

TURNING AND MECHANICAL MANIPULATION

Volume IV — The Principles and Practice of Hand or Simple Turning

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CHAPTER VII

The Elementary Practice of Softwood Turning

Section 1: Introduction

Stance at the Lathe, Treading, and Work Speed

Softwood turning is capable of producing a wide variety of attractive and useful objects for domestic, personal, and manufacturing purposes. It requires relatively few and simple tools, but rewards ingenuity and skill in both design and execution. Even a modest level of proficiency is well worth acquiring. In particular, developing a confident command of the gouge and chisel is strongly recommended — it not only simplifies the use of the other softwood tools, but the confidence and fluency gained will also carry over directly into hardwood and metal turning.

For elementary practice, the basic geometric forms serve as the ideal training ground: the external cylinder, flat surface, and cone; the internal cylinder, surface, and cone; and later, the sphere and internal hemisphere. These are the fundamental building blocks of turning. However complex a finished piece may appear, it can always be broken down into combinations of these primary shapes.

It should be noted that in all branches of turning — as in all crafts — many variations of technique exist. These arise from personal preference, the nature of the material, the tools available, and local tradition. The guidance in this and the following chapters is aimed at the practical needs of the amateur turner, rather than providing an exhaustive survey of every possible method.

Stance

Your stance at the foot lathe is determined less by the material being turned than by the nature of the work itself.

For cylindrical work: stand squarely facing the lathe bed, body upright, weight supported on either leg with knees and ankles fairly firm. Point your toes outward, with the supporting foot an inch or so back from the front rail of the treadle. The ball of the treadle foot rests on the front edge of the treadle, toes also pointing outward, so that its heel and the arch of the supporting foot are roughly opposite each other. You can switch which leg bears your weight from time to time; for most cuts, it makes little difference. However, since the tool is held in the right hand, standing on the right leg stiffens and braces the entire right side — this position naturally suits cuts requiring particular care and precision.

For surface and internal work: the same basic stance applies, but the body turns slightly to face the work more directly, at roughly 45° to the lathe bed. For deep surface and internal work, stand on the right leg, face the surface at right angles to the bed, and lean your right hip against it, with the right foot parallel to the treadle rail and the left leg crossing over.

Starting and Treading the Lathe

To start the lathe, take the drive band between the left finger and thumb and pull it downward while placing your foot lightly on the treadle without pressing. This partial revolution brings the crank past top dead centre; the treadle then begins to descend, at which point you apply foot pressure. Continue: the treadle descends under foot pressure, driving the flywheel; the treadle then rises again ready for the next stroke.

In regular treading, the pressure should build gently from the start of the downstroke, reach its peak in the middle, and ease off toward the bottom — with pressure fully released on the upstroke, even though your foot remains on the treadle. This rhythm is quickly and almost instinctively acquired.

Your foot can usually stay on the treadle throughout. Occasionally, once the lathe is up to speed, you may lift it briefly to stand on both feet for a moment of extra steadiness during a particularly precise cut.

Work Speed

The treadle speed — and therefore the mandrel speed — must be adjusted for the diameter of the work. If the mandrel turns at a constant rate, the surface speed of the work increases proportionally with its diameter. To maintain a consistent surface speed suited to the material and tool in use, smaller-diameter work must be driven faster than larger.

This consideration applies equally when a single piece combines sections of very different diameters, and on flat surfaces, where surface speed falls off continuously from the rim toward the centre. In the latter case, set the drive band for the medium diameter of the surface, then vary your treadle speed slightly faster as the tool approaches the centre, and slower as it moves toward the rim.

Pulley groove selection: for softwood up to 2–3 inches diameter, use a large groove on the flywheel driving a small groove on the mandrel pulley (highest speed). For 3–6 inches, use medium grooves. For larger diameters, step down further to keep the work manageable.

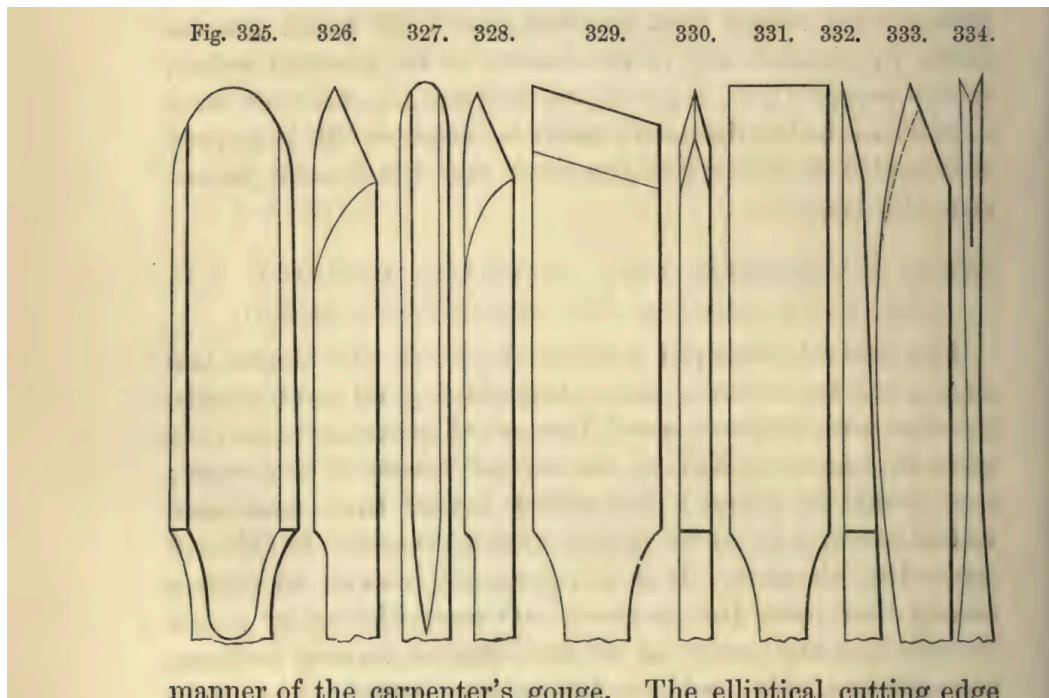
Softwood requires the highest speeds of any material; for small-diameter work it is almost impossible to go too fast. At large diameters, however, speed must be reduced — partly to protect the tools, and primarily to avoid excessive physical effort.

