The Home Mechanic's Library

CARPENTRY AND WOODWORKING

A Handbook of Tools, Materials, Methods, and Directions

BY

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INTRODUCTION

This book concerns the varieties of wood, and the tools, materials, operations, and processes that are familiar to the woodworker. Before consulting this section for specific information, the reader is urged to acquaint himself, in a general way, with the contents of each chapter.

Chapter 1 is a fairly comprehensive treatise on the common woods and their uses. Various types of wood are described, and information is given regarding their use, price, and the common practice in ordering. The last two sections of this chapter deal with various manufactured wood products and wood substitutes.

Chapter 2 describes the ordinary woodworking tools and their uses, in considerable detail. The objective is to describe all the tools which might be used by the home craftsman, including the power tools adaptable to the requirements of the home workshop.

Chapter 3 describes the various materials commonly used by the woodworker. The materials discussed are available, in ordinary times, in the average hardware store, and thus should be familiar to the home craftsman.

Chapter 4 gives information, which has been prepared for the needs of the beginner, on the various basic operations and processes of woodworking. Hints are given on the proper care of tools and materials. The common joints, and their construction are described.

Chapter 5 is devoted to wood turning, since the wood lathe is a power tool frequently found in the home workshop. The correct methods of preparing and setting up work on the lathe are discussed, as well as detailed explanations of the various kinds of cuts. Instructions are given also for drilling, boring, sanding, and carrying out other operations on the lathe.

In Chapter 6, the most important elements of inside and outside carpentry are discussed. The projects described are well within the ability of the average individual. The tools needed are those described in Chapter 2. In the last third of the chapter, twelve typical projects are outlined, and are used to explain how the home craftsman can plan his work.

Chapter 1

THE COMMON WOODS AND THEIR USES

Ways of Classifying Wood . . . How Wood Is Measured . . . How Wood Is Sold . . . Structure and Grain in Wood . . . Woods Used in House Framing: Fir, Spruce, Sitka Spruce, Hemlock, Hard Pine . . . Woods Used in House Trim: Soft Pine, Basswood, Chestnut, Oak, Maple, Birch, Whitewood . . . Woods Used in Cabinetmaking: Black Walnut, Mahogany, Cherry, Red Cedar . . . Miscellaneous Woods: Cypress, White Cedar, Locust, Hickory, Ash . . . Manufactured Wood Products: Plywood and Veneer, Molding, Shingles, Clapboards, Lath . . . Wood Substitutes: Hardboard, Wallboard, Insulating Board, Fire-resistant Board

Ways of Classifying Wood. All varieties of wood may be classified in various ways. One basis of classification is the hardness or softness of the wood. Although no attempt will be made to classify woods according to their degree of hardness or softness, the general statement may be made that the varieties of wood obtained from trees that shed their leaves annually are generally known as hard wood, while the trees of the needle-leaf variety, the evergreens, yield the soft woods.

Another basis of classification is porousness of grain, and from this standpoint varieties of wood are said to have open grain or close grain. This second classification is more useful in judging woods used in cabinetmaking than it is for those used in house framing, since the type of finish may be determined largely by closeness of the grain.

How Wood Is Measured. Lumber is usually sold in standard dimensions of thickness, width, and length. Most lumber dealers stock various thicknesses of the hard woods, ranging from ½″ to 6″ (the symbols ″ and ′ stand for inches and feet), and random lengths and widths, ranging from 4′ to 16′ in length, and 3″ to 12″ in width. Dealers often have pieces of lumber known as "shorts," equal in quality to the standard sizes, but are sold at lower prices. The soft woods come in standard thicknesses of 1″ to 3″, and lengths ranging from 8′ to 20′, in multiples of 2′. There are a few exceptions to these standard dimensions.

How Wood Is Sold. As purchased from the dealer, lumber is either rough or surfaced. Lumber that is surfaced on two sides only is known as S2S (surfaced two sides). Lumber may also be purchased with both edges and sides surfaced, and in that case, it is known as S4S (surfaced four sides).

The purchaser must keep this in mind, as surfacing removes some of the material, reducing the dimensions. For example, a piece of lumber 2″ thick, and 4″ wide in the rough, may be only 1⅝″ thick, and 3⅝″ wide when dressed, or surfaced. If lumber of definite dimensions is required, the finished dimensions must be specified when ordering.

Most lumber is sold by board measure. The unit of board measure is the board foot. A board foot is an amount of lumber equivalent to a board which is 1″ × 12″ × 12″. When ordering lumber, each size is listed separately, giving the number of pieces, then the thickness, then the width, then the length. For example, ten pieces 1″ × 8″ × 10′. The lumber dealer then charges the purchaser for the number of board feet at a price per thousand board feet. The number of board feet is found by multiplying the thickness in inches, by the width in feet, by the length in feet. In the above example, 1″ × 8″ × 10′, if the width is expressed in feet, each piece contains 1″ × 8/12′ × 10′ which equals 20/3, or 6⅔ board feet. As there are ten pieces, the total would be 6⅔ × 10, or 66⅔ board feet. If the lumber were quoted at $120 per M ($120 per thousand board feet), this would be 12¢ per board foot. Thus the total cost of the lumber in this example would be 67 × 12¢ or $8.04. The charge would be for 67 board feet.

If the purchaser simply orders a certain number of board feet of lumber, such as 100 board feet of 1″ thick pine, he may get a variety of widths and lengths. When the lumber is ordered, less than 1″ thick, the dealer usually charges for the 1″ thickness. Special lumber, such as molding, is sold by the linear, or running foot. Laths and shingles are sold by the bundle. Plywood and veneer panels are sold by the square foot.

Most lumber can be purchased in different grades. Lumber is graded according to its freedom from imperfections, such as knots, checks, pitch pockets, etc. These various lumber grades are described in the *Wood Handbook*, published by the U. S. Department of Agriculture, pages 72–94. It is advisable to consult a lumber dealer about the grade of lumber needed for a specific job.

Structure and Grain in Wood. The worker with wood should have some knowledge of wood structure, in order to become familiar with some of the important terms used in woodworking.

Wood is composed of layers of fibers which resemble small tubes. The walls of these fibers, known as cells, vary in thickness with different species of wood. The wall thickness and the cell size determine whether the wood is porous or nonporous. Porous woods are usually known as *open-grain* woods, while nonporous woods are called *close-grain* woods.

Layers of wood are added to the tree each year by the growth of additional cells. Due to greater ease in obtaining food, the tree grows most rapidly in the spring, producing a growth of new wood which is usually soft, spongy, and light in color. Cells are added less rapidly in the summer, and the wood is harder and darker in color. In the fall and winter, the tree is dormant, with practically no growth of new cells. See Fig. 2.1.

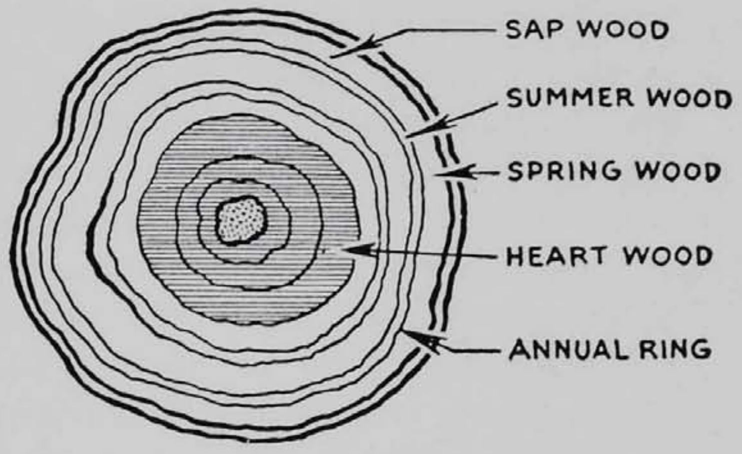


FIG. 2.1. Cross section of tree showing growth rings.

The layer of light wood, called *spring* wood, and the layer of darker wood, called *summer* wood, together make a distinct annual growth ring which may be distinguished in most trees. These rings form concentric circles within the tree and, when the tree is cut down, the annual growth rings appear as

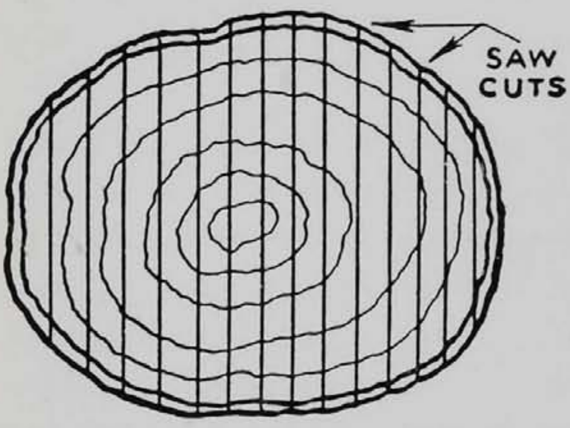


FIG. 2.2. Slash sawing of lumber.

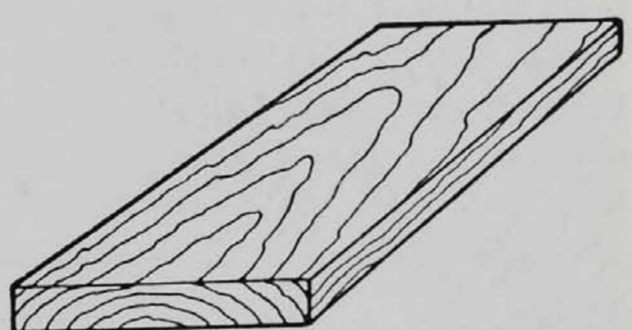


FIG. 2.3. Appearance of grain in slash-sawed board.

shown in the diagram. The outer rings are composed of cells still active in carrying the sap which nourishes the tree. Thus the outer layers of a log are called sapwood.

When the tree is cut into boards, the annual rings form a pattern in the board known as the *grain*. The pattern is more pronounced in some woods than in others, and will also vary in the same species. However, the pattern of annual rings, or grain, has more or less definite characteristics in each species of wood and is one means by which the species can be identified.

The appearance of the grain is greatly affected by the manner in which the board has been cut from a log. Boards produced by one method are known as plain, or slash sawed, and the grain appears as shown. See Figs. 2.2 and 2.3.

The other common method of sawing a log into boards is first to quarter the logs, then to make the saw cuts as nearly as possible at right angles to the annual rings. This produces a grain of quite different appearance in the board. See Figs. 2.4 and 2.5.

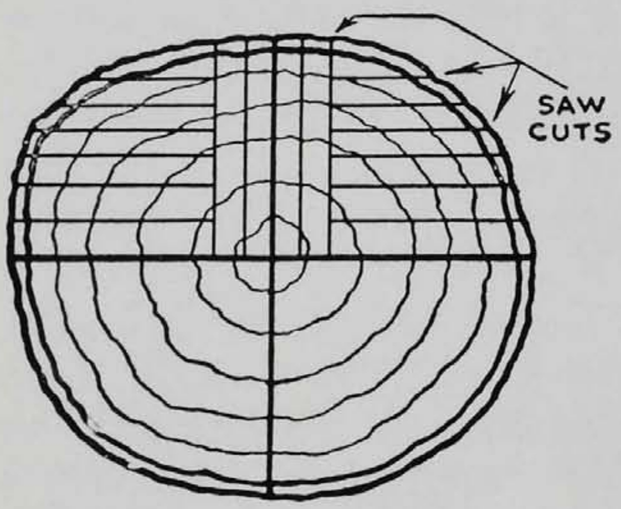


Fig. 2.4. Quarter sawing of lumber.

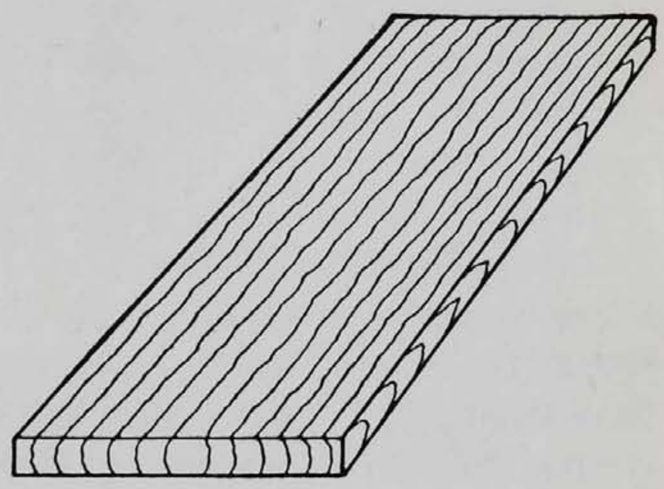


Fig. 2.5. Appearance of grain in quarter-sawed board.

Much more space could be devoted to the growth and structure of wood. However, this brief explanation will give the home mechanic an understanding of what is meant by grain, so that he can better understand the descriptions of the various species of wood.

Woods Used in House Framing. *Fir* wood is pale brown in color, with lighter sapwood. It is light in weight, rather low in strength, moderately soft, and straight grained. It shrinks and warps little, and is easily worked. Its chief use is in the construction of small houses, usually as dimension lumber and common boards. It is also used extensively for making boxes and plywood.

Spruce. The term Eastern Spruce includes three species: red, white, and black. All three have about the same properties. The color runs from light yellow to light brown. The wood is light in weight and of medium strength, it is easily worked, and has a moderate amount of shrinkage. Eastern

Spruce is used principally for framing and general mill work. Large quantities are also used in boxes and crates.

Sitka Spruce, which grows in the West, is light brown in color, with straight, coarse grain. The wood is light in weight, of medium strength, rather stiff and tough, durable, and easy to work. Because it can be obtained in clear, straight-grained pieces of large size and uniform texture, Sitka Spruce is used in airplanes. Its greatest use is for sash, doors, siding, ceiling, flooring, and exterior and interior finish. It is a good wood for the construction of boxes, crates, and ladders.

Hemlock is reddish brown, light in weight, and moderately low in strength. It is rather soft, and warps and checks badly. It is splintery and splits rather easily, though it holds nails well. It is rather difficult to work. It is commonly used for framing, sheathing, roofing, and subflooring and for other purposes where a coarse, cheap lumber is desired.

Hard Pine. There are many species of pine that are commonly classed as Southern Yellow Pine. In general, the heartwood and summer wood are red, while the spring wood is yellow. The annual rings are very pronounced, with a sharp contrast between spring and summer wood. The wood is rather resinous with many ducts, and the grain is straight and coarse. The wood is moderately hard, with extreme hardness in the darker portion of the annual ring. It is very strong and moderately heavy. It warps little and it is quite durable, although it is troublesome to work, and likely to split along the annual rings in nailing. It is commonly used in railroad ties, house trim, shipbuilding, cars, docks, bridges, and other heavy timber construction.

Woods Used in House Trim. *Soft Pine*. There are many species of pine known as soft pine. They range in color from a creamy white to a light reddish brown. Most of the soft pines are light in weight, moderately strong, and have little tendency to shrink. These pines work easily and hold nails well. They are used largely for general millwork, such as the making of doors, window sash, interior finish, blinds, and cabinetwork; they are also used in general carpentry, and in patternmaking.

Basswood is very light brown, approaching cream in color. The grain is straight and close; the wood is light in weight, and comparatively tough. It is soft in texture, rather durable, warps little, and holds nails well. Basswood is very easily worked, and bends without splitting. It is commonly used in the manufacture of wooden kitchenware, picture frames, toys, fruit baskets and boxes. It can be used to good advantage in the construction of the less expensive types of furniture and cabinetwork.

Chestnut is reddish brown, with large, distinct pores. It is moderately low in weight and strength. It is fairly easy to plane, chisel, and saw, although it splits easily. It is highly resistant to decay, and for this reason, poles and fence posts are among its important uses. Commercially, it is used for core stock in veneer panels, caskets, and coffins. In the home workshop, it may be used as an interior finish, and for the construction of furniture.

Oak. There are many species of oak, which may be divided into two groups, red oak and white oak. Red oak is reddish brown in color, with a very coarse grain, which makes the wood appear porous. White oak is light brown to whitish in color. It is heavy, hard, and stiff. It warps and checks badly, and is difficult to nail. Both kinds are difficult to work, although red oak is not quite as difficult as white oak. Red oak is used most frequently for interior trim, for furniture, flooring, barrels, shipbuilding, cabinetmaking, farm implements, and motor vehicle parts. It is also used as a material for timbers, cross ties, and piling, in heavy construction.

Maple. There are about thirteen species of maple grown in the United States. Sugar maple is probably the most abundant, and is classed as hard or rock maple. The wood is light reddish brown to white in color. It is heavy, very hard, very strong and stiff. The grain is usually straight, but it is sometimes curly and wavy. It warps to some extent, splits badly in nailing, and is very hard to work. It is used extensively for many types of furniture and flooring. Large quantities are used for agricultural implements, handles, and vehicle parts. It is excellent for wood turning.

Birch. Probably the most common of the birches is the yellow birch, which is light reddish brown in color, with white sapwood. The grain is close and fairly straight. This wood is heavy, moderately hard, and very strong. It polishes well, splits with difficulty, holds nails well, and is rather hard to work. Birch is used for the construction of furniture, some flooring, interior finish, and wood kitchenware. It is well adapted as a base for enamel coating.

Whitewood is often called yellow poplar. The color is light greenish, or yellow brown with a creamy white sapwood. The grain is straight and close. It is light in weight, moderately strong, and soft. It warps little, does not split readily, nails very well, is easy to glue, holds paint and enamel well, is easily worked, and finishes smoothly. It is used in less expensive furniture, interior trim, boats, and cabinetwork. This wood is highly recommended for home workshop use.

Woods Used in Cabinetmaking. *Black walnut* is one of the most beautiful of native woods. It has a chocolate brown color, with much lighter sapwood. The pores are rather large, but the grain is straight. Black walnut is strong, hard, and moderately heavy. It warps very little, is durable, splits with some difficulty, takes and holds nails well, and is very easy to work. Black walnut is used chiefly for cabinetwork, furniture, interior finish, veneers, and gun stocks.

Mahogany. In lumber yards, mahogany is usually known by the name of the place from which it comes, such as Honduras, West Indies, Mexican, Spanish mahogany, etc. It is usually red brown in color, with a porous grain. It is heavy, very strong, and generally classed as very hard. These characteristics vary with the species. The wood warps little, holds its shape well, is very durable, splits easily, nails with difficulty, polishes well, and takes glue readily. Some species are hard to work, while others may be worked easily. This is probably one of our best known woods because of its frequent use in furniture, for cabinetmaking, interior finishes, veneers, and in patternmaking.

Cherry. The color varies from light to dark reddish brown. The grain is straight, close, and fine. The wood is medium in weight, strong, shrinks and warps little, splits readily, but is easily worked. It is used for cabinetwork and furniture, and to some extent for patternmaking. Cherry is an excellent wood for turning.

Red cedar. The heartwood is dull red, and the sapwood white. It has a straight grain, but is usually very knotty, very light in weight, and of medium strength and hardness. It warps little, and is very durable, splits in nailing, holds paint well, and is very easy to work. It is used for interior finish, for chests, shingles, siding, porch columns, poles, and posts.

Miscellaneous Woods. *Cypress* is reddish brown in color, and has a straight grain. It is light in weight, medium in strength, and soft. It does not warp readily, but is likely to check. It is especially valuable in places where resistance to decay is an important factor. It is used for small boats, doors, porch materials, water tanks, shingles, posts, sash, siding, greenhouse construction, and interior finish.

White cedar is pink to brown in color, with lighter sapwood. It has a straight grain. It is very light in weight, weak, and soft. It shrinks little, warps only slightly, is extremely durable, nails well, and is easily worked. It is used chiefly for boats, barrels, shingles, posts, and railway ties.

Locust. The color is from yellow to brown. The wood is rather porous, with a crooked grain, but is compact. It is very heavy, very strong, and very hard. It warps badly, splits in nailing, and is tough and difficult to work. Its common uses are in shipbuilding, in heavy construction, for mine timbers, and for fence posts, and poles.

Hickory is dark brown, with the sapwood nearly white. The grain is porous, and usually straight. The wood is very heavy, very strong, and very hard. It splits with great difficulty, is almost impossible to nail, and very difficult to work. It is used largely in the vehicle industry for spokes, rims, poles, and shafts. In the tool industry, it is used to make handles for axes, picks, sledges, and hatchets. It is also used for golf club shafts, ladder rungs, and similar purposes.

Ash. White ash and black ash are the most common species. Black ash is dark brown in color, with light sapwood. White ash is a very light reddish brown, with white sapwood. The wood is porous, but straight in grain. It is rather heavy, strong, and hard. It warps little, splits readily, nails poorly, and is quite hard to work. Its most common uses are for interior finish, cabinetwork, farm implements, carriages, baseball bats, skis, and snowshoes.

Manufactured Wood Products. *Plywood* is a composite board made by gluing together several sheets, usually three or five, of veneer (thin-sliced wood), with the grain of the alternate layers at right angles to each other, and with the grain of the two outside layers running in the same direction. The layers are usually of equal thickness. However, in heavy plywood, the inside layers are sometimes thicker than the two outside layers. The inside layers, or core stock, are usually made of the same kind of wood as the outside layers. Formerly, all plywood was bonded together with hot glue; an improvement was the use of a casein glue. The most recent development is the use of the plastic adhesives.

Plywood is very strong, flat, and of uniform thickness. The alternate grain layers, together with the glue between the layers, minimize the changes in shape caused by moisture. Plywood can be obtained in a number of different kinds of wood, with either one or both sides smooth.

It is excellent material to use for panels, drawer bottoms, and ceilings, and now is being made in sheets large enough to use on the walls of a prefabricated house. Due to the excellent adhesives now available, plywood may be used in boat construction, and for many other purposes where the waterproof glue insures its permanency. Large quantities of a cheaper quality of plywood are used for shipping cases and boxes, and for concrete forms. In many manufactured articles, plywood is glued in curved forms, the layers being easy to bend one by one, and the adhesive giving the material permanent shape, after the glue has set.

Plywood is one of the handiest materials in the home workshop. It can be fastened together with nails or screws, but projects should be planned so as not to require nailing into an edge or end.

Plywood is manufactured in a variety of sizes. The common sizes are ¼″, ½″, or ¾″ in thickness, 2′, 3′, or 4′ in width, and 2′ to 8′ in length. It is best to determine the exact size needed for a project, and to ask a dealer for the nearest available size.

Veneer is a form of plywood, in which an outer layer is chosen for its appearance rather than for its strength and is usually much thinner than the core. Both outside layers may be of some decorative wood. The core of veneer stock is usually made of a soft wood of cheaper quality, one that can be worked easily, and that stays in shape well. This is the type of plywood used in furniture panels, giving a combination of strength and beauty of grain. The sizes are approximately the same as those of ordinary plywood, but the cost of the veneer stock depends upon the price of the wood on the outside layers. A catalog of any of the large plywood companies contains a fund of information about both plywood and veneer.

Molding is a strip of wood machined to give a desired contour in cross section. There are a number of standard forms, and many special ones. A form of molding commonly used in the home is picture frame stock. Another widely used form of molding is quarter round. Other standard forms are cove molding or scotia, picture molding (not picture frame stock), and the rake and eave molding used on the outside of houses. Many older houses were finished with molding around baseboards, doors, and window casings.

White pine is the wood most commonly used for molding, although any straight-grained wood can be used. Molding is often machined on large pieces of furniture with a router, after the pieces are assembled. The portable electric router is an excellent tool for this work.

Molding is sold by the linear foot, the price depending upon the kind of wood used, the size of the cross section, the quality of the stock, and the shape to which it is machined. A stock molding will usually be satisfactory for home workshop projects. Any lumber yard will supply information as to the types immediately available. For example, quarter round is usually available in ½″, ¾″, and 1″ radius.

Shingles. Up to twenty-five years ago, wooden shingles were almost universally used on dwelling houses and farm buildings. Since that time, many different types of roofing have been developed. However, the wooden shingle still finds a large field of use. The standard wooden shingle is normally 16″ in length, about ½″ thick at the butt, tapering to less than ⅛″ at the tip, and of random width. On roofs they are laid 4″ to 6″ to the weather. They are sold by the *thousand*, in bundles. As used in selling shingles, the term thousand means four bundles. Shingles from 18″ to 24″ in length may be purchased today, having proportionately thicker butts according to the lengths. These longer shingles were developed for use on side walls of houses, where they are laid 8″ to 12″ or more to the weather. Shingles are made of cedar, cypress, or redwood.

Its tapering shape makes the shingle a useful "fix it" in carpentry work and in the home workshop. It is widely used in shimming up the ends of unsized timbers, and is very convenient in lining up the strapping on a ceiling that is to be reconstructed. It is ideal material to use for shims in leveling machines that are being installed on an uneven floor.

Shingles can be purchased either stained, painted, or natural. They are obtainable in about four different grades. The prices vary greatly with the locality and the quality.

Clapboards were formerly almost always made of white spruce. The usual dimensions were 4′ long, 6″ wide, ½″ thick at one edge, and less than ⅛″ at the other, with one side planed smooth. Redwood clapboards may be purchased today with the same cross section as spruce, and in lengths up to 12′ or 16′. They are sold by the bundle and in ordering, the number of square feet to be covered should be specified. They are usually exposed to the weather about 4″ or 4½″, and have one row of nailings about ½″ from the butt and 8″ apart. To lay clapboards with good joints and without springing the casings requires a high degree of skill. Practically the only use for clapboards is on outside walls.

Lath. Wooden lath is another product that has been replaced to a large degree by other materials. A lath is a rough strip of wood, usually spruce, about 4′ long, about 1½″ wide, and ⅜″ thick. Laths are sold by the bundle, and lathers are paid for laying them by the bundle. They are nailed direct to the studding or strapping on the ceiling, with four single nails per length. Laths are spaced about 5/16″ apart. The original type of lath was a board split at alternate ends about 2″ to 4″ apart, and these splits were opened as the boards were nailed. This was board thickness (about 1″); and in old houses, when the plaster is removed, this type of lath may be found in thicknesses up to 1½″. The variation in thickness is leveled by the mason as he applies the ground coat of plaster. In the fireproof construction of today metal lath is common. It provides more clinchers and eliminates the shrinking and swelling that take place in wooden lath.

Wood Substitutes. *Hardboard* is made of finely ground wood, mixed with a bonding material and pressed to a standard thickness under heavy pressure. Hardboard is heavy, very hard, stiff, and brittle, has one extremely smooth side, is fire-resistant, and practically waterproof. It can be nailed with difficulty, but should preferably be drilled for nails, because it is practically impossible to drive nails flush without countersinking them. It has no grain, but can be sawed, planed, and worked like wood. It can be bent around a curve if steamed, or soaked for considerable time. It is excellent material for drawer bottoms, small shelves, and panel work that is to be painted. It is often used on the ceilings and walls of rooms, and when finished, produces a durable, strong, smooth, and flat surface. This material is excellent for permanent templates or patterns, because of its smoothness and permanency of shape.

It can be purchased in sheets 4′ wide and from 6′ to 12′ long. Prices range from 6¢ to 8¢ per square foot. There are many hardboards available under various trade names.

Wallboard. There are several boards on the market which might come under this category. The term *wallboard* means those inexpensive sheet materials which are not specifically hard, and which have no particular insulating value. Some are made from a wood-fiber pulp, others have a wood-fiber pulp cover, with a thin wood core.

These materials are no more durable than hard pasteboard of comparable thickness, and do not resist moisture. They can be nailed with ease. The edges should be protected by a wooden strip or molding. Wallboard should be sized before it is painted. It may be used for panels in low cost jobs, and it may also be used on ceilings and walls, provided it has some sort of backing to prevent buckling. It is good sheet material for temporary jobs. It is one of the best materials to use in the shop for full size layout work.

Thicknesses usually range from 3/16″ to 5/16″; widths, 4′; lengths, from 6′ to 12′. It may be purchased under various trade names.

Insulating Board. The materials called insulating board vary greatly in their texture and composition. Insulating board is usually much thicker than wallboard or hardboard; it is fairly smooth on one side, and can be nailed easily, but is not firm enough to receive the threads of a wood screw. It is quite absorbent, and much more inflammable than the hardboards; it can be worked with woodworking tools, although because of its soft texture it does not hold sharp corners and edges. Before painting, this material should be sized.

Insulating boards may be obtained in sizes from 4′ to 8′ wide, and 6′ to 14′

long. The thickness ranges from approximately ½″ to 2″. Detailed descriptions of various types of insulating boards may be found in manufacturers' catalogs.

Fire-resistant Board. There are many different fire-resistant boards available. Some may be classified as hardboards; others are heat-resistant, but merely filler material, not having sufficient strength to be used without protection.

Chapter 2

WOODWORKING TOOLS AND HOW TO USE THEM

Hand Tools: Rules, Straight, Two-foot Folding, Folding Rule, Tape Measure . . . Squares: Steel Framing Square, Try Square, Combination, Bevel . . . Saws: Crosscut, Rip, Back, Coping, Keyhole, Compass, Dovetail, Miter Box Saw, Bucksaw, One-man and Two-man Saws . . . Hammers: Claw, Tack . . . Screwdrivers: Hand, Screwdriver Bit, Offset, Special . . . Planes: Block, Smooth, Fore, Jointer, Match, Rabbet, Router, Universal, Cabinet Scraper, Spokeshave, Drawknife . . . Chisels and Gouges: Tang, Socket, Paring, Firmer, Framing, Butt, Mortise, Gouges . . . Mallet . . . Boring Tools: Auger Bit, Ship Auger, Electrician's Bit, Twist Drills, Countersink, Forstner Bit, Expansion, Plug Cutter . . . Miscellaneous Hand Tools: Bit Brace, Hand Drill, Nail Set, Marking Gauge, Pocketknife, Sharpening Wheels and Stones, Putty Knife, Wrecking Bar, Dividers, Brad Awl, Vise, Plumb Bob, Wood File, Rasp, Saw File, Bar Clamp, Hand Screw, Chalk Line, Level, Miter Box, Ax and Hatchet . . . Power Tools: Circular Saw, Lathe, Wood Turning Tools, Drill Press, Jig Saw, Scroll, Jointer, Band Saw, Surface or Thickness Planer, Shaper, Portable Belt Sander, Portable Router

HAND TOOLS

Rules. The *rule* is probably the most necessary tool of all. There are several different types of rule, each suited to its own purpose.

The *straight rule* is usually chosen by the patternmaker or the bench woodworker. Always used at or near the bench, it need not be folded, and

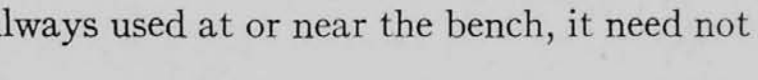


FIG. 2.6. Straight rule.

its lack of joints gives it several advantages, such as readiness for immediate use, and freedom from changes in length, particularly important in patternmaking or cabinetmaking, where all measurements must be accurate. See Fig. 2.6.

The *one-joint, 2′ rule* is very handy for the bench or the carpenter's tool box. Its size permits the use of figures and graduations that are large enough to be read easily. The three-joint, folding rule is convenient to carry in the pocket, and is very handy in the home workshop. The *4′, 6′, and 8′ folding rules* are carpenters' tools. They are convenient in taking longer measure-

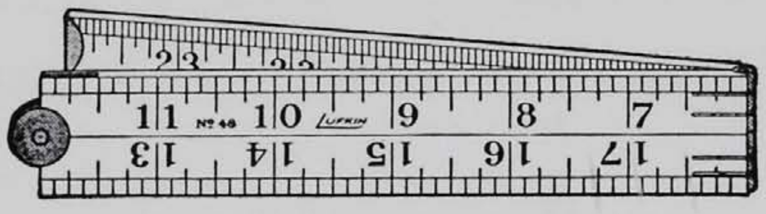


FIG. 2.7. One-joint, 2′ rule.

ments, and yet are suitable for the pocket or the tool box. The most expensive type of rule is made of boxwood. The one- and three-joint rules may be purchased bound in brass, although the same style with no binding is much less expensive. See Figs. 2.7 and 2.8.

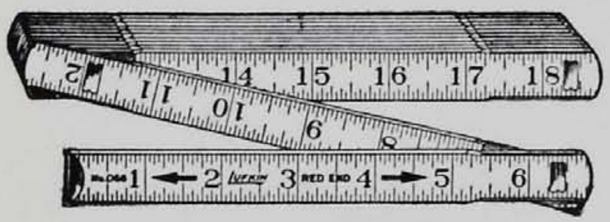


FIG. 2.8. Folding rule.

FIG. 2.9. Tape measure.

Tape measures are used in taking longer measurements, and the steel tape is, of course, the most durable and accurate. The woven tape has been used a great deal, but if the measurement is to be reproduced by another rule, its accuracy should be checked, because of the changes in the length of the woven tape caused by weather conditions. A 50′ steel tape is very handy, if many measurements over 10′ are needed. See Fig. 2.9.

Squares. Another indispensable tool is the square. Many types of squares are made; a few standard types are described below.

The *steel framing square* is an all metal tool, permanent in shape, and very convenient for testing and layout work. It is indispensable for the carpenter. The long arm is called the blade and the short arm, the tongue. A convenient size has a 24″ blade, and a 16″ or 18″ tongue. See Fig. 2.10.

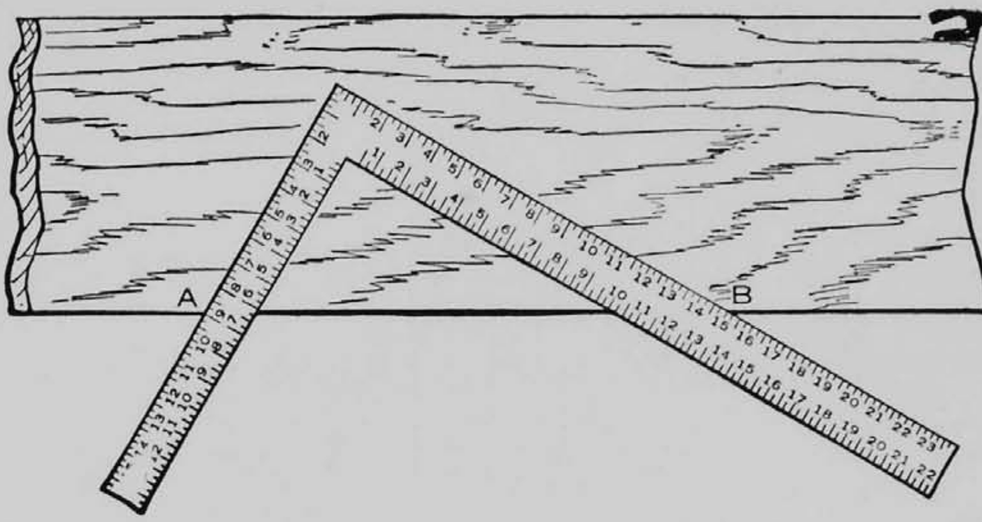


FIG. 2.10. Steel framing square.

The *try square* is a necessary tool for the mechanic. The handle may be of steel or wood but the blade is always steel. The blade length is commonly from 4″ to 12″. It is a precision tool and should be handled as such; if dropped on the floor, it should immediately be checked for accuracy. See Fig. 2.11.

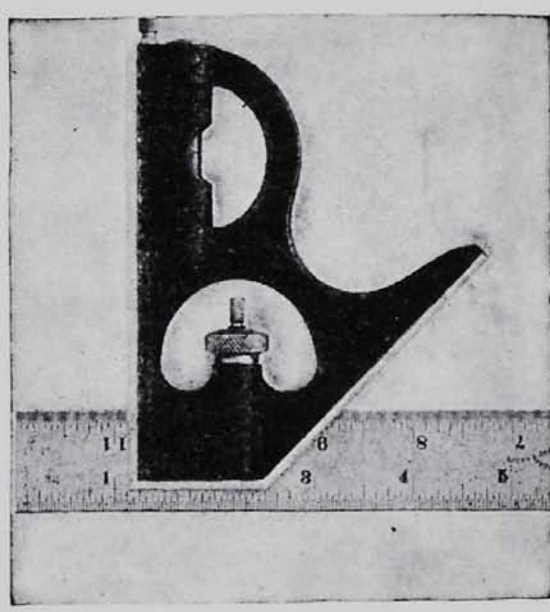


FIG. 2.11. Try square. FIG. 2.12. Combination, or universal, square.

Another type of square is the *combination*, or *universal*, *square*. It consists of a cast-iron head, and a 6″, 9″, or 12″ blade which slides through the head and can be fixed at any point by a set screw. The head makes a 90° angle with the blade on one side, and a 45° angle with the blade on the other side. Many of these squares have a level glass on the head, and very often are fitted with a scratch awl, which is useful in layout work. See Fig. 2.12.

The *bevel square,* like the combination square, has a loose blade which can be locked in position by a set screw. However, the blade of the bevel square may be set at any angle with the handle from 0° to 180°. It is an indispensable tool for the woodworker. See Fig. 2.13.

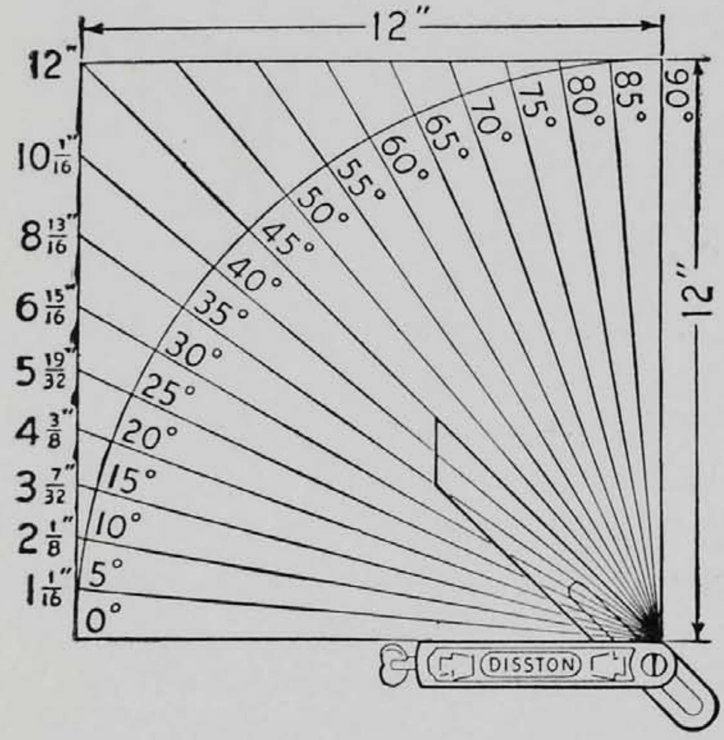


FIG. 2.13. Bevel square.

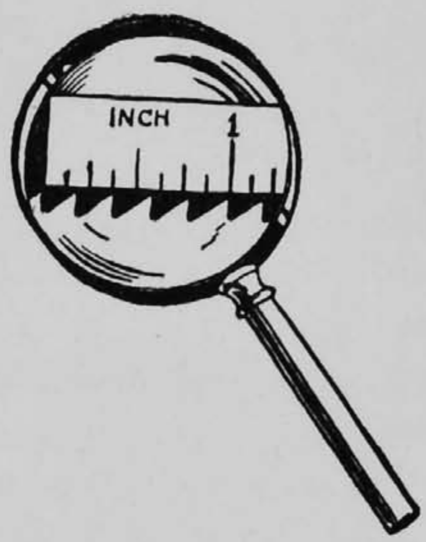


FIG. 2.14. Saw teeth, points per inch.

Saws. There are two general types of hand saw, the crosscut saw and the ripsaw. The crosscut saw is used for sawing across the grain of wood, and the ripsaw is used for sawing with the grain.

The size of the teeth of a saw is usually given as the number of points to an inch. The number of points per inch is always one more than the number of teeth per inch. It is evident that 4 points per inch means larger teeth than 10 points per inch. The number of points is usually stamped on the heel of the saw. See Fig. 2.14.

FIG. 2.15. Skewback and straight back saws.

Some hand saws have a straight back, others a skewback. The straight back is a little heavier and a little stiffer. Many woodworkers believe that the difference between these shapes is entirely one of appearance (Fig. 2.15).

To prevent a saw from binding in the slot which it cuts, called the *kerf*, the teeth are *set* by bending the points alternately to one side and the other. Hard, dry wood requires less set than soft, wet wood. Only enough set should be given the teeth to provide adequate clearance for the blade.

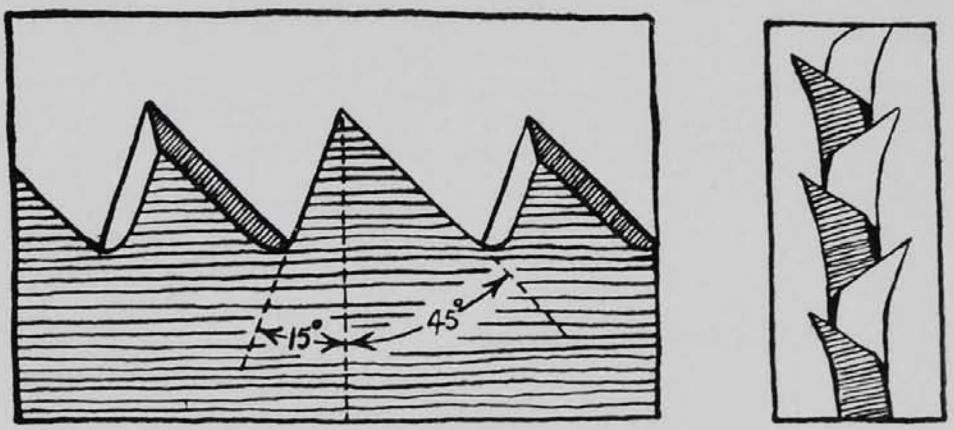


FIG. 2.16. Crosscut saw teeth.

The *crosscut saw* has teeth like small triangular knives which cut the fibers of the wood as the saw moves across them. It is made in lengths from 20″ to 26″. For all-around use an 8 or 10 point crosscut saw is best. See Fig. 2.16.

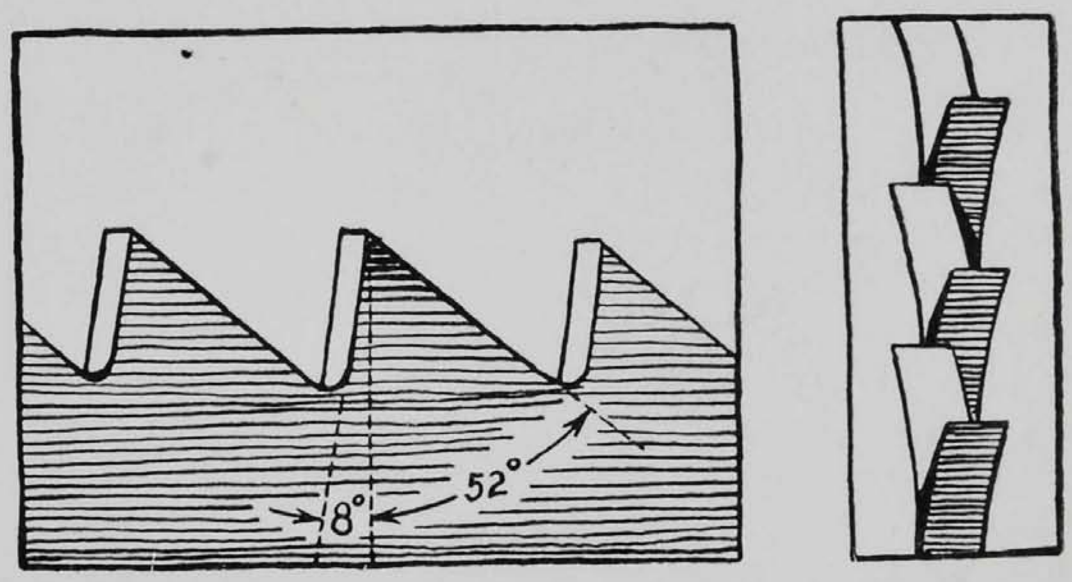


FIG. 2.17. Rip saw teeth.

The *ripsaw*, as its name indicates, is designed to cut parallel to the grain of the wood. Except for the shape of the teeth, the ripsaw is similar to the crosscut saw. The teeth of the ripsaw are chisel edges, as shown in the diagram, and are filed straight across. It will be noticed that the front of each tooth is nearly perpendicular to the blade of the saw. The teeth of a ripsaw cut like vertical chisels, each tooth cutting out a small portion of the wood. The teeth on a ripsaw are not set quite as much as the teeth on the crosscut saw. See Fig. 2.17.

The ripsaw usually ranges from 20″ to 26″ in length. For general purposes a 5 to 7 point ripsaw is preferable.

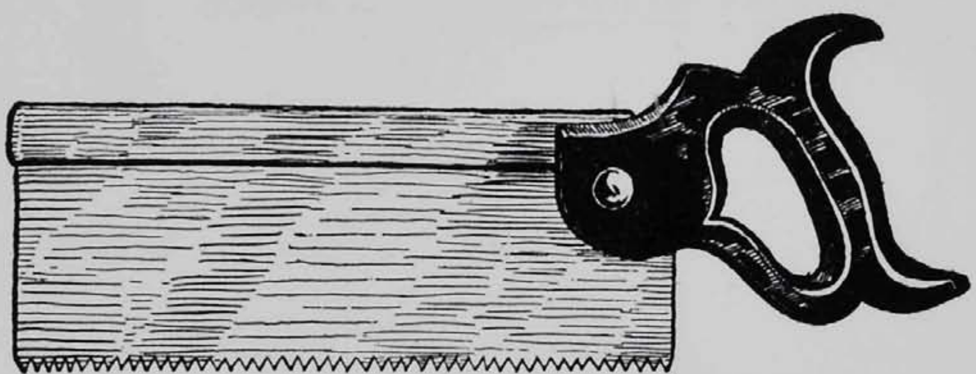


FIG. 2.18. Back saw.

The *back saw* is a fine-toothed crosscut saw with a thin blade, designed for particularly accurate work. It ranges in length from 8″ to 14″ and, as its name indicates, its back edge is reinforced with a heavy rib of steel. It is used in fine joinery and cabinetwork. The back saw usually has about 12 to 16 points per inch. See Fig. 2.18.

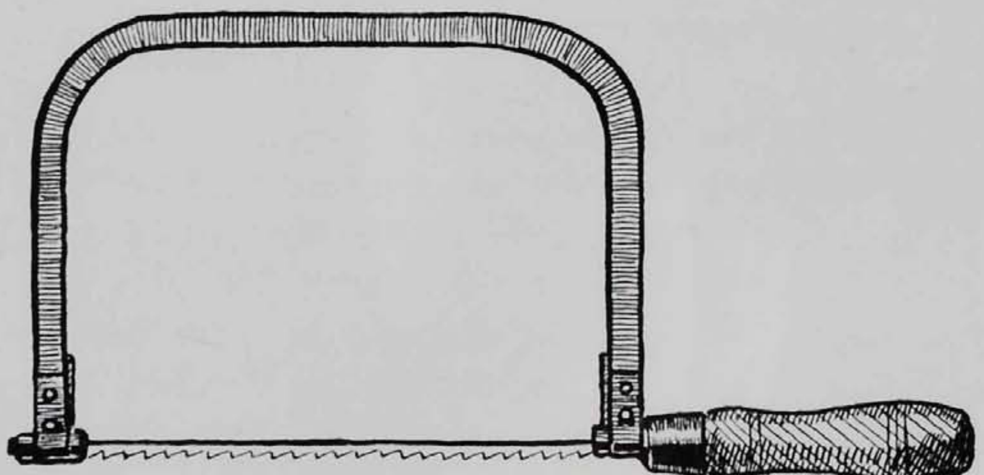


FIG. 2.19. Coping saw.

The *coping saw* is used for cutting curves in thin stock. It has a steel frame somewhat the shape of a C which holds a narrow, thin blade under tension. Frames and blades are available in different sizes to suit various types of work. The usual coping saw blade is 6″ or 6½″ long and has 10 or 15 points per inch. The teeth are shaped like those of a ripsaw. See Fig. 2.19.

The *compass saw* has a narrow tapered blade attached to a wooden handle. The blade can usually be removed by loosening a screw in the handle. It is used to cut curves or circles in stock where a coping saw cannot be used

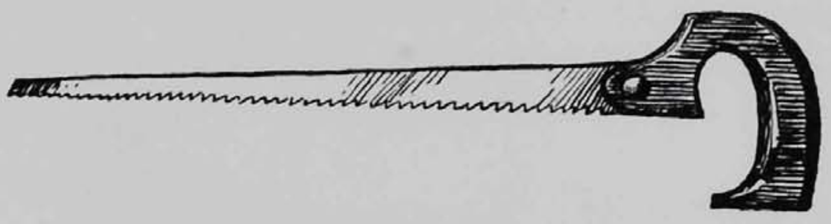


FIG. 2.20. Compass saw.

because of its frame. The cut is usually started after a hole has been bored near the line to be cut. The blade may be from 10″ to 16″ in length. The compass saw may be either a crosscut or a ripsaw. See Fig. 2.20.

FIG. 2.21. Keyhole saw.

The *keyhole saw* has a blade similar to that of the compass saw, except that it is smaller and narrower. The handle is usually of iron, fastened to the blade with a thumbscrew, although some are made with wooden handles and permanently attached blades. The keyhole saw is used for cutting keyholes and small curved work. The blade may be from 7″ to 12″ in length. The teeth are usually filed like those of a crosscut saw. See Fig. 2.21.

The *dovetail saw* is like the back saw, but has a thinner blade and finer teeth. The blade is also a little shorter and a little narrower. The handle is fastened to an extension of the steel back and is shaped like the handle of a chisel. This saw is used to make joints and for other fine sawing. The length may be from 6″ to 12″. The teeth are like those of a crosscut saw.

The *miter box saw* is a large back saw designed for use in the miter box. The frame of the miter box holds the saw rigidly in a vertical position, but it can be adjusted so that stock can be cut at any angle. The blade is placed deep into the handle, and the back is heavy, preventing any twisting of the saw. Usually miter box saws are made 11 points to an inch.

The *bucksaw* is used principally for sawing firewood. It has a frame of wood or metal, large enough to enable the user to grip it with both hands. Tension is applied to the blade, on the wooden frame type by a turnbuckle, and on the metal frame type by the stiffness of the frame itself, usually a metal tube formed to a U shape. The blade is usually 30″ long, and from

1¼″ to 3″ wide. The teeth are sometimes shaped like those of a hand crosscut saw, and if so they are usually 4 to 4½ points to an inch. Bucksaw blades are also made with two cut-off teeth and a clearer tooth, and are available in the wider sizes. Some operators prefer a wide blade, believing that it will saw straighter than a narrow one. Others prefer the narrow

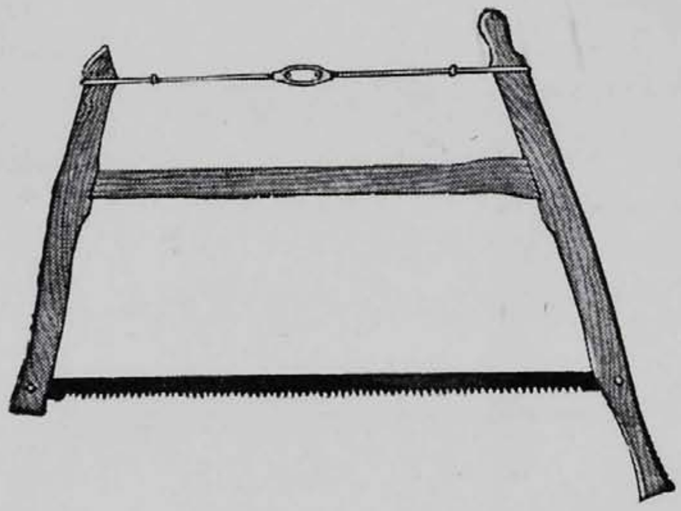


FIG. 2.22. Wood frame bucksaw.

blade, because if the kerf closes, it will not pinch the blade so quickly. Most cordwood and pulpwood cutters in the north woods choose the narrow blade. See Fig. 2.22.

