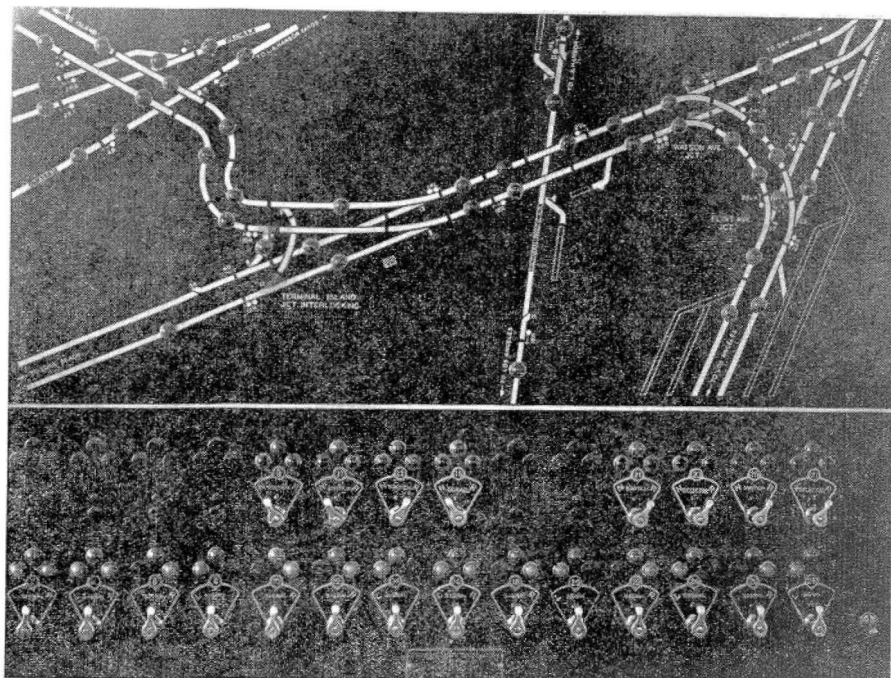
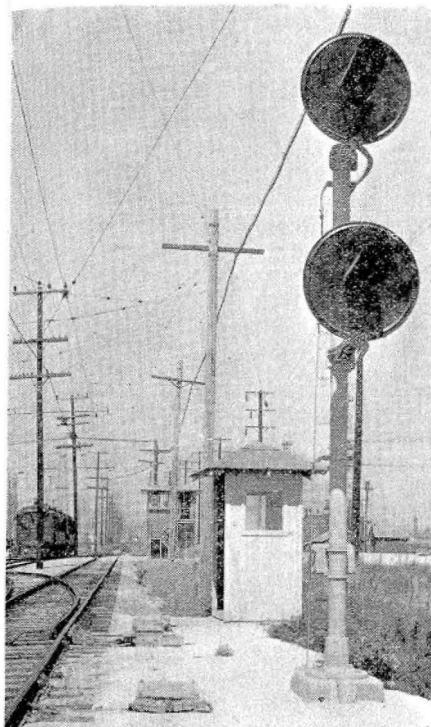


Right—The panel of the new interlocking machine.
Below — Island Junction showing home signal 12R



Switches, signals and derails scattered over a square mile, are controlled by one machine

Pacific Electric Installs a Large All-Relay Interlocking

A LARGE all-relay, electric interlocking has been installed by the Pacific Electric Railway at Terminal Island Junction, which is located in the south part of Los Angeles, Cal. This new interlocking is a part of a project including track changes and extensions to provide rapid transit passenger service between Los Angeles and the ship building yards on Terminal Island, as well as between Long Beach, Cal., and Terminal Island.

The accompanying plan shows, in solid lines, the tracks formerly in service, and, in dash lines, the tracks which were added to provide the new passenger service. Second main track was added on the east-and-west line between Wilmington Junction and

Long Beach. A new double-track connection was built between a point now known as Watson Junction and a point now known as Flint Junction, thus connecting the east-and-west line with the north-and-south main line between Los Angeles and San Pedro. At a point now known as Island Junction, two south legs were built to form a double-track wye, and a new double-track line was built from Island Junction 2.5 miles to a station on Terminal Island.

Five Interlockings in One

The various track layouts controlled from the new Terminal Island Junction interlocking machine are

scattered over an area about a mile square. In reality, the one new machine controls five layouts, each of which would be a separate interlocking if local controls, such as mechanical interlockings, had been used.

The first layout, at Flint Junction, includes, one power switch, No. 25; one spring switch, No. 27; and three home interlocking signals, No. 26R, No. 28LA and No. 28LB. The top "arm" of signal 26R governs on the straight track to San Pedro and the lower "arm" governs via the connection to Watson Junction, with power switch No. 25 normal.

