A fast freight train passing a westward home signal bridge

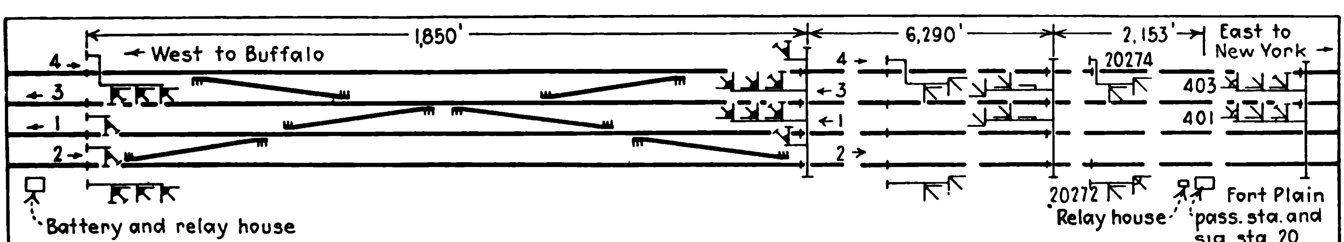
New N.Y.C. Interlocking Controlled by Syncrostep

Installs plant, including eight home signals and six crossovers between four main tracks, controlled by new high-speed line code system over two wires---Electric snow melters on switches

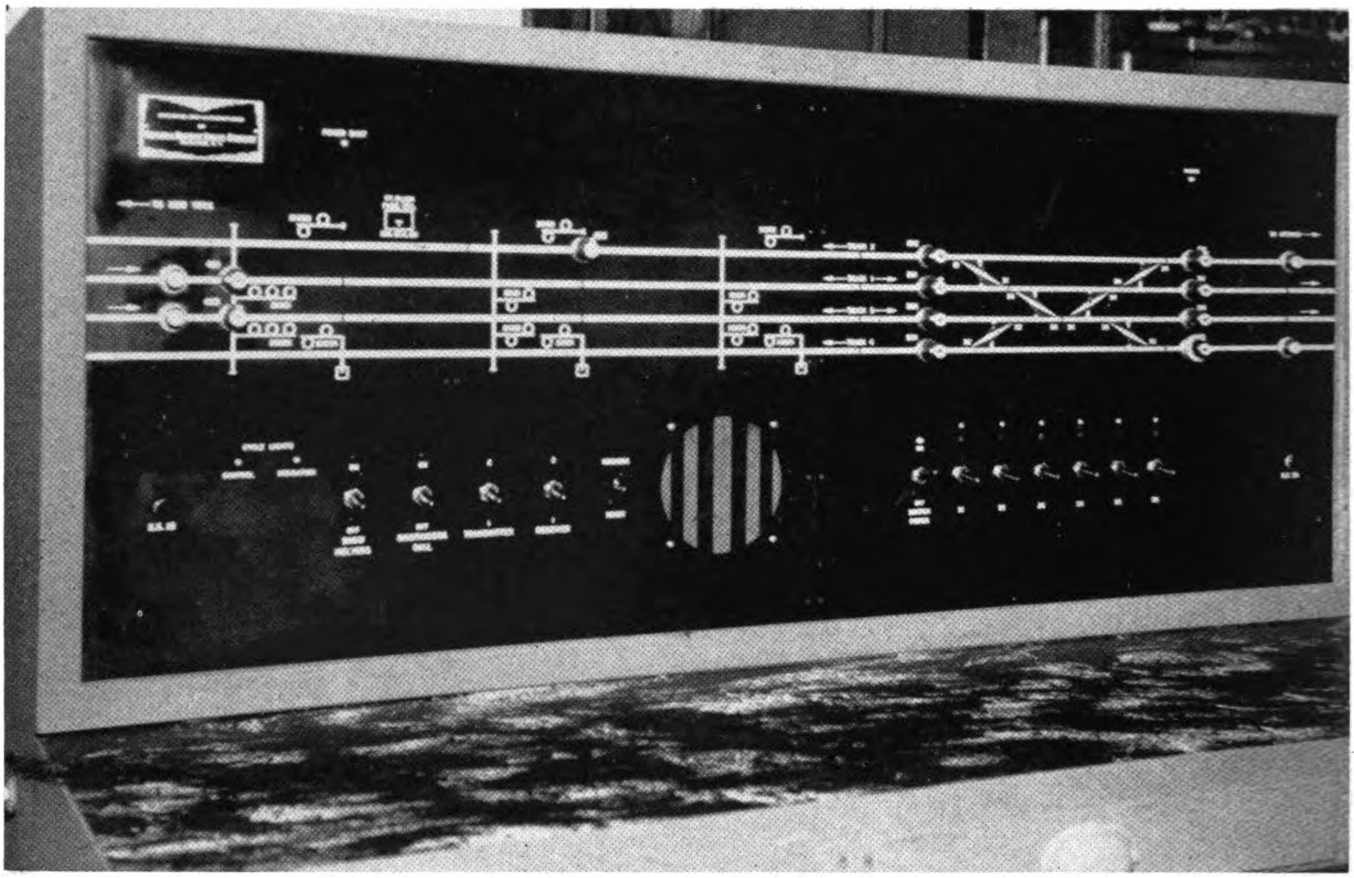
THE New York Central has installed a new interlocking 3.1 miles west of Fort Plain, N. Y. The interlocking, including 8 home signals and 6 No. 20 crossovers, is controlled remotely from Signal Station 20 located in the Fort Plain passenger station. Switches and signals are controlled by syncrostep from a panel type machine. As shown in the plan herewith, the six crossovers are so arranged that trains may be diverted from any main track directly to any other main track. This arrangement is known, on the New York Central, as a universal layout.

