

Upgrading the Drive Train in Older Brass Locomotives

May 2017



Intro

Beauty in the eyes of a model railroader is a smooth running brass steam locomotive:

- Creep along at low speed with no hitch
- Quiet operation in either direction over the entire speed range
- With today's modern DCC they look and operate like the real thing

Intro

Modern brass locos exhibit all these characteristics because the manufacturer:

- **Research** – prototype detail and paint
- **Engineering** – created a miniature, complex machine that runs well
- **Quality Control** – inspected and tested to high standards before ever leaving the factory

Intro

**But - a modern brass steam locomotive is
Expensive!!**

- HO/O Scale = \$1,000 - \$2,000
- Painted, but often not with DCC or sound
- But – you get what you pay for – quality

Intro

You can approach the quality of a modern brass steam locomotive with today's Ready-To-Run (RTR) plastic locomotives at a fraction of the cost.

- Not quite the level of detail (but rapidly approaching that of brass)
- Smooth runner
- Strong consideration

Intro

But if you're like me

- You like the detail of brass
- You've acquired older brass models before the newer brass or plastic RTR became available
- You don't have the capital funding for a modern brass fleet

Intro

Today we're going to show you how to convert your older brass loco into one that runs much like the new ones.

With materials costing <\$100 and a few readily available tools you can perform this conversion.

Intro

The 'Achilles Heel' of older brass locomotives is the **Drive Train**.

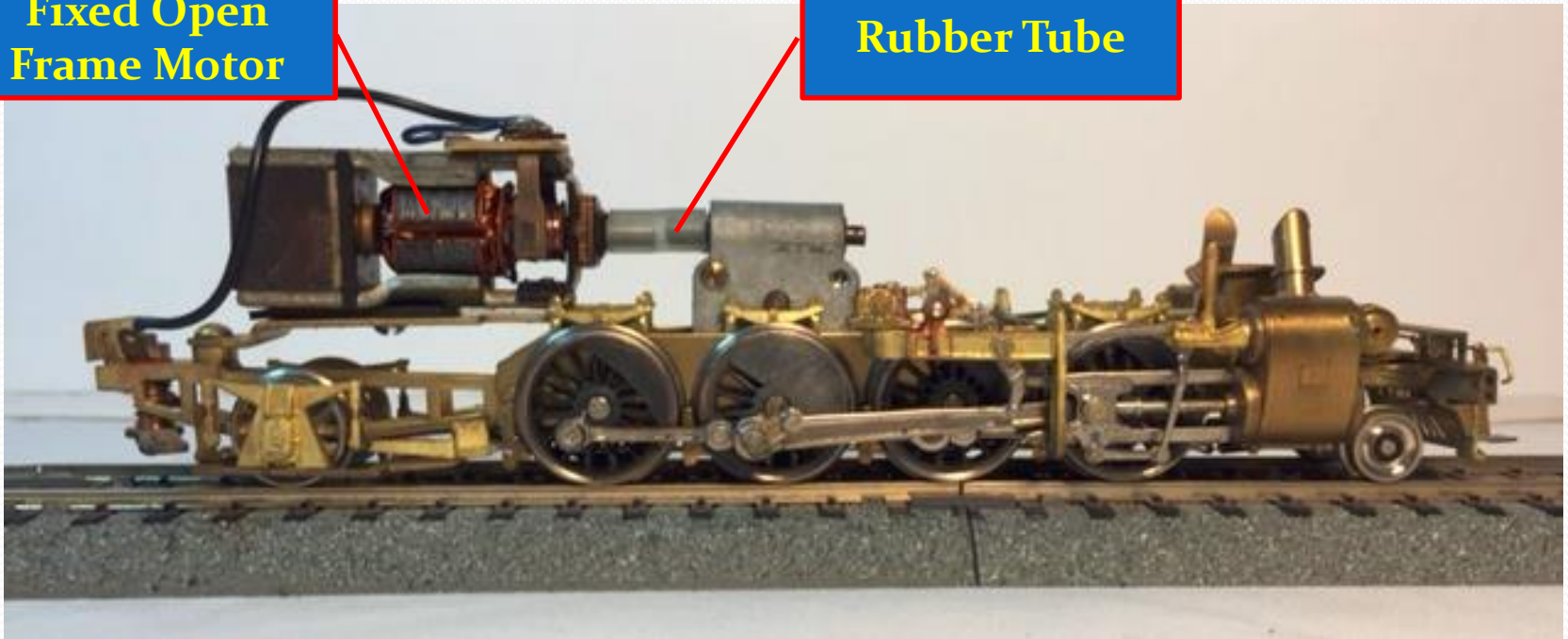
- Fixed, open frame motor
- Motor is joined to the gearbox with a rubber tube
- As the gearbox floats it can cause binding with the motor

Intro

Traditional brass drive train:

Fixed Open
Frame Motor

Rubber Tube



Intro

Today we'll show you how to modify your drive train from the traditional to a 'Torque Arm Drive'

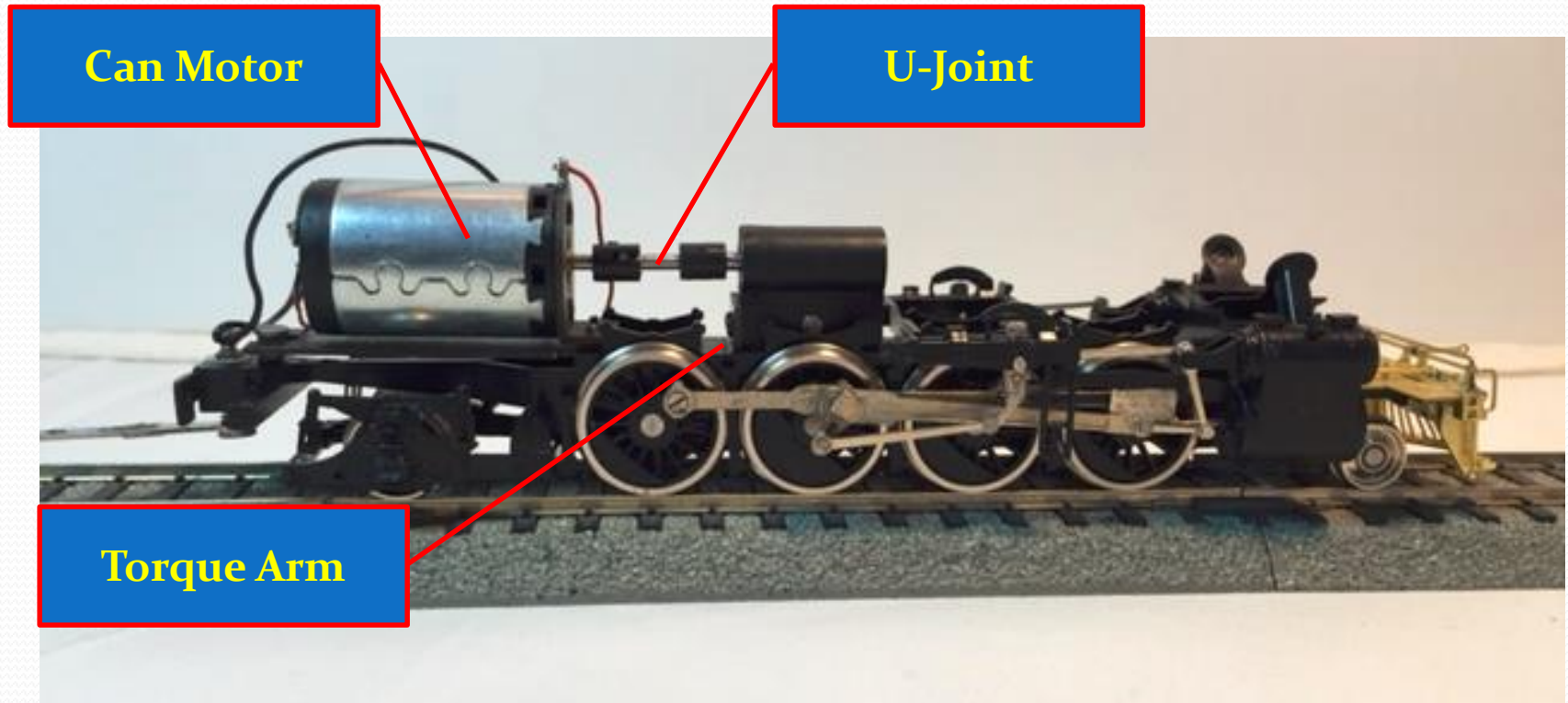
Intro

Modern 'Torque Arm Drive'

- Utilizes a Can Motor
- Motor is fixed relative to the Gearbox
- Rubber tube is replaced by a Universal Joint
- Results in a much smoother, quieter operation at all speeds

Intro

Modern 'Torque Arm Drive'



Intro

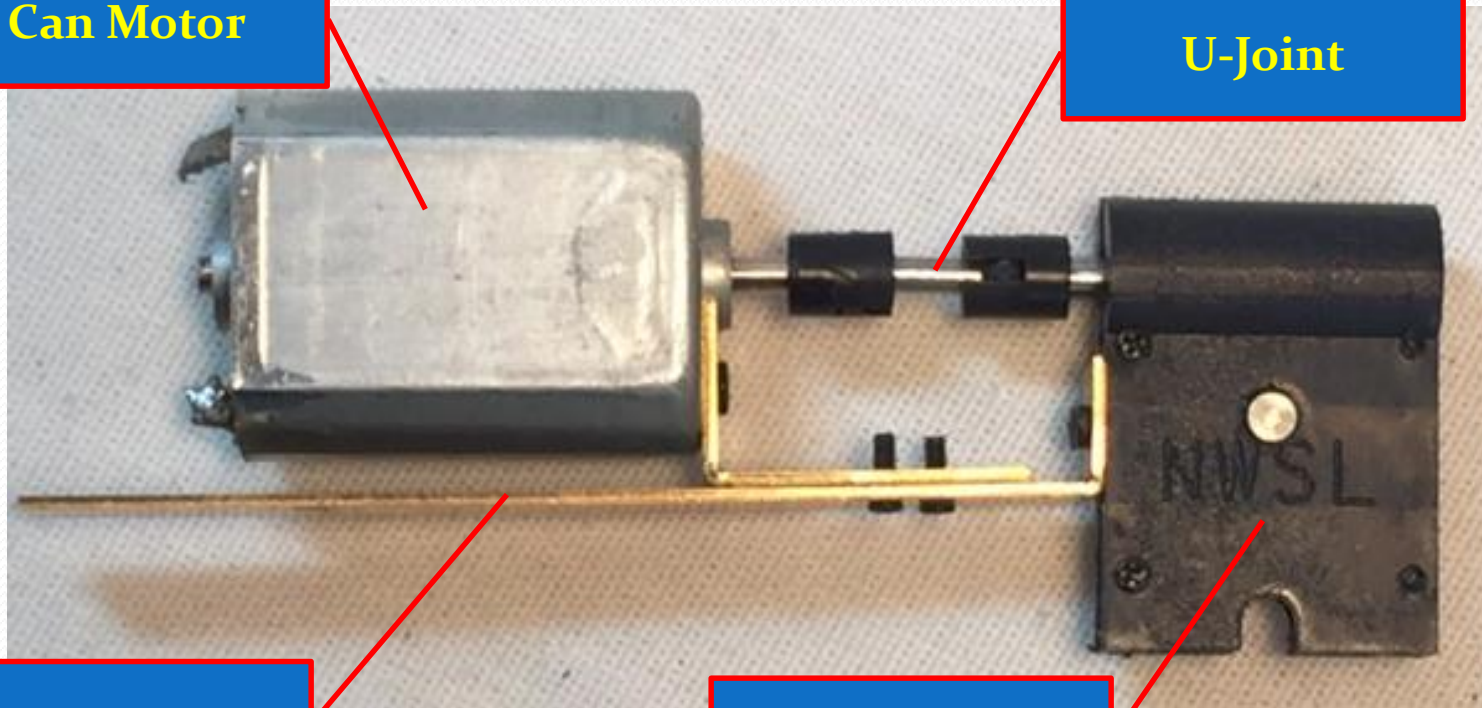
Modern 'Torque Arm Drive'

Can Motor

U-Joint

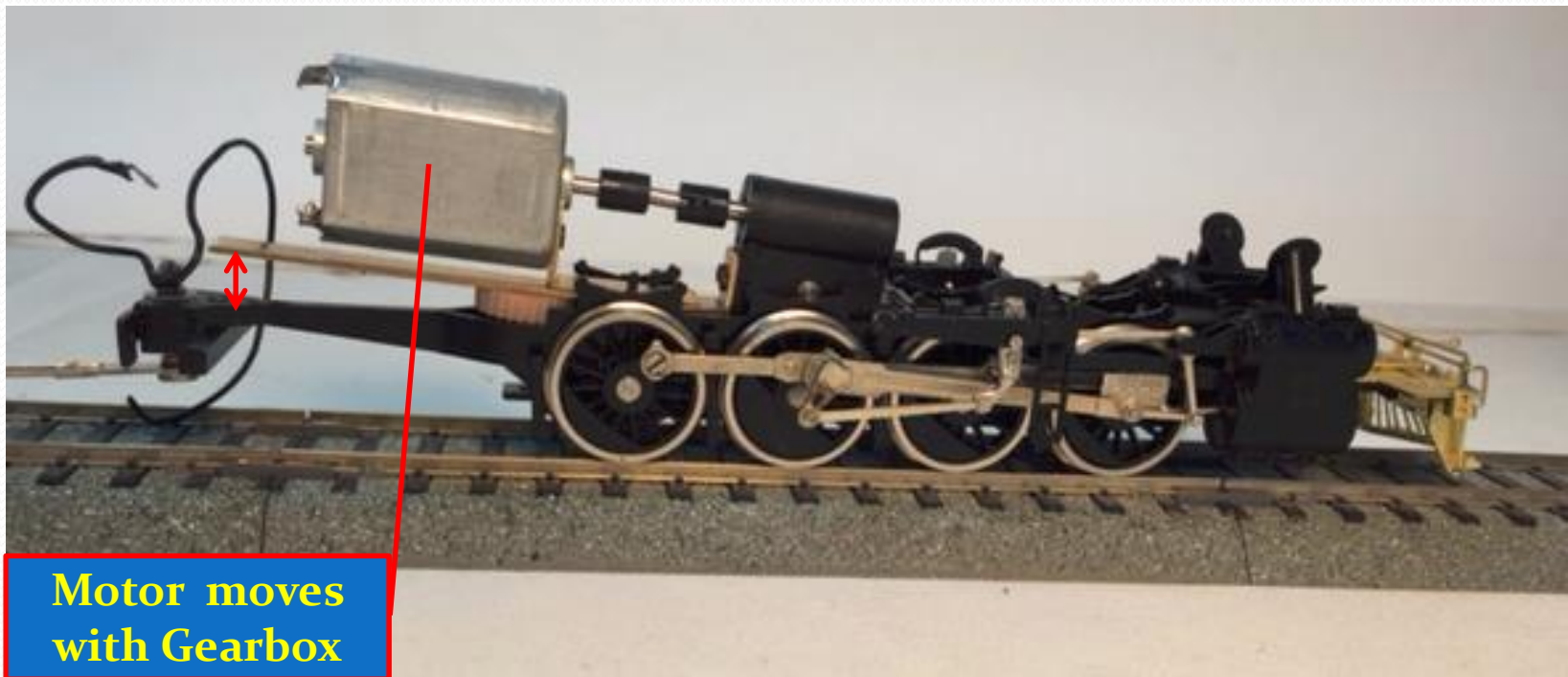
Torque Arm

New Gearbox



Intro

Modern 'Torque Arm Drive'



**Motor moves
with Gearbox**

Intro

We will use the following 3-step process to build and install a 'Torque Arm Drive'

- **Installation of the new Gearbox Axle Gear (and quartering of the drivers - if necessary)**
- **Construction and assembly of the Torque Arm Drive**
- **Final Installation and Start-Up**

Axle Gear

Tools:

- Screwdriver set
- Foam cradle
- Puller III – NWSL 65-4
- Sensi-Press
- 3 mm Aligner (NWSL 33-4) or equivalent

Materials:

- NWSL Gearbox – 150-6
- Replacement axle springs:
 - Light – NWSL 1401-4
 - Wimpy – NWSL 1410-4

Axle Gear

Prep Work:

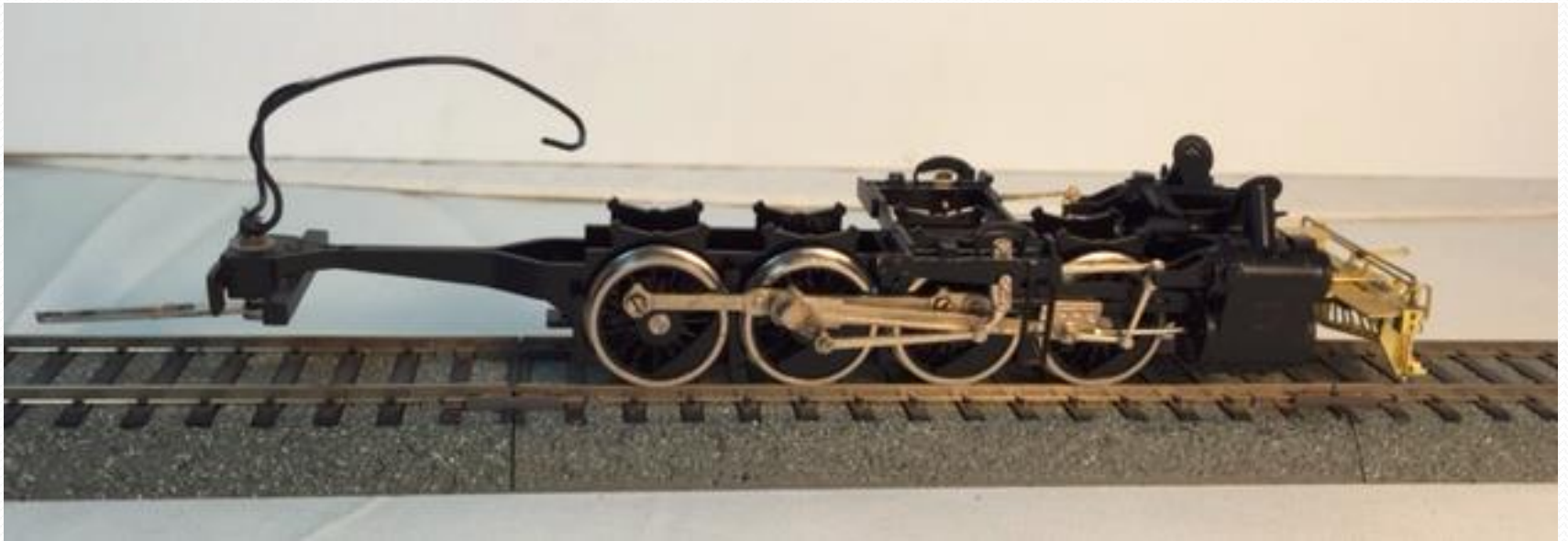
- Remove the boiler shell and pilot/trailing trucks
- Next remove the old motor and gearbox
- Remove the side rods and disconnect the valve gear from the driver
- Bag the parts and set aside

Important Note!

