Savings on wrecks that don't happen cannot be ignored. Here, a hot box detector would have saved its cost several times over.

## *Fewer Wayside Observers Makes . . .*

# Automatic Hazard Detection Necessary

**Ten forms of apparatus can automatically detect hazardous conditions of tracks, bridges, and passing trains, and can control signals to stop the trains. John H. Dunn, our Western Editor, has prepared a summary of these devices for your reference. A bibliography of articles appearing in Railway Signaling and Communications dealing with safety detectors is included.**

RAILROADS are having difficulty in finding enough competent telegraph operators willing to work at outlying points. Interlockings at crossings of railroads at outlying locations are being converted from manual to automatic control, or are being included in centralized traffic control projects. Automatic electric crossing gates are being installed at numerous crossings to replace watchmen and gatemen at manual gates. Many offices previously open 16 to 24 hours daily have been abandoned.

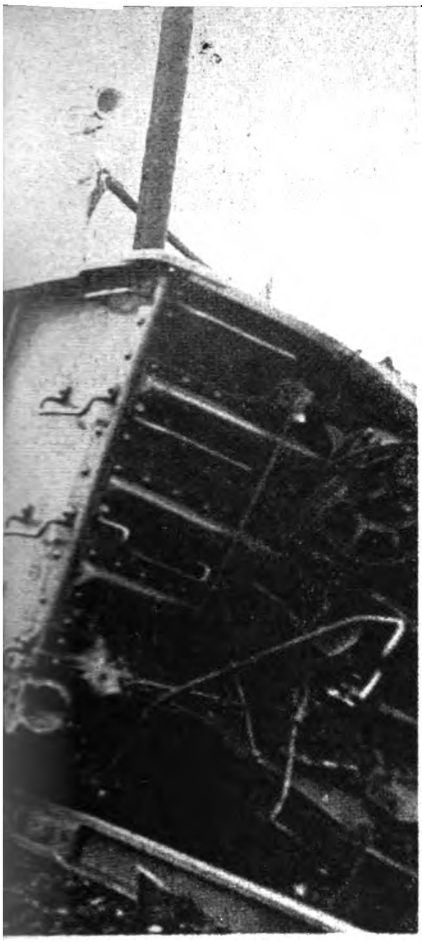
Furthermore, on many roads, new forms of power machines are being used to do practically all of the track maintenance work. Spot maintenance is done by small crews covering sections of 30 miles or more. On numerous roads, these long-range track crews use highway trucks rather than track motor cars.

This means that the number of operators, levermen and track men working on the wayside on most railroads has decreased decidedly in recent years, and will decrease further. As one consequence, there is a definite need for extensive applications of automatic devices that will detect hazardous conditions on tracks and bridges, as well as defects on trains.

Conventional automatic block signaling, in addition to indicating track occupancy, includes safety checks for (1) broken rail, (2) normally-closed position of all main track switches, and (3) cars occupying turnouts short of the clearance point. In addition, there are 10 more forms of automatic safety detectors which have definitely proved their worth in railroad service for periods ranging from one year to 25 years or more.

### *For Dragging Equipment*

Brake beams or other loose equipment when hanging or dragging from cars or locomotives may cause derailments. About 22 years ago, devices were developed to detect such defects. One type consists of a series



of brittle cast iron loops mounted between and outside the rails, just below standard clearance for rolling stock. Hanging parts will break one of the detector loops which are so connected in a circuit that a relay is released.

Another type of dragging-equipment detector consists of sheet-metal panels bolted to a horizontal shaft mounted on bearings between two track ties, so that the top edge of the panels is about level with the top of the rails. When dragging equipment strikes one of the panels, the shaft is rotated a few degrees, operating a circuit controller. Then spring pressure returns the panel to normal position.

Dragging equipment is most likely to cause derailments at switches where turnout rails may deflect the loose parts under the wheels. Therefore detectors are placed in approach to interlockings which include numerous switches and crossovers, as well as at important bridges and tunnels where a derailment might cause serious damage and perhaps block the line.

A total of more than 800 sets of these detectors have been installed on the lines of such railroads as the B&LE, B&M, DL&W, CGW, CMStP&P, GN, GM&O, NYC, MP, PRR, SP, SP&S, T&NO, UP and Wabash. Some of these roads, and others, have installed these detectors as part of car inspection facilities on the track approaching the hump in gravity classification yards.

