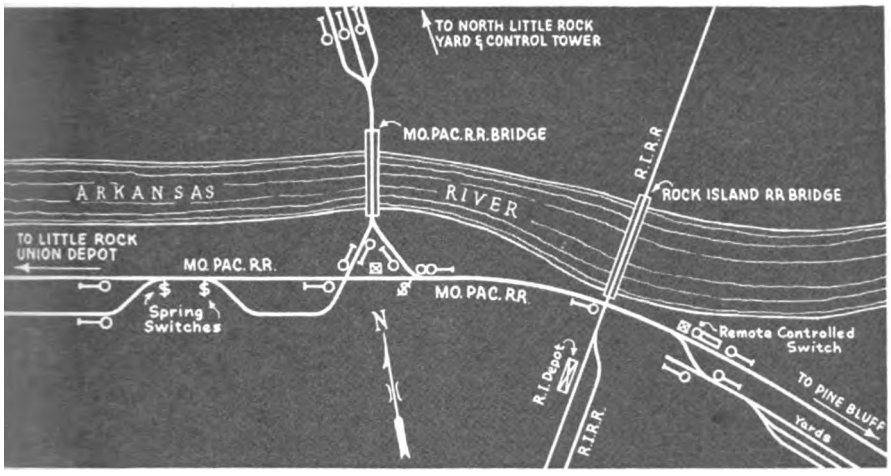
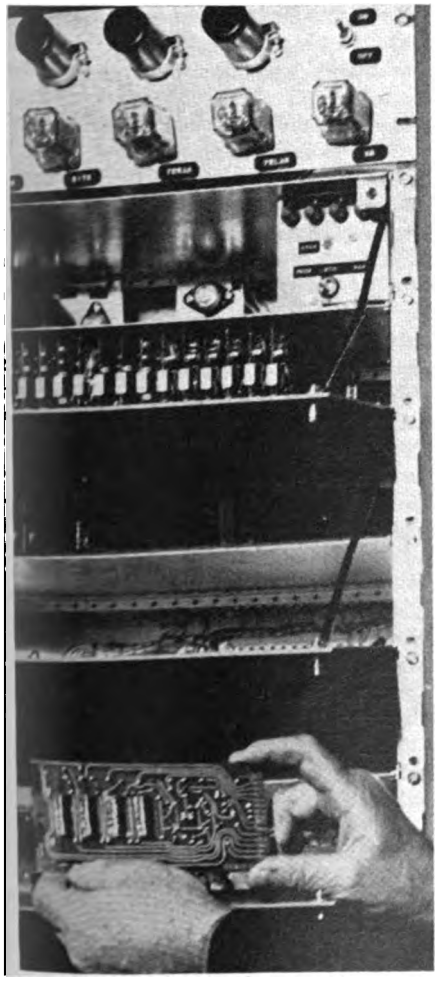



# MP interlocking uses solid-state control system



Four buffer relays are mounted on a plug-in printed circuit card.

Missouri Pacific has replaced a mechanical and electric interlocking control machine at Little Rock, Ark., with a solid-state control system. The mechanical interlocker was located in East Little Rock at the crossing of the MP and Rock Island lines. This plant is now of the semi-automatic type. The interlocking at the junction of three MP lines, just south of the MP Arkansas river bridge, was formerly controlled from the mechanical interlocking machine by a multi-conductor cable and a small toggle switch control panel. (One wire for each function, plus a common return).

The control office for the new system is in North Little Rock. The system is capable of being expanded to 16 stations, each with 20 controls and 26 indications. First proposals were to control both the stations from the present control office, using a multi-conductor cable. The solid state system was installed for about two thirds the cost of the proposed cable.

The Missouri Pacific system is half duplex and is as nearly compatible with existing CTC system as possible. This permits comparing the reliability of the solid-state with existing systems.

The new installation is a Moore Associates Marc VIII system, which employs a comparison of two control frames (cycles) on a bit-by-bit basis before any change can result. This is done to guard against line disturbances distorting the line pulses and resulting in a wrong control function.

Concern about the system not delivering a control due to line disturbances resulted in adding a third scan to the control and indication modes. Thus, if a disturbance occurs during the first or third frame, there are still two frames that would compare bit-by-bit and give an execution to the command that was transmitted; unless the disturbance occurred in the second frame, since the comparison has to be made between two successive frames.

