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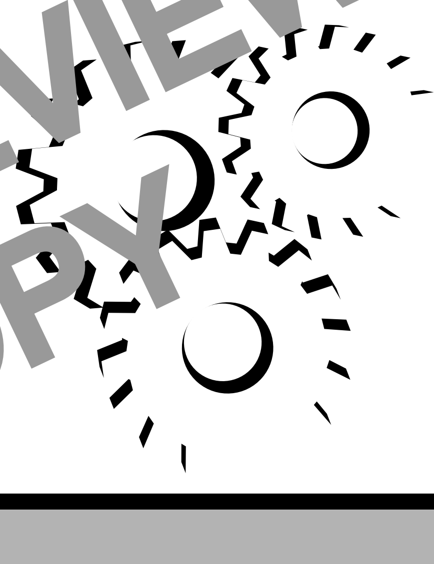
MACHINE SHOP PRACTICES

Lesson One

Lathes and Attachments



TPC Training Systems

31601

Lesson

1 Lathes and Attachments

TOPICS

Engine Lathes
Principal Parts of a Lathe
Lathe Capacity
Lathe Gearing
Lathe Drive Systems
Holding Work in a Lathe
Steady Rest
Follower Rest
Using a Lathe

OBJECTIVES

After studying this Lesson, you should be able to…

- Explain the function of each of the following lathe parts: lathe bed, ways, headstock, tailstock, carriage, compound rest, and spindle.
- Name the two dimensions usually used to describe lathe capacity.
- List and describe several methods of holding work in a lathe.
- Explain the function of a steady rest and follower rest.

KEY TECHNICAL TERMS

Lathe bed 1.05 major supporting structure for the moving parts of a lathe
Ways 1.06 highly accurate surfaces machined into or mounted on the bed
Headstock 1.07 cast housing containing a latheís gearing and drive components
Tailstock 1.08 supports one end of a workpiece
Carriage 1.09 travels on the ways between the headstock and tailstock
Feed rod 1.13 controls the feed of the tool into the workpiece

A lathe is probably the most useful and versatile machine in a maintenance shop. No shop can function properly without one—whether it is a simple engine lathe, a screw machine, or a turret lathe. To be a competent machinist, you must know how to use a lathe to make parts for repairing and maintaining a variety of manufacturing and processing machinery.

The focus of this Lesson is the engine lathe. It is the machine on which you'll be doing most of your work. All lathes look alike, and they all operate in more or less the same way. This means that you can apply the knowledge gained from this Lesson to almost all the lathes you may encounter in your work. The Lesson also describes how to maintain the lathe in good condition and operate it safely.

Engine Lathes

1.01 The name *engine lathe* is broadly used to describe almost any lathe in the maintenance shop. The term is a carry-over from the days when all shop machinery was powered by a stationary steam engine through a system of overhead line shafts and belting. Today most lathes that have self-contained drive motors are known as engine lathes.

1.02 A lathe is ideal for machining single pieces that require individual setups. You can use it to perform a great many maintenance tasks. Because of its simple controls and the variety of ways in which it can handle machine work, it is easy to operate once you learn the basic steps.

1.03 Most lathes are a lot alike because their basic parts are alike. The main purpose of a lathe is to reshape rough pieces of stock, called *workpieces*, into objects with round shapes and specific sizes. Basically, a lathe operates by rotating a workpiece while a sharp stationary tool shapes or turns the workpiece by removing material from it in the form of chips. In addition to turning, a lathe can also perform facing, boring, drilling, and reaming operations. Manufacturers often offer attachments that enable lathes to do milling, grinding, or other specialized work.

Principal Parts of a Lathe

1.04 Figure 1-1 on the following page shows the parts of a typical lathe. Study this photo carefully. Most lathes have all the parts shown, and in the approximate positions indicated. You should know the name and location of each part, as well as what it does.

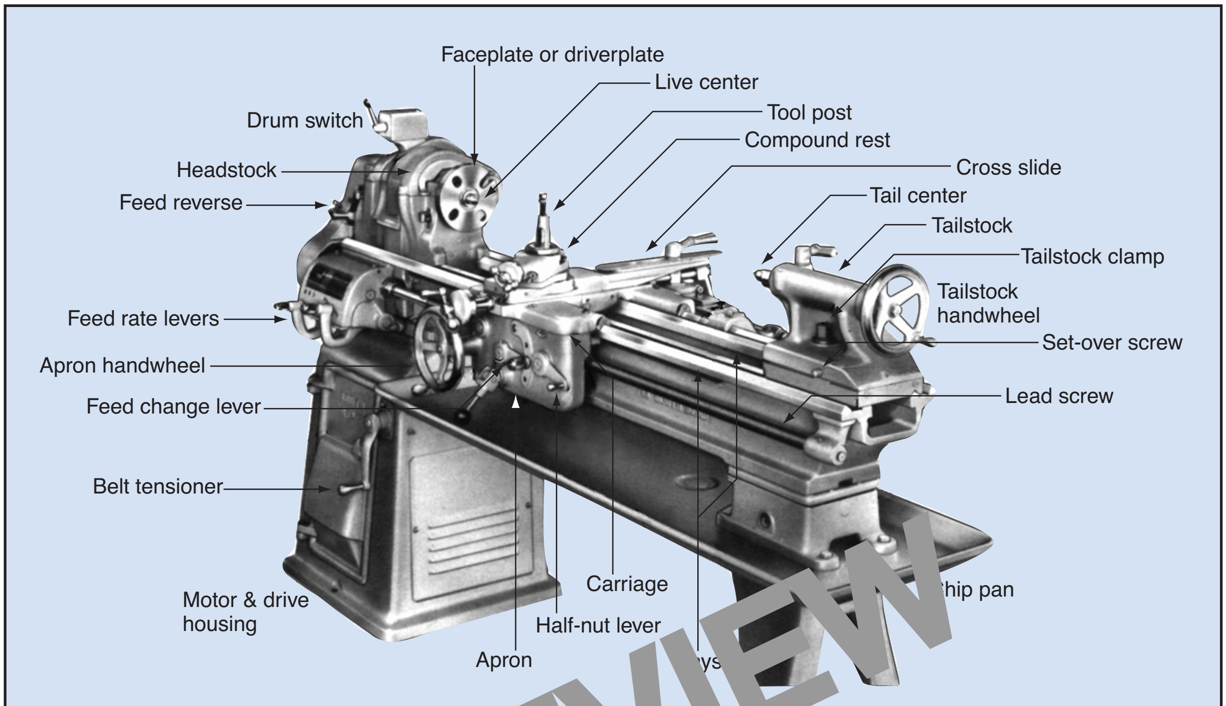
1.05 **Lathe bed.** The *bed* of a lathe is the major supporting structure for the moving parts of the machine. It is usually a very heavy casting. On smaller lathes designed to sit on a workbench or table, the bed may be the only support. The beds of larger lathes usually rest on cast or welded steel frames or legs secured to the floor. For example, the lathe shown in Fig. 1-1 is floor-mounted

