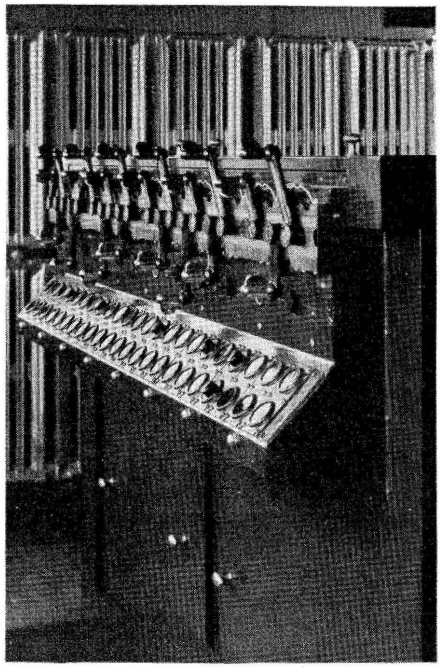


Right—The new interlocking machine is the Model-14. Left-Pere Marquette freight train, bound for Clearing yard, on the Belt northward main track, showing signal 14LAB at the east end of the new plant

Belt Railway of Chicago

Electric plant replaces layout formerly handled by hand throw switches and crossovers at busy layout, thus increasing the safety and eliminating numerous train stops and delays of trains

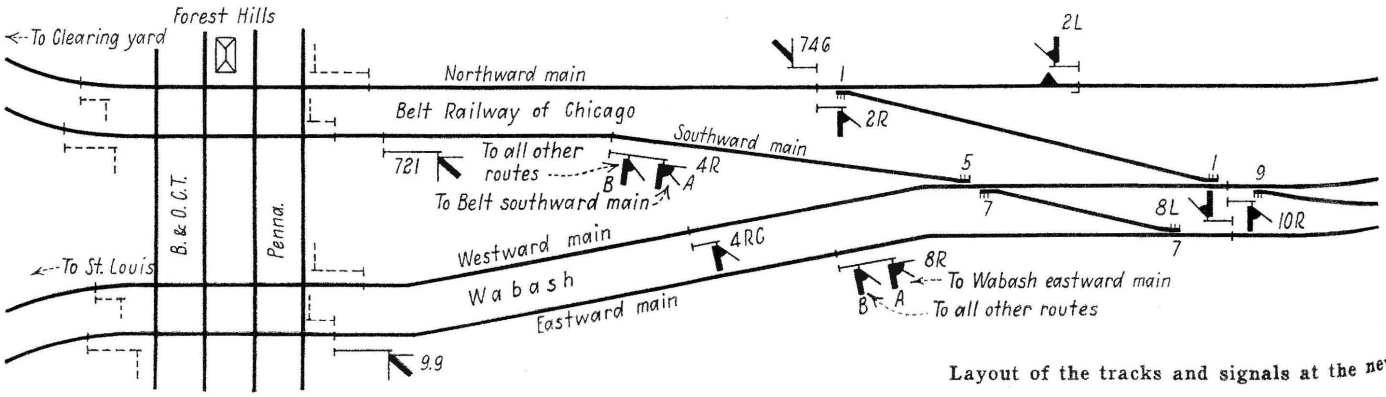
THE BELT Railway of Chicago has recently installed and placed in service a new Type-F electric interlocking at 75th Street and Loomis boulevard in Chicago, covering a crossing and junction with the Wabash at that point.

As shown in the accompanying diagram the tracks within home signal limits of this new plant lie in an east and west direction. Beyond the west end of home signal limits and on the north side of the right-of-way are the two main tracks of the Belt Railway extending to the Clearing classification yards and north. Likewise at the west of the home signal limits but to the south side of the right-of-way are two main tracks of the Wabash on the route between Chicago and St. Louis.

Beyond the east end of home signal limits and at the north side of the right-of-way are two main tracks of the Wabash extending east and then north to connect near 74th Street with the main north and south line of the Chicago & Western Indiana extending to the passenger terminal Polk and Dearborn Streets in downtown Chicago. The passenger trains of the Wabash as well as freight transfer cuts between yards and downtown freight stations use the route through the new Loomis Boulevard plant.

Belt Railway Tracks

In addition to the two tracks used primarily by the Wabash beyond the east end home signal limits of the Loomis Boulevard plant, the Belt Railway operates over four main tracks which extend east and south and connect directly or indirectly with various main lines and yards of several railroads, including the Pennsylvania, Chicago, Rock Island & Pacific, Illinois Central, Chesapeake & Ohio,



Layout of the tracks and signals at the new

Chesapeake & Ohio freight train, bound for Clearing yard, on the Belt northward main track, showing home signal 4RAB at the west end of the new electric plant

