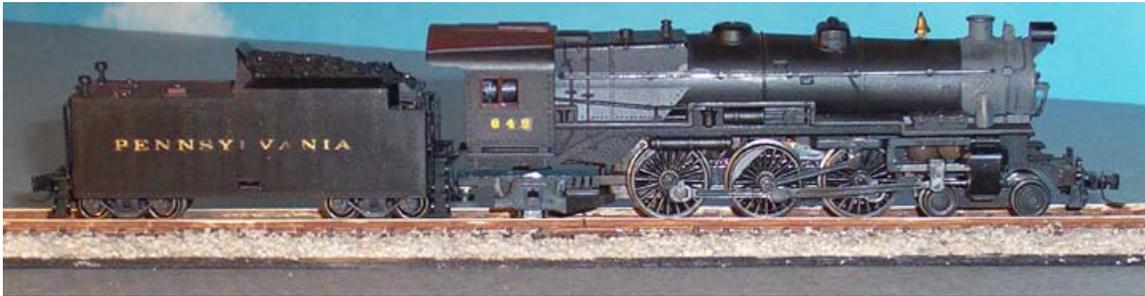


A Complete Minitrix N Scale 4-6-2 K4 Overhaul
Max Magliaro
May 28, 2009
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The venerable Trix 4-6-2, actually a very specific PRR K4 model, has been around since the 1970s. It suffers from a myriad of ills, yet thousands upon thousands of these still ride the rails in modelers' collections. Why?

For one thing, other than a few scant brass models, there is no other commercial K4 model. Secondly, even after all these years, it's a pretty good looking engine. The boiler and tender profile and detailing are quite good.

So, here we have yet ANOTHER article on repowering this beast? Surely we've seen this enough times. Well, true enough. I myself have written articles on improving the K4 for the magazine and on-line audiences, and so have many others. But in spite of that, technology has changed enough, yet again, that it's time for a comprehensive look at how to turn a stock Trix K4 into the good-looking and good-running engine that it can be.

A major component to this project is a new upgrade kit from www.micro-locomotion.com, consisting of a new motor, worm, and double-gear specifically designed to fit the Trix K4. These components make it possible to upgrade the Trix more easily than ever before.

This article will focus entirely on functional, mechanical upgrades. In addition to what you'll read here, the finished model in the above photo has been cosmetically enhanced. I'm not going into great detail on that aspect here, but here is a short list of the work I did purely in the "looks" department to the above model:

- a) Blacken the drivers, rods and valve gear with Carr's Metal Black, a commercially available chemical blackening solution
- b) Replace the headlight bulb with a white LED (and its required 1.6k ohm dropping resistor)
- c) Paint the smokebox gray
- d) Lower the tender by filing the tops of the truck bolsters
- e) Put Micro-Trains couplers on the front and rear
- f) Paint the tender deck and cab roof a reddish-brown "Tuscan" color

None of the above changes affect *how it runs*. Improving *how it runs* is the focus of this article.

The mechanical improvements fall into 4 stages:

- a) Reducing the wheel flange size so the model can run on modern code 55 track
- b) Improving electrical pickup
- c) Improving the motor
- d) Reducing the overall speed with a higher-reduction gear ratio

We will cover each of these steps in turn.

Parts used for this project:

- Maxon 1320 coreless motor (www.micro-loco-motion.com)
- Custom double-gear and worm (www.micro-loco-motion.com)
- 1/4" piece of 1.5mm drill rod (www.micro-loco-motion.com)
- 3/32" styrene tubing
- Fine stranded wire "superflex" (www.engineering.com)
- 1/72 x 1/4" screw
- liquid styrene cement
- Kato tender trucks (www.katousa.com part number 941032) or Bachmann Spectrum tender trucks (www.bachmanntrains.com, part number OOTO1)

Note on the Kato C55

Before we get started, I will point out that since this instruction guide was originally written, the Kato C55 steam locomotive has become available again, and it provides a better-looking, smoother-running chassis than the Trix 4-6-2. It has more correctly-spaced drivers and much better-looking valve gear and rods. Many have had good success mating a Trix K4 boiler shell over the Kato C55 mechanism, resulting in a better-looking model than one based on the Trix mechanism. However, for those who have some Trix K4 engines that they would like to upgrade, this guide may be of value.

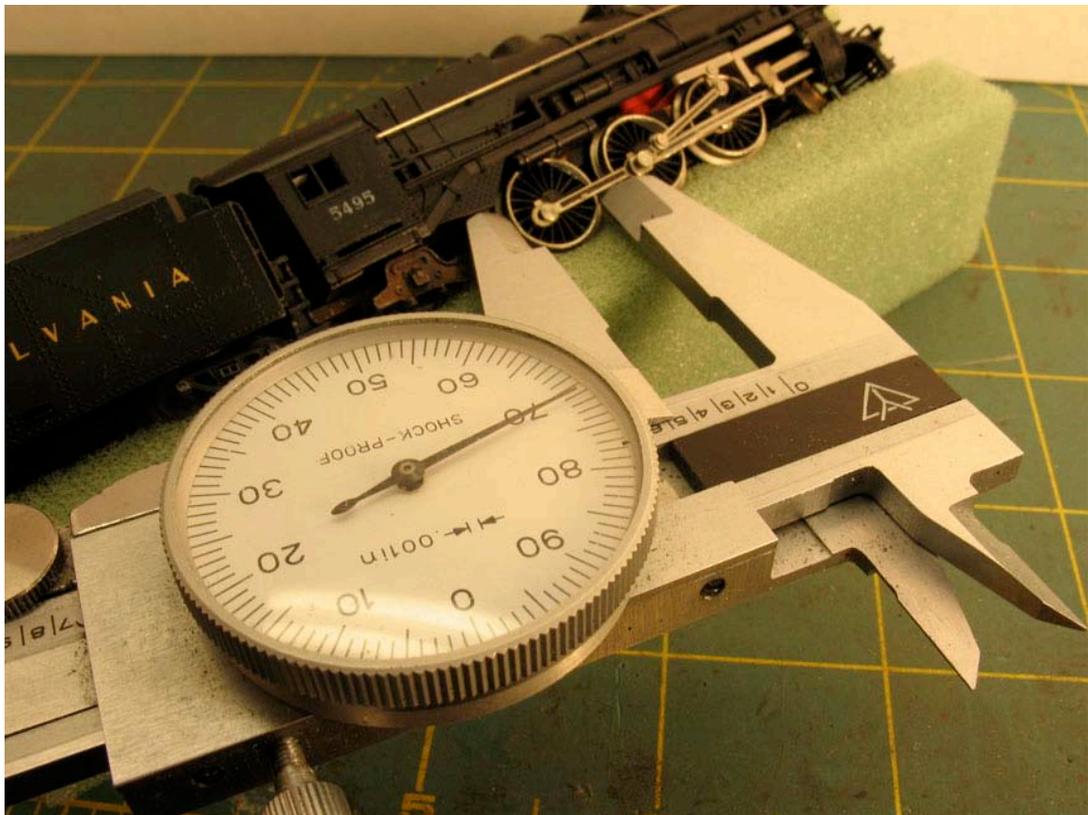
A - Reducing Wheel Flanges

Long ago, when this model was first made, there was no such thing as code 55 N Scale track. Then K4 runs just fine on the standard code 80 rails. But if you want to run your K4 on code 55 track (Atlas or Micro Engineering), the flanges have to be ground down.

I began by measuring the driver diameter across the flange and across the wheel tread itself. From these two photos (below), we can see that the flange diameter is 0.567" and the tread diameter is 0.471". Therefore, the flange depth is $(0.567 - 0.471) / 2 = .048$ "



Wheel diameter across flanges is 0.567"



Wheel diameter across the tread is 0.471"

So, how bad is a flange that is 0.048" deep? Pretty bad. Anything deeper than about 0.028" will hit the ties on some code 55 track. The NMRA spec says the flanges should be no deeper than .022". So, we will grind ours down to .025", a little deeper than spec, yes, but I like to have a little more flange for a safety margin, to help things stay on the track! $0.567" - (.048 - .025) * 2 = 0.521"$ In other words, we need to grind down the flanges until the diameter we measure across the flange is only 0.521"

Turning down drivers can be done using a machinist's lathe, but that's very specialized equipment that most of us don't have. You can do a perfectly adequate job by just laying the engine on its back in a foam cradle, applying power, and running a Dremel grinding stone against the spinning flange in the opposite direction.

The photo shows a conventional stone. However, a diamond-coated one does a MUCH better job. The diamond stones will be smoother, causing less drag, pull, and stress on the mechanism. This also makes it less likely that you'll make the wheel come off, or otherwise damage it.

The key here is to GO GENTLY. Check the distance across the flange with your calipers frequently, until you get it down to 0.521".



Grinding the driver flanges with a stone in a motor tool.

Use a diamond drum, rather than the grinding stone shown in the photo, if at all possible, to reduce stress on the mechanism

For the trailing and pilot truck wheels, you can chuck one in a power drill, and hold a file against the flange to grind it down. The same principle applies. Measure the distance across the wheel tread and across the flange, and calculate what the distance across the flange needs to be such that the flanges are no deeper than 0.025"

The following photos show more grinding techniques you can use on the pilot and trailing truck wheels, and a final polishing of the drivers that you should do with 400 grit sandpaper. Don't skip this last step. The flange grinding will leave the flanges rough, with cuts and tiny nicks and burrs in it, which will increase friction and noise against the rails. Polish the wheels with 400 grit sandpaper after all the grinding it done.



Grinding the pilot truck wheels

At this point, do a quick test run on your code 55 trackage and make sure no wheels hit the ties.

THINGS TO WATCH OUT FOR WHEN GRINDING FLANGES:

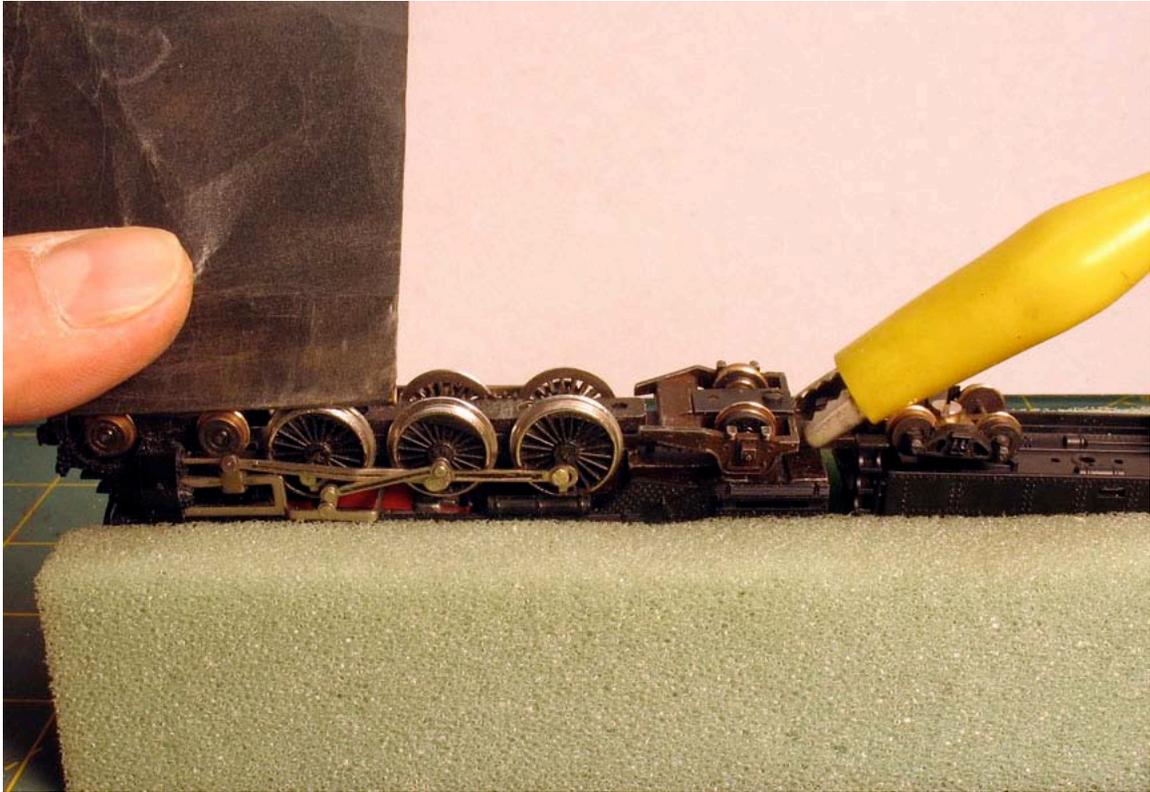
- Go **SLOWLY** and **GENTLY** when riding the motor tool against the flange, and again, use a diamond grinder if at all possible. If you put too much pressure on the wheel with your tool, it will pull and vibrate right off the axle, which is a major headache. You'll need to get that wheel pushed back on in just the right spot relative to the other drivers ("quartering") or the

mechanism will relentlessly jam, or at least click, bind or otherwise “hitch” when it runs.

