RESTORING AN ANCIENT EVINRUDE

By Christopher Scratch

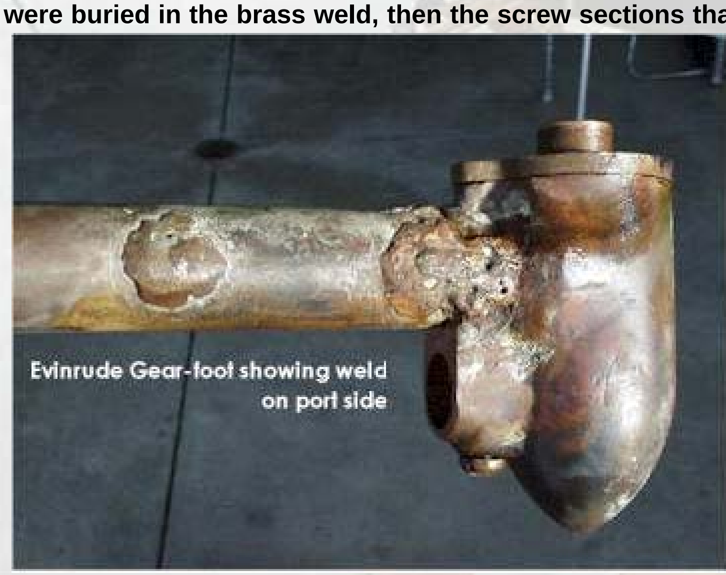
Chapter 3 – Gear-foot Reclamation

Up until now, things had gone relatively routinely, aside from me managing to break an antique piston ring. The power-head part was pretty much dealt with, except for constructing a muffler assembly. I tried calling Midas, just on a hunch, but the 4-to-6 year waiting time seemed a tad excessive, so it was decided that better progress could be made by designing and building my own muffler based on some pictures of other motors from the same era. We'll go into that project later. First we'll get it to run and push a boat, then concentrate on keeping her quiet.

If you recall back in Chapter One, a comment Mr. Skinner had made to me about the overall condition that he found the motor in out in Wisconsin had to do with the appearance of the lower unit casing. There was a heavy build-up of bronze from welding quite evident at the point where the drive-shaft tube joined the gear-foot casing itself, someone has decided to weld the gear-foot screws to the drive-shaft tube, and in addition to that, there was a heavy layer of solder on the outside of the starboard wall on the gear case. Now it was time to discover just what was under all that additional metal build-up and go about fixing whatever condition it might be concealing.

Applying heat from a propane torch was enough to melt off the solder and uncover a patch that had been applied over an access window that had been cut into the starboard side of the gear-foot casting. The only logical explanation for such butchery was that possibly the setscrew for the prop-shaft pinion had become seized or broken, and the window had to be cut to facilitate removal. A tin patch was laid over the hole and soldered in place in an attempt to seal up the hole. I don't think it was a factory-authorized fix-it job, but it wasn't something to give up on. The decision was made that the parts were salvageable, so the task was undertaken to attempt to correct the previous "repairs".

The braze buildup that was used to lock the four screws that fastened the gear-foot to the drive-shaft tube was ground off close to the outside diameter of the tube, thus removing the screw heads which were buried in the brass weld, then the screw sections that were remaining got slots cut in them with a hacksaw to allow the "freed" sections of screw to be turned out in a conventional manner with a screwdriver. The hacksaw was utilized to make further cuts in the brazing that joined the tube to the gear-foot casting. By being careful with the saw, damage to the various parts was avoided, and the tube could be separated from the gear-foot. Turning it in the lathe, allowing the welded sections to be machined back to the appropriate diameter, revitalized the brass tubing. Polishing the tube with emery cloth brought it back to the point that it could be buffed bright if desired. Easy part is over, now on to the good stuff.



With the drive-shaft tube out of the way, the rest of the parts in the gear-foot could be inspected for analysis. The synopsis was that a rebuild or replacement of almost all the gear-foot components, save and except for the gears, prop and water pump, was in order. I suppose that in retrospect, it's nothing you wouldn't expect from a motor that has lived even longer than my parents. The front prop-shaft bushing, which is just a pocket machined into the gear housing itself, was amusing to look at, if for no other reason than to try and guess how it had managed to attain such a degree of ovality. While the rear prop-shaft bushing was in reasonable condition, the shaft itself was worn down to .618" to in spots, while the "good sections" of the shaft were closer to .625". The drive shaft had sections that measured down as low as .610" in diameter, while its corresponding support bushings displayed an out-of-round condition not unlike the front prop-shaft bushing. While yours truly is neither a very experienced nor overly competent machinist, I felt it was a challenge not to be feared, so onward it is.