### For Broken Wheels

Freight car wheels with sections of the flange broken out have caused serious derailments. Such defects are difficult to find, even when a car is standing in a yard. A device that automatically detects broken wheel flanges, as well as wheels that are loose on the axle, while cars are in motion, has gone through several years of development.

Each detector consists of a series of spring steel fingers, at right angles

**This dragging equipment detector is self restoring. The Southern installed six of these safety detectors in a 150-mile CTC project.**

**Dragging equipment breaks cast iron detector circuit.**

**Series of pointed fingers check for broken flanges and loose wheels.**

to the rail, with an insulated hardened steel pad near the end of each finger. The upturned end of each finger extends ⅜ in. above the top of rail. The flange of a normal wheel encounters the insulated pads, thus depressing the upturned fingers away from the tread of the wheel. If a section of flange is broken out, the contacting finger tips touch the tread and cause a relay to operate.

This device will also detect a loose wheel if it fails to stay on the insulated pad. Each detector is 11 ft 6 in. long, i.e., more than the circumference of a 42-in. wheel. The detector functions at train speeds up to 20 mph. When a defective wheel is detected, an automatic pump sprays yellow paint on it, and an alarm is sounded.

Locations at which these detectors have been installed include: Grand Junction, Colo., on the D&RGW; Potomac Yard, Va., on the RF&P; Covington, Ky., on the C&O; Pasco, Wash., on the NP; Birmingham, Ala., on the Southern; Florence, S.C., on the ACL; Mechanicville, N.Y., on the B&M; and Cumberland, Md., on the B&O.

Six months after the device was installed on the RF&P it detected a wheel with a 14-in. section of the flange missing; and the next day it detected a wheel with a 12-in. section gone. In about four years service on the D&RGW, the device detected ten wheels with broken flanges, one wheel loose on the axle, and one false flange. The NP installation detected one wheel with 8 in. of flange gone, a second with 10 in.; and a third with 3 in. gone and with a 36-in. crack in the flange, in its first six months of service.

These installations listed are at yards where speeds are slow. However, there is no reason why this detector cannot be installed on line of road at junctions, or other places where speed restrictions up to 20 mph are in effect. The detector can be damaged by equipment that is hanging or dragging from cars or locomotives. Therefore, a logical practice is to install dragging-equipment detectors in approach to the broken-wheel detectors. Considering the increased safety achieved by these broken-wheel detectors at a comparatively small cost, more extensive use on more roads can be expected.

#### *For Hot Boxes*

The newest member of the detector family, the infrared ray electronic hotbox detector, has proved to be an effective and economical means for detecting hot boxes on passing trains. These devices have been in service for some time now on the ACL, B&O B&M, C&O, CMStP&P, D&H, DL&W, L&N, NYC, N&W, P&LE, PRR, Reading, and the Southern.

Boxes that are dangerously hot, but not evident to train crews or railroad employees watching from the wayside, are detected by this device. The B&M located the detectors 30 miles out from a terminal so boxes that are going to heat will have time to reach a temperature to be detected. This B&M project detected 52 hot boxes in five months. In one month alone the C&O installation detected 8 hot boxes, only one of which had been discovered by the train crew or the operators at wayside offices.

Other roads have located detectors to check incoming trains as they enter a yard. During about four months one at the Roanoke, Va., yard entrance on the N&W detected 104 boxes which had abnormal temperatures. Because this detector proved to be so effective, in checking for such conditions, this road looks forward to the practicability of omitting journal inspection of cars coming into the yard.

