

Repairing a Tail-Twister Rotator

My Tail-Twister rotator was purchased new around 1976 and has been in constant use since that time. It was originally used with a large [Mosley TA-36 with the added, and heavy, TA-40KR traps](#) to add 40 meters to the driven element. I also usually always have had a pair of Cushcraft 2 meter twists A144-11T above that, topped with a variety of 2 meter and VHF/UHF ground planes, so there was always a good amount of windload on the rotator.

I moved it to my present QTH in 1992 but it remained on the same 69 foot Rohn 45 tower with the same Cushcraft 2 meter beams and various ground planes above it so it has had a good and hefty windload on it for many years. All during that time it has served me well.

In 2002, I brought it down and rebuilt it, a job which consisted mostly of a thorough cleaning, new bearings and races, new direction indicating pot and a complete relubrication. I've usually kept a spare stainless steel ring gear on hand but I don't recall replacing that gear at that time. [The rotor swap story is available elsewhere on this website.](#)

It came time to do more work on my rotor again when it developed the strange anomaly of stopping when pointed around the 90 degree area. With this installation (the center of the meter scale was on North) it caused some problems. Around Oct of 2005 I had replaced the Mosley beam with a new [3-element SteppIR](#), still with the Cushcraft 2 meter beams and ground plane above it. When my rotor began to have its stoppage problems when aimed toward the East, the SteppIR became a real life-saver since I could aim West and use the SteppIR's 180 degree reverse feature to shoot back to the East. My only problem would come when my excitement and the technology became too intense.

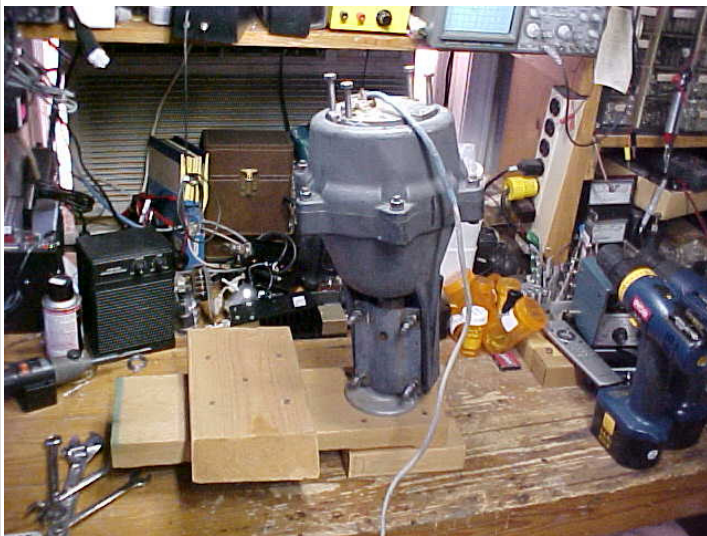
I also have the [Rotor-EZ](#) built into the rotator indicator box and that is attached to my computer while running [Logger32 logging and control program](#). Features in this program allow me to simply click on a small dot on the map where a new DX station has appeared and my rotator automagically turns to that location. Logger32 makes it easy to also click on a spot for long path, and with the 180 degree selection on the SteppIR, that works fine..... except in the heat of battle..... or a sudden pileup. Without thinking, it's possible to attempt to send the beam to aim at the new spot, not thinking about the "dead zone." Several times I let the technology send my array to the East..... Oh No!! Too late.

Once it got the "dead zone," there were only two ways to get out. One was to either climb the tower and manually turn the antenna away from East while someone below operated the rotor box (pictures of me at other places on this website help to explain why my climbing was not an viable option). The other way was to be in the shack when the wind was blowing hard and when it seemed to be blowing the right direction, I could release the brake and if the wind was blowing just right, it would move back into the rotator's "active zone" and I was OK. Unfortunately, although the wind blows often in

Oklahoma (remember the song -- "When the wind goes sweeping down the plains....."), I was never able to completely anticipate when I needed to perform this delicate operation. Sometimes, if I was lucky, I could get it back within a day but there were times when it sat watching the Eastern sky for more than two weeks.