- Lean the grinder from one edge to the other over the flange as you work, to create a **ROUNDED** edge. You don’t want a chunky squared-off flange, and you don’t want it sharpened like the edge of a knife blade, either.



Grinding a pilot truck wheel, which we have temporarily pulled off its axle.



Always follow up the grinding process with 400 grit sandpaper. This will smooth the flange surface and edges, which is VERY important for good tracking on the layout

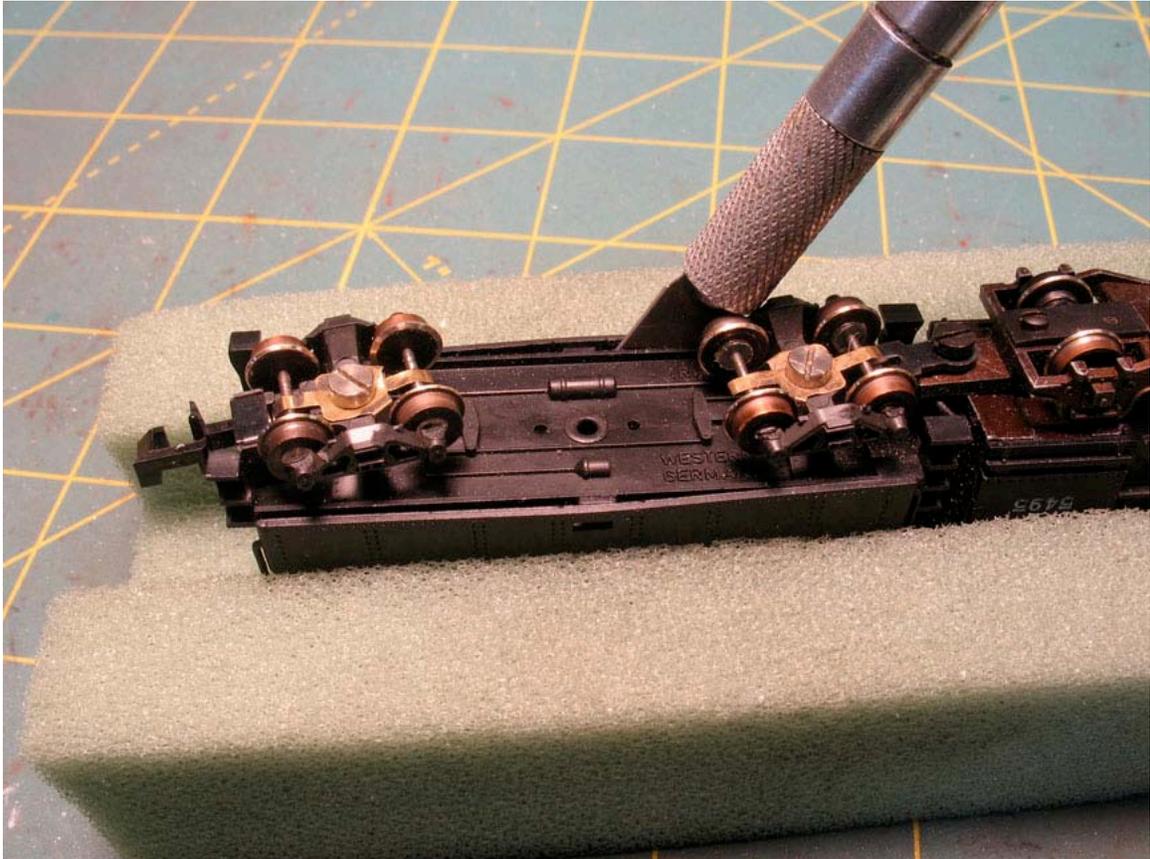
B - Improving Electrical Pickup

The standard Trix K4 relies on a system of axle wipers and a spring wire to carry current from the tender to the motor. This, coupled with wheel wipers on the drivers, and only half the wheels of the pilot and trailing trucks being electrically live, makes for a system that is erratic and intermittent. Most K4 engines I have seen simply cannot run very slow at all without stalling, mostly due to loss of electrical contact. This can be remedied in a number of ways, but all of them boil down to one basic idea: use all-wheel-pickup tender trucks and hard-wire them to the motor. This provides 8 very reliable pickup points in the tender, and eliminates all the problems between engine and tender cause by the spring wire and drawbar arrangement of the stock model.

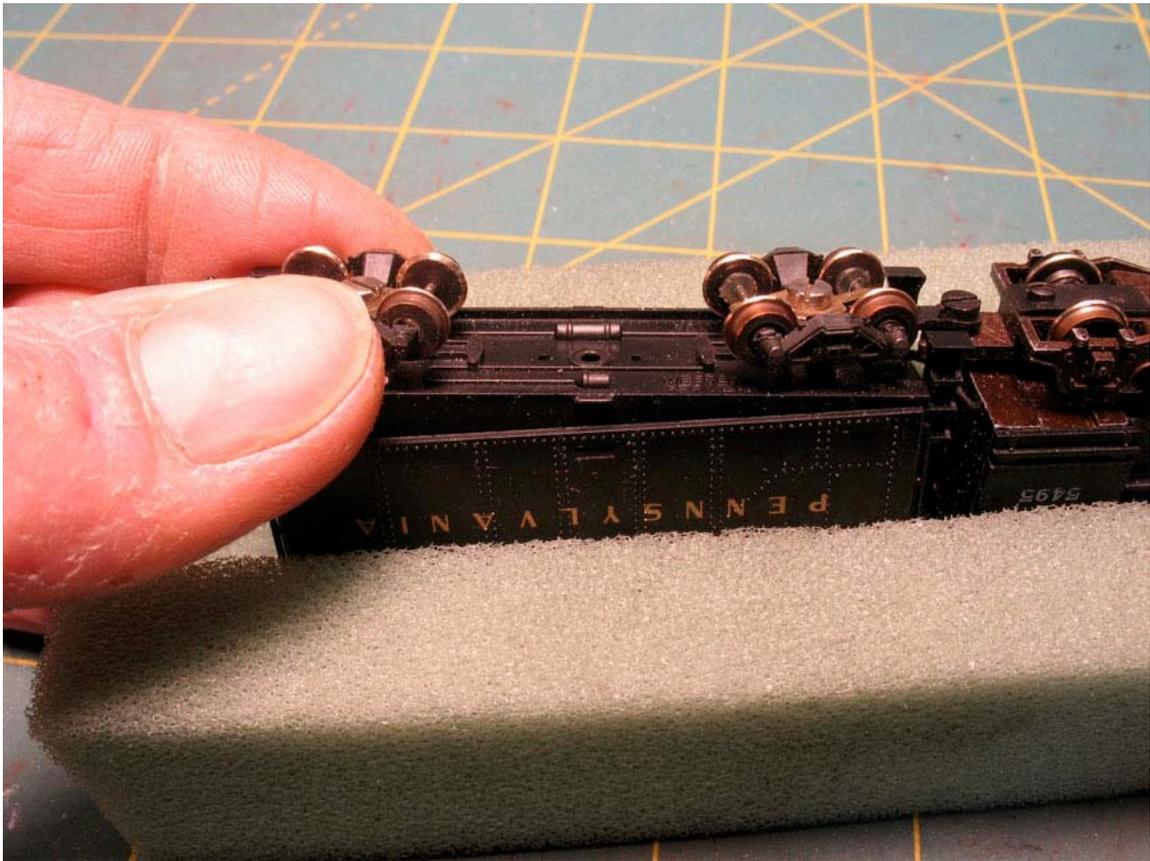
For my project, I mounted tender trucks from a Kato 2-8-2 Mikado in the Trix tender floor. If these are not available, you can use trucks from the Bachmann/Spectrum 2-8-0, which are more commonly available (visit Bachmann's website, or call them directly). Another alternative would be to purchase a Spectrum tender as a separate part (also

available from Bachmann). The K4 shell could be fitted to that tender bottom, with wires soldered to the tender contacts and run forward to the motor.

The next series of photos illustrate fitting Kato trucks into the Trix tender.



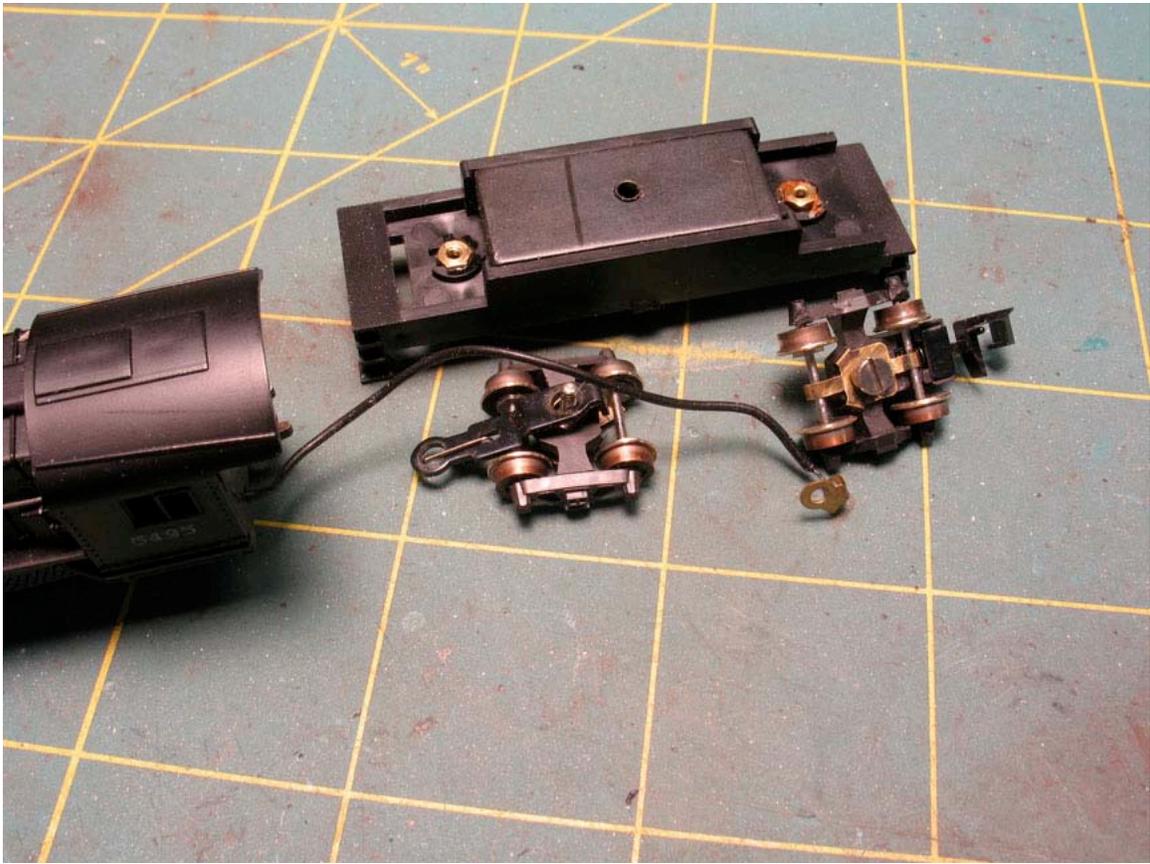
Use an Xacto knife to pry the shell away from the two retaining tabs near the center of the tender body. Pry the bottom up and out slightly on each side.