The interlocking replaces two mechanical plants, one at Palatine Bridge and one at St. Johnsville, and, in addition, replaces facilities formerly available at Little Falls. Palatine Bridge, located 3.7 miles east of Fort Plain, was a universal layout of No. 18 crossovers. St. Johnsville and Little Falls, located 6.2 and 15.7 miles west of Fort Plain respectively, were each a single ladder of 4 No. 10 crossovers. The crossovers at these old plants limited the speed to 15 or 30 m.p.h. when making diverting moves.

In this four-track territory, the two tracks on the south are for high speed trains, Track No. 1 westward and Track No. 2 eastward. The two tonnage freight tracks are on the



Track and signal plan of new remotely controlled interlocking and signaling through Fort Plain



The control panel at Fort Plain includes toggles for control of crossovers, and knobs for control of signals

north, Track No. 3 westward and Track No. 4 eastward. The maximum speed on Tracks Nos. 1 and 2 is 80 m.p.h. for passenger and 60 m.p.h. for freight. Maximum speed for all trains on Track No. 3 is 60 m.p.h. and Track No. 4 is 45 m.p.h.

Four Main Tracks

The entire new interlocking layout is on tangent track, with the four main tracks located at 13-ft. centers. The new crossovers include No. 20 frogs and turnouts with 39-ft. reinforced switch points. These crossovers are designed to handle diverging train movements at 45 m.p.h., and the signaling is so arranged. The four home signals for moves against the current of traffic are searchlight dwarfs. Each of the high home signals for normal-direction train operation has three operative searchlight signal units.

For a straight track route, a home signal displays the clear aspect green-over-green-over-red. For a diverging route, a home signal displays the clear-limited aspect, red-over-green-over-green. When the home signal block is occupied the restricted speed aspect, red-over-red-over-yellow can be displayed. The high home signals display additional aspects as required to carry four-aspect automatic block through the plant.

Three-arm positive stop signals, controlled by the operator, are provided east of signal station on tracks No. 1 and No. 3 to facilitate emergency operation, and, in addition, provide station protection on Track No. 1. These signals together with traffic control permit reverse movements on Tracks No. 1 and No. 3 from interlocking to the signal station where orders to proceed against the current of traffic can be delivered to the train. The operator has control of the first automatic signal on Track No. 2 west of station to provide station protection.

As a part of the overall improvement program, the automatic signaling on all four tracks was replaced throughout this territory for about 10 miles. This new signaling includes coded track circuits to control new searchlight signals which display four aspects.

