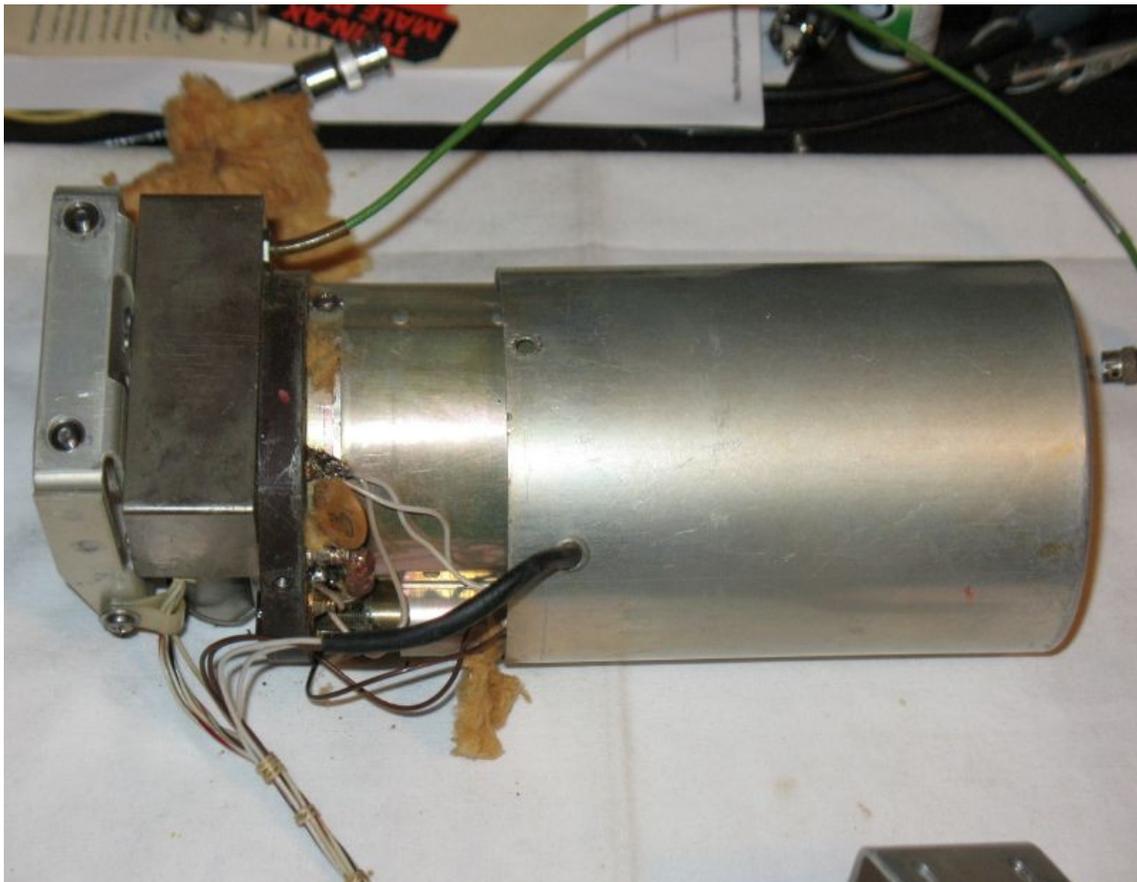


R-390A Collins PTO Observations
Larry Haney, 6-22-2018.

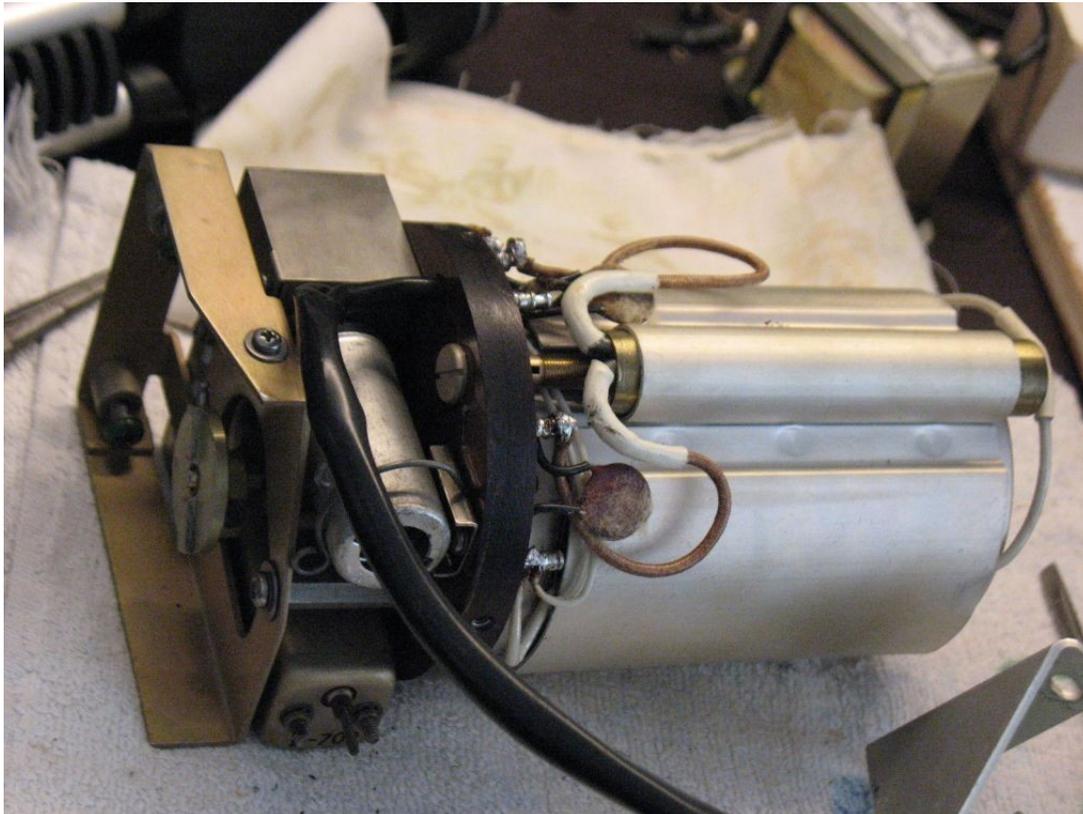
I went through an R-390A Collins PTO and got it working quite well. I'd like to share my experience with you. There was a lot of great information online, and I studied it carefully. It's very worth while and I won't be covering it here, so you should read through it. Thank you all very much for your contributions.

