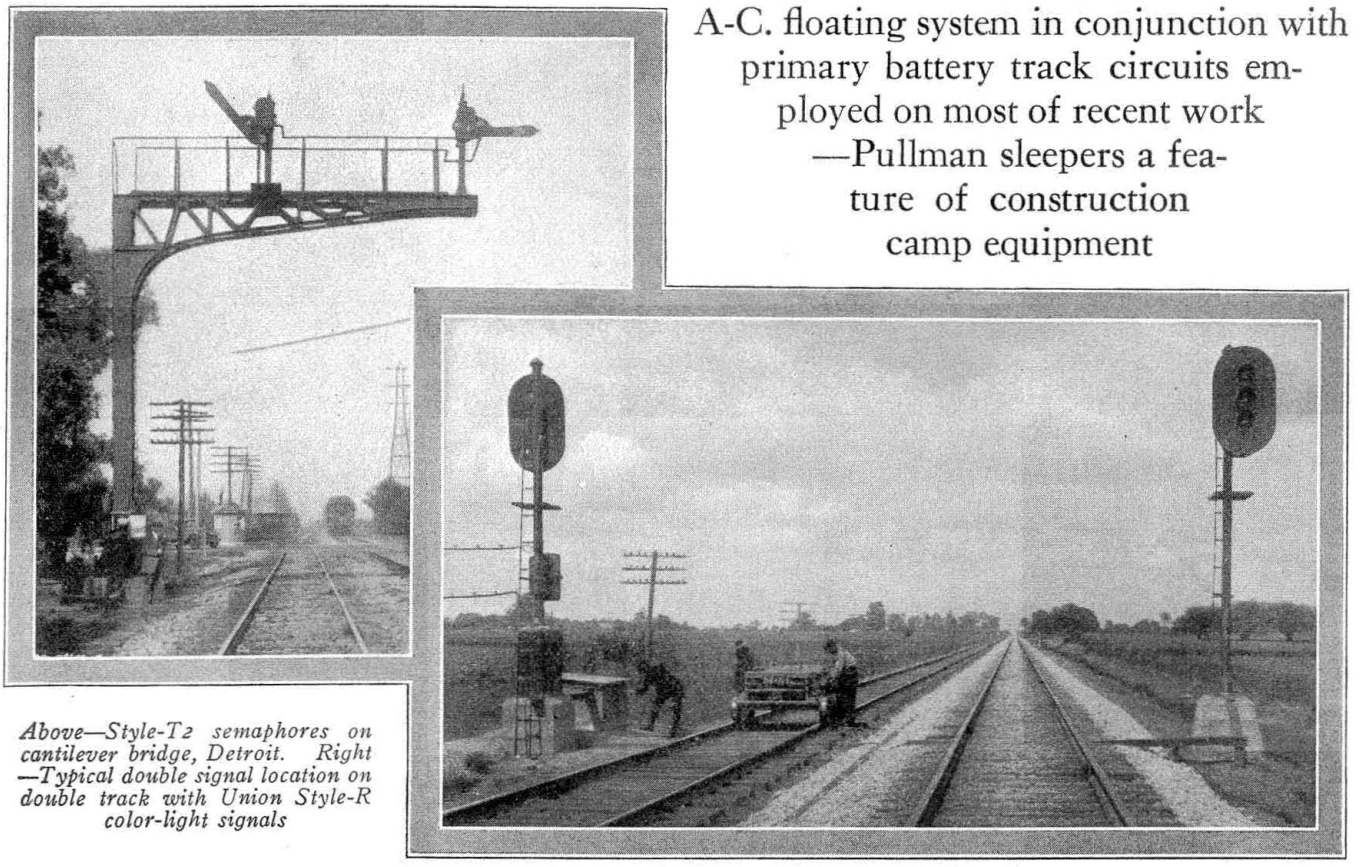
Wabash Extending Color-Light Signals to Increase Operating Efficiency

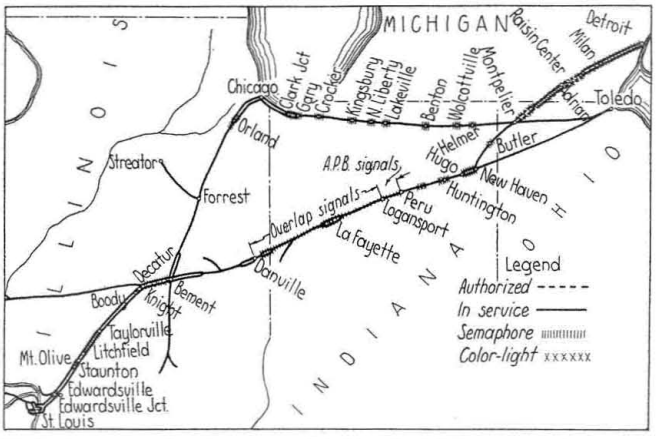
A-C. floating system in conjunction with primary battery track circuits employed on most of recent work —Pullman sleepers a feature of construction camp equipment



Above—Style-T2 semaphores on cantilever bridge, Detroit. Right —Typical double signal location on double track with Union Style-R color-light signals

RECENT automatic signal installations on the Wabash are the result of the increased traffic, largely freight, which this road has been handling. Its lines extend from Buffalo, Detroit and Toledo on the east, to Chicago, St. Louis, Kansas City, Des Moines and Omaha on the west, and it has the distinction of being the only road in the eastern district with a Kansas City or Omaha connection over its own rails. Traffic men point to the road's peculiar advantage in having a direct line from the important Niagara "gateway" to Kansas City, avoiding the congested terminals at St. Louis and Chicago, but at the same time having access in each direction to both of these important railroad centers. Due to its traffic advantages the road has held a favored position in fast freight service eastward from Kansas City and is said to have handled for many years a large share of the packing house products moving east out of that city. The phenomenal growth of the automobile industry at Detroit has also favored this road to a considerable degree. Thus, comparing 1926 with 1916, the Wabash enjoyed an increase in revenue ton-miles of over 17 per cent whereas the railroads of the eastern district as a whole had an increase in their revenue ton-miles of only 1.1 per cent. Considering only the increase in tonnage of manufactured and miscellaneous products, this road handled 85 per cent more business of this character during the same 10-year period.

