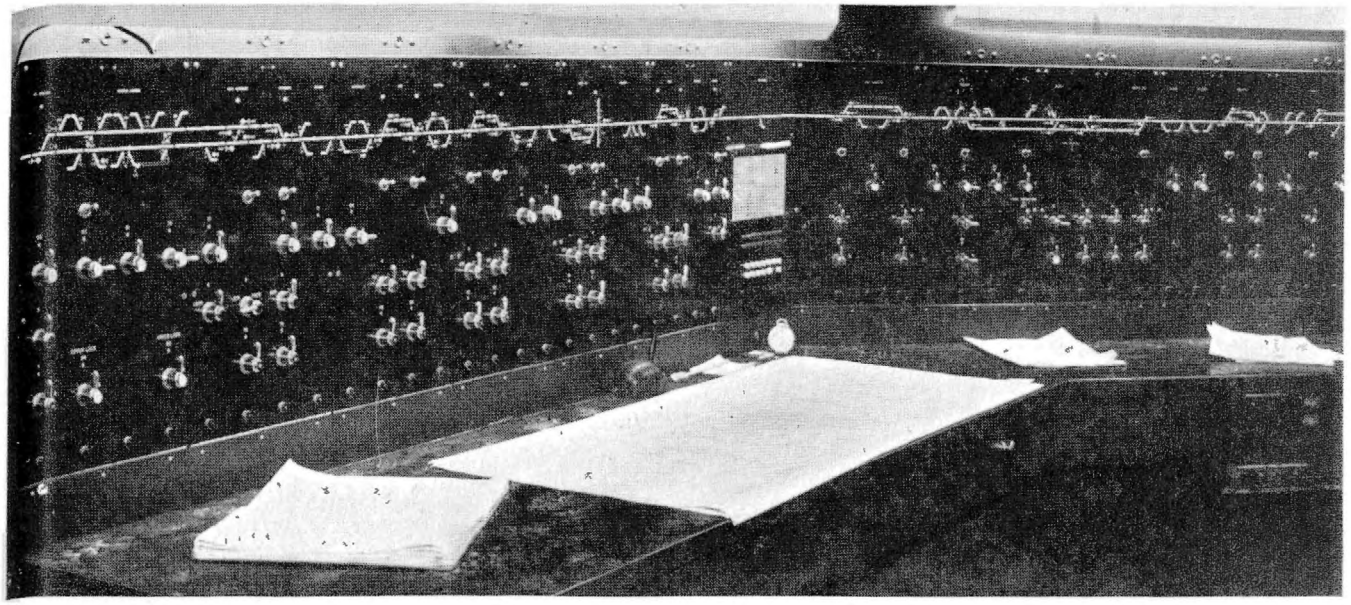


The machine in the office at Waverly controls the C.T.C. between Lamar and St. Joseph

Modern Signaling on a Division

Five year program of relocating and extending sidings, to be adapted for installation of centralized traffic control on 133 mi. of the P.M. District of the C. & O., increases track capacity and saves train time

THE Chesapeake & Ohio, Pere Marquette District, has completed a well-planned, five-year program of improvements on 119.2 mi. of single track and 13.9 mi. of double track on the Chicago-Petosky division between Porter, Ind., and Lamar, Mich., which is the west entrance to the terminal at Grand Rapids, Mich. In this reconstruction program, no changes were made in the grade or alignment of the main track; however, the rail, ties and rock ballast are all new throughout. The major change, in adapting the division for more efficient operation of trains, was the modernization of the sidings with respect to length and location, as well as the reduction of the number of sidings.

The final phase of the program was to install power switch machines and signaling to form complete centralized traffic control, thereby providing means to authorize train movements by signal indication, rather than by timetable and train orders. Having completed this coordinated program of improvements of a division as a whole, the results in saving train time and improving train operations are in accordance with those calculated in advance.

The 84.4 mi. of C.T.C. between Lamar and St. Joseph is controlled by a machine in the dispatcher's office at Waverly, which is the junction with the sub-division to Muskegon and Allegan. The 48.6 mi. of C.T.C. between St. Joseph and Porter is controlled by a machine at New Buffalo which is handled by an operator who works under the direction of the dispatcher at Waverly. The schedules include six passenger trains, eight manifest freights and two local freights. Extra trains are operated as required so that the trains vary from about 20 to as many as 30 daily.

