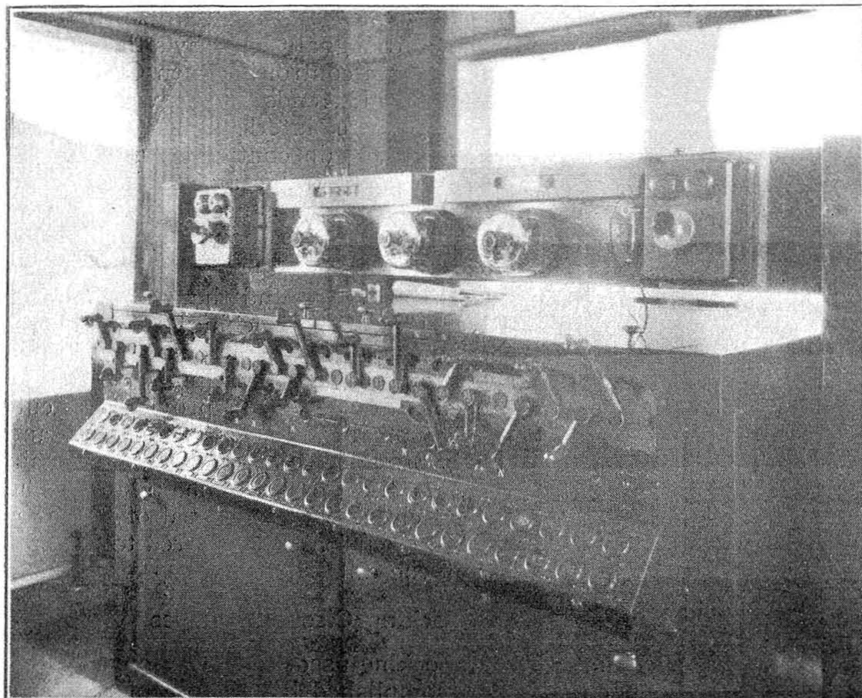
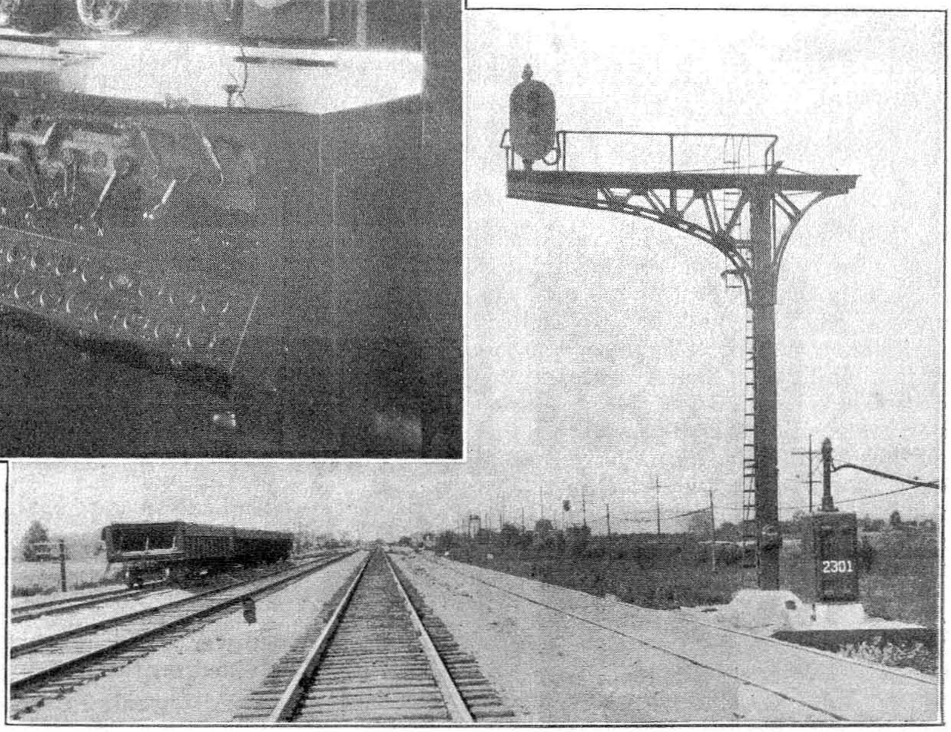
Santa Fe Installs Low-Voltage Plant on New Mississippi Bridge

