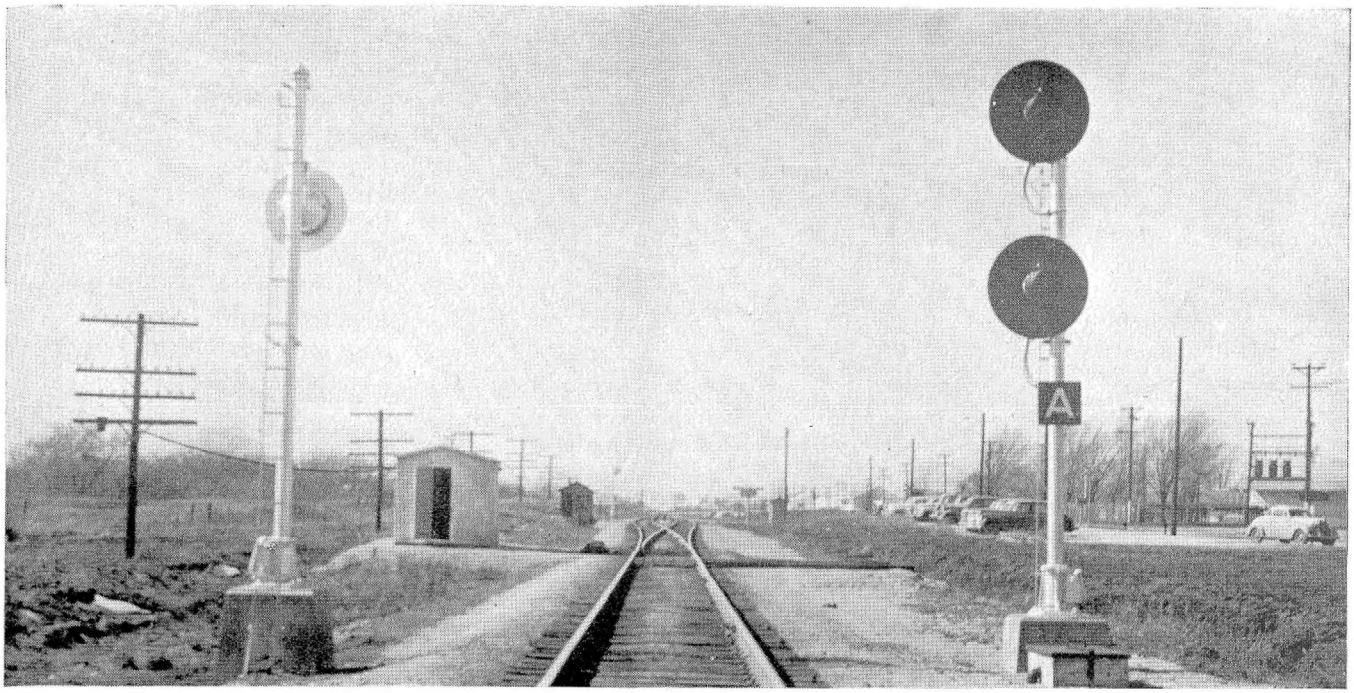


View looking west toward the No. 20 equilateral turnout at East Tulsa

Signaling Saves Time on Frisco

Project on 75-mi. eliminates several sidings, reduces time of freight trains, discards yard limit delays, and includes motor car indicators

As a means of saving train time, the St. Louis-San Francisco has installed centralized traffic control on a 75-mi. bottleneck section of single track between Afton and Tulsa, Okla. At Afton two important lines diverge; one eastwardly through Monett and Springfield, Mo., to St. Louis, and the second northward through Ft. Scott, Kan., to Kansas City, Mo. Two main tracks extend between East Tulsa and Sapulpa, 13.7 mi., and then from Sapulpa two lines diverge, one westward to Oklahoma City, and the other southward to Dallas and Ft. Worth. Thus, the traffic to and from two lines at both ends must be handled over the one single track between Afton and East Tulsa.

Four passenger trains and four scheduled freight trains, in each direction, are operated daily between Afton and Tulsa. About eight extra freight trains are operated daily. Two local freight trains run daily except Sunday. In addition, one through passenger train each way, operated jointly with the Katy, uses the 11.6 mi. of the Frisco between Afton and Vinita, as well as between Afton and St. Louis. Thus, the total number of trains on the Afton-Tulsa section is about 30 to 35 daily. The difficulties of operating trains with minimum delays is increased because trains are bunched in certain periods. For example, nine trains, including three passenger and six freight trains, must be handled during the early morning hours.

