RAILWAY SIGNALING AND COMMUNICATIONS

AUGUST 1961

The work is done and the trains are rolling over 44 miles of new double track, CTC controlled for reversible running.

Santa Fe Signals New Main Line

Everything has been included in the Santa Fe's new 44 miles of railroad that would make operations as swift and efficient as possible. The double-tracked line has signaling arranged for reversible running, with crossovers spaced at about 11-mile intervals, automatic inductive train stop to permit high speeds, and set-out tracks efficiently oriented. An interesting feature is the two-mile spacing between the two legs of a double crossover, thus giving the effect of a passing siding (see diagram). Operation over the new line commenced on December 19, 1960.

The project is known as the Williams line change, after the town which is the take-off point for the Santa Fe's line to Grand Canyon. The previous line between Crookton and Williams was a double-tracked line, with the two tracks often taking quite separate routes. Automatic block signaling was employed. Sharp curves, exceeding 10 degrees, made speed restrictions of 15 mph necessary at some locations. Grades up to 1.8 per cent also held down train speed. The westbound and the eastbound tracks west of Ash Fork will be torn up. One track east of Ash Fork will be retained as a connection to Phoenix. The old line employed left-hand running from a point just east of Crookton to Dalies, near Albuquerque, 352 miles east of Williams Junction. Much of the trackage in this territory was laid originally as single track. When a second track was added later, it was designed to provide more favorable grades, and left-hand traffic employed to take advantage of the better grades for tonnage trains.

On the new layout, traffic east of Maine is left-hand, as it has been in the past. West of Seligman, traffic is right-hand. Between Maine and Seligman trains may run in either direction on either track. This means that somewhere between these two points, every train must crossover.

The new route, approximately the same length, permits maximum passenger train speeds of 90 mph through-

out (60 mph for freights). Experience has borne out the expected savings of about one hour for passenger and two to three hours for freight train schedules. Much of the project was through flagstone or malpais (lava) which required blasting even for poles and signal bridge foundations. About half the mileage is on curves, but curvature never exceeds one degree. Total cost of the project was $20 million.

Use Colorlight Signals

The line change joins the original mainline at a point east of the town of Williams, which is known as Williams Junction, and at Crookton. Initially, signaling for reversible running was installed between these two points. An extension of reversible running, from Seligman on the west to Maine on the east, has just been completed. The TCS is controlled from a 15-ft TCC machine at Winslow, 92 miles east of Williams. In a change from more recent Santa Fe practice, colorlight signals, rather than searchlight signals, were installed. (Many Style R2 colorlight signals are in service between Albuquerque and Barstow. These were installed years ago, before the searchlight type was developed.)

"We decided to use colorlight signals on the Williams Line Change in order to develop standards for modern construction, and afford a comparison with late searchlight installations," says J. A. Parkinson, General Superintendent of Communications and Signals. "Our past experience has indicated that colorlight signals are quite satisfactory in this territory."

Signals on the line change have one or two arms. A three-unit signal head is used in all cases (to simplify stock) even though no red is ever displayed on the lower arm. (In territory where searchlight units are used, in the bottom unit the roundel, where red would normally be, is blanked out. The Santa Fe's philosophy is to keep aspects as simple as possible. Since a single green or a single red aspect has the same meaning as green/red or red/red, respectively, the lower arm, where used, is dark in these cases.)