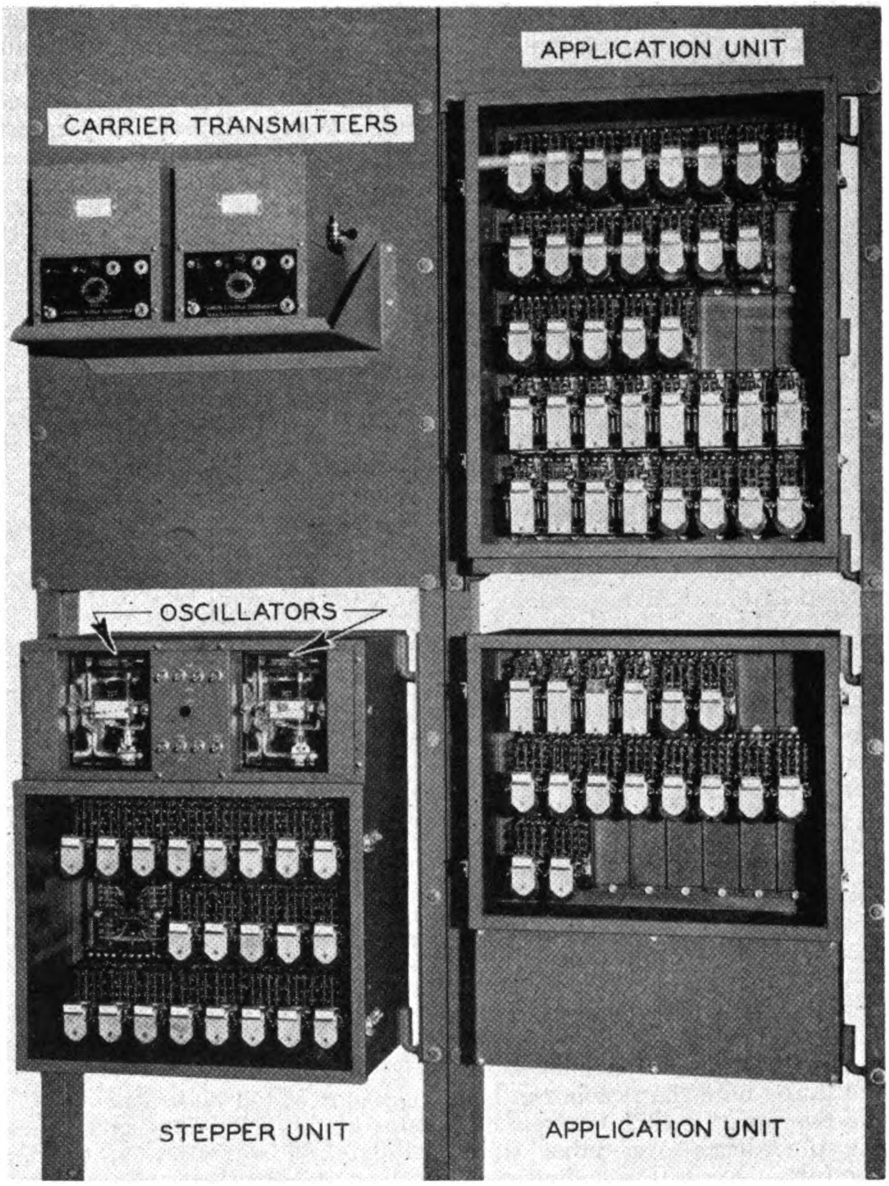
The control machine panel is 21-¾ in. high and 55 in. long. The illuminated track diagram, on this panel includes not only the interlocking area, but also the positive stop signals east of the signal station and the automatic signal west of station on track No. 2.

On the control panel, the outer ring of each signal control knob can be rotated. Inside of the ring there is a fixed transparent lens with a black arrow which points in the direction which the signal governs. On the outer ring, there is a white dot which normally is positioned at the base of the arrow. The ring is rotated 90 deg. upward to permit a proceed aspect more favorable than restricted speed. The ring is rotated 90 deg. downward to control a restricting aspect. When the signal clears, a white lamp is lighted behind the black arrow in the face of the corresponding knob. The controls of the interlocking home signals are 'stick', which means that after a train accepts a signal, the operator must turn the knob back to normal, and then operate it again, to clear the signal for the next train. If a signal which has been cleared is to be taken away, the operator places ring in normal position and pushes signal control knob to transmit a stop control.

