What's the Answer?

Crossing Problem

"It is desired to install an entirely automatic interlocking plant at a grade crossing where it is necessary for trains on one line to make a 10-min. station stop within 25 ft. of the intersecting track. How should the circuits be designed in order to avoid the possibility of the plant being unnecessarily 'tied up' by reason of this stop? The home signals must be located 300 ft. to 500 ft. from the crossing."

Suggests Use of Additional Signals

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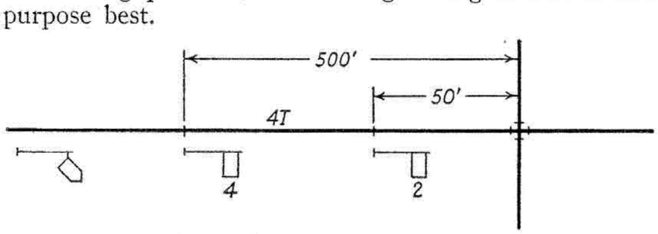
The same train operation as that described in the question has occurred at interlocked crossings where the depot for both lines is located at the crossing and where it is desired to bring the train as close to the crossing as possible and still allow the train on the conflicting route to move over the crossing. In such a case, the regular home signal, *4*, as shown in the sketch, is located 500 ft. from the crossing, and signal *2* is located about 50 ft. from the crossing.

Some may question the merit of the additional signal, *2*, but when a train once stops in the interlocking limits and waits for 10 min., some sort of an indication should be provided for the engineman to start again, and further, some sort of marker should be provided to mark the fouling point of the crossing. A signal serves this purpose best.



Sketch showing location of signals

When a train enters the approach circuit for signal *4*, signals *4* and *2* will clear provided no train has the conflicting route. After the train has stopped on track circuit *4T*, a trainman will operate the push-button, which will put signal *2* at Stop and then release the conflicting route, whereupon the signal will clear provided the train is approaching. When the train is ready to proceed the trainman will operate another push-button which will clear signal *2*, providing the conflicting route is clear. If the conflicting route is occupied, signal *2* will clear automatically without the necessity of the push-button being again operated after the route is cleared.

If the push-buttons are not desired and the layout is to be entirely automatic, an automatic time release can be provided, the release to operate while the train is in track circuit *4T* and, after one minute, putting signal *2* at Stop, and, after another minute, releasing the conflicting route. Another time release is provided, to operate for 10 min., which will again clear signal *2*, provided the conflicting route is not occupied. In this case, the train will always have to wait 10 min., except in the case when a push-button is provided to take care of the second release.

The push-button release seems to be the most desirable method as it assures that the train has actually stopped before the release of the conflicting route is effected, for the trainman has to get off the train, after it has stopped, in order to operate the push-button.

To Be Answered in an Early Issue

(1) Should some form of locking, i. e., approach, time or stick locking, be applied to levers controlling dwarf signals in regular power interlocking plants?

(2) How can rust and tarnish be removed from brass and other metal parts of relays, switch circuit controllers, etc., in the repair shop?

(3) What methods are being used to prevent lamp failures in light signals? To what extent are auxiliary devices such as reserve lamps, etc., being used? What is being done to prevent shop failures without having to depend upon a rigid system of inspection and removal of lamps?

(4) In terminal areas involving only dwarf signals, is four-position signaling justifiable as a general rule?

(5) Are switch lamps essential in automatic block signal territory?

Would Extend Approach Circuits on One Line

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One method would be to arrange the approach circuits so that trains moving through the plant without stopping, would have a substantial advantage over trains moving on the line where they stop within home signal limits for a period of 10 min. For instance, if the approach circuit for trains on the line where they stop 10 min. 275 ft. beyond the home signal, would start about 1,500 ft. in advance of the home signal, the time such trains would occupy the plant would be a minimum.

Then, for trains on the line where no stops are made, the approach circuit could be extended several miles in advance of the home signal. This would give such trains the advantage in the event trains were approaching the plant on both lines at approximately the same time, as the train on the through line would be on its approach circuit, and would set up the route through the plant before the train on the other line reached the approach circuit. It is probable that the latter train would arrive at the home signal before the other train cleared the plant, but the fact that it is going to stop again after passing the home signal, makes it seem more reasonable to stop it than to stop the through train at its home signal for a period of 10 min. or more.