Special locking circuits for controlling operation of the bridge, indication lights on machine and submarine cable, features of job





Above—Electric interlocking machine in tower

Right—Westbound home signal at East Ft. Madison, interlocking and automatic block location 2301

THE Atchison, Topeka & Santa Fe opened for traffic a new double-track bridge across the Mississippi river at Ft. Madison, Ia., on July 25, of this year. The bridge has two decks, the lower being used for main line tracks while the upper deck serves as a roadway. The draw span, 565 ft. long, is electrically operated and swings 60 deg. A Union Type-F interlocking machine, arranged for low-voltage control, is employed for the operation of the signal facilities at the draw span and for the operation of two crossovers and three passing track switches located at East Ft. Madison, Ill., which is 1.2 miles from the Mississippi River bridge tower.

Tower and Track Layout

The tower is located over the roadway deck in the center of the draw span. The interlocking machine and also the switchboard for the control of the electrical equipment for the operation of the draw span, are located on the first floor of the tower.

The track layout at the Mississippi River bridge consists of two main line tracks which are provided with split point derails located on each shore. At East Ft. Madison, Ill., the track layout consists of two crossovers between main lines and two passing sidings each being 7,900 ft. in length. The two crossovers, the westward ends of both passing tracks, and the eastward end of the north passing track, are interlocked.

Type of Interlocking

When the preliminary study was made of this layout, to determine the type of interlocking which would be most suitable, several factors were considered as follows:

(1) It was the desire that no line wires be attached to the bridge, which made it necessary to use submarine cable. It was considered preferable to use a low-voltage operating current.

(2) The distance from battery to the operated functions is such that, if a common battery were used and located at the tower, the voltage drop would have to be reduced by using larger conductors which would necessarily increase the cost of submarine cables.

(3) By using a low-voltage interlocking, a separate battery could be used for each group of operated functions and if there should be a failure which would place one group of functions out of commission, the

remainder of the plant would still be operative. With a common battery, a power failure occurring would cripple the entire plant. It was concluded that a low-voltage interlocking could be designed which would meet all the desired requirements. The Union Switch & Signal Company's Type-F interlocking machine arranged for low-voltage control was selected. It is made up of the following levers:

6	Levers for switches
2	Levers for derails
7	Levers for signals
1	Lever for rail locks
1	Master lever
1	Traffic lever
3	Spare levers
6	Spare spaces
27	

The signal levers are equipped with an indication light and when the lever is placed at the indication point and the light burns, it indicates to the tower operator that the signal has assumed its normal position and that the lever can be restored to full normal position.

Each switch and derail lever is equipped with two indication lights, one of the lights burns after the switch movement has made its full movement to the reverse position and has so indicated electrically, while the other light burns when the lever is in the normal indication position and after the switch has completed its movement from the reverse to the normal position, and has so indicated electrically.

These indication lights have proved very useful to operators because, where slow switch machines are used the only indication which they have, when the switch has made its full movement, is the energization of the indication magnets; whereas with the lights, the towermen have a visual indication that the switch has made its full movement and that the lever can be restored to its normal or reverse position.

Style-M switch and lock movements arranged for 30-volt d-c. operation, and Style-R, three-indication, color-light high signals and two-indication, color-light dwarf signals, are used throughout the installation. The signals are burned continuously in normal operation from a 30-volt a-c. source of power and in case of a failure they are transferred, by a cut-over relay, to the 30-volt d-c. switch operating battery.

The Electric Storage Battery Company's Type-KXHS-9 cells are used for the operation of switch movements and line circuits. The batteries for switch movements are float charged by Union rectifiers, while the batteries used on line circuits are charged by Balkite rectifiers.

A large number of relays are required in this installation and Union steel relay cabinets are used at the tower and also in the battery and relay house at East Ft. Madison.

