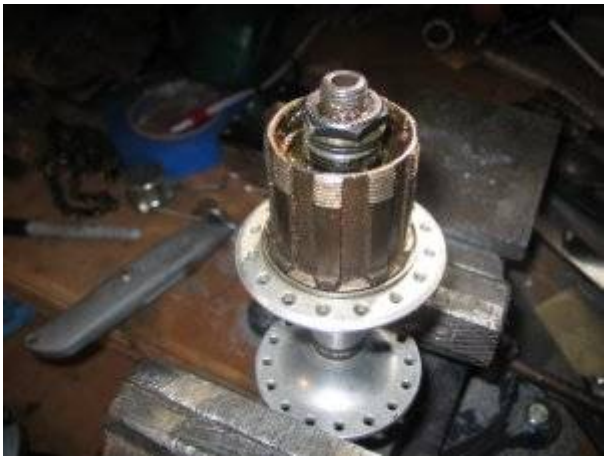
Making an HPV Jackshaft (Intermediary gear)

By Warren Beauchamp - Updated 2/24/08

Most recumbent bikes and HPVs in general are designed for ergonomics, or low aerodynamic drag, or both. Because of this, the chain line is often not a straight shot between the crank chain ring and the driving gear cluster, causing the chain to be "bent". The are two methods of bending the chain line. The first is to use a large pulley to redirect the chain. The advantage to this is a simple one chain, one derailleur system. It's so simple I don't even have to explain it.

The second method is to use an intermediary set of gears somewhere between the front chain ring and the driving gear cluster. The advantages to this design are relatively low friction and the ability to "step up" the gearing. This step up in gearing allows the use of smaller driving wheels to achieve high speeds, without the use of hard to find 73 tooth chain rings, or power robbing internal geared hubs. The disadvantage is that there are now two chains to manage. This usually means a secondary derailleur to manage the tension in the front chain, as well as chain guides or "keepers" everywhere. In this page I will explain how to make these intermediary gears, which are commonly known as a "jackshaft".

You can make a jackshaft using either a Shimano style freehub, or an older Suntour style freewheel. The first example is using a freehub.



First remove the gear cluster assembly. You may need the special Shimano cluster too to accomplish this, as well as a chain whip tool.

Most freehub gears clusters are riveted together, but it's pretty easy to drill out the rivets and free them up.

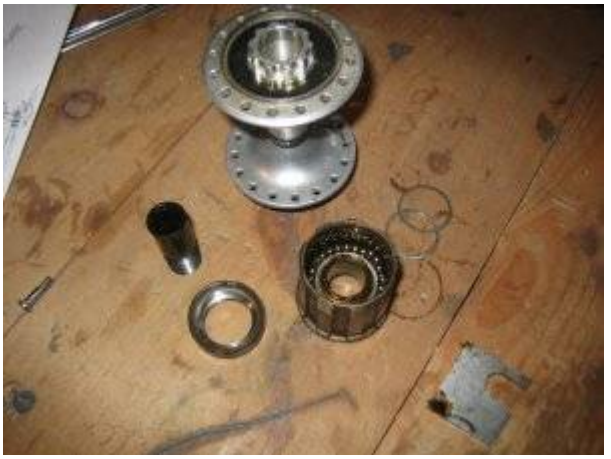
Next remove the hollow axle. After the axle is remove there is still a thin metal cap over the bearings. You can pry that out with a screwdriver. Remove the axle bearings so they don't bounce around underfoot.

Next loosen the hollow hub bolt counter-clockwise a couple turns with a 10mm metric Allen wrench. This keeps everything together while you wrestle with the bearing cup.

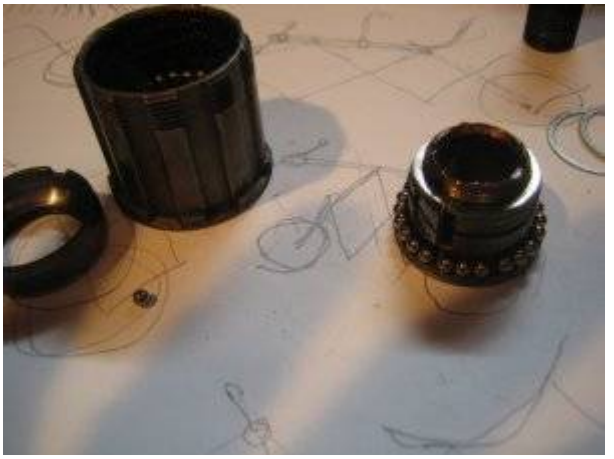
The freehub needs to be taken completely apart so the pals can be removed. This allows will allow the freewheel to spin in either direction.

