Signal Construction on the Sante Fe

Program for 1922 Includes 398 Miles of Automatics, Light Signals and Semaphore

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Dwarf Signal and Telephone at End of Passing Track.

THE signal construction program of the Atchison Topeka & Santa Fe system during the present year includes quite extensive installations of automatic block signals, a number of which are already in service. The following statement and accompanying map of the main lines of the Santa Fe indicate the points at which the various installations are being made, and it will be noted that the program includes installations in eight states and that the total mileage of automatic block signaling under construction this year is 378 miles of road, 549 miles of track.

Western Lines

(I) New Mexico—From Dillon to Otero—2 miles single track.
(J) New Mexico—From Las Vegas to Gise—41 miles single track.

Eastern Lines

(A) Illinois—From Willow Springs to Nerska—10 miles double track.
(B) Missouri—From New Boston to Medill—20 miles double track.
(C) Kansas—From Olathe to Le Loup—24 miles double track.
(D) Kansas—from Melvern to Ridgeton—8 miles (one track only).
(E) Kansas—From Neosho Rapids to Emporia—10 miles double track.
(F) Kansas—From Neva to Cedar Point—15 miles double track.
(G) Kansas—From Wagner to Braddock—10 miles double track.
(H) Kansas—From Walton to Newton—7 miles double track.

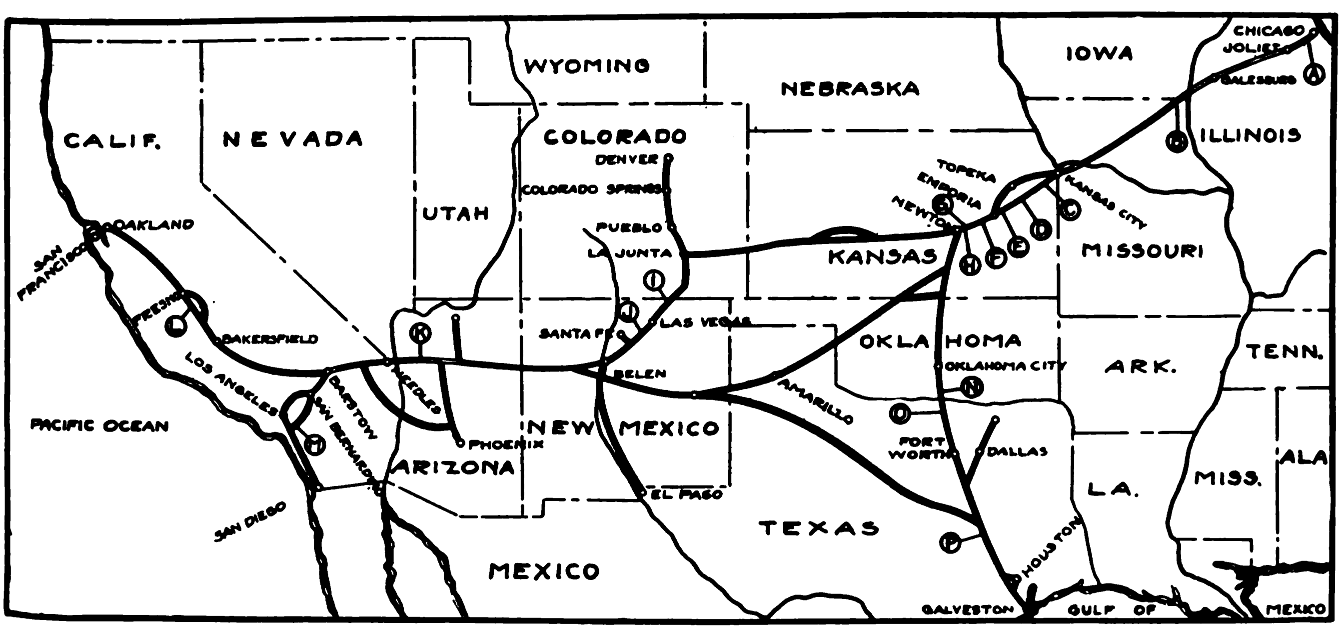
Coast Lines

(K) Arizona—From Yampai to Griffith—75 miles double track.
(L) California—From Calwa to Shirley—21 miles single track.
(M) California—From Corona to Atwood—18 miles single track.

