



EXTRA 2011 WEST  
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NMRA 2011 SACRAMENTO, CA



## Troubleshooting and Repairing Brass Steam Locomotives

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Copies of this presentation can be found at

<http://www.markschutzer.com>

# Clinic Overviews



## Part 1 – Troubleshooting and Repairing

- Brass steam locomotives have a reputation for running poorly. This clinic will discuss the common problems and show you how to fix them. A step by step example of a locomotive repair will be illustrated. This clinic is tailored to the beginner who wants learn how to improve the running of those cranky steam locomotives.

## Part 2 – Rebuilding Steam Locomotives

- This clinic will show you how to turn those “noisy growlers” into prize runners that will silently creep down the track. Re-motoring and re-gearing will be discussed and illustrated in detail. Topics include motor and gearbox selection, motor mount construction, and the use of universal joint couplings.

# The tale of three KTM locomotives...



A quick little demonstration

## Mountain 4355

- Original condition, as obtained



## Pacific 2467

- After completion of clinics
  - Re-motored
  - Re-geared
  - Universal coupling
  - Decoder equipped



## Mountain 4353

- After completion of clinics
  - Re-motored
  - Re-geared
  - Universal coupling
  - Decoder equipped



# Troubleshooting and Repairing Overview



Common Problems

Step by Step Process

Tools and Materials

Questions

# Common Problems



Poor electrical pickup

Electrical shorts – continuous or intermittently occurring

Motor problems

Gearbox problems

Mechanism binding or loping

Stiff or broken motor coupling

Noisy

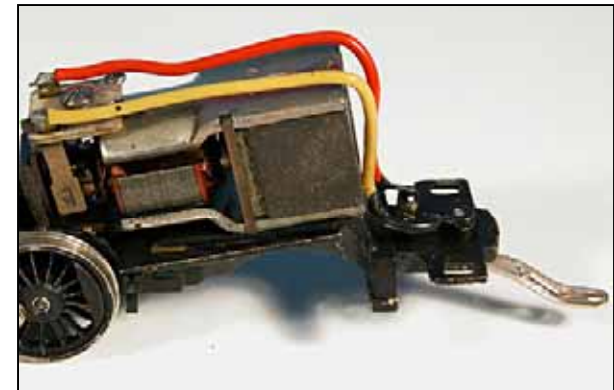
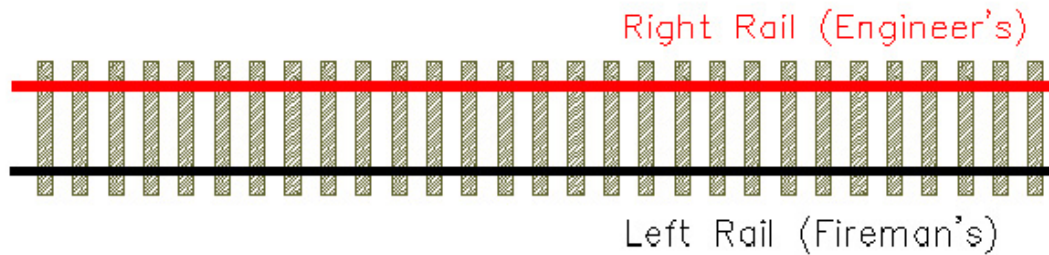
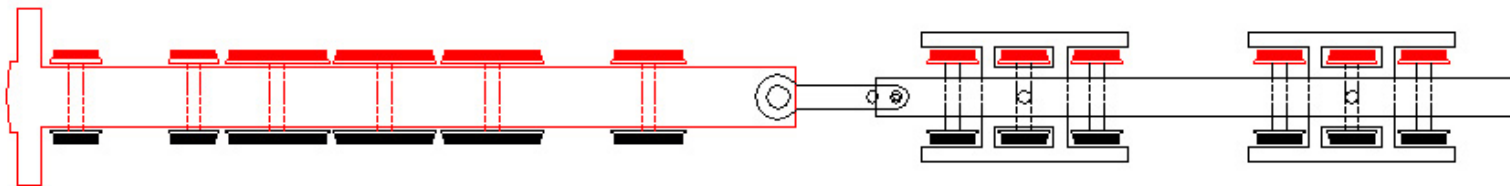
Out of gauge wheels including narrow tread width

# Electrical Pickup



Locomotive Frame is connected to right rail.

Tender Frame is connected to left rail.



# Poor Electrical Pickup



Dirty wheels, tender or locomotive

Drawbar problems

- Broken or bent tensioning wire
- Oxidized brass drawbar
- Oxidized drawbar pin
- Missing or compressed spring at drawbar attachment point

Oxidized tender truck bolsters

Paint in the tender wheel journals

Paint in the locomotive bearing contact areas

Motor brush problems, incorrect brush tension

Broken wire to motor connection

# Electrical Shorting Problems



## Continuous shorts

- Separate the tender from the locomotive and place each on the track one at a time.
- Does the short occur with the locomotive only?
  - Check left side wheels
  - Metal brake shoe touching wheels?
  - Pilot wheel touching cylinder, or frame?
- Does the short occur with the tender alone?
  - Check right side wheels
  - Truck turned around?
- Does the short only occur with the locomotive and tender connected?
  - Cab touching tender?
  - Pinched motor or headlight wire?
  - Boiler or weight touching motor brush?

