Making Springs on the Small Lathe

This article deals with making small springs using a metal lathe. There may be other, better ways of doing it. This is how I've done things in my own home shop for years, and these methods have worked well for me.

You will find two parts to this write up. This one, and a second part linked to at the bottom of this page. This first part deals with small extension springs.

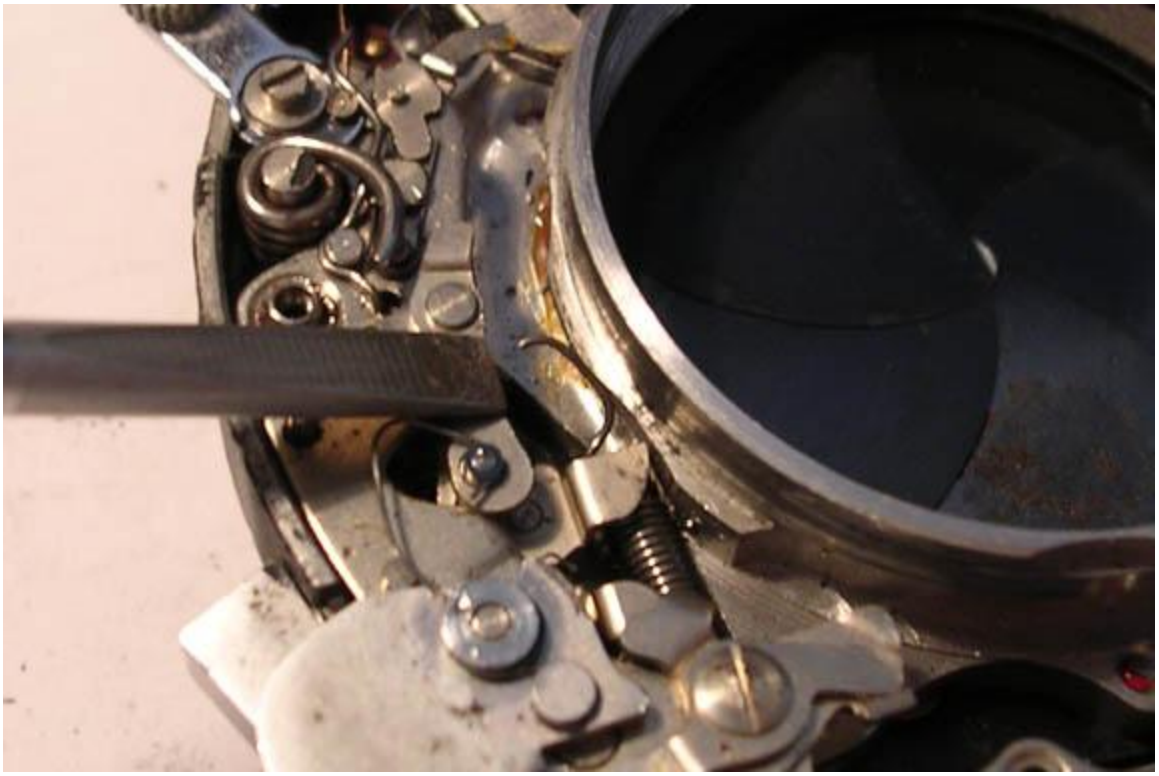
<u>NOTICE</u> - Safety glasses are a must in any machine shop, at all times.

This is never more true than when working with spring wire. Wear safety glasses!

Now, on to the fun stuff.

I make my daily bread working on old cameras. Stuff that was made before anyone ever thought of taking film out of cameras and replacing it with a computer. Most of my work involves purely mechanical cameras, made even before cameras needed batteries, much less chips and memory cards.

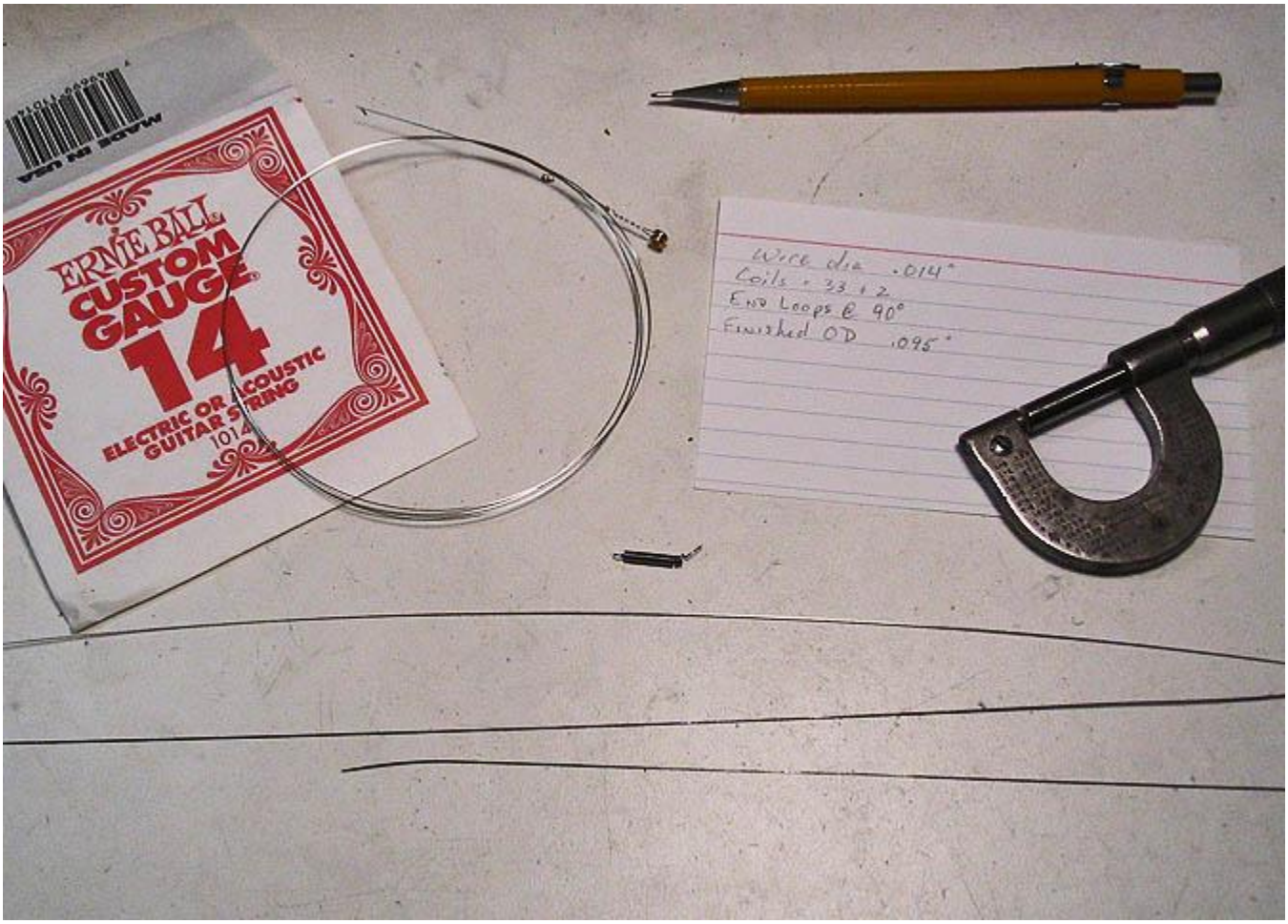
One of my typical jobs is repairing shutters, which involves taking them to pieces, like the one in the picture above.



This particular unit is a German made Synchro Compur, and this type was last made about 45 years ago.

The screwdriver is pointing to the end of the broken mainspring. I'll bet lots of repair shops, of any type, rely on a fair percentage of problems caused by someone just not listening to their bit of machinery, whether it's a camera or a car, or whatever. Something else was originally wrong with this shutter that wouldn't let the last operator cock it, so they forced it.

So, on to what this is really about. A quick demo on making small springs.



With the spring out of the shutter, it can be measured for a number of need-to-know things. Mainly, the wire diameter, the coil diameter, how many coils, and whatever other notes may be useful, like the direction of any hooks or eyes/loops needed on the ends of the spring.

The original spring is shown in the center of the picture, above. The wire size on this spring is .014" diameter. There are a couple of sources of wire suitable for this type of spring, shown here. One is guitar strings, which are really just tarted up music wire. The other is regular music wire that is sold as just that, or sometimes called spring wire. It's all music wire, as far as I know.

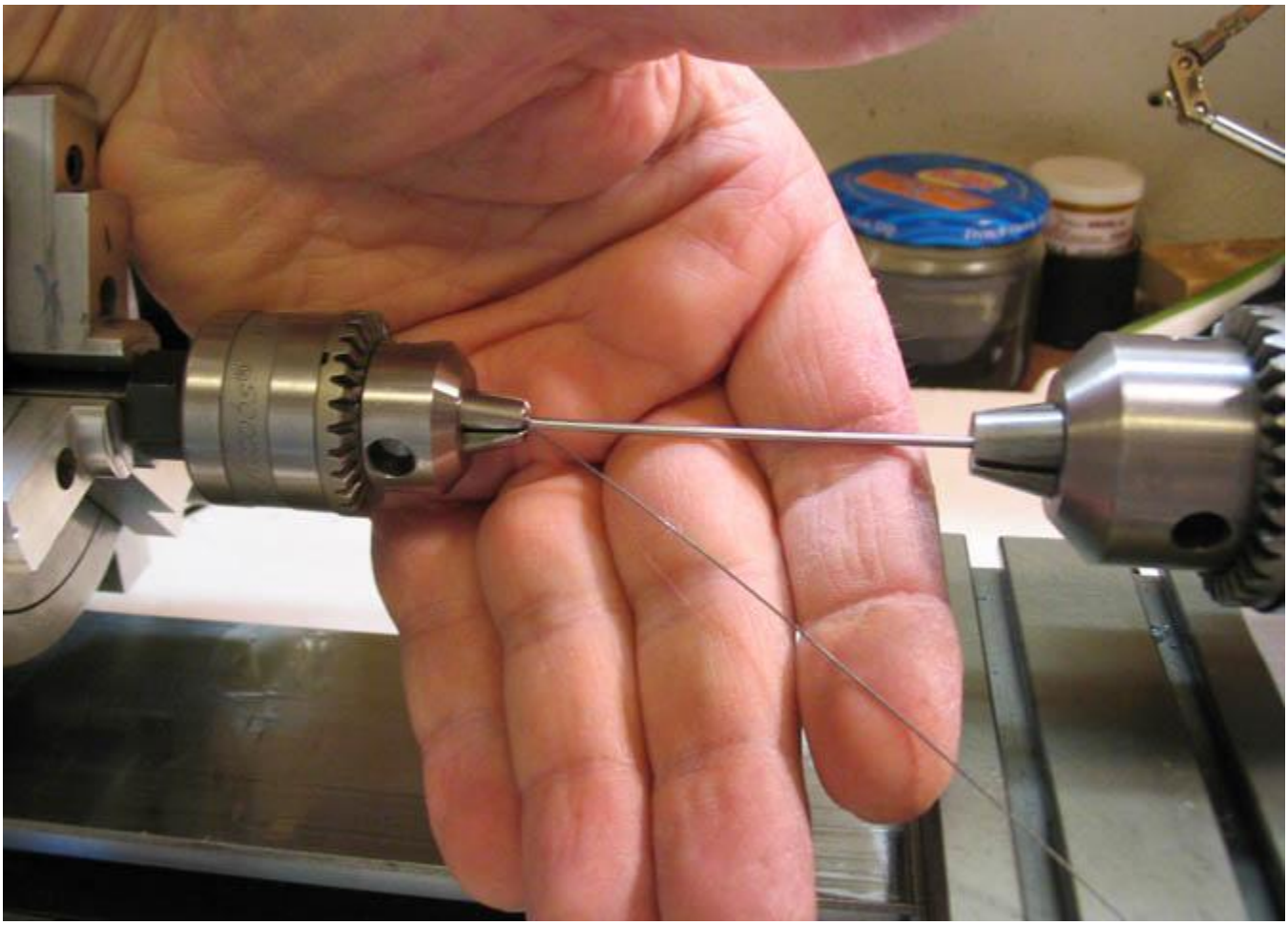
Guitar strings are really easy to get in almost any town. They're very good for small springs of almost any type, but they only come in a limited size range. If you want a quick assortment of small spring wire, go buy every different sized solid steel

guitar strings you can find, and you'll have a good start.