Train Control Circuits

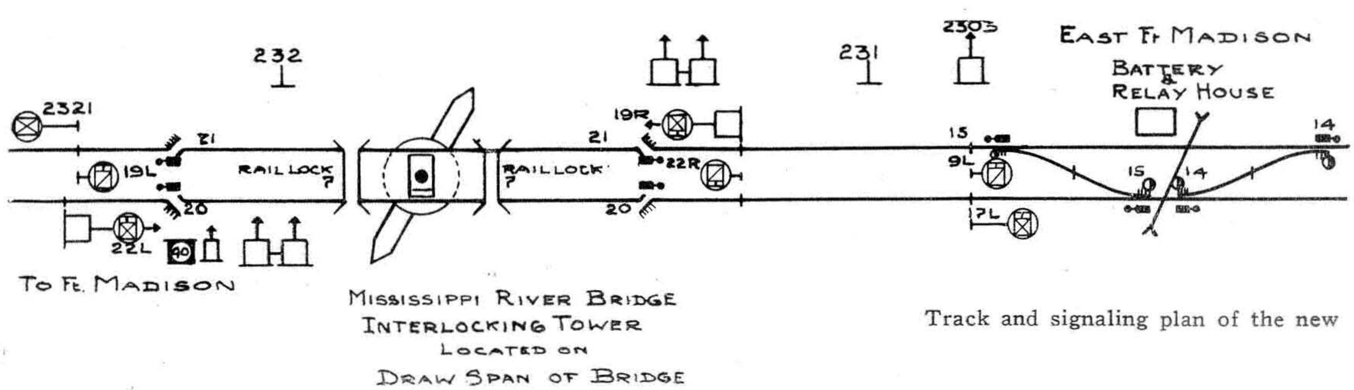
The Union Switch & Signal Company's three-speed type of continuous train control between Chillicothe, Ill., and Ft. Madison, Ia., ends at the west end of Mississippi River bridge interlocking. Eastward from East Ft. Madison train control circuits are arranged for the reversal of traffic and an interlocked crossover at East Ft. Madison is used to move traffic from the eastbound to the westbound main line for reverse-current movements.

Between East Ft. Madison and the west limits of Mississippi River bridge interlocking, train control is arranged for movements with the current of traffic only. At the west end of the Mississippi River bridge plant a high-speed cut-out circuit is provided for cutting out engine equipment on westbound trains, and a cut-in circuit is provided for trains entering train control territory on the eastbound main line. The high-speed cut-out circuit is constructed of No. 6 insulated wire in ½-in. garden hose secured to the outside of the web of the rail.

Interlocking Circuit Features

The indication locking used in connection with signal circuits is accomplished by the use of relays in series with the lamp filament, and the controls for indication locks are cut through a normal repeating relay whose control circuit is cut through the series relays in the filament circuits. The signal controls select through the switch indicating relays located in the vicinity of the movements as well as in the tower. By using this scheme, a double check is provided on the position of the switches.

All signals in the plant, with the exception of signal 22L, are power-operated, which means that in case of a failure of the a-c. source of power, a caution indication can still be displayed at the signals. The reason why it was necessary for signal 22L to be controlled through track circuits is, that on approaching this signal, trains are not moving through automatic control territory, while other high signals on the plant have an automatic train control approach which would mean that in case there was a failure to the a-c. source of power, all trains would be ap-



Track and signaling plan of the new

proaching signals under the speed limitation provided for by the train control.

The circuits used for the control of switch and lock movements are polarized and controlled direct from the operating levers. The operating levers for switches are provided with independent indication and detector locks and the detector locks are cut through detector track circuits, while the indication locks are cut through polarized relays operated from pole-changers in the switch and lock movements on the ground.