The front prop-shaft bearing seemed to be the worst-case scenario here, so that's where the attack began. Using the Bridgeport and a suitable vise & Vee-block set up, the housing was secured on the mill table and indicated to pick up the center axis of the prop-shaft by using the "good" rear prop-shaft bushing as the origin point. After verifying that the rear face of the gear-foot was parallel to the table, the bushing ID was indicated at two "Z-axis" points to verify alignment. Now that the part has been indicated, the rear-bearing cap could be removed to facilitate the machining of the front bore. A long ¾ inch end mill was used to bore the oval hole round again. Since the manganese bronze used to cast the housing is relatively soft, it doesn't take much effort for a sharp cutting tool to make its way through the antique metal. The "window" that had been cut in the gear housing did come in handy for verifying the progress & depth of the cut, I must say; but I'd rather that it wasn't there just the same. At any rate, with the new hole machined to an appropriate depth, the shavings from the end mill operation were washed out of the part, and I used a pair of Oilite bushings (.750" OD X .625" ID by .500" long) as the new front prop-shaft support system. The bushings were pressed into place, and voila, the matter of supporting the front end of the prop-shaft was solved, and I'm not ashamed to say that I was quite proud of the result.

Now, time for phase two. The drive shaft displayed some wear issues in the area that runs against the bushings that support it. After talking with some folks that do spray welding on shafts such as this, it was decided that it would be more economical to make a new part out of a length of Thomson shafting. There were three main operations involved in the manufacturing of this component; cut the stock to length, drill the locking-pin hole for the drive pinion, and mill the slot along the length of the shaft to allow the passage of a .187" key for the power-head-to-drive-shaft coupler. The Bridgeport went to work again here, after indicating the shaft stock in the vise to find the centerline, a 3/16 inch carbide end mill was used to mill the slot. Slot length was about 7 inches, or about half the length of the shaft itself. Slot depth on the old part was measured at about .230", but I decided to mill to a depth of .250" just to relieve any possible clearance issues. Thomson shafting is case hardened, and has a very hard outer "shell" for durability. You have to machine about .050"/.060" into the material to get through the hard outer skin and into the softer mild steel in the center. Machining through the skin, I made cuts of no more that .005" deep; after I hit the softer center, I increased the depth of cut to .010". I was not in a hurry. The RPM's were set at 1200, and the hand feed was used to advance the table. Twenty cuts later, I had the result I wanted and I didn't break any tools doing it. Now, without removing the shaft from the mill vise, I used the old part as a pattern to indicate the drive-shaft pinion gear lock-pin hole location. Just to make sure it was centered properly, I went through the exercise of using an edge-finder to verify the centerline location. The end mill went to work again as I cut through the hard outer layer to make a flat spot for the center drill. With the flat milled, and the center drill used to make a pilot counter-bore, first a 3/16, then a ¼ inch carbide end mill was employed to punch the rest of the way through the shaft stock. I know you're supposed to use a carbide drill on this material, but there were more end mills around than there were carbide drills. Twas a bit of a bugger coming out the other side, but lots of oil helped the progress of the end mill. With the hole machined to .250", it would allow me to use a ¼ inch roll pin to lock the drive gear onto the shaft, in place of the original straight pin that was peened over to keep it from coming out. A ¼ inch roll pin has an uncompressed diameter of about .260"; once it goes into a bore that is .010" smaller, it won't easily work its way out. The pinion had to be re-sized to suit, as the original holes in it were 15/64 inch (.234"). After using a hand-grinder to break the sharp edges of the slot and put a slight chamfer on the machined hole, I grabbed the mating parts and tried to fit them all together. Perfecto! Now I can breathe again.

But, we're not done here yet. After working with the Thomson shafting, it was decided to use a more

easily workable material for the prop-shaft itself. A length of ¾ inch cold-rolled steel was turned in the lathe to the appropriate diameter(s). There is a section that the prop-shaft gear fits over that is 5/8 inch in diameter; the rest of the prop shaft is .687”. There is also a ¾ inch long stub at the rear of the shaft that has to be machined so that a threading die can be used to make the thread for the prop-nut. Not a difficult job to turn the shaft in the lathe as long as you know what you’re doing. I’m one who doesn’t know what he is doing, so I rely on tips and advise from those who do. Anyway, after turning the diameters to within about .001”/002” of the desired finished size, the emery cloth went to work for final sizing and finishing. The emery cloth they sell as “utility roll” is handy to keep around. I started out using 120 grit to begin with, and then graduated to 220 grit to smooth out the finish. I spin the part at about 1200 RPM for polishing. When I’m happy with the finish from the 220, then I turn the strip of emery cloth over, oil the back of the strip, and hit the shaft with that, it really does a pretty good job of polishing up what you’ve created. Works really well on crankshafts too, but you might not want to spin them quite as fast. (An old leather belt is good for polishing journals as well). The holes for the shear pin and the prop shaft pinion gear retaining set-screw were drilled, and after using a die to put the 7/16 NC thread for the prop nut on the stub, which completed the manufacturing of the prop-shaft, it was time for another breather.