Wire that is sold as music wire is basically the same stuff, but it doesn't usually come polished like guitar strings. (You don't need polished wire, unless that's what you want for appearances.) Regular music wire is usually black, and you can get it at hobby stores that sell supplies for RC airplanes and the like.

The two wire sizes I had on hand were both slightly different sizes than the original spring.

One was almost .015", one about .0135". I'll make a few spring blanks in both sizes. I always make extras for a particular job, in case "someone" goofs.



This is the basic setup I use for making SMALL springs. This way only works well with small wire sizes, up to about .025". Larger wire sizes absolutely must be done using a winding jig, for your own safety.

The first consideration here is the size of the arbor that will be used to form the spring coil diameter. I do it the simplest way I know how, which is to check the inside of the broken spring using different sizes of wire. When I find the wire that fits, I use that size to judge what I think will work. The spring wire usually has to be wound smaller than the size spring you actually need, because as soon as it's done being wound, it springs open a little bit.

For an example of what I mean, the nearest sized wire I had that fit close inside the broken spring was .062" dia. If I wind the new spring on that size arbor, the new spring might be too big in dia. So, I used the next size smaller wire I had as an arbor, which was .055" dia. I did make a couple using an .062" arbor too, because of a peculiar thing that happens to the wire that will be noted a little farther down in this post.

In the picture above, the winding arbor has been mounted in the chuck on the left, with one of the chuck jaws pinching on the spring wire. The chuck on the right is not tight on the wire. Just closed down enough to keep the arbor from bending when the spring is wound, but still loose enough that the arbor can spin freely.

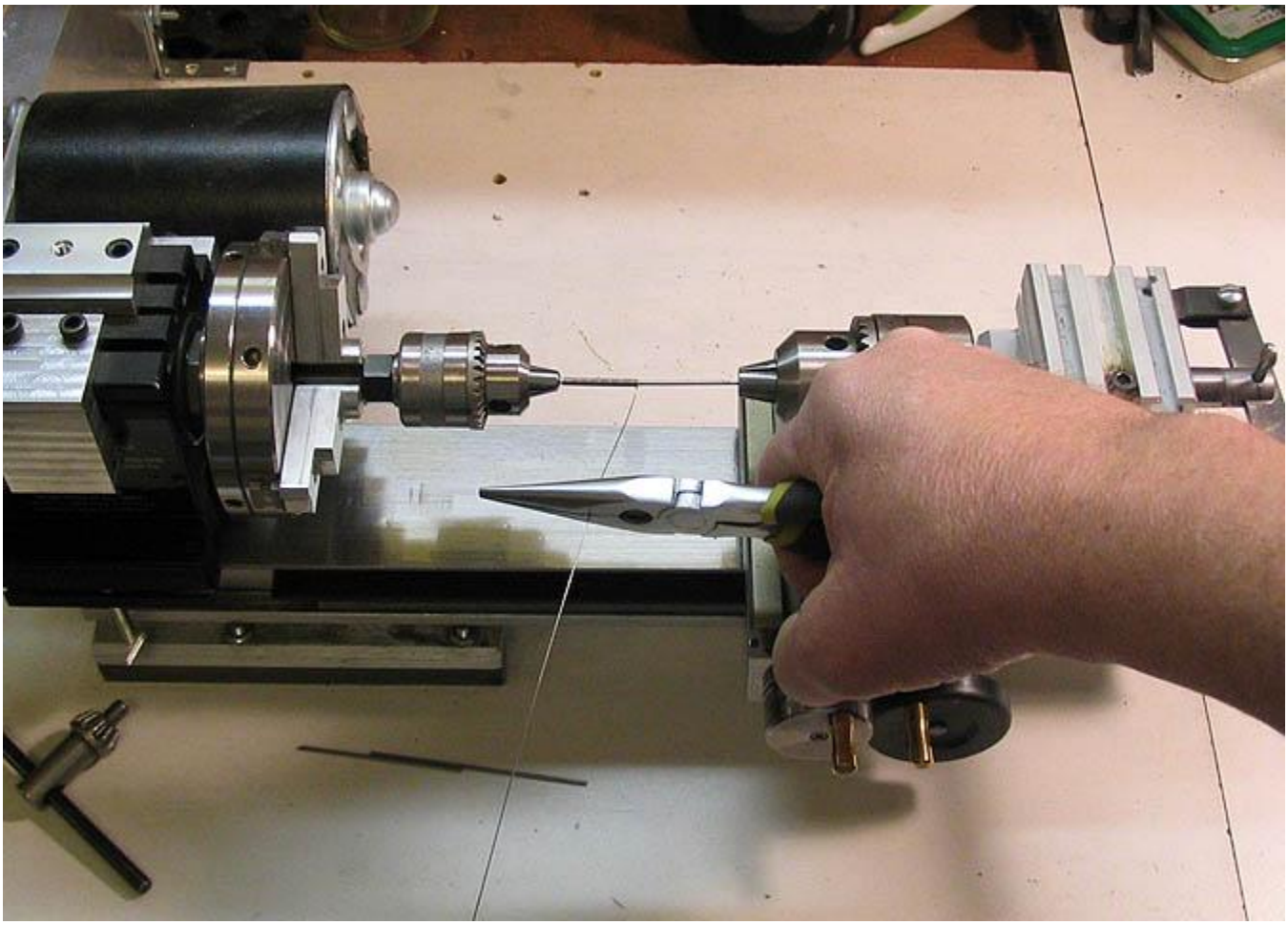
Some safety things that have to be said;

Safety glasses! Tiny wire will go right into your eyeball, just like a needle.

Gloves are okay as long as you are not using the power on your lathe.

Start with a piece of wire that will be enough to make your spring, of course, but don't have wire hanging out and drooping down to the floor, (unless you need that long of a spring). Keep it short as is practical.

Don't let go of the wire when winding until you have let it relax. The small wire size being used here won't break anything if you should turn it loose, but it's not good practice, and if you were to do it with larger wire, it will scare you at the best, scar you at the worst.



The piece of wire is now gripped tightly with pliers, and the headstock pulley on the lathe is turned by hand to form the coils. Unplug the lathe, turn it by hand, when using this method.

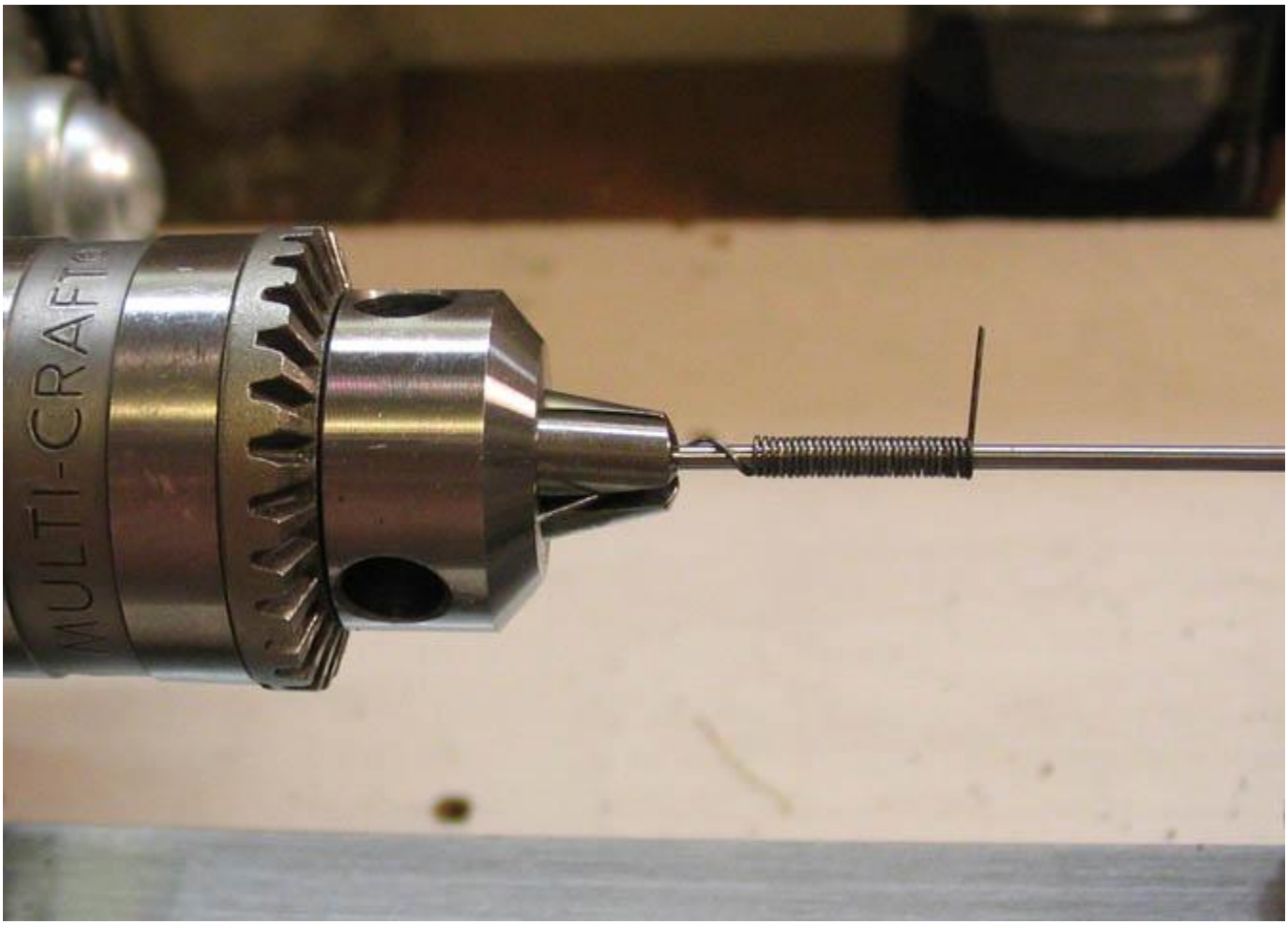
As soon as a coil or two are formed, the wire is moved to the left, as shown in the picture above.