Special Circuits for Control of Bridge Operation

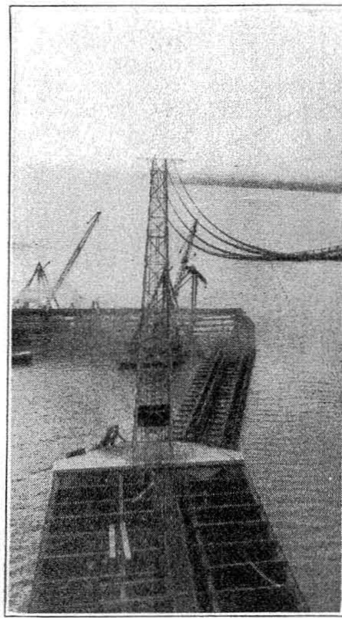
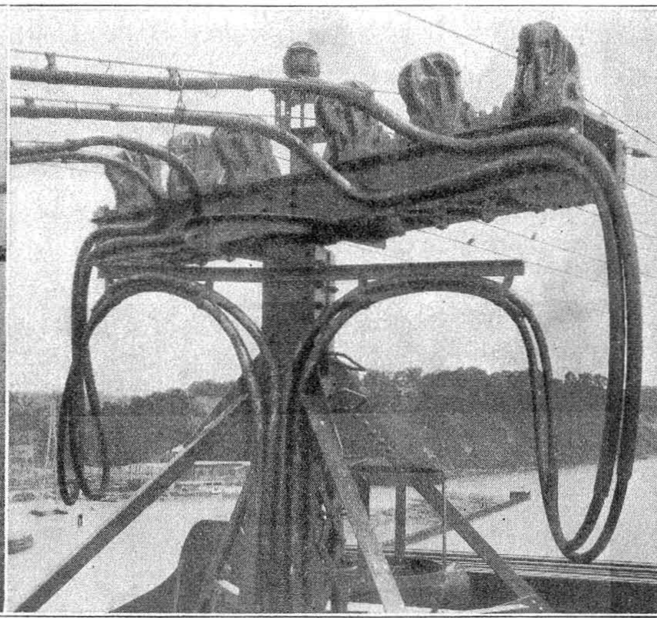
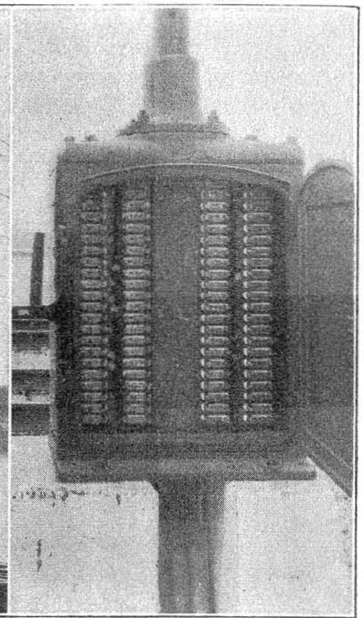
A master control relay, when energized, connects the operating switchboard for the draw span to the power line. This relay is controlled through a reverse contact on lever 24, and lever 24 locks the end-rail locks 7 in the reverse position; therefore, when the end-rail locks are withdrawn and all levers, which operate derails and signals, are in their normal position, lever 24 can be reversed and the master control relay will beocme energized and the draw span can then be operated under the following sequence:

(1) Close the barrier gates and draw the end-rails separately or together. After this operation has been completed, circuits will be closed for the end lifts.

(2) Lower the ends, which break the circuits for the operation of the barrier gates and end-rails, and when the ends have been lowered, circuits for the ends will be broken.

(3) Swing the draw span. When fully swung and in place, the circuits for the ends will be broken.

Light indicators are provided which indicate to the operator the completion of each of the above movements.

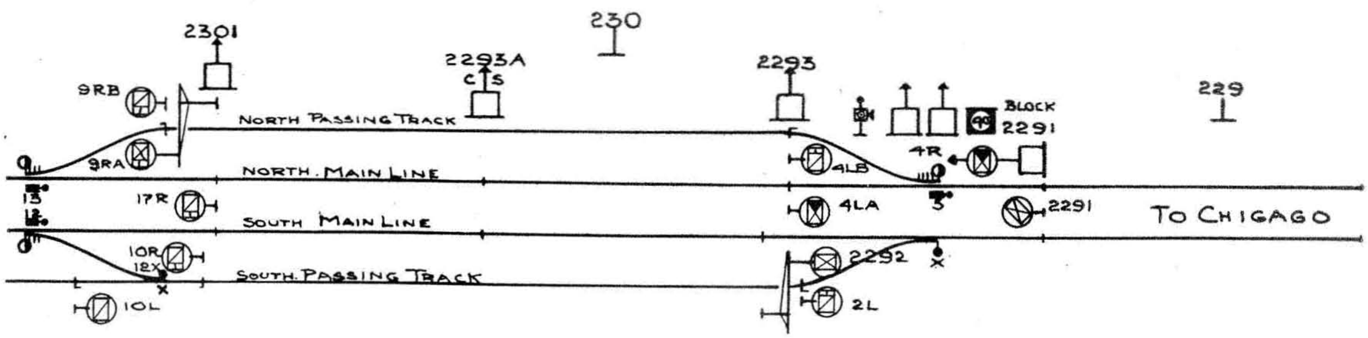
Steel cable tower on down-stream nosing of bridge **Pivot arrangement for cable located on bridge structure over tower on draw span** **Submarine cable terminals on east shore**

