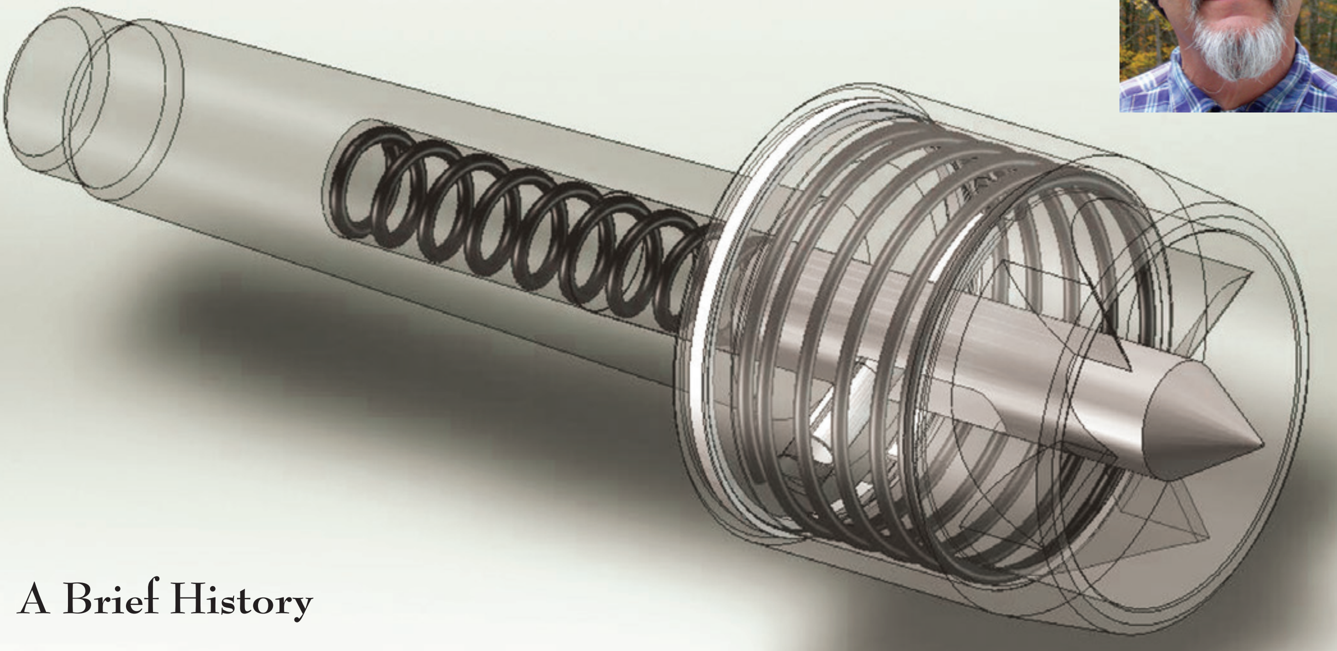

A Brief History

# Lathe Centers for Woodturning

Obtaining a patent is a fascinating process. To qualify for a patent, an inventor must prove two things—that the idea is new, and that it is non-obvious. To determine if the idea is new, it is necessary to research the history of similar inventions. This step is much easier now than it was in the past because of Google patent search engines. While doing research regarding a recent application for a patent on a new type of spur center, I realized the rich history associated with lathe accessories and this article is the result.

Early lathes probably evolved from bow drills and/or fire-starting kits (Fig. 1) and were made entirely of wood. The spindle to be turned was pointed at both ends and the points rotated in depressions in a bearing of very hard wood, bone or smooth stone (Fig. 2). Over millennia, as lathes evolved, parts that were once made of wood, gradually changed to being made of metal. The first parts to undergo this transition were the lathe centers which evolved into conical metal points fixed into the lathe structure (Fig. 3). This eliminated the necessity of pointing the spindle, because the new metal centers could be embedded into the workpiece much as we do today. The result was less time and effort preparing the workpiece, less waste caused by cutting off the points from the spindle, less turning friction, and better stability of the workpiece.