Section 2: External Tools — Gouge, Chisel, and Callipers

The principles governing the form, geometry, and cutting action of turning tools are covered in Chapter XXIV of Volume II, which should be consulted. All softwood tools are ground to a cutting angle of 25°–30°.

The Gouge and Chisel

The gouge and chisel — illustrated in Figs. 325–330 — are the principal tools for external softwood turning. They are made in a range of sizes, from about $\frac{1}{8}$ inch to 2 inches in blade width. The most generally useful gouge size is $\frac{1}{2}$ – $\frac{3}{4}$ inch wide; for the chisel, $\frac{3}{4}$ –1 inch wide — both in long handles of 14–20 inches overall.



Figs. 325–334: Gouge and chisel profiles (face and side views), flat tool, and softwood parting tool

The turner's gouge is ground on the convex face only at an angle to the sides, producing an elliptical cutting edge that prevents the corners catching the work. The chisel's cutting edge is set obliquely at approximately 70° and 110° to the blade sides, and is ground with a bevel on both faces so the cutting edge falls at the centre of the blade's thickness. The softwood parting tool (Figs. 333–334) is about $\frac{1}{8}$ inch wide at the cutting edge, tapering to a thicker stem for clearance, with the edge divided into two points by an angular groove.

Leverage

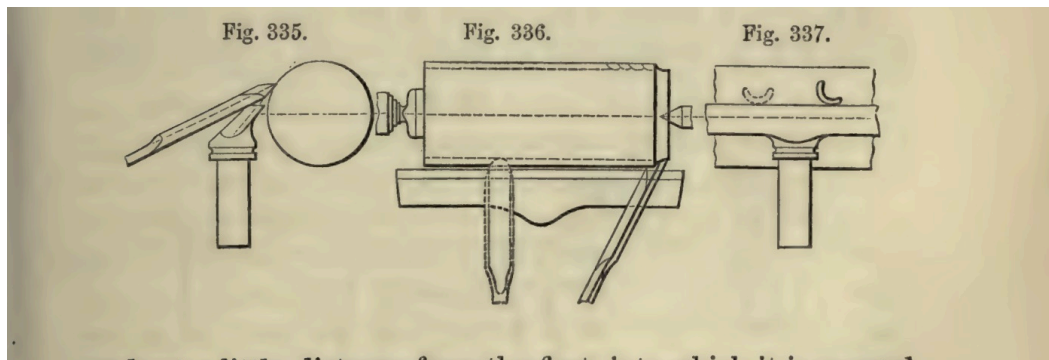
All hand turning tools work on lever principles: the cutting edge is at the short end, the toolrest acts as the fulcrum, and the handle is the long arm. Move the rest closer to the

work and grip the handle further from it, and you increase mechanical advantage, reducing the muscular effort needed to control the cut. Long handles are necessary for the larger softwood tools, but the leverage they provide must be used with care — too deep an engagement tears rather than cuts, and can wrench the work from the chuck.

Using the Gouge on the Cylinder

For softwood cylindrical work, the gouge is gripped firmly in the left hand, knuckles on top, fingers beneath, wrapped around the blade a short distance from the cutting edge. The right hand holds the end of the handle, pressed close against the side of the body. The convex back rests on the toolrest, with the rest height set so the bevel lies nearly tangent to the cylinder being turned.

When the bevel is exactly tangent, the tool is not cutting. To begin cutting, raise the handle slightly — the edge becomes tangent to a slightly smaller circle and material is removed. Always lay the bevel to the work first, then raise the handle into cut.



Figs. 335–337: Three views of the gouge on the cylinder — side elevation, plan, and end-on view showing blade position

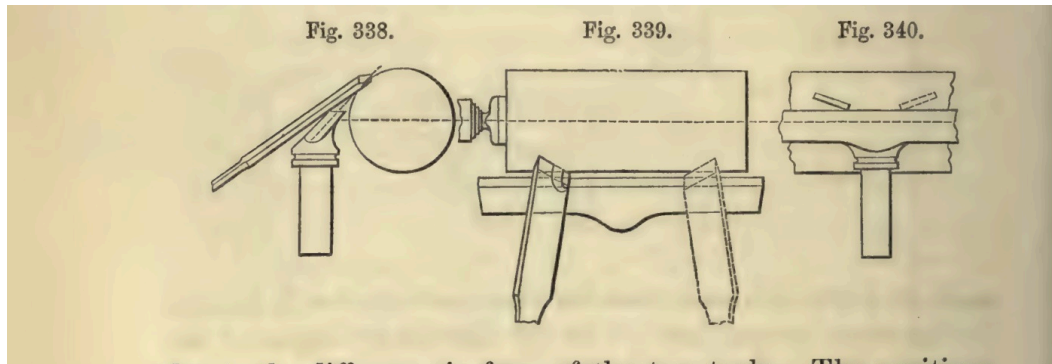
Roughing Out

In roughing, hold the gouge with considerable firmness, handle tight against the side. For the first cuts, the gouge is twisted until the blade lies on the rest on its right side near the edge (Fig. 337), shaft at approximately vertical inclination (Fig. 335) and inclined to the right in plan (Fig. 336). Start the first cut about $\frac{1}{2}$ inch from the end; as soon as a full circle is cut, push the gouge steadily toward the end, reducing that section to round. Continue along the full length, taking two or three passes if necessary.