Gulf Lines

(N) Oklahoma—From Pauls Valley to Arbuckle—28 miles single track.
(O) Texas—From Gainsville to Thackerville—12 miles single track.
(P) Texas—From Temple to Somerville—77 miles single track.

The work is scattered with the idea of filling in automatic block signals between points so as to gradually extend it over the majority of main lines from Chicago to Denver, San Francisco, Los Angeles and Galveston. When the present program is completed the Santa Fe system will have automatic block signaling over 1,318 miles of road, 2,115 miles of track. Between Yampai, Ariz., and Griffith, a distance of approximately 75 miles, second track is under construction and the signals are being installed in connection with this double track. These are the three-unit Style-L Union Switch & Signal Company color-light signals equipped with a white back light

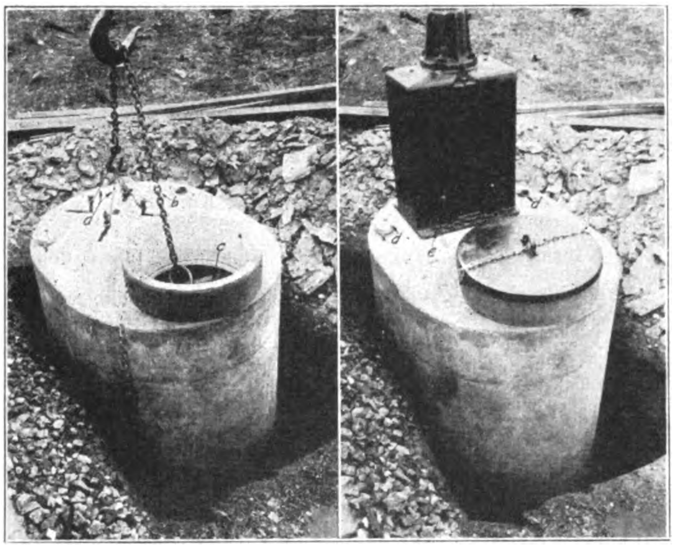


Map of Santa Fe System Indicating Sections of New Signaling

on the red unit and operated by alternating current with a 25-cycle, 4,400-volt 3-phase power line. With this exception all the signals under construction this year are d. c. three-position, upper-quadrant, operated by primary battery.

Organization of Construction Forces

The construction work is being performed entirely by the Santa Fe's signal forces under the immediate direction of the signal engineers of the Eastern, Western, Coast and Gulf lines, with supervision by the central organization. All of the material for the entire construction,



Signal Cellar Handled by Yoke and Cable to Bolts Signal Bolted in Place on Cellar

with the exception of the a. c. light signals in Arizona, is purchased in large quantities and shipped direct to the store house at Topeka, Kan. It is then distributed as required, so as to promote maximum facility in handling the work at the various points.

Separate construction gangs were organized to handle each of the following classes of work on a given territory: (1) Concrete work; (2) Pole line; (3) Track bonding; (4) Miscellaneous signal work.

Each gang is equipped with an outfit comprising bunk cars, tool and material cars and kitchen car so that it can work entirely independent of the others and move on to another location as soon as the class of work being handled is completed. This results in the men becoming especially proficient in the class of work they are handling with a consequent speeding up of the entire construction and economy of labor.

As much of the construction as possible was performed by work train. Very little concrete work was performed in the field, most of the concrete structures being constructed at a central point, distributed and installed by work train; this avoided the waste which usually results in distributing concrete materials along the right-of-way.

