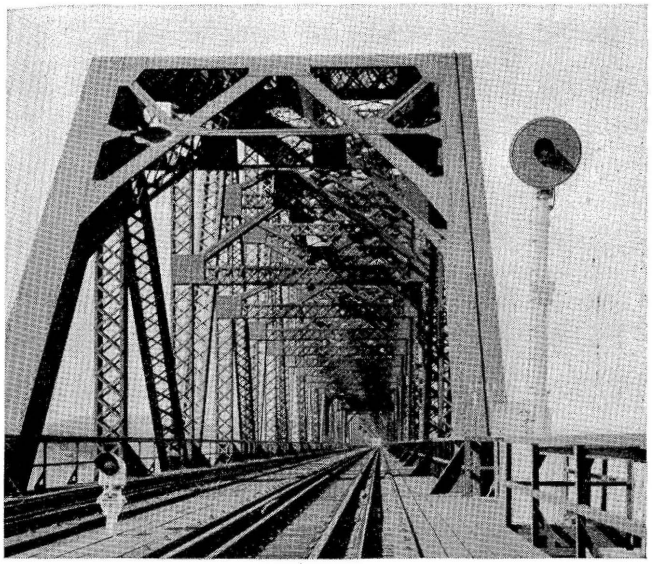
# Interlocking on Southern Pacific Suisun Bay Bridge

## Electro-pneumatic plant with special rail-checking device includes train-stop protection to obviate use of derails



Searchlight-type signals are used on the interlocking




THE EIGHT-LEVER electro-pneumatic interlocking, installed as protection on the new Southern Pacific drawbridge over Suisun Bay, 37 miles north of San Francisco, Calif., includes several interesting features such as special rail-checking devices and automatic train stop in lieu of derails.

The bridge, which is 5,603 ft. long, including the approach spans, was constructed at a cost of approximately 12 million dollars to carry the double-track main line across an arm of Suisun Bay over which trains were ferried prior to the construction of this bridge. As this is the main line to San Francisco from points north and east, the traffic includes 24 passenger trains and about 12 freight trains daily. The bridge clears the surface of the bay at high water by 70 ft., so that it is not necessary to raise the bridge except two or three times a day when larger boats pass.

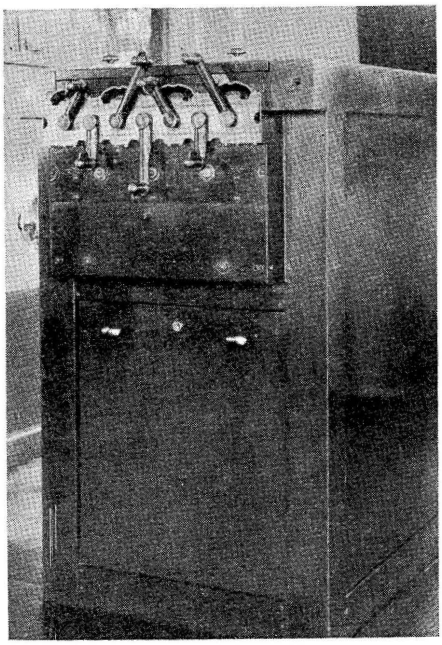
The electro-pneumatic interlocking machine, with an eight-lever frame, is located in the control room built in the bridge structure over the tracks on the movable span. Four levers are used to control 8 signals, 1 lever for 8 rail wedges, 1 lever for 2 bridge locks and 1 lever for a selector between the electric and gasoline-engine drive for the operation of the bridge.

The interlocking signals are of the searchlight type, one unit being used for each signal. The high signals operate to three aspects, red, yellow and green. Each signal has a number board with the addition of a second line reading "SA", meaning semi-automatic, and indicating that it is an interlocking signal with the control extending past the interlocking limits into the automatic block beyond. No provision is made at this interlocking for call-on aspects. Each signal is equipped with a 10-volt, 13.5—3.5 watt, double filament lamp. The eastward high home signal is mounted on a mast located on a platform, which is supported by brackets from the bridge structure, while the westward home signal is mounted on a bracket attached to the bridge structure. The two back-up dwarf signals are each mounted on a three-inch pipe post high enough to bring the center of the lens 1 ft. 11 in. above the level of the top of the rail.

