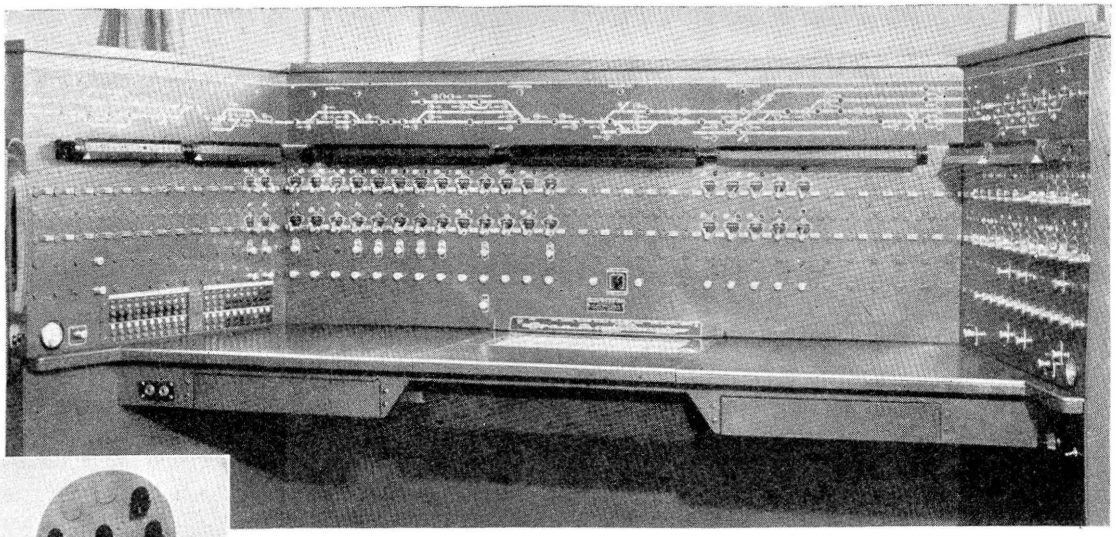
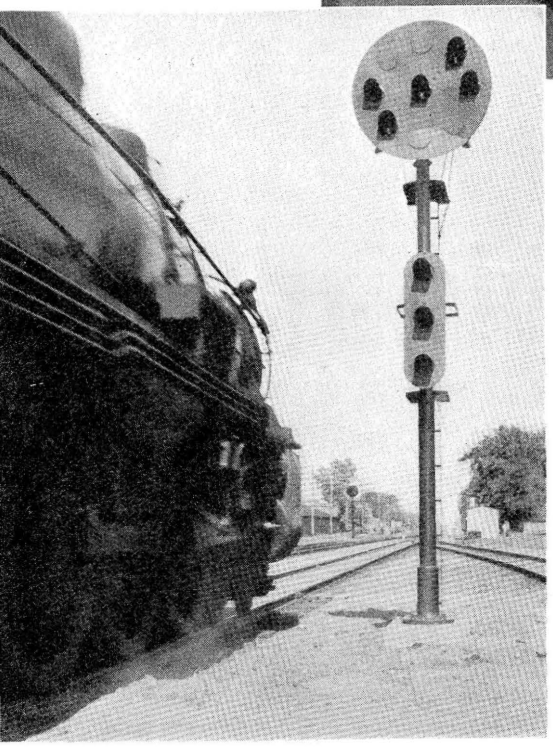


Right—The control machine is located in the dispatcher's office in the passenger station at Terre Haute, Ind. Below —Eastbound "Spirit of St. Louis" passing home signal 26R at Casey



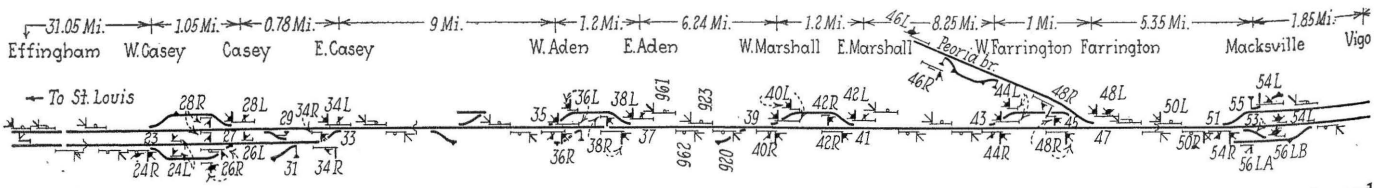
Pennsylvania Installs

IN ORDER to facilitate train movements and increase track capacity, the Pennsylvania Railroad has installed centralized traffic control on 23.9 miles of double track and 45 miles of single track between Limedale, Ind., and West Casey, Ill., on the St. Louis division, which extends 240 miles between Indianapolis, Ind., and St. Louis, Mo. In 1930, centralized traffic control was installed on 33 miles near the eastern end of this division, starting at Ben Davis interlocking, 7 miles west of Indianapolis, and extending on 30 miles of single track to Almeda and 3 miles of double track between Almeda and Limedale, the control station being located at Limedale.

The 1940 installation of C.T.C., with the control machine at Terre Haute, Ind., extends from Harmony, Ind., 53 miles westward to West Casey, Ill., including 22 miles of double track from Harmony through Terre Haute to Macksville, 29 miles of single track to East Casey, and 1.9 miles of double track to West Casey. On the 13 miles of single track between Limedale, which is the west end of the previous C.T.C. project, and Harmony, the east end of the new project, signals for directing train movements by signal indications are controlled jointly by the C.T.C. machines at Limedale and at Terre Haute, thus centralized traffic control is now in effect between Ben Davis interlocking and West Casey, a total of 102 miles. Including the 75 miles of single track and the 27 miles of double track in this territory, there is a total of 112 track miles. In terms of track miles, number of power-operated switches and controlled signals, and train movements handled, this is the most extensive continuous project of centralized traffic control in the world.