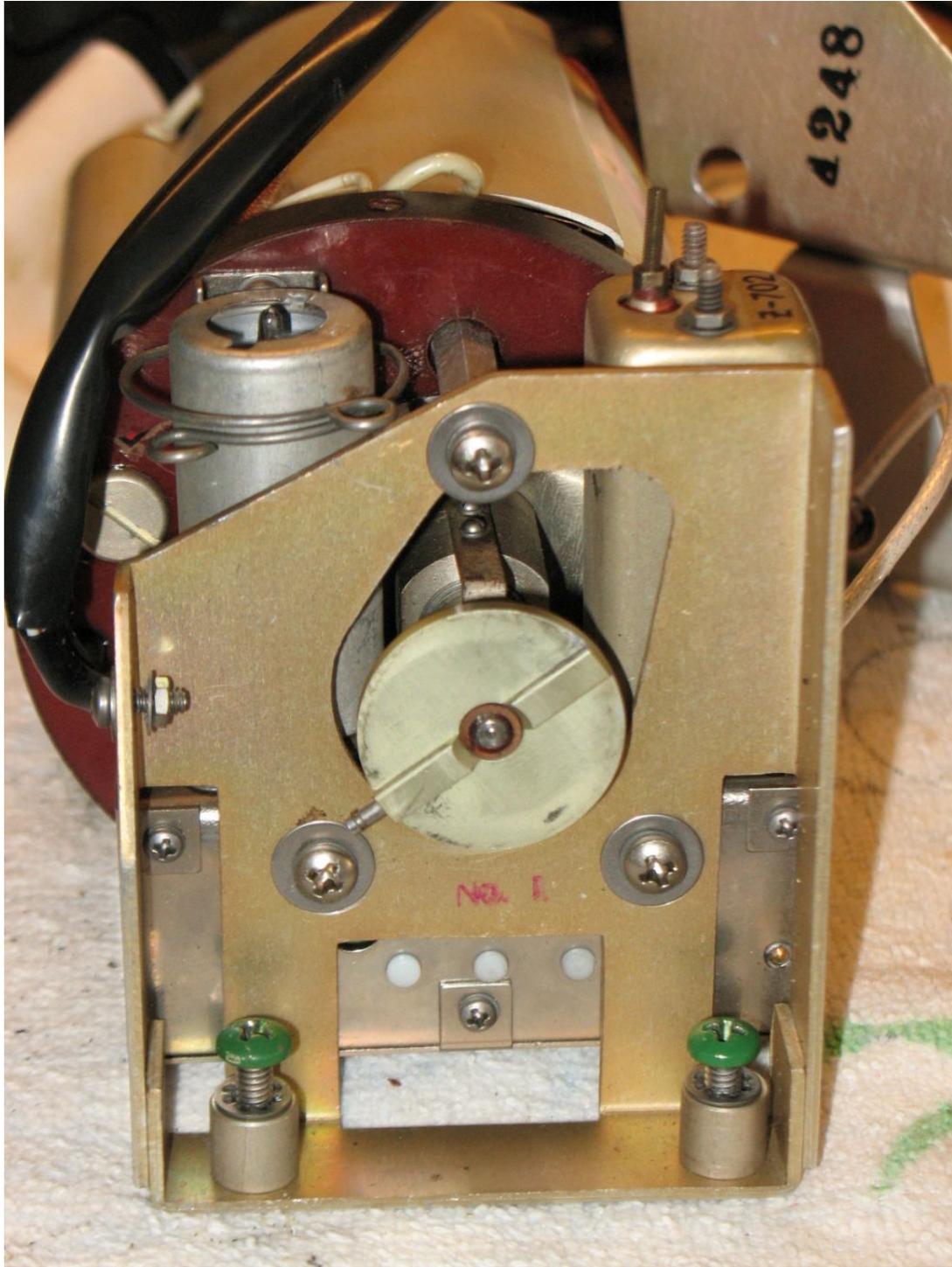
All of the designs of the R-390A PTOs made by numerous makers are basically the same except for the Cosmos. Opening them up is like any 390 PTO. Before you do though, check the end play on the main tuning shaft. There should be none that you can feel. If there is and it goes unrepaired, you will have forward/backward tracking issues, and probable warbles trying to zero beat a station or trouble tuning in CW or SSB stations. You should also check the rotational freedom and smoothness of the shaft. You need a slight resistance, but it must be very smooth and consistent from end to end. If not, it will have tuning and wear issues.

