MAL WARE TECHNICAL REPORT

A MALware Technical Report
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Edison amplifier horn restoration

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Introduction

Details the process of restoration for the horn amplifier from the Edison Disc Phonograph. Includes repairing solder, re-finishing, and extending the pivot arm. This was the final stage in replacing the original motor and horn from the Edison Disc Phonograph after the clockwork in the original seized and stopped working entirely. The replacement motor, plate, and horn were listed as being the same model as the original, however this was discovered to not be the case and has thus required extensive restoration and adjustment within the cabinet and on the replacement parts.

Process

At start, the horn amplifier was in three pieces (horn, upper horn attachment/pivot and pivot axle, lower attachment/pivot.) The project scope:

1. Repair broken solder joints.
2. Recoat.
3. Extend the lower pivot arm by 10cm with a steel stub.

Machining

Item three seemed easiest. I took some steel (12L14 free machining) that was the same diameter as the lower pivot hub diameter, so it would look aesthetic,

and cut a 10cm long chunk. The lower pivot is a threaded bolt ending in a sort of ball that snaps into the Edison case, and is threaded so it screws into the bracket that is soldered to the lower end of the horn. It was obviously 24 threads per inch. I thought it was 3/8” in diameter because that’s a (well, the only) common diameter for 24 threads per inch material. It was not.

Fig. 1: well now what.

On the bottom, a 3/8-24 tap, which is an SAE UNF

standard. On the top, the Edison lower pivot. So what is it.

Well, when you have a manual thread-cutting lathe, at some point you don't really care: you just make something the same size.

