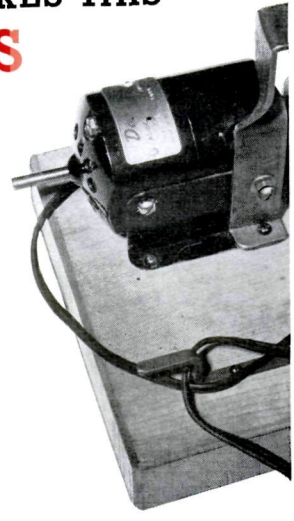
KIT OF 12 CASTINGS MAKES THIS

MODELMAKER'S METAL LATHE

By Howard Natter



IT TAKES A LATHE to make a lathe and that's why this little modelmaker has become a standard shop project, for teaching machine-shop students at Stuyvesant High School in New York City, the basics of metal turning. Each boy makes his own lathe, machining the castings as well as the rest of the parts on a classroom lathe, and from this one project he learns the fundamentals of lathe setups and practices, ending up with a lathe he can use.

For the man with a lathe it makes an interesting project which he can put to work in modelmaking. For the boy who is taking a machine-shop course at school, it makes an excellent class project. The set of twelve grey-iron castings are available from Honacast, 185 Grand View Blvd., Yonkers, N.Y. for $9.95 F.O.B.

Your very first step is to make a master drilling template from flat steel. This is used to spot the holes in the headstock, tailstock, ways support and carriage to assure they will be spaced identically in all four

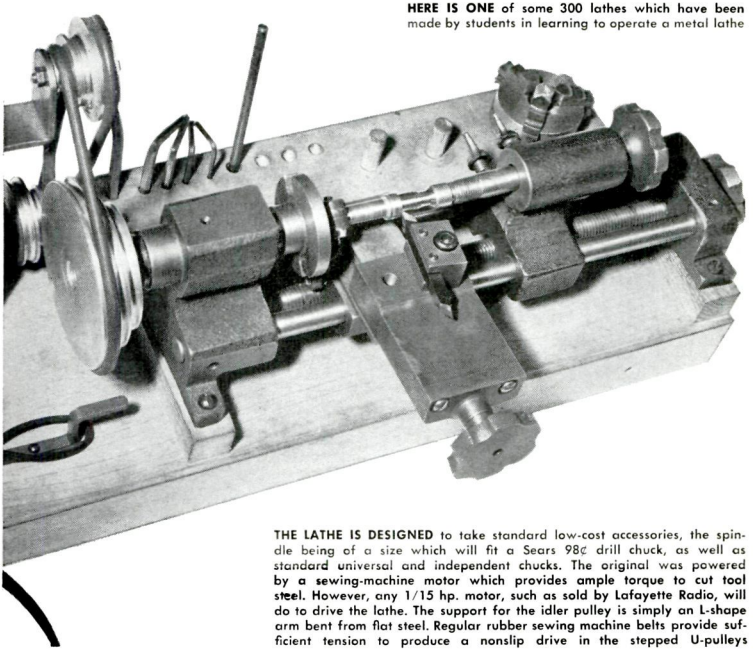
castings. A full-size pattern of the template is given on page 184. Here the dotted outline of the headstock merely serves to show the position of the holes in relation to the casting—your template need only be square.

Begin by marking the spindle hole on the rough headstock with a center punch, and mounting the casting in a 4-jaw chuck. Face off the end with two cuts, taking off the scale with one, following with a light $\frac{1}{32}$-in. finish cut. Now with the casting still chucked, drill the spindle hole to $\frac{15}{32}$ in., starting with a center drill, then switching in succession, to $\frac{1}{4}$, $\frac{3}{8}$, $\frac{7}{16}$ and $\frac{15}{32}$-in. bits. Finish up by reaming to $\frac{1}{2}$ in.