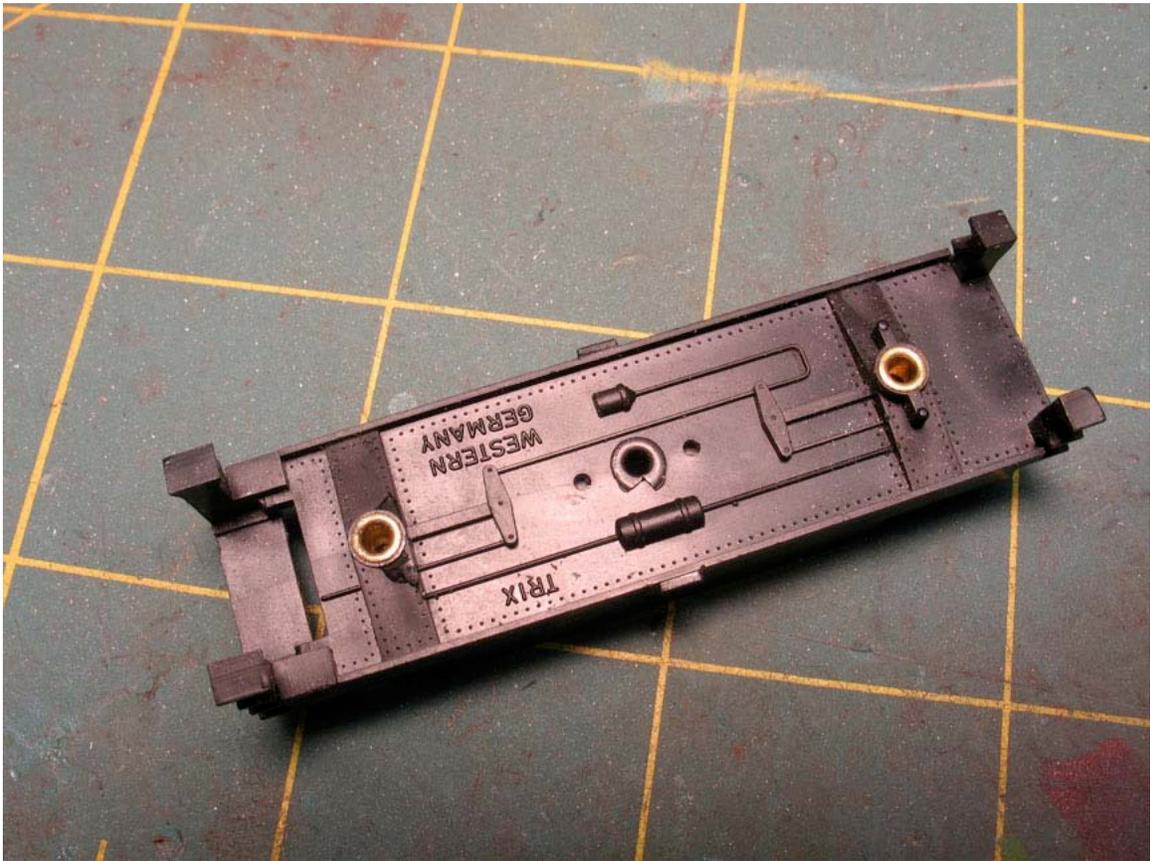
The bottom will now lift out easily.



View of the tender bottom, with the shell removed



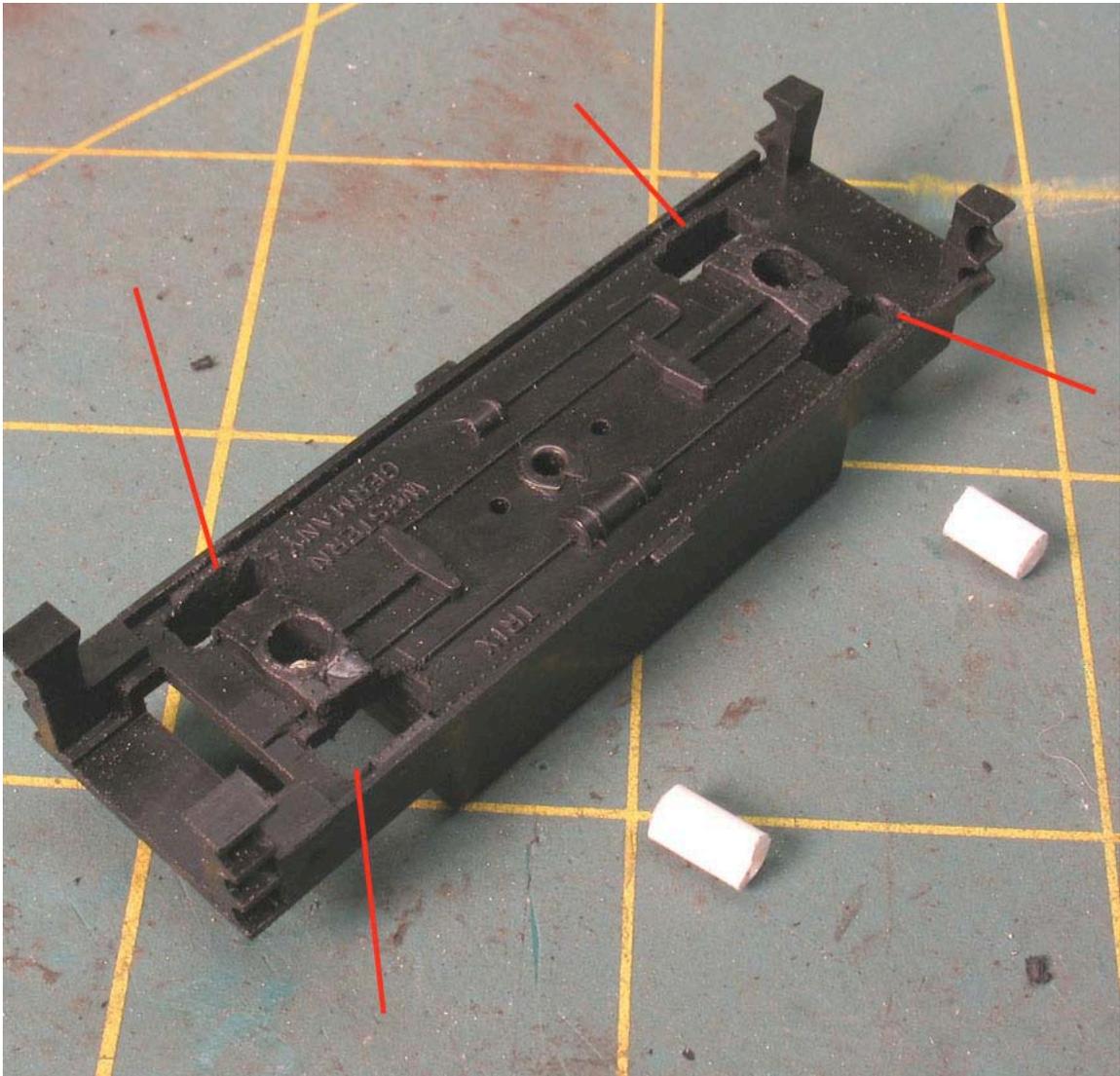
Remove the screws holding the trucks in place, and remove the trucks and the drawbar.



The tender bottom, with trucks removed



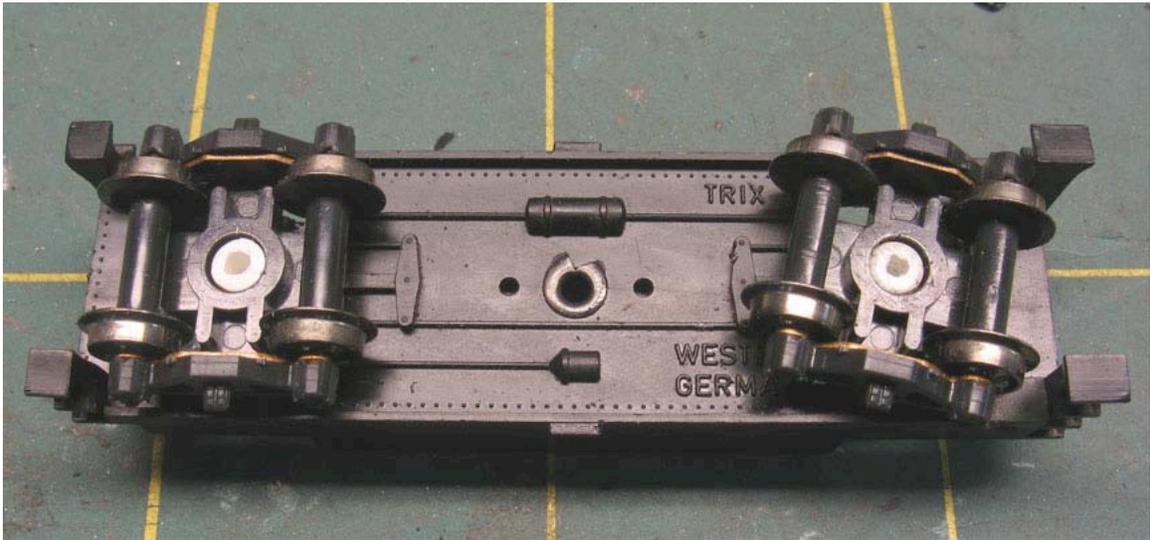
Remove the brass eyelets in each truck hole, and drill out the hole with a 3/32" bit. Cut two short lengths of 3/32" styrene tubing at this time (tubing cutter shown in the background)

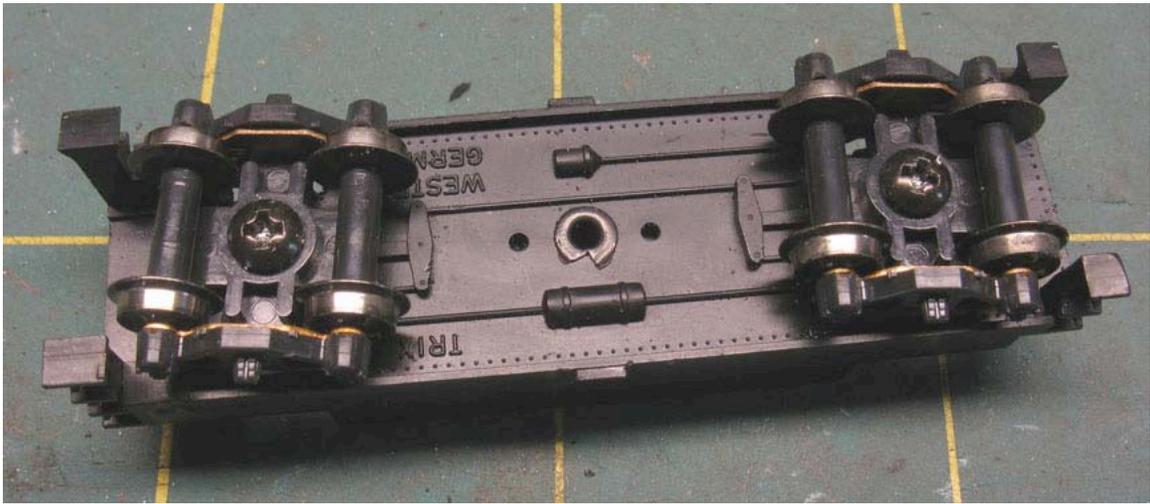


This view shows the two short styrene tubing sections. Also, note the large rectangular holes indicated by the 4 red lines in this diagram. Drill these areas out and then enlarge them to smooth rectangular holes with a jeweler's file. These openings are required to allow the new Kato truck contacts to protrude up into the tender floor.



Mount the styrene tubes into the holes, securing them with styrene liquid cement from the inside so they securely fuse to the tender floor. Check the fit by placing the new tender trucks over the tubes. The end of the tubing should be just flush with the truck as shown below.





Mount the trucks using the screws from the original Kato tender. Tighten the screws until the trucks just bind, then back the screws off 1/2 turn.

