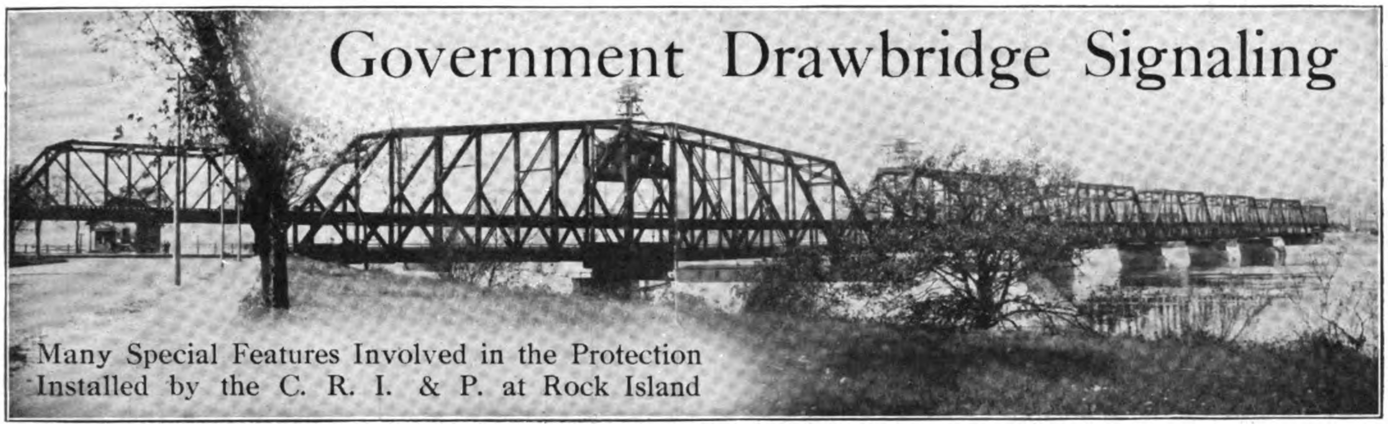
Government Drawbridge Signaling



Many Special Features Involved in the Protection Installed by the C. R. I. & P. at Rock Island

General View of the Mississippi River Bridge at Rock Island, Ill.

The double-track main line of the Illinois division of the Chicago, Rock Island & Pacific crosses the main channel of the Mississippi river between Rock Island, Ill., and Davenport, Ia., on a steel truss bridge about 1,850 ft. long, including a 370-ft. swing span. As this bridge connects the Iowa shore with an island on which a government arsenal is located, the government is vitally interested in the structure. It was built jointly by the road and the government in 1896, replacing the first bridge ever built over the Mississippi river, which was put in service by the Rock Island in 1856, about ¼ mile above the present structure. The responsibility and cost of operation and maintenance are also divided between the War Department and the Rock Island.

A bridge superintendent is constantly in charge, who is assisted by three operators and three draw tenders. The supervisor of signals on the Chicago, Rock Island & Pacific is kept advised in regard to the signaling features and co-operates with the government men as much as possible. This bridge handles on the average about 3,000 trains per month, and is opened for about 250 boats per month. The largest number of boats ever passing in one month was 1,026.

Until recently there was no interlocking between the signals and the drawbridge control, and there was no automatic protection across the structure. A Hall disc signal at each end of the bridge gave warning of an open draw, the control of these signals being broken through the end jacks of the movable span in addition to single-pole, double-throw knife switches in the operator's tower on top of the span, so that before the bridge was moved the signals would be set to danger, even if the operator neglected to throw the switches. The desirability of improving this arrangement had long been realized, but in addition to unusual physical difficulties which confronted any plan to extend the automatic signal protection across the bridge, the unavoidable complications incident to the negotiations with the government delayed a decision and resulted in the final adoption of a plan which, under ordinary conditions, might possibly have been further perfected. By the use of a trap circuit, this gap in the automatic signals has been filled, and by a number of special arrangements the control of the bridge has been interlocked with the new signal protection.

AUTOMATIC FEATURES.