Coupled with the substantial increase in traffic in the past few years, this road has displayed an improvement in its operating efficiency, indicating that it is interested in not only getting the business but also in handling it expeditously, the two being related to a certain extent. As an illustration, the Wabash reports one of the highest figures of any railroad in the country for average



Wabash main line between St. Louis, Chicago and Detroit showing principal automatic block and station signaling

freight train speed—14.5 miles per train-hour—the average being 12 miles per train-hour. This unusually high average train speed, coupled with an increase in its average gross train load of 18.1 per cent (comparing 1926 with 1920) has effected an increase since 1920 of 49.6 per cent in its gross ton-miles per train-hour, a factor of importance in gaging operating efficiency.

Primarily it is the recognition which the management has afforded to automatic block signals as an effective medium for increasing average freight train speeds, which has led to the recent automatic signal program on the heavier traffic sections of the railroad.

Extensive Signaling Program

Automatic signals were first installed to any substantial extent on the single track main line between Danville, Ill., and Lafayette, Ind., Union Style-S semaphore signals being installed in 1914 and 1915. Eastward from Lafayette the semaphore signal installation was continued to Clymers, Ind., in 1919 and from Clymers to Logansport (A. P. B. System) in 1924. Two years later an 18-mile section of A. P. B. semaphore signaling was completed between Logansport and Peru, the earlier installations west of Clymers being controlled on the single track overlap principle.

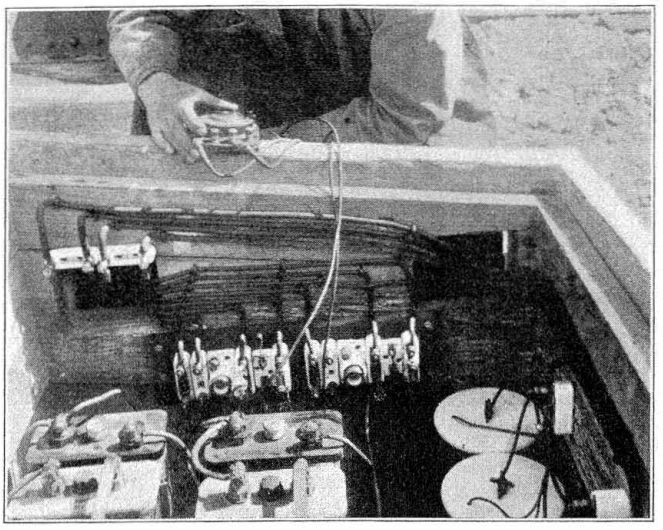
Installation Data on Wabash Automatic Signaling—In Service and Authorized

Location	Miles of Road	Date Installed
St. Louis, Mo.	5.8d	1903
Ferguson, Mo. (Yard protection)		1908
Edwardsville, Ill.	(s)	1911
Staunton, Ill., to Mt. Olive	8.d	1911
Delphi, Ind.	(s)	1912
Lafayette Jct. to Lafayette	3.s	1912
Logansport	(s)	1912
Milan, Mich., to Delray	33.d	1912
Peru, Ind.	(s)	1912
Williamsport, Ind., to Attica	3.1s	1912
Benton, Ind.	(s)	1913
Butler, Ind.	(s)	1913
Decatur, Ill.	4.d	1913
Helmer, Ind.	(s)	1913
Lakeville, Ind.	(s)	1913
Litchfield, Ill., to Taylorville	34.d	1913
Wolcottville, Ind.	(s)	1913
Crocker, Ind.	(s)	1914
Danville, Ill., to Williamsport, Ind.	21.9s	1914
Gary, Ind., to Clark Jct.	6.4d	1914
High Hill, Mo.	(s)	1914
Hugo, Ind., to New Haven	9.3d	1914
Kingsbury, Ind.	(s)	1914
N. Liberty, Ind.	(s)	1914
Martinsburg, Mo.	(s)	1914
Wright, Mo.	(s)	1914
Attica, Ind., to Lafayette	21.4s	1915
Paris, Mo.	(s)	1916
Lafayette, Ind., to Clymers	31.1s	1919
Clymers, Ind., to Logansport	6.s	1924
Excelsior Springs, Mo.	(s)	1924
Harlem, Mo., to Birmingham	7.s	1924
Alvorton, Ohio, to Adrian, Mich.	33.6d	1926
Boody, Ill., to Bement	33.6d	1926
Britton, Mich., to Milan	8.6d	1926
Logansport, Ind., to Peru	18.s	1926
Mexico, Mo.	(s)	1926
Salisbury, Mo.	(EDT)	1926
Tilton, Ill., to Danville	4.d	1926
Wabash, Ind.	(s)	1926
Adrian, Mich., to Britton	12.d	1927
Montpelier, Ohio, to Alvorton	11.2d	1927

Note: (s) denotes station signals.

