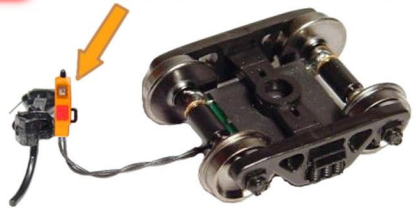


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Hot Boxes

WHEN I DESIGNED MY YOSEMITE VALLEY RAILROAD layout 35 years ago I assumed that some day I would finish building the layout and then begin formal layout operations. Therefore, one of my design goals was to make sure that the layout would be fun to operate. Toward that goal, all of the yards and sidings duplicate the prototype YV yards and sidings as closely as possible, and passing tracks are spaced far enough apart that trains could actually travel from station to station without having the caboose still short of the last station stop.

However, I will readily admit that I enjoy building models more than operating my layout. I don't have a dedicated train crew and the modelers who do get to operate the layout are most often first-timers.

When layouts are operated by the same operators on a regular schedule, discussions sometimes center on how to deal with boredom from the constant repetition. One solution often mentioned is to add situation cards which add delays

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such as maintenance of way issues, accidents, and special car movements.

Prior to the general adoption of freight car trucks with roller bearings, hot boxes were a common occurrence which could cause delays. A situation card could specify that a certain car needed to be set out at the next siding. But how many of us know what a hot box was, what caused it, and how it was handled?

Basic freight car truck design

To understand hot boxes, we first need to understand freight car truck design. The early arch bar and Andrews trucks had separate journal boxes which bolted to the truck side frames.



1. A prototype wheel and axle. The larger diameter section on the end of the axle is the "journal collar" while the portion of the axle next to the wheel with the same diameter is the "wheel seat." The axle bearing surface is the portion of the axle between the journal collar and the wheel seat. A

"dust guard" slides over the journal collar and wheel seat to fit up tight to the wheel. Note that the rust on the bearing surface between the journal collar and wheel seat is not a problem and will be removed with fine sandpaper before the wheelset is placed in service. These are narrow gauge wheelsets but their design is identical to standard gauge wheelsets.

The ends of the axles rode below plain brass or bronze bearings in journal boxes, which is why these trucks were called "plain bearing" trucks. Cast steel trucks were eventually developed with integral journal boxes cast into the side frames but retained the same basic journal box design.

The journal boxes held oil to lubricate the axle bearing surfaces [1]. The back of the journal boxes extended up just short of the axles and the lubricating oil level in the journal boxes was kept below the bottom of the axles in minimize leakage. There were "dust guards" at the back of the journal box around the axle which were designed to keep dust out of the journal box. These dust guards were typically made of a thin piece of wood with leather, felt, or another material in contact with the axle.

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2. Looking into a narrow gauge arch bar truck journal box with the journal box lid raised. The oily waste below the axle bearing surface is visible, as is the axle journal collar. Directly above the axle is the plain bearing.

The lubrication system relied on the oil in the waste to migrate along the entire surface of the axle bearing surface, and that the waste itself not be caught up. As shown, the waste needs to be in contact with the lower portion of the axle in order for oil to coat the axle.



3. Looking up in the journal box toward the bearing. The actual contact surface between the bearing and the axle can seem small, but it covers the entire top surface of the axle and transfers the weight of the

freight car to the axle. Bearings are made of bronze with a thin, smooth layer of Babbitt metal on the curved underside. This particular bearing is cast in Babbitt rather than machined from brass or bronze due to the none-demanding service for this car. Babbitt is an alloy made up of small hard crystals dispersed in a softer metal. As the bearing wears, the softer metal erodes somewhat, which creates paths for lubricants to migrate between the hard high spots that provide the actual bearing surface. Babbitt was originally composed of tin, antimony and copper.

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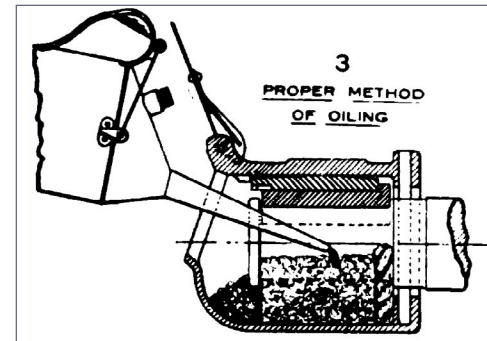
Lubrication of the contact surfaces of the axles and the bearings was accomplished by adding “waste” in the bottom of the journal boxes [2, 3]. Waste was a fibrous cotton material which would soak up the lubricating oil. The proper amount of waste in a journal box was when the waste was about even with the middle of the axle. Capillary action (such as when a paper towel will wick a water spill by just touching it slightly) would result in oil saturating all of the waste, thus directly coating half of the axle and lubricating the entire bearing surface [4, 5].