The interlocking arrangement between the bridge and interlocking machine for the control of signals and derails is believed to provide full protection by virtue of the special circuits used:

(1) Before power for the operation of the draw span can be applied, it is necessary that all derails be placed in the derailing position with all signals at stop.

(2) When the master control relay is energized, which controls power for the operation of the draw span, power for the operation of the end-rail locks is cut off, which makes it impossible to operate them.

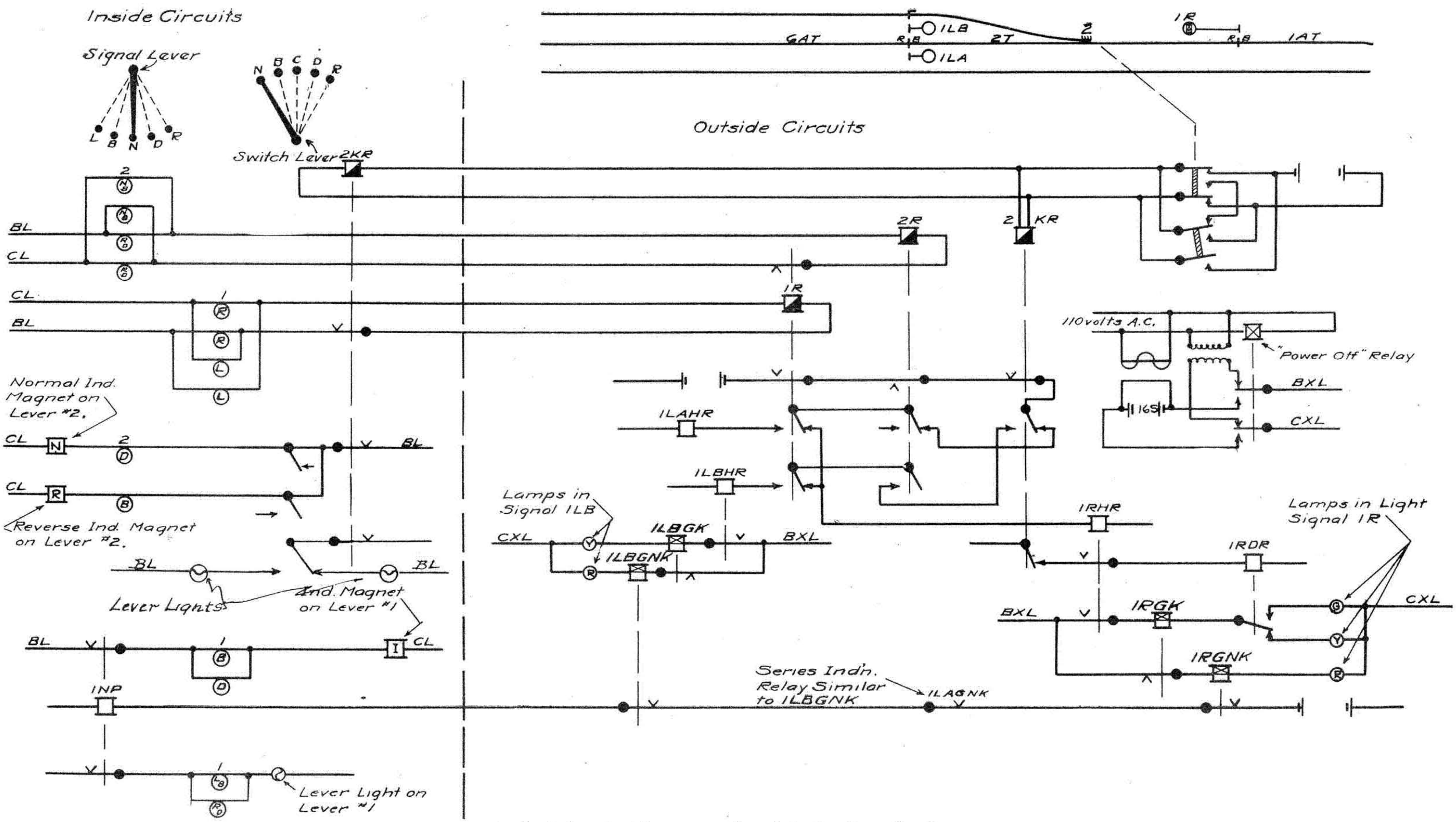
(3) The controls for the draw span are so arranged that when each movement is made, the completion of such movement automatically connects the power supply for the next movement and cuts it off when the movement is completed.