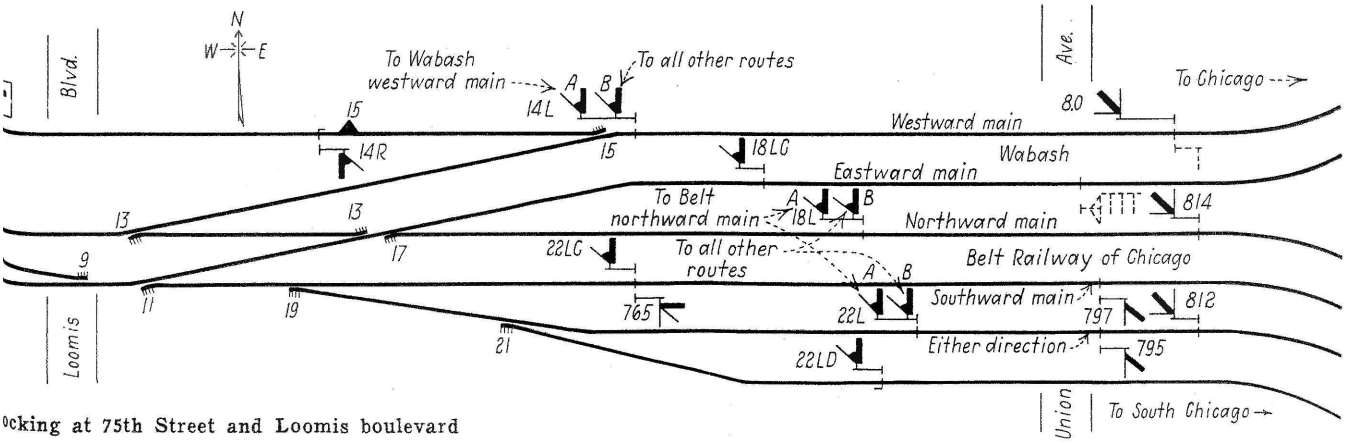
Installs Interlocking

Pere Marquette, Chicago, Indianapolis & Louisville, Erie and Chicago & Eastern Illinois. Freight trains of the various roads mentioned as well as the Belt Railway are operated through the Loomis Boulevard interlocking on routes between the two Belt Railway tracks at the north side of the right-of-way west of the home signal limits and the Belt Railway tracks at the south of the right-of-way east of the home signal limits. Thus the route used by these trains crosses the route used by the Wabash trains. Prior to the elevation of the tracks through this territory some 20 years ago there was a crossing of the Wabash and the Belt Railway tracks located at Union Avenue about a mile east of Loomis boulevard. During the elevation program the crossing was eliminated and a track layout of switches and crossovers somewhat similar to that now in service was installed at Loomis boulevard. Starting as a temporary measure at that time, No. 8 and No. 10 turnouts with hand throw stands were used, and in the intervening years the routes have been lined by switch tenders. On account of the fact that the routes crossed each other, all trains were required to stop. In order to obviate these train stops, a decision was made to install the interlocking. In addition, to reduce delays, new No. 20 turnouts and crossovers were installed as a part of the improvement program.

Signal Aspects and Indications

The time-tables are in terms of northbound and southbound trains. As confined to this article, the terms westward and eastward signals will be used in the following explanations.

For the normal Stop indication all home signals display a red-over-red aspect and the dwarfs a single red light. The home signal 4RAB, on the main track of the Belt at the west end of the plant, displays green-over-red for Clear when switch 5 is reversed, crossover 7 is reversed, crossover 9 is normal, switches 11 and 19 are normal and dwarf automatic signal 79, at the other end of the plant on the Belt main track, is at yellow for Approach. If signal 79 is red for Stop-and-Proceed, signal 4RAB will display yellow-over-red for Approach over the same route. Signal 4RAB will display a red-over-yellow aspect for Restricting as a call-on signal, or to all other routes other than the one just explained. Dwarf signal 4RC, which, with signal 4RAB, are selected over switch 5, governs reverse movements from the Wabash main track to the Belt southward main track, and displays yellow for Restricting when cleared. Dwarf signals 2R and 2L,



Ocking at 75th Street and Loomis boulevard

governing movements over the west end of crossover 1 between the Wabash westward main track and the Belt northward main track, display yellow when cleared. High signal 8RAB on the Wabash eastward main track displays green-over-red for a movement to the Wabash eastward main track at the east end of the plant, with crossovers 7 and 9 and switches 11, 13 and 17 normal and the home signal at Hamilton Park clear. If the home signal at Hamilton Park is at Stop, signal 8RAB displays yellow-over-red. Signal 8RAB will display a red-over-yellow aspect as a call-on signal, or to all other routes other than the one just explained. Dwarf signals 10R and 8L display yellow when cleared. Dwarf signal 14R, governing movements from the side track to the Wabash westward main track displays yellow when cleared. High signal 14LAB on the Wabash at the east end of the plant displays yellow-over-red for a movement to the Wabash main track at the west end of the plant, with switches 15 and 13, crossovers 9, 1 and 7, and switch 5 in the normal position. This signal will not display a green-over-red aspect because it is the distant signal to a mechanical semaphore home signal at the crossing with the Pennsylvania and Baltimore & Ohio Chicago Terminal at Forest Hills. Signal 14LAB will display a red-over-yellow aspect as a call-on signal, and for all other routes besides this one. High signal 18LAB on the Belt main track will display green-over-red for a move to the Belt main track at the west end of the plant with switch 17 and crossover 13 reversed, crossover 9 normal, crossover 1 reversed, and automatic dwarf signal 764 at yellow. If signal 646 is red, signal 18LAB will display yellow-over-red. Signal 18LAB will display red-over-yellow for a call-on signal and for all other routes other than the one just explained. Dwarf signal 18LC on the Wabash governs reverse movements over switch 17. Signal 22LAB on the Belt track, signaled for either-direction running, displays the same aspects as signal 18LAB, but with switch 21 normal, switch 19 reversed, switch 11 reversed, crossovers 9 and 1 reversed. Signals 22LC and 22LD governing movements over switches 19 and 17, respectively, display yellow when cleared.

