West end of siding at Marne, showing power switch machine, signal, and motor car indicator

# C.T.C. on Sunset Route

## A 50-mi. single track project between Los Angeles and Colton connects with previous 72 mi. installation to afford train operation by signal indication on an operating engine district

THE Southern Pacific has installed centralized traffic control on 50 mi. of single track between Colton, Cal., and Alhambra, near Los Angeles. This project connects at Colton with an installation completed in 1944 between Colton and Indio, 72 mi. so that all of the single track on the entire engine district of 122 mi. is now equipped with power switches and signals for authorizing train movements under the direction of the dispatcher at Beaumont. This division is just east of Los Angeles on the 2,497-mi. Sunset Route between New Orleans and San Francisco.

From Los Angeles, the line is double track 6 mi. to Alhambra, and single track from there east. From Alhambra at elevation 459 ft., the grade is rolling and in general descending for 9 mi. to El Monte, from which point the grade is rolling and general ascending at up to 0.6 per cent for 44 mi. to Colton. From Colton, at 964 ft. elevation, the grade ascends eastward at about 1.5 per cent for 23 mi. to Beaumont, at an elevation of 2,559 ft. East from Beaumont, the railroad descends at about 1.9 per cent for 20 mi. to Palm Springs and from there to Indio, 28 mi., the line descends eastward at rates varying between 0.4 and 1.8. Indio is 20 ft. below sea level. The operating problems on the Colton-Indio territory were discussed in an article in the February, 1945 issue.

Switching lines to Los Angeles harbor and numerous industrial areas branch off from the yard at Aurant which is just west of Alhambra. Therefore, in numerous instances, eastbound through freight trains pick up cars at Aurant, and westbound trains may set out cars at this yard. In order to facilitate

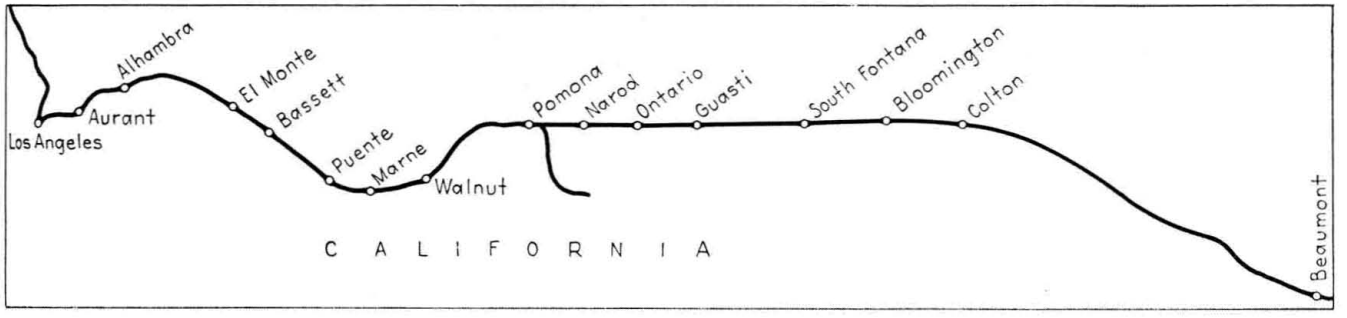



Fig. 1—Map of Southern Pacific C.T.C. territory between Los Angeles and Colton

these moves, the new C.T.C. includes two crossovers between main tracks at M.P. 486 and one such crossover at the Aurant yard office at M.P. 487. Signals are provided to operate trains in either direction on both tracks of the double track between M.P. 485.7 and the end of double track just east of Alhambra.


**Derail and dwarf signal on industry spur**

Also in addition to the switch at the end of double track at Alhambra, the C.T.C. includes power switches and dispatcher controlled signals at both ends of 11 sidings between Alhambra and Colton. The capacities of these sidings range from 71 cars to 136 cars.

At Pomona, the siding is 15,400 ft. long with a pair of crossovers at the center connecting with the main track so, that in effect, there are two independent sidings at this station.

