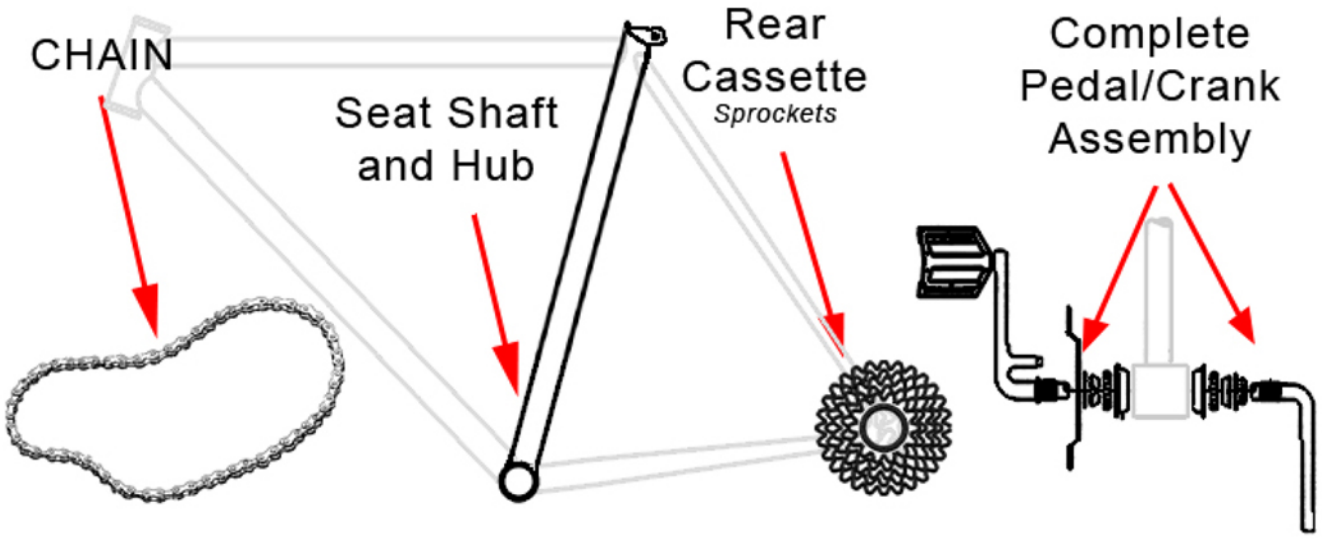
SpiroJib

The following is a set of instructions and parts used to build a light spirograph device out of primarily bicycle parts. Due to manufacturer differences, this PDF is more of a guideline than it is “Step by Step” instructions, though the walk-through is as complete and informative as I can make it.

PARTS LIST:

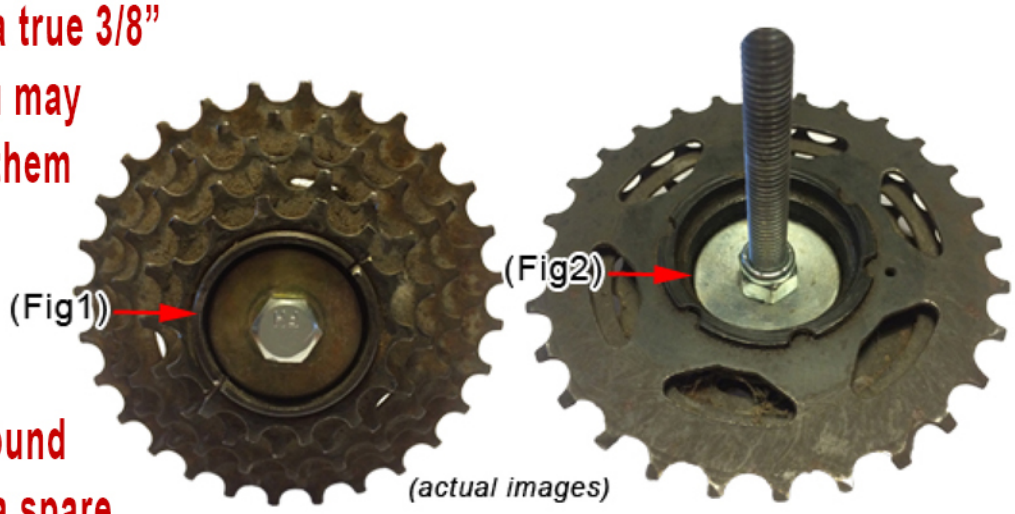
BICYCLE PARTS:



NUTS and BOLTS:

1- 6” 3/8 Standard Bolt
1- 3/8 Standard Lock Nut
3- 3/8 Standard Washers
2- Heavy 3/8ID Fender Washers
1- 2” 3/8 Standard Bolt
2- 3/8 Standard Nuts
2- 3/8 Wing Nuts

Notes: The 2- 3/8”, inside diameter, fender washers will be used to align the Rear Cassette (Fig1 & Fig2). These need to be a true 3/8” inside to fit the bolts tightly. You may have to buy smaller ID and drill them out to assure snug fit. Also, the outside diameter is based on the size of your cassette. Both the washers I used had to be ground down to fit. I mounted them on a spare bolt and chucked them up in a drill, then ran them against a grinder to work them down to a press fit.

