shank) to give the drill clearance in the hole. As a drill wears, its flute margins wear more at the tip than at the shank, and clearance is soon reduced to zero. A drill with worn margins still performs perfectly well for drilling shallow holes, but when a worn drill is used for deep-hole drilling it will wedge in the hole, overheat or break. Always use new drills to drill deep holes.

Drilling large-diameter holes with the Unimat is simply a matter of working within available power. First drill a pilot hole, and then enlarge the pilot hole with progressive larger drills. Whenever required a large hole can be finish-bored to very close tolerance with a boring tool held in the 4-jaw chuck.

Drilling very tiny holes, termed "sensitive drilling", involves the same problems encountered in deep-hole drilling. In machine shops #60 drills (.040") are the smallest commonly used. But in these days of miniaturization instrument repairmen often have occasion to drill holes much smaller. Extremely small drills are long in relation to their diameter, and the small holes drilled with them are proportionately very deep. Unless tiny drills are used with very sensitive touch, breakage is certain.

To set up the Unimat for small-hole drilling, remove the spindle return spring, oil the spindle cartridge, and adjust the spindle lock screws for very smooth, easy spindle advance. Clean the drill chuck in kerosene to make sure that no chips will wedge between the jaws—or if for high-precision work you will hold the drill in a collet, clean the collet's slots. Use light-viscosity cutting lubricant when drilling small holes, either mineral oil or kerosene.

Centerpunch the work to be drilled lightly to avoid work-hardening the metal, and be sure to mount the work rigidly. As you start a tiny drill in the work, watch its tip with a jeweler's loupe to make sure it begins cutting concentrically. Drill with very light feed, letting the drill cut its own way. Withdraw the drill frequently to clear chips and flush the hole with a syringe filled with cutting oil. High spindle speeds can be used when drilling tiny holes in soft metals, but use moderate speed when drilling steel or cast iron, since excessive speed may dull the corners of the drill's cutting edges and tiny drills are very hard to resharpen.

Countersinking or counterboring holes for screwheads involves no problems provided you work with light cuts to avoid chatter. When a hole you've drilled and countersunk requires tapping, start the tap before removing the work from the machine. With the tap chucked, turn it in by hand while applying light feed pressure with the pinion lever. Don't attempt to run taps in under power.

MILLING TECHNIQUES

With the Unimat set up as a vertical milling machine, you can readily mill slotted or recessed parts that would be difficult to machine in any other way. Many kinds of cutters can be used for vertical milling, but three types are most common: slotting cutters, spiral end mills and rotary files.

Slotting cutters have two flutes. They can be sunk into work like drills and then fed laterally to mill slots or recesses. Spiral end mills, which have multiple spiral flutes and mutiple cutting edges, are designed to make shallow cuts sideways, with the cutter's radial end teeth scraping the work to very smooth finish. Rotary files, which have cut rather than ground teeth, are less expensive than ground cutters and come in a wider variety of shapes. Woodruff key-seat cutters and other special cutters are also available. Since the Unimat's spindle rotates clockwise (viewed from above), always use right-hand-cutters.

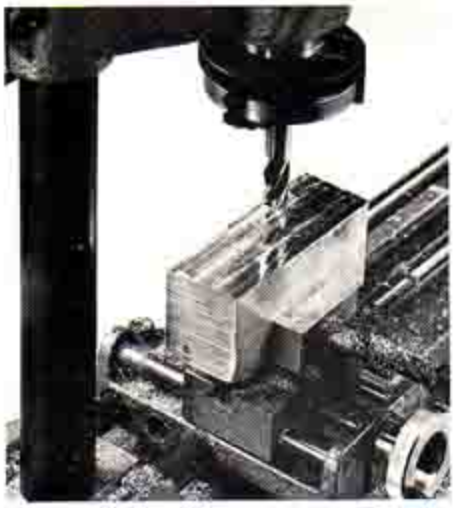
Milling cutters must be used with care in order to keep them sharp. Their cutting edges are hard and brittle, and to avoid chipping their teeth you must feed the cutters into the work slowly and evenly. Mount the workpiece to be milled on the cross slide as rigidly as possible, either in the

WHEN COUNTERSINKING holes use slow spindle speed to avoid chattering.

MANY TOOL-GRINDING SET-UPS are possible on the Unimat. Avoid overheating the tool.

USE VERY GRADUAL FEED when milling with small cutters. Use the Unimat's longitudinal feed screw to feed the work to the cutter whenever possible.

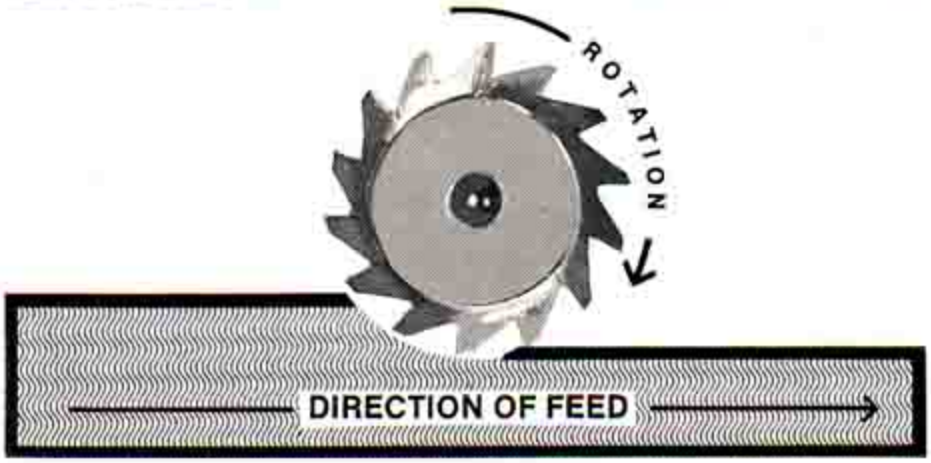
TO TAP HOLES, chuck the tap and turn it into the hole by hand—never under power.



LARGE DIAMETER END MILLS used to mill flats can be held in the 3-jaw chuck.

A SMALL FLY-CUTTER cuts neat holes in aluminum or brass. take light cuts.

ROTARY FILES, available in a variety of shapes, mill grooves or recesses.



machine vise, in a spindle chuck, fixed on a workplate or clamped on the accessory milling table. Since any "give" in the work may break the cutter, mount the work solid.

The machine's feed movements should be set up quite tightly, with the longitudinal feed used whenever possible to feed the work to the cutter. It's important when making milling set-ups to orient the work for "up" milling. The cutter's teeth should always sweep forwards along the line of cut, opposing the direction of feed, and then upwards and out of the work. Never mill with the cutter's teeth sweeping downwards and back, for the teeth would then tend to pull the work under the cutter, which would cause the cutter to climb and break. Milling at moderate spindle speed greatly prolongs the cutters useful life. Flood the mill with cutting oil when milling steel. Large-diameter end mills used to mill flat surfaces should be run at slowest spindle speed.

Very tiny end mills give best service when held in the collet chuck. Use very gradual feed. If you use a jeweler's loupe to mill to scribed lines, it's possible with practice and patience to make unbelievably intricate cuts with small mills.

SURFACE GRINDING TECHNIQUES

With a grinding wheel mounted on the spindle, the Unimat when set up vertically will do a beautiful job of finish-grinding small steel parts, either hardened or unhardened. Most surface-grinding jobs can be performed most satisfactorily with a cup wheel, though straight wheels can be used. Ordinarily the wheel should turn at fairly high speed, about 5000sfm. Since any grinding wheel throws swarf, remember to wear protective glasses when grinding.

Always grind with successive passes, removing no more than a few thousandth at each pass. When surface-grinding large areas, take very light cuts with gradual feed to avoid overloading the machine's motor. Be careful not to overheat the work when grinding heat-treated parts. If the grinding wheel leaves a mottled finish on the work, it's an indication that the wheel needs dressing, which is accomplished by feeding the point of a diamond dressing tool (pg. 35) across the wheel's face. Lacking a diamond dresser, you can use a piece of broken grinding wheel similarly. Dress the wheel very lightly—only enough to remove embedded metal particles and expose fresh abrasive grains.

Using the accessory indexing head (pg. 33), many cutter-regrinding set-ups can be made on the Unimat. When grinding cutting edges, grind "on" rather than "off" the edge. Start the pass beyond the edge, feed the wheel towards it, across it, then on across the edge-bevel.

MANY TYPES OF CUTTERS can be used for vertical-spindle machining. Some are shown above. Use milling cutters with care to keep them sharp.

USING UNIMAT ACCESSORIES

Several of the more commonly-used Unimat accessories are supplied with the machine, and with standard equipment the tool is uniquely versatile. The many other accessories available extend its capabilities even further. Most of these extra accessories are exactly like the accessories used on industrial machine tools but smaller. They simplify making various metal-machining set-ups. Others convert the Unimat for special work—each woodworking accessory, for example, making the machine a miniature version of a standard woodworking power tool. The extra accessories you'll want for your Unimat will depend upon the kind of work you'll do with it. Acquire basic accessories first, and then add accessories for special jobs to your outfit as you need them.

Numerous accessories are available for the Unimat, more accessories in all than are available for most larger machine tools. While several can be used in more than one way, the machine's accessories can be grouped loosely into four categories: lathe accessories; accessories for drilling, milling and grinding; watchmaker's accessories designed especially for very small ultra-high-precision work; and woodworking accessories, which are popular with model-builders.

Three of the machine's accessories are so useful for so many jobs that they could be termed basic, and these are the accessories a Unimat owner should acquire first. The three are the 3-jaw universal lathe chuck, the machine vise, and a ball-bearing live tailstock center (either of the two available). The 3-jaw chuck is the single most useful device for mounting work on the lathe spindle for turning. The machine vise is by far the most convenient workholding device for mounting work to be drilled, milled or surface-ground on the machine's carriage cross slide. The ball-bearing tailstock center makes it unnecessary to continually relubricate and readjust the lathe's dead center, and a live center is strongly recommended for any turning or polishing performed at high spindle speed.

Having equipped your Unimat with these three basic accessories, you can collect other accessories as you need them over a period of time, adding them one by one to complete your outfit. Some of the tool's accessories are multi-purpose devices; others are used less frequently only for special set-ups. Remember when selecting accessories that some of them are used in combination with others. You'll need collets for the collet chuck, for example, and a mounting plate for the T-slotted fixture plate. Since ordinarily the 3-jaw universal chuck is used to mount work on the indexing and dividing head, it's advisable to have the chuck before purchasing the indexing head.

Because most of the lathe and vertical-operation accessories are designed for precision work, they are manufactured to the same close tolerances as the Unimat itself, with critical parts hardened and ground. The collet chuck in particular is finish-ground with extremely high precision. Like the machine, these precision accessories must be cleaned and oiled regularly to protect them from rust, and they should be stored in a manner that prevents loss or accidental damage.

One way to keep the Unimat's smaller accessories neatly arranged ready at hand is to store them in a tool board. To make a suitable board, lay out the accessories you have in any way you like on a piece of ¾" hardwood plywood, draw around them with a pencil, and rout a recess in the board to pocket each accessory. You can rout these recesses with the Unimat, or you can use a portable electric router. Since a board of this kind is quite easy to make, whenever you acquire new accessories you can make a larger board with additional pockets. Painting the board a light color with a spray can prevents the wood from soaking up oil and makes the board easier to wipe clean.

Since from time to time new accessories are made available for the Unimat, order accessories from an up-to-date catalog. A current issue will be mailed to you on request. Dealers in larger cities keep the full line of accessories in stock for immediate delivery.

A TOOL BOARD cut from hardwood plywood keeps small accessories ready at hand.

THE THREE MOST USEFUL ACCESSORIES are the 3-jaw universal lathe chuck, the machine vise, and a ball-bearing "live" tailstock center.

Lathe Accessories

Accessories used primarily for lathework comprise the largest group of Unimat accessories. A variety of standard accessories are used on metal lathes, and the lathe accessories available for the Unimat are employed like the similar devices used on large industrial lathes.

3-JAW UNIVERSAL CHUCK

Although the self-centering 3-jaw scroll chuck is designed to grip only round or hexagonal workpieces, square or rectangular work can be chucked if the stock is first ground or filed round on one end. Large square or rectangular stock can be mounted between centers and turned round on one end for chucking. In one way or another the 3-jaw chuck can be used to hold nearly any kind of work up to 2¼" in diameter, which makes this chuck the single most useful Unimat accessory.

Jaws normal

Jaw reversed

THE 3-JAW CHUCK'S JAWS can be reversed for gripping large-diameter work pieces.

