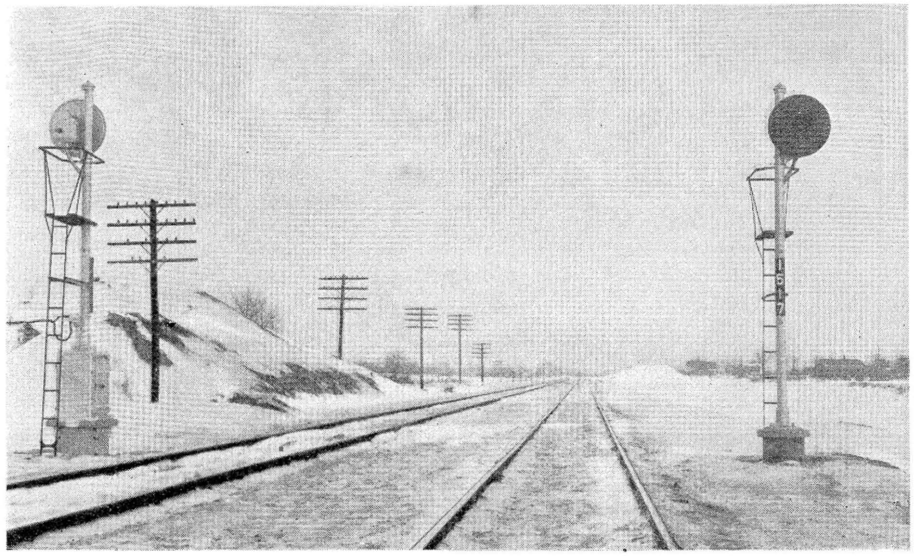
Major portion of St. Louis-Kansas City Line equipped in 1939—New type of portable sectional concrete signal foundation facilitates construction program in the field



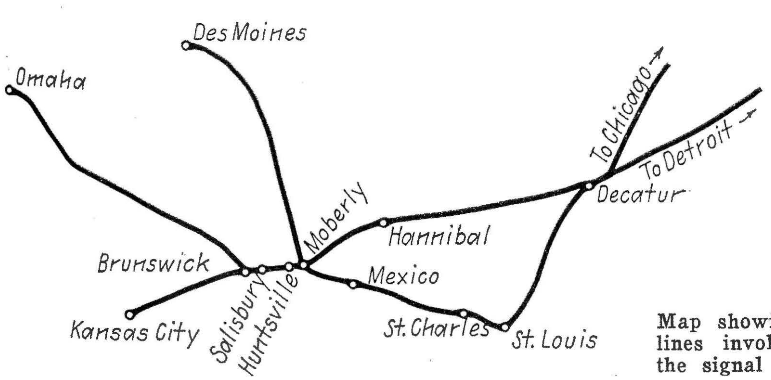
On the double track between Moberly and Huntsville

New Signaling on the Wabash

As a means of improving safety and reducing train delays, the Wabash is rapidly extending its already extensive system of automatic block signaling. The present objective is to complete the signaling on the 278.7 miles of main line between St. Louis, Mo., and Kansas City. In 1936, an installation was made on 13 miles of single track between Ferguson, Mo., M.P. 13 and Gardnerville; Gardnerville being 26 miles from St. Louis and Ferguson 12 miles. The mile-post numbers start at St. Louis. Track changes are contemplated between M.P. 7 and M.P. 12, and, therefore, signaling in that territory is being postponed. During 1938, signals were installed between Gardnerville and Foristell, Mo., M.P. 50. During 1939, automatic block signaling was installed on 97.5 miles of single track between Foristell, Mo., M.P. 50 and Moberly M.P. 148, on 7 miles of double track from Moberly to Huntsville, and on 14 miles of single track between Huntsville and Salisbury. Signaling is to be installed on single track between Brunswick, Mo., M.P. 187, and Carrollton Junction, M.P. 213, and between Camden Junction, M.P. 242, and Birmingham, Mo., M.P. 265, in the near future.

