

UKE BUDDY

A device for a ukulele player with one good arm

A Construction Article

by

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During the summer of 2014, at a ukulele class and jam session, Tavit Smith, a skilled musician and teacher, asked if there were any mechanical engineers present in the group. Tavit had a burden to provide a way for someone who had lost the use of one of their arms or hands to play a musical instrument. He wanted someone to design a device that could be used with a ukulele so that it could be played with one hand. I took up the challenge.

We decided it should be attached to the uke without modifying it or damaging it, would not dampen the sound, could be made with common shop tools, and be inexpensive. Also it should follow that hallowed engineering principle: KISS (Keep It Simple Stupid.)

The first prototype, a proof of concept model, clamped on the base of the neck where it joined the body. It worked but it was not easy to make and was far from a thing of beauty. But it worked! That was the important thing.

Tavit suggested placing the pivot of the swing arm below the bridge and strumming the across sound hole. Not traditional but it worked, and we kept the clamping bars from dampening the soundboards by placing bits of inner tube rubber at their ends.



And here is how you can make one yourself. (**NOTE:** The picture numbers are in parenthesis next to each of the following pictures. Larger copies of those can be found nearby.)

Don't be put off by all the verbiage that follows. It is really quite a simple device. There are just 4 different parts to make (as shown below) and what follows is a step-by-step process for making each one. All the rest is just hardware and that is outlined at the end of the article.



(1)

So what is it going to cost and what do I need?

I paid US\$22 for the hardware materials to build two Uke Buddies in 2014. That was from a very expensive hardware store. More than I wanted to pay but they had the stuff.

If you look at the Bill of Materials at the end of this article, you may notice that the clamp bars and swing arm are not listed. That is because what you can use can vary widely. For the clamp bars on the first one, I used some white oak that I had lying around the shop. I ripped that up into 1/2 inch (12 mm) square stock. For the second one, I used some salvaged 1/2 inch aluminum square stock that had a .050" nominal wall. Both worked well. Almost anything will if it is light enough and strong enough. If you don't have some hardwood lying around, poplar wood works well and is readily available at Home Depot or Lowe's in the US. If you don't have a table saw to rip up your square stock, find a friend who does. Then sand them smooth.

A note on the spring: in the US, the springs are usually stocked in the hardware store in a green cabinet with drawers. Be careful. The springs get mixed up. What you are looking for is probably the weakest spring in the drawers with the thinnest wire diameter (.020"). All the spring does is return the swing arm to its starting position, dragging the pick across the strings as it does. A stronger spring will just cause greater fatigue as you pull against it to swing the pick over the strings.

Those of you who are more familiar with hardware will question why I have specified for the swing arm bolt the more expensive 1/4"- 28 threads per inch (TPI) instead of the very common 1/4-20 TPI. It is done for good reason. The 1/4-28 is used as the pivot for the swing arm and the finer threads will cause less wear on the swing arm bearing. If you don't think so, just compare the two at the hardware store. I think you will be amazed at the difference in the coarseness of the threads.

A final note on hardware: buy extra 1/4" and #10 washers, lock washers and nuts. They are easy to drop, they always roll away, and they are inexpensive.

So how do I make it?

This article assumes that you have a working knowledge of hand tools. As you can see, it is really a very simple mechanism. If you are unsure of your craftsmanship, get a friend who is knowledgeable to help you.

In the site where you found this, you will also find larger images of the pictures shown in this article.

This article is written for a worldwide audience. Therefore, from this point on, all of the dimensions will be in millimeters. That is for two reasons. First, while it will be easy for a US reader to get a metric scale, it can be difficult for the rest of the world to get an inch scale. Second, working with millimeters is easy and, in my opinion, more precise!

Unfortunately I do not have a bill of materials in metric fasteners. To aid our metric friends, use a 4 mm threaded rod in place of the 10 – 24 rod and a 6 mm fine thread instead of the 1/4-28 bolt for the swing arm pivot.

A second item that you will need in addition to the standard hand tools is a countersink, 82° for the US, 90° for metric.

Finally, a drill press is not necessary but is very helpful.

CLAMP BARS Measure the width of the uke just below the bridge. To that dimension add 30 mm and cut the 1/2 " square stock to that length. Cut two and make sure they are the same length.



Mark the place where you are going to drill the holes for the threaded rod 7 1/2 mm in from the end and on the centerline. Also mark one of the clamp bars in the center also along the center line. See picture above. Yellow circles highlight locations.

Using a 3/32" or smaller drill, drill holes in five places. These are pilot holes to make your drilling to be more accurate.

Now enlarge the four holes on the ends with a 3/16" drill (apologies to our metric friends, you will have to use your own judgment on drill sizes based on your hardware. Drill large enough to allow the threaded rod to pass through – but not too loose.)

