

## Timing the 9n/2n steering sector gears

The procedure for timing a set of steering gears in the 9/2n tractors is published in the I&T FO4 shop manual. It may have been some time since it was written and Ford doesn't make the gears now. You may find that the procedure simply doesn't work. Follow along with this guide as I step through the procedure from the manual followed by what I had to do to get the gears synched correctly. I recommend that you dry fit the parts first before using any seals or gaskets.

Starting with the procedure as written most people will encounter the gear timing as a result of replacing the gears or rebuilding the steering assembly. On my latest overhaul I too was in the process of rebuilding the steering assembly with a nice set of used gears, new bearings, and new seals. I tried using the I&T manual but it did not work. I believe it is due to the way the gears are cut now vs. the way Ford used to cut them and I'll show that later. Try the original method first and if it works you are done.

I've had the opportunity to attend seminars and read some leadership/self help books and there are a couple that stick in my mind and one is "begin with the end in mind" by Stephen Covey. Everything aside what do we want to accomplish?

***Steering arms in the middle of their travel with the steering wheel centered allowing the spindles to be rotated equally and fully to their stops.*** So that's our goal.

## **What do properly timed arms look like? It depends.**

This is my 1943 Ford 2n. The sectors are timed and the wheels turn to full lock each direction. Note the arms are slightly behind the rear bolt for the radius rods. Note this tractor has replacement drag links and there is a lot of adjustment in them. They could be adjusted shorter and the arms synched a little more forward but they work as is and meet the requirement.



This is my 1940 Ford 9n and these steering sectors are properly timed. These arms a little ahead of the rear bolt for the radius rods. This tractor has re-production radius rods that are slightly longer than stock rods.



Here the tie rod ends are seen adjusted in the middle of their adjustment. While the amount of adjustment needed may vary by gear/rod set this would be an acceptable amount of adjustment.



### **Timing the steering assembly according to the I&T manual**

According to I&T manual, the sectors can be timed by removing the drag links, then turning the steering wheel to full left causing the left arm to go back as far as possible. At this position, the arms will dis-engage the steering pinion gear. The right arm should be moved as far forward as possible and everything re-engaged. When properly timed the steering arms will be pointed slightly back from center. I have done this on my 2n and it worked. It did not work on my 9n and I believe it's due to how the gears are cut. If this works for you jump ahead to assembling the steering housing.

## **Timing the assembly using my method.**

### **Understanding what's wrong.**

I'm not one to just accept that something doesn't work. After thinking about what the manual describes I was able to determine why it failed. The book calls for turning the steering to one extreme where the steering sectors travel far enough to disengage the steering pinion. After examining my set of gears it didn't take long to see why this wouldn't work.

In this view, we can see that the gears are not cut to the end of the casting. There is no way the sector can travel far enough to disengage the pinion.



After failing the method mentioned in the book the first thought I had was to find the center of the gears, center them in the lower casting, and set the top column on. It sounds easy enough. Both gears were examined and the center of the gears for these is a tooth in the middle. The center was marked on both sectors.

The next factor in the equation is where the steering wheel is going to end up. If you aren't concerned about steering wheel being centering the installation will be much easier. This picture is my 4 spoke steering wheel. After studying it and the 3 spoke on my 43 this orientation will center both a 4 spoke and 3 spoke wheel. Note the keyway is at about the 10:00 position. To further complicate the task, the pinion gears are not straight cut, they are helical cut meaning they have an arc or angle to them. So as the column is lowered and the pinion gear engages the sectors, the pinion has to rotate to engage the sectors while the sectors stay in place.



I made multiple attempts to "land" the upper steering column in the center of the gears while holding the sectors still, while allowing the steering shaft to rotate upon engagement, and having the key end up in the proper location. While it should work this procedure did not produce a repeatable outcome and cost me a set of gaskets and seals from the repeated attempts to get it right.

This was my second attempt as the first (procedure in the manual) failed. The attempt here was to hold the gears in the centered position and lower the upper column on them. Note the center marks on the gear sectors. This did not work, the gears would slip out of time and/or the steering pinion would end up in the wrong location preventing the steering wheel from being centered. At this point I realized I would need to come up with a method that I could dry test and only after being able to successfully install everything repeatedly would it be time for gaskets and seals



Attempt #3 was to modify the gear castings so that the I&T manual procedure could be followed. Working carefully with a grinder I added the last tooth and provided relief so that the pinion could rotate out of the sector as described in the manual. The gears are cast iron and are easily modified with a grinder. While not perfect this position is only used for timing, not steering.



