RGS Goose No. 5

Rear Axle of the Power Truck

The rear axle assembly of RGS Goose No. 5 is a Ford Ford Truck AA axle. It is oriented normally, the "pumpkin" of the front and back axles align. The back axle assembly is rotated not quite 180 degrees so that the drive shaft port faces to the rear. With rotation, the top of the "pumpkin" on this axle is on the bottom. (Without rotation, the rear axle assembly will not fit. The drive shaft port will hit a truck cross member). The fill/drain ports are not aligned correctly in this orientation, making it possible to overfill with gear oil. (The inside of the "pumpkin" should never be more than half full with gear oil.) "Louie" Vallejos said that he remembers removing the drive shaft plate and using a suction (turkey baster kind of thing) to change the oil and refill.

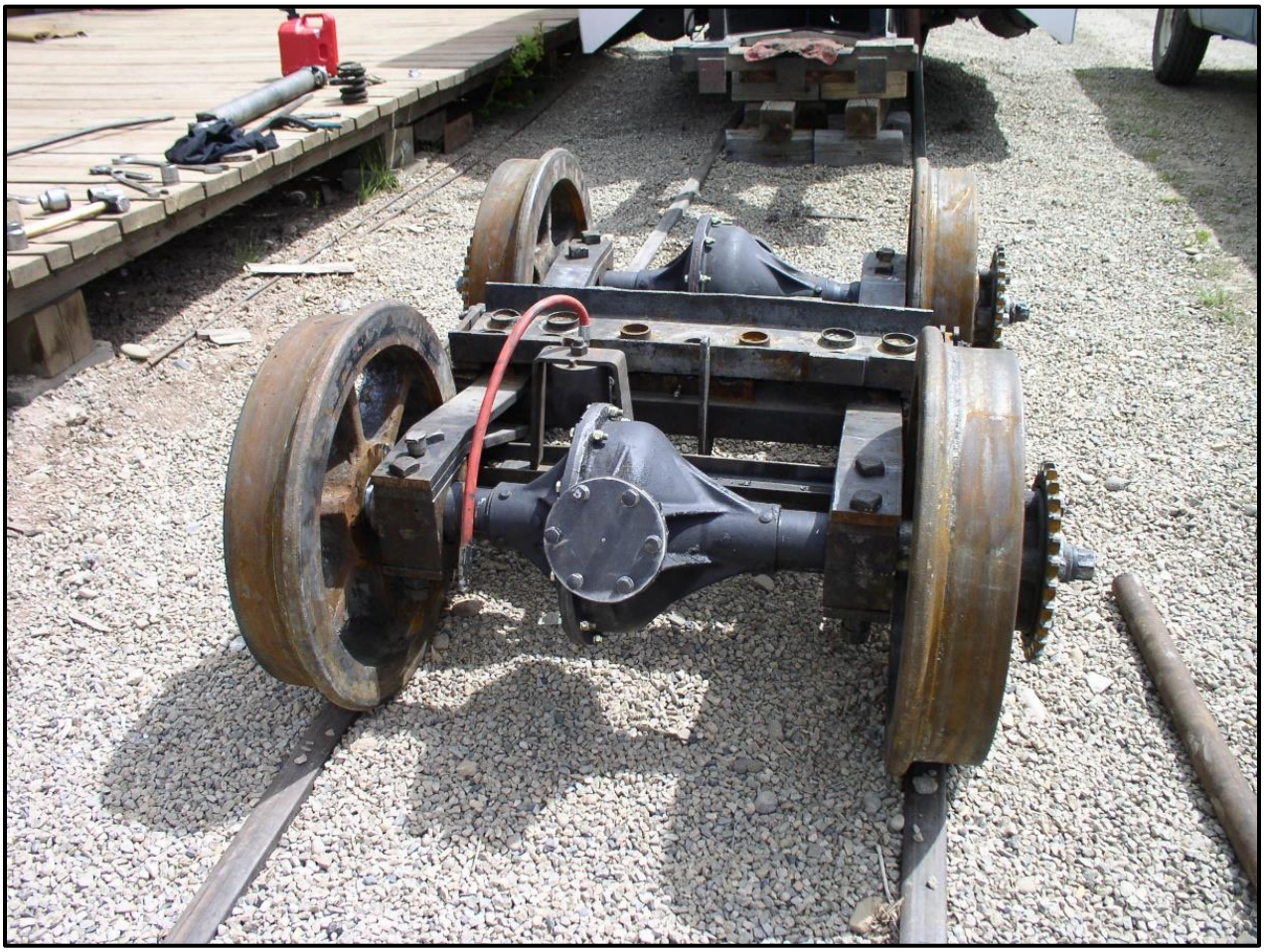
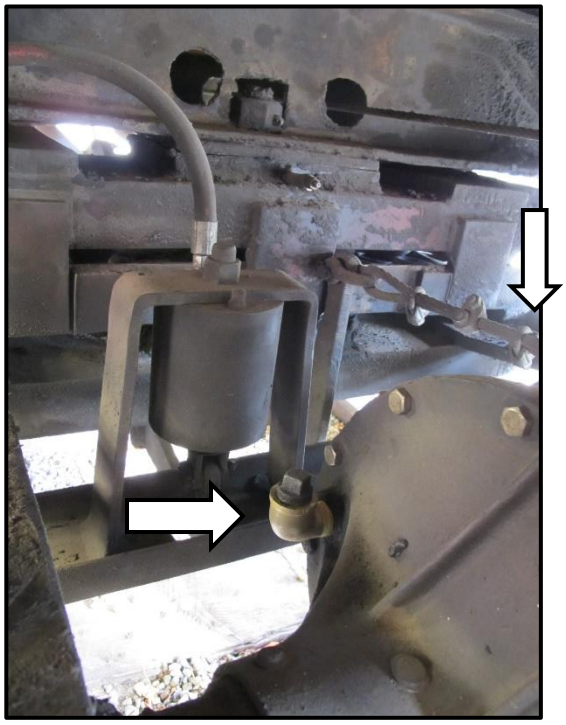


