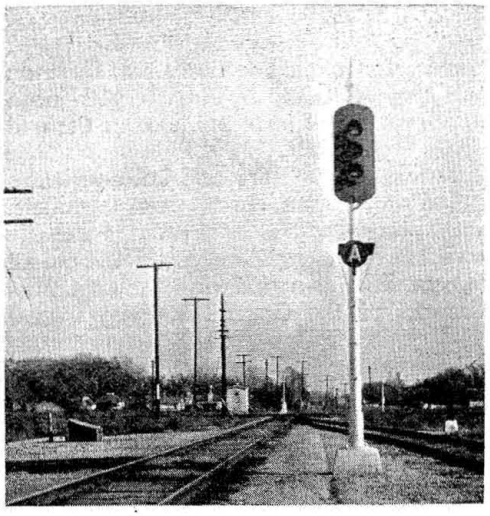
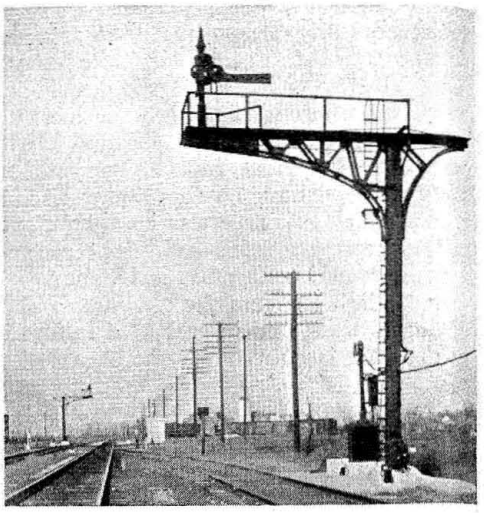
Automatic Interlockings on the Santa Fe

Automatic time-element release is feature of several plants



Eastward home signal on the M. P. at Iola



Northward home signal on the Santa Fe at Iola

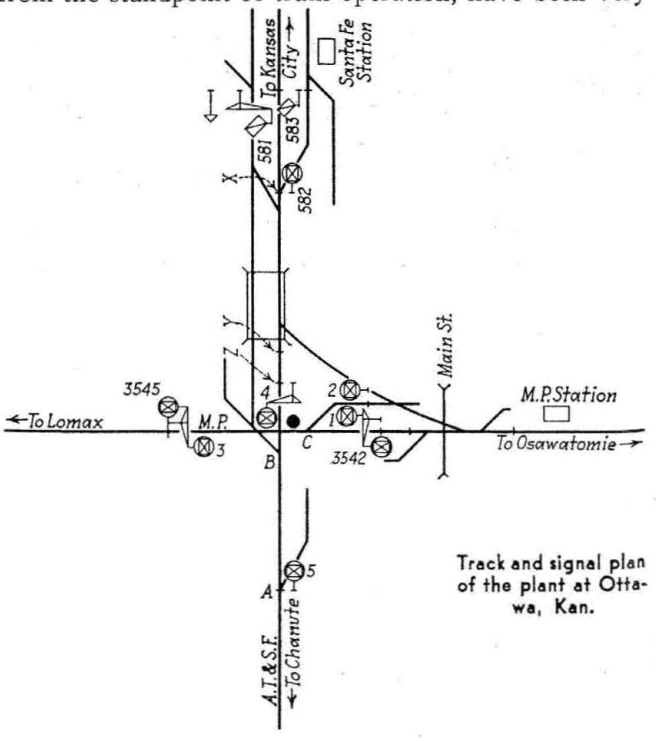
DURING the last several years, the Atchison, Topeka & Santa Fe has installed several automatic interlockings which have facilitated train movements and have instituted savings in operating expenses. A special feature of the control arrangement in these plants is the use of an automatic time-element release. Two of these plants—the one at Ottawa, Kan., and the one at Iola, Kan., have been selected as the subjects of this article, because these two plants, although they have different track arrangements and slightly different control arrangements, are typical of most of the automatic interlockings installed by the Santa Fe.