After installing the modified gears the upper column was installed and the I&T procedure was tried again using the following method: The sectors can be timed by removing the drag links, then turning the steering wheel to full left causing the left arm to go back as far as possible. At this position, the arms will disengage the steering gear. The right arm should be moved as far forward as possible and everything re-engaged. Unfortunately this did not work either. While I could now get the right gear to disengage I could not get the left gear disengaged. This prevented the right gear from being timed with the left and the result was not acceptable. After removing the upper column the problem was identified.

Here we see the left gear bottoming out on the lower steering casting preventing it from rotating far enough forward to disengage the pinion gear.



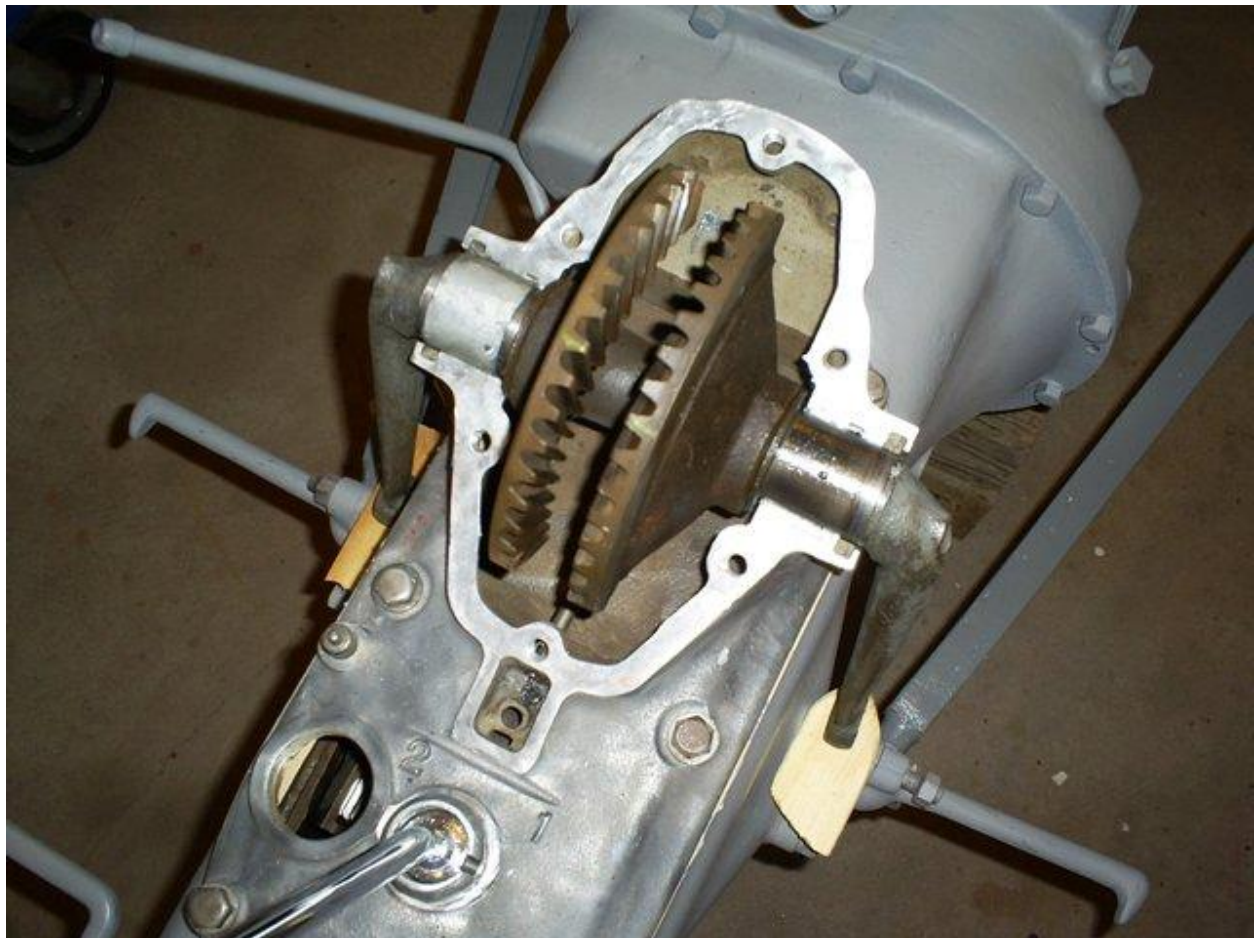
In this photo I'm running a square up from the casting and finding where the pinion is going to intersect the steering sectors. While the tape measure is not shown here with the gear all the way forward there is no way the steering pinion will be able to disengage this sector although it's not by much. With that the right one would have to be engaged by a couple of teeth to get the timing right so basically there is no way to use the I&T procedure with this gear set. One option would be to remove enough material off the left sector to allow it to rotate further ahead to disengage the pinion. After some evaluation I decided against that modification.