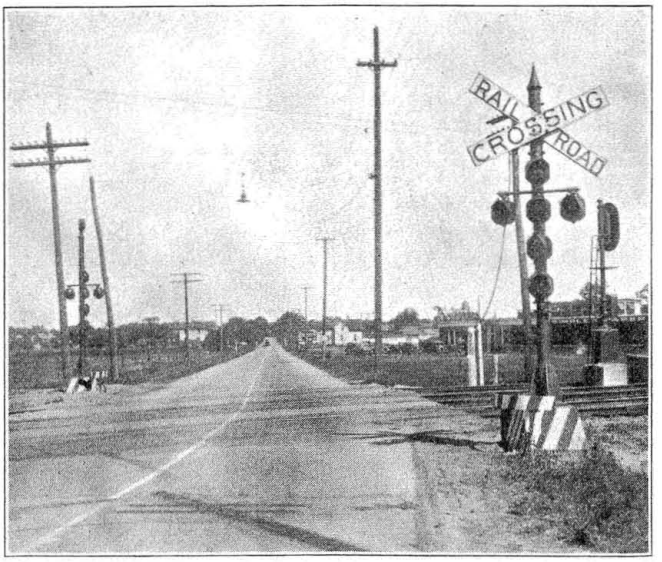
The most recent installations of automatics have been of the colorlight type with a-c. floating storage battery for signals and line control and primary battery for track circuit operation. The Decatur, Ill., to Bement installation on 22 miles of double track in 1925 and the numerous installations between Montpelier, Ohio, and Milan, Mich., made last year, and those that will be completed this year, as indicated in the accompanying installation table, are all of the colorlight type, using Union Style-R three-color-indication signals, with approach lighting control. A specially rebased 8-volt, 10-watt lamp is used and is burned at 10 per cent under rated voltage to secure added lamp life.

At the end of this year the double track main line between Montpelier, Ohio, and Delray, Mich. (Detroit)



Battery box interior showing No. 12 solid R. C. wire cleats and arrangement of resistance units, knife switch, A. R. A. terminals and fuses

will be completely signaled. The traffic density (gross ton-miles per day, per mile of road) on this section is greater than on any section of the road of comparable length (91 miles), a heavily rock-ballasted road bed with 110-lb. rail being used for most of this line. In addition, the grades and curvature are unusually low,



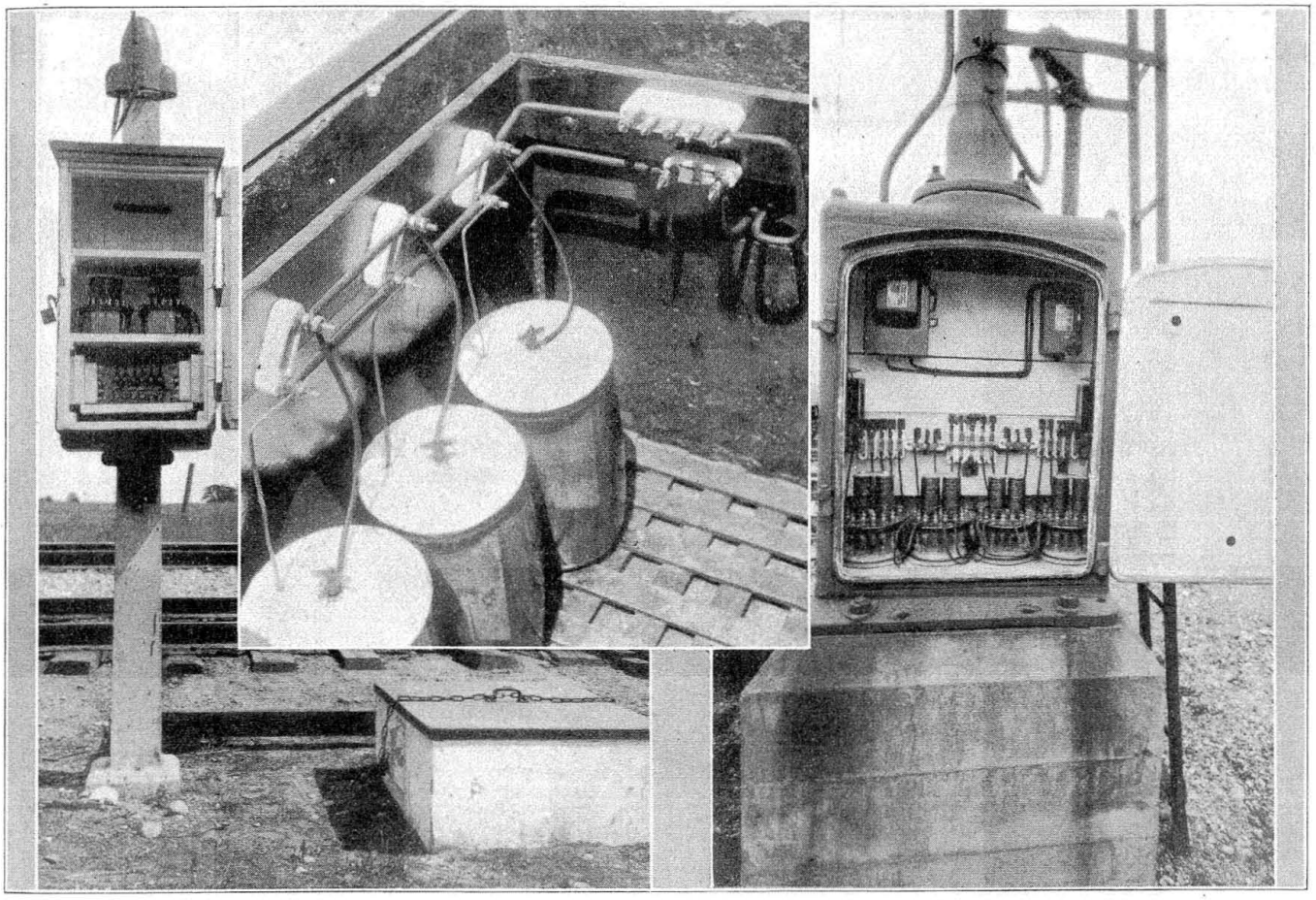
Typical highway crossing protection using Railroad Supply Company's flashing light signals, Adrian, Mich.

making this line an ideal "race track" although, of course, excessive passenger train speeds are not permitted.

