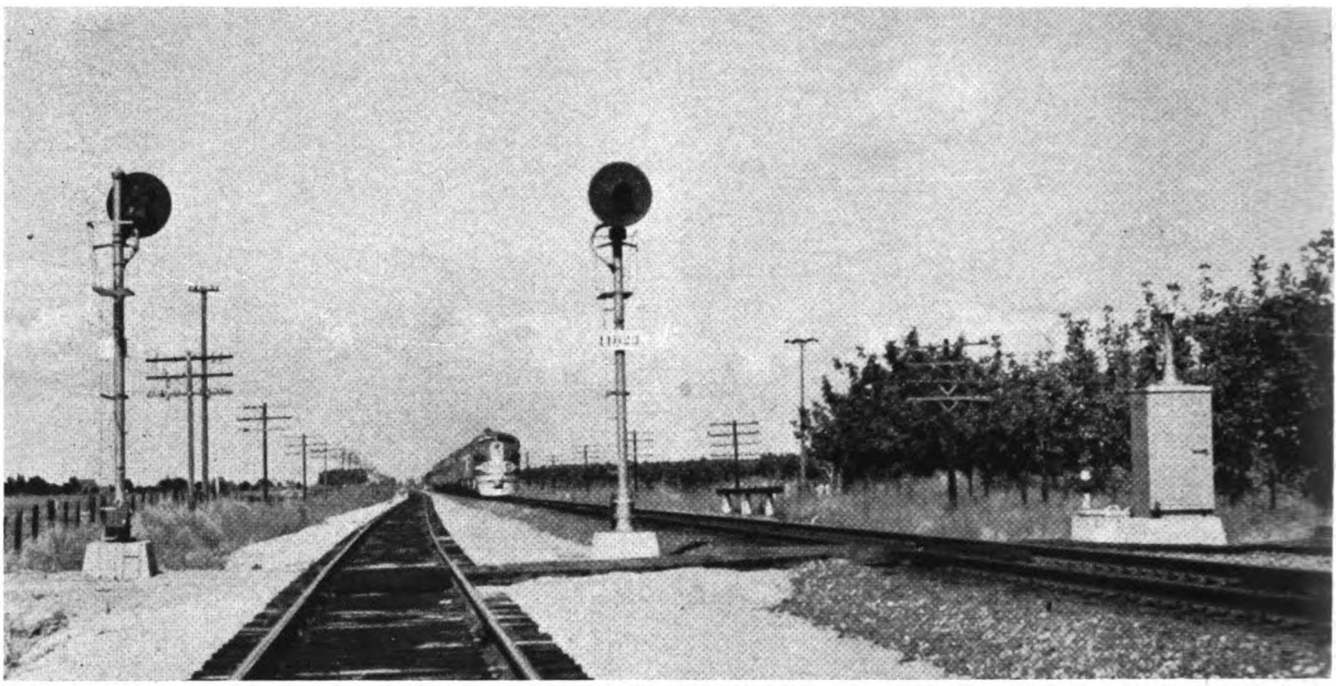


A special feature on the signaling is a pair of signals located at the center of the length of each siding

How to Make Non-Stop Meet with CTC

Signaled sidings about two miles long, with simple aspects to direct trains to utilize No. 20 turnouts efficiently at 40 mph, are aids in making non-stop meets on 234 miles of busy single track on Santa Fe

TO SAVE TRAIN TIME and increase track capacity, the Santa Fe has installed centralized traffic control on 124 miles of heavy traffic single track between Fresno, Calif., and Stockton. The power switches and signals for authorizing train movements are controlled by a CTC machine in the dispatcher's office at Fresno.

Formerly train movements were authorized by time-table and train orders, with automatic block signaling as protection. Spring switch mechanisms were in service at both switches at all the principal sidings, so that trains could depart without stopping. Thus all acceptable methods of moving trains, other than CTC, were being utilized.

This Fresno-Stockton section is an important part of the Santa Fe 2,547-mile route between Chicago and San Francisco; Stockton being 86 miles from San Francisco. This section is also a part of the Santa Fe route between San Francisco and Los Angeles.

Eight through passenger trains and about 14 through freights are operated daily on this Fresno-Stockton section. Extra trains, and a local freight each way daily except Sunday, increase the total to 20 to 24 trains daily. This section is in the heart of the famous San Joaquin valley, where thousands of carloads of potatoes, grapes, raisins, oranges and other vegetables and fruits are shipped each season, as well as cotton, livestock and other products.