The Ottawa Plant

At Ottawa the single-track main line of the Santa Fe between Kansas City, Mo., and Tulsa, Okla., crosses the single-track main line of the Missouri Pacific between Kansas City, Mo., and Pueblo, Colo. The through traffic each twenty-four hours, includes approximately 12 trains on the Santa Fe and 13 on the Missouri Pacific. The tracks of the Missouri Pacific are in a street through the business section of the town, and the Santa Fe tracks are in a street from the Missouri Pacific crossing southward to the city limits. Before automatic interlocking was installed, trains making the crossing stop delayed street traffic to the extent that there were numerous complaints, and public agitation, aimed at compelling the railroads to adopt some means of eliminating these delays, was started. From time to time estimates had been made for an interlocking, but it was decided that it was not practical to install a standard interlocking plant with derails at this particular point.

In addition to an interchange track between the two roads, there are several turnouts leading to industries, wholesale houses, etc. Because of these conditions, and on account of the numerous switching movements in the vicinity of the crossing, early investigations seemed to indicate that it would not be practical to operate an automatic plant at this crossing. However, because of the satisfactory results that had been effected at other automatic interlockings involving switching movements, a conference was held at Ottawa, by representatives of the operating and signal departments of both roads, and a plan was evolved by means of which it was felt that an automatic interlocking could be designed to meet the requirements.

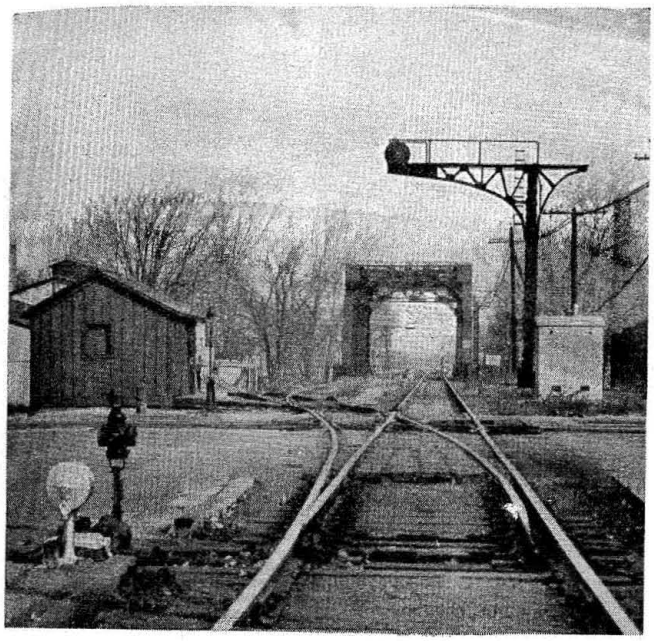
In view of the fact that all train movements are limited to slow speeds, on account of city ordinances, it was practicable to locate the home signals close to the crossing, thus excluding from the home-signal limits all but three of the turnout switches, and thus simplifying the operation in this respect. The next problem was to provide some practical means of preventing switching moves on one road from holding through trains on the other road. It was decided that an automatic release would handle this feature in a satisfactory way. The plant was installed in 1930, and the results, from the standpoint of train operation, have been very



Track and signal plan of the plant at Ottawa, Kan.

satisfactory. In addition to eliminating the public criticism that had been aroused by the delays to street traffic, the railroads have eliminated practically all of the stops for through trains at the crossing.

The main-line signals on the Missouri Pacific are mounted on cantilevers, as is also the southward home signal on the Santa Fe. However, on account of the Santa Fe track being in the middle of the street, with pavement on both sides, there was no place to locate either a cantilever or a bridge for the northward home signal. Therefore, a searchlight dwarf signal was



View looking north over crossing at Ottawa

used. Even when using a dwarf signal, it had to be located 575 ft. from the crossing, in order to find a place in the street where the signal could be located. The southward home signal on the Santa Fe is 150 ft. from the crossing, and the two home signals on the Missouri Pacific are 250 ft. from the crossing. It will be noted from the plant that switches *A* and *B* on the Santa Fe are both within home-signal limits, and, as this plant is located in automatic-block-signal territory, a switch indicator is located at each of these switches, to inform trainmen of the approach of trains from either direction on the Santa Fe. If a train is approaching, the train crew is supposed to hold its train out of the home-signal limits.