The trap circuit on the bridge was necessitated by the impracticability of using track circuits on the steel trough floor of the bridge. The railroad tracks are laid on an upper deck with a roadway and an electric car line below. This fact makes it essential to maintain a solid floor on the upper deck, and in the design used, the rails are laid directly on the transverse steel troughs without ties or ballast. Plans have been proposed at various times in the past for insulating the rails on this structure, but while it would doubtless be possible, it is easy to demonstrate that the expense would be prohibitive, both in first cost and maintenance.

Five new signals were installed, two home, two dwarf for back-up moves and one dwarf to repeat the indication of one of the home signals. It was desired to locate the home signals about 200 ft. from the ends of the draw span. As this span is the second from the east end of the bridge, it was possible to get a satisfactory location for the westbound signal just east of the end of the bridge, but the eastbound signal had to be mounted on the bridge superstructure. On account of considerations of clearance and visibility, it would have been practically impossible to use semaphore signals satisfactorily and light signals were therefore adopted. The westbound home signal is mounted on a standard mast, but the eastbound had to be suspended between tracks from the west portal of the span west of the draw span. While this signal is visible from a distance, it cannot be seen by the engineer at short range, and a dwarf repeater was therefore mounted near the bottom of the end post of this span on the engineer's side. The back-up dwarfs are located on the bridge floor between tracks. All signals give two aspects, red and yellow, the most favorable indication being caution. They are normally red, being cleared by the bridge operator only on the approach of a train. All trains are required to stop short of the home signals and then proceed at caution, if the light is yellow.

A short track section, just beyond the westbound home signal, drops a tower indicator, which holds the signal at stop behind the train until it has crossed the bridge and entered a short releasing track section, which again makes it possible for the operator to clear the signal. Since the eastbound home signal is located on the bridge, a track instrument with a normally-closed contact had to be used in place of a setting track section. This circuit is released in the same manner as that on the westbound track when the train enters a section just beyond the leaving end of the bridge. As there are a number of yard tracks and freight house leads just off of the west end of the bridge, switching movements onto the structure are frequent, and in many cases such movements are made across the bridge against the direction of traffic. In order to restore the trap circuits to normal after such moves, the operator is provided with push buttons in the tower. While it would be possible on account of the length of the circuit on the westbound track for him to use the release button with a train standing in the dead section and then clear the home signal behind the train, this is practically the equivalent of standard automatic signal protection where a train receives a "stop and then proceed with caution" indication at the entrance to an occupied block. The advantages of an advance signal on this track in handling switching moves were considered, but the expense involved was not considered justifiable.

INTERLOCKING.

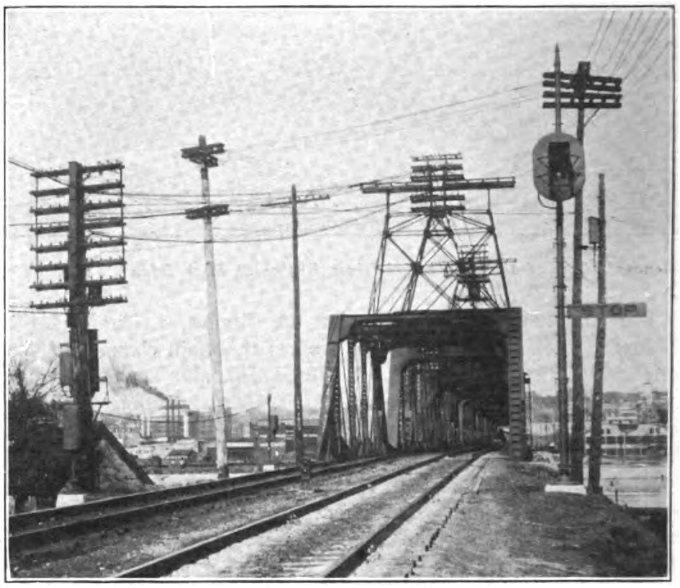
The rail locks on the movable span, which are easer rails moving longitudinally alongside the track rails and bridging the gaps between the movable and the fixed spans, are operated by air cylinders as are also the end jacks, while the bridge-turning mechanism is electric. In order to interlock the operation of the bridge with the signals, four circuit controllers equipped with levers like those used on electro-pneumatic machines were mounted over the mechanical levers controlling the pneumatic functions. Two of these circuit controllers govern the five signals, each lever having a left and right position in addition to the center. The other two levers, operating only to the left, are mechanically interlocked with the signal levers, and con-

Looking East Over the Draw Span Showing Two Dwarf Signals and Track Instrument.

nected by vertical rods to locking which controls the air levers below. In order to move the bridge it is necessary to have both signal levers on center. The circuit controller connected to the rail lock lever must then be thrown before that function can be operated pneumatically. This allows the pneumatic levers controlling the end jacks to be released by the circuit controller and then operated, after which the bridge can be turned.