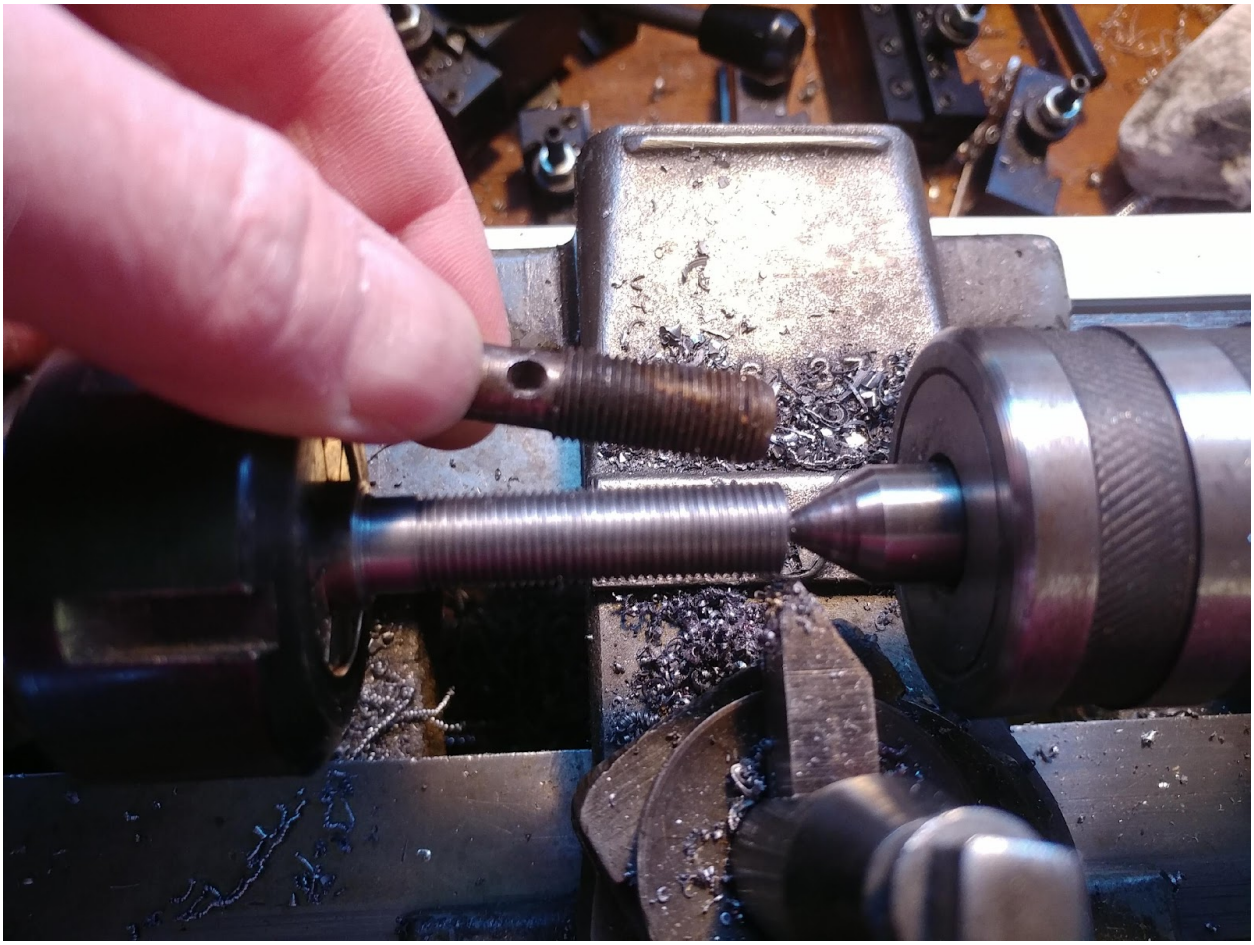

Fig. 2: can cut threads great, can't focus the camera

I cut this as an all thread stub, with a chamfer on each side, in some mystery steel (probably 12L14) and as it turns out it is approximately 7/16-24tpi. Thread form is

60 degree taper with a slight rounded root, as per SAE standard.

This threads into the original lower bracket. The 10cm pivot extension is drilled through and internally threaded the same way. That way it can thread onto the stub, the original brass end pivot can thread into it, and it behaves like a single unit.

