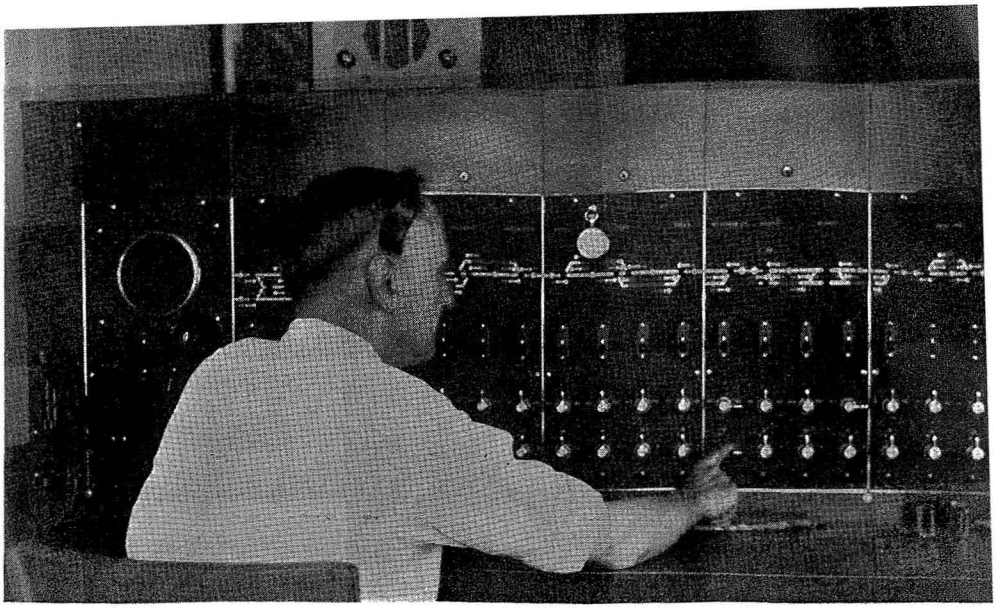


The centralized traffic control machine for the 27-mile territory is located in the office at Chester, Ill.

C.T.C. on the Missouri Pacific

THE Missouri Pacific has installed centralized traffic control on 27.2 miles of single track between Flinton, Ill., and Raddle Junction, which is a part of the Illinois division, extending south from East St. Louis, Ill., along the east side of the Mississippi river, 119 miles to North Junction near Thebes, Ill. From Thebes, one line extends to Cairo, Ill., and one line extends across a bridge over the Mississippi river at Thebes to serve the Arkansas, Louisiana and Texas territory.

In view of the fact that this Illinois division is a low-grade line throughout, practically all of the Missouri Pacific freight traffic to and from the south is handled on this route, rather than on the more direct Iron Mountain line between St. Louis, Mo., and Poplar Bluff, via Bismarck, because the Iron Mountain line crosses a range of the Ozark mountains with heavy grades and curvature. Only the through passenger trains and a limited amount of merchandise, originating in or destined to St. Louis proper, are routed over the Iron Mountain route.

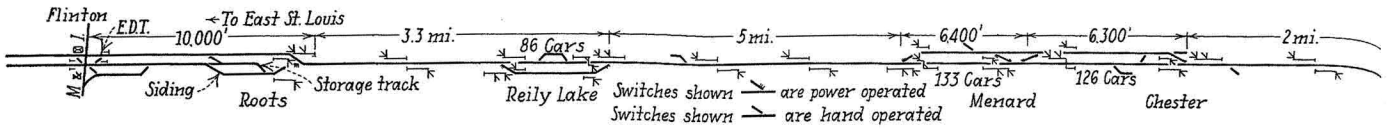
On the Illinois division, the Missouri Pacific operates one motor-type local passenger train each way daily between St. Louis and Marion, Ill., and the St. Louis-Southwestern operates one regular through passenger train each way daily. Branch line passenger trains of the Missouri Pacific operate each way daily between Flinton and Chester, and also between Chester and M. V. Junction. The M.P. operates five scheduled freight trains each way daily, and the St.L.-S.W. operates three such trains each way daily. A local freight is operated each way daily except Sunday. With the average number of extra freight trains, the total traffic at present is about 35 trains daily, and when business is good, 50 to 60 trains are operated daily. During the latter part of March, 1937, the number of trains daily ranged from 55 and 56 to as high as 63.

