Double-direction detectors were initially installed on New York Central at Fairview, Pa., near Erie.

Special Report on Hot Box Detection

Where does it stand today?
How accurate is it?
Is it economically justified?
How does it benefit train operations?
What of the future for hot box detection?

THIS SPECIAL REPORT is based upon a survey of the nine railroads now having installations of hot box detectors, plus field trips to detector installations by *Railway Signaling and Communications* editors.

The five questions above and others concerning hot box detection, are uppermost in the minds of many operating and mechanical department officers today. This is true because, while many solutions are proposed and some are very effective, the hot box problem remains. The majority of freight cars do run with hot journals at one time or another, resulting in delays to trains, and sometimes cause expensive wrecks. An economical means of reducing the delays and preventing the wrecks is to automatically and accurately locate hot boxes.

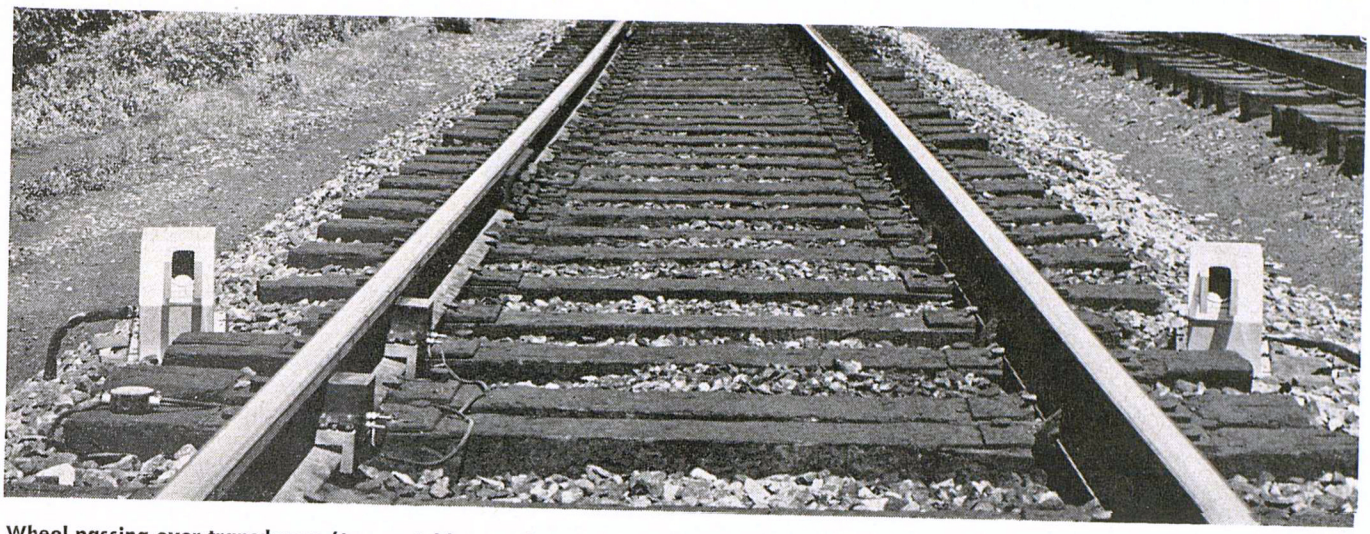
This can be accomplished by using a Servo Corp. hot box detector, mounted along the track to view passing journals of moving freight trains. A pen-graph recorder is actuated by the detector to record a pattern showing each journal on the train. The pen's deflection will be proportional to the heat radiated by each passing journal. Thus, an abnormally hot journal will show a relatively large deflection or "pip" when compared to a normal box. Roller bearing cars and locomotives can easily be identified as their pips are slightly taller than a solid bearing journal, but appreciably shorter than a hot box indication.

Working with the Servo Corp. of America, the Chesapeake & Ohio installed the first hot box detector, on a railroad, at Norge, Va., in November 1956. Since then these detectors have been installed on the Norfolk & Western, Reading, Boston & Maine, New York Central, Southern, Delaware, Lackawanna & Western, Baltimore & Ohio and Pennsylvania.

Where does hot box detection stand today? This type of detection is reliable and is now accepted. That nine railroads have installed several of these detectors stands as working endorsement.

How Accurate Is Hot Box Detection?