High-Voltage Primary Battery Used Exclusively for Track Circuit Operation

The batteries for track and signal operation are housed in concrete boxes and are wired up according to a standard plan which was prepared with the view to enable the maintainer or inspector to examine the cells,

or replace them with the least disturbance to other cells or to signal operation. The three Columbia high-voltage Type-72 cells which are connected in multiple are wired to a neat bus bar arrangement in the boxes on the recent installations as shown in the illustration and drawing. A Brach variable resistance unit (maximum value one ohm) is connected in series with the positive lead to the track. On account of the character of the traffic on the double track main line, most of the color-light signals being on double track sections, it is necessary to employ different values of resistance for the eastbound and westbound track circuits. Ballast resistance is considerably lower on the eastbound track they are made up in the field. The four storage cells and the Balkite cell are mounted on a wooden tray provided with cleats to segregate the jars. A 5-ohm adjustable resistance unit in series with a single pole knife switch is mounted on a wooden terminal board in each box. This 5-ohm unit is in addition to a 3-ohm Ward Leonard fixed resistance connected in the secondary circuit of the Balkite transformer in the relay case. A 6-amp. plug fuse is also connected in the operating circuit to protect apparatus against shorts and grounds and to prevent any grounds or shorts from running the storage battery down. A 1-amp. fuse is used to protect the primary of the transformers. A hydrometer is



Left—Relayed cut-section, Wabash standard wood relay box mounted on concrete cable post; Center—Bus-bar arrangement in track battery box, A. R. A. terminals mounted at 45 deg. in order to have cross leads clear binding posts; Right—Interior of signal case on Decatur to Bement color-light signaling

owing to the preponderance of refrigerator car movements under ice in that direction. About 0.4 ohms series resistance is employed on the eastbound track circuits, the average cell life being five months in contrast to an average life of seven months when used in westbound track circuits, where it is possible to use a higher limiting resistance, 0.7 ohms being a good average value for these latter circuits.

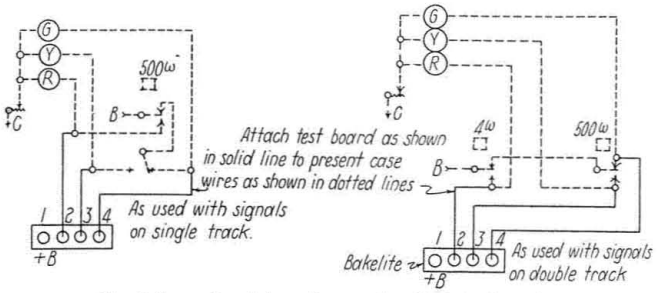
A-C. Floating System Used for Signal Operation

For signal operation and line control, four cells of Prest-O-Lite, Type-KALA 75-amp. hr., 7-plate storage battery are employed. These are on continuous floating charge using a Balkite rectifier which is located in the box with the battery, while the transformer is located in a separate housing, allowing only the secondary circuit to enter the battery housing. The storage batteries are of the type which are shipped dry by the manufacturer but are fully charged and ready for service when the electrolyte is poured into the cells as provided in each battery box for taking periodic gravity readings of the storage cells. The money spent for additional hydrometers is more than justified by the saving in breakage which results if they are carried on a motor car.

All battery wires are cleated to the sides of the well with cleats made by bending short lengths of weather-proof copper wire into a "U" shape and driving them into holes drilled into the wooden panels supporting the A. R. A. terminals. Kerite insulated No. 9 solid copper wire is employed for battery box and track wiring. A distinctive feature of the track wire connections is the use of a solid No. 9 copper wire from the battery or relay box to the copperweld wire boot-leg. This solid wire connection is supplemented with a No. 9 flexible copper, 19-strand, wire which is soldered to the solid wire about four or five feet from the end of the boot-leg, the flexible wire being soldered to a similar boot-leg for attaching to the inside web of the rail. It is believed that this construction produces a lower

resistance and more reliable track connection than where two flexible wires are soldered between the solid wires and copperweld boot-legs. The double boot-leg, rather than single boot-leg, also has reduced signal failures as there is double protection against breakage of boot-legs. There is 3 ft. of slack wire in the trunking for each boot-leg connection.

All track wiring for automatic signals is carried in cypress or redwood A. R. A. trunking, covered outside with creosote and paint. The creosote is applied with a brush in the same fashion as paint. No. 1 trunking is



Test board wiring for color-light signals

WHEN TESTING 8-VOLT, 10-WATT LAMP:
Both filaments good will read approximately 1.25 amp.
One filament burned out will read approximately 0.675 amp.
Both filaments burned out will read zero.

TERMINAL CONNECTIONS FOR USING AMMETER:
Terminals Nos. 1 and 2 to read current through red lamp.
Terminals Nos. 1 and 3 to read current through yellow lamp.
Terminals Nos. 1 and 4 to read current through green lamp.

employed for the individual leads, No. 3 trunking for the intermediate and main leads, and No. 4 trunking for the run between battery box and signal. The No. 4 trunking at the foundation enters through a Union inlet bracket to the regular inlet at the bottom of the mechanism case.

Copperweld wire is used for most of the bonded joints in rail, the two No. 8 wires being twisted about five times to stiffen the bond before the ends are bonded to the web of the rail with copper-coated single channel pins. A three-mile test section of O-B gas-welded bonds and welded rail connections on the Detroit division is being watched with the view to determining whether to use gas-welded bonding on future construc- and for replacing present bonding.

