

NEW YORK CENTRAL SYSTEM

HOT BOX DETECTORS

JUNE 1, 1959

INTRODUCTION

The purpose of the information contained herein is to give all concerned a clear and comprehensive explanation of the hot box detector and how it operates to detect abnormally hot journals, so that, through better understanding, full advantage may be taken of the device to improve safety of train operation.

Emphasis has been given to the importance of proper inspection of a suspected journal as, in the final analysis, the decision and action taken as a result of inspection is the measure of effectiveness of the hot box detector.

With hot boxes and burnt-off journals presenting a most serious problem on the railroads today, hot box detectors offer a means of reducing hot box incidence to a minimum.

Office of Chief Signal Engineer,
Cleveland, Ohio,
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NEW YORK CENTRAL SYSTEM

HOT BOX DETECTORS

The New York Central has installed electronic trackside devices known as hot box detectors at various points on the System. The purpose of these devices is to detect heat given off by passing journals and report this heat to an observer by tracing a series of marks or pips on a tape in a pen recorder. If a journal is running hot, the pip produced by this journal will be much larger than its neighbors and the observer can then take steps to stop the train and have the journal inspected.

HOW THE DETECTOR DETECTS HOT BOXES

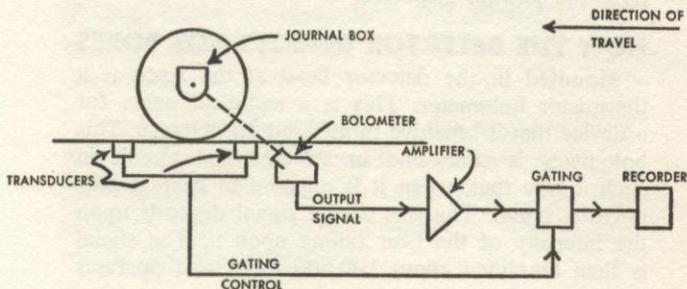
Mounted in the detector head at the track is a thermistor bolometer. This is a technical name for a device that is sensitive to infrared (heat) rays. This bolometer is connected in an electrical circuit in such a way that, when it is exposed to heat, it produces a signal. The size of the signal depends upon the intensity of the heat falling upon it. The signal is then amplified about 100,000 times and operates a pen recorder.

The bolometer is mounted in a lens assembly which is positioned so that it can look at the trailing side of passing journals. As a train moves over the detector, each journal in turn is scanned by the bolometer. Since all journals radiate some heat, a small pip is produced on the tapes for each journal. If a particular journal is running hot, it will produce a larger pip.

Also incorporated in the detector is a gating system. The gating circuits turn the detector "ON" and "OFF" so that it is "ON" only when there is a journal to be checked. This is done to minimize the possibil-

ity of picking up sources of heat other than journal boxes. Control of the gating is done by two rubber-like blocks called wheel transducers bolted to the rail in advance of the detector. These blocks contain a magnet and a coil of wire and are actuated by the presence of a wheel in the field of the magnet. The gating system also opens the protective shutter in the detector head and turns on the recorder while a train is passing over the detector.

The detector is very sensitive. A man waving his hand in front of the lens produces a signal comparable to a hot box.

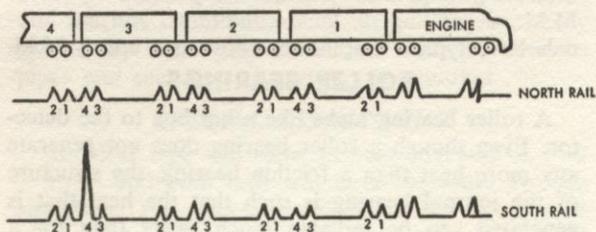


The lens looks at a spot on the journal box about 1 sq. inch in area. As the journal box first comes into range of the lens, the lens is looking at the bottom edge of the box. As the journal moves forward, the point at which the detector is looking moves up the journal box until at the last instance the detector is looking at the top edge of the box and possibly over the top.

The principal reason for looking at the trailing side of the journal box is to keep dirt from being blown into the housing and possibly damaging the lens.

READING TAPES

The tape will show a series of pips, one produced by each journal box. There are two such rows of pips, one for each rail. The sketch shows the relation between



groups of pips and wheels on a car. Each cluster of four pips represents the rear truck of one car and the front truck of the next car. The longer space between clusters represents a car body. A hot box indication is located by counting spaces from the end of the train to locate the car and then specifying the particular journal and side of the train. In the above sketch, the location of the hot box would be given as being on the third head car, number 4 journal, south side.

The chart is ruled with lines one millimeter apart. The height of the pip is given in millimeters. To determine if a particular pip is a hot box indication, its height is determined in millimeters. The height of the pip of the journal on the opposite end of the same axle is also determined. The height of the normal pip is then subtracted from the suspected pip and if this difference exceeds a predetermined amount, the car is considered as having a defective journal and the train is stopped.

For example, suppose the minimum differential is 10 M.M. and a journal shows an amplitude of 13 M.M. while the opposite journal shows 2 M.M. The difference is 11 M.M., which exceeds the minimum differential and so the train should be stopped. At the present time, minimum differentials used for indicating abnormal journals vary from 6 to 10 M.M., depending on local conditions. Normal journals have typical amplitudes between 1 and 3 M.M.

ROLLER BEARINGS

A roller bearing looks like a hot box to the detector. Even though a roller bearing does not generate any more heat than a friction bearing, the structure of the journal bearing is such that the heat that is generated can be radiated much easier than for a friction bearing. For this reason, the deflections for a roller bearing are about the same as for overheated friction bearings.