# Electrical Shorting Problems



## Intermittent shorts

- Usually caused by motion
  - Motion of wheels turning
  - Motion of trucks around curves
- Isolate to locomotive or tender if possible
- Troubleshoot by running slowly and observing
  - Watch and listen for spark at point of short
  - Watch the motion of the trucks and wheels

## Detailed Troubleshooting in Appendix

# Motor Problems



Dried out bearings and oil packings

Commutator problems – “ring of fire”

Brush problems

- Out of position
- Missing brush insulator
- Excessive brush spring tension

Broken wire to brush contact

Poor slow speed running

Inconsistent starting speed



# Step by Step Repairing

# Repair Example



## Step by step process

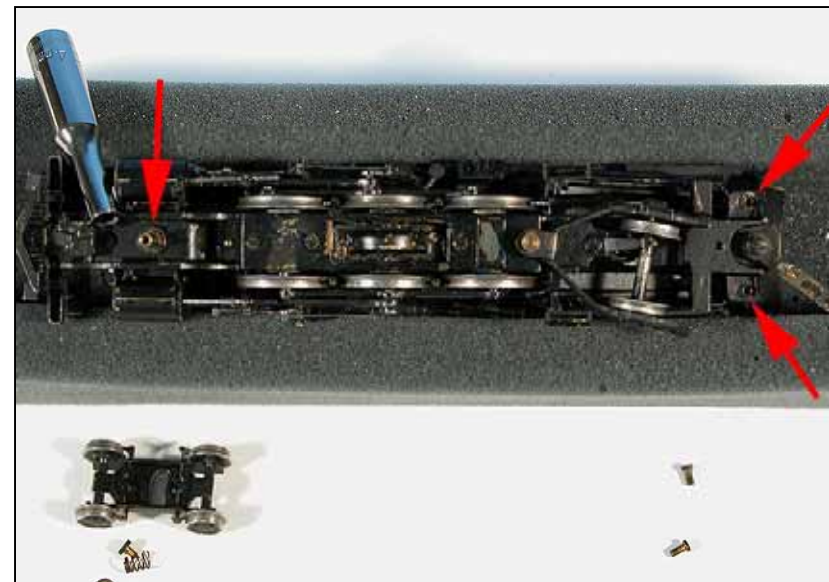
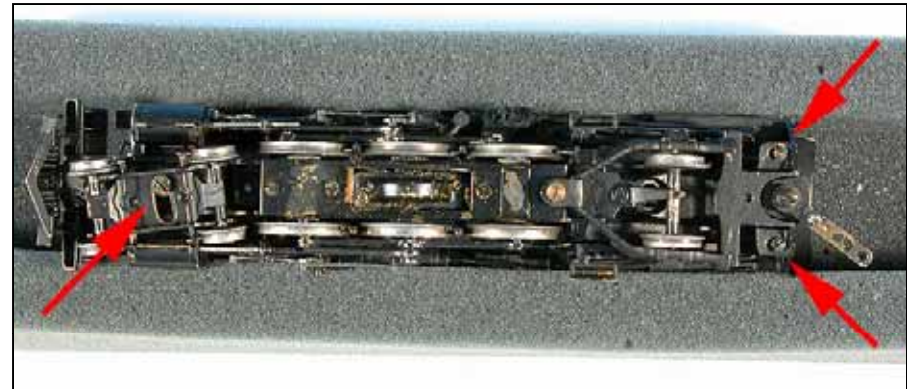
- Remove boiler shell
- Remove motor
- Remove gearbox
- Pull rods and check quartering
- Reinstall rods
- Check for binds
- Disassemble, clean and lube gearbox
- Service motor, clean commutator and brushes, adjust brushes, and oil bearings
- Reinstall gearbox
- Reinstall motor, replace coupling
- Fix electrical contact issues
- Test and adjust coupling for minimum current draw, and minimum noise

# Removing the boiler shell



## Boiler Removal

- Most locomotives use three screws to attach the boiler shell to the frame.
- The location of the two cab screws vary, they are usually either in the back wall of the cab, or directly under the cab as in this case.
- The front of the boiler is often attached with a long screw that also serves as the mounting stud for the pilot truck. A 4mm deep socket is useful for removing this stud.