Where long approach circuits are used a time relay should be used, so as to close the circuit after the maximum running time (including some margin) from the approach end to the home signal.

Modification of Standard Plan

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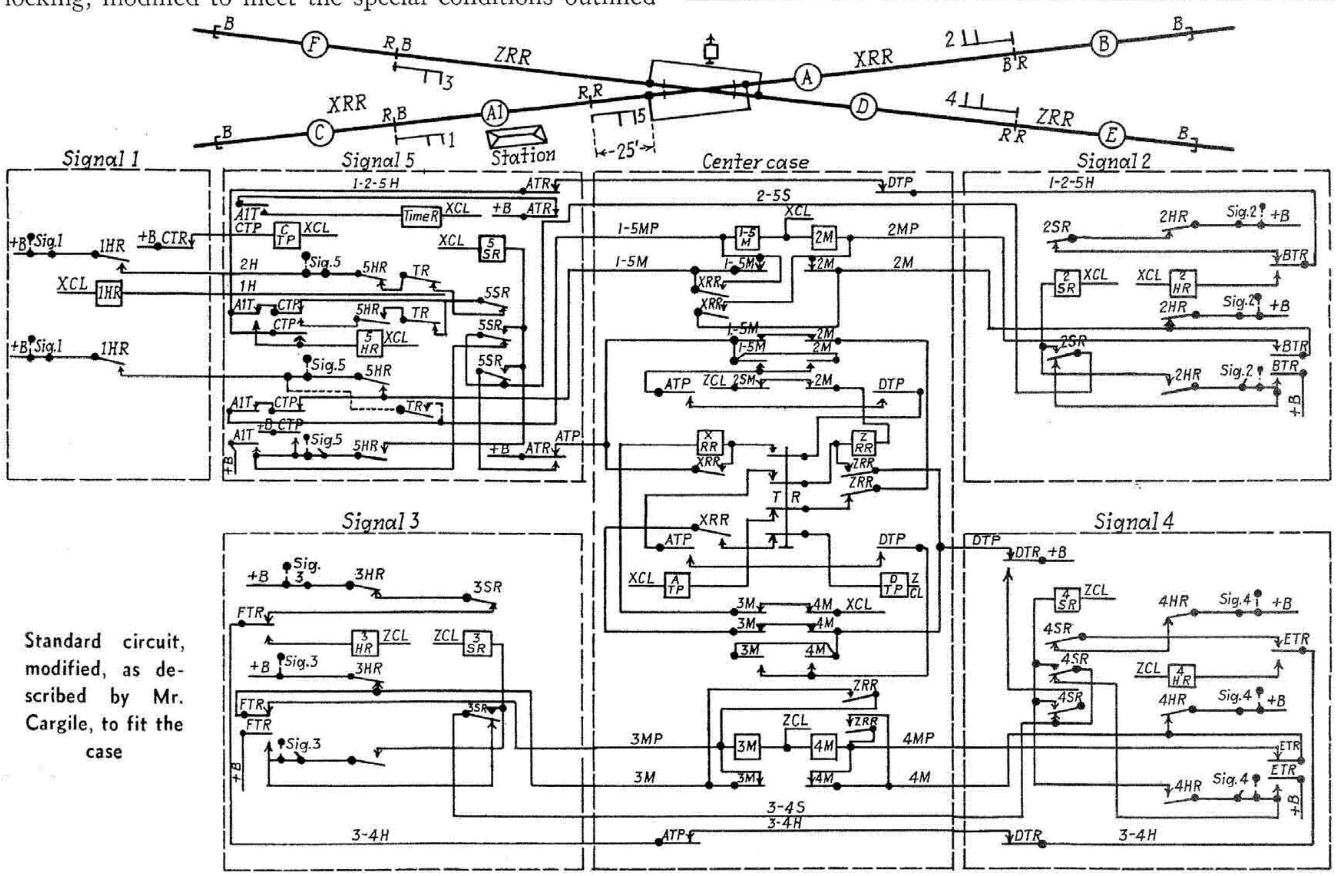
The special circuits necessary to control a special home signal 25 ft. from the grade crossing inside an automatic interlocking plant would necessarily depend on the scheme of circuits used in the plant. The accompanying sketch is a typical plant for automatic interlocking, modified to meet the special conditions outlined