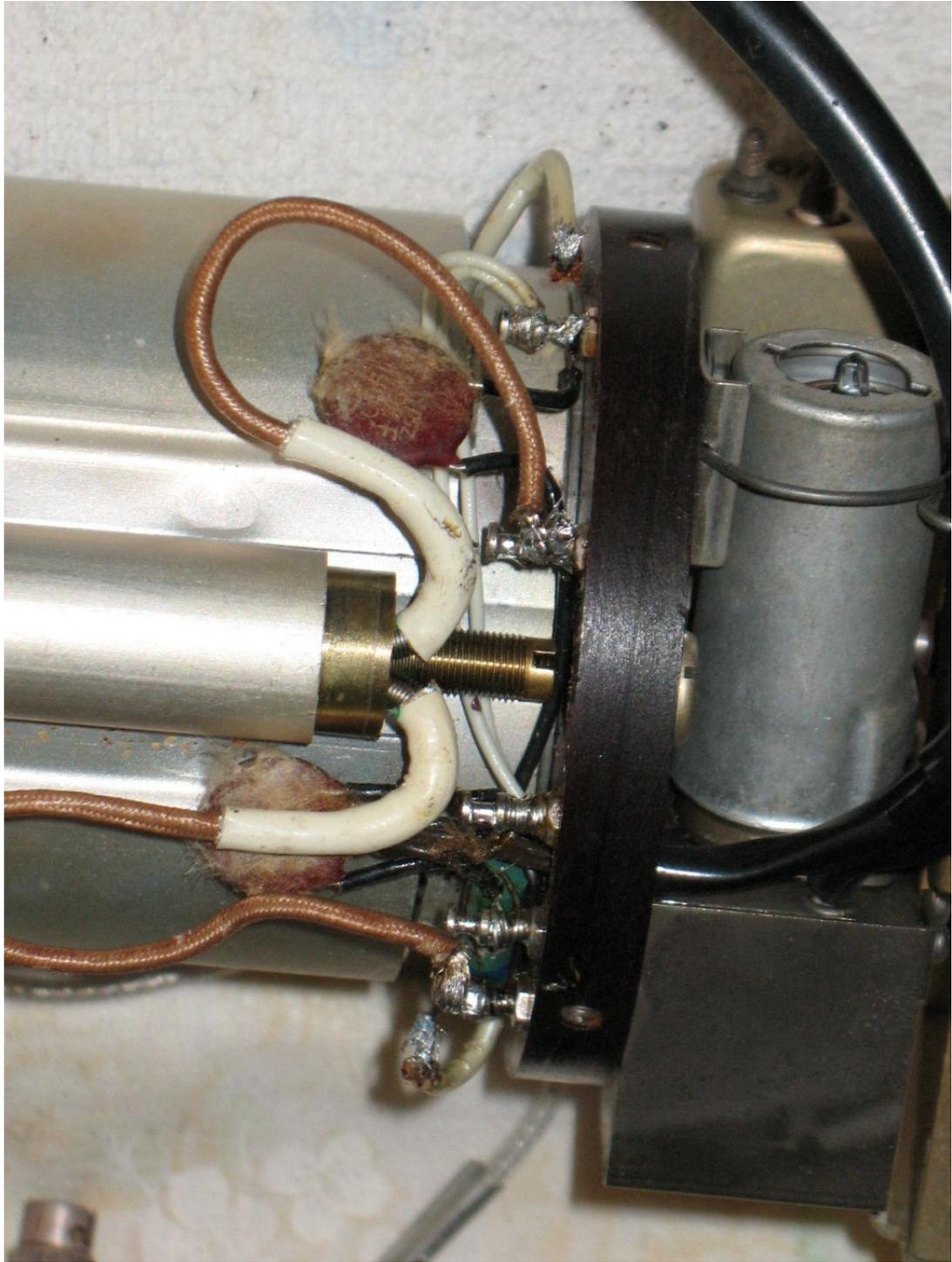
One of the differences among PTOs is in the way the 4 heater wires are routed to the inside to the heater. Some go through the outer cover. Others go through the phenolic base directly to the same terminal posts, thus making it easier to remove the outer cover. This next picture shows them going through the outer cover.