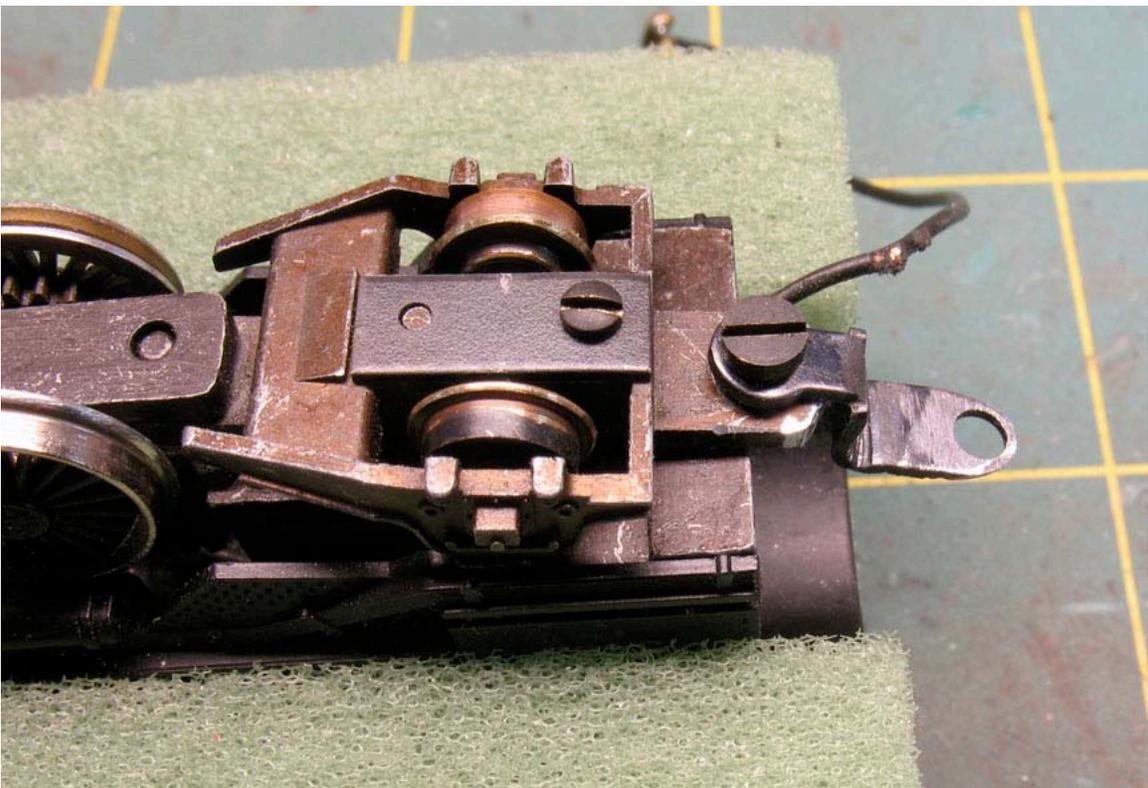
Now that the trucks are mounted, we turn our attention to refashioning the drawbar. The following photos illustrate how to make the new drawbar by bending the stock Trix one.



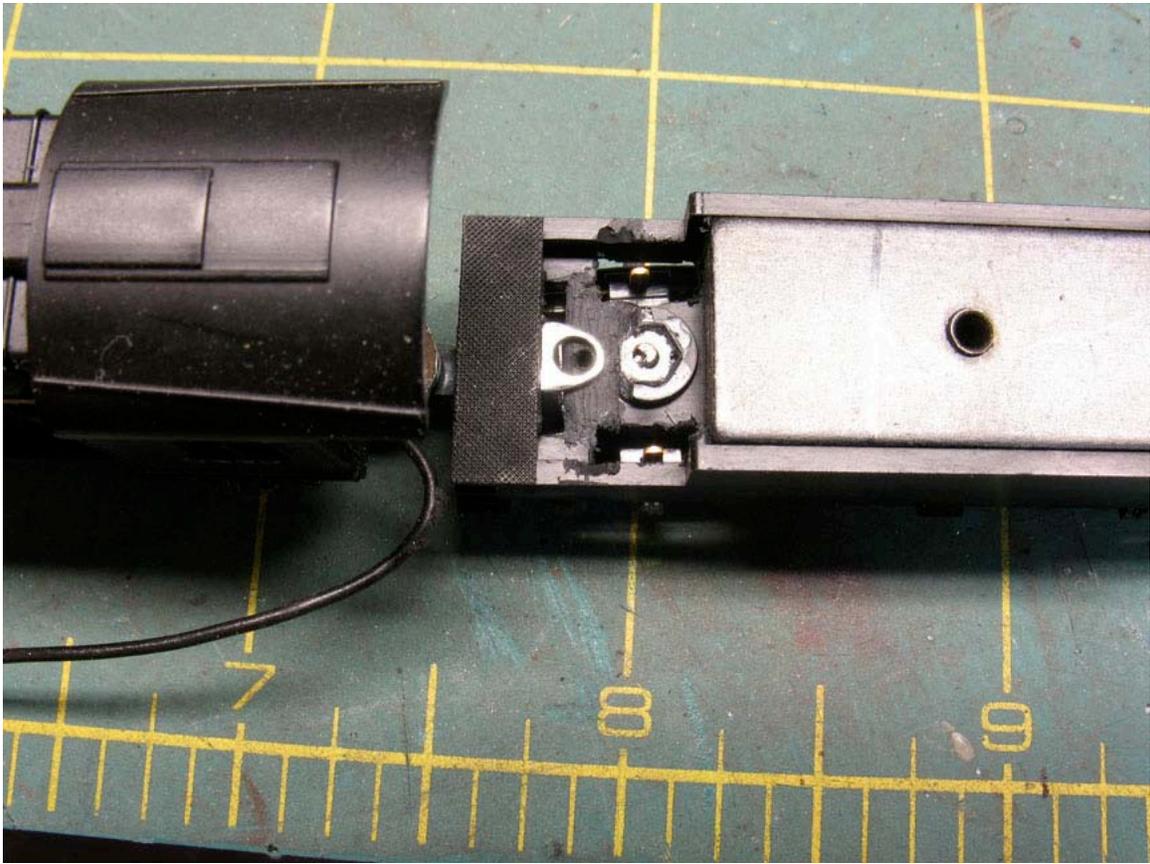
The stock Trix drawbar, with one modification: the tang at the far right normally bends down at a 90 degree angle. Here, we have flattened it out with pliers.



Carefully re-bend the drawbar as shown. The tang at the right has now been cut completely off, and that area filed smooth and round



Mount the new drawbar to the engine pin using the stock Trix mounting screw

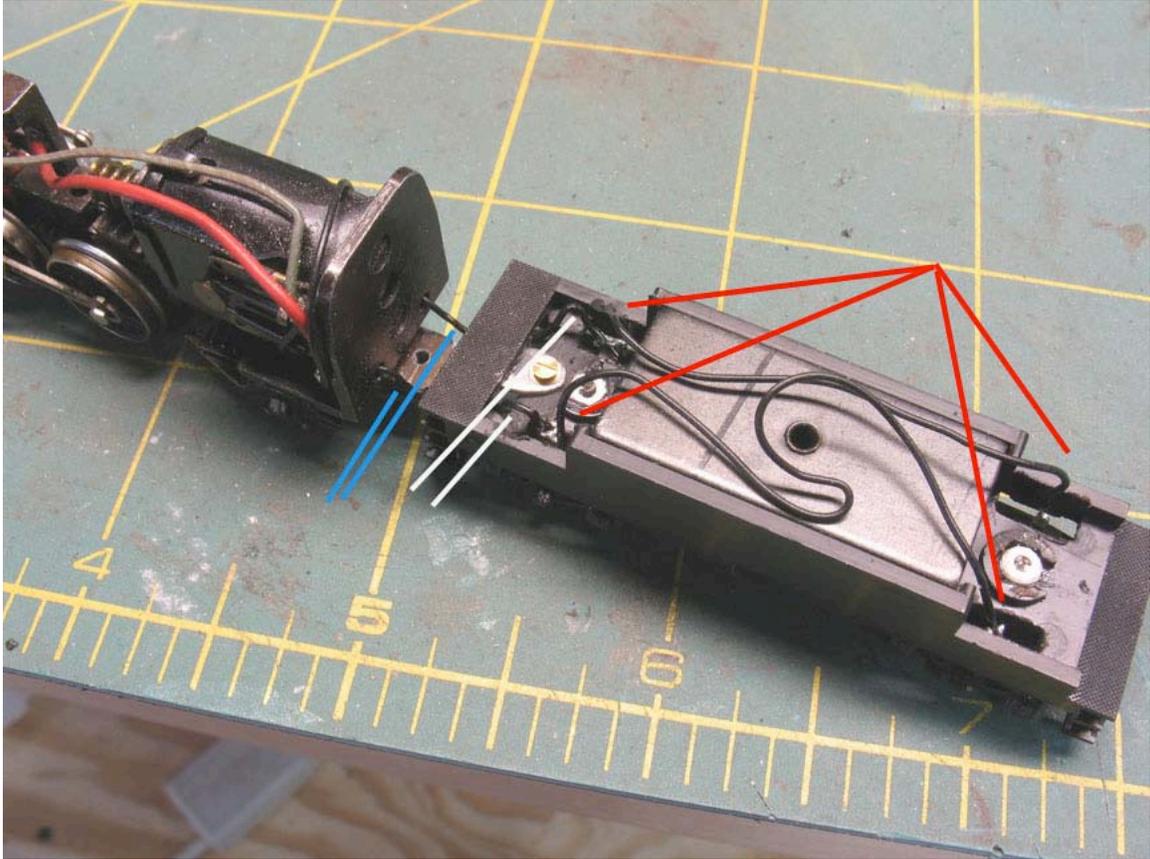


This photo shows how the drawbar fits up into the tender floor. You need to drill a hole in the tender floor, as shown, which will align with the hole in the drawbar end.

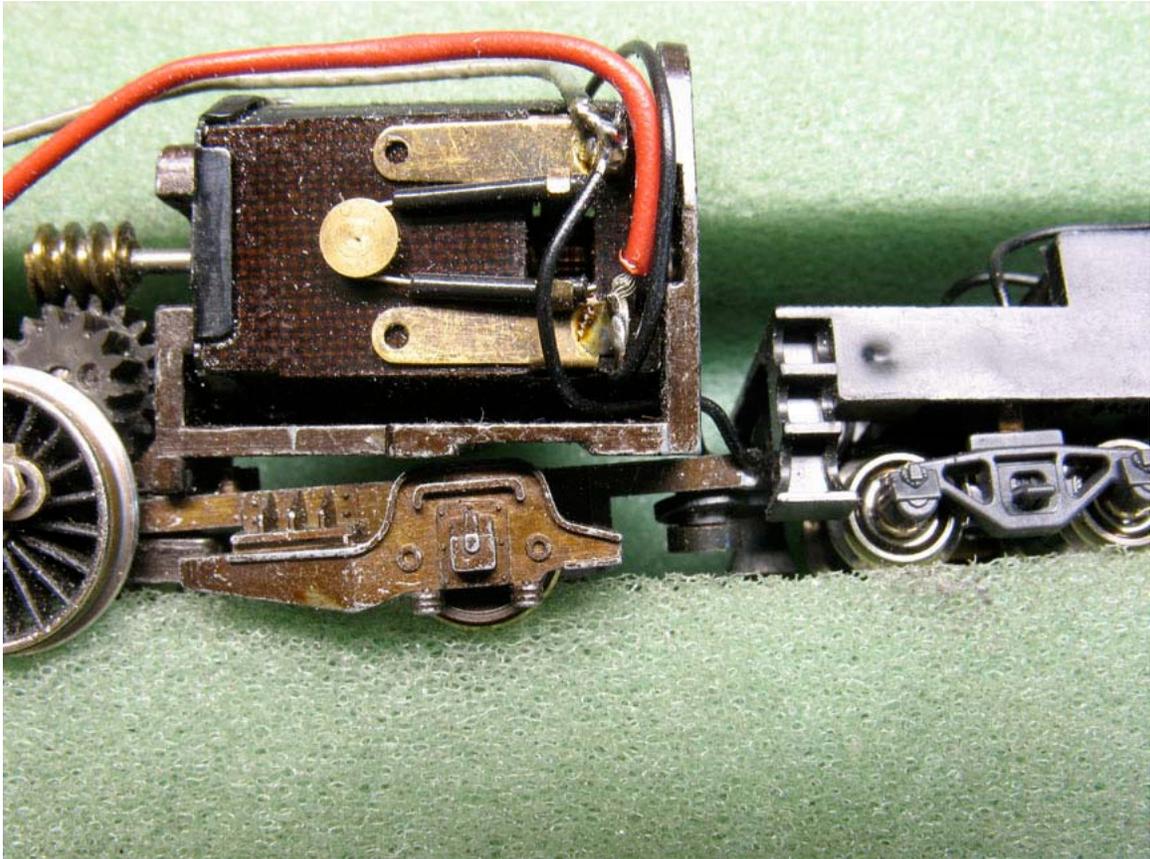


Put a 1-72 screw and washer in place to secure the drawbar inside the tender

The final rewiring step is to solder fine wires to the tender truck contacts, run them forward into the engine, and solder them to the motor.