Project includes 27-mile section of single track extending between sections of double track on division handling as many as 63 trains daily

The majority of the southbound freight traffic consists of merchandise and manufactured products, while the northbound traffic includes fruit, vegetables, packing house products, live stock, lumber and agricultural products, all of which is moved on fast schedules. In addition, coal is moved northward to East St. Louis, this coal for the most part being handled in solid trains on slower schedules. About two trains including coal are operated from the Mt. Vernon line daily. A new mine, opened in 1937, on this branch line, will result in an increase in coal traffic. The majority of the coal handled on the division, however, comes from the Southern Illinois coal fields in the vicinity of Bush, Ill., this traffic entering the main line at Gorham, Ill., 22.6 miles south of Chester.

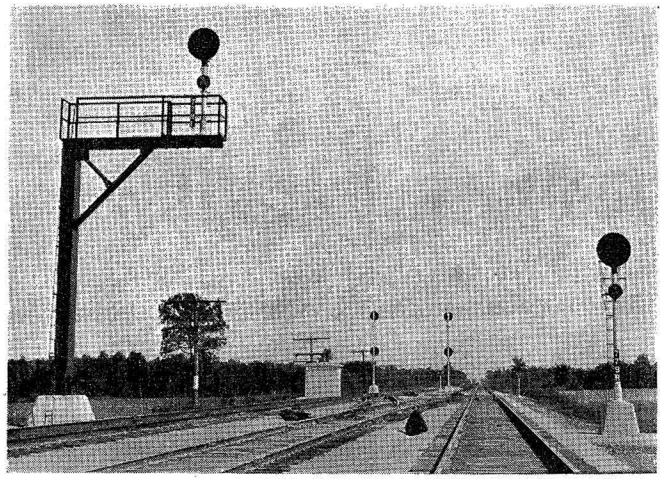
General Track Layout

The Illinois division is double track from East St. Louis to Flinton, 49 miles, single track 27 miles to Raddle Junction, double track 14 miles to Howardton, single track 4.5 miles to Halsey, double track 24 miles to North Junction, at Thebes. Centralized traffic control, controlled from Halsey, has been in service several years on the 4.5 miles of single track between Howardton and Halsey. This left the 27 miles of single track between Flinton and Raddle Junction as the neck of the bottle, with extended sections of double track on either end. When as many as 50 to 63 trains were being operated daily during the early months of 1937, delays were excessive on the section of single track, and something had to be done to relieve this congestion. The passenger trains and some of the merchandise freight trains were given preference, but the remainder of the freight trains met serious delays. On the average, from two to three hours was often required to move coal trains between Raddle Junction and Flinton.



Track and signal plan of the new centralized traffic

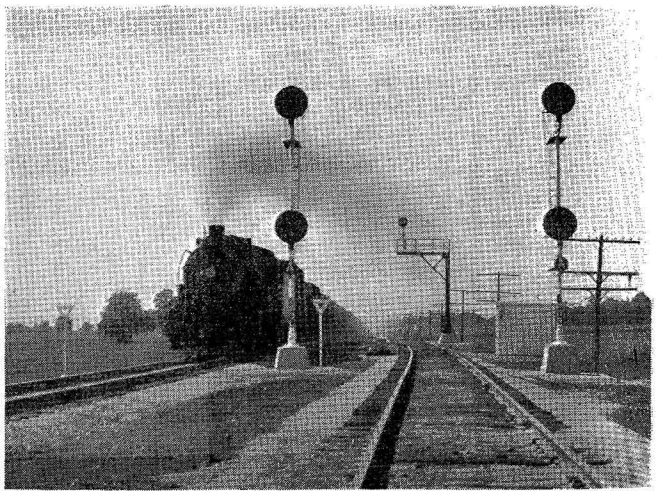
An additional handicap in the operation was that the trains were bunched. Several trains were dispatched from Dupo yard at East St. Louis between 5:30 p.m. and 7:30 p.m., and another group departed between 8 p.m. and 9 p.m. These fleets often met opposing fleets on or near the Flinton-Raddle section of single track. Considering scheduled trains only, there were three southbound and three northbound freight trains on the territory between 5:30 p.m. and 9 p.m.