Traffic and Routing of Trains

The number of train movements varies on different portions of this division. As shown in the sketch, the main line extends from St. Louis through Moberly to Kansas City. A single-track line extends from Decatur, Ill., across the Mississippi river at Hannibal, Mo., and connects with the St. Louis-Kansas City line at Moberly, Mo. Freight traffic between Kansas City and eastern points, such as Detroit and Chicago, is routed via the Hannibal short line. A local passenger train each way daily is operated between Moberly and Decatur via the short line. At Brunswick, Mo., a single-track line branches off and extends 226 miles northwest to Omaha, Neb. At Moberly, a second single-track line branches off and extends 192 miles north to Des Moines, Iowa. One through passenger train in each direction daily is operated between St. Louis and Omaha via Moberly and Brunswick. These trains make connections at Moberly with a train operated in each direction daily between Moberly and Des Moines, so that, in effect, through service is provided between St. Louis and Des Moines. Freight trains operated between Moberly and Des Moines, as well as between Moberly and Omaha, are made up and terminate at Moberly.



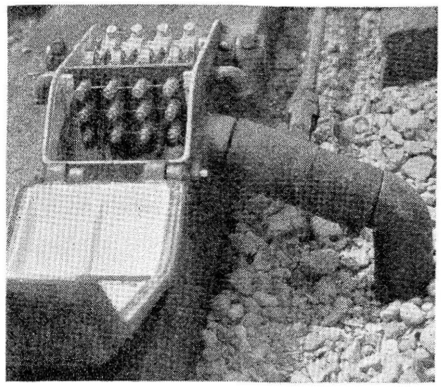
Map showing the lines involved in the signal project

In addition to the traffic explained above, four passenger trains each way daily are operated through between St. Louis and Kansas City, some of these trains making the 279-mile run in approximately five hours including six station stops. The speed limit for passenger trains is 75 m.p.h. and for freight trains 50 m.p.h. On account of the various routes explained above, the daily traffic between St. Louis and

Brunswick includes 10 passenger trains, and about 3 extra passenger trains are operated each week-end. Eight scheduled freight trains and about two extras as well as a local freight each way daily are operated between St. Louis and Moberly. This traffic is handled also between Moberly and Brunswick, to which is added the traffic to and from the short line via Hannibal. The Moberly-Brunswick territory, therefore, handles the heaviest traffic.

Signals and Interlockings Between Moberly and Salisbury

Double track extends westward from Moberly 6.8 miles to Huntsville. Between Huntsville and Salisbury, 15 miles, the line is single track, and from Salisbury to Brunswick, 18 miles, the line is double track. At the end of double track at Huntsville, the second track was extended westward about 500 ft. to get the switch off a curve. As a result of this change, the interlocking had to be entirely reconstructed, using a 12-lever mechanical machine to operate the end of double track switch, the switch at the east end of the passing track, and 6 signals. Semaphores were replaced with searchlight signals. Complete electric locking was provided, using Model-12 forced-drop electric locks, and vertical type controllers on the interlocking machine. A new illuminated track



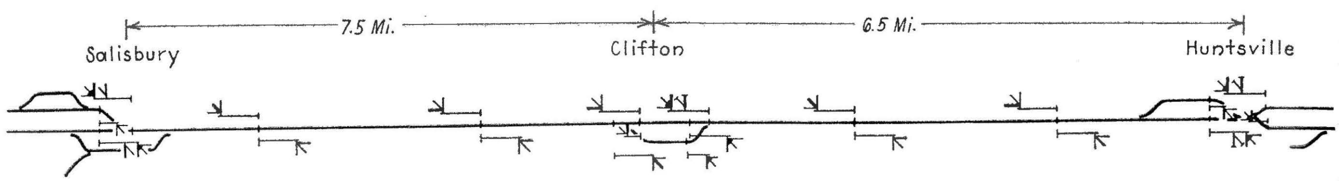
Hose conduit between bootleg and switch circuit controller

and signal diagram was provided.

The turnout at the end of double track at Huntsville is of special interest in that the single track to the west is lined with the center line between the two main tracks to the east, in other words, the divergency in the turnout is divided equally rather than all to one side. By using a No. 20 frog with 33-ft. switch points in such a layout, the turnouts can be constructed so that trains can operate in either direction over this switch at 50 m.p.h. At Huntsville, a curve in the main line just east of the end of double track necessitates a speed reduction so that the special turnouts cannot be used to full advantage. At another location on the Wabash, diverging train movements are made over such a layout at speeds up to 60 m.p.h., while on another road speeds up to 70 m.p.h. are authorized over such a layout.

