Brass Locomotive Remotoring and Regearing

with

Denny Surufka
These are some of the basic tools I use when working on a brass locomotive.
This is today’s project. It is an early issue PFM/United model of a Ma&Pa 2-8-0. This is how it arrived in my shop.
The underside of the model.
I assess every loco that comes into my shops prior to starting work. Check for driver travel. Look for binding.
Connect electrical leads directly to the loco and check motor performance. This loco did not run when it arrived. See no AMPS were being drawn.
After finding the break in electrical contact the loco pulled a bit over .5 amps at 7.5 volts with the original setup. Document these findings.
Start disassembly by removing the two screws holding the frame to the boiler/cab at the rear under the cab. On this model they were below the cab.
On this model those two screws are facing the rear under the cab.
Next unscrew and remove the pony truck at the front of the loco.
Under the pony/lead truck you will find the front screw holding the boiler to the frame. Remove this.
If you are not sure, this front screw is almost always directly under and in line with the smoke stack.
Keep all removed parts in a container that is properly labeled. I use a plastic drawer labeled with the loco information because I sometimes have multiple projects in the shops.
With the rear two screws and the front screw removed slowly separate the boiler from the chassis. Look for any wires or other items that may still be connected.
If nothing is connected pick the boiler/cab unit up away from the frame.
The exposed locomotive chassis. If you do not do this on a regular basis, consider taking pictures for your records of all steps to help reassembling the loco.
If you just want to make the loco perform a bit better, take a thin piece of 300-600 grit wet dry sand paper and with the motor spinning hold the sand paper against the brass commutator. This will polish and smooth it.
Follow that up by lubricating the motor at the front by adding several drops of oil to the front felt.
And the rear felt.
If you are replacing the motor completely flip the chassis over and remove the screw that fastens the motor to the frame.
Remove the motor and sever the electrical connection as close to the motor as possible.
Remove the gear box and check to see how easily the chassis rolls by pushing it back and forth. If there is the slightest bind you need to find it and correct it before you can continue. Ultimately the chassis should roll without sliding on a piece of smooth glass.
Remove the bottom plate and check how far the drivers move upward. Are they all even or is there one or more that is higher or lower.
This axle/drivers are higher than the others. I verify it can be moved up and down.
Remove each axle being sure to capture the springs. Sometimes they will stick to the frame, sometimes they will stick to the axle bearing.
Since this model will be stripped I now remove the screw that holds the saddle to the frame.
All the parts from the chassis are stored in the plastic box.
The tender is also disassembled for stripping.
Parts ready for stripping.
I use FULL STRENGTH Pine Sol to strip my loco. It smells good, cleans up well and besides your wife will think you are doing something to clean the house. On really heavy paint I leave it in this solution over night shaking it several times during the process.
Pine Sol is strong so I use rubber gloves when working with it full strength. This is how the model looked after about 8 hours in the solution and a bit of scrubbing with a OLD tooth brush.
The stripped components.
Do not put the drivers into any stripper. Clean these by hand if necessary.

This gear had been previously replaced and was in good condition but I still checked and cleaned every tooth of the gear to make sure they were in good condition.
I dismantled the gear box and cleaned every component. Make sure you keep track on which ends the bearings and thrust washers came out and which way they faced. You should put them back the way you took them out.
If your gear box is noisy or bad you can select from a bunch of different drive components. These are a few of my favorites. I always put the largest gear ratio into a model that I can. 36:1 or 40:1
The model I am working on is a PFM/United Ma&Pa 2-8-0. Here is my own copy of that model with a NWSL 36:1 gear box installed. The gear box cover kept hitting the track when going over turnouts so I shaved the gear box cover to provide the necessary clearance. I wish someone made metal covers for the NWSL gear boxes.
If you are replacing the gearbox, use a NWSL gear puller to remove the UNINSULATED driver. Do not remove the insulated driver.
You can then reposition the gear puller and remove the gear. This just shows the position the gear puller would be in to remove the gear.
You can also use the gear puller to push the gear on as well as the driver you removed.
I came across this tool many years ago which accurately positions the drivers and allows me to quarter them at the same time. No I do not know who made it.
Here is a quartering jig from NWSL.
Back to our model. With the paint removed I again check the axle bearings for free up and down movement within the frame. Use a small fine cut file to remove any burs.
The original spring is on the left and the NWSL replacement is on the right. I usually cut the NWSL springs so they are 1 to 1 and a half coils longer than the original coil length.
Here are the new springs installed. Be careful when bringing the bearings down over the new springs so that they get seated properly.
Before putting the gear box into the frame make sure the chassis rolls smoothly on glass. Once you have the bugs out then install the gear box.
So many motors so little time. Pick what is best suited for you loco.
Two of my favorite motors. One is a Sagami 16x31 the other is an inexpensive flat can motor with a 8900rpm no load speed. The Sagami was about $25 the other $5.
Data sheet for Sagami 16x30 notice the starting and no load RPM speeds.

