Enormous quantities of lumber have been wasted through neglect and carelessness, but much is being done to eliminate waste and conserve the supply of lumber. (See p. 224.)

A good stand of western yellow pine, Coconino National Forest, Arizona. (Photo by A. Gaskill. Courtesy U. S. Forest Service.)

Principles of Woodworking

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PREFACE

During all ages wood has played an important and friendly part in the development of mankind. It enters, directly or indirectly, into the construction of more manufactured articles than any other material, and there is not an engineering project nor construction of any kind, in which wood is not used in some way.

A material, which enters so extensively into every phase of life, is of tremendous economic value to all civilized nations. The woodworking industries in this country, particularly the building and furniture industries, are among the most important, because they employ thousands of highly skilled workmen, designers, and artists, to produce useful as well as beautiful articles of wood. Other thousands are engaged in the distribution and selling of these products, and still other thousands in the manufacture of the numerous tools and machines used in woodworking.

This text is intended not only for the use of students in secondary and vocational schools, but also for adults who have taken up the study and practice of woodworking as a hobby.

Fundamental tool processes, common to all woodworking trades, have been compiled and arranged in family groups. With these as a basis, cabinetmaking has been emphasized throughout the book, because of its universal interest and appeal, and because this phase of woodworking is probably elected by most students.

All tool operations have been described and written in the form of instruction sheets. These have been further supplemented with related information about materials, tools, and machinery, and by a series of furniture projects, the construction of which has been carefully analyzed and described.

The teacher of woodworking will find the subject matter — both instruction sheets and related information — in convenient form for assignments.

Special attention is called to the method of planning and analyzing the various tool operations involved in the construction of an object. By following this method, any cabinet job may be analyzed and reference made by number to topics describing the various tool operations. After the students have become acquainted with the book, they should do their own thinking and planning, and should formulate their own job sheets for approval by the teacher.

The review questions at the end of each chapter should be of value to the student in testing his knowledge of a given topic, and to the teacher in checking up on his class.

The teacher of general science will find much helpful material on

forest conservation, seasoning of lumber, and the physiological processes of the tree.

The teacher of physics will find the chapter on machinery helpful in illustrating the principles and practical applications of simple machines and the transmission of power.

It is the sincere hope of the author that the increasing number of "home woodworkers" will find this book helpful and stimulating, and that it will contribute to their interest and pleasure in craftsmanship. May they experience that satisfaction and joy of achievement which comes with a piece of work well done.

Grateful acknowledgment is hereby given to the following: Miss S. E. Sievers of Saunders Trades School for valuable help in reading and preparing the manuscript; Mr. J. Macdonald and Mr. H. A. Carlberg of Saunders Trades School for suggestions and criticisms; Mr. Arthur Wakeling, Home Workshop Editor of Popular Science Monthly, for permission to use the material on Wood Turning and Inlaying which was published in a series of articles in that magazine, together with some of the illustrations in topics 255, 325, 326, 327, 328, 330, 334, and 341, which were used in these articles; the Forest Products Laboratory, Madison, Wis., and the National Lumber Manufacturers' Association for most of the illustrations appearing in the chapter on Wood; the Oliver Machinery Company for the illustrations in Figures 97 and 118; and the Editor of the Industrial-Arts Magazine for permission to use material published in that periodical.

Yonkers, N. Y.
January, 1930

HERMAN HJORTH

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CHAPTER II

MACHINE TOOLS

During recent years there has been considerable progress in the field of woodworking machinery. Particular attention has been given to greater safety for the operator, and to convenience and ease in both the "setting up" and the operation of the machinery. Old types of production machines have been improved, and new types have been invented. Moreover, numerous types of bench and portable machines have been developed.

Since woodworking machinery is very dangerous to operate, improvements and inventions that will safeguard the operator are of the greatest importance. Some of the most notable advances have been cylindrical cutting heads on hand planers, safety switches, improved guarding devices, and the elimination of fast-moving belts through direct motor drives.

Developments within the field of production machinery have completely revolutionized the furniture industry, and have made cabinet-making in its century-old form one of the disappearing trades. In large furniture factories, handwork has been reduced to a minimum, because machines have been invented which can be operated by semi-skilled workers. Such machines perform practically all tool operations faster, better, and more uniformly than the skilled workman can by hand methods.

