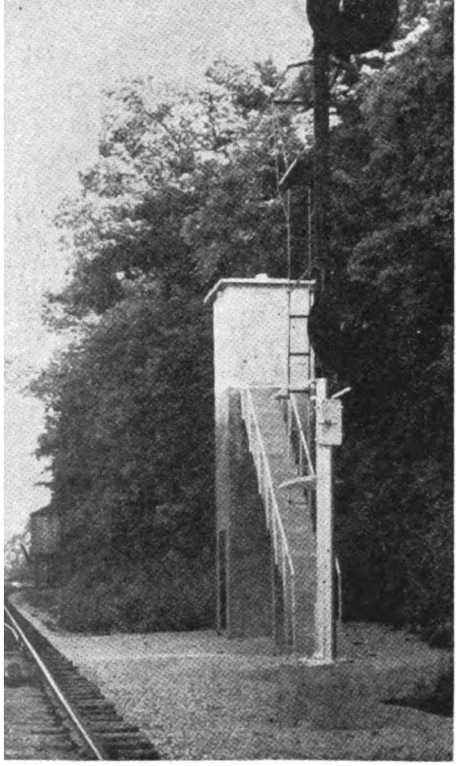
# C. T. C. Down by the Ohio



**Typical station-entering signal at north end of Rock Haven**

REDUCTION of train stops, delays and running time of tonnage freight trains, elimination of train orders, and increased overall operating efficiency and flexibility—these are the results of an installation of centralized traffic control on 137 mi. of single track of the Louisville & Nashville, between Louisville, Ky., and Henderson. The territory involved is that part of the main line between Louisville, Henderson, Ky., and St. Louis, Mo., designated as the L.H. & St.L. subdivision of the Evansville division. This territory is shown in the accompanying map, Fig. 1.

The south end of the territory is at Strawberry, about six miles from Louisville, where there is a junction with the main line between Louisville and Nashville, Tenn. From Strawberry, the line follows the valley of the Ohio river to Henderson, where it joins the main line between Nashville, Evansville and St. Louis. The control machine is located at division headquarters in the union station at Evansville, 12.4 mi. north of Henderson and across the Ohio river.

The traffic in this territory includes three passenger, three through freight and one local freight train in each direction daily, plus extras as required, thus averaging 14 to 16 trains daily. Northbound freight trains average 2,800 tons, while southbound freights average 3,200 tons between Howell and Doyle and 2,400 tons between Doyle and South Louisville. The differences in ratings are due to ascending grades southward, which are the heaviest between Mystic and Guston, but not exceeding one per cent.

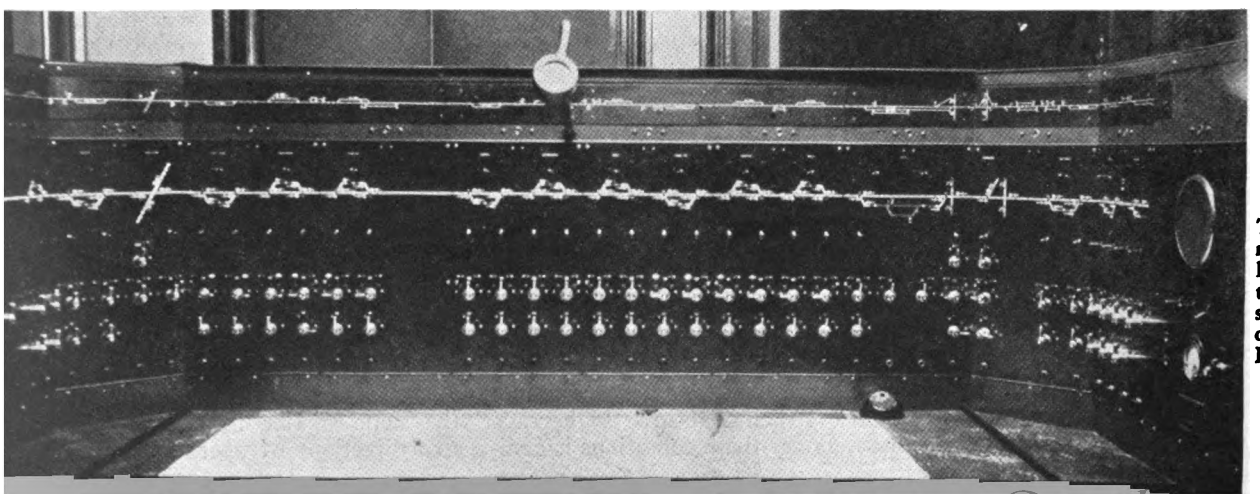
### Why It Was Installed

Prior to the installation of C.T.C., train movements were governed by timetable and train orders. Absolute permissive block signaling was in service on 60 mi. between Strawberry and Stephensport, no signal protection being provided on the remaining 77 mi. between Stephensport and Henderson, except at a drawbridge over the Green river at Spottsville, 9.4 mi. south of Henderson. In deciding on the type of signaling to be installed, consideration was given to extention of the existing A.P.B. from Stephensport to Henderson. However, this would not have eliminated the train orders, and while the average number of daily train movements is not great, delays of freight trains were being encountered because of the long distances between open train-order offices and the inability of the dispatcher to have train orders delivered promptly to cover last minute changes.

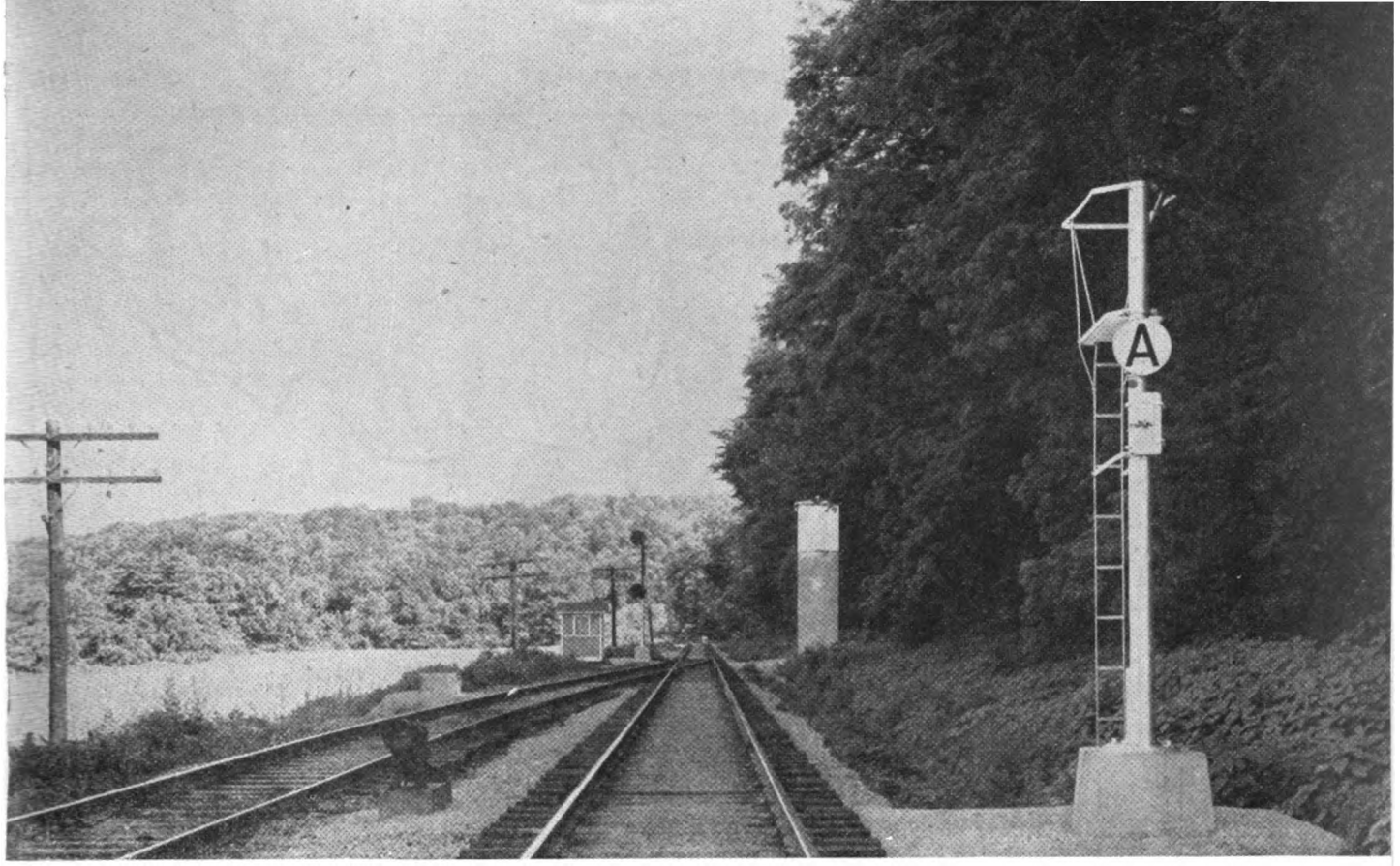
Train-order offices open 24 hr. were formerly located at Strawberry, Irvington, Cloverport, Doyle and Henderson, while 8-hr. offices were located at West Point, Brandenburg, Hawesville, Lewisport and Owensboro. Thus when only the 24-hr. offices were open, they were spaced at an average distance of 34 mi., and when the 8-hr. offices were open in addition, they were spaced at an average distance of 15 mi. These conditions, combined with the fact that the line is close to the Ohio river, where fogs prevail and on which there are numerous curves, lead to the decision to install C.T.C., rather than extend the existing A.P.B.