Benefits of C.T.C.

When discussing the centralized traffic control, the chief dispatcher, C. A. Etchason, explained that when the switches were operated by trainmen thus requiring trains to stop, about 40 min. was required ahead of the time of a passenger train, for a freight train to depart from a siding and proceed to the next siding and get into the clear for the passenger train. If the time was close to the 40 min., the freight crew would stay where they were, and if the passenger train was running late, without the freight crew being so informed, that much more time was lost. Now with power switch machines and signals at these switches under the C.T.C. control, a movement from one siding and into the next can be made in about 15 min. less time than previously.

Furthermore, the lamps on the track diagram of the C.T.C. machine show the progress being made by each train and, therefore, the dis-

patcher can control the signals to direct a freight train to keep moving, thereby advancing it one or more sidings for a close meet with a following passenger train. Similarly, the meets between opposing trains are made on very close time, and on account of the long sidings such meets are frequently made without either train being required to stop. The overall result is that the freight trains save considerable time on this territory.

As stated by C. J. Millikin, assistant general manager, "we cannot explain delays to the shipper and consignee in terms of broken drawbars. Therefore, the advantages of the new sidings and the C.T.C., to get trains over the road on time and to make up time that may be lost, are important factors in securing and holding important freight traffic."

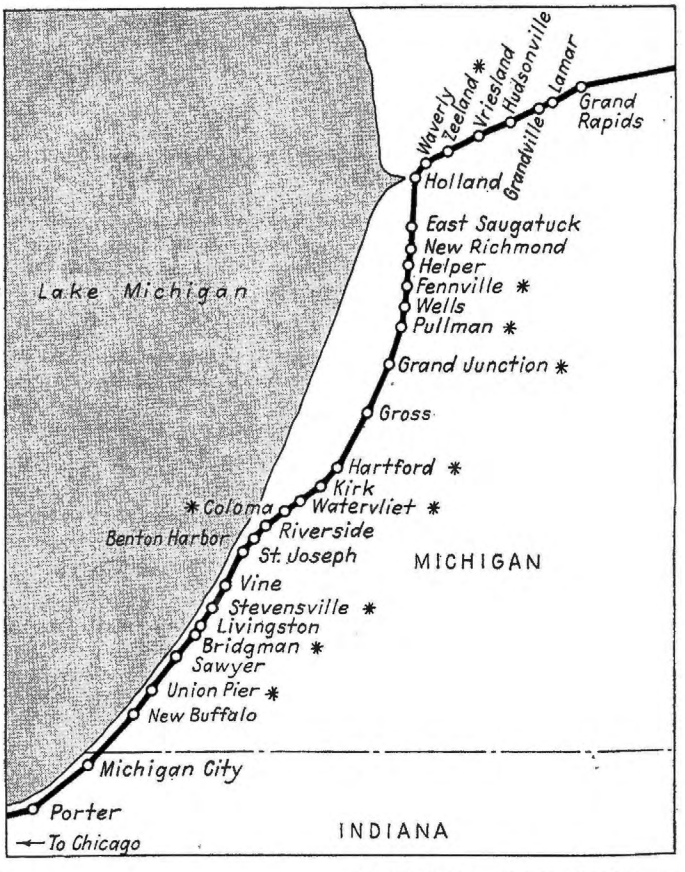
Sidings Reduced from 25 to 13

Prior to this five-year program, there was a siding at nearly every town, spaced an average of 5.3 mi. apart so that there were about 25 sidings, most of which had capacities ranging from 45 to 85 cars. Experience on previous projects showed that, with centralized traffic control, the number of sidings could be cut approximately in half, provided longer sidings, located on a time-distance basis, were made available. A major portion of the planning, therefore, had to do with the location of sidings, consideration being given: (1) to provide sidings about 2 mi. long, the idea being that sidings are not to "hold" trains but rather, if practicable, to keep them moving while making meets; (2) to space the sidings, if possible, on a time-distance basis; (3) to locate the new sidings or extensions of old ones where the cost of construction with reference to fills, cuts, bridges and culverts would be a minimum; (4) to locate the sidings where there were no streets or highways at which trains, when waiting on a siding would have to be cut for crossings; (5) to locate each siding, if possible, so that a starting train will be favored, rather than handicapped, by the grade. In order to benefit by the experience of all concerned, numerous conferences were held, and inspection trips were made by groups of men including the assistant general manager, division superintendent, signal engineer and superintendent of telegraph, division engineer, road foreman of engines, trainmaster and chief dispatcher. Out of these conferences was developed the five-year program which has now been completed.