Once roughly concentric, the gouge is repositioned at right angles to the work, lying on the centre of its convex back, and traversed slowly back and forth from end to end at a steady pace — maintaining a straight line parallel to the axis to avoid taper. After a few passes by eye, check with callipers to find the high spots before moving to the chisel.

Using the Chisel on the Cylinder

The chisel is held with the left hand folded round the blade near the cutting bevel — fingers beneath, knuckles on top. The shaft is presented at a small horizontal angle (Fig. 339) and tilted to rest on the lower corner of one side. It traverses from left to right, then is turned over and tilted the other way to proceed from right to left — the obtuse angle always leading.



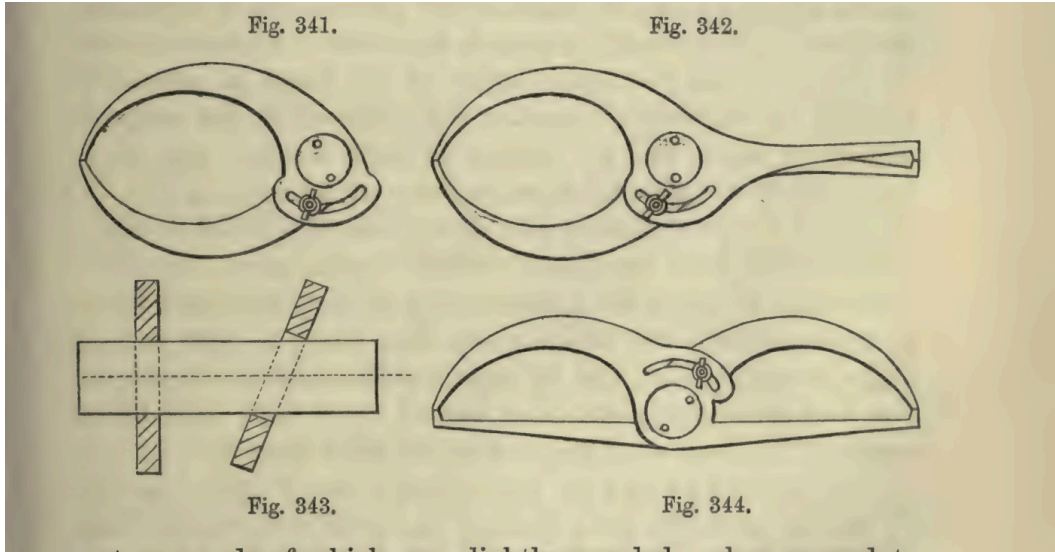
Figs. 338–340: Three views of the chisel on the cylinder — side elevation, plan, and end-on view

The chisel cuts very aggressively if its full edge width is presented; it will bury itself and become unmanageable. The tool must be tilted on one side corner and held at a horizontal angle so the cutting edge lies as an oblique tangent on the work, making contact at only one point — about one-third up from the obtuse angle — with both corners clear.

To apply the chisel: first lay the flat of the blade lightly on the work, then draw it gently toward you while setting both the horizontal angle and the tilt. The right hand comes to rest against your side at exactly the moment the bevel makes contact. No cutting occurs until the handle is gently raised. Maintain an even pace from end to end. Once smooth, check parallelism with callipers and reduce any high spots with shavings that taper to nothing.

Callipers

Single callipers (Fig. 341) for external measurement consist of two thin steel plates pivoted at a centre, tapering to slightly rounded points, locked with a screw and nut. They must always be held exactly square — at right angles to the axis — for accurate measurement.



Figs. 341–344: Single callipers (with locking screw); correct and angled (incorrect) application; double callipers; double side callipers

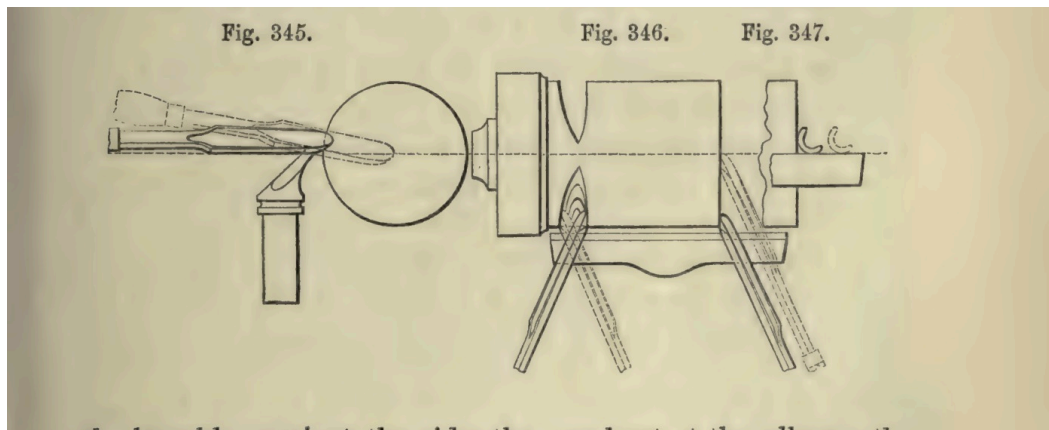
Correct technique: close the callipers onto the stationary work so the points pass over the diameter with a light, definite feel of contact. Lock the screw, then re-check at the same position. The comparison of two diameters relies entirely on the sense of touch. Double callipers (Fig. 342) give the same measurement externally and internally simultaneously, useful when turning a spigot to fit a specific hole. Double side callipers (Fig. 344) are useful for tubular work too small for ordinary callipers, and for checking wall thickness where projections prevent the callipers from being removed without opening.