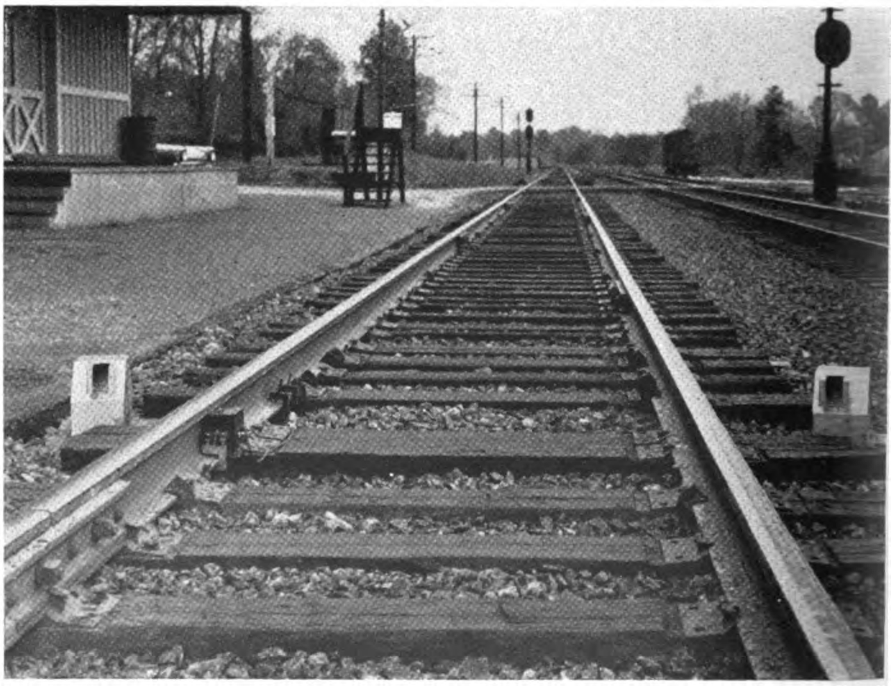
#### *For Floods and High Water*

Flood detectors include cork floats which rise with the level of water. By using a long rod from the float up to a controller, this controller can be at a level convenient for inspection. A latch holds the float in the raised position until the signal maintainer or track foreman arrives to check flood conditions.

These flood detectors are installed

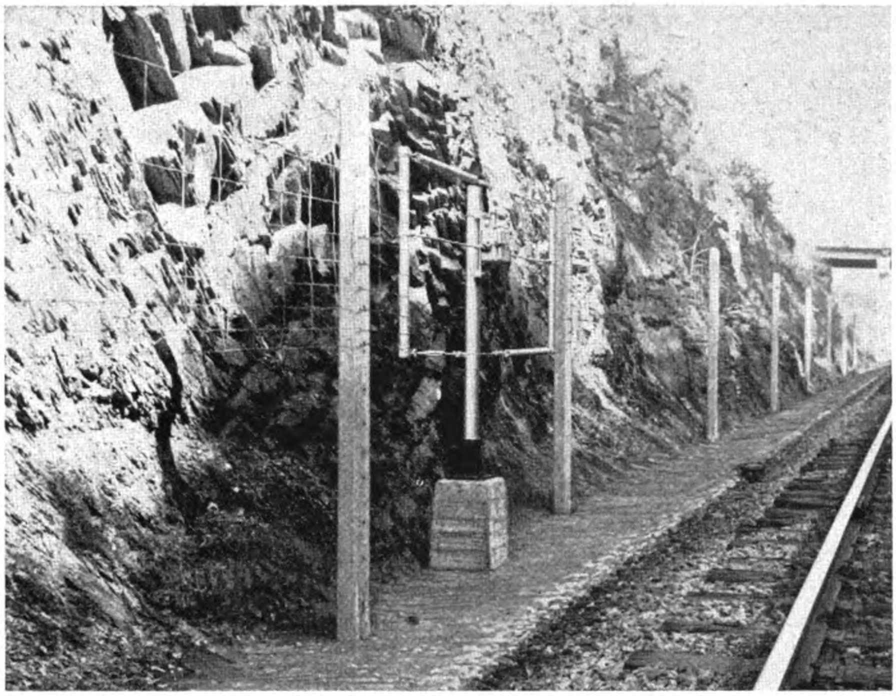
**Devices are available for detecting—**

- Hot Boxes
- Dragging equipment
- Flash-floods and high water
- Broken car wheels
- Fire on trestles and bridge decks
- Exact alinement of bridge piers
- Earthquake tremors
- Rocks falling on tracks
- Dirt slides and snow slides
- Falling snow and ice



**Many roads are appreciating the worth of these hot box detectors. Wrecks cost much more.**

not only adjacent to bridges and alongside embankments but also at points up stream to detect oncoming rushes of water caused by heavy rainfall in limited areas in hills remote from the railroad. The locations for each detector can be determined from records of rainfall in watershed areas. Some of the roads which use flood detectors are the Santa Fe, SP, Milwaukee, MKT, KCS, CRI&P, MP and T&NO.



This slide detector fence operates circuit controller shown when pulled or broken.