South end of Raddle siding looking south. Note low home signal between the tracks

No automatic signaling was in service on this territory previously, train movements having been directed by time table and train order using positive manual block when a passenger train was involved. For example, when a southbound passenger train was operated from Chester, no freight train could leave Chester until the passenger trains arrived at Raddle Junction, which required about 25 minutes.

Two freight trains daily, including coal and merchandise, are operated from the Mt. Vernon line through M.V. Junction and over the main line to Chester. In the majority of cases, these trains terminate at Chester, the cars being handled between Chester and East St. Louis in through freight trains which pick up or set out at Chester. This switching, and the fact that the two main-line local freight usually meet in the vicinity of Chester, caused congestion at this point which often resulted in holding other through trains at sidings in the approach to Chester. In 1933, power-operated switch machines and signals for directing train movements were installed at the lap siding at Ford and also at Mt. Vernon Junction, this layout being controlled from a machine in Chester. This installation had been of considerable assistance in relieving congestion, and this experience, in addition to that gained on other C.T.C. installations on the Missouri Pacific, led to the decision to install centralized traffic control on the entire section of single track between Flinton and Raddle Junction, including the passing track section of double track at the south end. With centralized traffic control available, the addition of a second main track between Flinton and Raddle Junction could not be justified, one reason being that this territory includes the crossing of two major rivers and several small streams at which new bridges would have been required, which would have made the cost extremely high.



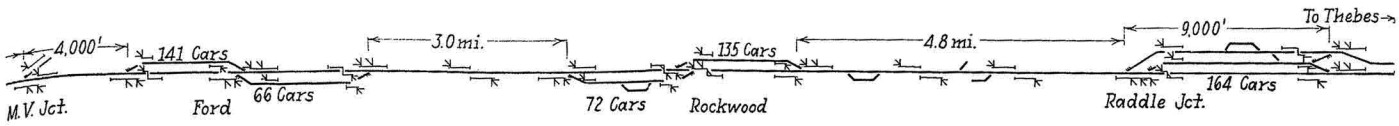
Southbound freight train passing the south end of Raddle

Track Layout and Switches Operated

Starting at Flinton, the end of double track, there is a 184-car capacity siding located west of the main track. At the south end of this siding, known as Roots, the track layout includes a hand-throw switch, which connects a storage track, located between siding and main track, with the siding. The north end of this siding is an extension of the southward main track, which is connected to the single track by a No. 20 crossover, which is operated in connection with the mechanical interlocking protecting the M.P.-M. & I. crossing.

At Reily Lake, no changes were made in the existing 86-car passing track, which is equipped with No. 10 turnouts. At Menard, a 133-car passing siding on the east side of the main line extended northward from Menard station. Another passing siding of 126-car capacity, also on the east side of the main line, extended southward from Menard to Chester. As a part of the improvements, these two passing tracks were connected together and two No. 10 crossovers were installed at Menard so that the two passing tracks can be used separately or as one long continuous siding. A new No. 20 turnout was installed at the north end of Menard siding, but it was not practicable, on account of local conditions, to make changes at Chester to permit replacing the existing No. 10 turnout at the south end of the siding.

At Ford, there is a lap siding layout, with the north siding long enough to hold 66 cars, and the south siding 141 cars. All four of the turnouts are No. 20. At the Rockwood lap siding, the north siding has a capacity of 72 cars and the south siding 135 cars. New No. 20 turnouts were installed for the south siding. The end-of-double-track switch at Raddle Junction is a No. 20 turnout. An interior



control recently installed between Flinton and Raddle

passing siding with a capacity of 164 cars extends from Raddle Junction to Raddle, about 8,000 ft. The north end of the siding is connected to the southward main with a No. 10 turnout. At Raddle, the interior passing siding is connected to both main tracks through No. 10 turnouts.

Power switch machines were installed at the end-of-double-track and all ends of passing sidings mentioned above, as well as at the junction with the Mt. Vernon line, located 2 miles south of Chester. At all of these locations, signals were installed to direct train movements by signal indication without train orders. Also, intermediate automatic signals were installed to serve as approach signals.