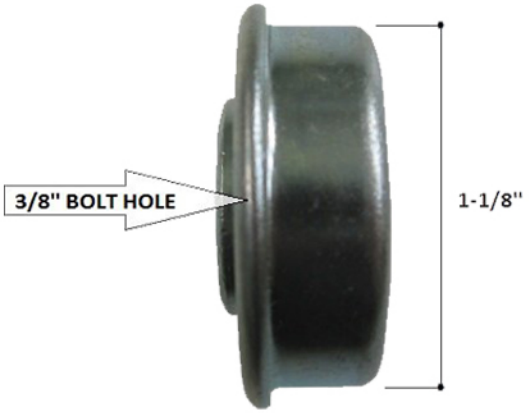


(actual images)

1 - 8” piece of 1/2” square tubing

NOTE: You will be tightening down on this, so use a heavy walled tube.

2 - Flange Bearings with a 3/8” bore.



NOTE: The bearing shown can be found on Amazon in a set of 8 for $49 USD + $4.99 shipping. Individually I’ve found them for $20+ so I just bought the set. They make various sizes and some are flanged some are not.
Some are threaded and some are not.
You want the 3/8ths Bolt Hole and is not threaded.
Using this code in the Amazon search should take you to the correct set: B00T0T3TI2

1 - 2” piece of 1-1/8 ID Steel Pipe.

NOTE: The 1-1/8” inside diameter pipe is based on use of the bearing listed above and should in fact be just a bit smaller. You want the bearing to fit the pipe firmly up to the flange so as the casing doesn’t slip, but not pressed in so tight as to deform or damage the bearing.

1 - 1-3/8” long 3/8 ID Spacer

NOTE: This spacer rides on the inner ring of the two bearings so when you tighten the through bolt down, the bearings won’t bind. It’s exact length is determined by the space left when the bearings are pressed into the pipe.

1 - Stand

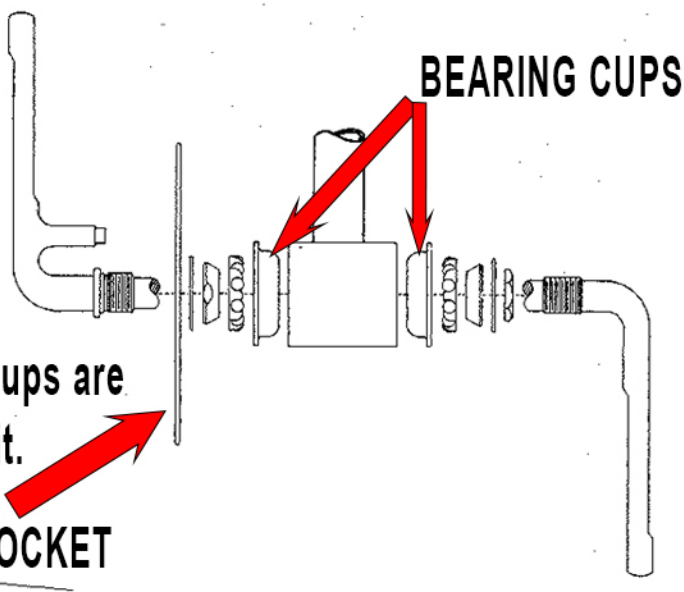
NOTE: My stand of choice is a Two-Stage Tripod Stand like this ProBuilt 311006 because it’s legs lay close to the floor and out of the way of the spinning light bar. They run about $40 USD and tend to much more rugged than photography pods. Also the top tube is generally the same size as the hub tube rising up to the seat on most bicycles, which we will be attaching to.

Before you collect all the parts, it's a good idea to obtain and strip the bicycle. Reason being, is so you can pair the cassette up to the fender washers for the correct size. Also there are some specialty tools required for the disassembly that if you don't wish to buy them, you'll have to have someone disassemble it for you. The only thing I'd order right away is the flange bearings so you don't have to wait for them to arrive. The rest you should be able to find locally.

Step 1: Break and pull the chain.

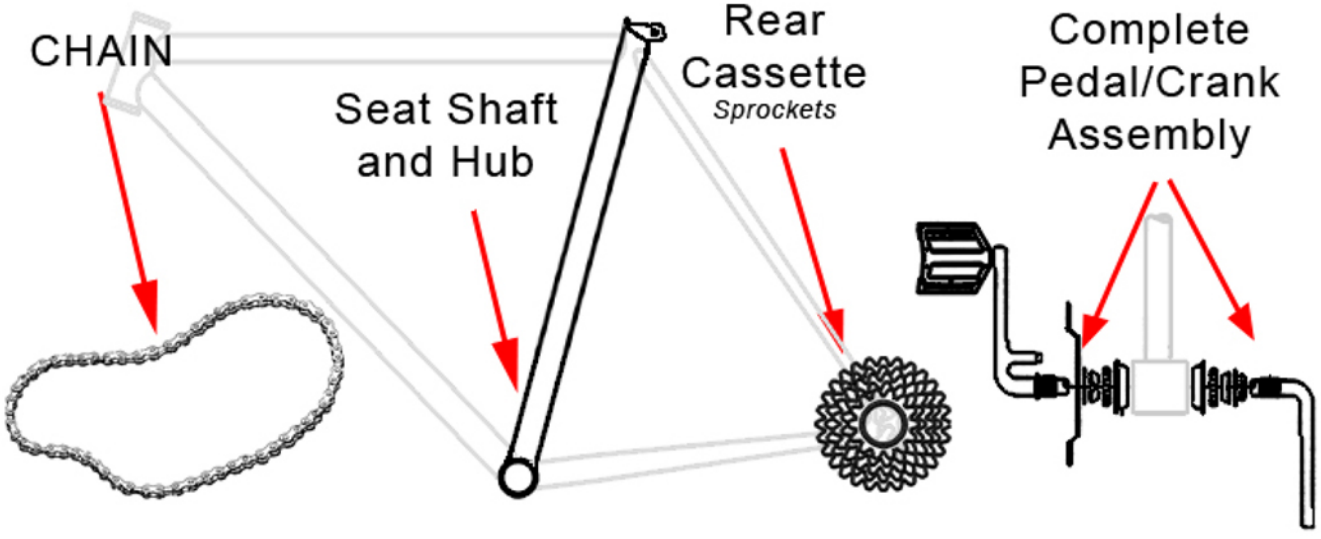
Step 2: Pull the rear wheel, dismount and strip the cassette. It needs to be completely stripped down to just the gear rings. The cassette is all we need to save off the wheel.