Crossover Controls

Each crossover is controlled by a small toggle-type lever. These six levers are in a horizontal row on the lower portion of the panel just below the portion of the track diagram which represents the interlocking.

Equipment panel with labels explaining the purpose for each unit



These levers are normally in the down position, being thrown to the up position to control a switch to reverse. In the track diagram, each switch is represented by a black triangular movable-point switch indicator which operates when the corresponding switch lever is thrown, so that the track lineup is shown by a continuous white line ¼ in. wide.

Above each switch lever there are two small indication lamps. The upper lamp which is white, is lighted when the switch is not over and locked in the position corresponding to that of the lever. If the operation of a switch lever "calls for" an improper lineup, the white correspondence lamp is flashed 75 times per minute as information to the operator that signal will not clear. For example, if crossover 53 has been reversed, and lever 52 is thrown to reverse position, the correspondence lamp for lever 52 will flash after switch 52 has operated to reverse position. The lower indication lamp, which is red, is lighted when electric locking is in effect to prevent operation of the switch even if the lever were thrown. The operation of a lever, while the locking is in effect, will not result in operation of the switch after the locking is released.

The Syncrostep which controls the remote section of the machine has a maximum capacity of 56 controls of which 42 are used as follows: 12 for switches, 20 for signals and 10 for miscellaneous function such as maintainers call, snow melters, etc. The indication capacity of the remote section is 88 of which 40 are used as follows: 15 for switches and locks, 8 for signal, 2 for approaches, 10 for track occupancy and 5 for miscellaneous indications. The controls and indications for local functions at Signal Station 20 are direct wire. The approach indications, until acknowledged by the operator, are a buzzer located in the machine and flashing of the approach indicator lamp which is in the approach indication button on the track diagram panel. Acknowledgment is effected by pushing approach indication button. This action stops the buzzer and also causes the lamp to give a steady light.

This Fort Plain project is the first installation which includes the new Syncrostep line code system developed by the General Railway Signal Company. In previous time code systems, the "office" and the "field" are kept in step by means of stepping relays which are driven by transmitted pulses. Such code systems must transmit these pulses, in addition to the pulses required to convey the intelligence borne by the code. In contrast, the new Syncrostep system maintains the "office" and "field" in synchronism by means of synchronized mechanical oscillators, one at the office and one at the field. This permits full use of the line code time for transmission of the "message".

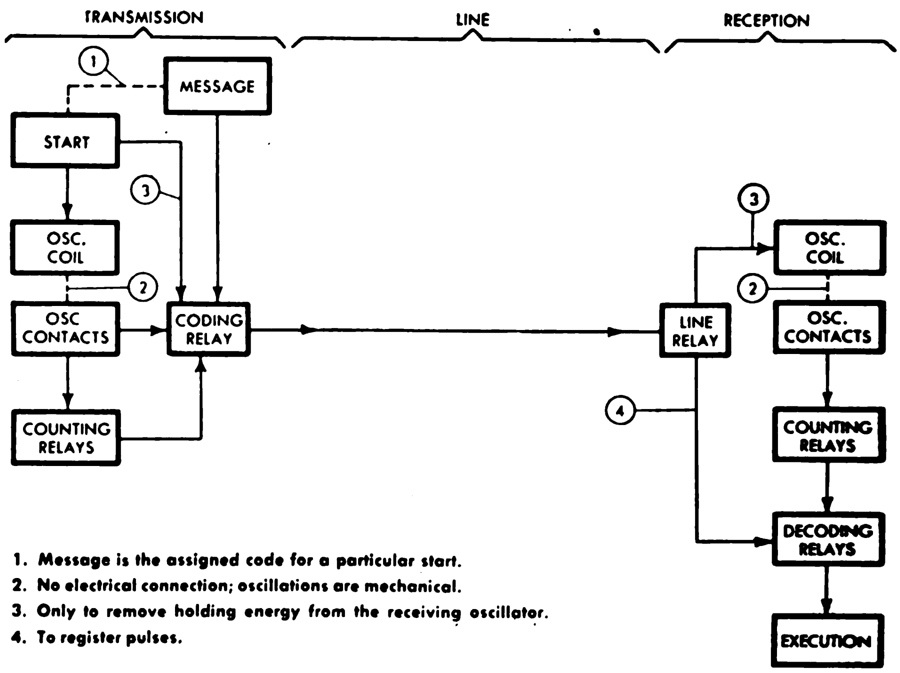
The synchronous devices used in the Syncrostep system are a modification of the G.R.S. Type-B oscillating code transmitter used on coded track circuits. This oscillator includes a vertical shaft, operating in bearings at the top and bottom. At the top of the shaft is a cam, which drives four contacts, two of which are on each side. Each set of contacts opens and closes once per oscillation. Below the cam is a balance wheel and a U-shaped armature, located between the two poles of an electromagnet. Below the armature is a spiral spring which creates the oscillations. Normally, the electromagnet is energized, and thus locks the armature against a stop, preventing it from turning. In this position, the spring is wound up. When energy is removed from the coil, the armature is released, thus allowing the rotor to oscillate like the balance wheel of a watch. The rate is 500 cycles per minute, factory adjusted to plus or minus a fraction of one per cent.