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The development of the small bench and portable machines, on the other hand, is of interest to the manufacturer and the individual workman, as well as to students of woodworking, and the increasing number of amateurs, who find recreation, satisfaction, and joy in manual work. Large up-to-date factories have found it to their advantage to distribute a number of these small machines among their benchworkers, because they help to speed up production by eliminating practically all handsawing and planing.

For the same reasons, contractors and individual workmen use them in increasing numbers, not only for sawing and planing, but also for routing, shaping, boring, and sanding.

This type of machinery has also become very popular in schools, es-

Principles of Woodworking

CHAPTER I

HAND TOOLS

The woodworker uses a large variety of hand tools. Every workman should be familiar with the tools which he uses. He should know their proper names, the purpose for which each is used, and how they are sharpened and kept in good condition.

In this chapter a brief description is given of the most commonly used hand tools. In a later chapter the sharpening of tools is explained in detail.

1. The bench is a tool or appliance of the utmost importance to the woodworker. The best type of bench has a top that is constructed of narrow strips of hard wood, glued and bolted together. It usually has

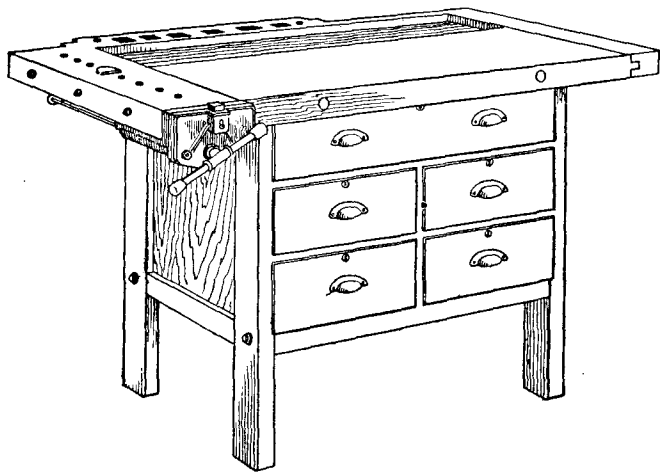


Fig. 1. Workbench

a recess or trough in which tools may be placed while working. The top is bolted to a frame consisting of four legs braced securely with crosspieces. This frame is often fitted with one or more drawers. (Fig. 1.)

The bench top is equipped with a side vise and sometimes also with a tail vise. These vises are made either of wood or iron. They have a central screw and parallel guide bars, one on each side of the screw. (Fig. 2.) Some iron vises are of the "continuous-screw" type and others of the "quick-acting" type. On some quick-acting vises a section of the screw thread is cut away throughout the entire length of the screw. This permits the movable vise jaw to be pulled in or out when the screw is in a certain position. A partial turn to the right tightens these quick-acting vises.

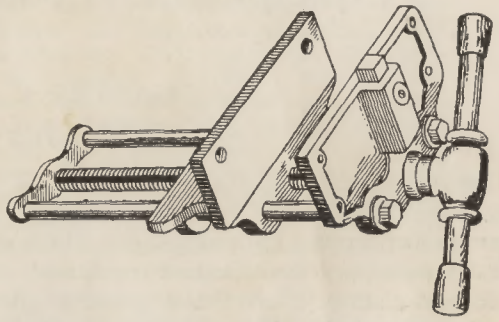


Fig. 2. Quick-acting vise

Some vises are equipped with an adjustable dog; i.e., a piece of iron which moves in a slot in the vise jaw. It can be set flush with the top of the vise jaw, or raised above it. A corresponding bench stop fits into holes bored in the bench top so that a piece of wood may be clamped firmly between the bench stop and the vise jaw.

A tail vise is a great convenience on a workbench, because it permits of clamping long pieces, such as table legs, for planing or mortising.

MEASURING TOOLS

2. **A rule** is generally the first tool used by the woodworker. Rules are made in different lengths and of different materials. Those used by the woodworker are usually of the folding type, and measure from 2 to 8 ft. in length. (Fig. 3.) Rules are generally marked off on both sides in inches and subdivisions of an inch, but they are also made with inch divisions on one side and metric divisions on the other.

