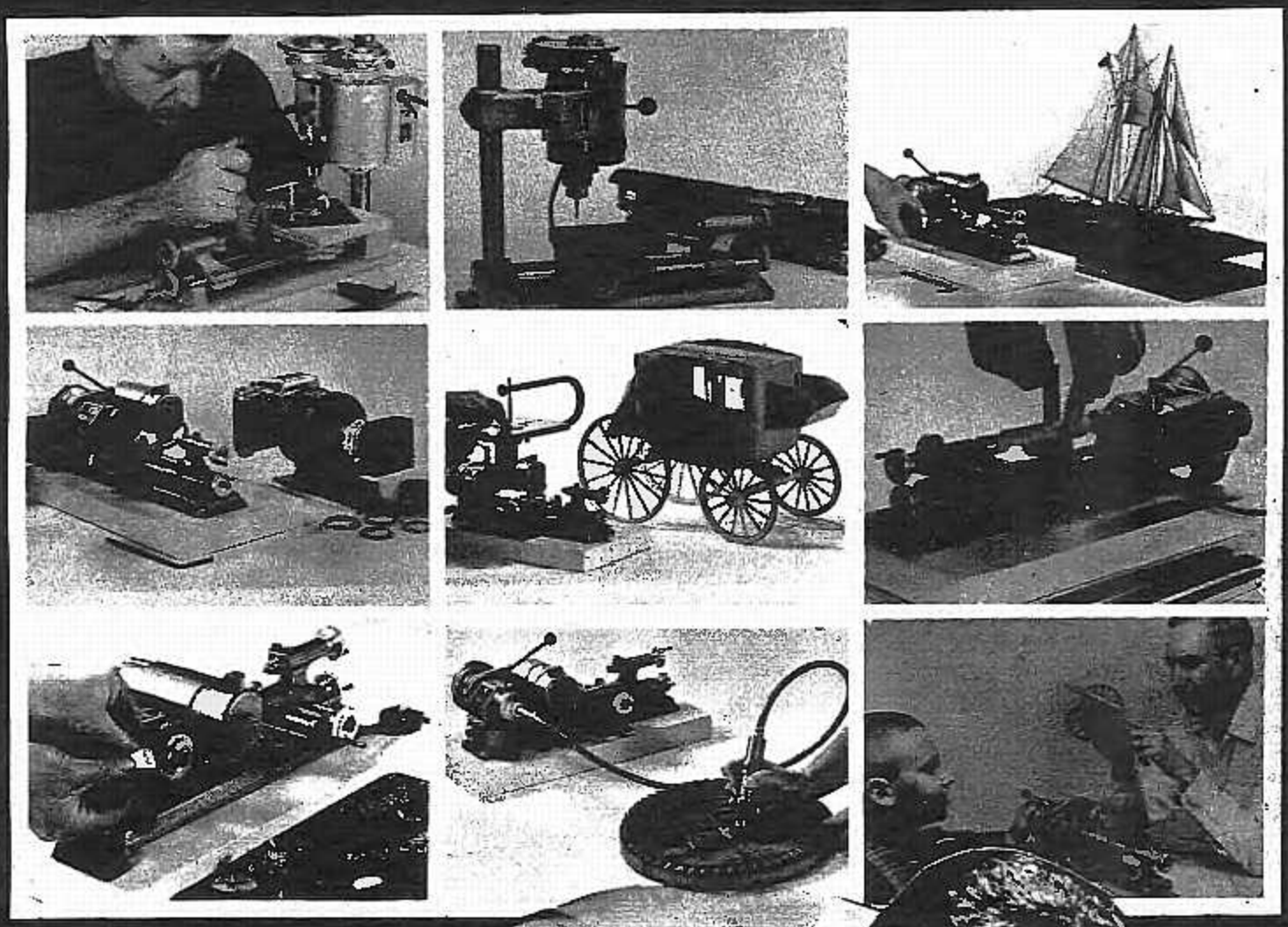
edelstaal®

MINIATURE MACHINING TECHNIQUES

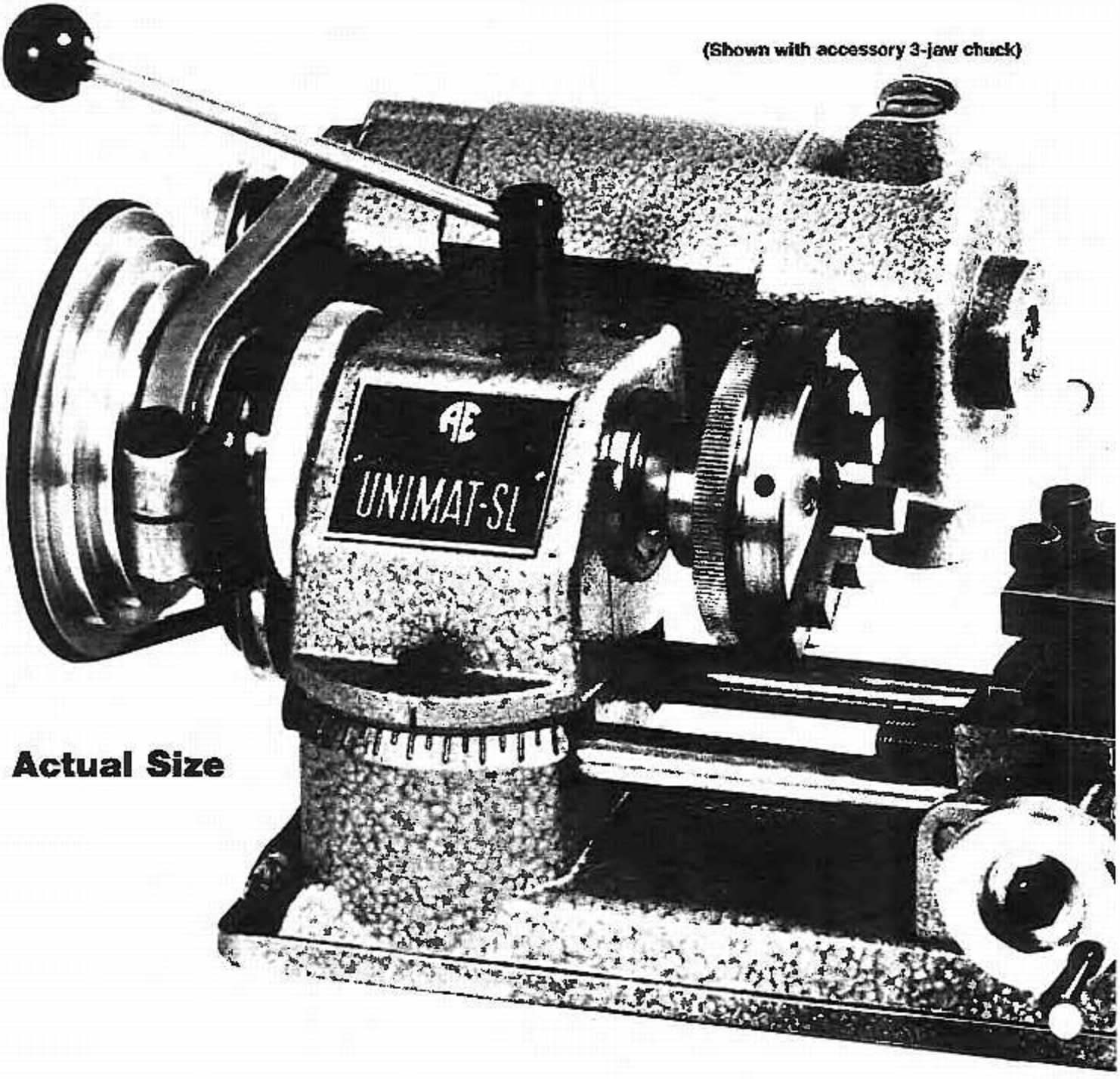
a general handbook and operator's manual