It may be necessary to make a tool like this from 1/8" thick steel to loosen the bearing cup. The notch is not needed, that was just a feature of the metal scrap I found.

Insert your tool into the notches in the bearing cup, and twist clockwise.



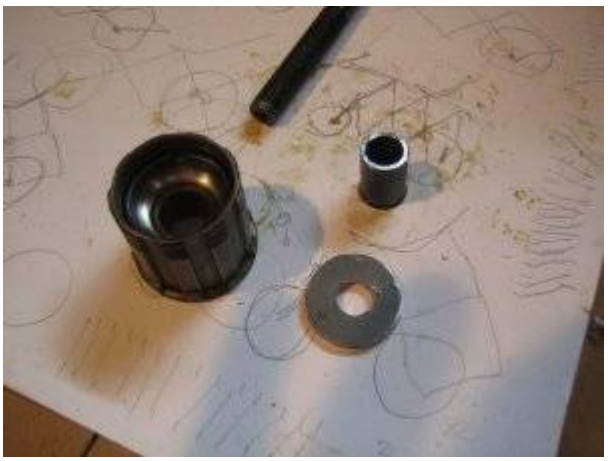
Here's the hub with the hollow bolt, and the bearing cup removed.



The inner guts of the freehub can then be removed. Make sure to take this all apart on something clean, as some of the bearing are going to fall out.

Remove the palls (the things that go clicky clicky), and the wire keeper that holds them in. Chase down the bearings and put them back into place, and reassemble the freehub.

Cut the threaded section off of the hollow bolt. It will be used as a spacer. You will need to use a cut off tool or dremel rather than a hacksaw, as

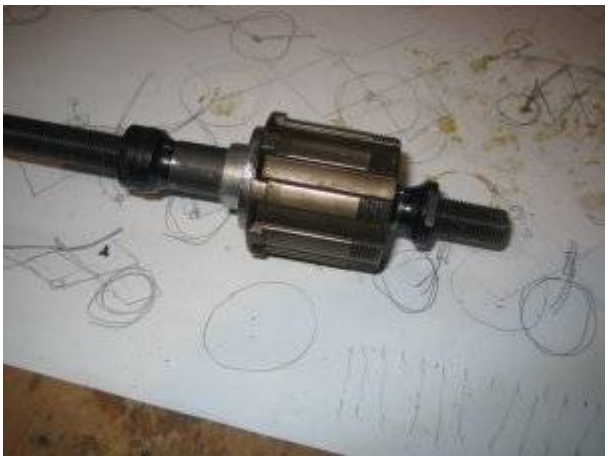


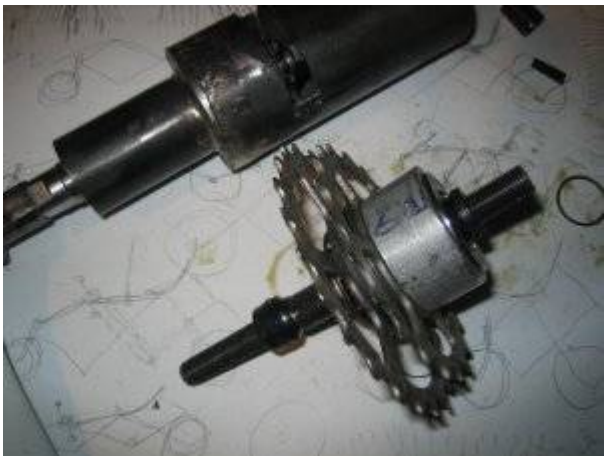
the hollow nut is made of hardened steel. Make a thick washer, which will go on the bottom of the freehub.

This mid-drive will be used as part of a human powered boat drive, so it looks a bit different that a bike mid drive, but the same concepts apply.