### Operating Specifications

<table>
<thead>
<tr>
<th>Condition</th>
<th>Volts</th>
<th>Current Amps</th>
<th>Torque OZ-IN CM-CM</th>
<th>Output HP</th>
<th>Speed RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting</td>
<td>0.5</td>
<td>0.05</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>No Load</td>
<td>12.0</td>
<td>0.08</td>
<td></td>
<td></td>
<td>15,000</td>
</tr>
<tr>
<td>Max. Cont.</td>
<td>12.0</td>
<td>0.28</td>
<td>0.20</td>
<td>14.4</td>
<td>.002</td>
</tr>
<tr>
<td>Stall</td>
<td>12.0</td>
<td>0.95</td>
<td>0.79</td>
<td>56.8</td>
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</tbody>
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- **Magnet**: Ferrite
- **Armature**: 5 slot
- **Net Wt.**: 0.95 oz.
- **Peak Eff.**: 48.4%

### Motor Dimensions

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>16</td>
<td>31.5</td>
<td>2.0</td>
<td>19.0</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>Inch</td>
<td>0.622</td>
<td>1.16</td>
<td>0.079</td>
<td>0.748</td>
<td>0.118</td>
<td>0.039</td>
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### Shaft Lengths (mm/in)

<table>
<thead>
<tr>
<th>Motor #</th>
<th>S1</th>
<th>S2</th>
<th>Accessory</th>
<th>STK #</th>
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</thead>
<tbody>
<tr>
<td>Motor #</td>
<td></td>
<td></td>
<td>Mount Screw</td>
<td>4881-5</td>
</tr>
</tbody>
</table>

Graph showing RPM vs. Amps and Torque vs. RPM.
Data sheet for Sagami 16x31 notice the starting and no load RPM speeds. This was why I preferred the 16x31 to the 1630. Slower speeds at both ends of the operating range.
This is a close-up of that flat can $5 motor.
Rear view of that same motor.
I use model airplane fuel tubing for my flexible connections between motor and gear box.
Here is the motor temporarily positioned on the chassis and connected to the gear box. With the chassis suspended off the ground I apply power and see how the drivers rotate. I also check to see how slow I can get the drivers to turn. Note, there is no lubrication in the mechanism at this point so do not run it very long or at high speeds.
Since about 1980 I have used this product to glue my motors to the frame. It provides great noise and vibration isolation.
The motor is now glued/siliconed to the chassis and I will test to find proper orientation of the electrical leads.
The loco is reassembled and ready to roll.
This model was to be painted by its owner so I delivered it without lubrication. But, these are the lubricants I use.
Lube at these points with LaBelle lightweight oil.
Lube at these points with LaBelle lightweight oil.
Weighting models provides better pulling power. You should consider the amount of weight when selecting the type of springs you use in the chassis. Do not use the wimpy springs if you weight your locos like a Mack Truck.
I use a soldering iron to heat Cerrobend low melting weight material and let it flow down into the boiler. As demonstrated this can be done with a painted loco. Do this after painting because if a loco is weighted there is a better chance you will drop it during painting. I know this to be true.
When properly weighted the loco should be a bit nose heavy. I am holding the running boards directly over the middle drivers.
This is where the center of balance is. I prefer nose heavy because when the model is pulling a load it will transfer the weight back a bit toward the rear anyway. Remember the chassis has to work well to achieve maximum pulling power.
For additional information
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Presented by:
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