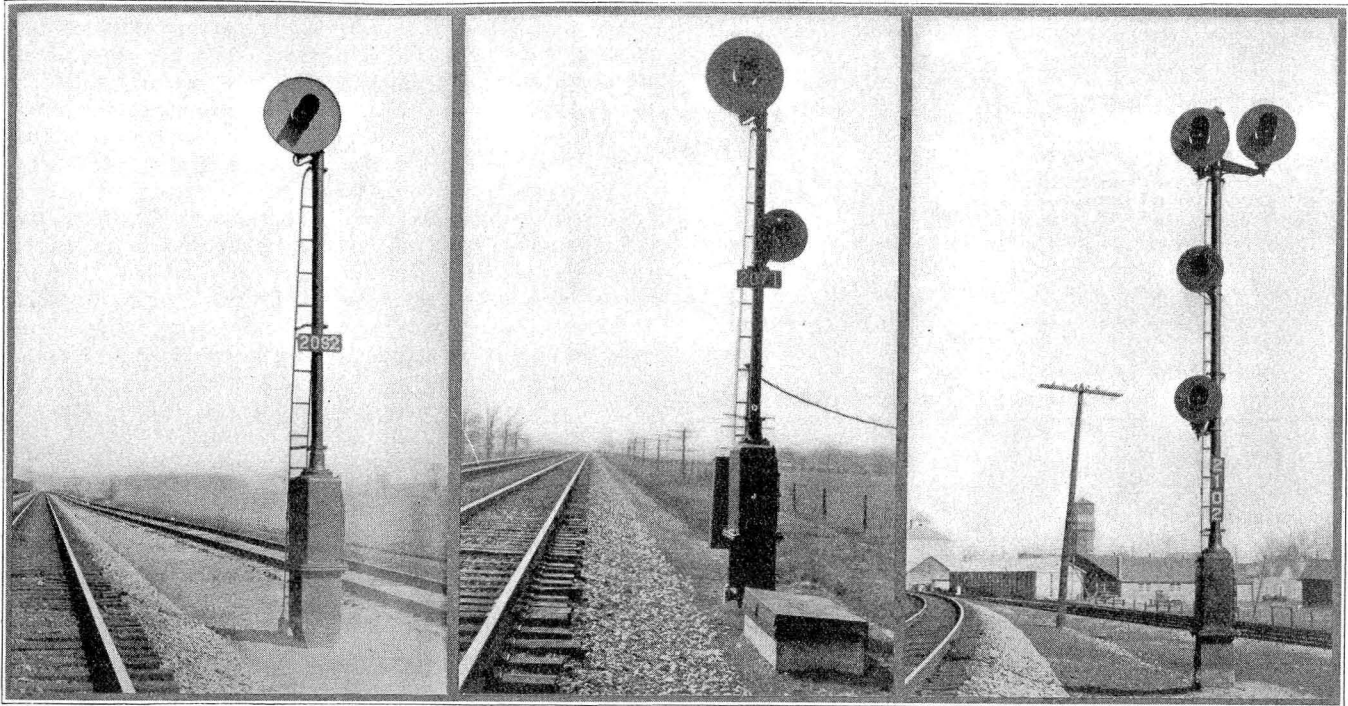


Michigan Central Makes Extensive

Improvements in Signaling System

On 513 Miles of Main Line

Typical signals in automatic and interlocking territory



Typical automatic signal

Automatic with take-siding signal

Train-order and home signal

Many new signals — Improved power supply — New aspects — Color-light train-order signal — Take-siding signals — Automatic train control

THE Michigan Central will soon complete a program of extensive improvements in the 513 miles of double-track main line from Niagara Falls (Bridgeburg), Ont., to Chicago. It amounts to practically a new signal system on the 247 miles from Niagara Falls to Windsor, while, between Detroit, Mich., and Chicago, color-light signals are replacing the semaphore type only at all home interlocking signals. Throughout the entire route an a-c. floating power supply is being provided to replace primary batteries. Intermittent inductive auto-manual train stop is being added between Niagara Falls and Windsor so that such protection is now complete on the entire route between Buffalo and Chicago.

Previous Layouts

In 1920, the lower-quadrant two-position signals between Detroit and Chicago were changed over to three-position upper-quadrant signals. Between Detroit and Niles, Union Style-B signals are in service, while, from Niles to Chicago, G.R.S. Model 2-A mechanisms are used. All these signals are of the 10-volt direct-current type and were operated on primary battery with primary on track circuits as well. These signals are spaced with blocks 4,000 to 8,000 ft. long.