The *One-Man* and *Two-Man Crosscut Saws.* A one-man saw is used to saw trees into log or cordwood lengths. This saw is usually made with a supplementary handle, so that it can also be used by two men. It is 3′ or 4′

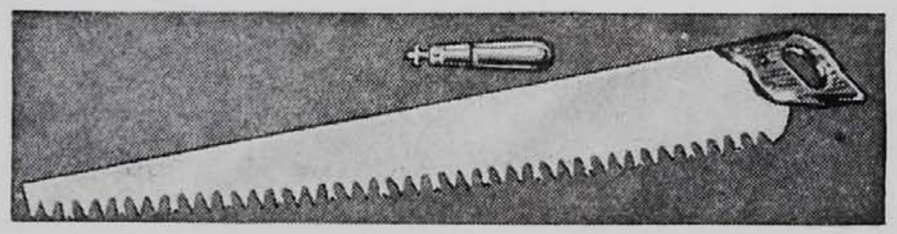


FIG. 2.23. One-man crosscut saw.

in length, with a blade about 5″ wide. The tooth line is considerably crowned. Some saws are made with plain teeth, others with two cut-off teeth and a clearer. This type of saw is very convenient for sawing pieces over 6″ in diameter. See Fig. 2.23.

A two-man saw has a handle on each end and is 4′ to 7′ long. One type has a wide blade and plain teeth and is commonly used for sawing trees into log lengths. The other type, which is used mainly for felling trees, has a blade about 3″ wide with teeth arranged in repeated groups of three, consisting of two cut-off teeth and one clearer tooth.

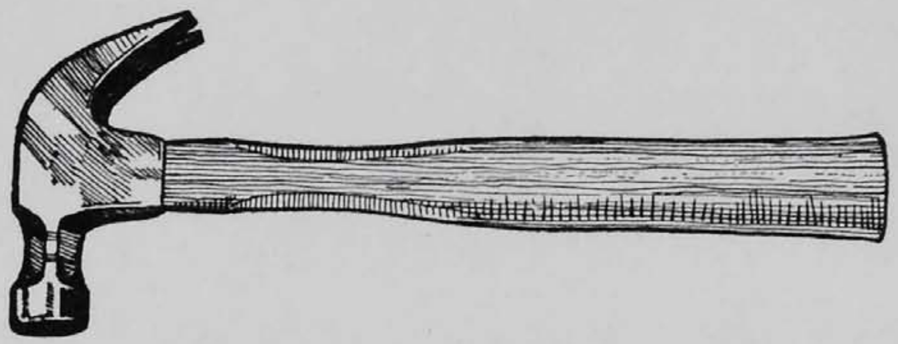


FIG. 2.24. Claw hammer.

Hammers. The *claw hammer* is one of the craftsman's indispensable tools. A good grade of claw hammer is made of cast steel, with a striking face on one side and a claw on the other. There are several patterns of claw hammers, but the two main types are the curved claw, which is the most common, and the straight claw. Hammers vary in weight from 3 oz. to 20 oz., but the 10- or 12-oz. size is the most convenient for all-around work. "The hang of the hammer," the shape of the face and the quality of the claws are the important points to look for. A cheap hammer is a poor investment. See Fig. 2.24.

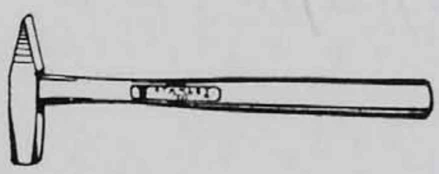


FIG. 2.25. Tack hammer.

Tack hammers are made in many different shapes. The upholsterer's tack hammer has a head 5″ or 6″ long, and a handle about 12″ long. The regular tack hammer, which will prove most useful in the home shop, weighs about 4 oz. and has a cross peen on one side, and a striking face on the other. See Fig. 2.25.

Screwdrivers. The *common screwdriver* is often the handyman's universal tool. It may be used as a cold chisel, a punch, or a crowbar, or in fact, for almost any purpose except that for which it was made. However, such uses of a screwdriver are not good craftsmanship.

There are many sizes and types of screwdrivers. The width and length of the blade, and the overall length of the tool are its important dimensions. Sizes usually range from a 3/16″ width of blade to a 24″ overall length. A handy size for all-around use is a blade 5/16″ wide, and a length of 8″. Ratchet screwdrivers have the same type of blade as a hand screwdriver, but are equipped with a ratchet mechanism which facilitates speedier and easier driving. Some have several blades of various sizes, interchangeable in the same handle. The blade of a screwdriver should be kept in proper shape. The two sides of the blade should be kept parallel; this helps to prevent the blade from slipping out of the slot, when driving a screw. See Fig. 2.26.

FIG. 2.26. Screwdriver blades or tips, common and Phillips.

The *screwdriver bit* is a blade like a screwdriver blade, with a tang to fit a bit brace. By using the ratchet on the brace, screws can be driven close to a wall, or in a corner. Also, the ratchet enables one to choose the point in the arc of swing where most pressure is to be applied.

The *offset screwdriver* is used to drive screws in very inaccessible places. It is a steel rod, with a screwdriver blade on each end. Both ends of the rod are bent at right angles, but in opposite directions. The blade at one end is parallel to the rod, and the blade at the other end is crosswise to the rod. The diagram shows clearly this type of screwdriver. It ranges in size from 4″ to 10″ in overall length.

Special Screwdrivers. There are now available several types of screw which require a driver of special shape. Among these is a type which has a blade in the shape of a cross; another type has a blade in the shape of an octagon. The advantage of these screwdrivers is that they cannot easily slip out of the screw head. The size range is the same as that of common screwdrivers.

Planes. The *block plane* is designed for end grain planing and for use on small pieces of stock. The length of the block plane ranges from 4″ to 8″. The usual width is 1¾″. See Fig. 2.27.

FIG. 2.27. Block plane.

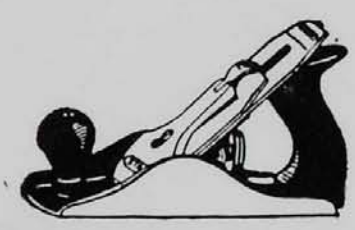


FIG. 2.28. Smooth plane.

The *smooth plane* is used to plane broad surfaces and to finish work before sandpapering. It may also be used to plane edges and ends. The length of a smooth plane varies from 5½″ to 10″. The width of the cutting blade, called the plane iron, is usually 2″. These planes may be purchased with a smooth bed or with a corrugated bed intended to reduce friction and to lessen the weight of the plane. See Fig. 2.28.

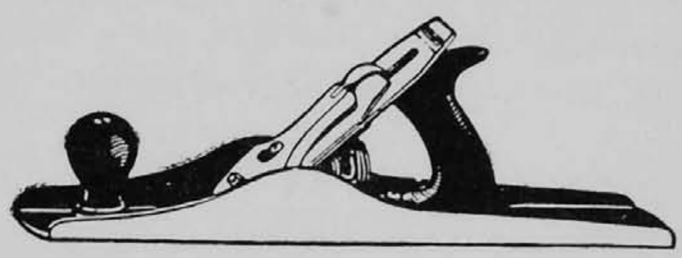


FIG. 2.29. Jack plane.

The *jack plane* is approximately 14″ or 15″ long and 2″ or 2¼″ wide and is used for all-around work. The plane iron is ground almost straight and the corners are slightly rounded. See Fig 2.29.

The *fore plane* is 18″ to 20″ long, 2⅜″ wide, and is used to plane long surfaces. The plane iron is usually ground straight across with corners slightly rounded. This plane is usually selected by carpenters as a general utility plane because it can be used as a smooth plane and also as a jointer.

FIG. 2.30. Rabbet plane.

The *jointer* is 22″ to 26″ long, 2⅜″ wide, and is used, as the name implies, to straighten and smooth long pieces in preparation for making edge to edge joints. One of its special uses is jointing doors. The iron of a jointer is almost always ground straight across with corners rounded.

The *rabbet plane* is used to cut channels or grooves in the edges and ends of boards. See Fig. 2.30.

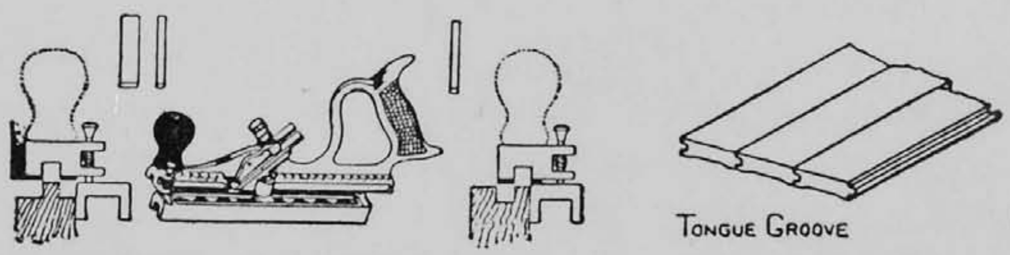


FIG. 2.31. Match or tongue and groove plane.

The *match* or *tongue and groove plane* is used to make a groove on one edge of a board and a tongue on the other edge, so that it can be fitted to other such boards as shown in the illustration (Fig. 2.31).

The *router plane* is used to make a level surface below and parallel to a given surface as, for example, a dado joint.

The *universal plane* has numerous interchangeable parts and adjustments and, as the name indicates, may be used for many purposes, such as matching, rabbetting, grooving, cutting moldings, etc. Because of its great variety of blades and cutters, it takes the place of many special planes.

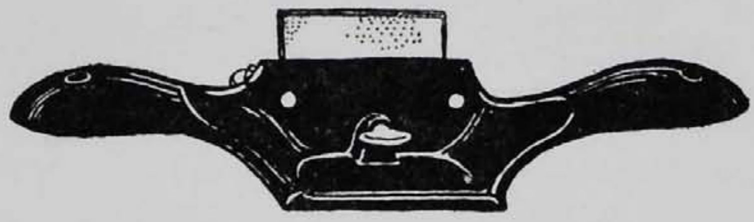


FIG. 2.32. Cabinet scraper.

The *cabinet scraper* is a form of plane used to remove tool marks and to produce a smooth surface where the wood is too coarse or cross-grained, to be smoothed by the smooth plane. See Fig. 2.32.

The *spokeshave* is used to smooth curved surfaces. Its blade has a convex edge.

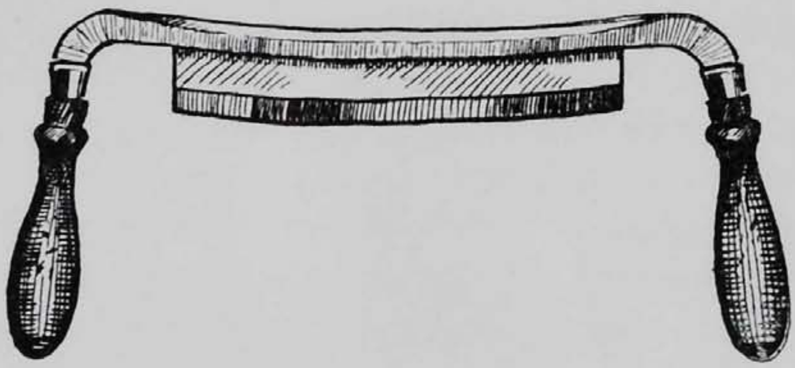


FIG. 2.33. Drawknife.

The *drawknife* is essentially a blade with a handle at each end. It is used for roughing out curved surfaces, and for removing excess stock rapidly. It is drawn toward the operator and may be used with the bevel either up or down. The blade may be 8″, 10″, or 12″ in length. See Fig. 2.33.

Chisels. The chisel is one of the most important tools used by the woodworker. It is a piece of tool steel, ground to a bevel at one end which is sharpened to produce a keen cutting edge. The main parts of the chisel are the blade, the shank, and the handle. The shank may be a tang or a socket, holding a wood or composition handle.

The *tang chisel* has a sharp-pointed shank or tang which is driven into the handle. The end of the handle is protected from splitting by a metal ferrule. This type is usually used for light paring work. See Fig. 2.34.

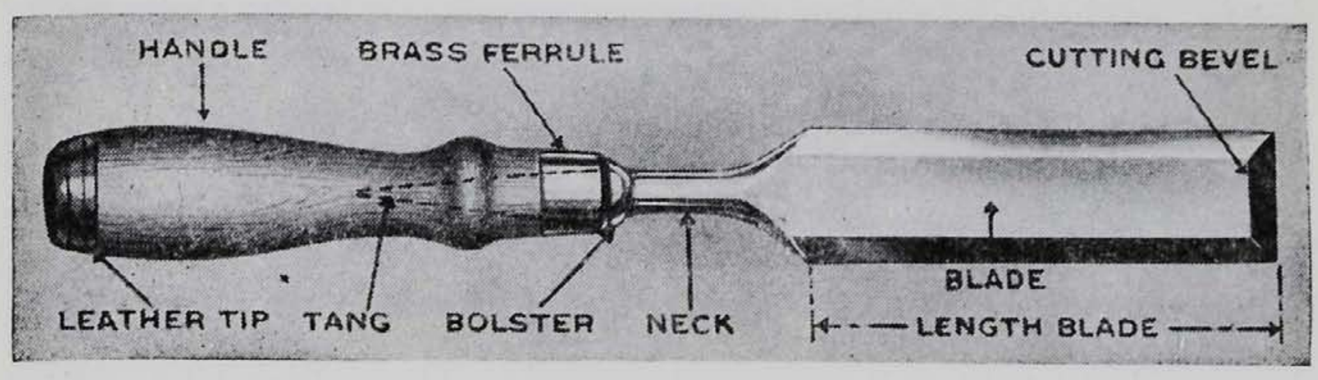


FIG. 2.34. Tang chisel.

The *socket chisel* has a tapered socket into which the tapered end of the handle is driven and held fast by friction. This type of chisel may be used for heavy work. See Fig. 2.35.

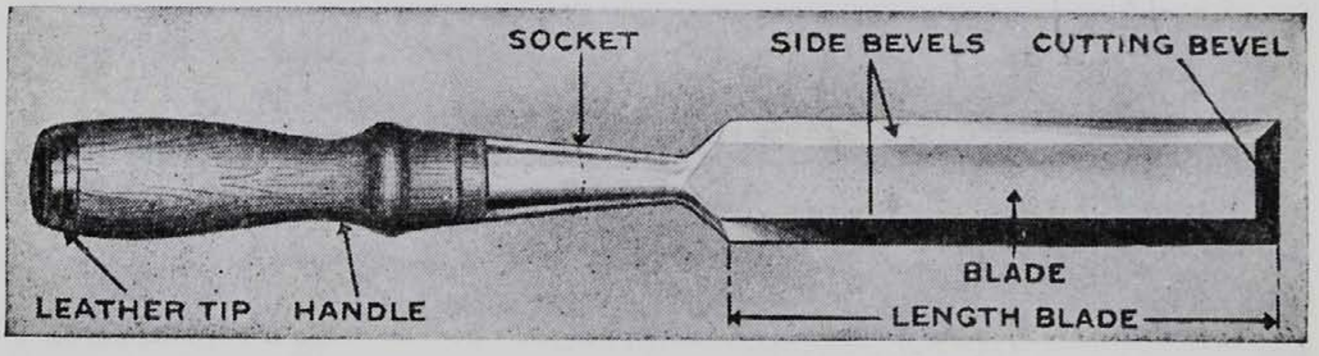


FIG. 2.35. Socket chisel.

Some manufacturers produce chisels in which the shank extends entirely through the handle. This is said to reduce the danger of breaking the handle when the chisel is used for rough work.

There are twelve chisels in a complete set of any one kind. Cutting edges range in width from 1/8″ to 2″, increasing by eighths up to 1″ and by quarter inches from 1″ to 2″. The blades of paring and firmer chisels range from 5″ to 6″ in length; those of butt chisels are 3″ or 4″ long.

The *paring chisel* has a thin blade which is usually beveled along the sides. It is used for thin slicing, or paring cuts.

The *firmer chisel* has a thicker blade than the paring chisel. It is more sturdily made and "firmer" than the paring chisel. Firmer chisels may be used for either light or heavy work.

The *framing chisel* has a very heavy, strong blade, making it most suitable for rough carpentry work.

The *butt chisel* is similar to the framing chisel except that the blade is very short.

The *mortise chisel* is used for cutting out mortises. It is very thick below the handle so that it will not break when it is used as a lever to remove chips from the mortise.

Gouges. The gouge is a chisel with the blade curved in cross section. Gouges are made with different amcunts of curvature in the blade to suit various types of work. The bevel may be ground either inside or outside. The description of chisels given above applies in general to the gouge as well.

Fig. 2.36. Gouge.

The use of the gouge is similar to that of the chisel except it is used for making concave cuts. Gouges may be used for either paring or for heavy work, except for the patternmaker's gouge which has a lighter blade and an offset handle, and can be used only for paring. See Fig. 2.36.

Mallet. The mallet is a wooden hammer. The mallet should always be used to pound chisel and gouge handles, to drive wooden pins, etc. A metal hammer will splinter a chisel handle, or mar a wood surface. A good rule is: Use wood to pound wood. Mallets are usually made of maple or hickory. The sizes vary greatly. For all-around use a good size is one with a head about 3″ in diameter, and about 5½″ in length. If the home mechanic has a wood turning lathe, it is very easy for him to make his own mallet.

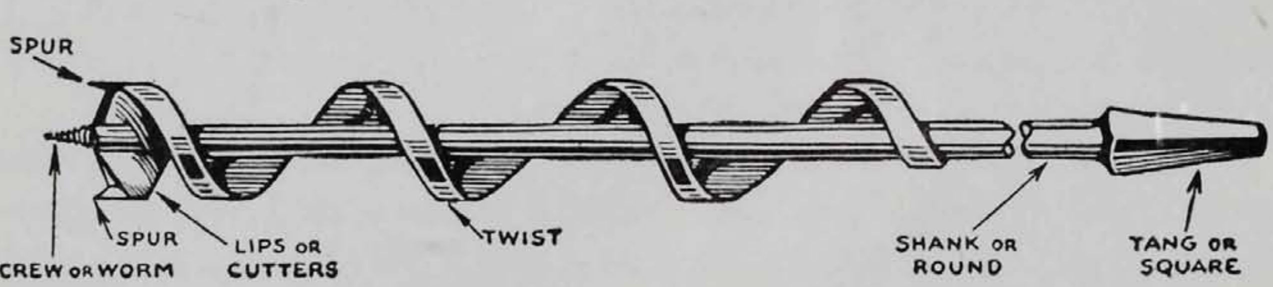


Fig. 2.37. Parts of auger bit.

Boring Tools. There are six parts to the common auger bit used in cabinetmaking: the *screw*, a threaded point which pulls the bit into the wood; the *spur*, which scores the hole; the *lips*, which do the cutting; the *twist*, a spiral flange which carries the chips out of the hole; the *shank*, which adds length to the bit; and the *tang*, a square part which fits into the brace. See Fig. 2.37.

Single and Double Twist Auger Bits. The single twist auger bit has a solid stem or core running the entire length of the bit, making it a rigid, powerful tool with extra strength at the head. The double twist bit, also known as the extension-lip bit, cuts a very smooth hole and is less rigid than the single

FIG. 2.38. Single twist auger bit.

twist bit, though strong enough for regular cabinetwork. Both types of bits can be obtained in sizes increasing by 1/16″ from 1/4″ to 1 1/2″. A number on the tang indicates the size of the bit in sixteenths of an inch. Larger sizes can be obtained if ordered specially. See Figs. 2.38 and 2.39.

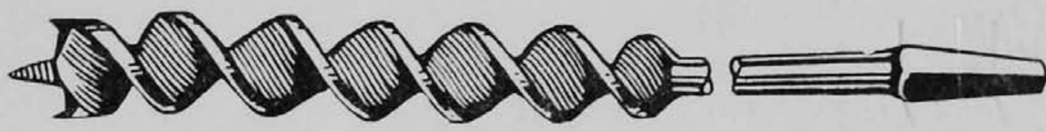


FIG. 2.39. Double twist auger bit.

The *ship auger*, as the name implies, is chiefly used to bore ship and dock timbers. It is particularly useful in boring soft wood, and in cross and end grain. It cuts very rapidly, leaves a comparatively rough hole, and is distinguished by the fact that it has no extension cutting nibs. Ship augers can be obtained in sizes from 1/4″ to 2″, increasing 1/16″ for each size. The number on the tang indicates the size in sixteenths of an inch.

The *electrician's bit* is designed for the use of electricians, telephone workers, linemen, gas fitters, and similar workers who must cut holes through stringers, sills, and floors. It usually has a solid center, with a head having one cutting lip and one extension nib on the other side of the head. Electrician's bits are obtainable in three standard sizes, 5/8″, 11/16″, and 3/4″.

The *expansion bit* is used to bore holes over 1″ in diameter or odd size holes for which there is no standard auger bit. There are two types: the plain expansion bit and the screw adjusting expansion bit. Either type can be obtained in sizes that can be adjusted to bore holes ranging from 1″ to 4″ in diameter. See Fig. 2.40.

The *Forstner bit* is especially adapted to boring holes in cross-grained wood, and to boring a larger hole when a smaller one is already present. It has no screw and thus can be used to bore almost through a piece of wood. It is also used where a flat, counterbore type of hole is needed. Forstner bits can be obtained in sizes increasing by 1/16″ from 1/4″ to 4″. See Fig. 2.41.

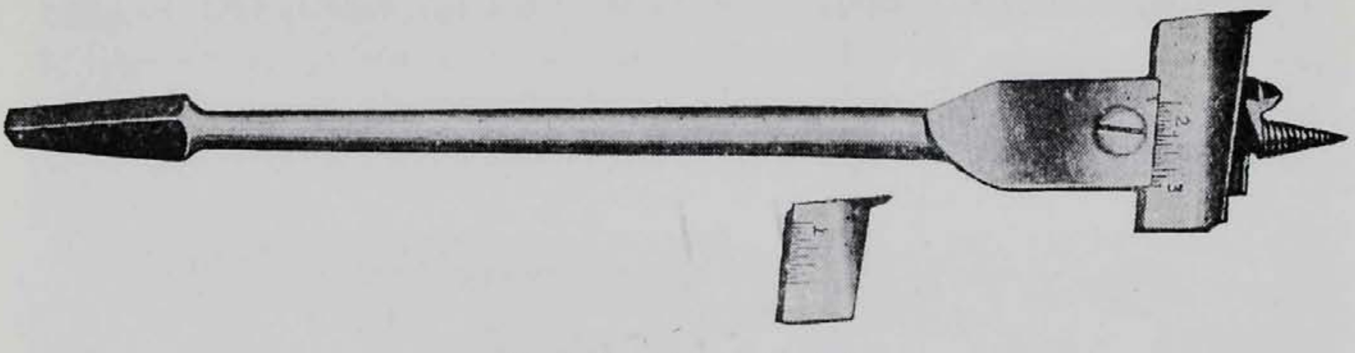


Fig. 2.40. Expansion bit.

The *countersink* is used to bore a conical depression to receive the head of a flat head screw. The included angle of the point is 82°. The countersink shown in the illustration is called a rose countersink and is the most common type. The sizes obtainable vary from ½″ to 1″ in maximum capacity. See Fig. 2.42.

Fig. 2.41. Forstner bit.

Fig. 2.42. Countersink.

Fig. 2.43. Twist drill.

The *twist drill* is most commonly used in metal work, but is also useful for fine work in hard wood. It has a straight shank and may be used in a drill press or in a hand drill. For woodworking purposes, the fractional sizes increasing by 1/16″ from 1/16″ to ½″ are adequate. See Fig. 2.43.

Plug Cutter. There are two types, one to be used as a hand tool and one as a machine tool. It is used to cut cylindrical plugs out of flat stock. It is made in the following sizes: ⅜″, 7/16″, ½″, ⅝″, ¾″, ⅞″, and 1″ (Fig. 2.44).

Miscellaneous Hand Tools. The *bit brace* is a tool used to hold an auger bit or other boring tool. Braces are made with or without a ratchet. A ratchet is a mechanism on the brace which allows the chuck to rotate by a succession of partial turns of the crank. Braces are made in various sizes,

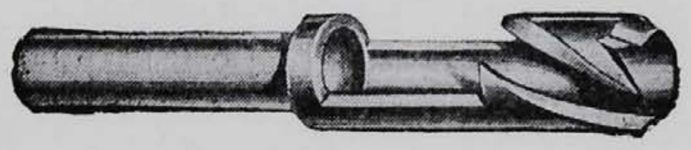


FIG. 2.44. Plug cutter.

measured by the diameter of the sweep, which is the circle described by the crank of the brace. The common sizes are the 8″, 10″, 12″, and 14″ sweep. The quality of a brace depends upon the type of jaws, the ratchet mechanism, whether or not the chuck and head are equipped with ball bearings, and the type of material used for the head and handle. See Fig. 2.45.

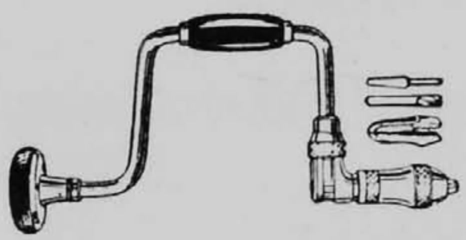


FIG. 2.45. Ratchet brace.

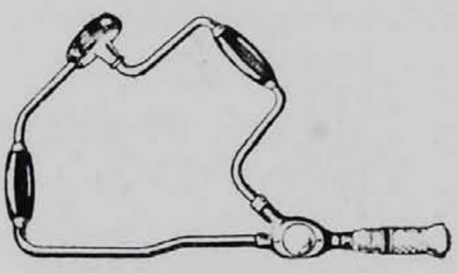


FIG. 2.46. Corner brace.

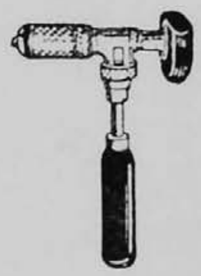


FIG. 2.47. Corner ratchet brace.

There are several types of brace designed for special purposes such as the double crank brace used extensively on heavy construction work, and the corner ratchet brace which permits working in small spaces. See Figs. 2.46 and 2.47.

FIG. 2.48. Nail set.

The *nail set* is a piece of high grade tool steel, hardened and tempered at both ends, used to drive the heads of nails and brads below the surface of wood. The tip is slightly cupped to prevent the nail set from slipping off the head of the nail. Nail sets come in different sizes measured at the tip. See Fig. 2.48. The common sizes vary by $\frac{1}{32}$″ from $\frac{1}{32}$″ to $\frac{5}{32}$″

The *hand drill* is a tool used to hold round-shank boring tools. It consists of a chuck to hold the drill, gears to increase the speed at which the drill is turned, a crank, and a handle. The main purpose of the hand drill is rapid drilling of small holes in wood and metal. Hand drills vary in size. The ¼″ and the ⅜″ chuck capacity are the common sizes. See Fig. 2.49.

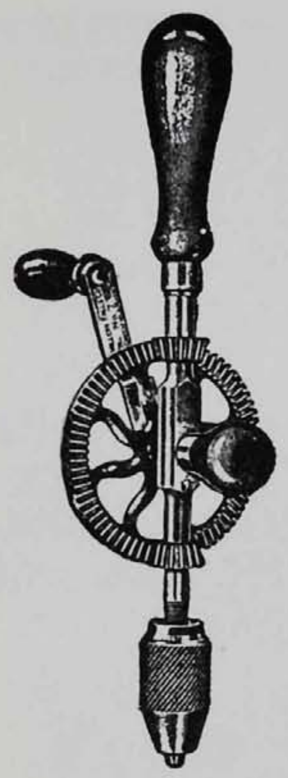


FIG. 2.49. Hand drill.

The Marking Gauge. There are two types of marking gauge, the gauge making a single mark, and the gauge which makes two or more marks. Usually the second type makes only two marks, although in lathe work special marking gauges are available which lay out from one to a dozen marks. The marks are made by either a scriber or a pencil.

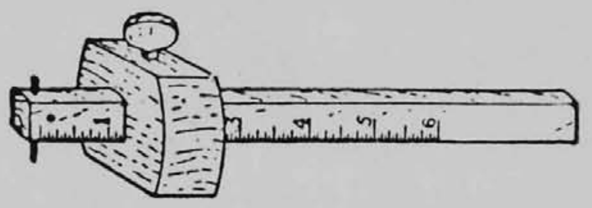


FIG. 2.50. Single marking gauge.

The most common type of gauge is the single marker, with metal point, or spur, sharpened to a wedge shape. The point, slightly sharper on the front edge, should be set to lead into the work. This assists in keeping the gauge against the working edge of the stock. Another type of gauge, convenient for rough work, has a pencil instead of a metal point as a marker. It is usually made with a wide head, or gauge, and a long arm or beam (Fig. 2.50).

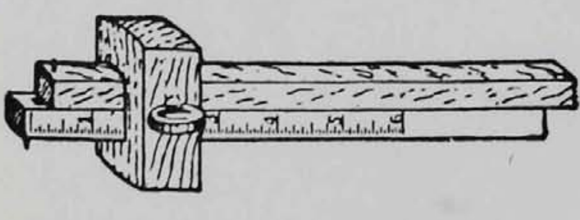


FIG. 2.51. Double marking gauge.

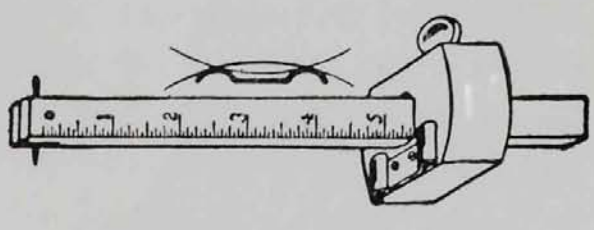


FIG. 2.52. Marking gauge for circular work.

The double marking gauge is used to lay out such details as mortise and tenon joints, slip joints, etc., or wherever two parallel lines are desired. Many gauges have a metal attachment on the head which adapts it to circular or curved work. See Figs. 2.51 and 2.52.

Pocketknife. It is not necessary to describe the pocketknife, except to say that a pocketknife with a small, sharp, pointed blade is one of the most important tools a woodworker uses. It is especially useful in accurate lay-out work.

Sharpening Wheels and Stones. Most of the sharpening wheels and stones used in woodworking shops today are of artificial rather than natural stone. A common type of grinding machine has two wheels, one fine and the other coarse, mounted on opposite sides of a motor. Each grinding wheel

FIG. 2.53. Sharpening wheel *Courtesy of Norton Company.*

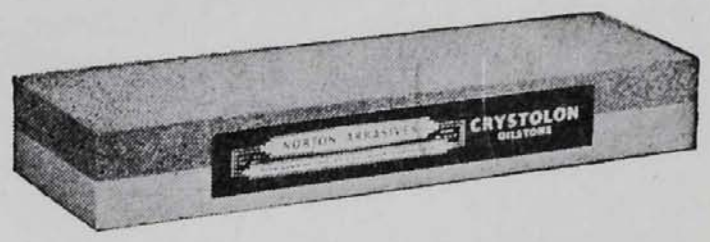


FIG. 2.54. Combination stone. *Courtesy of Norton Company.*

FIG. 2.55. Slip stone. *Courtesy of Norton Company.*

is from 6″ to 8″ in diameter, and from ½″ to ¾″ in thickness. The two materials most commonly used in grinding wheels are aluminum oxide and silicon carbide. The aluminum oxide, silicate bond wheel of about 80 grain size is an excellent grinding wheel for edged tools, and an aluminum oxide vitrified bond wheel of 40 grain size makes a good wheel for rough grinding. When ordering spare wheels, the diameter, the thickness, the hole size, the type of abrasive, the bond, and the grain size must be specified. Many manufacturers of abrasives issue brochures containing valuable information about grinding wheels and stones. See Figs. 2.53, 2.54, and 2.55.

After a sharpening wheel is used to remove excess metal rapidly, and to remove any nicks, a sharpening stone is used to remove the wire edge usually formed and to whet the edge to final keenness. The home workshop should be equipped with at least one combination sharpening stone about 8″ ×

2″ × 1″, coarse on one side and fine on the other. One side should be silicon carbide, extra hard and extra fine, and the other side a coarser grade of the same material. The shop should also have at least two slip stones, approximately 4″ in length and 1½″ in width. One edge should be about ½″ thick, and the other about ⅛″ thick. Both edges should be semicircular in shape. Two stones of this size, one extra hard and extra fine, and the other fine, are sufficient for the average shop. However, in addition to artificial stones, it is desirable to have a very fine, hard, natural stone for final whetting of edges that require special keenness. These stones come in various sizes and shapes.

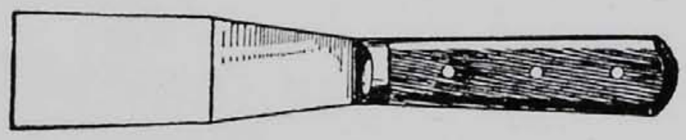


Fig. 2.56. Putty knife.

The *putty knife* is a thin, flat, steel blade with a wooden handle. It is used to apply the putty in glazing a window and in mixing colors, paints, glue, etc. A putty knife is useful also in any scraping or cleaning job. Putty knives are made in various widths and with stiff or flexible blades. A blade about 1½″ wide is a handy size. See Fig. 2.56.

Fig. 2.57. Wrecking bar.

The *wrecking bar* is a piece of tool steel, one end of which is bent in the form of a gooseneck, with a claw similar to that of a hammer. The other end is flattened somewhat like a large cold chisel, and has a slight bend in the opposite direction to that of the gooseneck. This tool is useful for ripping off old boards, and in any situation where great leverage is needed. Wrecking bars come in different sizes, from ½″ to ⅞″ in diameter, and from 12″ to 36″ in length. See Fig. 2.57.

The *dividers* is an instrument like a compass with two pointed, metal legs. It is used to transfer measurements, to scribe circles, and to lay out arcs. Some dividers have a removable point that can be replaced with a pencil to make the tool useful as a compass. Dividers are made in lengths of 6″ to 10″. See Fig. 2.58.

The *brad awl* is used to bore very small holes. Unlike most other boring tools, it does not remove the material from the opening which it makes. The brad awl looks somewhat like a very small screwdriver. The boring is done by twisting or turning the tool halfway around and back again,

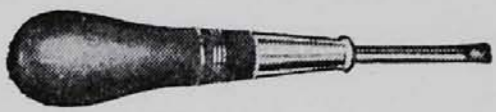


Fig. 2.59. Brad awl.

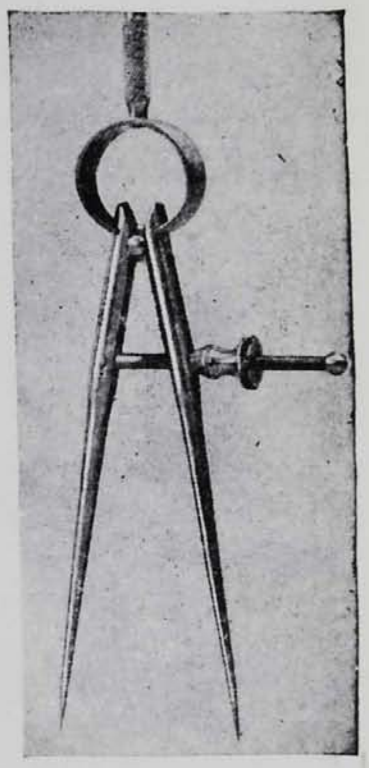


Fig. 2.58. Dividers.

while pressure is applied. This is repeated until a hole of the required depth has been bored. The two common sizes have blades 1¼″ or 1½″ in length, and 5⁄64″ or 3⁄32″ in diameter. See Fig. 2.59.

The *vise* is a large clamp, mounted on a bench, in which material to be worked can be held firmly. Most vises are made of metal, although wooden ones are occasionally used. In addition to the woodworker's vise, there are all purpose vises, suitable for use in both woodworking and metalworking. If only one vise is to be purchased, an all purpose vise should be considered. The size of the vise is measured by the length and depth of the jaws, and the maximum distance the vise will open. Sizes run from 6″ to 16″ in width, with maximum opening from 6″ to 16″. See Fig. 2.60.

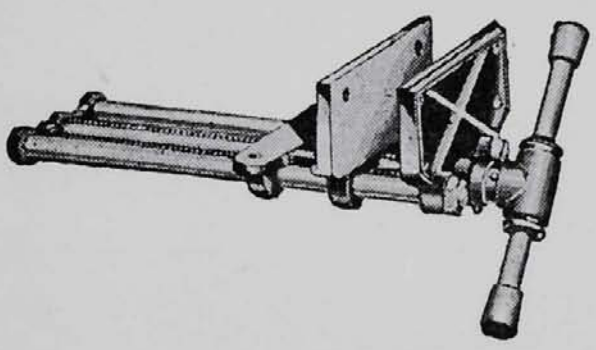


Fig. 2.60. Vise.

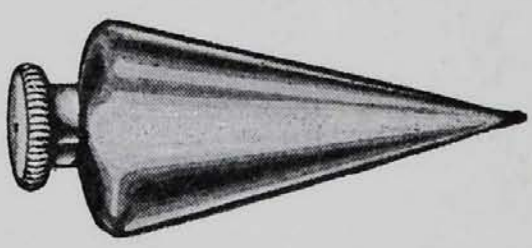


Fig. 2.61. Plumb bob.

The *plumb bob* is a piece of metal shaped like a boy's top, with a cord attached to the center of the large end. It is used in construction work to establish a vertical line. See Fig. 2.61.

Files. The *wood file* is used to smooth edges and curves that are difficult to smooth with other tools. The cutting surface consists of sharp edged ridges or teeth. The cut of the file is determined by the spacing between the teeth and the angle at which the teeth cross the surface of the file. When there is a single series of teeth which run in parallel lines diagonally across the surface, the tool is known as a single cut file. A double cut file

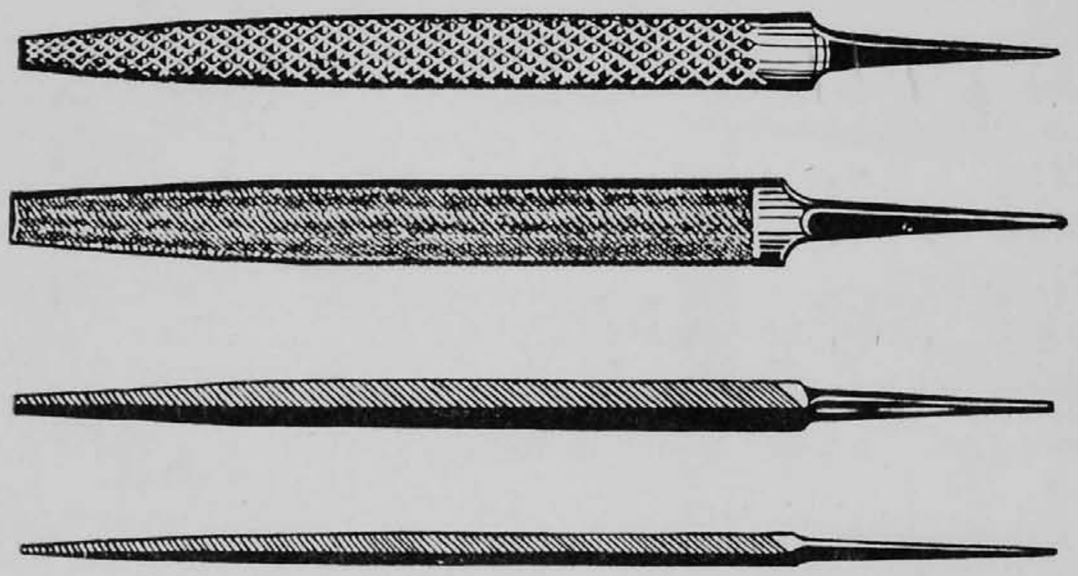


FIG. 2.62. Files, top to bottom, half-round wood cabinet rasp, half-round wood file, slim taper saw file, and extra slim taper saw file.

has a double series of teeth crossing each other at an oblique angle. Wood files may be obtained in a variety of shapes, such as round, flat, square, half round, or triangular, and in lengths from 3″ to 14″ not including the tang. See Fig. 2.62.

The *rasp* is similar to the wood file, except that its surface is covered with semi-circular points or teeth, each tooth being an individual projection rather than a diagonal ridge as on a file. Rasps cut faster, but leave a rougher surface than files, and are used only when considerable stock is to be removed.

Saw files have a triangular cross section, and are also known as three cornered files or three square files. The size of the file needed depends upon the coarseness of the teeth on the saw to be filed. The 7″ extra slim taper file is the appropriate size to use on the average hand saw.

The *bar clamp*, or cabinet clamp, consists of a bar with an adjustable stop on one end and a hand screw on the other. It is used to clamp frames and edge to edge joints, such as table tops, as well as in assembling various other types of glued joints in cabinet work. Bar clamps vary in length from 2½′ to 7′. See Fig. 2.63.

The *hand screw* is a clamp with a wide variety of uses. It is essential whenever two pieces of material that cannot be placed in the vise are to be held together. The size of the hand screw, measured by the length of the jaw, ranges from 6″ to 18″. See Fig. 2.64.

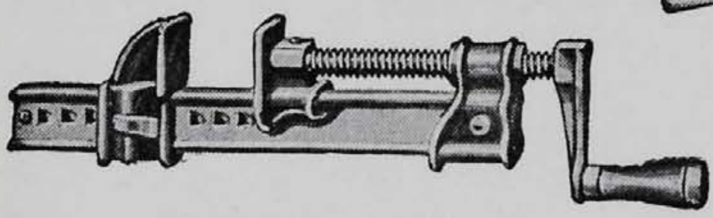


Fig. 2.63. Bar clamp.

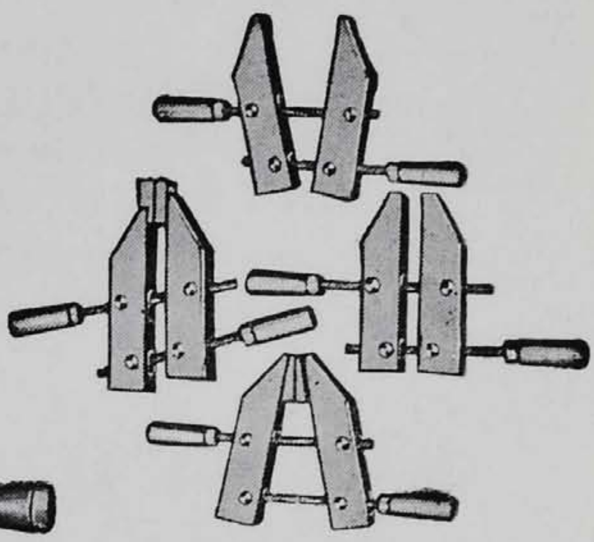


Fig. 2.64. Hand screws.

The *chalk line* is a heavy cotton cord that can be covered with chalk. When it is held taut between two fixed points on a surface, and snapped, it deposits a straight chalk line on the surface.

The *level* is an instrument which indicates true level position by means of a bubble in a sealed glass tube of liquid. Its chief use is in the construction of buildings. Levels are made of wood or aluminum, and vary in length from 12″ to 48″. They range in price from about $1.00 to $10.00 or more, according to the material, the type of level glass, and the number of glasses. See Fig. 2.65.

Fig. 2.65. Level.

The *miter box* is an apparatus in which a piece of wood can be held or clamped while a guided saw makes a cut. The guides which hold the saw can be set so that the cut is made at exactly 90° or at any smaller angle down to 30°, or in some cases less. The saw, described earlier in this chapter, has a heavy back or rib which fits the guides. A good quality miter box is very accurate and has a number of refinements which are less important to the home craftsman than to the professional carpenter or cabinetmaker. It is often provided with clamps to hold the work in place while a cut is being made, catches to hold the saw above the work except when it is actually being used, special marks to facilitate cutting special shapes, demountable parts so that the tool can be carried about easily. See Fig. 2.66.

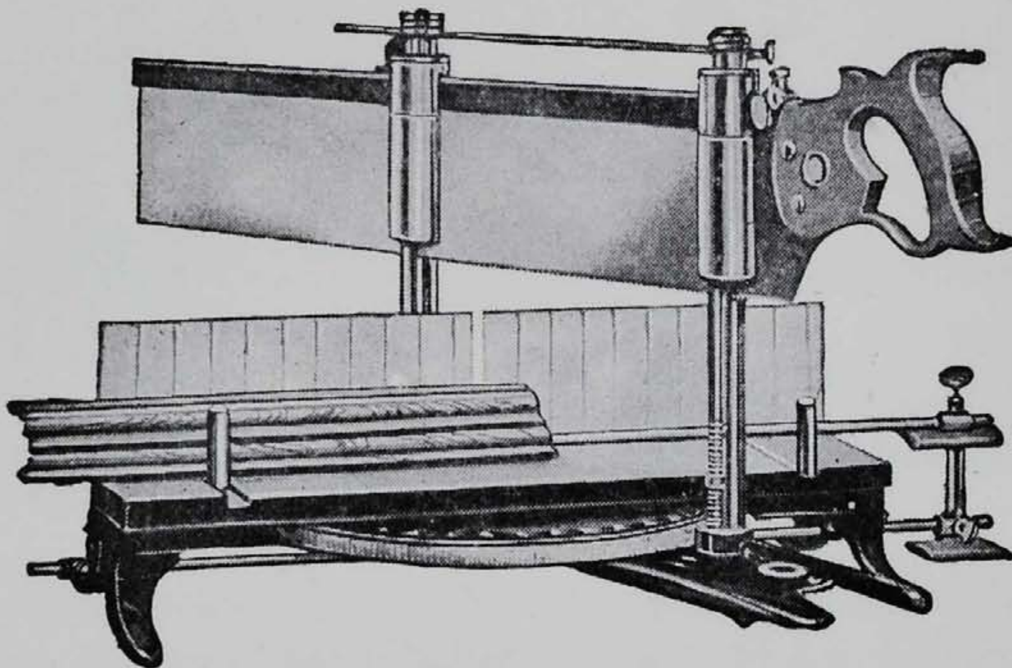


FIG. 2.66. Miter box.

The miter box is used to make accurate miter cuts for joints in frames, boxes, and construction work. It is an essential tool for the cabinetworker and the carpenter. The home craftsman can make a very satisfactory wooden miter box in his own shop. (See page 145.)

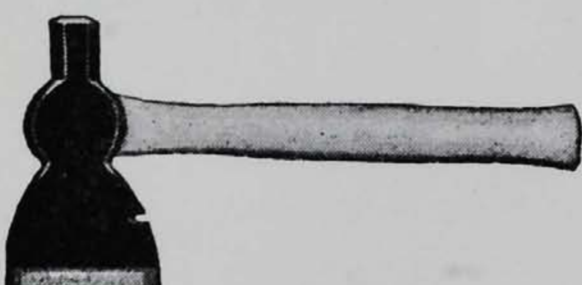


FIG. 2.67. Hatchet.

FIG. 2.68. Ax.

The Ax and Hatchet. There are many different styles of axes and hatchets. Probably the most useful hatchet for the home mechanic is the shingling hatchet. It has a cutting edge of 3½″ or 4″ and a 12½″ or 14″ handle. The type of ax in the home mechanic's tool kit depends largely on individual preference. See Figs. 2.67 and 2.68.

Basic List of Hand Tools. Persons who are planning to equip a shop will find that the following list includes the tools that need be purchased to start with. These tools will be enough for most simple projects. Additional equipment can be purchased as the need arises.

Three-joint, 2′ rule
12″ combination square
22″, 10 point crosscut saw
22″, 7 point ripsaw
12″ compass saw
6″ marking gauge
Two nail sets, 1/16″ and 1/8″
14″ jack plane
Three chisels, 1/4″, 1/2″, and 1″
1/2″ gouge with outside bevel
Set of 13 auger bits, 1/4″ to 1″
Set of drills, 1/16″ to 1/4″ by 32nds
3/8″ rose countersink
Screwdriver with 3/16″ blade
Screwdriver with 3/8″ blade
Bit brace, 10″ sweep
Hand drill, 1/4″ capacity
Claw hammer, 12 oz.
Oilstone, with coarse and fine sides
8″ dividers
Brad awl
Mallet (can be made on lathe)
Putty knife
Pocketknife

Power Tools. The *circular saw* is usually considered by home craftsmen to be the most desirable of power tools. It increases enormously the range of projects that can be undertaken. Besides making it possible to cut lumber to a desired dimension with great speed, a well made power driven saw enables the user to do much more accurate work than he can usually do with a hand saw.

The circular saw machine consists of a steel, or hard wood, table containing a slot through which a circular saw projects. In order to vary the depth and angle of the cut the machine is constructed so that the table or the saw can be moved up and down and tilted through an angle of 50° or 60°. A fence or rip guide can be set at any distance from the saw blade permitted by the size of the table and a miter gauge or cut-off guide slides in slots on either side of the blade, and can be set at any angle for miter cuts.

A saw blade 8″ in diameter is an adequate size for the home workshop. Saws as small as 6″ are made and are useful for some purposes. Too often, however, the smaller sizes are mounted in a less carefully manufactured mechanism and are thus not capable of accurate work. The 8″ saw can be operated by a 1/4 hp. motor, although a 1/3 hp. is more satisfactory and a 1/2 hp. motor should be used if much heavy work is to be done with the saw.

The *lathe* is a device in which a piece of wood or other material is rotated while it is shaped by a cutting or scraping tool held against it. The use of the lathe is one of the most enjoyable of crafts. The versatility of the lathe also makes it a desirable addition to the home shop.

The essential parts of a lathe are the bed, the headstock, the tailstock, and the tool rest. The headstock contains the spindle which is driven by a belt from the motor and which imparts its motion to the work, held against it by the tailstock. The pulleys on the spindle and motor usually have four steps or channels so that by moving the belt from one step to another the spindle speed can be changed from approximately 600 r.p.m. to 3500 or 4000 r.p.m. If more than four different speeds are needed a countershaft can be installed between the motor and the spindle, with additional stepped pulleys.

The bearings on which the spindle turns are of great importance. Ball bearings are found in most wood turning lathes, although bronze and even cast-iron bearings are occasionally used. The important dimensions of the

FIG. 2.69. Wood turning gouges

FIG. 2.70. Skew chisels.

lathe are the swing and the capacity between centers, that is, the working distance, between the spindle and the tailstock. The swing is the diameter of the largest piece of material that can be turned. For the home shop a lathe with a swing of 10″ and a distance between centers of 24″ is an adequate size. For this size lathe a ½ hp. motor is best, though for light work a smaller size can be used.

With extra attachments, many things can be done with the wood lathe besides wood turning; these include drilling, boring, sanding with disk or drum, and metal spinning.

Wood Turning Tools. The common wood turning tools are the gouge, the skew chisel, the parting tool, and the round nosed tool. The *wood turning gouge* is much like an ordinary gouge with an extra long handle. The cutting edge is ground in the form of a semicircle, with the bevel on the outside. Wood turning gouges are made in widths from ¼″ to 2″, and larger if ordered specially. See Fig. 2.69.

The *skew chisel* resembles an ordinary chisel with a longer and thicker blade, with the cutting edge at a 30° angle to the blade and ground with a bevel on each side. Some turners prefer the chisel ground with round shoulders rather than sharp angles between the cutting edge and the flat sides of the blade. Skew chisels are made in widths of 1/8″ to 2″, or larger if specially ordered. See Fig. 2.70.

FIG. 2.71. Parting tools.

The *parting tool* has a blade whose cross section is shaped like a diamond with the points cut off. The end is sharpened to a wedge with the cutting edge at the thickest part of the tool. The tool scrapes rather than cuts as it is pushed into the revolving work. See Fig. 2.71.

The home mechanic can make his own parting tool from an old 8″ or 10″ file by grinding off the teeth and grinding the end to the correct shape. Another efficient shape for a tool of this type is made by grinding away about one-half the width of the file for a length of 2″. Sharpen the remaining one-half of the file to a cutting edge of 45°. This makes a cutting rather than a scraping edge. In grinding either shape it is important to take care that the cutting edge is the widest point on the blade. Otherwise the sides of the tool will bind in the slot it is cutting

FIG. 2.72. Round nosed tool.

The parting tool must be used with care, or it may catch in the wood and break, or throw the piece out of the lathe. It is made of carbon tool steel, hardened and tempered for about three quarters of its length. The three common sizes are 3/32″, 1/8″, and 1/4″, in thickness.

The *round nosed tool* is flat and similar in shape to the skew chisel, but is ground with a semicircular bevel on the end, whetted to a cutting edge. It is used in places where a gouge might catch in the work. It is made in widths ranging from 1/4″ to 1 1/2″. See Fig. 2.72.

This type of tool can be made by the home mechanic by grinding an old square file, or any long piece of tool steel.

An adequate set of wood turning tools for the home workshop would consist of three gouges, 1¼″, ¾″, and ¼″, three skew chisels, 1¼″, ½″, and ¼″, one medium sized parting tool, and two round nosed tools, ¾″, and ¼″.

An *outside caliper* and an *inside caliper* are needed to make measurements of work in the lathe. The spring type of caliper shown in the illustration is much to be preferred to the friction type because its set is less likely to be disturbed by the friction of the turning work as the caliper is used (Fig. 2.73).