Spring switch No. 27, at Flint Junction, is set normally so that the points are not moved when a trailing

move is made by a train from Watson Junction through Flint Junction. Signal lever 28, when thrown to the left, clears either signal 28LA on the connection from Watson Junction, or signal No. 28LB on the old main line from Wilmington Junction to Flint Junction. In order to establish a selection between the controls for signals No. 28LA and No. 28LB, a switch lever No. 27 is associated with

sociated with spring switch No. 23, determines the selection between signals 24LA and 24LB in a manner previously explained.

Protection at Crossing of the Pacific Electric and the Southern Pacific

A single-track line of the Southern Pacific crosses the double track of the Pacific Electric at a point just

unlocked when the derails are reversed on the Southern Pacific and home signals on both the Southern Pacific and the Pacific Electric are in the "stop" position. A trainman cannot unlock the electric locks, without first having the towerman reverse the derails.

Terminal Island Junction Layout

The Terminal Island Junction layout includes three power switches: No. 9, No. 11 and No. 13; three spring switches marked "SS" but with no numbers, and three two-"arm" home signals. Train move-

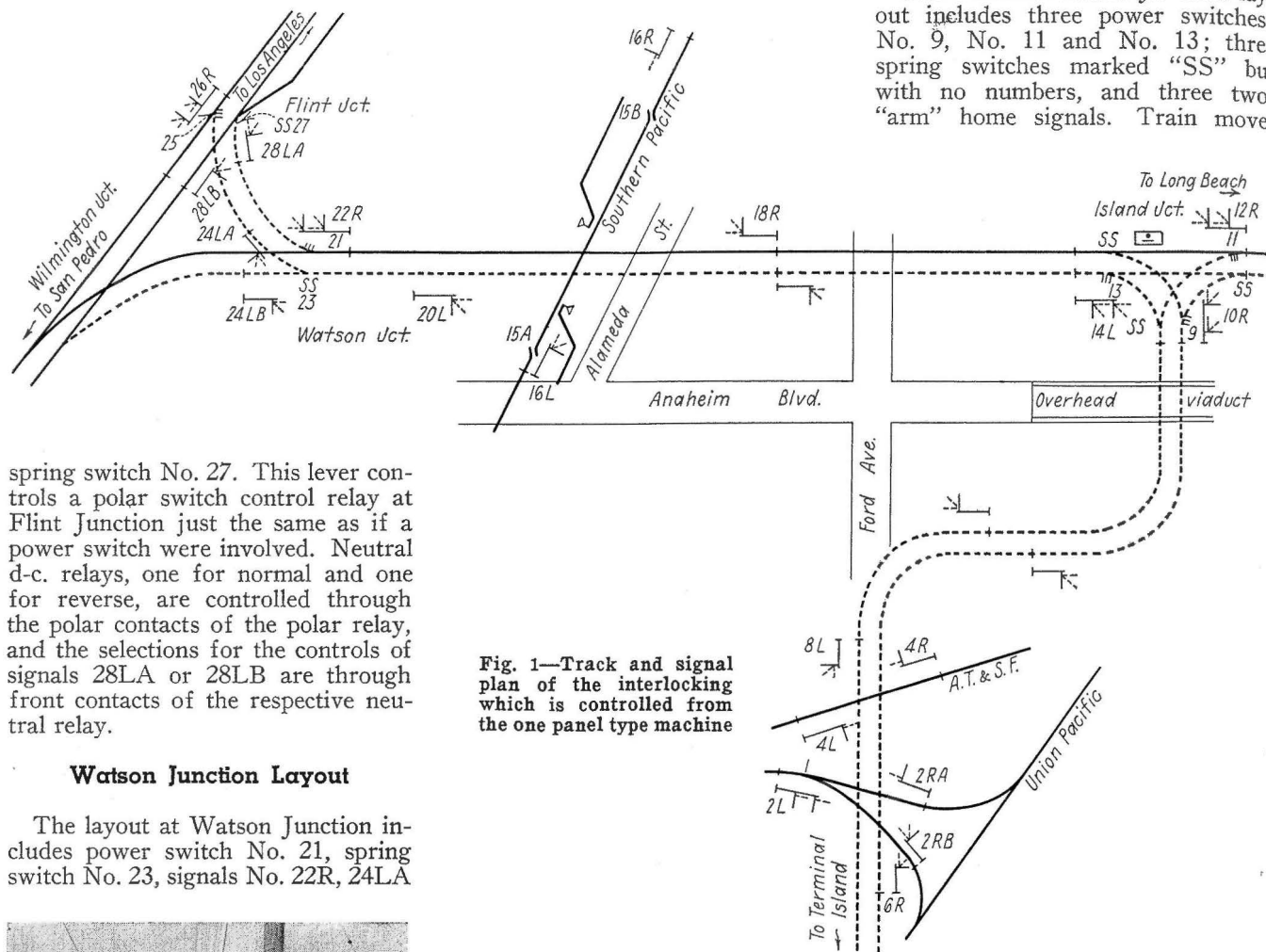
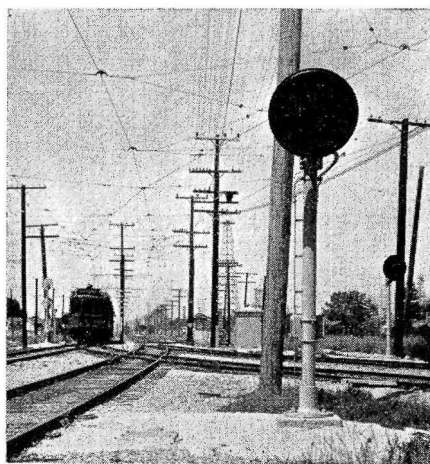