Four entirely new sidings, each about 2 mi. long, and out in the country away from towns, were built at Hudsonville (west of the town), Wells (west of Fennville), Kirk (between Watervliet and Hartford) and Livingston (between Stevensville and Bridgman). Long extensions were made to the sidings at Grand Junction, Gross and Michigan City, so that these sidings are now approximately 2 mi. long. The siding just east of Porter is 6,500 ft. long.

From New Buffalo a subdivision extends 35.2 mi. to La Crosse, Ind., to connect with the Chicago-Cincinnati line of the Chesapeake District of the Chesapeake & Ohio. A yard at New Buffalo is used for setting out and picking up cars, and as a terminal point by some trains which run between Grand Rapids and New Buffalo. Through New Buffalo there was formerly about 2.5 mi. of double track. However, eastward trains lost time when running at reduced speed through the two turnouts at the ends of the double track. When a train on the eastward main was taking coal or water, a following train could not be moved into the station area. For these reasons when installing the C.T.C., the eastward main track through New Buffalo was converted to a siding, leaving the westward track as a single track main line.

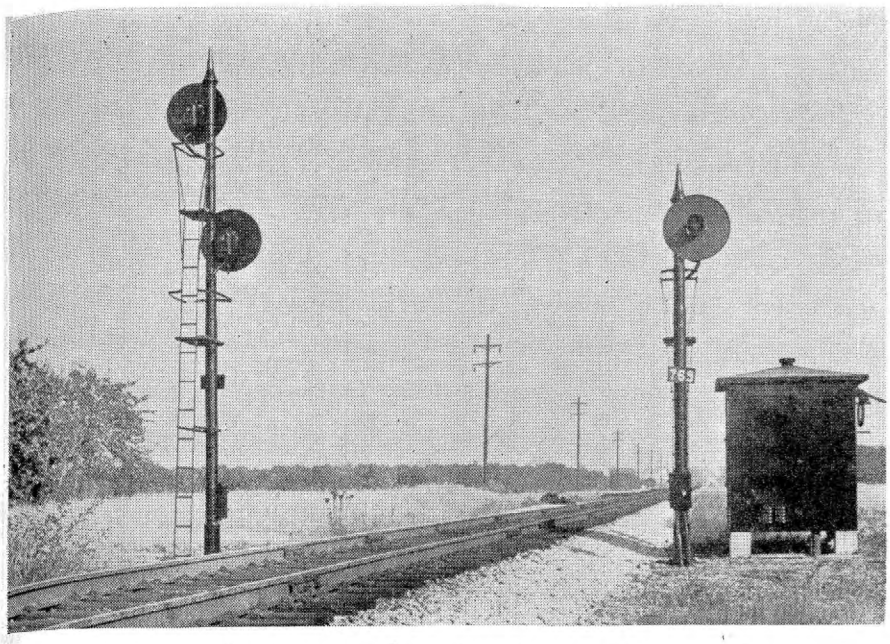
Counting New Buffalo, the C.T.C. project included power switches and signals at both ends of 12 sidings and at the east end of the siding at Porter, the west end being in the interlocking where the tracks of the Pere Marquette District connect with the other roads used jointly between there and Chicago. Also the C.T.C. includes power switches and signals at the ends of double track at Grandville, Riverside, Benton Harbor, St. Joseph and Vine, as well as three crossovers, two between the main track and siding at Waverly, and one between the two main tracks at Grey.



Map of the C.T.C. territory showing towns marked * at which sidings were taken out

Three Sections of Double Track

This Lamar-Porter territory includes three sections of double track; 2.5 mi. between Lamar and Grandville; 7.4 mi. between Riverside and Benton Harbor; and 3.9 mi. from St. Joseph up a grade westward to Vine. On these sections, both tracks are signaled for train operation in both directions. In the Benton Harbor industrial area between Riverside and St. Joseph drawbridge, switch engines are working day and night to serve industries. Formerly these switch engines were required to get in the clear whenever a through train was to move on the track on which they were working. Under the new system if a switch engine is working on one of the main tracks, a through train in either direction can be run



Instrument house at intermediate location

over the other track. This saves a lot of time in switching operation.

