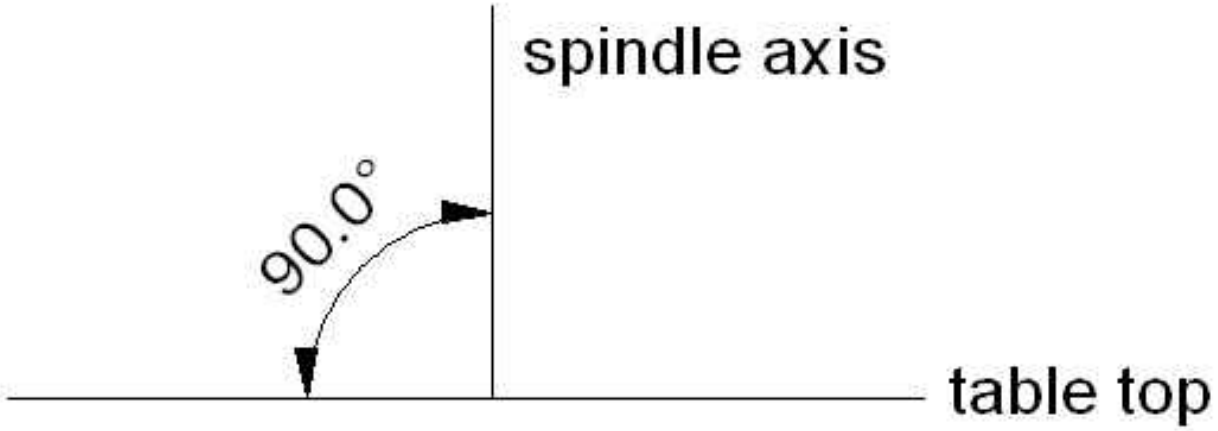
Thoughts about Tramming the Head of a Mill/Drill, Version 2

by R. G. Sparber

5/15/2009

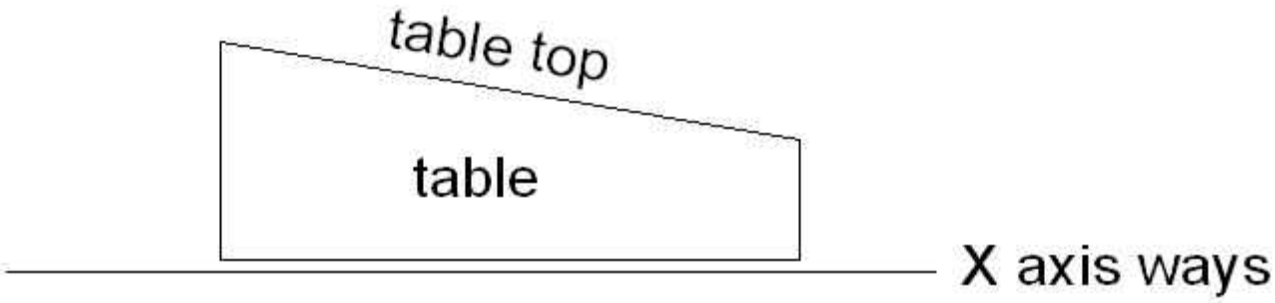
I have trammed the head on my RF30 mill/drill many times. Using the conventional wisdom, I have swung a Dial Test Indicator around on the spindle and adjusted the column support until the reading did not change. Today I gave it a second thought.

First, let me define what I mean by having my mill head trammed true. Most of the discussion will be addressing a single horizontal axis plus the Z axis since little is added by trying to deal with three axes at the same time.



Assuming that the table top is flat, conventional thinking has it that the head is true when the spindle, or Z, axis, is perpendicular to the table top.

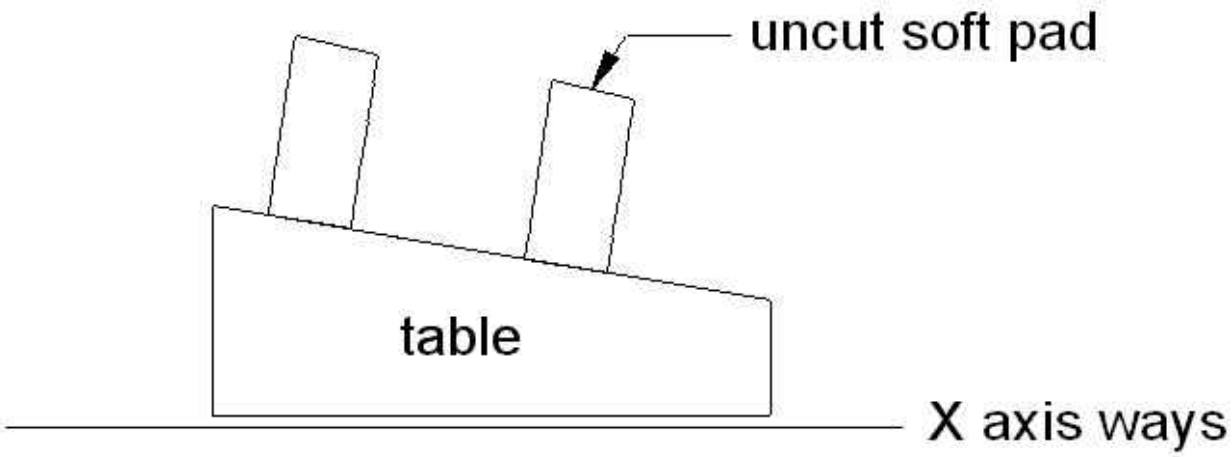
Well, at least on my mill/drill, I would not make this assumption nor is it really necessary.



