Revised: 8/09 Major addition

Chapter 10 – Gear Rebuilding Information

Table Of Contents **10-1**

Hi Jon!

Rebuilding the RF deck was TOTALY worth it! A couple of things I learned that I will apply to radio #2:

Before disassembling anything, take as many hi-resolution photos of the gear train from various angles in every stage of disassembly as possible. I referred to them many times to confirm the placement and location of the many small shims and washers.

When removing a gear/no-mar clamp/washer/shim assembly for cleaning, I used a short length of bailing wire and "threaded" the parts on in assembly order, then twisted the wire ends together. Not only did this keep the assemblies together (especially the shims and washers!), but provided a way to easily dunk whole groups of small parts in the Carb Cleaner/De-greaser basket.

I also found that gently cleaning the center of the slug rack coil forms with q-tips and 90% isopropyl removed waxy dirt/grease allowing the slug rack to move much more freely.

Good luck! Steve

R390A Gear Train Rebuild Procedure

By Scott Seickel 9/2/02 and with additional notes by Rodger Ruszkowski
Subject: [R-390] Gear Train Alignment At +7.000

Barry, I think the item we are missing here is some black lines scribed on the cams and RF subassembly. Hopefully your receiver still has them. These lines were just inked on during manufacturing. Aggressive cleaning of the chassis is known to remove the lines.

At +7.000 a line on each cam will line up with a line on the RF deck face. At +7.000 all the cams are mostly pointed up, and it makes it easy to check the alignment.

Two ways into the alignment after replacing the clamp (Quick, Full Process). Depending on the clamp that is being replaced the outcome is more or less precise. If its the 16-32 band, the outcome of a quickie is more positive than if you are doing the 5.-1 band. Always more precision in adjustment is better receiving.

1. Check the zero adjust. This is an eyeball to center it in the midpoint of the adjustment range. Do set it to center.

2. Check the dial counter over run on each end. It should be at least 25 or more on both ends. A. change the zero adjust a little to get both over run counts equal. B. drop the dial cover and reset the over run (this should be followed by a full RF deck alignment). If your receiver has had a full up good alignment, the dial over run should be good.

3. Roll the count up to 7.000+ and look at the cam alignment marks. All 6 RF band cams should have their marks aligned (except the one with the broken clamp).

4. If the-5-1 bank mark is off just a little, you can do a zero adjust of 2 or 3 maybe 5. If its off more than that, then a mechanical cam adjustment and signal alignment are in order. (The receiver will work as is, some of us are just fanatics)

5. If some of the other band cams are off, consider a full mechanical alignment and full RF alignment. Mechanical being an eye ball thing. RF being the signal generator and slug alignment.

6. When installing the new clamp consider where the clamp bolt goes and where the spline wrench is going to be placed to adjust the bolt. Once you get the new clamp on the shaft, rotate the clamp so you can get the wrench on it. Rotate the cam to the alignment lines. And tighten the clamp.

7. If you had a full up running receiver, you can just put the new clamp in on the visual alignment and be done with it. If the receiver is carefully aligned, then loose and broken clamps can just be reset, replaced and your good to go. The mechanical setting of the clamp should be within the zero adjust range. You are trading VFO frequency against the band pass skirt of the RF band section in use (the one with the to be replaced clamp). The old prior proper planning prevents poor performance applies here. Roger L. Ruszkowski KC6TRU

If you have any questions, corrections or comments please e-mail me at:Polaraligned@earthlink.net
Scott Seickel

I highly recommend you download and read the R390A Y2K manual and use it as a reference.

Follow these steps to rebuild the gear train,

1. Set the frequency to 07 +000. That is 1 KHz past 07 999.
2. Remove the slug racks and label each one to return it to the same place.
3. Remove front panel
4. Disassemble gear train until you reach the point shown in picture "Assembly 1". Do not disassemble the split gars and other "assemblies" at this point.
5. It is SUPER important to work on a large flat hard surface so you can carefully lay out the gears as you disassemble them. The floor below you should be hard and flat also because it is easy to lose a small spring or other part. Believe me, this is good advice.
6. Clean the gears one by one with solvent[1]. It is not necessary to disassemble the clutch/differential assembly. Just soak the whole thing. [[1]This may take a up to a week. See other supplemental posts for additional info. Ed]
7. Re-assemble according to the picture sequence starting with the photo called "Assembly 1". Carefully tighten each clamp where indicated. I strongly recommend having a few spares of each different size clamps as the clamps crack real easy.

   Split gears should be loaded. You may need someone to help you hold a gar in the loaded position wile assembling, or you can use very small clamps.
8. Perform mechanical alignment as follows:

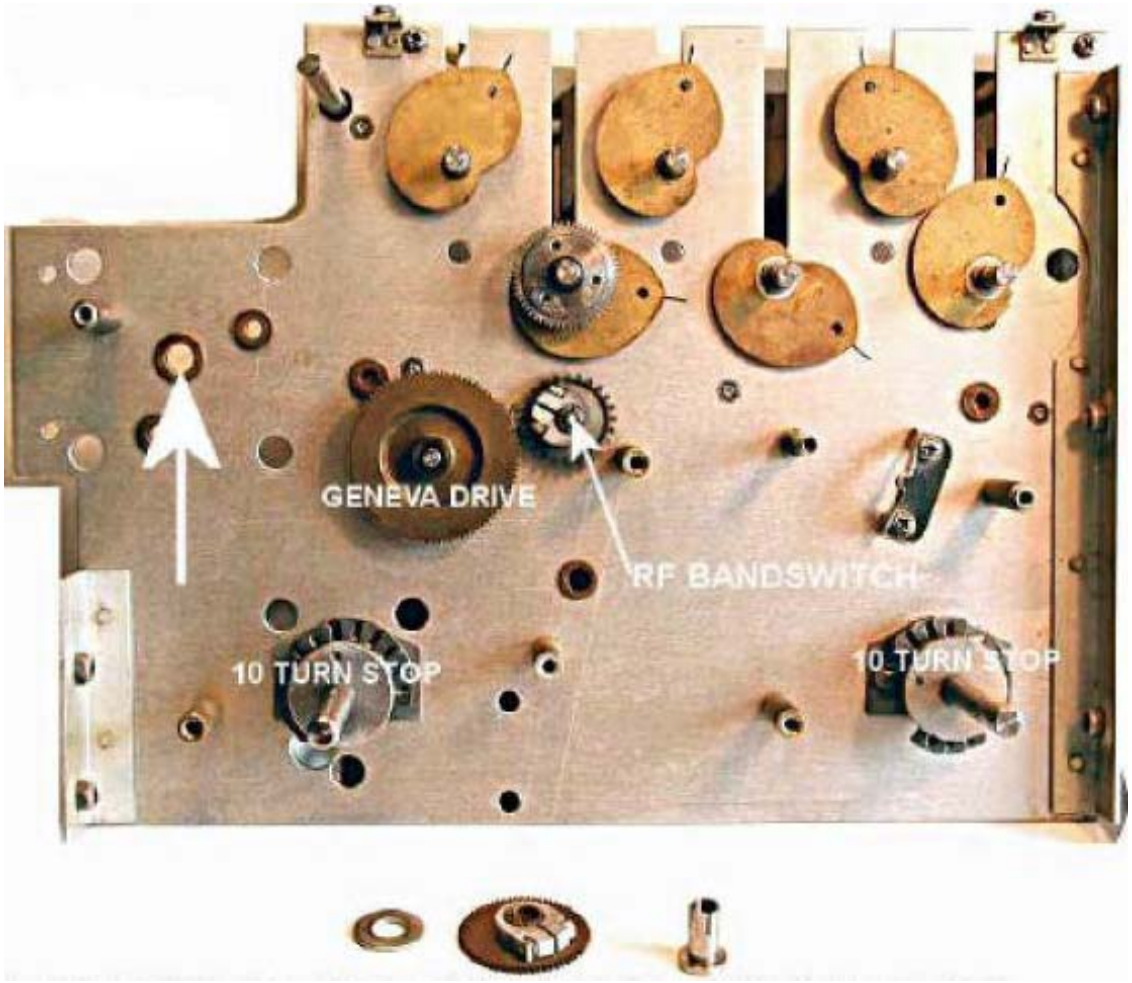
   a. Align cams as 07 +000 marks.
   b. Set RF bandswitch (see bandswitch pictures)
   c. Set counter display to 07 +000
   d. Set 10 turn stops (see Y2K manual)
   e. Set crystal oscillator bandswitch (see Y2K manual)
9. Re-assemble front panel and install slug racks.
10. Adjust PTO. You can do this by using a frequency counter or adjusting it for best signal on a local AM station.
11. Enjoy your radio.

[1]Kerosene is the general solvent of choice based on efficacy vs. toxicity. See other articles in the supplement for other choices. Ed.

Caution:	Verify the quality/condition of the cam alignment marks. They have been know to be dissolved by certain solvents. Missing marks cause massive problems upon re-assembly. One does not want to guess. You may want to consider using a center punch or scribed line marking.

STEP 1

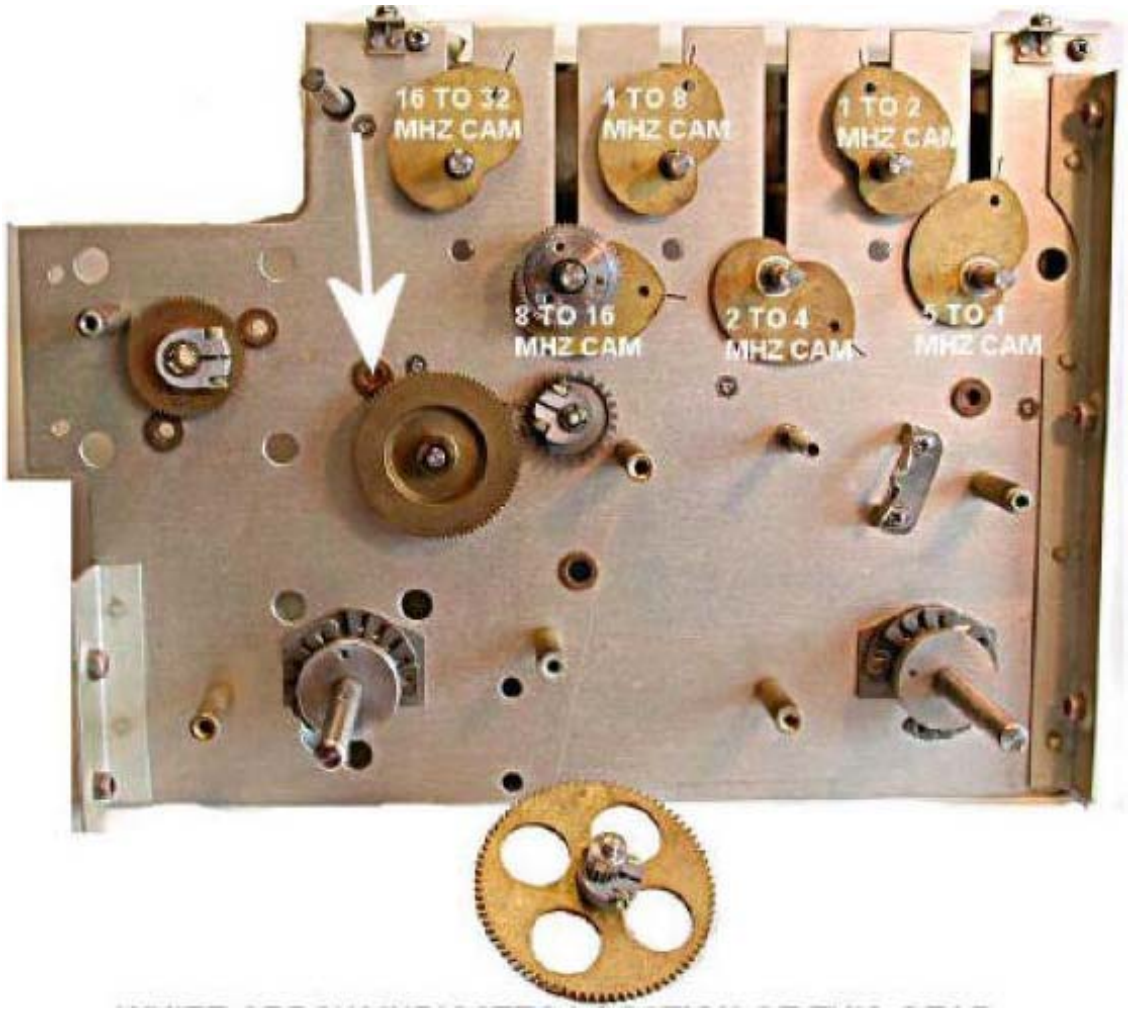
Here is your starting point. You can take apart the Geneva Mechanism if you like, but I found it easy enough to clean while still in place. If you choose to disassemble the Geneva Drive, watch out you don't lose the ball bearing inside.



Clean down the Cams, Geneva Drive, attached gears and the whole panel with a mild solvent. The gear goes where the large white arrow points. The bushing goes through the rear of the panel and then the washer goes on it and then the gear.

STEP 2

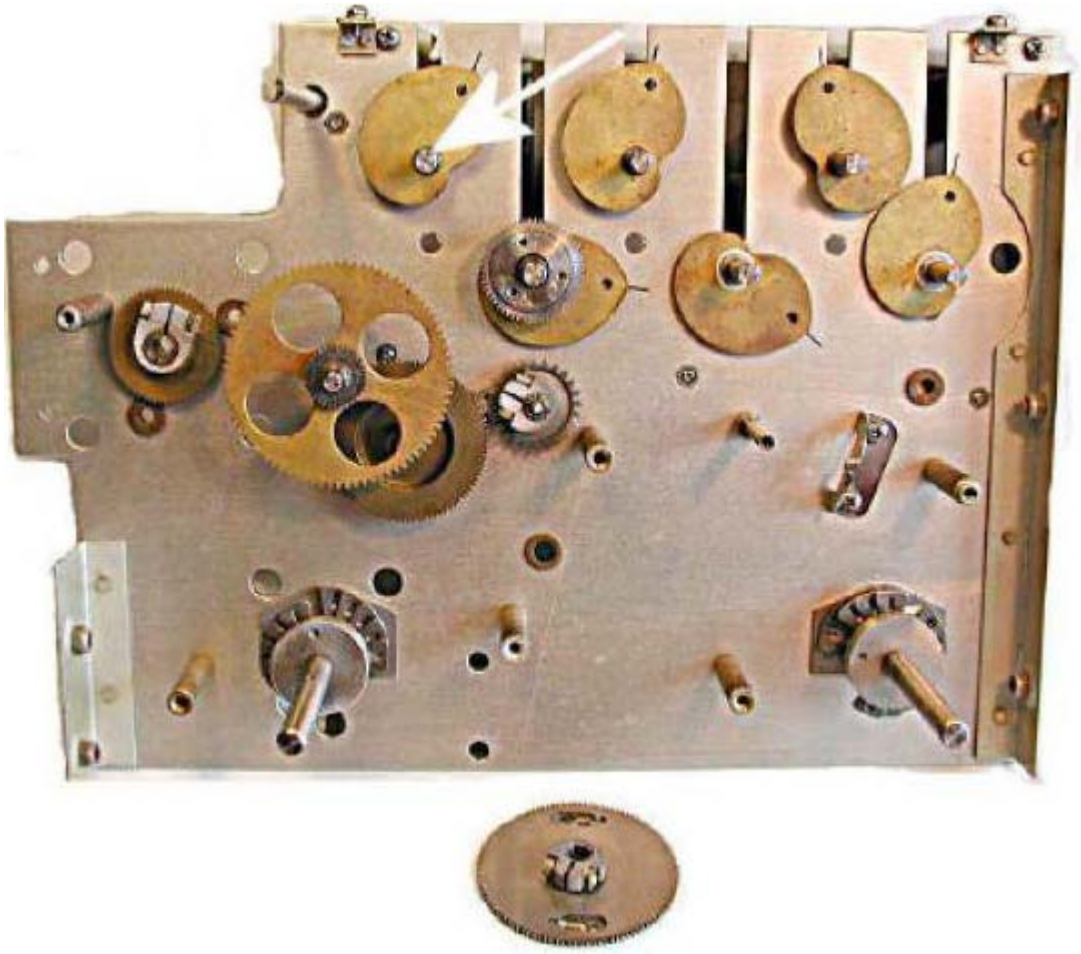
Notice the 6 cams are set for 07 +000. That is they are in the position they would be in when the MHZ dial is set to 07 and the KHZ dial is turned up so it is just past 999. The dial will read +000. The holes in the cams align with the lines on the panel. This is where you want them to be when you align the mechanics.