On this double track between Riverside and St. Joseph, there was formerly a hand-throw crossover between the two main tracks 18,966 ft. west of Riverside. This crossover was used primarily by switch engines. As a part of the program, this crossover was reversed and moved 4,437 ft. eastward, and power switch machines and C.T.C. signals were installed, this being named "Grey." At this new location, as shown in Fig. 1, the crossover can be used as well as before by the switch engine, and also in the new location the crossover is adapted, under C.T.C. control, for making run-around train movements. The section of the north track between this crossover and Riverside can be used as a siding when the remaining section of this track between Grey and St. Joseph is being used by the switch engine. While not as much switching is done on the sections of double track between Lamar and Grandville, and between St. Joseph and Vine, trains on these sections are frequently operated in either direction on either track to run a fast train around a slower one and thus keep both trains moving.

Pocket Track at Waverly

From Waverly one branch line extends 33 mi. to Muskegon, Mich., and a second branch extends 23.6 mi. to Allegan. A yard for exchanging cars between the main line and these branches is located at Waverly south of a long siding that extends from M.P. 23 at Waverly to M.P. 25.5 at Holland, as shown in Fig. 2. A switching lead was not built from the east end of this yard because of the expense for constructing a bridge over a stream. After considerable study, a decision was made that a portion of the siding could be used as a switching lead except at certain times. Two new crossovers, approximately 1,000 ft. apart, were added between the main track and the siding just west of M.P. 24, thus in effect making two sidings, the east one, holding 110 cars, being known as Waverly, and the west, holding 128 cars, is known as Holland.

Thus between the crossovers there is now 1,000 ft. of what was previously the one long siding, and this 1,000 ft. is a so-called pocket track that is used as a lead when making flat switching moves in and out of the east end of the yard tracks. This use of 1,000 ft. of track between signals 241 and 243B is authorized by the display of a flashing-yellow aspect on a special low signal, under the control of the man in charge of the C.T.C. control machine. If he needs to use this pocket track to run a road train through on the entire long siding, he sends out a control that stops the flashing-yellow aspect and displays a red aspect to warn the switch engine crew to get in the clear and stay there. This arrangement serves satisfactorily, and saved about $40,000 for a bridge which would have been required to extend the yard lead.

Hold-Out Signals

At Michigan City, Ind., there are several spur tracks leading to industries. Previously when a local freight was occupying the main track while serving these industries, no westbound train could be authorized to depart from New Buffalo, which is the next siding east of Michigan City. To prevent such delays to trains, the new system includes a double signal location No. 1245 and No. 1246 which, as shown in Fig. 3, is east of the most easterly spur track switch at Michigan City. When the local freight is to occupy the main track while switching at Michigan City, signal No. 1246 is held at Stop. This permits the local freight to work west of Signal No. 1246, and at the same time permits the clearing of the westward signal at the west