The chuck's body and scroll plate are made of steel, with both the jaw slots and the spiral scroll precision-ground. The scroll plate is held on the body of the chuck with a flat snap ring, which if necessary can be removed with ring pliers. It's not necessary to remove the scroll to clean the chuck. You can clean it thoroughly simply by screwing out and removing the jaws, and then washing the body and scroll as a unit, and the jaws separately, in kerosene. After cleaning lubricate the scroll and jaw slots with light machine oil, and also oil the snap ring retaining the scroll plate. Then replace the numbered jaws in the corresponding jaw slots and turn the scroll clockwise (viewed from the front) to engage the jaws in sequence, first #1, then #2, then #3.

The jaws can be reversed to hold large-diameter workpieces by interchanging jaws #1 and #3 in their slots. First insert jaw #3 reversed in slot #1 and turn the scroll clockwise to engage the jaw. Next insert jaw #2 reversed in slot #2 and turn the scroll clockwise to engage this second jaw. Then insert jaw #1 reversed in slot #3 and turn the scroll clockwise until this last jaw engages. The lip of the spiral scroll will catch the jaws smoothly when the jaws are properly positioned. Never force the scroll.

The 3-jaw chuck comes ready-mounted on a finish-machined threaded mounting plate that screws on the lathe spindle. Take care when handling the chuck to avoid marring the mounting plate's rear face, since a nick would prevent the plate from seating squarely against the spindle's shoulder and the chuck would then run with slight wobble. Always clean and oil the spindle's threads and shoulder before screwing on the chuck. Similarly, before mounting the chuck with the adapter stud on the carriage cross slide, clean and oil the top of the slide.

THE ADAPTER STUD, supplied mounts the chuck on the carriage cross slide.

Avoid marring the narrow ground faces of the chuck's jaws when tightening the chuck on hardened work. Be sure both chuck and work are clean. Remember to clean the chuck thoroughly to remove swarf whenever you've used it to hold work for grinding.

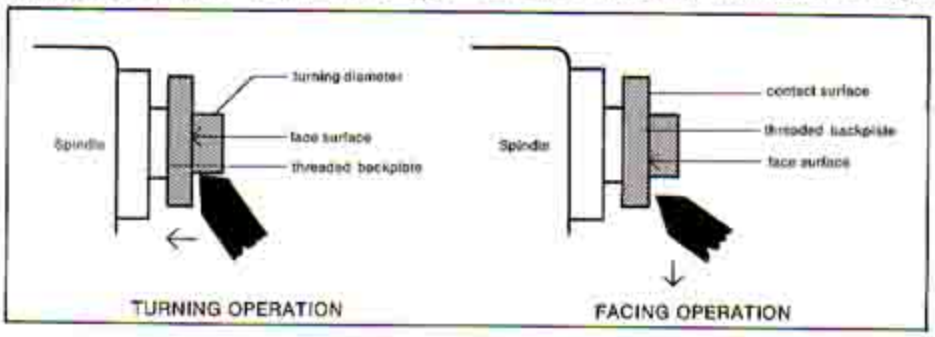
When chucking round workpieces that must be mounted with best-possible concentricity, twirl the work slowly with one hand as you close the chuck—using the two steel pins inserted in the body and scroll plate—with the other. When the jaws have gripped with square purchase, tighten the scroll only enough to hold the work firmly. Avoid overtightening the jaws, since severe overtightening can degrade the chuck's precision. Keep the screws holding the chuck on its mounting plate well tightened.

Precision built, the 3-jaw chuck centers work more accurately than larger scroll chucks—to within a thousandth or two. Use the collet chuck for work that must be centered with higher precision.

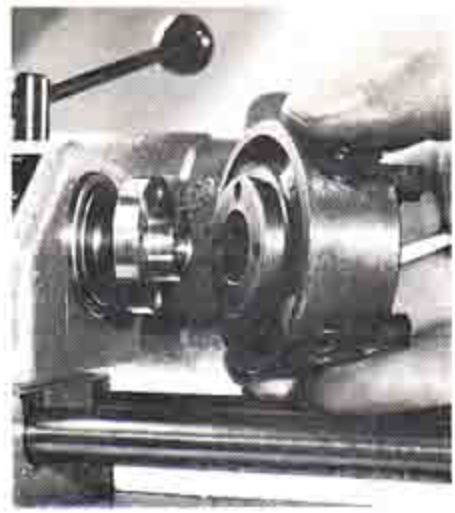
THE 4-JAW INDEPENDENT CHUCK

The 4-jaw chuck comes unmounted, with its mounting plate, which is included with the chuck, supplied slightly oversize to allow custom-fitting the chuck to the particular lathe's spindle. To mount the chuck you must accurately finish-turn the mounting plate to fit the back of the chuck's cast iron body.

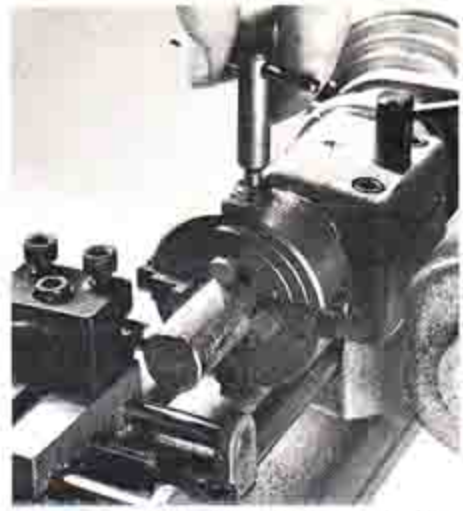
Before doing this make sure that the lathe's headstock is accurately aligned. Then very carefully clean and oil both the spindle's nose threads and the plate, and screw the plate on the spindle until it seats firmly against the shoulder. Next, taking very light cuts with a sharp-pointed bit whetted very sharp, turn the diameter of the mounting plate's tenon to the exact size required (.669") to push-fit into the chuck's bore. Work painstakingly, being very careful not to turn the tenon too small, for it must fit into the chuck with no lateral play whatever. If you lack a micrometer, turn the tenon to diameter with extremely light cuts, trying the chuck on the plate after each cut. Having turned the tenon to exact size, take a light truing cut across the plate's face to insure that the chuck will seat squarely against it. When truing the plate's face use very gradual feed and turn right



THE 4-JAW CHUCK'S JAWS screw-adjust separately and grip the work very tightly.



CAREFULLY FINISH-TURN the mounting plate to fit the bore in the back of the chuck body.



WORK MUST BE CENTERED in the chuck by hand by adjusting the four jaws in pairs.

across the four tapped screw holes.

With the plate finish-machined, clean and oil both the plate and the back of the chuck, and screw the chuck on the plate with the four flat-head machine screws provided. If the mounting plate has been accurately turned the chuck will now run perfectly true on the spindle.

The 4-jaw chuck holds square or rectangular work for turning, or large round work that must be centered with exact precision. Work can be centered in the chuck very precisely by adjusting the four jaws individually to shift the workpiece as needed. Setting a tool bit at the work's periphery indicates which way the work must be shifted to center it. The 4-jaw chuck's jaws can be screwed out and reversed in their slots to grip large-diameter work, but when screwed out to maximum capacity the jaws will strike the Unimat's rear way. The headstock raising block can be inserted under the headstock whenever needed to allow the chuck jaws or the corners of large square work to clear the machine's bed.

Remember when using the 4-jaw chuck that its square key screws the jaws down on the work with enormous force, and that excessive tightening can strip the threads in the cast iron body. Tighten the jaws only enough to grip the work securely. Work that overhangs the jaws more than four times its diameter should be centerdrilled and supported with the tailstock.

Keep the chuck's jaw screws well-oiled, and wash the jaws, screws and body regularly in kerosene to clean out dirt and chips. The jaws should slide smoothly in their slots without forcing. If a chip wedged in a jaw screw causes sticky operation, unscrew the jaw and remove the chip.

THE COLLET CHUCK

The collet chuck is also supplied with an unfinished threaded mounting plate that allows custom-fitting the chuck to the particular lathe's spindle. Although a simple device, the Unimat's collet chuck is very accurately ground, and the double-tapered spring collets used in it center small round workpieces with exceptionally close precision. To utilize this inherent precision it's necessary to mount the chuck with great care. Finish-turn the mounting plate's tenon to fit the chucks' bore snugly (if you should turn it too small, order another plate and try again). When you've trued the plate and screwed on the chuck body, test the chuck's concentricity by chucking a length of drill rod several inches long in a collet. If the chuck is accurately mounted the unsupported end of the rod will turn with very little runout.

The alternately-split collets used in this chuck, which must be purchased separately, are available in inch sizes from 1/64" through 5/16" by 64ths, and in metric sizes from 0.5mm through 8mm by half-millimeters. A special .0135" collet is available for holding tiny #80 drills, and unhardened collets that can be bored as required for special work also can be ordered.

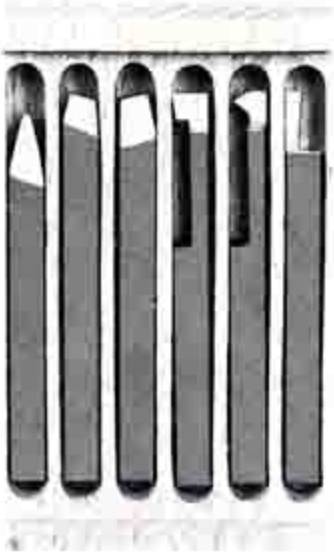
Keep the internal tapers in the body of the chuck and in the knurled nose-piece that closes the collet wiped clean with an oiled rag, since even a small speck of grit will cause runout. Grease the threads of the chuck's nose-piece for smooth closing action. After each use oil both chuck and collets liberally to prevent rust, for even a fingerprint will rust-pit their highly-finished surfaces.

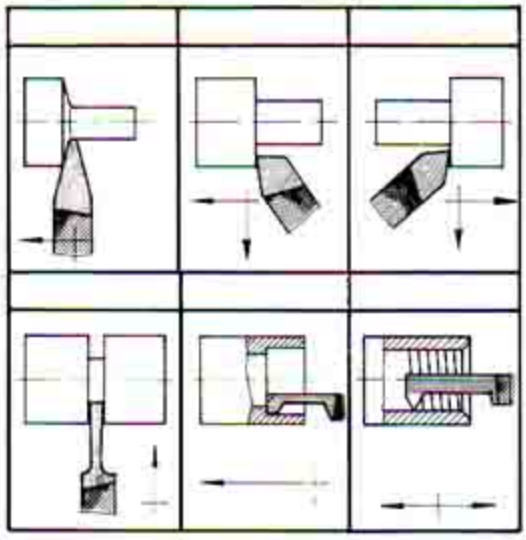
The double-tapered collets will open or close ten or fifteen thousandths, gripping tightly and evenly. To preserve their precision never close collets on work more than 1/64th undersize, on work that isn't perfectly round, or on marred tool shanks. If a collet sticks in the chuck's taper when the nosepiece is unscrewed, gently tap it out from behind with a length of brass rod.

STORE COLLETS in order of size in a case, which you can either buy or make yourself.

LATHE TOOL BITS

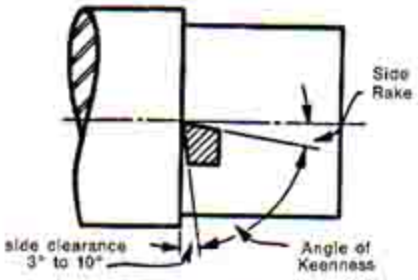
While the ready-ground general-purpose tool bit supplied with the Unimat makes either cylindrical or facing cuts, ordinarily lathe tools are ground especially for particular cuts in particular materials. As you learn to use your machine you'll soon need other bits ground for other turning operations. You can either order a set of ready-ground bits, or you can buy a number of unground bits and grind them yourself (as pictured below). Recommended rake and clearance angles for the more commonly used bits are given in machinist's handbooks.





It's primarily the heat generated at the point of cut that dulls a lathe tool's cutting edge. For this reason lathe bits are made of tungsten- or molybdenum-alloy high speed steel, steels which retain their hardness even at high heat. Cobalt added to a high speed steel alloy improves the steel's hot-hardness even more, and for high speed turning "high speed cobalt" bits hold sharpness longer than ordinary high speed steel bits. Small tungsten carbide bits also can be used in the Unimat, though they're more expensive and difficult to resharpen.

Bits ¼"-square, which the tool block mounts at approximately center height, are recommended for most lathework. The tool block's slot will also hold 5/16"- or ⅜"-square bits, however, and when extra length or rigidity is needed—for boring or cut-off tools, for example—you can grind tools from unground bits in these larger sizes.