The White Arrow indicates the location of this gear

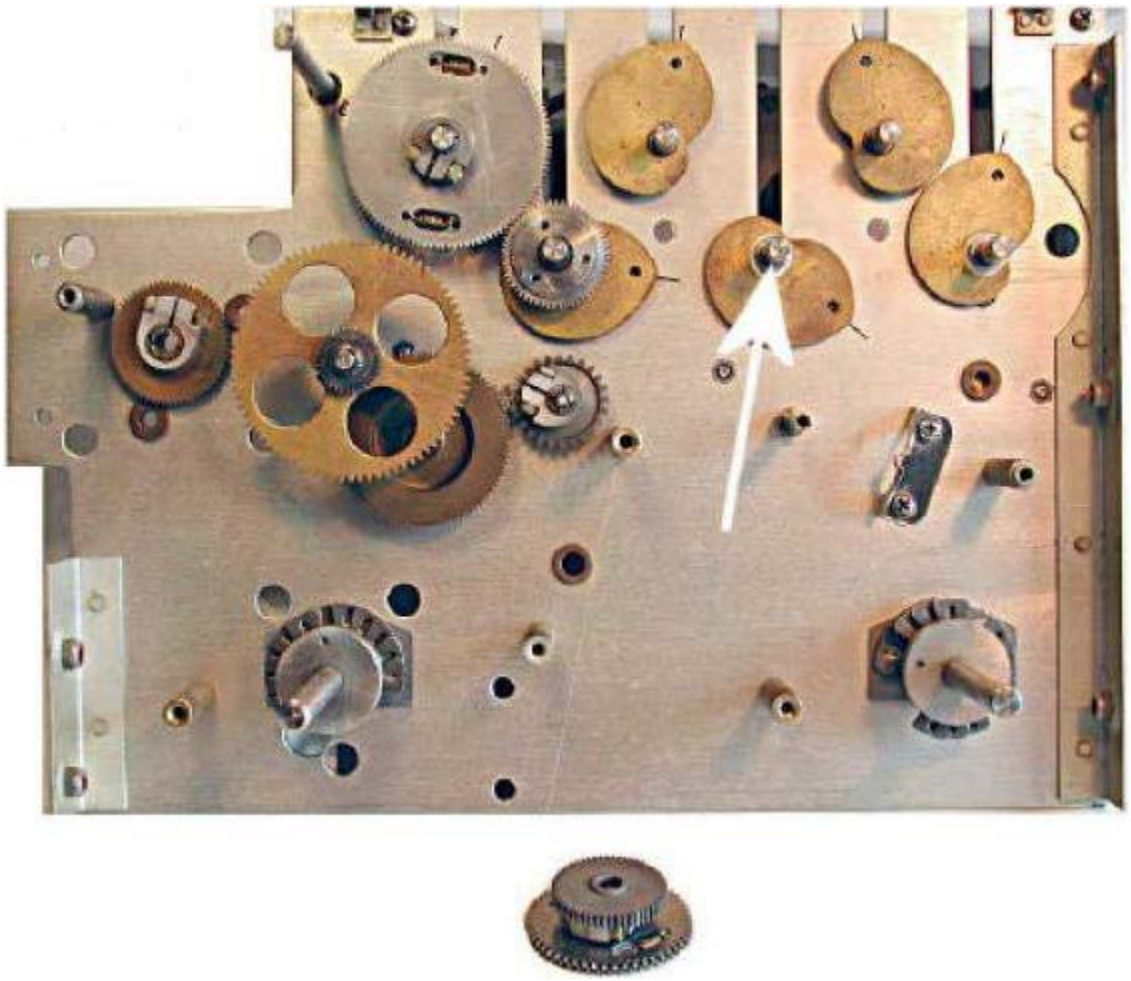
Insert it with the Pinion Meshing with the Geneva Drive Gear. Don't worry if the cams don't stay in this position at this time. Later we will realign them and clamp them to the Gear-train.

STEP 3



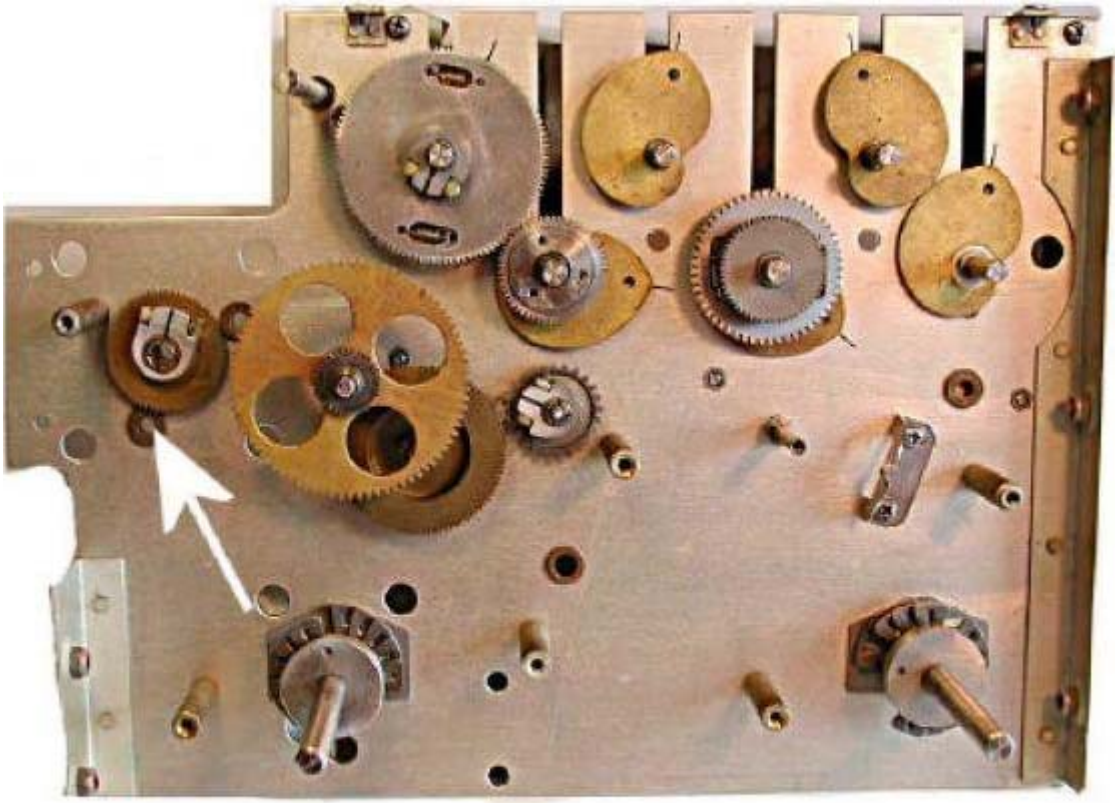
These Split Gears should be separated by removing the retaining ring and pulling apart. All the Split and Backlash Gears such as this one, should have the sides of the teeth lightly sanded with 220 to 320 grit paper. Do not sand the mating surfaces of the teeth but rather the sides of the teeth where burrs form. The gears should spin smoothly against one another when dry assembled. Use a very light coat of Synthetic Motor Oil between the gears upon final assembly. Put this gear on clamp facing out and tighten it lightly as the cam is going to need to be set before final tightening.

STEP 4



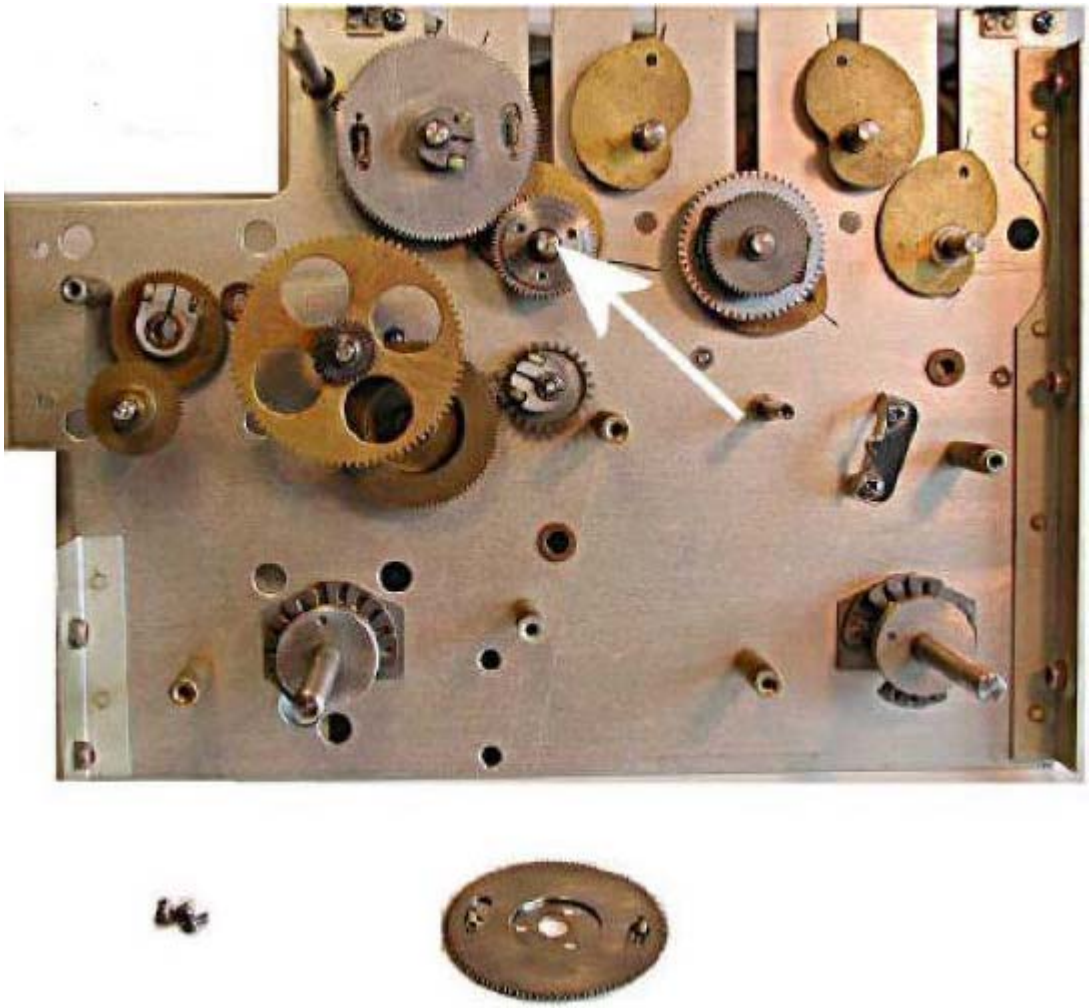
This gear goes on with the smaller gear facing out (towards you). Again only lightly tighten as the clamp will need to be adjusted later.

STEP 5



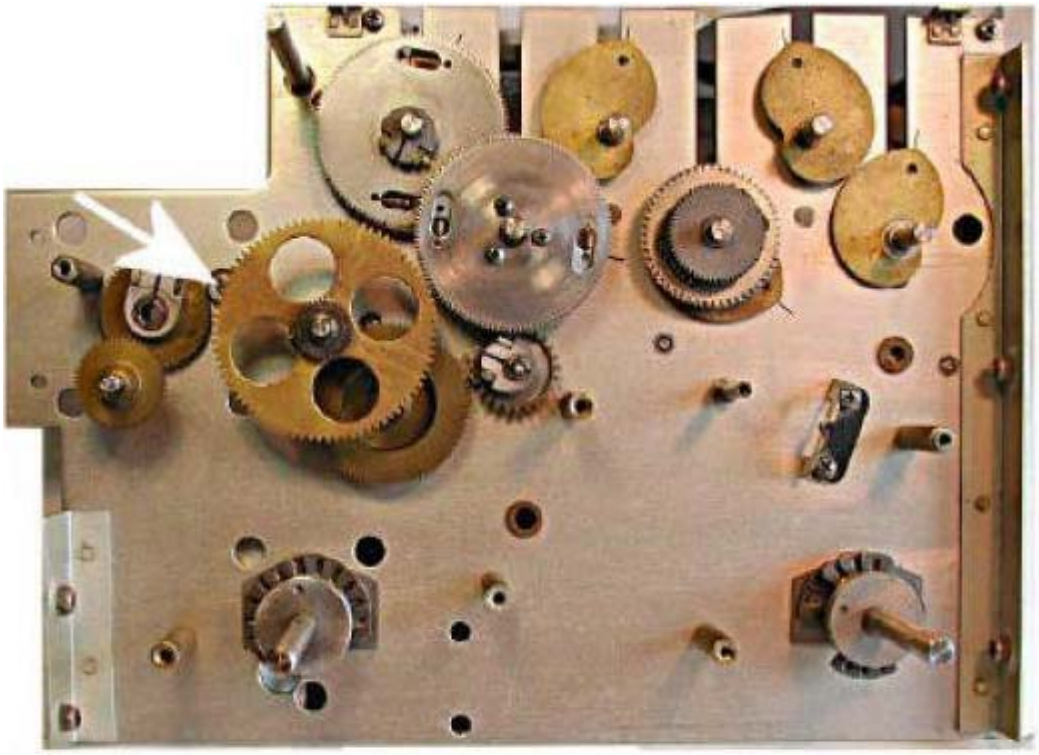
This gear drives the Bevel Gear of the MHZ display. Lightly lubricate the shaft and insert the long side of the shaft into the Bronze Bushing.

STEP 6



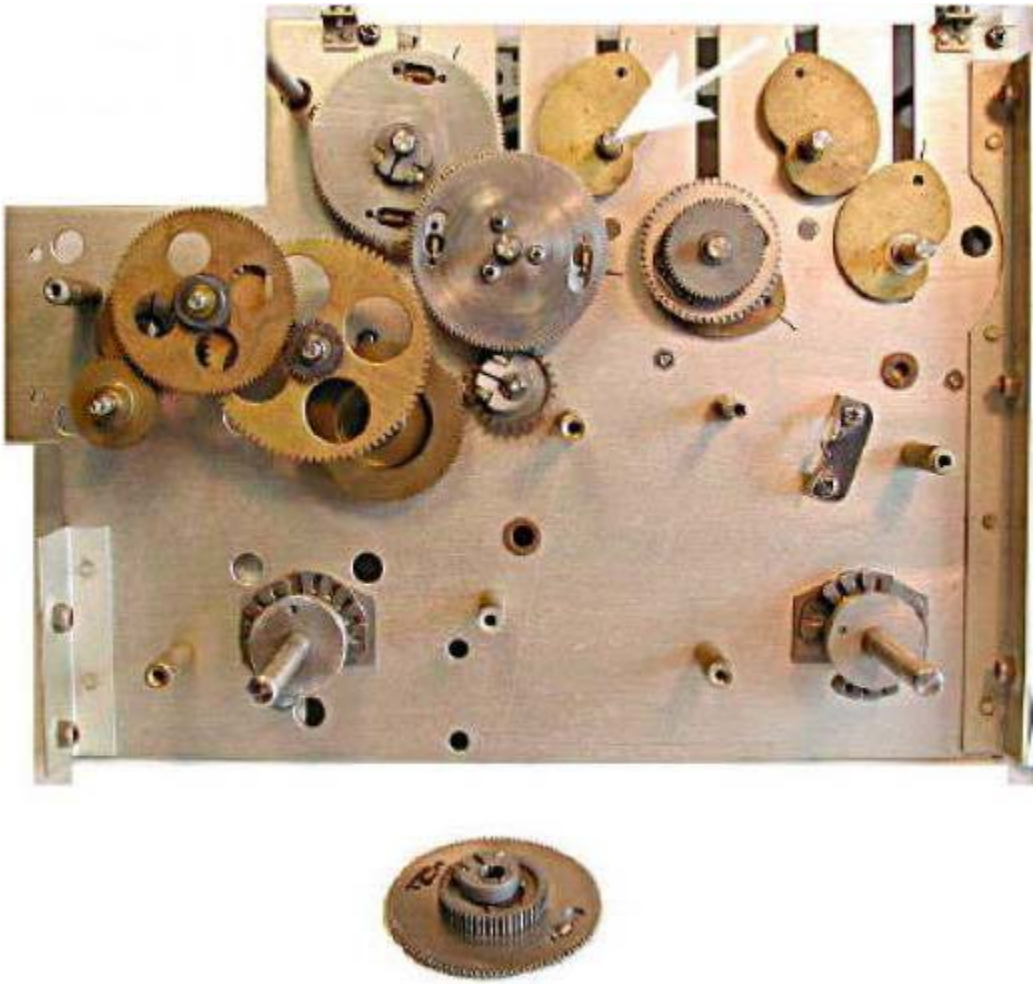
Treat these Split Anti-Backlash gears as described earlier (cleaning) and then fasten using 3 screws. Side with large center hole goes in towards the cam.

STEP 7



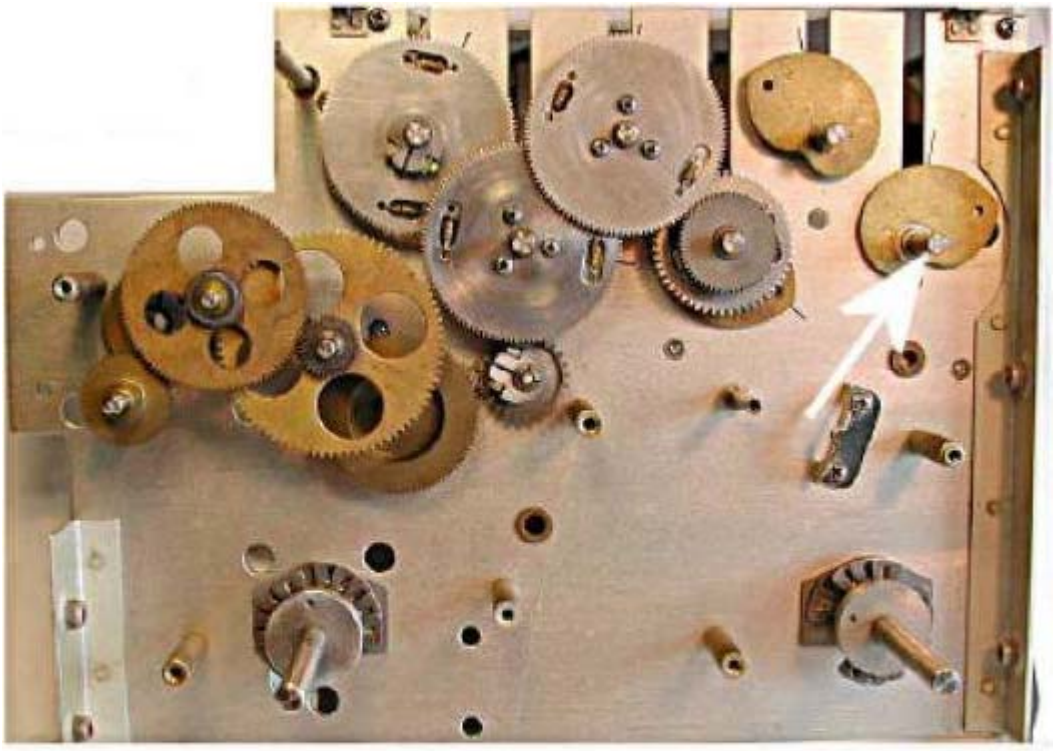
Lube shaft end and insert with small gear facing in and meshing with adjacent gear. **OK**

STEP 8



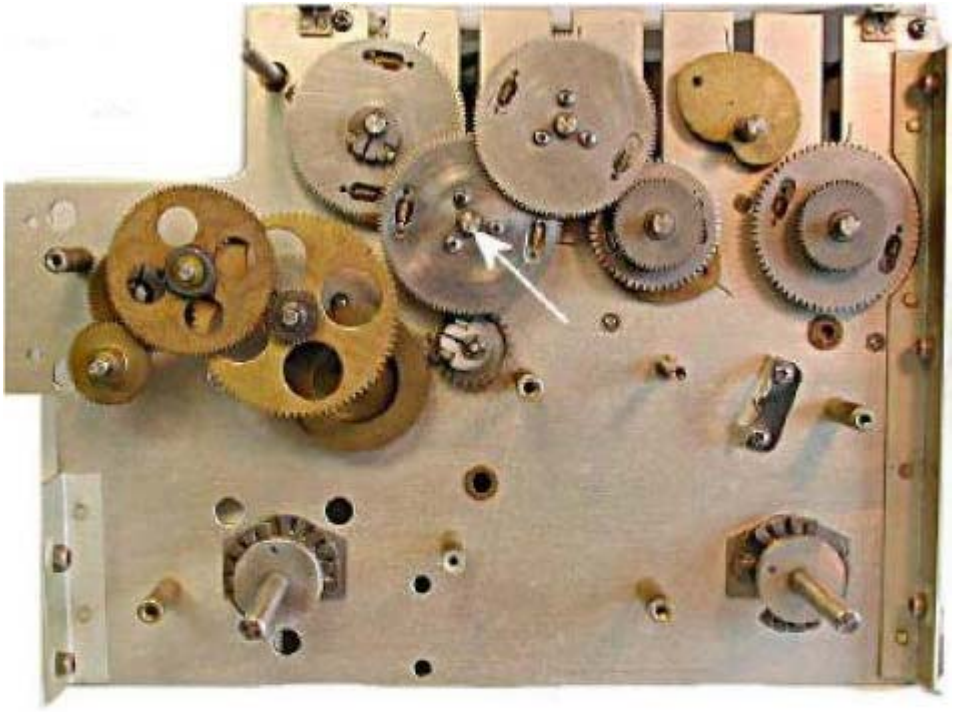
Again treat Split Gears and insert with small gear facing in towards cam. Only tighten lightly for now.