In accordance with the orders of the Interstate Commerce Commission, company forces installed the General

Railway Signal Company intermittent inductive train-stop system between Detroit and Niles in 1926, and, in addition, this equipment was extended voluntarily, in 1927, to complete the Chicago-Detroit route. The 1930-31 improvement program in this territory includes a change-over to the a-c. floating power supply and the addition of certain signal units to existing signals.

Wherever the block is not longer than 5,600 ft., a double-distant aspect of two "Yellows" is now provided at the signal next in the approach, the indication being, "Prepare to Stop at Second Signal." The second yellow is displayed by an inoperative light unit mounted to the right of the mast and 5½ ft. below the top light. This is a special unit, which was made by the General Railway Signal Company, and which is equipped with an 8¾-in. lens and a 10-volt 5-watt lamp. It is normally dark and is fed through a 400-ohm neutral line relay controlled over a two-wire line circuit. Train control is effective at the signal displaying the double yellow aspect.

The middle unit of three-unit color-light signals at interlockings is inoperative unless the track layout affords routes to require an operative signal. The lower unit, a call-on signal, is operative to only two indications: red for Stop, or yellow for "Proceed at Restricted Speed."

Each signal unit has a single-filament bayonet base 10-volt 5-watt lamp. If the lamp in the top arm burns out, the distant signal immediately changes to the Cau-

GENERAL ORDER NO. 22

— DEC. 1, 1930 —

The Color Light signals that replace two and three arm Semaphore signals between Detroit and Kensington, will display three lights, in a vertical line, on the left hand side of the signal masts to govern the movements of trains, and —

Wherever such signals are at Telegraph Offices, there will be added, a light on the right hand side, at the top of masts for Train Order indications, (Rules 289-D and 289-E below), and —

Wherever Train Order indications are combined with Automatic Block signal indications, there is a right hand light added to the (Color Light) Automatic Block signal (Rule 289-C, 289-D and 289-E below).

The Train Order indications, as seen from approaching trains, apply to all tracks and are so interconnected with the left hand light or lights as to prevent conflicting indications.

Color Light Train Order indications will be displayed on the following signals:—

| | | | | | |
|----------------|-------------------|---------------------|------------------|-----------------------|-------------------|
| TOWN LINE | Sig.No. 71 and 72 | Auto. & Div. Rte. | NILES E.YDS. | Sig.No. 1873 and 1882 | Diverging Route |
| WAYNE UGT. | " 181 " 182 | Interlocker | NILES LAKE ST. | " 1911 " 1912 | Auto. & Div. Rte. |
| WIARD | " 271 " 274 | Auto. & Div. Rte. | PORTER | " 2403 " 2404 | Interlocker |
| JACKSON E.YDS. | " 723 " | Diverging Rte. | WILLOW CREEK | " 2463 " 2464 | " |
| PARMA | " 861 " | Automatic | TOLLESTON | " 2561 " 2562 | " |
| ALBION | " 953 " 962 | Interlocker | IVANHOE | " 2571 " 2574 | " |
| BATTLE CREEK | " 1203 " 1204 | Int'kr. & Auto. | GIBSON | " 2613 " 2614 | " |
| KALAMAZOO | " 1434 " 1437 | Auto. & Interlocker | KENSINGTON C.END | " 2672 | Automatic |

The Semaphore Train Order signals now at other Train Order Offices are not changed

Rule 285-A on interlocking signals (two yellow lights vertical) and Rule 285-A on Automatic signals (two yellow lights diagonally) provide additional approach warning. Enginemen must foresfall on passing these indications in the same manner as at indications 285 and 285-A.