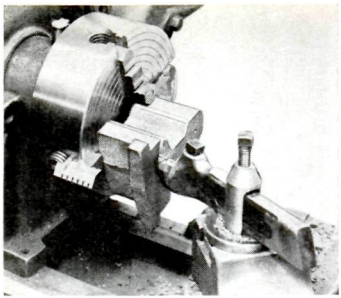
Turn the casting end for end in the 4-jaw chuck and use shims, or a piece of drill rod in the spindle hole, to chuck the casting squarely. Face off the rough end as before, cutting $\frac{1}{32}$ in. below the scale.

Remove the casting from the chuck and use the template to locate one of the way holes. This is done by inserting a locating plug in the casting's spindle hole and placing the template over it. With the template

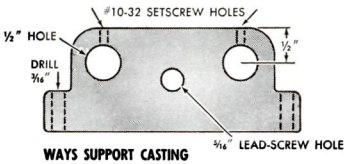
HERE IS ONE of some 300 lathes which have been made by students in learning to operate a metal lathe



THE LATHE IS DESIGNED to take standard low-cost accessories, the spindle being of a size which will fit a Sears 98¢ drill chuck, as well as standard universal and independent chucks. The original was powered by a sewing-machine motor which provides ample torque to cut tool steel. However, any 1/15 hp. motor, such as sold by Lafayette Radio, will do to drive the lathe. The support for the idler pulley is simply an L-shape arm bent from flat steel. Regular rubber sewing machine belts provide sufficient tension to produce a nonslip drive in the stepped U-pulleys



SCALE IS BEING REMOVED from face of rough headstock casting held in 4-jaw chuck. It's then turned end for end in chuck to face off opposite side. First bite should cut below scale to save cutting edge



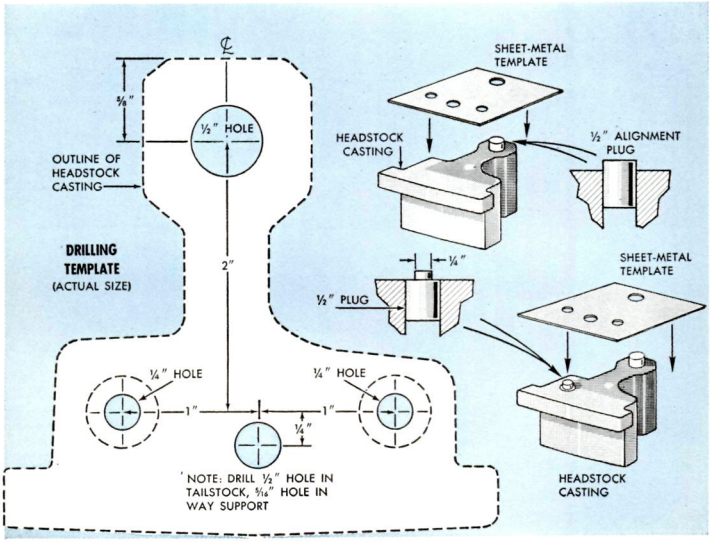
WAYS SUPPORT CASTING

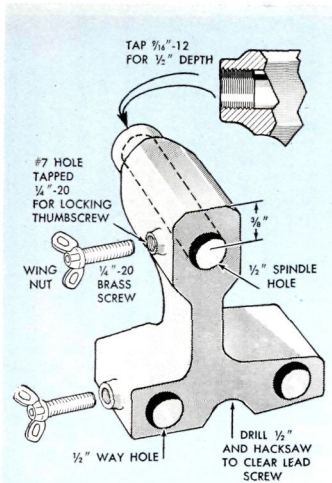
in position and the casting clamped to the drill-press table, drill a ¼-in. pilot hole all the way through. Then remove the template and enlarge the hole with progressively larger drills, finishing up with a ½-in. drill or reamer. Make sure this hole will be parallel with the spindle hole by first checking the squareness of the drill-press table.

To drill the second way hole, repeat the steps, using a shouldered locating plug in the first way hole to align the template. Finally, drill holes in from the side and top for $^{6}/_{32}$ setscrews, and an oil hole down from the top. Set the headstock aside for the moment.