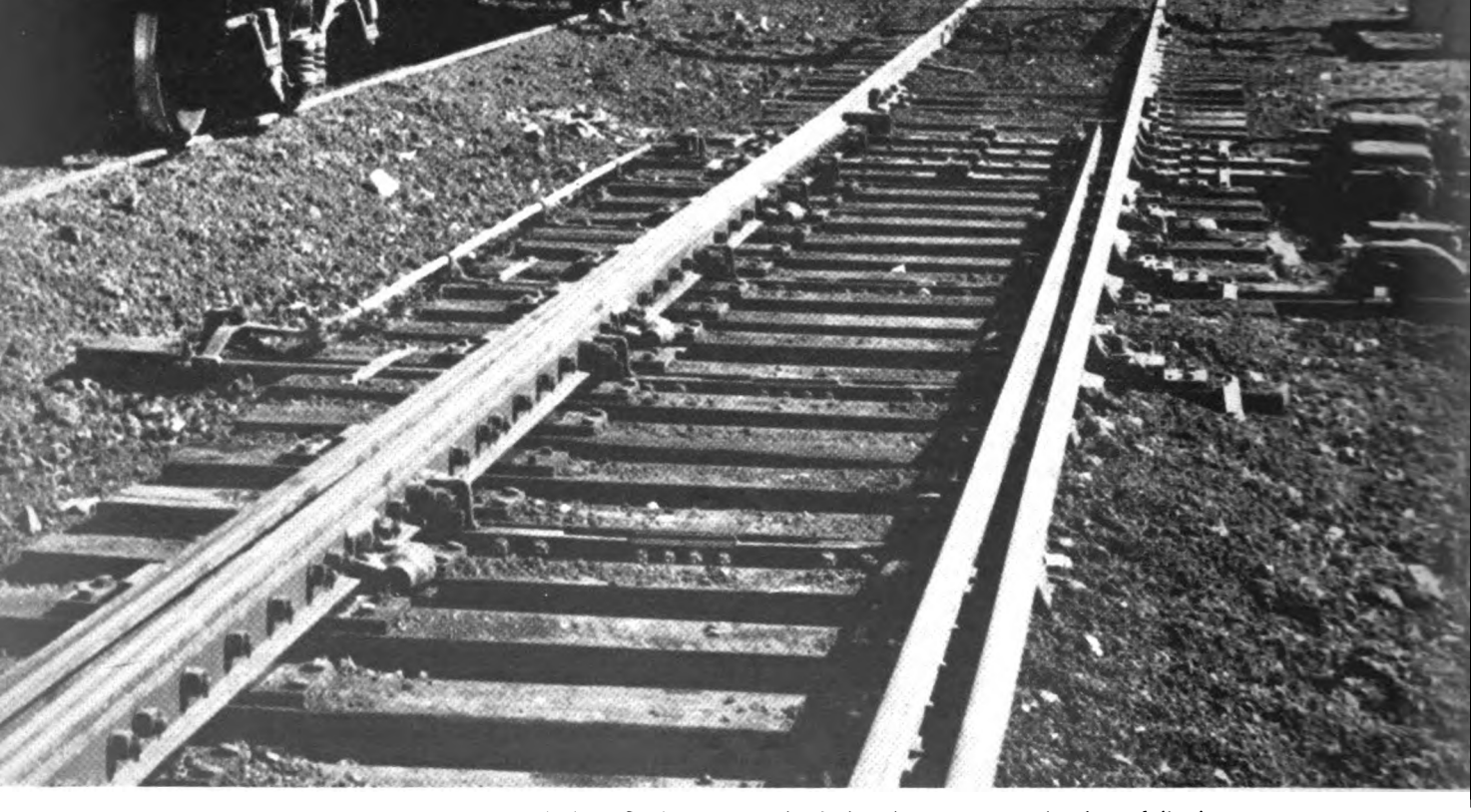
Unusual Crossover Spacing

Within the new line are three sets of crossovers, with a set of crossovers also located at each end of the change. The wide spacing between the individual legs of the pair of crossovers provides the equivalent of a two-mile siding in addition to the reversible running. Two extra signal bridges and four extra signals are required for each pair of crossovers by this method.