### Passing Tracks Removed

Under the previous method of train operation there were 40 passing tracks in the 137 mi. between Louisville and Henderson or, in other words, a passing track on the average of every 3.4 mi. Of these, 15 were converted to controlled sidings with



**The control machine is located at the division headquarters in Evansville**




**Typical high and dwarf station-leaving signals at the south end of Rock Haven**

power switch machines and signals, the turnouts being changed from No. 10 to No. 12, thus permitting diverging train movements up to 15 m.p.h. These sidings are spaced at an average distance of 9.1 mi., 5.7 mi. farther than under the old operation.

Two sidings were lengthened, namely, at Bishoff and Katharyn, so that the average capacity of the passing tracks is now 85 cars. Figured in this general average are the passing tracks at Irvington and Lewisport, which have a capacity of 117 and 116 cars, respectively. A total of 10 passing tracks were removed from service entirely, and 8 were cut off as spur tracks with an electric lock on the main-line switch. Seven passing tracks were converted to lock sidings by the application of an electric lock on the main-line hand-throw switch at each end of the siding.

**Installation on 137-mi. subdivision of the Louisville & Nashville cuts 1½ to 2 hr. from running time of tonnage freight trains, and includes numerous special construction features to provide protection of the signal equipment against possible floods along the Ohio river**

### Trains Progress Faster

While passing tracks are now farther apart, trains are able to progress over the division faster than before. Passenger trains are able to maintain their schedules and to make up time if running late. Freight trains save up to two hours in going over the division in either direction. Under previous operation an average tonnage freight train required from 8 to 9 hr. running time between Louisville and Henderson. The running time is now 6½ to 7 hr., and sometimes less, depending upon meets. Heretofore, a freight train made 8 to 9 stops, including those for water, between Henderson and Louisville. The run can now be made with three water stops.

When a northbound freight train is ready to leave South Louisville, the operator in the tower pushes an annunciator button, which lights a lamp on the control machine at Evansville. The dispatcher then lines up and clears the signals. Similarly, when a train is ready to leave Doyle, a member of the crew pushes a button to give the dispatcher the information. When a southbound train is ready to leave Henderson, the towerman pushes a button which indicates this information to the dispatcher. Thus trains are allowed to depart without delays occasioned by having to wait for orders, which saves considerable time.

Between Rock Haven and Brandenburg, 6.1 mi., sometimes it is necessary for northbound trains to double. This operation is facilitated by the dispatcher being able to control the train movements by signal indication without trainmen having to handle the switches. Another advantage under C.T.C. is that if passenger trains have mechanical failures, freight trains are kept moving, unlike under

**Typical dual-control power-switch layout**

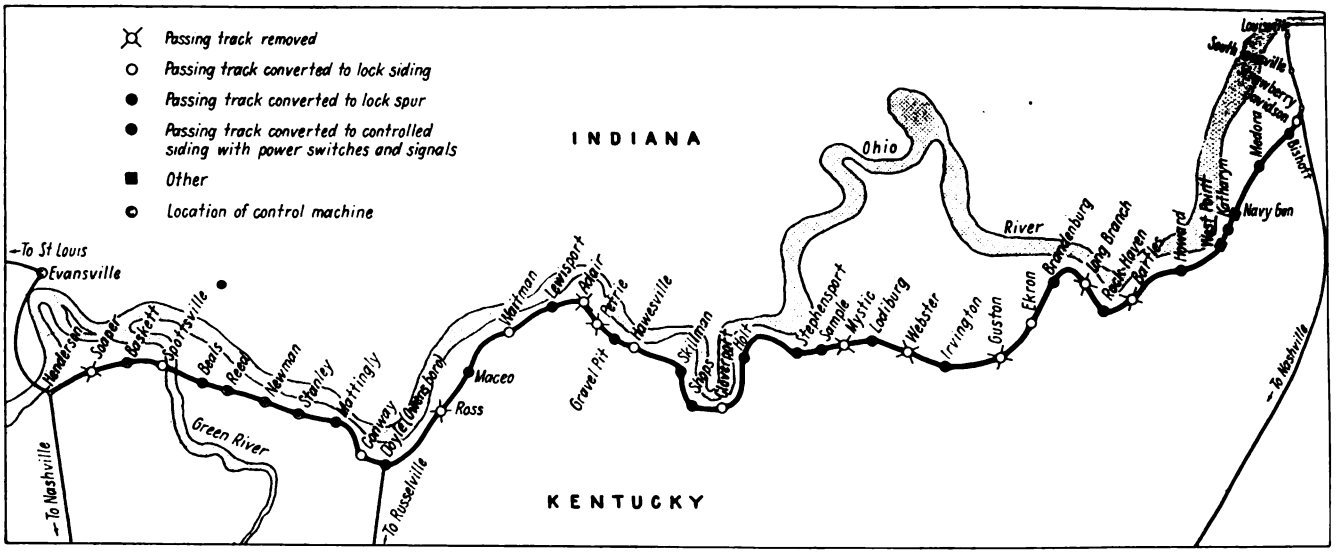



Fig. 1—Map of the C.T.C. territory between Louisville and Henderson

the old operation, when in such instances the freights had to be "dug out" of the sidings.

### About the Control Machine

The control machine, which is located at division headquarters in Evansville, is "U" shaped and includes the conventional arrangement of switch, signal and lock levers, code and maintainer-call buttons, various indication lights, track and signal diagram, and automatic train graph. Thirty switch levers are provided for the control of the same number of power switch machines; 37 signal levers for the control of 95 signals; 2 lock levers, each for the control of 2 electric locks; and 2 special indication levers. New features of the machine, compared with similar installations made previously on the L. & N., include two independently-controlled track-occupancy lights on the diagram for each station-to-station block. Only one light was used heretofore. The purpose of the second block light is to provide additional information to the dispatcher regarding the progress and location of trains, thus making for improved coordination of train movements.

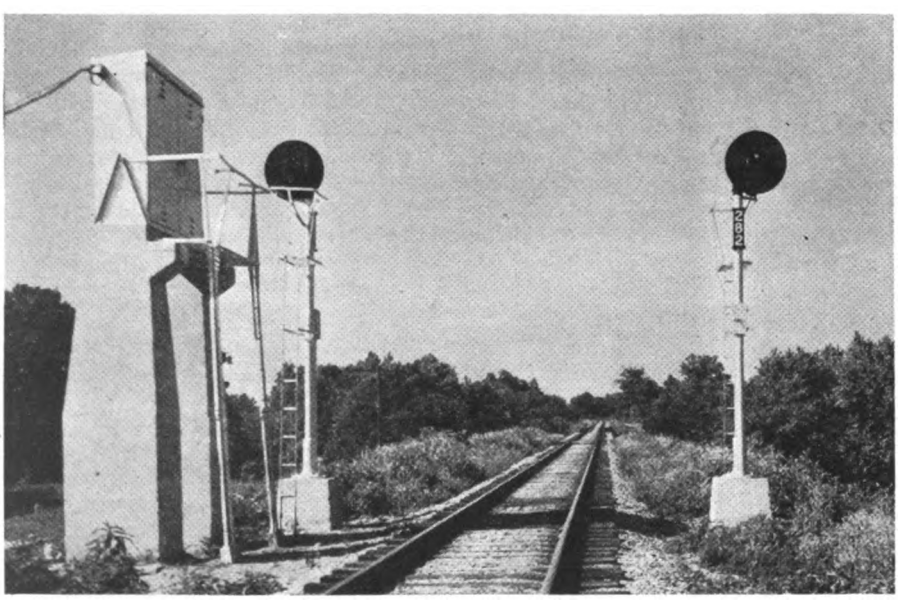
Small tags, representing trains, were formerly pegged in the diagram by the dispatcher as the trains moved over the territory and took siding. These have been replaced by white tell-tale lights on the sidings on the diagram. Each of these lights is controlled by a toggle switch.