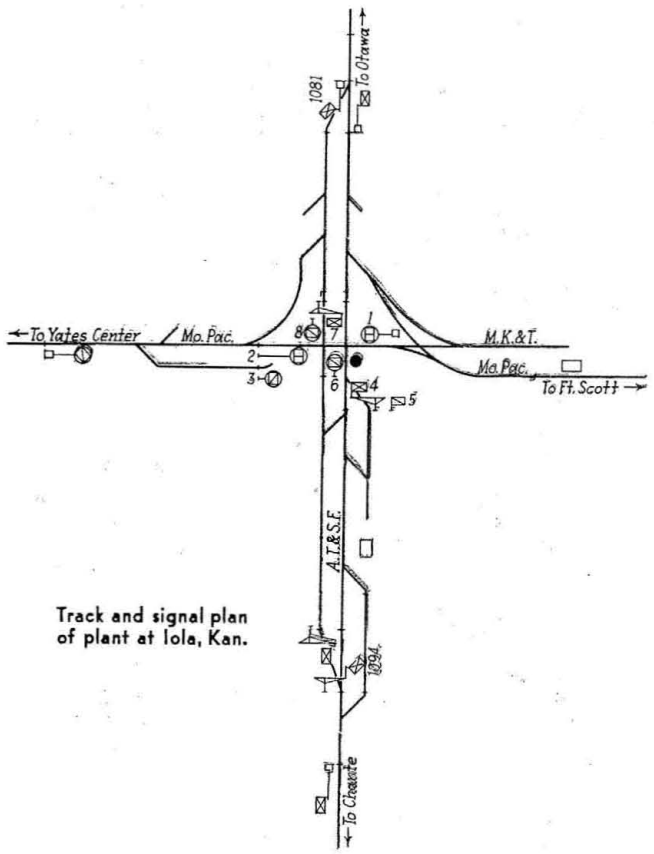
Another feature is that southward home signal No. 4, on the Santa Fe, governs movements from a yard track as well as on the main line. When a train on the yard track is ready to depart, a trainman first observes whether any trains are in sight on the Missouri Pacific, and, if not, the switch is thrown, and, by means of circuits through the switch circuit controller, the route is set up and the home signal clears, providing conditions are proper for the movement to be made. Signal No. 2, governing movements from an industry track on the Missouri Pacific, is likewise controlled by the position of switch *C*, in addition to the other conditions with respect to track occupancy.

Operation of the Automatic Release

Automatic releases are provided for southward movements on the Santa Fe and eastward movements on the Missouri Pacific. The southward approach section on the Santa Fe is 895 ft. long, and this includes two track circuits—one, X to Y, 795 ft. long, and a short track circuit, Y to Z, about 100 ft. long, just in the approach to home Signal No. 4.

Say, for example, that a switch engine with a cut of cars enters the approach circuit and stops short of Y to do some switching. Providing no trains are in the limits of the plant, home signal No. 4 automatically clears for a through movement. However, unless the train proceeds past Y within a period of five minutes, signal No. 4 is automatically returned to the stop aspect if a train moves onto either approach circuit on the Missouri Pacific, in which event the Missouri Pacific signal will clear and remain in that position for a period of five minutes, after which it will assume the stop aspect, and then either train desiring to make a movement over the crossing must move onto the short clearing section, and the signal will then clear for a movement over the crossing.

The use of this automatic time-release system obvi-



Track and signal plan of plant at Iola, Kan.

ates the necessity for trainmen or switchmen to operate any clockwork releases. An additional advantage is that in case of switching moves, the plant is promptly cleared automatically for trains on the opposing road, without any employee being required to take any action. Therefore, numerous train delays are eliminated.