### For Rocks on Tracks

To detect large rocks that roll down hillsides or fall from cliffs onto tracks, fences including circuit controllers are used. Some roads use ordinary stock fencing with wires loosely stapled at intermediate posts but attached at each end of a section to a cross member which in turn is attached to a circuit controller, tension in the fencing being maintained by springs. Fences are located near the tracks or up the slope as required. Where rocks fall from cliffs, overhead network fences can be used.

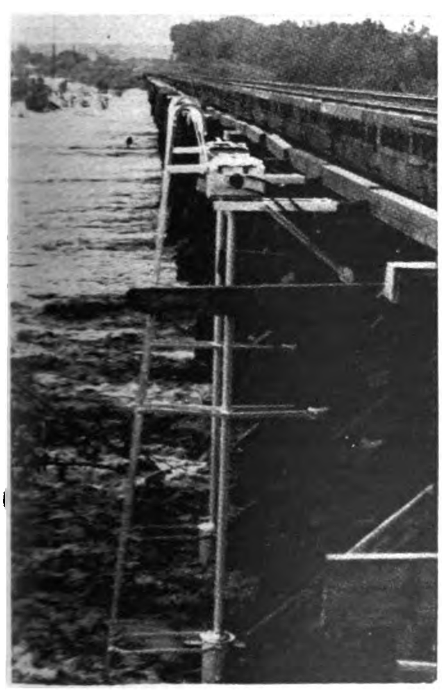
These rock detectors have been installed extensively on numerous railroads, including the D&RGW, MP, N&W, SP, SAL, WP, SP&S, and UP. The Clinchfield installed 24,645 ft of these detector fences. One of these devices on the Missouri Pacific detected a large rock that rolled down and came to rest on the main track. Thus it most certainly prevented a train accident.

At some locations, soft mud slides down from banks onto the track. At such places, some roads use low fences constructed of planks on posts which are jointed at the ground line with sections that break easily. Mercury-level circuit breakers detect any movement of the fence from vertical. A fence to detect snow slides has been used on some roads. When snow pushes against it, a plug is pulled to open a circuit.

### For Fires

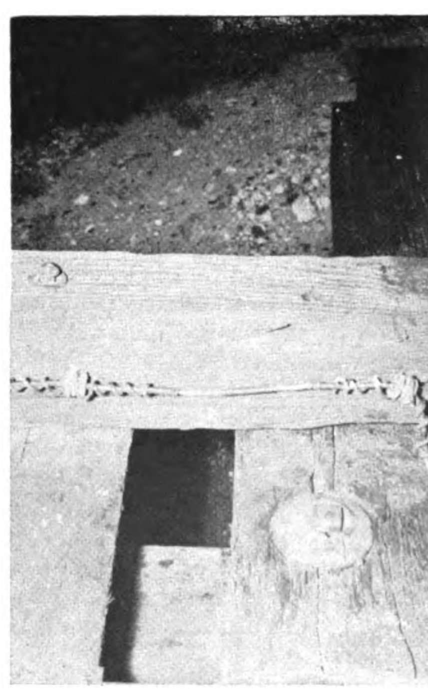
Fire damage to timber trestles, bridge decks, tunnel linings, and timber snow sheds can result in hazards to trains. Therefore, at such locations several railroads have installed fire detectors.