# Boiler shell removed



Boiler removed

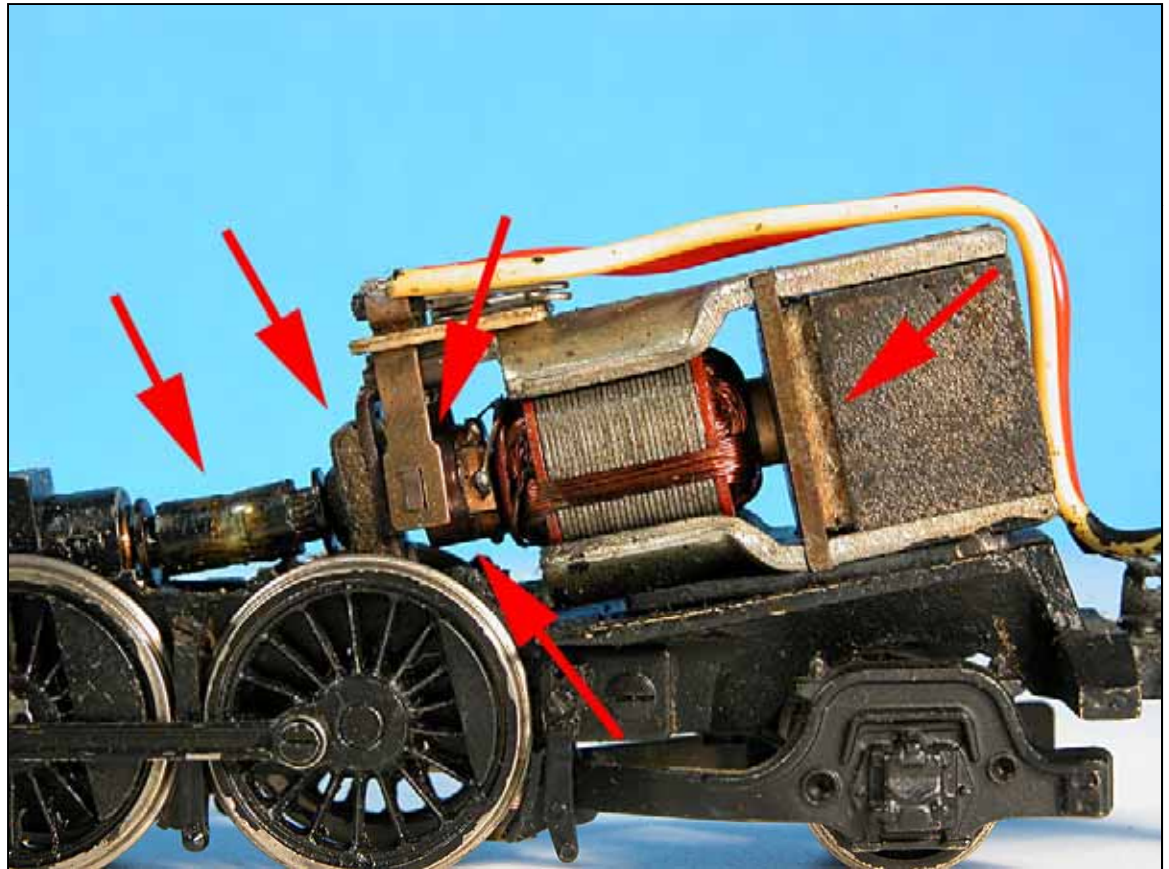


# Motor close-up



## Problem areas

- Stiff and misaligned coupling
- Grease packed commutator
- Dry oil packings
- Misaligned brush



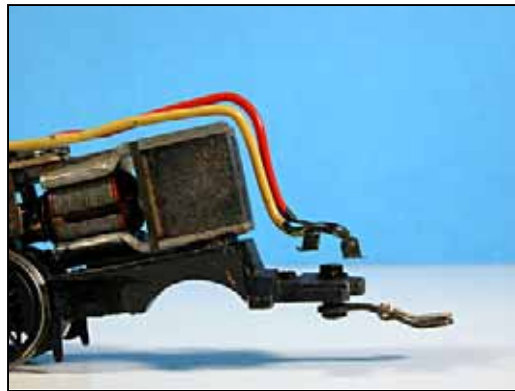
# Removing the motor



Remove motor mounting screw



Remove screws connecting to wire lugs



Remove motor



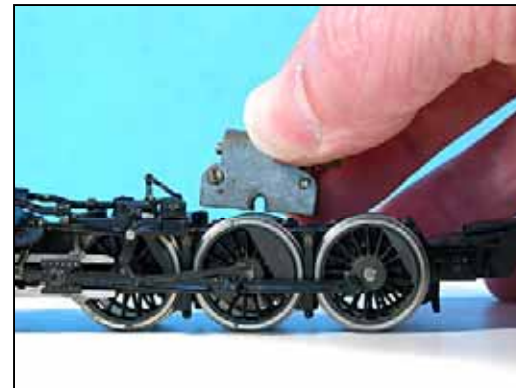
## Removing the gearbox



Remove two screws from gearbox cover.



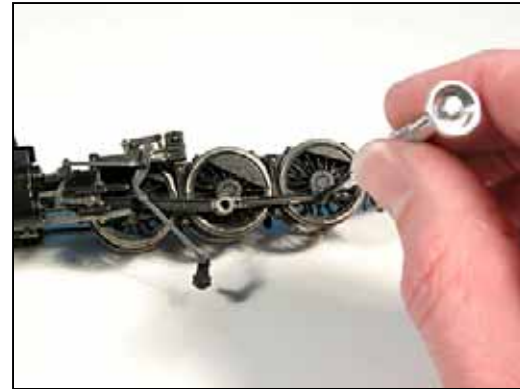
Turn over and lift out gearbox.