Benefits of CTC

The completion of this CTC on 124 miles between Stockton and Fresno, together with 107 miles of the same type of construction between Fresno and Bakersfield in 1953, makes a total of 232 miles of this arrangement of long sidings and CTC on single track. These new facilities have helped to improve on-time performance of passenger trains and have reduced delays to freight trains on the road. Also under the CTC, freight trains can be directed to leave yards promptly when ready to go, rather than waiting for orders. The time thus saved is considerable, although it does not become obvious in comparing present operation with train sheets of previous operation.

As explained by the division superintendent, S. Rogers, the new sidings and CTC have been effective, in general, in saving about two hours for each freight train, either way between Bakersfield and Fresno, as well as saving about two hours for each freight train between Fresno and Stockton. If passenger trains are received behind schedules, they can be given preference to help make up time. On the Bakersfield-Stockton section there are 5 meets daily between passenger trains. On an average day there may be about 15 meets between passenger trains and freights, and as many as 13 meets between freights with freights. About 50 per cent of these are running meets with neither train coming to a stop.

Light Grades and Curvature

Between Fresno and Stockton the railroad traverses open level terrain, with very light grades ranging up to about 0.3 per cent. The curvature is very light, with

sections of tangent 10 to 14 miles long. Of the 21 curves in the 124 miles, nine are 30 min.; four are 1 deg., seven are 2 deg., and one is 3 deg. Passenger train speeds, which are 95 mph maximum, are reduced to 75 mph on the 2-deg. curves, and to 55 on the 3-deg. Freight speeds, which are 60 maximum, are reduced to 55 mph on the 3-deg. curve. Because of the light grades and curvature, trains can accelerate quickly, and can maintain maximum permissible speeds for long distances.

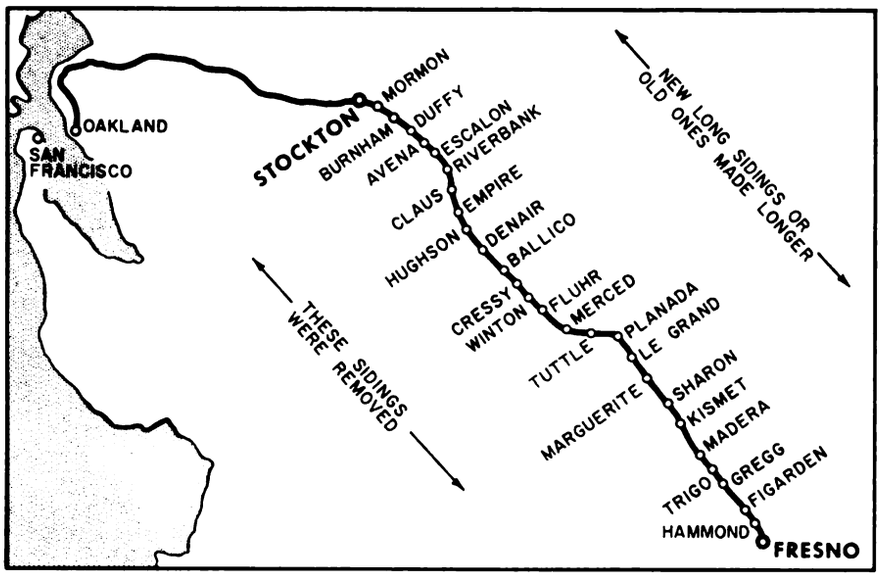
Long Sidings Big Success

The special Santa Fe feature of this project is the use of long sidings, about 2 miles long, which permit more meets to be made without either train stopping. Other factors, contributing to this objective, are long turnouts with special signaling to direct trains to approach and enter (as well as leave) these sidings at the speed for which the turnouts were designed—40 mph—as will be discussed later.

Previously, in this 124 miles, there were 25 sidings, most of which were about a mile long with a capacity of 80 to 96 cars, plus locomotive and caboose. Thirteen of these sidings were extended to about two miles in length (173 cars), at Figarden, Gregg, Madera, Kismet, Le Grand, Planada, Merced, Fluhr, Ballico, Denair, Empire, Riverbank and Escalon.

