WOODWORK

In Theory and Practice

by

JOHN A. WALTON

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FOREWORD

Mr. Walton's book will be warmly welcomed by Manual Arts Teachers who have long felt the need of a suitably compiled text book on woodwork.

The various chapters deal with tools, processes, fundamental constructions, hard ware, timbers, wood turning, inlaying, veneering, wood polishing and projects. The chief features of the principal styles of period furniture are dealt with at some length.

The excellent illustrations, of which there are many, have been specially drawn to elucidate the text.

The book will be a useful guide to students preparing for the Intermediate and Leaving Certificate Examinations in Woodwork. It will be of assistance also to everyone who is interested in the craft of woodwork.

I congratulate the author on the arrangement and general treatment of the subject matter, and I wish his book every success.

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Sydney.
21/4/47

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The author wishes to thank the Stanley Works, New York, U.S.A., for granting him permission to include information on their Multi and Universal Planes, and to use Diagrams 103 to 124. Thanks are also due to Messrs. C. & J. Hampton, of Sheffield, England, for information on their Record Combination and Multi Planes, and for the use of Diagrams 101, 102, 105 to 108 and 111 to 117.

ERRATA

Page	45	*Line*	24	"Abraiding" should read "Abrading."
,,	250	,,	16	"fig. 116, plate 25," should read "fig. 16, plate 101,"
,,	251	,,	3	"fig. 116, plate 25," should read "fig. 16, plate 101,"

PREFACE

The object of *Woodwork in Theory and Practice* is to provide the secondary and technical student and the amateur woodworker with a set of fairly full and detailed notes on the theory and practice of working in wood. Realising the difficulty of the student and amateur to obtain a complete volume dealing with the fundamentals of woodworking, this publication endeavours to cover completely all phases of woodworking technique and technology.

The hobbyist, as well as the student, should be interested in the detailed, illustrated notes and instruction sheets showing clearly the step by step correct procedure for constructing the fundamental joints and examples of practical woodwork.

For the student in Secondary Schools, notes on furniture styles, etc., have been included, so that *Woodwork in Theory and Practice* may cover the Syllabus of Courses in Woodwork as set out by the Board of Secondary School Studies for the New South Wales Department of Education. To assist the student there are questions at the end of each topic and extracts from examination papers.

I wish to thank and acknowledge the assistance of the Forestry Division of the C.S.I.R., Melbourne, Victoria, for permission to use material from their Trade Circulars, and for information on timbers, structure of wood, veneers and veneering processes and plywoods; the Board of Secondary School Studies, for permission to use extracts from Intermediate and Leaving Certificate Examination Papers; The C.S.R. Co. Ltd., and Masonite Corporation (Aust.) Ltd., for information on fibre boards; Mr. J. Keable, of Sydney Technical High School, for his valuable criticism and corrections; and Mr. J. R. Gardiner, Senior Technical Supervisor, N.S.W. Department of Education, for his helpful suggestions. Also, I wish to mention *The Woodworker* magazine, published by Messrs. Evans Bros., of London. This admirable periodical contains a wealth of information which would be of value to any woodworker or hobbyist.

JOHN A. WALTON

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The author wishes to record his indebtedness for the use of various plates in the preparation of the line drawings with which he has illustrated his text. His sincere thanks are tendered to the Victoria and Albert Museum, South Kensington, London, in respect of Diagrams, 374, 378, 380, 381, 382, 393, 394, 407, 408, 410, 411, 412, 417, 419 and 421, the items of furniture therein represented being included in the collections of the Museum and subject to Crown Copyright; to the author and publishers of *The Old Furniture Book,* N. Hudson Moore and J. B. Lippincott Company, Philadelphia, in respect of Diagrams 373, 375, 376, 395, 399, 406, 409, 416, 418, 422 and 423; to the author and publishers of *The Practical Cabinet Maker and Furniture Designer's Assistant,* F. T. Hodgson and Frederick J. Drake & Co., Chicago, in respect of Diagrams 372, 379 and 383; to the author and publishers of *English Period Furniture,* Charles Hayward and Evans Bros. Ltd., London, in respect of Diagrams 388, 389 and 392; and to *The Sydney Morning Herald* in respect of Diagrams 402 and 426.

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SECTION ONE

TOOLS USED FOR WOODWORKING

I. CLASSIFICATION OF WOODWORKING TOOLS

INTRODUCTION.

For convenience in the discussion of hand woodworking tools, they are in this book divided into four main groups, namely:

Group 1. Holding and Supporting Tools.
Group 2. Geometrical Tools.
Group 3. Cutting Tools.
Group 4. Percussion and Impelling Tools.

NOTE: They are here classified according to their uses. Cutting Tools have been further divided into subsections according to their cutting action.

Group 3. Cutting Tools—
Subsection 1—Paring and Shaving Cutting Tools.
Subsection 2—Abrading and Scraping Cutting Tools.
Subsection 3—Boring Cutting Tools.

Saws have been classified under Abrading Cutting Tools, although sometimes they are grouped separately under their own heading, "Saws."

Woodworking Machine Tools could be placed in a further group—Group 5.

CLASSIFICATION.

GROUP 1
HOLDING AND SUPPORTING TOOLS

A. The Bench and Its Appliances:—

1. Bench; 2. Vice; 3. Bench Stop; 4. Bench Hook; 5. "G" Cramp; 6. Sash Cramp; 7. Bench Holdfast; 8. Saw Clamp or Vice.

B. Shooting Boards:—

1. Square Shoot; 2. Mitre Shoot.

C. Mitre Box.

D. Panel Board.

E. Brace.
(May also be classified under Impelling Tools.)

F. Pincers.

GROUP 2
GEOMETRICAL TOOLS

A. Pencil.
B. Marking Knife.
C. Rules.
D. Straight Edge.
E. Winding Sticks.
F. Wing Compasses.
G. Calipers.

H. Squares:—

1. Try Square; 2. Mitre Set or Square; 3. Sliding Bevel.

I. Gauges:—

1. Marking Gauge; 2. Mortise Gauge; 3. Cutting Gauge; 4. Panel Gauge; 5. Pencil Gauge.

GROUP 3

CUTTING TOOLS

SUBSECTION 1. PARING AND SHAVING CUTTING TOOLS.

A. Planes:—

(i) BENCH PLANES for producing flat surfaces:—
1. German Jack; 2. Jack Plane; 3. Trying or Jointer Plane; 4. Smoothing; 5. Block (may also be classed as a Special Purpose Plane).

(ii) CURVE CUTTING PLANES for producing curved surfaces and edges.
1. Spokeshave; 2. Compass Plane.

(iii) SPECIAL PURPOSE PLANES for producing rebates, tongues and grooves, mouldings, etc.
(a) For Rebates—1. Rebate; 2. Fillister; 3. Bullnose Rebate.
(b) For Tongues and Grooves—1. Plough; 2. Match Planes.
(c) For Mouldings—Ovolo, Bead, Cavetto, etc., Combination Planes.
(d) For Trenching—1. Router Plane.

NOTE: The Block Plane and Cabinet Scraper (has a plane-like action) may be classed as Special Purpose Planes.

B. Chisels:—

(i) FIRMER CHISELS—1. Firmer; 2. Bevel Edge Firmer; 3. Registered Firmer.
(ii) PARING CHISELS—1. Bevel Edge Firmer; 2. Paring Chisel.
(iii) MORTISE CHISELS—1. Registered Firmer; 2. Socket Mortise Chisel.

C. Gouges:—

1. Paring or Scribing; 2. Firmer or Carving.

SUBSECTION 2. ABRADING AND SCRAPING CUTTING TOOLS.

A. Saws:—

(i) BENCH OR HAND SAWS used for straight cutting:—
1. Rip; 2. Cross Cut; 3. Panel; 4. Tenon; 5. Dovetail; 6. Light Back Saw.

(ii) CURVE CUTTING SAWS:—
1. Bow; 2. Coping; 3. Fret; 4. Compass; 5. Keyhole or Pad; 6. Nest of Saws.

B. Grinding and Sharpening Tools:—

(i) GRINDING WHEELS:—1. Grindstones; 2. Composition Wheels.

(ii) OILSTONES:—1. Natural Stones; 2. Artificial Stones; 3. Oilstone Slips.

C. Other Abrading and Scraping Tools:—

1. Cabinet Scraper (may be classed under Paring and Shaving Cutting Tools); 2. Abrasive Papers; 3. Files and Rasps.

SUBSECTION 3. BORING CUTTING TOOLS.

A. Bits.

1. Shell; 2. Spoon; 3. Nose; 4. Cobra; 5. Twist; 6. Dowel; 7. Centre; 8. Expansion; 9. Wood Drills; 10. Dowel Rounder; 11. Countersinks; 12. Forstner; 13. Screw Driver or Turnscrew Bit (an Impelling Tool).

B. Auger (handled). **C. Gimlet.** **D. Bradawl.**

GROUP 4

PERCUSSION AND IMPELLING TOOLS

A. Hammers:—
1. Claw; 2. Warrington.

B. Mallets.

C. Nail Punch.

D. Screw Driver and Screw Driver Bit.

E. Brace.

GROUP 5

WOODWORKING MACHINE TOOLS

E.G. **A. Woodturning Lathe.**
B. Band Saw.
C. Jig Saw.
D. Circular Saw.
***E. Jointer** (Planing Machine).
***F. Spindle Shaper** (Moulding).
***G. Belt and Disk Surfacer, etc.**

* Not dealt with in this volume.

QUESTIONS

1. Write down the names of the four main groups into which hand woodworking tools are classified.
2. Woodworking tools are classified according to one of the following:—Their size, their shape, or their use. Write down the correct one.
3. Name ten Holding and Supporting Tools and ten Geometrical Tools.
4. Write down the names of the three subsections of Cutting Tools.
5. Name three kinds of Paring and Shaving Tools.
6. Name the three groups into which planes are divided and name two planes in each group.
7. Make a list of the Bench Planes and the Bench Saws.
8. Why are Cutting Tools divided into the three subsections ?
9. Give the full classification of the following:—Bench hook, try-square, marking gauge, jack plane, spokeshave, firmer chisel, tenon saw, oilstone, warrington hammer, twist bit, mortise gauge, mitre box, smoothing plane, sliding bevel, gimlet, nail punch, rasp, rip saw, rebate plane and winding sticks.
10. Name three of each of the following and give their classification:—Gauges, bench planes, curve cutting saws, chisels, special purpose planes, bits.

II. DESCRIPTION AND USES OF WOODWORKING TOOLS (Plates 1 to 23).

GROUP 1

HOLDING AND SUPPORTING TOOLS (PLATES 1 and 2).

Comprises those tools used to hold the job while working on it.

A. THE BENCH AND ITS APPLIANCES.

1. **The Bench** is used for supporting the job while setting it out and during the various operations necessary for its construction. The centre or "well" of the top is usually a little lower than the sides to accommodate the tools. (Fig. 1.)

2. **The Vice** (Vyce)—old types made of wood (Spotted Gum) with a metal screw. Better types are made of metal and possess a release lever which allows quick movement and instantaneous grip. Used to hold the job while planing, sawing trenches, ripping tenons, chiselling out waste of trenches, holding sash and "G" cramps to facilitate cramping glued jobs.

3. **The Bench Stop**—many varieties, some made of wood and some of metal. The usual type is the wooden bench stop which fits through a mortise in the left hand end of the bench, being held in position by means of a bolt and thumb screw through the leg of the bench. Used to prevent the work from slipping while planing the face.

4. **The Bench Hook or Cutting Board**—used to hold the job while sawing or chiselling, and at the same time protecting the bench. (Fig. 2.)

5. **"G" Cramp**—a metal cramp used for holding the job to the bench while sawing or chiselling, sometimes used for holding small parts of the job together while gluing. Can be bought in several different sizes according to the opening of the jaws. (Fig. 5.) Cramps called "Hand screws," made of wood, are used for the same purposes.

6. **Sash Cramp**—a large cramp used for holding and drawing up the parts of jobs together while gluing, e.g., sashes, door frames, cabinet carcases, etc. (Fig. 4.)

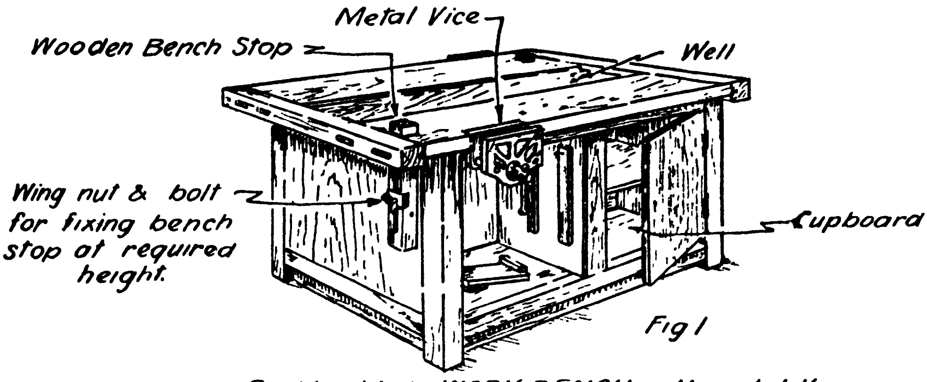
7. **Bench Holdfast**—an appliance used to hold the job firmly on the bench. Very useful for holding jobs when "sticking" (planing) mouldings and rebates, etc. (Fig. 6.)

8. **Saw Clamp or Vice**—a metal vice which can be fixed on the bench to hold saws during the various operations of saw sharpening. A wooden vice may be made large enough to hold a rip saw.

B. SHOOTING BOARDS.

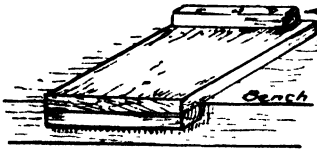
1. **Square Shoot**—used for holding pieces of timber when planing or shooting the ends square to a face or an edge. Made of wood or metal. (Fig. 3.)

2. **Mitre Shoot**—a shooting board used for holding the timber so that the ends



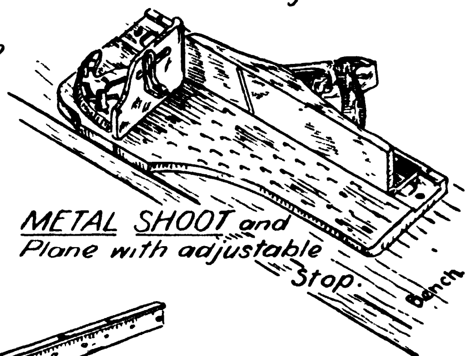
Double sided WORK BENCH with metal Vices.

Fig 2.



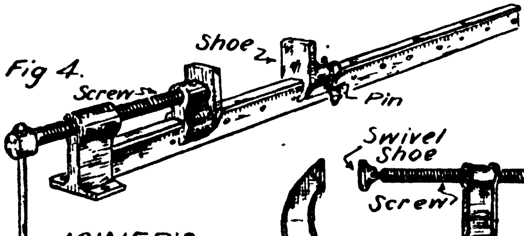
BENCH HOOK OR CUTTING BOARD

Fig 3.

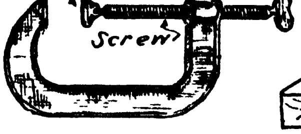


METAL SHOOT and Plane with adjustable Stop.

Fig 4.

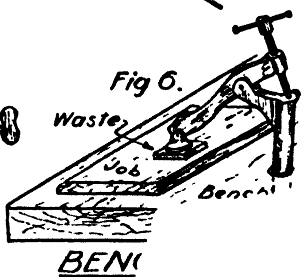


JOINER'S SASH CRAMP
Size 24" to 84" Long
Opening 18" to 78"



"G" CRAMP
Fig 5. 2" to 12"

Fig 6.



BEN
'DF.

— HOLDING & SUPPORT

PLATE I.

can be planed at an angle of 45° to the edge or face. The stop is at 45° to the sole of the plane instead of 90° as on the square shoot. Fig. 3 illustrates a Shooting Board made of metal which can be adjusted to any required angle.

C. MITRE BOX—an appliance used for holding jobs while cutting a mitre or an angle of 45° with either a large tenon saw or panel saw. Mitre boxes are made of steel or wood. The wooden make has its guides fixed at the required angle, whereas the steel type can be adjusted to the desired angle.

D. PANEL BOARD—is a board used for holding panels of thin timber when planing the faces. It consists of a perfectly flat board with a low stop running across one end. The stop is usually fitted into a tapering dovetailed trench so that new or larger or smaller stops can be fitted. Sometimes the board has a groove down the centre so that the job may be wedged against the stop.

E. THE BRACE—Fig. 7.

NOTE: The brace can also be classified under Impelling Tools.

USES: To hold and give leverage in a continuous rotary motion to the various bits.

PARTS—(a) *Head.* A block of hardwood shaped to fit the hand. It is screwed to a flanged steel sleeve, which in turn fits over the end of the crank rod and runs on hardened steel balls. The head is usually made of English Beech.

(b) *Crank.* This consists of a rectangular bend in the rod, varying from four to seven inches, thus giving a sweep of eight to fourteen inches. The crank is fitted with a hardwood handle usually made of Beech.

(c) *Chuck.* The end of the crank is enlarged to about one inch in diameter and is threaded and slotted to receive the socket and jaws respectively (called the Screwed Core). (Fig. 7a.) The *Jaws* (fig. 7b) are two pieces of hardened steel loosely riveted together and tapered on the outside to correspond to the inside of the *Socket* (fig. 7c), which screws on to the end of the screwed core to tighten the jaws over the square head of the bit.

(d) *Ratchet.* A ratchet is a contrivance fitted to the "ratchet brace" so that holes can be bored in confined spaces, such as corners, where it is impossible to make a complete turn or sweep of the crank handle. It consists of a ratchet wheel (on the end of the screwed core), and two pawls controlled by a knurled collar (on the end of the crank rod) which enables the chuck to be driven in one direction and released when the crank is returned. If the brace is used with a screwdriver bit for driving screws the job is made much easier if the ratchet is used.

F. PINCERS—Fig. 8. (Tower Pattern and Lancashire Pattern.)

USES: An instrument used chiefly for extracting nails or tacks which have become ... ing, etc. Sizes 5″ to 10″ long—6″ or 7″ being chiefly used in cabinet

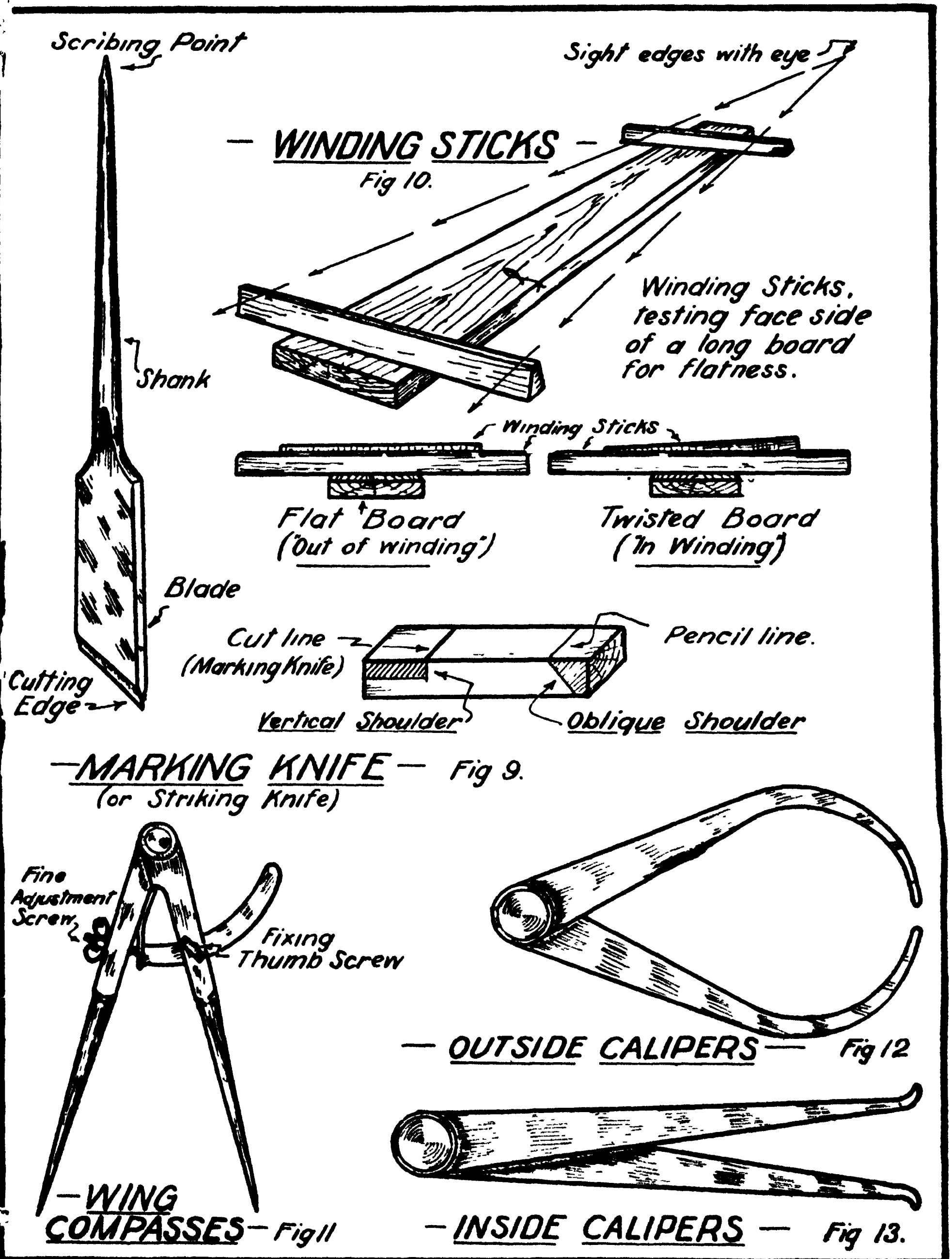
rms—Forged steel.

ivet—connects the two arms and acts as fulcrum.

s f hardened steel and sharpened to grip nails, etc.

of one arm is claw shaped for light levering, lifting

ail with pincers there is a danger of bruising the



— GEOMETRICAL TOOLS —

PLATE 3.

D. STRAIGHT EDGE—made of steel or wood with perfectly straight parallel edges, although sometimes has only one straight edge.

USES: For testing the straightness of surfaces and edges.

E. WINDING STICKS—a pair of perfectly straight pieces of timber with parallel edges. Usually they are about 15″ long and 1½″ wide.

USES: For testing timber for flatness. One stick is placed across one end and the other stick across the other end of the piece being tested. The top edges of the sticks are sighted, and if they are not parallel the board is said to be "in winding" and the high corners of the job must be planed down until it is "out of winding" and perfectly flat. The winding sticks tend to exaggerate the winding in the board. (See fig. 10.)

F. WING COMPASSES—a pair of dividers made of steel, the legs being sharpened to points. They are fixed at the required radius by means of a set screw.

USES: For setting out arcs of circles, etc. (Fig. 11.)

G. CALIPERS—two kinds, "inside" (fig. 13) and "outside" (fig. 12). The former are used for testing the diameters of holes, etc., the latter for testing the outside diameters of cylindrical objects.

Used in turnery.

H. SQUARES.

1. Try-Square—Fig. 14, Plate 4.

USES: For testing the squareness of material and for enabling lines to be marked at right-angles to a given surface. (Fig. 15, Plate 4a.)

PARTS—(a) *Blade* of well tempered steel, secured at right-angles to the "stock" by means of rivets which pass through brass plates on each side of the stock, thus preventing the wooden stock from splitting and making the blade more secure. Size 4″ to 32″.

(b) *Stock* made of steel or wood. If it is made of wood it must be well seasoned timber which will not warp or twist, Rosewood or Ebony being chiefly used. To prevent the wood stock from wearing a brass plate is fixed to the inside edge.

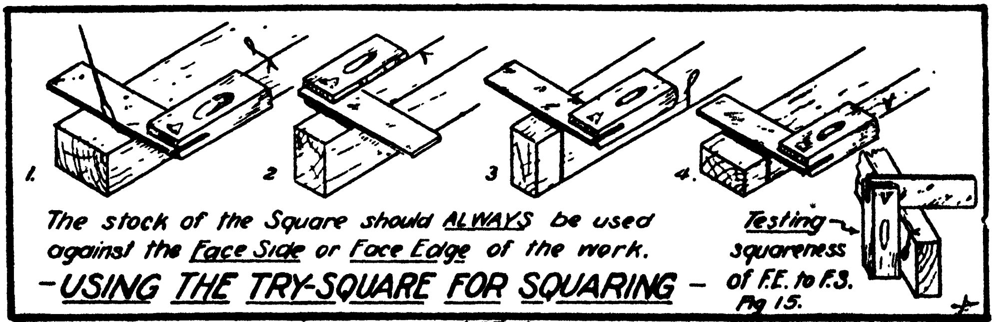
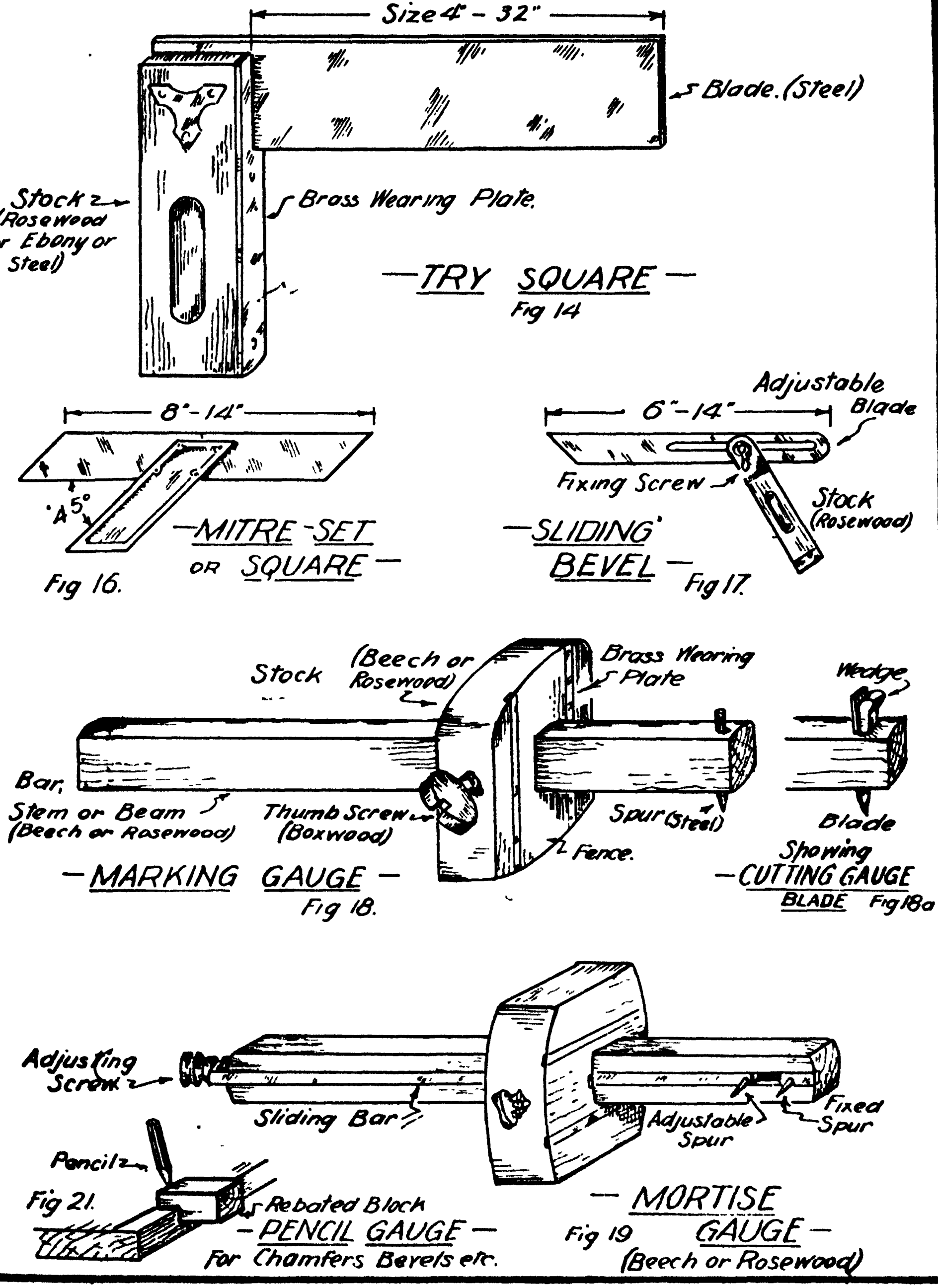


PLATE 4a.



— GEOMETRICAL TOOLS —

PLATE 4.

2. Mitre Square or Mitre Set—Fig. 16.

USES: For marking or testing angles of 45°. Consists of the same parts as the try-square, the blade is fixed at 45° to the stock. Length of blade 8″ to 14″.

3. Sliding Bevel—Fig. 17.

USES: For duplicating angles, and setting out and testing bevels and mitres, etc., where the line of the joint is other than 45°.

PARTS: Same parts as the try-square, but the blade is not fixed permanently at any angle; it is adjustable. A slotted blade passes through a slot in the stock and is held at the required angle by means of a screw or lever. Blade 6″ to 14″.

I. GAUGES.

1. Marking Gauge—See figs. 18 and 20.

USES: For marking lines parallel to a face or an edge, e.g., gauging width and thickness.

PARTS—(a) *Stem.* Made of beech and passes through the centre of the stock.
(b) *Stock.* Made of beech and slides along the stem.
(c) *Spur or Pin.* Made of steel, is fixed firmly into the end of the stem, the sharpened point projects about $\frac{1}{16}$″ to $\frac{1}{8}$″ to mark the timber.
(d) *Thumbscrew.* Made of boxwood, and is threaded into the stock. Its purpose is to fix the stock at the required distance from the spur.

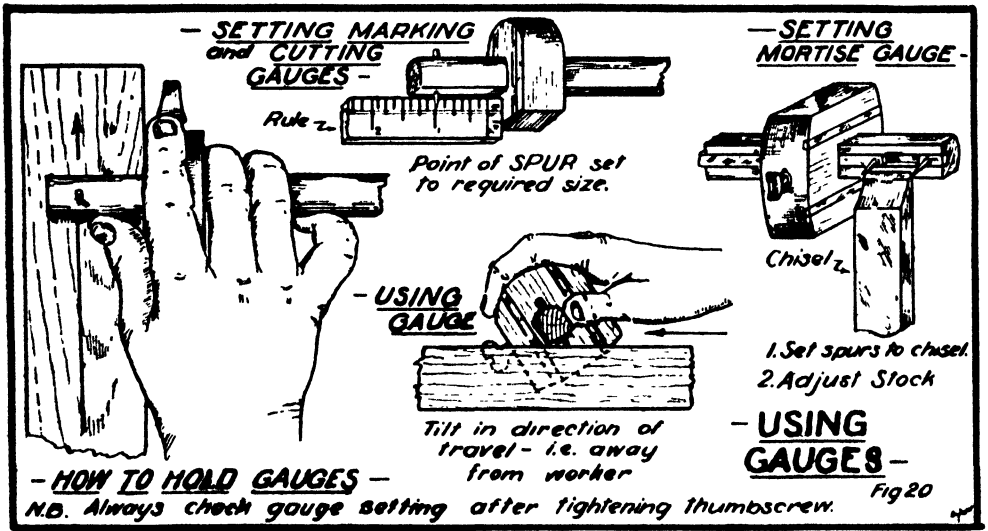


PLATE 46

2. Mortise Gauge—Fig. 19, Plate 4, and Fig. 20, Plate 46.

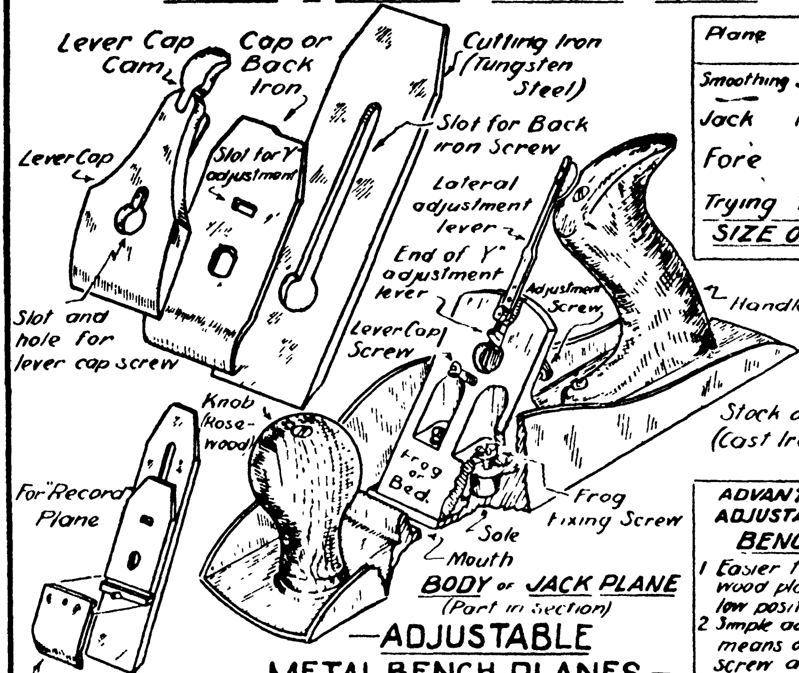
USES: To mark two lines parallel to a face or an edge, e.g., for gauging mortises and tenons, pins and sockets of bridle joints, etc.

PARTS: Consists of the same parts as the marking gauge, plus an extra movable spur fitted to a sliding brass rod, which in turn is moved by a thumb-screw at the end of the stem until the two spurs are the desired distance apart.

— PARING & SHAVING-CUTTING TOOLS —

Plane	Body Length	Cutter Width
Smoothing	$5\frac{1}{2}"$-$10"$	$1\frac{1}{4}"$-$2\frac{3}{8}"$
Jack	$14"$ & $15"$	$2"$-$2\frac{3}{8}"$
Fore	$18"$	$2\frac{3}{8}"$
Trying	$22"$-$24"$	$2\frac{3}{8}"$-$2\frac{5}{8}"$

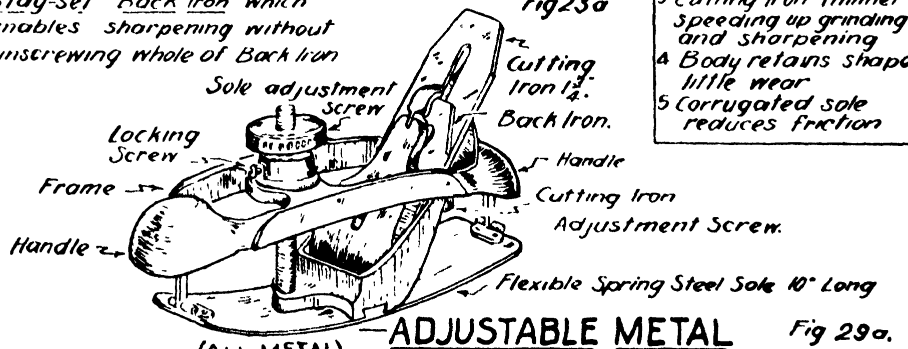
SIZE OF PLANES



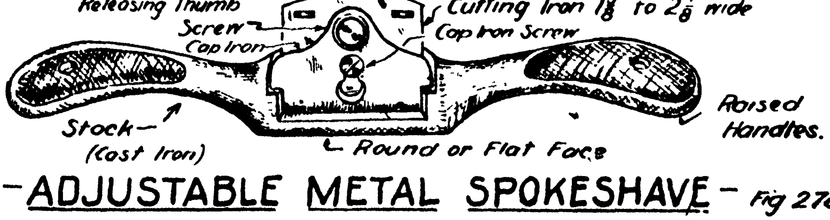
—ADJUSTABLE METAL BENCH PLANES— Fig 23a

ADVANTAGES OF ADJUSTABLE METAL BENCH PLANES

1. Easier to use than wood plane owing to low position of handle
2. Simple adjustments by means of adjustment screw and lateral adjustment lever.
3. Cutting Iron thinner—Speeding up grinding and sharpening
4. Body retains shape—little wear
5. Corrugated sole reduces friction



(ALL METAL) —ADJUSTABLE METAL COMPASS PLANE.— (or CIRCULAR PLANE) Fig 29a.



—ADJUSTABLE METAL SPOKESHAVE— Fig 27a.

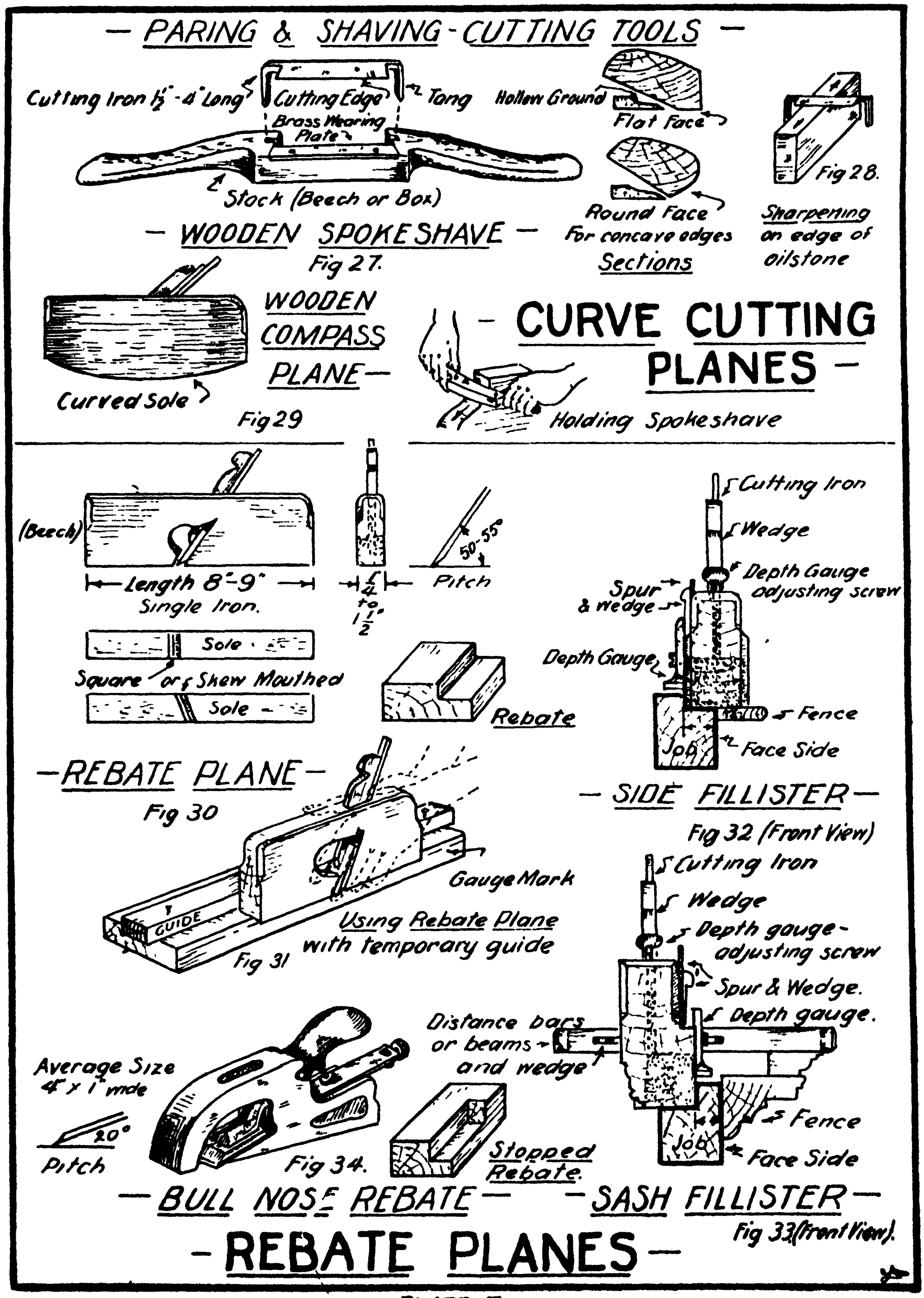

- PARING & SHAVING-CUTTING TOOLS -
Cutting Iron 1½"-4" Long
Cutting Edge
Tang
Brass Wearing Plate
Stock (Beech or Box)
- WOODEN SPOKESHAVE -
Fig 27.
Hollow Ground
Flat Face
Round Face
For concave edges
Sections
Fig 28.
Sharpening on edge of oilstone
WOODEN COMPASS PLANE -
Curved Sole
Fig 29
- CURVE CUTTING PLANES -
Holding Spokeshave
(Beech)
Length 8"-9"
Single Iron.
¼ to 1½"
50-55°
Pitch
Sole
Square or Skew Mouthed
Sole
Rebate
-REBATE PLANE-
Fig 30
Gauge Mark
GUIDE
Using Rebate Plane with temporary guide
Fig 31
Cutting Iron
Wedge
Depth Gauge adjusting screw
Spur & Wedge
Depth Gauge
Fence
Job
Face Side
- SIDE FILLISTER -
Fig 32 (Front View)
Cutting Iron
Wedge
Depth gauge-adjusting screw
Spur & Wedge.
Depth gauge.
Distance bars or beams and wedge
Fence
Job
Face Side
Average Size 4" x 1" wide
20°
Pitch
Fig 34.
Stopped Rebate.
- BULL NOSE REBATE -
- SASH FILLISTER -
Fig 33 (Front View).
- REBATE PLANES -

PLATE 7.

2. **Fillister Planes.**

USES: For planing rebates.

PARTS: *Stock* made of wood or metal. No cap irons.

Side Fillister (Fig. 32). A rebate plane about 2″ wide, with a *depth gauge* and *fence* attached. Used to plane a rebate the same width throughout on the side nearest the user.

Sash Fillister (Fig. 33). Is provided with a fence which extends on arms or beams from the body of the plane. The rebate is planed on the face or edge away from the user, leaving a fixed amount of timber between the fence and the rebate.

3. **Bullnose Rebate Plane** (Bullnose Cabinet Maker's Rabbet)—Fig. 34.

USES: Very useful for cleaning up rebates, stopped rebates and stopped chamfers.

PARTS: Same as rebate plane, average size 4″ long, 1″ wide.

(b) TONGUES AND GROOVES. (See also Multi Planes, pp. 50-54.)

NOTE: A groove is a rectangular recess or channel running along the grain of the timber some distance from the edge or side.

1. **Plough Plane.**

USES: For cutting a groove along the timber. E.g., the backs of some drawing boards are grooved to prevent warping.

PARTS: *Stock* made of wood or metal with a narrow metal sole. Usually equipped with a set of eight irons ranging from $\frac{1}{8}$″ to $\frac{5}{8}$″ to make grooves of corresponding sizes. It is provided with fence and depth gauge. The wooden make is similar in construction to the Sash Fillister (fig. 33), except that the steel sole is only about $\frac{1}{8}$″ thick.

2. **Match Planes.**

USES: For planing tongues and grooves for tongued and grooved joints (floor boards). Consists of a pair of planes which perform complementary functions and are used in pairs. With one a groove is cut along the edge of the board, with the other the edges of the board are cut away on both sides, leaving a projecting tongue which fits into the groove made by the first plane.

(c) MOULDINGS. (See also notes on Multi Planes, etc., pages 50-54.

This group includes a variety of planes with cutting irons of various shapes for the production of shaped mouldings, such as Ovolo, Bead, Cavetto, quarter round, half round, etc. See figs. 35a, b, and c, plate 8 (see also plates 33 and 72).

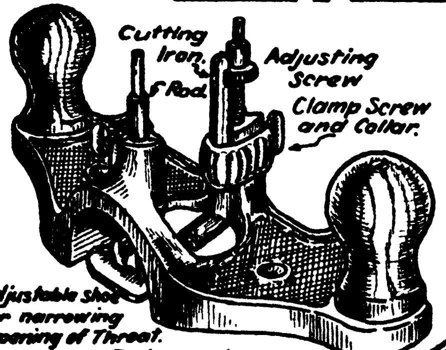
Special planes with shaped cutting irons and soles are made for making the simpler mouldings (see diagrams of Moulding Planes, plate 8), but it is possible to purchase one plane ("Combination" or "Multi") which has a set of plane irons for producing the different mouldings. Also the Combination Plane may be used as a plough or rebate plane for grooves, rebates or trenches. (Names: Stanley 45, Stanley 55 and Record Multi Planes.)

(d) FOR TRENCHING, ETC. (See also Multi Planes, etc., pages 50-54.)

1. **Router Plane.**—Fig. 35, plate 8.

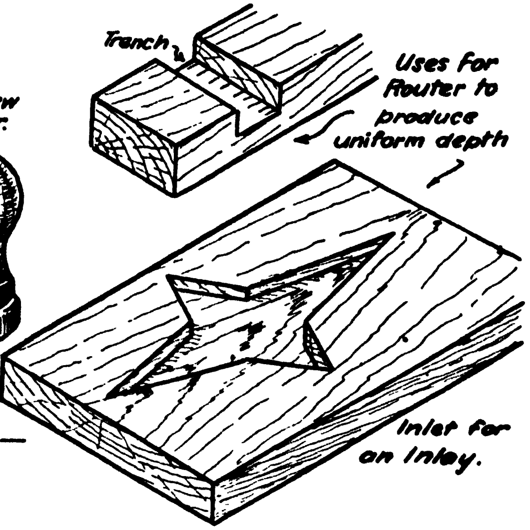
This plane, sometimes called an "Old Woman's Tooth," is used for surfacing the bottoms of trenches, back grounds of relief carving and inlets for inlays, etc., to

— PARING & SHAVING — CUTTING TOOLS —

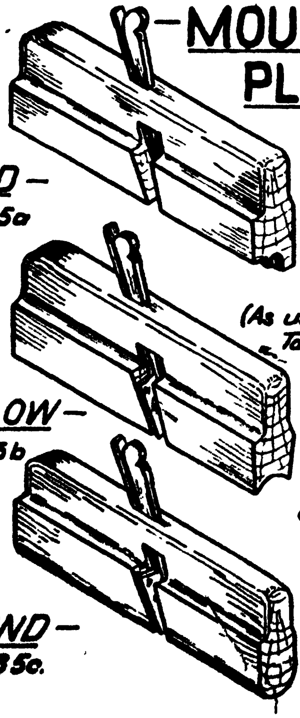


— ROUTER PLANE —

(Open Throat) Fig 35.



THREE TYPES OF WOODEN — MOULDING PLANES —

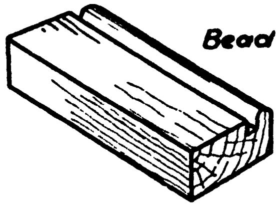


BEAD — Fig 35a

HOLLOW — Fig 35b

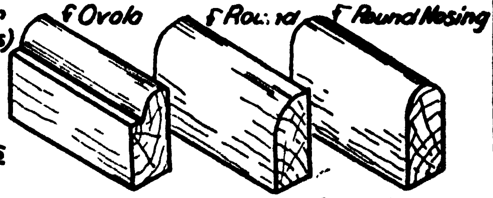
ROUND — Fig 35c.

Use



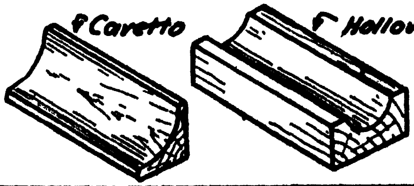
Sizes $\frac{3}{16}$" - 1"

(As used on Table Tops)



Uses

Obtainable in sizes 2-18 width of cutter



Uses.

Tools require less grinding than they require sharpening on an oilstone. They only require grinding when (a) they become gapped (caused by careless use or handling), (b) they have become worn to a thick edge by numerous oilstone sharpenings.

2. **Sharpening or Honing**—Fig. 44.

This process is carried out on an oilstone, the object being to produce a keen cutting edge. Oil (Neatsfoot) is necessary to reduce friction and float off particles of metal. (a) The tool is held at an angle of 5° greater than the grinding angle, thus producing a sharpening bevel of 25° to 30°. (*Note.*—The sharpening may commence with the tool at the same angle as produced by grinding, and at each succeeding honing lifted one or two degrees. This will increase the life of the cutting tool.) The tool should be rubbed on the stone with the bevel down, keeping it at a constant angle to the stone (fig. 44a) until a burr or "wire-edge" is produced. (b) The burr is removed by rubbing the tool flat on the stone with the bevel up.

These operations are repeated until the desired edge is obtained, finally stropping on the hand or a leather strop to remove all traces of the wire-edge.

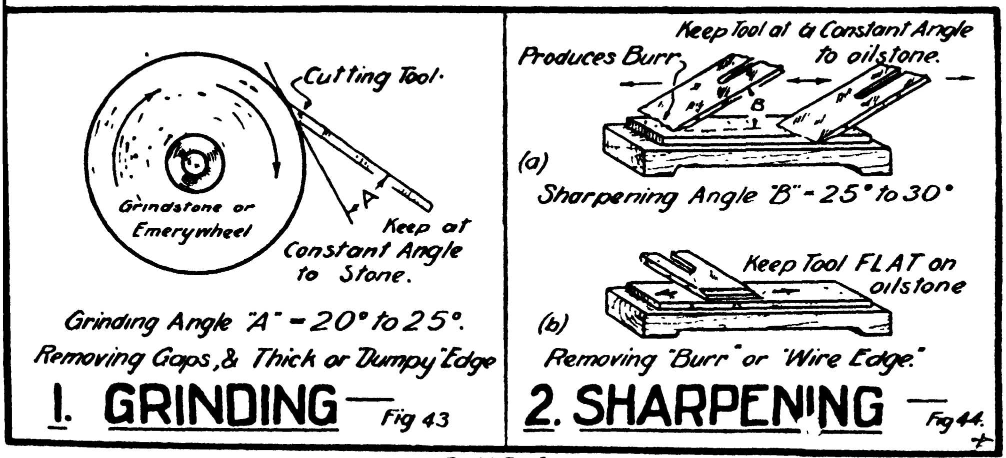


PLATE 10.

GRINDING AND SHARPENING OF TOOLS WITH CURVED CUTTING EDGES.

When *grinding* tools with hollow, or shaped cutting edges, special shaped stones or wheels are required. E.g., when grinding a scribing gouge. Those tools ground on the convex side can be ground on a flat grinding wheel.

For *sharpening* curved cutting edges small shaped oilstones called "slips" or "slipstones" are used to produce keen cutting edges. Fig. 73.

Sharpening Spokeshaves see fig. 28.

QUESTIONS.

1. Name the two operations necessary for putting a keen cutting edge on a chisel.
2. When is it necessary to use a grindstone or emery wheel on the cutting tool?
3. Why is it necessary to use water when grinding on either the emery wheel or grindstone?
4. At what angle is the cutting tool held to the emery wheel?
5. What stone would you use to produce a keen cutting edge? State the sharpening bevel.
6. Describe fully the operation of sharpening a chisel on an oilstone.
7. What oil is suitable for use on the oilstone? Why is oil used on the oilstone?
8. During the first stage of sharpening a wire-edge is formed. Describe how you would remove this burr or wire-edge.
9. Describe how you would grind and sharpen a scribing gouge.
10. Describe fully how you would put a gapped jack plane iron into good working order.

SUBSECTION 2. ABRADING AND SCRAPING CUTTING TOOLS.

Comprises those tools which cut the timber by taking away small particles at a time. (Also under this section Grinding and Sharpening Tools are grouped as their cutting action is similar to saws, files, etc., as they wear away metal particles.)

A. SAWS. Saws are sometimes grouped separately under a heading "SAWS," but as they *cut* or tend to wear away or *Abrade* the timber, they are here classified as Abrading Cutting Tools.

USES: Saws are used for cutting the timber to size and shape with a minimum amount of waste of material and effort.

SAWS may be divided into the following groups:—

(i) *Bench Saws or Hand Saws*—those used for straight cuts.
(ii) *Curve Cutting Saws*—those used for curved cuts.

(i) BENCH OR HAND SAWS—Figs. 45 to 50, plate 11.

1. **Rip Saw**—Figs. 45, 46 and 51—distinguishable by the shape of the teeth, which are chisel edged, and the front edge or advancing edge being at right angles to the line of the teeth or the back of the blade. Length 24″ to 28″, with 3 to 6 points per inch. (See also plate 13.)

USES: For cutting along the grain (Ripping) of thick timber. A rip saw with smaller teeth, often called a "half rip," is used for ripping thinner timber about ½″ thick.

2. **Cross Cut**—Figs. 45, 47 and 52. (Sometimes referred to as the Hand Saw.) Distinguishable by the knife-like edges of its pointed teeth, which are smaller than those of the rip saw. The front edge of the teeth being about 70° to 80° to the line of the teeth. Length 22″ to 28″, with 5 to 9 points per inch. (See also plate 13.)

USES: For cutting across the grain of thick timber. It can also be used for light ripping of thin timber.

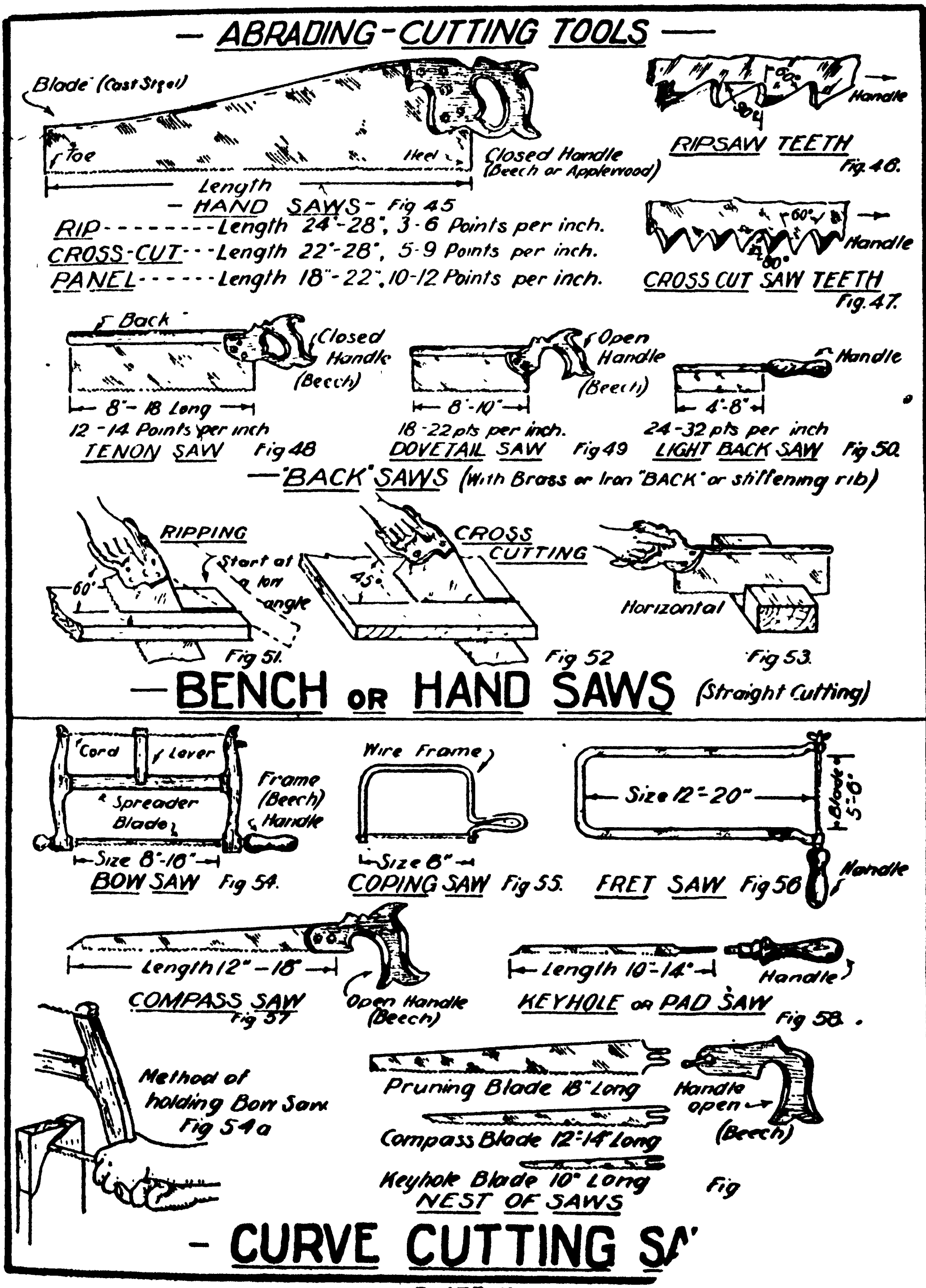

— ABRADING-CUTTING TOOLS —
Blade (Cast Steel)
Toe
Heel
Length
Closed Handle (Beech or Applewood)
— HAND SAWS — Fig 45
RIP - - - - - - - - Length 24"-28", 3-6 Points per inch.
CROSS-CUT - - - Length 22"-28", 5-9 Points per inch.
PANEL - - - - - - Length 18"-22", 10-12 Points per inch.
60°
80°
Handle
RIPSAW TEETH
Fig 46.
60°
Handle
CROSS CUT SAW TEETH
Fig. 47.
Back
Closed Handle (Beech)
8"-18 Long
12-14 Points per inch
TENON SAW Fig 48
Open Handle (Beech)
8"-10"
18-22 pts per inch.
DOVETAIL SAW Fig 49
Handle
4"-8"
24-32 pts per inch
LIGHT BACK SAW Fig 50.
— "BACK" SAWS (With Brass or Iron "BACK" or stiffening rib)
RIPPING
60°
Start at a low angle
Fig 51.
CROSS CUTTING
45°
Fig 52
Horizontal
Fig 53.
— BENCH OR HAND SAWS (Straight Cutting)
Cord
Lever
Frame (Beech)
Spreader
Blade
Handle
Size 8"-16"
BOW SAW Fig 54.
Wire Frame
Size 6"
COPING SAW Fig 55.
Size 12"-20"
Blade 5"-6"
Handle
FRET SAW Fig 56
Length 12"-18"
COMPASS SAW Fig 57
Open Handle (Beech)
Length 10"-14"
Handle
KEYHOLE OR PAD SAW Fig 58.
Method of holding Bow Saw Fig 54a
Pruning Blade 18" Long
Handle open
(Beech)
Compass Blade 12"-14" Long
Keyhole Blade 10" Long
NEST OF SAWS
Fig
— CURVE CUTTING SA'

PLATE II

3. **Panel Saw**—Figs. 45 and 52. Is smaller than the cross cut saw, length 18″ to 20″, with 10 to 12 points per inch.

USES: For sawing thin timber chiefly across the grain. For cutting tenons, and smaller work generally. (It is a handy saw for cutting plywood if kept almost flat on the wood.)

4. **Tenon Saw**—Figs. 48 and 53. (Belongs to a group of saws called "Back Saws" which possess a brass or steel stiffening rib to strengthen the back of the blade.) The tenon saw has a closed handle, which is so shaped that the saw is best used in a horizontal position on the bench (see Fig. 53). Length 8″ to 18″, with 12 to 14 points per inch.

USES: For general bench work and joint construction in conjunction with the vice and bench-hook, where accuracy is required. (See details of Tenon Saw, figs. 96 and 97, plate 21. Pages 45 and 46.)

5. **Dovetail Saw**—Figs. 49 and 53. (Back Saw.) Similar to the tenon saw, only smaller and has an open handle. Length 8″ to 10″, with 18 to 22 points per inch.

USES: For fine and very accurate joint cutting and light work only. E.g., construction of dovetail joints.

6. **Light Back Saw**—Fig. 50. Has a very small blade which has a strengthening rib. Has a plain round handle. Length of blade 4″ to 8″, with 24 to 32 points per inch.

USES: For super fine work, very small dovetails, and cutting fine mouldings, etc.

(ii) CURVE CUTTING SAWS.—These saws have narrow blades to enable them to turn in the saw cut or "kerf" when sawing curves.

1. **Bow Saw**—Figs. 54 and 54a. Has a thin blade about ¼″ wide, average length 12″, held in a wooden frame made of English Beech. Tension is applied to the blade by means of a length of cord and winding lever or an iron rod and thumb screw.

USES: Extensively used for external curve cutting. Owing to the frame, it cannot be used for cutting far from the edge of the work. For cutting thick timber.

2. **Coping Saw**—Fig. 55. Has a very fine blade held in a stiff wire frame. Length of blade usually 6″.

USES: For cutting quick or sharp curves either internal or external; owing to the smallness of frame it also cannot be used very far from the edge of the work. Mostly used for cutting thin timber, such as three-ply for toys and three-ply templates, etc.

3. **Fret Saw**—Fig. 56. Has a very fine blade similar to the coping saw, 5″ to 6″ long (usually not as coarse as the coping saw blade), held in a long rectangular steel frame 12″ to 20″ long (length of frame denoting size of saw).

USES: For cutting curves in thin wood, giving a clean cut without splintering the ... because of the long frame it can be used at a greater distance from the edge

... Saw—Fig. 57. Has a narrow tapering blade 12″ to 18″ long, fitted ... handle.

... large interior curves (the width of the blade governing the ... It is necessary to bore a hole in the job through which to start ... internal cuts. Can also be used for straight internal cuts where the hand saw cannot be used, such as for draining boards for sinks, floor and ceiling manholes, etc.

5. **Keyhole or Pad Saw**—Fig. 58. Has a narrower blade than the compass saw, length 10″ to 14″, fitted into a round handle.

USES: For quick internal curves where it is impossible to use other saws.

6. **Nest of Saws**—Fig. 59. Consists of three separate blades and a detachable open handle. The blades are: (i) Pruning Blade, 18″ long, (ii) Compass Blade, 12″ to 14″ long, and (iii) Keyhole Blade, about 10″ long. The pruning blade can be used for straight cutting or large flat curves, while the others are used as in 4 and 5 above.

Handles for Saws.—These are usually made of English Red Beech, although Pearwood and American Applewood are frequently used.

The Blades are made of cast steel, tapered in thickness from the teeth to the back, while the back itself has a slight taper from the handle to the point. The teeth of rip saws and saws with large teeth are usually slightly larger at the heel than at the toe or point.

NOTE: Always use the right saw for the right job, and DO NOT force the saw to cut; very little effort is required to operate a sharp saw.

QUESTIONS.

1. Name three Bench Saws and state their special uses.
2. Name three Back Saws and state their special uses. What is the purpose of the stiffening rib?
3. Name the two main groups into which saws are divided.
4. Why is it necessary for some saws to have very narrow blades? What saws have narrow blades?
5. Briefly state the difference between the uses of the rip saw and the cross cut saw.
6. Name two saws suitable for sawing the sides of small joints. Describe these saws.
7. Describe fully two saws used for external curve cutting.
8. Name two timbers suitable for handles for saws.
9. Write down what you learn from the examination of Figs. 51, 52 and 53.
10. Set out a table giving length and points per inch for the six Bench Saws. (See fig. 45.)

SAW SHARPENING (PLATE 12).

Like any other cutting tool, the cutting edge (i.e., the teeth) of a saw must be sharpened regularly if satisfactory work is to be carried out. The operations involved in putting a saw into good working order are—

1. *Topping or Jointing.*
2. *Shaping or Reshaping.*
3. *Setting.*
4. *Filing or Sharpening.*

SHARPENING OF SAWS USED FOR CUTTING ACROSS THE GRAIN (FIGS. 60 to 64).

1. **Topping or Jointing**—Fig. 60.

If on examination the teeth are found to be uneven, it is necessary to "joint the saw," that is, run a file along the tops of the teeth until they are all of equal height. To do this place the saw in a suitable saw vice and run a flat mill file, held square to the blade, along the tops until every tooth is touched by the file. (Most saws have a slight "camber" or arch along the line of the teeth, hence care should be taken not to file too much off the tops of the centre teeth).

2. **Reshaping**—Fig. 61.

After topping it is always necessary to reshape the teeth that have become flattened by the file. (Shaping need only be done when the saw has been jointed.) Place the file in the gullet between the teeth and file STRAIGHT ACROSS with the file at right angles to the blade. Care should be taken to make all the teeth the same shape, the front edge being 70° to 80° to the line of the teeth.

3. **Setting**—Fig. 62.

It is always necessary to set the teeth after jointing and shaping. "Setting" is the process of bending adjacent teeth to opposite sides, so that the cut or "kerf," made by the saw, is slightly wider than the thickness of the blade or "plate" to prevent it from jamming when sawing. (See figs. 65a and 66a.) Setting is done with a plier saw-set or a special saw-setting hammer. The TOP HALF ONLY of the teeth should be set. After setting some workmen "side file" the saw, that is, lightly run a file along each side of the saw to even up any irregularities in setting.

4. **Sharpening or Filing**—Figs. 63 and 64.

Use a three-cornered taper file of the correct size suitable to the saw being sharpened. (See table below for correct size of file.)

(a) Fix the saw in a saw vice with the *handle* to the *right* and the bottoms of the gullets about $\frac{1}{8}''$ above the jaws of the vice. Commence filing at the point of the saw. Place the file in the gullet to the *left* of the first tooth bent *towards* you ("A," fig 63, then *swing* the handle of the file to the *left* (i.e., away from the handle of the saw) at 30° to 45°. Hold the file level. File both teeth on each side of the file at the same time, filing on the push stroke only. Keeping the file at the same angle, file in each alternate gullet to the handle end of the saw.

(b) *Turn the saw round* so that its *handle* is on the *left*, and place the file in the gullet on the *right* of the *first* tooth bent towards you ("B," fig. 64), (start at the point of the saw), and swing the handle of the file to the *right* (away from the handle of the saw) at the same angle as above and file as in step (a).

NOTE: The turning of the file at an angle of 30° to 45° to the blade produces a bevel or knife edge on the sides of the tooth and at the same time bringing each tooth to a needle point, which severs or cuts the fibres on each side of the saw kerf when cutting across the grain. A bevel of 45° is suitable for softwoods and 30° for hardwoods.

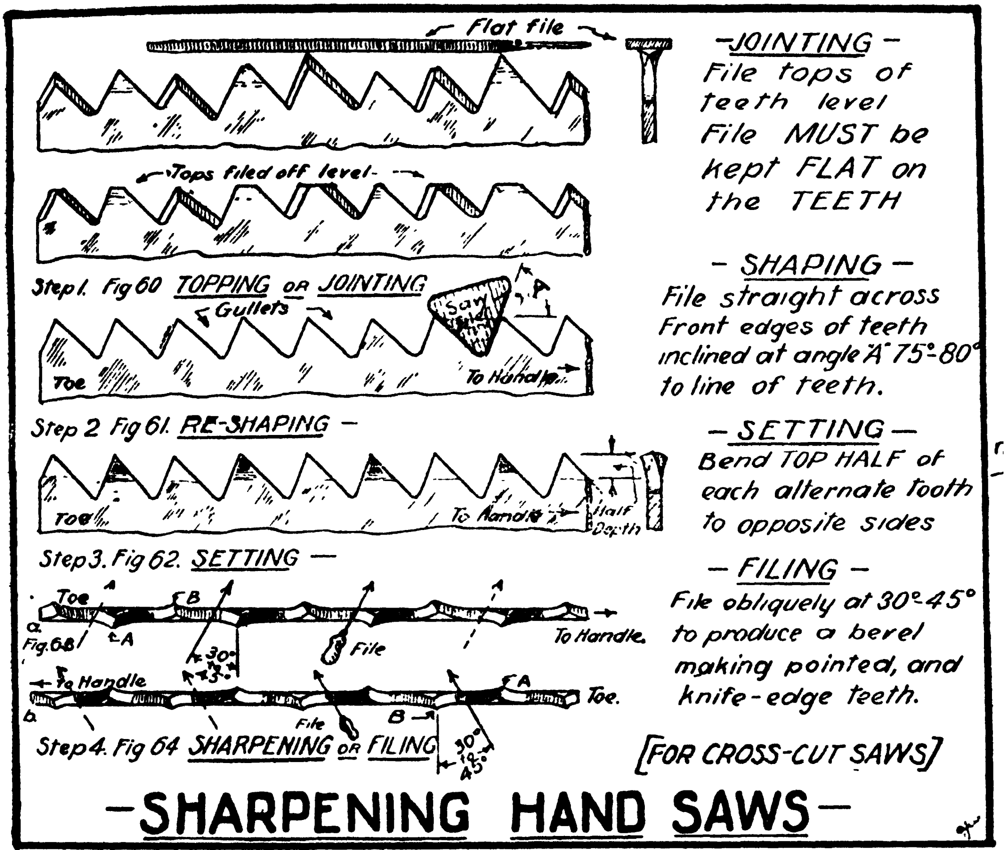


PLATE 12

SHARPENING OF SAWS USED FOR CUTTING ALONG THE GRAIN—RIP SAWS.

The teeth of the rip saw are not pointed but chisel-edged. To produce the chisel edge it is necessary to file straight across the saw.

Joint, reshape and set the teeth in the same manner as for cross-cut saws. Note that the shape of the teeth for ripping saws have the front edge at 90°. In step 4, Filing or Sharpening, place the saw in the clamp in the same position as in step 4a above, and file in each alternate gullet, but FILE STRAIGHT ACROSS with the axis of the file at right angles to the blade. Turn the saw around and proceed as in step 4b, still filing straight across.

SIZE OF FILE TO USE.

The size of the file is governed by the size of the teeth of the saw, i.e., the number of points per inch.

TABLE.

Points per inch—	3-3½	4-4½	5-5½	6-6½	7	8-9	10	11-12	over 12
Size of file—	9″	8″	7″	6″	5½″	5″	4½″	4″	3½ to 3″

QUESTIONS.

1. Write down the names of the four operations necessary to put a saw into good working order.
2. What is the purpose of "jointing?"
3. Describe the operation of reshaping the teeth of a cross-cut saw.
4. Why is it necessary to reshape after topping the teeth?
5. What is the purpose of set on a saw? ✓
6. How much of the tooth should be set and how is it bent?
7. What kind of a file is used for hand saw sharpening? What size file would you use for saws with 4, 6 and 11 points per inch?
8. Describe the operation of filing the bevelled teeth on the cross-cut saw.
9. At what angle is the file used to produce the bevel?
10. Why are the teeth of the rip saw filed straight across during the filing step?

SHAPE AND CUTTING ACTION OF SAW TEETH.

Cross Cut Saws—Fig. 65, plate 13.

When cutting across the grain the teeth of the saw must be so shaped that they will sever the fibres on each side of the saw kerf. To do this each alternate tooth is brought to point on opposite sides. These needle points and knife-like edges of the teeth cut the fibres and enable the centre portion of the kerf to break up and be carried away in the gullets as sawdust (fig. 67). The set on the teeth allows the blade to move freely in the kerf. The points and cutting edges are produced by filing at an angle to the line of the teeth. The pitch or slope of the front edge of the teeth has to be such that the teeth do not bury themselves in the fibres, making it difficult to saw. It has been found that an angle of 70° to 80° for the advancing edge gives the best sawing results. Teeth so shaped are often referred to as "raked" teeth.

Rip Saws—Fig. 66, plate 13.

When cutting along the grain there is no tendency for the grain to tear or splinter out, therefore there is no need to sharpen the teeth at an angle to produce points. The teeth of rip saws are sharpened by filing straight across, producing teeth with flat cutting edges, i.e., a series of chisel-like cutting edges, which chop out small particles of wood at each stroke of the saw (fig. 68). When sawing along the grain the teeth are not likely to dig in, and the front edge of the tooth may be sharpened at 90° to the line of the teeth, and are sometimes called "hooked" teeth. The teeth are set so that the kerf is slightly wider than the thickness of the blade. A rip saw cannot be used successfully for cutting across the grain, as the teeth dig into the wood and tear the fibres.

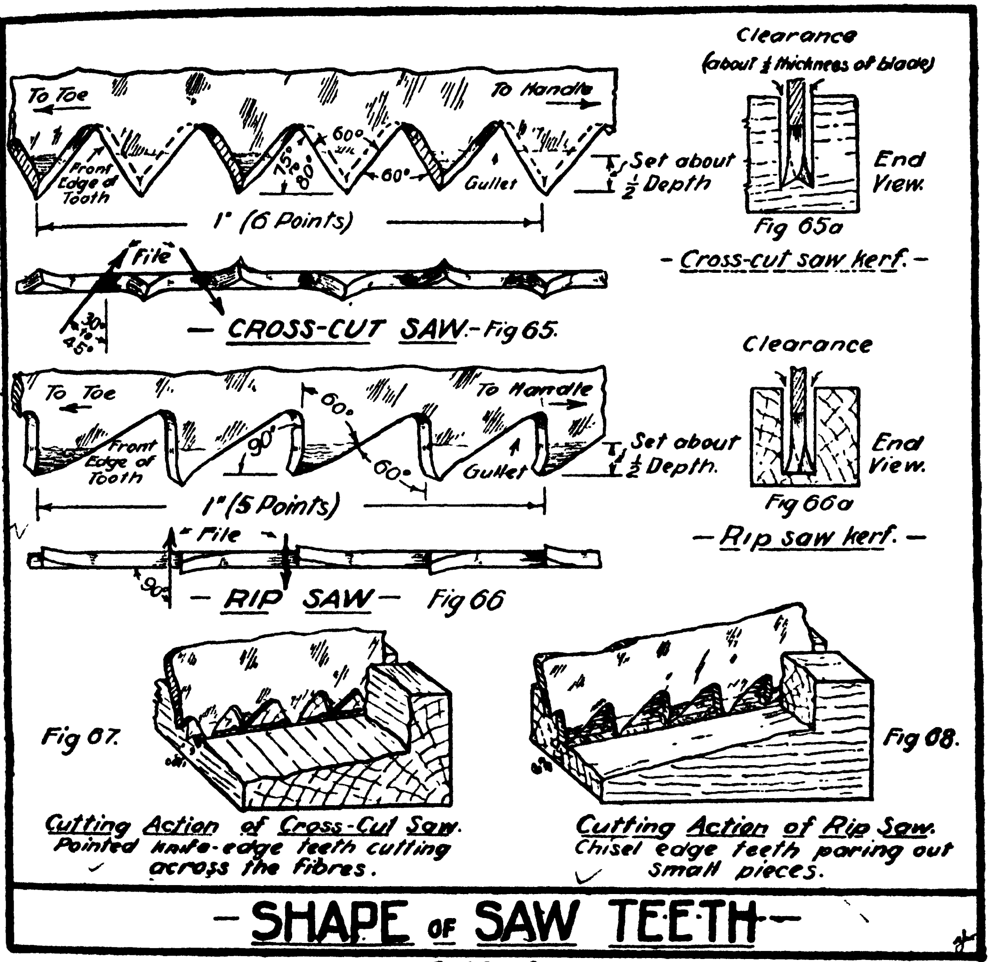


PLATE 13

QUESTIONS.

1. What saw would you use to saw across the grain?
2. Why are the teeth of a cross cut saw sharpened to needle points?
3. How are the needle points produced on the teeth of a cross cut saw?
4. Why are the front edges of the cross-cut saw teeth sloped at the angle of 75°?
5. How is the sawdust carried away from the cut?
6. When would you use a rip saw in preference to a cross cut saw?
7. What shape is the cutting edge of a rip saw tooth?
8. What is the angle of the front edge of a rip saw tooth to the line of the teeth?

9. Why is it unsatisfactory to use a rip saw for cutting across the grain?
10. Show by sketches the details and shape of the teeth of rip saws and cross cut saws.

B. GRINDING AND SHARPENING TOOLS—Plate 14.

(i) *Grinding Wheels.* (For Grinding.)
(ii) *Oilstones* and *Oilstone Slips.* (For Honing or Sharpening.)

(i) GRINDSTONES AND EMERY WHEELS.

USES: For removing quickly the burred, gapped or worn edges of plane irons, chisels and gouges, to form a new grinding bevel.

Grinding tools are of two kinds:—

1. **Grindstones**—Fig. 69—are quarried natural sandstones (particles of sand or grit naturally cemented together). When the grindstone is used it is necessary to use water to wet the stone for the following reasons:—

(a) It reduces the heat caused by friction while grinding which would quickly ruin the cutting edge of the tool by drawing the temper or burning the metal.
(b) It washes away the particles of stone and steel liberated while grinding, thus enabling the stone to cut freely.

(NOTE: As water softens the stone, the stone should be wetted all over, otherwise it will wear unevenly. For the same reason the stone should never be left standing in water.)

2. **Composition Abrasive Wheels**—Fig. 70—are artificial stones, that is, hand-made stones. Emery is an impure aluminium oxide found in the form of rock; it is crushed into various sizes of "grit." The powder or grit thus produced is mixed with a suitable bond, moulded and baked at a high temperature. Carborundum (silicon carbide) is artificially manufactured by heating together sand and coke in an electric furnace, forming a compound of silicon and carbon, which is crushed and treated in the same way as emery. Carborundum is used as a substitute for emery.

(NOTE: When using the emery wheel it is necessary to dip the cutting tool frequently into water to prevent over-heating or burning the cutting edge of the tool.)

Advantages of Sandstones.

(a) They permit the grinding to a keen edge with little risk of burning the cutting tools.

Disadvantages.

(a) The process of grinding is slow.
(b) The stone may wear unevenly.

Advantages of Emery Wheels.

(a) Because of the fast cutting qualities and speed at which they can be used, the grinding process is much quicker.
(b) They can be moulded to any shape for grinding curved or shaped edge tools.
(c) They can be manufactured in different grades, e.g., soft, medium and hard and different degrees of coarseness and fineness.

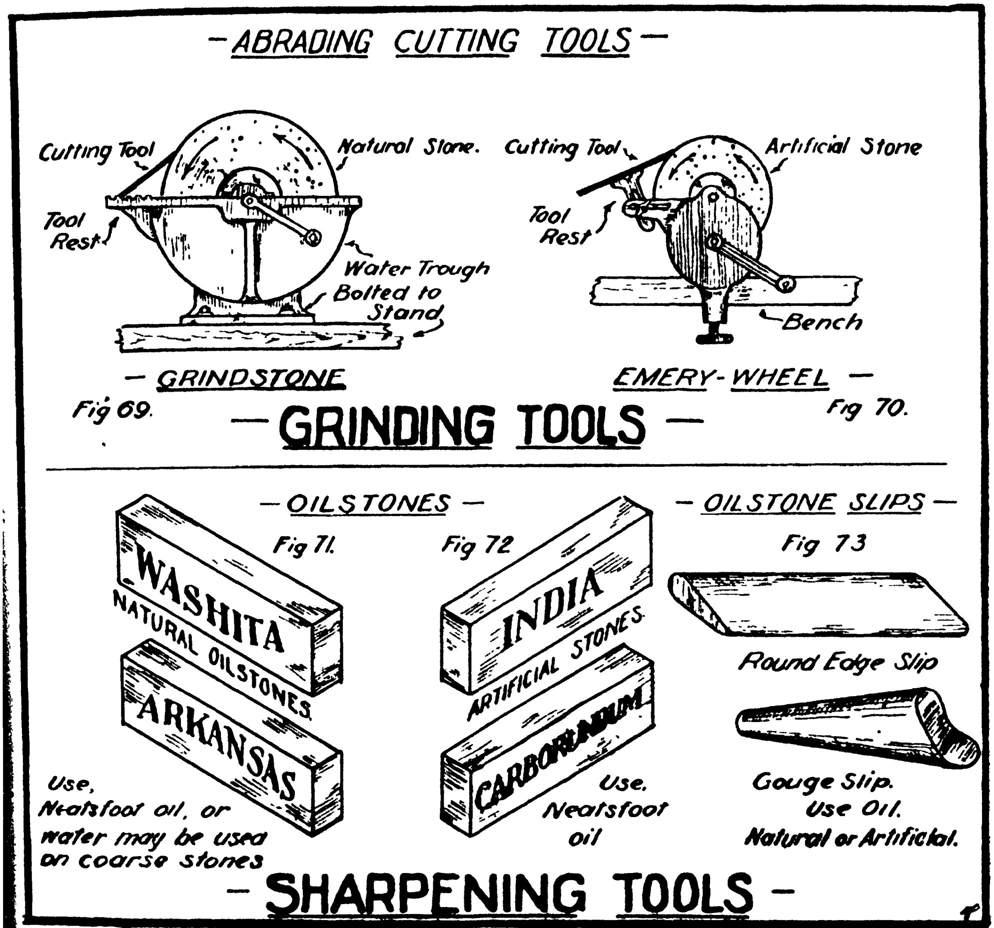


PLATE 14.

Disadvantages.

(a) Owing to the high speed at which the wheel is used, greater care must be exercised, as there is a danger of burning the cutting edge of the tool by friction, hence the tools have to be frequently cooled by plunging into water.

When using either the emery wheel or grindstone turn the stone towards the cutting edge to produce a better edge. When grinding small or narrow edges use the whole surface of the stone so that grooves are not worn in the surface of the stone.

(ii) OILSTONES AND OILSTONE SLIPS.

USES: To put a keen cutting edge on cutting tools, a process called "honing." Honing is always carried out after grinding.

Honing or Sharpening Stones are divided into: Natural Oilstones, Artificial Oilstones and Slip Stones.

1. **Natural Oilstones**—Fig. 71—are quarried (mostly in America), and can be obtained usually in two grades, hard and soft grained. The soft stone has a fairly coarse grit. Plenty of water should be used on all coarse grained natural oilstones, and oil of a non-drying nature on the finer grades (Neatsfoot oil). Two of the best natural stones are the "Washita" and "Arkansas." The latter produces the keenest cutting edge, but is the most expensive stone.

2. **Artificial Oilstones**—Fig. 72—are manufactured by cementing together particles of carborundum. The two most common makes are the "India" and the "Carborundum," made in fine, medium, coarse and combination grades. The combination stone is made up with a coarse grade on one side for wearing down quickly very dull or badly nicked edges, and a fine grade on the other side for producing a keen cutting edge. Oil is used on artificial stones.

The slow cutting natural stones produce a finer cutting edge than the fast cutting artificial stones.

Size of Oilstones: Average size, 7" x 2" x 1".

3. **Oilstone Slips or Slipstones**—Fig. 73—are pieces of oilstones of various shapes, used for sharpening tools with curved and shaped cutting edges (e.g., gouges and moulding plane irons), which cannot be honed on the flat surface of an ordinary oilstone. Oil should be used.

Oil.—Oils of non-drying qualities should be used during the sharpening process to prevent clogging or "glazing" of the stone by floating off the particles of steel. Oil also prevents overheating caused by friction. Neatsfoot oil, extracted from the feet of cattle, is generally used on the oilstone.