Because I usually end up removing the outer cover a few times for each repair, I drilled a hole in the phenolic base and rerouted the 4 heater wires (2 brown and 2 white) through it, thus bypassing the outer cover. This makes it a little easier to install the outer cover over the tight insulation with less of a possibility of damaging the insulation. Here's some pictures showing the type that has the heater wires through the phenolic base from a manufacturer:





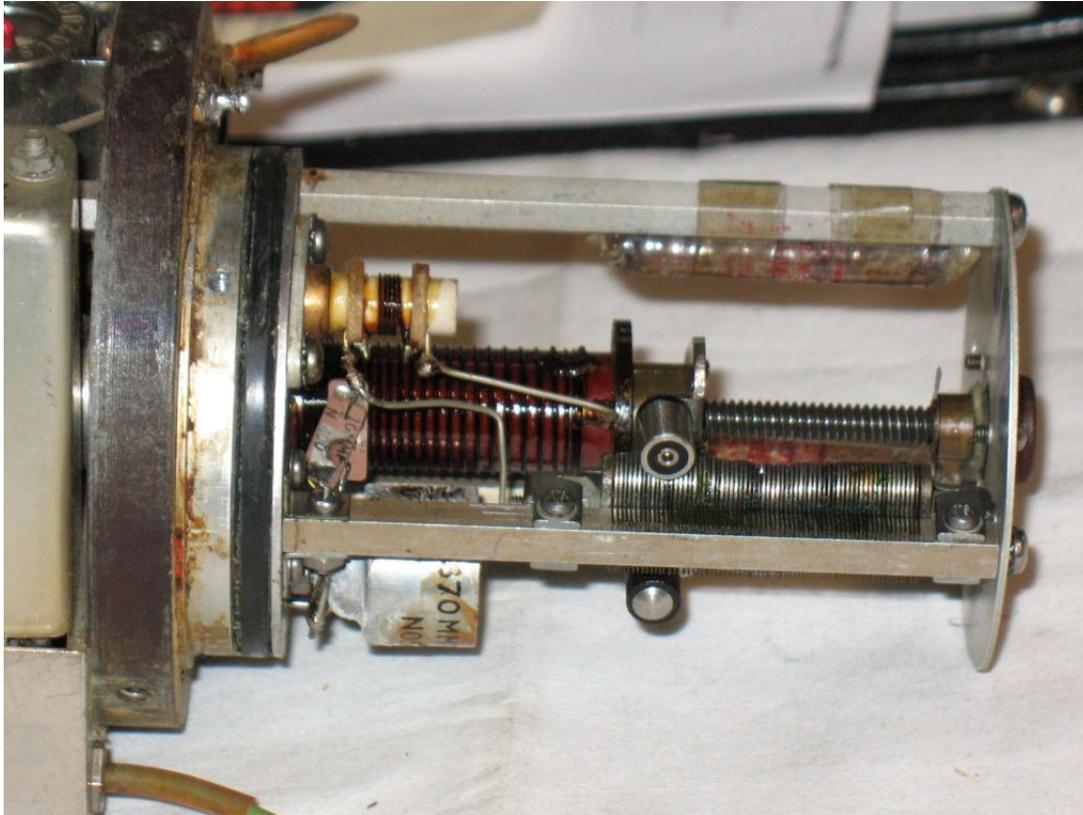


In the next picture you can see that the 4 heater power wires go through the phenolic base and therefore only 4 wires need to be unsoldered to remove the heater unit. If you choose to make this mod on one, be careful drilling the hole. I did it just fine with a hand drill.