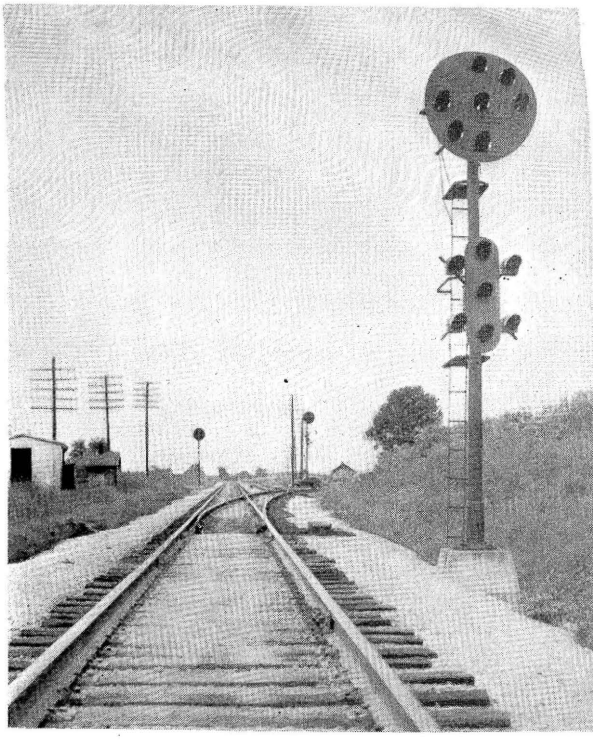
Train Movements Directed by Signals

In this C. T. C. territory, all the main line switches at the junctions and the ends of double track, and at the ends of passing tracks which are used normally in train operation, are power-operated by electric switch machines. These machines as well as the absolute signals are controlled by the C. T. C. system. These absolute signals, which are located directly in approach to the various switches, serve not only to govern routes over the switches, but serve also as block signals governing the use of blocks, and, unless otherwise provided, their indications supersede time-table superiority and take the place of train orders. Included in this classification are, not only the high signals for directing moves on single track and for right-hand run-



Location plan of the tracks and

Installation connects with 33-mile project installed in 1930 so that train movements are now, in effect, directed by signal indication which supersedes written train orders on 102 miles of the St. Louis division



Westward home signal 48L at Farrington

Centralized Traffic Control

On 69 Miles of Line

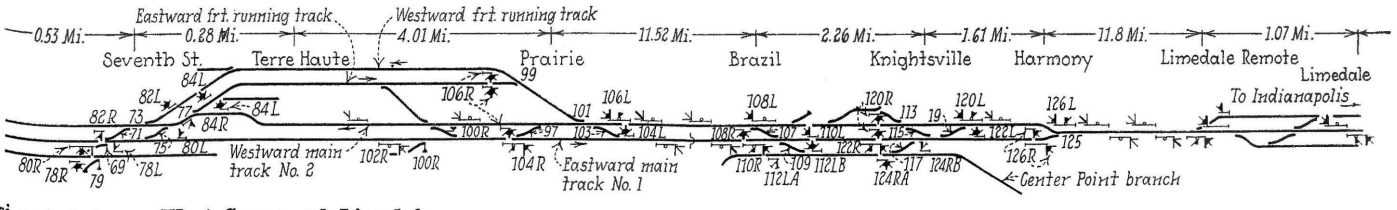
ning on double track, but also the "back-up" dwarfs for directing movements through blocks by reverse running on double track in the section between Harmony and Brazil. On the remainder of the double-track territory, trains are not operated reverse running except in cases of emergencies, and under such circumstances the train movements would be authorized by train orders. The C. T. C. control machine for the Harmony-Casey territory, located at Terre Haute, is handled by an operator who works under the direction of the dispatcher who is located in the same room. The C. T. C. control machine at Limedale is handled by an operator who also works under the direction of the same dispatcher at Terre Haute.

Character of Line and Traffic

The line between Indianapolis on the east and Casey on the west, passes over a rather rough rolling country with numerous short grades in both directions, the ruling grade westbound, at Farrington, varies from 0.75 to 0.98 per cent for two miles. The ruling grade, eastbound, at Limedale, is 0.77 per cent for about two miles. In the Ben Davis-Casey territory there are 69 curves with more than 30 min. curvature. Of the total, only 18 are more than 1 deg. 30 min., and there are only 4 curves, ranging between 2 deg. and 3 deg. 15 min., at which speed restrictions of 60 m.p.h. are in effect. The track is in excellent condition, using 131-lb. rail, good ties and rock ballast. The speed limit for passenger trains is 70 m.p.h., and for freight trains, 50 m.p.h. The turnouts are No. 20 at the ends of double track at Harmony, Macksville and East Casey. At Harmony, the turnout is practically equilateral, permitting train speeds of 50 m.p.h. eastbound and 70 m.p.h. westbound over this turnout. A "clear" aspect is displayed for either direction for such through moves. If the switch is reversed for a route from the single track to the reverse main track, signal 126L will display a "caution-slow-speed" aspect. Where the divergency is all in one direction over a No. 20 turnout, the speed limit for a diverging move is 30 m.p.h. and is authorized by a "clear-restricting" aspect. The turnouts at the ends of passing sidings on single track are No. 15, good for speeds of 30 m.p.h. for diverging moves, but dwarf signal indications only authorize speeds of 15 m.p.h.