Rough-turning and finish-turning tools are similar in shape and have the same clearance and rake angles, but while the points of roughing tools are left sharp, the points of finishing tools are ground to a small radius, usually about 1/32", and whetted smooth. Because less power is required to shear off chips when the tool bit has a sharp point, a sharp-pointed tool can make heavier cuts without overloading the machine than a round-nose tool. When turning large steel or cast iron workpieces in the Unimat it's advisable to use sharp-pointed bits for both roughing and finishing, feeding finishing cuts slowly for smooth finish.

Always make sure that any lathe bit you grind will have sufficient clearance under its cutting edge—usually 10°—to allow it to feed into the work. Too much clearance is better than too little. However sharp it may be, a cutting edge without enough clearance to allow it to bite into the work without rubbing cannot cut smoothly, and failing to provide clearance is the mistake inexperienced machinists commonly make when grinding lathe tools. An experienced machinist when either grinding or resharpening a bit first grinds side clearance, then end clearance, and finally suitable top rake. Whatever the shape of the tool, if its cutting edge has side clearance, end clearance and rake, the bit is sure to cut.

Most lathe tools can be reground about 100 times—until they are ground too short to be mounted in the tool block. Many machinists grind bits on both ends, grinding one end for right-hand cuts and the other for left-hand cuts.

BALL-BEARING LIVE CENTERS

Two live centers are available for use in the Unimat's tailstock ram. Both are similar in design, but one has a single ball-bearing and the other has two ball-bearings. The single-bearing center is adequate for all ordinary turning and polishing. The double-bearing center is preferable for critical high-precision work, since the double bearing gives the freely-revolving center point better support and minimize runout when the bearings eventually begin to wear.

The bearings in both centers are grease-packed. Never oil them. When long use at high speed warms the center, a little grease may ooze from the bearing's front seal, which isn't cause for concern. Once every few years the bearings should be regreased by forcing a little new bearing grease through the hole in the center's shank with a small swab.

For special jobs you can remove either center's hardened point and replace it with a cup center or pipe center you machine yourself. To remove the 60° point, place the center face-down on a wood block in which you've bored a ½" hole, and gently drive the point out of the bearing with a small drift punch inserted in the shank's hole. Turn the special center from tool steel to the same diameter as the 60° point, heat it red-hot and quench it in oil. Then tap it into the live center's bearing. It should fit tightly, but not tightly enough to distort the bearing.

HEADSTOCK RAISING BLOCK

The die-cast headstock raising block is exactly ¾"-thick. Inserted between the Unimat's headstock and bed casting, it increases the lathe's swing by 1½" and permits turning chucked or faceplate-mounted work up to 4-7/16" in diameter. When the machine is set up for drilling or milling the block can be inserted between the headstock and the column's adapter casting to increase the spindle's reach, making it possible to drill or mill to the center of a 7⅛" circle.

The raising block is required in order to use either the sanding plate or the large-diameter circular saw blade on the spindle, since both of these accessories require extra swing.

With the headstock raised on the block, the bed's clamping screw seats in the headstock tenon's lower chamfered groove. It simplifies accurately realigning the spindle with the ways if before mounting the headstock on the raising block you clamp a straightedge in the tool block and set its edge parallel with the face of a workplate screwed on the spindle. You can then easily realign the headstock after raising it on the block by adjusting it until the plate is again parallel with the straightedge.

Whenever the spindle is raised for turning large-diameter work it's necessary also to raise the tool block, since the lathe tool always should be set at center height. To raise the bit you can either screw the machine vise on the cross slide and clamp the tool block in the vise, or you can mount the tool block on a ¾"-thick spacer machined from scrap aluminum using a longer mounting screw. Extra Allen-head screws in assorted lengths are listed in the catalog.

RAISING BLOCK increases the lathe's swing for turning larger-diameter faceplate work.

THE BLOCK can also be used to increase the head's reach for vertical drilling or milling.

THE STEADY REST

The Unimat's steady rest is used in three ways.

First, it can be clamped wherever needed along the lathe's ways to provide intermediate support for long, limber work that otherwise would spring away from the tool's cutting edge and chatter. With the rest positioned as close to the point of cut as practicable, its three brass jaws should be adjusted to just touch the work as it revolves. The jaws then serve as bearing surfaces to prevent the workpiece from deflecting under the pressure of the cut.

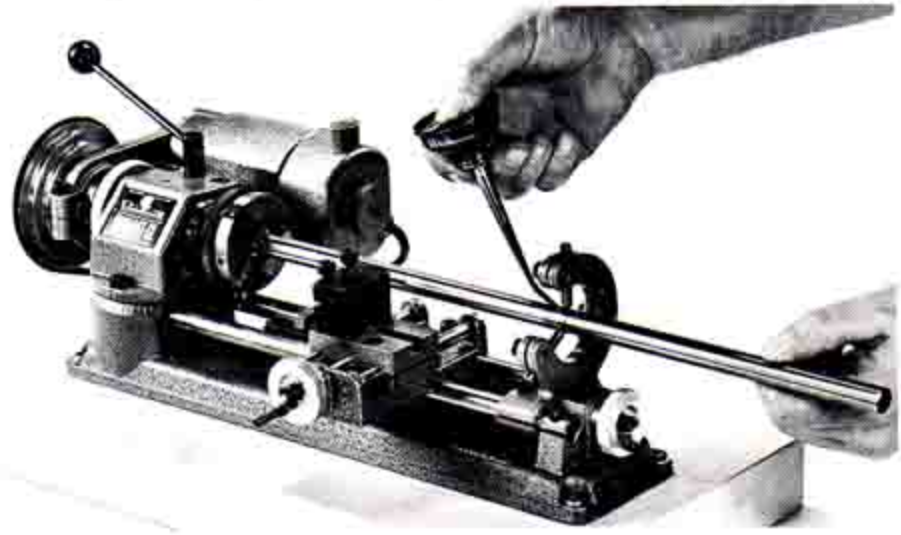
Second, the rest can be used to support the free end of workpieces that can't be supported with the tailstock—work to be faced or bored on the end, for example. Its jaws have 1½" capacity.

Third, the rest can be clamped at the end of the bed in place of the tailstock to support work that is longer than the machine.

Work supported in the rest must have a smooth, perfectly round surface for the jaws to bear on. Square stock can be supported in the rest if you press on a turned steel bushing. When using the rest to support work that has a standard diameter, slip a ball bearing on the workpiece and adjust the rest's jaws to clamp the bearing.

When the rest is used instead of the tailstock to support work longer than the bed, the jaws must center the work accurately if the lathe is to cut a true cylinder. An easy way to center the jaws is to slide the rest up to the headstock and set its jaws to correspond with the jaws of the 3-jaw chuck. The spindle end of overhanging work must either be gripped in a chuck, or if center-drilled and driven with a dog, lashed to the faceplate with a rawhide shoelace. Run overhanging work at slow spindle speed.

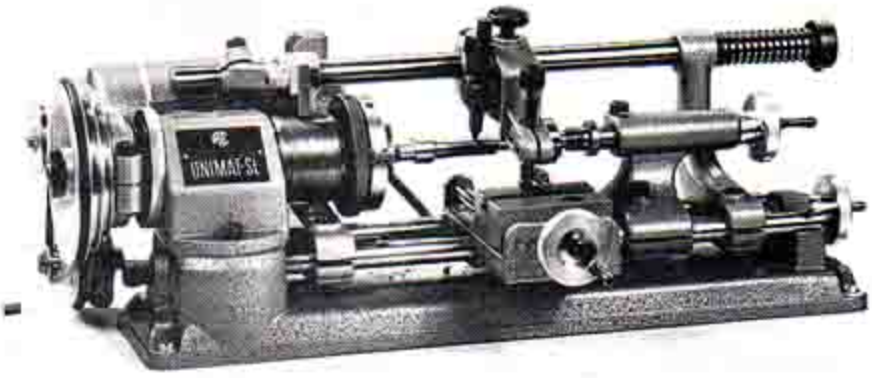
The rest's brass jaws must be kept well lubricated with oil or grease. When they eventually wear down you can buy replacements.



STEADY REST supports limber work, work to be machined on one end, or work that is longer than the lathe's bed. Keep the rest's three brass jaws well oiled.

THREAD CHASING ATTACHMENT

The Unimat's thread chasing attachment cuts standard inch threads from 16 through 56 threads per inch and threads in common metric sizes from 0,50 through 1,50mm, external or internal. Like the threading attachments used on some industrial lathes, the device employs a precision-threaded pattern bushing to lead a threading bit along the workpiece at the pitch required. As the brass follower that rides the pattern bushing slides the attachment's spring-loaded overhead guide bar in its brackets towards the headstock, the tool bit mounted vertically on the arm clamped on the guide bar duplicates the pattern bushing's pitch. While a separate pattern bushing is required for each thread-pitch cut, this method produces more precise threads than geared-leadscrew threading set-ups, and it also simplifies cutting threads to shoulders or in blind holes.



A PATTERN BUSHING mounted behind the chuck leads the threading bit along the work at the required pitch. Threads are cut with successive passes.

To install the attachment, clamp the guide bar's two brackets on the lathe's ways with the cutting arm on the bar between the brackets. Secure the coil spring on the tailstock end of the bar with the collar.

Either the 3-jaw universal or 4-jaw independent spindle chuck can be used to hold the work to be threaded. To mount the pattern bushing behind the chuck, extend the lathe's spindle housing all the way out, and unscrew the chuck from its mounting plate, leaving the plate on the spindle. Then slip the pattern bushing over the mounting plate and remount the chuck, sandwiching the bushing's flange between plate and chuck, with the extra-length flat-head screws provided. The bushing will now run concentrically with the chuck.

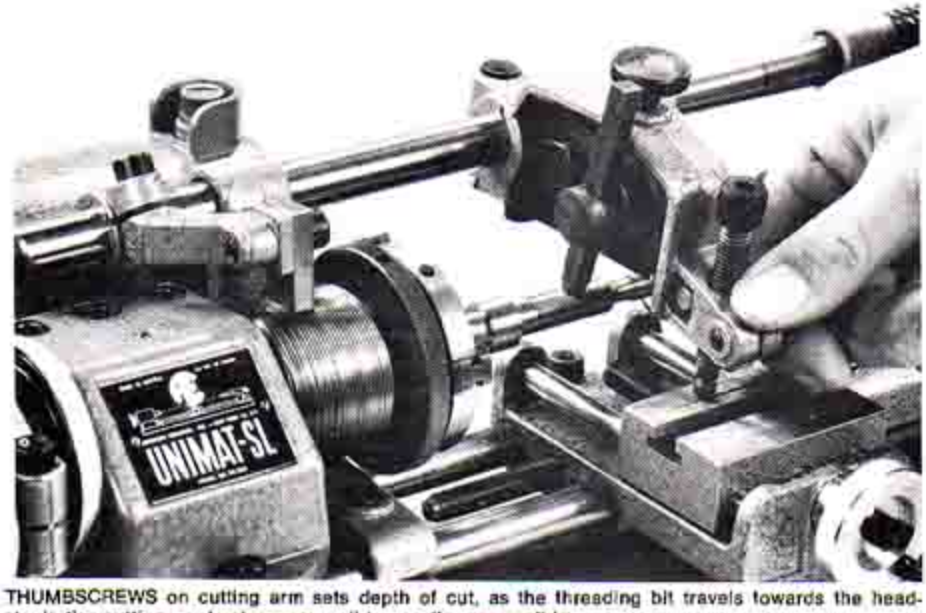
Next mount the threading bit in the cutting arm's holder. The ready-ground 60° bit supplied with the attachment cuts standard American National or metric threads, and Whitworth, square or Acme threads can be cut with bits ground to appropriate profile. Then, with the brass follower set to engage the pattern bushing's first threads, adjust the cutting tool in such a way that the bit's point just touches the surface of the workpiece when the arm's stop screw bears on the lathe's carriage cross slide.

Threads are cut with successive passes. Before each cut feed the tool in with the thumbscrew on the top of the cutting arm to cut a chip about .004" deep. Then to make the cut, pivot the cutting arm forward until its stop screw bears on the cross slide and hold it down firmly. This will engage the follower with the pattern bushing and the follower will lead the tool along the work, sliding the cutting arm's stop screw along the top of the cross slide. At the end of the cut raise the cutting arm to lift the tool out of the thread. As the arm is lifted, the guide bar's coil spring will return the tool to starting position for the next cut.

Gradually decrease the depth of cut as the thread nears finish depth. While you can measure the depth of the thread with a thread micrometer, ordinarily it's easier to use a nut having the proper thread as a gauge, simply deepening the thread little by little until the nut screws on the work.