INCOMPARABLY VERSATILE MINIATURE

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)

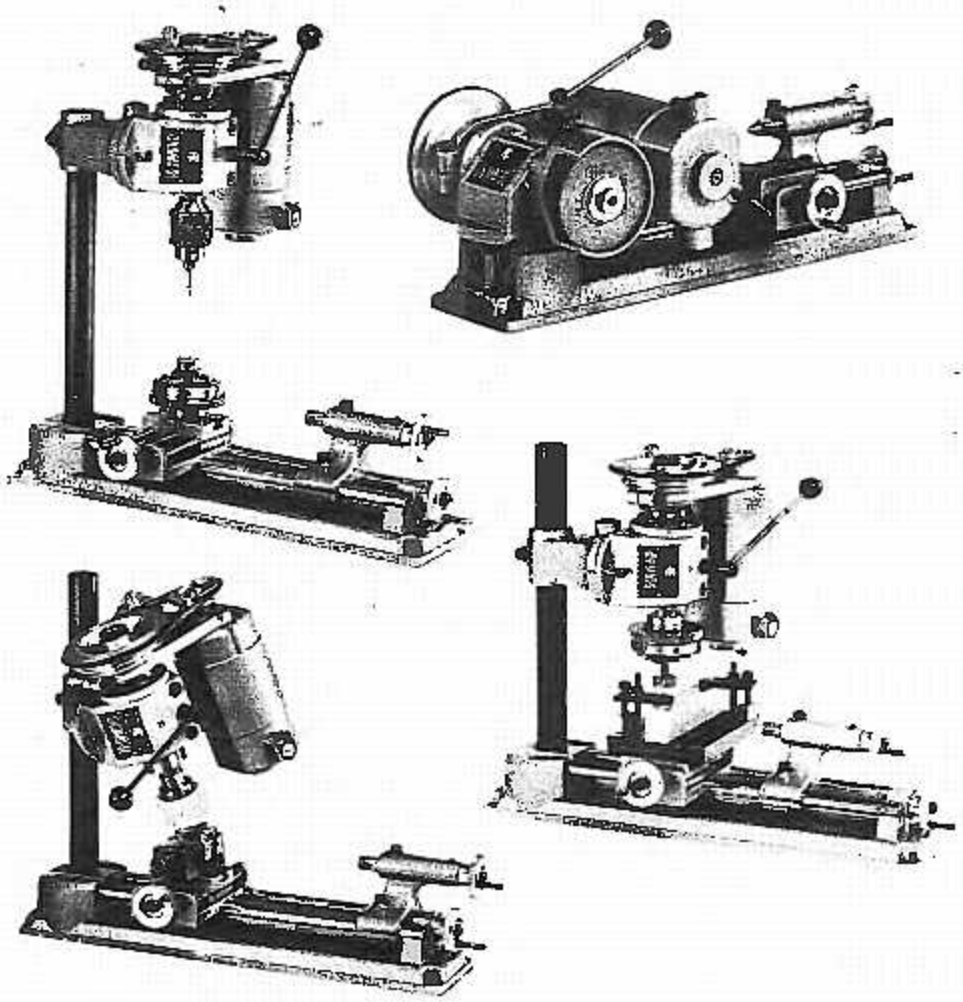


Actual Size

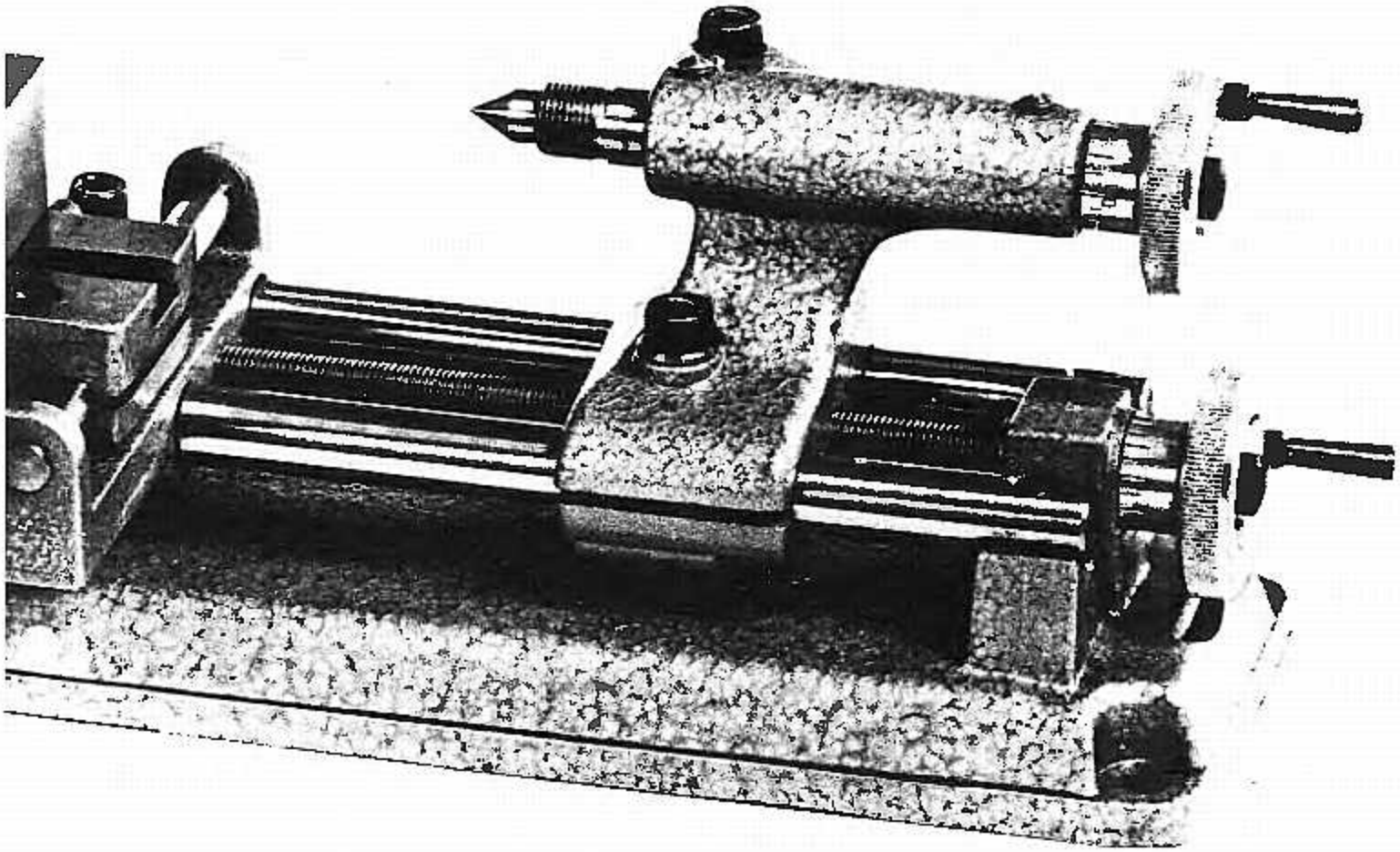
MACHINE TOOL

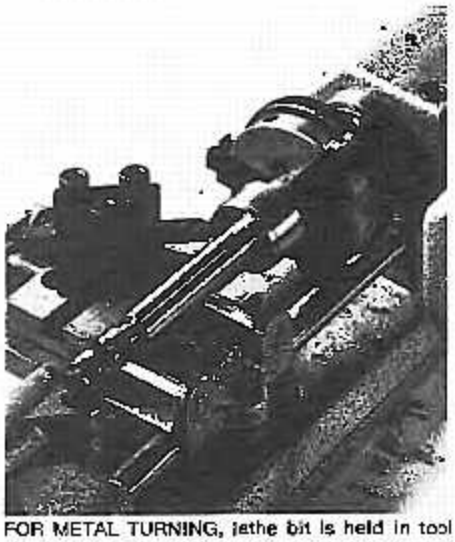
Surely the most fascinating little machine a craftsman could imagine, the Unimat is much more than simply an appealing little precision metal lathe. It's really a complete miniature machine tool system—a system of components that can be set up in various ways to perform on small scale *any* of the standard 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

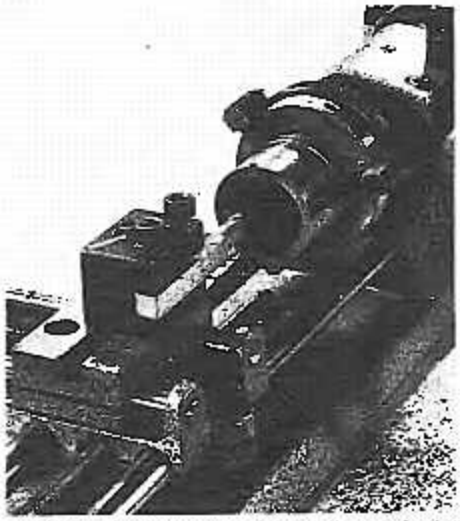


Here's The Basic Unit

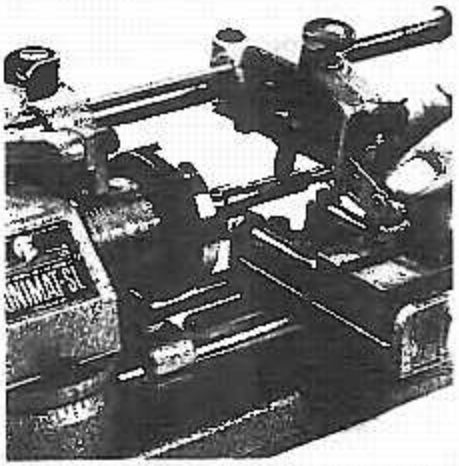




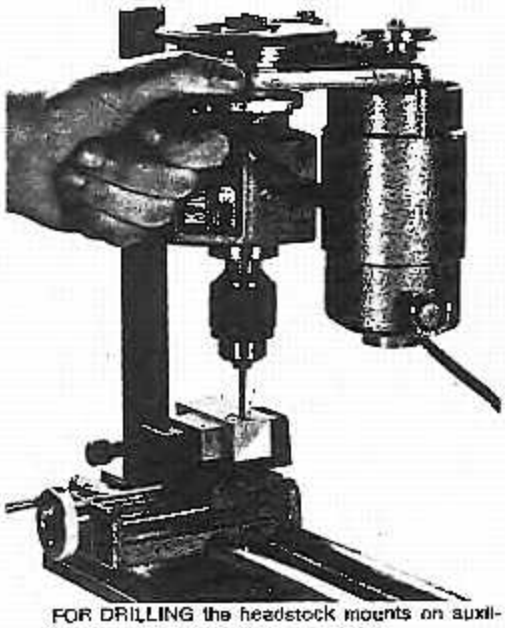