According to early industry publications, hot boxes could result from the type of lubricating oil, lack of adequate lubricating oil, or even too much dust and metal particles in the lubricating oil due to wear on the bearing surfaces — a problem which could be minimized by replacing both the waste and lubricating oil often. The oil level in journal boxes was regularly inspected and topped off when needed. A July 1890 issue of the *Railroad and Engineering Journal* outlined the problem as follows:

“Perhaps no subject connected with the operation of railroads causes more annoyance, not only to the public but also to the operating officers, than what are known popularly as hot boxes. In reality it is the journal and bearing which get hot, and not the box which encloses them, and carries the waste and lubricant. Much delay of trains and annoyance in every way is occasioned by these failures of the journal and bearing to run cool, and many speculations have been indulged in as to what the cause of hot boxes, using the technical term, is and what is the best cure.”

Those speculations resulted in a number of “best remedies.” Some suggested adding special lubricants in the journal boxes such as tallow in the form of candle wax or special greases. Lacking a solution to eliminate the problem (except for more inspections

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4. This illustration is from the July 1907 issue of *Railroad Men* and accompanied an article on journal box lubrication. It shows a cross-section view of an open journal box, the axle, waste, and an oil can being used to add oil. A caption on the

illustration reads “When using the oil can, oil should be placed on side of the journal. When saturated packing is used, it should be placed in contact with the journal.”



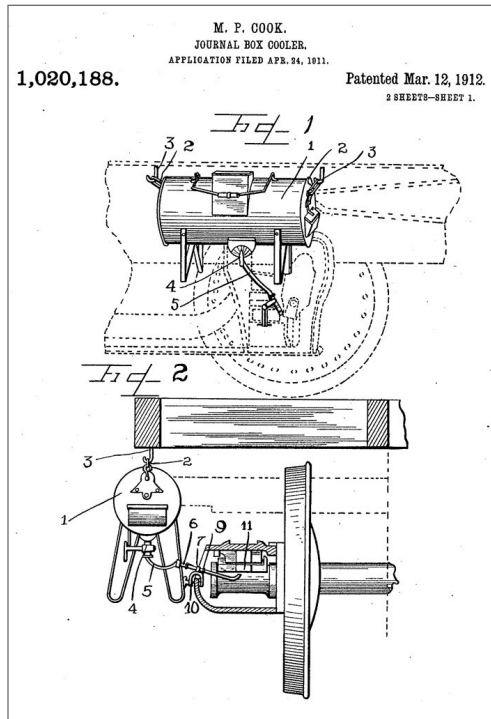
5. Not only oily lubricants but also waste are leaking out of the back side of this journal box. The leaking oil has also covered the area adjacent to the rim of the wheel. This freight car, in service on the narrow gauge South Pacific Coast RR at Ardenwood Historic Farm in Fremont, CA, only runs about 6-8 mph. It is easy to see how standard gauge freight cars in service in the 1920s and beyond could have the entire face of the wheel covered with lubricating oil.

and maintenance) ultimately lead to special devices to address hot boxes after the problem occurred. One was patented in March 1912 [6] and was reported in the December 1913 issue of *Popular Mechanics* as follows:

“Several railroads have recently adopted a new safety device for cooling hot journals on railway cars without crystallizing the metal. Ordinarily when a car develops a “hot box,” the train crew puts out the fire and cools the journal by throwing cold water on it. This usually crystallizes the metal and sooner or later the journal “burns off” and perhaps causes a wreck. But the real cause of the hot box is a rough place in the journal or the brass above it and the best way to treat it is to cool it slowly until the journal runs down to a proper bearing. The new device accomplishes

this by dripping water on the hot journal while the train is running. It is hung on the car in such a way that the heat of the journal and the motion of the train keeps it from freezing [during cold weather].”

6. M.B. Cook patented this Journal Box Cooler in March 1912. The device had a tank for the water (1), hooks to allow it to be attached to a grab iron (2), and a hose and clamp which allowed the nozzle to apply water directly on the underside of the axle.