Fig. 1—Track and signal plan of the interlocking which is controlled from the one panel type machine

spring switch No. 27. This lever controls a polar switch control relay at Flint Junction just the same as if a power switch were involved. Neutral d-c. relays, one for normal and one for reverse, are controlled through the polar contacts of the polar relay, and the selections for the controls of signals 28LA or 28LB are through front contacts of the respective neutral relay.

Watson Junction Layout

The layout at Watson Junction includes power switch No. 21, spring switch No. 23, signals No. 22R, 24LA



Signal 28LB at Flint Jct.

and 24LB. The position of power switch No. 21 determines the selection between the top and bottom "arms" of signal 22R. Switch lever 23, as-

west of Alameda Street, which is about 900 ft. east of Watson Junction. Previously no protection was in service at this crossing, all trains on both roads being required to stop and whistle before using the crossing. Protection at this crossing is included in the new interlocking. Signals 18R and 20L direct trains over the crossing on the Pacific Electric tracks. No "back-up" signals are provided for reverse train movements. On the Southern Pacific, there are two power-operated derails, both being controlled by lever No. 15. The two home signals 16R and 16L are controlled by lever 16. Two spur tracks enter the main line of the Southern Pacific at hand-throw switches within interlocking home signal limits. An electric lock was installed on each of these switches. These locks may be

ments are single-direction right-hand running, and no provision is made for signaling to direct "back-up" moves. The position of power switch No. 13 determines the selection between the top and the bottom "arm" of signal 14L, likewise the position of power switch No. 11, selections for signal 12R, and power switch No. 9 selects for signal 10R. The operations do not require selection levers associated with any of the three spring switches, because the selections in each route are already determined by the power switch in the track line up before encountering the spring switch for a trailing move.

Layout on Ford Avenue

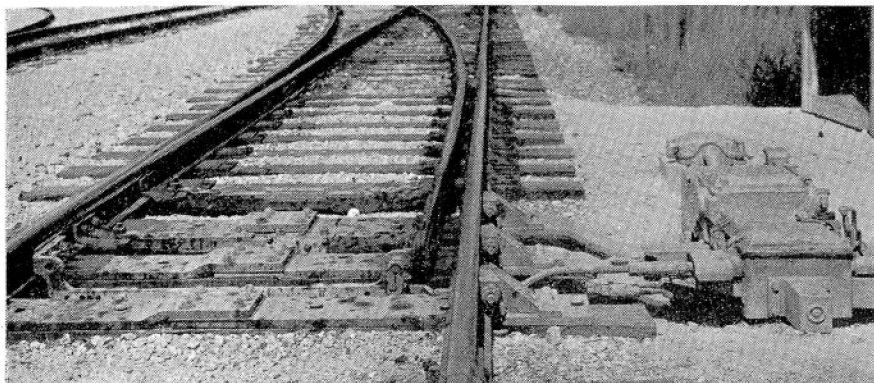
The new double-track Pacific Electric line south from Island Junction

crosses a single-track line of the Atchison, Topeka & Santa Fe, and two single-track lines of the Union Pacific. The three crossings are so close together, on the Pacific Electric, that one northward home signal, No. 6R, and one southward home signal, No. 8L, serve on the Pacific Electric. The home signals on the A. T. & S. F. are Nos. 4L and 4R.

The second Union Pacific track was added after the interlocking was planned, and, therefore, switch No. 1 is now operated by a hand-throw stand. As soon as materials can be secured, a switch machine will be installed at switch No. 1 and a second arm will be provided on signal 2L. Signals 2LA and 2LB, as well as signals 2RA and 2RB, will be selected through the position of the switch.

