dicate the position of the gate, trains should be required to approach the crossing at restricted speed, because the gate can be moved at any time to block the line which is normally clear.

There are a number of crossings protected by gates where home signals, distant signals, and approach locking have been provided, so that the gate cannot be moved, after a train is on the approach circuit to the distant signal, without operating a time element or release. An installation of this kind might be called a half automatic interlocking, because for one road it does all that an automatic plant would do. With an installation of this kind, the maximum permissible speed should be determined in the same manner as for an interlocking plant, either manual or automatic. If the signals are properly located, to my mind, no special restriction is required.

Switch Protection in Automatic Territory

"For the protection of facing-point main-line switches in automatic block territory, do you arrange the circuits in connection with the switch circuit controller to shunt the track and break the line control circuit, or only to shunt the track? Why?"

Special Relay

E. P. WEATHERBY
Signal Engineer, Texas & Pacific, Dallas, Tex.

Our standard for the protection of facing-point, main-line switches in automatic block signal territory, is to arrange our circuits so that the switch circuit controller shunts out the track circuits only. Where signals are used to operate trains by signal indications, without train orders, we break the line control circuit, in addition to shunting the track. To avoid carrying our line control circuits under the ground, we put in a special relay, controlled through the switch circuit controller, and break the line control circuits through the contacts of this relay.

Multiple Shunt Wires

W. J. ECK
Asst. to Vice-President, Southern Washington, D. C.

It is our practice to shunt the track for both facing and trailing point switches on double track. We use two wires to each rail and multiple contacts in the switch circuit controller and are of the opinion that the protection afforded is equal to that where line break control is used, as it obviates the possibility of grounding the line wires by lightning or otherwise, due to their proximity to the earth at such breaks.

On single track in APB territory, either the shunt or line break connections are used, depending upon the requirements of the signal circuit arrangements. Between passing tracks where stick or directional relays are used, we use line break. Where these relays are not used, such as between the absolute signals at the outgoing end of passing tracks in the vicinity of stations, etc., we use shunt protection.

Shunt Not Adequate for Facing-Point Movements

J. A. JOHNSON
Supt. Tel. & Sig., Missouri-Kansas-Texas, Denison, Tex.

We use a shunt on all of our switch circuit controllers, and, as an added safeguard, we break the line control circuits of facing-point signals through the contacts of the switch circuit controller.

We feel that a shunt only, for facing-point movements, is not adequate protection, for the reason that, if a shunt wire is broken or becomes defective from any cause, it then fails to shunt the track circuit, when a switch point is opened. In that event, with the signal controls broken through the contacts of the switch circuit controller, the line circuit would be open, causing the signal to display a proper "Stop" indication.

Depends on Type of Signaling

OTTO M. JENSEN
Office Engineer, C. M. St. P. & P., Milwaukee, Wis.

The standard practice on the Milwaukee for wiring of switch circuit controllers on facing-point switches in automatic block signal territory is as follows:

1. In d-c. track-circuit territory: Track shunts only.

2. (a) In a-c. track-circuit, steam-operated territory: Track shunt and selection of "H" control wire.

(b) In a-c. track-circuit, steam-operated, continuous cab signal territory: Track shunts and selection of loop circuit.

3. In a-c. electric-propulsion territory: Selection of "H" control wire —no shunts.

The method of shunt wiring consists of using multiple conductor No. 9 solid track cable to each rail. These conductors are so placed along one of the ties that inspection may readily be made. Results obtained from this type of construction, and maintenance over a period of years, has demonstrated that in d-c. track-circuit territory we have been justified in depending solely upon the shunts for protection and eliminating the selection of the "H" control wire in such territory.

In a-c. track-circuit, steam-operated, non-cab-signal territory we have found it necessary to continue selection of the "H" wire, since many of the track circuits are over 8,000 ft. in length, and it requires a very low resistance to fully shunt the track circuit under certain conditions. In cab-signal territory the selection of the loop circuit assures a positive check on the cab-signal control relay, and provides a means for reconnecting the loop circuit to rail in case a switch is thrown after the train has passed it.

In electric-propulsion territory, shunt wiring is not practicable, so that the selection of the "H" control wire is required on all switches.

Shunt and Break the Track Circuit

G. A. RODGER
Signal Engineer, Wabash, Decatur, Ill.

On the Wabash, the practice on our modern automatic signaling territory is to provide switch-position protection by not only shunting the track relay, but also by opening the track circuit, this result being effected by contacts in one switch circuit controller connected to the closed point.

On our latest automatic block signaling on single-track territory each set of head-block signals is located about 10 ft. from a passing track switch. With this arrangement it is very practicable to not only shunt the track relay with the switch circuit controller, but also to break the track connections to the relay through contacts in this controller. No extra insulated joint is required because the cable leads between the switch box and the instrument case are very short. In some instances, it is practicable to locate an intermediate signal or track cut location near an

(Continued on page 538)

outlying switch, thereby permitting the same arrangement as at a passing track switch. If no signal or track cut is located near a switch, an extra insulated rail joint is required to secure the shunt and break protection. However, locations requiring the extra joint are comparatively rare, in territory outside of yards.

