PRECISION MACHINE TOOLS & ACCESSORIES

edelstaal

Dear Customer:

Thank you for buying the UNIMAT multi-purpose machine. To get the most out of your equipment, it is important that you read the UNIMAT handbook, "Miniature Machining Techniques". It was written for the non-machinist and gives necessary information about the proper operation of UNIMAT equipment. A careful reading will ensure that you get the best possible results with UNIMAT.

> During manufacture and final inspection, UNIMAT equipment is subjected to hundreds of individual inspections and tests. Every part (with the exception of the drive belts) is completely guaranteed for six months, provided that your guarantee card is registered with us. So, protect your investment and return the postage-free warranty card, today!

IN THE EVENT OF DIFFICULTY . . .

> Most problems with UNIMAT are caused by improper set-up or incorrect adjustments. If you have a problem with your equipment, if a part is defective or has been damaged in shipment, please let us know immediately. Write to the Customer Service Department, American Edelstaal, Inc., One Atwood Avenue, Tenafly, N.J. 07670. Be sure to give complete details regarding the nature of the problem or defect.

Since most of our dealers cannot be totally familiar with the complete machine and all the parts, taking your problems to him may only result in further delay. That's why we urge you to contact us directly. Our Customer Service Department will give you the proper information promptly.

In the event a part is defective and must be returned, you will receive a special Authorized Return Label, plus necessary shipping instructions. Please do NOT return parts without our authorization first. Parcels arriving without our Authorized Return Label are refused by our receiving department, and will be returned to you, unopened.

We are obligated to you for buying our equipment, and part of our obligation is to help you get the maximum benefits from your UNIMAT. But we need your help and cooperation to this end. A thorough reading (and at intervals, re-reading) of the "Miniature Machining Techniques" manual will give you the details you need to get precision results from UNIMAT for years to come. Without your interest and care, even a quality machine like UNIMAT will suffer.

Over 100,000 units are now in use. We're certain your UNIMAT will serve you faithfully for years to come.

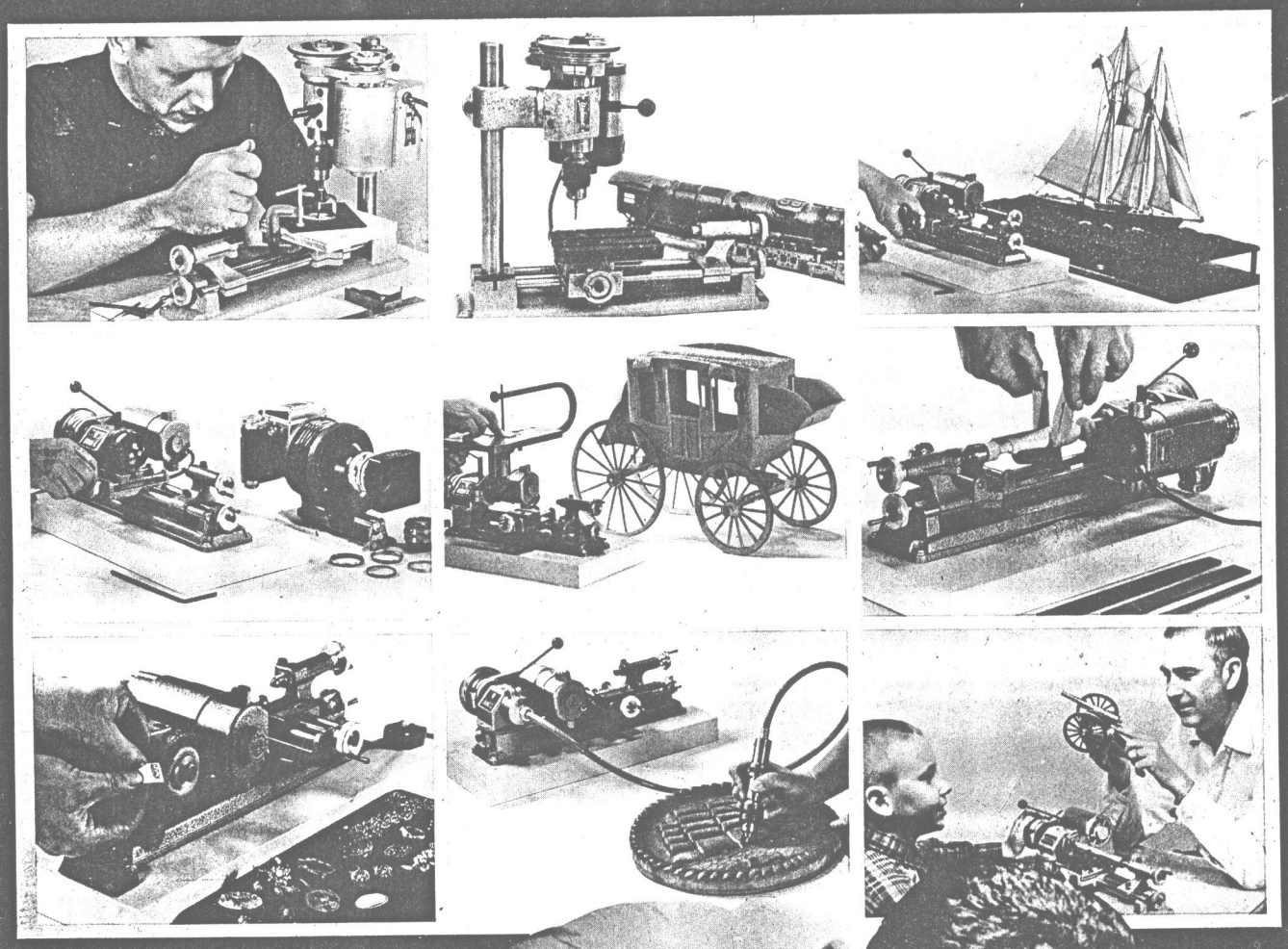
Sincerely,
AMERICAN EDELSTAAL, INC.

AMERICAN EDELSTAAL, INC. · ONE ATWOOD AVENUE · TENAFLY, NEW JERSEY 07670 · 201-871-3800

edelstaal

UNiMAT MINIATURE MACHINING TECHNIQUES

a general handbook and operator's manual

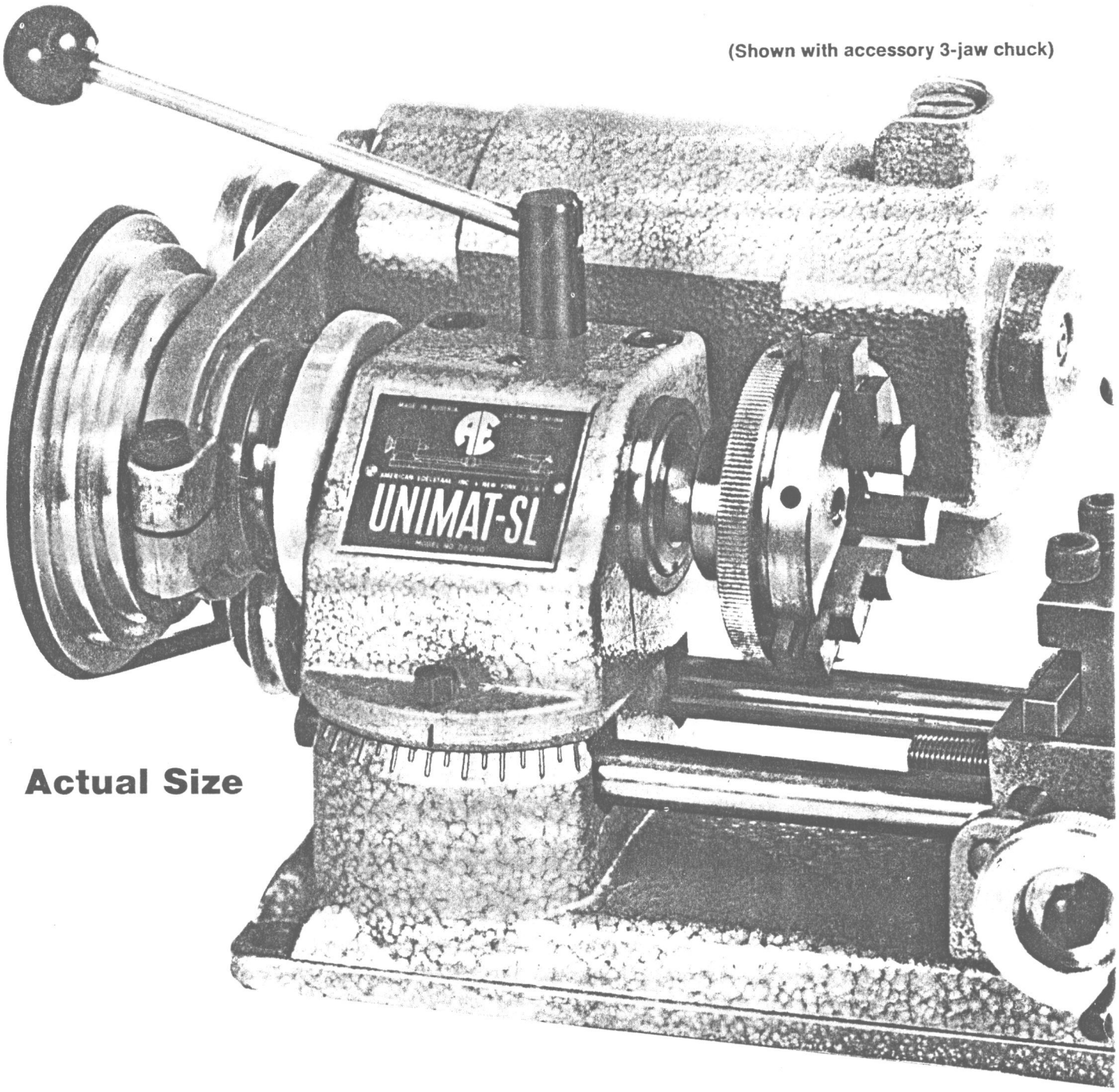


$2.00

INCOMPARABLY VERSATILE MINIATURI

Five machine tools in one, the Unimat is not only a small precision metal lathe—it converts in a minute to a universal drill press, vertical milling machine, small-parts surface grinder, or grinding-polishing head. It performs ALL common machining operations, and it's capable of the finest precision work. The tool equips an amateur or professional craftsman to precision-machine his own small parts from any material, metal, plastic or wood. Thousands of hobbiests, commercial modelmakers, inventors, prototype labs, gunsmiths, camera repairmen, locksmiths and jewelers the world over use Unimats for a wide variety of miniature machining jobs. The basic Unimat's versatility—and the many accessories available—makes the machine's uses almost unlimited.

(Shown with accessory 3-jaw chuck)

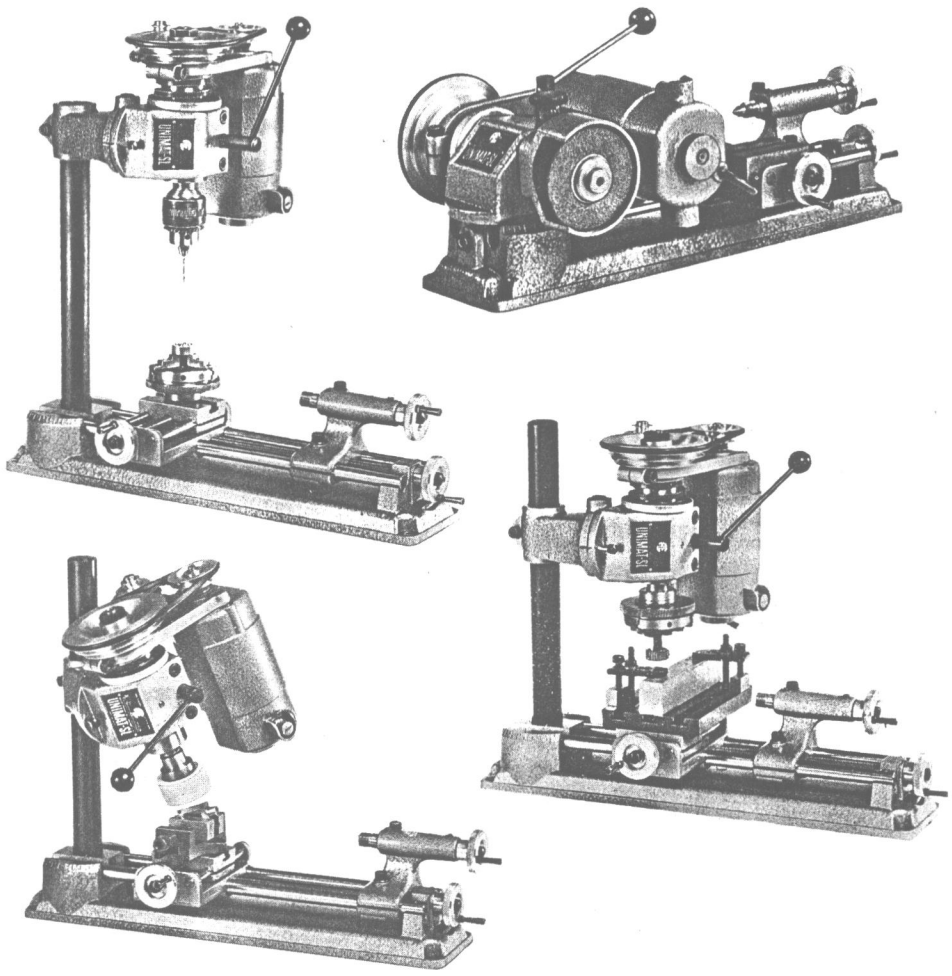


Actual Size

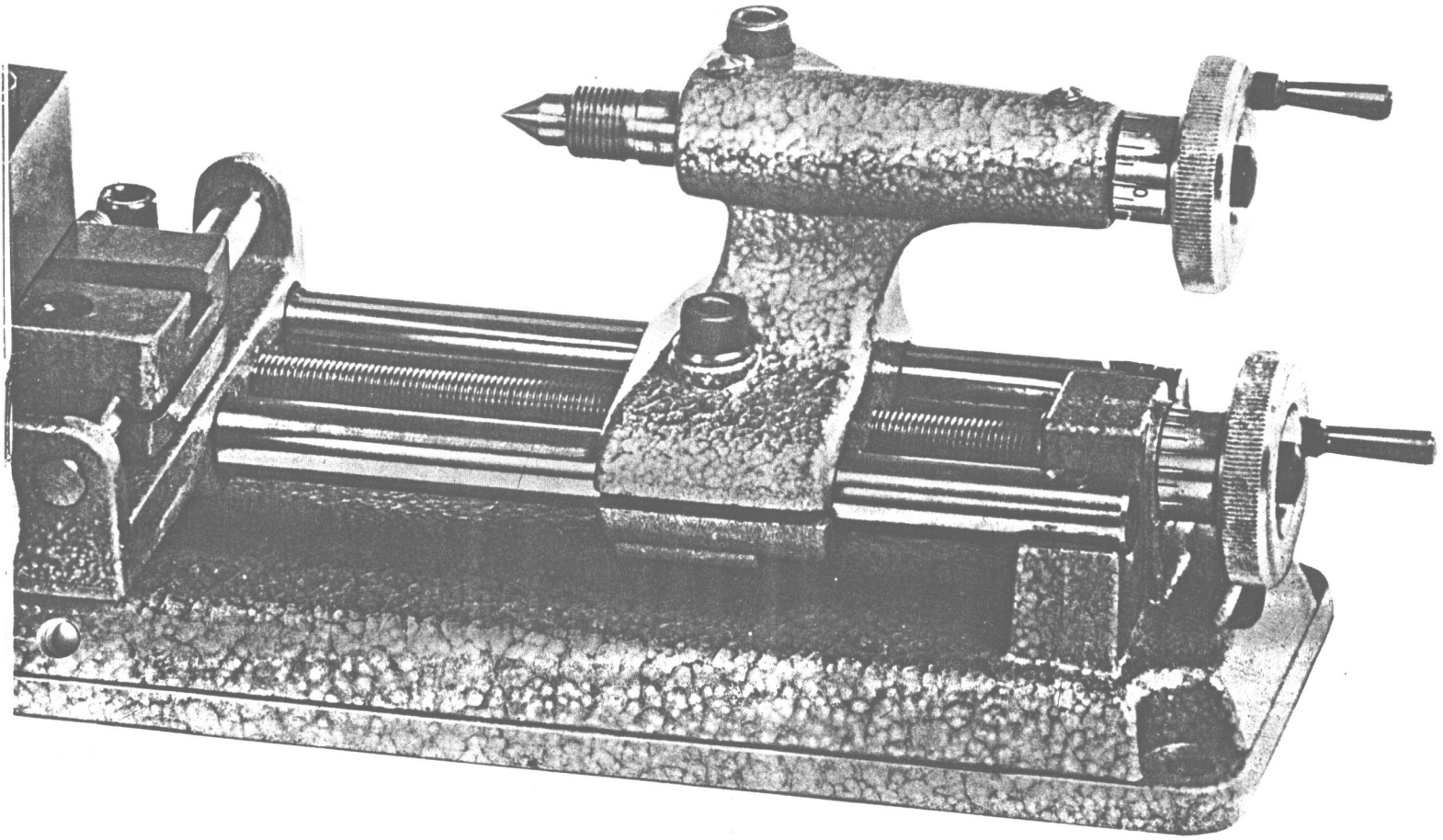
MACHINE TOOL

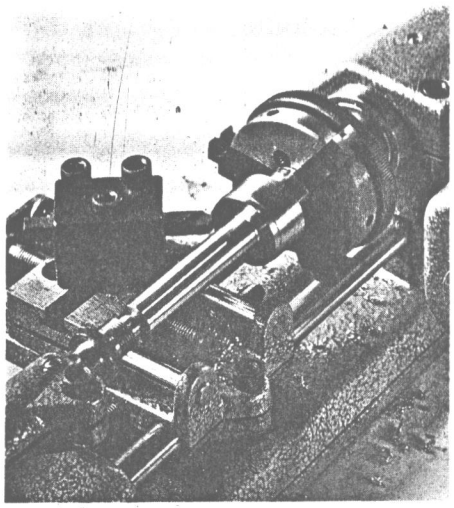
Surely the most fascinating little machine a craftsman could imagine, the Unimat is much more than simply an appealing little precision metal lathe. It's really a complete miniature machine tool system—a system of components that can be set up in various ways to perform on small scale *any* of the standard rotary metal-machining operations, turning, drilling, milling or grinding. More than that, the many accesories available for the tool extend its capabilities even further, and even include units to convert the basic machine to any of several woodworking power tools. All this makes the Unimat not merely a combination tool but a *universal* tool, a complete machine shop in itself. No other small shop machine compares with it. The Unimat is unique.

You can use it anywhere, even on a kitchen table. With the tool set up as a metal lathe, you're equipped to turn your own steel, brass or aluminum parts to split-thousandth tolerance. When you set up the machine as a drill press, you're able to perform on small scale any of the common drilling operations, including countersinking, counterboring, even "sensitive" drilling of extremely small holes with very tiny twist drills. When you set up the Unimat as a vertical milling machine, you're able to mill intricately-shaped metal parts you couldn't possibly make in any other way. With the machine set up as a surface grinder, you can precision-grind hardened steel parts

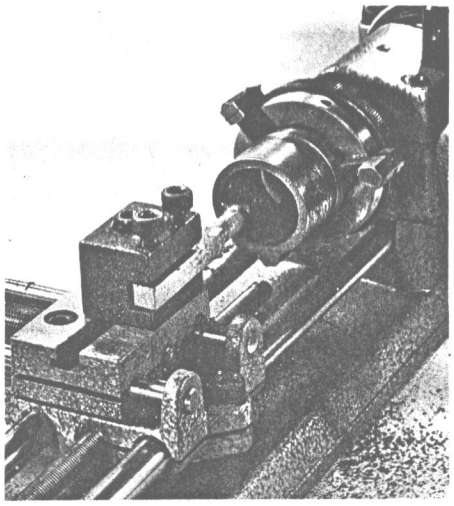


Here's The Basic Unimat

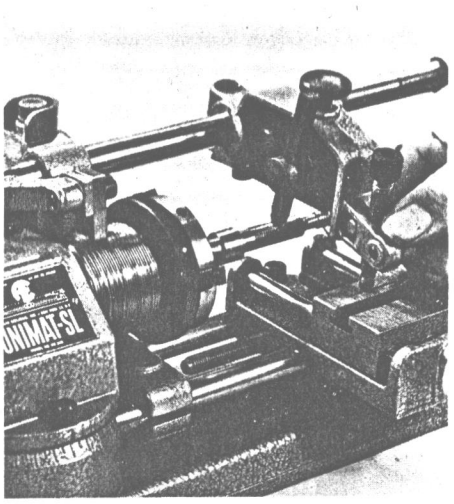




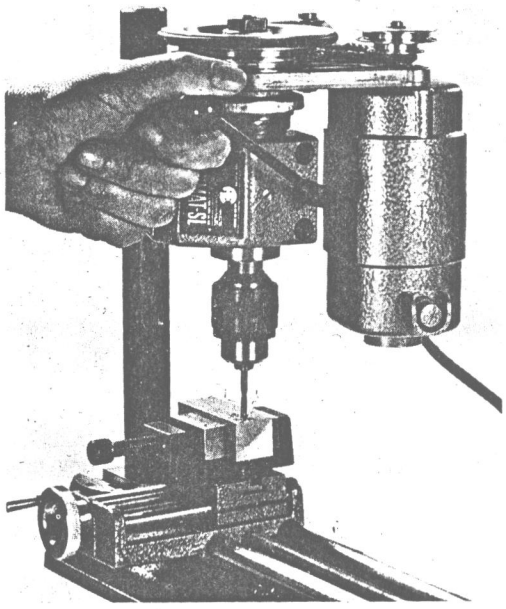
FOR METAL TURNING, lathe bit is held in tool block mounted on the carriage.



FOR BORING large holes in the lathe a boring tool is set parallel with bed.



FOR THREADING a master bushing advances the threading attachment's tool bit.



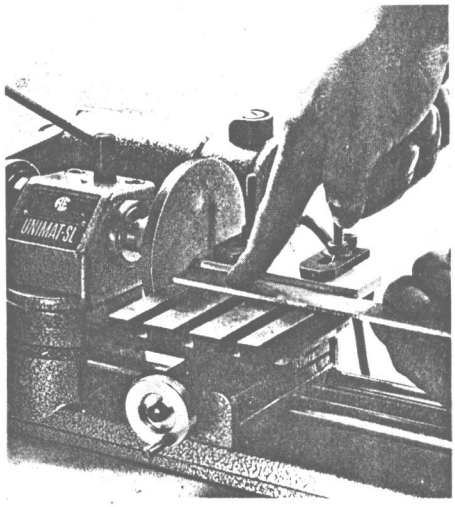
FOR DRILLING the headstock mounts on auxiliary column, lever advances spindle.

just as accurately as the world's leading toolmakers. Using appropriate accessories, you can also set up the Unimat as a small bench grinder, circular saw, jig saw, shaper, planer, flexible shaft tool, disc sander. On the one machine you can accomplish virtually any machining job in any common material, whether metal, plastic or wood, with the size of the work the only limitation. The accompanying photos show some—but by no means all—of the many ways the tool can be set up.

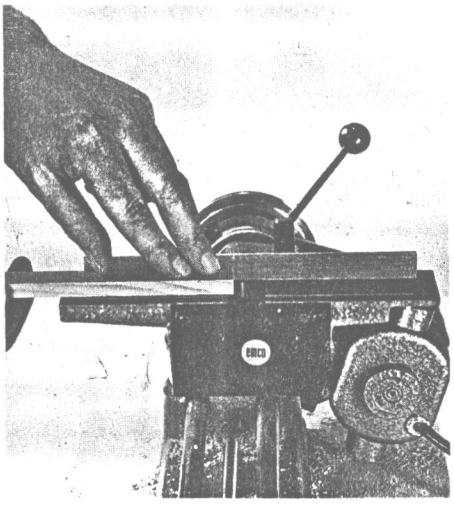
Since it can perform such a variety of machining operations on small workpieces, the Unimat is a simply marvelous tool for home-shop modelbuilding and craftwork. Using a Unimat an amateur modelbuilder can readily machine the special metal parts and fittings he needs to give his models professional finish. More than that, with a Unimat he's tooled up for projects he couldn't otherwise hope to tackle. He's able to machine model ship, locomotive, aircraft or automotive parts to exact scale from original blueprints. He can build his own working-model gas, steam or diesel engines right down to the last screw. If he wants to model an architectural structure, he can use the Unimat's woodworking accessories to cut and plane accurately-finished miniature timbers and planks. Because the Unimat itself is a scaled-down version of the actual production machines used to make the real equipment modelmakers model, it's possible with this remarkable little tool to build beautifully-detailed scale models of nearly anything.

The Unimat makes precision metal-machining so simple that with only a few hours' practice an amateur modelbuilder having no previous machine-tool experience whatever will be able to turn out machined metal parts that compare in every way with parts made commercially on expensive automatic equipment. For amateur craftsmen, and particularly for youngsters, the Unimat offers both adventure and education. It opens an entirely new, wide-scope field of interest.

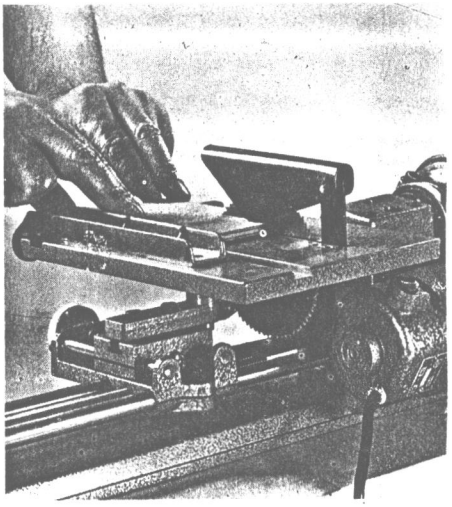
But while the machine is wonderful for hobbiests, a great many of the 100,000



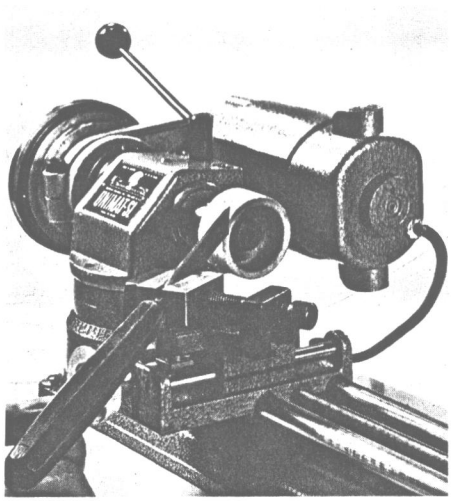
FOR DISC SANDING wood or metal an abrasive disc is cemented to the sanding plate.



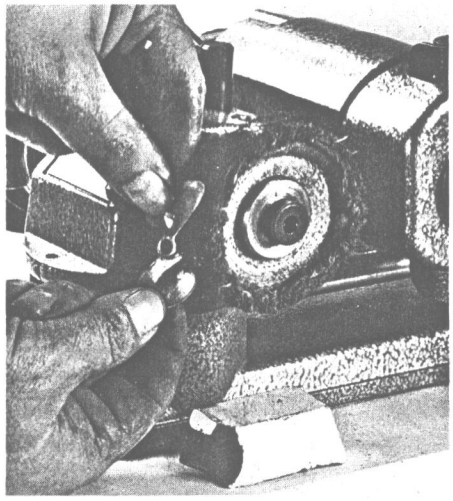
FOR PLANING wood, motor is tilted and planing attachment is clamped on spindle.



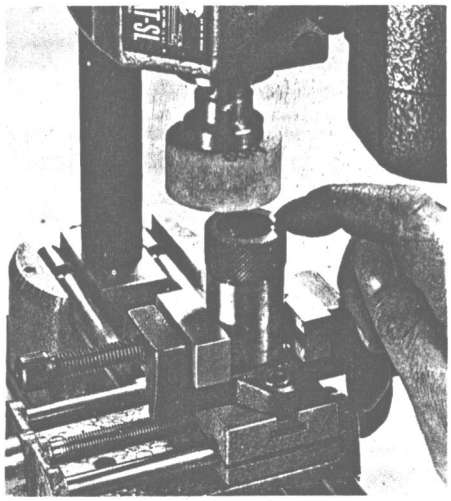
FOR CIRCULAR SAWING the saw attachment's table mounts on the cross slide.



FOR TOOL GRINDING many set-ups can be used. Headstock swivels to any angle.



FOR BUFFING a cloth buff is mounted on spindle and head is turned crosswise.

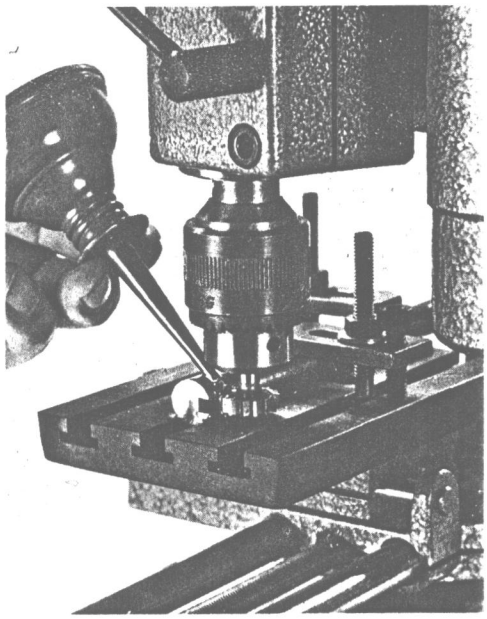


FOR GRINDING FLATS the spindle is set vertically. Vise holds work on cross slide.

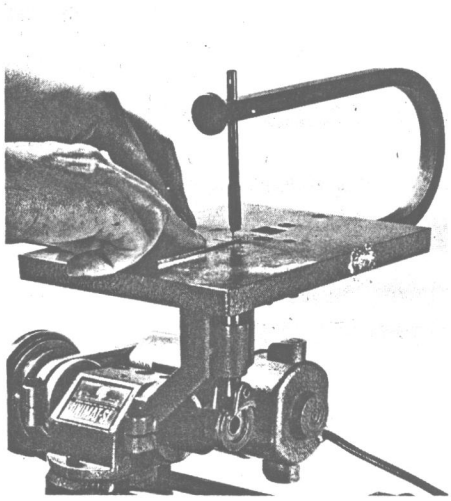
Unimats in use are used commercially. Inventors, designers, engineers, architects and physicists who build experimental models use Unimats to produce at practical cost small parts that if made on conventional machine tools would be quite expensive because of the set-up time involved. The Unimat is so adaptable that in industrial prototype labs the machine is often used for small work in preference to much higher-priced speed lathes. In pattern shops Unimats are used to machine intricate parts for foundry patterns. In optical instrument and electronics equipment repair shops the Unitmat has become standard equipment, since the machine gives an instrument repairman on small scale essentially the same manufacturing facility manufacturers have —and quite often with the Unimat he can rebuild damaged or worn instrument parts himself in less time than it would take to obtain factory replacements. Appliance repairmen often use Unimats instead of larger machines because the compact little tool is so much easier to set up and clean up. Gunsmiths, locksmiths, clockmakers, dental lab technicians, opticians, jewelers and lapidaries also use Unimats to make small parts for repairwork.

The Unimat's extraordinary versatility stems from the tool's four special design features.