To cut internal threads, mount an internal threading bit point-downwards in the drop-bar toolholder supplied with the attachment and position the tool with its point just touching the bottom of the hole to be threaded exactly on center. Cut the threads with successive passes just as when cutting external threads, but take care when lifting the tool out of the cut not to bump it against the top of the hole hard enough to mar the threads.

Use the slowest spindle speed for threading, since—particularly when you're cutting threads with coarse pitch—the tool travels quite rapidly. The slow-speed attachment (pg. 31) is recommended for threading large-diameter work. When threading steel always use cutting oil liberally.



THUMBSCREWS on cutting arm sets depth of cut, as the threading bit travels towards the headstock, the cutting arm's stop screw slides on the cross slide.

POWER FEED ATTACHMENT

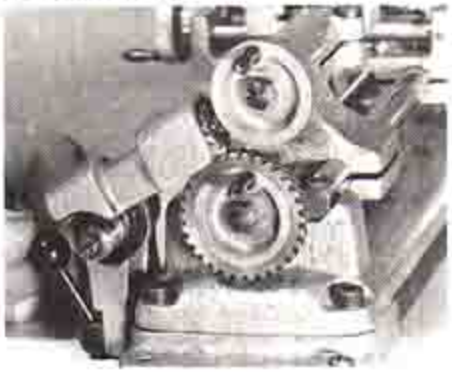
Saving the operator the tedium of feeding long cuts by hand, the Unimat's power feed attachment gradually slides the carriage along the ways automatically, advancing the cutting tool steadily and evenly at the rate of .0008" per spindle revolution. This slow longitudinal feed rate gives lathework a very smoothly-machined finish even when turned with a sharp-pointed bit, which makes the feed attachment especially helpful for turning or boring hard-to-machine metals, large diameter workpieces and cast iron. When disengaged the power feed does not interfere in any way with other Unimat operations, and the attachment can be permanently installed on the machine.

A pulley-nut screwed on the lathe spindle in place of the standard spindle pulley retaining nut, belt-drives the feed unit's shaft. Remove the spindle from the machine and grip the pulley's faces between wood blocks in a vise to unscrew the standard nut, and when tightening the pulley-nut supplied with the attachment on the spindle take care to maintain proper spindle bearing adjustment. The gear assembly on the tailstock end of the feed shaft worm-drives a special helical-toothed handwheel that replaces the Unimat's standard longitudinal feed handwheel. When installing the toothed handwheel adjust it to turn freely but without axial play.

A FEED SHAFT driven by the spindle gear — drives a special toothed feed handwheel which slowly power-feeds the lathe carriage along the ways towards the headstock.

After cleaning the bottom of the Unimat's bed casting, screw the machine to the feed attachment's two base plates with the four cap screws provided and align the plates' adjustable bearing brackets to permit the shaft to turn freely. Use light mineral oil to lubricate the sleeve bearings. Then, having positioned the spindle cartridge to align the pulley-nut with the feed shaft pulley, slip on the rubber drive belt.

Flipping the attachment's operating lever up engages the spring-loaded worm-gear assembly's pinion with the toothed feed handwheel. Lubricate these gears regularly with light grease. The toothed longitudinal feed handwheel can be operated manually when the operating lever is disengaged. Remove the belt when the feed attachment is not in use.



The power feed normally advances the carriage towards the headstock. Crossing the rubber belt to reverse the shaft's direction of rotation reverses the feed for left-hand cuts towards the tailstock.

SLOW-SPEED ATTACHMENTS

While the Unimat's slowest spindle speed provides enough power for machining ordinary work, for such jobs as turning large-diameter steel workpieces, drilling with large drills or cutting coarse-pitch screw threads even slower spindle speeds are desirable. Slower spindle speed can be obtained with either of two speed-reducing devices, one mechanical and the other electronic.

The mechanical speed reducer is a motor mounting bracket with an extra idler step-pulley that is installed in place of the Unimat's standard bracket. The extra idler pulley gives the belt drive double reduction —twice the power at half the speed. It reduces the standard speed range by half, giving a minimum speed of about 130 rpms.

Install the double-reduction bracket just as you did the standard bracket when first setting up your machine. Remove the standard bracket's idler and insert it in the new bracket, taking care not to clamp the idler's bearing tightly enough to cause binding. Then reverse the motor pulley on its shaft (with the largest step facing the motor) and replace the drive belts. Prestretch the extra rubber belt supplied with the bracket with your fingers before slipping it on the pulleys. The slow-speed attachment can be left on the Unimat permanently. Whenever high spindle speeds are required, simply omit the rearmost idler from the power train, reversing the motor pulley and driving the second idler from the motor.

The electronic speed control is an SCR device (silicon controlled rectifier) that will govern the speed of any universal (AC-DC) motor drawing up to 7.5 amps. It controls speed by cycling the current to the motor very rapidly on and off, and—unlike a rheostat—maintains 95% of the motor's torque at slow speed. With the unit plugged into the line, its knob gives instant speed selection from zero to full-rpm operation. A three-wire cord and plug is supplied.

Disconnect the control from the line when it's not in use.

THE ELECTRONIC SPEED CONTROL maintains motor torque through zero-to-full speed range.

Drilling, Milling and Grinding Accessories

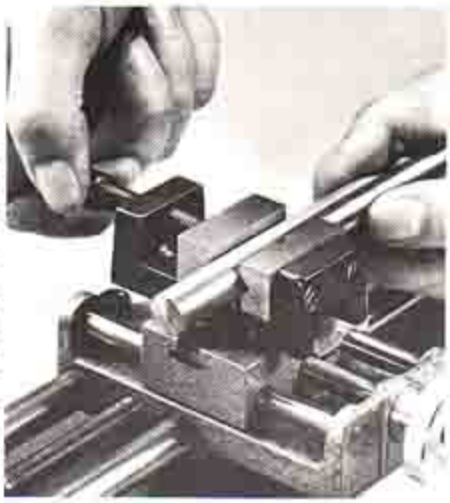
Of the accessories in this group the machine vise is the device used most often in ordinary work. The other work-mounting fixtures convert the Unimat to a miniature vertical-spindle milling machine, and with them work can be mounted and milled just as on larger machines. The grinding-polishing accessories make it possible to perform nearly any common finishing operation on the Unimat.

MACHINE VISE

Although work can be held for drilling or milling by clamping it directly on the carriage cross slide with stud clamps, it's ordinarily much easier to mount the Unimat's machine vise on the cross slide and grip the workpiece in the vise. The miniature vise is built exactly like larger precision vises, with a drop-forged steel body and hardened, precision-ground jaws. The jaw faces are 1⅜" wide, and the jaws open to 1⅛" normal capacity. Work up to 1½" thick can be gripped if the V-grooved fixed jaw is unscrewed and temporarily removed. An accurately-fitted slide plate gives the movable jaw smooth closing action. A precision vise has great holding power, and the jaws of the little vise grip work very firmly without excessive tightening.

When screwed on the cross slide the vise is oriented with its jaws parallel with the machine's ways. It can be mounted jaws-crosswise if the accessory milling table is first mounted on the cross slide and the vise then mounted on the table.

Keep the vise body's underchannel cleaned and oiled. Whenever the vise has been used for a grinding operation, wash it thoroughly in kerosene to remove abrasive swarf from the screw.

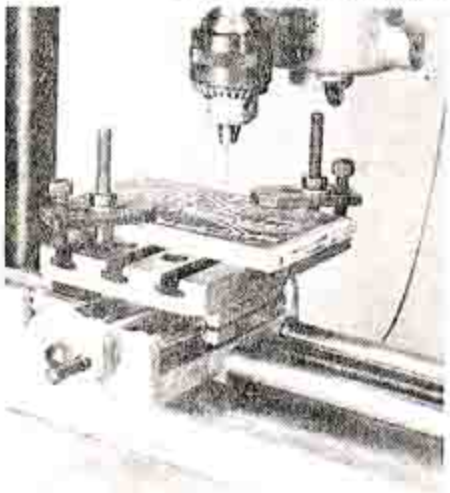


THE FIXED JAW of the vise has accurately ground V-grooves to center cylindrical work.

T-SLOTTED MILLING TABLE

Measuring about 3" x 5" by ½"-thick, with top and bottom faces finished accurately parallel, the T-slotted milling table simplifies mounting long or wide workpieces on the Unimat's cross slide for milling or drilling, and it's particularly useful for mounting irregularly-shaped castings. The two countersunk Allen-head screws that secure the table on the slide can be used in any two of its four mounting holes, which makes it possible to orient the table on the slide in eight ways (including four 45°-angled positions).

The three T-slots in the table, milled full length, are identical in size with the cross slide's T-slot and permit using stud clamps along the table wherever needed to clamp down work of nearly any shape. Two sets of T-studs and clamps are supplied with the table, and additional sets (often it's desirable to have four clamps) can be ordered separately. Cylindrical work should be clamped along the table's central T-slot. Irregularly-shaped work must be rigidly supported on shims, blocking or parallels to prevent the clamps from slipping. Work that has holes often can simply be screwed to the table with machine screws of suitable length screwed into T-nuts inserted in the table's T-slots. Flat work longer or wider than the table can be secured with either toolmaker's or 1" C-clamps.



THE MILLING TABLE simplifies mounting large work for vertical spindle machining operations.

Since the table makes the cross slide's tensioning screw inaccessible, remember to tighten the slide's movement before mounting the table. The table can be mounted 8 different ways. Mounted in some positions, the table has limited travel. When making set-ups for long milling or grinding cuts make sure that both table and work are mounted in such a way that the longitudinal feed will provide sufficient table travel to allow making the cut uninterrupted. Center the line of cut over the machine's ways for maximum rigidity whenever possible. Extending the headstock's reach with the raising block makes it possible to mill longer cuts.

Work to be drilled or bored can be mounted similarly, but the workpiece should be clamped on a square of scrap aluminum or hardboard to prevent the drill from drilling into the table when it passes through the work.

It's possible to make useful horizontal-spindle machining set-ups with the milling table if the lathe headstock is raised on the raising block. Work can be clamped overhanging the table's edge for cutting-off or end-grinding. Either the machine vise or indexing head can be mounted anywhere along the table's T-slots to hold work for horizontal-spindle milling, spot facing or rotary filing. Blocked to height, the table is an excellent worktable for the sanding plate.

Avoid marring the table's flat surface when clamping down work. Using the stud clamps' fulcrum screws head-down prevents the screw-ends from embossing dimples. Nicks should be whetted flush with a fine-grit oilstone.

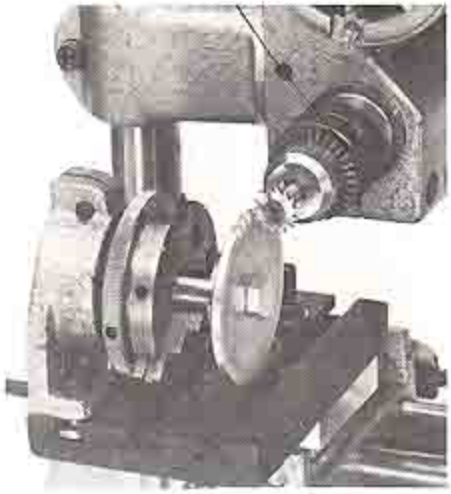
STUD CLAMPS can be used anywhere along the table's T-slots to mount workpieces.

INDEXING AND DIVIDING ATTACHMENT

An indexing head is indispensable for such jobs as drilling equally spaced holes in flanges, milling work triangular, hex or octagonal, milling radial slots, milling gear teeth or splines, or regrinding rotary cutters.

The Unimat's indexing head, which is simple and serviceable, has a special hardened and ground index plate that turns smoothly in its casting. The periphery of this gearlike hubbed plate is V-notched to divide it into 48 equal segments, and a spring-loaded indent pin engaging the notches makes it possible to revolve the plate in the frame exact fractions of a full turn. By pulling the pin and stepping off the appropriate number of segments, circles can be accurately divided into 2, 3, 4, 6, 8, 12, 16, 24 or 48 equal parts. Work also can be divided angularly, since each of the plate's 48 segments subtends an angle of 7½°, two segments 15°, six segments 45°, and so on.

THE INDEXING HEAD has a gearlike hubbed index plate (pictured below) that turns smoothly in the casting. Work is indexed by stepping off the plate's segments.