Composite results show automatic detection where human observation normally fails. Interpretation of the resultant data leads to pin-point location of the defect. As the chart shows, a pip is recorded for each journal and the height of the pip is proportional to the heat radiated by that journal. Thus it can be seen that it is a simple matter of counting pips from the front end of the train to accurately locate the journal that is abnormally

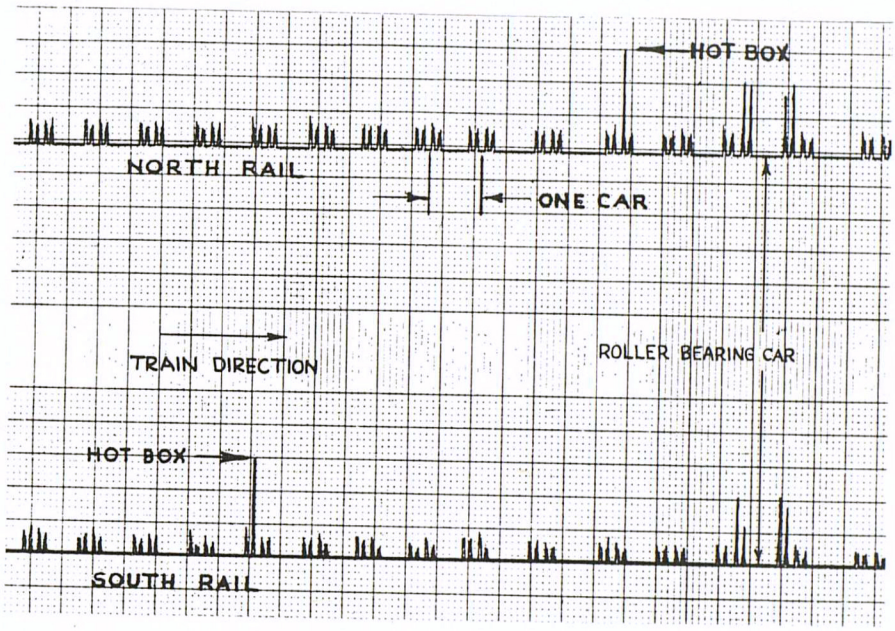


Wheel passing over transducers (two metal boxes along side rail) turn recorder "on" and "off"

hot. The consensus of railroads using hot box detectors, appears to be that a 12 or 15-mm deflection indicates an abnormally hot journal. A journal causing such a deflection should be stopped and inspected. As shown in the chart, the hot box having a 15-mm deflection is readily observed.

The identification of roller bearing cars has not been difficult, because a roller bearing car will show four large pips per side, that is, eight all together. The symmetry of the pattern of four tall pips in a row is easy to spot. Also, the operator may check these pips with those of the engine, which he knows has roller bearings. While it is true that all high pips on one car could indicate hot boxes, the chances are mathematically very remote that such an instance would arise. It has never happened on any of the nine roads having these detectors in service.

Another proof of accuracy of these hot box detectors is the fact that several roads reported that train crews, upon being informed that they had a hot box after stopping their train, walked back to the particular box, felt it and were unable to decide whether it was abnormally hot. One crew, while temporarily disbelieving the operator that the detector equipment had pin-pointed a hot box, rather scornfully opened the box and were surprised to have the waste burst into flame when the journal lid was lifted. In one instance on the Chesapeake & Ohio, the crew was unable to decide from inspection of the journal whether the car should be set out, but upon further consultation with the operator, who reported that the defective journal had produced a 15-mm deflection, the crew set the car out. When the carmen later came and jacked up the car to look at it, they found that the babbitt had already run down to the brass.