Some of the illustrations show signal cellars, battery wells and signals being placed by work train. Two different methods were used for handling the cellars by the derrick: (1) By means of a yoke with a chain sling surrounding the cellar, and (2) by means of a block set inside the cellar at the manhole, a set of bolts connected together with heavy steel stranded wire and secured in the slots for signal foundation bolts and a chain connecting the two and passing over the hook on the derrick. The latter method seems to be the best for work train handling, providing that a sufficiently strong steel strand wire is used. By this means the operation of placing a cellar in a hole can be performed in a minimum time and without danger of the cellar slipping as it is liable to do when the yoke and chain sling is used if the latter is not set exactly right before the cellar is lifted. The chain, cables and block can all be placed by one man, and this should be done before the train reaches the point at which each cellar is to be set.

It has been found that a cellar can be removed from the flat car and placed in the hole in from 3 to 5 min. and an assembled signal picked up from the ground, placed and secured to the cellar in from 6 to 10 min., making a total of 9 to 15 min. from the time the work train arrives at the hole till it is ready to proceed to the next location. If the signal is picked up from the flat car it takes 2 to 3 min. more, as it is generally best to set the signal horizontally on the ground, and then take another hitch to lift and place it vertically on the cellar or foundation. A good new rope serves as a hitch about the signal pole, much better than a chain, for the chain will often slip.

The most satisfactory method of handling is to assemble the signal pole instrument case and mechanism at the material yards and load all on flat cars for erection by the work train. It is best to add the ladder, platform, spectacle casting and pinnacle after the signal has been erected in order to avoid damage.

Assembled Signal, Mast and Relay Box Being Installed

The following is an actual record of a typical day's work of eight hours for the work train:

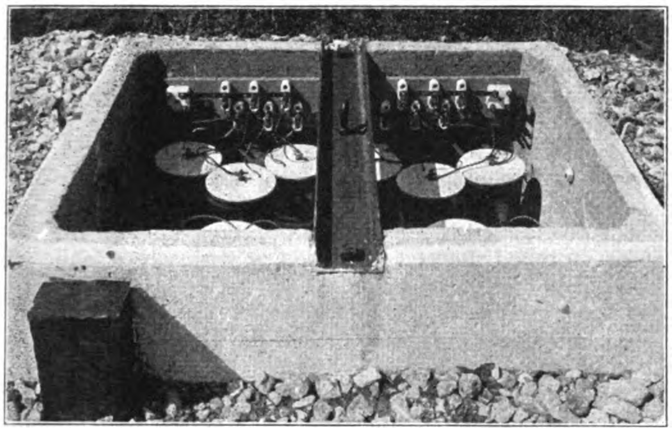
Total distance covered, including return trip	66 miles
Signal cellars installed	9
Signals erected	9
Cable post foundations installed	5
Signals distributed (not erected)	15
Complete signal ladders distributed	9
Concrete battery well removed from existing location and re-installed	1
Concrete cable post removed	1
Wooden cable post removed	1

The bottom of the hole in which a concrete cellar or well is to be placed should be as level as possible. It is not necessary to level up the cellar and fill in the hole around it immediately after it is placed. This would be an unnecessary delay to the work train and can just as well be done later.

Signal Indications

There are only three signal indications used in connection with all signals whether automatic or interlocked; these are "stop," "proceed under control" and "proceed." Each signal mast carries only one arm and controls are so arranged that the "Proceed under control" indication is given for all moves requiring caution or comparatively low speed, without a stop at the signal. Daylight indications are given solely by the position of the blade, which is painted either black or white, depending upon the background. Signals operated under automatic signal rules are designated by a number board.

Where it is desired to instruct a train by signal indication to take siding, a siding sign is mounted on the mast



A 20-Cell Concrete Battery Box

below the signal arm and is illuminated when the sign is uncovered. A standard signal mechanism is used to operate the siding sign.

The signals are Style T-2, three position, upper right hand quadrant, low voltage, d. c., manufactured by the Union Switch & Signal Company. Convex roundels and cast iron lamps are used.