Usually, roller bearing cars are easily spotted because all eight journals will be high. However, there are times when roller bearings do not behave properly as far as hot box detectors are concerned.

Several possible conditions can exist:

1. All eight journals will show uniformly high.
2. All journals will be high but one side will be much higher than the other. The differentials may even exceed the minimum reportable differential.
3. Only one side will be high. The differentials may exceed the minimum reportable indication.
4. Only an isolated journal will show high.

An operator probably will not be able to distinguish case 4 above from a conventional overheated bearing and so will probably stop the train. Occasion-

ally, a car will show up as a roller bearing, but one particular journal will show much hotter than the others. This is no cause for alarm. Needless to say, a roller bearing car readily identified as such is not stopped under any condition.

A note on Flexi-van cars. Flexi-van cars are roller bearing equipped and so can show up under any of the conditions listed above. However, they are easily spotted by their long wheelbase (distance between pips) and such cars should not be reported.

SPECIAL CONDITIONS

An ideal tape will show average journals of 1 to 3 M.M. and both rails will have the same average amplitude. The recording will have a "clean" appearance. That is, the pips will be smooth, not "fuzzy." If an unbalance develops between the amplitudes of the two rails, with one rail remaining normal and the other rail going down, chances are that wind or snow is blowing against the low side. On the other hand, if one rail goes up in amplitude and especially if this high amplitude exists for only a few cars at a time, the Signal Supervisor should be notified. More than two pips for a given journal are also a sign of trouble in the detector.

Sometimes a single axle will show high deflections on both ends though the differential may not exceed the minimum differential. This might be due to sticking brakes or perhaps due to two hot boxes on the same axle or some electrical fault in the detector system. In a case like this, the safe thing to do would be to stop the train since hot boxes may be overlooked by ignoring this type of indication.

SNOW

Operation with snow on the ground presents special problems. One obvious problem is that the detec-

tor might become buried in snow or the shutter might become frozen shut.

A more subtle problem is that caused by blowing snow. As a train moves along, it kicks up quite a cloud of snow which swirls about the journal box and prevents the heat of the box from ever reaching the detector. Whenever the train is kicking up a cloud of snow, there is a possibility that the heat given off by the journals may be entirely obscured and thus not recorded.

INSPECTION

The final success of the hot box detector lies in finding some defect for the indication. All through this article we have been talking about hot boxes and hot box detectors. The hot box detector, despite its name, does not detect hot boxes. It detects heat in the vicinity of the journal box, which heat is probably caused by a defective journal. The same defect in two different journal boxes will usually not produce the same indication on the tape. And so, when an operator stops a train and says that there is a hot box on a certain journal, all he is actually saying is that this particular journal box is giving off a sufficient amount of heat to be considered abnormal. From looking at the tape, he cannot tell what condition the journal is in.

Thus, the evaluation of the indication depends upon the person or persons doing the inspection. At locations where Car Department personnel perform the inspection, there is no problem. At these locations the brass is actually pulled from the box and given a close examination. If it deviates from normal, it is replaced.

The situation is somewhat different on the road. Here the inspection is performed by members of the

train crew, whose primary job is moving trains and not inspecting journals. Also, there is usually no equipment available to help in the inspection.

A few ideas might be helpful in determining if a given journal is defective. Remember that the detector merely says that a journal box is giving off more heat than its neighbors. Open the journal box and examine the suspected journal to see if it is any warmer than adjacent journals. Try to lay your bare hand on the journal, being careful not to get burned. If the journal is too hot to lay your hand on, there is something wrong with it. Since the indication was analyzed by comparing two journals, an adjacent journal should be felt to get some idea of the normal running temperature.

If the suspected journal is warmer than its neighbor, try to determine the cause. The bulk of hot box detector indications are caused by waste grabs. If a packing hook is available, run the point of it along the trailing side of the brass next to the journal and see if any waste is caught under the brass. Feel the journal itself, if not too hot, and see if there are any cuts on it. Examine the waste packing. If it crumbles into short pieces, there is a good possibility that there is lint under the rising side of the brass which cuts off the oil flow. Check the inside of the box carefully to see if any of the babbitt metal has melted from the brass. Absence of waste, lack of oil, or waste making poor contact with the journal will cause an indication. A new brass on a journal often causes an indication. Indications are often caused by sticking brakes or roller bearings.

There is always the possibility that the operator may have miscounted when determining the car location. Also, the person making the inspection might miscount when walking the train. For these reasons,

it is desirable to check at least two cars on either side of the suspected car.

If the journal feels warm, but the cause for the heat is not readily apparent, the journal should be treated with cooling compound and/or oil and carefully watched for the remainder of the trip to the next inspection point. There are some types of defects which produce sufficient heat to cause the detector indication but which will operate for extended periods without a hot box. On the other hand, there are defects which may not seem too hot when inspected, but which will rapidly progress to the burnoff point.

After the inspection has been completed, the results of that inspection should be given to the person who reported the indication to the train crew. The initial and number of the car should always be given, even if the journal appears to be okay or if it is a roller bearing. The following are typical of some of the conditions that might be found and that should be reported:

1. Car set out account of hot box.
2. Journal hot—cooling compound applied. Car taken through.
3. Journal warm—taking car through.
4. Journal okay.
5. Roller bearing.
6. Sticking brakes.
7. New brass.

The above by no means exhausts the list of possibilities.

Hot box detectors can do much to improve the safety of train operation. There have been many cases on the System where serious derailments have been prevented only by the presence of the detectors.