One oscillator located at the office and another at the field are started by opening a two-wire line circuit.

Normally, both oscillators are in the wound condition. The block diagram illustrates how Syncrostep operates when either a control or an indication is transmitted. A start removes holding energy from the coils of both oscillators, the contacts of which then open and close in synchronism. As this occurs, the normally-energized counting relays are released, one by one. Their function is to define the steps of the code. The coding relay is controlled by the oscillator contacts, combined with the counting relays which determine when the coding relay should operate, and the message which determines how it should operate. The line relay follows the operation of the coding relay. Each time the line is energized, the pulse is registered at the receiving end by the pick up of a decoding relay. If the pulses occur at the proper time, as determined by the counting relay, the code is complete and the control (or indication) is executed. The control code is of the self-checking variety in which a parity check is applied at the end of each cycle before the code may be used.

The code system starts automatically whenever the position of a switch lever is changed or signal lever is operated to a proceed position. The resulting cycle controls only the function whose lever has just been operated. All controls not able to be transmitted immediately are stored until the system can handle them, with switch controls having precedence over other stored controls. Due to the coding speed requiring approximately 1 second to transmit and execute a control, virtually no storage delay is experienced. Indications from the field are sent in groups which are transmitted in approximately 2 seconds, thus for all practical purposes, control between signal station and interlocking, in this instance 3.1 miles away, is about as fast as if direct wire circuits were used.

In this New York Central project, the circuit between the office and the field is on two line wires. An oscillator at the office and an oscillator at the field, using conventional d.c. code impulses on the line circuit, are used to transmit controls from the office to the field. A second oscillator at the office, and a second oscillator at the field, using impulses of 17 k.c. carrier energy on the same two line wires, are used to transmit indication codes from the field to the office. By this means, control and indication codes can be transmitted simultaneously over the same two line wires.

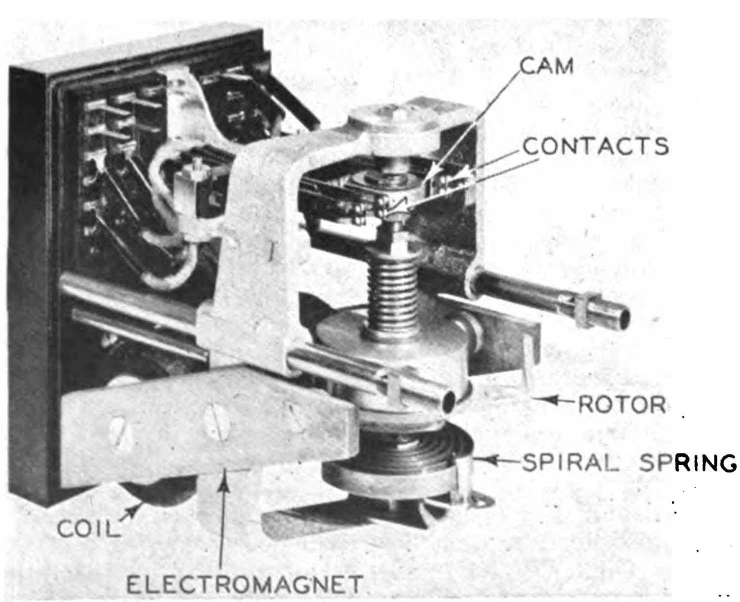


Block diagram of equipment in a Syncrostep installation

On the south side of the tracks at the interlocking, there is a one-story brick building which includes a room 12 ft. by 21 ft. for the maintainers' headquarters and a room 34 ft. by 21 ft. for relays, power supply and batteries.