Call-On Signals

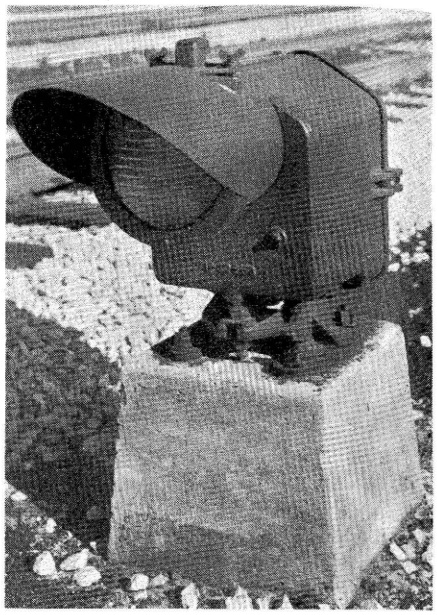
The signaling is flexible because of the provision for call-on aspects and controls for all signals. Moves into an occupied block, which could not ordinarily be made unless such signaling controls were in effect, can be made in any instance in this layout. However, it is impossible to give a call-on signal on both of two opposing signals at the same time, that would govern the movements of trains to an opposing and conflicting route. Such a case is checked by the standard mechanical interlocking of the machine, by lever position and by the interconnection of electrical circuits.

With the provision of call-on aspects and controls, for all of the signals throughout the plant, the track capacity is increased, thus reducing delays. This is an essential factor in this interlocking as many trains often follow each other on very close headway in both directions to and from Clearing yard.

Signals and Switches

The signal controls for all the signals are arranged for semi-automatic-stick operation. The signals are all the Union Switch & Signal Company's Style H-5 searchlight type with quick detachable plug-in operating mechanisms. The signals have 250-ohm operating coils, for operation on 10 volts, d-c., and are equipped with 10-volt, 13.5 + 3.5-watt, double-filament precision lamps. The lamps in the two-"arm" signals are fed at approximately 9 volts, while those in the back-up dwarf signals are fed at approximately 8.25 volts. All the searchlight signal units are equipped with close-up indication hot spot lenses. The dwarf signals are equipped with deflecting roundels, which provide an upward spread of light of 10 deg. The high signals have 20-in. backgrounds.

Outlying approach and automatic block signals of the H-5 type, as shown on the track and signal diagram, are included in this installation.



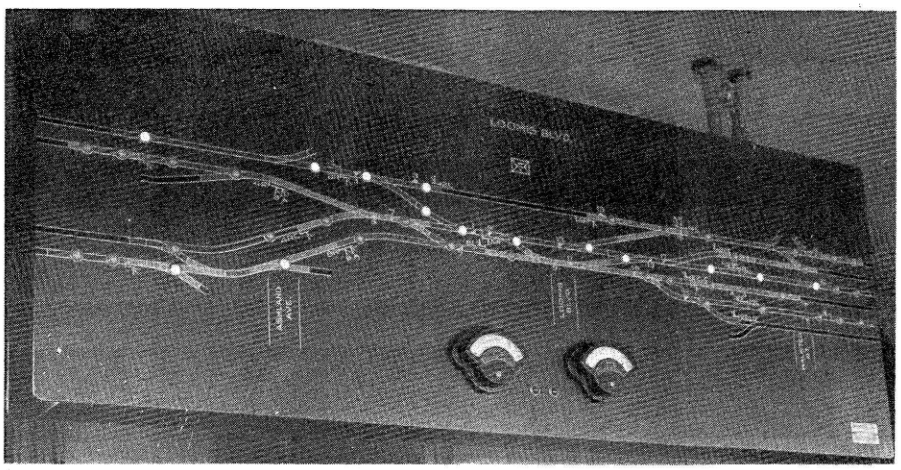
Typical H-5 searchlight dwarf signal

The switch machines on this installation are the Style M-2, equipped with Type-F controllers, and operate on 110 volts, d-c. Lock rods and point detectors are provided.