FOR METAL TURNING, lathe bit is held in tool block mounted on the carriage.



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.



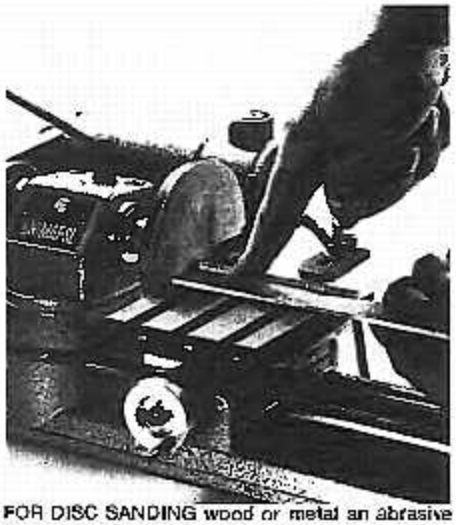
FOR DRILLING the headstock mounts on auxiliary column, lever advances spindle.

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.

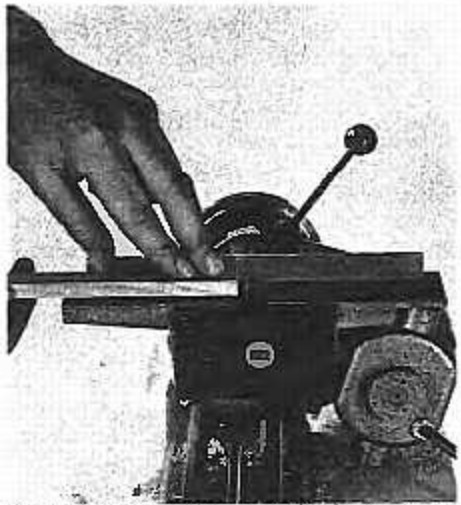
Since it can perform such a variety of machining operations on small workpieces, the Unimat is a simply marvelous tool for home-shop modelbuilding and craftwork. Using a Unimat an amateur modelbuilder can readily machine the special metal parts and fittings he needs to give his models professional finish. 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.