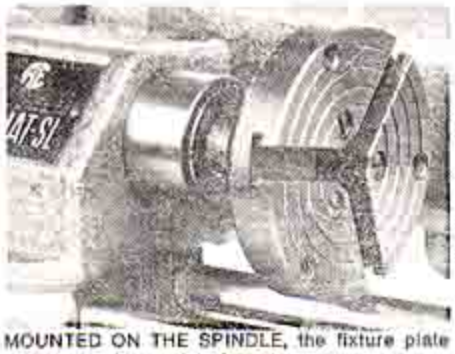
USING THE HEAD you can mill gears or splines, or mill stock triangular or hexagonal.

Besides the 48-division index plate supplied with the head, 30-, 36- and 40-division plates are available separately and can be used in the frame interchangeably to give other divisions. Plates are easily changed by removing a flat steel snap ring with ring pliers. The hub of each plate is finish-ground identical with the 3-jaw chuck's mounting plate, which permits screwing either the 3-jaw chuck or the T-slotted fixture plate directly on the index plate as a workholding device. The head's right-angle frame casting can be mounted on the Unimat's cross slide either end-down or back-down, to orient the index plate's axis either horizontally or vertically.

When indexing with the head first loosen its clamp screw, pull out the pin, turn the plate until the required number of segments (points between notches) have passed the frame's slit, and then retighten the clamp screw to lock the plate immovable for the cut. Keep the plate well oiled for smooth operation.

T-SLOTTED FIXTURE PLATE

One of the Unimat's three multi-purpose workplates, the fixture plate is made of close-grained cast iron and has three radially-milled T-slots the same size as the T-slot in the cross slide. Three stud clamps are supplied with the plate. This rigid fixture plate can be used in three ways: 1) on the lathe spindle as a faceplate; 2) on the cross slide as a drilling-milling worktable; or 3) on the indexing head to mount work that can't be held in the 3-jaw chuck.



MOUNTED ON THE SPINDLE, the fixture plate serves as a heavy-duty faceplate.

Concentric rings on the plate's 2⅝"-diameter face facilitate centering workpieces. Work can be held securely with the clamps, or when more convenient T-nuts can be inserted in the T-slots and the work clamped by its edges using screws with washers. The plate has three 6mm tapped holes for fastening clamping rings or other special holding fixtures, or for attaching weights to counterbalance irregularly-shaped work. The assortment of 6mm Allen-head screws listed in the catalog provides a selection of mounting screws in various lengths.

A threaded mounting plate, which must be ordered separately and finish-turned on the particular machine, is required to adapt the fixture plate for use either on the lathe spindle or on the cross slide's adapter stud. This mounting plate isn't needed to mount the fixture plate on the indexing head, as the fixture plate screws directly on the index plate's accurately-ground hub.

Because vibration occasionally may loosen the flat-head machine screws holding the fixture plate on its mounting plate or on the index plate, always make sure that these screws are tight.

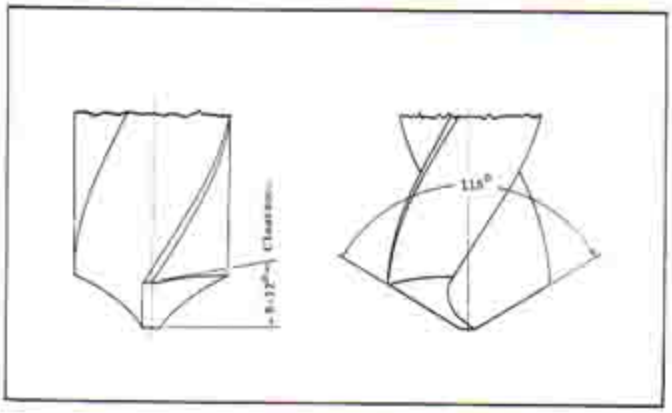
THE FIXTURE PLATE can be mounted either on the cross slide or on the indexing head.

TWIST DRILLS AND MILLING CUTTERS

Accurate drilling and milling require sharp cutting tools. Experienced machinists buy highest-quality high speed steel drills and mills. They use them with care to avoid nicking the corners of their cutting edges, and they keep them sharp with frequent touch-up resharpening.

Drills and milling cutters are much alike, both having cutting edges that cut exactly like miniature lathe bits. Like lathe bits, the teeth of rotary cutters must be ground with sufficient clearance behind the cutting edges—from 8 to 12°—to allow the edges to bite into the work without rubbing. Providing clearance is always the most important consideration when grinding any cutting tool, for without it an edge can't cut. In the case of rotary tools with more than one edge (any rotary tool other than a fly cutter), it's also important that all the teeth have exactly the same height and shape in order to successively cut chips of equal thickness.

If you keep these two requirements in mind you can learn to resharpen twist drills with very little practice. Ordinarily only a small quantity of metal need be removed



from the point of a drill to renew its edges. When regrinding the drill hold it with one of its edges parallel with the grinding wheel, lightly regrind the edge, and then with the same pass on the wheel—turning and lowering the shank with your fingers—grind down the metal behind the edge, grinding to the same depth all the way back to the flute to maintain original clearance. Then turn the drill 180° and regrind the other cutting lip identically.

When properly reground the drill's point will be exactly centered, and its cutting edges will form 59° angles with the drill's axis, giving a point angle of 118°. You can judge these angles by comparing the drill you're grinding with a new drill, or you can use a 59° drill point gauge. If the cutting lips are ground unequally the drill will wobble slightly as it cuts and drill a hole that is slightly oversize.

Using a jeweler's loupe to see what you're doing, you'll be able to regrind drills as small as 1/16" in diameter on the Unimat's straight grinding wheel. Drills smaller than this should be discarded when dull, for it's very difficult to resharpen them satisfactorily without special equipment.

It's possible using a small grinding wheel of suitable shape and an appropriate machine set-up to regrind nearly any milling cutter on the Unimat. If the cutter has straight teeth, grind the top of each tooth, maintaining original clearance. If the teeth aren't straight (ball-end cutters, for example), grind the face of each tooth. Carving burrs and rotary files can be resharpened by deepening the tooth gullets with a small knife-edge wheel.

Use resharpened drills and cutters for non-critical work. It's always wise to use new cutting tools for any job requiring extreme precision.

POLISHING ARBOR

Like the spindle of a jeweler's polishing head, the Unimat's polishing arbor is simply a threaded taper on which felt, rubber or other polishing wheels can be screwed firmly enough for use. The arbor mounts wheels with center holes up to ½" in diameter. Felt or rubber polishing points for inside polishing can be screwed on the arbor's tip.

Felt wheels or points can be sized with thinned glue and rolled in fine-grit abrasive, they can be charged with a paste of loose abrasive mixed with water or oil, or they can be rubbed with grease-stick compound like a buff. Rubber-bonded wheels and points, which are available from industrial supply firms, have an abrasive molded in, and new grit is exposed as the wheel wears. You can make other polishing wheels yourself. A wheel made by center-gluing circles of abrasive cloth snipped radially wish scissors, for example, is very useful for polishing irregularly- shaped small parts.

The arbor comes with a separate mounting plate that requires finish-turning on the particular lathe's spindle to insure that the arbor's taper will run true.

Don't use wheels with metal-bushed center holes on this arbor, since they would jim the threads. Metal-bushed wheels and ¼"-thick cloth buffs with ½" center holes can be mounted on the grinding wheel arbor more satisfactorily than on this tapered arbor.

FELT OR RUBBER wheels or polishing points can be screwed on the arbor's tapered shank.

GRINDING ACCESSORIES

The Unimat's grinding accessories— the grinding wheel arbor, the wheel guard, the wheels themselves and the diamond wheel dresser—not only convert the lathe to a small bench grinder but make it possible to set up the tool for precision machine-grinding operations.

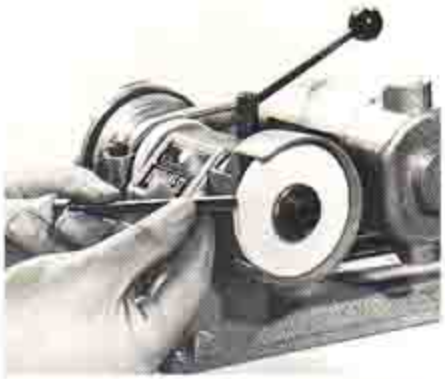
The three wheels listed in the catalog are suitable for the three grinding opefations most commonly performed. For off-hand grinding use the straight wheel, swiveling the lathe headstock 90°. For surface grinding use the cup wheel, taking successive light passes at slow feed. For tool grinding —regrinding the tooth faces of form-tooth cutters, say—use the saucer wheel. Never attempt to grind off more than a few thousanths of metal per pass. Always feed cuts in such a way that the face rather than the side of the wheel does the cutting.

EXTRA ARBORS can be turned as needed to mount special grinding or cut-off wheels.

These three wheels mount on the arbor supplied with the machine. True the arbor's shoulder on the particular lathe's spindle. Avoid overtightening the flange on a grinding wheel's cardboard pads. Extra arbors can be turned as needed to mount special wheels.

It's a sensible safety precaution to clamp the wheel guard on the end of the spindle cartridge whenever making any grinding set-up. Grinding wheels occasionally crack and break, and when they do the flying shards can inflict serious injury. When grinding without a guard because the guard would interfere with the work, recognize the hazard and *keep your face out of line* with the wheel. Always wear safety glasses when grinding.

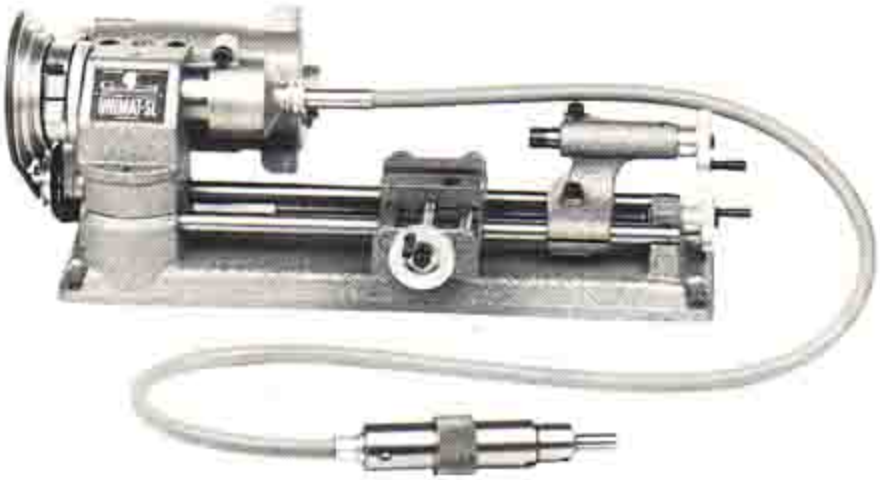
To true a wheel with the diamond dresser, mount the dresser rigidly in the tool block and run the wheel at 2000 rpms. Dress the wheel clean and true with successive .001"-deep passes, avoiding shock that might shatter the diamond.



FLEXIBLE SHAFT

The many grinding, polishing, sanding, carving and engraving jobs that can be performed with the Unimat's 45"-long flexible shaft make this accessory especially popular with hobbiests. Ruggedly built, it has a steel-cable core that turns in a flexible metal casing sheathed in plastic. The handpiece has the same nose thread as the Unimat's spindle, which permits using any of the machine's chucks or arbors on the shaft.

To assemble the shaft for use, first screw the drive thimble on the lathe's spindle nose, next clamp the cup-shaped housing on the end of the spindle cartridge, and then couple the shaft's union fitting to this housing, inserting the square end of the core into the square hole in the drive thimble. Often it's convenient to swivel the lathe's headstock 90°.



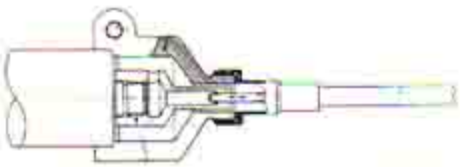
THE SHAFT'S HANDPIECE has the same nose thread as the Unimat's spindle.

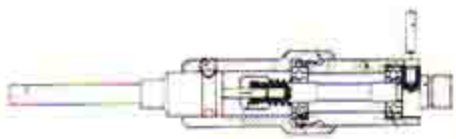
Small grinding and polishing points or carving burrs can be held in the drill chuck. Don't use the shaft for grinding with large wheels or drilling holes larger than ⅛" in diameter, for heavy work will overload it, causing bucking and shaking, and may break the core. When using the shaft for disc sanding, sand with very light pressure.

Limit its maximum speed to 3750 rpms, always keeping the shaft as straight as conditions permit to minimize friction. If the shaft heats excessivley, relube it and use slower speed.

The shaft comes prelubed, but the grease gradually works out. After each 100 hours of operation the handpiece should be unscrewed and the two ball bearings relubed with bearing grease. Relube the core by slipping it out of the casing and wiping it with grease.