This keeps the coils tight against each other. At the same time this is being done, pressure is kept on the wire, pulling it back toward the operator. You have to pull pretty hard, and keep an eye on the coils to make sure they are staying tight against each other.

When the coils are long enough to make the length of spring you need, give it a few more turns, then, slowly turn the arbor backward until all the tension on the new spring is released. It will relax a little and open up slightly. You must not just let go of the wire when the spring is as long as you need it. If you do, the wire will be pulled back toward the chuck, and make a rats nest, not to mention flailing around a bit when it does so.

I want to mention again here, you can only make springs that use small diameter wire with this method. And again, .025" wire is about the max. Anything larger than that needs a winding fixture. Serious!

I have a small setup for winding springs that use larger wire. I'll show that in Part 2.



When the spring is long enough for your needs, let it relax slowly, and cut off the tail. Then you can take it out of the lathe and off the arbor.

I made five blanks for this job. Ideally, I'll only need one, but since the next step takes a while, and I don't want to repeat it if I should mess up when bending the eyes, I make extras. I've been making springs like this for ten years or so, and have learned it's easier just to make a few more than you need than to start the whole process over.

You can see a couple there that have a loose coil. That's the reason those two are longer than the rest. I just made them a little longer when I saw the bad coil, and I can cut the bad part off later and still have a usable spring.

This next bit, including the following few pictures show the method I use to heat the springs. They have to be stress relieved after the winding process, or they won't hold their shape well. If you don't do this step, the springs won't be as springy as they should be, and can easily be stretched out of shape.

I make a nest for them using steel wool and foil. Put the springs on one half of the steel wool.

Fold the steel wool over to make a sandwich.

Fold the foil lightly around the wool to make a loose packet.

Pop it in the oven. This little toaster oven does a good job on music wire. I put it on its highest setting, which is 450f, and leave them for an hour, then turn off the oven and let it cool naturally.

It takes about an hour and a half, and that's why I make extra springs. The five springs took me about 10 minutes to make, but 1 1/2 hours to cook and cool. If I only made one spring, and messed it up after cooking, I'd have to start all over again.

There is another way to do the heating thing. You can use a small can, like a tuna can, fill it half full of brass shavings, put the springs in, and fill it the rest of the way with shavings. It does the same thing. I find the steel wool way more convenient.

This is what you want to see when you open the packet. The steel wool should be somewhat blue from the heat treatment. The springs that were shiny to begin with will be slightly off color. The springs that were black will still be black.

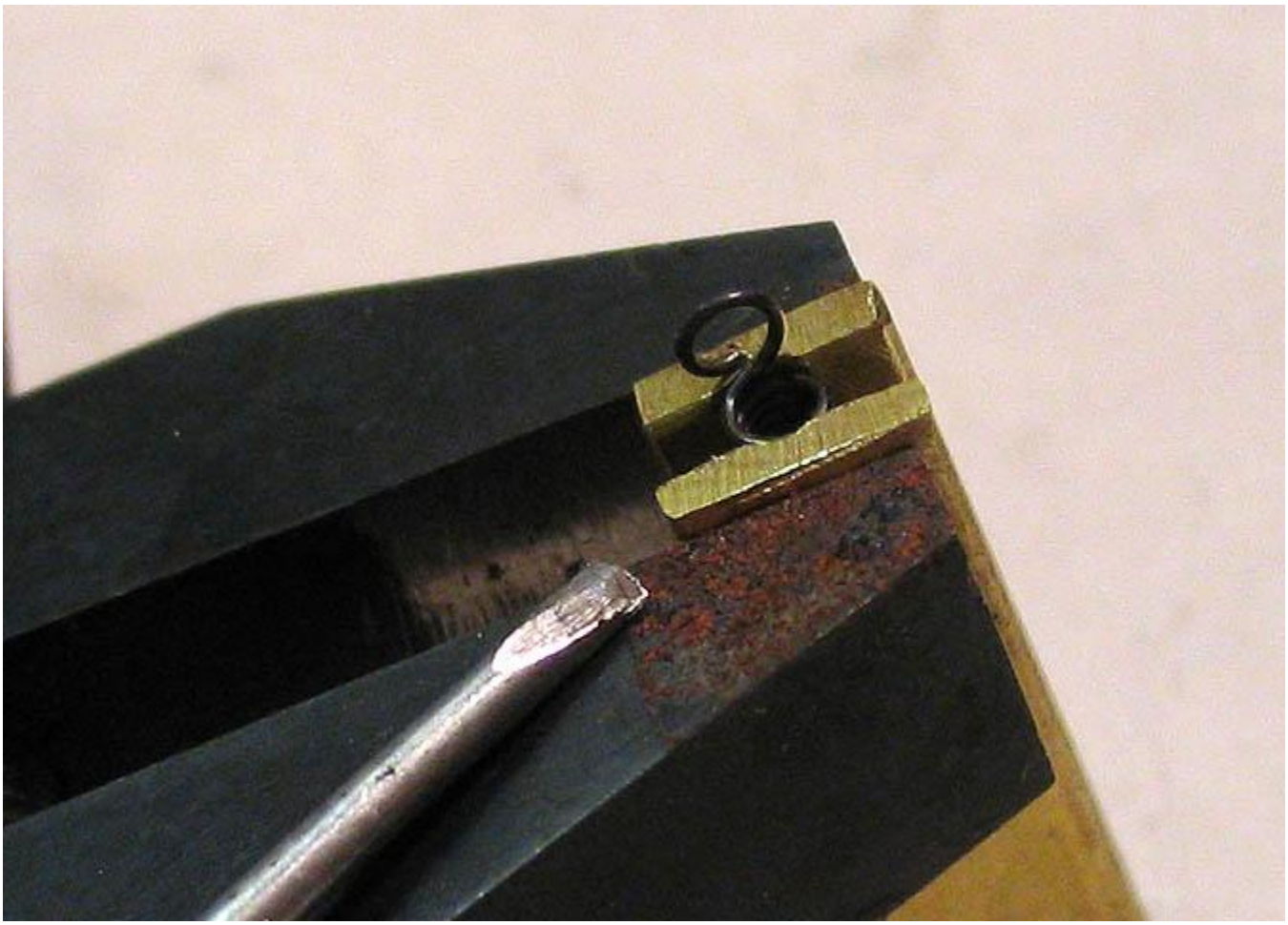
Here's where the peculiar thing I mentioned earlier comes into play when sizing the arbor for winding the spring. When you heat this stuff to stress relieve it, it gets a little smaller. The diameter changes just a touch. So, if you need a spring that has to be an exact diameter across the coils, you'll have to experiment a little with the arbors you use to wind them. If someone had asked me before I had ever done this, I would have thought they would get larger. But, they shrink.

Something you married folks should probably know before you do this step in the house. Steel wool has a tiny trace of oil on it, to keep it from turning to a ball of rust between the time you buy it and the time you get around to using it. That little bit of oil does make a slight odor when you cook it. My dog doesn't care about that odor, or, if she does, she doesn't mention it. A spouse may not feel the same way.

Here's one of the heat treated springs, ready for the final sizing and pulling out the eyes.

The two brass pieces are for holding the spring. They each have a small round bottomed channel filed in them so they won't rock around on the spring once it is positioned between them. I've made a lot of this size spring over the years. You can see some grooves that look similar to threads have started to wear into the slots where spring coils bear against them.

The little tail on one end of the spring is clipped off with flat nosed wire cutters, and it's then positioned between the blocks.



The first eye is pulled up. The spring has to be put between the blocks just so, in order for the end of the coil to end up in the correct place. You'll have to figure that out for whatever spring type you're making.

Then, using a small rod filed to the shape of a screwdriver end, it's wedged between the end coils, and levered up to bring up the eye. The clamp has to be pretty tight on the spring to do this, in order to keep the second coil in line from pulling up with the first one. Once it is pried up a little, I put a rod down the center of the spring, and pry against it a little to get the eye pointing straight out.

Here's the new spring, and the old one. In this shot, I'm just getting a sense of the position for the second eye needed on the other end. The eye pulling process is repeated.

The new spring looks somewhat fatter in this picture. It's a trick of the camera, though. The new one is within .001" dia. of the old one.

Well, that's it. The new spring is done, and by now, it's in the old shutter, ticking away.

Part 2 of this write up shows how I use the lathe for making springs with larger diameter wire, and shows making compression springs, as well as extension springs.

Making Springs on the Small Lathe

Part 2: Compression springs

This article deals with making small springs using a metal lathe. There may be other, better ways of doing it. This is how I've done things in my own home shop for years, and these methods have worked well for me.

NOTICE!

Safety glasses are a must in any machine shop, at all times. This is never more true than when working with spring wire. Wear safety glasses!