Typical construction consists of in-

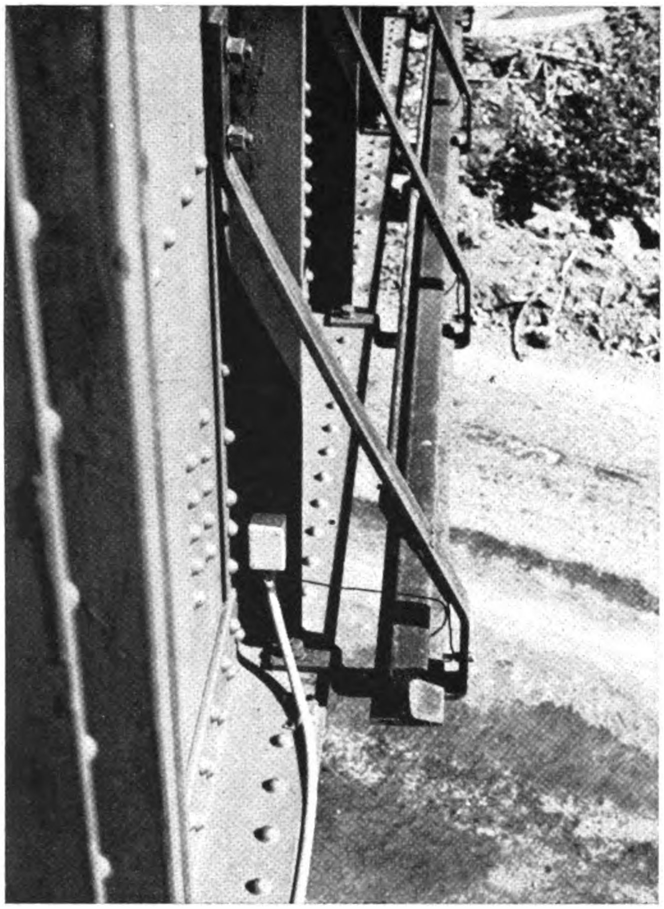


Flood detector alerts personnel of high water.

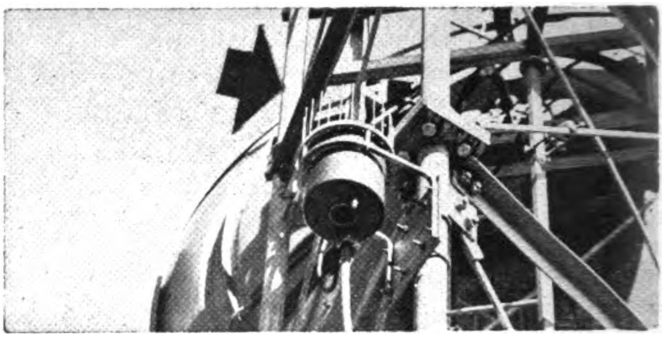
Wires form series circuit to detect rock falls.



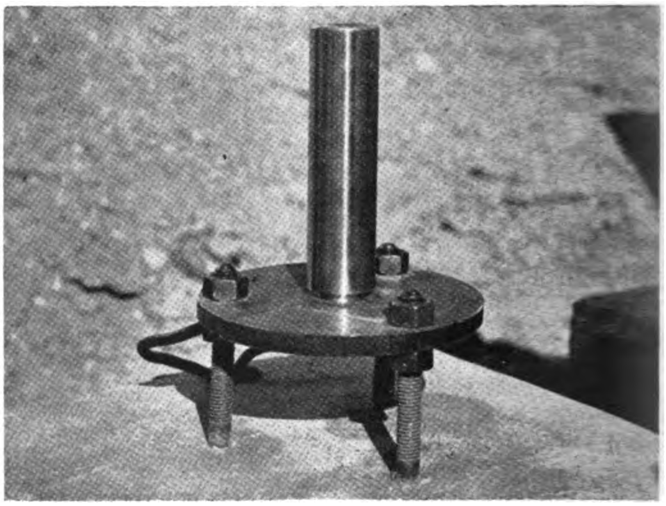
Bridge fire is detected by fusible link.



SP highway high load detector (RS&C, November 1955, page 27).



This snow detector controls heater on microwave reflector.



This device measures 12 different ranges of earth tremors.

sulated No. 10 copper wire supported on porcelain insulators with a 2-in. soldered lap joint between each set of insulators. The solder melts at a comparatively low temperature: If a fire melts the solder, the weight of the wire opens the joint, thus opening a circuit to operate a detector relay.

### For Snow

A special device, that detects falling snow and rain at freezing temperatures, can be installed at outlying locations to transmit such information to the nearest open office or to the dispatcher.

Also this device meets another need. Not enough track men are available these days to sweep snow from switches at outlying locations. Some roads have installed heaters to melt the snow in switches, and others use motor-driven blowers. These blowers or heaters are controlled by the dispatcher as part of the CTC.

A missing link is that snow heavy enough to block switches may fall at remote locations in CTC territory without the dispatcher knowing about it. To meet this need, railroads can now utilize the new device that automatically detects precipitation when the ambient temperature drops below 37 deg F. Snow or ice forming on the "bowl" (top) of the unit is melted, and thus completes a circuit to a relay which can control the switch heater or blower, as well as send an indication to the dispatcher. When snow or ice ceases to fall on the detector, the circuit is opened, thus turning off the heaters or blowers, and sending an indication to the dispatcher.

