# Shimano Nexus Inter-7
# Complete (dis)assembly manual

W.Pasman, 9 march 2012

## Introduction

This manual describes complete disassembly and assembly of the Shimano Nexus 7-speed hub SG-7R45 Inter-7. The axle unit gets the most attention, as this is the trickiest part and hardly any documentation on it is available [2]. This manual also covers the two carrier units and the sun unit. Discussion of the full assembly is kept short, as good documentation is available from Shimano [1,3].

There are other Nexus-7 hubs that seem exactly the same, e.g. the SG-7R42 and 7R46. The 7R40, SG-7C26, and SG-7C18 look very similar but have a two-part driver unit. I suspect that most of this manual still applies.

## Axle Unit Y-33E 98060

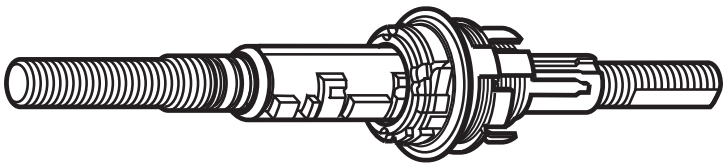


**Figure 1. The assembled axle unit.**

**Figure 2. Axle unit parts as in an exploded view.**

### *Disassembly*

With a flat-blade screw driver, carefully pull out the small spring assembly. It is slightly spring-loaded, so it may suddenly spring apart.

Next, pull off the return spring loader ring. Be careful: there is a moderately heavy load on the return spring and you don't want your fingers in the way if it springs loose. Now you can take off the main gear spring and the ring cap.

Finally, you can slide out the sleeve and remove the pawls from the pawl carrier. The ring with two slots can also be taken off the axle, but I recommend leaving it on.

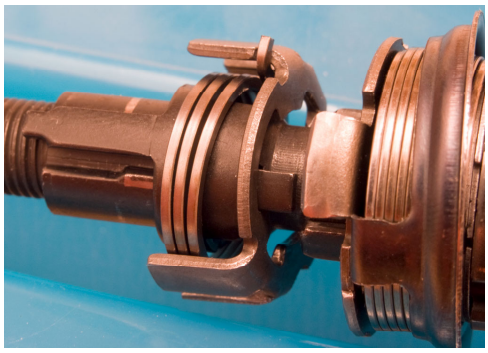


**Figure 3. The small spring at in the assembly at the left slides away from the return spring assembly.**

## *The parts*

There is no standard Shimano manual giving names to all these parts, so I have to coin names here. I did find names in some Shimano patents, and I use them when possible.

**Figure 4. All the parts of the axle unit. For the names of the parts, see the text.**

The main details of this hub are described in US patent 5,322,487 (1994) and 5,562,563 (1996). These patents do not exactly describe the Nexus 7, but it has many parts resembling those in the patents. Shimano uses "sleeve", "sleeve 1 and 2", or sometimes "shifter sleeve" for what I named the "main control sleeve" and "shifter sleeve". For clarity, I used my own names consistently. Furthermore Shimano uses "legs" and "forks" for the legs on the sleeves. Shimano calls the slots in the shaft "projections". I will stick with "slots" here. In the patents, Shimano gives the name "spring washer" to the return-

spring loader ring, but I think “return-spring loader ring” is more accurate, and I use it, for clarity.

Figure 4 shows the parts of the axle uit. The main axle at the top has, from left to right, a ring with 2 slots, a slotted area, a fixed pawl carrier (it seems to be a separate part, but it is permanently fixed), and a splined area.

The middle photo shows, from left to right: the spring cap, the ring cap and the return spring.

The bottom photo shows at top left the main control sleeve and at top right the pawls and small snap ring for the pawl carrier. The bottom row shows from left to right the return spring loader ring, the small spring, the small spring loader ring and the shifter sleeve. The shifter sleeve has two long legs on one side, and two short legs on the other side.