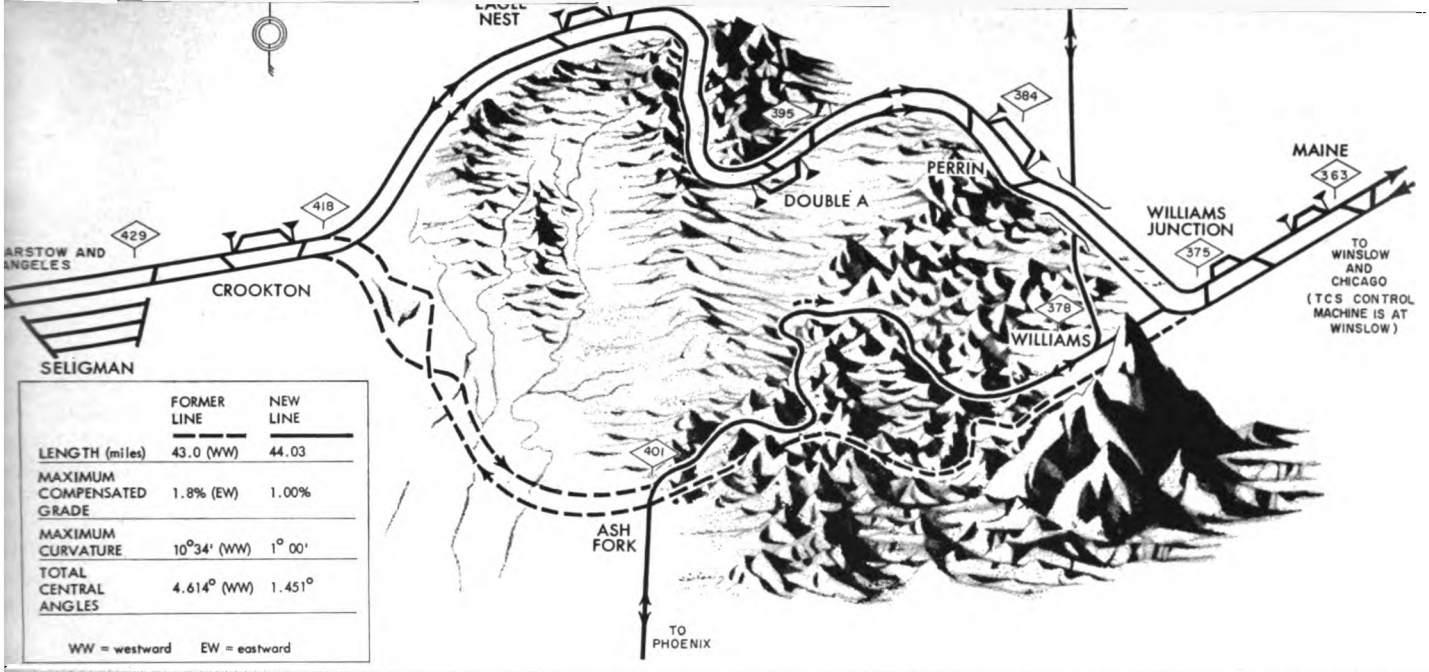
In proximity to each pair of crossovers is a setout track for bad order cars. It is connected to the mainline at each end by electrically locked switches located outside the signal limits of the crossover. Time release alone is used to release the electric lock of these switches. In three cases, this setout track is located outside the signals between the two crossovers. At "Double A" (named for a nearby ranch), however, the setout track spans the signal limits of one of the crossovers.