Step 3: Disassemble the pedal crank assembly and keep all parts. It's important to note the order and direction of the pieces as they are removed because we will reassemble all but the sprocket later on. Take care to not over look the bearing cups pressed into the hub. Those have to come out too. They are pressed in and can be difficult to remove without damage, so go easy and work your way around from the inside of the hub with a hammer and wooden dowel. There is a specialty tool for this, but new cups are cheaper if you mess them up so I'd go for it.



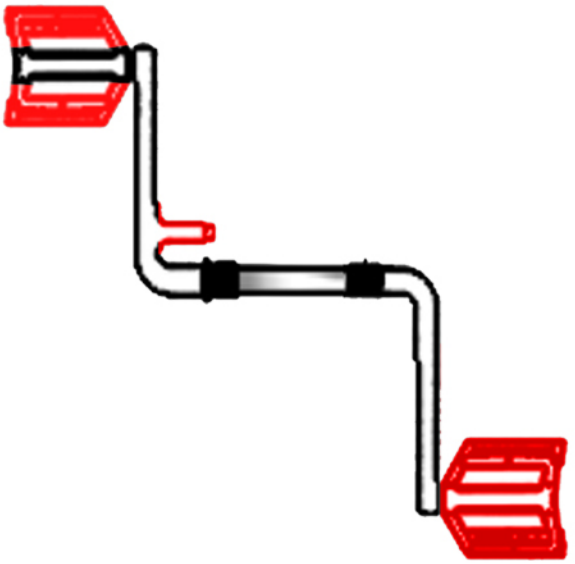
Step 4: Cut the pedal hub out of the frame

We only need a few inches of the tube going up the seat. The tubes to the rear wheel and up to the neck are not needed at all. Being careful not to cut into the hub, cut those tubes off and grind them down leaving only the hub and a few inches of the tube going up to the seat. Do as you wish with the rest of the bike, the parts pictured are all all we need.



Step 5: Clean up. Being that there is oil and grease on the bicycle parts, it's not likely you want to get dirty every time you change gear settings, so take the time now to clean everything up. It's much easier now than after the build.

Step 6: On the pedal arm where the sprocket rode, there is a spike sticking out that needs to be cut off and the arm ground smooth so it doesn't catch your hand as you're spinning. Also, you only need the pedal from that same side of the crank, so the other can be set out of your parts. A good idea on the remaining pedal is to cut it down to just its core. This makes gripping much easier when you're spinning.

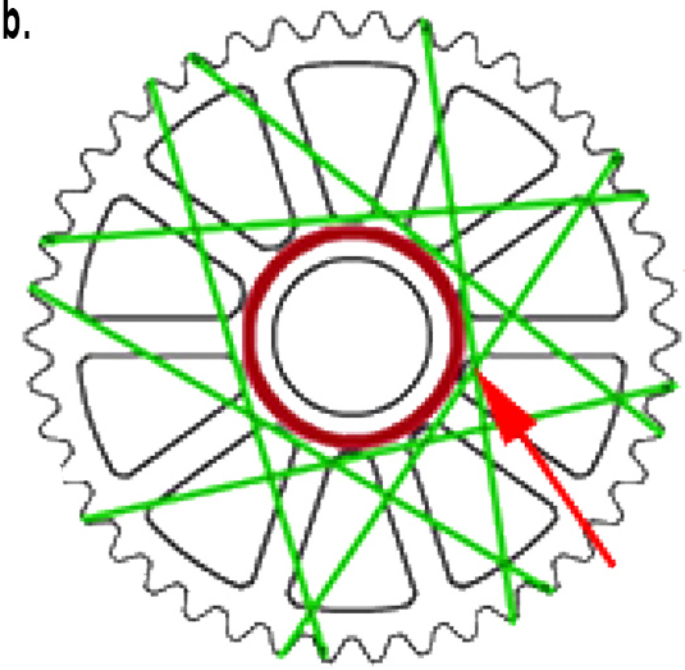


When reassembled, should look like this:

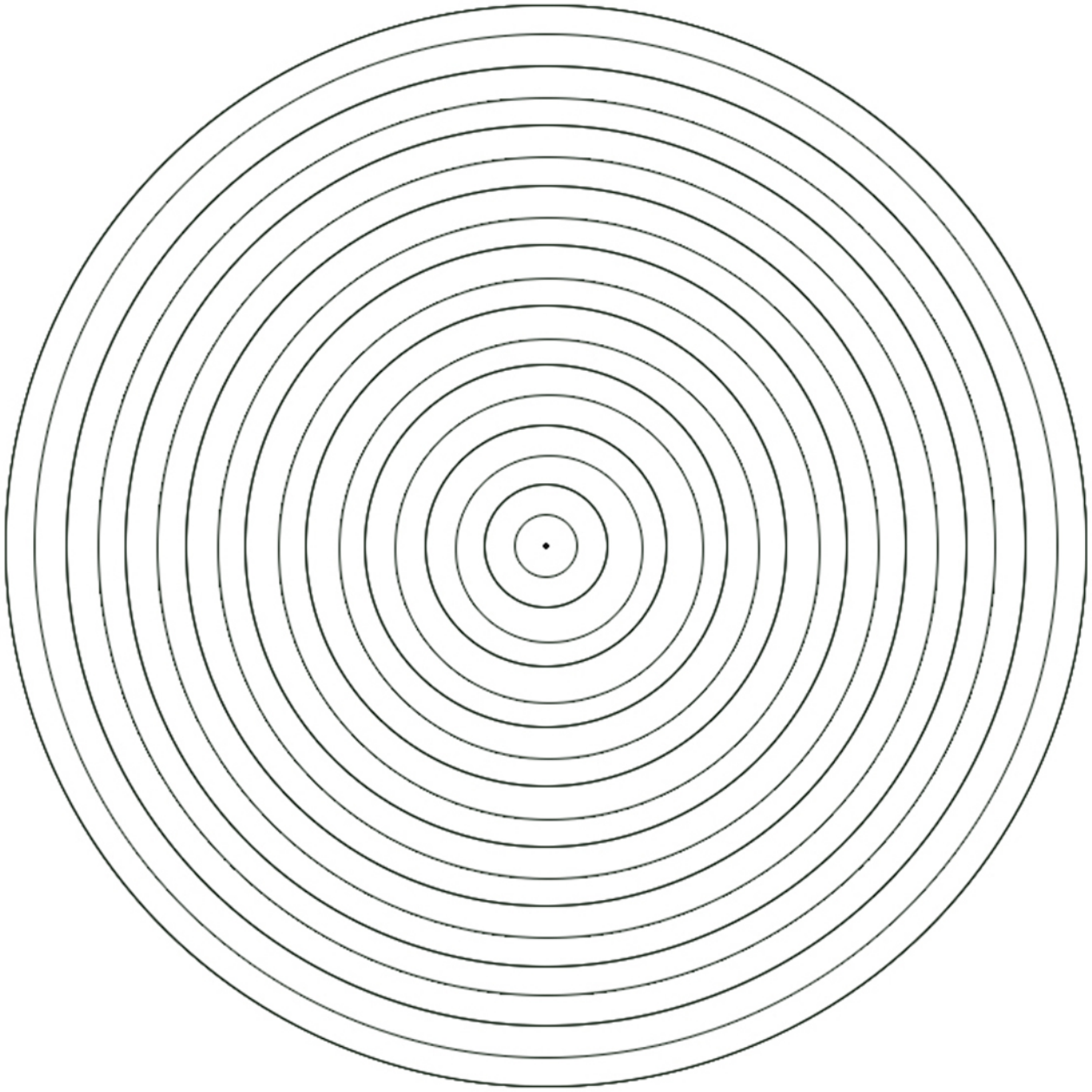
Step 7: Attaching the sprocket to the hub to make it a fixed gear. Centering and alignment are imperative here. If the fixed gear if off center, the chain will be tight on one side of the spin and slack on the other side. If the gear is not straight, the chain can't track properly and will jump off as you spin.

To attach the gear, we have to cut the center out enough that the gear will barely slide over the outside of the hub, then we will align and weld it to the hub. The results should look something like this:

There are several ways centering can be achieved. I'm going to give you the two ways I've done it. First method is to lay the sprocket down flat and place hub as close to center as you can get it by sight. Then take a straight edge and mark from one tooth on the gear to another. From both sides of the line you marked, count around the gear 4 or 5 teeth in the same direction and draw another line. Continue in this manner until you have encircled the hub enough that you're comfortable aligning the hub. Pressing the hub down in the center of lines, take a scribe and mark the gear tight around the hub.



The second method is by using a protractor and a centering wheel. For this method, print the sheet I've provided on the next page and lay it on a flat surface. Take the sprocket and lay it flat on the template evenly spacing the closest ring to the center hole of the sprocket. Measure the EXACT width of hub across its outside radius. Set the protractor to that measurement. Place the point of the protractor on the dot in the middle of the Centering Wheel and mark the sprocket. If you notice, the sprocket pictured is a three gear sprocket and because the small gear is inset, the gear's not touching the paper making it possible for me to not be centered as well as I should be. Two things I can do are, flip it over and grind the rivets off the small gear making it a two gear and flat or finding something that'll fit inside the small gear, trimming down the centering wheel fit and then mark the sprocket.