The Keeley

That “journal box cooler” eventually became known as a Keeley. A brakeman friend who worked on the YVRR in 1942 once explained the problem in an interview many years ago and how the device became to be known as a Keeley:

“The YV had plain bearings in all of the cars and when you’d have a hot box or one that is warming up, you’d hang what you’d call a Keeley on the car. This was a tank with water in it and it had a hose and you’d just open the journal box lid and fasten the hose in there and it would just kind of drip in there and keep that sucker cool enough so that you could get to some place to set it out or take it into Merced Falls that way.

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“It looked like one of these tanks that you carry air in for airing up tires when you are far from an air pump. It was hung right off of a grab iron and I suppose that it was 2 to 3 foot-long and 10 inches in diameter and it had this rubber hose on it. You’d just hang that thing in there and keep things cool.

“I just figured that the Keeley was made by the Keeley Company some place. After the war [WW2], I had to go and take a physical after I was discharged. They sent me to Dwight, Illinois. I went there and, by gosh, there was the Keeley Institute. I wondered, what in the hell is this?

It turned out that the Keeley Institute was a ‘drip’ rehabilitation deal back in the early days! There was a water cure and so I think that this tank got the name Keeley because that was the popular way to cure somebody [of addiction]. I don’t think that it was made by the Keeley Company at all. I think that it was just a clever name they hung on it.

“I remember one time they burned an axle so bad that we had to change the wheels. That is hard to do on a boxcar with cast trucks. With arch bar trucks it’s not too bad — you can just drop the bolts and pull the journal boxes and the whole works out. With a car with cast trucks, you can’t do that out in the field — you’d have to go out with a wrecker and put a new truck on it.”

My friend’s reference to Keeley was somewhat close to the actual facts, although it didn’t actually involve a “water drip regimen.” In 1880 Dr. Leslie E. Keeley opened a sanatorium in Dwight IL for persons addicted to alcohol or opium. The “Keeley Cure” was a bottled concoction which became known as the “gold cure” which was taken with volumes of water. Although Keeley was regarded as a quack, he eventually opened nearly 100 franchises



7. A journal box cooler, or Keeley, on display in the Lomita Railroad Museum behind a collection of tie date nails. The opening on the top is the fill spout. The filler is two inches in diameter and the legs are six inches long. There are simple handles on both ends for carrying the Keeley along with chains to hang the Keeley from a grab iron.

throughout the United States. He also became the subject of vaudeville jokes about the cure which had somehow morphed into dripping water on someone who was addicted. That is likely how the name was appropriated for many “curative” processes for other than addiction — including railroad car journals.

The Lomita Railroad Museum in southern California has a Keeley (although labeled as a Keeler Cooler) on display. [7 and 8] It is 24 inches long and 10 inches in diameter which matches dimensions of a Southern Pacific Railroad drawing of a “Journal Box Cooler.” That drawing is in Tony Thompson’s *Southern Pacific Freight Cars Volume 2: Cabooses*.



8. The red delivery hose tank on one end of the Keeley is connected to the outlet pipe and valve at the bottom of the tank. The hose is 30 inches long and terminates at the long nozzle and clamp which is hanging on the handle. The clamp let a brakeman attach the nozzle to the front lip of the open journal box and aim the cooling water directly on the hot axle.



9. Southern Pacific caboose No. 78 has a Keeley hanging on hooks near the front truck, ready to be taken off and carried to a car with a hot box. *Tony Thompson Collection*

Although I have no photos of Keeleys hung on hooks on YV cabooses, many SP cabooses were fitted with hooks for just this purpose. A photo of SP caboose 78 taken at Santa Cruz, California in 1935 shows a Keeley hanging above the front truck [9]. Many SP tenders also had hooks to hang Keeleys.

So how did the YV respond to hot boxes? They did have Keeleys in their cabooses. A dispatcher sheet from August 2, 1939 lists a hot box incident on the westbound El Portal Local, running as an extra. The hot box was noticed at around 9:15 p.m. as shown on the dispatcher sheet [10]. The entry reads "MP 43 915P 935P hot box yv 1209". That translates to "Delay at mile post 43 from 9:15 p.m. until 9:35 p.m. on account of a hot box on rock car YV 1209."

YV 1209 was one of 51 ex-Northern Pacific Railway hopper cars (called rock cars on the YV) purchased by the YV in 1924.