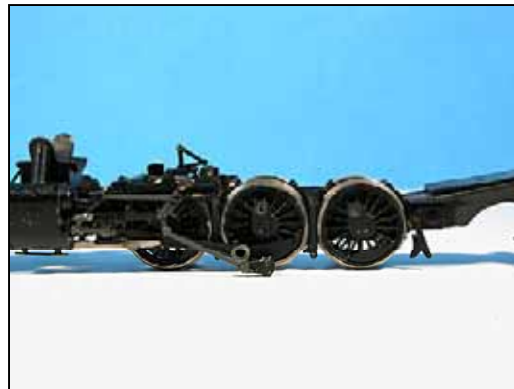
## Remove rods and valve gear



Remove crank screws from wheels



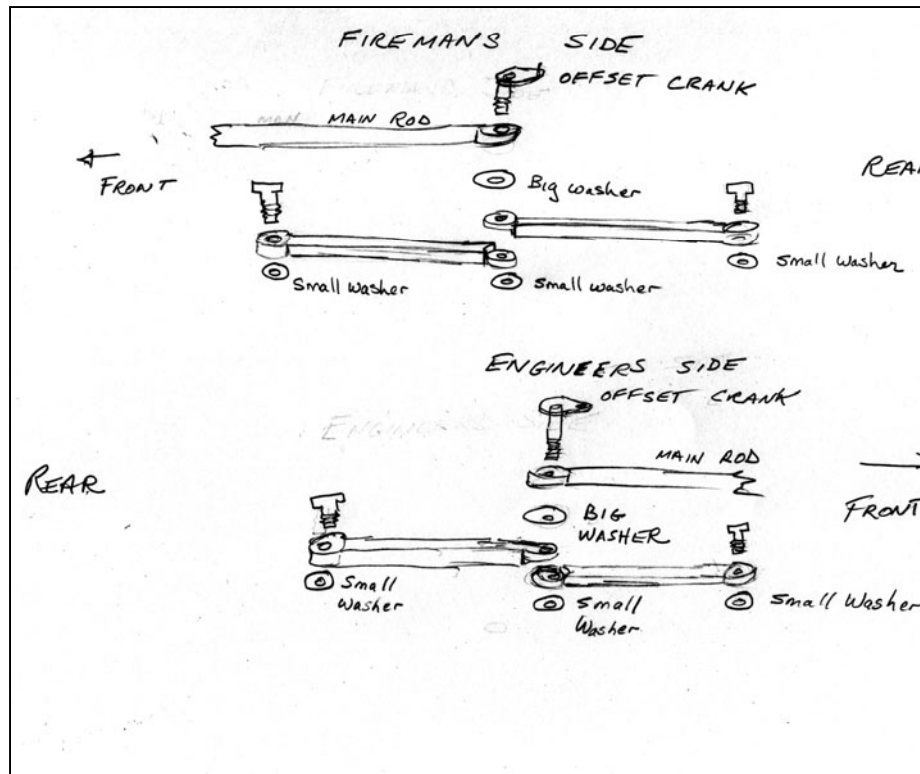
Remove rods and washers



# Write it down!



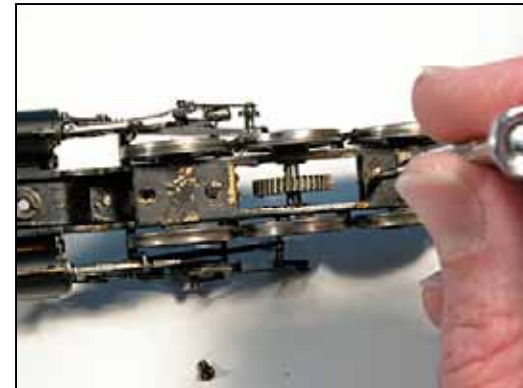
Make a sketch of the rods and washers as you remove them to aid in re-assembly.



# Remove Drivers



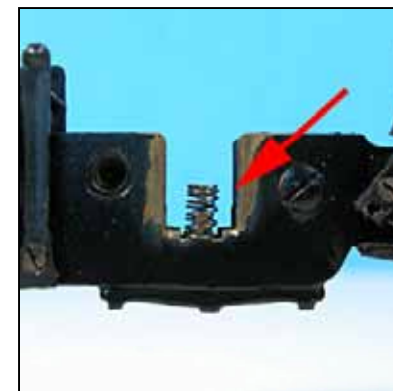
Remove bottom cover plate  
You may need to remove brake shoes



Lift out drivers



Watch those springs!



# Keep things organized



Get a storage box and separate the parts by where they go.



# Check the quartering



## Quartering

- In order for all the drivers to roll freely without binding they must all be quartered the same. Incorrect quartering is number one cause of binding and loping.
- Check the quartering of each driver set.
- The press fit of the driver on the axle is often loose allowing the quartering to change over time.
- Grasp the wheels on each driver set and gently twist the wheels in opposite directions, if the wheels move on the axle then the wheels need to be pulled, re-quartered and secured with Loctite.