### Bridge Locking Arrangement

The movable span, 336 ft. long, is of the vertical lift type. When seated in the normally-closed position, the

position of the lift span is checked by four plunger-type circuit controllers, one at each corner of the bridge deck. The bridge is locked in the normal position at each end by four wedges or plungers. The plungers at each end of the bridge are operated by an electro-pneumatic switch-and-lock movement, one lever in the interlocking machine controlling the operation of the two machines, one of which is at each end of the bridge. The bridge plungers or wedges operate a polarized-indication switch circuit controller which provides means for check-locking cir-



The electro-pneumatic interlocking machine is in the control room

cuits and indication circuits on the interlocking machine. The bridge plungers are locked in the normal position by a bar, operated by a separate electro-pneumatic valve, and controllers attached to this bar have contacts through which certain locking circuits are carried. A hand-operated cranking device is provided as an emergency means of pulling the bridge plungers, in case of failure of the power-operated mechanisms. The hand-operated mechanism is normally locked by an electric lock which requires a special release operation to cut it into service. The normal position of the rail ends, which extend from the movable span to the shore span, is checked and locked electrically and mechanically. A connecting rod, attached by a bolt to each rail end, extends down to a universal-type switch circuit controller mounted on the timbers under the track on the movable span. Check-locking circuits are carried through these controllers, the contacts being adjusted so as to check the normal position of the rail ends within ¼ in.

### Rail-Checking Device

Further protection is provided by a mechanical arrangement which checks the normal position of the rail ends and locks them. Fitting over the edge of the base of the rail is a cam or wheel 2 in. wide and 5½ in. in diameter, mounted in a vertical plane on a 1-in. pin. In the periphery of this wheel, there is a notch which fits over the edge of the rail, the upper lug extending about 2 in. In the normal position, these wheels are locked by plungers or cams attached to and actuated by a 2-in. by 2-in. rocker shaft. The four rail locks on each end of the bridge are connected to one rocker shaft which is operated by an electro-pneumatic switch-and-lock movement.

When the bridge is to be raised, the lever is reversed, operating the switch machine which rotates the rocker shaft, thereby moving the locking cams out of the notch in each wheel. As the rail ends are raised, the wheels rotate, freeing the edge of the rail from the notch in the wheel. The wheel is counter-balanced so as to stay in position to receive the edge of the rail again when it is lowered, at which time the wheel is again rotated to the proper position for the locking cam to enter the notch.

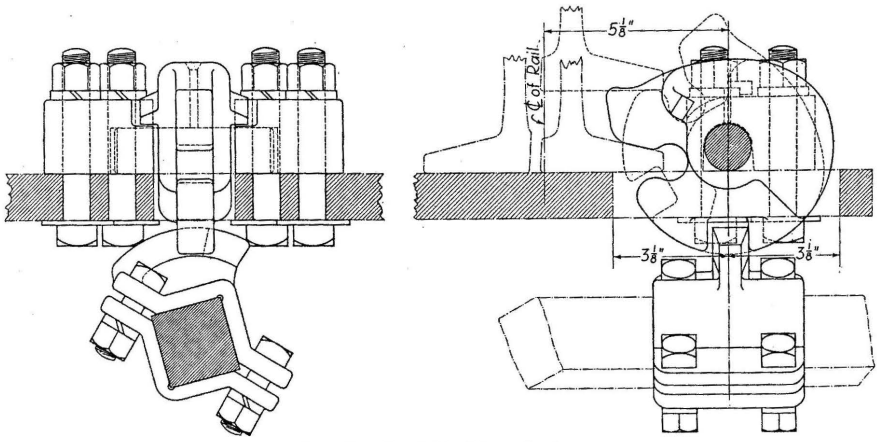
One electro-pneumatic switch-and-lock movement is used to operate the eight rail locks at each end of the movable span. The switch-and-lock mechanism is mounted on the bridge deck on the fixed span. However, the air cylinder and electro-pneumatic control valves are located on the movable span, a mechanical bridge coupler being used to form the connection between the two units. A second cylinder, with no pipe connections, is connected to the mechanism in the rear, being used as an air buffer to reduce the slam and shock on the various parts. The purpose of locating the cylinder on the movable span was to confine as many circuits as possible to the movable span, on which the tower is located, so as to reduce the number of wires on the cables between the movable span and the shore spans. Furthermore, this arrangement confines the air piping and supply to the movable span.