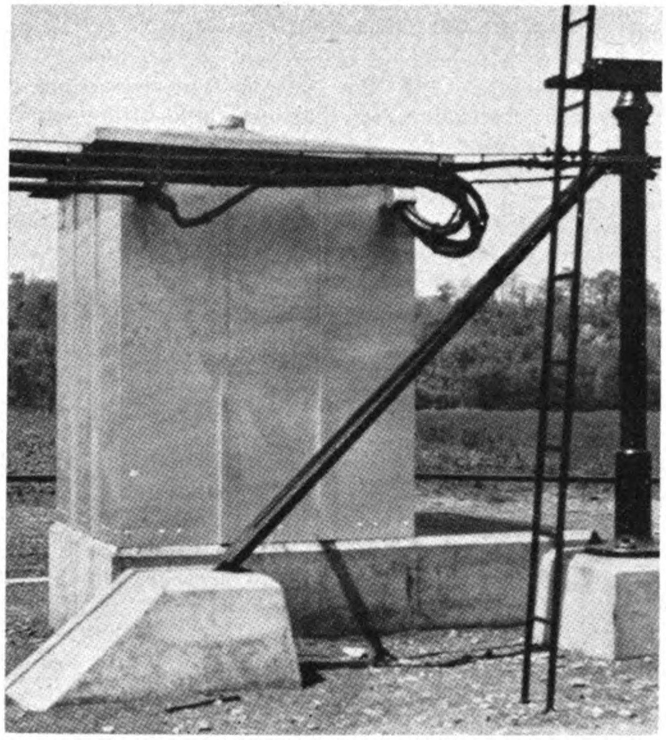
Commercial service 115/230 volt is obtained at St. Johnsville, Fort Plain interlocking and Palatine Bridge and transformed to 550 volts to feed the single-phase signal power line through the territory in which the revised signal program was carried out. Signal power is normally fed from west to east at the above locations. The signal apparatus is fed direct from the power line through transformers and dry-plate rectifiers. If the normal source of power fails, the power load is automatically transferred. The automatic transfer equipment was manufactured by the General Electric Company.

If a.c. supply at Fort Plain interlocking fails, 3-1.5 kva. General Electric inverter dynamotors, fed from the 110-volt switch battery, will be started in less than 1 cycle. The local dynamotor will take over the interlocking load in approximately 4 cycles. The other dynamotors will assume the automatic