Facing switches are protected by two switch circuit controllers, one being connected by a separate rod to each point and are wired independently to shunt the track so as to effect a low resistance track shunt. Trailing switches are shunted with one circuit controller only. The Rail Joint Company's continuous fibre insulated joint is standard for all track circuit work.

Color-light Signals Are Mounted on 14-Ft. Poles

The signal foundations are 15 in. above the top of rail, while the tops of the signal poles are 14 ft. above the foundation tops. In all cases the relay case is located on the pole line side of the track, the only wires, other than the No. 9 track leads, running in trunking across the track are the No. 12 light wires. Separate line drops are employed for the 440 or 220-volt power wires and line control wires, each entering its respective case through a separate service inlet. The cable drop for the control wires is brought into the top of the mechanism case through 1½-in. conduit using a U. S. & S. inlet bracket, while the a-c. cable drop is carried into the top of the case through ¾-in. conduit using a Crouse-Hinds Type FE service inlet. In making the cable drops a No. 6 iron wire messenger is used, the control wires (No. 14 Kerite) being fastened every 16 in. with cable hangers made from No. 12 weatherproof wire. Three twists are made around the cable and the free ends of the No. 12 wire are then coiled in opposite directions around the No. 6 messenger. Uniformity in case wiring is a noteworthy feature of the recent work on the Wabash as reference to accompanying illustrations will verify.

The approach lighting relay is an assembled unit with a 200-ohm coil and a single back contact. This relay is connected in series with the "D" relay at the preceding signal and this arrangement provides approach control for any indication. A red indication is given through the de-energized position of the "H" relay as long as the block is occupied regardless of whether or not a train is in the approach section. For lightning arrester ground connections, Paragon ground cones are used, buried in moist ground.