Volume of Traffic Heavy

For a territory which is mostly single track, this line handles heavy traffic, including 11 through passenger trains and 2 others which make local stops; 8 arranged through freight trains, and with extra trains as required. Thirteen local freights and mine runs are operated daily on various sections of this territory. A local passenger train, a local freight



Signals between West Casey and Limedale

and a through freight in each direction daily, for operation on the Peoria Branch, use the 7 miles of main line between Terre Haute and Farrington. Therefore, not counting extras, the total, on various portions of the territory, ranges from 20 to 24 train movements daily. The track layout at Seventh street in Terre Haute is used when picking up and setting out passenger train cars. Yard engines making switching moves to and from industries also use this layout, so that a total of about 56 switching movements in addition to regular trains are made in this area each 24 hours.

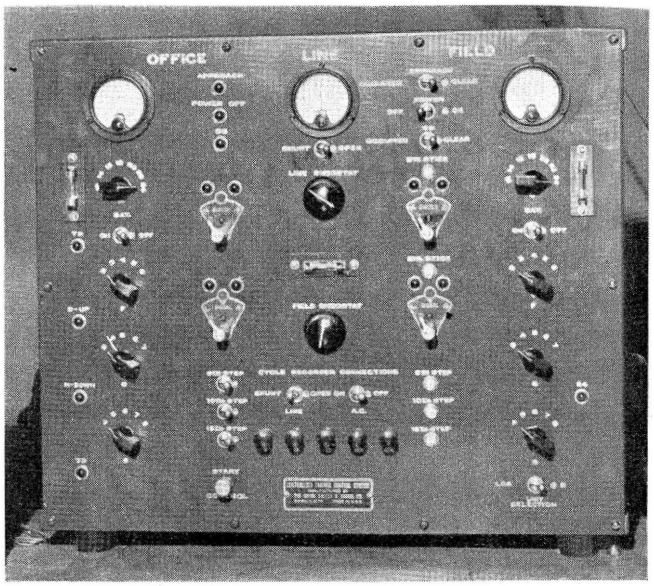
The passenger trains as well as the through freights operate on fast schedules, and very little time is allowed for meets or passes. For example, some of the passenger trains, such as the Spirit of St. Louis, is scheduled to 1 hr. 3 min. for the 66 miles between Terre Haute and Ben Davis interlocking. Freight trains on arranged schedules make the run between Ben Davis and Terre Haute yard in 1 hr. 45 min.

Previous Interlocking Facilities

In the previous arrangement, the end-of-double-track switch as well as the signals at Harmony were power operated and were controlled remotely from an electro-mechanical interlocking at Knightsville, which included three crossovers and a single switch leading to a siding. The switches and signals in both the Harmony and the Knightsville layout are now included in the C. T. C. system. At Brazil, where connections are made to branch lines extending to coal fields, the two crossovers were formerly operated by hand, but these switches and signals are now power operated as a part of the new C. T. C.

At Prairie, 4 miles east of Terre Haute, a junction layout includes two crossovers and two single switches leading to two freight running tracks which connect with the freight yard and extend through to a connection with the main line again at Seventh street just west of the station. At Prairie, a 14-lever mechanical interlocking was replaced by power switch machines and signals of the new C. T. C. system. At Seventh street, the switches and crossovers were previously operated by hand-throw stands and the signals were controlled by a set of four interlocked desk levers. These switches and signals are now power operated and are included in the C. T. C. system.

At the end of the double track at Macksville, the switch and signals formerly included in a 17-lever mechanical interlocking are now power operated as a part of the C. T. C. system. At Farrington, a change was made to connect the passing track into the Peoria Branch track, thus eliminating one main line switch. This switch and the junction switch were equipped with power machines, thus eliminating the mechanical interlocking formerly in service. A power machine and signals at the west end of the Farrington passing track are included in the C. T. C. system. At Marshall and at Aden, power switches and signals were installed at both ends of the existing 137-car passing sidings. The crossovers and switches at Casey were formerly included in an electro-mechanical interlocking, and the switches at East Casey and West Casey were power operated and remotely controlled from Casey. These interlockings were eliminated by installing electric switch machines and signals, all included in the C. T. C. system.



A special test panel is located in the maintainer's room in the passenger station at Terre Haute for the purpose of making complete tests of coding equipment when necessary

Within home signal limits at the various junctions, the switches and crossovers which are operated by hand-throw stands are each equipped with electric locks. The electric switch lock shown with numbers on the diagram are controlled by levers on the C. T. C. machine, but the other locks without numbers are controlled automatically by occupancy of certain track sections. The territory controlled from Terre Haute includes: 18 switches, 11 crossovers and one derail, which are power operated; 30 high and 36 dwarf home signals and 3 holding signals which are C. T. C. controlled, and 9 electric switch locks. Two of the holding signals, 50L and 50R, are located between Farrington and Macksville, and the third is 46R at West Farrington, immediately opposite to manual block signal 46L which also is controlled by the C. T. C. system. These holding signals are provided to hold out approaching trains when switching moves are being made at Farrington.

Electric switch lock 29 at Casey is controlled from the C.T.C. machine at Terre Haute

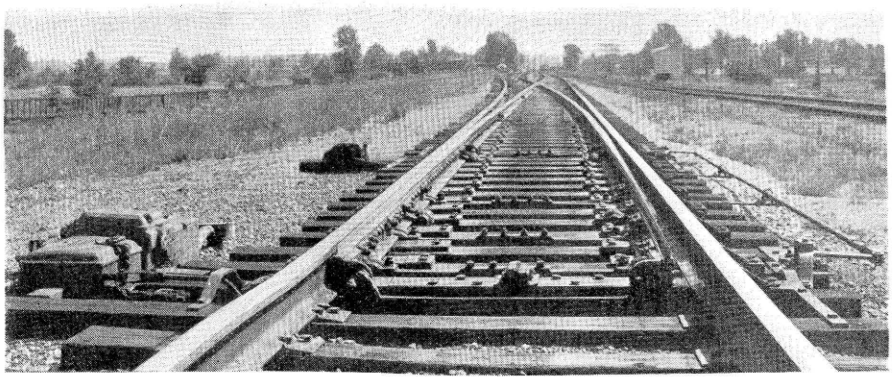
Centralized Control System

On this installation, the term "field station" applies to a switch or a group of switches and perhaps crossovers, together with controlled signals. The

control of the switches and signals at the field stations, and the return of indications of the positions of switches and aspects displayed by signals, as well as indication of track occupancy by trains, are all handled by time code controls over two line wires, one such circuit extending from Terre Haute to Harmony and another from Terre Haute to Casey. The C. T. C. control machine in the office at Terre Haute was made up as three panels totaling 10 ft. in length, but the two end panels 2.5 ft. long were set at an angle of 105 deg. with the center panel, so that the operator can reach any lever.