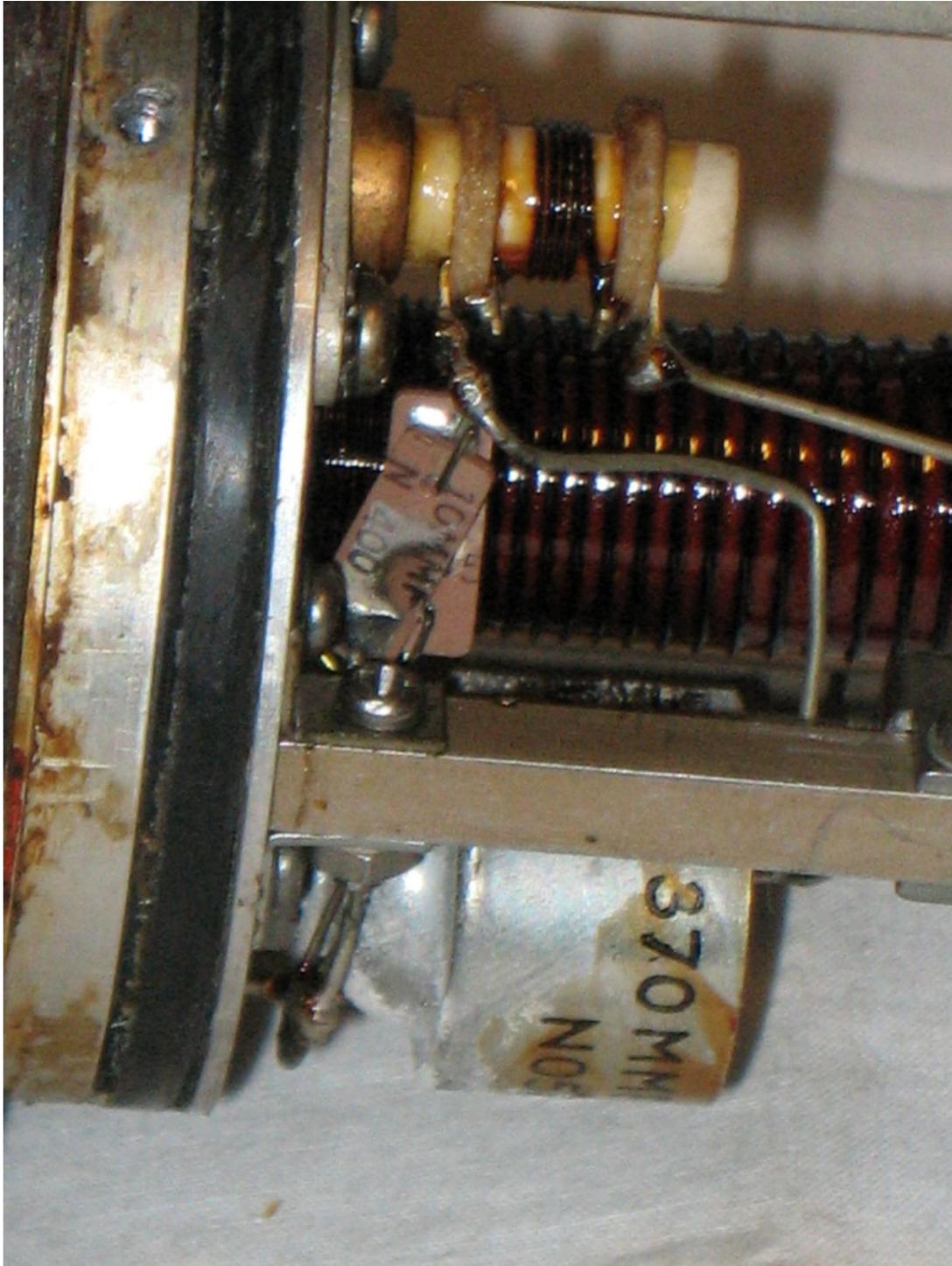


Once the heater unit is removed, you have access to the inner cover. Removing it for the first time after sitting for a long time can be quite difficult, even if the rubber seal is in good condition. As can be seen in the next photo, the seal is about a 1/4" from the base. You might try putting some silicone oil on the joint all around it and let it soak in. Sit it on the end with the electronics end up.

Once the covers are off, you can easily see the identifying linearity 'corrector stack'. It's just below the exposed main tuning screw shaft. The stack followers are at the left of the stack, a small silver colored drum on the top and a brown phenolic drum on the bottom.