Now that our gear is centered and on the hub, now it's time to align it. To do this, take one of the bearing cups and replace it on the side of the hub with the sprocket. Use a hammer and wooden block to tap the cup in all the way until its lip is seated on the hub all the way around. Next gently pull the sprocket to the edge of the cup ring, ensuring it's touching all the way around. Now tack weld the sprocket into place form the back side. Do not weld on the cup side. It doesn't take much to hold the gear in place, so don't stay on the heat so long you risk warping the sprocket. After each tack, it even helps to use a cool wet rag to cool the weld spot. As you go along, make sure the sprocket is still just touching the bearing cup lip so you know it's straight. After you've finished your weld, go ahead and insert the other bearing cup.

Step 8:

Steps 8~11 are based on you using the stand I suggested.

If you did not, you may want to stop here and think through how you wish to attach the head you just built to a stand. If you are using the stand, go ahead and remove the top tube. This is done by unscrewing the top lock while holding the top tube and lifting the lock off. You have to hold on the tube so is doesn't slide down into the second tube Next, using the tube as a tapper, lift the tube out by tapping it as you lift against the retainer ring holding it in. Once the tube is out, replace the retainer and lock screw into the stand.

Step 9:

Now that our top tube of the stand is out, first cut the flare of the bottom of it. We just want it as a straight pipe. Any hardware pulled off the tube, go ahead and replace on the stand. The tube should now just look like a piece of straight yellow pipe. On one end of the pipe, measure and mark it at 1” and again at 2”. Here we’re going to make 2 45° that are aligned with one another (FIG1). Spin and realign the pieces to make 2 90° bends (FIG2). Lay them out on a good flat surface and weld them back together, now goose-necked.

(FIG1)

(FIG2)

Step 10:

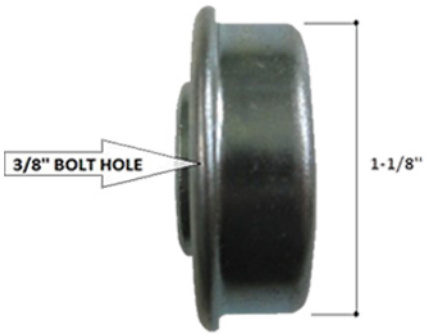
On the hub where the post went up to the seat, we now want take a hacksaw and cut that tube off to be about a 1” stub. If all things are right in the world, the now goose-necked tube should just fit inside the stub on the hub (FIG3). Eyeballing down and along the goose-neck, you should be able to align this pretty straight. Also, the sprocket should run parallel to post. Once aligned, go ahead and weld it into place

(FIG3)

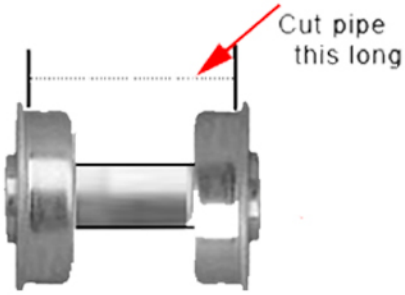
Step 11: Drive Arm. Over View

The drive arm is an 8" X 1/2" square tube with 2, 3/8" inner Bore flange bearings (FIG1) mounted in a 1-1/8" ID steel pipe, separated by a 3/8" ID spacer (FIG2), welded 90° off each other (FIG3). The trick here is to square the bearing carrier pipe to the 1/2" square tube and properly space the bearing carrier length to match the bearings / spacer as to not bind the bearings when tightened down. I bought the bearings and spacer first because it's easier to match the pipe to the bearings than it is to find bearings to fit a pipe. You want the bearing to just fit inside the pipe, so some honing may be required. The objective is to create a light press fit of the bearings into the pipe and have the pipe length cut to house the bearings and spacer without binding the bearings when the assembly is tightened (FIG3) The next few steps have the details.

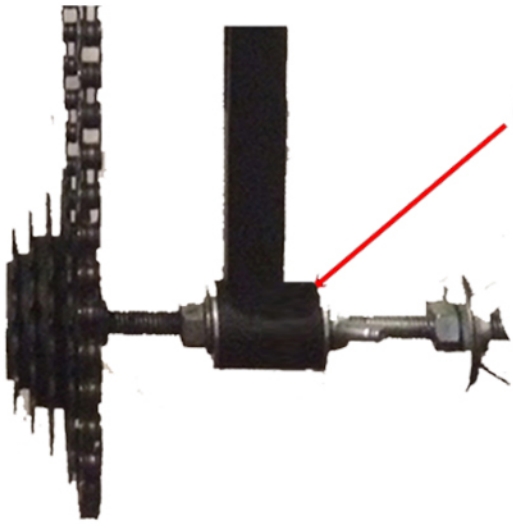
(Fig1)



(Fig2)



(Fig3)



Step 12: Pressing the FIRST bearing

(FIG4) shows how far you should be able to hand press the bearing in when you have the honing correct. I used an old 7/8" socket and hammer (FIG5) to tap (NOT POUND) the first bearing down to seat.