- Note/document where each part came from in the disassembly process. Sketches or a few pictures will help you remember the details during the reassembly process. It may seem obvious now, but it won't necessarily later!

Axle Gear

Prep Work:



**Chassis with the Motor and
Gearbox Removed**

Axle Gear

Decision Point:

Is the driver quartering on this locomotive okay??

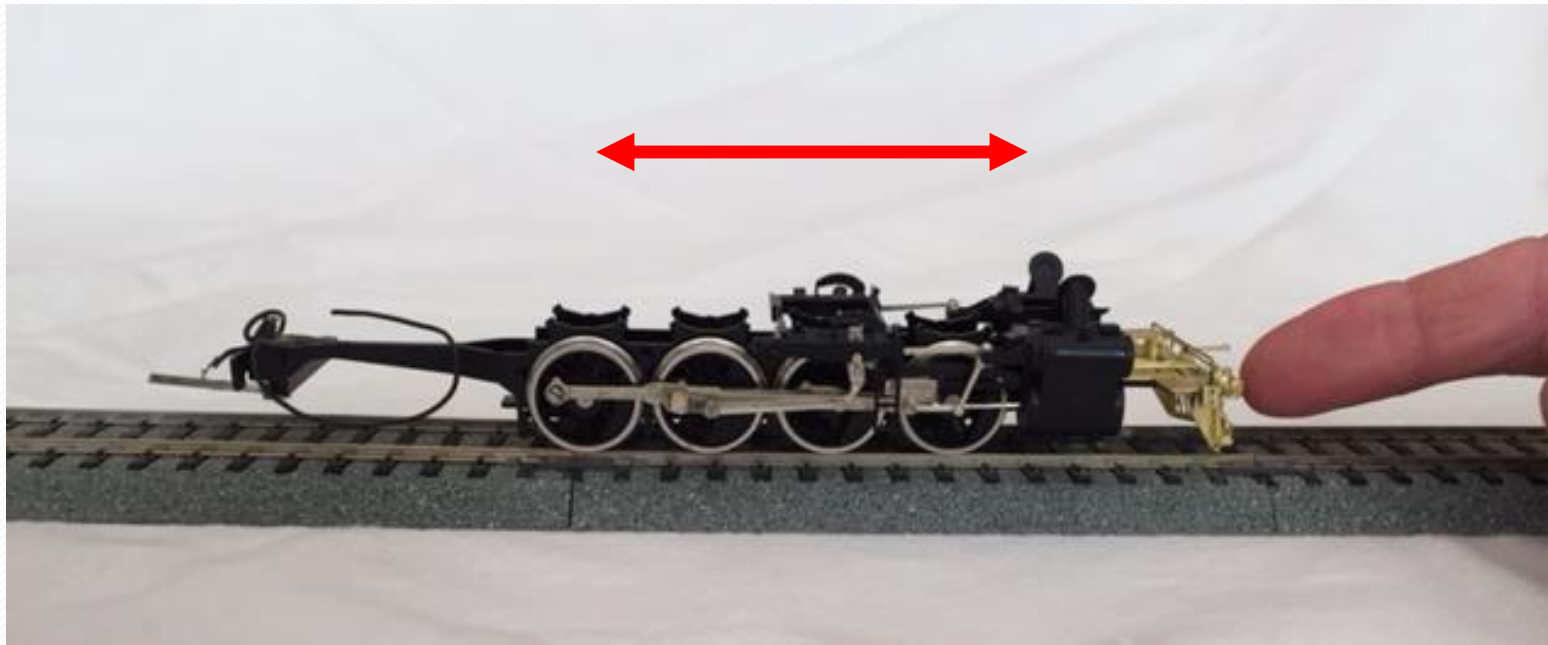
If yes, then we only need replace the existing axle gear.

If no then we need to replace the existing axle gear *and* re-quarter all the drivers.

Axle Gear – Evaluate the Quartering

To evaluate the quartering, place your chassis on a flat piece of track or a piece of glass.

Roll the chassis back and forth with your finger.



Axle Gear – Evaluate the Quartering

If the chassis rolls back and forth smoothly without sticking or binding, then the quartering is fine and you can proceed with the replacement of the existing axle gear on page 22

If the chassis exhibits any sticking or binding then you need to re-quarter all the drivers as well as replace the axle gear. Proceed to page 38

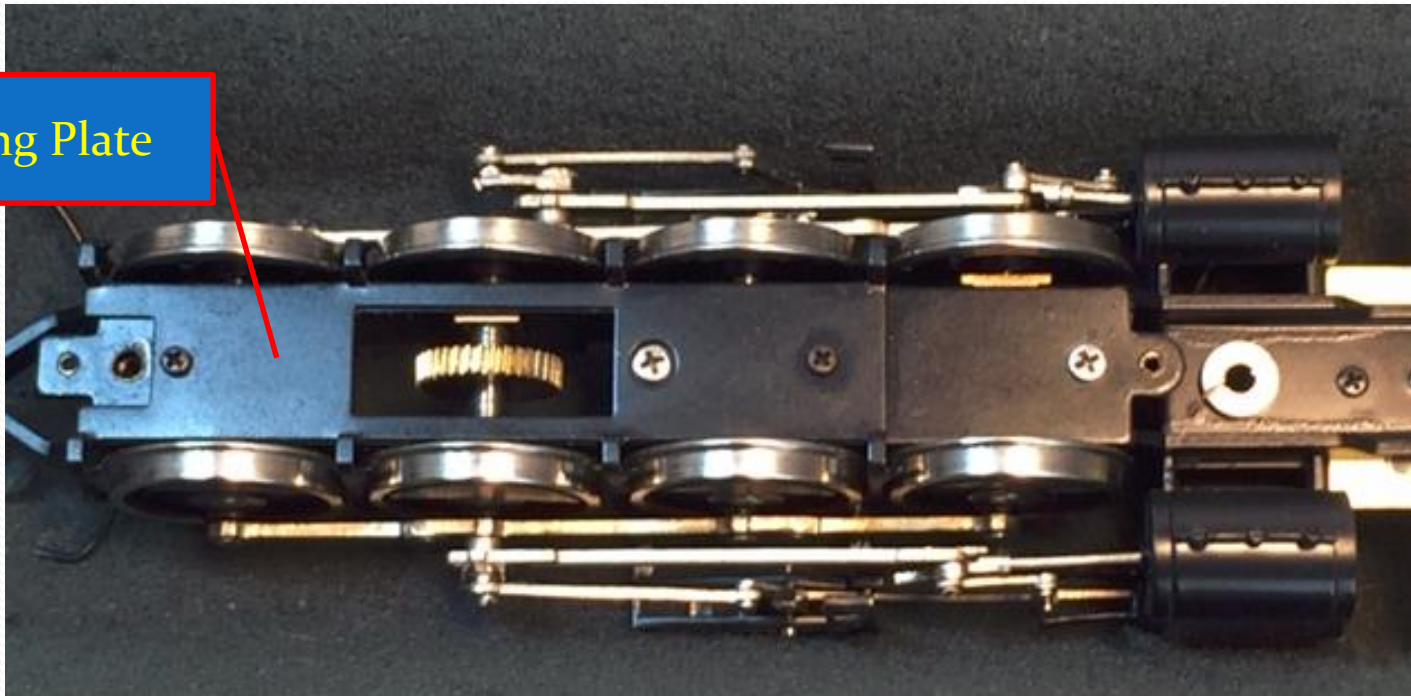
Note: Be Fussy – no amount of work later can correct a binding problem found here

Axle Gear Replacement

Prep Work:

- Turn the engine over and remove the backing plate and screws. Again, bag all of the materials and note where each of the screws came from. Remove the Geared Driver.

Backing Plate



Axle Gear Replacement

Match Mark the Uninsulated Driver and Shaft:

- With a straight edge and scribe (X-acto knife) make a match mark on the Uninsulated Driver (Uninsulated driver is on the Engineer's (right) side)



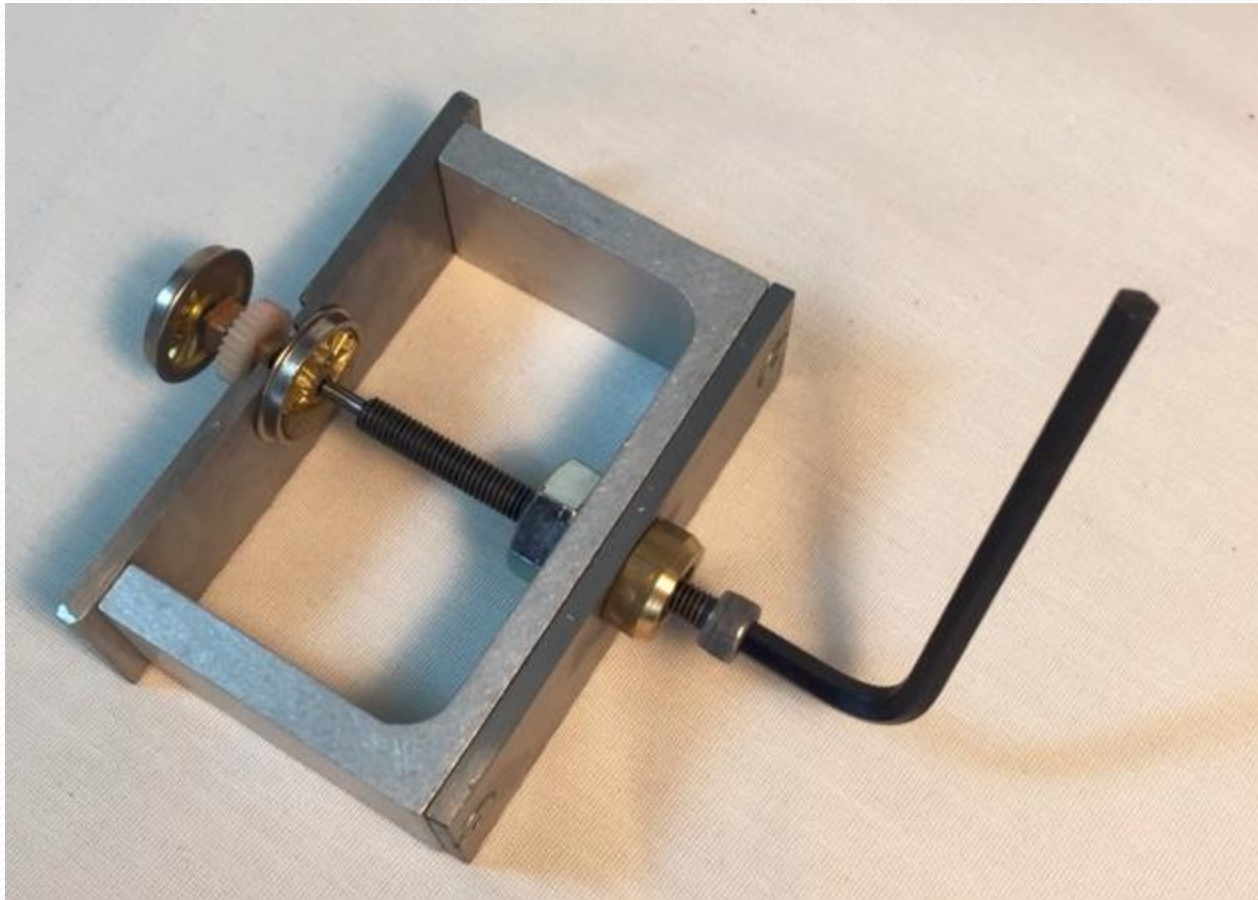
Axle Gear Replacement

Remove Geared Driver:

- If you have sprung drivers, bag the springs

Axle Gear Replacement

Remove the existing uninsulated driver/bearing:



Axle Gear Replacement

Remove the existing axle gear:



Axle Gear Replacement

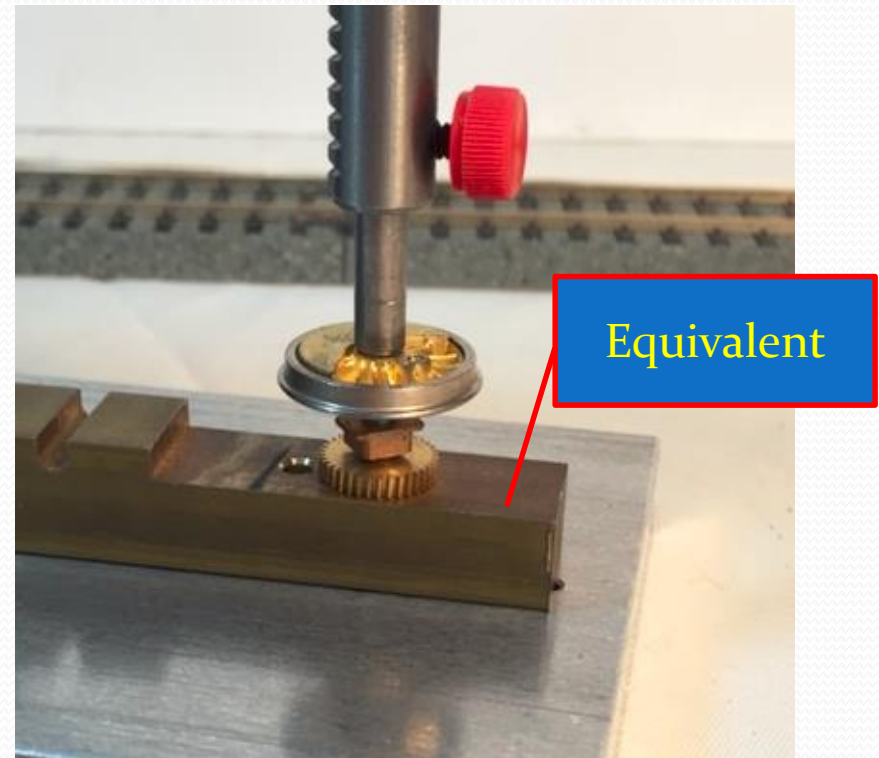
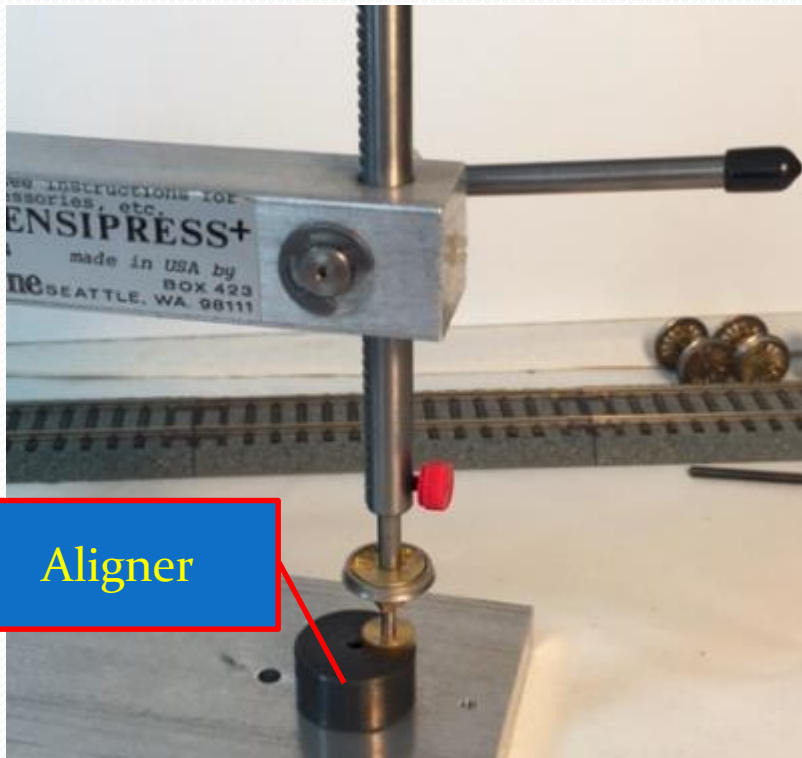
Install the new axle gear:

- Using the Sensi-Press and Aligner (or equivalent) carefully press the new axle gear onto the axle.
- Note – inspection of the brass axle gear will reveal a beveled hole on one side of the gear. Insert the axle into the beveled side of the gear (beveled side up).
- Important Note – it is essential to get the axle gear SQUARE on the axle. After installing the axle gear place the axle in a pin vise and slowly rotate to determine if it's square. If not remove and reinstall.