Care of Oilstones.—ALWAYS KEEP OILSTONES CLEAN AND MOIST. If allowed to dry they will become hard and brittle, and they will become glazed or smooth more readily. If kept in a dry place it is advisable to keep them oiled and in a covered box.

Any irregularities or glaze may be removed by grinding on the side of a grindstone or by rubbing down with a wet sandstone brick or emery powder mixed with water on a hard flat surface. They may be cleaned with kerosene.

QUESTIONS.

1. What is the difference between the composition of the emery wheel and grindstone?
2. Why should water be used on the grindstone?
3. What is the purpose of using water when grinding on an emery wheel?
4. Write down the advantages of composition stones.
5. Show by a sketch the position of the cutting tool and the direction the wheel should rotate when grinding?
6. Why is it necessary to use an oilstone after grinding?
7. Write down the names of (a) two artificial oilstones, (b) two natural oilstones.
8. Why should oil be used on an oilstone? What type of oil should be used?
9. What type of stone would you use to sharpen a gouge?
10. What steps would you take to prolong the life of your oilstone?

C. OTHER ABRADING AND SCRAPING TOOLS.

1. **Cabinet Scraper**—Fig. 74, plate 15. (May be classified as Paring and Shaving Cutting Tools.) The Cabinet Scraper is a flat piece of tool steel about 5″ x 3″. The cutting edges are formed by burring over the long edges. When drawn over the timber very fine shavings are produced. Some scrapers are fitted with handles to make them easier to manipulate; others are fitted into a stock similar to a smoothing plane stock and used like a plane. Another type has a stock similar to a spokeshave to hold the scraper blade.

USES: To produce a very smooth surface and remove marks left by the plane. A scraper is very handy for smoothing up a cross grained area on the job.

Small shaped scrapers may be held in a "scratch stock" (see fig. 331, plate 71) and used for producing small mouldings.

SHARPENING THE SCRAPER—Fig. 74.

Step 1. (a) File all edges straight and square to the sides with the length of the file along the edges of the scraper. A flat mill file is the most suitable to use.

(b) Holding the scraper vertical, rub it on the oilstone to remove file marks. (Fig. 74a.)

Step 2. Place the sides of the scraper flat on the stone and rub lightly to remove any burr or wire edge. (Fig. 74b.)

Step 3. Place the scraper in the vice and run a burnisher (a gouge may be used) along the edges:—(a) first holding it flat or horizontal to flatten the edges; (b) next

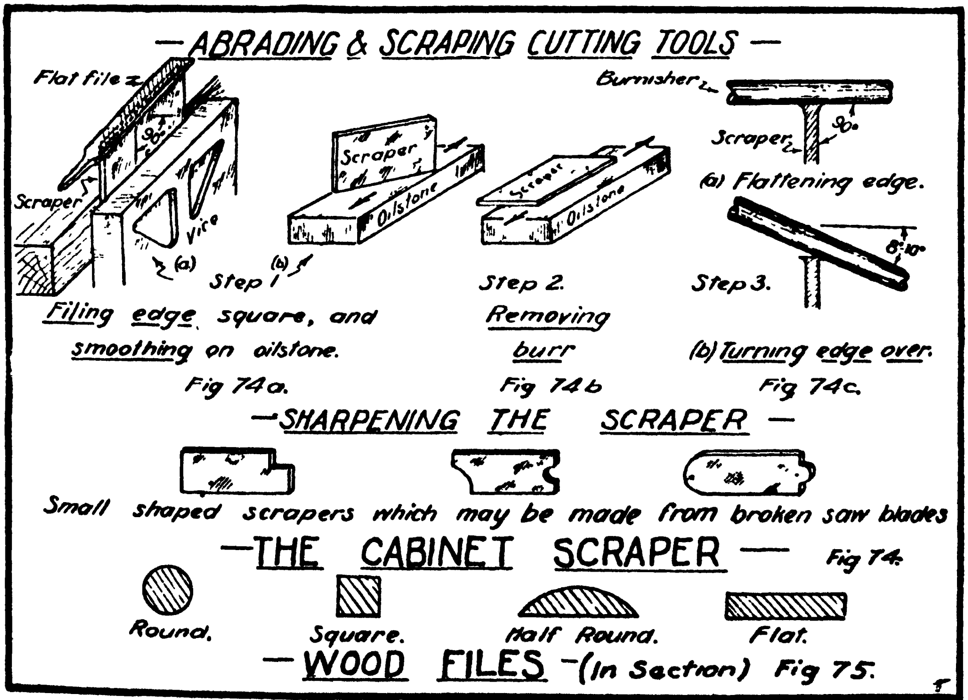


PLATE 15.

tip the burnisher over at an angle of 8° to 10° to bend or turn the edge slightly. Thus the small cutting edge is produced. (Fig. 74c.)

When using the scraper it is held in both hands in much the same way as the spokeshave and pushed away from the operator, the scraper being tilted away into such a position that it cuts, i.e., removing fine shavings and not dust.

2. **Abrasive Papers.**

GLASS PAPER consists of powdered glass or crushed flint rock or quartz glued to a stiff paper. The glass is crushed and passed through a series of screens or sifters to produce the various grades: Flour, 00, 0, 1½, F2, M2, S2, 2½, 3. Flour paper, being extremely fine, is used in the final stages of french polishing to level up the surface between coats. GARNET PAPER (usually waterproof) is made from crushed garnet, graded and glued to stiff paper. Grades 7/0 to 4. Garnet is a natural stone or rock used in jewellery, the less pure parts being used for the manufacture of garnet abrasives.

CARBIDE OF SILICON and ALUMINIUM OXIDE are artificial abrasives glued to waterproof paper.

USES: For removing scraper marks on the timber so as to produce a very smooth surface usually in preparation for a finish such as french polishing and lacquering. Garnet paper is more flexible than glass paper and is specially suitable for smoothing mouldings, etc. Waterproof papers are used with water for levelling enamelled surfaces.

NOTE: Glass paper should always be used wrapped round a block or rubber, and used carefully so that the sharp edges of the job are not rubbed off, spoiling the appearance of the work. (Cork rubbers are generally used.) Shaped rubbers should be made to suit moulded work.

3. **Files and Rasps**—Fig. 75, plate 15. FILES are made in a variety of shapes and grades of cut. Square: for filing square holes and slots, etc. Flat: used on flat surfaces or convex edges. Half-round: for filing concave surfaces and edges, also for enlarging holes, etc. Round: for enlarging holes and filing sharp concave edges. Triangular saw file (single cut tapered): used for sharpening saws, and can be used for filing grooves, etc.

RASPS. Usually half-round in section, the teeth being formed on the surface of the file blank with a special punch. The rasp removes the wood fairly quickly, but leaves a rough surface which should be finished with a file and then glass paper.

QUESTIONS.

1. Describe a cabinet scraper and state its uses.
2. What metal is used in the scraper? Why do you think this metal is used?
3. Describe fully how you would sharpen a scraper. (Use sketches.)
4. Why are the edges burred over with the burnisher?
5. What is glass paper?
6. What is garnet paper?
7. How is glass paper used? State its uses.
8. Describe the uses of the round, flat, and half-round files.
9. Draw the cross-sections of five files.
10. What is the difference between the rasp and the file?

SUBSECTION 3. BORING CUTTING TOOLS.

A. BITS—Figs. 76 to 83, Plate 16.

There are many varieties of bits, all having been designed for boring holes under special conditions.

KINDS:—

1. **Shell Bit,** 2. **Spoon Bit,** 3. **Nose Bit.** These bits are somewhat old-fashioned, and are very rarely seen in the workshop these days, being superseded by the cobra bit and wood drill. They have to be forced into the timber by continual pressure.

USES: All are used for boring small holes for nails and screws. If carefully used they will not split the timber. They are particularly useful for boring with the grain.

4. **Cobra Bit**—Fig. 76. (Also known as Half Twist, Nail, Snail, Screw and Gimlet Bit.) Has a twisted point which draws the bit into the wood. Owing to its tapered point, care must be taken not to split the timber while boring near the end. Sizes: $\frac{1}{16}''$ to $\frac{3}{8}''$, intervals of 32nds of an inch.

USES: For boring small holes for nails and screws.

5. **Twist Bit**—Fig. 77. (Sometimes called an Auger Bit.) This bit has both a twisted point and a twisted shank. The twisted point draws the bit into the wood. Two varieties are made, one for hardwood (without spurs or scribers) and one for softwood (Jennings Pattern, with spurs). Sizes: $\frac{1}{4}''$ to $1\frac{1}{4}''$, intervals of 16ths.

USES: For boring deep holes in hardwood or softwood. Particularly useful when boring in end grain, as the long twisted shank will keep the hole straight and throw out the waste.

6. **Dowel Bit**—Similar to the twist bit, only shorter. Sizes: $\frac{1}{4}''$ to $\frac{5}{8}''$.

USES: For boring holes for dowels and preliminary boring out waste of mortises.

7. **Centre Bit**—Fig. 78—is different from other bits as regards to shape, but its cutting action is similar to the twist bit. Sizes: $\frac{1}{4}''$ to $2''$, intervals of 16th up to $1''$ and 8ths from $1''$ to $2''$.

PARTS: (1) *Centre Point* (which is sometimes threaded) guides the bit.

(2) *Spur or Scriber* (which is slightly shorter than the point) cuts the rim of the hole.

(3) *Router or Cutter* (which is slightly shorter than the spur) removes the waste.

USES: Centre bits are suitable for boring shallow holes or holes through thin timber ONLY, as there is no guiding shank to keep it boring straight.

8. **Expansion Bit** is able to be adjusted to cut holes from $\frac{1}{2}''$ to $3''$. The cutting action is similar to the centre bit, which it resembles somewhat in its appearance.

USES: For boring shallow holes or through thin wood.

9. **Wood Drills**—Fig. 79. Are steel drills with twisted flutes and fitted with square heads to fit the chuck of the brace. They have no twisted point, and have to be forced into the timber. Sizes: 1/16″ to $\frac{1}{4}''$ in 1/32″ intervals. Numbers on shank of bit indicate 32nds of an inch.

USES: For boring holes for nails and screws, etc. Can be used in hardwood or softwood, boring a clean neat hole without fear of splitting the timber.

D

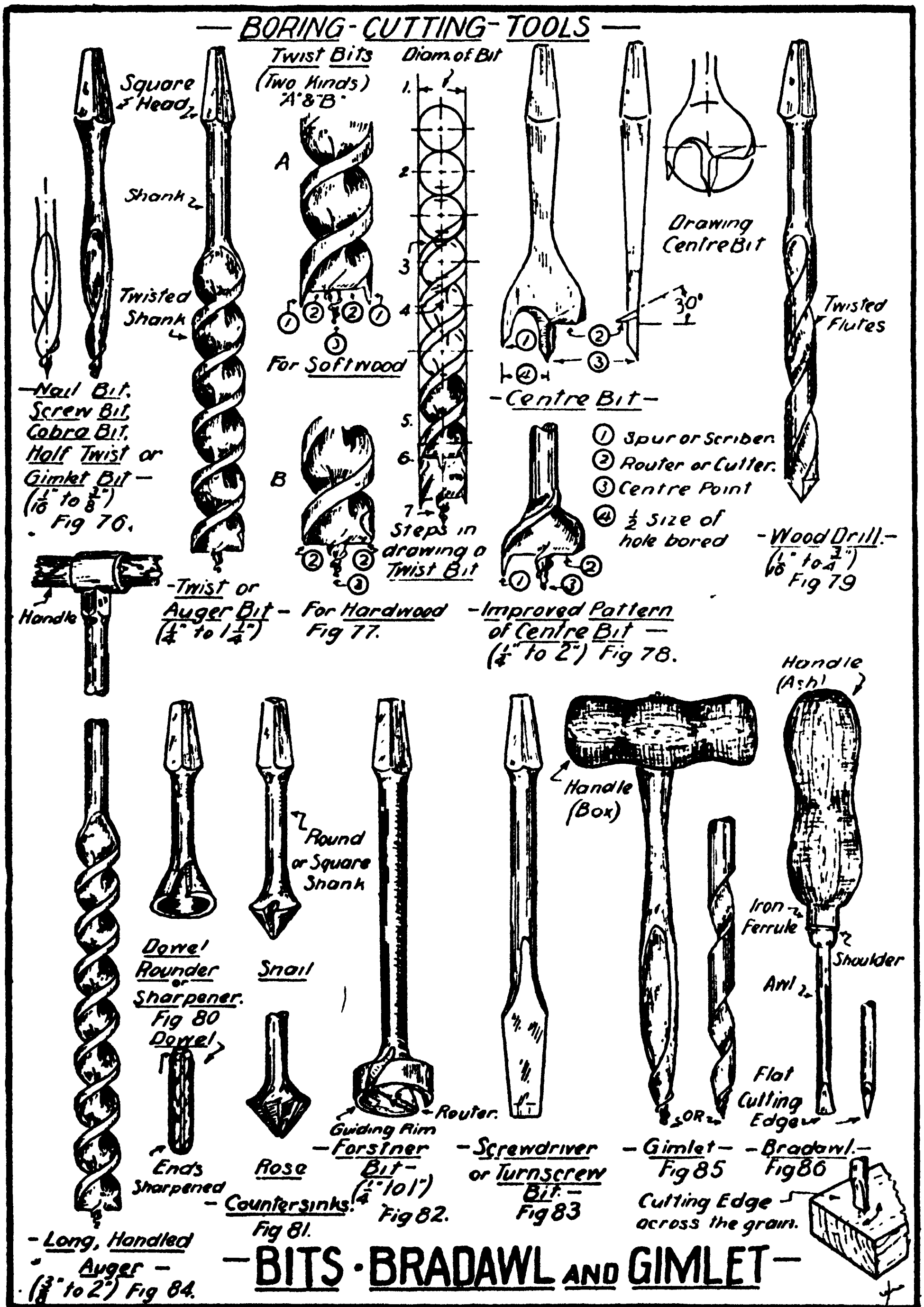

— BORING-CUTTING-TOOLS —
Square Head
Shank
Twisted Shank
-Nail Bit. Screw Bit. Cobra Bit. Half Twist or Gimlet Bit — (1/16" to 3/8") Fig 76.
Handle
-Twist or Auger Bit — (1/4" to 1 1/4")
Twist Bits (Two Kinds) "A" & "B"
A
B
For Softwood
For Hardwood Fig 77.
Diam. of Bit
Steps in drawing a Twist Bit
-Centre Bit-
Drawing Centre Bit
30°
① Spur or Scriber.
② Router or Cutter.
③ Centre Point
④ ½ size of hole bored
-Improved Pattern of Centre Bit — (1/4" to 2") Fig 78.
Twisted Flutes
-Wood Drill.- (1/16" to 3/4") Fig 79
-Long, Handled Auger — (3/8" to 2") Fig 84.
Dowel Rounder or Sharpener. Fig 80
Dowel
Ends Sharpened
Round or Square Shank
Snail
Rose
- Countersinks. Fig 81.
Guiding Rim
Router.
-Forstner Bit- (1/4" to 1") Fig 82.
-Screwdriver or Turnscrew Bit.- Fig 83
Handle (Box)
OR
-Gimlet- Fig 85
Handle (Ash)
Iron Ferrule
Shoulder
Awl
Flat Cutting Edge
-Bradawl.- Fig 86
Cutting Edge across the grain.
—BITS · BRADAWL AND GIMLET—

PLATE 16.

10. **Dowel Rounder**—Fig. 80. For chamfering or sharpening the ends of dowels.

11. **Countersinks**—Fig. 81. These bits have a tapered cutting point which enlarges the tops of holes, a process called countersinking.

USES: For countersinking the tops of holes to receive the heads of countersunk head screws. The snail pattern is most suitable for hard woods.

12. **Forstner Bit**—Fig. 82. This bit, unlike other bits, is guided not by a centre point but by its circular rim, consequently it can be used to bore at any angle to the surface of the work regardless of the direction of the grain. Sizes: $\frac{1}{4}''$ to $1''$.

USES: For boring skewed holes (called pocketing) for screws, e.g., as in the rails of tables to enable skew screwing of the top to the rails, also for flat bottomed holes in pattern making. (See fig. 249, plate 33.)

13. **Turnscrew or Screwdriver Bit**—Fig. 83. A bit shaped with a blade to fit the slots of screws, not a boring tool.

USES: For inserting and removing screws (it is held in the brace).

B. AUGER—Fig. 84. A twist bit with a long shank, the head being shaped with an eye for fitting a cross-bar or handle to give greater leverage. Sizes: $\frac{3}{8}''$ to $2''$.

USES: For boring large, deep holes for bolts, etc., in hardwood where the brace is not strong enough to turn a bit.

C. GIMLET—Fig. 85. Similar to a nail bit with a small cross handle for hand boring.

USES: For boring small holes for nails and screws where a brace cannot be used. The gimlet must be used with care; being like the nail bit, it will split the timber.

D. BRADAWL—Fig. 86. Consists of a thin steel rod, which is flattened to a small cutting edge at one end, and a tang fitting into a boxwood handle at the other end. The flat cutting edge is placed across the grain and forced into the timber while being twisted back and forth so that the fibres are cut, thus making a small hole.

USES: Used for making small holes where the brace and bit is not necessary.

SHARPENING BITS.—PLATE 17.

The Centre Bit—Fig. 87. Hold the bit more or less vertically with the point on a flat surface and file the top edge of the cutter at an angle of 30°. Lightly touch the inside of the scriber or spur with a file and finish with an oilstone slip.

The Twist Bit—Fig. 88. Is sharpened in the same manner as the centre bit, care being taken not to damage the threaded point. The spurs can be carefully filed occasionally.

The Cobra Bit—Fig. 89. Use a rat-tail file (round file), filing lightly the cutting edge towards the point. Remove the burr on an oilstone.

Countersinks—Fig. 89a. Use a rat-tail file for the snail pattern and a three-cornered for the rose pattern.

QUESTIONS.

1. Sketch a nail bit and describe its uses. Describe how you would sharpen this bit.
2. Why is it necessary to be careful when boring with the nail bit?

3. Name the most suitable bit for boring a deep hole for a bolt. Why is it suitable?
4. Show by sketches the difference between the cutting points of the hardwood and softwood twist bits.
5. Give the name of a bit most suitable for boring small holes for nails and screws.
6. Sketch and describe the parts of a centre bit. State its uses.
7. Describe the uses of the dowel rounder and countersinks.
8. Name three boring tools which are not used in conjunction with the brace.
9. What is the difference between the twist bit and the handled auger?
10. Show by sketches how you would sharpen (a) the centre bit, (b) the twist bit.

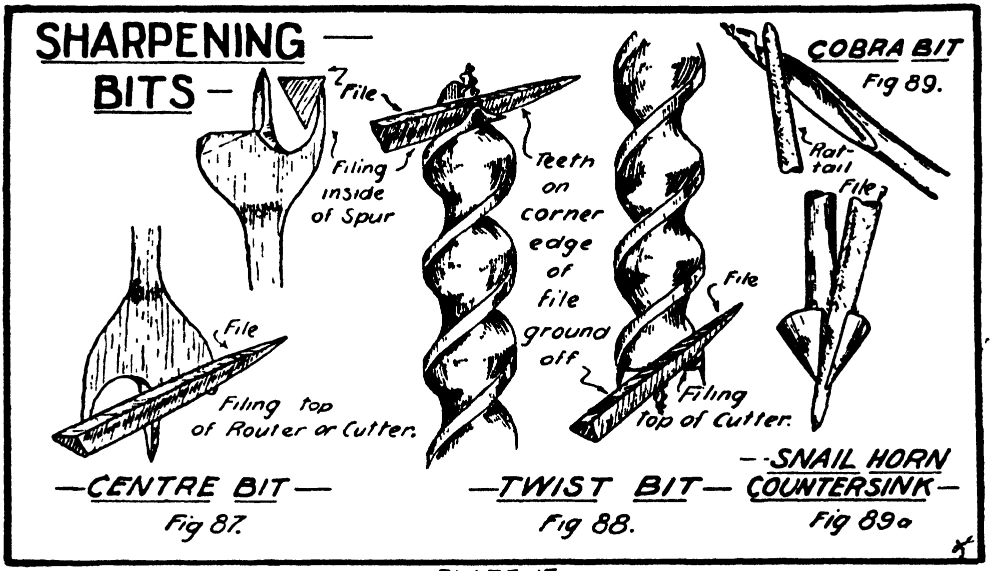


PLATE 17

GROUP 4.

PERCUSSION AND IMPELLING TOOLS (Plate 18).

A. HAMMERS.

1. **Claw Hammer**. Generally purchased according to the weight of its head; weights range from 8ozs. to 32ozs. This hammer, as its name suggests, possesses a claw for extracting nails. Handle made of Ash, Spotted Gum or Hickory.

Uses: Not of much use in cabinet work; mainly used for heavy work, as in carpentry, where a heavy hammer is necessary to drive large nails.

2. **Warrington Hammer**—Fig. 90. This is a light hammer with a cross pein (pane or pene or pean). Sizes run in number, 00 to 12, a No. 2 or 3 (about 10ozs.) being the most suitable size.

Uses: For general use in cabinet work and light hammering generally. The cross pein being used for starting small nails and brads, etc., and can be used for pressing small inlays and veneers into position.

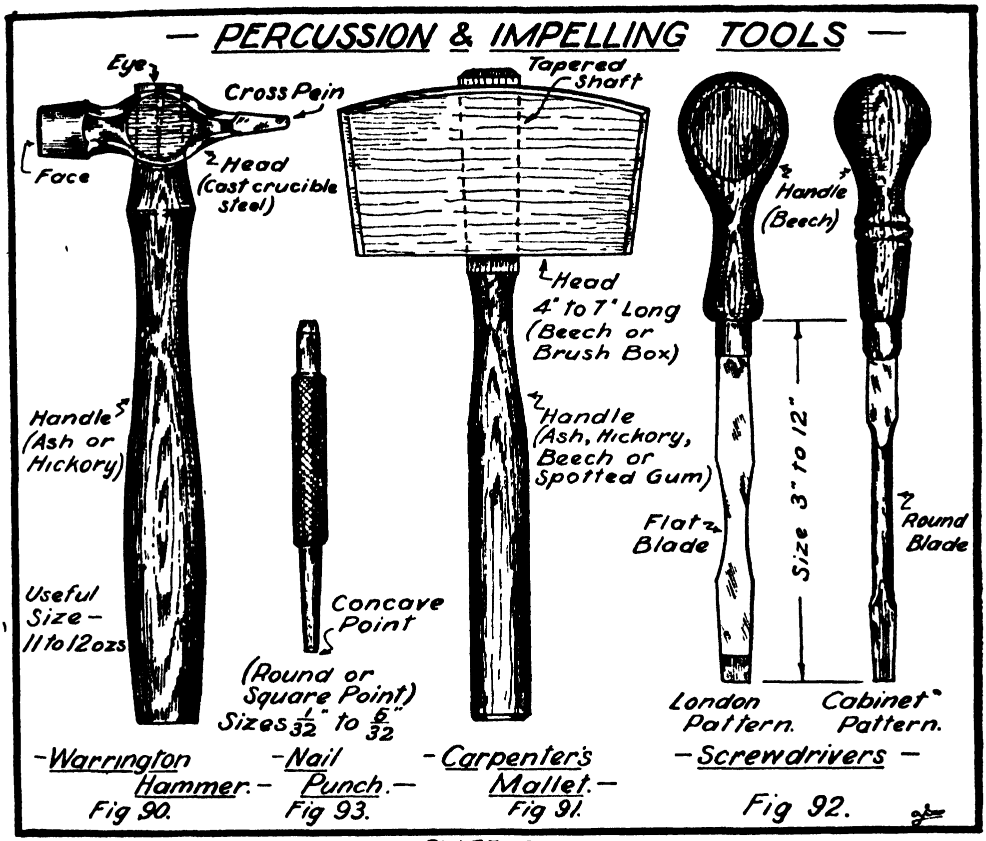


PLATE 18

B. MALLETS.

1. **Carpenter's or Joiner's Mallet**—Fig. 91. This is a wooden hammer, head 4″ to 7″. For general work a 6in. is a useful size. The head is made of beech or brush box, and fitted with a tapered shaft or handle made of beech, ash or spotted gum.

USES: For driving chisels and for assisting in assembling jobs.

C. NAIL PUNCH or Nail Set—Fig. 93. Can be obtained with round or square points, round being most generally used. Sizes: 1/32″ to 5/32″ diam. The smaller sizes being mostly used for cabinet work. The point is usually concave.

USES: Used in conjunction with the hammer for driving nails below the surface of the timber.

D. SCREWDRIVERS—Fig. 92. These are obtainable in a variety of sizes and patterns. Most common types are London and Cabinet patterns. Sizes 3″ to 12″ (length of blade). (See also Screwdriver Bit, No. 13, page 41.)

USES: For inserting and removing screws.

E. THE BRACE. Classified above under Holding and Supporting Tools, is sometimes grouped in Impelling Tools, as it impels the various bits. (See Holding and Supporting Tools for details.)

QUESTIONS.

1. Describe and state the special uses of the claw hammer.
2. Name the most suitable hammer for use in cabinet work; state its uses.
3. Sketch a Warrington Hammer and name its parts.
4. Name the tool used for driving chisels. What woods are used in its construction?
5. Give your reasons why a mallet and not a hammer is used for impelling chisels and tapping the parts of jobs together.
6. Describe how you would drive the head of a nail below the surface of the job.
7. Why is it necessary to use a nail punch?
8. Sketch a cabinet pattern screwdriver and name its parts.
9. Why is a brace sometimes classified as an impelling tool?
10. Name five timbers suitable for tool handles.

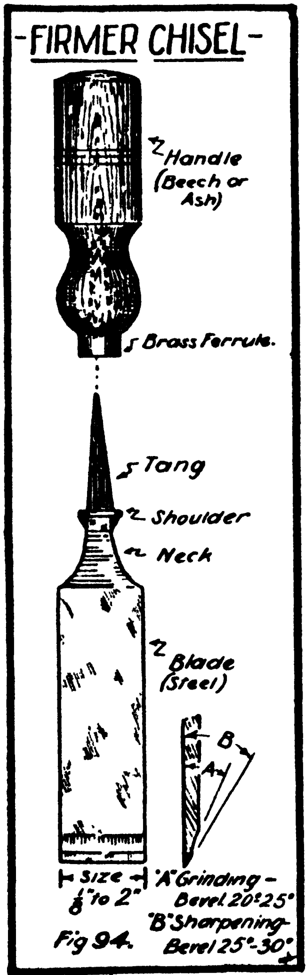


PLATE 19

III. THE FIRMER CHISEL
(Fig. 94, Plate 19)

CLASSIFICATION: Paring and Shaving Cutting Tools.

USES: For general chiselling purposes, such as paring out the waste of housing joints, halving joints, etc. Being fairly strong, it can be used lightly with the mallet.

Sizes: Width of cutting edge, $\frac{1}{8}''$ to $2''$.

PARTS:—

1. *Handle,* usually made of beech or ash, cylindrical in shape, the top being slightly rounded to prevent burring. It is fitted with a brass ferrule to prevent splitting where the "tang" of the blade enters.

2. *Blade* is made of well tempered steel, and consists of the following:—

(a) Blade proper is $\frac{1}{8}''$ to $2''$ wide and rectangular in section; the cutting edge is ground at about 20° to 25° and sharpened at about 30°.

(b) Tang. This is the tapered end of the blade which fits into a hole in the handle.

(c) Shoulder. The lower end of the tang is shaped to form a shoulder, which prevents the tang from being driven too far into the handle.

(d) Neck. The neck is the shaped portion beneath the shoulder.

NOTE: When using the chisel for paring purposes always keep every portion of the body behind the cutting edge; this is a safety first measure in case the chisel should slip. Also if using with the mallet for mortising, etc., keep the cutting edge across the grain; this prevents splitting the timber.

For Holding the Chisel see figure 95, plate 20.

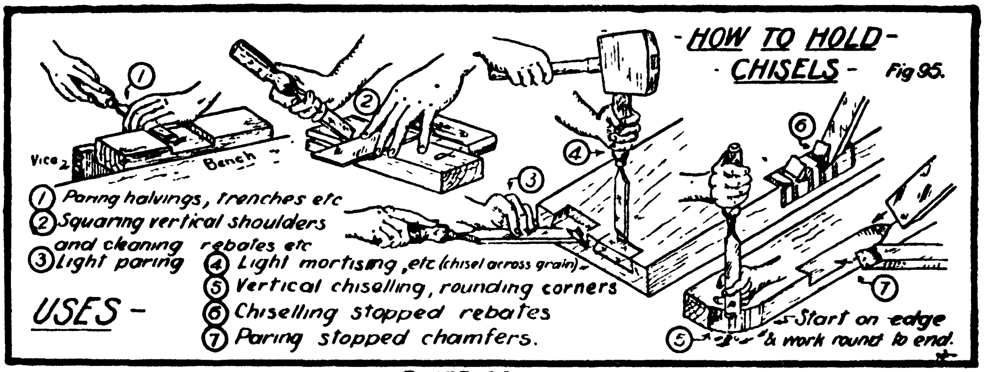


PLATE 20

QUESTIONS.

1. Give the full classification of the Firmer Chisel.
2. How would you determine the size of a chisel?
3. State the uses of the Firmer Chisel.
4. Name the timbers most suitable for chisel handles. State your reasons for selection.
5. Make a neat sketch of a Firmer Chisel and name all parts.
6. Show by a small sketch how the blade is fixed to the handle.
7. What is the purpose of the ferrule?
8. What is the purpose of the shoulder?
9. Write down the grinding and sharpening angles.
10. Briefly describe how the chisel is used for (a) rounding corners; (b) light mortising.

IV. THE TENON SAW (Fig. 96, Plate 21).

CLASSIFICATION: Abraiding Cutting Tools.

USES: For cutting tenons, sawing sides of trenches, etc., and general bench work in conjunction with the cutting board or vice.

Sizes: 8″ to 18″ equals length of blade.

PARTS:

1. *Handle* is a closed type of handle, made of beech, and so shaped that the saw

can be used in a horizontal position on the bench. C.F. rip saw and cross-cut saws, which are generally used at an angle on the sawing stool. (Figs. 51 and 52, plate 11.)

2. *Blade,* average length 14" long, made of well tempered steel and strengthened by a "back" or stiffening rib of brass or steel, which prevents the thin blade from buckling.

3. *Teeth*: Number from 12 to 14 points per inch, the front edge of the tooth being at an angle of 75° to the line of the teeth.

Note: When using the Tenon Saw hold it in the right hand with the pointer or index finger along the handle pointing to the blade; this gives a firmer grip. (See fig. 53, plate 11.) When starting a cut, guide the saw to the line with the thumb of the left hand and allow the teeth to just touch the job for the first few cuts. Do not try to force the saw to cut. (See fig. 97, showing the Use of the Tenon Saw for cross cutting and ripping.)

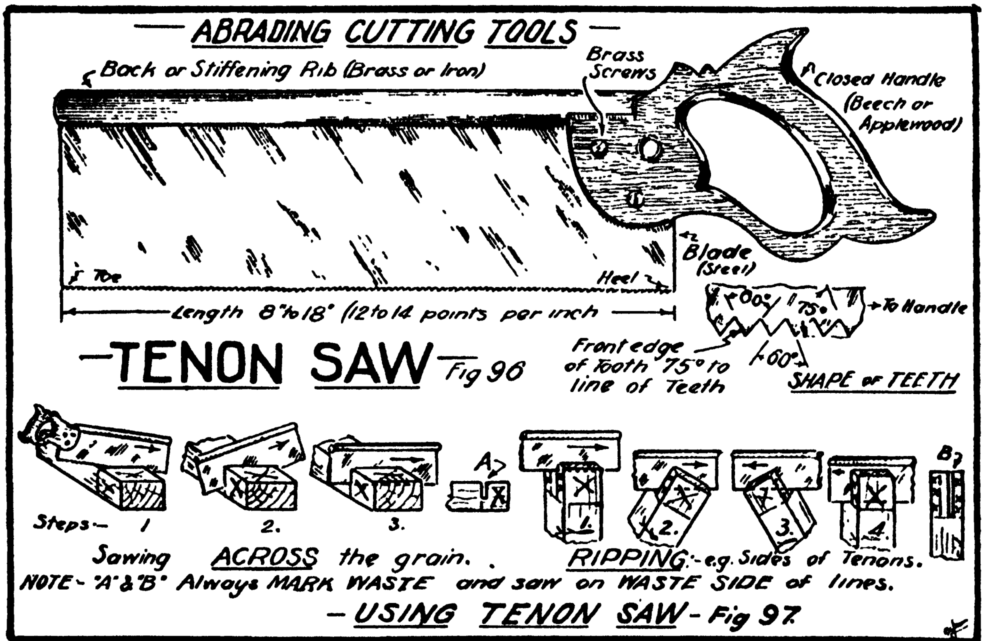


PLATE 21

QUESTIONS.

1. What is the classification of the tenon saw?
2. Describe the differences between the handles of the tenon saw and rip saw.
3. Describe the uses of the tenon saw.
4. How would you state the size of a tenon saw?
5. Why is the tenon saw sometimes referred to as a "Back Saw"? What is the purpose of the back?

6. Make a neat enlarged sketch showing the shape of the teeth of the tenon saw; insert all details.
7. What timber is used in the handle of the tenon saw?
8. Illustrate the uses of the tenon saw for ripping.
9. Describe how you would hold the tenon saw.
10. Make a sketch of the tenon saw and name all its parts.

V. THE WOODEN JACK PLANE (Fig. 98, Plates 22 and 23).

CLASSIFICATION: Paring and Shaving Cutting Tools.

USES: The jack plane is used for removing the rough surface of the wood fairly quickly and making it approximately true.

Wooden jack planes are made of English Red Beech. Beech being found most suitable for the following reasons:—

(1) It is uniform in texture.
(2) It retains its shape when thoroughly seasoned.
(3) It is a tough, straight grained, compact wood.
(4) It wears well and evenly.
(5) It is plentiful and reasonably cheap.

SIZES: Size is determined by the width of the cutting iron, 2″ to 2¼″. Length of stock, 14″ to 17″. The cutting iron is always fitted with a "Cap Iron."

PARTS:—

1. *Stock or Body*: Made of English Beech, 14″ to 17″, and about 2¼ to 2½ square. (See figure 98 for names of parts of the stock.)

2. *Handle or Toat:* Made of beech and let into the stock behind the cutting iron. The handle is so shaped and placed that the force of the hand is directed to the cutting edge, thus a minimum of effort is required to operate the plane. (See inset, fig. 98.)

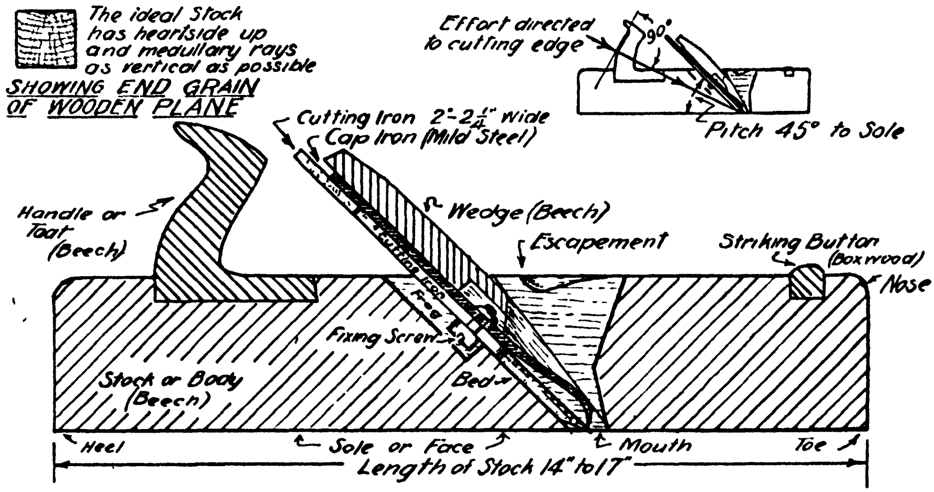
3. *Button:* Some planes have a button, i.e., a raised piece of tough wood (usually Boxwood) let into the nose of the stock to receive blows of the hammer when separating the irons from the stock or when reducing the set of the cutting iron.

4. *Wedge* is made of Beech and serves to hold the cutting iron in position. It fits into carefully prepared grooves in the side of the escapement.

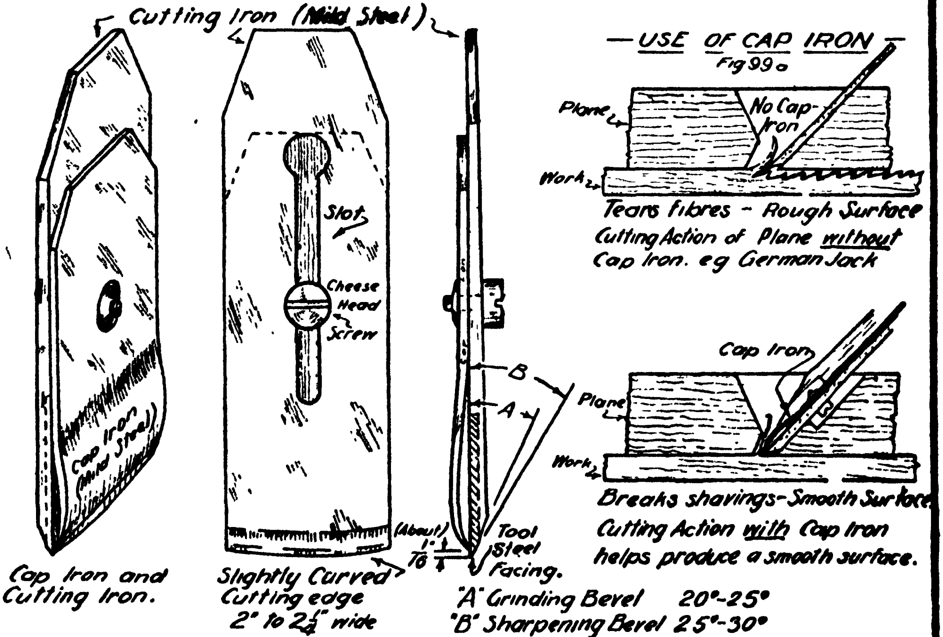
5. *Cutting Iron* is usually set at 45° to the sole of the stock and consists of (a) a blade of mild steel, with (b) a tool steel face welded to its front surface as far as the slot. This tempered steel facing forms the cutting edge (see shaded portion on edge view of cutting iron in fig. 99). The reasons for having only a thin portion of hard steel are to prevent the top of the cutting iron from splintering or breaking while being hammered when setting, and to reduce unnecessary effort when grinding and sharpening, as the soft iron grinds away quickly. The grinding angle is 20° to 25° and the sharpening angle 25° to 30.° The cutting edge is slightly curved, enabling it to take off fairly thick shavings with a minimum of effort. (Fig. 99.)

6. *Cap or Back Iron* is made of mild steel, and is secured to the cutting iron by means of a screw which fits through a slot in the blade. The purpose of the cap iron is to break the shavings, thus preventing the fibres from tearing up, enabling a smooth surface to be produced. Also to some extent a good fitting cap iron prevents

— PARING & SHAVING CUTTING TOOLS —



— SECTION OF JACK PLANE — Fig 98



— CUTTING IRONS — Fig 99.

— THE WOODEN JACK PLANE —

PLATE 22

the cutting iron "chattering" (vibrating). The edge of the cap iron is usually fixed at about 1/16" from the edge of the cutting iron. (See figs. 99 and 99a, plate 22; fig. 100, Holding Jack Plane, plate 23.)

SETTING THE WOODEN JACK PLANE.

Fix the cap iron about 1/16" back from the edge of the cutting iron.

Hold the stock in the left hand with the thumb in the throat to hold the loose parts when inserted, and the fingers under the sole of the plane. Insert the irons with the cap iron up and the bevel of the cutting iron down, temporarily fixing them in position with the wedge. Still holding the plane in the same manner, turn the plane over so that the sole and the cutting edge may be sighted, any adjustment is made and the wedge tapped "home." A sight is made again; the cutter should appear as a thin black line. If the cut needs increasing, tap the back end of the cutting iron; if it needs decreasing, tap the tapping button; this will bring the irons up; when satisfied, fix the wedge in tightly.

NOTE: To remove the cutting irons or decrease the set, hold the plane as above, with the heel of the plane against your groin and hit the tapping button sharply with a hammer or mallet until the irons and wedge are loose. As above, the thumb holds the irons, preventing them from jumping out. *Never hold the plane by the handle to do this, as the handle is liable to snap off owing to its short grain.*

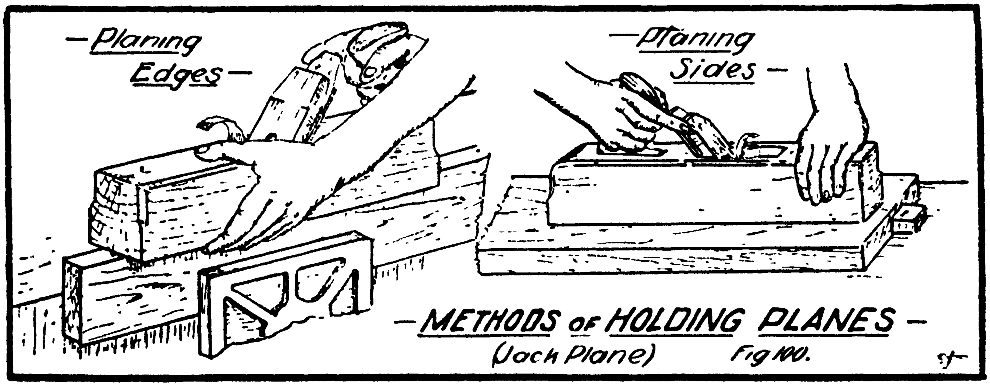


PLATE 23

QUESTIONS.

1. What type of cutting tool is the jack plane?
2. Name the timber used in the manufacture of wooden planes and state the reasons why this timber is used.
3. What governs the size of the jack plane?
4. Write down the special uses of the jack plane.
5. Make a neat sectioned sketch of the stock of a wooden jack plane and name its parts.
6. Describe the cutting iron of a wooden jack plane. Why are two metals used in making the cutting iron? Name the metals.

7. What is the purpose of the cap iron and how is it secured to the cutting iron?
8. How far away from the cutting edge is it usual to set the cap iron?
9. Write down the grinding and sharpening bevels of the jack plane cutting iron.
10. Describe how you would set a wooden jack plane. Why is it important not to hold the plane by the handle when removing the irons?

VI. THE COMBINATION, MULTI AND UNIVERSAL PLANES

These are metal planes capable of a wide range of planing operations which may be grouped broadly into grooving, rebating and moulding.

A. THE COMBINATION PLANE. (Two makes—Stanley No. 50 and Record No. 050A.) (Fig 101.) This plane is the smallest and the lightest of the "multi purpose" planes. The operations carried out by this plane are limited to (1) Ploughing or Grooving, (2) Rebating, and (3) Trenching or Dadoing with nine sizes of cutters; (4) Beading with seven sizes of cutters, and (5) Matching, i.e., tonguing and grooving with one cutter for ¼″ tongue (see fig. 102). The two makes of planes are almost identical in parts and uses.

PARTS. The Combination plane is made of nickel plated steel.

1. **The Main Stock** holds and supports one side of the cutter; the Cutter Adjustment Lever or Screw; the Depth Gauge and a Spur.

2. **The Arms** are screwed into the Stock and support the Sliding Section and Fence.

3. **The Sliding Section** is the counterpart of the Main Stock to hold and support the other side of the Cutter. It slides on the Arms and is bolted by means of the Cutter Bolt through the Stock, to clamp the Cutter securely in position. It is kept parallel to the Stock by the Sliding Section Adjusting Screw. A Spur may be fixed to the Sliding Section in advance of the Cutter to aid cross grain planing. A Beading Gauge can be attached to act as a fence when beading tongued boards.

4. **The Fence** is adjustable along the Arms and is fixed with Thumb Screws.

ASSEMBLING THE PLANE. (1) Screw arms into main stock. (2) Slide sliding section on arms. (3) Insert cutter from underneath; see that it engages on adjusting lever or screw. (4) Lightly tighten sliding section against cutter and adjust the screw which makes the sliding section parallel with the stock. (5) Adjust set of cutter. (6) Tighten wing nut to clamp cutter securely between the sliding section and the stock. (7) Adjust depth gauge. (8) Slide fence on arms and fix at required distance from cutter.

NOTE: Always slacken off the clamping nut before adjusting set of cutter, and tighten after adjusting. ⅛″ and 3/16″ cutters are clamped in position, using a special screw or bracket supplied with the plane. (Fig. 101.) The sliding section is not used with these cutters.

USING THE COMBINATION PLANE. (Plate 25.)

1. **Ploughing** or **Grooving.** Assemble the plane as above, using the required size plough cutter. Start planing at the far end of the job and gradually work back. To keep the plane vertical, press the fence against the side of the work. (Fig. 111.)

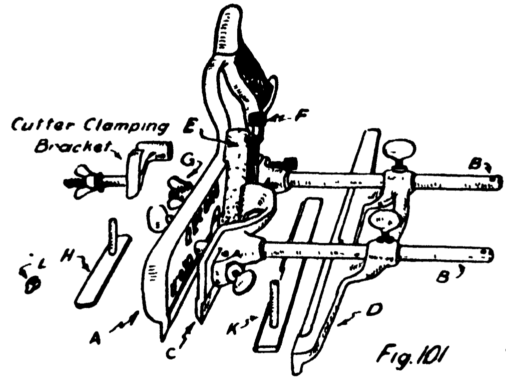
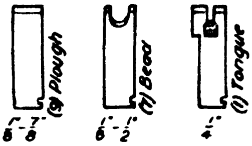
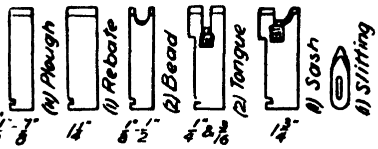


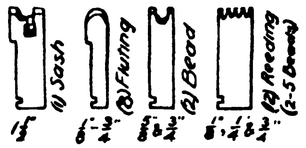
Fig. 101
— COMBINATION PLANE —



C Plane Cutters Fig 102



M. Plane Regular Cutters Fig 104

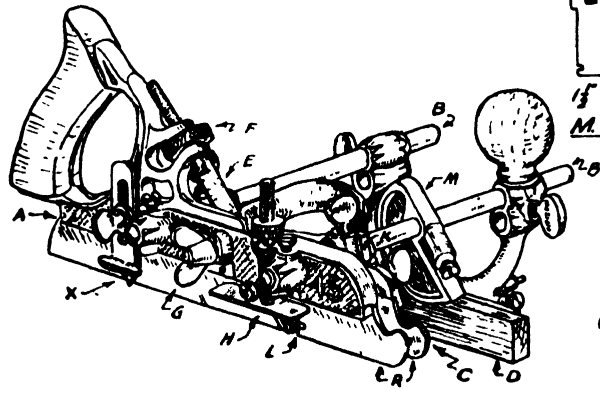


M. Plane Special Cutters Fig. 105.

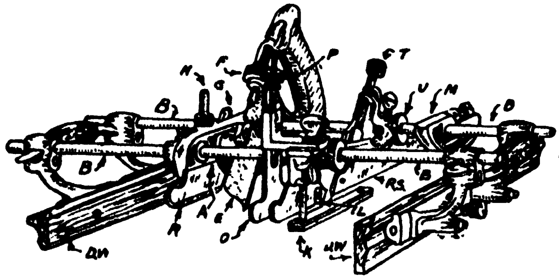

(4) Hollow Base & Cutters. Fig. 106.


(4) Round Base & Cutters Fig. 107


(1) Nosing Base & Cutter. Fig. 108



— MULTI PLANE — Fig. 103



— UNIVERSAL PLANE — Fig 109.

Universal Moulding Cutters Fig. 110.

A—Main Stock B—Arms. C—Sliding Section D—Fence. E—Cutter. F—Cutter Adjusment Nut. G—Cutter Bolt Wing Nut H—Depth Gauge. K—Beading Gauge. L—Spur. M—Cam. O—Auxiliary Centre Bottom. P—Aux. Bottom Adjusting Nut. R—Runners. S—Adj. Runner. T—Adj. Runner Screw. U—Thimble Check Nut. W—Fence Tilting Plate. X—Slitting Tool

PLATE 24.

2. **Trenching.** Assemble as for ploughing, adding the spurs to both the stock and the sliding section. If the trench is beyond the limits of the fence, cramp or pin a thin strip of wood on the work to guide the plane. (Fig. 112.)

3. **Rebating** (Rabbeting). Set up as for ploughing, using a cutter slightly wider than the desired rebate. Slide the fence under the cutter to guide the plane. Use the spur on the main stock for rebating across the grain. (Fig. 113.)

4. **Beading.** Use the bead cutter required and, when edge beading, attach the beading gauge to guide the plane. (Fig. 114a.) When centre beading, use the fence instead of beading gauge. Set the depth gauge level with the hollow in the cutter.

5. **Tonguing and Grooving.** Plough a groove, using a ¼" cutter. Use the tonguing cutter with its individual depth stop set to the required length of tongue. Adjust the fence so that the tongue is planed in the required position. (Fig. 115.)

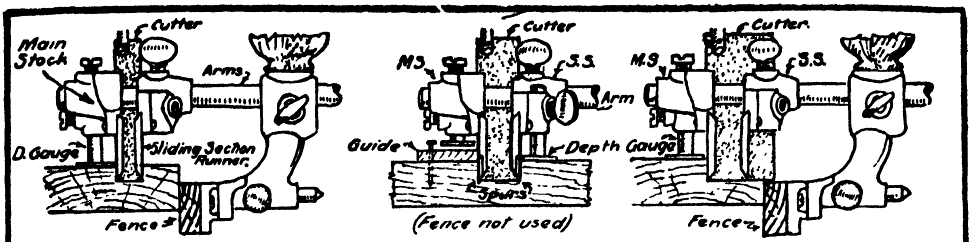
B. THE MULTI PLANE. (Two makes, almost identical in every respect—Stanley No. 45 and Record No. 405.) (Fig. 103, Plate 24.)

The Multi Plane is larger than the Combination Plane and has a wider range of operations. It is provided with 23 cutters. Up to 30 additional cutters may be purchased if required; some of these require special bottoms or soles to be used in place of the sliding section. (See figs. 104, 105, 106, 107 and 108.)

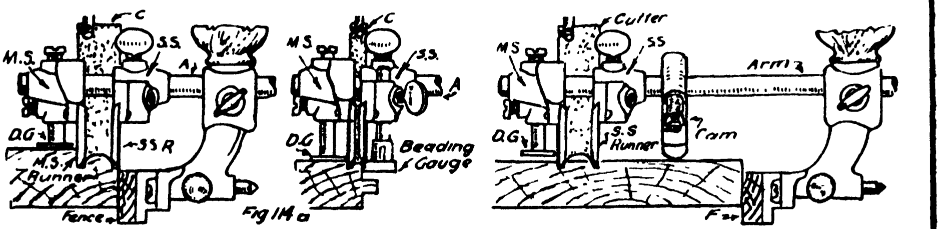
This plane can be set up as any one of the following:—(1) Plough Plane, and (2) Trenching or Dado Plane with 11 sizes of cutters; (3) Side Fillister Plane and (4) Sash Fillister Plane with one 1¼" cutter; (5) Match Plane with two cutters; (6) Sash Plane with one cutter; (7) Slitting Plane with one cutter for cutting off thin strips of wood; and (8) Beading Plane with seven sizes of cutters. By obtaining additional cutters and attachments the plane used as (9) Round Plane for planing hollows with four cutters and special soles; (10) Hollow Plane for planing rounds with four cutters and special soles; (11) Nosing Plane with one 1½" cutter and special sole; (12) Fluting Plane with eight cutters, and (13) Reeding Plane with 12 cutters having two to five beads in different sizes.

PARTS: The Multi plane is similar to the Combination plane, having (1) the Main Stock, (2) Sliding Section and (3) Fence, plus a few added refinements. The Cutter is held in place and secured to the Main Stock only by means of a Tapered Clamping Bolt. The Sliding Section can be moved to any required position independently to support the near side of the Cutter. The Main Stock Depth Gauge is adjusted by means of a fine Adjustment Screw. The Fence may be used on either side of the Stock. The Arms which pass through holes in the Stock are fixed by Set Screws. Two sets of holes in the Fence enable it to be used in a high or low position. The low position allows it to pass beneath the Cutter for edge rebating. An Adjustable Cam is provided to support the plane when centre beading. It can be attached to either Arm. The Slitting Cutter and Stop is fixed to the outer side of the Stock.

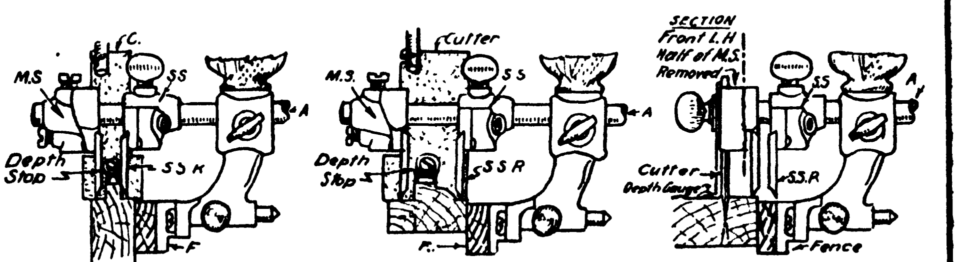
USING THE MULTI PLANE. The assembling of this plane is similar to the Combination Plane, the main difference being the method of fixing and adjusting the cutter. When setting up the plane for various operations follow the instructions as for the Combination Plane. For planing rounded nosing, hollows and rounds, use



—*Ploughing* Fig. 111. —*Trenching* Fig 112 —*Rebating* Fig. 113.

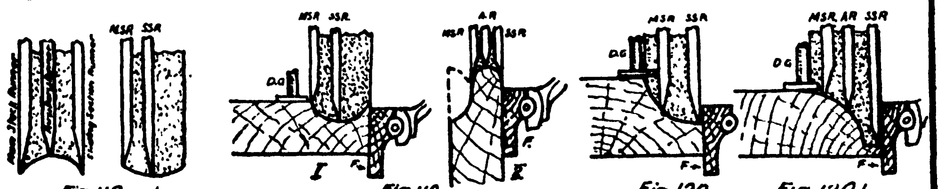


-*Ordinary Beading*; -*Beading Tongued Boards*- -*Centre Beading* Fig. 114 b



—*Tonguing* Fig 115 —*Sash Moulding* Fig 116. -*Slitting* Fig 117

Figs. 111 to 117 show settings of *Multi Plane* viewed from the front.



a. Fig 118 b. Fig 119 Fig 120 a. Fig 120 b.

—*Rounds* *Hollows*— —*Thumb Moulding*— —*Quarter Hollow & Round*—

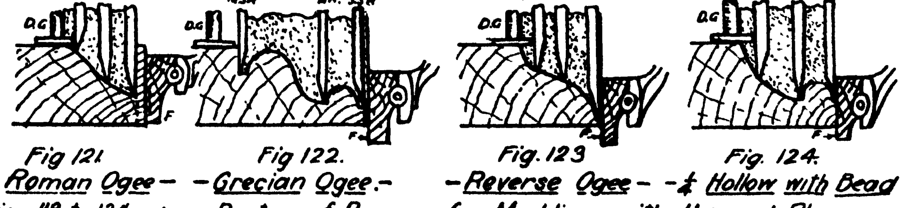


Fig 121 Fig 122. Fig. 123 Fig. 124.

—*Roman Ogee*— —*Grecian Ogee*.— —*Reverse Ogee*— —¼ *Hollow with Bead*—

Figs. 118 to 124 show *Position of Runners* for *Moulding* with *Universal Plane*.

PLATE 26.

the special attachments which may be obtained to fit the plane. (See figs. 111 to 117.)

C. THE UNIVERSAL PLANE. (One make—Stanley No. 55.) (Fig. 109, Plate 24.)

The Universal Plane will carry out all the operations of the Multi Plane and in addition will accommodate cutters of almost any shape and size to form mouldings. It is provided with 55 cutters and a further 41 may be purchased if required.

The regular cutters furnished with the plane are: (1) 11 Plough and Trenching; (2) One 1¼″ Fillister; (3) 8 Beading; (4) 1 Sash; (5) 2 Match; (6) 1 Slitting; (7) 1 right-hand and 1 left-hand Chamfer; (8) 4 Fluting; (9) 4 Hollow; (10) 4 Round; (11) 2 Quarter Hollow for planing ¼ rounds; (12) 2 Quarter Round for planing ¼ hollows; (13) 3 Reverse Ogee; (14) 2 Roman Ogee; (15) 3 Grecian Ogee; (16) 2 Quarter Round with Bead; and (17) 3 sizes of Bead with two beads each. (Fig. 110.)

The special cutters available consist of additional sizes of the above regular cutters. Blank cutters may be obtained on which special shapes may be ground or filed.

PARTS: The Universal Plane has the following parts:—Main Stock, Arms, Sliding Section, Auxiliary Bottom or Sole, two Fences, Depth Gauges, Cam Rest, Slitting Tool and Spurs, plus the 55 or more cutters. The parts are similar to those of the Multi Plane with these exceptions:—(1) The steel sole or Runner of the Sliding Section is adjustable so that it can be raised or lowered to support moulding cutters which may be higher or lower on one side or the other. (2) The Auxiliary Bottom or Runner can be attached to the Sliding Section to provide additional bearing on the work when using wide or irregular shaped cutters. It can also be raised or lowered. (3) Two Fences with rosewood faces (which can be tilted for angular planing) are provided, one for use on the L.H. side of the plane and one for the R.H. side.

ASSEMBLING THE UNIVERSAL PLANE.

(1) The Cutter, Depth Gauges and Fences are assembled in the same way as the Multi Plane, care being taken to loosen the Cutter Bolt before adjusting the Cutter with the feed Adjusting Screw and Wheel. (2) To adjust the Runner of the Sliding Section to suit the height of the near edge of the cutter, first slacken the Thumb Screws which hold the Sliding Section to the Arms, then loosen the Thimble Check Nuts and adjust the height of the Runner with the Screw provided. When the Runner is in the desired position tighten up in the reverse order. (3) The Auxiliary Sole is attached to the Sliding Section and adjusted to the desired height and position. (See figs. 118 to 124.)

USING THE UNIVERSAL PLANE. The plane is not difficult to handle provided it is set up correctly and the cutters are properly sharpened. Make sure the sliding section is in the required position. The plane must be perfectly upright, hence it is necessary to check the wooden faces of the fences to see that they are at right angles to the cutter and parallel to the runners.

SECTION TWO

MATERIALS.

I. NAILS AND THEIR USES (Plate 26).

GENERAL DESCRIPTION.—Nails possess a head, shank and point, and are usually made out of wire or plate metal. Most nails are made of mild steel, some being galvanised (coated with zinc) to prevent them from rusting when used in exposed conditions, e.g., roofing nails. For special purposes, such as boat building, where nails may be in contact with water, copper and brass nails are used.

USES: for securing pieces of timber together or materials to wood.

VARIETIES.—Nails generally obtain their names according to (a) shape of head, (b) shape of cross section, (c) their use.

Common varieties:—

1. **Diamond Head**—Fig. 125. A round wire nail with a diamond shaped head.

USES: For general constructional work, for securing flooring boards, lining boards, box or packing case construction, etc.

2. **Jolt Head**—Fig. 126. A round wire nail with a round head which enters the timber cleanly, leaving a smaller hole than the diamond head.

USES: Same as diamond head.

3. **Flat Head Round**—Fig. 127. A round wire nail with a large round flat head, which makes it less likely to pull through the timber.

USES: Packing case construction (fruit cases), etc.

4. **Flat Head Square**—Figs. 128 and 129. Similar to the flat head round except that it has a square shank which is sometimes twisted to give greater holding power.

USES: Packing cases, boxes, etc.

5. **Roofing Nail or "Springhead"**—Fig. 130. Made of iron and galvanised to prevent rusting. Has a large dome-shaped head; some have square twisted shanks. Length 1¾" to 2½".

USES: For fixing corrugated galvanised roofing iron.

6. **Panel Pin**—Fig. 131. A thin wire nail with an inverted cone-shaped head, which enters the timber cleanly. Sizes usually run from ½" x 20 to 2" x 16.

USES: For securing mouldings and small jobs together, fixing plywood to frames, etc.

7. **Finishing Nail**—Fig. 132. A small nail, rectangular in cross section, stamped from sheet metal, with little or no head and no point.

USES: For securing mouldings to frames, such as the mouldings surrounding door panels.

8. **Veneer Pin**—Fig. 133. A very thin wire nail, similar to the panel pin, but sometimes headless.

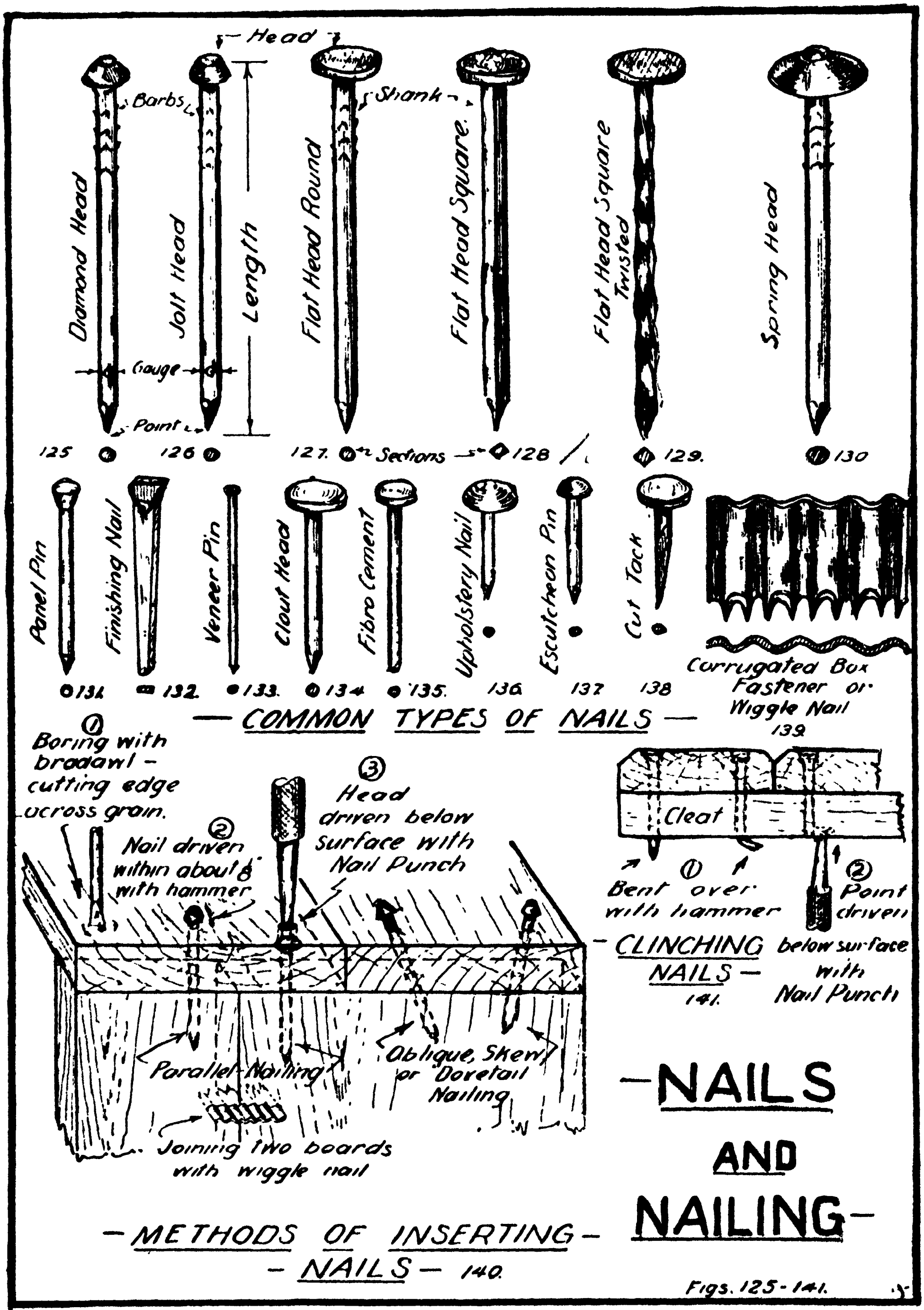

Head
Barbs
Shank
Diamond Head
Jolt Head
Length
Flat Head Round
Flat Head Square.
Flat Head Square Twisted
Spring Head
Gauge
Point
125
126
127. Sections
128
129.
130
Panel Pin
Finishing Nail
Veneer Pin
Clout Head
Fibro Cement
Upholstery Nail
Escutcheon Pin
Cut Tack
131.
132.
133.
134
135.
136.
137
138
Corrugated Box Fastener or Wiggle Nail
139.
— COMMON TYPES OF NAILS —
① Boring with bradawl - cutting edge across grain.
② Nail driven within about ⅛" with hammer
③ Head driven below surface with Nail Punch
Parallel Nailing
Oblique, Skew, or Dovetail Nailing
Joining two boards with wiggle nail
- METHODS OF INSERTING - - NAILS - 140.
Cleat
① Bent over with hammer
② Point driven below surface with Nail Punch
- CLINCHING NAILS - 141.
-NAILS AND NAILING-
Figs. 125-141.

PLATE 26.

Uses: To hold veneer in position while setting out and cutting or gluing, and for fixing very small mouldings, etc.

9. **Clout Head**—Fig. 134. Similar to the flat head round nail, but usually shorter, having a large flat head, and often galvanised to prevent rusting.

Sizes $\frac{3}{8}''$ x 13 to $1\frac{1}{2}''$ x 12.

Uses: For securing thin sheet metal (galvanised sheet iron or tinned plate) and other materials, such as roofing felt and leather, etc., to wood.

10. **Fibro-cement Nail**—Fig. 135. A type of clout but thinner, with a small flat head. The point is blunt so that the nail punches its way through, reducing the risk of fracturing the cement sheet. Usual sizes 1″ x 14 to $1\frac{1}{2}''$ x 14.

Uses: For fixing fibro-cement sheets and slates, etc., to wood.

11. **Upholstery Nail**—Fig. 136. A thin nail with a dome-shaped head, usually made of brass or iron (black japanned, nickel plated or oxidised, etc.) to suit the work.

Uses: For fixing materials such as tapestry, leather, etc., to wood, as in chairs, theatre seats, and upholstery in trams, trains, cars, etc.

12. **Escutcheon Pin**—Fig. 137. A small brass or nickel plated nail with a small dome-shaped head. Length $\frac{3}{8}''$ to $\frac{7}{8}''$.

Uses: For fixing small ornamental plates, such as escutcheon plates which protect key holes.

13. **Cut Tack**—Fig. 138. A short flat head nail with a tapering point. Length $\frac{1}{4}''$ to 1″.

Uses: To secure thin materials and fabrics to wood, as used by motor car trimmers and upholsterers, etc.

14. **Corrugated Box Fastener or Wiggle Nail**—Fig. 139. Made of corrugated plate iron, with parallel or divergent corrugations, with plain or saw teeth edges. Sizes $\frac{1}{4}''$ to 1″ long with 2 to 7 corrugations.

Uses: For strengthening edge to edge joints, as in the sides of packing cases, etc. (See fig. 253, plate 34.) Also used for holding the framed cores of cheap flush panel doors. Sometimes used in pattern making for holding together the parts of split patterns while turning.

ORDERING NAILS.

Nails are usually sold by weight (springhead roofing nails are sold in packets of a hundred), the common wire nails being sold by the pound in 7lb. packets. Panel pins are sold in 1lb. packets.

When ordering, state (1) length, (2) type, (3) gauge.

Length is governed by the amount of nail inserted into the timber, which usually includes the head. The length is given in inches.

Type or *Name* is determined by shape of head, or use, and the kind of metal used.

Gauge is the thickness of the nail, and is indicated by a number based on a Standard Wire Gauge number (ranging from 00 to 20). The higher the number the thinner the nail; a No. 16 panel pin is about 1/16″ in diameter.

Examples: 1″ bright steel panel pin No. 18=1″ x 18 (used for thin softwood);
5″ diamond head wire nail No. 8=5″ x 8 (for thick hardwood).

Common sizes of wire nails range from $\frac{1}{2}''$ to 6″ long and 20 to 00 gauge.

THE HOLDING POWER of nails depends upon—

1. The pressure of the wood fibres against the shank of the nail, which is greater in close-grained hardwoods than in open-grained softwoods.
2. Nails hold better when driven across the grain than along the grain.
3. Square nails with twisted shanks have greater holding power.
4. Greater holding power when driven obliquely or dovetailed. (Fig. 140.)
5. If the nail projects through both pieces being joined and is clinched along the grain, as in fig. 141, greater holding power is obtained. (Spoils appearance of work.)
6. Nails with large flat heads have greater holding power, as the heads are less likely to pull through the timber.
7. Experiments have shown that if the shanks are cement coated there is greater holding power.

METHODS OF DRIVING.

Nails should be driven with the hammer until the head projects about 1/16″ above the surface and then driven just below with a nail punch, so that the work may be planed and the hole stopped up with putty or filler. (Fig. 140.)

In softwoods it is rarely necessary to bore for nails unless near an edge or an end.

In hardwoods it is sometimes necessary to bore a hole slightly less than the diameter of the nail, to prevent splitting the wood or the bending of the nail. (Use a wood drill or nail bit or bradawl.)

If the point of the nail is hammered or bluntened, small work and fissile (easily split) timbers are less likely to be damaged. Also if the points are dipped in wax they may be driven more easily.

When withdrawing a nail a piece of waste wood should be placed under the claw hammer or the jaw of the pincers to protect the wood and give greater leverage. (See fig. 8, plate 2.)

QUESTIONS.

1. Name and sketch five common kinds of nails, and describe their uses.
2. Describe the uses of the following nails:—Fibro-cement nail, panel pin, clout, jolt head, corrugated box fastener.
3. What factors determine the names of nails?
4. What purpose does the head of the nail serve?
5. How are nails purchased?
6. What points must be kept in mind when ordering nails?
7. How is the required diameter of wire nails indicated? The following numbers indicate diameters of nails; place them in order, largest diameter first:—18, 4, 12, 20, 8, 10.
8. Write down five points which assist the holding power of nails.
9. What methods are used to assist the driving of nails?
10. Make out an order for nails to be used for the following:—For securing 1″ flooring boards; for fixing corrugated iron; for fixing plywood to a frame; and for constructing a packing case made of ½″ pine.

II. SCREWS AND THEIR USES (Plate 27).

GENERAL DESCRIPTION.—Wood screws are mostly made of mild steel, copper or brass. They consist of the following parts:—(a) *Head,* the shape of which gives the screw its name; (b) *shank* (beneath the head), about 2/3rds of which is threaded to a point; (c) *thread,* which draws the screw into the timber and gives the screw greater holding power than nails. The heads of most screws are slotted to take the blade of the screwdriver.

Mild steel screws are often galvanised (for use in damp positions), nickel plated, blued, japanned, oxidised, etc., to match the fittings they secure.

USES: For securing pieces of timber together, strengthening joints, and fixing metal fittings, such as hinges, catches, locks, to wood.

VARIETIES, named according to the shape of the head:—

1. **Countersunk or Flathead**—Fig. 142. The common countersunk screw is made of mild steel, but if used in damp conditions it is advisable to use screws that have been galvanised or screws made of copper or brass. Copper and brass screws must be driven carefully as they are easily broken.

USES: For general screwing purposes where it is necessary for the head to be flush with the surrounding surface. For holding pieces of wood together, as for table tops, chair seats, boxes, and for metal fittings to wood, such as hinges, etc.

2. **Round Head**—Fig. 143. Has a rounded head which is flat underneath. Made of steel, brass or copper. Brass and steel screws may be either nickel plated, blued, antique brassed or coppered, black japanned or oxidised to match the fittings being secured.

USES: For holding the parts of a job together, and securing metal fittings, etc., where the head of the screw is visible as an ornament. Galvanised steel round head screws with lead washers are sometimes used for fixing roofing iron.

3. **Raised Head or Oval Head**—Fig. 144. A combination of the countersunk and round head screws. It is made of the same metals and similar finishes as the round head screw, but being countersunk it is much stronger than the round head.

USES: For securing thick sheet metal and metal fittings to wood, where strength as well as ornamentation is required, such as ornamental hinges and metal brackets. It is often used by motor body builders with a small countersunk cup or washer under the head for fixing metal panels and cover strips and mouldings.

4. **Coach Screw or Square Head**—Fig. 145. Is a much stronger form of screw, made of mild steel (sometimes galvanised), and being larger has to be driven with a spanner. Made from ¼″ to ¾″ diameter and from 1½″ long.

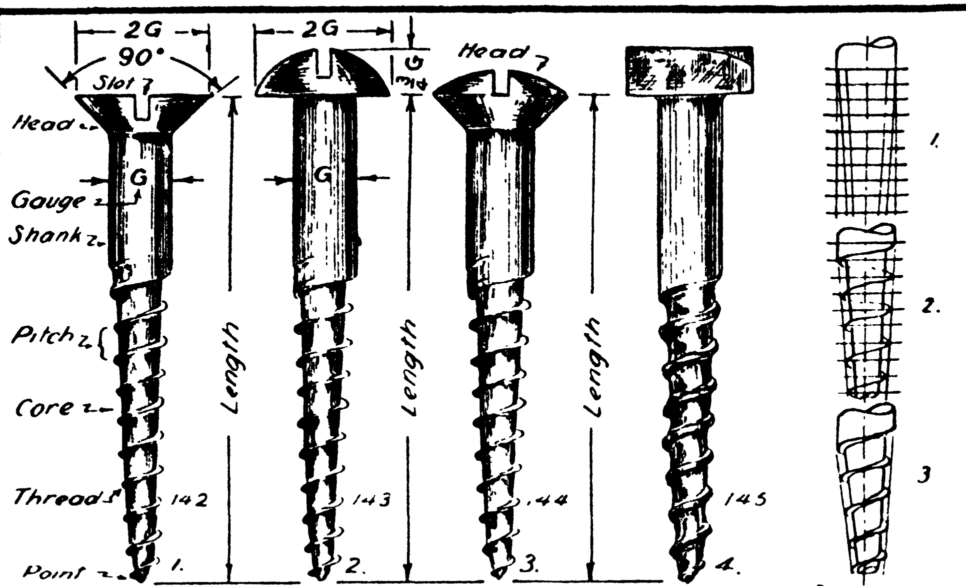
USES: For rough work, bridge construction, fixing gate hinges, coach and carriage construction, and for fixing machinery to bases, etc.

ORDERING SCREWS.

Screws are usually sold in packets containing a gross, although they can be bought by number.

When ordering, state (1) length; (2) metal and finish; (3) kind, shape of head; (4) gauge number.

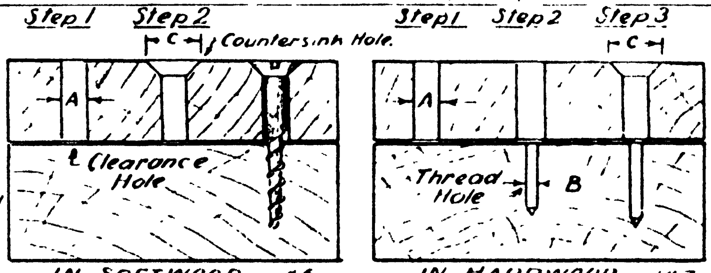
Length.—The length of screws is determined by the amount of the screw inserted



- COUNTERSUNK HEAD — ROUND HEAD — RAISED HEAD - COACH or SQUARE HEAD - Steps in drawing thread

Screws 1.2&3 are made of mild steel [which may be, blued, oxidised, black japanned, nickel-plated, antique brassed or coppered, galvanised etc]; stainless steel; copper, or brass etc to match fittings. Coach screw made of mild steel.

Note LENGTH is calculated by amount of screw inserted into timber ($\frac{1}{4}$" to 7" Long)
GAUGE (Diam. of Shank) of 1.2 & 3. is indicated by a Screw Gauge Number — from No. 0000 (about $\frac{1}{20}$") to No. 50. (about $\frac{3}{4}$")
Diam of Coach Screw is given in inches $\frac{1}{4}$" to $1\frac{3}{4}$" Length $1\frac{1}{2}$" to 6" & over

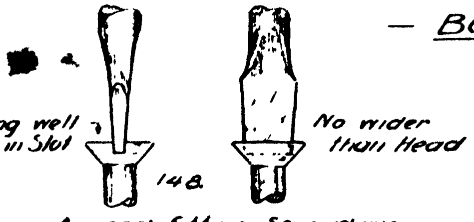


'A' Slightly more than diam of Shank
'B' Slightly less than diam of Core
'C' Equal to diam of Head

— IN SOFTWOOD 146. — IN HARDWOOD 147.

(Countersunk for Countersunk Screw Heads)

— BORING FOR SCREWS —



—WOOD SCREWS—

A good Fitting Screwdriver

Figs 142 - 148

PLATE 27

into the timber. (See figs. 142-45.) The length of the countersunk screw includes the head, while in the case of the round head the head is not included.

Metal.—Steel (whether oxidised, japanned, nickeled, etc.), brass or copper.

Kind.—Determined by the shape of the head.

Gauge.—The gauge (thickness or diameter of the shank) is indicated by a number (not based on a Standard Wire Gauge). A number 8 screw is approximately ⅛″ in diameter; higher numbers indicate larger diameters, and lower numbers for smaller diameters. The gauge number does not indicate fractional parts of an inch, except in the case of coach screws, where the diameter is given in fractions of an inch.

Examples: 4″ iron countersunk screw, No. 18=4″ x 18.
1½″ black japanned round head, No. 9=1½″ x 9.
¾″ nickel plated raised head, No. 6=¾″ x 6.

Flat head iron screws are made ¼″ to 7″ long, and in gauges 4/0 to 50. No. 4/0 is less than 1/16″ diameter, and No. 50 about ¾″ diameter.

THE HOLDING POWER OF SCREWS.

Screws derive their holding power from the fact that the threads become embedded in the fibres of the wood. When used for holding two pieces of wood together the length should at least be twice the thickness of the top piece of timber (if convenient) and longer if driven into the end grain of the second piece.

BORING FOR SCREWS.

In softwoods.—It is only necessary to bore a hole in the top piece equal to or slightly larger than the shank of the screw, and to countersink for countersunk head screws. (Fig. 146.)

In hardwoods.—Bore in the top piece for the shank and countersink if required. It is usually necessary to bore in the second piece a hole equal to the core of the screw. (Fig. 147.)

NOTE: The screw should turn easily in the hole in the piece being secured, otherwise it is almost impossible to draw the two pieces together.

METHOD OF DRIVING.

When driving use a screwdriver which fits well down in the slot and is not wider than the head of the screw. (Fig. 148.)

Screws should never be driven with a hammer, as this fractures the fibres of the wood, thus making a hole equal to the thread diameter of the screw and reduces the holding power. Drive the screw in until the head is just seated; if over-driven, the thread fractures the fibres and reduces the holding power, also the added strain may cause the screw to break. Screws are driven easier if the points are dipped in wax or soap. It adds to the appearance of the work, when a number of screws are used, if the slots run parallel to one another or parallel to the grain surrounding them. This is called "heading the screws." (See fig. 251, plate 33.)

SCREWS SHOULD BE USED IN PREFERENCE TO NAILS WHEN—

1. Greater holding power is required.
2. The appearance of the work may be spoilt by nails, and the round head and raised head screws may be ornamental.

3. The shock of driving a nail may damage the work.
4. The work may have to be taken apart (waxed screws assist in this operation).
5. Vibration may weaken the holding power of nails.

QUESTIONS.

1. Sketch a countersunk head screw and name its parts.
2. What metals are used in the making of screws?
3. Why are some screws oxidised, nickel plated, etc.?
4. Describe the uses of the following screws:—Countersunk, round head, raised head.
5. (a) How is the length of a screw determined?
   (b) How do screws derive their names?
6. What does the gauge number indicate? Which of the following numbers is the largest gauge:—00, 4, 12, 14, 6, 8?
7. How do screws obtain their holding power?
8. Show by sketches how you would bore for countersunk screws in hardwood and softwood.
9. How should screws be driven? What steps would you take to make driving easier?
10. When would you use screws in preference to nails?

III. GLUES AND THEIR USES (Wood Adhesives).

The correct use of glue plays an important part in many wood-using industries, such as in furniture construction for securing pieces of wood together.

USES: Mainly for securing pieces of wood together, as for joints, inlaying, plywood manufacture, laying of veneers and fixing mouldings, etc.

VARIETIES.—There are many varieties in use to-day, the most common being: 1. Animal Glues; 2. Casein Glues; 3. Other Glues: (a) Starch or Vegetable Glues; (b) Vegetable Protein Glues; (c) Liquid Glues; (d) Artificial Resin Glues.

1. Animal Glues (Hide Glue).

This is a strong gelatine extracted from an animal matter, such as the trimmings of hides and the fleshings next to the skin, and any waste pieces unsuitable for tanning.

MANUFACTURE OF ANIMAL GLUE.

(1) *Cleaning the Hides and Fleshings.*
   (a) The animal matter is first washed to remove dirt, etc.
   (b) It is then treated with lime to loosen the hair and remove injurious substances.
   (c) Finally, it is washed in dilute sulphurous acid to remove the loose hair and lime. The acid also bleaches the animal matter.

(2) *Heating to Extract the Glue.*—The material is placed with water in containers and quickly heated by steam, which breaks down the material into thin liquid glue and fat. The fat is used for tallow.

(3) *Concentrating the Extract.*—The thin liquid glue is concentrated by again

heating quickly until excess water is driven off, leaving a thick liquid. It is heated in vacuum pans; the vacuum allows the water to boil off at a low temperature.

(4) *Running into Moulds.*—The thick glutinous liquid is run into moulding pans and cooled until it forms a jelly.

(5) *Cutting into Cakes.*—The jelly is cut into slabs or cakes.

(6) *Drying.*—The slabs or cakes are then placed on wire netting frames and dried in hot air tunnels.