After mulling things over at this point, I decided that going after the drive-shaft bushing replacement would be next, and save the patching of the gear-case “window” for last. Back to the mill we go, as the foot is fixtured in a Vee-block & angle plate arrangement on the Bridgeport table. A bit of a quandary here, and only after much inner debate and careful consideration of the matter was it was finally decided to indicate the outside diameter of the bearing section as an origin point & alignment axis. Theoretically, I would want the bushings to be concentric with the OD of that section of housing, since I was assuming that the shaft should be in the center of the drive-shaft tube at all times. After much checking and re-checking with the co-axial indicator, finally I was satisfied with the alignment of the part relative to the machine collet. I believe that the proper procedure at this point would have been to use a boring bar to machine the diameter out to make it round again, but without such a tool in the arsenal, the end mill was put back to work. The end mill would not allow me to machine the entire length of the bore, but it was my opinion that if I could machine down to a depth of at least one inch and press in new bushings, enough support would be given to the new drive-shaft that there would not be any problems created; after all, this is not a motor that is going to run 2000 hours per year. I also had concerns about being able to mill a hole accurately much past the one-inch depth level. As it was, I went to about one-inch-and-three-quarters, and was able to pop three ½ inch long bushings into place. After some initial checking of the assembly for fit and function issues, it was discovered that the new shaft did not want to enter into the new bushings. Measurement of the installed bushing ID indicated that the diameter & alignment was not a problem, but the shaft diameter was the same as the bushing ID. Since the Thomson shafting is case-hardened, any resizing for clearance with have to be done to the bushings. This was accomplished by use of a suitable reamer. Most folks probably don’t have a .626” reamer sitting around, but there just happened to be one within arm’s reach, since we used to make pulleys to be installed on 5/8” furnace blower shafts, and the pulley had to be about .001/.0015 over the shaft diameter. After running the reamer through the re-built outboard part, the shaft fit through very nicely. You can only imagine the sigh of relief that was released when it all actually went back together and there was no additional binding evident as the drive-shaft was rotated. After using some blueing to verify the contact of the gears, it was now time to close the “window”. The guts of the gear-foot were removed and stored out of harms way.

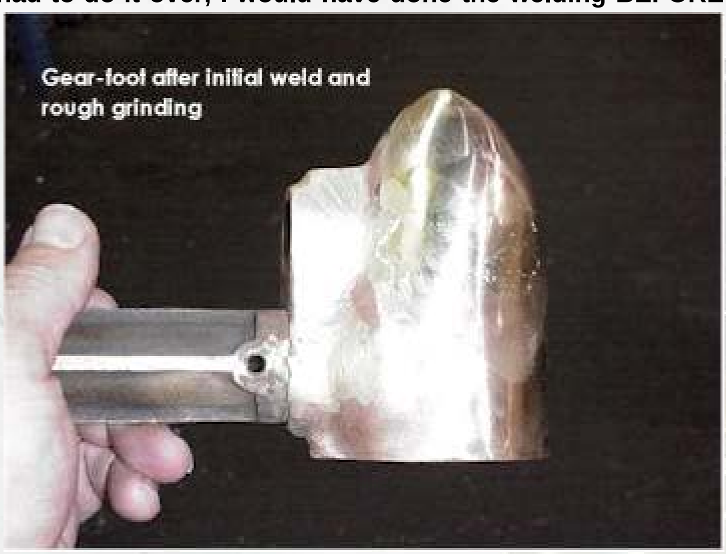
It was time for the patch job. Oh boy. Deep breath here. The thinking is that it had to done right the first time. Wrecking the lower unit housing would render the motor inoperable. How many spare gear-foot housings for a 1910 Evinrude might be laying around? If I mess this up, where am I going to get a replacement? Have to plan this just right. Plot out what is to be done, make notes, and follow your instincts. One step at a time, there’s no race going on here.

First operation was to remove as much of the lead solder as possible, which was accomplished by heating the affected area of the gear-foot slowly with the torch and wiping the solder off the surface with a damp rag. Then, a hand grinder was used to remove any last traces of solder from the outer surfaces and also the inside edges of the window. Lastly, a bevel was put on the window edges to assist in helping the weld penetrate sufficiently, and the housing was now ready to receive a replacement section. After more careful deliberations, it was decided that welding a piece of brass cut to fit the dimensions of the window would be the best approach. I had wondered where would be a simple place to find a piece of brass that would match as closely as possible the material I was