STEP 9



Again treat Split Gears and insert this time with small gear facing out. Only tighten lightly for now.

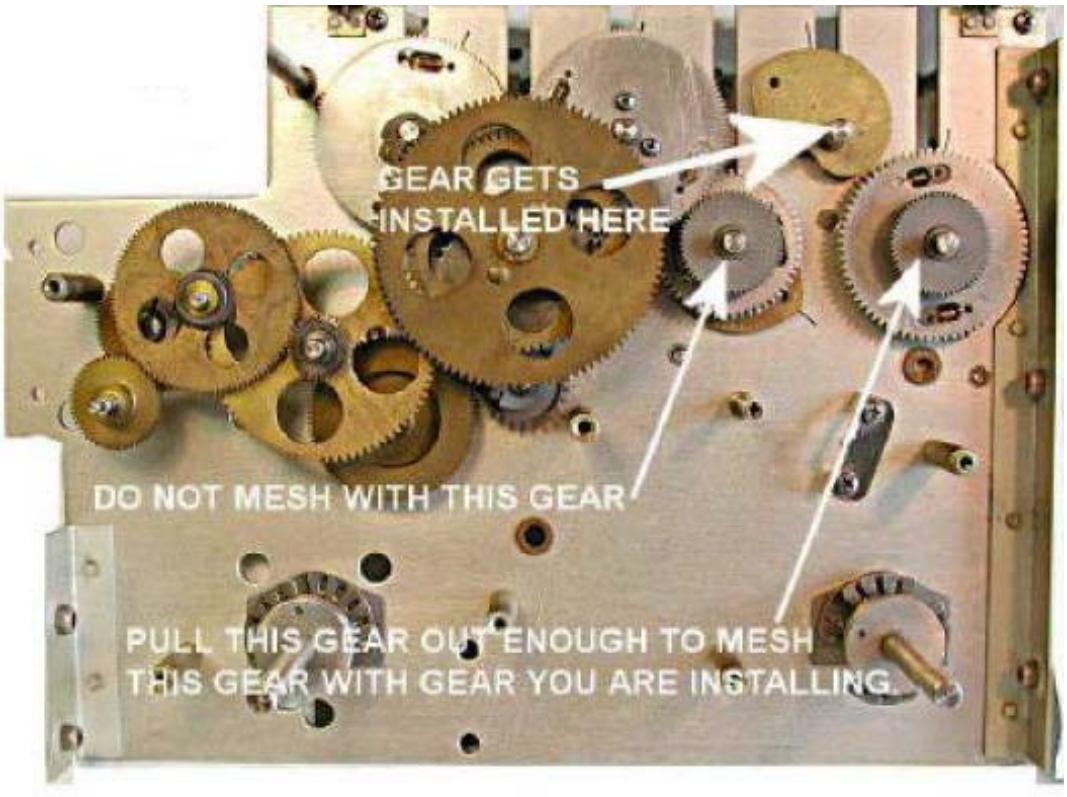
STEP 10



Small gear of this assembly faces in.

STEP 11

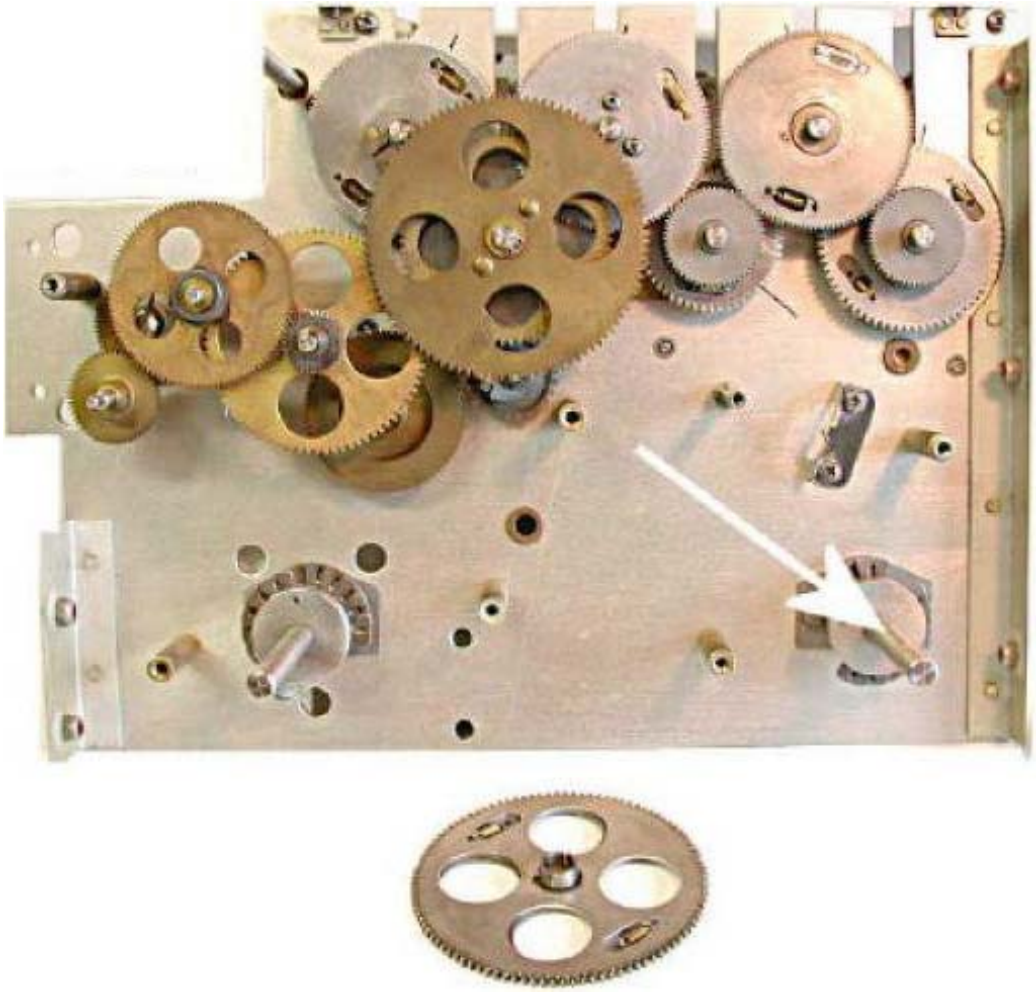
Clamp faces in. What is important with this gear is to only slide it in far enough so it does not mesh with the small gear on the third cam from the right. You may have to slide the gear assembly that is on the very right cam out a bit so it meshes with this gear.



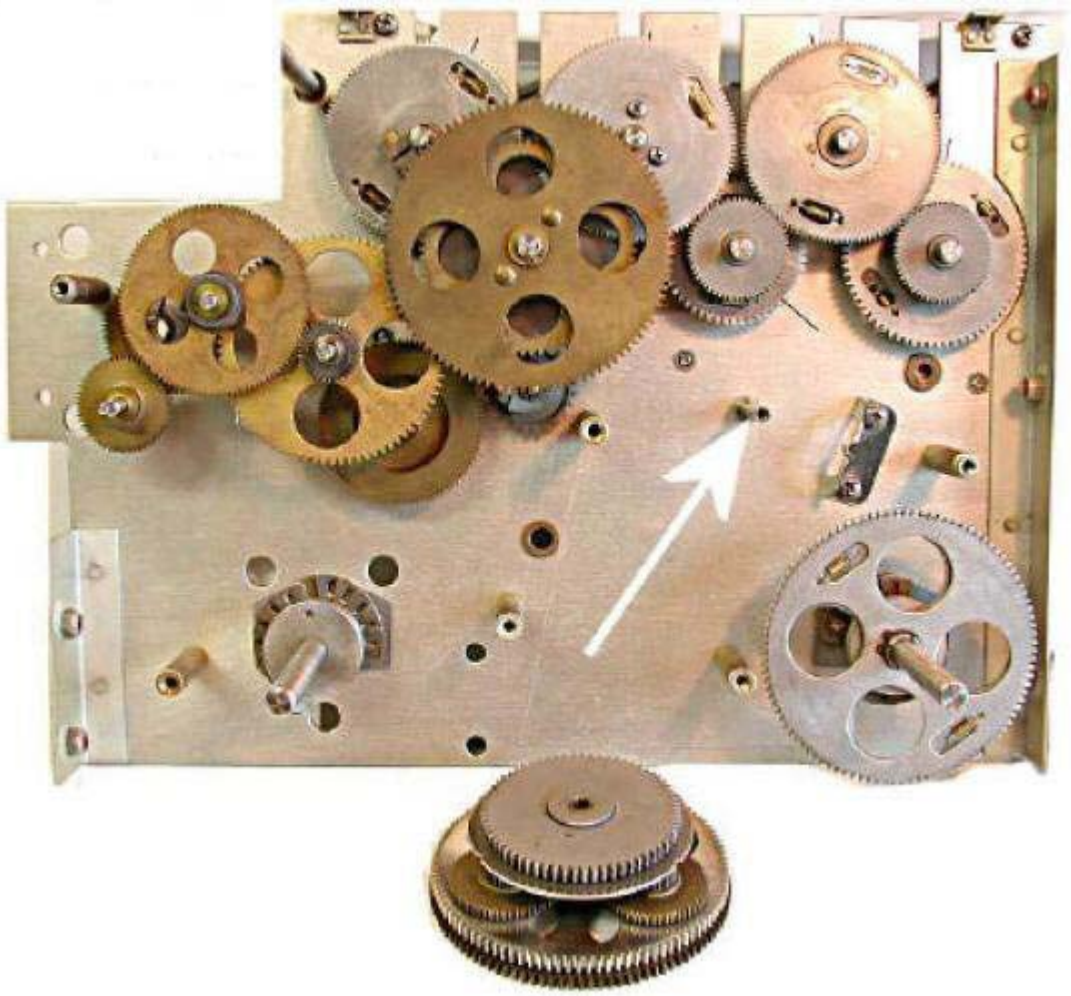
See pictures showing top view.

STEP 12

Slide gear onto MHZ shaft with clamp slide facing in. Only tighten clamp lightly as the 10 turn stops still need to be adjusted. **OK**



STEP 13



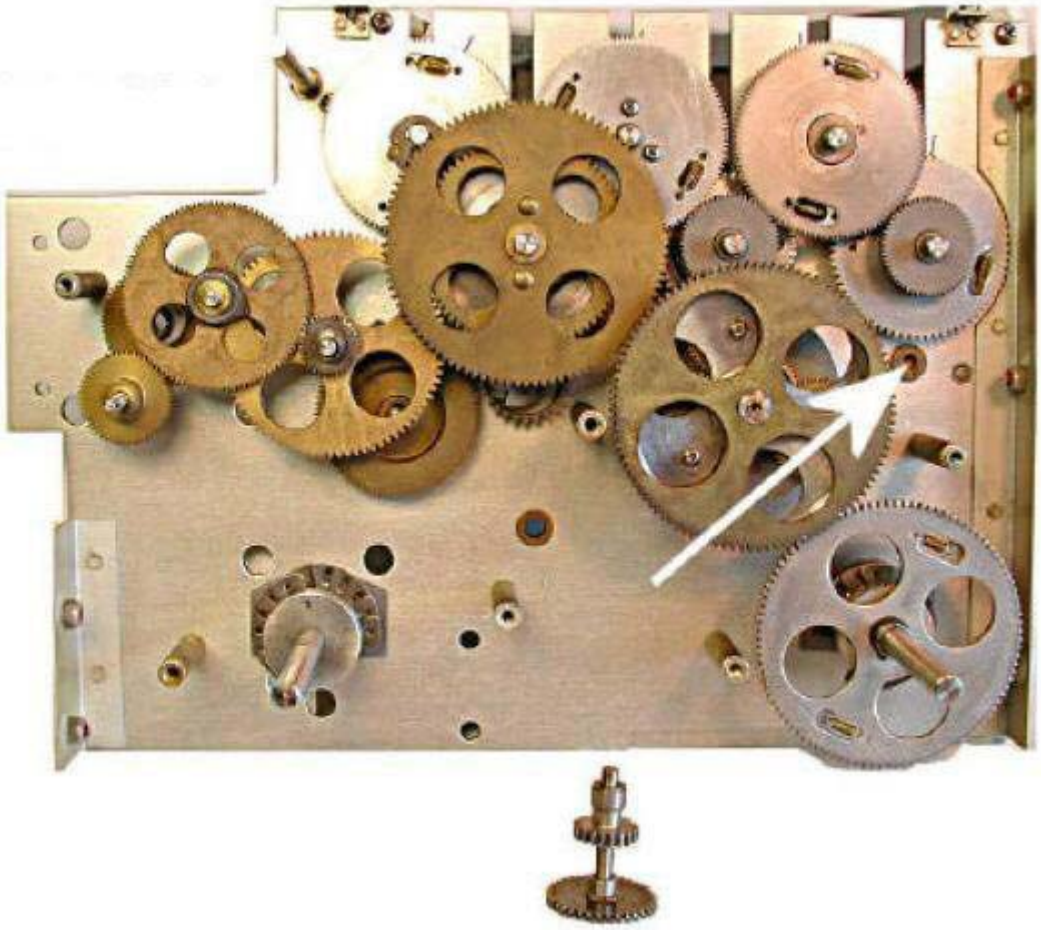
Soak the Differential Assembly in ~~gasoline~~[1] or other solvent for a day or until all grease and dirt is removed. Rinse thoroughly. Disassembly should not be necessary if thoroughly cleaned. Re-lubricate all gear mating surfaces with Synthetic Motor Oil.

⇒ **Danger:**	[1]While the author of this article used gasoline for a solvent this is an **EXTREMELY** dangerous due to the fire hazard. Others have advocated using carburetor cleaner, brake release spray and others that are basically carcinogens. The safest, far cheaper, but a bit slower alternative is kerosene. Radios are fun, but not to die for. [Lead Editor]

Slide gear assembly onto shaft, small gear facing inward. **OK CLARIFY SOLVENT ISSUE**

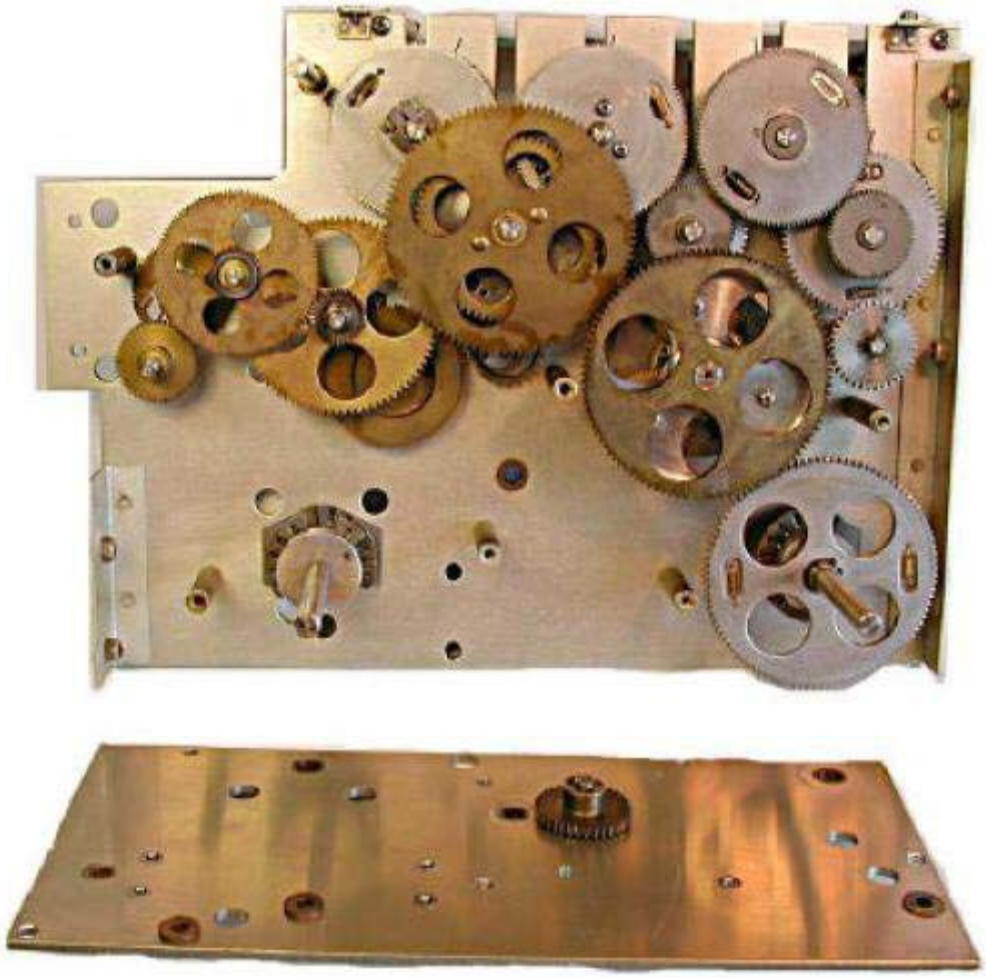
One thing I'd like to add to all this. When disassembling the planetary gears, I discovered the spring-loading mechanism is different from the standard ball-point-pen-style springs in the other gears. These are a single circular piece of spring steel enclosed inside the gear halves. Each half has a hollowed-out place to accommodate the spring. If your geartrain is particularly gritty, these can be great little traps for dirt. While you can probably get the regular flat split gears pretty clean without disassembling them, it would take a lot of washing and blowing to get these gears really clean without disassembling them.