The initial headstock steps are repeated in machining the tailstock: Center-punch the spindle hole, chuck, face off the flat end of the casting and drill the ½-in. spindle hole. Turn the casting end for end in the chuck, being careful to see that the spindle hole is aligned perfectly, and thread the hole with a $^{9}/_{16}$-12 tap for a depth of ½ in. Then face off the end of the casting. Next screw in the tailstock bushing tight against the shoulder, drill out to $^{3}/_{8}$ in. and face off the bushing to ¼ in. from the shoulder.

To make this tailstock spindle bushing, mount hex stock in a 3-jaw chuck and turn to an O. D. of ¾ in. for a distance of $^{3}/_{8}$ in. Turn a recess $^{1}/_{32}$ in. deep and $^{3}/_{32}$ in.





TAILSTOCK CASTING

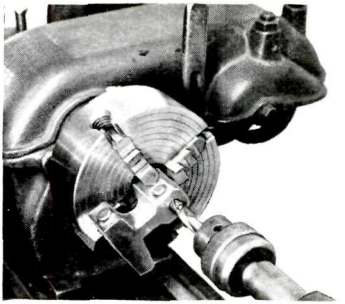
wide at the shoulder and run a 9/16-12 thread on the O. D. Finally, cut off the stock to make a bushing 11/16 in. long.

Remove the casting from the chuck and drill the way holes as before, first one and then the other. Here the drilling template is flipped over and the holes are drilled through from the rear side of it. As with the headstock, it is important to maintain the spindle hole parallel with the drill-press spindle.

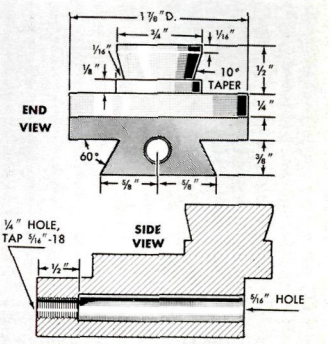
The leadscrew clearance hole on the underside of the casting is formed by locating with the template and drilling a ½-in. hole clear through after which the hole is cut V-shape with a hacksaw. The tailstock is completed by drilling #7 holes for locking setscrews and tapping ¼-20.

The rough support casting for the two ½ x 12-in. drill-rod ways is faced off on each side by mounting in a 4-jaw chuck and taking off the scale as before. Then with the work chucked so the jaws bear against the machined faces, the bottom of the casting is faced off. Now, using the drilling template once more, center punch and drill one way hole, following the steps already given, then drill the other. Now punch and drill the lead-screw hole, and complete the support by drilling and tapping the setscrew holes in the top, and drilling the holes in the shoulders.

Next comes the compound rest. First

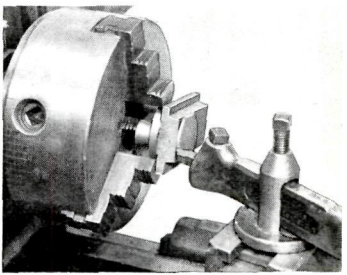


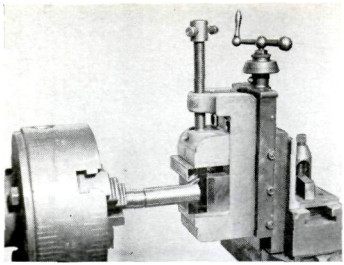
AFTER END OF TAILSTOCK casting is faced off smooth, spindle hole is center punched and bored with progressively larger drills chucked in lathe tailstock