The C.T.C. Control System

The signals for directing train movements and the power switch machines are controlled by the General Railway Signal Company's Type-F, Class-M, coded system, using three line wires extended from Roots to Raddle. The operation of this coded system is explained in detail in the G.R.S. Bulletin 170.

The C.T.C. machine in the office at Chester is constructed according to a unit-panel type design developed by the General Railway Signal Company. On the face of the machine, the track diagram and levers for the control of field functions in one general locality are assembled on one panel 10 in. wide and 18 in. high. The coding equipment operating in connection with the switches and signals controlled by a panel is arranged in a case the same width as the panel, the case being so constructed that it can be pulled out to the rear of the machine for inspection. With this type of construction, the machine is made up of a series of unit sections which are fitted together to form a compact machine. When changes or additions are made to the C.T.C. system, additional sections can be inserted at any point as required, without changing the existing units.

A new feature of this machine is that each separate unit has an individual cover, rather than one piece of metal for the entire machine, as has been used previously.

This machine has 19 levers for controlling 71 (54 posts) signals, and 20 levers for controlling 17 single switches and 3 crossovers. The levers are arranged in two rows on the lower portion of the vertical panel of the machine, the signal levers being in the top row and the switch levers at the bottom. A track and signal diagram extends across the panel above the levers, small lamps in the track diagram indicating the position of trains on main tracks throughout the controlled track sections.

When in the normal position, all levers point upward. The signal levers control signals for two directions of traffic, the lever being turned 90 deg. to the left to control southward signals and 90 deg. to the right to control northward signals. The control is so arranged that with a signal lever remaining reversed, the corresponding signal will operate stick, that is, it will not clear automatically for a following train unless the operator again pushes the coding button. However, if it is desired that the signal clear automatically for a following train, the non-stick feature can be cut in by operating a small switch located above the lever. Small indicator lamps in the signal levers are lighted when the signal controlled by the lever indicates proceed.

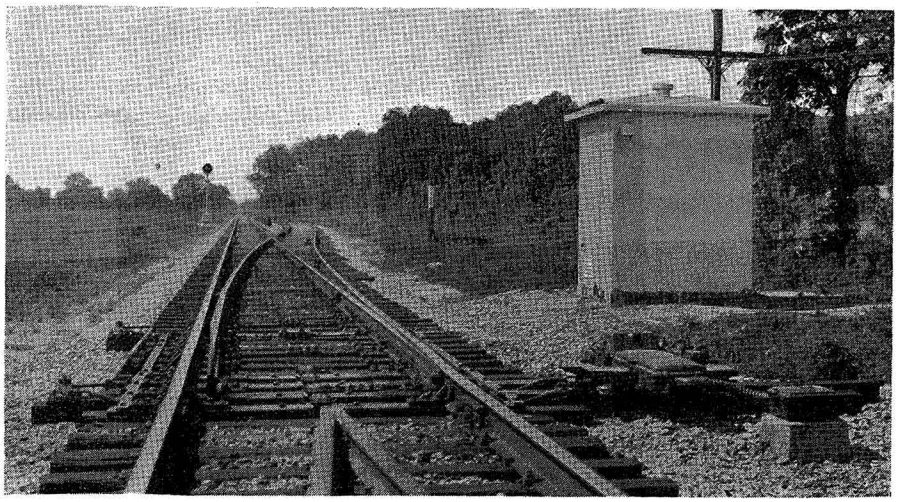
Operation of Switch Levers

The switch levers located in a row just below the signal levers are turned 90 deg. to the right to reverse the corresponding switch. A small lamp in the face of each switch lever is lighted from the time the lever is moved until the switch machine for the respective switch has operated and locked up in the position corresponding to that of the lever. In other words, this is an out-of-correspondence indication.

When making a line-up, the operator positions the switch and signal levers and then pushes the button below the two levers. This action causes the control code to be sent out on the line. The first six steps of the code are for selecting the particular station, the seventh and eighth ones for selecting the positions of the switches, one of these steps being required for each switch. Positive code on this step is for switch normal and negative for switch reversed. The ninth and tenth steps are signal selection. If both steps are negative, the signals are controlled to the stop aspect; if the ninth step is positive and the tenth negative, the southward signal is cleared; if the ninth is negative and the tenth positive, the northward signal is cleared.