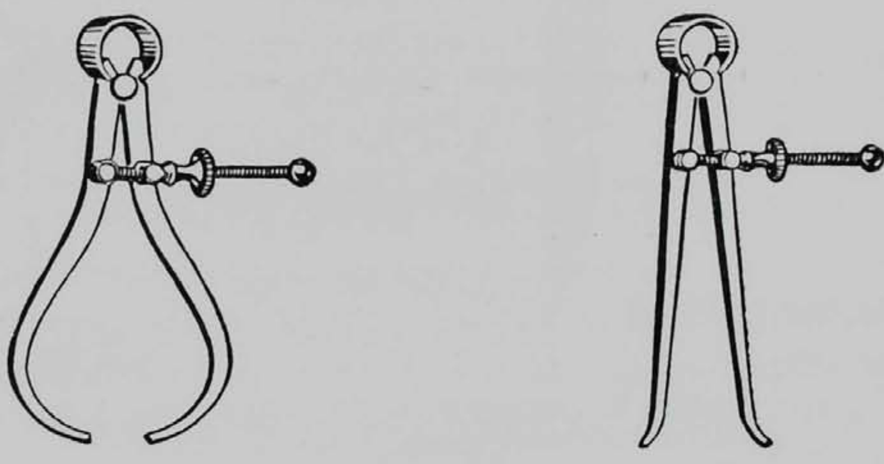


FIG. 2.73. Outside and inside caliper.

The Drill Press. Next to the circular saw and the lathe, the drill press is probably the most versatile machine in the home workshop. This machine may be obtained in either a bench model or a floor model. The important dimension is the diameter of a circle whose center hole may be drilled. For example, a 15″ drill press will drill a hole in the center of a 15″ circle. Sometimes, size is also specified by the capacity of the chuck. It is well to use a ⅓ or a ½ hp. motor on this type of drill press. See Fig. 2.74.

In addition to drilling, such work as mortising, shaping, routing, and sanding may be done on the drill press, by using special attachments.

The Scroll or Jig Saw. The jig saw is used to cut curves in thin material. By using a blade designed for the purpose and the proper speed, metal as well as wood may be cut on this machine.

The size of the machine is designated by the throat capacity, or distance from the blade to the column. An adequate size for general use is a 24″ machine. Most saws of this size will cut wood up to 2½″ in thickness, with a heavy blade, but the jig saw is commonly used for cutting thin wood.

Small files and sanding attachments may be used in place of saw blades to add to the usefulness of this machine. A 1/4 or 1/3 hp. motor is sufficient.

The jointer is another timesaving machine in the home workshop. Its name derives from its principal purpose which is to plane the edges of boards perfectly straight and smooth in preparation for an edge to edge joint. The size is designated by the width of the cutting head. For the home workshop an adequate size is 4″ or 6″. Larger sizes are heavy duty machines and are expensive. A 1/2 hp. motor supplies enough power to operate this machine. In addition to planing faces and edges of boards, it is possible to cut bevels, chamfers, and tapers. Some jointers are designed to do rabbeting also.

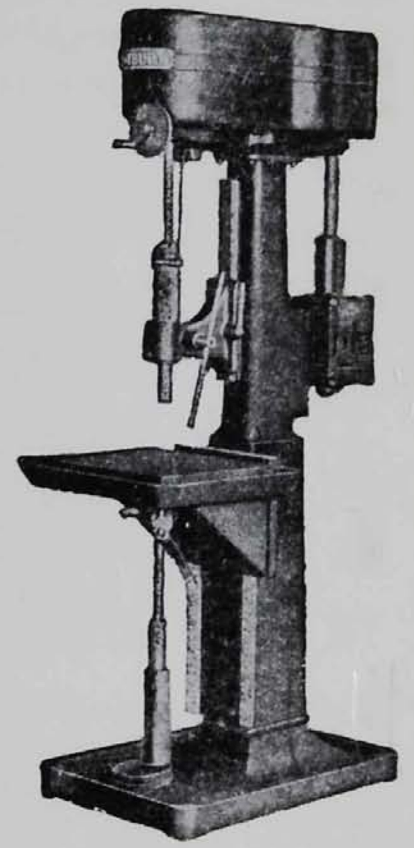


Fig. 2.74. Drill press.

The band saw is used to cut curves in thicker material than can be cut on a jig saw. It consists of an endless, beltlike steel blade running over two wheels, or over three wheels, depending on the type of machine. The size is designated by the diameter of the wheels. For the home workshop, either the 14″ or the 16″ size is suitable. These sizes may be operated by a 1/2 hp. motor.

Some types of band saw can be operated at a low speed which, if the proper blade has been installed, makes it possible to cut metal as well as wood.

The Surface or Thickness Planer. As the name implies, this machine is used to plane boards to a designated thickness. A machine which will plane a board 10″ or 12″ wide is a suitable size for the home shop. It can be adjusted to take thicknesses up to 4″. For satisfactory operation, a 3/4 or 1 hp. motor is required.

The **shaper** is a machine with a vertical spindle on which various kinds of cutters can be mounted. A table and guide are so arranged that stock pushed along the guide is given a molded edge of a pattern determined by the cutter used. Special cutters may be obtained for rabbeting and grooving. Shapers may be obtained in various styles and sizes.

The Sander. There are two types: the disk sander and the belt sander. Some manufacturers make machines which combine both types. The sander is used to give final shape and dimension to a wooden part as well as to smooth the surface. A coarse belt or disk will cut away a wood surface very rapidly. Many grit sizes from fine to very coarse are available on both belts and disks.

If a table of some kind can be mounted in front of it, a sanding disk on the spindle of a lathe will do most of the work of a regular disk sander.

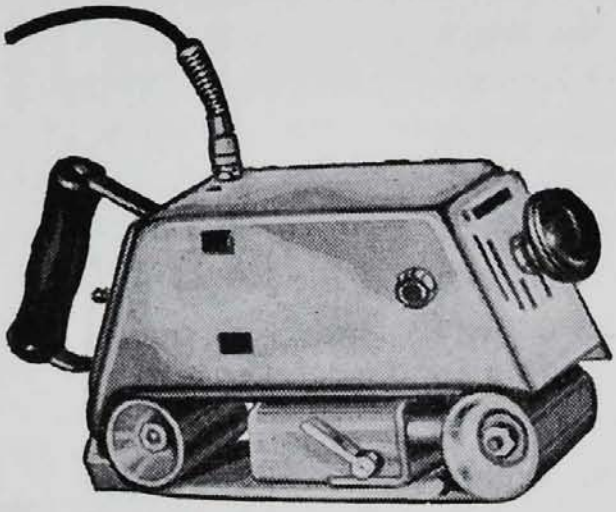


FIG. 2.75. Portable belt sander.

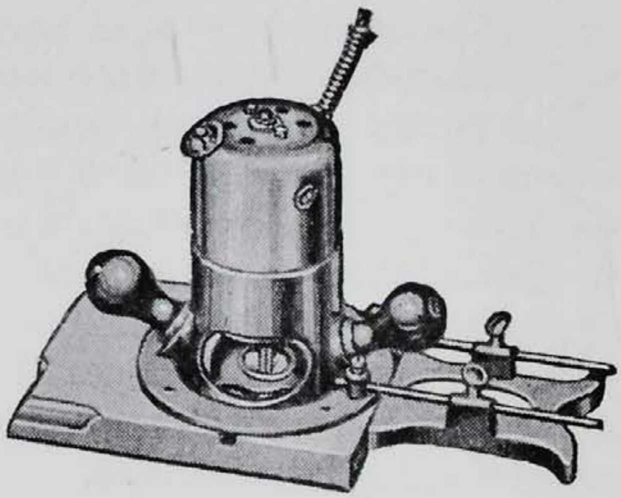


FIG. 2.76. Portable router.

The *portable belt sander* is designed for sanding work that cannot be done on a fixed machine. The belts are 2″ or more in width. With some makes an attachment can be obtained to hold the sander to a bench top so that it will serve as a stationary sander. See Fig. 2.75.

The **portable router** will cut many shapes of molded edge. It may be used for dadoing, beading, routing, fluting, veining, and carving (Fig. 2.76).

Chapter 3

MATERIALS USED BY THE WOODWORKER

Sandpaper . . . Screws . . . Nails . . . Other Fasteners: Corrugated Fasteners, Hooks and Eyes, Dowels, Bolts, Nuts and Washers . . . Hardware: Hinges, Storm Window and Screen Hangers, Locks and Latches, Glazier's Points, Mending Plates . . . Putty . . . Glue . . . Crack Fillers . . . Wood Preservatives

Sandpaper is used in woodworking to smooth surfaces after they have been shaped with cutting tools. It is made of various grades of paper, or cloth. The abrasive is held to the paper with glue, or for waterproof papers, with a synthetic adhesive. Nearly all sandpaper was formerly made with a flint abrasive, but garnet is now used extensively, especially for machine sanding. The artificial abrasives are found to last longer on high speed sanding machines, although they are more expensive than flint. See Fig. 2.77.

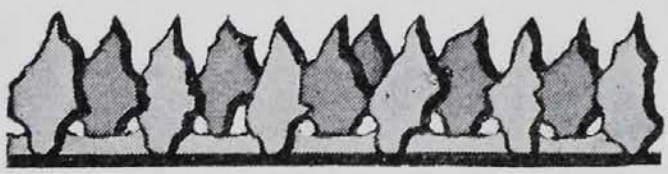


FIG. 2.77. Enlarged view showing arrangement of particles on surface of sandpaper.

The grit size of the abrasive determines the smoothness of the surface obtained. Grit sizes range from No. 8-0, extremely fine, to No. 3½, extremely coarse. The home craftsman should keep a supply of No. 4-0 and No. ½ and, if fine finishing is undertaken, of No. 6-0 and No. 8-0. Sandpaper comes in standard sheets, 9″ by 11″, or, if a large quantity is purchased, in rolls of various lengths and widths. For rough work, such as removing paint and wood finishing materials, a type of sandpaper called "Openkote," in which the particles of abrasive are comparatively far apart, has been found most efficient.

The use of sand disks, drums, and belts saves much time. The use of such tools is really wood grinding, a method of reducing a piece of material to a desired size and shape.

Screws. Wood screws, compared with nails, are a recent development.

Up until about thirty-five years ago, wood screws were made with a blunt point, and a pilot hole was needed wherever a screw was to be used. The screw with a sharp point was a big step ahead and opened a much wider field of use for this type of fastening. The wood screw, threaded into the material in which it is used, is a much more secure type of fastening than the nail, although it takes more time and care to drive a screw properly.

Ordinary screws range in length from ¼″ to 6″, and in diameter of shank from No. 0, approximately 1/16″, to No. 30, approximately ½″. There are three standard types of head: flat, round, and oval. Many special types are manufactured for specific purposes. The lag screw is similar to the ordinary wood screw, except that it is usually larger, rougher in finish, and the head is square so that the screw is driven by a wrench rather than a screwdriver. Steel and brass are the most common materials from which screws are made, although they are also made from rustproof materials like *Everdur*, *Monel*, bronze, and stainless steel (Fig. 2.78).

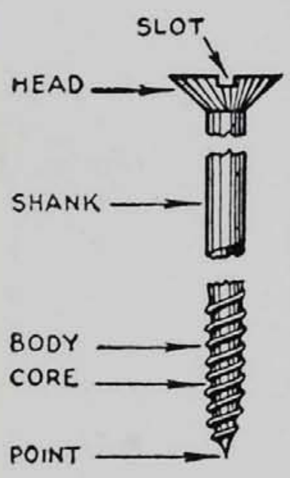


Fig. 2.78. Parts of screw.

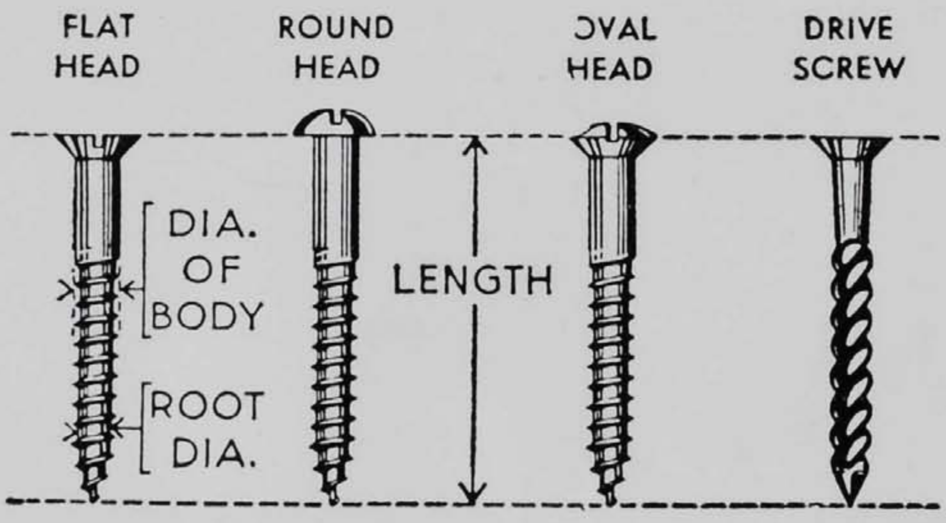


Fig. 2.79. Types of wood screws.

The parts of the screw, as indicated by the diagram, are the slot, head, shank, body, and point. When choosing a wood screw, three factors should be considered: First, the length of the screw, determined by the thickness of the materials to be joined. Second, the diameter of the screw, determined by the kind of material and the strength of joint needed. Third, the type of screw head, determined by the finish of the surface in which the screw is used. (See Fig. 2.79.)

Ordinary screws that are used about the home vary from ½″ to 1¼″ in length. Convenient sizes to have in the home workshop are: ¾″ No. 6 flat head bright, 1″ No. 8 flat head bright, 1″ No. 8 round head blued, and

1¼″ No. 8 round head blued. Other sizes can be chosen according to the work that is being done. In buying screws, all of the following information should be given: the quantity, length, diameter (by number), type of head, material from which the screw is made, and the finish of the screw.

Nails. For many generations, nails have been one of the most important fasteners used in wooden buildings. The common nail of today, and the only kind that need concern the home owner at this time, is the wire nail. Later in this section cut nails will be discussed. (See Fig. 2.80.)

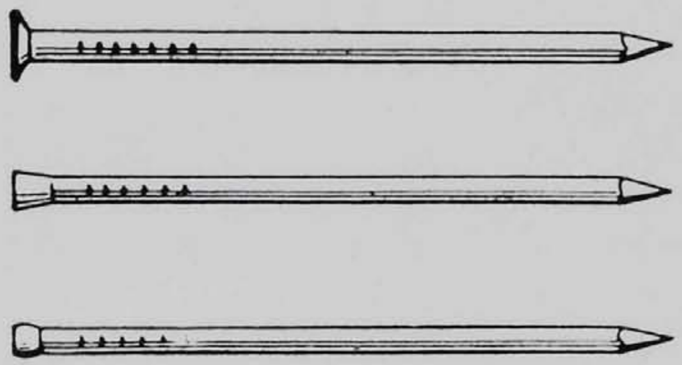


Fig. 2.80. Types of wire nails.

The size of a nail is designated by the term *penny*, the origin of which is uncertain. One theory is that the penny number originally indicated the weight, in pounds, of 1000 nails. Another theory is that the term refers to cost, the 6 penny nail being the size that cost 6 pence per 100, and the 4 penny 4 pence per 100, etc. At the present time nails are sold by the pound. It is economical, if nails are being used in quantity, to purchase by the keg.

A convenient size of nail for repair jobs is the 6 penny, smooth, box nail. It is made of about 12 gauge wire, about 2″ in length, and will clinch easily. It is not large enough in diameter to split ordinary materials, and will hammer into most woods easily. For building purposes, the 8 or 9 penny common nail is generally used. The 8 penny nail is about 2½″ long and is made of about 10 gauge wire. The 12 penny nail, 3¼″ long and made of slightly larger wire, will reach farther, which is desirable, especially if one is nailing to old timber which is slightly decayed. This nail is also used to toe nail studs to a horizontal member, i.e., to drive diagonally through the side of the stud down into the board on which the stud is standing. The 20 penny nail, often called a spike, is a common fastening used by the carpenter in heavier work. It is about 4″ long and strong enough to be hammered into fir or other dense wood.

For interior trim, for cabinet woodwork and wherever inconspicuousness is important, the finishing or brad type of nail is used. This is a nail with a very small head which can be driven below the surface of the wood with a nail set. On fine work the resulting hole is filled with putty before the final paint or varnish is applied. The size of a finishing nail is also indicated by a penny number.

The following tables will give an idea of the sizes and weights of some of the smaller nails.

Common Wire Nails
(d means penny)

Size	2d	3d	4d	5d	6d	7d	8d	9d	10d
Length	1″	1¼″	1½″	1¾″	2″	2¼″	2½″	2¾″	3″
Gauge Number	15	14	12½	12½	11½	11½	10¼	10¼	9
Number to 1 lb.	875	565	315	270	180	160	105	95	70

Finishing Nails

Size	2d	3d	4d	5d	6d	7d	8d	9d	10d
Length	1″	1¼″	1½″	1¾″	2″	2¼″	2½″	2¾″	3″
Gauge Number	16½	15½	15	15	13	13	12½	12½	11½
Number to 1 lb.	1350	800	580	500	300	235	185	170	120

An excellent description of all types of nails can be found in the American Steel and Wire Company's *Manual of Carpentry and Catalog of Nails.*

Other Fasteners. The *corrugated fastener* is a piece of corrugated mild steel, sharpened on one edge. It can be driven into wood across any flat joint and thus makes a rapid, cheap method of holding together small frames, screens, etc. It is only used on comparatively rough work. It is made in sizes from ½″ to 2″ long and from ⅜″ to ¾″ in width (Fig. 2.81).

The *hook and eye* is another fastener which can be rapidly and easily installed. Many shapes and lengths are made, in plain or galvanized steel, or brass. The forged hook was one of the most important fastenings of our forefathers. The 5 & 10 cent stores sell a good assortment of this type of fastener. See Figs. 2.82 and 2.83.

The *dowel* is a round wooden stick used to strengthen edge to edge joints and for many other purposes in woodworking. It is usually made of birch, in sizes from 1/8″ to 1 1/4″ diameter, and 3′ in length.

Hardware. The *hinge* is a most important item of house hardware. Of the many types, only those of particular interest to the home owner are described here.

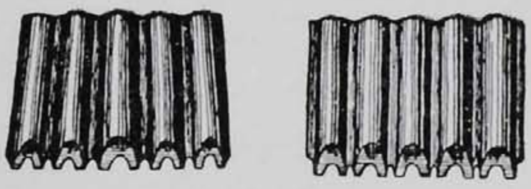


Fig. 2.81. Corrugated fasteners.

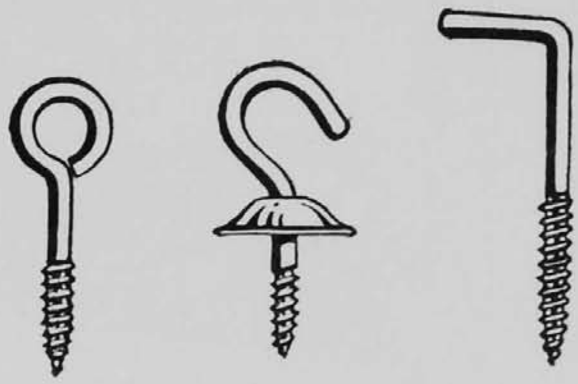


Fig. 2.82. Screw fasteners.

Fig. 2.83. Hook and eye.

The ordinary hinge is composed of two leaves and a pivot, called a knuckle. The most common type has leaves which lie flat when opened. Other types are *swaged* as illustrated. This type of hinge, when made with a removable

Fig. 2.84. Hinges, *left*, not swaged, swaged. *Right*, one leaf swaged, one leaf swaged flat.

pin, is called a butt, and is commonly used for hanging doors. The removable pin makes it possible to take a door from its frame without removing the hinges. This type of hinge is usually available in iron, brass, or brass plate and is made in many sizes and qualities.

The strap hinge is another common type. It is made with two long leaves which are screwed to the flat surface of the door instead of to the edge of the door. The leaves taper from the pin to the end. A 6″ strap hinge measures 12″ overall when opened. It is used on gates, bulkheads, and storm doors. The dimension of a hinge given in a catalog is the overall dimension when it is open. The tee hinge has one leaf like an ordinary hinge, and the other leaf

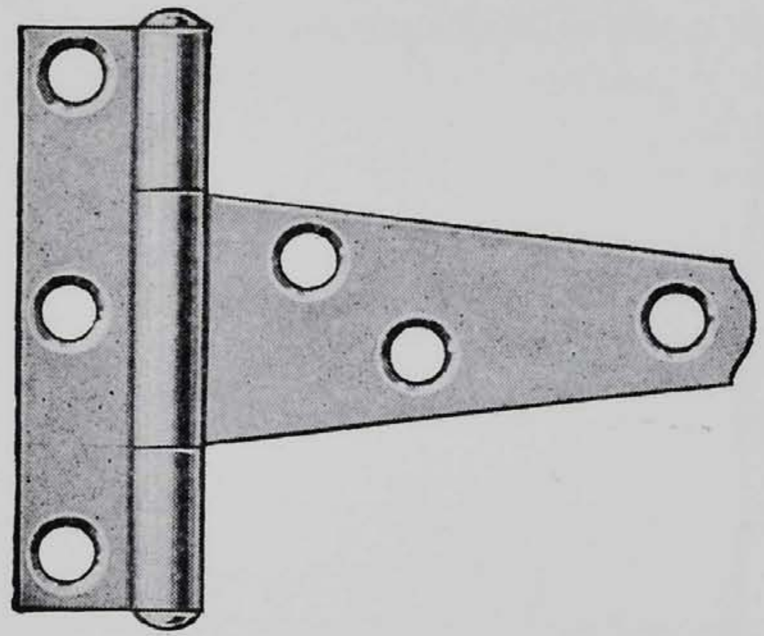


FIG. 2.85. Cabinet T-hinge.

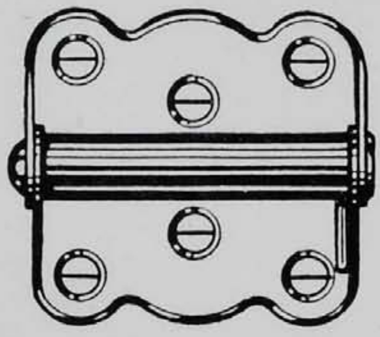


FIG. 2.86. Spring hinge.

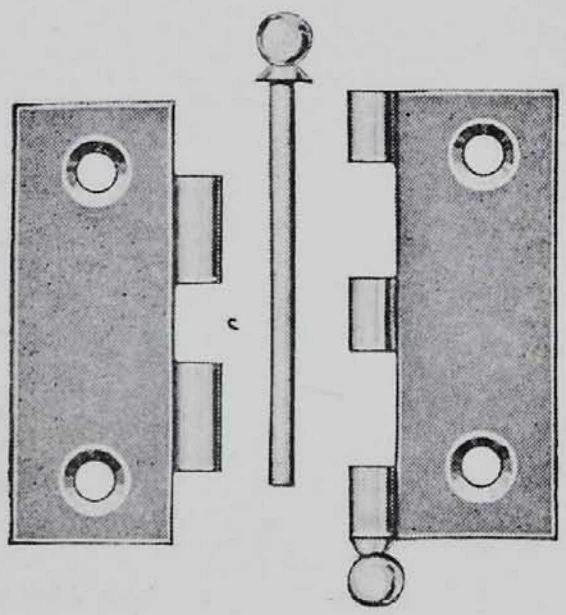


FIG 2.87. Parts of butt hinge.

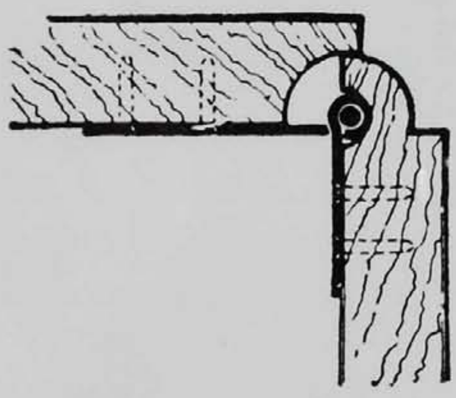


FIG. 2.88. Rule joint hinge.

like a strap hinge. Tee hinges are made in sizes from 2″ to 8″, and are used where there is not enough room on a door frame for the long leaf of a strap hinge.

Rule joint hinges are used on the leaves of tables and are like ordinary hinges except that one leaf is about twice the length of the other. They also are swaged hinges. The length of the pin determines the size of the hinge. Common sizes are 3/4″, 1″, 1 1/4″, and 1 1/2″.

Many types of decorative hinge will be found in the catalogs of hardware manufacturers.

Bolts, Nuts, and Washers. Many shapes and sizes of bolts and nuts are used in the manufacture of the various items of equipment now found in most homes. Some are particularly useful in woodworking projects likely to be undertaken by the home craftsman.

The *carriage bolt* has an oval head and is square in cross section for a short distance below the head. As the name indicates, it was used first in the construction of vehicles, in the horse and buggy days. The oval head looked well and the square part of the shank kept the bolt from turning while the nut was being screwed in place. The *machine bolt* is similar to the carriage bolt, except that it has no square section on its shank, and it has a square head, which can be held with a wrench while the nut is being tightened.

Two types of thread are commonly used on bolts. The National Coarse Thread is used on carriage bolts, and the National Fine Thread is standard for bolts used on automobiles and airplanes. Bolts having the National Fine Thread are usually made with octagonal heads and are stronger and more accurately dimensioned than carriage bolts.

Among the many special types of *nuts* and *bolts* are wing bolts, eye bolts, cap screws, cap nuts, wing nuts, and many kinds of lock nut. Wing nuts and bolts are particularly useful where a fastening may be assembled and taken apart frequently.

Washers are disks of metal with a hole in the center. A washer, placed over the end of a bolt before the nut is screwed on, prevents the nut from digging into the wood and adds strength to the assembled parts, or serves to separate moving parts held together by a bolt. They are made of mild steel, up to 3/4″ hole size. The larger sizes are usually made of cast iron and are much thicker.

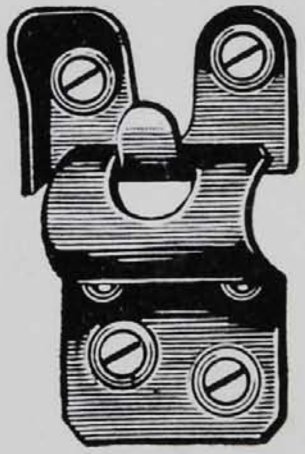


FIG. 2.89. Storm window and screen hanger.

Storm Window and Screen Hangers. There are various types of demountable hinge which can be installed on the top edge of a screen or storm window so that the bottom can swing out. The window can be lifted off the hanger when it is swung well out from the vertical position. If similar hangers are used on the storm sash and the screen for each window the two can be inter-changed each spring and fall with a minimum of trouble.

Hangers are usually made of galvanized mild steel and are fastened in place with screws. With this hanger some sort of bracket or hook is used to hold the storm window in any desired position.

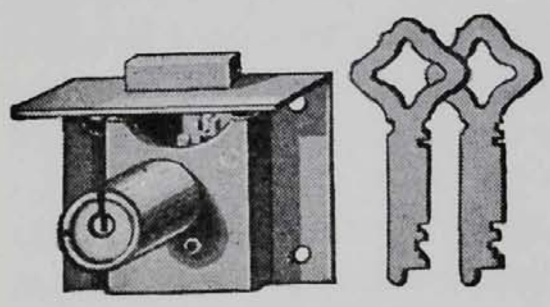


FIG. 2.90. Drawer lock.

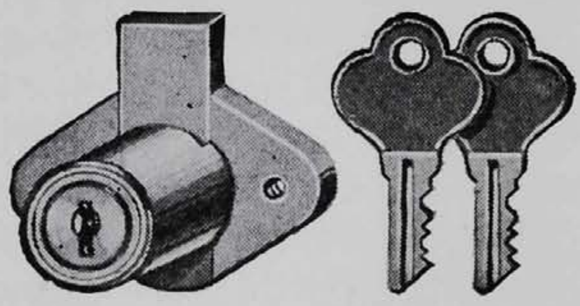


FIG. 2.91. Cylinder lock.

Locks and Latches. There are many types and grades of locks and fastenings available for the doors of a house. In general, door locks can be divided into two main types, the *mortise* lock and the *rim* lock. The mortise lock, as the name indicates, is installed in a mortise or slot in the door. The rim

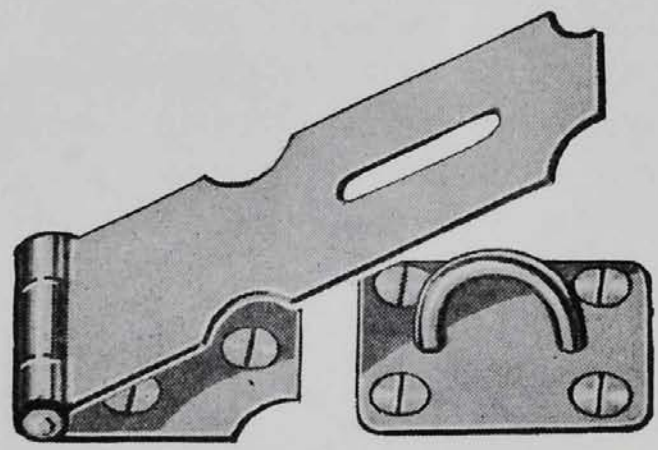


FIG. 2.92. Hasp, for use with pincer padlock.

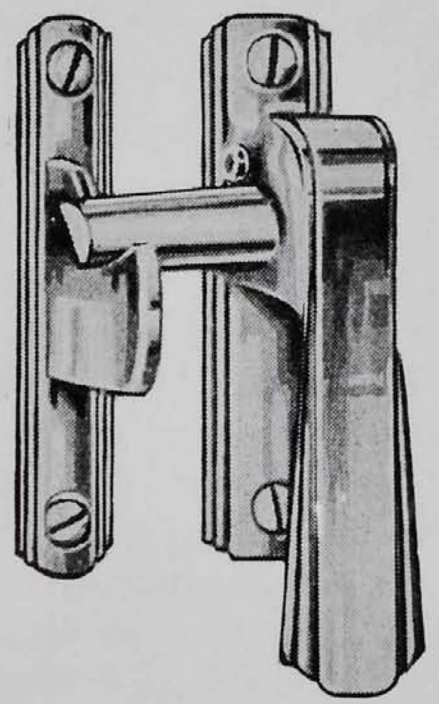


FIG. 2.93. Cabinet latch reversible

lock is simply screwed to the inside surface of the door; it is frequently found on the doors of older houses and is still occasionally used in cheap construction. It is obviously much easier to install than a mortise lock.

Either type may be the *cylinder* type of lock or the older style of *tumbler* lock. The cylinder lock has a small, grooved key with notches along its blade while the tumbler lock has a larger key with a small notched blade at the end. There are many varieties and styles of each kind.

Locks of various shapes are used to fasten the lids of chests, desks, or lockers. These also are sometimes attached to the surface of the wood, but in better construction are sunk into the wood so that the face from which the bolt issues is flush with the surrounding surfaces. The space cut away to install a lock of this sort is called a *gain.*

For doors which are merely to be held shut but are not to be protected from unauthorized opening, a great variety of latches or catches are made. Every house contains a number of closets or cupboards which need this kind of latch. It has a beveled bolt held in place by a spring and withdrawn by a handle.

The variety in style and grade of door hardware is so great that it is wise to consult a hardware store to select appropriate fittings as a project is being designed.

FIG. 2.94. Glazier's points.

Glazier's points are pieces of 20 gauge sheet metal the form of an equilateral triangle, $\frac{5}{16}''$ to $\frac{3}{8}''$ on the side. They are usually made of zinc, although galvanized iron, or even an old tin can, will serve. They are used under the putty to hold a pane of glass in place more securely than it would be held by putty alone. See Fig 2.94.

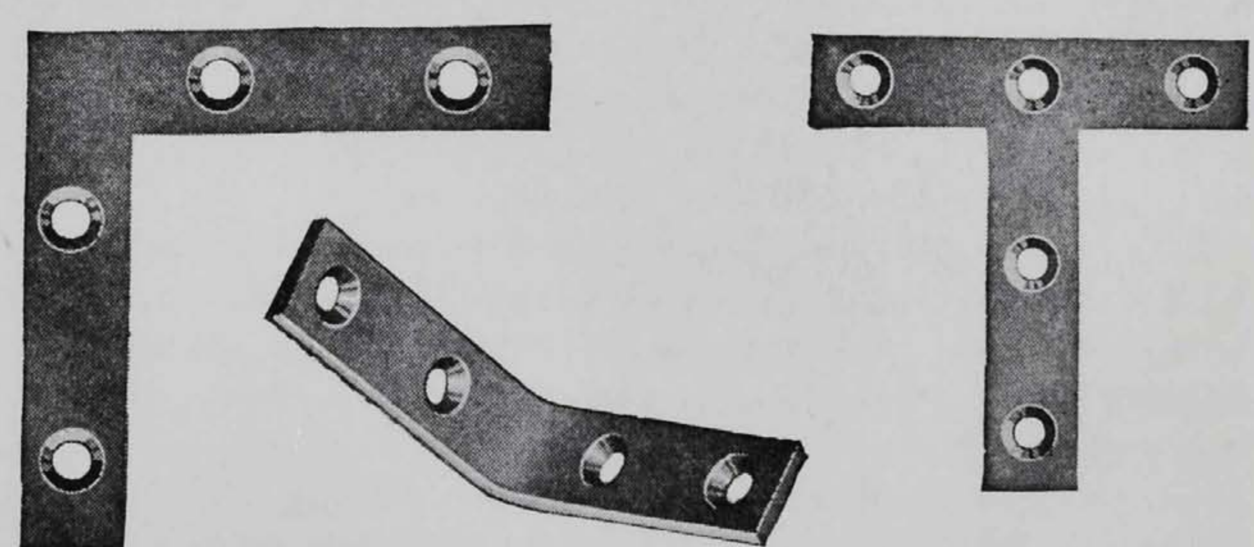


FIG. 2.95. Mending plates.

Mending plates are flat pieces of mild steel of various shapes with holes countersunk on one side to receive flat head screws. They are used to strengthen joints and corners. See Fig. 2.95.

Some of the shapes are: straight, from 2″ to 8″ in length and from ⅝″ to 1¼″ wide; T plates are designated by the length of the stem and the length of the cross of the T; corner plates, usually made with sides of equal length, and in sizes from 1½″ to 8″, and widths from ⅜″ to 1½″; and corner angles, countersunk on the inside of the angle, made in lengths ranging from 1″ to 8″, and in widths from ½″ to 1½″.

Putty is composed of white lead and whiting mixed with linseed oil. The larger the proportion of white lead, the more durable and hard the putty will be. Glazier's putty is composed of a large proportion of whiting mixed with boiled linseed oil, with just enough white lead to make it harden into a durable mass. Boatmakers' caulking putty is composed of white lead, with just enough whiting to keep it from sticking to the hands. Colored putty is made by adding either a little paint, or a little ground color mixed with dryer.

Putty should be stored in an airtight metal or glass container, or it should be covered with linseed oil or waxed paper. Putty should be mixed on a piece of glass or metal rather than wood, which will soak up the oil. Putty is waterproof, shrinks very little, and can be pushed into depressions easily if it is prepared correctly. It is economical, costing about 10¢ to 12¢ per pound. (More detailed information on putty and its use will be found in the Painting Section.)

Glue and Adhesives for the Home Craftsman. The average workshop of twenty-five years ago used a prepared liquid glue. There are many brands of prepared liquid glue still on the market, and it is in many ways a very satisfactory adhesive. It is very convenient to use. Its disadvantages are that it is not waterproof and it deteriorates with age. It can be obtained in containers of one quarter pint up to a gallon. The half-pint container is about as large as the home workshop can use economically.

In the past few years several new types of adhesives have been invented. Most of them are casein products. They come in powdered form and must be mixed carefully. They are thus less convenient to use than liquid glue. However, these resin or plastic adhesives seem to have few drawbacks. Some are waterproof, and they do not stain. They impregnate the wood to help preserve it and will adhere to practically any material. These glues are inexpensive and will last indefinitely in the powder state, if kept dry.

Crack Fillers. Below are listed a few of the crack fillers with a description of each:

Plastic wood is a commercial, prepared crack filler. It sometimes is used as a cure-all by the amateur in woodworking. It may be obtained in various colors. It shrinks considerably when hardening. It must be kept in an airtight container.

Savagran is another commercial crack filler. It is a powder which is prepared by mixing with water. It is economical, hardens well, can be stained somewhat, and shrinks little.

Glue and sawdust is a filling material prepared by mixing sawdust with ordinary glue to a salve-like consistency. It is usually prepared by the craftsman from sawdust of the wood on which it is to be used. This material is probably as satisfactory as any of the fillers. It should be rounded above the depression, to take care of the shrinkage while hardening.

For work that is to be painted and not moved, *plaster of Paris* is useful, but it becomes brittle on hardening, and will fall out if jolted.

Silex. Common wood filler is composed of silex (ground quartz), mixed with linseed oil and a coloring agent. If mixed to a consistency of thick cream, it makes a very hard, durable, crack filler.

Patternmakers use beeswax and carnauba wax as fillers. The woodworking industry uses a great deal of wood putty, which is made of woodflour in a vehicle, such as linseed oil or varnish.

Wood Preservatives. One of the most common forms of wood preservatives is asphaltum. This is usually applied as a paint, with kerosene or turpentine as the thinner. Often in commercial work it is applied while hot by the dipping process.

A more common wood preservative is ordinary paint, which is mixed with a large proportion of linseed oil. There are also many other chemical wood preservatives available.

Chapter 4

HINTS FOR THE WOODWORKER

Planning the Job . . . How to Take Care of Tools; Sharpening: Edged Tools, Saws, Ax, Auger Bit, Cabinet Scraper; How to Recondition Screwdriver Blade, Storing Tools, How to Remove Rust from Tools . . . Getting the Most out of Lumber . . . Lumber Storage . . . Storage of Small Supplies (Screws, etc.) . . . How to Drive Nails and Brads . . . How to Fasten with Screws . . . How Common Joints Are Made and Used: Lap Joint, Mortise Joint, Dovetail Joint, Dowel Joint, Gained Joint, Scribed Joint . . . Preparing Lumber for Use . . . What to Do about Surface Defects . . . Gluing: Edge-to-Edge Joints, Assembling the Job

Planning the Job. The first essential in the construction of a piece of furniture, or in almost any other project, is a plan. It may be a drawing from an outside source, or it may be drawn by the craftsman himself. A purchased drawing should be checked for dimensional accuracy. Many a disappointment is caused by following the design and measurements of an untried plan, which is found to be faulty before the project is finished. To prepare one's own design is likely to be more satisfactory. The first step is to make a freehand sketch of the article as it is to look when finished. From this sketch, a full-sized drawing is made, showing as many views as may be needed to prepare the detailed drawings of each part. As these drawings are made, the details of construction with respect to both appearance, strength and how the parts are fastened together, can be planned. While drawing details, it may be found necessary to change the outward appearance of the article. It is very desirable to discover changes before the construction is begun. Very rarely will time and effort spent on plans be found to have been wasted.

HOW TO TAKE CARE OF TOOLS

Edged Tools. *Sharpening* a tool is a process of removing by filing or grinding a certain amount of metal in order to create a cutting edge. A badly neglected tool may require reshaping before the actual sharpening. If a tool is very dull, it is ground on a motor driven grinding wheel, or on a grindstone. If a grinding wheel is used, care must be taken to avoid overheating, which would change the temper of the tool, softening it, and making it unfit for use. There is less danger of overheating a tool on a grindstone, because it cuts less rapidly and thus generates less heat, and also

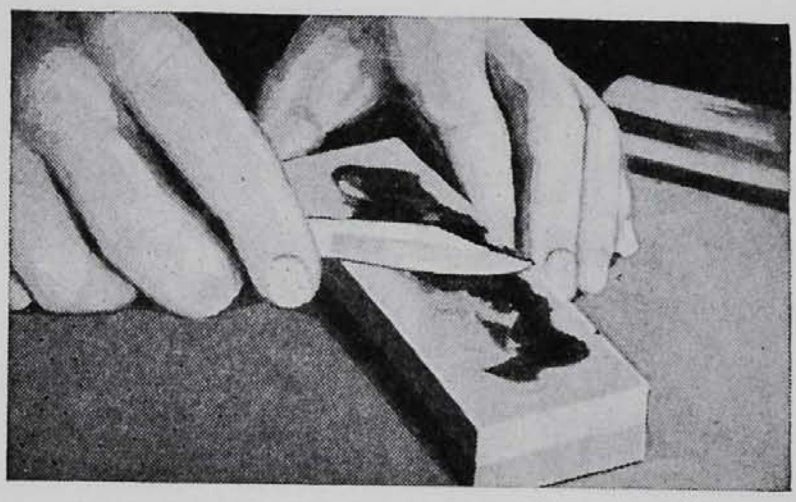


FIG. 2.96. Sharpening a knife on a whetstone.

because water is usually used on a grindstone. Often a tool does not require grinding but can be sharpened to satisfactory keenness on a whetstone. This may be a natural stone or one of the many kinds of artificial stone. Some stones are used with water but the most common and probably the most satisfactory is the oilstone. A good oil for this purpose can be made by diluting a light machine oil with an equal amount of kerosene.

An effective procedure in sharpening a straight-edged tool, like a chisel, is to grind the bevel, taking care to maintain it at the original angle, until a wire edge appears. A wire edge is a narrow rim of steel along the cutting edge, which has been ground so thin that it bends over. Its appearance is an indication that, if the general shape of the tool and the angle of the bevel are correct, nothing is to be gained by further grinding. After the grinding, a whetstone is used. The tool is held at such an angle that contact is made directly on the edge. Most of the whetting is done on the ground side. But when removing the wire edge, it will be found necessary to whet from the straight side, which must be kept flat on the stone. The final keenness can be obtained by using a stone of fine texture. For a particularly fine edge, the tool can be strapped on a piece of leather.

Saws. To put a saw in first class condition requires three separate processes:

The first is *jointing* the teeth, that is, restoring the tooth line to a uniform, slightly convex curve. This is accomplished by running a flat file

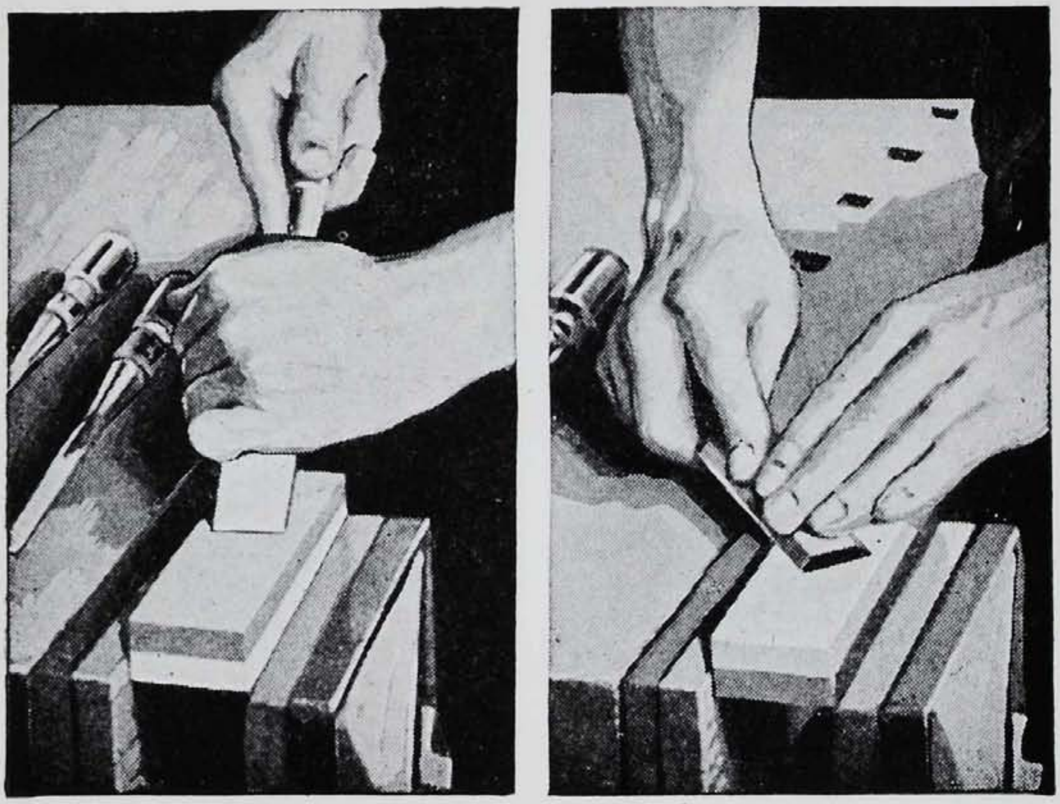


Fig. 2.97. Sharpening a straight-edged tool.

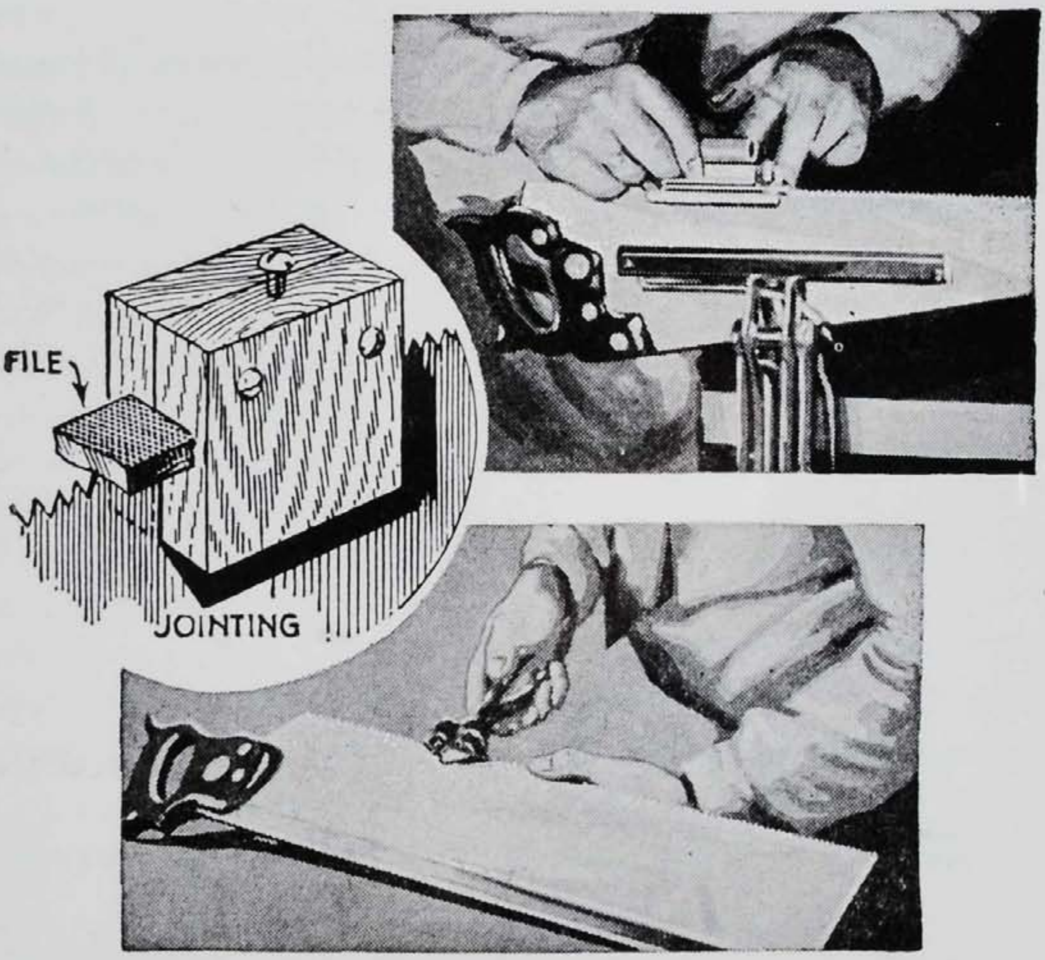


Fig. 2.98. Jointing and setting a saw.

over the teeth. See Fig. 2.98. A wooden guide to hold the file, as shown, can be easily made. In ordinary use a saw does not require jointing each time it is filed.

The second process is *setting* the teeth. This is usually done with a tool made for the purpose. The tool can be adjusted to bend the tooth more or less as desired. It is important that each tooth be bent the same amount. The amount of set needed depends on the use to be made of the saw. If much green or damp, soft wood is to be cut, a wide set is required. For cutting hard, dry wood a narrow set is best.

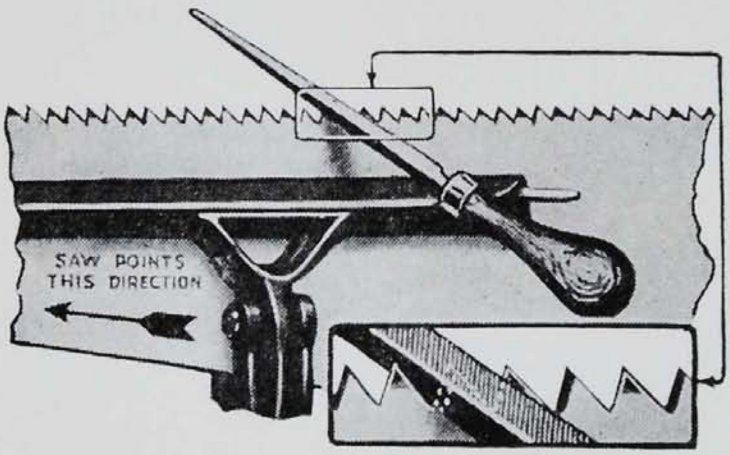
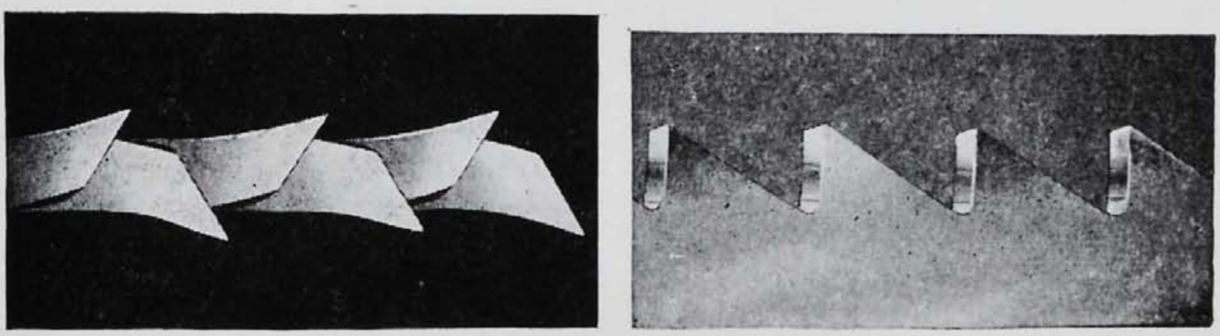


Fig. 2.99. Filing the teeth of a saw.



Cross-cut saw

Rip saw

Fig. 2.99*a*.

The third essential process is *filing* the teeth. Filing a saw is an operation which requires skill that can only be acquired by experience. It will pay the beginner to study closely the shape and cutting edges of the teeth on a new saw or on one freshly filed by an expert. The difference in shape between the teeth of a crosscut saw and a ripsaw should be carefully noted. A person who wishes to learn thoroughly the art of saw filing will find it worth while to buy a cheap saw on which to practice.

An *ax* is ground differently from some edged tools, like chisels, in that a flat bevel is avoided. The ground surface of the ax should be convex in outline from the cutting edge to the thickest part of the ax. This result is accomplished by rocking the ax blade up and down on the grinding wheel during the grinding. The operation requires experience, but if one understands the principle, it is not difficult to do.