Panel Type Control Machine

Considered as a whole, the new interlocking, controlled from the one machine at Island Junction, includes



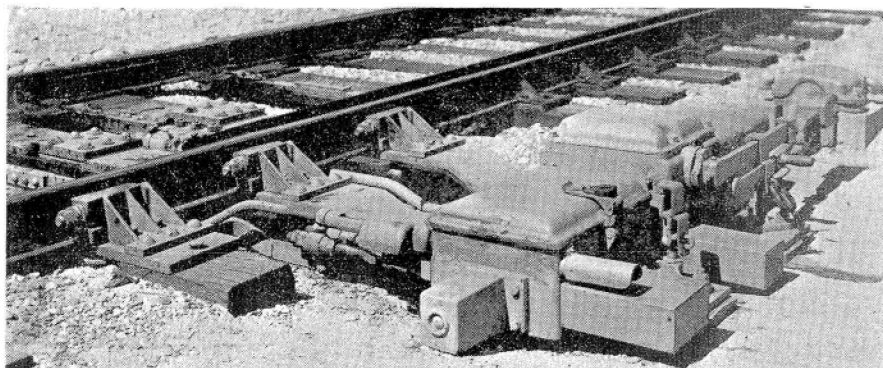
Insulated gage plates and adjustable rail braces

5 power switches, 2 power-operated main-line derails, 2 electric locks on hand-throw switches, and 20 home interlocking signals, of which 14 have one operative unit and 6 have two operative units.

The control machine for the new interlocking is of the panel type with an illuminated track diagram and two rows of miniature-type levers. No mechanical locking between levers or electric lever locks are included in this machine. Five levers each control a single power switch, one lever controls two power-operated derails, and two levers each are used to establish selections for signal controls over spring switch No. 23 at Watson Junction and switch No. 27 at Flint Junction.

Three indication lamps are mounted above each switch lever. The lamp at the left is lighted green when the switch is in the normal position, and the lamp at the right is lighted amber when the switch is in the reverse position. The lamp in the center is

lighted red when the electric locking is in effect to prevent operation of the switch even if the leverman operated the lever; in other words, this



Dual-control electric switch machine

is a "hands-off" lamp.

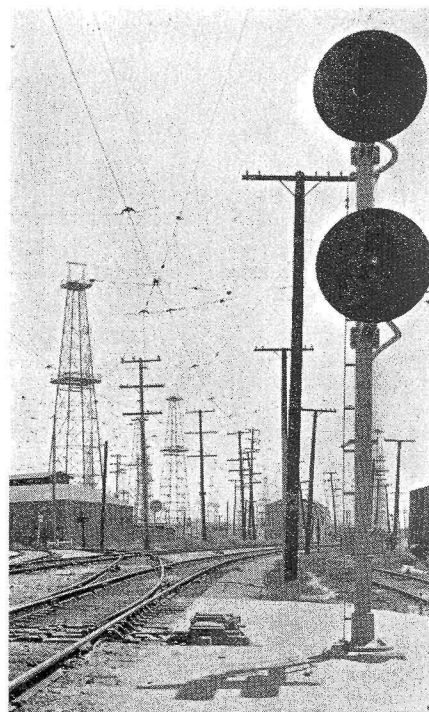
There are 14 signal levers in the bottom row. These signal levers normally stand in the vertical position, on center. Three levers, No. 2, No.

Island Junction. This sound, in conjunction with an indication by the track-occupancy lamp for this approach track section, informs the leverman that he should line up for

4, and No. 16, operate either to the left or to the right position to clear correspondingly numbered L or R signals. The remaining eleven signal levers operate either to the R or the L position to clear the correspondingly numbered signal. The indication lamps above the signal levers repeat the normal Stop aspect of the signals, or the Proceed aspect of the signal controlled by either the R or the L position of the corresponding lever. The lamps in the illuminated track diagram are lighted when the corresponding sections of track are occupied.

Microphone Annunciators

When trains approaching on a certain track may take either one of two routes, the leverman must be informed accordingly. For example, when a southbound train en route for Terminal Island approaches Flint Junction, the motorman sounds a long and a short blast of the whistle. This



Signal 26R at Flint Junction

a route via Flint Junction through Watson Junction and Terminal Island Junction.

Signals and Switch Machines

The signals in this interlocking are the searchlight type and are operated by 250-ohm direct current coils. The lamps in the signals are the double-filament type rated at 10 volt 13 + 3.5 watts.