Section 3: Surfaces, Back Surfaces, Plankways, and Cones

On the surface (turning the flat end face), the cutting bevels must coincide with the plane of the surface being formed. The cutting action is obtained by presenting the bevel at an angle slightly greater than coincidence. The bevel travels radially from the rim to the centre, exactly at right angles to the lathe axis.

Gouge on the Surface

Hold the gouge as before but with the right hand placed higher on the body, knuckles against the side, elbow bent. The gouge rests on its side (Fig. 347) with the cutting bevel nearly in the plane of the intended surface.

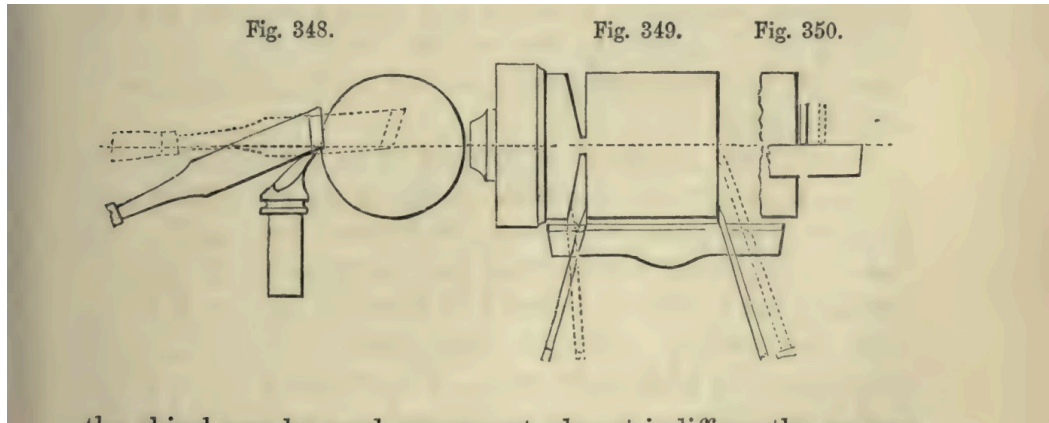


Figs. 345–347: Three views of the gouge on the surface — side elevation, plan, and end-on view

Hold the gouge firmly in both hands nearly horizontally (Fig. 345) and push it straight forward. It travels from the rim to the centre under the weight of the body, while the right hand continuously raises the handle to direct the tool toward the centre. The body sways slightly to the right as the shaft follows the surface inward. The tool need not traverse in one uninterrupted stroke — stop and restart as often as needed. The surface produced will at first be irregular; use a straightedge or square to identify and reduce the high spots.

Chisel on the Surface

Hold the chisel as for the cylinder, but support it upright on one edge with the shaft at a small lateral angle (Fig. 349), cutting bevel vertical and at right angles to the lathe axis. Present the chisel to the rim, begin the cut about one-third from the lower angle, and push forward while simultaneously levelling the tool, finishing at the centre with the actual tip of the lower angle.



Figs. 348–350: Three views of the chisel on the surface — entry angle, plan view, and end-on view showing upright position

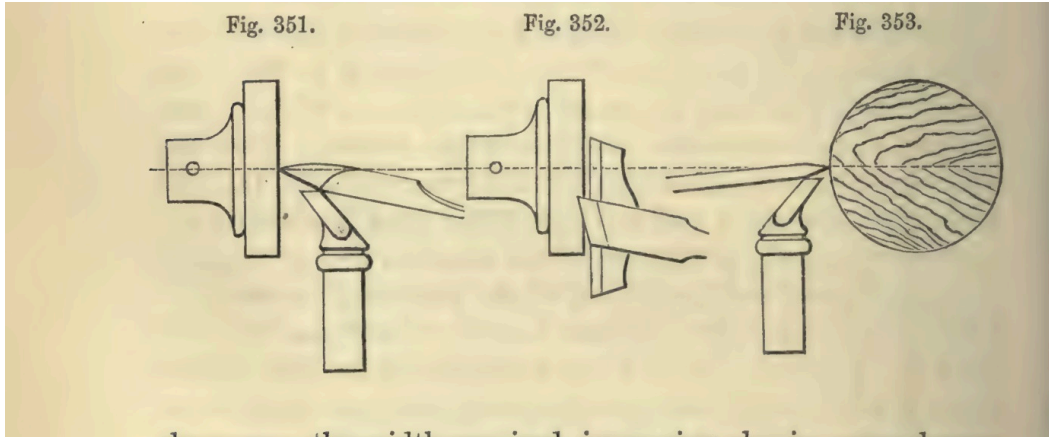
The most common error is tilting the top of the chisel toward the work. This causes the cutting edge to catch against the aris between the surface and the cylinder, violently dragging the tool toward the centre and scoring a deep helical groove. To avoid this, hold the shaft firmly upright and at a small horizontal angle, making the first incision as though for a very shallow obtuse cone, then bringing the bevel into the correct surface line without lifting the tool.