The C.T.C. control machine is in the dispatcher's office at Tulsa. The track diagram has lamps which are lighted in the conventional manner to indicate when corresponding sections of the main line are occupied. When a train enters a siding, the dispatcher throws a small toggle switch mounted below the line representing that siding. If it is an eastbound train, he throws the lever to the east, or if it is a westbound train he throws the lever to the west. When the lever is thrown either way, a red lamp is lighted on the line representing the siding. When the train departs, he returns the toggle lever to the center position, thereby extinguishing the track lamp. Thus, these toggle-controlled lamps serve as reminders to the dispatcher when a train is on a siding.

Characteristics of Line

Between Afton and Tulsa, the railroad traverses prairie, with rolling grades ranging up to a maximum of about 1 per cent. The curves are few and most of them are 2-deg. or less, although there is one 3-deg. and two 5-deg. curves at Garnett. For the most part, therefore, the grades and curves do not hinder train operations. The train speeds are limited to 70 m.p.h. for passenger trains; 50 m.p.h. for steam freights; and 55 m.p.h. for Diesel freights. Trains pulled by steam locomotives handle up to about

Typical take-siding indicator

3,500 tons, and by Diesel locomotives up to about 5,000 tons.

Semaphore automatic block signaling was previously in service on this territory and train movements were authorized by timetable and train orders. The passing track switches were operated by hand-throw stands with spring switches at 11 sidings.

Sidings Reduced from 21 to 11

Experience with previous installations on the Frisco indicated that the number of sidings could be decreased when installing centralized traffic control. Formerly, there were 21 sidings between Afton and East Tulsa. As a part of the project, five sidings were removed, namely, at Cort, Nemo, Sunsweet, Howard and Salsman, as shown on the map. Also, the short sidings at Foyil, Claremore, Garnett, Dawson and Bomber were no longer needed for regular service to meet or pass trains. These five sidings were left in place, with hand-throw switches. This left only 11 of the original 21 sidings to be equipped with power switches and C.T.C. controlled signals. Several of these sidings were lengthened so that the capacities of nine sidings now range from 106 to 155 cars, and the other two are 91-car and 98-car. New No. 15 turnouts with 22-ft. points were installed at both ends of these 11 sidings so that trains can enter and depart at speeds up to 25 m.p.h. At the end of double track at East Tulsa, a new No. 20 equilateral turnout was installed, thus permitting train movements in either direction at 50 m.p.h. The new power switch machine and signals at this location are part of the C.T.C. Also at Afton, the C.T.C. includes power switch machines at the junction switch and two switches leading from other tracks, as well as the east switch of a new 127-car siding extending from Vinita to Kahoga on the line toward St. Louis. Thus, in all, the C.T.C. includes 26 power switches with C.T.C. controlled signals.

The siding at Bomber, with a 77-car capacity, is long enough to be used by some shorter trains when making a meet. However, the occasion to use this siding for meets is rare, and, therefore, the hand-throw switch stands were left in place as previously stated. If the dispatcher encounters a special circumstance when he wants an eastbound train to take siding at Bomber, for example, he sends out a control that causes the letter "S" to be displayed in a "take-siding" indicator, which is on a regular mast located 3 mi. in approach to the first switch of the siding, as shown in the sketch, Fig. 2, herewith. Normally this indicator is dark. When controlled, the letter "S" in white is outlined in black on a 12-in. ground glass cover.

Train Time Saved

The centralized traffic control is the means of saving considerable train time, and also increasing the tonnage handled by some freight trains. Previously the siding switches were hand-thrown, and train movements were authorized by timetable and train orders. Now the siding switches are equipped with power machines, and the dispatcher controls these machines, as well as the signals at these switches, to authorize train movements on a minute-to-minute basis, so that meets can be made on close time.

Under the previous operation, a freight train was required to be in the clear on a siding at least 5 min. prior to the time of a passenger train or other superior train. This time is now saved by making close meets. In many instances, the timing is so close that neither train stops. For example, on February 7, eastbound freight train No. 30, with 95 cars, went through three sidings non-stop, at Degroat, Chelsea and Whiteoak, to meet one passenger and two freight trains which did not stop.