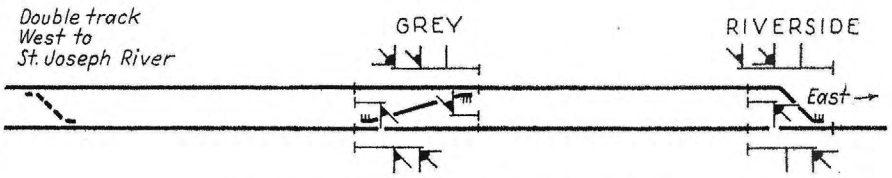


Fig. 1—New "Grey" crossovers near St. Joseph

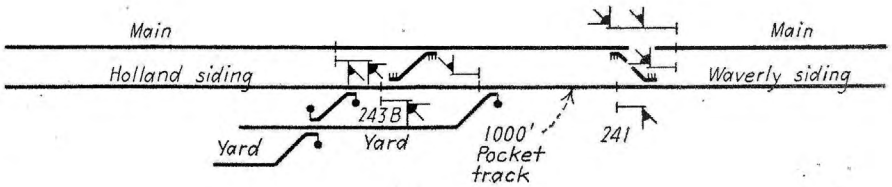


Fig. 2—Pocket track saves cost of $40,000 bridge

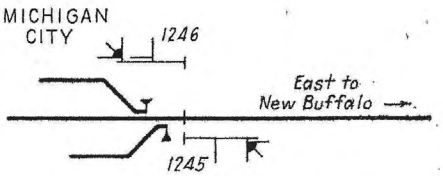


Fig. 3—Hold-Out signals near Michigan City

The new longer sidings are equipped with power switch machines and searchlight signals controlled by the C.T.C.

end of New Buffalo so that a westbound through train can depart toward Michigan City. In the meantime when the local freight gets in the clear, the signal No. 1246 can be cleared to permit the through train to proceed through Michigan City without stopping. When the local freight or any other train is to proceed eastward through Michigan City the signal No. 1245 is cleared.

New Helper Spur and Signals

Between New Richmond and East Saugatuck there is a grade of approximately 1.22 per cent ascending eastbound, with track curvature ranging up to 4 deg. 52 min. A helper engine is used to assist eastbound freight trains up this grade. A handicap was that an eastward train, after having stopped for water, had to pull past New Richmond and stop again to allow the helper to leave the side track and couple on at the rear. In that location, a train was close to the foot of the grade which increased the difficulty of getting a good start for the hill. This was the factor which limited train tonnage. As a part of the improvements, a new spur track for the helper engine was built and named Helper. It was located 6,500 ft. west of New Richmond, i.e., more than a maximum train length. Now an eastbound train can stop with the locomotive at the water tank at New Richmond and take water while the helper is being coupled at the rear. This saves 10 to 15 min., and a further advantage is that from this location the train can get a good run for the hill. This has permitted an increase in the tonnage rating.

Previously when the helper engine was moving westward down the hill, from East Saugatuck, no eastward train could leave Fennville until the helper engine was in the siding at New Richmond. As a part of the new system, two opposing C.T.C. controlled signals were installed an engine length west of the new track at Helper. Now, while the helper engine is returning from East Saugatuck to Helper, an eastward train can be advanced from Wells. After the helper engine is clear of the main track, the eastward C.T.C. signal at Helper can be cleared to allow the train to advance to the water station at New Richmond. This feature has saved considerable time. The two C.T.C. controlled signals just west of Helper are staggered 600 ft. as an added safety feature when a westbound helper engine and an eastbound train are being advanced to these signals.

Some Sidings and Main Track Switches Removed

Sidings as such were discontinued at Vriesland, Hudsonville, Zeeland, New Richmond, Fennville, Pullman, Stevensville, Bridgman, Breedsville, Hartford, Watervliet and Coloma; and two sidings were discontinued at Grand Junction and at Michigan City. At some of the towns where sidings were previously located, they were shortened and left in place to be used as house tracks. In several such instances such as at Fennville, Hartford and Coloma, one of the previous main track switches and a considerable portion of the old siding were removed. At Watervliet, where there are several coal yards and industries, the spurs are now connected to the old siding instead of to the main track. Also at Zeeland, the old siding was extended to connect all the industry spurs to it rather than as previously to the main track.

An overall result is that there are now 15 fewer main track switches than there were five years ago, and this was important in reducing the costs of new rail as well as in the track maintenance expenses now and through the years to come.

A second and important advantage of connecting all the industry spurs to the previous sidings such as at Fennville, Hartford and Zeeland is that the local freight train can work on this switching lead, clear of the main track, while serving the industries, which may require as much as 2 hr. or more each day.

Electric Locks on Hand-Throw Switches

Each of the hand-throw main track switches leading to house and industry tracks is equipped with an electric lock. A Hayes derail is located at the clearance point on the turnout and is pipe-connected to and operated by the switch stand. These electric locks are controlled by levers on the C.T.C. control machine. Where two or more locks are located in one automatic block, all such locks are controlled by one lever. To release a lock the corresponding lever is thrown 90 deg. to the right and the code-starting button is pushed. This causes a line code to go out to the field station nearest the lock from which point a local line circuit extends to the lock. If no train is occupying the block, the lock is released immediately. If a train is occupying the block, the release is

effected after a time interval measured automatically by a time-element. The pick-up of the lock is accomplished by energizing a relay at the location; therefore, in order to again restore the lock to the normal locked condition, the man at the C.T.C. machine must send out a C.T.C. line code control to de-energize the relay, thus locking the lock.