### Through Trains and Locals

The traffic on this Colton-Alhambra territory includes 10 passenger trains and about 18 through freight trains daily. A local freight train, operated each way daily, makes numerous switching moves at various stations such as Walnut, Pomona and Ontario where fruit and other agricultural products are loaded. Extra switching moves are made at Kaiser and Fontana where connections are made with tracks leading to steel mills. The local freight train also makes a run each day down and back over the branch line from Pomona to Chino.

Therefore, this 50 mi. of single track between Alhambra and Colton handles rather heavy switching operation in addition to about 25 to 30 through trains daily.

### Control Machine at Beaumont

When installing C.T.C. between Colton and Indio in 1944, the control machine was located at Beaumont, 23 mi. east of Colton. The additional C.T.C. between Colton and Aurant, completed in 1949, is controlled by a section added to the previous machine at Beaumont. The controls and indications are handled over one two-wire line circuit, which in the section between Beaumont and Aurant is cut into three independent sections by means of carrier control apparatus so that outgoing control codes or incoming indication codes can be handled simultaneously to or from each of the three sections. The "A" carrier section, between Aurant and Pomona, uses 12.8 kc. for controls and 20 kc. for indications. The "B" carrier section between Pomona and Colton uses 15.3 kc. for controls and 21.6 kc. for indications.

A special feature of this C.T.C. project is that in an instrument house at the end of each siding, there is a small control panel with a switch lever and a signal lever, as well as a master lever which is normally sealed in the out-of-service position. In case of C.T.C. code line trouble or other emergency, train operation can be carried on as usual by C.T.C. control by placing a man at each instrument house to operate these levers under the direction of the dispatcher.

### Track Circuits on Sidings

As part of the improvements, the sidings were lengthened, and new No. 14 turnouts were installed. The sidings are equipped with track circuits. When a power switch is reversed and a signal is cleared for a train to enter, the aspect is red-over-green, to enter a siding that is not occupied; or red-over-yellow to follow a leading train which is occupying the siding. When the aspect is red-over-green to enter an unoccupied siding, the distant signal displays yellow for Approach if there is a long-range sighting distance to the station-entering signal. However, in these locations where this distance is short, the signal in approach is equipped to display the yellow - over - green aspect. This gives an engineman advance information so that he can run his train up to and through the turnout at the speed for which it was designed, thus saving time as compared with approaching prepared to stop.

As applying to two-unit signals such as station-entering signals, an interesting practice on the Southern Pacific is that the lower unit is not lighted with a green or yellow in the top unit for a through move on the straight main track. The Southern Pacific reasoning is that a clear

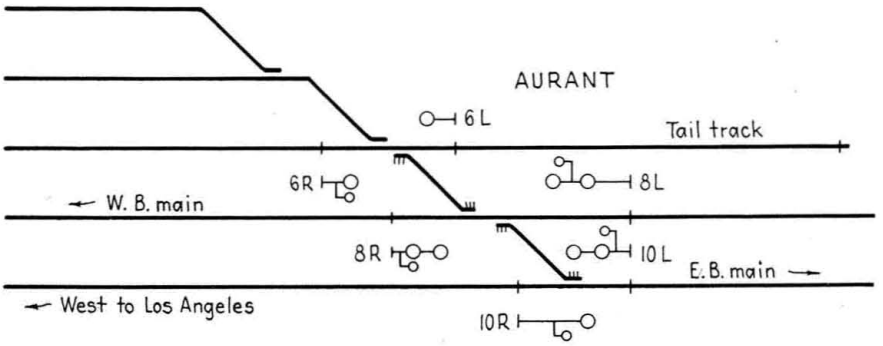



**Fig. 2—Layout at Aurant**

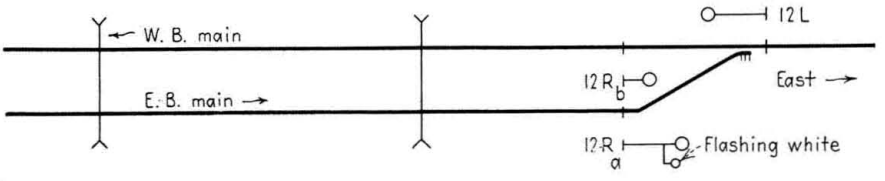



**Fig. 3—Flashing-white aspect on signal 12Ra**

aspect should not include red, because an engineman might see the red first before he saw the green or yellow and thus cause confusion in his reactions. The lamp in the lower unit is lighted in combination with that in the top unit only when a diverging route is lined up, or as a red-over-red for Stop. The lower unit will be lighted red if the mechanism of the top unit is in the green or yellow position and its light is out.