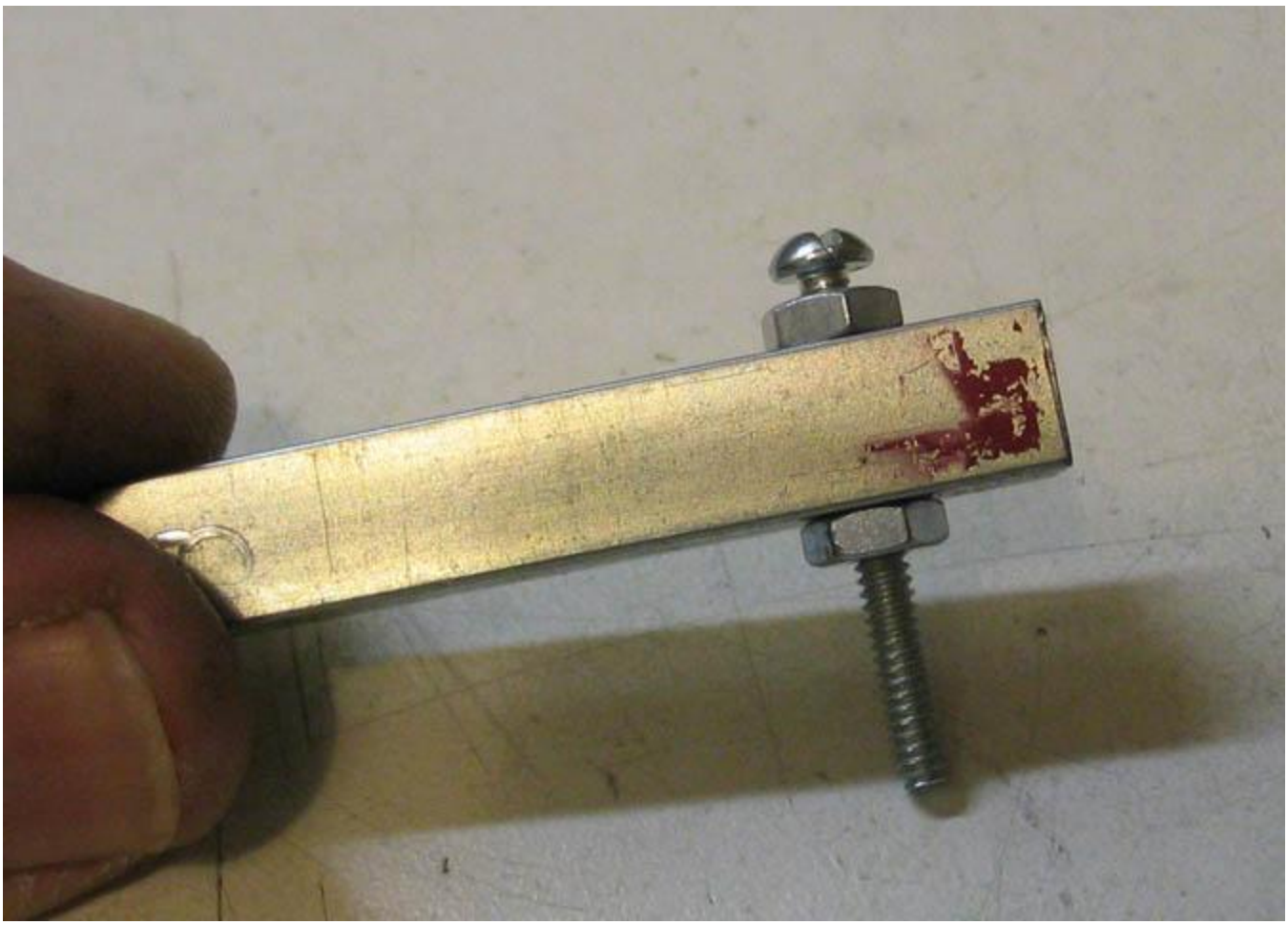
Now, on to the fun stuff.

This is part 2. The first part dealt only with making fine wire springs that you could do without any extra tooling, and it only concerned itself with small extension springs.

There is not much difference for making compression springs, except you need a way to evenly space the coils. There is something you need, though, when using wire larger than about .025", to keep things on the safe side.

All that's really needed is a little fixture similar to this one. It can be made as fancy as you like, or like the one in the picture above, very simple and basic.

Just a piece of square stock that will fit your tool post, and an adjustable screw large enough to withstand the force that will be against it when running larger wire.

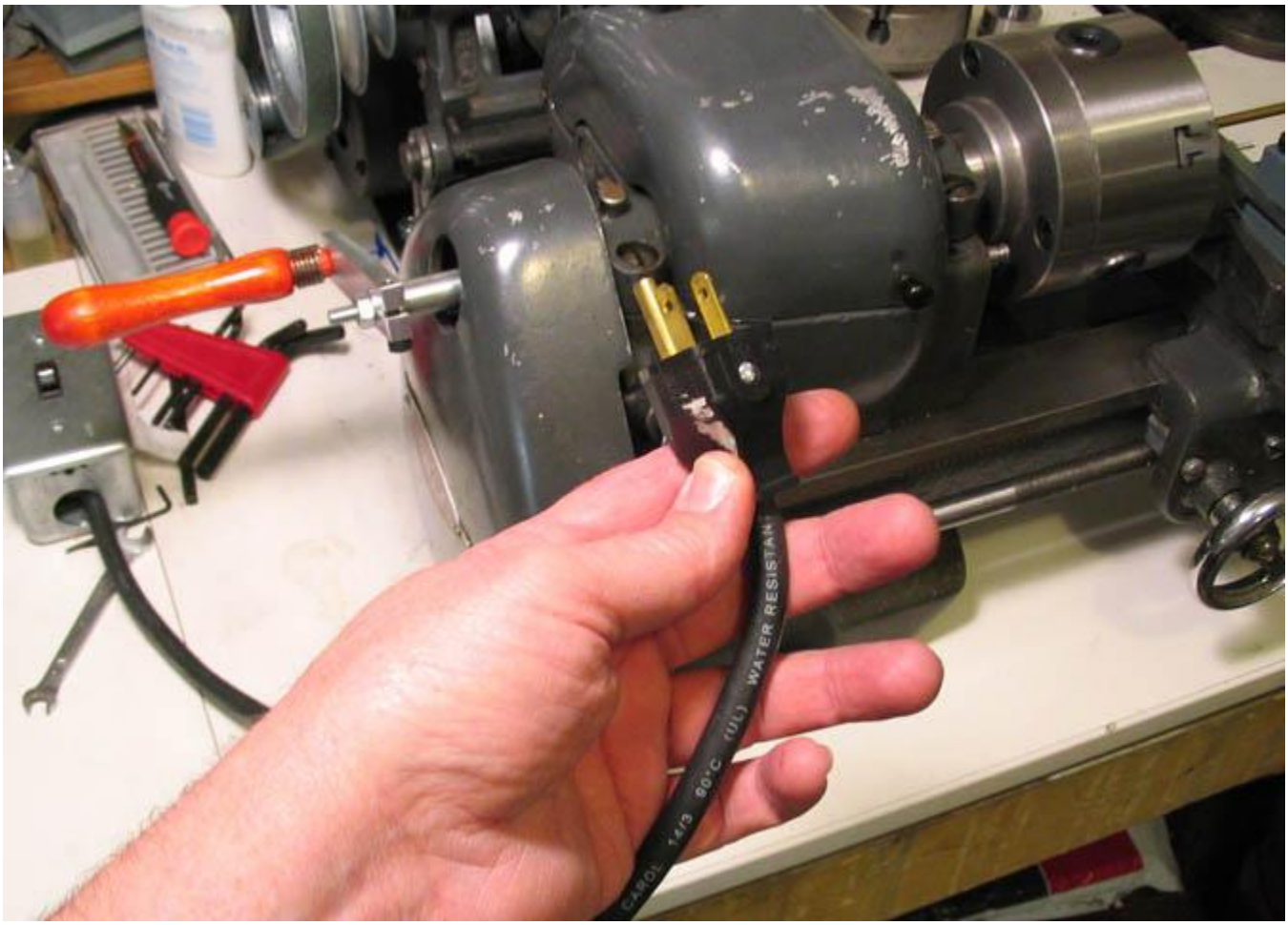


Here's a closer shot of the working end. This one will make springs using wire up to about 1/16", which would make a fairly stout spring if it was of small dimension.

There are only a couple of things to note when making this thing; The hole through it needs to position the bottom of the diameter of the screw slightly below centerline on your lathe. It's not a critical measurement. You can eyeball it.

The other thing is, the screw needs to be back a ways from the end of the square stock to allow the wire to roll up over the top of the arbor you need to form whatever spring you are making.

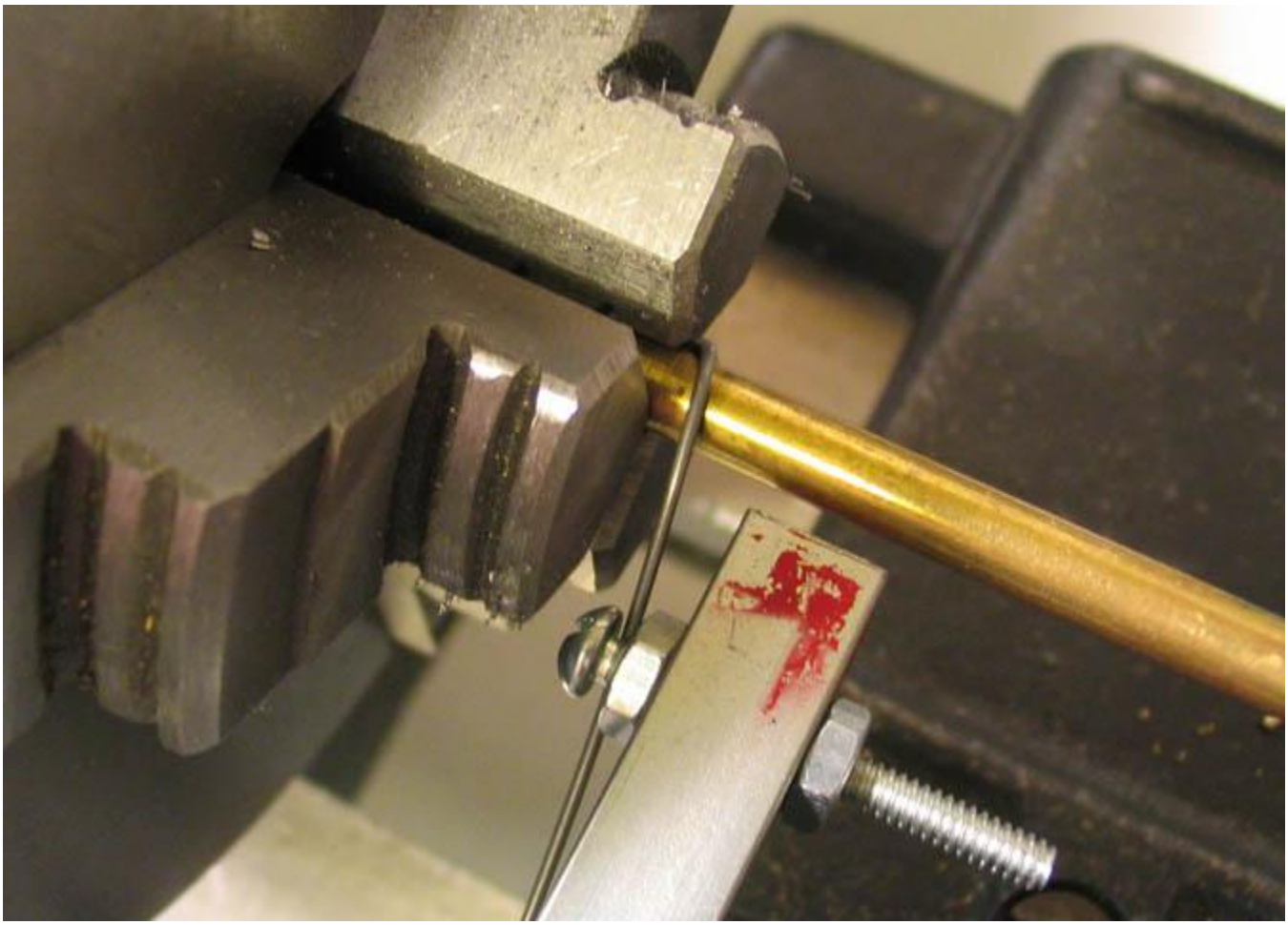
Also, not a critical measurement, since you can adjust it some simply by cranking the cross slide on your lathe in or out. I would just put the screw hole back from the front edge of the square stock about 1/2" and call it okie-dokie.



I'm going to do this using a hand crank to rotate the spindle, and I would suggest that until you have lots of practice and a good feel for it, that you do too. So, the lathe is unplugged.