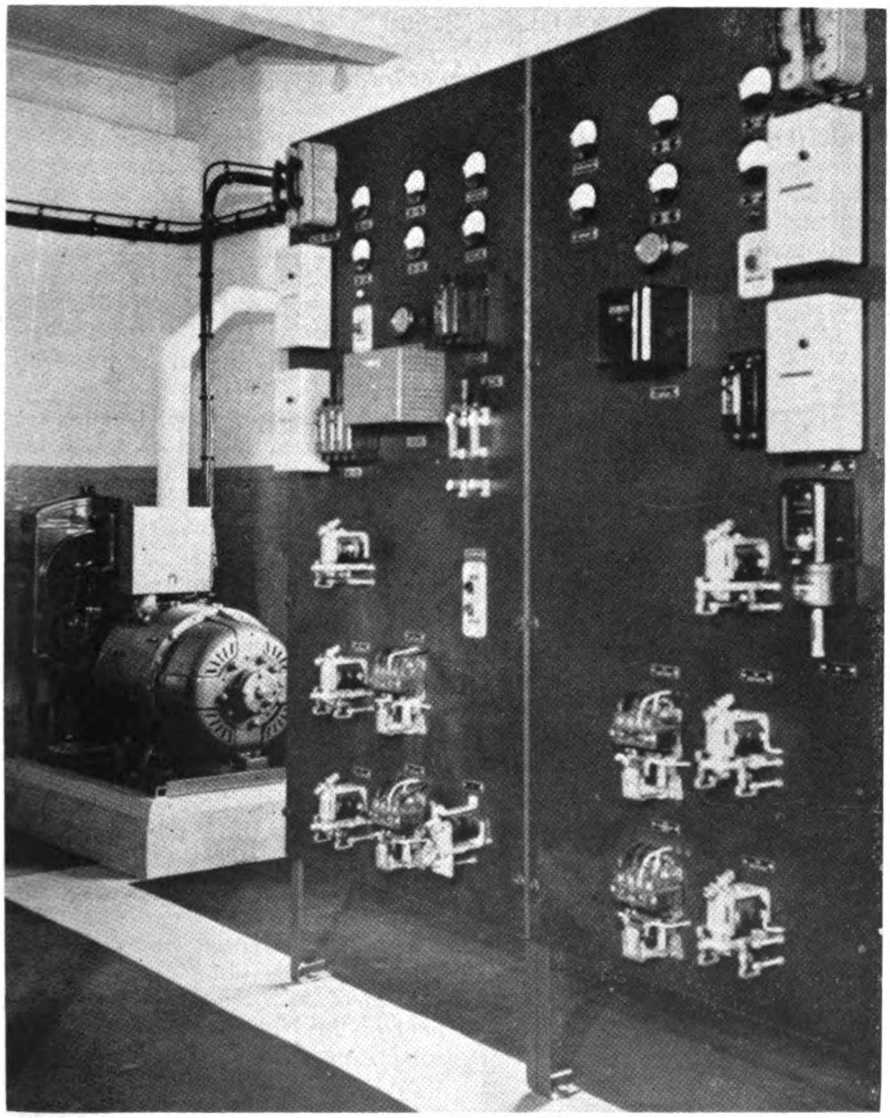


Picture with labels designating parts of oscillator territory line load in approximately 8 cycles. The change over in either case is so rapid that the signal system is not affected. The main battery has capacity to operate dynamotors as well as switch machines for at least 8 hours.

When a.c. service fails, as explained above, a normally-lighted white lamp on the control machine at Signal Station 20 is flashed and single stroke bell sounded. The operator then calls the maintainer. If the a.c. power is to be off for some time, the maintainer pushes a button on the power panel which starts a Kohler gasolene-engine driven generator with an output of 5 kva. at 115 volts a.c. When this machine is up to speed the maintainer switches the load to this engine-driven generator, and the dynamotors are automatically stopped. Thus, even though all sources of incoming a.c. power fail, there is no interference with interlocking or signal operations in this territory.



View showing a sheet-metal house and the aerial cable construction



Power switchboard and gasolene engine driven 5 kva. 115 volt a.c. generator

At this interlocking, the 110-volt d.c. switch machine motors are fed from a set of 60 cells of Exide DME21 Manchex battery rated at 400 a.h. This battery is on charge through a thyratron tube rectifier, the maximum output of which is rated at 5 amp. There is also a set of 14 cells of 160 a.h. Exide battery for supplying the Syncrostep code equipment and line controls.

Plug-In Relays

The conventional relays in this new interlocking are the modern plug-in G. R. S. Co. type "B", mounted on racks. Normally energized track circuits, fed by ½-wave rectifiers, are used within interlocking home signal limits. Relays for these circuits are 1.8 ohms. The switch control relays are the polar type, 276 ohms. Each switch has a separate operating relay and a separate over-load relay.