Solder fine flexible wires to each of the 4 truck contact prongs that protrude up through the tender floor through the 4 rectangular holes that were filed out earlier (red lines). On the front trucks, solder two more fine wires (white lines) that bend into a loop and then come out under the front of the tender, traveling into the locomotive (blue lines). Inside the loco, these are soldered to the motor.



Here we can see the fine tender wires snaking into the engine, soldered onto the motor contacts.

At this point, you should test run the loco for a while. It should start and run reliably and be completely stall-free. It will still run much too fast at full throttle, and it will often jerk to a start as it begins moving. But overall, it will perform much better than the stock engine just because it has reliable pickup now. It will not likely run much slower than about 25 scale mph. But that problem is caused by the motor. We will turn our attention there in the next step.

C – Improving The Motor / D – Improving The Gears

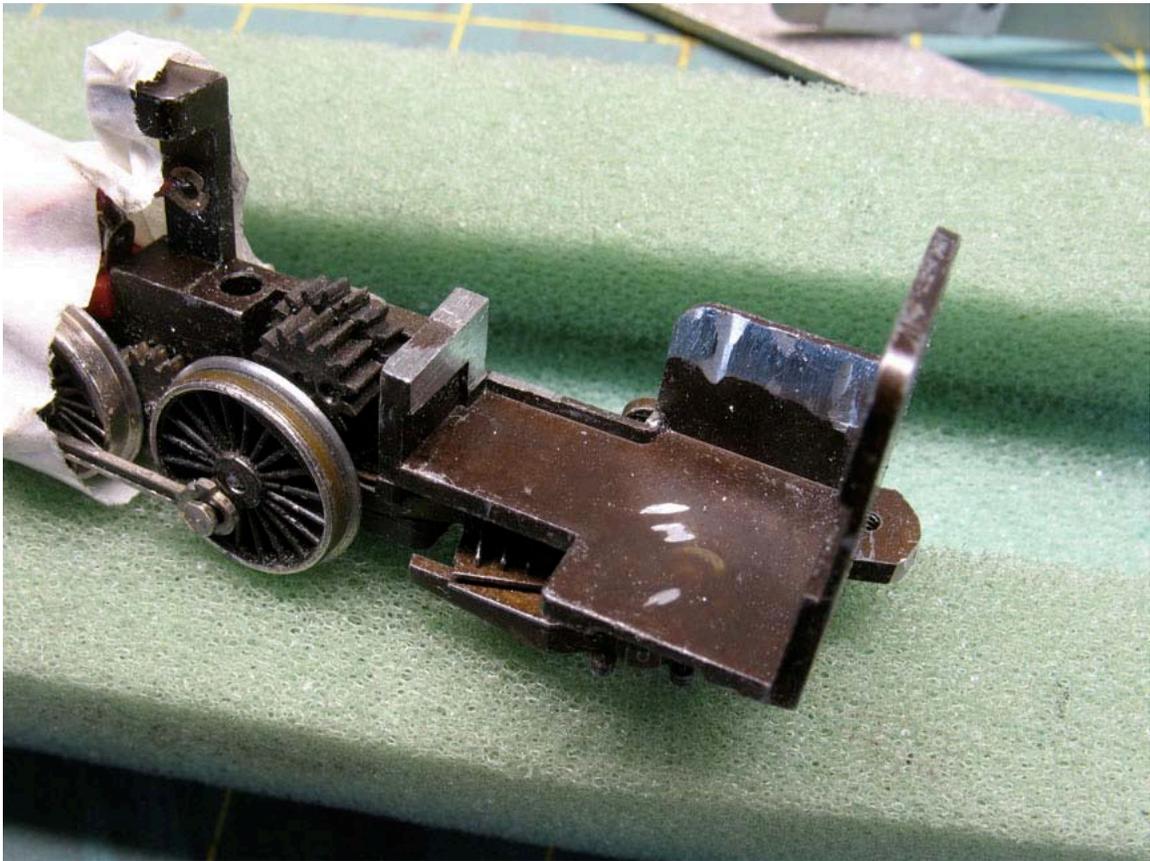
The motor used in the K4 is a very weak open-frame 3-pole design. It has poor low-speed performance and low torque. This makes for an engine that cannot start slowly or smoothly, and cannot pull through curves or up hills without losing speed. We will replace the motor with an extremely powerful coreless Maxon 1320 can motor. Because the motor, worm, and double-gear work together integrally, we are going to replace the motor and the gears in one step. The gear improvement consists of replacing the stock gears with finer-toothed ones to provide more reduction. This lowers the top speed of the K4, which is far too fast. It also provides more torque and allows the engine to start and run at slower speeds.



Old K4 motor (left), new Maxon motor (right). Chassis in the background, with the areas we need to modify highlighted by the red ovals. Note the mechanism is covered with masking tape to keep metal filings out of the gears while we work.

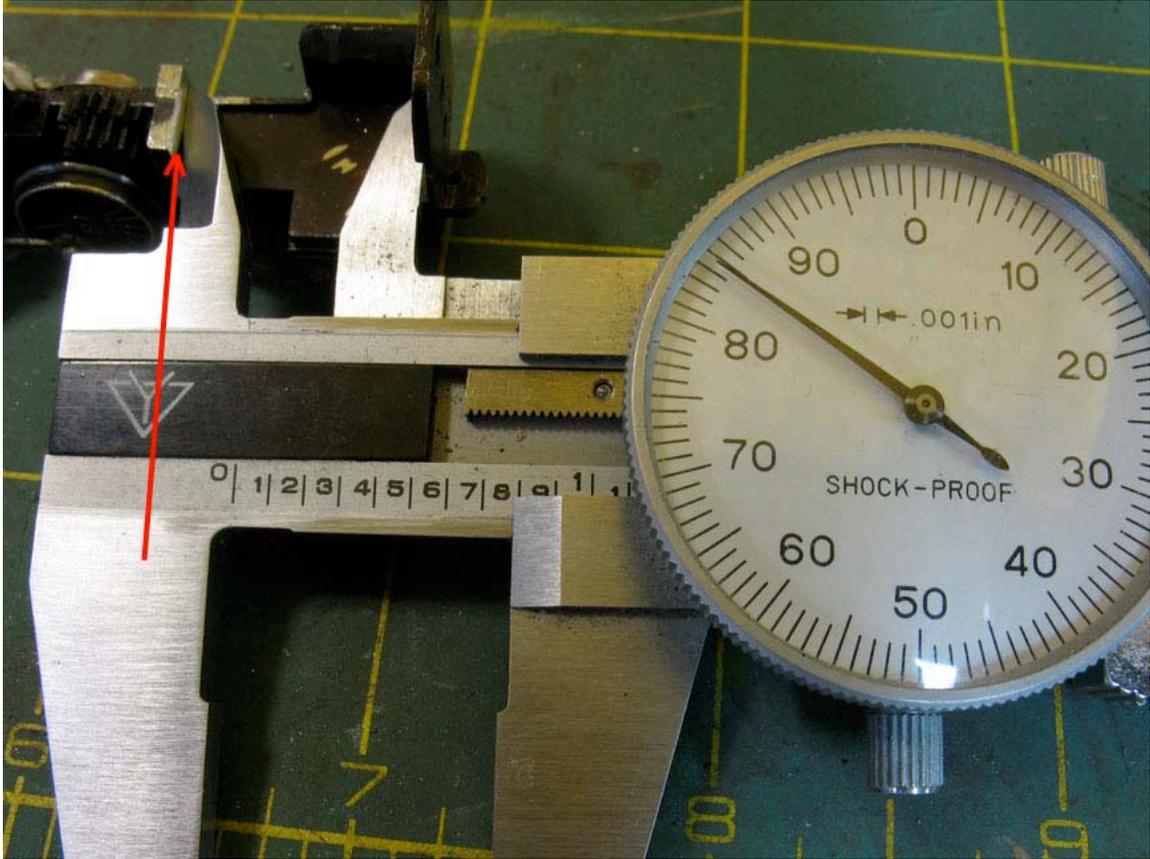
Begin by removing the original motor. To do this, you must unsolder the leads from it (the original wires, and the additional ones from your tender, if you chose to do that step and tested your engine that way). Remove the two screws from the back of the cab area that hold the motor in, and pull it out to the left.

We need to modify the two areas highlighted by the red ovals in the above photo. A motor tool with a cut-off disk works well to cut off the protruding piece in the left oval. After that, use a sharp flat file to finish the job. You should test-fit the new motor as you file. The photo below shows the modified frame.



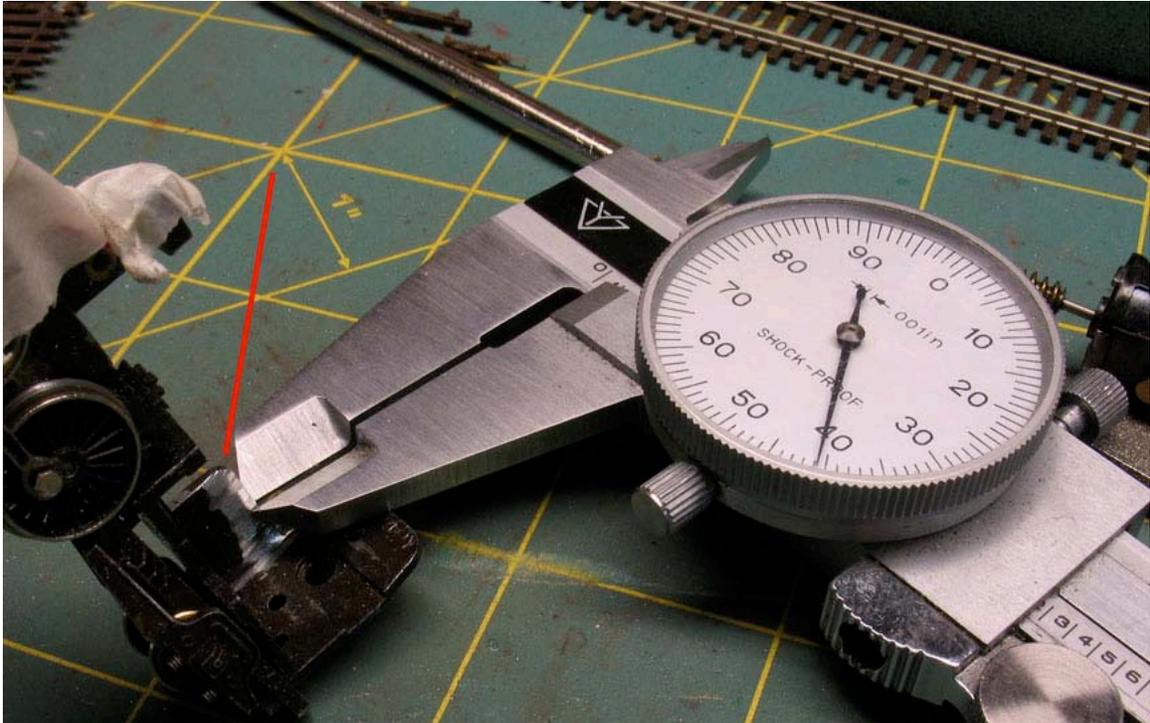
Note the shiny filed areas where the two red ovals were (in the previous photo).