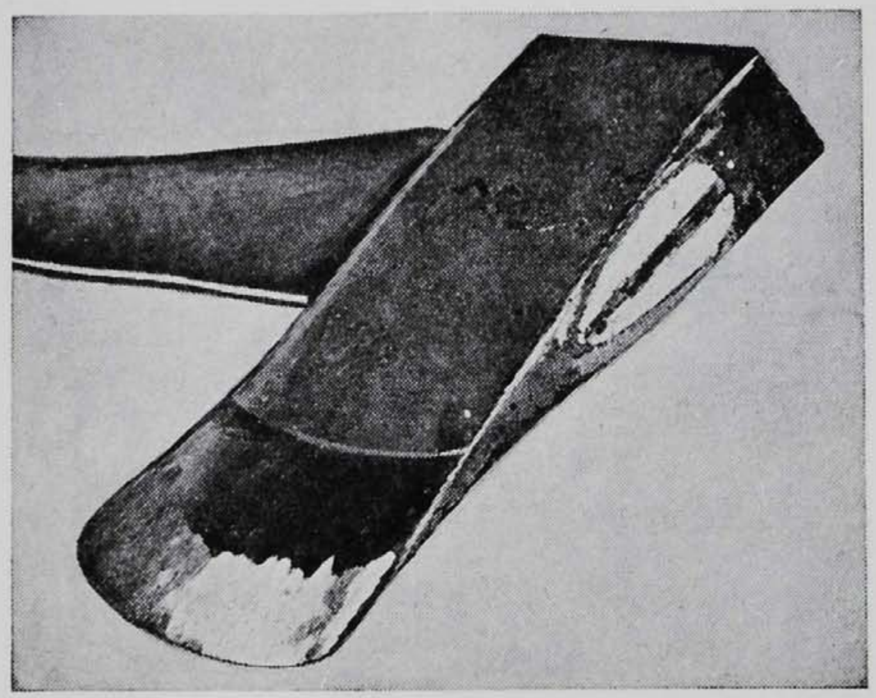


FIG. 2.100. An ax blade correctly sharpened.

The ax blade should be kept comparatively thin, if it is to be used for chopping. A thick ax is better for splitting. After grinding, a keener edge can be obtained if it is whetted a little with an oilstone. After long use and many grindings, an ax becomes blunt and should be reshaped by forging. The face of the ax is drawn out to produce a thinner cutting edge, and to give the ax its original form. After hardening and tempering, it may be ground and whetted ready for service again.

Auger Bit. To sharpen an auger bit, an auger bit file is needed. This is a specially shaped file, with cutting teeth on certain parts of each end. The teeth on the flat of the file are used to sharpen the lips or cutters of the bit, and the teeth on the edge of the file are used to sharpen the spurs. When sharpening the lips, the filing is usually done on the underneath surface, and the included angle of the cutting edge should be kept as near its original shape as possible.

If a bit is damaged, by striking a nail or screw, so that the cutting edge of one lip has been destroyed, the bit can still be used. It can be made into a fast-cutting bit which will make a hole that will do for everything but finished work. Remove one of the spurs entirely, and file the lip considerably below the level of the one that is to do the cutting. A bit is usable if it has one lip and one spur.

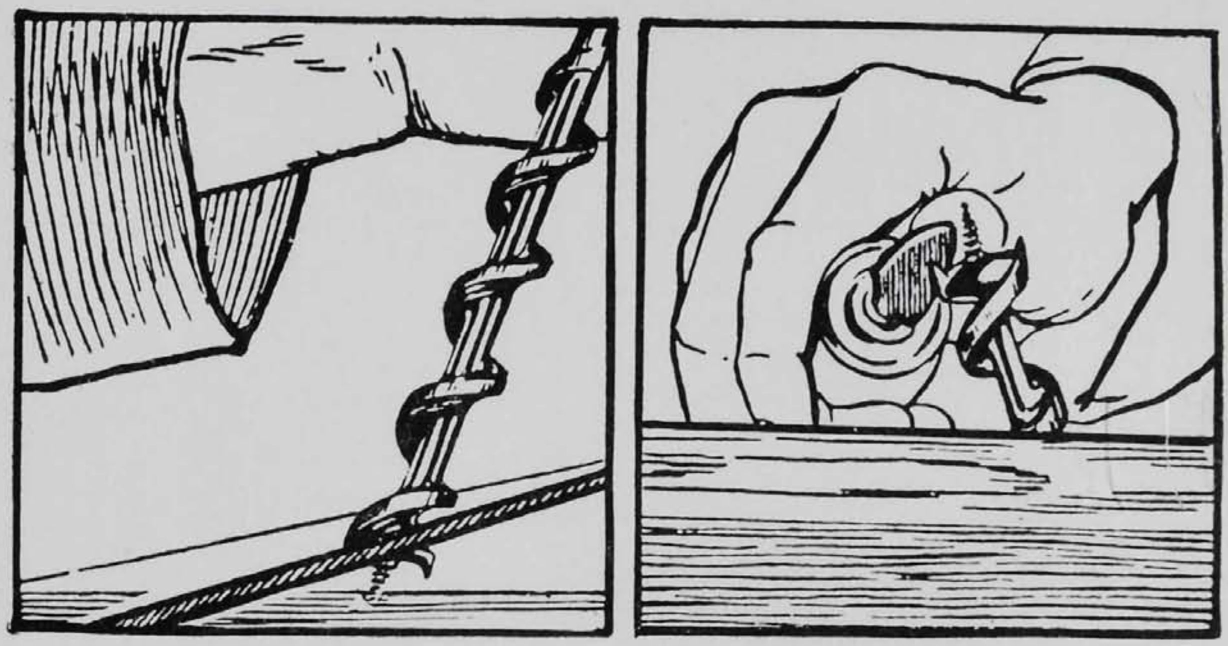


FIG. 2.101. Sharpening an auger bit.

Cabinet Scraper. Sharpening a scraper is a skill which should be learned, if articles of furniture for the house are to be made. See Fig. 2.102. The first step is to draw-file the cutting edge at right angles to the side, until the corners are sharp. Some woodworkers prefer to use a 15° angle, and to sharpen only one edge of the scraper (6). After draw-filing, a whet- or oilstone should be used to make a sharp, smooth, cutting edge (1 and 2). Next comes the most difficult step, that of using the burnisher to shape a hooked edge. The scraper should lie flat on the bench, with the sharp edge up (4). Rub the burnisher over the sharp edge, bearing down hard on the corner to roll over the edge. This will roll the edge in toward the center. Next (5), stand the scraper on end and hold the burnisher at an angle as illustrated (6). Draw the burnisher up and down, one or two strokes, to roll the edge and complete the operation. This leaves the edge in the form of a hook. If the edge is sharpened correctly, a small shaving will be obtained when the scraper is used.

How to Recondition a Screwdriver Blade. Screwdrivers can be reconditioned by either grinding or filing. Many screwdrivers are so hard that they cannot be filed easily, so grinding is necessary. The tendency of an ordinary screwdriver is to push up and out of the slot, when a hard twist is applied to the blade. To avoid this, the screwdriver bit should be kept shaped, so that the sides of the blade fill the slot and are parallel. If the

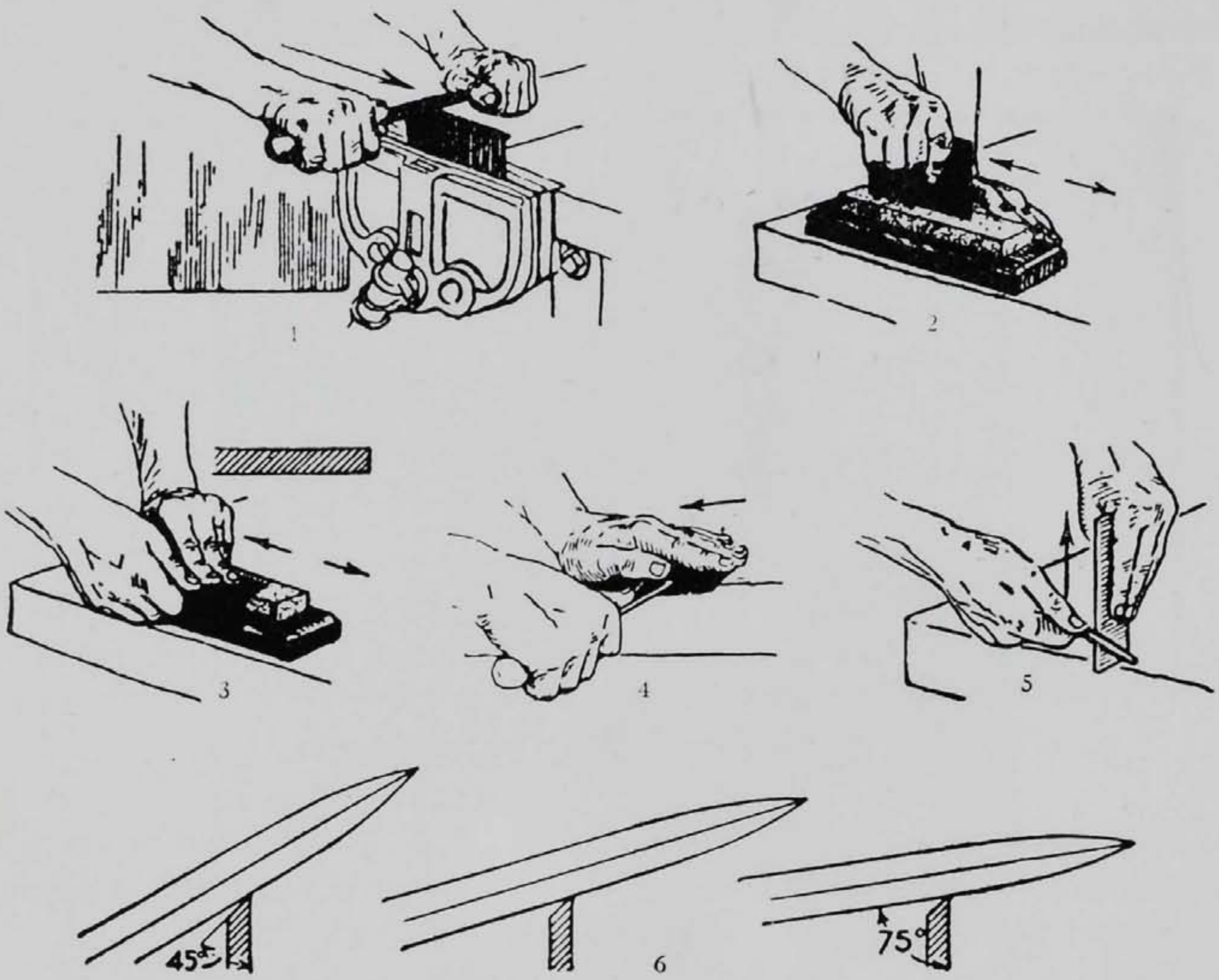


FIG. 2.102. Steps in sharpening a cabinet scraper

filing or grinding is done across the blade, the lines formed by this operation have the tendency to grip on the sides of the slot of the screw, thus helping to keep the blade from slipping out of the screw slot. The width of the blade should not be changed, unless the screwdriver is being reshaped. This is an error that oftentimes occurs when sharpening a screwdriver. If the width is changed, the blade will not fit the same size of screws as it did originally.

When shaping by grinding, care should be taken not to overheat the screwdriver, as overheating will change the temper of the blade and make it so soft that it must be hardened and tempered again. The change of temper is indicated by the appearance of a bluish color on the surface of the screwdriver.

Storing Tools. In preparing tools for storage, two factors are important. The tools should be prepared so that they will not rust, and they should be arranged so that they will not become damaged by contact with each other.

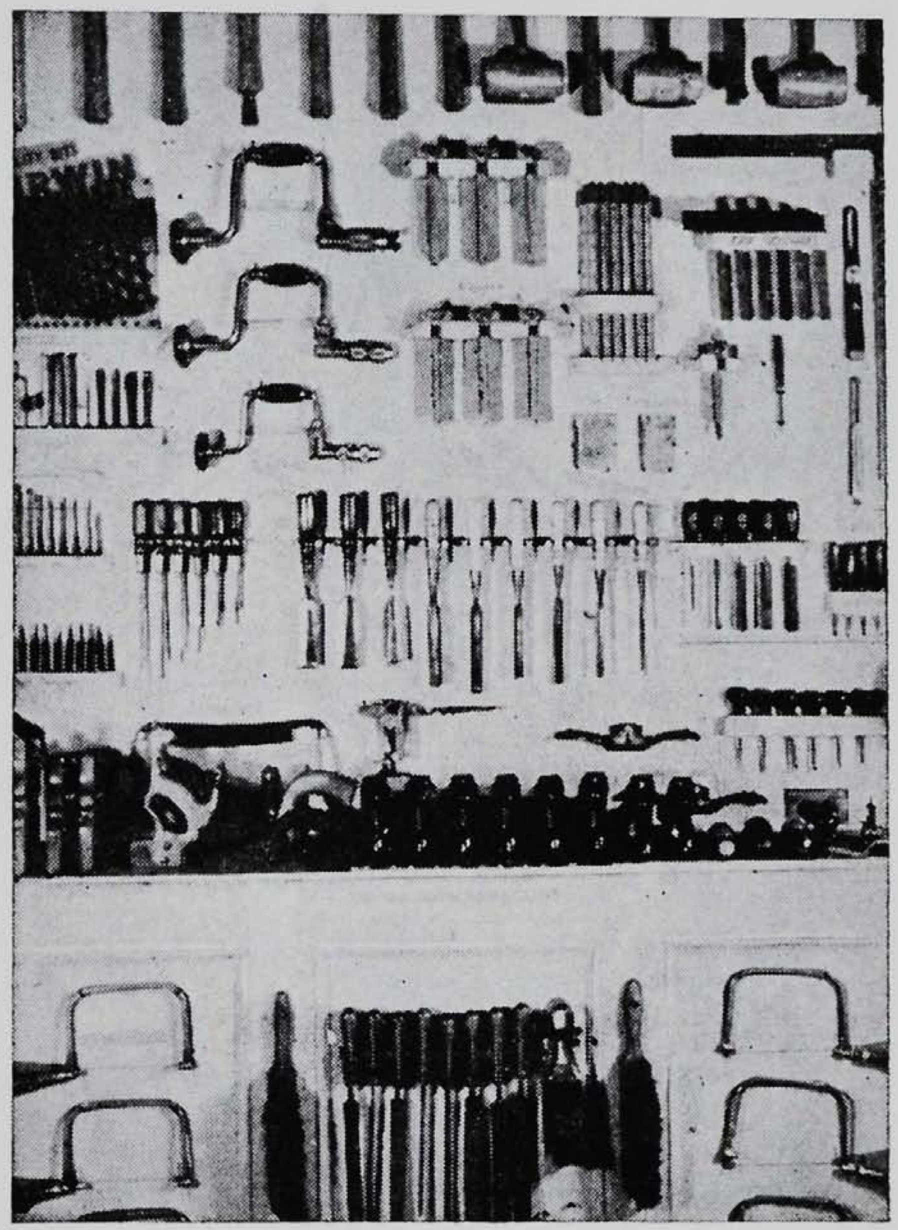


Fig. 2.103. Arrangement of tools conveniently stored.

Tools which are used infrequently can be stored in boxes, keeping the same kind together, or in the individual boxes in which the tools were shipped by the manufacturer. Frequently used tools can be arranged on racks or hooks, with each tool in its own individual place.

Each tool should be coated with a film of oil or grease, particularly during the summer months when rust is most likely to appear. Wrapping tools in paper protects them from both moisture and dust and is a wise procedure with tools that are not frequently used.

A well designed tool chest, in which each tool has its own place, gives tools sufficient protection under ordinary circumstances, if kept properly closed. Tool cabinets which are frequently open, and which are subject to dampness or steam heat, should have regular inspection to see if the tools are rusting. Most cabinets for woodworking tools are made of wood and seem to be more satisfactory than metal cabinets. There are several rust-preventing solutions and greases which can be obtained from hardware dealers.

How to Remove Rust from Tools. Surface rust on ordinary tools, like the hammer, saw, and chisel, can be removed satisfactorily with No. 240 grit emery paper or cloth. An ink eraser is a good abrasive to remove rust from a smooth surface like the bottom of a plane, or the blade of a steel square. If it is necessary to remove a heavy coating of rust from a surface which must be kept true, or one upon which graduations are marked, fine emery cloth should be placed on a flat surface, and the tool rubbed on it. This procedure will help to retain the original shape of the tool, and to remove any high spots that have been caused by corrosion.

There are several rust-removing solutions that work very well, which hardware dealers can usually supply. An old standby is kerosene and sandpaper, but this treatment should be used only on surfaces that do not have to retain their original shape. The kerosene should be wiped off and replaced by a film of oil before the tool is put away.

Getting the Most from Lumber. If only a certain amount of lumber is available for a project, it is wise to lay out the plans to full size, and to check all dimensions to be sure the undertaking is practicable. A cardboard pattern is a great convenience if many exactly similar pieces are to be cut. The use of a pattern makes it easy to take into consideration the direction of the grain of the wood and, many times, it will be found that the pattern can be reversed in such a manner as to save material. Laying out all the work, i.e., outlining each part on the material from which it is to be cut before the cutting is begun avoids also the danger of spoiling one part in the process of cutting another.

Lumber Storage. In storing lumber in the home workshop, two factors are important: first, the lumber should be laid straight, and not subject to warping or twisting; and second, lumber should be protected against a change in the moisture content.

The storage arrangement is more or less dependent upon the space available. Storing lumber on end is very satisfactory, although the ends of stock should not be placed directly upon a cement floor. The lumber should be so arranged that air can circulate around it. If the lumber is kiln dried, it can be piled so that one board rests directly upon another, if a foundation has been prepared so the pile is straight and level. If the lumber has not been kiln dried, it should be *stuck up*. First a foundation of stringers is laid down in line, and level. Each layer of lumber should be separated by *stickings*, which are merely narrow strips of board of equal thickness.

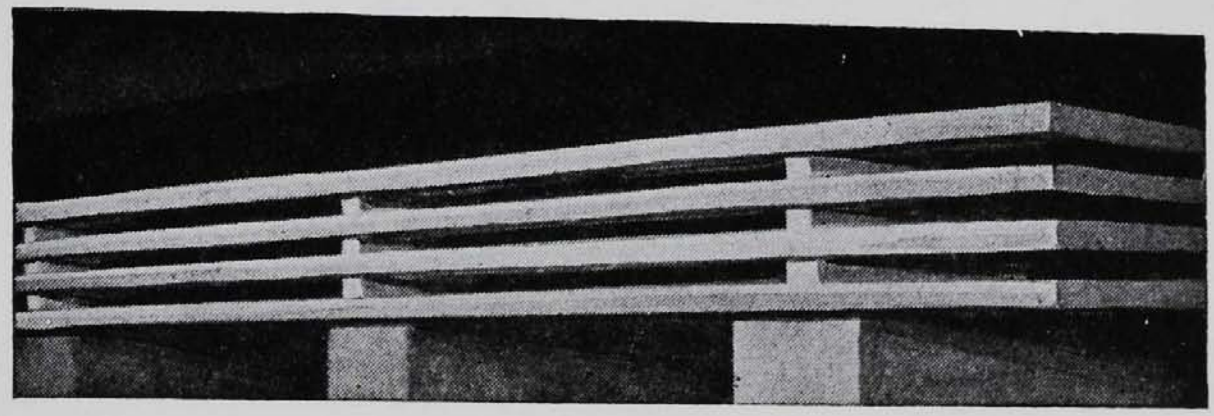


FIG. 2.104. Correct storage arrangement for lumber.

Enough stickers should be used so that the lumber is well supported throughout its length, thus eliminating sag, warping, and twisting. The boards should be placed at least ½″ apart to allow circulation of air. As an additional precaution, it is well to paint the ends of the lumber. This retards fast drying of the ends and helps to stop checking (minute cracks) or season cracking (actual splits on the ends).

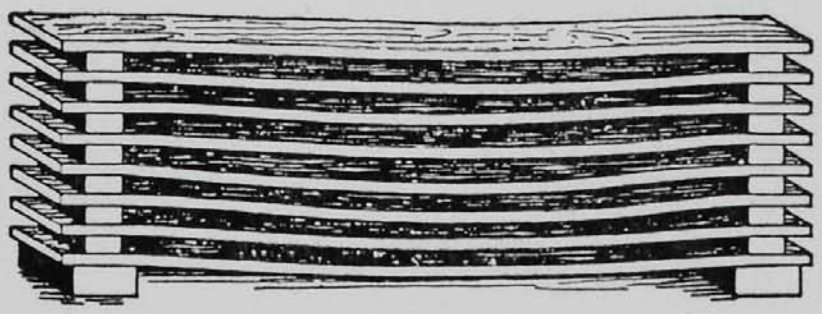


FIG. 2.105. Lumber incorrectly supported in storage. Note sagging.

If lumber is stored in a room subject to dampness, furniture made from it will not stay in shape. In a steam-heated room it will be subject to shrinkage, and may crack or come apart at the joints. When lumber is kiln dried for furniture making, its moisture content is usually reduced to about 6%, but lumber in the home workshop probably averages at least 25% in moisture content. This percentage is not extremely harmful.

The damp summer months are an exceedingly poor time to construct furniture, unless an arrangement can be made to have the lumber kept dry during the construction period. Many disappointments are caused by having the stock change in shape so much, during and after construction, as

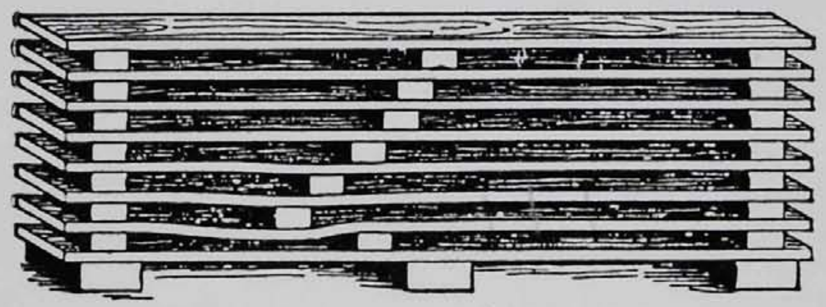


FIG. 2.106. Lumber carelessly supported.

FIG. 2.107. Convenient storage of small supplies.

to render the article of furniture almost useless. This is chiefly due to changes in moisture content. During the construction of furniture, if the pieces are to be left for extended periods of time, they should be carefully stuck up. This will help to retain a uniform moisture content and thus to reduce warping, swelling, or shrinking. Many home craftsmen store lumber in the basement, where it is usually damp in the summer and excessively dry in the winter. If this is done, it is very important to make sure that the lumber has a uniform moisture content before it is used.

Often during the construction of an article the parts are left piled one upon another and when the craftsman returns to work he finds the top board badly warped. This could be prevented by sticking all pieces during the periods when no work is done.

Storage of Small Supplies. The convenient storage of such items as nails, screws, bolts, nuts, washers, and tacks is a matter of real importance in the home workshop. They should be out of the way and protected from dust and dirt — and equally important, they should be readily available, so that time is not wasted hunting for something known to be in stock but which cannot be found.

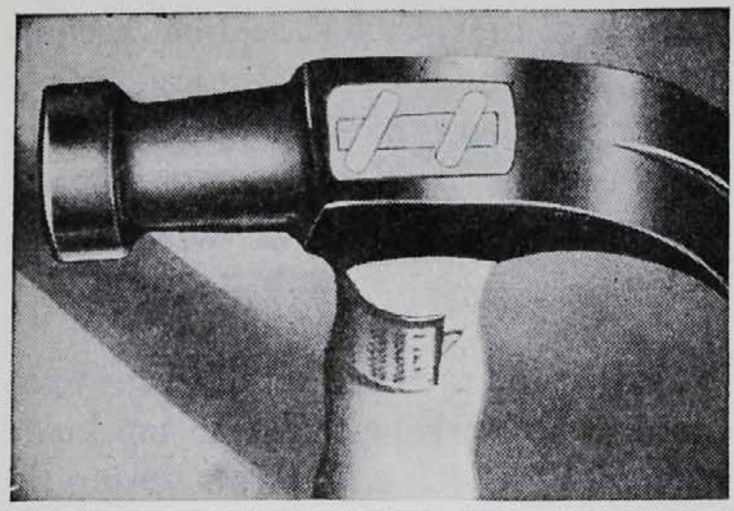
One excellent way of storing such material is in small mason jars. Each jar can be labeled and the quantity of each item can be seen at once. Space can be saved by fastening some jars to the under side of shelves. If the porcelain part of the cover is removed the cover can be attached to the shelf with two screws. The jar is then screwed into its cover. Its contents are visible, out of the way, but quickly available when needed.

A cabinet of small metal drawers is also very useful for the storage of material. Such a cabinet can be made in the home shop.

How to Drive Nails and Brads. Nails are always driven with a hammer. The hammer should be held near the end of the handle and swung with a free, natural motion. A hammer which is hung properly, that is, one in which the handle is properly placed, does not have the head at an exact right angle with the handle. The head of the hammer (see Fig. 2.108), toes in a little towards the handle. This position is believed to make the face of the hammer strike squarely on the nail head, when swung in the arc described by an ordinary blow. The size of the hammer that is chosen by the individual is a personal matter, but a good all-around hammer for the home workshop is the twelve-ounce size.

Some common problems and their solutions are discussed below.

To nail studding on any end to a board at right angles to it, toe nailing is used. The nail is driven through the side of the stud and into the horizontal board at a sharp angle, as shown clearly in the illustration. Piece No. 1 is



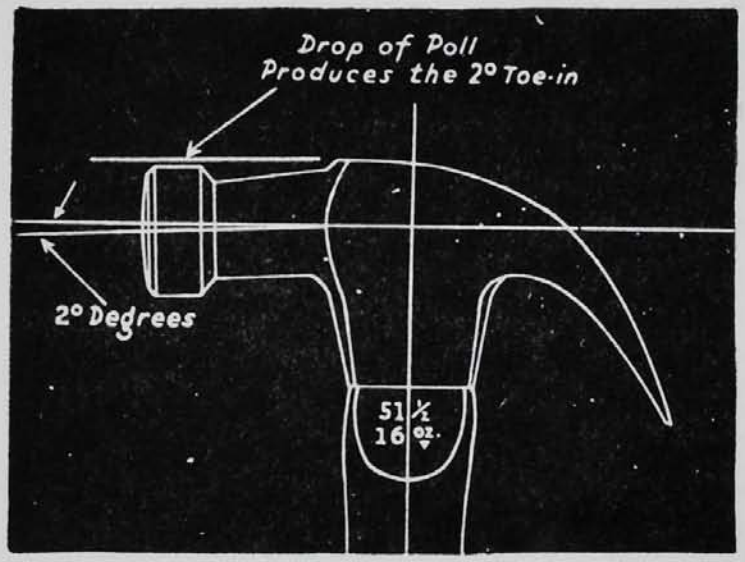


FIG. 2.108. Hammer which is properly hung.

to be fastened to piece No. 2, which is usually at a right angle to piece No. 1. See Fig. 2.109.

When nailing cleats to the top of a box, stagger nailing should be used. This means driving the first nail near one edge of the cleat, and the next nail near the other edge of the cleat, but not opposite the first nail. See Fig. 2.110. Usually,

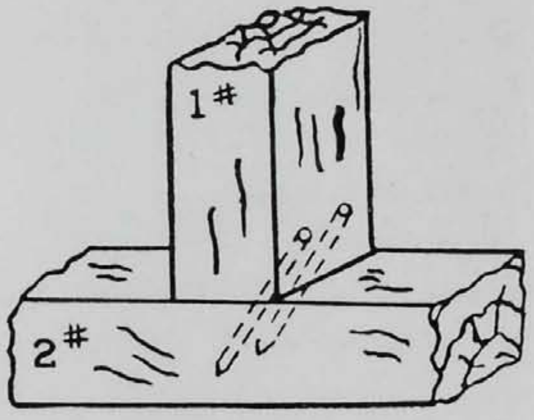


FIG. 2.109. Toe nailing.

two nails are driven near the ends of the cleat. The purpose of the stagger nailing is to avoid having too many nails enter the same line of grain of the wood, which might cause splitting.

It is often necessary to start a nail that cannot be reached by both hands. A good way to do this is to wrap the fingers around the head of the hammer, so that they hold the head of the nail against the cheek of the hammer. The hammer is held in the palm of the hand with the fingers supporting the nail, so that the force of the first blow on the nail will be taken up by the head of the hammer. This will start the nail which can then be driven in the usual way. Care must be used to hold the nail at right angles to the cheek of the hammer. Otherwise, when the blow is struck, the nail may slip off the hammer and injure the hand. See Fig. 2.111.

If it is necessary to drive nails into wood which is some distance under water, a good method is to use a piece of ⅛″ pipe, long enough to reach from the nail well above the surface of the water, and an iron rod that will fit inside it. The nail is started and the pipe is placed over it. Then the nail can be driven by pounding on the rod. The pipe keeps the nail from bending.

Cut flooring nails should be driven with the flat side of the nail parallel with the grain of the wood. It will be noted that this nail is oblong in cross section. It has a large blunt point and sharp edges and acts like a chisel,

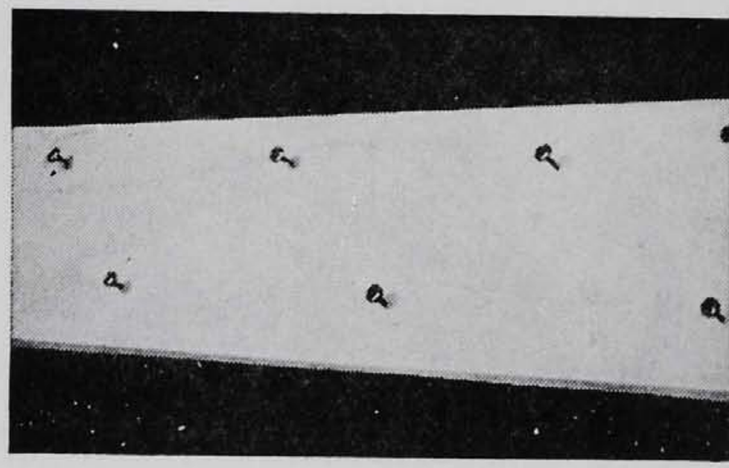


Fig. 2.110. Stagger nailing

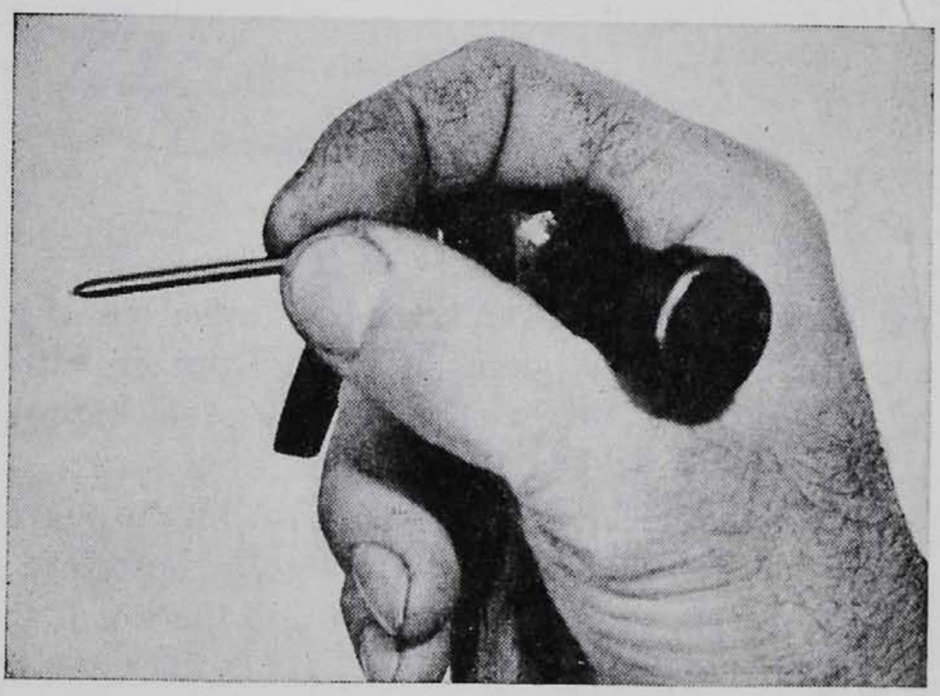


Fig. 2.111. Starting nail with one hand.

usually cutting its way without causing the wood to split. The nail is of parallel thickness, but tapers, being slightly wider at the head than at the point. This causes the sides to push on the end grain and, although it drives in hard, it does not have a tendency to split the wood, and also gives the nail great holding power. See Fig. 2.112.

In setting nails, choose a nail set which has a sharp, round, chisel edge. The diameter of the end should be less than the distance across the nail head.

Nails are usually set below the surface, when the nail head is to be hidden. In nailing all kinds of house trim, it is extremely important that one does not *strike off* or miss the nail, and it is also important that the hammer be held so that the face will hit as nearly flat to the wood as possible. If a dent is made in the wood it can sometimes be removed by moistening, which causes the fibers of the wood to swell.

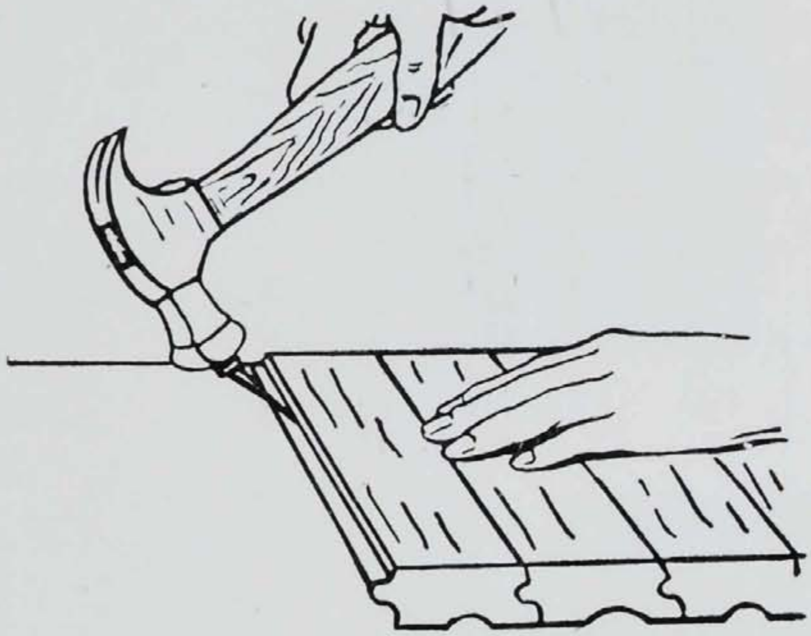


FIG. 2.112. Floor nailing.

For nailing brads there is a tool on the market called a ***brad pusher.*** This is merely a magnetized flat-end punch of small diameter, with a handle on one end, and a sliding shield on the other end. The shield projects over the punch about ½″ and is held in this position by a spring. The brad is inserted in a hole in the shield, and is held in place on the punch by magnetism. When the point of the brad is put in place, and pressure is applied on the handle of the punch, the brad is started into the wood, and the shield slides back, allowing the punch to push the brad in the whole length. This is very convenient when brads must be driven in almost inaccessible places, and it also helps to keep the brad from bending during the driving process.

For *tacking*, it is convenient to have a hammer with a magnetic head.

How to Fasten with Screws. The first step is to lay out the joint and decide where the screws are to go. In hard wood a hole the size of the shank of the screw is bored in the top piece. In the lower part of the joint a hole the size of the core of the threaded part of the screw is bored. This is commonly called the pilot hole. If the screw is properly installed it slips through the shank-sized hole, the thread takes hold firmly in the second piece of wood, and as the screw is tightened the two parts are clamped tightly together. If flat head screws are used the hole is countersunk. If round head screws are used no countersinking is needed.

Often no pilot hole is needed in soft wood, although for a large screw, it is convenient to bore a small pilot hole or to make one with a brad awl. The particular cautions to observe are: (1) The screw should be started straight; (2) Heavy pressure should not be used until the screw is well started, and (3) Just enough pressure should be used to keep the screwdriver from slipping out of the slot.

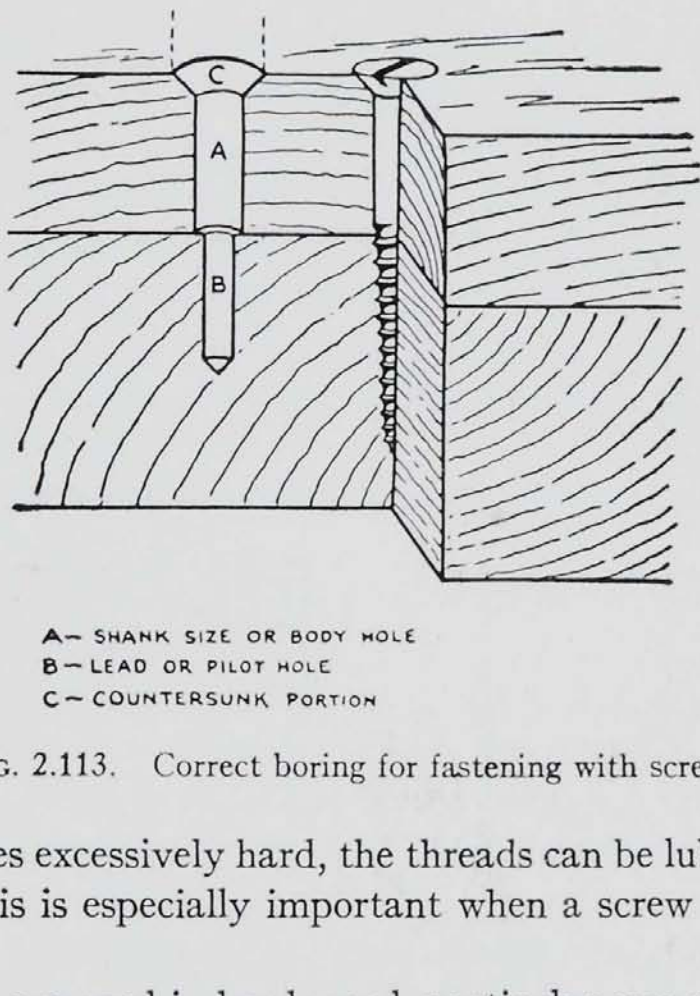


FIG. 2.113. Correct boring for fastening with screws.

If a screw drives excessively hard, the threads can be lubricated with soap or graphite. This is especially important when a screw is driven in hard, dense wood.

If brass screws are used in hard wood, particular care must be taken not to twist them off, because brass is not nearly as strong as steel and, if a screw is twisted off in the pilot hole, it is next to impossible to remove it without marring the piece.

How Common Joints Are Made and Used. *How To Make a Flat Cross Lap Joint.* See Fig. 2.114.

1. Prepare the two pieces of stock to be joined and mark them No. 1 and No. 2.

2. Mark one side of each as the face and draw a center line across the face on piece No. 2 and on the opposite side of piece No. 1.

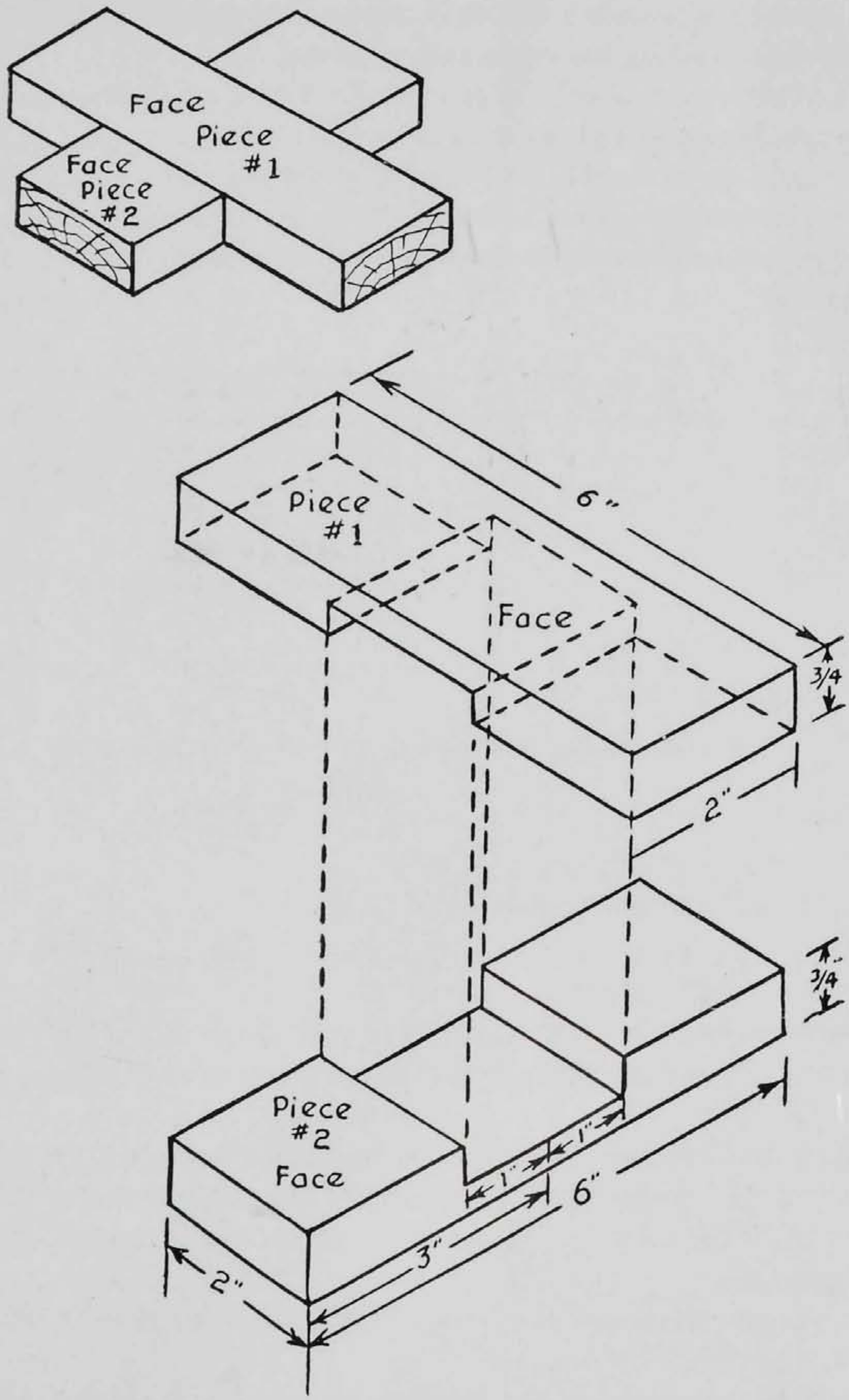


Fig. 2.114. How to make a flat cross lap joint.

3. On piece No. 2 measure one half the width of No. 1 away from the center line and with knife and square, scribe a line across the face parallel to the center line. This is called a *working* line.

4. Place piece No. 1 with an edge on the working line of piece No. 2 and with a knife mark the position of the opposite edge.

5. Scribe this knife mark into a working line.

6. In the same way scribe working lines on piece No. 1, remembering that on this piece they must be on the side opposite the face.

7. With the try square and knife, square these lines down the edges of each piece.

8. Set the marking gauge to one half the thickness of the stock.

9. With the guide of the marking gauge against the working face, mark a light line on both edges of each piece between the two working lines.

10. *Note* that the cut-out on piece No. 2 comes on the working face, and on piece No. 1 on the opposite face.

11. Make saw cuts carefully, being sure not to go outside the working lines.

12. Make two or three saw cuts between the end cuts. *Caution:* Do not saw quite to the working line.

13. Chip out the center portion, working from the edge up and toward the middle.

14. Skive carefully with a *keen* chisel and test for straightness with the blade of the try square.

15. The bottom of each joint should be flat and true, and the joint should press together with the thumbs, or by tapping lightly. When finished, a well made lap joint has the working faces of each piece in the same plane.

The above directions can be applied to the other kinds of lap joint. The following are the most important kinds.

The *cross lap* joint is probably the most widely used of the various types of lap joints. This type of joint may be used to connect two crossing members of a piece of furniture, such as the cross rails of a taboret, the base of a clothes tree, or the base of a Christmas tree standard. See Fig. 2.115.

The *half lap* joint is used for joining the ends of two short timbers, or pieces of wood, to form a long piece. This joint is not used extensively in the industrial arts shop, but finds greatest use in framing construction, boat building, etc. See Fig. 2.116.

The *end lap* is used extensively in light frame construction, such as flats for scenery, screen frames, and some types of cabinet construction (Fig. 2.117).

The *middle lap* joint is used in similar construction to the end lap, where the joint occurs in places other than in the corners of the frame being jointed. See Fig. 2.118.

The **Mortise and Tenon joint** is one of the most important joints in woodworking. If laid out correctly, and cut carefully according to layout, **it is a**

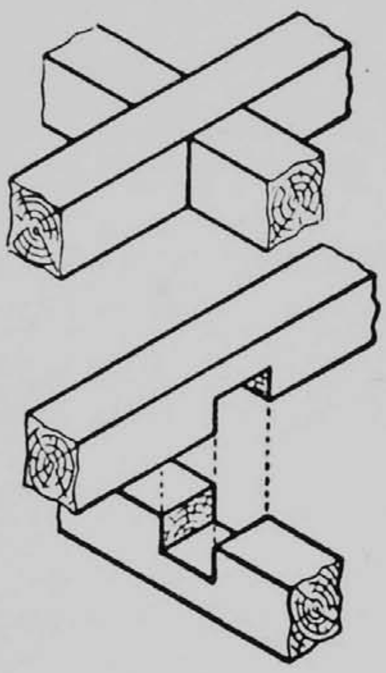


FIG. 2.115. Cross lap joint.

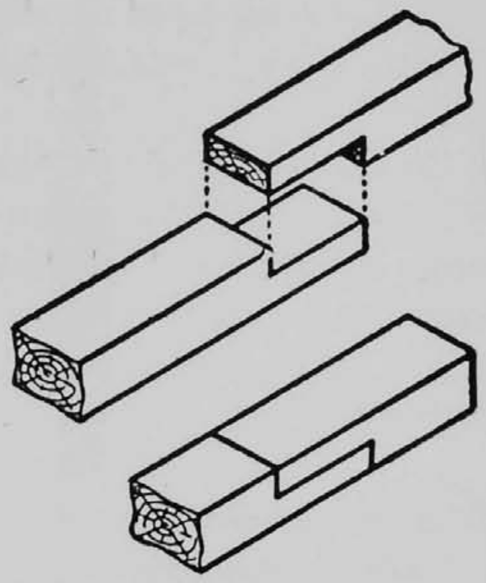


FIG. 2.116. Half lap joint.

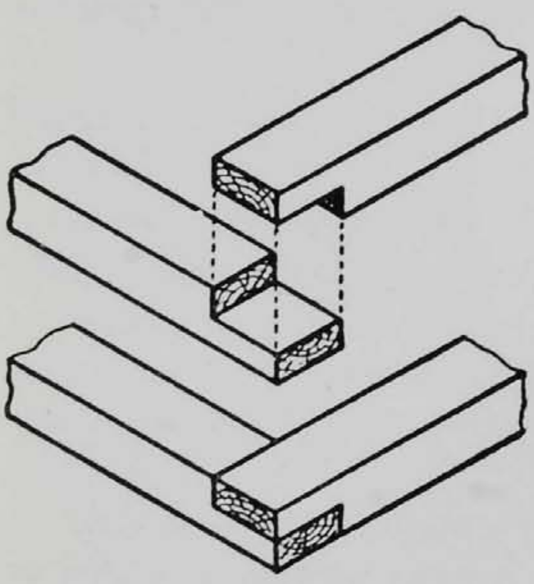


FIG. 2.117. End lap joint.

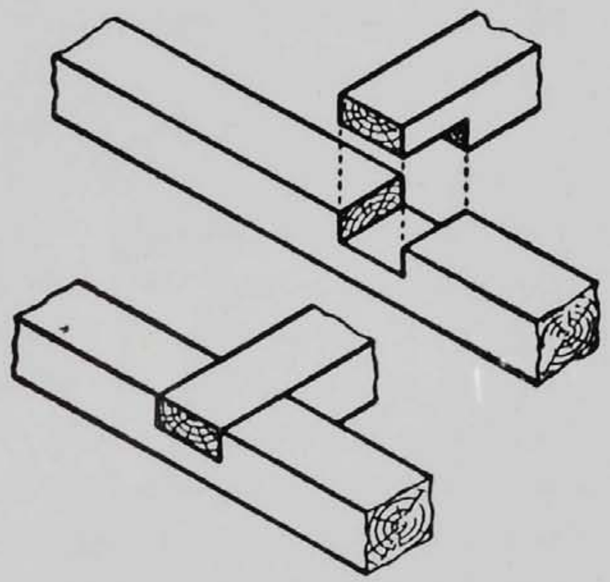


FIG. 2.118. Middle lap joint.

very strong joint. For maximum strength the fit in thickness should be such that the tenon can be pressed in by hand, but in width the fit should be tight. This makes for strength and rigidity and because the stress is parallel to the grain it will not split the piece.

How to Make a Through Mortise and Tenon Joint.

Laying out the mortise:

1. From a 2″ pine plank, cut a piece of stock as per drawing. Finish to size and mark the working face. Also, mark No. 1 on the face of this piece.
2. From a 1″ pine board, cut a piece of stock as per drawing. Finish to size and mark the working face. Mark this piece No. 2.

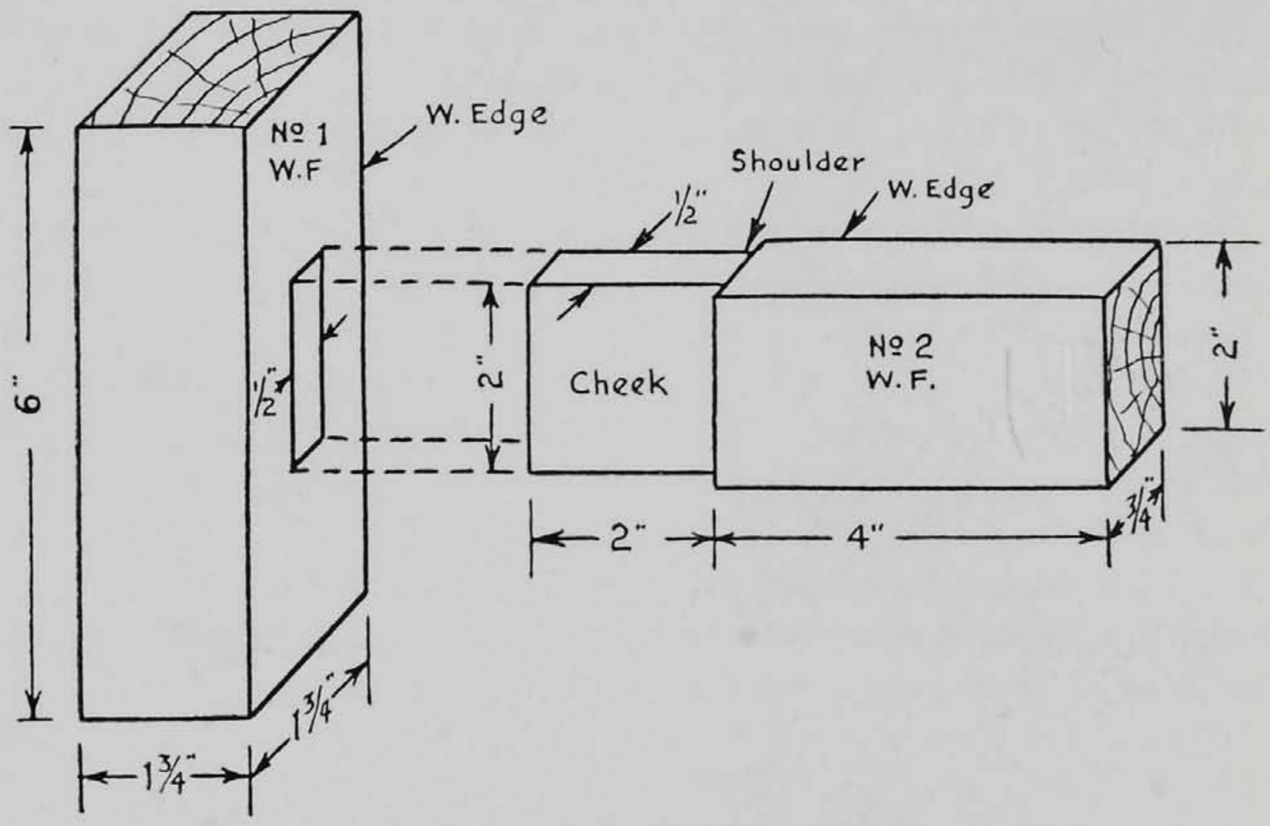


Fig. 2.119. Making a through mortise and tenon joint.