Axle Gear Replacement

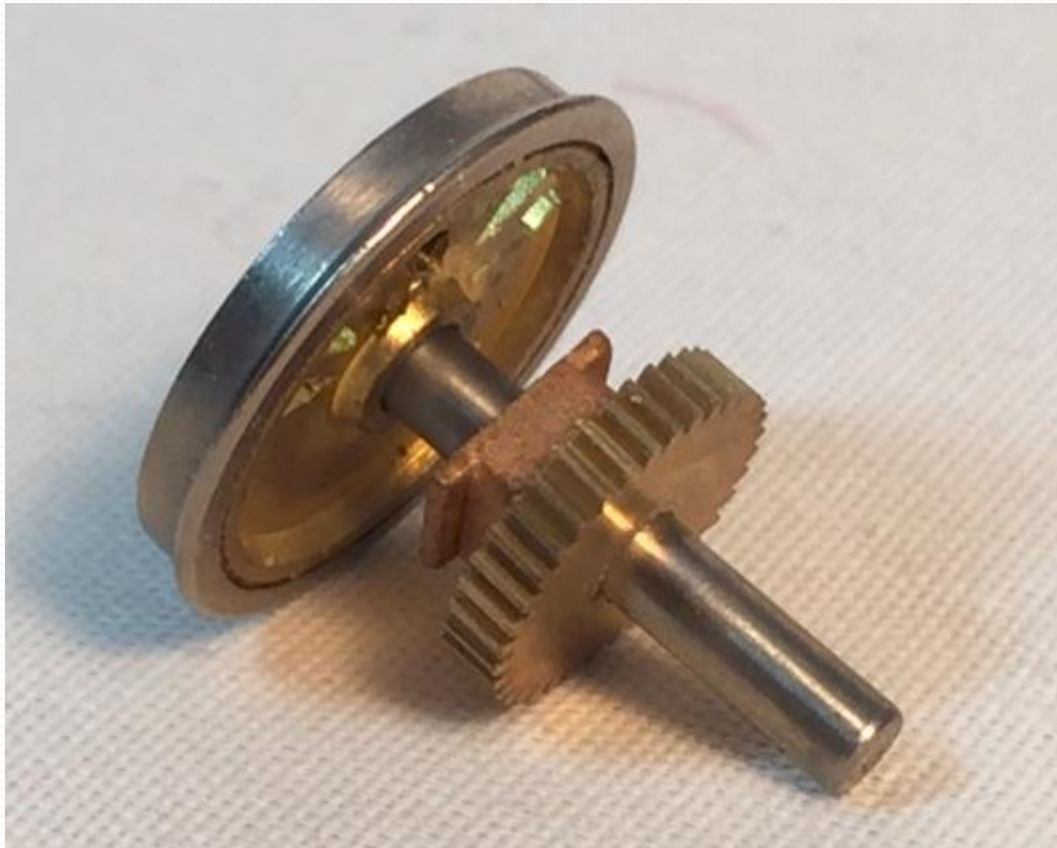
Install the new axle gear:

- Press the axle into the axle gear (beveled side up).



Axle Gear Replacement

Install the new axle gear:



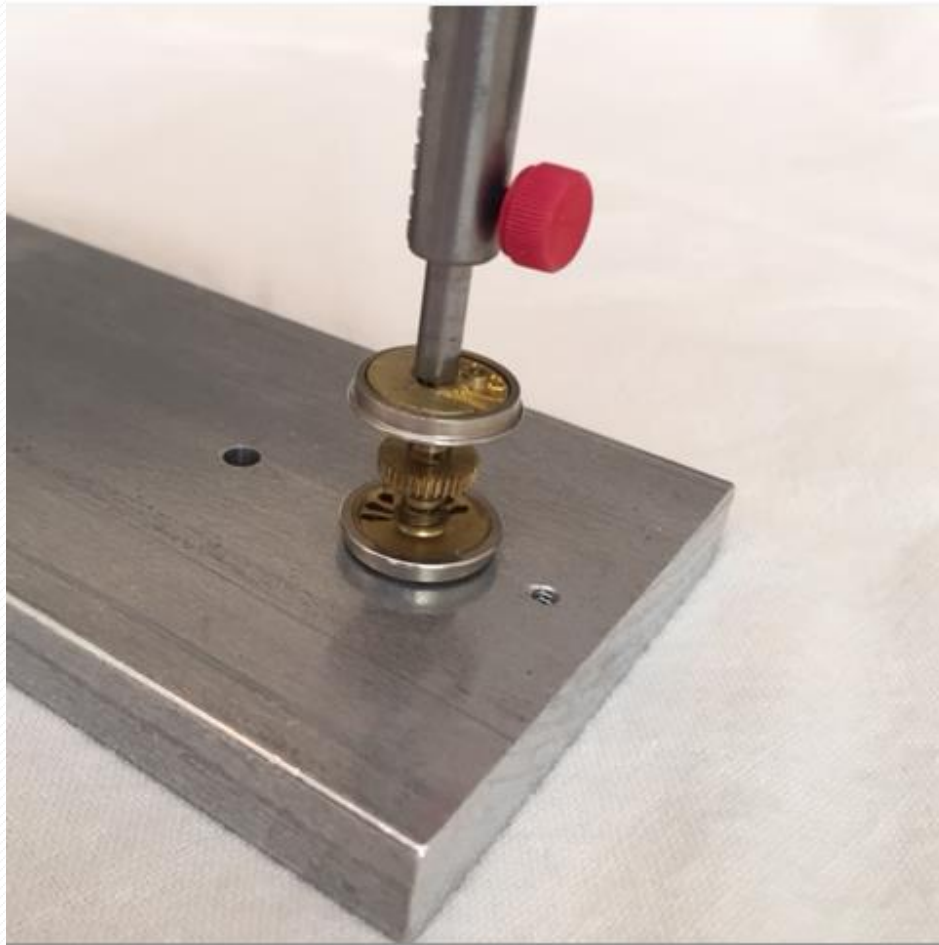
Axle Gear Replacement

Now re-install the driver on the shaft, lining up the match mark you scribed on the driver and axle earlier.

It is essential to accurately line up the match marks or binding will occur.

Axle Gear Replacement

Take care to get the axle on the shaft squarely



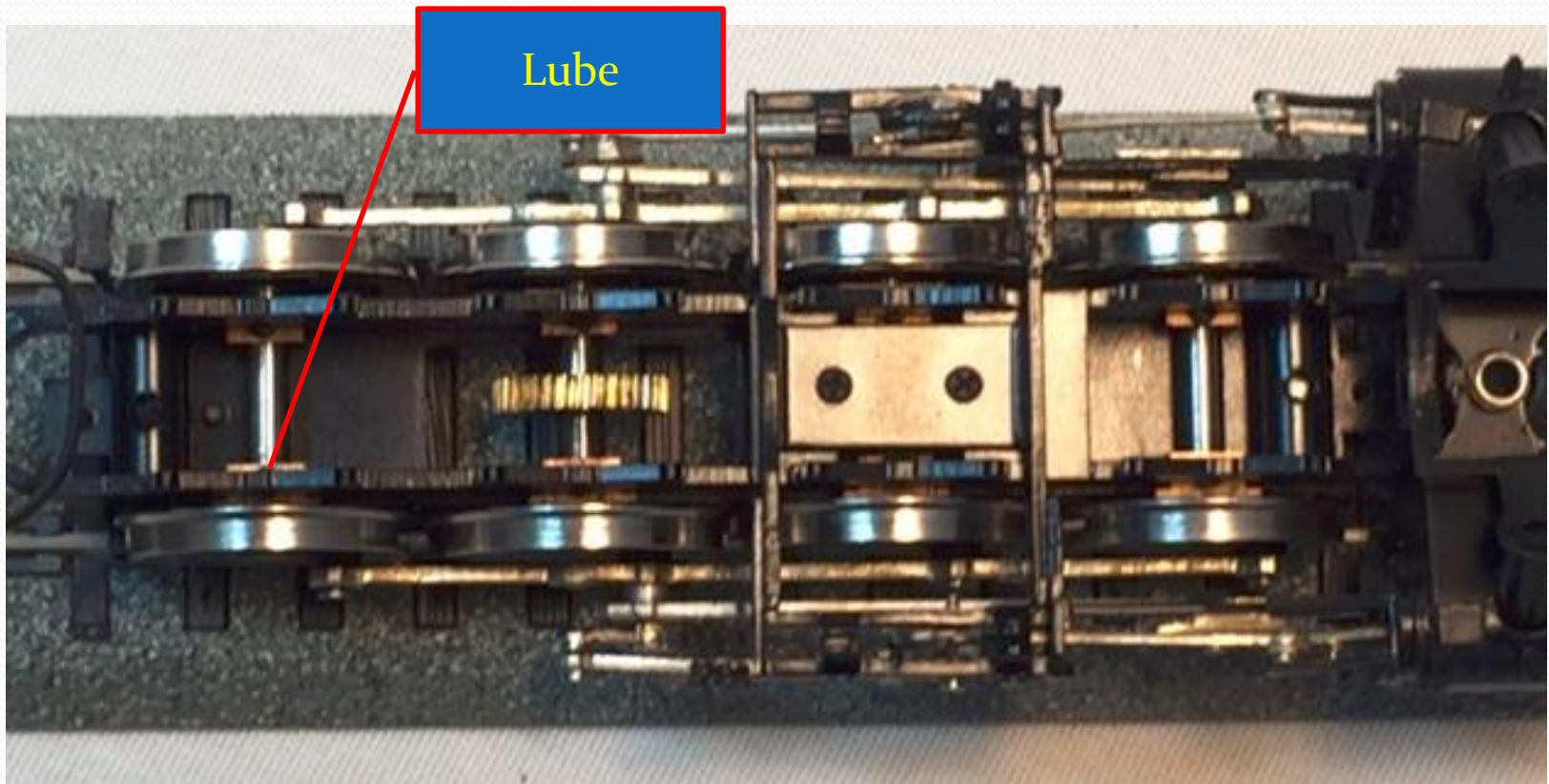
Axle Gear Replacement

Reassemble the drive train:

- Reinstall the driver springs.
- Reinstall the geared driver back on the chassis.
- Place a small drop of lubrication on each axle at the bearings.

Axle Gear Replacement

Reassemble the drive train:



Axle Gear Replacement

Reassemble the drive train:

- Reinstall the backing plate and screws. Make sure each axle 'floats' on its spring (fix if it doesn't).
- Reinstall the running gear at this time.
- Place the chassis on a piece of track or glass.
- All the side rods should be in a straight line.

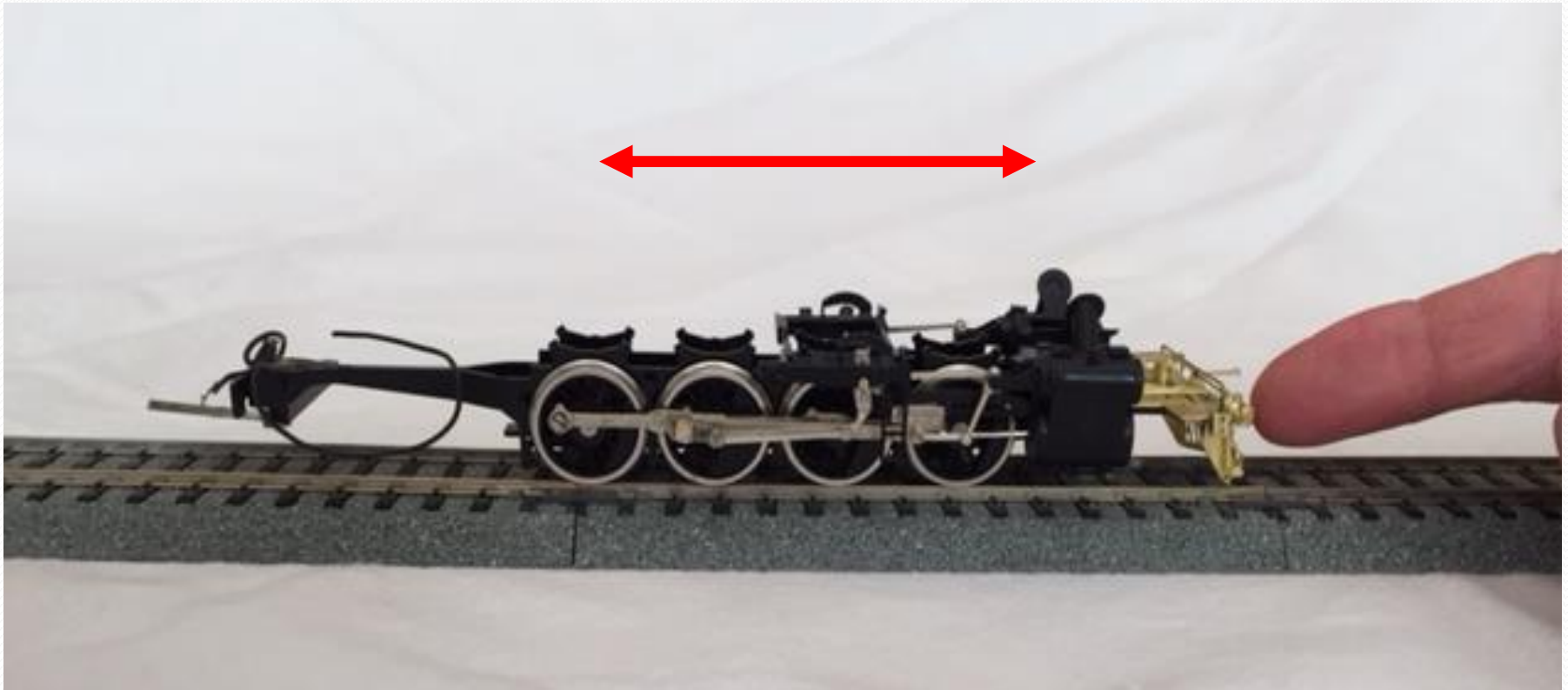
Axle Gear Replacement

Reassemble the drive train:

- Test the assembly by rolling it back and forth on the track. It should roll smoothly with NO binding.
- If you notice any binding, then the match marks are not lined up properly (you will need to remove and reinstall the driver).

Axle Gear Replacement

Remember – **Be Fussy Here.**



Axle Gear Replacement

- When this operation is completed -
CELEBRATE!!
- The most tedious part of the process is behind you.
- Now proceed to page 58 to begin building the Torque Arm Drive

Axle Gear and Driver Quartering

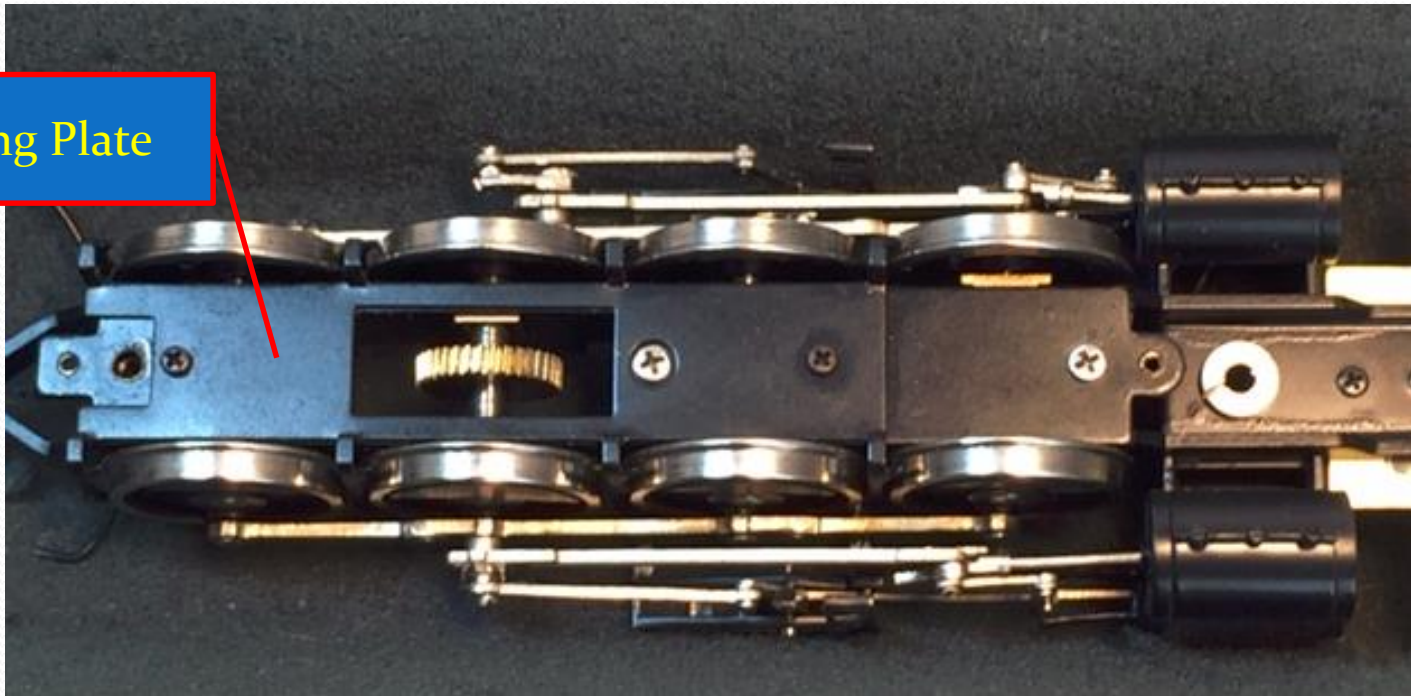
If you find you need to quarter your drivers as well as replace the existing axle gear, following the steps beginning on the next page (39)

Axle Gear and Driver Quartering

Prep Work:

- Turn the engine over and remove the backing plate and screws. Again, bag all of the materials and note where each of the screws came from.