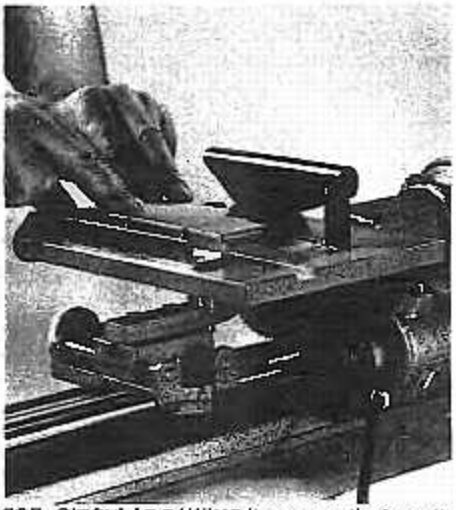
But while the machine is wonderful for hobbiests, a great many of the 100,000



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

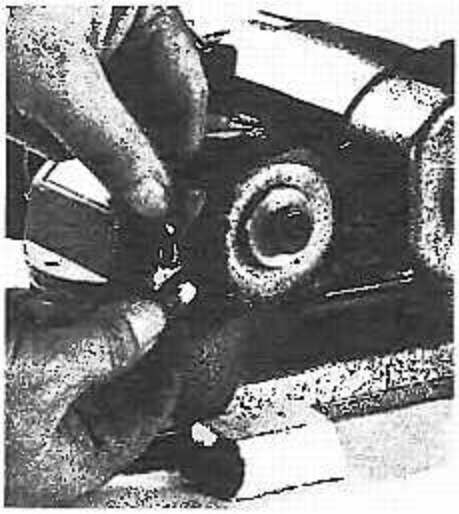


FOR PLANING wood, motor is tilted and planing attachment is clamped on spindle.

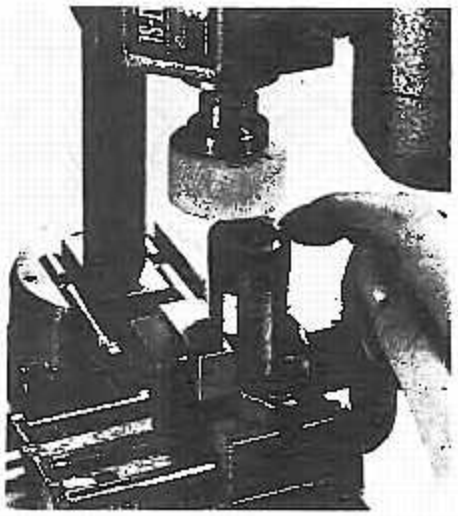


FOR CIRCULAR SAWING the saw attachment's table mounts on the cross slide.

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.

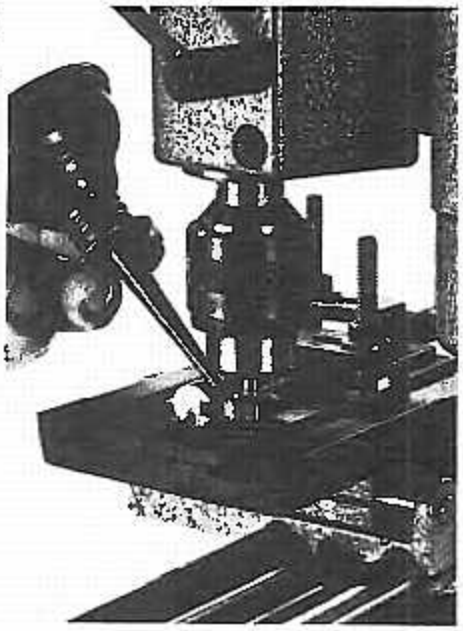


FOR GRINDING FLATS the spindle is set vertically. Vise holds work on cross slide.

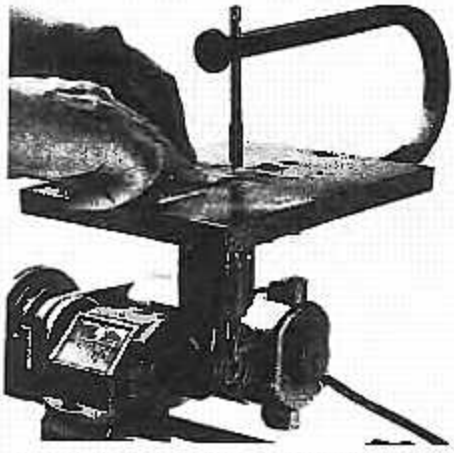
Unimats in use are used commercially. Inventors, designers, engineers, architects and physicists who build experimental models use Unimats to produce at practical cost small parts that if made on conventional machine tools would be quite expensive because of the set-up time involved. The Unimat is so 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 Unimat 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.

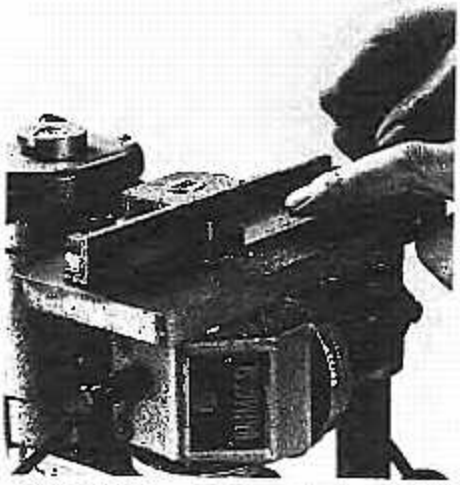
The first special feature is its convertible headstock. Conventional machine tools (reciprocating tools excepted) fall into two fundamental classes, horizontal-spindle machines and vertical-spindle machines. Metal lathes and bench grinders are horizontal-spindle tools. Drill presses, vertical milling 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 auxillary 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.