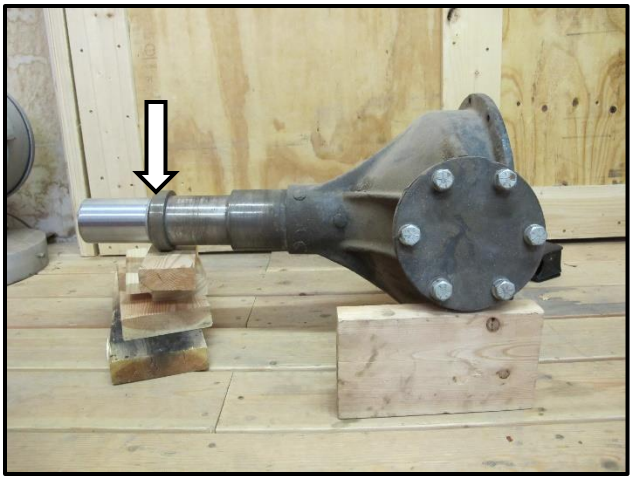
Photo taken in 2009 during reassembly of RGS Goose No.5 after power truck rebuild by Skansa Construction.

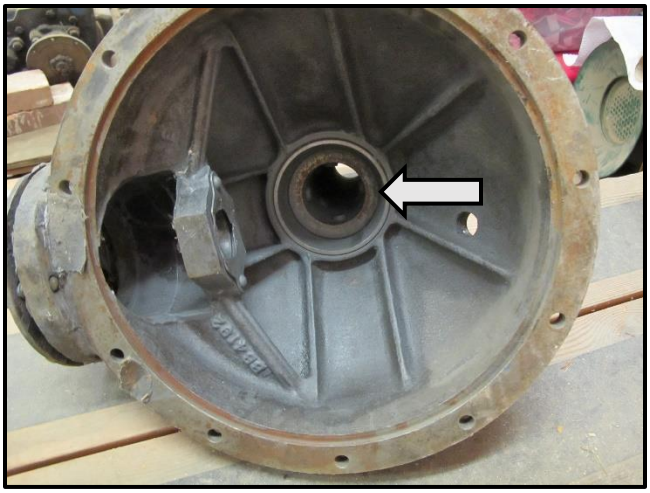
Here's the current orientation of the rear axle assembly. (Photo taken December 2017)