Heretofore the power-off indication for each field station was displayed by a separate light. However, on this installation the machine was simplified by combining the power-off indication with the station indication light. When there has been a power failure this light is illuminated, but is extinguished temporarily whenever an indication code is transmitted from the field station to the machine. This arrangement saves several lights and lessens chances of confusion on the part of the dispatcher. There are 33 maintainer call lights throughout the territory, by which the dispatcher can inform a maintainer that he wishes to talk to him. One is located at each C.T.C. field location. The line-coding system is the two-wire G.R.S. Type K, Class M, with a maintainer telephone circuit superimposed thereon, which permits the maintainers to talk to one another and the dispatcher, without tying up other phone lines.

### Searchlight Signals

The signals are the Type SA searchlight, with 10-volt, 250-ohm operating coils and 10-volt, 13 + 3.5-watt double-filament lamps. Precracked green roundels are used to minimize heat breakage, and 10-deg. and 20-deg. flat deflecting cover glasses are used on signals on curves.

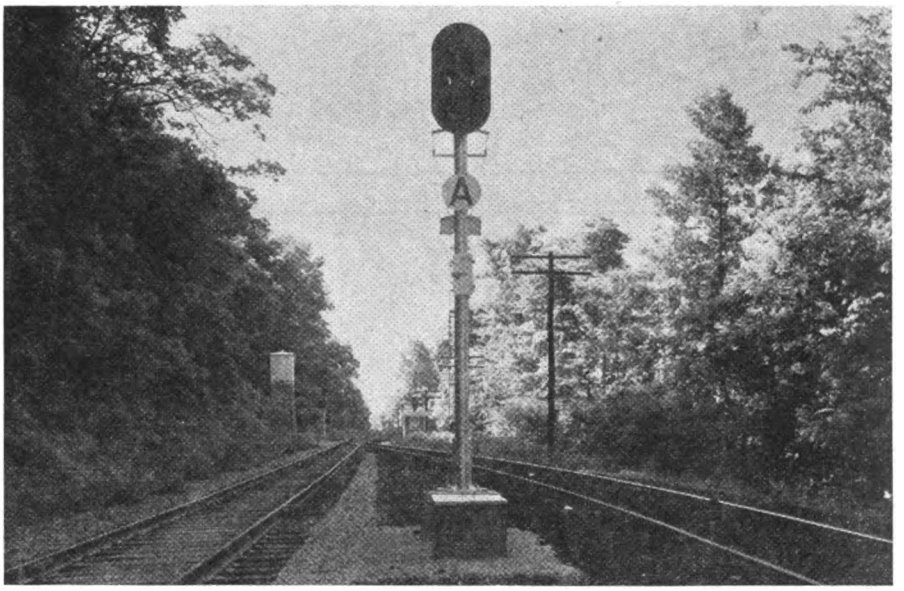
At the end of each controlled passing track there is a two-arm station-entering signal, a single-arm station-leaving signal on the main line, and a single-arm station-leaving dwarf signal on the siding. The top arm of the station-entering signals governs train movements on the main line and the bottom arm governs movements to the siding. These signals display red-over-red for Stop, red-over-yellow for Restricting, yellow-over-red for Approach and green-over-red for Clear. The leaving signals display a single red for Stop, yellow for Approach and green for Clear, the high leaving signal being designated as an absolute signal by a letter "A" mounted on the mast below the unit. In order to provide clearance where the high leaving



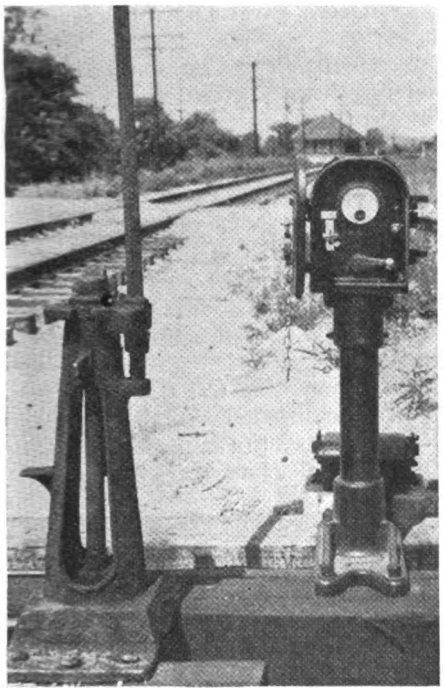
Intermediate location with instrument case on high foundation for flood protection

signals are located between the main track and siding, the siding was shoved over to a 19-ft. center, and more if on a curve. Such signals are equipped with 24-in. oblong backgrounds in place of the customary 35-in. circular backgrounds. Backgrounds are not used on the dwarf signals.

The intermediate automatic signals in the overall station-to-station blocks are arranged in the conventional manner and spaced approximately the same distance apart, none being under 10,000 ft. The majority of intermediate locations are double. For controls, a two-wire line circuit is used, which has been described in detail in these columns before. These signals are capable of displaying three aspects,



Station-leaving signal with oblong background at north end of Rock Haven



Electric lock on main-line hand switch

namely, red, yellow or green, for Stop and Proceed, Approach and Clear, respectively.

### Signal Lighting

In order to conserve battery, the station-leaving signals only are continuously lighted, and the station-entering signals, like the intermediates, are approach lighted. The track circuits are the coded type, except in congested areas, where ordinary neutral d.c. track circuits are used. The track circuit equipment on this installation was simplified, compared with that used on previous projects, by the use of two-point track relays. Heretofore, single-point track relays were used, and to obtain additional contacts for the control of the master decoding transformers, additional code repeater relays were required. Thus, with the new two-point relays, the additional code-repeater relays are eliminated.

The power switch machines are the G.R.S. Model 5D, designed for operation on 24 volts, d.c., all the new turnouts being No. 12's with 22½-ft. points and 100-lb. rail, good for 15 m.p.h. The old turnouts were No. 10's.

The switch machines were set up on ties in the general signal construction headquarters at Owensboro, Ky., before installation in the field, thus saving considerable time. This is not a new practice on the L. & N., however.

There are a total of 46 automatic electric locks on hand-throw switches in the territory. Station-leaving signals must be at Stop before a lock can be released.

When a trainman is to use a hand-throw switch with an electric lock for entering the main track from a turnout he must obtain permission from the dispatcher. After seeing that the leaving station signals are in the Stop position and no train is in the block, the dispatcher grants permission to use the switch. Then the trainman opens the lock door and pulls a button which holds the signals governing to Stop position, the unlock is given immediately, providing the leaving station signals were in the Stop position. If the leaving station signal had been cleared, the dispatcher would set this signal to Stop and then a delay of six minutes would elapse before the electric switch lock could be unlocked. For a train leaving the main track or switching from the main track, release track sections about 100 ft. long are in service at each lock. When occupied, an unlock is effective immediately.

### Layout at West Point

At West Point, 16.7 mi. north of Strawberry, a line of the Illinois Central crosses the L. & N. The layout is shown in Fig. 2. In addition to the home signals on both roads, this layout includes an interchange track, with an electrically-locked hand-throw switch at each end. The signals were formerly controlled by remote control from Strawberry, until incorporated in the C.T.C. system. Northward home signal 29R has a special call-on arm, which is controlled by a separate lever on the control machine.