No track circuits were installed on the passing sidings. However, a special arrangement is provided to prevent the clearing of signals to permit trains to head in at both ends of a siding. If both switches of a siding are reversed and an effort is made to clear both signals, the code control does not go out on the line because the circuit includes contacts on the switch levers and on the normal repeat switch relays which are so connected as to automatically prevent the clearing of both signals leading into the two ends of a siding.

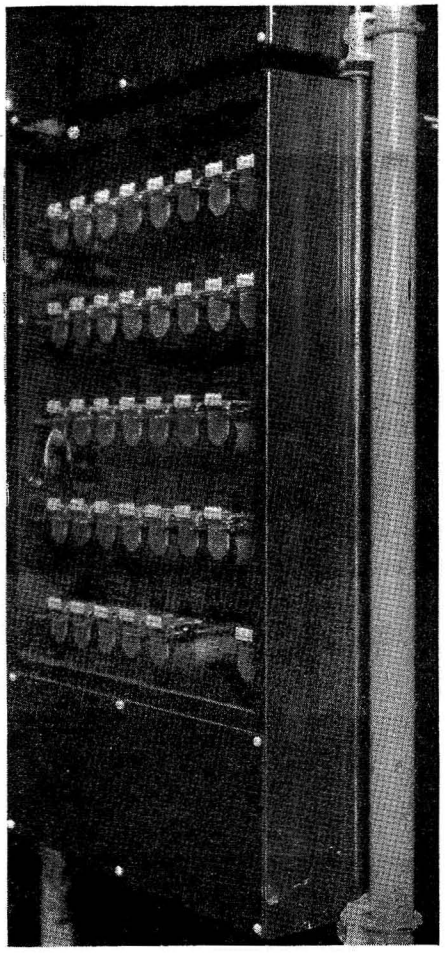
A cabinet in the office at Chester houses the battery, rectifiers and



Power switch layout and sheet-metal instrument house at south end of Rockwood. Note second operating rod

special relays required at this location. A set of 50 cells of Type-BTM storage cells feeds the code line control circuit, and 25 cells of the same type feed the indication circuit. Twelve cells of the DMGO-7 type feed the local relays. At each power switch layout there is a set of 12 Type DMGO-7 cells for the operation of the power switch machine and the local code relays. At each signal there is a set of five cells of the same type. Each track circuit is fed by one cell of the DMGO-7 type. All of the storage batteries are of the Exide lead type and charged by G.R.S. rectifiers.

A 550-volt single-phase, 60-cycle circuit, on No. 6 weatherproof copper line wires, was extended over the territory to distribute power to the various locations. The line code circuits, as well as the local signal control circuits, are on No. 10 weatherproof copper wire. These wires are on an extra crossarm on the communication pole line, except on the territory between Chester and Ford, where a separate signal department pole line was previously in service. Ohio Brass Company porcelain insulators are used, white insulators being used for the 550-volt circuits and brown ones for all other circuits.



The coding equipment at a field location is attached to a vertical pipe

General Electric Company gap-unit arresters are used on the code line circuits.

In the vicinity of each group of power switches and signals, a cabin is provided for housing the relays, coding apparatus, battery and charging apparatus. These houses are of various sizes, ranging from 6 ft. by 6 ft. to 6 ft. by 8 ft., depending on the space requirements at each location. The cabins or houses are of welded sheet-metal construction and are lined with ⅜-in. Celotex insulation, being constructed by the General Railway Signal Company.

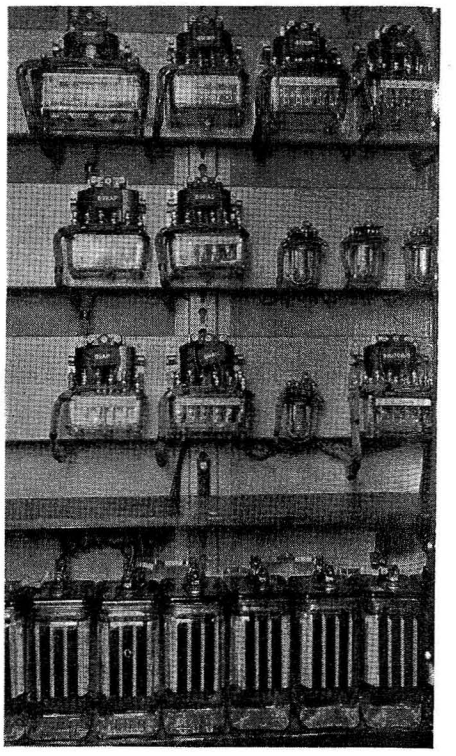
The coding equipment in each cabin is contained in a sheet-metal cabinet 11¾ in. deep, 23 in. high, and 19 in. wide, which is located in the center of the cabin, supported by a metal stand 24 in. high. The face of the cabinet is fitted with transparent fibestos, which is not subject to breakage like glass. The entire case is practically dust-proof. The operation of the relays can be observed through the transparent cover. If any of the relays are not operating correctly, the cover can be removed and the individual relay replaced readily, as each relay is a standard unit fitted with plug-and-jack connections.