The Back Surface and Parting Tool

When a cylinder is held between centres, surfaces can be turned at both ends. The back surface is begun by cutting a groove in the material, made with a series of angled gouge cuts or entirely with the chisel (Fig. 349). The chisel is then used alternately on the surface and the neck, working both simultaneously until the surface is complete to the centre and the work falls free from the chuck. For separation, the softwood parting tool (Figs. 333–334) can also be used — present it with the blade resting exactly vertically on its edge, grooved side down, apex directed radially, and keep it on the radial line as it approaches the centre.

Plankways Surfaces

Turning can be done with the grain along the axis (endgrain) or at right angles to it (plankways). Endgrain is used for slender cylinders; plankways for stouter pieces approaching a disc — and a pure plate is always plankways. For plankways surface turning, position the toolrest tee parallel to the surface, close to the work and well below centre, so the cutting edge travels in a line that is both horizontal and radial to the surface.



Figs. 351–353: Plankways setup — side view showing gouge angle, plan view showing chisel traverse, end-on view showing grain direction and fibre variation

Rough-turn the plankways surface with the gouge as on the cylinder but with considerably less shaft slope (Fig. 351). Finish with the chisel (Figs. 352–353), held at an even shallower inclination with its side lying flat on the tee. Traverse from the centre outward for about two-thirds of the radius, then turn the chisel over and proceed from the rim inward, overlapping the cuts. The leading corner is always kept just clear of the surface; the trailing corner does the cutting. Once the surface is confirmed flat by straightedge, it serves as a reference for checking the cylindrical rim using a steel square.

Cones and Conical Surfaces

A cone is geometrically intermediate between a cylinder and a flat surface. For shallow cones the chisel lies on its side as on a cylinder; for steep cones it rests on its edge as on a surface. In between, the tool travels in a path combining both movements — simultaneously traversing laterally and depressing inward, the cutting edge always coincident with the cone surface.

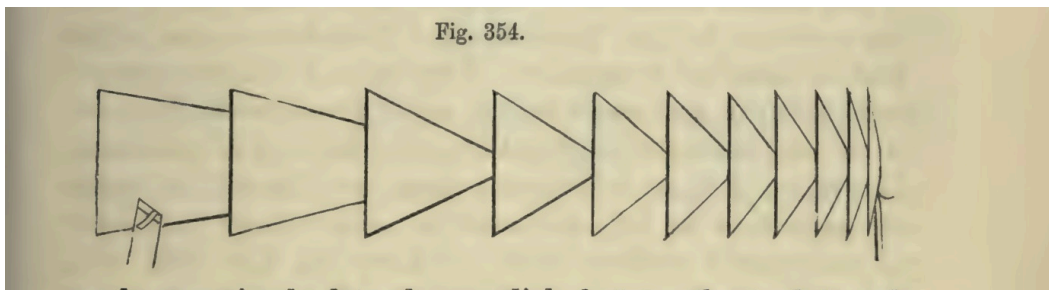


Fig. 354: Series of cones from shallow (near-cylinder) to steep (near-surface), showing progressive changes in chisel position

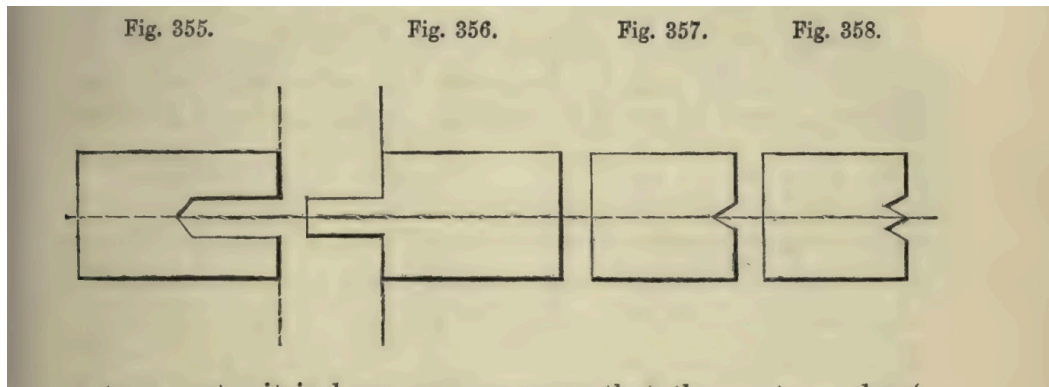
Use the gouge first to rough down to the required angle, guided by a bevel gauge. The chisel rests on the lower corner of its side, obtuse angle leading, bevel lying on the cone. The shaving is always cut travelling from base to apex. Allow extra length beyond

the apex for tailstock support; this piece is turned as a small reversed cone and parted off simultaneously with the completion of the apex.

Section 4: Internal Turning — Boring, Hollowing, and the Internal Surface

Plain Fittings and Small Bored Holes

The smallest internal softwood cylinders are the holes for 'plain fittings' — the cylindrical joints by which one turned part is attached to another. In softwood this joint is both stronger and easier to make than a screw thread. Small holes ($\frac{1}{16}$ – $\frac{1}{4}$ inch diameter) are made with the shell or nose bit; up to $\frac{1}{2}$ inch with the spoon bit; larger holes are started with the bit and enlarged with a small hook or side tool.

