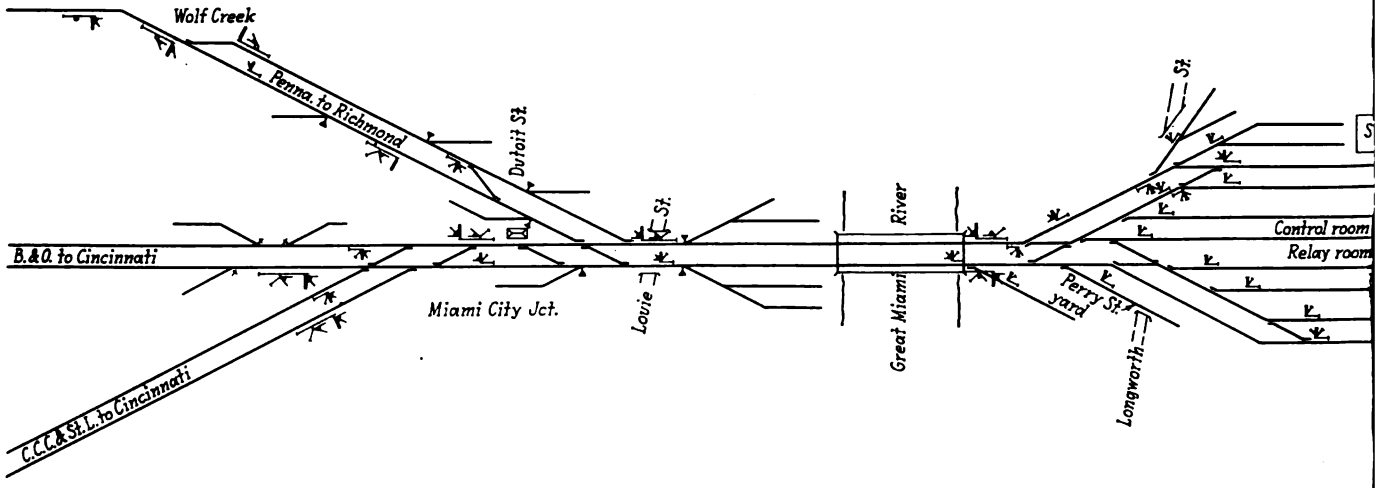
Centralized system with one control machine handles terminal layout formerly operated by five interlockings and several ground switch tenders

AN interlocking installed recently as a part of a major improvement of the Dayton Union Railway is of special interest not only because all train movements throughout the terminal area and junctions of the several roads are now controlled from the one point, but also because the latest type of C. T. C. control machine is used in connection with interlocking between circuits, thus eliminating the use of mechanical locking. The installation of the interlocking was part of an improvement program involving the elevation of the tracks for a distance of about one and one-half miles through the business district of Dayton.

The track layout through Dayton is unusual in that through traffic, both freight and passenger, of the several roads converges into one route through the business center of the city. Approaching Dayton from the east, the Pennsylvania and the Baltimore & Ohio have double-track lines, while the Erie and the Big Four have single-track lines which are used jointly as double track; and the Baltimore & Ohio also has another single-track line. All of these lines converge near Third street into a four-track line which extends to the east end of the station layout at South Main street where the two inside tracks develop into a six-track station layout served by platforms for passenger trains. The outside tracks, one on each side, are used ordinarily for through-freight movements, although any of the station tracks can be used for through movements in either direction. A double-track line extends west from the west end of the station layout from which two tracks of the Pennsylvania and two tracks of the Big Four diverge at Miami City Junction, while a two-track line of the Baltimore & Ohio continues westward. In addition to the three roads mentioned, which own the Dayton Union Railway jointly, the station facilities are used by the Erie and the Dayton & Union. The traffic handled through this terminal daily normally consists of 58 passenger trains, about 85 through-freight trains and heavy transfer cuts, and about 100 switching trains. In addition, switching movements are being made constantly in and out of the yards and industries in this territory.