As a means of reducing the chances for crosses in circuits extending underground from the instrument cases to signals and switch machines, each wire is run as a single conductor No. 9 cable, made up with protection including lead sheath and two wraps of steel tape armor. Six such cables are run to each switch machine, four to each three-position signal, and three to each two-position signal. The same type of cable is used for runs to rail connections. This cable is manufactured according to Signal Section Specification No. 14532.

Unusual Aspects for Turnouts

The high signals on this installation are the G.R.S. Type-G, except that Type-D is used for intermediates, and the dwarfs are Type-L. The lamps used in the signals are rated at 10-volt, 18-watt, and are burned continuously from the a-c. supply normally, with storage battery standby.

The high signals and top "arms" of the two-arm signals display three aspects, red, yellow and green. The low home signals governing train movements out of sidings display red, yellow and green. The high signals, which govern either through movements or diverging movements over turnouts, have two "arms." Where the diverging movement is over a No. 20 turnout, the second "arm" is spaced 5 ft. below the center of the top unit. At such a location, the second "arm" displays red or yellow. Where the turnout is a No. 10, the second unit is located 11 ft. below the top unit and displays yellow or purple. The vertical spacing between the light units is the means of conveying information to the engineman as to whether he is to diverge over a No. 20 or a No. 10 turnout. Purple is the standard stop indication color for the third "arm" on interlocking signals on the Missouri Pacific, and it is for this reason that the purple is used instead of the red, as explained in the aspects above.



Relays and batteries as arranged in one of the houses at a field location

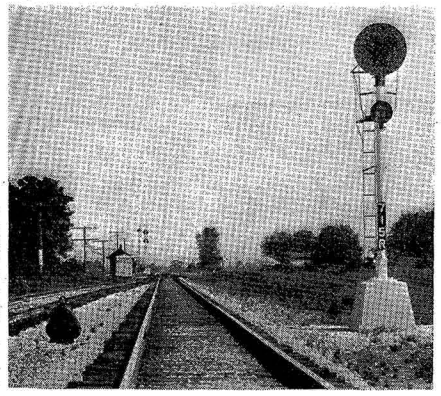
The power switch machines are G.R.S. Model-5D, with dual-control, and are equipped with point detectors. A special feature is that the switch control relay is housed in the case of the switch machine. The switch layout is constructed with 1-in. by 9-in. insulated gage plates on 4 ties, including the one ahead of the points and the first 3 under the points. Fixed rail braces on both sides of the rail on the tie ahead of the point prevent "rolling" of the stock rail. The gage plates on two ties extend under and are attached to the switch machine so as to prevent wear and lost motion. Tie straps bolted to each end of the ties assist in maintaining the relative position of the first 6 ties at a No. 10 turnout and 11 ties at a No. 20 turnout.

As the switch points for the No. 20 turnouts are 30 ft. long, it might be possible to lock a switch with an obstruction anywhere in the half of

the length toward the heel. In order to be sure that the point completes its movement throughout its entire length, a pipe connection, with cranks, is extended from the front rod to a second operating rod attached to the switch 12 ft. from the points. This arrangement assists in throwing the entire switch as a unit without springing the points.