The purpose of this signal is to permit local freight trains to leave

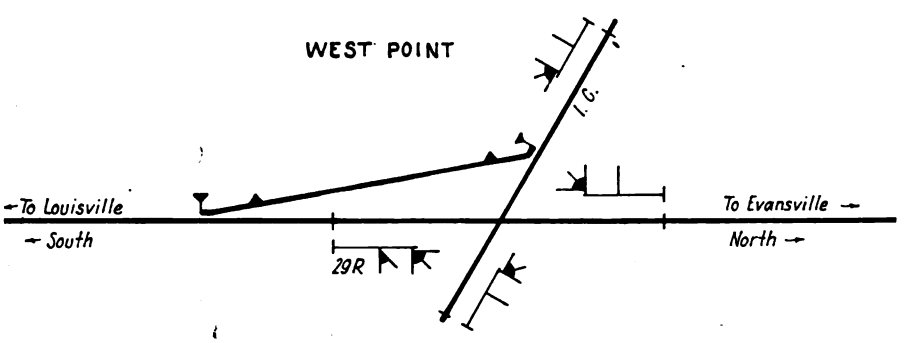



Fig. 2—Layout at West Point, showing signal 29R with special call-on arm

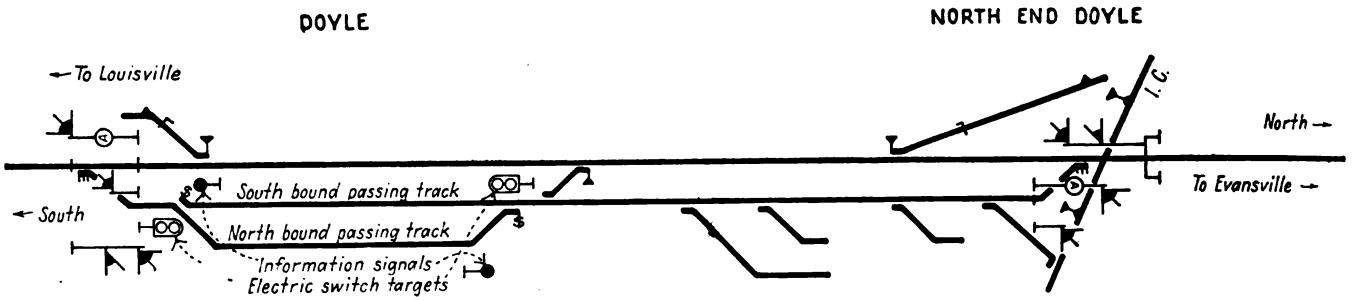



Fig. 3—Layout at Doyle, showing special information signals at the south end and the I.C. crossing at the north end

part of the train north of the crossing and then work on the I.C. interchange track. When returning to pick up these cars, the dispatcher displays a red-over-yellow aspect, which is authority for the train to enter the occupied block, thus eliminating the necessity of the crew having to obtain a clearance to pass a Stop signal.

### Special Features at Doyle

At Doyle, 1.5 mi. south of Owensboro, there is a southbound and northbound passing track, each having a capacity of 82 cars. This layout is shown in the accompanying diagram, Fig. 3. At the south end of these passing tracks, just before entering the main line, there is a spring switch and electric switch targets normally set for the northbound passing track. There is also a spring switch and electric switch target at the north end which is normally set for the southbound passing track. From this point a lead extends 4,000 ft. where it joins the main line. In order to eliminate congestion in these sidings and on the lead, a special information signal, consisting of a white light on a short post, was installed at the end of each passing track near the spring switch. These signals, which are normally dark, are not to be confused with the electric switch targets.

When a train is ready to leave on the main line a member of the train crew pushes a button which indicates to the dispatcher that a train is ready to leave Doyle in a certain direction. The dispatcher then lines up and clears the regular signals for the train to enter the main line. Clearing of the information signal at the end of the southbound passing track is authority for the train to proceed over the spring switch and up to the leaving dwarf signal. The information signal at the end of the northbound passing track is authority for a train to proceed north on the lead to the leaving dwarf signal. These information signals are controlled by two separate levers on the control machine at Evansville. This track arrangement at Doyle was made by conversion of the main line to the lead and southbound passing track and by rebuilding the existing siding as the main line.

### Other Crossing Layouts

At the north end of Doyle, a branch line of the I.C. crosses the L. & N., and there are two interchange tracks. At Owensboro the O. & N. which serves numerous coal mines south to Russelville, Ky., crosses the main line. Both of these crossings are protected by derails on the secondary lines. The junction switch to the O. & N. division is equipped with a power machine. The derails at the crossings are normally in the derailing position and are equipped with the new G.R.S. Model 10 switch-stand type electric locks.

When the padlock is removed from the stand an indication is received on the control machine, and, if there is no train approaching, the dispatcher sends out an unlock code which lights a lamp on the stand when the lock is released. The advantage of this type lock is that the train crews operate it just like an ordinary switch stand and do not have to push or pull any buttons.

### Green River Drawbridge

A Spottsville, 9.4 mi. south of Henderson, there is a center-pivot drawbridge over the Green river, which was formerly protected by split-point derails and home signals, controlled by an electro-mechanical interlocking machine on the bridge. This machine was continued in service, the circuits being coordinated with those of the C.T.C. system. In clearing the home signals in either direction the bridge tender must receive a "circuit consent" from the C.T.C. dispatcher. When the dispatcher sends out a code for this consent, a lamp is lighted on the control machine at the bridge, indicating that the release has been given and the bridge tender can then line up the route and clear the signals.

In accordance with standard practice on the L. & N., the signals governing up to the home signals at the drawbridge cannot display an aspect any more favorable than Approach, and, where braking distances are insufficient between signals, successive Approach aspects are given. This is to enforce the 15 m.p.h. speed limit and the rule that the engineer of a train approaching a drawbridge home signal must see that signal change from Stop to a more favorable aspect.

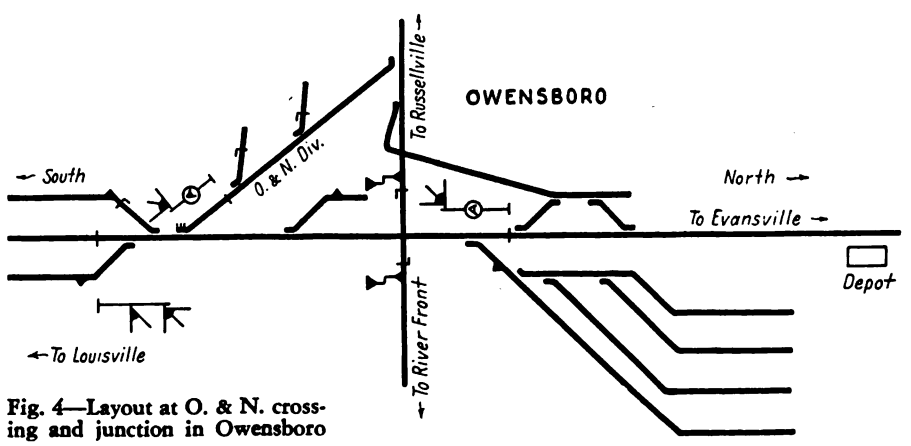
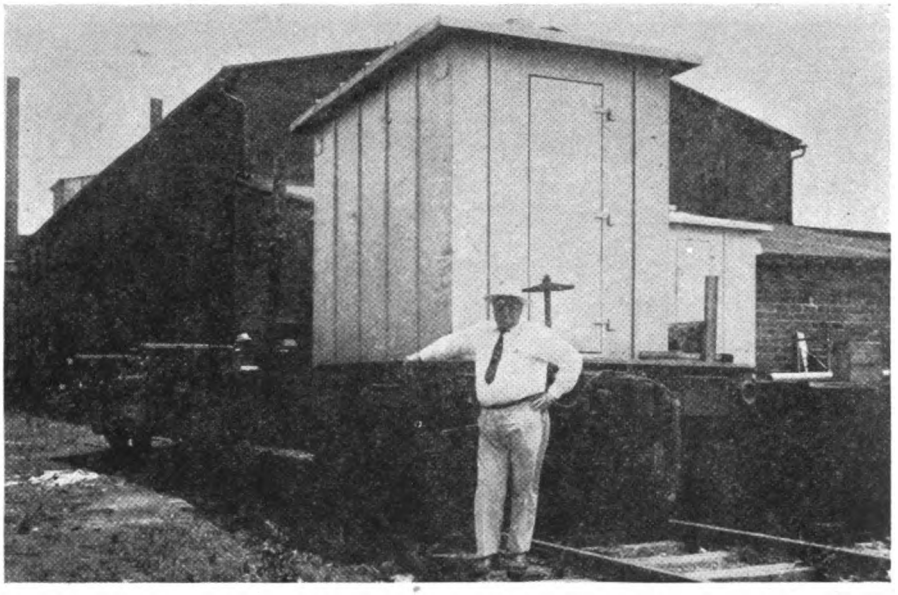



Fig. 4—Layout at O. & N. crossing and junction in Owensboro

### Crossing Protection Revamped

As part of the C.T.C. project the existing highway crossing protection was modernized by the installation of automatic flasher signals. Flashers were also installed at certain crossings not heretofore protected. A total of 28 crossings were involved in this work between Louisville and Henderson, 6 of which were between Strawberry and Irvington, 6 between Irvington and Owensboro, 13 in Owensboro proper and 3 between Owensboro and Henderson.

Auto-manual control is in effect for



Switch machines and bungalow on flat car ready for shipment from Owensboro. General signal construction foreman, H. L. Petty, is in the foreground

3 crossings in Owensboro. This installation will be discussed in a separate article in a forthcoming issue of *Railway Signaling*. The flashers used between Strawberry and Cloverport are the G.R.S. Type XA, while those between Cloverport and Henderson are the Peerless type, furnished by the Transport Products Corporation.