### Signal Protection at Hand-Throw Switches

The hand-throw main track switches leading to spurs are each equipped with an electric lock. At the clearance point on the turnout, there is a hand-throw derail and a dwarf signal which is normally dark. A telephone at each switch is connected to the dispatcher's circuit.

When a train on a spur is ready to occupy the main track, the conductor telephones to the dispatcher to determine when the main track is to be available. Then when the conductor opens the door of the lock, circuits are completed to check signals and track occupancy, and these checks, with a control code sent out by the dispatcher, release the lock. These circuits are explained in detail with diagrams on page 99 of Railway Signaling for February, 1945. When the switch and derail are reversed, and if the main track is unoccupied, the dwarf signal on the turnout displays a yellow aspect. Stick controls are used to permit such a signal to display proceed when a train is receding in the station-to-station block.

### East End of Aurant

At the east end of the yard at Aurant, the tail track is connected by a crossover to the westward main, and the tail track extends on east for about 650 ft., as shown in Fig. 2. As long as no trains are to enter or leave the east end of this yard, the crossover, No. 7, is left normal so that the tail track can be used to make switching moves back and forth, in and out of the yard tracks.

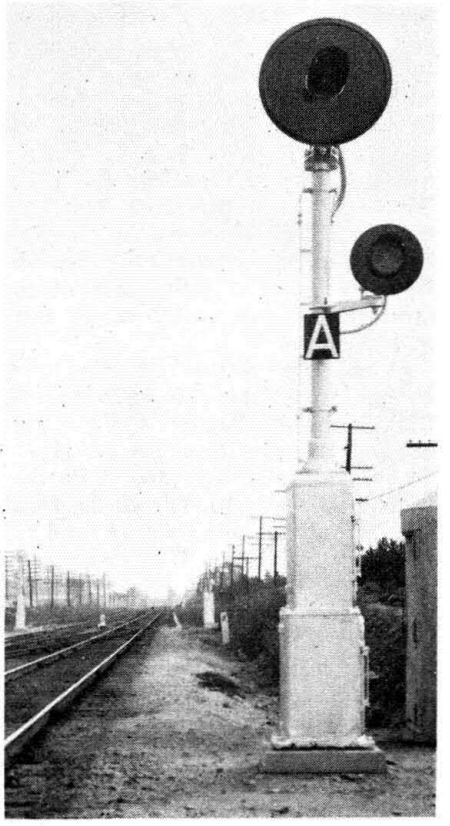
On a desk in the yard office nearby, there is a single signal lever. When this lever is in the center position, the dispatcher at Beaumont can reverse crossover No. 7 and clear a signal for a train to enter or leave the yard. When no such move is to be made for some time, the dispatcher codes permission for the single lever at Aurant to be thrown. This causes the yellow aspect to be displayed on the two dwarfs 6L or 6R, thus authorizing the switch engine to drill back and forth.

In some instances, an eastbound freight train may be required to stop and wait on the eastward track just west of the end of double track at Alhambra. In such instances, the train must be cut at the street crossings to allow street traffic to move. The dispatcher, by watching his illuminated diagram, knows the progress of the opposing train, and about eight or ten minutes before he will be ready for the eastbound waiting train to start, he sends out a special control code that causes an extra lamp unit on the side of the mast of signal 12Ra to display a flashing-white aspect. This indicates that the train is to be coupled up promptly and be ready to accept a clear aspect on signal 12Ra to depart. Thus, in such instances, this special flashing-white unit saves about 10 min. for the train involved, as compared with waiting until the opposing train passes and for the signal to be cleared before starting to couple the train.