Store the shaft straight, not coiled. Never run a flexible shaft backwards.





Type "WW" Watchmaker's Draw Bar Lathe Spindle and Accessories

The watchmaker's spindle is a special assembly designed expressly for turning very small high-precision work at high spindle speeds, the kind of lathework commonly performed by horologists and instrumentmakers. It is available only as an accessory and must be ordered separately (Unimats cannot be supplied with the watchmaker's spindle substituted for the standard spindle). This special spindle can be installed in place of the Unimat's standard spindle cartridge. It has the same external dimensions, it mounts in the lathe headstock in exactly the same way, and it can be advanced or retracted in the same way with the pinion feed lever. But it differs from the standard spindle in three respects.

First, the watchmaker's spindle has a smaller step-pulley for higher-range spindle speeds, and the pulley is Woodruff-keyed on the spindle shaft.

Second, it has special bearings designed for ultimate precision with longer service life when used at high speed. The spindle's front bearing is a high-quality precision roller bearing. The rear bearings are a pair of matched precision angular-contact ball bearings opposed to take thrust from either direction. Threaded rings retain the bearings in the sleeve, and the spindle shaft turns in them without end play.

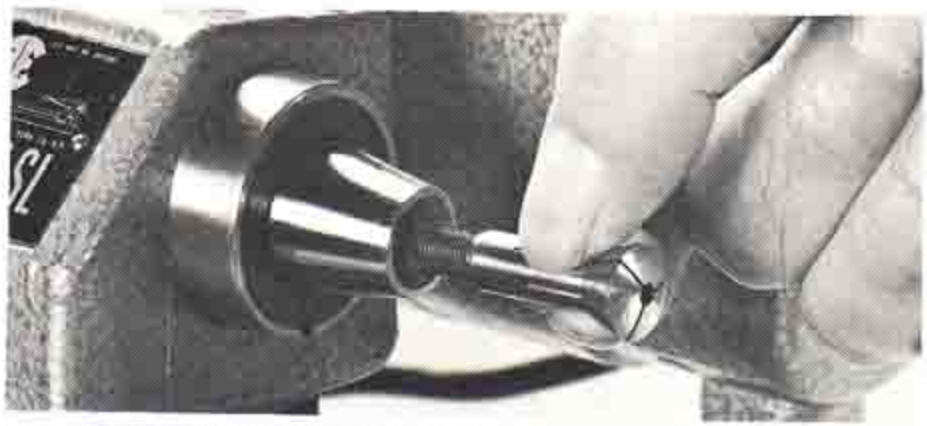
The third difference is the way in which workholding devices mount on the spindle nose. Instead of external threads, the nose of the watchmaker's spindle has an accurately-finished internal taper, and in the bore behind the taper, a pin key. Standard type WW spring steel draw-in collets seat in this internal taper and are closed with a drawbar inserted through the spindle bore from the rear. Screwing the drawbar on the threaded end of the collet draws the collet back into the taper and springs it together to close it on the work. The spindle bore's pin, engaging a keyway in the collet, prevents the collet from turning in the taper as it closes. The drawbar has a 4mm throughbore to permit feeding rod stock up to .157" in diameter through the headstock.

This keyed-taper system of mounting workholding devices has the advantage of inherently slightly higher precision than is possible with screw-on devices. The array of special type WW precision holding accessories available for use with the watchmaker's spindle are shown at right. They fit only the type WW spindle and cannot be used with the Unimat's standard threaded-nose spindle.

Type WW draw-in collets are available in either metric or inch sizes up to ¼" capacity. Metric collets can be purchased in sets at considerable saving (no substitutions can be made in a set's contents). If you buy inch-size collets individually, be sure to include a ⅛" collet for holding standard rotary tool shanks. Spring collets are designed to spring closed only a few thousandths. Forcing a collet to grip larger or more than 1/32" smaller than its nominal size, or closing it on work that is not perfectly round, may bend its jaws and degrade its precision. It's important to keep collets scrupulously clean, cleaning their slots with stiff paper, for dirt or chips in the slots can prevent their jaws from closing evenly. Before inserting a collet in the spindle taper always clean the taper carefully to remove any grit, and as you insert the collet be sure that its keyway slips over the spindle bore's pin. Because collets grip very tightly it's never necessary to overtighten the drawbar when closing them on the work. Collets will rust quickly unless protected by a film of oil and must be wiped carefully with a well-oiled rag after each use.

Similar type WW collets having larger heads that are counterbored to hold larger-diameter work are available in metric sizes from 7mm through 14mm by millimeters. The counterbores are 8mm deep (about 5/16"), which makes these collets handy for gripping short lengths of bar stock. Counterbored collets are commonly used in production work.

The drill chuck available for the watch-



CLEAN THE WATCHMAKER'S SPINDLE'S TAPER before inserting a collet. The collet seats in the taper with its keyway engaging a pin in the spindle bore.

STANDARD SPINDLE

TYPE "WW" SPINDLE

ALTHOUGH COLLETS are used for most high-precision work, a variety of other workholding devices and arbors are available for the type WW spindle.

maker's spindle is a small 4mm-capacity Jacob's-type chuck with an integral type WW shank that seats in the spindle taper and is secured with the drawbar. Precision built, this chuck centers work to within a thousandth or two, and like the drill chuck used on the Unimat's standard spindle it's a very handy general-purpose holding device for either twist drills or small workpieces.

A simple type WW set-screw chuck is available for holding bar stock or shafting up to 16mm in diameter, and the chuck also holds square work. The workpiece can be centered with the set screws just as you'd center work in the 4-jaw independent chuck.

Type WW arbors for grinding wheels and slitting saws are available to permit using the watchmaker's spindle for grinding and sawing operations. These arbors are also occasionally useful for mounting wheel-shaped work for turning.

If you have a Unimat 3-jaw or 4-jaw chuck, either can be adapted for use on the watchmaker's spindle with the appropriate type WW lathe chuck arbor. These arbors are similar to regular chuck mounting plates but have integral type WW shanks. Either arbor requires finish-turning on the particular lathe's spindle. A chuck mounted on a type WW arbor can be quickly unscrewed and remounted on its standard mounting plate whenever you have occasion to use it on the Unimat's cross slide. The type WW arbor for the 3-jaw chuck will also mount the T-slotted fixture plate on the watchmaker's spindle.

Unhardened type WW blank arbors for special tooling set-ups can be ordered from the catalog. The ½"-diameter cylindrical end of these inexpensive arbors can be bored, tapered, shouldered or threaded in any way required to hold special work. When a larger workholding fixture is needed a blank arbor can be brazed into a drilled plate. You can also use blank arbors to make special tools—a small fly-cutter boring head, for example. When it's desirable to harden an arbor after it's machined, you can easily harden it by heating the machined end to red heat and dipping it in Kasenit or similar hardening compound.

Like the standard spindle, the watchmaker's spindle should be disassembled and regreased every 1000 hours of operation. The spindle's type WW accessories must be stored with care to avoid jimming their tapers or the threads on the ends of the shanks. Collets should be stored in order of size in a wooden case, which you can either buy or make.

Some of the holding devices for the watchmaker's spindle duplicate accessories available for the standard spindle. When you own both spindles you're faced with the question of which to buy: for example, whether it would be wiser to buy alternately-split collets for the standard spindle's collet chuck or draw-in collets for the watchmaker's spindle. The answer will depend upon the kind of work you'll be doing. Accessories for the standard spindle are preferable for ordinary machinework. Accessories for the watchmaker's spindle are preferable for small, close-precision work.

PRECISION COLLETS

LARGE BORE COLLETS

PRECISION DRILL CHUCK

SET SCREW CHUCK

3-JAW & 4-JAW CHUCK ARBORS

SLITTING SAW ARBOR

GRINDING WHEEL ARBOR

UNHARDENED BLANK ARBOR

Woodworking Accessories

These accessories convert the Unimat to perform on miniature scale the same operations accomplished on standard woodworking power tools. With the same set-ups you can also machine hard rubber, fiber and many plastics.

TURNING CHISELS AND RESTS

A few special accessories—hand-held turning chisels, a tool rest, spur center and a ball-bearing tailstock center—facilitate turning wood in the Unimat.

The small woodturning chisels offered in the catalog are miniature versions of the two chisels used most often for work on full-size wood lathes, the gouge and skew chisel. The gouge is used to rough square stock round and to turn coves. The skew is used to square inside corners and to turn convex shapes. The edges of both chisels should be whetted razor-sharp. While expert woodturners using gouges and skews on large lathes often angle the chisel upwards in such a way that its edge-bevel rides the work and the cutting edge pares rather than scrapes, this is difficult when turning small work with narrow chisels. Holding the chisel horizontally on the tool rest and turning with scraping cuts is the most satisfactory way to turn wood in the Unimat.

The tool rest, which is simply a solid support on which to hold the chisel, should be set close to the work at a height that raises the chisel's cutting edge level with the work's axis. Two tool rests for hand-held turning chisels are available.

One of them, pictured at right, is simply a slotted metal block that screws on the machine's cross slide. This rest is adequate for turning small-diameter woodwork, and it's also useful for turning tiny metal parts

with engraver's burins used as turning chisels.

The other, the T-bar rest pictured below, is preferable for turning larger-diameter stock and for faceplate turning. Longer and easier to adjust, this rest clamps on the Unimat's front way. The carriage can be moved out of the way under the tailstock or to the end of the bed to permit using the lathe's full swing.

The two-pronged spur center drives stock to be turned without slippage. Sink the spur's prongs squarely into the end of the stock with a wooden mallet, and then screw both spur and stock on the spindle. Because woodturning is ordinarily performed at fairly high spindle speed, a ball-bearing live center is preferable to a dead center, which would be liable to burn. The wood should be deeply centerdrilled for the live center's point.

Hardwoods are easier to turn than softwoods, since they splinter less. The heavier hardwoods—lignum vitae, ebony, teak—are especially suitable for small turnings, for these dense, resin-filled woods turn beautifully and can be finished simply by rubbing with a rag. Walnut also turns smoothly. Hickory is first choice for turned tool handles. Mahogany because it glues well is excellent for foundry patterns.

Turning a pattern and having the pattern cast in metal at a job-shop foundry is usually the easiest way to make large metal parts. Make patterns slightly oversize to allow for shrinkage in casting and for finish-machining.

A BALL-BEARING CENTER, T-BAR TOOL REST AND A SPUR CENTER simplify making small wood turnings in the Unimat with hand-held turning chisels.

SANDING PLATE

Many Unimat owners buy two sanding plates, one for use as a drill press worktable and the other for disc sanding. In order to use the 3½"-diameter plate on the spindle for sanding, the lathe headstock must be raised on the raising block. Special disc cement is available for adhering paper or cloth abrasive discs to the plate. Never use ordinary rubber cement for this purpose, for a disc that flies off when the plate is run at high speed is a safety hazard. The special disc cement can be softened in hot water to remove worn discs.

It's convenient for most machine-sanding jobs to mount a worktable in front of the plate or at slightly below center height. Either the milling table, which can be screwed to the carriage cross slide on a spacer block to raise it to height, or the accessory circular saw table can be used as a sanding worktable. Position the table with its edge 1/16" from the plate. A fence can be clamped on the milling table wherever needed to guide the work to be sanded, or with the saw table the miter gauge serves as a guide. The sanding plate is handy for finishing metal as well as wood, and the ready-cut abrasive discs listed in the catalog cut either material.

When used for sanding wood—particularly resinous hardwood—sanding discs usually load with burned-in resin long before the abrasive wears dull. To minimize loading it's advisable to use coarse-grit discs for all but the smallest work, and always to feed the work against the plate with light pressure. When sanding thermoplastics use the lathe's slowest spindle speed and very light pressure to avoid softening the material with frictional heat.

Unimat owners who use their machines for lapidary work can face extra sanding plates with leather or felt for polishing flats.

JIGSAW AND SABER SAW

The jigsaw attachment's unique feature is a grooved blade guide rod that supports the saw blade immediately above the point of cut and prevents the blade from deflecting. The guide minimizes blade breakage and makes it much easier to saw precise, square-edged fretwork with delicate jeweler's blades.