Previous Operation Complicated

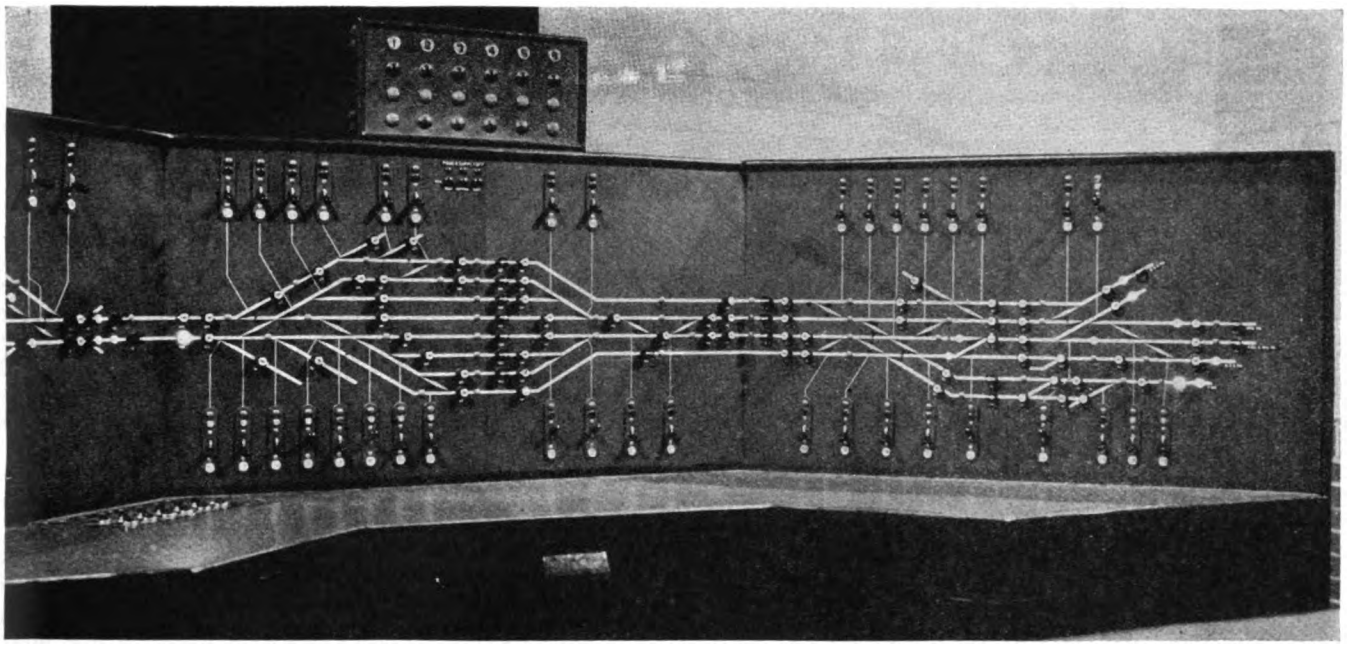
Under the previous operating arrangement, one train director, five operator-levermen, one operator and four switch tenders were on duty each trick, whereas now one train director and one operator handle the entire layout on each trick. One 37-lever mechanical interlocking was in service at the junction of the Baltimore & Ohio, Big Four, and Erie lines near East Second street; another plant of the same type with 8 levers was located at the Pennsylvania junction near Wayne avenue; a third mechanical plant with 8 levers was located at



Track and signal plan of extensive terminal layout controlled by one interlocking machine at central point

ıt the Dayton Terminal

to the east end of double track near Dutoit street, where another operator was on duty each trick. Therefore, in addition to the operators, levermen and switchmen relieved on the Dayton Union Railway, these six men on the Pennsylvania were displaced by the new interlocking system, a total of 39 men formerly as compared with 6 at present.