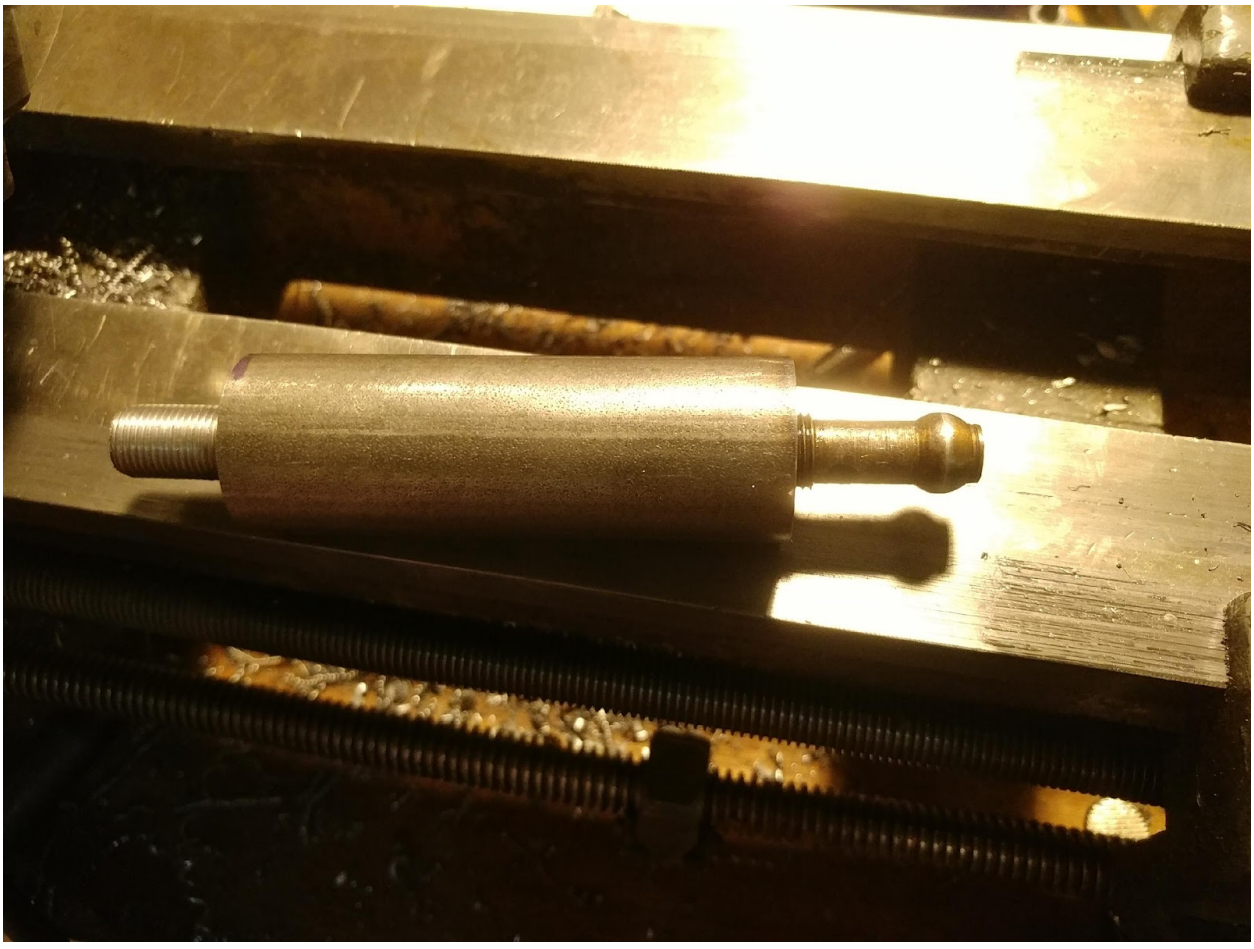

Fig. 3: extension with new threaded stub on one end, and original pivot on other, glamour sepia color.

The threaded section has some loctite on it so it'll stay in place in the extension. The extension was drilled and tapped with a 10-24 thread, and two brass thumbscrews were fabricated, one for the extension and one for the original bracket. These thread in and bear perpendicular against the steel threads (upper) and brass threads (lower, original pivot) to prevent them moving and unscrewing as the arm pivots back and forth during use.

Fig. 4: one thumbscrew, 10-24.

The thumbscrews were cut on the lathe, threaded, moved to the mill and grooved for increased gription, then moved back to the lathe and parted off. They're in brass with chamfered ends so they don't damage the steel threads, as they bear on the sharpest/weakest part of the steel thread.