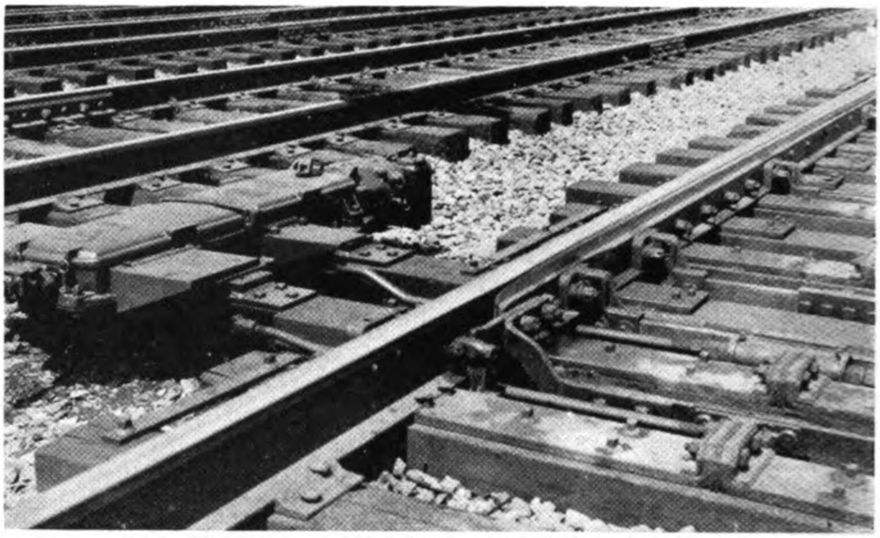
In home signal limits, the main distribution of wiring is in aerial cables which are supported in Raco insulated straps from standard Copperweld messengers on concrete posts. The control wires in these cables are AWG No. 12 and the 110-volt switch power wires are AWG No. 2. The 550-volt a.c. power circuit is on No. 2 wires, on open line. The code line is on two No. 6 copper weatherproof open line wires.

The switch machines are G.R.S. Co. Model 5A, with 110-volt d.c. motors. A type B overload relay and a type B switch control relay are located in a housing near each switch machine. If the switch points are obstructed, so that the motor takes excessive current, the over-load relay picks up automatically to open the feed to the motor.

Each switch has a standard arrangement of lock and point detector rods. Raco switch adjusters and self-adjusting controller sockets are used on the detector rod connections. Each switch machine is supported on two ties, mounted on ¾ in. saddle plates, 7 in. wide and 31 in. long, made up with 2-in. butt straps welded in place so that the switch machine fits snugly between these blocks. Each plate is fastened to the tie by five ¾-in. by 7-in. lag screws, and, in addition, a ¼-in. by 11-½-in. bolt extends through each switch machine lug, saddle plate and tie. The center line of each switch machine is 45 in. from the gauge side of the rail, thus clearance is provided without daping of the ties. This mounting of switch machines requires offsets in the rods, which are 2-13/16 in. in the throw rod, 4-15/16 in. in the lock rod, and 2-½ in. in the detector rod.

When installing a switch machine, the saddle plates are laid loose on the ties, and the machine is placed. The rods are then connected and adjusted, the saddle plates and machine being shifted slightly as required. After adjustments are complete, the lags and bolts are installed. This procedure eliminates considerable fitting work, and, therefore facilitates construction.

The switch points in this interlocking are 39 ft. long, and, although they are reinforced with steel bars, they are flexible. To insure that the full length of these points move over properly, a "helper or booster" connection is made 20 ft. from the point, and is pipe connected to the operating rod at that point.



Power switches are well constructed

In order to minimize interference by snow storms, electric heaters have been installed on each switch throughout the interlocking. These heaters consist of lengths of Westinghouse tubular heaters, each of which has the outward appearance of a straight oval rod ½ x ⅝ in. The heater unit for each switch point is in two sections. One unit, with an active heating length of 23 ft. 1-⅞ in., is attached to the upper part of the web of the stock rail and starts 24 in. ahead of switch point. The other unit, with an active heating length of 10 ft. 8-½ in. is attached to the lower part of the web of the switch point. These units are attached by clips bolted to the web of the rail.

The two units per switch point are connected in series across 480 volts. Power consumption is at the rate of 350 watts per foot of heater which is roughly 23.7 kilowatts for each of the switch layouts. This power is furnished from the power company's 4800-volt. 3-phase line with two banks of 50 kva. transformers to furnish the 480-volt energy. The power to the snow melters is connected through circuit breakers which are controlled remotely through the Syncrostep code line. By this means the operator turns the switch heaters on and off as required by local weather conditions.

The engineering, as well as the installation of the signal facilities at this new remotely controlled interlocking, was done under the direction of A. S. Haigh, signal engineer of the New York Central Railroad, Lines East. The major items of signal equipment for the installation were furnished by the General Railway Signal Company.

Booster is pipe-connected 20 ft. from point