The control machine is in three sections so that all levers are within reach

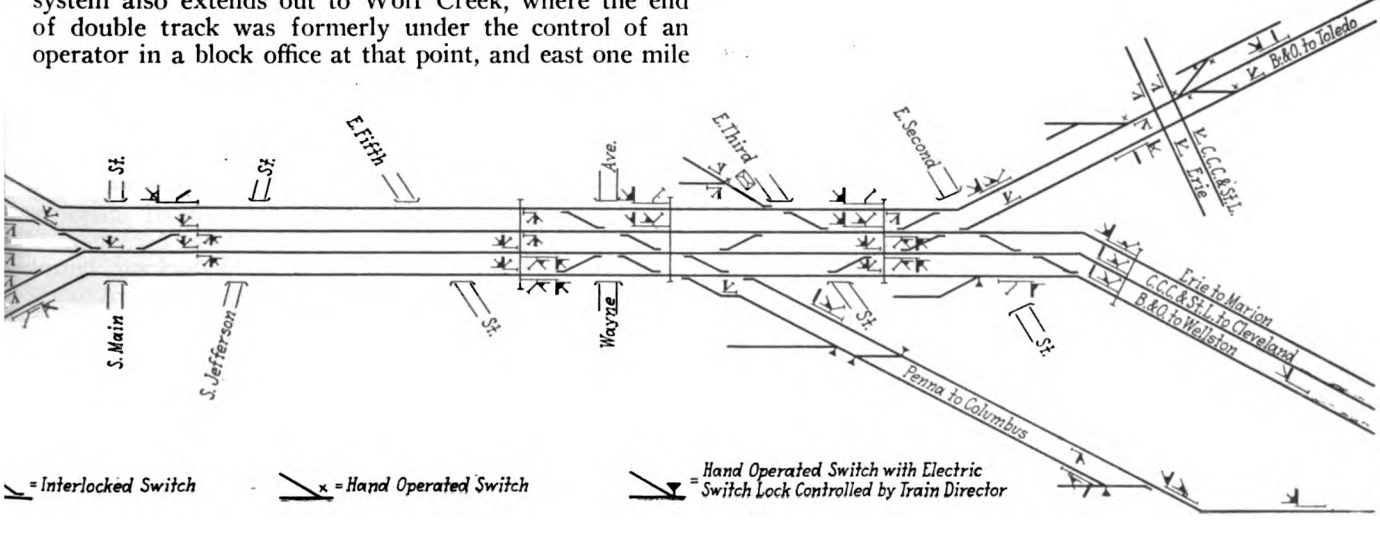
the east end of the station layout near Jefferson street; a fourth plant with 36 levers was located at Miami City Junction, and a fifth plant controlled the end of double track at Wolf Creek, two miles out on the Pennsylvania.

In addition to the interlockings, one switch tender was employed each trick at (1) the east end of the station tracks, (2) the switches leading to the Perry Street yard, (3) the switches and crossovers near Longworth street, and (4) the switches near the east end of the Miami River bridge. The five interlockings mentioned have been eliminated and the switch tenders dispensed with, all of the switches and signals now being included in the new electric interlocking under the control of the train director, assisted by an operator who handles communications with switching crews, as well as with dispatchers of the connecting roads. Furthermore, the new system also extends out to Wolf Creek, where the end of double track was formerly under the control of an operator in a block office at that point, and east one mile

Train Operation Decidedly Improved

Under the previous system of operation, the train director made arrangements for the movement of trains by telephone, directing the various levermen and switch tenders at the different locations to line up the routes desired. Standard rules were in effect for operation on the double track, which required the use of train orders if a move was to be made against the normal direction of traffic. Ordinarily passenger trains were handled without much delay, but frequently freight trains and switching cuts were seriously delayed because the line-up could not be changed immediately to take advantage of changed circumstances.

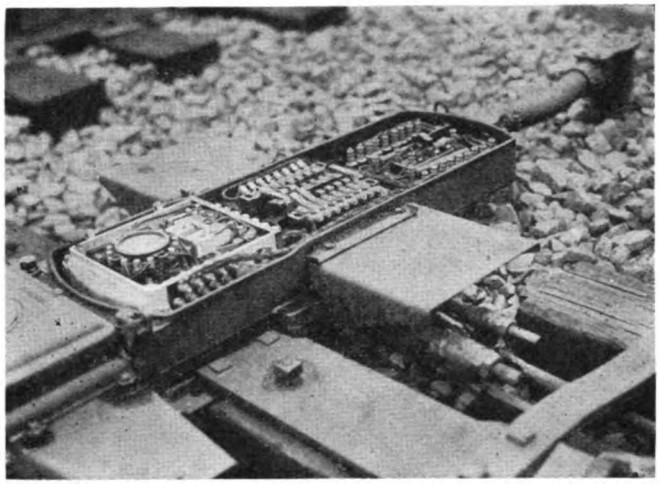
In contrast with this condition, the train director now has direct control of the entire area. As trains are now run by signal indication in either direction on any track,



the train director can choose routes for run-around moves in such a way as to utilize every available facility to keep trains moving. Regular switching movements in the station to pick up or set out passenger equipment are now made without delay, the signals directing the moves without occasion for communication with the switching crews. Irregular movements are made after such information is communicated by telephone.