As shown in Figure 3, the small spring and the shifter sleeve together form the small-spring assembly. The return spring, the spring cap and the return spring loader ring together form the return spring assembly.

## *Assembly*

Putting the axle unit together is the toughest part of assembly. The Nexus manual does not show how to do this.

We have to assemble three parts: the return spring assembly, the small spring assembly, and the pawls.

### Return spring assembly

Slide the sleeve under the pawl carrier and make sure that the end slides into the slots in the ring.

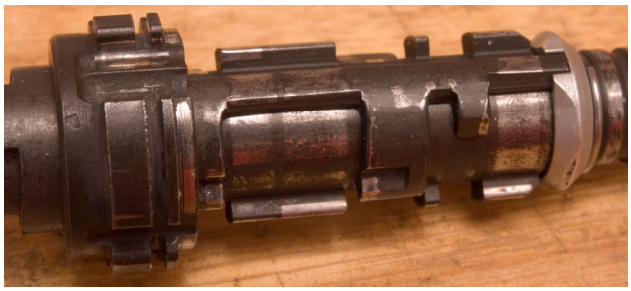


**Figure 5. Main control sleeve mounted. The ends must go all the way into the slotted ring.**

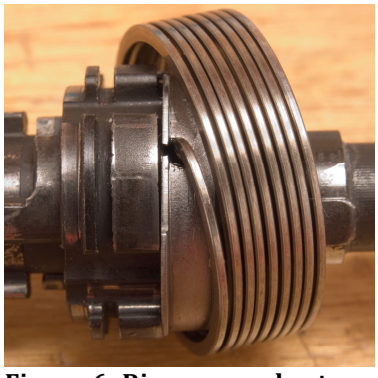


**Figure 6. Ring cap and return spring mounted**

Place the ring cap over the pawl carrier (note the hole), and insert the return spring into the hole as in Figure 6.

Put the spring cap and the return spring loader ring on top of each other. There is a shallow slot in the return spring loader ring into which the tabs of the cap slide. See Figure 7 and Figure 9.

Insert the end of the return spring into the hole in the return spring loader ring.

There are also tabs on the inside of the return spring loader ring (in the picture they are hidden behind the spring cap). Check that these tabs fall inside the return spring.

Fix the axle in a vise, with the right side in Figure 1 pointing up. Clamp the vise on the flat areas, not on the threads.

Now we have to load the spring. This takes substantial finger strength, and you may want to wear gloves if you are not strong enough to do this with your bare fingers. I would not use tools here, to avoid bending or damaging the spring cap; but maybe there are special tools for this.

Now give the return spring loader ring a few solid twists so that return spring loads up, and then slide the return spring loader ring onto the splines to hold the spring in its loaded position (Figure 7). The spring diameter decreases as you load it. Load it sufficiently so that the spring cap can freely slide over the return spring (about two twists of the return spring). At this point, check that the return spring did not pop out of its hole (Figure 8).

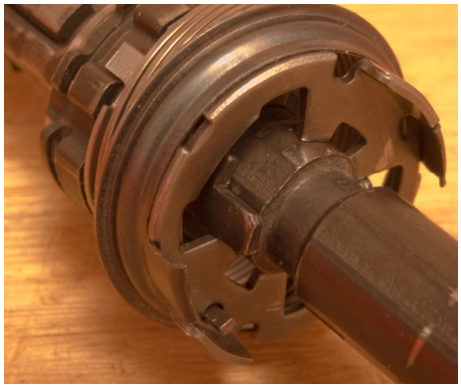


**Figure 7. Return spring loaded and held by the return spring loader ring.**

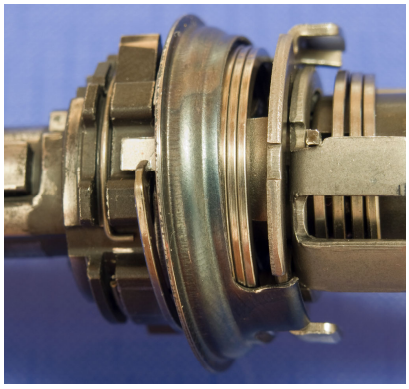


**Figure 8. Check that the return spring did not slip out of the hole while tensioning.**

## Small spring assembly

Now comes the hardest part of the assembly of the axle unit: the small spring assembly. To make this go smoothly we first do a test fit with only the gear shifter sleeve.