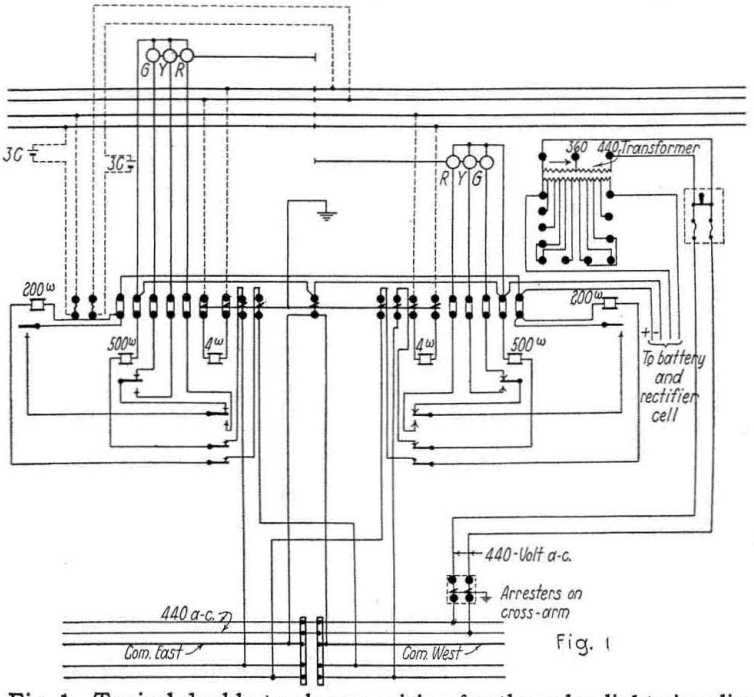


Fig. 1

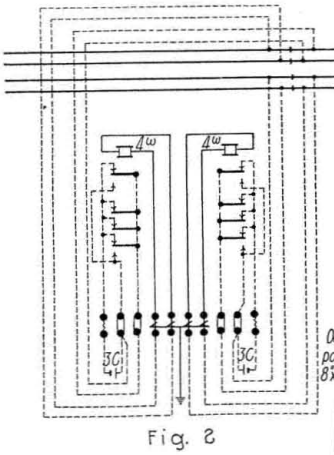


Fig. 2

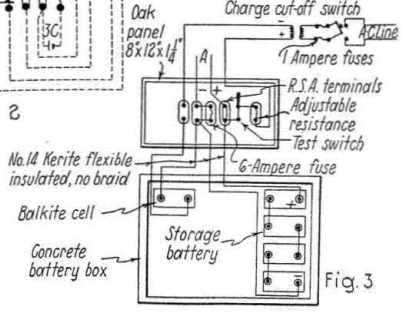


Fig. 3

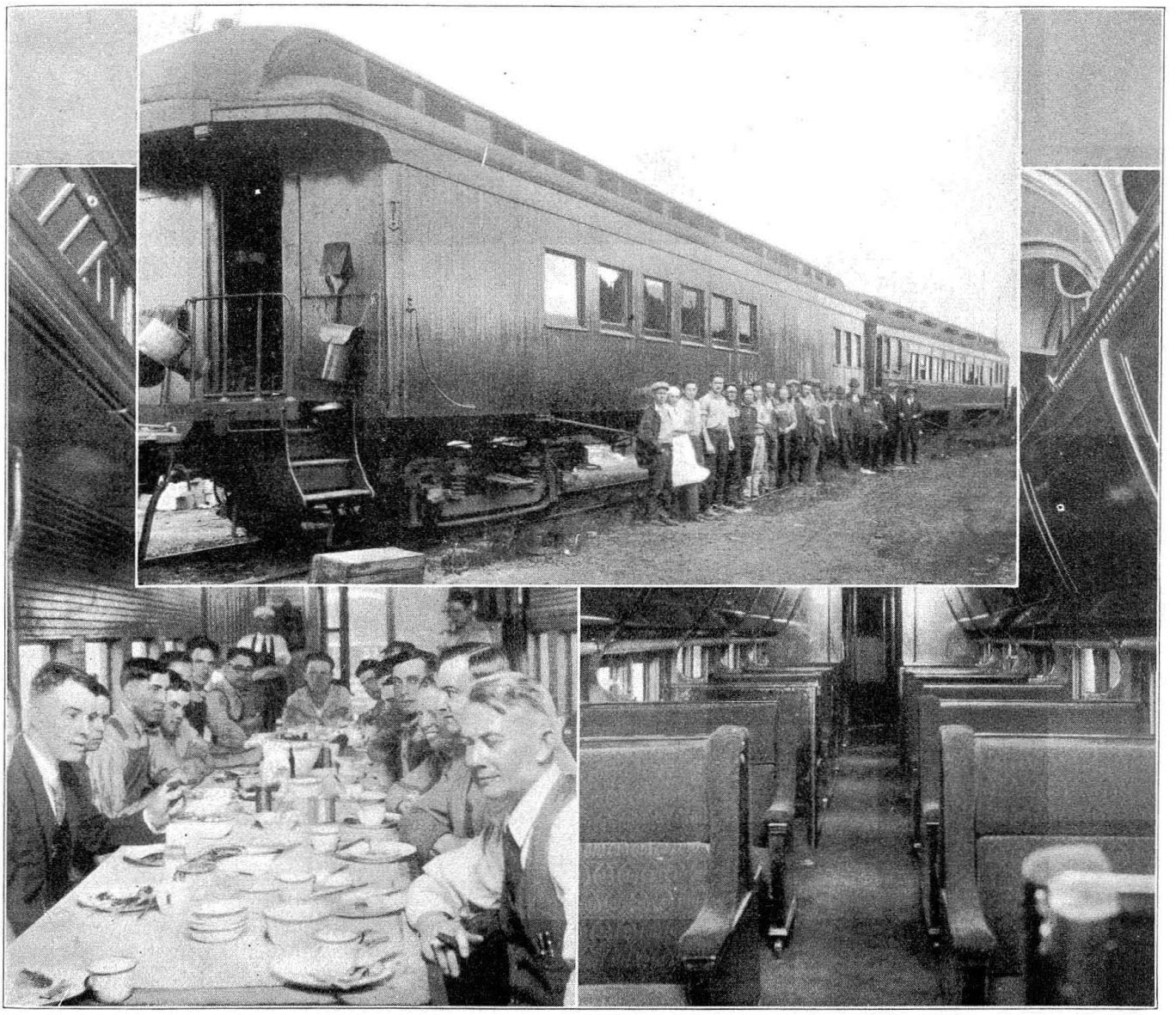
Fig. 1—Typical double track case wiring for the color-light signaling; Fig. 2—Typical relayed cut-section on double track; Fig. 3—Battery box wiring showing terminal board with adjustable resistance unit, knife switch and operating fuse

While the power wires are located in the same relay case on some of the earlier work the latest practice provides a separate case for the Balkite or Union transformer and safety switch. A Trumbull Type-C or Square D enclosed switch with one-ampere Economy renewable plug fuses are provided to control the primary circuit of the rectifier transformer. The latter is of the five-cell type and has two primary taps, depending upon the transmission voltage employed, some having 440 and 360-volt taps, while the others have 220 and 200-volt taps.

at the pole. About 10 miles is the maximum length of any 220-volt line.

Since relayed track sections are used for the "H" control of the signals, on double track, the only line control is the "D" or green indication control wire. No. 12 Copperweld weatherproof wire is standard for the "D" control wires and other special control wires such as at highway crossing signal locations, while No. 8 Copperweld with weatherproof covering is used for common.

The earlier semaphore installations are operated with



Left—Dining table after noon-day "chow"; Center—Cook and dining car with Pullman showing one of the construction gangs in foreground; Right—Pullman sleeper with "bunks" made up

The signal department places its own cross-arm on the second gain below the lowest arm on the existing Western Union lead for signal control and a-c. floating power wires. For the latter, two No. 6 solid copper weatherproof wires are used on the two track side pins supported on Hemingray No. 42 glass insulators where the voltage is 440 and where 220-volts is employed on shorter sections No. 8 weatherproof copper wire is used. At the end of feed sections these power wires are dead-ended on 3-in. porcelain strain insulators, with eyebolt and clevis fastened through the cross-arm. A Brach Type-25 arrester is mounted on the cross-arm at each distributing point and is connected to a ground rod

Edison 500 amp. hr. primary cells, 16 of them being hooked in series. These signals are all approach lighted from primary battery. Track sections average 2,500 ft. and are fed with three cells of Columbia high voltage Type-72 primary battery in multiple.