Here are some guides for the frame modifications. File the front motor support area until you can measure a length of 20 mm (0.787 inches), as shown in the photo below.



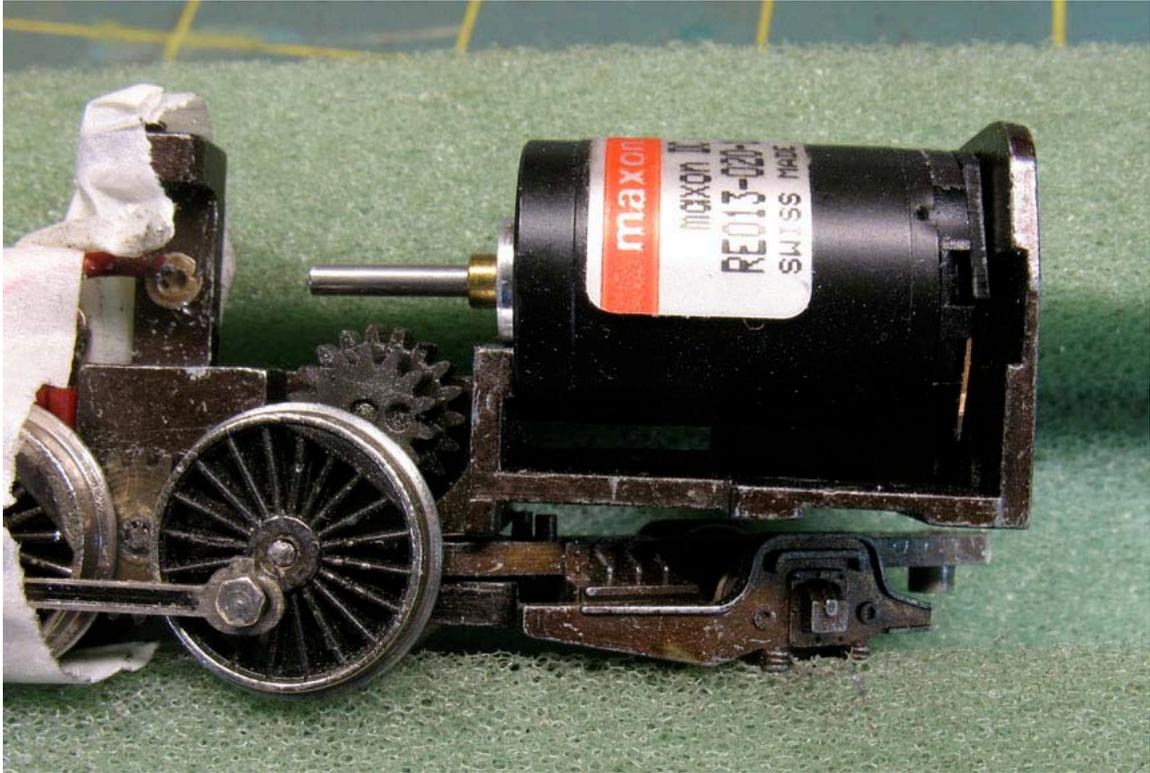
File the area indicated by the red arrow until you measure 20 mm of length for the new motor (0.787") In this photo, the clearance shown on the caliper is 0.785"

The side motor support plate must be filed down to a thickness of .040", as shown in the photo below:



File the area indicated by the red line until the metal thickness is .040" (caliper actually shows .041" in this photo).

Test fit the new motor, as shown in the photo below. It should just fit into place. Do NOT force it. If it does not slide easily in, the motor will push on the back plate of the frame, causing it to bend. That will cause gear mesh and derailment problems.



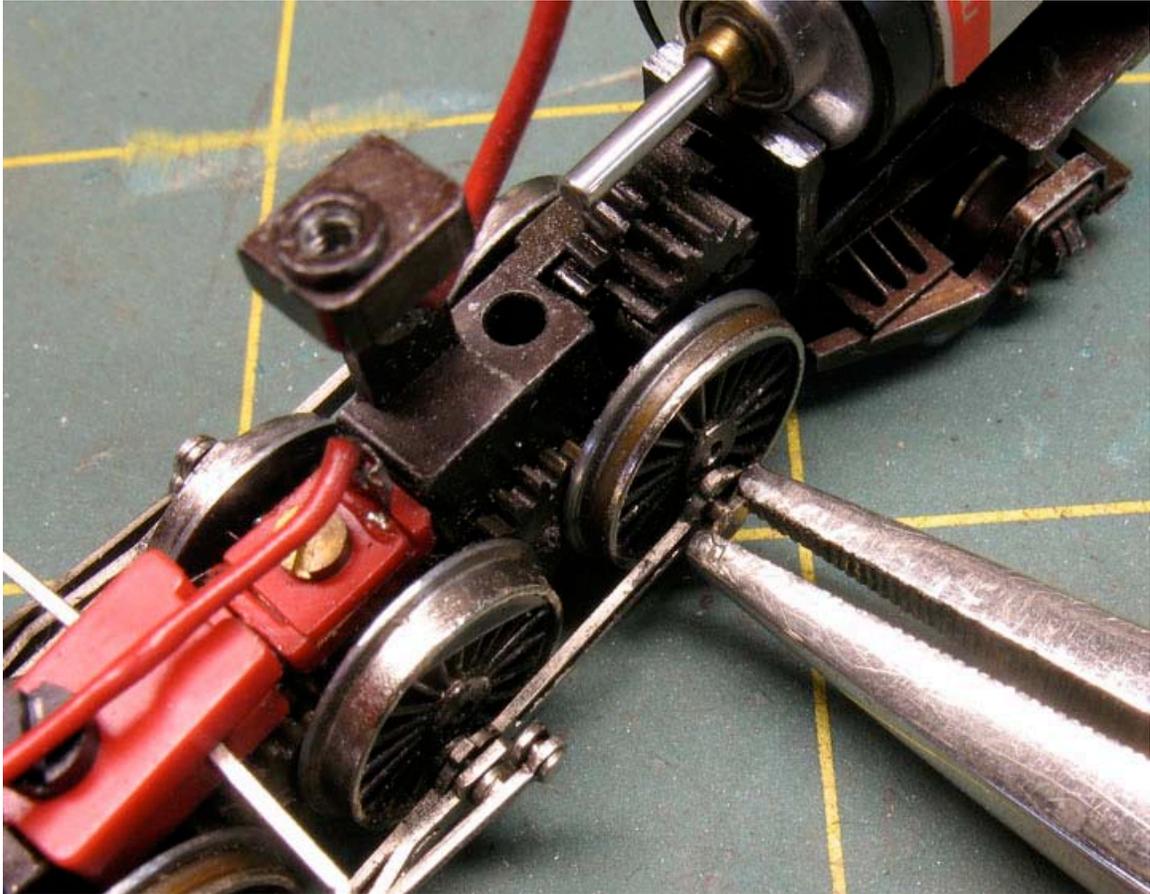
The new motor should slide into place freely. If it doesn't, file for more clearance.

Check the motor fit from the top. The shaft **MUST** line up directly over the center of the larger-diameter half of the double idler gear as shown in the photo below. If your K4 is the alternate style, with a single wide red gear, just align the shaft over the rightmost area of the gear.



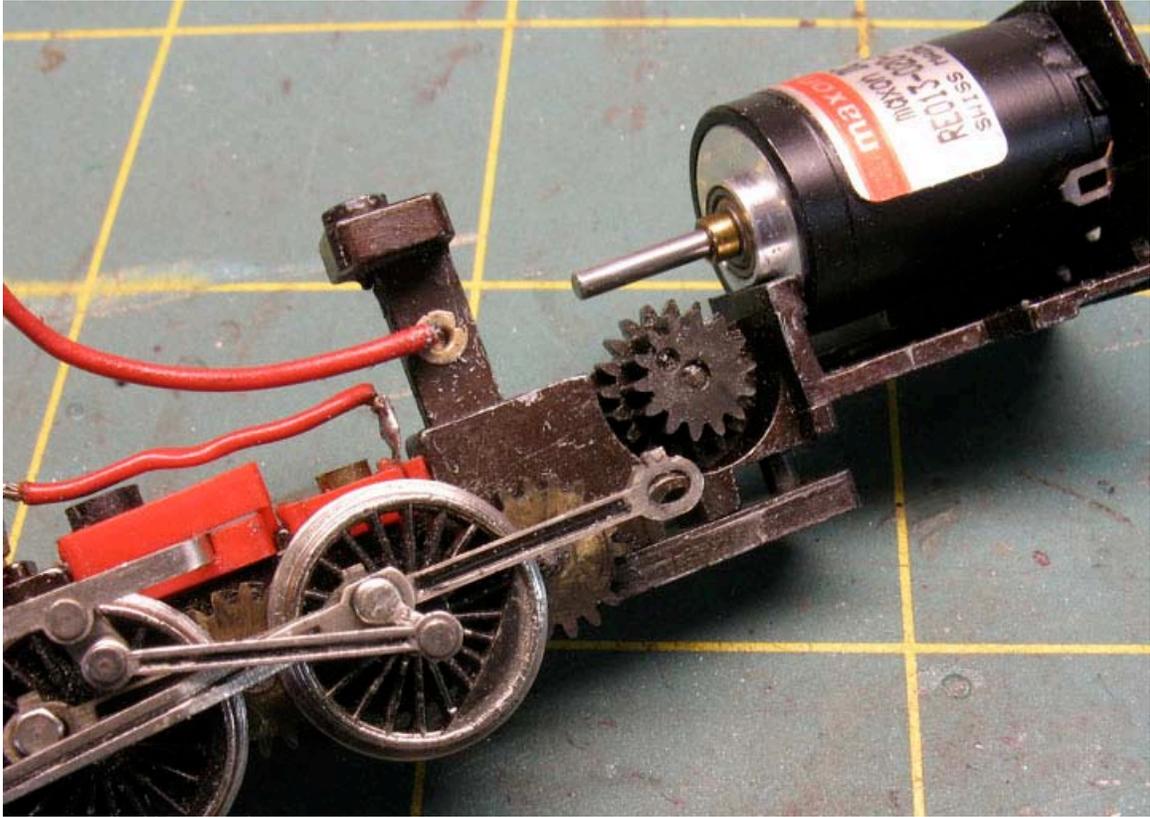
When the motor is completely slid into place against the frame side plate (on the right), the shaft must line up directly over the center of the large-diameter half of the double-gear. That half of the double-gear is barely visible here, because it is directly under the shaft, between the two red lines. That's how you want the motor to fit.

Do not secure the motor at this time! First, we need to change out the double-gear for a finer-toothed one that is designed to mesh with the new motor worm. Begin by unscrewing the two crank pins from the rearmost driver, as shown below.