## Test-fitting the shifter sleeve

Now we will do a test fit of the shifter sleeve. It is very hard to see and explain the proper alignment once the rest of the parts are in place, and you also will need some jiggling to get it in place as the springs will work against the proper placement.

Figure 9 shows the proper alignment of the shifter sleeve. Note the leg of the main control sleeve sticking up. It should fall somewhere in the slot of the gear shifter sleeve. Also, the short leg of the gear shifter sleeve should fall into the small hole of the return spring loader ring. If assembly is correct, the gear shifter sleeve slides down all the way so that the leg of the main control sleeve goes all the way into the slot.

As said, some serious jiggling may be needed to get this done. I assume that the axle is still in the vise. Carefully but forcefully grab the return spring loader ring and rotate it little a bit (loading the return spring even a bit further), while pressing down on the gear

shifter sleeve at the same time. Practice this a few times so that you can do this job without seeing the tabs and legs.

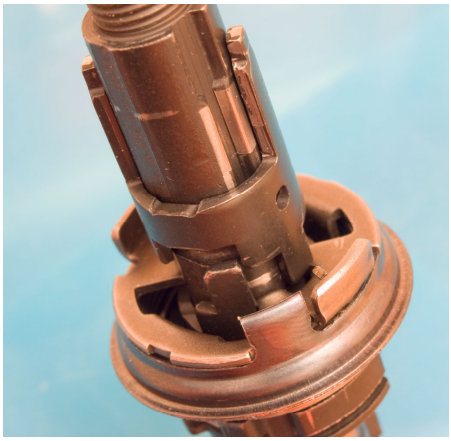


**Figure 9. Test fitting and proper alignment of the shifter sleeve.**

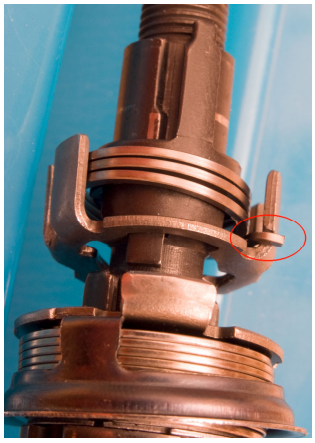


**Figure 10. The small gear assembly mounted correctly and ready to slide into the return spring assembly.**

Take out the shifter sleeve again. Now we can complete assembly of this last part.

### Assembling the small gear assembly

Place the small spring over the shifter sleeve, so the spring goes into the hole and the other end of the spring faces towards the short legs.

Place the small spring loader ring onto the axle with the legs facing upward. Put the shifter sleeve (with the small spring on it) on top of it, with the long legs facing upward. Place the lower end of the small spring into the small slot at the low end of the small spring loader ring (see Figure 10). Grip the small spring loader ring firmly and turn it about a quarter turn, so that the short legs of the shifter sleeve fall into the **wide** slots of the small-spring loader ring as in Figure 10. Align the legs as in the test fit (Figure 9). The small spring assembly is now assembled and ready to be slid into the main gear assembly (Figure 10).

Finally, slide in the small gear assembly in the same way as with the test fitting.

### Toy Assembly

If you want to play a bit with the Nexus without putting it on your bike, you need to leave out a few springs, otherwise manual operation will be difficult, if possible at all. I especially recommend leaving out the return spring. The small spring is essential: without it you can't shift the hub into all the gears. Figure 11 shows the toy configuration that I used.