The Iola Plant

At Iola, Kan., which is located 51 miles south of Ottawa, the same single-track main line of the Santa Fe is crossed by another single-track main line of the Missouri Pacific. At this point, a passing siding of the Santa Fe parallels the main line and extends over the crossing. It will be noted from the plan that just south of the crossing there is a crossover between the passing siding and the main line, the main-line switch being just south of the eastward home signal. A passing siding of the Missouri Pacific enters the plant, the east

switch being in the home-signal limits. The switch for a turnout, leading to the stock pens on the Santa Fe, is located within home-signal limits. Furthermore, the Missouri-Kansas-Texas has a track extending to a connection near the crossing, and the two interchange tracks, one from the Missouri Pacific and the other from the M-K-T., extend to a joint connection with the Santa Fe. West of the crossing there is a connecting track between the Missouri Pacific and the Santa Fe siding.

Considerable switching is done on these tracks, as well as to and from industries and elevators on spurs leading from the main line of the three roads in the approach circuits of both roads. All of these factors tended to complicate the operation of an automatic interlocking. In view of these complications in the track layout and the diversity in through train movements and switching movements, considerable study was required to devise a plan for an automatic interlocking which would provide train operation that would be acceptable to the operating officers of both roads involved.

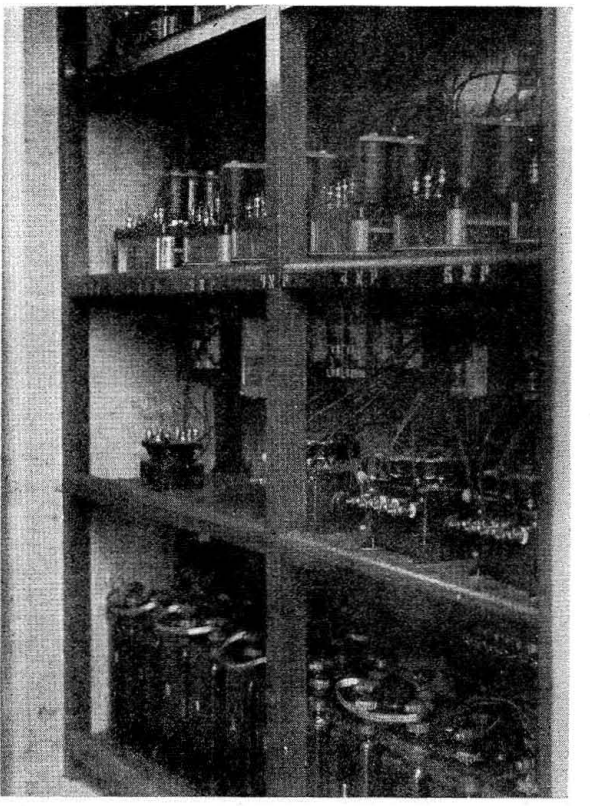
Short trains on the Santa Fe which are required to use the passing siding, use the portion south of the crossing, entering or leaving by way of the crossover just south of the northward home signal. Longer trains occupying the entire siding are, of course, required to cut for the crossing, and therefore it was necessary to reduce the idle opening to a minimum. Therefore, the dwarf signals on this siding are located 100 ft. from the crossing. In view of the fact that a train on the siding must not control the signals so as to block out trains on the Missouri Pacific, these passing-siding signals are controlled by clearing sections only 100 ft. long, and trains cutting at the crossing are required to clear these sections. The total length of track that must be left unoccupied when a train is cut for the crossing, is approximately 400 ft. The southward home signal on the main line of the Santa Fe is located 220 ft. from the crossing. The northward home signal on the main line is 300 ft. from the crossing. A switch indicator is located at the switch connecting to the stock-pen spur.