At Sharon, the old siding was extended to a total of 11,280 ft. with a crossover at the center. At Merced the previous siding was extended to a total of 11,350 ft. At Riverbank, where freight crews change, the previous 8,430-ft. siding on the north side was left as it was, and a new siding about the same length was built on the south side. At Duffy a new 2-mile siding was built. At Mormon, just east of Stockton, the previous second track was extended east 13,200 ft. with two crossovers 8,400 ft. west of the new east switch, thus forming more second track as well as a long siding.

Previous sidings, each about 6,000 ft., were removed at Marguerite, Cressy, Avena and Burnham. Previous 6,000-ft. sidings at six locations were removed, except for use as spurs or as house tracks, at Hammond, Trigo, Tuttle, Winton, Hughson and Claus. Thus in addition to the two extra long sidings —at Sharon and Merced—there are now 13 sidings, each about 2 miles long in the 124 miles between Fresno and Mormon, near Stockton.



The turnouts are designed so that trains can enter sidings at speeds up to 40 mph

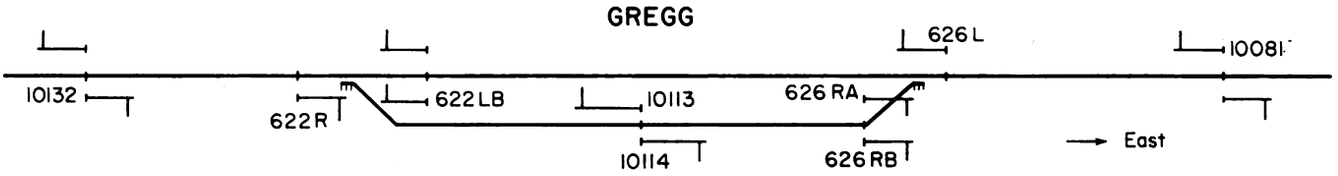
High Speed Turnouts

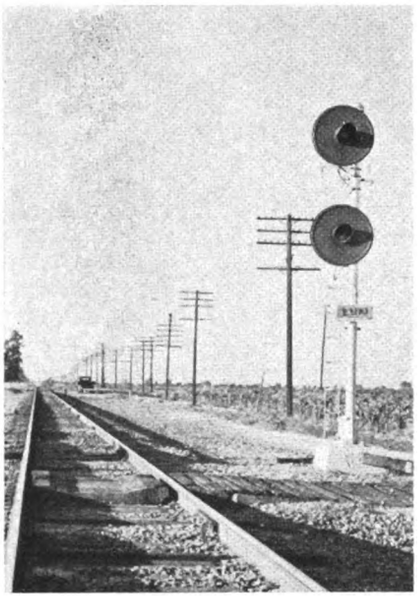
In order to increase the speed at which trains can enter and leave sidings, new No. 20 turnouts were installed at the ends of all these long sidings and at crossovers, that are now equipped with power switch machines in the CTC system.

To provide clearance for the signal masts between the main track and a siding, the Santa Fe continued the tangent through the frog to a point 403 ft. from the toe of the frog to a point of spiral of a 1-deg. 30-min. curve, with spiral lengths of 60 ft. This alinement beyond the 1-deg. 30-min. curve, consists of a tangent about 100 ft. long which brings the track centers back to 14 ft. This construction incidentally reduces the swaying of cars when going through these turnouts, because the long tangent allows sufficient time for car springs to react and come to rest.

Signals for 40 mph

The next point of interest is that the Santa Fe has a special arrangement of signals and simple aspects that direct enginemen to bring their trains up to and through a turnout at 40 mph, rather than at some slower speed. At Gregg, for example, with the siding unoccupied, when the dispatcher sends out a control for a westbound train to enter this siding, the switch is reversed and westward signal 626L displays the Diverging-Clear aspect. red-over-green, and the dis-





Advance aspect on "distant" signal

tant signal, 10081, displays the Advance aspect, yellow-over-yellow.

At the middle of the siding is an automatic block signal for each direction; signal 10113 being the westward signal. As the westbound train pulls into Gregg siding, this automatic signal 10113 displays the Approach aspect, yellow, leading up to the Stop aspect, red, on leave-siding signal 622LB. Thus the engineman has complete information to safely bring his train up to and through the turnout at 40 mph. Each of the 2-mile sidings is long enough for an engineman to pull his entire train into a siding at that speed, and still have enough track length in which to stop.