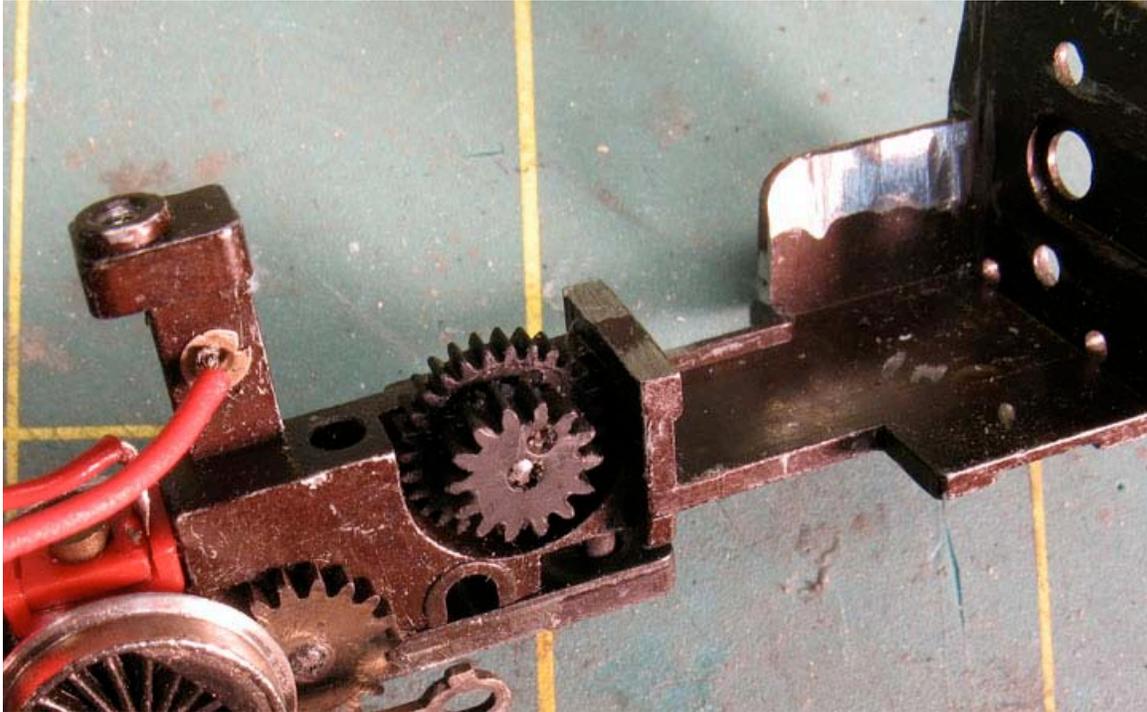
Carefully unscrew the crankpins from the rear driver (one on each side). They should unscrew easily with small needle-nose pliers as shown. Hold the driver with your fingers while you unscrew the pin to prevent it from slipping on its axle.

Now, you can flip the mechanism over, remove the bottom gearplate by removing the two screws that hold it in, and pull the rear driver/axle out. Reinstall the gearplate. Your mechanism will appear as shown below.



Mechanism with rear driver set removed

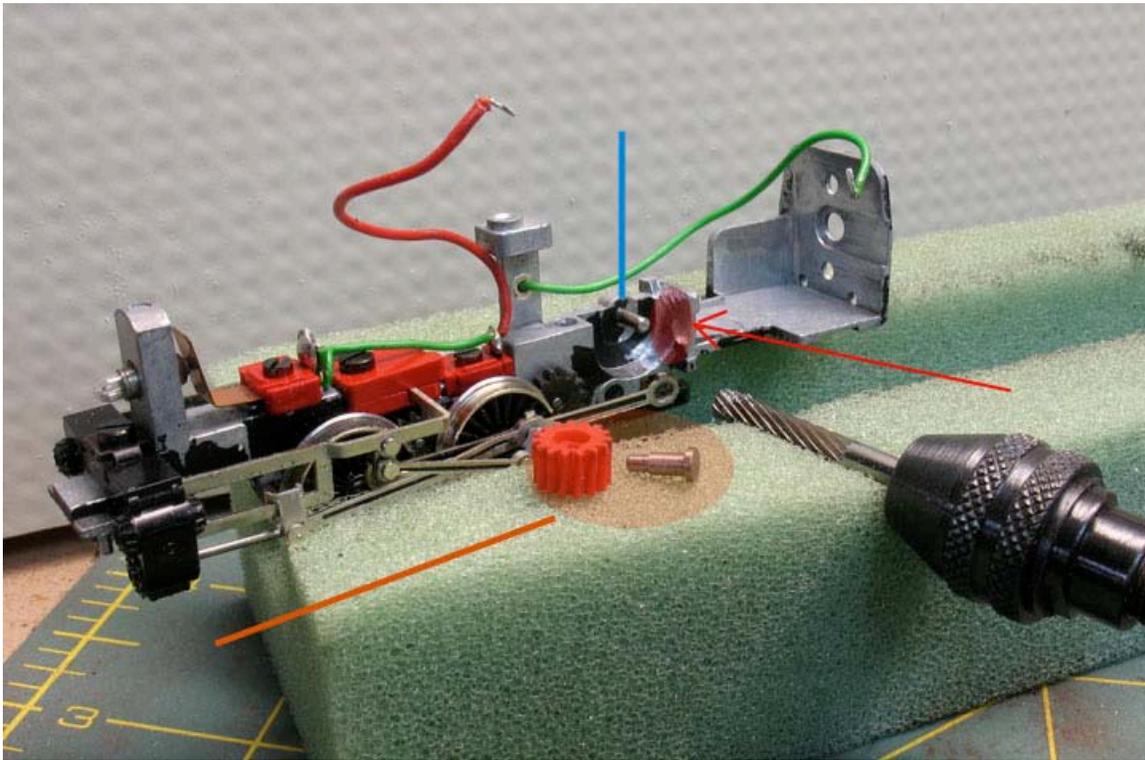
You can now take the stock plastic double gear off its shaft, and replace it with the new one provided in the Micro-Loco-Motion kit. The new gear is shown in the photo below. Note the finer teeth on the larger (rear) portion of the gear as compared to the stock part.



New double-gear installed. Note the finer teeth on the larger-diameter (rear) portion of the gear, as compared to the original gear in the previous photo.
This is the earlier style replacement gear. The newest version is made of brass rather than plastic.

You may have the alternate style of K4 that has a side red gear instead of a double-gear. If so, you will need to complete some extra work before installing the new double-gear.

Follow the photo below.



Extra steps for those with an alternate style K4 that originally has a wide red gear instead of a double-gear.

If your K4 has the wide red gear, you must do the following (follow the above photo as a guide):

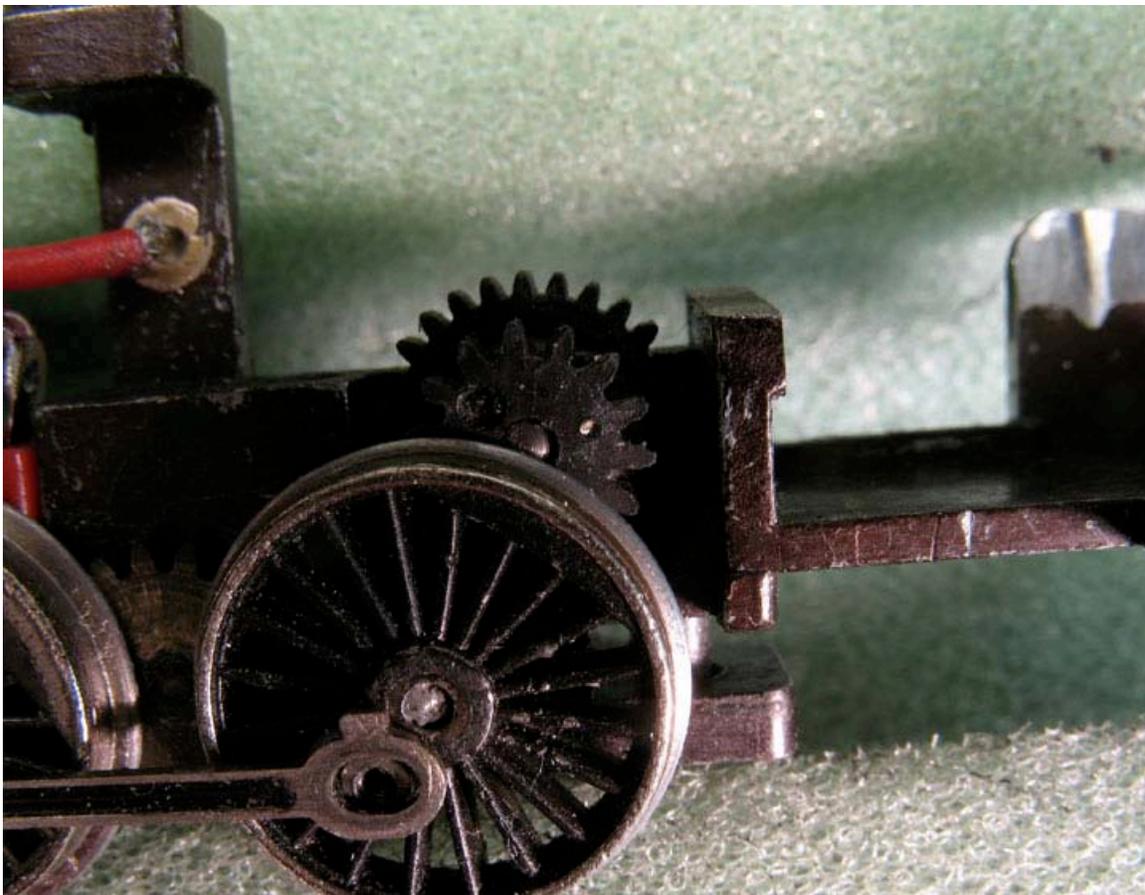
- Remove the retaining stud and red gear. The stud and gear are highlighted in the orange oval in the above photo. You should be able to press a punch or small Phillips head screwdriver into the small end of the pin that shows through the back of the frame (behind the gear). That will start pushing the pin out. Then, you can slip a small screwdriver behind the gear and pry it the rest of the way off.
- Push the supplied piece of 1.5mm drill rod into the hole (blue line in the above photo). This drill rod comes with the micro-loco-motion kit. A pair of needle-nose pliers will do to just push the rod into the hole. I like to get the pin just started in the hole with my fingers or the pliers, and then place the frame/pin into a jeweler's vise, using the vise to finish pressing the pin in. Put a drop of strong 2-part epoxy or Loctite on the pin before you insert it. Let it dry thoroughly.
- Ream some extra clearance in the frame in the area shown by the red arrow in the above photo. The new double gear will not fit into the recess area without doing this. Ream using a motor tool bit similar to the one shown in the photo. Go gradually, until the new double gear can be inserted into the cavity, over the drill rod, and rotates freely.
- Now you can install the new gear as shown in the *previous* photo.

Now, flip the mechanism over, remove the gear plate, and reinstall the rear driver set. As you do this, pay special attention to these issues:

- Make sure the contact wiper goes **BEHIND** the wheel as you drop the axle into place

- Make sure the siderod holes on all three drivers on one side are in the same point of their rotation. Double check it on both sides of the engine.
- Check that the siderod hole for the rear driver lines up exactly over the crankpin hole in the driver.

You may have to gently lift the axle out, rotate it slightly, and reinsert it, until you get it exactly right. When it's right, you will be able to easily screw the crankpins back into the driver using needlenose pliers.



Here is the rear driver reinstalled after putting in the new double-gear. Note how the hole in the siderod lines up exactly over the hole in the driver. The holes should be aligned like that on both sides.

Next, apply a strong 2-part epoxy to the motor shaft, and slip the supplied brass worm onto the motor. A good brand to use for this is JB Weld. Do NOT use too much cement, and be careful not to get any on the bearing where the shaft protrudes from the motor.

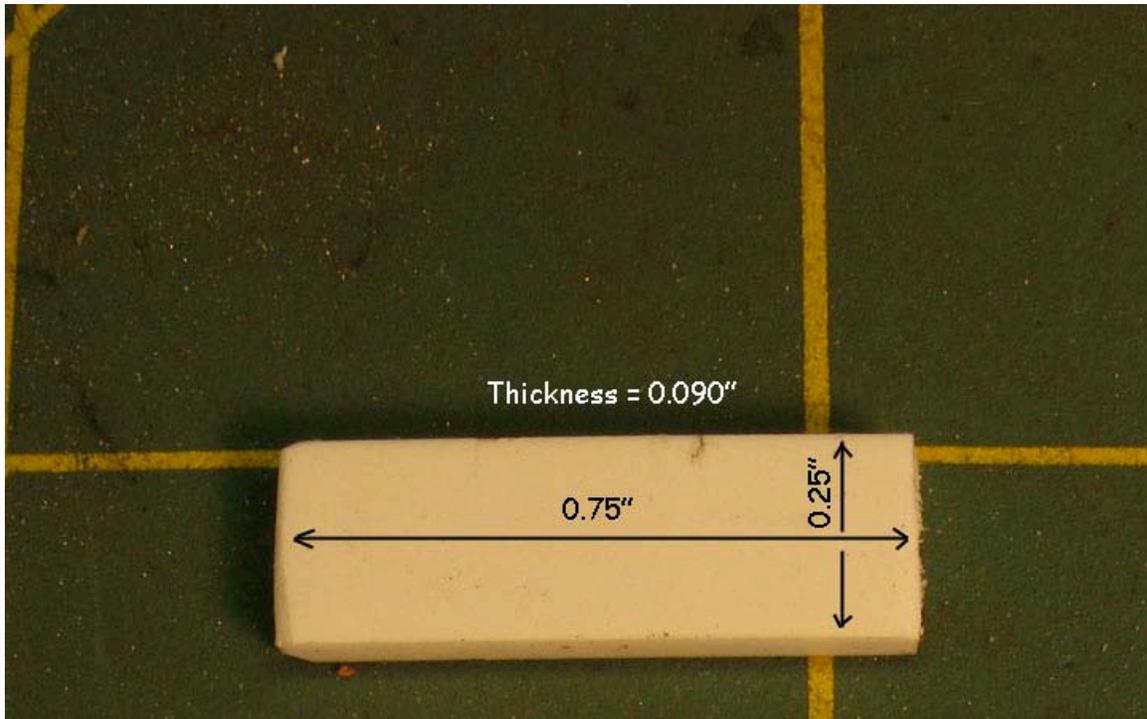
Allow the epoxy to thoroughly harden overnight before proceeding beyond this step!