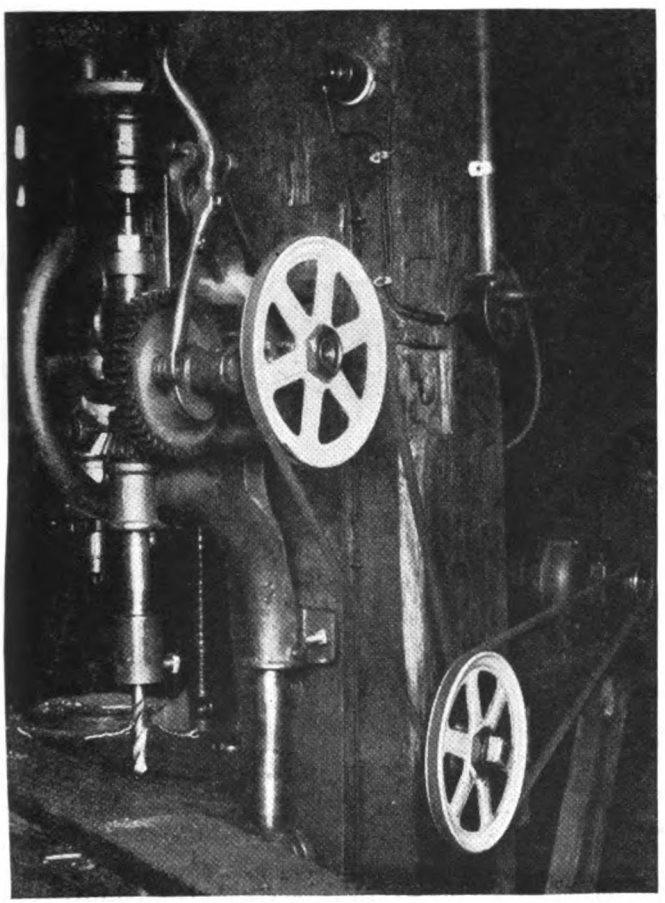
### Construction Procedure Improved

General signal construction headquarters for this project were set up in an unused canning factory at Owensboro. Basicly, construction organization and procedure were the same as on the 92-mi. Brentwood, Tenn.-North Athens, Ala., C.T.C. installation, explained on pages 420 and 688 of the August and December, 1942 issues of *Railway Signaling*, respectively. Since that time, however, there have been several refinements, which are of interest. For example, heretofore wiremen were provided with hand-operated brace-and-bit sets. Each wireman on this job was provided with a small ¼-hp. electric drill and set of round-shank wood bits up to ⅜ in., thus saving a considerable amount of time when any drilling had to be done.

### Post Drills Electrified

The large post drills at construction headquarters heretofore have been hand operated. Each drill is now equipped with a 1-hp., 110-volt, a.c. motor. The motor is connected to the drill by a "V"-shaped belt through a bough pulley which provides proper speed reduction. Thus, considerable time is saved here when drilling, compared with hand operation of the drills.

Ordinary block and rope tackle was formerly used in hoisting numerous heavy objects around construction headquarters in the field. This has now been replaced entirely by new ¾ and 1½-in. ball-bearing chain blocks, thus easing the work and increasing safety in heavy lifting. All these improved schemes in the handling and carrying out of the work have resulted in the ability to accomplish things considerably quicker than before, and, thus get the project in service that much sooner.



The large post drills at construction headquarters are now equipped with a 1-hp., 110-volt a. c. electric motor

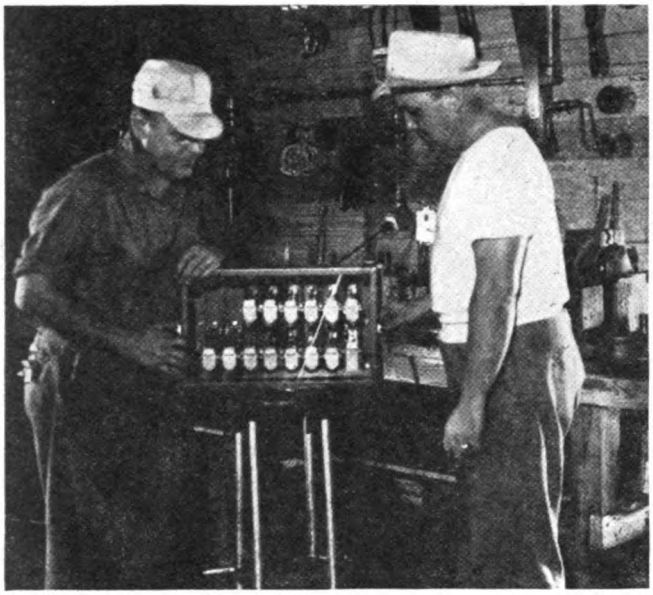
### Insulated Joints Rebuilt

All existing insulated joints on this project were shipped to Owensboro for complete reconditioning, a new procedure on this job. All joints were given a thorough lye bath and wire brushed. New insulation was installed, including new nuts and bolts if necessary, so that when the joints were finished they were just like new.

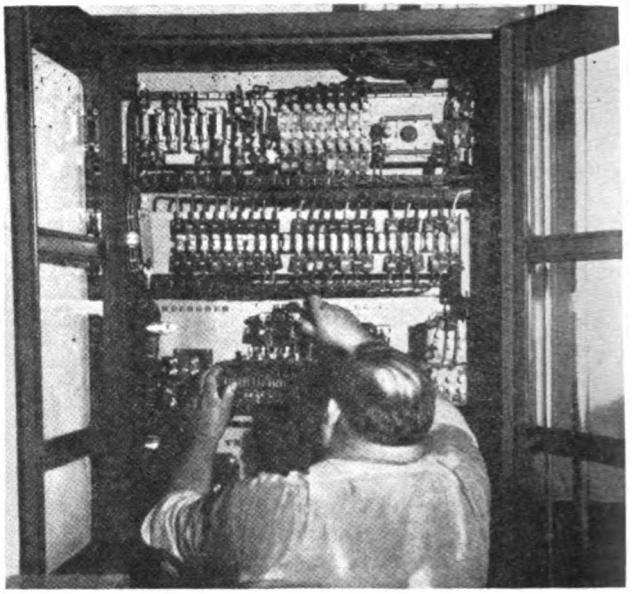
Metal equipment, such as instrument cases, bungalows, etc., was given one coat of red lead and two coats of aluminum paint before being sent out to the field locations. Concrete battery boxes for the installation were cast in steel molds at Owensboro, and thoroughly coated on the inside with Esblite acid-resisting paint to protect the concrete from "dusting."

### The Work Train

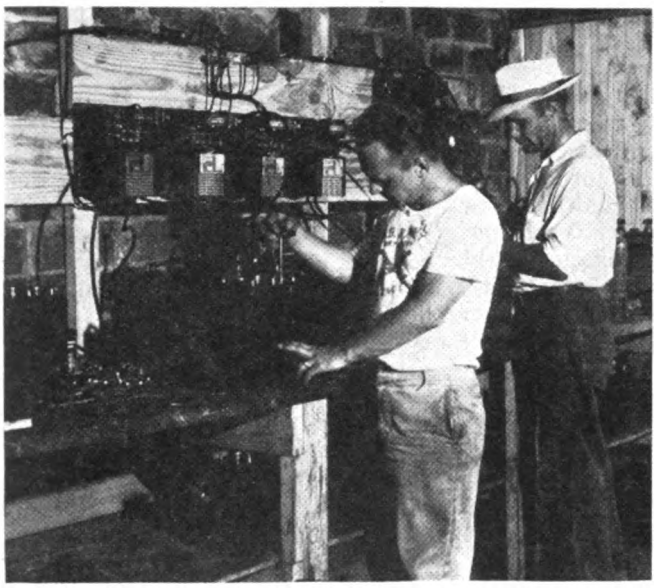
Another difference in the construction procedure on this project, compared with that on former jobs, was the handling of field materials by the work train. Heretofore, switch machines, signals, cases, bungalows and other equipment was handled piece



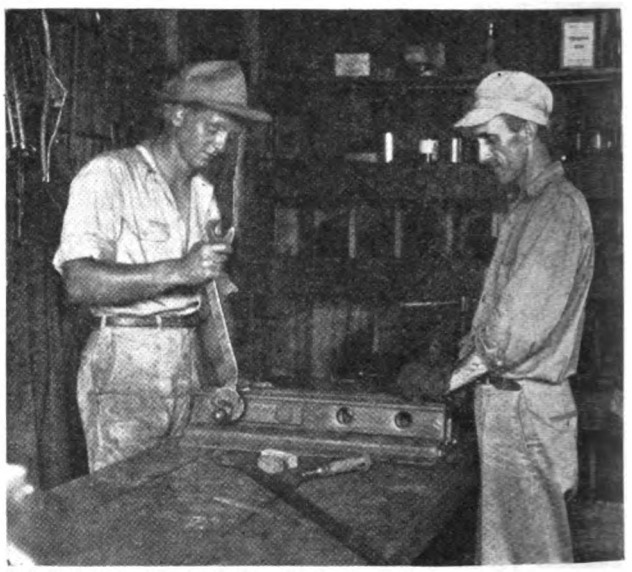
J. W. Darnell and E. T. Kirk checking code unit at Owensboro