Movements from the stock-pen spur to the main line are controlled by signal No. 5, which is controlled by the position of the main-line switch as well as by the track occupancy of the plant and its approaches. In making a move from the stock spur to the main line, a trainman first observes whether any trains are approaching on the Missouri Pacific, and whether the switch indicator, which denotes the approach of trains from either direction on the Santa Fe, is clear. If no trains are approaching, the trainman throws the switch, and the dwarf signal will then clear.

Eastward home signal No. 2 on the Missouri Pacific is located 250 ft. from the crossing. Dwarf signal No. 3 controls movements from the siding, depending upon the position of the switch and upon the track occupancy of the plant and its approaches.

On account of the switching movements made in the vicinity of this crossing, an automatic time-element release system was installed, which is similar to that described in connection with the Ottawa plant. With the exception of the switching handled on all approaches, a release was provided from both directions on each main line, each release section extending 100 ft. in the approach of each main-line home-signal. The operation of the release may be explained as follows: If a northbound Santa Fe way-freight leaves a part of its train on the approach circuit while switching some of the industry spurs for a period longer than five minutes, the signal will go to the stop aspect, thereby releasing the crossing, so that a Missouri Pacific train will receive a signal indication from either of the home signals, if a movement is to be made onto the approach clearing section on either side of the crossing.

If the Missouri Pacific train stops to do some switching on the approach clearing circuit and is detained longer than five minutes, the home signal will assume



The instruments and battery are located in a concrete house

the stop aspect, and, if the way-freight on the Santa Fe then completes its movement over the crossing, it will be necessary for it to move onto the releasing section, which will place the Missouri Pacific signal to the stop aspect, and, after a 40-second time interval has elapsed, the signal on the Santa Fe will clear for a movement over the crossing. It should be noted that the control of the Iola plant is different from that at Ottawa, in that when a signal is cleared by a train on the approach section, after a five-minute period the signal assumes the stop aspect, while at Ottawa, the signal does not assume the stop aspect unless a train moves onto the approach section on the other road after five minutes has elapsed.

Details of Construction

The signals used on the Missouri Pacific at Ottawa are the Railroad Supply Company's color-light type. At Iola, the Union Switch & Signal Company Style-R three-unit color-light signals are used. At Ottawa, Union searchlight signals are used on the Santa Fe, while at Iola, the home signals are Style T-2 semaphores, and the signals on the siding are Style-N color-lights, and the one on the stock-pen spur is a T-2 dwarf signal. The color-light signals are equipped with 10-volt 18-watt lamps, and the semaphores are equipped with 13.5-volt 3.4-watt lamps.

At each plant, there is a 6 ft. by 8 ft. Massey concrete house, in which are located the relays and battery

(Continued on page 150)

There are five sections to the relay rack—each with about 14 WP relays. It was considered sufficient to localize any trouble in one of these sections. The exact relay can easily be found either by inspection, if the maintainer is in the relay room, or, if the route is being restored, by restoring the switches one by one and observing when the indication light on the track diagram goes out. This will show which switch has failed.

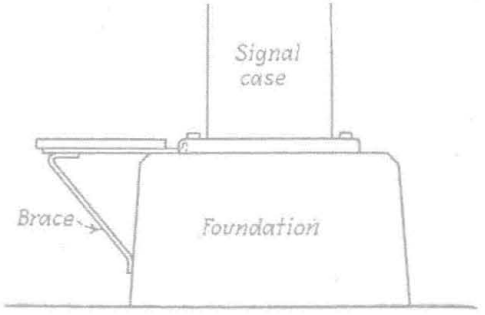
Step for Double-Case Signals

By Paul W. Davis

Signal Maintainer, St. Louis-San Francisco, Memphis, Tenn.

ANY maintainer having double-case signals with no step provided on the foundation, knows how hard it is to stand on about two inches of case and two inches of foundation, hold on with one hand, and try to balance while working with the other hand. The bank being from 10 in. to 2 ft. or more below the lower case, one cannot stand on the ground and reach circuit controllers, or even the motor, to good advantage.

I have put the step, illustrated, on my double-case signals and I find it to be a great help. This step is quickly and easily constructed from materials which most maintainer's can pick up here and there over their territory.