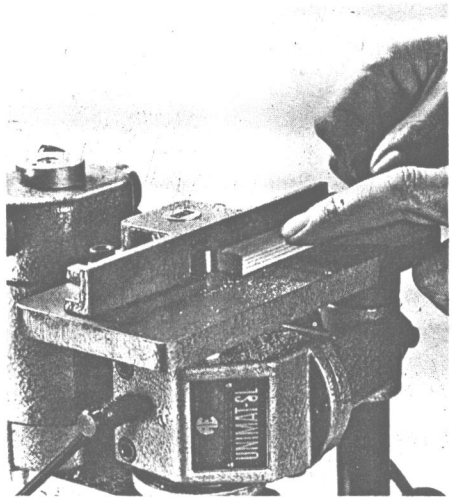
The first special feature is its convertible headstock. Conventional machine tools (reciprocating tools excepted) fall into two fundamental classes, horizontal-spindle machines and vertical-spindle machines. Metal lathes and bench grinders are horizontal-spindle tools. Drill presses, vertical milling machines and vertical surface grinders are vertical-spindle tools. All horizontal-spindle machine tools are basically much alike, and all vertical-spindle tools are basically alike. Because the Unimat's headstock can be mounted either on the machine's bed or on an auxiliary vertical column, the tool can be set up for *either* horizontal spindle machining jobs or vertical-spindle machining jobs, and this makes it possible to perform a wide variety of machining operations on the one



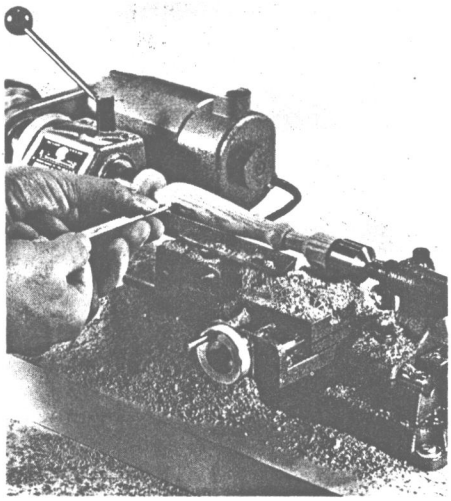
FOR MILLING, work can be clamped on the accessory T-slotted milling table.



FOR JIG-SAWING jig saw attachment's table clamps on spindle. Eccentric drives blade.



FOR SHAPING wood, shaper attachment's table is mounted above inverted head.



FOR WOODTURNING an accessory tool rest is clamped on the lathe's bedway.

machine. When the headstock is mounted horizontally on the bed, the Unimat becomes a metal lathe or grinding-polishing head. When the headstock assembly—spindle, motor, belt-drive and all—is mounted vertically on the auxiliary column, the machine becomes a drill press, vertical milling machine or surface grinder, depending upon how it's used. For drill press work, the tool's spindle can be raised and lowered drill-press-fashion with the spring-loaded spindle cartridge's rack-and-pinion advance. Work can be drilled at any angle, since the headstock can be swung 360° around the column and rotated 360° in the column mount. For vertical milling operations, the spindle's rack-and-pinion advance is locked, and the work to be milled is mounted on the carriage cross slide to permit precision-feeding the workpiece to a milling cutter chucked in the spindle. Set up similarly but with a grinding wheel on the spindle, the Unimat can also perform various precision-grinding operations, including surface grinding and tool-grinding.

SPECIFICATIONS

HORIZONTAL

Swing over bed	3"
Swing over cross slide	1-6/10"
Distance between centers	6-9/10"

VERTICAL

Spindle nose to cross slide	6-1/4"
Drill to center of circle	6-1/8"

COMPONENTS

Headstock rotation	360°
Headstock spindle bore takes	1/4"
Headstock spindle feed	5/8"
Tailstock travel	6-1/2"
Tailstock spindle travel	3/4"
Carriage travel	6-1/2"
Cross Slide Travel	2"
Tool post capacity—(centers standard 1/4" tool bits)	3/8"
Handwheel calibrations	.002"
Motor HP (110V-AC/DC)	1/10
Speed range (11 speeds)	310-5200 rpm.
Accuracy, spindle runout	.0005"
Over-all dimensions	14-1/2" x 4" x 5"
Weight	30 lbs.

The Unimat's second special feature is its high-rpm universal motor and 11-speed step-pulley drive, which gives a wide range and wide selection of spindle speeds. The drive provides both the very-high-rpm spindle speeds needed for such jobs as turning tiny shafts, drilling with very small-diameter drills or milling with small milling cutters, and, with the belts shifted, the powerful low-rpm speeds needed for rough-turning large-diameter work or drilling with large-diameter drills. The belt-drive also functions as a safety clutch, since the belts will stretch when severely overloaded and thus prevent damage to the machine if a cutting tool should wedge in a cut. Because the motor is bracketed on the spindle cartridge, the same wide selection of spindle speeds is available whether the headstock is used horizontally or vertically.

The third special feature contributing to the machine's versatility is the interchangeability of the Unimat's chucks and workplates. The tool's spindle nose, the threaded adapter stud that fits the carriage cross slide, and the tailstock ram all have the same thread, which makes it possible to mount any of the machine's chucks or workplates either on the spindle, on the cross slide or on the tailstock ram. This greatly simplifies making set-ups. Spindle chucks can be used either as workholding devices or as toolholding devices. A workpiece fixed on a plate first can be mounted on the lathe spindle for turning, and then later mounted plate and all on the carriage cross slide for drilling or milling. Workplates can be used in several ways. The accessory sanding plate, for example, can be used not only for sanding but also as a large lathe faceplate, as a carriage worktable for vertical drilling or milling, or as a tailstock pad to support a workpiece drilled in the lathe.

The fourth special feature contributing significantly to the Unimat's versatility is the tool's precision construction, since this makes it possible to accomplish accurate precision work with the machine. Because most machined parts needn't be finished to particularly close tolerance, precision performance isn't always really required. But whenever tolerances are critical, the Unimat provides high-precision capability. The tool's preloaded-ball-bearing-mounted spindle has less than .0005" runout. The spindle can be adjusted for perfect alignment with the bed in minutes. The cross slide travels precisely square with the ways. Feed screw handwheels are calibrated. Spindle collets are available for chucking small turned parts with perfect concentricity. Parts can be turned on the Unimat with the same exacting precision possible on the most expensive toolroom lathes, and flat work can be finish-ground with the same high precision possible with industrial precision grinding equipment.

Ultra-precise work of course demands a degree of skill on the part of the machinist. Anyone experienced in the use of larger machine tools will be able to set up the Unimat for any required machining job and perform critically precise work on the tool with no difficulty, since the Unimat is set up in much the same way and has essentially the same operational features as larger machines.

A complete novice using the Unimat for his first try at metal-machining will soon learn machining fundamentals by experience. This booklet briefs elementary procedures. While it's not a complete machinist's handbook, it will give a Unimat owner a survey of the many operations that can be performed with the machine, show the more commonly-used set-ups, indicate how the many accessores are used, and get him started in the right direction. Skill as a machinist, which is really a practical knowledge of cutting tools and the materials cut with them, comes with practice. The more you use a machine tool, the more you're able to do with it.

Keep in mind while exploring the Unimat's capabilities the sweeping range of work that machine tools accomplish. Machines larger than Unimat but performing the same operations in the same way make nearly all the consumer goods we use. Machine tools turn, drill, mill and grind, and these operations shape the output of the wealthiest nation on earth. With Unimat you can try them all on one machine in one afternoon—and then use the tool to do whatever kind of work interests you most. Metal-machining opens more possibilities than any other field of craftsmanship. When you're equipped to machine metal, you have the means to build anything you want to build—and do it just as well as anyone else could, even the largest corporations.

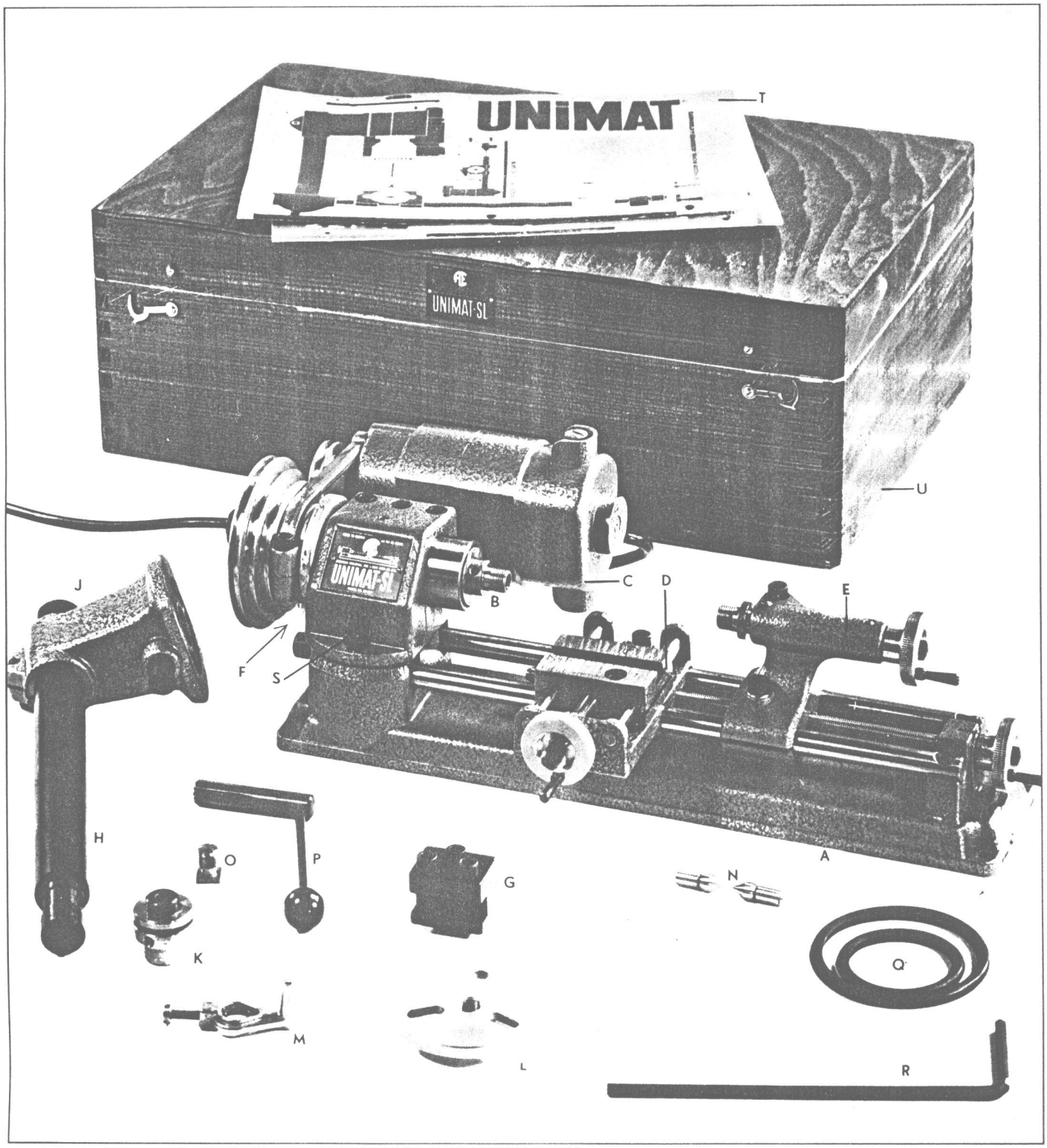
The Unimat gives you, on small scale, this faciilty. It's a universal tool, the most versatile machine a craftsman could imagine.

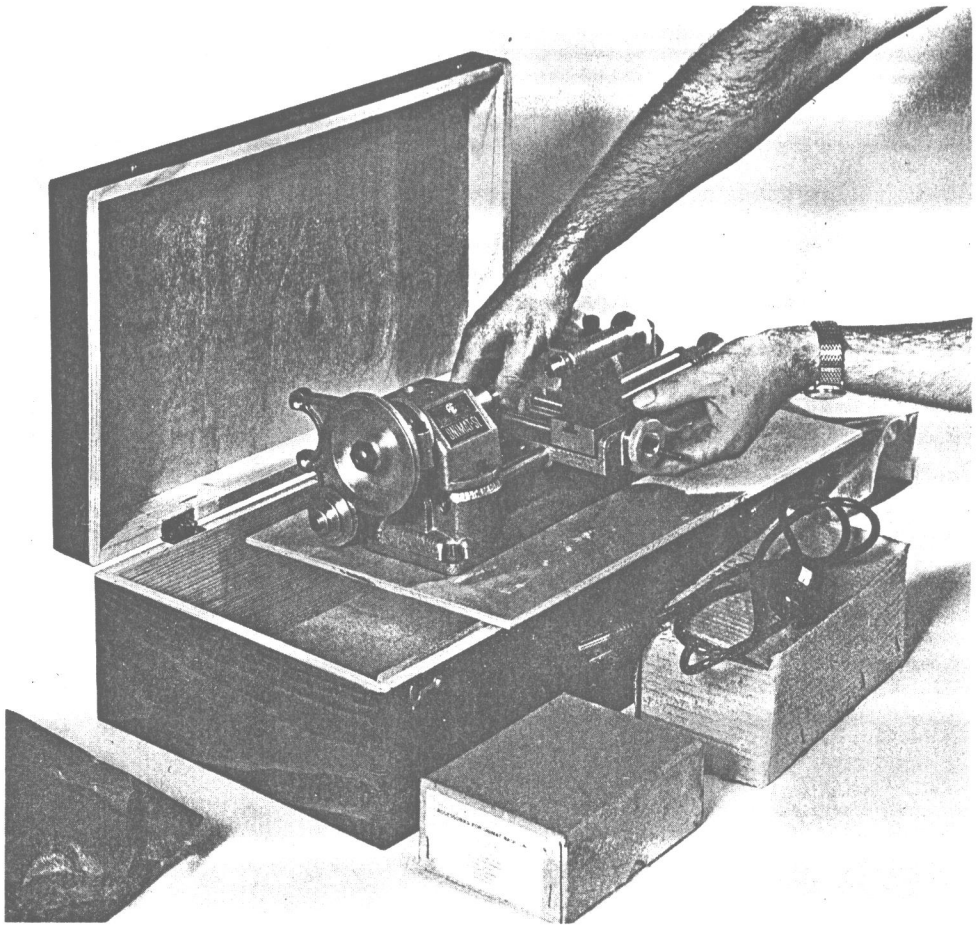
A COMPLETE MACHINE SHOP IN A BOX

- A. Ribbed Lathe Bed
- B. Ball Bearing Headstock Spindle
- C. 1/10 hp AC/DC 110V Motor
- D. Carriage Assembly
- E. Tailstock
- F. Ball Bearing Idler Pulley
- G. Tool Post
- H. 12" Steel Vertical Column
- J. Vertical Column Headstock Adapter
- K. Grinding Wheel Arbor
- L. Face Plate
- M. Lathe Dog
- N. Dead Centers (two)
- O. Slotted Adapter
- P. Spindle-feed Hand Lever & Pinion
- Q. Set of Drive Belts
- R. Allen Wrench
- S. Headstock Alignment Pin
- T. 44 Page Instruction Manual
- U. Wood Storage Chest

OPERATING INSTRUCTIONS

The Unimat is easy to set up and operate. Even an inexperienced amateur will soon learn to use it like an experienced machinist. But before you operate the tool, read these instructions. They show how to assemble the machine, how to perform simple metal-turning jobs, how the various special lathe operations possible on the tool are accomplished, and how to use the headstock on the auxiliary column for drilling, milling and surface grinding. Exploring the Unimat's capabilities is a fascinating adventure, since it can perform on small scale virtually any machining operation that can be performed on full-size machine tools. Following the basic procedures outlined, you'll find it easy to make the appropriate set-up for any precision metal-machining job you might want to do.





PRESTRETCH the rubber drive belts before slipping them on the pulleys.

Setting Up Your Unimat

Each Unimat is shipped in a sturdy wooden storage chest enclosed in a heavy cardboard outer carton. Two small boxes, one containing the motor and the other containing small parts, are packed with the machine in the chest.

Be sure to mail the guarantee card packed with the tool promptly. This card validates the machine's warranty, registers you as a Unimat owner and assures that you will receive catalogs and any other supplemental literature issued on the tool.

Before shipment from the factory every Unimat passes meticulous inspection. If when unpacking your machine you find that a part has been damaged in shipment—or in the event a part should become defective within the warranty period—write to the Customer Service Department, American Edelstaal, Inc., One Atwood Avenue, Tenafly, New Jersey 07670, and describe exactly what is wrong, referring to the part by the name and number indicated on the parts list. If it is necessary to return the part to us for replacement, we will mail you a special shipping ticket. Our repair department cannot accept parcels not previously authorized in this way.

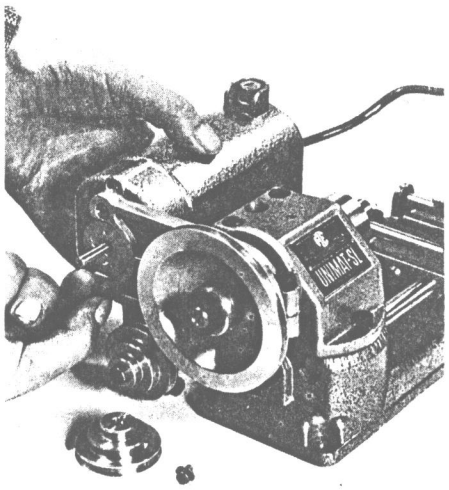
For shipment the Unimat is bolted to a thin plywood baseboard, with the vertical column (H) secured in two blocks behind the lathe. Wipe the machine with a rag dampened in solvent to clean off the sticky rust-inhibiting preservative compound protecting the tool. Then immediately oil all bright-metal surfaces with light machine oil. Loosening the two large Allen-head spindle lock screws in the top of the headstock casting will permit sliding the spindle cartridge back and forth with the ball-handled pinion lever for cleaning and oiling.

Mount the motor behind the headstock on its bracket with the two flat-head screws provided, cord leading to the rear. Then slip the 3-step pulley on the motor shaft and align the slot in the pulley with the shaft's crosspin. As you tighten the filister-head screw and washer that secures the pulley on the shaft, the crosspin will bend into the semi-circular slot and key the pulley.

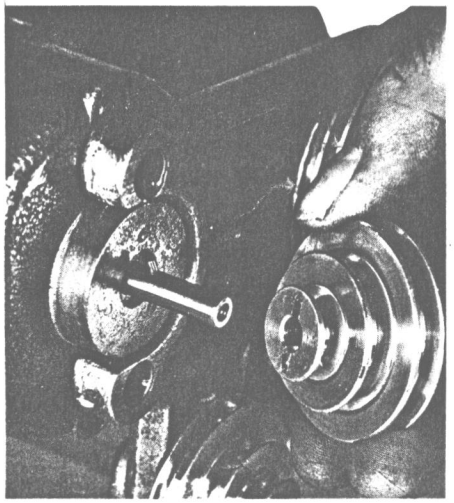
The motor bracket, which clamps on the spindle cartridge, can be positioned as desired to raise or lower the motor. Whenever the motor bracket's clamp screw is loosened, however, the coil spring that retracts the spindle cartridge pushes the bracket against the inner face of the spindle pulley, and this will prevent the pulley from turning. Slight clearance between bracket and pulley—about .010", or the thickness of tin can stock—is required to allow the pulley to turn freely. To adjust this clearance, first fully retract the spindle cartridge in the headstock with the ball-handled pinion lever (R). Next loosen the motor bracket's clamp screw, pull the bracket back along the spindle cartridge (against the tension of the spring) enough to provide clearance, and then retighten the clamp screw. Recheck this clearance whenever the motor is raised or lowered.

Before fitting the drive belts (S), make sure that the idler pulley turns freely. Avoid overtightening the Allen-head screw that clamps the idler's ball-bearing in the bracket, since this might distort the bearing.

The Unimat's special drive belts, which at first may seem too small, should be prestretched before they are slipped on the pulleys. Prestretch the belts by hooking your fingers in them and gradually pulling and



MOUNT THE MOTOR on its bracket with the two machine screws provided.



CROSS PIN in motor shaft bends into semicircular slot in the step-pulley.

stretching them, working around each belt several times. Then slip the smaller belt on the smallest step of the motor pulley and the largest step of the idler pulley. Slip the larger belt on the middle step of the idler and the middle step of the spindle pulley. This belting arrangement drives the spindle at its second-slowest speed, with ten other combinations possible. Run in new belts at this speed for ten minutes before shifting to higher speeds.

Like other quality universal-motor tools, the Unimat has a 3-conductor cord with a 3-prong plug. The plug's third prong safely grounds the machine and eliminates hazard in the rare event of an electrical breakdown. The tool's bronze-bearing AC-DC motor, which is fully enclosed to keep out dirt, heats somewhat when run continuously under load, which is normal. When pulling load a universal motor's speed drops, with the motor delivering full rated power when shaft speed falls to about half the no-load speed. When shaft speed drops to less than half the no-load speed, the motor is overloaded. You can easily judge when the Unimat's motor is delivering full power by its sound; the full-power speed is the point beyond which the machine sounds labored. Avoid repeatedly overloading the machine's motor. If a heavy cut or snagged drill stalls the motor, switch off power immediately and correct the situation before restarting.

If you mount your Unimat permanently on a bench-top, be sure that the mounting surface is perfectly flat, since screwing the machine down on an uneven surface might twist the bed casting. Many Unimat owners mount their machines on Formica-faced or white-enameled wooden baseblocks measuring about 11″ x 18″, which makes the tool readily portable. A piece of ¾″-thick Formica-covered plywood will serve, but a heavier base about 1½″-thick is preferable. A light-colored base will be easier to keep clean and will make small parts easier to see.

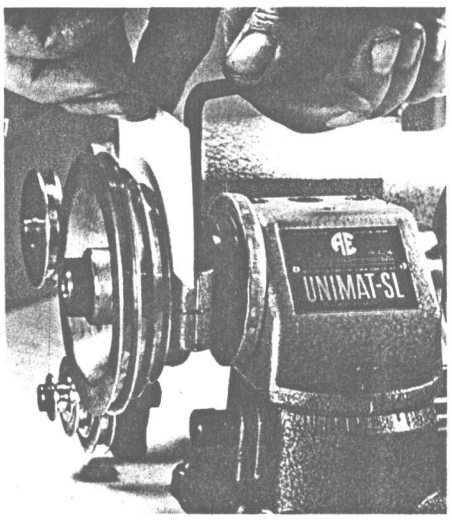
When you have your machine set up, familiarize yourself with its operating controls. Turning the longitudinal feed screw's calibrated handwheel slides the lathe carriage back and forth along the ways. When a cutting tool is mounted on the carriage, the longitudinal feed moves the point of the tool along a line of travel precisely parallel with the lathe's centerline. In this way work mounted in the lathe can be machined accurately cylindrical.

The cross feed screw's calibrated handwheel moves the carriage cross slide along a line of travel precisely square—at a 90° angle—with the lathe's centerline. The cross feed screw feeds the tool bit in or out to control depth of cut for cylindrical turning, and it is used for facing square shoulders and squaring the ends of workpieces.

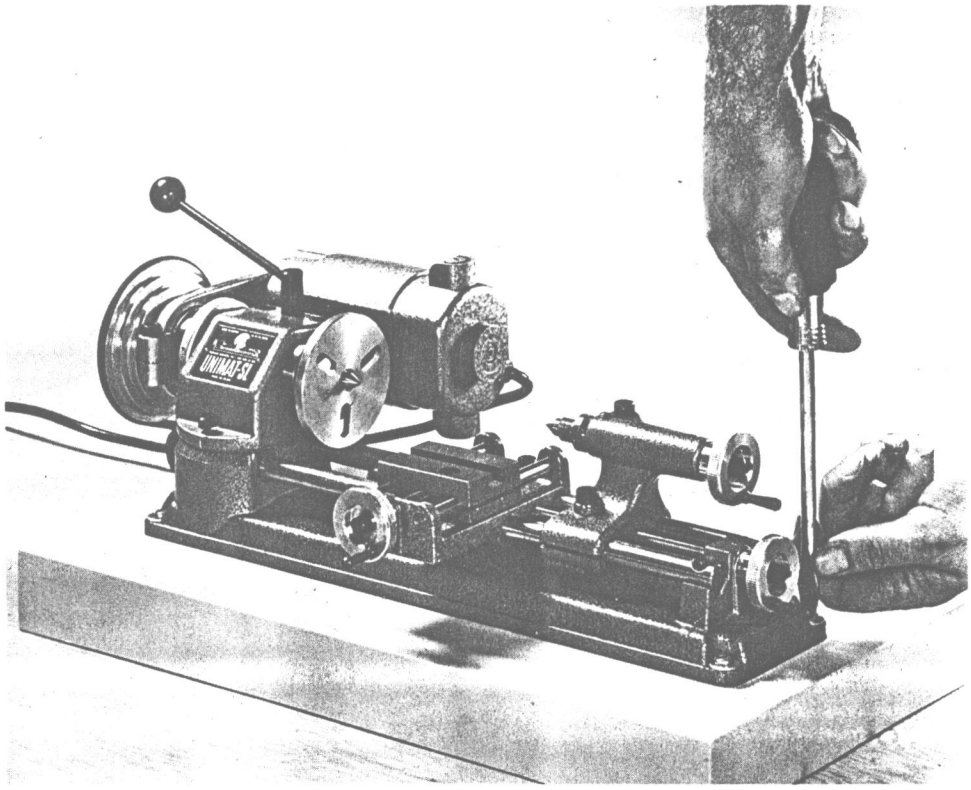
Both longitudinal and cross feeds have Allen-head tensioning screws. When fully tightened these screws lock the feed movements. When partially tightened they tension the movements to provide the sliding action desired—tighter or freer.

The Allen-head screw in the base of the tailstock clamps the tailstock wherever desired along the ways. The tailstock ram can be advanced with its calibrated handwheel and locked in position with the Allen-head lock screw at the top of the tailstock casting. All lock screws on the Unimat have the same size heads, and the machine's large Allen wrench fits them all. When the Unimat is set up for lathework the two Allen-head lock screws in the top of the headstock casting should be tightened enough to clamp the spindle cartridge immovable, but do not overtighten them. The ball-handled pinion lever, which slips loosely into its hole in the headstock, ordinarily isn't used for metal-turning. You can position the lever with the ball over the drive belts to serve as a belt guard, or you can remove the lever.

It's important to keep a metal lathe cleaned and oiled, since accumulated dirt, chips and swarf from grinding wheels or sanding discs cause unnecessary wear. You can clean metal chips from your Unimat in seconds with a shop vacuum, or you can



CLEARANCE is required between motor bracket and spindle step-pulley.



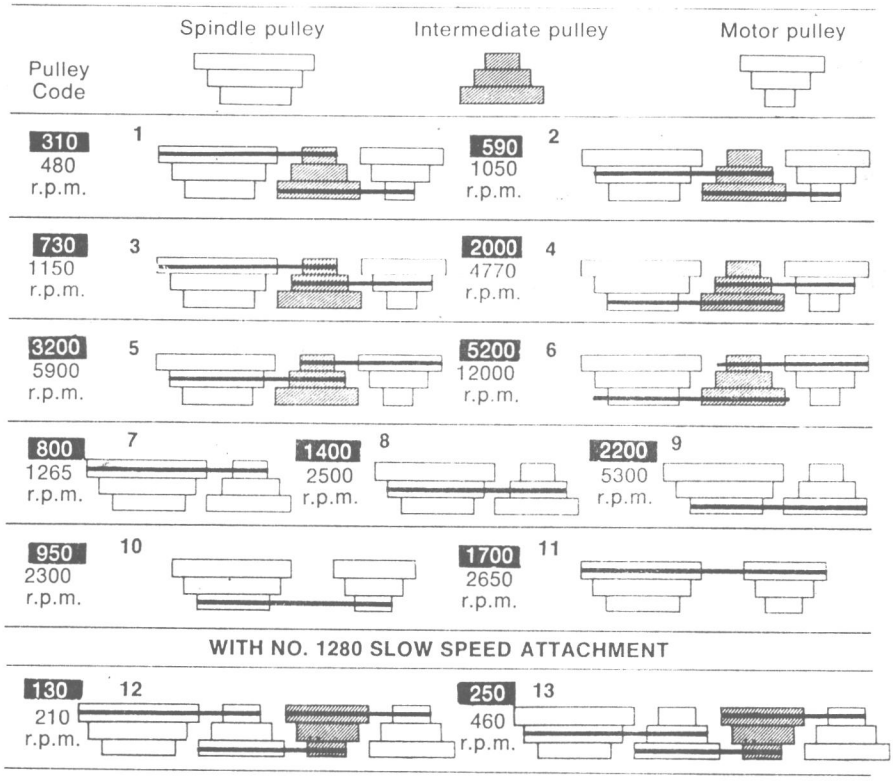
MOUNTING your Unimat on a wooden baseblock makes the machine easily portable. Make the base about 11″ x 18″ x 1½″ with white finish.

SPINDLE SPEEDS

(with motor 3450 r.p.m.)

Standard Spindle (r.p.m. indicated as 000)

"WW" Watchmaker Spindle (r.p.m. indicated as 000)

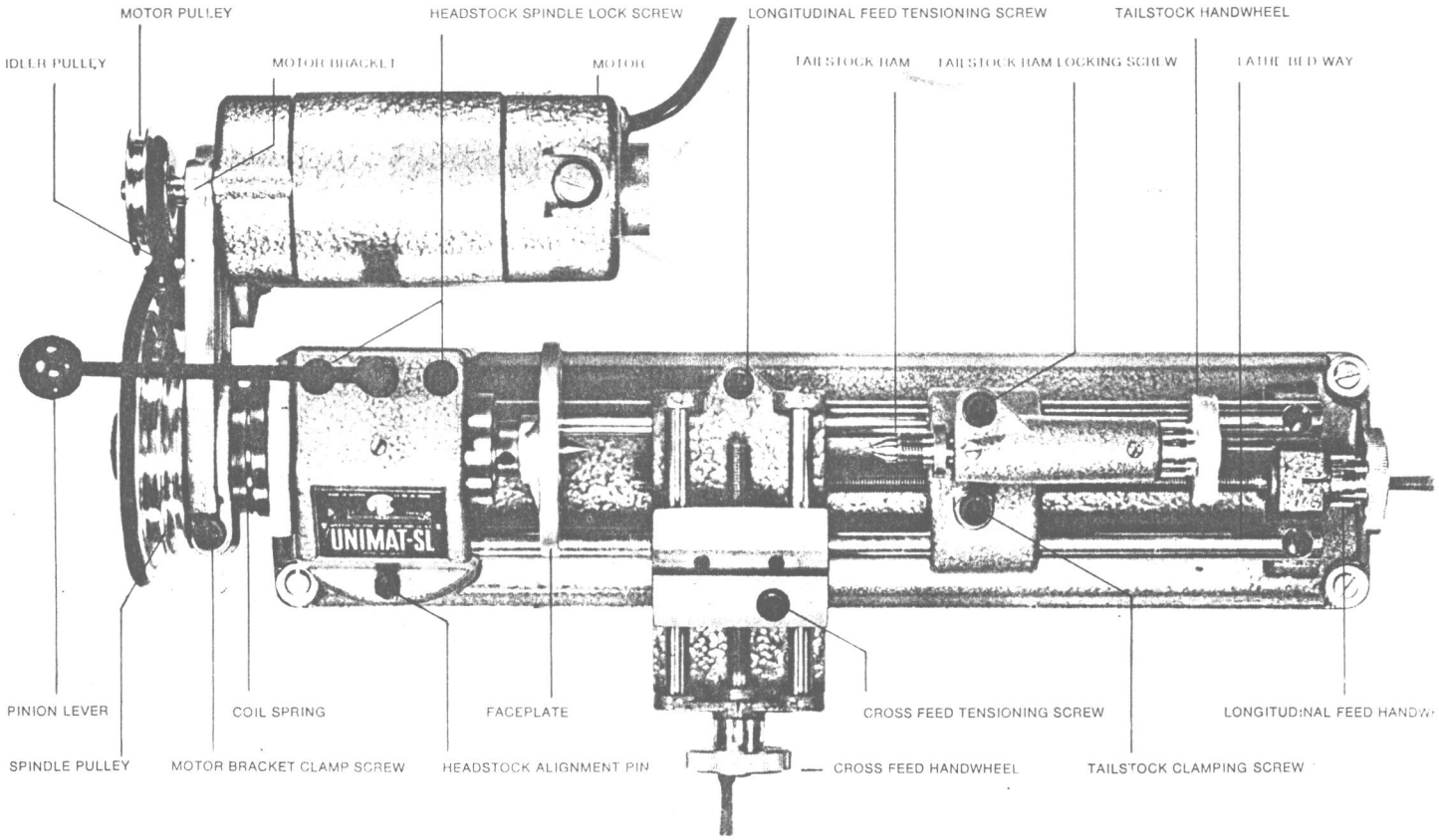


brush the tool clean with a paintbrush. After each use oil the ways and wipe down all bright working surfaces with the machinist's best friend, an oily rag, to prevent rust. Keep the tool's feed screws clean, and lubricate them regularly with light machine oil.