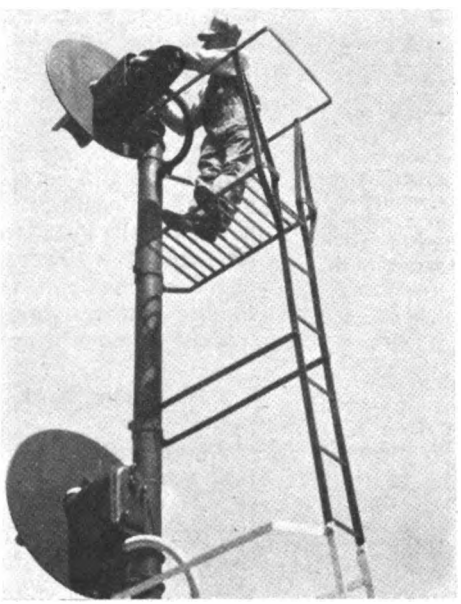
Equipment at Evansville is maintained by W. P. Reynolds



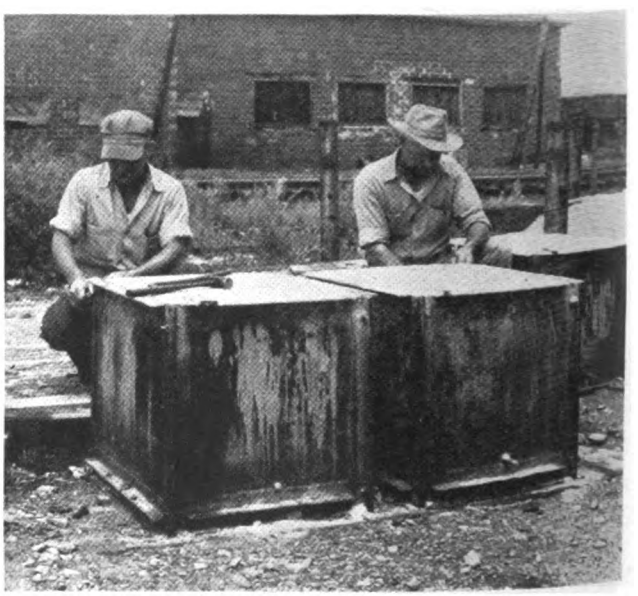
W. G. Cassidy and J. K. Taylor setting up battery at Owensboro



W. Hall and G. Denton assemble insulated joint at Owensboro



Maintainer Oscar Pearson checking signal unit at West Point



W. R. Cassidy and H. Carry check battery box forms at Owensboro

meal, necessitating several work train trips. On this job, all material was distributed on one trip over each section, cases, bungalows and switch machines being set off with a Burro crane on a flat car. A 30-ft. boom was used in setting cases and bungalows on high foundations. After the work train had completed its trip, it was followed by a couple of gangs to carry out the installation work. This improved procedure saved a considerable amount of time.

Construction was commenced at Henderson, the north end of the territory, with the concrete gang, consisting of about 18 men and Signal Foreman M. Thomas, working South to Strawberry. This gang set forms and did all the concrete work involved in the foundations for signals, instrument cases and houses. The line gang, with about the same number of men under Signal Foreman Talley Curtis, reworked the pole line over the same territory. This involved installation of code and power lines and making other changes.

Signal Foreman H. V. Coates was signed to the Green river drawbridge at Spottsville, with a gang of 18 men. Their job was to rewire the existing electro-mechanical interlocking for operation within the C.T.C. system. This gang was later assigned to Beals to carry out other work. Another gang, under Signal Foreman W. H. Dorsey, was assigned to working the entire city of Owensboro and Doyle yard, including C.T.C. and highway crossing protection work. One gang was assigned to construction headquarters at Owensboro. This gang, which consisted of about 16 men under Signal Foreman W. R. Cassidy, assembled signals, wired cases and handled material for shipment to the various field locations. All gangs, with the exception of the headquarters gang, were mobile and had camp car outfits. As work progressed, these various gangs were moved to other locations on the territory until the project was completed.

### Cutting in Service

The C.T.C. was cut in service from one siding to include one or two sidings per section. Where automatic block was formerly in service the last C.T.C. signal was temporarily tied in with the automatic block. Manual block was established temporarily in sections when automatic signals were taken out of service preparatory to installing the C.T.C. system.

In cutting in a section of C.T.C. where A.P.B. was in service, on the first day the old automatics were cut out of service and a train-order office and signal were set up at the end of the section to govern train movements into the section not yet equipped with C.T.C. On the second day a work train removed all the old automatic signals, and on the third day all the old line wires were removed, and the new line and track connections made.

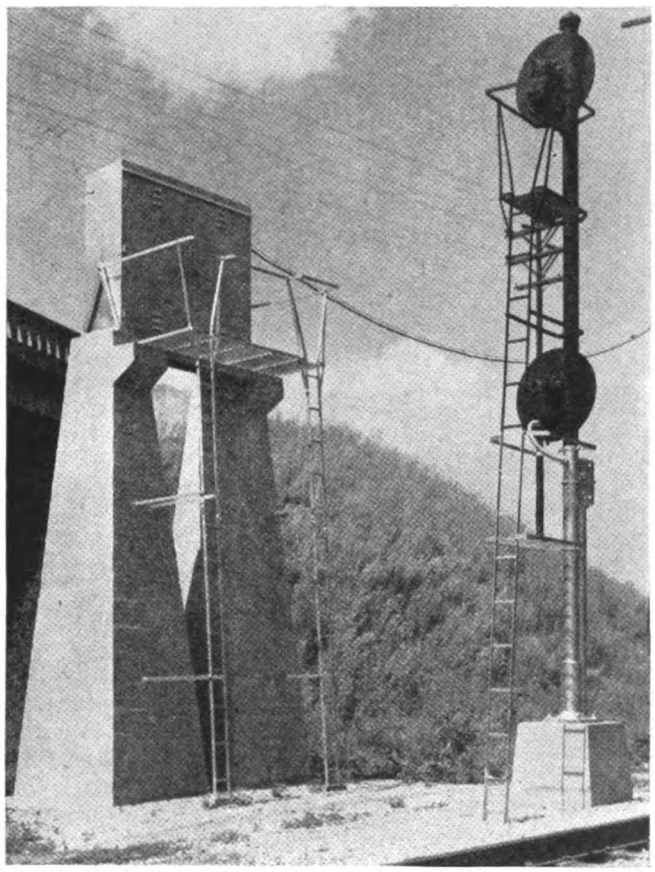
### Inspection and Maintenance

With this work completed, the section was turned over to the inspection forces for testing before placing in actual service. Inspection was carried out by W. H. Smith, signal supervisor of train control, M. R. Williams, office engineer, J. B. Long, assistant signal supervisor, and B. H. Ayres, general signal inspector, assisted by the necessary construction forces.

This C.T.C. territory is divided into five maintenance sections, each approximately 30 mi. long and covered by a maintainer and assistant. For example, the first maintenance section extends from Strawberry to South Brandenburg, under Maintainer Oscar Pearson. The next is under Maintainer A. J. Henning, and extends from South Brandenburg to Stephensport. The third section is from Stephensport to South Lewisport, the maintainer being D. F. Crook. The next maintenance section is from South Lewisport to South Mattingly, under Maintainer Rollie Darnell, Jr., while the fifth section extends from South Mattingly to Henderson. Leading Signal Maintainer W. P. Reynolds is in charge of maintenance of the machine and allied equipment at division headquarters in Evansville.