Finally I knew it was time to swap it out, bring it down, and rebuild it. The task went to [Harry - KC5TRB](#), my expert tower man. He got the Tail-Twister down without event and move the replacement back in its spot. The temporary replacement rotator is the Ham II discussed also on these webpages. Right now, after several months, it has developed some problems and the brake will no longer engage. I suspect that the spring or springs which draw the brake wedge to its "brake on" position, has failed. I have a TV camera with microphone mounted just above the rotator and I can usually hear the brake wedge popping in and out. Now, there is a sound but it is not a powerful and definite click like it was originally. Only the motor and its gear train are holding the beam from rotating in the wind..... and they have long ceased to perform this function. My antenna array is currently freely windmilling like a country weathervane without a rooster.

I suddenly now have an added incentive to rebuild my trusty Tail-Twister and that is what this article will describe.



Tail-Twister prior to opening

First, I placed the rotator upside down over the 1 1/2" pipe mounted on the wooden form. This form, shown on the right, was originally used to hold a portable TV antenna on my travel trailer. The piece with tapered ends is placed between tandem wheels. It works nicely as a rotator support form



too.

It is important to support the rotator, bottom-side up, when you're working on it. It does not need to be a solid support but you'll want to have your rotor bottoms up while you work on it.

The 4 longer bolts facing up are bolts used to hold the rotator to the rotor shelf on the tower. The replacement rotor uses different sized bolts so when this one was brought down, I kept its bolts with this rotor so they wouldn't get lost or used for something else.

Note that the Ham-M

series rotators use 4 bolts to hold the two halves together, the Tail-Twister has 6 bolts. Don't pay any attention to the messy workbench -- lots of simultaneous projects going.

Remove the 6 bolts and nuts (plus the 4 others mentioned above) and place all of them in an empty pill bottle. That's what those amber-colored bottles are and they help me keep track of removed hardware.

When I opened the rotator up, the grease was fairly dry and didn't look like it was doing much lubrication. Not sure how he got in but there was a dead spider inside the top bell. He was about 1/4" long in his current condition and I'm sure he had some interesting rides around on the wiper of the direction indicating potentiometer before assuming his current condition. I haven't found any small particles of broken metal pieces inside so I'm already encouraged with this.

As mentioned in another article about repairing antenna rotators, it's a good idea to mark the two case pieces with a magic marker so they can be matched up easily when reassembling. I also mark the bottom plate of the rotor (the one which rotates when it is upside down, and the bottom shell of the rotor. The Tail-Twister does not seem to be as critical along this line as some of the units in the Ham-M series. I actually did mark my cases before disassembly but ended up painting over the marks. It might help you to mark them, it shouldn't hurt anything, but you'll need to make some other provisions if you plan to repaint your Tail-Twister as I did.

An observant reader will see some atrocious-looking goo covering the screw terminals on the bottom of the rotor. This is the way I chose to seal or weatherproof the screw terminals. All of my rotors are the older type which have screw terminals for the 8 connections instead of the newer socket. I attached the wires of the rotor cable, then covered the area with black RTV silastic rubber compound. In recent years I have read about the vinegar-smelling goo causing problems with some connections over time but since it's been on there for several decades and I'm not aware of any of my rotor problems being caused by these connections, I'm going to not worry about it. It's kinda like asking the 98 year old man if he didn't think he should stop his smoking so he could live longer.





Once the motor assembly was separated from the bearing races, the bottom bell containing the brake "engagement slots" I looked over things, trying to find any obvious damage. A recent message on the TowerTalk reflector talked about a Tail-Twister which was slow running in one direction. His later message described the problem he had found with a broken gear shaft so I was looking, in particular, for that being a possible solution to my problem. See message



below:

The plastic bearing holders have a flange on one side.

Take careful note of the way this flange is seated, whether up or down.

You'll need to know when you put it back together.

On my Tail-Twister, the small and large bearing races (the first to be removed with the rotor upside down) both had the flange down. The smaller bearing race holds 40 ball bearings. The larger bearing race (the middle one in the rotor) holds 49 bearings.

At 04:41 PM 1/28/2008, Mike wrote:
Need some ideas on where to look to find out why the T2X turning in the CCW direction is slower than in the CW direction.

Recently noticed my T2X takes longer to turn in the CCW direction than in the CW direction. Wind is not the reason as slow CCW direction turning occurs even with ~0 wind. The phase capacitor is mounted at the T2X and the power and position indicator lines are, respectively, #12 and #14 gauge wire. The capacitors are several years old and mounted in a water resistant box (small vent hole on the bottom). The T2X is ~ 250 ft from the in-shack control box.