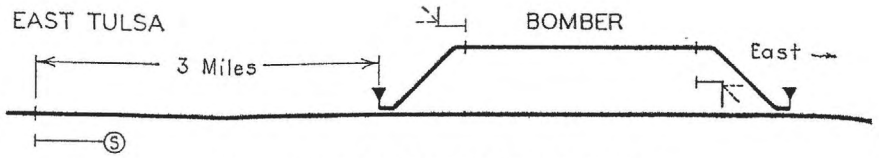


Fig. 2—Plan showing take-siding indicator

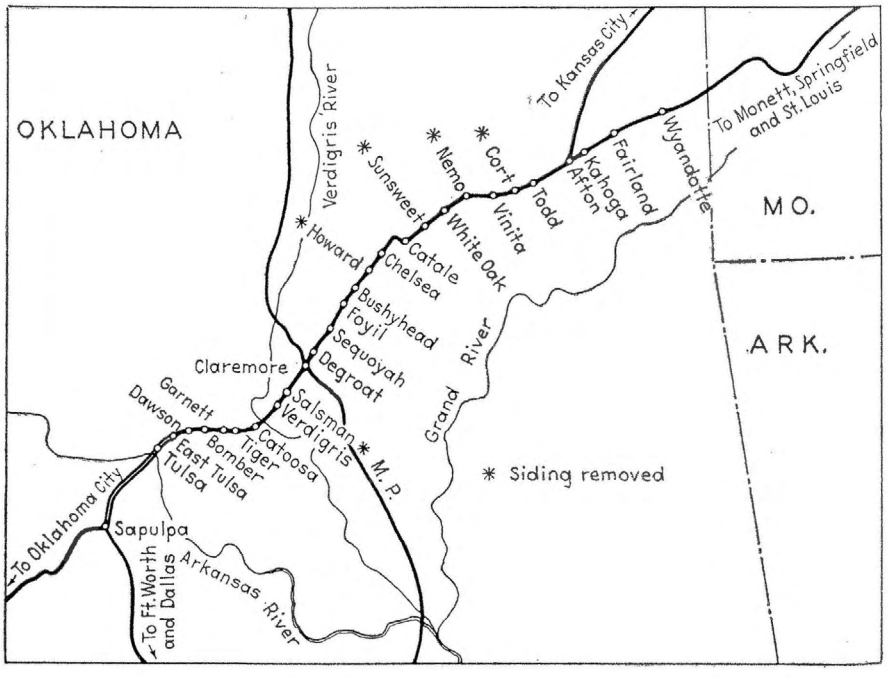
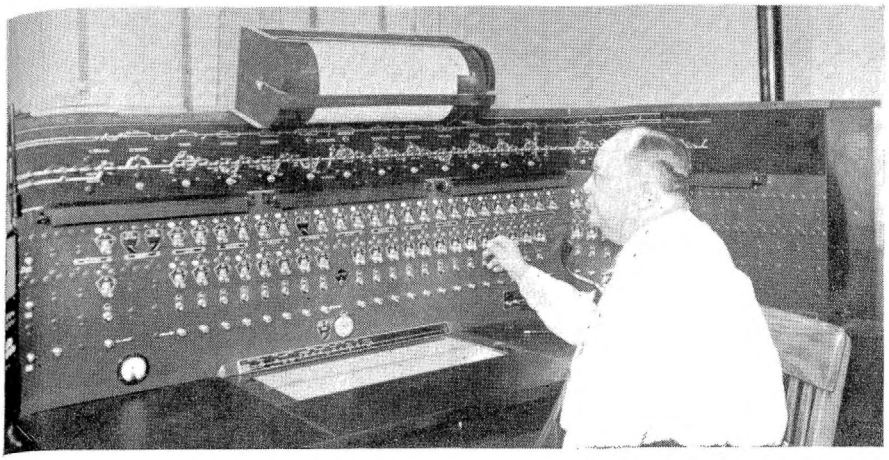


Fig. 1—Map of C.T.C. territory showing locations of sidings



The control machine in the dispatcher's office at Tulsa

The power switch machines, under the control of the dispatcher, eliminate train stops formerly required when trainmen operated the hand-throw stands for trains to enter and leave sidings. As stated by the dispatcher, a long freight train saves 8 to 10 min. when leaving a siding, and perhaps 4 to 5 min. when entering, depending on the local grades. Formerly the trains had difficulty in using some of the sidings, and the elimination of stops when entering and leaving has permitted an increase from 2,900 tons to 3,500 tons in the tonnage handled by certain types of locomotives. As further explained by the dispatcher, all the through freight trains are now making the run in either direction between Afton in an average of about 2 hr. 45 min., as compared with 3 hr. 45 min. previous for fast freights, and 4 hr. 30 min. for slower ones. Time is saved in two ways: (1) by closer meets, and (2) by the facility with which trains enter and depart from sidings.