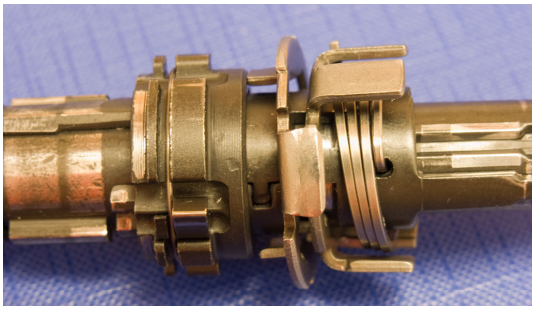


**Figure 11. Toy configuration without the return spring and cap.**

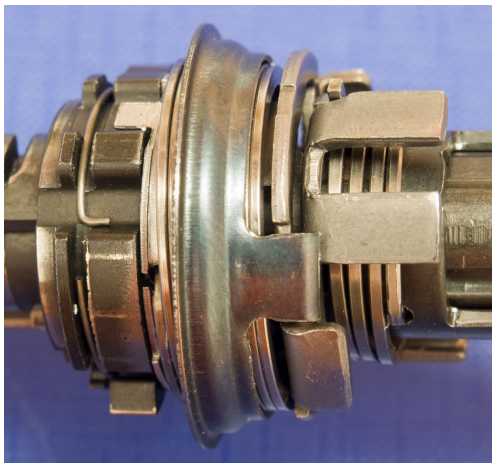


**Figure 12. Fully assembled axle unit.**

### Mount the pawls

As a last step, the pawls are mounted on the pawl carrier. The bent end of the snap ring should point towards the springs, so that it will not interfere with the sun gear that will go below it. This completes the assembly (Figure 12).

## Sun gear unit Y-33F 98060

### *Disassembly*

Just pry the two gear rings apart.with a falr-blade screwdriver. Pull out the pawls. I strongly recommend leaving the small springs in place. A special tool may be necessary to install them.

### *Assembly*

Press the springs against the bottom half with a small screwdriver, from the rear, and slide the pawls in from the front. Check that the springs drop into the slots in the back of the pawls.

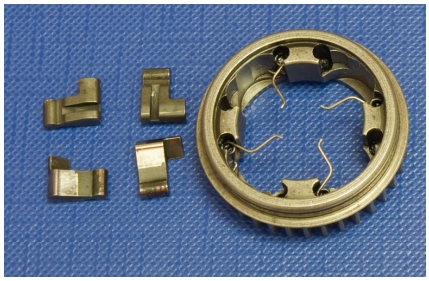


**Figure 13. Bottom half of the sun gear unit,**

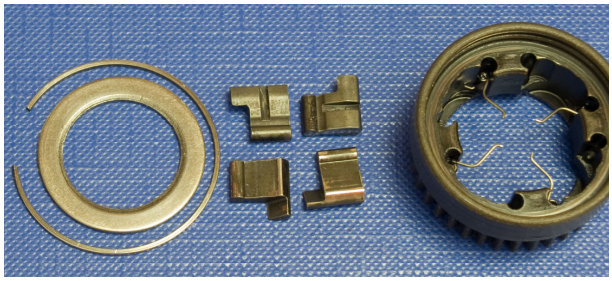


**Figure 14. Top half of the sun gear unit with the washer and snap ring.**

Put the bottom half on the table. Place the washer on top of the bottom half. then the snap ring, with the hole in the snap ring towards you. Place the other part of the sun gear unit on top, a bit slanted towards that hole. Press the rest of the ring into the cutout and let the other part of the sun gear unit drop down.