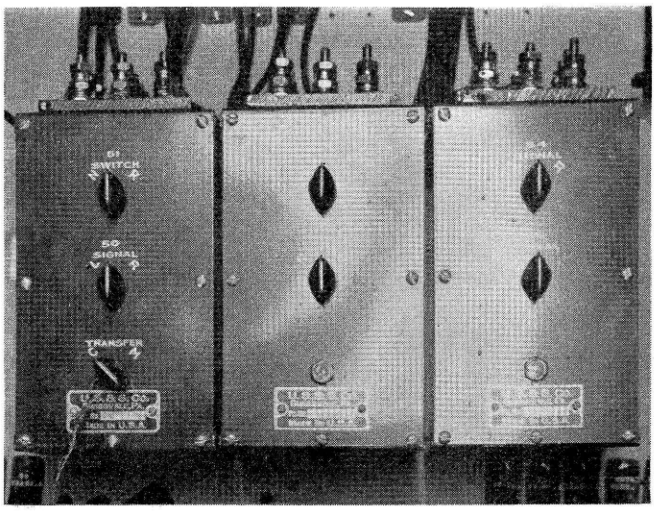
The illuminated track diagram, across the upper portion of the panels, has track-occupancy lamps which indicate the position of trains on all sections of the main tracks in the entire territory between Limedale and Casey. The lamp corresponding to each track section is lighted amber when the corresponding track section is occupied. In order to provide a quick means of determining whether entire blocks between field stations are unoccupied on the double track sections, separate block indication lamps are provided on the diagram, and are illuminated when the corresponding blocks are unoccupied. These lamps are controlled by direct wire circuits. An operator in an interlocking at Effingham has a diagram which includes lamps to indicate occupancy of each main track between Casey and Effingham.

Each C. T. C. controlled signal is represented on the illuminated track diagram by an indication lamp which is lighted green when the corresponding signal is displaying a proceed aspect. Near the upper edge of the diagram is a row of red lamps, one each to represent each field control station, and when the a-c. power is off at any station, the corresponding lamp is lighted and a warning bell is sounded to call the operator's attention so that he can get in touch with the maintainer for that section.



Switch 51 at Macksville, a No. 20 turnout with 45-ft. points and two operating rods

The two-position switch levers, with normal and reverse indication lamps, are located in the upper row. The normal indication lamp is green and the reverse amber. The signal levers in the second row, operate to three positions, on center to display the Stop aspect, and to the left or to the right to control westward or eastward signals. When all signals controlled by a lever are indicating Stop, a red indication lamp above the center position of the lever is lighted. A westward manual block signal 46L at West Farrington governs train movements in the manual block to Paris, on the single-track Peoria Branch. This signal is controlled as a part of the coded C. T. C. system, but a special feature is that when this signal is displaying the Stop aspect, the indication is repeated in the control machine by a constantly controlled rather than coded controlled circuit, which will be explained later.



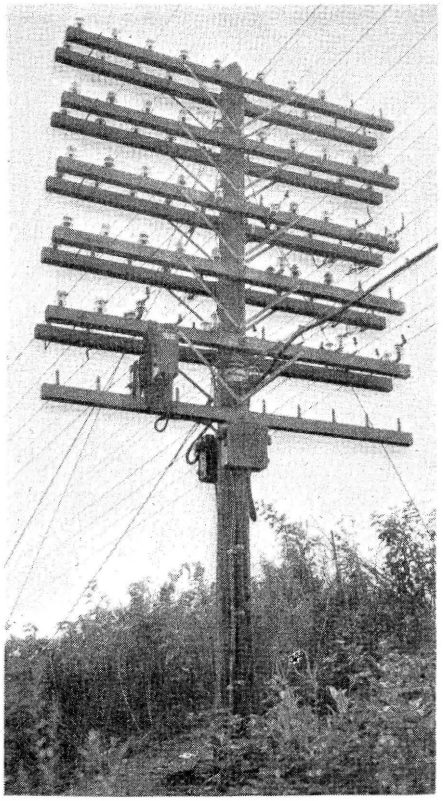
A set of manual control levers is provided in each instrument house at each field station for emergency control of signals and switches at these points within the C.T.C. territory

Certain levers in the second row are used to control electric locks on hand-operated switches, and a green lamp above the left position is lighted when the switch is locked, but an amber lamp above the release position is lighted as a reminder when the switch is unlocked. The code starting buttons are in the bottom rows on the panel. A total of 29 switch and crossover levers, 28 signal levers, and 5 electric lock levers are included in the machine. When a switch is to be operated and a signal cleared, the operator positions the corresponding levers, and then pushes the code starting button for that field location. The code goes out in about four seconds, and as soon as the switch is over and locked and the signal clears, indications are sent to the office in a return code requiring about four seconds. A special feature of this control machine is that the operation of special buttons above the code starters cause the corresponding signal to operate nonstick so that it will clear automatically for following trains without the operator again setting the lever and sending out another control code.