Step in place, showing brace on one end

Auxiliary platform facilitates maintenance work

Once installed, it is a permanent fixture and prevents double-case signals from being slighted.

All that is needed is some old crossarm braces, and 2-in. by 10-in. planks, with the necessary bolts. Cut the plank into 30-in. lengths, rounding both corners on one side. Cut the crossarm braces ¼ in. by 1 in. into 10-in. lengths and bend up ½ in. on one end; on the other end drill one hole of a size to fit the bolts that are available, about 2 in. from the end. Carriage bolts ¼ in. by 2½ in. make a nice job. These pieces can then be slipped under the case on the door side, where the case has an offset for ventilators, putting one piece on each side of the offset, leaving the end bent up inside the case to prevent the step from pulling out. The 2-in. by 10-in. plank, or other size as preferred, can then be bolted on.

Two braces can then be made from ½-in. iron, to support the weight of a man, cutting the iron into 14-in. lengths, and drilling a 5/16-in. hole 2 in. from one end. Then make an easy bend 4 in. back from the drilled end, at an angle of about 45 deg., and the brace is complete. Two of these braces are used for each step, one on each end.

Then hold the brace in place under the step and mark the place where it hits the foundation. Take a one-inch cold chisel or any sharpened piece of iron, and drill, for each brace, a hole ½ in. deep in the foundation. The brace can then be bolted on and the step is complete, except for painting.

Primary on Milwaukee

(Continued from page 132)

the battery discharge dropped to 700 m.a. and the rectifier discharged 550 m.a.

Inspection of this battery revealed that there were traces of white crystals on the zinc plates, indicating that, under certain conditions of the ballast, this battery had not been discharging, but that rather, the current had been reversed through it. Although such a condition is not desirable, it has been the experience of the maintainer that a cell is not damaged by a slight accumulation of the crystals, and that the crystals will disappear when wet ballast, for example, causes the discharge to be increased. It is not to be inferred from this statement that it is the practice of the Milwaukee to adjust the discharge so closely as to permit the formation of these crystals on track cells. In fact, this was the only set found during the inspection on which crystals existed. The point is that the Milwaukee has encountered no difficulty in the operation of the primary battery, even when the current from the rectifier is reversed through the cells during some periods of dry weather. The ampere-hour capacity of the battery seems not to have been affected by the process. The result obtained in using the a-c. primary battery system for power supply on this installation demonstrates to our satisfaction that it is entirely practicable and economical to operate track and line circuits with rectifiers floating on primary batteries.

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On Santa Fe

(Continued from page 138)

for the control of the automatic interlocking. At Iola, there are seven time-element relays, five of which are of Southern Signal Company manufacture, while three are the Union Switch & Signal Company's Type DT-10. Four of these relays are set for 5 minutes and are used for the approaches. Two are set for 40 seconds, being used to give an interval between the time that the signal on one road goes to stop and the time when the signal on opposing road can clear. The other time-element relay is set at 40 seconds, for the control of dwarf signal No. 3 leading off the Missouri Pacific siding. Also located in the house are repeater relays for the release clearing section, detector track circuits, approach track circuits, normal-indication repeaters for each signal, and polarized relays which indicate the position of switch points within home-signal limits. For each color-light signal, there is one ANL relay, which is in series with filament of the lamp in the red unit of the signal. If the filament burns out, the relay drops and prevents the signal from clearing. All relays are mounted on spring bases to guard against vibration from trains moving over the crossing.

Exide KXHS-9 storage battery is used for the various control circuits, and each set of battery is on a-c. floating charge through an RT-10 union rectifier. At Iola, where Style T-2 signals are in use on the Santa Fe, Edison primary battery is used for their operation and for lighting the approach-control signals, excepting the T-2 dwarf signal on the stock-pen track at Iola, which is lighted from a 3.5-volt battery controlled through a daylight relay. All light signals at both interlockings are lighted continously from the a-c. source, with a storage-battery standby. Three cells of primary battery are used on each track circuit at both interlockings.