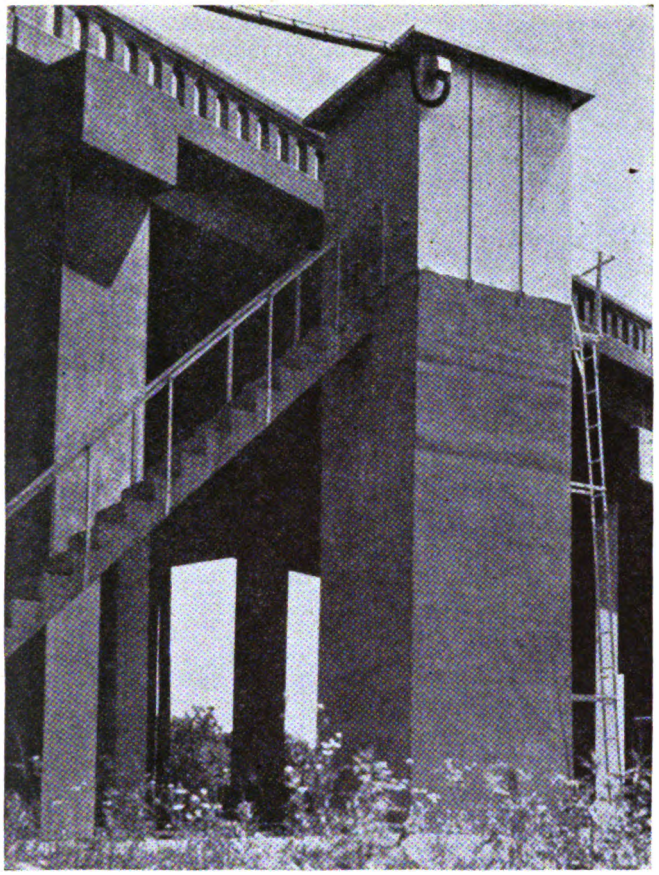
### Special High Foundations

The country through which the railroad runs along the Ohio river has been subject to severe floods in years gone by, the last having been in 1939. Consequently, when planning this installation considerable attention was devoted to the provision of proper protection of signaling equipment in the event of another flood. The heights of the 1937 flood waters along the line were determined from high-water marks, information from government charts, and consultation with natives. The highest flood level above the rails at any point along the line was about 16.6 ft. at West Point, Ky.

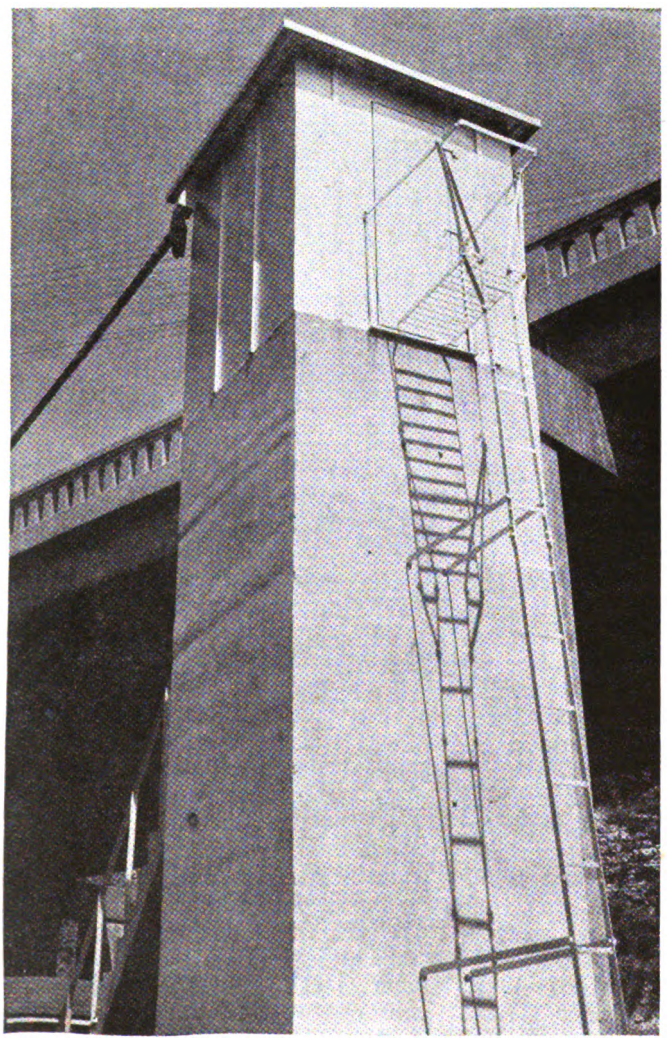


Northward home signal 29R at West Point, showing instrument case on high foundation for protection against possible floods

In order to provide protection against serious damage to coding and other signal equipment in the event of a flood the instrument houses and cases are mounted one foot or more above the 1937 flood level at the location involved. Consequently, special concrete foundations were required to do this at many locations. These are of three types, namely, the one-leg foundations for small single instrument cases, at such locations as cut sections; two-leg foundations for dou-



Oblique view of bungalow on high foundation for flood protection, showing concrete steps to front door of the bungalow



Rear view of bungalow on high foundation, showing signal ladder and platform for gaining access to rear of bungalow

ble cases as used at intermediate automatic signal locations; and, the bungalow foundations, such as at the end of passing-track locations.

The high foundations for single and double instrument cases are hollow, having 8-in. walls reinforced with ¾-in. and 1-in. reinforcing steel. The step slab, which is about one foot wide, is reinforced with old ladder sections, bolted in place. In addition to the step slab, each high foundation has one signal ladder and platform to gain access to the front of the case and provide a place to work. The double cases have a platform made from five signal platforms at the front of the case, access thereto being gained by two signal ladders at each end of the platform. On both types of installations the ladders are firmly held in place by stiffener straps extending from the ladder to the foundation wall where they are bolted in place.

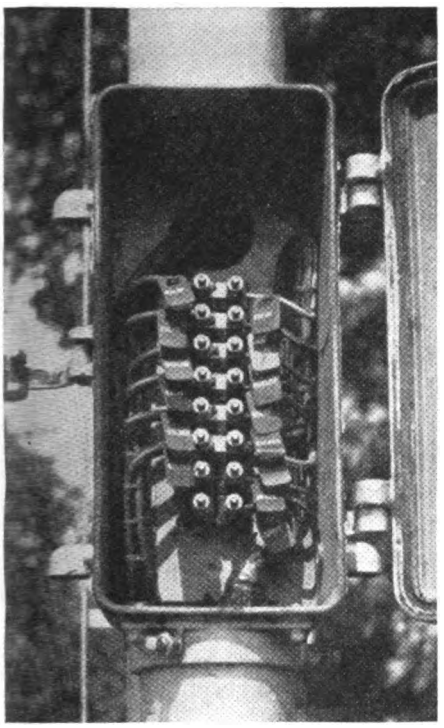
### Bungalow Foundations

The bungalow foundations are the equivalent of four 8-in. walls. A door is provided in the bottom of one, thus providing a storage space. The bungalow which sits on top of the foundation is reached by a standard signal ladder and platform in the rear. The ladder is supported by stiffener straps bolted through the foundation wall. The bolts on the inside of the wall are also used for the clamps which hold the underground cables in place up to the bungalow from the ground line. Concrete steps are provided in the front of the house to gain access to the inside of the bungalow. A railing is provided on each side, being supported by uprights which are bolted in place by 32-in. bolts which extend through pieces of old 1-in. derail pipe through the steps. Where especially high bungalow foundation are in service and require long steps, the steps are given extra support by a concrete pedestal in the center. Instrument cases and bungalows are usually located 12 ft. from the gage side of the nearest rail.

### Special Cable Termination on the Signals

Special flood protection was provided at all signals by the fact that very few base-of-mast instrument cases are used. Underground cables at signals are terminated in a special terminal box bolted to the front of the signal mast by a "U" bolt. Heighth of this box above the base-of-mast casting ranges from 4 to 8 ft., depending upon the 1937 flood level.

The underground cables are brought up through a hole in the foundation, through another hole in the



Inside view of special terminal box on the front of a signal mast for terminating underground cables

base-of-mast casting, thence in a piece of 4-in. pipe to the terminal box. The pipe is held firmly in place at the bottom by a special inside flange a little under 4 in. surrounding the top of the hole in the specially cast base-of-mast casting. The top of the pipe fits snugly into a flange on the bottom of the terminal box. This flange has set screws, and is also sealed with two parts mineral wool and 1 part cement.