Build up the new mid-drive. The parts pictured left to right on this axle are an axle bolt, a spacer made from a chunk of tubing, and axle spacer, the thick washer, the freehub, another spacer made from tubing and the right side nut.

I wrapped some electrical tape around the axle to space it out to the inside diameter of the hollow nut. This ensures that the freehub is properly centered on the axle when it's all tightened down.

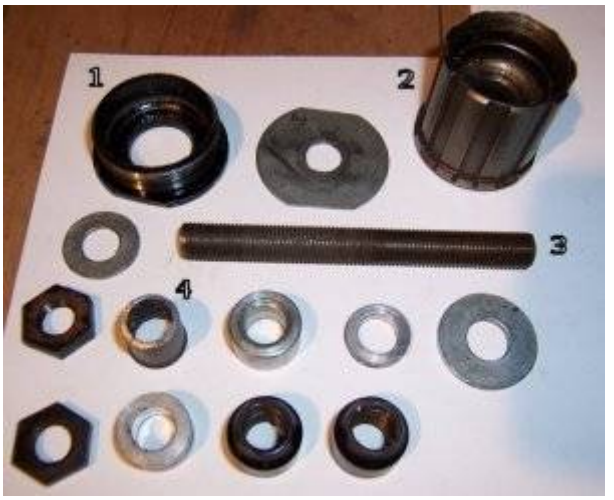


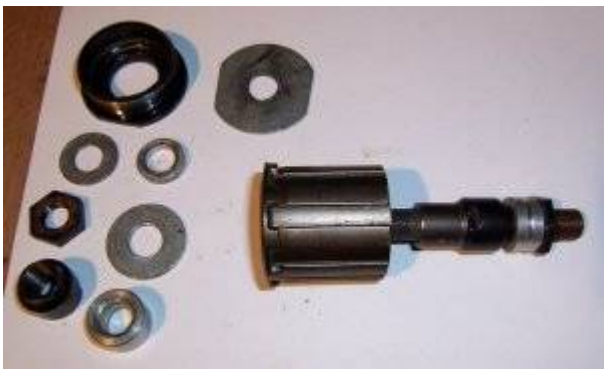


Here is the completed intermediary jackshaft. I used a couple of spacers between the two gears to ensure they were far enough apart that the chains would not rub. I made a big lightweight spacer for the remaining space on the hub with some handy aluminum tubing.

Here's how to attach the freehub to a bottom bracket cup, without having a machine shop at your disposal.

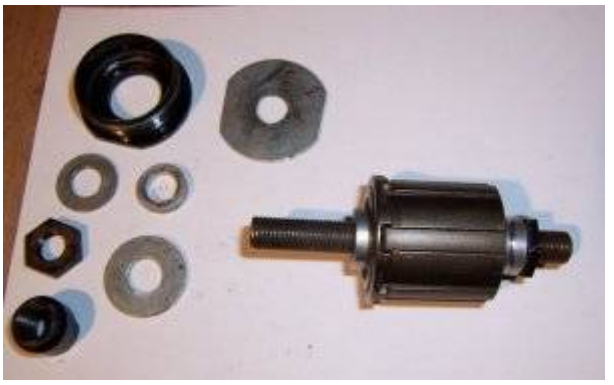
First you need a steel bottom bracket cup from a cheesy bike with a non-sealed-bearing-BB (item 1). Then you need to rip apart a perfectly good rear cluster, remove the pals so it turns both directions, and put it back together (item 2). Hack the threads off the hollow star nut that held the carrier to the hub so you can use it as a sleeve (item4). Use an old solid bike axle (item 3), plus a bunch of axle spacers and washer to complement...

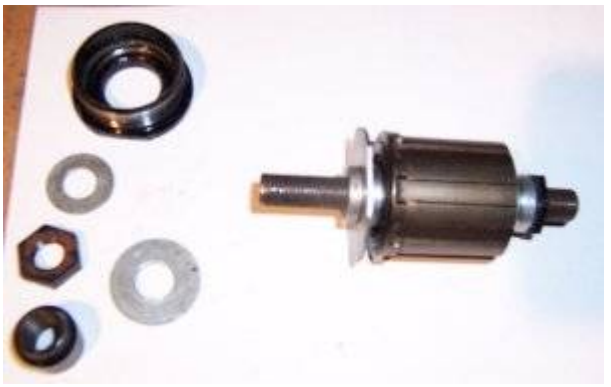




Slide the axle with the "item 4" sleeve into the carrier. An axle nut and a spacer and another nut are to the right of the sleeve. The additional spacer and sleeve will be used to mount the derailleur later.