NOTE: Animal glue is sold as cake glue, powdered glue, or glue pearls. Instead of running the concentrated extract into moulds, it is poured through a sieve down a column filled with cold oil, and the drops of glue so formed are known as "glue pearls." The cakes are sometimes ground into powder form, and known as powdered glue. These two types of animal glue have the advantage of taking less time to soak when preparing the glue for use.

PREPARATION FOR USE.

(1) *Breaking.*—If cake glue is being used it should be broken into small pieces so that it will absorb the water and jell quickly. Wrap the cakes in a piece of rag and break them up with a hammer or mallet.

(2) *Soaking.*—The small pieces of glue (whether broken cake glue, glue pearls or powder) are soaked in clean cold water to make them readily liquified by heat. The glue will absorb some of the water and swell, but should not dissolve. The proper practice to ensure the right quantities of water and glue is to weigh the glue and measure the water, which differs for different grades of glue. Soak for about one hour.

(3) *Heating.*—Place the soaked glue in a clean melting pot and bring the water in the outer pot to about 150°F. quickly, stirring continuously, then allow to simmer at about 140°F.

USES: General joinery work; for furniture construction; plywood; veneering, using veneer hammer and heated cauls; for indoor use only.

PRECAUTIONS to be taken when using animal glue.

1. ALWAYS use the glue HOT.
2. It is best to only prepare enough glue for the job in hand.
3. Always use clean containers.
4. See that there is plenty of clean water in the outer pot.
5. NEVER allow the glue to BOIL, as it will lose its adhesive qualities.
6. Make sure that the glue is of the right consistency.
7. See that the parts to be glued are clean and fit perfectly.

CONSISTENCY OF THE GLUE.—The consistency of the glue is important, and should be tested while it is hot; the exact thickness depends upon the wood on which it is used. Open-grained softwoods can take thicker glue, while hardwoods require a thinner liquid to penetrate the pores. The glue should run freely from the brush in an unbroken stream without breaking into drops.

QUALITY OF ANIMAL GLUE.—Good glue swells when soaked in cold water, but will not dissolve. It is slightly sticky if rubbed with a wet finger, and is clear, free from specks or dirt, etc. It should set hard in the joint after drying.

CHARACTERISTICS.—Must be applied hot; the work must be assembled immediately, allowing very little working time; not water or heat proof; slow drying; may be attacked by micro-organisms; makes good strong joints; does not stain, is applied by hand.

HOLDING POWER depends on—

1. Its penetration into the pores of the wood. (NOTE: If the glue is too cold or too thick it will not run into the wood.

2. Its strength when it sets and becomes solid. (NOTE: If used too thin the glue will not have enough solid matter to make a strong joint.)

3. The parts of the joint should fit together closely and should be clean.

THE GLUE POT.—The glue pot usually consists of two containers—

1. An inner pot to hold the glue, which fits into an outer pot or water jacket.

2. An outer pot to hold water or steam for heating the glue.

The two pots are used to prevent the glue from being burnt while heating, and the hot water in the outer pot provides a means of keeping the glue hot while using.

THE GLUE BRUSH.—The glue is applied to the job by means of a brush (although small strips of wood may be used for small work, such as dowel holes and dovetail joints). The brush should always be kept clean and washed immediately after use.

If a little powdered alum is added during the heating process it will help to make the animal glue water resistant.

2. **Casein Glues.** (A type of Plastic Adhesive.)

Although casein glues are of ancient origin, it is only in recent years that they have become more or less perfected. Casein is a milk product, being the powdered extract from the curds of sour milk. To make glue it is dissolved in water by the aid of alkalies. Other chemicals may be added to make it waterproof, etc.

TYPES OF CASEINS.—Casein is of three kinds: "lactic," "acid" and "rennet" casein. Lactic casein coming from the curds of naturally soured milk, acid casein from acid soured milk (hydrochloric acid or sulphuric acid being chiefly used), and rennet casein from milk soured by means of rennet. Lactic casein is generally used in making casein glues.

MANUFACTURE OF CASEIN.

(1) *Souring the Milk.*—Skim milk is used. If soured naturally, it is allowed to stand at about 30°C until it coagulates, then it is heated to about 45°. If soured artificially HCl is added (1 in a 1000 parts of milk), or H_2SO_4 is added (1 in 4000 parts of milk), or rennet is added.

(2) *Washing the Curd.*—The whey is drawn off and the curd is thoroughly washed.

(3) *Grinding and Drying the Curd.*—The washed curd is pressed to remove most of the moisture, then ground and dried in special driers.

TYPES OF CASEIN GLUES.—There are two main types of casein glues: "ready mixed" and "wet mixed." The *ready mixed* glues (powders) contain all the necessary chemicals, and may be purchased in small or large quantities, requiring only to be added to water for use. *Wet mixed glues* are generally used in factories, and consist of several ingredients, each of which is mixed separately with water before being added to each other to form the required glue, i.e., they are mixed wet—"wet mixed." The wet mix types are cheaper than the ready mix, but require more labour in preparing. Ready mixed glues generally consist of casein, plus lime (calcium hydroxide to make the glue when set water resistant), plus sodium fluoride, borax and sodium phosphate (to make the casein soluble in water).

PREPARATION OF READY MIXED GLUES FOR USE.

(1) The powder is added to cold water in the proportions set down by the manufacturer; usually the parts are measured by weight. The mixing pot should be glass or earthenware.

(2) Stir the mixture from one to five minutes until it becomes fairly thick. Factories use special mixing machines.

(3) The mixture should be allowed to stand for 15 minutes to one hour, depending on the make of the glue. It usually becomes thinner as chemical changes take place.

(4) After standing, it should be stirred again for a minute or two. The glue is then ready for use, and is generally usable for about 8 to 10 hours.

USES OF CASEIN GLUES.—For general joinery work, veneering, plywood construction for internal or external use.

CHARACTERISTICS.—Is used cold, allowing 5 to 15 minutes working time; dries and sets fairly quickly; water and heat resisting; stains certain woods; applied by hand or machine; tends to dull edges of cutting tools.

ADVANTAGES OF CASEIN GLUES OVER ANIMAL GLUES.

1. It can be prepared in about twenty minutes.

2. It is prepared cold.

3. Allows a longer assembling time, as it is used cold and does not chill like animal glue. It can be used in the open or a cold room. The pressure of cramps need not be applied for 10 to 15 minutes.

4. As the setting is due to chemical action, heat does not affect it (heat would remelt animal glue).

5. Depending upon the make of the glue, it can be used on work subjected to moist or wet conditions, especially if allowed to dry out for about a week.

Casein glue has one great disadvantage: it stains most hardwoods, such as oak, maple, mahogany and walnut, although a non-water resistant, casein glue is obtainable which does not stain. Any surplus glue should be washed off immediately. The stain may be removed by washing the surface with a solution of 1½oz. of oxalic acid to 1 pint of water and finally washing with clean water.

THE GLUE POT.—Owing to the fact that casein glue has a chemical action on aluminium, copper and brass, it is advisable to use an earthenware mixing pot, which should be cleaned out at the end of each day.

THE GLUE BRUSH.—Any hard-bristled brush is suitable for spreading the glue. For veneering mechanical spreaders are used. The brush should always be washed immediately after use.

NOTE: If the casein glue is used for veneering, a veneer hammer cannot be used successfully to force out the surplus glue and press the parts together; special cauls or presses are required, especially for large work. (See Notes on Veneering.)

3. Other Glues.

There are a variety of other glues used in woodwork, some of which have special advantages; but for the ordinary woodworker they are impracticable owing to the necessity of obtaining special and expensive machinery to apply them.

(a) **Vegetable Starch Glues.**—Starch used for the manufacture of glue is obtained mostly from the root of the tapioca plant. All vegetable plants contain starch mainly as reserve food material.

Briefly, the manufacture of starch glue consists of making a starch and water mixture to which is added caustic soda (to lengthen the working time of the glue), and heated at 150°F until the mixture changes to an amber coloured, stringy fluid. (100 parts of raw starch, 400 parts of water, plus 3 parts of caustic soda dissolved in 9 parts of water.) A special mixing machine is required, and owing to the thick nature of the glue, a mechanical spreader is necessary to apply the glue.

Characteristics.—It is prepared by heating, may be used cold, long assembly time, is usable for several days, slow setting after application, not water-proof, caustic soda starch glues stain certain woods, produces strong joints, cheap.

USES: Chiefly in plywood manufacture and veneered products. Being non-water-proof, they are used where water resistance is not essential.

(b) **Vegetable Protein Glues.**—These glues are manufactured from the residue after extracting the oil from the soya bean, peanuts and cotton seeds. To a certain extent protein glues are similar to casein glues, and require strong alkalies to make them soluble in water. They are prepared in a similar manner to casein glues, the prepared powder being added to water.

Characteristics.—Fairly water resisting, though not water-proof, dries fairly quickly, is used cold, but owing to the presence of alkalies the glue stains, and is therefore not used for fancy veneers.

USES: Chiefly used for plywood construction for box-making, drawer bottoms, etc.; also used in the manufacture of laminated fibre boards.

(c) **Liquid Glues.**—Liquid glues are generally made from the bones, heads, skins, trimmings, etc., of fish, and are sold in liquid form under various trade names. Sometimes referred to as fish glue. Animal glue may be treated with acids and sold in liquid form.

Characteristics.—Is bought ready for use, requiring no preparing, usually slow setting and drying, usually non-water resisting, some kinds stain the timber, applied by brush.

USES: Chiefly used for small repairing work and small work generally.

(d) **Blood Albumen Glues.**—Manufactured from albumen extracted from animal blood, plus other chemicals. Their use requires expensive machinery for heating and pressing the glued work. They require extreme care in preparation.

Characteristics.—Highly water resistant, almost stainless, is expensive, not particularly strong, dries quickly, heat is necessary in the pressing of the parts together.

USES: Chiefly for water resistant plywoods and gluing very thin veneers. Sometimes used in conjunction with casein.

(e) **Artificial Resin Glues.** (May be called Plastic Adhesives.)

NOTE: All of the above glues are of the "WET GLUE" type, requiring water to carry the glue into the pores of the wood. This makes them fall short of being ideal glues, as the water has to be dried out.

With the better types of resin glues water is not necessary, and they can be applied in dry form.

At the present time there are three forms of synthetic or artificial resin adhesives in use, namely, phenol-formaldehyde, urea-formaldehyde and melamine-formaldehyde resins. Briefly, the synthetic resins are produced from the chemical reactions between phenol, urea or melamine and formaldehyde.

Application of Resin Glues.—

(a) As a Varnish. Here the resin is dissolved in alcohol or acetone, but requires drying in a kiln to remove the solvent (moisture) prior to pressing.

(b) A Colloidal Solution; that is, the resin is carried in water, plus special chemicals. The moisture has to be dried out in air tunnels before heating and pressing.

(c) As a Dry Powder, which is dusted on the surface of the work and then heated under pressure.

(d) As a film. This method is commonly used in veneer gluing. A thin sheet of paper is impregnated with the resin and placed between the plies and then treated with heat and pressure.

(e) A Cold Application now in use, which can be used for ordinary work, consists of two liquids: (i) the glue, which is applied to one part of the joint, and (ii) a drying liquid which is applied to the other part of the joint. When the two liquids come in contact drying and setting takes place rapidly.

Most methods of application require heat (about 260°F) to make the resin plastic, and continued heat and pressure (100-300 lbs. per sq. inch) to set the glue in the pores of the wood. Depending on the thickness of the veneers, the time taken for three-ply is from 6 to 15 minutes under pressure.

Characteristics.—Entirely water resistant, heat resisting, non-staining, extremely strong, easy to apply, usually requires heat and pressure to bond the materials.

USES: Chiefly used in the manufacture of plywood and gluing of cross bands and face veneers to solid cores. Plywoods required for use out of doors are generally bonded with a resin glue.

QUESTIONS.

1. What is animal glue? Briefly describe its manufacture.
2. Briefly describe the preparation of animal cake glue for use.
3. What precautions would you take when using animal glue?
4. Describe the characteristics of animal glue.
5. How do glues hold pieces of wood together?
6. What precautions must be taken when heating animal glue?
7. If the glue is too thick, what type of joint will be produced? Why?
8. If you were gluing a velvet lining in a box, would you use a thick or a thin glue? Why?
9. If you were gluing together pieces of wood with very open grain could you use a glue of thicker consistency? If so, why?

10. What would be the best test for a glue?
11. What is casein?
12. Briefly describe the manufacture of casein glue.
13. Describe the preparation of a "ready mixed" powdered casein glue for use,
14. Why is it best to use an earthenware or glass container for casein glues?
15. What are the advantages of casein glue over animal glue? State the uses of casein glues.
16. Briefly describe three types of glues other than casein or animal glues.
17. Describe two methods of applying artificial resin glues.
18. What prevents resin glues being used universally as an adhesive for all jobs?
19. Compare the characteristics of hide glues, casein glues and resin glues.
20. Write down the chief uses of the glues mentioned in question 19.

IV. CABINET HARDWARE (Plates 28 to 32).

Plates 28 to 32 illustrate some of the common types of fittings used in cabinet work. They are included here to assist the worker to determine the type of fitting required for the job.

The selection of suitable fittings plays an important part in the ultimate finish and appearance of the article. The most common names have been applied to the fittings, although some manufacturers may give them slightly different names. The sizes inserted on most sketches are only suggestive, as there seems to be no standard method of determining the sizes by the different manufacturers. As a general rule it is best to order your fittings according to a catalogue, and obtain them before commencing your job.

The quality of the fitting depends mainly on (i) the type of finish applied to it, e.g., polished brass, chromium plated, nickel plated, brass or copper oxidised, black japanned, etc.; (ii) the material used, e.g., steel, brass, casein, bakelite, etc., and (iii) whether it is made of solid cast or drawn, or pressed plate metal.

ORDERING FITTINGS.

Nails and Screws—Plates 26 and 27. State type; metal; finish; length and gauge.

Hinges—Plate 28. State type; length of knuckle (strap and tee hinges require also length of strap); material (brass, steel, etc.); type of finish; whether pressed or solid drawn.

(NOTE: Butt hinges are of two types, narrow and broad leaved, narrow butts being used for thin doors, while the broad butts are used for heavier thick doors.)

Locks—Plate 29. State purpose for which they are required; length; whether for left or right hand doors; whether to be let-in or not let-in; material (brass or steel); finish applied (nickel plated, oxidised, etc.); whether pressed or solid drawn.

Catches—Plate 30. State type of catch required; purpose for which it is to be used; size, if possible; material and finish.

Handles and Pulls—Plate 31. State kind; material and finish. Are best ordered from catalogue, as designs differ according to the manufacturer.

Braces and Plates—Plate 32. State type; size; material (brass or steel); heavy or light gauge.

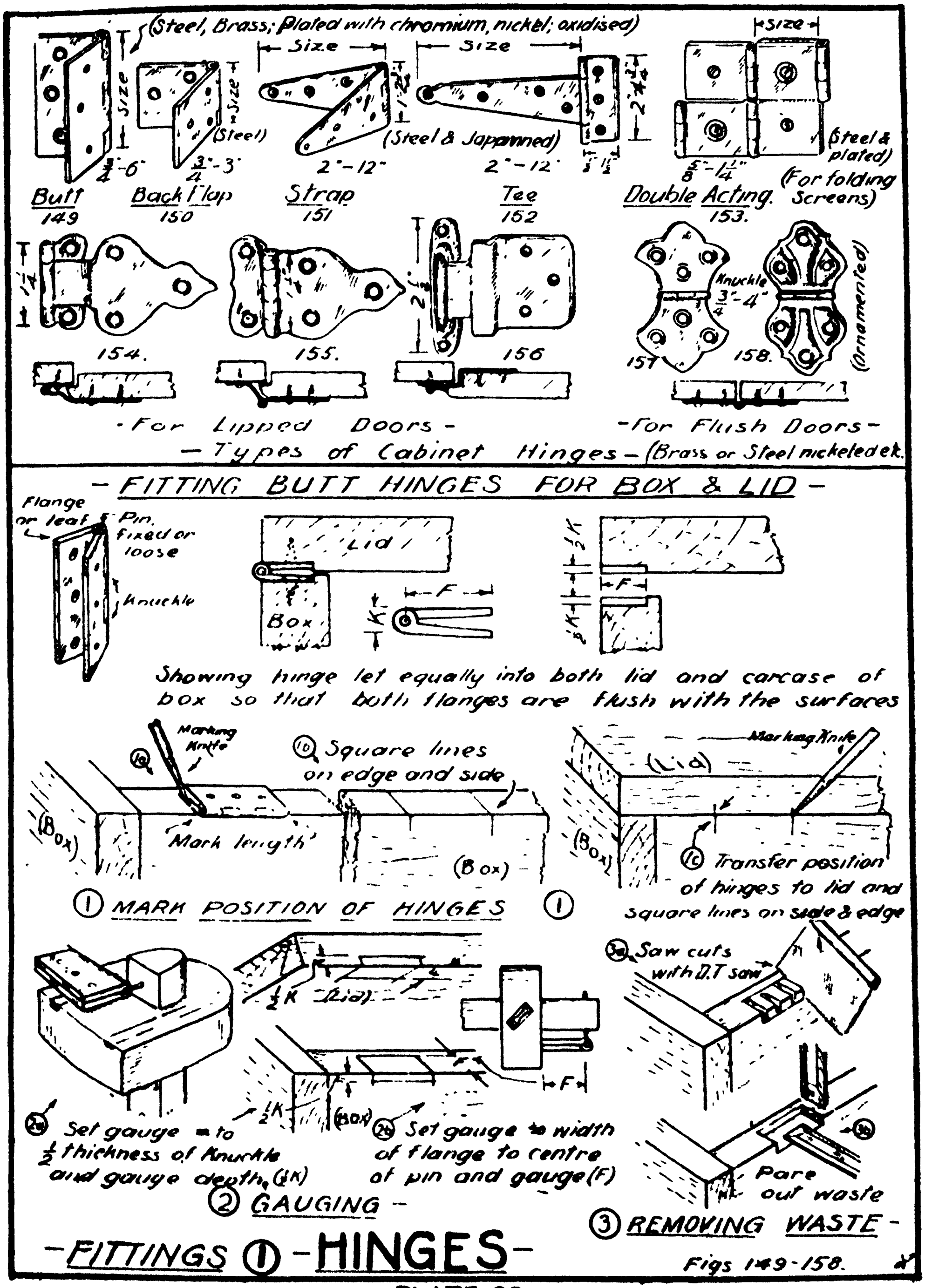

(Steel, Brass; Plated with chromium, nickel; oxidised)
Size
3/4"-6"
3/4"-3"
(Steel)
2"-12"
(Steel & Japanned)
2"-12"
1 1/2"
2 1/4"
5/8"-1/4"
(Steel & plated)
(For folding Screens)
Butt 149
Back Flap 150
Strap 151
Tee 152
Double Acting. 153.
1 1/4"
154.
155.
2 1/4"
156
Knuckle 3/4"-4"
157
158.
(Ornamented)
- For Lipped Doors -
- For Flush Doors -
— Types of Cabinet Hinges — (Brass or Steel nickeled etc.
- FITTING BUTT HINGES FOR BOX & LID -
Flange or leaf
Pin, fixed or loose
Knuckle
Lid
Box
F
1/2 K
Showing hinge let equally into both lid and carcase of box so that both flanges are flush with the surfaces
Marking Knife
1a
1b Square lines on edge and side
(Box)
Mark length
(Box)
1 MARK POSITION OF HINGES 1
Marking Knife
(Lid)
(Box)
1c Transfer position of hinges to lid and square lines on side & edge
1/2 K (Lid)
F
1/2 K
(Box)
2a Set gauge = to 1/2 thickness of Knuckle and gauge depth (1/2 K)
2b Set gauge to width of flange to centre of pin and gauge (F)
2 GAUGING -
3a Saw cuts with D.T saw
3b
Pare out waste
3 REMOVING WASTE -
-FITTINGS 1 -HINGES-
Figs 149-158.

PLATE 28.

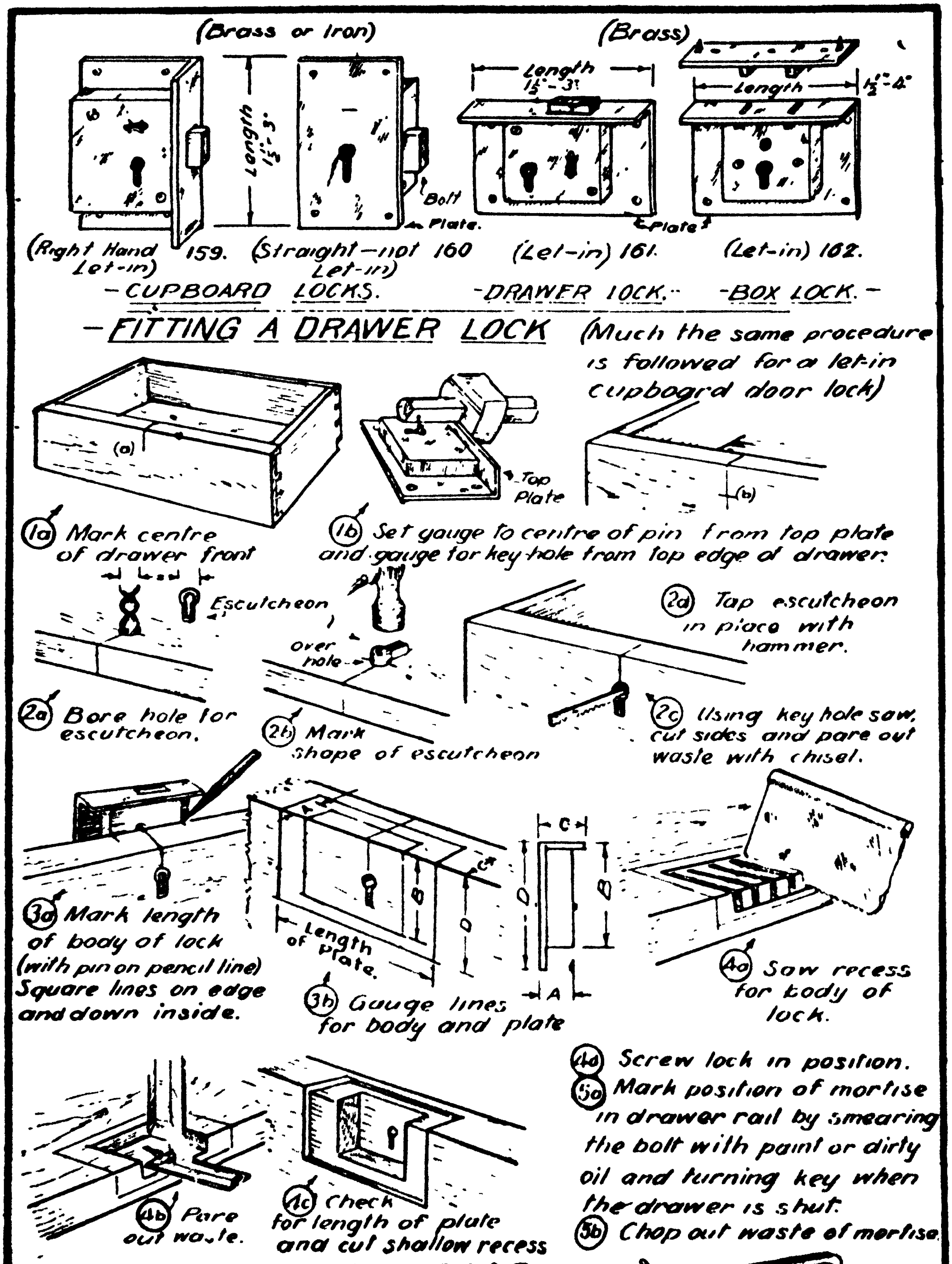

(Brass or Iron)
(Brass)
Length 1½"–5"
Length 1½"–3"
Length
½"–2"
Bolt
Plate.
Plate
(Right Hand Let-in) 159.
(Straight—not Let-in) 160
(Let-in) 161.
(Let-in) 162.
–CUPBOARD LOCKS.
–DRAWER LOCK.–
–BOX LOCK.–
–FITTING A DRAWER LOCK
(Much the same procedure is followed for a let-in cupboard door lock)
(a)
Top Plate
(b)
1a Mark centre of drawer front
1b Set gauge to centre of pin from top plate and gauge for key hole from top edge of drawer.
Escutcheon
over hole
2a Bore hole for escutcheon.
2b Mark shape of escutcheon
2c Using key hole saw, cut sides and pare out waste with chisel.
2d Tap escutcheon in place with hammer.
3a Mark length of body of lock (with pin on pencil line) Square lines on edge and down inside.
A
B
C
D
Length of Plate.
3b Gauge lines for body and plate
4a Saw recess for body of lock.
4b Pare out waste.
4c Check for length of plate and cut shallow recess
4d Screw lock in position.
5a Mark position of mortise in drawer rail by smearing the bolt with paint or dirty oil and turning key when the drawer is shut.
5b Chop out waste of mortise.
–FITTINGS ② –LOCKS–
Figs 159-162.
Drawer Lock Chisel.

PLATE 29.

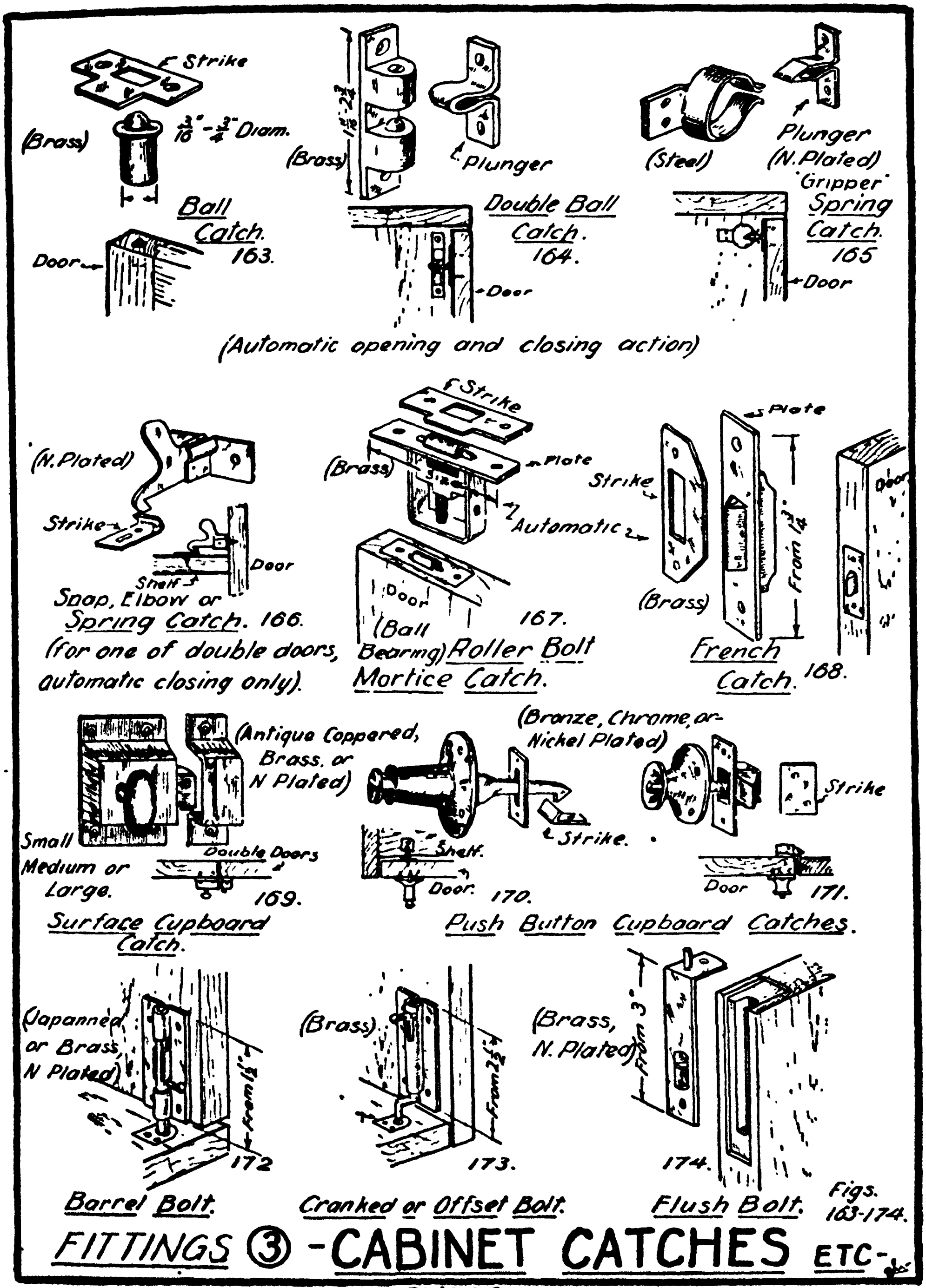

Strike
(Brass)
3/16"-3/4" Diam.
Ball Catch. 163.
Door
(Brass)
1 1/2"-2 1/4"
Plunger
Double Ball Catch. 164.
Door
(Steel)
Plunger (N.Plated)
"Gripper" Spring Catch. 165
Door
(Automatic opening and closing action)
(N.Plated)
Strike
Shelf
Door
Snap, Elbow or Spring Catch. 166.
(for one of double doors, automatic closing only).
Strike
(Brass)
Plate
Size
Automatic
Door
167.
(Ball Bearing) Roller Bolt Mortice Catch.
Plate
Strike
From 1 1/4"
(Brass)
Door
French Catch. 168.
(Antique Coppered, Brass, or N Plated)
Small Medium or Large.
Double Doors
169.
Surface Cupboard Catch.
Shelf
Door. 170.
Strike.
(Bronze, Chrome, or Nickel Plated)
Strike
Door
171.
Push Button Cupboard Catches.
(Japanned or Brass N Plated)
From 1 1/2"
172
Barrel Bolt.
(Brass)
From 2 1/2"
173.
Cranked or Offset Bolt.
(Brass, N. Plated)
From 3"
174.
Flush Bolt.
Figs. 163-174.
FITTINGS ③ - CABINET CATCHES ETC -

PLATE 30.

F

Brackets—Plate 32. State type (stayed or London pattern); sizes; finish (usually black japanned).

Lid and Table Leg Supports—Plate 32. Are best ordered according to catalogue. State purpose for which they are required; size (usually length when open); material and required finish; left or right hand.

Hooks—Plate 32. State type (round or square; shouldered or unshouldered); length; material (brass or iron).

Screw Eyes—Plate 32. State size number (the size is usually indicated by a number preceded by a letter). The number indicates the diameter and gauge. "B" stands for bright steel; "B One" for brass, and "C" for copper.

Rod Brackets—Plate 32. State type (straight or bent plate); size of rod; material (brass or chromium plated).

Domes of Silence—Plate 32. State diameter size.

Castors—Plate 32. State type of castor (screw, plate, etc.); size (depends on the make); material (brass or steel); type of wheel (brass, steel, rubber, rubber-tyred, etc.).

QUESTIONS.

1. Sketch and name four common types of hinges.
2. What points must you mention when ordering screws?
3. How would you write down an order for some butt hinges suitable for a small box?
4. What points govern the quality of fittings?
5. Sketch five handles which you could make for drawers or doors.
6. Name and sketch two types of catches which have automatic opening and closing actions.
7. Sketch a barrel bolt and state where it could be used in cabinet work.
8. What is the difference between the push button type of catch and the ball or roller catch?
9. Fig. 229, plate 32, shows a "Dome of Silence"; where might this be used?
10. Describe three ways by which castors are attached to chair or table legs, etc.
11. Sketch a butt hinge and name its parts.
12. Show by a sketch (a section) how the parts being hinged with a butt hinge may be recessed for the hinge. What governs the sizes of these recesses?
13. Briefly describe the steps involved in hinging a small cupboard with two butt hinges. Use sketches where possible.
14. Sketch a drawer lock.
15. Show by a sketch the full setting out of the recesses for a drawer lock.

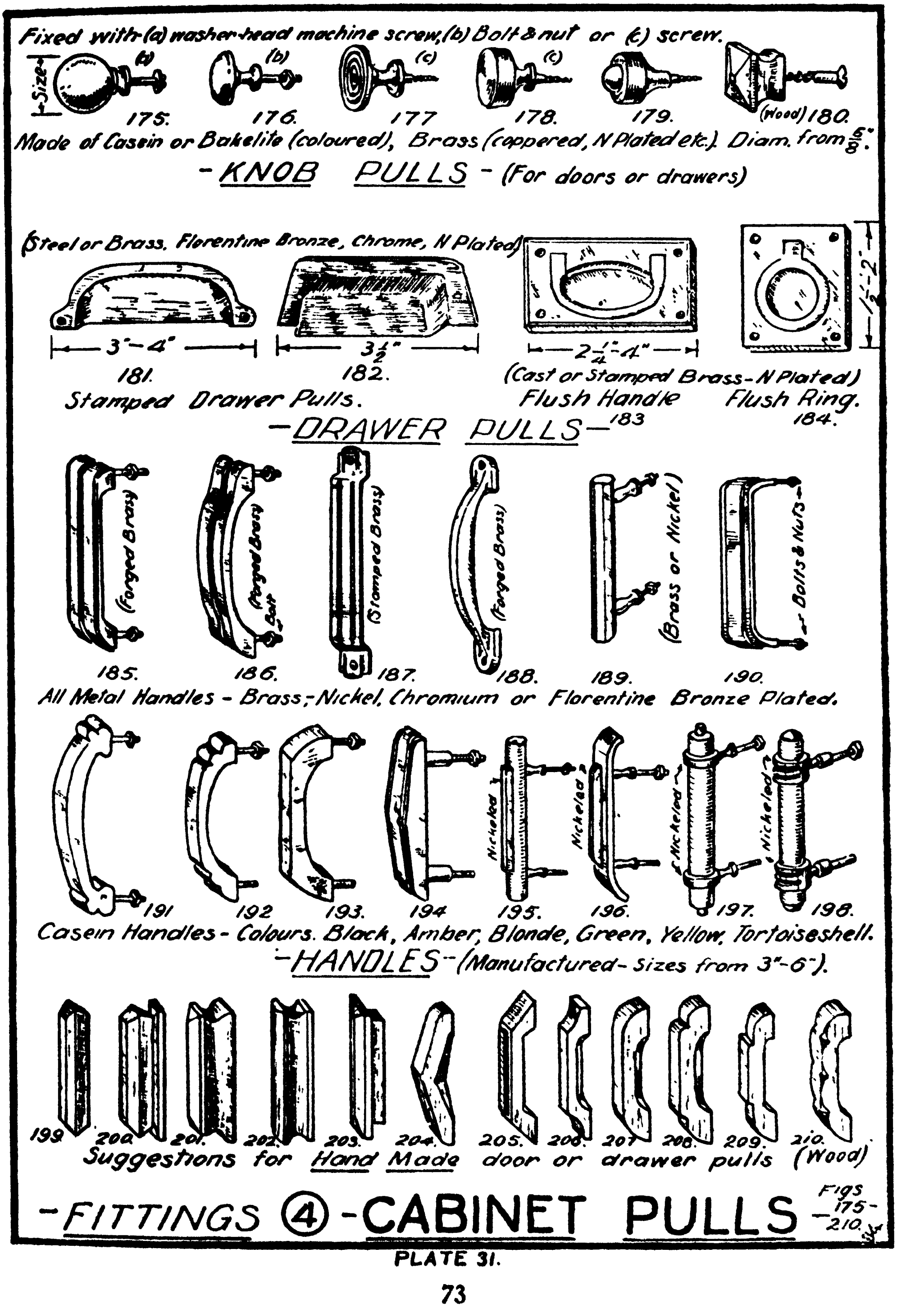

Fixed with (a) washer-head machine screw, (b) Bolt & nut or (c) screw.
Size
(a)
(b)
(c)
(c)
175.
176.
177
178.
179.
(Wood) 180.
Made of Casein or Bakelite (coloured), Brass (coppered, N Plated etc.) Diam. from 5/8".
- KNOB PULLS - (For doors or drawers)
(Steel or Brass, Florentine Bronze, Chrome, N Plated)
3"-4"
3½"
2¼"-4"
1½"-2"
181.
182.
(Cast or Stamped Brass - N Plated)
Stamped Drawer Pulls.
Flush Handle 183
Flush Ring. 184.
- DRAWER PULLS -
(Forged Brass)
(Forged Brass)
Bolt
(Stamped Brass)
(Forged Brass)
(Brass or Nickel)
Bolts & Nuts
185.
186.
187.
188.
189.
190.
All Metal Handles - Brass; - Nickel, Chromium or Florentine Bronze Plated.
Nickeled
Nickeled
Nickeled
Nickeled
191
192
193.
194
195.
196.
197.
198.
Casein Handles - Colours. Black, Amber, Blonde, Green, Yellow, Tortoiseshell.
- HANDLES - (Manufactured - Sizes from 3"-6").
199
200.
201.
202.
203.
204.
205.
206.
207
208.
209.
210.
Suggestions for Hand Made door or drawer pulls (Wood)
- FITTINGS ④ - CABINET PULLS - Figs 175-210.

PLATE 31.

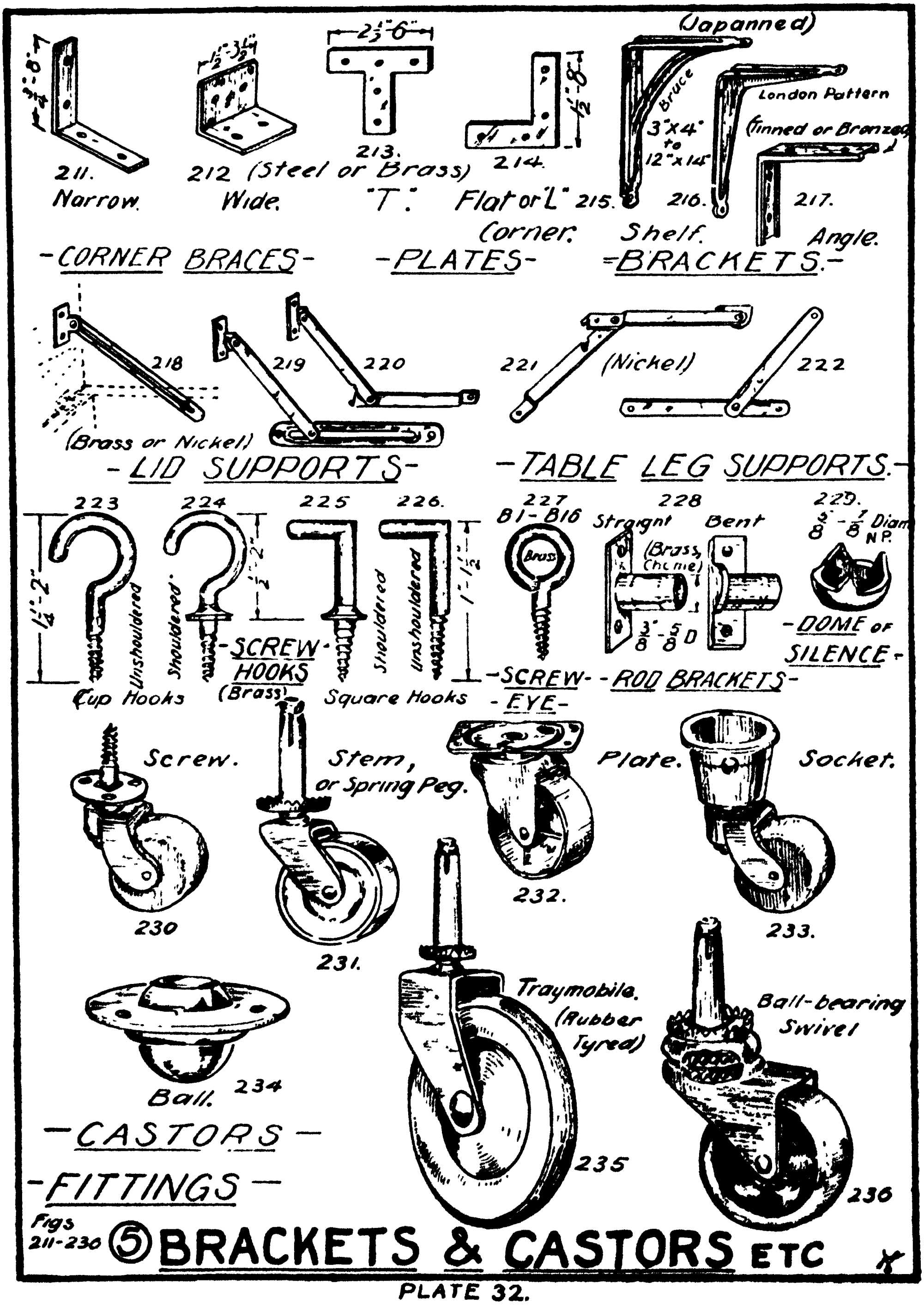

(Japanned)
211. Narrow.
212 (Steel or Brass) Wide.
213. "T."
214. Flat or "L"
215. Bruce 3"x4" to 12"x14"
216. London Pattern (Tinned or Bronzed)
217.
Corner. Shelf. Angle.
-CORNER BRACES- -PLATES- =BRACKETS.-
218 219 220 221 (Nickel) 222
(Brass or Nickel)
-LID SUPPORTS- -TABLE LEG SUPPORTS.-
223 224 225 226. 227 B1-B16 228 Straight Bent (Brass, Chrome) 229.
Unshouldered Shouldered Shouldered Unshouldered
-SCREW- HOOKS (Brass)
Cup Hooks Square Hooks
-SCREW- -EYE-
-ROD BRACKETS-
-DOME OF SILENCE-
Screw. Stem, or Spring Peg. Plate. Socket.
230 231. 232. 233.
Ball. 234
Traymobile. (Rubber Tyred) 235
Ball-bearing Swivel 236
-CASTORS-
-FITTINGS-
Figs 211-230
5 BRACKETS & CASTORS ETC

PLATE 32.

SECTION THREE

TECHNICAL TERMS AND JOINTS.

I. TECHNICAL TERMS USED IN WOODWORK (Plate 33).

1. **Sawing** is the cutting of wood by means of saws, either by hand or machine. Sawn timber is called "Rough Timber."

2. **Planing** is the dressing of timber by taking off shavings by means of planes (hand or machine). Planed timber is called "Dressed Timber."

3. **Shooting** is the planing of the edges or ends of boards perfectly straight and square to the face side.

4. **Arris Edge** is the sharp edge formed by two adjacent surfaces. If this sharp edge is in positions which may cause damage to clothing, etc., e.g., legs of chairs and tables, edges of shelving, desks, benches, etc., it is usual to remove the sharpness by taking off a shaving, or lightly rubbing with glass paper. This is termed "taking off the arris edge." NOTE: It is sometimes essential to preserve the arris edge in order to improve the appearance of the work, such as on mouldings, etc. (Fig. 237.)

5. **Chamfering.**—When it is desired to take off more than the arris edge, and a definite amount is gauged by means of a pencil gauge and planed off carefully to the lines, the new surface produced is called a "chamfer," and the operation is known as "chamfering." If the chamfer runs the entire length of the timber it is known as "through chamfering," and is usually planed with either a jack, smoothing or block plane, although a special chamfer plane may be purchased for chamfering. When chamfering end grain it is best to hold the plane on the skew to produce a slicing cut. If the chamfer is stopped at either end it is called a "stopped chamfer," and is produced with either a chisel, spokeshave or bull-nose rebate plane. Usually chamfeiing is done to improve the appearance of the work, although sometimes the edges of skirting boards, plinths, edges of door rails, are chamfered to prevent dust settling. Chamfers are usually planed at 45° to the side or edge. (Fig. 238.)

6. **Splayed Edge** is the surface produced when the side is planed at an angle other than 45° to the edge, e.g., edge of Tee Square and Straight Edges. (Fig. 239.)

7. **Bevelled Edge.**—When the whole of an edge is planed off to an angle other than a right angle, the edge is called a "bevelled edge." (Fig. 240.)

8. **Rounded Edge.**—When more than the arris edge is removed to form a definite rounded corner or quadrant of a circle. E.g., tops of chair bottoms, table tops, etc. (Fig. 241.)

9. **Nosing.**—When the edge of a board overhangs a vertical surface, e.g., front edge of window nosing boards, stair treads, etc., it is called "nosing." If the edge

is rounded to a semi-circle it is called "rounded nosing," or a form of moulding called "Torus." (Fig. 242.)

10. **Grooving** is the process of planing or cutting a sinking or recess along the grain either on a side or on an edge. Square or rectangular grooves can be planed with a plough plane. Other forms of grooves, such as hollow and "V" grooves, which are usually produced by milling machines, are sometimes used. Grooves which are stopped at one or both ends are known as "stopped grooves." They are cut with a chisel, and may be finished with a router plane. (Fig. 243.) Used in tongued and grooved joints, panelled frames and fixing bottoms of drawers.

11. **Rebating** is the cutting of a rectangular recess along the edge or across the end of timber. Used in picture frames, window sashes, framework for panelling, and the meeting stiles of doors, etc. Rebates are planed with either side fillister, sash fillister or rebate planes. Stopped rebates are chiselled and finished with a bull-nose rebate plane. (Fig. 244.)

12. **Trenching** is the cutting of a recess across the grain, the sides being sawn, the waste chiselled out, and the bottom surfaced with the router plane. If the trench extends right across the timber it is called a "through trench," if stopped at either end it is called a "stopped trench." Used chiefly for housed joints, e.g., fixing shelves into cupboards, etc. (Fig. 245.)

13. **Housing** is the fitting of the end of one piece of timber into a trench in the side of another piece. E.g., shelving. Termed "through housing" when the shelf is fitted into a through trench; "stopped housing" when a stopped trench is used; "dovetailed housing" when a dovetailed trench is used; "shouldered housing" when the trench is narrower than the thickness of the shelf. (Figs. 269-271, plate 35.) Used for fixing shelves in cabinets and sometimes for joining backs of drawers to the sides.

14. **Mitre.**—When two lengths of the same sectioned timber (e.g., moulding) meet at an angle and the ends of the pieces are cut so that the line of the butt joint formed bisects the angle at which the two pieces meet, the joint is called a mitred joint, such as on the corners of picture frames, architraves and plinths. The mitres may be cut in a mitre-box and planed in a mitre shoot. (Figs. 261, 262 and 278.)

15. **Scribing.**—Chiefly used where mouldings meet at an internal angle. The end of one piece is shaped to fit over the profile of the other, forming a scribed joint. E.g., mouldings such as skirtings, cornices, which meet at corners of rooms are scribed to fit one another, so that if any shrinkage takes place, very little gap appears, as often happens when a mitred joint is used. (Fig. 268.)

16. **Dowelling** is joining pieces of timber by means of cylindrical pins known as dowels glued into holes bored in each piece. May be used to strengthen butt joints, mortise and tenon joints and bridle joints, etc. When used for these purposes the dowels are called "pins." (Figs. 254, 279 and plate 49.)

17. **Keying.**—A method of strengthening mitred joints by gluing small pieces of veneer into saw kerfs across the corner of the joint. (Fig. 262.)

18. **Tongues or Feathers** are thin pieces of wood, either cut along the grain or across the grain, glued into ploughed grooves along the edges being joined. Used for strengthening the joints, especially mitred joints. (Figs. 255, 262, 278.)

19. **Wedging.**—A method of strengthening mortise and tenon joints by means of tapered pieces of wood, usually used in pairs and driven into the tenon to spread it in the mortise. Allowance for wedges is about $\frac{1}{8}''$ for each $1\frac{1}{2}''$ in the width of the tenon. (Figs. 280 and 285.)

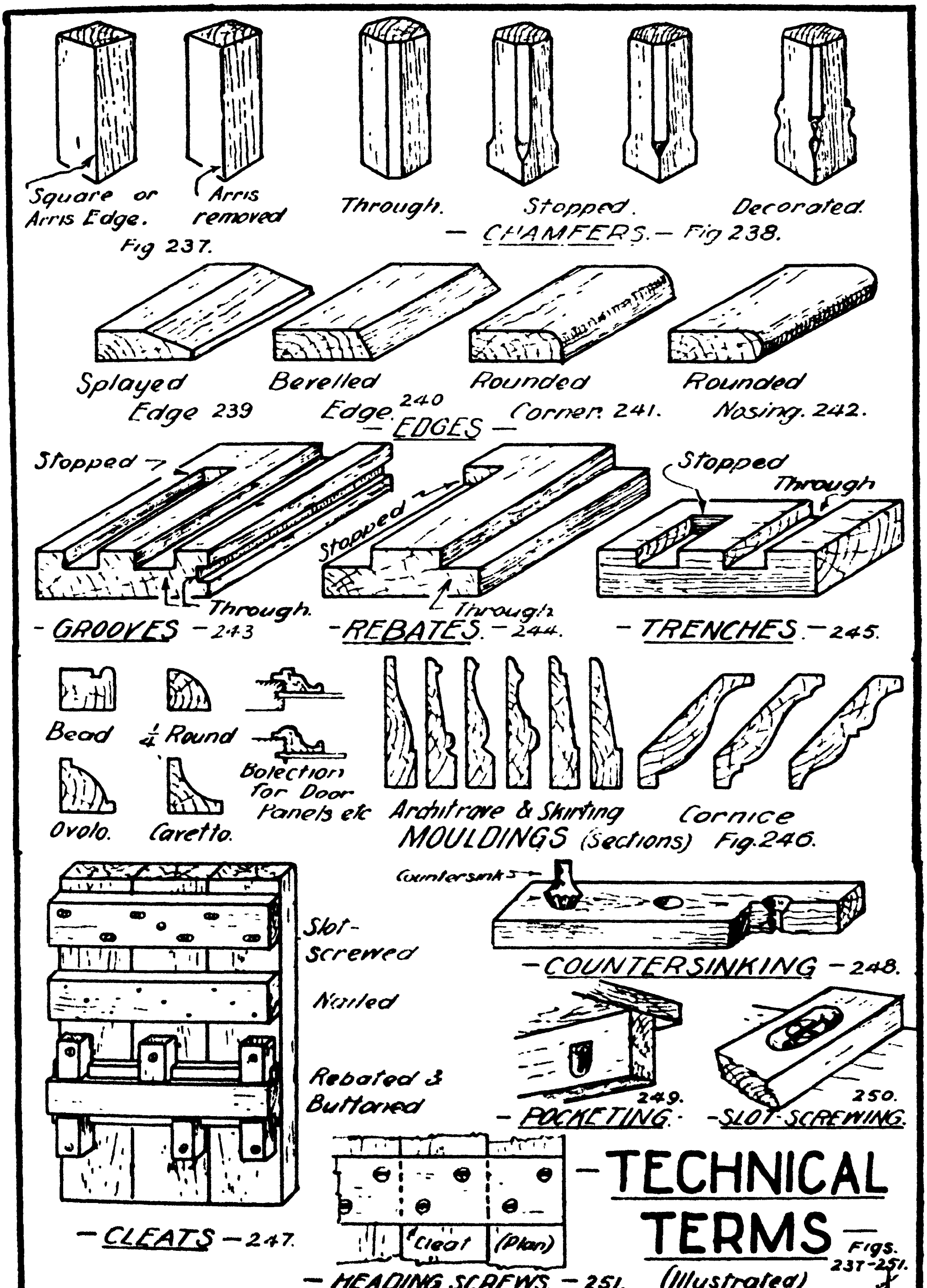

Square or Arris Edge.
Arris removed
Fig 237.
Through.
Stopped.
Decorated.
— CHAMFERS. — Fig 238.
Splayed Edge 239
Bevelled Edge. 240
Rounded Corner. 241.
Rounded Nosing. 242.
— EDGES —
Stopped
Through.
— GROOVES — 243
Stopped
Through
— REBATES. — 244.
Stopped
Through
— TRENCHES. — 245.
Bead
¼ Round
Bolection for Door Panels etc
Ovolo.
Cavetto.
Architrave & Skirting
Cornice
MOULDINGS (Sections) Fig. 246.
Countersinks
— COUNTERSINKING — 248.
Slot-Screwed
Nailed
Rebated & Buttoned
— CLEATS — 247.
249.
— POCKETING.
250.
— SLOT SCREWING.
Cleat
(Plan)
— HEADING SCREWS. — 251.
— TECHNICAL TERMS — (Illustrated)
Figs. 237–251.

PLATE 33.

20. **Foxtail Wedging.**—A method of wedging mortise and tenon joints where the tenon does not pass right through the stile. Generally used in high-class cabinet work in which the end grain of the tenon would spoil the appearance of the work. (Fig. 285.)

21. **Cleat.**—A narrow board or batten fixed across a wide board to prevent it from warping. Usually secured by means of nails, screws or buttons. (Fig. 247.)

22. **Haunch** is the small piece left on the tenon of a haunched mortise and tenon joint to give added strength and prevent the rail from twisting. (Plates 45, 46, 47.)

23. **Countersinking** is enlarging the top of a screw hole in metal or wood by means of a countersink bit or drill to receive the head of a countersunk head screw. (Fig. 248.)

24. **Pocketing** is the term applied to boring holes for heads of screws where countersinking would not be sufficient; frequently used when fixing table tops. The pockets may be bored with the forstner bit. (Fig. 249.)

25. **Slot Screwing.**—Used where screws are not seen for fixing cleats, drawer runners, table tops, etc., to allow for the "working" (expansion and contraction) of the timber. (Fig. 250.)

26. **Heading Screws.**—When the slots of the screws run in the same direction, usually in the direction of the grain which surrounds them. It is done to improve the appearance of the work. (Fig. 251.)

27. **Moulding** is the process of shaping the faces and edges of timber for ornamental purposes and breaking the continuity of plain surfaces; common forms are Bead, Ovolo, Cavetto, Quarter Round, Half Round. Used on ornamental picture frames, edges of table tops, architraves, picture rails, etc. (Fig. 246. See also plate 72.)

28. **Architraves** are mouldings which surround door or window openings.

29. **Fillet** is the name applied to a small piece of timber nailed, screwed or glued to the side of a job to support a shelf. (Also a type of Moulding, plate 72.)

30. **Carcase** is the term applied to the box-like frame work of a job before the interior fittings are added. E.g., wardrobe, or cabinet before the doors, shelves and drawers are added.

31. **Member.**—In framed work each piece which goes to make up the frame is called a member. In framed doors the members have special names. The vertical members are called stiles and the horizontal members are called rails.

32. **Plinth** is the name applied to the framework fixed underneath cabinets, wardrobes, etc., to raise the bottom off the floor instead of using legs.

33. **Cornice.**—The moulding at the junction of walls and ceilings. (Fig. 246.)

QUESTIONS.

1. What do you understand by the terms planing, sawing, and shooting?
2. What is an arris edge? How and why is the arris edge removed?
3. What is the difference between a through chamfer and a stopped chamfer? Show by sketches.
4. Name the tools used in setting out and cutting a stopped chamfer.
5. Why are chamfers used?

6. Show by sketches the difference between a splayed edge and a bevelled edge.
7. Sketch a rounded edge and a rounded nosing.
8. How could the rounded edge be produced?
9. What do you understand by the term "rough timber?"
10. Make a sketch showing a stopped groove and a through groove. What plane is used for planing a through groove?
11. Describe the uses of rebates. Sketch a rebate.
12. Sketch a through and stopped trench. Where are trenches mostly used?
13. Define the term "housing."
14. Describe a mitred joint.
15. Name and show by sketches two methods of strengthening mitred joints.
16. Where are dowels used? When used to strengthen joints, what are they called?
17. State the uses of mitred joints.
18. How are mitres cut and shot?
19. What is scribing and when is the scribed joint used?
20. How could through tenons be strengthened?
21. What is the purpose of foxtail wedges and where are they used?
22. What is the purpose of the haunch in a haunched M and T joint?
23. Explain the term countersinking.
24. What do you understand by the terms pocketing, slot screwing?
25. Define "moulding." Name five forms of mouldings; sketch them.
26. Sketch a small door with two panels; name the members of the door.
27. What hand planes could be used for producing mouldings?
28. Where are architrave and cornice mouldings used?
29. Sketch a moulding suitable for (a) an architrave.
    (b) a cornice.
    (c) a picture frame.
30. What do you understand by "heading screws?" Illustrate your answer.

II. CLASSIFICATION OF JOINTS (Plates 34, 35, 36).

The majority of joints used in cabinet work are very old, and were designed years ago to perform certain duties. From experience their proportions have become standard in order to maintain a maximum of strength with the pieces they connect. The most common forms of joints are listed below. Variations of these joints are occasionally necessary, and may be designed to suit special jobs.

Joints used in cabinet work may be classified into three main groups: (A) Widening Joints, (B) Angle Joints, and (C) Framing Joints.

A. WIDENING JOINTS.—Plate 34.

These joints are used to produce wide boards from a number of narrow boards by joining them edge to edge.

1. **Butt Joints.**—In the simplest form of butt joint the edges are shot square, butted together, and held in place by means of glue or corrugated box fasteners.

(a) When glued, excess glue and air bubbles may be rubbed out (rubbed glued joint) or forced out by means of sash cramps. Extensively used in table tops and

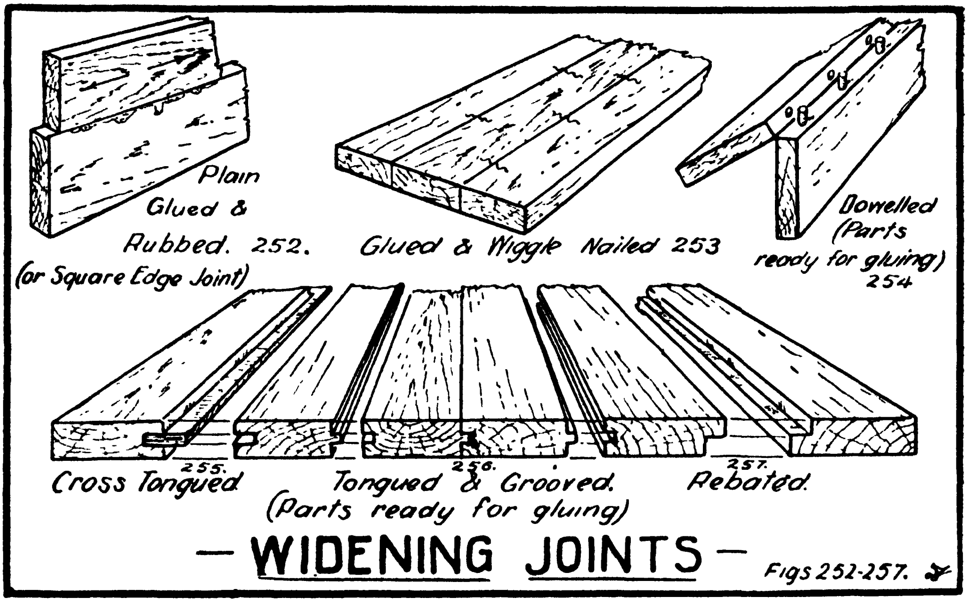


PLATE 34.

cores for veneers (solid core board). Joints up to 3′ 6″ long can be rubbed satisfactorily. (Fig. 252 and plate 38. For solid core board see plate 75.)

(b) For cheap constructional work, such as packing cases, corrugated fasteners are often used to hold the pieces together. Seldom used in cabinet work. (Fig. 253.)

2. **Dowelled Joint.**—Similar to the butt joint, added strength being supplied by the addition of dowels glued and inserted into holes in each edge (about ¾″ into each piece) and the boards cramped up. Not suitable for boards thinner than ½″. Used for table tops, etc., where a stronger joint than the plain butt joint is required. (Fig. 254 and plate 49.)

3. **Tongued Joint.**—For 1″ thick stuff the joining edges are grooved with a plough plane for a depth of about ½″ and a tongue glued into the groove, with its grain across the groove if greater strength is required. The tongue should be about 1/3rd thickness of timber. Not suitable for timber less than ½″ thick. (Fig. 255.)

4. **Tongued and Grooved.**—A common form of widening joint used in flooring boards and better types of packing cases, etc. When worked by hand a pair of planes called matching planes are used; one plane producing a tongue and the other a groove into which the tongue fits. If this joint is used for desk tops, etc., glue is necessary to make the joint permanent. (Fig. 256.)

5. **Rebated Joint.**—This joint consists of rebating both pieces, gluing and cramping. The purpose of the rebates being to give extra gluing surface. (Fig. 257.)

B. ANGLE JOINTS.—Plate 35.

Joints generally used for fixing together pieces which have their faces at right angles.

(i) CORNER ANGLE JOINTS, chiefly used in boxlike constructions, such as solid cabinets, boxes, drawers, etc.

1. **Simple Butt.**—The ends or edges of the members are shot and butted together at right angles and nailed, screwed or glued. Generally used in packing case construction. (Fig. 258.)

2. **Rebated Butt, Shouldered Corner or Angle Lap.**—The end of one piece is fitted into a rebate worked across the end of the other piece. It is an improvement on the butt joint, as it provides two nailing surfaces and more gluing surface. Used in boxes, cheap cabinets, book shelves, cheap drawers, carcases for veneered work, etc. (Fig. 259.)

3. **Housed and Shouldered or Tongued and Trenched or Dado Joint.**—Stronger than the angle lap joint. A barefaced tongue is worked on the end of one member to fit into a groove or trench cut across the face of the other member. Used in box construction, corners of cabinets and cheap drawers. (Fig. 260.)

4. **Rebated and Mitred Angle Joint.**—Each piece is rebated and the ends mitred to form a fairly strong angle joint (with two nailing surfaces), which does not show any end grain on the external surfaces. The shoulders act as stops while assembling. Used in box construction, plinths and corners of cabinets. (Fig. 261.)

5. **Plain Mitred Joint** (where the pieces are mitred across their thickness).—This is the simplest method of connecting the end grain of pieces (the same thickness and of similar sections, e.g., mouldings) to form an angle so that no end grain is seen. Used for external and internal angles where little strength is required, skirting boards, plinths, etc. NOTE: The line of the joint bisects the angle at which the pieces meet. Frequently strengthened by a "slip feather" or "tongue" inserted in a groove cut along the joint, or by "keys," which are pieces of veneer glued into saw kerfs across the corner of the joint. (Fig. 262.)

6. **Dovetailed Joints.**—These are the strongest form of angle joint used in cabinet work. The joints consist of (i) one or more dovetails cut on the end of one member, and (ii) a number of projections called "pins" on the end of the other piece, which are cut to fit into the recesses (pin sockets) on each side of the dovetails. The strength of the joint depends upon the shape of the dovetails (which can only be pulled away from the pins in one direction), and the added amount of gluing surface compared with other angle joints. The gluing surface can be altered as required by increasing the number of dovetails until they approximate the sizes of the pins. The wide side of the pins is usually made equal to $\frac{3}{4}$ the thickness of the piece on which they are cut, and the distance between them should not exceed three times the thickness of the material. The pitch of the sloping sides of the dovetails varies from 1 in 4 for softwoods to 1 in 8 in hardwoods. The average slope is 1 in 6. When a pitch of 1 in 4 is used it makes the narrow side of the full pins $\frac{1}{4}$ thickness of timber and the half pins $\frac{1}{2}$ thickness; these sizes can be measured instead of using a sliding bevel.

(a) *Single Dovetail Joint.* (May also be used as a Framing Joint.)—This joint consists of only one dovetail fitting into a dovetail socket in the second piece. A very strong joint used for narrow pieces, such as brackets, top and bottom rails of carcases, etc. Where it is necessary to hide the end grain of the dovetail the joint is sometimes lapped. (Fig. 263 and plate 50.)

(b) ***Common Dovetail Joint*** or ***Through Dovetail Joint*** is the strongest form of

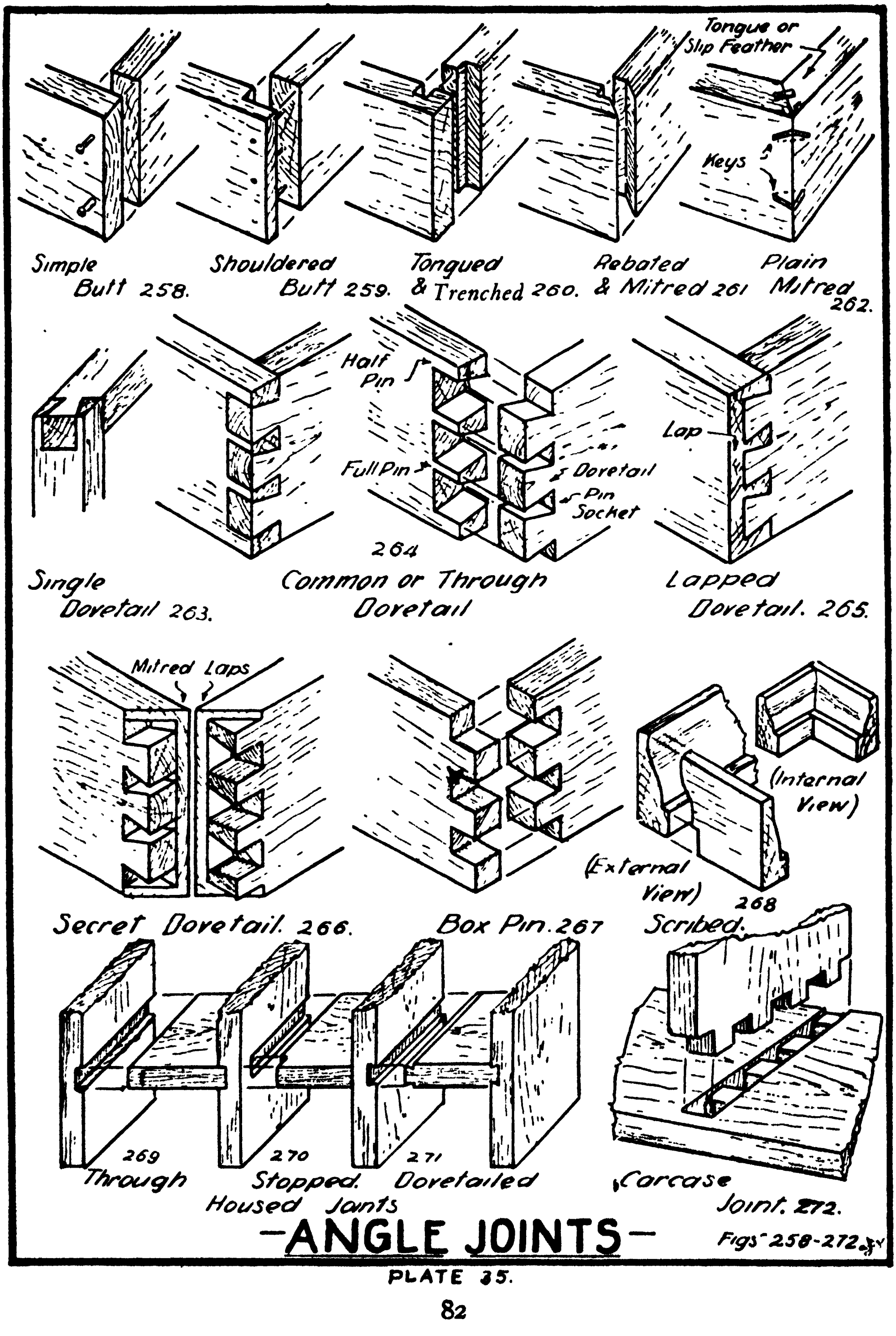

Tongue or Slip Feather
Keys
Simple Butt 258.
Shouldered Butt 259.
Tongued & Trenched 260.
Rebated & Mitred 261
Plain Mitred 262.
Half Pin
Full Pin
Lap
Dovetail
Pin Socket
264
Single Dovetail 263.
Common or Through Dovetail
Lapped Dovetail. 265.
Mitred Laps
(Internal View)
(External View)
268
Secret Dovetail. 266.
Box Pin. 267
Scribed.
269
270
271
Through
Stopped.
Dovetailed
Housed Joints
Carcase Joint. 272.
-ANGLE JOINTS-
Figs. 258-272.

PLATE 35.

angle joint. It has two or more dovetails. End grain is seen on both sides of the joint. Used in making strong boxes, rails of tea trays, in carcase construction and for fixing the backs of drawers to the sides. (Fig. 264. See also plate 51.)

(c) *Lapped Dovetail Joint.*—Similar to the common dovetail joint, differing to the extent that a lap is left on the outside of the pins to cover the end grain of the dovetails. The lap is usually from $\frac{1}{4}$ to $\frac{1}{8}$ the thickness of the timber. If a plain lap is left on both pieces to cover the end grain of the pins as well as the end grain of the dovetails, the joint is called a "double lapped dovetail." (Fig. 265 and plate 52.)

(d) *Secret Dovetail Joint.*—In this dovetail joint there is a double lap on both sides of the joint, which is mitred to hide all end grain. Assembled the joint has the appearance of a plain mitred joint. Used in high-class cabinet work, jewel boxes, etc., where both appearance and strength of joint are required. (Fig. 266, also plate 53.)

7. **Comb Joint or Box Pin Joint.**—Consists of a series of alternate notches and square pins of the same width which interlock in the assembled joint. Used in box construction. If required in numbers they are made by machinery. (Fig. 267.)

8. **Scribed Joint.**—An internal angle joint used in preference to the mitred joint at the junction of mouldings where the inside angle of the joint only is seen. E.g., on skirting boards, cornices, etc., which meet at the corners of a room, and on mouldings surrounding door panels. The joint is formed by cutting the end of one piece of moulding to fit over the shape or profile of the other piece. This joint does not show the effects of shrinkage. (See also note on Scribing, No. 15, Technical Terms.) (Fig. 268.)

(ii) ANGLE JOINTS OTHER THAN CORNER JOINTS.—Where one piece meets another but not at an end, with the faces of the pieces at right angles, such as shelves and partitions in cupboards, etc.

9. **Housed Joints.**.—Consists of sinking the end or edge of one member into a trench or groove in the face of another member. Used chiefly for fixing shelves or divisions in bookcases, cabinets, treads of step ladders, stairs, etc.

(a) *Through or Full Housing Joint.*—The whole end or edge is fitted into a through trench and the joint is visible on both sides. (Fig. 269 and plate 39.)

(b) *Stopped Housing Joint.*—In better class work this joint is used in preference to the through housing, for improved appearance. The end of the trench is stopped back from the front edge, and the end of the shelf notched to suit, so that in the assembled joint the trench is not seen. (Fig. 270 and plate 39.)

(c) *Dovetailed Housing Joint.*—Used where a stronger joint is required. The end of the shelf is dovetailed on one or both sides and fitted into a dovetailed trench.

NOTE: The depth of a trench is about 1/3rd thickness of timber. (Fig. 271 and plate 39.)

10. **Carcase Joint.**—As the name suggests, this joint is generally used in carcase construction for fixing partitions (sometimes shelves) where all the members are of solid timber or thick plywood. The end of the partition piece is divided into a number of short tenons which fit into suitable mortises in the top and bottom pieces. The tenons may pass through the bottom to be wedged, thus making the joint stronger. Usually the mortised piece is slightly trenched to improve the fitting of the partition. (Fig. 272. Plate 98 shows use of this joint.)

C. FRAMING JOINTS.—Plate 36.

Joints used in frame-like constructions, where the members are usually jointed end to edge, with their edges at right angles. E.g., Panelled doors, tables, chairs, picture frames, etc.

1. **Halving or Half-lap Joints.**—The name is applied to joints where the pieces of timber, which meet or cross each other, are halved in their thickness so that when assembled the faces are flush.

(a) *Angle Halving Joint.*—Used where the pieces meet at their ends to form an angle, as in light frames, such as fly screens, frames for cores of cheap flush doors, etc. Sometimes the lapping pins are bevelled when used in heavy timber to give added strength. (Fig. 273.)

(b) *Mitred Angle Halving Joint.*—Similar to the angle halving joint except that the pin of one member is mitred to fit against the mitred shoulder of the other member. It is the weakest form of halving joint, due to the decreased gluing surface caused by mitring. Its use is rendered necessary when the pieces are moulded, as in picture frames, etc. (NOTE: The lapping may be stopped to hide end grain.) (Fig. 274.)

(c) *Tee Halving Joint.*—Used in frames where a rail meets a stile away from the end. Sometimes the socket is stopped so that the end grain of the pin is hidden. (Fig. 275 and plate 40.)

(d) *Dovetailed Tee Halving Joint.*—Used for connecting cross rails of frames where an outside strain occurs. Sometimes the socket is stopped to hide the end of the pin. (Fig. 276 and plate 42.)

(e) *Cross Halving Joint.*—Used where the members cross each other, as in cross or diagonal rails of small tables, chairs, etc. (Fig. 277 and plate 41.)

2. **Mitred Joint** (where the pieces are mitred across their width).—The ends of the pieces are mitred, butted together and held together by nails, screws or glue. The joint may be strengthened by a slip feather or loose tongue of thin wood glued into grooves worked along the edges of the joint. Chiefly used in picture frames, architraves, frames round solid or plywood table tops, etc. (Fig. 278.)

3. **Dowelled Joint.**—A form of butt joint strengthened by means of dowels. Used in chairs and tables for fixing the rails and rungs to the legs. (Fig. 279 and plate 49.)

4. **Mortise and Tenon Joints.**—The most common and strongest form of framing joint. There are many forms of M & T Joints; the most common forms are listed below. Chiefly used in panelled frames for doors, framed carcases for cabinets, for joining rails to legs of tables and chairs, etc.

The main parts of the joint are (i) The TENON cut on the end of one member which is generally called the rail, and (ii) the MORTISE, a recess or hole cut in the edge of the second member, called the stile, into which the tenon fits. The tenon is usually glued into the mortise. If a very strong joint is required wedges are used, and an allowance is made on the outside ends of the mortise to receive the wedges (about $\frac{1}{8}''$ for each $1\frac{1}{2}''$ in the width of the tenon, and tapering 2/3rds through the stile).

(a) *Common or Through Mortise and Tenon Joint.*—Used in pieces of the same thickness, and where a rail meets a stile some distance from the end. The tenon is

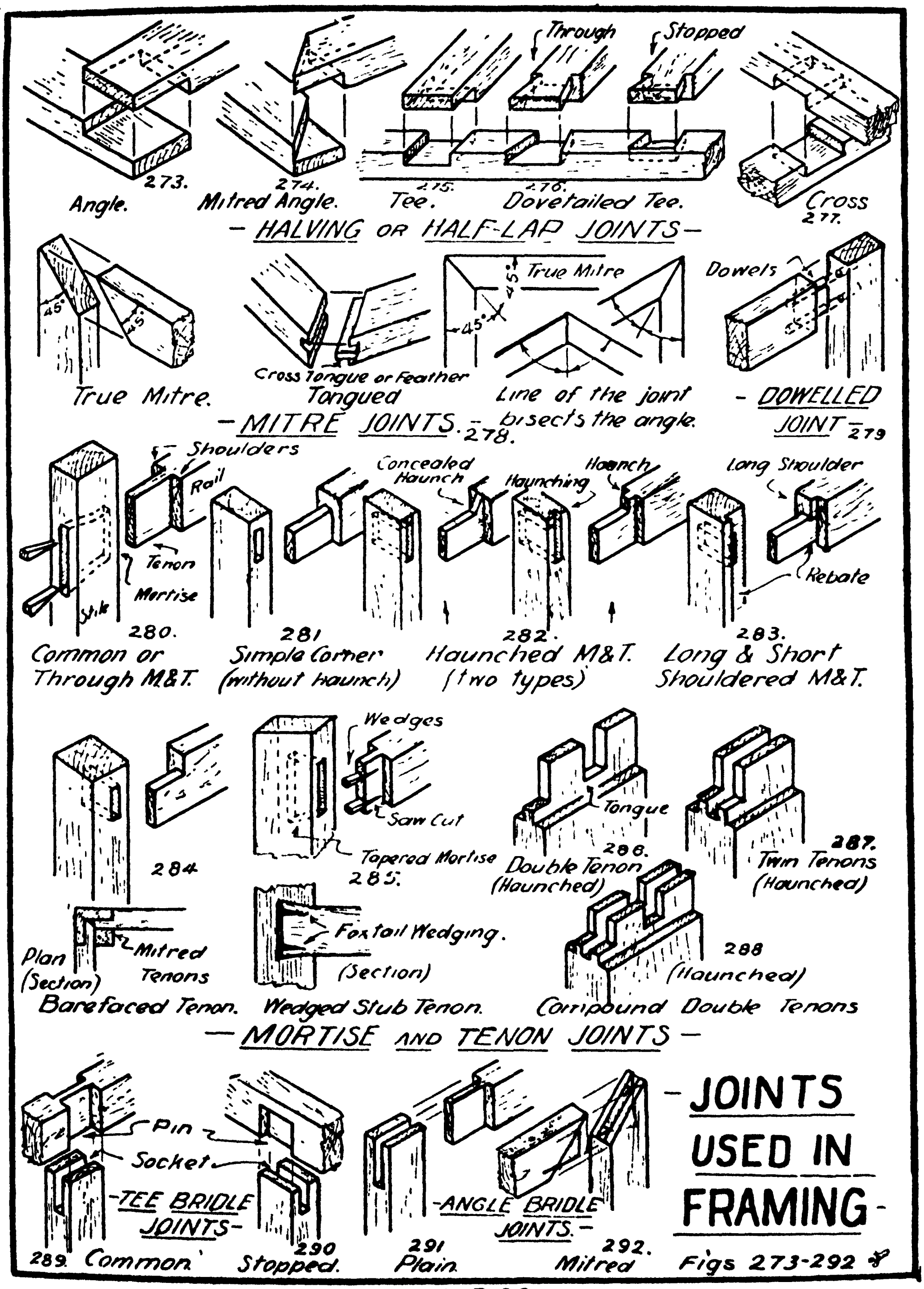

Through
Stopped
273.
274.
275.
276.
Angle.
Mitred Angle.
Tee.
Dovetailed Tee.
Cross
277.
- HALVING OR HALF-LAP JOINTS -
45°
45°
True Mitre
45°
45°
Dowels
Cross Tongue or Feather
True Mitre.
Tongued
Line of the joint bisects the angle.
- DOWELLED JOINT - 279
- MITRE JOINTS. - 278.
Shoulders
Rail
Tenon
Mortise
Stile
Concealed Haunch
Haunch
Haunching
Long Shoulder
Rebate
280.
281
282.
283.
Common or Through M&T.
Simple Corner (without haunch)
Haunched M&T. (two types)
Long & Short Shouldered M&T.
Wedges
Saw Cut
Tapered Mortise
285.
284
Tongue
286.
Double Tenon (Haunched)
287.
Twin Tenons (Haunched)
Plan (Section)
Mitred Tenons
Foxtail Wedging.
(Section)
288
(Haunched)
Barefaced Tenon.
Wedged Stub Tenon.
Compound Double Tenons
- MORTISE AND TENON JOINTS -
Pin
Socket
-TEE BRIDLE JOINTS-
-ANGLE BRIDLE JOINTS.-
- JOINTS USED IN FRAMING -
289. Common
290 Stopped.
291 Plain.
292. Mitred
Figs 273-292

PLATE 36.

the full width of the rail and passes through the stile. Wedges may be used to strengthen the joint. The thickness of the tenon is usually about 1/3rd the thickness of the timber, depending on the size of the mortise chisel to be used in cutting the mortise. As a general rule the width of the tenon is limited to six times its thickness, as wide tenons may buckle when wedged and split the stile, or may shrink and become loose. If the rail is wide it is advisable to make a double tenon, see below (f). Sometimes when the joint is used for outdoor work a dowel, called a "pin," is inserted, passing through the face of the stile and tenon to strengthen the joint, but the end grain of the pin spoils the appearance of the work for cabinet jobs. (Fig. 280 and plate 44.)

(b) *Haunched Mortise and Tenon Joint.*—Used where the rail meets a stile or leg at the end. To prevent the tenon from slipping out of the end of the mortise, the tenon is cut narrower (about 5/9ths the width of the rail), and the mortise reduced to suit. A small portion of the base of the tenon is left the full width of the rail to form a haunch, which fits into a recess called a haunching on the end of the stile. The length of the haunch is usually equal to the thickness of the tenon, and its purpose is to prevent the rail from twisting or showing an opening should the stile shrink. Used in the corners of frames, such as panelled doors, sashes, some tables, etc. If wedges are used they are cut from the waste of the tenon while cutting the haunch. (Fig. 282 and plate 45.)

(c) *Long and Short Shouldered Mortise and Tenon Joint.*—Used where the members are rebated for panels, as in some panelled doors for cabinets and cupboards, etc., one shoulder of the tenon is cut longer to fill up the rebate on the stile. (Fig. 283 and plate 46.)

(d) *Barefaced Mortise and Tenon Joint.*—This joint is used where the rail is of thinner material than the stile or leg, as in the rails and legs of ordinary tables. The tenon has only one shoulder, and is approximately half the thickness of the rail; it may be the full width of the timber or it may be haunched. When two rails meet the adjacent faces of table legs, etc., it is necessary to mitre the ends of the tenons so that each tenon is cut as long as possible. (Fig. 284 and plate 47.)

(e) *Stump or Stub Mortise and Tenon Joint.*—When the tenon does not pass right through the material, it is known as a "stump" or "stub" tenon. It is used in high-class cabinet work so that the end grain of the tenon is not seen on the edge of the stile. The length of the tenon is usually only about 2/3rds the width of the stile, depending on the required strength of the joint, the mortise is cut to suit. Added strength may be obtained by using fox wedges; these are inserted in saw cuts in the tenon. When the joint is cramped up the wedges spread the tenon in the mortise. The mortise must be dovetailed on the inside. (Fig. 285.)

(f) *Double Tenon.*—Where the joining rail is wide, as in the middle and bottom rails of panelled doors, it is usual to divide the width of the rail into two tenons so that the width of each tenon does not exceed six times its thickness. A wide tenon would weaken the stile and may become loose by shrinkage. A haunch is used on the outside tenon for top or bottom rails and a tongue is usually left between the tenons to prevent the rail from warping, and light showing through if the stile shrinks. (Fig. 286.)

(g) *Twin Tenons.*—These are used on very thick timber, where a very strong joint is required. The thickness of the rail is divided into five parts to produce two tenons side by side. (Fig. 287.)

(h) *Compound Double Tenons.*—Used where the timber is wide and thick, as in the middle rails of some doors where the lock is mortised into the stile. It consists of two double tenons side by side. (Fig. 288.)

(i) *Haunched M. and T. for Grooved Frames.*—As seen in plate 47, used in frames where the members are grooved instead of rebated for panels, the panel is assembled with the frame.

(j) *Sash Joint.*—Shown in plate 48; used where the members are rebated and moulded, as for window sashes.