3. Mark the center of the length on the working face of piece No. 1. Also, mark the center of the width on one end of piece No. 2.
4. Place piece No. 2 on piece No. 1, with these two marks together, and make a layout point on No. 1 against the left edge of No. 2.
5. With a square, and this point as a guide, scribe a line with the point of a *sharp* pencil across the face of piece No. 1.
6. Place one edge of piece No. 2 *directly* along this line and, using the other edge as a guide, make a layout point on the face of No. 1.
7. With a square, and this point as a guide, scribe a line with the point of a sharp pencil across the face of piece No. 1. This line should be absolutely parallel with the first line scribed.
8. With a square, carry these two lines around the working edge and across the face opposite the working face.
9. Set the marking gauge at 5/8″ and, from the working edge, gauge a line

between the two parallel lines on both the working face and the face opposite.

10. Set the marking gauge at 1⅛″ and, from the working edge, gauge a second line between the two parallel lines on both faces. This completes the layout of the mortise on both faces of piece No. 1.

11. With an auger bit about $\frac{1}{16}''$ smaller than the mortise, bore a hole at each end of the mortise so that the edge of the hole is $\frac{1}{16}''$ away from the layout line. Bore these holes half way through the piece. Now bore as many holes as possible between these two holes. Reverse the piece and follow the same procedure boring through from the opposite face.

12. With a 1″ chisel, carefully cut out the center portion of the mortise, but not quite to the line.

13. With a chisel the same width as the mortise, cut half way through the piece about $\frac{1}{16}''$ from the end layout line of the mortise. Repeat this on both ends of each side.

14. Next cut to the line, making sure that the face and edge of the chisel is at right angles to the surface of the piece. This is necessary to insure square ends in the mortise. (This is the most difficult operation when cutting the mortise.)

15. With the first chisel used, pare the sides of the mortise to the working line and test all sides, corners, and ends of the mortise to make sure there are no bunches or crowning places left. *This is important.*

Laying out the tenon:

16. On the working face of piece No. 2, lay off the thickness of piece No. 1 plus $\frac{1}{16}''$. Scribe the working line completely around the piece, using a try square and knife.

17. With the marking gauge set at the correct dimension, gauge lines on the end and edges of piece No. 2 to form the layout for the thickness of the tenon. Use the same procedure as used for laying out the mortise.

Cutting the tenon:

18. The cutting of the tenon should be done with a hand saw. Clamp the piece horizontally in the vise and saw shoulder cuts. Next saw the cheeks.

19. Check all parts of the tenon carefully for correct dimensions and for squareness. Next make a *small* chamfer on the end of the tenon. Then drive the tenon into the mortise.

20. If all shoulders fit properly, the tenon will project through the mortise $\frac{1}{16}''$. This amount is planed off to complete the job.

The principal types of mortise and tenon joints and their uses are the following.

The *through mortise and tenon* joint is often used in the construction of small cabinet doors. It is also used in window sash, of both the check rail and the casement type. It was much used in the nearly obsolete craft of the wheelwright which included building wagon and express bodies, as well as on the cross trees of carriages and wagons, because it will withstand a large amount of strain. See Fig. 2.120.

The *blind mortise and tenon* joint is most used in cabinetmaking. It is used on chairs, tables, stands, etc., to join the rails, or stiles, to the legs. See Fig. 2.121.

There are many variations and types of mortise and tenon joints for special purposes. Among these are the open mortise and tenon, or slip, joint, the haunched mortise and tenon, and double mortise and tenon.

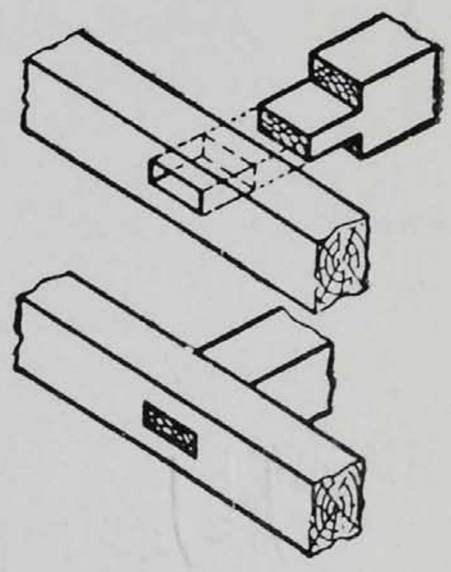


FIG. 2.120. Through mortise and tenon joint.

The **dovetail joint** is known as the aristocrat of wood joints. It is one of the strongest of all wood joints because of the tapering shapes of the sides of the pins and tails with their many interlocking surfaces. Dovetail joints are used mostly in drawer and box construction.

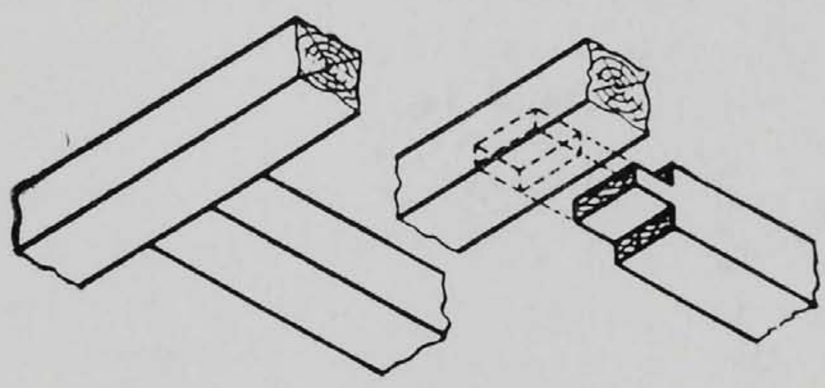


FIG. 2.121. Blind mortise and tenon joint.

The projections which have the taper on their faces are called *dovetails* or *tails*. The projections whose ends are tapered are called the *pins*. The spaces remaining between the tails and pins are called the mortises or *sockets*. A joint consisting of but one dovetail is called a *single dovetail*. A joint consisting of a series of dovetails and corresponding pins is a *multiple dovetail*. The *through dovetail* has tails and pins projecting through and showing on both surfaces. On the *half blind dovetail* the dovetails do not project through. Only ends of pins and sides of dovetails are seen on the side of the

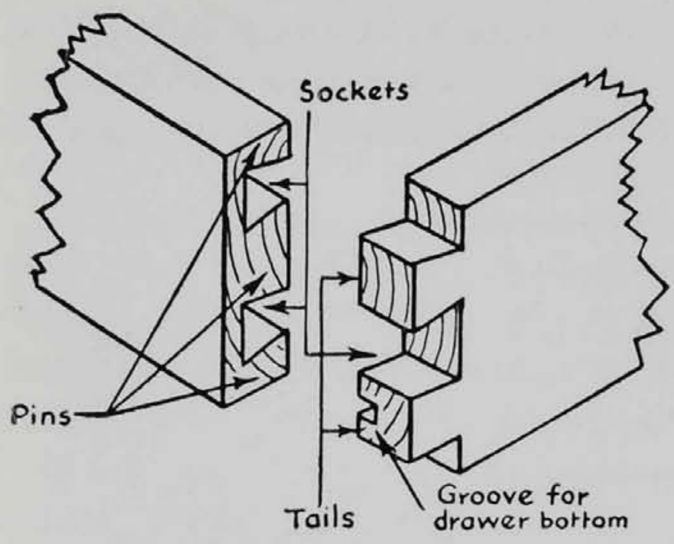


FIG. 2.122. Dovetail joint.

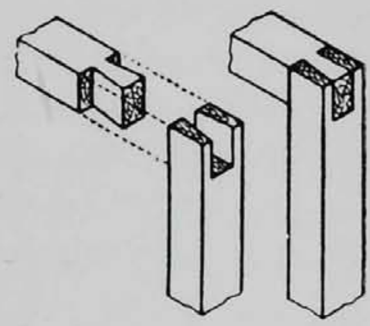


FIG. 2.123. Through single dovetail joint.

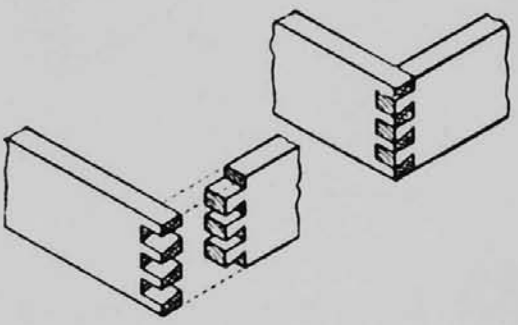


FIG. 2.124. Through multiple dovetail joint.

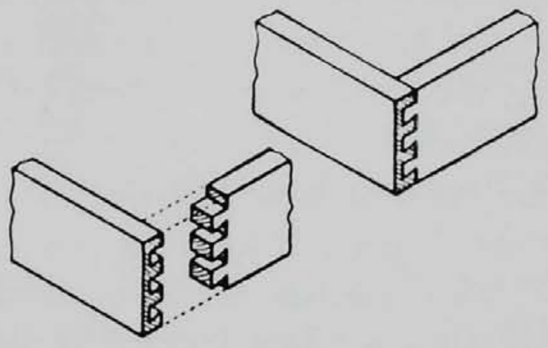


FIG. 2.125. Lap or half blind dovetail joint.

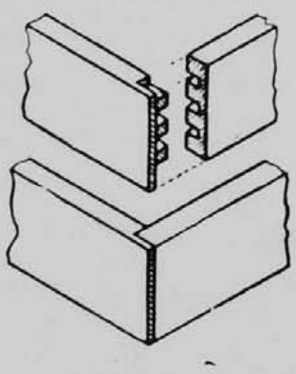


FIG. 2.126. Stopped lap dovetail joint.

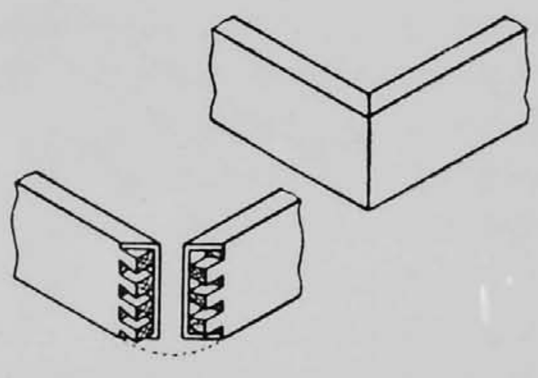


FIG. 2.127. Blind miter or secret dovetail joint.

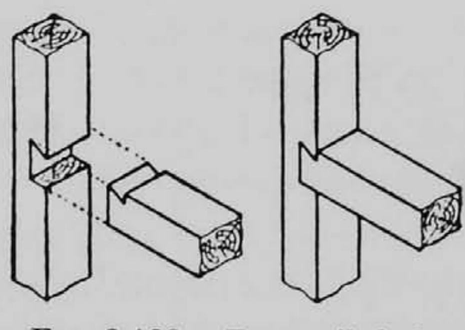


FIG. 2.128. Dovetail dado.

joint. On the *stopped lap and blind miter* joints the dovetails and pins are entirely hidden from view. The *lap dovetail* is used in construction similar to the middle lap where a little more strength is desired to resist strain or end pull of a member being jointed.

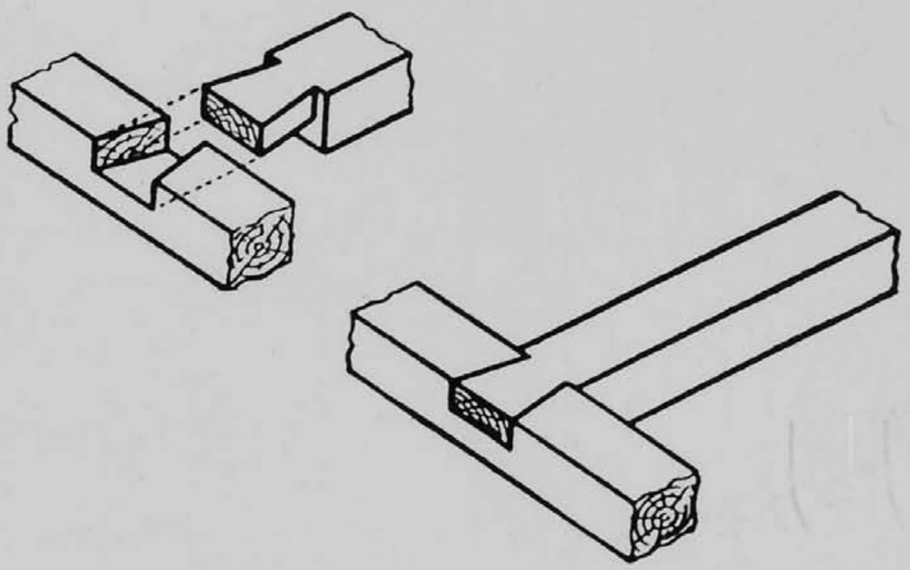


Fig. 2.129. Lap dovetail joint.

The angle of the dovetail should not be too great or the joint will be weak because of the short grain at the corner. The correct angle is about 80°. This can be established by using a protractor. Or it may be obtained by either of the following methods: Construct a right triangle with one leg ⅝″ long and the other leg 3″ long. The hypotenuse and long leg will make an acute angle which will be approximately correct. Or construct a right triangle with one leg one unit long and the other leg five units long. This will give about the same angle. Probably the strongest dovetail joint is one having the tails and pins the same size, but for the sake of appearance the tails are often made larger than the pins.

How to Make a Half Blind Dovetail Joint. The procedure is substantially the same as in making a *through dovetail* joint except for the preliminary layout. See Fig. 2.130.

1. Obtain two pieces of wood and square one piece to ¾″ × 3″ × 5″ and the other piece to ½″ × 3″ × 5″.

2. With a marking gauge, mark off the depth of the joint on the end of the front. (Fig. I.) The gauged line should not be less than ¼″ in from the front face.

3. With the same set on the gauge, mark the depth on the edges of the side piece and square across front face with sharp pencil. (Fig. II.) The

inside line can be cut with a knife but the outside line should not be, as it would be permanent across the tails.

4. Lay off a distance on the working face of the front equal to the thickness of the side. (Fig. I.) If dovetail is for a drawer, the groove for the

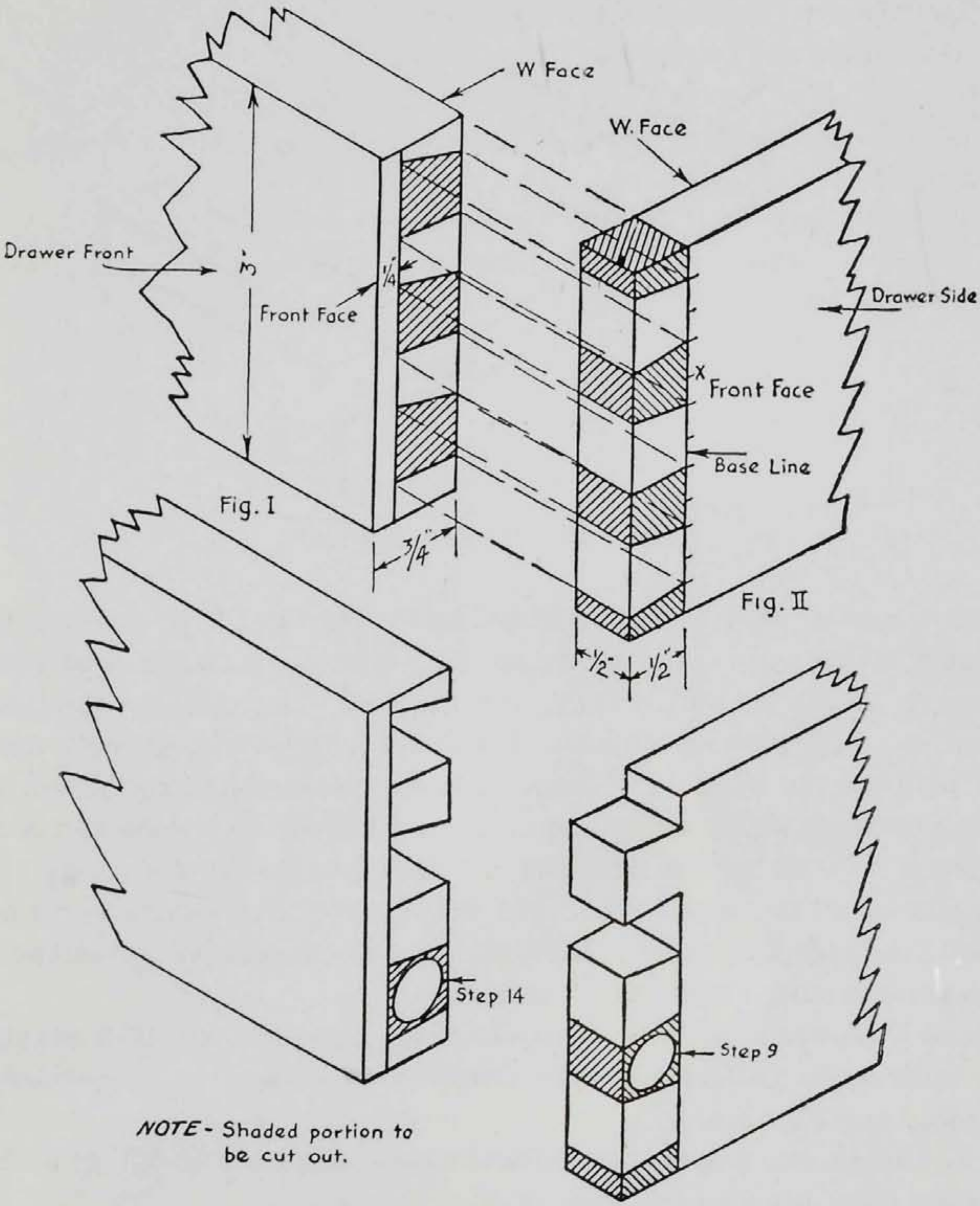


FIG. 2.130. How to make a half blind dovetail joint.

bottom should now be laid out or cut to make sure that it comes in the lower tail. (Fig. I.)

5. On the side, divide the base line into as many equal parts as there are to be dovetails.

6. Divide these spaces into four parts, the two center parts constituting the narrow end of the tail.

7. With sliding bevel square set at the proper angle, mark off the dovetails.

8. Square these lines across the end and on the working face. Mark plainly the mortises to be cut out.

9. Select an auger bit of a size that is not quite tangent to the layout lines of the dovetails and bore out mortises or sockets, boring from both sides to avoid splintering.

10. Saw on waste side of lines with a dovetail saw or fine back saw.

11. Chisel out remainder carefully, working from both surfaces and check with square.

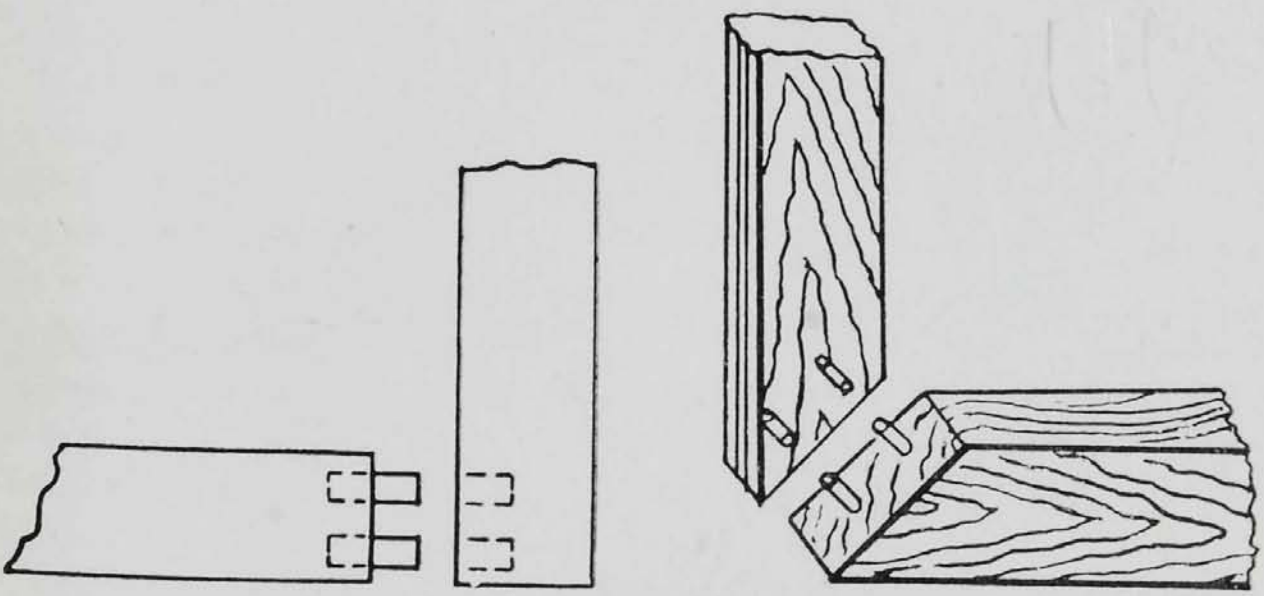


Fig. 2.131. Dowel joints.

12. Having finished the tails, locate the pins on the end of the front by placing the side on the end of the front and scribe the side lines of the sockets with a knife. To assist in this step, clamp a board or strip on the base line of the working face of the side to act as a stop.

13. With a square carry these lines to the depth line of the sockets.

14. Bore out mortises parallel to grain as in step No. 9.

15. Saw on the waste side of pins. Guide block of correct angle may be used.

16. Chisel out remainder carefully and check with square. Be sure all internal corners are clean and straight.

17. Properly made, the joint may be pressed together by hand but do not force it so as to break or fracture any of the tails or pins.

The **dowel joint** is particularly useful for window frames, small doors, and panel frames in cabinetmaking. No attempt is made here to outline exact dimensions, as these are necessarily decided after the purpose and location of the piece are determined.

When using the dowel joint, all dowels should have the square corners removed before they are inserted in their holes. This not only assists in keeping glue on the dowel, but materially aids the dowel to enter the snug-fitting hole.

The **gained joint** is most frequently used in fitting a hinge. Formerly, floor beams were gained into sills and stringers, but this practice is not common today.

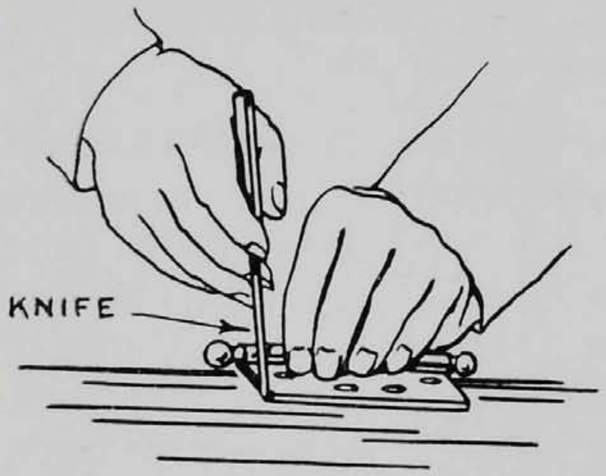


FIG. 2.132. Scribing layout line for cutting gained joint.

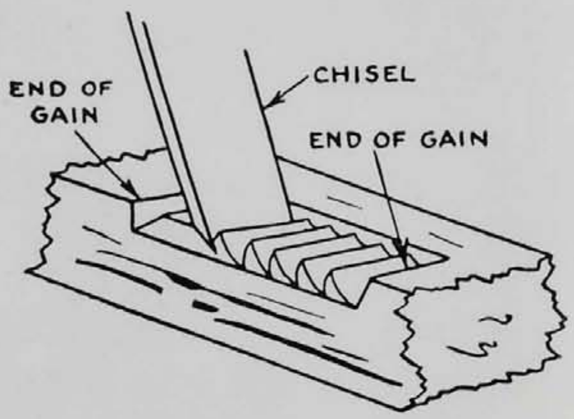


FIG. 2.133. Cutting gained joint.

How to Make a Gained Joint for a Hinge.

1. Lay the hinge in position.
2. Locate screw holes.
3. Drill pilot holes.
4. Fasten the hinge in place with screws.
5. Carefully scribe around the hinge with a knife, making sure to keep the point close to the edge of the hinge.
6. Remove the hinge and, with a marking gauge, mark depth of the hinge.
7. With the aid of a square connect the end line to the depth line.

This completes the layout. With a sharp chisel as wide or wider than the width of the gain, cut down on each end to the depth line about 1/16″ away from end layout line. With same chisel and mallet, chip as in Fig. 2.133. Clean out the gain and work down to the layout line, using a chisel as a paring tool. The end and width lines should be finished last, and great care should be used to avoid splitting that portion left beyond the width line in the case of a door. Test for accuracy, and be sure the corners are clean. When working to a layout made by scribing around a hinge allowance must be made for the excess length of the layout.

The **scribed joint** might be termed a carpenter's helper. It is the kind of joint that is used when a piece must be fitted to an irregular surface, such as a stone or brick wall, or in fitting molding against a plastered ceiling.

FIG. 2.134. Scribing line for scribed joint.

The procedure in making this joint follows: Place the piece to be fitted a given distance away from and exactly parallel to the final position which the piece is to assume. Set a pair of dividers to the distance that the piece is placed away from its desired position. Scribe a line on the edge of the board, by holding one leg of the dividers against the surface to which the board is being fitted, and running the other leg, pencil or scratch point, on the surface of the board in such a position that a line connecting the ends of the two legs of the dividers is at right angles to the joint. (See Fig. 2.134.) Draw the dividers the full length of the joint in this position and this will give the correct layout for the joint, which can now be cut.

Preparing Lumber for Use. To make a rough board square and true to a definite size is the first step in nearly every woodworking project the craftsman undertakes. The tools needed are: Straightedge, try square, jack or smooth plane, knife, rule, pencil, marking gauge, saws.

Cut out in rough, avoiding all imperfections. The average piece of lumber should be cut ¼″ in width and ½″ in length larger than the piece needed to allow for the squaring operation. The amount of allowance over actual size may vary slightly from above dimensions.

To Prepare a Working Face. Plane for straightness. When a board is *in wind*, two diagonally opposite corners test high, while the other two are low. Plane across high corners until straight.

Plane for smoothness. Press down firmly on toe of the plane during the stroke and pick up at the end of the stroke. When the board is hollow, or warped, it can be easily trued by planing across grain with a shearing cut until full length shavings are obtained.

Test for straightness lengthwise by sighting or by using a straightedge along the grain.

Test for straightness across the grain by holding the piece at eye level, placing the blade of the inverted try square on the surface of the stock, and sighting towards the light. When no light appears between the blade of the square and the stock, the surface is level across the grain.

To test for *wind* with a straightedge placed on each end of the surface, across the grain, sight under these edges in the direction of the grain of the stock. If the straightedges are parallel, the surface of the stock is correct; if they are not parallel, the piece is *in wind*.

When it passes these three tests the piece has a working face or face side. Mark with a check or cross to denote *working face* as this will now be the side from which remaining tests will be made.

To prepare a working edge use the jack plane or smooth plane. Do not try to get the edge square and straight in one shaving. It will probably take several shavings. To test the working edge, press the handle of the try square against the working face and bring the blade of the square down to the edge of the stock. Test with straightedge for straightness. Mark this edge to denote the *working edge*.

To prepare a working end mark the width on the working face with the marking gauge. This is done for the purpose of knowing how much the corner can be cut off for planing the ends. Remove the corner outside the gauged line at about a 45° angle. This prevents wood from chipping while planing towards that corner. With the handle of the try square against, first, the working edge and next, the working face, square a line around the piece. Plane this end to the knife line. Test the end of the stock for squareness with the face and with the edge. Mark this end to denote the *working end*.

Squaring to Length. Measure and mark off the correct length of the board, measuring from the working end. From this mark proceed as in preparing the working end.

Squaring to Width. With the marking gauge lay out the width on other side of the piece. Plane this edge to the gauge line, as in planing the working edge. Test for squareness with the working face frequently during the planing.

Squaring to Thickness. Set the marking gauge to the desired thickness. With the head of the marking gauge held against the working face, mark a line around the edges and ends of the stock. Plane down *to the line*.

What to Do about Surface Defects. In preparing lumber for wood finishing, there are many different kinds of defects that must be removed. Some of these can be removed by planing, scraping and sandpapering, whereas others must have a filler of some sort. Machine marks such as planer marks, shaper marks, and coarse sanding disk marks can usually be removed by using a cabinet scraper and sandpaper. Torn grain, if not too deep, can be removed by using the smooth plane and finishing with the scraper and sanding. If the grain is torn too deeply, it must have a filler of some sort. End grain is best smoothed by use of a block plane and sandpaper. A scraper is not of much use on end grain. Knots which are solid can be smoothed to a surface, but a loose knot must be removed, and the hole patched.

Dents can often be removed by applying a few drops of water, and picking the surface with a scratch awl. This allows the moisture to enter the wood, thus causing fibers to swell and raise the dent. Raising the dent can be hastened by applying a hot iron to the moistened surface. After the moisture dries out, the surface will have to be sanded.

The appearance of a split can sometimes be improved by the use of a filler. It may be necessary to cut out the section which is split and to insert a piece which has a similar grain. A split in the end of a piece can be removed by cutting out a wedge-shaped section, and gluing in a piece which exactly fits the opening.

After several pieces of stock have been glued together, the glue should be removed with a glue scraper before the wood is machined, because casein glue and some of the new resin glues are hard enough to cause gaps in high speed steel machine knives. A hand glue scraper made out of a file can be used. After the glue is removed, it will probably be necessary to plane or scrape the piece and then sand to a smooth surface. A surface which is to be finished in a natural color and grain should be sanded until no scratches can be seen. This may require a very fine grade of sandpaper. Sandpaper as fine as 8-0 is available. Experience is necessary to judge what grade of sandpaper is needed.

Gluing. In gluing *edge to edge joints*, bar clamps, long enough to reach across the project being glued, are necessary. They can be placed on horses about 36″ high, or on a table or bench. Several hand clamps or hand screws and binding sticks to go across the ends of the pieces being glued may be needed. The purpose of binding sticks is to line up the boards and to keep them from buckling. The step by step procedure is as follows:

1. Decide how many clamps are needed and place them on the horses.

2. After the boards have been faced on one side and both edges made square with the face side they are placed, face side down, on the bar clamps, which have been adjusted to the correct opening.

3. Place the binding sticks on the ends of the boards to be glued.

4. Decide how many hand screws are to be used, and where they are to be placed.

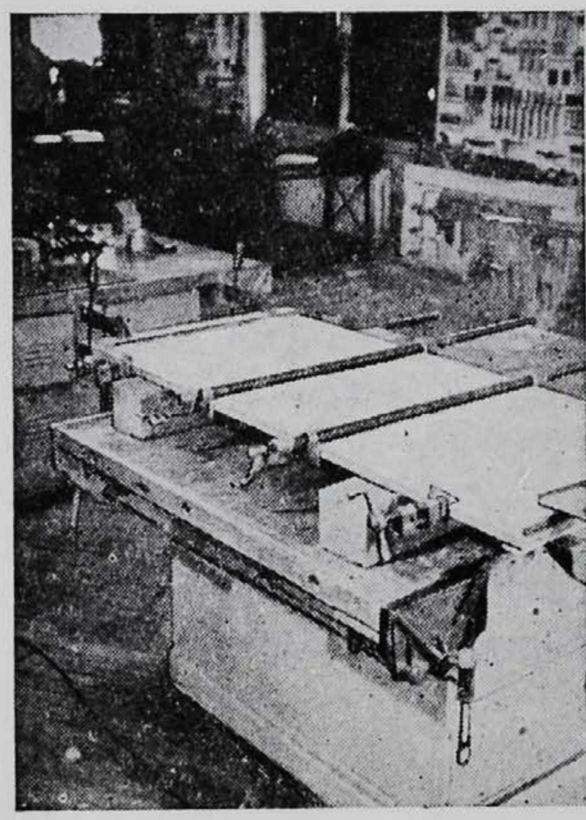


FIG. 2.135. Gluing edge to edge joint.

5. Adjust the hand screws to the correct opening, and place within easy reach.

6. Place the boards on edge and apply the glue to both edges.

7. Lay boards face side down again and partially tighten the bar clamps. Use wooden protection blocks, if necessary, to avoid clamp marks.

8. Put on the binding sticks and tighten the hand screws. It is good practice to put a piece of paper between the binding sticks and glued articles to prevent the sticks from being glued to the work.

9. Test for an even surface and with a mallet, rap the work so that the pieces are even on the face side. This is done by rapping on the top side of the board so that the face surfaces will rest on the bar clamps.

10. Look the glued joints over carefully to detect any that may not be tightly pulled together.

11. In gluing long pieces, it is good practice to place alternate bar clamps on opposite sides of the work. This eliminates the tendency for the work to spring away from the clamp, as the action of one clamp counteracts the other.

12. After it is certain that all joints are tight and the work surfaces are even, remove the excess glue.

13. Place the work in a position where it will not warp or be subjected to excessive heat or moisture.

Assembling the Job. When parts for a piece of furniture have been prepared, the problem of assembly arises. A flat work table, hand screws, and bar clamps are pieces of equipment that are absolutely necessary. Small pieces of soft wood should be placed against the surfaces of the work, to protect them from being marred by the bar clamps. They should be used also to protect the work if it is necessary to rap against the edges to drive the joints together.

It is best to assemble flat parts first. For instance, in assembling a flat top desk, two end legs with cross rails and panel should be assembled first. This is one subassembly, which is duplicated for the other end of the desk. Next, the two subassemblies are put together to form the side of the desk that holds the drawers. This is another step toward the final assembly of the desk.

It is well for a beginner to check over all necessary parts when making assemblies to see that none are left out, because sometimes it is found that parts cannot be put in unless they are inserted at the time the subassembly is made. Each piece of furniture has its own assembly problems and no general directions apply to all.

Chapter 5

WOOD TURNING

Care of the Lathe . . . Wood Turning Tools Needed for the Home Shop . . . Setting up Work on the Lathe . . . Preparing for the Layout and Laying Out the Stock . . . The Different Cuts: Shoulder, Taper, Concave, Convex, Combination . . . Faceplate Turning: Preparing the Stock, Setting up the Lathe and Preparing for Layout . . . The Different Cuts in Faceplate Turning: External, Internal Shoulder, Taper, Concave, Convex, Combination, Roughing, Facing . . . Sanding and Finishing . . . Other Uses for the Woodworking Lathe: Drilling and Boring, Sanding, Mortising, Spinning, Polishing

Care of the Lathe. The lathe should be oiled each day before it is used. It should be kept clean and free from chips, hardened oil, finishing materials such as shellac, and all other foreign material. Accessory parts of the lathe should be kept in a rack immediately available to the user. A rack should also be made to hold the turning tools and all other tools and attachments used on a wood lathe. When replacing centers after using the faceplate, the center hole should be cleaned carefully to remove all shavings or all foreign particles that may have lodged on the inside taper.

Wood Turning Tools Needed for the Home Shop. A handy set of wood turning tools for the home workshop should include three gouges, 1¼″, ¾″, and ¼″, three skew chisels, 1¼″, ½″, and ¼″, one medium sized parting tool, and two round nosed tools, ¾″, ¼″. See Fig. 2.136.

Setting Up Work on the Lathe. The simplest way to prepare stock for turning on centers is to cut it out square, draw both diagonals on each end, and then with a mallet drive the spur center onto one end until the spurs are firmly embedded. Next, place the spur center in the spindle, move up the tailstock and tighten its center, with the point at the intersection of the diagonals, until it is also firmly embedded. Release slightly, oil, and lock in place. The rest should be set at a height which will place the cutting edge of the gouge slightly above center when held at an angle of about 25°, with the handle pointing down. The rest should be placed as near the rotating piece as it is possible to place it, with its edge parallel to the axis of the work.

Preparing for the Layout and Laying Out the Stock. The stock can now be rough turned in preparation for the layout. Having selected a slow speed

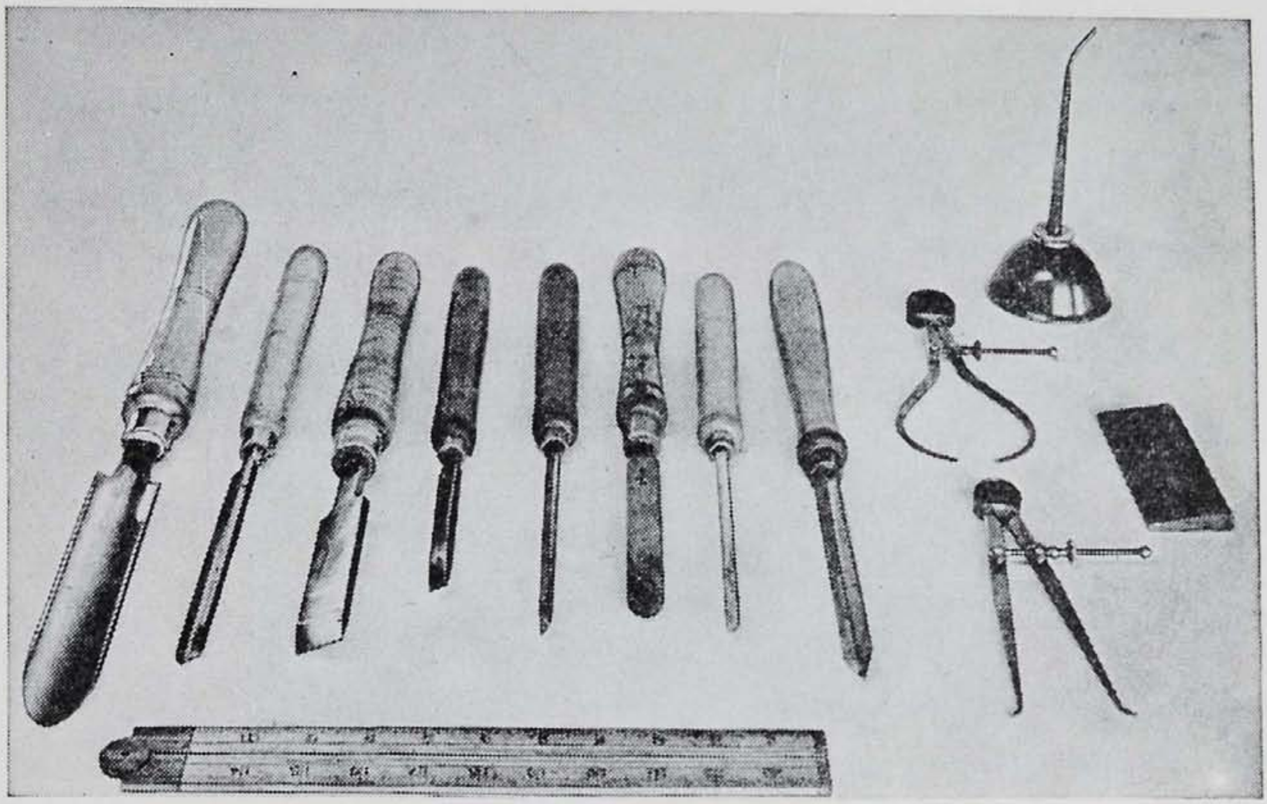


FIG. 2.136. Handy set of tools for wood turning in the home workshop.

for roughing, and using a fairly large gouge, turn the stock to the largest cylinder that can be made. This cylinder can be made quite smooth with the gouge by taking a cut with the edge of the gouge held at an acute angle with the surface. The surface is now ready for laying out.

Lay out, with rule and pencil, the largest and smallest diameters of the various parts of the piece, while it is rotating. This locates the points at which diameters should be turned with a parting tool. The lathe can now be speeded up to 2500 r.p.m., if the diameter does not exceed 2″.

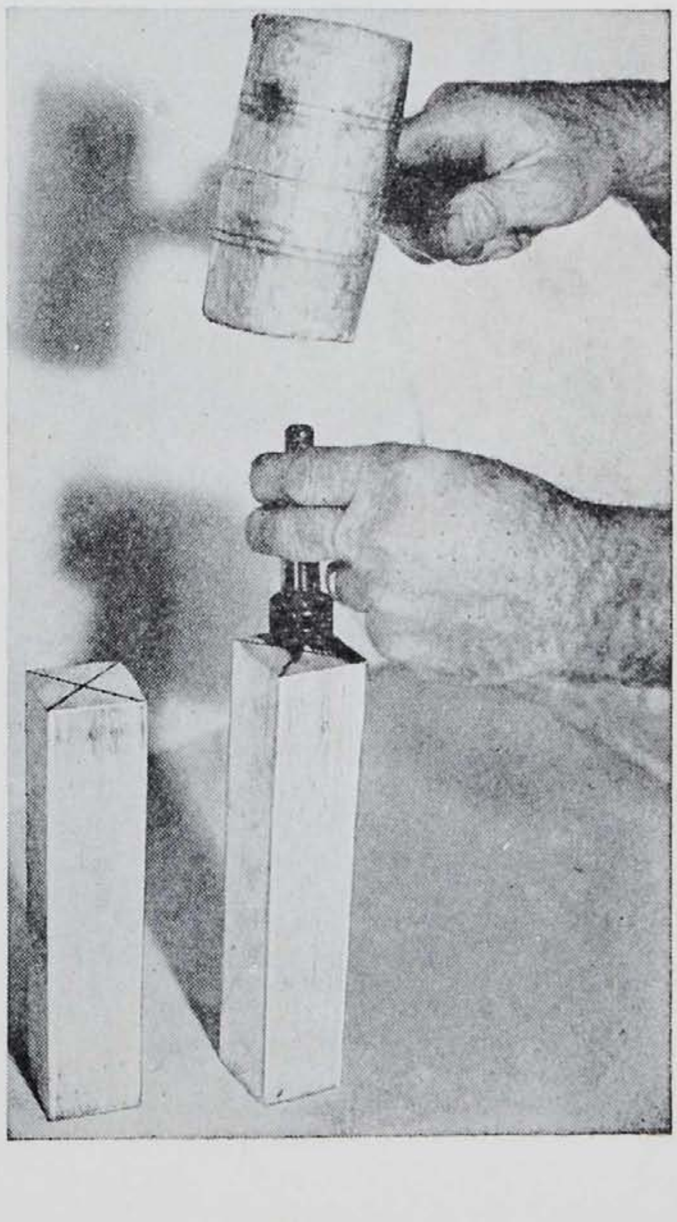


FIG. 2.137. Driving spur center into one end of stock in preparation for turning.

Next, set the calipers about $\frac{1}{16}''$ larger than the finished diameter at a location nearest one end. Hold the calipers in the left hand and the parting tool in the right hand and make a groove down to the caliper size at the layout point. A similar groove is turned at each place marked on the layout, each to the correct diameter.

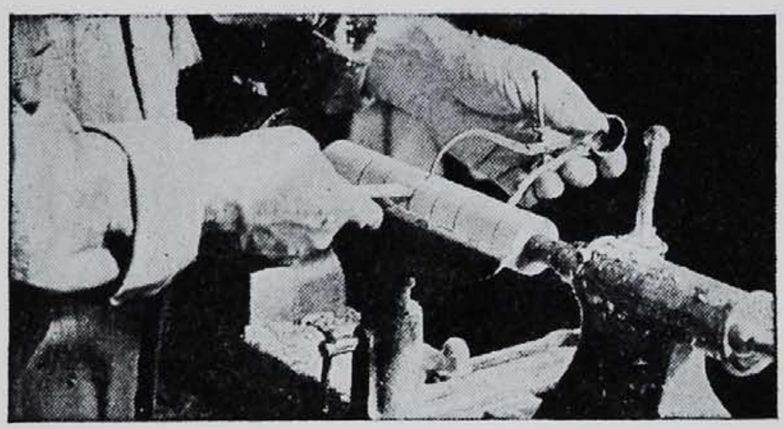


FIG. 2.138. Holding the parting tool and caliper.

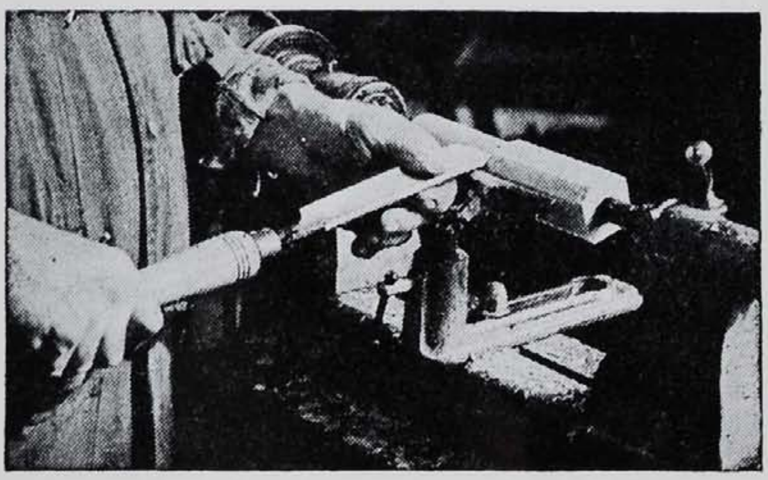


FIG. 2.139. Holding the gouge

When holding the parting tool, it is extremely important to hold it rigidly and to grip the end of the handle between the forearm and the hip. This will take a scraping cut but, if it is fed reasonably fast, it will neither dig in nor burn.

The Different Cuts. *Shoulder.* First, lay out the piece as previously described. Then, with a parting tool and caliper, turn the piece down to the small diameter at each end of the cut. The waste stock between the two cuts is roughed out with a gouge, and smoothed by either a shear cut, or a scraping cut with a skew chisel. See Figs. 2.140–2.141.

Taper cuts are made in much the same manner by turning the stock down on the layout lines to the large diameter at one end and to the small diame-

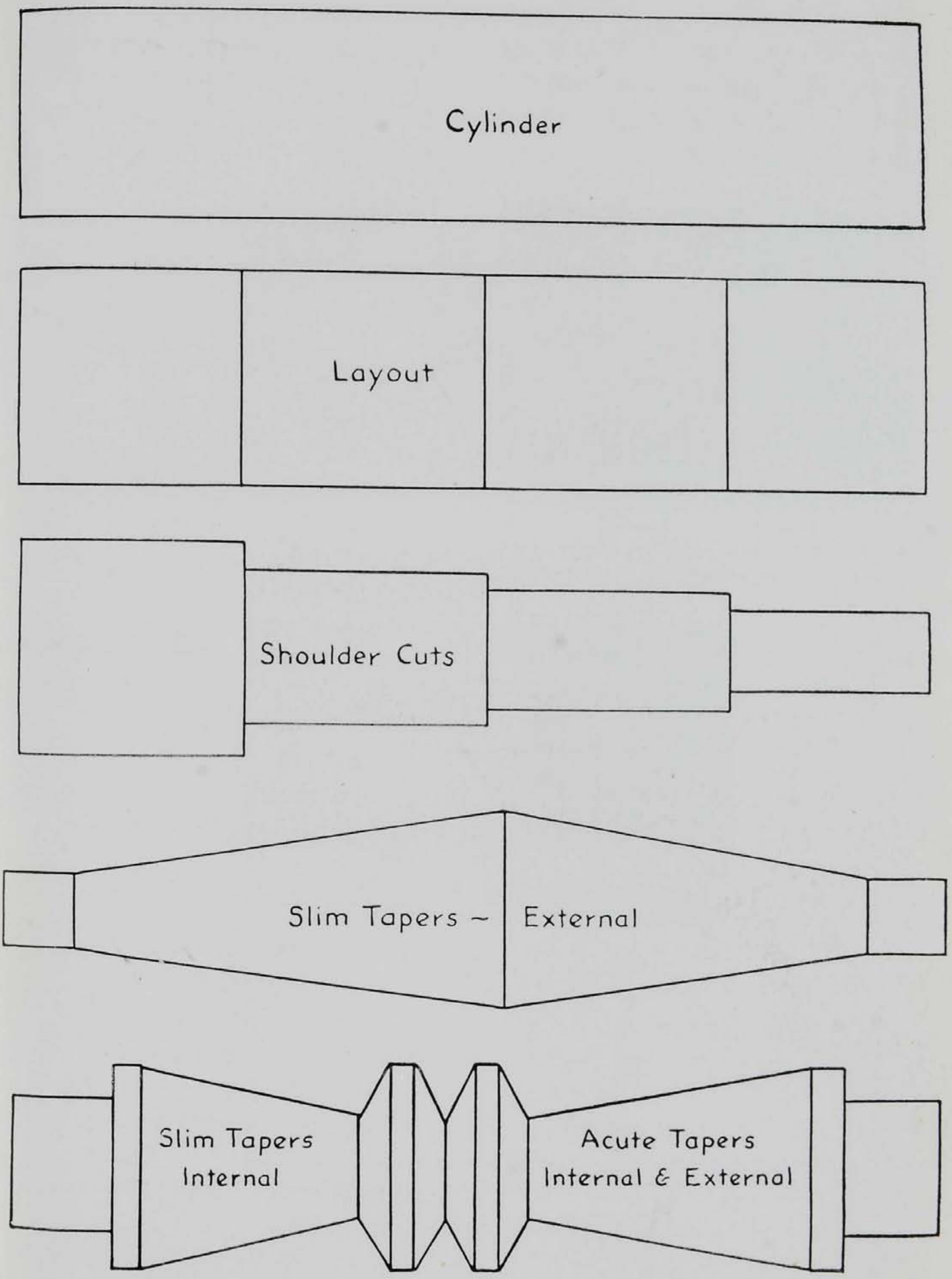
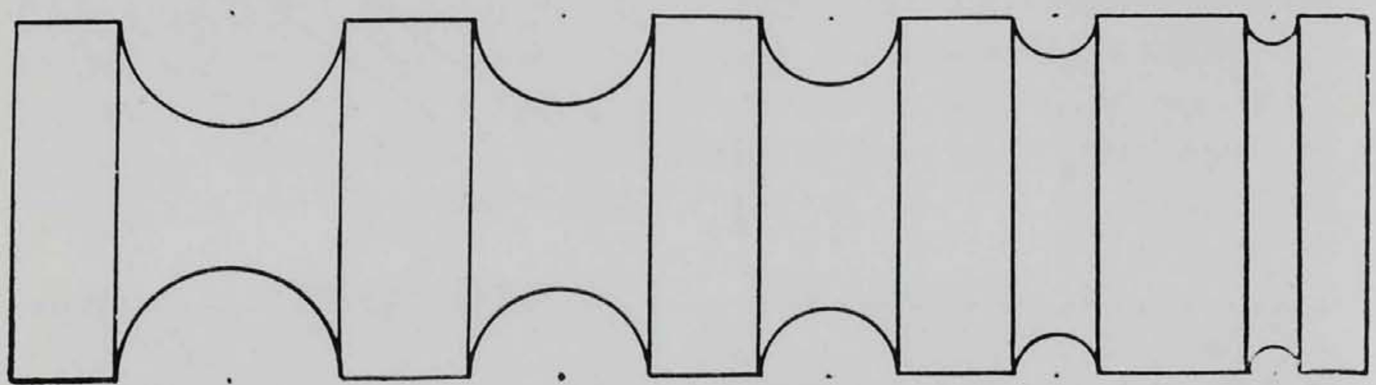
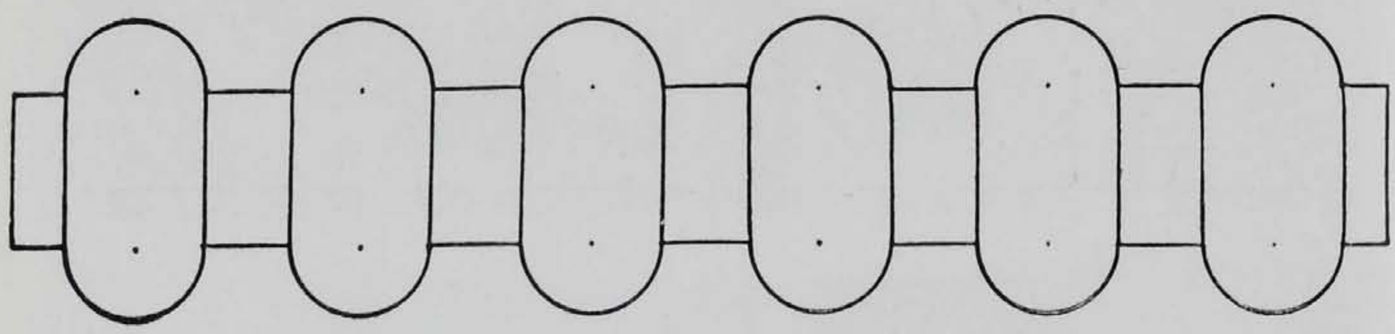


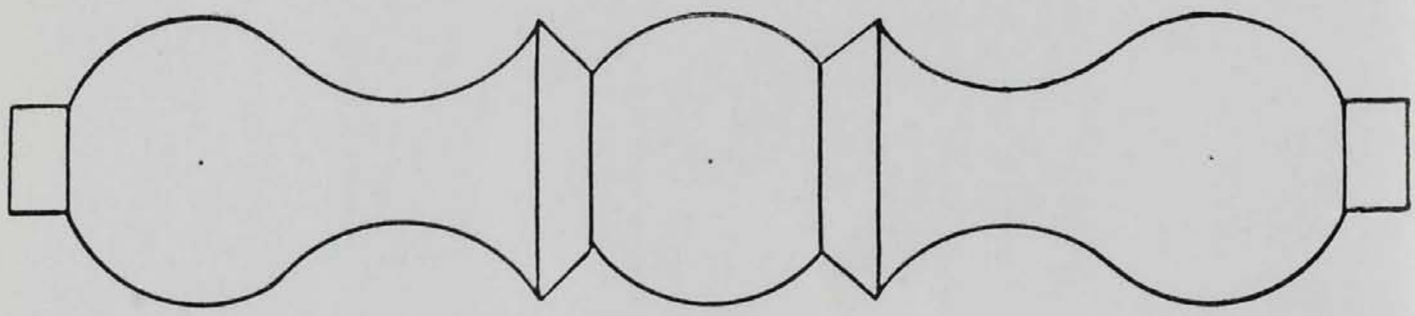
FIG. 2.140. Woodworking cuts.