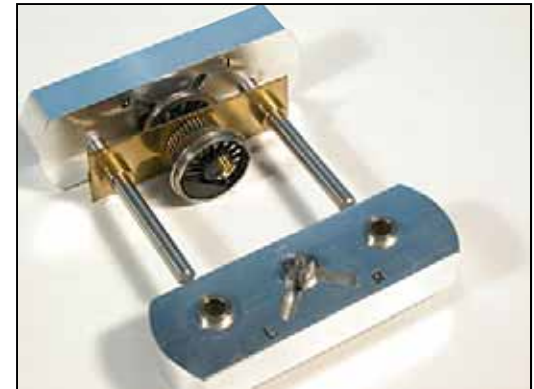
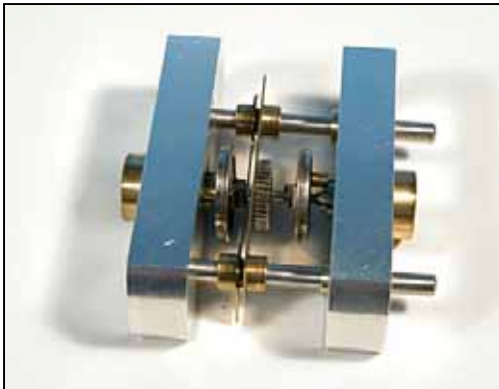
# Checking quartering



NWSL Quarterer



NWSL Quarterer 2



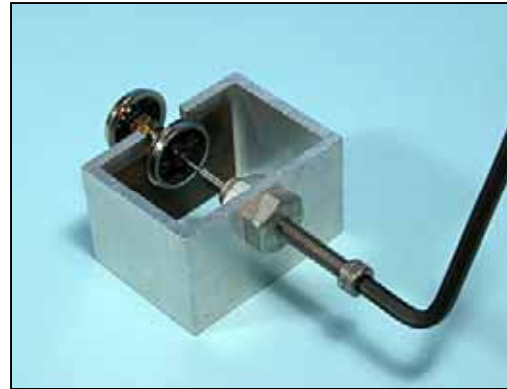
Quartering vise



# Pulling Drivers

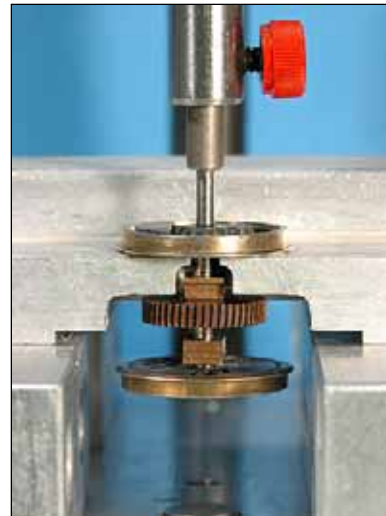


## NWSL Puller



## Arbor Press

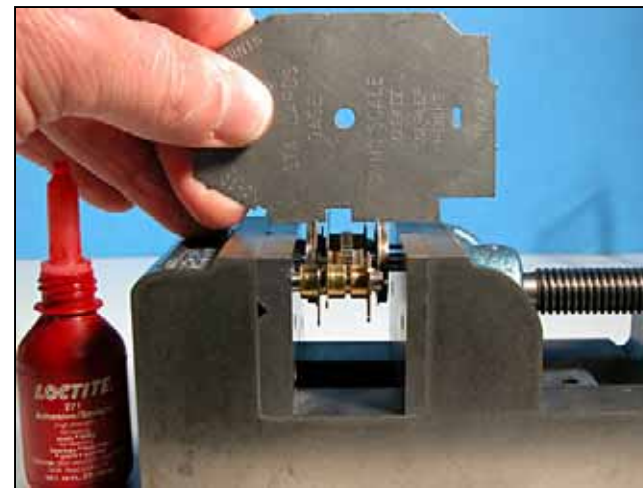
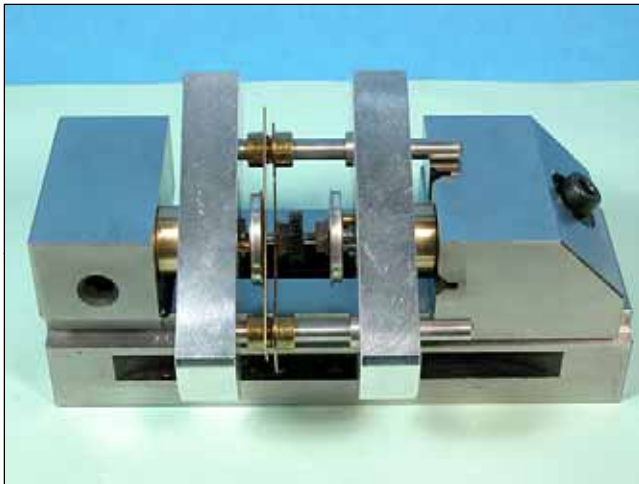
- NWSL Sensipress
- PanaVise press