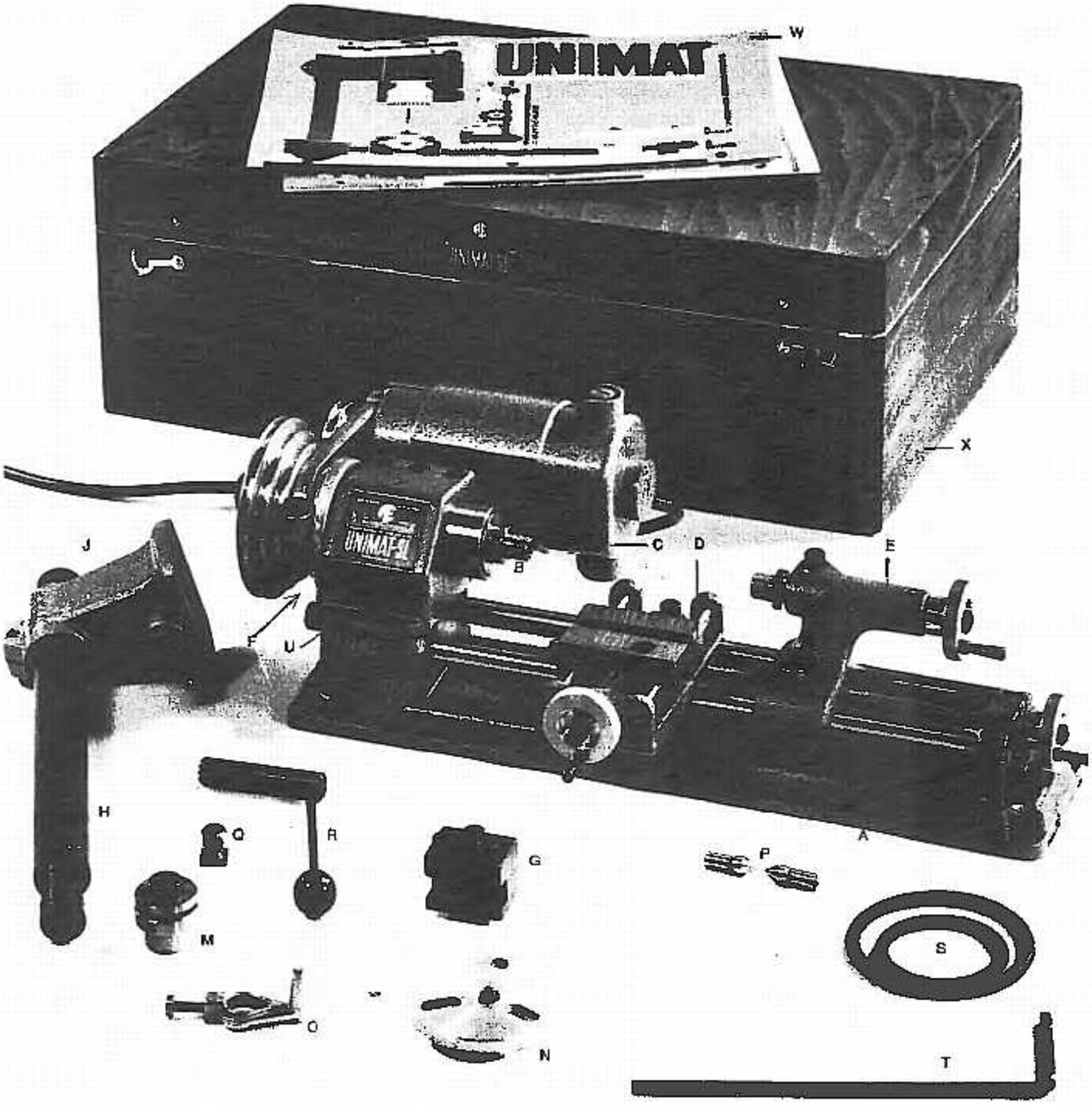
The Unimat gives you, on small scale, this facility. It's a universal tool, the most versatile machine a craftsman could imagine.

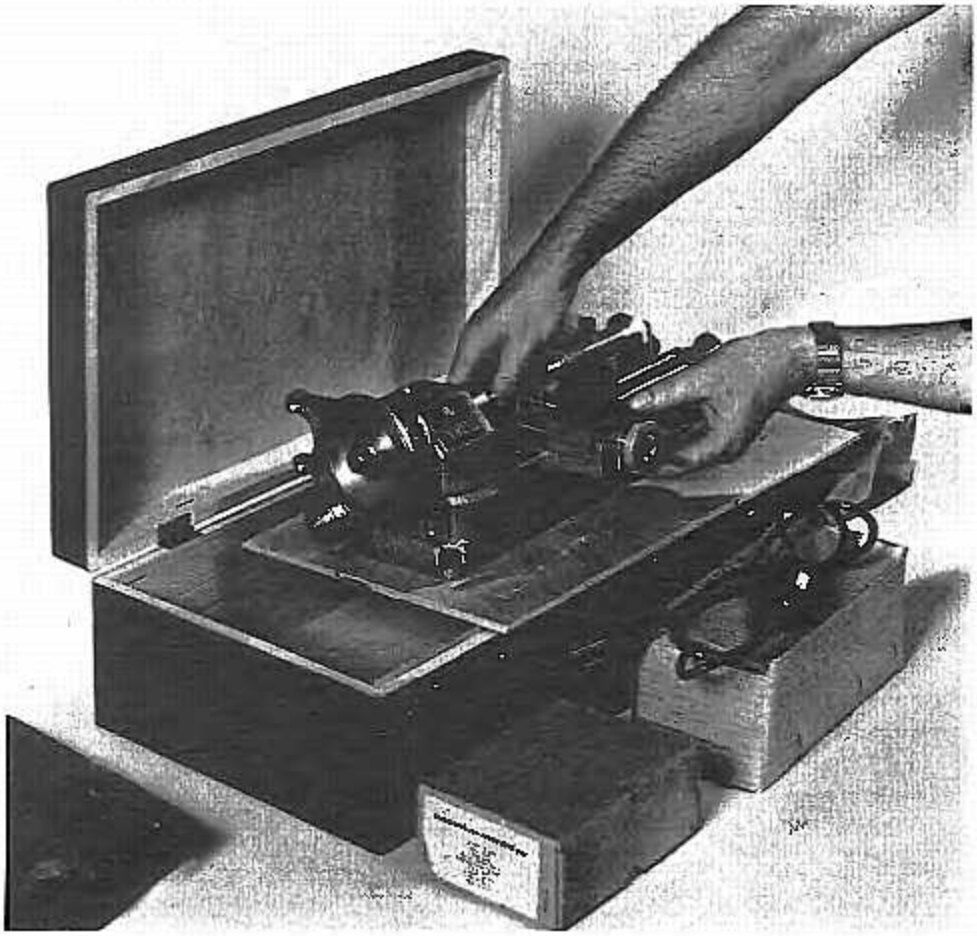
A COMPLETE MACHINE SHOP IN A BOX

- 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
- M. Grinding Wheel Arbor
- N. Face Plate
- O. Lathe Dog
- P. Dead Centers (two)
- Q. Slotted Adapter
- R. Spindle-feed Hand Lever & Pinion
- S. Set of Drive Belts
- T. Allen Wrench
- U. Headstock Alignment Pin
- W. 44 Page Instruction Manual
- X. 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.





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.