Remember to observe sensible safety precautions when using your Unimat. Any machine tool cutting at high speed throws flying chips that may endanger the user's eyes, and the fact that the Unimat is so often used for close precision work—with the operator's face close to the action—makes it particularly important to keep this hazard in mind. Wear protective safety glasses when performing any machining operation that produces flying chips, especially when machine-grinding or disc-sanding on the machine.

When the Unimat is used for special work, a special base for the machine may be desirable. In instrument repair shops Unimats are sometimes screwed to small cast iron surfaces plates. The surface plate provides a true surface behind the bed on which to use a magnetic-base dial indicator.

THE UNIMAT'S operating controls are much like the controls on larger machine tools. Take a few moments to become familiar with them before mounting work in the machine for turning.



Turning Work Between Centers

In most metal lathe operations the lathe revolves the work to be machined against a fixed cutting tool that peels off shavings. It takes considerable force to pare chips from solid metal. The workpiece must be mounted very securely in the lathe to make the tool bit's cutting edge cut the work instead of lifting it out of the machine.

The most elementary way to hold work is to mount the workpiece between centers. Two 60° centers (P)—hardened and ground can be inserted in the lathe spindle and tailstock ram. They are supplied with the Unimat. If each end of the stock to be turned is first centerdrilled with a 60° countersink centerdrill, the work then can be supported between the two hardened points. The center in the lathe's spindle, termed "live" because it rotates, keeps the work aligned. The center in the tailstock ram, termed "dead" because it doesn't turn, serves as a conic bearing on which the workpiece can revolve. Usually work mounted between centers is rotated with a dog (O), which is a bent-tailed fixture clamped on the spindle end of the work in such a way that the dog's tail engages a slot in a faceplate (N) screwed on the spindle.

STRAIGHT TURNING

Turning work mounted between centers to simple cylindrical shapes, termed "straight" turning, is the most basic metal lathe operation. Mounting between centers is also the most accurate way to turn precision work. Work turned between centers can be removed from the lathe for other machining operations and later replaced for additional turning without loss of precision. Or the workpiece can first be machined half its length, then turned end-for-end and machined the rest of its length with perfect concentricity.

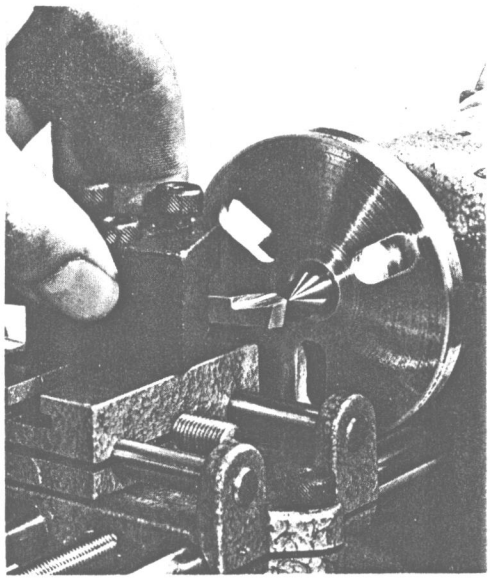
Before attempting critical work with your Unimat, however, it's advisable to try some practice turning on scrap stock to get the "feel" of the machine. If you've never before used a metal lathe, you'll find this a revealing experience. Aluminum is perhaps the most suitable metal for practice turning, since it turns freely. You can get some ½"-diameter rod stock at a hobby shop, or you may be able to obtain some scrap aluminum.

Having squared the ends of a piece of aluminum about 6" long, centerpunch both ends exactly on center. You can locate the centers accurately with a small combination square's centerhead or with dividers. To centerdrill the stock, screw the Unimat's drill chuck (K) on the spindle, insert a 60°-centerdrill in the chuck, and with the spindle operating at slow speed, advance the tailstock ram to feed the stock against the rotating drill. Feed the work slowly. Drill the centerholes to nearly the full diameter of the centerdrill—but not deep enough to leave a ridge around the countersinks. Although cutting oil should be used when centerdrilling steel, no lubricant is needed to drill non-ferrous metals.

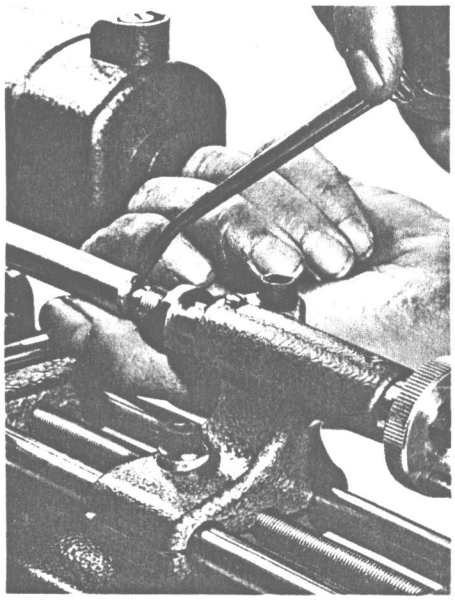
After drilling, clean out the centerholes and fill them with machine oil. Then clamp the dog firmly tail-outwards on one end of the stock, screw the faceplate on the lathe spindle, and with the tailstock positioned as needed on the ways, advance the ram enough to support the work between the points of the centers. Be sure the dog's tail enters one of the three slots in the faceplate.

The dog supplied with the Unimat will drive work up to ½" in diameter. For larger

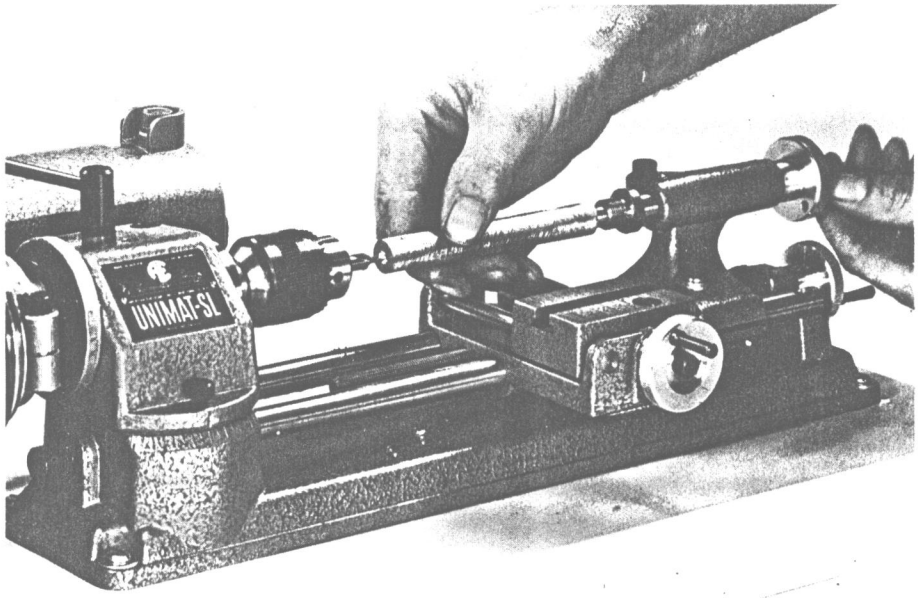
LOCATE CENTER POINTS on each end of stock with square or dividers and center punch.



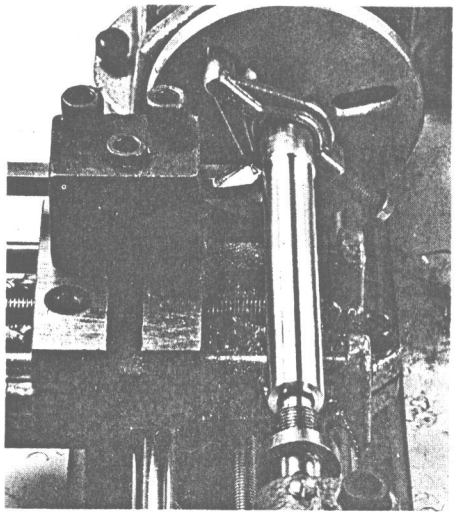
THE TOOL BIT'S POINT must be at exactly center height. Align tool with point of center.



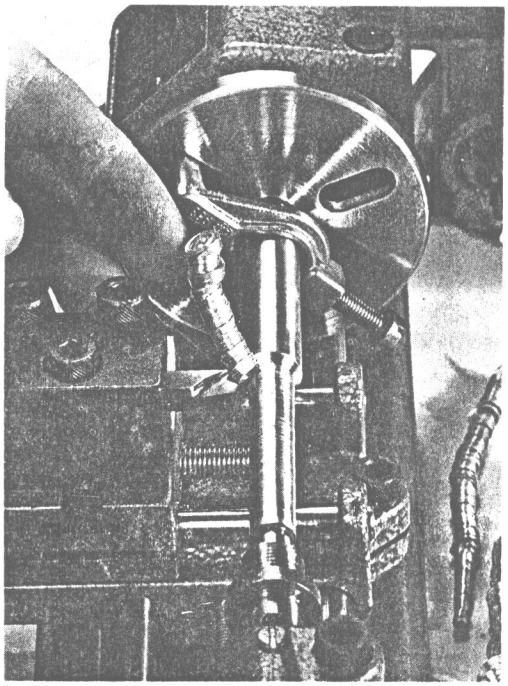
LUBRICATE THE DEAD CENTER with light machine oil and adjust it carefully.



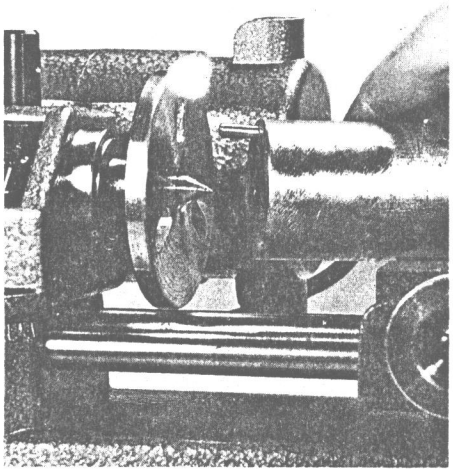
CENTERDRILL THE STOCK with a 60° countersink centerdrill chucked in the drill chuck. Feed the work to the rotating drill with the tailstock's handwheel.



A LIGHT CUT along the stock will give you the feel of the longitudinal feed.



HEAVY CUTS remove metal faster but leave the workpiece with rougher finish.



DRIVE LARGE WORK with a steel pin set in one end of stock. Pin engages faceplate.

workpieces you can machine a similar but larger dog, or to drive even larger work you can set a steel pin in one end of the stock.

MOUNTING CUTTING TOOL

Next remove the work temporarily from the lathe and mount the cutting bit. The ready-ground ¼"-square bit supplied with the machine (V), a general-purpose (roughing) turning-facing tool sharpened on its left edge, is a "right-hand" tool. Fed into the work *from* the operator's right, it cuts leftwards—towards the lathe spindle.

The Unimat's open-side tool block (G), the same type of tool-holder used on large industrial lathes, mounts on the T-slotted carriage cross slide with a screw and T-nut. It can be angled in any way most convenient, and by rotating the block the tool can be mounted on either side. Generally for cuts towards the headstock the tool should be mounted on the left side of the block, and the block should be set square with the bit's shank at a 90° angle to the workpiece.

For best cutting action the bit must be mounted with the point of its cutting edge exactly at center height, level with the axis of the work. Use a sheetmetal shim of the thickness required to align the bit's point with one of the centers, inserting the shim under the tool's shank. For maximum rigidity the bit should overhang the block as little as possible.

With the bit mounted, feed back the cross slide and replace the work in the lathe, adjusting the dead center carefully with the tailstock handwheel and locking the adjustment. Since the tailstock center functions as a bearing, adjust it just tightly enough to eliminate end play but not tightly enough to bind. The center will require periodic relubrication and readjustment as the workpiece is machined. After each few cuts the lathe should be stopped, the center partially withdrawn, the work's centerhole refilled with machine oil and the center then readjusted. Relubing and readjusting the dead center at short intervals is especially important when you're turning work at high spindle speed. It's also important when you're roughing long stock to size with cuts that heat and expand the workpiece, for unless the center is frequently readjusted the work's expansion will cause binding and the friction will soon burn the center.

Taking a light truing cut along the scrap aluminum workpiece will give you the feel of the Unimat's longitudinal feed. After moving the tool bit beyond the work's right-hand end, position the bit with the cross feed for a cut about 1/32" deep and tighten the cross feed tensioning screw to lock the movement. Also partially tighten the longitudinal feed's tensioning screw enough to give smooth carriage glide when you turn the handwheel. Then, having revolved the workpiece in the lathe once by hand to make sure it turns freely, set the drive belts for medium spindle speed and switch on the motor.

If you turn the longitudinal feed handwheel steadily and evenly when making the cut, the bit will pare off a continuous light chip and accurately machine the work to a beautifully smooth finish. You can continue the cut until the carriage nears the rotating dog. At this point stop the lathe, unlock the cross feed and withdraw the tool.

Next try a deeper cut, setting the tool bit to pare off a chip about 3/32" deep. Shift the belts for slow spindle speed, and crank the longitudal feed handwheel fast enough to make the bit cut a thick, curled chip. As you'll see, this heavier cut will remove metal much faster but will leave a rougher finish on the work.

Ordinarily any metal-turning operation is performed with first a series of deep roughing cuts and then a light finishing cut. Roughing cuts are taken as needed at slow spindle speed to reduce the work to slightly more than finish diameter; then a light cut is taken at higher spindle speed to finish the work to exact size. Roughing cuts are always made towards the headstock. They can be made as deep as the lathe will pull at slow speed without excessive laboring. The allowance left for finishing generally should be about .010", for a finish cut about .005" deep.

The depth of the roughing cuts the lathe can pull, which you'll soon learn to judge by experience, depends upon a number of factors: the metal being machined, the work's diameter, the spindle speed, the feed rate, the rigidity with which the work is mounted, and the shape and sharpness of the cutting bit. The Unimat can pull deeper cuts when machining soft, easily-cut metals than when machining tough, hard-to-cut metals. You can take deeper roughing cuts when turning soft aluminum than when turning brass. You can take deeper cuts when turning brass than when turning steel or cast iron.

SELECTING SPEEDS

The optimum spindle speed for a particular cut depends both on the work's machinability and its diameter. Small aluminum or brass parts can be turned at high speed. But when turning large-diameter steel workpieces it's necessary to use slow spindle speed and take very light cuts. Deep cuts on large-diameter work will stall the motor. If you do stall the motor, immediately switch off the machine, back out the tool and try a slower, lighter cut.

Slow spindle speed also minimizes tool chatter. When the tool vibrates in the cut and leaves a corrugated finish on the work, it's an indication that the set-up isn't sufficiently rigid to resist the cutting forces involved. Chatter is often a problem when turning slender work that springs away from the bit's cutting edge. When a tool chatters, reset it at another angle and take a lighter cut at slower speed.

FACING

Try some practice facing cuts before discarding your scrap aluminum workpiece. To face the end of the work, set the tool at the angle required to make its point cut cleanly slightly more than 45°, lock the longitudinal carriage feed, and make the cut with the cross feed handwheel. If the tool chatters, increase the bit's angle. Although on larger lathes facing cuts are usually made from the center of the work outwards, facing cuts made on the Unimat often will have smoother finish if made from the work's periphery towards the center. When facing large-diameter work center-out, take very light cuts to avoid overloading the motor. A heavy cut that the lathe can pull easily near the center of the work will stall the motor as the diameter of the cut increases.

The opposite end of the workpiece can be faced by turning the stock end-for-end and clamping the lathe dog on the other end. Use pads cut from thin fiber or sheet metal softer than the work under the dog's screw to avoid marring the finish on finish-turned work.

Many parts turned between centers will have stubs at one or both ends that must be cut off after the part is turned. While a specially-ground tool bit can be used for cutting-off in the lathe, it is usually simpler to turn a V-shaped notch at the end of the part and to cut off the stub with a hacksaw after the work is removed from the machine. When turning down the stock beyond the part, particularly when machining brass or aluminum, avoid turning it so small in diameter that the stub might break off before the part is completely finished.

Perhaps with another piece of scrap stock you'll want to try machining work accurately to size. For precision work you'll of course need a precision measuring instrument, either a micrometer (preferable) or vernier caliper.

ALIGNING THE SPINDLE

For precision turning the Unimat's spindle must be very accurately aligned with the ways. The headstock's hex-head aligning pin (U) provides only moderately accurate alignment. To align the spindle more precisely, mount a workpiece between centers, take a light cut along its length, and then measure the diameter of the turned work at each end with a micrometer. Chances are you'll find that the two ends differ in diameter by a few thousandths, which indicates that the lathe is cutting a very slight taper. This can be corrected by loosening the headstock's Allen-head clamping screw and rotating the headstock very slightly to make the lathe's line of centers (the axis around which the work revolves) precisely parallel with the ways (which guide the cutting tool along its line of travel). If after the trial cut along the workpiece the work's spindle end is larger in diameter than its tailstock end, turn the headstock a hair's-breadth clockwise, which will shift the spindle end of the workpiece towards the cutting tool. If the spindle end of the workpiece is smaller in diameter than the tailstock end, rotate the headstock slightly counterclockwise, which will shift the spindle end of the workpiece away from the cutting tool. Several trial cuts with minor readjustments may be needed to align the spindle so exactly that the lathe will turn a perfect cylinder. When the headstock is precisely aligned, scribe witness marks on the headstock and bed casting to facilitate resetting.

Although less accurate, a faster way to align the lathe spindle is to advance the tailstock and then adjust the headstock until the dead center will seat squarely in the spindle's bore.

HANDWHEEL CALIBRATIONS

The Unimat's longitudinal feed and cross feed screws have identical metric 8x1mm threads. Turning the handwheel on either feed screw moves the cutting tool exactly one millimeter. The hub of each handwheel is calibrated with 20 divisions, each 1/20th-revolution mark indicating a feed of .05mm.

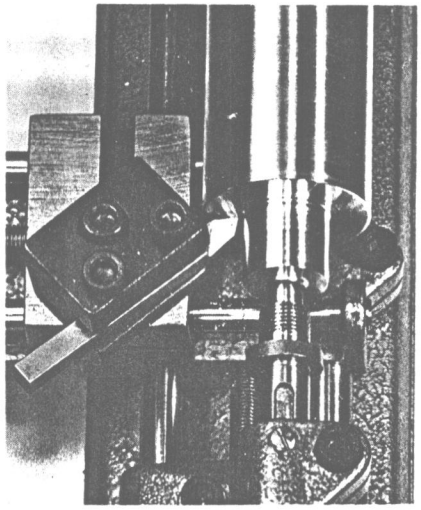
While camera and instrument parts are made to the metric system of measurement, for other work you'll want to use inch-system measurement, measuring in thousandths of an inch. With the Unimat this is no problem. One millimeter equals .03937", or (rounded off) .040". One full turn of either feed handwheel advances the tool forty thousandths, with each of the 20-division hub calibrations indicating a feed of two thousandths. Simply remember that one mark feeds .002" and reduces the diameter of the workpiece twice that, or .004". If you should want to reduce the diameter of a workpiece .012", for example you would feed the tool in three marks.

For smooth operation all machine feed screws must have some backlash, or play, normally about 1/8th turn. You can adjust the backlash of either of the Unimat's feed screws by loosening the lock nut holding the handwheel, tightening or loosening the wheel, and then retightening the lock nut. When machining cast iron, which produces powdery chips that are quite abrasive, protect the feed screws and the lathe bed with aluminum wrapping foil.

Together the feed screw backlash adjustments and the tensioning of the carriage movement tensioning screws determine the "stiffness' of the feed controls. You'll soon learn to judge the feed tension most appropriate for particular machining jobs by experience. "Easier" feed permits faster work when you're turning soft aluminum, plastic or other easily-cut material. The lathe should be set up more tightly for machining steel or cast iron, and small parts to precision tolerance. Feed adjustments that are too slack will cause tool chatter.

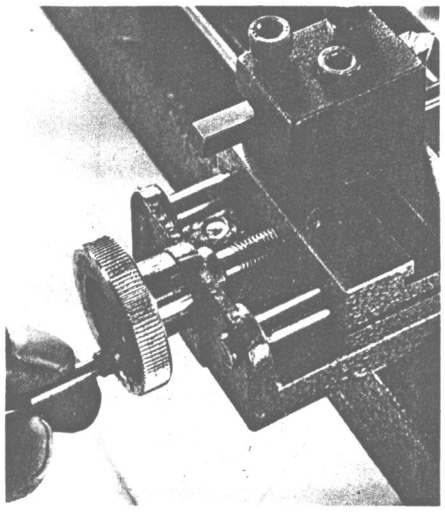
CUTTING TOOL TECHNIQUES

Keep your lathe tools sharp. As you'll

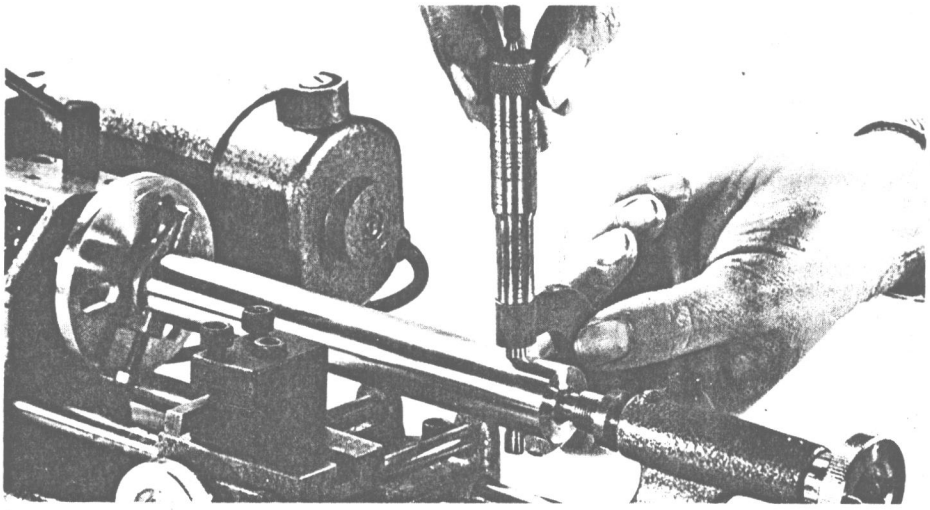


FOR FACING CUTS angle the tool to make its point cut cleanly. On large work take light cuts.

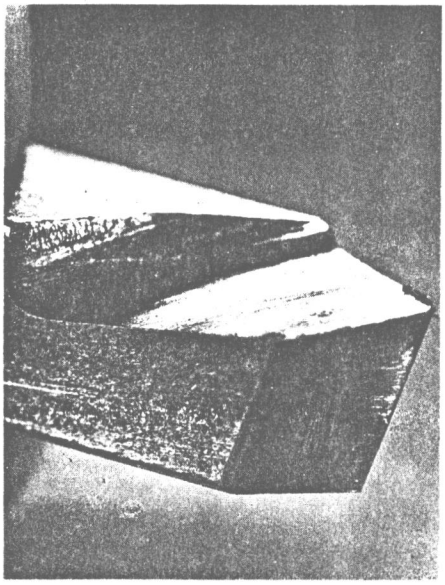
PARTS MAY BREAK before they're finished if you turn end stubs too small in diameter.



EACH CALIBRATION on the hubs of the feed handwheels indicates a feed of .002".



FOR PRECISION WORK the lathe spindle must be precisely aligned with the ways. Machine a test bar, measure both ends, then adjust headstock until lathe cuts true.



A "FALSE EDGE" gradually builds up on the bit's cutting edge. Whetting removes it.

notice in the course of your practice turning, a deposit of metal being machined gradually builds up along the top of the cutting edge, forming a pressure-welded "false edge." In rough turning this false edge does no harm, but for finish-turning the built-up metal should be removed by rubbing the bit's faces flat on a fine-grit oilstone. If you avoid rounding over the cutting edge, a lathe tool can be resharpened by whetting many times before it will require regrinding.

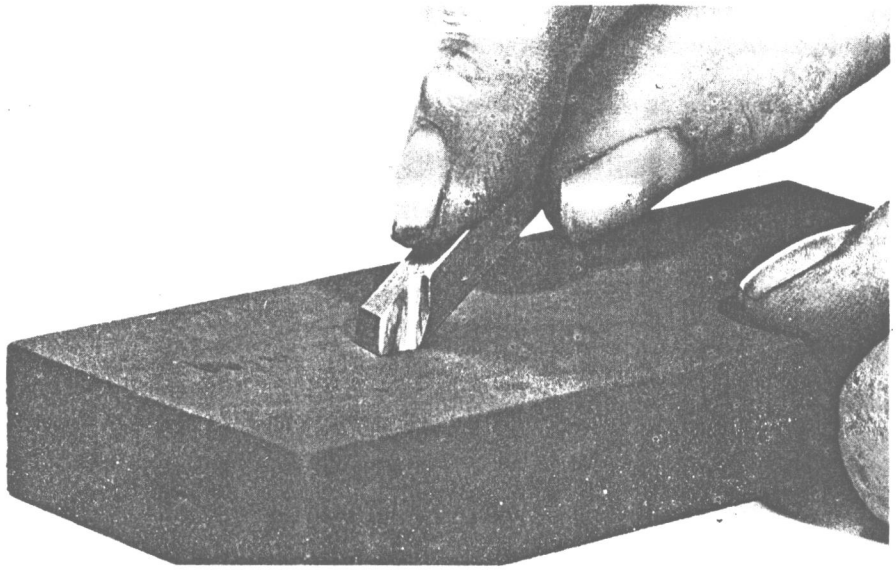
But when a tool's cutting edge finally becomes chipped and dulled, the bit needs regrinding. You can grind lathe tools on the Unimat itself with the headstock set up for grinding, or you can use any bench grinder. Regrind the bit's faces slowly on a medium-grit wheel enough to renew the edge, maintaining the tool's original shape. Avoid overheating the steel.

There are a number of fairly standard shapes of lathe tools that have proved efficient for the more common turning operations, and machinists soon learn to grind special bits for special jobs. A novice at machinework probably would be well advised to buy a set of ready-ground bits. Unimat tool bits are ground exactly like bits used in large industrial lathes—but smaller. If you can buy unground ¼"-square tool bits and grind them yourself, keep in mind the two important requirements for all metal-cutting cutting tools — clearance and rake.

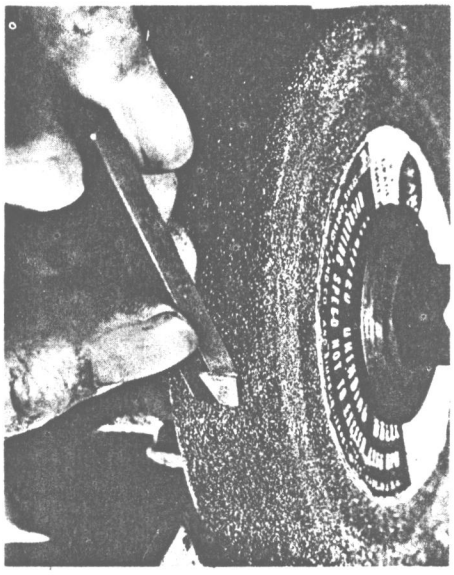
Both are angles expressed in degrees. Clearance is the angle at which the bit is ground for relief *under* its cutting edge. This relief, which usually should be about 10°, allows the sharp edge to advance into the work without rubbing. A lathe tool's cutting edge must have both side clearance and end clearance.

Rake is the angle of slope across the top of the tool. The rake may slope either sideways away from the edge or backwards from the edge. Side rake gives the cutting edge its shearing action. Back rake directs chips away from the work. In general tools with smaller rake angles (with squarer, beefier cutting edges) are used to machine hard-to-cut metals, and tools with larger rake angles (giving more acute cutting edges) are used to machine easier-to-cut metals. For turning hard cast iron, tool bits with about 10° rake usually give best results. For tools to turn soft steel, a 19° rake angle is most efficient. For turning soft aluminium, bits should be ground with 35° rake.

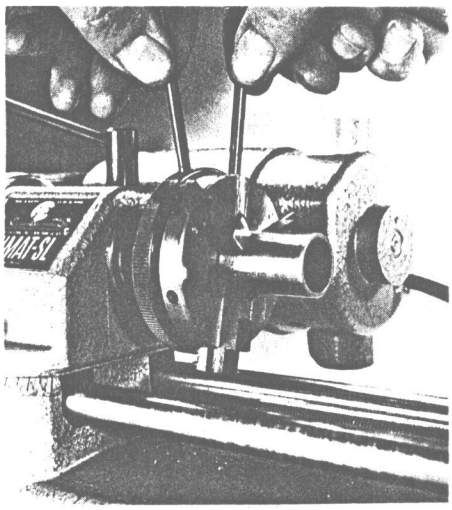
Tools for turning brass are an exception. Because a cutting edge with rake digs into brass and causes the tool to chatter, brass-cutting bits are always ground with standard clearance but with 0° rake—perfectly square across the top. Machinists usually keep a separate set of tools for brass-turning.



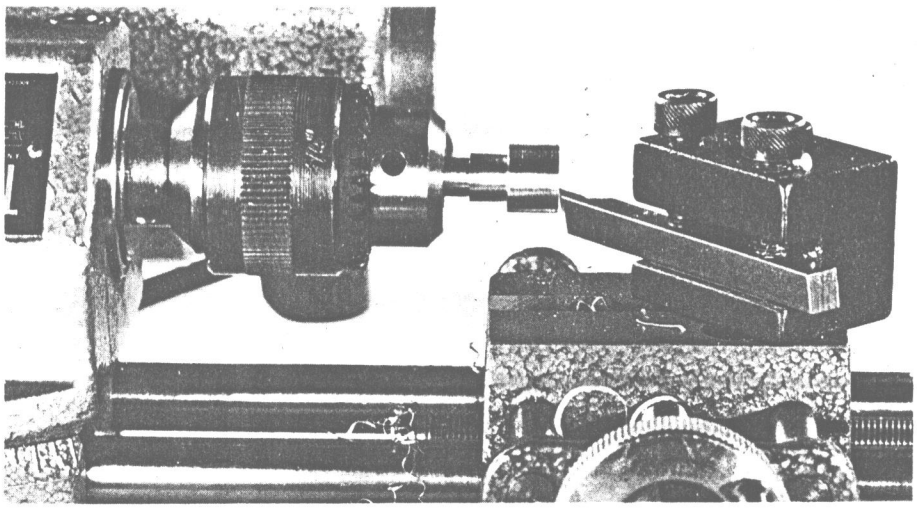
YOU CAN RESHARPEN lathe bits by whetting on an oilstone many times before they will require regrinding. Rub the bits' three ground faces flat on the stone.