Backing Plate



Axle Gear and Driver Quartering

Remove All the Drivers:

- Note the slot each driver came from on the chassis. Label the slot location on a piece of tape and attach to the back of the driver. You will reinstall each driver in the chassis slot it originally came from.
- Note the orientation:
 - Insulated driver on the Fireman's (left) side
 - Uninsulated driver on the Engineer's (right) side
- If you have sprung drivers, bag the springs

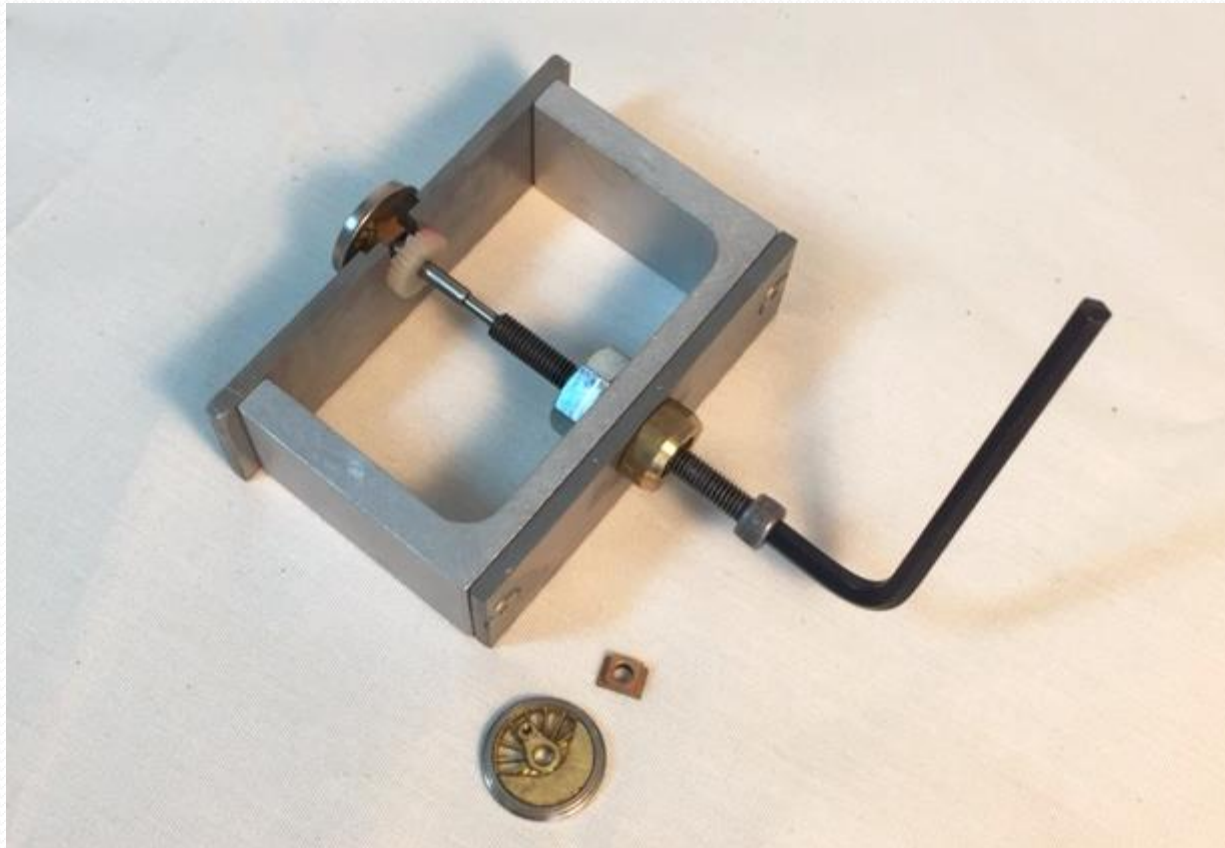
Axle Gear and Driver Quartering

Remove All the Drivers:



Axle Gear and Driver Quartering

Remove the existing axle gear:



Axle Gear and Driver Quartering

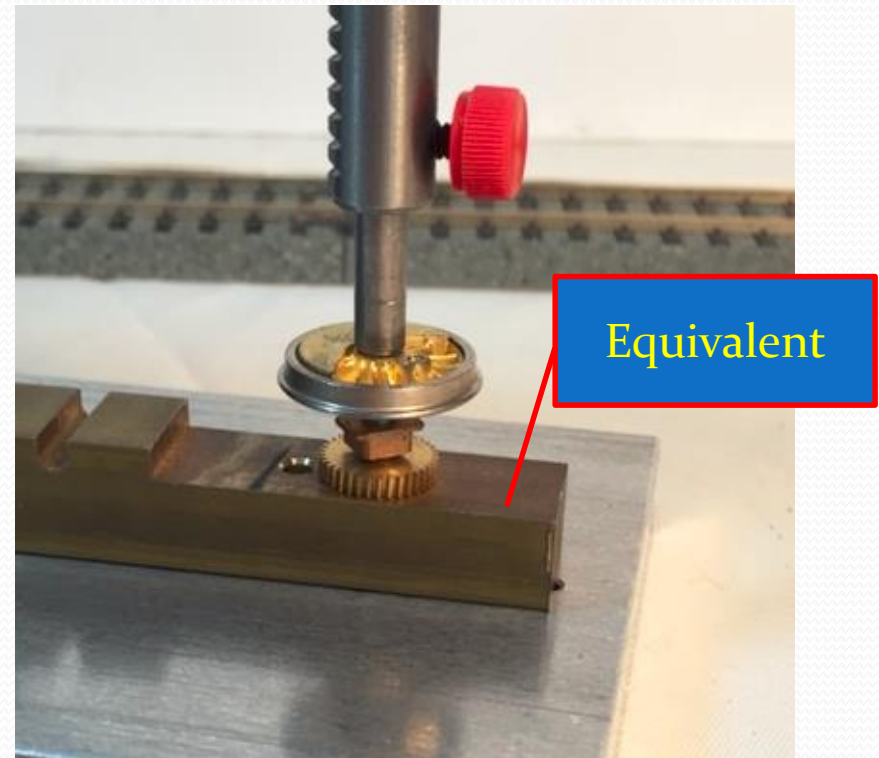
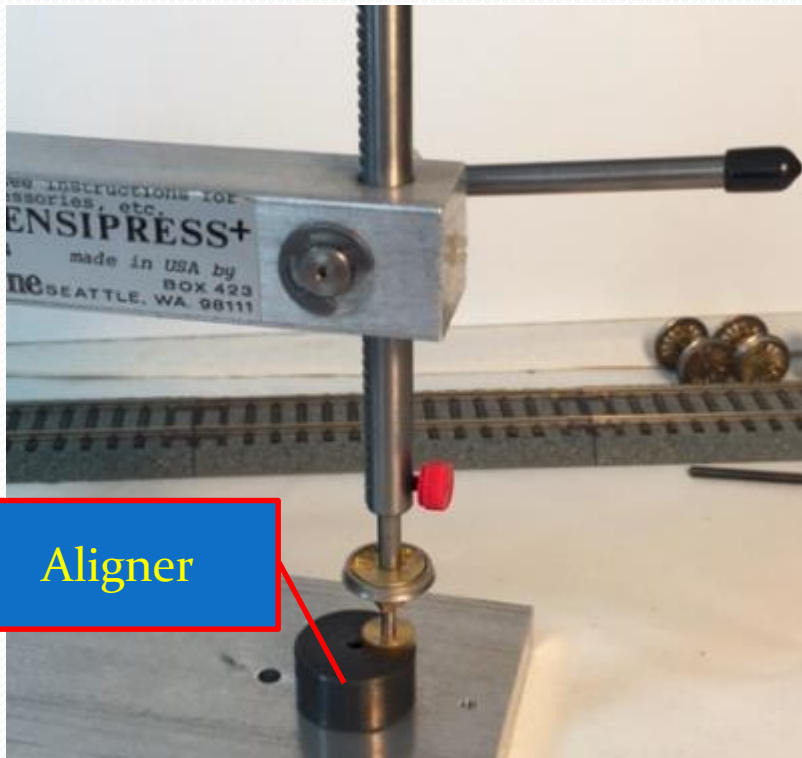
Install the new axle gear:

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- Note – inspection of the brass axle gear will reveal a beveled hole on one side of the gear. Insert the axle into the beveled side of the gear (beveled side up).
- Important Note – it is essential to get the axle gear SQUARE on the axle. After installing the axle gear place the axle in a pin vise and slowly rotate to determine if it's square. If not remove and reinstall.

Axle Gear and Driver Quartering

Install the new axle gear:

- Press the axle into the axle gear (beveled side up).



Axle Gear and Driver Quartering

Install the new axle gear:



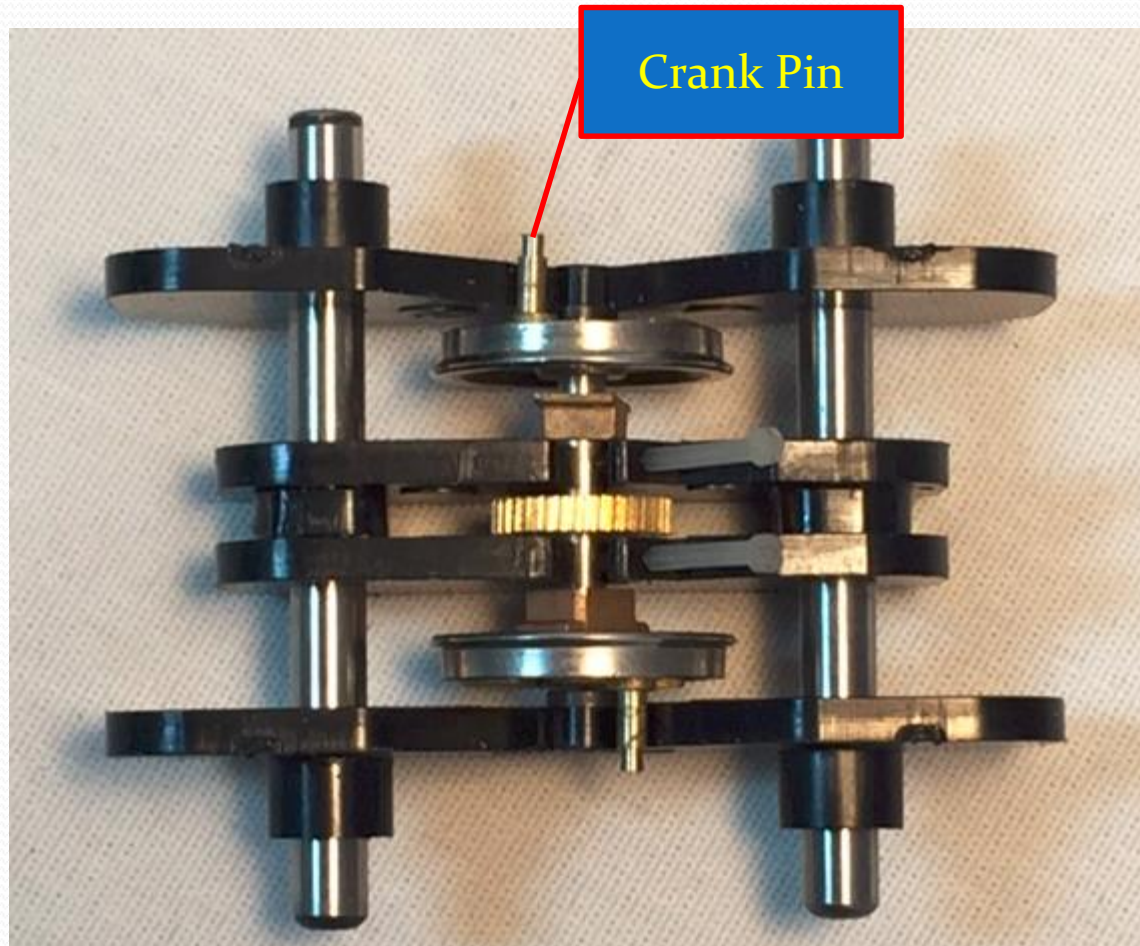
Axle Gear and Driver Quartering

Reinstall and quarter the driver:

- Install the a crank pin in each driver
- Place the driver (and bearing if applicable) loosely on the axle.
- Place the assembly in the Quarterer.
- Place the Quarter/Driver assembly in the Sensi-Press and carefully press the driver back on the axle
- Note – it is important that the driver be square on the axle. If not pull the driver and repeat the process.

Axle Gear and Driver Quartering

Reinstall and quarter the driver:



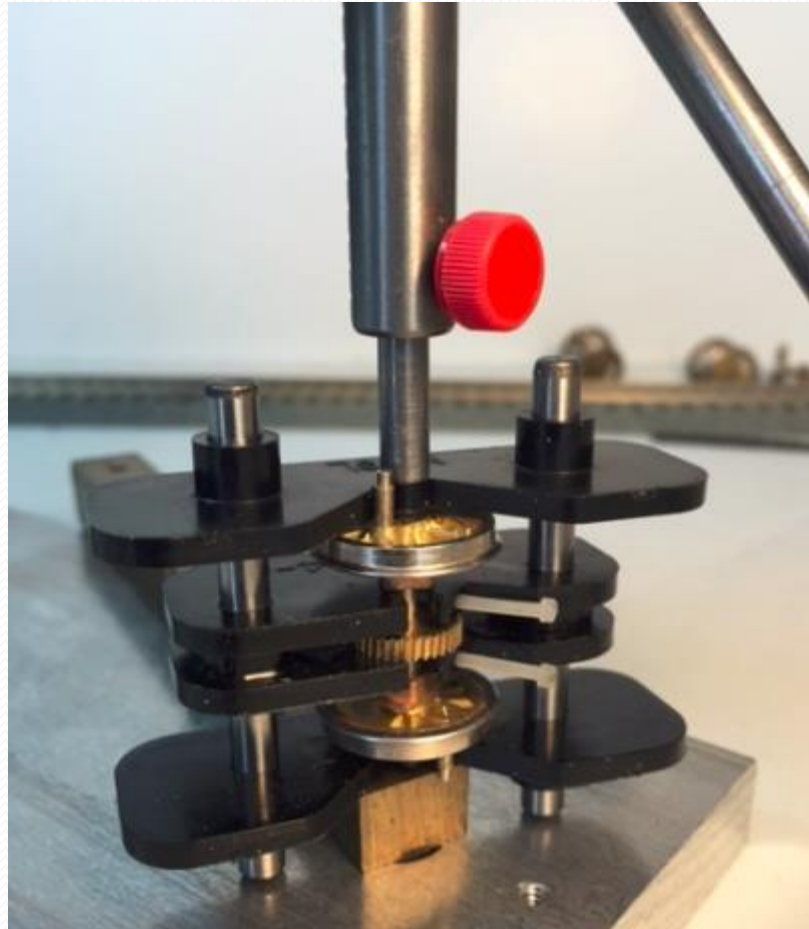
Axle Gear and Driver Quartering

Reinstall and quarter the driver:



Axle Gear and Driver Quartering

Reinstall and quarter the driver:



Axle Gear and Driver Quartering

Remove and quarter the remaining Drivers:

- Repeat the steps above to pull the remaining uninsulated driver from each remaining driver set.
- Reinstall and quarter each driver.
- **Note – you must quarter each driver. You cannot quarter only the driver with the axle gear.**

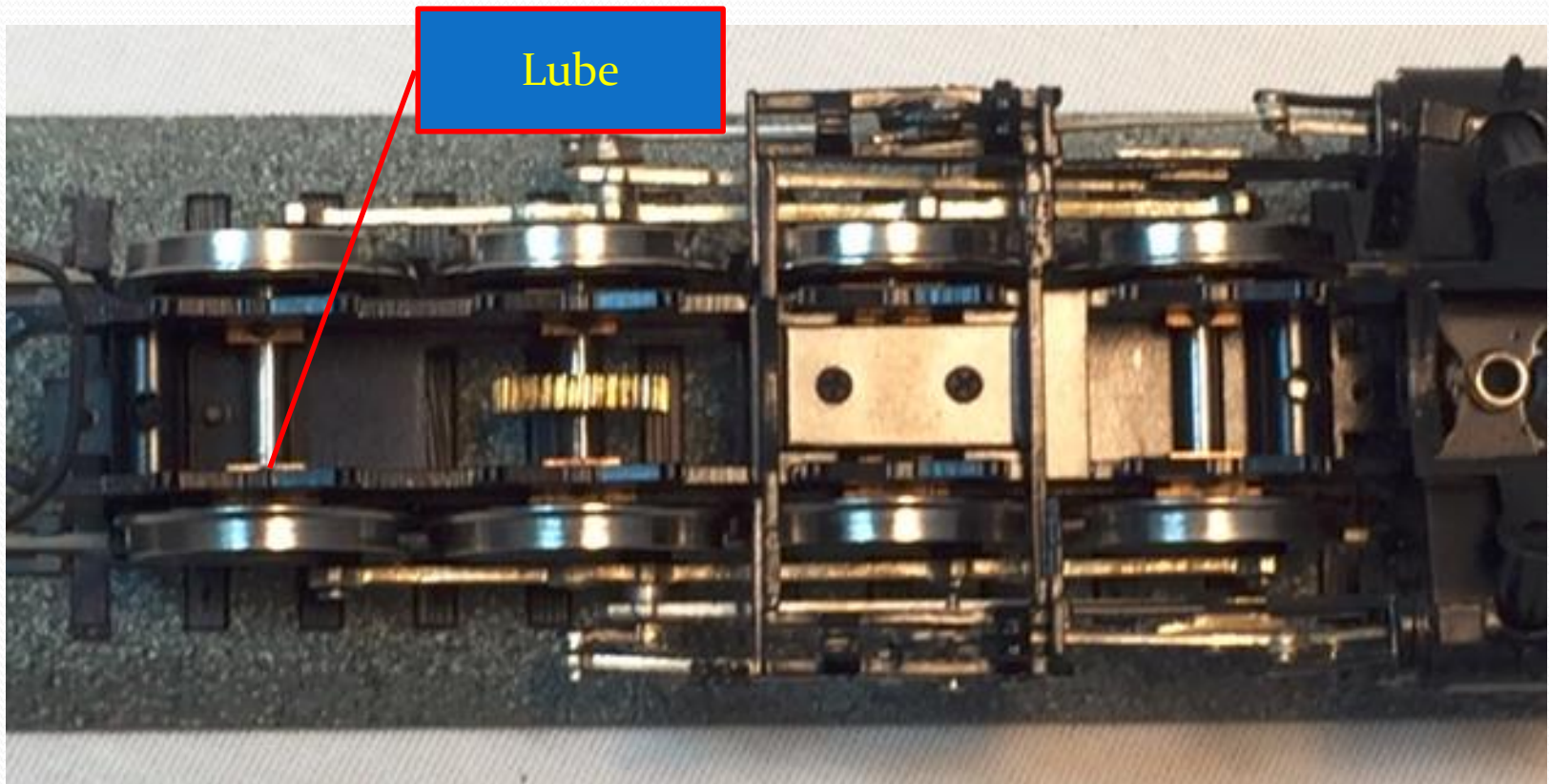
Axle Gear and Driver Quartering

Reassemble the drive train:

- Reinstall the driver springs.
- Reinstall the driver sets (all uninsulated drivers go on engineer's side).
- Place a small drop of lubrication on each axle at the bearings.