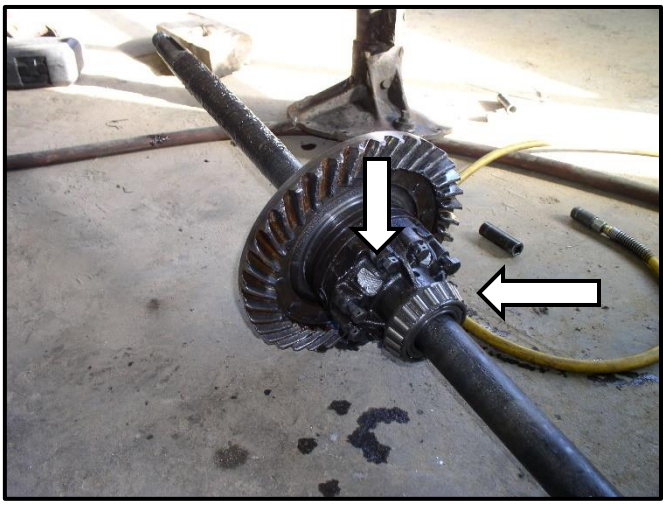
Note that the rear axle assembly has rotated almost 90 degrees to where the drive shaft plate is now on the top. The fill/drain ports are still not not aligned correctly in this orientation either. The fill port is near the top of the pumpkin, making it possible to overfill with gear oil. The hand brake cable also binds on the side of the axle housing.



The middle power truck carries a share of the weight of RGS Goose No.5's front cab and rear freight box to the rails. A "fifth wheel" bears this weight to the truck suspension and on to the truck frame. Weight is distributed from the truck frame to the cast iron axle housings via fixed brass blocks. The axle housings extends inside the cast steel wheels. The housings are incased in a cage bearing that rides inside the wheel. Weight is bore by the axle housings, not the axle itself. There are no bearings or lubricant at the end of the axle housing for the axle. The only axle bearings are tapered roller bearings inside the "pumpkin". A seal inside the "pumpkin" keeps gear oil from leaking down the axle housing .







Note the collar on the axle housing, the bearing race, the cage bearing and seal somewhat hidden by the socket. Also note the tapered roller bearing and the "lead" that is locking the differential.

The front and rear wheels are keyed and bolted to the tapered ends of the axles. The front axle rotation is powered by a drive shaft from the transmission via worm gear inside the front axle assembly. Rear axle rotation is powered via external chains. The front axle provides rotation and keeps the wheels in track gauge. The rear axle only keeps the wheels in track gauge.