Of course in those days there were no drive centers, and the work was rotated directly by a cord wrapped around it and connected first to a bow, and later a springy board or "lath" from which the word "lathe" is derived (Fig. 4 & 5). Both centers were identical and did not rotate—they were dead centers. It is probably best not to refer to these early lathes as machines since they had no moving parts other than the workpiece itself. The invention of the live rotating lathe spindle came next, changing the device that was formerly little more than a workholding fixture into a true machine (Fig. 6). It is probably a safe speculation, although there is no archeological proof, that the lathe spindle evolved from the potter's wheel, and since the potter's wheel is over 5,000 years old, there is a long history of machines with live spindles.

Starting with the lathe centers and ending with the lathe bed itself—one by one the parts of the lathe were modernized, and eventually the entire machine came to be made from metal. This allowed the development of lathes for turning metal, and automated lathes for mass production of wood parts. As a result, the manual wood lathe (or speed lathe) became less important, causing improvements in the design of wood lathes to falter even as the industrial revolution went into full swing.

The development that triggered the industrial revolution was the production of cheap iron without which there could be no steam engines, railroads or tall buildings. The advent of cheap iron had a profound effect on the development of lathes and all machine tools. Along with the massive use of cast iron came the rise of patternmaking as a separate branch of woodworking—one that employed woodturning to a very high degree.


Fig 1—Fire starting kit—*Field and Stream*

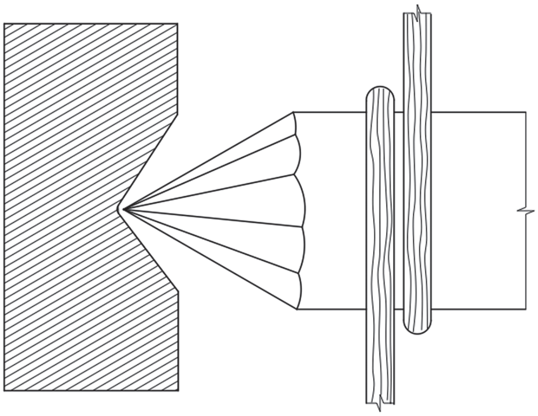

Fig 2—In its most primitive form, the bearing consists of the pointed end of the spindle (workpiece) fit into a depression in a hard material like bone or stone

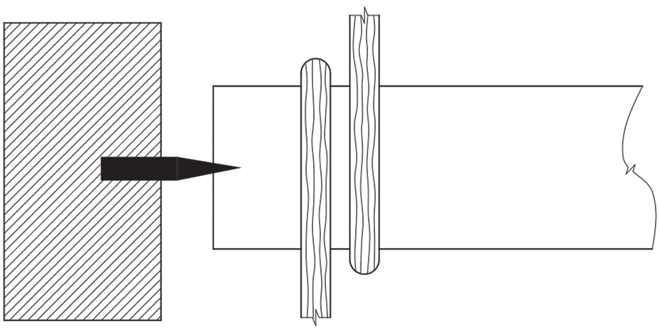

Fig 3—Even at a time in history when small bits of metal were precious, dead centers were used to mount the workpiece in the lathe that was otherwise entirely made of wood

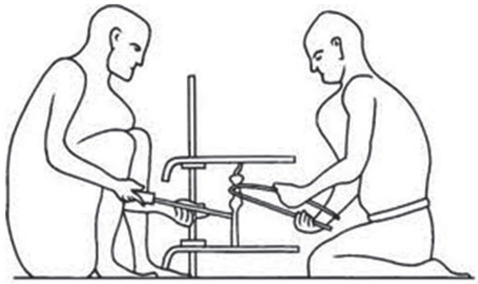

Fig 4 —The earliest known depiction of a lathe shows Egyptian craftsmen using a cord to rotate a turning on a lathe in the third century BC.

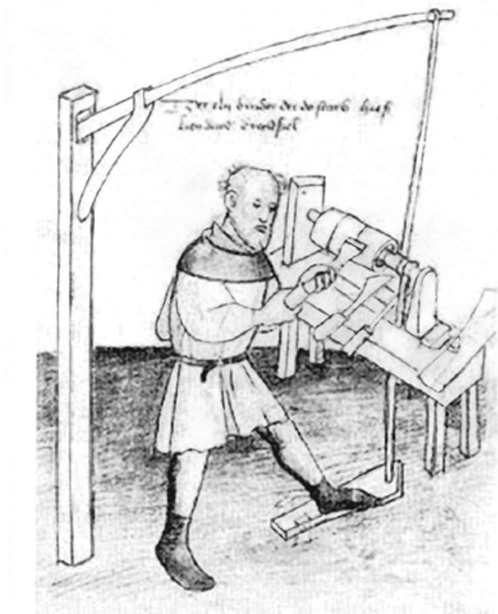

Fig 5—In 1395 this turner is using a treadle to activate a cord attached to a spring pole. (Zwolfbruderbuch)