The Control Machine

The control machine is located in the train director's room on the station concourse level beneath the elevated



The switch machines are the G-R-S 110-volt d-c. type

track structure, so that the director cannot see the track layout, but he is informed as to the exact location of all trains on the main tracks of the Dayton Union Railway as well as on the various lines approaching, by means of the illuminated diagram on the machine. This machine is of the same general appearance as those used in centralized traffic control systems and is somewhat similar to the machine installed by the Big Four in an interlocking at Linndale, Ohio, in 1930. However, the type and location of the levers and the indication lamps are improvements over any machine previously installed, the machine and control circuits representing the latest developments in this field. The control board consists of three panels, in front of which the director sits. In order that all levers may be within easy reach, the two end panels are set at 45 deg. with the central panel forming the chords of a circle. Each panel is 23 in. high and 40 in. long.

The plant includes 22 crossovers and 25 single switches, each crossover being controlled by one lever the same as a single switch, making a total of 47 switch levers. The machine includes 21 traffic-direction buttons which provide the equivalent of check locking between groups of interlocking, and 11 buttons operated by the director for controlling electric switch locks on a number of hand-throw switches leading to industry tracks. Each signal button or knob is located on the control board in a position corresponding to that of the signal on the ground, and its normal position is marked by a white dot; the desired indication is displayed by the knob being rotated one-quarter turn to bring this dot to the top when displaying the high or semi-automatic indication, or turned down to display a low-speed or call-on indication. A frosted glass in the center of each knob has a black arrow indicating the direction for which the signal is displayed, this arrow being illuminated when the signal is indicating proceed.

Each switch or crossover is operated by a small lever located on the control board either above or below the track diagram, a line extending from the lever to the diagram showing which switch is controlled. The lever operates to two positions, in a vertical direction: down for the switch normal and up for reverse. Two small lamps are located just above each switch lever. The top one, which is yellow, is lighted when a switch is not in correspondence with the lever and is extinguished only when the switch movement is fully completed and is back into correspondence. The lower one of the two lamps is red and is lighted when conditions are such that no action would result from the operation of the lever. This lamp, known as the "hands-off" light, informs the director either that he has a signal cleared over that route, thus locking the switch in its present position, or that there is a train occupying the track, which likewise locks the switch. Therefore, nothing would be accomplished by operating the lever. Moreover, the "hands-off" light is lighted and the switch is locked when the signal lever for that route is operated, thus giving the effect of mechanical locking. If the switch lever is moved when the switch is locked (red light is lighted) the correspondence light also lights, and both lights remain lighted even though the condition, which originally lighted the red light, is corrected. In other words, the only way to produce operation of a switch is to move the lever from the position of correspondence when the red light is not lighted.

Movable switch points are provided in the track diagram, these miniature points being moved by magnets which are so controlled from the switch-repeating relay that after the track switch is over and locked, the point on the diagram moves to the corresponding position, the result being that the train director can glance down the track line on the diagram and follow through the entire route which is lined up. This, then, is an efficient means of checking routes, as compared with having to check lever positions.

An important feature of this plant is that there is no mechanical locking between the levers, as ordinarily used in interlocking. The director is free to move any lever at any time, incorrect operation being prevented by the interconnections of the control circuits. For example, if the director lines up a switch and clears a signal for the route over the switch, he may again operate the switch lever, but the switch will not operate until he has replaced the signal lever to normal and again moved the lever, thus changing the indication to Stop and enforcing the elapse of a time-locking period before the switch could be moved. One of the advantages of having no mechanical locking is that levers can be operated quickly without waiting for indications and without being confined to a certain sequence in the operation of the levers, all of which facilitates the changing of line-ups, thus preventing train delays.