Also, he said that time waiting in the yards, after trains are ready to go, is saved, because, with C.T.C., he can run a freight on close time ahead of a passenger. For example, on February 3, an eastbound freight train departed from Tulsa at 1:25 p.m., only 35 min. ahead of the "Firefly" passenger train. With the previous timetable and train order operation, the freight train would have been held at Tulsa, thus losing at least 35 min. and maybe more. As it was on the day mentioned, the freight went all the way to Afton ahead of the passenger train.

No Yard Limit Delays

Previously, under the requirements of Rule 93, all trains, other than first class, were required to run at reduced speeds, prepared to stop short of train or obstruction in yard limits, which extended throughout a switching and industrial area from East Tulsa eastward to Rice about 4.5 mi. Compliance with this rule not only handicapped the work of the switching crew which served these industries, but also slowed down the speed of through freights. With the C.T.C., the yard limit boards were removed and, therefore, Rule 93 does not apply. Under C.T.C. operation, the dispatcher can authorize the switching crew to make moves on the main track as required, and when they are in the clear and locked on some spur, the through trains are authorized by signal indication to operate at maximum permissible speed with safety, because the switching crew cannot open a switch or foul the main track.

At the clearance point on each hand-throw turnout, there is a three-aspect dwarf signal. When the electric lock is released and the switch is thrown, the signal takes over line control circuits to display aspects depending, not only on the switch position, but also on track occupancy. On industrial tracks where the grade is descending toward the main track, there is a hand-throw derail on the turnout at the clearance point. Each such derail is equipped with a circuit controller.

Tail Track Signal

At Afton, the inside end crossover to the main line is hand-operated, and is normally lined for movements to the main line. This inside track is used as a tail track when switching the yard and, when so used, requires that this inside switch be lined for straight track.

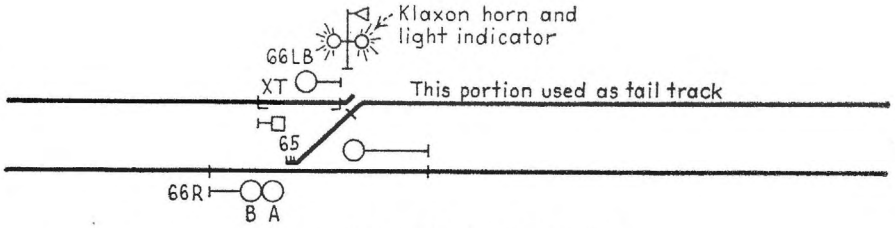
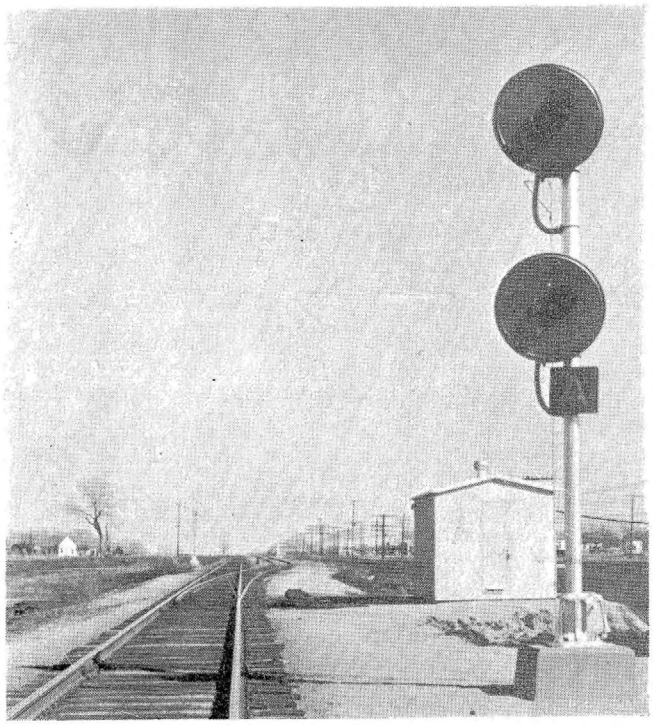