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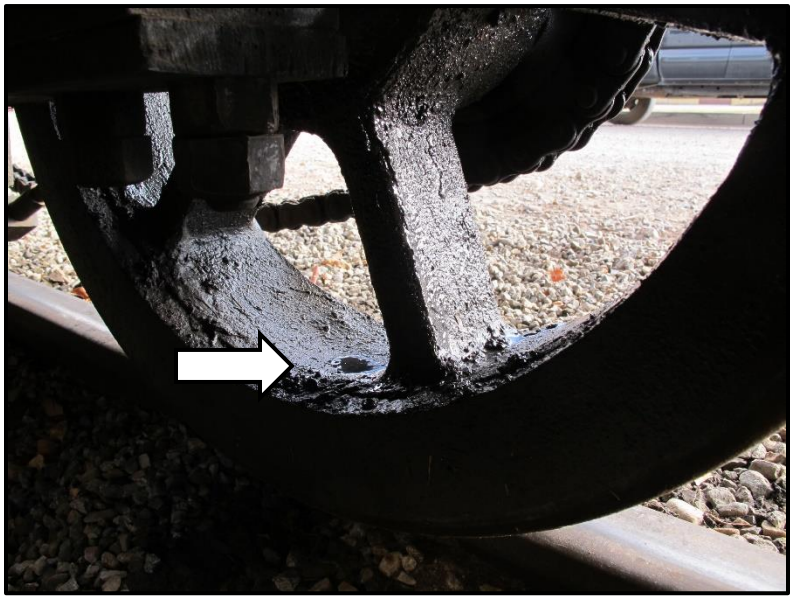
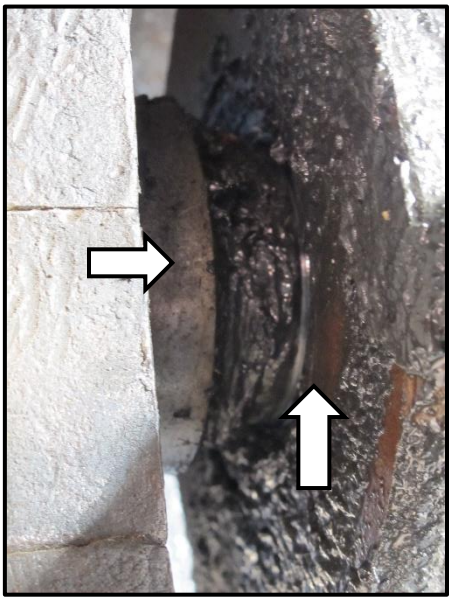
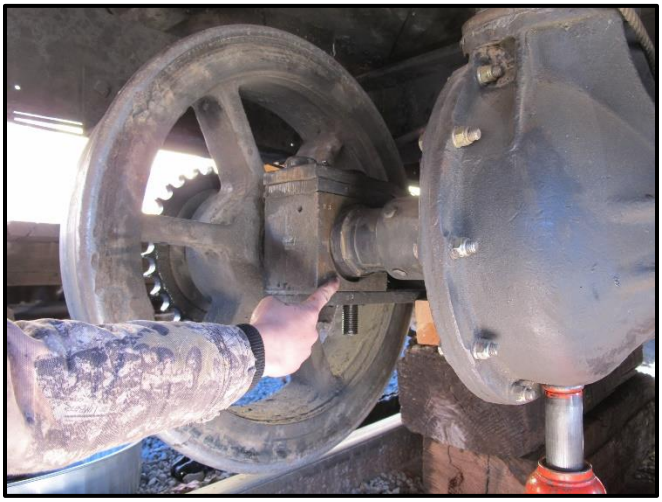
Here's a photo of the inside of the rear right side wheel. (Photo taken December 2017). Notice the pool of oil collected on the inside rim of the wheel. The other picture is taken of the axle housing between the wheel and brass blocks. Note the collar and the cage bearing.