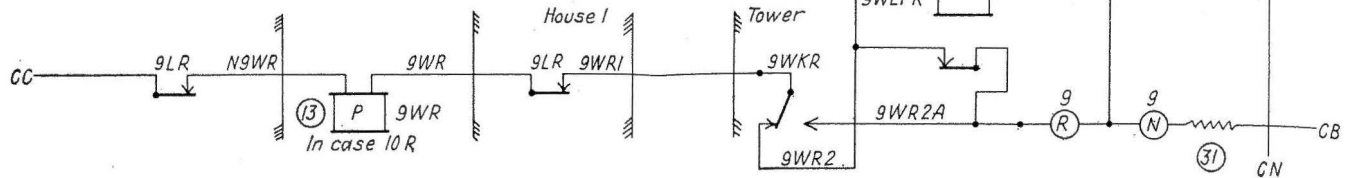
The switch machines are the Model M22A, with dual-control, and equipped

for operation on 110-volts a-c. At each switch, 1-in. by 9-in. insulated gage plates are used on three ties, and adjustable rail braces are provided on these plates. Two of the plates extend

nue. At each of these five layouts, there is a 5-ft. by 7-ft. welded sheet metal instrument house which includes the local track and control relays, as well as local interconnections

tacts of a lock relay in the local sheet-metal house, and then one wire goes to the center tap between the two rectifiers in series, and the other wire goes to the tower and is connected to

Fig. 2—Typical switch control circuit



and are attached to the switch machine, thus preventing lost motion. The ties are dapped 4.5 in., so that the base of the machine is 4 in. below the level of the base of the rail.

Track Circuits and Power Supply

On account of the fact that direct current propulsion is used on the Pacific Electric, the track circuits are the alternating-current type, using Model 15 two-element vane relays or Style SLV13 single-element vane relays.

All control circuits are d-c. and are fed from constant potential rectifiers which are fed from a-c. power. The direct-wire remote control circuits are fed from rectifiers in series, arranged to provide the equivalent of a split battery connection. The overall voltage of this d-c. is 35 volts, and the maximum rated output of the rectifiers is 1.9 amp.

The signal lamps are fed from low-voltage transformers, approach lighting control being provided. By means of a switch on the panel of the interlocking machine, relays at the various layouts can be controlled and contacts of these relays control circuits through the primaries of the lighting transformers to dim the lights during hours of darkness. The 110-volt a-c. switch machines are fed from transformers. Thus directly or indirectly the switches, signals, control circuits, track circuits, etc., are all fed from the alternating-current supply, with no battery standby. This practice is satisfactory in this instance because the Pacific Electric cannot operate trains if the electric propulsion supply fails.

Control Circuit Arrangements

From the standpoint of circuits, there are five separate and independent propositions: (1) Flint Junction, (2) Watson Junction, (3) Southern Pacific Crossing, (4) Terminal Island Junction and (5) the U. P. and the A. T. & S. F. crossings on Ford Ave-

of circuits. The control circuits from the interlocking machine to each of these five instrument houses, as well as the circuits for the return of indications to the tower, are all direct-wire circuits.

The position of each interlocked switch is repeated by two neutral relays, one for normal and one for reverse, these relays being in the local sheet-metal house. Each of these neutral relays has a repeater in the tower, such as relays 9NWKR and 9RWKR in Fig. 2. When switch No. 9 is in the normal position, 9NWKR is energized, which closes the circuit

of the hinge of the polar contact of the polar switch repeater relay.

As shown in the diagram Fig. 3, power switch No. 9 is controlled by polar relay 9WR. In the control circuit for 9WR lever repeater relay 9WLPR is normally energized. When lever No. 9 is thrown to the reverse position, a circuit is closed from battery CN, through a reverse lever contact 9R, the coil of 9WLPR, another reverse lever contact 9R, the front contact of 9WLPR, the left polar contact of 9WKR, a front contact of lock relay 9LR, the coil of switch control relay 9WR, another contact