The T2X is turning a EF240X and a 4 el. SteppIR on a 2" dia., 1/8" wall, 21 ft chrome-moly mast. The mast and ant. weight are supported by the T2X. Sixteenth inch shim stock is used to center the mast in the T2X. Thrust bearings are used to center the mast but not for supporting the mast and ant. weight. The T2X is mounted 8 ft from the top of the tower. Several months ago the T2X's mounting bolts and thrust bearing mounting bolts were checked for snugness.

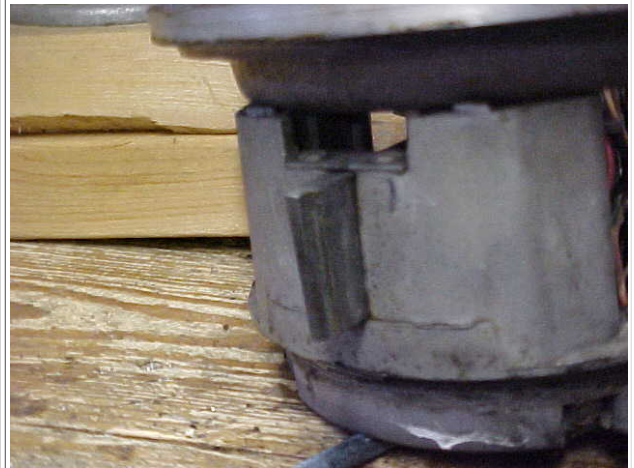
This CCW rotation slowness was just noticed this last month when the weather turned cold. The last several years the T2X rotated the mast/ant. equally the same speed in both directions.

73, Mike, K4GMH

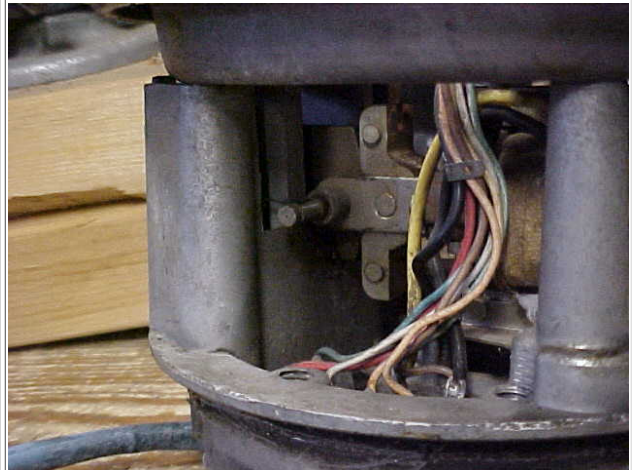
From: Mike <k4gmh@arrl.net>
Subject: Re: [TowerTalk] T2X Slow CCW Rotation Problem
Date sent: Thu, 06 Mar 2008 14:15:03 -0500

Hello,

Brake wedge



Brake solenoid



Brake engaging grooves

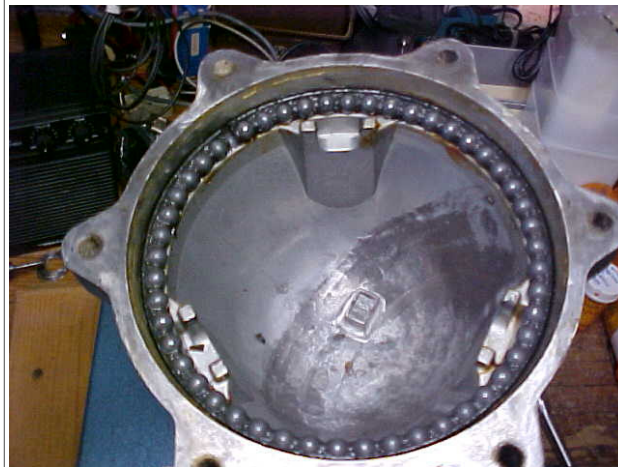


The problem with the rotor is the rod holding the series of gears used to turn the internal ring gear and the rotor had sheared off in two places.

When the rotor housing was first removed, noticed the drive gear was wobbling. The wobble is the reason for the delayed start in the CCW direction as it wasn't engaging the ring gear at start up. This same thing, post shearing off, happened three years ago and the T2X part was replaced. Probably a good indication that its trying to turn too much ant.