1.06 **Ways.** Lathe *ways* are highly accurate surfaces machined into the beds of smaller lathes and mounted separately on the beds of larger ones. The ways serve to keep the lathe's headstock, tailstock, and carriage aligned. The tailstock is movable towards or away from the headstock on the ways during operation, and the carriage rides on the ways. Most lathe manufacturers harden and grind the ways for increased accuracy.

1.07 **Headstock.** The *headstock* (at the left in Fig. 1-1) is a cast housing that contains the lathe's gearing and other drive components. It supports two or more precision bearings whose bores are exactly parallel to the ways. These bearings, in turn, support the hollow spindle that drives the workpiece. The headstock never moves. It must keep the same position relative to the motor, which is usually in the headstock pedestal. Figure 1-2 on the following page shows the headstock in greater detail.

1.08 **Tailstock.** The *tailstock* (on the right side in Fig. 1-1) supports one end of a workpiece that is being turned between centers. Like the headstock, the tailstock is also a heavy casting. Most tailstocks have a handwheel to operate the retractable (moving in and out) center. The tailstock is movable lengthwise along the ways to support workpieces of different length.

Fig. 1-1. A lathe and its parts



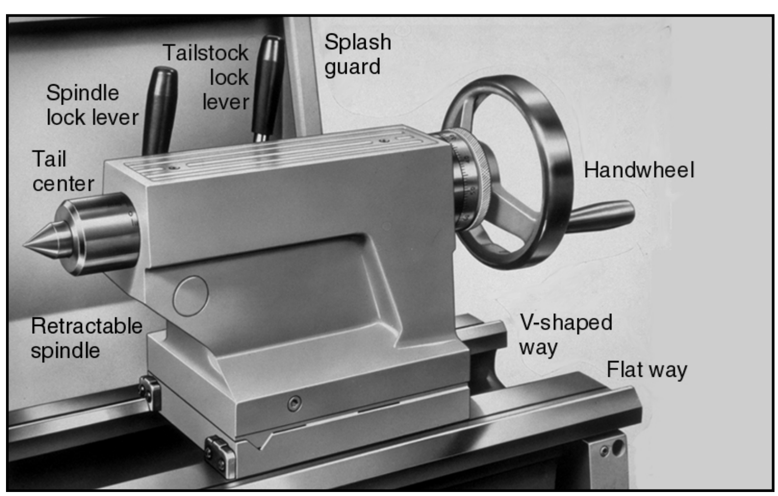
The tailstock also serves as a toolholder for certain drilling and boring operations. Always lock the tailstock in position before you start machining. Figure 1-3 is a detailed illustration of the tailstock.

1.09 **Carriage.** The lathe carriage, which consists of the *cross slide*, *saddle*, and *apron*, travels back and forth on the V-shaped ways between the headstock and tailstock. For turning operations, the carriage is connected to the *feed rod*. For threading, it is connected to the *lead screw*. For cross feeding, the *feed shaft* is connected to the cross slide by gears.

1.10 The carriage contains the clutch for engaging the feed shaft, and half nuts for engaging the lead screw. It also houses controls for longitudinal and cross feeding, and sometimes a control for reversing the carriage movement. The part of the carriage that hangs

Fig. 1-2. Details of the lathe headstock

Fig. 1-3. Details of the lathe tail stock



down over the front of the lathe bed is called the apron. Figure 1-4 shows a typical lathe carriage in detail.

1.11 **Carriage stop.** The *carriage stop* is usually mounted on the ways of the lathe as shown in Fig. 1-5 on the following page. You can position the stop anywhere along the ways to stop the carriage at a specific point. It is very useful when making several parts the same length. Instead of repositioning the tool after every operation, you simply set the stop once. If you are making several cuts on a piece, you can also use the stop to make the tool stop at the same point after each cut.

1.12 **Lead screw.** The *lead screw* is usually a very accurate Acme-thread screw driven by the headstock of the lathe. It is connected to the carriage through the apron. The lead screw is used only for thread-cutting operations, and should be disengaged from the carriage during any other operation.

1.13 **Feed rod.** The *feed rod* controls the (cross) feed of the tool into the workpiece and the (longitudinal) feed of the tool along the length of the piece. The rod, which is actually a splined shaft driven by the main gearing in the headstock, drives a worm gear in the apron. In some lathes, the lead screw and feed rod are combined into one piece.

1.14 **Saddle and cross slide.** The *saddle* rests on the lathe ways and guides the apron along the ways. The cross slide is mounted on top of the saddle. Its purpose is to feed the cutting tool into the workpiece at an angle of 90° to the axis of the lathe—primarily for facing and cutoff operations. Always use the cross slide to set the depth of cut for longitudinal turning.

1.15 **Compound rest.** The *compound rest* is mounted on top of the cross slide and travels along with it. The rest holds the cutting *tool post* or *toolholder* at the correct angle to the workpiece. Its base is graduated to make setting the angle easier, and it can be locked at the desired setting. In the United States, the most commonly used angular setting is 29 to 30° off the perpendicular of the carriage. This setting avoids interference between the hand cranks of the compound rest and cross slide.

1.16 **Tool post and toolholders.** The *tool post* is mounted on the compound rest (Fig. 1-4). A horizontal slot through the post is used to clamp the *toolholder* securely in place. Just insert the holder in the slot and tighten the locking screw on top of the post. Figure 1-6 on the following page shows three basic types of toolholders. Note that the cutting tool is held in place by a setscrew in the nose of the holder.

1.17 Before operating a lathe, be sure the tool is tight in the toolholder and the toolholder is tight in the tool post. Tools that are not supported properly or not clamped tightly can vibrate or slip, producing a poor finish and ruining your work. Also, you can be seriously injured if a loose tool flies out of the lathe.