Although the holes in the two halves look the same size, the lower part has a hole of 20.43mm and the upper part 20.00mm. The wider hole on the lower side just fits over the teeth ring of the axle unit; the small hole just does not fit. So in the final assembly step, the bottom half of the sun gear unit goes into carrier unit 1 and the upper ring into carrier unit 2. See Figure 15. **Forcing the gear in the wrong way may cause damage.**

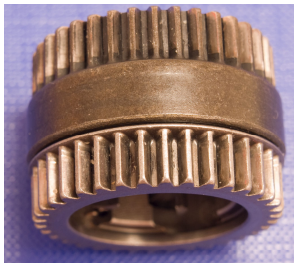
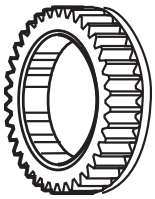
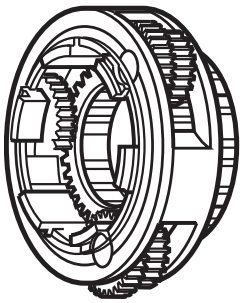


**Figure 15. Assembled sun gear assembly oriented properly.**

## Carrier unit 1 Y-330 98060



Internal sun gear of Carrier unit 1



Carrier unit 1

### *Disassembly*

Remove the snap ring. The gear pins, small gears and the internal sun gear fall out.

### *Assembly*

Putting  together the carrier unit 1 Y-330 98060 is simple but there is a little catch here: the gears need proper alignment – they must be “timed”. Find the places on the 3 small gears where the small and big teeth line up, and mark this position. i found white markers on two of the three gears, but they were almost worn off.

**Figure 16. small gears marked (black line) where the small and big teeth line up.**

Put the carrier on the table, large hole up. Put the internal sun gear in, the ring side down. Place the gears into the carrier unit, with the markings all pointing to the center of the gear. **Failure to do this correctly most likely locks up the hub**. Slide in the gear axles. Note that one flat end of the pins is worn and shiny. That side goes up (but probably this does not really matter). Put the lockring in place.

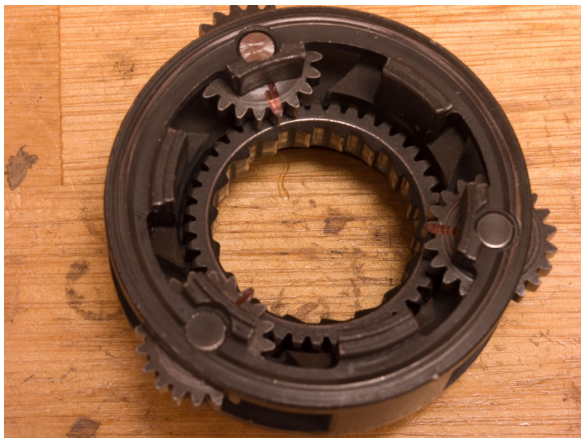


**Figure 17. Gears placed correctly, with the markings pointing toward the center.**

## Carrier Unit 2 Y-330 98070

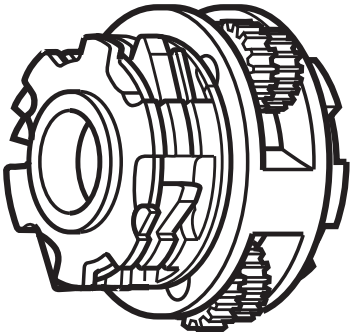


**Figure 18. Carrier Unit 2 Y-330 98070**

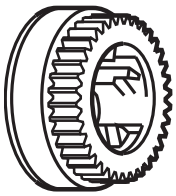


**Figure 19. Small sungear unit inside Carrier unit 2**

### *Disassembly*

Remove the two spring rings and the snap ring. The pawls and gear pins will drop out. The gears then drop out, and then the small internal sun-gear unit.

The pawls of the small sun-gear unit can also be taken out, as with the other sun gear unit.

### *Assembly*

Put the gear into the small sun gear unit (see the instructions for the other sun gear unit).

Put the carrier down, large hole facing up. Put the small sun-gear unit in, teeth facing up and ring side down.

Find the places on the 3 small gears where the small and big teeth line up. There are tiny holes drilled in this tooth on each of the three gears (Figure 20).