Axle Gear and Driver Quartering

Reassemble the drive train:



Axle Gear and Driver Quartering

Reassemble the drive train:

- Reinstall the backing plate and screws. Make sure each axle 'floats' on its spring (fix if it doesn't).
- Reinstall the running gear at this time.
- Place the chassis on a piece of track.
- All the side rods should be in a straight line.

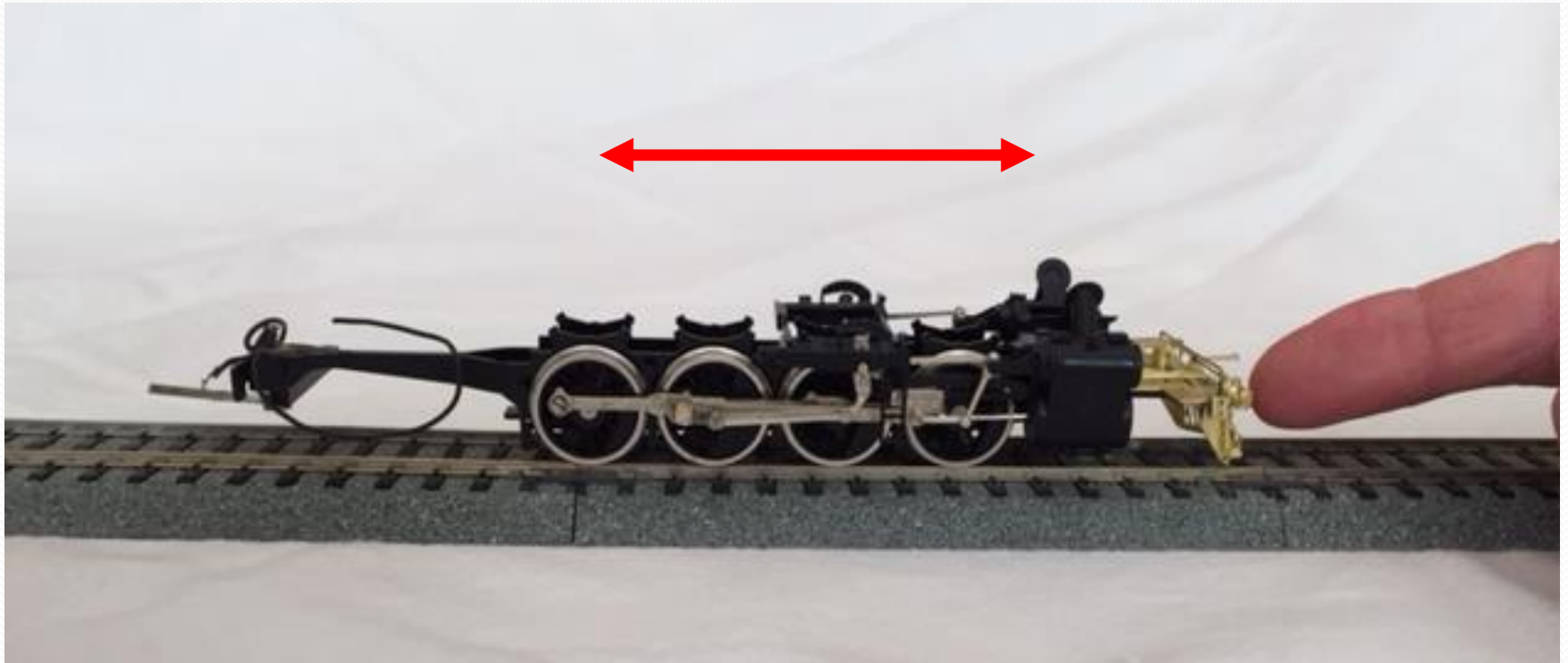
Axle Gear and Driver Quartering

Reassemble the drive train:

- Test the assembly by rolling it back and forth on the track. It should roll smoothly with NO binding.
- If you notice any binding, then at least one of the drivers is not quartered correctly.

Axle Gear and Driver Quartering

Reassemble the drive train:



Axle Gear and Driver Quartering

Reassemble the drive train:

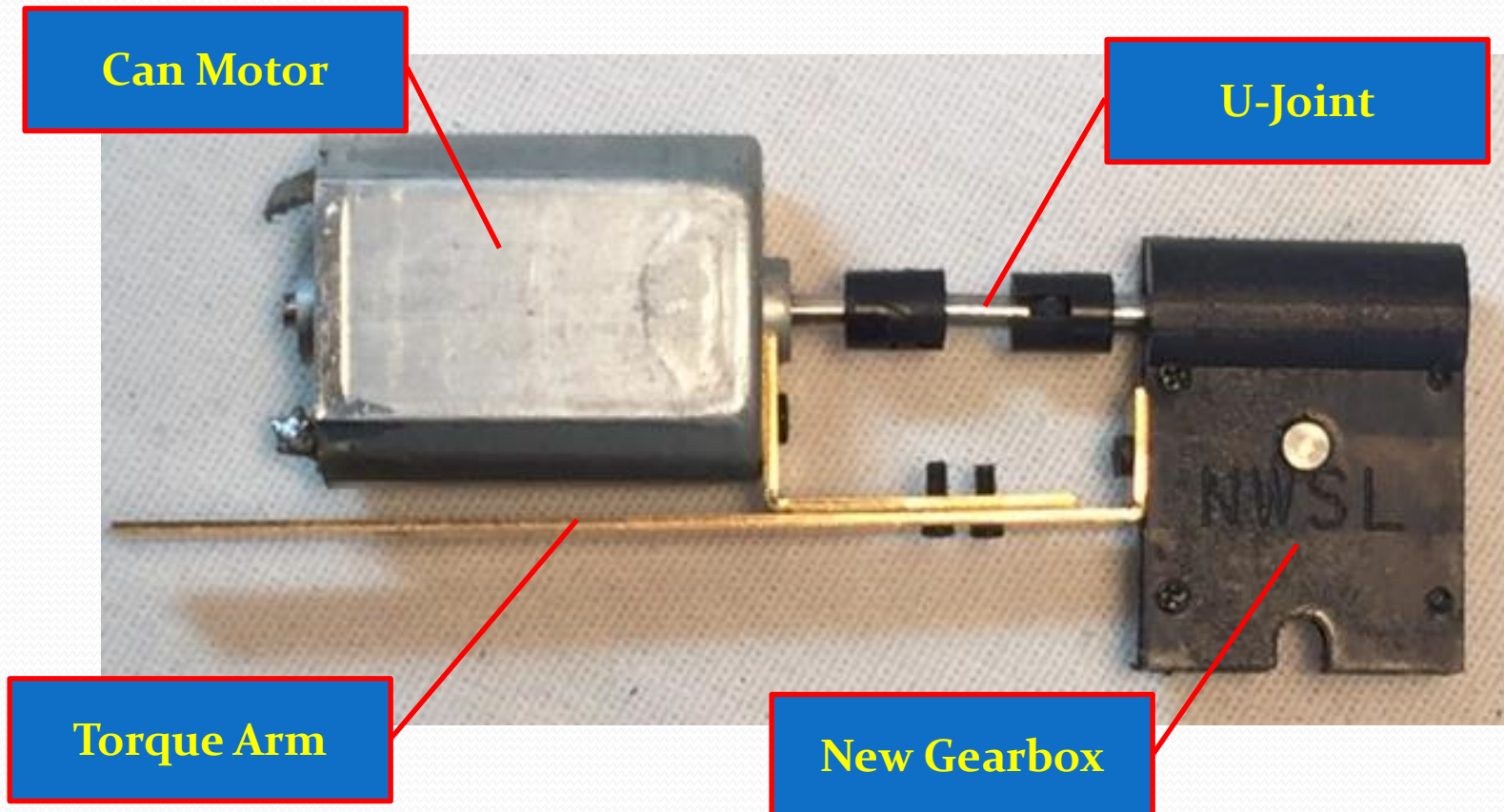
- If this happens, take a deep breath and then remove and re-quarter the driver(s).
- **Note** – it is essential to have a properly quartered driver set before proceeding. No amount of work later on can correct a binding problem found here.

Axle Gear and Driver Quartering

- When this operation is completed -
CELEBRATE!!
- The most tedious part of the process is behind you.

Building the Torque Arm Drive

This is what we are going to build:



Building the Torque Arm Drive

Materials:

- Can Motor
- NWSL Gearbox – 150-6
- NWSL U-Joint Kit – 482-6
- 0.25" wide x 0.032" thick Brass Flat Stock (for torque arm and motor mount)

Key Tools:

- NWSL 1.4mm Tap Set – 3064-5
- Bending brake or pliers
- Round File
- Dremel tool with abrasive wheel
- Dial Micrometer

Building the Torque Arm Drive

A word about Materials:

- **Can Motor** - top speed of 10,000 rpm for good low end operation.
 - Sources:
 - ❑ NWSL
 - ❑ Internet
 - Can be a much cheaper option
 - Google Cannon Can Motors
- **Gearbox** – Idler gearbox with 36:1 reduction (preferred)
 - Other options:
 - ❑ 27:1 ratio (smaller axle gear – give up some low end performance)
 - ❑ Non-idler gearbox

You want the largest motor/gearbox combination that will fit comfortably in your engine.

Building the Torque Arm Drive

Key Steps:

1. Selecting the Gearbox
2. Setting the Gearbox in the Chassis
3. Fabricate the Torque Arm
4. Fabricate the Motor Mount
5. Cut the Worm and Motor Shafts to Length
6. Mounting the U-Joint Cups
7. Install the Torque Arm on the Gearbox
8. Install the Motor Mount to Torque Arm
9. Fabricate/install the U-Joint Shaft

Building the Torque Arm Drive

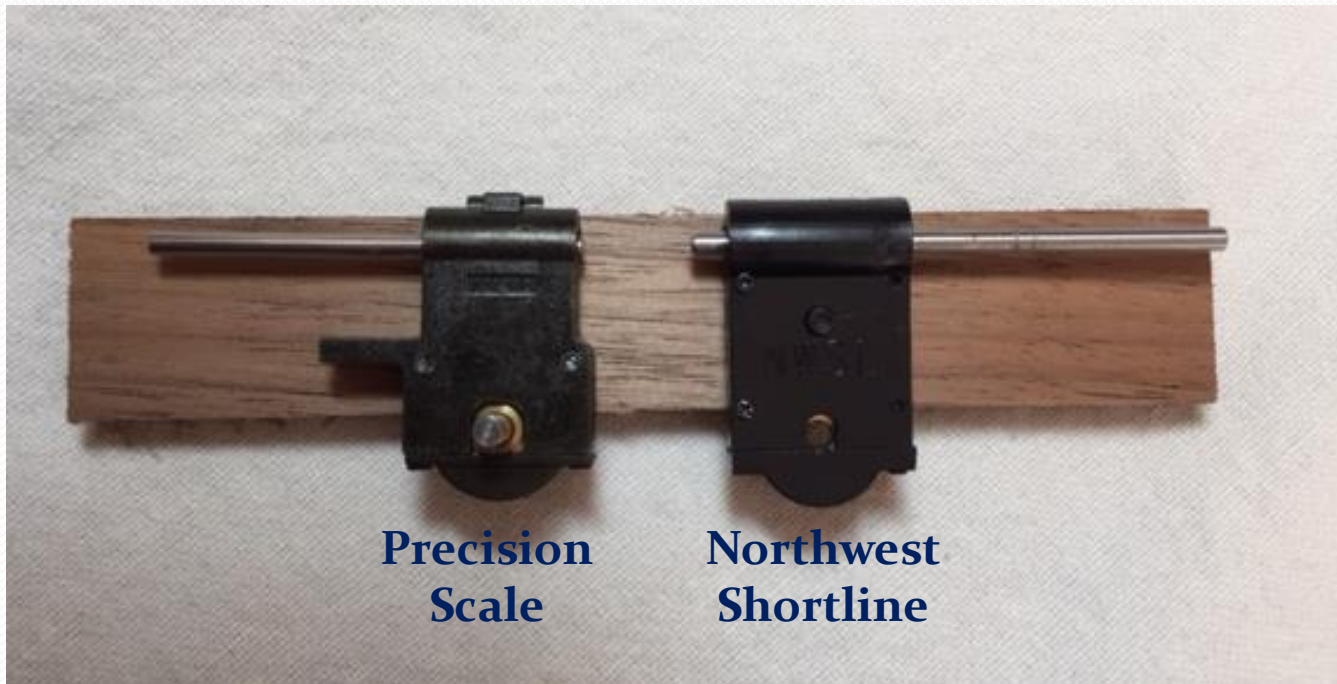
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8. Install the Motor Mount to Torque Arm
9. Fabricate/install the U-Joint Shaft

Building the Torque Arm Drive

1. Selecting the Gearbox:

- There are a number of choices on the market (Northwest Shortline, Precision Scale, etc.)



Building the Torque Arm Drive

1. Selecting the Gearbox:

- Northwest Shortline (NWSL) has the most available supply
- If you choose NWSL, make sure you get an assembled gearbox (not in kit form).
- You can order one from NWSL if no assembled versions are available at your local hobby shop.

Building the Torque Arm Drive

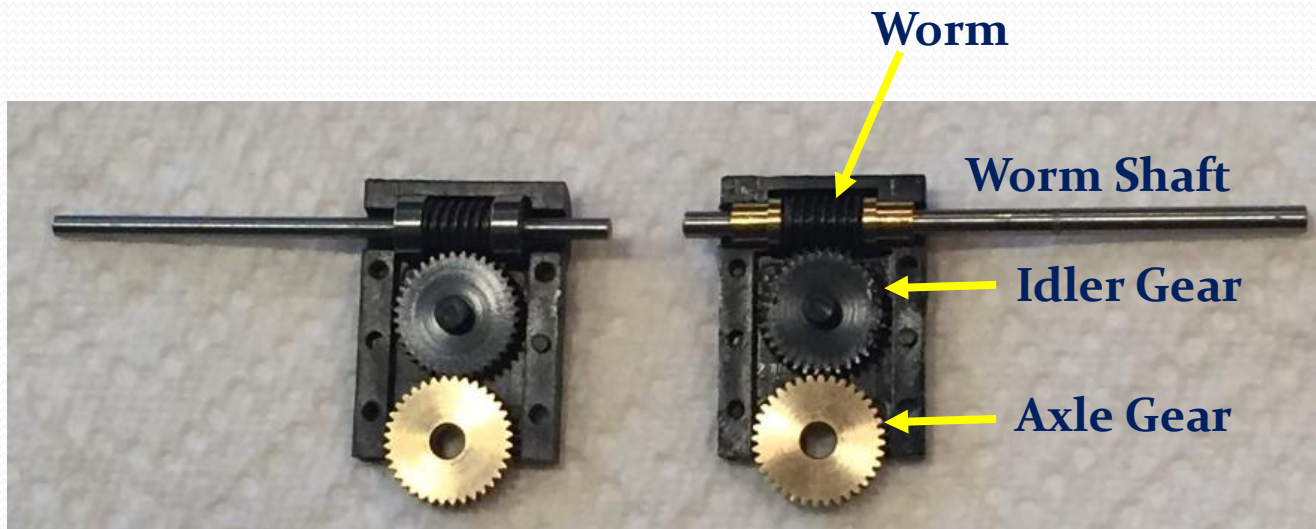
1. Selecting the Gearbox:

- Gearbox Component Terminology
 - Case
 - Worm and worm shaft
 - Bushings or ball bearings on the worm shaft
 - Thrust washers
 - Idler gear
 - Axle gear
 - Bottom bracket

Building the Torque Arm Drive

1. Selecting the Gearbox:

- You have a choice from NWSL between ball bearings (1150-6) or brass bushings (150-6) or on the worm shaft:



1150-6
Ball
Bearings
36:1

150-6
Brass
Bushings
36:1

Building the Torque Arm Drive

Key Steps:

1. Selecting the Gearbox
2. **Mounting the Gearbox in the Chassis**
3. Fabricate the Torque Arm
4. Fabricate the Motor Mount
5. Cut the Worm and Motor Shafts to Length
6. Mounting the U-Joint Cups
7. Install the Torque Arm on the Gearbox
8. Install the Motor Mount to Torque Arm
9. Fabricate/install the U-Joint Shaft

Building the Torque Arm Drive

2. Mounting the Gearbox in the Chassis

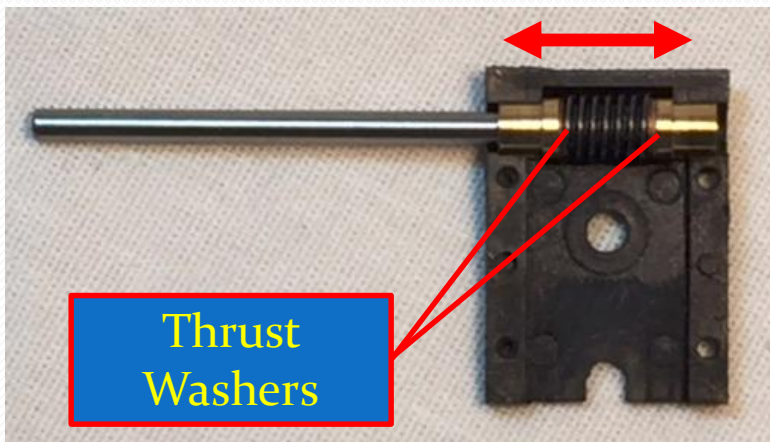
- **Thrust Washers**
 - If you install the NWSL gearbox you will be supplied with two thrust washers.
 - You can install the thrust washer(s) to take up any slack in the worm shaft. A slight wiggle is okay – any tightness is not.