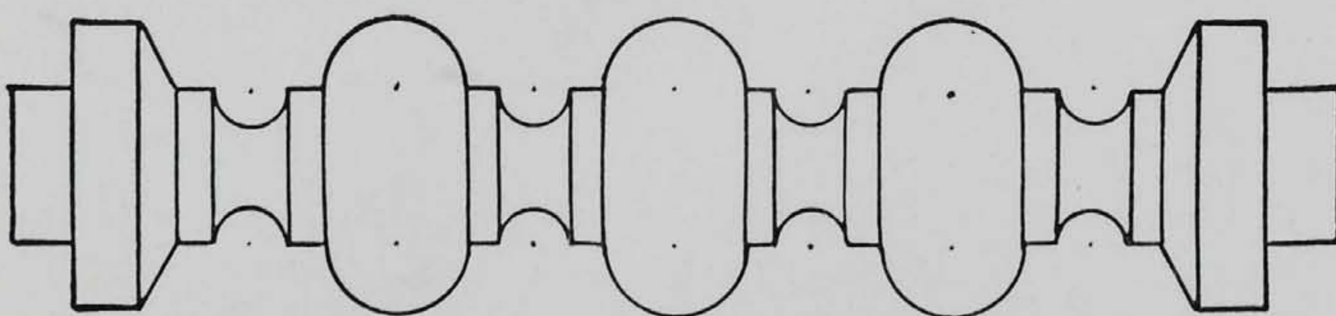
Concave Cuts



Convex Cuts



Combination Cuts



Combination Cuts

FIG. 2.141. Woodworking cuts.

ter at the other end. Then cut away the waste stock with a gouge, and smooth the taper with either a scraping or shear cut with a skew chisel. When shear cuts are made with the skew chisel, many operators prefer to set the rest at a height which will make it possible to take the cut on top of the cylinder. In this position the skew chisel is less likely to throw the piece

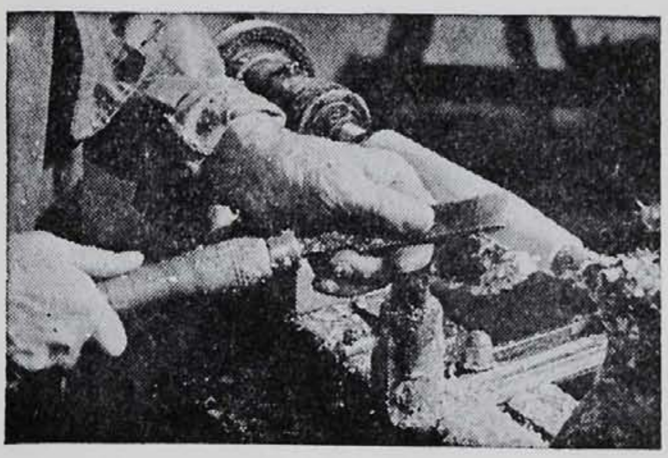


FIG. 2.142. Taper cutting.

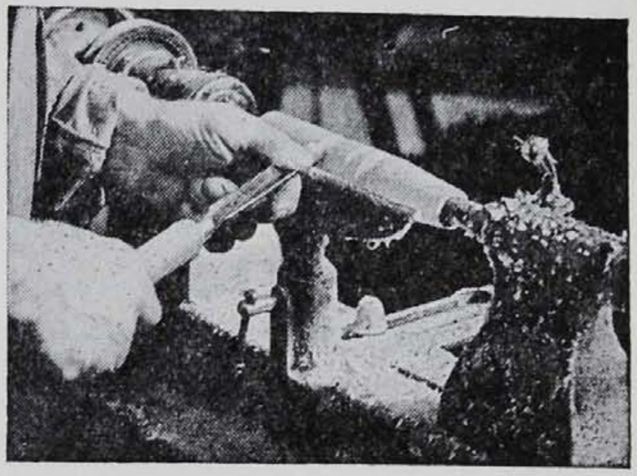


FIG. 2.143. Cutting away waste stock with a gouge.

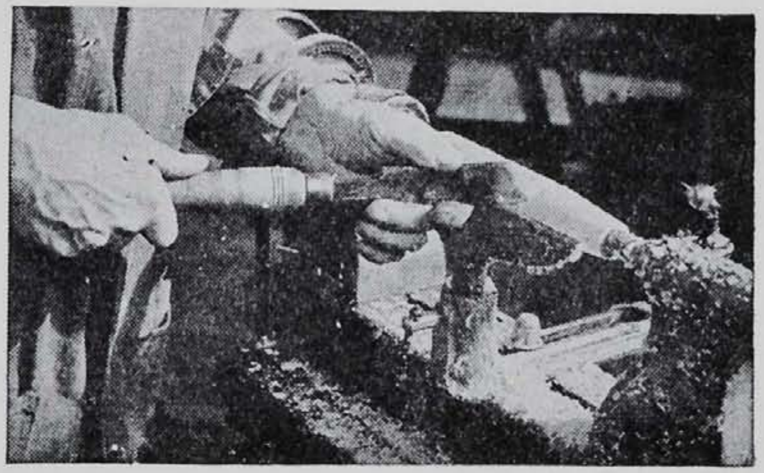


FIG. 2.144. Cutting acute taper.

out of the lathe, if it catches on the long point, because the chisel tends to slide back toward the operator, rather than to lift, as it does when used with the rest set at center height.

Acute tapers on cylinders are usually cut with the long point of the skew chisel down. The chisel is then pushed into the work, making sure that the edge of the tool follows the cut made by the point. If the chisel is tipped sidewise, it will immediately dig into the work, and probably throw the piece out of the lathe.

Concave cuts can best be made by laying out the cut with three pencil lines, two determining the width, and one in the middle. A parting tool is used in the middle to cut down to a diameter slightly larger than the finished diameter of the concave cut. After this cut has been made, a round nosed tool or a gouge may be used. If a gouge is used, care must be taken that it does not catch on the other side of the cut. The round nosed tool is easier to use but does not leave such a smooth surface. When sanding these cuts, it is best to hold the sandpaper in the cut around a cylindrical piece slightly smaller than the diameter of the cut.

Convex cuts are laid out in a manner similar to that used for the concave cuts, that is, with three lines, one at each outside edge of the convex part, and one in the center. The parting tool and calipers are used to turn down to the diameter desired on the outside edges of the cut, and to a diameter slightly larger than the finished diameter of the convex cut. The piece is then roughed out with the gouge and finished by using the skew chisel either as a scraping tool or, if the turner is sufficiently skilled, as a shearing tool.

Combinations. Nearly all projects require a combination of these various cuts. They are laid out as described above, and then the various diameters are established by the use of the parting tool and caliper. After this, the operator must select the cut required for the shape to be turned.

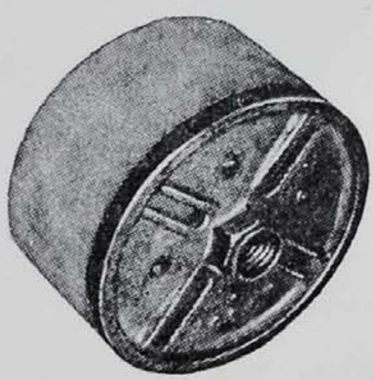


Fig. 2.145. Mounting stock on face plate.

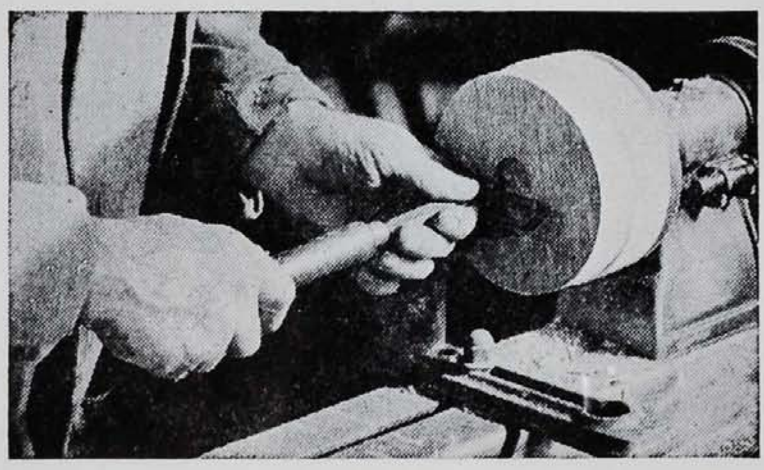


Fig. 2.146. Face plate turning.

Faceplate Turning. *Preparing the Stock.* Stock which is to be turned on the faceplate should be laid out with a circle of maximum size, and if possible sawed close to this size on a band saw. It is then fastened to the faceplate with wood screws. These screws must be short enough not to go through the finished piece and large enough in diameter to insure that the stock is held rigidly. In selecting the screws, it should be remembered that when the lathe is first started the work is nearly always out of balance and causes vibration, imposing considerable strain on the screws which hold the wood to the faceplate. Some turners plane the back side of the stock before it is fastened to the faceplate and thus secure a flat, smooth surface which clamps tightly to the plate. See Figs. 2.145–2.146.

Another method of fastening stock to a faceplate is to screw a waste piece to the plate and turn this until it runs true and flat. Then the stock to be turned may be glued directly to this first piece, or a piece of heavy paper may be glued between the two pieces of wood. This is a good method to use when the material being turned is not thick enough to take screws. After the material has been turned the glued joint can be separated. The paper will separate before the wood will split.

Setting Up the Lathe and Preparing for Layout. After the stock has been fastened to the faceplate, the spur center is taken out of the lathe, and the faceplate is screwed on to the spindle. A slow speed is maintained until the roughing cut has been made. A good tool to use in preparing for the layout is the round nosed tool. This will not catch in the wood when turning the end grain encountered in faceplate turning, and can be used to give a fairly smooth surface for the layout on the edge of the piece. If this tool is kept sharp by frequent whetting, it will cut the end grain very satisfactorily. The face of the piece is then given its final flat surface by scraping with a wide skew chisel. It is now ready for the layout, which is a process similar to that of laying out the stock for cylindrical turning.

The Different Cuts in Faceplate Turning. The different cuts in faceplate turning are illustrated by profile diagrams in Fig. 2.147.

Roughing is most easily performed with the round nosed tool. It consists of turning the outside diameter of the piece down to a size slightly larger than the finished project, or turning stock on a faceplate down to slightly more than the thickness of the finished project.

Facing is a combination of roughing with a round nosed tool and flattening the surface by a scraping action with a skew chisel.

Shoulder Cuts and Boring. Making shoulder cuts is similar to facing and is usually done with either a skew chisel or an ordinary carpenter's chisel. It is a boring process performed by holding the chisel on one diameter and pushing it toward the headstock until the proper depth shoulder is obtained. It is entirely a scraping process.

Taper cuts are usually roughed out with a round nosed tool, and a finished surface obtained by scraping with a skew chisel.

Concave cuts can safely be made with a round nosed tool small enough to enable the operator to push the tool in to the desired depth, without making the cut too wide. It is better to use a round nosed tool narrower than the cut to be made. This will mean that the tool will cut only on one side.

Convex cuts also are roughed out with a round nosed tool, and finished with the scraping cut of a skew chisel or carpenter's chisel.

Sanding and Finishing. When a cylinder is sanded the sandpaper must not be held at one point on the cylinder, but should be moved slowly back

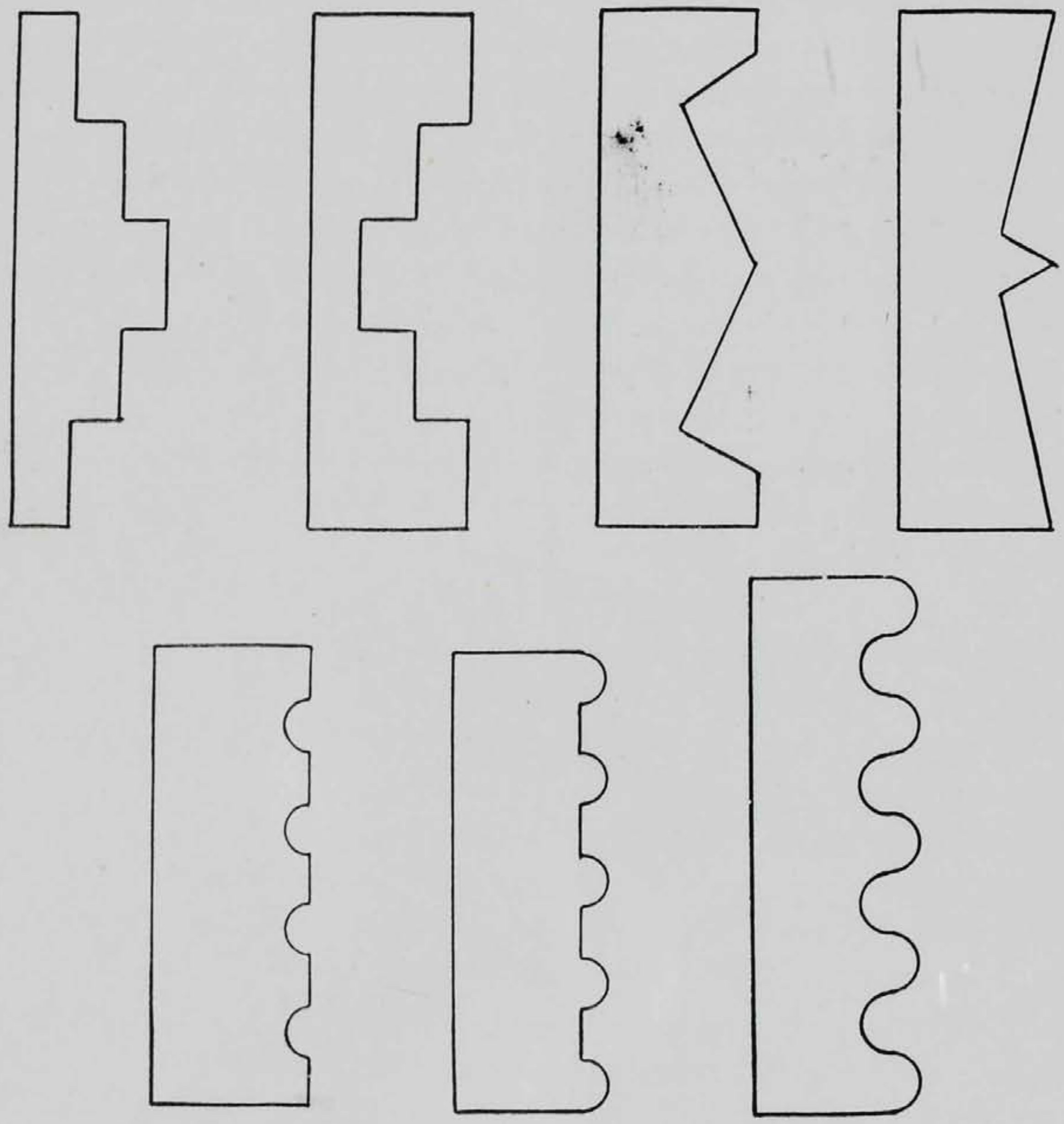


Fig. 2.147. Profile diagrams of cuts in face plate turning.

and forth lengthwise on the piece. This will prevent scratches that appear as rings if the paper is held stationary. In sanding taper cuts, follow the same procedure and, if a sharp angle is desired, care should be taken that the sandpaper is not run over the vertex of the angle, as this will round the edge and eliminate the sharp corner. Here again, the sandpaper must be moved back and forth along the cut and never held stationary.

In sanding concave cuts, the sandpaper should be prepared by pulling it over a rounded surface to limber up the backing. Roll into a cylinder and, with a dowel for support, sand the concave surface with a rolling motion. The sandpaper can be held with the fingers, if it is rolled up like a pencil.

In sanding convex cuts, it is best to hold the sandpaper in the fingers, watching the contour of the cut to be sure it is not spoiled. Material disappears rapidly when rotating in the lathe, especially if the sandpaper is new. With the sandpaper folded to form a sharp edge, it is possible to sand all the way down to the point where the convex cut joins another form of cut.

In sanding all of these cuts it is essential that the sandpaper be slid along the piece and not held stationary. Otherwise scratch rings will develop. They may not be visible at first glance but they will show up when the piece is finished.

Other Uses for the Woodworking Lathe. *Drilling* and *boring* can both be performed on the woodworking lathe, if a chuck is available to use in either the head- or the tailstock. If the chuck is held in the headstock, a crotch center should be available if one wishes to bore at right angles to the axis of a cylindrical piece. To bore through a long piece of small diameter, such as a standard for a bridge lamp, the best method is to revolve the piece and hold the boring tool in the chuck in the tailstock. This allows the boring tool to follow the center of rotation of the piece being bored. It will automatically do this unless it is pushed off by knots, uneven grain, or soft places in the wood.

Sanding. One of the handiest attachments for the woodworking lathes is the sanding disk. The disk can be mounted on the faceplate. Or, if a hole is bored in the back of the disk slightly smaller than the outside diameter of the threads on the spindle, it can be screwed directly to the headstock. The sanding disk should be rough turned, both on its face and outside diameter. The next step is to fasten on the sandpaper. Some prefer to put a layer of felt between the disk and the sandpaper. The paper can be fastened with glue, wallpaper paste, mucilage, or almost any adhesive. The disadvantage of glue is that it holds the paper so firmly that when one wishes to renew the sandpaper it is necessary first to face off the disk itself. Large sanding disks often have the paper secured by a clamp ring which has a tightening screw to hold it to the periphery of the disk.

Another useful attachment for the lathe is the sanding drum. This is a cylinder mounted between centers, on which a sheet of sandpaper is either glued or held by a stick fastened in a recess below the surface. It can be used for sanding curved surfaces, or a flat table can be mounted on the lathe with the drum projecting slightly above it to sand flat surfaces.

Mortising attachments are available for many woodworking lathes, and most manufacturers furnish specific directions when selling the attachments.

Spinning. For description of metal spinning on the lathe, see Chapter 3 in the Metalworking section.

Polishing. A very efficient polishing attachment is available for most woodworking lathes. This may be screwed directly on the live spindle, or it may be a polishing arbor with a taper which fits the taper in the headstock spindle. Either type has a taper screw on which polishing wheels can be mounted. For the process of polishing, see Chapter 3 in the Metalworking section.

Chapter 6

REPAIR JOBS AND PROJECTS

***Inside Carpentry:** Glass Cutting . . .Replacing a Broken Window Pane . . . Replacing a Sash Cord . . . Fixing a Tight Window Sash . . . Fixing a Drawer that Binds . . . Crating Furniture . . . Tightening a Loose Chair . . . What to Do about Squeaking Floor Boards . . . Replacing a Worn Threshold . . . Laying a Floor . . . Repairing a Sagging Floor . . . Repairing Stair Treads and Risers . . . Building a Partition . . . Coping a Joint on Molding . . . Hanging a Sink and Building a Drain Board . . . Building a Coal Bin . . . Installing a Vise . . . Hanging a Door*

***Outside Carpentry:** Repairing Outside Stairs . . . Replacing a Window Frame . . . Leveling and Repairing a Porch Floor . . . Replacing a Porch Post and Rail . . . Replacing a House Sill . . . Fitting Storm Windows . . . Repairing a Saddle Roof . . . Constructing a Clothesline Post . . . Screening in a Piazza . . . Building a Chicken House . . . Building Concrete Forms . . . Shingling or Repairing a Roof*

***Projects for the Home Workshop:** Lawn Chair . . . Saw Horse . . . How to Make a Door . . . Drawing Board . . . Woodworker's Bench . . . Kitchen Cupboard . . . Window Screen . . . Shoe Rack . . . Sewing Screen . . . Cold Frame . . . Wooden Mallet . . . Miter Box . . . Wooden Handle*

INSIDE CARPENTRY

Glass Cutting. *Materials and Tools.* A piece of glass; a flat top table to lay the glass on while cutting; a straightedge; a glass cutter; cloth; kerosene.

Single strength glass (S.S., approximately 1/10″ to 1/12″ in thickness) is suitable for small panes. Do not use S.S. glass as a single pane over 24″ × 36″. Double strength glass (D.S., approximately 1/9″ in thickness) should be used in larger panes. Do not use D.S. glass as a single pane over 36″ × 48″. Glass is assorted into three classes based on quality: AA is the best grade; A is the middle grade, and B is the least perfect.

Procedure:

1. Lay the glass on a smooth, flat surface. Measure the width at the top and bottom, and nick the edges with the glass cutter. The pane should be 1/8″ smaller than the dimensions inside the rabbet to allow for any irregularities.

2. Clean the surface of the glass with a rag dampened with kerosene or turpentine. This is very important; the cutter will not function correctly on a dirty surface.

3. Lay a straightedge, such as a yardstick, on the glass, so the roller of the cutter will be guided in a straight line from one nick to the other.

4. Hold the glass cutter against the straightedge in a vertical position, and bear down hard enough to score the line the first time. Do not allow the glass cutter to run over the edge of the glass, or try to score a line a second time, as the cutting wheel may be damaged and the glass will not have a perfect edge.

5. Raise the pane and tap the glass lightly beneath the scored line with the handle of the glass cutter until the glass begins to crack along this line.

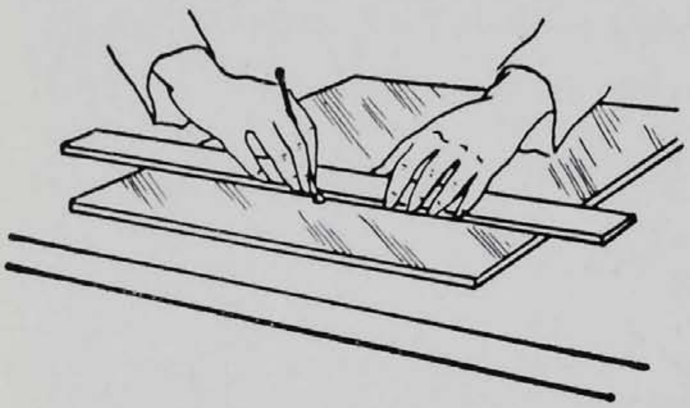


FIG. 2.148. Scoring operation in glass cutting.

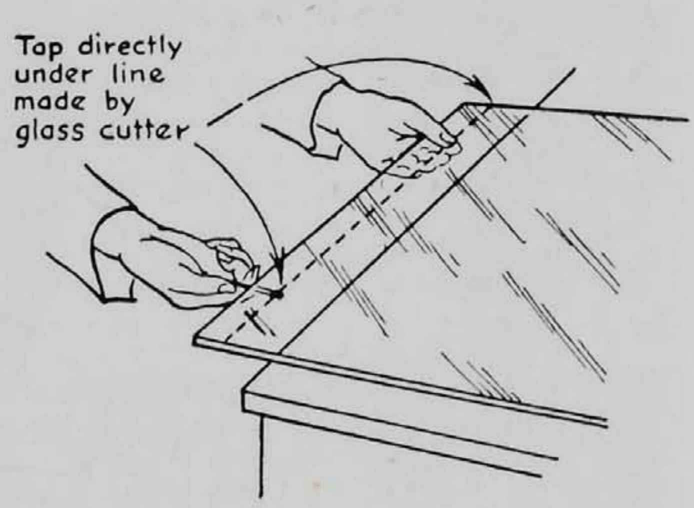


FIG. 2.149. Breaking-off operation in glass cutting

6. Lay the glass flat with the scored line on the sharp edge of the bench and with the waste edge protruding.

7. Hold the pane down firmly and break the waste glass off by bearing down suddenly with the other hand.

8. If the waste glass is very narrow or if a small portion refuses to break off, the jaws of the glass cutter should be used as a lever to break off this remaining glass.

Be sure to hold the glass firmly so that it does not cut the hands when it breaks. Be careful of glass splinters. Wearing goggles while cutting glass is a wise precaution.

Replacing a Broken Window Pane. *Materials and Tools.* Putty is applied with a putty knife. A medium sized wood chisel is used for cleaning the sash and driving the glazier's points. A pane of glass is cut to fit the sash.

A good grade of putty can be made by mixing equal parts of white lead paste and whiting. (See the Painting Section.) Putty can also be made by mixing whiting and boiled linseed oil. The solid material in the bottom of a can of paint makes good putty when mixed with whiting. Putty may be colored by mixing in such pigments as burnt umber, ochre, or lamp black. Linseed oil hardens when exposed to air and, for this reason, putty should be kept in a tight can, covered with either boiled linseed oil or water.

Putty should never be applied to unpainted wood without first priming the surface with linseed oil. Bare wood will draw the oil from the putty and cause the putty to crumble.

Glazier's points are small triangular pieces of sheet metal. They are used to secure the glass to the frame before the putty is applied. No. 00 is the largest size, and No. 3 the smallest. For ordinary household purposes, Nos. 1 and 2 are satisfactory.

Procedure. 1. As far as possible, remove all the broken glass. With a wood chisel, remove the old putty, glazier's points, and any small pieces of glass that remain. The rabbet may be cleaned further, by brushing a small amount of new putty lightly over the rabbet. If a portion of the broken pane is to be saved for future use, care must be taken not to break it any more. Run the chisel parallel to the glass, cleaning the putty away from the surface. Also, run the chisel perpendicular to the glass, cleaning the putty away from the wood. Do not run the chisel into the wood, as putty will not adhere to new wood.

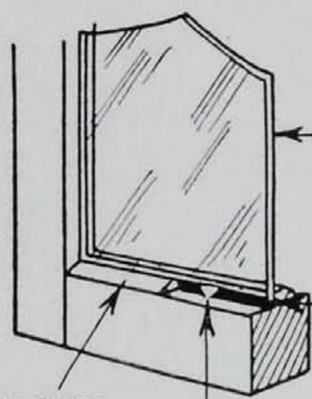


Fig. 2.150. Replacing of broken window pane.

2. Prime the rabbet of the sash with linseed oil.

3. Spread a thin layer of putty in the rabbet of the sash. This is known as *back puttying.* This seals the glass against the sash, making a weatherproof joint. If the lower edges of the rabbet do not lie in the same plane, that is, if one edge is lower than the other, apply enough putty to fill this space to the level of the other surfaces.

4. Place the glass in the sash. Make sure that the glass is lying absolutely flat. A piece of hard putty under one corner may cause trouble.

5. Press the pane firmly into the putty until the putty oozes up around the edges of the glass. Apply pressure as evenly as possible.

6. Fasten the pane by means of glazier's points. With the fingers, start the points into the sash at a slight angle, and then drive them with the flat edge of the chisel. Drive them deep enough to hold the pane securely and so they will not show after the putty has been applied. When working with

very thin glass, lay the glazier's points flat on the glass when starting them into the sash, otherwise they may pinch the glass and break it.

7. Form the putty into a roll approximately 3/8″ in diameter. With one

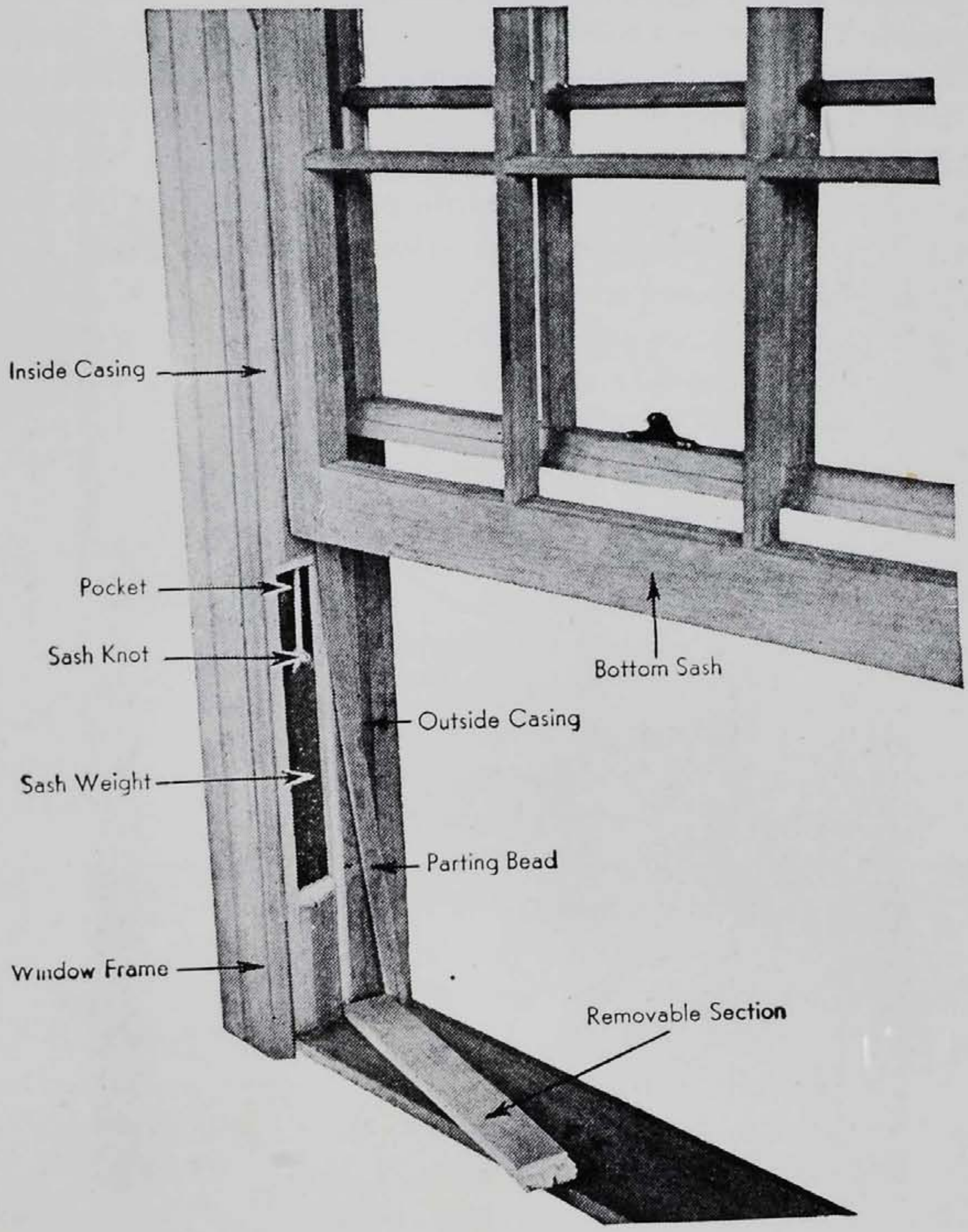


FIG. 2.151. Parts of window and frame I.

hand feed the putty along the edge of the glass and with the putty knife in the other hand press the putty firmly into the rabbet.

8. After applying the putty smooth it out with the putty knife so it makes a neat even bevel that fills, but does not extend beyond the rabbet of the sash.

9. Clean the sash with a soft paper or cloth. Be careful not to disturb

the fresh putty as it takes some time for it to harden. Approximately a week should elapse before applying paint to new putty.

Replacing a Sash Cord. The first step is the removal of the sash. The window band or molding which forms the channel for the lower sash is care-

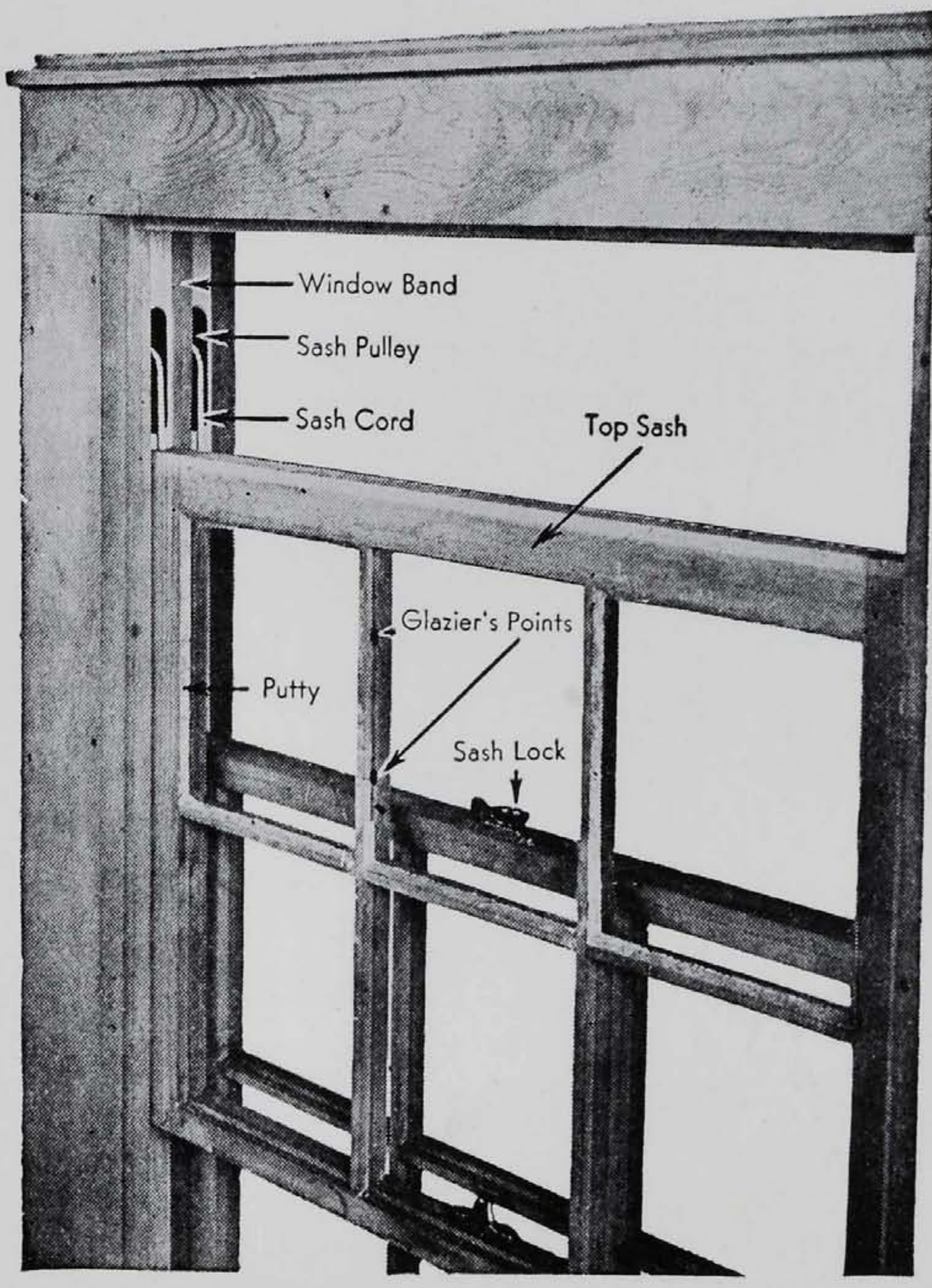


FIG. 2.152. Parts of window and frame II.

fully removed from one side of the frame. The lower sash can now be slid out of the frame. When an upper sash is to be removed, it is necessary to take out one of the parting beads which separate the lower and the upper sash.

The cord fits in a groove in the edge of the sash. A knot on the end of the cord fits in a hole at the end of this groove. This hole is bored at an angle, so that tension on the cord wedges the knot against the shoulders between the hole and the groove. As soon as the sash is away from the frame the cord can be pulled off.

After the cord is removed from the sash, the weight must be removed from its space in the frame called the *pocket.* The side of the frame usually has a removable section, held in place by two screws. It is a strip of wood about 2″ wide and 10″ long, with the ends sawed on a bevel. If this piece has never been removed, it may be necessary to use a saw and chisel to remove it the first time. After it is out, the weight should be visible and easily removed.

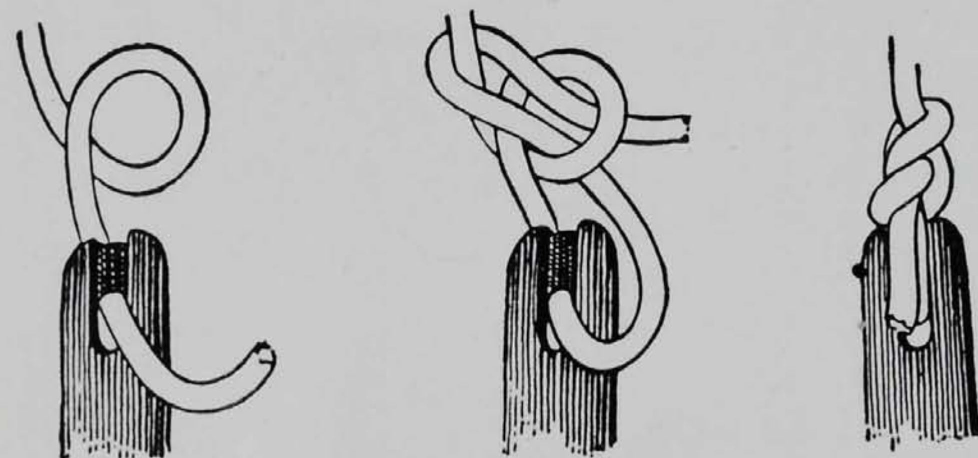


FIG. 2.153. Attachment of sash cord to sash weight.

The next operation is to measure the length of the old cord, being sure to make enough allowance for the knot which fastens the weight to the cord, and for the other knot which holds the cord in the sash. The new cord is knotted at one end, put through the pulley in the frame, and dropped down into the pocket, with the knotted end serving as a stop at the pulley while the weight is tied on. The accompanying diagram illustrates the bowline knot commonly used on window weights. The half hitch or square knot can also be used.

Tie on the weight, put it in the pocket, and replace the section of frame that was removed. Then insert the sash cord in the groove on the sash, and the knot in the hole. It may be necessary to rap the knot in place with a hammer. After this is done, the sash is slid back into the frame, and the window band is fastened in place, making sure that the position of the window band will allow the sash to slide freely the whole length of the frame.

Fixing a Tight Window Sash. If a window sash binds enough to need planing, it must be removed from the frame. This is accomplished by removing the window bands, which are either nailed or screwed in place. This will free the lower sash and make it easy to locate the exact point of binding. If the binding is due to the width of the sash it should be removed entirely from the frame. A few strokes with a plane on one edge will probably stop the trouble. If it is the thickness of the window sash that causes the binding, the window band should be replaced at a sufficient distance from the sash to prevent all binding. If the location of the window band cannot be changed, a few shavings taken off the edge of the band will loosen the sash. If it is the top sash that binds, the parting beads must be removed and the above procedure followed.

Sometimes a binding sash can be eased by applying a little stick graphite, especially if the binding is due only to the swelling of the sash in damp weather. In this case, it is probably better not to plane the sash because planing may make it too loose in dry weather.

In removing the sash from the frame, care should be taken that a window cord does not jump out of the sash and allow the weight to fall so rapidly in the pocket that it breaks the cord. By tying a loop in the cord and lowering the weight, this danger can be prevented and the replacement of the sash facilitated.

Fixing a Drawer that Binds. The binding of a drawer may be caused by swelling of the wood in damp weather, or by a change in shape of some part of the piece of furniture. If binding is due to the damp weather and if the drawer does not bind excessively, it can probably be fixed by rubbing paraffin or stick graphite on the spot that binds. Even well fitted drawers which slide easily under normal weather conditions perform erratically in hot, damp weather and in dry, steam-heated rooms.

It is unwise to start planing a drawer until it is certain that the drawer has not begun to come apart at some point, and that the frame which holds the drawer is not out of shape. Most furniture is made of kiln-dried lumber and fitted carefully. Most drawer troubles are due to the drawer being in a state of collapse or the frame part of the furniture being pushed out of shape.

A common trouble with large drawers is the spreading of the sides caused by a heavy article in the drawer, which has pushed the bottom out of the groove in the sides. This spreads the sides and, of course, causes the drawer to bind. If a drawer binds between the two sides of the frame it is wise to look at the bottom of the drawer to see if it is in the groove on each side.

Crating Furniture. A good way to start a crate for an article of furniture, whether it is rectangular or irregular, is to construct a square frame about an inch wider and longer than the base of the piece to be crated. A similar frame should be constructed for the top of the crate. Making the frames an inch or so too large leaves room for cushioning pads. Slats nailed on between the two frames complete the ordinary crate. If there is a projection or particularly delicate part on the piece being crated, it must be protected with extra slats, preferably with a piece on each side of each corner of the projection. Corner pieces are nailed together longitudinally, as well as on the ends. Other pieces may be put on the frame diagonally, as braces, or parallel to the side pieces, as protection against bumps or knocks. Crate material $\frac{5}{8}''$ to $\frac{3}{4}''$ thick and 3″ to 4″ wide, of soft wood, is probably best for this kind of use. Six penny box nails are good because they can be driven into the edge of a board without splitting it and because, when driven through two thicknesses of crate material, they project just enough to be clinched, or bent over.

If some part of the article being crated must have special protection, the inside of the crate should be lined with plywood, wallboard or some similar material.

Tightening Loose Chair Joints. Sometimes a chair round is broken, or a glued joint becomes loose due to improper gluing, dampness, or poor construction. In most cases, these repairs may be made in the home workshop with little expense or trouble.

Carefully remove the broken round or loose joint, taking care not to mar the finish of the piece. Sometimes it may be necessary to remove the end of a broken round from its mortise by boring it out with an auger bit. Use a bit which is smaller than the original hole.

All old glue and other foreign material should be scraped from the joint. The parts of the joints should never be sanded as this would spoil the fit of the joint. Test the joint for tightness. If the fit is too loose, a saw kerf may be cut in the tenon, and a wedge placed in the kerf. This expands the tenon when pressed into the mortise. See Fig. 2.154.

Whenever possible, a glued joint should be strengthened by some means of fastening other than glue. A nail driven through the tenon from the inside or corner blocks glued to the post and rail, will strengthen the joint considerably.

Before applying the glue, all clamps should be set to the proper length. If no clamps are available, a rope or heavy cord may be used, with a stick twisted between two strands in a manner to exert pressure on the proper joint. See Fig. 2.155.

Always protect the finish by placing small, soft wood blocks under the jaws of the clamps, and always remove the excess glue with a soft cloth and warm water.

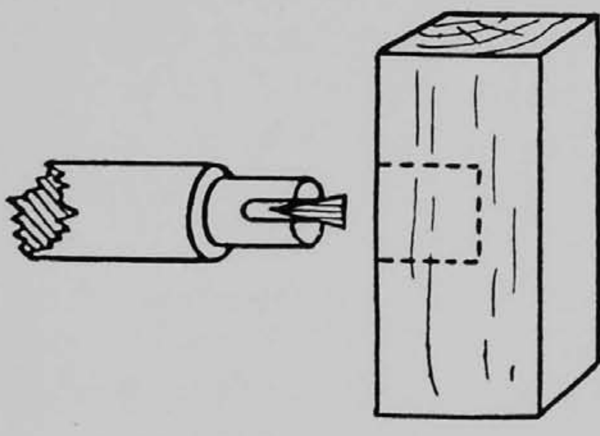


FIG. 2.154. Wedging the tenon.

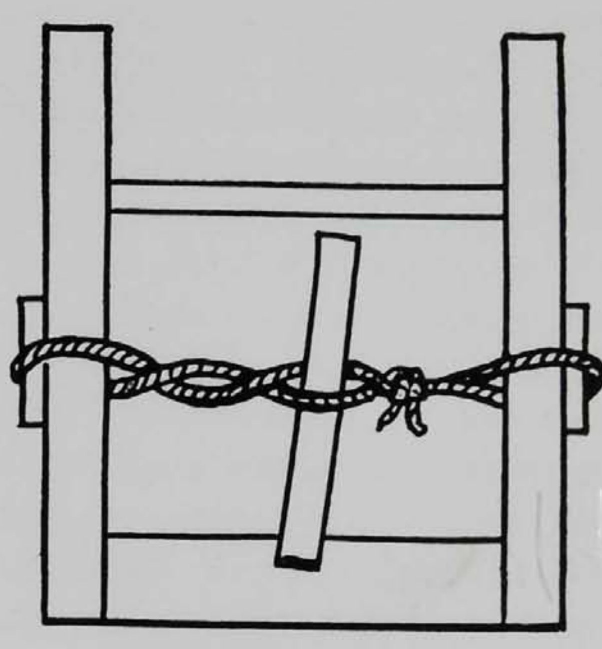


FIG. 2.155. Using rope in place of clamp for gluing.

What to Do about Squeaking Floor Boards. A squeaking floor board is usually difficult to fix. If the board is in a finished floor that is usually waxed or that has a natural finish, one remedy is to drive a finishing nail straight down through the board in the spot that squeaks. This nail should be set and then covered over with putty mixed with color to match the floor. If a standard cut flooring nail is used instead of a finishing nail and the squeak is not fixed, it may be made worse because the taper of the nail may add to the noise as it goes in and out the hole.

Another more drastic method is to counterbore a screw or several screws at the squeaking point to pull the board down to stop the up and down motion which causes the squeak. These counterbored holes should be filled with wooden plugs to cover the heads of the screws. The plugs should be cut and glued with the grain parallel to the grain of the floor. After the glue is dry, they can be planed off, scraped, and sanded to a surface. Refinishing is then necessary.

Replacing a Worn Threshold. The present tendency in building construction is to eliminate inside thresholds, leaving a smooth walking surface through doorways, and avoiding the old-fashioned hump which was likely to trip an unwary individual.

The only threshold that can be replaced without a major construction job is the inside threshold. Outside thresholds, called sills, project under the sides of the door frame. To replace a sill the whole door frame must be removed, and this in turn involves removing the door and the inside and outside casings.

The wood used for a threshold is usually chosen to match the adjacent floor. A maple floor should have a maple threshold, and an oak floor should have an oak threshold. A threshold is usually from 5/8″ to 3/4″ thick, with the edges beveled off at about a 35° angle, leaving a 1/8″ vertical edge near the floor. A worn threshold should be replaced by one of equal width. Stock material can be obtained for a threshold, but it is usually much narrower than the custom built threshold. It is recessed on the bottom, to insure that the edges fit snugly to the floor.

The first step in replacing a threshold is to remove it in one piece, if possible. It is probably worn thin and weak in the center. It is best to drive a chisel under each end, thus loosening the nails. Then pound the threshold back, and pull each nail individually. This procedure may not always work because the nails pull right through the threshold as it is lifted. In this case they can be removed after the threshold is out.

If the house is old enough to need new thresholds, the traffic has been heavy through that particular doorway and probably the side frames of the door may be somewhat shrunk away from the ends of the threshold. If this is the case, the old threshold cannot be used as a pattern. It is better to make a template for each end out of cardboard or zinc and mark this pattern on the new threshold before cutting. The template should be fitted carefully and the length measured along a center line.

After the stock has been planed and sanded smooth, the template is placed on it and marked out carefully. It is then sawed as laid out. The cuts are not made square to the top surface but are beveled slightly toward the middle of the bottom. This is to insure a good fit on the ends and also to facilitate the operation of putting the threshold in place. It is now ready to install. This is done by holding one end down as near to its position as possible and the other end high enough to enable the piece to slide into the frame. It is then pushed down until it is flat on the floor.

Thresholds are usually nailed directly through with finishing nails which are then set below the surface. It will be advisable to drill pilot holes for the nails, especially if the threshold is made of hard wood. After it has been nailed in place and the nails set, the holes are puttied and it is finished like the floor.

Laying a Floor. The average American home has maple or oak floors. The boards are usually from 3/4" to 1 1/4" thick, of various widths and lengths. They have a tongue on one edge and a groove in the other edge. When laying these boards tongue edge to groove edge, the width of coverage of each board is the face width. Most modern flooring is also end matched, that is, the ends of the boards are tongued and grooved.

Sometimes a single floor is satisfactory if there is a warm cellar under the entire house. When laying single floors, the craftsman should be careful in sorting the lengths of the flooring, so that every end joint, or head joint, will center a joist. If a head joint should come between joists, the boards would spring badly or even break off. When sorting the boards, also consider matching the grain of abutting boards, if the floor is to have a natural finish.

Usually floors are laid in two layers. The first or subfloor is made of rough boards nailed to the joists, and the finished floor is laid on top of the subfloor. The subfloor is often laid at a 45° angle to the floor joists, and a layer of building paper is usually placed between the subfloor and finished flooring.

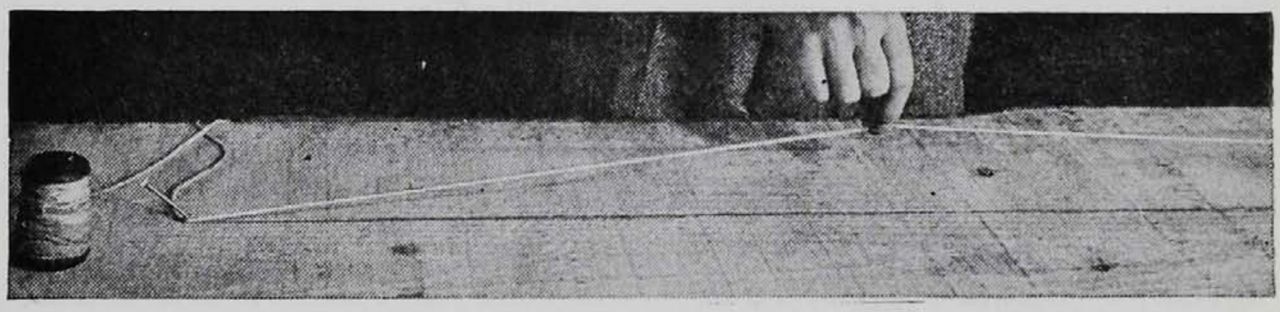


FIG. 2.156. Snapping a chalk line.

When starting a floor, snap a chalk line parallel to the wall of the room, and nail the first line of boards of finish flooring to the line. The nail should be started at the top of the tongue, and driven through the board at approximately a 45° or 50° angle. Never try to drive the nail its full length with the hammer. A nail set should be used when the nail is driven nearly into place, as damaged edges of flooring are very unsightly. Match the next piece of flooring to the first, and continue nailing the successive lines of boards.

To bring the joints tightly together, hammer or pry on a piece of scrap flooring placed over the tongue of the board being laid. It is well occasionally to measure the width of the flooring laid and to make any necessary corrections for parallelism as the other side of the room is approached.

The baseboard molding should be nailed to the flooring and not to the baseboard. It should also be applied after the baseboard has been painted or varnished. Thus, if shrinkage takes place in the joists, no cracks will appear between the molding and the floor, and no unfinished wood will appear above the molding. Never nail molding to both baseboard and flooring, as shrinkage may bring stresses on the molding causing it to split.

Repairing a Sagging Floor. The usual cause of a sagging floor is a lack of the proper size of joists, or floor beams, or improper spacing of the joists. Sometimes green or unseasoned lumber is used and a sag appears. Green lumber is much more pliable than dry lumber. The best remedy for a sagging floor is to put a timber crosswise underneath the joist at the low point and to jack up the floor until it is level. Then a post can be put under the timber. In many places, of course, this is not possible. If it is possible to get at the floor timbers, any defective ones can be replaced or additional ones installed. If it is impossible to get under the floor or get at the joists, about the only remedy is to fill in the low place with something. If the condition is serious enough to warrant it, the first floor can be ripped up and filler pieces installed. This is, of course, quite a construction job. In putting in the filler pieces, they should be scribed to the old floor and lined from one side of the room to the other, in order to determine the height that is necessary. After three or more pieces have been put down, a straight-edge can be used to determine the height of the remaining number, although it is wise to check with a line occasionally to see if the straightedge is giving proper guidance. The filler strips should be at least 2″ wide and placed over the floorings if possible.