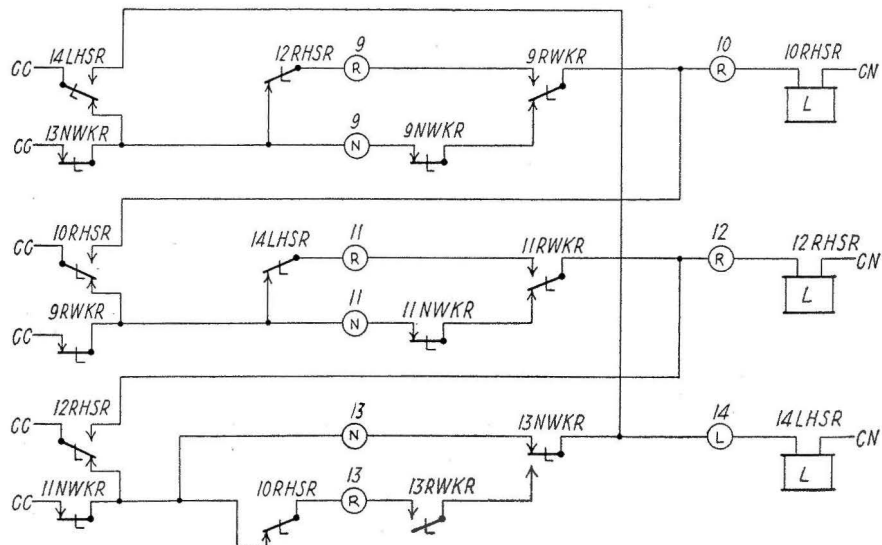


Fig. 3—Typical signal agreement circuit

to energize polar switch-repeater 9WKR with the polar contacts to the left. Relays such as 9NWKR and 9WKR are the L-type relays, and are housed in the case of the interlocking machine.

The operation of each switch machine is controlled through the neutral and polar contacts of a DP-25, d-c. 280-ohm polar relay, which is located in a case near the corresponding switch machine. Such a switch control relay is controlled by a two wire circuit, both wires of which each extend through front con-

of 9LR and to center feed connection of battery CC. Thus the polar switch control relay is reversed, and the switch is operated to the reverse position, after which switch position relay 9WKR is reversed.

The purpose of lever repeater relay 9WLPR is to prevent pre-condition or switch storage control of a switch control relay.

For example, if a train occupies a track section that locks switch No. 9, then relay 9LR would be released and, as a result, relay 9WLPR is released. As long as the front con-

tact of 9WLPR is open, operation of lever No. 9 will be ineffective in operating relay 9WR. Therefore, before switch No. 9 can be reversed, the leverman must wait until after the train clears the track section to permit lock relay 9LR to be energized, and then the lever must be placed normal to pick up relay 9WLPR, after which the switch can be reversed by placing lever 9 in the reverse position.

The indication circuits from the instrument houses back to the control machine are fed from indication transformers with 17.0-volt secondaries. Selection through rectifiers is provided to carry two indications over one wire, with either one or both operating at any one time.

Signal Control Interconnections

The interconnection of signal agreement circuits through the L-type relays in the interlocking machine, are shown in Fig. 4. For example, if switch No. 9 is normal, and lever No. 10 is thrown to the right, then battery feeds from CC through front contact of switch repeater 13NWKR, through 9N lever contact, through front contact of 9NWKR, back contact of 9RWKR, through the 10R lever contact and the coil of relay 10RHSR to battery CN. After relay 10RHSR is thus energized, it stays picked up by a circuit through its own front contact to battery CC. As long as 10RHSR is thus stuck up, circuits to energize control relays for conflicting signals cannot be complete, be-