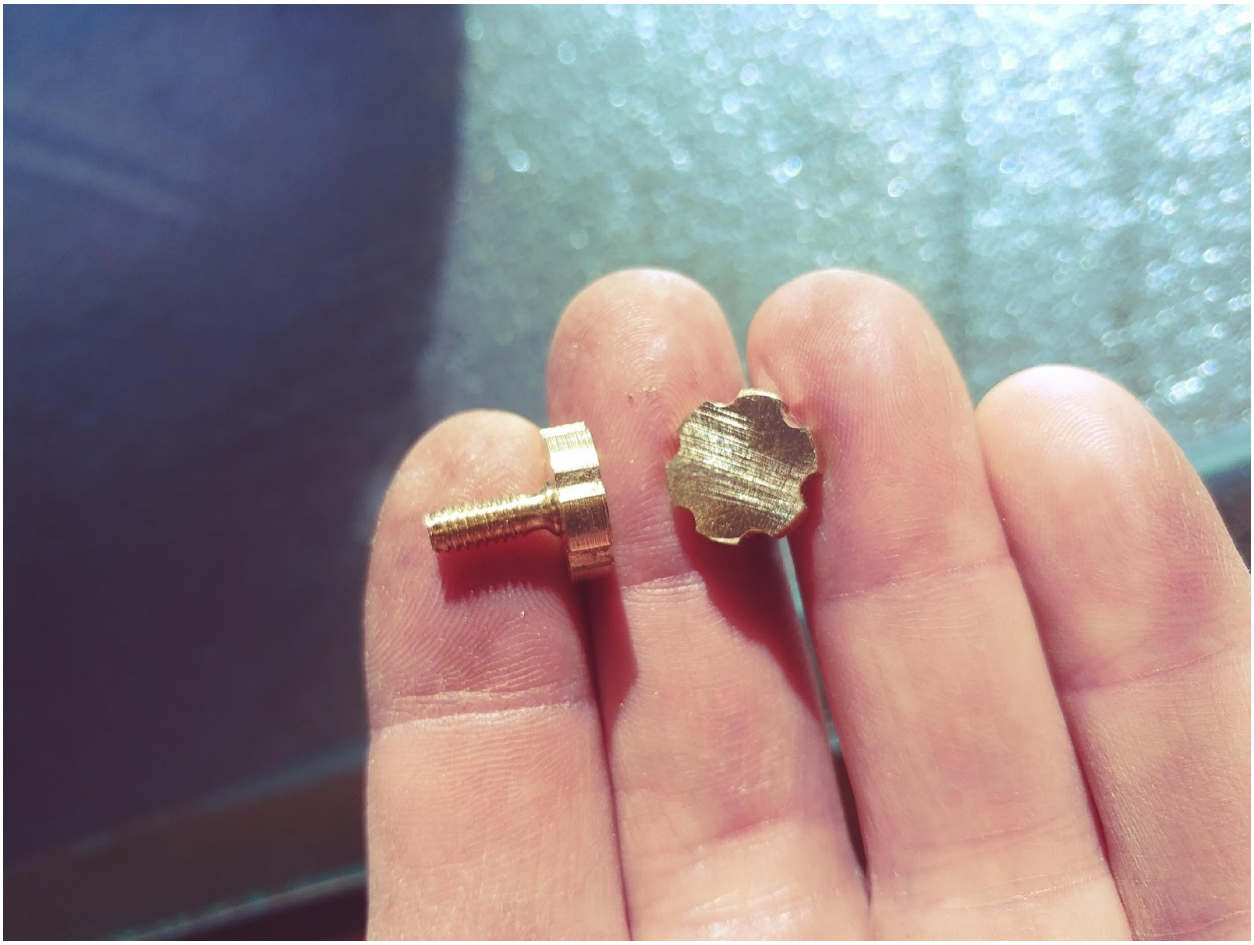

Fig. 5: both screws.

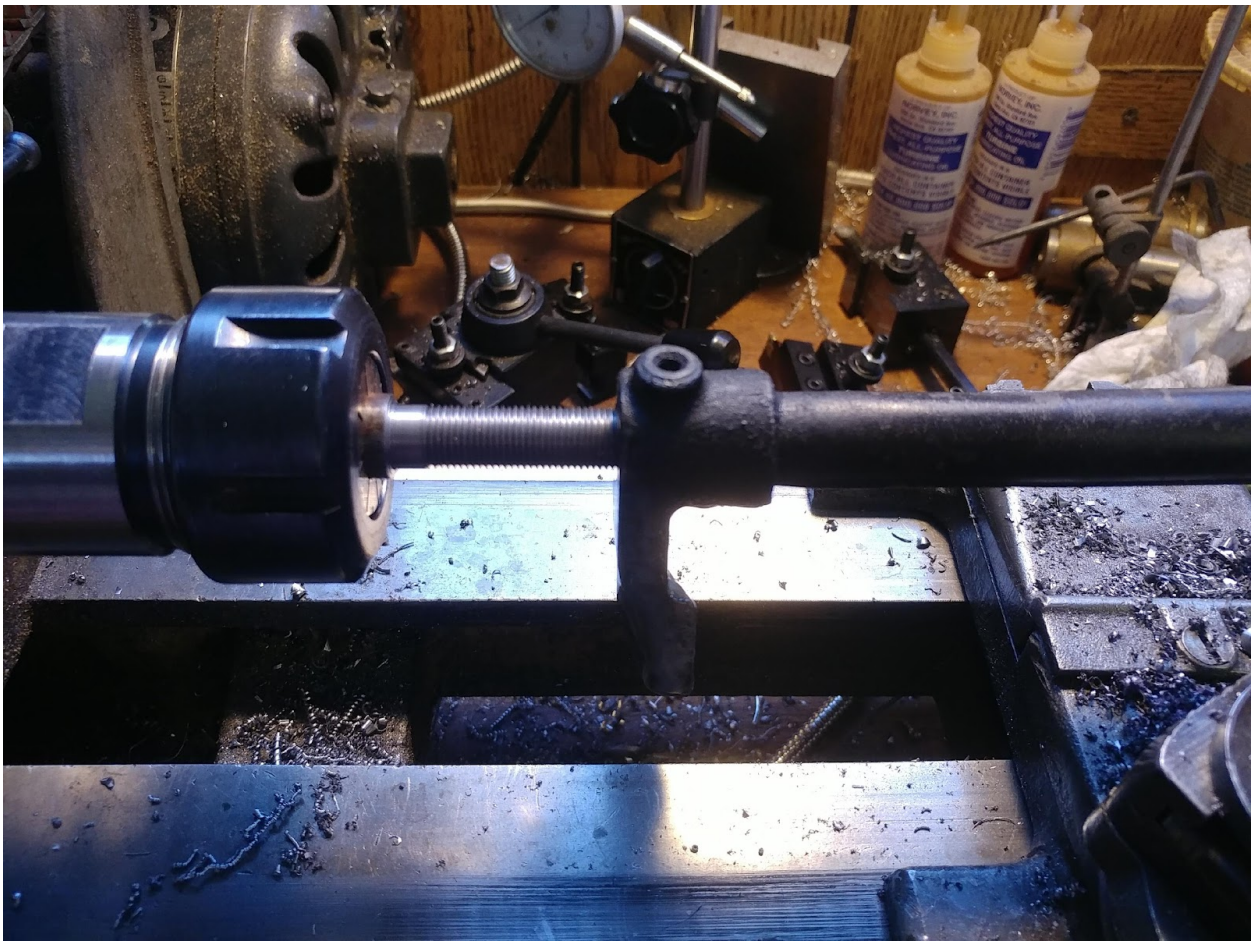

Fig. 6: lower bracket test fit.