Train Graph and Telephones

Recessed in the top of the desk of the control machine is a train graph mechanism which automatically records, on a roll of paper, the passing of trains at a total of 23 "OS" points on this territory. The graph sheet moves 3 in. each hour. The sheet is torn off of the roll on the midnight line by the maintainer the following morning, and is filed as a record of train movements on this territory. The graph mechanism is operated by an a-c. synchronous motor, but if the a-c. power is cut off, power to operate this mechanism is supplied by a tuned-alternator fed from battery.

A telephone, for the use of members of train and engine crews or other employees, is located in the vicinity of each C. T. C. controlled signal, and these telephones are connected to a line circuit which extends to a telephone line concentration unit operating in conjunction with a loudspeaker mounted on the control machine. A high-fidelity breastplate transmitter is used by the operator for talking over these lines. In addi-



Typical field station line-drop location

tion to handling the control and indication codes over a two-wire line circuit between the office and the field stations, a telephone circuit is superimposed on these wires for conversation between maintainers in any of the instrument houses at the various field locations, and the operator or a maintainer in the control office. The line for this service is terminated in the telephone line concentration panel mounted in the lower portion of the panel to the left.

A special feature, provided for the first time, on this C. T. C. project, is a set of manual control levers in the instrument house at each field station, the purpose being to provide a means of local manual control for use in those rare emergencies when storms may tear down the line control wires for such extended distances that repairs connot be completed in a short time. When such emergency arises, and local manual control is to be in effect, an operator would be placed on duty at each of the field stations, and they would work under the direction of the dispatcher. Normally these control levers are sealed, and a seal must not be broken without the authority of the superintendent.

Benefits of the New System

The train schedules have not been changed since the final section of the new C. T. C. was placed in service on July 31, 1940; however, in numerous instances, the new system has been used to an advantage in preventing delays and in making up train time when certain trains are off schedule or when extra trains are operated. Under the previous method of directing train movements by timetable and train orders, a westbound freight train would be held at Farrington unless 25 to 30 min. was available to go to Marshall and get in the clear of a superior train. With the new C. T. C. system, this move can be made in 13 min., and the man at the control machine knows from his illuminated track diagram whether the required 13 min. or more is available, and he directs the movement of the train accordingly; thus, in numerous instances, saving 30 min. or more on such trains. As another example, under the previous practices, if the dispatcher had given a freight train 45 min. to go from Farrington to Casey, and the crew saw that they could not make it, they would take siding at Aden. With the C. T. C. system, changing conditions concerning the progress being made by all trains is shown on the diagram and on the graphic train sheet of the control machine so that the dispatcher can use the signals to direct trains at each field location. If he wanted the train to take siding at Aden or to continue through onto the double track at Casey, he could direct and authorize the movements accordingly, thus saving 15 to 20 min. time.

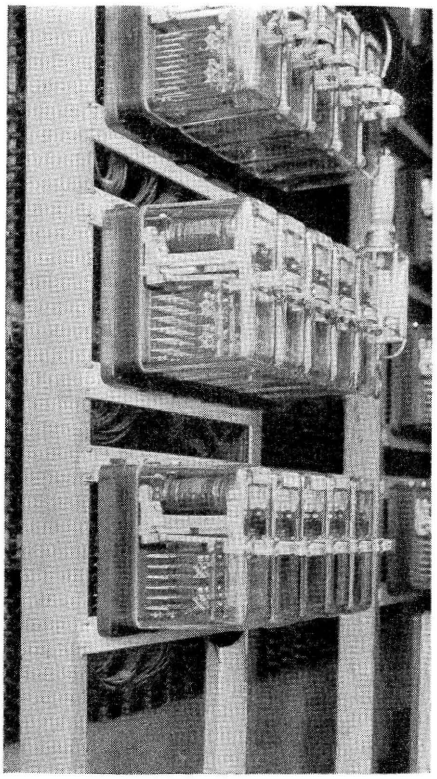
Through passenger trains No. 26 and No. 11 are scheduled to meet at Aden at 7:38 p.m. With both trains on schedule, the operator watches his diagram, and the train which arrives first is diverted onto the passing track, and the other train continues on the main line, thus in numerous instances accomplishing non-stop meets. If either train is behind schedule, the meet can be changed to some other point, so that a minimum of train time will be lost. From 75 to 100 train orders were previously issued daily in the Limedale-Casey territory, whereas no train orders are issued for this territory now except for slow orders.

As a part of the signaling improvement program, dragging equipment detectors, with circuits arranged to control the signals, were installed on the eastward main track between Prairie and Brazil, on single track between Farrington and Macksville, and between Aden and Casey, and on the eastward main west of Casey.

Multiple Line Rather Than Series

In the previous installations of C.T.C. coded systems using two line wires, the line relays at the various field stations have been connected in series with the line. In such an arrangement, if the line circuit is broken at any point the entire system is out of service. On this Terre Haute project, a new arrangement is used with the line relays connected in multiple across the code line, so that if the line is broken at any point, the system can be continued in operation up to that point. A broken line wire causes a roar in the loudspeaker in the dispatcher's office and a maintainer is called to locate and correct the fault.

Each of the line relays at the various field locations has a resistance of 1,700 ohms, and a 10,000-ohm resistor



Detachable type relays at Casey

is connected in series with the relay, so that the current through the most distant line relay is approximately 3 m.a. Line relays nearer the office have progressively slightly larger currents because of the increase in line voltage as the office is approached. The total line current, for the west line with 22 stations, is approximately 75 m.a. The line circuit is normally energized by storage batteries located at the Terre Haute office, a 60-volt battery feeds the line west, and a 40-volt battery feeds the line east. At Casey, the far end of the line west from Terre Haute, the voltage is about 35 volts.

Each control code going out from the office consists of long and short periods of current or absence of current to the line, totaling 16 steps re-

quiring about 4 sec. total. The line relay at each controlled station on the line is picked up and released accordingly, thus controlling the selective equipment at the correct field station to cause the switch to operate or the signal to be controlled.