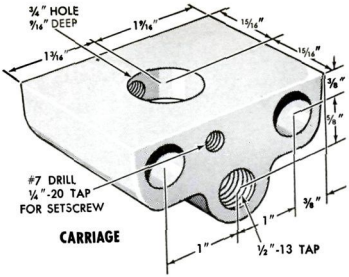
COMPOUND REST CASTING

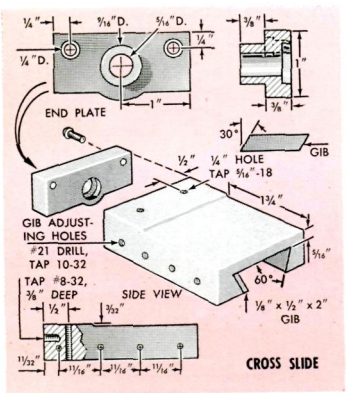
THREE-JAW CHUCK holds top of compound-rest casting for facing off the bottom. Work is then mounted in lathe milling attachment for dovetailing





HERE IS THE SETUP for forming the dovetail way in the cross slide by using flycutter mounted in chuck

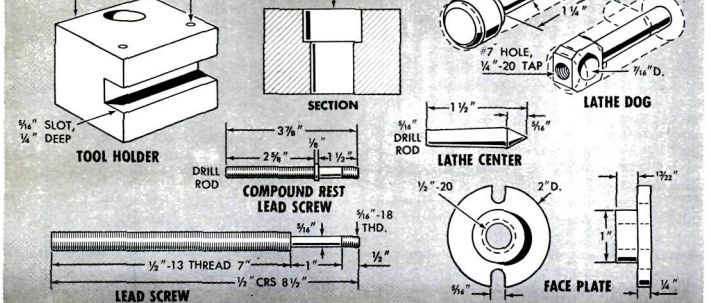


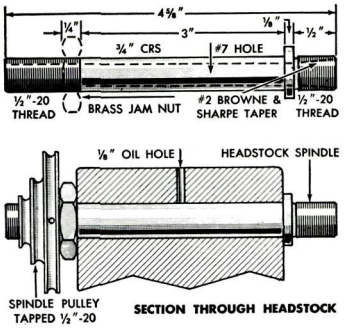


chuck the casting and face off the bottom, then turn it end for end and face off the top of the large diameter hub. Shift the casting in the chuck so the large hub is centered and turn it to a 1⅞-in. diameter. Next mark the center of the smaller swivel hub with a center punch and again shift the casting to center the mark and bring the shoulder parallel with the face of the 4-jaw chuck. *With this done, turn the* swivel hub to ¾ in. diameter, and machine the 1⅞-in. hub to a finished height of ¼ in., plus or minus .010 in. The swivel hub has a finished height of ½ in.

Cut a 10-degree taper on the hub for a depth of 5/16 in. This will leave a 1/16 x ⅛-in. shoulder at the base. Face off the other surfaces of the casting by clamping the chuck jaws against the machined surfaces. Finally, mount the work so the jaws grip the 1⅞-in. hub so you can machine the bottom to a final thickness of ½ in.

Now lay out and scribe dovetails on the square end of the casting and clamp it in

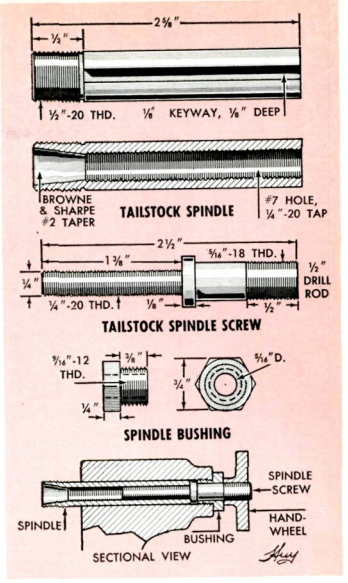




the vise of a milling attachment mounted on the lathe cross feed. With a boring bar chucked in the headstock and fitted with a tool bit that's ground to cut a 60-degree dovetail, run the lathe at low speed and cut one side of the dovetail. If possible, cut through the scale in one cut as this will keep the tool bit sharp longer. Use a fine feed, with the carriage locked, and tighten the gibs to limit backlash. If there is insufficient adjustment in the vise of the milling attachment to let you raise the work enough to cut the second dovetail side without disturbing the setup, you must take care, when you invert the casting in the vise, to maintain perfect alignment; the dovetail sides must be precisely parallel. Complete the compound rest by center-punching and drilling the hole for the cross-slide lead screw. Drill all the way through with a 1/4-in drill first, then finish up with a 5/16 in. drill, stopping the drill 1/2 in. from the far end of the hole. The remaining portion of the initial 1/4-in. hole is tapped 5/16-18.