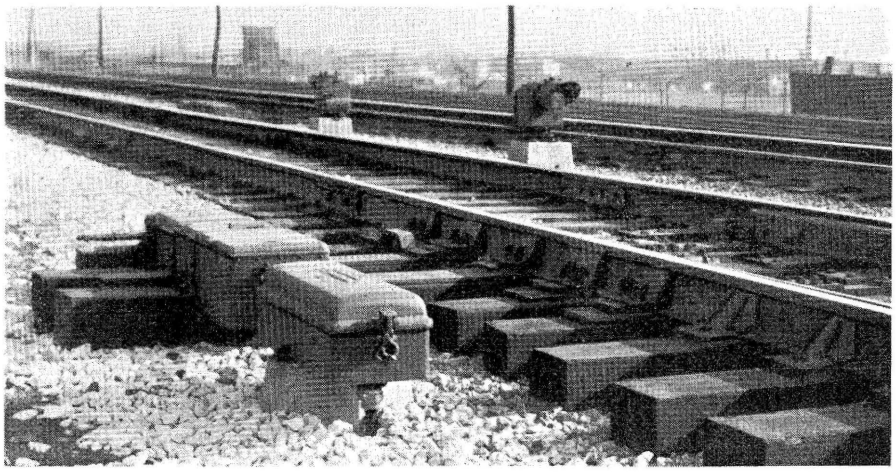
Interlocking Machine

The interlocking machine is the Union Model-14, and is composed of a 23-lever frame, with 11 switch levers to control 6 switches, 4 crossovers and 2 derails; and 7 signal levers to control 14 signals. In addition, one spare signal lever, one spare switch lever and three spare spaces are provided to accommodate future changes.

For displaying call-on signals, a push button is provided below each signal lever. When a block is occupied between home signal limits, and it is



Directly over the interlocking machine, an illuminated track and signal diagram is suspended from the ceiling by means of chains



Typical switch layout, showing rail bracing and Style M-2 switch machine. Note H-5 searchlight dwarf signals in background of picture

desired to admit a train into that block, as is frequently the case with following trains, the lever controlling the desired signal is manipulated to the proper position and the button which is stick, is depressed, retaining the call-on signal. It will be recalled that all signal units are otherwise semi-automatic-stick in operation.

Indication Panel

The standard arrangement of indication lamps is provided below the switch and signal levers of the interlocking machine. The indication control system is on the low-voltage polarized scheme. Also located on the indication panel, there are single push

Wabash train No. 11, "Banner Blue," at west end of the plant, showing signal 8R

buttons under signal levers 4, 8, 14 and 18 to enable the clearing of these signals for against-traffic moves. As mentioned previously, the signaling is arranged so that a signal can be displayed for any possible route throughout the plant. It will be recalled that the two-"arm" home signals at one end of the plant are arranged to have the top "arm" govern train movements to but one particular track at the opposing end of the plant, and over one particular route through the plant. The top "arm" clears immediately when the respective lever is thrown, providing the correct route is set and not occupied. If the route is occupied, the call-on button must be operated, which will clear the lower arm. However, in case any other route, except one leading to a track with the opposing direction of traffic, is set up and not occupied, the lower "arm" will clear immediately when the respective signal lever is manipulated. If such a route is occupied, the proper call-on button must be operated to clear the lower "arm," the aspect for any other route than that indicated by the top "arm," and the call-on aspect being synonymous. However, if a route is set up for a train movement from one end of the plant to a track at the opposing end, and the direction of traffic is opposing on that track, the lower "arm" of the home signal governing such a move will not clear immediately when the signal lever is operated.

Let it be assumed that the towerman desires to route a train from the Wabash westward main, by signal 14LAB, over switch 15 normal, over the west end of crossover 13, normal, over the east end of crossover 1, normal, over the west end of crossover 7, normal, over switch 5, normal, and by signal 4RAB on the Belt southward main track. This is an against-traffic move, and the push button under signal lever 4 on the indication lamp panel must be depressed after the route has been set up, the lever for signal 14LAB operated, to clear and hold the lower "arm" of that signal cleared. Providing that signal 4RAB is at Stop and has not been cleared for a similar opposing move, and lever 4 is in the center position, the towerman can move lever 14 to the "L" position. However, as mentioned before, the lower "arm" will not clear until the against-traffic button is depressed, which closes the control circuit to the H relay for that signal unit. This button must be held until the signal is accepted by the train, at which time the signal will assume the Stop aspect. If the same route is to be followed by a following train, and the limits between signal 14LAB and signal 4RAB are occupied, the lower arm can again be cleared for a synonymous indication as a call-on signal by depressing the call-on button under lever 14 and holding the against-traffic button under lever 4. The purpose of the against-traffic buttons is to prevent the immediate clearing of the lower "arm" of the two-"arm" signals, used as an indication to all routes, other than the one indicated by top "arm," when a route is set for an against-traffic move. When such a route is set up, the pushing of one of these buttons makes the towerman definitely realize that he is giving a signal for a train to proceed against the direction of traffic.