Standard circuit, modified, as described by Mr. Cargile, to fit the case

in the question. This typical plan, which is standard on several roads, is very flexible, and can be adapted with modifications to meet practically any conditions.

Signal No. 1, located at the standard distance from the crossing, is a repeater of the special signal, No. 5, located 25 ft. from the fouling point of the crossing. When a train approaches the crossing on X-RR over approach *C* and stops at the station on track *A1*, a time relay at signal No. 5 starts operating, and if the train does not pass signal No. 5 in a predetermined time (say two minutes), the route locking is released as shown by the dotted connectoion between circuits *1M* and *1-5MP* through the time-relay contact. This will enable an approaching train on Z-RR to get its route and take signal No. 5 away from the train standing at the station, which will get signal No. 5 again when the train on Z-RR has cleared the plant. But if the train at the station is ready to proceed before a train enters approach circuits *F* or *E* on the opposing road, full locking protection will be effective again as soon as it enters track circuit *A* past signal No. 5. The time relay is checked by cutting *1H* and *2H* through it in the deenergized position so that whenever it is up signals No. 1 and No. 2 will be at stop.

Automatic Time-Element Device Used

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The conditions specified in this question would prevail where joint station facilities are used, and where the depot and platforms are placed in one of the angles forming the intersection. This is not an unusual condition, as there are at present a number of such layouts protected by standard interlocking to provide for train movements as outlined above, these plants having two home signals for each track to govern the movement, one being located 300 to 500 ft. from the crossing and the second located, say, 25 ft. from the crossing, which is usually at the end of the station platform.

With standard interlocking, the manipulation is such that it is necessary for the close-up home signal to be clear in order to be able to clear the one farther out. If the train should stop at the platform for a time, both home signals are put to the Stop position and the conflicting line is cleared in the same manner.

To handle this situation with an automatic interlocking, an automatic time device must be introduced into the circuit so that after a train has occupied the track circuit between the home signals a predetermined time, the near home signal would go to Stop, and, if there should be a train approaching on the conflicting track, its presence would automtically clear the signals to permit it to complete the movement.

To avoid circuit complications, it is desirable to make use of trainmen to release such a locked-out condition by the manipulation of a push-button located at the near signal.

To illustrate the method of operation with such an arrangement, we will assume that a train movement is being made by train No. 1, which stops at the platform. After a predetermined time has elapsed, the near signal goes to Stop. About this time train No. 2 on the conflicting line approaches and automatically clears both signals governing this movement. If train No. 1 should wish at this time to proceed and the trainman pushes the button, the governing signal will not clear nor will the operation of the push-button put signals governing train No. 2 to block. Therefore, train No. 1 waits until train No. 2 has completed its movement or made a stop at the platform, and sufficient time has elapsed for the near signal, governing train No. 2, to assume the stop position. When this occurs, the trainman of train No. 1 can be operating the push-button for clearing the signal to permit train No. 1 to proceed. When train No. 2 is ready to proceed, it is necessary to push the button even though train No. 1 has cleared the plant.

Since the speed of trains is restricted at automatic interlockings, the logical method of overcoming the tie-up, as outlined in this question, is to use only the near signals, and not to install those signals 300 to 500 ft. from the crossing, and reduce the speed to such a point as will permit safe operation with signals close up to the marker to show enginemen where they must not pass. The days of railroading have become history when a distance of 500 ft. is provided for an engineman to be sure of coming to a full stop.