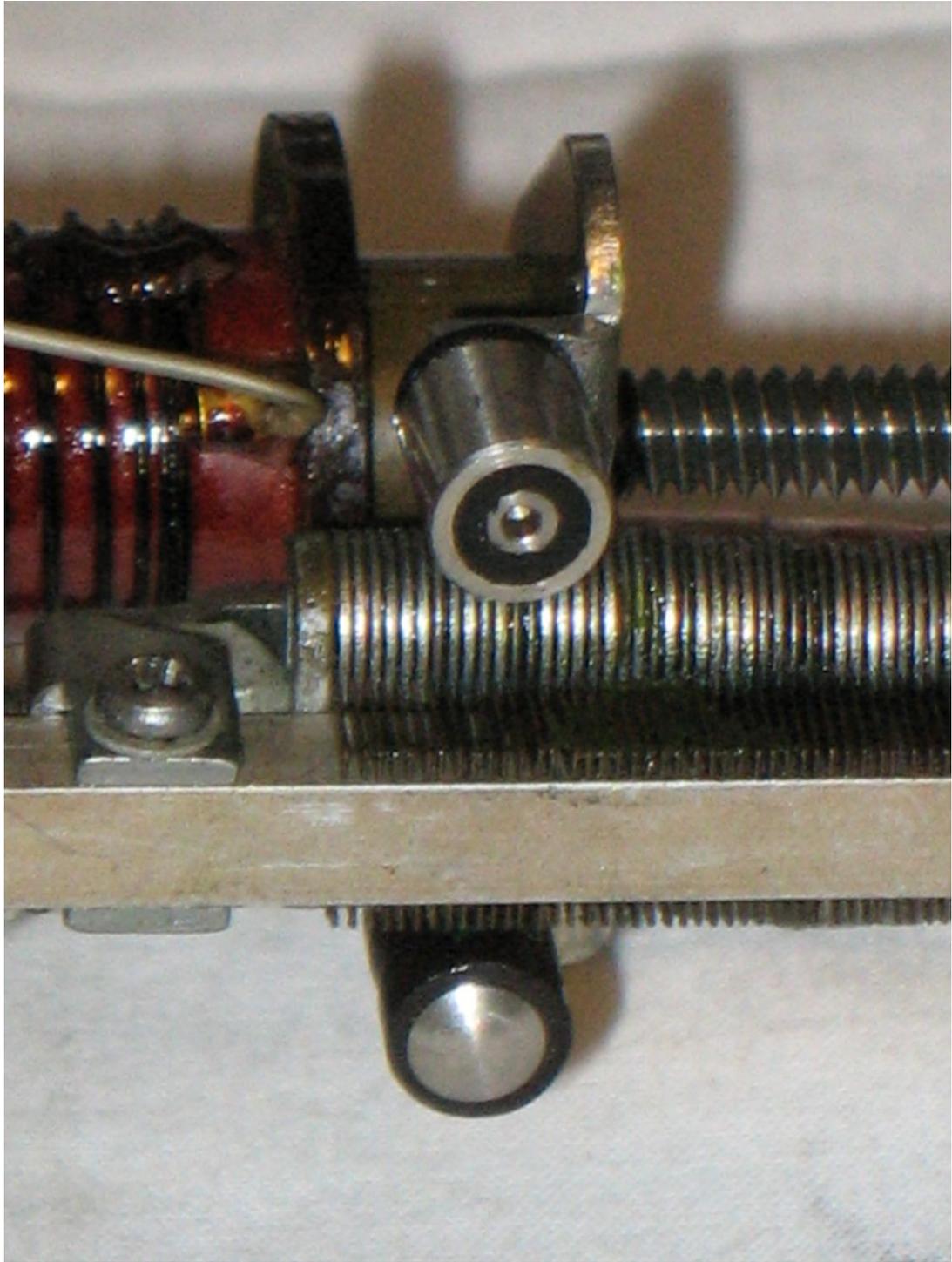


In the next photo, you can see the small rectangular wafer caps. These are usually 10 pf and have an NTC of 100 to 400. They are usually VERY fragile. Be careful with them. Above them you can see the small EP adjustment inductor (they have 5 turns on them from the factory). The next picture shows a close up of these 2 items.

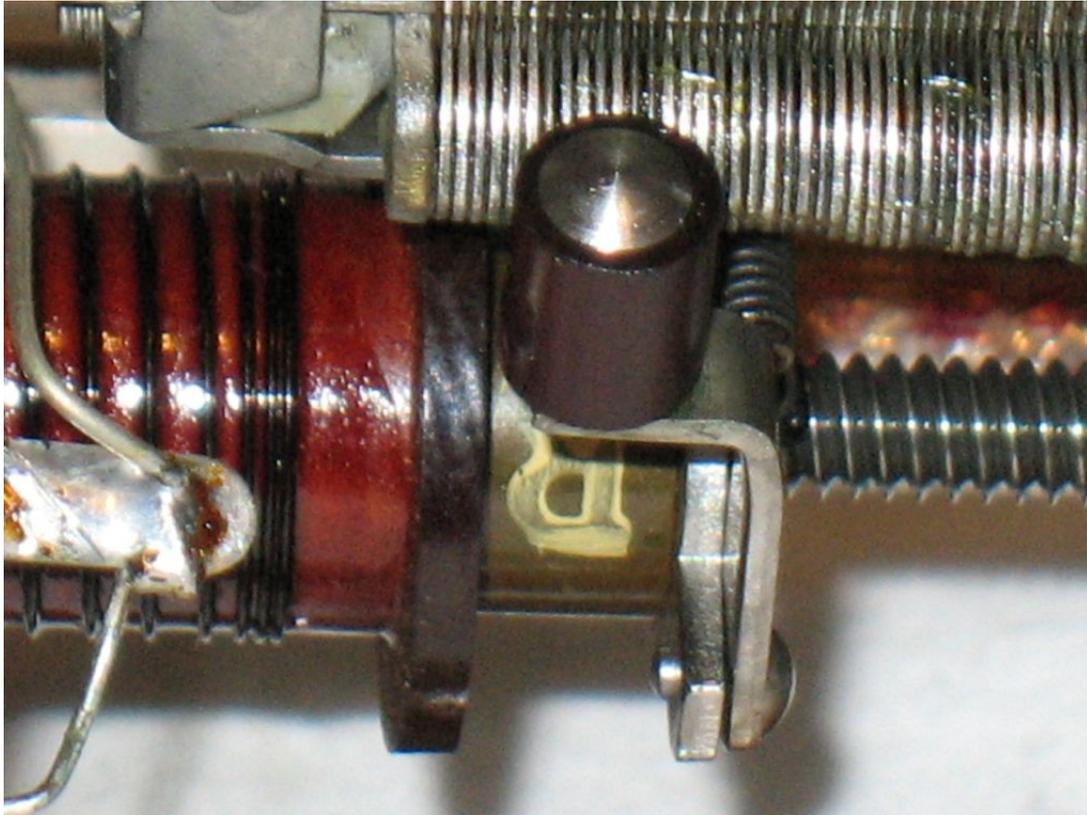


At the bottom of the above picture you can see the main capacitor. They are usually 370 pf at NTC 50.

This next picture shows the spring operated cam follower that keeps the top and bottom followers tight against the correction stack.