### For Bridge Position

Even with the best of construction, some bridge piers in streams may settle out of alinement. This may change the relative position of the end girders and the abutment piers. To check these conditions, some roads have installed detectors. The device includes a heavy pendulum which normally hangs vertically. If it swings off center, it breaks a short strand of fine wire, thus initiating a warning.

To check the normal position of a girder, a terminal on the end of this girder is connected by a fine wire to a second terminal directly opposite on the face of the masonry of the pier. The wire will be broken if the girder moves away from the pier more than 1 in. in excess of normal contraction. A relative change of horizontal alinement can likewise be checked.

### For Fog

A device which detects fog has been developed recently. The basic principle is that of measuring the amount of light reflected from water particles suspended in the atmosphere. The manufacturer states that the device will detect mist, fog, heavy rain or snow.

### For Earth Tremors

In areas where earth faults are known to have caused earthquake tremors in recent years, one road uses the bridge-position detector as explained above. Although there has been no damage to railroad tracks and structures, in one danger area a means of recording the intensity of tremors, and informing the dispatcher when such tremors occur, seemed desirable. Therefore, signal department forces developed and installed devices that detect 12 different ranges of intensity and transmit information accordingly to the dispatcher.

Having detected a hazardous condition on the track or a defect on a car in a passing train, the next problem is to give this information to the engineer so that he can stop his train. This objective is readily obtained by arranging circuits so that operation of a detector indirectly controls a wayside signal to display an aspect to direct the engineer to stop his train.

### *Using Existing Signals*

In some installations, existing signals at interlockings or in automatic block are used. Where no such signals are available, some roads are using a special flashing-lunar aspect on a wayside mast which indicates "stop train for inspection." The hotbox or dragging equipment may be on any car in a train, therefore, the detector should be located, in approach to the flashing-lunar signal, a distance equal to the length of the longest train plus approximately 1,000 ft sighting distance from the locomotive to the signal. The use of such a single signal, with no approach aspect, is based on the fact that the flashing-lunar aspect does not mean that the train must be stopped short of that signal, but rather that the engineman is to stop his train as soon as he can do so with safety, i.e., without applying the brakes in emergency.

In connection with devices which detect hazards on tracks and bridges, such as washout, floods, fire, and falling rocks, the signals that are to be controlled are located to stop trains before arriving at the hazard. In many instances, existing automatic signals can be used.

On the SP each such signal has a special rectangular marker which designates that the control of each signal so marked includes not only the conventional automatic block controls but also special detector devices. If the engineman and conductor do not already know what the devices are, as applying to a signal at which they are stopped, the information is given in the timetable. Then they look for the corresponding rock on the track, washout, etc. Telephones connected to the dispatcher's line are located at these signals so that conductors can advise the dispatcher of the condition.

### *What to Do Now*

Need for action in this matter has been brought about by reduction in the number of men who watch for hazardous conditions on railroad tracks and on passing trains. Opportunity to use any or all of the ten forms of detectors that have proven satisfactory is a further consideration.

With one exception, the detectors are comparatively inexpensive in first cost and maintenance. Roads which up to now have not installed these protective devices can easily make a few trial installations of each type soon, and thus secure information on which to base decisions about extensive programs.

A complete analysis of numerous local circumstances and number of trains is required when planning an extensive program. Locations for falling rock detectors are obvious. Detectors for flashfloods and high water can be located according to watershed area and short-period record rainfall. Dragging-equipment detectors are applicable in approach to all important bridges and tunnels, as well as in approach to junctions or turnouts 25 to 30 miles apart on medium traffic lines or 10 miles apart on heavy traffic lines.

Hot-box detectors may be located at the entrance to yards, and at points 25 to 30 miles from a departure yard, so that journals which are in condition to heat will have time to get hot in that distance. Experience may indicate more locations. Broken-wheel detectors can be located at entrances to yards and at junctions or other places on line of road where train speeds are restricted to 20 mph.

Installation of these safety devices is not going to accomplish a determinable reduction in operating expenses, such as 25 per cent or 50 per cent. No one can figure the expense for an accident that was prevented. On the other hand, practically every road has data on the expense involved in wrecks during years past.

Descriptions of various forms of detectors discussed here, as well as the operation of signals in connection with detectors, have been published in Railway Signaling and Communications. A bibliography follows.

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