In the meantime, the dispatcher can bring an eastbound train up to Gregg for a close meet. He controls eastward signal 622R to display the Approach aspect, yellow, and distant signal 10132 to display the Advance aspect, yellow-over-yellow. Thus the eastbound train is brought up to signal 622R at medium speed and continues toward signal 626RA. In the meantime, as soon as the westbound train clears the east switch it is placed normal, and signal 626RA is cleared for the eastbound train, so that train can go through at accelerating speed. As soon as this eastbound train clears the west switch, it is placed reverse, and signal 622LB is cleared for the westbound train to keep right on going out through the west end switch. Thus, in this Santa Fe arrangement, long sidings, high-speed turnouts, and complete but simple signaling, are coordinated so that approximately 80 per cent of the meets between opposing trains are made with neither train being required to stop.

Two Trains on a Siding

Another important advantage of a long siding, with signaling such as at Gregg, is that, when necessary, it can be used by two trains, while a third train passes. For example, a leading westbound train enters the siding and stops short of the leave-siding signal 622LB, with its rear west of signal 10113, which displays red. Then westward entering signal 626L can be cleared to display the Diverging Approach aspect, red-over-flashing-yellow, which directs the second westbound train to enter the siding and stop short of signal 10113.

At Sharon, where the siding is 2.7 miles long, there is a crossover between the main track and siding at the center of the length of the siding. In this arrangement, a westbound train can be directed to enter the east end of the siding, and pull on down to the west end, to stop short of leave-siding signal 596LB, with its rear west of signal 598R at the crossover. Then an eastbound train can be directed to enter the siding at the crossover and stop short of leave-siding signal 602RB. After another train passes on the main track, the leave-siding signals can be cleared for the two trains to depart promptly.

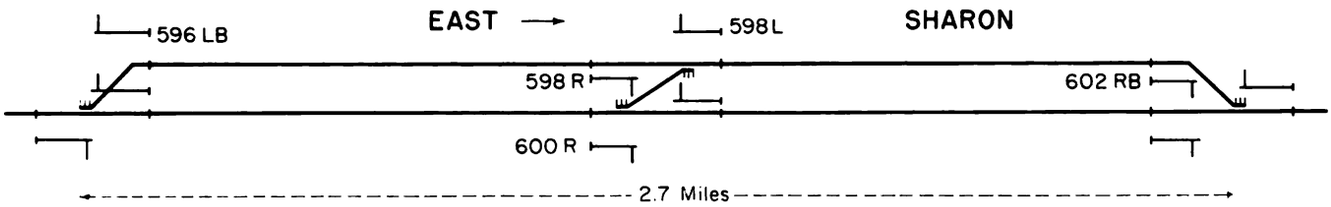
Signals and Signal Aspects

The signals on this project are the searchlight type, the H-5 being used for all single-unit signals, and as the top unit for two-unit signals. On two-unit signals where the lower unit can display yellow or green, this unit is the H-2 type. (No. HC-33 on new job.) All signals on this installation are high signals (no dwarfs). The aspects use only the three basic colors, red, yellow and green. Ordinarily a signal displays only one light, such as green for Clear; yellow for Approach; or red for Stop. The second light appears only when needed to form part of an aspect, other than the three named above. In the yellow-over-yellow aspect, if one yellow lamp burns out, the single remaining yellow is more restrictive. In the red-over-flashing-yellow aspect, if the flasher fails to operate, the red-over-steady-yellow is more restrictive. In signals arranged to display the red-over-green, and red-over-yellow aspects for diverging movements, if the red burns out, a relay operates to extinguish the green or yellow, and unless this relay is functioning, the top unit cannot clear from the Proceed or Approach aspect for straight-away movements.

Also Automatic Train Stop

Another special feature is that an automatic train-stop system, of the intermittent inductive type, forms a part of the signal protection on this territory. A wayside inductor is located on the ends of long ties at the right of the track about 80 ft. in approach to each main track signal.

On each diesel locomotive the train-stop equipment includes a receiver which is mounted on the



rear journal box on the front truck. The center line of the receiver is 25⅝ in. from the gage of the rail, so that it rides directly over the center line of the wayside inductors, with a vertical clearance of at least 1 7/16 in. When a signal is displaying the clear aspect (high green), the corresponding wayside inductor is controlled so that it makes no change in the locomotive apparatus as the locomotive passes the wayside inductor. However, if the signal displays any aspect other than Clear, the train-stop equipment will function to apply the brakes automatically, if the enginemen does not "acknowledge" as he approaches and passes over the wayside inductor.