STEP 14



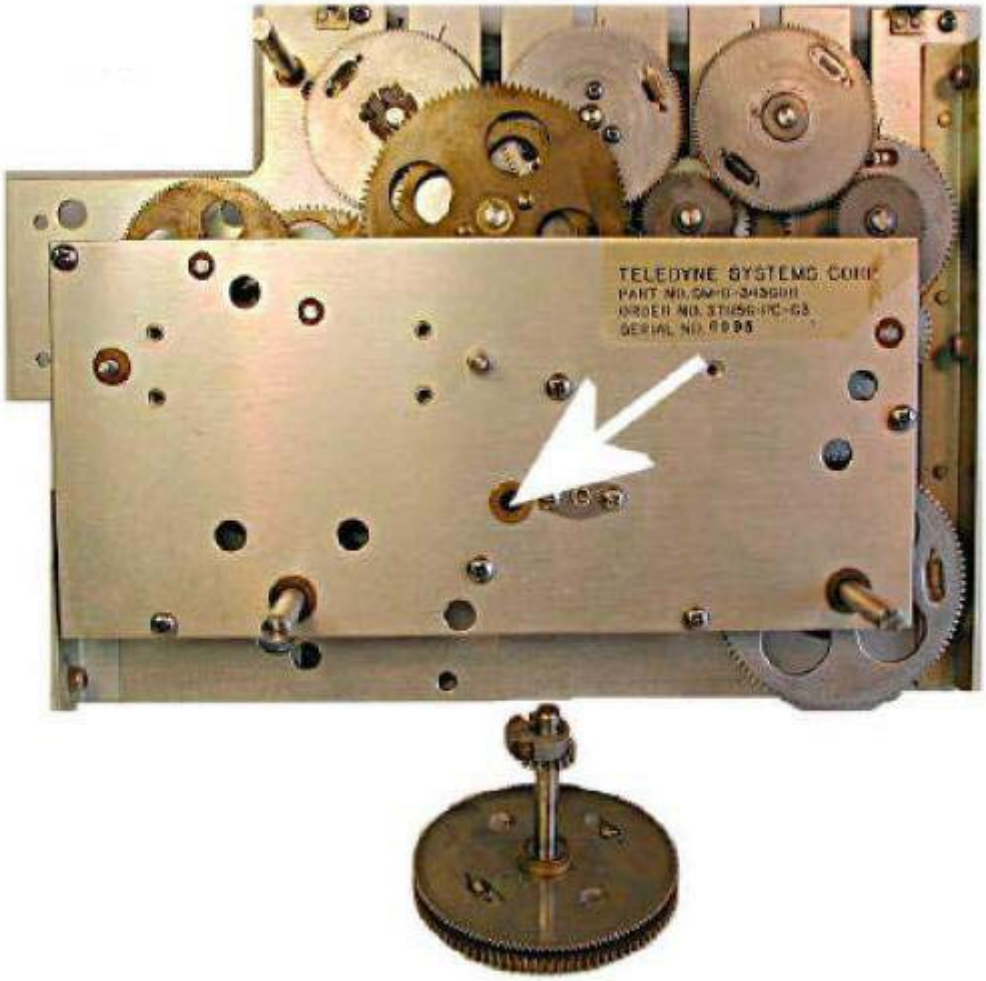
Lubricate end of shaft and slide into Bronze Bushing.

STEP 15



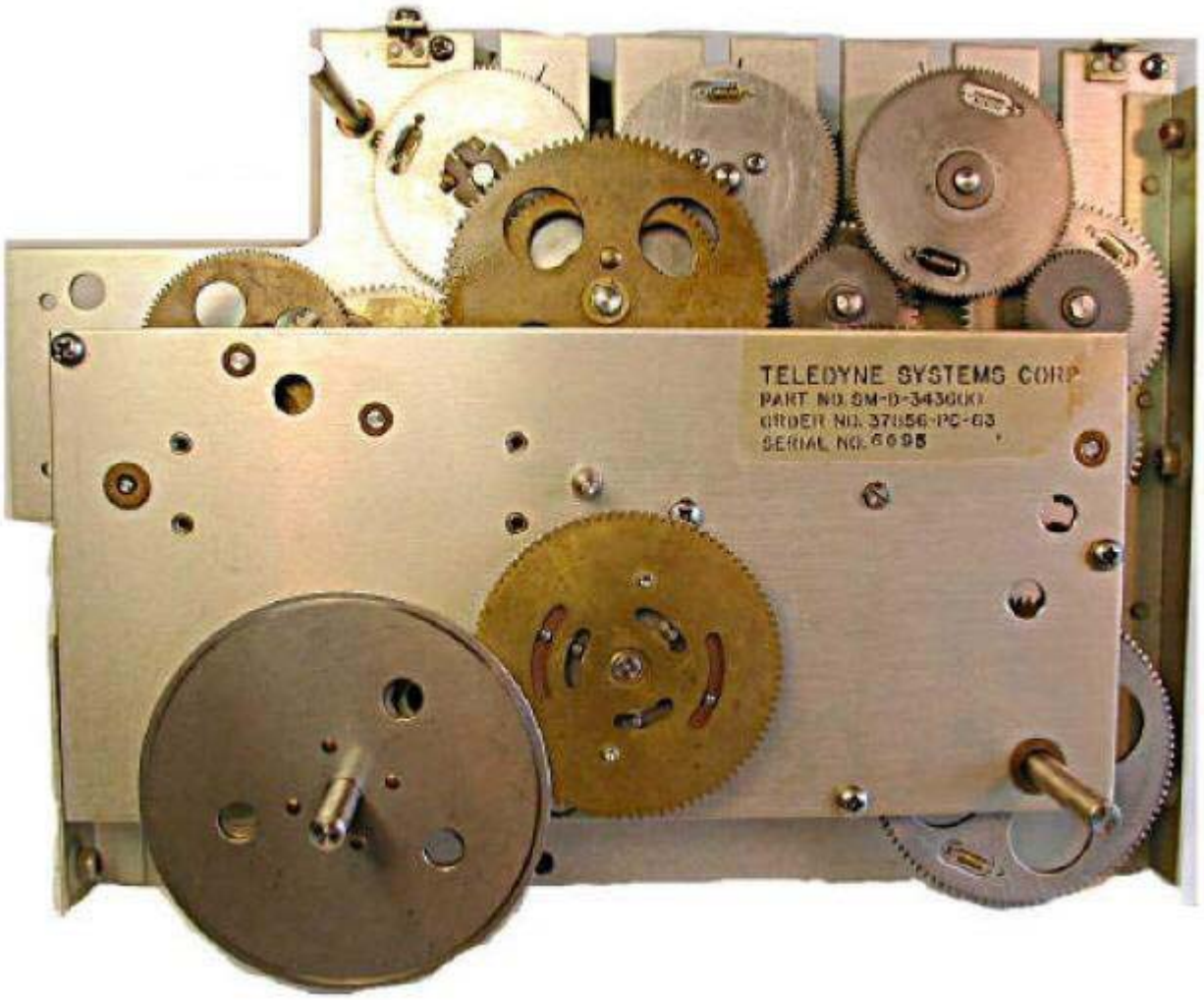
Panel goes on next. Carefully align shafts into Bronze Bushings on panel. Tighten all screws gradually and evenly.

STEP 16



Shaft with clutch assembly goes through bushing and small gear clamp. Install on shaft behind panel.

STEP 17

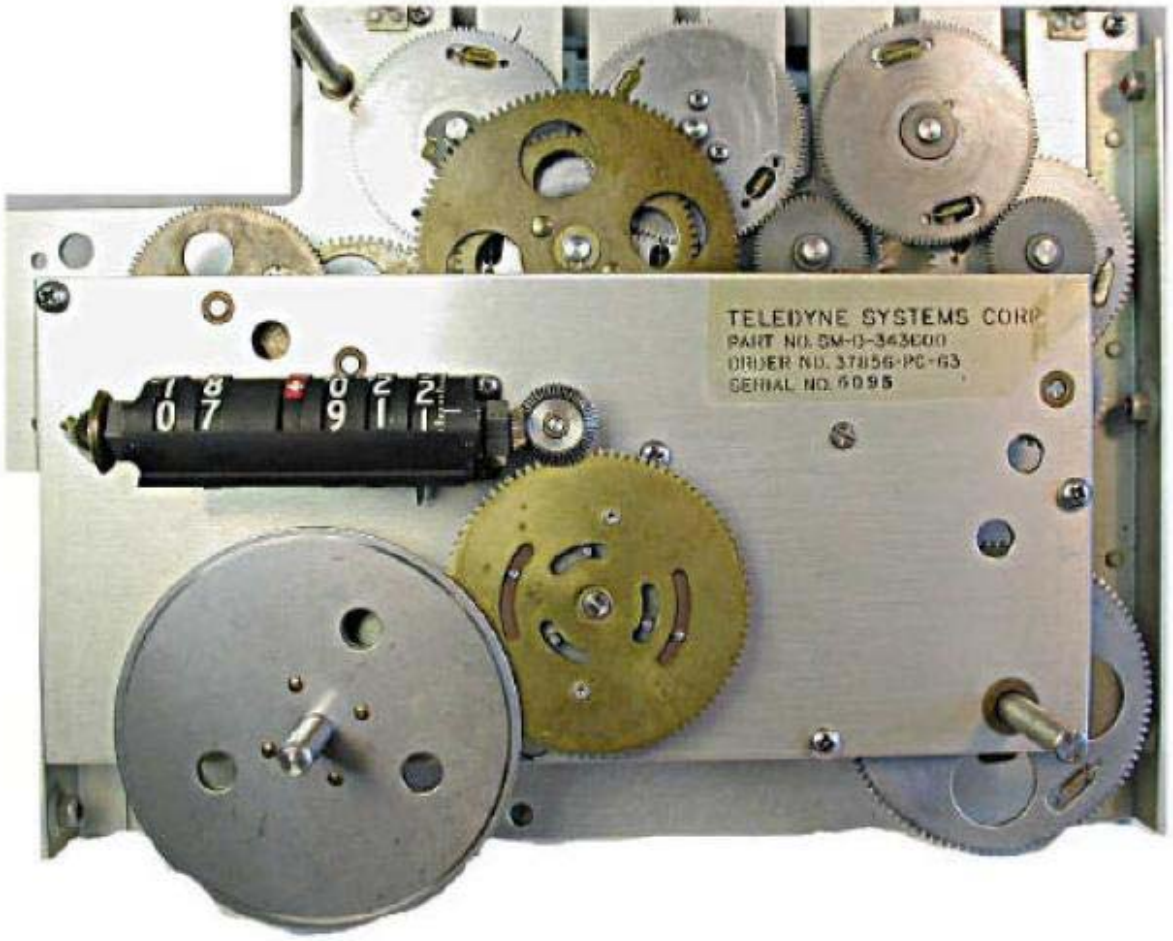


Clutch disk is clamped onto KHZ shaft.

STEP 17A

Install Veeder Root counter.

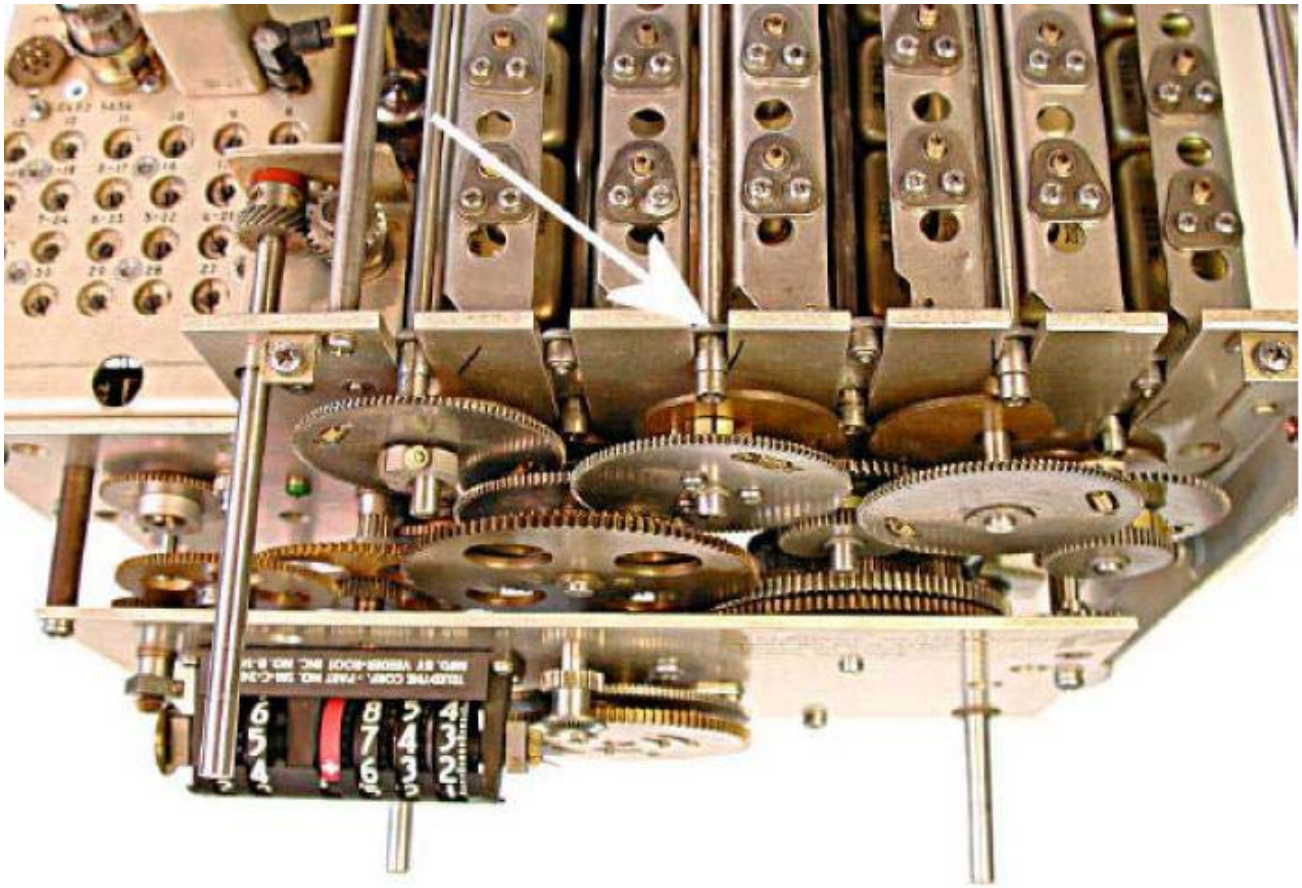
STEP 18



Assembly finished!
Time for Mechanical Alignment which consists of:

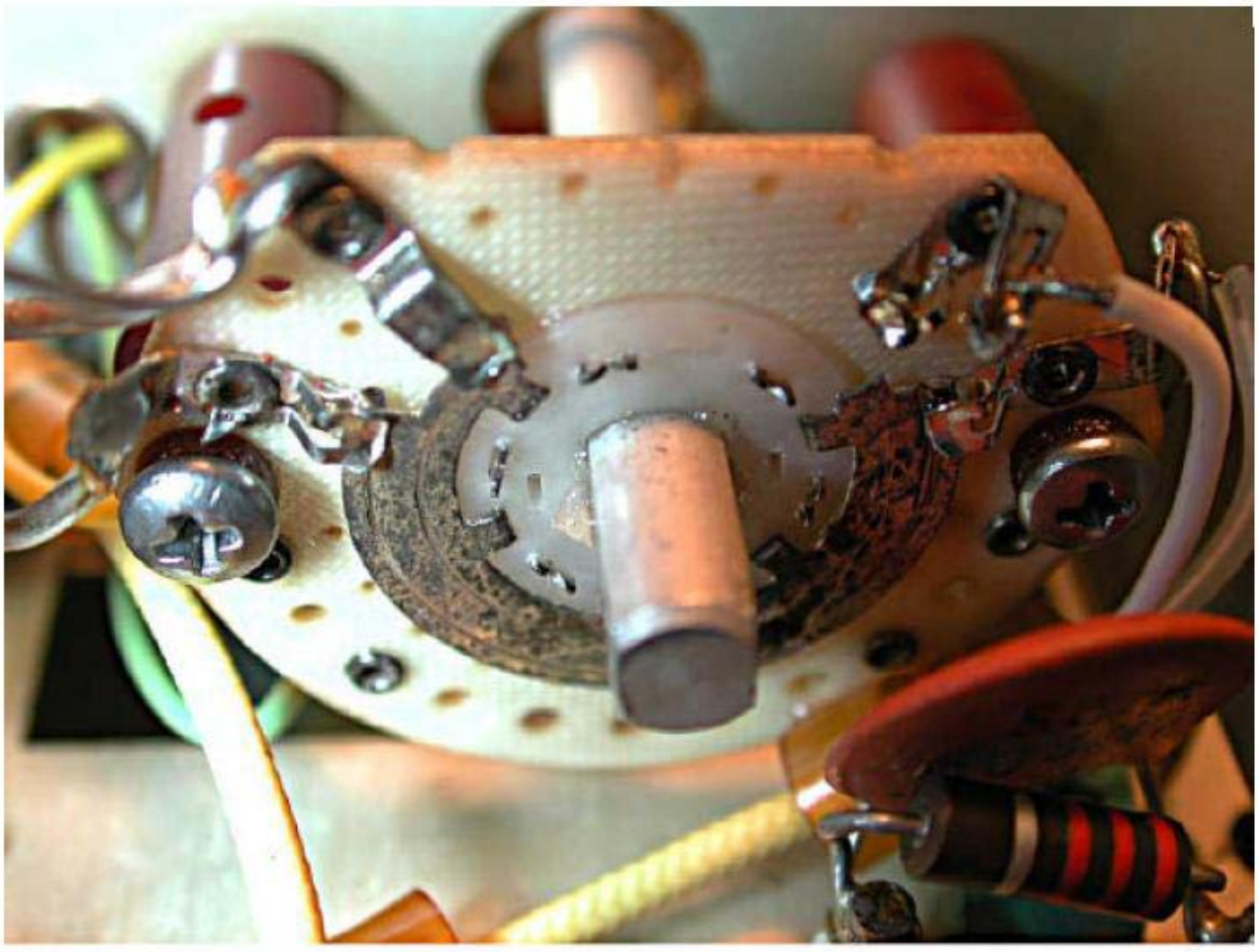
1. Align the cams at 07 +000 Marks.
2. Align the counter to this reading.
3. Align the bandswitch.
4. Set the 10 turn stops.