5. **Bridle Joints.**—These joints are sometimes used in place of mortise and tenon joints, where a stronger joint than a halving joint is required. The parts are the reverse of the mortise and tenon. Instead of the tenon, an open slot or socket is cut in the end of the rail to fit over a pin produced by trenching both sides of the stile. The pin and socket are usually 1/3rd the thickness of timber.

(a) *Common or Tee Bridle Joint.*—Used in place of the Common M & T Joint, where one member meets the other some distance away from the end. Sometimes seen on small tables and stands where a leg meets the middle of a rail. "Pins" can be used to strengthen the joint. If it is required to hide the end grain the pin is not cut the whole width of the timber and the socket is shortened to correspond. (Figs. 289 and 290, and plate 43.)

(b) *Angle or Corner Bridle Joint* (sometimes called an Open M & T Joint).—Used as a substitute for the haunched mortise and tenon at the corners of frames. (Fig. 291.)

(c) *Mitred Angle Bridle Joint* (also known as Mitred M & T Joint).—One or both sides of the socket may be mitred as required. Used where a stronger joint than the mitred halving joint is required on either plain or moulded timber, as on mirror frames, etc. (Fig. 292.)

QUESTIONS.

1. Name and describe four widening joints.
2. Show by sketches the difference between a loose tongued and a tongued and grooved joint.
3. What is the simplest form of widening joint?
4. How could you strengthen a plain glued butt joint?
5. What advantages has the rebated butt joint over a plain glued butt joint?
6. Show by sketches the difference between the simple butt and the rebated butt angle joints.
7. (a) How are the two above joints held together?
   (b) Why is the rebated butt joint stronger than the simple butt angle joint?
8. Sketch a tongue and grooved angle joint. Where could this joint be used?
9. When would you use a rebated and mitred angle joint in preference to a rebated butt joint?
10. (a) Sketch a plain mitred angle joint.
    (b) Show by sketches two methods of strengthening this joint.
11. (a) Name the strongest form of angle joint.
    (b) What makes this joint so strong?

12. What is the average pitch of the slope of the dovetails in a dovetailed joint? Show by a sketch how to set the sliding bevel to the required pitch.

13. Sketch a single dovetail joint with its members separated. Where might this be used?

14. Name two joints used in drawer construction.

15. When would you use a lapped dovetail in preference to a common dovetailed joint?

16. What type of a joint is a housed joint?

17. Name three forms of housed joints.

18. Sketch a through housed joint. Where is it most frequently used?

19. When would you use a stopped housed joint in preference to a through housed joint?

20. Why is a dovetailed housed joint stronger than a through housed joint?

21. Sketch three kinds of halving joints and name them.

22. Write down briefly what you understand by halving.

23. Why is the dovetailed halved joint stronger than a plain through halved joint?

24. Why are halving joints referred to as framing joints?

25. Where could you use a mitred angle halving joint?

26. Sketch a mitred joint suitable for a frame. Describe some methods used for securing this joint.

27. Name a joint frequently used in the construction of chairs and tables (not an M & T joint). Is it weaker or stronger than the M & T joint? Why?

28. Briefly describe the parts of a mortise and tenon joint.

29. Sketch a common M & T joint and name its parts. How could the tenon be made more secure in the mortise?

30. What is the approximate thickness of the tenon in the C. M & T Joint?

31. What governs the exact thickness of the tenon?

32. Where is the common M & T used?

33. What joint would you use where a rail of a door meets the stile at the end?

34. Sketch a haunched M & T joint and name its parts. Where would this joint be used?

35. Why is the tenon cut narrower than the full width of the rail in the H. M & T joint?

36. What is the purpose of the haunch? About how long would you make the haunch?

37. Name the joint suitable for a strong rebated frame, such as the frame of a panelled door.

38. When the rail is thinner than the stile (or the leg in the case of a table), what type of M & T joint is frequently used? Sketch the joint with members separated.

39. When would you use a stump M & T in preference to a through tenon?

40. Name two types of M & T joints suitable for extra heavy framing jobs.

41. When is it necessary to use double tenons?

42. Show by sketches the difference between the C. M & T and the "T" Bridle joints. Name their parts.

43. Name two joints which could be used at the corners of a picture frame.

44. Name the three main groups into which joints may be divided.

46. Name four joints which could be used for joining the sides of boxes together. Which joint would you consider to be the strongest joint for this purpose? Why?
47. Name two common framing joints and two common angle joints. Sketch them.
48. What joint would be most suitable for the corners of a veneered box? Why?
49. What joint is used for fixing together the strips of solid core board?
50. State the uses of scribed joints. Briefly describe a scribed joint.

III. PREPARATION OF TIMBER (Plate 37).

In order to carry out the construction of an exercise or job, it is necessary to understand clearly the correct procedure to be followed in preparing each member of the job to the required sizes. The steps should be carried out in the order set out below on every piece of timber, be it large or small.

NOTE: If possible, it is best to select the face side and edge so that when the face edge is being planed along the grain, the face side is nearest the worker with its grain running towards the left (the bench stop). This enables mouldings, rebates, etc., to be worked on the face side face edge corner without tearing up the grain of the wood with the plane. (See step 2, plate 37.)

PROCEDURE.

Step 1.—Select the face side and plane it perfectly flat. Test with winding sticks and straight-edge. Mark with a face side mark pointing to the edge which has been slected as the face edge.

Step 2.—Plane the face edge. Test for straightness with the straight-edge, and for squareness to the face side with the try-square. Mark this edge with a face edge mark pointing to the face side.

Step 3.—Gauge to the required width on both sides, using the marking gauge from the *face edge.* Plane down the gauge lines. Test for straightness and squareness.

Step 4.—Gauge to the required thickness from the *face side* down both edges. Plane down the gauge lines. Test for flatness.

Generally the timber is not prepared to the exact length. A small amount of waste is usually left at each end of the piece to protect the corners against damage. But if the piece is required immediately to be finished to length, it is carried out as in—

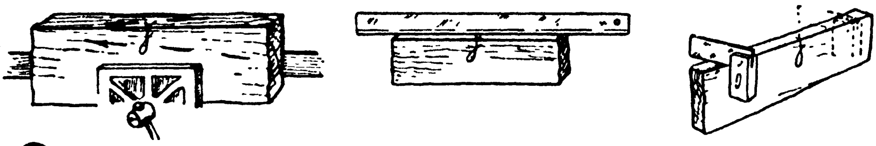
Step 5.—Square, cut and shoot (plane) one end. Test for squareness to face side and face edge.

Step 6.—Measure the required length from the prepared end, and square, cut and shoot off waste.

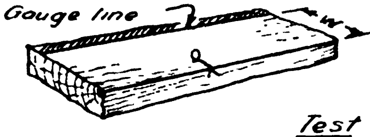
NOTE: Square the lines marking the length, round the timber with the marking knife. (See plate 4a.)

USE OF FACE MARKS.—The purpose of the face marks is to show clearly the prepared and tested sides and edges which are square (at right angles to one another) for gauging and squaring, and to assist in assembling and testing the work.

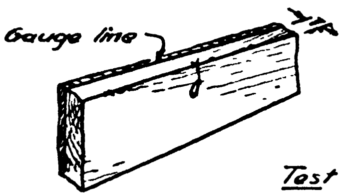
① Plane face side perfectly flat. Test with straight edge and winding sticks



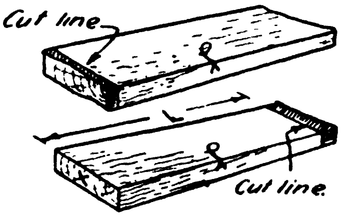
② Plane face edge perfectly straight and square to face side. Test with straight edge and try-square



③ Gauge to the required width, on both sides from the face edge. Plane down to gauge lines. Test with straight edge and try-square.



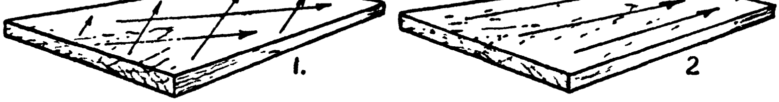
④ Gauge to the required thickness on both edges, (and for wide boards along the ends) gauging from the face side. Plane down to gauge lines. Test with straight edge and winding sticks.



⑤ Square, cut, and shoot one end. Test with try-square

⑥ Measure required length from prepared end. Square, cut, and shoot off waste. Test with try square.

NOTE:- When planing up wide surfaces, first plane diagonally (traverse planing), and finally plane along the grain. Test with straight edge and winding sticks.



- PREPARATION OF TIMBER -

PLATE 37

QUESTIONS.

1. Describe how you would prepare a piece of timber to width and thickness.
2. What tests would you apply to ensure accuracy in preparation?
3. Make a list of tools you would use in carrying out each step.
4. Describe how to mark and cut the piece to its required length.
5. Why is the waste left on the ends of some pieces when preparing?
6. Show by a sketch the position of the face side and edge marks.
7. When gauging to width, is the gauge used from the face side or face edge?
8. When gauging to thickness, is the gauge used from the face side or face edge?
9. Why is it necessary to use face side and edge marks?
10. Describe how you would test the face side for flatness.

IV. CONSTRUCTION OF JOINTS (Plates 38 to 53).

1. THE RUBBED GLUED JOINT. (A Widening Joint.)

(Plain Glued Joint). PLATES 38 and 34.

USES: For joining together two or more boards edge to edge in order to produce a wide board. For table tops, chair bottoms, shelves, cores of solid core veneer panels, etc. (Although the glued and rubbed joint is described here, the same construction would apply if the joints are to be cramped, except that the cramps are used after STEP 3a to force out air bubbles and surplus glue, instead of rubbing.)

NOTE: It is necessary to select timber slightly thicker than required for the finished board, as cleaning up the joints after gluing will reduce the thickness. Hence the only preparation necessary is the trueing up of the edges to be glued, unless more than two boards are required, then the centre boards would need to be gauged and planed parallel in their width. After gluing and drying, the whole board is prepared in the usual way. To ensure flatness of a large wide board, traverse planing of the sides may be necessary, i.e., planing diagonally both ways across the board until any winding has been removed, and finally planing along the grain. (See plate 37.)

CONSTRUCTION.

STEP 1.—**Select Edges to be Joined.**

(a) Find the direction of the grain on the sides of the boards (test by planing if necessary) and mark the direction with arrows. This enables the finished board to be planed in one direction.

(b) Place the pieces with the edges to be joined together and mark with a distinguishing mark over the joint.

NOTE: If possible, the edges to be joined should be selected so that the pieces are alternately heart side up and heart side down. This reduces the amount to be planed off after gluing should there be any "cupping" of the pieces.

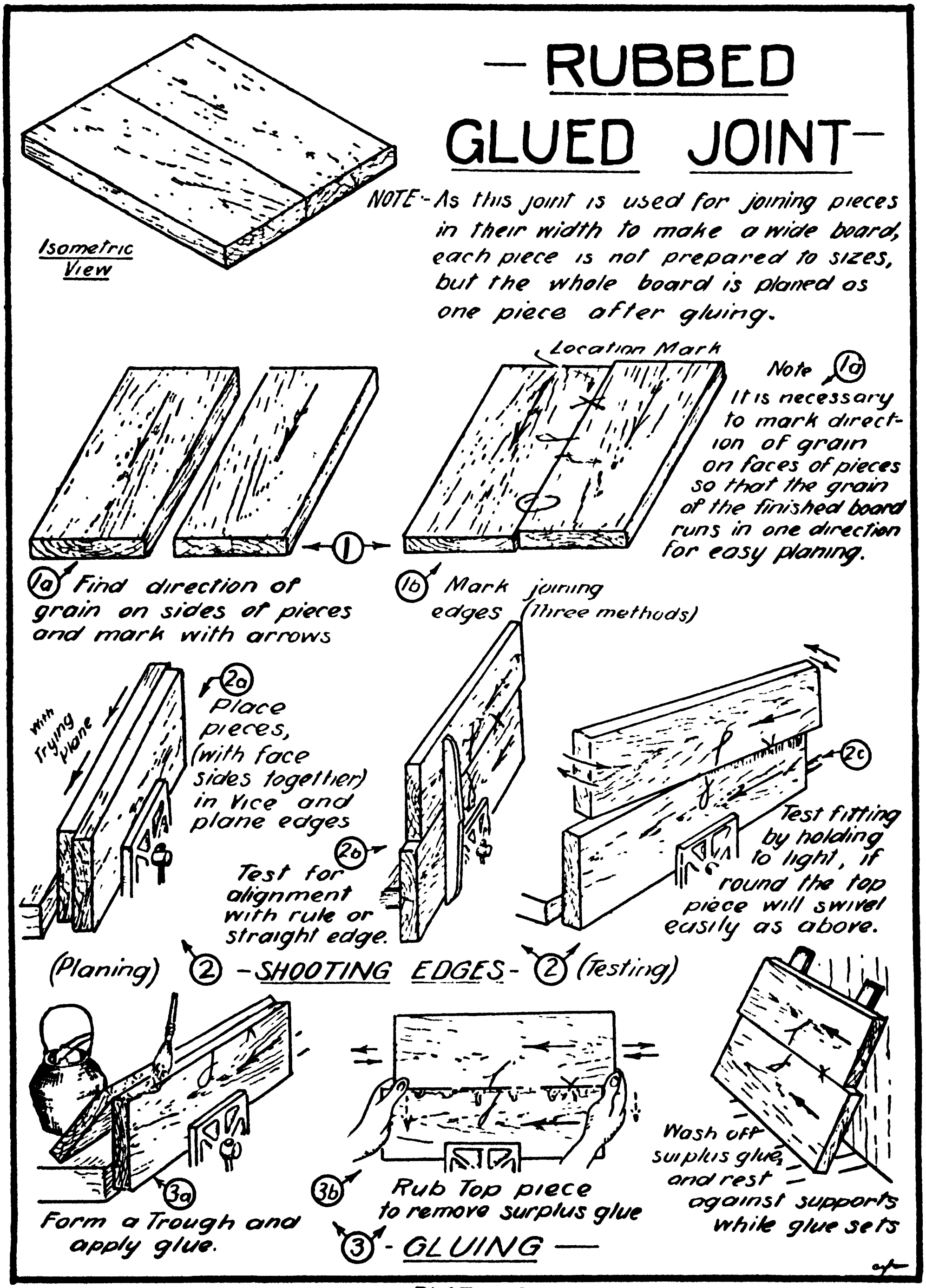

— RUBBED
GLUED JOINT —
Isometric View
NOTE:- As this joint is used for joining pieces in their width to make a wide board, each piece is not prepared to sizes, but the whole board is planed as one piece after gluing.
Location Mark
Note (1a)
It is necessary to mark direction of grain on faces of pieces so that the grain of the finished board runs in one direction for easy planing.
(1)
(1a) Find direction of grain on sides of pieces and mark with arrows
(1b) Mark joining edges (Three methods)
With Trying plane
(2a) Place pieces, (with face sides together) in Vice and plane edges
(2b) Test for alignment with rule or straight edge.
(2c) Test fitting by holding to light, if round the top piece will swivel easily as above.
(Planing) (2) - SHOOTING EDGES - (2) (Testing)
(3a) Form a Trough and apply glue.
(3b) Rub Top piece to remove surplus glue
Wash off surplus glue, and rest against supports while glue sets
(3) - GLUING —

PLATE 38.

STEP 2.—**Shooting the Edges** (Planing).

(a) Hold the pieces in the vice with their marked faces together and shoot the edges with the trying plane. (If one board is narrower than the other they may be "G" cramped together OR each edge may be planed separately.)

(b) Test alignment of the pieces when in position with straight edge.

(c) Test the fitting of the edges by holding to the light. (No light should be seen if the edges are ready to be glued.)

STEP 3.—**Gluing.**

(a) With one piece in the vice and the other against it to form a trough, apply the glue to both edges at once.

(b) Before the glue has time to chill (i.e., if heated animal glue is used), swing the top piece into position and rub end ways (only about 1″ movement is needed) to remove air bubbles and surplus glue. Note position of hands in diagram, the fingers and thumbs keeping the faces flush. When satisfied all surplus glue has been rubbed out, draw the hands down to prevent the fingers sticking to the top piece and breaking the joint.

Carefully wash off the surplus glue and set the job aside to dry, resting against supports to prevent warping and damage to the joint.

NOTE: If casein glue is used the joints should be cramped, not rubbed.

QUESTIONS.

1. Why is this joint called a Rubbed Glued Joint?
2. Show by sketches how you would select the edges to be glued.
3. What tests would you apply to the pieces before gluing?
4. Describe the steps to be followed when planing up the finished glued board.
5. State the uses of this joint.

2. HOUSED JOINTS (PLATES 39 and 35).

(An Angle Joint.)

USES: Chiefly used for fixing shelves and partitions into cabinets, book-cases, boxes, etc.

The instructions here cover the construction of three different types of housing joints. For the exercise the timber is previously prepared in one length to 3″ wide by $\frac{5}{8}$″ thick and about 13″ long. One piece $5\frac{7}{8}$″ is measured from one end, and the three pieces for the shelves are measured from the other end, leaving about $\frac{1}{8}$″ waste in between them. After setting out the trenches, it is advisable to check the fitting of the shelves before cutting the trenches.

CONSTRUCTION.

STEP 1.—**After Preparing the Pieces to the Required Sizes.**

(a) Set out the positions of the trenches, with *pencil lines* squared across the face side and half-way down the edges.

(b) Gauge depth of trenches ($\frac{1}{4}$″) gauging from the face side.

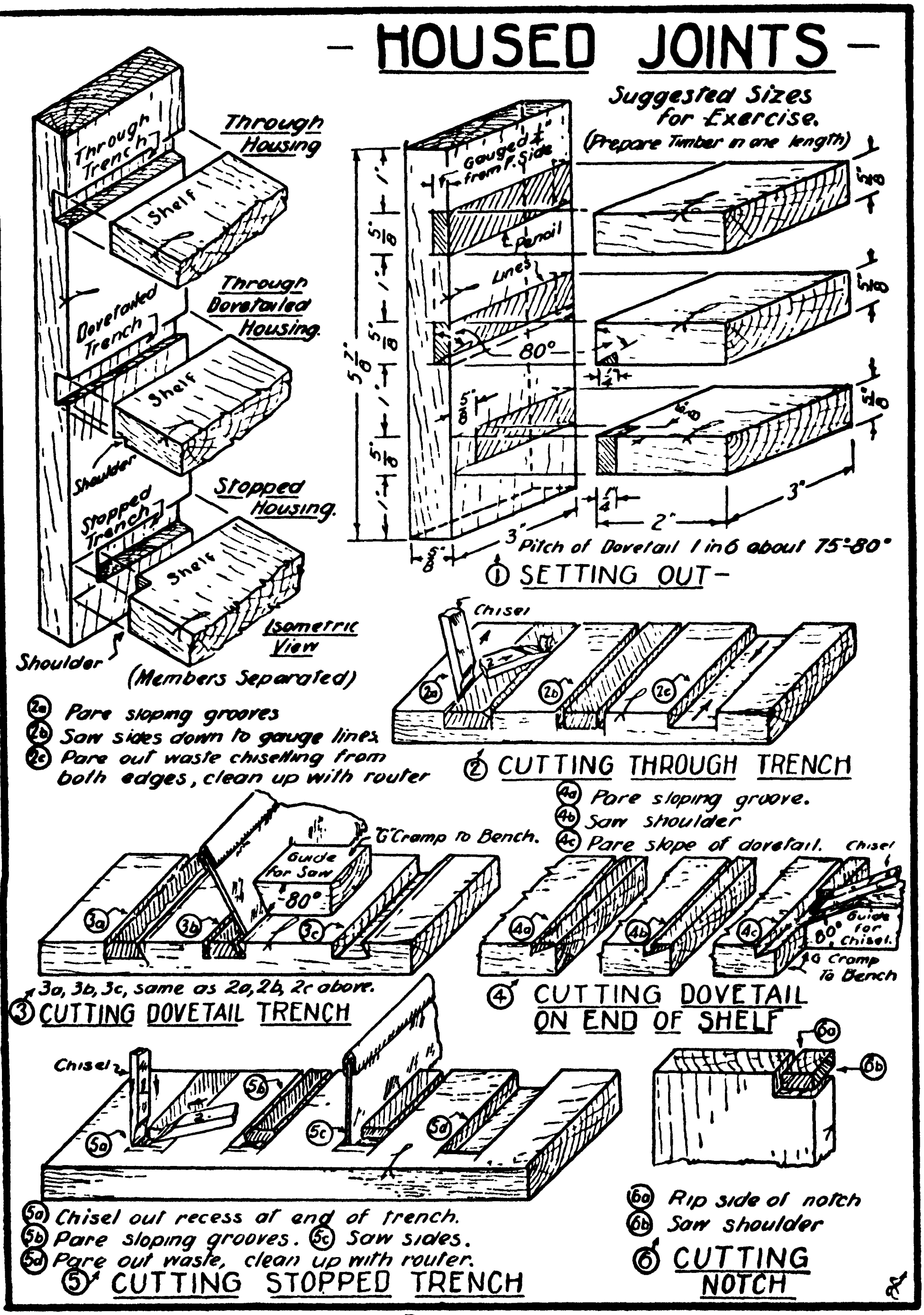

- HOUSED JOINTS -
Suggested Sizes for Exercise.
(Prepare Timber in one length)
Through Trench
Through Housing
Shelf
Dovetailed Trench
Through Dovetailed Housing.
Shelf
Shoulder
Stopped Trench
Stopped Housing.
Shelf
Isometric View
Shoulder
(Members Separated)
Gauged 1/4" from F. Side
Pencil Lines
80°
5 7/8"
Pitch of Dovetail 1 in 6 about 75°-80°
1 SETTING OUT -
Chisel
2a Pare sloping grooves
2b Saw sides down to gauge lines.
2c Pare out waste chiselling from both edges, clean up with router
2 CUTTING THROUGH TRENCH
4a Pare sloping groove.
4b Saw shoulder
4c Pare slope of dovetail.
"G" Cramp to Bench.
Guide for Saw
80°
Chisel
Guide for Chisel.
G Cramp to Bench
3a, 3b, 3c, same as 2a, 2b, 2c above.
3 CUTTING DOVETAIL TRENCH
4 CUTTING DOVETAIL ON END OF SHELF
Chisel
6a Rip side of notch
6b Saw shoulder
5a Chisel out recess at end of trench.
5b Pare sloping grooves. 5c Saw sides.
5d Pare out waste, clean up with router.
5 CUTTING STOPPED TRENCH
6 CUTTING NOTCH

PLATE 39.

(c) Gauge length of dovetail from end of shelf ($\frac{1}{4}''$ long) to suit dovetailed trench. Set out required slope of dovetail on trench and edges of shelf.

(d) With gauge still set at $\frac{1}{4}''$, gauge depth of notch from end of shelf to fit stopped trench.

(e) Gauge end of stopped trench $\frac{3}{8}''$ from face edge, and gauge width of notch from face edge of shelf to suit stopped trench. MARK ALL WASTE PIECES CLEARLY WITH CROSSES.

STEP 2.—**Cutting Through Trench.** Check lines to fit end of shelf.

(a) Square sides of trench across face side with *cut lines* (marking knife or chisel) and pare sloping grooves on waste side of lines to aid sawing and to ensure sharp edges on the sides of the trench.

(b) Saw down to gauge lines (tenon saw). ("G" cramp job firmly to bench.)

(c) Pare out waste, chiselling half-way through from both edges. For wide trenches the bottom may be levelled with router plane.

STEP 3.—**Cutting Dovetailed Trench.**

(a) Mark sides of trench with cut lines and pare sloping grooves.

(b) Saw sides down to gauge lines. A guide made from a block of wood may be cramped to the job to help keep the saw at the correct angle.

(c) Chisel out waste, chiselling half-way through from both edges.

STEP 4.—**Cutting Dovetail on End of Shelf.**

(a) Pare sloping groove to keep the shoulder of dovetail sharp.

(b) Carefully saw shoulder of dovetail.

(c) Pare off waste of dovetail. A guide may be used to obtain the correct angle, both the job and the guide being cramped to the bench.

STEP 5.—**Cutting Stopped Trench.**

(a) Chisel out a recess about $\frac{1}{8}''$ from stopped end of trench about $\frac{1}{4}''$ deep and the exact width of the trench and about $\frac{3}{4}''$ along the trench. This allows for the working of the saw when sawing the sides.

(b) Pare sloping grooves for sawing.

(c) Saw sides down to the required depth.

(d) Pare out waste and clean up end of trench with paring chisel.

STEP 6.—**Cutting Notch in Shelf to Fit Stopped Trench.**

(a) Rip (i.e., saw along the grain from end of shelf) side of notch down to $\frac{1}{4}''$ gauge line, sawing on waste side of line.

(b) Saw shoulder from edge for $\frac{3}{8}''$, sawing on waste side of line.

QUESTIONS ON HOUSED JOINTS.

1. State the chief uses of housed joints.
2. Sketch a through housed joint with the members apart; name its parts.
3. Briefly describe the cutting of a through trench.
4. What points must be kept in mind when sawing the sides of a trench?
5. Sketch a stopped housed joint with members separated.

6. Briefly describe the cutting of a stopped trench.
7. When would you use a stopped housed joint in preference to a through housing?
8. When would you use a dovetailed housing in preference to a plain through housing joint?
9. What tool would you use to make the bottoms of the trenches level?
10. What is the purpose of the recess cut in the end of the stopped trench ?

5. THE TEE HALVING JOINT (PLATES 40 and 36).

(A Framing Joint.)

(Tee Half Lap.)

USES: Used in frames where the end of a rail meets another piece some distance from the end, both faces of the pieces finishing flush. This joint is frequently used in cabinet frames, and frames for cheap flush panelled doors, where a strong joint is not required.

CONSTRUCTION.

STEP 1.—**Prepare** the pieces to the required width and thickness in one length.

STEP 2.—**Setting Out.** Set out as in working drawing.

(a) Find centre of piece for socket or trench and mark position of trench with pencil lines on the face side and half-way down the edges.

(b) Set out length of pin on end of the reverse side of the other piece. Allow a little waste on the end to be shot off when the joint is completed.

(c) Set gauge to half the thickness of the timber and gauge depth of socket on both edges. Gauge thickness of pin along the edges and across the end. Gauge from the face side of both pieces. Mark waste with crosses.

NOTE: Mark the waste of the socket on the face side and the waste of the pin on the reverse side, so that when the joint is assembled the face sides will be together. ALSO the gauging is done from the face side of both pieces so that the amount of waste taken out of the socket is equal to the amount for the pin. When assembled the face sides will be flush.

STEP 3.—**Check Fitting of Pin.** Separate the pieces and check the width of the socket equal to the width of the pin.

STEP 4.—**Cutting Trench.**

(a) Square sides of socket across with marking knife or chisel and pare sloping grooves on waste side of lines.

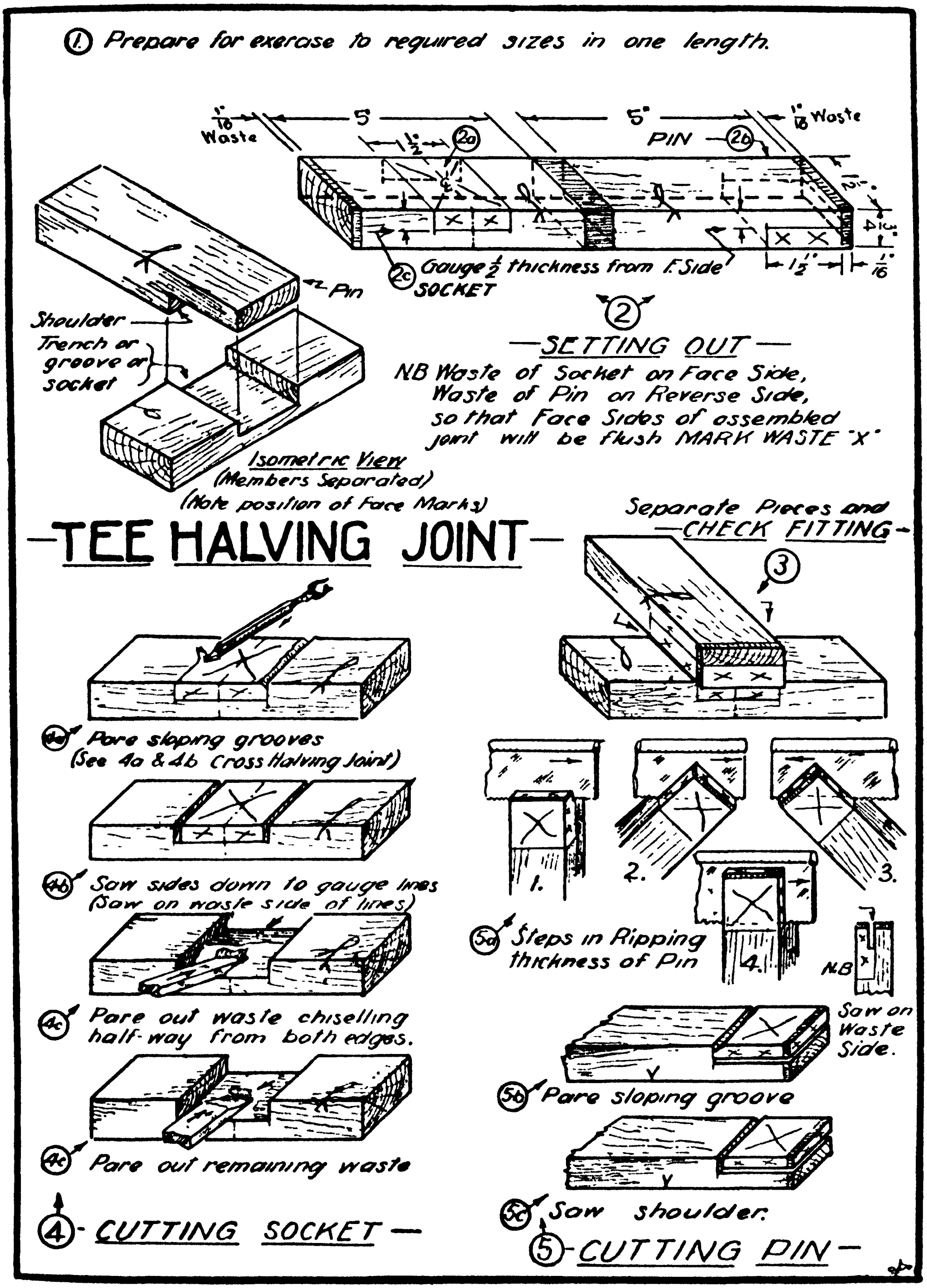
(b) Saw sides down to gauge lines, being careful to saw vertically.

(c) Pare out bulk of waste with bevel side of chisel down, chiselling half-way through from both edges. ("G" cramp job firmly to bench or hold in vice.)

(d) Pare out remaining waste down to gauge lines.

STEP 5.—**Cutting Pin.**

(a) Rip the thickness of the pin, being careful to saw just on the waste side of gauge lines. See sketches showing steps in ripping pin.



(1.) Prepare for exercise to required sizes in one length.
1/16" Waste
5
5"
1/16" Waste
1 1/2"
2a
PIN
2b
1 1/2"
1 1/2"
1/16"
2c Gauge 1/2 thickness from F. Side
SOCKET
Pin
Shoulder
Trench or groove or socket
Isometric View
(Members Separated)
(Note position of Face Marks)
2
—SETTING OUT—
NB Waste of Socket on Face Side,
Waste of Pin on Reverse Side,
so that Face Sides of assembled
joint will be flush MARK WASTE "X"
—TEE HALVING JOINT—
Separate Pieces and
—CHECK FITTING—
3
4a Pare sloping grooves
(See 4a & 4b Cross Halving Joint)
4b Saw sides down to gauge lines
(Saw on waste side of lines)
4c Pare out waste chiselling
half-way from both edges.
4c Pare out remaining waste
4 - CUTTING SOCKET —
1.
2.
3.
4.
5a Steps in Ripping
thickness of Pin
NB
Saw on Waste Side.
5b Pare sloping groove
5c Saw shoulder.
5 - CUTTING PIN —

PLATE 40.

(b) Square shoulder line across with cut line and pare sloping groove on waste side of line.

(c) Saw shoulder to remove waste of pin.

Assemble and shoot off waste end of pin.

NOTE: If all joints are set out, checked and cut correctly, they should fit straight from the saw. A joint should, as far as possible, be assembled only once before being glued up. Many trial assemblies tend to loosen the parts.

QUESTIONS.

1. Sketch a tee half lapped joint with its members apart; name its parts.
2. Sketch the pieces in one length, showing all necessary setting out of the parts.
3. Briefly describe the steps in cutting the socket.
4. Show by sketches how you would rip the thickness of the pin.
5. Why is it necessary to saw on the waste side of the gauge lines when ripping the thickness of the pin?

4. THE CROSS HALVING JOINT (PLATES 41 and 36).

(A Framing Joint.)

(Cross Half Lap.)

USES: Used where the members cross each other and the faces of the pieces are required to be flush, as in the diagonal stays of tables and chairs, and frames for cheap flush panelled doors.

CONSTRUCTION.

STEP 1.—**Prepare** the pieces to the required width and thickness in one length.

STEP 2.—**Setting Out.** Set out as in diagram.

(a) Find centre of both pieces and set out position of both trenches about these centre lines.

NOTE: In order that the face sides will be together in the finished joint, one trench is set out on the face side and the other on the reverse side.

(b) Gauge depth of trenches from face side of both pieces. This ensures the face sides being flush in the finished joint. Mark waste on sides and edges with crosses.

STEP 3.—**Check Fitting of Trenches.** Place the pieces in position and check the accuracy of the lines.

STEP 4.—**Cutting Trenches.**

(a) Square sides of trenches across with cut lines.

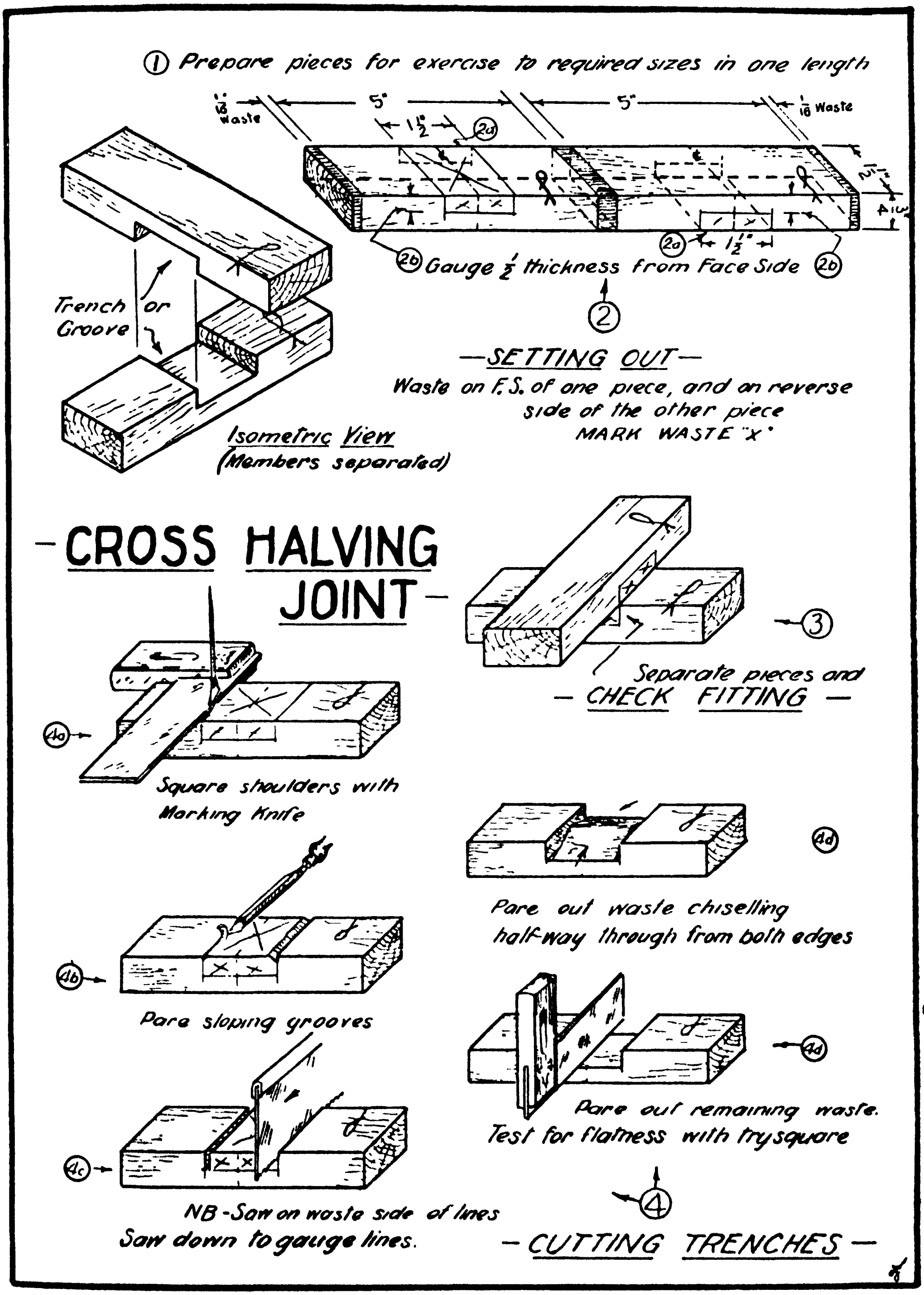
(b) Pare sloping grooves on waste sides of lines for sawing.

(c) Saw sides of trenches down to gauge lines.

(d) Pare out bulk of waste, chiselling half-way through from both edges, using chisel bevel side down.

(e) Pare out remaining waste down to gauge lines, using chisel bevel side up, paring half-way through from both edges.

Assemble.


① Prepare pieces for exercise to required sizes in one length
1/16" Waste
5"
5"
1/16 Waste
1 1/2"
2a
2b
1 1/2"
2b Gauge 1/2 thickness from Face Side 2b
②
—SETTING OUT—
Waste on F.S. of one piece, and on reverse side of the other piece
MARK WASTE "X"
Trench or Groove
Isometric View
(Members separated)
-CROSS HALVING JOINT-
③
Separate pieces and
- CHECK FITTING -
4a
Square shoulders with Marking Knife
4d
Pare out waste chiselling half-way through from both edges
4b
Pare sloping grooves
4d
Pare out remaining waste.
Test for flatness with trysquare
4c
NB -Saw on waste side of lines
Saw down to gauge lines.
④
- CUTTING TRENCHES -
PLATE 41.

QUESTIONS.

1. Make a neat freehand sketch of a cross halving joint with its members apart.
2. Show by a sketch how a piece of timber is set out for a cross halving joint.
3. Briefly set out the steps in cutting a trench for a cross half lap joint.
4. Why is the waste on the opposite sides of the two pieces?
5. Why is it essential that the gauging be done from the face side of both pieces?

5. THE DOVETAILED TEE HALVING JOINT (Plates 42 and 36).

(A Framing Joint.)

(Dovetailed Tee Half Lap.)

Uses: Used for connecting the ends of cross rails in frame-like constructions where an outside strain occurs. This joint can only be separated in one direction.

CONSTRUCTION.

STEP 1.—**Prepare** the pieces in one length to the required width and thickness, allowing a little waste at each end for cleaning up after assembling.

STEP 2.—**Setting Out.** Set out as in diagram.

(a) Mark position of socket on face side of one piece. Square lines across and half-way down both edges, using pencil only to mark the lines. Mark waste on face side.

(b) Mark length of pin (plus 1/16″ waste) from end of second piece (rail). Square shoulder line all round with pencil. Set out shape of sloping sides of pin on both sides. Mark waste with "X" on reverse side.

(c) Set marking gauge to half thickness of timber and gauge depth of socket and thickness of pin, using the gauge from the face side of both pieces.

STEP 3.—**Cutting Pin.**

(a) Rip the thickness of the pin, sawing on the waste side of gauge lines. (See ripping of pin for plain tee halving joint, Step 5a.)

(b) Rip sloping sides of pin, sawing on the waste side of lines.

(c) Square shoulder on reverse side and across the edges with cut lines, and pare sloping grooves.

(d) Saw wide shoulder across reverse side down to gauge lines.

(e) Saw short shoulders down to sloping sides.

STEP 4.—**Set Out Shape of Socket.** Place pin over position of socket, with shoulder of pin against face edge, and mark along the sides of the pin to make the shape of the socket exactly the same size as the pin.

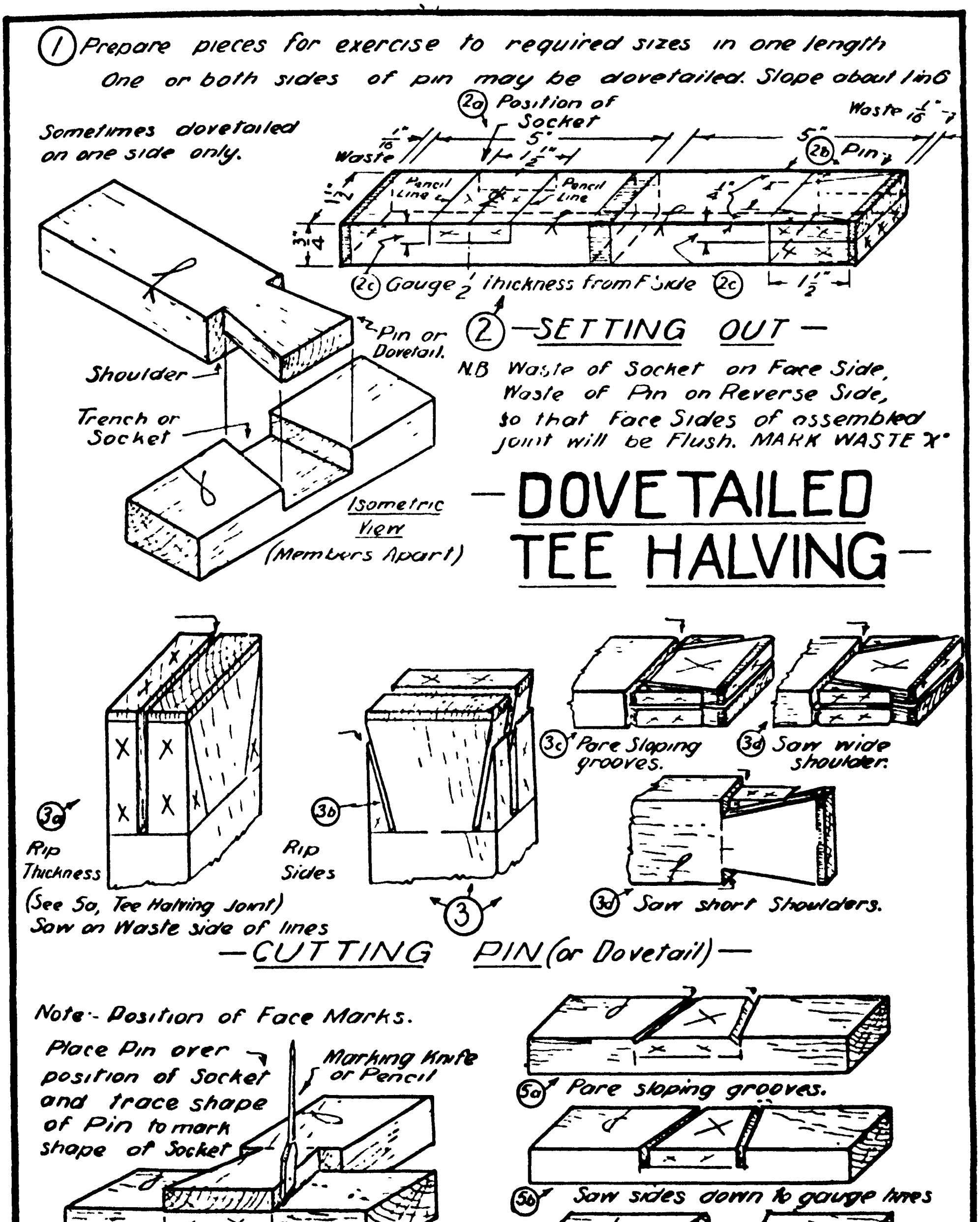
STEP 5.—**Cutting Socket.**

(a) Mark sides of socket with cut lines and pare sloping grooves.

(b) Saw sides down to gauge lines, sawing on the waste side of lines.

(c) Pare out waste down the gauge lines, test flatness of socket with trysquare.

Assemble and shoot off waste end of pin.



1 Prepare pieces for exercise to required sizes in one length
One or both sides of pin may be dovetailed. Slope about 1 in 6
Sometimes dovetailed on one side only.
2a Position of Socket
Waste
5"
1½"
Waste 1/16"
2b Pin
Pencil Line
Pencil Line
2c Gauge ½ thickness from F. Side
2c
1½"
Pin or Dovetail.
Shoulder
Trench or Socket
2 —SETTING OUT—
N.B. Waste of Socket on Face Side, Waste of Pin on Reverse Side, so that Face Sides of assembled joint will be Flush. MARK WASTE "X"
Isometric View (Members Apart)
—DOVETAILED TEE HALVING—
3a Rip Thickness
(See 5a, Tee Halving Joint) Saw on Waste side of lines
3b Rip Sides
3
3c Pare Sloping grooves.
3d Saw wide shoulder.
3d Saw short Shoulders.
—CUTTING PIN (or Dovetail)—
Note:- Position of Face Marks.
Place Pin over position of Socket and trace shape of Pin to mark shape of Socket
Marking Knife or Pencil
4 SETTING OUT— SHAPE OF SOCKET—
5a Pare sloping grooves.
5b Saw sides down to gauge lines
5c Pare out waste from both edges
5 CUTTING SOCKET—

PLATE 42.

QUESTIONS.

1. Make a dimensioned working drawing showing the setting out of a dovetailed "T" halving.
2. Make a neat freehand sketch showing a dovetailed tee halving joint assembled.
3. Why do we always mark the waste clearly with crosses?
4. Describe the steps in setting out the joint.
5. Why is the pin set out to shape and cut to shape before the socket?

6. THE TEE BRIDLE JOINT (PLATES 43 and 36).

(A Framing Joint.)

USES: Used in place of a common mortise and tenon joint where one member meets another some distance from the end. Sometimes used on tables where a leg meets the rail away from the end.

CONSTRUCTION.

STEP 1.—**Prepare** the timber in one length to required width and thickness.

STEP 2.—**Setting Out.** Set out parts as shown in working sketch.

(a) Mark position of pin in centre of long piece. The distance between the shoulder lines being equal to the width of the other piece. Square lines all round with cut lines.

(b) Mark length of socket (plus waste) on end of short member equal to width of pin. Square length across face side and down both edges with pencil lines.

(c) Set mortise gauge to 1/3rd the thickness of timber and gauge round end of socket and thickness of pin on both edges, using gauge from face sides. Mark waste of socket between the mortise gauge lines, and waste of pin on both sides.

STEP 3.—**Cutting Pin.**

(a) Separate the pieces and check fitting, pare sloping grooves on waste sides of shoulder lines on both sides of timber.

(b) Carefully saw shoulders down to gauge lines.

(c) Pare out waste, chiselling half-way through from both edges, down to gauge lines.

STEP 4.—**Cutting Socket.**

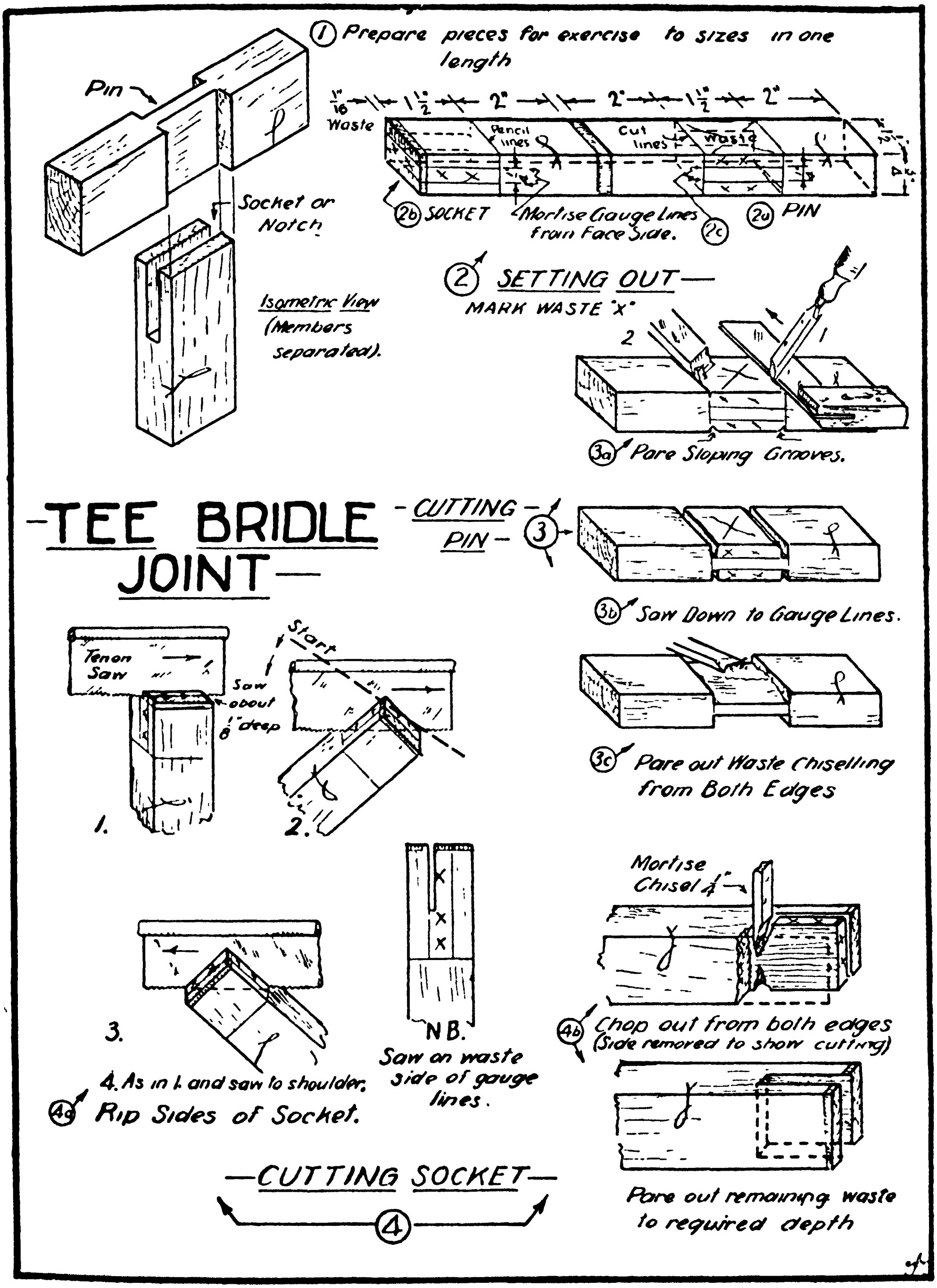
(a) Rip sides of socket down to the required depth, sawing on the waste side of gauge lines (i.e., between the gauge lines).

(b) Chop out waste with mortise chisel to suit size of socket, chiselling half-way through from both edges.

Assemble and shoot off waste ends of socket.

QUESTIONS.

1. Make an isometric drawing of the tee bridle joint, showing the members apart. Name the parts of the joint.
2. Make a neat sketch, showing the setting out of the joint.
3. Briefly describe the setting out of the joint.
4. Make a complete list of the tools used in each step.
5. State the names of two other types of bridle joints.



1 Prepare pieces for exercise to sizes in one length
Pin
Socket or Notch
Isometric View (Members separated).
1/16" Waste
1 1/2"
2"
2"
1 1/2"
2"
Pencil lines
Cut lines
Waste
2b SOCKET
Mortise Gauge Lines from Face Side.
2c
2a PIN
2 SETTING OUT—
MARK WASTE "X"
2
1
3a Pare Sloping Grooves.
-TEE BRIDLE JOINT—
-CUTTING PIN—
3
3b Saw Down to Gauge Lines.
3c Pare out Waste Chiselling from Both Edges
Tenon Saw
Saw about 1/8" deep
Start
1.
2.
Mortise Chisel 1/4"
3.
N.B.
Saw on waste side of gauge lines.
4. As in 1. and saw to shoulder.
4a Rip Sides of Socket.
4b Chop out from both edges (Side removed to show cutting)
—CUTTING SOCKET—
4
Pare out remaining waste to required depth

PLATE 43.

7. THE COMMON OR THROUGH MORTISE AND TENON JOINT

(PLATES 44 and 36.)

(A Framing Joint.)

USES: Used in pieces of the same thickness and where a rail meets a stile some distance from the end. It is one of the most common and strongest joints used in frames, etc. Used in framed doors (for joining the middle rail to the stiles), frames for cabinets, tables, and chairs, etc.

CONSTRUCTION.

STEP 1.—**Prepare** the timber to the required width and thickness in one length.

STEP 2.—**Setting Out.** Set out as in working drawing.

(a) Set out position of mortise, square lines across face side and edges with pencil lines.

(b) Set out length of tenon on end of piece for rail (allowing 1/16″ waste on end). Square lines round with cut lines (marking knife or chisel).

(c) Set mortise gauge to chisel selected to cut mortise (size of chisel should be as close as possible to 1/3rd thickness of timber) and gauge round end of tenon and on both edges of mortise. Doing all gauging from the face side. Mark waste "X."

STEP 3.—**Cutting Mortise.**

(a) The bulk of the waste may be bored out, boring half-way through from both edges. In softwoods boring is not always necessary.

(b) Chop out remaining waste with mortise chisel, chiselling half-way through from both edges. It is advisable to leave about ⅛″ at each end of the mortise at first so that when levering out the waste (core) the ends of the mortise are not damaged. Keep the cutting edge of the chisel across the grain.

STEP 4.—**Cutting Tenon.**

(a) Rip sides of tenon down to gauge lines, sawing on the waste sides of gauge lines. (See steps showing ripping, 4a in diagram.)

(b) Pare sloping grooves on shoulder lines to aid sawing.

(c) Carefully saw shoulders, sawing vertically.

Assemble and shoot off waste end of tenon.

QUESTIONS.

1. Make a neat drawing showing the full setting out of a piece of timber suitable, making a common mortise and tenon joint.
2. Why are pencil lines used in the setting out of the mortise?
3. Describe how you would set the mortise gauge to the required size for the joint.
4. Why is the mortise gauge set to the mortise chisel instead of 1/3rd thickness of timber?
5. How is the mortise chisel used when cutting out the core of the mortise?
6. Describe how you would hold the job while cutting the mortise.
7. Make a complete list of the tools required for the construction of the joint.
8. (a) Where is the waste of the tenon? (b) Where is the waste of the mortise?
9. Make an isometric sketch of the completed joint, members separated.
10. Write down two uses of the common M & T joint.

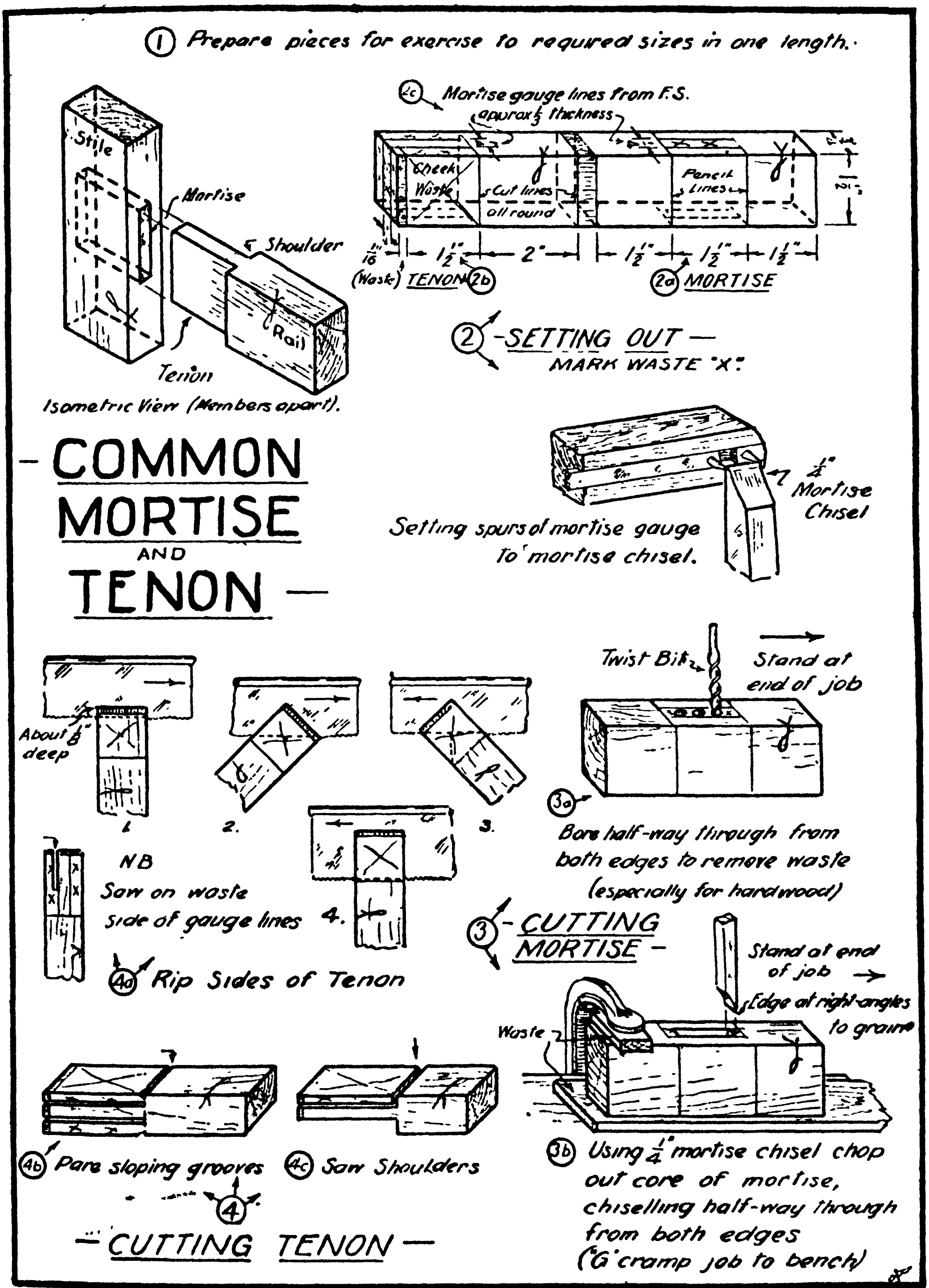

(1) Prepare pieces for exercise to required sizes in one length.
Stile
Mortise
Shoulder
Rail
Tenon
Isometric View (Members apart).
(2c) Mortise gauge lines from F.S.
approx ⅓ thickness
Cheek Waste
Cut lines all round
Pencil Lines
1/16" (Waste) 1½" 2" 1½" 1½" 1½"
TENON (2b)
(2a) MORTISE
(2) - SETTING OUT -
MARK WASTE "X".
- COMMON MORTISE AND TENON -
¼" Mortise Chisel
Setting spurs of mortise gauge to mortise chisel.
Twist Bit
Stand at end of job
About ⅛" deep
1. 2. 3. 4.
NB
Saw on waste side of gauge lines
(4a) Rip Sides of Tenon
(3a) Bore half-way through from both edges to remove waste (especially for hardwood)
(3) - CUTTING MORTISE -
Stand at end of job
Edge at right-angles to grain
Waste
(4b) Pare sloping grooves
(4c) Saw Shoulders
(4)
- CUTTING TENON -
(3b) Using ¼" mortise chisel chop out core of mortise, chiselling half-way through from both edges
("G" cramp job to bench)

PLATE 44.

8. THE HAUNCHED MORTISE AND TENON JOINT

(Plates 45 and 36.)

(A Framing Joint.)

Uses: Where a strong joint is required at the junction of the ends of two pieces when the edges are at right angles and the faces flush. E.g., where the top and bottom members (called rails) meet the vertical members (called stiles) of a framed door.

CONSTRUCTION.

STEP 1.—**Prepare** pieces to the required width and thickness in one length.

STEP 2.—**Setting Out.** Set out the joint as in sketch. (The pieces may be separated or left in one length.)

(a) Mark width of rail plus $\frac{1}{4}''$ waste from end of stile with pencil lines across face side and edges, for position of mortise.

(b) Mark length of tenon equal to width of stile (allowing $\frac{1}{4}''$ waste) on end of rail, squaring line right round with cut lines.

(c) Mark width of tenon about 5/9ths width of rail, measuring from face edge. Gauge lines along sides and across end, gauging from face edge. Mark length of mortise to correspond with width of tenon on face edge of stile, square round to back edge with pencil lines.

(d) Set mortise gauge to chisel to be used, and gauge round end of tenon, and on both edges of mortise, gauging from face side of both pieces. (Thickness of tenon approximately 1/3rd thickness of rail.)

(e) Measure length of haunch along from shoulder lines of tenon on back edge of rail, and depth of haunching on end of stile from face edge. Mark waste on each part clearly with crosses.

Note: After setting out, check width of tenon with width of mortise, and when face sides are together, see that the face edges are inside the angle of the joint.

STEP 3.—**Cutting Tenon.**

(a) Rip sides of tenon down to shoulder lines, saw on waste side.

(b) Rip width of tenon down as far as haunch, saw on waste side.

(c) Pare sloping grooves on waste side of shoulder lines, and saw shoulders to remove waste cheeks. Note: Wedges, if required, may be cut from waste of tenon. (See 3d, plate 45.)

(d) Saw off remaining waste to leave haunch.

STEP 4.—**Cutting Mortise.**

(a) Chop out waste with mortise chisel previously selected, chiselling half-way through from both edges.

(b) Saw sides of haunching down to required depth.

(c) Pare out waste of haunching with mortise chisel.

Assemble and shoot off waste end of tenon, saw off waste end of stile (horn) and shoot end.

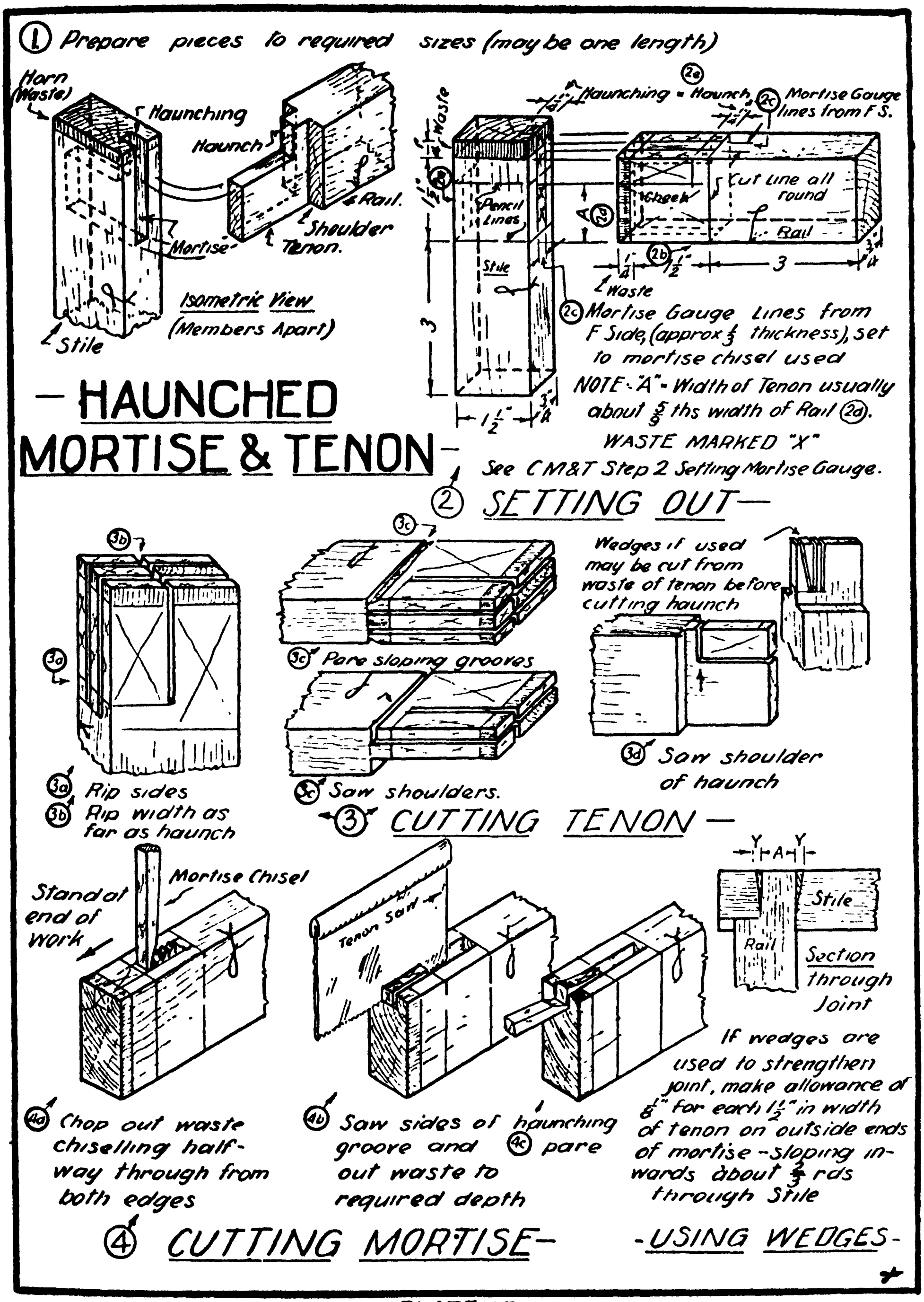

① Prepare pieces to required sizes (may be one length)
Horn (Waste)
Haunching
Haunch
Rail.
Shoulder
Tenon.
Mortise
Stile
Isometric View (Members Apart)
– HAUNCHED MORTISE & TENON –
2a Haunching = Haunch
2c Mortise Gauge lines from F S.
Waste
Pencil Lines
Stile
Cheek
Cut line all round
Rail
A
2d
2b
3
Waste
2c Mortise Gauge Lines from F Side, (approx ⅓ thickness), set to mortise chisel used
NOTE:- "A" = Width of Tenon usually about ⅗ ths width of Rail 2d.
WASTE MARKED "X"
See C M&T Step 2 Setting Mortise Gauge.
② SETTING OUT –
3a Rip sides
3b Rip width as far as haunch
3c Pare sloping grooves
3c Saw shoulders.
Wedges if used may be cut from waste of tenon before cutting haunch
3d Saw shoulder of haunch
③ CUTTING TENON –
Stand at end of work
Mortise Chisel
Tenon Saw
Y A Y
Stile
Rail
Section through Joint
4a Chop out waste chiselling half-way through from both edges
4b Saw sides of haunching groove and 4c pare out waste to required depth
If wedges are used to strengthen joint, make allowance of ⅛" for each 1½" in width of tenon on outside ends of mortise – sloping inwards about ⅔ rds through Stile
④ CUTTING MORTISE –
– USING WEDGES –

PLATE 45.

QUESTIONS.

1. Make a neat sketch of a haunched M & T joint with its members separated.
2. What is the approximate thickness of the tenon?
3. What is the width of the tenon? From which edge would you measure the width?
4. Why is the tenon made narrower than the width of the rail?
5. Describe the position of the haunching.

9. THE LONG AND SHORT SHOULDERED MORTISE AND TENON JOINT—HAUNCHED (PLATES 46 and 36).

(A Framing Joint.)

USES: Used for framed work where the members are rebated to take glass, plywood or solid panels, etc., such as panelled doors, cupboards and cabinet doors.

CONSTRUCTION.

STEP 1.—**Prepare** the pieces in one length to width and thickness.

STEP 2.—**Setting Out.**

(a) Gauge position of rebate on both pieces. Gauge depth 3/16″ down reverse side from face edge, gauge shoulder of rebate on face edge ¼″ from face side.

MORTISE.

(b) Mark width of rail from end of stile (allowing ¼″ waste on end for horn) on face edge only.

(c) Measure back from inside line 3/16″ equal to depth of rebate, square round to back edge with pencil lines.

(d) Measure length of mortise 1″ from 3/16″ line, square round to back edge with pencil lines.

(e) Measure depth of haunching on end of stile, measuring down from the bottom of rebate line.

(f) Set mortise gauge to mortise chisel and gauge width of mortise on both edges from face side. Mark waste with crosses.

TENON.

(g) Mark width of stile from end of rail (allowing ¼″ waste on end). Square across face edge and face side to back edge with cut lines. This line is the short shoulder line.

(h) Measure along tenon from short shoulder line 3/16″ equal to depth of rebate and square across edge and down the reverse side with cut lines. This line is the long shoulder line. Measure length of haunch ¼″ along tenon from this line on the back edge and square part way across both sides.

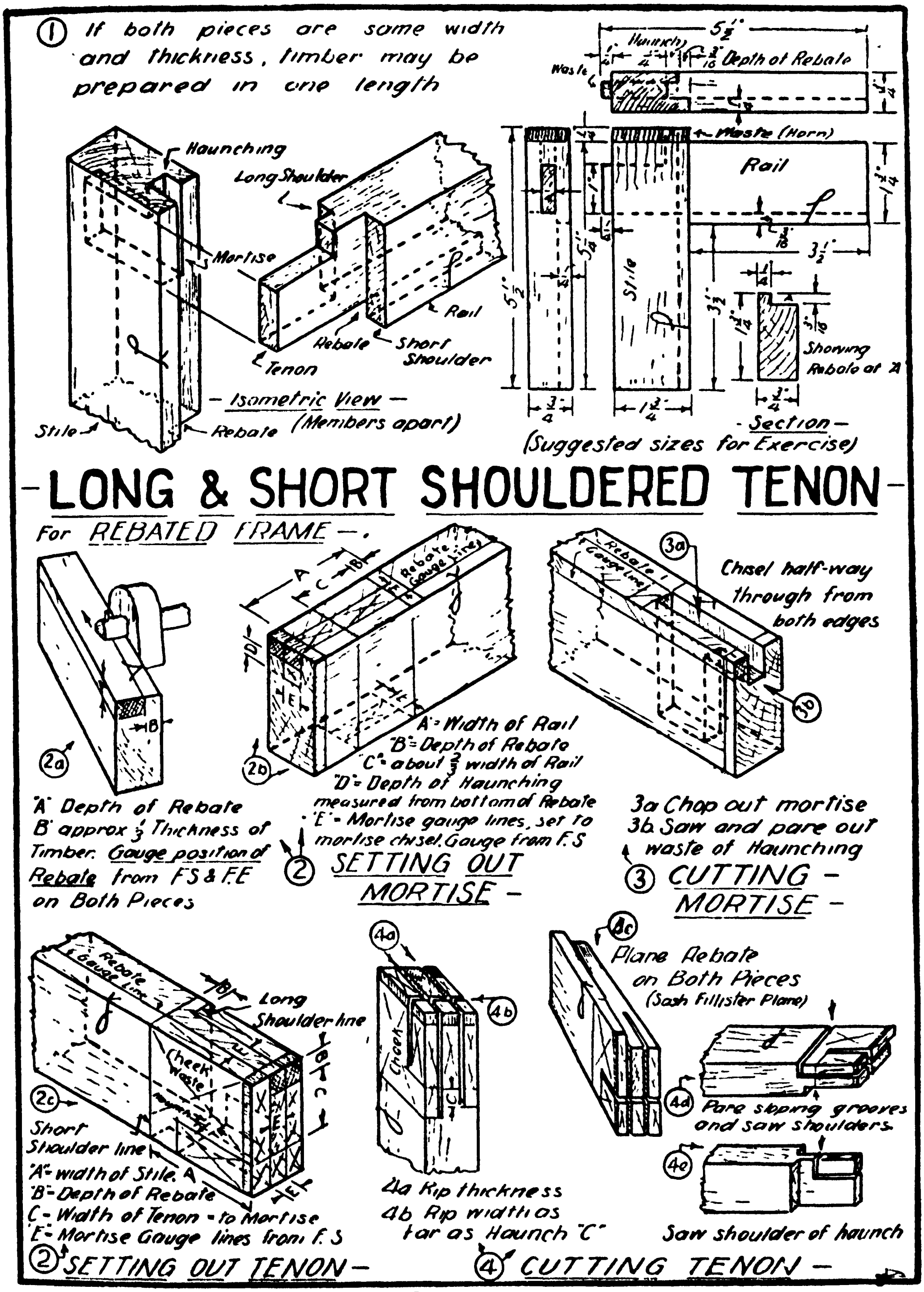
(i) Measure width of tenon equal to mortise, measuring from bottom of rebate line.

(j) Gauge thickness of tenon round end, gauging from face side. Mark waste.

STEP 3.—**Cutting Mortise.**

(a) Chop out core of mortise, chiselling half-way through from both edges.

(b) Saw sides of haunching and pare out waste.



① If both pieces are same width and thickness, timber may be prepared in one length
Haunching
Long Shoulder
Mortise
Rail
Rebate
Short Shoulder
Tenon
Stile
Rebate
- Isometric View -
(Members apart)
5½"
Haunch
¼"
3/16 Depth of Rebate
Waste
Waste (Horn)
Rail
1¼"
3/16
3½"
5½"
5¼"
Stile
3½"
1¼"
3/16
Showing Rebate at 'A'
¾"
1¾"
¾"
- Section -
(Suggested sizes for Exercise)
-LONG & SHORT SHOULDERED TENON-
For REBATED FRAME -.
B
2a
'A' Depth of Rebate
'B' approx ⅓ Thickness of Timber. Gauge position of Rebate from F.S & F.E on Both Pieces
A
C
B
Rebate Gauge line
D
E
2b
'A'= Width of Rail
'B'= Depth of Rebate
'C'= about ⅔ width of Rail
'D'= Depth of Haunching measured from bottom of Rebate
'E'= Mortise gauge lines, set to mortise chisel. Gauge from F.S
② SETTING OUT MORTISE -
Rebate Gauge line
3a
Chisel half-way through from both edges
3b
3a Chop out mortise
3b Saw and pare out waste of Haunching
③ CUTTING - MORTISE -
Rebate Gauge line
B
Long Shoulder line
Cheek Waste
2c
Short Shoulder line
'A'- width of Stile A
'B'- Depth of Rebate
'C'- Width of Tenon - to Mortise
'E'- Mortise Gauge lines from F.S
② SETTING OUT TENON -
4a
4b
Cheek
4a Rip thickness
4b Rip width as far as Haunch 'C'
4c
Plane Rebate on Both Pieces
(Sash Fillister Plane)
4d
Pare sloping grooves and saw shoulders.
4e
Saw shoulder of haunch
④ CUTTING TENON -

PLATE 46.

STEP 4.—**Cutting Tenon.**

(a) Rip thickness of tenon down to shoulder lines (saw on waste side).
(b) Rip width of tenon as far as haunch (saw on waste side).
(c) Plane rebate on BOTH pieces, using sash fillister plane.
(d) Pare sloping grooves and saw shoulders.
(e) Saw off waste of tenon, leaving haunch.

Assemble and shoot off waste end of tenon, saw and shoot off horn on end of stile.

NOTE: The waste of tenon is removed after planing rebate. Wedges may be cut from waste of tenon.

QUESTIONS.

1. Write down the uses of the long and short shouldered M & T.
2. Describe the position of the rebate in relation to the face side and face edge. Use sketches to illustrate your answer.
3. What is the purpose of the long shoulder?
4. Make a neat orthographic drawing of the joint; insert all sizes; name parts.
5. What plane would you use to plane the rebate?

10. THE HAUNCHED MORTISE AND TENON FOR A GROOVED FRAME (PLATE 47).

(A Framing Joint.)

USES: Used in frames where a groove instead of a rebate is worked on all members to take a panel. The panel is inserted when the frame is being glued up.

CONSTRUCTION.

STEP 1.—**Prepare** pieces for exercise in one length to width and thickness.

STEP 2.—**Setting Out.**

(a) Gauge width of groove with mortise gauge from face side.

MORTISE.

(b) Mark position of mortise on face edge of stile equal to width of rail (allowing for waste—horn).

(c) Measure back from the inside line ¼" equal to depth of groove, then 1" equal to the width of the tenon. Square these lines round to back edge with pencil lines. Mark waste of mortise between these lines on each edge.

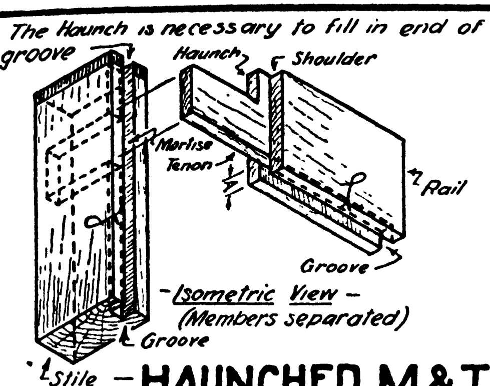
TENON.

(d) Mark length of tenon on end of rail equal to the width of the stile (allow ¼" waste). Square round with cut lines.

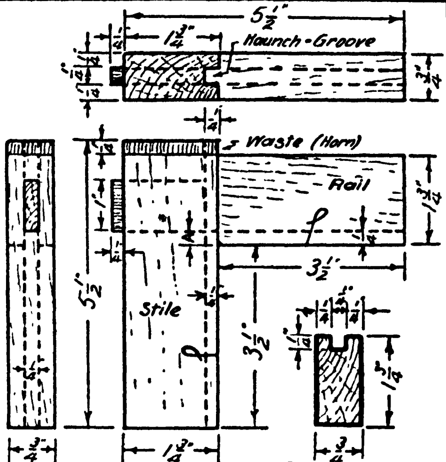
(e) Mark width of tenon on end of rail by measuring ¼" from face edge (this allows for depth of groove), then 1" for width of tenon. Square or gauge these lines along each side from end to the shoulder lines.

(f) Allow ¼" at base of tenon on the outside edge of rail for a haunch to fill in the haunching made by the groove in the stile.

(g) Set mortise gauge to chisel and gauge round end of tenon and on both edges of the stile for the mortise, gauging from the face side. Mark waste with crosses.



HAUNCHED M&T. FOR GROOVED FRAME-

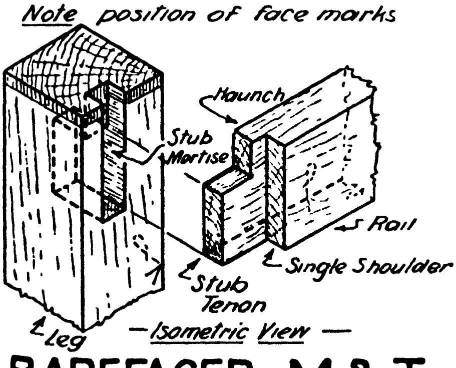


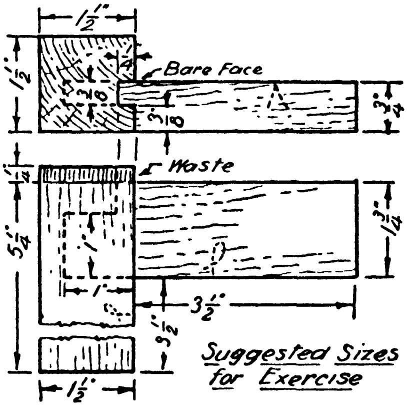
NOTE:- Groove may be narrower depending on thickness of panel.

Suggested Sizes for Exercise

CONSTRUCTION:- Similar to Haunched Mortise and Tenon-with the exception the tenon is cut away on the inside edge by an amount equal to the depth of the groove as shown at "A".

NOTE:- Groove is worked AFTER ripping sides of tenon and cutting mortise.





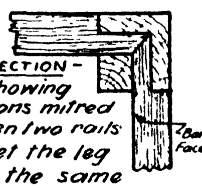
Suggested Sizes for Exercise

BAREFACED M&T.- (HAUNCHED)

CONSTRUCTION ① Prepare pieces to sizes

②TENON (a) Square shoulder line (= to length of tenon)
(b) Square width of tenon (about $\frac{5}{8}$ ths width of Rail)
(c) Gauge thickness (= to chisel with Marking Gauge)
(d) Rip thickness & width down to haunch (Saw on Waste Side)
(e) Pare sloping grooves and saw shoulders

③MORTISE (a) Mark position & length = to width of Tenon
(b) Gauge from outside of leg with Mortise Gauge, spurs set to Mortise Chisel Fixed spur set to thickness of Rail
(c) Chop out waste to required depth
(d) Saw sides of haunch and pare out waste



- SECTION - Showing Tenons mitred when two rails meet the leg at the same level as in the Top rails of Tables etc

STEP 3.—**Cutting Mortise.** Chop out waste, chiselling half-way through from both edges.

STEP 4.—**Cutting Tenon.**

(a) Rip thickness of tenon.
(b) Rip width of tenon down to haunch.
(c) Plane groove on BOTH pieces with plough plane.
(d) Pare sloping grooves on shoulders of tenon and saw shoulders.
(e) Saw off waste of tenon, leaving haunch. Wedges may be cut from waste of tenon.

Assemble and shoot off waste end of tenon, saw off horn on end of stile and shoot end.

QUESTIONS.

1. Where would you use this joint?
2. Make an isometric drawing of the joint with its members separated. Name the parts.
3. What plane would you use to make the groove?
4. Why is it necessary to have a haunch on the tenon?
5. Why is the edge of the tenon $\frac{1}{4}''$ away from the face edge of the rail?
6. What is the difference between the H. M & T and the barefaced M & T?
7. Where is the barefaced M & T most frequently used?
8. Sketch a barefaced M & T with its members apart.
9. Show by a sketch how the ends of tenons on rails which meet adjacent faces of a table leg are mitred.
10. Why are the ends of the tenons mitred, and how?

11. THE SASH JOINT (Plate 48).

(A Framing Joint.)

Uses: A mortise and tenon joint used for window sashes where the members are rebated and moulded.

The steps below refer to timber which is to be moulded and rebated by hand.

CONSTRUCTION.

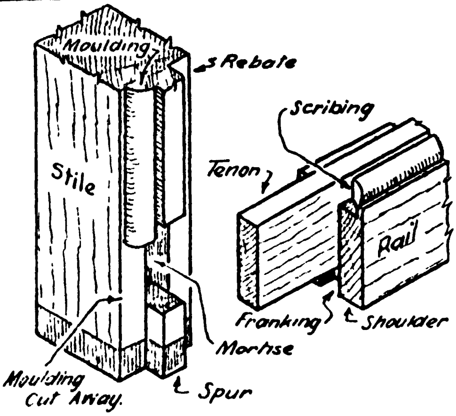
STEP 1.—**Prepare** the timber in one length to width and thickness.