There are compounds on the market which the manufacturers claim can be used as a filler between old and second floors to fill in sag. This, of course, means that the fastening used must be long enough to reach through the filler and enter a sufficient distance into the lower floor to hold.

Unless one has had considerable experience, it is probably wise to call in a carpenter for advice before attempting a job of this nature.

Repairing Stair Treads and Risers. There are two classes of treads and risers in general use, plain, and tongue and grooved. The first type is more simply constructed, while the latter is used in better types of construction.

There are two methods of constructing plain treads and risers. In one the lower face of the riser is nailed to the back edge of the tread. In the second method, the lower edge of the riser rests upon the top face of the tread. In both methods the top edge of the riser supports the tread above.

In either case the home craftsman should remove the broken riser or tread, cut off all nails flush with the stringers or side supports of the stairs, and make a new tread or riser to exact size. Place the tread on top of the stringers, and nail with finishing nails through the tread into the stringers. Place several nails through the top of the tread into the lower riser. If a riser is also to be replaced, it may be nailed to the stringers, and several nails may

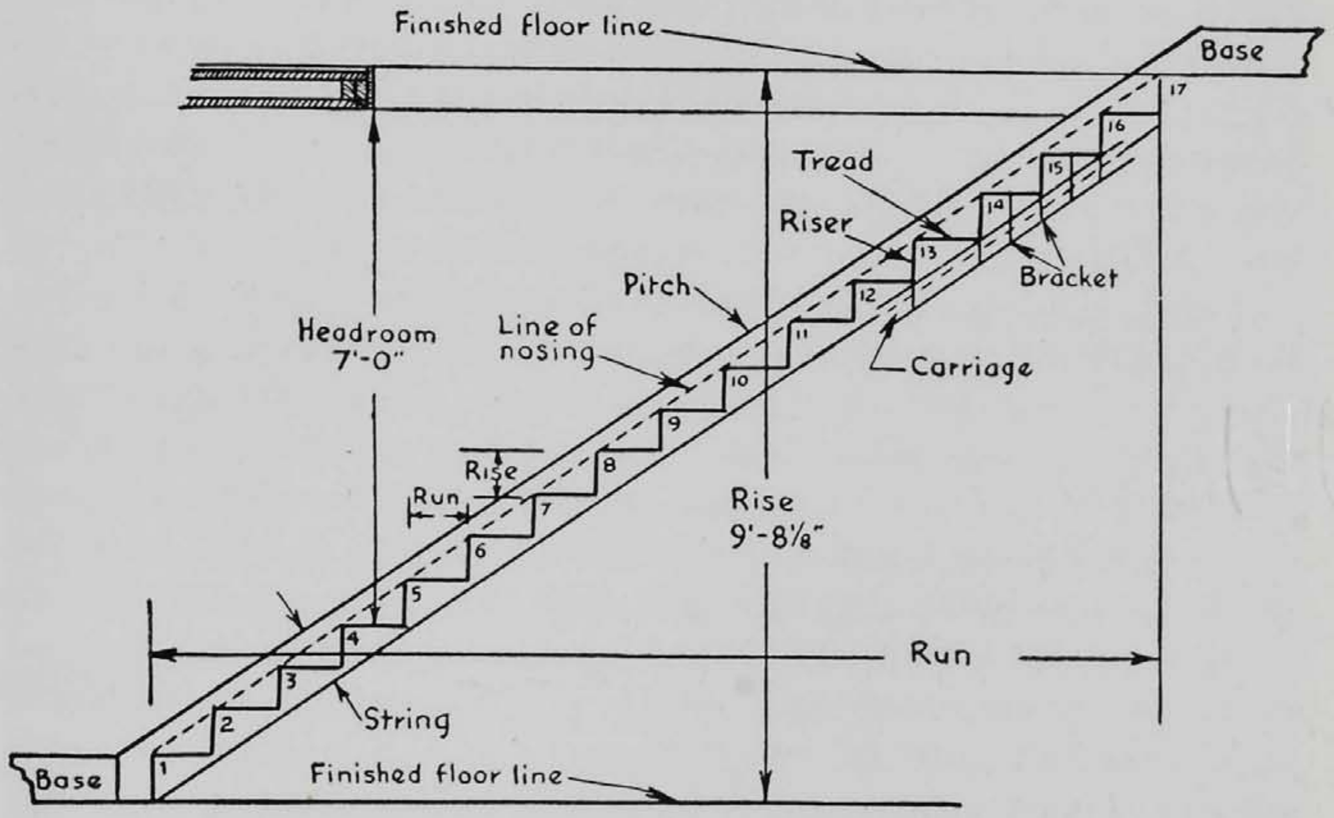


FIG. 2.157. Stair layout.

be driven into it from the top of the above tread. Set nail heads below the surface of the wood with a nail set, fill with putty or plastic wood, and finish to match the stairs.

Headroom. The distance between header and tread below. The header which determines the headroom should be so placed as to secure at least 7′-0″ of headroom from the tread vertically beneath it.

Proportioning of Treads and Risers. Experience teaches that between 6″ and 7″ is the limit for easy stepping. A good rule for determining the proportion that should exist between treads and risers for dwelling houses, considering an easy line of travel as well as the appearance of the stairs, is to have the sum of the run and rise equal, as nearly as possible, 17.

Formula is: $\dfrac{\text{Total rise in inches}}{7}$ = number of risers required.

$\dfrac{\text{Total rise in inches}}{\text{Number of risers required}}$ = exact width of risers.

17 minus exact width of risers equals width of tread necessary to afford an easy travel.

In the tongue and groove construction there are rabbets on the top edge of the riser and on the back edge of the tread. Grooves are cut in the lower front face of the riser and along the front underside of the tread. Thus the treads and risers are held together with joints. Retaining blocks, 2″ square and 4″ to 6″ long, are glued in the underside angles formed by the tread and riser. Repairing this type is similar to repairing the plain type. Duplicate pieces should be made, the joints fitted together, the assembly made and nailed to the stringers. If the underside of the stairs is exposed, retaining blocks may be toe nailed or glued to the angle of the steps.

Building a Partition. If a standard type of partition is needed in a house, the correct way to proceed is first to mark the location of the partition on the floor, then, using the level in a vertical position and a long strip of wood with a straight edge, make a vertical line on the wall at each end of the floor line. Now, with the chalked cord, snap a line on the ceiling. Next, spike a 2 × 4, called a *shoe*, on the proper side of the line on the floor, and one against the wall on each side of the room. A 2 × 4 should also be placed on the ceiling, fastened into the overlays, or ceiling beams. If it does not cross overlays, it can be fastened to the strapping. Fastening to the lath is not sufficient; it would cause the loosening of the plaster, and the partition would not be firm. Next, locate the doors, if there are to be any, and saw out the 2 × 4 on the floor in the correct spaces for the door frame. Next, space the studding 16″ on centers, that is, 16″ from the center of one to the center of the next and put the 2 × 4 studs between the shoe on the floor and the 2 × 4 on the ceiling. They are fastened in place by toe nailing. A double stud should always be used on each side of a door to provide a nailing for the casing around the door frame. Next, headers should be put in for the door.

If the partition is to be plastered, the next step is to place the ground strip, which serves as a stop for the lath and plaster. In lathing, one should be careful not to get the laths too close together, otherwise the plaster will not go through to form clinchers. If the partition is made of fiber board or some other wallboard, backing for this material must be put in according to requirements of the material. Manufacturers are glad to furnish specifications as to the backing required for each type of material.

The finish of the partition, the style of the door, the casing, etc., must be chosen by the individual craftsman.

The Coped Joint on Molding. The purpose of coping molding is to make a joint that will not open with changes of shape caused by shrinkage, swelling, or change of position.

One method of coping molding is to fasten one piece in place and hold the other piece with the end tight against the first piece and scribe the joint (see page 82). After the joint is scribed, the coped joint is cut out with a coping saw. Another method is to place one piece of molding endwise against the piece which is to be fitted to it and mark around the first piece to obtain the profile of the cut that is to be made. When marking off the scribed joint, each piece of molding must be in its final relative position, in order to give the correct layout for the coped joint. It is hardly possible to do very much fitting to a coped joint, unless it is done with a file. When the joint is put together, it is necessary to be sure that the first piece is not drawn away from the joint as it is nailed. This sometimes happens when molding is fitted against a plaster wall, because the nailing of molding on the plaster sometimes causes the molding to sink into the plaster.

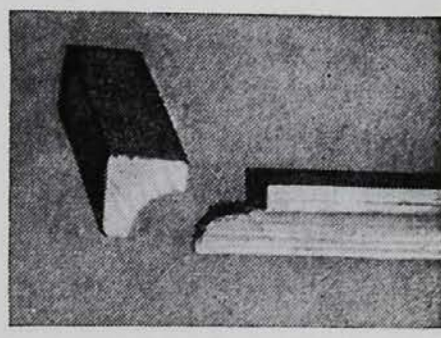


FIG. 2.158. Coped joint on molding.

This type of joint is used for chair rail, picture molding, quarter round, etc. It will also be noticed that this type of joint is superior to an inside miter because, if an inside miter joint is nailed away from the other piece, it will immediately open the joint.

Hanging a Sink and Building a Drain Board. The design of the old time, cast iron sink was such that it had to be hung on a slope to have the water drain properly. Now the porcelain sinks which are hung in wooden frames are set level and the necessary slope is built into the sink. The construction necessary to hang the sink is very simple. Build a rectangular frame at the height chosen, usually 34″ to 36″, and of a size to allow the edge of the sink to rest on it. The frame is usually made of boards at least 6″ wide. The sheathing under the sink is recessed about 3″ or 4″ to allow footroom while standing at the sink. This is accomplished by fastening a strip, of a width equal to the depth of the recess, on the back bottom edge of the front board of the frame supporting the sink. The sheathing then runs from the back of this strip, which serves as a nailing support, to a support of some sort on the floor. This may be either a grooved piece in which the sheath enters, or a strip to which the sheathing can be toe nailed. Sometimes quarter-round molding is fastened over the sheathing on the floor, after it is toe nailed into position.

The drain board is given a slope of at least ½″ per foot, and it sometimes has grooves to guide the water. It projects over the edge of the sink to carry the water into the sink. The slope of the drain board is usually obtained by fastening a wedge-shaped piece onto the front supporting board of the sink, which runs along the sink as far as one wishes to carry the drain board. Another wedge-shaped piece is fastened on the back of the sink, and supporting cross pieces are placed between. In taking the measurement of the support, the extreme outside dimensions of the sink should be the overall dimension of the support.

Building a Coal Bin. A coal bin is usually built of matched boards on a frame of 2″ × 4″ studding. Its construction is similar to that of the partition described on page 216. First, a shoe is fastened to the floor. It must be securely fastened, either by toggle bolts, or expansion shields and bolts, or an auxiliary floor must be placed in the bin to which the studding can be fastened. The wall must be strong enough to resist the side pressure of the coal when the bin is filled.

The top of the bin may be fastened to the beams of the floor above. If the top frame goes across the beams, the 2″ × 4″ can be spiked to the floorings. If it runs parallel to the beams, a short piece of 2″ × 4″ will have to be spiked between the floorings.

The 2″ × 4″'s which support the uprights of the bin should not be spaced less than 16″ on centers, and the boarding should be made of sheathing to avoid having dust or small particles of coal slip out of the bin.

It is advisable to have the door in the form of boards in grooves so that as the coal lowers, the door may be removed a board at a time. Some prefer to have a slide door at the bottom, which allows a certain amount of the coal to come out on the floor, where it can be reached with a shovel. The size of the slide door depends on the size of the shovel to be used, but probably a slide 15″ square would serve all purposes.

One of the most important structural requirements of a coal bin is sufficient strength to resist pressure from the inside, because coal is heavy and will exert great pressure near the bottom of the bin. The boards should be nailed directly through with eight penny nails, and, of course, all of the boarding should be put on from the inside. A scribed joint can be made at the ends of the boards, if they fit up against a brick or stone wall. It is always wise to consider how the bin is to be filled when deciding on the location. If it can be built near a window in which a coal chute can be placed, carrying charges of 50¢ or more per ton may be saved.

Installing a Vise. The first step in installing a vise on the home workshop bench is to place the vise on top of the bench approximately in the position that it is to be fastened. This is usually on the front of the bench at the left end. If the vise is a flush type it should be installed near enough to the end so that work in the vise may be sawed off without interfering with the bench top. Most flush-type vises fasten on the under side of the bench top, and some recessing must be done before they are fastened. Locate the holes for the bolts while the vise is on top of the bench. In that case, place the vise underneath and fasten it to the bench temporarily while marking

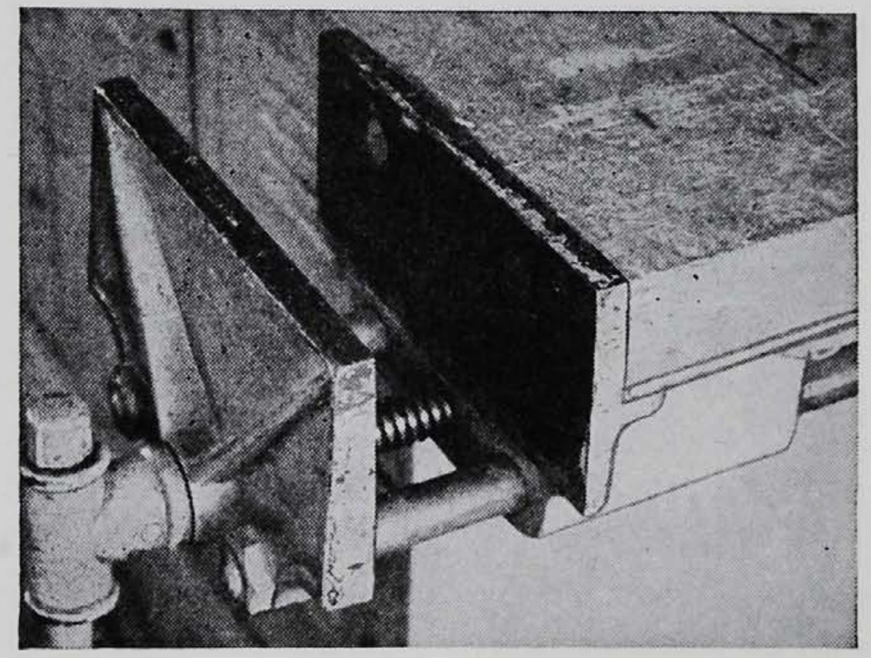


FIG. 2.159. Flush-type vise installed on woodworker's bench.

the part to be recessed. Whether the work is done this way or whether a cardboard pattern is made, is immaterial. In recessing, it is probably better to bore with an auger bit to remove as much wood as possible and then to finish the remainder of the recess with a mallet and chisel. Sometimes it is possible to saw into the bench plank and remove the excess stock with a chisel and mallet. This operation may require two or three saw cuts because the bench top is always made of hard wood and must be chiseled carefully in order not to split it. If the vise is one of the type that rests on top of the bench it may also require some recessing, but it is best to place the vise so that the back jaw will be at least flush, and not back of the front edge of the bench top. This makes it possible to hold a long piece in the vise with one end dropped below the bench top. This statement also holds true for the flush-type vise, but usually the flush type is constructed so that the back jaw projects in front of the bench top.

It is best to fasten a vise with bolts rather than screws whenever possible. Bolts permit the maximum strain to be placed on the vise without ripping it off the bench, and they also make it rigid so that there is no tendency to slide.

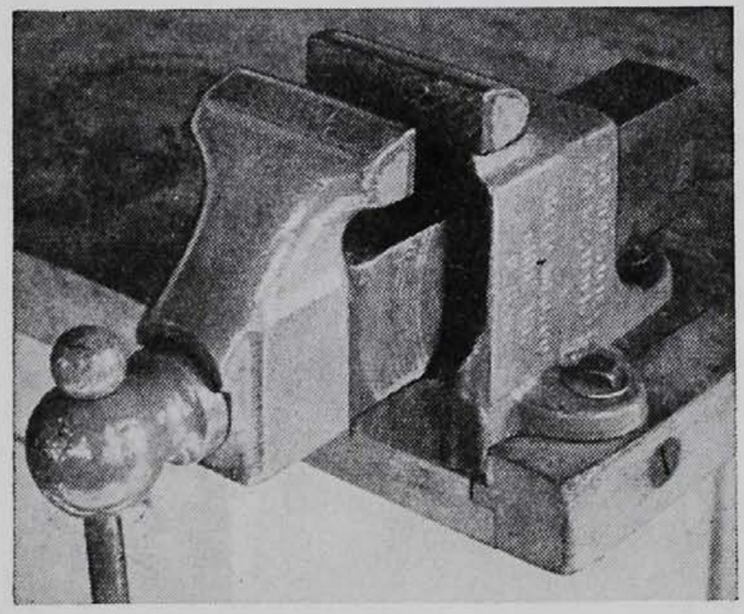


FIG. 2.160. Installation of metalworking vise.

Directions for installation often accompany a vise, but it is wise to plan the job carefully before proceeding. A good type of vise for the home workshop is one that may be used for either wood or metal. The flush-type vise is usually designed for wood only. It is good practice to have a metalworking vise on one end of the bench and a woodworking vise on the other end. It is convenient in the home workshop to have the metalworking vise fitted with a set of pipe jaws that can be inserted and removed at will. Thus shafting or pipe can be held firmly while it is being processed. A set of copper jaws should be made for the metal vise in order to protect any polished work that may be held in the vise.

Hanging a Door. Select a pair of loose pin butts suitable to the size of the door. Next, joint the back edge of the door. Place this back edge up against its side of the frame and mark along the other edge guided by the frame, to lay out the proper width of the door. Next, plane the door to width or, if there is too much stock to plane, rip off a piece with the ripsaw and then joint to width. In jointing, an 18″ or 24″ plane should be used to keep the edge of the door straight. Now, insert the lower part of the door in the frame and mark off the bottom of the door parallel to the threshold or flooring that it is to fit. This can be done by scribing a line, or by laying a strip on the floor or threshold and drawing a line along the top of the strip. It is well to check the length of the door before sawing off this bottom piece to avoid taking off too much. Gauge the distance according to the allowable waste. After the bottom waste is removed by sawing and planing, the door should again be pushed in place and marked on the top jamb to give the length of the door.

A good rule to follow in fitting a door to width and length is to allow about the thickness of a five-cent piece all around the door. This allows easy hanging, easy swinging and, if the door is hinged correctly, it will not bind.

Next, mark the bottom edge of the lower butt in line with the top edge of the lower rail of the door and mark the top edge of the upper butt in line with the lower edge of the top rail. This placing of butts can be varied if necessary. Place the lower butt in position on the edge of the door and mark its outline with a sharp knife. A butt gauge is a very handy tool for marking hinge layouts. The gain for the butt is usually about the depth of the thickness of the leaf. Cut this gain (see page 82) and screw the leaf on the door. Do the same for the top hinge. Next, place the door in the frame in position, with wedges underneath to raise it from the sill, in order to give proper clearance. It can be wedged nearly as high as it will go because the door will sag a little after it is hung. Mark the location of the hinges on the frame with a knife and take the door away. Remove the loose pin from the butt, place the half of the leaf against the frame but pulled back from the rabbet $\frac{1}{16}''$ to make certain that the door will close without binding against the jamb. This is important. After both hinge positions are laid out on the frame, cut the gains and screw on the hinges. Place the door so that the hinge parts intersect and replace the pins. The door should now swing freely and evenly.

A common error in putting on hinges is placing the hinges too close to the shoulder of the rabbet. This causes the back face of the door to bind against the jamb. Another common error is to cut the gain too deep. This makes the edge of the door tight against the frame and tends to pry the hinge off as the door shuts. If the gains are laid out carefully and cut out on the line, most door troubles are eliminated.

OUTSIDE CARPENTRY

Repairing Outside Stairs. If outside stairs need repairs it is usually because the foundation has given way, or because decay has occurred. If the run of stairs is short and easily detachable, a much better job of repairing the foundation can be done if the stairs are taken out of the way. If the stairs cannot be removed, place a jack under them and raise them to the correct height. Then dig into the earth and place concrete blocks, or pour mixed concrete, under each stringer.

Outside stairs should be made so that they are level across the stringers, but slope a little toward the front. If rotting has gone so far that the stringers must be replaced, an entire new construction job must be done. Usually the treads are the first part of the stairs to give way, and they should be inspected frequently. In an ordinary outside run of stairs, the stringers and risers will outwear at least three sets of treads. A coat of paint on the stringers, and on the back of the risers and bottom of the treads before assembling, is good practice.

Replacing a Window Frame. Sometimes a window frame leaks around the sill and allows moisture to gather inside the house and run down on the plastered wall. This stains the paint in the room or loosens wallpaper. Almost the only remedy is to remove and replace the window frame. In order to do this, the sash must first be removed. Then the inside casing is taken off and the stool cap and the sur-base are removed. Then the frame can be knocked out by rapping on a block of wood held against the outside casing through the weight pocket.

In a shingled house, one must be careful that the shingles do not bind against the outside casing and split as the frame is being removed. Sometimes the headers project beyond the casings and cause complications in removing the frame. Before removing the frame, it should be noted whether or not the outside casings fit closely to the shingles or clapboards. If they do not, it is wise to make the new casings a bit wider and plane them until they just fit the opening. A good nailing should be made on the studs, starting at one lower corner of the frame and placing a level on the sill to check it.

Leveling and Repairing a Porch Floor. A porch floor is almost certain to need repair after a period of about five years if it has not been kept thoroughly painted. Most permanent porches which are on a solid foundation, rather than on posts, will last as long as the house itself. The repair jobs as a rule are needed on porches which are open underneath or latticed. If water seeps onto the sill, or through the cracks in the boards, rotting will occur and repairs will be required. Sagging or settling of the foundation is another reason repairs are necessary. To overcome sagging, jack up the porch to its original position. If new posts are needed, first inspect the foundation on which the posts rest. Then new posts should be put underneath the sills, after checking the height and allowing a little for settling when the jacks are removed. A porch on a brick foundation is more satisfactory, and a new sill will probably be all that is needed.

If a new porch floor is needed, the old floor should be ripped up, the beams cleaned free of nails, and then the new floor put down. Some porches have tight floors which will keep out mosquitoes and bugs, and others are laid open, that is, each board is about ⅛″ to ¼″ away from the next board, allowing ventilation through the floor.

If there is a sag between the posts, the repair job may require a new beam or an additional post under the sag. If the two ends of the porch are jacked up to their correct height, and if a line is stretched over the floor from one end to the other, it will serve as a guide to show whether or not the rest of the floor is in a correct position. If it is not, the floor must be jacked up and new posts put in, or shims put on top of the existing posts. New posts may be required between the original posts.

Painting the bottom side of the floor boards helps to preserve a floor. Galvanized nails can be used when a soft wood floor is nailed through the boards, although it is not convenient to use galvanized nails for blind nailing.

Replacing a Porch Post and Rail. Replacing a porch post and rail is a job similar to replacing the posts under the porch floor. The first step is to place the jack in such a position that it will support the weight that the post should support. It is advisable to place this jack over the foundation of the porch, if possible. Next, remove the old post and rail. Probably the post has been fastened in by toe nailing, although it may have been cased in with quarter round, or a similar molding. The rail should be taken out carefully to avoid splitting the posts to which it is fastened. Any remaining nails should be removed before starting to fit the new post or rail.

In fitting the post, the slope of the porch should be considered. This will require a slight bevel on the bottom end of the post. This bevel can be obtained by placing the level on the porch floor and finding out how much it slopes in the length of the level or in 1′. After obtaining the slope, set the bevel to this angle and mark the bottom end of the post. To obtain the length of the post, two sticks are used, neither of which is quite equal to the final length of the post. These are called slip sticks and are placed in the post's position and one slid upon the other until they just equal the required post length. They are then clamped or nailed together in this position and used as a measuring stick on the post. The top end of the post is probably square where it fits against the plate although it may be complicated by finish that was put on the porch after the post was in place

Place the post in position and take out the jack. Then use slip sticks to find the length of the rail. After sawing the rail to length, it is fastened in position. A good way to keep the rail at the proper height while nailing it is to saw a board just equal in length to the distance from the top of the floor boards to the bottom of the rail. This is used as a support for the rail while nailing one end, and then removed to use at the other end. This insures an accurate height of rail and makes it much easier to fasten the rail in place.

Replacing a House Sill. In replacing a house sill the first step is to place a substitute sill under the floor beams, which are then jacked up to bear the weight of the house while the new sill is being installed. It may be necessary to remove clapboards or shingles and boarding to get at the studding. Sometimes a $2'' \times 4''$ or a $1'' \times 6''$ is spiked to the studding and used for a support to jack against. Sometimes a support can be obtained from the window headers, if the sill or wall is not too long or heavy. It is sometimes possible to swing the new sill in as the old sill is swung out.

After removing the old sill, measure the exact length and position of the gains to be cut, locate them and cut them out on the new sill. If the sill was mortised into the corner, this mortise should be made first. After each measurement has been carefully checked, the sill should be slid in, preferably from the outside.

It is always well to check the foundation when replacing a sill. There may be other repairs to make. A water pocket in the foundation may be one cause of the rot in the old sill. After the ends of the sill are in place it should be tested with a chalk line to see if it is straight as it determines whether or not the wall of the house is straight. When it is straight the studs are then nailed down, the boarding replaced, and the clapboards put back.

Fitting Storm Windows. Storm windows have a sash usually made of pine or cypress. The mail order houses sell storm windows for about the price that it would cost to buy the glass elsewhere. The Stanley Rule and Level Company and other hardware manufacturers make hangers for storm sash which allow the window to be hung and removed easily.

Before starting to plane the new sash to make it fit the window casing, it should be placed up against the frame and spaced so that approximately equal amounts may be taken off each side. In fitting the storm sash, the first step is to straighten one edge of the sash with the jointing plane. On a measuring stick mark off the top and bottom widths between the casings and lay out these widths on the sash. Using a straightedge, draw the layout line and plane the sash to width. Next, place the sash in the frame and scribe a line on the bottom of the sash using the sill as a guide. Mark the slope of the sill on the side of the sash. Saw and plane to this layout.

After having fitted the sash to the sill, put it in place and mark and cut the top. Allow very little clearance on a storm sash, because it should fit comparatively tightly. The standard fastener for storm windows is usually made so that the window can be swung out and held in position for ventilation.

After jointing, all of the sharp corners should be removed. The sash is held in place with wedges or a chisel and the hangers are put on. It is always well to paint the sash after fitting, before the hardware is installed.

Repairing a Roof Saddle. The saddle sometimes needs repair before any other part of a roof. If this is the case, the old board should not be ripped off until after its measurements have been taken. Then the nails are pulled out and a new board is made to the same dimensions.

Saddle boards are made in about 4″, 5″, and 6″ widths. One board is approximately 1″ wider so that it can lap over the other. The lower board should be put on first, and only its lower edge nailed. The position of the lower board is determined by placing a straightedge on the opposite side of the roof so that it projects above the ridge. Push the edge of the saddle board tight against the straightedge, and preferably about 1/8″ beyond. Nailing should start at one end of the board and, with the straightedge as a guide, the nailing should be continued at about 18″ intervals to assure correct positioning. If two boards are needed to reach the full length of the roof, they are butted together in a square joint. The ends of the boards are usually allowed to project about 1/4″ over the edge of the roof.

The board on the opposite side of the ridge should be nailed into the top edge of the first saddle board. The top board should project above the lower board, by at least 1/16″ to 1/8″. This allows the nailing to pull the two boards together, and makes a watertight joint. After the top board has been nailed the full length of the saddle on the top edge, it should be nailed on its lower edge. Eight penny common nails are generally used for this purpose.

It is good practice to paint both sides of a saddle board before installing it, and especially the top edge of the lower board, thus making a water seal at the joint. The saddle board should be painted again outside after installing.

Constructing a Clothesline Post. A common type of clothesline support is constructed by erecting two posts about 6′ apart. These posts should be sturdy and should be set into the ground about 2½′, and project above the ground about 5′. A 2″ × 6″ plank should be nailed to both posts and project at least a foot on each end. White cedar makes a good post and, if it is waterproofed before it is set in the ground, it will last a long time. Another pair of posts should be erected at a suitable distance from the first pair, depending upon the space available for the clothesline. Then hooks at least ¼″ or 5⁄16″ in diameter should be screwed into the plank 15″ apart. After a coat of paint has been applied the support is ready for the clothesline.

Screening a Porch. The first step is to fill in all the irregular spaces around the braces, moldings, etc., so that rectangular screen frames will fill the remaining space. This operation may require the coping of boards to go around porch posts, or it may require fitting against brackets or other decorations. If the height of the porch is between 6′ and 7′, frames similar to screen doors, but made of much narrower stock, can be used. These frames can be hooked or screwed in place, with a strip to cover the joint between the two frames. Standard screen brackets can be used as braces in the corners.

If the porch has a tight rail, it often happens that the frame between each two posts can be made in one piece, using hooks to hold it in place. The frame can be made of almost any soft wood, although white pine or cypress is most commonly used. Both are durable, take tacks easily, and stay in shape well. For longitudinal frames, stock should be 3″ wide and ¾″ thick. If the frames are placed vertically, the strips can be of light weight, if fastened together at intervals close enough to avoid springing of the frame. It is not necessary to make frames as durable as a door although they should be sufficiently rigid and strong to allow handling without danger of breaking. Frames with a span of more than 4′ need a spacer to which the screen cloth may be fastened. It is economical to give the frames at least one coat of paint before fastening the screen cloth. Copper screen cloth is so far superior to iron or galvanized iron that its installation is advisable.

Screen cloth should be tacked to the frame at the middle point of each end, and then at the middle point of each side. Pull the corners diagonally tight and fasten.

Put tacks midway between the center fastenings and the corners, holding the screen cloth tight. Repeat the process until finished. The cloth should be tacked at intervals of not more than 4″. The line of tacks and the edge of the cloth are covered by a molding. Standard screen molding is best for this purpose although a strip of straight-grained white pine ⅝″ × 3⁄16″ will serve. It should be put on with ¾″ brads, and it should be painted on the under side before installing. Trim any screen cloth that may project beyond the molding.

After the screens have been installed, they should be numbered and the space in which they are installed should be numbered, so that they can readily be replaced in the same position each season.

Building a Chicken House. Before building a chicken house, one should consult the pamphlets that are now issued by most state agricultural experiment stations and the U.S. Department of Agriculture. These pamphlets give definite, thoroughly tested information about planning, methods of construction, proper exposure, and other points of interest.

To build a small house for temporary use, the construction can follow one of several methods for box-type houses, using corner posts, with braces between them, with the boarding acting as the support for the walls. This house is very easily constructed of crates. The windows are often fastened on the inside and hinged at the top.

If the house is built of sheathing, it should be applied in a vertical position, so that the rain will run down the joint. Some types of chicken houses are built by boarding vertically and nailing a narrow strip about 2″ wide and ¾″ thick over each joint between two boards. This strip is often called a *batten*. This is an easy method of building a strong structure which will serve very satisfactorily. The house should have a floor at least 6″ or 8″ from the ground, to keep it dry and well ventilated.

Building Concrete Forms. Forms or molds are necessary when concrete is poured so that it will harden in the shape desired.

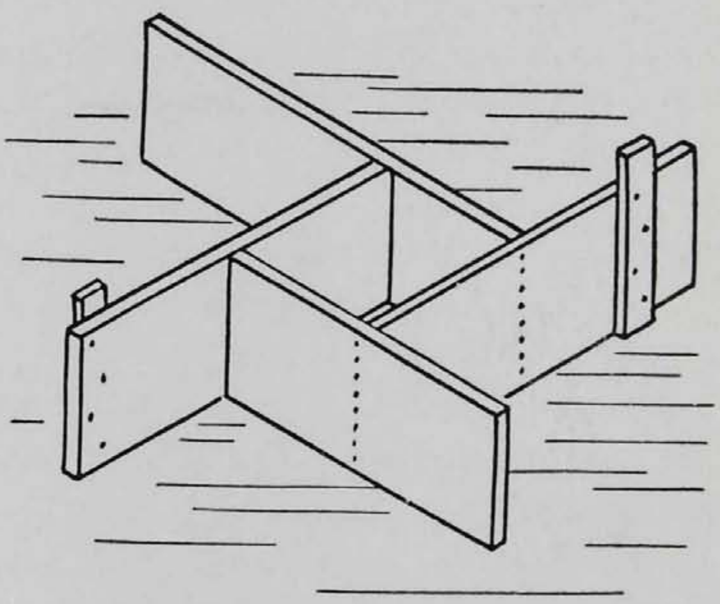


FIG. 2.161. Sketch of form for concrete.

Various kinds of wood are used for forms. If decorative trim like molding is to be reproduced in concrete, white pine is used for forms because it is easily worked. Clear white pine is quite expensive, and hard woods are not only expensive, but hard to work. Spruce, fir, Norway pine, and plywood are therefore most commonly used for form work. Green lumber, or lumber only partly air dried, is best to use.

If possible, build forms from stock lengths of lumber. After use, forms so built can be carefully taken apart and the lumber used again. A simple form may sometimes be made, as shown in Fig. 2.161, without cutting the lumber.

Knots or other defects will be reproduced by the concrete, and boards of different thickness will cause irregularity in the concrete. Lumber which is dressed on two edges and one side, or tongue and grooved lumber, is often used for form building. Ship lap or boards having slightly beveled edges are excellent because the edges swell shut and prevent the water from leaking away and carrying the cement with it. Because of the danger of warping and bulging no wide boards should be used. Widths of 4″ to 6″ are preferred, with 8″ as the maximum.

Usually 2″ × 4″'s or 2″ × 6″'s are used for form studs. Forms constructed with 1″ boards should have studs spaced not more than 2′ apart, to prevent bulging when the concrete is poured and rammed.

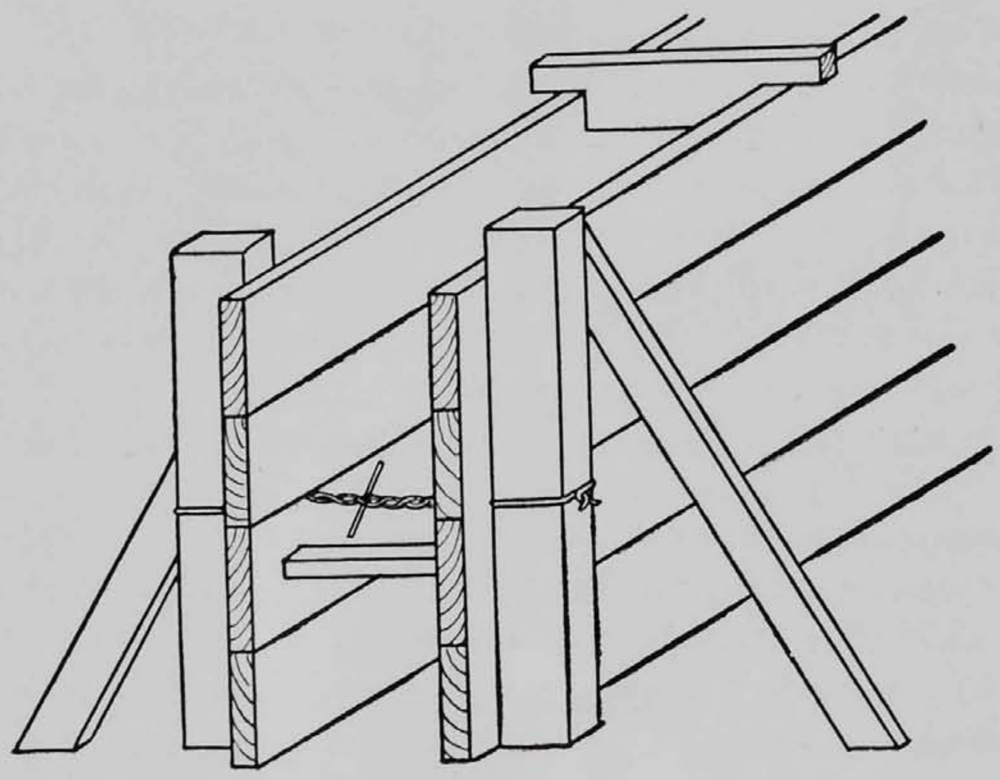


FIG. 2.162. Wire ties for holding forms against spacers to prevent spreading.

Forms should be braced thoroughly and held apart the correct distance by spacers which are removed as the concrete is poured into the mold. Bolts or wire ties may be used to hold the forms against the spacers and to keep the sides from spreading apart. See Fig. 2.162. Wire ties are cut when taking down the forms, and the wire, except the protruding ends, is left in the concrete.

Concrete weighs approximately 125 lbs. per cu. ft., so the forms for floors and roofs must be designed with enough studs, braces, or struts to prevent them from sagging. Forms for floors or walks laid on the ground should consist of 2″ lumber well staked into place, as high as the depth of concrete desired. The top edges of the forms should be even with the surface of the concrete. These edges will be used as guides in leveling the surface. Forms for square or rectangular tanks should be constructed with the walls sloping outward so that the expansion of freezing water will be upward instead of directly against the sides.

Forms should be designed with every regard for economy in the use of lumber. Use as few nails as possible. Screws and clamps may be used to make the removal of forms possible with a minimum of hammering.

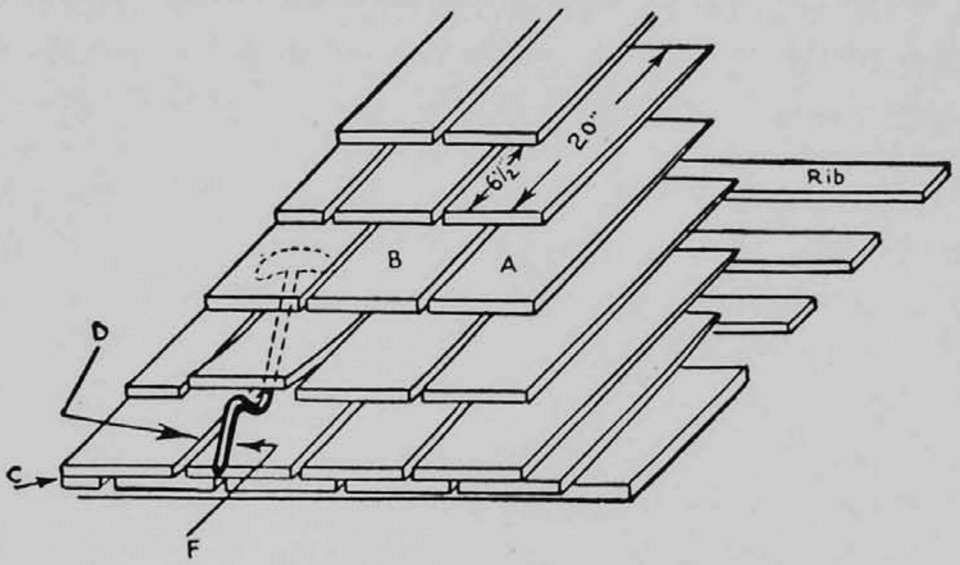


FIG. 2.163. Arrangement of shingles and use of shingle hook.

Shingling or Repairing a Roof. Wooden shingles are made of cypress, pine, redwood, or cedar; they are cut in lengths from 16″ to 24″; and they are from 5⁄16″ to ¾″ thick at the butt end, tapering to approximately ⅛″ thick at the top. They are generally sold in bundles of about 250 and vary greatly in width.

It is important to remember that there should always be three thicknesses of shingles at every point on the roof; each shingle should overlap the two courses below it. See Fig. 2.163. This means that one third or less of the shingle will be exposed to the weather. Therefore, 6½″ is the maximum length of a 20″ shingle that may be exposed to the weather. Charts may be obtained from lumber companies which show the number of square feet 1000 shingles will cover at various exposures.

If shingles are laid too close together they swell when wet and cause buckling. A space of approximately 3⁄16″ or more should be left between the edges of well seasoned shingles. See D, Fig. 2.163.

There are various methods of laying shingles in a straight line across a roof. A chalk line may be snapped across the roof to line each course of shingles, or several chalk lines may be snapped to permit the laying of several courses at once. A straightedge may also be used. It should have a width equal to the exposure of the shingle. Keep the lower edge of the straightedge flush with the lower edge of the course of shingles just laid. The upper edge will then be the line for the next course. Hatchet gauges are used extensively to measure the space between courses. The gauge is a small clip which is fastened to the back of the blade of the hatchet at a distance from the face equal to the exposure of the shingle. When nearing the ridge and within 8 or 10 courses of the top, the remaining distance should be divided so that the courses will come out evenly, and be as near the original exposure distance as possible. This will prevent finishing with a short course and at the same time will not be noticed from the ground.

The first of the two layers of the starting course should be nailed as close to the butt as possible. If the nail is placed near the butt end of the shingle, it will hold more securely. However, nail far enough back for the following courses so that the nails will be covered by each succeeding course. Use only weatherproofed nails.

If a roof has hip and valley rafters, chimneys, dormer windows, or other projections, it is recommended that the home craftsman refer to a text on roofing for information on the various techniques of finishing with flashing and estimating wastage for trim of hip and valleys.

Sometimes it is necessary to repair a shingled roof. One method of removing impaired shingles is to insert a long, flat piece of steel, sometimes called a shingle hook, shaped like the one in Fig. 2.163. It will reach up under a shingle, hook over a nail with the sharpened flat end, and cut off the nail when a blow is struck downward on the shoulder. See Fig. 2.163. Only the shingles which are to be replaced are removed. If weathered shingles are used for the repair, the patch will be less unsightly then if new ones are used.

PROJECTS FOR THE HOME WORKSHOP

Lawn Chair. The drawing shows a typical lawn chair that can be built by the average home craftsman. It is an example of a good type of construction for garden furniture. See Fig. 2.164.

BILL OF MATERIAL

Number Required	Part	Size	Kind of Material
1	Back	¾″ × 16″ × 48″	Pine
1	Seat	¾″ × 18″ × 16″	"
2	Front Leg	¾″ × 5½″ × 24″	"
2	Back Leg	¾″ × 5½″ × 36″	"
2	Arm	6″ × 24″	"
1	Brace	3″ × 29″	"
1	Front Brace	5″ × 19½″	"
2	Arm Support	2½″ × 5½″	"
2	Back Seat Support	3″ × 10½″	"

Tools Needed. Rule, pencil, steel square, crosscut saw, smooth plane, jointer plane, bevel square, screwdriver, hammer, bit brace, countersink, pilot and shank drills.

Procedure. After the stock is cut to size, the parts are assembled in the following order:

1. Screw the back legs to the front legs.
2. Screw on the arm supports.
3. Fasten the back brace and front brace to the arms and legs.
4. Put on the back and screw on the back support.
5. Fasten in the seat.
6. Sand the chair and give it a coat of primer. It should then have at least two coats of paint.

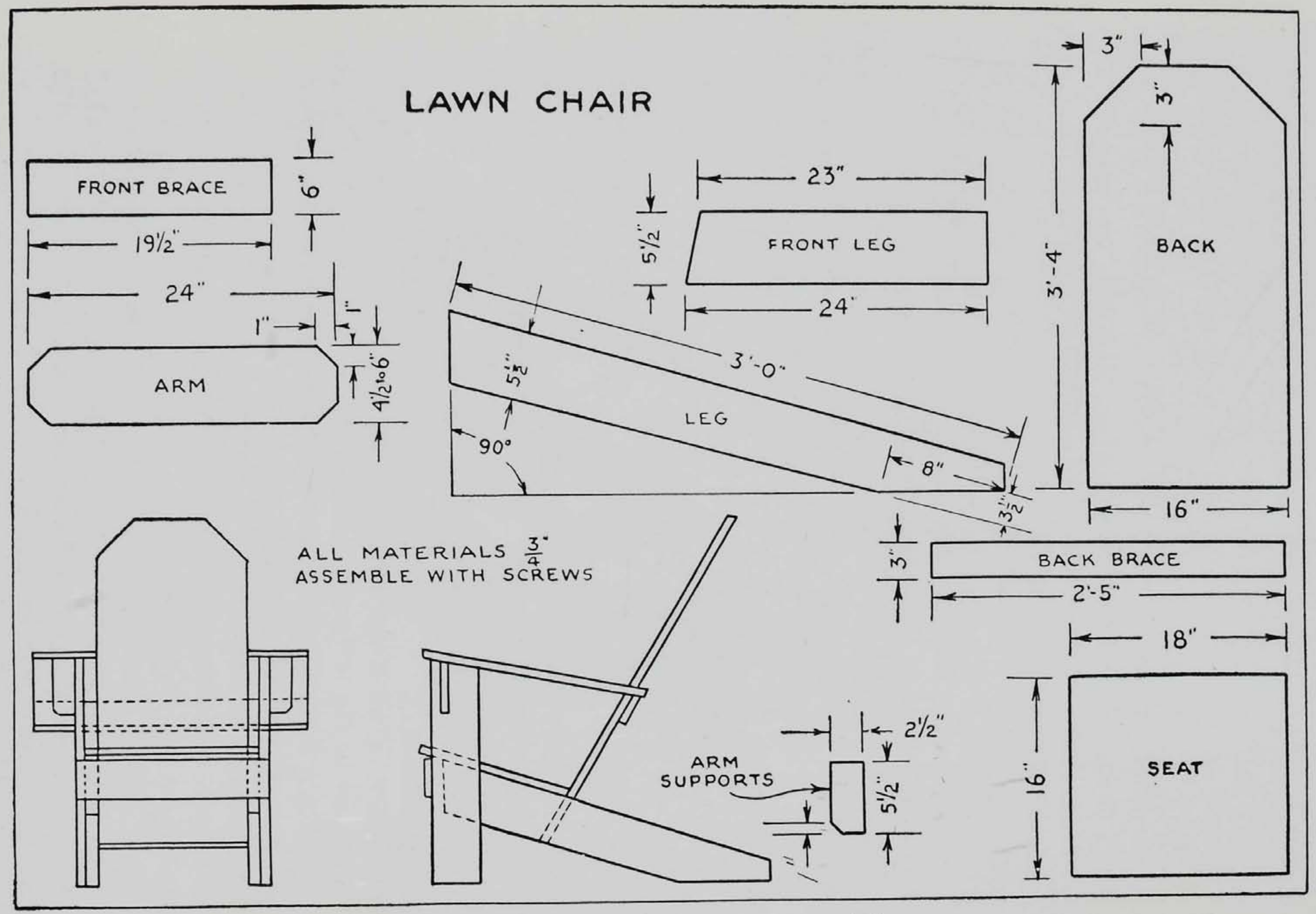


Fig. 2.164. Diagram of parts for lawn chair.

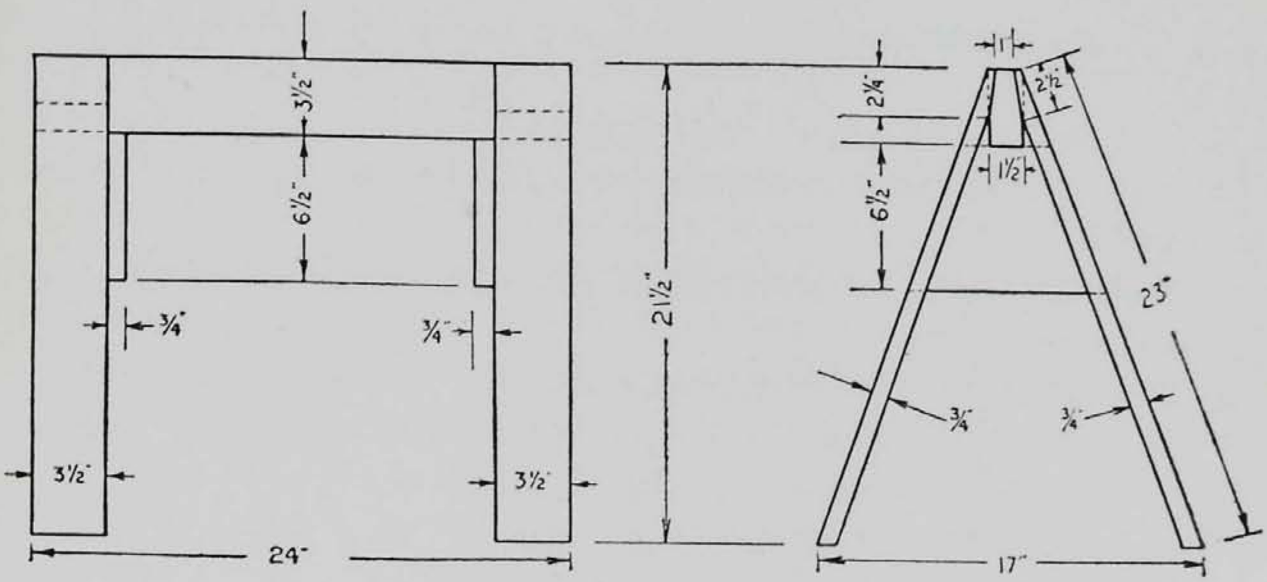


FIG. 2.165. Diagram of parts for saw horse.

Saw Horse. A carpenter's horse is handy as a support for materials that are being cut to size or assembled. Carpenters' horses are usually used in pairs. The following plan is typical of the many types that can be built.

BILL OF MATERIAL

Number Required	Part	Size	Kind of Material
4	Legs	¾" × 3½" × 2'	Pine
1	Top Piece	1½" × 3½" × 2'	Pine
2	Braces	¾" × 6½" × 9"	Pine
3 doz.	Flat Head Screws	1½" No. 10	Steel
	Primer		Shellac
	Finish		Paint

Tools Needed. Rule, crosscut saw, bit brace, sandpaper, pencil, screwdriver, countersink, paint brushes, try square, hammer, twist bits, jack plane, ripsaw, knife, chisel, hand clamps.

Procedure.

1. Prepare four pieces for the legs to overall dimension.
2. Prepare one piece for the top to overall dimension.
3. Square a knife line on the side of the top, 3½" from the end.
4. Lay out the four gains on the top by placing the side of the leg on the knife line with the width of the leg as a measure of the length of the gain. Repeat this process for all four gains.
5. Square the gain lines across the top edge.

6. Set the marking gauge and lay out the depth of the gain on the top edge.

7. Cut the tapered gains. (See page 82.)

8. Lay out, drill and countersink screw holes in the top end of each leg. (See page 71.)

9. Place the legs in the gains and drill pilot holes in the top piece.

10. Drive the screws.

11. Prepare braces to overall dimension.

12. Mark the position on the legs for the braces.

13. Clamp the lower brace in position.

14. Lay out, drill, and countersink screw holes.

15. Drive the screws.

16. Repeat these operations for the top brace.

17. Lay out the lines for cutting off the braces. The line should be flush with the outside of the legs.

18. Saw braces off approximately 1/16″ beyond the line. Be careful not to mark the legs with saw.

19. Lay out the bottom of each leg parallel to the floor and cut to length.

20. Smooth the ends of the braces and the top ends of the legs with the jack plane.

21. Sand smooth.

22. Finish to taste.

How to Make a Door. Most doors are constructed with panels. A large wood surface, like a panel, shrinks and swells as atmospheric conditions change. Panels are generally placed in frames to prevent the surface from warping or twisting and for this reason, panels are seldom glued in the frame but are held in place only by the grooves. Almost all panels are now made of plywood or veneer.

Doors are usually constructed with haunched mortise and tenon joints. However, the blind mortise and tenon, dowel, slip, end lap and miter joints may be used. The project described below is a cupboard door and the haunched mortise and tenon joint is used. No dimensions are given because the door should be made of a size to fit a particular need.

Bill of Material

1/4″ 3-ply white pine panel stock
3/4″ white pine for frames
Glue

Tools Needed. Crosscut saw, ripsaw, 1/4″ and 3/4″ chisels, mallet, jack plane, try square, framing square, folding rule, marking knife, marking gauge, bar clamps.

Procedure.

1. Saw and square the four pieces of frame to size.
2. Plow a groove on the inside edges of the four pieces. The groove should be ¼″ wide and ⅜″ deep to receive the plywood panel. These grooves may be made quickly and accurately on the circular saw.
3. Lay out and make the haunched mortise and tenon joints.