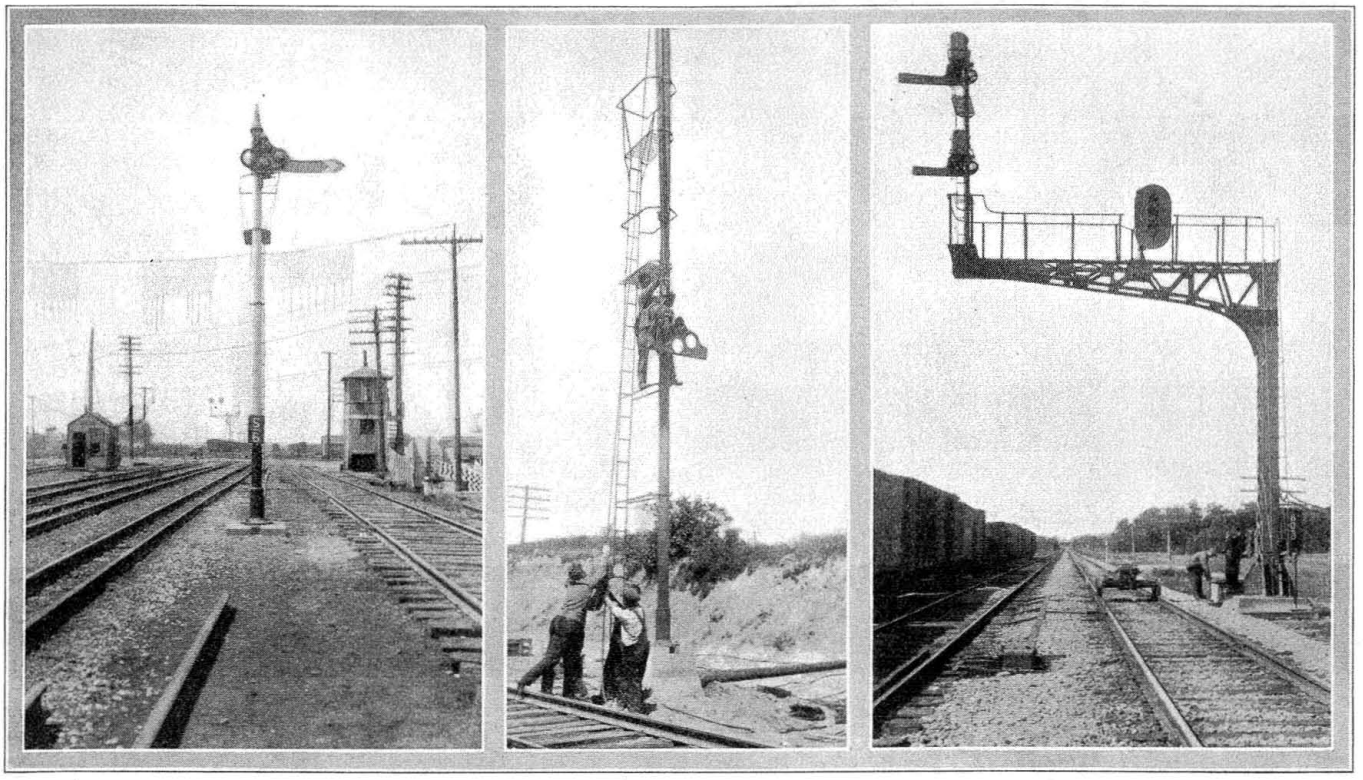
A low-voltage Union Style-M switch machine is in service at South Adrian, Mich., to operate a derail at a mechanical interlocking plant and another similar machine is used at Gary, Ind., for a switch at end of double track. The derail at South Adrian was considered too far from the tower for mechanical connection and hence it was decided to control it from an electric lever in the Style-S8 electro-mechanical ma-

chine. This low-voltage machine has the latest type gearing and operates to the full reverse position in 20 sec. using 11 cells of storage battery. These cells are kept charged by two Balkite electrolytic rectifiers.

A similar low-voltage machine will shortly be installed at the end of a passing track about 2 miles east of Adrian, Mich., and will be controlled from the station. This remote power switch will be protected with a semaphore signal and the latter will indicate to trains when to take siding. One of the construction views shows the signal mechanism being fitted to the pole at this location.

Flashing light type highway grade crossing signals as furnished by the Railroad Supply Company, and L. S. Brach Company, are in service at most of the protected crossings.

These have the vertical stop sign arranged between the flashing units. Operating power is supplied by a five-cell storage battery and Balkite rectifier. An interesting feature of the protection at highway crossings is the "bumper" provided around the concrete foundation to protect it from trucks principally, but to no small extent also from carelss autoists who sometimes run into them. This bumper is made from steel bar bent to conform to the outline of the foundation and is bolted to rails buried in the ground a few inches away.



Right—Two-track signal bridge as furnished by American Bridge Company with two Style-T2 semaphore home signals and one Union Style-R color-light automatic signal, at South Adrian, Mich.
Center—A construction view taken while raising Style-T2 Union mechanism, Adrian, Mich.
Left—Style-T2 semaphore in yards at Detroit

Construction Organization

On the Detroit division work, three crews of about 12 or 15 men were employed, the first task being the foundation work. This was accomplished by casting each foundation in the field with the aid of a small gas engine concrete mixer mounted on a four wheel section car. Rail bonding and insulated joints were handled as a unit until completed. A similar practice with a few modifications was followed in the pole line work. The wires on the track side were strung with the aid of a motor car and lifted in place with hook sticks.

Battery Supervisor Checks Up on Storage Cells

Few railroads have a man whose sole job is looking after batteries, but the Wabash is one which shares this distinction and is obtaining more serviceable and economical performance from storage batteries in consequence of this intensive maintenance. Each maintainer is required to keep a permanent record, in a suitable book, of specific gravity and voltage readings for all cells on his territory. These readings must be taken every two weeks and from the permanent record book a report is prepared on a special form provided for that purpose and forwarded to the battery supervisor, showing the gravity of each cell on the territory together with voltage during floating charge, voltage across lamps, charging current, hold-clear current (semaphore signals), operating current and temperature. Because of the necessity for frequent and thorough specific gravity readings of all cells it was deemed best to provide hydrometers at all battery boxes. The detail record of each cell thus made available enables the maintainer to regulate his charging current.