New Water Station

When stopped to take water at the old water station at Watervliet, a long freight train had to be cut at the main street crossings, which often added about 15 min. to the delay and at the same time obstructed other train movements. As this old water station required extensive repairs it was abandoned and a new water station including new wells is being built near the center of the new siding at Kirk at which location trains can take water from either the main track or siding without the disadvantages which existed at Watervliet.

Interlocking Removed

A mechanical interlocking at a grade crossing with the New York Central at Grand Junction was removed. New home searchlight signals were installed on the Pere Marquette District of the C. & O. On the New York Central, Hayes derails were installed 100 ft. from the crossing in both directions, and these derails are pipe-connected to and operated by an ordinary switch stand which is equipped with an electric lock. Normally the signals on the C. & O. track can be cleared one direction or the other by C.T.C. control when lining up for a train movement. When a New York Central train arrives and is stopped short of its derail, a trainman goes to a telephone at the crossing and tells the man in charge of the C. & O. centralized traffic control machine that the N.Y.C. train is waiting. If no C. & O. train is approaching, a C.T.C. control is sent out to hold the C. & O. signals at Stop, and to release the electric lock so that the N.Y.C. trainman can operate the stand to throw the derails off the track. After the N.Y.C. train passes over the crossing and beyond the leaving derail, the trainman restores the derails to normal, and the stand is again locked in the normal position by the electric lock. Indications transmitted by C.T.C. code to the control machine show: (1) when the electric lock is released; (2) the track section on the New York Central between derails is occupied, and (3) when the derails are in the normal derailing position. With a C. & O. signal clear, or with a train in the governing signal limits, the electric lock cannot be released. With the C. & O. signals at Stop and an approaching train on the C. & O. track beyond the governing signals, a predetermined time must elapse before the electric lock can be released.

At the drawbridge over the St. Joseph river just east of St. Joseph, an old electric interlocking machine was replaced by a modern all-relay electric interlocking. The control of the home signals of this plant are interconnected with the C.T.C. so that the levers of the C.T.C. machine and the interlocking machine must be positioned in coordination, in order to clear a home signal for a train movement over the bridge.

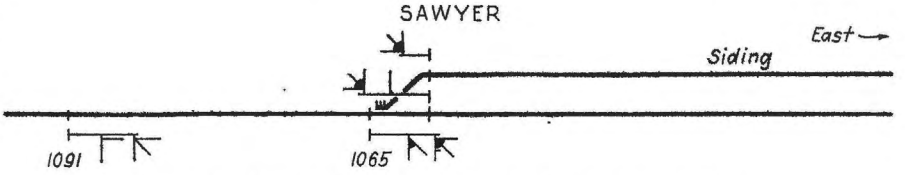
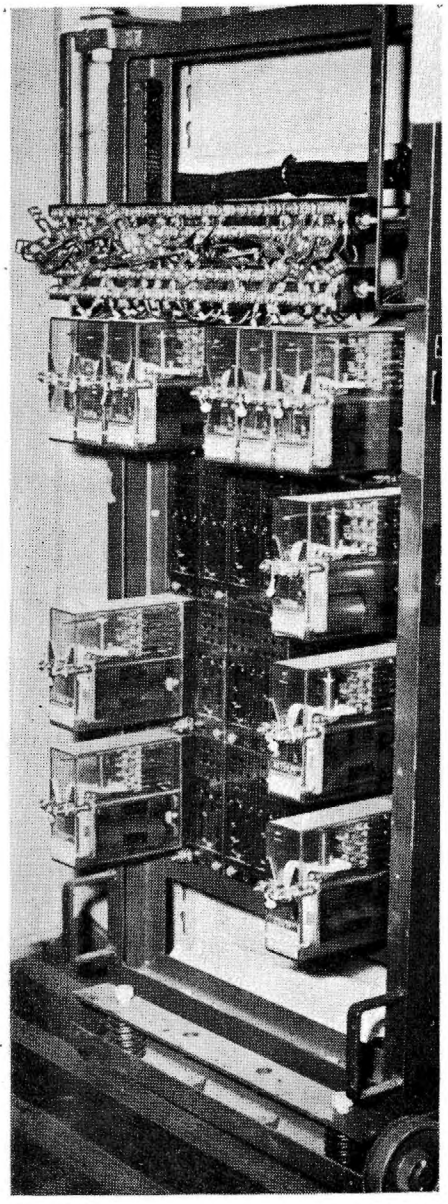