In fig. 6 the original (missing) thumbscrew location is visible. This prevents the adjustment screw from shifting during use, so this is where the other thumbscrew is fitted.

Japanning: Removal

The black coating is some mystery stuff that comes off on your hands if you handle the material. Emily Velasco (@MLE__online@twitter.com) suggested it was japanning, which was the standard anti-rust coating for

steel and cast iron for the entire 1800's. It removed easily with paint stripper.

Fig. 7: starting the process of stripping off the coating.

This stuff worked well. The horn needed to have the coating stripped on inside and outside of each solder joint (bottom and top) and the brackets similarly needed their contact points with the horn and with each other stripped prior to re-soldering.

Fig. 8: more stripping.

All joints were wire brushed post-stripping in preparation for re-soldering.

Re-Soldering

The original was soldered with pure lead. The original was probably soldered using pure lard as flux, although sometimes rosin, which is pine sap cut with turpentine or alcohol, was also used. I ended up using commercial flux, but I did use pure lead to add.

I cleaned up all the joints with a wire brush and using the old broken lead joints as guides, clamped all three pieces together, then reflowed with an oxypropane torch. Because lead is such a poor conductor of heat, it's pretty easy to direct the torch on an area and melt it, add some lead, then move on to an adjacent area, letting the first bit freeze. It is not necessary to heat the whole joint to melting, so it's similar to TIG welding but much lower temperature. The original coating was stripped back to about 3cm away from the joint and did not get hot enough to get hurt during the process of reflowing the joints.

Fig. 9: bracket clamped to horn, first solder joint finished. Flux debris is visible across the joint.

Fig. 10: closeup of top joint post-soldering.

I worked my way around the joint, adding flux with a brush and then reflowing the lead locally.

Fig. 11: soldered, washed, and wire brushed.

Fig. 12: lower bracket soldered, washed, cleaned up.

Japanning the phonograph tube

Japanning mix is a poorly defined combination of turpentine, boiled linseed oil, and asphaltum.
I bought 500g of gilsonite, a trademarked brand of asphaltum, and started trying to figure out a good mix. Emily Velasco suggested a YouTube video by a guy who had worked with it a bunch and had some recipes. What I ended up using was a 4:1 ratio of turpentine and linseed oil and adding gilsonite to that.

Fig. 13: vile brew

What I found is that the turpentine/linseed oil mix is quite thin, like water, and I added the recommended amount of asphaltum (about 1.5x by weight) and then I had a slightly sludgy colloidal mix of very thin material that would run off, and I kept adding asphaltum until it finally got to the consistency I wanted, which was more like molasses, and I went to apply it to some steel, and then it was like chewing gum.

This is the mix I used on the pivot extension. It's very thick and not smooth. So the second time, I made the same mix of the liquids, added the recommended amount of asphaltum, and used a stirring hotplate to mix it. At a heat of 45C, with low stirring, after maybe five minutes it fairly quickly dissolved fully and became a molasses-like mix that painted on very nicely.

Fig. 14: like chewing gum.

Fig 15: consistency of molasses.

Fig 16: Japanning applied, thick viscous coat slowly drying.

The recommended way to dry this is to put it in an oven and heat it to 200F, then cool it down, then heat it to 300F, then cool it down, and then to 400F and cool it down.
This is not going in any oven I ever want to use again. This stuff reeks. This stuff smells like pure liver damage.

I put a forced air heater beside it and a thermocouple on the back side of the material and heated it to 200F, let cool, heated to 300F, let cool, but could not manage 400F in an open room in the middle of winter in an unheated workshop.

Edison phono amplifier: finished

This has the completed extension, with the thumbscrews populated, the solder joints fixed, and the inside, outside, and brackets re-japanned.

Fig. 17: finished and assembled

Fig. 18: Japanning cured

There was a side plot involving a dent (visible) in the horn near the needle end making it sit too low to adjust the needle to the right tension. I unbent that a little by sticking a wooden dowel the same diameter as the input to the horn in a vise and bending the whole assembly to get an extra 8mm of clearance between the two ends of the horn. Then it seemed to work okay.