Building the Torque Arm Drive

2. Mounting the Gearbox in the Chassis

- **Thrust Washers**
 - The thrust washers go between the worm and bearing
 - The worm shaft should spin freely with no binding - the case should not turn with the shaft

Slight wiggle okay



Building the Torque Arm Drive

2. Mounting the Gearbox in the Chassis

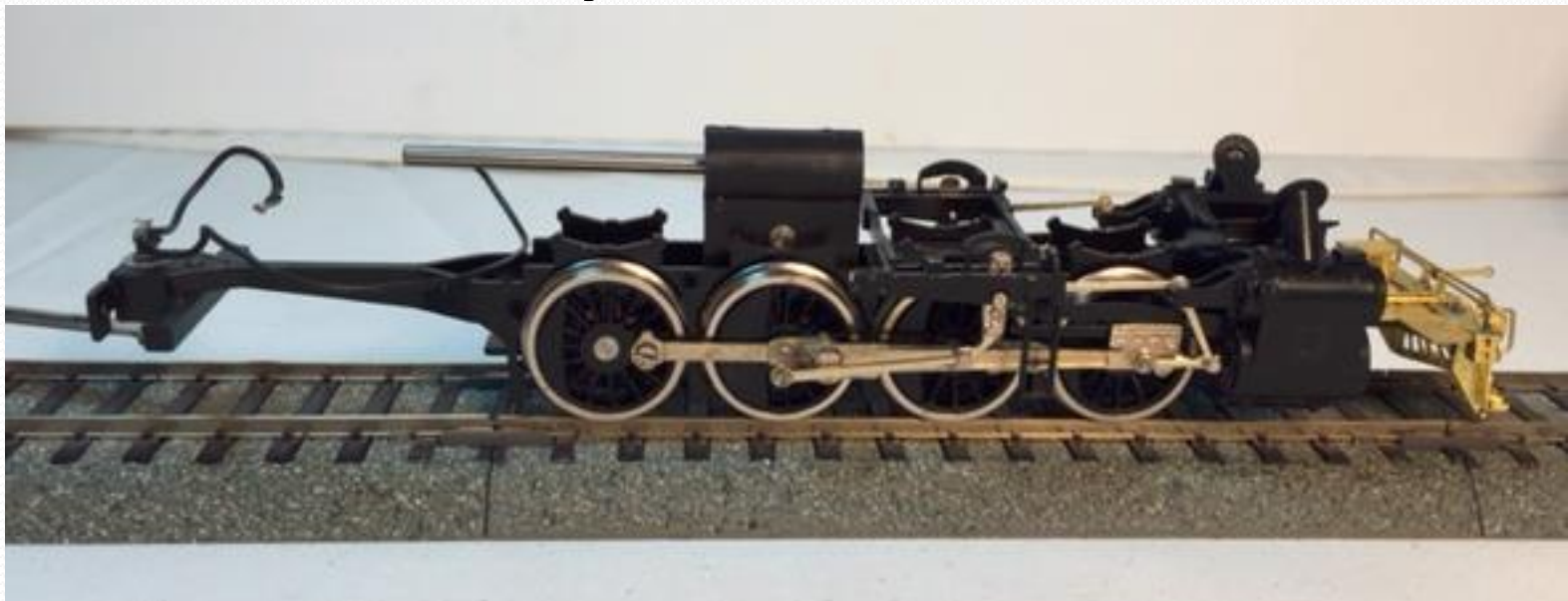
- **Thrust Washers**

- If not, squeeze both sides of the top of the case tightly with your fingers.
- If still not, remove one of the thrust washers and try again.
- Note – the top edges of the case do not have to touch.

Building the Torque Arm Drive

2. Mounting the Gearbox in the Chassis

- Now install the gearbox on the locomotive's driver shaft
- Note you do not need to install the bottom bracket at this time (we will be taking the gearbox on and off several times before final assembly)



Building the Torque Arm Drive

Key Steps:

1. Selecting the Gearbox
2. Setting the Gearbox in the Chassis
3. **Fabricate the Torque Arm**
4. Fabricate the Motor Mount
5. Cut the Worm and Motor Shafts to Length
6. Mounting the U-Joint Cups
7. Install the Torque Arm on the Gearbox
8. Install the Motor Mount to Torque Arm
9. Fabricate/install the U-Joint Shaft

Building the Torque Arm Drive

3. Fabricate the Torque Arm:

- On the brass flat stock scribe two lines 0.060 (~1.5mm) from each side.
- Mark a perpendicular line 1/8" from the end.
 - Where this line crosses the two scribed lines will be where the two mounting holes will be for attaching the torque arm to the gearbox.
- Center punch, the drill two 0.059" (#53) diameter clearance holes in the torque arm only (we'll drill and tap the gearbox later).
- Finally, bend a 1/4" 90 degree tab at the end of the torque arm.
- Leave the torque arm length long for now and set it aside.

Building the Torque Arm Drive

3. Fabricate the Torque Arm:



Building the Torque Arm Drive

Key Steps:

1. Selecting the Gearbox
2. Mounting the Gearbox in the Chassis
3. Fabricate the Torque Arm
4. **Fabricate the Motor Mount**
5. Cut the Worm and Motor Shafts to Length
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7. Install the Torque Arm on the Gearbox
8. Install the Motor Mount to Torque Arm
9. Fabricate/install the U-Joint Shaft

Building the Torque Arm Drive

4. Fabricate the Motor Mount:

- On your motor, measure the diameter of the bearing boss, and locate the 2mm threaded mounting screw holes. Measure the distance between the motor shaft centerline and the lower mounting screw hole.
- On the brass flat stock scribe a line down the center.
- Near the end punch a point that will be the location of the motor shaft centerline.
- Next center punch the location of the lower motor mounting hole. Drill the 0.086" (#44) diameter clearance hole

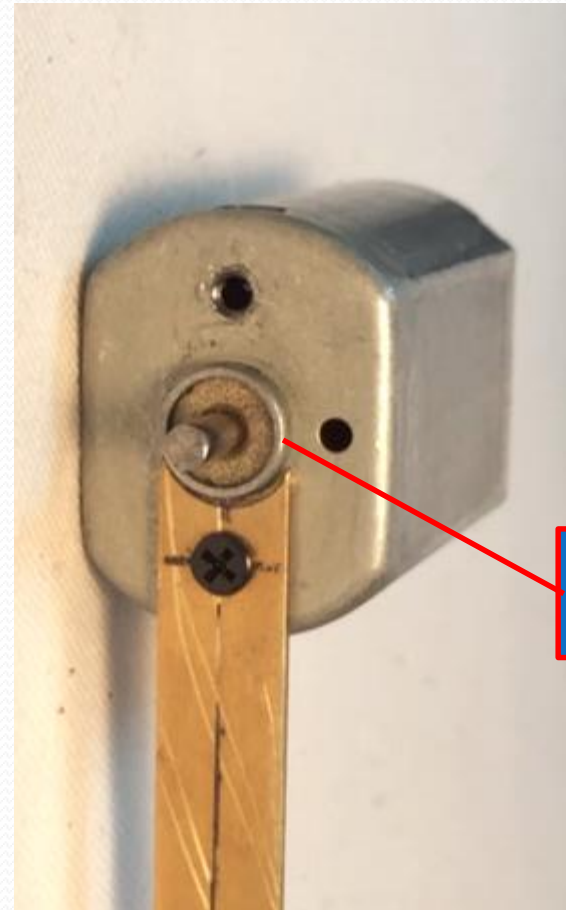
Building the Torque Arm Drive

4. Fabricate the Motor Mount:

- Using the Dremel tool for rough cuts and the round file for finer cuts, cut the motor mount to receive the motor.
- Test fit the motor on the mount. The important part is that the centerline of the mount and centerline of the motor shaft are aligned.
- If the mounting hole does not line up exactly it's not a big deal. You can oversize the hole in the mount if needed.
- We are now ready to fit the motor, torque arm and gearbox together.

Building the Torque Arm Drive

4. Fabricate the Motor Mount:



Bearing Boss

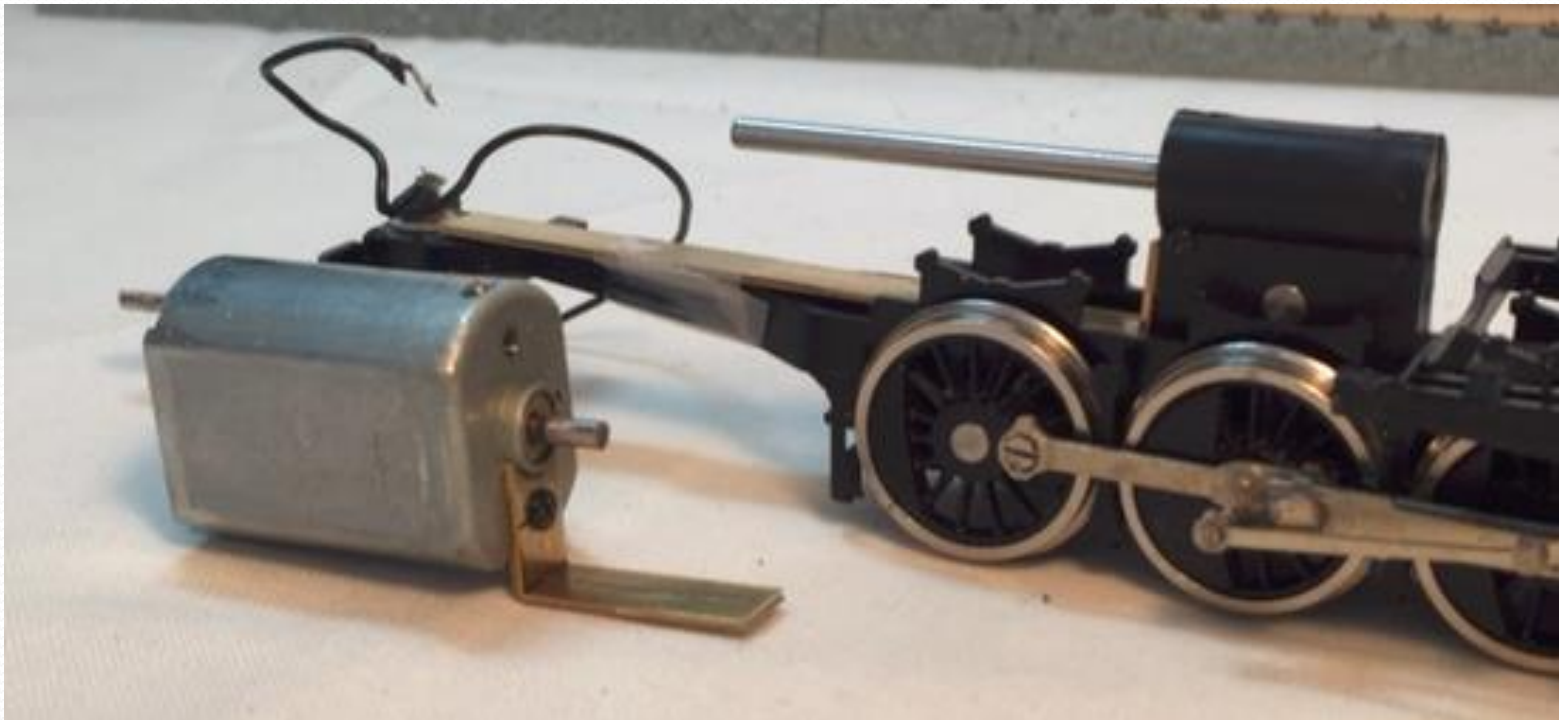
Building the Torque Arm Drive

4. Fabricate the Motor Mount:

- Bring out the chassis with the gearbox mounted.
- Lay the torque arm in the chassis so that it seats in the chassis and butts against the gearbox.
- Now determine the height of the motor centerline (ideally the motor and worm shafts should line up. The closer the better, but any misalignment will be taken care of by the U-Joints).
- Once you have the motor height figured out, mark the motor mount and bend it 90 degrees away from the motor (towards the gearbox).

Building the Torque Arm Drive

4. Fabricate the Motor Mount:



Building the Torque Arm Drive

Key Steps:

1. Selecting the Gearbox
2. Mounting the Gearbox in the Chassis
3. Fabricate the Torque Arm
4. Fabricate the Motor Mount
5. **Cut the Worm and Motor Shafts to Length**
6. Mounting the U-Joint Cups
7. Install the Torque Arm on the Gearbox
8. Install the Motor Mount to Torque Arm
9. Fabricate/install the U-Joint Shaft

Building the Torque Arm Drive

5. Cut the Worm and Motor Shafts to Length

- Remove the Gearbox from the chassis.
- Cut the long end of the worm shaft 0.25" from the gearbox case with the Dremel cutoff wheel as square as possible.
- Slightly chamfer the end of the shaft (to receive the U-Joint cup next).
- Remove the motor from the motor mount and cut the end of the motor shaft to the same dimension in the same manner.

Building the Torque Arm Drive

Key Steps:

1. Selecting the Gearbox
2. Mounting the Gearbox in the Chassis
3. Fabricate the Torque Arm
4. Fabricate the Motor Mount
5. Cut the Worm and Motor Shafts to Length
6. **Mounting the U-Joint Cups**
7. Install the Torque Arm on the Gearbox
8. Install the Motor Mount to Torque Arm
9. Fabricate/install the U-Joint Shaft

Building the Torque Arm Drive

6. Mounting the U-Joint Cups



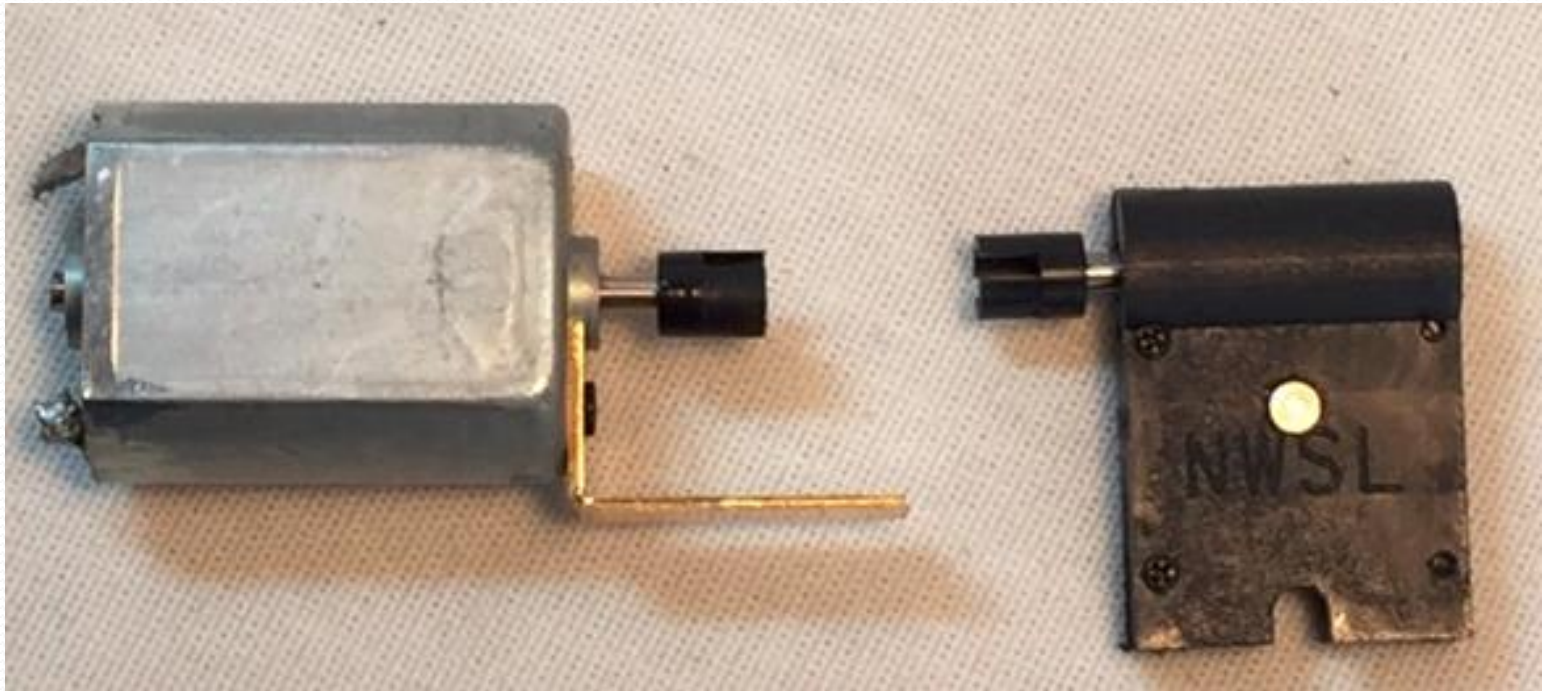
Building the Torque Arm Drive

6. Mounting the U-Joint Cups

- Using the Sensi-Press carefully press the U-Joint Cups onto the motor and worm shafts.
 - Easier if you leave the cup on the parts sprue for mounting
 - Make sure they are square to the shaft.
 - The shafts should not protrude beyond the bottom of each cup.