Fig. 4—Signals for 30-m.p.h. turnouts at ends of sidings

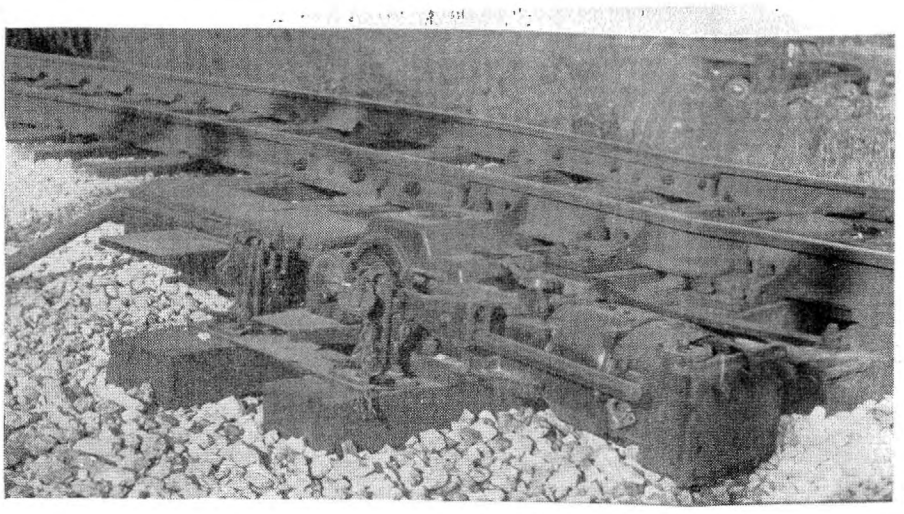
Just west of Michigan City, a single-track line of the Monon crosses the C. & O. at grade. Normally the route is lined for the C. & O., and the C. & O. signals can be cleared by C.T.C. control. The derails and signals on the Monon are controlled by the leverman in the tower at the crossing. When he is to line up for a Monon train, he first operates a lever which then holds the C. & O. signals at Stop and mechanically releases the rest of the plant so that he can reverse the derails and clear a Monon signal.

Signaling at Turnouts

The new turnouts at most of the sidings are No. 16 with 30-ft. points so that trains may make diverging moves at speeds up to 30 m.p.h. As part of the program, track circuits were installed on the sidings. If a siding is occupied, a signal cannot be cleared for a train to enter. For example as shown in Fig. 4, with the switch reversed and the siding unoccupied signal No. 1065 will display an aspect of red-over-yellow for a train to enter the siding, and at the same time the distant signal No. 1091 will display the Approach-Medium aspect, yellow-over-green. This gives an engineman advance information that he is to enter an unoccupied siding and accordingly he can bring his train up to and through the turnout at the speed for which it is designed, in this instance



Interior of house at intermediate signal showing plug-in relays on a rack which is hinged at left to swing around to give access to wiring on the rear of panel



The power switch layouts include dual-control machines, heavy tie plates and the adjustable rail braces

30 m.p.h. On the other hand, if the distant signal was the single-unit type capable of displaying Approach as the best aspect, in this instance, the engineman, according to rule, must reduce to half authorized speed at the distant signal and approach the station-entering signal 1065 prepared to stop short of that signal.