All six faces of the cross slide are machined first. Then the mating dovetail for the compound rest is scribed on one end of the casting and cut as before with a flycutter. When this is done, remove the work and center-punch, drill and tap the four holes along one side for the gib adjusting screws. Next lay out, punch, drill and tap the 1/4-in. holes for the tool holder. Set aside the cross slide and machine the end plate next. Mark the center of the hub and chuck the casting for turning the hub and shoulder to size. After this, switch to a 3-jaw chuck to hold the machined hub for facing off the back of the end plate, parallel to the front.

Drill a 3/16-in. hole concentric with the hub, using a 1/4-in. drill first, and then



counterbore it with a 9/16-in. drill for a depth of 1/8 in. After drilling the 1/4-in. holes in the end plate, use the latter as a guide in drilling mating #7 holes in the cross slide itself. Note that the 1/4-in. holes in the end plate are counterbored 1/8 in. for screw heads. Now with the end plate attached to the cross slide, mount the assembly in the lathe milling attachment and relieve the top of the casting 3/32 in. with an end mill or flycutter. The edges of the end plate are filed smooth.

Now for the carriage: First mark the location of the compound-rest bearing hole and chuck the casting in a 4-jaw chuck so the mark is centered. Face off the top surface 1/16 in. below the scale. Now with the casting still chucked, center drill and bore a 3/4-in. hole 9/16 in. deep to mate with the swivel hub. It should be a tight sliding fit. Next face one end of the casting so it is square with the top surface, then turn it end for end and face off the opposite end so it is parallel with the first. Remove from the chuck and locate one way hole with the template. Drill as before, then form the second hole. Use locating plugs in the way holes, place the template over them and drill a 1/4-in. pilot hole for the lead screw. Enlarge the pilot hole to 7/16 in.,

then thread it with a ½-13 tap. Finish up by drilling and tapping setscrew holes.

To make the 8½-in.-long lead screw, use a lathe dog and faceplate to mount the stock between centers. Thread the rod for 7 in. by chasing or using an adjustable die, well lubricated. Remove the work and reverse it between centers by using two ½-13 jam nuts on the threaded portion to serve as a drive and to protect the threads. Turn the remaining 1½ in. to a 5/16 in. O. D. and thread the end for ½ in. with a 5/16-18 thread for mounting a handwheel.

To turn the tailstock-spindle screw, center drill both ends of a 2½ in. length of ½-in drill rod. Mount between centers and turn to ¼ in. O. D. for 1⅜ in., then thread ¼-20. As was done with the lead screw, run nuts on the threads, turn the work end for end and turn the rest of the spindle screw to 5/16 in. O. D., leaving a ⅛-in. shoulder with an O. D. of ½ in. Thread the end for ½ in. to fit a 5/16-18 tapped hole in the handwheel.

Turning Headstock Spindle

The headstock spindle is made by center-drilling both ends of ¾-in. CRS or oil-hardening tool steel and mounting it between centers. Turn to ½ in. O. D. for 3 in. to fit the headstock spindle hole smoothly and without play. Thread the end for 1 in. with a ½-20 thread. Remove the work and run a brass hex nut against the shoulder of the thread until it locks, but not too tightly. Remount and face both sides of the nut to a ¼ in. thickness. The nut serves as a thrust washer and is used to take up spindle end play. Remove the work and run a second nut against the first, so the lathe dog won't mar the threads, and remount between centers, end for end. Turn down the end to ½ in. O. D. for ½ in., leaving a ⅛-in. shoulder. Cut a 1/32 in. recess adjacent to the shoulder as before and thread the end with a ½-20 thread. Now remove the nuts from the spindle and mount it in a 3-jaw chuck, protecting the threads with soft-metal shims. Drill a #7 hole all the way through the spindle, starting with a small drill. The Browne and Sharpe #2 taper is cut in the end of the spindle on the lathe itself, when assembly is complete. This assures accuracy and concentricity.