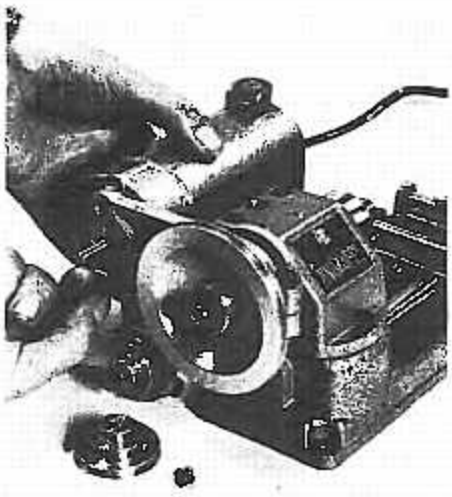
The motor bracket, which clamps on the spindle cartridge, can be positioned as desired to raise or lower the motor. Whenever the motor bracket's clamp screw is loosened, however, the coil spring that retracts the spindle cartridge pushes the bracket

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

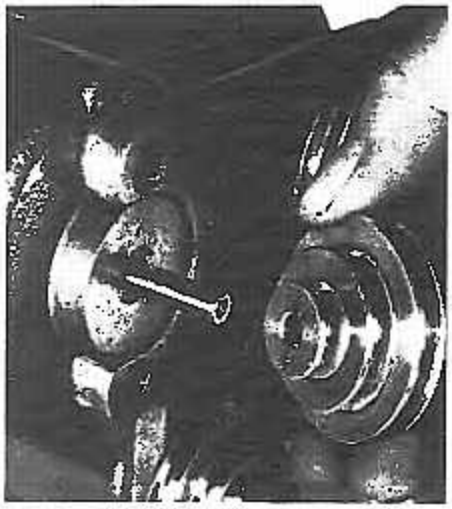
against the inner face of the spindle pulley, and this will prevent the pulley from turning. Slight clearance between bracket and pulley—about .010", or the thickness of tin can stock—is required to allow the pulley to turn freely. To adjust this clearance, first fully retract the spindle cartridge in the headstock with the ball-handled pinion lever . 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 ( ), 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.

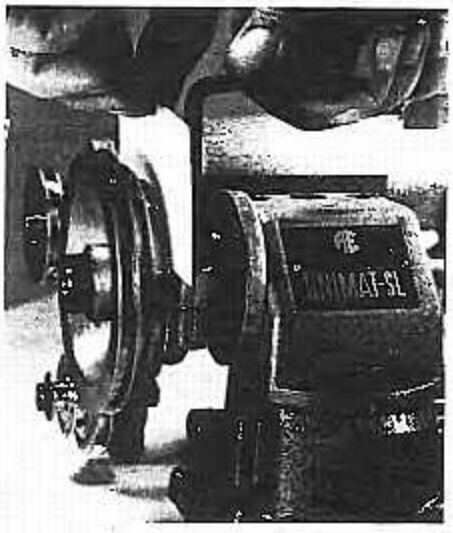
When you have your machine set up, familiarize yourself with its operating controls. Turning the longitudinal feed screw's calibrated handwheel slides the lathe carriage back and forth along the ways. When a cutting tool is mounted on the carriage, the longitudinal feed moves the point of the tool along 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.

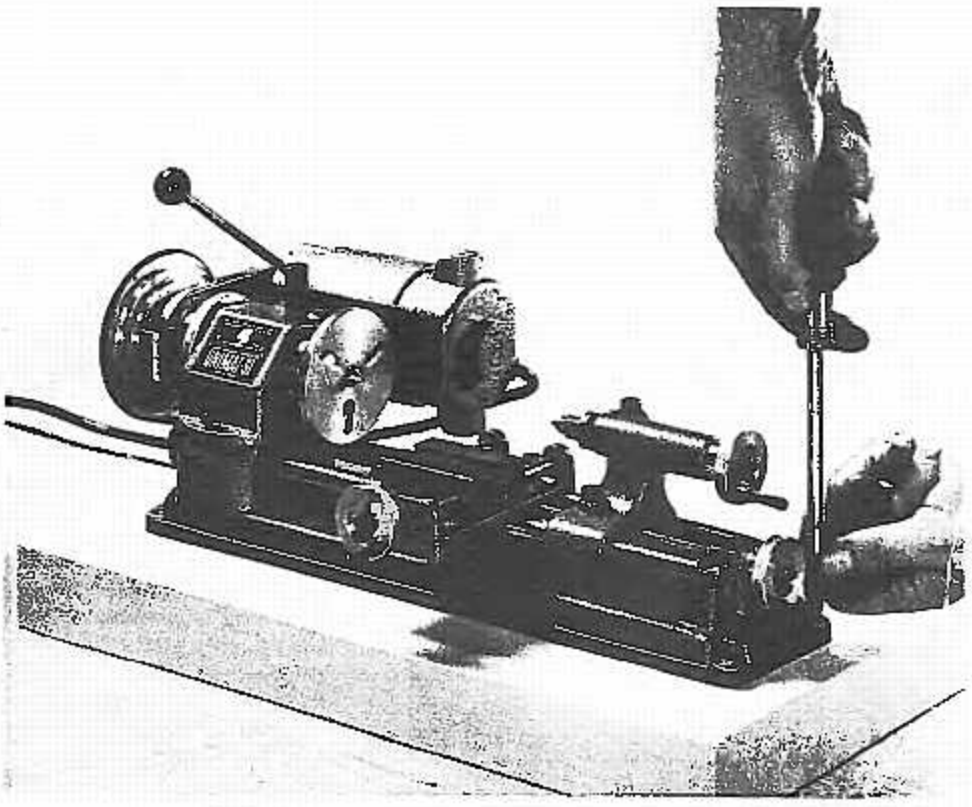
Both longitudinal and cross feeds have Allen-head tensioning screws. When fully tightened these screws lock the feed movements. When partially tightened they tension the movements to provide the sliding action desired—tighter or freer.