To clear the signals, the pneumatic levers must be in the position corresponding to a closed and locked bridge, and locked in this position by the circuit controllers. After either of the signal levers is thrown to clear, a push button must be operated to complete the signal actuating circuit. Three such push buttons are provided for each signal, one in the tower, one on the track deck and one on the turntable deck, thus enabling the operator to throw the signal lever and then go below to work, pushing the most convenient button to let a train pass without the necessity of climbing back to the operating tower.

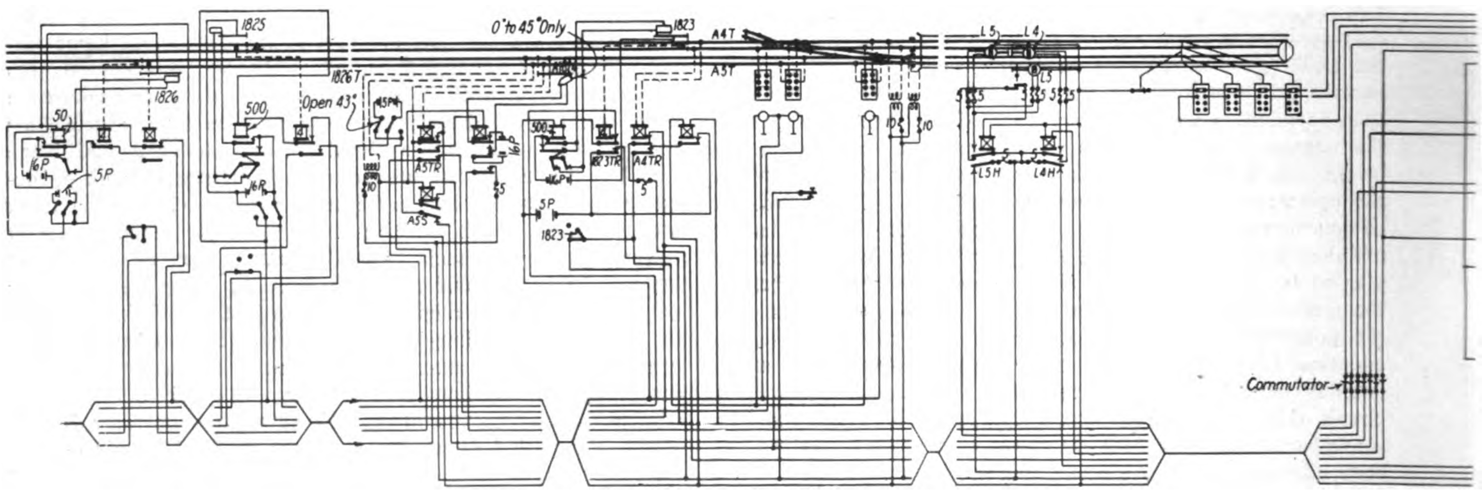
The manipulation of the signal-control levers is prevented by electric locking actuated by track circuits in advance of the home signals and released by circuits beyond the limits of the plant. Electric locks on the levers governing the bridge movements are controlled by switch-circuit controllers on the rail locks. Clockwork time releases provide an emergency means for releasing the locking on the signal levers, and a double-throw switch in a sealed glass case in the operating tower provides a means in extreme cases for releasing all lever locking. In case this is not sufficient, the mechanical connections between the circuit controllers and the pneumatic levers are so made that by breaking two seals these rods may be removed and the bridge operated at will. An unusually complete set of indicators is installed for the guidance of the operator. There are two approach indicators, one to indicate the position of the rail



The Home Signal at the East End of the Bridge.