Siren Buttons

There are also two buttons together near one end of the machine on the indication lamp panel. Both of these buttons are for the control of an electric motor siren on the outside of the tower for calling the maintainer, etc. One button causes the siren motor to operate while the other is used to control the sounds. By having two buttons, clear and distinct sounds are produced, which would not be the case if merely one button was used, as the motor would have to stop and start several times in sounding certain code signals.

Indications as to the locations of trains are shown on an illuminated track diagram, suspended over the machine by two short chains from the ceiling at each end of the diagram. Opal lights, normally extinguished, are used to indicate track occupancy on various track sections at "OS" locations at the switch movements.

Mounted on the track diagram are two Weston meters for checking the 110-volt switch operating circuits, the voltmeter having a scale of 0 to 150 volts, and the ammeter 0 to 80 amp.

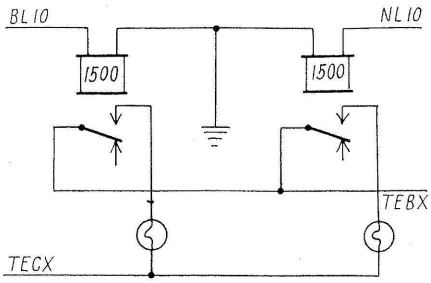
The machine is provided with complete electric locking, including ap-

proach, detector and route locking with sectional release. The group time release system is in service which necessitates but one clockwork time release for the whole plant. This release is located on the inside wall of the tower behind the interlocking machine. Whatever lever is on indication will be released after 2 min., 40 sec., for main routes, 1 min. for all other routes, and 15 sec. for back-up or reverse movements. Two yellow automobile fog lamps, suspended from the ceiling on a bracket made of 1½-in. by ⅛-in. strap iron, provide illumination of the interlocking machine and the interior of the tower. The advantage of this type of illumination is that it is spot instead of general illumination with the absence of glare.

Ground Indications

Between the two meters on the illuminated track diagram, there are two normally-extinguished red lamps. One of the lamps is illuminated should a ground occur on either the circuits fed from the 10-volt battery for control circuits, or from the 110-volt switch operating battery.

The accompanying diagram shows the circuit for the ground detector on the low-voltage battery circuits. Two Automatic Electric Company telephone type relays are connected in series across the battery for each circuit. The connection between the two relays is connected to ground permanently. For the low-voltage circuit, the spring tension of each relay is adjusted so that either of the



Ground light circuits

relays will pick up on approximately 6 volts, which requires approximately 1 volt from ground from the opposing side of the battery circuit, which would result with a 5-volt ground on either the negative or positive side of the battery. When either the negative or positive side of the battery is grounded in any control circuit, the respective ground relay is energized, and the red lamp controlled thereby is illuminated. The lamp will remain illuminated until the ground is eliminated and the relay released again.

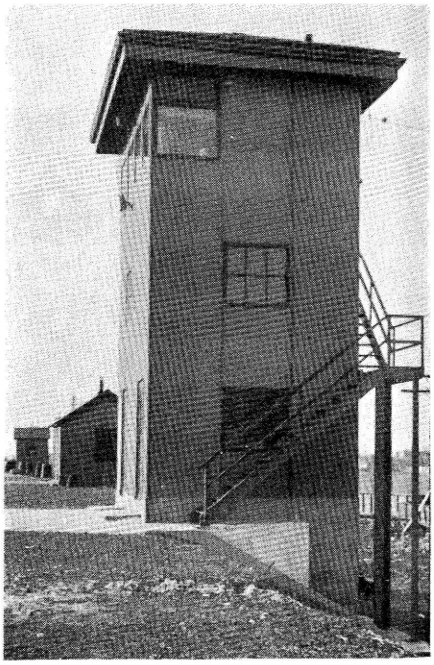
Insulated Sheet-Metal Tower

The tower at this interlocking is of special interest because of the type of construction. The foundation and basement are concrete poured in place, the ceiling section of the basement forming a floor at track level for the first story of the three-story tower structure, which is 12 ft. by 16 ft. The frame of the building includes a 4-in. by 4-in. I section and 3 in. by 3 in. angle uprights at each of the four corners, and 3-in. by 3-in. angle uprights every four feet along each wall. These uprights are set on the concrete of the ground floor level and extend to the roof line. At the floor levels for the second and third stories, steel cross beams as required were attached to the upright members, and crossmembers of lighter weights were provided at the ceiling line of the third story. The concrete floors for the second and third stories was then poured in place.

The walls of the building consist of standard width panels made of insulating material 1 in. thick enclosed on both sides as well as the edges with copper-bearing galvanized sheet metal with all joints sealed moisture proof. The panels are 4 ft. wide and come in different lengths as required. When the frame of the building was completed as previously explained, the edges of the wall panels are fastened to the 3-in. angles by metal molding by means of bolts through the molding and the 3-in. angles of the structure. Thus the joints between the panels are sealed and the wall panels are attached permanently to form a part of the building without drilling through or opening the seal of any of the insulated panels. This form of insulated wall panel is known as Ferro-clad, this material as well as the molding, steel structure members, doors, window frames, etc., being furnished by the Truscon Steel Company.