Battery Housing and Special Features

Except in California and Texas where, on account of climatic conditions, batteries do not require protection from low temperatures, the ground signals are mounted on concrete signal cellars manufactured by the Massey Concrete Products Corporation. This makes a very neat appearing signal location and provides a most convenient arrangement of the signal wiring. In the two states mentioned above all battery is housed in the type of concrete battery box shown in one of the illustrations. The design of this box is such that it may be constructed in any capacity required and the same size and style of iron lid is used for all sizes. About 1,200 iron lids were manufactured in the Santa Fe shops at Topeka for the work during 1922.

Because of the necessities in connection with developing a second track of lower gradient, trains are run left handed on much of the double track on the Santa Fe. Where tracks run parallel, this necessitates the use of signal bridges in order to place the signals properly with respect to the track which they govern. For permanency and to reduce fire hazard, concrete slabs are used for flooring on the bridges.

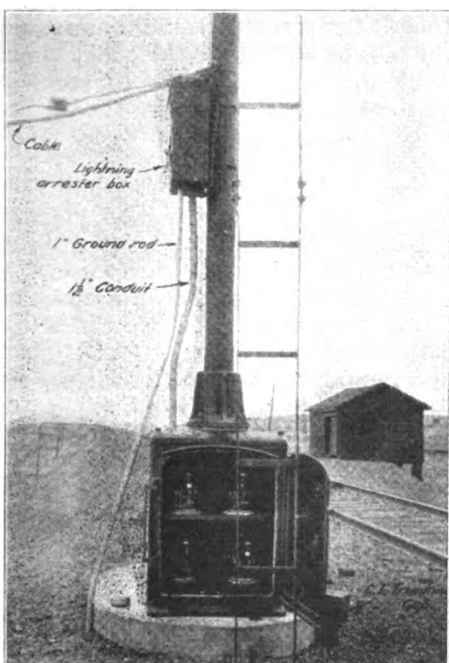
Iron cable posts are used throughout. Most of the track bonding is performed by means of power rail drilling outfits. Each joint is bonded with two No. 8 BWG galvanized iron bond wires on d. c. circuits, and No. 6 B & S G copper bond wires on a. c. circuits, each 39-in. in length, except on some test sections where a special grade of 37-strand flexible bond wires is being tested.

In addition to the lightning arrester with artificial ground, which is used in connection with each wire coming from the pole line, spark-gap arresters are mounted on the terminal boards in all relay housings and so connected that they form a bridge across each pair of relay magnets and provide paths for lightning discharge from all circuits to the rail and between the rails of each track circuit.

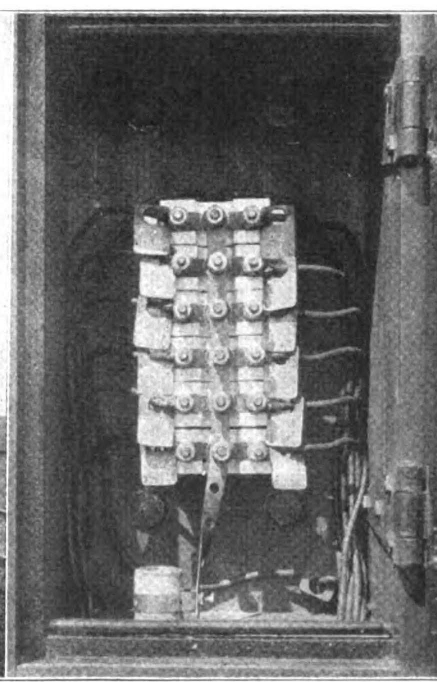
A. R. A. specification wire is used throughout and all underground wire, where metal conduits are not used, is surrounded with R. S. A. petroleum asphaltum and enclosed in redwood or creosoted pine trunking. The trunking is laid 11 in. below the bottom of the ties. Cast iron trunking caps are used, as may be seen in the photographs.

