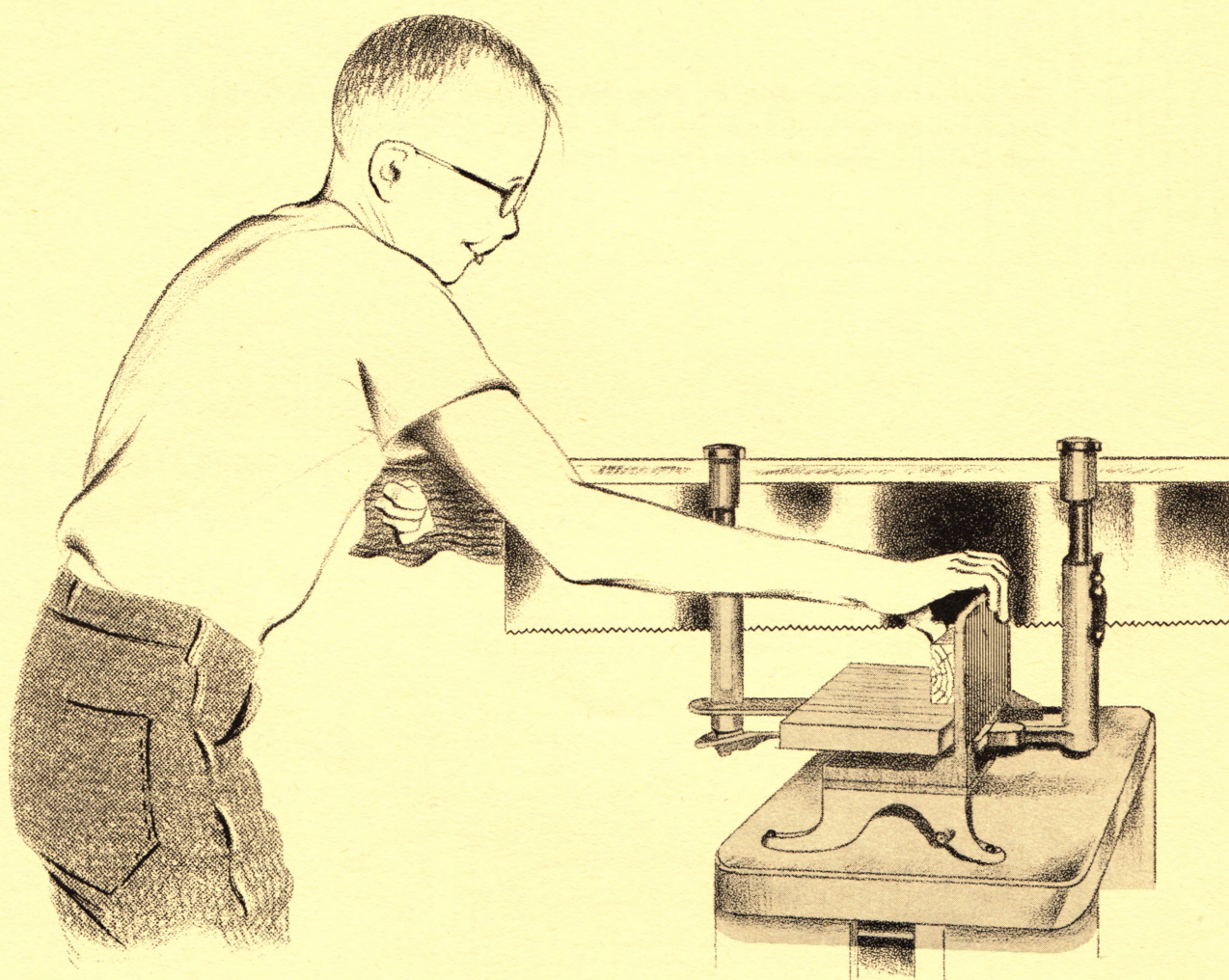


4-H AGRICULTURAL ENGINEERING

WOODWORK UNIT FIRST YEAR



UNIVERSITY OF CALIFORNIA

AGRICULTURAL EXTENSION SERVICE

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Co-operative Extension work in Agriculture and Home Economics, College of Agriculture, University of California, and United States Department of Agriculture co-operating. Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914. George B. Alcorn, Director, California Agricultural Extension Service.

AUGUST-1965--6,000 Rev.

WOODWORKING PROJECT

UNIT I

You spend much of your life using wood or wood products—the house you live in, the paper you write on, the chair you sit in, and many other everyday items. You will be able to use carpentry, woodworking, and building knowledge on the farm or around your home. Also, what you learn in this project will help you in future 4-H projects in agricultural engineering, livestock, crops, home furnishings, and beautification of home grounds.

THINGS TO LEARN

In this unit you will learn:

1. The proper, safe use and care of:
 - a. Measuring tape
 - b. Crosscut saw
 - c. Ripsaw
 - d. Claw hammer
 - e. Wood chisel
 - f. Brace & bit
 - g. Screwdriver
 - h. Plane
 - i. Nail set
 - j. Wood rasp
 - k. Combination square
 - l. Try square
2. How to use a plan.
3. How to use nails and wood screws properly.
4. To identify kinds and grades of wood (visit a lumberyard).

THINGS TO MAKE

In this project you'll have an opportunity to choose articles to make from the following list. Remember to use your tools safely. Use the plans to help you make your articles the right size and shape.

1. First article — choose one
 - a. Sandpaper block
 - b. Cutting board
2. Second article — choose one
 - a. Bolt and screw rack
 - b. Toolholder (nail or screw brackets)
 - c. Hardware display board of common wood fasteners
3. Third and fourth articles — choose two
 - a. Toolbox
 - b. Hoe rack
 - c. Miter box
 - d. Toolrack with wood notches
 - e. Bench hook
 - f. Concrete float

THINGS TO DO

Keep a record of your project.

Give one or more demonstrations on your project.

Exhibit what you have made.

Identify nail sizes and 12 common wood fasteners.

GETTING STARTED

SELECT YOUR PROJECT from the list of Things To Make in this unit.

STUDY THE WORKING DRAWINGS. A company that builds a skyscraper, a rocket launching pad, a jet airplane, or anything else, must have a plan to work from before any construction takes place. As a woodworker, you also must have a plan of the project you will make.

The working drawing is your plan of work. A working drawing shows all the dimensions as well as how to construct the article. Look at the drawing to find the thickness, width, and length of each part of the article before you do any sawing or hammering.

WORK CAREFULLY AND SAFELY. Remember, you can cut down a board with a plane, but you can't stretch it.

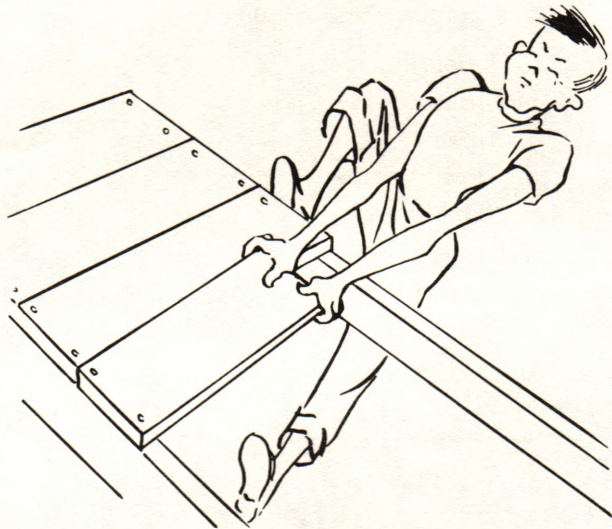
DO YOUR BEST. A neat, well-fitted project is worth the extra effort.

In later units of the Agricultural Engineering Project you will learn how to make working drawings. But first, read the drawings on pages 18 to 21. These plans will give you a picture of the items you will make in this unit. Think of these working drawings as pictures of your projects, and use the dimensions given to guide you in constructing each item. If you follow the plans, you'll save time and your construction materials.

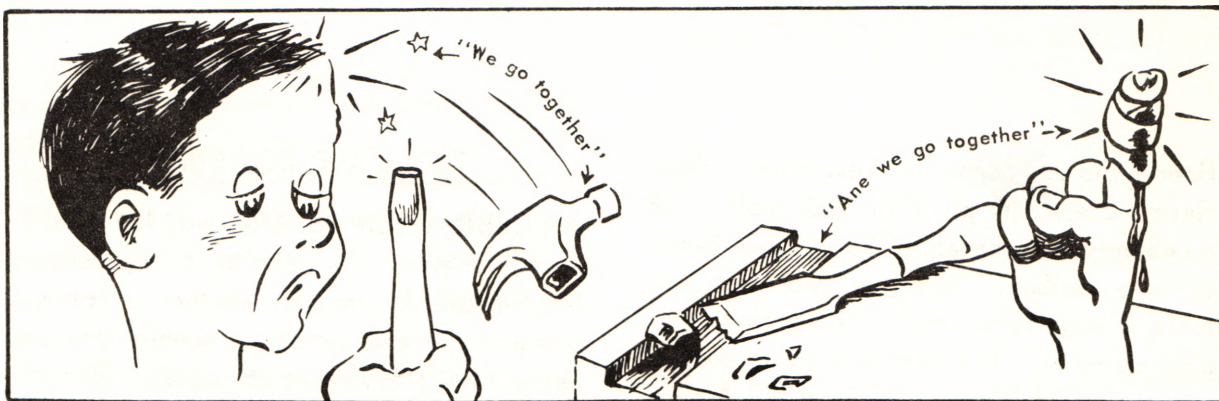
SELECT YOUR MATERIALS after you learn the requirements of the project from the working drawing.

LAY OUT YOUR PROJECT. Doublecheck your measurements and then use your rule and square to mark the necessary cuts. Use a square to mark boards before cutting them to length. Mark across the top and at least one edge. The mark on the edge will help you judge whether or not your saw is straight up and down. Lay the rule so that the graduations touch the work; then your eye cannot mislead you. Accurate measurement is essential for good work. If you don't understand the drawing, ask your leader to help you. Don't saw until you are sure.

It won't s-t-r-e-t-c-h!



SAFETY IN WOODWORKING



Keep your safety rating high. Prevent accidents to yourself and your fellow workers. In this project, remember these two important rules:

- ★ Develop skillful, efficient, and safe work habits.
- ★ Use these habits when making all articles — from the plan to the finished article.

Think about the tools you will use. What do you expect of them? Each has a special job to do. Learn what it should do; then use it correctly. If you had to earn the money to buy all your tools, you'd certainly learn to use and care for them properly. Men who earn their living with tools, such as those in the home shop, learn very early in life to treat their tools as friends for best results. Correct use prevents injuries and lessens breakage and damage.

LEARN SAFETY HABITS

DRESS FOR SAFETY. Loose collars are comfortable. For safety, don't wear a tie while working. Roll your sleeves to the elbow, using an inside roll so the cuffs won't catch. Clothing should be loose, but never bulging or flying.

PROTECT YOUR EYES. Your eyes cannot be replaced. Do not expose them to unnecessary danger. Wear goggles when you use high-speed grinders or other equipment. Metal particles, abrasives, nails, sawdust, and shavings may cause eye injury. Keep the goggles clean.

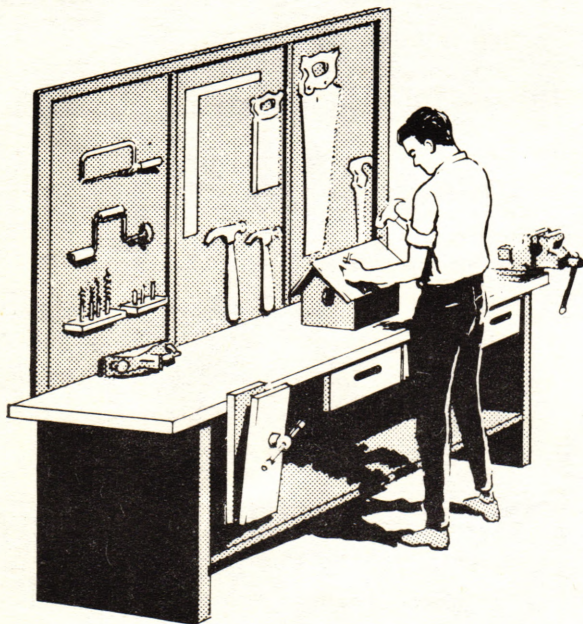
TREAT ALL INJURIES, no matter how slight. Even a scratch may start an infection. A slight injury treated at once is not likely to develop into serious trouble. Every workshop should have a handy first aid kit for treating injuries immediately.

KEEP TOOLS IN GOOD SHAPE. Keep tools that bear an edge well sharpened. Dull tools are hard to use, they do unsatisfactory work, and usually are the ones to cause accidents. Also, be sure that the heads of hammers, mallets, and hatchets are wedged on tightly. If they are not properly attached, the heads may fly off and injure someone. Loose handles on saws, chisels, and other tools also cause trouble.

SAFETY TIP: Don't leave nails in a board where you may step on them and injure your foot.

USING TOOLS AND WOOD FASTENERS

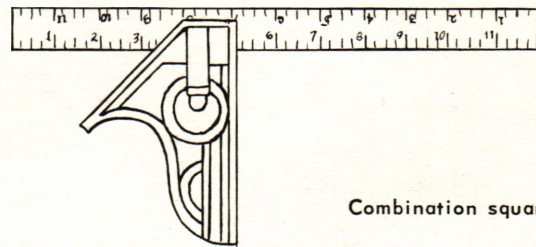
Good tools do good work. Take care of them. Have a clean, dry place for your tools — in a cabinet over a bench, in drawers in a bench, or in a toolbox. Wherever you keep your tools, always return each to its proper place after using it. The best tool is no good if you can't find it when you need it. A good workman keeps his bench and tools clean and ready for use, and his work area in order. Keep your tools dry. Rust and careless handling are great enemies of handtools. Oil helps prevent tools from rusting, but use it sparingly. If your tools become rusty, remove the rust by rubbing with pulverized pumice stone; then oil thoroughly.



Workbench and toolholder

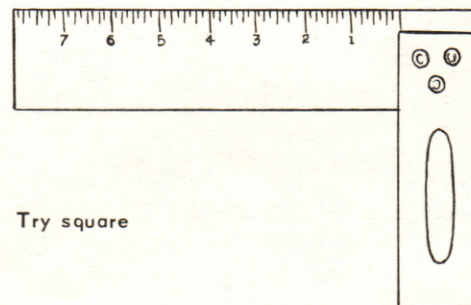
TOOLS AND EQUIPMENT

A **COMBINATION SQUARE** will lay off 90° or 45° angles. In addition to measuring lengths and determining whether or not the end of a piece of lumber is square, you can use a square to determine angles. Remember that measuring tools are precision instruments. Wipe squares, rules, and steel tapes with an oil rag to protect the steel from rusting.



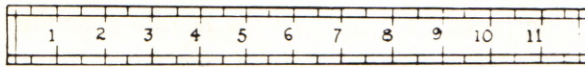
Combination square

A **TRY SQUARE** is handy for laying out projects as well as checking stock during squaring.



Try square

Bench rule

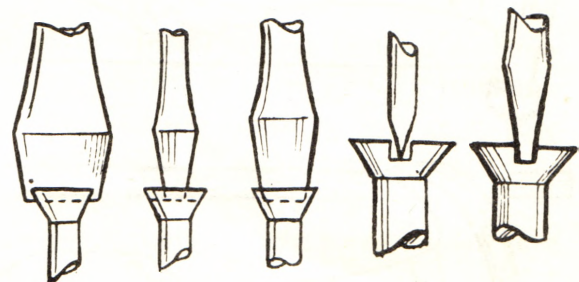
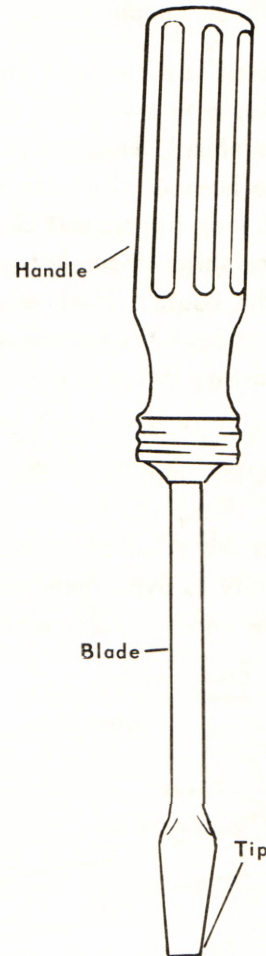


RULES include the bench rule, school ruler, yardstick, flexible tape (made of plastic, wood, or metal). Most are marked off in eighths or sixteenths of an inch.

SCREWDRIVERS get more than their share of abuse. It is easy to ruin a good screwdriver by misusing it. So remember:

- Don't use a screwdriver with a blade too large or too small to fit the screw slot snugly.
- Hold the screwdriver square with the work. Keep a firm downward pressure as you apply the twisting motion. A long screwdriver is easier to hold.
- Don't hammer on a screwdriver. A screwdriver is not a substitute for a cold chisel.
- Don't sharpen the tip to a point. If it is too thin, it will break. A tip that is rounded on the corners will ruin the screw slots.
- Don't use pliers on the blade to give greater turning force.
- Choose a screwdriver with a plastic handle or a good wooden handle. Cheaper wooden handles often become loose and useless.

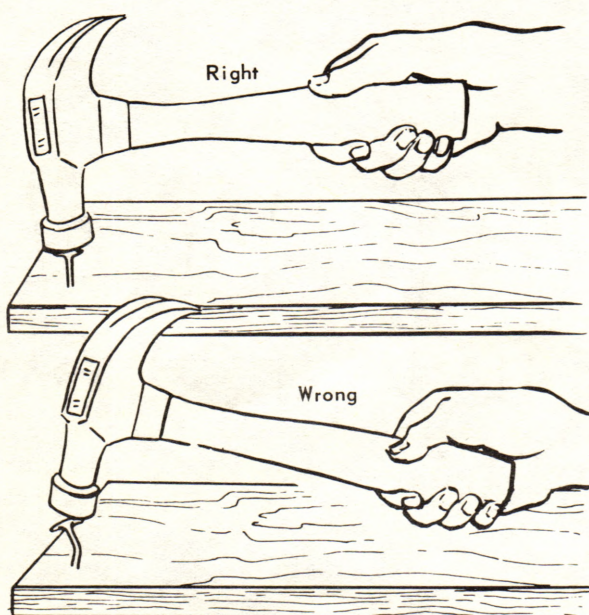
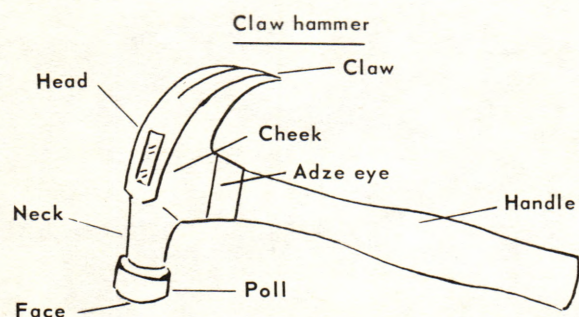
Screwdriver



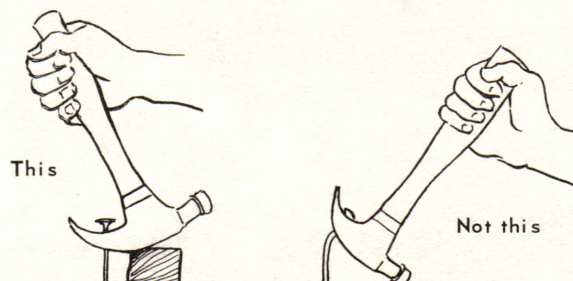
- | | | | | |
|-----------------------------|--------------------------------|-------------------------|------------------------------|--|
| Wrong | Wrong | Right | Wrong | Right |
| Too wide. Will damage wood. | Too narrow. Will damage screw. | Tip same width as slot. | Tip too sharp. May slip out. | Sides of tip parallel with sides of screw. |

CLAW HAMMER is perhaps the most used and most abused tool. To use it safely and well, remember these simple rules:

- To start a nail, hold the nail high, just under the head, with the thumb and forefinger of the lefthand. This saves bruised fingers—if the hammer slips off the nailhead, it will knock fingers out of the way rather than mashing them between the hammer and the board. If necessary for control, you can hold the hammer near the head while starting the nail.
- Drive the nail with full, strong blows. Use wrist action and hold the handle near the end. Keep the handle parallel to the work at the point of impact. Hit the nail squarely to avoid bending it and marking on the wood. Practice helps.



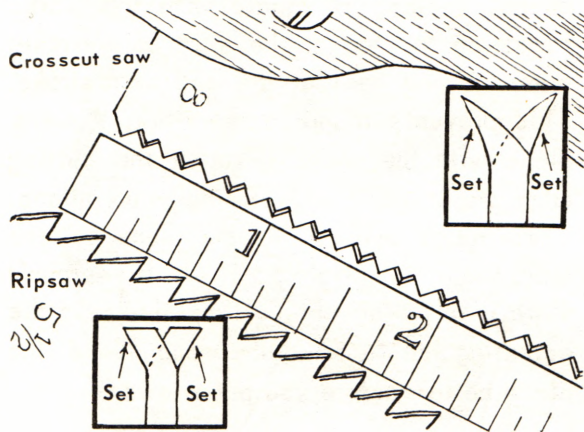
- To pull a nail, insert the claws under the nailhead. Do not pull the handle past the straight-up-and-down position. When the handle has reached the vertical, place a block of wood under the head before you pull the nail further.



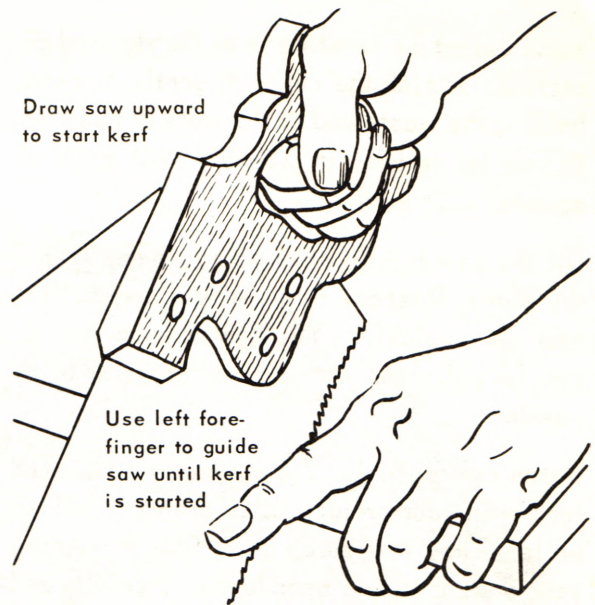
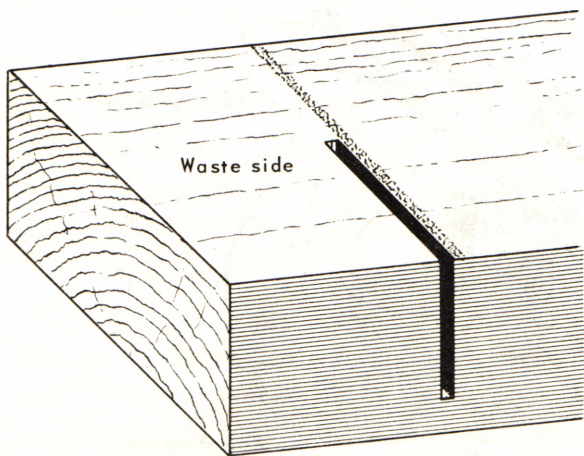
- Don't use a hammer that is "loose on the handle." Someone may be hurt.
- Don't use the side of the hammer to pound. The cheek (see diagram) is the weakest part of the hammerhead and may be broken.
- Don't use a hammer to pound a cold chisel or other hard metal objects.
- Careless handling ruins tools. Don't do it. Protect cutting edges. Keep tools where you can see the one that is needed.



THE HANDSAW is another useful tool. Two frequently used types of handsaws are the crosscut saw and the rip saw. The crosscut saw cuts across the grain of the wood, with saw teeth like two rows of knife points. The wood is crumbled out between the cuts. Rip-saw teeth are chisel shaped and cut with the grain. They cut as a gang of chisels in a row. Saws are designated by the number of tooth points to the inch. A crosscut may have 8, 10, or 11. A rip saw will have only 5, 5½, or 6. Usually you will find this number stamped on the blade near the handle.

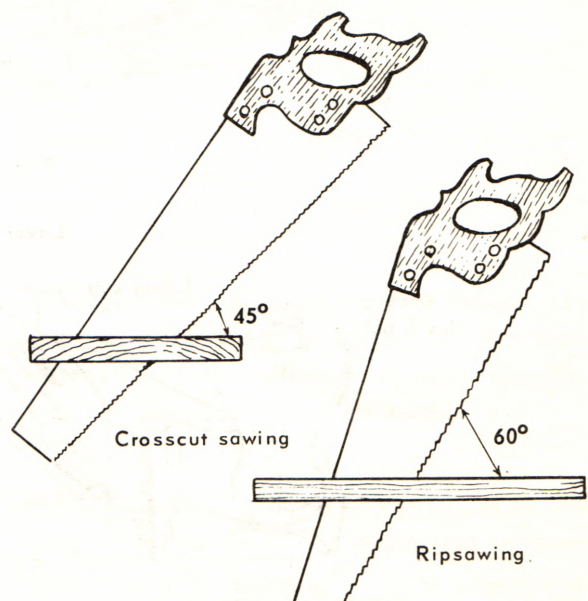


Kerf is the term carpenters use to describe the cut made by the saw. Keep the kerf on the waste side of the line—not on the line nor on the inside of the line. Saw with steady, long strokes, taking care not to “kink” the blade. It is easier to keep a saw straight than to straighten a crooked one.



To start the kerf, draw the saw toward you. Guide it with the forefinger of your left hand until the cut is deep enough to hold the saw steady. **Be careful.** The saw is designed to cut through hard wood; your finger is much softer.

Hold a rip saw at a 60° angle to the work. If using a crosscut saw, hold it at a 45° angle. It takes practice to keep the cut square. The side of the saw should be square with the board. While learning, you can use a try square to check. You can guide the saw to



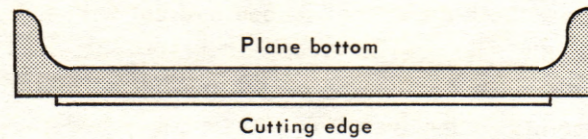
some extent by twisting it in the desired direction. Finish the cut with gentle strokes, holding the waste end of the work in position. If you let it fall, it probably will split or splinter your work.

Oil the saw lightly after using. Keep it in a dry place. Rust can ruin a saw or any cutting tool very quickly. You can remove rust by careful polishing with pumice stone or brick powder.

Watch out for nails. You may work with used lumber in your project. Be careful of hidden nails. They will break or dull teeth, ruining your saw. Examine used lumber carefully and remove all nails before you try to saw it.

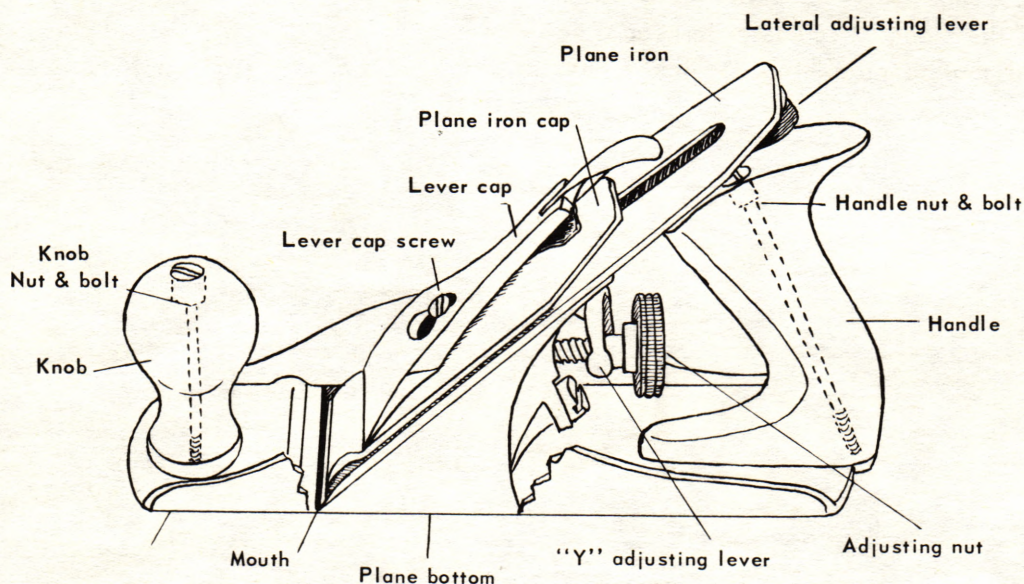
A PLANE removes the rough and ridged surface left by sawing. It helps bring stock down to size when you need to remove only a fraction of an inch. To adjust the plane, bring the cutting edge just below the plane. (Note the illustration.) If one side of the

cutting edge is lower than the other, use the lateral adjusting lever to even it. Try the plane. If the shaving is too thick or too thin, readjust until you reach a satisfactory thickness of cut.



When using your plane, push it straight ahead, keeping it square with the work. Press on the toe at the start of a stroke; press on the heel at the end of a stroke. This prevents rounding the work. Always plane with the grain. Protect the cutting edge when using and storing your plane. When not in use, store your plane on one side, not in an upright position. If you can't store it to protect the cutting edge, use the adjusting nut to bring the edge above the plane bottom before you put it away.

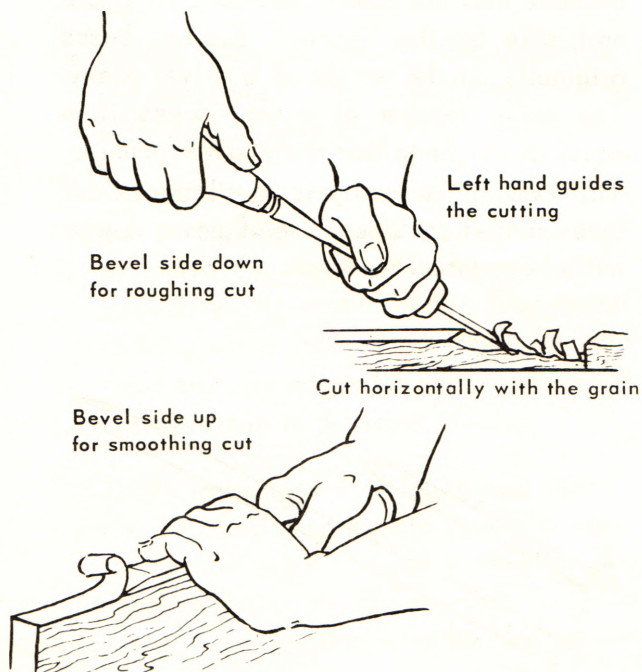
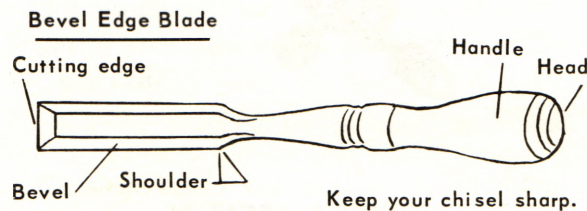
Plane



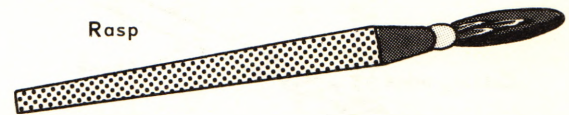
THE WOOD CHISEL may be regarded as a more primitive plane. Because its blade is unprotected, you can use it for routing (cutting grooves) and gouging. Be careful. The chisel is the most dangerous of woodworking tools. Always keep both hands on the chisel except when driving it with a mallet.

As with the plane, work with the grain whenever possible. Angle the blade slightly or move it from side to side as it moves forward. You'll find it cuts more smoothly and evenly. For most work, you will hold the bevel side up. For rough gouging, you may hold the bevel down.

Protect the blade during storage. A wall rack is one of the best methods.

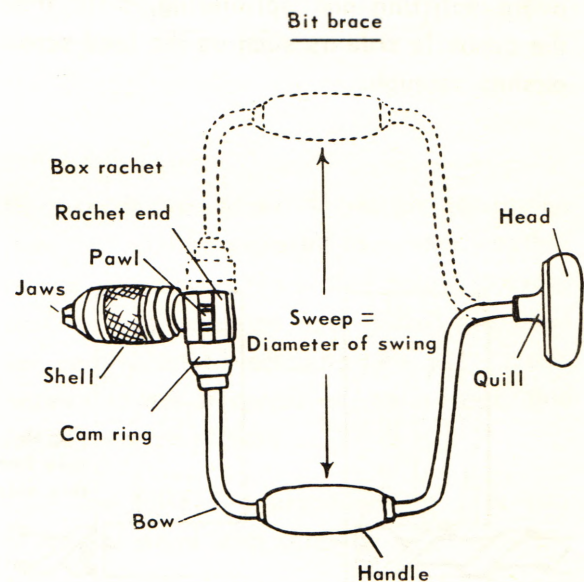


THE WOOD RASP is used for rough shaping a piece of wood. The rasp is used as a file with teethlike projections cutting the wood.

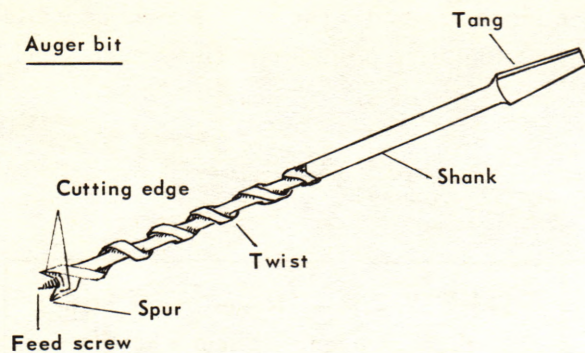


SAFETY TIP — Never use a rasp that has a tang without a handle.

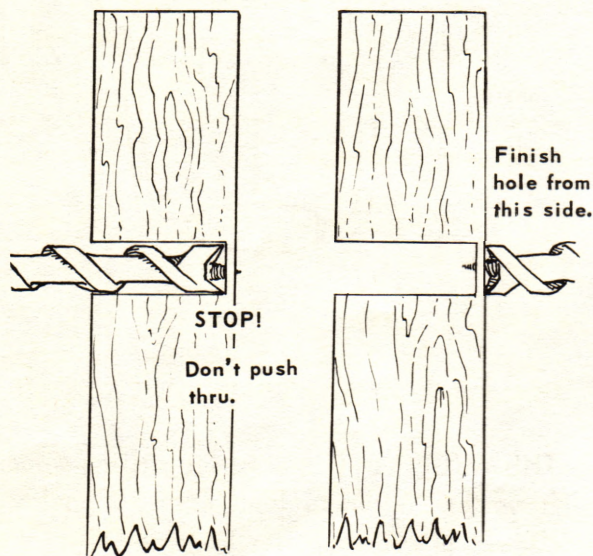
THE BIT BRACE is another tool woodworkers use often. Pictured is the ratchet type which you can use in corners and tight places.



THE AUGER BIT is used for drilling wood. It varies in length from 7 to 10 inches. (Dowel bits are shorter.) Auger bits are sized by the number of sixteenths of an inch in the diameter. A bit marked No. 8 is $\frac{8}{16}$ inch (or $\frac{1}{2}$ inch) in diameter. Twist bits are marked in the same way by thirty-seconds of an inch; No. 8 means $\frac{8}{32}$ inch or $\frac{1}{4}$ inch.

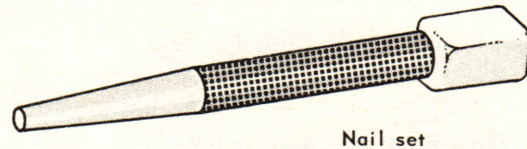


Practice drilling a few holes in scrap lumber. Take care to place the bit accurately when starting a hole. Mark the location clearly on the wood. Check with the try square to see that the hole is straight. To avoid splitting and splintering, drill from the opposite side as soon as the lead screw pushes through.

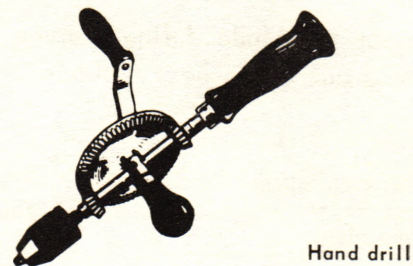


Store the bits to protect their cutting edges, spur, and lead screw. A good storage method is to drill a block of wood and keep the bits in holes.

THE NAIL SET. To drive nailheads below the surface of the wood, we can use a nail set or a slightly larger size nail. Finishing nails have small indentations that allow the use of a pointed nail set.

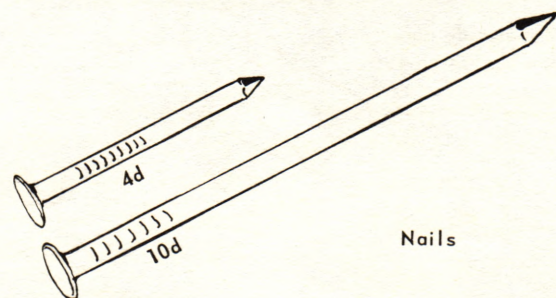


THE HAND DRILL works in the same way as an eggbeater. Cranking a geared side-wheel causes the drill to revolve, drilling a hole.



WOOD FASTENERS

NAILS are most widely used in joining wood because they are handy and fast. We figure nail size by the "penny" system, based originally on the weight of a silver penny. The penny number of a nail means it is equal in weight to that many silver pennies. The symbol for penny is the letter "d." Sizes range from 2 penny to 60 penny. Larger nails have larger numbers.

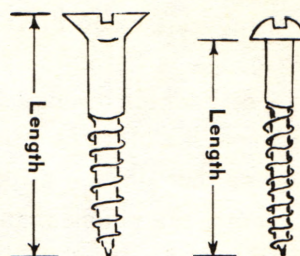


It's easy to remember the lengths of various sizes of nails through the 10-penny size, if you follow this rule: Divide the penny number by 4 and add $\frac{1}{2}$ inch to obtain the length in inches. (For example, a 4d nail is $1\frac{1}{2}$ inches long, and a 6d nail is 2 inches long.)

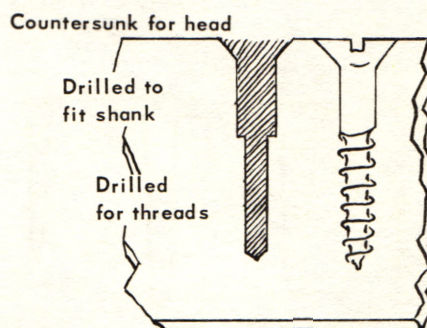
Certain types of nails do special jobs. Here are some different types of nails:

- Common nails are for general purposes—sheathing, flooring, framing, etc. The nails on page 10 are common nails.
- Box nails are lighter than common nails. They are used with light or easily split lumber because they are less apt to split the wood.
- Finishing nails are preferred when we don't want nailheads to show. Use a nail set to sink them below the surface of the wood. Then cover the heads with putty or plastic wood before you apply the finish.
- Common brads are similar to finishing nails. The small sizes frequently are used in fine assembly work, such as model making.
- Shingle nails are used for putting on roofing materials. They usually are coated with zinc to help them resist corrosion.
- Corrugated fasteners join the edges of boards together. Sometimes they are used to fasten the corners of screen frames—more often for repair work. Corrugated fasteners may have plain edges for hard wood and saw edges for soft wood. They are available in different sizes.

SCREWS make a much stronger joint than do nails, but they require more time and work. Two common types of wood screws are the flathead and the roundhead. The flathead screw can be countersunk to leave a smooth surface.



Screws



Most screws are steel. If you are making an item that will be exposed to severe weather or use, you may want a plated screw to avoid rust. Zinc, cadmium, and nickel are used for coating steel screws. We use brass screws to resist corrosion, salt water, and for decorative effects.

Use the following procedure to join two pieces of wood with screws:

- Select a bit for your hand drill equal in size to the shank of the screw. Use the hand drill to drill a hole equal in depth to the length of the shank.
- Use a bit slightly smaller than the diameter of the screw as measured between the threads. Make a hole equal in depth to the length of the screw.
- If you are using flathead screws, countersink for the heads. In soft wood, you may find that countersinking is not necessary.

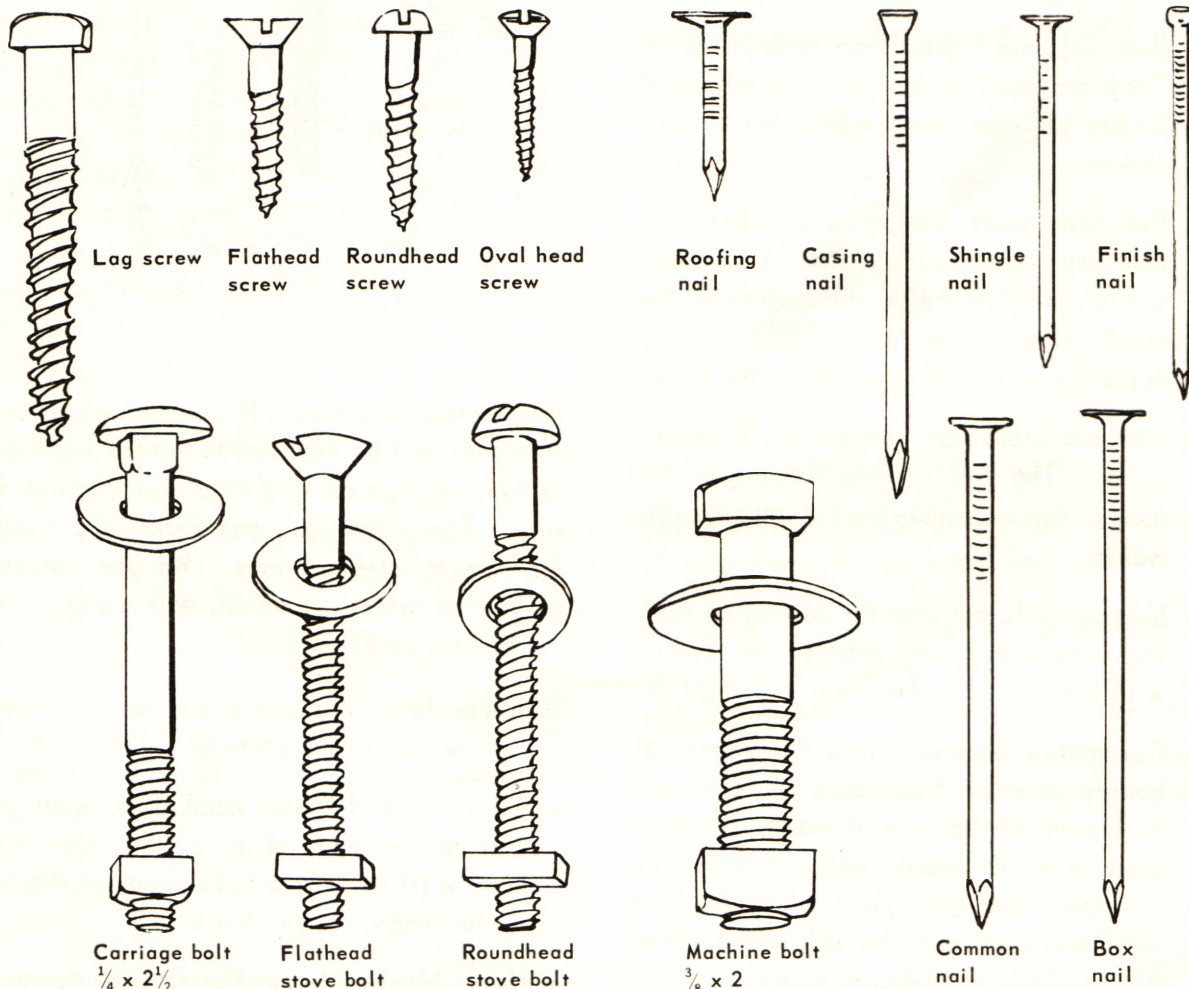
- If you have many screws to drive, some sort of depth gauge is helpful. To make a depth gauge, drill a hole through a dowel so that it fits over the bit to be used. Cut off this dowel so that when it slides over the bit and against the chuck of the drill, only enough bit is exposed to drill the

proper depth. Soap applied to the threads of the screw makes it much easier to drive in hard wood.

SAFETY TIP —

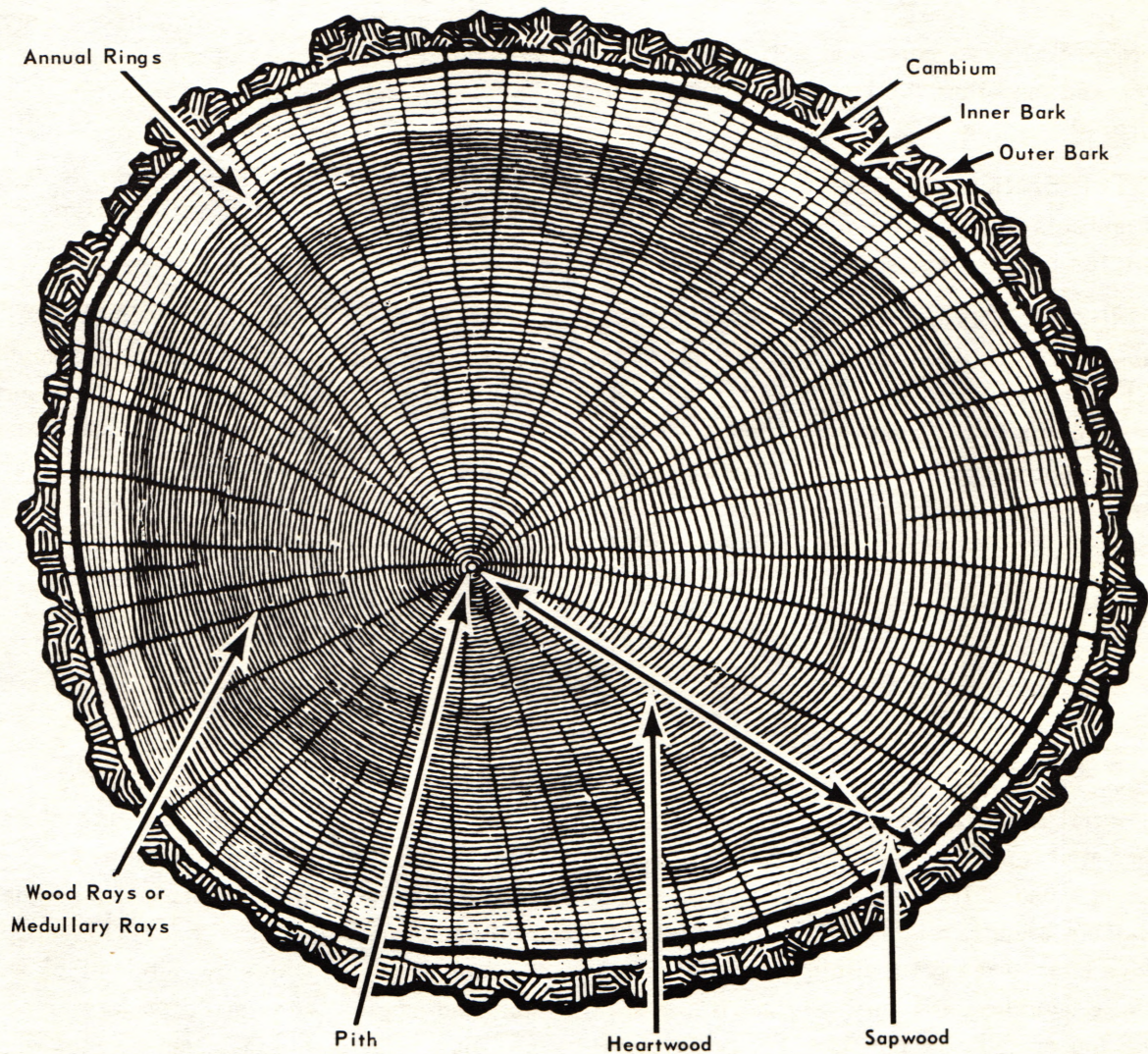
Throwing and catching tools cause injuries.

SOME COMMON WOOD FASTENERS



SAFETY TIP — Never put brads, tacks, or screws in your mouth. If you cough or stumble while they are in your mouth, you may swallow them. Screws and nails also carry germs and might cause infection in your mouth.

STRUCTURE OF WOOD



PITH is the soft core in the center of the tree. It may be round, oval, triangular, or more or less star shaped. It usually is less than $\frac{1}{4}$ inch in diameter.

HEARTWOOD surrounds the pith. Earlier in the life of the tree, it was sapwood. As the tree grew, the inner layers of sapwood turned into heartwood. As heartwood, it no longer contains living cells. Its chief function is

to support the weight of the tree crown. The heartwood is generally darker in color than sapwood. The heartwood is more durable than the sapwood of the same species.

SAPWOOD, or outer layer of wood next to the bark, contains the living cells and reserve materials. The sapwood of most species is lighter colored than the heartwood.

CAMBIUM is a layer too thin to be seen with the naked eye. All growth in thickness of the bark and the wood takes place in the cambium. It is located between the sapwood and the bark.

INNER BARK is moist and soft. It carries prepared food from the leaves to all growing parts of the tree.

OUTER BARK is composed of dry dead cells. It protects the growing areas from external injuries and serves as insulation.

ANNUAL RINGS are the light and dark circles that appear on the cross section of a tree. They represent the growth layers a tree puts on in a single year. The light rings are composed of soft, thin-walled cells, formed as the cambium layer cells divide in the spring. The dark rings are composed of

small, thick-walled cells formed during the slow summer growth. Therefore, an annual ring usually consists of one dark ring and one adjoining light, soft ring. By counting the rings on a log or stump, it is possible to tell the approximate age of a tree. Trees growing in a fully stocked mature forest will have narrower growth rings than the same species in a second-growth forest. The second-growth trees grow faster because they are younger and possibly have less competition.

WOOD RAYS or **MEDULLARY RAYS** are the strips of cells extending radially from the center of the tree to the bark. These rays conduct sap across the grain. In some species of wood, the rays are extremely small; in others, such as oak, they are very large and prominent.

KINDS OF WOODS

Wood probably is the most commonly used material in the world today. Lumber is more than just a piece of wood; it has taken years to grow and skill to shape. Unwise logging and the ravages of insects, fire, and storm have caused the great virgin forests of America to dwindle until only very small areas of the timberland now remain. Today we grow trees as a crop to furnish wood.

There are two general classes of wood — softwoods and hardwoods. Wood also is graded according to quality, with grades designating finish uses, where appearance is most important, and structural and construction uses where strength is the first requirement.

Hardwoods come from trees with broad leaves. Softwoods have needles and carry their seeds in cones. "Hardwoods" are not always

harder than "softwoods." Cedar, fir, white pine, yellow pine, and redwood are classified as softwoods. We use softwoods for framing, foundations, siding, and other general construction. Some trees classed as hardwoods are oak, hickory, birch, black walnut, and maple. They are used for flooring, furniture, interior finishes, and cabinet work.

SOFTWOODS

CEDARS are fragrant softwoods. They include the eastern red cedar, northern white cedar, western red and yellow cedars. Eastern red cedar is a popular wood for lining closets and chests because moths dislike its odor. The heartwood of cedar is dark red. The sapwood is white. Cedar's many

knots add beauty to the wood, but make it difficult to plane. Cedar is best dressed (smoothed) with a cabinet scraper. The wood seasons (dries) rapidly. It shrinks and checks (cracks) very little, and the heartwood is durable for outside use. It is used as we use soft pine, but because cedar is so durable, we prefer it for shingles. The smaller trees are used for fenceposts and railroad ties.

DOUGLAS-FIR, a softwood, is one of the largest trees native to North America. It is the most frequently cut wood of commercial importance. Although it is distinctly a western species, it also is used in many parts of the Middle West and East for structural timbers, railway ties, rough and finished lumber, flooring, plywood, furniture, lath, tanks, and many other articles. The sapwood is white, and the freshly cut heartwood is light reddish yellow. When exposed to light and air it becomes distinctly reddish. Sometimes it turns cherry red or brown. The average fir lumber from the West Coast is strong, moderately hard, moderately heavy, and very stiff. It splits easily and is rather difficult to work with handtools.

REDWOOD, another softwood, is one of the largest trees known. It grows only in the extreme western part of the United States. Redwood is very durable in contact with soil and is widely used for flower boxes, fenceposts, water pipes, railway ties, and water tanks. It also is used for siding and shingles in home construction. Both the bark and the wood are cinnamon brown. The wood is light, soft, moderately strong, and easily worked with tools.

WHITE PINE is more in demand for carpentry and building than any other kind of wood. It is nearly white, lightweight, works easily, and warps little when properly seasoned. We use it in building and for doors and window

frames. The heartwood is moderately durable in contact with soil and moisture. The heavier the wood, the darker, stronger, and harder it is, and the more it shrinks and checks. The cheaper grades of white pine are used for general carpentry.

YELLOW PINE grows in the southern part of the United States. It is used chiefly in building construction. Most of the commercial resin and turpentine of the U.S. come from longleaf and slash pines. Yellow pine is hard, and the summerwood portion of the annual rings is dark colored. It warps little and the heartwood is moderately durable. The grain usually is straight. The wood tends to split during nailing. It is used for house sills, foundation timbers, concrete forms, and also for heavy structures such as bridges, trestles, wharves, pilings, ship frames, and docks.

HARDWOODS

BIRCH grows best in northern United States and Canada. It is hard, tough, and elastic. Its heartwood is reddish brown, and the sapwood white. The wood is heavy, strong, of fine texture, and handsome with a satiny luster. The wood shrinks considerably in drying. It takes a good polish, but is not durable if exposed.

Birch is difficult to work because the grain is irregular and it is very hard. It takes a beautiful natural finish as well as a good stained finish. Birch is an excellent base for a white enameled surface. It may be stained to imitate mahogany, walnut, and maple.

MAPLE trees generally are divided into two main groups—hard and soft maple. The most common hard maple is sugar maple. Its sap is used for making maple sugar and maple

syrup. Soft maple is of lesser importance. Red and silver maple trees are classed as soft maple.

Hard maple wood is one of the most popular cabinet woods. It is light brown to white, with darker heartwood. Maple is either curly grained or straight. When hard maple contains a figure, it is called bird's-eye, landscape, or curly maple. It can take a high polish because of its fine, uniform texture. Although not easy to work, it can be brought to a good surface and will turn well on a lathe.

Hard maple grows best in the northeastern part of the United States. We use maple extensively for veneering, furniture, musical instruments, woodenware, tool handles, ships, bowling pins, athletic equipment, school apparatus, and millwork products such as flooring and fine interior trim.

WHITE OAK is grayish brown, with a reddish tinge and has an open grain (visible pores). The oak's medullary rays (streaks running out from the center of the logs) are very prominent. When the log is quartersawed, these rays produce an attractive flaky-looking surface. We use oak for interior finish, cabinetwork, furniture, flooring, implement parts, and heavy construction such as bridges and railroad ties.

White oak is strong, hard, tough, elastic, durable, beautiful in grain, and rather easy to work. Oak furniture is never out of style, and modern finishing methods have increased the demand for it.

BLACK WALNUT was used for fuel and fences during colonial times. Acres and acres of black walnut trees were wasted when land was cleared. Despite the fact that these trees were cut without regard for value or supply, there is enough black walnut growing in American forests, under proper control, to meet the demand for many years.

Black walnut is one of the finest and most beautiful of hardwoods. This ideal American cabinet wood is noted for its rich color, fine grain, durability, and beauty. It grows mainly in the eastern half of the United States and requires a deep, rich soil. Stump and burl walnut are very valuable for veneers and panel work. More walnut is used for fine furniture than any other wood.

The heartwood of black walnut is rich, chocolate brown. It does not warp or check when properly seasoned. The wood is heavy, brittle, hard, strong, and coarse grained. The sapwood is pale brown and must be artificially darkened to match the heartwood. Walnut is used for fine furniture, cabinets, interior trim, gunstocks, airplane propellers, musical instruments, fine boats, and many other articles.

PLYWOOD

CONSTRUCTION of all plywood is based on veneer. Veneer is a thin sheet of wood made by one of three methods. The rotary cut method is most common. In this method, a continuous strip of veneer is cut by rotating a log against the edge of a knife. The log or bolt is held by a big lathe. Sliced veneer is produced by moving a log, bolt, or portion of same against a large knife to remove thin slices. Sawed veneer is produced by sawing thin slices from a log, bolt, or a portion of same.

The thickness of veneer varies greatly. Common thicknesses are from $\frac{1}{32}$ inch to $\frac{3}{16}$ inch, and a slice $\frac{1}{200}$ inch thick is possible.

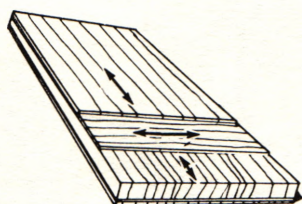
Plywood is made by gluing together three, five, or any odd number of layers (plies). The alternate layers of veneer have the grain at right angles to each other. This odd number of plies, with grains in opposite direc-

tions, gives the product a balanced construction. This tends to eliminate warping, shrinking, and expanding of the plywood.

The various veneer plies may be of the same or different thickness. The center ply is called the core. If the core is a ply of veneer, the product is called all veneer plywood. If the core is made of pieces of lumber glued together, the product is called lumber core plywood. The outer layers are called face-and-face or face-and-back veneer. In five-ply construction, the plies between the core and outer plies are called crossbands.



Veneer core plywood



Lumber core plywood

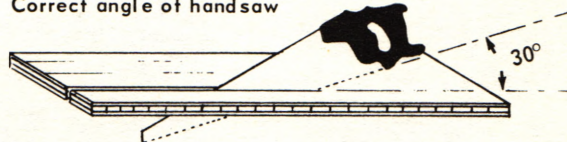
Plywood is constantly being adapted to a greater variety of uses. It is used extensively in building construction, wall paneling, drawers, doors, cabinets, and furniture.

HINTS FOR USING PLYWOOD will help you construct wood articles successfully. Follow these suggestions when using plywood on articles that require a fine degree of craftsmanship.

- Use only those types of plywood that the manufacturer recommends. For example, use only plywoods designed for exterior use where the wood will be subject to the weather.

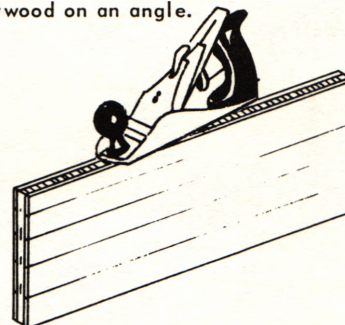
- Use a fine-toothed handsaw whether sawing with or across the grain of the face, or good side. Have the face of the panel up and hold the saw at a low angle (about 30 degrees).

Correct angle of handsaw



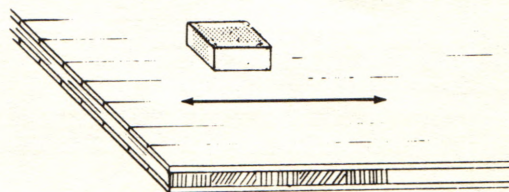
- To plane the edge of plywood, use a plane with a low angle blade, such as the block plane. Hold the plane in an angled position as it runs along the plywood edge. Never plane off the end of an edge; turn the plane around and start at the other edge.

Plane plywood on an angle.

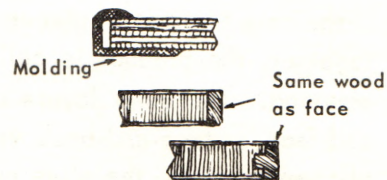
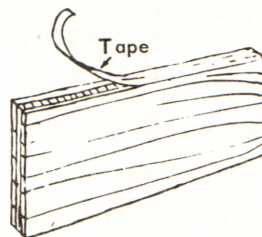


- When sanding plywood, always move the sandpaper in the direction of the grain. If you sandpaper across the grain, it will leave scratches on the surface. To obtain a fine finishing surface, start with medium sandpaper and follow with fine sandpaper. Many plywoods are pre-sanded at the mill. These require only light sanding with fine sandpaper before applying a finish.

Sand with grain of wood



- With a little more effort, you can make more attractive the visible edges of the plywood. Some commercial concerns sell easily applied cap moldings. However, they extend over the edge onto the face and back. This is objectionable in many places. Also available is woodlike tape to apply to the edge of the plywood. Follow the manufacturer's recommendations in applying this tape. The edge may be capped with a strip of similar wood nailed and glued in place.



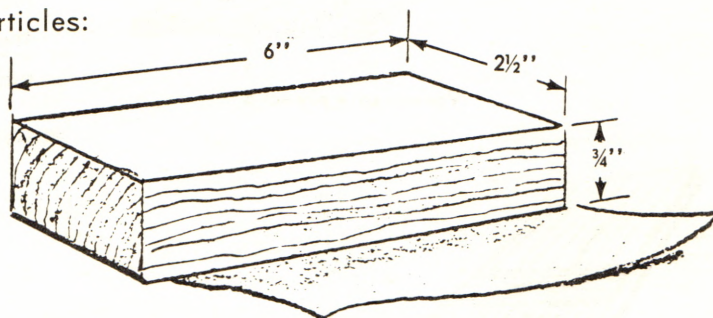
WORKING DRAWINGS

Make one of the following two articles:

SANDPAPER BLOCK

Material:

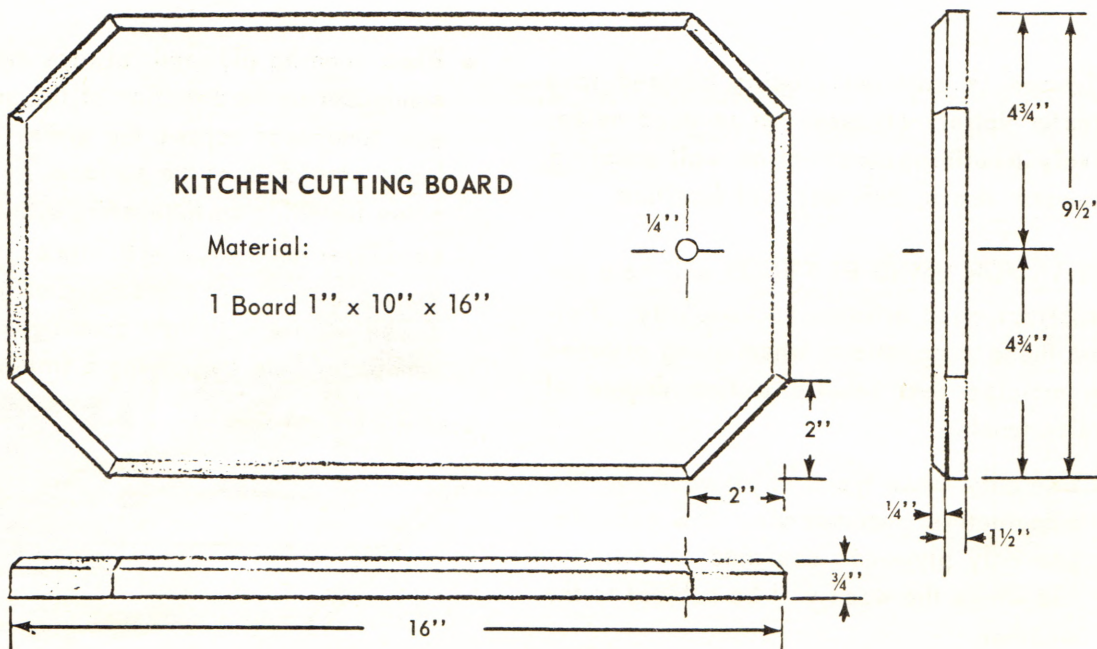
1 Board 1" x 3" x 6"
 1/4 Sheet sandpaper



KITCHEN CUTTING BOARD

Material:

1 Board 1" x 10" x 16"

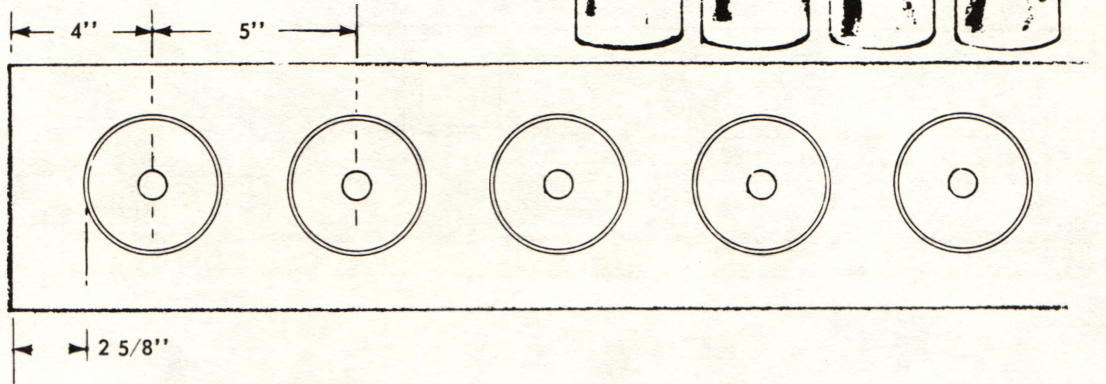


Make one of the following three articles:

BOLT AND SCREW RACK

Material:

- 1 Board 1" x 4"
- Roundhead screws
- Jars with lids



Screw lids of pint jars onto underside of storage shelf, and screw jars into lids.

TOOLHOLDER

See page 4. Use dimensions to suit your shopbench.

HARDWARE DISPLAY BOARD

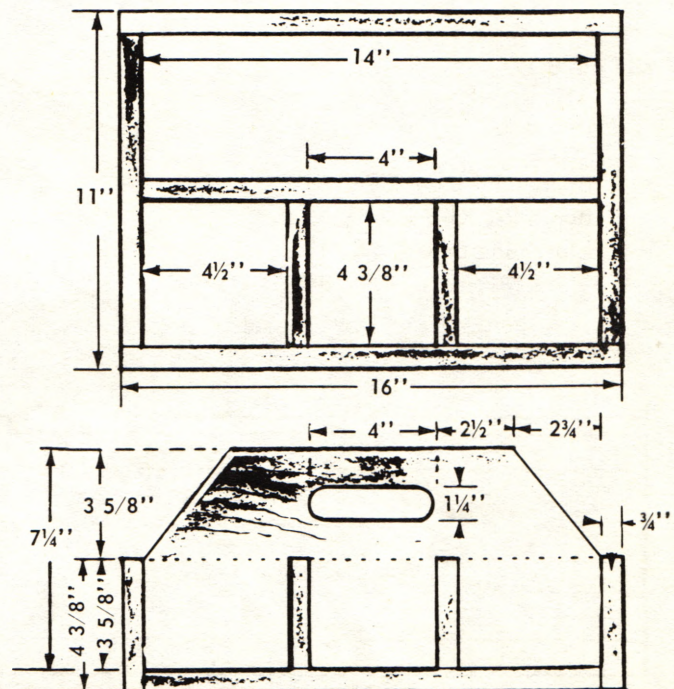
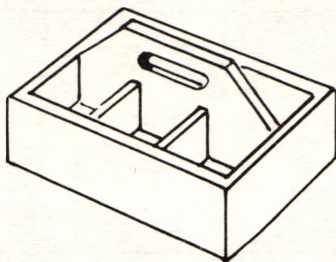
See the sketch on page 16. Plan to display at least 14 different kinds of wood fasteners. To fasten each nail, screw, or bolt, drill a small hole in the display board and tie the items to the board with fine cooper wire. Label each item.

Make two of the following six articles:

TOOL AND NAIL BOX

Material:

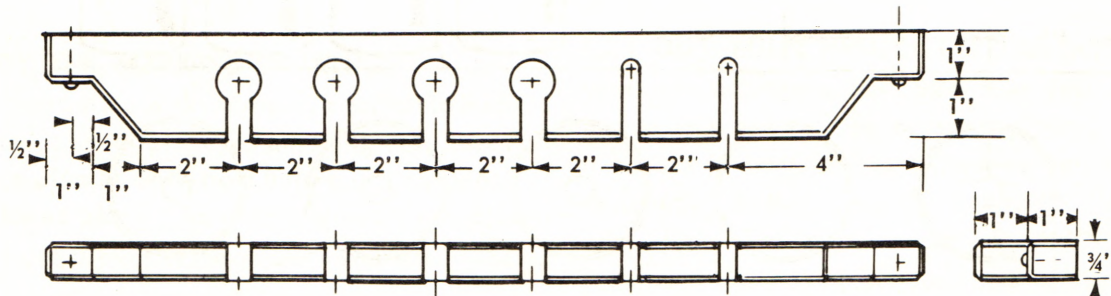
- 1 Board 1" x 12" x 17"
- 1 Board 1" x 4" x 10"
- 1 Board 1" x 6" x 54"
- 1 Board 1" x 10" x 15"
- Nails or screws



TOOLRACK

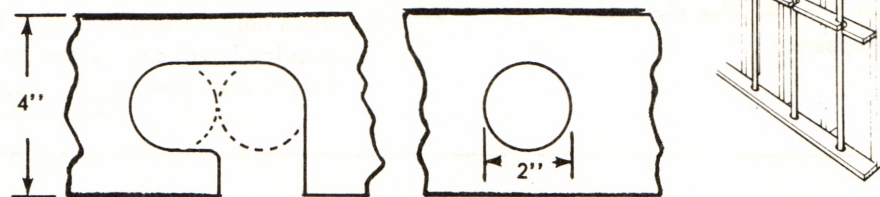
Material:

- 1 Board 1" x 2 1/4" x 18" (oversized dimensions of rough piece for square cutting and planing)
- 2 Roundhead screws, #6, 1 1/2" long



HOE RACK

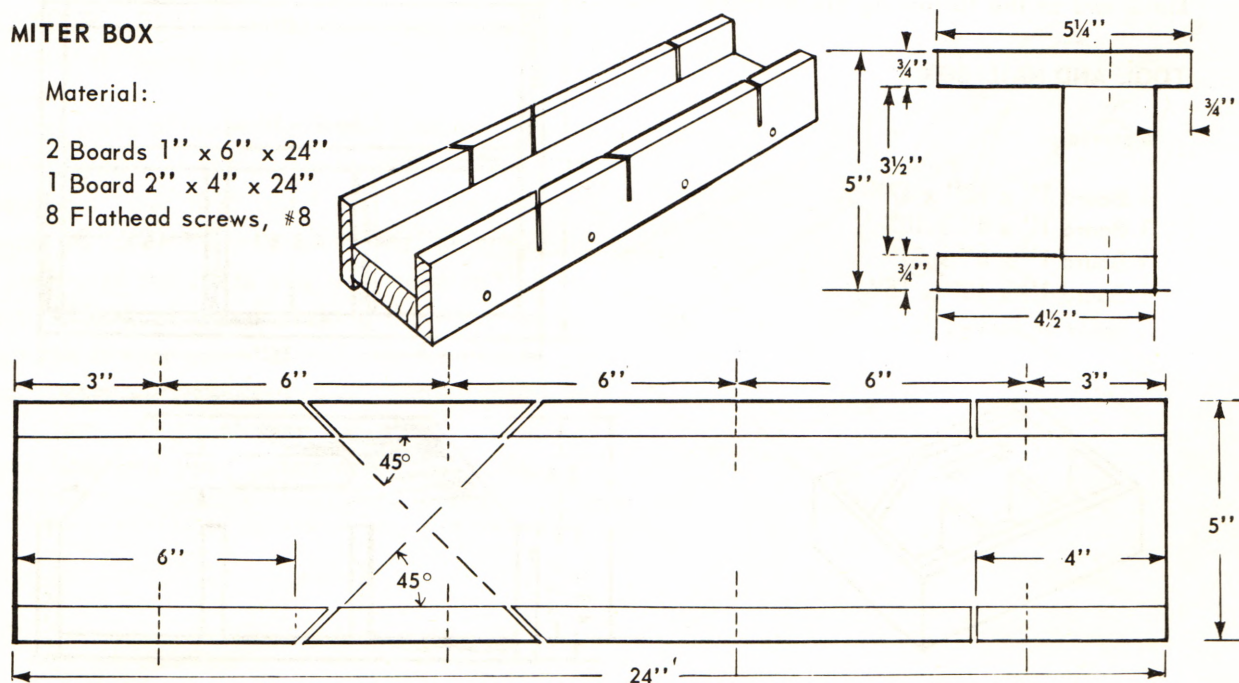
Hoes, rakes, spades, and brooms stay out of the way and within easy reach in notches made in rack close to wall.



MITER BOX

Material:

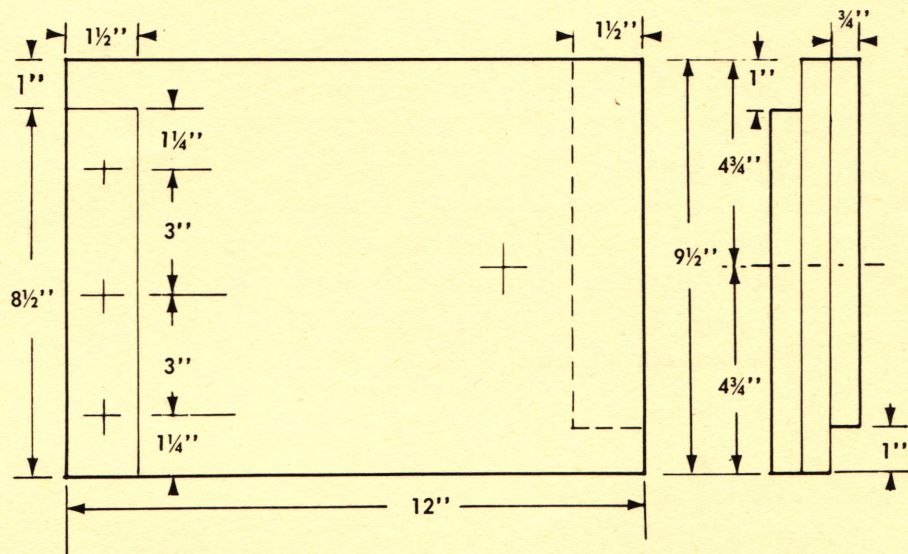
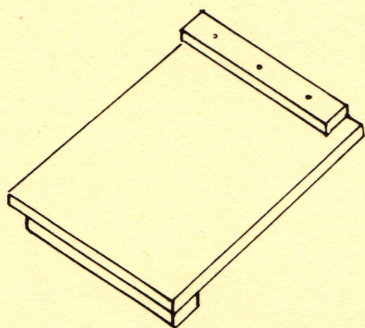
- 2 Boards 1" x 6" x 24"
- 1 Board 2" x 4" x 24"
- 8 Flathead screws, #8



BENCH HOOK

Material:

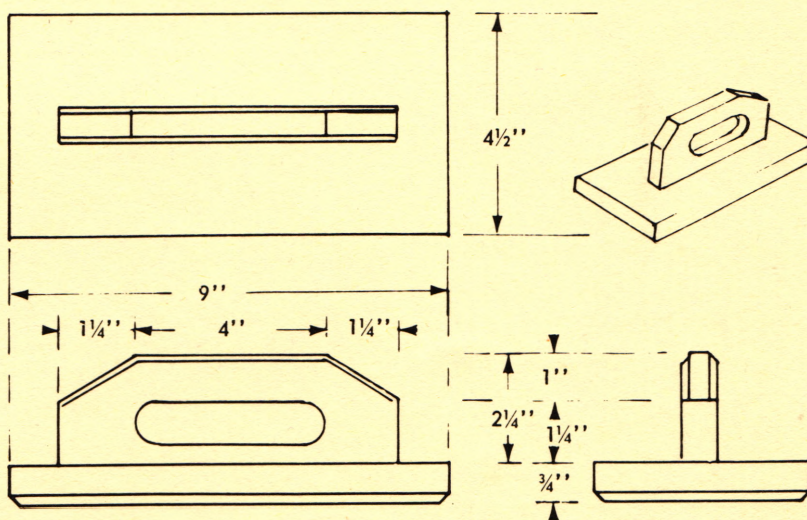
- 2 Boards 1" x 2" x 8½"
- 1 Board 1" x 10" x 12"
- 6 Flathead screws, #4,
1¼" long



CONCRETE FLOAT

Material:

- 1 Board 1" x 9" x 4½"
- 1 Board 1" x 7" x 2¼"



DEMONSTRATIONS

Demonstrations are fun. A demonstration is a good and easy way for you to tell your friends what you are learning in the Agricultural Engineering Project. A demonstration puts words into actions. It may show how to make something or how to do something—the main thing is, you are **showing** how to make it easier for your friends to understand as you are **telling** how.

You will want to use the 4-H demonstration manual To Show How You Must Have the "Know Hows" of 4-H Demonstration to help you plan your demonstration. Your 4-H leader and farm and home advisors can advise you in preparing demonstrations.

Start by choosing a subject that you like and that is interesting to others. The skills you are acquiring in this project will make excellent topics for demonstrations. Here are a few:

- Proper use of tools
- Care of tools
- Sawing a straight line
- Use of wood fasteners
- Drilling holes
- Grades, kinds, and uses of woods
- Safety tips in using tools
- Pulling or driving nails
- Steps in constructing a project from wood