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



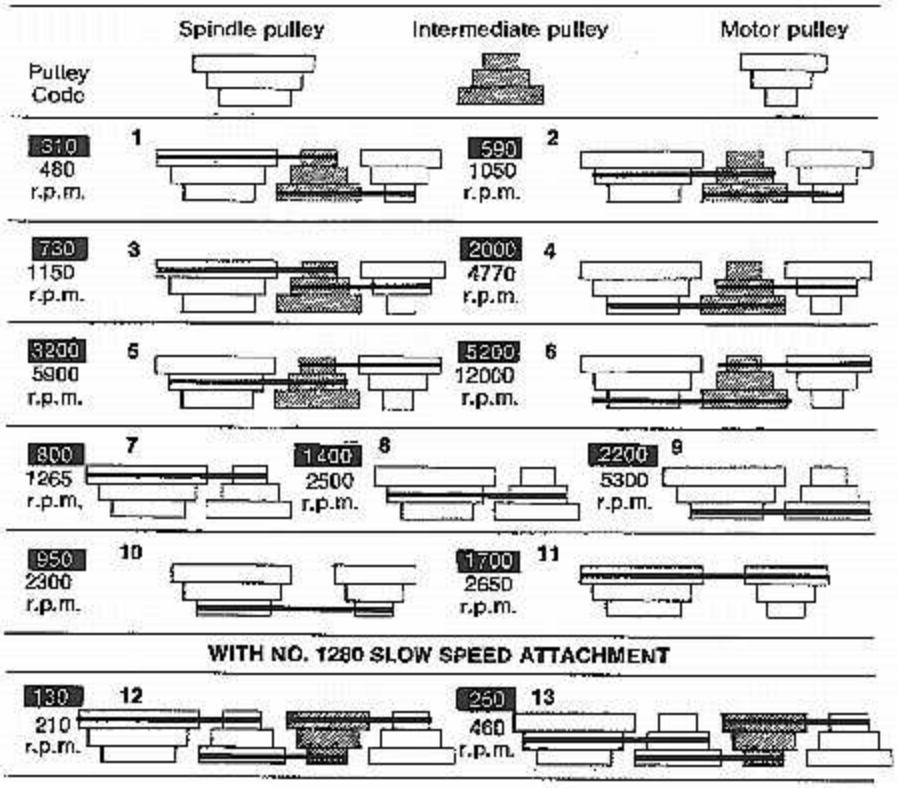
CLEARANCE is required between motor bracket and spindle step-pulley.



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)

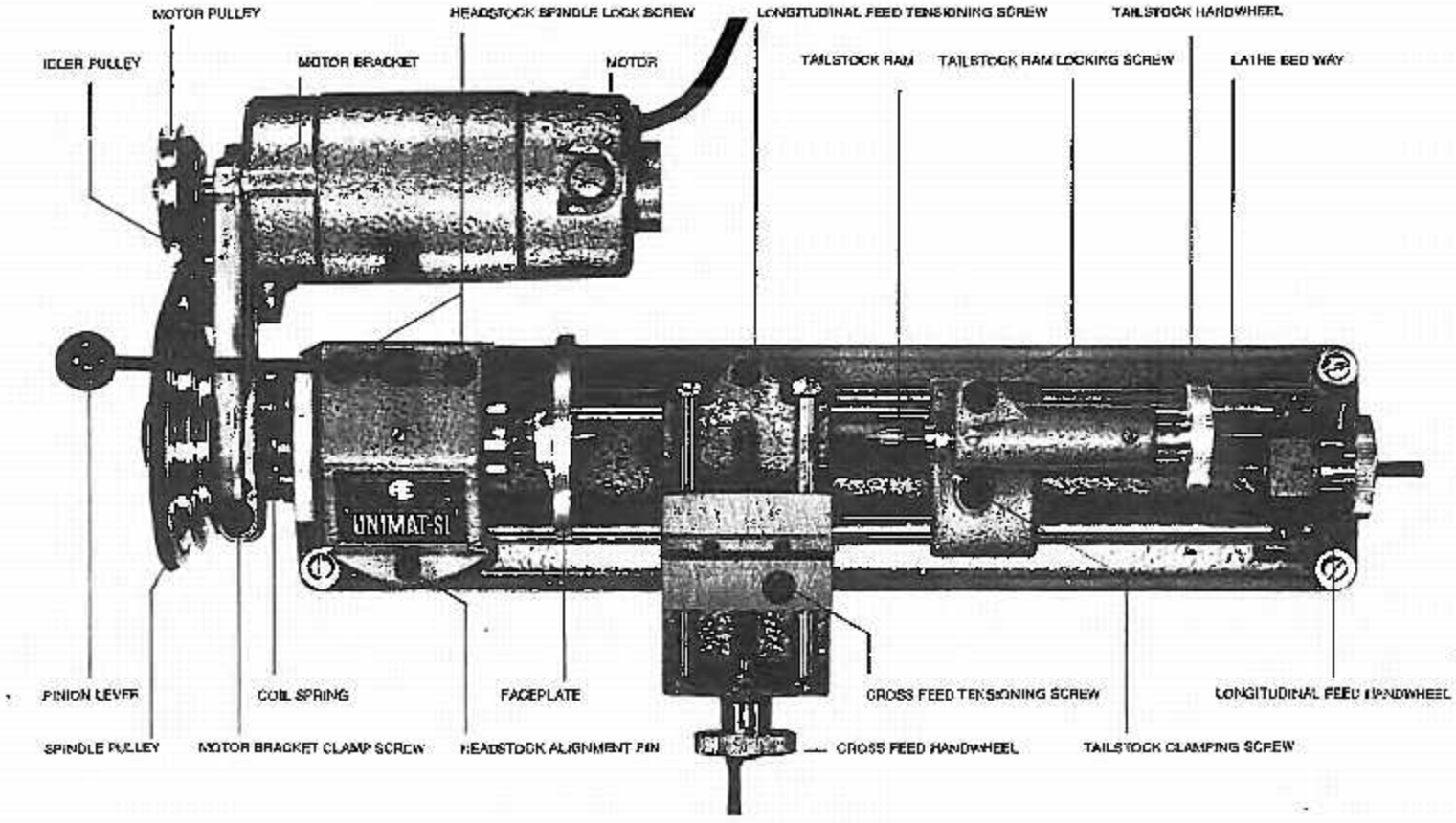


brush the tool clean with a paintbrush. After each use oil the ways and wipe down all bright working surfaces with the machinist's best friend, an oily rag, to prevent rust. Keep the tool's feed screws clean, and lubricate them regularly with light machine oil.

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.

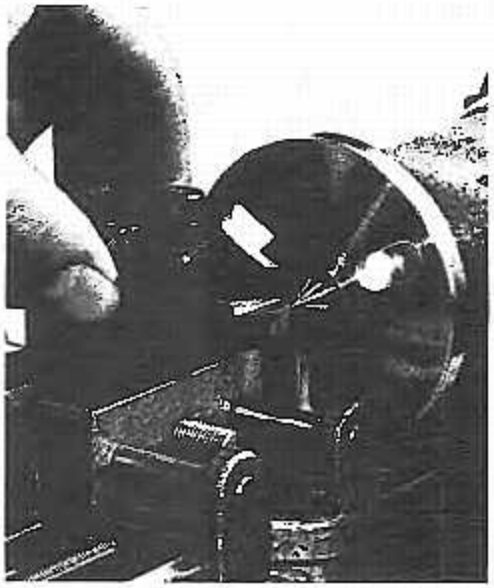
Before attempting critical work with your Unimat, however, it's advisable to try some practice turning on scrap stock to get the "feel" of the machine. If you've never before used a metal lathe, you'll find this a revealing experience. Aluminum is perhaps the most suitable metal for practice turning, 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.