73, Mike, K4GMH

Top bell with upper bearing race (old race with dried grease)

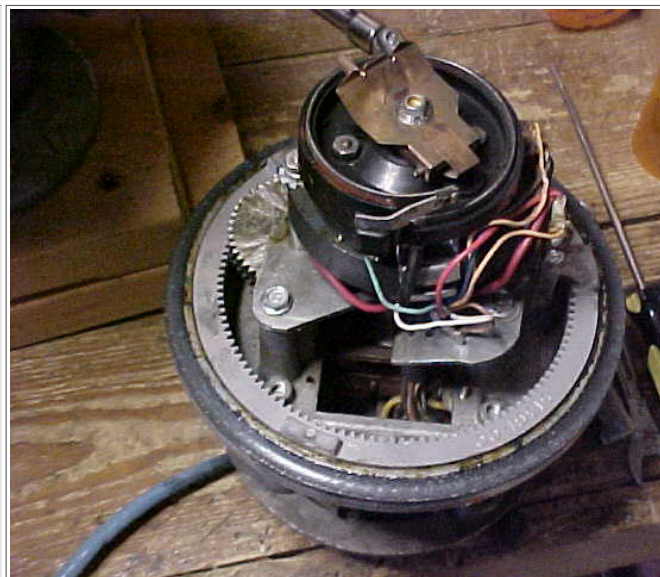


All the gears in my Tail-Twister seemed to be secure with no broken posts. I hooked power back up to the motor and turned it all the way CCW. It moved the ring gear around normally and tripped the end of rotation switch, just as it should. Remember this is a stainless steel ring gear and not the cast metal type used in the older Ham II, III, etc. series. I turned it back CW and it turned beautifully until it got to what would have been the eastern direction on my tower, and it stopped. The motor continued to turn, as long as I kept my finger on the switch, but the rotation on the ring gear had stopped.

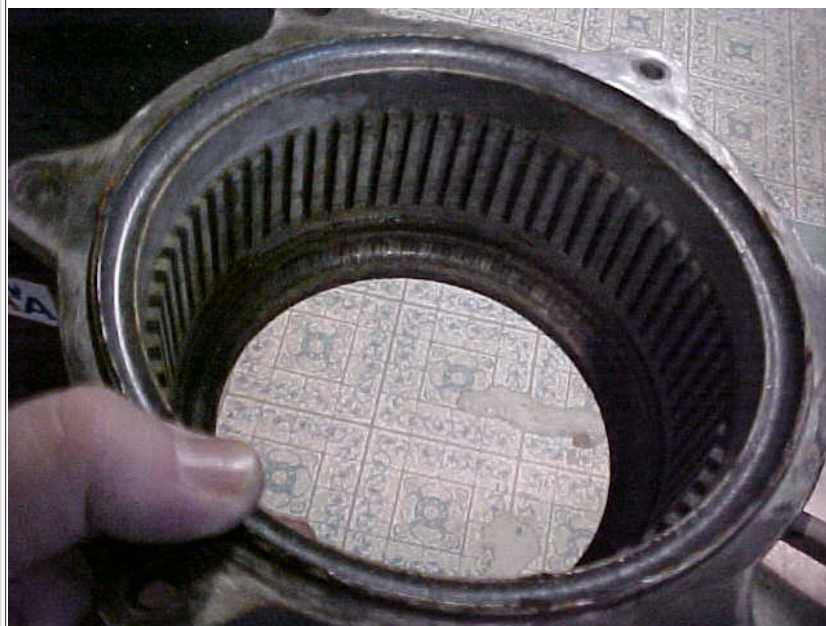


Still, I didn't see what might be causing this, how as soon as I dug out my extra bright flashlight, the problem became evident. Eight teeth on the ring were missing but they had not been apparent when I first looked because the missing teeth were directly under the stob which trips the end of rotation switch. In addition, there were 3 teeth partially chewed off from 1/4 to 3/4 of the height of a normal tooth. Once I knew what I was looking for, I could look back around the ring gear and see several of the teeth missing which were unshielded by the stob. In no other spots around the ring gear were any teeth even partially damaged. It would be interesting to learn what caused those teeth to be broken out of just that one area. Perhaps, some day I will sit with my feet propped up and the cleaned-up culprit ring gear in hand and contemplate the possibilities of the damage.

The cure became simple, replace the stainless-steel ring gear with another of the same material (but several more good teeth) and continue the clean-up, lubrication, and repainting of the Tail-Twister. Fortunately, I like to keep a spare stainless steel ring gear and a spare direction indicating potentiometer. It was an easy fix for me. This old antique may outlive me now.