Two Plans

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Two schemes are presented for consideration, one involving a special manual release, the other involving a special automatic release with an electrically-driven smash-board. In both schemes use is made of signal route stick relays, which check the normal position of the home signals, and of track or repeater relays for the home sections, on both roads. It is assumed that interlocking relays are used for directional control; that the track section between home signals on both roads is divided into two track circuits, the dividing point being at the intersection; and that the following apparatus is located at the intersection: Interlocking relays, signal route stick relays, central battery for home-signal operation, and other apparatus necessary for the normal release of an automatic interlocking plant. It is also assumed that the home signals are normally at danger, and that they are cleared by means of approved track circuits. The railroad on which the 10-min. stop is made is designated as "X Railroad" and the other "Y Railroad."

Scheme No. 1

The following apparatus is required: Two push-buttons, one with a normally-open contact and one with a normally-closed contact; three neutral line relays, two being required for track repeaters, and the other for a stick relay; two electric lamp bulbs, one white, the other red; a small wooden box with a door secured by a switch padlock. The push-buttons and lamps are to be located in the box and are to be conveniently located at the depot or intersection, as desired.

Upon the arrival of the train that is to make the 10-min. stop, the conductor or another authorized person should immediately go to the box, unlock same and operate a push-button marked "Arrival". This button is the normally-open type; when pushed in, it will pick up a stick relay by a circuit carried through the back contact of the repeater relay for the track circuit occupied by the train. The stick relay, having been picked up, will hold through one of its own front contacts, through the normally closed contact on the push-button marked "Departure", and through a back contact on the repeater relay for the track circuit occupied.

The picking up of this stick relay will in turn pick up the signal route stick (SRS) relay which had been de-energized by reason of the home signal clearing for the train movement up to the intersection, and will bridge the control for the home signals on the Y Railroad where same were broken through track or repeater relays for the occupied track circuit on the X Railroad, releasing the Y Railroad for train movements.

The circuit for the white lamp is carried in series through front contacts of the SRS relays, repeater relay for home section on Y Railroad, and a front contact, to plus battery, on the stick relay controlled by the two push-buttons as described above. This lamp, lighted, will indicate that there is no train approaching the intersection on the Y Railroad and that the track section between the home signals on that road is unoccupied.

The circuit for the red lamp is carried in multiple through a back contact of the SRS relays, and of the repeater relay for the section between the home signals on the Y Railroad, and to plus battery through a front contact of the stick relay controlled by the two push-buttons. This lamp will indicate, when lighted, either that there is a train approaching on the Y Railroad or that the track section between the home signals on that road is occupied.

Before departure, the conductor or some other authorized person should go to the box where the push-buttons are located, and, if the white lamp is lighted, indicating that it is safe to proceed over the intersection, the Departure push-button should be operated, thus restoring the plant to its original condition. It is of course understood that no train movement should be made over the intersection if the red light is burning, unless fully assured that there are no trains on the Y Railroad.

Scheme No. 2

The following apparatus is required: One electrically-driven smash-board, four neutral line relays, and one time-element relay. Two of the neutral relays are track repeaters and two are for smash-board operation. The smash-board should be located on the X Railroad approximately 10 ft. from the intersection, on the side where the train will stop. The insulated joints on the X Railroad, separating the track circuits, should be located approximately 10 ft. farther from the intersection than the smash-board and on the same side of the intersection, with some kind of a marker indicating the location of these joints, for the benefit of enginemen when stopping the train.

When the train that is to make the stop on the X Railroad arrives, the pilot wheels of the engine should not pass over the insulated joints mentioned above. All other trains should pass over these joints if possible.

The circuit for the time-element (TER) relay should be carried through a back contact of the repeater relay for the track occupied and through a front contact of the track relay of the circuit not occupied on the X Railroad, and thence to plus battery. After the TER relay has run, enforcing the necessary time interval as desired, the front contacts will close and will bridge the same circuits as in the case of the stick relay described in Scheme 1.

It will be noted from the foregoing that those trains, on the X Railroad, which do not have to make the 10-min., stop, will stop so that both track circuits are occupied, and therefore the TER relay will not function.