# Pressing Drivers



## Quartering

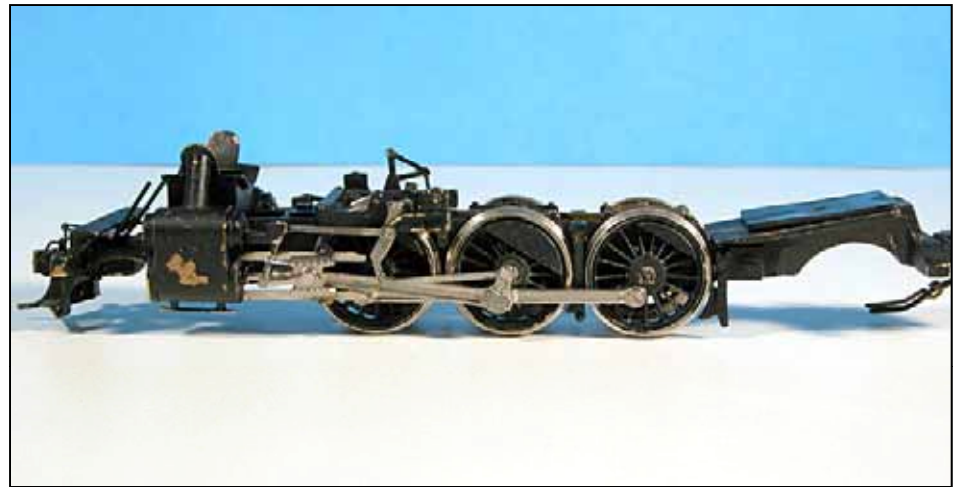


# Reattach Rods



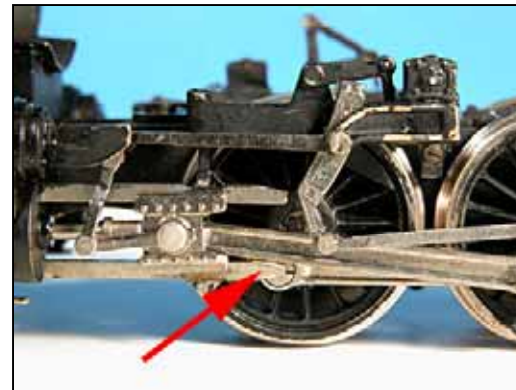
## Reassembled mechanism

- Test roll mechanism, make sure there are no binds or interference issues.



## Interference

- Main rod was hitting crosshead guide, required a little filing of the crosshead guide to fix.



## Other Issues



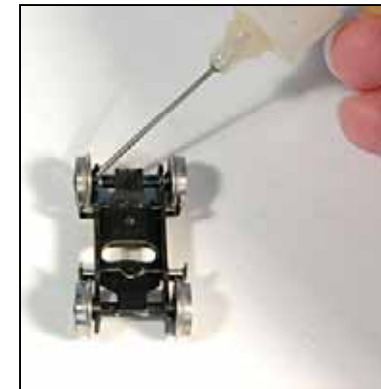
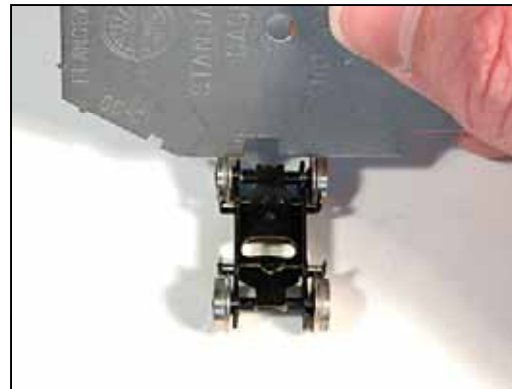
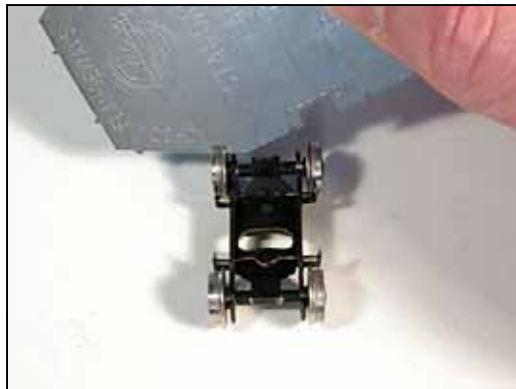
### Other problems

- Occasionally you may have some binding problems even after the drivers have been quartered correctly.
- While fairly rare there can be some problems with the frame, and or the side rod spacing. The distance between the crank screw holes in the rods must exactly match the distance between the wheel journal bearings.
- If these distances don't match the drivers will bind. Measure these distances with a caliper and shim and adjust accordingly.
- Sometimes a crank screw will stick out too far and catch on the main rod. You may here a clicking sound. Usually occurs on curves.
- A missing crank screw washer may cause a rod to catch on a driver counterweight.
- Carefully check alligator style crosshead guides, if bent out of position these often can cause binding of the crosshead. Bend and adjust crosshead guide position to eliminate binding.

# Pilot and trailing trucks



Check gauge and lubricate



Narrow tread width on trailing truck wheelset



# Gearbox



Disassemble, clean, and lube gearbox



# Motor



Remove brushes

Clean brushes and commutator with an alcohol soaked Qtip.