Cleaning the parts became quite a challenge. Ideally, if a person had a solvent dunk-tank, they could let the pieces (with the exception of the motor assembly) have a good soaking. If you had such a tank, or know a mechanic who has one, I would recommend it highly. Unfortunately, I did not have one nor did I know anyone who did so I had to do it all by hand, like the early pioneers did.



The bottom bell, which has the brake-engaging grooves, showed a lot of places where dust/dirt and grease became mixed together and solidly adheres to the walls of the metal. It's in the grooves, the machined bearing runs, and any little nook or cranny it can find. I wore out numerous wooden toothpicks scrapeing this gunk off the rotor's insides. It's not an easy task but I believe it is well worth the time I spent doing it. If I had owned one of those brass-bristle toothbrushes (hhmmm, I guess those aren't really toothbrushes but they're about the same size) I would have used that on the grooves. I didn't, so I didn't. When I reassemble my rotator, I want the metal inside it to look as shiny as a baby's behind..... no wait, that phrase is soft as a baby's behind, isn't it? Oh well, I want the metal to look like the day it was manufactured. This rotator resides in a place I personally can't get to and must depend on my friends to make any changes. I hope my friends will always be around to help but..... I'd

better go do something extra nice for my friends.

An air compressor with a good on/off blower nozzle is mighty handy here too. Once some of the pieces of gunk are loosened, it helps to use air to blow them free. That air blast can find hidden pieces as well or better than your bifocals or trifocals.



Here's a couple of the old ball bearing races

Once I had begun to clean up my ball bearing races and get the old grease off them, I discovered that many of the bearings had rust spots. They weren't particularly severe rust spots but any rust can be detrimental to a smooth movement of the bearings. Since I had seen rust on the bearings when I previously rebuilt my Tail-Twister, I had already bought some replacement bearings and replacement bearing holders at an earlier



One of the old races with rusty ball bearings
dry grease

hamfest when MFJ had a booth. The ball bearings are sold as a package of supposedly 48 bearings and two plastic bearing holders for \$14.95. The package is labeled "Ball Bearing Kit for HAM-IV P/N"5131010 hy-gain" I thought, at first, that the actual bearing holders from my Tail-Twister seemed to be a little better built than the replacement holders in the package. They seem to hold the bearings better when you move the assembly around for cleaning. Actually, I discovered that the reason the old ball bearings held fast to the holders was,

the grease had dried out and was holding them in like a cheap glue. Originally, when I rebuilt my Tail-Twister I had bought replacement ball bearings from a bearing place in Tulsa and I'm sure they were much less expensive than the packages from MFJ but I wasn't around the bearing place, I didn't plan to be around the bearing place, gasoline is getting more expensive and the MFJ booth was right in front of me. Suffice it to say that there are several ways you can get your replacement ball bearings.

Most of the rusted bearings were in the smaller race which fits in the bottom area of the rotator, below the motor assembly. The bearing race holds only 40 bearings whereas the larger two races hold 49

bearings each. I believe that these were the most rusted because the bottom of the rotator provides the poorest seal against the weather. When mounted normally, the rotor body does shield this area but there is still a space which must be there to allow the rotator to rotate. Dust, moisture, and evidently my spider were able to enter the unit at this point.

By the way, MFJ didn't seem to have a specific package listed for the Tail-Twister, only the HAM-IV (Ham-M series). The third bearing race, the one mentioned above from the lower run and with the rusted bearings, is actually smaller and takes fewer ball bearings. This means I'll have some left-over bearings when my project is complete. If you are buying the replacements from MFJ for a Tail-Twister project and they only had the same package they offered to me, you will obviously need two packages.

The more I checked the metal machined tracks attached to the motor assembly, the more I found much evidence of the goopy material made up of dust/dirt and dried grease. It clings to every piece and needs to be completely removed down to the original bare metal. Not a particularly easy job but a necessary one. It seems to hide too. Clean, inspect, and clean some more. Put the piece aside for a while and when you come back to it, you'll probably find more goopy stuff which also needs to be removed. I even used a quantity of Q-tips with solvent to clean those hard-to-get-to places. I'm quite sure, when I rebuilt my Tail-Twister back 6 years ago, I did not check it as carefully as I did this time. I didn't remove any but the most obvious goopy stuff back then. Of course, that may explain why it lasted 26 years until its first rebuilding but only 6 years until the second. I recommend you spend lots and lots of time cleaning it up while you have it opened up. This may also explain why you thought it was too expensive to send your rotor to a commercial rebuilding facility that advertises in QST. If it's done correctly, you'll spend some time in the effort.