The Aspects and Indications are as follows:—

| RULE | ASPECT | INDICATION |
|---|--------|---|
| ◊ INTERLOCKING SIGNALS ◊ | | |
| 281 | | Proceed |
| 282 | | Approach next signal at not exceeding Medium speed, (30 M.P.H.). |
| 283 | | Proceed on Medium speed route. (Not exceeding 30 M.P.H.). |
| 285-A | | Prepare to Stop at Second signal |
| 285 | | Prepare to Stop at next signal. If train is exceeding Medium speed, (30 M.P.H.), it must at once reduce to that speed. |
| 286 | | Proceed at not exceeding Slow speed, (10 M.P.H.), prepared to Stop at next signal |
| 290 | | Proceed at not exceeding Slow speed, (10 M.P.H.), expecting to find a broken rail and prepared to Stop short of train, obstruction, car foul or switch not properly lined. |
| 292 | | Stop Note (a) — Anyone of the three lights out is an imperfectly displayed signal and requires a "Stop." |
| ◊ TRAIN ORDER SIGNAL ADDED TO INTERLOCKING SIGNALS ◊ | | |
| 289-D | | Proceed at not exceeding Slow speed, (10 M.P.H.), expecting to find a broken rail and prepared to Stop short of train, obstruction, car foul or switch not properly lined and get Train Orders. |
| 289-E | | Stop for Train Orders Note (b) — Right hand light out indicates there are no Train Orders. Rule 289-C. |
| ◊ AUTOMATIC BLOCK SIGNALS ◊ | | |
| 281 ^a | | Proceed |
| 285-A ^a | | Prepare to Stop at second signal. |
| 285 ^a | | Approach, prepared to Stop at next signal. If train is exceeding Medium speed, (30 M.P.H.), it must at once Reduce to that speed. |
| 291 ^a | | Stop and then Proceed in accordance with Rule D-505 |
| ◊ TRAIN ORDER SIGNAL ADDED TO AUTOMATIC BLOCK SIGNALS ◊ | | |
| 289-C ^a | | Stop and then Proceed in accordance with Rule D-505 No Train Orders. |
| 289-D ^a | | Reduce speed for Train Orders and prepare to Stop at next signal. If train is exceeding Medium speed, (30 M.P.H.), it must at once Reduce to that speed. |
| 289-E ^a | | Stop and get Train Orders. Train must then be governed by Rule D-505 unless a less restrictive block indication (left hand light) is displayed. |

Enginemen and Trainmen must understand the signal indications. Bulletin notice of the signal locations and the time they will go into service, will be issued from time to time by the Superintendents.

Note—Rules 285-A and 285-Aa are not included in order issued for territory in Canada.

tion indication. This result is accomplished by using a W-type 0.33-ohm relay in series with the filament. This relay in turn controls the line circuit of the signal in the rear to give the approach indication. As a part of the program, oil lamps on all semaphore signals were replaced with electric lamps using an A. & W. No. 1184 unit with a 6½-in. reflector and an 8⅜-in. lens. The lamp is rated at 10 watts, 10 volts, and is burned continuously at about 8.5 volts.

At train order offices within the limits of interlocking plants an SA signal unit is located at the right of the mast on a line with and 2 ft. 9 in. from the top unit of the home signal; in automatic signal territory this SA unit is located in a similar position on such of the automatic signals as are properly located with respect to local train order offices. The train-order unit is controlled by a three-position lever controller near the operator's desk. The aspects presented by the signal are shown in the accompanying diagram. The circuits are so arranged that a train-order indication for either a 19 or a 31 order cannot be given with a clear block or a clear route. The circuits are also arranged to check a lamp failure, this being accomplished at interlocking signal locations by displaying a train-order light only when there are orders to be delivered, thus corresponding to the usage, at interlocking plants where a separate train-order signal is not used, of withdrawing the flag by day and the lantern at night.

When 19 orders are to be delivered, for which a stop is not required, a yellow light is displaced in the train-order signal and also a yellow light on the lower unit of the interlocking signal. When 31 orders are to be delivered, for which a stop is required, a red light is displayed on the train-order signal and a red light is the only color that can be displayed on any of the three interlocking signal units.

Whenever an indication for 31 or 19 orders is to be displayed, the signal in the rear is put to the "Approach" indication, and if a lamp fails on any unit of either the interlocking or the train-order signal, only red lights can be displayed on the other signal units of the combination.