Note: It is necessary for easy working to ensure the direction of the grain is such that when the face edge is being planed in the ordinary way the face side is nearest the worker with its grain running towards the bench stop.

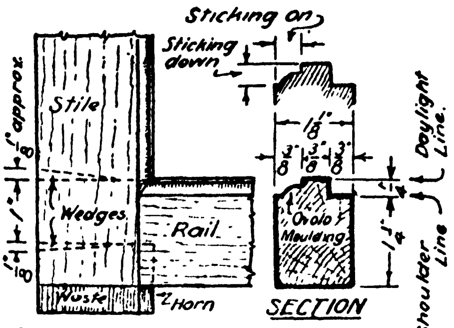
STEP 2.—**Setting Out.**

(a) Mark the length of the tenon on the end of the rail equal to the width of the stile less $\frac{1}{4}''$ (depth of the rebate and moulding). An $\frac{1}{8}''$ waste may be left on the end of the tenon for shooting off when the joint is assembled. The shoulder line is squared round with cut lines.

(b) Mark width of rail from end of stile for position of mortise (allowing waste for horn), the length of mortise is marked from the inside line 2/3rds width of rail. Mark width of tenon equal to width of mortise.



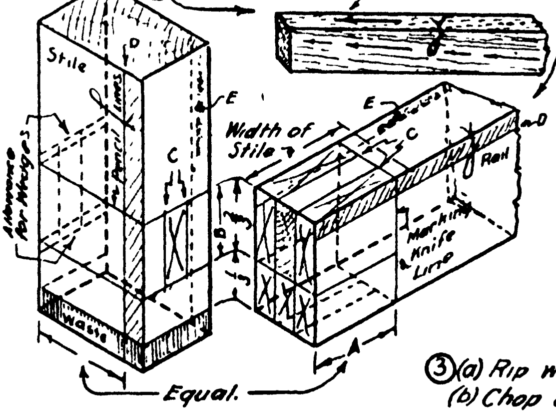
Isometric View. (Members Apart)



Suggested sizes for exercise

—SASH JOINT—

① Prepare timber. NOTE: Direction of grain & position of Face Marks.



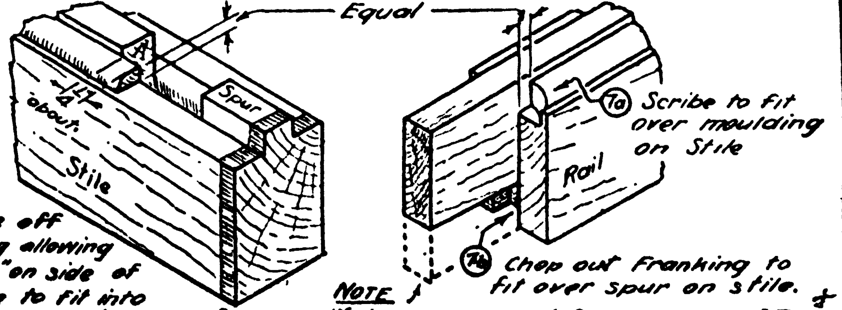
② SETTING OUT—

(a) Mark length of Tenon on end of Rail = width of Stile less depth ("sticking-down") of Orolo as at "A".
(b) Mark position of Mortise on end of Stile = $\frac{2}{3}$rds width of Rail as at "B". Mark width of Tenon = Mortise.
(c) Gauge thickness of Mortise & Tenon from Face Side as at "C".
(d) Gauge "sticking down" i.e. depth of Orolo down Face Side as at "D."
(e) Gauge depth of Rebate down reverse side as at "E."

③ (a) Rip width & thickness of Tenon.
(b) Chop out core of Mortise – cut wedge-ways on outside edge.

④ (a) Rebate both pieces with Sash Fillister Plane.
(b) "Stick" or plane moulding with Orolo Plane on Face side & edge.

⑤ (a) Pare sloping grooves and saw shoulders of Tenon.



⑥ Pare off moulding allowing about $\frac{1}{4}$" on side of mortise to fit into scribing on rail. Leave Spur.

⑦(a) Scribe to fit over moulding on Stile

⑦(b) Chop out Franking to fit over spur on stile. &

NOTE: Wedges may be cut from waste of Tenon.

PLATE 48.

(c) Gauge thickness of mortise and tenon from face side ($\frac{3}{8}''$, i.e., 1/3rd thickness of timber).

(d) Gauge depth (called "sticking down") of moulding down face side from face edge.

(e) Gauge depth of rebate (equal to sticking down of moulding) down the reverse side from face edge.

STEP 3.

(a) RIP width and thickness of tenon.

(b) CHOP out waste of mortise (if wedges are to be used, cut wedge-ways on outside edge about $\frac{1}{8}''$ and tapering about 2/3rds through the style).

STEP 4.

(a) Plane rebate on both pieces with sash fillister plane.

(b) Plane moulding on both pieces.

STEP 5.—Pare sloping grooves and saw shoulders of tenon. Cut wedges from waste of tenon. (7b, plate 48.)

STEP 6.—Pare off moulding on end of the stile, leaving about $\frac{1}{4}''$ along the side of the mortise.

STEP 7.

(a) Scribe the end of the moulding on end of rail to fit over the moulding left on the stile.

(b) Chop out groove or "franking" to fit over the spur left on the end of the stile.

Assemble, using glue and wedges, then shoot off end of tenon and wedges. Saw off waste horn and shoot.

QUESTIONS.

1. Where is the sash joint most frequently used?
2. Make a sketch showing the section of the members used in this joint.
3. What length would you make the tenon?
4. What depth would you cut the franking?
5. On what edge is the allowance made for wedging?

12. THE DOWELLED JOINT (PLATES 49 and 36).

(A Framing Joint.)

USES: For joining together the rails and stiles or legs of framed cabinets, tables, chairs, etc., instead of using the mortise and tenon joint. Dowels are used in place of the tenon for strengthening the butt joint between the members.

CONSTRUCTION.—If a number of joints are to be made using the same sectioned rails, a dowel marking template, shown in sketch, should be made to assist in setting out. One shoulder of the template is marked "R," and the other "S." "R" should always be used against the face side of the rail and "S" against the face side of the stile.

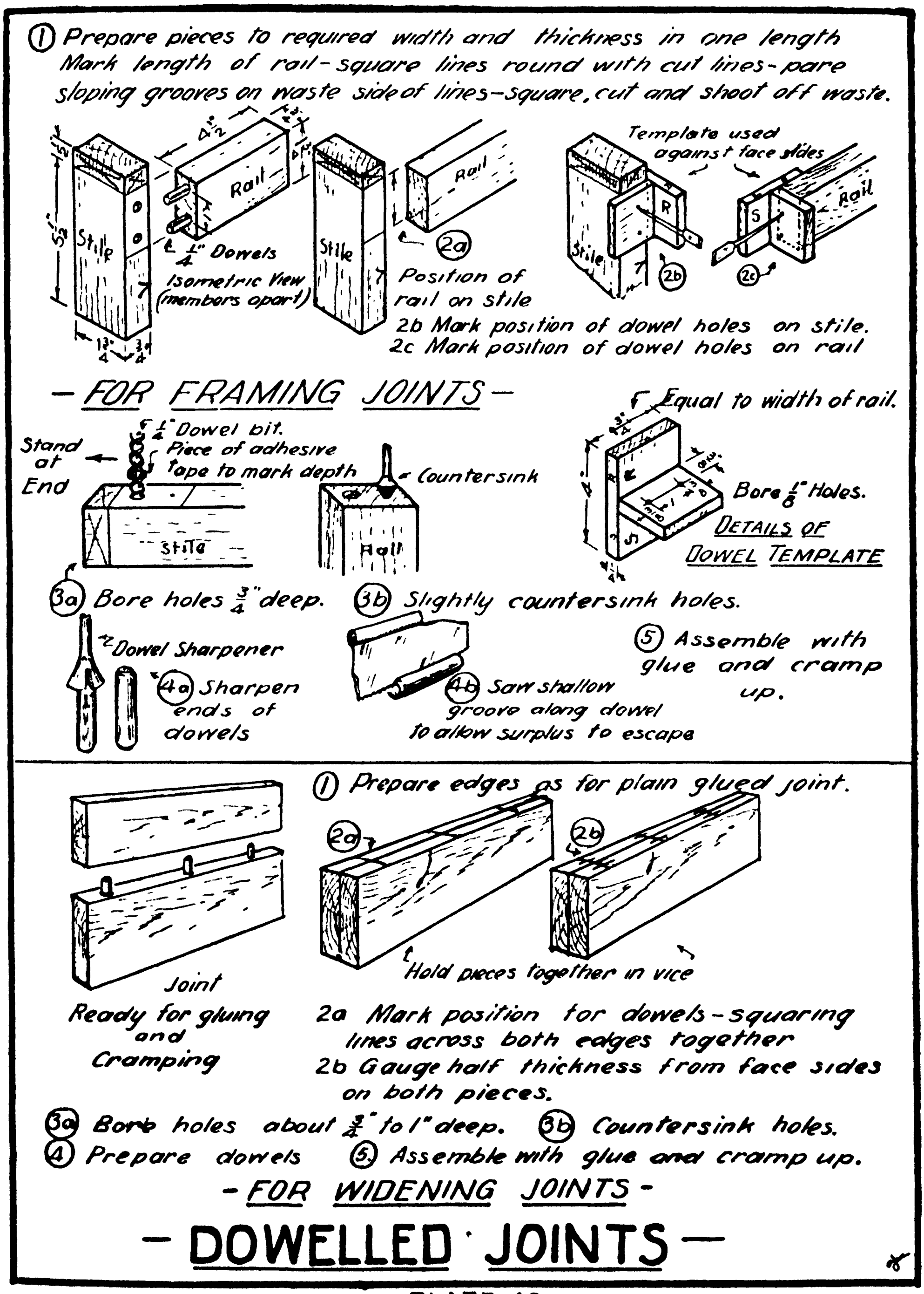

① Prepare pieces to required width and thickness in one length
Mark length of rail - square lines round with cut lines - pare
sloping grooves on waste side of lines - square, cut and shoot off waste.
Rail
Stile
¼" Dowels
Isometric View
(members apart)
Stile
Rail
2a
Position of
rail on stile
Template used
against face sides
R
Stile
2b
S
Rail
2c
2b Mark position of dowel holes on stile.
2c Mark position of dowel holes on rail
- FOR FRAMING JOINTS -
¼" Dowel bit.
Piece of adhesive
tape to mark depth
Stand
at
End
Stile
Countersink
Rail
Equal to width of rail.
Bore ⅛" Holes.
DETAILS OF
DOWEL TEMPLATE
3a Bore holes ¾" deep.
3b Slightly countersink holes.
Dowel Sharpener
4a Sharpen
ends of
dowels
4b Saw shallow
groove along dowel
to allow surplus to escape
5 Assemble with
glue and cramp
up.
① Prepare edges as for plain glued joint.
2a
2b
Hold pieces together in vice
Joint
Ready for gluing
and
Cramping
2a Mark position for dowels - squaring
lines across both edges together
2b Gauge half thickness from face sides
on both pieces.
3a Bore holes about ¾" to 1" deep.
3b Countersink holes.
4 Prepare dowels
5 Assemble with glue and cramp up.
- FOR WIDENING JOINTS -
- DOWELLED · JOINTS -

PLATE 49.

STEP 1.—**Prepare** the pieces for the exercise in one length to width and thickness. Square the length of piece for rail round with cut lines, pare sloping grooves on waste side and carefully cut and shoot the end perfectly square to the face side and face edge. This is to ensure the rail fitting square against the face edge of the stile.

STEP 2.—**Setting Out.**

(a) Mark width of rail on face edge of stile, allowing ½″ waste.
(b) Mark position of dowel holes on face edge of stile, using template.
(c) Mark position of dowel holes on end of rail, using template.

NOTE: Instead of using a template the position of the dowel holes may be marked with a gauge.

STEP 3.

(a) Bore holes a little more than ¾″ deep in both pieces (stand at end of work while boring and keep bit vertical) A piece of adhesive tape wrapped round the bit can be used as a guide to obtain the required depth.
(b) Slightly countersink the holes to remove sharp edges which might break away when the dowels are inserted.

STEP 4.

(a) Prepare the dowels to required length (1½″), removing sharp edges with dowel sharpener.
(b) Saw a shallow groove about 1/16″ deep along the dowel to allow air and excess glue to escape when inserting the dowel.

STEP 5.

Assemble. Glue dowels into end of rail, apply glue to end of rail and edge of stile and cramp joint up.

13. THE DOWELLED JOINT (PLATES 49 and 34).
(A Widening Joint.)

USES: For strengthening the square edged plain glued joint.

CONSTRUCTION.

STEP 1.—**Prepare** the edges to be joined by shooting them with a finely set trying plane. See steps 1 and 2 of the Rubbed and Glued Joint (Plate 38).

STEP 2.—**Setting Out.**

(a) Hold the pieces together in vice or with "G" cramps (face sides on the outside) and mark the distance between the holes about 9″.
(b) Set the marking gauge to half the thickness of the timber and gauge position of holes, gauging from the face side of both pieces.

STEP 3.

(a) Bore hole ¾″ deep for ¼″ or ⅜″ dowels. Stand at end of work.
(b) Slightly countersink holes.

STEP 4.—Prepare dowels to length, sharpen and saw grooves.

STEP 5.—Glue dowels into one piece, apply glue to both edges and cramp up with sash cramps.

QUESTIONS.

1. Make neat sketch showing a dowelled joint for framing (with members apart).
2. Sketch a dowel marking template suitable for rails 3½" x ¾" for three ½" dowels.
3. What is the purpose of the groove along the dowel?
4. Sketch the marking of position for dowels in a widening dowelled joint.
5. What is the purpose of using cramps to draw up the joints?

14. THE SINGLE DOVETAIL JOINT (PLATES 50 and 35).
(A Framing or Angle Joint.)

USES: A very strong form of joint for joining narrow pieces with their faces or edges at right angles. Used for strong brackets, rails of tea trays, etc. The top and bottom rails of cabinets are frequently dovetailed to fit into stopped sockets in the solid ends of the cabinet.

CONSTRUCTION.

STEP 1.—**Prepare** the timber in one length to the required width and thickness.

STEP 2.—**Setting Out.** As in working drawing.

(a) Mark position of socket on end of one piece, making the depth of the socket equal to the thickness of the other piece. Square lines round with pencil lines. (Allow about ⅛" waste on end.)

(b) Mark position of dovetail on the end of the second piece, making its length equal to the thickness of the piece for the socket. The lines are squared round with the marking knife. (Allow about ⅛" waste on end.)

(c) Set out shape of dovetail on both sides of the timber, squaring the lines across the end of the timber. See sketch showing setting of sliding bevel to slope of 1 in 6. Mark waste on outside with crosses.

STEP 3.—**Cutting Dovetail.**

(a) Rip sides of dovetail down to shoulder lines.
(b) Pare sloping grooves along shoulder lines, on waste side of lines.
(c) Saw shoulders.

STEP 4.—**Setting Out Socket.**

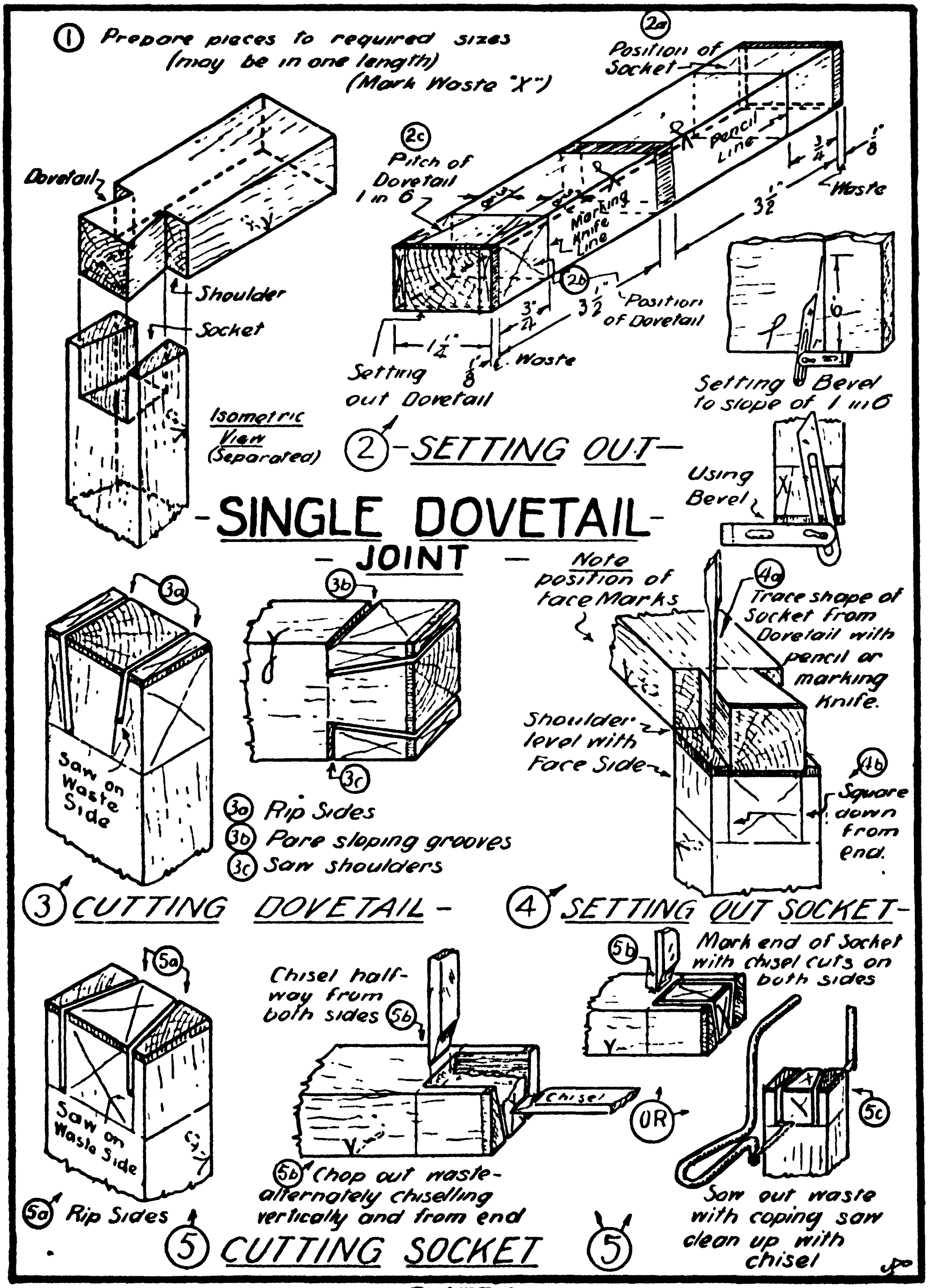
(a) Place dovetail over the end of position for socket so that the face sides of the two pieces are inside and the face edges flush, and trace the shape of the dovetail.

(b) Square the sides of the socket down from the end on both sides. Mark the waste in the middle with crosses.

STEP 5.—**Cutting Socket.**

(a) Rip the sides of the socket, sawing the waste side (inside) of the lines.

(b) Chop out the waste half-way through from both sides, chiselling alternately, vertically and from the end. *OR* a "V" shape cut may be made from each side. (See 4b, plate 43, Removing waste socket of Bridle Jt.) Hold the job firmly by


① Prepare pieces to required sizes
(may be in one length)
(Mark Waste "X")
Dovetail
Shoulder
Socket
Isometric View (Separated)
2a
Position of Socket
Pencil Line
3/4"
1/8"
Waste
3 1/2"
2c
Pitch of Dovetail 1 in 6
Marking Knife Line
2b
Position of Dovetail
3 1/2"
3/4"
1 1/4"
1/8"
Waste
Setting out Dovetail
Setting Bevel to slope of 1 in 6
6
1
② -SETTING OUT-
Using Bevel
-SINGLE DOVETAIL-
- JOINT -
3a
Saw on Waste Side
3b
3c
3a Rip Sides
3b Pare sloping grooves
3c Saw shoulders
③ CUTTING DOVETAIL -
Note position of face Marks
4a
Trace shape of Socket from Dovetail with pencil or marking knife.
Shoulder level with Face Side
4b
Square down from end.
④ SETTING OUT SOCKET-
5a
Saw on Waste Side
5a Rip Sides
Chisel half-way from both sides 5b
5b
Mark end of Socket with chisel cuts on both sides
Chisel
OR
5c
5b Chop out waste-alternately chiselling vertically and from end
Saw out waste with coping saw clean up with chisel
⑤ CUTTING SOCKET ⑤

. PLATE 50.

"G" cramping to the cutting board. The bulk of the waste may be removed if desired by using the coping saw.

Assemble and shoot off waste ends.

QUESTIONS.

1. Make a freehand sketch of the single dovetail joint with its members apart. Name the parts of the joint.
2. Show by a sketch how the socket is set out from the dovetail.
3. Write down the uses of the joint.
4. What is the pitch of the dovetails?
5. Make a sketch showing the setting of the bevel to the required pitch.

15. THE COMMON OR THROUGH DOVETAIL JOINT (PLATES 51 and 35). (An Angle Joint.)

USES: Is the strongest form of angle joint. Used in box-like constructions, such as boxes, cabinets made from solid timber or thick plywood. Also used in the backs of drawers. (See plates 63, 90 and 98.)

CONSTRUCTION.

STEP 1.—**Prepare** the pieces in one length (if they are of the same thickness). In describing the joint here one piece for pins is called piece "A" and the other for the dovetails is called piece "B."

STEP 2.—**Setting Out.**

(a) Set out the position of the joints by gauging or squaring lines all round from the end: (i) on piece "A" equal to the thickness of piece "B"; (ii) on piece "B" equal to the thickness of piece "A." (A 1/16" waste may be added for cleaning up after assembling.)

(b) Set out POSITION and SHAPE of DOVETAILS on the face side of piece "B." (If the members are to be used for a box where external appearance is important the face sides should be outside, i.e., opposite to those shown on Plate 51.)

NOTE: The width of the wide end of the pin sockets is usually $\frac{3}{4}$ thickness of the timber. See sketch showing setting out so that all the dovetails are of the same size. Set bevel to slope of one in six for pitch of dovetails. *Mark waste between dovetails, i.e., pin sockets, with crosses.*

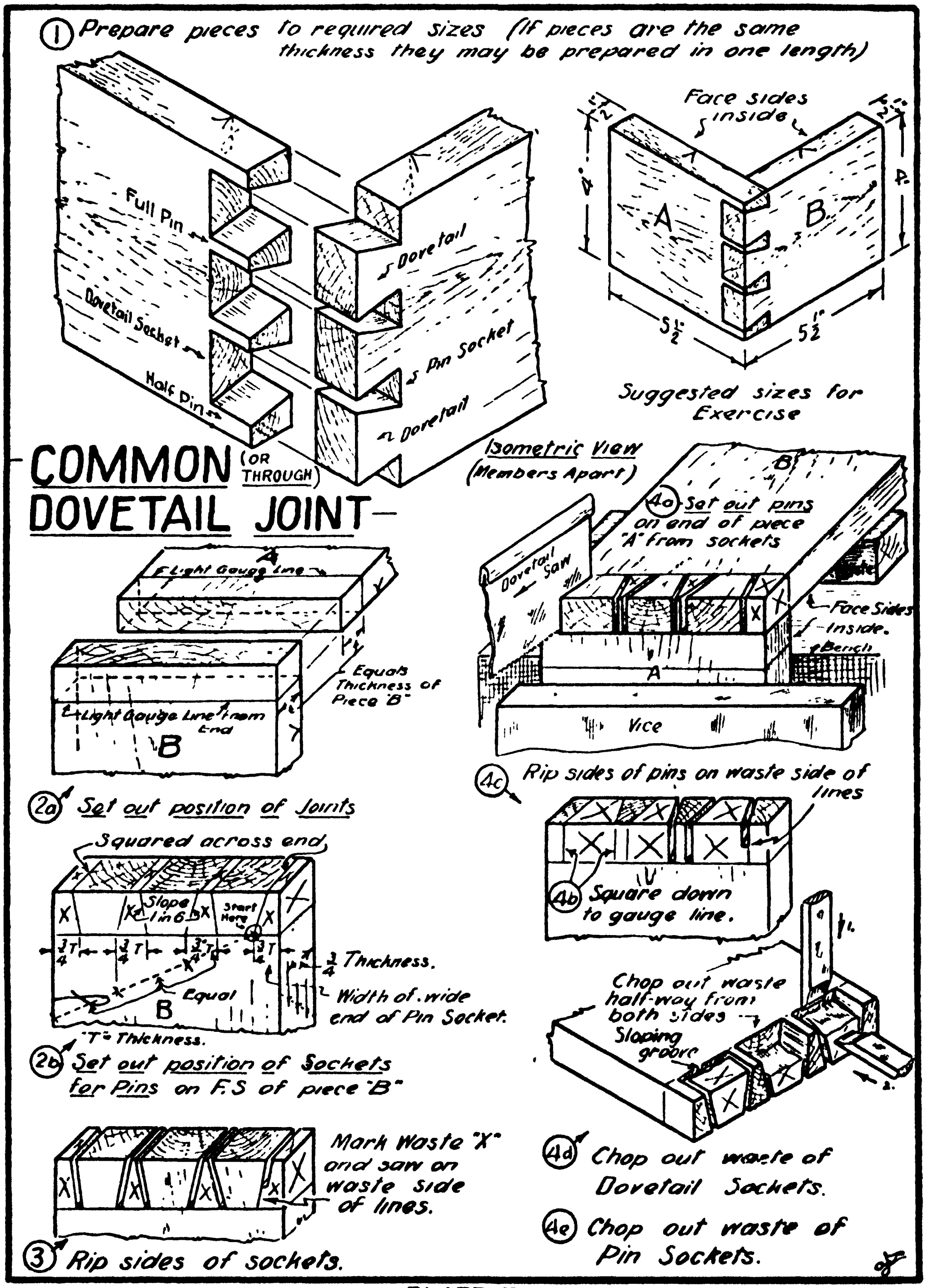
STEP 3.—Rip the sides of the dovetails, sawing on the waste side of the lines.

STEP 4.—**Mark Shape of Pins.**

(a) Place piece "B" over the end of piece "A" with face sides inside or outside and face edges flush, and trace the shape of the dovetails by drawing the dovetail saw through the saw kerfs in piece "B."

(b) Remove piece "B" and square the sides of the pins down both sides. (*Mark waste between the pins, i.e., dovetail sockets with crosses.*)

(c) Rip sides of pins down to gauge line, sawing on the waste side.



(1) Prepare pieces to required sizes (If pieces are the same thickness they may be prepared in one length)
Full Pin
Dovetail Socket
Half Pin
Dovetail
Pin Socket
Dovetail
Face sides inside
A
B
$5\frac{1}{2}$"
$5\frac{1}{2}$"
Suggested sizes for Exercise
COMMON (OR THROUGH) DOVETAIL JOINT
Isometric View (Members Apart)
A
Light Gauge Line
Equals Thickness of Piece "B"
Light Gauge Line from End
B
(2a) Set out position of Joints
Squared across end
Slope 1 in 6
Start Here
$\frac{3}{4}$T
$\frac{3}{4}$ Thickness.
Width of wide end of Pin Socket.
Equal
B
"T" = Thickness.
(2b) Set out position of Sockets for Pins on F.S of piece "B"
Mark Waste "X" and saw on waste side of lines.
(3) Rip sides of sockets.
B
(4a) Set out pins on end of piece "A" from sockets
Dovetail Saw
Face Sides Inside.
Bench
A
Vice
(4c) Rip sides of pins on waste side of lines
(4b) Square down to gauge line.
Chop out waste half-way from both sides
Sloping groove
(4d) Chop out waste of Dovetail Sockets.
(4e) Chop out waste of Pin Sockets.

PLATE 51.

(d) CHOP OUT waste of DOVETAIL SOCKETS, first paring sloping grooves on each side, then alternately chiselling vertically and horizontally from both sides, or by making "V" cuts from each side.

(e) CHOP OUT waste of PIN SOCKETS, chiselling from both sides.

Assemble and shoot off waste.

NOTE: The *PINS* may be set out and cut first, and the *DOVETAILS* traced from the pins. This method of marking the "tails" from the "pins" would be necessary for large work, e.g., sides and tops of cabinets. (See step 5, plate 53.)

QUESTIONS.

1. State the uses of the common dovetail joint.
2. What is the pitch of the dovetails?
3. Make a sketch of the common dovetail with two full pins, members apart.
4. Make a detailed sketch showing the setting out of the dovetails.
5. How many full pins would there be in a dovetail joint having two dovetails?

16. THE LAPPED DOVETAIL JOINT (PLATES 52 and 35).

(An Angle Joint.)

USES: In this dovetail joint a lap is left on the outside face of the pins to hide the end grain of the dovetails when the joint is assembled. For this reason the joint is generally used for joining the fronts and sides of drawers. It is also used in box making, and sometimes for fixing the bottom to the sides of cabinets when solid timber is used. (See also plate 63.)

CONSTRUCTION.

STEP 1.—**Prepare** the pieces to the required sizes. When used for drawer making the piece containing the lap and the pins is usually thicker than the side piece. In the exercise described here the front is referred to as piece "A" and the side as piece "B."

STEP 2.—**Setting Out.** (NOTE: When the external faces of the joint are seen, as in boxes and drawers, it is advisable to have the better sides of the pieces on the outside.)

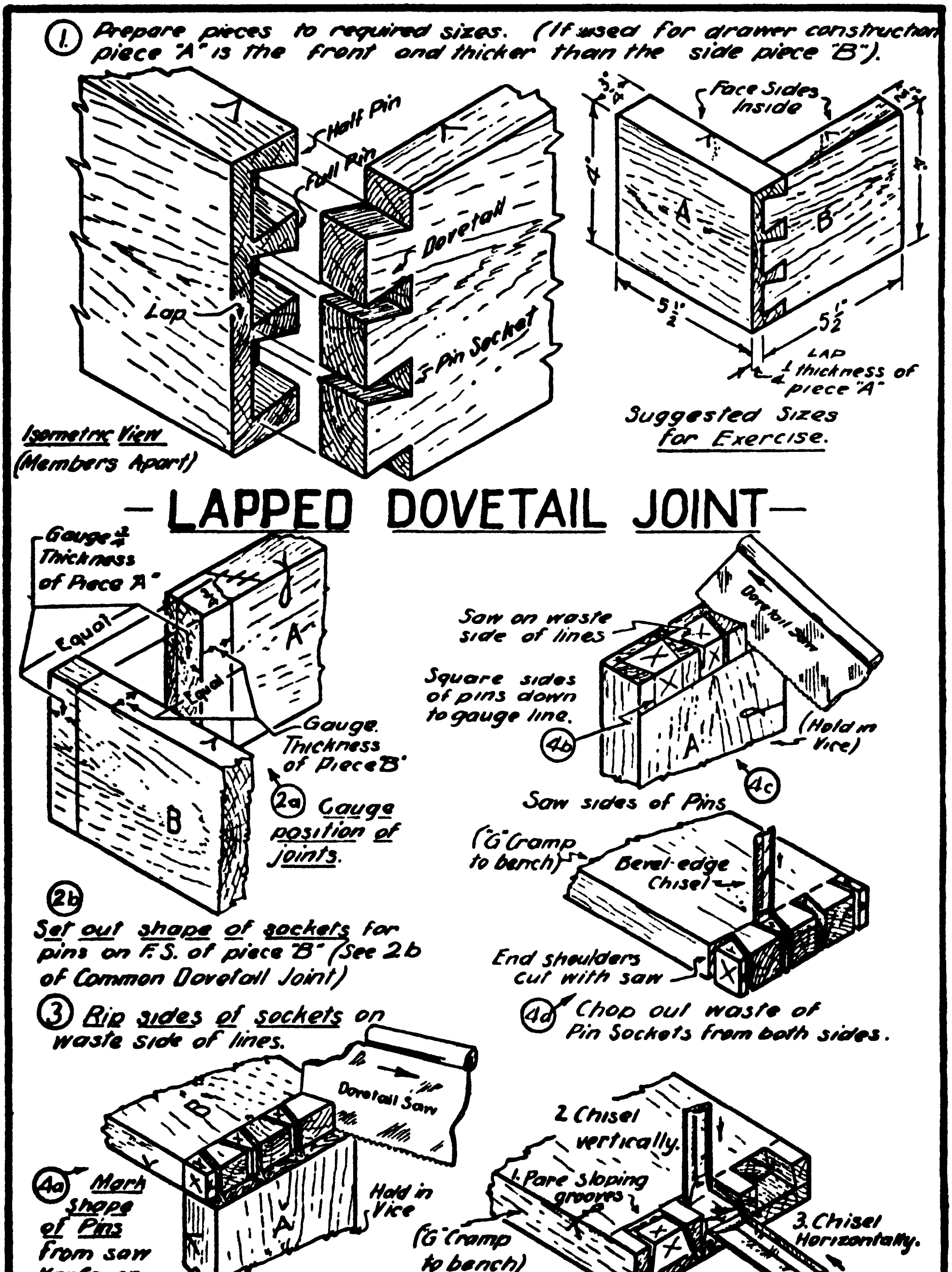
(a) Gauge position of joints:—(i) Gauge thickness of piece "B" down the face side from end of piece "A"; (ii) gauge $\frac{3}{4}$ thickness of piece "A" along end of piece "A," gauging from face side; this leaves a lap $\frac{1}{4}$ thickness on the outside; (iii) with gauge at same setting, gauge across both sides and edges from end of piece "B."

(b) SET OUT DOVETAILS on face side of piece "B" (see step 2b of common dovetail). Mark waste between dovetails with crosses.

STEP 3.—Rip sides of dovetails, sawing on the waste side of lines. (See sketch step 3, Common Dovetail.)

STEP 4—**Mark Shape of Pins.**

(a) Place piece "B" over end of piece "A" with face sides inside and face edges flush, and trace shape of dovetails by drawing the dovetail saw through the kerfs in piece "B."



1. Prepare pieces to required sizes. (If used for drawer construction piece "A" is the front and thicker than the side piece "B").
Half Pin
Full Pin
Dovetail
Lap
Pin Socket
Isometric View (Members Apart)
Face Sides Inside
A
B
4"
5 1/2"
LAP 1/4 thickness of piece "A"
Suggested Sizes for Exercise.
LAPPED DOVETAIL JOINT
Gauge 3/4 Thickness of Piece "A"
Equal
Gauge. Thickness of Piece "B"
2a Gauge position of joints.
2b Set out shape of sockets for pins on F.S. of piece "B" (See 2b of Common Dovetail Joint)
3 Rip sides of sockets on waste side of lines.
Dovetail Saw
Hold in Vice
4a Mark shape of Pins from saw Kerfs on sides of sockets.
Saw on waste side of lines
Square sides of pins down to gauge line.
4b
(Hold in Vice)
4c Saw sides of Pins
("G" Cramp to bench)
Bevel-edge Chisel
End shoulders cut with saw
4d Chop out waste of Pin Sockets from both sides.
2. Chisel vertically.
1. Pare sloping grooves
3. Chisel Horizontally.
4e Chop out waste of Dovetail Sockets.

PLATE 52.

(b) Square the sides of the pins down to the gauge line. Mark waste.

(c) Saw as much as possible of sides of pins, sawing on waste side of lines.

(d) Chop out waste of pin sockets, chiselling half-way through from both sides. The end sockets may be sawn. Use a bevelled edge chisel.

(e) Chop out waste of dovetail sockets, pare sloping grooves and chisel alternately vertically and horizontally. "G" cramp job firmly to bench.

Assemble. The inside sharp edges of the dovetails may be slightly bevelled to prevent them breaking off while assembling.

NOTE: "Pins" may be set out first and the "tails" marked from them.

QUESTIONS.

1. Make an isometric sketch of the lapped dovetail joint assembled.
2. State the special uses of the joint.
3. How much lap would you leave to cover the end grain of the dovetails?
4. When would you use the lapped dovetail in preference to the common dovetail?
5. Show by a sketch how you would remove the waste of the dovetail sockets.

17. THE MITRE OR SECRET DOVETAIL JOINT (PLATES 53 and 35).

(An Angle Joint.)

USES: A dovetail joint having laps on the outside of both pieces mitred so as to conceal all end grain. The joint is used when a strong form of angle joint is required showing no end grain, as in high-class cabinet work and boxes.

CONSTRUCTION.

STEP 1.—**Prepare** the pieces to the required width and thickness in one length.

STEP 2.—**Gauging Position of Joints.**

(a) Gauge thickness of timber on face sides only from the ends of the pieces.

(b) Gauge ½ thickness along ends from reverse side.

(c) Gauge also ½ thickness across face sides from ends of both pieces. (These lines mark the position of a rebate across the ends.)

STEP 3.—**Cutting Rebates.**

(a) Rip depth of rebate from end on waste side of lines in both pieces.

(b) Pare sloping grooves and saw shoulder of rebate. OR the rebates may be planed if a waste piece of timber of the same thickness is cramped against the edge to prevent it from breaking away.

STEP 4.—**Set Out and Cut Pins.**

(a) Set out shape of PINS on end grain of rebate, leaving ⅛" waste for mitre at each end. Mark waste for dovetail sockets with crosses.

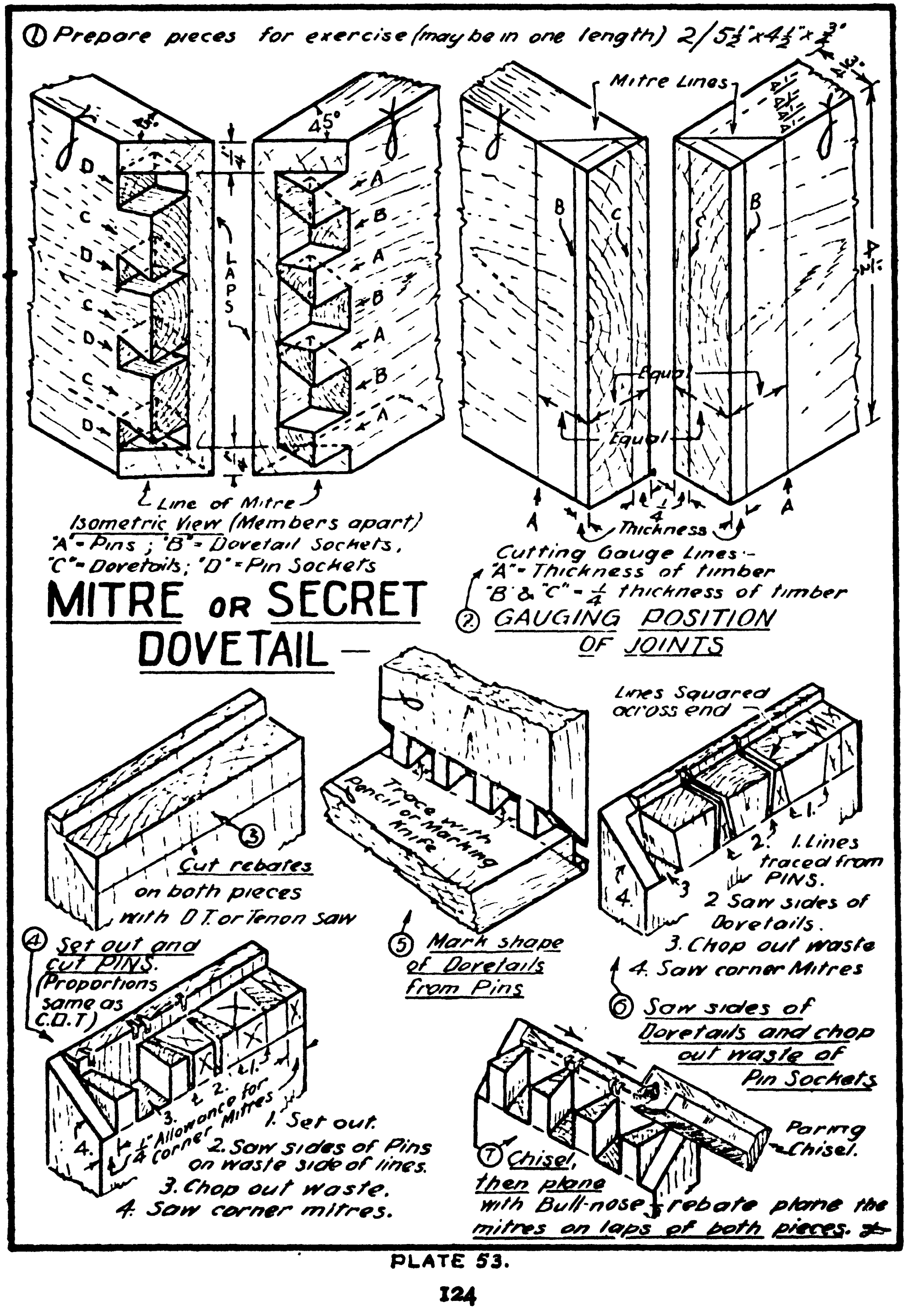
(b) Saw sides of pins, sawing obliquely on waste side of lines.

(c) Chop and pare out waste as in step 4e of Lapped Dovetail.

(d) Carefully saw corner mitres.

STEP 5.—**Set Out Dovetails.**

Place the ends of the pins over the position for the dovetails and trace the shape of the pin sockets from the pins with a sharp pencil or point of the marking knife.



(1) Prepare pieces for exercise (may be in one length) 2/5½"x4½"x¾"
45°
D
C
D
C
D
C
D
LAPS
A
B
A
B
A
B
A
Line of Mitre
Isometric View (Members apart)
"A" = Pins ; "B" = Dovetail Sockets,
"C" = Dovetails ; "D" = Pin Sockets
MITRE OR SECRET DOVETAIL —
Mitre Lines
B
C
Equal
Equal
¼
Thickness
A
Cutting Gauge Lines –
"A" = Thickness of timber
"B" & "C" = ¼ thickness of timber
(2) GAUGING POSITION OF JOINTS
(3)
Cut rebates on both pieces with D.T. or Tenon saw
(4) Set out and cut PINS. (Proportions same as C.D.T)
¼" Allowance for Corner Mitres
1. Set out.
2. Saw sides of Pins on waste side of lines.
3. Chop out waste.
4. Saw corner mitres.
Trace with Pencil or Marking Knife
(5) Mark shape of Dovetails from Pins
Lines Squared across end
1. Lines traced from PINS.
2 Saw sides of Dovetails.
3. Chop out waste
4. Saw corner Mitres
(6) Saw sides of Dovetails and chop out waste of Pin Sockets
Paring Chisel.
(7) Chisel, then plane with Bull-nose rebate plane the mitres on laps of both pieces.

PLATE 53.

STEP 6.—**Cutting Dovetails.**

(a) Square the ends of the dovetails across the end of the rebate. Mark the waste for the pin sockets with crosses.

(b) Saw sides of dovetails, sawing obliquely on waste side of lines.

(c) Chop and pare out waste of pin sockets.

(d) Carefully saw end mitres.

STEP 7.—**Cutting Mitres on Laps.**

The bulk of the waste may be removed by paring with bevelled edge chisel, and cleaned up with bull nose rebate plane.

Assemble. The ends of the pins and the sides of the dovetails may be lightly bevelled to prevent the sharp edges of the parts breaking away.

QUESTIONS.

1. What are the advantages of this joint?
2. When assembled, what other angle joint does this joint resemble?
3. Why are the pins set out and cut before the dovetails?
4. Would it be possible to set out the dovetails from the pins when making a common or lapped dovetail joint?
5. Why is a bevel edge chisel most suitable for chopping out the waste of dovetail joints?

V. PRACTICAL TESTS (Plates 54 to 59).

A METHOD OF CONSTRUCTING THEM.

Plates 54 to 59 are copies of Practical Tests given by the N.S.W. Department of Education to Intermediate Students. They test the student's ability to interpret working drawings, correct use of tools, accuracy in setting out and workmanship. Provided the test is attacked in an orderly fashion, the average student can turn out a satisfactory job in the prescribed time.

The instructions set out on the examination paper state:—

1. Original face and edge marks are to be left on the job.
2. No sanding or cleaning off is to be allowed after the timber has been prepared.
3. The joints are not to be glued.

A GENERAL PROCEDURE. (NOTE: Use a sharp black lead pencil. Keep your work clean.)

STEP 1.—**Preparation of the Timber.**

Prepare the timber to the required width and thickness (if all the pieces are of the same section, plane it up in one length). Accuracy in gauging and planing is essential, as incorrect preparation will spoil the rest of the job.

STEP 2.—**Setting Out.**

(a) Set out carefully all lengths, leaving about $\frac{1}{4}''$ between pieces; check the lengths and square round with cut lines. Mark each piece clearly with face, side and edge marks. Separate the pieces, allowing a little waste at each end.

(b) Mark the parts of the joints on the examination paper A:A, B:B, C:C, etc., as shown in plate 55. Place the pieces of timber together in their relative positions (face side up and face edge inside, or as in the case of the 1938 Test, face edges up and face sides inside), and mark the corners to be joined A:A, B:B, etc., to correspond with the drawing.

(c) Carefully set out the position of the joints, squaring the lines round with pencil lines. Check the distances between the joints on each piece.

(d) Do all gauging necessary from the face side or edge of each piece. If mortising is to be done, set the mortise gauge to the mortise chisel to be used.

(e) Set out chamfers, etc., with PENCIL lines.

(f) *Mark all waste clearly with crosses and check setting out for fitting of joints.*

STEP 3.—**Cutting the Joints.**

(a) Chop out mortises, etc., chiselling from both edges (make sure the job is held firmly).

(b) Rip thickness of tenons or pins, sawing on the WASTE side of lines.

(c) Pare sloping grooves and saw shoulders of tenons and pins.

(d) If there are halving joints, check shape and size of socket with pin before cutting the sides.

(e) Pare out waste of such joints as halving and bridle joints.

(f) Shoot off waste ends. (If tenons are to be flush, the ends may be planed off after the job is assembled.)

(g) Carefully pare off waste of chamfers and rounded corners, etc., just leaving the setting out lines. (See plate 20, Use of Chisel.) (NOTE: As glass paper, spokeshave, and files are not prescribed for the work, all rounding and stopped chamfers must be finished with the chisel. Through chamfers may be planed.)

STEP 4.—**Assembling.**

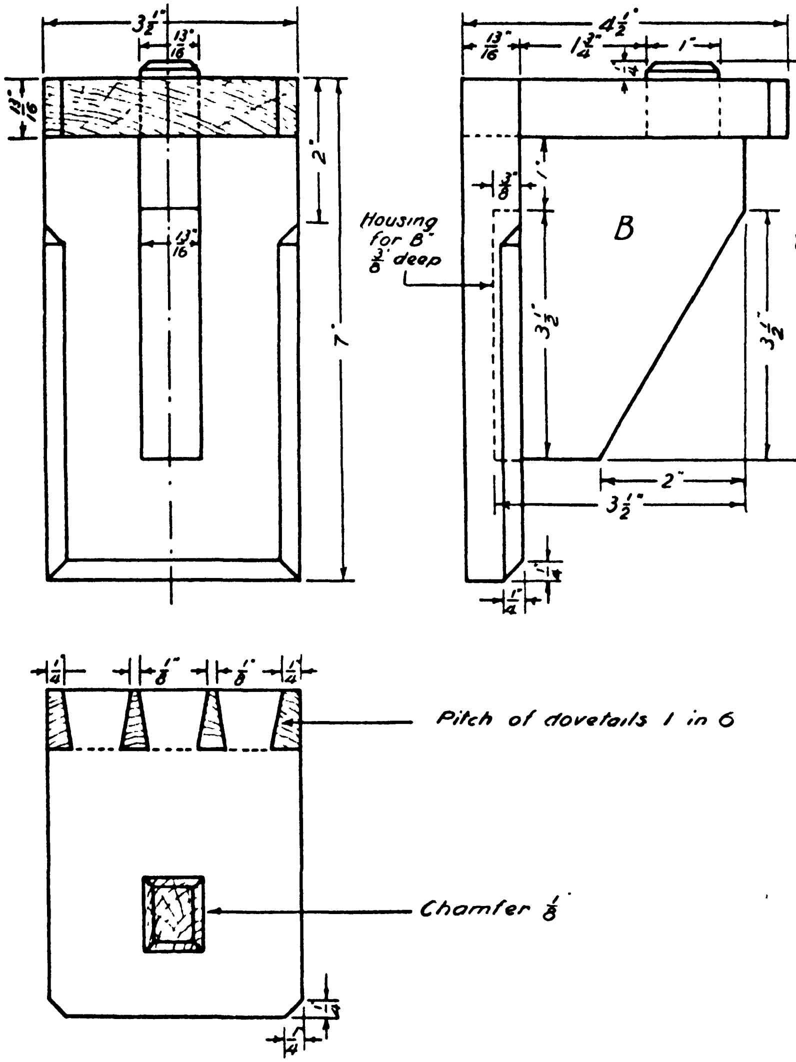
The joints should push together by hand and NOT HAMMERED. If it is necessary to ease any part a little, make sure where it is tight and only take off a little at a time.

Do not clean off the work; any setting out lines should be left on the work.

A warning to the slow worker: Do not spoil your effort by hurrying at the last. You may only complete three out of four joints in the time, but if you have worked methodically you will at least have the final joint and chamfers set out, showing that you know something of their construction.

QUESTIONS

1. What points must be kept in mind by a student when constructing a practical test?
2. Set out fully the steps involved in constructing the set of joints on Plate 55.
3. Name and classify the joints in the tests illustrated in Plates 55, 56, 57, 58 and 59.
4. Describe clearly the setting out of the test shown in Plate 59.
5. Describe how you would cut the chamfers and rounded corners in Plate 57.



from **INTERMEDIATE CERTIFICATE EXAMINATION**

N.S.W DEPARTMENT OF EDUCATION - **1935** - $3\frac{1}{2}$ Hrs.

The joints are not to be glued. Original face and edge marks to be left on the work. No sandpapering or cleaning off is to be allowed after the timber has been prepared to size.

PLATE 54

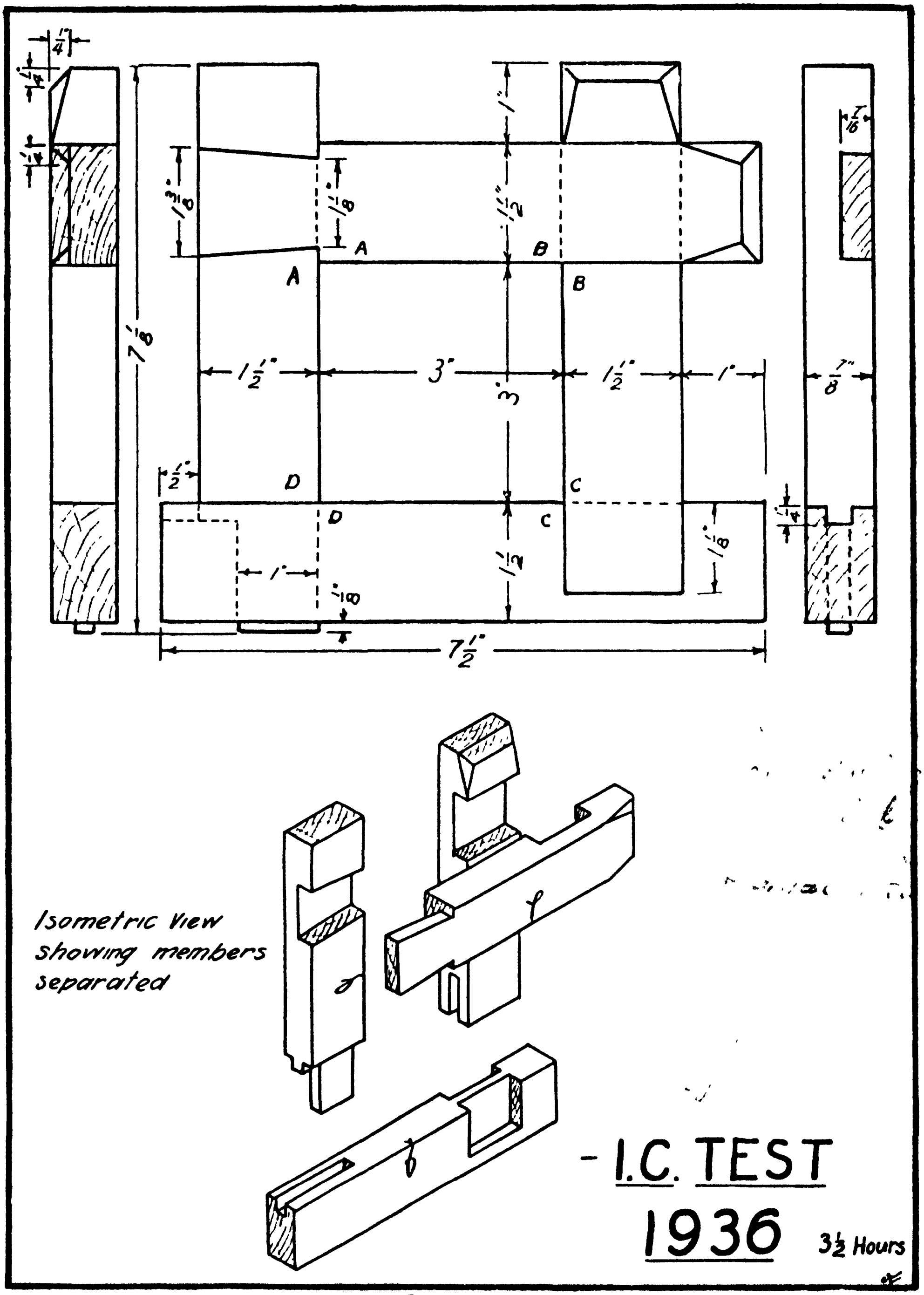

Isometric View showing members separated
7½"
I.C. TEST
1936
3½ Hours

PLATE 55

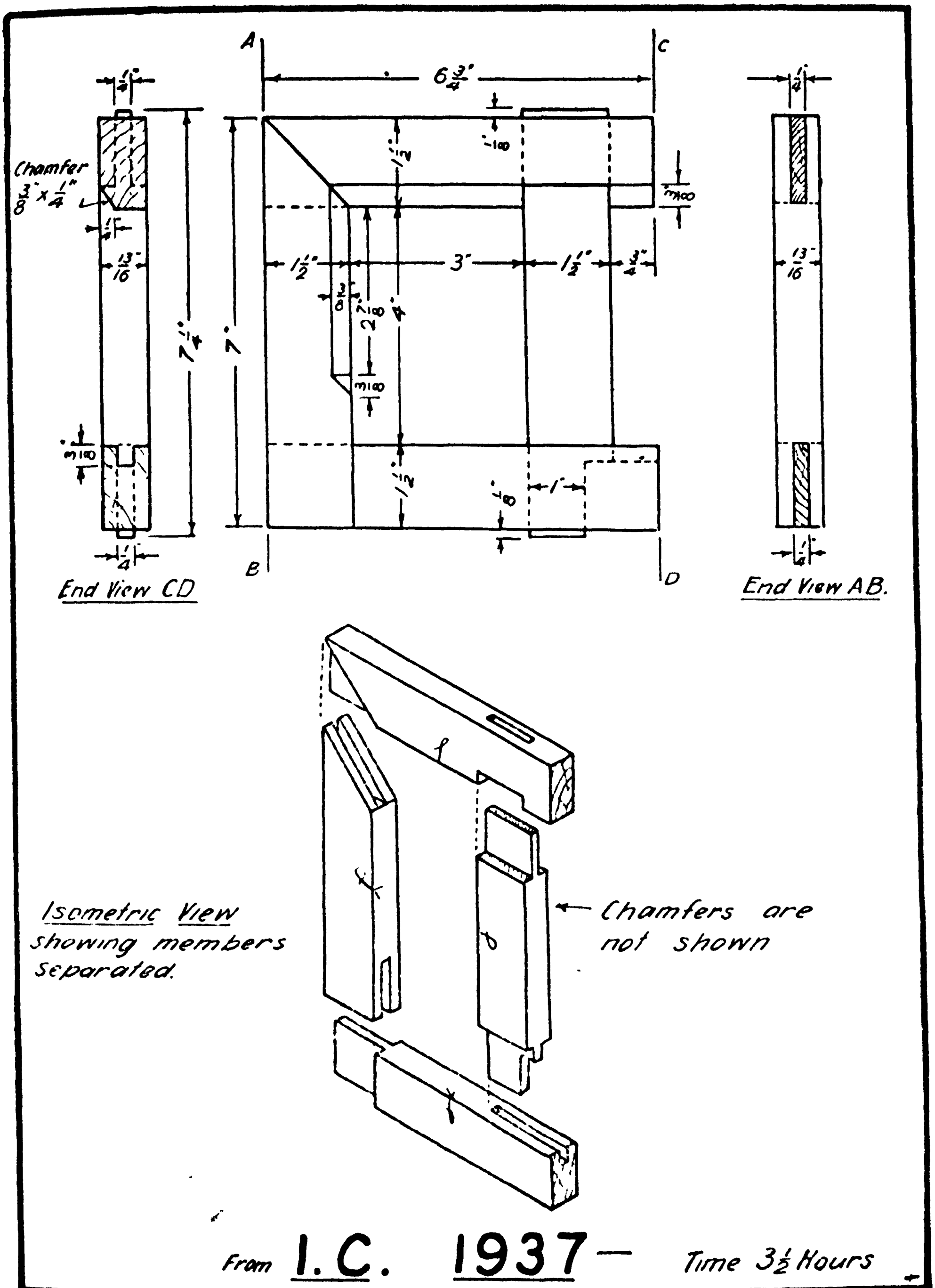
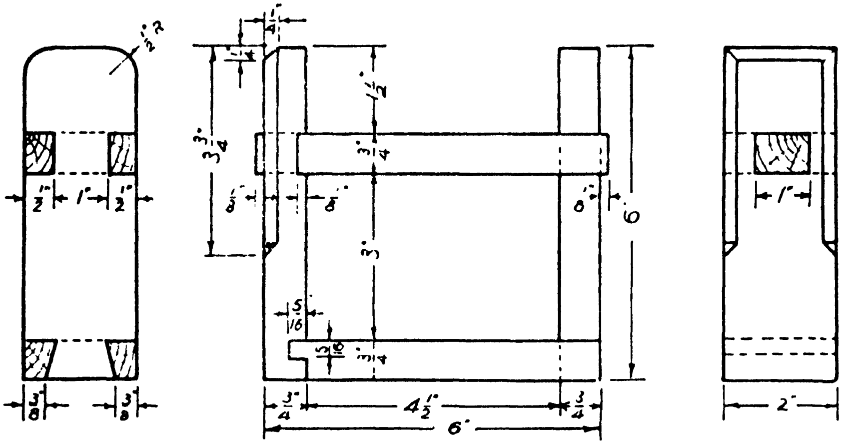
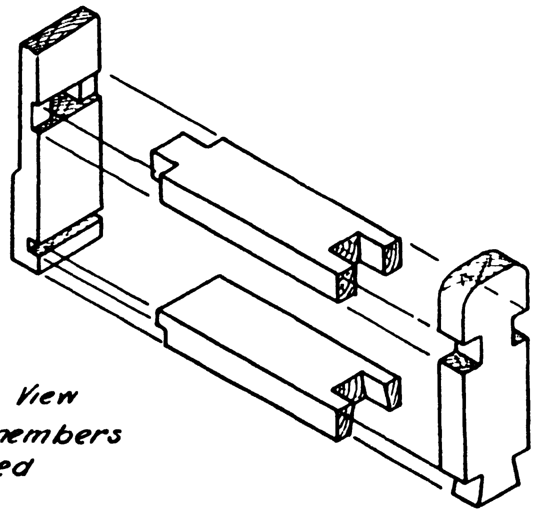

End View CD
Chamfer 3/8" x 1/4"
End View AB.
Isometric View showing members separated.
Chamfers are not shown
From I.C. 1937— Time 3½ Hours

PLATE 56.

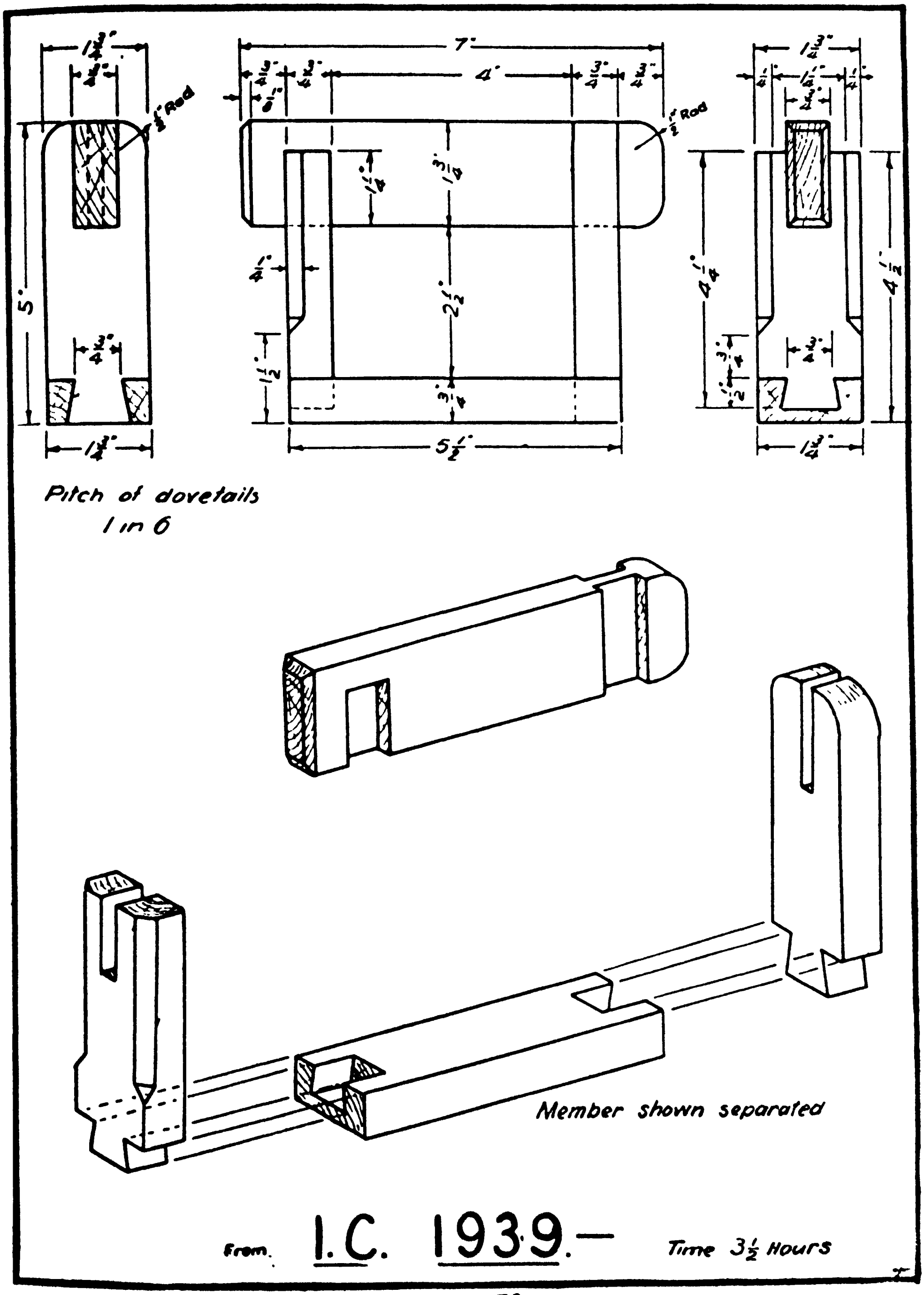




Isometric View showing members separated

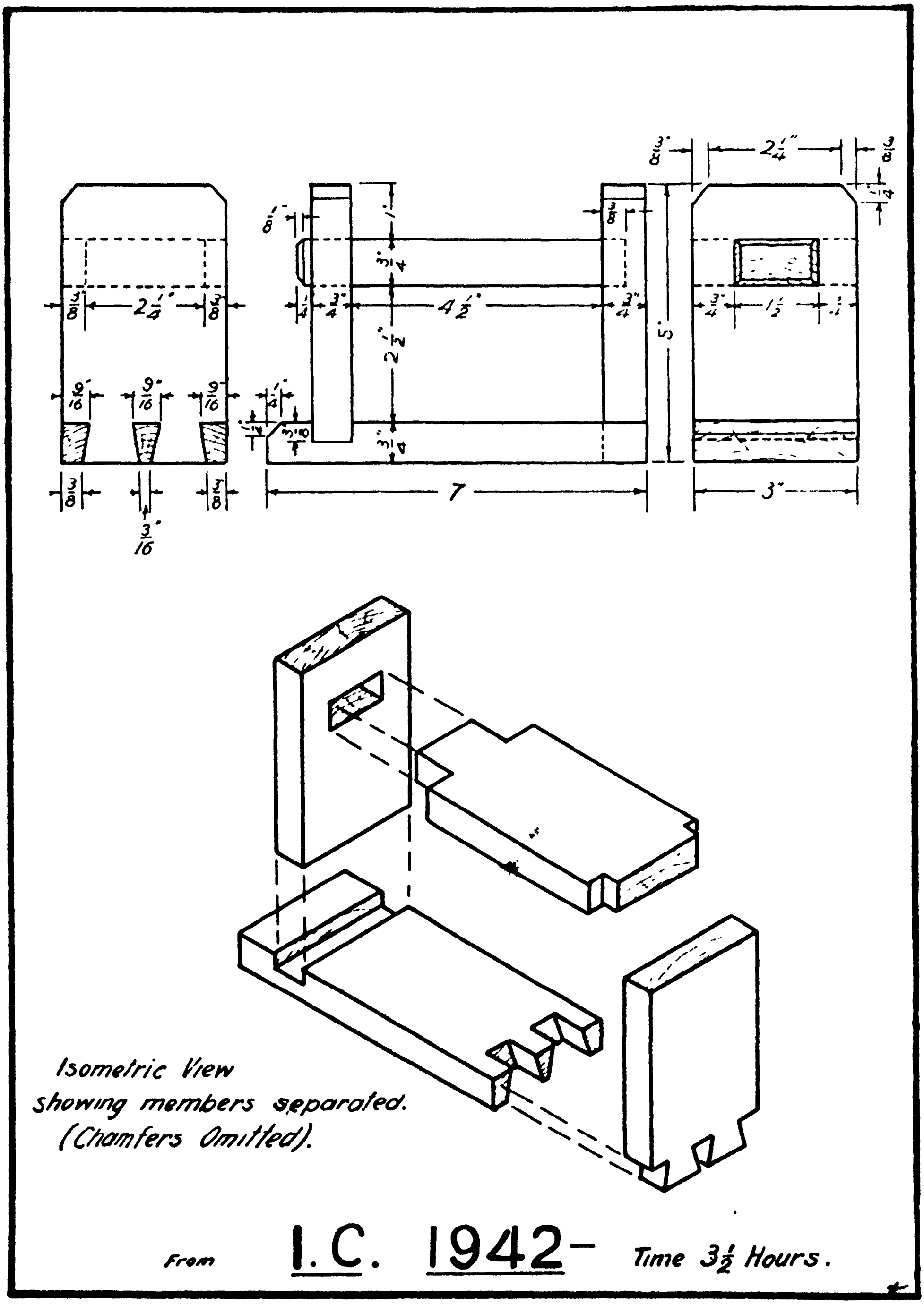
From I.C. 1938 — Time $3\frac{1}{2}$ Hours.

PLATE 57



Pitch of dovetails
1 in 6
Member shown separated
From. I.C. 1939.—
Time 3½ Hours

PLATE 58

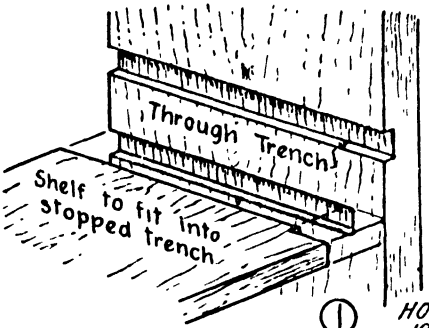


From **I.C. 1942**– Time 3½ Hours.

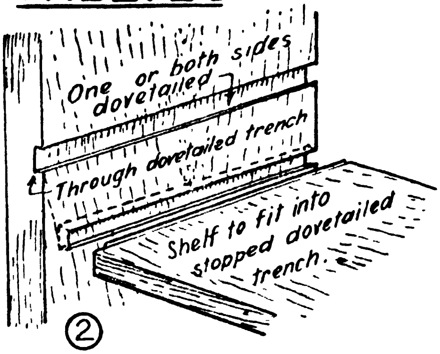
PLATE 59

— METHODS OF —

— SUPPORTING SHELVES —



①

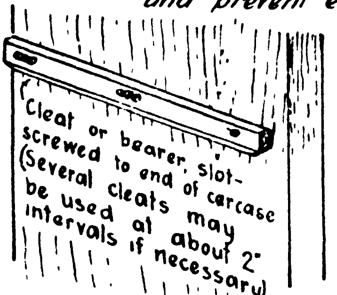


②

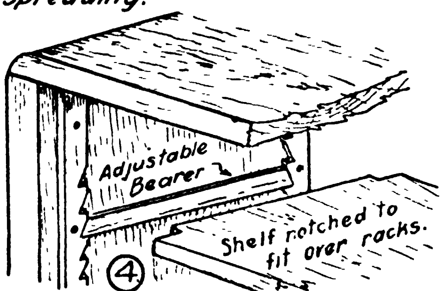
HOUSED JOINTS

For shelves fitted into ends of carcase in fixed positions. Usually glued in, to strengthen the carcase and prevent ends spreading.

③

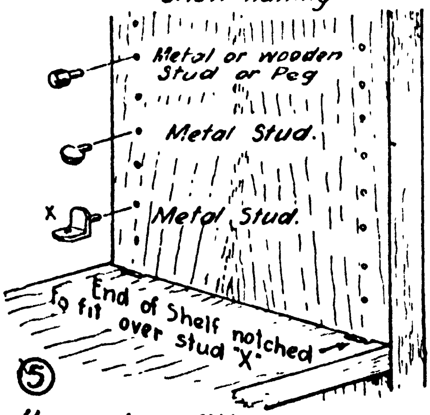


Using cleats - shelf may be loose or fixed by skew nailing



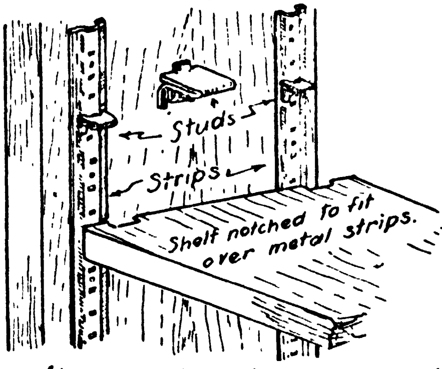
④

Using "saw-tooth" racks (screwed to carcase) and adjustable bearer.



⑤

Using studs fitting into holes in ends for adjustable shelves.



⑥

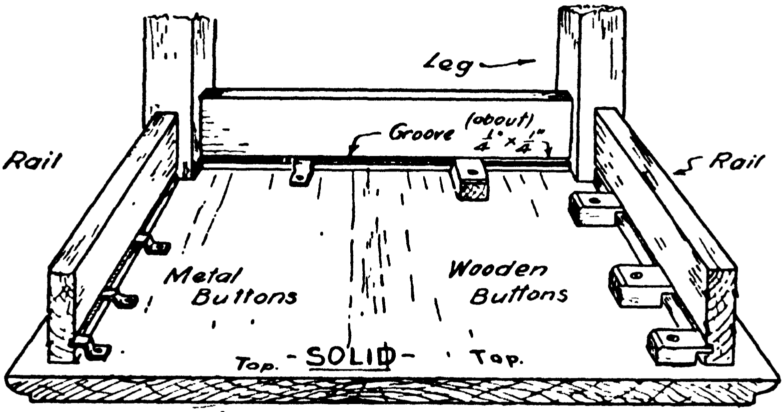
Using metal strips screwed to ends. Suitable studs fit into slots. Shelves may be adjusted to any height.

PLATE 60

—METHODS OF—

- SECURING TABLE TOPS -

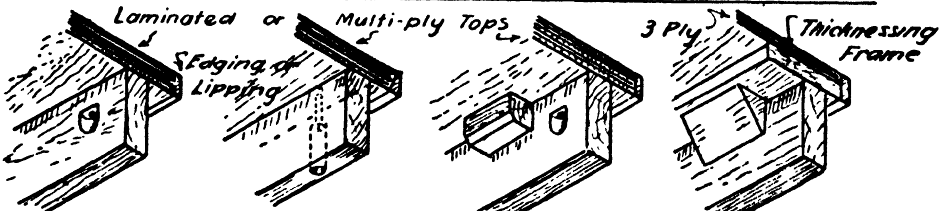
The method used depends upon the construction of the frame of the table and the material used for the top. (Solid or plywood). If solid wood is used, care must be taken to allow for the "working" of the wood, i.e. swelling and shrinkage due to changes in the humidity of the atmosphere.



(Table up-side-down)

Showing rails grooved for use of wooden or metal buttons.

NOTE - If used on writing desks etc. the front edge of of the top may fixed rigidly to the front supporting rail with screws and glue-blocks and buttoned to the side and back rails, thus leaving the back edge free to shrink



Pocket Screwed. | *Screwed through Rail.* | *Screwed with Glue-blocks* | *Glue Block*

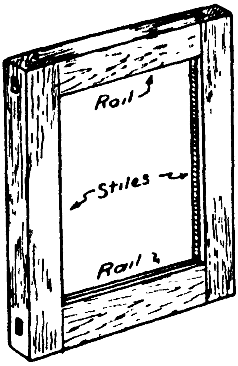
-FOR PLYWOOD TOPS-

PLATE 61

- MAKING A DOOR -

FOR A REBATED IN PANEL

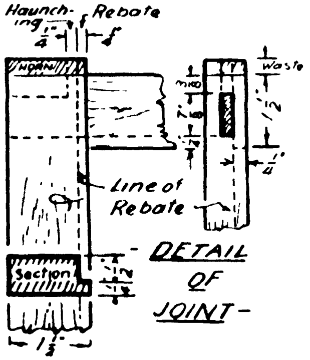
(Joint used, haunched long & short shouldered M&T)



Note. The door frame is made after gluing up the carcase of the cabinet, and made to suit the sizes of the opening.

Cutting List :- (for door 16" high x 12" wide).

2 Stiles $16" \times 1\frac{1}{2}" \times \frac{3}{4}"$
2 Rails $12" \times 1\frac{1}{2}" \times \frac{3}{4}"$
(Allow $\frac{1}{4}"$ waste on each end of Stiles)

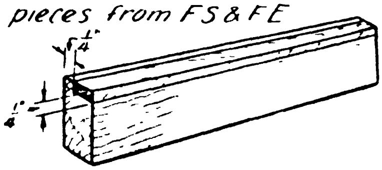


- DETAIL OF JOINT -

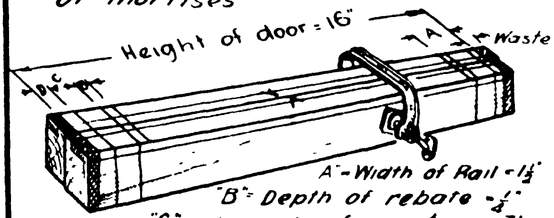
CONSTRUCTION -

① Prepare pieces to required width and thickness - allow about $\frac{1}{2}"$ waste on length of stiles, and $\frac{1}{4}"$ waste on length of rails

②a Gauge position of rebate on all pieces from FS & FE

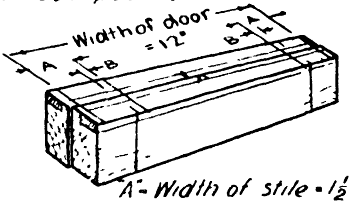


②b Cramp stiles together and set out position of mortises



"A" - Width of Rail - $1\frac{1}{2}"$
"B" - Depth of rebate - $\frac{1}{4}"$
"C" - Length of mortise - $\frac{7}{8}"$
"D" - Length of haunching - $\frac{3}{8}"$
Square mortise lines round to back edge

②c Cramp rails together and set out position of tenons.



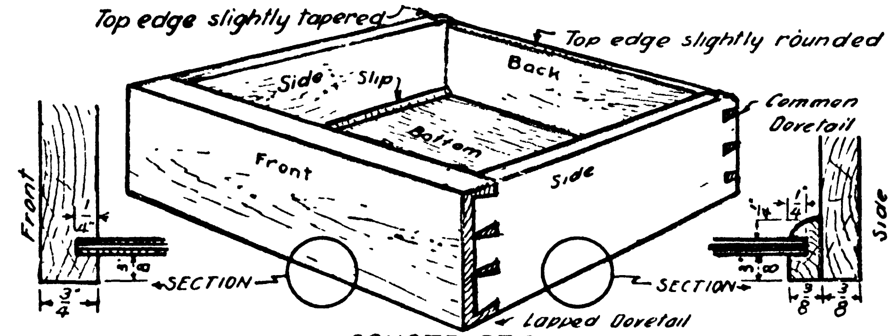
"A" - Width of stile - $1\frac{1}{2}"$, square down face side for short shoulder line
"B" - depth of rebate - $\frac{1}{4}"$ square down reverse side for long shoulder line.

②d Set mortise gauge to $\frac{1}{4}"$ mortise chisel and gauge for mortise and tenon from face side

③ Cut mortise and tenon and plane rebate (For detail of construction of JOINT see Plate 46)

PLATE 62

— DRAWER MAKING —



— CONSTRUCTION —

① PREPARATION:-

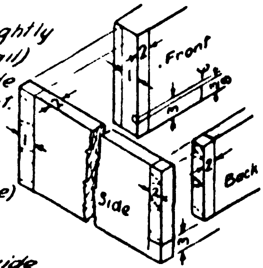
(a) Front Usually of $\frac{7}{8}$ or $\frac{3}{4}$" stuff, planed to fit the opening in the carcase.
(b) Sides· Usually of $\frac{1}{2}$" or $\frac{3}{8}$" stuff, equal in length - $\frac{1}{2}$" shorter than drawer space. and planed to a hand-tight fit along the sides of the drawer space.
(c) Back· same thickness as sides, about $\frac{1}{8}$" shorter than front. As it stands on the bottom its width depends upon the height of the top edge of the groove. Also the back is usually rounded along the top edge for appearance & is about $\frac{1}{8}$" lower than the sides to prevent rubbing against the top.

② SETTING OUT -

(a) Place all pieces in position (Face sides inside & face edges down) & pencil indication marks showing parts to be joined
(b) Set out position of all joints using cutting gauge lightly (see Plate 52 for Lapped Dovetail & Plate 51 Common Dovetail)

Note Its only necessary to set out the dovetails on one side piece, the others being cut from the same setting out.

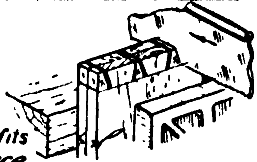
(c) Gauge position of groove on front piece



- Position of Joints -

③ CUTTING JOINTS ETC -

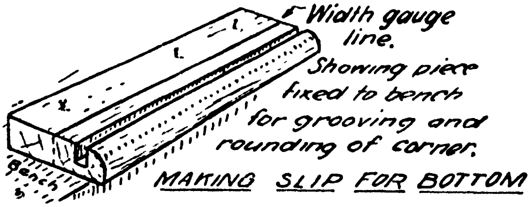
(a) Rip sides of dovetails (sawing both pieces at one time) set out pins from dovetails and chop out waste
(b) Plough groove in drawer front
(c) Plough groove in slips. This is best done on a wide piece and afterwards sawn off to required width
(d) Check out back ends of slips to fit under drawer back.



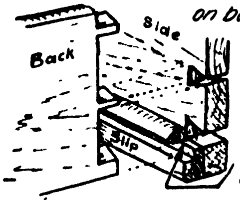
- Ripping Dovetails on both sides at once

④ ASSEMBLING -

(a) Clean up inside faces of all pieces assemble with glue
(b) When dry clean up sides and edges until the drawer fits
(c) Glue and pin slips in position, slide bottom in place, and screw or pin to drawer back



MAKING SLIP FOR BOTTOM -



Showing end of slip cut away to allow for back

VI. WALL PLUGS AND WALL PLUGGING (Plate 64).

It is frequently necessary to secure small cabinets, picture rails, brackets for shelving, etc., to brick, concrete and masonry walls. Nails or screws, if they were able to be driven into such walls, would have little, if any, holding power. It is therefore necessary to plug the walls with either wooden or patented metal plugs.

Wooden Plugs may be either flat, square or round and slightly tapered. Cedar has been found to be a suitable wood for this purpose. Greater holding power is obtained if they are shaped so that there is a slight twist. (See fig. 1, plate 64.)