I do make extension springs using the lathe power fairly often. I've done a lot of those. For compression springs, you have to watch pretty close to get the right amount of coils, and you don't need to be counting coils, thinking about when you need to turn off the lathe, and worrying about the tail end of your spring wire getting loose and whipping you like a bad dog all at one time.

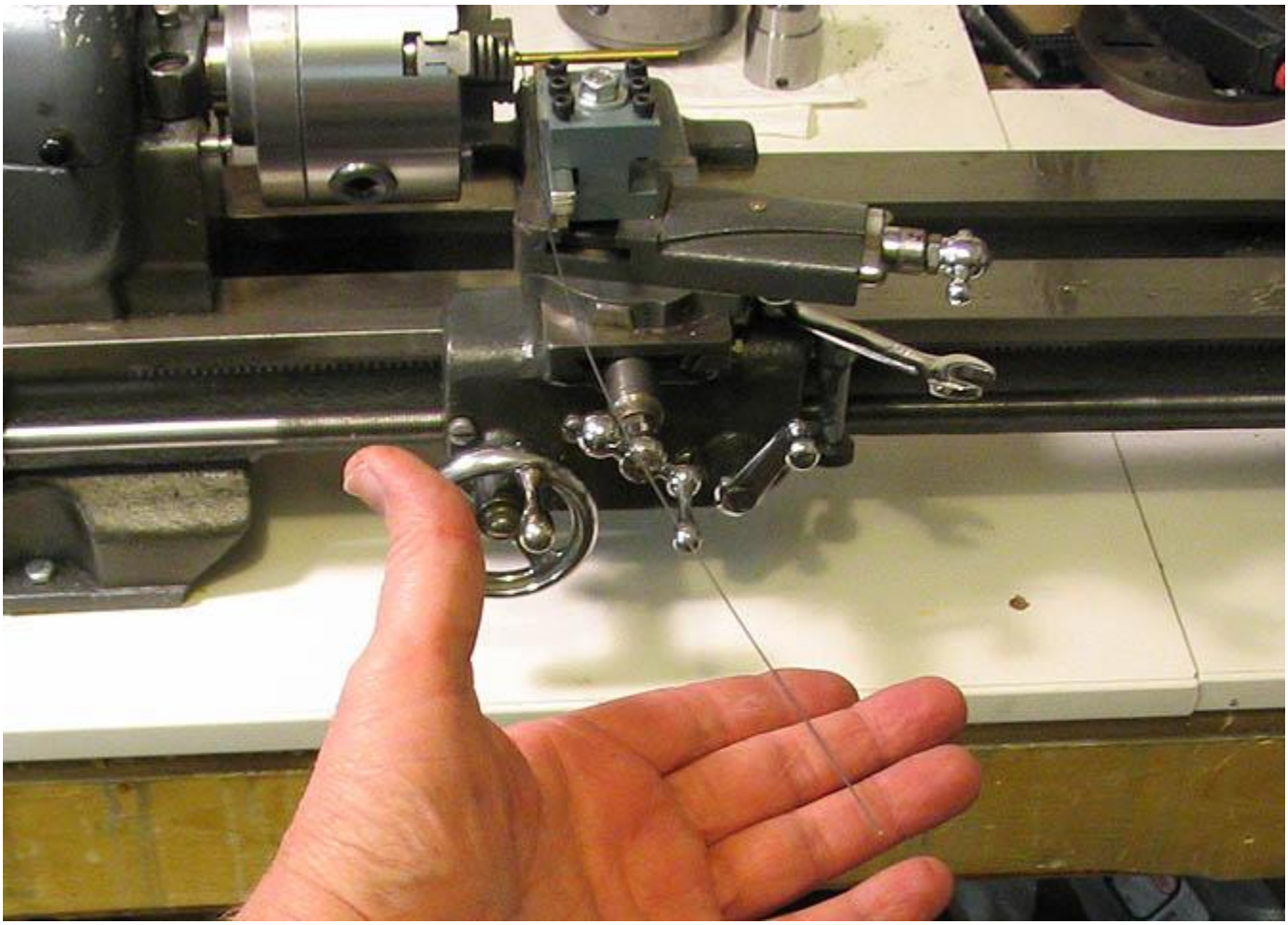
So do it without power.



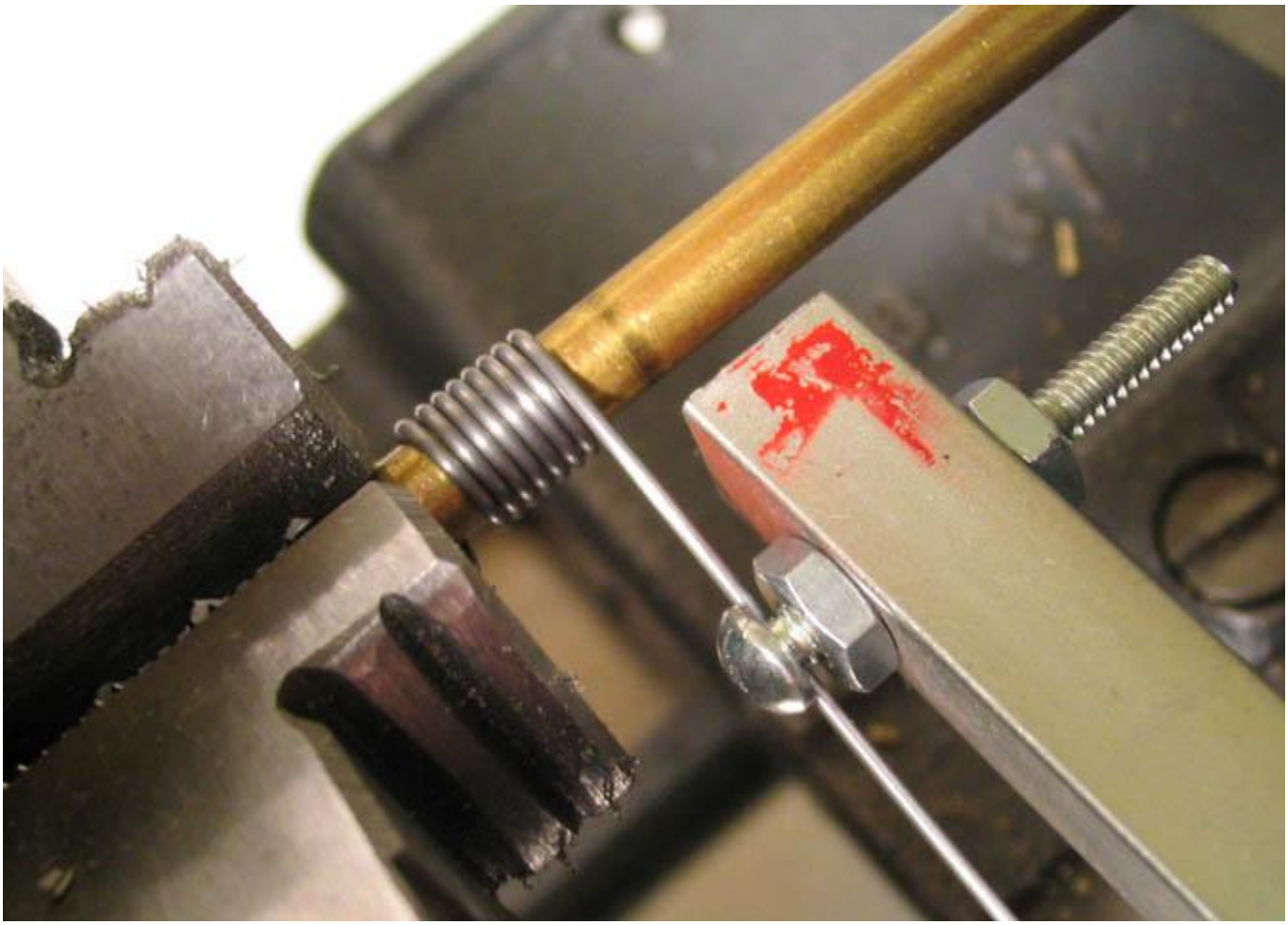
This piece of wire that I'll start with is .032" diameter regular music wire. It's quite light, but still, at this diameter it's stiff enough that you would really have to tug on it to get a good coil if you were using pliers to hold it. So it is done with the tool post jig, which makes it quite easy.

I'll just show a regular close coil spring for this first few shots, so you can see how the tool post thing works. The wire is trapped in the chuck same as I did for the thinner wire in the first part of this write up.

The wire is then put under the screw on the tool, and allowed to trail out past the top of the cross slide.



Here, you can see how the wire hangs off the end of the cross slide. Have a care about it as it sets there. It's small wire, and you can lose it in the background and forget it's there as you are making the spring. Don't put your face in that area.

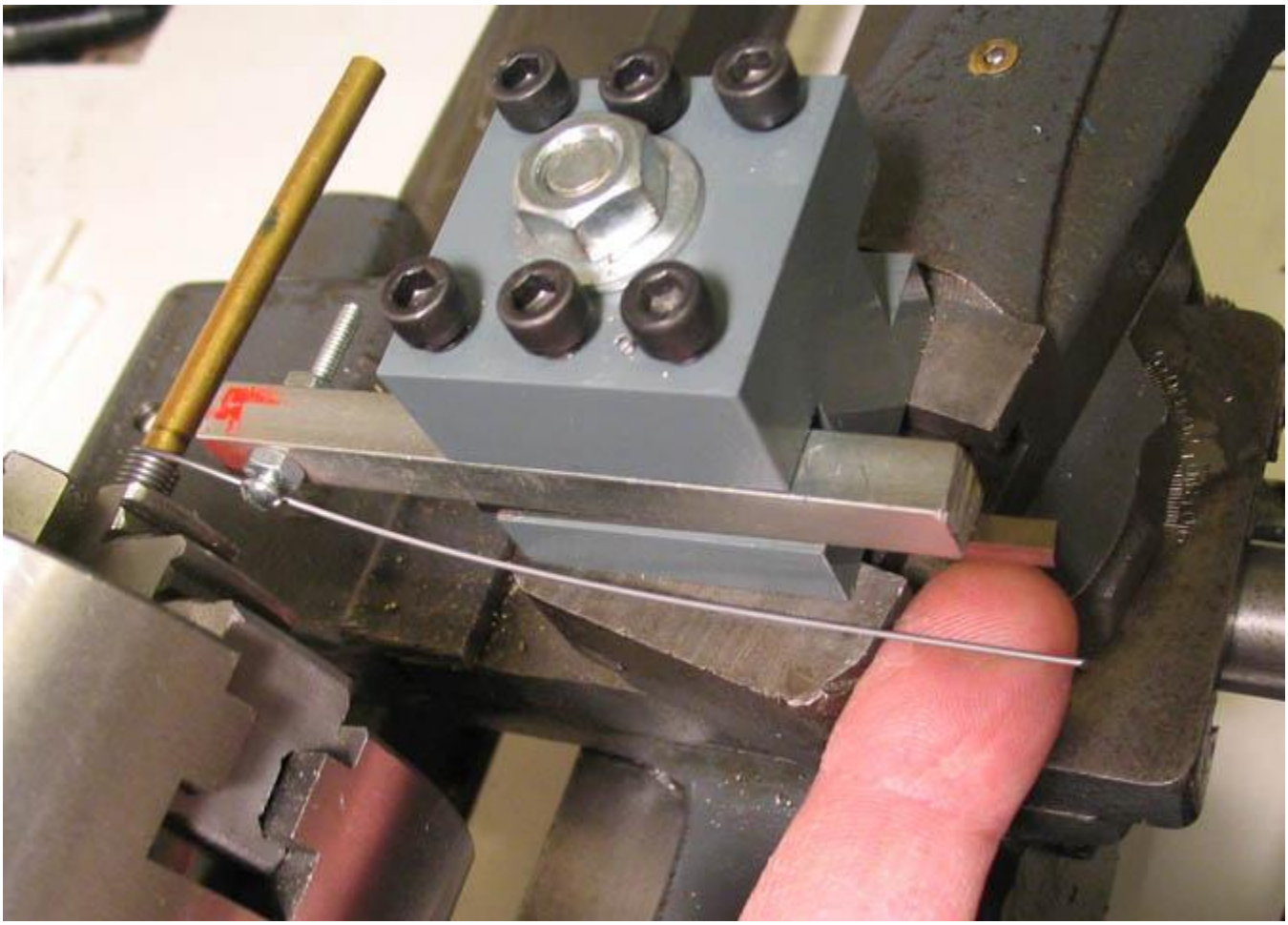


The lathe spindle is cranked backward and the coils form over the top of the arbor. The screw on the tool keeps the wire in line, and prevents it from flipping over the top of the arbor.