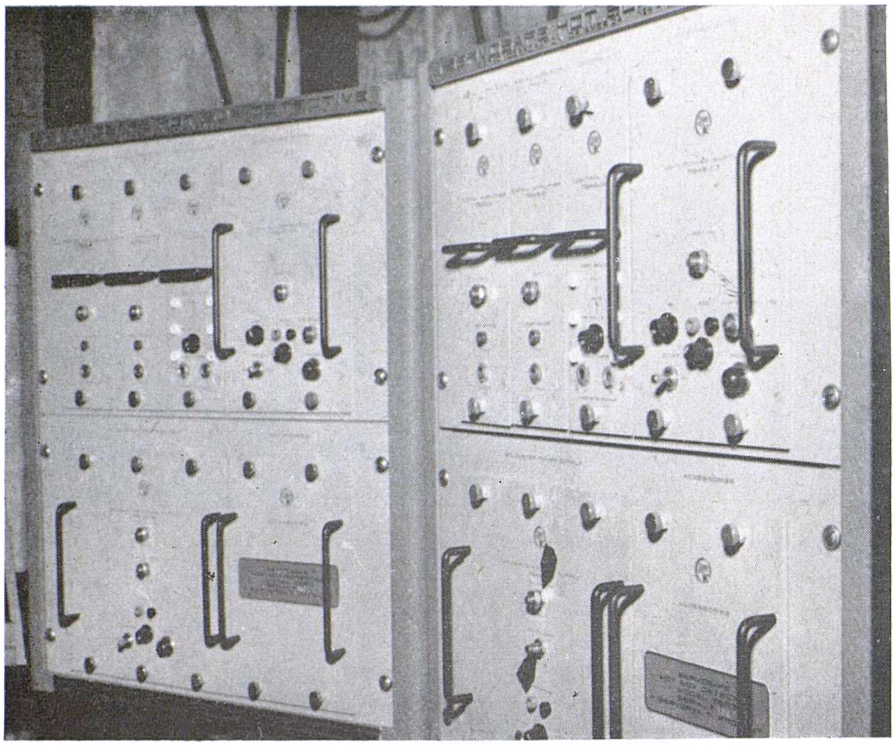


Composite chart shows normal, "hot," and roller bearing journal indications

The old theory that a journal will smoke when it gets hot seems to have gone into the discard recently with the use of journal lubricators. However, the hot box detector has pointed out abnormally hot journals which are equipped with journal lubricators. In one of these cases the lubricator pad was not working properly, so that the oil was not being evenly distributed around the journal. The detector picked up this hot running journal. This was another case when visual inspection by the crew did not seem to indicate anything out of order. However, when carmen inspected this journal they found the true situation.

Some roads have claimed that they have stopped trains upon deflection above normal by the detector and have found no hot box. The train has been permitted to continue on to a yard and no incident occurred. But the general opinion appears to be that, with proper adjustment of the recorder (4 to 5 mm deflection for a normal running journal), trains should be stopped which show journals with 12 or 15 mm deflection. Servo Corp. recommends that the critical deflection for a hot box should be a differential deflection of 8 mm or more. That is, the difference in the deflections indicated by the journals at each end of the same axle.

One railroad follows these instructions concerning the detectors: Any time a train causes a detector to show a 12 mm or larger deflection, the train is stopped and a member of the crew is instructed to go to the particular journal, open the lid, look inside, and report back



Amplifier gets signal from detector, amplifies it, and feeds it to recorder

by telephone to the operator. As one man put it, "It's remarkable how many times the crew walked back and said, 'We don't think there's a hot box, but we'll look anyway.' And then lifted the lid to find a condition where the car had to be set out."

Is Hot Box Detection Economically Justified?

Most everyone will agree that hot box detection is economically justified, first, on the basis of the wrecks that such detectors prevent. Of course, the problem is, how much do you save by preventing a wreck? As one railroad man put it, "We don't save money on something that doesn't happen." However, the Reading has made studies of savings and they estimate that because the hot box detector system detects an overheated journal before it becomes a hot box, this results in savings of approximately $300 per axle, when no wheel change is required. Going further, they state that because the system detects overheated journals early, journal and axle cuts are minimized, thereby preventing possible derailments.

Speaking of economies, time savings naturally come under discussion. The Boston & Maine reports considerable time savings in car set-offs with their detectors at Ayer, Mass. Other roads report similar instances. The Reading reports that because the detector system is able to pick up an overheated journal prior to a journal cut, and in this case the cars are set out and repairs are made in the field, they save at least three days when the car does not have to be sent to the shop. One railroad has had the experience of reducing considerably the number of set-outs, daily, which they experienced on a 330-mile length of main line. For a period of six months before the hot box detector was installed at one end of this territory, as many as 25 set-outs, daily, were required because of hot boxes. For the six months after the detector was in service, the number of set-outs, daily, was reduced to an average of two. The reason for the reduction of set-outs is that the detector often picks up journals in their early heating, and thus the crew is able to make the minor repair or repack the journal without setting out the car.