Signal Control Circuits

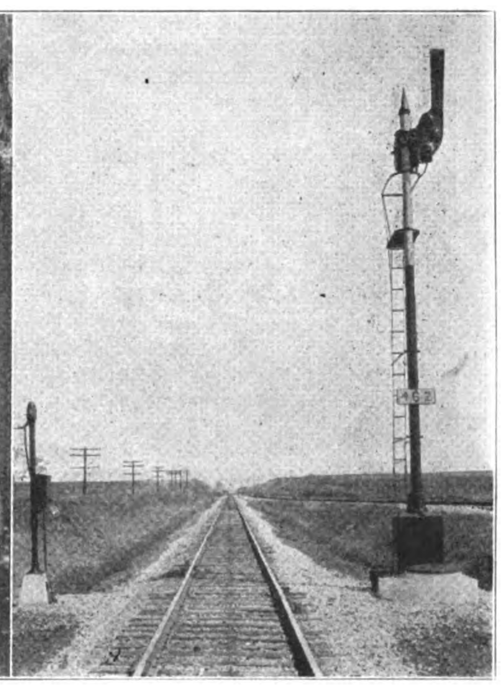
Neutral track and polarized line circuits are used on both single and double track. There are no cut sections in the track circuits, the signal controls being made com-



Lightning Arresters in Separate Box

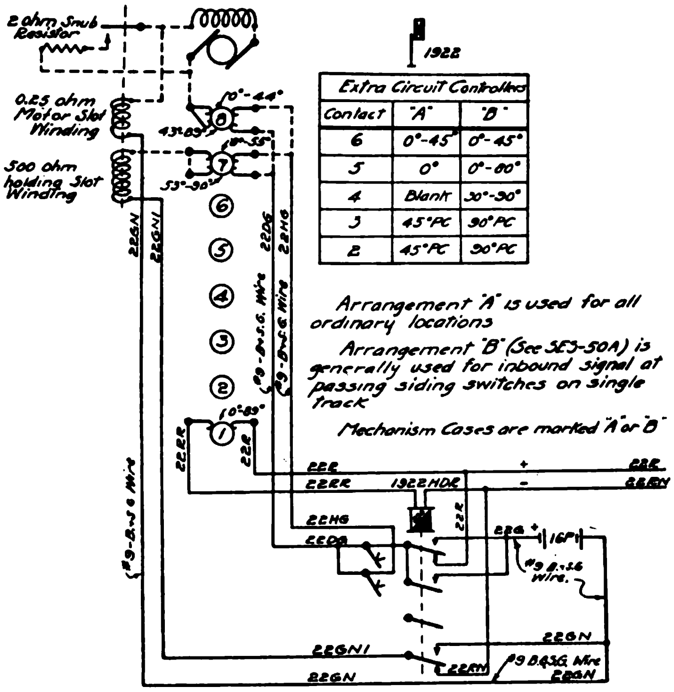


Ground Pipe Extends Up Into Arrester Box



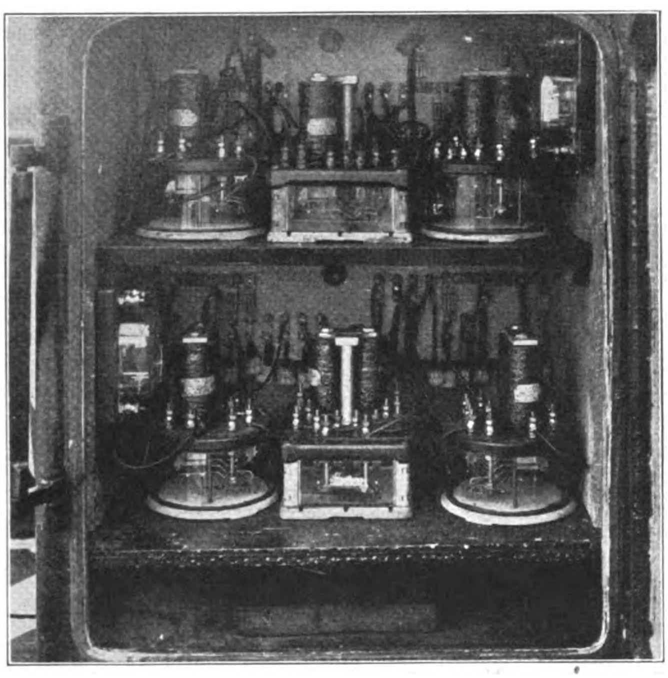
Arrester Box on Pole Line Side

plete by cutting the line control circuit through all of the track sections in the block. Metallic line circuits are used throughout so as to avoid the complications often caused by the use of common returns. All line relays