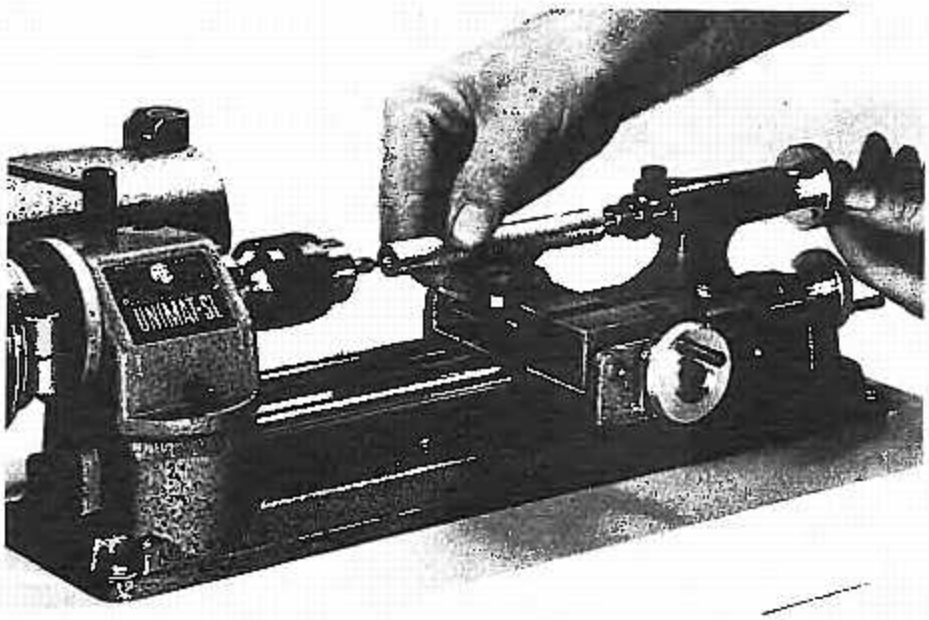
The dog supplied with the Unimat will drive work up to ½" in diameter. For larger

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

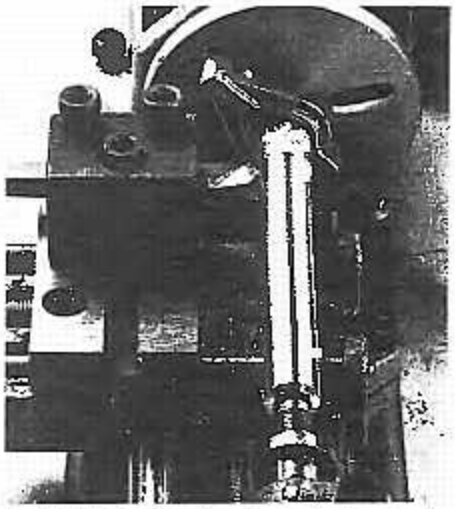


THE TOOL BIT'S POINT must be at exactly center height. Align tool with point of center.

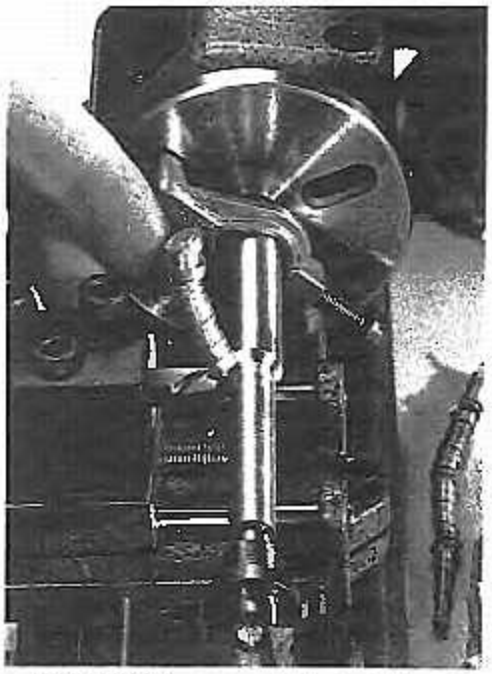
LUBRICATE THE DEAD CENTER with light machine oil and adjust it carefully.



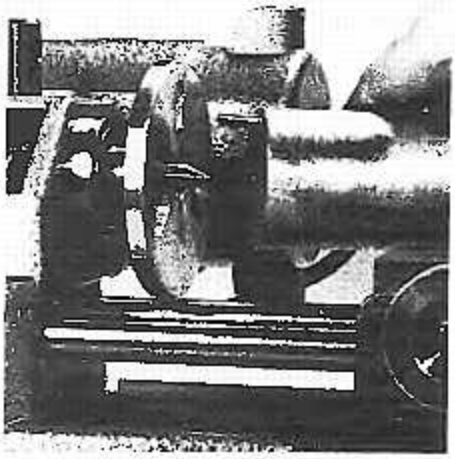
CENTERDRILL THE STOCK with a 60° countersink centerdrill chucked in the drill chuck. Feed the work to the rotating drill with the tailstock's handwheel.



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.

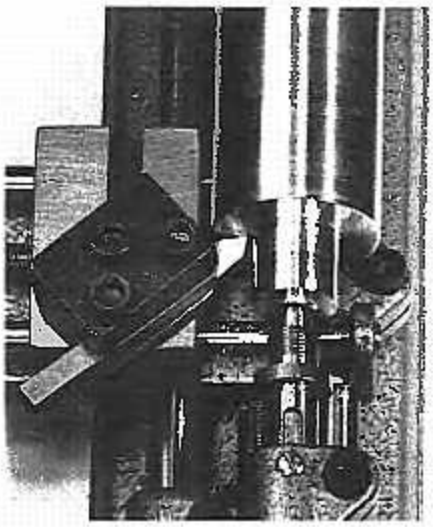
While camera and instrument parts are made to the metric system of measurement, for other work you'll want to use inch-system measurement, measuring in thousandths of an inch. With the Unimat this is no problem. One millimeter equals .03937", or (rounded off) .040". One full turn of either feed handwheel 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.

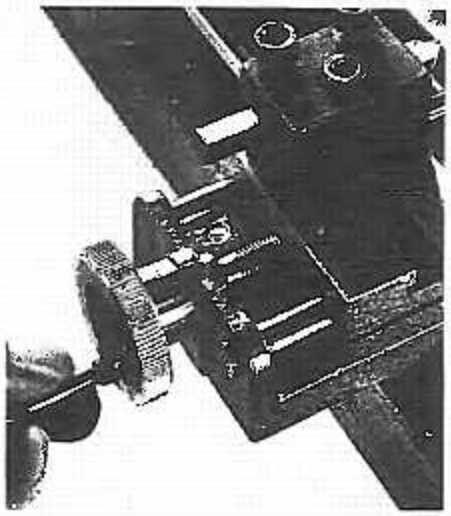
CUTTING TOOL TECHNIQUES

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".