Interlocking at Clifton

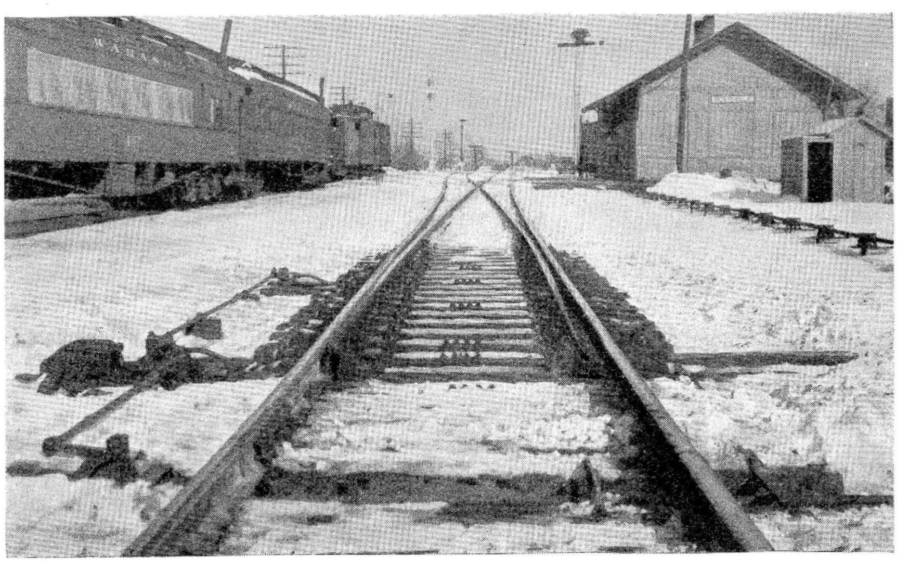
At Clifton, 6.5 miles west of Huntsville, the east end of a passing track is located on a 1.1 per cent ascending grade such that if tonnage trains are stopped to enter the switch, difficulty is encountered when starting again. For this reason, a mechanical interlocking had been in service at this location for several years, and, as a part of the signaling program, the plant was overhauled, replacing the semaphore with searchlight signals and also providing complete electric locking, and a new illuminated track and signal diagram. At Salisbury, where single track from the east joins double track to the west, the automatic signals governing movements over the end-of-double-track switch are controlled by a two-lever table controller located in the depot.



Track and signal plan between Huntsville and Salisbury

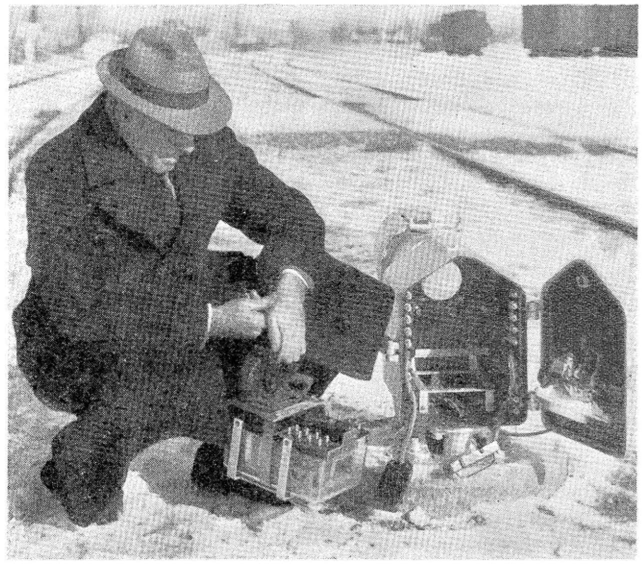
In the entire territory between Moberly and Salisbury, new automatic block signaling was installed. The automatic as well as the interlocking signals are located properly with reference to turnouts so that centralized traffic control can be adapted without any further changes in signal locations. For example, at the west end of the passing track at Clifton the two westward automatic signals are located opposite the clearance points on the turnout rather than on the single track beyond the turnouts, as ordinarily done on single-track signaling. The westward home signals at Huntsville, the eastward home signals at Clifton, and the eastward automatic signals at Salisbury are all absolute signals governing train movements throughout the respective station to station single-track blocks.

At each of the two interlockings,



View of the equilateral turnout at Huntsville. Note the second operating connection near center of the points

Huntsville and Clifton, a semaphore type train-order signal is provided, the arms being operated by pipe connection to levers in the interlocking machines, and mechanical locking is arranged so that a train-order signal for a given direction cannot be cleared unless a home signal for the same direction is previously cleared.