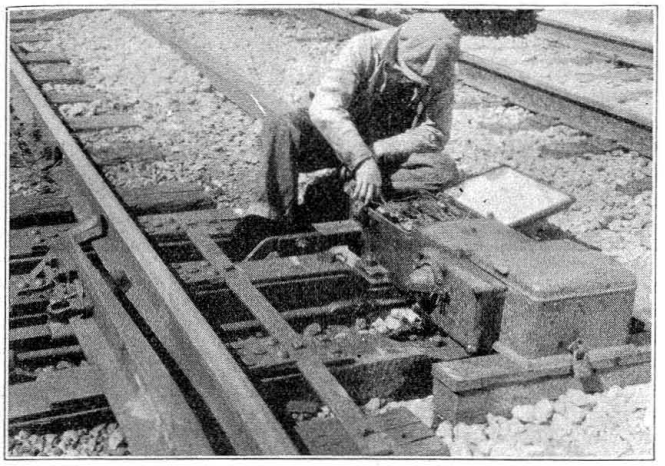
For testing color-light signal lamps, a simple test board scheme has been devised to enable maintainers to check up on their lamps with an ammeter. This scheme is explained in the accompanying circuit drawing.

Camp Car Equipment Marks a Decided Advance in Signal Construction Work

The Wabash is one of the pioneers in supplying its signal construction gangs with the most comfortable and livable sleeping and dining car equipments. Almost every city convenience is incorporated in these cars—they have hot and cold running water, electric lights, shower baths, lockers, Pullman berths (instead of box

car bunks), vacuum cleaners and radio sets. These cars are kept up in first class shape by periodic shopping and painting and are in every respect a credit to the railroad. The splendid employee morale displayed by the signalmen working in these gangs is evidence that the men appreciate the conveniences furnished them. In all, there are at present three complete Pullman camp units in service.

Sleeping cars were purchased from the Pullman Company and reconditioned for camp car service by the mechanical department at the Decatur shops. The heating system originally in each car was replaced with an Arcola hot water heating plant using wall type radi-



Low-voltage Union Style-M switch machine at South Adrian, Mich.

ators. The 250-gal. water tank originally underneath the car was placed in a vertical position inside one end of the car where pressure is maintained in it by means of a ½-hp. air compressor mounted close by. This small motor is a 32-volt machine and is operated from the 32-volt car lighting battery. In order to keep this battery charged the railroad installed a ¾-kw. Westinghouse gas-electric lighting unit in the end of the Pullman car. This generator is operated about every other day for six hours to keep the 16-cell lighting battery charged.

Most of the men prefer the upper berths, each man making up his own bunk every morning. Other household duties such as sweeping the floor, cleaning cushions and washing windows are assigned to all the men in the gang in proper rotation. Closets are provided in the sleeping car for street clothes in order to keep them away from overalls and other work clothes. The latter are kept in individual steel lockers in the utility end of the dining car. Wash basins with hot and cold running water are provided at each end of the Pullman car.

Wabash Tool Car Equipment

1. Fairbanks, Morse 3-hp. gasoline engine.
2. Line shafting to emery wheel and drill press.
3. Emery wheel grinder (floor stand).
4. Vertical drill press (capacity up to 1¼-in. drills).
5. Forge and hand-operated blower.
6. Oxy-acetylene welding and cutting equipment.
7. Work bench with padlocked drawers for hand tools.
8. Power-operated pipe threading and cutting machine (capacity ¼-in. to 3-in. pipe).
9. Blacksmith type vises.
10. Fairbanks, Morse Type 40B motor cars.
11. Push cars.

The "dining car" is a remodeled day coach with a steel underframe. It is rebuilt to conform to present day passenger train requirements and can be operated together with the Pullman car as part of a regular passenger train. In the head end of the car a mess table has been built and this end is reserved exclusively as the dining room. The rear end of the car is the "utility room," containing the steel lockers for work clothes, and the shower bath. A coal range is employed for cooking and also for hot water supply for washing. This range is at the extreme head end of the car and across from it is the pantry and work table for the cook. A built-in ice box of 500 lb. capacity has been provided in the same room but at the other end. The "diner" is electrically-lighted from the battery in the Pullman car but has its own Arcola hot water heating system, the furnace being in the "utility" room. The shower bath has both hot and cold running water and is completely enclosed, except for a small window at the top. It is lined with sheet metal on all sides as well as bottom, the seams being water-tight.

Food Is the Only Item of Living Expense Which the Men Have to Meet

Under the present arrangement the company furnishes the sleeping and dining quarters free of charge and pays the cook's wages. In addition the company furnishes wash water and supplies the ice and coal needed in the dining car and also for heating purposes. Water is supplied from a tank car ahead of the diner and this when empty is picked up by the local freight and hauled to the nearest water station. After filling it is returned by the same agency. Drinking water is supplied from the depot drinking water wells or faucets. The cook prepares a weekly statement of expenses and pro-rates the cost for food (which is the only cost) among the men on the basis of the number of meals obtained. Recently this has been averaging about 25 cents a meal or $4.50 a week if a man receives three meals a day for six days a week. The service is so well liked that all men in the signal department who have expense accounts prefer to eat in the camp diner than elsewhere and gladly pay more than the actual cost of the meal, the surplus going into a "kitty" which is used to purchase needed accessories such as vacuum cleaners; radio sets, extra dishes, extra cooking utensils, etc.

Typical Luncheon Menu—Wabash Signal Camp Dining Car

Appetizers and Vegetables

Radishes Lettuce Corn Peas
String Beans

Meat

Roast beef with dressing and mashed potatoes
Bread and butter

Dessert

Chocolate custard pie
Milk or coffee

With each gang outfit, an electrical supply car and blacksmith car are provided. Conduit, wire, tape, solder, terminals, insulators and miscellaneous wiring appliances are kept in the electrical car. In the other car a complete blacksmith shop with a 3-hp. gasoline engine driving a line shaft to which are connected a 1½ in. drill press, emery wheel and power threading and cutting machine, is set up. Switch and derail layouts can be fitted up in the portable shop thus provided with minimum labor. The tool and supply cars of this type, on the Wabash are painted a dark green to harmonize with the Pullman and dining cars of each camp unit, and can also be hauled in local passenger service.