As now installed, the control office equipment consists of a black phenolic panel engraved in white, with the levers and lights mounted on it. This panel is mounted on a sloping front cabinet mounted on a standard pedestal. Mounted in the bottom of the pedestal is the terminal board for the interconnecting cables.

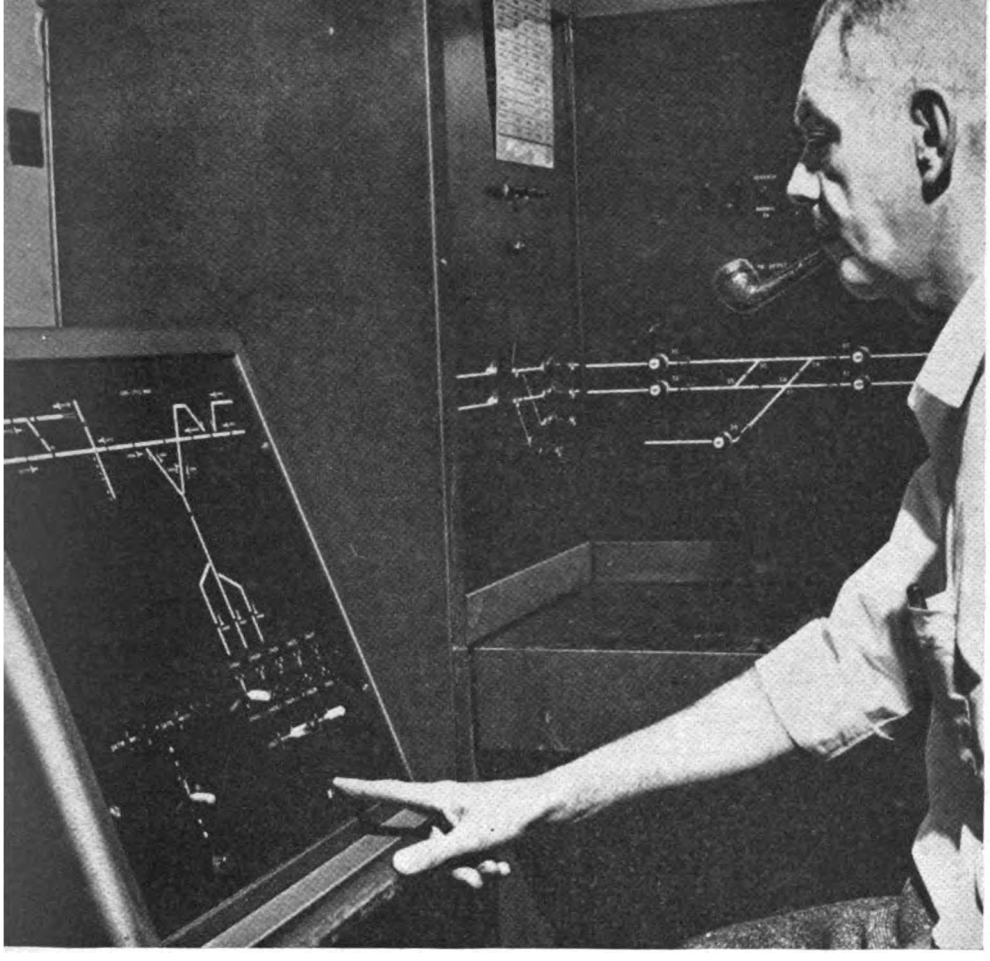
The panel is on the second floor of what was formerly a yardmaster's tower in North Little Rock vacated when MP's new automatic classification yard was placed in service in 1961. The interconnecting cables are run down to the first floor of the tower where the control office equipment is mounted on a 6 ft high, 19" cabinet. The control office equipment takes 21" of rack space.

The field equipment takes 7" of 19" rack space and is 13" deep. At the MP bridge plant, the equipment is housed in a 6 ft by 6 ft metal cabin. A swing rack was built for this installation. At the MP-RI crossing, an 8 ft by 10 ft metal cabin houses the equipment mounted on a plywood board fastened to a pipe frame in the center of the cabin. All connections are to screw-type terminals on the rear of the equipment.