P. J. Bangert, assistant signal engineer, demonstrating the quick-detachable type H-5 signals

Automatic Signaling Foristell to Moberly

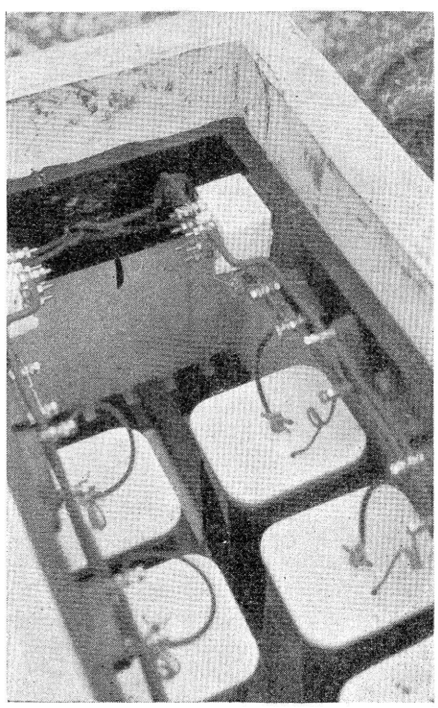
Through the station layout at Moberly, the double-track main line has been equipped with single-direction automatic signaling, an interesting feature being that dwarf signals were used because they could be installed within the clearance limits between existing tracks, thus obviating the expense of throwing tracks over or installing expensive bridges.

Absolute-permissive automatic block signaling was installed on the 97 miles of single track between Foristell and the east end of double track at Moberly. This territory includes 19 passing track and station layouts. At each end of each of these sidings a double signal location is provided approximately 10 ft. in approach to the facing point of the switch. In each instance, the station-departure signal governing movements through the single-track block to the next station, is designated as an absolute signal by absence of a number plate and by a circular reflectorized "A" marker mounted on the mast.

Where the distance between passing tracks is short, as for example 3.7 miles between Mexico and Thompson, one set of staggered intermediate signals, staggered 3,500 ft., are provided. Where the distance between passing tracks is from 5 to 7 miles, two double locations of intermediate signals are provided at spacing up to 12,000 ft. between the intermediate signals. In some instances a passing track is less than train stopping distance in length, therefore, an engineman encountering an Approach aspect at a station-entering signal could not stop his train short of the station-leaving signal. At all passing points when the station-leaving signal is displaying the Stop aspect, the two successive signals in approach display the Approach aspect. This control for the second signal is accomplished by simply making this signal repeat the Clear and the Approach aspects of the first signal.

Types of Signals Used

The signals are of the searchlight type with 250-ohm coils operated at 10-volts d-c. On the territory between Foristell and Mexico, Mo., the signals are the H-2 type, while on the remainder of the installation the new quick-detachable H-5 type are used. Each signal is mounted on a mast to bring the center of the lens 15 ft. 3 in. above the level of the rail, so as to be in direct line with the engineman in the cab of the locomotive. The signal lamps are single-filament and are rated at 10 volts, 5 watts, or 11 volts, 11 watts where deflecting cover-glasses are used. Special efforts were made to obtain the maximum efficiency in the indication by providing deflecting cover-glasses or spread lens where they would be of any benefit. Approach-lighting control is used for all signals. Directional signal lighting control is used. Signals are lighted on approach from signal to signal, with the exception of the "A" signals or head-blocks, which are lighted when the train passes the opposing "A" signal. For receding movements, the signals are lighted for only one track circuit. The series line approach-lighting relays are the DN-22A type.



Primary battery for track circuits

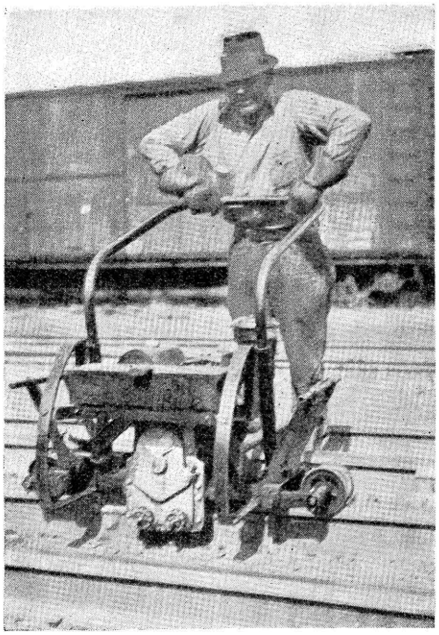
Arrangement of Controls

The controls are so arranged that when a train passes an intermediate signal for the opposing direction, that signal continues to display the Stop aspect until the train clears the block, although the light remains only through one track circuit. With this arrangement, if a train stops between stations, it does not have a clear signal to authorize a back-up move in the reverse direction.