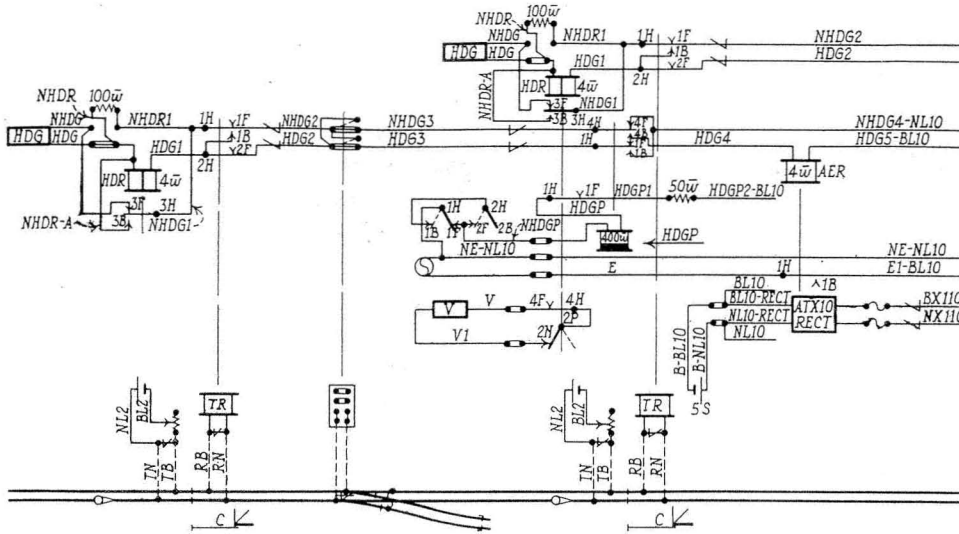
At automatic block signal locations, green, the "No Order" light, is displayed when no orders are to be delivered and the block is clear. The aspect is two horizontal green lights. When the block indication is "Approach—Prepare to Stop at Next Signal," there is a yellow and green light horizontal, and when the block is red, "Stop—Then Proceed in Accordance with Rule," there is a red and a green light horizontally arranged. When 19 orders are to be delivered, for which a stop is not required, two yellow lights are displayed horizontally, and when 31 orders are to be delivered, for which a stop is required, two red lights are displayed horizontally. If there is a lamp failure in either the train-order signal or the automatic block signal, it causes the other to display red, and at the same time the block signal in the rear to display "Approach—Prepare to Stop at Next Signal."

It will be noted that by this arrangement, the lamp failure is checked so that a light out requires a "Stop" indication, and it also prevents the display of a clear block when either 19 or 31 order indications are given. At the automatic signal with a train-order signal, if either lamp filament burns out, the other signal goes red.

A "Take-siding" signal was added on the automatic signal located 3,000 ft. or more in the approach of certain passing track switches. This take-siding signal consists of an A. & W. No. 1184 lamp unit with a 6½-in. Lebbly reflector and an 8⅜-in. red roundel, and a 5-watt, 10-volt lamp. This unit is mounted at the right of the mast and 5½ ft. below the signal unit.

Normally, this take-siding unit is dark, and, when in operation, flashes about 35 times a minute, this operation

Counting both home and distant signals, there were 554 signal masts, as compared with only 328 signals



Typical circuit for searchlight-type block signals in Canada

being controlled by a 400-ohm flasher relay which is controlled by a two-wire line circuit from a stick push-button located in the nearest telegraph office.

Changes in Canada

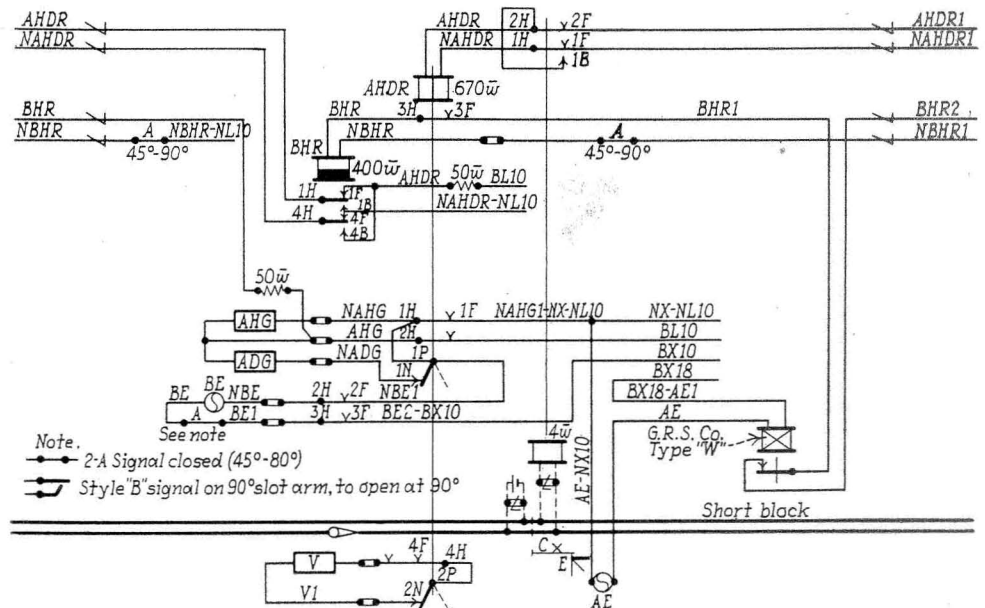
On the line between Niagara Falls (Bridgeburg) and Windsor, Style-B 2-position lower-quadrant d-c. signals were installed between 1901 and 1904. The home signals were spaced 8,000 ft. to 10,000 ft., the distant signal being about 3,000 ft. from the home signal. On this division there are few curves and no heavy grades, so that the line is particularly well suited for high-speed operation of both passenger and freight trains. Therefore, when it was decided to extend the automatic train-stop