REGRIND BITS on a medium-grit wheel, maintaining the tool's original shape.



THE 3-JAW UNIVERSAL CHUCK centers work up to 2" in diameter automatically.



THE DRILL CHUCK can be used to mount small workpieces as well as twist drills. Tighten the chuck evenly, using the key in all three pinion holes.

Other Ways To Mount Work

A metal-machining operation always involves two steps: first fixing the work in the machine rigidly enough to withstand the force required to shear off chips, and then, with a reasonably efficient cutting tool, applying that force. The machinist mounts the workpiece, making an appropriate "set up", and the machine then does the work.

Workpieces of any shape can be mounted in metal lathes for turning with various special workholding devices, most of which screw on the spindle's threaded nose. Two of the most commonly-used devices, a drill chuck (used to hold workpieces as well as twist drills) and a face plate, are supplied with the Unimat. A number of other workholding devices are available as accessories.

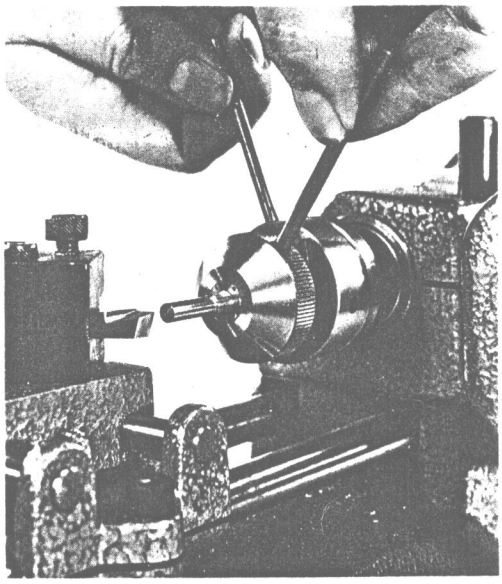
The Unimat's drill chuck centers small round work up to ¼" in diameter to within about .002". In order to grip very small-diameter drills the drill chuck's three hardened jaws have very narrow ground faces, and the jaws will bite deeply into a soft-metal workpiece if overtightened. Always tighten the chuck gradually and evenly on the work, using the key in each of the three pinion holes, and tighten it only enough to hold the work firmly. Work that hangs beyond the jaws enough to whip should be centerdrilled and supported with the tailstock center.

USING THE 3-JAW CHUCK

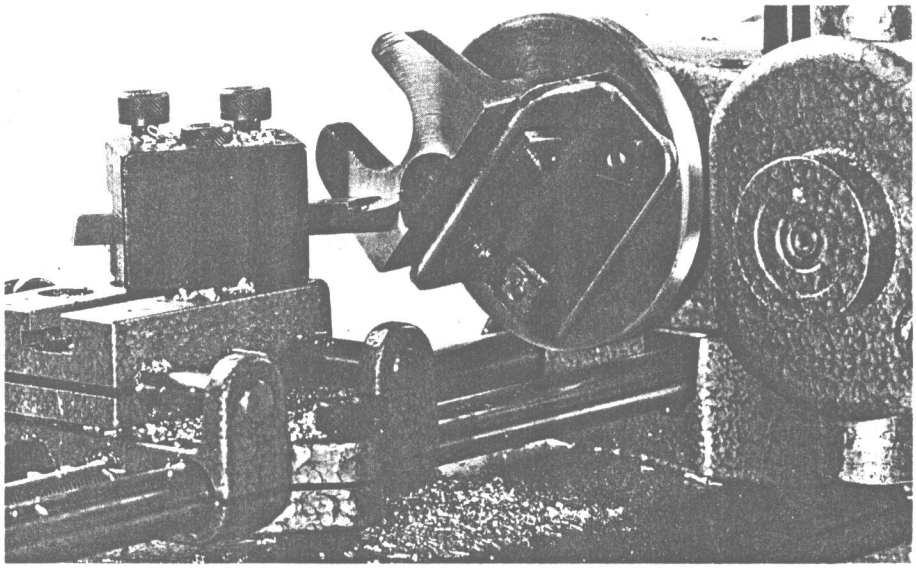
The simplest way to hold most large-diameter round workpieces for turning is to mount the work in the 3-jaw universal chuck, which is perhaps the most generally useful of all the Unimat's accessories (pg. 26). The 3-jaw chuck is supplied with its mounting plate finish-machined and attached, ready to screw on the spindle. The chuck holds work from .118" to more than 2" in diameter. Its three hardened jaws close simultaneously, centering the workpiece automatically as the chuck's knurled outer ring is rotated with pins inserted in the ring and chuck body. A scroll on the knurled ring screws the three jaws in or out. Jaws and jaw-slots are numbered. If you should screw the jaws out beyond the scroll, reengage them in 1-2-3 order.

For chucking work larger than 15/16" in diameter the jaws can be reversed and work gripped in their steps. To reverse the 3-jaw chuck's jaws, turn the ring to screw out the jaws until they disengage, remove them from their slots, and replace them in this order: jaw #3 in slot #1, jaw #2 in slot #2, and jaw #1 in slot #3. Then reengage the reversed jaws with the scroll in reverse order—3-2-1.

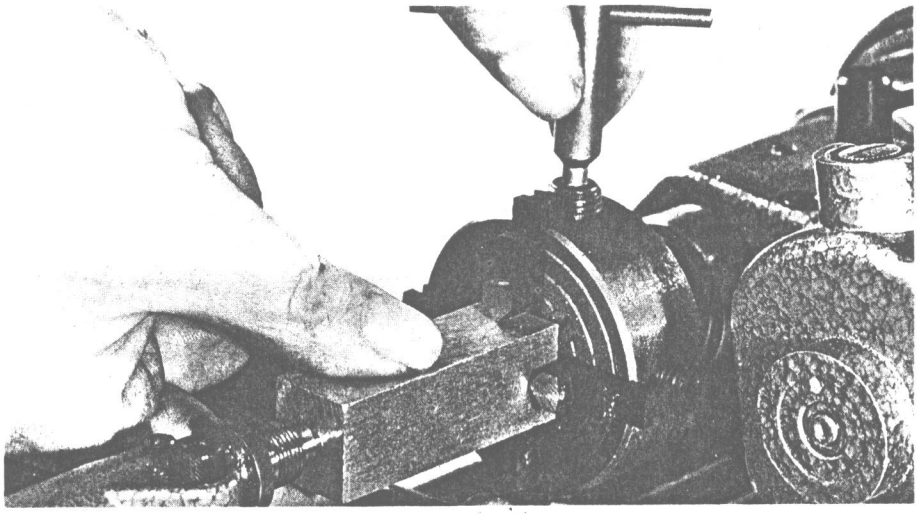
Besides round and hex stock, this chuck



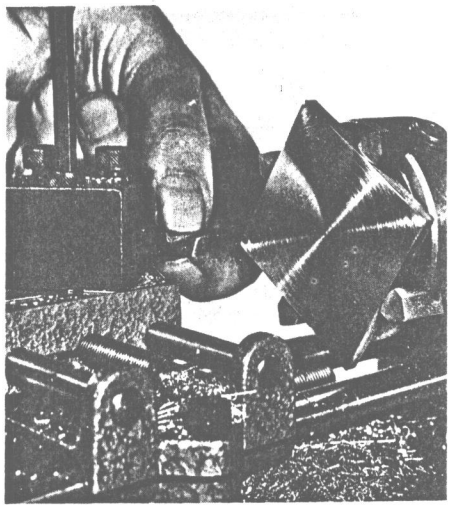
THE COLLET CHUCK centers drill rod or small parts with extremely high precision.



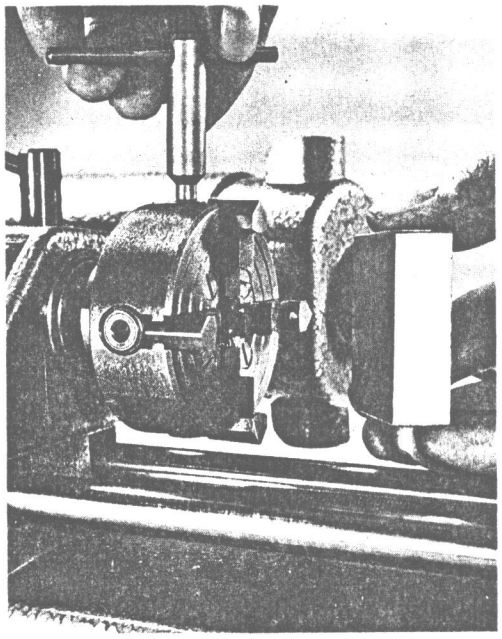
IRREGULARLY-SHAPED WORK can be mounted on the faceplate for turning. Angle plate or other special fixture may be needed to mount some workpieces.



WORK THAT OVERHANGS a chuck more than four times its diameter should be centerdrilled and supported with the tailstock. Avoid overtightening chucks.



SQUARE PLATES as large as lathe's full swing can be accurately faced in the 4-jaw chuck.



THE 4-JAW INDEPENDENT CHUCK holds round, square or irregular workpieces.

will also hold large work that has been bored or recessed. For this the jaws are opened to make the steps grip inside the bore.

The 3-jaw chuck centers workpleces to within less than .003". Since the jaws are tightly fitted, a new chuck at first may work quite stiffly, but the jaws soon wear in and thereafter if kept cleaned and oiled slide very smoothly. For consistently accurate centering make sure that the jaws grip with even purchase as they close on the workpiece. Use jaw pads cut from soft sheet metal to prevent the jaws from marring finish-turned work.

USING COLLET EQUIPMENT

Toolmakers and instrument repairmen when turning small parts that must be centered with extremely high precision usually hold the work in a split spring collet, which centers small-diameter round stock more accurately and grips more securely than any other workholding device. The accessory collet chuck available for the Unimat (pg. 27) uses precision-ground double-tapered spring steel collets that are alternately split to close full-length and grip with even pressure. The body of the chuck screws to a mounting plate that is supplied slightly oversize. The mounting plate is first screwed on the lathe spindle and accurately finish-turned to accept the chuck, and the chuck is then screwed to it. The chuck's threaded nose-piece has a precision-ground internal taper that when the nose-piece is tightened squeezes the collet back into the ground taper in the body of the chuck. Collets, purchased separately, are available in inch or metric sizes. Because they can spring closed only about 1/64th inch, the collet used must be no more than 1/64" larger than the work. A full set of collets is needed to handle work from 1/64" through 5/16" in diameter, the chuck's capacity. The collet chuck is especially useful when you're turning a quantity of small precision parts from drill rod or other smooth-finish rod stock. Avoid closing a collet on work that isn't perfectly round. Long stock up to ¼" in diameter can be fed through the lathe spindle's through-bore. Since both the collet chuck and its collets are extremely high-precision devices, handle them with care to avoid nicking them, keep them scrupulously clean, and lightly oil them regularly with an oily rag.

USING THE FACEPLATE

Odd-shaped work that can't readily be mounted in a chuck often can be screwed, bolted or clamped on the Unimat's faceplate for turning. Flat work as large as the lathe's full swing can be bolted directly to the plate. L-shaped work can be bolted to an angle fixture cut from angle iron and bolted on the faceplate.

When faceplate work must be turned with exacting precision, true the plate—taking a light cut across it with a sharp tool—before mounting the work, and when fixing the workpiece make sure that the mounting screws or bolts do not spring the plate. Ordinarily faceplate turning should be performed at moderate spindle speed. When irregularly-shaped work will be turned on a plate at high speed, counterbalance it to prevent vibration. Using the accessory T-slotted fixture plate on the Unimat's spindle as a faceplate simplifies mounting some workpieces.

USING THE 4-JAW CHUCK

The spindle workholding device that can hold the widest variety of work shapes is the 4-jaw independent chuck, which has four reversible step-jaws that screw-adjust individually with a square key. The 4-jaw chuck holds round, square, rectangular or irregular work, and the jaws grip very securely. Work can be centered in the chuck, or it can be offset for turning eccentrics. This chuck's only disadvantage is that it does not center the workpiece automatically. The work must be centered by hand. To accomplish this you first center the stock in the chuck roughly by eye, using the concentric rings on the face of the chuck for guidance, and you then make corrections by adjusting opposite jaws—loosening one jaw and tightening the jaw opposite—to shift the work as needed. The point of the tool bit will indicate which way the work requires shifting if the tool is set close to the workpiece and the lathe spindle is revolved by hand. For exacting work a dial indicator can be used to indicate runout. Although it takes patience, it's possible to center work in the 4-jaw chuck with extremely close precision.

The 4-jaw chuck's body screws to a mounting plate supplied oversize to permit finish-machining on the lathe spindle (as shown in the accessories section pg. 26), which insures that the chuck will run perfectly true. Always tighten the four jaws firmly and evenly on the work, but avoid

overtightening them. Since the key screws in the jaws with enormous force, severe overtightening can strip the threads in the chuck's cast iron body. When chucking tubing or bushings that might be distorted by the jaw pressure, first turn a closely-fitted metal plug and insert it in the work. Stock that overhangs the chuck's jaws more than four times its diameter should be center-drilled and supported with the tailstock center.

Quite often the 4-jaw chuck is used to hold square or rectangular stock to be turned round, and this involves interrupted cuts—with the lathe bit cutting only the corners of the workpiece. Such cuts should be made at slow spindle speed to avoid excessive hammering, and the lathe's feed controls should be set up fairly tightly.

SPECIAL WORK HOLDERS

Some work because of its shape or the machining operation required can neither be held in a chuck nor mounted on a faceplate. A brass washer to be accurately finish-turned on all sides would be an example. Often such parts can be fixed on a piece of scrap metal and the scrap metal can be chucked. The washer could be soft-soldered on a piece of scrap brass, and with the brass chucked could be machined on three sides; it then could be melted off and resoldered on the brass other-face-out for turning on the fourth side.

A wheel-shaped workpiece is generally first gripped in a chuck, bored, and then remounted for additional machining on an arbor or mandrel. The work can be pressed on a specially-turned tapered mandrel and the mandrel mounted between centers. Easily turned from scrap steel, the special mandrel should have a taper of about .001" per inch of length (machined by offsetting the Unimat's headstock slightly). When pressed on the mandrel's taper firmly enough to prevent slippage, the wheel-shaped workpiece can be turned on both faces and its diameter with exact precision. For some work the mandrel can be threaded and the workpiece secured with a nut. A wheel-shaped part with a hub often can be fixed on a straight mandrel with a set-screw.

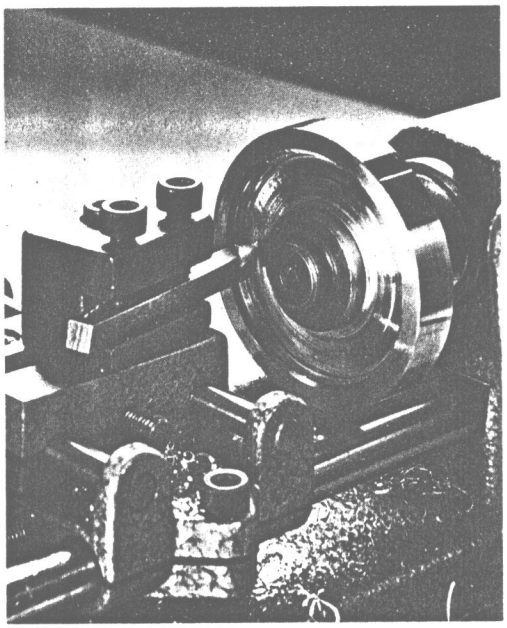
When you encounter work that can't be satisfactorily mounted with any of the standard workholding devices, it's nearly always possible to improvise a special fixture of some sort that will do the job. For example, you might turn a special split chuck—turned to accept the work, split with a hacksaw, and closed with screws or a tapered clamping ring. You might put an irregularly-shaped workpiece in a turned ring with Plaster of Paris. You might devise special lug-clamps to secure odd-shaped work on a fixture plate. You might drill and tap a large workpiece with counterbored 12x1 metric threads and screw the work directly on the Unimat's spindle nose.

Special tooling-up may also be required when you have occasion to machine a number of duplicate parts. To make special setups easier, unhardened steel jaws that can be machined as required are available for the Unimat's 3-jaw universal chuck, and soft steel collets that can be bored to any size needed are available for the collet chuck. After machining either soft chuck jaws or sotf collets to suit the work, you can harden them with *Kasenit* or other surface hardening compound. Arbors or mandrels turned from mild steel can be similarly case-hardened.

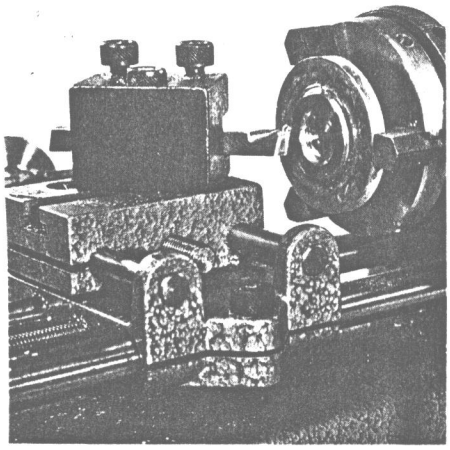
Since the various chucks and work plates all screw on the machine's threaded spindle nose, to maintain the Unimat's precision it's important to protect the spindle threads both from unnecessary wear and from accidental damage. Always clean and oil the threads and the spindle's shoulder before screwing on a chuck or plate. To avoid accidentally nicking the threads, it's good practice to keep either the faceplate or other device screwed on the spindle whenever using the machine.

When chucking lathework that must be turned with exacting precision, be sure to mount the work in such a way that you can finish-turn critical surfaces without rechucking. If a workpiece is bored and faced with one chucking, for example, the face will be machined precisely square with the bore. But if the piece were bored and then rechucked for facing, you could not expect perfect accuracy. It wouldn't be possible to remount the work in the chuck without losing some precision.

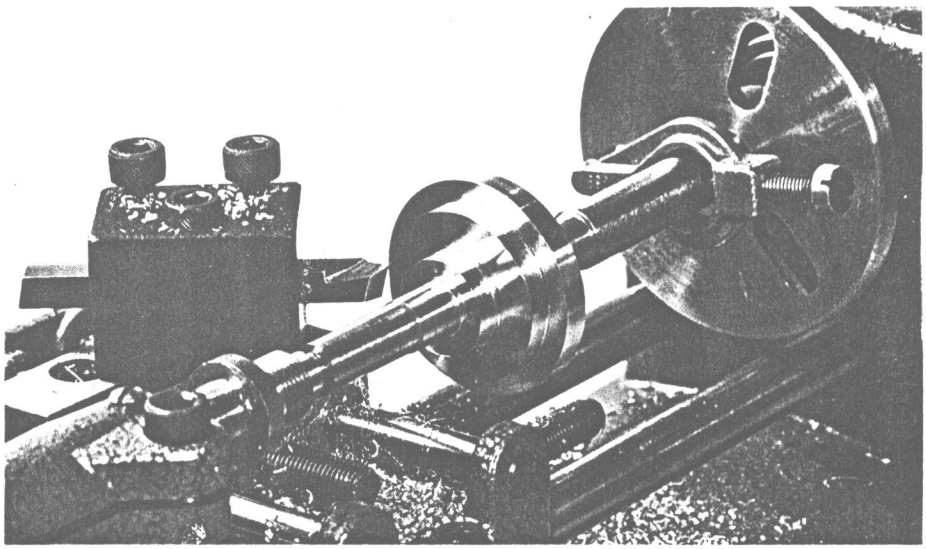
Spindle chucks should be cleaned and lightly oiled after each use. Avoid overoiling, however, for when overoiled a chuck throws black spray when run at high speed. Wipe the oil from the chuck's ground jaw faces before chucking a workpiece.



SOME WHEEL-SHAPED WORK can be mounted on the grinding wheel arbor for turning.



SMALL WASHERS can be soft-soldered on scrap brass, turned, then melted off.



PULLEYS AND WHEELS can be pressed on a tapered mandrel for finish-turning. Turn the mandrel to suit work from scrap steel and mount it between centers.

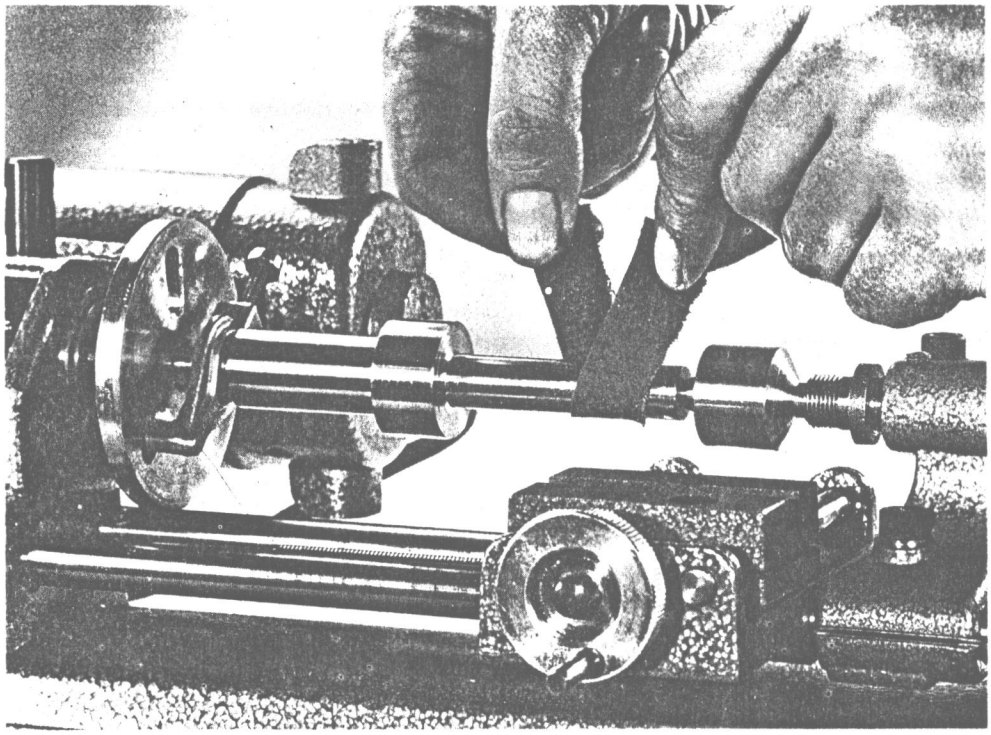
Special Lathe Operations

Of all machine tools the metal lathe is the most versatile. Many operations other than plain turning can be performed on lathes, and all of these special jobs can be accomplished on small scale with the Unimat. This section surveys some of them.

FINISHING

Lathework often requires one or more finishing operations. To remove burrs or round sharp edges, turned work can be filed as it revolves in the machine. For filing use the slowest spindle speed, angle the file for best cutting action, and file with slow strokes.

Any turned work can be polished with strips of abrasive paper or cloth to as high a finish as desired. Use extra-fine wet-or-dry silicon carbide paper for an attractive soft polish on small parts. To polish larger workpieces use strips of aluminum oxide cloth, oiling a worn strip for final mirror-finishing. Since for polishing the lathe is run at high spindle speed, the dead center must be adjusted somewhat loosely and relubricated frequently to prevent it from binding and burning. Using a ball-bearing center in the tailstock that rotates with the work eliminates the risk of burning center points.



YOU CAN POLISH turned work to high finish with strips of abrasive cloth. Using a ball-bearing live center in the tailstock makes frequent readjustment unnecessary.

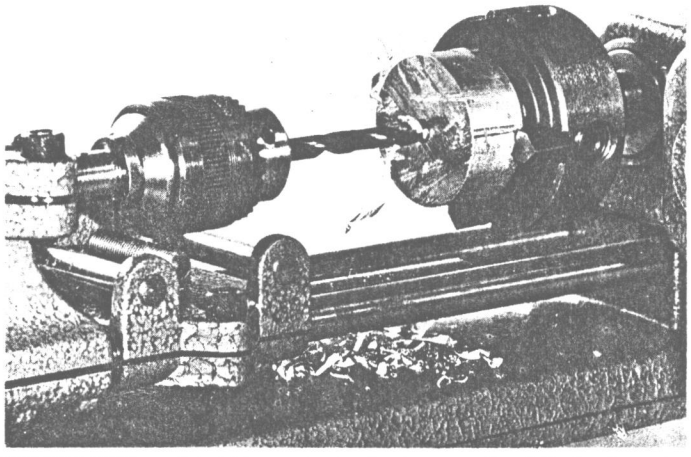
HORIZONTAL DRILLING & REAMING

A metal lathe is an excellent horizontal drill press, and drilling is one of the more commonly performed operations. Ordinarily the drill is mounted on the tailstock ram and revolved in a spindle chuck. Either the drill fed with the tailstock handwheel into work chuck or the collet chuck (for precision small-hole drilling) can be screwed on the Unimat's tailstock to hold small straight-shank twist drills. Large drills with straight shanks can be held in the 3-jaw universal chuck screwed on the tailstock.

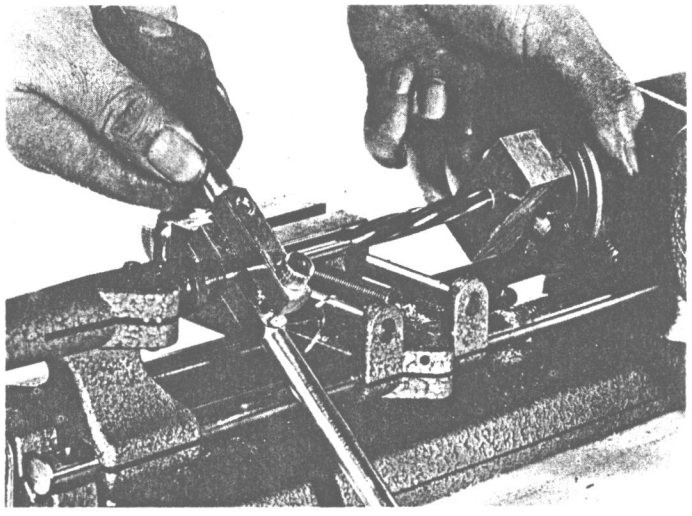
In order to start a twist drill cutting without wobble, turn a small starting dimple in the work with a sharp-pointed lathe bit. The feel of the drill in the work will indicate proper feed rate. Advance the drill with the tailstock handwheel just fast enough to make it cut smoothly, using cutting oil liberally when drilling steel. Withdraw it from the hole as often as necessary to prevent chips from packing in the flutes.

Except when drilling with very small drills, use the slowest spindle speed for drilling in the lathe. Each lip of a twist drill cuts exactly like a lathe bit, and forcing the lips to bite into hard metal takes considerable power. The larger the hole, the more the power required. To avoid overloading the motor when drilling a large-diameter hole with the Unimat, enlarge the hole in steps—first drilling a small pilot hole, then enlarging the pilot hole with a larger drill, then enlarging the hole again with a still larger drill, and so on. Drilling an extra-deep hole is also likely to overload the motor, since friction increases as the hole deepens. Don't try to drill a deep hole with a drill that has worn margins. For deep holes use new drills.

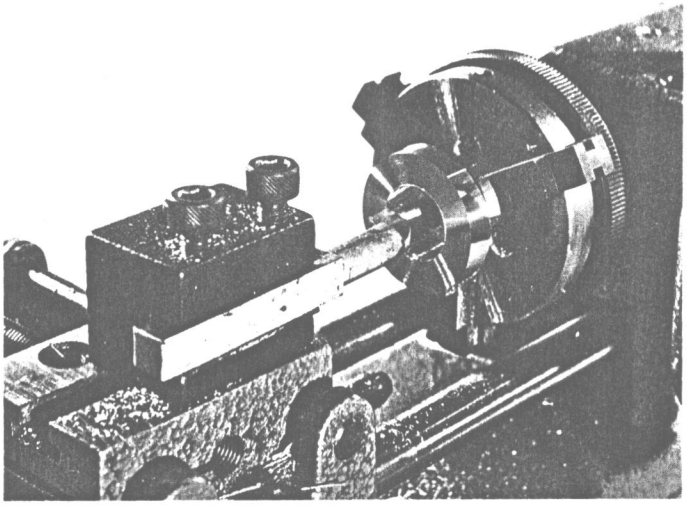
A twist drill drills a hole a few thousandths larger than the drill's nominal size. When the diameter of a hole must be exact, the hole is drilled slightly undersize and reamed to finish size with a reamer. When reaming in the Unimat, support the reamer in alignment with the hole with the tailstock



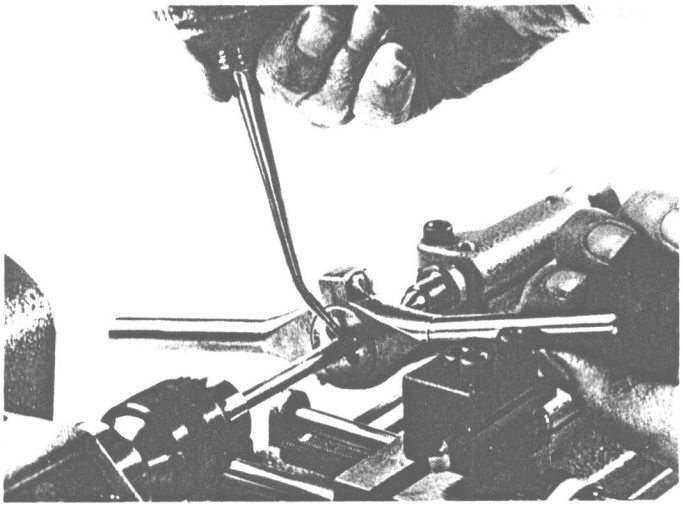
FOR DRILLING work held in a spindle chuck, screw the drill chuck on the tailstock ram. Ram's handwheel feeds the drill.



WHEN REAMING HOLES in the lathe support the reamer with the dead center. Hold the reamer and turn the spindle by hand.



TO BORE ACCURATELY-FINISHED HOLES, set a boring tool in the tool block parallel with the ways. Bore with light, continuous cuts.



WHEN CUTTING THREADS with taps or dies, turn the work by hand, holding tap or die in a tap wrench or die holder.

center, and feed it into the work slowly with the tailstock handwheel while revolving the lathe spindle by hand. When reaming holes for tapered pins with a tapered reamer, avoid feeding the reamer at too fast a rate. Never back a reamer in the hole, which would nick its teeth. Flood the hole with cutting oil when reaming steel.