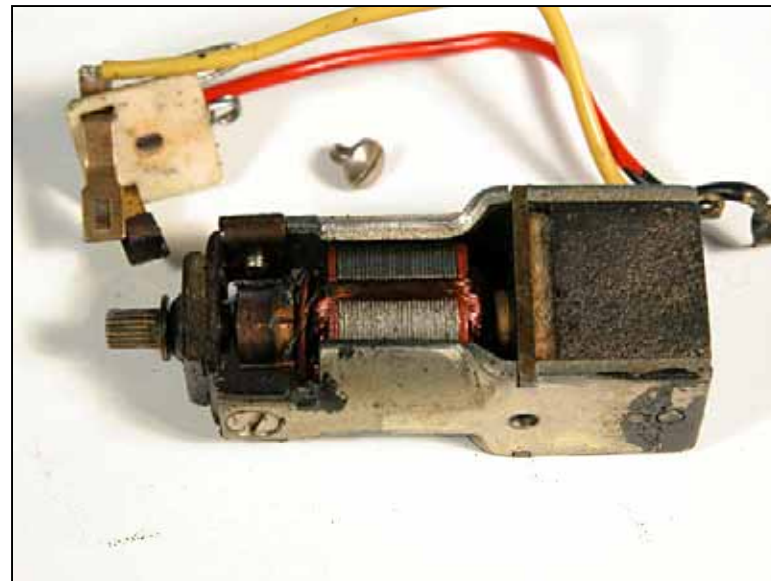
Oil bearing areas and soak oil packings.

Adjust brush spring tension, usually far to much tension causing excess drag and current draw.

Reassemble when cleaned up.

Test run

**Better solution – Replace it!**



# Drawbar fixes



## Original drawbar and pin

- Oxidized and dirty brass
- Oversized stiff brass wire contact spring



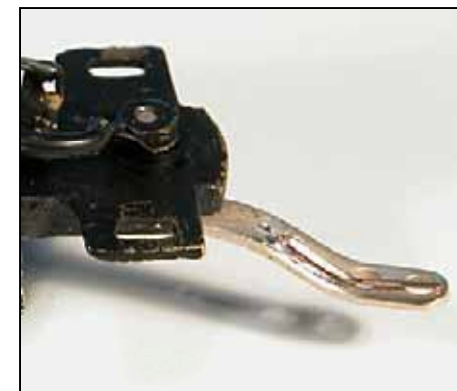
## Alternate Method:

Use super flexible wire and connect in parallel with drawbar connection

## Silver plating drawbar and pin.



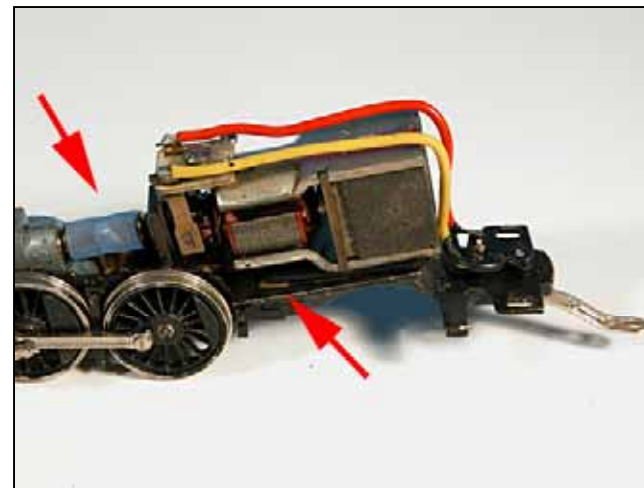
## Plated drawbar with phosphor bronze contact spring.



# Reassembled mechanism



Note new coupling and motor shim.



# Test Run



Connect the leads from a throttle to the locomotive and test run.

Use a throttle with a built in ammeter.

Run at medium speed and adjust motor and gearbox coupling for minimum current draw and minimum vibration.

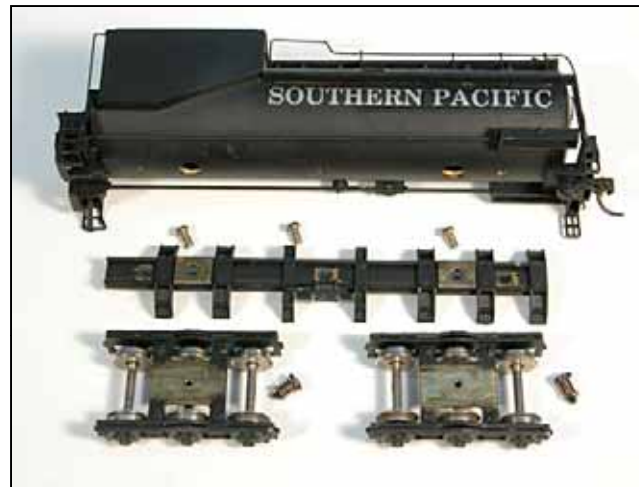
Push and pull between motor and gearbox to adjust coupling position and tension.

# Tender contact fixes



Silver plate truck bolster areas and drawbar pin.

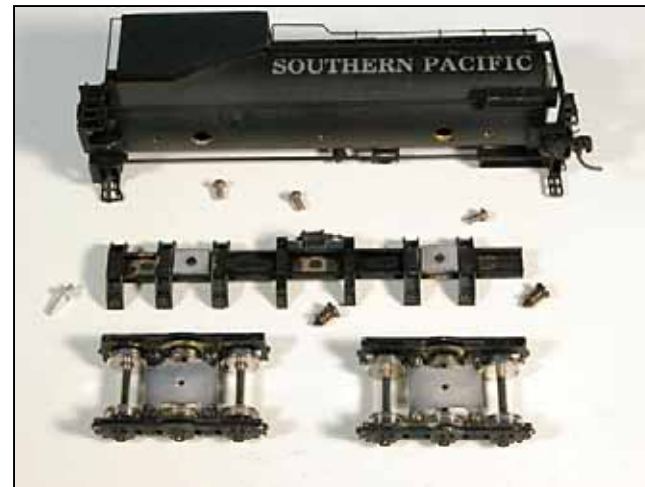
- Before plating



## Alternate method:

Use super flexible wire and solder a wire from the tender frame to each of the trucks.