Electric Locks on Hand-Throw Switches

As mentioned previously, trains can be operated in either direction on any track, the direction of operation to be used being fixed by a traffic-locking arrangement controlled by the position of a traffic-locking button mounted in each of the major track sections. A white arrow on the face of the black button points in the direction of the traffic set-up, the button being turned in one direction or the other, as desired, to set up the desired direction of traffic.

Within the interlocking limits are 26 hand-throw switches in turnouts leading from the main tracks to industry tracks, and all of these switches are protected

by electric locks under the control of the train director. The electric switch locks for all switches located between a set of opposing signals are controlled by a single button on the control machine, this button being located in a position on the diagram corresponding to the territory in which the switches are located. These electric lock buttons are similar to the signal buttons, but are red instead of black, and display the letter "L" instead of an arrow. When the conductor of a switching crew telephones the director, asking permission to use a certain switch, the director turns the button, unlocking the electric switch lock. When the switchman unlocks the switch, the lamp is lighted in the director's control button, and stays lighted until the switch is returned to the normal position and locked, after which the director restores the button to the normal position, again locking the switch. All signals governing the section of track involved are automatically held at Stop while the switch is unlocked.

Train-Starting System

For the starting of trains, a small case with six sets of three lamps each is mounted on top of the control machine, while the push-buttons for the operation of this system are countersunk in the top of the director's desk. Corresponding units of this train-starting system are located at the gates in the station concourse, and on certain columns on the train-shed platforms. One minute before a train is ready to depart, the conductor pushes a button on the platform unit, which lights a red light on the director's desk for the corresponding track. The director, if ready for the train to depart, pushes the corresponding button, thereby lighting his own yellow light and a yellow light at the gate, thus directing the gatemen to close the gate for passengers. When all the passengers are through, the gateman pushes a button which lights a green light on his gate unit, on the director's unit, and on the conductor's unit. The director then clears the signal for the train to depart and after it passes the signal he pushes a button which returns the entire train-starting system to normal.

Outside Equipment

The switches are operated by 110-volt d-c. General Railway Signal Model-5C switch machines. The signals are the position-light type, high signals being used on bridges or masts for the approaches and at the principal junction points, while dwarf signals are used throughout the station area.

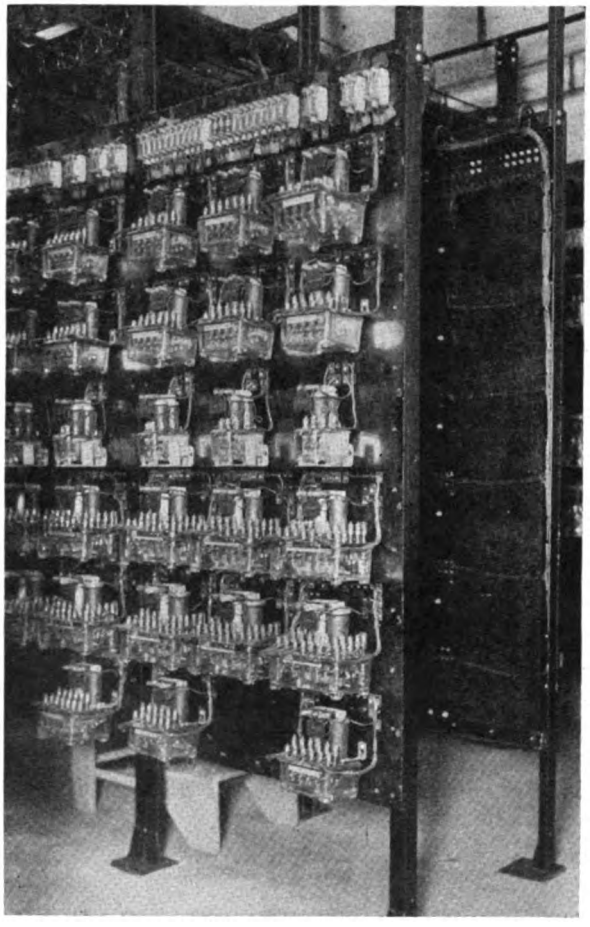
A unique feature of this installation is that no relay boxes or battery housings are located along the tracks, as is customary at such plants. All such apparatus is located in rooms or special buildings provided for this purpose. At the control point the relays, batteries, and charging equipment are housed in a room adjacent to the control room. All of the apparatus of this class for the east end of the interlocking is housed in a new brick building located on the north side of the tracks near East Third street. A similar building is located near the former location of the old Miami City Junction tower for housing the equipment required for the west end of the interlocking.