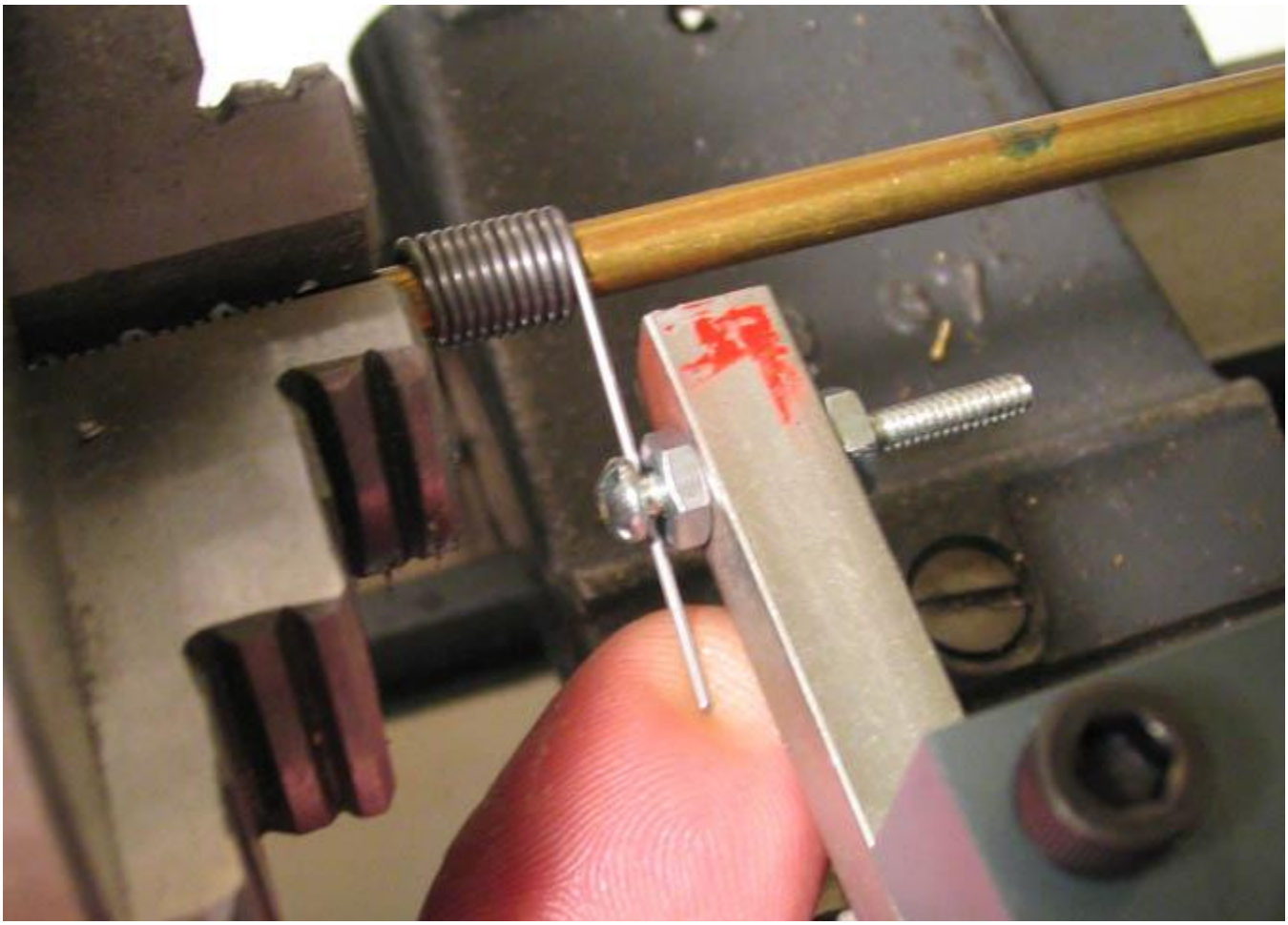
As you crank the lathe spindle, watch the coils form, and advance the carriage (toward the tailstock) slowly, keeping the head of the screw roughly lined up where the previous coil has been formed.

You want it to move so the coils are just about to roll up over the top of its neighbor, but not quite.

It might seem finicky to do it this way, but it works very well, and you'll soon find that you can crank the lathe and the carriage in a way that will produce a bunch of well formed coils in short order.



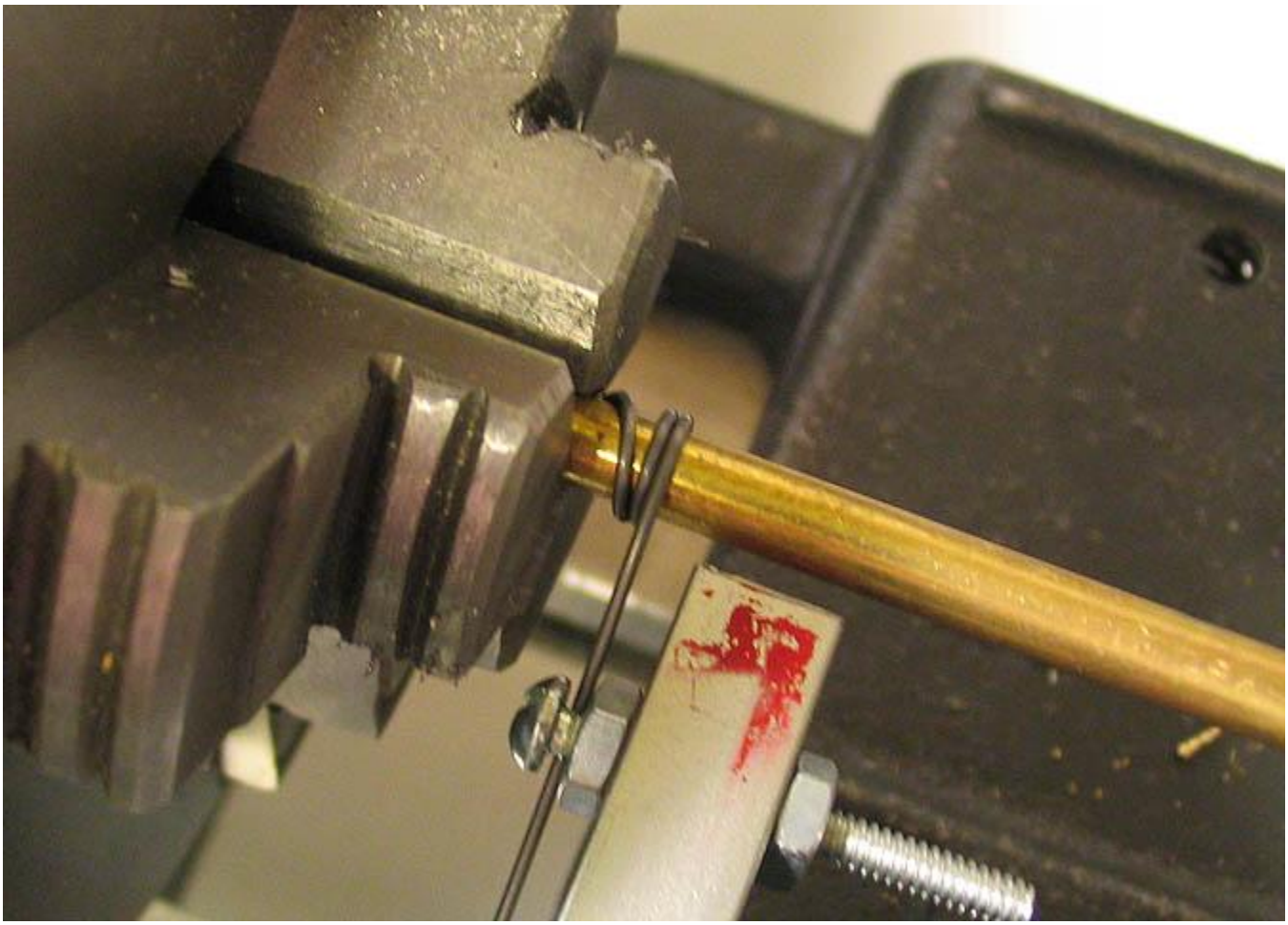
You can see here how the wire pulls up over the top of the cross slide.
The screw/tool will keep it in line. Just mind the end of the wire.



This is where you need to stop. Don't let the end of the wire get past the screw or it may "pop" and make you jump. If it's fairly large wire, like 3/32", it can do damage.

Keep your mind on your business, here.

When you have your spring as long as you want, or when you run out of wire, release the tension on the spring by unwinding until it relaxes, and you can take it out.



For compression springs, you need an even spacing between the coils. This can be done by eye, using a ruler to judge the distance between the coils, but it's not terribly precise, and if you don't use a precision way of winding the coils, you cannot count on making two compression springs that are the same strength.