working with; it turned out to be a old beat-up propeller from a Mercury Mark 55. It had the right thickness, and even close to the correct curvature for this application, so a resection of prop blade was performed. After using a belt-sander to size and fit the repair piece, it was off to the welding station. Oxy-acetylene torches were used. I understand that a person can tig-weld brass, but I don't have a tig-welder at my disposal that I know how to use, and anyway, this is an antique motor, so the thought was that an antique process should be used to restore it. I also figure that with oxy-acetylene torches, I can weld a pop bottle to the sidewalk if I put my mind to it. It took about 10 minutes to heat things up to the point where I was satisfied with the puddle formation, and so the weld repair proceeded. Fortunately, the torch did not "pop" on me, thereby sparing the frustration of having a weld puddle spatter all over the place with the resulting gross porosity that almost always is the end result of such an event. When the welding was finished, the part was allowed to air-cool until it could be safely handled, then the excess brass was sanded off using the belt sander to the point that a hand-grinder could finish the rough profiling. The hand-grinder was followed by wet-sanding with 600 grit paper, then the repair site was surveyed, and a decision made to further attempt to fix up some of the pinholes in the weld. The second welding attempt would be the last, one way or another. Well, maybe NOT the last; maybe just the second of many. I suppose I was being too fussy, and ended up doing a lot more remedial welding and grinding than was originally planned to plug pinholes that kept popping open, but finally got a result that was considered as acceptable.


- Section of Mercury propeller cut & sized to fit Evinrude Detachable gear-foot

With the final weld, grind, sand and polishing of the gear-foot completed, it could be re-assembled for once and for all. I guess in retrospect I got really lucky (again) with the repair of this lower unit; if I'd had to do it over, I would have done the welding BEFORE I did the work of machining and installing the bushings into the housing. It never occurred to me that applying heat with the torch might possibly cause some distortion in the housing until one of the guys in the maintenance department at the plant asked me about if it could happen or not. Well, no sense worrying about it after the fact, might as well carry on and see what result we had. With all the components installed, and packed full of fresh grease, I attempted to rotate the shaft by hand. It did rotate, but with some resistance, so some further inspection of the shaft alignment took place. Nothing seemed out of the ordinary, so I chucked the drive shaft in the mill and turned it on. The resistance rapidly decreased as the shaft turned, and after a minute or two, I was satisfied that the resistance was merely due to the overall tightness of all those new parts not being broken in yet. Later on that afternoon, the lower unit was put back in place at the base of the drive-shaft tube of the motor, ready for action. I just had to try cranking the flywheel. It felt so velvety-smooth as it rolled over; I thought it was almost as good as one of Skinner's motors, he he.


Gear-foot after initial weld and rough grinding

Now I was curious to see if it would run now that's its just about all back together.

Sure looked purty, sittin there all painted and cleaned up, but its gonna get dirty sooner or later, eh! Since I was in the garage anyway, and the test barrel was still full of water, temptation got the best of me and, after finding and installing a length of clear plastic hose for the water line from the pump to the cylinder, the motor got clamped onto the tank. I poured about 2 cups of 8:1 mix into the tank, hooked up my battery and buzz-coil, opened the needle valve about ¾ of a turn, bounce back and forth a few times to prime it, turn on the juice, bounce against compression, and POW!!! It fired once or twice, then quit. Now, what did that Chilton's manual say about starting these motors? Let me think for a minute….. oh yes, "repeat if necessary", so the start sequence was repeated, with the same result. Checking the carb setting, I figured it wasn't getting enough fuel, so turned the valve out to about 7/8 of a turn, and try again. This time, no fire, no pop. Hmmmm…… maybe I went the wrong way with the needle, so its back in to the closed position, bounce the wheel, bounce the wheel again, bounce it a third time which gets the motor running for about 3 seconds. OK, I was flooding it, I forgot how sensitive these old mixing valves can be. Setting it at ½ turn out, primed and bounced again, with the result being that this time the motor took off and ran as one would expect it should. It made quite a racket, running with the open exhaust and with the sound reverberating throughout the garage. The motor was actually outside the garage, in the driveway, but the sound snuck in through the open doorway just the same. Her bark sounded like a serenade from a firing squad, she smoked like trailer-park trash in a bingo parlour, and she did an admirable job of pumping a fair amount of cooling water out of the cylinder and onto the crushed stone, but she ran like a champ for a good two or three minutes. After reveling in the success of the starting and overall quality of the running of the motor, I realized that it was quite possible that the neighbours might not appreciate this as the historic event in marine history that any collector might deem it to be, nor share in my enthusiasm in the revival of some ancient aquatic iron; so, after snapping a couple of digital pictures for posterity's sake, the fuel valve was closed, the motor quickly came to a halt, and thus peace and tranquility were restored to the neighbourhood, and I was spared a tongue-lashing from the folks in the subdivision who were so rudely disturbed during their Sunday morning brunch.

Well, that's all for now, hopefully things get finished off in the next chapter. Until then, good luck with your old iron Eh!

[Chapter 1]
[Chapter 2]
[Chapter 4]