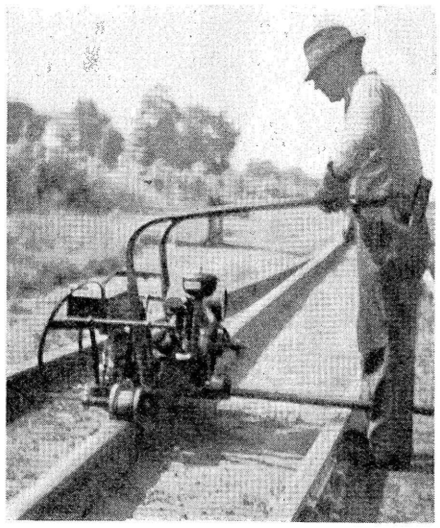
The signaling is arranged for operation on the absolute permissive block system. Each signal is controlled to three aspects by a polarized line circuit connected to the searchlight relay. The line to the rear is polarized through contacts in a 350-ohm, DN-18, d-c. slow-pickup, slow-release relay, which, in turn, is controlled by contacts in the signal to repeat the yellow and green positions. The use of this slow-pickup, slow-release relay prevents "flips" of the signal aspects due to the operation of light engines at high speeds.

Pole Line and Power Supply

The line control wires as well as the power supply wires are strung on an extra 10-ft. crossarm installed on the existing pole line. By using Ohio-Brass breakarms at line break locations no double-arming was required. The wires have double-braid, weatherproof covering. The line control circuits are on No. 10 Copperweld 40 per cent conductivity wire, and two No. 8 solid copper wires are used for



Two views of twin-spindle power-driven drilling machine used for drilling the holes for rail-head bonds



the 220-volt a-c. power distribution circuit. These two wires are on the two end pins on the track side, and they are transposed every mile in order to reduce inductive interference with communication circuits. The 220-volt distribution circuit is not continuous throughout the installation. Choosing stations 10 to 12 miles apart at which power was available, the 220-volt circuit extends in each direction from such a station for four to five miles, ending at a signal location. From that point on to the end of the next feed, no 220-volt circuit is provided, thus saving considerable first cost and maintenance expenses.

At each signal location, connections to the 220-volt a-c. line wires extend in cable to the instrument case, where they terminate in a Raco enclosed fused cut-out switch. From this switch the 220-volt circuit feeds a RT21 rectifier for charging batteries. At some locations such as home signals, it also feeds a W10 type transformer with a DN22P power-transfer relay to switch the lamp feed to the battery in case of an a-c. power outage. A set of five cells of Exide lead storage cells is used at each signal, the KXHS-7 type being used at intermediate signals, and the DMGO-7 at the head-block locations, on account of the heavier normal discharge at these head-block signals.

Track Circuits and Bonding

The maximum length of track circuits is about 4,000 ft. Except as noted below, each track circuit is fed by three No. 572 Columbia high-voltage 500 a.h. primary cells connected in multiple with a 2.5 ohm adjustable Raco limiting resistance in series. Through the Moberly station layout where the tracks are occupied for extended periods, an RT-10A automatic rectifier is connected across the battery of each track circuit to carry the major portion of the load.

Through the Moberly station layout, two Ohio-Brass welded bonds were applied to each rail joint. Also through the Moberly yard where the rail was worn, American Steel & Wire Company type DS-1 stranded plug type bonds were used. On the remainder of the territory, mechanically-applied, rail-head plug-type bonds were installed, both the Raco and the Ohio-Brass types being used. The holes in the rails for applying these bonds were drilled with an Ohio-Brass Company twin-spindle power machine. The drills were sharpened accurately on a micrometer grinding machine, thus insuring accurate diameter of the holes.