1.18 **Spindle.** The *spindle* is located in the headstock and rotated by the lathe's power train. Its function is to hold and rotate the various work-holding

Fig. 1-4. Details of lathe carriage

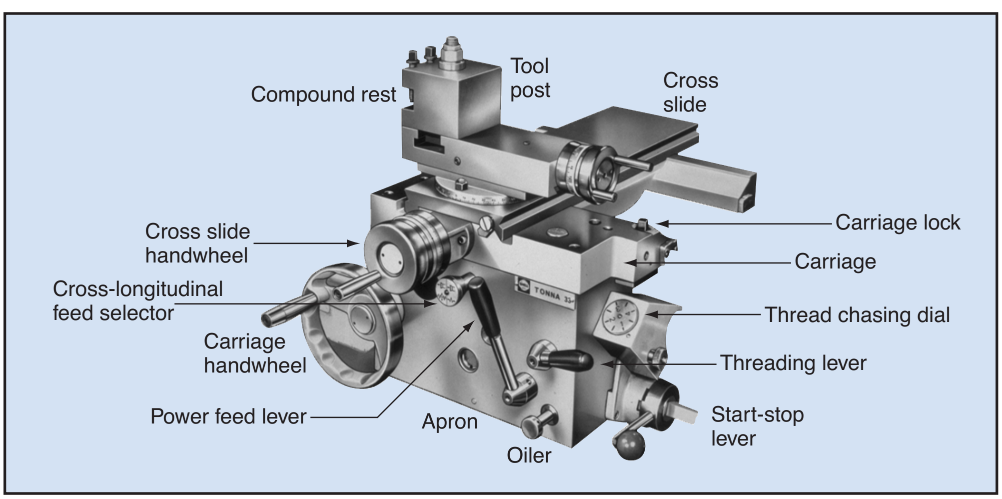


Fig. 1-5. Carriage astop location and construction

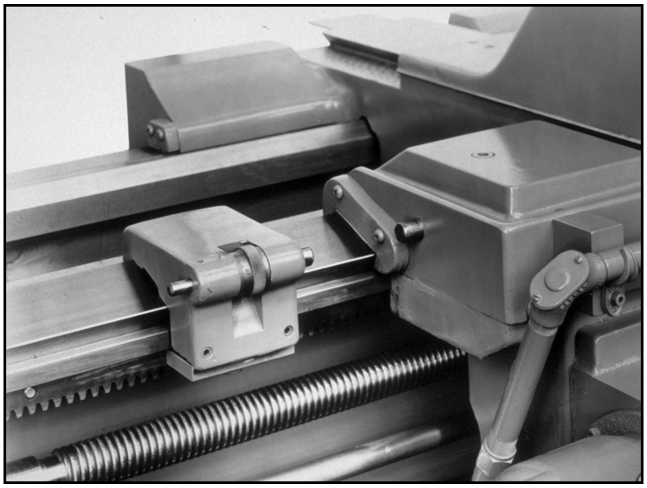
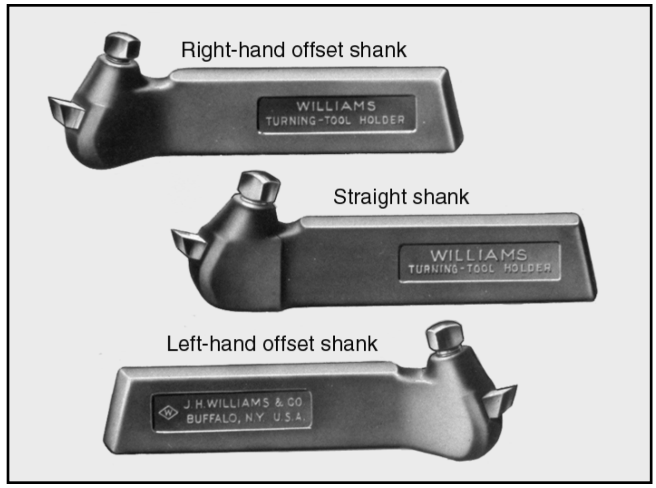


Fig. 1-6. Common types of lathe toolholders



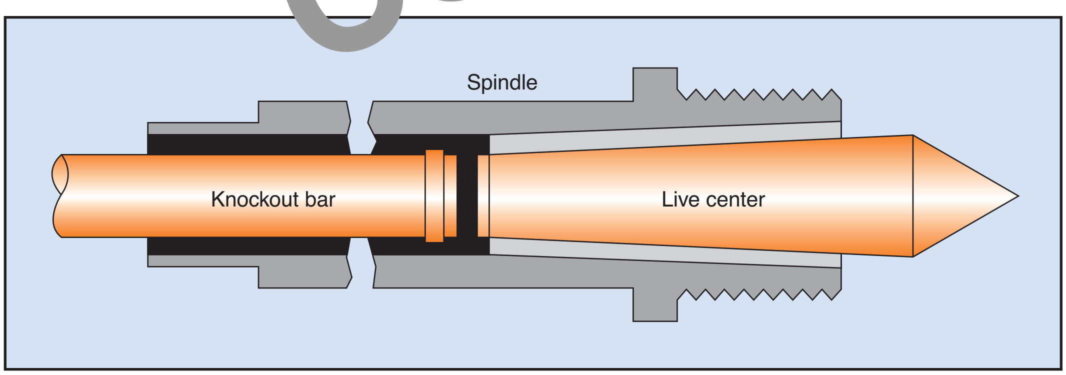
devices used on a lathe. Lathe spindles are hollow with internally tapered sleeves for holding tools and attachments with tapered shanks. A hole through the rear of the spindle permits the lathe to handle long workpieces. It also provides an opening for a knockout bar to remove tapered-shank tools as shown in Fig. 1-7.

Lathe Capacity

1.19 The capacity of a lathe is usually expressed by two dimensions, both given in inches. The first describes the *swing*, or diameter of workpiece the lathe can rotate. This distance is limited by the ways and cross slide of the lathe (Fig. 1-8). The second is the maximum length of stock that the lathe can turn between centers. It is somewhat shorter than the length of the lathe bed.

1.20 As an example, a 12 × 84 in. lathe can handle workpieces up to 84 in. long with diameters no larger than 12 in. Be sure to check swing and length when selecting a lathe for a job.

Fig. 1-7. A knockout bar in use



Lathe Gearing

1.21 Gears in the lathe's headstock control the speed of the lead screw and feed rod in relation to the speed of the spindle. The various gear ratios are obtained by shifting levers on the quick-change gearbox. An index or instruction plate on the gearbox tells you how to arrange the levers to obtain the desired power feed for various turning, boring, and facing operations.