We feel this practice not only gives the desired protection, but results in considerable battery savings over a large territory by having the shunt on the relay and not on the battery.

Shunt Is Enough

R. D. MOORE
Signal Engineer, Southern Pacific, San Francisco, Calif.

Our standard practice in automatic signal territory is to shunt the track only, with switch circuit controllers.

While a switch circuit controller that breaks the line circuits, in addition to shunting the track, appears to afford a greater degree of protection than one that shunts the track only, the benefit, in my opinion, is insufficient to justify the expense and complications involved. In addition to increasing the expense of installation required to bring the line circuits to the controllers, the maintenance expense is increased. There is also the danger of open or grounded circuits, due to running underground to the controllers.

Where the controllers merely shunt the track, the installation becomes a very simple matter, and by proper construction and maintenance this method is quite reliable. While the "shunt" box is on the open circuit principle, we have adopted certain practices that assist in guarding against open circuit failures. For shunt controllers, we use the vertical rotary type, and the contact springs are adjusted to automatically close should the spring board cap become broken or loose. That is, the top contact springs are bent downward and are held open against spring tension so that they follow the spring board downward without assistance.

We normally use two sets of contacts in each controller, and in wiring them, the two sets are kept separate and not connected in multiple. A separate wire runs from each top contact to one rail and one wire from each bottom contact to the opposite rail. With this method of wiring, the maintainer is able to press the sets of contacts together separately and determine if all wires leading to the rails are intact. This test is made with a voltmeter connected across the track, and if pressing the contacts together does not shunt the circuit completely, it indicates either an open circuit or high resistance.

To guard against resistance, due to corrosion or loose connections, the binding post and contact spring are soldered together after assembly. This insures a solid connection.

Separate Track Circuit

B. J. SCHWENDT
Assistant Signal Engineer, New York Central, Cleveland, Ohio

It is our practice where bolt locking is not in use, to provide a separate track circuit at the turnout or crossover. The line control wires are broken through the relay operated by this track circuit. The switch circuit controller, in addition, shunts the main and special track circuits.

Where bolt locking is in use, we eliminate the special track circuit and provide a WR circuit and break the line controls through the WR relay. In addition, the main track is shunted by the switch circuit controller.

The reason for this is to improve signal performance as the result of the elimination of grounds, which commonly occurred in the old arrangement where we attempted to break the line control circuits through the switch circuit controller direct.

In some odd cases we eliminate the special track circuit and depend entirely upon the switch circuit controller shunting the main track circuit.

Shunt Protection Considered Adequate

L. S. WERTHMULLER
Assistant Engineer, Missouri Pacific St. Louis, Mo.

It is the practice on the Missouri Pacific to use shunt protection for facing-, as well as trailing-point switches except where it is necessary to select different routes through the switch, in which case normal and reverse switch-repeating relays are used. While I understand quite a few of the railroads carry their signal circuits through the switch circuit control contacts, and others do this as well as shunting the track circuit, our experience on the Missouri Pacific has been that we have very dependable operation by using the four contacts in multiple for shunting the track circuit. We use two independent No. 6 wires to each rail and we have never found where more protection would be afforded by breaking the signal control circuits through the contacts.

A. P. B. Circuits

"Do you design your A. P. B. circuits so that, if a train going from station 'A' to station 'B' should desire to back up to station 'A' for some cause, in place of going to station 'B' after it had passed the first pair of double signals, with another train about to leave station 'A', it would be impossible for these two trains, now traveling in opposite directions, to pass signals at 45 degrees entering the same block at identically the same moment?"

Flag Protection Provided

G. C. SCHINDLER
Assistant Engineer, Chicago & North Western, Chicago

The design of A.P.B. circuits which we use would permit a train which left station "A" and had passed the first pair of double signals, to reverse its movements to return to station "A", to pass the signal at 45 degrees at the same instant that a second train leaving station "A" passes the leaving signal at 45 degrees. However, under our rules and operating practices, a train leaving station "A" to proceed to station "B" establishes a definite direction, and if then the train desires to reverse its movement, which would be contrary to the established direction, the reverse movement could be made only under full flag protection against any possible train from station "A."

Covered by Operating Rules

A. HUNOT
Chief Draftsman, Missouri Pacific, St. Louis, Mo.

More than 99 per cent of the train movements between station A and station B will be through movements.

As operating rules on our railroad provide the same restriction for movement of trains after passing a signal displaying a caution indication as for movement of trains after passing a stop and proceed indication, we have made no circuit changes to prevent the two caution indications described.