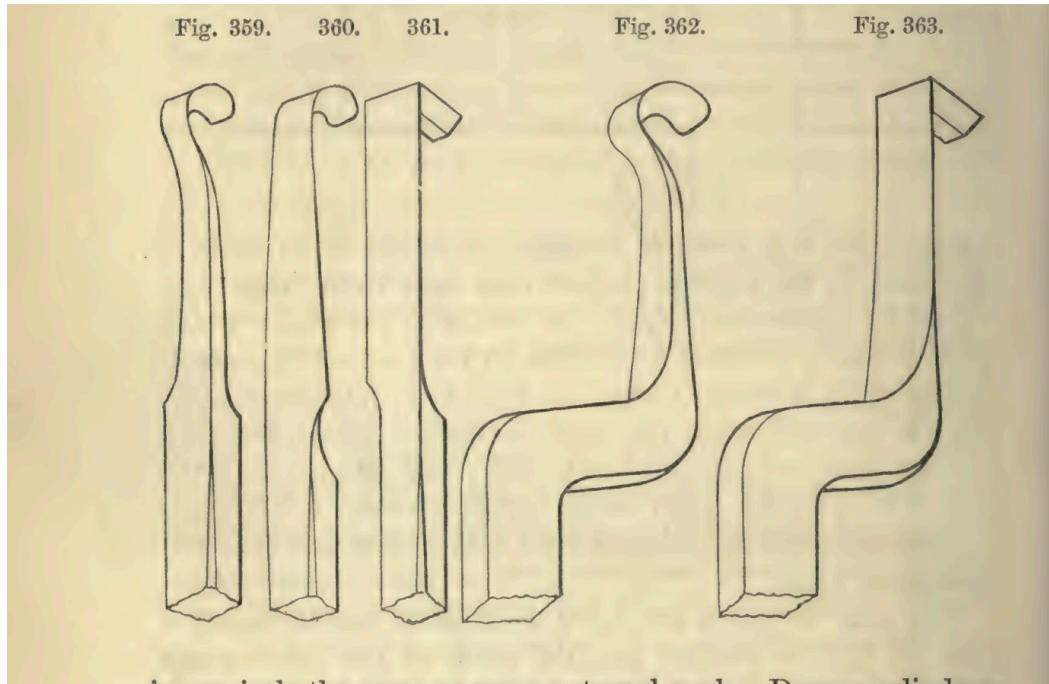


Figs. 355–358: Plain fitting joints — single-hole fitting, two-hole fitting with dowel pin, true internal centre cone (Fig. 357), off-centre double cone (Fig. 358)

Always begin with a centre hole struck with the acute angle of the chisel. The internal cone so formed (Fig. 357) is the universal starting point for all internal turning — it guides pointed tools to centre, arrests blunt-ended tools at the central position, and locates the turning tool when placed against its side. The spoon bit is pressed into the wood with the palm of the hand, forefinger and thumb extended along the tool as a guide, advancing strictly along the mandrel axis. Withdraw frequently to clear shavings; grease the blade with tallow to reduce heat and friction.

Internal Softwood Tools

Internal cylinders and hollows of sufficient diameter but moderate depth can be hollowed from the solid with the ordinary external gouge. For deeper work, the dedicated internal tools are used (Figs. 359–363).

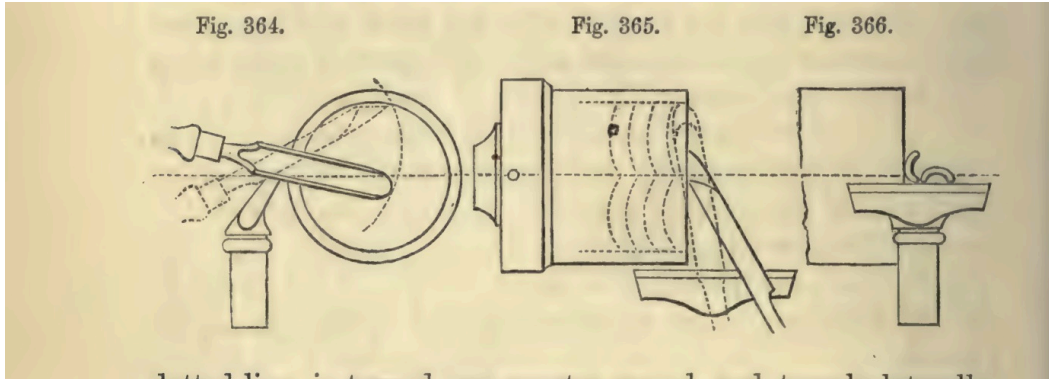


Figs. 359–363: Internal softwood tools — three hook tools (including the combination hook-and-side tool, Fig. 360), two side tools with straight and cranked stems

Hook tools (Figs. 359 and 362) are sharpened only around the hook. The combination tool (Fig. 360) is sharpened around the hook and along the entire straight edge. Side tools (Figs. 361 and 363) have end and side cutting edges meeting at slightly less than a right angle, with the internal corner keenly sharpened; their side cutting portions run from about 1½ to 3 inches. All tools are in long handles and ground with a single inner bevel.

Hollowing with the Gouge

The hollowing gouge ($\frac{3}{8}$ – $\frac{3}{4}$ inch width) is traversed from rim to centre cutting the surface in the normal way. Instead of withdrawing at the centre, push it slightly beyond while simultaneously urging it into the face — increasing the bevel angle beyond coincidence by a slight pull with the left hand and a sway of the body to the right.