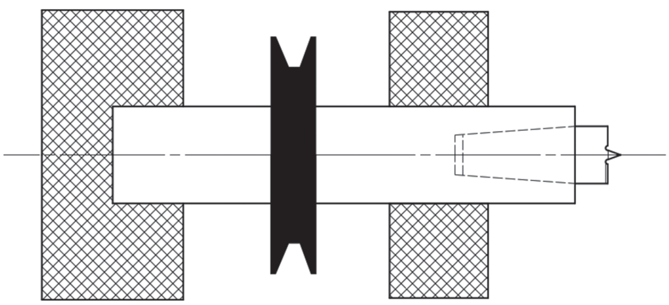

Fig 6—A live spindle consists of a cylindrical part that rotates in its own bearings, and this drives the workpiece through a spur center or a chuck.

### The Origin of the Ring Center for the Tailstock

Patternmakers are often confronted with the problem of making split turnings, that is, spindles that separate along their axis into two equal parts (Fig. 7). This problem is not unique to patternmaking however, because split turnings are also used in furniture and architectural work.

There are two approaches to making split turnings. You can make the turning the usual way and saw it apart afterward. Or you can use two pieces of wood and hold them together temporarily until the turning is complete. The second method has the advantage of producing pieces that are more accurate, but more important, it allows the use of thinner and therefore less expensive lumber.

It can be a challenge to hold two pieces of wood together temporarily so they can be turned and yet later separated easily without breaking. This is especially true if the pieces are slender and fragile. The most common solution is to sandwich a piece of thick paper in the glue joint to weaken it. This is a balancing act, and obviously a lathe center, being pointed and located exactly on the intentionally weakened glue line, will combine with centrifugal force to wedge the two pieces apart. Premature separation during the turning process usually results in a total loss of the workpiece as well as possible danger to the operator.

Faced with this problem, patternmakers developed a new type of tailstock center: one that held the two sides together instead of prying them apart. It was the cup center or ring center (Fig. 8). The ring center does its job of holding the two sides together, but obviously has one huge disadvantage—more friction. In spite of this disadvantage, ring centers became the standard type of tailstock center by the middle of the twentieth century. Those of us who learned during that period remember the smell of burning wood and oil, and sometimes smoke rising from the tailstock center. This primitive system forced us to develop a light touch with the tailstock screw, as overheating of the center was a constant problem.

Fig 7—Split turnings—at left is wood with paper glued to one face.

Fig 8—A typical 20th century cup center for the tailstock (dead center).

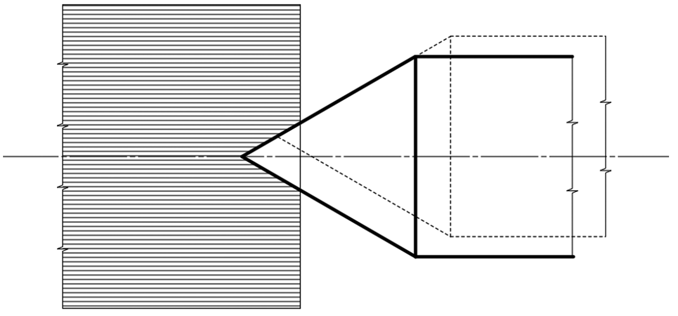

Fig 9—The position of a 60° center on the workpiece can be easily adjusted, making it superior to cup centers for general work.

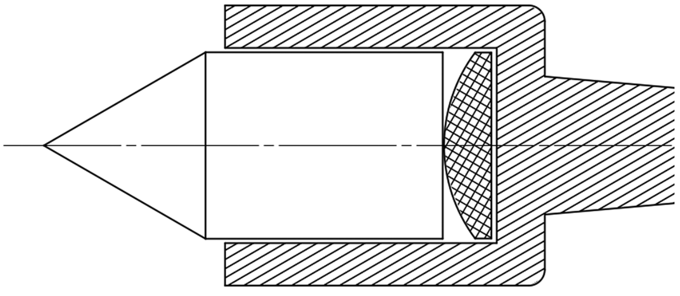

Fig 10—The first revolving tailstock centers needed constant oiling because they had simple plain bearings and a brass pad to receive the thrust load.