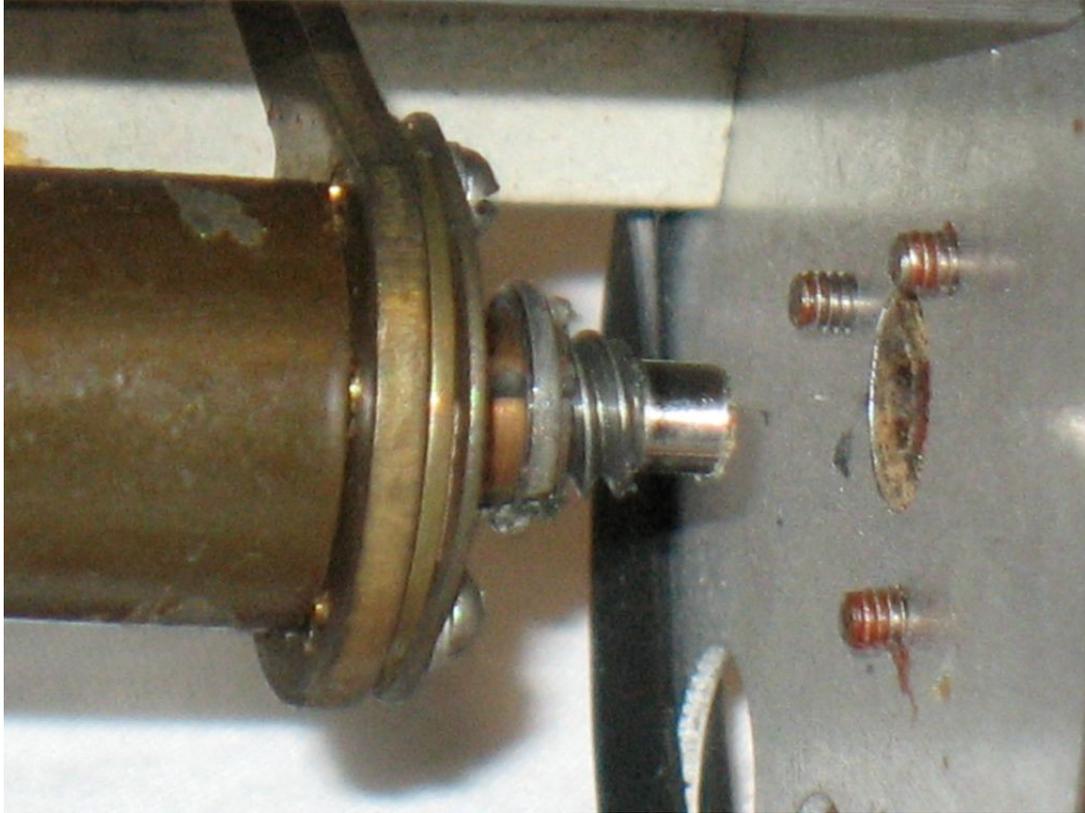


This next picture shows the hinged cam follower. Make sure that the hinge moves freely. You may need to unhook the spring temporarily to do it. Oil the hinge very sparingly. Test the spring tension to make sure that there is good contact, but not too much. Rotate the main shaft back and forth quickly to make sure that the followers do not loose contact with the stack.



If they do, check the bushing (shown in the next photo) attached to the end of the core for being too tight on the shaft.

If it is, it may need to be cleaned and greased. It's very important for correct operation that the bushing fit snugly, but not too tight. This is what keeps the tuning core movement in sync with the shaft rotation with minimum back lash. The next picture shows one type of bushing. There are others, but they all do the same job.

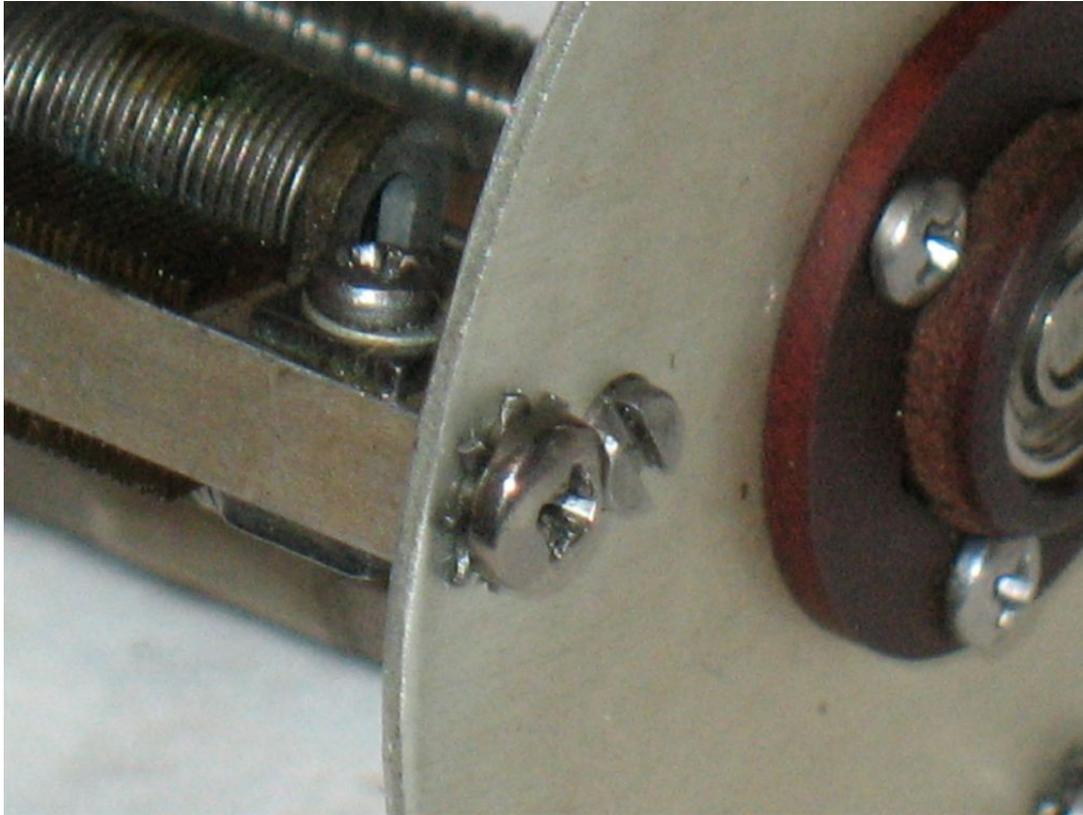


Here's the bushing that is on one of the Collins PTOs that I worked on.