Drill out the fifth hole in the center with a 1/4 inch drill and countersink it so that the 14 – 28 swing arm bolt is flush or slightly below flush with the bottom surface of the bar. Sand the sharp corners of the square stock to "break" the edges. See photo 4.

(4)



In the top clamp bar (the one with three holes in it) and at right angles to the previously drilled holes, mark the center of a hole about 22 mm in from the threaded rod hole and above the center of the bar centerline. This is for the eyebolt through which the cord to the swing arm passes in order to keep uniform motion of the swing arm. It needs to be above the horizontal centerline so that the eye does not contact the sounding board. See photo 5 below.

Before you drill, lay the eye on the bar with the center of the eye over the mark. Does it come flush with the bottom surface of the clamp bar? You don't want it to touch the sounding board. (If you've already drilled the hole and the eye touches the sounding board, do not despair. Drill the other end - as I did. Note: the eyes are not symmetrical. Rotate the eye bolt in its mounting hole and see if the problem goes away before you drill another hole.) Now drill the pilot hole and then a 3/16 inch hole.

Here's how it will look after it's assembled.

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Cut four pieces of rubber about 10 mm square. An old bicycle inner tube works well. Glue them to the underside of the clamp bars. Any glue will do. All it has to do is hold the rubber squares in position until the Uke Buddy is assembled. I used rubber cement. The squares keep the bars from contacting the sounding board and dampening the sound. You can see them on the bottom clamp bar in photo 5.

Put some type of the finish on the clamp bars if they are wood. This will protect them from getting dirty and improve the looks of the device.

THREADED RODS Ideally, we would buy bolts long enough but they are not available. It would require a special order, so we'll have to make them. Stack the two clamp bars on top of the ukulele and measure the height (uke and clamp bars). Add 20 mm to that dimension and cut two pieces of threaded rod that length.

“Dress” one end with a small file to remove the sharp burrs left from cutting. By “dress” I mean to file off the sharp edges left by the saw. Smooth it off and round the end slightly. TIP: put a nut on the rod before dressing the end, then dress. When you remove the nut you will clean up the ends of any little burrs that would make threading on a nut difficult.

(6)



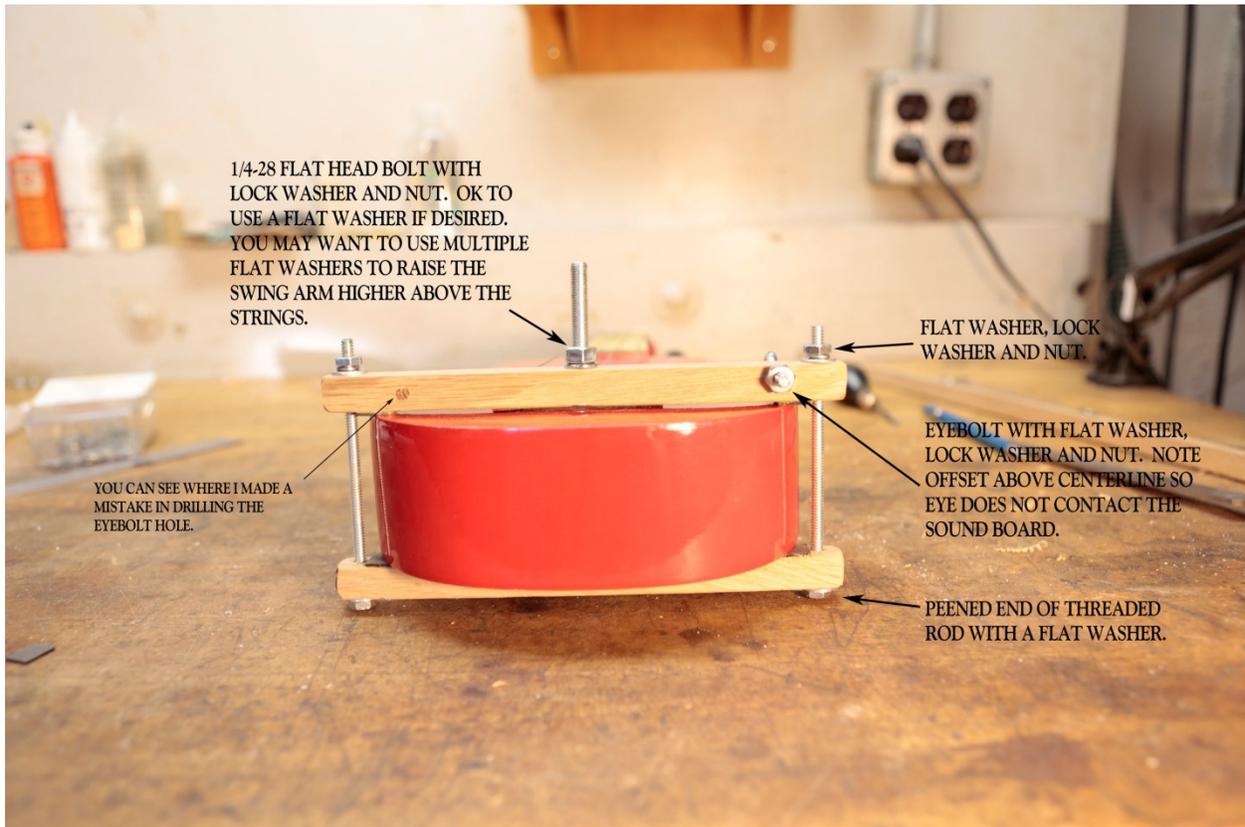
On the non-dressed end, screw a nut on until the end of the rod pokes out about 1 mm. Put it in a vice with the nut just touching the vice jaws. Using a ball peen hammer, peen (hammer the end) over to prevent the nut from coming off. Make two. See photo 7.