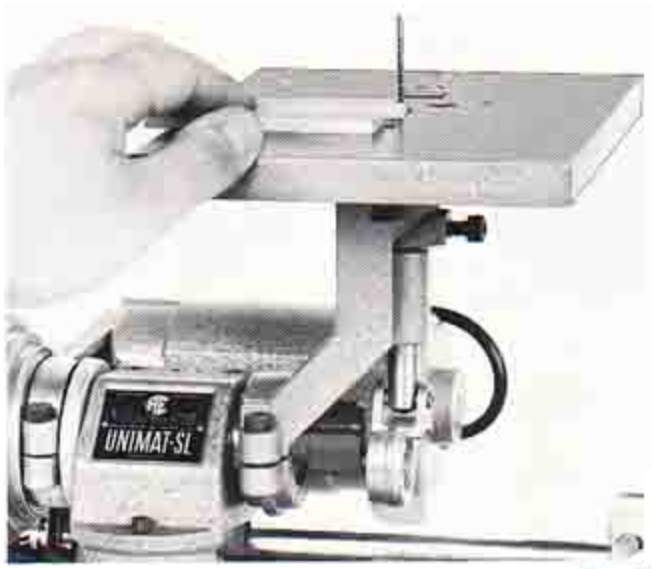
A rigid bracket that clamps on the Unimat's spindle cartridge supports the attachment's ribbed 6x8" table. The saw's overarm, or bow, which has an 8"-deep throat, can be easily removed, and saber blades then can be used for sawing panel stock or other large work.

To assemble the attachment, screw the bow's foot to the underside of the table, and next mount the table on the bracket assembly with the three screws provided. Make sure that the reciprocating saw bar's chuck, the table's blade guide insert and the bow's grooved blade guide rod all align. Then screw the counterbalanced eccentric on the spindle nose, and having fully extended the spindle cartridge, clamp the bracket on the end of the cartridge with the eccentric's pin inserted in the connecting rod's ball bearing. After making certain the mechanism operates smoothly, slide a blade with its teeth angled to cut on the *downstroke* into the grooved blade guide rod from the top, and clamp the blade's lower end in the saw bar's chuck. The blade's upper portion must slide freely in the guide rod's groove. The thumbscrew in the end of the bow permits lowering the guide rod to rest on the work as a hold-down.

Use blades suitable for the material to be cut—coarse-toothed blades for wood, medium-toothed blades for soft metal or plastic, or fine-toothed blades for hard metal or very thin material. For sawing wood the saw can be operated at fairly high speed. For sawing steel use slow speed and flood the kerf with cutting oil to prolong blade life.

Keep the reciprocating saw bar clean and oiled.

THE JIGSAW'S BOW has a grooved blade guide rod that minimizes blade breakage. With the bow removed, saber saw blades can be used in the saw as shown below.



CIRCULAR SAW ATTACHMENT

A miniature version of a conventional table saw, the Unimat's circular saw attachment is especially useful for modelbuilders who need accurately cut wood, plastic or soft-metal parts for architectural or engineering models. It performs on miniature scale the same jobs accomplished on larger saws—ripping, crosscutting, rabbeting and mitering. Small work can be sawed more easily and more accurately on this inexpensive attachment than on a full-size saw.

Three blades, which must be purchased separately, are available for use with the attachment. Two of them are 2⅜"-diameter (60mm) high speed steel "slitting saws" that are hollow ground to make very smooth cuts up to ½" deep. The coarser-toothed slitting blade is suitable for precision woodcutting and for sawing softer synthetics. The finer-toothed, slitting blade is suitable for cutting metal, and will saw brass or aluminum sheet, tubing extrusions, or harder synthetic materials. Besides the two slitting saws, a larger 3-9/16"-diameter (90mm) flat ground blade with set teeth is available. This blade, for sawing larger woodwork, can make cuts up to 1" in depth. To give it clearance over the ways the lathe's headstock must be raised on the raising block.

All three blades have .638"-diameter centerholes and mount on the saw arbor included with the attachment. The arbor requires finish-turning on the particular lathe's spindle to insure that blades will run perfectly true. Having cleaned the spindle's nose threads and screwed the arbor firmly on the spindle, turn it true with a sharp-pointed bit. First turn the shoulder to exact diameter (.638") to allow the blade to slip on without play. Next take a light cut across the arbor's face, making sure that the shoulder's inside corner is square. Then trim the length of the shoulder to about .025" measured from the face (the shoulder must be shorter than the thickness of the blade). Extra arbors can be turned as required to mount special blades.

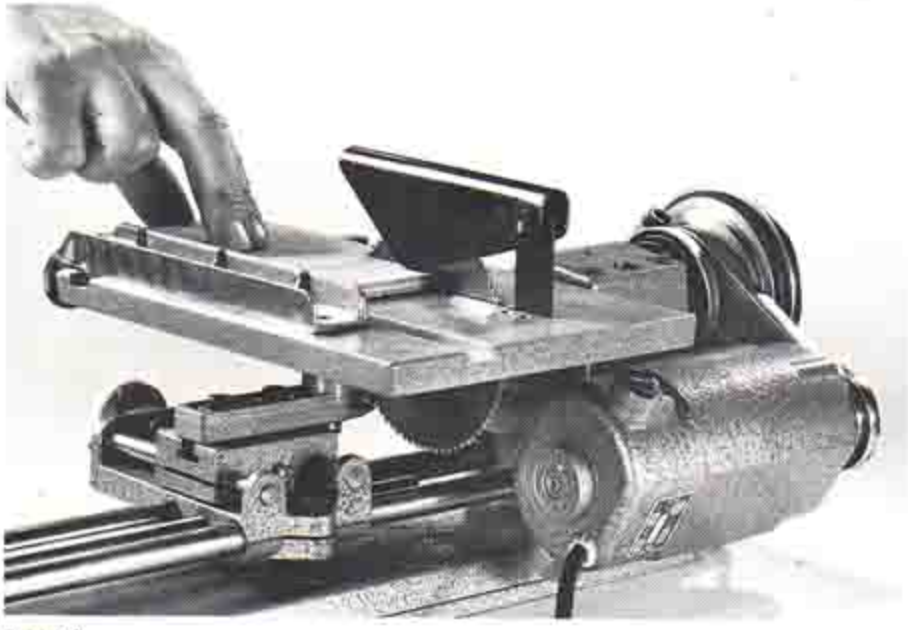
A tenon on the attachment's rigid 6x8" table clamps in an angle bracket that screws on the Unimat's cross slide with T-nuts. The table can be raised or lowered in this bracket to adjust the saw blade's depth of cut, and the bracket itself can be flopped to provide the extra ¾" elevation needed when the large set-tooth blade is used.

When setting up the table, position it to center the blade in the table's slot and then lock the carriage movements. The table must be aligned accurately with the blade to make the blade run parallel with the table's rip fence. The slitter supporting the blade guard must also be aligned with the blade. The rip fence, included with the attachment, is finished on both sides and can be used on either side of the blade. A miter gauge, not supplied but available separately, slides in the table's longitudinal groove to support stock for crosscutting. The gauge's calibrated head adjusts 45° in either direction and has screw holes for attaching a wooden facing.

Make sure that the blade's teeth point in the *direction of rotation*. When cutting wood with the hollow ground slitting blade, belt the headstock's drive for a spindle speed of about 4000 rpms. The larger set-tooth blade gives best performance at about 1600 rpms. Run the spindle at its slowest speed when cutting metal with the fine-toothed slitting blade (using the slow speed attachment for even slower speed will pro long the saw's useful life). Always feed work to any blade slowly to let the saw's teeth cut cleanly. Too fast a feed rate when cutting thick stock will cause excessive speed drop and overload the machine's motor.

Keep your saw blades clean and sharp. When blades become gummed they burn the work. Gum can be removed by soaking the blade in liquid household cleaner. Dull blades can be resharpened with a small triangular file if you're careful to maintain original tooth shape.

Abrasive cut-off discs and knife-edge grinding wheels can also be used in the circular saw attachment.



TRUE THE SAW ARBOR on the lathe to insure that the saw blades will run true.

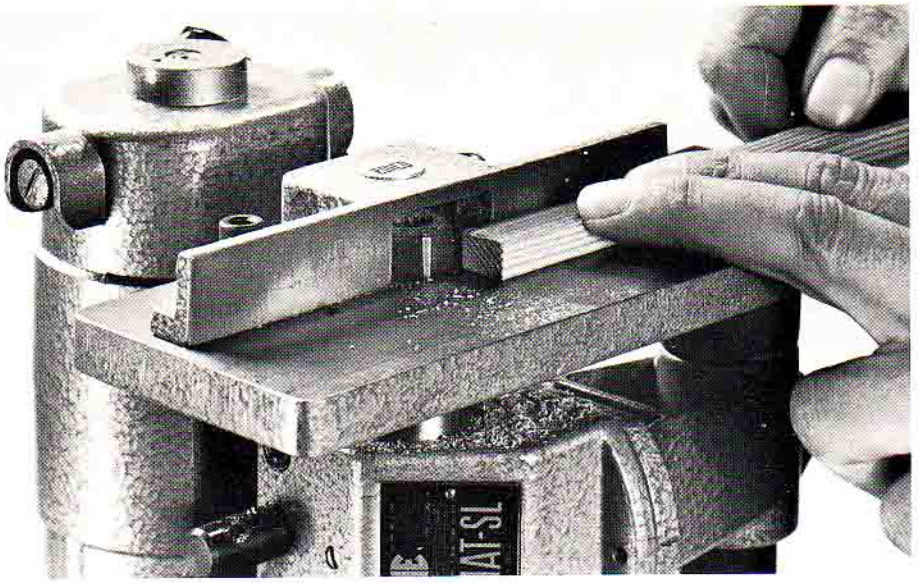
SHAPER ATTACHMENT

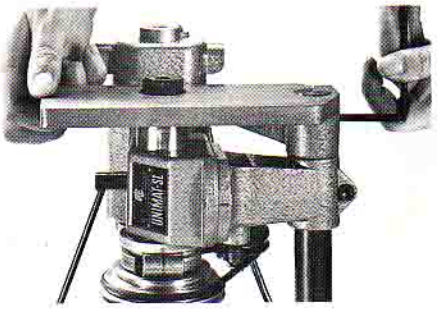
First mounting the headstock on the auxiliary column spindle-nose-up and then clamping the shaper attachment above the headstock converts the Unimat to a serviceable miniature shaper. The straight-faced cutter included with the attachment smoothly planes or rabbets the edges of small wooden parts. When profiled cutters are used—router bits, rotary files or cutters you lathe-turn yourself—the attachment cuts molding or molds the edges of minature boards exactly like a full-size shaper. Since it's difficult to make small molding in any other way, for anyone building architectural models the shaper attachment is an especially useful accessory.

To set up the attachment mount the head vertically on the column and screw the cutter on the spindle. Cutters with shanks can be held in either the drill or collet chuck. Next clamp the shaping table on the column above the headstock with the top of the table flush with the end of the column. Then raise the head, centering the spindle in the table's hole, until the bottom of the cutter is level with the table top and clamp the headstock securely. The spindle's rack-and-pinion advance can be used for further cutter height adjustment. Finally, position the table's fence to give the desired depth of cut.

Like router bits, shaper cutters are used at high spindle speed, and they must be kept razor-sharp. The straight-faced cutter that comes with the attachment can be resharpened by whetting the faces of its two cutting edges with a slipstone. When feeding work to shaper cutters, always feed the workpiece against the cutter's direction of rotation, using slow, continuous passes. If you stop the work in mid-cut the cutter may burn the wood.

Working similarly but using rotary files at the machine's slowest spindle speed, it's possible to power-file molded edges on soft-metal parts. With the fence removed the shaping table is also sometimes very handy for free-hand routing.





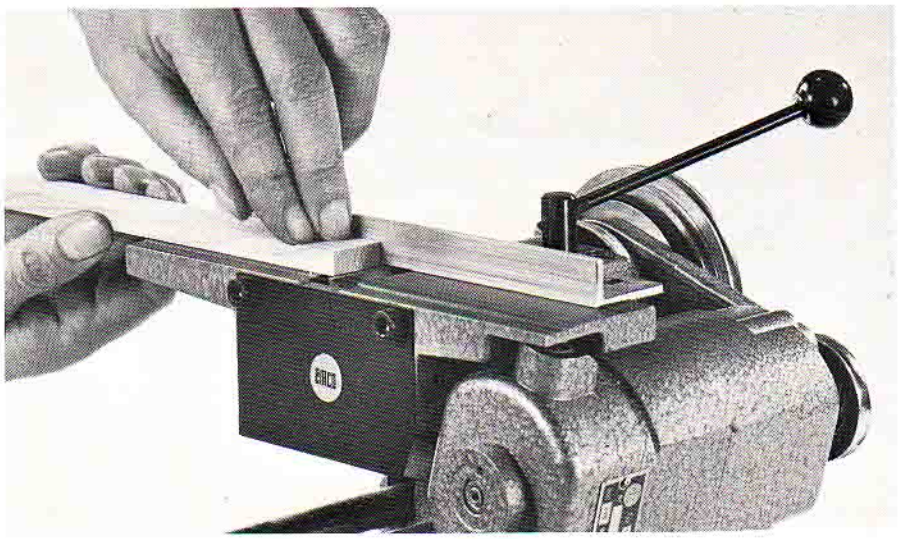
MOUNT THE SHAPER TABLE flush with the top of the Unimat's vertical column.