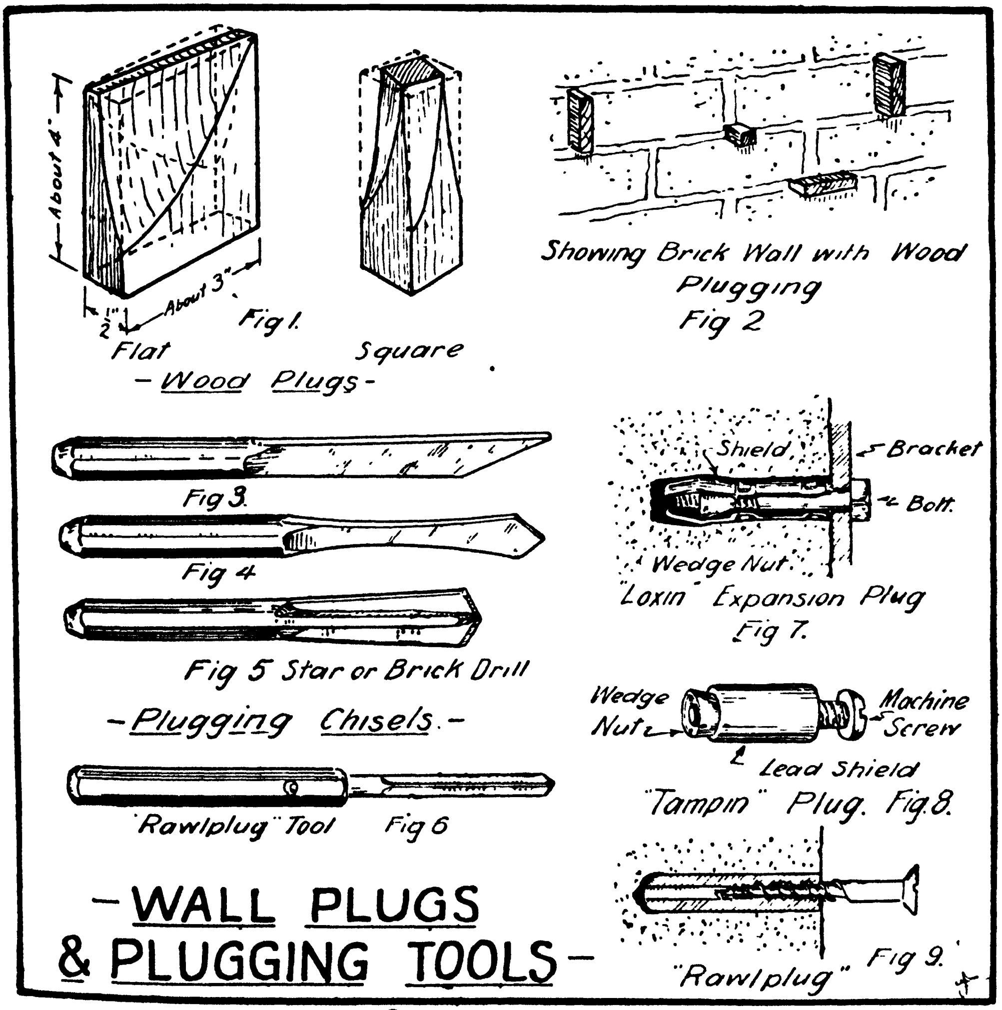


PLATE 64.

Patented Metal Plugs.—There are several types of expansion devices on the market designed to be used in place of wooden plugs. They are especially suited to concrete or masonry walls, or for brick walls where the joints between bricks are not known or cannot be used. (See figs. 7, 8 and 9, plate 64.) They make a much neater job, and there is no need for subsequent repairing of the wall, as is often necessary after raking out the joints in brickwork.

Plugging Chisels.—Figs. 3 and 4 show two types of flat cold chisels used to rake out the mortar in brick joints. Fig. 5 shows a star or brick drill used for drilling holes in solid walls. Fig. 6 shows a type of drill used for drilling plugging holes in solid material. Different size drills as required are held in a special handle.

All chisels are lightly struck with a hammer. Drills should be slightly turned in the hole to keep them free after each stroke of the hammer.

The wooden plugs are driven home and the waste sawn off flush with the wall.

For the metal expansion plugs, the hole drilled should be of the same size as the plug to be used.

QUESTIONS.

1. Show by sketches two methods of securing shelves in cabinets so that they are permanently fixed.
2. What advantage has the permanently fixed shelf over the adjustable method?
3. No. 3 sketch in plate 60 shows a cleat screwed to the solid end of a cupboard. Why is this cleat slot screwed to the end.
4. Describe with sketches two methods of supporting shelves so that they are adjustable.
5. Briefly describe how you would secure a wooden shelf bracket to a brick wall.
6. What tools are necessary for wall plugging? Sketch a wall plugging chisel.
7. Sketch two types of wooden plugs. What timber is suitable for wood plugs?
8. Show by a sketch one kind of metal expansion wall plug.
9. Make a sketch showing how wooden buttons may be used for securing table tops.
10. Why is it best to use buttons for securing solid tops of tables, etc.?
11. Sketch two methods of securing plywood table tops.
12. Make a sketch showing the type of joint suitable for a rebated door frame.
13. Show by a sketch the details of the setting out of the stiles for a rebated door.
14. Show by a sketch the setting out of the tenon shoulder lines on the rails of a rebated door. What is the name of this type of tenon?
15. Make up a cutting list for a single panelled door with a rebated frame to fit an opening of 15″ x 11″, using timber $1\frac{1}{2}$″ x $\frac{3}{4}$″.
16. Name the two joints generally used in drawers.
17. Show by a sketch how the bottom may be held at the sides.
18. Make a sketch showing the setting out of the joints for a drawer.
19. How is the bottom held to the front of the drawer?
20. What tool would you use to produce the grooves in the front and slips? What is the use of these grooves?

SECTION FOUR

TIMBER—SHRINKAGE—SEASONING—CONVERSION—PRESERVATION—FINISHES—ETC.

1. GROWTH, STRUCTURE AND PROPERTIES OF TIMBER (Plates 65 and 65A).

INTRODUCTION.

Timber is solid wood used for constructional purposes, and is the product of a class of trees known as "exogens." Exogenous trees are those which grow by the successive additions of new layers of wood on the outside of the tree trunk and branches, etc.

The wood is made up of countless tube-like cells packed closely together and joined end to end. The cells are of different kinds and have special functions in the growing tree. (See below, Structure of Wood.)

GROWTH.

(a) *Growth in Height* of a tree is confined to specialised cells at the extreme tip of the tree and branches. These cells do not produce wood tissue.

The formation of wood is left to another set of cells a little further back from the growing tip. The outer cells of this group go to form the *Cambium Layer* which actually surrounds the whole tree and manufactures the wood cells and fibres. Once the wood is formed it does not grow in length or height.

(b) *Growth in Girth or Diameter* is brought about by the cambium layer which, by the division of its cells, forms on the outside new bark, and on the inside wood tissue. This outward growth is continuous in the living tree, new bark being formed and new layers of wood being built round the old layers. Neither the bark nor the wood cells grow in height. Fig. 294 shows the sheath-like formation of each year's growth of wood over the last year's growth.

Food for feeding the cambium layer is conveyed in solution up the cells of the sap-wood (immediately beneath the cambium layer) from the roots to the leaves, where it is converted into starch and sugar by the action of the sunlight and air. The converted food material is then brought down through the inner layers of the bark to feed the cambium layer and the growing wood cells of the sap-wood.

THE PARTS OF A TREE, as seen from a cross section (fig. 293).

1. **Pith or Medulla** is the centre or heart of the tree and forms a passage for the sap in the young tree. It is more distinct in some trees than others. In many of the

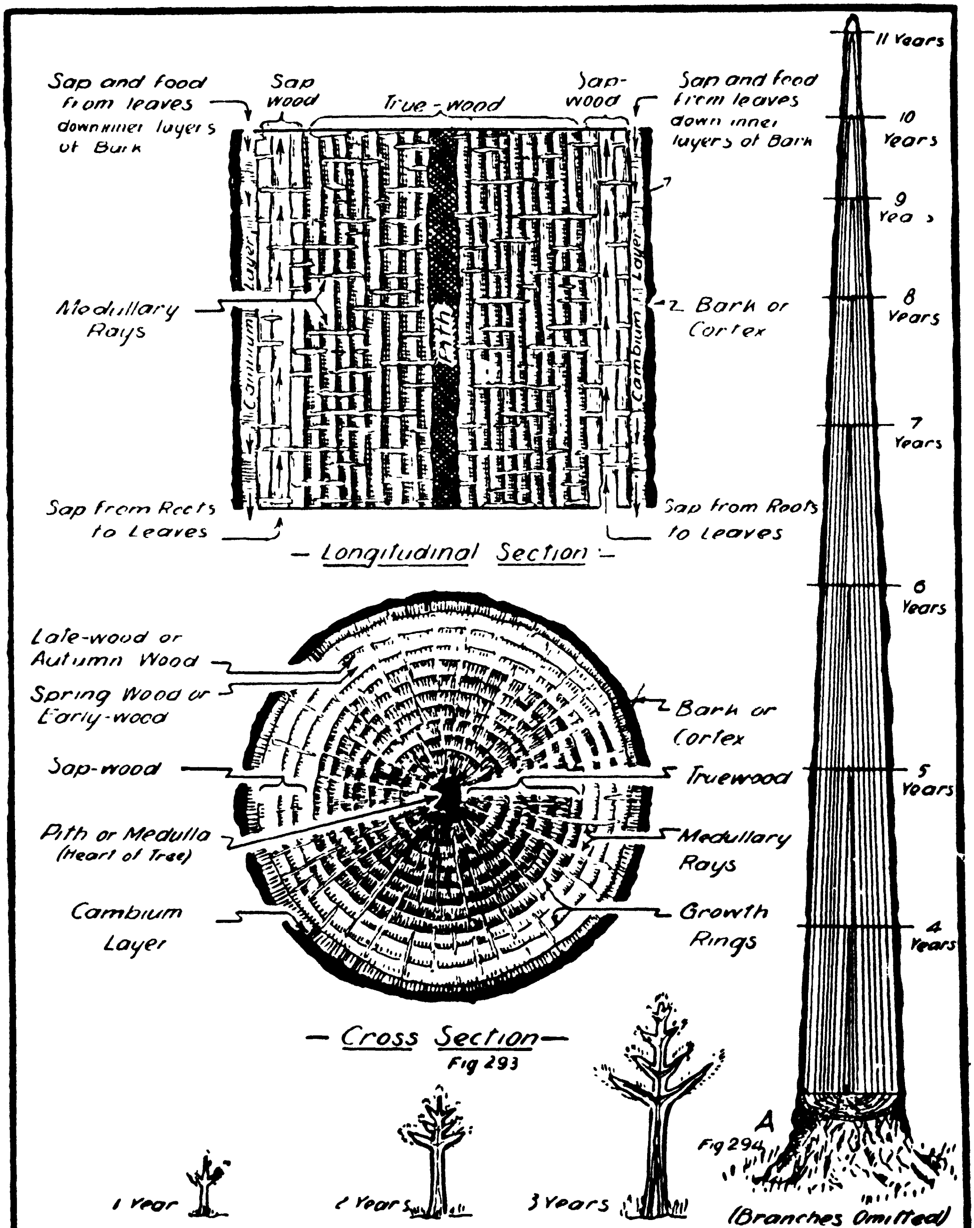


Fig "A" Shows diagramatically the cone or sheath-like formation of each years growth.

—GROWTH & STRUCTURE OF TIMBER—

PLATE 68

Australian trees it hardens and decays, and is useless as timber. It is usually darker in colour than the rest of the tree.

2. **The Truewood or Duramen** (sometimes referred to as the heartwood) is the fully developed wood which surrounds the pith. It is called true wood as it is wood which has reached maturity. Most of the timber for building purposes is taken from this part of the tree. The truewood is often distinctly darker in colour and harder than the sapwood surrounding it. Truewood is dead wood; it has ceased to live and grow, even in the living tree.

3. **The Sapwood or Alburnum**, which surrounds the truewood, is usually softer and lighter in colour. As the tree grows the sapwood will harden and mature into truewood (other sapwood having been formed to take its place and perform the function of conveying the sap from the roots to the leaves). Owing to the sweet foods stored in some of the cells of the sapwood, making it liable to the attacks of insect pests and decay, this part of the tree is not generally used for the better class building construction. Although in recent years great improvements have been made in seasoning and preservation, and it has been found that the sapwood can be used with a greater degree of safety. Trees cut down before reaching maturity have more sapwood.

4. **The Cambium Layer** is a layer of specialised cells immediately beneath the bark. It forms new bark on the outside and new sapwood on the inside over the last year's growth, and is fed by the food brought down from the leaves through the inner layers of the bark. It cannot be seen without the aid of a microscope.

5. **The Bark or Cortex** is the layer of fibrous material on the extreme outside of the tree, and forms a protecting covering for the delicate cambium layer from fires, frosts, insects, etc. The inner layers of the bark convey the food solutions from the leaves to the cambium layer.

6. **Medullary Rays.** These are rows or bundles of cells running radially from the cambium layer to the pith or intermediate growth rings. They serve to store the sap food and convey it to the inner growing parts of the tree. They also tend to bind the growth rings together. Medullary rays can be seen clearly in such timbers as Oaks.

7. **The Growth Rings** (or annual rings) are the layers of wood usually formed one each year, and may be seen in most woods in both the truewood and sapwood. They can be seen clearly in oregon, redwood, and alpine ash.

A growth ring is formed of two parts:—

(a) *The Spring Wood* (early wood) is the layer or growth formed during the spring and summer seasons, when the growth is rapid. Larger thin walled cells are produced. It is usually softer, porous, light in weight and colour.

(b) *The Autumn Wood* (late wood) is the layer formed during the autumn and winter, when the growth is slow, and the cells are small and thick walled. It is harder and darker in colour in most woods.

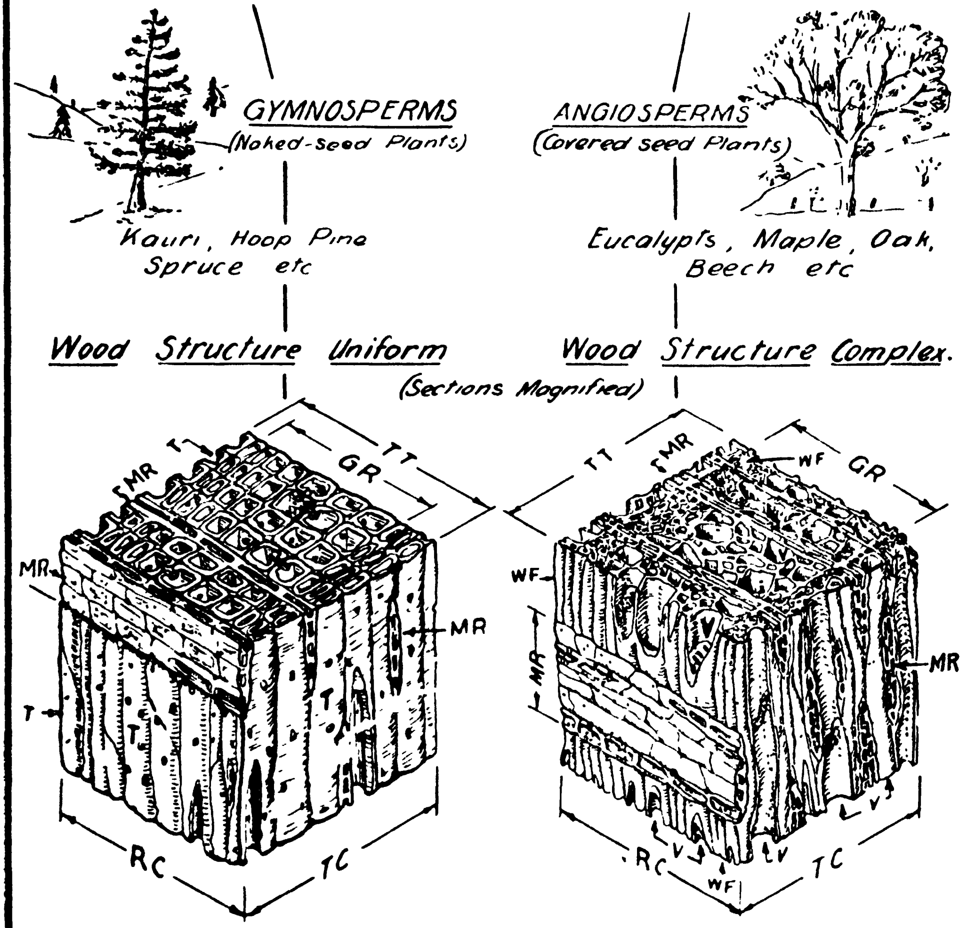
The growth rings vary in shape, density, colour and distinctness according to the climatic conditions, type of soil, place of growth and type of tree.

THE STRUCTURE OF WOOD (plate 65A).

As mentioned in the introduction, wood is made up of numerous cells. Timber is divided into two groups, depending on the type of cells present in the wood.

1. **Porous Timbers**:—Timbers containing vessels (sometimes called hardwoods).

DIFFERENCE IN WOOD STRUCTURE OF SOFTWOODS (NON-PORED) & HARDWOODS (PORED)



TT, Transverse Surface (Cut across the grain). RC, Radial or Quarter Sawn Surface. TC, Tangential or Back Sawn Surface. GR, One Growth Ring. MR, Medullary Rays - cells - chiefly for food storage. T, Tracheids - elongated, closed cells - for conducting water and for strength. V, Vessels or Pores - large, long, open cells - for conducting water. WF, Fibres - long, pointed cells - for strength.

PLATE 65A

This group of timbers contains in the main two kinds of cells: (a) "Vessels" or pores, large thin walled cells, which convey the sap solutions from the roots to the leaves in the living tree. The vessels are surrounded by (b) "Wood Fibres," small thick walled cells, which serve to strengthen and support the tree.

2. **Non-Porous Timbers**:—Without vessels (referred to as softwoods). This group of timbers is characterised mainly by one type of cell called "tracheids," which perform the dual function of conveying the sap to the leaves and supporting the tree.

NOTE: The terms "hardwood" and "softwood" mentioned above are misleading, as many timbers which possess vessels (porous woods) are softer than timbers without vessels (non-porous woods), while some of the non-porous timbers are quite hard. The vessels, fibres and tracheids have the length of their cells running in the direction of the axis of the tree. Medullary rays are present in both groups of timbers.

The following columns set out the characteristics of hardwoods and softwoods. (See also plate 65A.):—

WOOD STRUCTURE.

SOFTWOODS—Non-pored Woods.

1. *One* type of *cell*—the "tracheids" —performs two functions: conduction of sap and supporting the tree. These cells are small and regularly arranged so that no variation in texture is visible (except for variations due to growth rings).

2. Medullary rays are narrow and indistinct to the naked eye on cross and back-cut surfaces. (Back-cut is the tangential cut. See Conversion of Timber.)

HARDWOODS—Pored Woods.

1. *Two* types of *cells*. (a) "Vessels" arranged to form long tubes or pipes running up the tree and convey the sap. (b) "Fibres"—thick walled—packed round the vessels and support the tree. The vessels are seen as rounded holes or pores on a clean cross cut surface.

2. The Medullary rays vary from narrow to very broad, and may be indistinct to very conspicuous to the naked eye on cross and back-cut surfaces (show up very clearly in Oaks giving "silver grain" figure on quarter cut surface).

BOTANICAL.

1. Belong to the Botanical group Gymnosperms—(naked seeds).

2. Leaves typically spiky and needle-like (some exceptions, e.g., kauri pine, hoop pine, and bunya pine).

3. Branches frequently arise in whorls, i.e., more than two at the same level.

1. Belong to the Botanical group Angiosperms (enclosed seeds).

2. Leaves typically broad and flat, not needle-like (exceptions: swamp oak, black she-oak).

3. Branches usually grow out at different levels, at the most only two at the same level.

PROPERTIES OF TIMBERS.

The arrangement and the types of cells, together with the presence of varying quantities of chemical substances, such as starch, sugars, gums, resins, essential oils, tannins, colouring matter, etc., give the different kinds of timbers their special properties or characteristics. E.g.:—

(a) *Durability* depends largely upon the nature of the chemicals present in the cells and cell walls which are destructive to fungus growth and insect attack.

(b) *Strength* depends upon the types of cells and cell structure.

(c) *Weight* depends upon the cell structure, size of the cells, and the amount of chemical substances present in the cell cavities.

(d) *Hardness* of the wood depends upon the size of the cells and the thickness of the cell walls. Usually hard woods have small thick walled cells closely packed together, and may be filled with resinous material.

(e) *Light Soft Woods* usually have thin walled cells.

(f) *Figure* is a term usually applied to timbers which possess unusual or attractive designs in texture, grain and colour.

The figure may be due to—

(i) The natural arrangement of the wood elements (cells, etc.) and the method of conversion which may give growth ring figure or medullary ray figure;
(ii) grain variations and irregularities, such as wavy grain, and ribbon grain;
(iii) irregularities in the tree, such as knots, burls, bird's eyes and crotches.

NOTE: The texture and grain of the wood depends upon the size and direction of the various cells (or wood elements).

1. **Texture** refers to the size and quality of the cells; e.g., fine, medium, coarse, uniform, uneven, etc.

2. **Grain** refers to the direction of the cells; e.g., straight, sloping, diagonal, interlocked and wavy grain. (See Defects in Timber, plate 70.)

USES OF WOOD.

Besides supplying solid material for constructional purposes, wood forms the synthetic base for rayon, sugar, synthetic rubber, acids, alcohols, dyes, paper, lacquer, paints, glues, films, charcoal, toothpaste, baking powder, explosives, medicines, yeast, cellophane, artificial horse hair, gramophone records, etc.

QUESTIONS.

1. In a few words explain the composition of wood.
2. Briefly explain how a tree increases in girth.
3. Make a half-page sketch of the cross section of a tree trunk and name its parts.
4. Explain the difference between the sapwood and truewood.
5. Where is the cambium layer? What is its purpose in the growing tree?
6. Why are some timbers more durable than others?
7. What is the difference between "grain" and "texture?"
8. What do you understand by the term "figure?" What factors help to produce figured timber?
9. Briefly explain the difference between pored woods and non-pored woods.
10. Why are some woods harder than others?

II. SHRINKAGE OF TIMBER (Plate 66).

Shrinkage takes place during the process of drying or seasoning of the timber. All timber will shrink, regardless of the type or the method by which it is seasoned. Some timbers shrink more than others.

There are two stages in the drying of green timber. Firstly, the removal of the "free water" from the cell cavities, and, secondly, the drying of the "combined moisture" from the cell walls. It is during this second stage that the wood shrinks; no shrinkage occurs during the removal of the free water.

When the moisture is drawn from the cell walls, the cell walls themselves become smaller, consequently the board becomes smaller, just as a piece of bread or orange peel will shrink when dried in an oven.

The cells do not shrink to any extent in their length, hence there is very little shrinkage in the length of a board when it is dried. Similarly the medullary rays do not shrink very much in their length, and as they run across the timber (i.e., in a quarter sawn board) they tend to prevent the layers of growth rings from shrinking towards the centre or pith. Most shrinkage, therefore, takes place in the direction of the growth rings, at right angles to the medullary rays. This is called tangential shrinkage. (See figs. 295, 296 and 298.) Tangential shrinkage is about double radial shrinkage and about one hundred times as great as longitudinal shrinkage.

The sapwood, containing more moisture, will shrink more than the truewood.

EFFECTS OF SHRINKAGE.

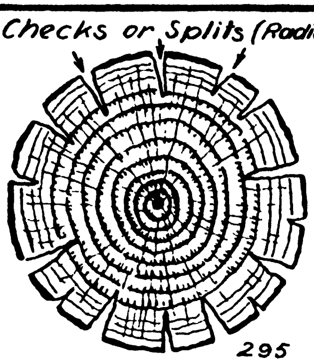
Owing to the fact that the outer surfaces of a log are in contact with the air they dry more quickly, and therefore shrink before the inner layers of wood. This causes stresses to set up round the outer layers which will cause splitting or surface checks. It is therefore advisable to "break down" the log into commercial sizes as soon as possible after felling. (See fig. 295.)

Fig. 297 shows how boards "cup" or curve away from the centre or heart due to the length of the growth rings being greater near the edges of the boards, and therefore greater shrinkage. This defect can be overcome by placing weights on the stacks during seasoning. Similarly fig. 298 shows the change in shape of square and round, tangential cut and radial cut boards after shrinkage.

NOTE that the shrinkage is mostly in the direction of the growth rings, i.e., tangentially.

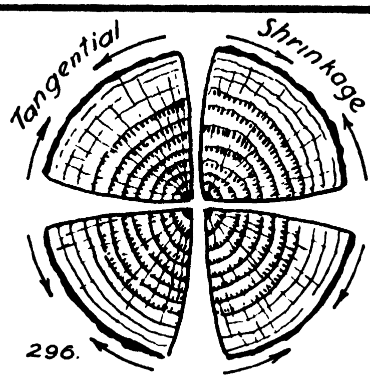
QUESTIONS.

1. Why does timber shrink?
2. In what direction does most shrinkage take place? Illustrate your answer.
3. Why should the logs of wood be sawn up as soon as possible after the tree has been felled?
4. Why is there less shrinkage in the direction of the medullary rays?
5. Why do boards cut tangentially to the growth rings cup away from the heart?



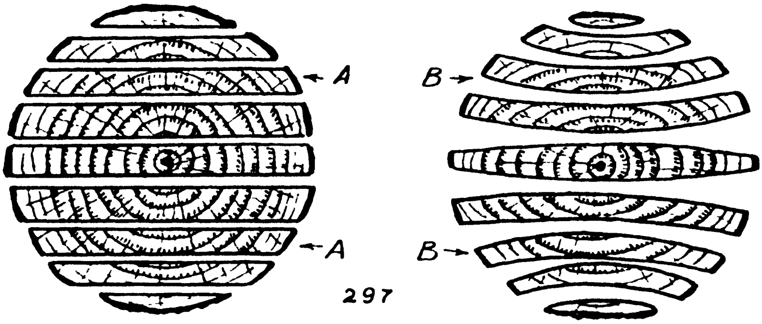
295

Effect of Shrinkage on a log.



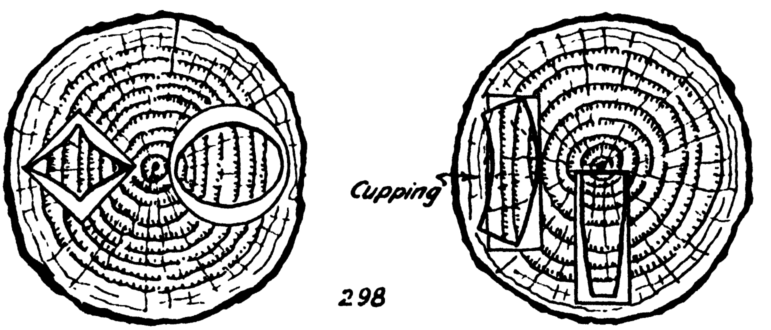
296.

Direction of Shrinkage.



297

Showing at "B" how boards at "A" "CUP" away from heart due to Tangential Shrinkage.



298

Showing effects of Shrinkage on shaped pieces.

Figs 295 – 298

— EFFECTS OF SHRINKAGE —

PLATE 00.

III. SEASONING OF TIMBER (Plate 67).

DEFINITION.

Seasoning is simply the drying out of the sap or moisture in the cell cavities and cell walls of the wood. The purpose being to reduce the moisture content of the wood equal to the moisture content of the atmosphere where the timber is to be used. Thus shrinkage is reduced to a minimum. Seasoning also helps to prevent decay, warping and splitting.

The moisture of the timber can be removed by natural (Air Seasoning) or artificial (Kiln Seasoning) means. The sap is first dried out of the cell cavities, then, on continued drying, out of the cell walls. It is during the process of drawing the sap out of the walls that shrinkage takes place. If a log is not seasoned "V" shaped splits or checks appear around the circumference, owing to the fact that the outer surface, being in immediate contact with the air, dries more quickly than the inner wood. To prevent this splitting the log should be cut up or converted as soon as possible after felling, and stacked for seasoning.

METHODS OF SEASONING.

1. **Natural Method**—Air Seasoning—Fig. 299. The timber is stacked in the open air, where it is dried by the prevailing weather conditions. Timber that is air dried is most suitable for outdoor use. The stack is laid on bearers to keep it clear of the ground, and strips of wood, called "stickers," usually about 1½" wide and ½" thick, are placed between the layers of boards to allow the air to circulate. The "stickers" should be carefully placed immediately above each other so that the boards remain straight. A waterproof covering should be placed over the stack to protect it from the sun and weather.

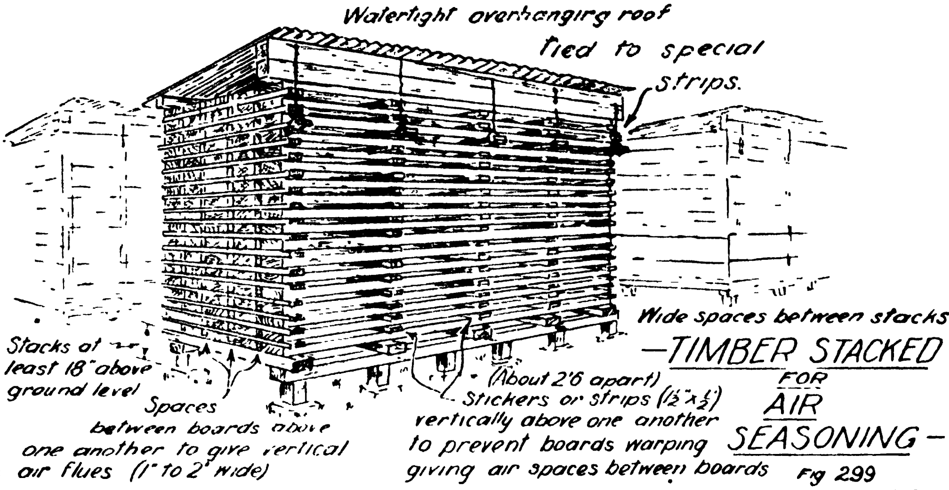
2. **Artificial Method**—Kiln Seasoning.—The timber is stacked on special trucks and placed in ovens called "kilns," where heat and humidity can be carefully controlled. Care must be taken to see that the drying process in the early stages is not too rapid when drawing the "free water" from the cell cavities, or the outer surfaces of the timber will harden and prevent the inner wood from seasoning. This may cause severe shrinkage and distortion, due to "collapse" of the soft inner fibres and cells.

TYPES OF TIMBER SEASONING KILNS.

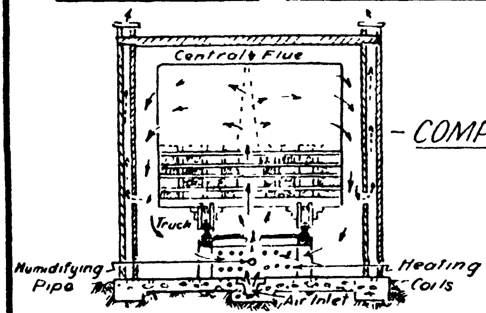
There are two kinds of kilns: (a) COMPARTMENT KILNS and (b) PROGRESSIVE KILNS.

(a) *Compartment Kilns*—Figs. 300 and 301. The heat and humidity are carefully controlled from cool, moist air (when charged with green stock) to hot, fairly dry air (when the stock is ready for use and thoroughly seasoned). The conditions at any one time are the same throughout the kiln. Heat is supplied by heating coils and the moisture content by steam inlets. The air may be allowed to circulate naturally (fig. 300), or it may be forced to circulate by means of a fan (fig. 301).

(b) *Progressive Kilns*—Fig. 302. In this type of kiln (sometimes called "tunnel" kilns, because they resemble long tunnels) the conditions at one end of the kiln differ from the conditions at the other end. Green stock (placed on trucks) enters at the

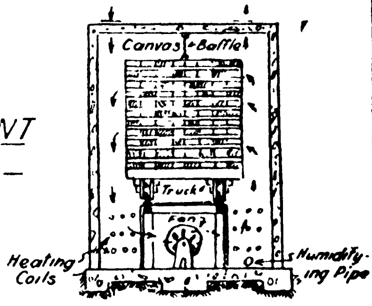


—TIMBER STACKED FOR AIR SEASONING— Fig 299

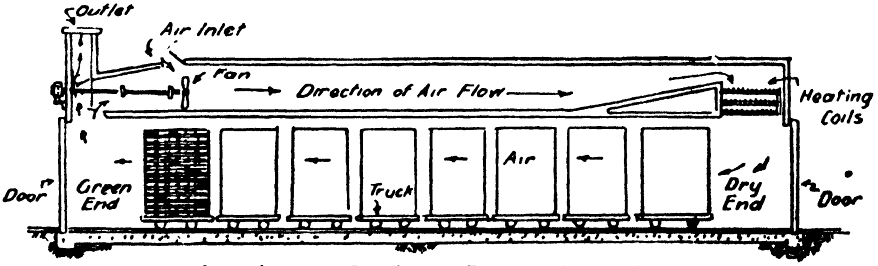


Natural Circulation Fig 300
(End Section)

—COMPARTMENT KILNS—



Forced Circulation
(End Section) Fig 301



Longitudinal Section – Forced Circulation.

—PROGRESSIVE KILN— Fig 302

—TWO METHODS OF ARTIFICIAL SEASONING—
Figs 299–302

—SEASONING OF TIMBER—

PLATE 67

cool moist end of the tunnel and is gradually dried as it slowly passes along the kiln, until it emerges at the hot dry end ready for use.

The air must be in constant circulation throughout the kiln so that it does not become stagnant and laden with moisture from the timber. The circulation is usually assisted by fans.

The final moisture content of the timber can be regulated so that the timber can be used either in moist conditions or dry indoor conditions.

3. **Combined Air and Kiln Seasoning.** This type of seasoning is, as its name suggests, a combination of natural and artificial seasoning.

1. The timber is first dried by air for about 3 months until the "free water" in the cell cavities has been dried out.
2. The timber is then kiln dried to remove the "combined moisture" from the cell walls, which can be done rapidly, and may only take about one week, and for some timbers down to 24 hours, depending on the thickness.

ADVANTAGES OF COMBINED SEASONING.—As mentioned above, it is during the early stages of drying that care must be taken not to dry the timber too rapidly, as distortion and "checking" (Splitting) will ruin the timber. It has been found difficult to control the conditions of kilns during this early drying, and slow natural seasoning does away with the difficult first stage of kiln drying.

PRECAUTIONS TAKEN DURING SEASONING.

As the ends dry more quickly than the rest of the board and are likely to split, they are sometimes painted or covered with a thin strip of wood to retard the drying process.

The air must be in constant circulation throughout the stack or kiln, otherwise some boards may not be thoroughly seasoned or only parts of boards seasoned, and when put into use will continue to shrink, and may warp and twist, due to uneven seasoning.

Charges for kilns should be made up of boards of the same timber and same width and thickness.

TIME TAKEN FOR SEASONING.

(a) *Air Seasoning* depends upon several factors, such as type of timber, size of boards, time of the year, site on which the stack is built, and the method of stacking. Roughly it takes about twelve months for every inch the timber is in thickness.

(b) *Kiln Seasoning* depends upon the same factors as air drying, also the type of kiln used, and the way the kiln is operated. 1″ thick boards about 5 to 30 days. Generally back sawn timber will dry more rapidly than quarter sawn timber of the same species, but more care has to be taken to prevent the backsawn boards from distortion, splitting or collapse.

DRYING OF VENEERS

Several methods of drying ... eers after they have been cut have been adopted. One of the oldest methods is to ... k them on edge between vertical supports and allow them to air dry, or they m ... stacked on trucks and dried in a progressive kiln. Another method is to pass t ... neers through a series of steam-heated rollers. Another type of dryer consists of a ... s of horizontal hollow plates heated by steam.

The veneer is passed between pairs of these plates, which are made to separate and close from about 20 to 700 times per hour. When closed they heat the veneer and keep it flat, and when open they allow the moisture to escape and let the veneer shrink.

QUESTIONS.

1. What is seasoning or drying of timber?
2. Why is seasoning necessary?
3. Describe briefly what is meant by natural seasoning.
4. What is artificial seasoning?
5. Describe one type of kiln used in seasoning.
6. What are the advantages of combined air and kiln seasoning?
7. How might the ends of the board be prevented from drying out too quickly?
8. Why must the air be in constant circulation throughout the stack?
9. Why does air seasoning take longer than kiln seasoning?
10. Briefly describe how veneers or plywoods are dried.

IV. CONVERSION OF TIMBER (Plate 68).

The conversion of timber is the cutting up of the logs into the marketable or commercial sizes most suitable for use by carpenters, joiners, and cabinet makers, etc.

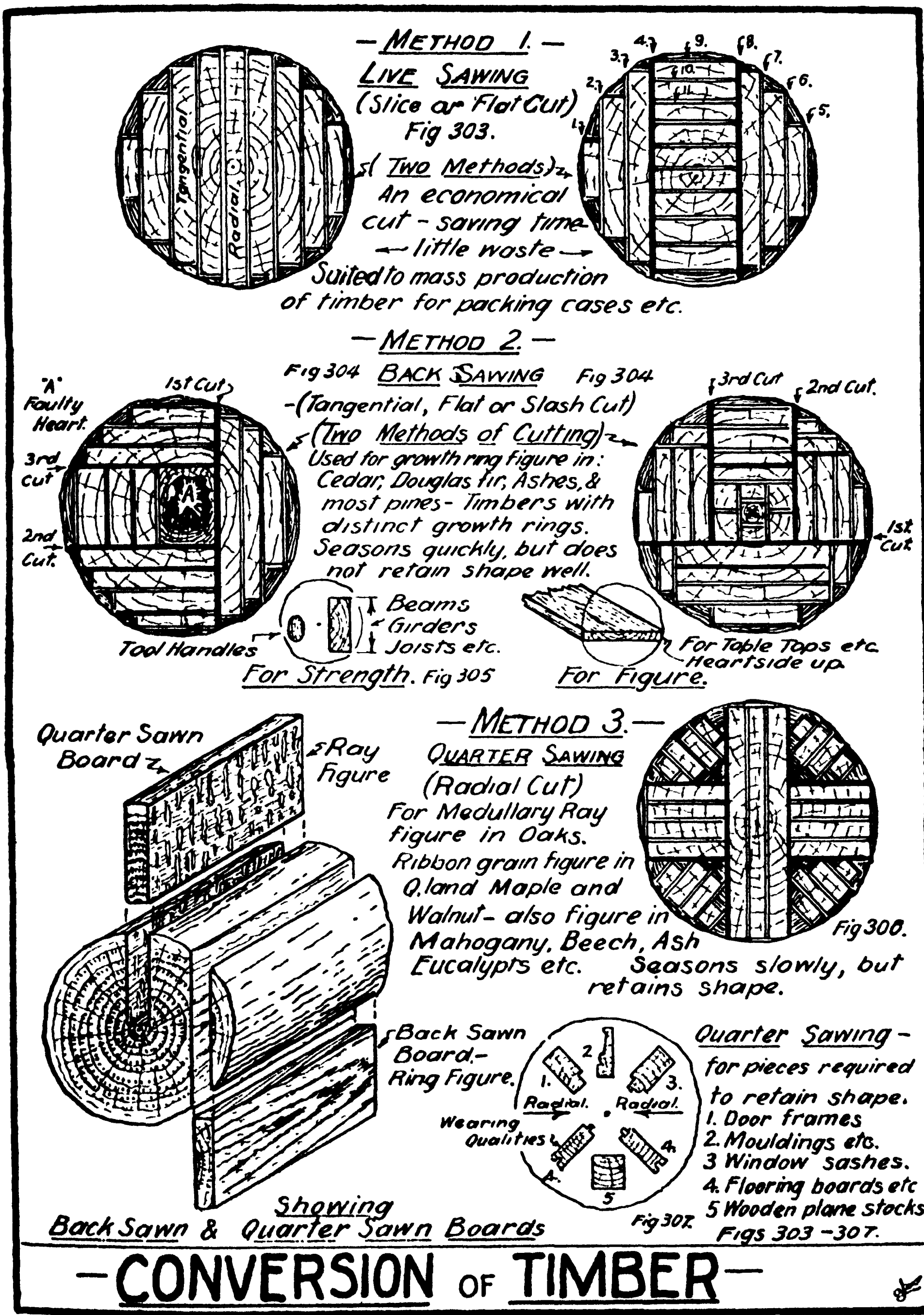
METHODS OF CONVERTING LOGS.

1. **Live Sawing** (or Flat or Slice Cut)—Fig. 303. Is the simplest and most economical method of cutting up the log into boards by a series of parallel saw cuts. There is little waste of timber and time as the log need not be turned to new positions for sawing, but its chief fault lies in the fact that most of the boards "warp." Used for timber required for cheap constructional work, such as packing cases, fence palings and pickets, etc.

2. **Back Sawing** (or Tangential Cut or Slash Cut)—Fig. 304. Is a method by which the log is cut so that the widths of the boards are tangential to the growth rings The log has to be turned frequently to new positions for sawing to produce the tangential cut; this also allows for sawing around faulty parts of the log. There is little waste of timber. Back sawn boards usually season more rapidly than other cuts. Timbers such as Red Cedar, King William Pine, Alpine Ash, Douglas Fir, which possess distinct growth rings, are usually back sawn, as the best figure is obtained for panels, desk and table tops, etc. As there is more strength in the direction of the growth rings, back sawn timber is used for floor and ceiling joists, bearers, hammer and axe handles, etc. (See fig. 305.) Back sawn boards shrink mostly in width and are likely to warp.

3. **Quarter Sawing** (or Radial Cut)—Fig. 306. Here the boards are cut with their width in the direction of the medullary rays. Quarter sawn boards from timbers which have distinct medullary rays, such as Oaks, or interlocked grain, such as Maple, show decorative figure which increases the .lue of the timber for cabinet work. It is important to have the faces of the b .s as nearly as possible parallel to the medullary rays; fully quarter sawn boa ve their faces within 10° of the rays.

If the timber is required for flooring, decki c., i.e., for good wearing surfaces,



— METHOD 1. —
LIVE SAWING
(Slice or Flat Cut)
Fig 303.
Tangential
Radial
(Two Methods)
An economical
cut - saving time
little waste
Suited to mass production
of timber for packing cases etc.
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11.
— METHOD 2. —
Fig 304 BACK SAWING Fig 304
-(Tangential, Flat or Slash Cut)
(Two Methods of Cutting)
Used for growth ring figure in:
Cedar, Douglas fir, Ashes, &
most pines - Timbers with
distinct growth rings.
Seasons quickly, but does
not retain shape well.
"A" Faulty Heart.
1st Cut
3rd Cut
2nd Cut.
A
3rd Cut
2nd Cut.
1st Cut
Beams
Girders
Joists etc.
Tool Handles
For Strength. Fig 305
For Table Tops etc.
Heartside up.
For Figure.
— METHOD 3. —
QUARTER SAWING
(Radial Cut)
For Medullary Ray
figure in Oaks.
Ribbon grain figure in
Q.land Maple and
Walnut - also figure in
Mahogany, Beech, Ash
Eucalypts etc. Seasons slowly, but
retains shape.
Fig 306.
Quarter Sawn Board
Ray figure
Back Sawn Board.-
Ring Figure.
1. 2 3.
Radial. Radial.
Wearing Qualities
4. 5
Quarter Sawing -
for pieces required
to retain shape.
1. Door frames
2. Mouldings etc.
3 Window sashes.
4. Flooring boards etc
5 Wooden plane stocks
Figs 303 - 307.
Fig 307.
Showing
Back Sawn & Quarter Sawn Boards
— CONVERSION OF TIMBER —

PLATE 68.

it is usually quarter sawn, as this produces an "edge grain" (edges of the growth rings) which wears evenly. (Fig. 307.)

Quarter sawn boards are most suitable for mouldings, architraves, sash and door frames, etc., as they retain their shape better than other cuts and there is less shrinkage in width. (NOTE: The stocks of wooden planes are quarter sawn so that they will retain their shape and wear evenly.) (Fig. 307.)

Boards that are quarter sawn do not "cup" or "check" to any extent while seasoning, although the drying process is slower than for back sawn boards.

This method of conversion has one great disadvantage—the cost of cutting is higher owing to the fact that there is more handling of the log in turning it into new positions for sawing, thus taking more time. There is also more waste for fully quarter sawn stuff.

QUESTIONS.

1. What is conversion?
2. Name three methods of converting logs into boards, etc.
3. What methods of conversion would be best for timber required for the following:—(a) packing cases; (b) to show growth ring figure; (c) to show ray figure; (d) to season quickly ?
4. Draw the cross section of a log and show in it how pieces are cut for (a) strength; (b) wearing qualities; (c) to retain shape; (d) least shrinkage in width; (e) "edge grain" on the wide surface of the board.
5. Show by sketches the end grain of (a) a "quarter" sawn board; (b) a "back" sawn board.

V. TRADE SIZES AND MARKETING TIMBER (Plate 69).

CLASSIFICATION OF SIZES—Figs. 308 to 313.

Trade Names:—

Log	A trunk with the branches cut off.
Baulk or Flitch	Pieces over 4″ thick and 6″ or over wide.
Plank	Pieces 1½″ to 4″ thick and over 6″ wide.
Scantling	Pieces 1½″ to 4″ thick and up to 6″ wide.
Boards	Pieces ⅜″ to 1½″ thick and 3″ and over wide.
Battens	Pieces ¾″ to 1½″ thick and from 1″ to 3″ wide.
Strips or Laths	Pieces under ¾″ thick and up to 3″ wide.

MANUFACTURING TERMS.

1. **Rough Timber** is timber straight from the saw.

2. **Dressed Timber** is machine planed timber; may be (D1S) dressed one side; (DD) or (D2S) double dressed or dressed two sides; (D2E) dressed two edges; (D1S1E) dressed one side and one edge, etc. NOTE: Dressed timber is always less than the stated size, unless specially ordered dressed to full sizes; e.g., if a board is ordered ¾″ (D2S), it will possibly be about ⅛″ less than ¾″ unless ordered ¾″ full. The price is based on the sawn size, extra being charged for planing or milling.

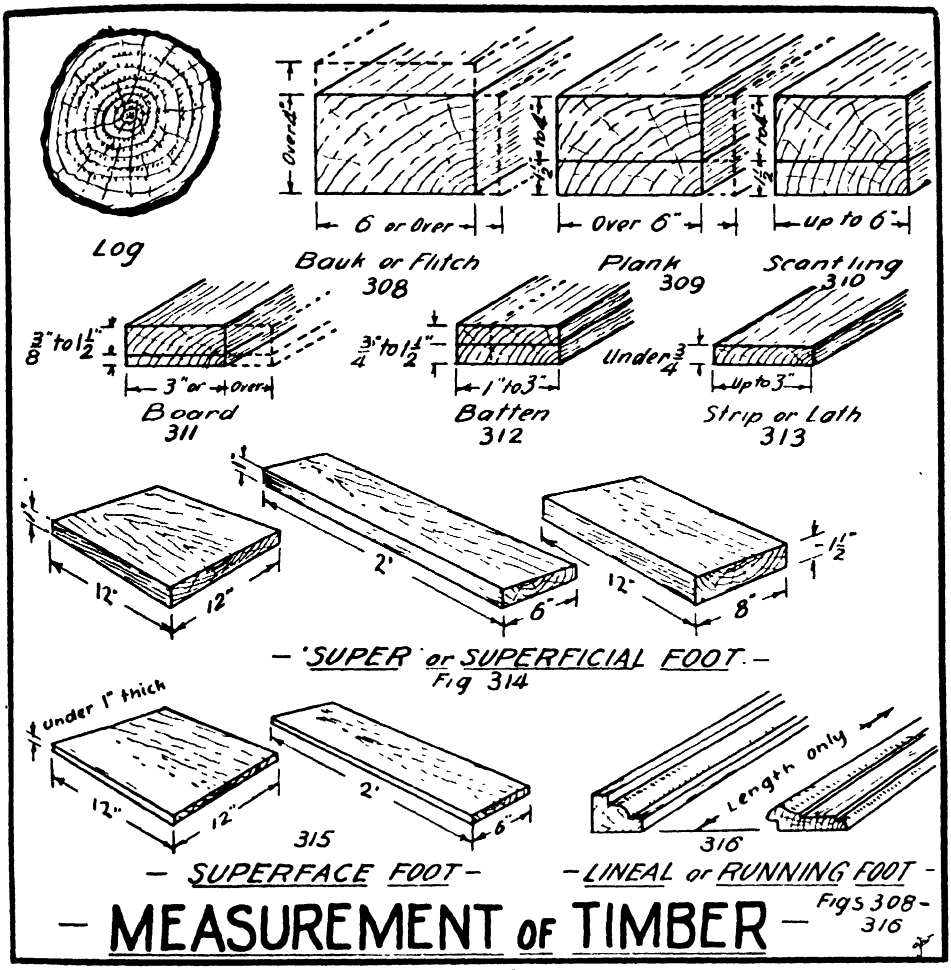


PLATE 69

3. **Milled Timber** is timber that has been run through a machine and moulded or shaped, tongued and grooved, or rebated, etc.

QUALITY.

1. **No. 1 Clears.**—Specially selected and free from any defects, suc knots and gum veins.

2. **No. 2 Clears.**—Straight grained, almost entirely free from mi efects.

3. **Selected Merchantable.**—A better grade of timber than merch le, straight grained, suitable for dressing.

4. **Merchantable.**—Timber unsuitable for dressing or milling.

NOTE: The above are not standard qualities for all timbers, b uld be understood by timber merchants.

HOW SOLD.

Timber is usually sold by (i) superficial foot, or superfoot; (ii) superface foot (not very common for solid timber); (iii) lineal foot or running foot.

The Superficial Foot—Fig. 314. Usually applied to timber 1″ thick and over. A board 1 foot long, 1 foot wide and 1 inch thick (144 cubic inches) = 1 super foot, i.e., 1/12th of a cubic foot. Price is usually quoted per 100 superfeet. The general rule to calculate the number of superfeet in a piece of timber is to multiply length in feet by width in feet by thickness in inches.

E.g., Find the number of superfeet in a plank 8′ x 4″ x 1½″.

I.e., 8′ x 1/3′ x 3/2″ = 8 x 1/3 x 3/2 = 4 superfeet.

The Superface Foot—Fig. 315. Is usually applied to timber less than 1″ thick. i.e., thin timber such as panels, etc., the measurements of the face surface only being taken. A superface foot is 144 square inches, one square foot. Multiply length in feet by width in feet disregarding thickness.

Example:—12′ x 8″ x ½″ = 12 x 2/3 = 8′ of ½″ superface.

Plywoods and veneers are sold by superface foot, i.e., square foot.

The Lineal Foot—Fig. 316. Is applied to milled timber such as mouldings, weatherboards, and flooring boards, etc. Only the length of the timber being taken into account and quoted per 100 lineal or running feet.

ORDERING.—When ordering, state the kind and quality of timber and sizes: if required:—

Example:—If a number of pieces of similar section are required, say, for a bookcase made of selected Silky Oak with three shelves 3′ x 8″ x ¾″ and two sides 2′ x 8″ x ¾″, order:—Quarter cut Silky Oak (D4S) Full, 8″ x ¾″—3/3, 2/2.

NOTE: Extra is charged for dressing, and you will possibly be charged for 1″ thick stuff to be dressed to full ¾″.

QUESTIONS.

1. What do you understand by the terms: (a) Log; (b) board; (c) plank; (d) batten; (e) strip?
2. Explain D2S1E.
3. What is the difference between rough timber and milled timber?
4. What quality timber would be best for high-class cabinet work?
5. ... is timber sold?
6. ... is a superficial foot?
7. Ho... ould you determine the number of superfeet in a board?
8. How ... illed timber, such as flooring boards and mouldings, sold?
9. How ... superfeet are there in a board 1½″ thick, 8″ wide, 8′ long?
10. Calcula... cost of the material listed below:—

    4/2′ ... ½″ x 1½″.
    4/1′... ...″ x 1″. The timber is 75/- per 100 superfeet.
    2/2′— ... x 1″.

VI. DEFECTS IN TIMBER (Plate 70).

DEFINITION.—A defect is any irregularity occurring in or on the timber that may lower its strength, durability or utility value.

CAUSES.—Lightning, strong winds, fires, diseases, parasites (insects, fungi, etc.), carelessness while felling and seasoning.

COMMON DEFECTS.

1. **Burls** are abnormal growths on the side of the tree caused by some injury or irritation to the trunk.

2. **Case Hardening** is a condition in which the outer layers of timber are abnormally hard, caused by careless seasoning when the outer layers are dried too quickly.

3. **Check** is a separation of the wood extending for a few inches along the grain and formed while drying.

End Check.—When the check or split occurs on the end of the piece of timber.

Internal Check.—Occurring in the interior of the piece.

Surface Check.—Occurring on the surface of the piece.

Through Check.—One which extends through the piece from one surface to the other.

4. **Collapse.**—A flattening of the cells caused by excessive or uneven drying.

5. **Decay.**—A partial disintegration of the wood due to the action of wood destroying fungi (a low form of plant life), which live on the wood, using it as food. Decay is commonly known as "wet rot" and "dry rot."

"Wet rot," caused by fungi which requires a large amount of water to enable it to live. Generally seen in living trees and old dead logs. It can be prevented by keeping the wood dry or treating the timber with killing poisons, such as creosote oil.

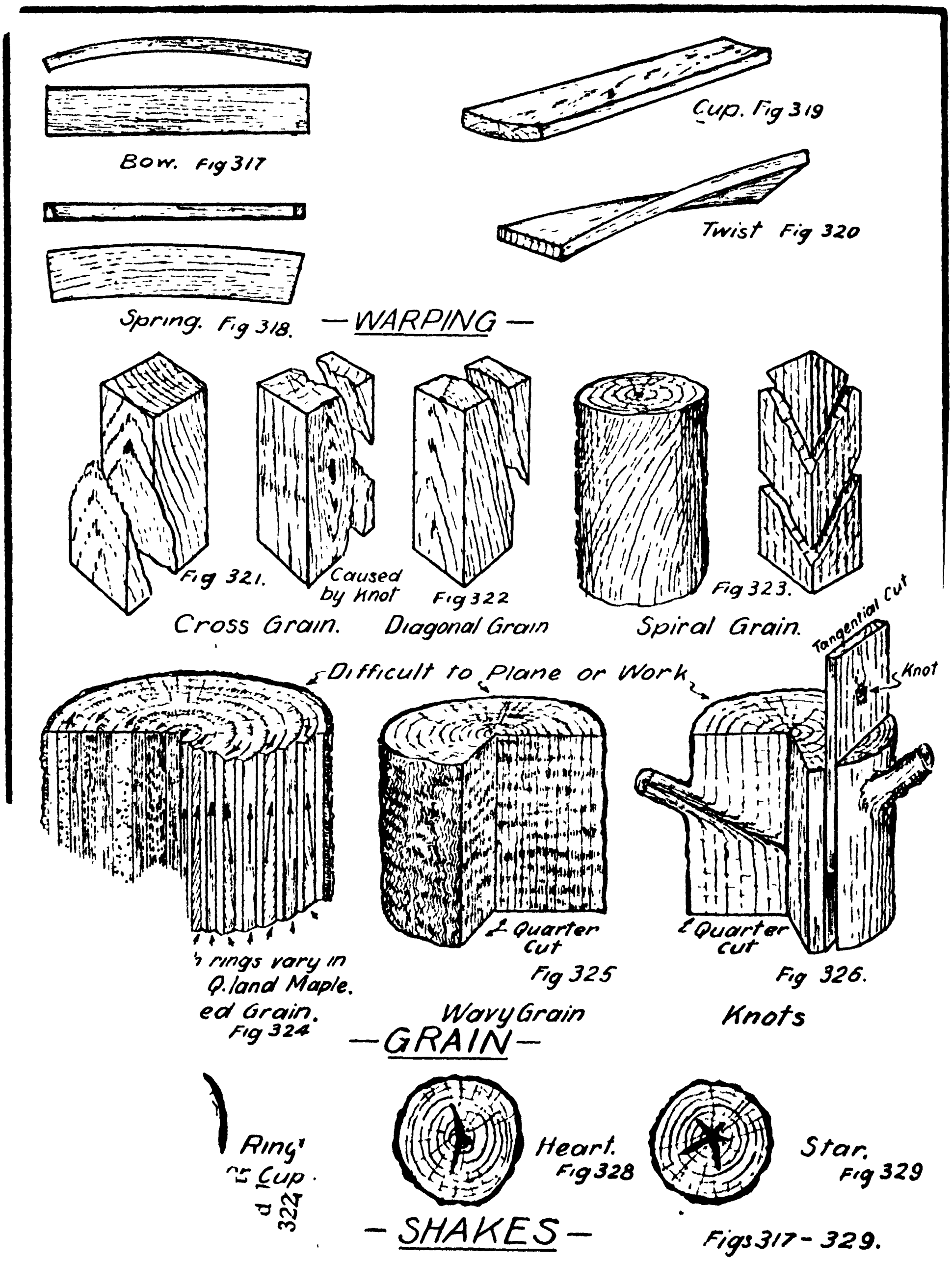
"Dry rot," caused by a fungi which attacks apparently dry timber generally restricted to the understructure of buildings which are badly ventilated. The fun requires a certain amount of moisture to live. This moisture is conveyed to t normally too dry to support fungus growth by long threads or stran fro or from damp timber in areas of bad ventilation. "Dry rot" sp means of its root-like threads, or by its spores (fungus seeds), wh t they may be carried round in the air currents and so commen y lodge in suitable places.

6. **Grain** refers to the direction of the cells and vessels of the termed a defect if the direction of the wood elements weaken the difficulty in planing, etc.

Cross Grain.—When the fibres have a varying inclination to th due to cutting from timber in which the straightness of the (Usually occurs only in small areas on the piece.) (Fig. 321.)

Diagonal Grain.—When the fibres do not run parallel to although cut from straight grained timber. May be cause the axis of the log instead of parallel to the bark. (Fig.

Interlocked Grain.—Caused by the fibres of adjacent layers inclined in opposite directions. (Queensland Maple and Mah interlocked grain which produces a distinctive figure called difficult to plane.) (Fig. 324.)



—ECTS IN TIMBER—

PLATE 70.

Spiral Grain.—Occurs when the fibres have taken a spiral course in the tree trunk as if the tree has been twisted. The cause is not definitely known; probably may be due to strong winds twisting the tree during growth. (Fig. 323.)

Wavy Grain.—A wavy arrangement of the fibres, also known as curly or fiddle-back grain, which is difficult to plane and work.

7. **Heart.**—That part of the centre of the tree which is often affected by decay or of no appreciable strength.

8. **Knot.**—Caused by a branch or limb being cut through during the process of sawing up the log. Generally these are a distinct defect either in appearance or weakening the piece.

Loose or Dead Knot.—Left by branches that have been cut off or broken before felling, and which cannot be relied on to remain in position in the piece.

Live or Sound Knot.—One that is left by a branch when the tree is felled; it is solid across its face and as hard as the timber surrounding it, and free from decay. (Fig. 326.)

9. **Pipe** is the absence of wood in the centre of a log.

10. **Shake** is a partial or complete separation between adjoining layers of wood usually due to causes other than drying, and may extend quite a few feet along the board.

Heart Shake.—A split or cleft extending from the pith and existing in the log before conversion. (Fig. 328.)

Ring or Cup Shake.—A separation on the wood around the growth rings. (Fig. 327.)

Star Shake.—A number of heart shakes more or less in the form of a star. (Fig. 329.)

11. **Wane or Waney.**—The absence of wood on the edge or corner of a piece showing the bark or surface of the sapwood.

12. **Warp.**—Any variation from a true plane surface (i.e., not perfectly flat).

Bow (or Camber).—A curvature from the plane along the wide surface of the board, caused by uneven shrinkage and uneven drying during seasoning. (Fig. 317.)

Cup.—A simple curvature in the plane across the board caused by shrinkage and bad stacking when seasoning. It is more pronounced in back sawn boards; the curvature is usually away from the heart. (Fig. 319.)

Spring.—A curvature along the edge of the board, not affecting the face, caused by uneven shrinkage and poor drying of the timber. (Fig. 318.)

Twist.—A spiral distortion along the length of the piece of timber, also known as "wind," and may be caused by uneven shrinkage due to uneven drying (Fig. 320.)

QUESTIONS.

1. What is a defect in timber?
2. Show by named sketches four ways timber may warp.
3. What is decay in timber?
4. What do you understand by the terms (a) diagonal grain; (b) shakes? Illustrate your answers.
5. What are knots?

VII. DEFECTS CAUSED BY INSECTS, ETC.

WOOD BORERS.

Wood borers may be divided into three main groups which attack—

1. Living trees.
2. Unseasoned timber.
3. Seasoned Timber.

1. BORERS WHICH ATTACK LIVING TREES.

Most of the damage done to forest trees is caused by the grubs or larvae of certain beetles and moths, which spend their lives in the trunks eating the living wood tissue. The tunnels made by them vary from ¼″ to 1″ diameter, and are many feet long according to the species of grub. The chief offenders are the Longicorn Beetles, Jewel Beetles and Wood Moths. The larvae of the Moths grow to a length of two to three inches.

The eggs are laid in crevices in the tree, and after hatching the grubs tunnel into the living wood, where they may live for years. The grubs usually die after the tree is felled. Nearly all Australian commercial timbers are liable to the attacks of these insects.

Timber from trees attacked in this way is usually useless for furniture and plywood stock, and if severely attacked it is too weak for building construction.

Prevention.—It is impossible to prevent all attack, but it may be minimised by preventing damage to the trees by fire, disease, etc. Felled timber should be barked immediately after felling to prevent further attack.

2. BORERS WHICH ATTACK UNSEASONED TIMBER.

General.—The Pin-Hole, Shot-Hole or "Ambrosia" Beetle is the chief offender in this group, causing most damage in tropical and semi-tropical countries. All Australian commercial timbers are attacked by this beetle. Usually they only attack felled timber, although one species is known to attack unhealthy living trees. The beetle and larvae die during seasoning.

Life.—One species of beetle lays its eggs in cracks in the timber, and when the eggs hatch the larvae bore into both the sapwood and the truewood. It is the grub that causes the damage. Another type of beetle bores its way into the timber before laying its eggs, the beetle itself doing the damage, the larvae living on a fungus growth left in th[illegible] tunnels by the mother beetle. The "pin" holes are about 1/32″ to 1/16″ in [illegible]er, usually running across the grain radially. The wood is not reduced to a [illegible] form, as is common with the Lyctus and Anobium species mentioned below.

Timber atta[illegible] these borers can safely be used for building purposes, but it is not suitable to[illegible]inet work, as the stained tunnels and "pih" holes deface the work.

Prevention.—Sprayi[illegible]g the logs with creosote oil has proved satisfactory. If the logs are immediately converted and stacked to dry, further attack is prevented, and if borers are present they will soon die. The heating of the sawn timber in kilns will kill all beetles, larvae and pupae.

3. BORERS WHICH ATTACK SEASONED AND SEASONING TIMBER.

The most important insects in this group are—

(a) Powder Post Borer (Lyctus Species).
(b) Furniture Borer (Anobium Species).

(a) Powder Post or Lyctus.

General.—This borer derives its name from the way in which it reduces the wood to a fine powder (like flour). The lyctus only attack the sapwood of hardwoods, especially of eucalypts, and do not attack softwoods, such as pines, etc. They are found in partly seasoned and fully seasoned timber used for building and furniture making. The sapwood of timber infested by the lyctus beetle is usually tunnelled to such an extent that the interior is completely reduced to a powder and unfit for use.

Life.—Eggs are laid by the beetle in the pores of the sapwood and hatch (8-25 days) into small grubs, which tunnel along the cells (i.e., along the grain), reducing the wood tissue to a fine powder of partly digested wood. The grub matures to about ¼" long after about 10 months and bores its way close to the surface, where it pupates, turning into a black beetle about 3/16" long. The beetle eats its way to the surface, making holes usually less than ⅛" in diameter, and carrying with it some of the fine white powder. The presence of the dust about the flight holes is often the first sign of infestation, as all the work and damage is done below the surface by the larvae.

Prevention.—Most effective method of killing the beetle or its larvae and pupae is heat treatment, i.e., heating the boards (temperature and time depending on the humidity and thickness of boards). Logs may be treated in a steam box. Dipping in suitable chemicals, such as zinc chloride, or spraying with creosote diluted with kerosene is fairly satisfactory. For furniture it has been found that creosote plus kerosene, or kerosene, or turpentine, either applied with a brush, spray-gun, or syringe (eye dropper) is satisfactory; the holes are afterwards plu‹ged or filled with a mixture of 2 parts beeswax and 1 part of resin (mixed hot and stained).

NOTE: Creosote stains the wood, and cannot be used on surfaces whic[h] polished.

(b) Furniture or Anobium.

General.—The name is misleading, as the beetle does not confine its furniture only; it also attacks flooring, studding, rafters, and any inter work. It prefers old, well seasoned timber, either softwoods or hardwoods. or truewood, although it does not seem to like Eucalyptus timbers. Like t[h] most of the damage is done beneath the surface by the larvae. The int[e] is never reduced entirely to a powder, but is honey-combed, and the powde[r] fairly coarse and gritty to the touch. The Anobium generally causes m[ore] than the Lyctus, rendering the article worthless if no preventative taken.

Life.—The eggs are laid in cracks, openings between joints, surfaces, or in old flight holes. They hatch in about one mont[h] which tunnel, often at right angles to the grain, reducing th powder. The grubs (very like the lyctus larvae) mature in a[bout] after boring almost to the surface, pupate and emerge as small brown beetles (about ¼" long), making flight holes about 1/16" diameter.

Prevention.—Use same preventative measures as for the Lyctus.

TERMITES OR WHITE ANTS.

General.—Termites, commonly called "white ants," probably cause more damage than any of the borers mentioned above. Wood destroying termites can be divided into three main groups according to the nesting habits—

(1) Subterranean Species.
(2) Tree-dwelling Species.
(3) Dry-wood Species.

1. **Subterranean Species** attack converted timber which has contact with the ground in which they build their nests. Some subterranean species form their colonies in mounds, which they build to a height of from a few inches to 20 feet.

2. **Tree-dwelling Species** build their nests in trees, but must have contact with the ground in order to live. They do enormous damage to forest trees, but do not continue their work after the trees are felled.

3. **Dry-wood Species.**—These live in growing trees, old decayed logs, or in seasoned timber, and can work and live without communication with the soil. This species is only important in restricted districts in Australia.

The species most troublesome is the subterranean species. Termites attack both sapwood and truewood of most commercial timbers, although the truewood of some timbers is almost immune to their attacks. (See list below.)

Wood in the ground or near it is liable to attack; even timber separated from the soil by brick, concrete, or metal may be attacked if the termites are able to build communicating tubes (which protect them from the light) from the soil to the wood. Like the Lyctus and Anobium, etc., the presence of termites is not always apparent on casual inspection; all the damage is done beneath the surface away from the light. Nearly all t· e wood is eaten away, leaving smooth walled, irregular shaped tunnels r gallerie:, usually in the direction of the grain, and may be several inches in width. e galleries are often lined with disintegrated wood and clay mixture, and the shell r left is often decayed.

Termites live together in large numbers, forming a colony which is made up ifferent types or castes: (a) Worker Caste, which build the nest, seek food, . care for the rest of the colony; (b) Soldier Caste, which protect the colony er insects by secreting offensive substances; (c) Winged Reproductive Caste, g of males and females provided with wings, which enable them to leave y to form new colonies; (d) the Queen, whose duty it is to lay eggs, from nbers of the different castes are produced as required.

culiar habits of the termites enable us to control their activities: (i) they vn dead, and (ii) "grooming," which is the cleaning of each other by icles of dust, moisture, etc. Thus poisons can be used in their eradica-

revention.—The truewood of the following timbers is fairly resistant termites, and may be used in building construction close to the eafed Iron Bark (Eucalyptus crebra), Jarrah (E. marginata), rocorys), Yellow Stringybark (E. muelleriana), Grey Ironbark

(E. paniculata), Red Box (E. polyanthemos), Grey Gum (E. punctata), Red Gum (E. rostrata), Red Ironbark (E. sideroxylon), Cypress Pine (Callitris species), Turpentine (Syncarpia laurifolia).

Added protection can be given in building construction by the use of properly constructed shields, made of metal, between foundations and woodwork to prevent the building of communication tubes with the ground.

Impregnating the soil surrounding foundations with creosote oil and zinc chloride solution serves to retard the movement of the termites.

Further protection may be given by coating or soaking all timber used in the understructure of flooring, etc., with creosote.

Infested timber may be treated with sodium fluosilicate powder, by carefully opening the galleries and blowing in the poisonous powder, the poison being conveyed from one termite to another during "grooming." Similarly liquid poisons, if used carefully, may be used in the same manner; carbon bisulphide or benzol are the two liquids used (both are very inflammable).

NOTE: See "Preservation of Timber."

QUESTIONS.

1. Make a list of the insects which attack timber.
2. How does the powder post borer destroy timber.
3. What type of wood does the powder post attack?
4. Briefly describe the effects of termites on wood?
5. Describe an effective method of preventing the attacks of termites.

VIII. PRESERVATION OF TIMBER

INTRODUCTION.

In order to prolong the life of wooden constructions it is necessary to apply some form of protection or preservative. The timber may be coated with the preservative or it may be impregnated (i.e., saturated) with it.

As timber is mainly used for two classes of work, external and internal, the preservatives required may be divided into two groups: 1. Preservatives most suitable for protecting wood used for posts, poles, railway sleepers, bridges, understructure of buildings, etc., and 2. Preservatives required to protect the woodwork of walls, ceilings, furniture, etc.

1. PRESERVATIVES FOR EXTERNAL WOOD WORK.

To lengthen the life of timber used for external work it is necessary to coat or impregnate the wood with a solution which will reduce its liability to insect attack and decay (fungus growths). These preservatives, in the main, are divided into (a) Oil Preservatives, and (b) Water Soluble Preservatives, and (c) Mechanical Preservatives.

(a) **Oil Preservatives** for external work.

(i) *Coal Tar Creosote,* commonly called "creosote oil," is produced by the distillation of coal tar.

Creosote offers good protection from termites and decay provided the oil penetrates deeply and evenly into the wood in sufficient quantity. It is easy to apply and does not evaporate quickly. If several coats of oil are applied hot with a brush or spray it will give very satisfactory results.

USES: Creosote is chiefly used for fencing posts, telegraph poles, understructure of buildings (floor joists, bearers and wall plates), street blocks, etc.

(ii) *Tar* is often used for the same purposes as creosote, but is less effective, being less poisonous to fungi and insects. Tar is more difficult to apply, and does not penetrate very far into the wood. It is commonly applied either hot or cold with a brush or swab.

(iii) *Crude Oil,* by itself or with creosote, is sometimes used and is fairly satisfactory.

(iv) *Patented or Proprietary Preservatives.*—The following preservatives have been found to give good results:—Novolineum, Peterlineum, Jodelite and Solignum.

(b) **Water Soluble Preservatives,** for external work.—These are chemicals which are soluble in water, and when applied to the wood assist in preventing decay and the action of insects.

(i) *Zinc Chloride* is sold in solid form or in a highly concentrated solution, and added to water to make a dilute solution containing 2% to 5% of zinc chloride. The preservative is cheap, easy to handle, odorless, and the treated wood can be painted. It is excellent for use against fungi, but unless used in large quantities is not very effective against termites. Zinc chloride is liable to be washed out of timber used under wet conditions, therefore it is unsatisfactory for poles, etc., which may be subjected to heavy rainfall.

(ii) *Sodium Fluoride* has similar properties to zinc chloride, but more expensive. It is a white powder, soluble in water to about a 4% solution.

(iii) *White Arsenic* dissolved in water is a very effective preservative against termites, but is very poisonous to human beings and animals, and must be used with caution.

(iv) *Mixtures.*—Where both termite and fungi attack may be encountered it is advisable to use either zinc chloride or sodium fluoride in conjunction with arsenic.

There are several methods of impregnating the wood with the solutions mentioned above. The most effective involves the use of pressure chambers which force the preservative in the pores of the wood under heat and pressure. Another method consists of placing the seasoned timber in a tank of hot preservative for some hours and then immediately removing it to a tank of cold preservative. This method is commonly used and gives satisfactory penetration. (May be used for creosote.)

(c) **Mechanical Preservatives.**—This term applies to preservatives which are more or less coverings over the wood, such as:—

(i) *Sheathing.*—Timbers that are continually in contact with water, such as the bottom of boats, wharf piles and pontoons, are sometimes protected from marine borers and pests by covering the wood with sheets of copper or muntz metal.

(ii) *Charring.*—This method consists of charring the outside of the post or pole by means of an oil blow torch or oxy-acetylene torch. The latter type of torch is to be preferred, as it produces a finer textured and harder char. The coating of charcoal (which is $\frac{1}{8}''$ to $\frac{1}{4}''$ thick) will not support fungi growth, and therefore protects the wood beneath. If creosote oil is sprayed over the charring while it is still hot added protection is obtained.

(See also notes on "Wood Destroying Insects.")

2. PRESERVATIVES FOR INTERNAL WOOD WORK.

Timber used for walls, ceilings, furniture, etc., generally require some form of protection against changes in moisture content of the air, dust, and soiling due to continual handling by persons, also to prevent attacks of furniture borers and beetles.

All timber is affected by changes in atmospheric conditions; it swells when the air is damp and shrinks when it is dry. This expansion and contraction of the wood can be greatly reduced if a protective covering is applied to exclude the moisture changes in the air. External and internal walls and ceilings are usually painted; articles of furniture are generally stained and given some form of transparent coating to protect the timber. The latter method also prevents the wood from being soiled and allows the natural grain figure to be seen, while both methods provide a form of decoration.

The preservatives for the above purposes are more in the nature of timber finishes, and are described under "Timber Finishes." (See below.)

E.g., Oil Paints, Water Paints, Cellulose Lacquers, Varnishes, etc.

QUESTIONS.

1. When is it necessary to apply a preservative to timber?
2. What is "Creosote Oil," and what is it used for?
3. What are water soluble preservatives? Name three types of water soluble preservatives.
4. What is "sheathing" and "charring?"
5. Why is it necessary to preserve interior wood work?

IX. TIMBER FINISHES

As mentioned under the section "Preservation of Timber," interior woodwork is preserved by applying some type of coating or film, either transparent or opaque, which will protect the timber from atmospheric moisture and dirt, the latter for hygienic reasons. These protective, preservative films also serve to beautify the appearance of the work. The type of finish applied depends largely upon the nature of the material used and the use of the article. Figured timbers, which are generally used for bedroom, dining room and occasional furniture, are usually stained and given some form of transparent finish to intensify and bring out the ornamental beauty of the natural grain. Plain timbers, such as those used for kitchen and bathroom furniture and fittings, are generally coated with opaque finishes.

NOTE: In general, most finishing products are made up of several ingredients:—

(i) A Body or Base—this is the foundation material which usually forms the protective film on the work.

(ii) A Vehicle—(liquid)—which acts as a carrying agent for the base materials.

(iii) A Solvent and Thinner—which are necessary to thin out the above so that they may be readily applied and flow evenly over the surface.

(iv) A Drier—is required for oil products to assist and hasten drying.

(v) A Pigment—(if required)—these are colouring materials, finely ground, and usually added to produce an opaque, coloured finish.

TYPES OF FINISHES.

1. **Paints.**—Paint is usually applied to walls and ceilings for either exterior or interior finishing. Generally applied by brushing.

MATERIALS USED IN OIL PAINTS.

(i) *Body or Base.*—The basic or body pigment used in practically all Long Oil Paints (long drying) is usually a metallic oxide. The basic pigments generally used being: red lead, zinc oxide, zinc white, white lead, or titanium dioxide. These materials serve a dual purpose in providing both a colouring and a covering power in the paint.

(ii) *Vehicle.*—Natural drying oils are used to carry the basic pigment and other pigments, enabling them to be spread evenly over the surface. They are called "Drying Oils," as they possess the quality of drying by absorbing oxygen from the air, forming a film. These oils are vegetable oils, obtained from either the seeds of plants or nuts of trees. Linseed Oil (obtained from flax-seed) is generally used in oil paints, oil varnishes and varnish enamels. Castor oil, a non-drying oil, can be processed and changed into a drying oil suitable for paint making. Other oils sometimes used for special paints are: Chinawood oil (tung oil), soya bean oil, and fish oil.

(iii) *Solvent or Thinner.*—Turpentine (distilled from the gums of various pine trees) is generally used as a thinner to allow economical application of the paint. Turpentine is a good solvent for the oils and dries out by evaporation.

(iv) *Driers* are materials added to oil paints to hasten the drying by assisting oxidation. Driers commonly used are cobalt, litharge, acetate of lead, japan, etc. Only small quantities of driers should be added, as too much drier will shorten the life of the paint.

(v) *Pigments.*—Colours—either natural earth colours (ochres, umbers, siennas) or vegetable colours (vegetable black, indigo), or chemical colours (prussian blue, chrome yellow)—are added as required. Carbon black and lamp black are produced by burning and gas. The pigments are sometimes called "stainers."

It is essential that the correct proportions of the above materials are used, also that the correct basic pigments be used, otherwise there will result an early "breaking down" of the film with rapid decay of the finish applied. Care should be taken in the early coats, as they provide a foundation for the final finish.

NOTE: WATER PAINTS generally consist of a lime base with whiting and pigments mixed with a glue, using water as the vehicle. The glue acts as a binder to hold the particles of the base and pigments together and to assist adhesion to the surface of the work. Casein is used in the better types of water paints. To make the paint more durable and to add gloss to the finish, linseed oil is sometimes added

2. **Varnishes and Varnish Enamels** may be applied to metal or wood, and are sometimes applied as a finishing coat over an oil paint undercoat, to give high gloss and a hard durable surface.

Varnish is a finishing material consisting of gums or resins mixed with linseed oil and thinned to a working or brushing consistency with turpentine. Varnishes dry by evaporation of the turpentine thinner and by oxidation of the oil and resins. When pigments or dyes are added to the varnish the material is often referred to as a varnish enamel. They are generally applied with a brush, sometimes the surface being finished by rubbing (similar to french polishing). May be sprayed if thinned with 25% thinners.

MATERIALS USED IN VARNISHES AND VARNISH ENAMELS.

(i) *Body or Base.*—Resins or gums provide the film or solid material as a body for the varnish. The choice of resin for making a varnish is important, as the fossil and natural gums vary in texture, some being brittle and hard, whilst others are elastic and soft. Usually they are suitably blended to produce each particular kind of varnish.

NOTE: Sometimes synthetic (artificial) resins in tung oil are used to produce a finish referred to as a synthetic varnish.

(ii) *Vehicle.*—Linseed oil is generally used as a carrier and binder for the gums and helps to make the film more plastic and less brittle. Linseed and Chinawood oils are called "drying oils." If a large proportion of oil is used, the product is known as a "long oil varnish"; if only a small amount of oil is used, it is called a "short oil varnish." "Long" and "short" referring to the time taken for the varnish to dry. Long oil varnish may take up to three days to dry, drying by oxidation.

(iii) *Solvent or Thinner.*—Turpentine and naphtha are thinners used to make the varnish thin and fluid so that it can be easily brushed. The thinners dry by evaporation.

(iv) *Driers.*—Driers similar to those used in oil paints are added to hasten drying.

(v) *Pigments* are added to produce a coloured varnish generally called a varnish enamel.

MANUFACTURE OF VARNISHES.

Briefly, the manufacture of long oil varnish consists of:—

"Running" the gum—the gums or resins are melted by heating.

Boiling the oil—the raw linseed oil is heated to 400° F. The oil is then added gradually and mixed with the gums.

The mass is boiled—i.e., the gums and oil are again heated.

Thinners are added—turpentine or naphtha.

Driers are added—litharge, etc.

Maturing—the mixture is then set aside to cool and mature.

The above produces a reasonably clear liquid which, when applied to a surface, will dry with a glossy appearance. Zinc oxide may be added if a white enamel is required, or other pigments for coloured enamels.

NOTE: SPIRIT VARNISHES differ from oil varnishes, as they do not contain drying oils. Volatile solvents, usually alcohol or turpentine, are used, and these dry rapidly by evaporation. Stains may be added to produce varnish stains.

Oil Paints and Oil Varnishes and Varnish Enamels are generally referred to as Long Oil Products, because of the length of time taken to dry—average 24 to 48 hours.

These finishes rely on the "key" or "tooth" provided by the surface or previous coat, as the undercoat is not dissolved or affected by the next coat. Hence it is necessary to roughen or glass paper the surface between coats.

3. Lacquers and Synthetic Finishes.

Lacquers and synthetics produce similar finishes, but as the materials used in their manufacture are entirely different, it is important to note that the one type of finishing material should be used throughout the coating of the surface. In other words, they will not mix, also they should never be applied over any other type of finish.

(a) NITRO-CELLULOSE LACQUERS AND ENAMELS.

"Nitro-cellulose" (pyroxylin) is used as the body or base for lacquers. It is produced by treating the fibrous tissue of plants—chiefly cotton fibres—with a mixture of nitric and sulphuric acids. The Nitro-cellulose forms the main substance of the film after being dissolved in a vehicle or liquid. The possibility of using nitro-cellulose derivatives was first discovered about 1855. Since this discovery investigations and experiments have been carried out, resulting in much improved products. Lacquer is the fastest of all air-drying finishes, drying "dust free" in from 5 to 15 minutes, and producing a hard, durable, weather-proof, heat-proof surface in about two hours.

The main materials used in lacquers are:—

(i) *Base or Body*—Nitro-cellulose forms the base substance for the film coating.

(ii) *Resins*—to give gloss and adhesion.

(iii) *Placticisers*—to render the film elastic and aid adhesion. Those used in higher grade products are complex compounds of high boiling point.

(iv) *Solvents*—to reduce the above to working consistency and make it fast drying. Solvents of low boiling point being used.

(v) *Thinners* (sometimes known as retarders)—to reduce the viscosity (stickiness) and cost and to improve the flow and levelling quality. The type of thinner used is governed by the solvent, as it is essential that the thinner should not evaporate more quickly than the solvent, otherwise defects will develop, such as "blushing" or "pin-holing." Hence the thinner should be one of medium boiling point. There are a large number of thinners available—generally a combination of two or more liquids are used. NOTE: It is advisable to always use a brand of thinner suggested by the manufacturer of the lacquer.

(vi) *Pigments*, or colouring dyes, are added to produce a lacquer enamel.

APPLICATION OF LACQUERS.—Although brushing lacquers were manufactured, they were not satisfactory because of the rapid evaporation of the solvents, their nature making them more useful as spraying materials. Owing to the volatile solvents used, lacquers should never be applied near a naked flame or where there is any fire risk. Each successive coat dissolves and unites with the previous coat to form one film.

(b) SYNTHETICS AND SYNTHETIC ENAMELS.

To meet the demand for a "brushing" finish with fast-drying qualities, "Synthetic" finishes were introduced. Synthetic finishes are "dust free" in approximately one to two hours and dry to a hard, weather-proof, lustrous surface in from four to six hours.

Synthetic finishes are produced by dissolving synthetic (artificial) resins in natural oils together with suitable thinners as solvents, OR by using artificial oils and natural gums or resins. The latter are still in the experimental stage and little is known of them.

Synthetic resins used in the manufacture of these finishes are generally produced by the reaction of formaldehyde with other substances, such as phenol. They are soluble in "drying oils" at low temperatures. No "running" is required as for varnishes. The use of synthetic resins in combination with Chinawood oil (tung oil) has produced a type of material which, although it may be applied with a brush, competes favourably with a rapid drying cellulose lacquer. Coloured dyes or pigments may be added to produce a synthetic enamel. If thinners are required to enable spraying of the product, use a thinner supplied by the manufacturer.