How Does Hot Box Detection Benefit Train Operations?

First, of course, this type of detection prevents possible derailments caused by over-heated journals. The fact that the detector accurately pinpoints the location of a hot box, materially reduces the time that a train is held up on the main line while the crew inspects the car and decides whether to set it off or repack the journal. The fact that hot box detection is accurate has enabled some roads to reduce materially the time required to inspect trains in yards, particularly if they have detectors which check these trains as they approach the yards. One road makes it standard practice now where incoming trains are checked by hot box detectors, for inspectors to give attention only to those indicated abnormally hot by the detector.

Detector Location Is Important

The basic requirements for detector location appear to be that they must be located so that once a train with a hot box has passed the installation, an interlocking operator, CTC dispatcher, or other person, can control a signal on the wayside to indicate to the train crew that they should stop the train. At the point of stoppage, a telephone should be located so that the train crew can call in to the interlocking operator or CTC dispatcher, who by this time has read the pen-graph recording of the indications and can tell them the specific journal which is overheated.

For example, the Baltimore & Ohio has an installation at Hancock, W. Va., with the detectors 500 ft from the tower in which the recorder is located. This detector location is 8.7 miles in approach to Miller's interlocking, where the train can be stopped by the operator for inspection by the crew. Thus, the Hancock interlocking operator, on seeing the hot box indication on the recorder, telephones the Miller's interlocking operator to stop the train for inspection.

At the Boston & Maine installation at Ayer, the detectors are two miles in approach to an interlocking and the recorders are in the interlocking tower, where the operator, noting that a hot box is indicated, can set signals to stop the train. The New York Central has similar installations of detectors at Angola, N.Y., and Dock Junction, Pa., with recorders in the dispatcher's office in Erie. The information is telemetered into Erie, 64 miles from Angola and 6 miles from Dock Junction. The dispatcher at Toledo, Ohio, receives journal readings from hot box detectors at Wauseon, Ohio, 32 miles distant, and Brimfield, Ind., 97 miles away. In these installations the trains are operating in CTC territory and the dispatcher is able to put the train into work sidings after it has passed the detector, if a hot box in indicated. Or he can route trains into nearby yards where car inspectors are located.

The Reading also has its hot box detectors at interlockings and the

operator is able to control signals 6 miles away to stop trains. Crews telephone the operator to ascertain the reason for stoppage. In all these instances, the trains are stopped by direct or remote controlled signals.

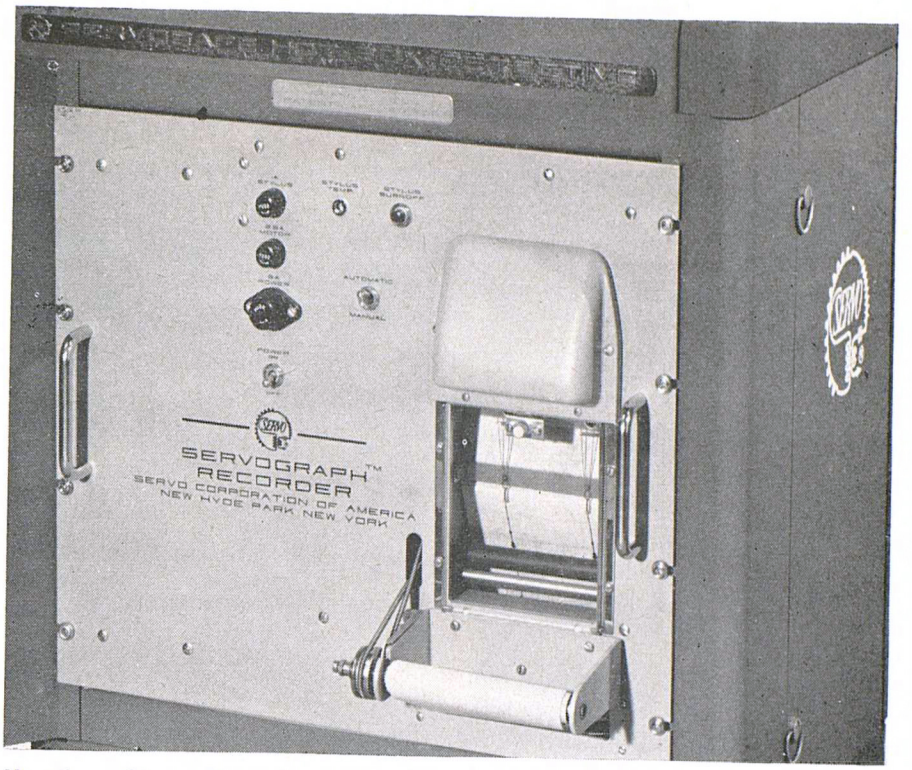
The Chesapeake & Ohio and another railroad use a flashing lunar-white signal aspect to indicate to the train crews that they are to stop and call in to ascertain which journal box is hot. This special signal on the C&O is controlled from an interlocking.