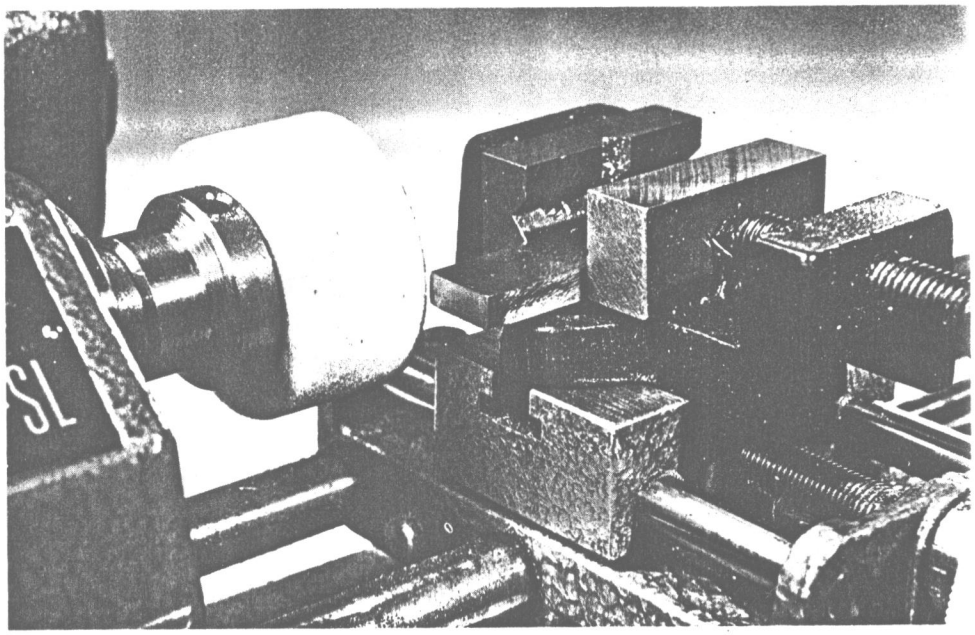
BORING

Boring in the lathe—simply internal turning with an extended cutting tool— is the easiest way to finish large-diameter holes accurately to size. The boring tool is advanced by screwing the cross-feed out; then run through the hole with the longitudinal feed. When making a boring set-up be sure that the tool's cutting edge has sufficient clearance to prevent the bit's heel from rubbing in the hole. The lathe's feed controls should be set up snugly, and the boring tool positioned in the tool block with no more overhang than necessary. Since all boring tools spring somewhat, use lighter cuts for boring than you would for turning. When boring a hole to close tolerance, be sure that the Unimat's headstock is accurately aligned, and having honed the boring tool very sharp, finish the hole with very light cuts, making the final finish cut continuous.

Work requiring precision through-boring can be fixed on the Unimat's carriage and bored with a small fly-cutter boring bar (which you can make yourself) mounted between centers.

THREADING

Many parts turned in lathes require threading. Usually the easiest way to cut small-diameter threads in turned work is to use a tap or die, revolving the workpiece in the lathe by hand as the tap or die is kept from turning with a tap wrench or die holder. A tap with a centerdrilled shank can be supported to start it squarely with the tailstock center. When taps or dies are used to cut threads larger than ¼" in diameter, the threads are started in the lathe, and the work is then removed from the machine and gripped in a bench vise for the rest of the operation. Use cutting oil when threading steel.

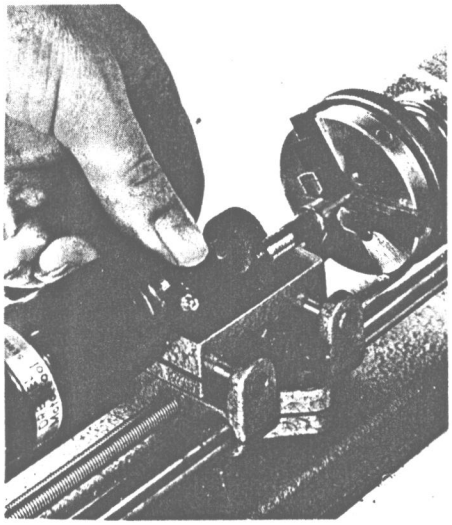


MACHINE GRINDING with a cup grinding wheel on the lathe spindle and the work held in the machine vise is an easy way to finish-grind the edges of small parts.

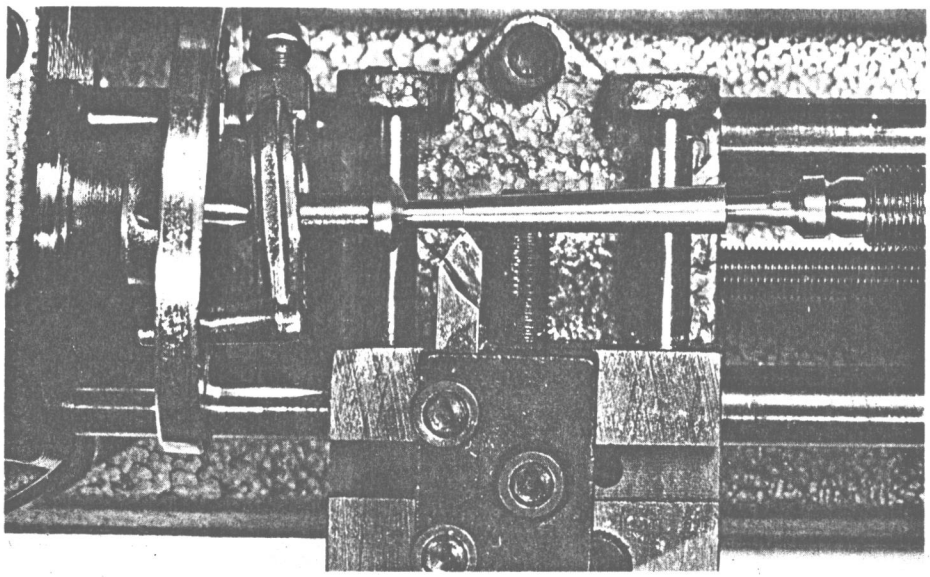
Screw threads can also be cut with the Unimat's accessory threading attachment (pg. 30), which is used whenever it's not practical to cut the thread required with a tap or die. With this attachment threads can be cut to a shoulder, for example, or fine threads can be cut on instrument bezel rings. Unimat's threading attachment employs a precision-threaded pattern bushing to lead a 60° threading bit. Threads are cut to finish depth with successive light cuts.

SPECIAL TECHNIQUES

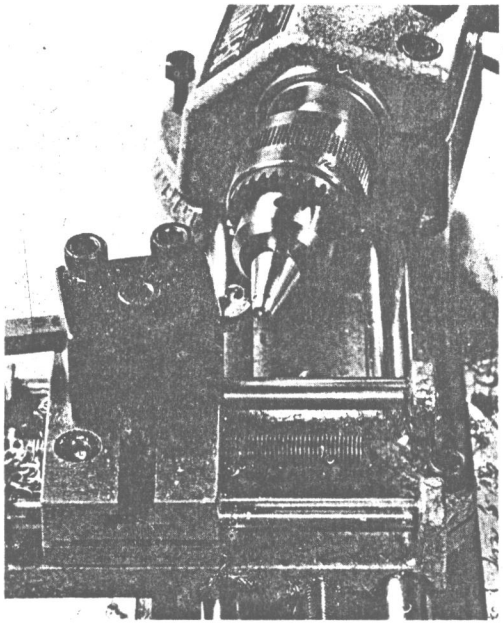
A number of useful machining operations can be performed on the Unimat with a rotary cutting tool mounted on the lathe



HAND GRINDER can be used on cross slide to machine-grind hardened parts.



TO TURN TAPERS, rotate the Unimat's headstock to offset the spindle center one-half the amount of taper required. Be sure the lathe dog revolves freely.



FOR STEEP TAPER, simply mount work in a chuck and rotate the headstock.

spindle and the workpiece held on the carriage in the accessory machine vise. Grinding wheels, end mills or rotary files can be used in this way. A cup grinding wheel on the spindle will beautifully finish-grind the edges of small parts. If the workpiece is blocked to height in the vise, an end mill held in a spindle chuck can be used for slotting, spot-facing, or squaring the ends of rough-cut stock. Rotary files are useful for grooving or recessing. Although end mills and rotary files can be chucked in the drill chuck, the collet chuck centers them more accurately and grips them more securely.

If you mount a small hand grinder on the Unimat's cross slide wtih an improvised clamp—or simply hold the neck of the grinder down firmly in the cross slide's T-slot with your fingers—you'll be able to accurately finish-grind hardened steel parts chucked in a spindle chuck. When grinding in this way belt the lathe's spindle for slowest speed and take very light cuts, advancing the cross slide only a thousandth or two at each pass.

TAPER TURNING

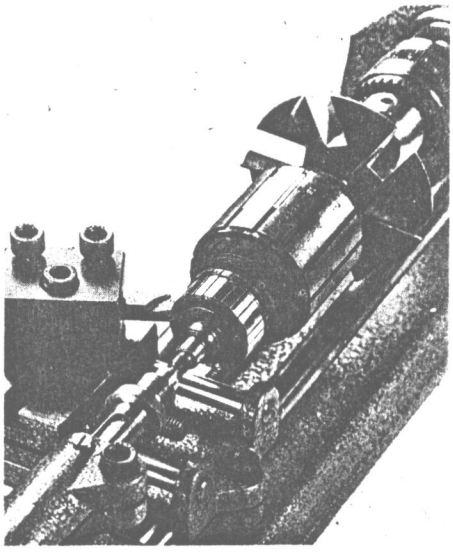
If a lathe's line of centers is not precisely parallel with the ways, the machine turns a taper rather than a true cylinder. When you want to turn tapered pins, shaft ends, fittings and seats or other tapered work on the Unimat, set up the machine to cut the required taper by rotating the headstock. To turn a gradual taper on long work, mount the workpiece between centers, and then rotate the headstock to offset the spindle center half the amount of taper. Shifting the spindle center towards the rear of the lathe makes the taper larger at the spindle end. Shifting the spindle center towards the front of the lathe makes the taper larger at the tailstock end. The amount of spindle center set-over can be measured from the tailstock center, but usually tapers are turned by trial and error—by making trial cuts and correcting set-over as needed. An easy way to find the set-over required to turn a tapered pin that must fit a hole reamed with a tapered reamer is to mount the reamer in the lathe and then adjust the headstock until a tool bit travels parallel with the reamer's cutting edges.

By rotating the headstock you can also cut short, steep tapers on work held in spindle chucks. Tapered holes can be bored similarly. Cones and sockets or conic fittings and seats that are turned and bored with the same set-up will match exactly. Be sure when cutting tapers to set the point of the tool bit exactly at center height.

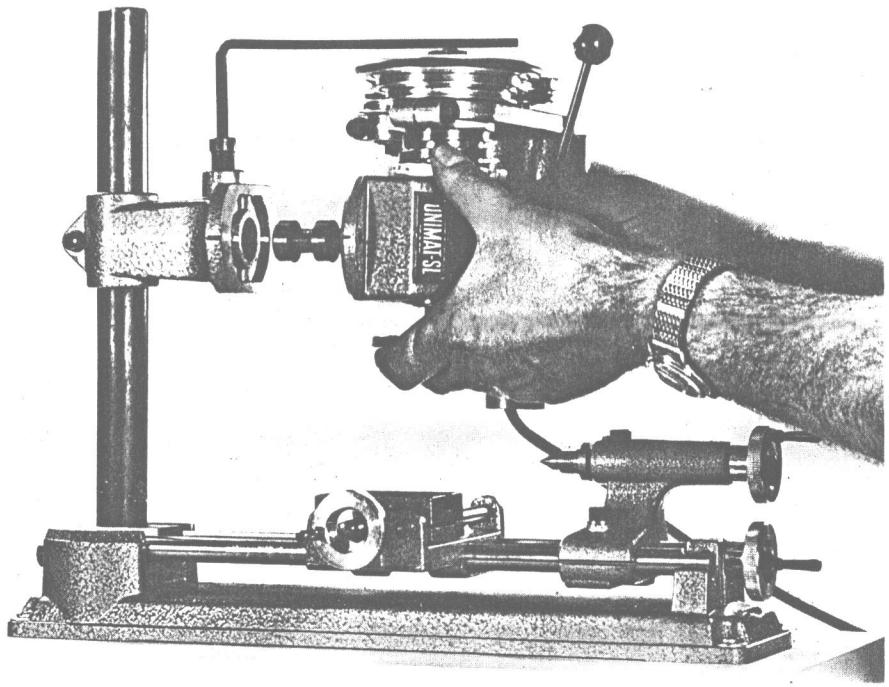
Truing worn commutators on small brush-type AC-DC motor armatures is a common repair job that can easily be accomplished on the Unimat with nice precision. If the armature's shaft is centerdrilled, the armature can be mounted in the lathe between centers. If not, chuck one end of the shaft in the drill chuck and support the commutator end in a brass cup center turned to fit the tailstock ram. Operating the lathe at slow spindle speed, take a light finish cut across the commutator using a very sharp round-nose tool bit having a 1/32" radius, and then polish the copper segments with fine flint sandpaper. After turning, undercut the mica between the commutator's segments using a piece of hacksaw blade with the teeth ground down to proper thickness. Make sure that no metal chips remain in the commutator's slots.

A few special lathe jobs that would otherwise present difficulties are no problem at all when you have the appropriate lathe accessory. A steady rest (pg. 29), for example, makes it possible to turn work longer than the lathe bed. Other special jobs can be performed if you make or adapt suitable accessories yourself. You can knurl turned work with knurling rolls, for example, if you machine a holder to mount standard rolls on the Unimat's cross slide. Or you can use the lathe to wind coils for electronics work if you make a coil from mandrel and wire guide.

Broaching is still another special lathe operation you occasionally may want to perform on the Unimat. A broach is simply a hooked scraping tool drawn repeatedly lengthwise through a hole to scrape a groove. With suitably-ground broaches you can cut square keyways in pulley holes, broach round holes square, or broach internal splines. Mount work to be broached in a spindle chuck and wedge the spindle's step-pulley to prevent the work from turning. Pull the broach with the lathe's longitudinal feed.



REFINISH COMMUTATORS of small AC-DC motors, with a sharp round-nose tool.



Vertical-Spindle Machining

Although in one way or another it's possible to accomplish any metal-machining job in a lathe, a number of machine operations, particularly drilling, milling and surface grinding, usually can be performed more conveniently on a machine that has a vertical spindle. The Unimat can be set up for *either* horizontal-spindle or vertical-spindle jobs—either horizontally for lathe-work, or vertically, with the headstock on the auxiliary column, for drilling, vertical milling or surface grinding. The changeover takes only half a minute.

To make the conversion, pull out the headstock's alignment pin and unscrew the headstock clamping screw enough to permit lifting the entire headstock from the bed. In its place insert the auxiliary column and retighten the clamp screw, making sure the screw seats in the column's tapered hole.

The column's adapter casting slides along the column and can be positioned wherever needed. Inserting the headstock's tenon in the adapter and tightening the adapter's clamp screw mounts the head. The easiest way to align the spindle accurately perpendicular with the machine's bed is to screw the faceplate on the spindle nose, lower the headstock on the column until the plate rests on the carriage cross slide, and then adjust the head until the plate touches squarely. Having aligned the head, raise it and loosen its two spindle lockscrews just enough to permit advancing the spindle cartridge with the ball-handled pinion lever. When these screws are nicely adjusted, the spindle's coil spring will retract the spindle smoothly as the pinion lever is released. The lever advances the spindle about ⅝". When more vertical movement is needed, the return spring can be removed to increase travel to 1".

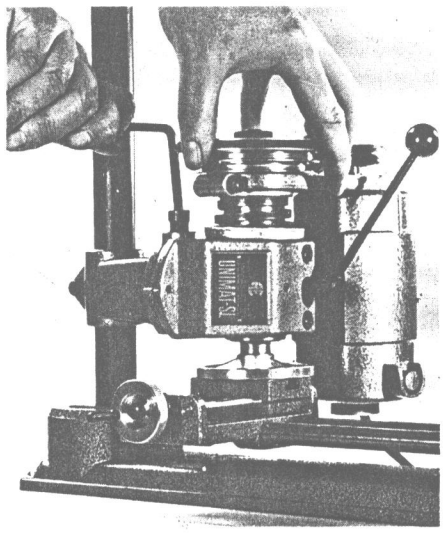
With the drill chuck screwed on the spindle, the Unimat is now set up for 90° drilling. When you want to drill at some other angle, insert a length of drill rod in the chuck and set the head as required with a protractor.

While inexpensive plain carbon steel twist drills are satisfactory for drilling wood, plastic or soft metal, high-speed steel drills, which hold their hardness even at near-red heat, are needed for drilling steel or cast iron. You can buy them singly or in sets, in fractional-inch sizes, numbered wire-gauge sizes, letter sizes or metric sizes. Sets usually are packaged in cases with sized holes that simplify keeping the drills in order. Drills commonly sold in hardware stores are termed "jobber length." "Short sets," which are screw machine drills with shorter shanks and flutes, are available from industrial supply firms, and because they're more rigid at the tip these shorter drills are preferable for use in the Unimat.

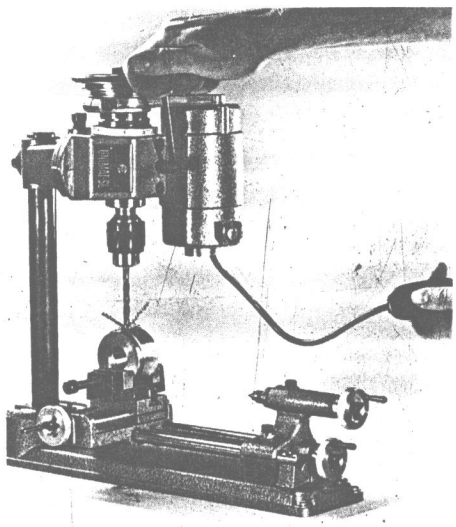
MOUNTING THE WORK

Any work drilled should always be securely fixed on the cross slide, both for safety's sake and to avoid drill breakage. Rectangular work can be held conveniently in the accessory machine vise (pg. 32), which bolts on the cross slide with T-nuts. Position the work in the vise in such a way that when the drill breaks through it will clear the vise body. Work awkward to grip in the vise can be mounted in a spindle chuck or on a work plate, and the chuck or plate then can be mounted on the cross slide with the Unimat's T-head adapter stud. Since this stud has the same thread as the spindle nose, any of the Unimat's spindle chucks can be used on the cross slide as circular drilling vises. This makes it possible to unscrew chucked work turned in the lathe, mount it chuck and all on the cross slide for a drill press operation, and then remount it on the lathe spindle for additional turning, all without removing the work from the chuck.

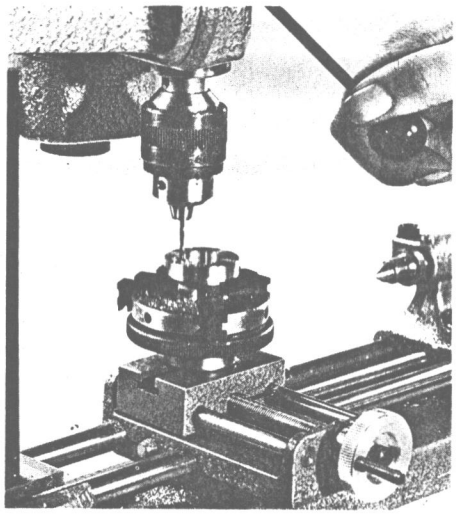
The Unimat's faceplate serves as a drill press table for small work, but mounting either the accessory sanding plate (pg. 38) or the T-slotted fixture plate on the cross



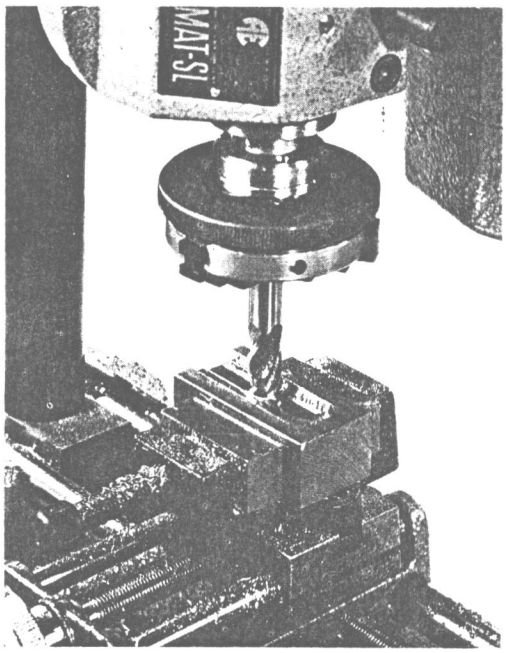
TO ALIGN SPINDLE perpendicular with bed, screw on faceplate and lower head.



COIL SPRING retracts the spindle when you release the pinion feed lever.



ROUND WORKPIECES can be held for drilling in the 3-Jaw or 4-Jaw chuck.



SPIRAL END MILLS are used for milling recesses. Take light cuts with even feed.

slide as a drilling table gives a more rigid set-up for drilling larger workpieces. Work can be secured on the sanding plate with 1" C-clamps. Wipe the cross slide clean before screwing the plate on the adapter stud, and after centering the plate's hole under the spindle, tighten the carriage feed tensioning screws to make the set-up rigid. Long or odd-shaped work that can't readily be mounted on a round plate can be clamped on the accessory milling table for drilling (pg. 32). A 5"x5" piece of ½"-thick hardwood plywood secured on the cross slide with bolts makes a handy table for drilling woodwork—and often metalwork, since small parts can be fixed on the table easily with wood screws.

SELECTING DRILLING SPEEDS

Twist drills can cut soft materials faster than hard materials. For each material drilled there is most efficient drilling speed, and this speed, termed "surface speed," is always expressed in surface feet per minute or sfm. Average surface speeds for drilling common materials with high-speed drills are:

Alloy or stainless steel	20-40sfm
Mild steel or cast iron	80-100sfm
Bakelite	100-150sfm
Brass or aluminum	200-300sfm
Wood	300-400sfm

The formula that relates surface speed to spindle rpms is:

$$\text{Rpms} = \frac{3.8 \times \text{desired sfm}}{\text{drill diam. in inches}}$$

Rounding off the 3.8 to 4 simplifies calculating the approximate spindle speed needed to give a required surface speed. To find the rpms needed to drill mild steel at 100sfm with a ⅛" drill, for example, you'd figure:

$$\text{Rpms} = \frac{4 \times 100\text{sfm}}{⅛"}, \text{ or } \frac{400}{.125}$$

or 3200 rpms. A machinist soon learns to solve this equation in his head without bothersome arithmetic. He'd simply reason that (in the example given) if 400 is ⅛th of the speed needed, the total rpms would be 8 times that, or 3200.

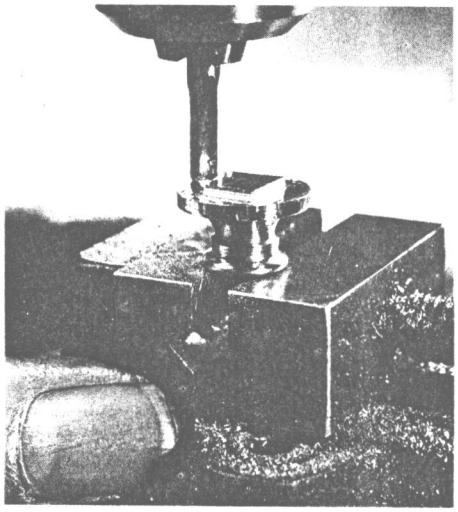
DRILLING TECHNIQUES

When a hole must be located with exact precision, lay out and accurately center-punch its center point before mounting the work in the machine. Then fix the workpiece on the cross slide with the punch mark accurately aligned with the axis of the spindle. To do this, unscrew the drill chuck, insert a lathe center in the spindle bore, and carefully position the carriage until the point of the center seats exactly in the punchmark. Then remove the center, replace the chuck and insert the drill. Enlarging the punchmark with a centerdrill before drilling the hole insures that the drill used will start concentrically.

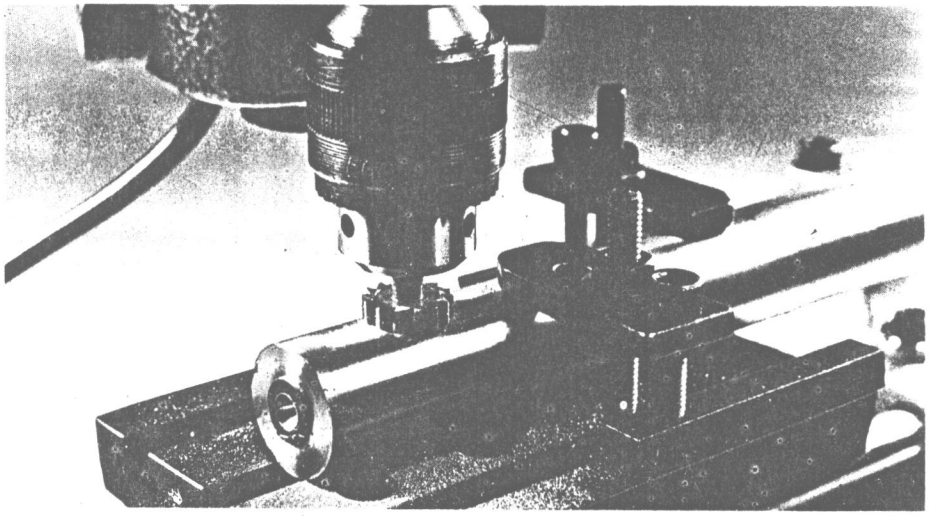
Use cutting oil liberally when drilling steel. The cutting oil functions both as coolant and lubricant. Light machine oil is the most satisfactory lubricant for drilling mild steel. Use turpentine or kerosene to drill tough alloy steel. Brass and aluminum ordinarily are drilled dry. Cast iron always should be drilled dry, since fine chips of cast iron are abrasive and when mixed with oil form a compound that laps the drill dull.

Feed the drill into the work with enough pressure to keep it cutting, but avoid excessive feed, which can chip the cutting edges or even break off the tip. A sharp drill drilling mild steel at correct feed rate produces two identical curled spiral chips.

Drilling deep holes—deeper than five times their diameter — presents special problems. When a drill cuts a shallow hole its flutes lift chips clear. But when the hole is deep the chips pack in the drill's flutes, and this makes it necessary to withdraw the drill periodically to clear the cutting edges. Most other deep-drilling problems are caused by lack of clearance. A twist drill's flute margins are ground to a very slight taper (the flutes are about a thousandth larger in diameter near the tip than near the



USE TWO-FLUTE CUTTERS like woodworking router bits but at slower speed.



MILLING TABLE supports long work for milling. Mount the work as rigidly as possible, clamping it down with T-head bolts inserted in table's T-slots.

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.

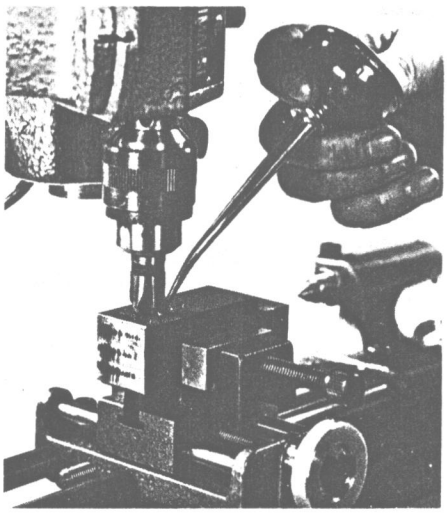
Countersinking or counterboring holes for screwheads involves no problems provided you work with light cuts to avoid chatter. When a hole you've drilled and countersunk requires tapping, start the tap before removing the work from the machine. With the tap chucked, turn it in by hand while applying light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

MILLING TECHNIQUES

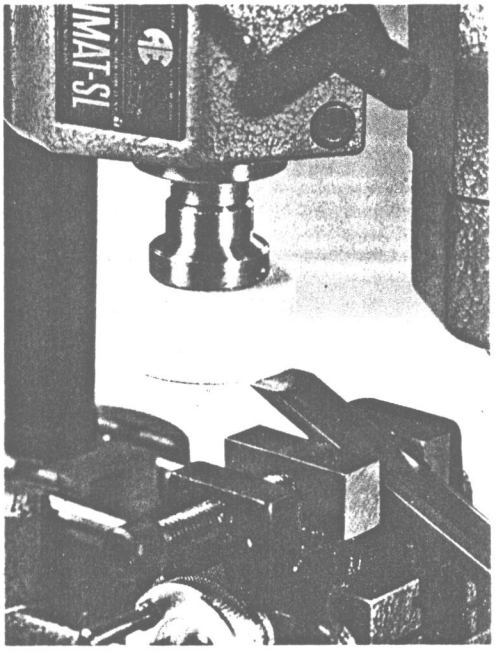
With the Unimat set up as a vertical milling machine, you can readily mill slotted or recessed parts that would be difficult to machine in any other way. Many kinds of cutters can be used for vertical milling, but three types are most common: slotting cutters, spiral end mills and rotary files.

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.

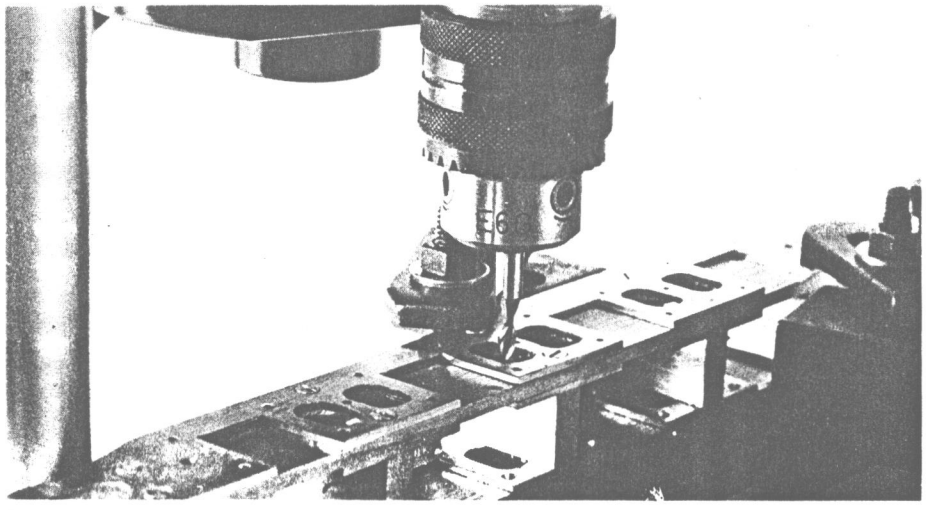
Milling cutters must be used with care in order to keep them sharp. Their cutting edges are hard and brittle, and to avoid chipping their teeth you must feed the cutters into the work slowly and evenly. Mount the workpiece to be milled on the cross slide as rigidly as possible, either in the



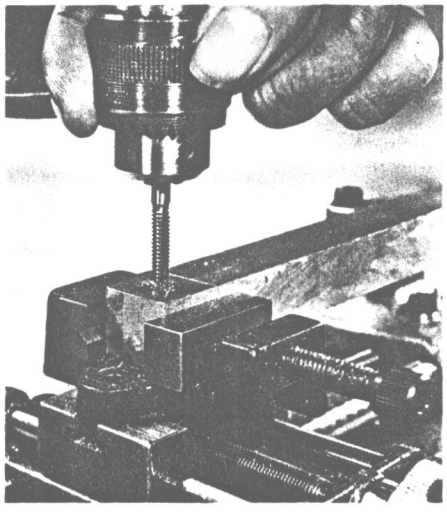
WHEN COUNTERSINKING holes use slow spindle speed to avoid chattering.



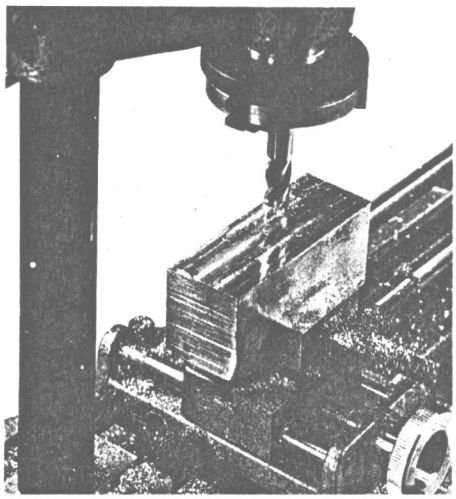
MANY TOOL-GRINDING SET-UPS are possible on the Unimat. Avoid overheating the tool.