- After silver plating



# Everything reassembled



## Summary

- With the work done in this clinic the locomotive should run reasonably well and shouldn't have any binding in the mechanism. The locomotive should run reliably without any electrical pickup, or shorting issues.
- Given the limitation of the original motor and gearbox the locomotive will likely be noisy, and its slow speed performance may be limited.





# Tools and Materials

# Tools and Other Stuff



## Tools

- Jeweler's screwdriver set, Radio Shack
- Tweezers
- Needle file set
- 4 mm deep socket or deep nut driver

## NWSL Items

- Quarterer, Quarterer 2
- Puller, Puller 2, SensiPress
- Spare metric screws
- Spare wheel springs, medium, light, and wimpy

## Lubricants

- Labelle #102 gear oil
- Labelle #108 light oil
- Labelle #106 Teflon grease

## Tools and Other Stuff



### Silver Plating Kit

- Caswell Plating, Plug N Plate Silver plating kit

### Thread locking

- Loctite 271 (red) high strength

### Other Stuff

- NMRA track and wheel gauge
- Silicon Fuel line, various sizes to match original motor / gearbox coupling
- .020" diameter Phosphor bronze wire (for drawbar tensioner)

# Silver Plating Kit



## Plug N Plate Silver plating kit

Sources:

<http://www.caswellplating.com>

7696 Route 31

Lyons NY 14489 USA

Phone: 315 946 1213

PNPSLV35                      \$46.99

### SILVER PLATING KIT

Ideal for repairing antiques with wear damage, or plating from scratch! Quickly puts a heavy layer of silver just where you want it. Headlight reflectors are easily done with this system.

- 1 x Plug N' Plate™ Power Supply
- 1 x 4oz Silver Solution
- 1 x Stainless Steel Wand
- 1 x Wand Bandage
- 1 x Instruction Booklet





Questions?



# Appendix

# Troubleshooting Shorts (detailed)



Is the short continuous or intermittent?

- Continuous shorts
  - Separate the tender from the locomotive and place each on the track one at a time.
  - Does the short occur with the locomotive only?
    - Check for anything touching the wheel treads on the left (fireman's) side such as metal brake shoes, or hanging details.
    - Check clearance on the left side pilot wheels, make sure that the wheels are not contacting the pilot truck frame or brake shoes.
    - Check clearance on the left side of the trailing truck wheels, make sure there is no contact with the frame.
    - Using an Ohmmeter check the continuity between each of the left side wheel treads and the frame of the locomotive. Are any of the wheelsets installed backwards?
    - If nothing is touching the left side wheel tread and a wheel reads shorted the paper insulation between the driver and the wheel tread may be bad.
    - Make sure that no part of the frame or pilot is touching the track.

# Troubleshooting Shorts (detailed)



- Continuous shorts (continued)
  - Does the short occur with the tender alone?
    - Is one of the tender trucks turned around backwards? This is very common as many tenders allow the trucks to spin completely around.
    - Are any of the wheelsets installed backwards?
    - Check the clearance between the frame and all the right side (engineer's) wheels. Make sure there is adequate clearance between the truck frames and the wheels.
    - Measure the continuity between each right side wheel and the tender frame.
  - Does the short only occur with the locomotive and tender connected?
    - Check for any contact between the locomotive cab and the tender. The drawbar should be the only contact point.
    - Check the insulating washers on the shouldered screw used to attach the drawbar to the locomotive.
    - Make sure that nothing is shorting the brush contacts inside the boiler.
    - Check to see that the motor wire is not pinched between the boiler and the frame.
    - Make sure that the headlight wires and connections are not pinched or touching the weight or boiler.

# Troubleshooting Shorts (detailed)



- Intermittent shorts
  - Some possible causes
    - Intermittent shorts usually occur in response to motion, either the motion of the wheels turning, or motion on the track, such as the locomotive going around a curve.
    - Inadequate clearances around insulated wheels may cause shorts as the wheelset rotates.
    - Shorts that occur on curves are usually caused by the movement of the trucks. The pilot truck and the tender trucks rotate as the locomotive negotiates curves. Often this movement will allow an insulated wheel to contact a portion of the frame.
    - Shorts may also occur due to the back of the locomotive cab touching the tender frame when negotiating curves. Connect the tender to the rear hole on the drawbar.
    - Metal couplers not isolated from frame may also cause shorts, always use insulating draft gear boxes, or as an alternative use non conductive versions of couplers.

# Troubleshooting Shorts (detailed)



## – Isolating and troubleshooting

- Troubleshoot by running the locomotive and tender over the troublesome track at slow speeds and carefully look over the truck areas. You should be able to see and hear a spark when the short occurs. Observing in dim light also helps. Look for sparks on the left side of the locomotive, and look on the right side of the tender.
- When the short occurs, remove the tender to see if you can isolate the short to locomotive, tender, or the combination of both. Follow the same process of elimination as in the continuous shorting case.