Lathe Drive Systems

1.22 Many manufacturers build lathes, and each builder has his own special designs for lathe parts, especially drive components. In most lathes, a gear train or a belt drive transmits power from the motor to the various components. Be sure you understand the drive and gearing of the lathe you use. If you have any questions, read the lathe's operating manual provided by the manufacturer.

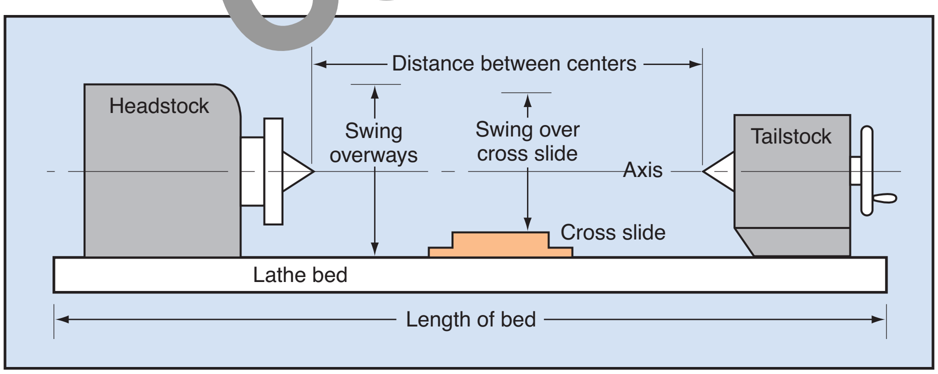
1.23 Some lathes are equipped with flat belts that transmit power to the spindle. To change the spindle speed, you must stop the machine and move the belt to the next step on the pulleys. (The driving pulley is the lower one, mounted in the leg below the headstock. The driven pulley is the upper one, attached to the spindle.) Before starting up the lathe again, be sure that the belt fits properly on the pulleys.

1.24 Most modern lathes have a geared drive system to transmit power to the spindle. To change the spindle speed, you need only to move the speed-change levers on the headstock. Medium-duty lathes often have infinitely variable speed drives that allow you to change the spindle's speed with the motor running.

1.25 Many lathes have a back gear. When necessary, you can engage this back gear in the lathe's drive train to slow down the spindle and obtain greater power. Of course, you should *never* try to engage the gear when the spindle is rotating. The location of the back gear varies with different manufacturers and you may have to check the lathe's operating manual to find it.

The Programmed Exercises on the next page will tell you how well you understand the material you have just read. Before starting the exercises, remove the REVEAL KEY from the back of your Book. Read the instructions printed on the Reveal Key. Follow these instructions as you work through the Programmed Exercises.

Fig. 1-8. Principal dimensions of a lathe



1-1. Today almost all lathes that have self-contained drive motors are called __________ lathes.	1-1. ENGINE Ref: 1.01
1-2. On a lathe, the tailstock and carriage are aligned with the headstock by means of the lathe's __________.	1-2. WAYS Ref: 1.06, Fig. 1-1
1-3. For turning operations, you should connect the carriage to the __________.	1-3. FEED ROD Ref: 1.09
1-4. The lead screw is used only for __________ operations.	1-4. THREAD-CUTTING Ref: 1.12
1-5. The tapered shanks of cutting tools are held in the hollow __________.	1-5. SPINDLE Ref: 1.18, Fig. 1-7
1-6. The lathe dimensions that limit the workpiece size are its distance between centers and its __________.	1-6. SWING Ref: 1.19, Fig. 1-8
1-7. The torque of the motor is transmitted to the spindle by gears or __________.	1-7. BELTS Ref: 1.23, 1.24
1-8. To slow down the spindle and obtain greater power, engage the __________ in the lathe's drive train.	1-8. BACK GEAR Ref: 1.25

Holding Work in a Lathe

1.26 The most common way to hold a workpiece in a lathe is to place it between the lathe's centers, or hold it in a chuck or on a faceplate mounted on the spindle. Sometimes (but not often) the workpiece is held on the lathe carriage, with the tool rotated in the spindle. No matter what method you use, you will probably need a number of lathe accessories and attachments. Some of these accessories you will need on almost every job. Others, such as mandrels, steady rests, and follower rests, are used less often.

1.27 The shape of the workpiece and what you plan to do to it determine how the workpiece should be held. As an example, if the piece is relatively long and you are going to reduce its diameter, mount it between the lathe's centers. If you must reduce the length or turn the face of the piece, clamp it in a chuck or, if its shape is irregular, mount it on a faceplate.

1.28 **Between centers.** Lathe centers (see Fig. 1-9) are pointed axle-like pieces that support the workpiece between the headstock and tailstock. The centers are tapered and fit into tapered holes in the headstock and tailstock. The accurately ground noses of the centers fit into centerdrilled, countersunk holes in the ends of the workpiece.

1.29 The center in the headstock (spindle) turns with the workpiece and is called the *live center*. The center in the tailstock is stationary and does not rotate. It is called the *dead center*, or *tail center*. The live center can be hardened or unhardened steel, but the tail center must be hardened steel to resist the heat caused by friction between the rotating workpiece and the stationary center. A hardened tail center usually has a groove machined in it just below its nose. Always keep the tail center lubricated with white lead paste or a commercial lubricant to reduce friction.

1.30 When you are turning a workpiece between centers, you must link it securely to the spindle so that the rotating spindle can drive it at the proper speed. The usual way to transmit the spindle's rotation to the workpiece is to use a *faceplate* with a *lathe dog*, as shown in Fig. 1-9. Depending on its design, the faceplate is either clamped or screwed on the spindle. Figure 1-10 on the following page shows three typical faceplates. Notice that each faceplate has a slot to hold the tail of a lathe dog.

1.31 Lathe dogs come in various shapes and sizes (Fig. 1-11 on the following page). To use a lathe dog, choose one that has a hole a little larger than the diameter of your workpiece. Slip the dog over the workpiece, but do not tighten it. Place the work between the lathe centers, and move the tailstock (with its spindle drawn in as far as possible) towards the work.

1.32 When the tail center almost touches the workpiece, lock the tailstock in position on the ways. Then advance the tail center into the center drilled hole in the workpiece, using the tailstock handwheel. Don't make the centers so tight that the work cannot move. You should be able to rotate the work slightly with your hand.

1.33 Now insert the bent tail of the dog into one of the slots in the faceplate, and tighten the screw to clamp the dog on the workpiece. Make sure the tail of

Fig. 1-9. Setup for turning a workpiece

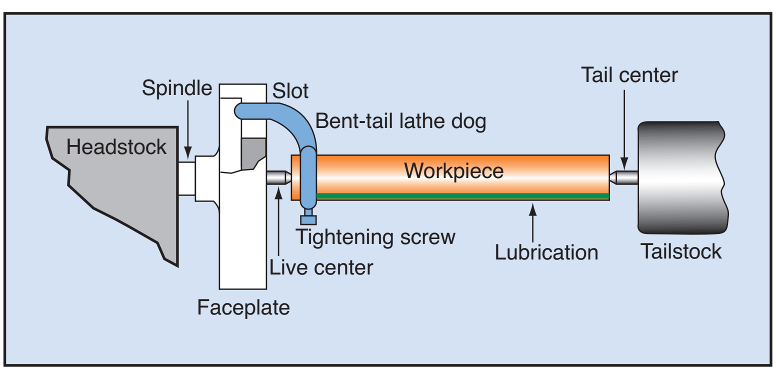
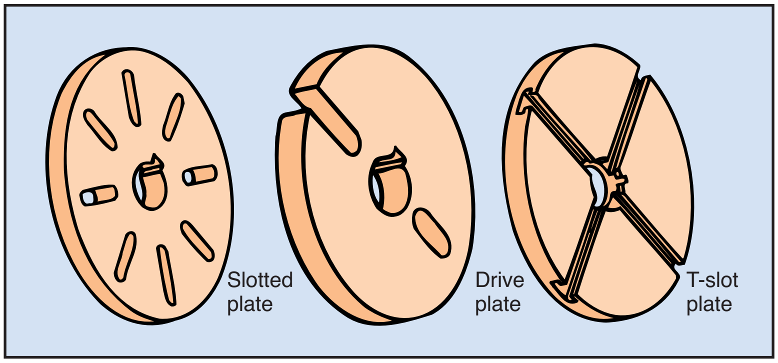


Fig. 1-10. Typical faceplates for a lathe



the dog doesn't bind, but is free to move in the faceplate slot. Neither should it hit the bottom of the slot. When you are sure that the setup is free of all interference, start the machine.

1.34 If the lathe dog clatters or clanks against the faceplate slot, the centers are too loose. Stop the lathe and tighten them. If the tail center heats up or squeals, the centers are too tight and should be loosened slightly.

1.35 If the center feels warm, Stop the lathe, check the lubrication in the workpiece's centerdrilled hole, and readjust the tailstock spindle. Check the center occasionally for tightness, because the heat of cutting makes the workpiece expand.

1.36 Some tailstocks have ball or roller bearings that allow the tail center to rotate with the workpiece . You don't have to lubricate tailstock centers equipped with bearings, because they rotate with the stock. Check them regularly for tightness, however. Also, all centers eventually become worn and chipped, requiring sharpening. Sharpening a center is a precision grinding operation usually done only by an experienced toolmaker. Once the center is sharpened, check it to make sure the nose angle has not changed—it should measure 60°.

1.37 **On a faceplate.** The easiest way to hold an odd-shaped workpiece that cannot be held between centers is to mount it on a faceplate. Many types of faceplate are available. Once you have selected the plate that best suits the job, inspect it to be sure it is flat, true, and free of nicks and chips. Clean its mounting surface, as well as the nose of the spindle, before mounting it. Faceplates have various patterns of hold-down bolts, clamps, and slots to handle workpieces with a wide variety of shapes and sizes.

1.38 Make sure that the faceplate is screwed or clamped tightly onto the spindle so it cannot work loose while rotating. Then clamp the workpiece firmly to the faceplate. Be sure everything is tight before starting the lathe. Remember, you can be hurt and the

Fig. 1-11. Types of lathe dogs

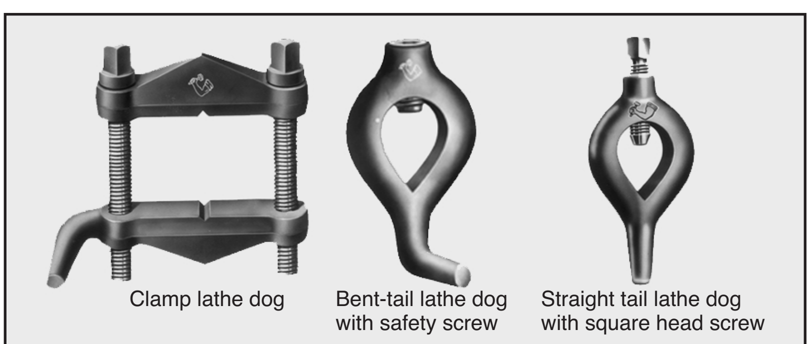
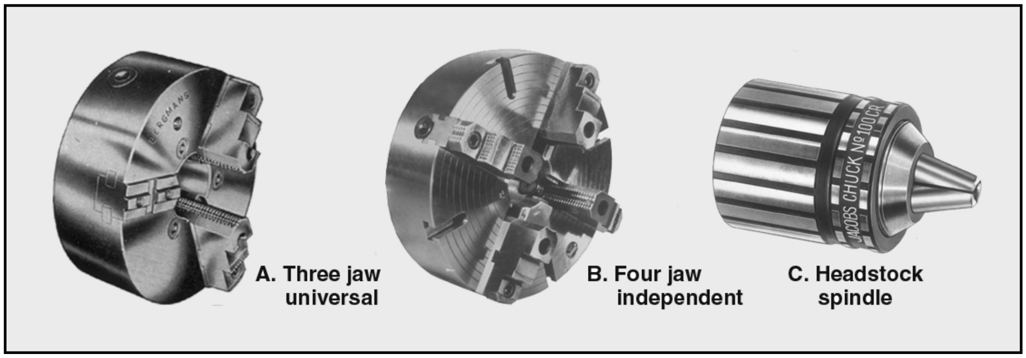


Fig. 1-12. Types of chucks for lathe work



workpiece or lathe can be damaged by loose pieces flying from a lathe operating at high speed.

1.39 **In a chuck.** Use a chuck to hold workpieces for any of the following lathe operations: turning, facing, drilling, boring, reaming, and threading. The type of chuck used depends on the size and shape of the workpiece. Normally, you will use two types of chuck in the maintenance shop. One is a *four-jaw independent chuck*, whose jaws close around the workpiece in a series of separate adjustments. The other is a *three-jaw universal chuck*, which centers the work automatically as the jaws close. Both are shown in Fig. 1-12.

1.40 The four-jaw independent chuck has reversible jaws that can hold odd-shaped or large diameter workpieces. With this chuck, you can partially or completely reverse the jaws to conform to the shape of the workpiece and clamp it securely (Fig. 1-13). To reverse the jaws, just remove the capscrews that hold the jaws to the chuck, reverse the jaws, and reinstall the screws. The four-jaw arrangement permits you to make very fine adjustments to center the workpiece accurately on the lathe.

1.41 The three-jaw universal chuck usually has two sets of jaws: a regular set, and a reverse set for large-diameter stock. The jaws of each set are numbered 1, 2, and 3, corresponding to the numbered slots in the chuck. A key-operated mechanism in the chuck is used to open and close the jaws. This chuck is used with round stock. You can also use it with multi-sided stock, but only if the number of sides is a multiple of three (triangular, hexagonal, etc.). Table 1-1 on the following page lists the recommended chuck sizes for three-jaw universal and four-jaw independent chucks for use on lathes with swings from 9 to 24 in.

1.42 Another chuck you will sometimes use is the *headstock spindle chuck* (Fig. 1-12C). This chuck, which looks very much like a drill-press chuck, is basically a hollow three-jaw chuck that is mounted on the spindle's nose. It is ideal for holding small-diameter stock. Because the spindle chuck has a smaller outside diameter, it provides more clearance than

Fig. 1-13. Standard and reversed chuck jaws

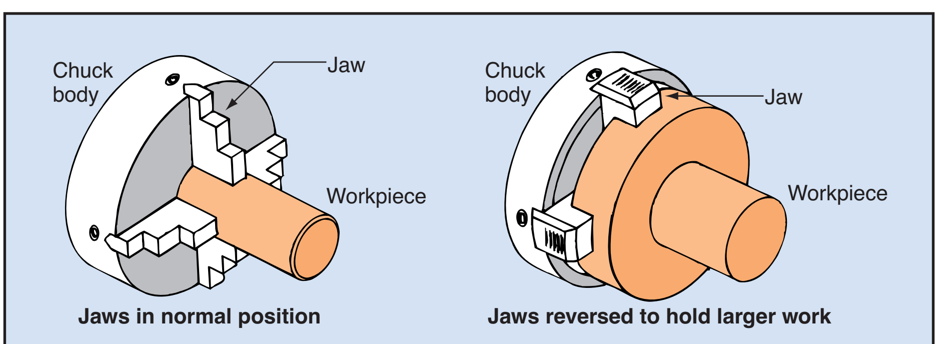


Table 1-1. Recommended chuck sizes for common lathe sizes

	Diameter of chuck (in.)	
Size of lathe (swing, in.)	Four-jaw independent	Three-jaw universal
9	6	5
10	6	5
13	7½	6
14½	9	7½
16 to 24	10	7½

other chucks. This allows you to move the compound rest and cutting tool very close to the workpiece.

1.43 The *draw-in collet chuck*, shown in Fig. 1-14, is a highly accurate chuck for making small parts. The collet is a collar or sleeve with three equally spaced slots. This construction allows the chuck to grip small-size stock tightly without damage. For example, when a part with a machined finish requires additional machining, you can hold it in a collet chuck without damaging the finished surface.

1.44 Collets are usually made of heat-treated steel, but brass and other materials are sometimes used, depending upon the application. The inside surface of a collet is shaped to fit a particular type of stock (round, square, etc.). Most collets hold a certain range of sizes, such as ½ in. through ⅝ in. As a rule, you can open and close a collet chuck by turning a handwheel connected to a bar that runs through the lathe's spindle. A chuck very similar to a collet chuck—called a Jacobs chuck—is a common part of every electric drill.

1.45 **On a mandrel.** Occasionally, you may have to machine the outside diameter of a workpiece to make it concentric with a hole already drilled in it. For example, you may need to machine the belt grooves in a pulley after the pulley has been drilled and/or bored to fit an axle. To be sure that the grooves and axle hole are concentric, you can mount the pulley on a *mandrel*, then mount the mandrel between the lathe centers, as shown in Fig. 1-15. Drive the mandrel with a faceplate and lathe dog.

1.46 Standard mandrels are made of hardened steel and have tapered outside diameters. Several types of mandrel are available (Fig. 1-16):

- **Solid**—Hardened steel with 0.006 in./ft taper. One end is slightly smaller for entering the workpiece. (The mandrel's size is stamped on the large end.)
- **Expansion**—A two-piece design with a tapered inner body that is driven into an expanding sleeve, and wedges the sleeve inside the workpiece.
- **Gang**—Resembles a huge bolt with a locking nut and washer. You can mount several pieces, such as spacers, on it and machine them all at the same time.
- **Spud** (not shown)—A mandrel made to fit the inside diameter of a particular part. A stud and plate on the end of the mandrel hold the part on the mandrel.

Steady Rest

1.47 For some jobs, you may need to support the outer end of a very long workpiece. To hold the work-

Fig. 1-14. A draw-in collet chuck

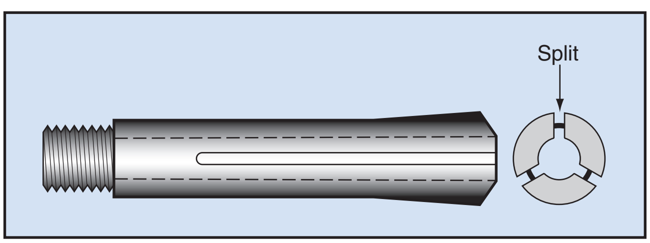


Fig. 1-15. A workpiece mounted on a mandrel

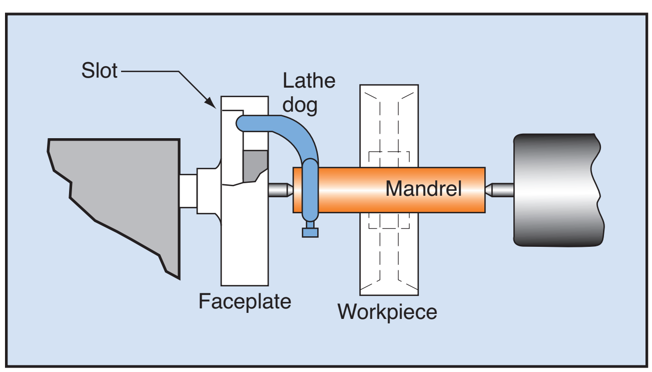
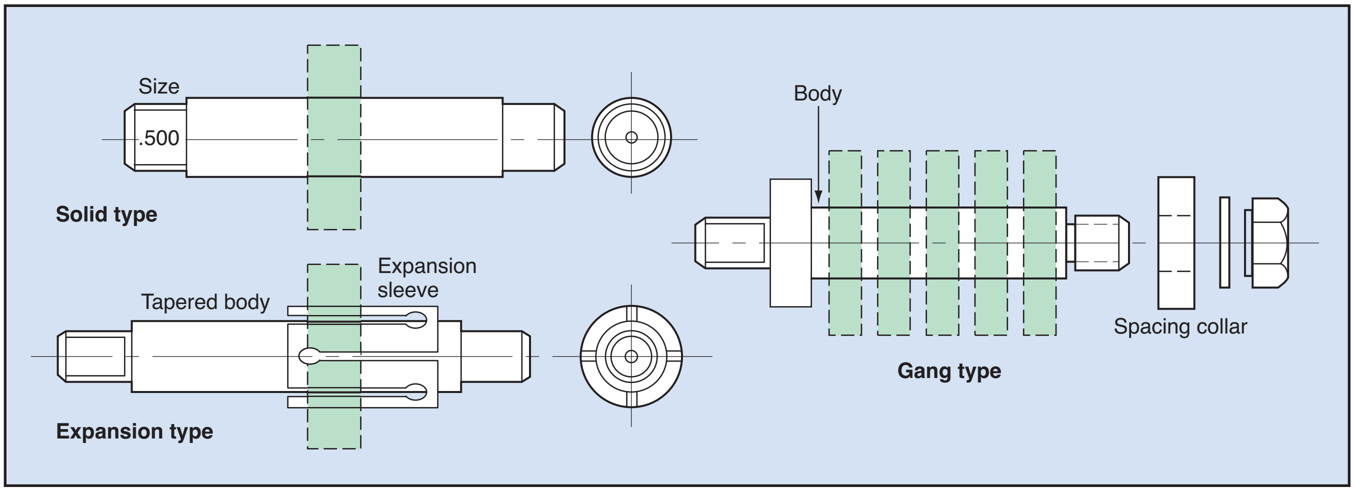


Fig. 1-16. Types of mandrels for lathe work



piece securely, you can use a *steady rest* as shown in Fig. 1-17 on the following page. This device is sometimes called a *center rest* because it centers the workpiece with respect to the axis of the lathe. The rest, which is clamped to the lathe bed by a single bolt, has three adjustable jaws that just touch the workpiece. In operation, the workpiece must be running on center, and the jaws must contact only a perfectly round, finished surface on the workpiece.

Follower Rest

1.48 The *follower rest* is similar to the steady rest, except it is attached to the lathe saddle so that it follows the cutting tool. The follower rest is especially useful when machining long, slender workpieces held between the lathe centers. It keeps them from springing out of line at the point of the cutting action, and helps assure a better machine finish.

- Wear safety goggles and a protective apron. Do not wear a wristwatch, necktie, ring, long unbuttoned sleeves, or other items that can become caught in the moving machinery.
- Wear gloves. Gloves prevent heavy workpieces from cutting your hands. They also protect you from metal chips when you clean the lathe.
- Use a chip brush. Always use a soft brush to remove chips from lathes. Never use compressed air to blow them off.
- Get help. If a workpiece is heavy, ask for help—or use a chain hoist to mount it in the lathe.

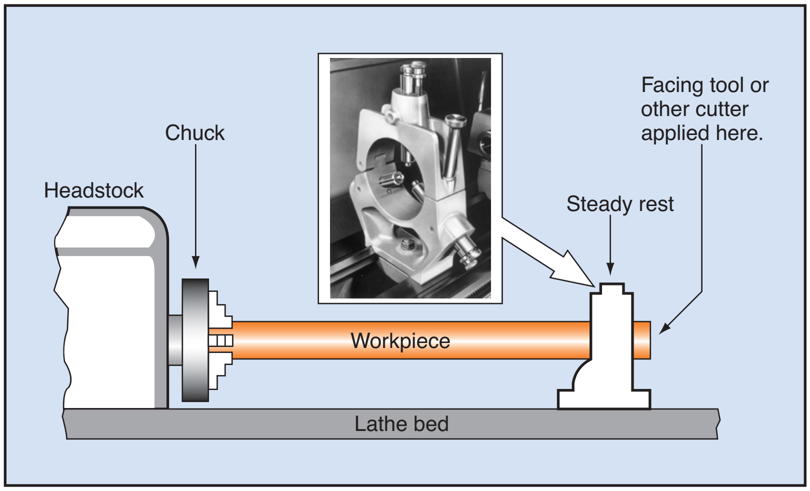
Using a Lathe

1.49 When you get ready to operate a lathe, you should go through a certain preparation routine to make sure it is ready for use. The procedure is similar to the one you follow when you get into your car. Before you turn the key in the ignition, you probably adjust the driver's seat, release the parking brake, check the rear-view mirror, and fasten your safety belt.

1.50 In the same way, before you mount a workpiece in a lathe, you should:

1. Make sure that you lubricate all parts of the lathe that need lubricating, according to the manufacturer's recommendations.
2. Check to see that all safety appliances and guards are in place.
3. Loosen the belt tension and turn the spindle by hand to be sure that the back gear is not engaged.
4. Move the carriage and cross slide to check their operation.
5. Wipe the spindle clean, apply a few drops of oil, and mount the work-holding attachment on the spindle.

Fig. 1-17. The steady rest and its function



1.51 In general, you should be sure to keep your lathe clean. This includes cleaning it after each work day. Start by brushing the chips off with a soft brush. Never use your hands or an air hose to remove chips. Chips and grit driven by air can get into your eyes, and also between precision sliding surfaces on your lathe—where they can cause wear and inaccuracy. Wipe all painted surfaces with a soft cloth, and wipe oil and chips from the bed and ways with a cloth. Coat the machined surfaces of the lathe with a light oil.

1.52 Learn to use a lathe safely. First, and most important, do not operate a lathe unless you know the operating procedure and have been checked out on it by your supervisor. When you do know the procedure, be careful to follow all recommended safety rules for your own protection, including each of the following:

- Wear safety goggles and a protective apron. Do not wear a wristwatch, necktie, ring, long unbuttoned sleeves, or other items that can become caught in the moving machinery.

- Wear gloves. Gloves prevent heavy workpieces from cutting your hands. They also protect you from metal chips when you clean the lathe.

- Use a chip brush. Always use a soft brush to remove chips from lathes. Never use compressed air to blow them off.

- Get help. If a workpiece is heavy, ask for help—or use a chain hoist to mount it in the lathe.

1-9. The spindle's rotation is transmitted to a workpiece held between the centers by a faceplate and __________.	1-9. LATHE DOG Ref: 1.30, Fig, 1 -9
1-10. If the lathe dog chatters in the faceplate slot, the centers are too __________.	1-10. LOOSE Ref: 1.34
1-11. Odd shaped workpieces can best be held on a __________ screwed or clamped to the spindle.	1-11. FACEPLATE Ref: 1.37
1-12. If you need a chuck for holding an irregularly shaped workpiece, use one that has __________ jaws.	1-12. FOUR Ref: 1.40, Fig. 1-13
1-13. The ideal chuck for holding workpieces of small diameter is the headstock __________ chuck.	1-13. SPINDLE Ref: 1.42, Fig. 1-12C
1-14. To machine the outside of a workpiece after the inside diameter is finished, mount the piece on a __________.	1-14. MANDREL Ref: 1.45, Fig. 1-15
1-15. To keep long slender workpieces in line while cutting them, equip your lathe with a __________ rest.	1-15. FOLLOWER Ref: 1.48
1-16. When cleaning your lathe, remove the metal chips with a soft __________.	1-16. BRUSH Ref: 1.51

Answer the following questions by marking an "X" in the box next to the best answer.

1-1. The highly finished surfaces that align the tailstock with the headstock are the

- ☐ a. facings
- ☐ b. ways
- ☐ c. aprons
- ☐ d. flats

1-2. What part should you move to put a longer workpiece in a lathe?

- ☐ a. Tailstock
- ☐ b. Carriage
- ☐ c. Apron
- ☐ d. Headstock

1-3. Which of the following operations requires you to use the lead screw?

- ☐ a. Cutting a taper
- ☐ b. Drilling the ends
- ☐ c. Centers are too tight
- ☐ d. Cutting threads

1-4. Which of the following statements about a lathe spindle is not true?

- ☐ a. It has a straight-sleeve bore
- ☐ b. It holds work-holding devices
- ☐ c. It is located in the headstock
- ☐ d. It rotates work-holding devices

1-5. The lathe's gears change the speed of the feed rod in relation to the speed of the

- ☐ a. clutch screw
- ☐ b. lead screw
- ☐ c. spindle
- ☐ d. head stock

1-6. If you must turn the face of an irregularly shaped workpiece, mount the piece

- ☐ a. on a faceplate
- ☐ b. in a mandrel chuck
- ☐ c. between centers
- ☐ d. in a three-jaw chuck

1-7. Rotation is transferred from the spindle to the stock held between centers by the

- ☐ a. tail of the lathe dog
- ☐ b. live center
- ☐ c. tailstock spindle
- ☐ d. center rest

1-8. If the center in the tailstock heats up or squeals, it means that the

- ☐ a. dog setscrew is too tight
- ☐ b. live center needs lubrication
- ☐ c. centers are too tight
- ☐ d. cross-feed rate is too high

1-9. The most accurate chuck for centering a workpiece in a lathe is which type?

- ☐ a. Four-jaw independent
- ☐ b. Reversed jaw
- ☐ c. Three-jaw universal
- ☐ d. Expanding collet

1 -10. To machine the outside diameter of a piece concentric with the inside, you should use a

- ☐ a. collet
- ☐ b. spindle chuck
- ☐ c. mandrel
- ☐ d. universal chuck

SUMMARY

The lathe is useful for performing many maintenance tasks. A lathe operates by rotating a workpiece while a sharp, stationary tool shapes the workpiece. The basic parts of a lathe are the same from one model to another—the ways are machined into or attached to the lathe bed, all lathes have a headstock and tailstock, and all have a moving carriage. The capacity of a lathe is usually expressed, in inches, by the swing (diameter of the workpiece the lathe can rotate) and by the maximum length of stock the lathe can turn between centers. Although lathe manufacturers all have special designs for lathe parts, in most lathes a gear train or belt drive transmits power from the motor to the various components.

The shape of a workpiece and what needs to be done to it determine how it is held on a lathe. Most often, a workpiece is held between centers, in a chuck, or on a faceplate mounted on the spindle. When held between centers, the center in the headstock (called the live center) turns the work with the help of a lathe dog. The center in the tailstock (called the dead center) does not rotate. Odd-shaped workpieces are usually mounted on a faceplate. Turning operations can also be performed while workpieces are held in a chuck. Occasionally you might use a mandrel to machine the outside diameter of a workpiece to make it concentric with a hole already drilled in it. Some jobs require that the end of a long workpiece be supported. You will use a steady rest or follower rest for this purpose.

Before mounting work on a lathe, make sure all parts are properly lubricated and all safety guards are in place. Loosen the belt tension and turn the spindle to make sure that the back gear is not engaged. Check the operation of the carriage and cross slide. When using the lathe, wear protective eyewear, gloves, and an apron. Do not wear jewelry or long, unbuttoned sleeves.

Answers to Self-Check Quiz

1-2. a. Tailstock. Ref: 1.08

1-3. d. Cutting threads. Ref: 1.12

1-4. a. It has a straight-sleeve bore. Ref: 1.18

1-5. c. Spindle, Ref: 1.21

1-6. a. On a faceplate. Ref: 1.27

1-7. a. Tail of the lathe dog. Ref: 1.31

1-8. c. Centers are too tight. Ref: 1.34

1-9. a. Four-jaw independent. Ref: 1.40

1-10. c. Mandrel. Ref: 1.45

Contributions from the following sources are appreciated:

Figure 1-2.	Clausing Corporation
Figure 1-3.	Clausing Corporation
Figure 1-4.	Clausing Corporation
Figure 1-5.	LeBlond Machine Tool
Figure 1-6.	J.H. Williams and Company
Figure 1-11.	Armstrong Brothers Tool Co.
Figure 1-12.	Ball Machinery Company
Figure 1-17.	Clausing Corporation