(FIG4)

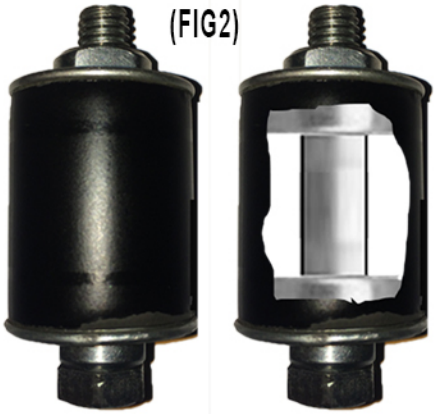
(FIG5)

Step 13: Sizing and squaring up the bearing carrier

This is another piece of the build where precision is key. You will have 2 bearings separated by a spacer (FIG1) and this assembly needs to fit the carrier without binding (FIG2)

(FIG1)

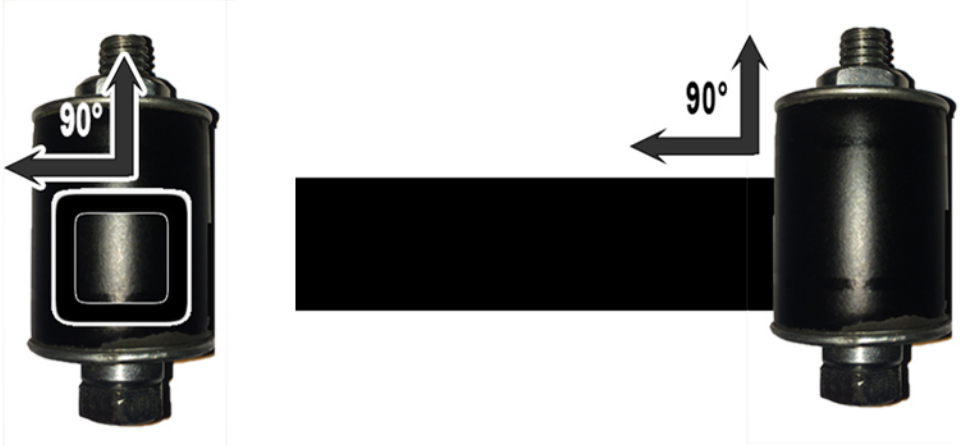
(FIG2)



If the carrier is too long, when tighten, the bearings will bind against their own casing. If it's too short, the bearings won't seat properly. If the pipe is too big around, the casings fit loose and may move distorting alignment. If the pipe's it too narrow, when pressed in, you may distort the bearing casing causing the bearing to seize up.

Step 14: Welding the Carrier to the square tube.

The drive arm assembly is what controls your spinning gears. If not centered and squared properly on both the X and Y axis, the chain will bind as you spin and likely never stay on. A small Squaring Magnet does great for this (FIG3). The length of the square tube should be cut to 8" then welded center of the radius and 1/8" from one side of the carrier.



(FIG3)

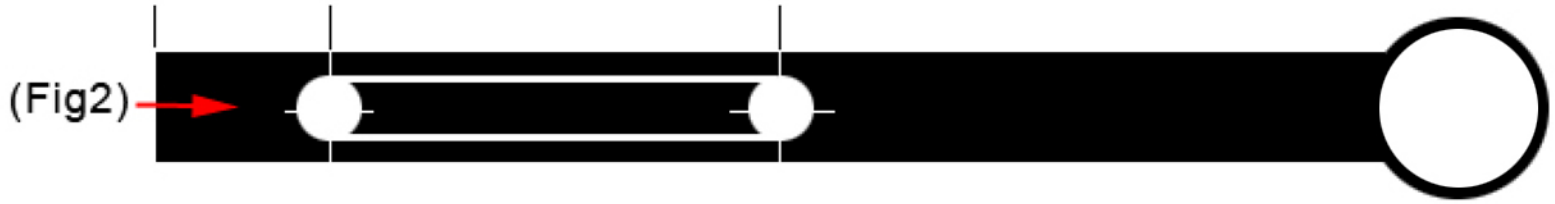
Do not weld the square tubing to the carrier pipe with the bearings installed! Size and fit everything then disassemble the carrier before welding it to the square tube.

Step 15: Chain Adjuster.

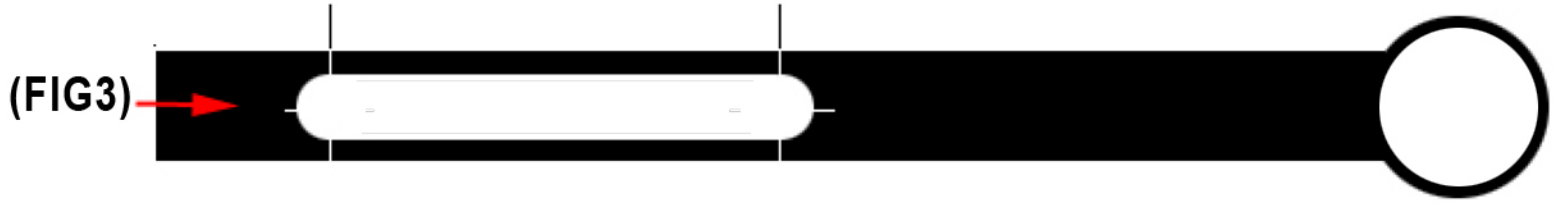
As this is a multi-gear system, the chain tension has to be adjustable. To accomplish this we cut a 3/8" X 4" slot in the drive arm allowing it to be adjusted up and down as needed. We start by drilling a 3/8" hole 1-1/2" down from the opposite end of the square tube from and aligned with the bearing carrier (FIG1). Then drop down 4" and drill another through hole.