under the new arrangement, in which most three-indication signals are spaced 7,000 to 9,000 ft. With this block length, the ordinary three indications are adequate, no double-yellow indication being required.

As a part of the change-over, all semaphore train-order signals were replaced with color-light signals mounted on the interlocking signals or automatic block signals, as explained previously.

Excepting where the location of the signal was fixed, as at interlocking plants, it was necessary to move practically all the signals. The cast-iron foundations, as well as the mechanism cases, masts and ladders were moved to the new locations and utilized as a part of the new system. With a supply of such layouts to start, the new signal locations were constructed in place on sections of

Three-indication automatic block signal circuit arranged for a location where there is a three-block signal in the rear



Note.
 - 2-A Signal closed (45°-80°)
 - Style "B" signal on 90° slot arm, to open at 90°

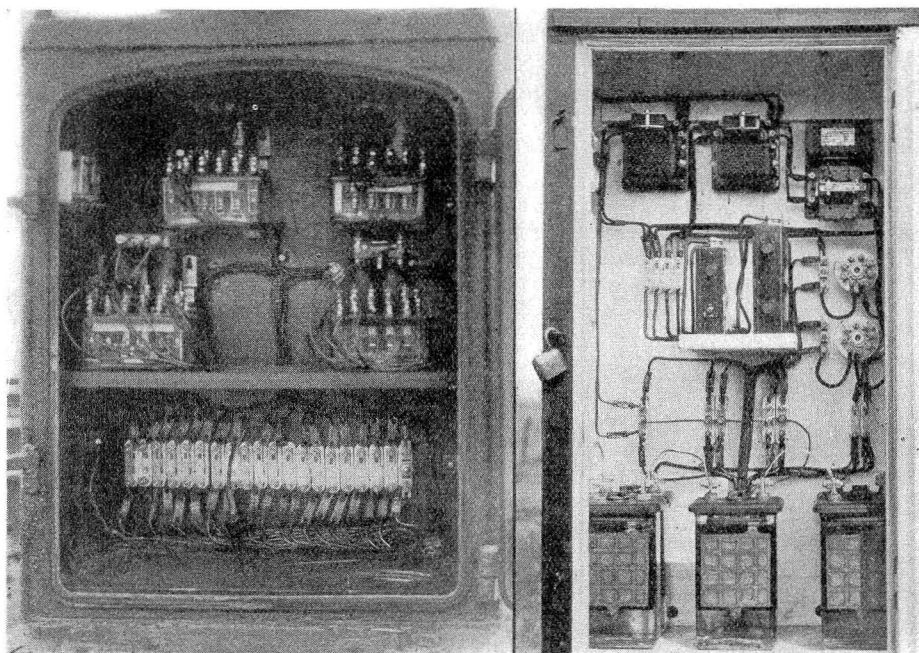
system, it was considered desirable to re-locate the signals and lengthen the blocks to provide for the longer braking distances required for modern train-speeds. In view of the fact that the signals had rendered about 30 years of service, it was decided to make a thorough job of replacement. Therefore, when revising the block lengths, the semaphore mechanisms were all replaced by Type SA three-indication color-light signals.

about 20 miles at a time and cut into service. The old locations were then dismantled, the masts and ladders being cut off to give a height of 17 ft. from the top of the rail to the center of the new SA signal. The old signal mechanisms, up-and-down rods, etc., were removed. The scrap was left on the ground, the foundation, case, mast and ladder being loaded on push cars and hauled to the next station, where they were loaded

in cars and shipped to stations down the line according to a definite schedule in the construction program.