This concentration of field relay and battery apparatus in three locations has several advantages. In the first place, the right-of-way is free from instrument cases, thus improving the appearance. Second, the testing of equipment and the locating of trouble is facilitated. Third, the maintainer is not subject to so much hazard in crossing tracks from point to point. Finally, the apparatus is protected much better against dust, dampness, and changes of temperature.

Underground cable is used for all circuits between the central office and the two outlying buildings, as well as to the various signals and switches. Throughout the area covered by the station platforms, lead cable was run in conduit, but beyond this area parkway cable was buried in the ballast. On the decks of bridges over streets where the cable could not be buried full two feet, the cables were run in two-inch iron pipes.

The Power Supply

Connections from the local power lines are carried in to a board in the central tower as well as to a board in each of the two outlying buildings. The power switches and all control circuits are operated by direct current from storage batteries charged from the a-c. supply through rectifiers. At each of these locations, there is a set of 56 cells of 120 a. h. storage cells to furnish the

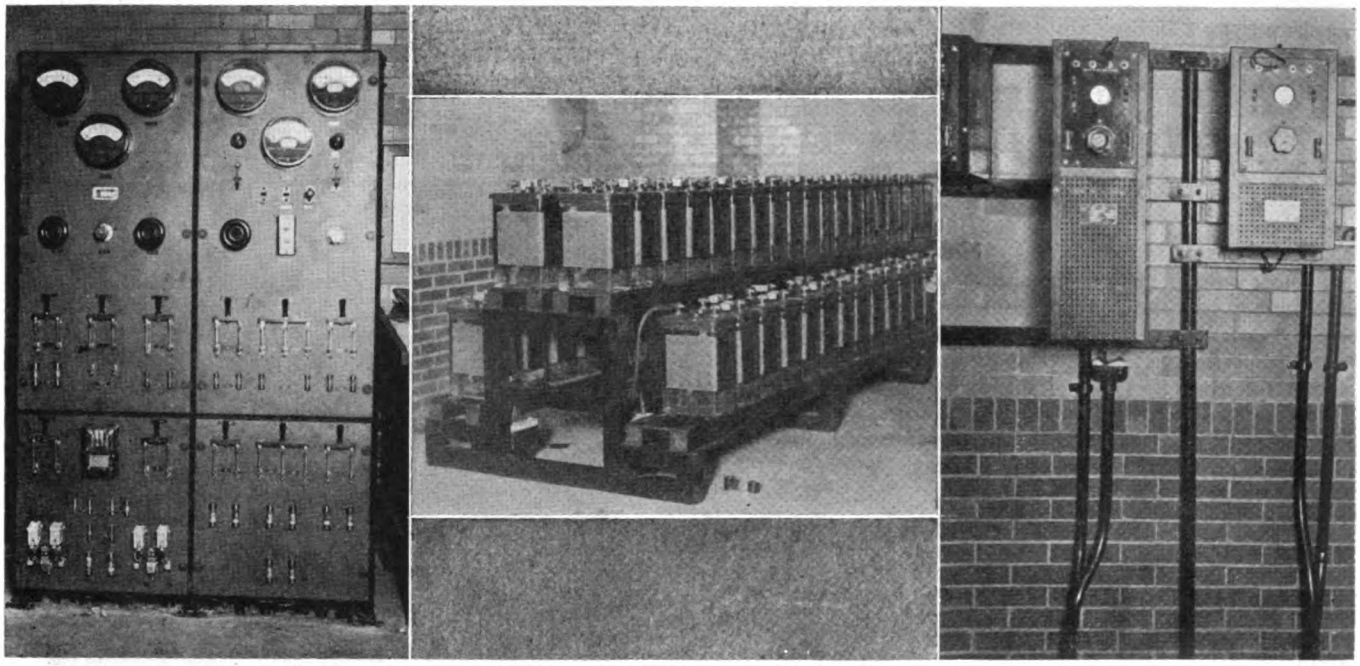


The relays are the wall type mounted on asbestos board fastened to angle-iron uprights