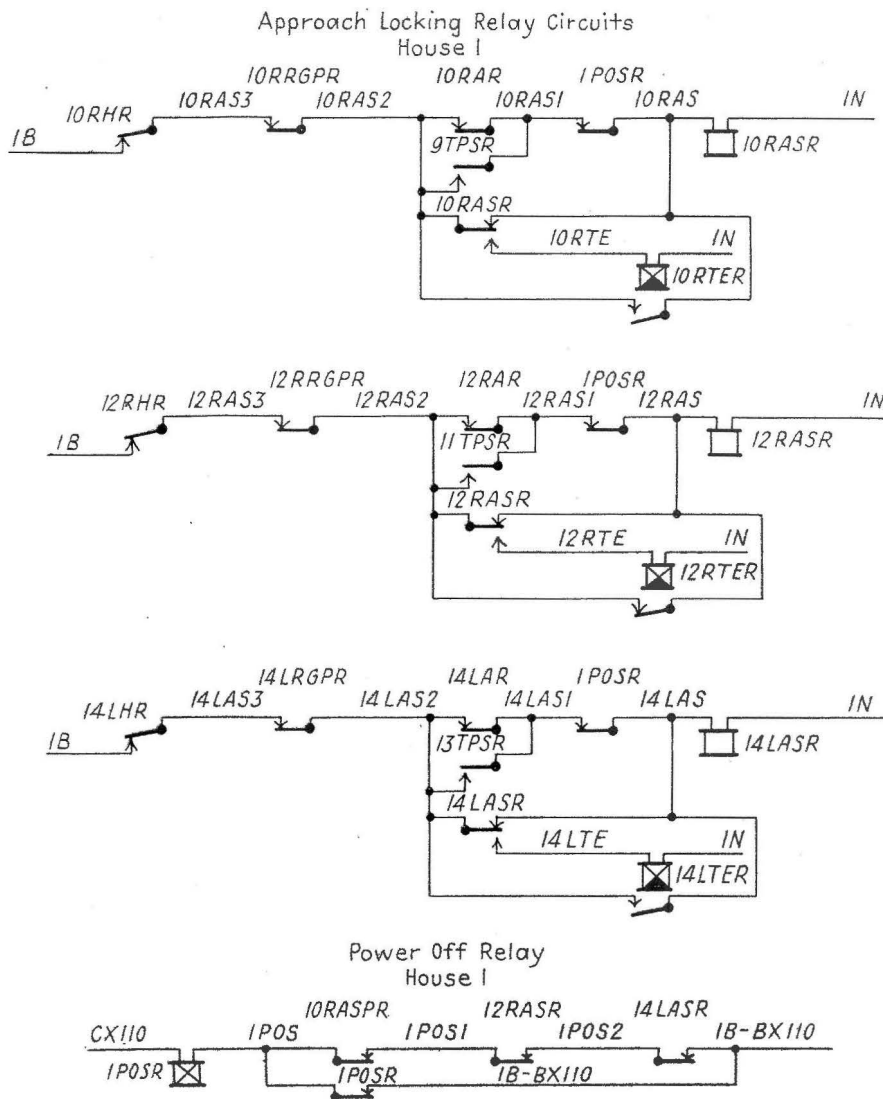
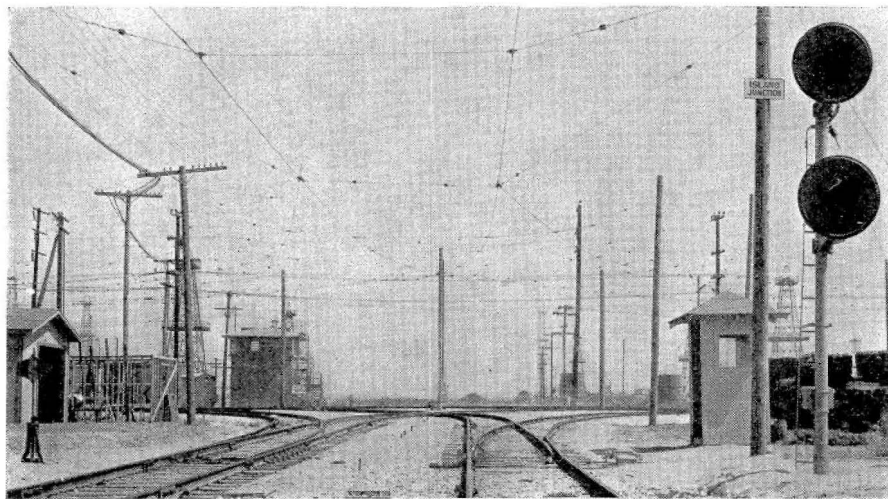


Fig. 4—Approach locking circuit



Home signal 10R at Island Junction

cause back contacts of 10RHSR are open. Also inadvertently moving switch lever 9 or any other switch or signal control levers on the control panel will not drop relay 10RHSR and kick-off signal 10R in the face of an approaching train.

The 9WLPR relay, being in series

with 9WR switch control relay, checks the switch locking circuit through front contacts of the 9LR relay and lights the hands-off light over the switch lever when the relay is down.

Approach locking protection is provided with automatic time release

effected by DT-10 time element relays. The DT-10 time element relays are adjustable from 0.5 to 6.0 minutes. If the a-c. power should fail, the approach locking relays and the power-off relay will drop. The approach locking relays will not pick up until after the power is on and the time element relay has operated. After all the approach locking relays are energized, the power-off relay is picked up to restore the a-c. feed to the plant. The circuit for accomplishing these results automatically are shown in Fig. 4.