Fig. 3—Tail track signals at Afton

A special white indicator light is



A typical power siding switch layout with signals and relay house

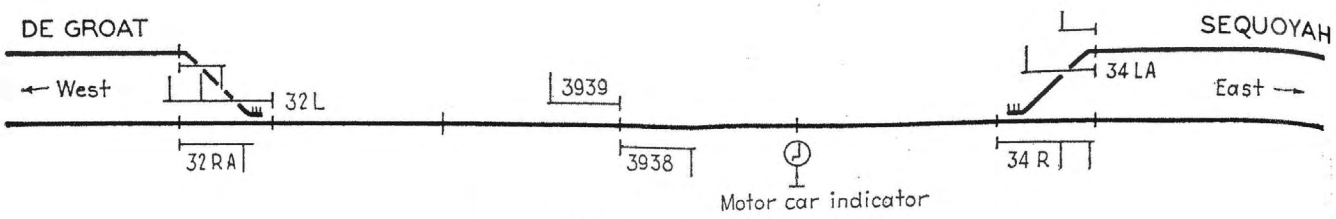


Fig. 4—Plan showing motor car indicators

provided at this switch, together with a Klaxon horn. When the dispatcher wishes to move a train into the yard through switch 65 reversed, he codes the line-up desired, which causes the white indicator light to be extinguished and the Klaxon horn to sound for about 15 sec. This warns the yard crew to clear this track and to line the switch for crossover movements. After the inside switch has been lined for movements to the main line, and if track circuit XT is unoccupied, signal 66RB or 66LB will display a proceed indication. A similar arrangement is in use at the west end of Kahoga siding.

Motor-Car Indicators

At power switch locations at the ends of sidings, and at certain other intermediate places, there are motor-car indicators which provide information concerning the approach of trains, for the benefit of men operating motor cars. At the ends of sidings, these indicators are the lamp type made of old semaphore lamps, using 13.5-volt 3.5-watt lamps. The lens is directed toward the track so that a man can see the light as he passes on his motor car.

The lamp is normally lighted from a.c. through contacts of the signal line relays. For example, as shown in Fig. 4, the indicator at the west end of Sequoyah is controlled through a front contact of the eastward and westward line relays. If the dispatcher lines up eastward signal 32RA at Degroat, this opens the westward line circuit, thus releasing the line relay at the west end of Sequoyah. The circuit for the lamp in the indicator is opened, thereby giving warning that an eastward lineup is in effect. This lamp stays dark until the train passes Sequoyah.

If westward signal 34LA at Sequoyah is cleared, the motor-car indicator at this location continues to stay lighted, except when a westward train is approaching this signal, but when the westbound train passes that signal, the indicator is extinguished. When the rear of the train passes intermediate signal 3939, the directional stick relay is picked up, thus establishing a feed east on the line circuit to the line relay at the west end of Sequoyah, thereby causing the motor-car indicator to be lighted.

Motor-car indicators are provided also at various places between stations where the view of approaching trains is restricted. At these outlying locations, there is no a.c. power to feed indicator lamps, and, therefore, the indicators are the semaphore type with 670-ohm coils. Referring again to Fig. 4, a semaphore-type indicator is located midway between the west end of Sequoyah and signal 3938. At the indicator location, there is a 78-ohm DNL relay in series with the eastward two-wire APB line circuit. A front contact of this DNL relay is included in a circuit which connects the 670-ohm coil of the indicator across the two wires of the westward APB line circuit.

When the dispatcher clears the westward signal 34L at Sequoyah, this opens the eastward line circuit, thus releasing the DNL relay, thereby releasing the indicator. When the westward train passes signal 34L, the indicator stays released until the train passes Degroat. If the dispatcher clears eastward signal 32R at Degroat, this opens the feed east to the westward two-wire line circuit, thus removing energy from the coil of the indicator.