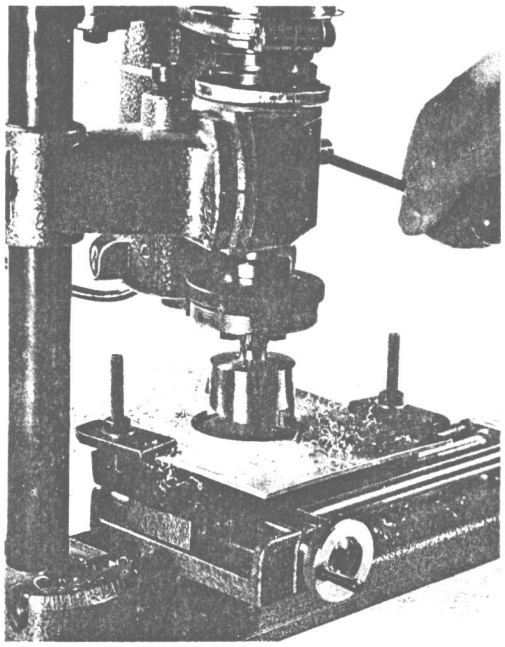
USE VERY GRADUAL FEED when milling with small cutters. Use the Unimat's longitudinal feed screw to feed the work to the cutter whenever possible.



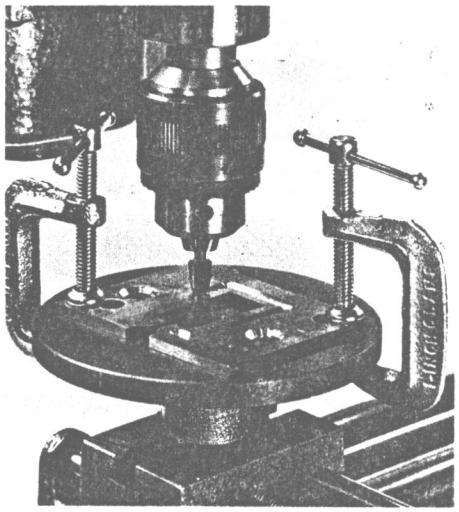
TO TAP HOLES, chuck the tap and turn it into the hole by hand—never under power.



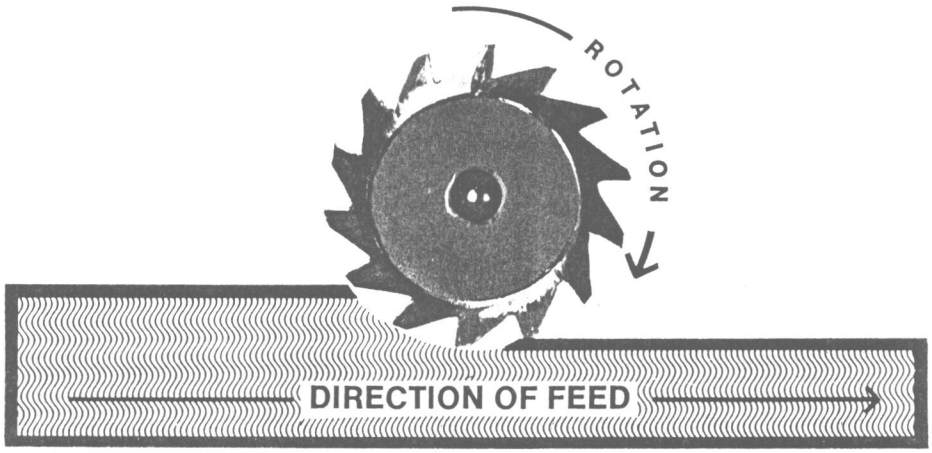
LARGE DIAMETER END MILLS used to mill flats can be held in the 3-jaw chuck.



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.

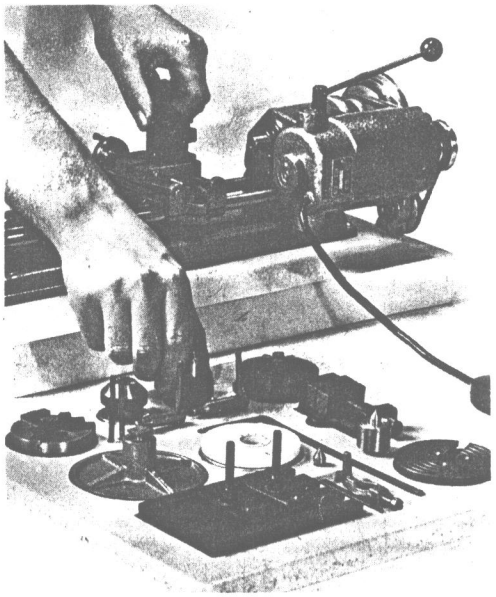
Three of the machine's accessories are so useful for so many jobs that they could be termed basic, and these are the accessories a Unimat owner should acquire first. The three are the 3-jaw universal lathe chuck, the machine vise, and a ball-bearing live tailstock center (either of the two available). 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.

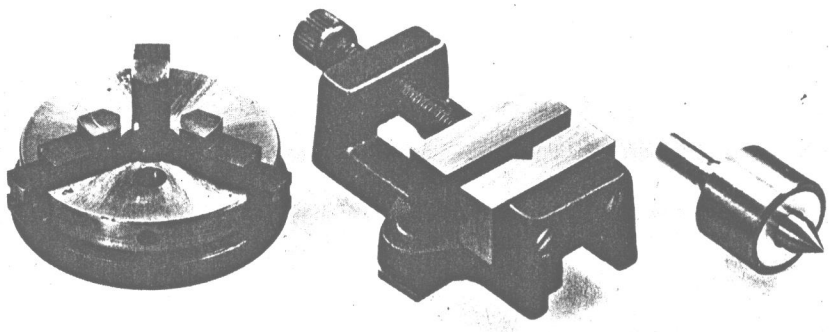
Because most of the lathe and vertical-operation accessories are designed for precision work, they are manufactured to the same close tolerances as the Unimat itself, with critical parts hardened and ground. The collet chuck in particular is finish-ground with extremely high precision. Like the machine, 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.



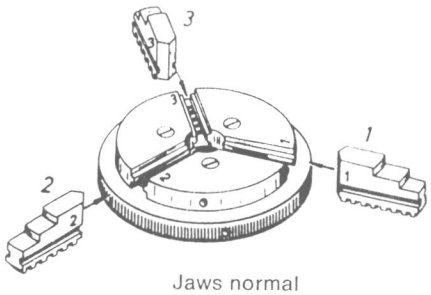
THE THREE MOST USEFUL ACCESSORIES are the 3-jaw universal lathe chuck, the machine vise, and a ball-bearing "live" tailstock center.

Lathe Accessories

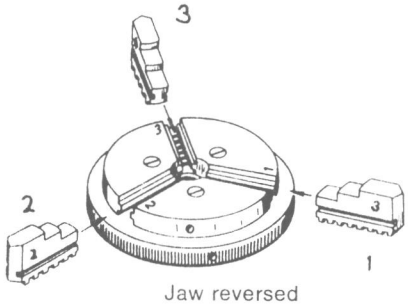
Accessories used primarily for lathework comprise the largest group of Unimat accessories. A variety of standard accessories are used on metal lathes, and the lathe accessories available for the Unimat are employed like the similar devices used on large industrial lathes.

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



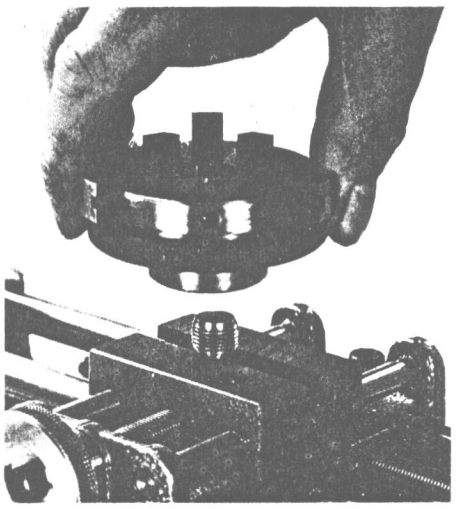
Jaw reversed

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.

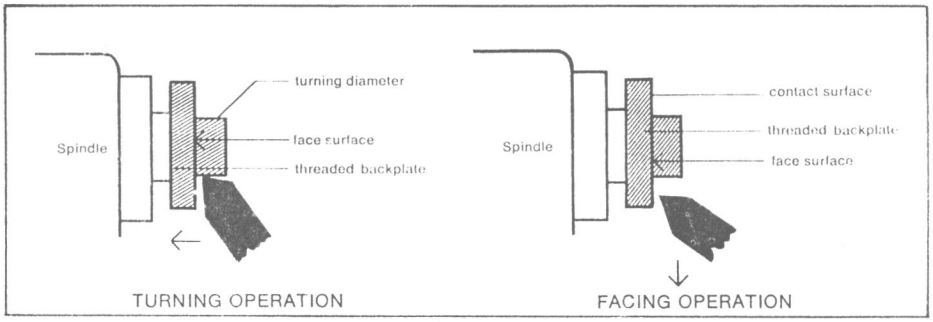
When chucking round workpieces that must be mounted with best-possible concentricity, twirl the work slowly with one hand as you close the chuck—using the two steel pins inserted in the body and scroll plate—with the other. When the jaws have gripped with square purchase, tighten the scroll only enough 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.

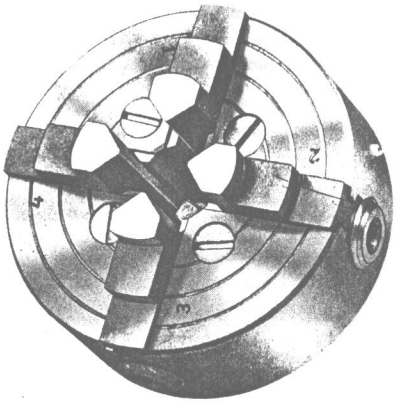
Precision built, the 3-jaw chuck centers work more accurately than larger scroll chucks—to within a thousandth or two. Use the collet chuck for work that must be centered with higher precision.

THE 4-JAW INDEPENDENT CHUCK

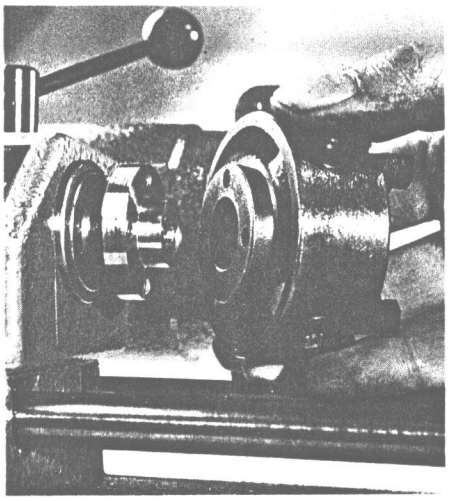
The 4-jaw chuck comes unmounted, with its mounting plate, which is included with the chuck, supplied slightly oversize to allow custom-fitting the chuck to the particular lathe's spindle. To mount the chuck you must accurately finish-turn the mounting plate to fit the back of the chuck's cast iron body.

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

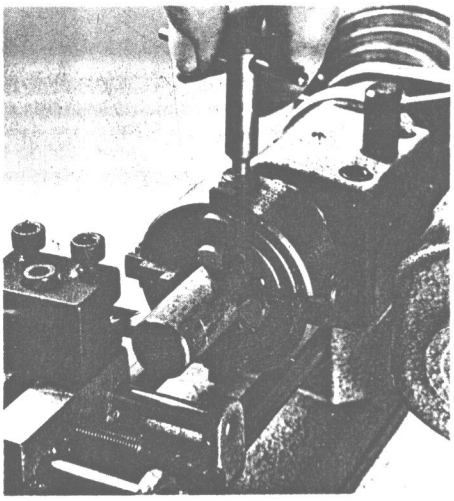




THE 4-JAW CHUCK'S JAWS screw-adjust separately and grip the work very tightly.



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.

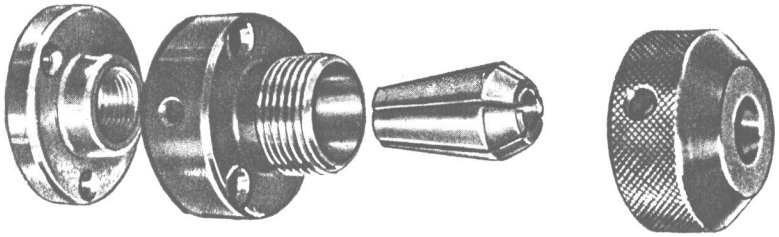
Remember when using the 4-jaw chuck that its square key screws the jaws down on the work with enormous force, and that excessive tightening can strip the threads in the cast iron body. Tighten the jaws only enough to grip the work securely. Work that overhangs the jaws more than four times its diameter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

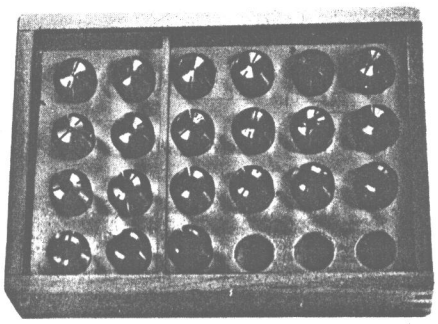
The collet chuck is also supplied with an unfinished threaded mounting plate that allows custom-fitting the chuck to the particular lathe's spindle. Although a simple device, the Unimat's collet chuck is very accurately ground, and the double-tapered spring collets used in it center small round workpieces 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.

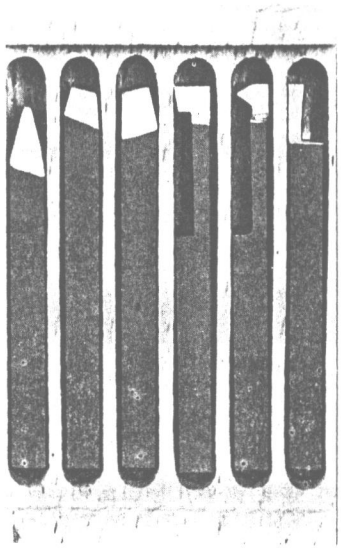
The double-tapered collets will open or close ten or fifteen thousandths, gripping tightly and evenly. To preserve their precision never close collets on work more than 1/64th undersize, on work that isn't perfectly round, or on marred tool shanks. If a collet sticks in the chuck's taper when the nosepiece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

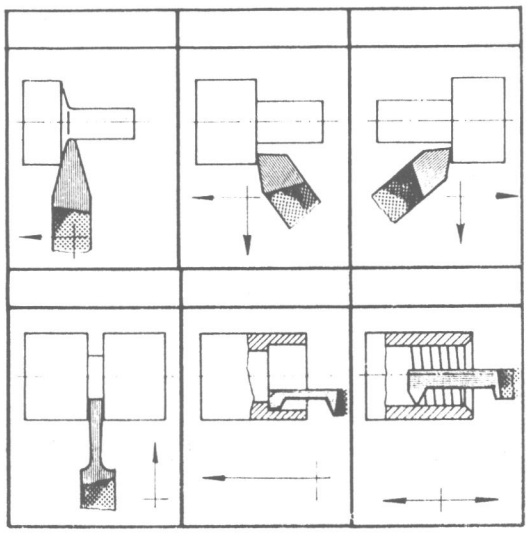


STORE COLLETS in order of size in a case, which you can either buy or make yourself.

LATHE TOOL BITS

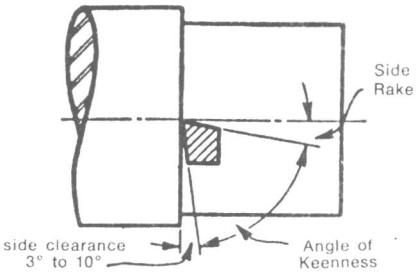
While the ready-ground general-purpose tool bit supplied with the Unimat makes either cylindrical or facing cuts, ordinarily lathe tools are ground especially for particular cuts in particular materials. As you learn to use your machine you'll soon need other bits ground for other turning operations. 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.



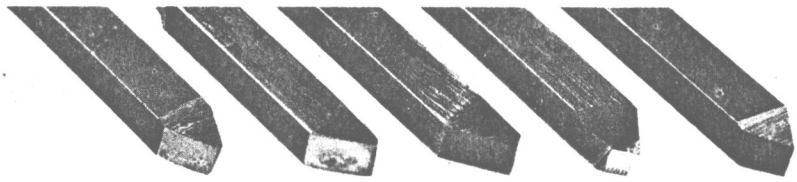


It's primarily the heat generated at the point of cut that dulls a lathe tool's cutting edge. For this reason lathe bits are made of tungsten- or molybdenum-alloy high speed steel, steels which retain their hardness even at high heat. Cobalt added to a high speed steel alloy improves the steel's hot-hardness 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.

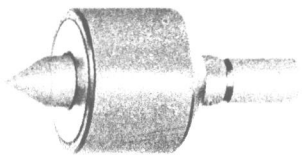
Most lathe tools can be reground about 100 times—until they are ground too short to be mounted in the tool block. Many machinists grind bits on both ends, grinding one end for right-hand cuts and the other for left-hand cuts.

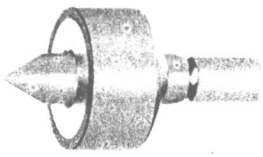
BALL-BEARING LIVE CENTERS

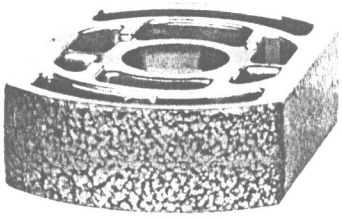
Two live centers are available for use in the Unimat's tailstock ram. Both are similar in design, but one has a single ball-bearing and the other has two ball-bearings. The single-bearing center is adequate for all ordinary turning and polishing. The double-bearing center is preferable for critical high-precision 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.







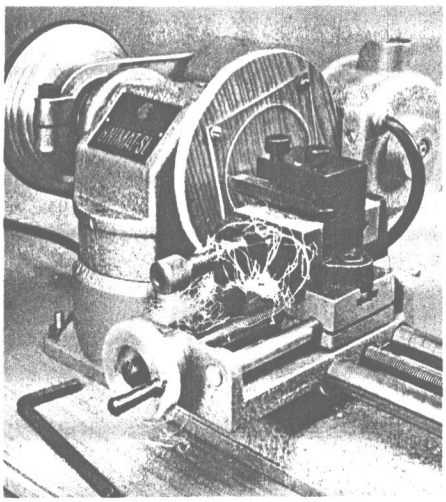
HEADSTOCK RAISING BLOCK

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 7⅝" circle.

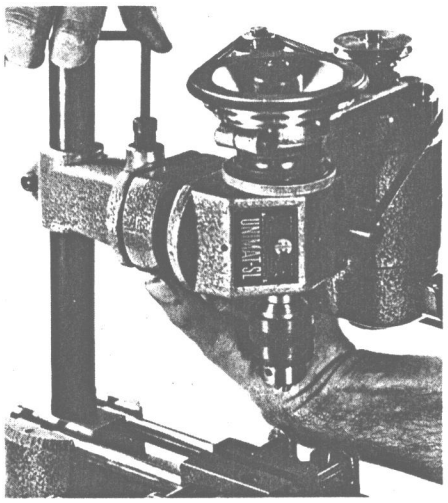
The raising block is required in order to use either the sanding plate or the large-diameter circular saw blade on the spindle, since both of these accessories require extra swing.

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.

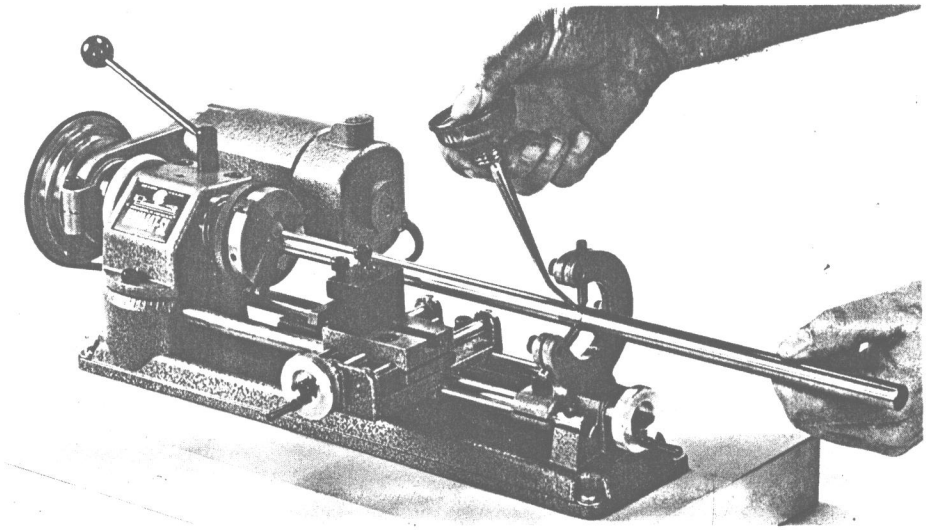
Second, the rest can be used to support the free end of workpieces that can't be supported with the tailstock—work to be faced or bored on the end, for example. Its jaws have 1½" capacity.

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.

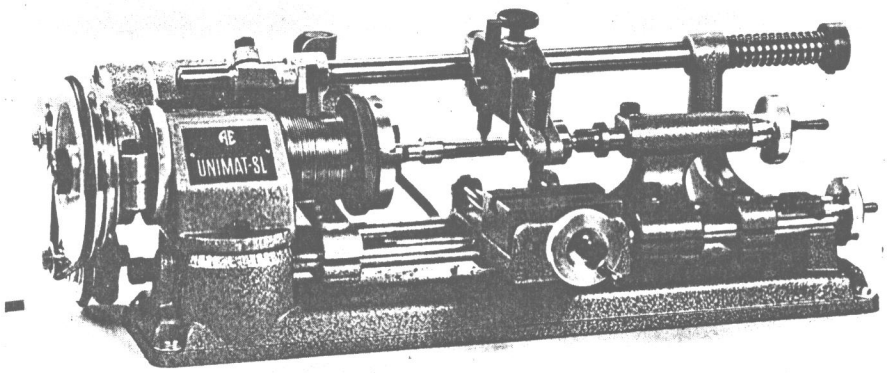
The rest's brass jaws must be kept well lubricated with oil or grease. When they eventually wear down you can buy replacements.



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.

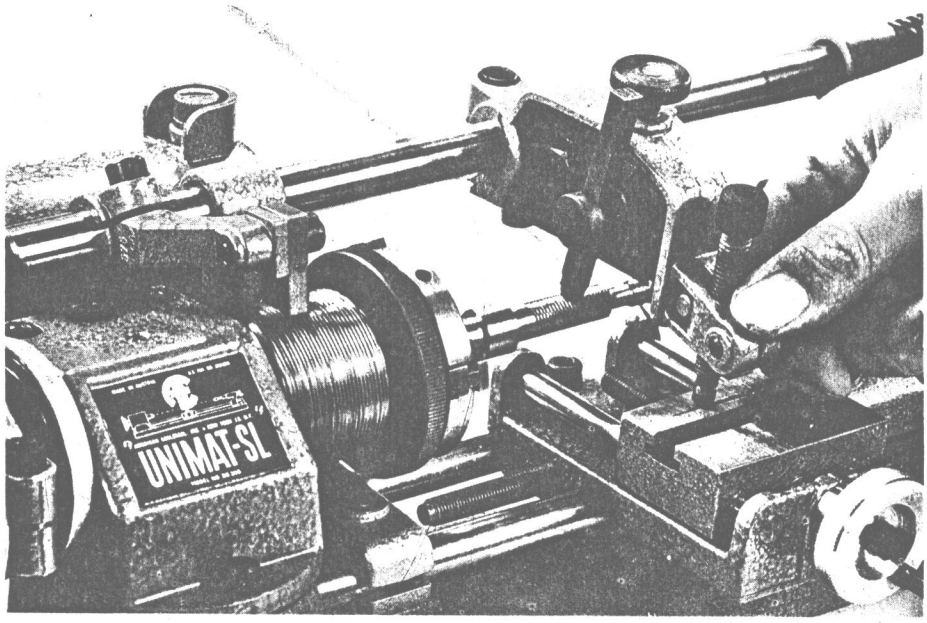
Next mount the threading bit in the cutting arm's holder. The ready-ground 60° bit supplied with the attachment cuts standard American National or metric threads, and Whitworth, square or Acme threads can be cut with bits ground to appropriate profile. Then, with the brass follower set to engage the 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.

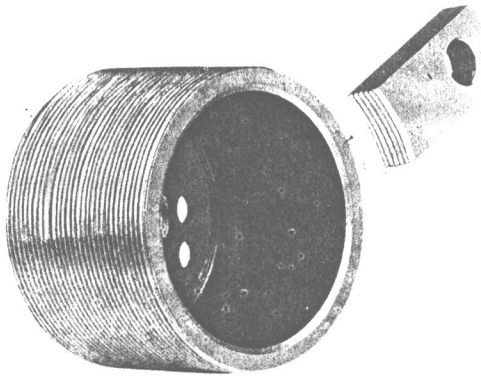
Gradually decrease the depth of cut as the thread nears finish depth. While you can measure the depth of the thread with a thread micrometer, ordinarily it's easier to use a nut having the proper thread as a gauge, simply deepening the thread little by little until the nut screws on the work.

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.



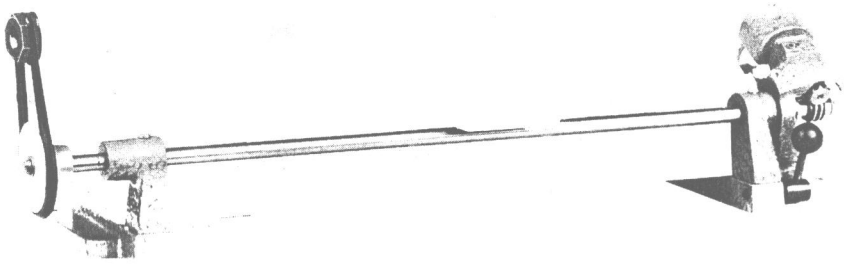
THUMBSCREWS on cutting arm sets depth of cut, as the threading bit travels towards the headstock, the cutting arm's stop screw slides on the cross slide.



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.

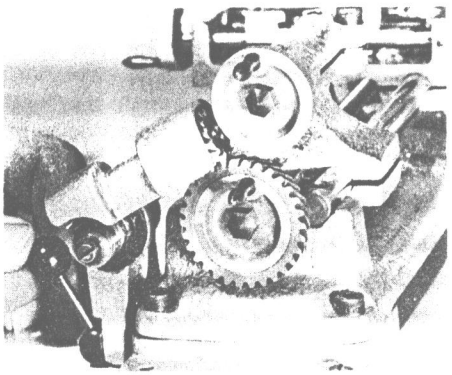
A pulley-nut screwed on the lathe spindle in place of the standard spindle pulley retaining nut, belt-drives the feed unit's shaft. Remove the spindle from the machine and grip the pulley's faces between wood blocks in a vise to unscrew the standard nut, and when tightening the pulley-nut supplied with 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.

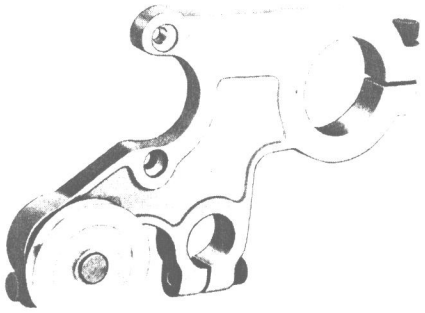
Flipping the attachment's operating lever up engages the spring-loaded worm-gear assembly's pinion with the toothed feed handwheel. Lubricate these gears regularly with light grease. The toothed longitudinal feed handwheel can be operated manually when the operating lever is disengaged. Remove the belt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

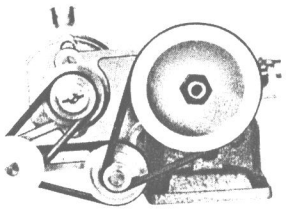


The power feed normally advances the carriage towards the headstock. Crossing the rubber belt to reverse the shaft's direction of rotation reverses the feed for left-hand cuts towards the tailstock.

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.

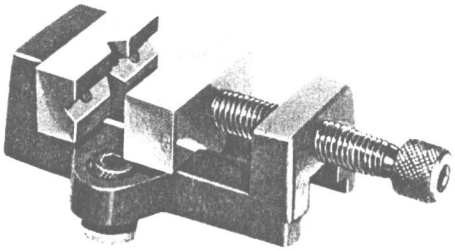
THE ELECTRONIC SPEED CONTROL maintains motor torque through zero-to-full speed range.

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.

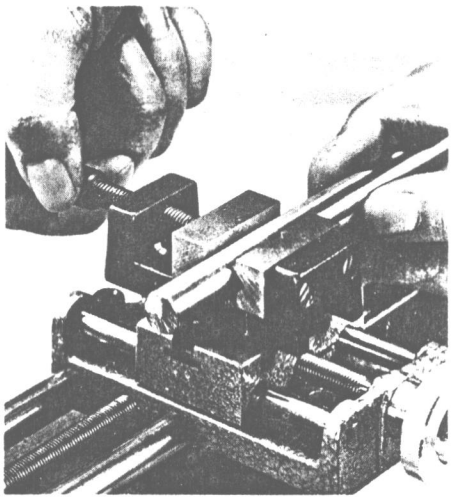
MACHINE VISE

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.

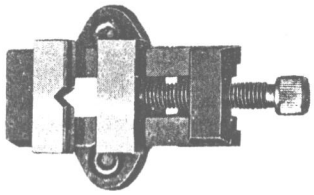


When screwed on the cross slide the vise is oriented with its jaws parallel with the machine's ways. It can be mounted jaws-crosswise if the accessory milling table is first mounted on the cross slide and the vise then mounted on the table.

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.



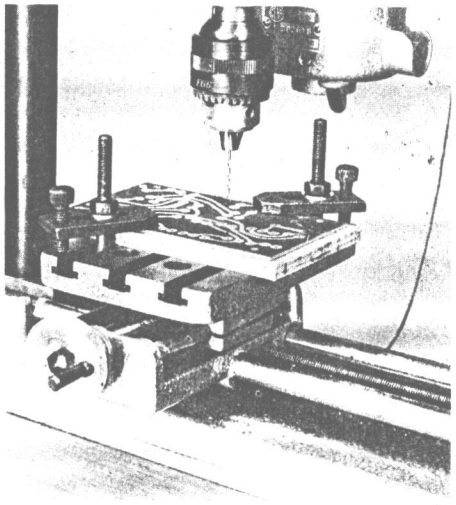
THE FIXED JAW of the vise has accurately ground V-grooves to center cylindrical work.



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.



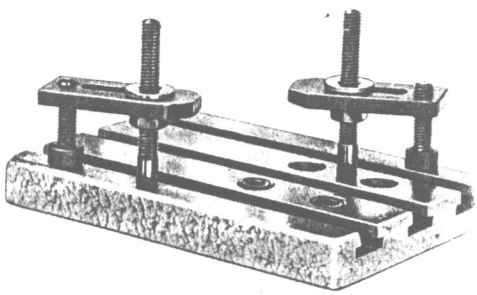
THE MILLING TABLE simplifies mounting large work for vertical spindle machining operations.

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.