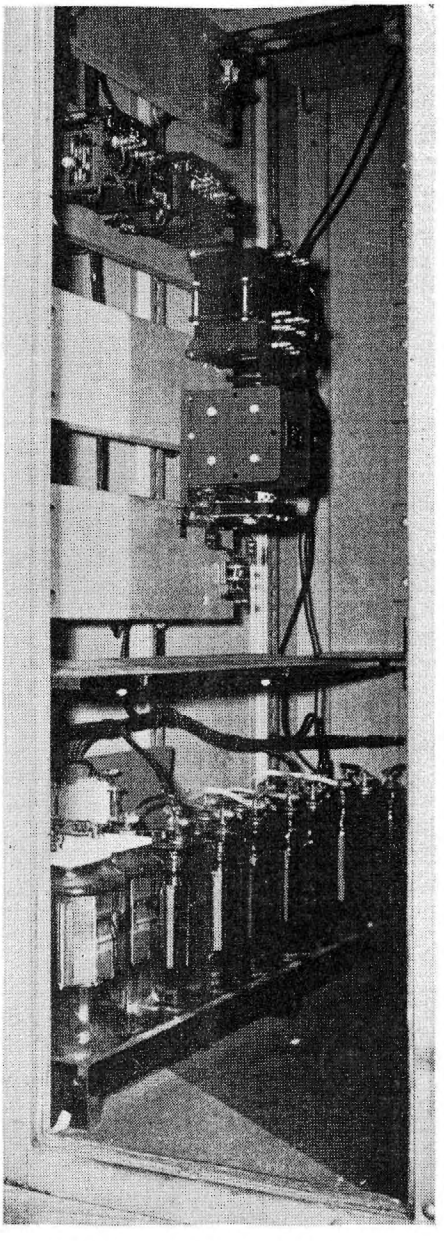
The leave-siding dwarf signals at power sidings are the three-aspect type rather than two. At locations where the dwarf is on the field side, it is placed on a special mast to bring the base of the signal 3 ft. above the level of the top of the rail. This extra height is an aid in preventing the signal from being hidden in deep snow.

With the exception of the "OS" sections, the track circuits on this project are the conventional d.c. neutral type using 4-ohm relays. For the "OS" detector track section at power switches, special series-connected track circuits were installed with the primary-secondary relay scheme to insure sensitive shunting.

Pole Line Work

The signaling line wires are on a crossarm on the same pole line with the telegraph and telephone wires. The C.T.C. code line is on No. 8 copper wire for the most part. The three wires for the signal controls are No. 10 Copperweld. Two No. 8 copper wires distribute the 110-volt a.c. power. All the wires have double-braid weatherproof covering. At each power switch layout there is a set of 12 cells of either DMGO-7 or DMGO-9 Exide storage battery which feed the switch machine and the code equipment. Two separate sets of six cells each feed the signal line. Each "OS" track circuit is fed by two 1,000-a.h. Edison primary batteries. The other track circuits are each fed by three cells of 500-a.h. primary battery.

At each power switch there is a sheet-metal instrument house for the relays, battery and line coding equipment. In these houses the relays are the modern plug-in type which have the advantage of saving space and can be changed out quickly without any chance of making a mistake in the wire connections. In the last section constructed, i.e., on the 55 mi. between East Saugatuck and St. Joseph, sheet-metal houses and plug-in relays are used not only at the switch locations but also at the intermediate signal locations. This practice of using sheet-metal houses at intermediate signals is new and was adopted so that the maintainers can work at these locations under more favorable conditions during adverse weather. Also the houses are better protection for the equipment, especially during rain or snow storms.



Batteries in sheet-metal house

Trucks and Jeeps

The signal construction forces on this project were equipped with two 1½-ton trucks and two ½-ton trucks which were used to transport men and materials. A jeep was used also for these purposes as well as to pull in line wire. In some instances as many as four No. 10 weatherproof line wires were pulled at one time by this jeep. Train movements were not hindered, nor did train movement delay this work, because the jeep could be operated on the right-of-way near the pole line. A second jeep equipped with a machine for digging trenches was used to dig all the cable trenches parallel with the tracks. This saved a lot of time because one man could operate the jeep and machine while the other men, who normally did the digging, were assigned to other work.

This project of reconstructing the main track, building new sidings and installing the centralized traffic control was planned and constructed by railroad forces. The track work was under the jurisdiction of H. J. Bogardus, chief engineer, and under the direction of T. F. Burris, division engineer. The signaling work was under the jurisdiction of H. C. Lorenzen, signal engineer and superintendent of telegraph, and G. N. Black, assistant signal engineer, the new signaling and centralized traffic control apparatus being furnished by the General Railway Signal Company.