(7)



Now the clamp bars are ready for assembly. Install the eyebolt using a flat washer against the wood, then a lock washer, then the nut. (The lock washer always goes next to the movable nut.) Add the other hardware as shown in the photograph below, again with the flat washer against the

wood and a lock washer between it and the nut. Test fit by placing the clamp bars in position on the ukulele and tighten the threaded rods tight enough to prevent moving but not so tight as to crush the uke. You will be later removing this sub-assembly to install the swing arm.



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SWING ARM I made the wooden swing arm out of poplar because it is a lightweight hardwood and it is relatively inexpensive. We want to keep the mass of the swing arm down as an aid in fast strumming. The swing arm is the same size as the clamp bars (1/2 inch or 12 mm square) and about 130 mm long. I drilled a 5/16 inch hole on the centerline at one end for the bronze bushing. 50 mm in from the center of that whole I drilled an 11/64" hole for the swing arm return spring bolt, also on the centerline. Lastly, I drilled a hole large enough to accommodate the actuating cord. This is placed at right angles to the other two drill holes. It is the one on the left in picture 9. Its location is far from critical and can be an area of experimentation to suit your needs/preferences. I placed mine about 68 mm in from the first hole. See picture 9 below.

Three other operations remain before assembly: taper down the swing arm as shown in the photo to cut down unnecessary mass and make it easier to clamp the pick to the arm. Second, countersink the spring hole, the one in the middle. And finally put a coat of finish on the wood to improve its looks and keep it clean.

(9)

(10)



Now, all that remains is to press the bronze bushing in. I found that this is most easily done by using a small vice. See photo below. To ensure the bushing was pressed all the way through, I placed a couple of pieces of thin wood as shown. Their thickness is not critical as you will probably reposition the arm on the bushing later as you experiment with the expression of the ukulele.

SPRING LINK This is the last and easiest part to make. I made mine out of .031" aluminum that I had lying around. Almost any metal will do; a tin can would work fine. The purpose of the spring link is to connect the spring to the swing arm and provide some adjustment to the spring tension.

I made it 40 mm long and 11 mm wide. I rounded the ends. I drilled a $5/32$ " hole close to the end through which the eye of the spring would attach. I drilled three $3/16$ " holes nine millimeters apart as shown in the photo below.

(11)