It is important that these holes are centered on both sides, so if you do not have a good drill press and vice, I would drill from both sides instead of trying to drill through.

Once the holes are drilled, use a straight edge and scribe between the outer edges of the holes on both sides (FIG2).



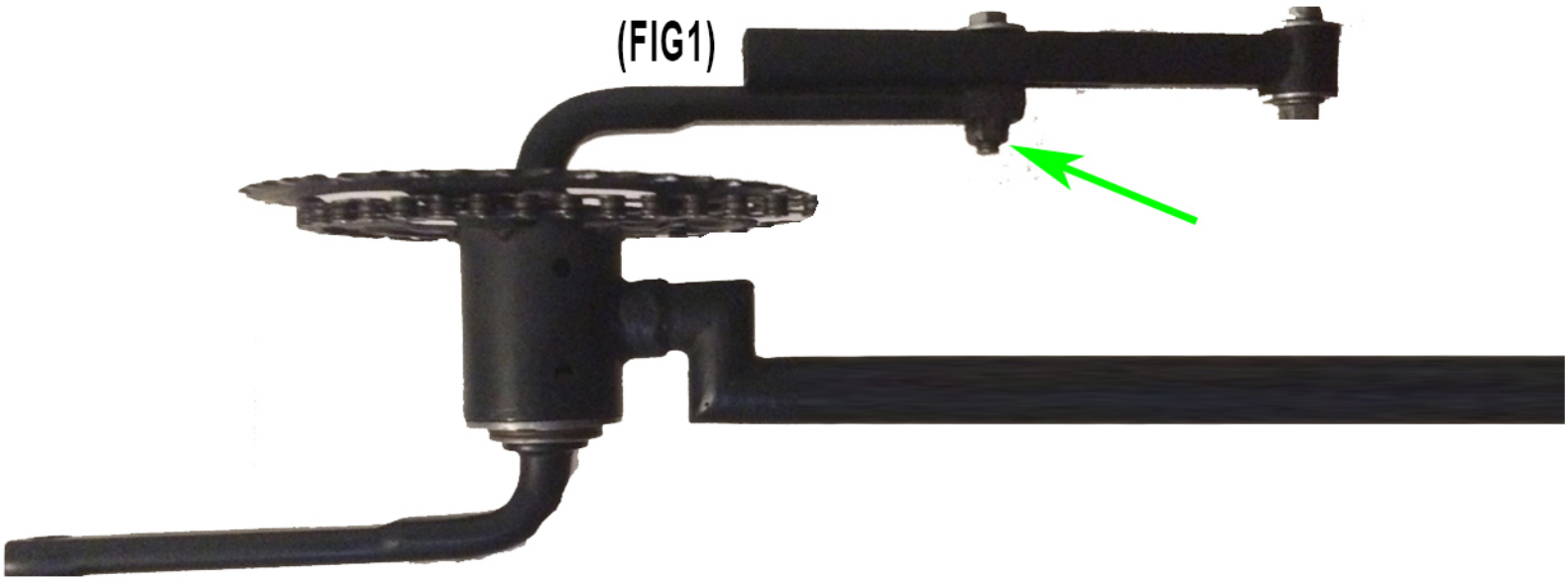
Using a cutting disc, carefully cut just to the inside of the scribed lines creating a 4" by 3/8" slot (FIG3).



Step 16: Prepping the Crank Arm

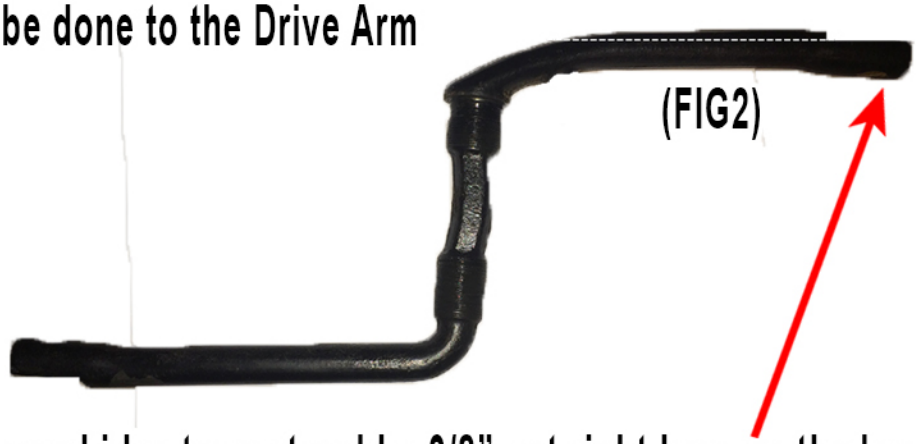
The Drive Arm will be bolted to the Crank Arm Pedal Mount via the slot we previously cut in the square tube as shown in (FIG1). You can run

(FIG1)



Often times, though the pedal mount is 90° and flush with the through crank, the crank arm itself may not be flush all the way to the pedal as the dotted line shows in (FIG2). Trying not to scare where the pedal mounts, you'll need to remove (grind off) the extra material. This only has to be done to the Drive Arm side of the crank.