Signal 12Ra with flashing-white

### Call-On Signals

At Aurant, through freight trains stop on the main tracks to set out or pick up cars at the yard. In order to direct a locomotive with or without cars to back down on its own standing train, some signals, such as 10R, are equipped with an extra lamp unit mounted on an arm at the side of the mast, as shown in one of the accompanying pictures. When a call-on aspect is to be displayed for the purpose explained above, the dispatcher must send out a control code, and the locomotive or leading car of a back-up move must stop and shunt a track circuit 100 ft. long in approach to the signal. The call-on aspect is red in the main signal and flashing yellow in the extra lamp unit. The control is stick, so that having accepted and passed the signal, new controls must be established to clear the call-on aspect again.




Signal 10R displays call-on

### Junctions of Chino Branch

At Pomona, a switch connected to the siding leads to a branch line extending 5.7 mi. through a fruit district to Chino. A local freight train makes one trip each day over this branch to set out cars and pick up loaded cars. This Chino branch crosses the Union Pacific about 300 ft. from the switch where it leaves the siding at Pomona. This is a spring switch. As shown in one of the accompanying pictures, one switch circuit controller is operated by a connecting rod which is attached to the throw rod at the end toward the switch stand. Therefore, this controller is operated by the stand and will not be operated

when a train in the opposite direction trails through the switch.

On this territory, the Union Pacific has C.T.C. controlled by a dispatcher at Los Angeles. When the Southern Pacific local freight on the siding at Pomona is ready to proceed down the Chino Branch, the train stops and the junction switch is thrown by hand. With the siding track circuit occupied and switch thrown by hand, then an indication is displayed on the Union Pacific C.T.C. machine, and if there are no trains approaching on the U.P. their dispatcher clears the signal for the S.P. train to proceed over the crossing. Before departing, the S.P. train crew returns this switch to the normal position.

When the return of the local freight, from Chino, is indicated on the Southern Pacific C.T.C. machine, two indications are required: (1) to indicate that the S.P. dispatcher is ready to receive the local freight onto Pomona siding, and (2) to indicate that the U.P. crossing is clear for the train to pass over. When such a move is to be made, the S.P. dispatcher initiates code, causing a flashing-white aspect to be displayed on a special dwarf signal, which is across a roadway and around a curve from the signal at the crossing. This flashing-white aspect with the approach track circuit from Chino occupied, initiates an approach indication on the Union Pacific C.T.C. machine. The U.P. dispatcher than authorizes S P. train to pass over the crossing by lining switches and clearing the signal for the crossing.

The train trails through the spring switch from the branch line to the siding. When making this move, no indication is sent to the U.P. dispatcher requesting a line up to go to the branch, because as previously explained, the switch circuit controller which is connected to the operating rod is not operated.

Type M-22A dual-control low-voltage d.c. switch machines were installed at all the power switch layouts. As a reminder to trainmen, the selector lever, as viewed from the top when in the normal position, is painted white, but the other side is red.

At each switch, there are three 1-in. by 9-in. insulated gage plates with Racor adjustable rail braces. Two of these plates extend out under the switch machine which fits snugly between two toe plates. These toe plates and the riser plates at the rails are welded in place on the plates. As shown in the picture, the ties are daped, and plates are set so that the base of the machine is 4½ in. below the base of rail, and the highest part of the machine is only 2 3/16 in. above the level of the top of the rail where the rail is 7 5/16 in. high.

Each set of switch points is equipped with a pair of roller bearings which facilitate operation and reduce friction. A solution of oil and powdered graphite is applied to the switch plates as a lubricant. This solution resists weathering and will not accumulate dust and sand as badly as heavy oil and grease.