The tailstock spindle is made similarly from the same kind and size material. It should be noted that the length given for the spindle in the drawing is its finished length. However, to provide for mounting the spindle in the headstock for cutting the inside taper, it must measure at least 1-in. longer than its finished length so it can be threaded at both ends like the headstock spindle. As with the headstock spindle, the Browne and Sharpe #2 taper is left until later when it is cut by inserting the spindle in the headstock of the completed lathe. At that time, the opposite end is chamfered and the #7 hole is threaded with a ¼-20 tap until it meets the taper. The last step is to mount the spindle in the milling attachment, and with a ⅛ in. milling cutter, or a modified drill bit, cut a longitudinal groove ⅛ in. deep all the way to the shoulder. Note: If oil hardening steel is used for the head and tailstock spindles, harden it by tempering to a light straw color.

Compound-Rest Lead Screw

The compound-rest lead screw consists of a length of ½-in. drill rod, 3⅞ in. long. Center-drill both ends, mount between centers and turn to a 5/16-in. O. D. for 2⅝ in. Then thread 5/16-18, using a threading tool or a die and stock. Run two nuts on the threaded portion, reverse between centers and turn to 5/16 in. O. D., leaving a ⅛-in. shoulder. Complete by threading the end 5/16-18 for a distance of ½ in.

The two lathe centers are turned from lengths of 5/16-in. drill rod chucked in a 3-jaw chuck. Set the lathe compound rest to cut a 1/12-degree taper (½ in. per ft.) and machine taper the rod for 1 in. from a point 5/16 in. from the end. Cut off at the taper's end and turn the points later.

A 1-in. length of ¾-in.-square steel is needed to make the tool holder. Face off the ends in a 4-jaw chuck; then with the work mounted in a milling attachment, mill a slot 5/16 in. wide and ¼ in. deep with a ¼-in milling cutter. Lay out, punch, drill and tap for 8/32 setscrews, and finish up by drilling the 5/16 in. tool holder locking-screw hole, counterboring it with a 7/16 in. drill for a depth of ¼ in.

Three Handwheels Required

All handwheel castings are machined alike in a 3-jaw chuck. Turn the hubs to 9/16 in., and face the ends and shoulders. Center-drill and bore a ¼-in. hole in each, tap 5/16-18 clear through. Reverse the work in the chuck to machine the outer diameters and face. Finally, drill and tap for 8/32 setscrews. In the case of the lead-screw handwheel particularly, you can add a crank-type handle to it to make it easier to turn on long cuts.

The round-belt grooves in the three-step spindle pulley are cut with a round-nose tool having a ⅛-in.-radius. First chuck the casting in a 3-jaw chuck and face the end. Follow by center-drilling and boring with a 7/16-in drill, then thread with a ½-20 tap. Now mount the work on a threaded arbor (a bolt will do) and turn

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Modelmaker's Metal Lathe

(Continued from page 188)

the second face and O. D. of the pulley steps, then turn the belt grooves.

Two additional three-step pulleys will be needed for the motor and the idler to increase speed selection. Make these from 1½ or 2-in. round stock (steel, aluminum or brass) and cut three steps, allowing ⅜ to ⅝ in. between steps. Drill a hole in one to fit the motor shaft, the other to fit the idler bearing. Drill a #7 hole in the groove of the middle step for a locking setscrew.