interlocking plant at Mississippi River draw

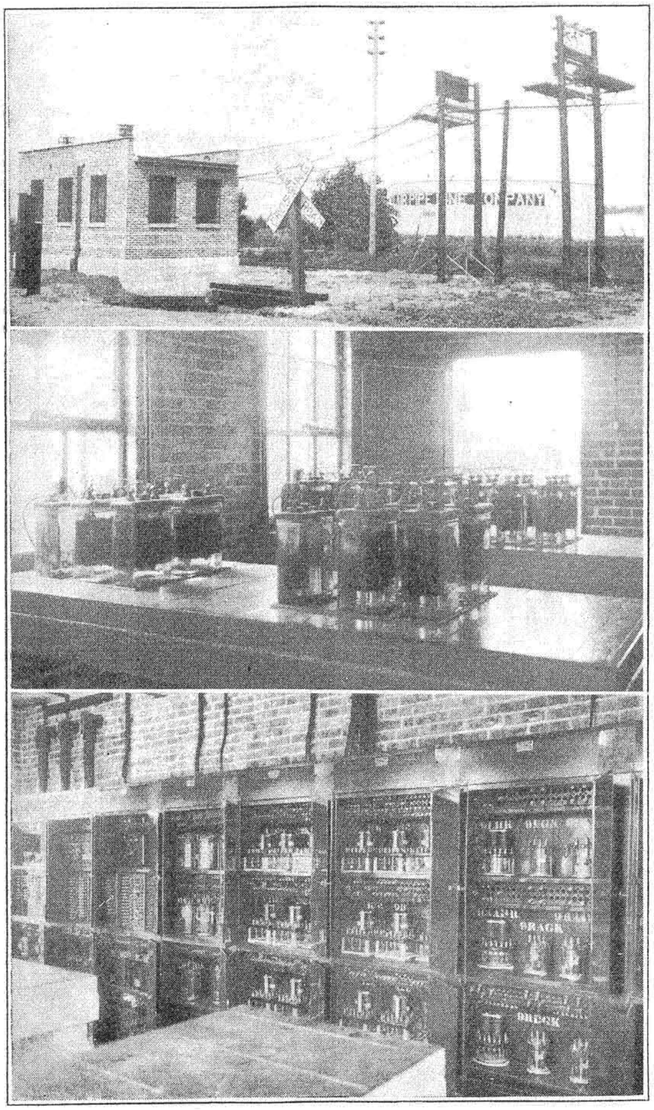
Relay House at East Ft. Madison

At East Ft. Madison a brick building was built in which to house the relays and storage batteries. This



Typical interlocking control and indication circuits building is of concrete and brick construction, with a concrete roof fitted with a ventilator.

Parkway cables are used between the battery and relay house, and the operated functions at East Ft. Madison. A wire chace is built into the wall of the building through which these cables are carried. They are supported from the ceiling in running to the relay cabinet which is located on the back side of the building. A metal cover plate is placed over the chace. Concrete tables support the storage cells.