STEP 19



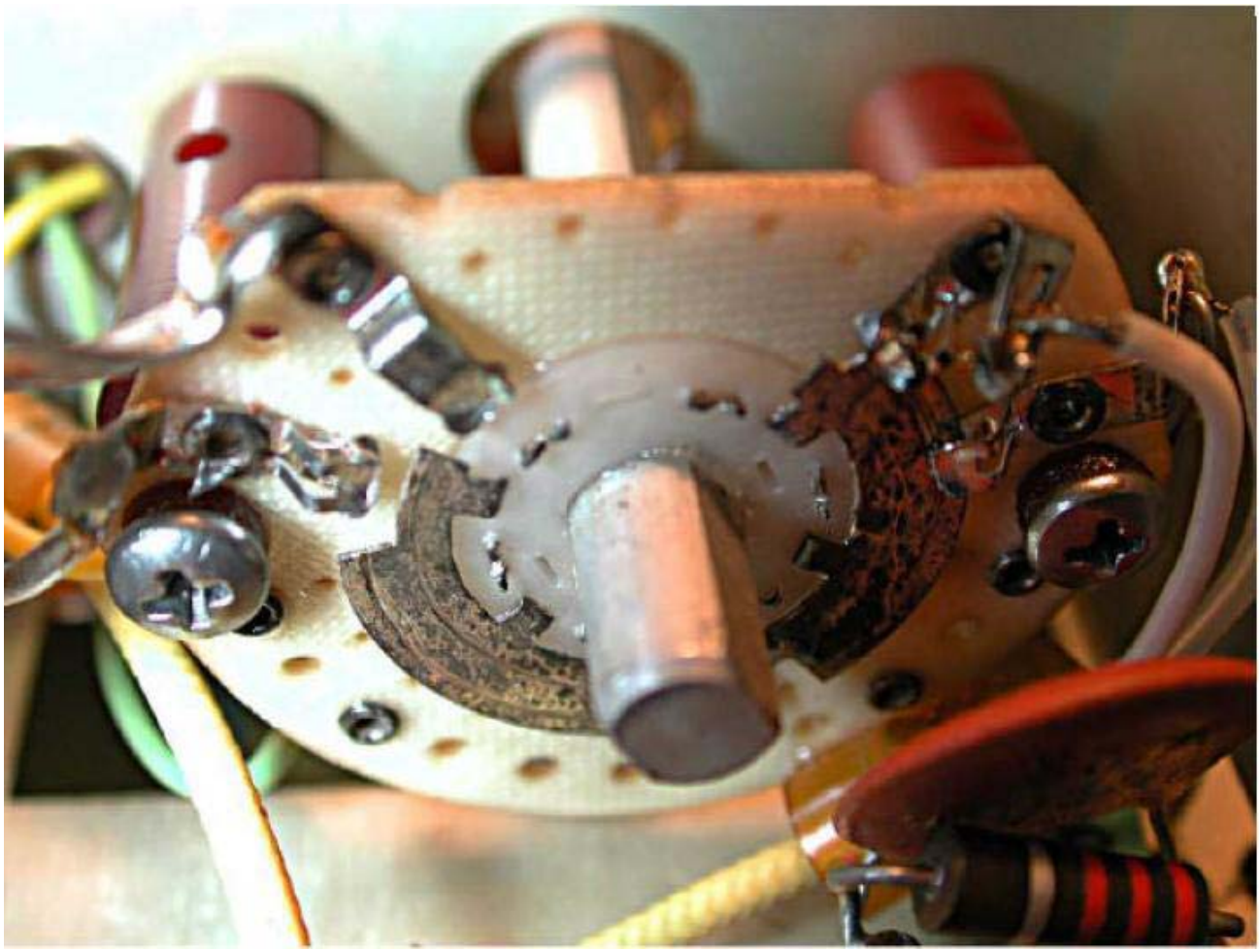
Lubricate slides with “Mobil 1” 90 weight Synthetic oil. Lubricate all gears with “Mobil 1” Synthetic 30 weight oil. It is important to use Synthetic oil because it will not dry out and harden with age. The Gear Train will need to be lubricated every 6 months to 1 year. Never use grease. It will just make a big mess.

STEP 20



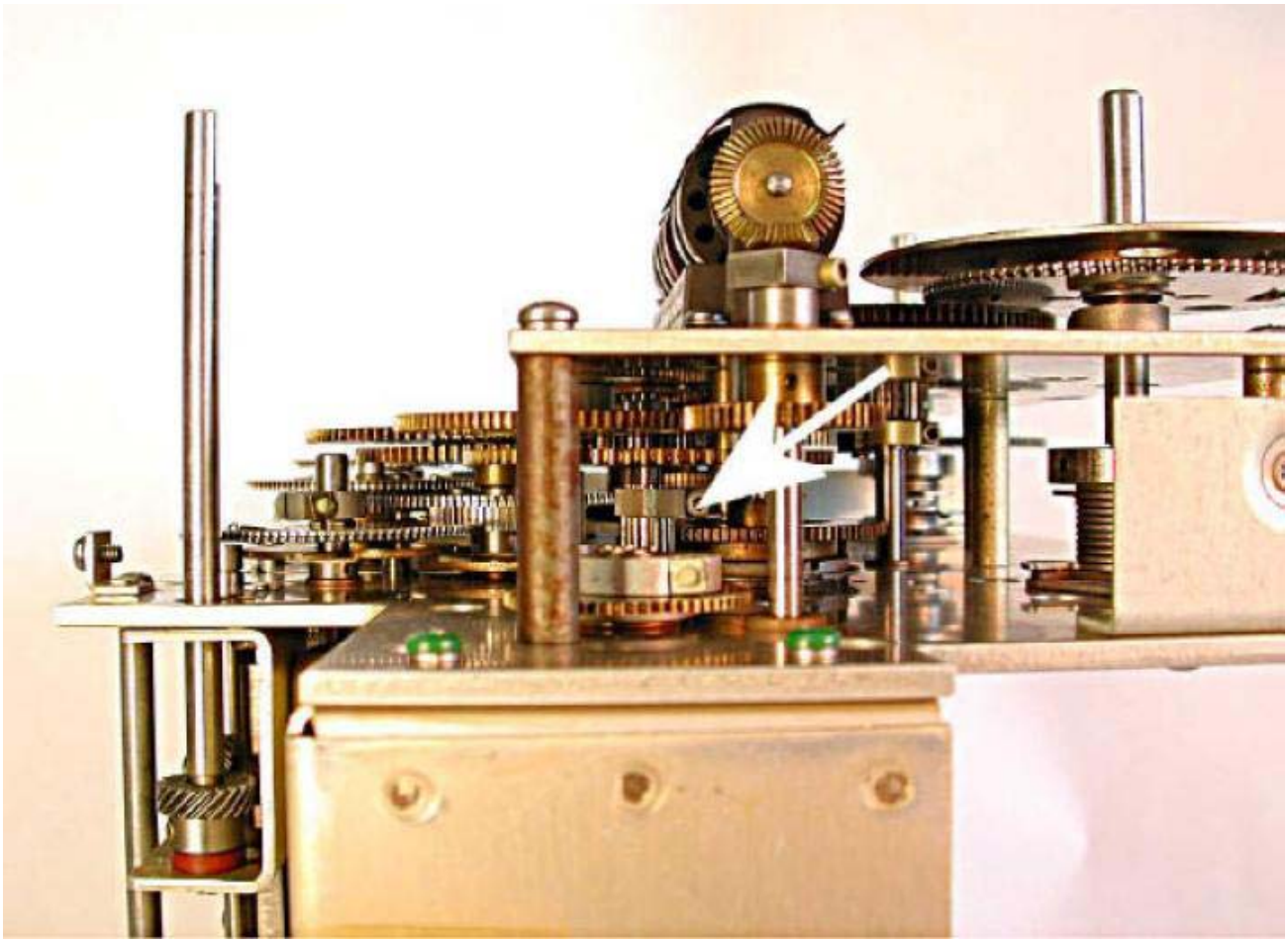
This is the position of the RF Bandswitch rearmost contacts when the dial is set in the 07 MHZ position. The KHZ dial has no effect on this switch setting.

STEP 21



This is the position of the RF Bandswitch rearmost contacts when the dial is set in the 08 MHZ position. The upper left contacts should open up as the switch is turned from 7 MHZ to 8 MHZ. There is only one position of the Geneva Switch that will produce this result.

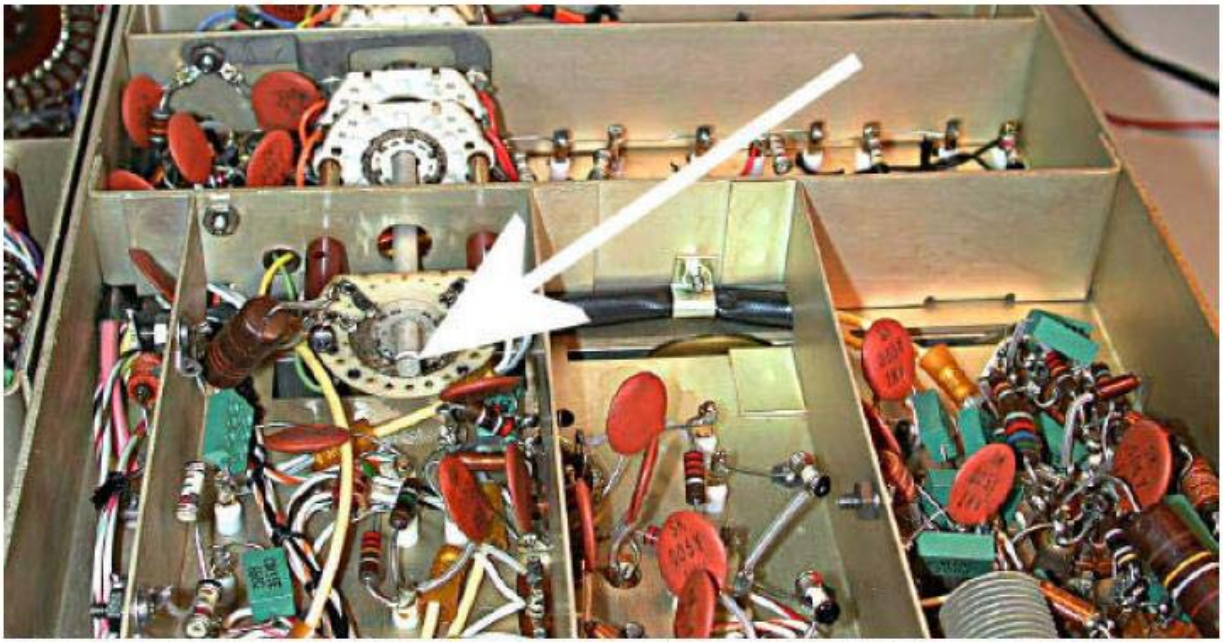
STEP 22



This is the clamp that you need to loosen in order to adjust the RF Bandswitch. The clamp holds the Pinion Gear as shown in assembly picture #2.

You need to hold the large gear attached to this small Pinion gear and only turn the Geneva drive to set the RF Bandswitch.

STEP 23



This is the wafer of the RF Bandswitch that we will be looking at to mechanically align this switch. It has 6 positions. The switch changes positions when the MHZ dial is changed from 0 to 1 MHZ, 1 to 2 MHZ, 3 to 4 MHZ, 7 to 8 MHZ and 15 to 16 MHZ. Note: that I said that these are the transitions at which the switch changes. The 6 switch settings represent the following bands: .5 to 1 MHZ, 1 to 2 MHZ, 2 to 4 MHZ, 4 to 8 MHZ, 8 to 16 MHZ and 16 to 32 MHZ.

When looking at the RF Deck and the Geneva Drive as shown in the step #1 Picture, turn the Geneva Drive fully counter-clockwise to set the switch on the lowest band, which is .5 to 1 MHZ. Now turn the Geneva Drive slowly clockwise and the switch will transition to the 1 to 2 MHZ band, then the 2 to 4 MHZ band, then the 4 to 8 MHZ band, then the 8 to 16 MHZ band, stop after this transition. Now very slowly turn the drive back until it just, and I mean just switches back to the 4 to 8 MHZ band. This is the proper switch position for mechanical alignment at 07 +000. See close up photos to confirm switch alignment.

Comment:

I care not what the manuals say about you can do a band switch alignment with a meter probing into the pins of tube sockets. Sure you can do a lot of things. The question is should you do it?

Drop the front panel, pull the RF deck, turn the deck upside down on the bench and put the MC knob back on the shaft.

Roll the MC through the ranges both up the bands and down the bands. Look at the switch and the amount of contact mesh at each wafer section and at each change point going both up and down. As you move the MC change knob through the receiver range you will see the band switch change as you roll up or down across (.5-1 , 2-3 , 4-7 , 8-15, 16-31). At each change point, the switch should move over one contact and seat as the MC change knob sets into its detent position.

Now this is a judgment call. Depending on the free lash slop, mechanical exact construction of any given wafer and straightness of the switch assembly, how much contact mesh you will get varies. Resist thoughts of touching or adjusting wafer switch contacts of section. Just do not go there.

Now looking at the switch contacts do the adjustment of the band switch. Your goal is to get the maximum contact overlap at all switch sections on each band.

You will find that one end the wafer is just making to the left of a contact, and when you dial to the other end of the receiver, the same wafer will just be making to right of a contact. One switch wafer will be lining up real good and another wafer will just barely be making contact. Remember, that receiver has worked for over 40 years, what ever adjustment is needed is very small.

Clutch Information

Subject: [R-390] Clutch!

Fellows,

The zero adjust clutch has no "adjustment" they either work or do not work. The different production runs had different "feels" to the adjustment.

The critters did and do get dirty, mostly they were "washed" and "run dry" with a minimum of oil.

The disk on the zero adjust shaft does not have such a good shaft bearing. This has always been a point of friction in the design.

You can read the TM and take the clutch apart if you need to really get one clean (you may have to). Otherwise you hung the RF deck off the edge of the bench and sprayed liberal amounts of your favorite solvent through the gear train and followed with compressed air to blow dry. Mobil synthetic oil is now the relube of choice.

The clutches all sort of had a different feel. Some would open up and roll nice, others just felt like they dragged. We never did any thing about them in the service. The zero adjust was a go no go item. It did or did not function. when the receivers were much younger a good wash and lube got them back into a passing condition. No disassembly was required. Considering the age and where some of these receivers have been, a one time disassembly and cleaning could very well be in order.

I see some on the market trying to tell me I need to go an extra C on a receiver that has a smooth zero adjust and knobs that do not induce tunnel carpo and I may need a few minutes to pick my butt back up off the floor and stop snickering.

Real R390's needed work to operate and were part of every operators personal physical fitness program. A day cranking a R390 and you bend an elbow to get a few beers disposed of. Roger KC6TRU

Gear Train Alignment At +7.000

Subject: [R-390] Geartrain Alignment Question

Joe Foley pointed me in the right direction. On page 112 of the TM 11-5820-358-35 Field & Depot Maint Manual, it shows the position of the "intermittent switch drive". Not too absolutely clear as to how to verify it's set right, but it gets me in the ballpark. Thanks! Barry(III) - N4BUQ

I care not what the manuals say about you can do a band switch alignment with a meter probing into the pins of tube sockets. Sure you can do a lot of things. The question is should you do it?

Drop the front panel, pull the RF deck, turn the deck upside down on the bench and put the MC knob back on the shaft.

Roll the MC through the ranges both up the bands and down the bands. Look at the switch and the amount of contact mesh at each wafer section and at each change point going both up and down. As you move the MC change knob through the receiver range you will see the band switch change as you roll up or down across (.5-1 , 2-3 , 4-7 , 8-15, 16-31). At each change point, the switch should move over one contact and seat as the MC change knob sets into its detent position.

Now this is a judgment call. Depending on the free lash slop, mechanical exact construction of any given wafer and straightness of the switch assembly, how much contact mesh you will get varies. Resist thoughts of touching or adjusting wafer switch contacts of section. Just do not go there.

Now looking at the switch contacts do the adjustment of the band switch. Your goal is to get the maximum contact overlap at all switch sections on each band.