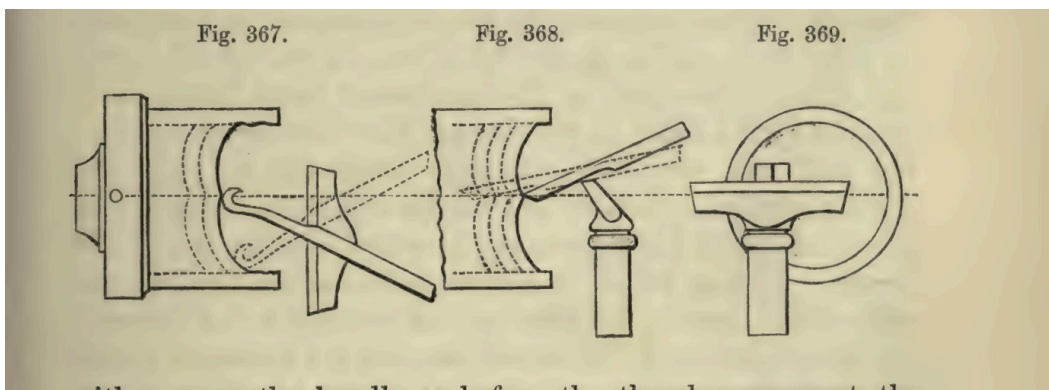


Figs. 364–366: Three views of the gouge in the hollowing position — side elevation showing curved path, section of work showing progressive cuts, end-on view

The cutting edge buries itself, then is raised by gradually depressing the handle, while the shaft also rotates a quarter turn by turning the right wrist. The complete path is a quadruple motion: the tool advances beyond centre, rises in a curve, rotates a quarter turn, and travels laterally along the rest by a distance equal to the depth hollowed. The technique is rapid and highly effective. The gouge cannot usually be taken deeper than approximately the radius of the aperture; beyond that depth it is exchanged for the hook tool.

Hollowing and Finishing with the Hook Tool

For the hook tool, the rest is placed above centre. Both hands are well above the cutting edge, which overhangs the rest below (Fig. 368) — this 'underhand' position is the reverse of the external cylinder stance. The hook is presented to the centre of the work with the stem at a horizontal angle (Fig. 367); while cutting the tool swings on the rest as on a pivot, describing the curve shown by the dotted lines.



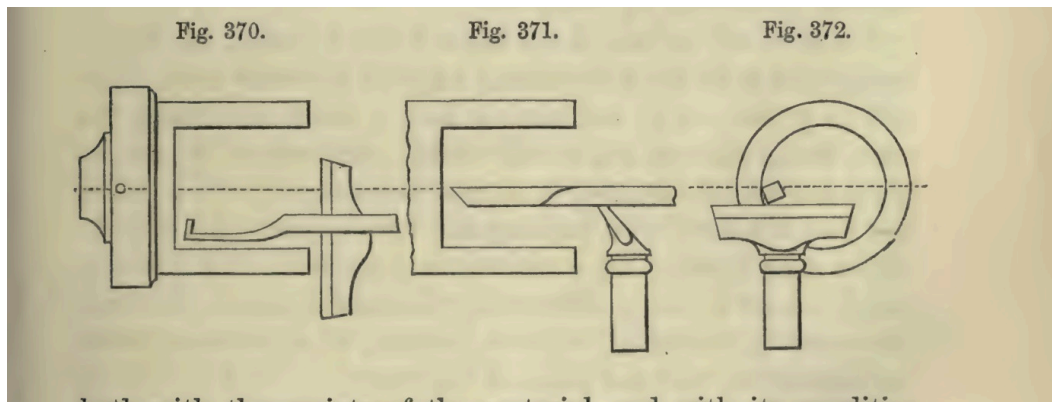
Figs. 367–369: Hook tool in use — plan view showing horizontal angle, side elevation showing underhand position and curved cutting path, end-on view

To smooth the cylinder sides: hold the hook tool quite horizontally, rest lowered to place the edge at centre height, and traverse with the shaft parallel to the lathe axis, slightly

tilted on its left lower corner. Check frequently with callipers. Finish with a series of light cuts from the bottom outward.

The Side Tools

Side tools (Figs. 361 and 363) are used after the hook tool to produce more accurate internal cylinders and surfaces (Figs. 370–372). The shaft is held first parallel to the cylinder, then given an almost imperceptible inclination so the cut falls mainly on the portion of the edge nearest the end corner.



Figs. 370–372: Side tool in use — plan view showing cylinder finishing, plan view showing surface finishing, end-on view of rest position

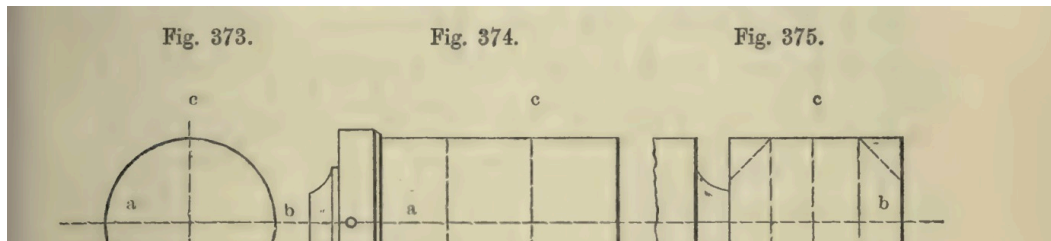
The hook and side tools signal when they are being pushed too hard: the surface becomes ragged and fibrous; continued forcing produces deep splintered cavities. Once a ragged surface is established it tends to get worse. The remedy is more, lighter cuts. The internal surface at the base of the cylinder (Fig. 370) is turned flat with the end cutting edge of the side tool, working from the centre outward in cuts each the width of the tool. The sharp corner of the side tool (less than 90°) means surface and cylinder can be worked independently without damage to either, producing a truly square internal corner.

Section 5: The Sphere and Internal Hemisphere

The Sphere

The sphere is mainly a decorative form in softwood. This form is introduced last because facility on the cylinder, surface, and cone is a prerequisite — the chisel's path around the sphere is a combination of the movements used for all three.

