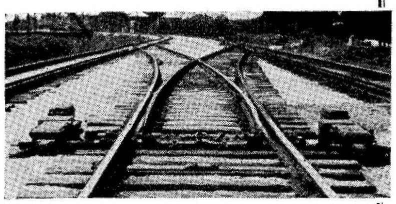
What's the ANSWER?

IF YOU Have a Question That You Would Like to Have Someone Answer, Or If You Can Answer Any of the Questions Shown Below, Please Write to the Editor.



Two switch machines—Why?

Contributions Paid for in Cash or by a Subscription to Railway Signaling

To Be Answered in a Later Issue

1. At mechanical interlocking plants, where gravity type electric locks are used with track circuit control, what method of installation and inspection is used to insure proper co-ordination between mechanical and electric locking, so that a lever cannot be reversed until the quadrant of the electric lock on the preceding lever has taken a position which will insure the dog dropping into place and making the electric locking on that preceding lever effective. As such movements are reflected in the latch lift of the lever, at what maximum lift should the mechanical locking be effective, between what limits should the electric locking become operative, and what is the minimum total lift that should be allowed in order to clear the quadrant?

2. What sort of an arrangement have you found most practicable for unloading signal mechanisms or instrument cases from a box car and setting them on foundations?

3. At interlocking plants where electric locking is installed, is it your practice to approach lock the dwarf signals so that these signals cannot be taken away from an approaching train without operating the time release; i.e., does clearing the dwarf signal break down the stick relay controlling the lock circuits?

4. What arrangement of instruments, switches, etc., is required for a testing set for code control apparatus, and how should the testing panel be constructed?

Shunt Sensitivity and Broken Rail Protection

"How do you compare the shunting sensitivity of two d-c. neutral track relays on similar track circuits? How can the broken rail protection afforded by two relays in similar track circuits be compared? Please give some examples."

Many Variables Complicate the Problem

L. F. Howard
Chief Engineer, Union Switch & Signal Co., Swissvale, Pa.

The question is not entirely clear to us with regard to whether a comparison is to be made on similar or identical track circuits and whether it is to be made between two identical relays, or relays of different types.

Of course, data can be obtained in the field on any track circuit to determine its conditions, namely, what resistance shunt will cause the relay to drop away, and thus define the shunting sensitivity of that track circuit, or what resistance can be inserted in the circuit to just permit the relay to pick up after being shunted, which will determine the broken rail protection. Methods such as this cannot give reliable data when comparisons are made as to the characteristics of a given relay. There are numerous items in any track circuit that have a very definite effect both on the shunting sensitivity and broken rail protection, namely, the calibration of the relay, the energy level to which the relay is adjusted, the battery voltage, the resistance between the battery and the rails, the resistance of the leads to the relay, the length of the track circuit, the rail and bond resistance, and the ballast resistance. With all of the variables that can exist in a track circuit, definite comparisons between types of relays, or relays of the same type and different resistances can be made only when very accurate control is made on all of the variables. On account of this, it has been found that the comparisons are best made by calculation and with certain definite assumptions with regard to each variable.

In our opinion, there is no better way to illustrate this than to refer the readers to the article prepared by J. A. Parkinson of the Atchison, Topeka & Santa Fe, entitled, "The Use of Modern D-C. Relays on Track Circuits", as published in the February, 1935 issue of *Railway Signaling.* This article brings out the points asked in the question under consideration, namely, a comparison of d-c. neutral track relays with regard to shunting sensitivity and broken rail protection on similar track circuits, and the comparison is between 2-ohm and 4-ohm relays of both the old Model-13 type and the newer DN-11 type; the data also shows the comparisons between the two types of relays. Calculations have been made

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for voltage obtained with multiple primary battery, with series multiple primary battery, or with lead acid storage battery.

Emphasizes Necessity for Good Bonding

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The readiness with which a track relay responds to a shunt on the track may be checked by placing an ammeter in series with the relay and watching the reading carefully while one of the lightest trains proceeds over the track circuit. To complete this test and further check the track for shunting conditions, a voltmeter should be connected across the limiting resistance at the battery end and the reading watched closely while a train is passing over the circuit. In the first test a defective bond could be helping to keep the current out of the relay. Such a defective bond could also enable foreign current to flow through the relay after a train had passed between the defective bond and the battery, since it would decrease the effectiveness of the train shunt. If this condition existed, it would be revealed by the second test, since the passage of a train over a bad joint while traveling from the relay to the battery end of the track circuit would result in a sudden increase in the current flowing through the limiting resistance to the track, and a consequent increase in the reading of a voltmeter connected across the resistance. Good shunting conditions would be indicated by a large flow of current to the track when the train came on the circuit, and a very gradual increase of that flow as the train neared the battery end.