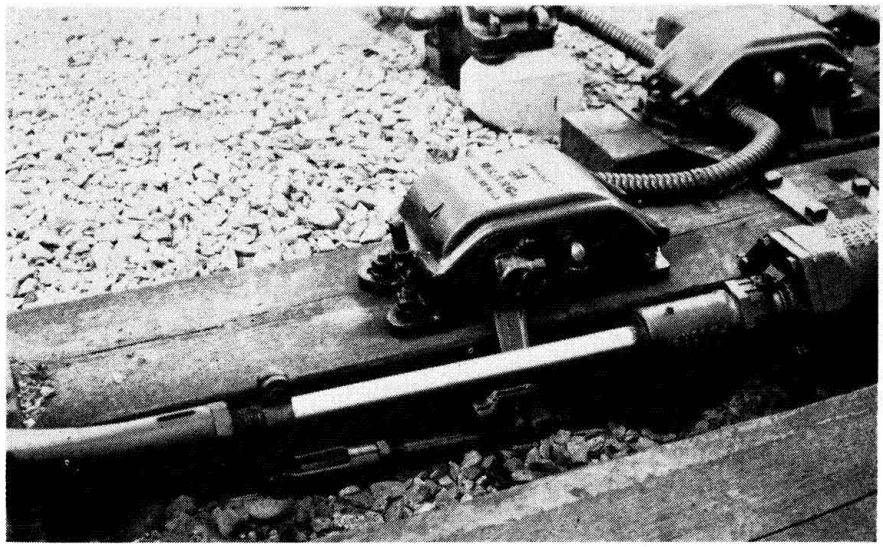
### Local Line Controls

A separate two-wire, normally-energized local line circuit is used for the control of signals for each direction. Each circuit is checked double break through track relays for respective blocks. If a station-leaving signal is cleared, energy is cut off the line circuit for all opposing signals in a station-to-station block. The intermediate signals are double locations, and the circuits are arranged so that the controls for each signal check the other signal in the Stop position.

The line controls for opposing station leaving signals are through contacts of relays controlled by approach locking. If a proceed aspect is taken away by lever control, with the approach occupied, the line control of the opposing station-leaving signal is not closed until the expiration of the time release period.

Also the two line wire circuits detect track occupancy of the station-to-station block as a whole and, in connection with relays at an outlying hand-throw switch, are used to detect track occupancy as a factor in the release of the electric lock, all of which was explained in detail with diagrams on page 99 of Railway Signaling for February, 1945.

Throughout this Aurant-Colton territory, there are numerous street and highway crossings with the



One controller connected to throw rod

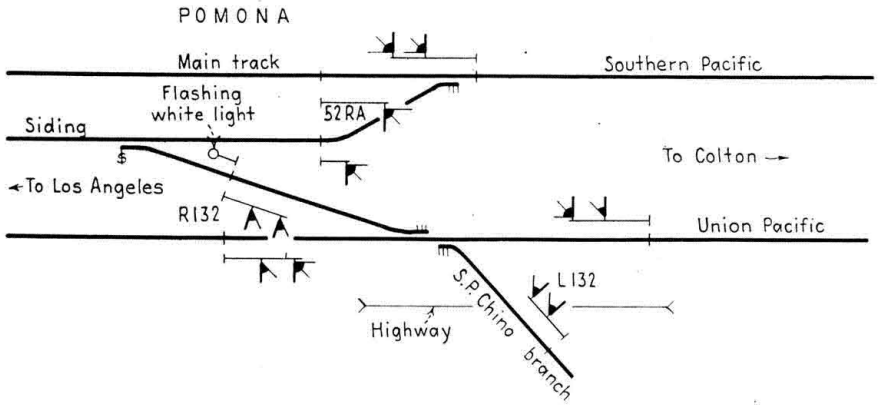



Fig. 4—Special signaling arrangement at Pomona

railroad at grade. Most of these crossings are protected by track circuit controlled signals or gates. On account of track circuits being so cut up for crossing protection, conventional d.c. neutral d.c. track circuits were used rather than coded track circuits. The track relays are the DN-11 type rated at 4 ohms.

The circuits are arranged with the relays at the signals. The length of main track opposite a siding is cut into two or more track circuits, and each siding has two or more track circuits. One purpose for this track circuit arrangement is to secure "two-track circuit" release of the detector locking. A train must first occupy an OS track circuit and then occupy the next proceeding track circuit. This procedure prevents incorrect operation of a switch if an OS section is inadvertently shunted and a switch control sent out which, under some other methods of control, might release the locking with a train approaching.