Building the Torque Arm Drive

6. Mounting the U-Joint Cups



Building the Torque Arm Drive

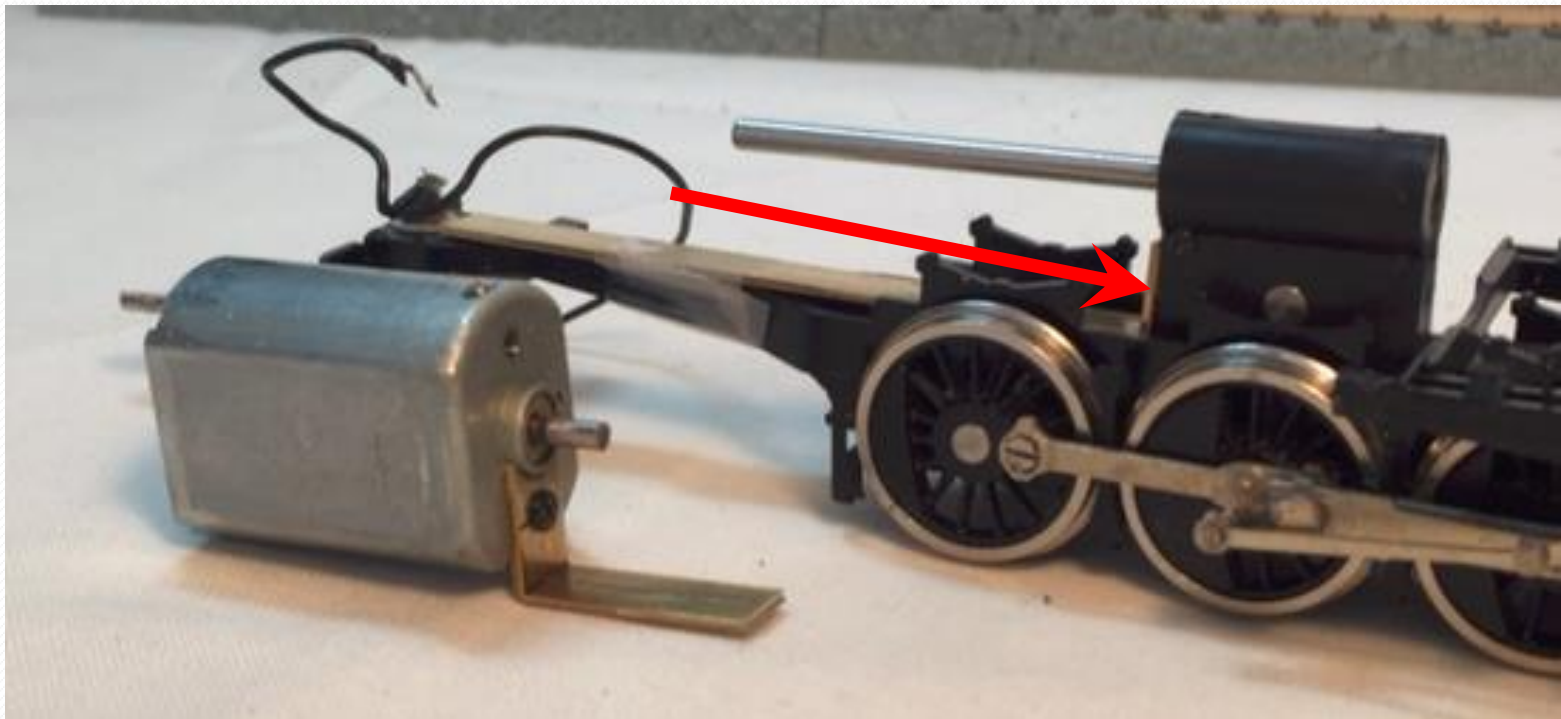
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9. Fabricate/install the U-Joint Shaft

Building the Torque Arm Drive

7. Install the Torque Arm on the Gearbox

- On the gearbox case mark the location of the torque arm screws with a Sharpie.



Building the Torque Arm Drive

7. Install the Torque Arm on the Gearbox

- **Mounting the torque arm to the gearbox:**
 - Now remove the gearbox from the chassis.
 - Take the gearbox apart and remove the idler gear and worm shaft. (This is so that we do not damage the idler gear when we drill and tap the holes for the torque arm in the gearbox case.)
 - Reassemble the gearbox case.

Building the Torque Arm Drive

7. Install the Torque Arm on the Gearbox

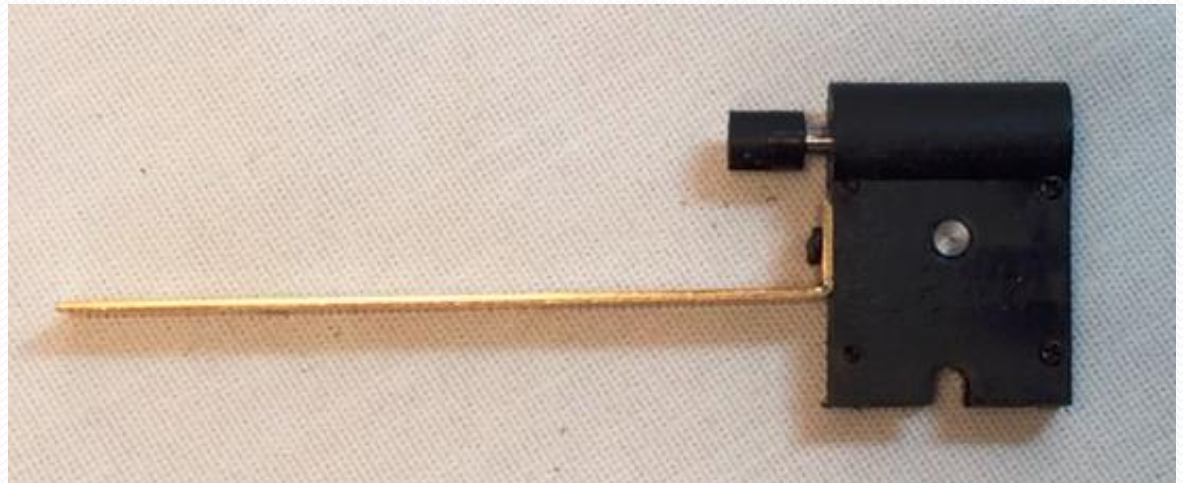
- Mounting the torque arm to the gearbox:
 - Mark the centers of the mounting screws for the torque arm with a sharp X-acto knife.
 - Now **carefully** drill and tap the two 1.4mm mounting screws in the gearbox case. You can use a drill press and vise, or by hand with a pin vise.
 - The two holes need not go deep into the gearbox case, only the length of the screws (4mm).
 - Test mount the torque arm, then remove it and reassemble the idler gear and worm shaft assembly. Once everything turns freely remount the gearbox on the chassis.

Building the Torque Arm Drive

7. Install the Torque Arm on the Gearbox



Mounting
Holes



Building the Torque Arm Drive

7. Install the Torque Arm on the Gearbox

- **Cut the Torque Arm to length:**
 - Place the gearbox in the chassis (do not attach the bottom bracket yet).
 - Cut the Torque Arm to length. It should stop under the motor and in front of the drawbar screw.

Building the Torque Arm Drive

Key Steps:

1. Selecting the Gearbox
2. Mounting the Gearbox in the Chassis
3. Fabricate the Torque Arm
4. Fabricate the Motor Mount
5. Cut the Worm and Motor Shafts to Length
6. Mounting the U-Joint Cups
7. Install the Torque Arm on the Gearbox
8. **Install the Motor Mount on the Torque Arm**
9. Fabricate/install the U-Joint Shaft

Building the Torque Arm Drive

8. Install the Motor Mount on the Torque Arm

- **Determine the horizontal position of the motor and cut the motor mount to length:**
 - Reassemble the motor and mount.
 - Line up the motor and gearbox. You want the worm and motor shafts an inch or two apart if possible.
 - At the same time you want the motor to fit within the cab or backhead.
 - Cut the horizontal portion of the motor mount to a length that easily fits on the torque arm.
 - Mark the torque arm at the end of the motor mount. Set the motor mount aside for now.

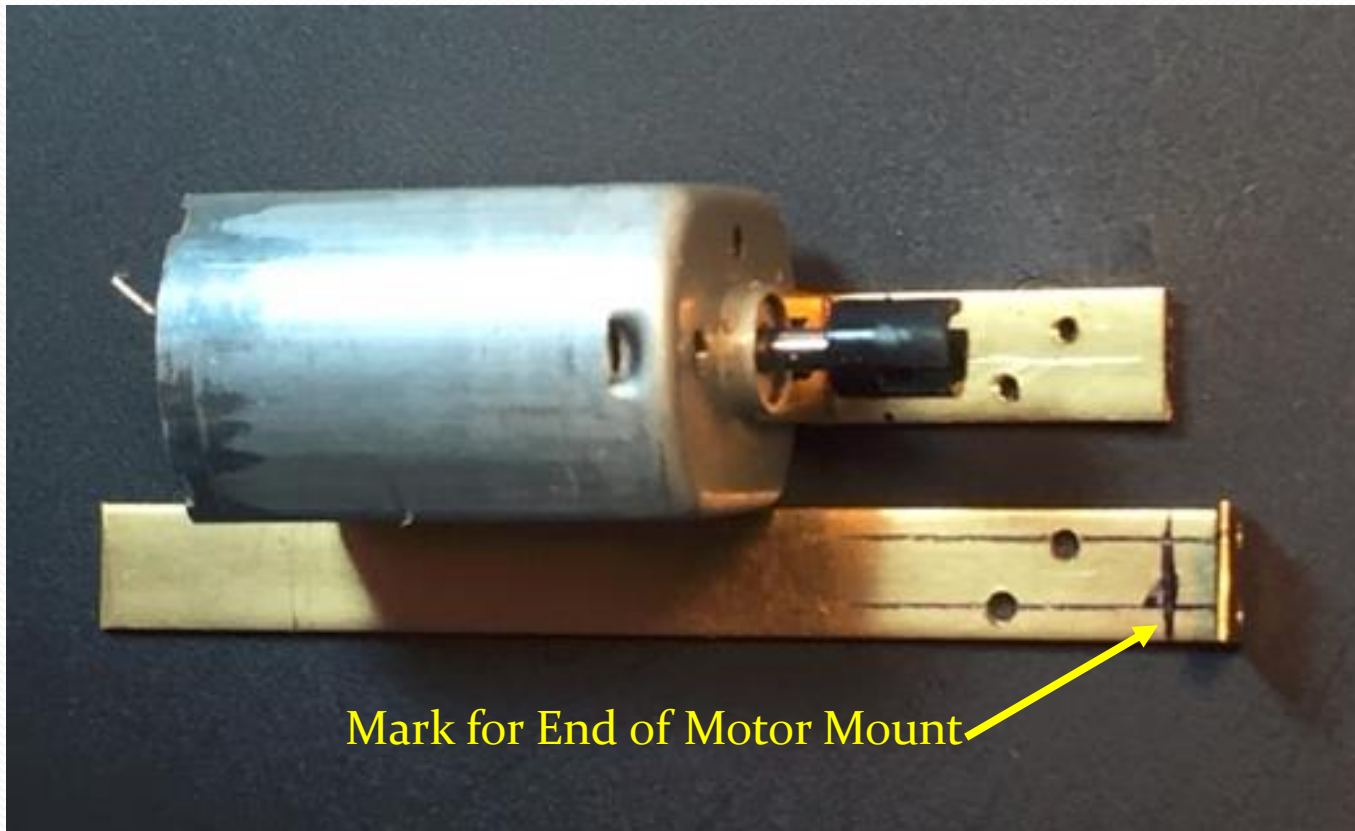
Building the Torque Arm Drive

8. Install the Motor Mount on the Torque Arm

- **Drill and tap the mounting holes:**
 - Scribe two lines 0.060" (~1.5mm) from the edge of the horizontal portion of the motor mount.
 - Mark and center punch the location of the mounting holes (I usually stagger them if possible).
 - For this installation we will drill and tap the motor mount.
 - Center punch the hole locations then drill two 0.043" (#57) diameter holes in the motor mount.
 - Tap the mounting screw holes with a 1.4mm tap.
 - Line up the motor mount on the torque arm and mark the location of the mounting screws on the torque arm. The mounting screws will go through the motor mount and thread into the torque arm. Drill two 0.059" diameter (#53) clearance holes in the torque arm.

Building the Torque Arm Drive

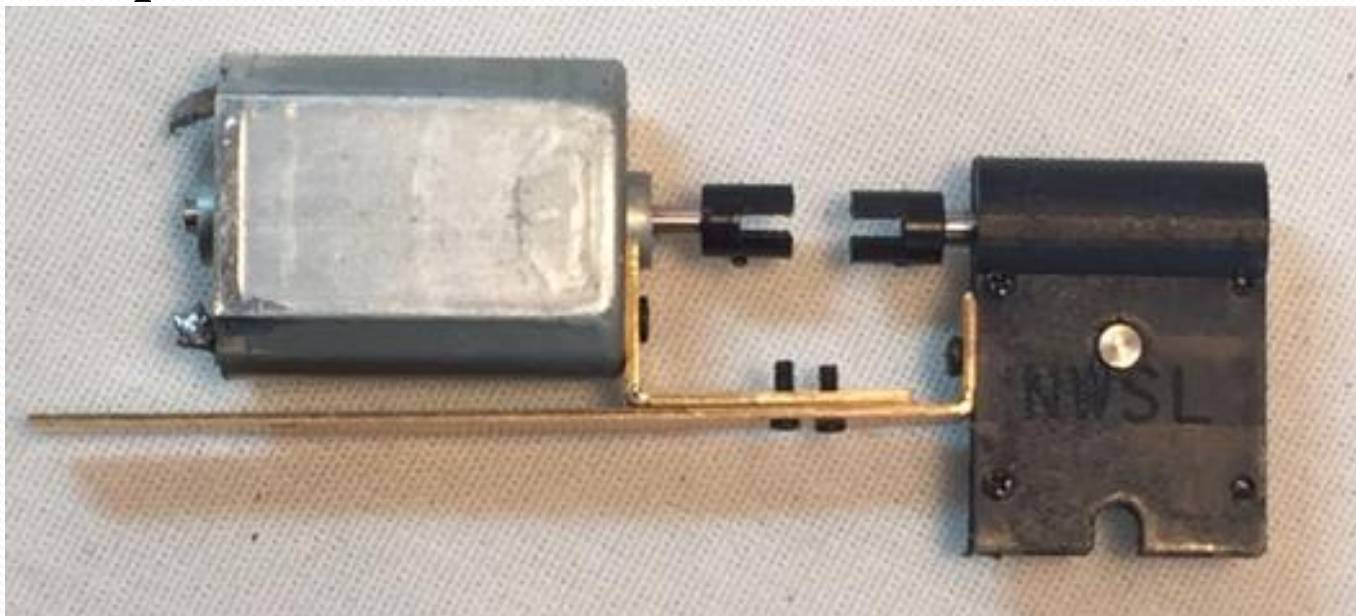
8. Install the Motor Mount on the Torque Arm



Building the Torque Arm Drive

8. Install the Motor Mount on the Torque Arm

- Test fit the motor mount on the torque arm. You may need to bend the mount slightly to get the motor shaft to line up with the worm shaft.



Building the Torque Arm Drive

Key Steps:

1. Selecting the Gearbox
2. Mounting the Gearbox in the Chassis
3. Fabricate the Torque Arm
4. Fabricate the Motor Mount
5. Cut the Worm and Motor Shafts to Length
6. Mount the U-Joint Cups
7. Install the Torque Arm on the Gearbox
8. Install the Motor Mount on the Torque Arm
9. **Fabricate/install the U-Joint Shaft**

Building the Torque Arm Drive

9. Fabricate/Install the U-Joint Shaft

- **Fabricate the Shaft:**

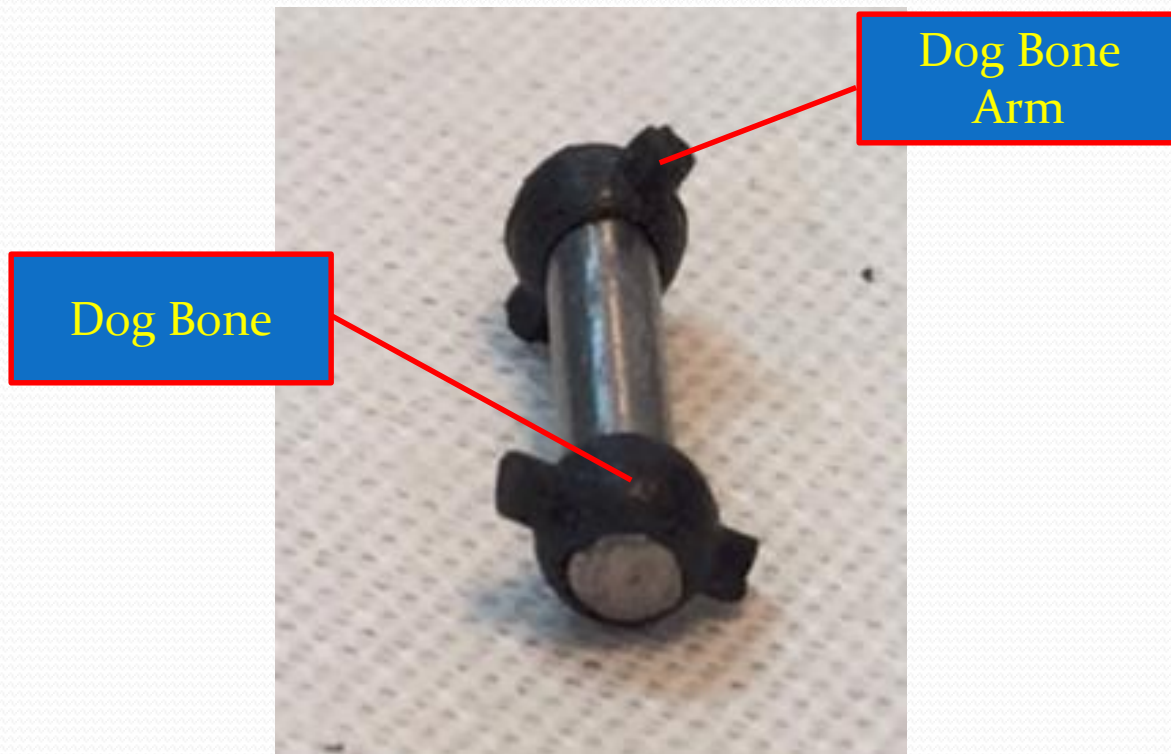
- Measure the distance between the bottom of the cups on the motor and worm shafts.
- Cut a length of 2.0mm shafting to fit between the bottoms of the U-Joint cups. Slightly chamfer each end of the shaft.

- **Install the ‘Dog Bones’ on the shaft:**

- Sensi-Press the “dog bones” onto each end of the shaft. The dog bones should be offset 90 degrees (easier if the dog bones are left on the sprue for mounting).
- Trim the dog bones so the “arms” do not extend beyond the sides of the U-Joint Cups.