The following is an example of the effect of a defective bond on shunting. An ammeter was placed in series with the track relay of a signal which had been reported as having failed. The reading was found to be subnormal. When a train entered the circuit, the meter pointer went to zero and remained there until the train had passed a point near the battery end, at which time there suddenly appeared a reading of about five mils, which remained until the train had passed off the circuit, when a full normal reading was obtained. By this test, not only was imperfect shunting over a part of the circuit indicated, but the presence of a defective connection was indicated twice, first, when the reading of five mils suddenly appeared (this evidently came from a nearby electric car line), and the second time when a full normal reading was obtained after the train had passed off the circuit, indicating that a defective connection, or at least some defect had been corrected by the train passing over it. A broken bond was found in a crossing near the battery end of this circuit.

The amount of resistance it is necessary to insert in series with the coils of a track relay to cause the latter to open its contacts is a good indication of the readiness with which it will respond to a broken rail. The relay that will be caused to drop with the least resistance is evidently the one that affords the most broken rail protection. If the drop away point of a 4-ohm relay is 0.035 amp. and the drop across its coils is 0.42 volts, it would be necessary to insert 8 ohms in series with the relay to cause it to drop its contacts, but if the drop across the coils of such a relay was 0.56 volts, it would be necessary to increase the series resistance 50 per cent, or to 12 ohms, in order to reduce the current flow to 35 mils. This does not mean that the first relay would afford 50 per cent more broken rail protection, but it would afford more protection than the second relay.

This, I believe, well illustrates the importance of good bonding. Not only will low resistance bonding enable a train to more readily shunt out a relay but, other things being equal, the lower the resistance of the bonding, the less the voltage required to operate the relay and, of course, less voltage makes for easier shunting. Likewise, the lower the voltage used, the greater will be the broken rail protection.

Describes Test

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Usually, a sticker tag is placed inside each relay to show the pick-up and release values required to operate the relays safely. In order to determine whether the relay will operate as required, the first procedure is to check to see if there is enough current to operate it safely in wet as well as dry weather, or if there is too much current for both dry and wet weather conditions. In normal track circuits, tests should be made during a dry period, and about 0.030 or 0.035 mils excess should be allowed to insure satisfactory operation for wet conditions. In a normal track circuit, ballast conditions are good and, above all, there is good bonding. However, if ballast conditions are bad, tests should be made during the wet season. At this time the current at the relay can be kept down to a minimum to take care of bad ballast conditions, because the worst condition to be experienced exists. Operation of the relay with safety and allowance for broken rail protection should be afforded.

Many roads use 4-ohm relays on neutral circuits and 3½ and 4-ohm relays on neutral polar circuits. In checking the track circuits, proceed as follows: First take a voltage reading at the battery, then proceed to the relay end and get the voltage reading there, then compare the drop from the battery end to the relay end. Proceed then to cut an 80-ohm resistance in series with any accurate d-c. meter using the 150-mil scale, or if on a track section where the current used is much higher in proportion as stated, use the 3-amp. scale. Proceed to connect the resistance in series with the relay, gradually working the slide of the resistance and watching the contacts at the same time. When making these tests, be sure that the contacts drop entirely away from the carbon points and are resting on the back contacts, before reading the actual drop-away on the meter. Then proceed to work the slide back on the resistance unit, noting the contacts of the relay as to when they pick up. Make sure that they pick up firmly and be sure that the contacts actually complete their slide movement over the carbon. Then take an ordinary current reading with the meter, using the ampere scale which is adapted for this purpose.

This procedure gives all the operating data required, including the actual drop-away and pick-up of the relay. All that has to be done is to figure the amount of current necessary to operate the relay under the conditions governing that particular circuit. If the current is too high, cut down at the battery by adding external resistance until you get the proper amount. If too low, cut out resistance, or add battery if resistance units are not used on this particular circuit. If too much current is attained at the relay end after adding battery, add sufficient resistance at the battery to give the normal amount of current for the operation of the relay. This will give the best that can be attained as to broken rail protection by this method, with ordinary conditions.

Abnormal conditions will always exist with broken rails. Sometimes the rail ends pull apart or close up after a break. Sometimes rails break over a tie plate and make contact

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through the plate. I have had some very unusual experiences with broken rails, one occurring this past winter when I was called out and found there were 12 broken rails on my territory and that in every case, after a train had gone over them, the rails had closed up at the breaks, clearing the signals. The natural tendency in cold weather is for the rails to pull apart at the break, but on this particular night, with the temperature at 20 below zero, the unusual occurred. The signals in this territory had to be set until the broken rail were found and changed, the dispatcher being notified to put out a slow order, because snow was piled up over the tracks and with the signals clearing in spite of the breaks it was almost impossible to know just where all the breaks would be found until all the track had been inspected. The test given previously to compare broken rail protection afforded by two relays in similar track circuits is really all that can be done.