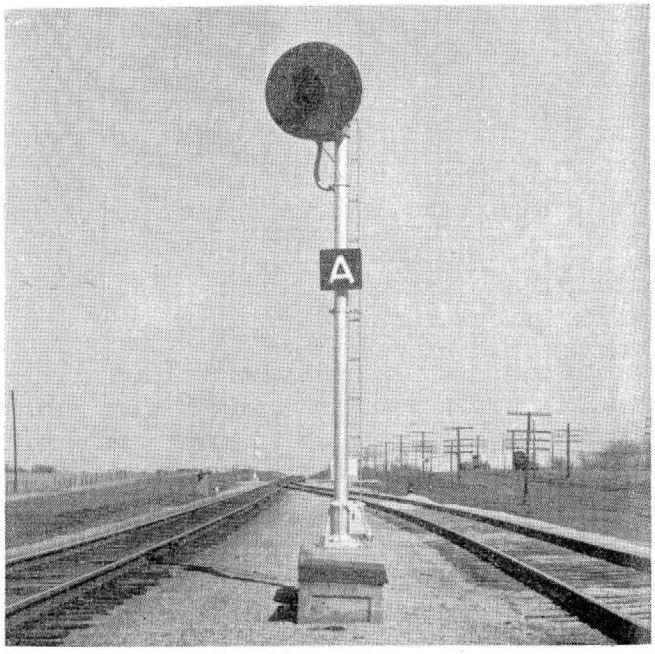
Where an indicator is located at a single intermediate signal, the control for the indicator can be taken through a front contact of the pole-changing signal-repeater relay, thus eliminating the DNL relay. At a double-intermediate location, both controls can be through front contacts of the pole-changing relays. The two two-wire line circuits are used also in the control of electric locks at outlying hand-throw switches. The station-to-station track-occupancy lamps on the C.T.C. machine are controlled through line codes which are controlled through front contacts of the line relays which control the station-departure signals. Thus, no extra line wires are required to check station-to-station track occupancy, except where more than one pair of intermediate block signals are used between sidings.

Power Supply

From various towns, 440-volt a.c. is fed for 7 to 10 mi. in both directions. From the end of one such feed to the end of the next, there is a gap of the length of a track circuit, thus saving line wire. The 440/110-volt line transformers at all locations are rated at 500 va., thus being interchangeable in case of replacements. These transformers are the air-cooled type made by the General Electric Company. The 110-volt transformers feed through low-voltage transformers to operate the local signal lamps. The rectifiers operate on 110-volts a.c.

At each siding location, there is a

(*Continued on page 373*)



A siding thrown over to 19-foot centers to allow clearance for the main-line signal

each reel was removed, a steel bar was inserted through the center of the reel to act as an axle, and the reel was jacked up with a pair of Simplex reel jacks until free to turn. The free end of one cable was then hauled aboard the cable boat, and made fast to the horizontal reel on the vessel. This reel was then set in motion and the cable was all reeled onto the boat. This operation began at 10:30 a.m. and was completed at 12 o'clock noon.

The trip from the dock to the point of work—about four miles—required 45 minutes, because the boat was sailing against a heavy tide and because of a 10-min. delay at one drawbridge.

As soon as the cable boat reached the point of work, the Captain investigated the depth of water near each side of the river, and then proceeded to a point near the west bank and anchored. A stout line was passed ashore and, after being passed through a snatch block, which was secured on the shore, was then returned to the boat. One end of this line was made fast to the free end of the cable, while the other end was passed around one of the power-operated capstan winches on the boat.

Using the capstan as the pulling power, the free end of the cable was hauled ashore at 1:00 p.m. and made fast. The boat then weighed anchor and moved rapidly across the river, paying out the cable over the port side.

When close to the east bank, the boat was again anchored while the section of first length of cable remaining on the reel was removed. This was done with the aid of the boat's derrick, and the cable was coiled across the bow of the vessel in the form of a large figure eight. A line was made fast to the pulling eye on this end of the cable and was then passed ashore where it was attached to the frame of a signal department truck. The truck, moving slowly, then pulled the end of the cable ashore, completing the operating at 2:00 p.m.

The LIDIV then returned to the west bank to start the laying of the second length of cable. By this time, the rapid tidal current had slackened considerably and less difficulty was experienced in maneuvering the boat. The second cable was laid in only 35 minutes, and the entire operation was finished at 2:55 p.m.