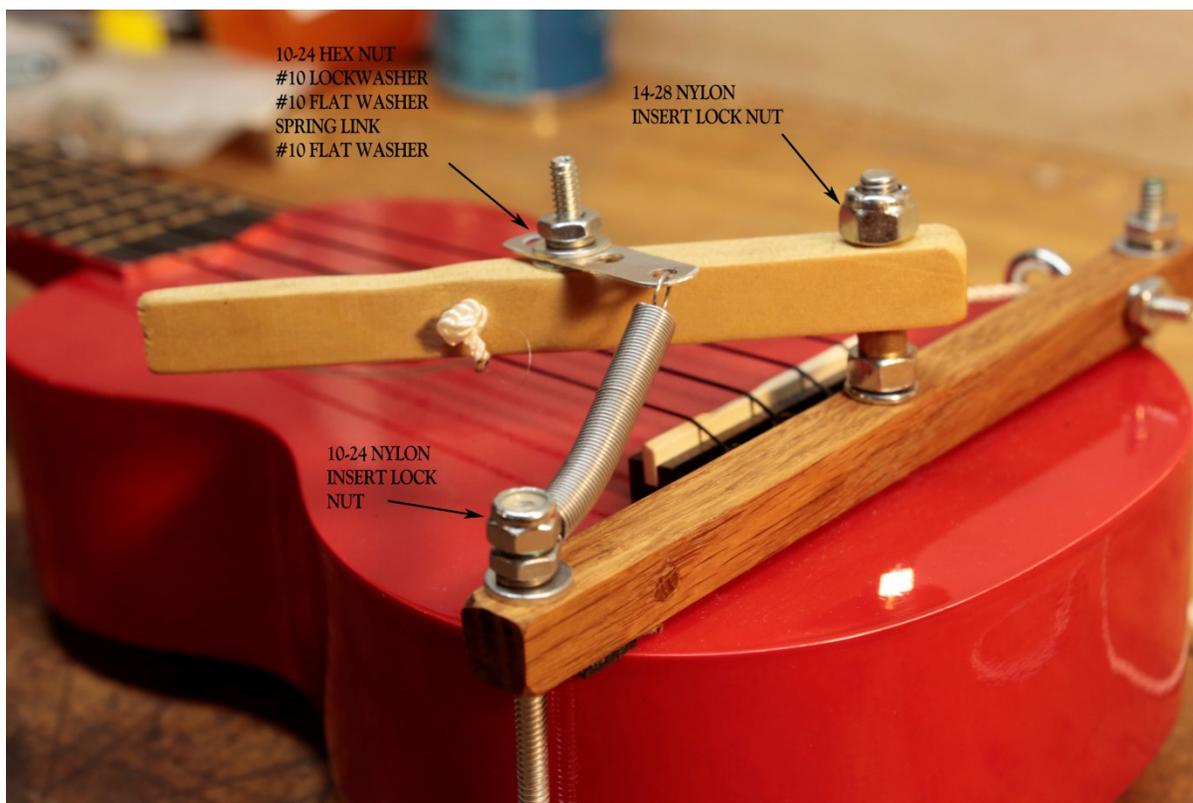
Remove the clamp bar sub-assembly (page 6, picture 8) from the uke and assemble the swing arm as shown in the photo below (12). Tighten the spring link so it can take its position to retract the arm without having to turn but not so loose that it flops around. Properly done, it will take a position as shown in the photo below. Place the spring in position as shown and put a nylon insert lock nut on the end of the threaded rod to prevent the spring from jumping off. The spring attaches to the $5/32$ " hole in the spring link.

Put a little oil on the swing arm pivot bolt and tighten the nut down. Note that no flat washers are needed. Tighten sufficiently so that swing arm swings freely without any slop.

Now install the entire assembly on the uke. Tighten down the nuts on the clamp bar so that the bars don't move during playing but not so much as to crush the uke.

Take about 1 ¼ meters of cord if you are going to use your foot to actuate the Uke Buddy and tie a loop as appropriate in the far end. Thread the other end through the eyebolt, through the hole in the swing arm and tie the knot to prevent its coming out.

Clamp a pick of your choice to the swing arm. In the photo at the beginning of this article you will see that I have used a common paper binder. The best pick – so far - has turned out to be one that is the most flexible. The one pictured is made by Jim Dunlap. It is made of white nylon and is 0.46 mm thick.



(12)

You might find it necessary to use a strap to support the uke while playing. Clip one end to the threaded rod for the clamp bar and the other end above the ‘nut’ (the small bar that the strings pass over on their way to the tuning mechanisms) in such a way so as not to affect the tuning of the strings.

If the uke is to be used left-handed, reverse the assembly of the Uke Buddy and string it in the opposite direction.

EXPRESSION Expression, the variation in tone and sound as you strum, is the weak link of this design. Normally, one’s finger changes its angle to the strings as it strums down and then up. By using the most flexible pick and pushing the swing arm up on the bushing (see photo above) one can increase the distance between the swing arm and strings. This allows the pick to flex more and increase the angle relative to the strings. You can also add some ¼” flat washers between the bronze bushing and the lower nut.

THE CHALLENGE

To our inventive friends out there: Invent a way to improve expression. It's got to be simple, easy to make, and inexpensive. Remember that KISS principle. If successful, share the results of your work.

Good luck & have fun!

BILL OF MATERIALS

Item	Quantity	Notes
10-24 threaded rod	1	1
10-24 x 7/8 or 1 flat head machine screw	1	
10-24 hex nut	5	
10-24 nylon insert lock nut	1	
#10 washers	7	
#10 lock washer	5	
1/4-28 x 2 flat head machine screw	1	
1/4 washer	1	
1/4 lock washer	1	
1/4-28 hex nut	1	
1/4-28 nylon insert lock nut	1	2
1 14x5/ 16x3/4 bronze bearing/bushing	1	
Eye bolt, 3/16 x 1 1/2 with nut	1	
#84 spring, (1 3/4x14x.020)	1	

Notes

1. Comes as a three foot piece. Soprano uke requires about 8 inches.
2. This is an oil impregnated bearing also known as Oilite.

Not included: 12mm (1/2") square tubing or hardwood, 20" for a soprano, a pick, and a binder clip to hold the pick to the swing arm.