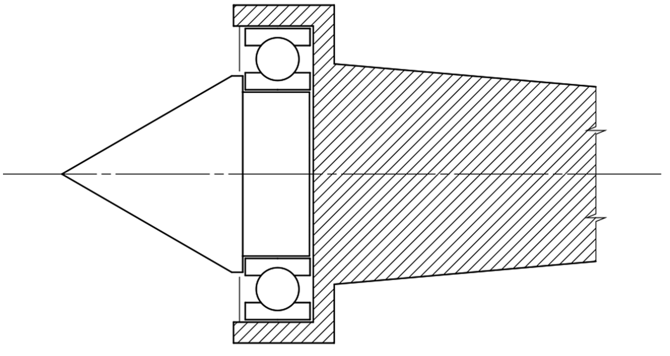

Fig 11—Avoid cheap centers that have only a single bearing.

### Why Cup Centers are Not the Ideal Tailstock Centers for General Woodturning

With the widespread acceptance of tailstock centers with bearings, it can no longer be argued that the cup center generates more friction than a pointed center. However there are two reasons why cup centers are not ideal for general work:

- They Get in the Way—Cup centers are so large, that they get in the way when turnings need to be tapered down to a small diameter at the end. This occurs whenever making tenons for chair rungs or similar parts or any type of work that requires a small end.

- They are Not Easily Adjustable—When I teach woodturning for furniture, I stress the importance of precise centering to insure that the round and square parts are concentric. I show students how to adjust the position of the center in the workpiece by testing and correcting. Many turners are surprised by this, as their usual routine is just to tighten the centers and accept whatever happens. However adjustment is necessary because wood has hard and soft layers, and as the centers are tightened, the center moves into the nearest soft layer, and away from the true position. A frequently asked question is, "Doesn't that process create an oval hole and thus an ambiguous position of the center point?" The answer is NO, because the center is pressed deeper every time it is moved (Fig. 9). It is very difficult to adjust a cup center.

### So-Called "Live Centers" and Unintended Consequences

Throughout the 20th century, technical improvements in lathes trickled down from machine lathes to wood lathes. Among these improvements are the so-called "live centers"—tailstock centers with built-in bearings. They are not live centers, because the live center is attached to the live part of the lathe—the headstock spindle. In other words, the live part of a machine is an element in the drive train (a mover), and by this traditional definition can only be connected to the headstock. Nonetheless, most people now refer to revolving tailstock centers as "live centers." By whatever name, these centers have become indispensable for turning both wood and metal, and once you get used to them, it is almost unthinkable to go back to dead centers.

Figures (10) through (14) are schematic views that represent the evolution of revolving tailstock centers. Many types of bearings such as angular contact, and tapered rollers are often employed, so these views are not literal representations of how the parts fit together.

No revolving tailstock center can be as rigid or as accurate as a solid center, but some high-end models come close. There is a great variation in the quality of revolving tailstock centers. Some are simply a single ball bearing inside a housing, and these can cost as little as $10 (Fig. 11). The most elaborate types cost over $300. High quality tailstock centers have the following features:

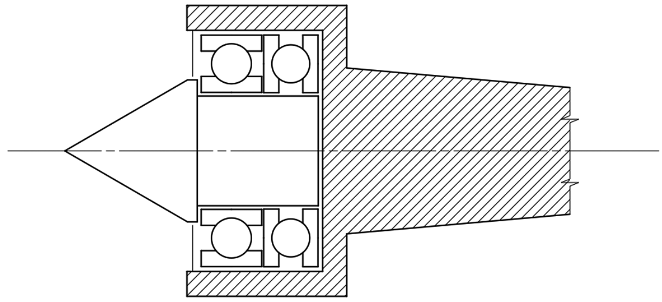

Fig 12—Better centers have separate bearings for radial and thrust loads

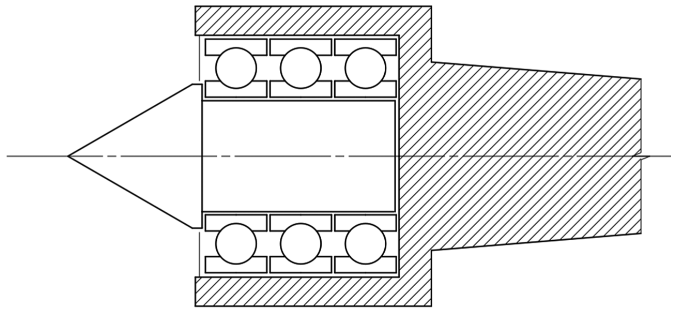

Fig 13—Triple bearings are more rigid, but the overhang is excessive and they are certainly not compact.

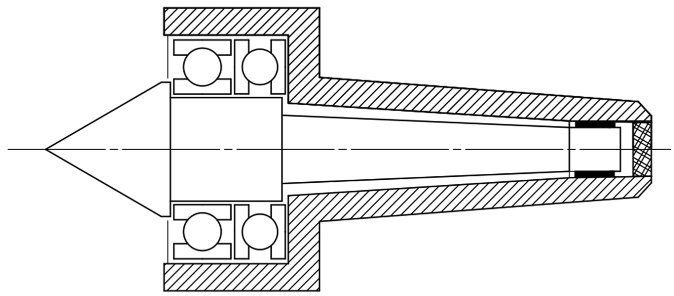

Fig 14—The best design is the spindle type, because they are compact and extremely rigid due to the length of support for the revolving center inside the housing.

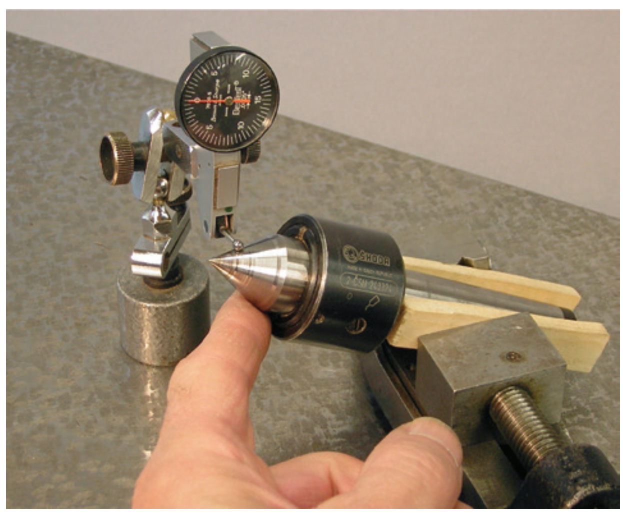

Fig 15—Revolving centers must run true in their own bearings.

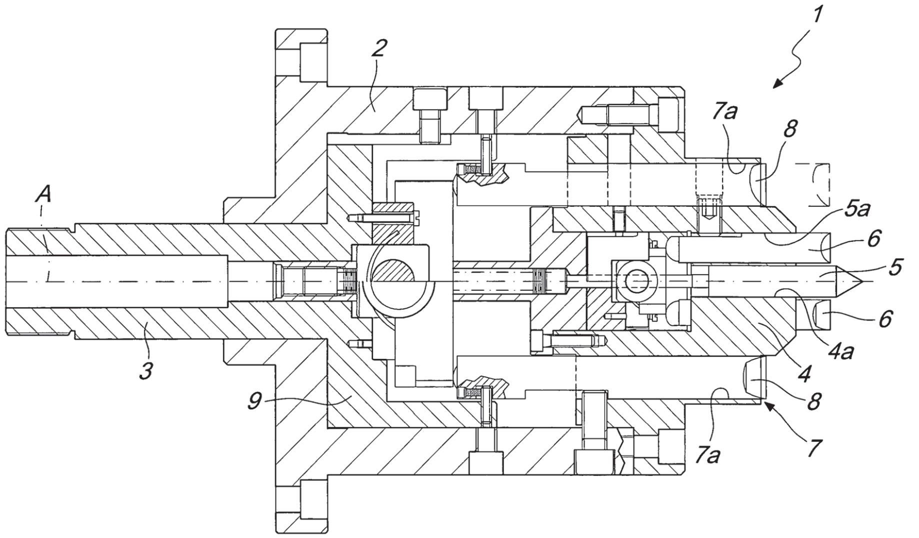


Fig 16—Some spur center designs are extremely elaborate. This one has two separate rings of spurs, allowing the outer spurs to retract as turning progresses to a smaller diameter. Marco Franceschelli—2008.