The control office and field equipment operate on 9 to 13 volts DC, and the line circuit, which is approximately 1.5 miles, operates on 24 volts. All power is supplied by normal storage battery on trickle charge from standard signal rectifier. Surge suppression was furnished between the battery and equipment by using a 1-ohm relay coil in series with the positive battery lead with a 13.5-volt zener diode across the load side of the coil and the negative battery lead. Also, a 130-volt thyrector was placed across the 110-volt source to the rectifiers.

The transmission is by DC pulses of either long or short duration; a long pulse for an "on" function and a short pulse for an "off" function. A half duplex line is used and with no controls in progress, the system 'calls' each field station, one at a time, and each field station, upon being called, will shunt the line indicating one or two answers, "have no change" or "a full set of indications."

This interrogation continues until a



Operator has control of 14 signals and 1 power switch from panel at left.

control is transmitted, at which time the interrogation stops, the control cycle is sent, and the field station to which the control was sent, transmits a complete set of indications. The reason for this is to facilitate an indication recheck in case the operator doubts the indications displayed by any particular field station.

When the system was first engineered, a pulse rate of 10 pulses per second was considered adequate. After adding a third scan to both the control and indication cycles, 10 pulses per second seemed fairly slow, so it was decided to increase the rate to 30 pulses per second.

The code system is capable of this speed, and speed much faster, but the cables in use were not. Tests are in progress for a rate of 20 pulses per second, and indications are that this will work. If tone channels were used, much higher speeds could be obtained from the equipment.

Some intermittent troubles were experienced when the system was first installed due to timing in the changing over from transmit to receive at the control office. This was easily remedied by the manufacturer, but it would not have occurred had the system been operated as a full duplex.

It was believed that the high inductive pulses generated by the energizing and de-energizing of the safety relays would damage a transistor output stage used to drive it, so the manufacturer agreed to supply a buffer relay stage between the relays and the transistor output stages. The relays supplied are mounted four on a plug-in card. These relays are C. P. Clare type HgS magnetic stick with one Form D contact. An Automatic Electric taper tab, Class E relay is used to repeat these at one field location and GRS type K relays are used at the other field station.

At each field station the C. P. Clare relay coils were brought out to terminals so that a contact of a track relay could be inserted to prevent a switch control from being effective with a train occupying the switch circuit; if a hold-out circuit is not necessary, then the two terminals are connected together. Also, the "off" coil is brought to a terminal to enable cancellation of a signal control as the train passes the signal.

Control and indication inputs to the equipment are 12 volts through a single dependent (Form C) contact for each function. The switch controls were made a two-function operation, using one step for switch normal and a second step for switch reverse. This was done so that an open circuit at the control office would not call the switch to the opposite position. A signal to the right and a signal to the left were each assigned a separate step. An open circuit when trying to call the signal right would only result in not clearing a signal.

Some difficulties were experienced in the relay output stages which would occasionally lose an output transistor, and sometimes a relay at one field station would respond to a control transmitted to the other. Inductive pulses being generated by the C. P. Clare relays were causing the transistors to break down.

Adding suppression to these relays solved this problem. It was found that the cut-off bias for each relay card which contained four relays would vary, as the components are not exactly alike. This was corrected by putting in one common bias supply in the control office and one in each field station.

Shortly after the system was put into service one field station was put out of service by a severe local thunderstorm. In order to prevent this happening again, lightning filters were added on the field input circuits.

Maintenance of the system has been made as simple as possible since all components are mounted on plug-in printed-circuit cards. These cards are arranged so that a particular system function can be easily isolated to one or two cards. Maintenance personnel were given instructions in the system operation and in basic transistor switching circuits. These instructions (along with a manual on the system and printed material on transistor switching) have made MP's personnel proficient in maintaining this system.

The most useful piece of equipment to locate malfunctioning has been a Brush recorder. The recorder can isolate the trouble to the field or control office almost immediately, and then by observing carefully the line pulses that are obtained with the tape, the trouble can be entirely localized. By replacing a card, the trouble can be cleared. It is also possible to shoot trouble with a multimeter, as many of the voltages are brought out to test points on the printed circuit cards.

While the system as now installed is working well thus far, MP signal engineers believe that more experience with it should be obtained before any evaluation of its in-service performance characteristics can be fairly and intelligently made. Additionally, such experience will indicate the future adaptability of the new system into existing CTC installations on the railroad. To date there has been virtually trouble-free operation. RS&C