Normal and reverse smash-board relays are required for placing the smash-board in the stop or clear position. The circuit for the normal smash-board (NSB) relay (for holding the smash-board clear) should be carried normally in series through a back contact of the reverse smash-board (RSB) relay and through a back contact of the time-element (TER) relay, to plus battery. When the TER relay has run down and has closed its front contacts, the NSB relay circuit should then be carried through a front contact of the TER relay and in series through the front contacts of the signal route stick (SRS) relays on the Y Railroad, and through the repeater relay, to plus battery, for the section between the home signals on that road. The NSB relay should be of the slow-acting type to take care of the interval when the back contact of the TER relay opens and front contact makes.

The function of the reverse smash-board (RSB) relay is to place the smash-board in the Stop position should there be any train on Y Railroad approaching the intersection, or when the section between its home signals is occupied. The circuit for the RSB relay should be carried in series through a back contact of the NSB relay and a front contact of the TER relay, then in multiple, to plus battery, through the back contacts of the SRS relays on the Y Railroad and repeater relay for same for the section between home signals on that road.

Testing Storage Cells

"What tests can be made in the field to determine the state of charge of storage cells on a-c. floating charge? Should the cell voltage be measured with the rectifier in operation? How often should specific-gravity readings be taken?"

Charging Regulated Entirely by Voltage

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It has been the writer's experience that there are no infallible methods which may be used in the field to determine quickly and accurately the state of charge of any storage cells on a-c. floating charge. At one time or another all of the so-called quick methods have failed to reveal the lack of capacity in various cells.

This conclusion can readily be checked by choosing several storage batteries of different makes and ages, operating under varying service conditions, and estimating their apparent state of charge by any one or all of the generally advocated methods. Having done this, a capacity test of the cells involved will prove or disprove the accuracy of this statement.

Of all the popular procedures for adjusting the charging rate in a-c. floating service, the voltage method is undoubtedly considered most convenient. Exhaustive capacity tests, both in the field and in the laboratory, of Edison storage cells known to be mechanically and chemically perfect have indicated that cells charged week in and week out at certain specific voltages can generally be depended upon to "carry on" in case of prolonged a-c. power failures. The following set of rules under which thousands of Edison storage cells have been satisfactorily maintained for the past several years is quoted for those who may not already be familiar with them:

"When charging Edison storage batteries in a-c. floating service, it is recommended that charging be regulated entirely by voltage. Charge the cells at a rate which will consistently maintain a voltage of between 1.5 and 1.6 volts per cell as indicated by consecutive readings taken over a period of time as from week to week. These voltages refer to adjustments made at normal electrolyte temperatures of 60 to 70 deg. F. Having once made proper adjustments at these temperatures do not change the charging rate as the voltage rises or falls due to temperature alone. At 120 deg. F., or above in extreme cases, the same charging rates may result in cell voltages of only 1.4, while at unusually low temperatures they may result in charging voltages of 1.7. The point is to adjust them properly at normal temperatures and to leave the charge alone when temperatures are temporarily above or below normal.

"When installing batteries for the first time, set the charging rate considerably higher than would normally be required at the location and gradually decrease this rate until consecutive voltage readings indicate that a proper adjustment has finally been reached.

"Unnecessarily heavy overcharging will be recognized over a period of time by the necessity of adding distilled water at too frequent intervals as well as by excessive gassing."

In a-c. floating service both the charge and discharge vary materially from month to month. Therefore, to provide assurance against lack of capacity, many signalmen consider it good practice to set the charging rate slightly higher than the indicated load would otherwise warrant. Since the cost of overcharging is insignificant as compared with the cost of serious train detentions, the value of a method that substantially reduces the possibility of signal failures is obvious. Continuous overcharging at the comparatively light rates encountered in this service has no harmful effect on Edison storage batteries.

Gravity readings are necessary only at infrequent intervals with Edison storage cells—seldom oftener than once a year. They merely show the condition of the electrolyte with respect to its serviceability.

Checks Voltages on Discharge with Rectifier Disconnected

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If the charging rate has been adjusted to the requirements of the circuit, a voltage reading, with the rectifier in the circuit, will give a fairly accurate indication of the state of charge of the cells. A better test