The next task at hand was to lubricate the internal workings of the rotator. This was discussed in the other article on the website about rebuilding rotators. I used a different grease for that rotator and it worked well but after doing that rotor, I discovered an antique plastic packet of grease sold by CDE for their rotors. This came from the time I owned a ham store (*Derrick Electronics* in Broken Arrow, OK) which would have been during the 1970s. I suspect this packet of grease was purchased around 1978 or so and was still just as greasy and as messy as the day it was bought. The picture shows this package and, although I have used from it at least twice, it still has plenty. I don't know if it is still available or not. If you're interested in tracking down some of this grease, I would suggest a call to MFJ to see if that was one of the items passed down from CDE to Hy-Gain to MFJ.





Once the parts were all cleaned up, it was time for re-assembly. With the pieces apart, it was easy to repaint the rotor shell. The previous paint had changed to a dull gray color so I used a can of flat black spray paint. If a sand-blasting facility had been available, I would probably have had the outer shells sand-blasted but that was not available. Since it's mostly the birds and the wasps that get to see it, I didn't want to spend too much time in making it too pretty. It was important to keep the paint out of the large



hole in the bottom of the lower shell so I was able to find a nice plastic funnel (purchased several years ago at Wal-Mart) to completely fill the hole. It served perfectly and kept any paint spray from entering the inside of the rotor.



Here are the two outer shells, complete with their new flat black paint job. Note that I did take out, i.e. did not paint, the stainless steel U-bolts and the other clam-shell piece used to hold the mast



tightly
against
the taller
V-shaped
piece on
the top of
the
rotator.

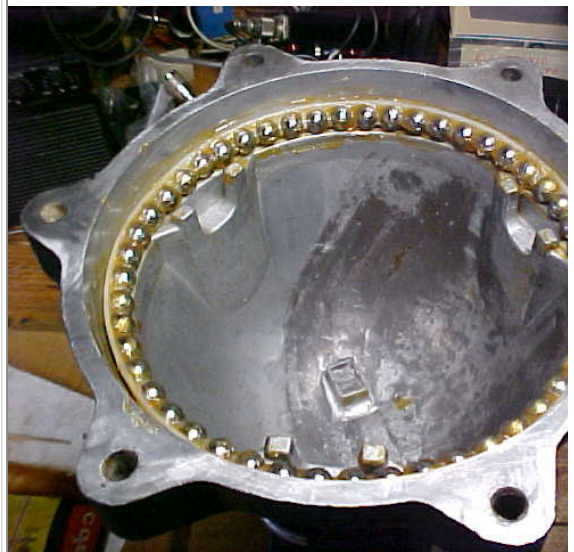


It's hard to adequately describe how to grease the new set of ball bearings and plastic races.

There's just simply no way to do it delicately -- or cleanly.

First, as mentioned in the other article, you should ALWAYS work over some type of container with small sides to capture the ball bearings when they accidentally fall.

Notice that I did not say "if they accidentally



fall," I said
"WHEN
they
accidentally
fall" and
they will
fall. Load
the bearing
races, one
at a time,
then
squeeze out
a small
amount of
grease onto
your finger
and work
that grease
into the
race on
each side of
the
bearing. It's
a process
akin to
repacking a
vehicle's
wheel
bearing.
Work the
grease into
the race on
both sides
of the ball,
squeeze out
more and
continue
around the
entire race.
Resist the
urge to do
this too
quickly,
take your
time and do
it right.
When you
are

finished, there will be grease evident on both sides of each ball bearing, all the way around, but there will not be any extra blobs of grease which can fall off and get somewhere where it shouldn't be. How much grease is enough? Well..... just enough. If you finish greasing up one bearing race and your fingers, and maybe your hands, are a mess and you're looking around for a paper towel, it probably is greased well enough.