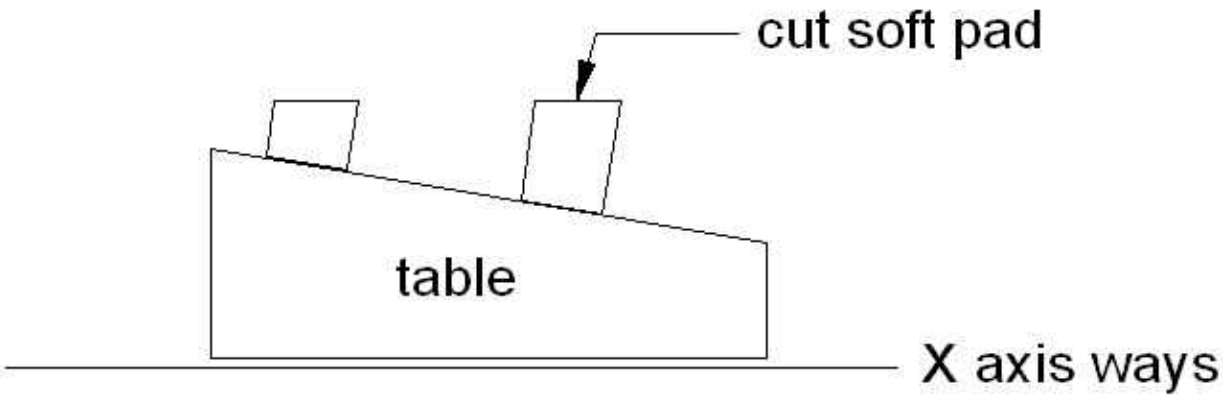
Let me assume that the X axis ways is, in fact, flat but that my table top is not parallel to the ways.

I maintain that we should be tramming the head to the ways and not to the table top.

Consider the effect of having soft pads on the table top.

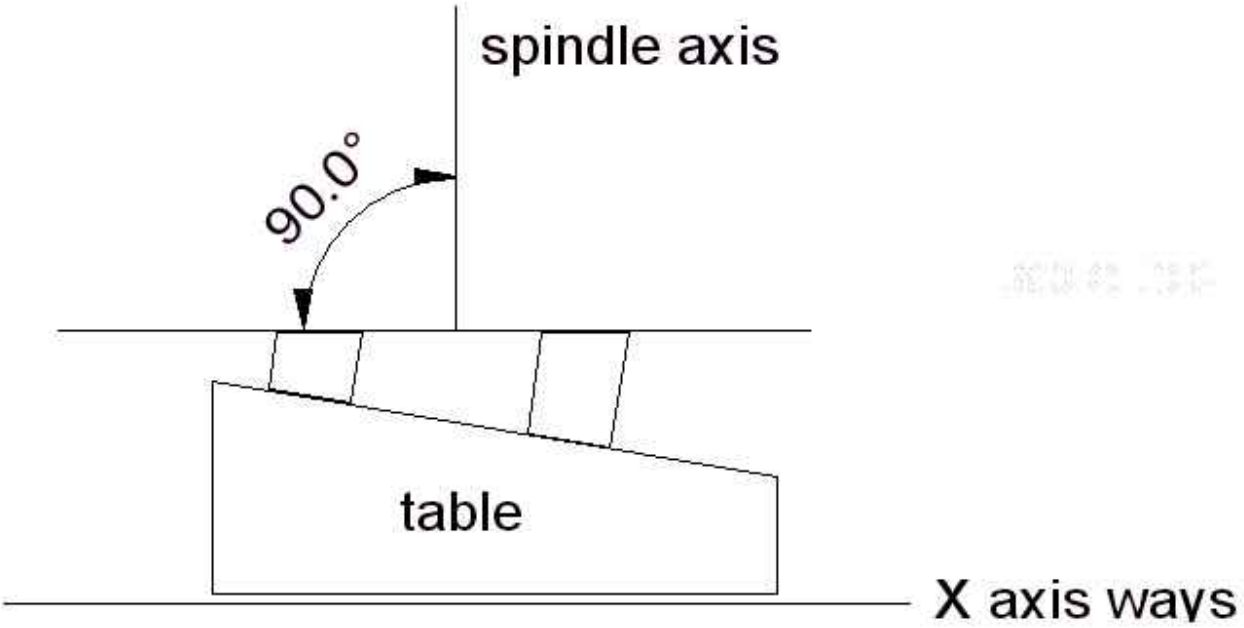


I have solidly attached block of sacrificial metal, usually aluminum, to the table top.