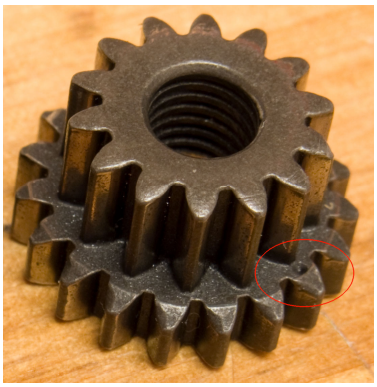


**Figure 20. small gear. Note the alignment hole at the lower right.**

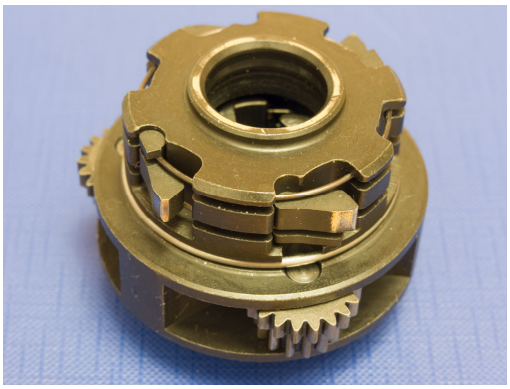
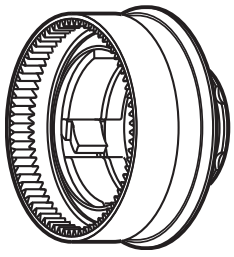


**Figure 21. pawl placement.**

Put the gears into the unit with the markers pointing toward the center of the unit. **Failure to do this correctly most likely will cause your hub to lock up**.

Turn the unit upside down (with the small hole up), drop in the pins and put the snap ring in place. install the two rows of pawls. There are four places for the pawls. There are 6 cutouts in the top of the unit; 4 are for the pawls and two for the ends of the spring. Of two adjacent pawls, the left one takes the upper pawl, and the right one the lower pawl. Carefully check Figure 18 and Figure 21.

## Driver Unit Y-308 98120



### *Disassembly*

Push the snap ring on the inside of the unit around till its straight end sits in the open area. Push the ring inwards and up with a screwdriver. Take out the washer. Take out the spring ring. The pawls now drop out. You should now see all parts as in Figure 22.

### *Assembly*

Place the unit with the large hole facing up. Put in the pawls and the spring ring. Insert the washer, ridge facing up. Insert the snap ring with the kink at the right of the opening in the ring.

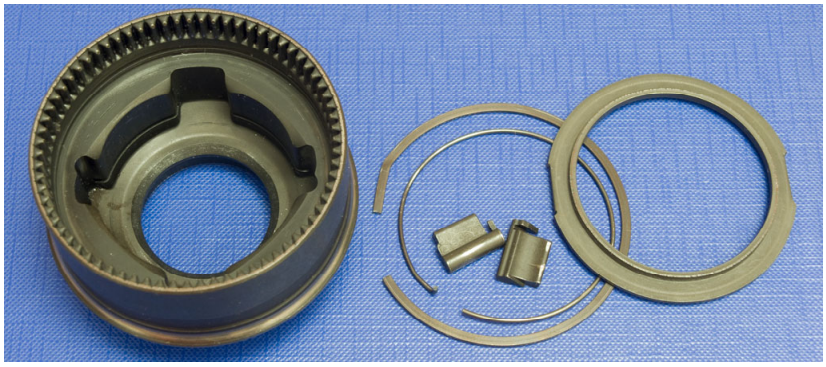


**Figure 22. Parts of the driver unit.**

## Assembling all units

The final step of combining all the components is discussed here. Basically, all parts slide together as shown in the Shimano manual, but a few remarks are in order.

First, put together the carrier guide as in Figure 23. From left to right we see the internal assembly, shift cam return spring, shifting cam, feed cam, driver unit, ball retainer, right hand cone, seal for right hand cone, seal ring, driver plate, seal ring, lock washer, stop washer and right hand lock nut.