The next step is to place the

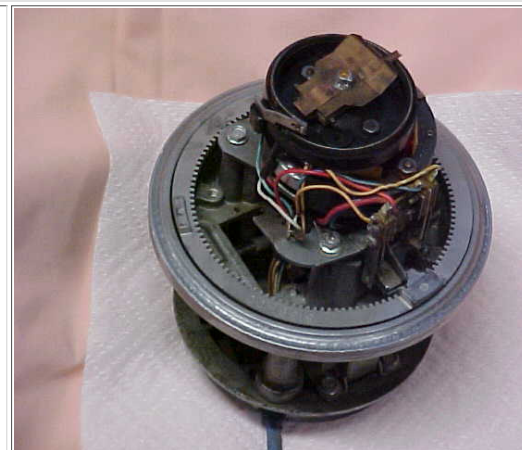
greased bearing race back on the rotor. At first, you should have the top bell turned upside down on the workplace.

The race is c-a-r-e-f-u-l-l-y lifted from the box or lid where you've been working and place it into the rotor on the metal track machined to receive it. It is possible, since the grease is a makeshift adhesive, to get the race into place and not drop any bearings. I did not say it was guaranteed but it is possible. Once it's in place it's time to find another paper tower --- that

other one has already outlived its useful life. The rotator now looks like the pictures on the left and right.

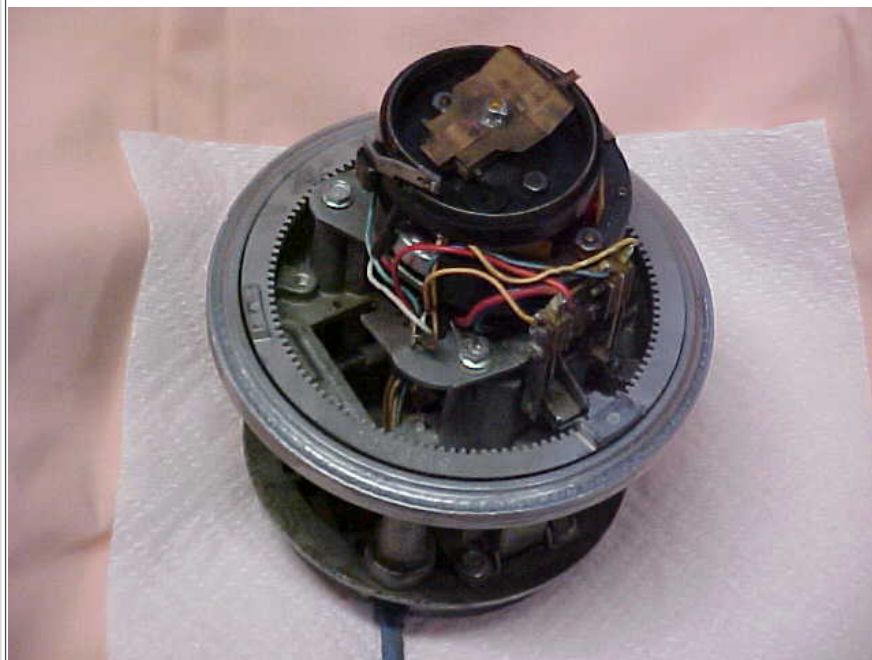
Now you're ready to assemble the motor assembly to the rotor upper bell. This operation can be quick and easy and highly successful or can be one of the most frustrating activities you've encountered since first trying to learn the morse code. Several pieces must be identified:

The direction tracking piece - the piece attached to the potentiometer's center (wiper) arm which has a rather W-shaped piece. This piece shouldno..... MUST fit correctly into the raised boss at the top inside of the upper rotor bell housing.



The is the boss in the bottom of the bell and, although the picture may not show it well, you must identify the two raised parts which will fit inside the valleys of the W-shaped piece above.

Caution: *If the top piece on the potentiometer is not correctly placed on the two raised pieces on the boss, the rotor will not (cannot) indicate the direction where your beam is aimed. If you get it off to one side or the other of the boss, the potentiometer's wiper may be pushed around (and actually indicate movement) for only one time. When the rotor comes back the other direction, it cannot be pulled back for the indication meter will remain at the extreme where it was pushed.*



Having said that, it's time to place the do this activity I place the potentiometer rotation. I also make sure the "stop switch" is 90 degrees away from the end stop switch regardless of whether you use an indicator or a South-center scale.

NOTE: This picture shows the stop position where it has tripped the end stop switch. When I insert the motor assembly, the ring moved so the stop stop is on the center where shown. The wiper on the potentiometer is correctly in the picture.