The work of constructing the new locations was

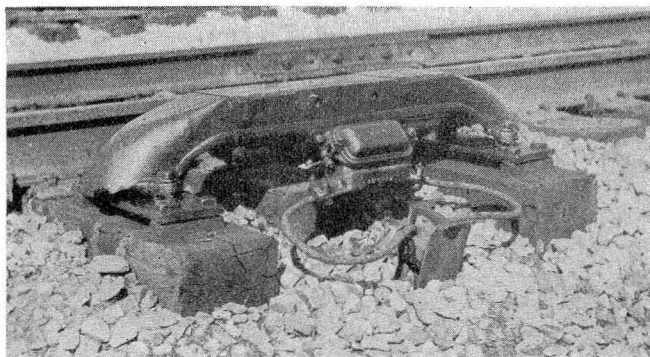
cable post in which are housed the lightning arresters, transformer rectifiers, batteries, etc. The 110-volt circuit from the line is brought into this box and taken to a



Housings
for
relays
and
power
equipment

divided between three groups of men, one of which groups erected the signals and cable posts, and ran the cables, a second group mounted the apparatus and made all the connections, and a third group set the train-control inductors.

The line control circuits and the power-feed circuits are run on a lower arm on the Western Union pole line. The line control circuits are No. 10 double-braid weather-proof Anaconda High-Tenso wire, which is an alloy of copper having a tensile strength of 771 lb. and a conductivity of 55 per cent as compared with copper of the same size. These wires are run on Hemingway No. 43



Inductor for automatic train control

glass insulators. The 25-cycle, 110-volt power circuit is No. 8 copper, with double-braid weather-proof covering and is run on Pyrex No. 662 top-grooved glass insulators. This power line is not continuous, but is run in either direction from various places wherever 110-volt power is available, gaps being left between signal locations wherever they happened to come, no provision being made to transfer from one service to another, as the battery capacity is sufficient to care for the operation of all the apparatus, during any probable interruption.

At each signal location a wooden case is attached to the pair of screw-type plug fuses rated at 10 amp.

The 110-volt wires go from the plugs to a G.R.S. Type-K Size-2 transformer from which the rectifiers are fed. The rectifiers are G.R.S. Type-TXS double-wave copper-oxide, those used for charging signal batteries are rated at $\frac{1}{2}$ amp. and those for track batteries at 1 amp. On the installation in Canada, a set of 5 cells of 78-a.h. Exide DMGO-7 storage cells is used for the signal and line circuits and 1 cell of Edison B4H is used for each track circuit. On the change-over between Detroit and Chicago, all the storage batteries are Edison.

All control circuits are the two-wire polarized type using G.R.S. Type-K and U. S. & S. Co. Model-12 line relays. Almost all track relays are new, G.R.S. Type-K 4-ohm, and the slow-release relays are G.R.S. Type-K, 40-ohm. The older type relays were utilized for the approach-lighting circuits, etc.

The Raco-type impedance lightning arresters, used for the line circuits, are located in the box on the cable post A $\frac{5}{8}$ -in. by 8 ft. Copperweld ground rod is used.

No trunking is used on this installation, all underground circuits being in Trenchlay cable made up with no metallic protection whatsoever. The runs from the relay cases to the rail are No. 8 flexible 7-strand cable run 18 in. below the bottom of the ties.

This same No. 8 single-conductor flexible cable is used for the two separate runs from the relay case to the train-control inductor which in each instance is approximately 75 ft. in the approach of each signal. These cables are placed about 8 in. apart in the trench and are brought up on opposite sides of the rail-section bootleg and then run in a long loop to the terminal box on the inductor, as shown in one of the views.

The rail is bonded with stranded plug-type bonds made up of seven No. 10 galvanized iron wires. The rail is either 105 lb. or 127 lb., and the insulated joints are the 6-hole continuous type of the Rail Joint Company, insulated on one end only.

This reconstruction program was handled by signal department forces. A crew of about 34 men completed the 96-mile section from Windsor to St. Thomas between October 7 and December 31.