Automatic Block Signaling

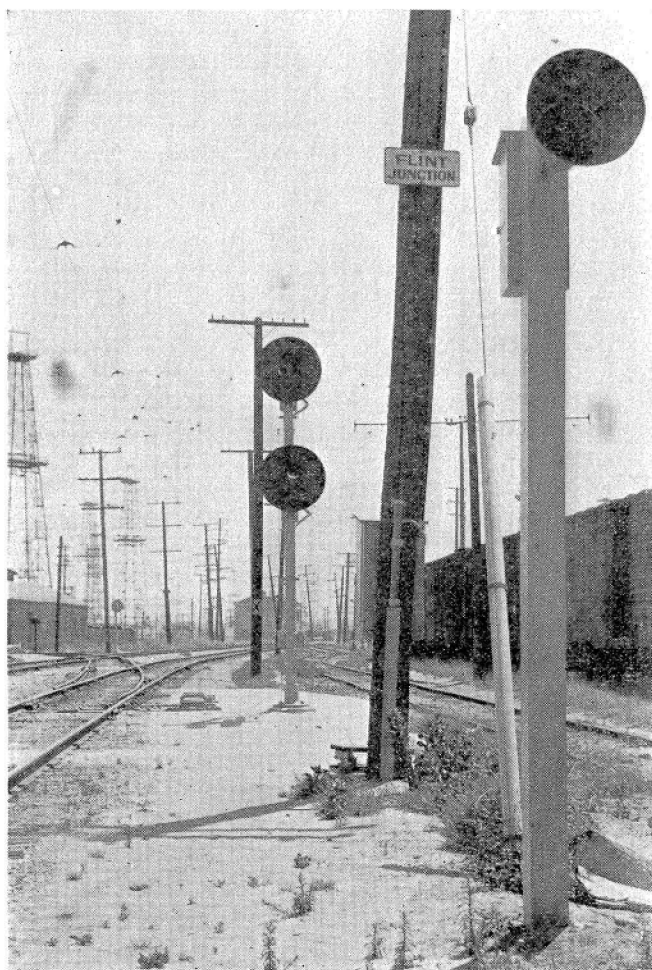
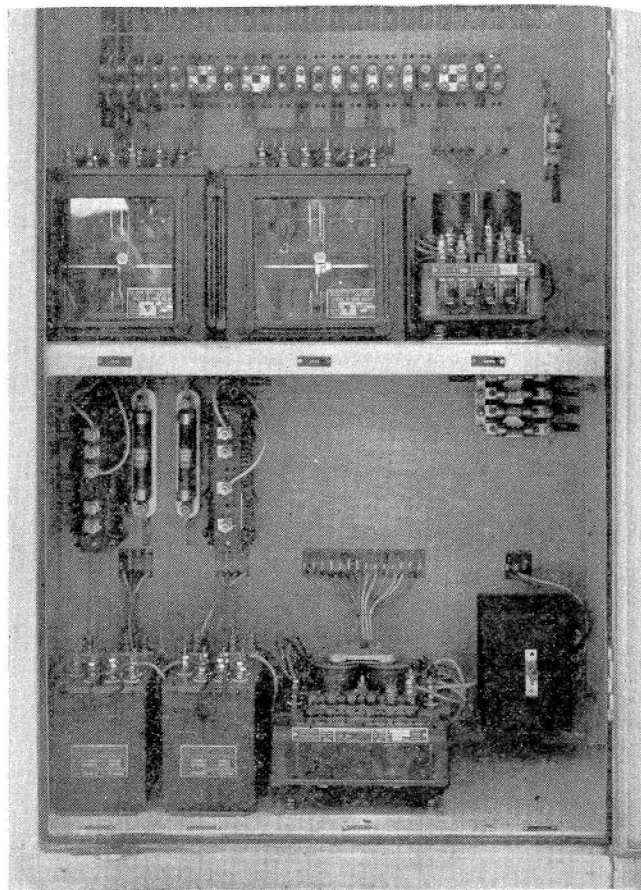
On the 2.5 miles of the new double track line between Terminal Island Junction and the station on Terminal Island, new automatic block signaling was installed as a part of the improvement project. These signals are of the searchlight type and are mounted as dwarfs. The signaling is for single-direction train operation, right-hand running, the blocks being approximately 1,200 ft. long, to space

trains on approximately two-minute headway. These signals are controlled by neutral a-c. track circuits, in combination with polar a-c. line circuits. The signal lamps are controlled by approach lighting circuits.

Bridge Over Cerritos Channel

The new section of railroad crosses the Cerritos Channel, between the main land and Terminal Island, on a double lift bascule bridge. On each side of the bridge, double track converges to single track which extends over the bridge. The ends of double

Right — Interior of instrument case at Terminal Island Jct.



Left — Microphone at home signal No. 26R at Flint Junction

volts direct current which is fed from rectifiers. The interlocking equipment at this drawbridge location was furnished by the General Railway Signal Company.

The major items of equipment for the Terminal Island Junction interlocking and the new automatic block signaling were furnished by the Union Switch & Signal Company.

These new interlockings and signaling were installed under the direction of A. Orin Smith, signal engineer of the Pacific Electric. L. H. Cash is assistant signal engineer in charge of plans and engineering, and W. E. Stratman is foreman of the field forces.

track switches are operated by Pettibone Mulliken oil buffer spring switch mechanisms. On each of these switches there is a General Railway Signal Company Type-A automatic mechanical facing-point lock.

The single track over the draw bridge is protected by a derail and a home signal on each side, Model 5B switch machines and Type SA searchlight signals being used. These interlocking derails and signals are controlled by levers which were added to an existing Model-2 unit lever interlocking machine which was previously in service to control interlocking protection for a Union Pacific single track over this same bridge. The switch machines are rated at 110-

Right — A north-bound car passing signal 28LB at Flint Junction