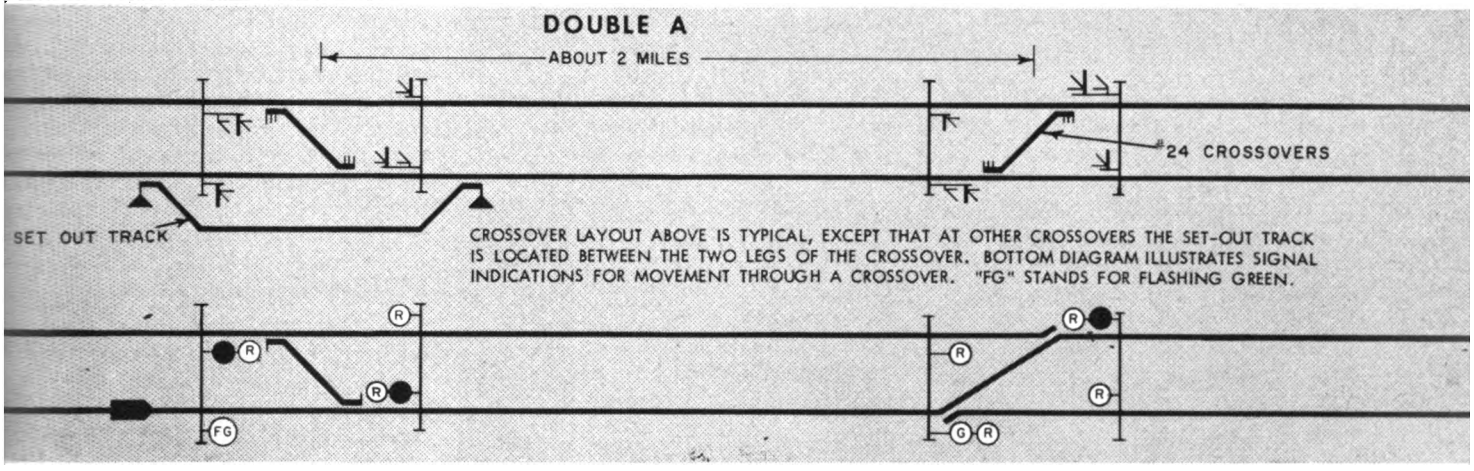
The crossover turnouts are No. 24, good for a speed of 50 mph. Consideration is being given to increasing the allowable speed through the crossover to 60 mph. Helper connections are provided, as shown in the accompanying pictures. The switch points on this size turnout are 39 ft long, and there is quite a bit of spring in these long points. A switch controller is connected to the No. 5 rod to insure that the entire point moves instead of just the tip. It is hoped thus to detect obstructions, such as rocks, which are some distance back of the tip.

For a movement through a cross-



A circuit controller is attached to the #5 rod of the 39 ft points to check that the entire point has been fully thrown.





over, a train first encounters a flashing green aspect, "Approach Limited," at the approach signal. This flashing green aspect is properly safeguarded by checking the flasher relay operation with two slow-release relays. Should the flasher fail, the aspect is changed to a steady yellow "Approach," a medium speed indication. At the home signal the aspect displayed is red over green, "Diverging Clear," unless track occupancy conditions require a red over flashing yellow, "Diverging Approach" (red over a steady yellow is "Restricting"). The diverging route aspects carry no speed restrictions in themselves; the timetable specifies the maximum allowable speed through the turnout.

Signals In Place Before Track

The signal bridges (all signals are on bridges) and instrument houses were set in place before the track. This was done for two reasons: first, once the grading had been completed, the track was put in place at a very rapid pace (all welded rail in 1,440-ft lengths), so the signal gangs had to work ahead of the track gangs to have time for a thorough check before the system was ready for service. Secondly, the 12-ton concrete instrument houses (complete with instruments and wiring) would have had to be lifted from a flat car with the wrecking crane, a costly operation, and then the crane could often not reach as far out as needed. The houses and steel structural members for the signal bridge were delivered to the site by flat-bed trucks and hoisted into place with truck cranes.