Signal department activities on the Erie are carried out under the general direction of W. S. Storms, signal engineer, Cleveland, Ohio. J. H. Storms, signal supervisor, S. D. Richardson, assistant signal supervisor and R. S. Wharton, construction foreman were in direct charge of the cable laying work described above.

C.T.C. on the Frisco

(*Continued from page 370*)

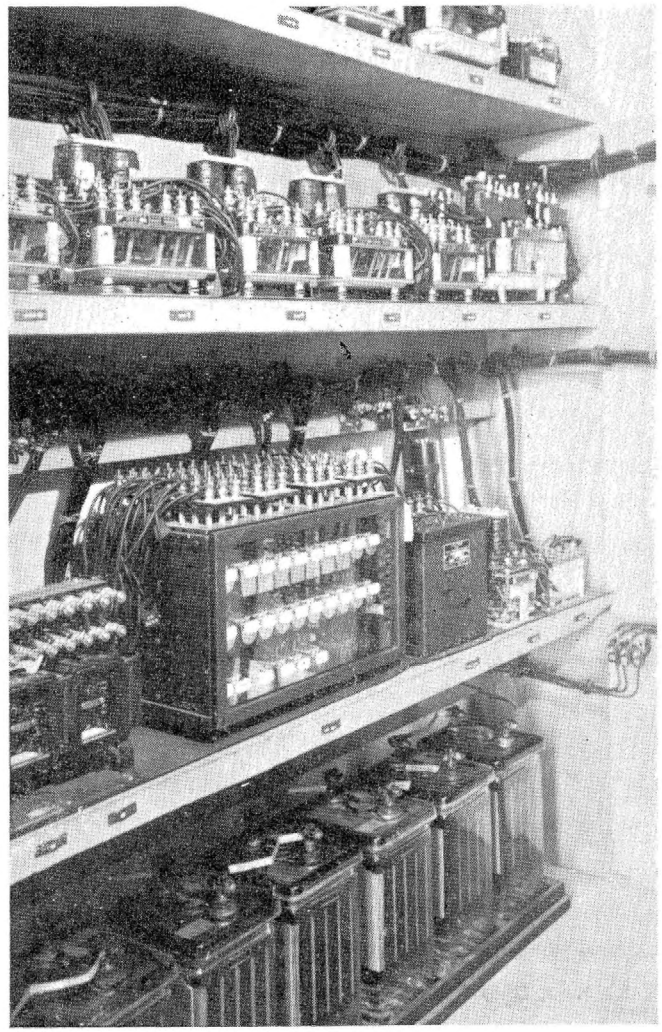
set of 13 cells of 80-a.h. Exide lead storage battery which operates the switch machine. Eight of these cells also feed the line code equipment. Also at each switch and at each intermediate signal, there is a set of 5 cells of 60-a.h. battery to feed the line circuits and to serve as a standby for the lamp feed. Each track circuit is fed by two cells of Edison 500-a.h. primary with a rectifier in multiple to take all but about 12 m.a. of the load.

A concrete house, 8 ft. by 10 ft., is located at each field station power switch. These houses were wired complete with relays and other equipment in place at the shop in Springfield. The relays and code equipment are on shelves on the side walls. On the rear wall is a ¾-in. plywood panel on which are mounted the terminals, arresters, transformers, rectifiers and power-off relay. Raco Clearview type arresters are used on line circuits, and Model-12 Western Railroad Supply arresters on the track circuits.

Also on this board is a special case with levers which are similar to those on the dispatcher's machine. If the code line fails, a man can be sent to each field station to use the small panel to control the switch and signals locally. In order to cut a field panel in service, a lead seal must be broken to operate a master lever.

The signal line wires are on the lower arm on the poles used also for communications. These signal wires are all provided with weatherproof covering. The four signal wires are No. 12 Copperweld, the two code wires No. 8 Copperweld and the two a.c. power wires are No. 8 solid copper. The underground cables are Kerite, using a seven-conductor No. 14 from each concrete house to a signal; five single-conductor No. 9 and a seven-conductor No. 14 to each switch machine, and single-conductor No. 9 for track connections.

This C.T.C. project was planned and installed by signal forces of the St. Louis-San Francisco, under the direction of R. W. Troth, superintendent of communications and signals, the major items of signaling equipment being furnished by the Union Switch & Signal Company.



Relays, coding equipment and batteries in house at one typical siding