Use a strong two-part epoxy to secure the worm to the motor shaft. Do not proceed with the project until this epoxy has thoroughly hardened.

Make up a styrene mounting shim that is 0.75" long x 0.250" wide x .090" thick. To do this, use two pieces of styrene sandwiched together. Since .080" and .010" thick styrene are commonly available, use a 0.75 x 0.25" x .080" and a 0.75" x 0.25" x .010" piece. They can be put assembled using ordinary liquid styrene cement.

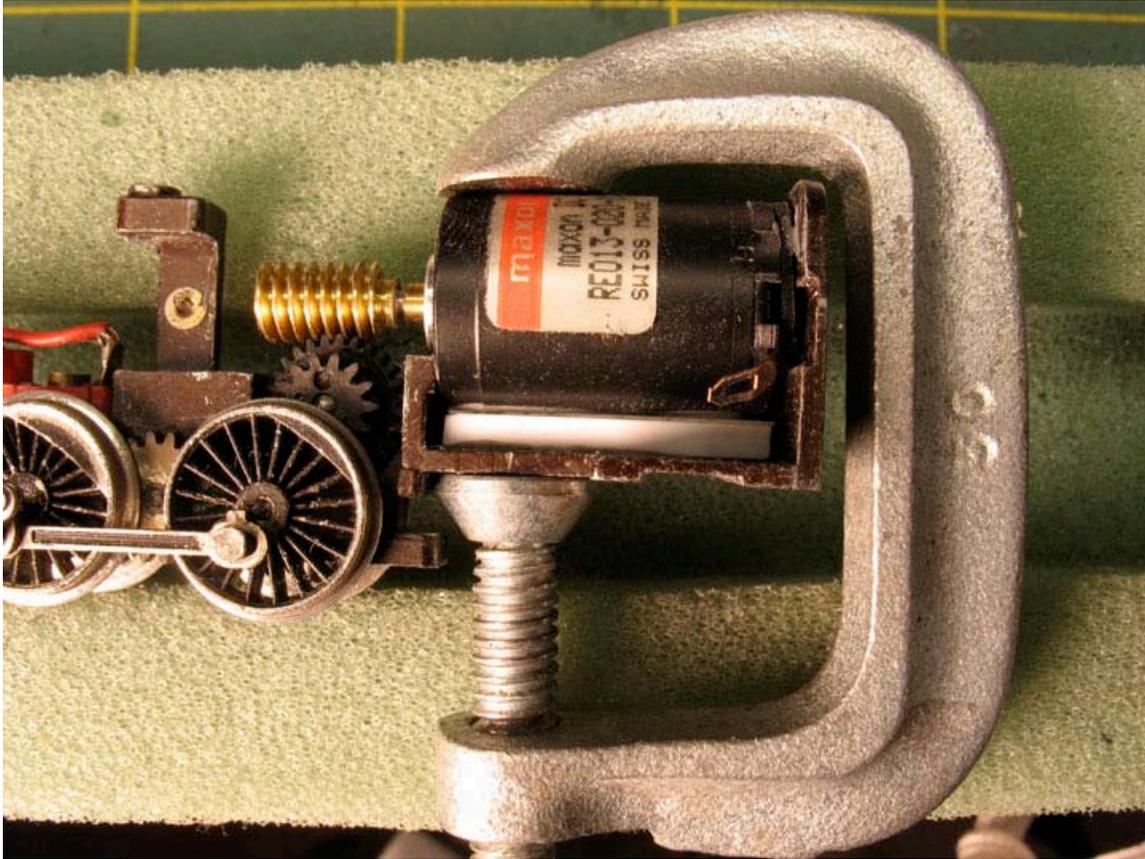
Note: for some engines, usually the ones that came with the older red gear, this shim needs to be 0.110" thick, not 0.090" thick. It will be obvious if this is the case, because the thinner shim won't even be able to touch or support the motor.



Styrene mounting shim, made from two pieces (.080" thick and .010" thick) sandwiched together. *If you need the alternate thicker shim, make it from a piece of 0.100" and 0.010" thick styrene.*

The shim and motor can now be installed in the frame, again using strong two-part epoxy. Firmly, but GENTLY, clamp the motor into position. Do NOT APPLY EXCESS PRESSURE TO THE MOTOR CASE – YOU WILL RUIN THE MOTOR. The idea here is to just hold it firmly enough so it can keep itself in position.

If you have not already done so, screw the crankpins back into the rear drivers (one on each side) to hold the siderod properly in place



Epoxy the shim and motor into position. Check the gear mesh. You should apply clip leads to the motor from a power pack, and check the operation. It should be VERY SMOOTH in both directions and at very low speeds. (Note that the crankpin in the rear driver has been reinstalled in this photo)

DO NOT APPLY STRONG PRESSURE IF YOU USE A CLAMP AS SHOWN IN THE PHOTO. USE ONLY ENOUGH TO KEEP THE MOTOR IN PLACE. THE SLIGHTEST DISTORTION OR “CRUSH” OF THE MOTOR CASE WILL RUIN IT!

You can fine-tune your gear mesh, if you so desire, as follows. After gluing the shim “sandwich” together, and allowing it to dry, sand it down by .005”, making it only .085” thick (check it with a caliper). If you are using the alternate thicker shim, sand it to .105”. This will make the gear mesh more precise and it will run better.

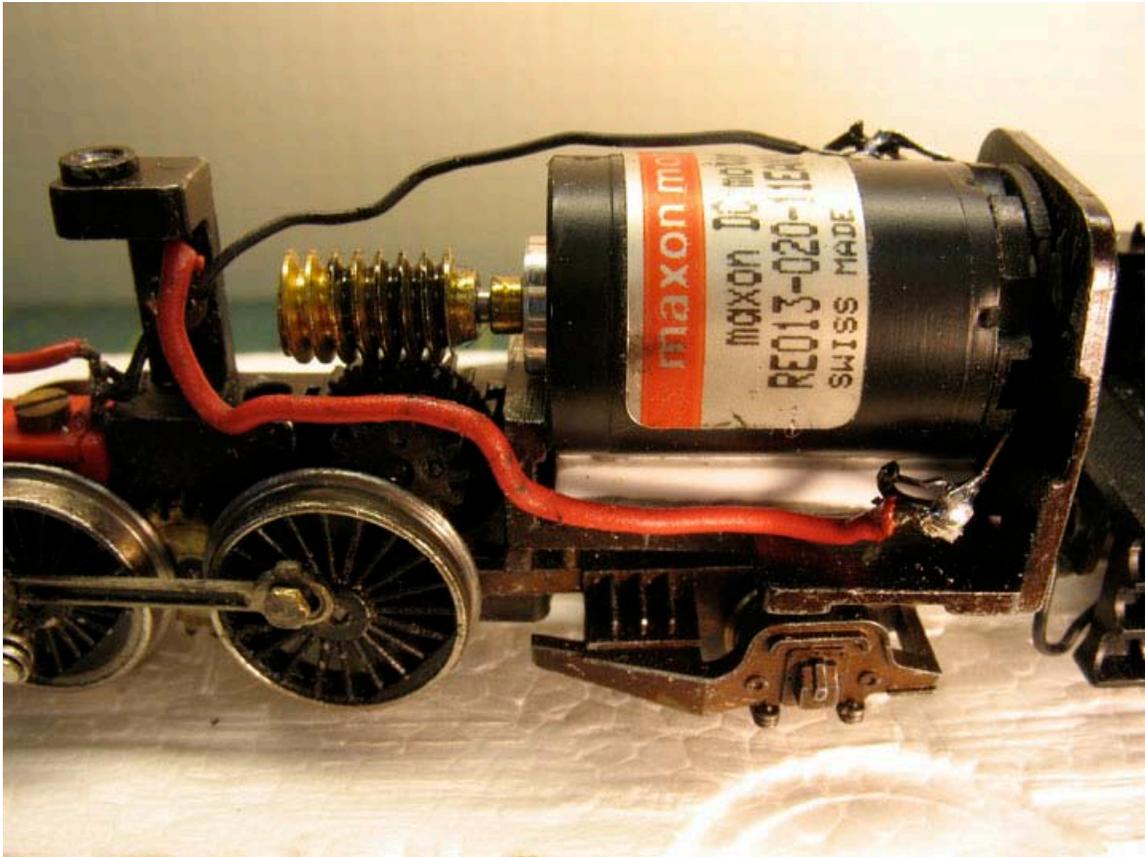
Test-run the mechanism by attaching some clip leads to the motor at your workbench. Do this BEFORE the epoxy sets! If the mechanism does not run smoothly IN BOTH DIRECTIONS, check these items:

- Make sure the motor is not skewed in the frame.
- Make sure the worm lines up exactly over the double-gear
- If you cannot turn the worm freely with your finger, unclamp the motor, and first check that the drivers and gears work properly.
- Put the motor back in and gently hold it with your fingers (no clamp). See if the mechanism runs okay until you press the motor firmly. If the worm binds too tightly to the double-gear as you press the motor down firmly into the frame, you may need to insert another .005" thick styrene shim under the motor. Use .005" – no thicker. The tiniest amounts make a huge difference here and you don't want a sloppy gear mesh.

Once the mechanism runs smoothly, *in both directions*, at the workbench, allow the epoxy to set overnight.

After the epoxy sets, re-solder all the leads to the motor. If you orient your motor the same as in the photo below, you can follow that photo to orient your wires and all will be well. Start with the two fine leads from the tender. Make sure you get the polarity right by placing the engine on the track and giving it a quick test. If it runs the wrong way compared to your other engines, reverse the tender leads at the motor.

Next, solder the two leads inside the engine to the motor. If you get these wrong, you will create a short circuit and the engine won't run. If that happens, reverse those two wires.



Orientation of wires. Note: the thick red wire runs from the eyelet in the loco from to the left-hand tab on the motor. The left-hand lead from the tender also attaches to the left-hand tab on the motor. The thin black lead in the photo runs from the tab in the loco, at far left, that protrudes from the red plastic insulator. The other end of this thin black lead attaches to the opposite motor tab in the upper right of the photo. Finally, the right-hand tender wire also attaches to the opposite motor tab.

D – Reaming the Boiler Shell

You will likely find that the boiler shell will not quite fit on the mechanism after installing this motor without filing or grinding away some of the inside of the firebox area. I use a high speed steel grinder bit in a Dremel for this. Just grind away small amounts, particularly from the left side, inside the firebox area, until the shell can clear the motor. The shell is quite thick in this area and allows for the removal of a good bit of material without compromising the shell. But be careful. It is easy to get carried away

and grind right through the shell. Take of a little at a time, continuing to test-fit the boiler, until it just clears the motor.

This completes the conversion. One final note: As you reinstall the boiler shell, take care not to force any of the wires against the worm or double-gear, and also remember to reinstall the metal weight over the front driver area before putting the shell on.