The arms inside the gear shifting cam should lock inside the legs of the small spring loader ring. Also note the correct orientation of the shifting cam: the step ring on it helps the spring to sit. You may have to press hard on the feed cam because you are working against the force of the main return spring. If these are mounted correctly you can see the hole in the feed cam (Figure 24). The legs of the shifter sleeve protrude from the driver unit and the driver plate (5th element from the right of the picture) has two claws that grips them.

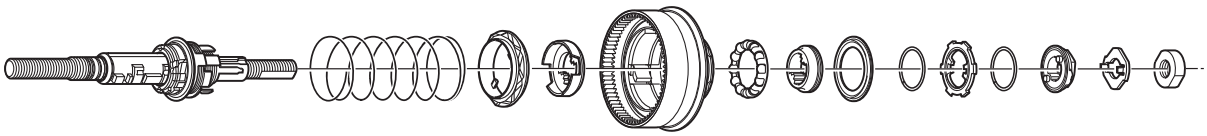


**Figure 23. Carrier guide. See text for the part names.**

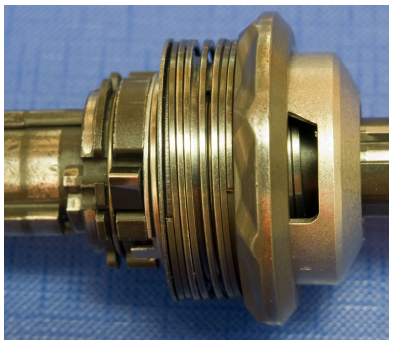


**Figure 24. correctly assembled shifting cam and feed cam. Note the hole in the feed cam.**

Next, put together the entire internal assembly as in Figure 25 (note, a few parts were left out to illustrate the main points; check the Shimano manual for the few remaining parts). If you have made the toy assembly: to enable Carrier unit 1 to slide in, you have

to turn the driver plate all the way clockwise (lowest gear). This will put the gear shifting cam into the high position, pushing the pawls inside the driver unit apart. If you have made a working assembly this is the default position.

Slide in the units carefully one by one and rotate them a bit while pushing lightly.

Make sure the orientation of the sun gear unit is right: the lower end (see Figure 13, Figure 15) goes to the bottom, assuming you have the axle in the vise with the left end (as in Figure 25) pointing up.

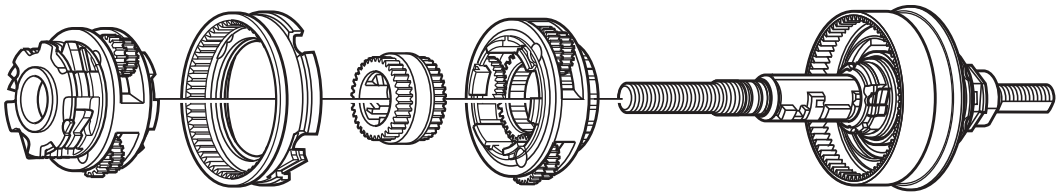


**Figure 25. Full internal assembly**

To complete assembly, refer to the Shimano manuals.

## Acknowledgements

Thanks go to Doc7speed and John S. Allen [4] for checking this document, and giving suggestions for improvement.

## References

[1] Shimano (2010). Shimano Nexus 7-Speed hub: SG-7R42 Inter-7 Hub. Available at http://techdocs.shimano.com

[2] Keith Lang (2011). Axle Unit Assembly for Shimano Nexus 7 SG-7R46 vol.1. Available at http://sheldonbrown.com/nexus-7-axle.html.

[3] Shimano (2004). Shimano Nexus 7-Speed Hub SG-7R46 Service Manual, Vol. 1. Available at http://sierrabear.com/home/images/tn_11_en.pdf

[4] John S. Allen's Home Page (2003). http://bikexprt.com