Fig. 3. Folding rule

3. **Measuring tapes** are used by carpenters, contractors, and architects. They are made of steel or cloth, and usually measure from 25 to 100 ft. in length. (Fig. 4.) They are divided into inches and feet, or meters and centimeters.

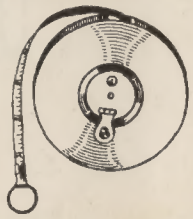


Fig. 4. Steel tape

4. **Try-squares** are used for testing the squareness of lumber, and in checking the squareness of work being assembled, especially in places where the framing square would be too large. Try-squares consist of two parts, the stock and the blade, which are firmly fastened together at right angles. The stock

is thick and is made of wood or iron. The blade, which is thin, is made of steel and has an inch scale stamped on it. (Fig. 5.) Try-squares are made in sizes of from 4 to 12 in., measured from the end of the blade to the stock.

5. **Miter and try-squares** (Fig. 6.) can be used at both 90 and 45 deg. Miter squares can only be used for angles of 45 deg.

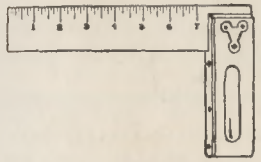


Fig. 5. Try-square

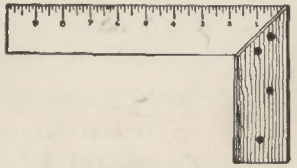


Fig. 6. Miter and try-square

Fig. 7. Sliding T bevel

6. **Sliding T bevels** (Fig. 7) are similar to try-squares, but differ in that their blades are adjustable to any angle. They are used for laying out angles other than right angles, as for instance corner braces, dovetails, or side rails for chairs.

7. **The steel square** measures 16 by 24 in., or 18 by 24 in., and is of the same thickness, about ⅛ in., throughout. The 24-in. part is called the "blade" or "body," and is 2 in. wide. The 16- or 18-in. part is called the "tongue," and is 1½ in. wide. The "face" of the square is the side on which the manufacturer's name is stamped. The steel square is a very important tool, especially to the carpenter, who uses it in laying out the many different cuts employed in roof framing, stair building, oblique joints, etc. The cabinetmaker uses it mostly for testing the flatness of large surfaces (Art. 189) and for testing for squareness in gluing. The uses of the steel square are so numerous and varied that whole books have been written on this subject.

Besides the divisions of the inch into eighths, tenths, twelfths, sixteenths, and thirty-seconds, which are marked on the inside and outside

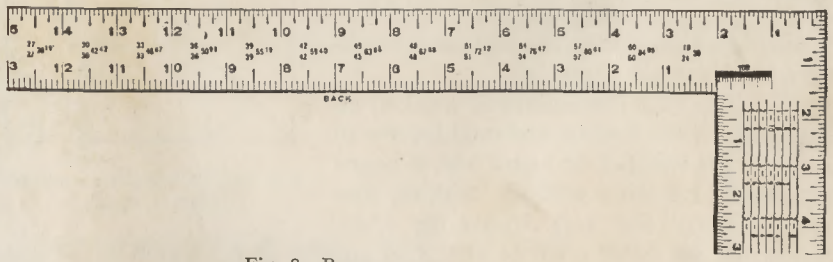


Fig. 8. Brace measure

edges on both sides of the square, the following tables are marked on it: brace measure, octagon measure, board measure, rafter table, and the divisions of 1 in. into 100 parts.

Planes, like saws, are made in many different forms for different planing jobs. Some of the most common types are as follows:

34. **The jack plane** is the most useful, all-around plane in the woodworker's kit. (Fig. 36.) It is 14 or 15 in. long, and consists of an iron body to which the plane iron can be clamped. The bottom of the plane, which is either smooth or corrugated, is called the "sole." The front part of the sole is called the "toe," and its rear part, the "heel." A casting, called the "frog," is screwed to the iron body near its center. A wooden knob is screwed to the forward part of the body, and a handle to its rear part.