Yard Track Indicator

A yard track indicator at the east end of Mormon is used to direct train crews which track they are to pull in on. A similar indicator is used at each end of Riverbank yard, where crews are changed. Each yard track indicator consists of an assembly of electric lamps which can be controlled remotely, from the yard office, to display digits corresponding to yard track numbers.

Motor Car Indicators

At the end of each siding and at each intermediate signal, there is a device, known as a motor car indicator, by means of which the men using motor cars can check to determine whether trains are within certain limits shown in figures on the plate attached to the pipe post under the indicator head as shown in one of the pictures herewith. Each indicator circuit has two line wires which break through contacts of all track relays for the limits of its control. These motor car indicator circuits are separate and independent from signal line control circuits. A motor car set-off platform is located at each end of every siding and at each intermediate signal.

Protection at Many Crossings

Numerous highways cross the tracks at grade, and therefore automatically controlled wigwags, flashing lights and, at some crossings, gates, are in service at 75 crossings between Fresno and Stockton. Because of the numerous extra track circuits required for controlled points and for crossing protection, conventional track circuits using DN-22BH relays and Edison storage batteries, rather than coded track circuits, were used on the CTC as a whole.

High Strength Code Line Wires

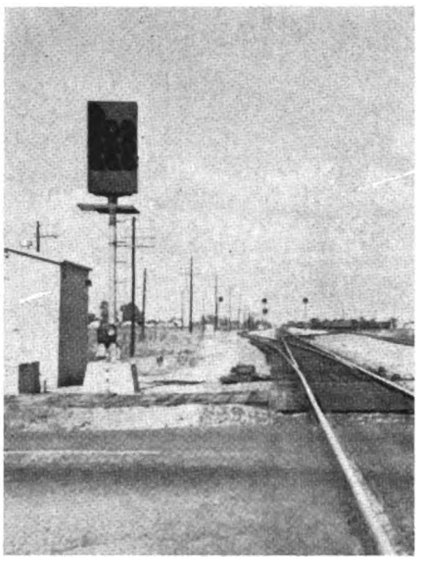
The signal wires are on a 10-pin, bottom arm on the pole line used also for communications line wires. In accordance with Santa Fe practice the CTC code line circuit is on two No. 6 Copperweld special weatherproof line wires. This large sized wire, with extra tensile strength, is used to prevent failures due to storms. The Santa Fe thinking is that CTC must function with complete reliability because the entire operation of the railroad depends on the CTC. The local line circuits are on No. 10 Copperweld; and the 110-volt a.c. is on No. 6 copper, all these wires having polyethylene covering.

Except for the normal supply of a.c. to signal lamps, flashing light signals and gate-arm lamps, all signaling equipment on this project operates on d.c. from storage batteries which are on floating charge from Fansteel selenium rectifiers. The batteries for switch machines, line circuits and track circuits in the CTC are the Edison nickel-iron type, and the batteries for the flashing-light signals and gates at highway crossings are the Exide lead-acid type.

If the commercial a.c. power fails, at Fresno, an a.c. 5-kw 110/220-volt gas engine driven Onan generator starts automatically to take over the a.c. office equipment load including carrier. At field carrier locations a 1-kw Onan gas engine generators, manually started, take over the a.c. load.

This project was constructed by Sante Fe signal forces. One crew did the pole line work; one crew dug the trenches and installed the buried cables; one crew set the concrete foundations and erected the signal masts with ladders and heads in place; one gang installed the aerial cables and power supply connections; another gang hooked up the cables; one gang installed the switch machines and switch stands at hand-throw switches.

Each gang lived in highway type house trailers that were moved along from town to town to keep close to work under way. The pole line gang had a four-wheel drive truck, known as a power-wagon, which could haul as many as 10 reels of line wire at one load. When stringing line wire, as many as four payout reels were mounted on this truck, and moved along to pay out the wire. This crew as well as other crews were equipped with conventional highway trucks and station wagons to transport men and materials.



Yard-track indicator at Mormon

"Clear" on motor-car indicator

This signaling project was planned and installed by Sante Fe forces under the general jurisdiction of G. K. Thomas, system signal engineer, and under direct charge of E. R. Fraschiseur, signal engineer, Coast Lines. The major items of signaling equipment were furnished by the Union Switch & Signal Division of Westinghouse Air Brake Company.