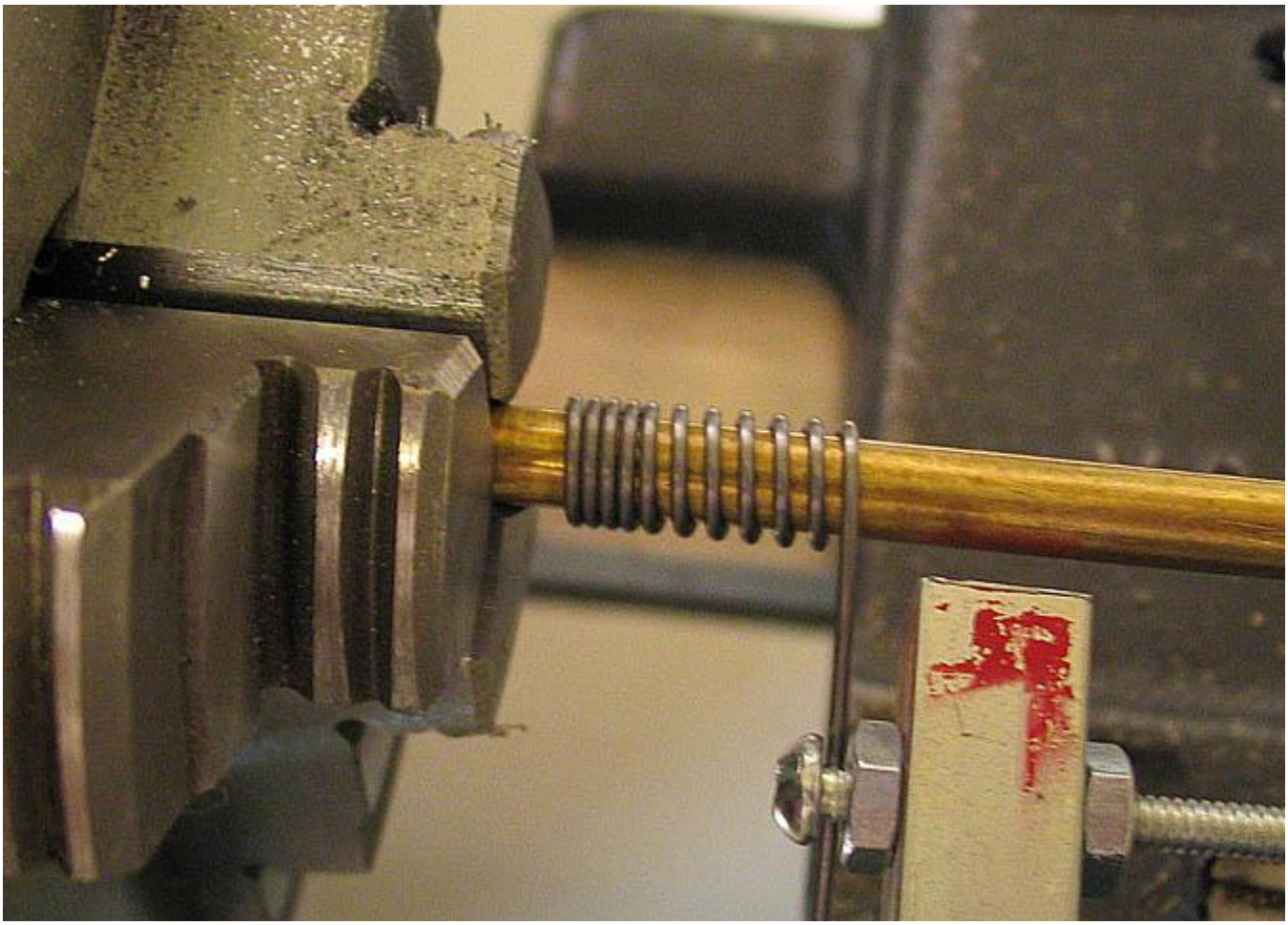
A better way is to let the lathe space it for you by setting up the threading gears and running the ratio through the lead screw, just like if you were threading a rod.

Everything shown up to this point can be done on a plain turning lathe, (a lathe that doesn't cut screw threads). I use a Taig lathe for winding springs all the time, but I use it mainly when I make extension springs. For the next steps I'll be using a small Atlas screw cutting lathe.

To start, set the change gears to what you need. An easy example would be if you needed a spring with 16 coils and an inch long. Set the lathe to cut 16 threads, and you're ready to get started.

Begin the spring just as if you were making a extension spring. Leave the lathe half-nut disengaged, and wind on a few coils. Doesn't matter how many, really, as long as you give yourself two or three close coils at the beginning and end of the compression spring.

In the shot above, I've wound a couple of close coils, and will now engage the lathe half-nut to make the compression coils.



Just as with threading, the lathe spaces the coils nice as can be.

When you have enough compression coils to make your spring, disengage the half-nut, and put on two or three close coils at the end, just like at the beginning.

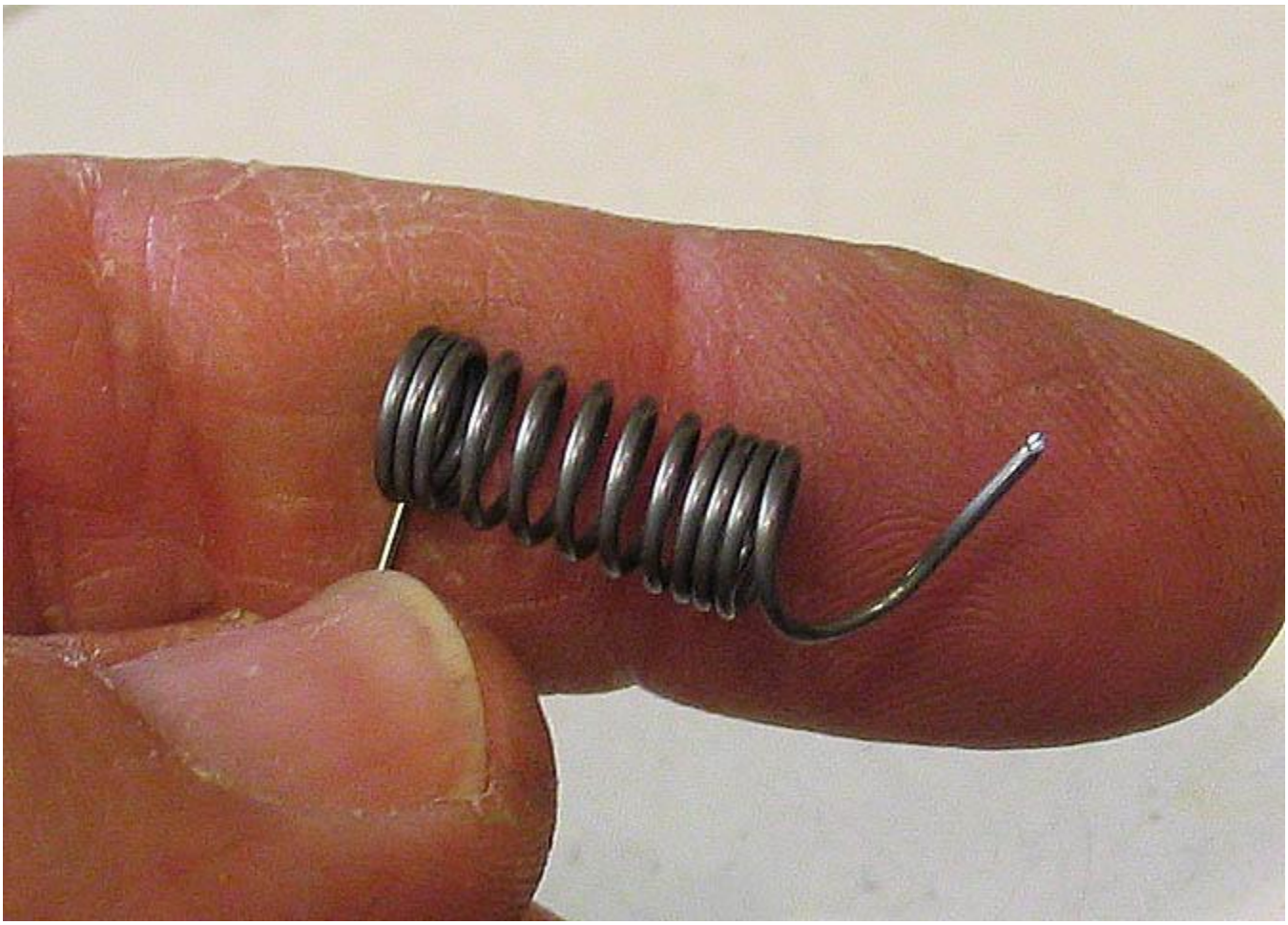
You have to do a little figuring to get the length right, but it's not a big chore. Start with the length you want, and subtract 2x the wire diameter. What is left is the length that can be filled with compression coils. The coil on each end has to be there, but it doesn't do any work. It's basically a flat ring. What you can fit between the end coils is the length that does the work, (but it's not the overall length).

When you have that length figured, you can decide how many coils will fit for a given pitch, or, what pitch you want for the wire size you need. Then set your lathe to thread that pitch for your given distance.

I hope that makes sense! Explaining stuff like that isn't my high point.

Now, you probably won't get the exact length you want the first time. The back lash in the lathe comes into play a little, and judging the exact point at which your first compression coil starts is left up to your eye. It will help a little if, before you engage the half-nut, you reach into the gear box and take out the back lash on the gear-train. (Remember, your lathe is not plugged in, right?)

Enough of that, then.



The compression spring will look something like this when you take it off the arbor.

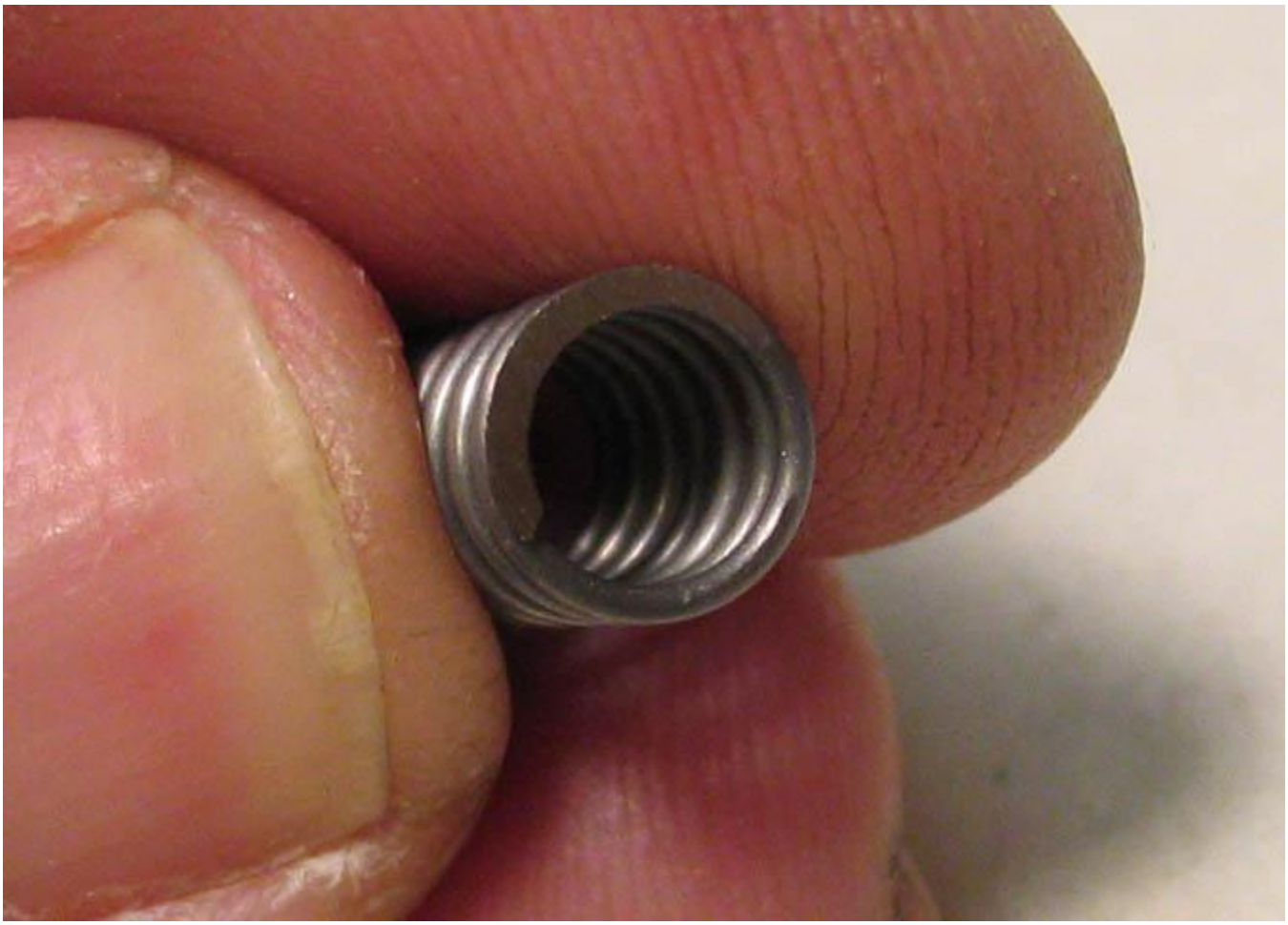
Look at it closely, and determine where the last compression coil on each end meets the first tight coil, leave a little extra on the flat coil side, and snip the extra coils off.