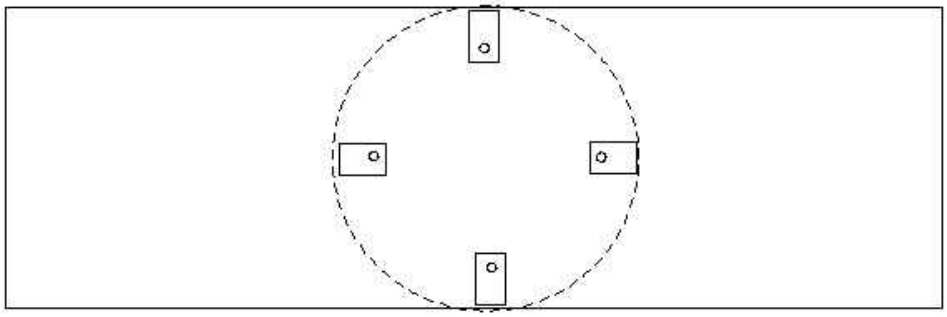
I then mill the tops flat. Even if the head is not trammed, I can get the tops of these pads arbitrarily flat by making each pass over the surface close to the last one. In the above example, we are only dealing in two dimensions so a single pass is sufficient. I now have the top face of each soft pad parallel to the X axis ways.

If I now tram the head by referencing these pads, I will have my spindle axis perpendicular to the X axis.



Now, it seems to me this is a better reference.

In practice, I would place soft pads as shown below. Each pad is bolted down using the nearest T slot.

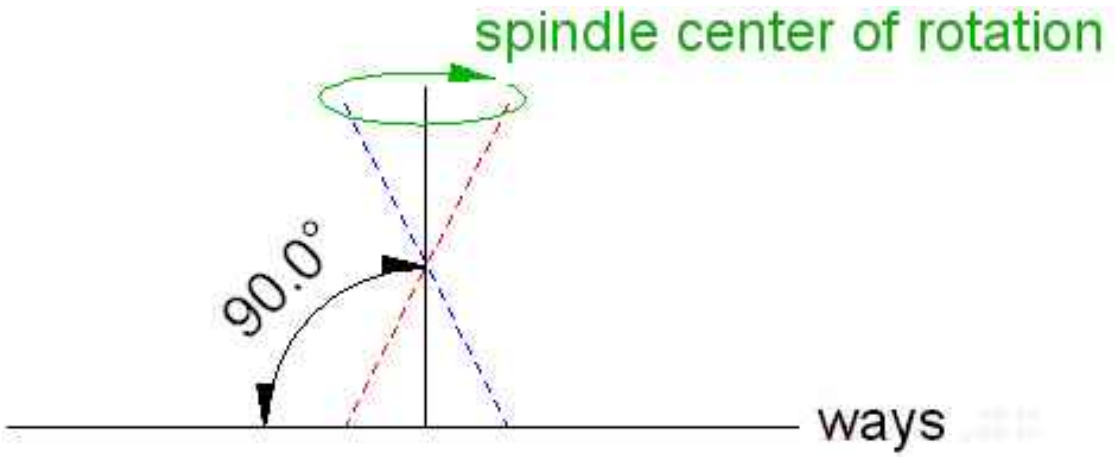


After taking a light cut over the top face of each pad[1], I would place a dot with a black marker to define the exact location of my reference point. The dot would be as close to the dashed line circle as possible. Then, with the spindle at the center of the circle, I would begin my tramming process.

I will skip the tramming process steps for now, but assuming that I now have my Z axis perpendicular to my X and Y axis, I believe the head is now in proper alignment. When doing any precision machining, I will use soft jaws or soft pads to define holding faces that are true to the ways and **not** necessarily to the surface of the table.

1 The entire top face would not be cut because I must stay away from the hold down bolt.

“Carl” from the Yahoo group Gingery_Machines points out that another source of error comes from the vertical collet holder. This can be represented by



Ideally the center of rotation would be aligned with the Z axis. Rotation should not change its relationship to the ways. If the spindle center of rotation moves as it turns, then we must have this error.

In practice, this error will always exist to some extent. If fly cutting, it will be evident by a hopefully small sweeping pattern in the surface as the cutter is fed straight down a few thou. It can be measured by taking a known straight bar and holding it in a collet. A DTI attached to the table and resting on the tip of the bar will show the Total Indicated Run-out[2]. This will tell you the TIR for that collet. By using a selection of collets, you may be able to discern collet error from spindle error.

When tramming the head, I'm not so sure this error has an effect. By sweeping the DTI around a circle on the soft pads, you will still put the average spindle center of rotation perpendicular to the ways.

So how is my reasoning?

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2 See http://rick.sparber.org/Articles/tir/tir.pdf for more details.