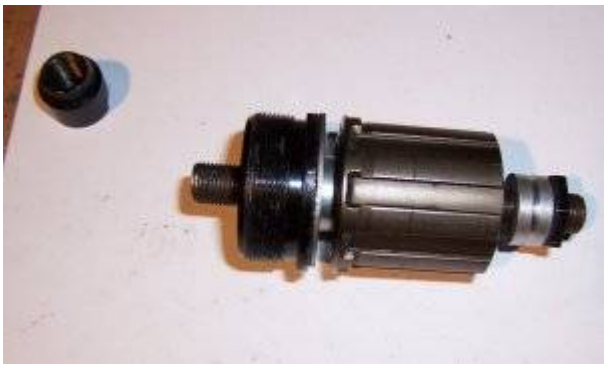
Add another spacer to the back of the carrier, to keep the axle centered in the hole back there, and to space it out a bit from the BB cup.





Add the big washer, and another spacer. This fills in that huge hole in the BB cup, and centers the axle in there.

Note that there is a certain amount of slop between axle and the sleeve, and between the spacers and the BB cup hole. You can wrap the axle with electrical tape to make the sleeve fit snugly, and when it's all tightened down it will be plenty strong.



Add the BB cup, a couple more washers, and a nut. Tighten to a torque of one grunt.

Uh. That last nut sitting there forlornly is left over.

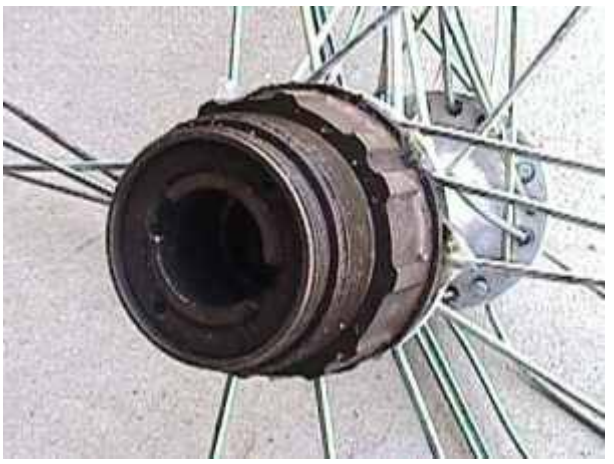
Move along now...

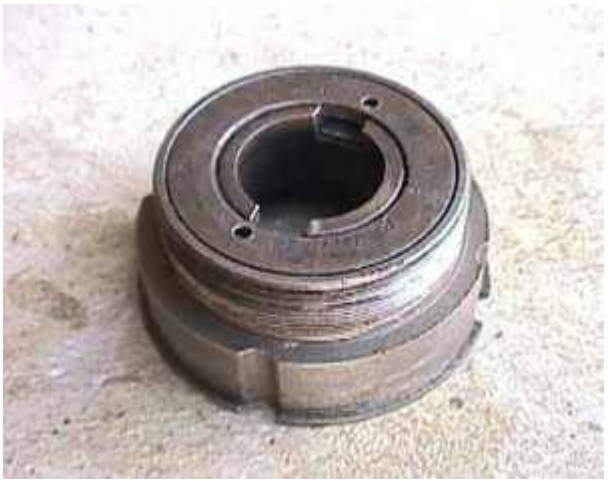
Suntour Freewheel Jackshaft

You can make also make a jackshaft using a freewheel, which is an older type of gear cluster, commonly made by Suntour. You'll need a chain whip to remove the gears.