A series-connected fouling circuit, used at each turnout, checks for broken rail and open bonding. If any of the four insulated joints fail, the battery will be shorted and the relay released.

The C.T.C. project includes track-car indicators which show whether trains are approaching, so that track forces, signal maintainers and others using track cars can know when they can proceed safely. The spacing of indicators and control limits are based on the practice that having seen an indication at clear, a man on a motor car has time to proceed at 15 m.p.h. to the next indicator and take his car off the track before any train traveling at maximum speed may arrive.

These indicators are controlled by line circuits on the old iron wire previously used for control of automatic signals, and these circuits are separate from signal control circuits, except that the indicator circuits break through contacts of track relays. Therefore, crosses or grounds on the indicator circuits cannot affect the signal circuits.

The pole line was reconstructed as part of the C.T.C. project. The poles are creosoted pine, 20 ft. to 25 ft., 8 in. maximum at the top, spaced 150 ft. i.e., 35 to the mile. New 10-pin crossarms were installed. Each line wire is identified by a stenciled zinc tag nailed to the crossarm below the wire. The two new line wires for the C.T.C. code are No. 8 Copperweld. The four local line control circuits are No. 10 Copperweld. The six wires have

**Ties are daped—rods are straight**

plastic weather-proof covering known as Formex, made by General Electric. The two code wires are transposed every 1,000 ft.

The line wires for the control of track-car indicators is the same No. 9 galvanized iron wire that was used previously for line controls of automatic signals.

Alternating current power at 110 volts is distributed throughout this C.T.C. territory on two No. 8 copper wires. This circuit is extended to W-10 transformers, DN-22P power-transfer relays and rectifiers in the instrument housings. At each power switch, a set of 18 cells of Edison storage battery, which, as a whole, feeds the switch motor. Six of these cells feed the signal controls and act as standby for the signal lamps, and the other 12 cells feed the code equipment.

At each intermediate signal, there is a set of 6 cells of Edison type battery which feeds the line circuits and serves as standby for the lamps. Each track circuit is fed by two cells of Edison 500-a.h. primary battery with an RTA-104 automatic rectifier which carries all but about 10 m.a. of the load.

The buried cable to each switch machine includes six No. 6 wires. The track connections are in single conductor No. 10 buried cable. These cables, furnished by General Electric, have Flamenol insulation and covering.

The track outlet bootlegs at each location are all on the same side of the track nearest the instrument case. This is done to avoid digging under the track which disturbs the ballast, thus resulting in improperly tamped ties and damage to the insulated joints.

The connections from the bootlegs to the "far" rail are heavy strand, seven No. 12 Copperweld, run in creosote pine wood moulding nailed to the side of a tie. This moulding has a channel ½ in. by 1½ in. in which the wires are run. Before applying the moulding, the wires are held in place by Copperweld staples driven into the tie.

The rail bonds on this C.T.C. territory are the rail head pin type, about half of them were made by the Ohio Brass Company and the remainder by the Railroad Accessories Company.

Clearview arresters made by the Railroad Accessories Corporation are used on the C.T.C. code line, and Premier arresters made by Western Railroad Supply Company were reused on the local signal line circuits. These arresters are in a box on the line pole just below the crossarm. A second set of Westinghouse Type RVS arresters is located in each factory-wired instrument house. At the pole, there are two ⅝ in. by 6-ft. Copperweld ground rods, and also a ground connection is made to a rail. Of the four track leads coming into each instrument housing, three are connected to arresters, the same as line circuits, but the fourth track wire is connected to the ground post of all arresters, including those for line circuits and the three for the other track wires. Also arresters are provided at track cuts, the ground post in each instance being connected to the same rail extending in the same direction. Lightning charges coming in on the line circuits are dissipated to the track and ground through several track circuits. Lightning which comes in on the rails passes through the locations rather than affecting track relays.

This C.T.C. project was planned and placed in service by the regular signal construction forces of the Southern Pacific, under the direction of H. B. Garrett, signal engineer. The major items of signaling equipment were furnished by the Union Switch & Signal Company.