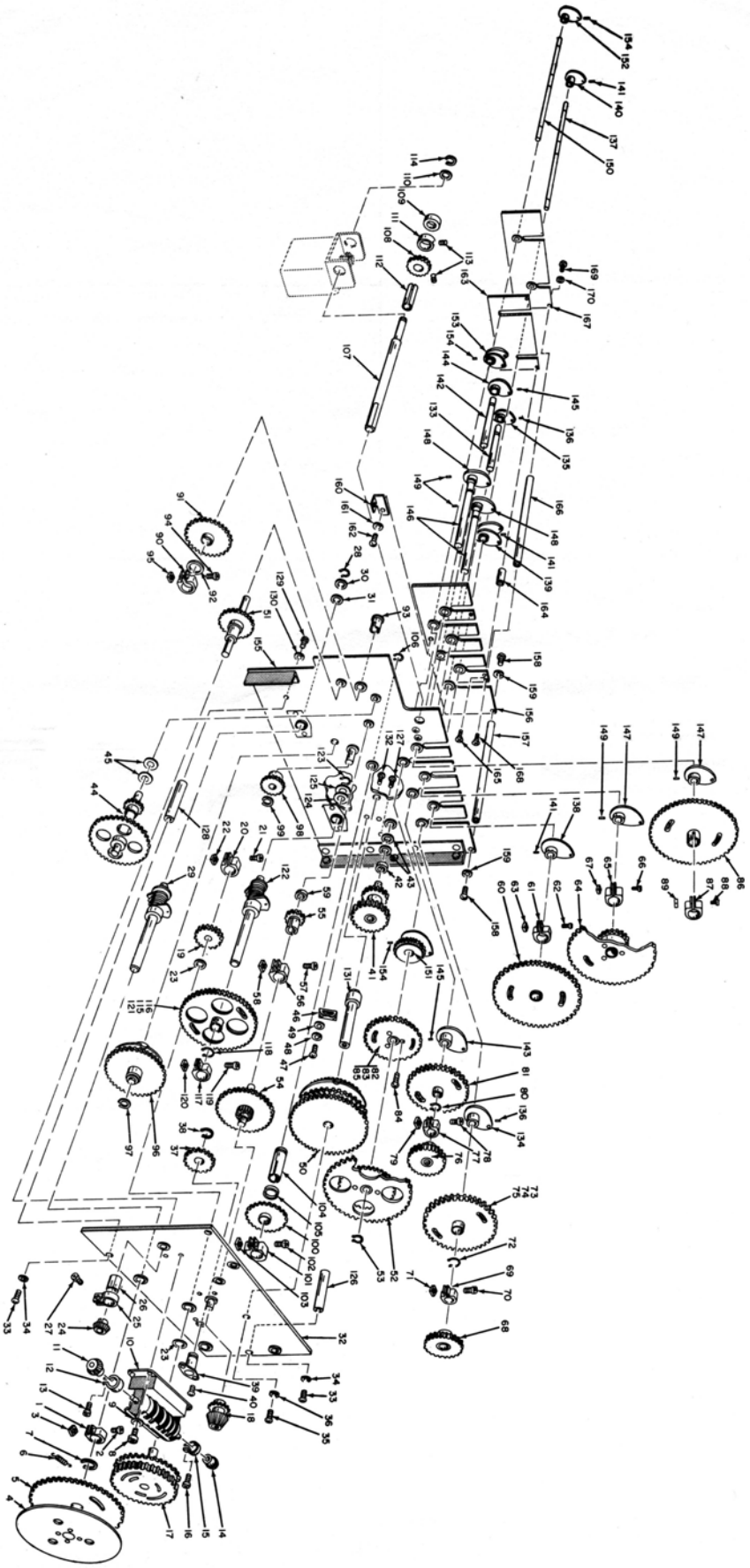
You will find that one end the wafer is just making to the left of a contact, and when you dial to the other end of the receiver, the same wafer will just be making to right of a contact. One switch wafer will be lining up real good and another wafer will just barely be making contact. Remember, that receiver has worked for over 40 years, what ever adjustment is needed is very small.

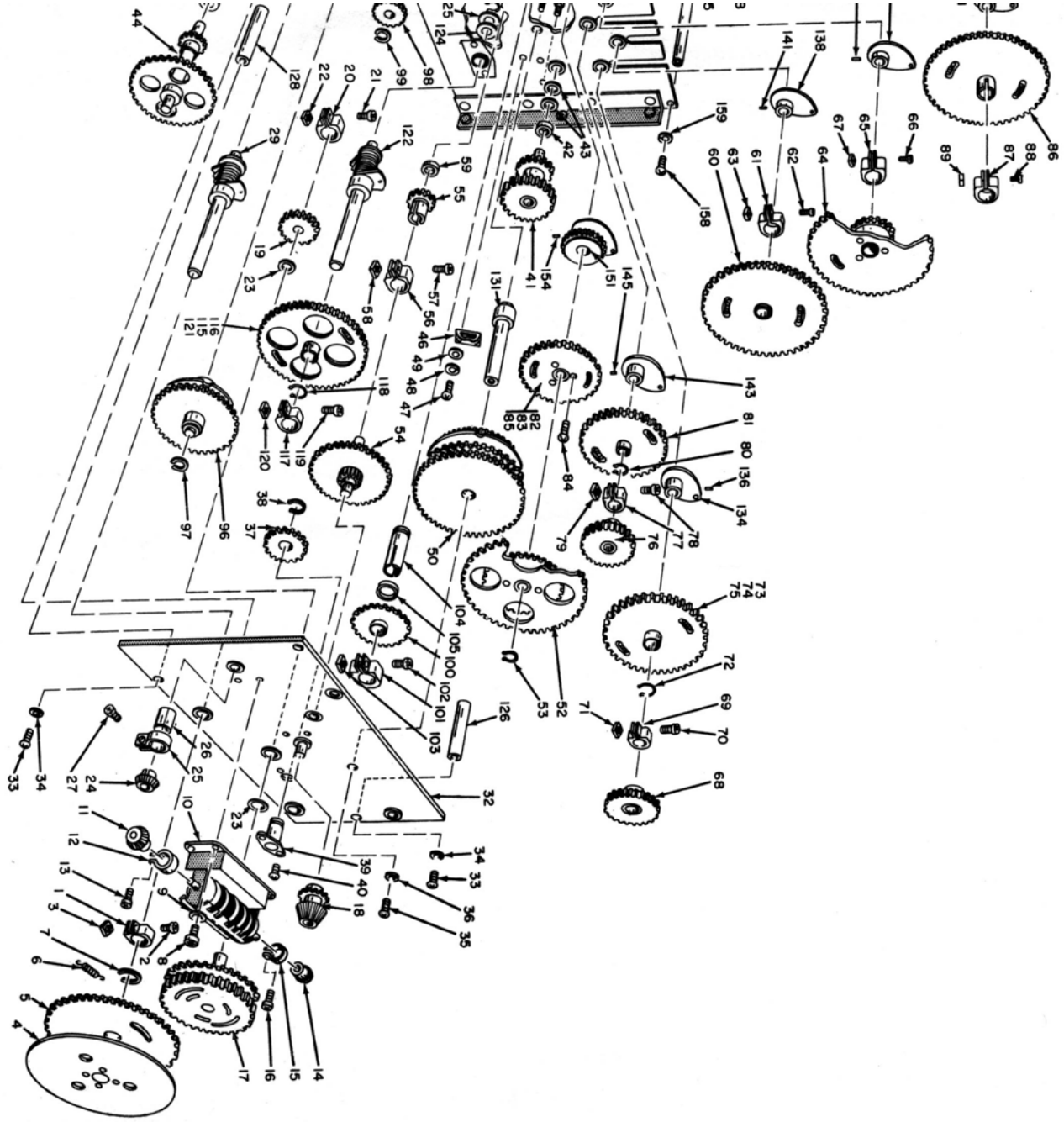
The idea of doing this adjustment visually is to get maximum switch contact area. When you are doing the meter check, the meter current is very low and contact will "test" OK. You can get close with a meter and start burning the switch contact in actual use. Also the meter test is only one switch section. One section may be making contact while another switch section is not quite making it.

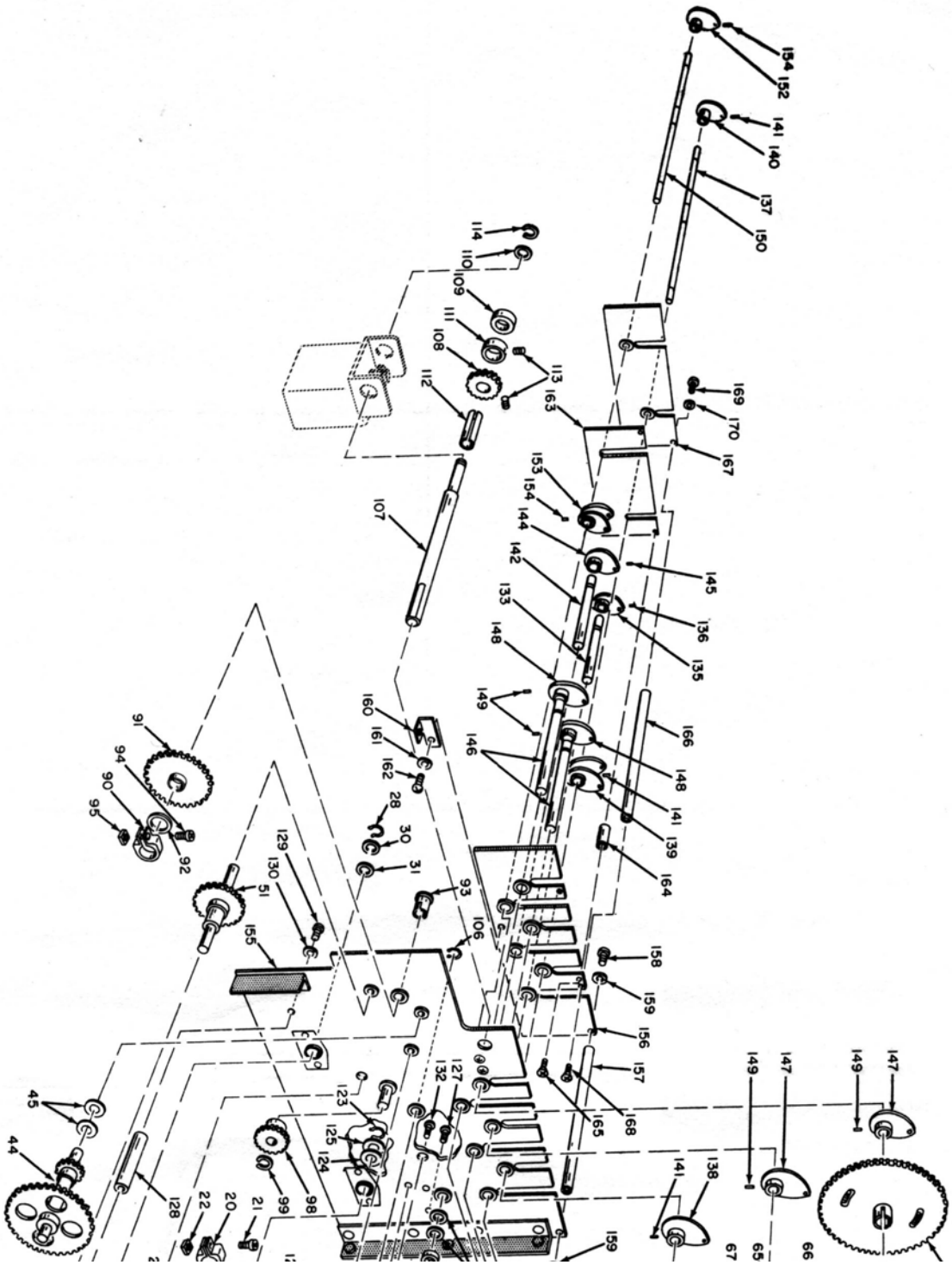
The first indication you may need a band switch adjustment is when you change bands and have to roll over (up or down past) the switch change point to get switch contact.

As long as you have the RF deck and crystal OSC deck there on the bench, check the crystal oscillator switch also. It changes every MC. Again contact area will drift from end to end. Also some contacts in the mid range may not be exactly spaced so some judgment must be applied to where best to set the switch. Check the contacts tuning both up and down as the gear lash will be different each way.

Roger KC6TRU P.S. Am I using the correct detent spelling here?





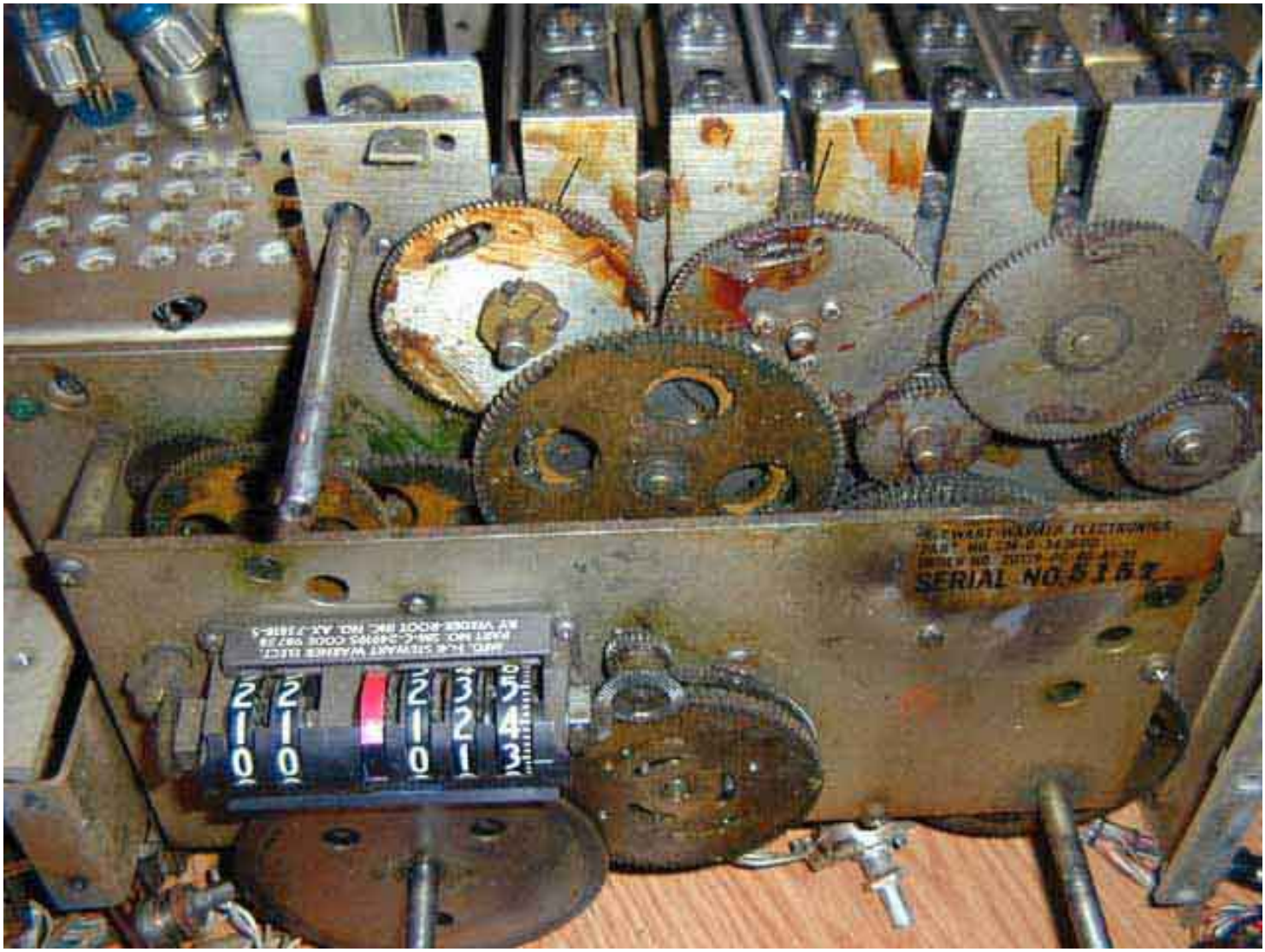


Walter Wilson's gear train rebuild instructions

Gear Train Rebuild

A truly outstanding gear train assembly instructions and photos.

This above great train initially looked like this:



After many years of use and abuse (dirt, dust, sand, over-lubrication), the R-390A gear train can become rather stiff. When properly cleaned and re-lubricated, the difference can be startling. At one time I simply cleaned most gear trains and only disassembled the really bad ones. But after a few I noticed that the ones I had disassembled were typically smoother and tighter than the ones I had only cleaned. I now disassemble all gear trains, separate the split gears, clean, lubricate, and reassemble with correct split gear tensions.

The rebuild of the gear train is time consuming. There are a couple of "traps" that can spoil the enjoyment of a good afternoon with your radio. Before proceeding, become very familiar with the procedure and understand what your main goals are:

- Smooth functioning of the gear train because it is clean and lubricated properly
- Little or no backlash because the split gear spring tensions are properly set
- KC 10-turn stop about 33 KC below the bottom to 33 KC above the top of the band with the zero-adjust at midpoint
- MC 10-turn stop set to stop movement at just below 0 KC and just above 32 MC
- Cams properly set at the 7+000 KC position

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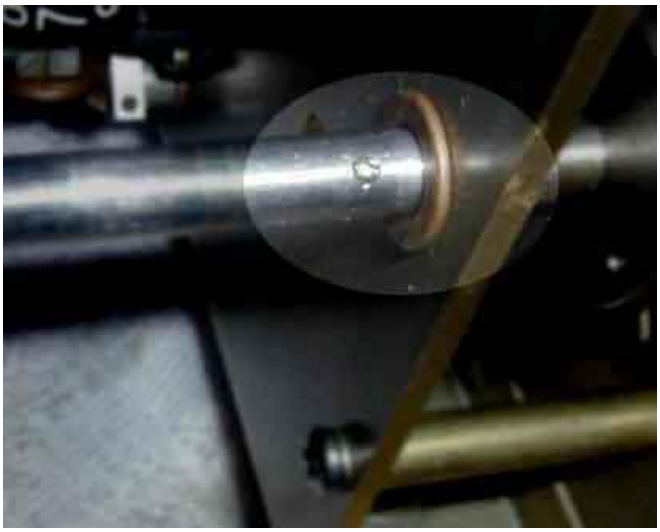
- Crystal oscillator bandswitch properly synchronized with veeder root counter and RF six-position bandswitch
- Intermittent gear causes the RF bandswitch to rotate into the correct position as you move up past the 1, 2, 4, 8, and 16 MC marks
- RF six-position bandswitch moves so that it stops at the same location regardless of the direction of rotation at the band transitions (0,1,2,3,4,7,8,15, and 16 MC)

CAUTION: I recommend you completely understand the above objectives before you begin any disassembly of the gear train. This is not necessarily a step-by-step procedure.