	El Portal Local
Ro	515P 540P yard
By	545P 555P plu
Mc	6p 610p water turn
En	615P 625P plu
Em	650P 705P plu + mase
B	825P 856p no3 water ^{insp} per
MP43	915P 935P hot box yr 1209
Det	945P 10p comm ^{water} mase plu
B	1025P 1110p lunch ^{water} mase plu
Em	1215a 1240a water slo mase
En	105a 130a 810 mase
Mc	135a 140a water
By	145a 155a slo plu
Ro	2a 230a yard

10. The Yosemite Valley dispatcher sheet log entry for August 2, 1939 for the westbound El Portal Local shows a "hot box" at MP (Mile Post) 43, which was between the first listing of Bagby (B) and Detwiler (D). As mentioned in my article on dispatcher sheets in the April 2014 "Getting Real," YV locals traded crews at their meeting point so the dispatcher reported actions based on the crew and not the train number. That delay started at 9:15 p.m. and lasted until 9:35 p.m. The next trailing point spur west of the mile post 43 was at mile post 39.1 (Jasper).



11. YV 1216 was one of 51 ex-Northern Pacific hopper cars purchased in 1924. It was identical to YV 1209. Rock car 1209 would have been loaded with 40 tons of limestone when the hot box was noticed.

[11] These cars hauled limestone from a quarry 67 miles east of Merced to a Portland cement plant a couple of miles east of Merced. As such these cars were rarely moved beyond these two locations and may have not received timely journal box lubricant maintenance. That lack might have been the cause of this hot box.

During the 20-minute delay listed by the dispatcher, the brakeman hung a Keeley on the car to cool the hot box. Based on the dispatcher sheet for that day, the hot box was on one of nine loaded rock cars picked up that night along with 17 loaded log cars and seven other freight cars. The short rock cars would have been placed in front of the caboose. But it would have taken time to find the hot box and take the Keeley to it and set it in place — hence the 20-minute delay. Once the Keeley was in

place and the brakeman back in the caboose, the extra continued west and met the eastbound Merced Local at the passing track at Detwiler just a mile away. After that meet, YV 1209 was set out at the next trailing-point spur at mile post 39.1 at Jasper.

From the entry shown on the dispatcher sheet for the following day, August 3, [12] YV 1209 was picked up that day by the eastbound Merced Local. There are no entries on the dispatcher sheet for that day listing an extra train dispatched to change out the journal box on the car so the crew may have simply added lubricating oil to the journal box, filled up the Keeley hung on it the previous night, and brought it in for inspection and repairs if needed.

Years ago, I thought that hot boxes were only caused by a piece of waste being pulled up from the journal cellar box only to be caught between the axle bearing surface and the bearing. But, from period literature, it seems that poor maintenance was the primary cause of hot boxes.

Detection

One final question ...how did the crew notice a hot box?

Smoke might be visible during daylight hours,. There was also the smell. Warren McGee, a Northern Pacific Railway conductor, talked about hot boxes in an issue of the Northern Pacific Railway Historical Association *Mainstreeter* magazine and mentioned:

“At night you opened the window [in the caboose] in every cut and every narrow channel, between cars, anything, you got your head out the window and you smelled for that hotbox up there, ‘cause it was a different smell. You had your nose and

	Merced Local
CS	6p 610p yard
In	655p 705p 10
m 7	725p 815p yard
Barnett	905p 925p no 3 lunch
Set	945p 950p connection
Jasper	10p 1010p flu
m 7	1120p 1240a yard
In	1a 115a pu under
CS	210a 235a spot rock
	240a 4a yard

12. The dispatcher sheet log entry for the following day, August 3, 1939, for the westbound El Portal Local shows the pickup (p/u) at Jasper between 10:00 p.m. and 10:10 p.m. That would have been YV 1209.

your eyes going all the time. When it’s dark you had nothing but that. Usually, maybe 15 cars ahead of the caboose was all you could smell, but I once smelled a car 43 cars ahead, coming west against the wind.”

To reduce the occurrence of hot boxes, there were car inspectors at division points to check the lubricating oil level in all of the journal boxes of trains headed out. But one early report mentioned that, when there were too many arriving and departing trains for inspections, that practice wasn’t always followed. On the YV, foreign cars might travel only 150 miles before being returned to

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either the SP or ATSF so hot boxes on cars from interchange railroads might not have been that much of a problem for the YV. But the majority of YV cars, both rock cars and log cars, continually ran between intermediate stations on the railroad so hot boxes from those cars might have been more frequent.

For other railroads, especially those which handled mostly interchange traffic, hot boxes were a real and costly problem until the wholesale conversion to roller bearings eliminated the problem. ☒



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