Even if the wheel is a throwaway, leave the spokes attached to the wheel until after you are done removing the freewheel. It's much easier if you have something to hold onto while you are grunting away, removing gears that have been

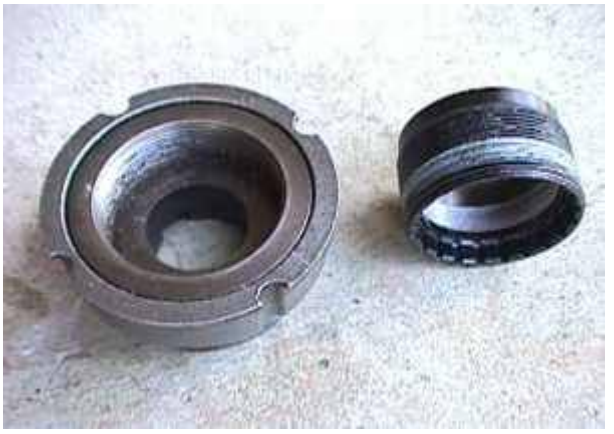
gunked in place for the past 20 years. As you can see in the picture below, I cut the spokes before removing the freewheel body, making it much harder to remove.

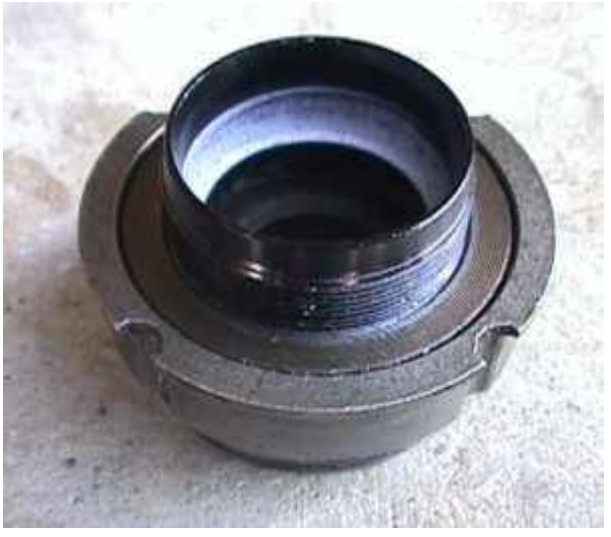




You'll need to completely disassemble the freewheel, to remove the palls. This will allow the freewheel to spin smoothly in either direction. Depending on how tight it is, you may need some special tools to disassemble the freewheel itself. If you don't have the special tools, you can just mount the freewheel body in a vise and use a punch in one of the two holes in the bearing keeper to tap the keeper loose. Note that loose is clockwise. Be careful when you get it loose, there are approximately 1 million ball bearings inside. Clean everything well. Use some grease to stick the ball bearings in place when you are reassembling it. Wash the grease out with a lightweight oil. Grease is too heavy a lubricant for those little balls.

The threads that held the freewheel onto the hub are the same as in a bottom bracket. The picture below shows the back of the freewheel and a bottom bracket retainer.

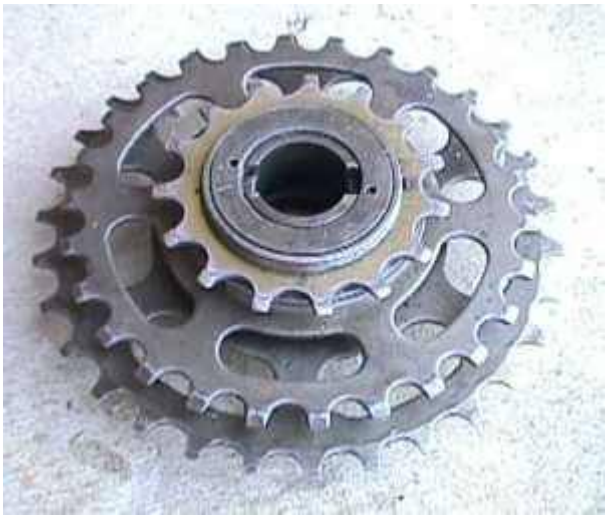




After you screwed the bottom bracket retainer into the freewheel, you can just screw that into a bottom bracket.

If your project happens to have a bottom bracket in the right place, you are lucky. If you are not so lucky, you can buy plain bottom bracket shells, hack them up, and braise them right to the frame. If you are unsure of the jackshaft placement, you can mount the remnants of the bottom bracket to an adjustable clamp. Note that by using larger gears you will attain higher power transfer efficiency. The smaller gear in the photo below is just there to retain the larger gears.

You will need a secondary derailleur to keep the front chain from popping off. I recommend mounting it as close to the intermediary gears as possible.



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