Special Locking Release

"At interlockings where levermen have been replaced by operators, who are now required to hand up train orders to train crews, what changes, if any, have been made in the controls so that the operator will not have to operate the time release if he does not return to the machine in time to place the home signal lever normal while the train is passing?"

Track Indicator Picks Up Stick Relay

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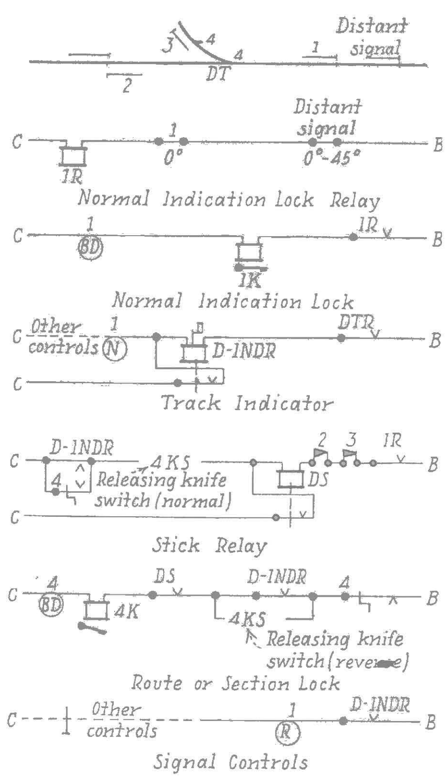
The Milwaukee has used, at several locations, an automatic pick-up of the route stick relay by the passage of a train to prepare circuits for the release of the route and section locking. Actual release of the mechanical locking is not provided until the signal lever has been restored to normal. The accompanying sketch illustrates the general design of the various interlocking circuits with regard to this feature only; the complete circuits, involving all features of interlocking protection, of course, would be much more complicated.



Track layout and electric locking circuits

Assuming the interlocking to be unoccupied, the clearing of signal 1 initiates the following action: 1R is de-energized, the controls of 1K are broken, D-INDR remains stuck up, DS is de-energized, and the controls of 4K are broken at DS. If the operator desires to take the signal away before the train has traversed the route and throws the signal lever to the normal indicating point, the following action occurs: The signal controls are broken at the signal lever band, the home signal goes to stop and the approach signal to approach, 1R picks up, 1K picks up, D-INDR remains energized, DS remains de-energized, and 4K remains de-energized; in order to pick up 4K to release the switch, relay DS must be picked up by operation of the time-release, and the time-release restored to normal. The time-release is not equipped with a latch and stands normally run down.

Assuming that the operator has displayed a proceed signal and is on the ground to deliver train orders, automatic preparation for the release of the plant when the operator returns and restores the signal lever, after the train has cleared the plant, is provided in the following manner: Passage of the train drops DTR, D-INDR drops, the signals go to their normal position, 1R picks up, and DS picks up automatically over a back contact on D-INDR and a front contact on 1R; when the operator returns and places the signal lever towards the normal position, 1K picks up with lever between "B" and "D" positions; when the operator completes the motion of the lever to normal, D-INDR picks up, DS remains stuck up, the controls for 4K are closed by D-INDR, and 4K is energized, releasing the switch lever.

4KS is a double-pole double-throw releasing knife switch located in a metal smash box with a glass front cover secured with a seal. This knife switch is to be used only when there is a track circuit failure within the interlocking limits or failure of D-INDR to function. When this occurs, all signal levers controlling signals governing over the route must be placed normal, the seal of the smash box broken, and the knife switch reversed. This will bridge the break in the 4K circuit at D-INDR and will release 4K, provided clockwork time release 4 is normal, in run down position. To assure the restoration of 4KS to normal after the plant is in normal condition, the circuit for the pick-up of DS is carried through a normal blade of 4KS. When DS is again de-energized, it will not pick up automatically upon the passage of a train. This should call the leverman's attention to the oversight and cause him to place 4KS normal.

Uses Normally Open Stick Relay

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The approach and route locking circuit in general use at our interlocking plants utilizes an open circuit stick relay for the approach, picked up through a half-reverse contact on the home signal lever lock in series with a back point of a stick indicator, repeating the track circuit through the home signal zone of the plant, which also, through its front contact, provides the route locking. The stick indicator, of course, controls the home signal circuits to prevent clearing behind trains and its pick-up circuit is also cut through a half-reverse contact on the home signal lever.

The only change required in this circuit, to take care of the condition mentioned in the question, is to extend the pick-up contact for the open-circuit stick relay so that it makes through the half and full reverse positions of the home signal lever.

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