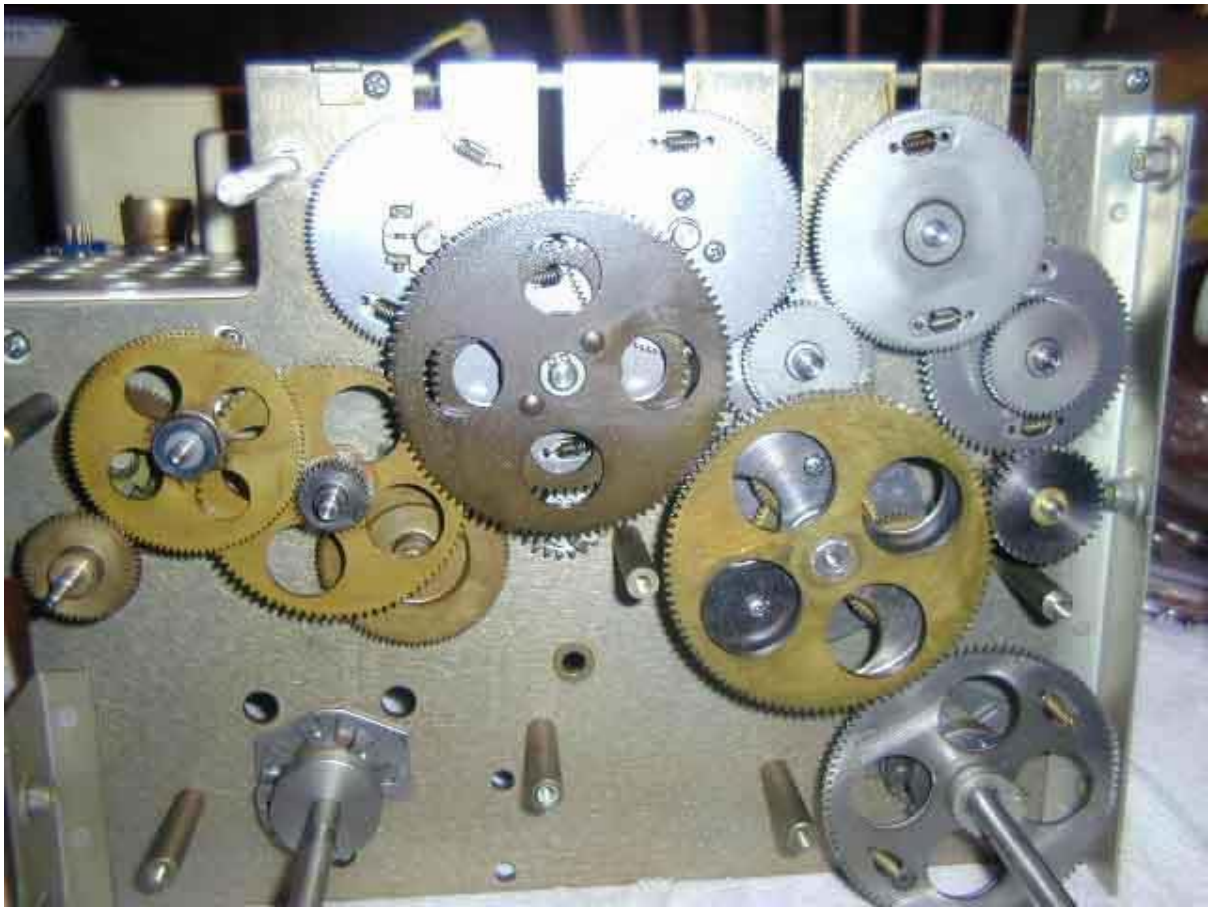
The gear train rebuild should always be started at the 7+000 KC position. You will be doing a mechanical alignment as it goes back together, and the alignment marks are all set for 07+000 KC. That's one KC above 07 999 KC. Also make sure the zero adjust is centered in its range of adjustment.

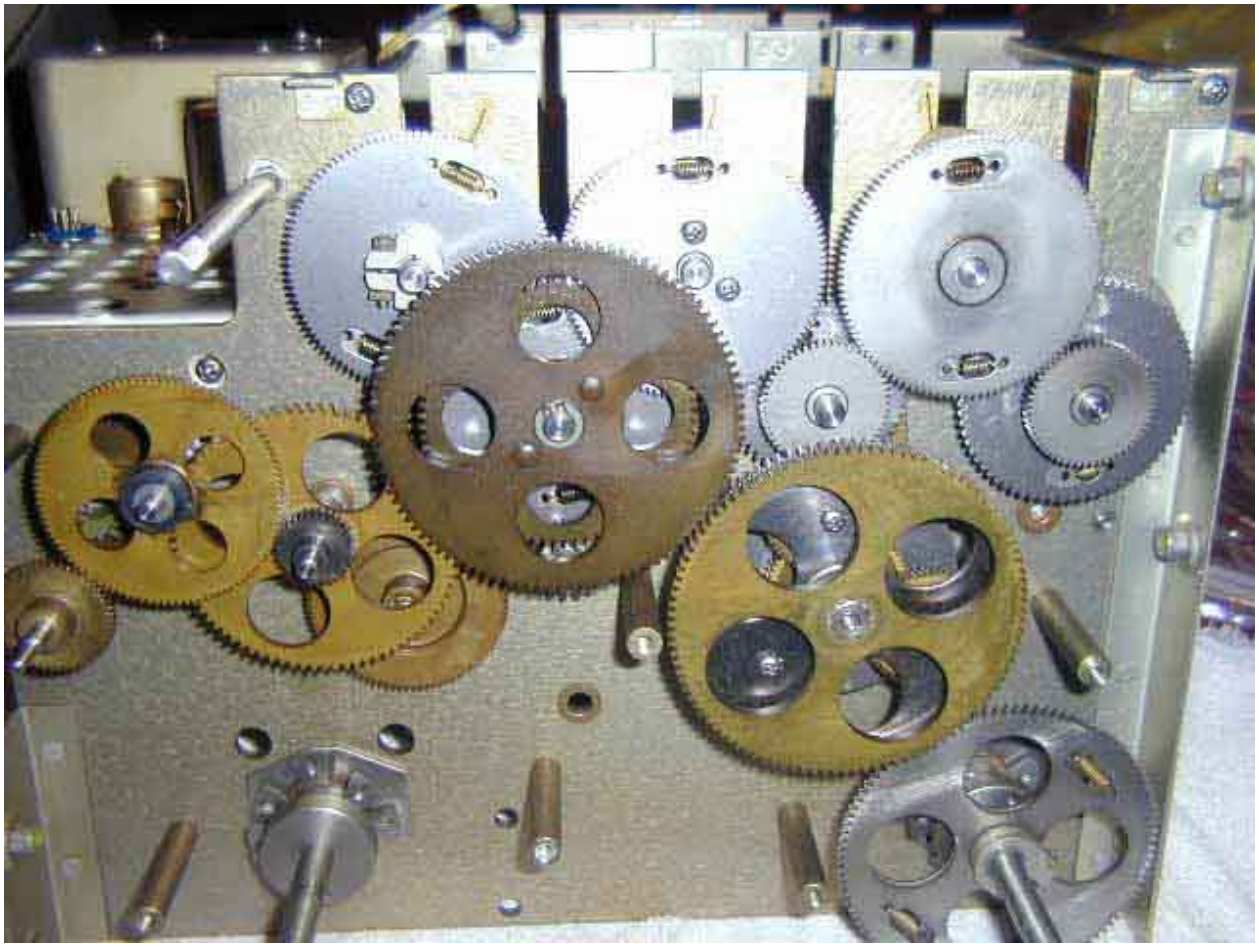
I always start by removing the Veeder root counter and the two gear wheels in front of the aluminum plate. Removing the gear to the right of the KC shaft will require loosening the gear clamp behind the aluminum panel, and pulling its shaft through the panel bearing. It looks to be a simple matter of removing the few screws that hold on the plate. But before removing the screws, see if you can tap the pin on the KC shaft (see photo) far enough into the shaft to give clearance through the bearing. This pin will have to clear the bearing as the shaft pulls through.

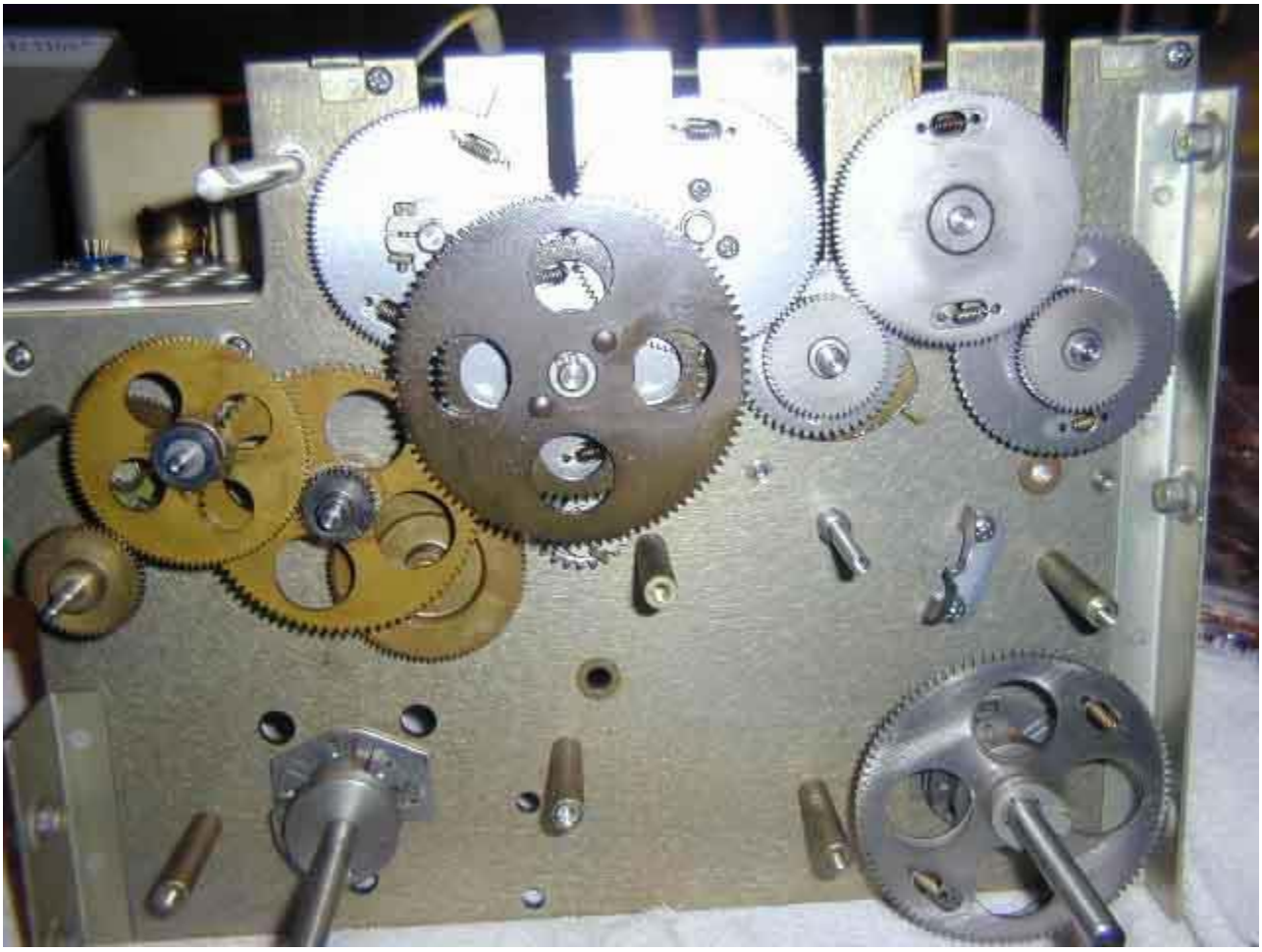


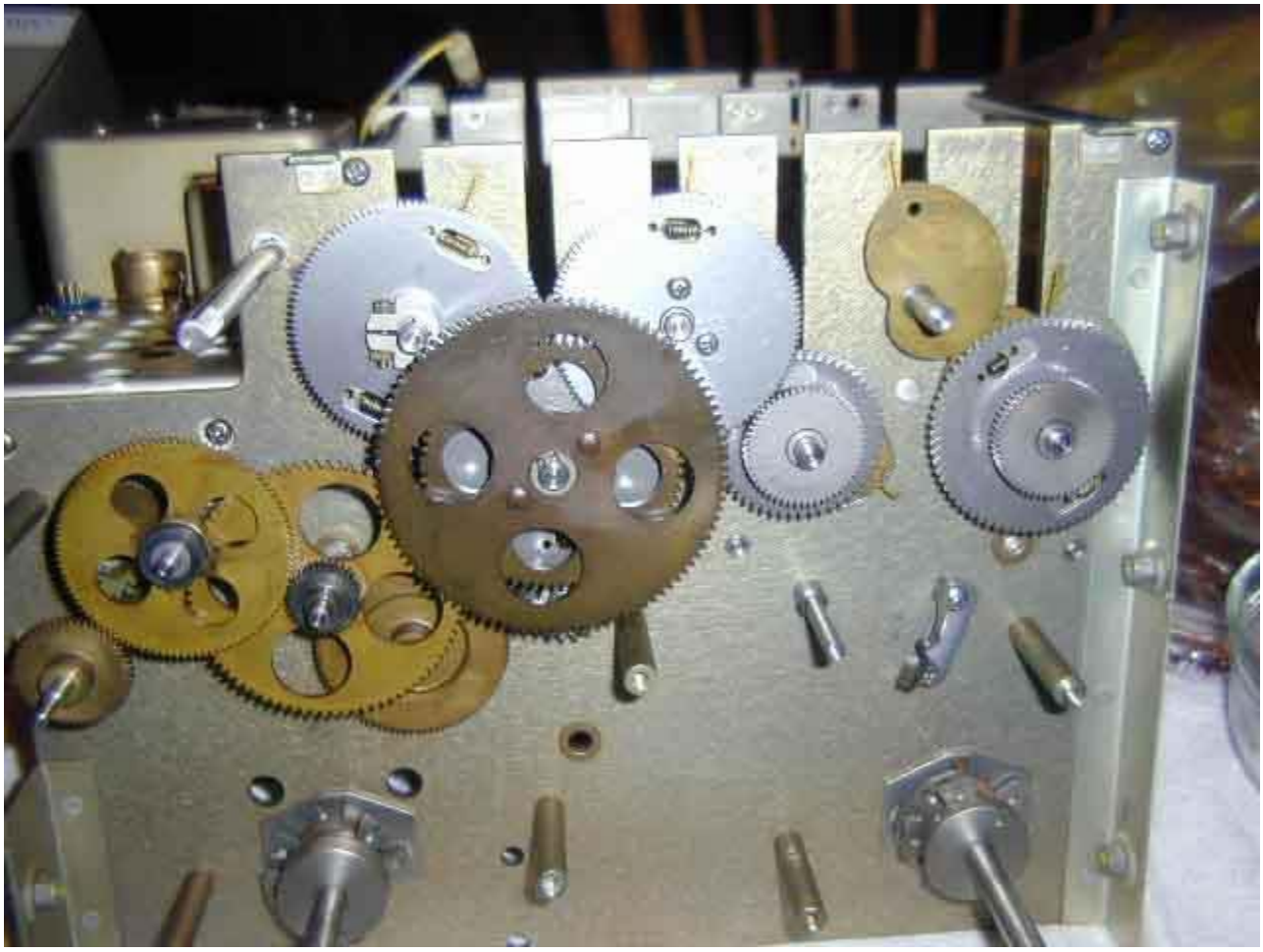
If you can't tap the pin into the shaft to get it out of the way, you will have to remove the 10-turn counter from the back side and keep the KC shaft intact with the aluminum panel.
Now remove all the screws holding on the front plate, and remove the front plate.

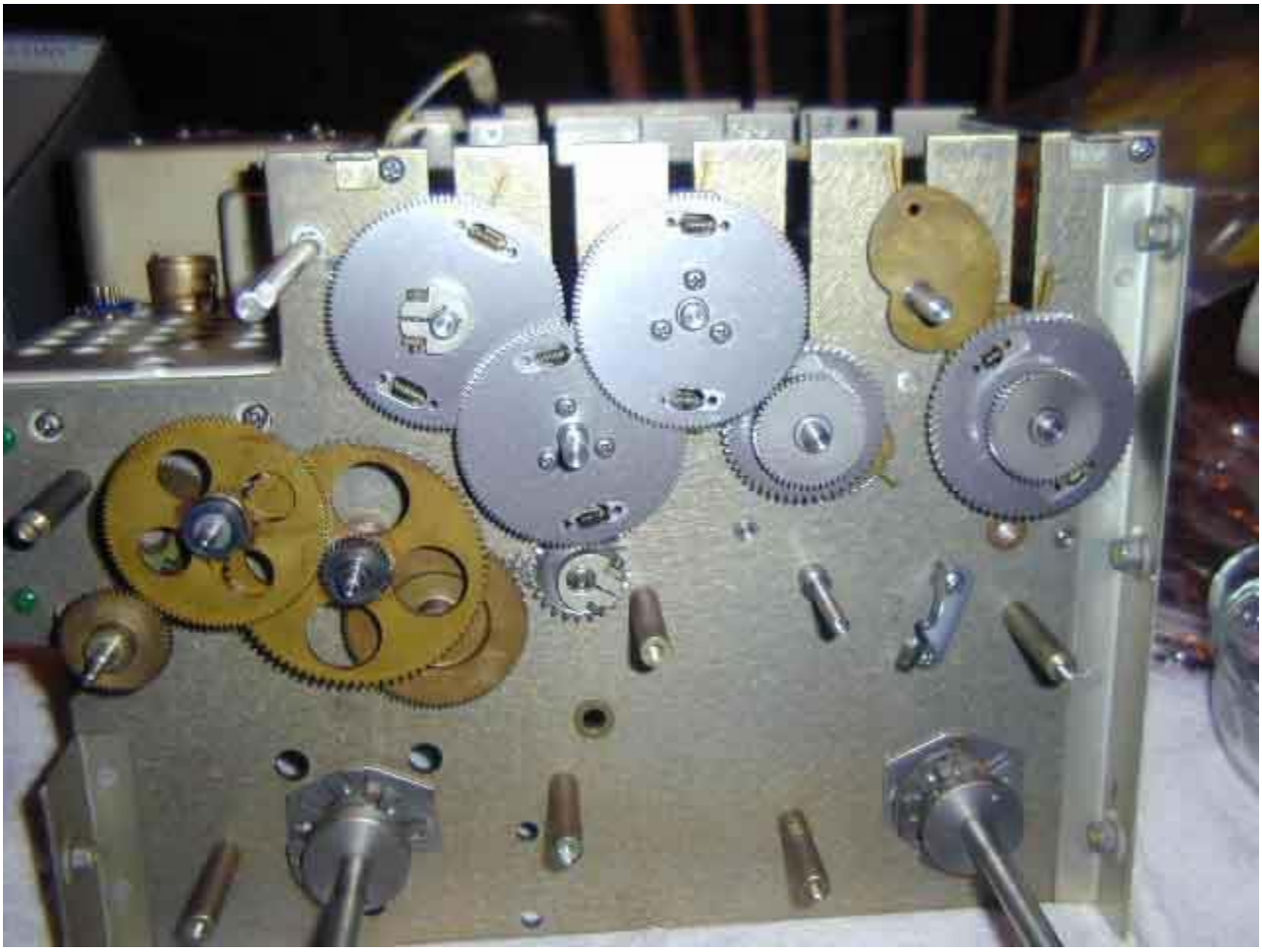
The following series of photos show the disassembly step-by-step. Re-assembly will be a simple reversal of this procedure, with a couple of adjustments and checks along the way.