Oil Paints and Varnishes dry by oxidation; Lacquers by evaporation; Synthetics dry firstly by gelatination, which makes them dust free, and then by oxidation, producing a hard, glossy, heat and acid resisting film.

Successive coats, like lacquers, will unite with each other by a partial softening of the previous coat to produce one complete film. Therefore it is essential that the undercoat be totally free from raw linseed oil and lead, otherwise rapid destruction of the protective film will result.

APPLICATION OF THE ABOVE FINISHING MATERIALS.

(1) **Paints,**—Usually three coats are applied.

(i) *First Coat* (priming coat).—The paint is usually thinned—containing an excess of oil and turpentine. This undercoat acts as a filler and forms a base for further applications.

(ii) *Second Coat* (body coat).—Care should be taken to see that the materials in the paint are of correct proportions for this coat. Use "ready mixed" paints straight from the tin.

(iii) *Third Coat* (finishing coat).—For a gloss finish a paint mixture with oil as the main vehicle is used; for a flat or matt finish, turpentine is the principal vehicle.

(2) **Varnishes, Lacquers and Synthetics.** (Applying a finish to new work.)

(i) *Prepare Surface.*—Sponge the surface with warm water to raise the grain. Allow to dry and paper with No. 2/0 garnet paper, followed by No. 4/0 garnet paper. Wipe the surface clean with a soft rag.

(ii) For *Enamels* apply a special undercoat or primer supplied by the manufacturer of the finishing material to be used. Usually applied by brushing. When dry, grind down the undercoat to a smooth, level surface with No. 4/0 waterproof paper, using water as a lubricant. Wipe clean with a soft rag.

For *Clear or Transparent* finishes, the surface may be stained. When dry the stain may be fixed by spraying a thin coat of shellac. The pores are then filled with a silex paste filler. (See Stains and Fillers in notes on French Polishing.)

(iii) *Applying the Finish.*—The first coat of the finishing material is usually slightly thinner, and may be applied with a brush or a spray gun. (Lacquers and lacquer enamels should be sprayed on.) Paper lightly between coats with 5/0 waterproof paper plus plenty of water (or using 2/0 steel wool) to remove "nibs" of dirt. When using varnish the surface should be well papered between coats to roughen it and provide a "key" for following coats.

(iv) *Final Coats.*—Usually two final coats are applied as a finish, using the material straight from the tin when brushing. If sprayed on the material is thinned with about 25% thinners. This amount varies with different products.

A dull, satin finish may be produced by rubbing the dried final coat with No. 2/F or 3/F pumice powder and rubbing oil or by using a special rubbing compound.

4. **Stains.**—Stains are liquids containing transparent colours in solution, and are generally applied to the timber for the following reasons:—

(i) To darken the wood to a uniform colour which will wear well.
(ii) To help intensify the natural beauty of the grain.
(iii) To make a cheap colourless timber (e.g., pine, alpine ash), an imitation of a more expensive timber (maple, walnut, oak, mahogany, etc.).
(iv) Oil stains (colours in oil) to some extent help to prevent the timber being affected by moisture.

It is usual to protect and fix the stain in the wood by covering it with some form of transparent finish, such as french polish, wax polish or clear lacquer.

Wood stains are of three kinds: 1. Water stains; 2. Spirit stains; 3. Oil stains.

1. *Water Stains* consist of various dyes (powders or crystals) which will dissolve in water. They give a good clear penetrating colour, and they are fairly easy to apply. As water stains tend to raise the grain, it is advisable to wet the job once or twice, and when dry paper off the roughness before applying the stain. The stain may be applied with a brush, rag or sponge, and wiped off with a clean rag.

Water soluble aniline dyes may be used—about 4oz. to a gallon of hot water. Walnut crystals and vandyke brown crystals are used for brown tones. Mahogany crystals for medium to dark red colours. Bichromate of potash depends upon its chemical action on the tannic acid on the wood to give brown tones.

2. *Oil Stains* are made by dissolving dyes or colours in turpentine, naphtha, tutuol or benzol. Some are not as penetrating as water stains, but are easy to apply over a large surface (especially if it has been previously oiled), and do not raise the grain. The stain is applied with a brush or a piece of wadding, the surplus being removed by wiping along the grain with a clean piece of rag.

It is advisable to set the job aside for a day or two to allow the oil to dry out thoroughly. A coat of thin shellac should be applied to fix the stain in the wood before applying a polish finish. Oil stains are not very satisfactory for use under cellulose lacquers.

Proprietary lines are available in many colours, usually named according to the timber they are required to imitate, such as maple, dark maple, mahogany, walnut, rosewood, oak, brown oak, and ebony, etc. They usually have a naphtha solvent. A good brand of oil stain is "Wattyl."

The following colours (ground in oil), thinned with the solvents mentioned above, will give a wide range of colours if suitably mixed:—

Brown and yellows: Brown umber, raw umber, raw sienna, vandyke brown, purple brown, black japan, brunswick black, ochre, orange chrome, and lemon chrome.

For reds: Burnt sienna, indian red, venetian red, red oxide.

For blacks: Ivory drop black, vegetable black.

If the colours are difficult to dissolve in the above solvents, they may dissolve in methylated spirits and the oil may be added afterwards. It is advisable to strain through muslin before applying.

3. *Spirit Stains* consist of powders or dyes soluble in methylated spirits. They are difficult to apply and require careful handling as they dry immediately. They tend to fade quickly. May be applied with a soft brush or a large piece of absorbent rag, or they may be sprayed on.

NOTE: It is always advisable to raise the grain with warm water and paper off before applying any stain. It is best to stain slightly lighter than required at first; a second or third application will darken the work. Horizontal members, such as chair rails, plinths, table rails, etc., usually require to be darkened. The end grain, which soaks up more stain, should be treated with a lighter colour.

Stains should be applied to the work along the grain, and wiped off with a clean rag, and allowed to dry thoroughly before applying a polish.

Cleaning Brushes.—The brushes used for applying the above finishes should be cleaned immediately after use. If left only for a few minutes they may be spoilt.

For Oil Paint Brushes: Use turpentine.

For Cellulose Paint Brushes: Use the special thinners supplied by the manufacturer, or wash with lux soap flakes and warm water until all trace of lacquer is removed.

For Varnish Brushes: Use methylated spirits, turps or benzine, depending on the type of varnish.

For Staining Brushes: Use water, spirits or turps, depending on the type of stain.

A warm solution of borax and water may be used to soak and clean spirit stain and french polish brushes.

5. **Wax Polishing** is one of the oldest and simplest methods of preserving and polishing wood. It is still a popular finish for high-class cabinet work.

Preparation.—The polish is made by shredding beeswax with a knife into a suitable container and covering it with pure turpentine (not turpentine substitute). The wax and turpentine are then heated by placing the container in hot water until the wax mixes with the turps. (An oil perfume, such as oil of roses or lavender, may be added while the mixture is hot.) When cool the prepared polish should spread easily on the wood; it should be about the consistency of soft butter.

Application.—If the natural grain colour of the wood is required the wax is applied directly on the glass papered surface. If the work has been previously stained and filled, a thin coat of shellac polish should be brushed on to fix the filler in the wood before waxing.

The wax is rubbed well into the grain with a soft rag or flannel pad and then allowed to set for about half an hour. The surface is then friction polished by burnishing (rubbing hard) with a clean cloth or bristle brush.

Several applications of the wax may be necessary to obtain the desired finish.

One advantage of wax polishing is that the surface may be brightened up from time to time by further applications and rubbing.

6. **French Polishing** is a method of coating furniture with a varnish consisting of shellac dissolved in methylated spirits.

Shellac is produced from the secretions of the lac insect (Laccifer lacca), which lives on certain types of trees growing mainly in the central provinces of India. The insects cluster in great numbers on the young shoots of the tree and suck the sap. They secrete a resinous material which forms a protective coating over their bodies.

After the insects die and the young have crawled to new shoots, the resin-covered twigs (called "stick lac") are collected and washed to remove the dead bodies, etc. The twigs are then packed into cloth bags and heated until the lac filters through the cloth. The plastic mass is moulded into thick slabs and stretched into thin sheets, which, when cold, are broken into small flakes and is known as "flake shellac" or "orange shellac." The lac is also produced in disc or button form, and it also may be bleached to make white shellac.

Orange Shellac.—Orange or flake shellac is used for general work, but makes a polish too dark for light coloured woods. It is best for medium coloured timbers requiring a golden shade polish.

Button Shellac (Button Lac)—produces a polish slightly darker than orange, hence it is most suited to dark woods, although care must be taken, as this polish is not as transparent as orange, and may hide some of the grain figure.

White Shellac (White Lac)—is made from orange shellac which has been bleached with chemicals. This type of lac is used for making up polish for finishing light coloured woods; it is also used on dark timbers where the other forms of shellac may tend to obliterate the grain. The finish is said to be inferior to that of unbleached lac in hardness and resistance to water and heat.

POLISHING PROCEDURE.

1. Preparation of Surfaces —It is essential that the surfaces and edges, etc., of the work be perfectly smooth before attempting to apply any type of finish.

Actually the last step in the construction of the job is the first step in finishing (polishing, painting, varnishing, etc.), that is, carefully scraping and glass papering the work to remove plane marks and minor blemishes, using No. 1 glass paper.

It is advisable to raise the grain by damping the work with warm water, and when dry smooth up with fine glass paper. Wide surfaces should be damped both sides to prevent warping. Always paper along the grain.

Nails and panel pins should be punched and the holes stopped up. Putty is generally used for painted work, but for transparent polishes stained plastic wood should be used. "Beaumontage," which is a home-made hard stopping, may be used. It is made by heating together equal parts of beeswax and resin, plus a few flakes of shellac. While the mixture is liquid it is dropped carefully into the holes with a sharpened match stick. As stains will not take over this stopping, it is necessary to add a suitable powdered colour to the mixture while hot. After the stopping has set hard in the holes the surplus is removed with a moistened chisel and fine glass paper.

2. STAINING.—If it is desired to change the colour of the wood the work should be stained, using any one of the methods of staining mentioned above under "Staining."

3. OILING.—Oiling is a process which may be carried out on hardwoods and richly coloured timbers. Linseed oil (raw) or a mixture of oils is applied over the stain with a clean cloth, the purpose being to darken the wood and intensify the grain figure. A good oiling solution is made by mixing together 1 pint of turps with 3 pints raw linseed oil, plus a tablespoonful of terebene. This solution dries better than linseed oil only. Apply the oil lightly so that the stain is not washed out, and set the job aside to dry for at least 24 hours.

4. FILLING.—This is the filling up the pores of the wood in order to produce a smooth level surface and prevent abnormal absorption of the polish.

(i) Plaster of Paris may be used for very light coloured timbers, but for dark woods powdered colours (vandyke brown and/or rose pink) should be added.

Place some of the mixed powders in a shallow container, and, using a wet rag or canvas, "dip up" some of the powder. Rub this well into the grain with a circular movement; it should form a thick paste on the work. Allow a few seconds to dry and wipe off the surplus across the grain with a clean piece of coarse cloth or canvas.

Only fill as much of the surface at a time as can be wiped off before the plaster sets hard.

When thoroughly dry the surface may still have a thin covering of filler. This is removed by smearing with a rag soaked in linseed oil or white mineral oil and papering off along the grain. The oil will combine with the plaster to form a thick paste, which can be wiped off with a clean soft rag.

NOTE: This type of filler cannot be used satisfactorily over an oil stain.

(ii) A Paste Filler made of the following ingredients will give good results:—3 parts of crushed whiting, 1 part of plaster of paris, plus powdered earth colours, such as rose pink, vandyke brown or ochre (or a mixture of them until the desired shade is obtained). The powders are thoroughly mixed and made into a thick paint-like paste with equal parts of turps and raw linseed oil. Immediately before applying the filler a teaspoonful of gold size should be added for each pint of paste. The gold size helps to dry and seal the filler in the pores.

The paste is rubbed into the pores of the wood with coarse cloth, and when semi-set wiped off across the grain, leaving some of the filler in the pores. Finally, the work is wiped with a clean rag and set aside to dry for about 12 hours.

(iii) Proprietary Fillers are obtainable ready stained and mixed for use. They are sold usually in pound containers, and generally require thinning with turps before application. They are usually a mixture of silex, china clay and whiting in turpentine, plus some form of drying oil with a stain added. The thinned filler is applied in the same manner as for No. (ii) filler, or it may be painted on the work with a brush.

NOTE: Always allow the paste to just set before wiping off across the grain. If allowed to set hard it will be found difficult to remove the surplus.

(iv) Close grained hardwoods may not require filling with a paste, the polish itself acting as a filler.

5. SIZING-IN OR FADDING.—This is the first application of polish which fixes the filler in the pores of the wood and provides a perfectly smooth and hard surface on which to polish proper.

Materials.—(i) Polish.—The type of polish depends upon the colour desired. For orange and button shellac polish dissolve about 5 or 6 ozs. of the shellac in 1 pint of methylated spirits. For white polish dissolve 6 or 7 ozs. of bleached shellac in a pint of spirits.

Place the shellac in a bottle and add the spirits; shake the contents occasionally (especially for white shellac, as this dissolves slowly and tends to form a hard mass). When dissolved, strain the polish to remove any impurities.

(ii) Polishing Rubber.—This is best made with unbleached wadding, although medicated cotton wool is fairly satisfactory. The wadding is formed into the shape of a pear with one side flat (for general work about the size of an egg). When in use the pad is charged with polish direct from the bottle and then covered with a piece of well washed rag or linen, such as an old white handkerchief. See that there are no creases on the face of the rubber. Whenever the rubber needs recharging, first remove the rag covering.

(iii) Glass Paper.—No. 0 glass paper is required to remove brush or rubber marks and dust specks.

Procedure.—Charge the rubber with polish, fairly wet, so that when pressed with the thumb the polish comes through the rag covering, and apply to the work in straight strokes along the grain. Little pressure should be required at first. Rub until the rubber is fairly dry, and then recharge with polish. Allow the work to dry for a few minutes between coats. Continue until the work tends to become sticky and rubber seems to grip the work. By this time a fairly good coating should completely fill up the pores and cover the surface. Set the job aside to dry and harden for about 12 hours.

6. BODYING-IN is the polishing proper, which increases the coating or body of shellac on the surface of the work.

Materials.—(i) No. 0 glass paper, or 7/0 garnet paper or 2/0 steel wool is used to cut down the surface after sizing-in.

(ii) Use polish which has been diluted by adding $\frac{1}{4}$ pint of methylated spirits to each pint of polish.

(iii) A polishing rubber with a fine linen rag covering.

(iv) An oil to act as a lubricant and prevent the rubber sticking to the work. Raw linseed oil or liquid paraffin (white mineral oil) are generally used.

Procedure.—Rub down the surface with glass paper or garnet paper, and dust off the work. Apply the diluted polish with the polishing rubber. The first coat using a fairly wet rubber with straight strokes along the grain. For the following coats use a drop of oil on the face of the rubber. Use the rubber in circular or figure eight movements in order to pull the surface of the polish flat. Use just enough oil to prevent the rubber sticking to the work. A very thin smear of oil should be seen on the surface. Rub lightly at first, gradually increasing the pressure as the rubber dries out. The rubber may have to be recharged two or three times to obtain the desired body.

NOTE: Oil is not a polishing agent; it is only used as a lubricant. Too much oil will clog up the face of the rubber and will prevent the shellac on the work drying out properly. It should only be used after the pores of the timber have been thoroughly filled up with polish during the sizing-in operation. The oil may be flicked on to the work with the finger instead of applying it to the face of the rubber.

Set the work aside to dry and harden.

7. FINISHING AND SPIRITING-OUT —These are the final steps in polishing, the purpose being to remove the oil and to burnish the surface, producing a gloss.

Procedure.—Lightly paper up the work with well-worn glass paper which has been slightly oiled. Charge the rubber with half polish and half spirits, and still using a circular motion and a spot of oil, rub until the polish is worked out of the rubber. Recharge the rubber with two parts of spirits and one part polish, no oil is required, and continue rubbing until the rubber is dry. The next rubber may be charged with spirits only and squeezed out until almost dry. Using this rubber, go over the surface with straight strokes in the direction of the grain. By this time the oil marks will have been removed. For a final burnish, dip the face of the rubber in Vienna chalk and rub in straight strokes along the grain and dust off the job.

QUESTIONS.

1. Generally, preservatives for interior woodwork serve a dual purpose; what are these two purposes?
2. What might govern the type of finish required for a job?
3. Name five types of finishes applied to internal woodwork.
4. Paints are mainly made up of two ingredients; briefly describe them.
5. What is varnish? How is varnish applied to the work?
6. Make a list of jobs which could be suitably finished with a synthetic or lacquer enamel.
7. What are stains, and how are they applied?
8. Give four reasons why we use stains.
9. Wood stains are of three kinds; name them, and briefly describe one type of stain.
10. How might stains be fixed to prevent them wiping off or becoming soiled?
11. What is shellac? What is it used for?
12. What is french polishing? What types of jobs are finished with french polish?
13. Write down the steps involved in french polishing.
14. What is the purpose of a filler? What ingredients could be used to make a filler?
15. When and how much oil should be used during the polishing processes?
16. What is a polishing rubber? Name the materials used for making one.
17. Describe how to make up a polish for wax polishing.
18. How is the polish obtained when wax polishing?
19. What is one advantage of wax polishing?
20. What would be the best type of french polish to use over a coloured inlay? Why?

X. ORNAMENTATION OF TIMBER (Plate 71).

INTRODUCTION.

Ornamentation or decoration of wooden articles should emphasise the general outline of the work and enrich and beautify without interfering with its usefulness.

Craftsmen from the earliest times have endeavoured to beautify their work by some form of decorative process.

SOME TYPES OF ORNAMENTATION OR DECORATION.

1. **Figured Timber.**—The natural grain of figured timber, if carefully selected, matched, stained and finished, is sufficient in itself to beautify the work. A good designer relies chiefly on figure, grain and colour of the timber.

2. **Inlaying.**—This is one of the oldest methods of ornamentation. Inlaying consists chiefly of cutting designs in thin wood and gluing them into carefully cut shallow recesses in the solid wood of the work. (Fig. 332. See also fig. 35.)

Inlay "strings" or "lines" are single strips of thin wood (usually square in section) which are let into rebates cut along the edges of the work to protect the corners or edges of veneers.

Inlay "bandings" are strips of inlay of built-up patterns, and are let into specially prepared grooves cut in the surface of the work. (Fig. 330.) For inlaying bandings a special tool, called a "scratch" is helpful. The scratch is made of two pieces of wood with a cutter clamped between them. (See Fig. 331.) The cutter can be made from part of an old saw blade, its width depending on the width of the banding. The cutting edge is filed perfectly square. When in use the tool is worked back and forth, keeping the shoulder of the stock against the edge of the job. When cutting across the grain the edges of the recess should first be cut with a cutting gauge.

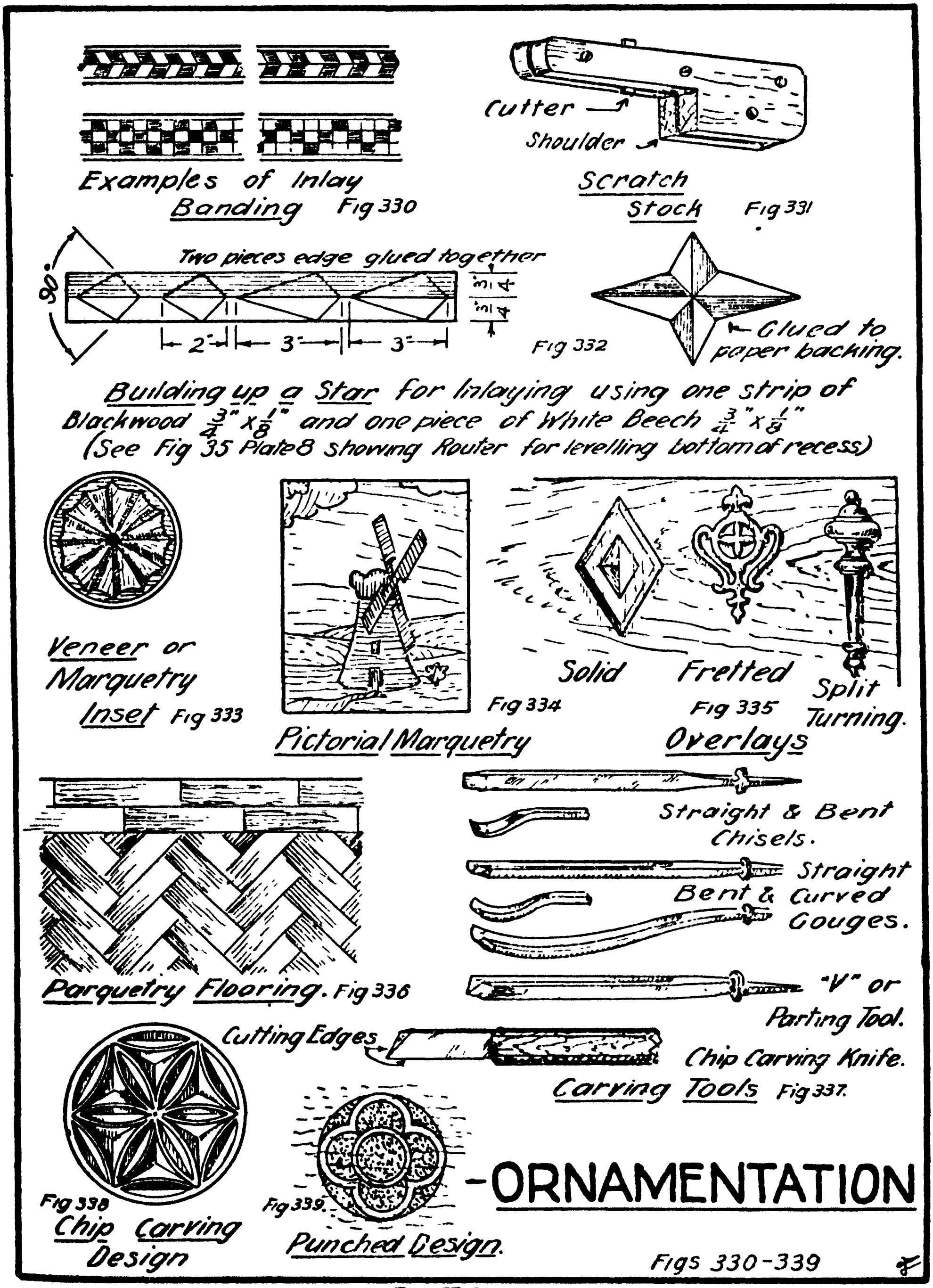
Veneer "inlays" or *"insets"* can be bought ready-made for decorating the centres or corners of solid or veneered panels. They are usually 1/28″ thick. (Fig. 333.)

When designs are inlaid in the centre of work the shape of the recess is traced from the pattern and the edges carefully cut with chisels or gouges, just leaving the lines. The waste may be removed with a chisel and levelled up with a router plane.

Other materials, such as bone, mother-of-pearl and metals, may be inlaid if desired.

3. **Marquetry** is a form of inlay, but differs to the extent that the whole surface is overlaid or covered with a veneer-like pattern cut from veneers of various coloured wood (sometimes dyed the required colour) and other materials as silver, brass, tin, tortoiseshell, etc. The designs for marquetry are usually based on geometric or floral patterns. Pictorial effects, such as landscapes, seascapes, made from coloured veneers of wood are a type of marquetry called "intarsia." (Fig. 334.)

Briefly, the various pieces for the marquetry design are cut from several sheets of different coloured veneers held between two sheets of three-ply. The top piece of ply has a drawing of the design or picture pasted on it. The design is then cut out by a thin-bladed fret saw cutting through all thickness of veneer at once. By interchanging the pieces several pictures or patterns are produced. These are then glued to the surface of the panel, using the caul method of veneering. (See Notes on **Veneering.** Pages 201-9.)



Examples of Inlay Banding Fig 330
Cutter
Shoulder
Scratch Stock Fig 331
Two pieces edge glued together
90°
3/4
3/4
2"
3"
3"
Fig 332
Glued to paper backing.
Building up a Star for Inlaying using one strip of Blackwood 3/4" x 1/8" and one piece of White Beech 3/4" x 1/8"
(See Fig 35 Plate 8 showing Router for levelling bottom of recess)
Veneer or Marquetry Inset Fig 333
Pictorial Marquetry Fig 334
Solid
Fretted
Split Turning.
Fig 335
Overlays
Parquetry Flooring. Fig 336
Straight & Bent Chisels.
Straight Bent & Curved Gouges.
"V" or Parting Tool.
Cutting Edges
Chip Carving Knife.
Carving Tools Fig 337.
Fig 338
Chip Carving Design
Fig 339.
Punched Design.
-ORNAMENTATION
Figs 330-339

PLATE 71.

M

4. **Veneering** is the process of decorating plain wooden flat, curved, or shaped surfaces by gluing over them a thin layer of highly figured wood called a veneer. (See Notes on Veneers and Veneering.)

5. **Parquetry.**—Parquetry is a form of decoration used chiefly for flooring. The surface of the floor is overlaid with blocks of different coloured woods to form geometrical designs. (Fig. 336.)

6. **Wood-Carving.**—Wood-carving is also an ancient art, being a form of decoration applied to solid wood by cutting or carving designs by means of chisels, gouges or knives.

Chip Carving is a simple method of carving requiring few tools. A carving knife or one or two carving gouges and a carving chisel is all that is wanted. The process consists of cutting a series of recesses or pockets with sides which slope into the wood at an angle to the surface. Chip carving designs are essentially geometrical patterns which are made up of straight lines and arcs of circles. (Fig. 338.)

Relief Carving is a much more complicated method of carving. Briefly, it consists of drawing a design (which may be floral, pictorial or interlacing straps, etc.), cutting away the background, then moulding and shaping the various forms. In this way the design is made to stand out in relief from the background. Special carving tools are required for this type of work. (See Fig. 337.) All carving tools are ground and sharpened on both sides, and should be particularly sharp if satisfactory work is to be done.

7. **Matting or Punching.**—This is a form of surface decoration produced by punching a design in the surface of the work, using various shaped punches. Thus the design or its background is slightly brought into relief by roughening or matting the surface of the wood. The matted areas may be stained or coloured. (Fig. 339.)

8. **Overlays** consist of shapes or designs cut out of wood or metal and laid on the surface of the work. Some overlays may be carved or fretted. Another type of overlay consists of split turnings. These are turned shapes which have been cut in two along their axes and glued to the surface of the job. (Fig. 335.)

9. **Fretted or Pierced Work.**—This method of decoration consists of cutting open designs, using a fretsaw, coping-saw or jig-saw. It is suitable for such articles as small boxes, clock cases, brackets, overlays, etc. (Fig. 335.)

10. **Pokerwork.**—A type of surface decoration where the outline of the design is burnt into the surface of the work with a red-hot needle. The design is then coloured with stains or poster colours, which are fixed with shellac or varnish. Suitable for trays, boxes, vases, breadboards, bookends, etc.

11. **Transfers.**—Many varieties of coloured transfers are available, those with geometrical designs resembling wood inlays being suitable for decorating the surfaces of trays, boxes, etc. They may be applied with water and sometimes varnish, but must be fixed and protected by coatings of some type of transparent finish.

12. **Graining** is a method of decorating the surface of wood by painting it to resemble the grain of some figured timber. The job is first coated with a base colour, when dry is followed by a coat of another colour. Part of the second coat of paint is removed before it dries, using various combs, rollers, sponges, rags, brushes, etc, until the imitation is effected. One or two coats of varnish are applied as a finish.

13. **Mouldings.**—Various shaped mouldings are planed or applied to edges and surfaces of jobs to give added ornamentation. Some mouldings themselves may be further decorated with carving or inlay. (See also Notes on Technical Terms under sub-head Mouldings, and Notes on Mouldings below.)

QUESTIONS.

1. What is "inlaying"? Briefly describe how to inlay a "banding."
2. What do you understand by the term "marquetry"?
3. What is the difference between inlay and marquetry decoration?
4. Briefly describe the meaning of the term "veneering."
5. Show by sketches what you understand by overlay, parquetry, matting, chip carving.

XI. MOULDINGS (Plate 72).

Mouldings are ornamental forms or profiles worked on the surface and edges of members to give added decoration. They may be worked by hand or machine. The shapes are made up of straight or curved lines, or a combination of straight and curved lines. They may project or recede depending upon their shape.

The mouldings generally used are based on Grecian and Roman classical forms. The basic mouldings of each style or order have the same names applied to them. The chief difference being that the Greek curves are those of conic sections (ellipse, parabola and hyperbola), while the Roman curves are arcs of circles. The projection of Grecian mouldings is less than the height, while the projection of the Roman mouldings equals their height.

Mouldings are divided into four groups according to the purpose for which they are used:—

1. Crowning Mouldings (above the eye)
   (a) Cyma recta—a combination of concave and convex lines.
   (b) Cavetto—concave, about a quarter circle or similar curve.

2. Supporting Mouldings (above the eye possibly supporting other mouldings)
   (a) Cyma reversa—combination of curves the reverse of the cyma recta.
   (b) Ovolo—a convex quarter circle or similar curve, reverse cavetto.

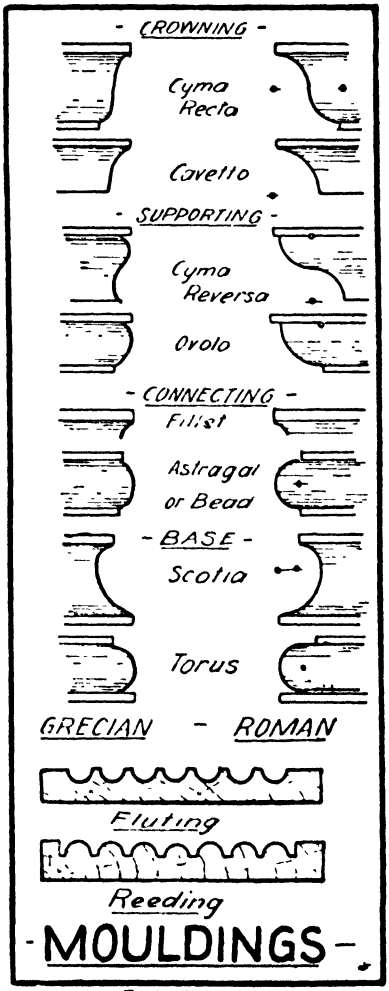


PLATE 72

3. Connecting Mouldings (generally used for dividing individual or groups of mouldings)
   (a) Fillet—a narrow flat or square projection or band.
   (b) Astragal or Bead—a convex half circle or similar curve. Called *astragal* when the moulding projects from the surface and *bead* when flush with the surface.
4. Base Mouldings (below the eye)
   (a) Scotia—a concave curve.
   (b) Torus—a convex curve slightly less than half a circle, reverse scotia.

Many intricate sections or shapes can be made up from the eight foundation mouldings mentioned above.

In modern furniture design there is little use for elaborate ornamentation, and mouldings have been almost eliminated in favour of simple chamfers, bevels and rounded edges which appear quite effective and are easy to keep clean of dust, etc.

See also Notes on Technical Terms Nos. 27, 28, 29.

QUESTIONS.

1. What are mouldings? Briefly state their origin.
2. In what way do Grecian mouldings differ from Roman mouldings?
3. Name four groups into which mouldings may be divided.
4. Carefully draw the eight basic Roman mouldings.
5. Show by sketches the difference between reeding and fluting. What tools could be used to produce these mouldings?
6. (a) Make profile sketches of the following Grecian mouldings:—Cyma recta, cyma reversa, ovolo, cavetto, scotia.
   (b) Describe the making of two of the above mouldings.
   (c) Why are mouldings sometimes scribed at junctions? Sketch an example of a scribed moulding·junction.

SECTION FIVE

COMMERCIAL TIMBERS.

Note: See notes of Structure of Wood (page 143, also plate 65a), showing the difference between "hardwoods" and "softwoods." The terms "hardwood" and "softwood" are misleading as so-called hardwoods include some of the softest timbers in the world and the so-called softwoods include some quite hard woods. The terms "PORED" (hardwood) and "NON-PORED" (softwood) woods provide an accurate distinction.

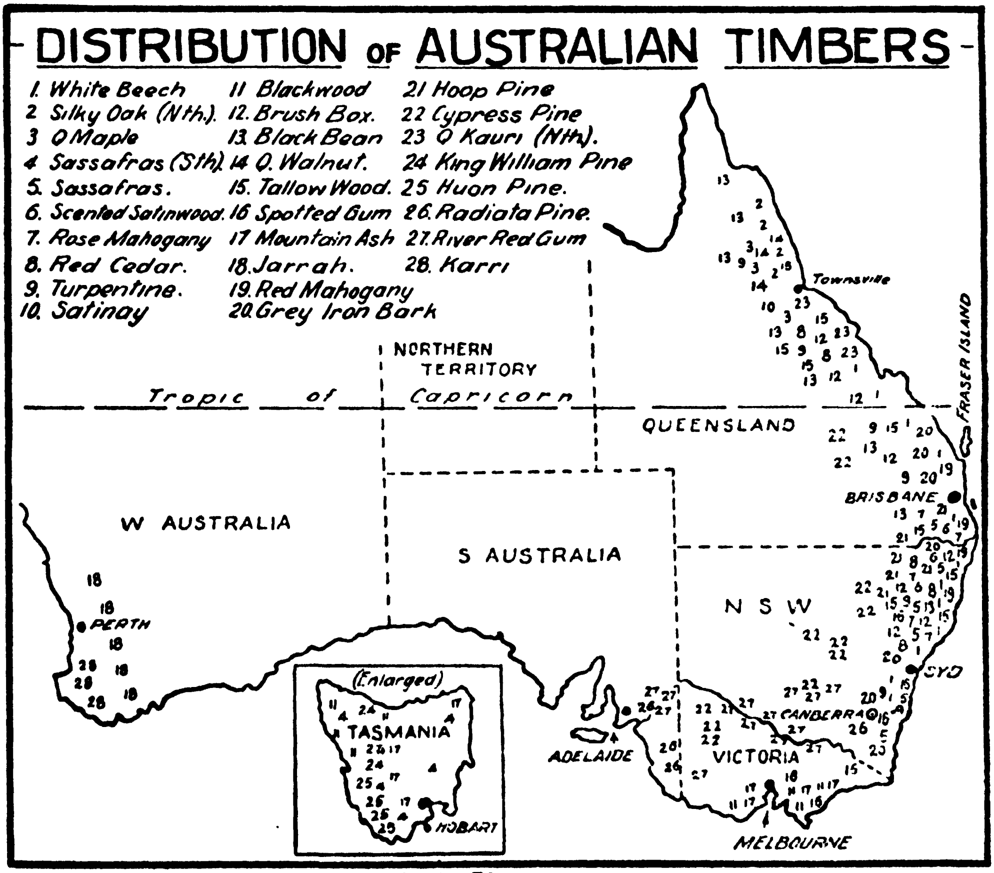


PLATE 73.

In the following notes on Australian Timbers the Standard Trade Common Name is given then the Standard Trade Reference Name followed by other Common Names (according to C.S. & I.R. Division of Forest Products, Trade Circular No. 47 "Nomenclature of Australian Timbers").

Density in all cases is given in lbs. per cubic foot for timber dried to 12% M.C. (Moisture Content).

I. AUSTRALIAN PORED WOODS (Hardwoods) (Plate 73).

1. **White Beech**—Gmelina leichhardtii (Grey teak, Queensland).

Distribution.—Coastal districts of Central N.S.W. to coastal areas of Central Queensland.

The Tree.—Attains a height 125 ft. and a diameter of 4 ft.

THE TIMBER.

Colour.—Very pale brown to grey brown.

Density.—Light in weight, about 32 lb./cub. ft.

Texture.—Coarse to medium, slightly greasy nature.

Grain.—Straight, often interlocked, slight distinction between sapwoods and truewood.

Qualities.—Easily planed and chiselled, clean cutting, soft and cheesy, strong, tough and durable. Seasons well though slowly, does not shrink very much.

USES: Can be used for almost all indoor joinery such as furniture, fittings, carving, etc.; also for pattern making and boat decking.

2. **Silky Oak, Northern**—Cardwellia sublimis (Bull oak, Q.).

Distribution.—North Queensland.

The Tree.—Large and massive—trunk up to 120 ft. high and 4 ft. diameter.

THE TIMBER.

Colour.—Pink to light reddish brown with silvery silk lustre due in some degree to the colour of the medullary rays.

Density.—Light in weight, average 34 lb./cub. ft.

Texture.—Coarse and irregular, partly due to medullary rays.

Grain.—Straight except for irregularities due to large rays, which are very conspicuous on quarter sawn surfaces. Non-fissile.

Qualities.—Easy to work, nail, glue, stain and polish. Can be carved; seasons easily, fairly tough, durable for external and internal work, but not in the ground.

USES: A decorative timber prized for panelling, furniture, and interior decoration, also for motor bodies and railway carriage construction and panelling. Locally it is used for general building purposes. Extensively used for production of veneers and plywood, etc.

3. **Queensland Maple**—Flindersia brayleyana (Maple silkwood; Red beech, Q.).

Distribution.—North-east Queensland.

The Tree.—Height up to 100 ft., diameter 4 ft.

THE TIMBER.

Colour.—Varies in colour from light brown, brownish pink to pink with silken lustre.

Density.—Light in weight, about 34 lb./cub. ft.

Texture.—Medium and uniform.

Grain.—Somewhat interlocked, often wavy or curly, giving rise to decorative figures often ribbon grain and fiddle back.

Qualities.—Strong, tough, non-fissile. Excellent working qualities, glues well, stains and polishes to perfection. Seasons well, not durable in the ground or damp positions. Is somewhat resistant to borers.

USES: This timber ranks among the best cabinet woods in the world and is the most valuable on the Australian market. It is used in high-class furniture and cabinet work, and for reproduction of antiques, for interior decoration in panelling, stairways, doors, mouldings, etc. Also for rifle stocks, aeroplane propellers and in rudders and stems for small craft. It is in active demand for veneer and plywood manufacture.

4. **Sassafras, Southern**—Atherosperma moschatum (Tasmanian sassafras, Tas.).

Distribution.—Tasmania, Victoria, S.E. New South Wales.

The Tree.—Small to medium, height 50-80 ft., diameter 3 ft.

THE TIMBER.

Colour.—Almost white or grey to light brown; heart frequently black.

Density.—Moderately light, about 37 lb./cub. ft.

Texture.—Fine and uniform.

Grain.—Fairly straight, fine, even, smooth. Growth rings fairly distinct.

Qualities.—Easily worked, cuts cleanly, fairly soft, non-durable in the ground.

USES: Turnery, clothes pegs, small handles, cotton reels, wooden screws, buckets, interior fittings and carvings. Chemicals are extracted from the bark.

5. **Sassafras**—Doryphora sassafras (Golden deal; Yellow sassafras; Canary sassafras, N.S.W.).

Distribution.—Coastal areas from Victorian border to Southern Queensland.

The Tree.—Large, height up to 120 ft., diameter 4 ft.

THE TIMBER.

Colour.—Pale yellow—darkening on exposure to yellowish brown.

Density.—Light in weight, average 35 lb./cub. ft.

Texture.—Very fine and uniform.

Grain.—Rather short straight grain, which tends to be brittle. Rays fairly distinct.

Qualities.—Works readily, planes cleanly, fairly soft, nails, stains and paints well. Lacks strength and durability in the ground or damp positions. Seasons satisfactorily though slowly. Very resistant to termites and borers.

USES: Suitable for interior work, lining and flooring boards, packing cases. Also for turnery, pegs, brush stocks, etc. Extensively used in N.S.W. for solid core-stock manufacture.

6. **Scented Satinwood or Coachwood**—Ceratopetalum apetalum (Coachwood, N.S.W.; Rose mahogany, Vic.).

Distribution.—Along the coast of N.S.W. from south of Sydney to Queensland border.

The Tree.—Attains height 100 ft., 2 ft. diameter.

THE TIMBER.

Colour.—Light brown to pink brown.
Density.—Moderately light, about 41 lb./cub. ft.
Texture.—Fine and uniform.
Grain.—Straight, figured on back sawn surfaces, due to bands of soft tissue.
Qualities.—Characteristic odour resembling caramel or new-mown hay, works and turns well, although somewhat leathery. Moderately soft but tough.

USES: Motor body construction, turnery, brush stocks, broom handles, dowels, shoe heels, railway carriage roof sticks, gun stocks, flooring and lining, interior joinery and furniture, rotary cut veneers and plywoods, veneer core-stock. Highly figured logs are used for knife cut veneer for furniture making.

7. **Rose Mahogany**—Dysoxylum fraseranum (Rosewood, N.S.W.).
Distribution.—Coastal areas of N.S.W. and Southern Queensland.
The Tree.—Height up to 130 ft., diameter 5 ft.

THE TIMBER.

Colour.—Reddish brown, sometimes marked with small dark coloured oily patches, sapwood white.
Density.—Moderately light, about 45 lb./cub. ft.
Texture.—Medium and uniform.
Grain.—Often interlocked, figure on back sawn surfaces due to bands of soft tissue.
Qualities.—Aromatic rose-like odour. Dresses fairly well, somewhat brittle. Not very strong but very durable, resists dampness and termites. Needs careful and slow seasoning. Takes a high polish.

USES: For ornamental purposes, veneers, inlays, turnery, carving, engraving; also furniture, panelling, shop and office fittings and polished flooring.

8. **Red Cedar**—Cedrela toona.

Distribution.—Coastal areas of N.S.W., Queensland, also Pacific Islands. Mostly North Queensland.

The Tree.—One of Australia's few deciduous native trees; height about 140 ft., 6 ft. diameter.

THE TIMBER.

Colour.—Light to deep red with silken lustre.
Density.—Light, about 33 lb./cub. ft.
Texture.—Open and coarse—fibres somewhat woolly.
Grain.—Straight, fairly distinct growth rings, producing pleasing figure on back sawn surfaces.
Qualities.—Slight aromatic odour. Light, very soft, easy to work, planes cleanly and takes a high polish. Not very strong, sometimes brittle. Very durable when exposed to the weather, and resists termites and borers.

USES: One of Australia's most valuable cabinet woods (although somewhat scarce). For shop and office fittings and furniture. Also for racing skiffs, pattern making, carving, panelling for railway cars, veneers and plywoods.

9. **Turpentine**—Syncarpia laurifolia. Also known as LUSTRE.
Distribution.—Coastal districts of N.S.W. and Queensland.
The Tree.—Attains height 140 ft. and diameter 3ft. 6ins.

THE TIMBER.

Colour.—Reddish brown, resembles Brush box.

Density.—Moderately heavy to heavy, 55-65 lb./cub. ft.

Texture.—Fine and uniform.

Grain.—Straight, often interlocked and wavy.

Qualities.—Hard, but comparatively easy to work. Somewhat gritty nature, tending to dull saws, etc. Takes a good polish and can be bent under steam. It is very durable in the ground or exposed positions, being resistant to termites and marine borers. Also it is especially fire resistant. It is difficult to season, being very liable to warp and twist. Wears well without splintering when exposed to friction.

USES: Principal use is for saltwater piles. Also for wood paving, sleepers, decking for bridges and wharves, flooring, ship planking, mallets, fencing, etc.

10. **Satinay**—Syncarpia hillii (Fraser Island turpentine, Q.).
Distribution.—Fraser Island (off coast of Queensland).
The Tree.—Attains height 140 ft. and nearly 3 ft. diameter.

THE TIMBER.

Colour.—Red to red brown.

Density.—Moderately heavy, about 52 lb./cub. ft.

Texture.—Fine and uniform.

Grain.—Generally interlocked, with ribbon or wavy figure.

Qualities.—Hard, moderately strong, tough and wears well. Fairly durable in exposed positions. Stains and polishes well, and fumes with ammonia to a greyish brown walnut colour. Requires care in seasoning.

USES: High-class cabinet work, for fittings decorative panelling, flooring, for handles of fishing rods, chisel handles, etc. Building construction, joists, studs, etc. Also for piles, poles and posts.

11. **Blackwood**—Acacia melanoxylon.
Distribution.—Coastal districts of N.S.W. and Victoria, but chiefly Tasmania.
The Tree.—Height up to 100 ft., about 3 ft. diameter.

THE TIMBER.

Colour.—Light golden brown to red brown with dark brown streaks, sapwood white.

Density.—Light to moderately light, about 40 lb./cub. ft.

Texture.—Medium to open and uniform.

Grain.—Straight, often interlocked or wavy, giving rise to fine decorative figure. Fairly distinct growth rings, which produce a pleasing figure on both radial and back sawn surfaces. Fissile.

Qualities.—Fairly strong, fairly soft, works easily, turns and carves well, dresses to a smooth surface, which takes a high polish. One of the best Australian timbers for bending. Fairly durable, but not when exposed.

USES: Valuable for cabinet work, interior decoration, office fittings, panellings and veneers. For parquetry flooring and inlays. Its steam bending qualities make it useful for tennis racquet frames and beer barrel staves. Used extensively in carving, turnery—walking sticks and ornamental articles.

12. **Brush Box**—Tristania conferta (Brisbane box; Scrub box, Q.).

Distribution.—Forest areas along coast from North N.S.W. to Fraser Island, Queensland.

The Tree.—Height up to 120 ft., diameter 7 ft.

THE TIMBER.

Colour.—Grey brown to red brown.

Density.—Fairly heavy, average about 57 lb./cub. ft.

Texture.—Close, fine and uniform.

Grain.—Plain, often slightly interlocked—non-fissile—waxy nature.

Qualities.—Hard, tough, somewhat liable to warp and twist in seasoning. Excellent wearing qualities, durable except in the ground and damp positions. Resists termite attack.

USES: Bridge and wharf construction, decking, paving blocks, wooden tram rails, coach and carriage work. Mauls, mallets, stocks for wooden planes. For high-class floors and interior fittings.

13. **Black Bean**—Castanospermum australe (Moreton Bay chestnut, N.S.W.).

Distribution.—Coastal areas from north N.S.W. to Cape York Peninsula.

The Tree.—Attains a height of 130 ft. and 4 ft. diameter. (Obtains its name from the bean-like fruit and dark wood.)

THE TIMBER.

Colour.—Truewood dark brown to almost black, sapwood white to pale yellow.

Density.—Moderately light, about 48 lb./cub. ft.

Texture.—Coarse and uniform.

Grain.—Usually straight and sometimes interlocked, slightly greasy. Prominent figure, due to light coloured soft tissue surrounding the pores.

Qualities.—Fairly easy to work and plane although a hardwood. Attractive figure, takes a high polish. Carves and turns well. Durable in the ground and is termite resisting. Rather difficult to season as it is liable to warp—seasons slowly. Tends to become brittle with age. The dust from machine working of Black bean tends to irritate the skin and breathing passages.

USES: Black bean is a high-class cabinet wood used for internal fittings, panelling, mouldings and framings, shop and office fittings. Also used for veneers, turnery—walking sticks, serviette rings, nut bowls, etc. Was used when plentiful for general building purposes owing to its durability.

14. **Queensland Walnut**—Endiandra palmerstoni (Australian walnut, Q.; Walnut bean, Q.; Oriental wood, U.S.A.).

Distribution.—North Queensland.

The Tree.—Height up to 140 ft., diameter 6 ft.

THE TIMBER.

Colour.—Variegated grey brown to red brown with dark and light (pinkish) longitudinal streaks, which, in combination with a wavy grain, gives an exceptional variety of figure.

Density.—Moderately light, 46 lb./cub. ft.

Texture.—Medium and uniform.

Grain.—Straight, often wavy, producing nicely figured veneers.

Qualities.—Works fairly well with hand tools, but when dry it is difficult to cut with high-speed machine tools, owing to the presence of silica, which quickly dulls the cutting edges. Can be cut for veneers without difficulty. Has a high electrical resistance. Requires careful seasoning. Not durable in the ground. Turns and polishes well.

USES: Decorative furniture, panelling, shop and office fittings, ornamental turnery, walking sticks, egg cups, nut bowls, etc. All types of veneers.

15. **Tallow-wood**—Eucalyptus microcorys.

Distribution.—Coastal ranges of North N.S.W. and Queensland.

The Tree.—Reaches a height of 150 ft., diameter 6 ft.

THE TIMBER.

Colour.—Light greyish yellow to yellow brown with a shiny lustre.

Density.—Fairly heavy, about 60 lb./cub. ft.

Texture.—Moderately coarse.

Grain.—No prominent figure, often interlocked, greasy in appearance and feel, non-fissile.

Qualities.—Characteristic greasy nature, hard, strong, tough, and very durable for use above or below the ground. Comparatively easy to work, turns moderately well, and polishes easily. Seasons well and wears evenly. Often difficult to split.

USES: One of the most valuable flooring timbers in N.S.W. and Queensland. Used for all building purposes, weatherboards, window sills, paving blocks. Electrical transmission poles and cross arms, sleepers, etc. Bridge construction, heavy coach and carriage framing. Best possible timber for dancing floors.

16. **Spotted Gum**—Eucalyptus maculata.

Distribution.—Coastal districts of North N.S.W. and South Queensland.

The Tree.—Attains a height of 120 ft. and about 4 ft. diameter—slim and erect.

THE TIMBER.

Colour.—Light pinkish brown, grey brown to dark brown. Sapwood light.

Density.—Heavy in weight, from 52-70 lb./cub. ft.

Texture.—Moderately open to coarse.

Grain.—Straight, often interlocked, somewhat greasy appearance.

Qualities.—Heavy, hard, strong, very tough, and flexible. Sapwood liable to attack by powder post borer. Works fairly easily. Not very durable in the ground.

USES: An important commercial hardwood. Used for all types of building construction; framing for coach, motor, and waggon bodies, spokes, shafts, heavy bent work. All kinds of handles—axe, pick, hammer, etc. Also for meat skewers.

17. **Mountain Ash**—Eucalyptus regnans (Swamp gum, Tas.; White mountain ash, Vic.; Australian oak, Tasmanian oak, Victorian oak).

Distribution.—Eastern Victoria and Tasmania.

The Tree.—One of the tallest trees in the world, often up to 280 and 300 ft., diameter 2-4 ft. Largest hardwood tree in the world.

THE TIMBER.

Colour.—White to pale brown, sometimes with pinkish tinge.

Density.—Light, average 30 lb./cub, ft.

Texture.—Fairly open and uniform.

Grain.—Usually straight with little figure, but sometimes interlocked and wavy—growth rings often distinct.

Qualities.—Fairly tough, strong, ranks among the lightest and softest Australian pored-woods. Works easily, bends moderately well, and gives a good finish with waxes and stains. Fairly durable in the ground, seasons easily, though subject to collapse.

USES: One of the most generally utilised of Australian timbers. All types of building work, flooring, framing, fittings and furniture. Handles for axes and agricultural tools; for fencing, palings, sleepers and packing cases. Paper pulp. Highly figured veneers are often cut from the butt. Often used to replace imported softwoods.

18. **Jarrah**—Eucalyptus marginata.

Distribution.—S.W. of W. Australia.

The Tree.—Ranges from 100 to 150 ft. in height and 3 to 6 ft. diameter at the base.

THE TIMBER.

Colour.—Red brown to dark red—darkening with age.

Density.—Fairly heavy, about 55 lb./cub. ft.

Texture.—Coarse and uniform.

Grain.—Straight, often interlocked producing fiddleback figure.

Qualities.—Has a world-wide reputation on account of its durability and fire-resisting qualities. Very strong, tough, fairly hard, easily worked and polishes well.

USES: Principal hardwood timber of W.A. Exported for railway sleepers and flooring. Locally it is used for piles, wharf and bridge construction, paving, posts and sleepers, etc. Dressed it is chiefly used for flooring, doors, window frames, interior fittings, panelling, etc. In N.S.W. it is imported for high-class parquetry flooring, etc.

19. **Red Mahogany**—Eucalyptus resinifera (Red stringybark, Red messmate, Q.).

Distribution.—Coastal districts of North N.S.W. and Queensland.

The Tree.—Height up to 130 ft. and 5 ft. diameter.

THE TIMBER.

Colour.—Rich deep red.

Density.—Heavy, about 62 lb./cub. ft.

Texture.—Moderately close to open.

Grain.—Usually straight, often somewhat interlocked, giving a ripple figure.

Qualities.—Somewhat resembles Jarrah. Durable except in badly ventilated positions and in the ground. Wears very well, strong, tough, fairly hard, old wood tends to be brittle. Fairly easy to work and takes a high polish.

USES: Valuable for general building purposes, oiled weatherboards, fencing and flooring. Posts, poles, paving blocks, carriage construction, ship building. Although heavy, it is sometimes used for furniture and interior panelling and fittings. Often used as a substitute for Jarrah.

20. **Grey Iron Bark**—Eucalyptus paniculata.

Distribution.—Coastal areas of southern half of N.S.W. and southern half of Queensland.

The Tree.—Greatest of the iron barks, attaining a height of 130 ft., basal diameter 4 ft.

THE TIMBER.

Colour.—Varies considerably from grey brown to red.

Density.—Very heavy, average about 68 lb./cub. ft.

Texture.—Fine and compact.

Grain.—Often interlocked with little or no figure.

Qualities.—Hard to cut and difficult to work. Very strong, tough, and durable in the ground, not resistant to termites.

USES: Possibly the most valuable of the iron barks for all kinds of heavy constructional work, girders, bridge construction, piles, sleepers, poles, posts, spokes, shafts, machinery foundations, framing for houses, factories, very heavy vehicles, etc. Also for weatherboards and flooring.

II. AUSTRALIAN NON-PORED WOODS (Softwoods)

(Plate 73)

1. **Hoop Pine**—Araucaria cunninghamii (Colonial, Dorrigo and Richmond River pine, N.S.W.).

NOTE: In trade practice Bunya Pine (Araucaria bidwilli) is also sold as Hoop Pine, since there is little difference between the two timbers.

Distribution.—Hoop pine, North N.S.W. and Queensland; Bunya pine, Queensland. Also mountain ranges of New Guinea.

The Tree.—Hoop pine—almost cylindrical trunk, ranging up to 150 ft. high and 5 ft. diameter.

THE TIMBER.

Colour.—White to light yellow brown with slightly darker streaks due to growth rings.

Density.—Light in weight, average about 33 lb./cub. ft.

Texture.—Fine and uniform.

Grain.—Straight, often with growth ring figure on back sawn surface, and rotary cut veneers.

Qualities.—Excellent to work, easy to cut, plane, saw, nail, glue, stain and polish. Takes a lustrous finish. Soft, tough, strong, very durable except in damp positions. Liable to bluing due to sap staining fungi. Usually odourless. Peels easily for veneers.

USES: For all kinds of interior joinery, shelving, flooring, lining boards, ceilings, mouldings, etc. Pattern making, light handles, dowelling, brush and broom stocks. Cabinet work, kitchen furniture, etc. Also light spars and masts. Tram car and truck flooring. Particularly suitable for veneer and plywood manufacture. Sawdust is suitable for polishing plastic articles such as buttons, buckles, etc. It is Australia's chief timber for butter boxes.

2. **White Cypress Pine**—Callitris glauca (Cypress pine, Murray pine, N.S.W., Q., Vic.). Most important of the Cypress pines.

Distribution.—Grows in most States except Tasmania.

The Tree.—Medium height, about 80-100 ft., diameter 2 to 2½ ft.

THE TIMBER.

Colour.—Pale yellow to brown, streaked longitudinally with dark brown of the growth rings, spotted with dark brown firm knots.

Density.—Fairly light, about 42 lb./cub. ft.

Texture.—Close, fairly uniform.

Grain.—Usually straight except around knots, which are numerous. Growth rings sometimes distinct. Slightly greasy nature. Fissile.

Qualities.—Characteristic odour, fairly hard, inclined to be brittle and fissile, causing some difficulty in nailing when dry. Very durable in the ground, very resistant to termites and borers, due to the presence of oils. Subject to numerous firm knots, which often produce a beautiful figure when sliced for veneers. Very inflammable.

USES: Because of its high durability Cypress pine is specially suited for use in exposed positions or termite-infested areas. For all building purposes, linings, ceilings, weatherboards, flooring joists, studs, house stumps, etc. For poles, posts, concrete forms, etc. Also an excellent wood for paper pulp.

3. **North Queensland Kauri**—Agathis palmerstoni (Black or Bull kauri, Bull pine, Q.).

Distribution.—Highlands of North Queensland.

The Tree.—Large, up to 150 ft. in height, average 100 ft., 4 to 5 ft. diameter.

THE TIMBER.

Colour.—Ranges from creamy white to brown.

Density.—Light in weight, average about 39 lb./cubic ft.

Texture.—Fine, uniform and compact.

Grain.—Straight and plain.

Qualities.—Easy to work, stain, nail, glue and polish. For a soft wood it is fairly tough. No odour or taste. Seasons satisfactorily, not durable in the ground or damp positions.

USES: Extensively used in cabinet work, joinery, flooring, framing, panelling, shelving. Also marine buoys and floats, small boats, butter boxes, pattern making, piano cases, staves for casks and for plywood.

4. **King William Pine**—Athrotaxis selaginoides.

Distribution.—Tasmania.

The Tree.—Height up to 100 ft., about 4 ft. diameter.

THE TIMBER.

Colour.—When dry, light pink to yellow pink.

Density.—Light in weight, average about 24 lb./cub. ft.

Texture.—Moderately fine to open, fairly uniform.

Grain.—Straight, sometimes with a pleasing figure due to fairly distinct growth rings, which are sometimes wavy. Fissile.

Qualities.—Very soft, very easy to work and plane, fairly strong, very durable even in damp positions. A good bending timber. Resembles in texture Californian Redwood.

USES: Cabinet work, joinery, window frames, sashes, mouldings, etc. Also oars and sculls, for pattern making, vats, wood pipes, weatherboards and violin backs.

5. **Huon Pine**—Dacrydium franklinii.

Distribution.—Confined to Tasmania.

The Tree.—Average height about 80 ft. and diameter 3½ ft.

THE TIMBER.

Colour.—Pale yellow to yellow brown.

Density.—Light, about 32 lb./cub. ft.

Texture.—Close and uniform.

Grain.—Straight, with fine growth rings, which are sometimes wavy, giving a pronounced figure. Sometimes shows "bird's eye" figure, due to small knots. Fissile.

Qualities.—Smooth and oily, with characteristic odour due to the presence of an essential oil. It is very durable, soft and fairly strong, but not tough. Is easily worked, bends satisfactorily, and takes a good finish, staining and polishing very well.

USES: Favoured for shipbuilding, for which there is probably no superior timber. Also cabinet work, joinery, interior fittings, etc.—doors, sashes, and drawer slides. For ornamental articles decorated with poker work and hand painting.

6. **Radiata Pine**—Pinus radiata (Insignis pine, Monterey pine and Remarkable pine).

Distribution.—A conifer grown in plantations in various States of Australia, largest plantations being in S.A., Vic., and N.S.W. Also grown extensively in South Africa and New Zealand. Radiata pine was introduced into Australia for plantation growing about 1880 from its native habitat, California.

The Tree.—Average height 80-100 ft. and diameter up to 3 ft.

THE TIMBER.

Colour.—White to pale brown, darker near the pith.

Density.—Light in weight, average about 30 lb./cub. ft.

Texture.—Fine and fairly uniform. Distinct growth ring figure.

Grain.—Straight, often spiralled near the pith, resin canals prominent. Growth rings vary in width, producing a coarse figure. Knots sometimes fairly common. Non-fissile.

Qualities.—Fairly soft, resinous, sometimes knotty, wide sapwood. Not regarded as a first-class softwood. Nails and works easily, planes to a smooth lustrous surface, taking stains and polishes readily. Not durable for exterior use unless treated with preservatives.

USES: Very useful for box making, interior joinery—mouldings, flooring, lining, weatherboards. Also plywoods, paper pulp, rayon, matchboxes and matches.

III. IMPORTED TIMBERS—PORED WOODS (Hardwoods)

1. **Pacific Maple**—Shorea spp.

Distribution.—Philippines.

The Tree.—Several varieties, varying in heights and diameters.

THE TIMBER.

Colour.—Pink to red, sapwood pale.

Density.—Light in weight, about 32 lb./cub. ft.

Texture.—Open and uniform.

Grain.—Usually straight, often interlocked, giving a pleasing ribbon figure on radial surfaces.

Qualities.—Easily worked, soft, bruises easily. Not durable for work which has to stand much wear.

USES: All classes of interior joinery, mouldings, panelling, framing, window sashes, furniture. Railway carriages, etc.

2. **Oak**—Quercus spp. (English oak—Q. pedunculata; American whiteoak—Q. alba; Japanese oak—Q. crispula).

NOTE: There are over 300 species of oak, the common varieties being very similar, any variations are mainly due to growing conditions.

Distribution.—Widely distributed—Europe, Asia, Canada, North America, etc.

The Tree.—Reaches a height of 50-100 ft. and diameter 2-4 ft.

THE TIMBER.

Colour.—Creamy white to pale brown.

Density.—Moderately light, 40-50 lb./cub. ft.

Texture.—Generally coarse, open and uniform.

Grain.—Straight, conspicuous figure, due to broad distinct medullary rays which produce "silver grain" on quarter sawn surfaces.

Qualities.—Noted for strength, durability and toughness. Hard, fairly light to heavy. Takes a smooth hard finish, usually requiring a filler prior to polishing. Fumes to a grey colour with ammonia. Works and carves easily.

USES: Its fine figure makes it a valuable cabinet wood, also for panelling, staircasing, and interior decoration of all types. Its toughness makes it a good wood for motor body work, machinery frames, wheel spokes, boats, gymnasium equipment, etc. Also used in tanks for brewing and distilling. Japanese oak is imported for furniture, mouldings, carving, parquetry flooring, church, shop and office fittings, steam bending, etc.

3. **Ash**—Fraxinus spp. (English ash—F. excelsior; American white ash—F. americana).

NOTE: There are numerous species of Ash widely distributed in the temperate regions of the Northern Hemisphere.

English Ash.

The Tree.—Reaches a height of 50-60 ft. and about 3-4 ft. diameter.

THE TIMBER.

Colour.—White to light brown, sometimes pinkish brown. Sapwood white.

Density.—Moderately heavy, about 45 lb./cub. ft.

Texture.—Fairly coarse and uniform.

Grain.—Characteristically straight grained, distinct growth rings producing a pronounced figure.

Qualities.—Fairly hard, heavy, tough and elastic, particularly good bending properties. Not durable in exposed positions. Works well, stains, paints and polishes well. Seasons fairly well and quickly.

USES: Aeroplanes, automobile bodies, tool handles, sporting goods (particularly skis), hockey sticks, racquet frames, etc. Agricultural implements and ladders, joinery and furniture. Bent edges of trunks, hoops for casks, hood frames for cars, etc. Figured veneers are obtained from the butt.

4. **Mahogany**. The true mahoganies belong to the genus Swietenia. (Spanish mahogany—S. mahogoni; Honduras mahogany—S. macrophylla.)

Honduras Mahogany—supplies the bulk of imported true mahogany.

Distribution.—Cuba and British Honduras—Tropical America.

The Tree.—Reaches a height 80-100 ft. and a diameter 4-6 ft.

THE TIMBER.

Colour.—Light red or yellow brown to rich dark red brown.

Density.—Fairly light, 35-37 lb./cub. ft.

Texture.—Open and uniform.

Grain.—Frequently interlocked, producing a variety of figure, fiddle back, etc.

Qualities.—Works readily, takes glue excellently, stains well and gives excellent results for all finishing treatments. Strong, durable, very little shrinking and swelling for changes in moisture content. Bends fairly well.

USES: Highly prized for high-class cabinet and furniture making, joinery, and interior decoration and fittings. Selected high-grade used for airscrews—also used for shipbuilding and printers' blocks. Figured wood used for veneers.

IV. IMPORTED TIMBERS—NON-PORED (Softwoods)

1. **Redwood**—Chief varieties Sequoia gigantea and S. sempervirens.

The trees are of gigantic proportions—among the largest in the world.

Californian Redwood—S. sempervirens.

Distribution.—East coast of North America.

The Tree.—Height ranges from 130 to 340 ft. and diameter from 8 to 30 ft., about ½ to 2/3rds the height being clear of branches. The bark is very thick, up to 24 inches.

THE TIMBER.

Colour.—Truewood red, sapwood yellow to white.

Density.—Light, from 25-30 lb./cub. ft.

Texture.—Fairly open and uniform.

Grain.—Straight, free of knots, with distinct growth rings.

Qualities.—Soft, easy to work, fairly durable in the ground or exposed positions, resistant to fire, borers and termites. Figure due to growth rings.

USES: General building, joinery and furniture—panelling, mouldings, doors, sashes, veneer corestock, drawing boards, pattern making, etc. Also weatherboards, shingles, tanks, wood pipes, sleepers, fence posts and street paving. King William pine is often used in Australia as a substitute for Redwood.

2. **New Zealand Kauri**—Agathis autralis.

Distribution.—Mainly North Island of New Zealand.

The Tree.—Large forest tree up to 150 ft. in height, diameter from 5 to 15 ft. Very slow growing.

THE TIMBER.

Colour.—Creamy white to brown.

Density.—Fairly light, 30-40 lb./cub. ft.

Texture.—Fine, firm and uniform.

Grain.—Straight.

Qualities.—Remarkable for its strength and durability. Works easily, glues well and is readily stained and polished. Durable in wet positions, sometimes brittle. Wears well and evenly. Frequently shows considerable longitudinal shrinkage.

USES: In N.Z., for boats, masts, spars, etc. All interior joinery, flooring, lining, etc.—furniture, turnery, pattern making and veneers. Imported for vats and boat-building. Exudes a gum used for varnish making—sometimes called copal gum.

3. **Douglas Fir** or **Oregon**—Pseudotsuga taxifolia (British Columbia pine).

Distribution.—On western coasts of North America and Canada.

The Tree.—Reaches a height of over 300 ft. and 15 ft. diameter. Averages 150-200 ft., diameter 3 ft.-6 ft.

THE TIMBER.

Colour.—Pale yellow to reddish brown, sapwood very narrow, about 2″—pale yellow.

Density.—Fairly light, 30-37 lb./cub. ft.

Texture.—Open, not uniform, due to hard bands of late-wood in growth rings.

Grain.—Usually straight, but sometimes with wavy, prominent growth rings which produce pronounced figure when back sawn or rotary cut for veneer.

Qualities.—Among the hardest of the softwoods, easy to work, easy to season, and takes stains and polishes readily. Very strong, wears well, tough and fairly durable, but requires preservative treatment for prolonged use in exposed positions. Rarely attacked by borers, but very subject to termites.

USES: For every department of the building trade, carpentry, joinery and fittings. Flooring, doors, window sashes, mouldings, veneers and plywoods. Also flag poles, posts, telegraph poles, jetties, piers, bridges, piles, water tanks and pipes, spars and masts for boats. Also used for paper pulp.

4. **Rimu**—Dacrydium cupressinum.
Distribution.—New Zealand.
The Tree.—Reaches a height of 60-120 ft. and diameter of 2-4 ft.

THE TIMBER.

Colour.—Pale straw brown, frequently streaked with greyish brown. Sapwood pale.
Density.—Fairly light, average 36 lb./cub. ft.
Texture.—Fine and uniform.
Grain.—Straight, sometimes rather short grained.
Qualities.—Easy to work, planes smoothly and cleanly, glues fairly well, stains and polishes excellently. Not durable when exposed to the weather.

USES: Building construction (except for parts in the ground), flooring and lining weatherboards, interior fittings for coaches and trams, turnery, sliced veneers and plywood.

QUESTIONS.

1. Describe two Australian cabinet woods. State their colour, qualities and uses.
2. Draw a map of the eastern coast of Australia and on it show where the following timbers grow:—Northern silky oak, Queensland maple, White beech and Hoop pine.
3. Name and describe a timber with very distinct medullary rays.
4. Why is Hoop pine suitable for the manufacture of butter boxes?
5. Compare the characteristics of Queensland maple and Pacific maple.
6. Describe fully Hoop pine. Why is this timber suitable for the making of butter boxes?
7. Describe the timber and uses of two Australian hardwood cabinet woods.
8. Describe two timbers suitable for making cores for veneered furniture. Name them.
9. Describe the timber and uses of Turpentine.
10. Describe and state the special uses of Tallowwood.
11. Describe an Australian timber suitable for making tool handles.
12. Describe the uses of Cypress pine. Why is this timber suited to its uses?
13. Describe the timber and uses of Queensland kauri.
14. Draw a map of Australia and show on it the habitats of the following timbers:—Sassafras, Scented satinwood, Rose mahogany, Red cedar, Turpentine, Tallowwood and Spotted gum, Cypress pine and Queensland kauri.
15. Describe the tree, timber and uses of Redwood.
16. In what way does Blackwood differ from the other Australian pored woods mentioned in the third year course? Describe the timber and uses of Blackwood.
17. Compare the timbers and uses of Red mahogany and Jarrah.
18. Compare the uses of Red mahogany and Rose mahogany.
19. Compare the timber and uses of Mountain ash and Brush box.
20. Name and describe two Tasmanian softwood timbers.

21. Draw a map of Australia and show in it the habitats of the Australian timbers mentioned in your third year course.

22. Describe the timber and uses of Oregon. Where does this timber grow?

23. Compare Queensland kauri and N.Z. kauri.

24. Describe the timber and uses of Black bean and Queensland walnut.

25. Describe fully the timber and uses of (a) English oak, (b) English ash, (c) Honduras mahogany.

SPECIFIC USES OF AUSTRALIAN TIMBERS

Veneer and Plywood

Plain, rotary peeled—

Hoop pine
Bunya pine
Radiata pine
Alpine ash
Mountain ash
Queensland kauri
Coachwood
Sassafras
Silky oak

Figured, sliced—

Queensland maple
Queensland walnut
Silky oak
Radiata pine
Black bean
Blackwood

Bending Timbers

Alpine ash
Blackwood
Mountain ash
Radiata pine
Rose mahogany
King William pine
Spotted gum
Red tulip oak
Nth. silky oak
Silver ash

Carving Timbers

White beech
Silky oak
Blackwood
King William pine
Huon pine
Black bean
Sassafras
Jarrah

Furniture

Plain—

Queensland kauri
Hoop pine
Radiata pine
Ash, Mt. and Alpine

Figured—

Queensland maple
Red cedar
Queensland walnut
Silky oak
Rose mahogany
Blackwood
Tulip oak
Silver ash
Coachwood
Mountain ash
Sassafras
Satinay
River banksia

Drawing Boards

King William pine
Huon pine
Queensland kauri

Tools

Axe & Hammer Handles—

Spotted gum
Hickory ash
Sth. blue gum
Yellow wood
Leatherwood
White and grey handlewood

Chisel, screwdriver, etc.—

Brush box
Coachwood
Blackwood
Sassafras
White and grey handlewood

Mallets—

Brush box
Jarrah
Iron bark
Red gum

Planes—

Brush Box
Jarrah
Red gum

SECTION SIX

VENEERS—PLYWOOD—FIBRE BOARDS.

I. VENEERS (Plate 74).

DEFINITION.—A thin layer or sheet of wood which may vary from 1/120" to ¼" in thickness.

USES AND ADVANTAGES OVER SOLID TIMBER.

Originally veneer was used only for decorative purposes, being glued with a suitable adhesive to the solid wood of furniture; but the many advantages associated with its use have led to the world-wide adoption of veneered construction for all types of furniture, cabinetwork, panelling, etc., using built-up corestock or plywood as groundwork, to which the figured veneer is glued.

The advantages of veneered construction may be summarised as follows:—

(a) A large quantity of thin veneer can be obtained from one piece of highly figured timber.

(b) It allows the use of figured timber showing unusual and beautiful effects due to grain irregularities, etc., which under ordinary circumstances could not be seasoned successfully.

(c) Veneered panels are stronger and less liable to check and warp than solid wood.

(d) The cores of veneered panels may be built up of softer, lighter and cheaper timber than that used for solid construction.

(e) Better use can be made of figured timber by the "matching" (arranging symmetrically) of consecutively cut sheets of veneer. This cannot be done with solid timber. (Figs. 340-347.)

(f) Bent or curved panels can be readily made using veneer.

TIMBERS USED.

Any timber may be used as a veneer. Local fancy timbers which are commonly sold as veneers are Queensland maple, Queensland walnut, and Northern silver ash. Imported veneers include Italian walnut and Mahogany.

MANUFACTURING VENEERS.

Figured veneers may be cut from the trunk, the stump or butt (junction of the roots and trunk), crotches (junction of the trunk and branches), or burls ("burls" are large wartlike growths on the tree trunk).

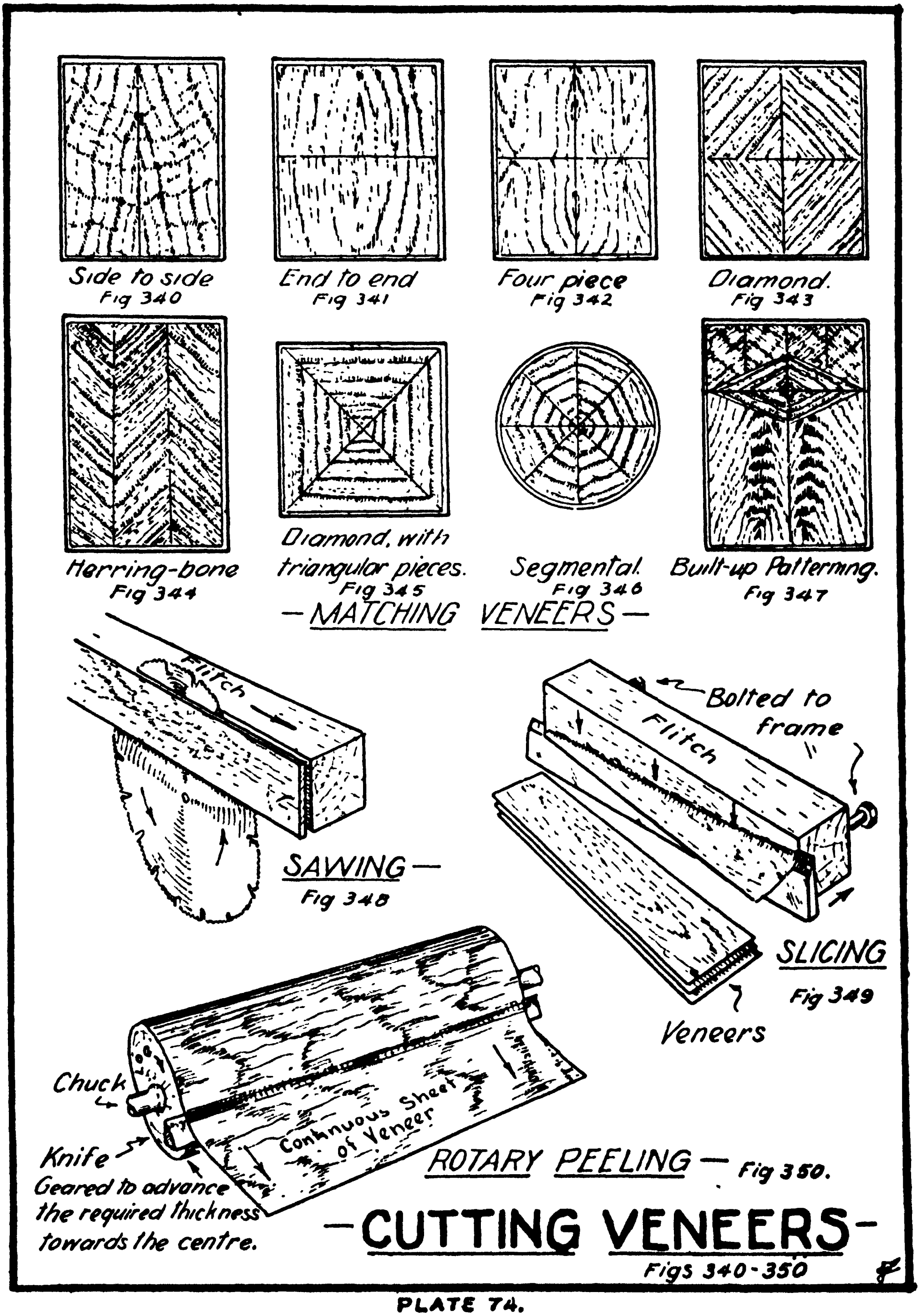

Side to side
Fig 340
End to end
Fig 341
Four piece
Fig 342
Diamond.
Fig 343
Herring-bone
Fig 344
Diamond, with triangular pieces.
Fig 345
Segmental.
Fig 346
Built-up Patterning.
Fig 347
—MATCHING VENEERS—
Flitch
SAWING—
Fig 348
Bolted to frame
Flitch
SLICING
Fig 349
Veneers
Chuck
Knife
Geared to advance the required thickness towards the centre.
Continuous Sheet of Veneer
ROTARY PEELING— Fig 350.
—CUTTING VENEERS—
Figs 340-350

PLATE 74.

1. **Softening the Flitches.** The logs or "flitches" (sections of a log) of wood are steamed or boiled to soften the fibres so that they may be cut with a minimum of tearing or breaking.

2. **Cutting the Veneer.** The veneers are then cut by one of three main methods:

(i) *Rotary Peeling.* Rotary peeling is used mainly for ordinary grades of plywood from Hoop pine, Kauri pine, Oregon, Silky oak, Tulip fig, and Silver ash.

The logs are cut into about 6ft. 6in. lengths and fixed between centres in a large lathe and forcibly rotated against a blade which advances towards the centre of the turning log, peeling off the required thickness of veneer—usually from 1/120″ to ¼″. (Fig. 350.)

Logs which show strongly contrasting growth rings and eccentric heart give the best figured veneer as a tangential cut.

(ii) *Slicing.* Slicing (sometimes called "Flat Cut") is usually the method used for cutting valuable, high-grade, radial cut figured veneers, such as Walnut, Maple, Silk wood, Silky oak, Black bean and Mahogany.

The flitch is bolted to a strong frame which moves diagonally across a knife, shaving off thin sheets of veneer of standard thickness, 1/28″, and widths from 4″ to 16″, and lengths up to 13 ft. 6 in. In some machines the flitch is fixed and the knife moves. (Fig. 349.)

(iii) *Sawing.* Sawn veneer is rarely seen in Australia.

The flitches are fixed to a movable carriage and cut by a large, thin-gauge segmental circular saw. (Fig. 348.) Owing to the waste due to the saw kerf, this method is mainly used for cutting veneers from hard curly grained wood (¼″-1/20″).

NOTE: As the veneers are cut they are numbered and stacked in order of cutting to assist in the proper matching when used for building up patterns in the veneering shop.

3. **Drying the Veneers.** The excess moisture in the veneer is removed by drying in kilns or special machines until the moisture content is reduced to approximately 10%—the average moisture content of wood used under normal atmospheric conditions. (See Notes on Seasoning, pages 147-150.)

HOW VENEER IS SOLD.

Rotary cut veneer is usually sold in 6 ft. x 3 ft. sheets, the price varying with the thickness.

Sliced veneer is marketed in lengths up to 12 ft. and in widths varying from about 4″ to 16″—average about 9″. Stump and crotch veneer is obtained in larger sheets. Sliced veneer produced in Australia is normally 1/28″ thick. High-grade types of imported veneers may be 1/40″ thick.

Veneer prices are quoted at so much per 100 square feet.

GLUES USED IN VENEERING.

Animal glues, casein glues and resin glues are generally used. Animal glues must be used hot and are very low in water resistance. They do not stain the veneer, however. Casein glues are used cold; the water resistance may vary from low to very high; they are, on the whole, slow setting and may stain certain types of veneer. Synthetic resin glues are water and heat resisting, but generally require heat and pressure for satisfactory bonding. (See also notes on Glues, pages 62-68.)

Animal glues are particularly useful for hand veneering small articles.

QUESTIONS.

1. What is a veneer as applied to woodwork?
2. Write down five advantages of veneered constructions.
3. Name ten timbers suitable for veneers.
4. Name and describe three methods of cutting veneers. Add sketches.
5. From what parts of the tree are figured veneers obtained? Show by a sketch.
6. How are logs prepared for veneer cutting?
7. State briefly how veneers are sold.
8. Name two glues suitable for veneering.
9. Show by sketches four methods of matching veneers.
10. Why should veneers be seasoned or dried after peeling or slicing?

II. PLYWOOD—SOLID CORESTOCK (Plate 75).

1. PLYWOODS.

DEFINITION.—Plywood is the name given to the product obtained when two or more layers of veneer are glued together.

The number of layers (or plies) in plywood is usually odd, varying from 3 to 13, with the direction of the grain in each successive layer at right angles, which gives greater strength and stiffness in all directions.

USES OF PLYWOOD.

1. *Building Construction.*—For panelling of interior walls and ceilings, flush doors, built-in cupboards, etc. Special waterproof plywoods are made for exterior work such as walls and forms for concrete work.

2. *Furniture Construction.*—Backing of wardrobes, sideboards, all types of cabinets, and drawer bottoms, etc. Figured face veneer plywood is used for all types of high-class cabinet work, such as doors for wardrobes, wireless cabinets, etc.

3. *Coachwork.*—Figured panels are used in interior decorating of railway coaches, tram cars, etc.

4. *Shipbuilding.*—Fancy plywoods are used for furnishings and fittings (over 1 million square feet of plywood was used in the Ocean Liner, "Queen Elizabeth," some ceiling panels being 16 ft. long and 84" wide). Special grades of waterproof plywood are used in the building of yachts, skiffs and racing boats, etc.

5. *Aircraft Construction.*—Owing to the strength, durability and lightness, plywood has been found to be of great value in the construction of aircraft.

6. *Miscellaneous.*—Box making (tea chests, rubber chests, butter boxes), table tennis tables and bats, etc.

ADVANTAGES OVER SOLID TIMBER.

1. Can be manufactured in large sheets.

2. Possesses high uniform strength, due to crossing the veneers at right angles in adjacent plies. Ordinary timber is 25 to 45 times stronger along the grain than across the grain, and in plywood the strength is equalised in both directions.

3. It is practically free from shrinkage, swelling and warping. Solid timber shrinks and swells across the grain, but there is very little shrinkage along the grain.

The balanced construction of plywood tends to equalise stresses which are set up, thus reducing any movement to a minimum.

4. Plywood can be satisfactorily nailed or screwed near the edge without damage.

5. It is economical in the use of figured timbers as the thin veneers of highly figured woods (which are often weak in structure) can be glued to a core of unseen, cheaper but stronger veneers.