The track circuits are carried from the fixed span to the movable span by special circuit controllers or connectors made of ¾-in. by 2½ in. iron bars, so mounted, as shown in the illustration, as to bring the two bearing surfaces together under tension at an angle, when the bridge is in the normally-closed position. Pieces of copper are welded to the bars to form low-resistance contacts.

### Train Control in Lieu of Derails

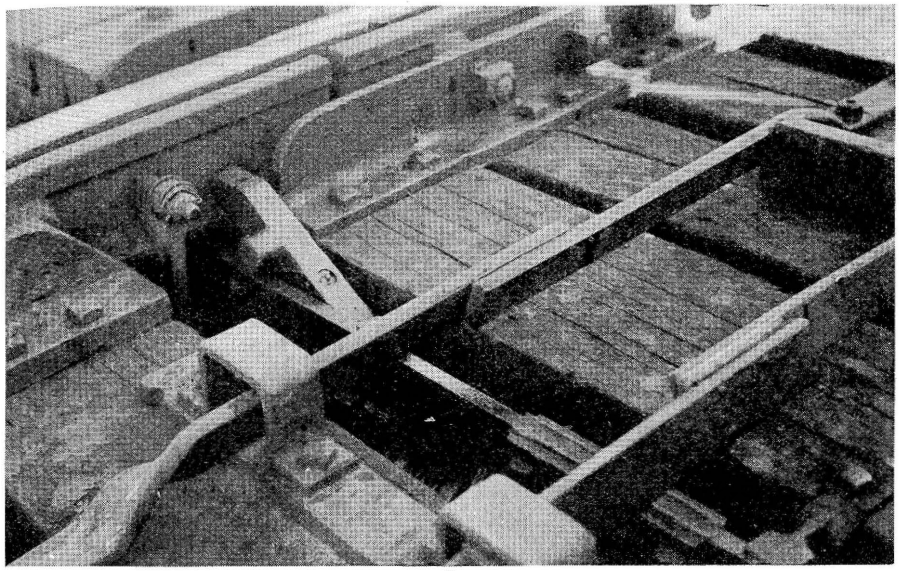
The use of derails for the protection of this drawbridge was not considered practical because of the potential hazards of derailing a train in the bridge structure or on the approaching spans. In view of the fact that the main line from Oakland via Martenez to Tracy is equipped with intermittent magnetic-type train control, all of the locomotives operated over the new bridge are equipped for train control. Therefore, it was decided that use of automatic train control would render more efficient and also much safer protection for the bridge, than derails would.