Windows and Doors

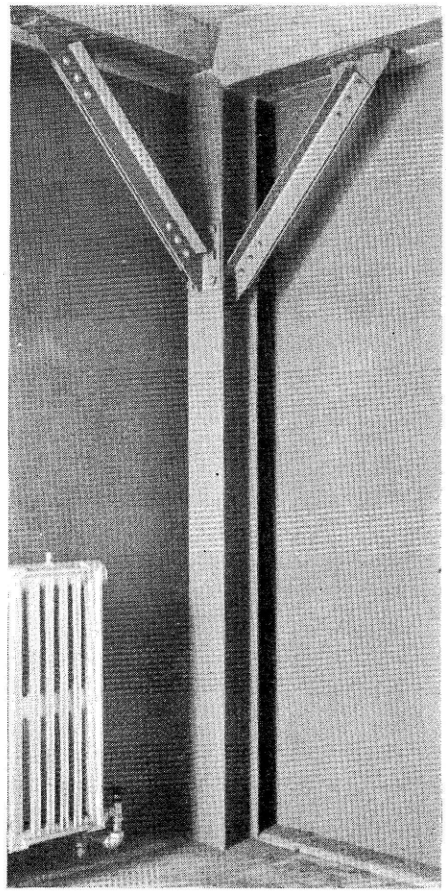
The window and door frames are of angle iron, the doors being sheet metal and the window frames metal. The windows are of the single-pane



The tower is on the north side of the right-of-way west of Loomis boulevard

type, arranged to swing out at the bottom. On the operating floor, windows extend along the entire side facing the track, with one window in each end of the tower. The ceiling of the operating story is sheetrock and the roof is slate. The open stairway, outside the building, is of steel construction and is supported on steel posts entirely independent of the building structure.

One advantage of the type of construction used for this tower is that it is fireproof, the only wood being that used for the floor in the operating room which was installed over the concrete not only to minimize dust, but also because a wood floor is less tiring for the leverman. A second advantage of this type of construction is that such a building can be erected



I section and angle uprights in a corner

at minimum cost, and, furthermore, if at a later date the building is no longer needed at its present location, it can be taken down and erected at some other point without loss of materials other than the foundation.

Heating System

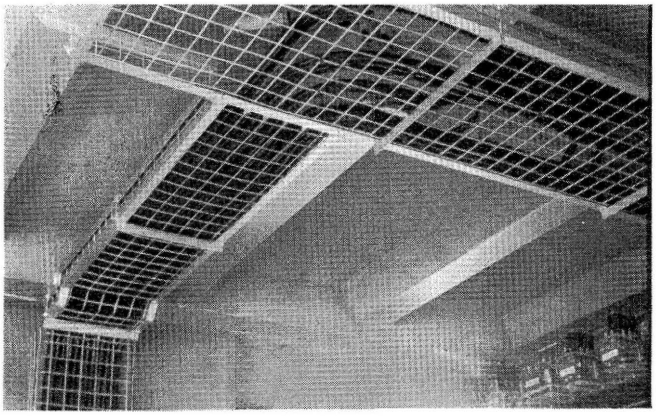
A coal-fired boiler in the basement supplies a hot water heating system for the building. The maintainer's shop and the battery room are located on the ground level floor, the partition being built of tile blocks. The relays are located in the second story and the third story is for the operating room.

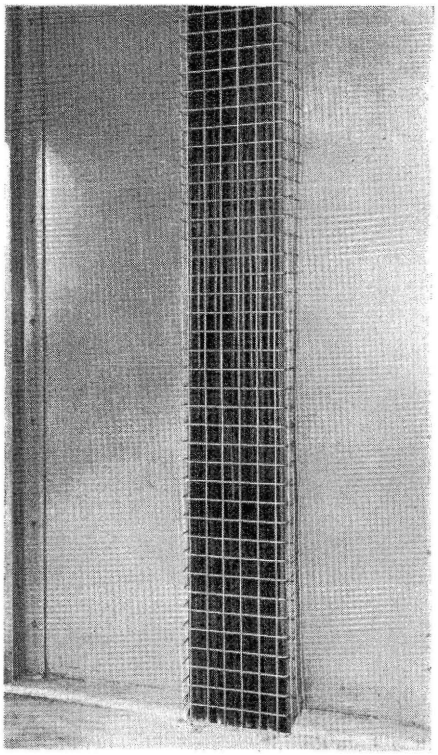
When designing the building, a study was made of a structure with a basement and only two stories. This would have required space for the relay room, maintainer's shop and battery room all on the ground level floor, thus requiring a building at least 12 ft. by 20 ft. By adopting the plan for a three-story building, 12 ft. by 16 ft. and using 7 ft. 6 in. ceiling height, only four or five feet had to be added to the total height, this expense being more than offset by the saving in the construction of the foundation, basement, and roof for the 12 ft. by 20 ft. building as compared with the 12 ft. by 16 ft. building.