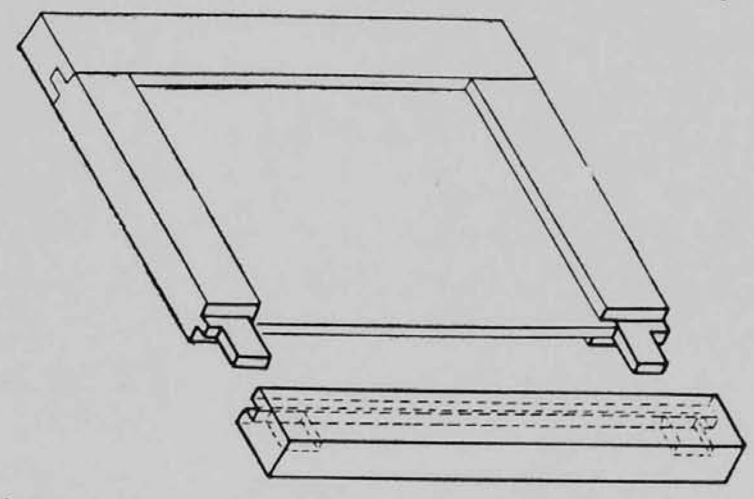


FIG. 2.166. Haunched mortise and tenon joint used in doors.

4. Cut panel to dimensions. It should fit in the grooves without play or binding. The size of the panel should be such that when it is assembled it does not quite touch the bottom of the groove.
5. Make a final check on dimensions to be certain that the parts will assemble correctly.
6. Glue the joints, insert the panel, and clamp the assembly. Do not put glue in the grooves or on the panel.
7. The door may be finished as desired, and fitted.

Drawing Board. See Fig. 2.167.

BILL OF MATERIAL

Number Required	Size	Kind of Material
6	⅞″ × 2¼″ × 16″	Pine or Basswood
2	⅞″ × 2″ × 12″	" " "
		Casein glue
		White shellac

Tools Needed. Rule, pencil, crosscut saw, square, ripsaw, fore plane, carpenter's steel square, sandpaper block, 4-0 sandpaper, shellac brush, 3 bar clamps.

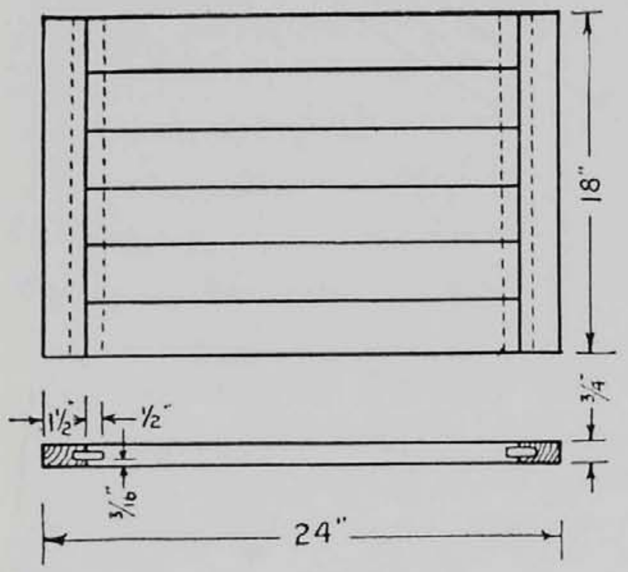


FIG. 2.167. Drawing board.

Procedure.

1. Select clear basswood or pine and saw off enough pieces 21″ long to make six strips 3¼″ wide and two pieces 19″ × 2¼″ wide.

2. After ripping into strips, joint one face of each strip.

3. Then joint both edges of the strips with the face side as a guide.

4. Prepare casein glue.

5. Adjust the clamps to fit the width of the board.

6. Place glue on both edges of the strips.

7. With the face side of strips against the clamp and with a clamp on each end of the piece, tighten moderately. Next, place a clamp on the opposite side and in the center of the board. Make sure that all faces are even. Tighten clamps and remove excess glue.

8. When glue is dry, remove board from clamps and scrape off all glue.

9. With face side down plane to proper thickness. Plane the end strips at the same time.

10. Joint one edge and with that as working edge, mark the end square.

11. Saw off the ends and joint.

12. Cut the slot for the spline in both the boards and end strips.

13. Make the spline to fit the slot. Test it in both board and strip.

14. Glue the end strip in place with the spline.

15. After glue dries, saw off end of strips about 1/16″ long, then plane smooth.

16. Smooth with sandpaper and block, using 4-0 sandpaper.

17. With sand block and 4-0 sandpaper, go over the corners once.

18. Give one coat of white shellac.

19. Sand the board lightly.

Woodworker's Bench. A workbench is essential in the home shop and is a very good project which is easy to build. See Fig. 2.168.

BILL OF MATERIAL

Number Required	Part	Size	Kind of Material
4	Legs	3¾" × 3¾" × 33½"	Maple
4	Side Stretchers	1½" × 3¾" × 37½"	"
4	End Stretchers	1½" × 3¾" × 18½"	"
1	Top Plank	2½" × 14" × 5'	"
1	Top Board	¾" × 14½" × 4' 11"	"
1	Back Strip	¾" × 1¾" × 5'	"
1	End Strip	¾" × 1¾" × 13¼"	"
16	Bolts (machine)	⅜" × 7"	Iron

Tools Needed. Circular saw, power jointer and surfacer, try square, knife, marking gauge, ⅜" and 11/16" auger bits, bit brace, ⅜", ¾" and 1½" chisels, mallet, smoothing plane, clamps, hammer, screwdriver.

Procedure.

1. Cut and plane the parts to width and thickness on the circular saw and jointer.
2. They can be cut to length and mortises and tenons made by hand.
3. Lay out and bore the holes for the draw bolts.
4. Chamfer all corners of the legs and stretchers that are exposed.
5. Groove the bench plank and fabricate the board and strips.
6. Sand all parts smooth.
7. Assemble the job and finish with two coats of shellac.
8. Install a vise and bench stop, and the bench is ready for use.

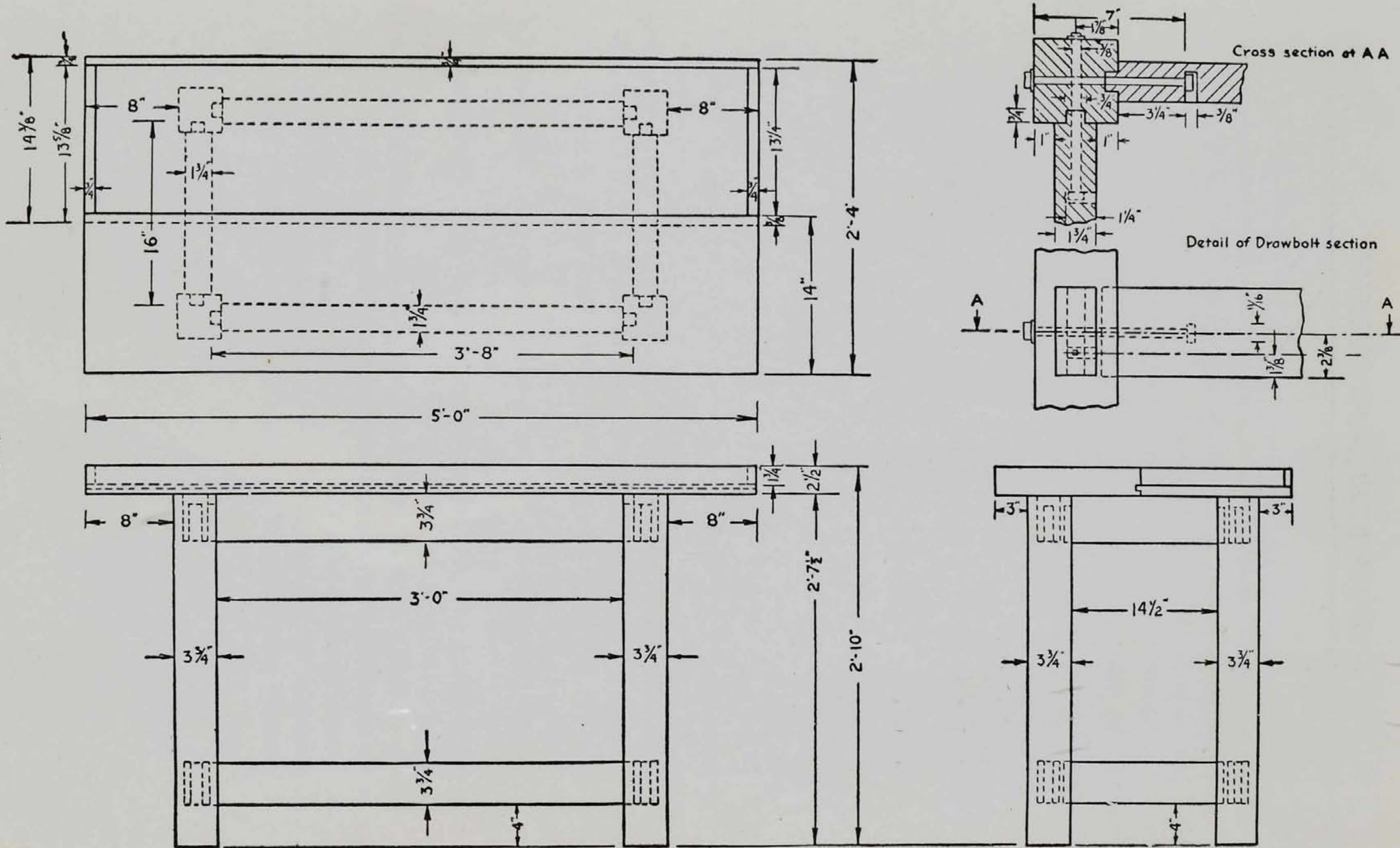


FIG. 2.168. Woodworker's bench.

Kitchen Cupboard. Most home craftsmen are called upon to make shelves of some type or other, such as kitchen cabinets, linen closets, book shelves, etc. Shelves may be fastened between uprights in a variety of ways. Dados, stop dados, mortises and tenons, cleats, and many types of patented devices for adjusting shelves may be used. The stopped dado is used in this project.

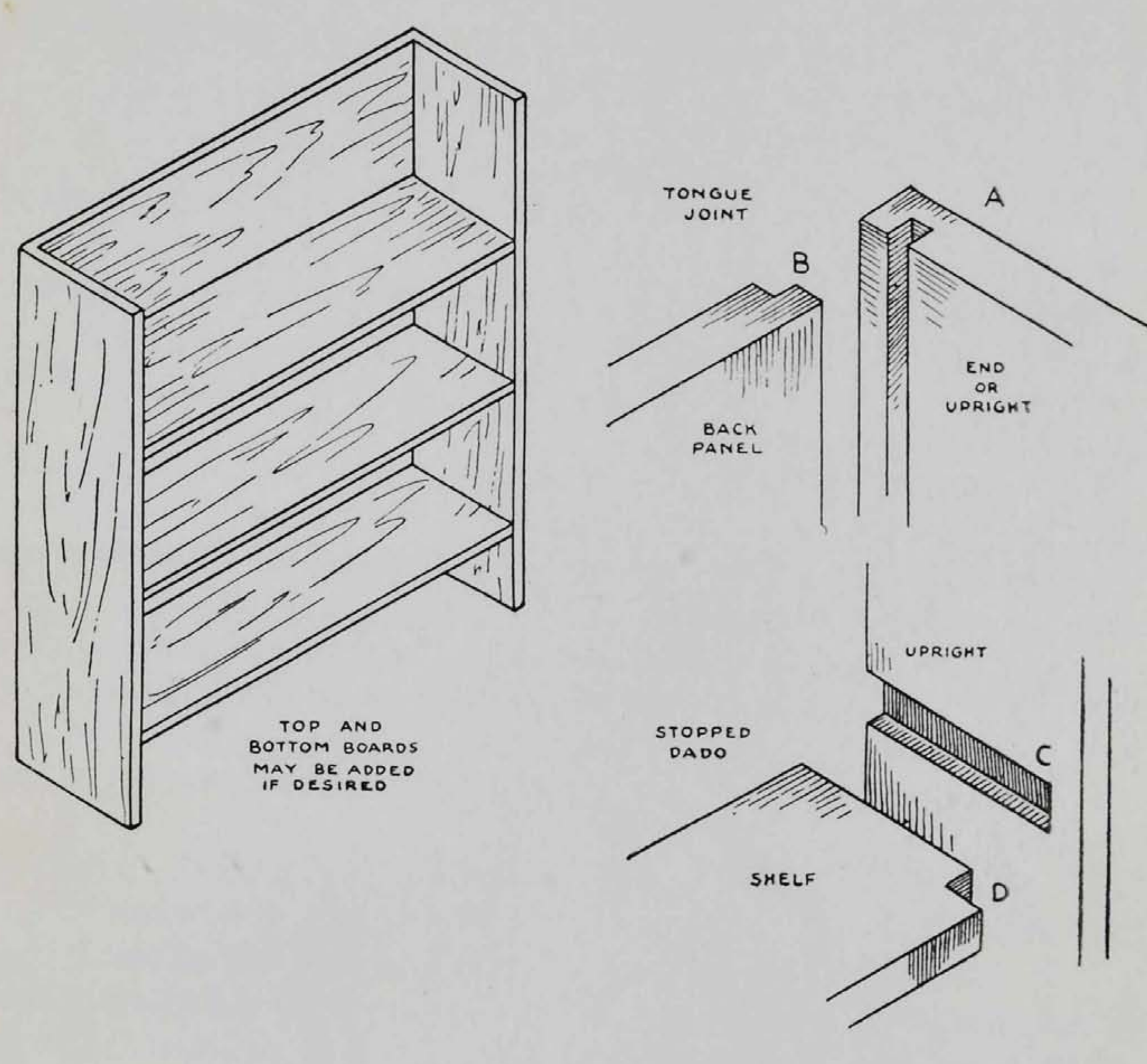


Fig. 2.169. Kitchen cupboard.

As every job is a different problem and has different dimensions, the kitchen cupboard described below is only suggestive. Furthermore, although not shown, kitchen cupboards are more practical with deep shelves. This may necessitate edge to edge doweling and gluing to make shelves of the desired width. (If doors are desired see page 130.)

Bill of Material

2 pieces ¾″ white pine cut to width and length for uprights.
3 pieces ¾″ white pine cut to width and length for shelves. Be sure to deduct thickness of back panel from width.
1 piece ¾″ white pine panel for back.
Screws or finishing nails as required.

Tools Needed. Crosscut saw, framing square, jack plane, folding rule, marking gauge, ½″ and ¾″ chisels, back saw, mallet, router plane, bar clamps, knife, claw hammer, screwdriver.

Procedure.

1. Cut lumber to size. Square surfaces and ends if necessary.
2. Plane a groove as indicated at *A* in drawing. This groove may be made on a circular saw if one is available.
3. Plane a rabbet on the panel to fit the width and depth of the groove. (See *B*.) This tongued joint can be made quickly and accurately on the table or circular saw and is used where it is desirable to have strong flush joint construction.
4. Lay out location of the shelves and stopped dado joints. The stopped dado differs from the dado joint in that it does not extend across the entire width of the board. The dado should stop a suitable distance from the front edge of the upright. (See *C*.)
5. Make dado with back saw, chisel, and router plane. Perfect joints can be made by using a dado head on the circular saw. Be careful not to run the piece entirely through the saw, however.
6. Gauge the depth of dado on front edge of shelf and saw out notch. (See *D*.)
7. Glue and clamp together shelves, ends, and back panel. Finishing nails, screws, and angle braces may be used to strengthen the construction.
8. If cupboard fits against the ceiling or floor, top and bottom boards may be nailed, screwed, or otherwise fastened to the cupboard and crown or base moldings applied. If the cupboard is decorative in character, top and bottom curves may be sawed on the back panel as well as the tops and bottoms of the uprights.
9. Finish to taste and fasten to the wall.

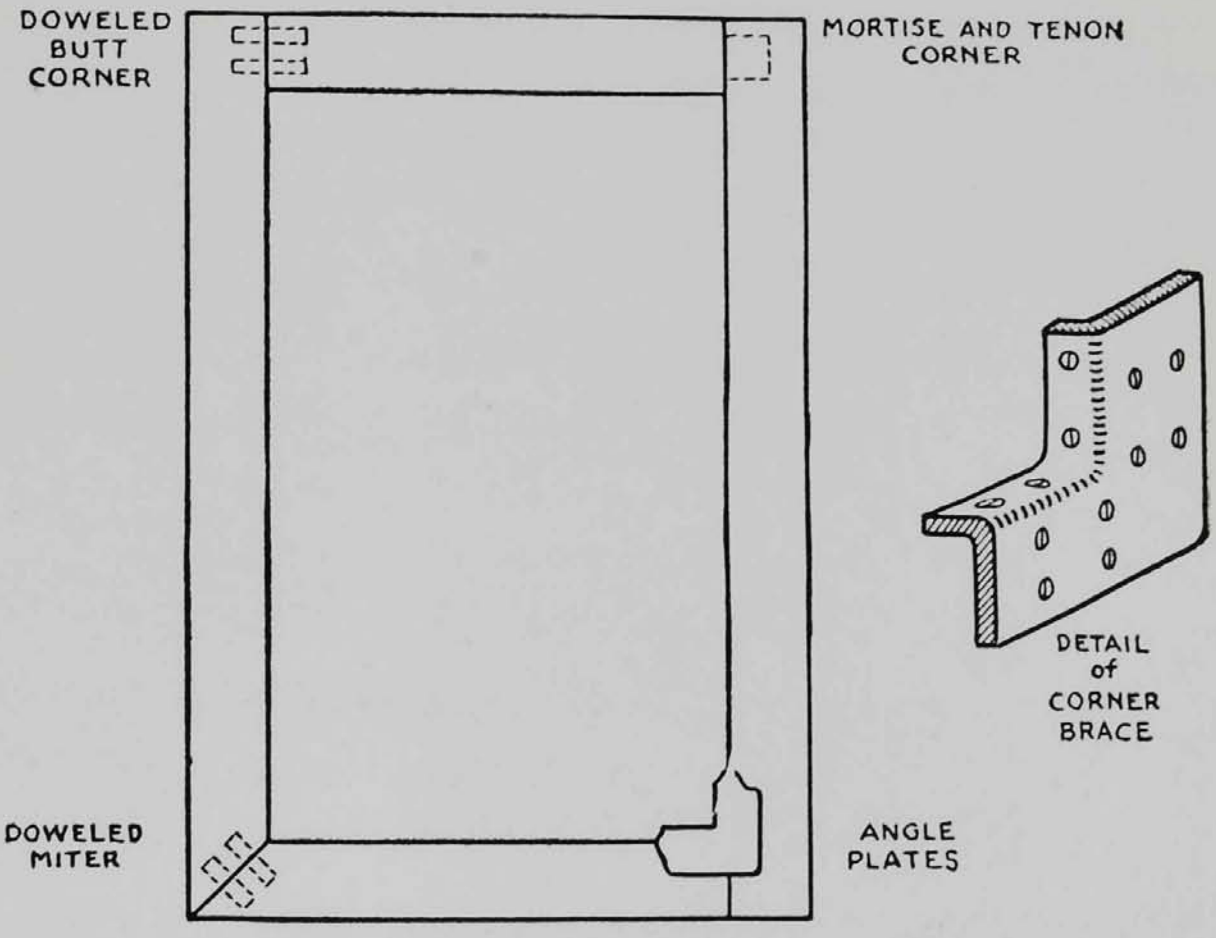


FIG. 2.170. Window screen. Various types of joint are shown; any one type may be used.

Window Screen. Making window screens for the home or cottage is a comparatively easy job for the home craftsman. There are many kinds and types of construction used for window screens, but a simple type is described here.

BILL OF MATERIAL

1″ × 2″ white pine according to size of window
Standard screen molding
Four standard angle braces
No. 6, Round head wood screws
No. 4, ¾″ corrugated steel fasteners
No. 8 tacks
Standard mesh screen cloth

Tools Needed. Claw hammer, crosscut saw, jack plane, rule, chisel, tinsnips, miter box.

Procedure.

1. Measure the window to be fitted.
2. From 1″ × 2″ white pine, cut four pieces for the frame. Lengths depend upon the type of joints used and the size of the window

3. Construct the frame. The corners may be made with mortise and tenon joints, miter joints, doweled butt joints, corrugated steel fasteners, or with steel angle plates. There are various angle irons which may be purchased to strengthen and stiffen the frame. They fit into the inside 90° corner and are fastened to both the surface and inside edge with wood screws.

4. To obtain the dimensions of the screen cloth, measure the overall width and length of the frame. Deduct from each of these measurements the width of the frame stock.

5. Lay out this distance on a piece of screening and cut to size with tin-snips. Screening may be purchased in various widths and usually a standard width can be used.

6. Place the top edge of the screening on the center line of the top rail and fasten with two or three tacks in the center.

7. Stretch the screening tightly to the center of the bottom rail and fasten in place with several tacks.

8. Repeat this operation on the two side rails. Proceed with alternate stretching and fastening, working from the center to the corners of the frame.

9. Cover the rough edges of screening by nailing on standard screen molding, a type of decorative molding, usually half round.

10. Fit the screen to the window. Bevel the lower edge of the bottom rail to conform to the slope of the window sill. If the screen binds, remove a shaving or two with the plane.

11. Finish as desired.

Shoe Rack. The shoe rack has been designed to conserve space in the clothes closet, and to keep shoes in an orderly manner and in good condition.

The design and dimensions may be altered to adapt its use to a particular situation. It may be given a natural finish or stained to harmonize with its surroundings.

Bill of Material

Number Required	Part	Size	Kind of Material
2	Ends	$\frac{7}{8}'' \times 7\frac{1}{4}'' \times 9''$	Whitewood
1	Stretcher	$\frac{7}{8}'' \times 7\frac{1}{4}'' \times 30''$	"
6			Flat head wood screws

Tools Needed. Rule, jack plane, hand drill and twist drills, crosscut saw, combination square or sliding T bevel, brace and countersink, ripsaw, dividers, screwdriver, try square, marking gauge, coping saw, chisel.

Procedure.

1. Obtain stock for sides, allowing about 3/8″ width and 1/2″ in length for waste. *Caution:* Have the grain run long way of side.
2. Square these to the required size.
3. Lay out 45° cut as shown on drawing, with combination square or sliding T bevel.

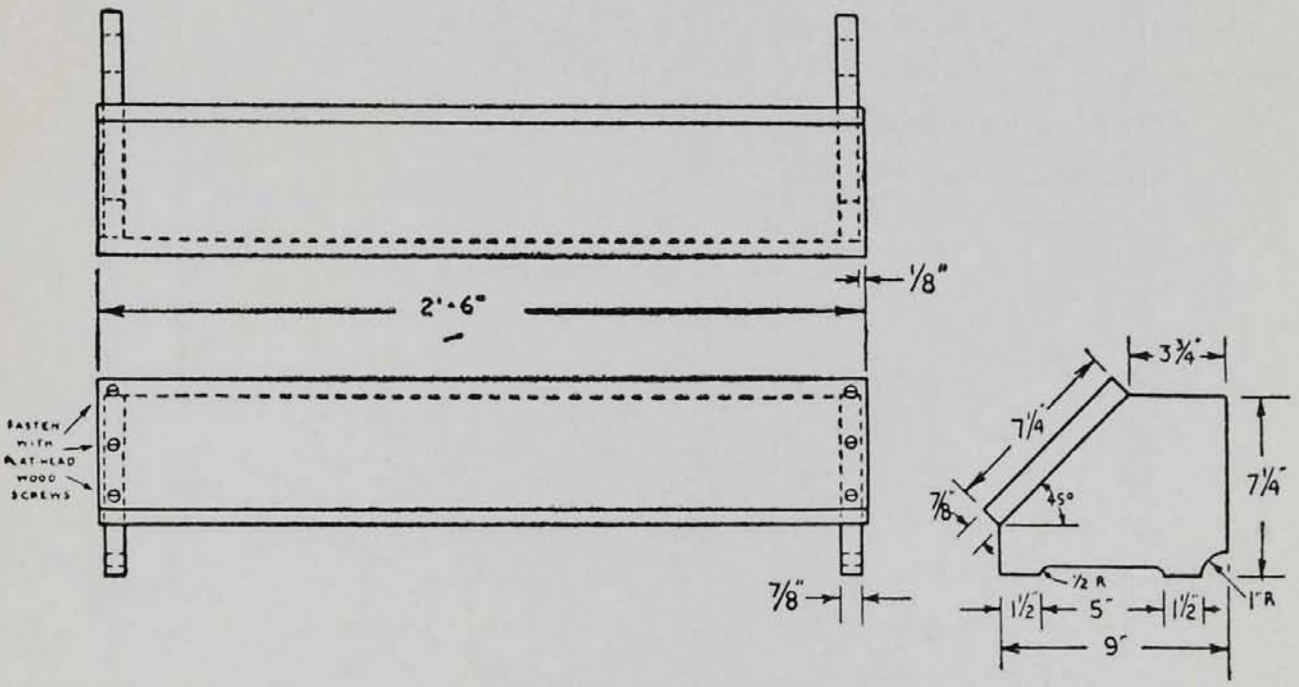


Fig. 2.171. Shoe rack.

4. Remove waste with crosscut saw and plane to line. *Caution:* Plane in general direction of grain.
5. Lay out recessed bottom with dividers and marking gauge.
6. Remove waste with coping saw and pare with chisel to gauged lines.
7. Obtain stock for top, allowing usual waste for squaring.
8. Square to stated size.
9. Assemble and finish.

Sewing Screen. The sewing screen is an article that can be used in the average household to help keep sewing materials in order, and it also furnishes a handy place to store articles that need mending. See Fig. 2.172.

Bill of Material

Number Required	Part	Size	Kind of Material
4	Sides	1/2″ × 2 1/2″ × 28″	Whitewood
6	Cross Pieces	1/2″ × 2 1/2″ × 16″	"
16	Dowel	1/8″ × 2″	Birch
2		16 3/8″ × 18″	Cretonne cloth
Box		1/2″	Upholstery tacks
			Round head screws

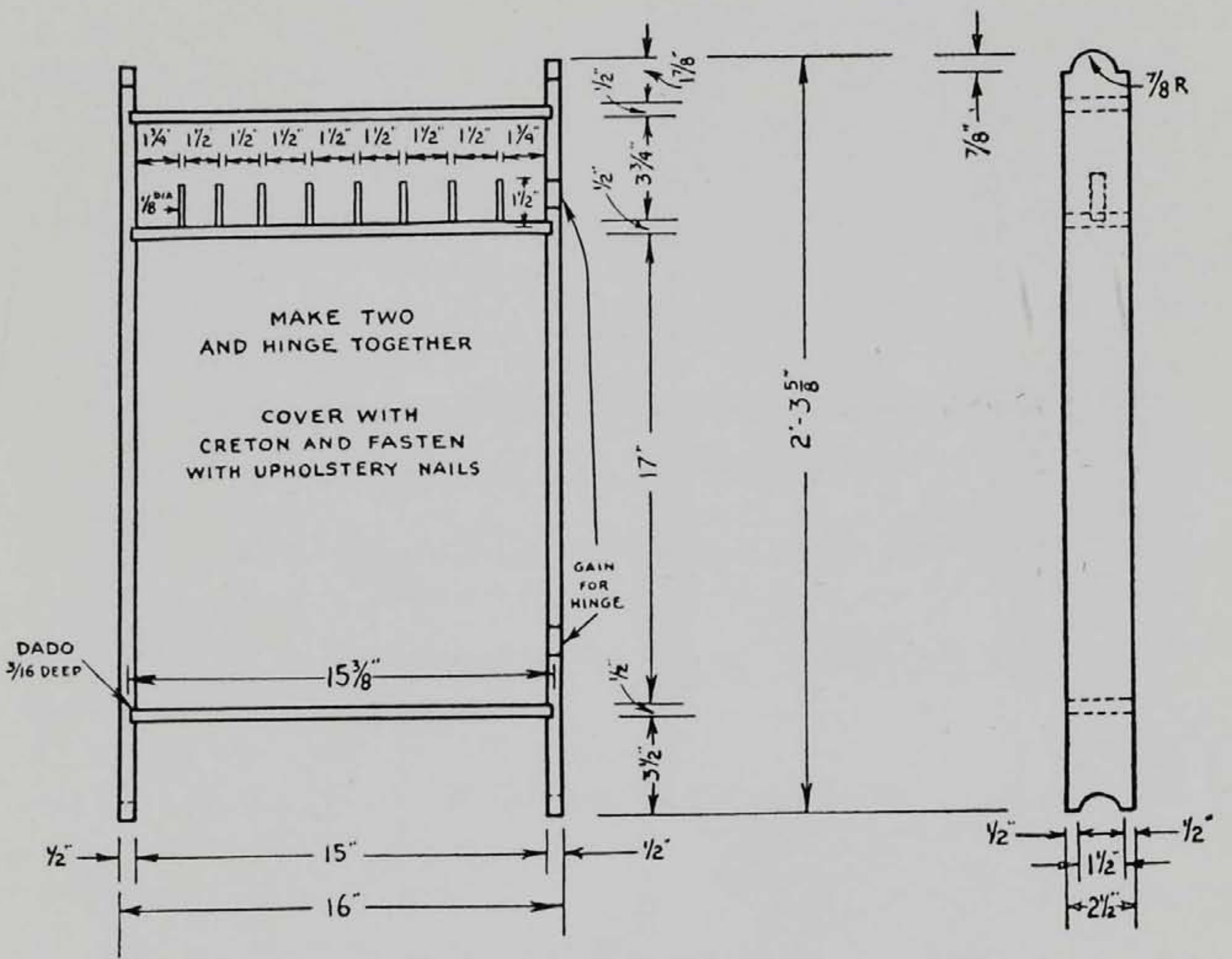


FIG. 2.172. Sewing screen.

Tools Needed. Rule, pencil, try square, jack plane, crosscut saw, ⅜" chisel, hammer, mallet, screwdriver, hand drill and ⅛" drill, coping saw, compass, file, and sandpaper.

Procedure.

1. Lay out ends of the side pieces with square and compass as per drawing.
2. Lay out the three dado joints.
3. Cut the ends.
4. Cut the dados.
5. Square off three pieces 15⅜" long.
6. Lay out and bore the dowel holes for the spool dowels.
7. Saw off eight 1⅛" dowels, 1½" long and glue them into the holes.
8. Put the frame together, using clamps. The joints should be glued and fastened with 1¼" No. 6 round head blued screws.
9. After glue is dry, sand the frame smooth.
10. Locate and cut the gains for the hinges.
11. Fasten hinges in place, inspecting carefully the relative positions of the two frames when closed.

12. Finish to taste.

13. Fasten on the cretonne with upholstery tacks. This should cover the outside of each frame from the top to bottom crosspiece. It is sometimes desirable to tack one or two strips of cretonne across inside uprights to support material which is kept in the frame.

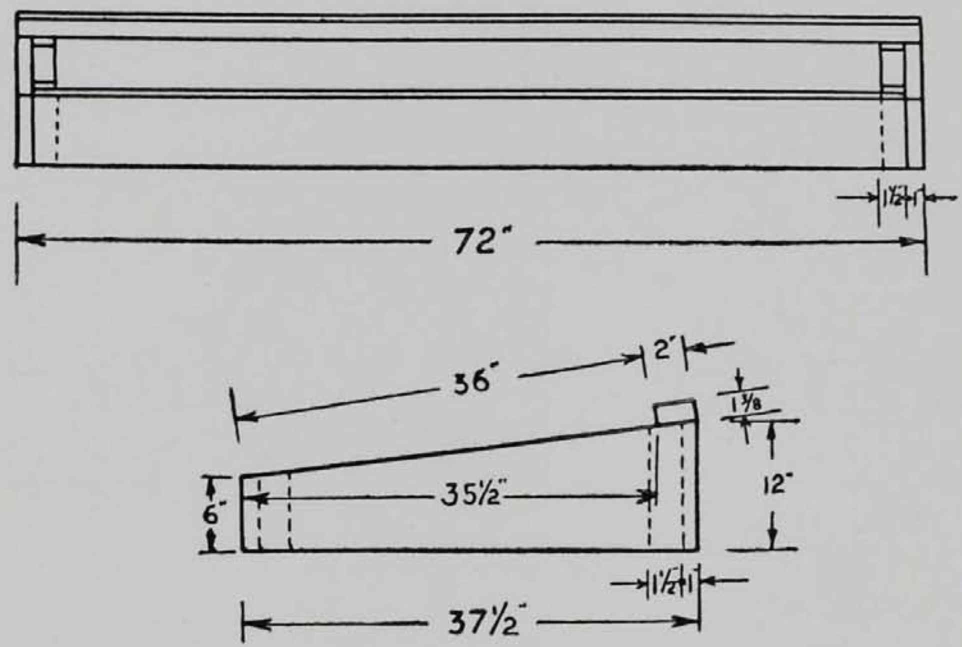


FIG. 2.173. Parts of cold frame.

Cold Frame. The cold frame is a very necessary piece of equipment for farmers and gardeners. It is used for a variety of purposes. In the spring seedlings are planted in it for fast growth and during the summer months it may be used for plants which require special care. In the fall the cold frame is used to extend the normal producing season for many garden vegetables.

BILL OF MATERIAL

Number Required	Part	Size	Kind of Material
1	Back Board	1″ × 12″ × 72″	Cypress or Redwood
1	Front Board	1″ × 6″ × 72″	" " "
2	Side Boards	1″ × 12″ × 37½″	" " "
1	Corner Brace	1½″ × 1½″ × 36″	" " "
1	Hinge Board	1⅜″ × 2″ × 72″	" " "
1	Window Sash	3′ × 6′	
24	Flat head wood Screws	No. 10—2½″	Brass
2 or 4	Hinges		
	Paint	Aluminum or good outdoor paint	

Tools Needed. Crosscut saw, ripsaw, bit brace, 3/16″ auger bit, 1/8″ auger bit, countersink, marking gauge, screwdriver, hammer, jack plane, smooth plane, square, hand clamp.

Procedure.

1. Lay out the pieces and cut them to sizes shown in diagram. The two pieces for the sides are made by sawing and then planing along a slant line

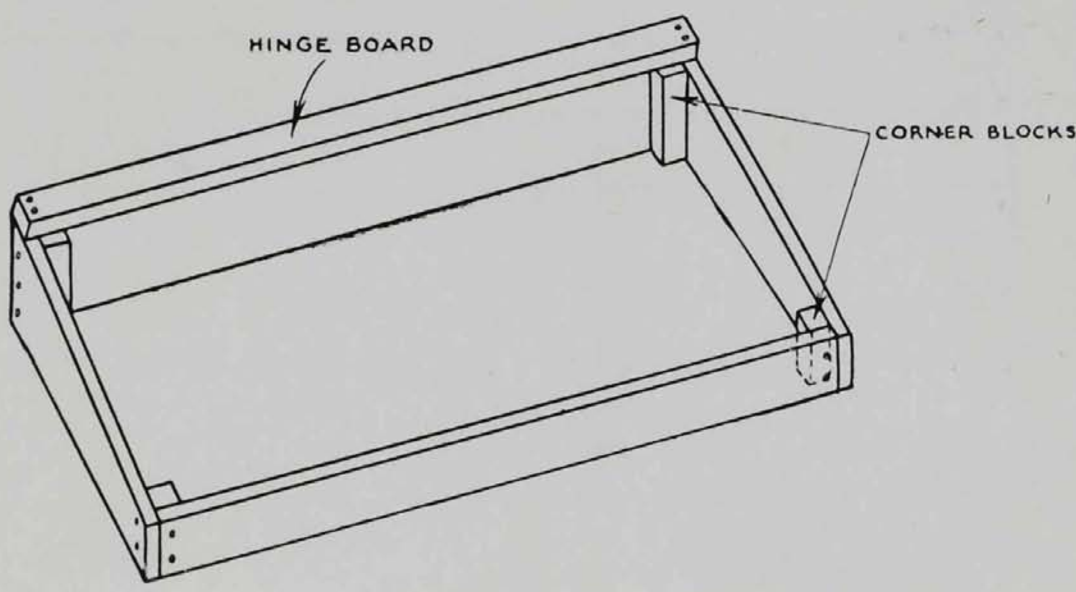


FIG. 2.174. Cold frame.

laid out to make the front height 6″ and the rear height 12″. The corner blocks must be beveled at the top to conform with the slant of the sides. The top of the frame is planed smooth along the slant after the frame is assembled. The corner blocks can be left long and tapered to allow the ends to be driven into the ground.

2. Lay out and bore 3/16″ staggered screw holes near the ends of the pieces. The screw holes must be spaced from the ends of the frame so that the screws will enter the block at about the middle. The blocks are set back a distance equal to the thickness of the front piece. The screws should be staggered so that they will not meet in the center of the blocks. Countersink the holes.

3. Clamp the blocks against the side pieces in the correct position and bore 1/8″ pilot holes in the corner blocks, using the holes already bored in the sides as a guide for the pilot drill. Drive the screws.

4. Assemble the front and back pieces. During this operation, the frame should be squared up and the bottom should be resting upon a plane surface.

5. Screw on the hinge board. Don't forget the pilot holes or the side piece will split.

6. Plane the top edges smooth to layout line.

7. The sash may be bought in one piece 3′ wide and 6′ long to fit the frame, or two sash, each 3′ square may be used. If two sections of sash are used, a center cross rail should be used.

8. Apply coat of outside paint.

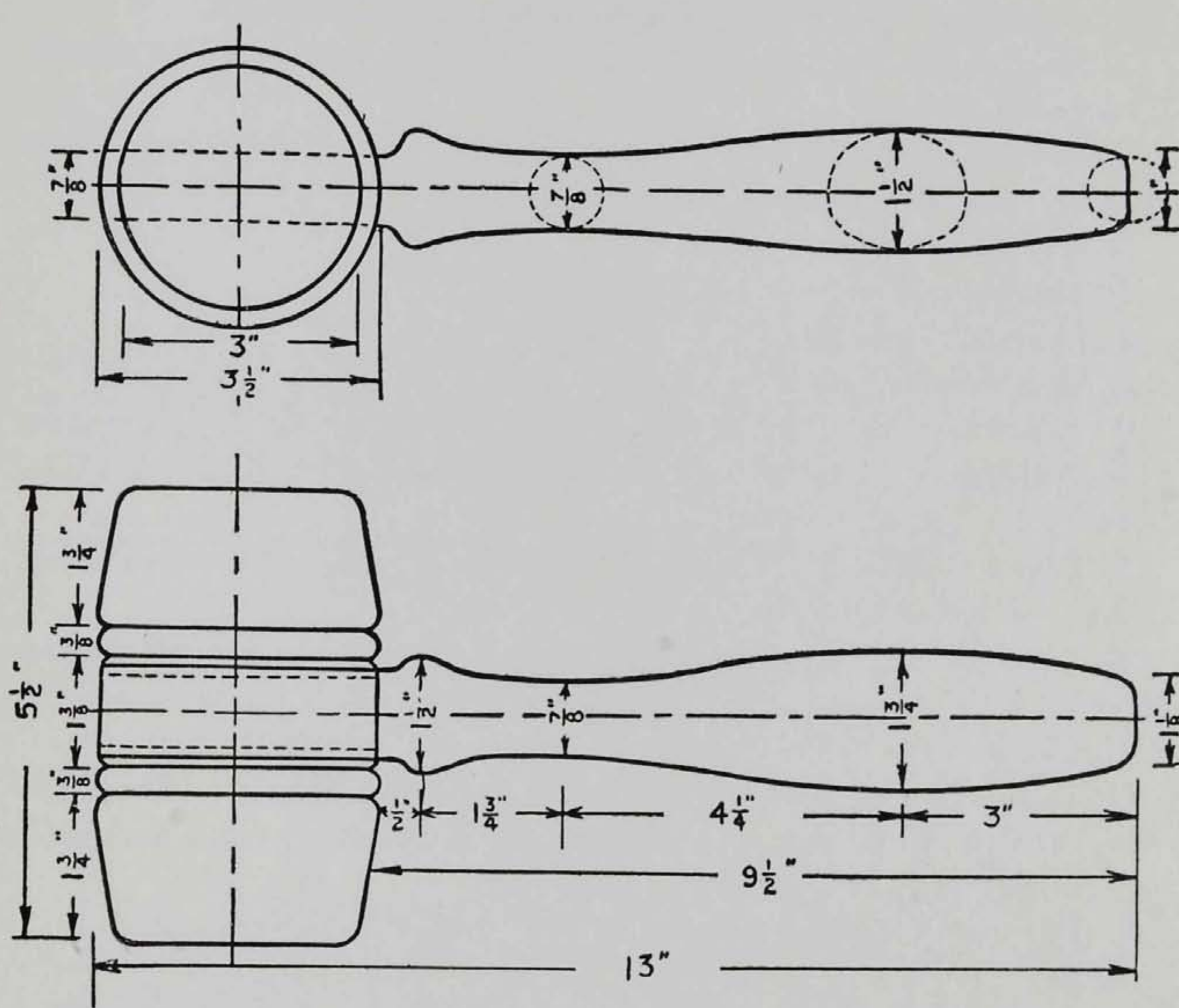


Fig. 2.175. Wooden mallet.

Wooden Mallet. A mallet is one of the necessary tools for the home workshop and is a very good project for the craftsman to make.

Bill of Material

Number Required	Part	Size	Kind of Material
1	Head	4″ × 4″ × 6″	Maple
1	Handle	2″ × 2″ × 14″	Hickory
			Shellac
			Linseed oil

Tools Needed. Wood turning tools, polishing cloth, sandpaper, rule, pencil.

Procedure. Head.

1. Set up in lathe a piece of 4″ × 4″ maple 2″ longer than finished mallet.
2. Turn down to cylinder 1/16″ larger than finished dimension.
3. Mark center longitudinally with skew chisel. Lay off correct distance on each side of center.
4. Cut faces of mallet down with parting tool leaving about 1″ in diameter, noting first that the face is convex.
5. Turn slim tapers on ends.
6. Lay out and make beads.
7. Shape face and corner.
8. Sand smooth.
9. Take out of lathe and shellac, dry about one hour and polish in lathe.
10. With parting tool, cut remaining ends down carefully to about 3/8″ diameter.
11. Take out of lathe and cut off each end 1/16″ long, then smooth down with file. Polish and shellac.
12. Mark a point on the center layout line at right angles to slash grain and, with a strip of paper long enough to go around mallet in midsection, record distance.
13. Take paper off mallet, fold in half and find midpoint. Then wind around mallet again, making sure ends are on previous mark and locate opposite midpoint.
14. Set endwise in vise and with auger bit bore half-way from each side.

Handle.

1. Place a piece of hickory 2″ square and 13″ long in lathe on centers.
2. Turn down to largest possible cylinder.
3. Make layout with dowel end for mallet head toward tailstock.
4. Turn dowel end and test for size with proper size hole in piece of board.
5. Turn rest of handle as per drawing.
6. Sand thoroughly, being careful not to produce scratches.
7. Remove from lathe and shellac.
8. When dry, set back in lathe and polish with cheesecloth and linseed oil.
9. Remove from lathe and saw a slot for wedge at right angles to slash grain about 1½″ deep.
10. Make wedge.
11. Drive handle in mallet head, put glue on wedge and drive in hard.

12. Flatten the sides of handle while gripping faces of mallet head in the vise.

13. Smooth side with spoke shave, file, and sandpaper.

14. Saw off excess stock on both ends of handle. Smooth and shellac btoh ends of handle.

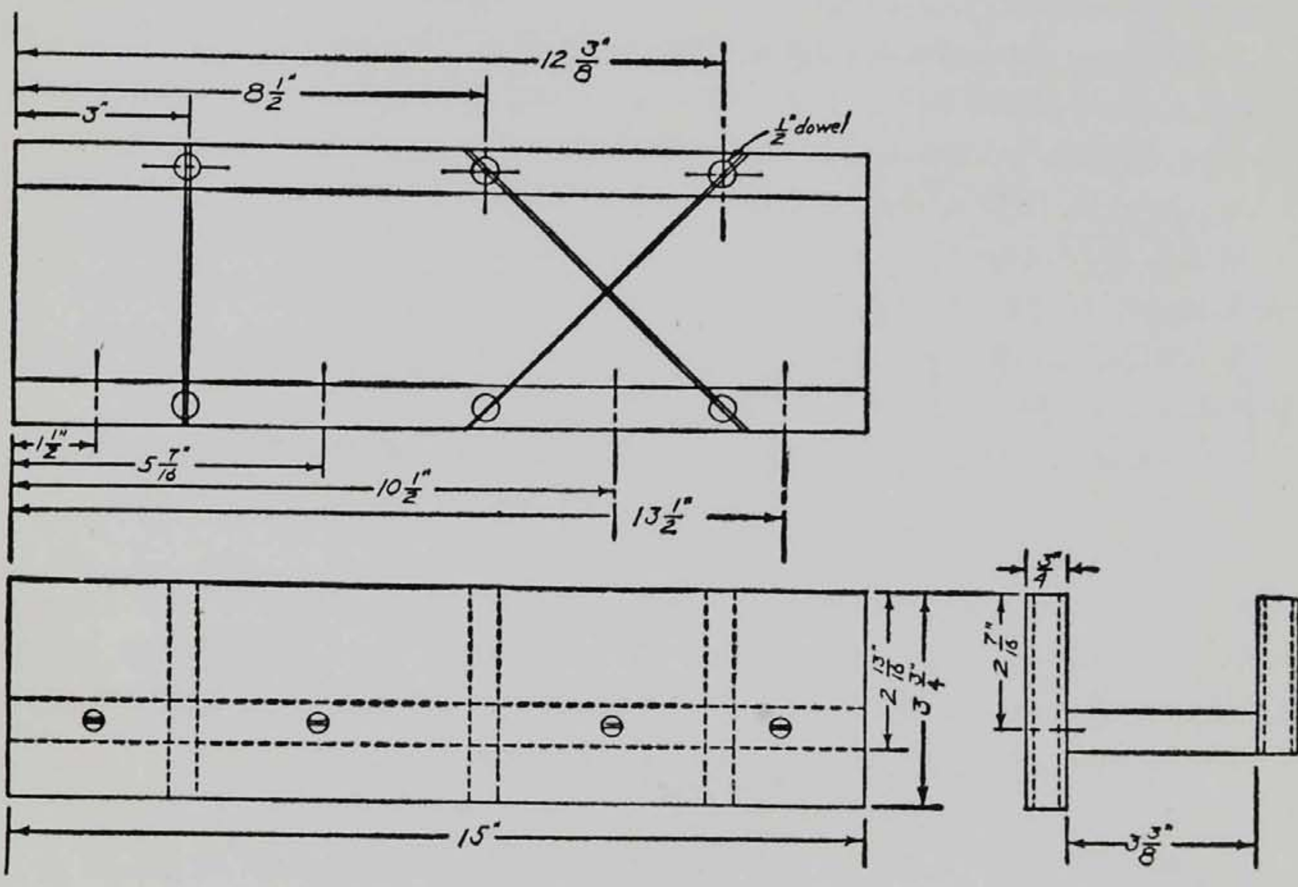


Fig. 2.176. Miter box.

Miter Box. A miter box is a tool which guides a saw when making cuts at certain angles. The usual cuts made in the miter box are 90° and 45°, although other angles may be cut.

Bill of Material

Number Required	Part	Size	Kind of Material
1	Side	¾″ × 3¾″ × 15″	Whitewood, Basswood, or White Pine
1	Side	¾″ × 3³⁄₁₆″ × 15″	Whitewood, Basswood, or White Pine
1	Bottom	¾″ × 3⅜″ × 15″	Whitewood, Basswood, or White Pine
3	Dowels	½″ × 3¾″	Birch
3	Dowels	½″ × 2¹³⁄₁₆″	Birch
8	Screws	1½″ No. 8 Flat Head	Steel

Tools Needed. Rule, ripsaw, hand clamp, pencil, fore plane, hammer, combination square, 3/16″ drill, 8″ screwdriver, knife, countersink, sandpaper block, crosscut saw, 1/2″ auger bit, 4-0 sandpaper.

Procedure.

1. Select three pieces of whitewood and cut to size. (White pine or basswood may be used.)
2. Lay out the holes for the screws. *Caution:* Be sure the top side of the base is used as the working face and that the edges are absolutely square with the face, as this determines the angle that the sides make with the base.
3. Bore the shank hole for the screws with a 3/16″ drill, and countersink.
4. Lay out the holes for the dowels on the top edge of the sides, carry the line around the pieces with a square and locate them on the bottom edge.
5. With a proper size bit, bore halfway through from each edge for the dowels.
6. Fasten the box together with a clamp, put a screw in the shank hole and tap it with a hammer to locate the pilot hole.
7. Take box apart and drill.
8. Fasten box together with 2″ No. 8 flat head bright screws.
9. Test 1/2″ dowel in the hole to make sure the dowel is not too large. If not the right size, work it down with sandpaper.
10. Put glue in the holes and drive in the dowels.
11. Wipe off the excess glue and plane off the ends of the dowels.
12. Lay out the 90° and 45° cuts with a sharp knife.
13. Saw the cuts.
14. Sandpaper carefully, taking care not to round the corners.
15. Put on a coat of shellac which has been thinned with an equal amount of alcohol. When this dries, sand lightly and put on two more coats.

Wooden Handle. The turning of a round wooden handle for a chisel, a gouge, or a file is a project that is very useful for the home craftsman's shop. The process of putting on a ferrule should be a precision job and is outlined below.

BILL OF MATERIAL

1 piece of square maple, 1″ longer than the finished handle and 1/4″ larger than the finished diameter
1 metal ferrule

Tools Needed. Lathe, turning tools, outside spring calipers, sandpaper, shellac, and cloth.

Procedure.

1. Place a 2″ × 2″ × 8″ piece of maple in the lathe on centers.
2. Turn down to the largest possible cylinder.
3. Taper the tailstock end 45° to a diameter of 1/16″ below the inside diameter of the ferrule.

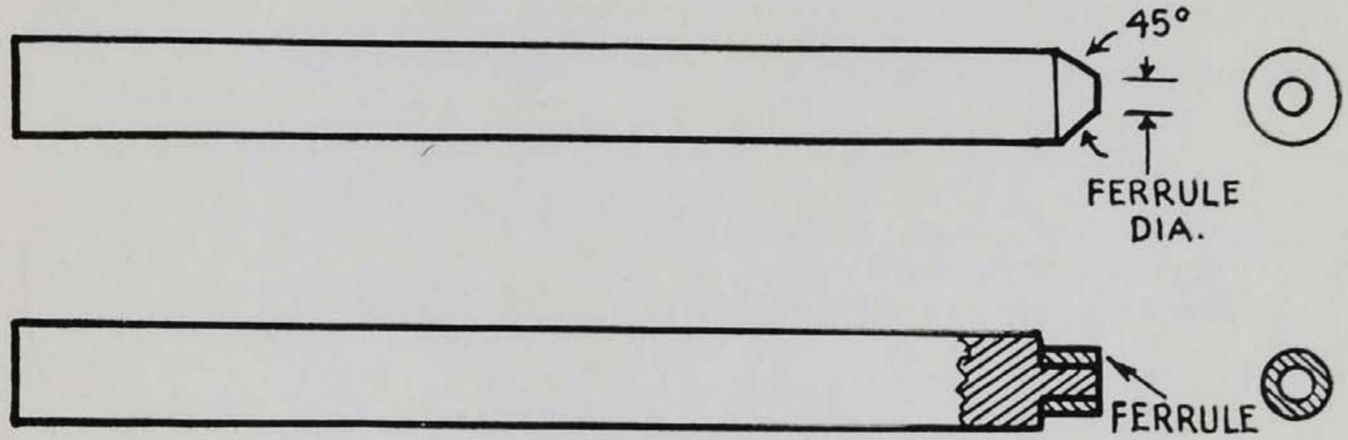


FIG. 2.177. Tapering end of stock for application of ferrule.

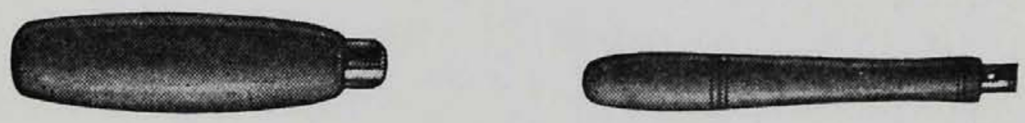


FIG. 2.178. Tool handles with metal ferrules.

4. Remove from lathe and press the ferrule on part until a mark is clearly made.
5. Turn down to this diameter for the width of the ferrule.
6. Remove piece from lathe and drive the ferrule on the shoulder.
7. Put piece back in lathe and turn to desired shape.
8. Sand carefully, shellac, and polish.
9. Remove from lathe, cut off excess stock, and smooth end.

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