The train control used is of the intermittent magnetic type of the National Safety Appliances Company. A track magnet unit is located at each home and distant signal. When a signal displays a restrictive indication, the magnet is effective in actuating the locomotive equipment to initiate a brake application automatically. Train speeds are limited by




Details of rail-locking device

rule to 45 m.p.h. for passenger and 55 m.p.h. for freight trains, when approaching or passing over the bridge so that, on account of the ascending grades, a train can ordinarily be stopped short of the end of the lift span in case the engineman disregards a "stop" indication of a home signal. However, as an extra precaution, a second or intermediate train-control magnet is provided for each home signal. These are located between the home and distant signals



View of rail-locking device and track circuit connectors

to provide additional braking distance if needed. For example, if an eastbound train traverses the approach track section, 500 ft., at a speed of more than 18 m.p.h., the intermediate magnet will be set to initiate a train stop, provided signal 2R has not been cleared in the meantime. This control is accomplished by a DT-10 time-element relay which is cut into the circuit only when the home signal is at "stop."

As mentioned previously, the interlocking signals are of the searchlight type, and, as a special protection in case of a lamp burn out, an ANL relay, in series with the filament of each signal, controls circuits which cut in the track magnet in case of a lamp burn out.

On the lift span, the wires are distributed from the tower to the electro-pneumatic valves and circuit controllers in an aerial-type cable run in an angle-iron channel attached to angle-iron brackets on the handrail on the bridge. The wiring from the tower, which is on the lift span, to the signals on the shore spans, is run in a 60-conductor steel-taped Kerite aerial cable suspended from a stranded steel cable stretched between the two ends of the fixed span at one side of the lift span, a lead from the center of the cable extending to the tower in such a way as to be clear of the opening when the span is raised.

The various control and lock circuits on the interlocking are fed from two sets of Exide DMGO storage batteries, one having six cells and the other four cells. The signal lamps are normally fed from the a-c. supply, with a power-off relay which switches the feed to a standby battery of four cells of storage in case of a power outage. A separate set of four cells of the same type of battery is used to feed each of the eight track magnets. Each track circuit is fed by three cells of Edison primary battery.

### Interlocking on West Approach

The junction, between the line to Tracy and the double-track line extending to the new bridge, is located near Martinez at the bottom of the incline about two miles from the bridge. In order to eliminate crossover train movements at the junction, a new westbound track was constructed on the Tracy line from Mococo to Martinez, this line going through an underpass under the double-track approach to the bridge. Spring-switch mechanisms were provided at the end of double track at Mococo and also at the junction switch of the westward track at Martinez. A power-operated switch machine was installed for the junction switch at Martinez where the eastbound track of the Tracy line branches off of the double-track main line. This power-operated switch and the interlocked signals at the junction at Martinez are controlled by an all-relay, remote-control interlocking, with the control panel in the operator's office at Martinez. This panel consists of an illuminated track and signal diagram and three miniature-type non-interlocking levers, similar to those used on C.T.C machines. The operation of switch No. 1 is controlled by a two position lever, the position of the switch being indicated by lamps on the diagram. Four signals, 2Ra, 2Rb, 2La and 2Lb, are controlled by three-position lever No. 2. If the switch is normal for main-line moves, the operation of lever No. 2 from the center position to the right clears the high arm 2Ra; or, if the switch is reversed for the diverging route to the Tracy line, the low arm signal 2Rb clears. Likewise, signals 2La and 2Lb follow the position of the lever to the left and the position of the switch.

The two signals 351 and 353 are controlled by three-position lever No. 3. When the lever is on center, both signals indicate "stop." When the lever is thrown to the right, signal 351 clears, or when thrown to the left, signal 353 clears. Approach, route and detector locking is provided according to regular practice.

The three signals at the junction at Mococo, 356, 358 and 359, are controlled automatically by track circuits and by the position of the junction switch. Train control is in service also on this Tracy line and magnets at distant signals D352 and D365 are so controlled as to effect brake applications if the engineman does not observe the "caution" as well as "stop" indications. The signals on this installation are of the searchlight type, and a Model-M 20 volt d-c. switch machine is used.

The interlocking plants described in this article were designed and installed by signal forces of the Southern Pacific, the signal and interlocking equipment being furnished by the Union Switch & Signal Company.

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Spring switch with facing-point lock on the Great Northern