Top—Battery and relay house at East Ft. Madison
Center—Interior, showing concrete battery tables
Bottom—Interior, showing steel relay cabinets

The circuits between Mississippi River bridge and East Ft. Madison, with exception of the 6,600-volt transmission line for automatic train control, were carried in braided cables and terminate on an "H" fixture on which lightning arrester boxes were placed and a platform was constructed in order to provide accessibility for inspection and test purposes. Another "H" fixture was constructed on which transformers are located, from which source, power is obtained for a-c. circuits.

Submarine Cables

Submarine cables were laid between each shore and the down-stream nosing of the drawbridge protection. A steel tower was erected on the down-stream nosing of the drawbridge protection and a steel terminal box was attached to the base of this tower in which all submarine cables were terminated.

Braided cables were run from this terminal case up to the top of the steel tower and were carried from that point to the pivot arrangement on the top of the interlocking tower. Copperweld messengers were used in order to provide as permanent construction as possible. The cables run from the pivot arm under a hood which is placed on top of the tower and through a wire chace to the steel relay cabinet on the second floor of the tower, where all cables are terminated. The flexibility of these cables is such that, with the construction methods used, it is believed that the arrangement will hold up in good shape with a low maintenance cost. It was the desire of the bridge engineer that no open wire line be attached to the new structure; therefore, it was necessary to provide an arrangement whereby cables could be terminated at the tower and at the same time no more attachments be made to the bridge than absolutely necessary. The scheme used has proved satisfactory to all concerned.

Telephones, located at the home signals, are used by trainmen to communicate with the tower operator. An illuminated diagram over the interlocking machine indicates to the tower operator whether all track sections are occupied. At East Ft. Madison, where switching moves are made, the trainmen communicate with the tower operator by telephone before proceeding.

Frisco Train-Stop Approved

THE Interstate Commerce Commission, Division 1, has approved the installation of the automatic train-stop system of the National Safety Appliance Company—intermittent magnetic type, with forestalling feature—on a part of the Southwestern division of the St. Louis-San Francisco from Monett, Mo., to Afton, Okla., 66.1 miles, pursuant to the commission's second order. The installation adjoins that from Springfield to Monett, Mo., under the first order. The cost of the roadway installation was reported as $100,132, and that of the equipment for 68 locomotives as $42,719. The installation is approved without exceptions.

The automatic visual signals on this section of the road were installed in 1924 and the system was designed with a view to the latter addition of automatic train control. There are three interlocking plants in this territory; two, mechanical, at crossings of other railroads and a third at Pierce City which is a low voltage electric plant and controlled from a desk machine of four levers. The automatic roadside signals are semaphores, lower quadrant; two arms at each post. At double signal locations one magnet serves for both signals.

The installation is approved without exceptions, but certain requirements with which the company is expected to comply are set forth in six paragraphs. These have to do with imperfect operation of the forestalling valve and the duplex control valve.

During the inspection, 12 locomotives were found in which the control valves were not fixed at the right height above the rail. A cautionary paragraph says that the locomotive equipment has to be kept in order by men at a number of widely separated points and that locomotives have to be run for long periods in non-train-stop territory.

Letters to the Editor

Automatic Interlocking

To the Editor: St. Paul, Minn.

In respect to the editorial in the December issue, "Why Not Use the Term Automatic Interlocking?" it seems to me that such a designation for this kind of signaling facility serves the purpose adequately. If it is correct to employ the term "Automatic Signal Protection for Railroad Grade Crossings," what should we call such an installation when just as successfully employed at a junction? I would suggest that a time card showing, for instance, "Findley, A.B.C. Crossing, Interlocked," be changed to read, "Findley, A.B.C. Crossing, Manual Interlocking," or, "Findley, A.B.C. Crossing, Automatic Interlocking" as the case may be.