As you can see, it's been 'adjusted' to fit on the shaft with the correct tightness. It may look rough, but it works great.

This next picture shows the flat head screw adjustment for the tightness of the stack holder (retainer). It's right next to the phillips head screw that holds the end plate onto the square support posts.



If you need to adjust the stack to improve linearity, be careful to not loosen the retainer screw too much. It should never be loose enough that the shims can be moved easily by hand. When adjusting the shims, keep the retainer fairly snug, but loose enough that you can move a shim by lightly tapping on an end with a very thin screw driver. Find a screw driver tip that is about the same width as the shims. Do not tap very hard, as that will bend the end of the shim. There is a shim for each $\frac{1}{4}$ turn of the full range of the tuning shaft, which is about 14 turns, about 2 on either side of the 10 turn 1 MH range.

As for which way to move the stack shims to change the frequency, I believe that when the oscillator tube is on the left and you're looking at the stack as on page 6, moving the shim up reduces the frequency. You can test this by watching your counter and manually raising up the cam follower on the top of the stack.

Because taking the inner cover off of the PTO changes its operating frequency, you will need to know which shim represents 2.455 MH or 3.455 MH and start there. Set the frequency with the cover on, then remove it and put a pencil mark on the support post next to this shim as a guide. Make sure the tuning shaft is not rotated. If the shim height is about the same from one end to the other, then the EP should be adjusted fairly close before you attempt to adjust the linearity.

For starting at a point other than the end, use the same method as above. I'd place the tuning at the point where it's off the most and try to maintain that position while you open it up so you can put a pencil mark next to that shim in the stack as a reference. A reminder, don't loosen the stack too much. Getting the linearity to within 200 is very difficult, the spec is 300, and 400 is good. Take your time. For adjusting a few of the shims at one time, try a tool with a rounded end like a 3" crescent wrench. Place the round end of it against the shims and tap lightly with another wrench.

There's a lot of very good information in the PTO section of the 'pearls'. I strongly recommend that you read it before trying to linearize it.

I found this worthwhile note on page 145 in the PTO Pearls. It describes how the capacitance/inductance relation can cause or correct a linearity bulge in the middle, around 500. I have not tried this procedure but believe it should work.

Date: Wed, 06 Apr 2005 21:20:16 -0400

From: "Miles B. Anderson" <mbalaw at optonline dot net>

Subject: [R-390] PTO Rebuild

I'd like to caution against jumping to the conclusion that the corrector stack needs adjustment whenever the PTO can't be made to track at the intermediate points. I tried once to adjust the corrector stack on a Collins PTO and made such a hash of it that the whole assembly wound up in my junk box. I later discovered that the real problem is often much easier to solve. The problem in my case was that one or more of the little unencapsulated mica capacitors went west. There is no way to adjust the shunt capacitance of a Collins PTO. All you can do is adjust the start point of the tuning slug and the little series inductor that is used to trim the end point. This means that there is a unique shunt capacitance which will make the tuning equation come out right at both ends and the middle. If that shunt capacitance changes because of aged components, no amount of fiddling the inductances will make the tuning linear anywhere except at the end points. The procedure I followed was to adjust the start point and the end point as per the manual. Then tune the PTO to the midpoint (500). If the oscillator is high at the midpoint, add more shunt capacitance. If it is low, remove shunt capacitance. Adjust both end points again per the manual and check the error at the middle. If it is still off, repeat the process. We are only talking about 10 to 30 pf difference,

but that small capacitance difference can knock the daylights out of the linearity by putting an "error bulge" in the middle. When you think you have the middle and both endpoints "spot on," check the tuning error every 100 kHz. If there are two "error bumps" (at, say, 300 and 700) these can be washed out by simply overcompensating the middle so the error runs in the other direction. By the way, I replaced the inner shield cover before each measurement. The main thing to bear in mind is that the corrector stack was set properly at the factory. The main coil is heavily doped and is not likely to move or change. What IS likely to happen is a change in the shunt capacitance. The shunt capacitors are intended to be temperature compensating, but this never bothered me much. Ordinary NPO ceramics seem to work fine.

Date: Mon, 5 Nov 2007 14:21:40 -0800
From: "David Wise" <David_Wise_at_Phoenix_dot_com>
Subject: RE: [R-390] PTO Problems

>The curve is not necessarily symmetrical from end to end..But the curve should
>be nicely done with not sudden jumps.<snip>

If your **PTO frequency curve has a bow, you may get away without a corrector stack recal by changing the tank circuit capacitance**. Beware - the originals were selected for temperature compensation. For curiosity's sake, I replaced the little ones with two trimmers with different tempco's, and got to where the curve was pretty much a horizontal line, and the frequency drift was also low. Don't try this unless you have lots of time on your hands, and patience too.

Best of luck. Larry Haney