Fig. 36. Jack plane

The plane iron, which in a jack plane is 2 in. or 2¼ in. wide, consists of two parts, the cutter and the cap. The latter is screwed to the back of the cutter, and is used to stiffen it and to break up the shavings. The plane iron is clamped to the frog by means of another iron, corresponding to the wedge in a wooden plane, called the "lever cap." The plane iron can be adjusted to the depth of the cut by means of a brass screw engaging a wishbonelike casting. This is called the "Y adjustment." It can be adjusted laterally or level with the sole of the plane, by a lever riveted to the top of the frog. (Fig. 37.)

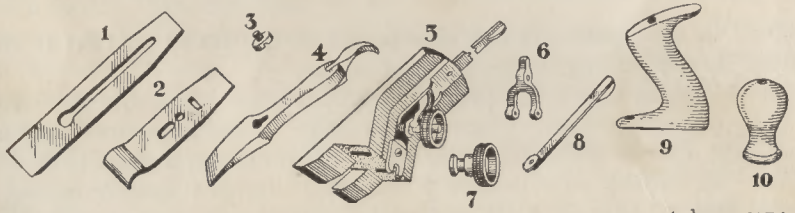


Fig. 37. Plane parts. 1, cutter iron; 2, plane-iron cap; 3, cap screw; 4, lever cap; 5, frog; 6, Y adjustment; 7, Y-adjustment screw; 8, lateral-adjustment lever; 9, handle; 10, knob

The sole of the plane keeps the thickness of the shaving uniform. If the board to be planed is uneven, it prevents the cutting iron from touching the hollow parts until all the high parts have been leveled off. Therefore, the longer the sole, the straighter the edge that is produced. The shavings enter through a narrow slit called the "throat" or "mouth." This slit is in the sole just forward of the cutting iron. The toe of the plane presses down on the wood in front of the shaving being taken, thus preventing it from splitting ahead. The width of the throat can be narrowed by moving the frog forward.

When planing an edge or a narrow board, the entire sole of the plane should be in contact with the wood to produce a straight edge. The tendency among beginners to hold the plane obliquely should be avoided and discouraged. Oblique cutting is a little easier, but it does not produce a flat surface, because only a small part of the sole is in contact with the wood.

35. **The fore plane** is built exactly like a jack plane, but is 18 in. long and has a plane iron 2⅜ in. wide.

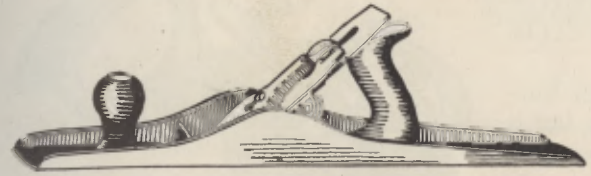


Fig. 38. Jointer

Fig. 39. Smooth plane

36. **The jointer** is also like the jack plane, but is 22 to 24 in. long, and has a plane iron 2⅜ or 2⅝ in. wide. (Fig. 38.) The latter two planes are used for leveling larger surfaces and for jointing the edges of boards to be glued.

37. **The smooth plane** is of the same construction as the above-named planes, but it is shorter, being from 5½ to 10 in. in length. (Fig. 39.) It also has narrower plane irons, from 1¼ to 2 in. It is used for planing smaller pieces and for very fine work.

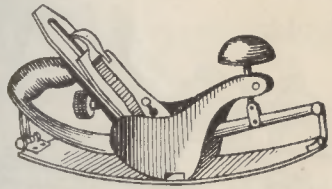


Fig. 40. Circular plane

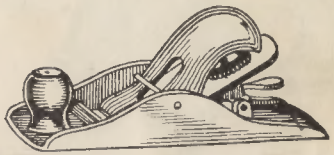
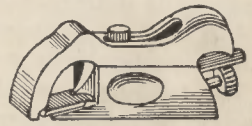


Fig. 41. Block plane

38. **The circular plane** differs from the others in that it has a flexible bottom 10 in. long, which can be adjusted to either convex or concave curves. (Fig. 40.) It is used on curved work, such as round table tops and aprons.

39. **The block plane** is a small plane from 4 to 8 in. long. (Fig. 41.) It has only a single plane iron, which is placed at a very low angle with the beveled side up. The lever cap is generally curved so that it fits smoothly within the hollow of the hand. This plane is used for planing end wood and in places where an ordinary plane could not be used.

40. **The bullnose rabbet plane** is about 4 in. long, and has the plane iron fastened to the extreme front of the body. (Fig. 42.)



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