Relay Racks and Tower Wiring

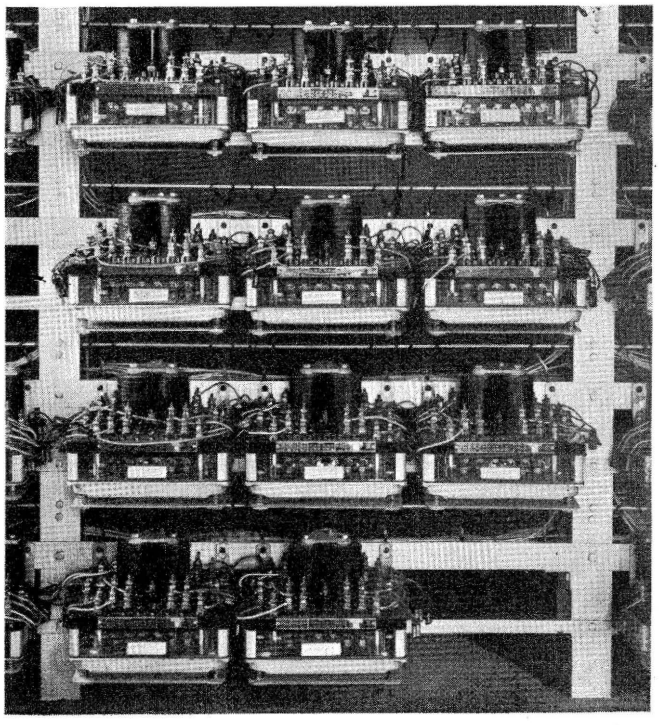
In the relay room on the second floor, the relays are located on an open type relay rack. This rack is made up of angle irons ⅛ in. by 1½ in. by 2 in., with supporting angle irons 3 in. by 1½ in. by ⅛ in. No shelves are used, the wall-type relays being supported on angle irons ⅛ in. by 1 in. by 1 in., spaced 15 in. apart. Round rods ⅜ in. in diameter, with National Copperweld cable rings used for wiring distribution on the racks. No terminals are used on the rack. On the relay racks as well as between the interlocking machine and the rack, jumper wiring is No. 16 single-conductor 19 strand with synthetic rubber insulation, but no braid. An advantage is that this wire is flame proof. A further item is that the jacket can be furnished in various colors. Yellow wire is used between the interlocking machine and the instrument rack, blue for cross connections between terminals of instruments on the rack, and red for connections between the rack and the terminals on the board on the first floor where incoming underground cables are terminated. The yellow wires between the machine and the rack and the red wires between the terminal board on the first floor and the rack are in 19-conductor cable formed with flame resisting outer braid.

The cables to the machine are run through the concrete floor from the machine in fiber tubes, 1-1/16 in. outside diameter, each cable being ¾ in. in diameter. The cables from the first floor come through the second floor in a rectangular hole to one side of the room, thence in a wire meshing run made up of 2-in. concrete reinforcing meshing to the ceiling. The run on the ceiling is made of the same material, but is supported by an angle iron frame made up of 1-in. by 1-in. by ⅛-in. angle iron. This run extends across the ceiling, under the tubes through the third floor, where the cables from the machine enter. The run then extends to the top of the relay rack. On the rear of the relay rack the cables are run on vertical

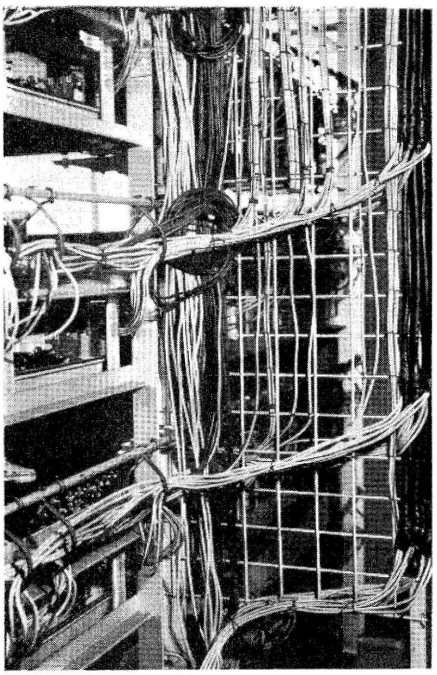




Left—The wire run on the ceiling in the relay room is made of concrete reinforcing meshing and supported by an angle-iron frame. Note cross-beams in ceiling. Right—Wire run of plain meshing on relay room wall



In the relay room of the tower, the relays are supported on an open type relay rack towards one side of the room. Only a portion of the relays are shown in view