Local Wiring for a Three-Position Style T-2 Signal With Polarized Control

are of 250-ohms resistance, each line circuit is energized from an individual battery of 10 caustic soda standard primary cells. The local wiring of the signals is illustrated



Instrument Case on a Two-Truck Signal Bridge Containing 4 Neutral, 2 Polarized and 2 D. N. L. Lighting Relays

herewith and is so arranged that when the signal is about to change from the 45-degree to the 90-degree position, due to change of polarity of the line circuit, the slot is momentarily energized through the back contacts of the relay, and thus the time element is bridged without the use of a slow acting slot. The circuit also provides that when the blade reaches the 90-degree position the 250-ohm controlling relay is de-energized, the signal operating battery is placed on open circuit, and the 500-ohm slot is energized direct from the line circuit. Obviously this results in a very great saving in battery consumption.

Approach Lighting

Approach electric lighting is used on all signals and so arranged that the lamp is energized when an approaching train is not less than one mile from the signal on straight track, or not less than sighting distance on curved tracks. Edison adaptors are used with concentrated filament, bayonet socket lamps which consume 0.75 watt on four standard caustic soda cells connected in series. The lighting circuits are controlled by means of 36-ohm type D. N. L. relays connected in series with the line control circuit for the next signal in the rear, except where sighting distance is less than the length of track circuit, in which case a back contact on the track relay controls the light.

R. S. A. circuit nomenclature is used and all wires are carefully tagged with black fibre tags having the wire name stamped thereon and filled in with white lead. The wire names are also stencilled on the crossarms for convenience in following the circuits.

All interlocking plants, located in territory where automatic signals are under construction, are brought up to date with respect to electric circuits. Detector bars are removed, illuminated track diagrams added and the plants equipped with approach, route and indication locking.

On single track the overlap scheme is used and signals at the ends of passing sidings are staggered, permitting the use of circuits which provide the maximum facility for train movements in the vicinity of the station.

The Care of Dry Cells

During the last four years the Illinois Central system purchased 262,910 dry cells at a cost of $71,156.45. This represents an expense of $58.13 for each working day. The annual cost of these dry cells, capitalized at 6 per cent equals the interest on an investment of $296,487.

Much of this expense is due to lack of care in handling and using the cells. Few users of dry cells realize that they require considerable care and that large numbers are ruined or badly damaged through improper handling.

Dry cells should never be stored with the terminal end down, nor should the cells be laid on the side; they should always be stored with the bottom down. In receiving dry cells for storage, those in charge should mark the date of receipt on each cell, issuing them in the order of receipt, the oldest ones first.

Dry cells should be stored in a dry, cool place and never near radiators or steam pipes, as excessive heat will wear the cells out more quickly than continuous use. On the other hand, they should never be allowed to freeze.

Old, weak cells should never be used in the same battery with fresh cells, as the strength and life of the battery will be only that of the weakest cell.

In using an ammeter or battery tester, touch the terminals firmly, but remove the contact as quickly as the reading is obtained. Prolonged contact will short-circuit the cell and run down its strength quickly.

Many motor car operators have the erroneous idea that seven or eight dry cells are necessary to provide an efficient spark. Four or five cells are sufficient for any motor car battery and will provide just as good a spark as eight cells, with about three times the life of the eight-cell battery. The five-cell battery has an added advantage in the fact that it will not burn out the coils and the contact point so quickly as one with a greater number of cells, thus actually furnishing more reliable ignition.—*Illinois Central Magazine.*