Other Location Factors

What other factors are to be considered in locating hot box detectors? Most roads seem to agree that it certainly is desirable to locate the detector so that when a train is stopped for inspection, the car with a hot box is convenient to a siding, where it can be set out, if necessary. A third factor in the matter of location appears to be, from the experience of most roads with detectors, that they should be located approximately 30 miles in approach to a yard where the freight train can be inspected. Thus, the detector will catch or pin-point hot boxes for trains inbound to yards, and these can be given attention by car inspectors. This does not eliminate the need for stopping the train and inspecting the hot journal, as indicated by the detectors, because the car might have to be set out. But it certainly can help in the inspection of the train when it arrives at the yard. As has been pointed out earlier, roads are already working on the premise of having inspectors in the yard check only those journals which have been indicated hot by the detectors.

Some thinking is that perhaps the best location for hot box detectors in approach to yards, is only 3 to 5 miles out. Thus when a hot box is indicated, the train pulls into the yard where the hot journal is looked at by car inspectors. Thus the car with the hot journal does not have to be set out along the line. The time savings by having the train checked in the yard and not setting cars out, is estimated to be considerable.

Detectors should also be installed 30 miles from a yard to check outbound trains. Experience has indicated that if a journal is going to heat up after standing in a yard, it will do so in the first 30 miles of running. Some feel that an additional installation should be made another 20 miles on, that is 50 miles from the yard. This second detector would catch those journals that might be "warming up," but had not reached the critical stage when they passed the detectors 30 miles out.



New Servo Corp. unit that has pen-graph recorder for making indication chart

One other factor concerning location should be brought out, and that is, does the recorder have to be at the same location as the detector? In the beginning, this was considered to be an essential and possibly deterred some roads from installing detectors, as they felt they could not afford to justify an installation economically, if they had to put someone out by the detector to read the pen-graph recorder. The New York Central is telemetering the information from the detector heads to recorders in the dispatchers' offices. As indicated earlier, the Toledo, Ohio, dispatcher receives indications from a detector 97 miles west at Brimfield, Ind. The manufacturer of these detectors, Servo Corp. of America, is now in the testing stage for telemetering hot box indications to the recorder. Thus, it appears, for all practical purposes, that the detector heads can be located any distance from the recorder that is necessary. New York Central experience has been that it is of tremendous advantage to have the recorders at the same location as the signal control.

What Is the Future of Hot Box Detection?

An analysis of the survey results of the nine railroads which have purchased hot box detectors to date, would indicate that the future is very bright for hot box detection. Although some of the railroads reported that they were not able to speak for publication at this time, it is known that a considerable number of hot box detectors are on order or are planning to be ordered by several of the roads for future installation. The New York Central, plans to install hot box detectors on all of its operating districts. The Chesapeake & Ohio plans to install a hot box detector near Clifton Forge, Va., which will check every tonnage train approaching this yard, where forces in the yard can immediately check the hot boxes indicated. The Boston & Maine is contemplating two more installations, one at Wells Beach, Maine, and one at North Adams, Mass. Most other roads in the survey are planning to make further hot box installations, although their plans are not definite at this time. One road has ordered a large number of hot box detectors and is planning to put them in approaches to all their major yards.

Potentially, the hazard of the hot box was never greater. The efficiency of the modern signal system and the diesel locomotive has resulted in satisfying the demand for higher speeds and longer non-stop runs. Installations for automatically detecting and locating the hot box appear to be an economic necessity, as part of the modern signal system.