Another new feature of this installation is the arrangement for indicating from a field station by shunting the line and removing the shunt to form code, thus producing variations of the current from the office line battery. The lockout for preventing interference by other stations involves a reversal of the line polarity at the office by the first impulse of an indication code, together with an arrangement which permits the transmitting station to continue operation only if supplied by current of reverse polarity from the office. The stations are conditioned to initiate codes only when supplied steadily with current of normal polarity. Outgoing control codes take precedence over incoming indication codes. The indication codes come in as soon as the line is free of control codes. Two or more indication codes can start simultaneously, but codes initiated after the start are locked out because the polarity of the field line is changed by an arrangement of the pole-changer relays and repeaters. Indication codes which start simultaneously continue coding together as long as their codes are the same. At the first point of difference, the station having code superiority continues and the others drop out.

Circuits on the Code Line

The two line wires for the code line circuit are No. 8 copperweld with weatherproof covering, wires of this type being used to provide adequate mechanical strength to withstand sleet loads. In addition to carrying the control and indication codes of the C.T.C. system, these two line wires also carry the telephone circuit for communication between the Terre Haute office and telephone sets located in the instrument houses at the various field stations.

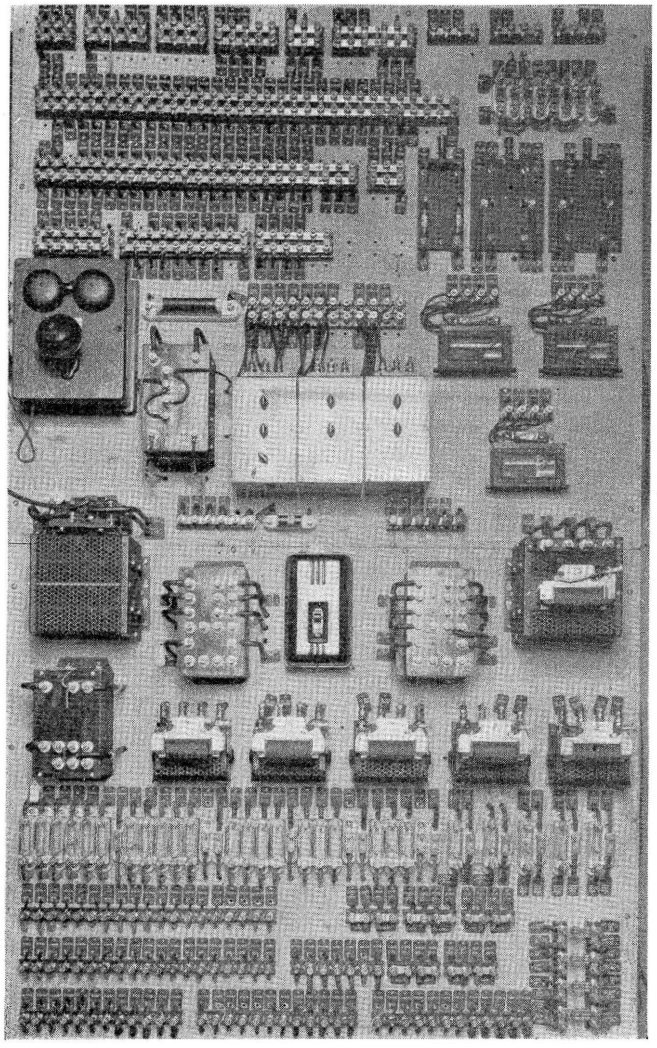
The telephone sets are connected to the line through condensers so that they do not form a direct current path between the wires. All relays contacts which operate in the line circuit are separated from the line by "low-pass" filters. These filters remove the noise which otherwise would be introduced by the opening and closing of the contacts. There is one filter at the control point for each line, and one filter at each C.T.C. field station. Telephone conversations on the line do not interfere with the control or indication codes, nor do the codes interfere with telephone conversations. There being no relay contacts or coils in series with the line wires at the field stations, the line wires are available for carrier current telephone or telegraph circuits.

Once each hour during working hours, each maintainer reports by telephone to the operator in charge of the control machine. When a maintainer is working in or near an instrument house, the operator can call the maintainer to his telephone by sending out a special code of the C.T.C. system which causes a buzzer in the house to sound for 3 sec.

In addition to the telephone system being superimposed on the code line, a "simplex" circuit also is handled on this line between West Farrington and Terre Haute. At all times during which the westward manual block signal 46L at West Farrington displays its most restrictive aspect, a code of 180 per minute, originated by a code transmitter, is transmitted by the "simplex" on the code line wires from signal 46L to the Terre Haute office where decoding equipment is used to pick up a relay which causes the corresponding indication lamp on the illuminated diagram to be lighted. Thus this indication is controlled constantly on the equivalent of a closed circuit rather than by coded control of the C.T.C. system.

Power Switch Layouts

Each power switch included in the C.T.C. system is operated by an electric switch machine equipped with a 24-volt d-c. motor, the operating time being about 14 sec. An automatic overload cut-out relay is connected in the power circuit for each switch so that if the points are fouled by snow or ice, and the motor takes more than 12 amp., the cut-out operates automatically, but it can be reset by operating the lever to the opposite position. As a means of preventing operating failures which might be caused by the accumulation of moisture or frost on the motor commutators or contacts in controllers, an electrical heater unit is mounted inside the indication case of each switch machine. During winter months, this heater, which is rated at 65 watts, is fed from the 110-volt a-c. source. The standard arrangement of facing-point locks and lock rods as well as



A board inside and at the end of each field station house supports terminals, lightning arresters, resistance units, switches, overload relays, filters and a telephone set