Poured Foundations Necessary

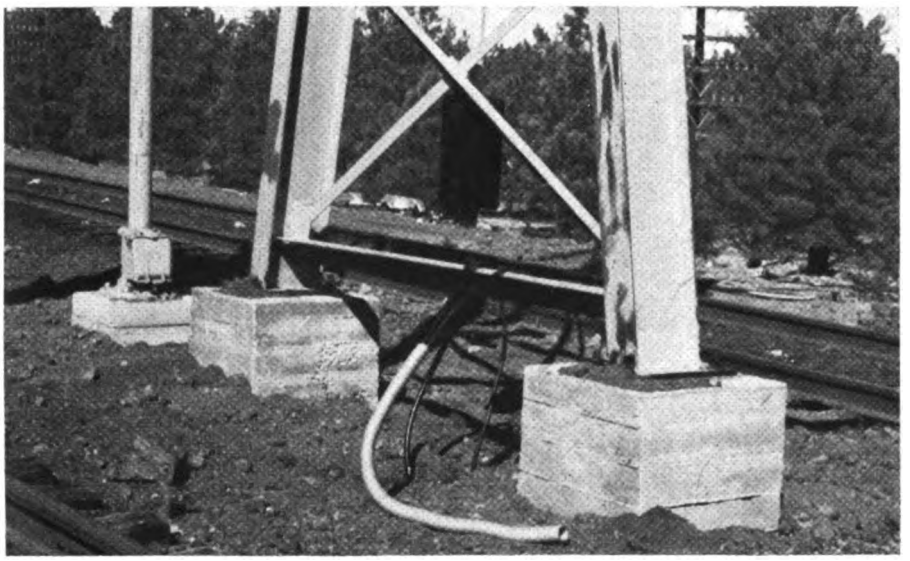
The signal bridges used by the Santa Fe are relatively simple steel girder affairs. Normally, the two legs at each end of a bridge come straight down, parallel, on 4-ft 4-in. centers. These are then attached to a single large precast foundation. However, due to the hard rock, it was decided that poured foundations were more practicable for this project and the legs of the bridge were spread to wide centers at the base.

Foundations for small cases consist of precast concrete "logs" forming the base of the foundation, topped by a precast cap. These concrete foundation parts were cast at the Santa Fe's San Bernardino shops.

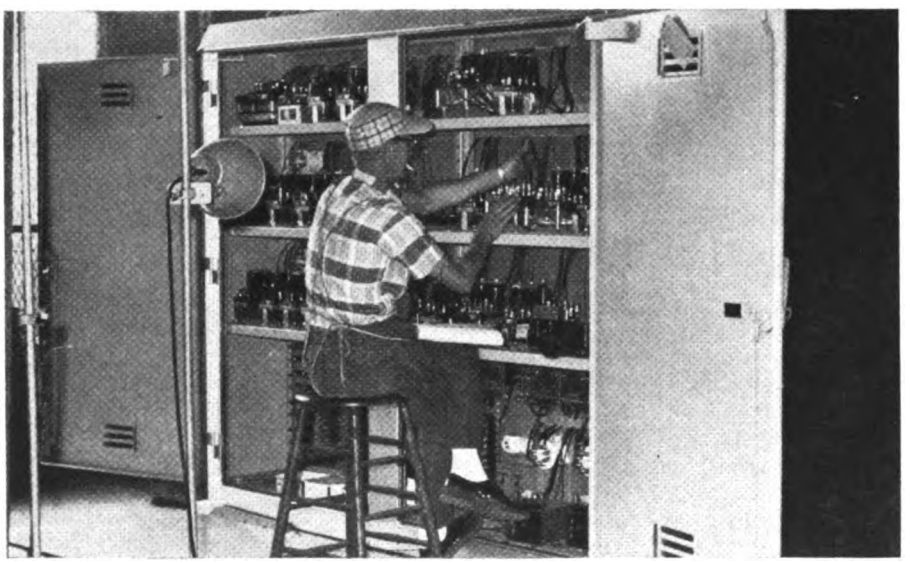
Blast Holes for Line Poles

A pole line was constructed along the line change, with 35 Class 5 poles to the mile (light-heavy loading)—their standard for comunication pole lines. The holes for 90 per cent of the approximately 1,540 poles had to be blasted out of rock. There are two signal crossarms and one communication crossarm, all 10-pin, throughout the line change, plus a shorter arm for a 4,800-volt transmission line part of the way. The communications crossarm is below the two signal arms where the 4,800-lines exist, and above the signal arms in the remaining distance.