Right—Special terminal box for flood protection on the front of a signal mast. Note pipe for underground cables from base of mast to the box

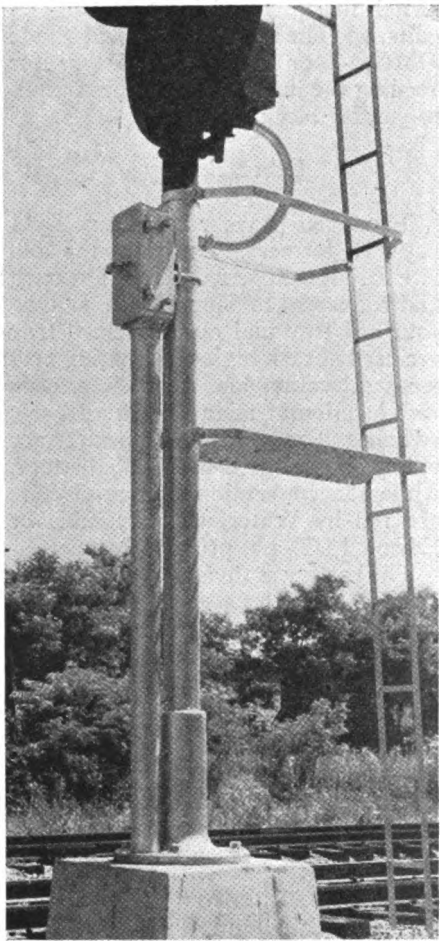
The flange at the bottom of the pipe is also sealed with this compound. From the box, individual wires are run through a piece of 2-in. pipe into the mast, and thence to the units. The pipe is threaded at both ends and sealed with No. 1 Smooth-On iron cement. Thus the cable ends and terminals are thoroughly sealed against water in the event of another flood. A terminal box is used with each dwarf signal to terminate underground cables. The box and signal are mounted on a concrete foundation 3 ft. long by 1 ft. wide, the depth depending upon the nature of the soil.

### Circuit Controllers Present Problem in Owensboro

Since the tracks are flush with the street in Owensboro, location of the switch circuit controller on hand-throw main-line switches presented a problem. As a result, the controller at each of these switches is installed in a concrete battery box, located on the opposite side of the sidewalk from the curb.

Connection of the controller to the switch points is accomplished by the use of a 1-in. oil-filled stuffing box and rod which is under the street and

Switch circuit controller in battery box near sidewalk in Owensboro, where tracks are flush with the street. End of stuffing box is at the left



sidewalk. This box is supported underground by several concrete blocks with a semi-circular groove in the top to receive the box. The box is held firmly in place by another grooved small concrete block which is bolted in place on top of the other block by two nuts and bolts. This support obviates disruption of the alinement of the stuffing box between the circuit controller and switch points in the center of the street.

### Several Power Sources

Power for the territory is picked up from the R.E.A. and public utilities at 13 locations, and in the majority of instances is transformed to 550 volts, 60 cycles. The power circuit, which is on two No. 6 hard-drawn copper wires on the pole line, is not continuous, being run only where necessary, thus conserving a considerable amount of wire. Existing wire was used for this circuit, which is sectionalized at all power sources and other convenient locations with Line Material Company underarm disconnect switches, and transposed according to Western Union standard transposition schemes.

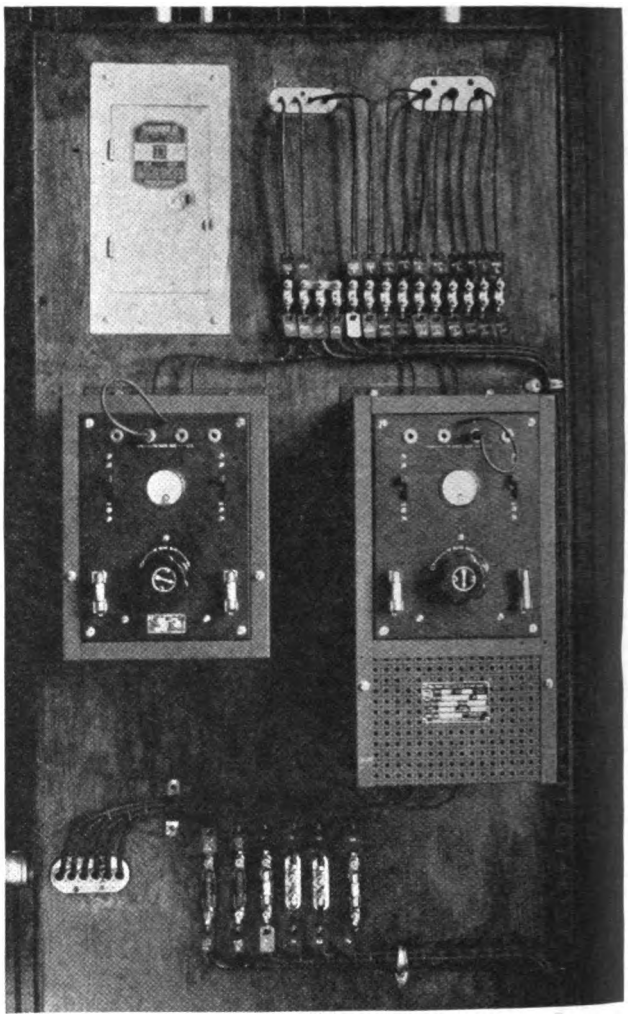
At each passing track power switch location there are 12 cells of Exide DMGO-9 or Gould 80-a.h. lead acid storage battery for operation of the

switch machine and local control circuits, and one set of five cells of Exide DMGO-7 or Gould-a.h. battery for feeding the line circuits in the station-to-station block.

### Other Battery

Three-cell trays of Edison B4H battery, formerly used on the old A.P.B. signaling, were reconditioned and converted to four-cell trays. One four-cell tray and one three-cell tray are used at each highway crossing protection location and at each electric lock location at main-line hand-throw switches. The coded track circuits are fed by one cell of B4H 80-a.h. battery, while the conventional track circuits are fed by Waterbury, Columbia or Edison 1,000-a.h. primary battery.

The battery at division headquarters in Evansville consists of 12 cells of Exide EM-11 lead-acid storage battery for the local control circuits at the machine. This battery, which is on floating charge from a G.R.S. BP-448 rectifier, is rated at 200 a.h. on the 8-hr. rate and 290 a.h. on the 72-hr. rate. The code line battery consists of 75 cells of Exide 5 BTMP-3 3-plate battery on floating charge from a BPC-480 G.R.S. rectifier.



Power panel and rectifiers for charging the storage battery at division headquarters in Evansville

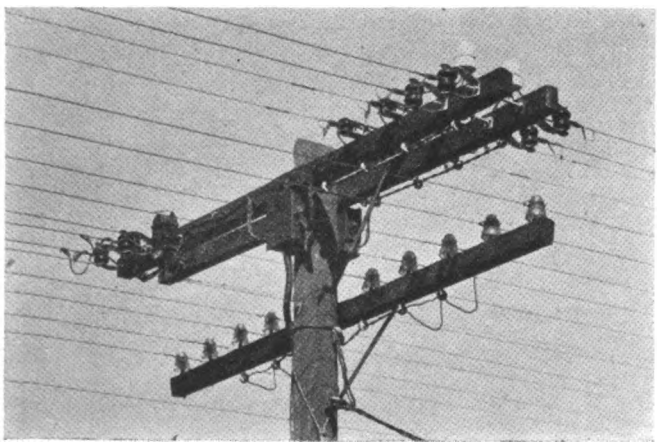
### Cable and Wiring

The underground cables for this installation were furnished by the Okonite and Kerite companies. Line drops are No. 14 aerial cable, supported on ¼-in. Copperweld messenger strand by 1½-in. Bonita Copperweld cable rings. Track connections are made with No. 9 trench-lay cable. Other underground cable varies from 2 to 12 conductors. Number 6 conductors are used for motor leads, No. 14 are used for control circuits, and No. 9 used for lighting. From the terminal box on the signal mast to the signal unit 37-strand No. 9 extra flexible wire is used.

The code line is on two No. 6 hard-drawn copper wires tied to Hemingray No. 40 glass insulators. White glazed porcelain dry-spot insulators are used at all tap locations to minimize line leakage during wet weather. Manual sectionalizing switches are in each bungalow. In reworking the pole line, everything was placed on a top arm where possible, using 10-ft., 10-pin creosoted yellow pine crossarms.

### Pole Terminal Boxes

Twelve-terminal Transport Products Corporation boxes are used on line-drop poles for termination of bridle wires and aerial cable. Western Railroad Supply Company and G.R.S. terminal strips and Raco Clearview lightning arresters are used in all case wiring. The rails are bonded with Cadweld rail-head type bonds. All new track circuits over 4,000 ft. in territory formerly equipped with A.P.B. were also rebonded with this type bonding. Western Railroad Supply Company bootleg risers, as well as the Peerless mechanical-clamp type, furnished by the Transport Products Corporation, are used for track circuit connections. Bootleg bonds are the American Steel & Wire Company's 52-in. double Type DS-1, with ⅜-in. plug, which are cut in two to serve two bootleg connections.



Typical pole-line construction at a line-drop location in the field

The project was planned and installed by the regular signal department forces of the Louisville & Nashville, under the direction of W. H. Stilwell, signal engineer, and P. P. Ash, assistant signal engineer. All construction forces were under the jurisdiction of H. L. Petty, general signal construction foreman, and C. S. Gates, assistant general signal construction foreman. The major items of signaling equipment were furnished by the General Railway Signal Company.