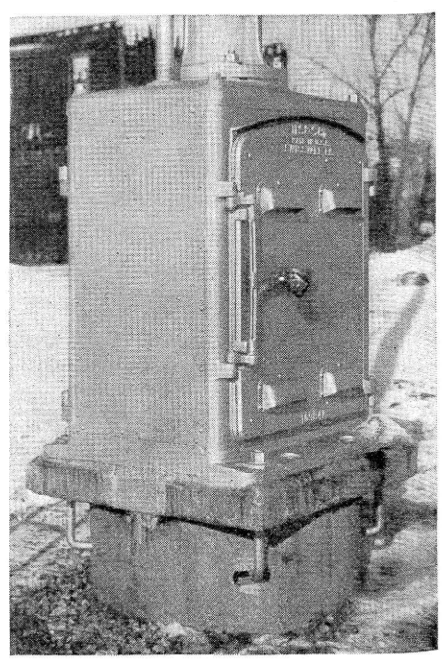
Insulated Joints and Circuit Controllers

On the new 112-lb. rail the insulated rail joints are of the six-hole armoured type furnished by the Rail Joint Company; on other sizes of rail the regular Continuous joint was used. The switch circuit controllers are the U-5 type, equipped with a spring which will operate the controller if the rod becomes disconnected. The rod is equipped with a ball-and-socket joint at both ends. Switch-position protection is effected by series-opening and shunting the track circuit, except where the shunting of the track would cause highway crossing signals to operate, when the line circuits were broken. As the insulated joints at head-block signals are located only 10 ft. from each passing track switch, no extra insulated joint is required to provide the series-shunt protection. The cut sections, where possible, are located adjacent to the main line switches to eliminate the additional insulated joint.

The bootleg outlets for rail connections are set 14 in. from the rail so that when installing the bootleg and underground cable, the ballast under or between ties need not be disturbed. The bootlegs are all on the "case" side of the track, and, for a joint on the opposite rail, stranded jumpers 9 ft. 6 in. long are used and are attached to the sides of ties by conduit straps nailed in place. Throughout the installation, the ground rods are Copperweld, ½ in. in diameter and 8 ft. long, and they are driven 18 in. from the line poles in order to facilitate the application of salt or other chemicals to reduce ground resistance.

New Portable Sectional Concrete Foundation

During the signal construction, the local distribution of equipment in the field was handled exclusively on motor cars and lorry trailer cars without requiring work-train service. This procedure was made possible to a large extent by the use of a new type of sectional pre-cast concrete foundations, which were furnished by the Massey Concrete Product Corporation. Various different sizes of foundations are used for signals, cable posts, relay cases, etc. The explana-



Foundation with square top

tion below is confined to dimensions of the standard foundations for signals.

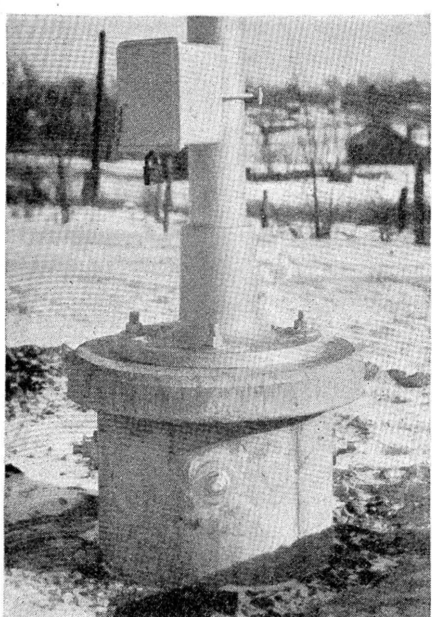
The main portion or so-called "body" of each signal foundation consists of a section of concrete pipe about 64 in. long, 23 in. in diameter outside and 18 in. in diameter inside. The top and the bottom of each foundation consists of a slab of concrete 4 in. thick, with a section 2 in. thicker which fits in the end of the pipe. The foundation tops or bottoms used with ground signal masts are circular and 29 in. in diameter, slots being provided for anchor bolts. Where instrument cases are to be used with masts on top, the foundation tops or bottoms are 31 in. square and have slots for anchor bolts.

Different Types of Tops

With a circular foundation top, the anchor bolts, which have a right angle bend, go down through the top and out through holes in the pipe sections so that washers and nuts are applied *outside* of the pipe. With the rectangular tops, the anchor bolts go down through the top and outside of the pipe, then through holes in the pipe, with washers and nuts *inside* the pipe.