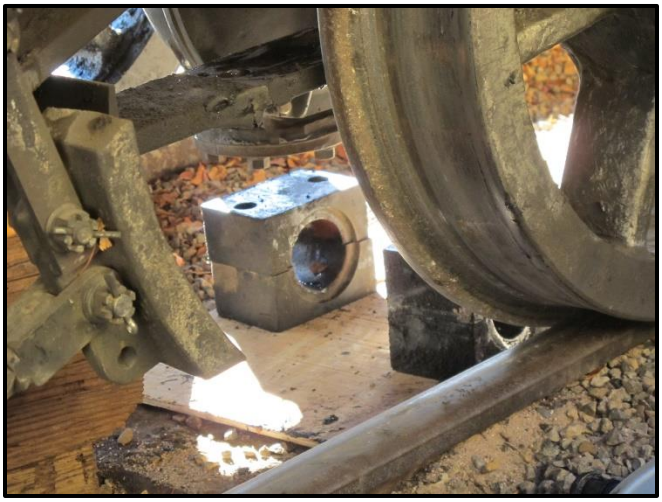


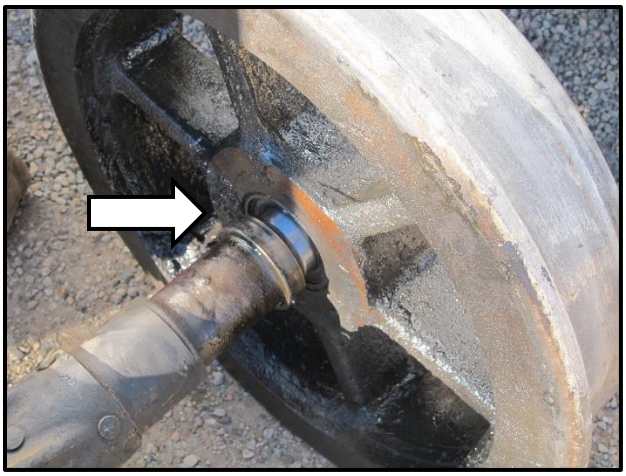
1/2/2018 Rear Power Axle Removal

- Wheels spin freely and independent of each other with chain off and rear differential housing jacked.



- Note the oversized and/or wear on the brass bearing on the left side (non-leaking).
Differential housing was clamped firmly to truck assembly on only the right side. Left side was deliberately loose to allow power truck to flex.





Note the shiny part on the differential housing next to the wheel.

With rear differential axle being dis-assembled, the chains will be soaked and cleaned. Wheels will not be turned. Like automobile tires, it is thought that power wheels should be turned as sets of four.

1/5/2018 Rear Power Axle Disassembly

On Friday 1/5/2018, Ken had invited "Mike the Machinist" (MM to help design a wheel puller. (MM is a machinist who retired to the Four Corners area. During his career, he specialized in building heavy manufacturing equipment. He has shop privileges at Ken's shop). Lew Matis also contacted Gary Merrifield to help. Gary dropped off a wheel puller from the old Skanska garage. With no need for a puller, MM stuck around to help with disassembly and provided expert guidance.

Here's the wheel puller in action.

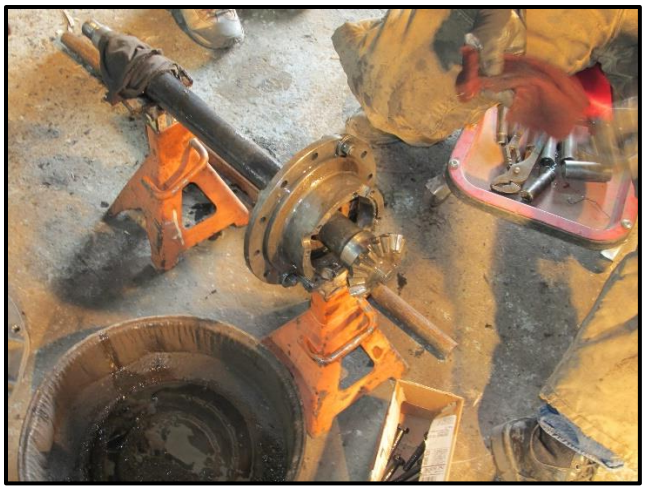
Degradation of the hard chrome on the axle.

The inside of wheel with cage bearing.

The inside of wheel with cage bearing removed. (Thanks to Nicholas, the town bicycle mechanic, who spotted the retaining ring on the seal.)

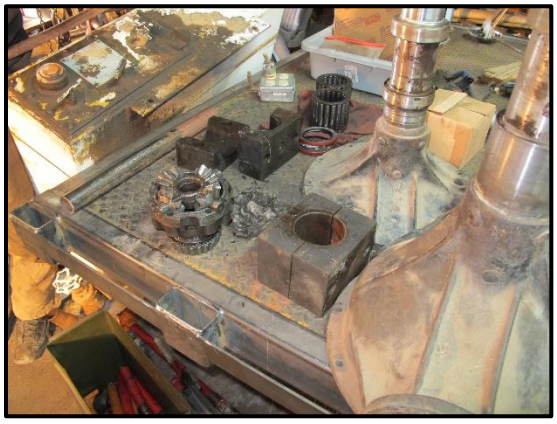
The other wheel being pulled.

The interior tapered bearing.



The internal gear that is part of the spider gear.

The failed outer seal of the differential housing.



Work bench with some of the parts.

