

Signal 1412F near South Junction is typical of the signals used

THE MAIN LINE of the Atchison, Topeka & Santa Fe runs through Cajon Pass of the San Bernardino mountains to San Bernardino, from which point two separate lines extend about 65 miles, to Los Angeles, the western terminus of the system. One of these lines runs from San Bernardino westward through Riverside and Fullerton, entering Los Angeles terminal from the south, while the second line runs westward from San Bernardino through Pasadena, entering the Los Angeles terminal at the north end. This terminal layout, which is about two miles in length, is just west, and along side of, the Los Angeles river. During the past year or two several viaducts were built to carry street traffic over the Santa Fe tracks and the river, as well as the Union Pacific tracks on the east side of the stream. The construction of these viaducts resulted in numerous track changes. In the present track layout the double-track through freight line is located on the west bank of the river; and at North Junction and South Junction, which are

Automatic Interlockings of Involving Spring

Santa Fe installation at Los Angeles permits practically all trains to pass without stopping

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two miles apart, the two-passengermain tracks diverge westward to the passenger station, the yards being located in the area between the freight and passenger main lines. An additional freight yard is located at Hobart in the southern outskirts of Los Angeles on the line via Fullerton. Trains made up at Hobart for northbound movement, as well as southbound trains for Hobart yard, are run through the Los Angeles terminal layout on the through freight tracks

without entering the Los Angeles vard.

After the new track arrangements were completed consideration was given to the installation of power interlockings, controlled remotely, at North Junction and South Junction. However, on account of the numerous train movements, especially those involving switching, there was some question as to the practicability of using remote control for these junction layouts, and the installation of



View at North Junction looking toward passenger station



Two Junctions Switches

General view of South Junction looking north with double-track leading to station at the left and the through freight tracks at right



After further study the decision to install a combination of spring switches and automatically-interlocked signals with traffic-direction features was made. The layouts are such that all inbound and outbound passenger trains and the outbound freight trains may proceed through the junctions without stopping or handling a switch, but inbound freight trains must handle one switch.

Typical Train Operation

For example, when a westbound freight train is coming from Mission Tower, switch 1 must be reversed so that the train can take the crossover, the spring switch mechanism on switch 3 permitting the train to pull through, and switch 4 is set normal so that the train can pull out onto the westward freight main or into the yard. An eastbound freight train approaching North Junction on the freight main trails through spring switch 2 and does not have to stop. Likewise, the switches are lined normally for westward passenger trains

to be routed through the junction, while outbound passenger trains trail through spring switch 4.

As these junctions are not within yard limits a special rule in the time table covering the operation of trains, reads as follows:

"At following stations, between limits described, (North and South Junctions included in the list), all trains and engines will move governed by automatic and/or interlocking signals, whose indications are superior to class and direction. Secondclass extra trains and yard engines moving under these provisions will be expected to avoid delay to first-class trains."

On account of an adjacent grade crossing, speed at North Junction is limited to 8 m.p.h., and all trailing movements springing the points of spring switches are limited to 20 m.p.h.

Between the two junctions there are

non-signaled sections in both the passenger and freight lines and in this territory there is no superiority of trains. All trains and engines must move at restricted speed, and responsibility for accident rests with the approaching train.

Signals Normally at Stop

The signals at the junctions are of the searchlight type, standing normally at "danger," and clearing on the approach of trains. With the normal-danger system, a check is secured that opposing and conflicting signals are at "stop" before any signal clears. Sun relays are used to reduce the voltage on the signal lamps at night so that there is no excessive brilliancy to interfere with the passing of hand signals. The controls are



and North Junction at Los Angeles

RAILWAY SIGNALING



Power-operated train sign indicates approach of a train

such that passenger train movements have preference over all other movements, and freight movements have preference over all movements against the current of traffic. signals. Providing that the route is clear, that no conflicting movements are being made, and that conflicting signals are at "stop", when an eastward freight train enters approach section 4FAT, signal 1404F changes its aspect from red to yellow.

This signal 1404F is controlled to "stop" by track sections 2T1, 2T2, 5BAT and, if switch 3 is reversed, this is the complete control. If switch 3 is normal, then signal 1404F is also controlled to "stop" by an eastwardmoving train in sections 3T1, 4T2A, 4T2B and 4T1.

If switch 14 is also in the normal position, signal 1404F is controlled to "stop" by an eastward-moving train in sections 8AT1, 6PAT2 and 6PAT1, unless 8AT1, 8AT2 and 6PAT2 have been occupied for a period of three minutes or more. Signal 1404F is always controlled to "stop" through the three-rail "spotting" section 6PAT1, if switch No. 3 is normal.

A "train indicator," so located at North Junction as to be visible from all points in that end of the yard, gives warning of the approach of inbound trains. At South Junction it was impossible to locate a "train sign" that would be visible from all points at that end of the yard, and consequently



Spring switch layout at North Junction

and painted with acid-resisting paint before being assembled. Sets of KXHS-15 storage cells are used for stand-by for the signal lamps which operate normally on alternating current. Sets of KXHS-9 storage cells are used to feed the various line circuits.

The relays, transformers and terminals are mounted on racks fabricated from wood and angle iron, the wire chases being built-in.