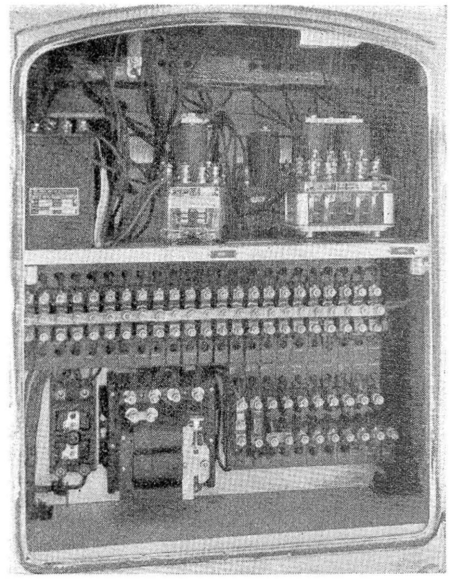
The tops and bottoms of any particular foundation are interchangeable. A hole 4 in. in diameter extends through the center of the top plate as a wire entrance to a signal mast or case. Two holes 4 in. in diameter extend through the walls of the pipe at a point 20 in. below the top, one or the other or both of these holes are used for cable entrances.

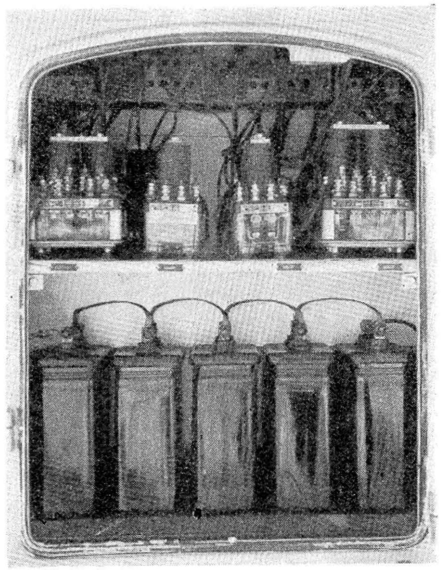
The circular top or bottom slab weighs about 275 lb., and a rectangu-



Foundation with circular top

Two views of the interior of an instrument case at a signal location





lar top or bottom slab weighs about 335 lb. The concrete body section for ground mast signal weighs about 907 lb. and for instrument case 1,415 lb. Dwarf signal and sheet steel instrument case foundations are of the same general design and, of course, smaller and lighter.

When digging a hole for a foundation, care is taken to arrive at the proper depth with a level surface of undisturbed earth. The bottom slab is dropped in the hole and leveled. The body section is slid into hole onto the base. At some locations where space is restricted the body section is set by means of a wooden frame support and a chain hoist. The top is then bolted to the body section. On the average, a crew of 12 men dig 12 holes and set 12 of these foundations in each eight-hour working day. Two men did the digging, two men set the foundations, and six men, with a motor car and lorry trailers, hauled the foundations from the nearest freight station or other point where cars could be set out for unloading.

Inspection Work

The field inspection was handled by an inspector and assistant, with two signal helpers of the field force, reporting to the general inspector, independent of the construction forces. Case and wiring plans were checked by the inspector who was then ready for the field check. The case and location check included a check of tagging and the position of all connections on relays and terminal board, followed by a check of the correct size of wires in accordance with its function, line drops, clearance of guy wire, pot heads, rail connections, track insulation, switch circuit controller and connections, proper fouling clearance, and the focus of lights.

Electrical Check

An electrical check includes a check of all circuits to determine the current flow, and the proper operating voltages to the various units. Megger tests were made of each individual control circuit, underground cable and internal wiring of each instrument case, which includes all apparatus and batteries. Signals and relays were tested for release and working values in accordance with that for which they were designed. Readings were recorded on forms provided for each kind of test. These were checked and filed at the office of the signal engineer. A complete circuit check of each control circuit was made by opening the circuit at the contacts of each relay, circuit controller or any function within the limits of the control in accordance to the circuit plans. Operating checks were made by opening and closing relays in sequence of train movements. Observation tests were made from engine cabs, rear end of train, and from the ground, for operation and proper focus of indication.

The signaling explained in this article was planned and installed by signal department forces of the Wabash under the direction of G. A. Rodger, signal engineer. The major items of equipment were furnished by the Union Switch & Signal Company.