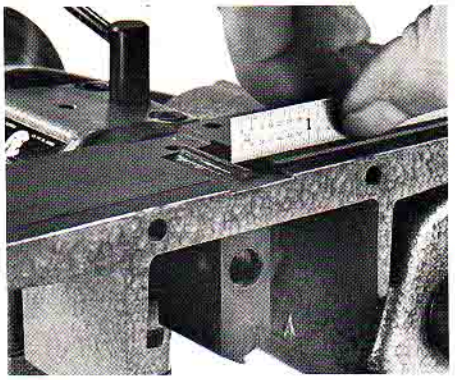
PLANER ATTACHMENT

The planer attachment has a wider cutter than the shaper attachment and planes stock up to 1" wide glass-smooth. The attachment's table assembly mounts on an eccentric bushing that clamps on the end of the Unimat's spindle cartridge. Table height can be adjusted by removing the table's front cover, loosening its two Allen-head mounting screws, and then loosening and rotating the eccentric clamping ring on the cartridge. The table's rear half, which is slightly higher than its front half, must be set exactly level with the cutter's cutting edge.

Guided by the fence, work to be planed is fed against the cutter's rotation. The stock slides along the table's lower front half, the cutter planes off a shallow cut, and the stock then slides on along the table's higher rear half, supported full length. To avoid cutter-burns the work must be planed with continuous even passes.

Keep the planer's block-type cutter very sharp, and use the highest spindle speed possible without excessive speed drop.





THE REAR HALF of the planer table must be set level with the cutter's cutting edge.

MAINTAINING YOUR UNIMAT

The Unimat is precision-manufactured to high standards from quality materials. When used and maintained with reasonable care, it will retain its original precision indefinitely and give lifetime service. Maintaining the machine in like-new condition takes only a little extra effort. It makes the tool easier to use for precision work, and makes it more pleasant to use. It also conserves the machine's resale value, which protects the owner's investment. If a Unimat is ever accidentally damaged, it needn't be sent to a service shop for repair. The owner can easily make any repair that might be required himself simply by replacing parts. As shown in the parts list, replacement parts are available down to the smallest screw both for the machine and for its many accessories.

TO REPLACE MOTOR BRUSHES, unscrew the brush caps and lift out the brushes.

Normal wear on the ways or carriage does not degrade the Unimat's precision in the slightest. As the ways eventually wear the tool bit travels a fraction of a thousandth lower, but its line of travel will still be parallel with the machine's line of centers and the lathe will still cut an accurate cylinder.

But the machine does have three critical surfaces—surfaces on which its accuracy depends. To preserve precision performance the operator should take special care whenever using the tool to keep these three surfaces true.

One of them, the Unimat's most easily-damaged part, is the threaded nose of the spindle, and also the shoulder behind the nose threads. If the spindle threads or shoulder are accidentally nicked, workholding devices will no longer seat squarely against the shoulder and work held in them will not run precisely true. Keep the nose threads clean and oiled, and avoid jimming them when screwing on chucks or plates. If you should nick the threads try to restore them with a knife-edged slipstone, or if this isn't possible, order a replacement spindle shaft. If you should mar the spindle's shoulder, take a very light truing cut across its face with a sharp-pointed lathe bit.

The machine's second critical surface (critical for accurate vertical-spindle operations) is the cross slide's tool platform. If this surface is nicked the nick can be whetted flush with a fine-grit oilstone.

The third critical surface is the machined base of the headstock casting, together with the machined portion of the bed casting the headstock bears on. To preserve the lathe's spindle alignment these surfaces must be kept free from embedded chips or grit. Clean, inspect and oil them each time you remount the machine's headstock.

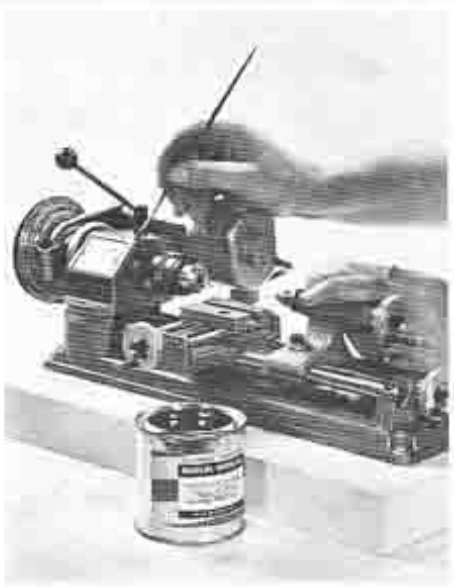
Other than preserving the accuracy of these three critical surfaces, the Unimat requires little maintenance. Infrequently, however, the motor will need attention. The motor has lifetime-lubed bearings, but occasionally the carbon brushes will need replacement. The brushes should be replaced when they wear to half their original length —to about ¼" long. Replace them in pairs, being sure to use manufacturer's replacement parts (since the composition of carbon brushes varies). If the motor's cord wears order a replacement cord.

While the regular cleaning and oiling you give the Unimat after each use will keep it reasonably clean, periodically the machine should be stripped, more thoroughly cleaned with solvent or liquid household cleaner, and inspected. Use a toothbrush to scrub the feed screws, and after cleaning immediately recoil all bright-metal parts. Color-matched touch-up lacquer is available to keep the finish looking like new.

The spindle bearings are grease-packed at the factory and need no attention for the first 1000 hours of operation. At the end of each 1000 hours of use the spindle should be disassembled and the bearings re-greased. To do this remove the spindle cartridge from the headstock and unscrew the nut retaining the step-pulley, holding

PERIODICALLY GIVE THE MACHINE a thorough cleaning, using solvent or strong household cleaner. Then immediately recoil the feed screws and bare metal parts.

THE SPINDLE'S BALL BEARINGS require relubing every 1000 hours of use. Disassemble the spindle and regrease the bearings with No. 1 bearing grease.



KEEP THE MACHINE'S FINISH looking like new with color-matched touch-up lacquer.

the shaft and turning the nut counterclockwise. If the nut is difficult to remove, apply penetrating oil. After slipping off the pulley, gently drive the spindle's shaft out of the bearings from the rear, using a wooden mallet to avoid damaging the shaft's threads. Laying the parts out in order same-side-down as you remove them simplifies reassembling them later. Wash the parts one by one in kerosene, wipe them clean with a lint-free rag, and regrease the ball bearings with No. 1 bearing grease, which is listed in the catalog. Since the bearings' brass ball retainers hold the balls rather loosely, be careful not to lose balls that might fall out.

The spindle cartridge is assembled much like a bicycle wheel hub. When reassembling it be sure to replace the dished washers, which preload the bearings slightly, in correct order. With the spindle assembled, carefully adjust the shaft's axial play, tightening the pulley retaining nut just enough to eliminate play but not enough to cause binding. The spindle must spin freely in its bearings to run smoothly at high speed. If the Unimat is used continuously at high speed, the spindle bearings should be regreased at more frequent intervals.

Sooner or later the machine's rubber drive belts will harden and break. While this can be annoying, consider belts expendable and order replacements. The heavy-duty belts listed in the catalog last longer than rubber belts and are recommended as replacements.

Order parts by the numbers shown in the parts list, also giving the machine's model number.

IF YOU NICK the lathe's ways, rub the nick flush with a hard Arkansas stone.

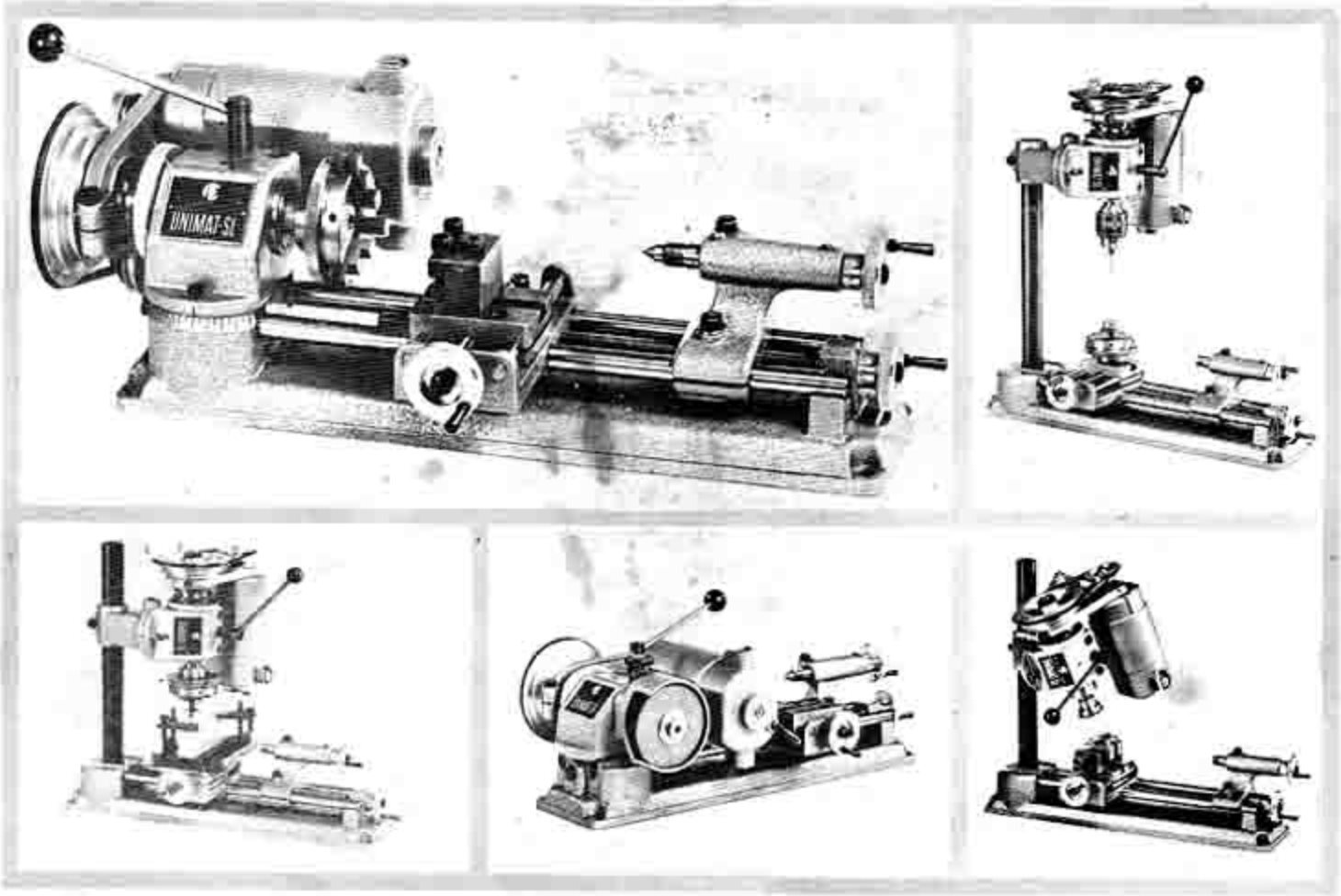
Unimat Thread Sizes

Threaded Part	Thread Size	Drill Size
Headstock, tailstock spindles	M 12 x 1	10.8mm
Leadscrew, cross-feed screw	M 8 x 1 (left)	6.7mm
Allen head screws	M 6 x 1	5.0mm
Spindle locating screws	M 4 x 1	3.3mm
Watchmaker spindle draw-bar	6.9	15/64"
Handwheels	M 5 x 1	4.2mm

All Unimat Allen head screws have a 6mm diameter.
A set of screws in assorted lengths is available. See accessory catalog.

Owner's Guarantee

American Edelstaal, Inc. guarantees this equipment to be free from defects in workmanship for 6 months after date of purchase. This guarantee is effective only if the attached Guarantee Registration Card is returned with the information as therein called for, and provided further that any part claimed defective is returned by prepaid parcel post or express to American Edelstaal, Inc. No such returns will be accepted unless we are first notified of part to be returned and nature of defect. This guarantee applies only if the equipment has been operated in accordance with normal procedure, and if no unauthorized repairs have been attemped. In such cases, we will repair or replace parts at cost. When writing, please refer to your registration number on this card.



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