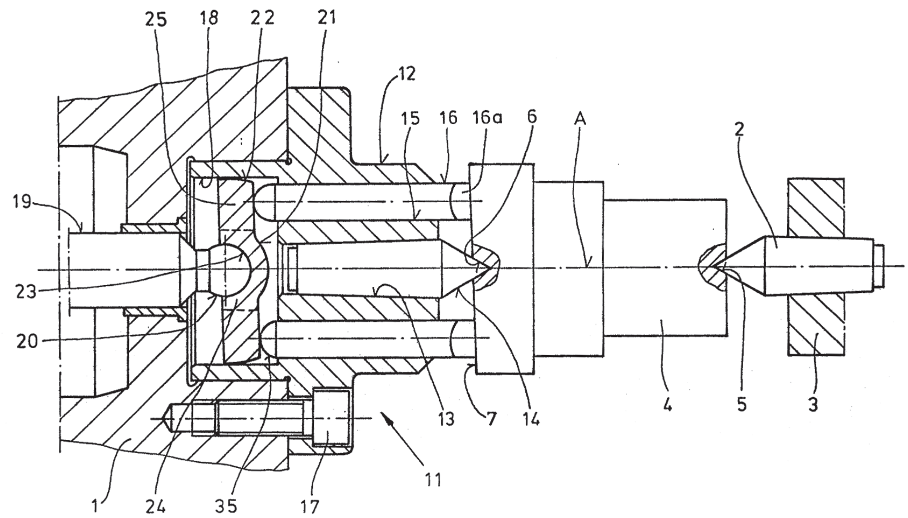


Fig 17—In this center, the sliding spurs are pushed by a swivel plate that automatically adjusts to the end of the workpiece, even if it is out of square. Karl Heistand—1986.

- The center point rotates inside a stationary housing.
- Separate bearings for radial and thrust load.
- The rotating center point consists of a spindle that extends deep into the hollow shank and has a bearing at the outboard end near the small end of the shank (Fig. 14).
- A 60° center point (not a cup center) that runs true in its own bearings within 0.0005″ TIR (Fig. 15).

Revolving centers that possess these features start at around $80. You can spend less, but be aware that if you do, you may be introducing vibration from lack of rigidity of the center point, or concentricity errors if the point does not run true in its own bearings. It should be noted here that besides being more rigid, the greatest advantage of dead centers is the fact that their run-out is always zero.

One of the unintended consequences of using bearings in the tailstock center is a desensitization of the operator to the negative effects of excess force exerted by the tailstock. No longer alerted by smoke or squeaks, the woodturner can crank the tailstock screw as if the lathe were a vise. The result of this excess force is premature wear on the bearings of the headstock spindle and the tailstock center. But the most important negative effect of excess tailstock force is increased vibration of long thin workpieces, also known as spindle whip.

#### To Slip or Not to Slip–That is the Question

Some teachers use cup centers (intended for the tailstock) as drive centers in the headstock—a technique that is only possible with a ball-bearing tailstock center. This might be a good idea for beginners and young students, because it limits the torque that the lathe can impart to the workpiece. It will not, however, reduce the effects of a catch if the workpiece has a sizable mass, because momentum will continue to carry the workpiece forward. Driving the work with a friction device such as a cup center is extremely limiting and inevitably leads to increased force being applied from the tailstock causing all the associated problems that were mentioned earlier.

Serious woodturning is not possible with a drive center that slips, because slipping is the opposite of what a drive center was brought upon the earth to do.

#### The Center Point of Spur Centers

A historical review of patents for spur centers reveals that there are many complex forms having multiple parts. This includes moveable spurs and center points, some of which are attached

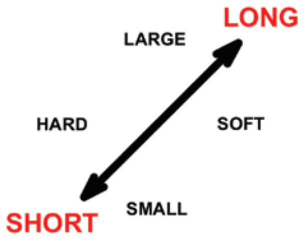


Fig 18—Large workpieces of soft material require deep penetration of the center point; small workpieces of hard wood require very little penetration. The center point of a drive center must adapt to these variable working conditions.