With the I&T procedure out for good it was back to landing the upper column in the correct place. Reviewing the previous failures I would need a way to hold the sectors in place as the column is lowered which allows the pinion to rotate into place. I found some wood wedges in my scrap box and tried a better way to secure the sectors. You can't provide much interference as the sectors will pop out of the lower casting.



Here we see both sectors wedged in place and the gears centered. Note the center marks on the gears. The way the pinion is made running parallel to the pivot shaft of the gears are teeth on the pinion. I've provided a space for a tooth to be centered. The left gear is slightly ahead, the right slightly behind. The sectors are equally spaced and when using the square again the center marks are half the distance from the edge of the shaft (meaning the marks are truly centered). This method turned out to be successful. The small amount of friction was enough to hold the sectors in place and the pinion rotated into position as the upper column was lowered into place. Additionally, I could do this repeatedly with the same result. The next step was to determine how to land the pinion in the right place so that the steering wheel was centered.



The steering pinion shaft rotates counter clockwise as the upper column is lowered onto the gear set (assuming the sectors do not move). Beginning with the keyway at 12 noon I tested lowering the column into position and making note of where the keyway ended up (wanting it at 10:00) with the column in position. Within a couple of attempts I had located the starting spot and marked it with a marker (no picture). I tested a couple more times and was successful at landing the column with the gears in time and having the keyway in the correct position. A quick check with the steering wheel can confirm that the wheel is indeed centered.

With the column in place the next step is to confirm that your drag links are in the correct position. The first time I had the gears timed the rods were found to almost be too short. Remember the goal of being able to rotate the spindles lock to lock, and have a reasonable amount of adjustment left in the drag links. Apparently the gear surface provided on the gear set provides a little more travel than is required. If the tie rod ends are adjusted out all the way the steering sectors are pointed too far back. You only need to move one tooth on one sector to make a difference. If the tie rod ends are bottomed out the arms are pointing too far forward. Once you have confirmed yours are correct prepare for final assembly. This is also a good time to make the initial adjustment on toe in. I used 4 foot strait edges against the back side of the front hubs and lined the first one up parallel to the tractor with the steering wheel centered. Then adjust the other side to match



Like the rope seals in the motor they should be rolled into place while not distorting the rope unnecessarily.



The rope ends are cut slightly higher than the mating surface using a sharp knife producing a clean cut. I cut mine slightly higher one casting and flush on the other.



New gaskets can be made. I ruined my first new set and made another out of a similar thin slick paper like the originals. The paper in the I&T manual is very similar to the new gaskets. Hold the paper against the surface while going around the casting with a ball peen hammer carefully striking the edges of the casting creating lines and holes.



Here new bearings and seals are installed. The bearings and seals receive a light coat of engine assembly lube (dark gray). The lube is kept off the rope ends.



While not the best picture I used a small dab of Ultra Gray Silicon on the rope ends and a very sparing amount of Permatex #2 on the remaining surfaces, both sides of the gasket. I like to use a matchstick for applying small amounts. Not everyone will agree but I think of sealer as cheap insurance against leaks. In a perfect world the castings would be machined perfectly flat and the parts would not distort when tightened but that's not where we are with 70 year old parts.

Install the upper column keeping the sectors in place and orienting the steering wheel keyway. Tighten the 6 bolts gradually pulling the upper casting down evenly. This will assemble stiff as the ropes compress over the sector gear shafts.



The key point is practice your assembly until you get it right before breaking out the gaskets and seals. Once you can land the column in the right place with the steering wheel keyway correct it's time for assembly. Check to see that the drag links are in the correct place and adjust your segments if necessary before final assembly. Once everything is right install the ropes and gaskets and assemble the column. Finally, check the toe in on the tractor with the front tires and adjust to 1/4" narrower at the front of the front tires vs. the rear of the front tires.