When you have them snipped off, should look something like this.

I've actually cut just a little bit too much. Would have been better if I had left another 1/8" on the tail, here, but it's okay for this demo.

Now, before you cook the spring, just like in the other write up, take the spring to your grinder, or break out your Dremel tool, and flatten the ends. It only takes a little touch on the grinding wheel to do it for a spring this size.

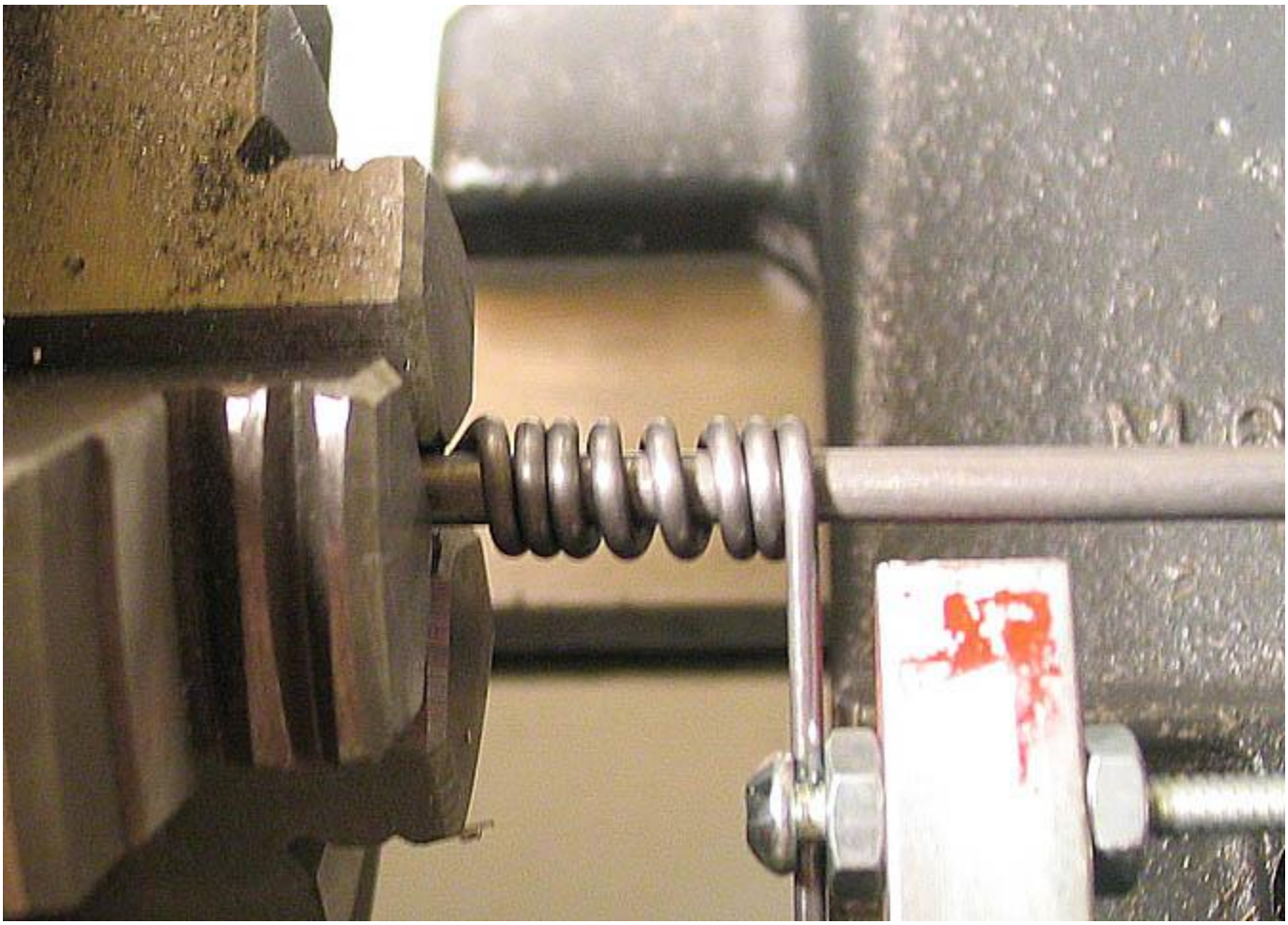
See the next pic.



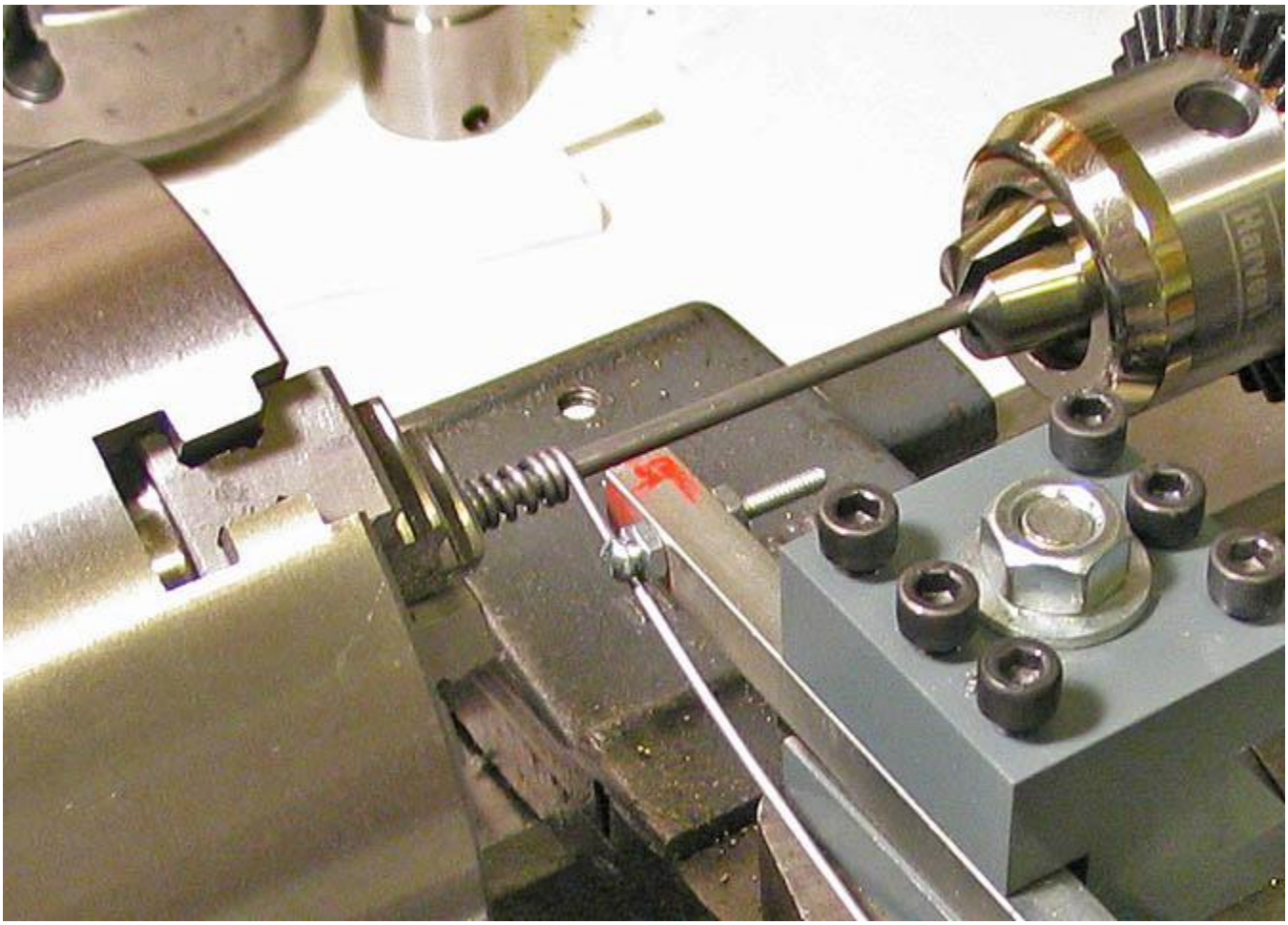
You can see how it came out, here. The last coil now has a flat end. If I'd left a little more of that coil, like I said to do, the flat would go almost 3/4 of the way around the end of the spring.

As it is, though, the spring sits nice and flat. It just needs to be stress relieved as explained previously, and it will be ready to go.

Note in the shot above that the very end of the top coil is a little blue. Take care not to do that. That was just about one second on the grinding wheel. One second too long.



One last shot, of some fairly heavy wire being coiled for a very short compression spring. The wire diameter is .055", which may not sound like much, but it's very stiff. This spring will take probably 20-25 lb.



Okay, another last shot of that heavier wire, mainly to show the tailstock chuck being used to support the arbor. For larger music wire, especially, (and this is fairly large wire in my shop) the arbor must be supported. The wire being coiled here would bend the arbor on the first rotation if it wasn't.

For what it's worth, and I mentioned this in the other spring making post, I'm not an expert. This stuff I'm showing works well for me. Simple as that. Don't forget, safety glasses, especially when working around wire! And, keep an eye on your wire end, (not the other way around!).