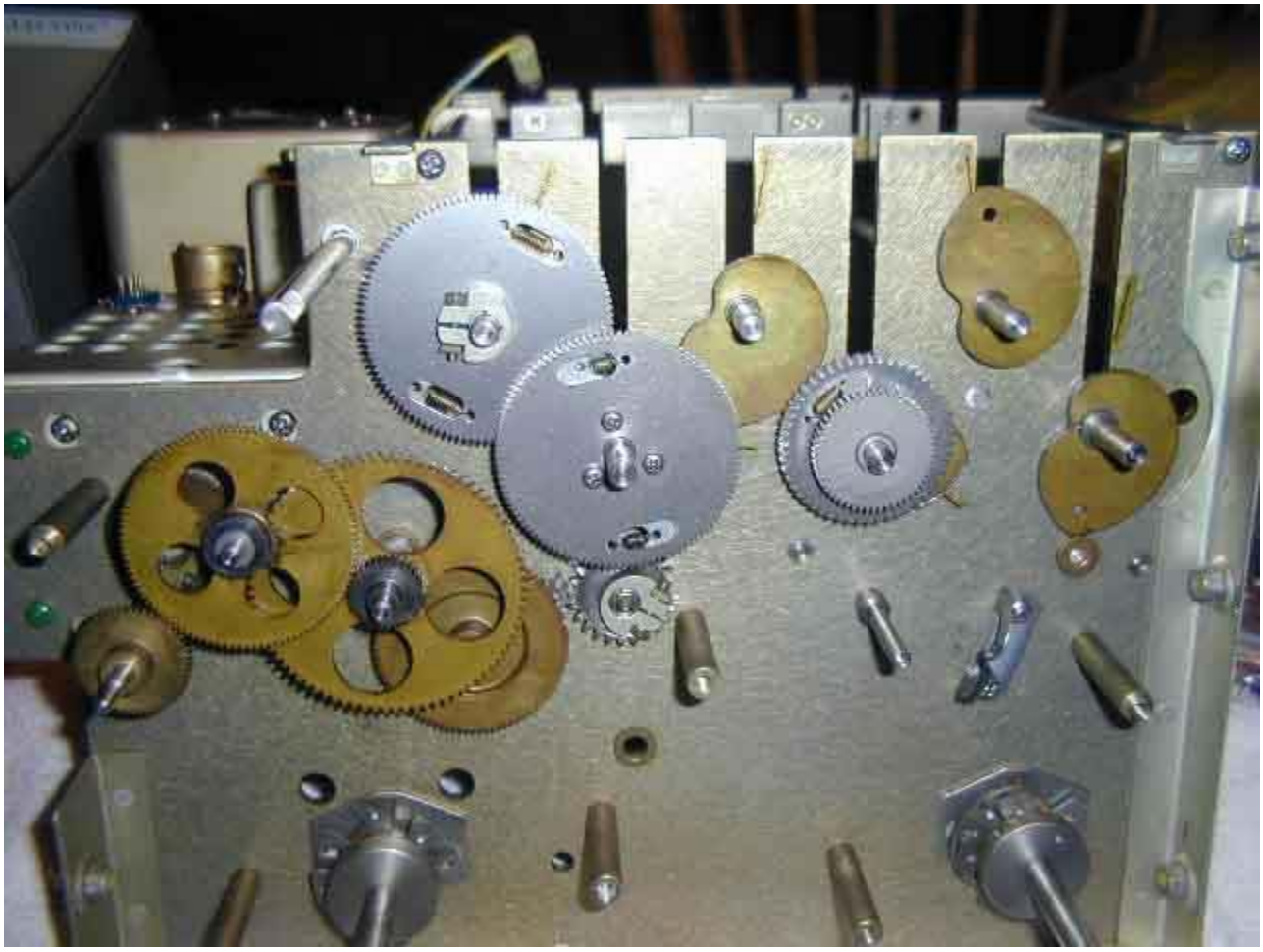


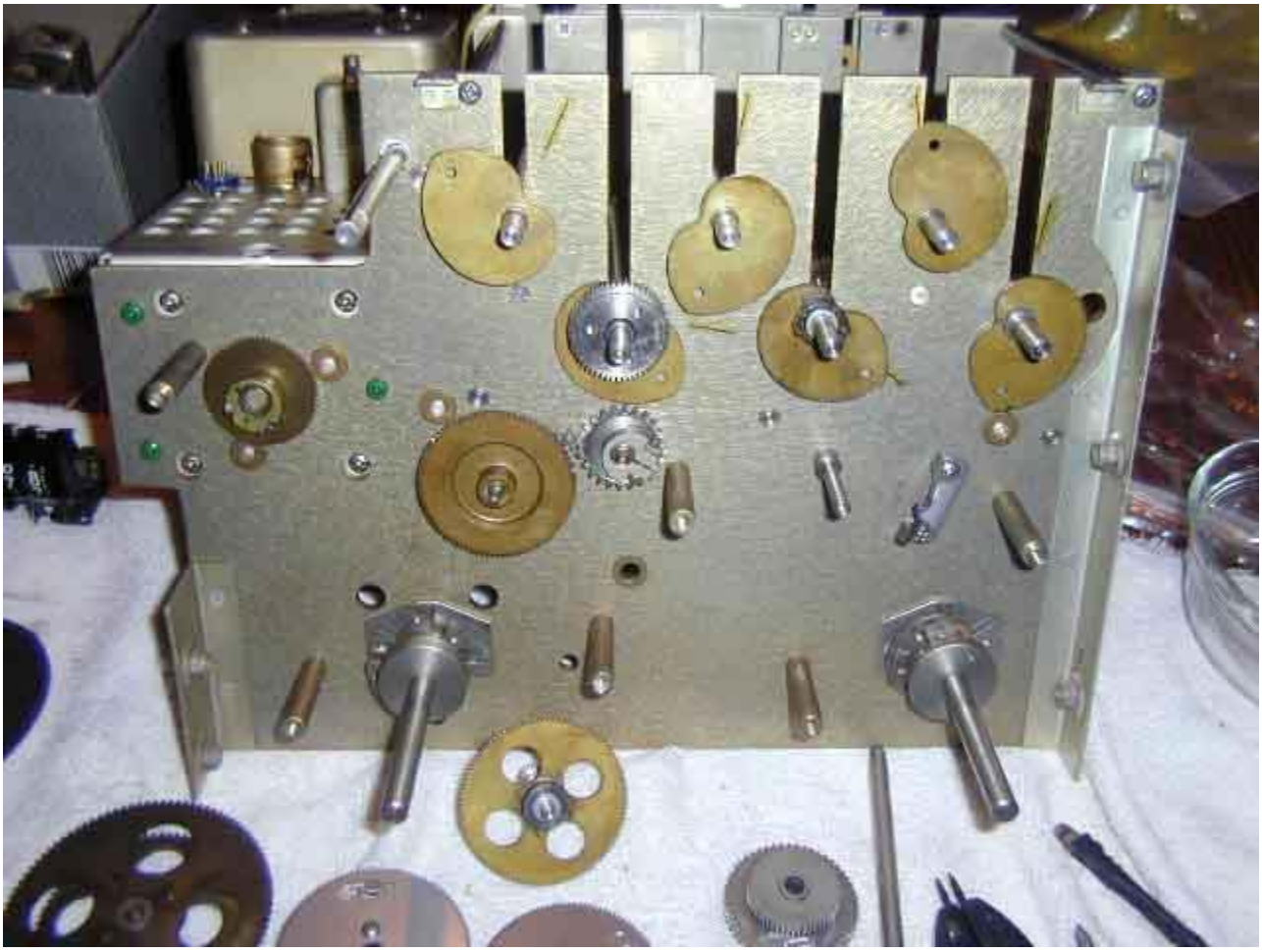












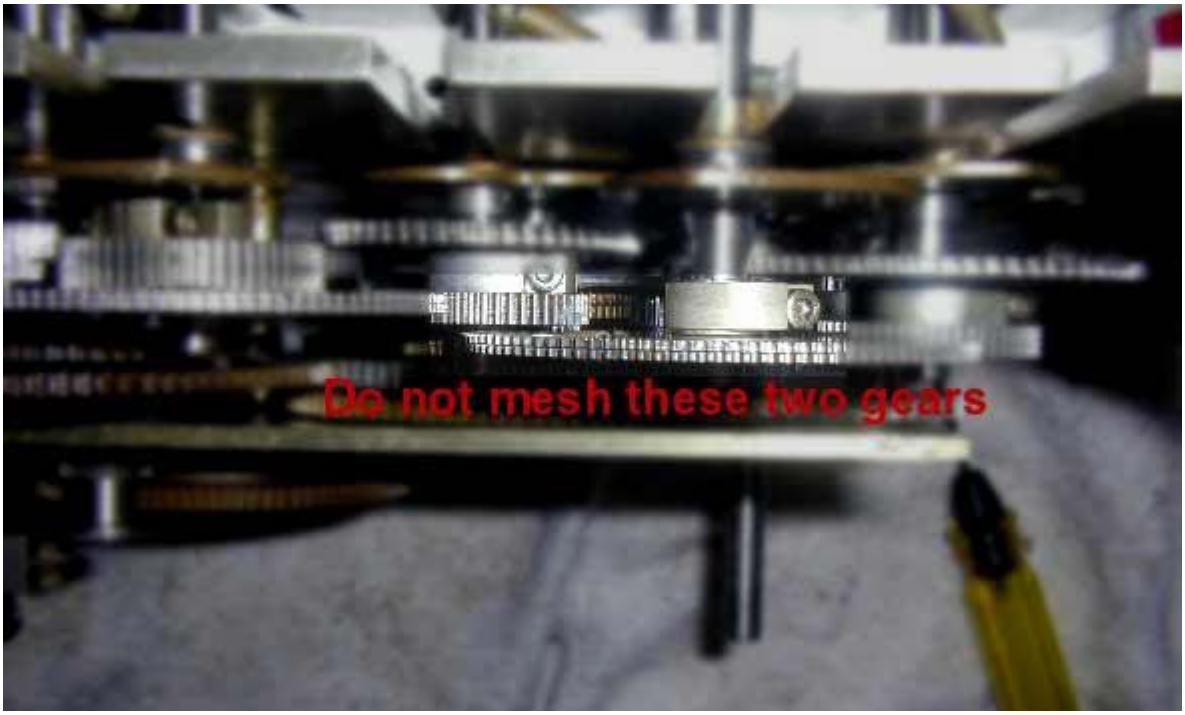
Did you make it this far? If so, now it's time to separate all the split gears. You'll need a pair of snap ring pliers to remove the snap rings which hold the gears together. Just remove the snap ring, and leave the springs attached. You can use a paper towel to wipe out any grit or grease between the gears, then re-lubricate with a 50/50 mix of Mobil 1 10W30 and Marvel Mystery (penetrating) oil. Put the gear back together with the snap ring, and move on to the next one.

Now clean everything thoroughly. I spray WD-40 onto a rag or paper towel, and then use the rag to wipe and clean. You can also use brass polish on the brass gears if you like. Give it a good cleaning and oil all the rotating surfaces well (but not the gear teeth themselves). You can take apart the multi-gear if you feel brave by loosening three screws.

Reassembly is just a reversal of disassembly. First, study the drawing of the intermittent gear position shown in the manual. You must have this gear set correctly before proceeding. Getting it wrong can cause great weeping and gnashing of teeth. The intermittent gear causes the RF bandswitch to turn as you move up past the 1, 2, 4, 8, and 16 MC marks.

Lubricate where the gear shafts seat into their brass bearings as you go using synthetic grease. As you put each gear back on, line the camshaft pointers and alignment holes over the alignment marks. If you reassemble in reverse order as shown, you will not have to make too many split gear teeth line up at once (two as you move from step 2 to 1, one elsewhere). In step 2, where the big multi-section gear goes back in, have the big gear to the right on the megacycle shaft pushed all the way back. Also, temporarily remove the detent spring piece which is above the MC shaft and held in place by two screws. This keeps these out of the way while the multi-section gear goes in. After the multi-section gear is in place, you can pull the MC gear forward into position. To set the split gear tension, start with the spring at resting position (slack out but no tension), and then move the teeth about two teeth marks to stretch the spring.

One gear that many have tried to mate together is shown below. They will mesh together with some effort. Do not mesh these gears together, or nothing will move.



If you kept the camshaft pointers aligned as you went, you should be in pretty good shape by now. You can still make minor adjustments to the cam positions by loosening the gear clamps and rotating the cams. With the cams aligned, put the veeder root counter back on. You'll want to make sure the KC shaft is about 1/3 turn away from the 10-turn stop which occurs at full clockwise rotation. Make sure to return the KC shaft pin back to it's original protruded position before putting the KC shaft gear back in place.

It is now important to get the bandswitches aligned correctly. The crystal oscillator bandswitch has a label printed on the drum. It should be at the line between the 6 and 8. I also visually check the wafer contacts to make sure it is truly centered on the contact.

The RF bandswitch is a little more tricky, as it's proper alignment is integral to the mechanical gear train. Since you never moved these gears from the 7+000 KC position, the RF bandswitch is still set at the correct position. Now move the MC wheel to 8MC, and watch the rotation of the RF bandswitch from underneath. If you got the intermittent gear in the right place, you should see the bandswitch move to the next set of contacts. Move it back and forth a time or two between the 6MC and 9MC positions. It should begin moving immediately after 7 and stop at 8, with no movement below 7 or above 8. This usually requires some amount of adjustment. Look at the picture below.

See that little gear clamp that is highlighted? That's the one we want to work with at this point. It is this gear shaft that couples the rest of the gear train to the RF bandswitch intermittent gear. You want motion between 7 and 8 MC, with no motion below 7 or above 8 MC.

OK. Your gear train is back together with the bandswitch aligned. Be sure and put some synthetic grease (see Hints and Tips for type) on the detent wheel and the veeder root gears. If your gear train is stiff after reassembly, adjust the veeder root gear clamps to make sure these are not too tight. It may take a few adjustments to find the "sweet spot" for these.

As you reinsert the slug racks back into the RF deck, be sure and lubricate all the bearing slides and ALL surfaces where the slug rack fingers slide against metal with synthetic grease. Move the MC and KC knobs to where each slug rack is lowest, loosen the three slug positioning screws to allow the slug to re-position itself, and retighten the screws.

You'll have to realign the PTO to the RF gear train properly, getting 2455 KC from the PTO at the 7+000 KC mark (and of course 3455 KC at 7 000 KC).

Hints and Tips

R-390A and R-390

- Some Orange Drop capacitors have a black line (right side) indicating the side connected to the outside foil. I'm told that ALL orange drops have the outside foil attached to the lead on the right-hand side as you read the lettering. For bypass capacitors, the outside foil end should be attached to ground. For coupling capacitors, the outside foil should be connected to the plate of the prior stage rather than the grid of the following stage.

- Put an "aged" 5749W tube with good transconductance and low noise in the PTO. New tubes are not recommended here.

- bullet Test all the 12AU7/5814A tubes in a tube tester for transconductance. Put the best one in the detector, and the worst one in the line audio stage (unless you use the line output).

- bullet To check the AGC oil filled capacitor (C551 on the R-390A), let the receiver warm up for about an hour. You can use a hair dryer to warm up C551 if you're impatient. Set the FUNCTION switch to CAL mode with the BFO off and the AGC on Fast, and tune to one of the 100 Hz markers, peaking the carrier meter reading. Note the carrier meter reading. Now switch the AGC to Slow and recheck the carrier meter reading. If the capacitor is good, you should see little or no drop in the carrier meter level. If the level drops, the capacitor is leaking enough to affect AGC action to a degree.

- bullet Use Phil Wood waterproof bike grease for lubricating the detent wheel, camshaft edge surfaces, veeder root gears, brass shaft bearings, slug rack bearing slides, and all mating surfaces where the slug rack fingers slide against metal. There is an incredible difference between this and other "similar" products. If you want a smooth gear train, this stuff is a "must have" item. I found mine at a local bike shop, but they also have a website. Thanks to Matt Parkinson, KE6UOS, for this great tip.

R-390A only

- Pull the 6C4 tubes, and test all 6C4 tubes for noise in socket V204. Or even better, inject a 455 KC signal at E211, and check each tube in socket V204 for best S/S+N ratio. Put the best tube in V202, the second best in V203, and the worst in V204. Throw out any tubes that are significantly worse than your "best" performer. Final sensitivity can vary considerably depending on the noise of the 6C4 tubes. (Don't try this on an R-390, as some of the filaments are in series, and breaking the filament chain to voltage regulator tubes makes B+ go through the roof)

- Do the same for all 5749W tubes in the IF deck, testing in socket V504 and putting the better (lower noise) tubes in the earlier stages.

- Always remove the can around Z503 before making any adjustments. This coil often has come loose, and spinning the coil core will spin the coil and break the wires. After you are sure it's firmly in place while you adjust the coil, but the can cover back in place and make your adjustments.

- If you have to remove a turn from your Cosmos PTO: Take an aspirin tablet and place it under the litz wire. Get a ball of solder on a hot soldering iron and use it to press the litz wire into the aspirin tablet. The wire will be stripped and tinned all in one operation.

- On an old R-390A IF deck, replace C553 with a 600V Orange Drop prior to first power-on. Failure of this capacitor will destroy mechanical filters.

- RF slugs and IF slugs are NOT the same. Sometimes they are hard to tell apart. Some IF slugs have more of a greenish tint to them, compared with the RF slugs. The IF slugs have a shiny, shellac looking surface appearance, as compared to a dull surface on the RF slugs.

- Any bad mechanical filter can wreak havoc with the AGC. The filter does NOT have to be switched in to cause problems.

- If you have the IERC or other black (inside and outside) tube shields, use them. But if you have the shiny aluminum ones, the tubes will run cooler without the shiny shields. But HSN suggests leaving the tubes on V201, V206, V505, and V701 to prevent leakages paths.

- You should be able to find date codes on C603, C606, C103, and S106.

- Q-reducing resistors are used inside the T501, T502, and T503 IF cans. These give a flatter frequency response. Some rigs may have had these resistors "clipped" inside the cans, which gives higher Q. I always reconnect these resistors if they've been clipped. Older IF transformers have 47K resistors for R511, R512, R553, and R554, and have 82K for R522. Later models have 39K and 68K. These values are matched to the coils so don't alter them.