110-volt d-c. feed for operation of the switches. Likewise, at each point there is a 20-volt set and a 10-volt set of the same type of battery used for control circuits. One cell of 80-a. h. battery is used for each track circuit. All the storage battery is of the Exide manufacture.

The signal lamps operate on alternating current normally secured from the outside source. In case of a power outage, a motor-generator set, which starts automatically, will carry the signal load. This motor generator takes its d-c. supply from the large storage battery set and can carry the load for several hours. There is one of these motor generators at each battery location. There is a set of indicators which show when the normal ac. supply is cut off from each source. If the power

comes back in a short time, the automatic switch arrangement cuts the signal feed back to the a-c. source and shuts down the motor-generator. However, if the train director sees that the outage is to continue for some time, he calls the maintainer who can start a gas-engine-driven a-c. generator set to carry the load so that the motor-generator can be shut down, thus preventing a continued drain on the main storage battery. This gas-engine set is started by a push button control, the electrical part of the machine functioning as a 110-volt d-c. motor fed from the storage battery until the gas engine is started, at which time the d-c. is shut off and the machine starts to function as an a-c. generator. These gas-engine generator sets, there being one at each battery location, have each a capacity of 3 kv.a. at 125 volts and are thus capable of handling not only the signal lighting load but also provide alternating current for charging the storage batteries through the regular rectifiers. Therefore, the interlocking can be operated indefinitely entirely independent of the outside power source if necessary to do so.



The power switchboard, battery and rectifier equipment at each of the three towers is the same.

The Control Circuits

The control circuits represent the very latest developments in the field of interlocking. Safety was the first consideration, every effort being made to insure proper co-ordination of functions, not only in connection with regular operation, but also for unusual occurrences.

Another outstanding feature of the installation has to do with the circuits employed for the remote control and indication of the outlying functions, with a minimum number of wires. This problem was made easier by the fact that the means for co-ordinating the functions is at the sub-tower instead of at the control point as has usually been the case in the past. Thus the controls from the control machine do not involve safety and the indications are for information only and are not needed for checking purposes.

Two wires with a common return are employed between the control machine and the sub-tower to control and indicate a switch or crossover. One of these wires controls the switch and sends in an indication when the electric locking will not permit the switch to respond to the lever. The other wire indicates whether the switch is in one position or the other, or if it is in midstroke. The combined usage of the two wires indicates the occupancy of any one track circuit in which the switch or crossover is located.

One wire with a common return is used to control each signal, one polarity giving a high or medium-speed signal, and the other polarity giving a low-speed or call-on signal. One wire is sometimes used to indicate a single signal, but oftentimes to indicate several conflicting signals. The purpose of the signal indication is to afford a means whereby the train director can check his own work to determine that he has set up a complete route and that the signal is clear, thus avoiding a train delay in case that he overlooks some requirement.

The switch machines are operated on 110 volts d-c. which is distributed on 110-volt buses to the various switch machines, 110 volts a-c. serves the position-light signals from their respective control relays, and 110-10-volt transformers are located at the signals.

This interlocking plant is being operated and maintained under the jurisdiction of F. E. Jones, superintendent of the Dayton Union Railway Company. The interlocking equipment was furnished and installed by the General Railway Signal Company under the direction of J. D. Moffat, chief engineer of the Dayton Union Railway Company with C. F. Stoltz, signal engineer of the Big Four, acting as consulting signal engineer.

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The Southern Pacific's Old Kentucky Home

Prosperity came to Woodford County, Ky., the other day when the Southern Pacific turned over $98,500 in franchise taxes. As is well known, the Southern Pacific, although it has no tracks there or even in adjoining states, maintains its corporate offices in Kentucky. The offices were recently moved from Anchorage, near Louisville, to Spring Station in Woodford County.