Building the Torque Arm Drive

9. Fabricate/Install the U-Joint Shaft



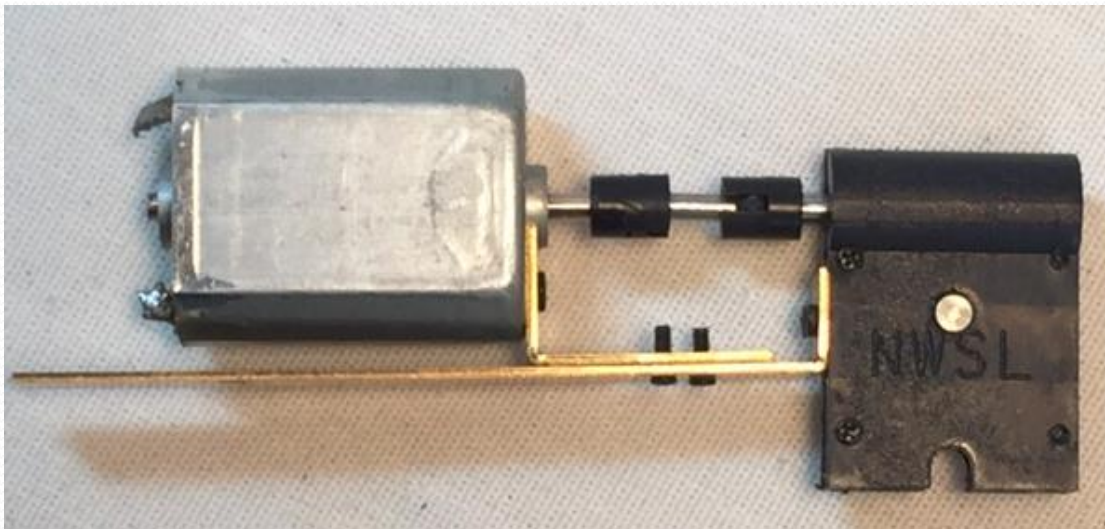
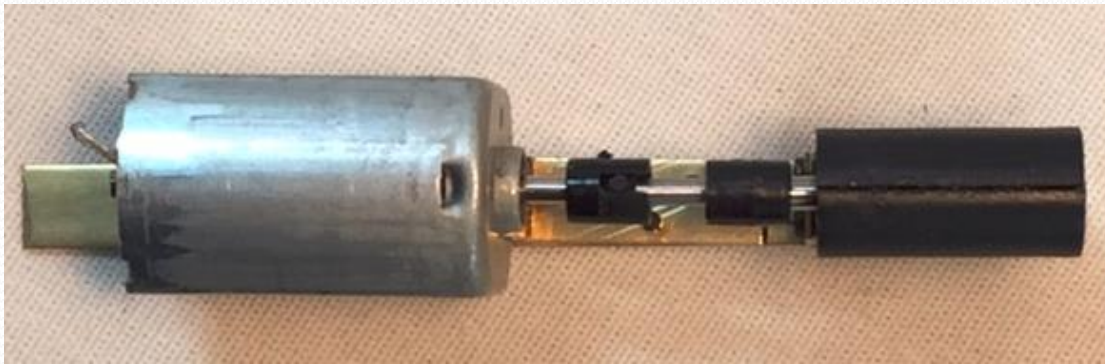
Building the Torque Arm Drive

9. Fabricate/Install the U-Joint Shaft

- **Installing the U-Joint:**
 - Loosen the motor in the mount enough to install the dog bone shaft in the U-Joint cups. There should be a small amount of play with the shaft in the cups (if not, shorten the shaft).
 - Make sure everything lines up and turns freely by hand. You can tweak the motor mount slightly as necessary.
 - Put a small drop of lubricant on each end of the motor shaft.
 - Hook up DC power to the motor and test run it. The assembly should run quiet and smooth through the speed range of the motor. Adjust as necessary.

Building the Torque Arm Drive

9. Fabricate/Install the U-Joint Shaft



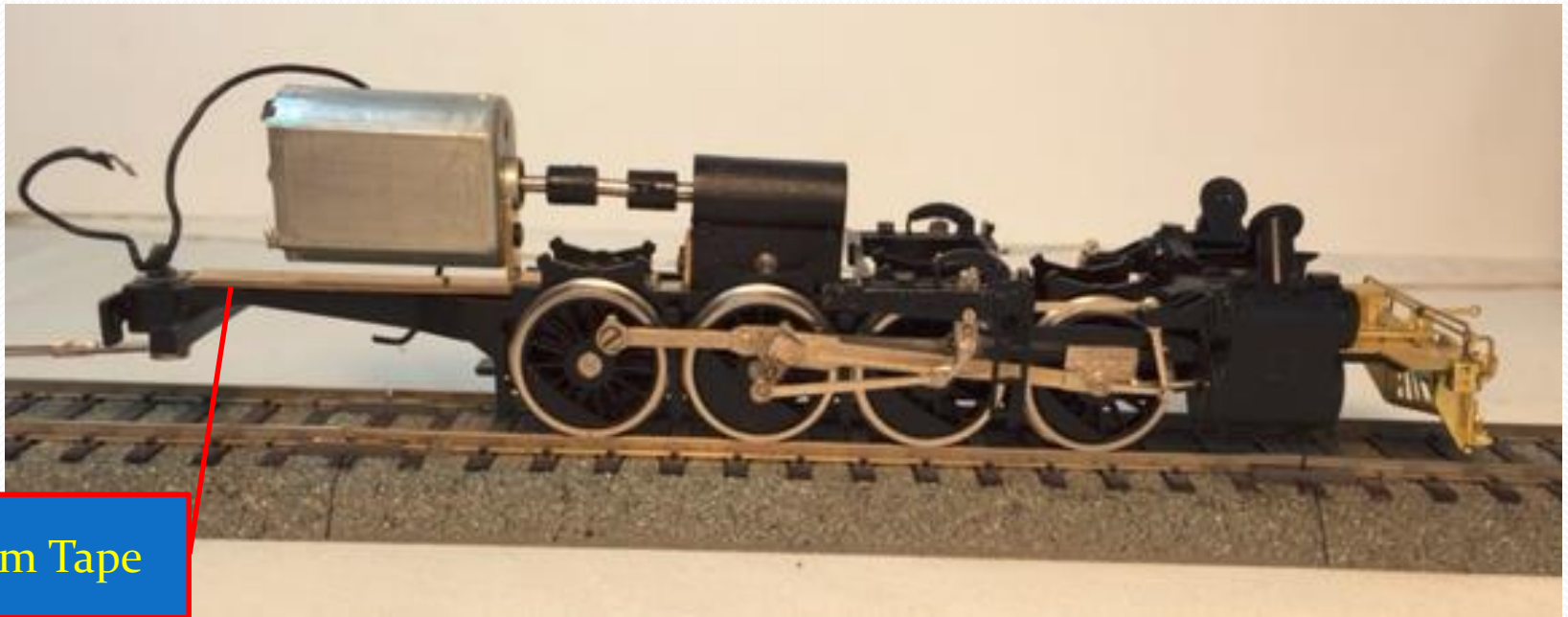
Building the Torque Arm Drive

Final Assembly

- **Reinstall the Torque Arm Assembly:**
 - Lubricate the axle gear with some Labelle 106 lubricating grease (or equivalent).
 - Now install the torque arm assembly in the chassis and reinstall the gearbox bottom bracket with two 1.4mm screws. The assembly should seat in the chassis and rotate with the gearbox. Adjust as necessary.
 - I use a small piece of foam tape (attach to chassis – do not stick to torque arm) under the motor end of the torque arm to insulate/cushion the torque arm.
 - Before you test run make sure all the drivers have the uninsulated driver on the engineer's side of the chassis.

Final Assembly

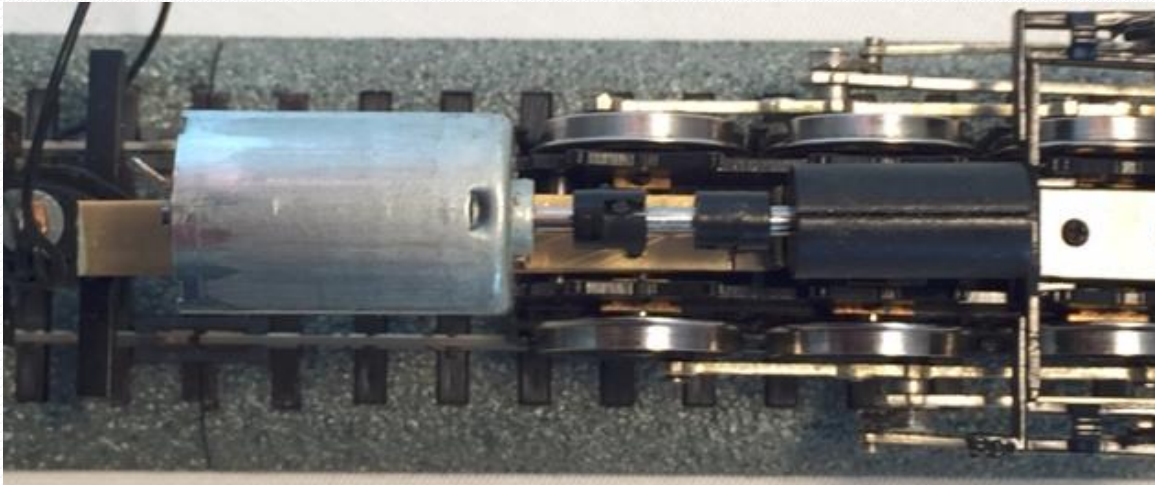
Reinstall the Torque Arm Assembly:



Foam Tape

Final Assembly

Reinstall the Torque Arm Assembly:



Top View

Final Assembly

Test Run:

- Again hook up DC power to the motor.
- Test run the chassis assembly in both directions on a piece of test track.
- It should run quietly and smoothly in both directions.
- When you're satisfied with the way it runs solder the chassis wiring to the motor (positive to the frame, negative to the drawbar screw). If you're installing DCC leave the wires loose for connection to the decoder.
- Reinstall the remaining running gear, pilot/trailing trucks and boiler. Add the tender and away you go!
 - Now give it a little run-in time.

Troubleshooting

Common problems at startup:

- Dead short on startup
- Loco runs well in one direction, but not the other
- Wheels are quartered but binding still occurs

Questions???

Future Topics

- **Balancing your engine**
- **How to fix a driver that no longer has a press fit on the shaft**
- **Options if there is not room for a Torque Arm Drive**
- **Quartering splined driver shafts**
- **A tool to ensure your drivers are square on the shaft**

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- **Dave Connery**
- **Wayne Floyd**
- **Shawn Stevens**

Contact Information

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For Installation Services:

Shawn Stevens (guru on diagnosis, troubleshooting and installation)

- E-mail: thegearbox@peoplepc.com
- (541) 862-2039

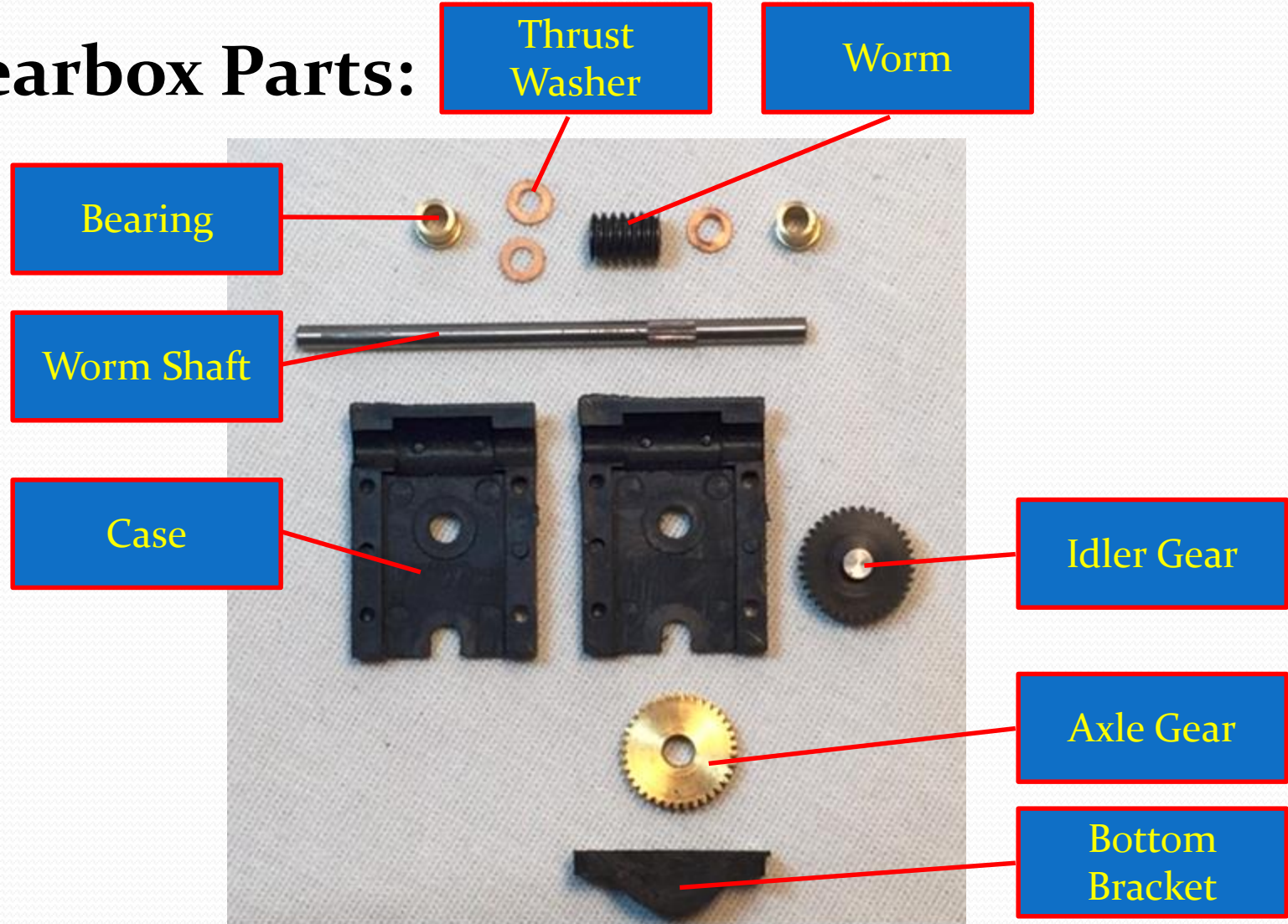
Appendix A

Assembling a Northwest Shortline Gearbox

If you have or receive an older gearbox in kit form, follow these tips for assembly and installation.

Assembling a NWSL Gearbox

Gearbox Parts:



Assembling a NWSL Gearbox

Assembling the Gearbox

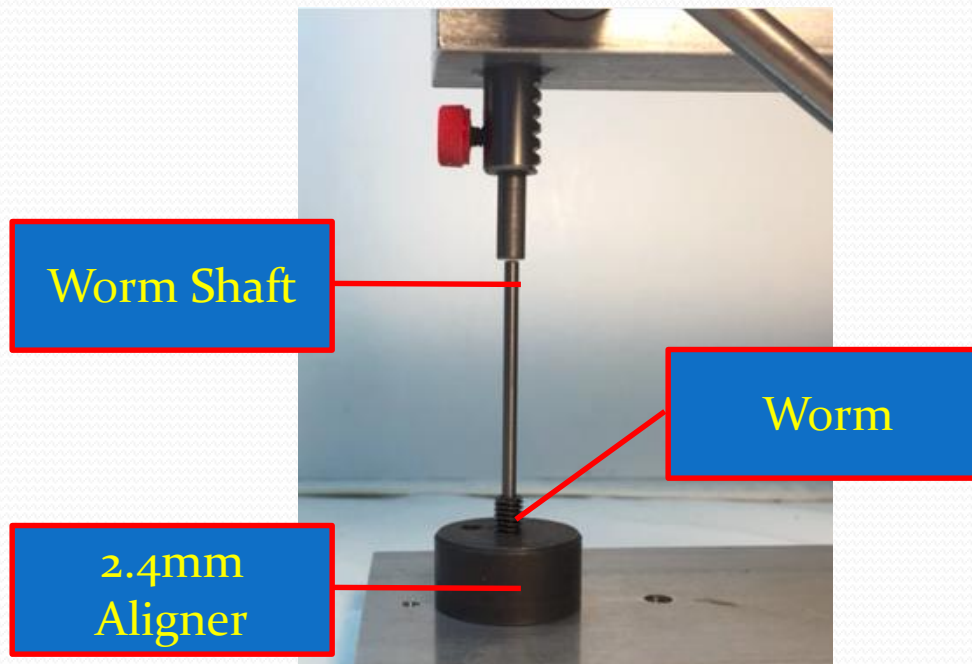
- Prep the case
 - Using the 1.4mm tap in a pin vise, tap the 6 screw holes in the case:
 - 2 in each side (4 total)
 - 1 in bottom (2 total)



Assembling a NWSL Gearbox

Assembling the Gearbox

- Press the worm onto the worm shaft
 - Using the Sensi-Press and Aligner (2.4mm), press the worm onto the wormshaft.



Assembling a NWSL Gearbox

Assembling the Gearbox

- **Install the worm shaft and thrust washers in the case:**
 - Place the worm/shaft/bearings in one of the gearbox sides.
 - Install thrust washers so that it just takes up the slack. A slight wiggle is okay – any tightness is not.
 - Now install the other side of the case and secure with the top two screws (1.4 x 6mm).

Assembling a NWSL Gearbox

Assembling the Gearbox

- Install the worm shaft assembly in the case (thrust washers go between the worm and bearing – both sides of the worm)



Assembling a NWSL Gearbox

Assembling the Gearbox

- **Install the worm shaft and thrust washers in the case:**
 - The case should turn freely with no binding on the shaft (note – the top edges of the case do not have to touch).
 - If not, squeeze both sides of the top of the case tightly with your fingers.
 - If still not, remove one of the thrust washers and try again.

Assembling a NWSL Gearbox

Assembling the Gearbox

- **Install the Idler Gear in the case:**
 - Take the case apart and install the idler gear.
 - Reassemble the case using all 4 side screws (1.4 x 6mm).
 - Put a small drop of lubricant on both ends of the worm shaft and both ends of the idler shaft.
 - Turn the worm shaft – the assembly should turn freely (no binding).

Assembling a NWSL Gearbox

Assembling the Gearbox

- **Install the Idler Gear in the case:**
 - Now install the gearbox on the locomotive's driver shaft with the bottom bracket and two screws (1.4 x 4mm).
 - Note – we will be taking the gearbox on and off several times before final assembly.

Assembling a NWSL Gearbox

Assembling the Gearbox

- Install the Gearbox in the Chassis:

