

Figure 1—This illustration of a steady rest (back rest) from Frank Pain's *The Practical Woodturner* also appeared in *Fine Woodworking* in the 1970's.

Sometimes the exuberance of youth combines with stubbornness to allow us to do things that any rational experienced person could tell you are impossible. If you are too dumb to know that what you are trying to do can't be done, you just do it. This happened to me in 1966 when I was 19 and home from my freshman year of college—where I spent a lot of time in the “auxiliary physics lab”, AKA the pool room. Determined to make a pool cue, I took what little experience I had at the lathe and set out on a journey that produced, by the end of the summer, about eight cues.

The shaft of a two-piece cue is 29" long. It is less than  $\frac{7}{8}$ " diameter at the big end (where the joint screws together), and the tip is  $\frac{1}{2}$ ". Now, with 45 years of woodturning experience behind me, I can tell you that a workpiece that long and thin can't be turned without a steady rest. But at the time I did not know that steady rests existed, so with a leather glove squeezing the work with my left hand, I was able to scrape away lightly with a chisel, until I had some rough form. Relying heavily on sandpaper, I was able to cover up all the problems caused by faulty tool work. This was possible only because the shape had no details whatsoever—only the long taper of the cue shaft.

## Conquer the Long and Thin Steady Rests

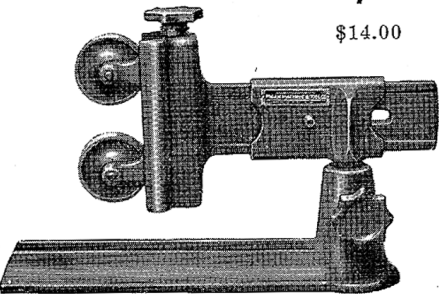


Years later, when I got serious about woodturning, I realized that complex detailed designs could only be achieved through accurate tool work producing smooth surfaces that required little sanding. To accomplish this it is necessary to control workpiece vibration. My first experiments using steady rests with metal wheels were a failure because these steady rests modeled after ones used for metal turning, failed to take into account that wood is compressible and uneven in hardness. At the time I was turning a lot of oak, and as oak is a ring-porous wood, it has hard and soft layers. As the metal wheels compressed the wood, they created a rough surface. As the wheels rolled against this surface, the steady rest was creating vibrations instead of stopping them.

Then, as with so many things, I found the answer in Frank Pain's classic work, *The Practical Woodturner*. In this book he depicts three steady rests (back rests), all made entirely of wood! The only part of the steady rest that touches the revolving workpiece is a single piece of wood with a notch in it (Figure 1). Even my first crude experiments with this type of steady were reasonably successful, and I realized that the more I used the wooden shoe that contacted the turning, the better it got over time; as it became impregnated with wax, and the surface broke-in to the curvature


Figure 2—From the 1929 catalog of *Woodworkers Tool Works* in Chicago, a company that still exists. The two steady rests depicted here are fascinating from a number of historical perspectives. The one with the two metal wheels seems to have some good design features, but as stated in the text, metal wheels are not suitable for woodturning. Note the price of \$35 in 1929. That would be the equivalent of \$400 today. The other steady has rotary selection with 18 sizes of circular contact areas on two discs. Here we have examples of faulty wood lathe accessories that were designed by metal workers or pattern makers, and evidence of the low ebb of hand woodturning in this country that persisted for 40 more years until the renaissance of the 1970's.

## Wood Lathe Centers



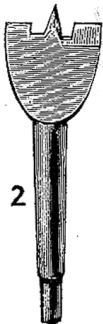
**Roller Back Rest No. 30**

Indispensable for turning long work.  
Price .....\$35.00




**1**

\$14.00




**2**

\$12.00




**3**

\$12.00



**4**

\$8.00



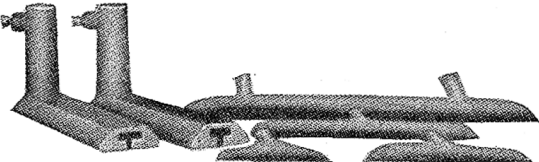
**5**

\$6.00

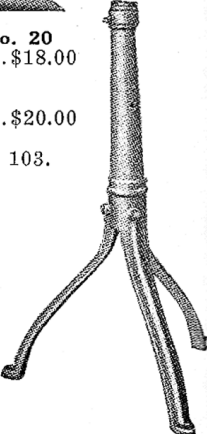
When ordering, send correct turning of bore you want the center to fit in, so as to enable us to get correct size of shank. Also give diameter of spur and length from shank to point.

**Lathe Rests and Sockets**

Price, per pound.....\$0.75

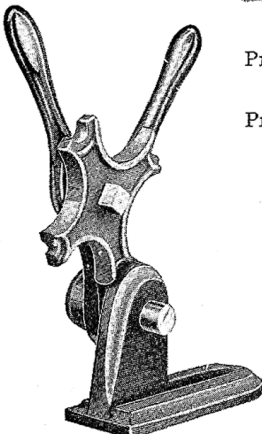



**Back Rest for Turning Lathe No. 20**  
Price .....\$18.00



**No. 219 Lathe Floor Stand**  
Price .....\$20.00

For the turning Chisels see page 103.

of the turning. Why did this steady rest work so well, when the wheels did not? The answer is surface area. The wheel was only making line contact with the turning (parallel to the layers), but the wooden shoe slides smoothly because the contact area is larger than the width of the annular rings.

The main features of this "system" are:

- Wood sliding on wood.
- The workpiece contacts steady in two places, and the angle of contact is about 75°.
- The shoe is very soft wood, and it helps if the work is very hard wood.
- The steady pushes from the back to counteract the force of the chisel.
- The front is unobstructed and will not get in the way of the tool

rest or your hands.

- There are no pinch points.

However, there were many things about the steady rests depicted in Pain's book that were crude and made adjustments difficult—especially the way they were attached to the lathe bed. So I began searching for a better way.

In old catalogs I had seen steady rests that mounted on a round shank that fits into a tool rest base (Figure 2). I got the idea that a steady rest could be made with a wooden shoe mounted on a 1" diameter shank. This allows the assembly to be horizontally adjusted and locked to the lathe bed while the height remains constant. My invention allows for free rotation of the shoe in the horizontal plane (making set-up easier), and simple adjustment for zero free-play in the vertical axis with a locking nut. Finally, I

developed the 75° bearing shoe, that gives the same “two point” contact as Pain’s notched stick, but breaks-in faster because the grain is horizontal, and has more surface area (Figure 3). I have used this type of steady rest successfully for 35 years, and I have sold hundreds of them to satisfied customers. Anyone with a machine lathe can make one—it is just a single piece of turned and threaded metal, and a Nylock nut (or two nuts locked together). Shoes are easy to make from soft pine (Figure 4).

## Why You Need a Steady Rest

The steady rest makes life easier. That should be reason enough to have one. But I should explain that before I had one, I was constantly compensating by making my turnings too thick. When I look back on my work from that period, I see designs that are not effective because the shapes are not cut deeply enough, and so lack definition. There was a huge improvement in my designs when I began using a steady rest that made machining problems of long and thin workpieces a non-issue by taking those problems below the threshold of strength required for functionality.

In my work, I use two types of steady rests: the one described above, and a three-point steady for drilling into the end (like pool cues). This article discusses only the type of steady rest used for thin furniture parts, balusters, and similar work.

## Why Not a Chuck?

Many authors have pointed out that a spindle in a chuck is more rigid, at least in the left half, than one between centers. This may be true, but the disadvantages of using a chuck for spindle work far outweigh any benefits.

A chuck will:

1. Make dents in the wood.
2. Not allow easy centering adjustments (unless an independent chuck is used).
3. Deflect (bend) the workpiece out of alignment with the tailstock.
4. Make it inconvenient to remove and replace or turn the workpiece end-for-end.
5. Introduce the danger of collision with tool or fingers.
6. Discourage “working in steps” that is so important for efficient duplication. (See *The Old Saw Vol. 21, No. 2, November 2008*, for my article on duplication.)

## Why Not a Skateboard?

People are still making useless steady rests for woodturning that have hard metal wheels, but meanwhile someone invented soft plastic wheels for skateboards. Being kinder to the wood surface, these wheels and roller-blade wheels opened up new possibilities for steady rests. For 35 years I have been content with my pine shoe that has no moving parts, but my limited experience with skateboard wheel steady rests has revealed the following disadvantages:

1. Difficult set up.
2. Interferes with the tool rest (front obstructed) and with your hands.
3. Soft plastic is bouncy.



Figure 3—The steady rest made by my company, Big Tree Tools, LLC. The shank is 1 inch. It comes with two shoes, and instructions for making special size shoes.

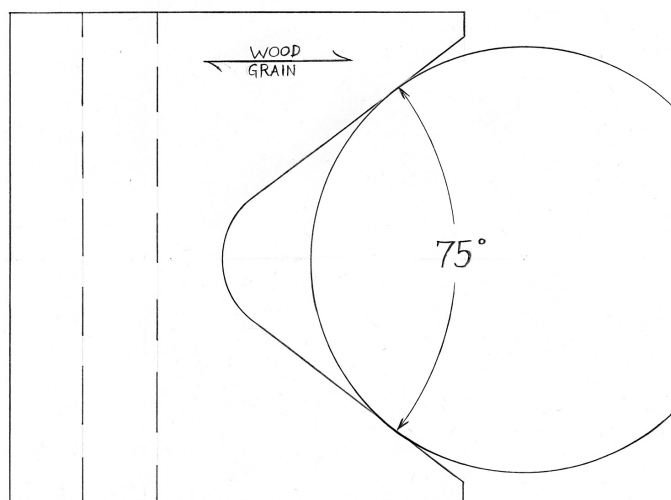


Figure 4—The wood shoe is made from soft pine and makes two-point contact with the workpiece at about 75° angle.

4. Chips stick on the surface, causing rough rolling.
5. Each wheel is a dangerous pinch point.

## Identifying Workpiece Vibration Problems

If your turning is ten or more times longer than its diameter, you will probably experience workpiece vibration. Often called “chatter”, you will notice it first as a sound—a squeaking rattle or screeching sound coming from the tool, and you will feel the vibrations. This causes ridges to be formed on the surface of the work, (often in a spiral pattern), that are very difficult to remove





Figure 5—The first line of defense is to use your hand to dampen vibrations of the workpiece, while guiding the chisel with your thumb.

by sanding. You can't see these ridges while the work is rotating, but you can feel them.

Sometimes it is not easy to differentiate between vibrations of the tool (caused by the flexibility of the chisel or the tool rest) and vibrations of the workpiece. If it is the tool or the tool rest that is vibrating, obviously a steady rest won't help. Therefore an attempt should be made to determine the source. Usually if it is the tool that is vibrating, you will feel it in your fingertips. Try to make the tool more rigid by shortening up the overhang of the blade and working near the center of the tool rest directly over its shank. If this does not change the vibration, then it is almost definitely the workpiece itself that is vibrating.

There are two types of problems associated with long and thin spindle turnings. The first is the high frequency chatter mentioned before, which leaves spiral bands or lumps on the work. The second is the phenomenon of the work "climbing up" and over the chisel, which is a kind of catch. The steady rest will cure both.

### What Causes Workpiece Vibration?

Frank Pain writes that turnings vibrate because wood has different flexibility in the radial and tangential directions. This is true of course, but would result in two vibrations per revolution, and in fact the frequency of workpiece vibration is usually much greater than that. In my opinion, a common trigger of chatter is the tool passing through the annular rings; which is why ring porous woods vibrate most. In final analysis, we should remember that a bow can play an infinite number of notes on a violin, serving only to stimulate the natural harmonic frequencies already present in the string. In the same way, every woodturning has certain frequencies that it tends to vibrate, and all we have to do whilst turning is not encourage it—or failing that, at least not give it room to achieve significant amplitude.

The first line of defense is to use your hand as a steady, leaving your thumb to assist the other hand in holding the chisel (Figure 5). This is a "must have" skill for spindle turners, but obviously it has its drawbacks because it makes control of the chisel more

difficult. On long straight sections, this method works beautifully, because your hand not only dampens vibrations; it brings your tactile senses into the process of smoothing the line of the turning. Sometimes you need both—a mechanical steady rest and your hand. But at the end of the day, there is only so much skin you can afford to leave behind on the wood. Forget using a glove. It not only takes away the tactile advantage mentioned above. And wearing a glove is probably dangerous.

The need for a steady rest is not always predictable by the simple application of length ratio explained before. This is because it depends on the type of wood, complexity of design, and the depth and location of the deepest cuts. You might start out roughing a square and find that the piece has sufficient rigidity to allow roughing to proceed smoothly. But things change as you continue. The act of reducing a square to a round removes 22% of the material ( $\pi/4$  remaining), so before we even begin cutting the design, we have lost that much. Following the rule of thumb that the smallest diameter (minor diameter) of most turnings is  $\frac{1}{2}$  of the full diameter, the material left at the neck is  $\frac{1}{4}$  of the round, and only 20% of the original square. In the struggle to combat workpiece vibration, things often start out fine, but in the final stages of turning, just when you need everything to go just right—everything starts to go wrong.

### Strategy

When you approach a project that is long and thin, you need to maximize every possible advantage.

1. Use wood that is hard and smooth. Diffuse-porous hardwoods such as maple (my favorite), cherry, or birch are best. Avoid ring-porous woods such as oak or ash that have hard and soft layers; or soft woods that have distinct hard annular rings such as douglas fir or yellow pine.
2. Calculate the finished length of the turning, and cut the wood to the final length before you start. Do not leave extra length to be cut off later—length is the enemy.
3. Carefully consider the location of the steady rest. It is best placed near the center of the turning, because this is where the amplitude of vibration is the greatest. But do not place the steady where it will interfere with working on small details. It is best to place it on a straight part of the turning.
4. Engage the steady rest as the first step. Do not wait until the workpiece vibration becomes a problem—kill it before it starts. Rough out the square in the area where the steady is to be placed, and create a smooth straight section (journal) that is wide enough for the steady to engage (usually about 2"). Then the roughing process and all subsequent steps will be faster and easier.
5. Start work in the middle of the turning, or a cluster of details near the middle. Do the hard part first. Work around the steady on both sides, possibly turning the work end-for-end to accomplish this. Leave the ends for last (such as the foot of a table leg), because there is rarely a vibration problem working near the lathe centers where the vibration is the least.
6. In the final stage, move the steady a few inches from its initial position, and finish the area previously obstructed (usually



about 3" wide). Try to move the steady only once, as circularity errors will compound.

7. Use a gouge with a small nose radius—one that will produce a narrow chip. (This is one of the few principles that I learned from metal turning that is also applicable to woodturning.)
8. Use a slower speed than you would normally use, and experiment with different speeds to find one that does not reinforce resonant vibration frequencies.

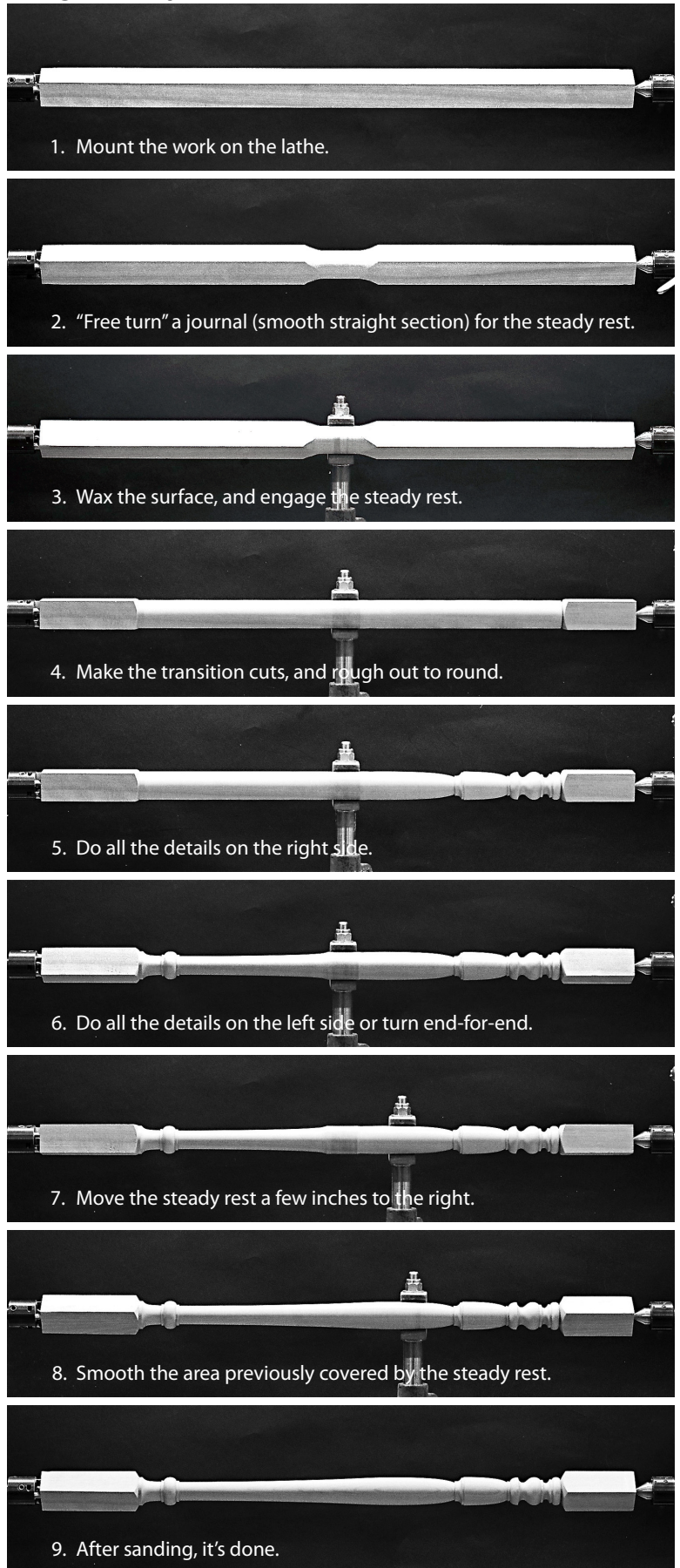
### The Role of Tailstock Force

A lathe is not a vice. Excessive force from the tailstock increases workpiece vibration because it tends to push the work away from the centerline. Long and thin pieces should be held with the minimum force from the tailstock. To accomplish this your centers need to be well tuned. Spurs should be sharp—as sharp as a chisel—and all the same length. If the center point is too long, it will inhibit the entry of the spurs (with hard woods) making excessive force necessary, but a spring center adjusts itself.

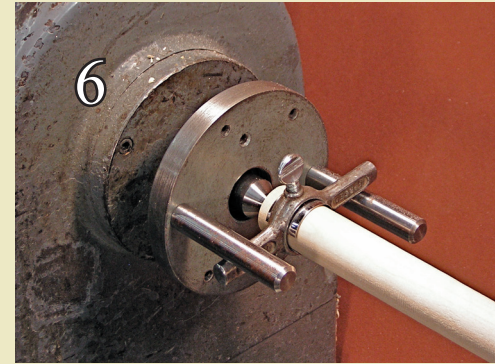
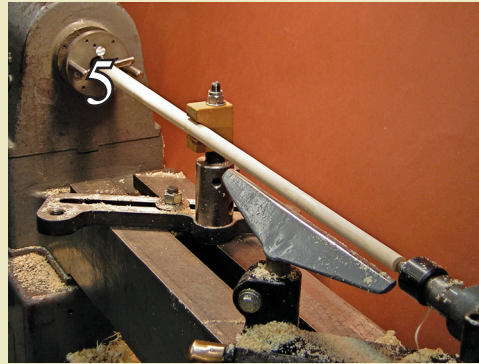
Ideally, the force from the tailstock would be zero, but this is not possible with a conventional spur center. For super accurate work, the spur center is replaced by a “dog drive,” as described in the sidebar on making billiard cue shafts. ■



### Using a Steady Rest to Make a Baluster







## A Cue Shaft...an example of an extremely long & thin turning

This is how I make pool and billiard cue shafts. Some of the methods shown here, such as “dog drive,” are meant for precision turnings such as cues, and are rarely used for furniture parts. (For an exception see *The Journal Vol. 2 No. 2, Winter 2010, Making Chair Back Legs*). The photo sequence offers a view of how the steady rest works in extreme conditions demanding high accuracy.

A cue shaft starts out rough at 1” square and 30” long. The shaft will be turned and tapered about ¼” oversize, then hung up vertically and aged for a period of one year or more before completion.

What is “free turning”? This means the turning is not touching a steady rest or a chuck, and is allowed to settle into its natural straight position between centers with almost zero tailstock force. A journal created this way will provide a bearing for the steady rest that runs true. In the course of turning a

cue shaft and aging the wood between steps, the shaft will warp. Free turning to reset the steady periodically throughout the process corrects this problem, resulting in a finished product that is straight. A pool cue is nothing if it is not straight.

- 1 The first step is to create a journal (smooth straight section) for the steady rest. This is the initial free turning, using the left hand to dampen vibrations and detect smoothness of finished surface.
- 2 After roughing, some bending may have occurred, and a new journal is “free turned” to set the steady again. Notice that the tool rest base is on the right side of the steady, but I can still work on both sides because the front is unobstructed with this kind of steady rest.
- 3 Working to the right side of the steady, this photo provides a good view of the hand positions.

- 4 Advanced hand-dampening sometimes requires guiding the tool with your wrist.
- 5 Switch from spur center drive to dog drive for less deflection and zero tailstock force. This method promotes precision (free turning) and allows the work to be removed and replaced or turned end-for-end an infinite number of times. Dog drive is the most precise workholding method because it separates the jobs of locating and rotating. (The centers locate the work, and the dog rotates it.)
- 6 This dog is made from an old forged steel die stock. Most lathe dogs, probably designed for slow turning metal, have only one leg, but for woodworking at higher speed, the balanced dog is a must. Only one leg and its drive pin are working—the other is just there for the weight. ■