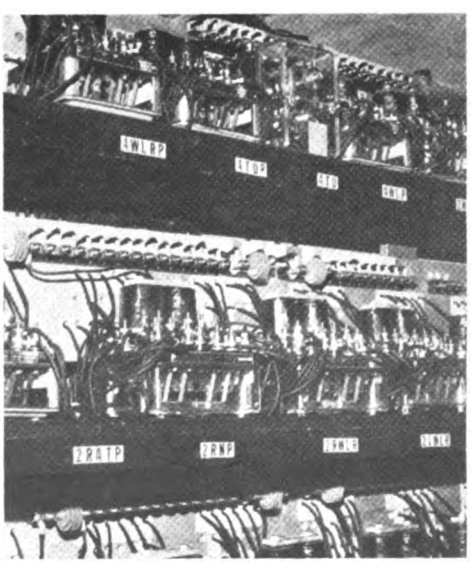
Communications circuits are carried on four pairs of No. 8 Copperweld Polene (insulated) wire. Microwave will carry through communication circuits, and is already in service from Seligman to Winslow. Signal circuits



Poured foundations were a necessity. Cable is buried in the 4 ft of gravel that overlays the hard rock base. Ground signal at left governs Williams Junction house track.



Above: Signalman at the San Bernadino signal shop wires a relay case for the line change. Operation and breakdown check of wiring will be made at the shop before case is shipped to the site. There full system check will be made.



Right: The Santa Fe has adopted a practice of marking the relay nomenclature on the front edge of the shelf with large black - on - yellow stick-on letters. This makes it easier for a maintainer to find check points when chasing a case of trouble.

are carried on No. 10 Polene, with th number of wires varying. The code lin consists of two No. 6 Polene wires.

Electric energy at 4,800 volts is fe from Williams 22 miles westward. Thi is carried on two No. 6 hard draw bare copper wires on the top arm. O an H fixture 22 miles west of Williams the energy is stepped down to 48 volts, at which voltage it continues fo 10 miles on two No. 6 HD insulate wires on a signal arm. Also at the H fixture, the communications wires, o the bottom arm east of the H fixture jump to the top arm and continu westward. Energy at 480 volts is als fed eastward from Crookton 12 mile on a signal crossarm.

Previously, AC signaling without battery standby was employed through out this territory (on the old line, and extending both directions from the lin change). The Santa Fe generated elec tric energy at 25 cycles at Seligman. Now DC signaling with battery standby will be used. Energy at 480 volts will be fed eastward from Williams.

Six 15-Man Signal Gangs

From four to six signal gangs worked on the line change; four were used in the earlier phases of construction, and six later on as the completion date neared. The average gang consisted of 15 men. The problem of finding experienced signalmen, familiar to many roads, troubled the Santa Fe also.

The signal equipment was supplied, for the most part, by Union Switch and Signal. The instrument cases were wired at the San Bernardino signal shop, and were given a circuit breakdown check there. When the cases arrived at their ultimate site, only external connections and final circuit check were required.

Relays performing similar functions in different relay cases are placed in similar locations within the cases. The instruments are identified on the front of the shelf by ¾-in. high, black-on-yellow letters on a cloth tape. The large lettering and similar placing make the instruments easy to locate and identify in case of trouble. The San Bernardino shops also cast concrete battery boxes and foundations used on the line change.

The signal work for the line change was under the immediate supervision of J. L. Bartlett, General Signal Supervisor for the Coast Lines, with headquarters at Los Angeles. J. M. Rice is Signal Engineer for the Coast Lines, and J. A. Parkinson is General Superintendent of Signals and Communications, System.