Here's the **consensus scenario** of those present during disassembly of what caused the failure of the hard chrome and the subsequent failure of the outer differential hosing seal.....
"The cage bearing became dry due to lack of grease from the Zerk fitting near the axle nut. The cage bearing heated up and caused a partial failure of the hard chrome and the adjoining outer seal on the differential housing."

Mike the Machinist's recommendation on how to grease the cage bearing is to pump grease through the Zerk 5-6 times until it oozes out on the other side, rotate the wheel 1/4 to 1/3 turn and re-grease again and again. You should not be overly be fearful of blowing a seal because of over-greasing.

The hard chrome on the other side of the differential housing also is degraded. Gary Merrifield had mentioned that the hard chrome surfaces were beginning to pit, back when it was serviced in 2004. The tapered bearings and their races are all in good shape as are the spider gears. Only the seals have to be replaced and the hard chrome on the differential housing needs to be repaired. Luckily, during Larry Spencer's era, a complete spare differential housing with good hard chrome was obtained and stored in the freight shed.

Lew Matis went to Cortez and ordered six cage bearing seals and six outer differential housing seals (2 to be used and 4 spares) from NAPA. All the seals had legible serial numbers. Lew also ordered 3 paper seals to mate the banjo together via the internet (Thanks John Randall). We were informed that the proper terminology for the bulbous of the differential is a banjo and not a pumpkin.

GGHS has four spare cage (roller) bearings that Gary Merrifield obtained the last time the power truck was serviced. He said he had trouble finding them and bought extras. We will use two of the spares on the Goose. Both of the used bearings show some wear. The new bearings fit well on the new "Banjo" assembly (It looks more like a mandolin or a pumpkin though).

Parts are due to arrive FedEx next Friday 1/12/18. Thursday is planned to be a cleaning parts party and Friday is reassembly. All are invited...

The one set of brass blocks that provide flex to the power truck on the back axle will be machined to .005 tolerance and reused. The Zerk fitting on top will be reinstalled and used. The brass blocks on the front differential will also be inspected.

Also mentioned was that the gear oil we use must be rated GL -1. Some of the differential parts used on RGS Goose No.5 contain brass. Gear oil rated GL-5 will erode brass parts and cause failure. We must check the synthetic oil that is used in the front power differential to make sure it is not GL-5.

Here are John Randall's comments….
Super good job with getting this assembly apart.
Thanks to all of those involved.

From what I see in the pictures the failure was classic brinellling. The chrome plating separated from the housing due to the high concentrated loads imposed by the roller bearing. The pitted chrome and irregular surfaces created friction. Chrome itself is capable of extremely high temperatures. I have used it in turbine engines in locations where temps are 1200F.
What is the condition of the bearing itself? Is it reusable? Is there a part number on it?

RGS used the chrome to get a hard surface for the roller bearing to ride on. We just need to plan to have this plating removed and replaced on a scheduled basis. The housings should be sent out for a "Grind/plate/grind". Please measure the diameter of the chrome surfaces of the replacement housings. This is a standard process used for repairing shafts, including crankshafts in automotive engines.Arizona Hard Chrome in Phoenix is a place I know of (azhardchrome.com).

There are other methods to have a hard surface for the bearing. The housing could have the section where the chrome plating is cut off and a tube of 4340 chrome moly welded on, then machined to size and induction hardened. But I would stick with the current design and have a spare set ready.

I don't think the bearing ever ran out of grease. The failure of the chrome plating resulted in the axle losing center line control resulting in the seal not capable of performing its job.
I always would use the gun and measure the brass block temperatures of the power truck. They were always less than the other journal blocks.

Maybe after the last excursion of the season we should take off the chains and jack up the axles one at a time and rotate the wheels, listening or any "grinding" or rough sounds.