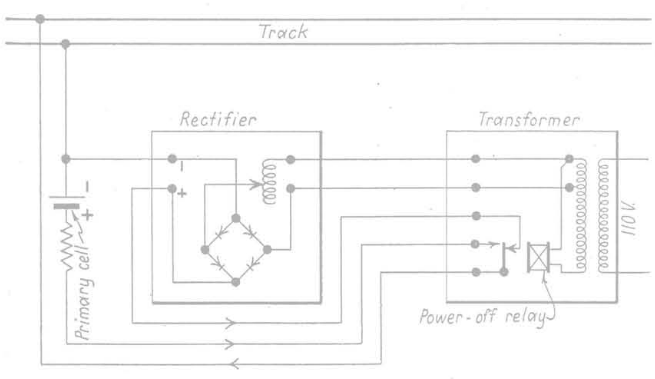
It does not seem good policy to assume that state commissions withhold authority for installations of "automatic interlocking" for the reason that the application is for the installation of "automatic signal protection for railroad grade crossing." The commissions, I think, are interested in determining the efficiency of the protection proposed, and not what the system is called.

E. J. Relph,
Mechanical Engineer of Signals, Northern Pacific.

Rectifier for Track Circuit Operation

To the Editor:

Shortly after the advent of the copper-oxide rectifier it occurred to the writer that the rectified wave form of this device would be quite suitable for the operation of d-c. relays. One of these units was accordingly connected to supply a track circuit 2,900 ft. long, using a transformer having a power-off relay. The secondary provided 4 volts a-c. for the rectifier, the connections for primary battery reserve power being as shown in the accompanying sketch. It was found that the track relay operated reliably under all sorts of weather conditions and that no current limiting device, other than the small reactor integral with the instrument was necessary, the high reactance of the circuit as a whole limiting the current when the track was occupied to a value only slightly more than when normal. The rectifier operated cold with plenty of reserve capacity available.



Copper-oxide rectifier and power-off relay for track circuit power supply

This circuit had previously been operated by an electrolytic rectifier and Edison storage cell under floating charge, the outfit consuming, under normal conditions, 13.6 watts at a power factor of 55.8 per cent. When powered direct from the copper-oxide rectifier, the circuit consumed 8.4 watts at a power factor of 22.6 per cent, a reduction of over 38 per cent in the power required.

While thus far no shunting tests have been made, it is thought that because of the wave form and the fact that the current flow to the track increases only slightly when the track is occupied, that the shunting of the relay is probably more effective with a copper-oxide rectifier than with a battery. The low power factor of this scheme would seem to be an obstacle to its extensive use, but methods of balancing inductance with capacity, now coming into general use, will eliminate this objection. Signal Foreman.

A Factor in the Life of Lamp Bulbs

To the Editor:

One of the principal subjects of discussion in recent years among those who have to do with railroad signaling, is the life of electric lamps. Most of the discussions seem to deal with the type of filament, voltage to be used, etc. These facts are all worthy of discussion but it seems to me that one important point has been overlooked, either by the designers or the inspectors, namely, lack of free access to the lamp.

The electric lamp is a delicate article and should be treated as such. This being a fact, we should be ready to assist our maintenance force in protecting the lamps and thus eliminate lamp failures. Probably some of the readers have had an experience similar to mine. A campaign of electric lamp cleaning was followed by an epidemic of lamp failures. Even when the lamps were renewed, failures occurred.

After I had had this experience, an investigation developed that a large percentage of the bulbs that had failed were in lamp cases that required the use of a hammer, or equivalent, to gain access to the lamp; not necessarily due to lack of maintenance but to the construction of the lamp cases. This applies not only to old type cases but also to some of the modern signals.

The signal engineers can assist by including this feature in the lamp case specifications. Perhaps this may increase the cost of the case a bit but this expenditure is more than justified by savings made in preventing train delays, overtime and lamps. Why not investigate?

Signal Supervisor.

1927 Index Now Ready

The 1927 index of *Railway Signaling* covering the 12 issues of last year is available for distribution and will be sent without charge to those who request it. Subscribers who bind their copies and others who desire to have this index should send a request to the editor at 105 W. Adams street, Chicago, and a copy will be sent promptly.

An Apology to an Author

The article "Santa Fe Installs Low-Voltage Plant on New Mississippi Bridge" as published on page 457 of the December issue was prepared by D. W. Fuller, assistant signal engineer of the Atchison, Topeka & Santa Fe, with headquarters in Topeka, Kan. The omission of Mr. Fuller's name as author from the heading of this article was due to an unintentional oversight on the part of the editor, and is indeed regretted.