Track Connections

Throughout all track circuits, each rail joint is bonded with two No. 8 BWG Page Armco galvanized bond wires using 9/32-in. single channel pins. No trunking was used on this installation, all of the underground wire runs being in parkway cable made up with a lead sheath, steel tapes and jute covering. An interesting feature is that the parkway bootlegs are located 18 in. from the rail on the gage side. The reason for using this location is to keep the tie spaces clear to permit proper tamping and maintenance of the track. The bootleg outlets are of a type designed for the Missouri Pacific and made by the Western Railroad Supply Company, and consist of a cast-iron box on a pipe riser and a cast-iron flared base. The cable is brought up through the riser, which is equipped with a clamp



Typical arrangement of signals at the end of a siding

to hold the cable in place, preventing mechanical strain on the copper conductor at the soldered connection. The strand is carried into the bootleg through a sleeve 9/16 in. in diameter, threaded to be held in place with insulation in a hole through the side of the box. The parkway cable is soldered to a ⅜-in. Copperweld stranded connection which extends to a plug in the rail.

The track shunt connections at main-line switches each consist of Copperweld stranded bare cable, stapled to the sides of the head block tie about 2 in. from the top edge. Each of these cables consists of seven No. 10 Copperweld wires. The same type of stranded bare cable is used for fouling jumpers.

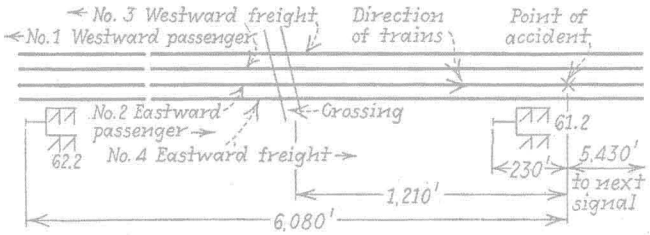
Flashing Light for Train-Order Signal

Under certain circumstances, it may be necessary to issue train orders at Chester effective after trains in either direction pass off of the C.T.C. territory. For this reason, a semaphore type train-order signal was retained in service at Chester. This signal normally stands at clear, displaying a green light at night. In order to prevent any confusion between this train-order signal and the other signals, the lamp in the train-order signal, when lighted, is flashed about 30 times per minute, this flashing being effected by a Peerless flasher relay of the rotating disk inductive type.

The major items of signaling equipment for this installation were furnished by the General Railway Signal Company, and the construction was handled by the Missouri Pacific signal forces, supervised by L. S. Werthmuller, assistant signal engineer, and E. T. Troughten and R. M. Spillman, signal foremen, under the direction of P. M. Gault, signal engineer.

Accident Involving Signals and Train-Stop System

At 7:06 p.m. on July 31, the New York Central's eastbound passenger train First 68, the Commodore Vanderbilt (fast Chicago-New York train) ran into the rear of the eastbound Mercury, No. 76 (streamlined Detroit-Cleveland passenger train) at Rocky Ridge, Ohio, 20 miles east of Toledo. One passenger was killed and several other passengers and employees were injured. An abstract of the report made by the Bureau of Safety, I.C.C., concerning this accident follows:



Track and signal layout in vicinity of accident

In the vicinity of this accident, this is a four-track line on which trains are operated by time table, train orders, and automatic block signals of the two-arm, lower-quadrant semaphore type, supplemented by an intermittent automatic train-stop system. The caution aspect of a signal, green-over-yellow, indicates, "Proceed preparing to stop at next signal; train exceeding medium speed must at once reduce to that speed." Medium speed is defined as "a speed not exceeding 30 m.p.h." Unless the forestaller is operated when passing a signal displaying a caution aspect, a service application of the brakes will be made automatically. A rule reads, "Enginemen must not forestall until after signal indication has been observed and is being obeyed."

Approaching from the west, the tracks are tangent for more than eight miles to the point of accident, and for several miles beyond. The grade is practically level, being 0.04 per cent descending for eastbound trains at the point of accident.

No. 76 was stopped due to striking the front end of an automobile at a grade crossing located 980 ft. west of signal 61.2, the train stopping 6,640 ft. beyond the crossing. On instructions from the conductor, the train was then backed against the current of traffic to a point 230 ft. east of signal 61.2 and 1,210 ft. east of the crossing. While standing at this location, the rear of No. 76 was struck by No. 68, which was reported as moving at not more than 7 or 8 m.p.h.

When No. 76 was making the back-up movement, a flagman was not sent back to protect the train, in spite of