track will provide a decided improvement on the ordinary track circuit from a shunting standpoint or a momentary loss of shunt. The momentary loss of shunt feature can be further improved by introducing a time feature between the primary and secondary relay that will be of sufficient duration to prevent having energy applied to the secondary relay during these momentary loss of shunt periods. Broken rail protection can be solved somewhat, within certain limitations, by lowering the resistance winding of the relay with a consequent increase in current to pick the relay up.

Train Shunt at Automatic Plants

"What circuits have been designed for automatic interlockings, based on the requisite that a loss of train shunt will not permit a change in line-up?"

Two Methods Available

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The problem, of shunting infrequently-used track circuits, is one which has always presented extreme difficulty on account of the high resistance of the film of silicates or oxides which form on the surface of the rails when they are not used. Two methods of improving shunting sensitivity under this condition are available: One, the use of the special combination known as the primary-secondary relay; the other, the use of increased voltage across the rails which has the faculty of more readily breaking through the rail film insulation.

The primary-secondary combination consists of a primary relay connected to the track which when picked up in turn picks up the secondary relay, a slow pick-up quick-release instrument, through which are carried the signal circuits. Pick-up of the secondary relay also cuts out of the primary relay circuit a portion of the turns of its windings so that its energization is reduced to near its release point, thus making the shunting of this relay much easier than if it were fully energized. On a given track circuit the shunting sensitivity can be approximately doubled by this method.

The second method, involving increased rail voltage, can be effected by inserting resistance in series with the leads of the track relay so that the relay receives but normal energy under worst ballast conditions. This will, of course, require higher battery voltage and reduction of resistance in battery leads. Where alternating current power is available, the track batteries may be replaced by half-wave or full-wave rectifiers and still better application of this principle obtained due to the peaks of the rectified voltage wave being of much higher value than the average or corresponding battery voltage. Unfortunately this method to obtain the most improved results is limited to relatively short track circuits of the order of 2,000 ft. or under, but it should have a useful field in interlockings where the track circuits are generally short.

Prevents Change in Line-up by Use of Stick Relays

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On the Santa Fe, we have a circuit for use at automatic interlocking plants which prevents a change in line-up in case of loss of train shunt. It is illustrated in the accompanying diagram and works as follows: A train enters track circuit 1AT, dropping 1ATP, which picks up 1-2RS. A front contact on this relay, in series with a back contact on 1ATP, picks up 1HR, which opens the control of 1NP. When 1NP drops, it de-energizes 1-2LR. Since 1-2LR and 1-2RS have both opened the control of 3-4RS, a train on 3AT or 4AT does not get a signal until the first train accepts its signal or until signal No. 1 has remained red long enough for the time-element relay 1-2TU to wind up and pick up the lock relay 1-2LR. The lock relay cannot be picked up by the momentary shunt of one track circuit within home signal limits, but requires the occupancy of two track circuits, at which time the slow acting repeaters of the track relays pick up the lock relay. This plan works equally well for trains coming on any of the four approaches.