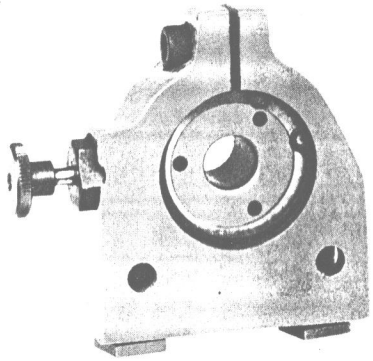


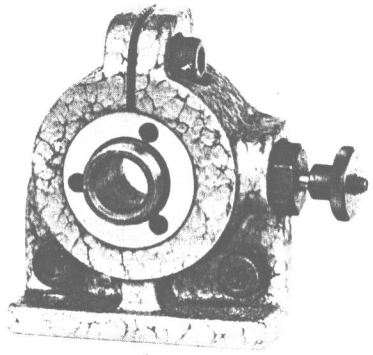
STUD CLAMPS can be used anywhere along the table's T-slots to mount workpieces.

INDEXING AND DIVIDING ATTACHMENT

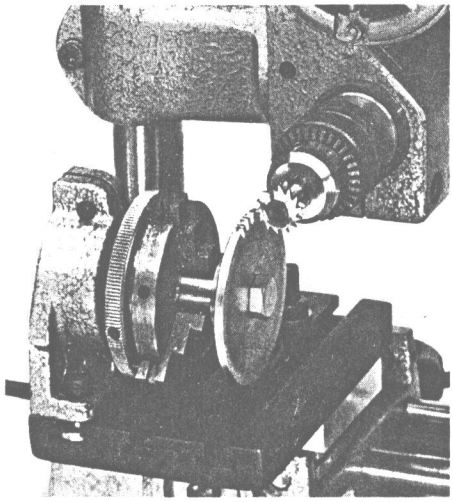
An indexing head is indispensable for such jobs as drilling equally spaced holes in flanges, milling work triangular, hex or octagonal, milling radial slots, milling gear teeth or splines, or regrinding rotary cutters.

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.





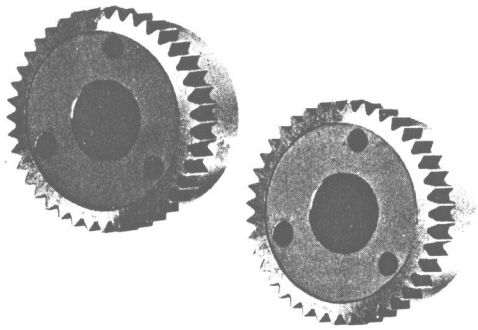
THE INDEXING HEAD has a gearlike hubbed index plate (pictured below) that turns smoothly in the casting. Work is indexed by stepping off the plate's segments.



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

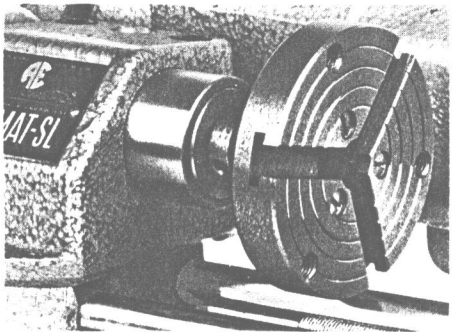
Besides the 48-division index plate supplied with the head, 30-, 36- and 40-division plates are available separately and can be used in the frame interchangeably to give other divisions. Plates are easily changed by removing a flat steel snap ring with ring pliers. The hub of each plate is finish-ground 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.

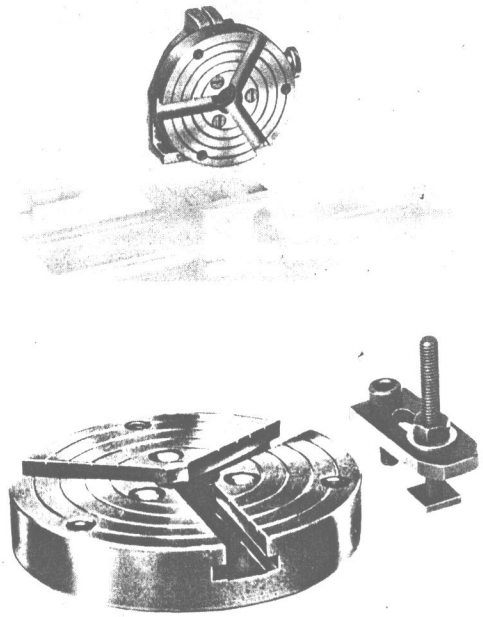


MOUNTED ON THE SPINDLE, the fixture plate serves as a heavy-duty faceplate.

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.



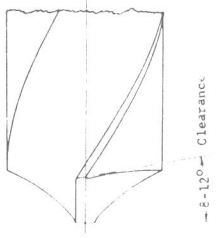
THE FIXTURE PLATE can be mounted either on the cross slide or on the indexing head.

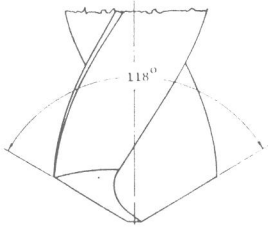
TWIST DRILLS AND MILLING CUTTERS

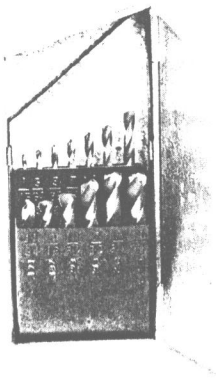
Accurate drilling and milling require sharp cutting tools. Experienced machinists buy highest-quality high speed steel drills and mills. They use them with care to avoid nicking the corners of their cutting edges, and they keep them sharp with frequent touch-up resharpening.

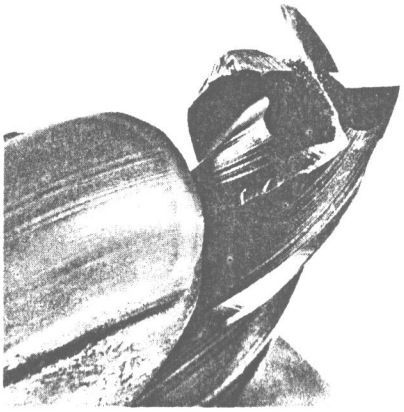
Drills and milling cutters are much alike, both having cutting edges that cut exactly like miniature lathe bits. Like lathe bits, the teeth of rotary cutters must be ground with sufficient clearance behind the cutting edges—from 8 to 12°—to allow the edges to bite into the work without rubbing. Providing 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.







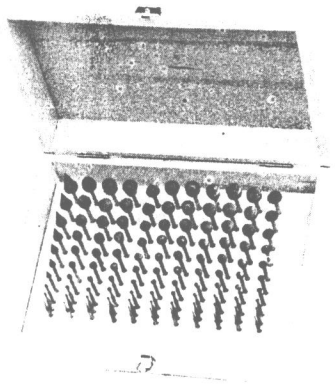


When properly reground the drill's point will be exactly centered, and its cutting edges will form 59° angles with the drill's axis, giving a point angle of 118°. You can judge these angles by comparing the drill you're grinding with a new drill, or you can use a 59° drill point gauge. If the cutting 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.

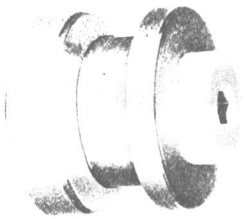
Don't use wheels with metal-bushed center holes on this arbor, since they would jim the threads. Metal-bushed wheels and ¼"-thick cloth buffs with ½" center holes can be mounted on the grinding wheel arbor more satisfactorily than on this tapered arbor.

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 operations 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.

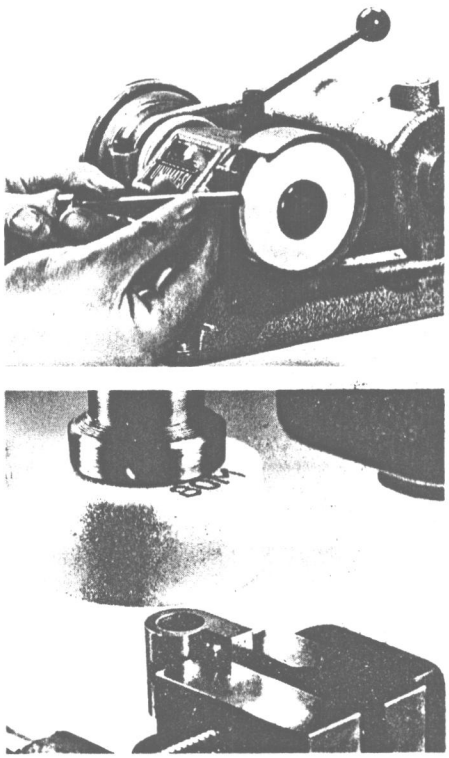


EXTRA ARBORS can be turned as needed to mount special grinding or cut-off wheels.

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.

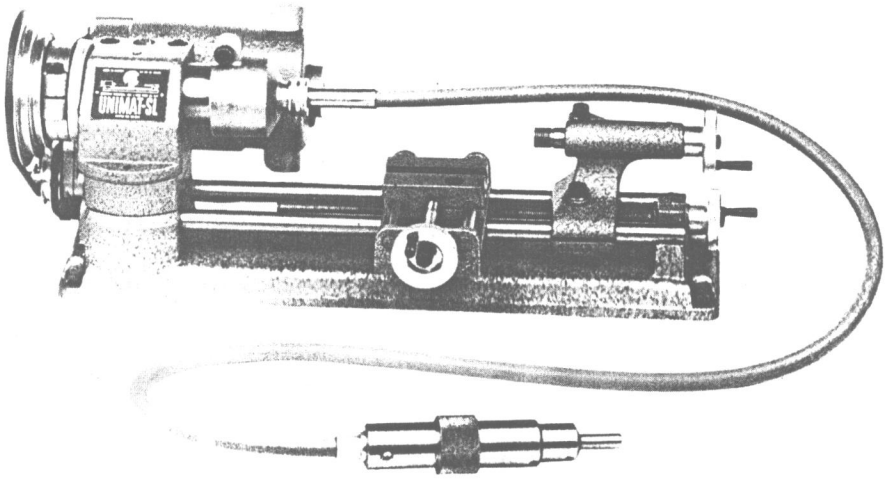
To true a wheel with the diamond dresser, mount the dresser rigidly in the tool block and run the wheel at 2000 rpms. Dress the wheel clean and true with successive .001"-deep passes, avoiding shock that might shatter the diamond.



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°.



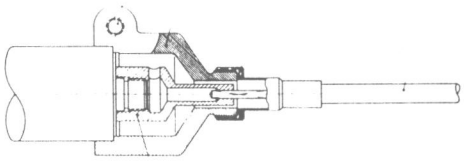
THE SHAFT'S HANDPIECE has the same nose thread as the Unimat's spindle.

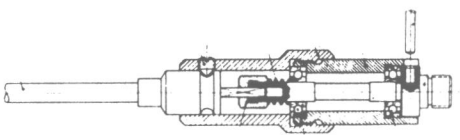
Small grinding and polishing points or carving burrs can be held in the drill chuck. Don't use the shaft for grinding with large wheels or drilling holes larger than ⅛" in diameter, for heavy work will overload it, causing bucking and shaking, and may break the core. When using the shaft for disc sanding,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

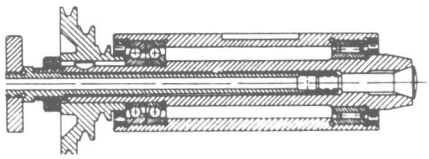
The shaft comes prelubed, but the grease gradually works out. After each 100 hours of operation the handpiece should be unscrewed and the two ball bearings relubed with bearing grease. Relube the core by slipping it out of the casing and wiping it with grease.

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 instrument-makers. 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.

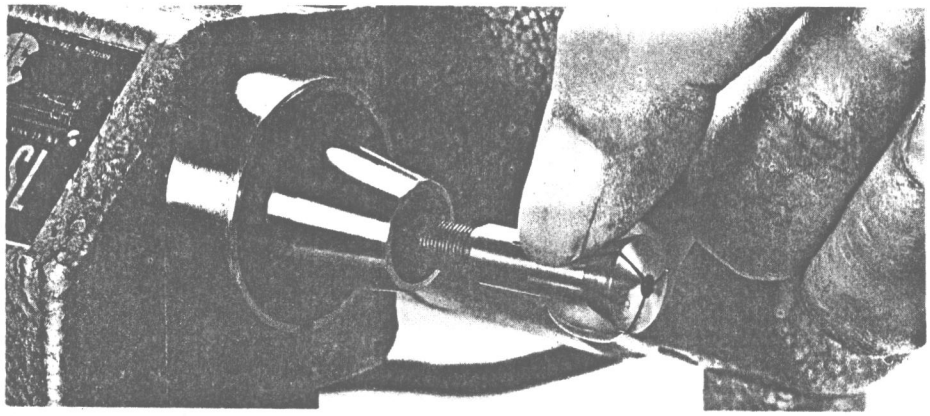
The third difference is the way in which workholding devices mount on the spindle nose. Instead of external threads, the nose of the watchmaker's spindle has an accurately-finished internal taper, and in the bore behind the taper, a pin key. Standard type WW spring steel draw-in collets seat in this 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 through-bore 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.

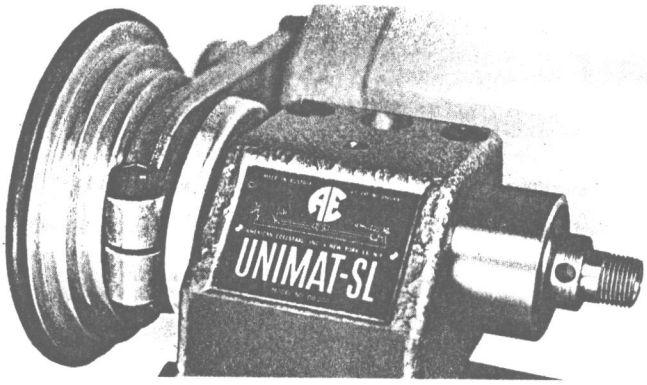
Type WW draw-in collets are available in either metric or inch sizes up to ¼" capacity. Metric collets can be purchased in sets at considerable saving (no substitutions can be made in a set's contents). If you buy inch-size collets individually, be sure to include a ⅛" collet for holding standard rotary 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.

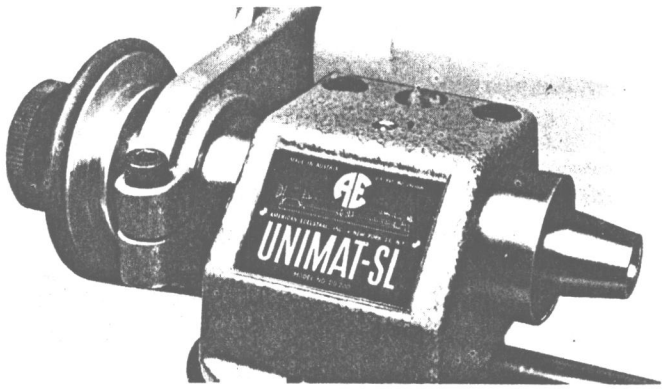
The drill chuck available for the watch-



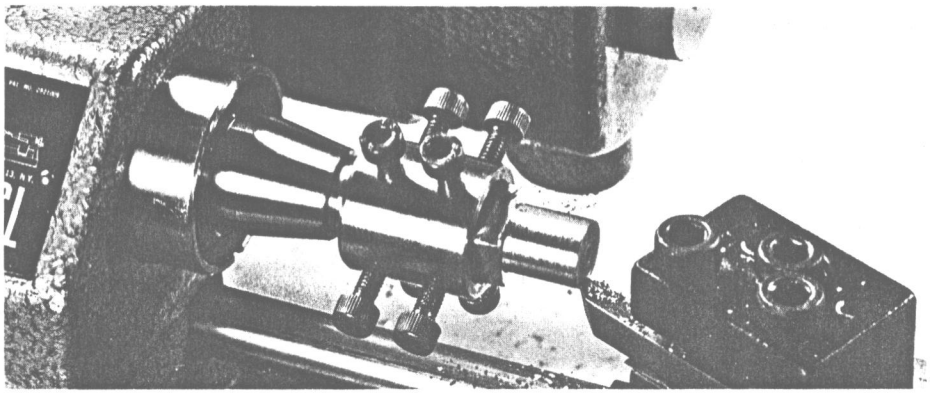
CLEAN THE WATCHMAKER'S SPINDLE'S TAPER before inserting a collet. The collet seats in the taper with its keyway engaging a pin in the spindle bore.



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.

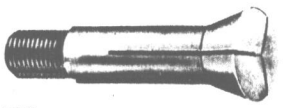
Type WW arbors for grinding wheels and slitting saws are available to permit using the watchmaker's spindle for grinding and sawing operations. These arbors are also occasionally useful for mounting wheel-shaped work for turning.

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.

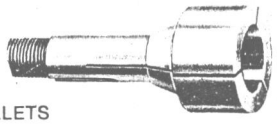
Unhardened type WW blank arbors for special tooling set-ups can be ordered from the catalog. The ½"-diameter cylindrical end of these inexpensive arbors can be bored, tapered, shouldered or threaded in any way required to hold special work. When a larger workholding fixture is needed a blank arbor can 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.

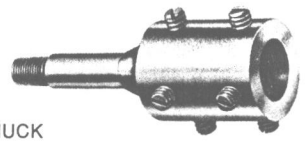


PRECISION COLLETS

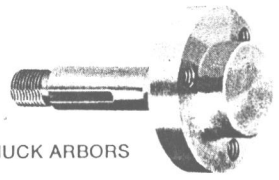


LARGE BORE COLLETS

PRECISION DRILL CHUCK

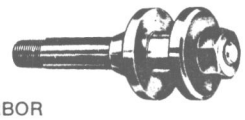


SET SCREW CHUCK

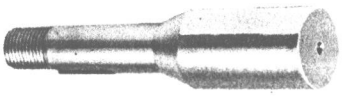


3-JAW & 4-JAW CHUCK ARBORS

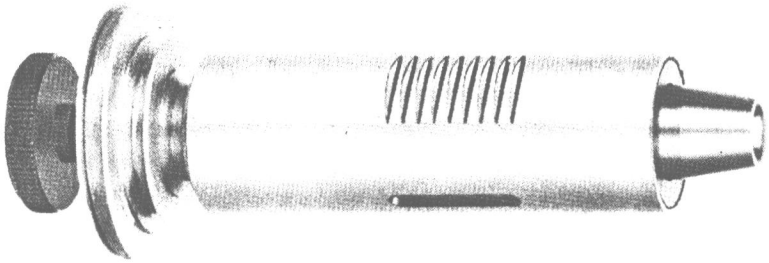
SLITTING SAW ARBOR



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.

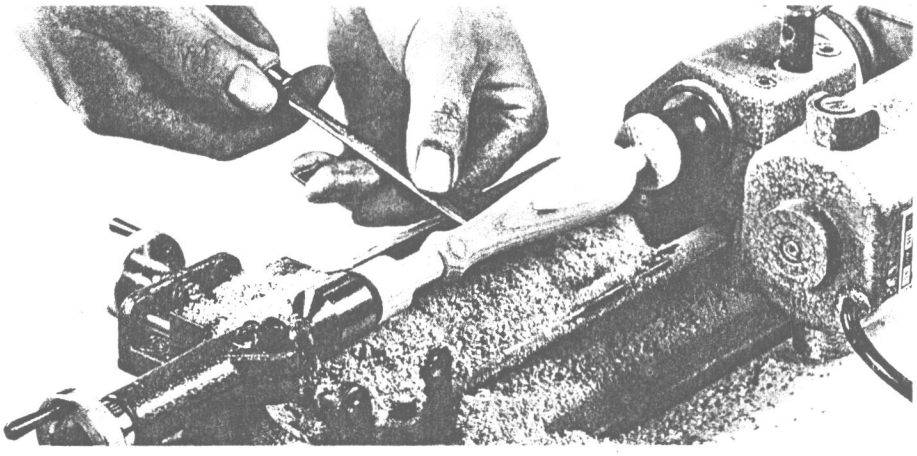
TURNING CHISELS AND RESTS

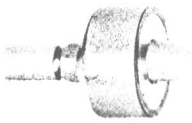
A few special accessories—hand-held turning chisels, a tool rest, spur center and a ball-bearing tailstock center—facilitate turning wood in the Unimat.

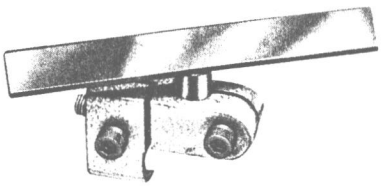
The small woodturning chisels offered in the catalog are miniature versions of the two chisels used most often for work on full-size wood lathes, the gouge and skew chisel. The gouge is used to rough square stock round and to turn coves. The skew is used to square inside corners and to turn convex shapes. 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.

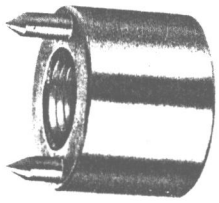
The tool rest, which is simply a solid support on which to hold the chisel, should be set close to the work at a height that raises the chisel's cutting edge level with the work's axis. Two tool rests for hand-held turning chisels are available.

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

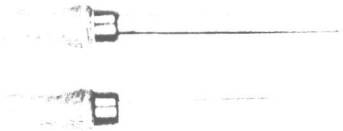


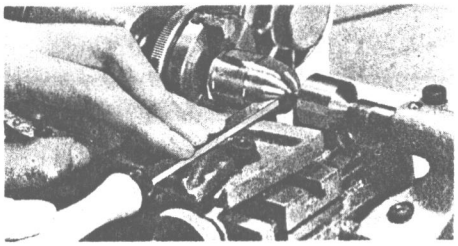






A BALL-BEARING CENTER, T-BAR TOOL REST AND A SPUR CENTER simplify making small wood turnings in the Unimat with hand-held turning chisels.





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.

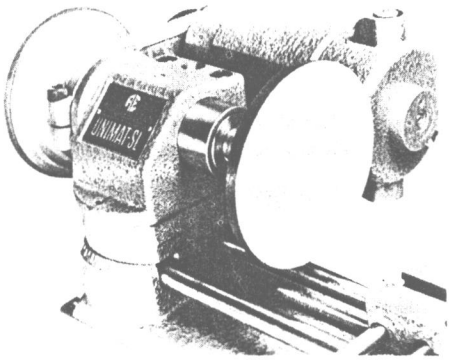
Hardwoods are easier to turn than softwoods, since they splinter less. The heavier hardwoods—lignum vitae, ebony, teak—are especially suitable for small turnings, for these dense, resin-filled woods turn beautifully and can be finished simply by rubbing with a rag. Walnut also turns smoothly. Hickory 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.

SANDING PLATE

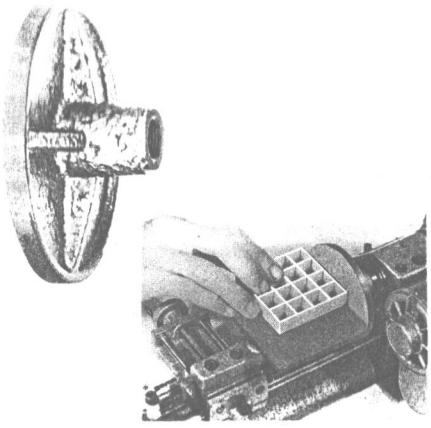
Many Unimat owners buy two sanding plates, one for use as a drill press worktable and the other for disc sanding. In order to use the 3½"-diameter plate on the spindle for sanding, the lathe headstock must be raised on the raising block. Special disc cement is available for adhering paper or cloth abrasive 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.

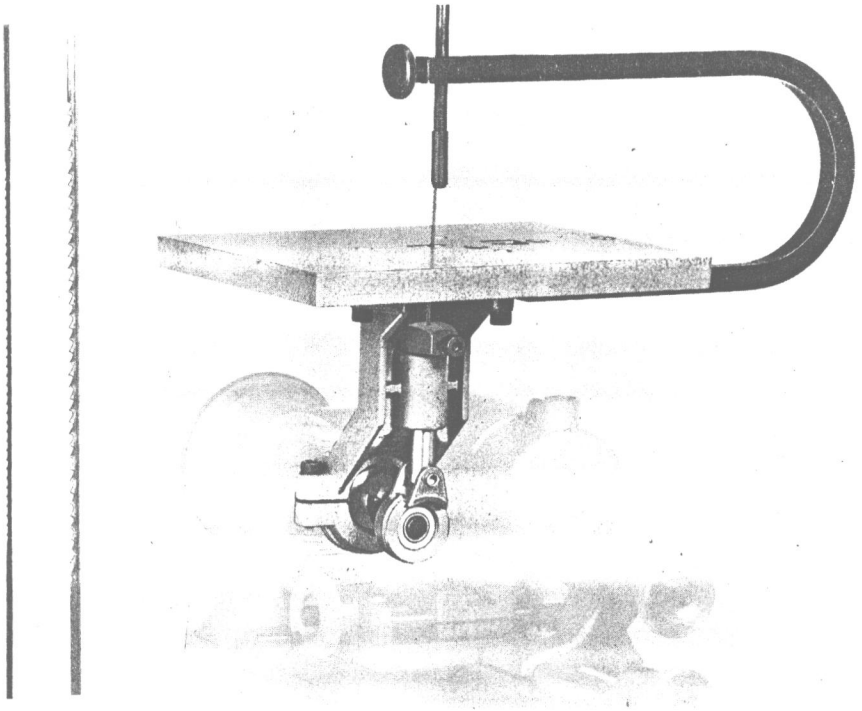
Unimat owners who use their machines for lapidary work can face extra sanding plates with leather or felt for polishing flats.



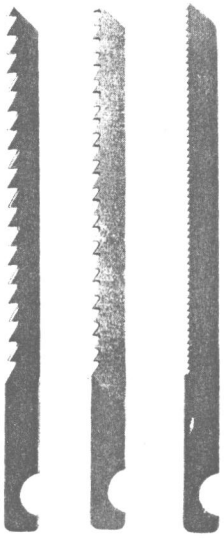
JIGSAW AND SABER SAW

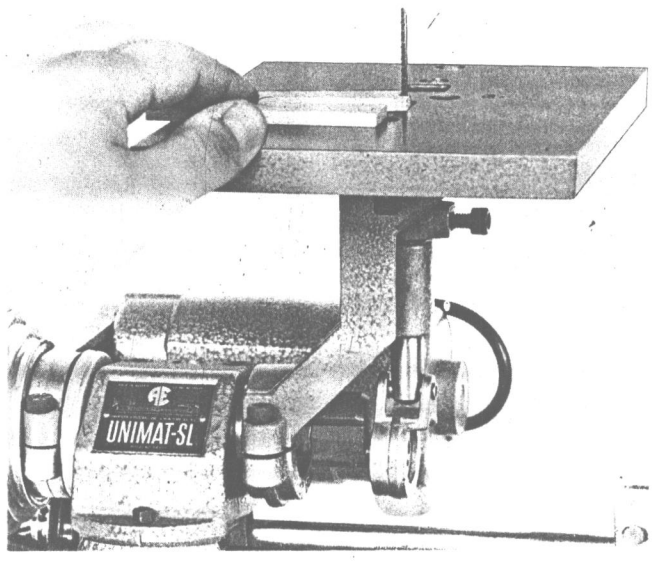
The jigsaw attachment's unique feature is a grooved blade guide rod that supports the saw blade immediately above the point of cut and prevents the blade from deflecting. The guide minimizes blade breakage and makes it much easier to saw precise, square-edged fretwork with delicate jeweler's blades.

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.



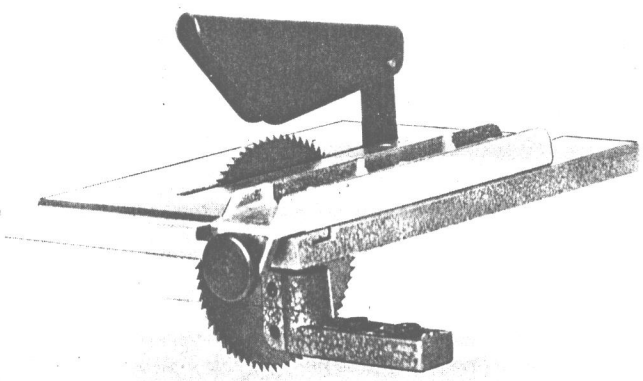


Use blades suitable for the material to be cut—coarse-toothed blades for wood, medium-toothed blades for soft metal or plastic, or fine-toothed blades for hard metal or very thin material. For sawing wood the saw can be operated at fairly high speed. For sawing steel use slow speed and flood the kerf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

Keep the reciprocating saw bar clean and oiled.

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.

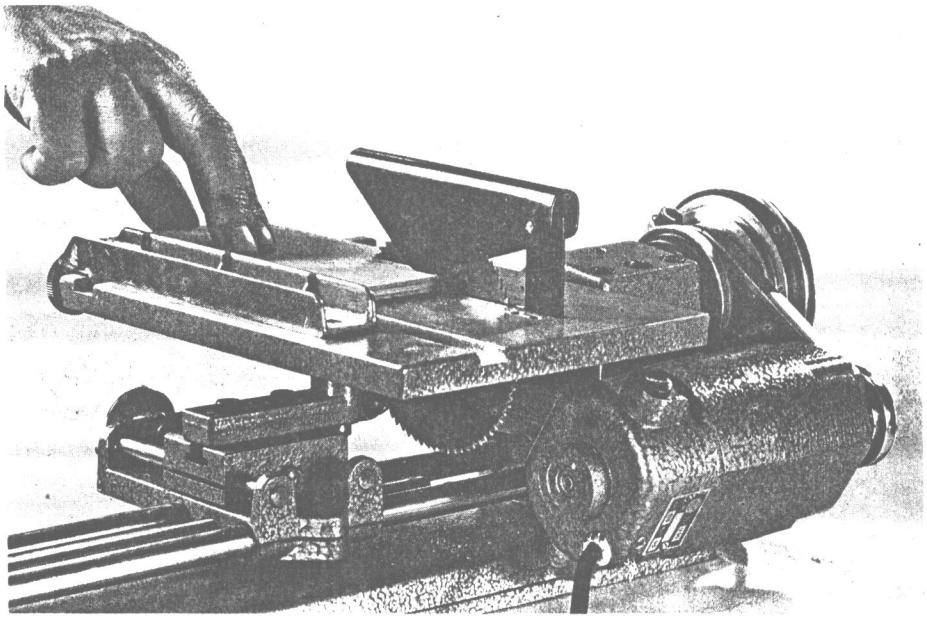
A tenon on the attachment's rigid 6x8" table clamps in an angle bracket that screws on the Unimat's cross slide with T-nuts. The table can be raised or lowered in this bracket to adjust the saw blade's depth of cut, and the bracket itself can be flopped to provide the extra ¾" elevation needed when the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

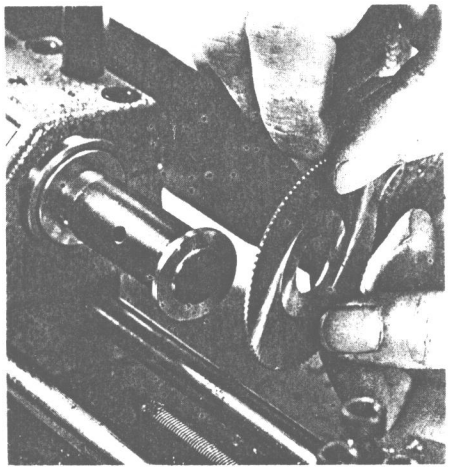
When setting up the table, position it to center the blade in the table's slot and then lock the carriage movements. The table must be aligned accurately with the blade to make the blade run parallel with the table's rip fence. The slitter supporting the blade guard must also be aligned with the blade. 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 prolong 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.