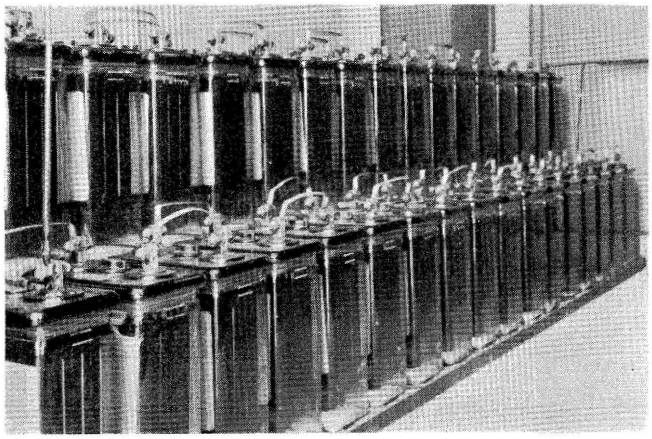


View showing the wiring distribution on the rear of the relay rack in the relay room. Note the cable rings and vertical meshing

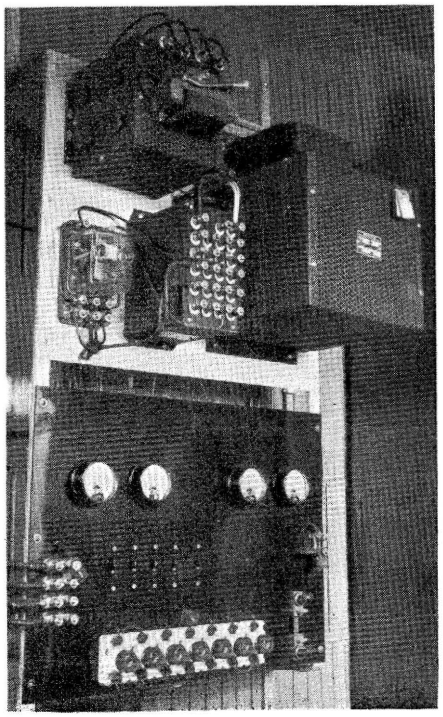
strips of 1-in. square, No. 13 gage wire meshing to which it is tied with marlin string.

Power Supply

Power is supplied at the tower at 120 volts, a-c., 60 cycles. The main battery for the operation of the 110-volt d-c. switch machines, located in the tower battery room, consists of 55 cells of Exide EM-7 120-a.h., eight-hour rate, storage battery. This battery is on a floating charge of 250 m.a. from a Union RP-41 copper oxide rectifier. The maximum d-c. output of this rectifier is 120 volts, 1.25 amp. In addition to this battery a separate set of five cells of Exide EM-9 160-a.h., eight-hour rate, storage battery is located in the same room. A set of five cells of the same type battery is located outside of the tower at each end of the interlocking for signal lighting in case of a power outage. This battery is used for the interlocking control circuits, and is on a floating charge of 11 volts, d-c., 0.6 amp. from a Union low-voltage 20-volt a-c. RX-42 copper-oxide rectifier, the maximum d-c. output of which is 13.5 volts, 2.2 amp. The rectifiers, low-voltage transformer and power-off relay are mounted on an asbestos panel. Directly below is a bakelite panel on which are mounted battery switches, terminals, fuses, and Weston ammeters and voltmeters to show the charging rates on the high and low-voltage batteries.



A portion of the main battery in the battery room of the new tower



Battery charging apparatus mounted on panels in the maintainer's room on the first floor of the tower

D-C. Track Circuits

Direct-current track circuits are used, circuits being fed from a cell of Exide EM-5, 80-a.h. storage battery, on floating charge from a 5-volt, a-c. R3X-104 copper-oxide rectifier, the charging rate of which is 3 volts, 2.2 amp. The feed to the track is adjusted by an 8-ohm fixed and a 25-ohm or 8-ohm adjustable resistance unit. The track relays are the 4-ohm DN-11 type. Each rail joint is bonded with a Cadweld welded rail-head bond.

Underground Cables

From the tower to various junction boxes, instrument cases and switches in the plant area, underground cable was used. Single-conductor No. 8 cable is used for the connections to the rails, and multiple-conductor No. 14 for other circuits. At the switch machine locations one 12-conductor underground cable enters the controller box through one hole. The 110-volt d-c. for the switch machine operation is distributed throughout the plant on No. 6 and No. 8 underground cables. Two or more No. 14 single-conductor cables for each side of the circuit are used between the junction boxes and switch machines. Stranded 12-conductor cable is used between the controller and switch machine. A 12-conductor No. 14 cable extends to each signal. On the high signals the cable is run on the outside of the mast.

The cable is made up of insulated conductors, filler, lead sheath, filler, two wraps of steel tape, filler and an outer covering of impregnated cotton duck, which was specified because of the long life as compared with jute. The insulated wires and cables on these installations were furnished by the Okonite Company.

This installation was handled under the general jurisdiction of F. E. Morrow, chief engineer, Belt Railway of Chicago, with planning by F. E. Beutler, assistant engineer. The construction work, in charge of W. L. Fox, general superintendent, was performed by company forces, under the direct supervision of C. B. Lomas, signal supervisor. The major items of signaling and interlocking equipment were furnished by the Union Switch & Signal Company.