Here are Joe Becker's comments….
It's amazing the expertise that is available, not only within our organization, but in the Four Corners area as well. Jacking up the power truck at the end/start of each season makes good sense. Our excursion season seems to have evolved into an August/September to February season rather than a calendar year to calendar year season. A late spring work session could accomplish a lot in moderate weather conditions. Long term, should GGHS try to find a second spare Banjo assembly, maybe one with a functioning differential? We also need two more cage bearings for spares. We are purchasing additional seals for spares. Do we want to start working out specs for a reverser for the drive shaft so that we will have five reverse and five forward gears to speed up photo runbys? Maybe plan a spring work session for reverser installation and check out the front axle differential as well?

Here are Scott Gibbs comments….
I agree with John. A hard chrome layer is extremely heat resistant. After a lot of fatigue loading it will suffer a failure like observed. Several of the D&S steam engines have had hard chrome on the piston rods that has cracked and eats the steam packing until it is removed and replaced. Remove, re-plating and regrinding to size is a good repair. I think there may be someplace in Farmington that can re-plate a shaft. This is a wear coating used on many oil rig shafts.

Regarding oil, Our VW transaxle has many brass internal parts. If you use many of the GL5 grade gear oils, they will react when hot and cause a lot of corrosion of the brass due to the active sulfur. VW and Porsche used a GL4 grade oil in most of their transaxles. GL4 gear oils are not super easy to find anymore but I think NAPA has one. LubroMoly has one that will work as does Redline.

Here are Jeff Taylor's comments….
I would consider consulting with Karl Schaeffer on the axle.

Additionally the diff blocks that clamp it to the truck, SHOULD only clamp one side. The "loose" side should also have an oil cup on top like the rear truck. This oil cup is to lubricate the block that is loose, like a bushing. The front diff should have the same set up on the opposite side of the truck. This allows the truck to flex over uneven track.

Outer seals should be easily found. We bought new ones for #3 at Knott's.

I can't tell from the photo what is going on with the gap behind the wheel and where the clamp block goes. Joe what is the gauge of the wheels? Measure the back or inside of the wheels? I wonder if an axle is moving side to side.

Motor 2 has what looks like a solid rear axle. I don't know if it's a tube with and axle through it or if it has spindles at the ends. I do know it is not a diff. I will have to ask around and investigate.

At Knott's we discovered that the front diff was rebuilt open at some point and the rear axle was locked/leaded. We left it alone, but it made the chains skip teeth or skip and fall off a lot. This was due to the fact that the right front wheel was driving the right rear, then the rear axle was driving the left rear where the chain drove the left front. The left front was trying to rotate faster on right hand curves and through the chain tried to slow the rear axle and subsequently the whole right side. So the right side chain would skip sometimes. If everything was running normal you could tell how the power was moving around the truck. The drive chain on the right was tight on top and the left was tight on the bottom.

I would say this is why the RGS has 5 set up the way it is. With the front diff locked and the rear open each chain is only trying to drive one wheel. Whereas at Knott's the chains we're driving 3 wheels.

Here are Lew Matis's comments….

The lubricant we need is GL-1. It is a mineral oil base according to CARQUEST, and Ken verified that. 90 weight, by the way.

On Ken's advice, I went to CARQUEST. They will have to order the lubricant, so on Monday I will first check with NAPA to see if they have it or can get it. I also checked with Stottz Equipment, the John Deere dealer, and all they carry is GL-5. They recommended Cortez Diesel.

Just a note to Larry: Your pictures from the earlier rebuild have been very useful in helping us "figure out the next step" in this whole process. Just think of the fun you're missing in not being here. Goose grease all over your hands and pants and face (if you're not careful!); working outside in the January cold. If you have fond memories of such, come join us on Thur. and Fri. Otherwise, have fun playing golf!

Also I must mention Gary Merrifield's help in all this. Gary was able to get the wheel puller for us, not to mention his input on what we can expect to find at each step and things to consider. I will get his email address and forward all of this to him and will add him to the cc list above.

Also, Jeff Taylor needs a pat on the back. His description of the power truck on No. 3 and his comments proved to be very useful.

And a last shout out to Jack Odenbaugh. He really was a mechanical genius. The things we know today are built on the knowledge and experience of guys like him. Amazing that nearly 85 years later, his basic design, while needing some major repair, still prevails and is worth fixing.