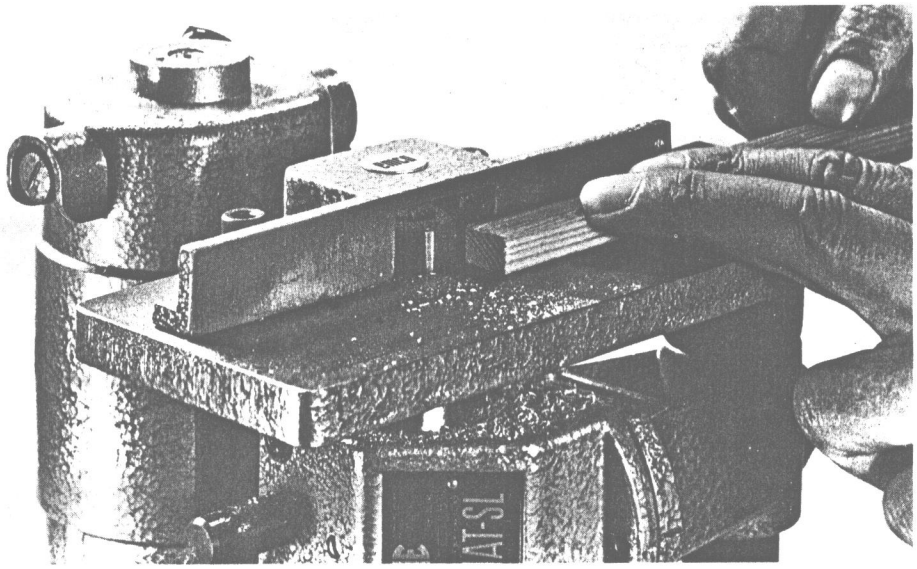
SHAPER ATTACHMENT

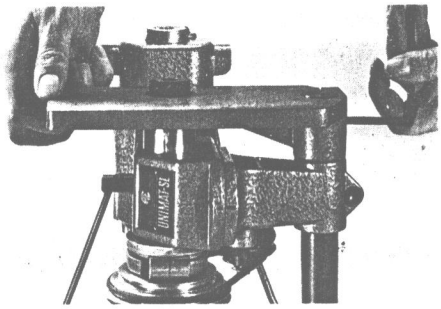
First mounting the headstock on the auxiliary column spindle-nose-up and then clamping the shaper attachment above the headstock converts the Unimat to a serviceable miniature shaper. The straight-faced cutter included with the attachment smoothly planes or rabbets the edges of small wooden parts. When profiled cutters are used—router bits, rotary files or cutters you lathe-turn yourself—the attachment cuts molding or molds the edges of miniature 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.





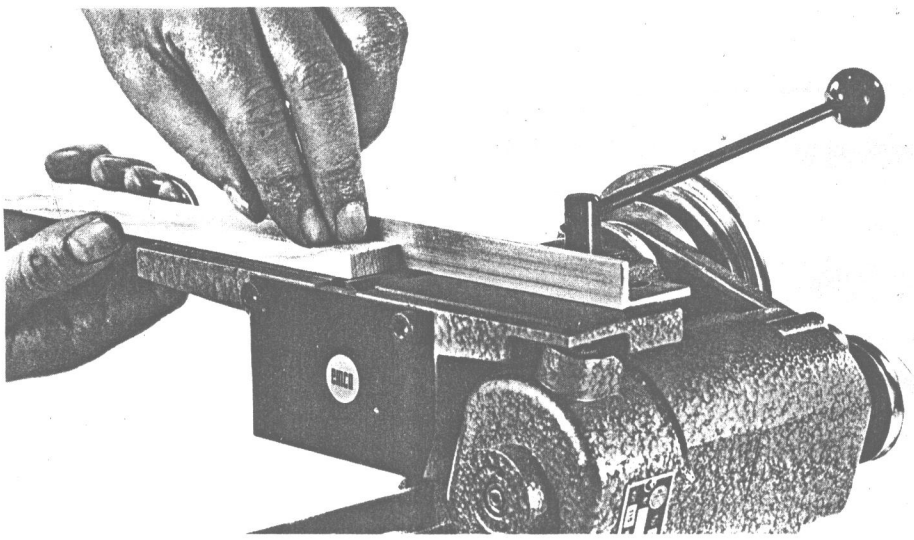
MOUNT THE SHAPER TABLE flush with the top of the Unimat's vertical column.

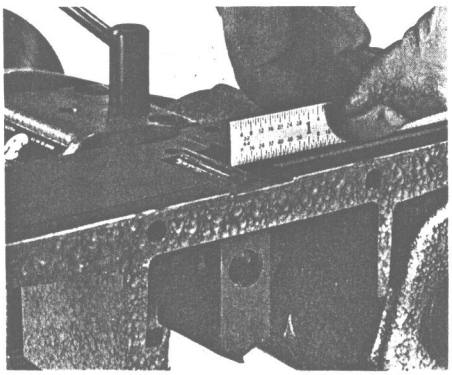
PLANER ATTACHMENT

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.

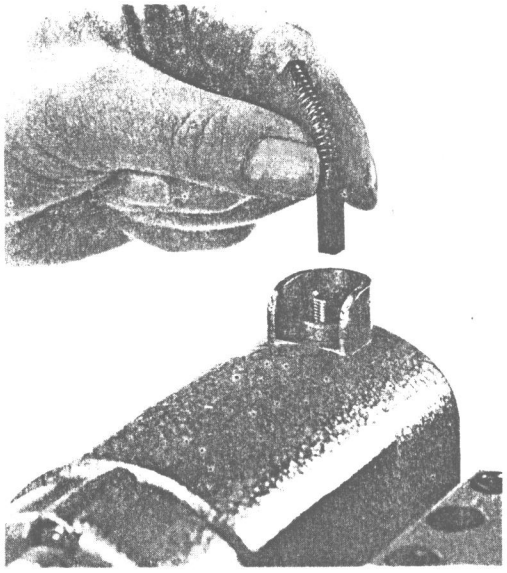




THE REAR HALF of the planer table must be set level with the cutter's cutting edge.

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.

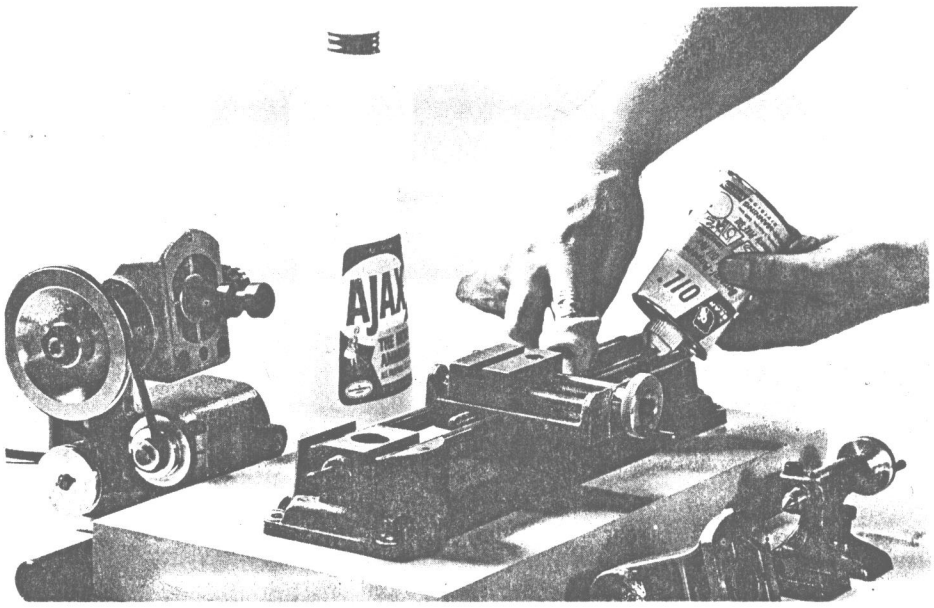
The machine's second critical surface (critical for accurate vertical-spindle operations) is the cross slide's tool platform. If this surface is nicked the nick can be whetted flush with a fine-grit oilstone.

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.

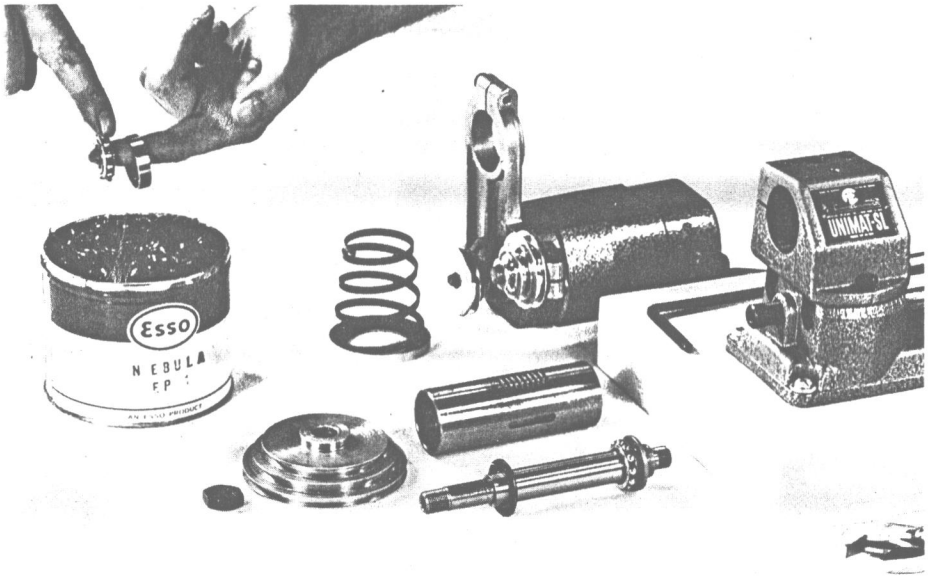
Other than preserving the accuracy of these three critical surfaces, the Unimat requires little maintenance. Infrequently, however, the motor will need attention. The motor has lifetime-lubed bearings, but occasionally the carbon brushes will need replacement. The brushes should be replaced when they 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 reoil all bright-metal parts. Color-matched touch-up lacquer is available to keep the finish looking like new.

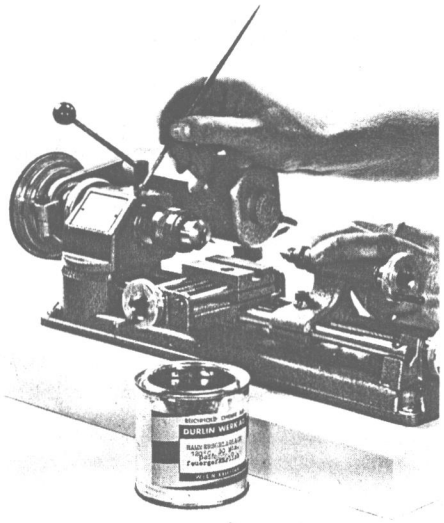
The spindle bearings are grease-packed at the factory and need no attention for the first 1000 hours of operation. At the end of each 1000 hours of use the spindle should be disassembled and the bearings re-greased. To do this remove the spindle cartridge from the headstock and unscrew the nut retaining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



PERIODICALLY GIVE THE MACHINE a thorough cleaning, using solvent or strong household cleaner. Then immediately reoil 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.



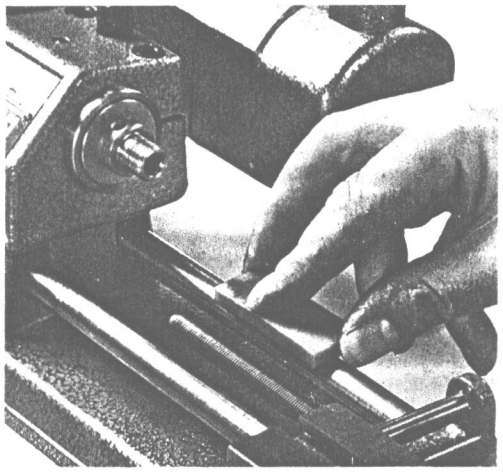
KEEP THE MACHINE'S FINISH looking like new with color-matched touch-up lacquer.

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.

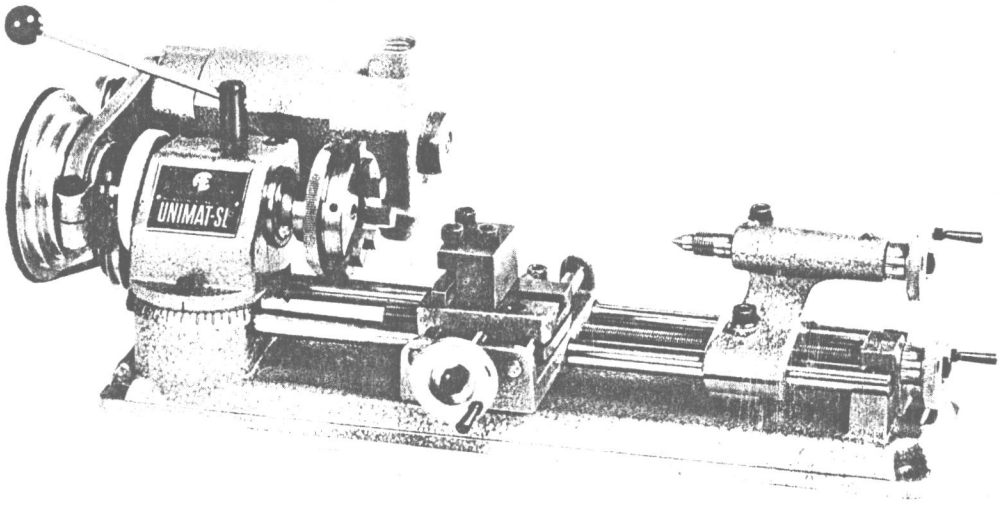
Unimat Thread Sizes

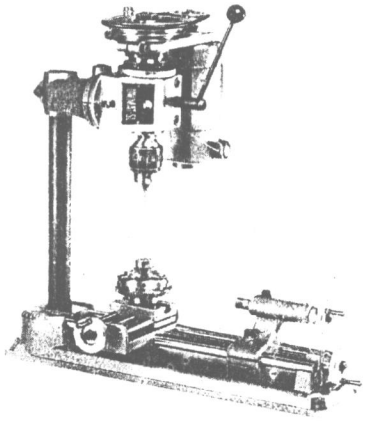
Threaded Part	Thread Size	Drill Size
Headstock, tailstock spindles	M 12 x 1	10.8mm
Leadscrew, cross-feed screw	M 8 x 1 (left)	6.7mm
Allen head screws	M 6 x 1	5.0mm
Spindle locating screws	M 4 x 1	3.3mm
Watchmaker spindle draw-bar	6.9	15/64"
Handwheels	M 5 x 1	4.2mm

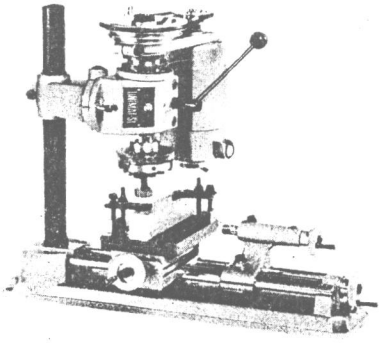
All Unimat Allen head screws have a 6mm diameter.
A set of screws in assorted lengths is available. See accessory catalog.

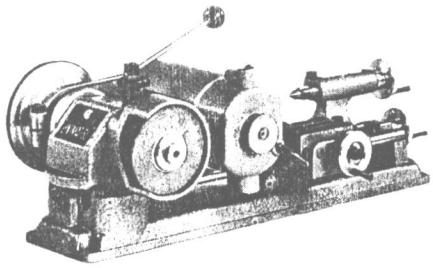
Owner's Guarantee

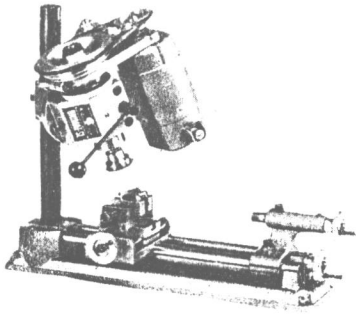
American Edelstaal, Inc. guarantees this equipment to be free from defects in workmanship for 6 months after date of purchase. This guarantee is effective only if the attached Guarantee Registration Card is returned with the information as therein called for, and provided further that any part claimed 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.











Abrasive Discs 39
Adapter Stud 6, 21
Adjusting Motor Bracket 8
Aligning Spindle 13

Backlash Adjustment 13
Belts 6, 8, 9, 31
Boring 19
Buffing 35

Chucks, Drill 15, 37
  3-Jaw 25, 26
  4-Jaw, Mounting 16, 26
  Collet, Mounting 27
Circular Saw Attachment 40
Cleaning and Oiling 8, 9, 10, 25, 27, 42
Collets 16, 27, 36
Countersinking Workpieces 11, 22, 23
Cutting Lubricant 11, 18, 22, 23

Drawbar Lathe Spindle 36
  Type WW Accessories 37
Dressing Grinding Wheels 35
Drilling 18, 22
  Deep-Hole Drilling 18, 22
  Horizontal 18
  Sensitive Drilling 23

Faceplate Turning 16
Facing 13
Finishing 18
Flexible Shaft 35

Grinding Wheels 35
  Wheel Guard 35
  Wheel Arbor 35
Guarantee 8, 43

Handwheel Calibration 13
Horizontal Drilling and Reaming 18

Indexing and Dividing Head 33

Jigsaw Attachment 39

Lathe Dog 11, 13
Live Centers 11, 18, 25, 28, 38
Lubricating Spindle 42

Maintenance 42
Mandrels 17
Milling 23
  Milling Cutters 23, 24, 34
  Milling Table 32
Mounting the Machine 9

Operating Controls 9, 13

Planer Attachment 41
Polishing 34
  Polishing Arbor 34
Power Feed Attachment 31

Raising Block 29
Reaming 18
Replacement Parts 8, 44-47
Resharpening Lathe Bits 14, 28
  Milling Cutters 34
  Twist Drills 34

Sanding Plate 38
Setting Up the Machine 8
Shaper Attachment 41
Slow-Speed Attachments 31
Specifications 6
Spindle Speed Chart 10
Spindle Speeds, Turning 12
  Drilling 18, 22, 23
Steady Rest 29
Straight Turning 11, 12
Surface Grinding 24

T-Slotted Fixture Plate 33
Taper-Turning 20
Threading, Taps and Dies 19
  Thread Chasing Attachment 30
Tool Bits 12, 28
Tool Board 25

Vertical-Spindle Set-Ups 21
Vise 21, 25, 32

Watchmaker's Spindle 36
Woodturning Accessories 38-41

AMERICAN EDELSTAAL, INC.
1 Atwood Avenue, Tenafly, N. J. 07670

CANADIAN EDELSTAAL, LTD.
47 Granger Avenue, Scarborough, Ontario, Canada

Printed in Spain

PRECISION MACHINE TOOLS & ACCESSORIES

edelstaal

THIS PRICE LIST SUPERSEDES ALL PRICE LISTS AND BULLETINS PREVIOUSLY ISSUED.

TERMS: Net 10 days to rated accounts. All others, cash with order.

SMALL ORDERS: Minimum Order $10.00. Repair parts—No minimum.

PRICES: USA: All prices are f.o.b., Tenafly, N.J.

CANADA: Canadian prices are approximately 5% to 10% higher, and are f.o.b. Scarborough, Ont. Warehouse. Request Canadian Price List for specific details.

ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

UNIMAT PRICE LIST No. UPL – 3/73 Effective March 1, 1973

Cat. No.	Price	Wt.	Cat. UA/72 Page No.	Description
1000	$169.50	30 lbs.	2,3	UNIMAT Basic Unit with 1/10 hp 115V Motor, Steel Vertical Column, Face Plate, Dog, 2 Centers, Grinding Wheel Arbor, Adaptor, Belts, Wrenches, Operating Handbook, Wood Chest
14/6	1.60	1 oz.	9	Set of 6 T-Nuts
50	1.70	2 oz.	15	Set of Rubber Drive Belts
50/01	.85	1 oz.	15	Small Rubber Drive Belt
50/02	.85	1 oz.	15	Large Rubber Drive Belt
70	4.95	2 oz.	15	Set of Polyurethane Drive Belts
70/01	2.50	1 oz.	15	Small Polyurethane Drive Belt
70/02	2.50	1 oz.	15	Large Polyurethane Drive Belt
105/05	.50	1/4 oz.	9	Slotted Adaptor Screw
600	2.25	2 oz.	15	Set of 15 Allen-head Screws
1001	32.95	1 lb.	4	3-Jaw Universal Lathe Chuck
DB106/139	2.50	1 oz.	4	Chuck Plate
DB106/135	7.95	2 oz.	4	Set of 3 Soft Jaws
1002	32.95	1 lb.	4	4-Jaw Independent Lathe Chuck
ZF59/5	2.50	1 oz.	4	Chuck Plate
1003	5.95	3 oz.	10	Snap Ring Remover
1005	10.95	6 oz.	5	Drill Chuck 1/4"
1010	15.00	13 oz.	8	Machine Vise
1020	16.50	8 oz.	4	Collet Chuck
DB190/3	2.50	1 oz.	4	Chuck Plate
1021	5.50	2 oz.	4	Steel Collett, sizes .0135" plus 1/64" thru 5/16 in 64th Specify sizes desired
1021/40	4.00	2 oz.	4	Soft Steel Collet
1025	7.95	8 oz.	4	Collet Case
1030	10.50	8 oz.	13	Polishing Arbor
DB106/139	2.50	1 oz.	4	Mounting Plate
1034	3.95	3 oz.	13	Set of 3 Felt Polishing Discs
1040	14.95	1 lb.	5	Steady Rest
1050	29.95	3 lbs.	12	Planing Attachment
1051	5.95	3 oz.	12	Planer Cutter
1060	29.95	3 lbs.	12	Jointer Attachment
1061	5.95	3 oz.	12	Jointer Cutter
1080	34.95	6 lbs.	11	Jig Saw Attachment
1081	2.75	1/4 oz.	11	Jig Saw Blade (metal) 1 dz.
1082	1.50	1/4 oz.	11	Jig Saw Blade (wood) 1 dz.
1083	1.95	1/4 oz.	11	Jig Saw Blade (assorted) 1 dz.
1085	2.50	1/8 oz.	11	Sabre Saw Blade (metal)
1086	2.35	1/8 oz.	11	Sabre Saw Blade (wood)
1087	2.50	1/8 oz.	11	Sabre Saw Blade (plastic)
1115	5.95	12 oz.	13	Grinding Wheel Guard
1150	Discontinued	2 oz.	13	Brass Wire Wheel Brush
1151	Discontinued	2 oz.	13	Steel Wire Wheel Brush
1201	3.50	5 oz.	12	Steady for Wood Turning
1202	10.95	1 lb.	12	Adjustable Tool Rest
1205	2.95	2 oz.	12	Spur Drive Center
1210	17.95	2 lbs.	8	Milling Table
1210/02	5.00	1 oz.	9	Set of 2, T-Stud & Clamps
1220	7.95	3 oz.	5	Single Ball Bearing Live Center
1221	9.95	3 oz.	5	Double Ball Bearing Live Center
1240	27.95	3 lbs.	11	Circular Saw Attachment
1241	4.50	1 oz.	11	Circular Saw Blade (metal) 2-1/2"
1242	3.95	1 oz.	11	Circular Saw Blade (wood) 2-1/2"
1243	4.50	2 oz.	11	Circular Saw Blade (wood) 3-9/16"
1244	7.95	10 oz.	11	Mitre Gauge
1250	33.00	3 lbs.	13	Flexible Shaft
1260	19.95	1 lb.	10	Indexing & Dividing Attachment
1261	13.95	1 lb.	2, 9, 10	T-Slotted Work & Fixture Plate
1261/03	2.95	1 oz.	4	Work Plate Adaptor
1263/30	8.95	3 oz.	10	Index Plate, 30 div.
1263/36	8.95	3 oz.	10	Index Plate, 36 div.
1263/40	8.95	3 oz.	10	Index Plate, 40 div.
1264	5.95	3 oz.	10	Snap Ring Remover
1270	39.95	3 lbs.	6	Thread Chasing Attachment
1271	5.95	4 oz.	7	Master Thread Pattern & Follower. Specify Size!
1280	19.95	2 lbs.	7	Slow Speed Attachment
1290	39.95	6 lbs.	6	Power Feed Attachment
1311	4.50	6 oz.	5	Headstock Raising Block

Cat. No.	Price	Wt.	Cat. UA/72 Page No.	Description
1312	4.95	6 oz.	5	Double-Hole Bolt
1330	6.95	4 oz.	9, 13	Drill Press Table/Sanding Disc
1334	4.95	1 lb.	13	Set of Abrasive Discs (1 dz. ea.: 60, 80, & 100 grit) plus 4 oz. Abrasive Disc Cement
2800	59.00	2 lbs.	14	Watchmaker's Spindle, type "WW"
2801	13.95	8 oz.	14	Drill Chuck, type "WW" (for No. 2800 spindle only)
2802	11.50	4 oz.	14	Jumbo Chuck, type "WW" (for No. 2800 spindle only)
2803				Precision Collet, type "WW" (for No. 2800 spindle only) Specify sizes desired!
	7.50	1 oz.		size: 0.1mm, 0.2mm, 0.3mm, each
	4.50	1 oz.		size: 0.4mm thru 7.2mm, 1/32" thru 1/4", each
2806	11.50	8 oz.	14	Collet Case (holds 40 No. 2803 collets)
2807	14.95	12 oz.	14	Collet Case (holds 72 No. 2803 collets)
2808	7.95	2 oz.	14	Large Bore Collet, type "WW" (for No. 2800 spindle only) size: 7.0mm thru 14mm, each Specify sizes desired!
2811	3.50	3 oz.	14	Blank Arbor, type "WW" (for No. 2800 spindle only)
2812	5.95	2 oz.	14	Grinding Wheel Arbor, type "WW" (for No. 2800 spindle only)
2813	11.95	3 oz.	14	Slitting Saw Arbor, type "WW" (for No. 2800 spindle only)
2814/01	11.95	2 oz.	14	Arbor, type "WW" (for chuck No. 1001 in No. 2800 spindle)
2814/02	11.95	2 oz.	14	Arbor, type "WW" (for chuck No. 1002 in No. 2800 spindle)
EDELSTAAL Cutting Tools & Miscellaneous Accessories				
2700-R	4.95	4 oz.		R/H Tool holder, 1/4" & bits set
2700-L	4.95	4 oz.		L/H Tool holder, 1/4" & bits set
2701-R	5.15	4 oz.		R/H Tool holder, 5/16" & bits set
2701-L	5.15	4 oz.		L/H Tool holder, 5/16" & bits set
2702-R	5.55	5 oz.		R/H Tool holder, 3/8" & bits set
2702-L	5.55	5 oz.		L/H Tool holder, 3/8" & bits set
2703-R	5.95	5 oz.		R/H Tool holder, 5/8" & bits set
2703-L	5.95	5 oz.		L/H Tool holder, 5/8" & bits set
2710	7.50	3 oz.		Boring bar, 1/4" & bits set
2712	8.50	3 oz.		Boring bar, 3/8" & bits set
2713	9.25	4 oz.		Boring bar, 1/2" & bits set
2719	1.95	1 oz.		Set of 2 V-blocks
2720	3.75	1 oz.		Set of 5 bits, M-2 HSS
2722	5.00	1 oz.		Set of 5 bits, T-15 HS Cobalt
2725	6.95	1 oz.		Set of 5 bits, Carbide
2750	5.15	2 oz.		Fly cutter, 1" & bits set
2751	5.55	2 oz.		Fly cutter, 1-1/2" & bits set
2760	5.55	3 oz.		Cut-off holder, 5/16" & blade set
2761	2.50	1 oz.		Set of 2 Cut-off blades
2818	45.00	10 oz.	1	Set of 6 Ground Tool Bits, 5/16" sq.
2819	49.95	12 oz.	1	Set of 6 Ground Tool Bits, 3/8" sq.
2820	17.95	8 oz.	1	Set of 6 Ground Tool Bits, 1/4" sq.
2820/01	2.95	1 oz.	1	Roughing Tool
2820/02	2.95	1 oz.	1	Right-hand turning tool
2820/03	2.95	1 oz.	1	Left-hand turning tool
2820/04	3.95	1 oz.	1	Cut-off tool
2820/05	3.95	1 oz.	1	Boring Bar
2820/06	3.95	1 oz.	1	Inside Threading Tool
2820/07	2.95	1 oz.	1	Outside Threading Tool
2820/08	1.95	1 oz.	1	Unground Tool Bit
2821	12.95	3 oz.	1	Diamond Dressing Tool
2823	1.50	1 oz.	1	Set of 4 assorted Drill Bits
2824	14.50	1 lb.	2	Drill Set, 1/16" thru 1/4"
2826	19.95	2 oz.	2	Drill Set, No. 61 – 80
2827	1.95	1/2 oz.	2	Center Drill Bit
2828	2.95	1 oz.	2	Countersink Bit
2833	3.95	1 oz.	3	Single End Mill Cutter
2834	3.95	1 oz.	3	Woodruff Key-Seat Cutter
2841	8.95	6 oz.	3	Set of 3 Grinding Wheels
2841/01	2.90	2 oz.	3	Straight Grinding Wheel
2841/02	3.25	2 oz.	3	Cup Grinding Wheel
2841/03	3.25	2 oz.	3	Dish Grinding Wheel
2850	Discontinued			
2851	39.95	1 lb.	3	Set of 24 HSS Miniature Mills
2852	19.95	12 oz.	3	Set of 12 HSS Miniature Mills
2860	27.95	1 lb.	1	Tool Kit
2867	2.95	2 oz.	2	Wood-turning Chisel, (gouging tool)
2868	2.95	2 oz.	2	Wood-turning Chisel, (veining tool)
2870/04	7.50	4 oz.	15	Tap & Drill Set, 4mm
2870/06	7.50	4 oz.	15	Tap & Drill Set, 6mm
2870/08	9.50	4 oz.	15	Tap & Drill Set, 8mm, left
2970/12	14.00	6 oz.	15	Tap & Drill Set, 12mm
2870/68	7.95	4 oz.	15	Tap & Drill Set, 6.8mm
2871/04	9.95	2 oz.	15	Die, 4mm
2871/06	9.95	2 oz.	15	Die, 6mm
2871/08	12.95	2 oz.	15	Die, 8mm, left
2871/12	14.95	2 oz.	15	Die, 12mm
2871/68	9.95	2 oz.	15	Die, 6.8mm
2890	.95	4 oz.	15	3 oz. Hi-Precision Bearing Grease
2891	3.95	1 lb.	15	1 lb. Hi-Precision Bearing Grease
2893	3.95	11 oz.	15	Touch-up Paint, Specify: "UNIMAT Green"
2975	15.95	8 oz,	4	Machinist's Combination Square, 4"
2980	14.95	11 lbs.	4	Bending Brake
2981	14.95	6 lbs.	4	4-in-1 Metal Worker
2981/01	5.50	2 oz.	4	Set of 5 Round Punches
2981/02	2.95	1 oz.	4	Set of 2 Square Punches
2981/03	3.75	1 oz.	4	Set of 3 Hex Punches
2981/04	2.95	1 oz.	4	Set of 2 Rectangular Punches
2982	22.95	1 lb.	4	Miniature Gas Welding Torch
2982/01	4.00	1 oz.	4	Oxygen Replacement Cylinder, Set of 4
2982/02	2.75	1 oz.	4	Butane Replacement Cylinder, Set of 4
2996	44.95	2 lbs.	4	Instrument Set, Basic
2997	74.95	3 lbs.	4	Instrument Set, Deluxe
2998	19.95	1 lb.	4	SCR Motor Speed Controller