If you only plan to take your time once the time. The W-shaped piece on the potentiometer must be placed properly on the boss. Personally, when I assemble the potentiometer assembly sitting in what seems to be the correct position in the indicator box and test it out. You still have to turn the rotor but the weight of the motor assembly is not properly and you do have a good set of gears upon. When you hook up the indicator and test it out a couple of paragraphs ago, the meter should be showing the scale. You should be able to turn the rotor to the end of that 180 degree rotation, the stop. The meter should be showing all

can turn the rotor all the way clockwise degree rotation the other way, the motor stop.

Did the meter follow the rotation back and now indicate full scale? If it did --- you hit the right position with the top of the motor assembly. You've just finished the most difficult part of rebuilding the rotator.

Oh, but you say it didn't track to full scale? Then it's time to pull the assembly wiper to the center of the pot, move the ring gear's stop stop to 180 degree switches and try again. A successful repair/rebuild/reconditioning operation is complete or you must not continue on to completion.

Assuming that all is OK, i.e., the first set of greased ball bearings is seated correctly, the motor assembly is correctly inserted in the top bell housing, the rotor is able to rotate a full 360 degrees and the motor stops completely at the end of each rotation, and (most importantly, at this point) the meter indicator moves from zero scale at one extreme rotation to full scale at the other extreme rotation and keeps following the rotation, regardless of where the rotor position is moved. You're now on the home stretch, but wait!!!!!! Don't get in too much of a hurry because that's how ball bearings get accidentally knocked out of the race and roll under the work cabinet or down the heater and air conditioner vent in the floor. Of course, since you had some left over ball bearings, the one that dropped is still findable but if you only had just enough, that puppy that dropped would now be in China.

Take the second larger plastic bearing race and load it up with its 49 ball bearings while you still have the whole thing in a box with small sides or a larger box top. Completely grease up the race as described above. Use enough grease because it's going to be up there on your tower, unattended, for the next 5, 10, maybe 20 years without needing any intervention from you (we can dream, can't we?). Immediately, while your hands and fingers are still greasy, place this bearing race in place in the rotor housing, paying particular attention to which way the race's flange is pointing (you did write down that information when you started, didn't you?)

When that race is in place, you'll want to finish up the bottom bearing race. Actually it's at the top of what you're working on since you should still have the rotor upside down on the workbench. This plastic bearing race will be too long as it comes from MFJ so you'll need to trim it down. The piece, as it comes from the package, will hold a total of 49 bearings but this last race is smaller and should only have 40 balls. It can be trimmed easily with a pair of side-cutters but I must caution you with the old carpenter's axiom: "Measure twice, cut once" I suggest counting from one end to the 40th hole and count backward from the other end to make sure there were 9 other spaces. Once the race is trimmed, the last bearings should be inserted and greased up as above.

The completed greased bearing race can be now placed in its proper place atop the motor assembly. The same caution mentioned above is important here too, make sure the flange is place correctly for the race.

This picture shows all three bearing races in place (the lowest one is covered by the motor assembly already so it can't be seen) and the bottom shell is ready to be placed back on the rotator. Note the brake wedge sticking out on the right side between the two sets of races.

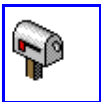


Now it's time to clean up those hands --- they're probably too messy now for just paper towels and may require a trip outside to rub them in the grass or on the family sheepdog. Perhaps a trip to whatever room has the Lava soap is your safest bet.

Now the bottom shell of the rotator, perhaps now well cleaned up and freshly painted, is ready to be mounted back on the complete assembly. There doesn't seem to be any particular way to mount this, besides making sure the 6 bolt holes line up, but you will probably need to manually push the brake wedge back in so the shell fits down easily. I'd also be careful not to rattle the whole thing around too much to make sure the last two bearing races stay in place. Once the bottom shell fits against the top bell housing, you can place the bolt, lock washer, and nut in each hole and tighten things up. How tight? Well, I wouldn't try to tighten them right after I had a 20 oz steak but I try to remember that they're going to be up there where I'm not..... and have no intention of going..... EVER, so I get them good and tight. The ears on a Tail-Twister case don't seem to be a such an angle that overtightening might break one off but I try to be somewhat gentle..... in a rugged sort of way.

Here's my Tail-Twister, all rebuilt, relubricated, repainted, and ready to go up on my tower to provide my SteppIR with many more years of service. Perhaps hundreds of DXpeditions, thousands of contacts and many, many hours of total satisfaction await me in the greatest hobby around, Amateur Radio.

*Jim -
K5LAD*



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