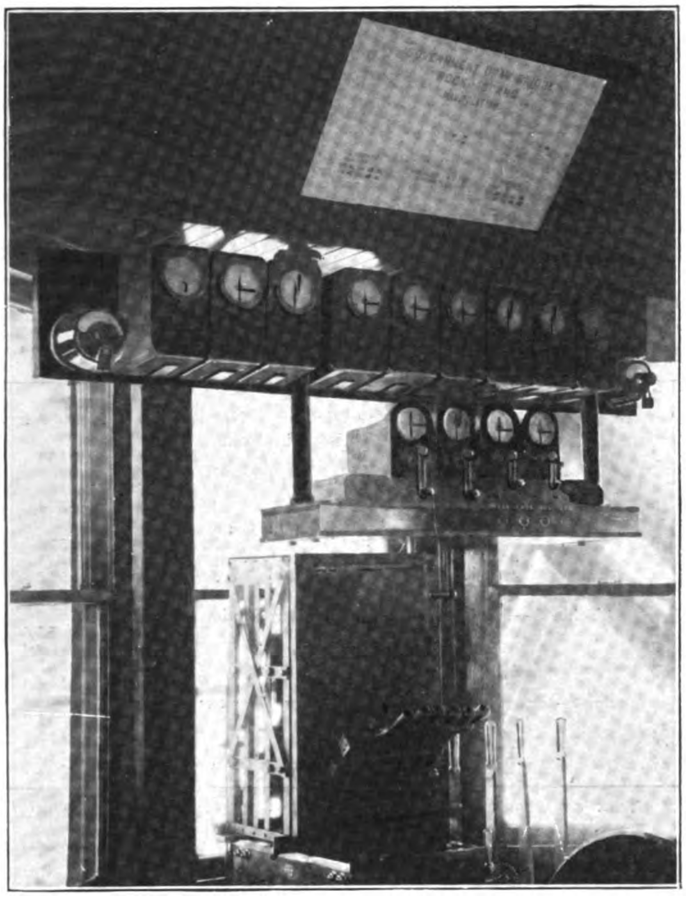
locks, three track circuit indicators, one signal repeater and two stick indicators. The rail lock indicator is so controlled that a movement of 2¾ in. in these locks will drop the indicator. The action of a train passing over the ends of the span has a tendency to slide the lock rails back and this indication of movement in the tower enables the operator to admit a little air to the operating cylinders, thus driving the rails back into place before they have moved far enough to do any damage. The pneumatic levers are so arranged that the locking does not prevent this manipulation.

The electric power for the operation of signals, as well as for turning the bridge and operating the air compressor supplying the pneumatic functions on the bridge, is furnished by the People's Power Company, which is a local public utility supplying both lighting and street railway circuits. The signal supply is taken normally from an a.c. lighting circuit, being transmitted to the operator's tower at 110 volts from a 4,800-110-volt transformer at the end of the bridge. All wires are brought overhead to a commutator on the center of the swing span so that the connections are not interferred with when the span