(FIG2)



If using a steel crank, it's a good idea to spot weld a 3/8" nut right here on the back of the pedal mount AFTER the build is complete. Can't do it now because of the crank assembly later, but a good thing to keep in mind. The pedals are larger than 3/8" so you'll need a nut and bolt to mount the drivearm. Saves you caring an extra wrench if this nut is welded. Take a spare bolt with a flat washer and run it through the mount so you know it's square to pedal mount face. Tighten the nut on the back side of the mount and weld it where the red arrow points. Remove the spare bolt/wash and you have your drive arm mount. It's shown by the green arrow in (FIG1)

Step 17: Cassette Mounting

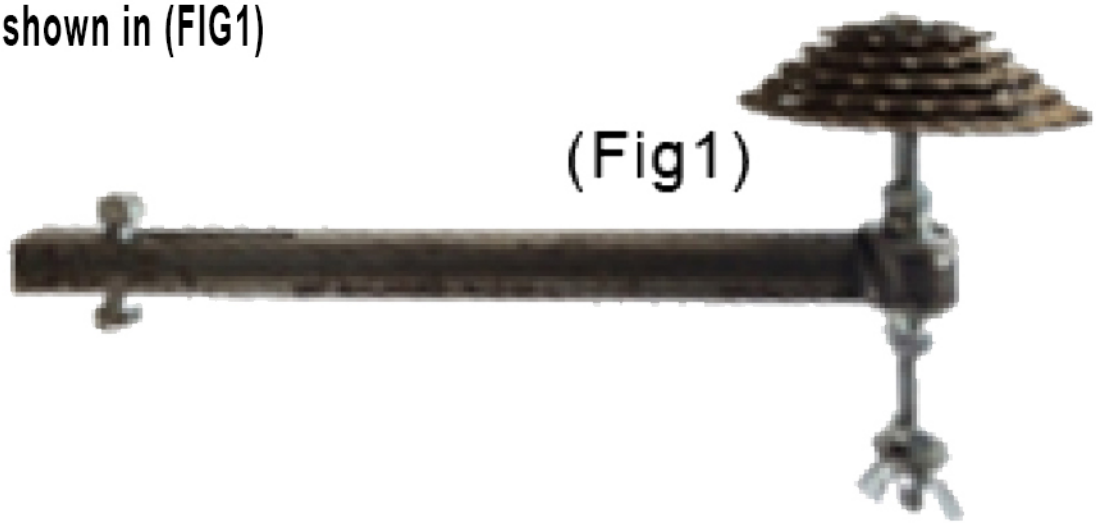
To drive the lights, the cassette has to be mounted solid on a bar running through the bearings in the drive arm and out the other side to mount the lights on. This is the reason for the 6” X 3/8” bolt. As shown in (FIG1), the 6” bolt is held center by two fender washers.

(Fig1)

The washers I use are heavy built and actually smaller than 3/8” and I drill them out to 3/8” on with a drill bit. Generally a standard 3/8” washer is very loose on a 3/8” bolt and we want these to fit snug on the bolt. The washers should also be a bit larger than the hole in the cassette and cut down to exact fit. To size the radius of the washers, I mounted them on a spare bolt, chuck them up in a drill and turned them against a grinder one at a time until I had the perfect fit. Notice also in (FIG1) image to the right, I secured the bolt with the lock washer from our parts list.

Step 18: SpiroJib Assembly

1) Mount the Cassette to the Drive bar. First run a Standard 3/8” nut all the way down the cassette bolt to use as a lock down, then run the bolt through both bearings. Add a 3/8” wing nut, another Standard 3/8” nut, 2 3/8” flat washers and lastly anouther 3/8” wing nut. All as shown in (FIG1)



2) Reassemble the crank in the hub. The side you ground the stub off the hub was the original sprocket side. I use the other side as my drive arm side and the drive arm should be on the side of the fixed gear we welded to the hub. Once the hub is complete and bearing tention adjusted, now we can spot weld the Standard 3/8” nut I meantioned back at Step 16. (Prepping the Crank Arm)

3) For final assembly, mount the head into the stand and tighten it down. Next take the drive arm, sprocket down and facing the stand, and mount it to the pedal mount with the 2” 3/8ths bolt with a flat washer. Lift the arm up until the bottom of the adjustment slot hits the bolt , then back down 1/2” and snug the bolt down. The reason for the half inch space, is now it’s time to resize the chain and you don’t want the arm bottomed completely out for that.

Step 19 : Resizing the Chain

You will want to size the chain to the two largest gears (if you used a multiple sprocket for the fixed gear as I have), but first you need to align them. To do this, loosen the wing nut and nut on either side of your drive arm bearings. This should allow the cassette to travel in and out toward the stand. Just eyeballing it, align the two largest sprockets and reset the bearing nuts. Next drape the chain around the two sprockets and cut it to the closest fit. Just holding the chain in place, loosen the drive arm and make sure it doesn't bottom out before the chain would tighten. If it does, remove one more link. If it doesn't bottom out, you should be good to go to reconnect the links at the new size.

Step 20: Time to build some light bars and get to spinning!

It does take a bit of practice to get the chain alignment right every time, and also to hold the SpiroJib steady while spinning it, but it is so much fun to use once you get the hang of it.

HAPPY SPINNING!