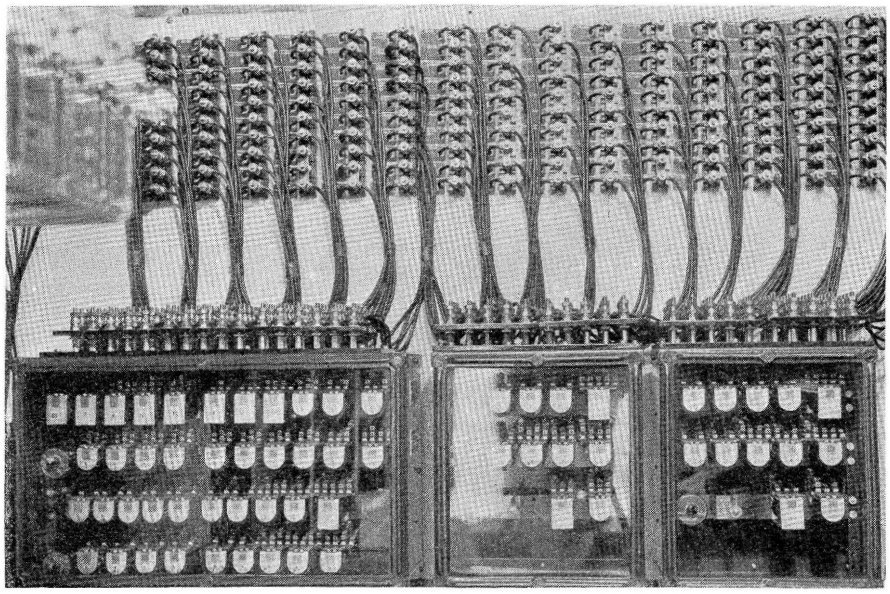
lock-out point-detectors are used on each power switch.

At the ends of double track at Harmony and at Macksville, No. 20 turnouts with 45-ft. points are used. In order to insure that the full lengths of these long switch points are operated properly, a second operating rod, located 23 ft. from the points, is operated by a pipe connection from the first operating rod. A separate switch circuit controller is connected to the switch at this second operating rod. Experience showed that it was necessary to set these contacts for a ½-in. variation in the normal position of this section of the switch points. In order to ease the operation of these switches, two sets of roller bearings are provided under each switch point. Normally, these bearings support the switch points just free of the slide plates, but when a train comes on the points they are pressed down on the slide plates.

Position-Light Signals

The signals controlled by the C.T.C. system as well as the intermediate automatic block signals on the entire territory are all of the position-light type and the various aspects are in accordance with Pennsylvania standards. As a part of the construction program the intermediate signals were relocated, where necessary, so that each block is at least train stopping distance in length, thus permitting the use of three-aspect signaling. In the approach to junctions including high-speed crossovers or turnouts, an additional aspect, "approach restricting" is provided in approach to an "approach" aspect, or a "clear-restricting" aspect.

The semi-automatic signals which are manually controlled by the C.T.C. system, all normally display their most restrictive aspect, except when the non-stick control is in effect. When one of these signals is cleared to authorize a train movement through a block from one field station to another, as, for example, eastward signal 38R at East Aden, then opposing signals 40L at West Marshall are prevented from being cleared, and, furthermore, the opposing intermediate automatic block signals 961 and 923 are set to their most restrictive aspect and are held to display such aspects as long as the C.T.C. control for the other direction is in effect, even on stick control. On account of these two features, i.e., normal Stop aspect for signals authorizing movements through blocks, and the setting of opposing intermediate signals, the layout of the intermediate signal need not involve the problem of staggering the intermediate signals on the basis of train stopping distance, which is a matter of importance with reference to normally-clear automatic block signaling on single track. For these reasons, the intermediate signals were spaced on a time-distance basis, thus effecting the most efficient utilization of track capacity and train spacing for following moves.



Typical field storage and line-coding storage units located in concrete house

Signal Lamp Controls

The home and distant signals at all of the field stations are lighted constantly, and the remaining signals, all of which are intermediate automatic block signals, are approach lighted. On single-track, when the home relays for the signal for one direction are released by the C.T.C. control, the opposite signal is lighted through a back contact of the H relay.

Power Supply

Single-phase power at 440-volts, 60-cycle is distributed over the entire territory on circuits using two No. 6 copper, w.p. wires on the pole line. These circuits are fed at various towns spaced 8 to 10 miles apart. At each location a 1.5 kv.a., 440/110-volt line transformer is located on the line pole to feed the low-voltage transformers in the houses or cases, which in turn feed the signal lamps and rectifiers to charge the storage batteries. The storage cells used for feeding the track circuits are rated at 80 a.h., and those used to feed the switch machines and local relay circuits at each field station are rated at 240 a.h. At stations where brick instrument houses are used, the storage batteries are located in these houses, but where concrete houses are used, the batteries are in outdoor sheet-metal boxes which are heavily insulated as a means of minimizing the effects of low temperatures.

The track circuits are of the d-c. neutral type using 4-ohm relays. None of the blocks between signals are more than two miles long and the vast majority are less. Where the distance was more than 6,000 ft., two track circuits were used so that none of the circuits are more than 6,000 ft. in length. One storage cell on floating charge feeds each track circuit. The rail joints are bonded with mechanically-applied, head-of-rail type bonds. A special feature of the track circuit arrangements is that series connections rather than shunting connections are used on the foulings at turnouts.

Instrument Housings

At many of the field locations such as Macksville and Farrington, the relays, coding equipment, etc., for an entire station is located in a concrete house about 8 ft. by 10 ft. At some of the stations where an 8-ft. by 10-ft. house was not large enough to contain all the apparatus, such as at Seventh street in Terre Houte and at Knightsville, larger-sized houses, 12 ft. by 18 ft. were built, using brick walls, and with floors and roofs of concrete poured in place.