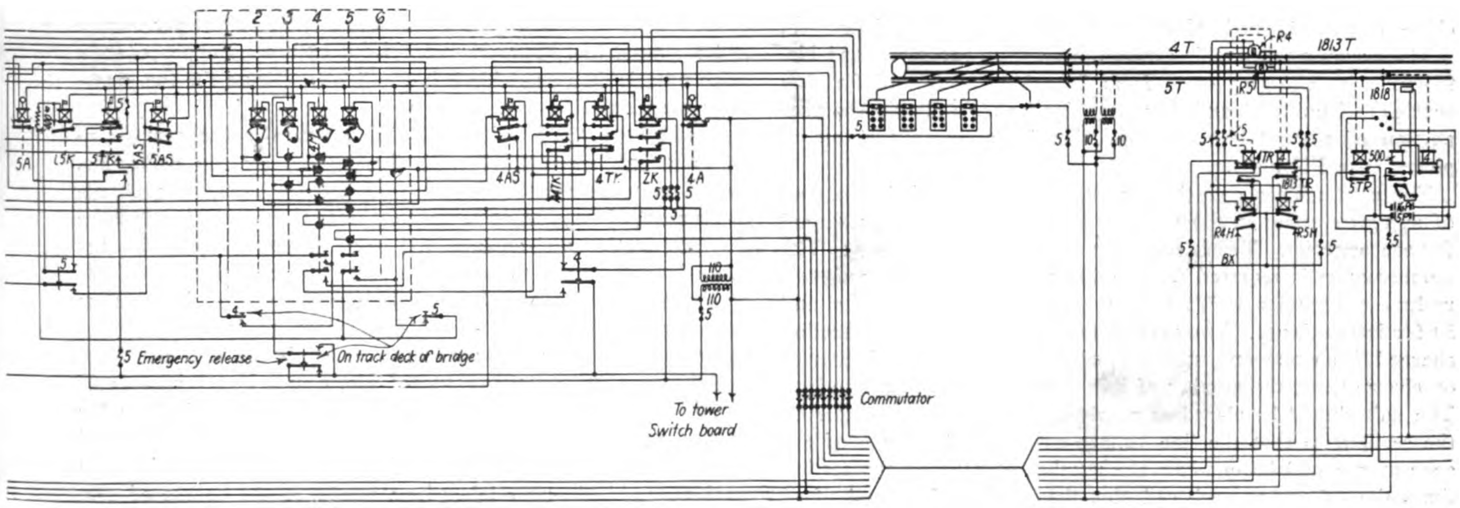


Control Circuits West of the Drawbridge.

is turned. The bridge-operating power is 500-volt direct current drawn from the electric railway trolley circuit. This is used to drive a motor-generator set supplying 110 volts a.c. to the signal system in case of a failure of the normal supply, and is started automatically upon failure of the latter.



Interior of the Operating Room Showing Indicators, Circuit Controllers and Time Releases.



Circuits in the Operating Tower and East of the Draw Span.

THE FIRST INTERLOCKING MACHINE in New England was installed in 1881 at Walpole, Mass. at the crossing of the New York & New England and the Old Colony railroad, according to a statement by C. Peter Clark before a recent meeting of the New England Railroad Club. Mr. Clark was at that time with the New York & New England. According to his statement, this was the first crossing where trains were not obliged to make a full stop before crossing the tracks of another railroad. The machine referred to had 32 levers.

DESIGNING BATTERY CHARGING LINE

By H. D. W. Riley

Some installations of automatic signals, operated by storage batteries, having the batteries charged from a line drawing power from several individual units, have been made after a careful survey of actual conditions and others have been experimental only. This fact warrants a careful consideration of the many problems which installations of this type involve. To make this discussion clear, concrete figures will be used and a specific case worked out. A brief synopsis of the methods followed in computing the type and amount of power equipment will be given, followed with a comparison of the different arrangements of equipment.

In a system of 100 miles of automatic signals it is possible to estimate closely the total energy consumption of the system in kw. hours or ampere hours by calculating the unit consumption of the various apparatus. The average three-position, upper-quadrant signal consumes about .02 ampere hours per movement. As two signals are usually operated from one battery, twice this amount is used per movement. The average track circuit consumes not more than .600 ampere, the maximum steady output on short circuit possibly being 1 ampere. From the type of the apparatus at interlockings (electric locks, time releases, indicators, etc.), the amount of battery consumed at these points may readily be calculated.

There are other factors which must be considered to some extent, the spacing of the signals, the length of the track circuits, the number of cut sections, the number of interlockings, whether the road is single or double track, and whether it is located in a thickly settled or in a rather isolated country. For this article it will be assumed that the signals are spaced 4,600 ft. apart, the track circuits average 2,300 ft. long, interlockings are located at intervals of 8 to 10 miles, and that the road under consideration is double track with a traffic of 30 trains in 24 hours.

The average current consumption in one week's time from a signal battery (5 cells in series), operating two signals, is not over 10 ampere hours, assuming the time for clearing to be 7 seconds, the current used by motor, 3.5 amperes, and the steady current while clear .020 ampere. The average current consumption in one week's time from a track battery will not be over 100 ampere hours, on the basis of a maximum steady output of 550 mils. The average current consumption in one week's time from a tower battery will not be over 550 mils per hour. This is based on a test of 22 interlockings, ranging from 12 to 68 levers with a maximum steady output ranging from 200 mils to 1,100 mils. The above factors show that if 30 ampere hour cells were used for the signal battery and 200 ampere hour cells for the track and interlocking battery, that a schedule of charging