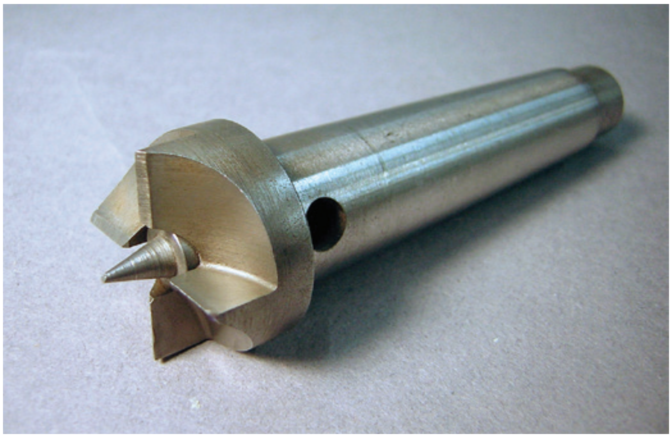

Fig 20—In spite of its sophisticated construction, this type of spur center is unsatisfactory, because the length of the center point is not adjustable.

Fig 19—This common type of spur center has an adjustable point, but the locking method is crude and does not result in a center point that runs true.

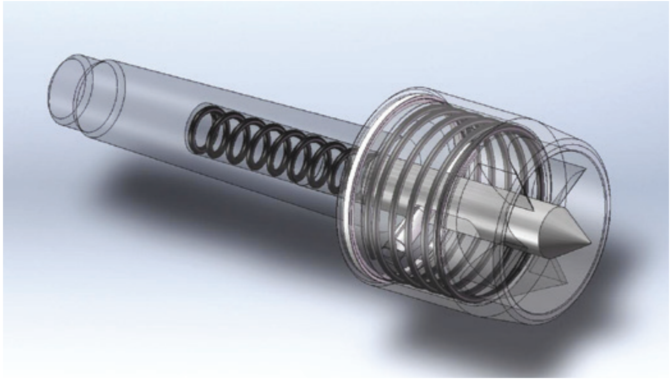

Fig 21—A spur center with a spring center point and a safety guard. Patent Pending by the author and G. More—assigned to Big Tree Tools, LLC.

to springs or other mechanisms. Apparently very few of these were ever manufactured to any extent, as I cannot find them or descriptions of them in any literature other than the patent documents themselves (Fig. 16 & 17).

Many spur centers have center points that are adjustable in length. This offers the advantage of changing the length of the point according to the characteristics of the workpiece, as shown in the chart (Fig. 18).

Usually adjustable points consists of a $\frac{3}{16}''$ diameter pin that is locked in place with a set-screw from the side (Fig. 19). This system is not conducive to accurate concentricity, because the center point does not fit precisely and is thrown off-center by the set-screw.

Another common type of spur center has a removable center point that is fitted in a tapered seat (Fig. 20). The body is cross drilled just behind the head, or the shank is drilled through to allow ejection of the center point. Even with all this complex engineering, this design fails to deliver satisfaction because the length of the center point cannot be adjusted.

### Spring Points

I do not know the origin of the spring-loaded center point used on a spur center. This feature appears frequently in patents 100 years ago, so the concept was once common knowledge. But in the late 20th century such centers were only used in production duplicating lathes and were not known to hand turners.

In 1996 I patented a spur center with a spring loaded center point that combined several other features, such as removable, replaceable and independently adjustable spurs. This includes interchangeable center points that operate in different modes. My invention was not a commercial success because it was too complicated and expensive. Several years later the Stebcentre, and others were introduced, so today drive centers with springs are common. My latest patent application has not only a spring center point but also a safety guard (Fig. 21).

The spring center is a great improvement for three reasons:

- It completely eliminates the problem of center-point length because it simply adjusts itself and thus does not inhibit the entry of the spurs into the workpiece.
- It allows the workpiece to be removed, replaced or reversed end-for-end without stopping the spindle.
- It allows the workpiece to be stopped briefly for inspection (for example while sanding) without stopping the spindle. ■