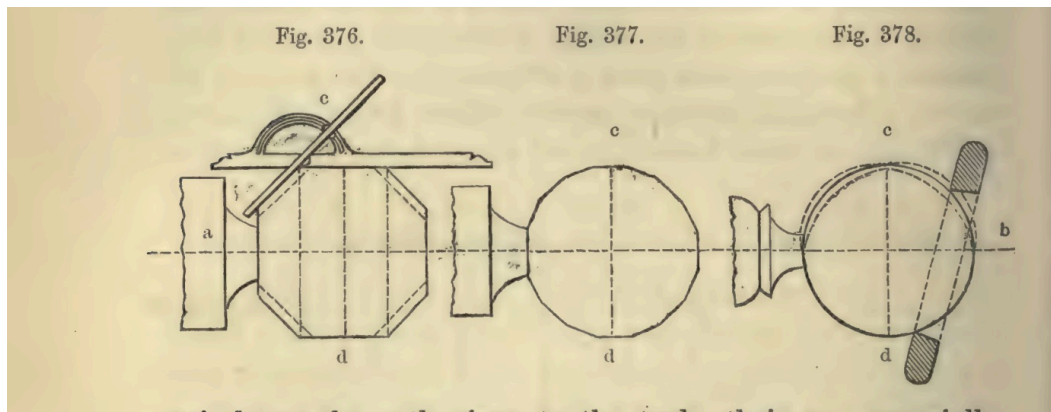
The sphere contour is generated by a series of minute conical elements. At the equator, the chisel lies on its face as on a cylinder. At the pole, it is balanced on its edge as on a surface. Between these extremes, the chisel passes through every intermediate cone position. Three simultaneous motions: lateral sliding along the rest; a quarter-turn rotation; and continuous depression of the cutting edge from equator to pole. The chisel travels in either direction with the obtuse angle leading. The straight cutting edge must remain consistently parallel to the lathe axis at all times.



Figs. 373–375: Sphere geometry and marking — finished sphere showing axes; cylinder at starting dimensions with equator line; cylinder with bisection lines for the polygonal method

The Polygonal Method — for Accurate Spheres

For larger or more accurate spheres, the polygonal method provides a reliable guide. Turn a true cylinder slightly larger than the intended sphere diameter. Mark the diameter as the cylinder length from the end (Fig. 374), bisect to find the equator c–d, and reduce the chuck end to the final stem form. Bisect each half and score two more lines (Fig. 375).

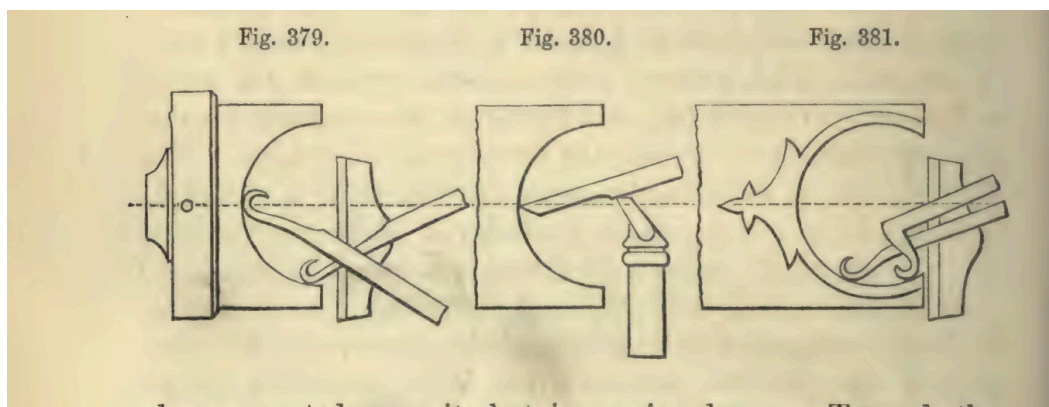


Figs. 376–378: Polygonal method — first reduction to 45° facets (Fig. 376); 16-facet stage approaching circular profile (Fig. 377); error shapes from incorrect chisel twist rate (Fig. 378)

Turn away the four corners to exactly 45° , guided by a bevel gauge. Continue reducing the 45° bevels until all five bands (central cylinder, two 45° cones, two surface circles) are of equal width (Fig. 376). Reduce the eight 135° angles to sixteen planes of $157\frac{1}{2}^\circ$ (Fig. 377), and for large spheres to thirty-two. Final cut: traverse the chisel from equator to each pole, stem always near-perpendicular to the lathe axis, removing just enough to melt the facets into one circular line. Use a ring turned to slightly less than the sphere diameter as a gauge — apply at various orientations and mark any spots where it fails to seat.

The Internal Hemisphere

The internal hemisphere is first roughly hollowed with the gouge as for the internal cylinder, then completed with either the gouge or the hook tool. Hold the hook tool well underhand and sweep it around the curve with a moderate, free-moving cut, commencing from the centre. Toward the centre, the body's sway predominates; as the tool travels toward the rim, the left hand's pull takes over.



Figs. 379–381: Internal hemisphere — section showing hook tool positions and curved path; end-on view of rest position; deeper-than-hemisphere hollow form requiring bent-stem hook tool (Fig. 381)

The hook tool leaves the work cleanly cut and sharp, without requiring any subsequent tool. A thin ring or plate, accurately turned to the required diameter, can be applied within the hemisphere from time to time as a gauge to test the truth of the sweep. For forms deeper than a hemisphere — such as the hollow shape for humming tops (Fig. 381) — the straight-stemmed hook tool is supplemented by a hook tool with its stem bent at right angles.