Underground Cables

The track wiring is in single-conductor No. 9 trenchlay, and the cables between the relay houses and the junction cases, which serve as dis-



Diagram of the control circuits for signal 1404F

A passenger train approaching from either direction clears the signal for its movement and locks out conflicting routes. If the passenger train should stop or delay its movement for three minutes, it loses its signal, provided that a freight train has, in the meantime, entered the clearing circuit on the freight main. The passenger train may regain its proceed signal by "spotting" in a three-rail track circuit, located immediately in the approach to the signal, provided that its route has not been occupied in the meantime. The occupancy of this "spotting section," of course, holds all conflicting signals

in the "stop" position. Signal 1404F at North Junction is the outbound signal on the freight main and its control is more or less typical of the control of all of the switch indicators, for inbound trains, are located at the main-line switches.

Instrument Housings and Equipment

At North Junction, two concrete houses, each 8 ft. by 10 ft., were provided for the apparatus, the relays, transformers and cable terminals being located in one house and the storage batteries and electrolytic rectifiers in the other. At South Junction one sheet-metal building, 10 ft. by 15 ft., houses all of the relays, storage battery and other apparatus. Each of the track circuits is fed by four Edison 500-ah. primary cells, each set housed in a concrete box at the location where it is used.

In the houses, the storage cells are mounted on racks which are constructed of wood, boiled in paraffin tribution points, are of the parkway type. The cables enter the instrument houses through the floor along one side under the relay rack, and are potheaded at the floor line.

The unbraided cable wires, between the potheads and the terminal posts located above the lower shelf of the relay racks, are protected by varnished cambric tubing. After the tubing was in place the potheads were filled with pothead compound.

The wiring in the relay houses is 19-strand, No. 14 copper with 3/64in. wall and double braid. These wires run direct from the posts on which the cable strands were terminated to the binding post of the relay or transformers, without any intervening terminals. The wires are drawn through individual holes above the instrument

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an 11-volt, 11-watt single-filament lamp, which is normally fed from the a-c. service, the voltage being adjusted to about 10-volts at the lamp. The automatic signals, as well as the interlocking signals, are controlled for approach lighting, except that dwarf interlocking signals, having no track circuit in the rear, are continuously lighted.

At each signal location a large sheet-metal case, with a door on the track and one on the field side, is provided to house the battery and the instruments. Each of these cases has a partition dividing the case into two compartments, the one on the track side being used for relays, while the one on the field side is used for transformers, rectifiers and storage battery. The terminals and arresters for underground cables are located at the bottom of the partition, while the terminals for line cables are at the top. Jumper wires from these terminals run in back of the board, up and out through individual holes to the instruments.

Ordinarily at a signal location, a set of five KXHS-7 lead storage cells is provided for the signal operation and for line circuits. One cell of the same type is used to feed each track circuit. Type-K rectifiers of various ratings are used to charge these batteries.

The track connection wiring is in underground parkway cable which has



Line transformer and protective devices mounted on crossarm



Two-unit multiple-aspect signal in approach to interlocking home signal

outer covering of a non-metallic combination. A two-conductor No. 9 solid-wire cable extends from the instrument case out to a concrete riser set opposite each insulated rail joint. Each of these risers, as shown in the detail plan, has a section of 2 in. pipe 8 in. long set in the top of the foundation so that about 114 in. extends above the top of the foundation. A bootleg head is clamped to the section of pipe extending out of the top of the foundation. The details of the construction of this bootleg head are shown in one of the illustrations; in brief, the feature of this device is that it consists of two separate terminals, insulated from each other and from the pipe. Each of the two cable wires extends to one half of the bootleg head and a 5/16-in. stranded galvanized iron bond 4 ft. 2 in. long is clamped to the head and extends to a 3/8-in. plug driven into the rail. As shown in one of the illustrations, the bootleg outlet is set beyond the ends of the ties and the cable from the head is run across the end and along the edge of each tie, being held in place by Copperweld staples. The parkway bootlegs for both rails of a track are located on the field side, and at the location of the insulated joint on the far rail, stranded connections 10 ft. 4 in. long are used, being stapled to the side of each tie 1 in. below the top edge.

These installations were planned and constructed by signal forces of the Boston & Maine, the signal equipment being furnished by the General Railway Signal Company.

Santa Fe Automatic Interlocking

(Continued from page 474) to which they connect and are tagged with fibre tags. Each hole is similarly tagged.

The signals on this installation are the Union Switch & Signal Company's searchlight type, and this company also furnished the relays. The power-off relays are of the ANL type. Neutral track and line relays are the DN-11 type, while the polars are the DP-14, and the time relays the DT-10 type. Fansteel electrolytic



Interior of instrument house

rectifiers and transformers are used for charging the storage batteries, the lighting transformers being the Union type W-10.

The spring-switch mechanisms are the Pettibone-Mulliken Company's mechanical-switchman type. Each spring-switch layout is equipped with two switch circuit controllers, one connected to the point, and the other to the throw rod. The circuit for the KR relay is selected through both of these controllers, thus insuring that the points are in proper position and that they correspond in position with that of the switch stand.

The cost of power for the North Junction layout is averaging about \$8 monthly and for the South Junction \$7 monthly. The maintenance charges are nominal, amounting to approximately the same as for a new automatic installation of the same size.