The compound rest has to have a gib to take up play in the dovetail. This is simply a 2-in. strip of ⅛-in. flat steel that's filed to a 30-degree angle along its two edges to fit one side of the dovetail. Locate the four adjusting screws on the gib and spot-drill to a depth of 1/16 in. These dimpled holes keep the gib from shifting.

Thumbscrews for locking the tailstock to the ways, as well as the spindle in the tailstock, are made from ¼-20 x 1-in. brass screws with the heads cut off. Wing nuts are peened to the ends of the screws after first turning a ⅛ x ⅜-in. tenon at one end.

There's a Blank for Faceplate

The kit of castings includes a blank for making your own faceplate. Start by drilling a hole in the center and treading with a ½-20 tap. Follow by mounting the work on a threaded arbor, like you did with the spindle pulley, and turn the blank to the dimensions given. The two slots are cut in the edges by drilling 5/16-in. holes and then hacksawing in from the edge.

To make a campanion lathe dog to fit the faceplate, center-drill both ends of a 2-in. length of ¾-in. round stock and turn to a 5/16 in. O. D. for a distance of 1¼ in. Reverse the work between centers and turn chamfers on the ¾ in. O. D. portion of the turning. After forming two flats on opposite sides of the chamfered hub with a hacksaw or file, drill a 7/16-in. hole through it crosswise and file a square corner in one side of the hole as detailed. Follow by drilling and tapping a hole in the end for a ¼-20 setscrew. Complete the dog by placing the end of the turning in a vise and bending it 90 degrees to fit the faceplate grooves.

Now you're ready to assemble the parts. Insert the drill-rod ways in the headstock and lock with the setscrews. Slide the carriage on the ways and fit the support casting over the ends. If the carriage is tight and difficult to move, remove it and enlarge the rear way hole with an expansive reamer until the carriage slides without binding. When satisfied, remove the way support and slide on the tail-

stock. If it doesn't slide freely, do the same with the rear way hole in it.

Now remove the way support so the lead screw can be inserted in the carriage, reassemble and add the handwheel to the end of the lead screw. Mount the assembly on a hardwood base, driving wood screws through holes in ¾-in. wood spacer blocks. Note that the way support should be mounted at the very end of the board so there's room for turning the handwheel freely. Do not "twist" the assembly in fastening it down; where this happens, use shims to level it. Assemble the compound rest and cross slide with gib in place, and add the tool holder.

Now with the motor belted to the idler pulley and from there to the spindle pulley, insert the tailstock spindle in the headstock to cut the Browne and Sharpe #2 taper. This is done by running the nut (borrowed from the headstock spindle) against the thread shoulder, passing the spindle through the headstock and turning it into the three-step pulley. Add oil to the oilhole and let the motor run for a few minutes. Grind a long ¼-in. tool bit to reach into the spindle 1 in. and clamp it in the holder. Adjust the compound rest to cut a ½-in.-per-ft. taper, and make it with a series of light cuts. The finished diameter at the start of the taper should be .300, plus or minus .020 in.

Now remove the tailstock spindle and shorten it to $2\frac{5}{8}$ in. Repeat the steps to taper the headstock spindle. Note here, however, that there is no extra threaded portion to cut off.

Turn the 60-degree points on the head and tailstock centers by swinging the compound rest around past center to feed the tool bit into the work properly. Finally, mount the faceplate on the spindle and check the compound rest for alignment. When aligned properly, scribe a witness mark on the $1\frac{7}{8}$-in. hub. Other important angles should be noted and marked on the hub at the same time. Your lathe is now completed. ★★★

Salt Plus Heat Equals Trouble

Cars parked in heated garages suffer greater damage from salt and other deicing chemicals than those parked in the cold, according to tests that were carried out by various government agencies in Ontario, Canada.

Further tests revealed little benefit from the use of inhibitors, which, it was found, don't eliminate all corrosion; they only retard the type of corrosion caused by salting. The report concluded that corrosion can best be controlled by the automotive manufacturers themselves.