All of the wires which enter each of the houses are taken to a board mounted in the end of the house. These boards are made of ½ in. sheet asbestos, which are bolted to angle-iron upright frames. Mounted on these boards are the bakelite-based

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C.T.C. on the Pennsylvania

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single-post terminals, lightning arresters, resistance units, switches in the code line, low-voltage transformers, rectifiers, telephone set, filters, automatic overload cut-out relays in the switch power circuits, and the manual control levers.

Using facilities at Terre Haute, these panels were drilled and assembled, according to scaled drawings, and all of the equipment was mounted in place, complete with tagging. Wires from the terminals on these large boards run through overhead ducts and down to the terminals on the back boards behind the relays. The relay racks in these houses are made up with shelves made of sheet iron and back boards of asbestos supported on angle-iron frames. A rubber mat is provided on each shelf. The relay racks, terminal boards and all interior wiring, complete with tags, were installed in the concrete houses before they were shipped from Terre Haute. The racks and boards were installed in the brick houses after they were constructed.

The relays in the house at Casey are of the modern quick-detachable type, using plugs and receptacles, as shown in one of the illustrations. The relays on the remainder of the installation are of the shelf type, and, where required, are equipped with spring mounting to minimize the effects of vibration.

Cable Distribution

At the line pole at each field station, taps from the line wires are extended to terminals in a cast-iron junction box mounted just below the crossarms. From this box, cable extends down the pole and underground to the instrument house. This cable, which is of the type buried directly in the earth, is made up with protective coverings including a lead sheath, two steel tapes, and impregnated jute. Cable of the same construction extends from the house to each switch and signal, for example, 5 No. 9 and 7 No. 14 wires extend to each switch. In the bootleg riser box at each switch, the ends of the wires of the cable are soldered to pieces of No. 9 flexible insulated wires which extend through flexible metal conduit to the switch machine.

At Terre Haute, the line batteries and charging equipment are located in a separate room provided for the maintainer. Also located in this room is a special test panel with levers, indication lamps, meters and rheostats, for making complete tests of the coding apparatus.

This centralized traffic control was planned and installed by signal forces of the Pennsylvania.

Wabash Crossing Protection

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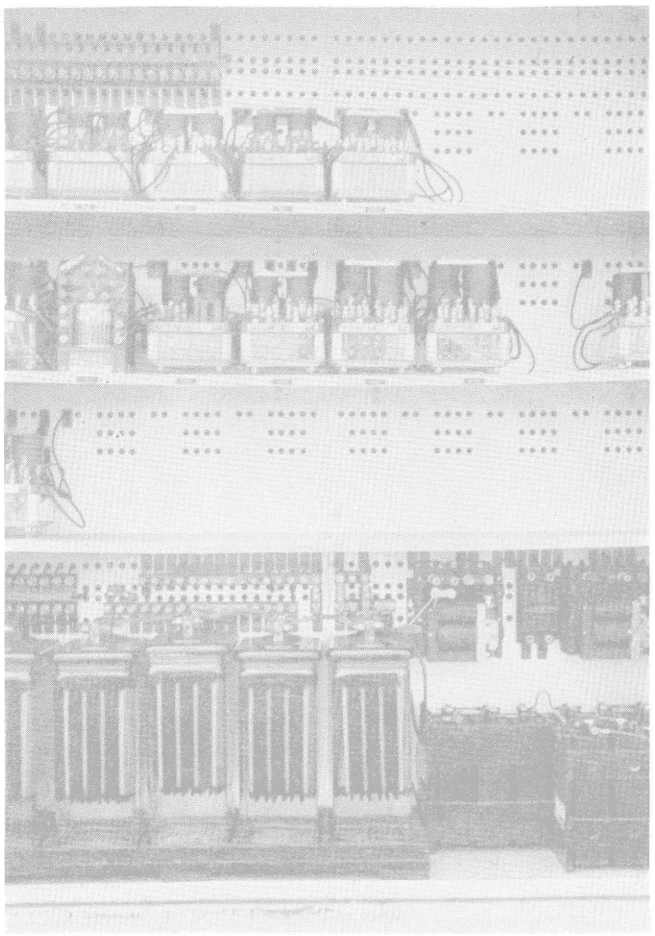
ating mechanisms, and a similar set of batteries operates the other two gates. The batteries are on floating charge through Union copper-oxide rectifiers. Each track circuit is fed by three cells of No. 572 Columbia 500-a.h. primary battery, connected in multiple, with a 2.5-ohm Raco limiting resistance in series with the circuit.



Interior view of one of the instrument cases at the crossing, showing the control relays and storage battery for control and gate operating circuits

The relays, rectifiers and batteries are located in two sheet-metal instrument cases, one to the northwest and the other to the southwest of the crossing. As a means of supporting each case it is mounted on a rack or frame made of ⅜-in. by 2-in. by 2-in. angle iron, with a piece of this material along the front and back, across each end, and across under the middle of the case. This frame rests on two precast concrete foundations 27 in. by 27 in. by 48 in. Before the case is set in place, the bottom and the portions which rest on the frame are covered with a coating of No-Oxide Grade A grease to prevent oxidation. Plastic, elastic and adhesive signal cement are used to fill any space between the case and angle-iron rack.

The slow-acting relays are of the 350-ohm DN-19 type, the control relays are of the 500-ohm DN-11 type, the track relays are of the 4-ohm DN-11 type, and the flasher relays are of the 500-ohm FN-16 type, all of which were supplied by the Union Switch & Signal Company.

All wiring distribution to the signals is underground cable, the outer protection being of the mummy type, excluding all metal, which was furnished by the Kerite Insulated Wire & Cable Company. The cables leading to signals 3 and 2 pass under the highway from the instrument cases in 4½-in. conduit.

This crossing protection was planned and installed by the regular signal construction and office forces of the Wabash under the jurisdiction of G. A. Rodger, signal engineer. The project was installed under agreement with and financed by Cook County.