6. Curved surfaces can be easily built up of plywood construction.

MANUFACTURE OF PLYWOODS.

All cheaper grades of plywood are made from rotary cut veneers (Hoop pine plywood is rotary cut). More expensive grades are usually manufactured with rotary cut centre veneers and slice cut fancy or figured veneers as the face and back plies.

After peeling, the veneer is dried and the glue is spread on the centre veneer in the case of three-ply and placed between face veneers in a hydraulic press. For cheap plywoods the veneers are sometimes glued "wet," i.e., straight from the veneer cutting machine without drying. About fifty sheets can be pressed at once. The pressure is maintained for about four hours, after which the three-ply sheets are separated and dried to remove excess moisture added by the glue. The sheets are then sanded in multiple sanding machines or surfaced in a machine scraper, and trimmed to finished sizes. (Figs. 351 and 352.)

GLUES USED IN MANUFACTURE OF PLYWOODS. (See GLUES, page 62.)

The bulk of plywood manufactured is bonded with casein glue. Soya bean glue or a mixture of soya bean and casein glues is sometimes used. Extremely water resistant plywood, used for special purposes, e.g., boat and surf ski construction, concrete forms, signboards, and permanent exterior uses, are bonded with resin glues.

HOW PLYWOODS ARE SOLD.

Plywood is sold in a number of standard sizes, e.g., 6 ft. x 2 ft., 6 ft. x 2 ft. 6 in., 4 ft. x 3 ft., 5 ft. x 3 ft., 5 ft. 6 in. x 3 ft., 6 ft. x 3 ft., 7 ft. x 3 ft., 8 ft. x 3 ft., 6 ft. x 4 ft., 7 ft. x 4 ft., 8 ft. x 4 ft.

6 ft. x 3 ft. is the most common. The first figure in each case represents the direction of the outer plies. It is possible to obtain larger panels on special order from the manufacturers.

Standard Thicknesses of Plywood range from $\frac{1}{8}$ in to $\frac{7}{8}$ in. in 3, 5, 6, 7, 9, 11 and 13 plies, e.g., $\frac{1}{8}$ in., 5/32 in., 3/16 in. (3 plies); $\frac{1}{4}$ in., 5/16 in. (3 or 5 plies); $\frac{3}{8}$ in., 7/16 in. (3, 5, 6 or 7); $\frac{1}{2}$ in. (3, 5, 6, 7 or 9); $\frac{5}{8}$ in., $\frac{3}{4}$ in., 13/16 in. (5, 6, 7, 9 or 11); $\frac{7}{8}$ in.(5, 6, 7, 9, 11 or 13 plies). 3/16 in. is the commonest thickness.

Prices are quoted at so much per 100 square feet.

Plywood is marketed in Australia in two grades: 1st and 2nd. Details of these grades are given in Australian Standard Specification for Plywood No. 0.6—1938.

Plywood is sold and branded S.1.S., "Sanded one side," and S.2.S., "Sanded two sides."

LAMINATED BOARDS.

When a plywood is used as a groundwork for the laying of figured face veneers it is sometimes referred to as "laminated board." For uses see Solid Corestock below.

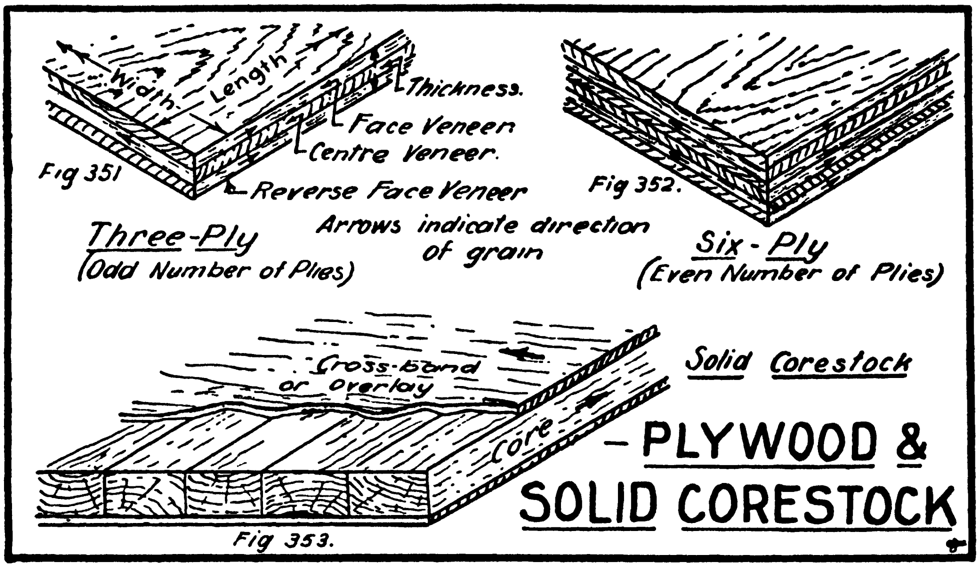


PLATE 75

2. SOLID CORE BOARD OR SOLID CORESTOCK.

DEFINITION.—Solid core board or solid corestock is a special type of construction used as a groundwork for the laying of veneer, comprising a built-up solid timber core covered on both sides with a single sheet of veneer known as a cross band or underlay.

MANUFACTURE OF SOLID CORESTOCK.

The core proper may be built up of strips of well seasoned solid wood which is light and straight-grained, the strips varying in width from 1″ to 6″. They are jointed and glued edge to edge with alternate strips joined with the heart side of one strip up and the heartside of the next one down. This is to prevent twisting of the panel. After gluing, the core is dried and surfaced prior to the application of the crossband veneers or underlays on either side. The crossbands may vary in thickness from about 1/20″ to 1/12″, and are glued with their grain at right angles to the grain of the core proper. The purpose of crossbanding is to counteract expansion and contraction of the core proper. The moisture added in the gluing of the crossbands is removed by drying prior to sanding. (Figs. 353 and 366.)

USES: Laminated board and solid coreboard is used as a base or groundwork for the laying of face veneers. If properly constructed they provide a non-warping core with level, easily glued surfaces. As they are not seen they can be made of lighter, cheaper timber than that used as face veneer, thus effecting worthwhile economies without detracting from the appearance or serviceability of the article.

DRYING OF VENEERS AND PLYWOOD.

Veneers and plywood may be dried by piling with wooden strips separating the sheets to air-dry under cover. The rate of drying depends, of course, on the temperature and humidity. If left long enough the sheets will ultimately reach what is termed the "equilibrium moisture content," which varies for different timbers in different parts of the country and for different periods of the year. The general range of the "e.m.c." is about 8% to 15%.

The more modern practice, however, is to bring the sheets down to "e.m.c." condition in a room or kiln in which the temperature, humidity and air circulation are carefully controlled. This saves time and money, and a better product is obtained.

It is essential to dry veneers and plywood down to approximately the moisture content they will be at under ordinary atmospheric conditions. If this is not done, shrinkage, splitting and warping, etc., are sure to result.

See also Notes on Seasoning of Timber, pages 147-150.

QUESTIONS.

1. What is plywood?
2. State ten common uses for plywood.
3. Make a list of advantages of plywood over solid wood.
4. Briefly describe the manufacture of plywood.
5. Name two glues in plywood construction.
6. State briefly the range of thicknesses and number of plies for plywoods.
7. What is solid corestock?
8. State the uses of solid corestock.
9. Describe briefly how plywoods are dried.
10. Why does plywood "work" (shrink and swell) less than solid timber?

III. VENEERING (Plates 76 and 77).

DEFINITION.—Veneering is the art or process of decorating by gluing a thin sheet of figured, expensive wood (called a veneer) to a backing (called the ground or core) of cheap but straight grained wood.

HISTORY.

There is evidence that the advantages of veneering and practical use of glue was understood over 3,500 years ago. The use of veneered construction has been recorded in Egypt during the time of the great Pharaohs, and subsequently in the Greek and Roman civilisations. Following a long lapse, through the Middle Ages, veneering was revived in Italy during the Renaissance in the 15th century. By the 17th century the art of veneering was practised throughout Europe, and was introduced into England by European craftsmen who settled there and practised cabinet making as distinct from the general craft of carpentry. At this time all veneers were cut by hand sawing and were naturally thicker than those with which we are familiar. Walnut was used during the Queen Anne period. Mahogany superseded walnut in the 18th century. Later Satinwood was used by Adam, Hepplewhite, Chippendale and Sheraton.

The use of veneer was further popularised by the development of furniture styles and the utilisation of a greater number of fancy timbers. With the introduction of machines in the 19th century veneers were cut on large circular saws and by a large mechanical planer, which was the forerunner of the modern slicer. At the same time a patent was taken out in America on the first veneer lathe.

Circular saws were very wasteful in saw kerf, and have practically been discarded as a method of cutting veneer. Lathes and slicers have been progressively improved in size, design, and mechanical efficiency, enabling production of the accurately cut high quality veneers which are now available.

TOOLS USED IN VENEERING (PLATE 76).

Straight Edge.—A good straight edge is required for marking out and for a cutting guide when preparing veneers for gluing. (Figs. 354, 356, 360 and 371.)

Veneer Knives.—Knives are used for cutting thin veneers. Quite a good knife can be made from an old hacksaw blade. The knives should be ground and sharpened on one side only. (Figs. 355-357 and 371.)

Chisel.—A chisel may be used for cutting thin veneers.

Veneer Saw.—The veneer saw is usually used for cutting thick veneers guided by the straight edge. (See fig. 360.) A veneer saw may be made from an old saw blade screwed to a wood handle. The curved edged blade should not project far from the handle, and the teeth should be small and without set. An ordinary dovetail saw, if used carefully, may be used as a veneer saw for occasional veneering jobs.

Veneer Clamp.—When the edges of a number of veneers are to be planed or jointed they may be held together in a veneer clamp (fig. 359) with the edges projecting slightly from the clamp and then planed or shot in the shooting board. The clamp may be made from two straight-edged pieces with their inside faces slightly rounded. They are held together by two bolts with wing nuts. (Fig. 358.)

Bench Planes.—The bench planes are used for preparing the groundwork or cores and for the jointing of the veneer, and in cleaning up the edges of finished panels.

Toothing Plane.—The toothing plane is similar in shape to the wooden smoothing plane. The vertical cutting iron is grooved on the face so that when ground and sharpened a series of fine points are produced. The plane is used diagonally across the core to level out smoothing plane marks and to roughen the surface, thus providing a better glue penetration. (Fig. 361.)

Veneer Hammer.—The veneer hammer is used to flatten the veneer and force out air bubbles and surplus glue when veneers are laid with hot glue. The rounded brass strip in the head of the hammer is pressed down on the veneer and worked in a zigzag movement from the centre of the work to the edges. (Figs. 363 and 364.)

Flat Iron.—A heated flat iron is used to melt the glue and flatten the veneer so that the veneer hammer may be used to squeeze out the glue. The surface of the veneer should be dampened before applying the hot iron, to prevent burning or scorching. (Fig. 362.)

Cutting Gauge.—The cutting gauge is used for cutting narrow strips of veneer for applying to the edge of a panel or as borders for the face of the panel. (See fig. 18a.)

Taping Stick.—A flat stick with a rounded end is useful for pressing the tape into place when edge jointing veneers. (Fig. 369).

Gummed Tape.—Gummed tape or strips of paper are required for gluing over edge joints in the veneer after hammering, to prevent the joints opening while the

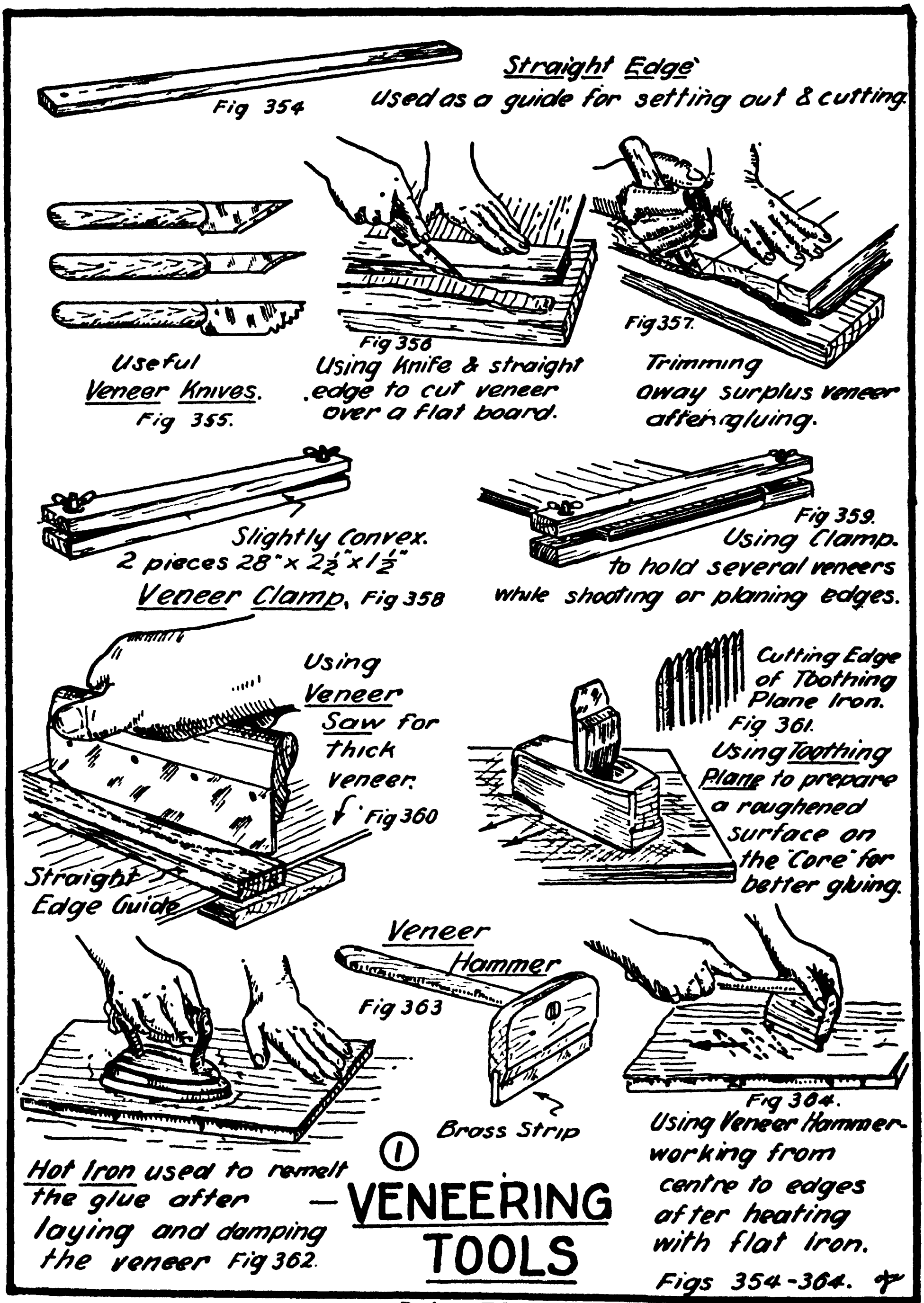

Straight Edge
Used as a guide for setting out & cutting.
Fig 354
Useful Veneer Knives.
Fig 355.
Fig 356
Using knife & straight edge to cut veneer over a flat board.
Fig 357.
Trimming away surplus veneer after gluing.
Slightly Convex.
2 pieces 28" x 2½" x 1½"
Veneer Clamp. Fig 358
Fig 359.
Using Clamp to hold several veneers while shooting or planing edges.
Using Veneer Saw for thick veneer.
Fig 360
Straight Edge Guide
Cutting Edge of Toothing Plane Iron.
Fig 361.
Using Toothing Plane to prepare a roughened surface on the "Core" for better gluing.
Veneer Hammer
Fig 363
Brass Strip
Fig 364.
Using Veneer Hammer working from centre to edges after heating with flat iron.
Hot Iron used to remelt the glue after laying and damping the veneer Fig 362.
1
VENEERING TOOLS
Figs 354-364.

PLATE 76.

work is drying. Tape is also required to hold together the joints of built-up patterns when caul veneering.

Cabinet Scraper or Scraper Plane.—The scraper is required to assist in the smoothing off the veneered surfaces after gluing.

GLUES USED IN VENEERING.

Animal Glues.—Animal glue is used for hammer veneering and for small jobs. By using heated cauls it can also be used for veneering large curved or flat work. (See also notes on Glues.)

Casein Glues.—The main advantages of casein glues are that they are used cold, change very little in consistency with temperature, and can be applied either by hand or by mechanical spreaders. The use of the glue cold allows sufficient assembly time to glue large quantities of material or large surfaces in one operation. Casein glues, because they contain alkali, may cause staining of the wood, particularly in figured face veneers. Glues may be purchased with a reduced tendency to stain. Staining will also be reduced by keeping the consistency of the glue fairly high and reducing the pressure and the time the panels remained under pressure, within the safe margins necessary for good gluing. After releasing from pressure, the panels should be immediately separated to permit rapid drying of water introduced in the glue.

Casein glues are used for more than 90 per cent. of all veneering. They are extensively used where any kind of pressure can be applied, but they are not suitable for the hammer method of veneering.

Synthetic Resin Glues.—These are used in the manufacture of waterproof plywood and moulded veneer construction in which water resistance is important, but they are not generally used for decorative veneering.

VENEERING OPERATIONS (PLATE 77).

1. **Core Construction.**—The core or groundwork is the solid portion of the job to which the veneer is glued.

The first step in the manufacture of a veneered article is the selection of a good groundwork or core for the job. Solid wood, solid corestock or plywood may be used for this purpose. (Figs. 365-367.) The wood should be properly seasoned, free from defects and accurately planed. When solid corestocks are made the alternate strips should be reversed and joined with the heart side of one strip up and the heart side of the next one down. (Fig. 366.) This will balance the construction and prevent twisting of the panel. After the strips have been glued together the panel must be redried to remove the moisture from the glue lines, otherwise sunken joints will occur. Core boards must be cleaned up to a true flat surface and the thickness should be carefully checked at the ends and along the edges. To produce a better gluing surface the core may be roughened by diagonal planing with a toothing plane.

2. **Cross-banding.**—Crossbanding is the gluing of a plain veneer to the sides of the core with the grain of the veneer at right angles to the grain of the core. (See figs. 353 and 369.)

The use of cross-banding veneer on solid wood or solid corestock is recommended, although it is not always used in cheaper classes of veneered work. Crossbanded panels are superior because they are less likely to warp, twist or change in dimension, and minor defects in the core are unlikely to show through on the face veneers. It is preferable for the crossband veneer to be a species with a low shrinkage value and not cut too thin. One piece sheets should be used if possible. If jointing is necessary the tape should be applied to the face of the veneer over the joint and removed after the crossbands have been glued to the core. For balanced construction crossbands should be glued to both sides with the grain at right angles to the core (Fig. 369.)

After the core has been prepared and the veneer for the crossband has been cut to size (a little larger than the core), the glue is spread on the core and the veneer fastened in position with veneer pins or small panel pins. If the veneering is done by the hammer method only one side can be done at a time; but if the caul and press method is used both sides may be crossbanded in one operation. It is advisable to place newspaper over the veneer before putting the glued assembly between the cauls. This operation should be carried out as rapidly as possible, particularly when hot glue is used. Crossbanded cores should be dried for two or three days before the face veneers are applied.

3. **Preparation of Face Veneers.**—In the preparation of face veneers it will be necessary to cut veneers to size and possibly to cut and joint them for matching into patterns. (See figs. 340-347, plate 74.) A large flat, smooth and fairly soft wooden board is the most suitable base on which to do this work. The veneer is laid on the base and a straight edge or carpenter's steel square is placed along the line of the cut. Whilst pressing on the straight edge the saw or knife is drawn towards you, holding it perpendicular against the straight edge. It is advisable to have the veneer placed with the grain running toward the straight edge because the cutter always has a tendency to run with the grain.

When making two piece "side to side" or "end to end" matches (see figs. 340 and 341) the two pieces of veneer are laid on top of each other so that the figure coincides. They are then cut across the ends or along the edges, according to the desired match. with the saw or knife in the manner described above. To form a perfect joint the cut edges of the veneer should be planed whilst held in the veneer clamp.

Another method of jointing is used when veneering with the hammer method One sheet of veneer is glued so that it overlaps the other by about one inch. A straight edge is pressed firmly along the overlap while a cut is made through both thicknesses with a knife or keen chisel. The upper strip of waste veneer is then peeled away, and by raising the veneer the underneath strip is also removed. (Fig. 371.) The two edges of the joint are then ironed down with the hot iron and pressed firmly with the hammer. Gummed tape is then applied over the joint. Generally, however, the pieces of veneer for built-up patterns are marked out, cut, and then taped together into a complete unit before laying by the caul method of veneering.

Crotch (cut from a fork in the tree trunk) and burl (cut from large wart-like growths on the tree trunk) veneers are usually very brittle and curly. They can be flattened by swabbing them with warm glue size and placing them between two pre-heated boards which are then clamped together or weighted.

4. **Methods of Applying Veneers.**

(a) *Hammer Veneering.*

Hammer veneering may be employed when animal glue is used to lay comparatively simple built-up patterns.

The hot glue is spread on the groundwork and underside of the veneer. (It should be noted that there is always a "tight" or "closed" and "loose" or "open" side to a

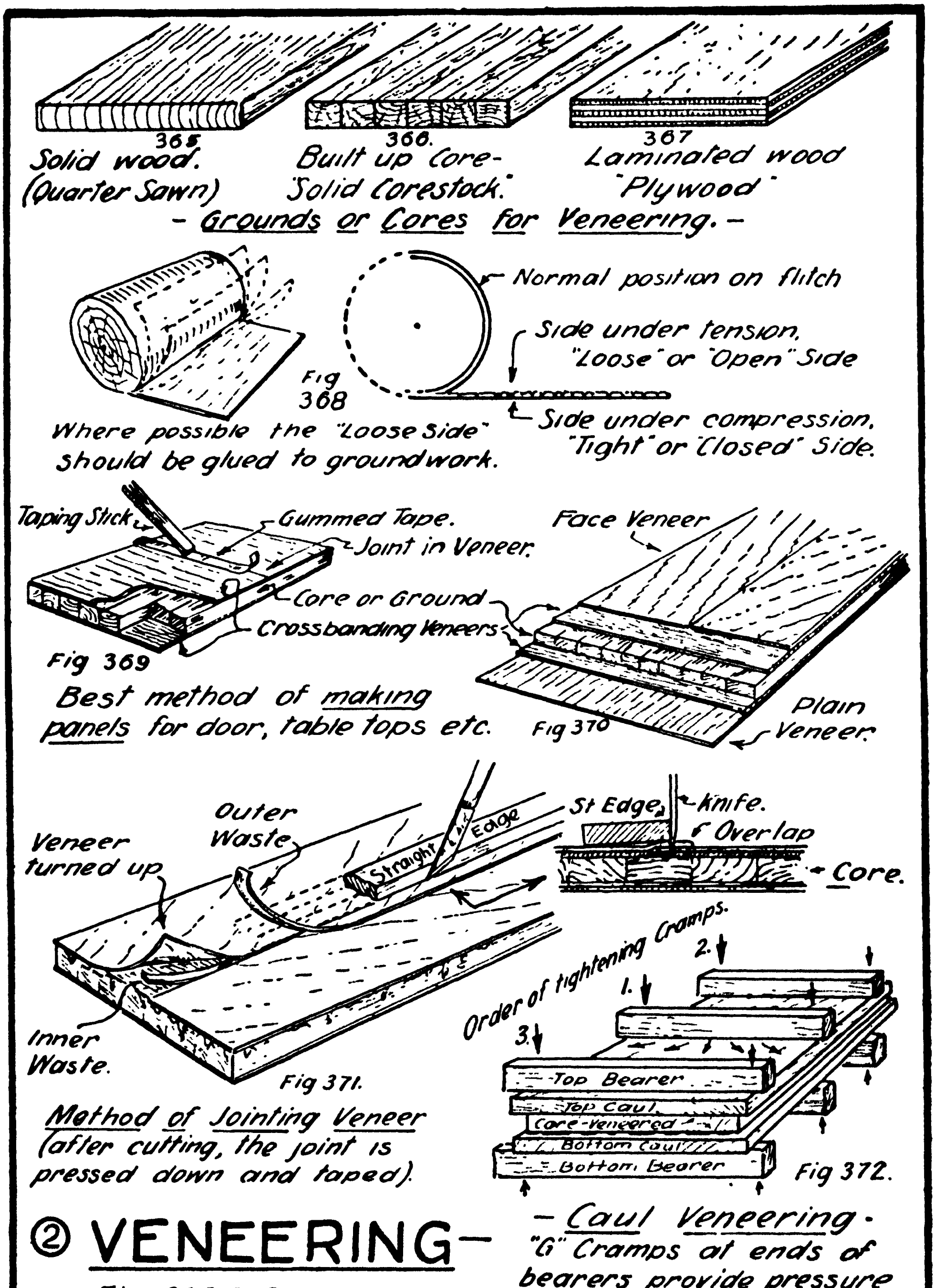

365
Solid wood.
(Quarter Sawn)
366.
Built up Core-
"Solid Corestock."
367
Laminated wood
"Plywood"
- Grounds or Cores for Veneering.-
Normal position on flitch
Side under tension.
"Loose" or "Open" Side
Fig 368
Side under compression.
"Tight" or "Closed" Side.
Where possible the "Loose Side" should be glued to groundwork.
Taping Stick
Gummed Tape.
Joint in Veneer.
Core or Ground
Crossbanding Veneers
Fig 369
Best method of making panels for door, table tops etc.
Face Veneer
Plain Veneer.
Fig 370
Outer Waste
Veneer turned up
Straight Edge
Inner Waste.
Fig 371.
St Edge
knife.
Overlap
Core.
Method of Jointing Veneer (after cutting, the joint is pressed down and taped).
Order of tightening Cramps.
1.
2.
3.
Top Bearer
Top Caul
Core-Veneered
Bottom Caul
Bottom Bearer
Fig 372.
② VENEERING—
Figs 365-372
—Caul Veneering.
"G" Cramps at ends of bearers provide pressure

PLATE 77.

sheet of veneer, and whenever possible the glue should be applied to the loose side.) (See fig. 368.) The veneer is then placed in position on the groundwork and pressed down with the hands. A wet rag may be used to damp one half of the surface to prevent the veneer from being burnt by the hot flat iron, which is then drawn over the surface to melt the glue sufficiently for working with the hammer. (Fig. 362.) Using firm but not excessive pressure, the hammer is worked with a zigzag movement from the centre of the panel to the edges in all directions. (Fig. 364.) To prevent breaking the overhanging veneer at the edges, due to the hammer dropping down, it is a good plan to hold the hammer at an angle so that one corner overhangs the edge, and work along parallel with the edge. These operations work the glue from the centre of the panel to the edges, causing the veneer to go down flat and smooth. When one half of the panel is finished the other half is damped and pressed out in the same manner. If it is necessary to go over any part of the work a second time further damping and heating is required. Tapping lightly over the surface with the finger nails will reveal the presence of bubbles by a difference in feel and sound. Bubbles should be damped and heated locally and worked out with the hammer.

(b) *Caul Veneering.*

A much simpler and more common method of applying pressure to veneer panels is provided by the use of wooden caul boards with bearers and cramps, particularly when veneer is laid with cold setting glues.

The cauls may be made of any wood having a smooth close textured surface. Jointed boards may be used for cold press adhesives, but they are not suitable for hot glues, when the cauls have to be heated. It is a good plan to grease the cauls with a mixture of paraffin wax and paraffin oil, or a mixture of beeswax and tallow, to prevent glue from adhering to them. Cauls should always be kept clean because foreign matter will cause dents in the panels.

Good stout bearers should be used in proportion to the size of the job to be done. The edges of the bearers in contact with the caul should be slightly crowned so that they will apply pressure to the centre first. Pressure is applied to the ends of the bearers by means of hand screws or "G" cramps. (Fig. 372.)

Before proceeding with gluing operations the cauls, bearers, cramps, newspaper and the work should be in readiness. When a pattern is to be laid it should be marked out on the core so that the face veneers can be accurately located when they are applied. If the panel has been crossbanded any tape must first be removed. A good even spread of glue is applied to the surface which is to be the plain veneered back of the panel. The veneer is placed on the glued surface tight side out and pressed down with the hands and fastened in position with veneer pins. The board is then reversed and glue is spread on the face side and the face veneer applied and carefully tacked in position with veneer pins. A double sheet of newspaper is placed over each veneered surface before the panel is put between the caul boards. Pressure is applied to the centre bearer first, then towards the ends of the panel in order from the centre out. If animal glues are used the cauls must be heated before they are applied and the panel must be placed under pressure very quickly, before they cool and the glue chills. In any case, pressure should be applied as rapidly as possible to prevent excessive swelling of the veneer due to moisture picked up from the glue. When using cold glues it is the practice of some craftsmen to place a sheet of fibre board between the caul and the veneered panel. This board compresses and allows for any unevenness in the thickness in the veneers or panel or any dents or irregularities on the cauls.

Pressure is maintained for about two hours until the cauls have cooled and the glue has set when hot glue is used, or for a minimum of six hours when cold glue is used. After taking the veneered panel from the press it should be placed on strips with weighted strips on top of it to prevent warping during the period of two days which the glue should be given to set properly. In this period the moisture will dry out from the glue lines.

Curved work may be veneered in the manner outlined above, by using cauls which are accurately fitted to the shape of the work. Another method of gluing curved work is to have a canvas bag of sand in a box and press the curved groundwork of the job into the sand so that its shape is outlined. The core or groundwork is then removed and cleaned and the glue is spread and the veneer applied and fixed with pins. The curved surface is then pressed down into the sand by means of a weighted caul board or by bearers fitted across the caul board and cramped to others underneath the box.

When the ends of the boards have to be veneered it is advisable to coat the end or grain with glue size. Up to three coats may be given, allowing each coat to dry before applying the next. This will close up the pores in the end grain and prevent poor adhesion which would otherwise be caused by the wood absorbing the glue and producing a starved joint. The veneer hammer or cross pein of the warrington hammer being used for hot glue, while sash cramps and wooden strips are used for cold glues when laying the veneer.

5. Cleaning Up Veneered Panels.

When animal glue is used the surplus glue should be wiped off with a warm damp swab immediately after pressing while it is still soft. After redrying the panel, the edges are trued up with the saw or knife and finished with a finely set plane. The paper tape is removed by damping it with warm water and peeling it off. Veneer pins are removed or set in and the holes stopped up with filler or stick shellac. The face of the panel is then scraped. No difficulties are experienced with plain straight-grained veneers, but to prevent tearing out of fancy veneers or inlays it is advisable to hold the scraper at an angle so that it takes more of a slicing cut. Care should be taken not to scrape too deeply. The work should then be finally prepared for polishing by sanding with fine glasspaper. A very finely set smoothing plane may be used before scraping.

Factory Methods of Veneering.

Practically all factory production veneering is done with casein glue. Glue-spreading machines are used to spread the glue on the sheets of veneer, cores and cross-banded cores. Numerous panels are pressed in one operation by large screw or hydraulic presses. Curved panels are pressed in multiples between properly fitting cauls or forms. Many curved veneered jobs are also pressed in sealed rubber bags or under rubber sheets having their edges sealed on tables. The glue is applied, and the veneer is laid over a form of the desired shape. The assembled work is then placed inside the bag or under the sheet, which is sealed, and a vacuum is applied by sucking the air out of the bag. Thus atmospheric pressure is utilised to provide a pressure of 12 to 14 lbs. per sq. in. at right angles to the work over its whole area.

After gluing and pressing, panels are redried in redrying rooms in which the temperature and humidity of the air circulated through the stacks is carefully controlled.

Belt sandpapering machines or machine scrapers are used in the initial finishing process of the veneered panels.

QUESTIONS.

1. What is veneering?
2. How are veneers cut?
3. Make a list of the tools required for veneering.
4. What are the uses of the following tools:—(a) Veneer clamps, (b) flat iron (c) cauls?
5. Sketch and describe the uses of the veneer hammer and toothing plane.
6. What glues are used in veneering? State their special advantages.
7. What do you understand by the term "core" or "ground" as applied to veneering?
8. Why is "crossbanding" recommended for use under face veneers?
9. Briefly describe how crossbands are laid, using the hammer method.
10. Briefly describe the caul veneering method.

IV. FIBRE BOARDS.

DEFINITION.—Fibre boards are sheets of fibrous material suited for structural, insulating, or interior finishing uses. They are composed of vegetable fibres, which may be made more or less water-resistant by sizing agents.

There are numerous types of fibre board obtainable, made from raw materials such as bagasse, cork, cornstalks, cotton, hair, jute, kapok, moss, wheat, straw and wood. In Australia bagasse (or megass) and wood are the chief materials.

1. Masonite "Presdwood."

Material Used.—Masonite boards are made entirely from the fibres of Australian hardwoods. Faulty, inferior and timber which is unsuitable for general building purposes may be used.

Manufacture.

1. The timber is cut into 5ft. lengths called "billets" and stacked to dry for about three months.

2. The dried billets are conveyed to the "chipper." This is a machine which reduces the logs to small chips about 1″ square and ¼″ thick.

3. The chips are passed into a long pressure cylinder called a "gun." When the gun is full, steam under pressure of about 1,000 lbs. per sq. inch is introduced for about half a minute. The steam penetrates the wood rapidly. The gun discharges its contents suddenly. The escaping and expanding steam explodes the chips, separating the wood into a mass of fibres. The mass of fibres is then washed to remove dirt.

4. The fibres are made into a mash with water and fed on to an endless belt and

formed into a blanket of interlaced fibres called "wet lap," the thickness of the lap varying from ¾" to 2", depending on the thickness required for the finished sheet.

5. This blanket is passed through a series of rollers to force out excess water and compress the fibres. The edges are trimmed and the blanket is cut into 12ft. lengths by means of a rotary knife.

6. The lengths of wet lap are conveyed to a rack and placed in a large hydraulic press and subjected to a pressure of about 350 lbs. at a high temperature for about 20 minutes. Under pressure and heat the fibres *consolidate* without the aid of any artificial cementing material or glue. The natural lignin and cellulose of the fibres acts as a binder.

7. The pressed boards are allowed to dry or season thoroughly before being packed into crates for transportation.

Masonite "Tempered" Presdwood sheets, suitable for heavier and external work, are made from Masonite Presdwood sheets by passing them through a bath containing a mixture of linseed oil and tung oil and then treating them in kilns at controlled temperature and humidity for about 24 hours. "Tempered" Masonite boards are stronger and more resistant to moisture.

Sizes.—Masonite Presdwood sheets are made up in the following sizes:—⅛ in. and 3/16 in. thick, 4 ft. wide, 4ft. to 12 ft. long.; ¼ in. and 5/16 in. thick, 4 ft. wide, 6 ft. and 12 ft. long.

Uses of Masonite.—Interior wall and ceiling panelling, cupboards, lockers, partitions, flush doors, display cases, furniture, toys, etc. "Tempered" Masonite for extra heavy work such as exterior walls, panelling for truck bodies, railway cars, trams, table tops, boats, floors and forms for concrete work, etc.

Being a wood product, Masonite can be worked with ordinary woodworking tools and machines. It may be bent, provided it is moistened for about 30 hours and bent on shaped forms or placed between heated dies until quite dry. Any finish applied to wood may be applied to Masonite. The sheets are usually fixed in position by 1½" x 16 panel pins.

2. **Cane-ite**—a homogeneous cane fibre insulating board.

Material Used.—Cane-ite products are manufactured from cane fibre called "Megass" or "Bagasse." Megass is the fibrous, woolly refuse of sugar cane from which the juice has been extracted by pressure.

Manufacture.

1. The cane material is softened and sterilised by soaking and cooking in a digester, lime being added to remove all traces of sugar.

2. The softened megass is then passed through refining machines, which separate the fibres.

3. The refined material is carried in water containing alum-rosin size (waterproofing agent) to the board forming machine.

4. In the board forming machine a suction cylinder or vacuum drum sucks out the bulk of the water solution, leaving a continuous blanket of intimately matted fibres or pulp about 12′ 6″ wide.

5. Mechanical presses next reduce the wet mat to the required thickness and remove

more of the moisture and assist to consolidate the fibres. The sheet is automatically cut into 16 ft. long boards.

6. These large boards are then dried in special dryers and cut into widths of three feet or four feet by saws.

7. The cut boards are seasoned in a "seasoning room" before being packed for despatch.

Characteristics.—Cane-ite is chemically treated against insect and fungi attack; has a high moisture resistance; is the strongest and most rigid insulating board on the Australian market; 1" thick Cane-ite is equal to 3" thick wood as insulation against heat and cold; owing to the cross-grained fibres producing countless dead air cells, Cane-ite is an excellent sound insulating material. Cane-ite can be bent round curves of 24" radius after moistening the board on both sides 24 hours before using.

Sizes.—Cane-ite insulating board is supplied in standard sizes 3 ft. and 4 ft. wide and lengths from 6 ft. to 12 ft. Thicknesses ranging from 5/16" to 1".

Uses.—Cane-ite is chiefly used as an interior wall and ceiling insulating and lining material, although 1" boards can be used for external work provided they are suitably treated with water-proof paints, etc. It can also be used for numerous other projects, such as motion picture screens, wall partitions, refrigerator lining, roof insulation, sound insulation under floors, stage props, telephone booths, tram and bus insulation, etc.

For interior decoration the board itself may be left plain, or it may be painted, stained, varnished or stencilled.

The boards are usually fixed in position by means of nails or panel pins, which should be 1" longer than the thickness of the board.

Special tools are used for cutting, chamfering and "V" grooving.

QUESTIONS.

1. What are fibre boards?
2. Name two types of fibre boards.
3. Briefly describe the manufacture of Masonite.
4. State the common sizes and some of the uses of Masonite.
5. State the common sizes and uses of Cane-ite.
6. Compare the uses of Masonite and Cane-ite.
7. Name the materials used in the manufacture of Masonite and Cane-ite.
8. What finishes can be applied to Masonite?
9. How are the two types of boards attached to the work?
10. What finishes can be applied to Cane-ite?

SECTION SEVEN

FURNITURE STYLES, DESIGN AND CONSTRUCTION.

I. NOTES ON FURNITURE STYLES. (Plates 78-85).

INTRODUCTION.—The term "furniture" may be applied to all household articles for use or ornament. They may be fixed (e.g., built-in cupboards and presses) or movable (e.g., chairs, tables, etc.).

There are few examples of ancient furniture in existence to-day owing to the perishable nature of the material from which they were made. Mainly articles of stone, bronze and pottery have survived the ravages of time to give us some idea of the arts of the Egyptians, Greeks and Romans. Very few wooden pieces lasted through the Dark Ages.

The Egyptians had tables, chairs, chests, wardrobes and beds, some of which were highly ornamented with carved figures. The legs of tables and chairs were carved to resemble the limbs of animals. Greek furniture was inlaid with ivory, ebony, gold and silver. The Romans possessed bronze lamp stands (carved and moulded), tripod tables, inlaid chairs and couches (made of bronze and marble). They were skilled in the art of veneering—designs chiefly geometrical.

However, it was not until the Renaissance about 1400-1600 that there was any important development in furniture design and construction.

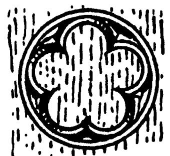
In studying the different periods into which furniture styles may be divided, it must be remembered that the changes are not definitely marked. One period overlapped and may have influenced the work of another. A definite or perfect style was arrived at only after several years.

The dates mentioned in the following notes refer broadly to the various periods of furniture styles.

1. ITALIAN STYLES (Plate 78).

(1) Tracery.

(a) 13th and 14th Centuries—Pre-Renaissance.



(2) Cinque-foil.

Furniture prior to the Renaissance was mainly the possession of the wealthy or upper class, and belonged to the style known as Gothic. Such furniture was characterised by its heaviness and simplicity. Any ornamentation was based mainly on Gothic architectural details, such as Gothic tracerised panels, Gothic pointed arches, etc. Flat surfaces were sometimes painted with landscapes or decorated with geometric designs in marquetry, using woods, bone and ivory.

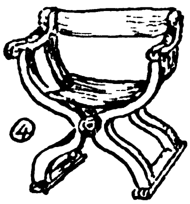
(b) 15th and 16th Centuries—Renaissance Styles.

Early Renaissance 1400-1500, High Renaissance 1500-1540, and Late Renaissance 1540-1643.

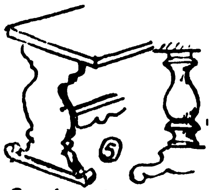
Early Italian Renaissance furniture was characterised by the development of Classic Architectural lines (Classic=ancient styles of Greece and Rome). Florence was the leading city in Renaissance arts and crafts.

Ornamentation took the form of Classical Architectural shapes and details scaled down to suit furniture construction. At first it was simple, but later gradually became highly decorative, e.g., carved or gesso (type of plaster moulding) mythical figures of humans, animals and birds, and foliated panels (panels with leaf carving designs) (Fig. 372.) Flat surfaces were decorated with inlay, marquetry or landscape and historical paintings. Some pieces were gilded or painted in colours.

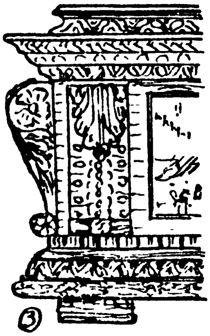
Carved Panel - (1) Renaissance



(4) Dante Chair.



(5) Slab Leg. Baluster Leg Refectory Table.



(3) Carved Cassone Classic Details.

The cassone or marriage chest was a prominent and ornate article in the 15th and 16th centuries, carved with mythical figures and gilded or painted. Some were fixed to solid bases or pedestals. Chairs were generally straight, rectangular constructions, large and uncomfortable. The "X" type (the Dante chair) was popular, consisting of curved legs with arm rests attached at the top, and upholstered with fabric or tooled leather on the seat and back.

Tables were of the refectory type, consisting of a solid slab top and shaped slabs for the legs at each end. Some tables had heavy turned baluster legs strengthened by low rectangular stretcher rails.

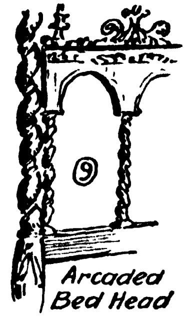
The High Renaissance style developed from the earlier work with added classical decoration in the form of rich carving in high and low relief of acanthus leaf motifs, human and animal forms, masks (human and animal faces), cartouches (representation of scrolls of parchment with ends rolled up), scrolls, strapwork, turned rosettes, broken pediments (triangular top added to cabinets, etc.), pilasters (half turned or rectangular columns applied to surfaces), and ornamented architectural mouldings, etc.

Chairs assumed more comfortable lines, some being padded and covered with velvet and embroidery, the legs, arms and rails were frequently turned or elaborately carved. The sideboard evolved out of the chest, consisting of drawers and cupboards elevated on legs or stands.

Walnut was chiefly used, and main form of decoration was rich elaborate carving.

(c) 17th Century—Baroque Style.

"Baroque"—name applied to extravagant, over-emphasised, fantastic shapes and ornamentation.


Arcaded Bed Head
Spiral Turnings.

This style developed out of the High and Late Renaissance styles during the counter-Reformation in Italy towards the end of the 16th Century.

Furniture was essentially showy, highly decorated to strike the eye. In some cases it was covered with so much ornamentation as to make it unbalanced and ugly, motifs for ornamentation being lions, eagles, amorini (Cupids, carved or painted), scrolls, shells, leaves; large decorated mouldings, spiral turnings, fluted turnings, veneering, inlay and marquetry in marble, ivory and bone, gilding and painted landscapes and flowers. (Fig. 373.)

The bases, pediments and mouldings of cabinets, etc., and nearly all the exposed woodwork were covered with elaborate carving or gesso and painted or gilded.


Amorini 7


8 Scrolls-
Chair-Leg-Rail.

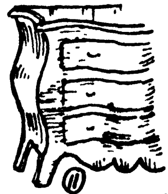
The form of furniture was much the same as during the Renaissance, ornamentation serving to make the pieces very striking and impressive.

(d) Early 18th Century—Rococo Style.

"Rococo"—decoration based on rock and shell forms with leaves and flowers, i.e., ornamentation derived from nature.

18th Century Italian furniture was smaller, delicate and more graceful, a reaction to the classical and baroque style. The Rococo style is often said to be the feminine counterpart of the baroque style.

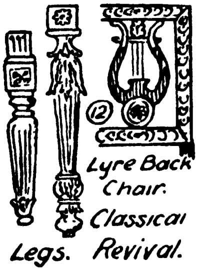

10 Rococo (Shell) Ornament.

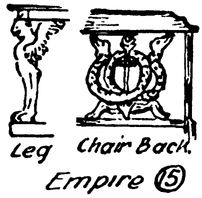

11 Bombé Chest or Commode

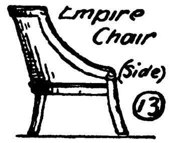
The general trend was delicately balanced, irregular curves, lavishly decorated with carving, painted ornaments, inlay and gilt bronze mounts, etc. Foliage, rock, shell and ribbon forms were the chief motifs for the carving, painting and inlaying. Chairs, sofas, beds, and especially bombé commodes (chests with bulging fronts and ends), were constructed with curved flowing lines, elaborately decorated with rococo carvings. Ceilings, walls, furniture panels, and mirror frames were decorated with paintings of flowers and pastoral scenes. The panels were surrounded with gilded shaped edgings and delicately modelled mouldings.

(e) Late 18th Century and 19th Century—Classical Revival, Empire and Directoire Styles.

During this period the Italian styles were somewhat influenced by the English and French styles. The unearthing and study of the classical remains at Pompeii and Herculaneum produced a renewed interest in the beauty of the classical arts and architecture. Designers more or less revolted against the curved lines and the highly ornate early 18th century work, and returned to the more formal, rectangular form of the classic styles. Inlay, veneering, marquetry, painting and gilding were the main forms of decoration.







The Empire and the Directoire styles of the 19th century continued the Classical Revival details, but with more extravagant decoration in the form of brass and gilt mounts of wreaths, emblems, laurel branches, torches, mythological figures and swags (suspended decoration resembling ribbons, fruit, flowers, drapery, etc.). The Empire style was influenced by the Napoleonic Empire style of France and the Egyptian excavations.

The Directoire style was lighter and more graceful than the Empire style, using more delicate decoration, such as swans, lyres and scrolls.

2. FRENCH STYLES (PLATES 78 and 79).

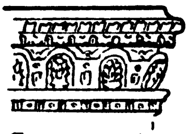
(a) Early French, 14th-15th Centuries.

Early French furniture was very crude and was the possession of the upper classes. The chest or coffer was the most important article of furniture, being merely constructed of planks reinforced with iron bands and brackets. Later, cabinets, cupboards and trestle tables appeared, usually made of oak. These were ornamented with architectural details following the Italian Gothic lines. The use of Italian decorative details was more pronounced towards the end of the 15th century, when some of the Italian artists and materials were imported by a few of the wealthier French nobles. Beds, sofas with cushions, dressing tables and chairs (the "X" type and the massive, uncomfortable throne-like chair) were introduced. Walnut was used during the 15th century.

(b) French Renaissance, 16th Century.

The early French Renaissance style was greatly influenced by the Italian furniture styles during the reign of Francis I (1515-47). Francis I invited Italian artists and designers to decorate and furnish his courts and palaces. Naturally the earlier pieces were very similar to the Italian Renaissance style, being heavy and very ornate, with Gothic architectural lines. Elaborate mouldings and panels were covered with surface carvings in high relief, motifs for carving being foliages, swans, dolphins, sphinxes, masks, cartouches, ribbon and strap-work. (Fig. 374.)

Chest Panel.16th.
Dolphins



Decorated Moulding 18

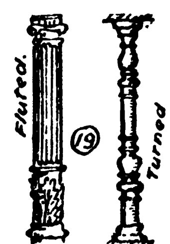
Tables were large and heavy, with bases covered with relief carving. The large throne-like chairs of the 15th century continued, but gradually gave way to lighter and smaller chairs with carved panelled backs.

With slight changes the style of Francis I continued to the end of the 16th century. Chairs remained stiff and uncomfortable. Carving was the chief form of decoration, some pieces being painted or gilded. Framed doors for cupboards, etc, were often panelled in geometric designs in high relief. Walnut and ebony were the principal timbers.

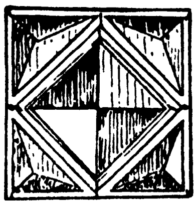
(c) Louis XIII (1610-1643), 17th Century—High Renaissance.

The reign of Louis XIII brought to an end the French Renaissance style, influenced by Flemish and Italian styles.

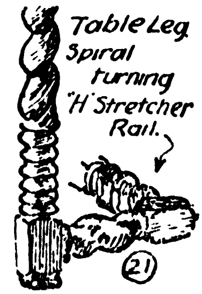
In construction the furniture was generally rectangular in form with classical details—architectural columns, pediments, mouldings, and panelling.



Ornamented Pillars.



Diamond point
Panel. 20

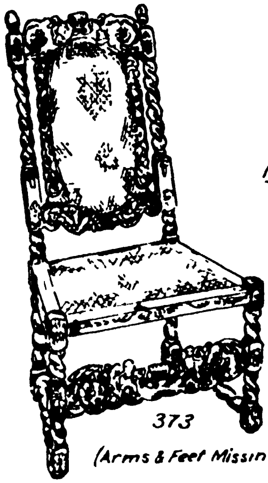


Ornamentation consisted of rich elaborate carving, moulded stucco or gesso shapes, inlay and marquetry in coloured woods, brass, tortoise-shell and marble, extravagant use of moulded and spiral turnings, richly carved mouldings and geometric panelling. Some carving and whole articles were painted in bright colours. Motifs for ornamentation were of classical origin—human and animal forms, foliage (mainly fruits), shells, and strap work.

Bureaux (writing desks) with fall fronts and extension top tables were introduced.

372.

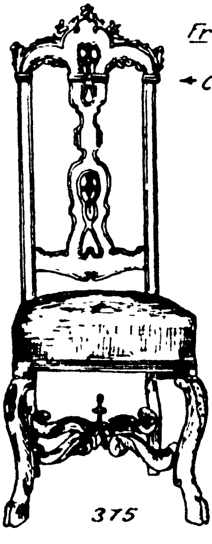
Italian Cassone or Marriage Chest - 16th C (Late)
Carved & ornamented with gesso work & gilded



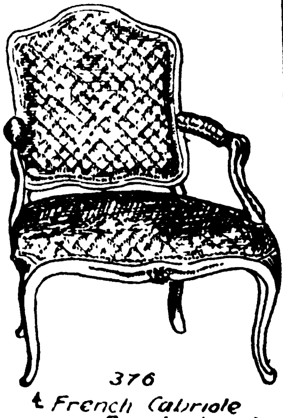
373
(Arms & Feet Missing)

Italian Chair. Late 17C Carved oak, cane filled back and seat Elaborately carved top rail and underbrace. Spiral turnings

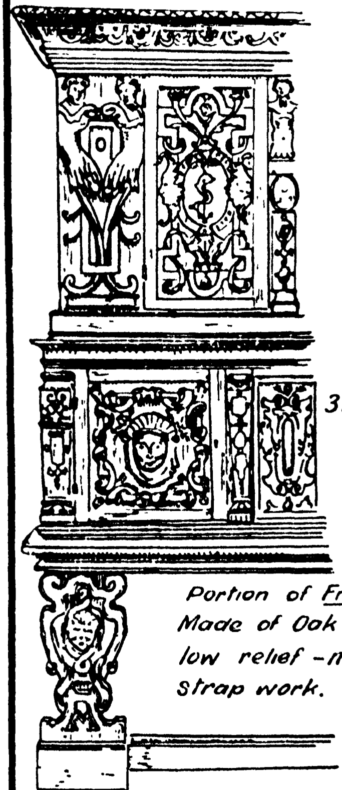
French Gilt Chairs 17thC (Louis XIV).
← *Carved. Covered with tapestry materials*



375

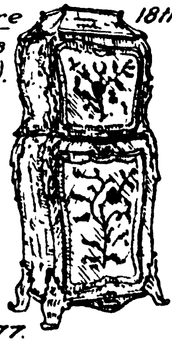


376
↑ French Cabriole or Bandy Leg ↓



374

French Pedestal Secretaire 18th C.
in marquetry - gilt mounts (Louis XV).



377

Portion of French Cabinet 16thC
Made of Oak - Panels carved in low relief - masks, scrolls and strap work.

① FURNITURE STYLES. —

Figs 372 – 377.

PLATE 78.

Very elaborate heavy turned legs (sometimes strengthened with "H" stretcher rails) were used for tables, chairs, and bases of cupboards, etc. Some tables were supported by as many as twelve ornamental turned legs. Chairs were smaller, some being upholstered with leather and velvet, fixed with silver-headed and gilt-headed nails. Timbers used were oak, cedar, walnut and ebony.

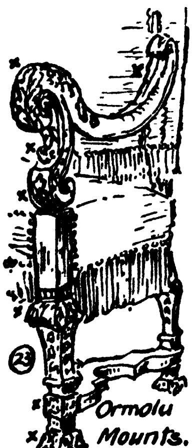
(d) Louis XIV (1643-1715), 17th Century—Baroque Style.

France at the time of Louis XIV was one of the wealthiest powers in Europe. Louis XIV became known as the "Grand Monarch" because of his magnificent courts and his love of art and literature. The furniture of his reign was greatly influenced by his extravagant tastes. Early work of the period was mainly baroque in style (from Italy), but towards the end of the century it became more refined, losing much of its exaggerated, fantastic form.

Construction was similar to that of Italian Baroque furniture—at first rectangular (rectangular panels, large classic mouldings), later a blending of straight and curved lines.

Decoration was chiefly rich carving, marquetry and inlay. Motifs—from nature and mythology—water lilies, leaves, acanthus, festoons (loops or chains of flowers, drapery, etc.), swags, masks, sphinxes, weapons, strapwork, etc.

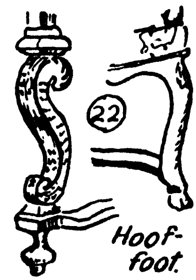
The name of Andre-Charles Boulle (cabinet maker, sculptor and metal chaser) is always associated with Louis XIV style. Boulle was responsible for perfecting the method of marquetry decoration. He used woods imported from India and Brazil, ebony, brass, copper, tin, white metal, mother-of-pearl, tortoise-shell, ivory and horn to produce elaborate designs of ruins, landscapes, baskets of fruit and flowers. Added decoration was effected by applying gilded brass or bronze mountings and mouldings, beautifully chased and carved—heads of animals and humans, delicate scrolls, acanthus, leaves, etc. Painting, gilding and silvering were also popular.



23 Ormolu Mounts.

Scroll Arms and Serpentine Stretcher

The commode (wall cabinet) was the most imposing article of furniture, combining straight and curved lines—e.g., bombé fronts. The commodes were decorated with inlay, marquetry and brass mounts. The curved leg with doe's foot was used (forerunner of the cabriole leg). Chairs and sofas were generally carved and gilded, and strengthened by "H" or serpentine or carved arched underbracing. The seats and backs were usually padded and covered with tapestry materials. Silk, woollen, silver and gold threads were used for tapestry making. (Figs. 375 and 376.)



22 Hoof-foot

Scroll Leg

Acanthus Scroll Mount. 24

Scrolled, flat and turned legs were generally used.

Chief timbers: Chestnut, ebony, oak and walnut.

(e) Louis XV (1715-1774), 18th Century—Rococo Style.

The early part of this period is known as the Regency style (during the regency of Phillippe d'Orleans). It was a transitional period from the high baroque style of Louis XIV to the light feminine rococo style of Louis XV. This short period is characterised by softer lines and gradual change from rectangular forms to curved flowing lines. Ornament became less classical, with a preference for natural objects rather than mythological. The cabriole leg was more evident, replacing the scrolled baroque forms. Charles Cressent was an outstanding craftsman of the Regency style.

When Louis XV was old enough to take his place as ruler in 1723, he continued to lavish vast sums on building and art.

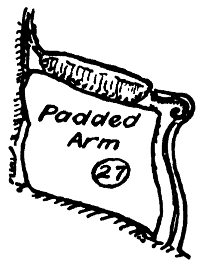
There seemed to be a horror of the straight line and rectangular form. The curves and fantastic shapes and ornaments, characteristic of the Rococo style, became popular.

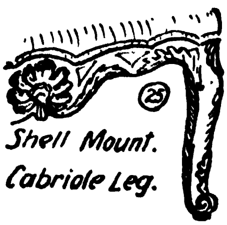
In construction most articles were lighter, with comfort and beauty combined. Curved outline was used wherever possible.

Ornamentation consisted chiefly of veneering, marquetry, inlay and chiselled mounts and mouldings of gilded brass or copper (called Ormolu mounts). The latter form of decoration almost universally displaced wood carving. The use of ormolu mounts was in some cases carried out to an extreme, the woodwork being merely a foundation to support excessive metal ornament. The mounts were used for mouldings, panel framing, corners, handles, legs and feet, etc., to protect veneering. (Figs. 377 and 378.)

Designs for ornamentation were based on almost every believable object (except architectural forms), such as foliages, flowers, fruit, vegetables, insects, animals, Cupids, rocks and shells.

Later work showed the influence of Japanese and Chinese styles of lacquered or japanned work with painted picture panels, plus the applied metal mounts. The Martin brothers perfected a method of lacquering known as Vernis Martin varnishing. Coloured painting was also popular.



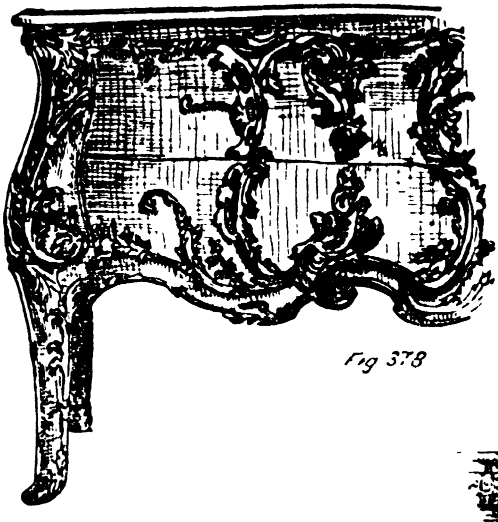


Shell Mount.
Cabriole Leg.

Metal Shoe.

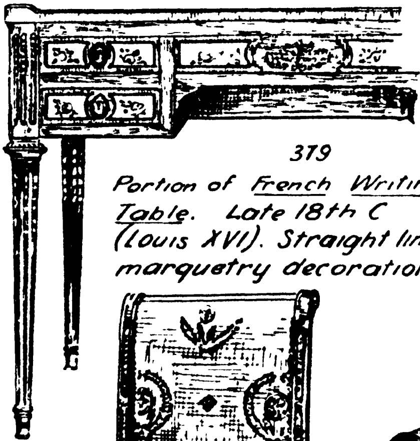

Mask 29

Veneered and
Marquetry Panel.



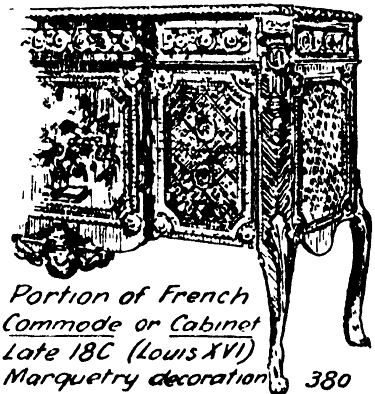
Portion of French Commode or Wall Cabinet 18th C. (Louis XV). Decorated with gilt mounts in scrolled leaf designs, serpentine front

Fig 378



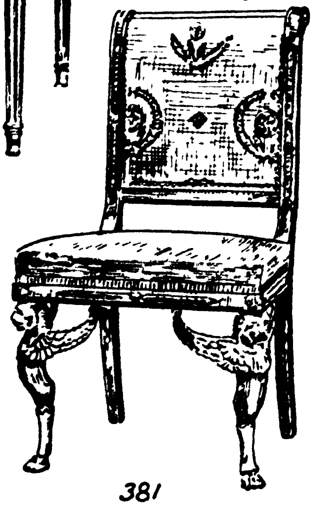
379

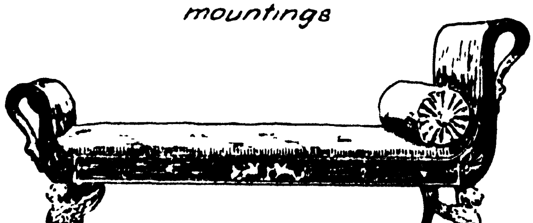
Portion of French Writing Table. Late 18th C (Louis XVI). Straight lines, marquetry decoration



Portion of French Commode or Cabinet Late 18C (Louis XVI) Marquetry decoration with added gilt mountings

380





382

French Chair and Sofa 19th C. Empire Style. Ornamented with bronze winged lion heads.

381

Figs 378-382

② FURNITURE STYLES:-

PLATE 79.

Tables for every purpose were evolved, some with marble tops. Chairs and lounges were smaller and more comfortable, with or without arms. The seats and backs were lower to suit the mode of dress.

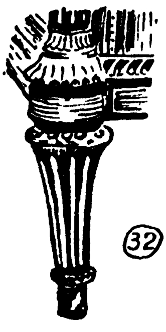
Jean Oeben (noted for marquetry), Phillipe Caffieri (metal chaser), and Meissonier (designer and cabinet maker) were chief exponents of the Louis XV Rococo style.

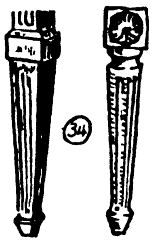
Timbers used were mahogany, tulipwood, ebony, rosewood, boxwood, and satinwood. Dyed woods were often used for marquetry designs.

(f) Louis XVI (1774-1793), 18th Century—Classic Revival.

Towards the end of the Louis XV period there was a change in design and ornamentation of furniture. This was due to the study of the classic pieces which had been unearthed during the excavations of Pompeii and Herculaneum, about the middle of the 18th century. These changes effected a taste for the more severe classic designs of the straight line and rectangular form. It was an architectural style, similar to, but more refined than that of the Renaissance classic revival. This inevitable change was a reaction to the curvilinear Rococo style of Louis XV. (See fig. 379.)

Construction was simple, rectangular with few curves, dainty and graceful, being based on the ancient architectural forms.



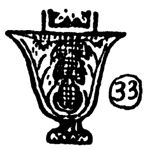


Louis XVI. Legs

Marquetry Panel

Louis XVI Ornament

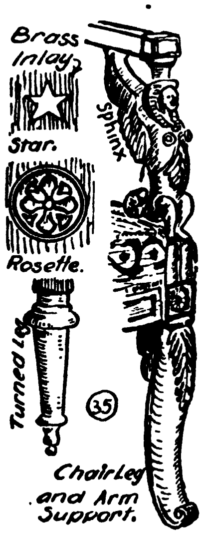
Ornamentation was symmetrical, and consisted chiefly of small delicately carved mouldings (scaled down from classic shapes), carving in low relief, veneering, inlaying, marquetry, gilding, painting and lacquering in white, black and gold. Surfaces were generally flat and veneered or inlaid in geometric patterns. (See fig. 380.) The metal mount or ormolu was still favoured as added decoration, with designs based on scrolls, medallions, clusters of flowers, palm leaves, acanthus leaves, oak leaves, birds, ribbons, knots, arrows, musical instruments, agricultural implements, etc. These mounts were applied to all articles of furniture, chairs, cabinets, tables, clocks, etc. Brass and gilt borders or galleries were often applied to the edges of small tables, desks and cabinets.



The cabriole leg or curved leg gradually disappeared and was replaced by slender, light, straight, square or turned tapered varieties, which were sometimes lightly carved or fluted, or decorated with gilded mounts. Upholstery in tapestry, silks, or embroidered satin was applied to head and foot boards of beds and to chairs and sofas. Some whole pieces were painted in colours, gilded or lacquered.

J. H. Riesener is usually associated with Louis XVI style for his furniture designs and marquetry decoration. His creations were generally ornamented with bronze gilt mounts and mouldings designed and chased (etched or engraved) by Pierre Gouthiere. David Roentgen was another outstanding cabinet maker of the Louis XVI style.

Mahogany, rosewood, tulipwood, satinwood, ebony, and oak were timbers used during this period.



(g) Directoire and Consulate Styles (1795-1804).

After the revolution the Directory assumed control in 1795. The Directoire furniture was a simpler form of the Louis XVI style, lacking its elaborate richness. In construction, furniture closely followed classic lines (especially Roman and Pompeiian), rectangular with restrained curves.

Ornamentation: chiefly applied mounts and carving—motifs were of revolutionary symbols, such as swags, rosettes, sphinxes, torches, urns, arrows, acanthus, wreaths, clasped hands, rams, swans, lions, human and animal heads and figures, etc.

Chairs and sofas were of Roman form with rolled-over backs upholstered with vividly striped coverings. Legs were generally turned and decorated with carving or ormolu.

Reisener and David Roentgen (known as David) helped to produce the style. Other names associated with this period were Joseph Desmalter, Percier and Guillaume Beneman.

Chief timbers: Mahogany, amboyna, walnut, and oak.

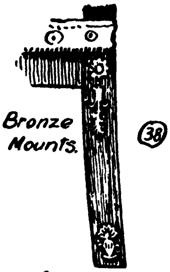
(h) Empire Style (1804-1815).

The Empire style derives its name from the expansion of the French Empire during the Napoleonic era. The furniture designs, and especially the ornamentation, reflect to a certain extent the glory of Napoleon.

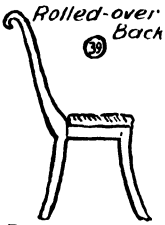
The Empire style grew out of the Directoire and Consulate forms, generally rectangular constructions with architectural features such as heavy colùmns, mouldings and cornices. It was massive, heavy and symmetrical. Large surfaces were generally flat and plain, without any panelling or mouldings.

Ornamentation was mainly ormolu or brass mounts on veneered or painted surfaces. Motifs were based on military or triumphal symbols, e.g., armorial trophies, shields, swords, arrows, flaming torches, wreaths, winged animals, and sphinxes (Egyptian), honeysuckle, swags, and medallions. (See figs. 381-382.)

Tables were generally round, often with marble tops and pedestal or tripod bases. Beds were very heavy solid constructions resembling boats, with scrolled or rolled-over ends. Upholstery fabrics: Tapestry, satin and velvet, with centre designs and borders designed to fit the backs and seats of chairs, etc. (colors—green, red and blue most popular).



Chair Leg.



Empire Chair

Wreath. 36
Bronze

Honeysuckle 37

Timbers used were rosewood, mahogany and ebony.

Charles Percier and Fontaine were responsible for the early Empire pieces copied from archeological discoveries of Rome, Greece and Egypt.

3. ENGLISH STYLES (Plates 80-85).

(a) Tudor Gothic, 16th Century. "Age of Oak."

Household furniture before 1500 consisted of very few pieces, the most important item being the oak chest. The chests served several purposes—for storing clothing and valuables; as seats in the day time and the large ones as beds at night. They were crudely made of solid slabs held together with wooden pegs, and with little or no ornamentation.

Church furniture reflected the Gothic architectural style in both form and decoration—pointed arches, Gothic tracery and deep Gothic mouldings.

The early Tudor kings, Henry VII and Henry VIII, employed Italian artists, sculptors and architects, who brought with them many Italian Renaissance ideas. Furniture retained its Gothic construction (heavy, squat, rectangular and square form) with a mixture of Renaissance and Gothic ornament. A few new pieces were introduced, such as four-poster beds with frames completely covered with drapery (possession of the wealthy); dressers with curved panelled cupboards; chairs—solid box type (known as wainscot chairs, fig. 388)—"X" type (Italian); writing boxes or desks, consisting of a box with a sloping top used on a table or stand; refectory or trestle tables. (Fig. 387.)

Ornamentation consisted of Gothic and Renaissance motifs, e.g., Gothic linenfold panels, tracery, quatrefoil, rope mouldings, Tudor roses, rosettes, medallions, acanthus leaf scrolls, and arabesques (carved, painted or inlaid panels of floral and geometric designs). (See figs. 384-386.)

Towards the end of the 16th century, during the reign of Queen Elizabeth, the Renaissance spirit became more pronounced, although the traditional Gothic form still persisted. Turned work became popular, e.g., the characteristic "melon-bulbous" or carved turnings frequently used for vertical members, posts and legs, etc. Renais-

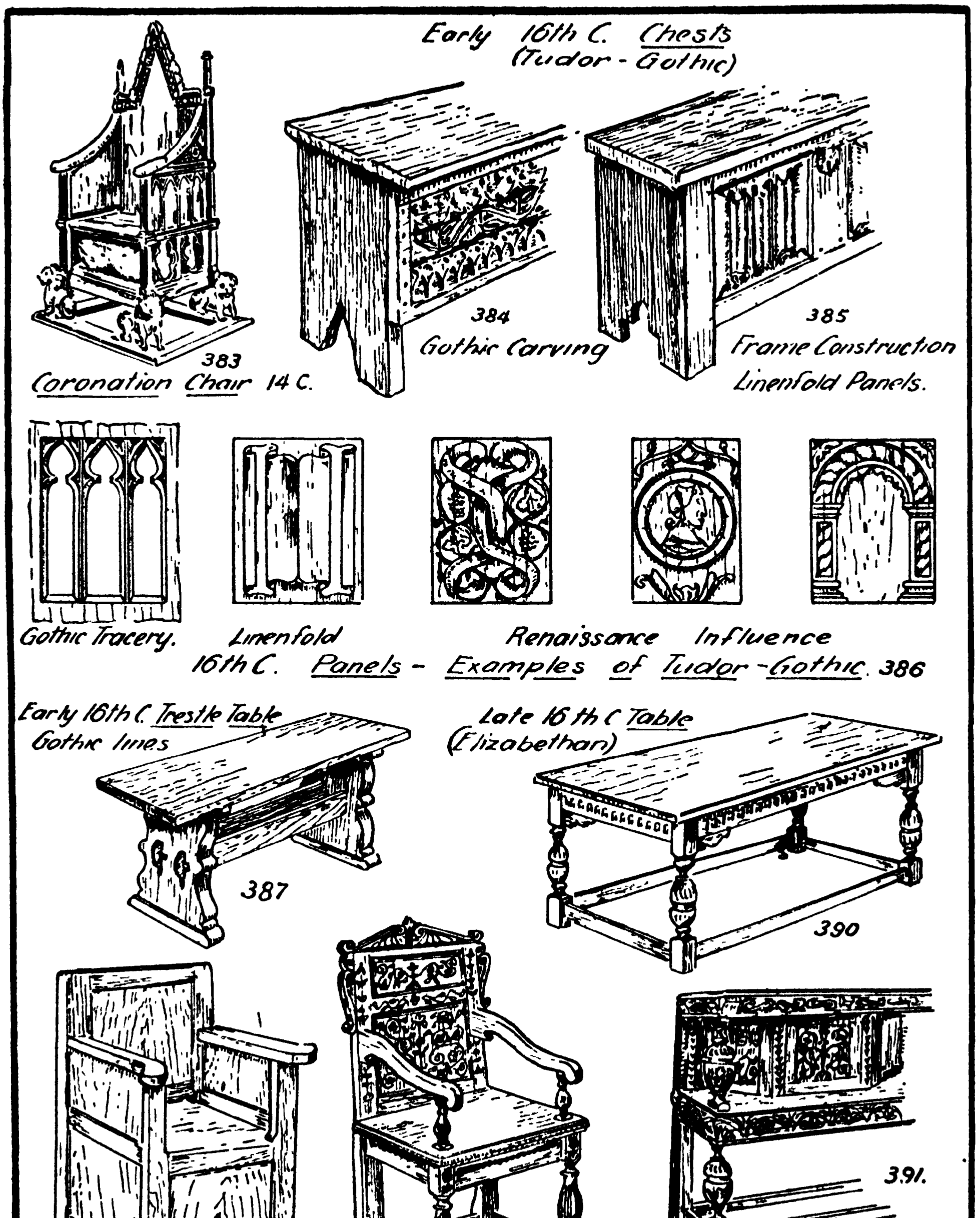
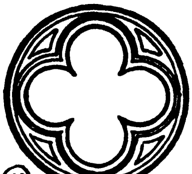

Early 16th C. Chests
(Tudor - Gothic)
383
Coronation Chair 14 C.
384
Gothic Carving
385
Frame Construction
Linenfold Panels.
Gothic Tracery.
Linenfold
Renaissance Influence
16th C. Panels - Examples of Tudor-Gothic. 386
Early 16th C. Trestle Table
Gothic lines
387
Late 16th C Table
(Elizabethan)
390
Early 16C.
388
Tudor-Gothic
Chairs
Panelled Construction.
389
Late 16C.
Carved & Inlaid.
3.91.
Elizabethan
Court Cupboard. Late 16C.
Carved & Inlaid
3
FURNITURE STYLES
Figs 383-391

PLATE 80.

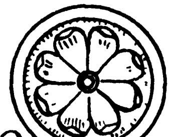
sance ornament was more evident in the form of carved and inlaid designs based on floral and geometric patterns, also delicately carved strapwork and chanelling, human and animal forms, floral scrolls, etc.



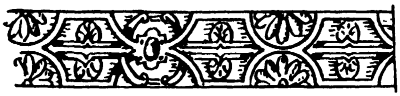
40 Quatrefoil.

The straight line and rectangular shapes continued, chairs, tables and court cupboards (forerunner of the sideboard) were usually of massive proportions with low stretcher rails. (See figs. 389-391.) Chairs were often decorated with inlaid or carved panelled backs. (Fig. 389.) The court-cupboard consisted of a cupboard with a recessed upper section and a heavy cornice supported by large turned bulbous props. (Fig. 391.)

43 Melon-Bulbous Turning — "A" Gadrooning.



41 Tudor Rose.



42 Strapwork

Timbers: Chiefly oak with coloured or stained woods for inlay.

(b) *Jacobean-Stuart, 1603-1688. 17th Century.*

"Age of Oak," beginning of "Age of Walnut."

The term "Jacobean Style" as applied to furniture, broadly refers to the period from 1603-1688. It includes (i) Early Jacobean or Early Stuart (1603-1649), Kings James I and Charles I; (ii) Commonwealth (1649-1660); (iii) Late Jacobean or Late Stuart (1660-1688), the Restoration of Charles II and James II.

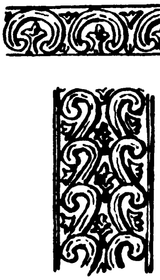
There were many changes in the styles of furniture and decoration during this period. Oak was chiefly used, although some chests were made of olivewood. Walnut, an imported timber, gradually took the place of oak during the latter half of the century.

(i) Early Jacobean, 1603-1649.

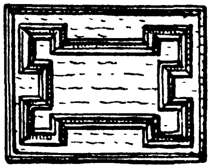
The Renaissance style continued, crowding out the Gothic forms. Furniture was generally smaller, lighter and more simple in construction with less ornament. The ornament consisted mainly of flat chip carving or incised work of Renaissance motifs —acanthus, guilloche (band ornament of interlacing circles), applied mouldings to panels, and applied split turnings. The melon-bulb, carved turning was smaller.

Chairs became more popular and not limited to the upper classes. The solid oak chair with its carved or inlaid panelled back of the Tudor period continued, although it was made more comfortable by the addition of padded seat or loose cushions, the legs and arm supports were frequently turned. A type of chair known as the "farthingale chair" was introduced by James I. This chair was less cumbersome, low and without arms, designed to suit the hooped, wide-spreading skirts of the ladies of the day. (Fig. 392.) The dining tables (with fixed or extension tops) were similar to the Elizabethan tables, but with lighter turnings and less carving decoration. A lighter form of table, called the "gate leg table," was introduced for occasional use. It consisted of one or two drop leaves hinged to a fixed centre top. When in use the hinged leaves were held up by means of a leg, which opened out

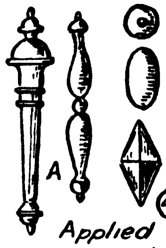
Incised Carving Panel 44



45 Guilloche Carving

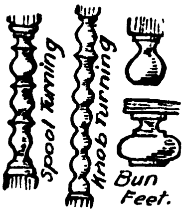


46 Panel Applied Mouldings



Applied Ornament. 'A' Split Turnings 47

from the main frame like a gate. The legs were usually turned (bobbin pattern). The court cupboard was of lighter construction, carved or inlaid, often with turned pendants instead of the heavy, turned cornice supports. Jacobean chests had added decoration in the form of applied mouldings and drop ornaments (overlays of rectangular and diamond shapes and split turnings). (Fig. 395.) Previously mouldings had been worked in the solid wood of the panels and framing, now they were worked on separate strips and applied, using true mitres for jointing.



Cromwellian Legs & Feet. 48

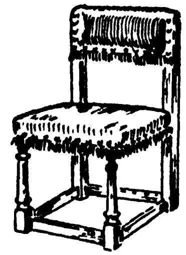
(ii) Commonwealth (1649-1660).

Furniture during this period was severely simple. Ornamentation was reduced to a bare minimum. It consisted of simple turnings and simplified inlay and carving. Turned knobs and pendants are characteristic ornament on chairs, etc., the legs were either turned (bobbin or spiral), or rectangular with bun feet. (See Late 17th Century Jacobean chairs, plate 81.) Added comfort was obtained by the use of a wide padded top-rail, decorated leather upholstery being used after the Spanish style.

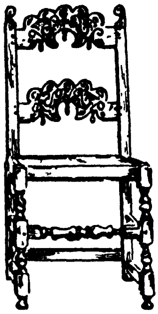
(iii) Late Jacobean (1660-1688).

When Charles II returned from his refuge in Flanders (1660) he brought with him ideas of continental luxury and elegance. A marked change was effected in furniture design and ornamentation, due to French, Italian and Flemish influence. There was a change from simplicity to extravagance.

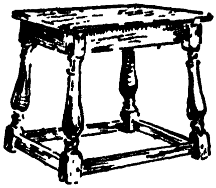
Curved forms were introduced following the Louis XIV baroque style. Characteristic shapes being spiral turnings (single, double or triple twist); double scroll or Flemish scroll legs and scrolled feet. Walnut increased in popularity during the Late Jacobean period, and its use in veneering and furniture making made possible lighter and more graceful pieces. Veneering was little practised prior to the Restoration, but during the reign of Charles II the art of veneering and marquetry decora-



"Farthingale" 392
Early 17. C.



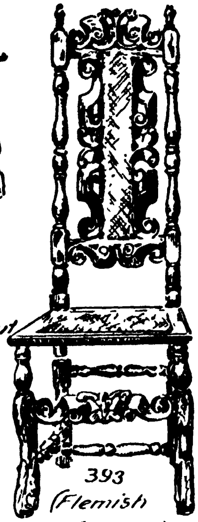
Late 17th C.



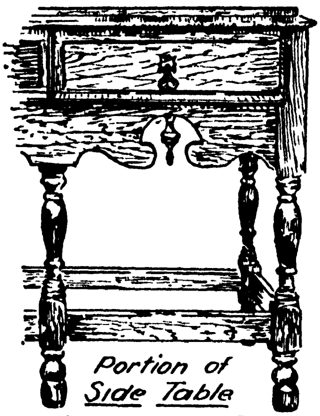
Stool
Early 17 C.

Carved Walnut

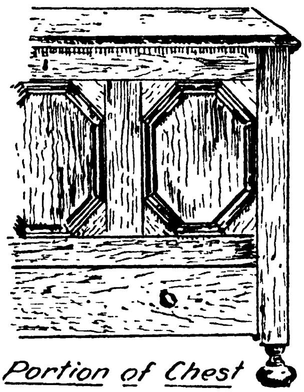
Jacobean Chairs 17th C



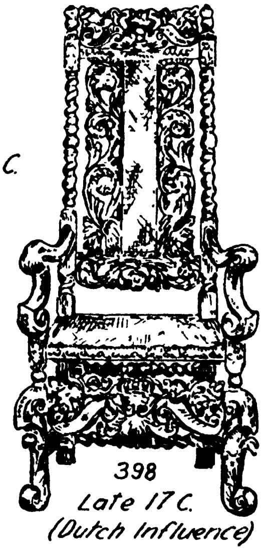
393
(Flemish Influence)
Crested Flemish scroll back, legs and rail



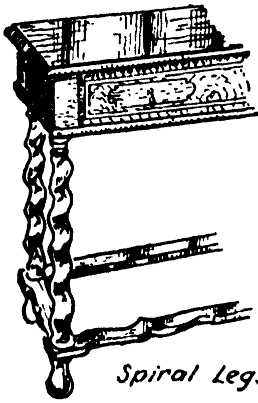
Portion of Side Table
Jacobean 17th C.
394



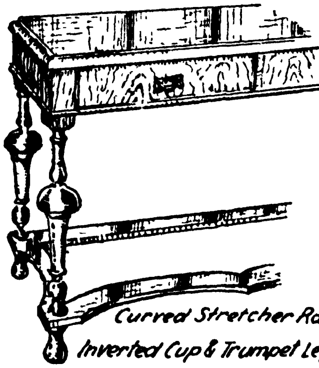
Portion of Chest
Jacobean Late 17th C.
395



398
Late 17 C.
(Dutch Influence)



Spiral Legs
396



Curved Stretcher Rails
Inverted Cup & Trumpet Legs
397

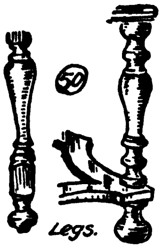
William and Mary Side Tables
Veneered - Late 17 th C

William & Mary Carved Arm Chair.
Scroll legs & arms.

④ - FURNITURE STYLES -

Figs 392-398

PLATE 81.



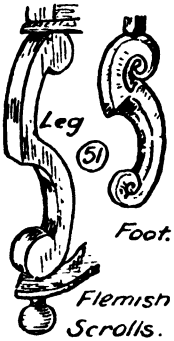
50 Legs. Baluster Turnings

tion was greatly improved, although it never reached the high standard of Boulle, the French designer.

Ornamentation: Deep rich carving (cherubs, lion, crowned crest, tracery, rose, acanthus), C and S scrolls on rails and arms of chairs, turning, veneering (characteristic oyster designs produced by veneers cut from sections of branches), inlay and marquetry (floral patterns), painting, gesso work (silvered or gilded). The art of carving during the 17th and 18th centuries was improved and influenced by Grinling Gibbons, who produced carvings in the highest possible relief of birds, flowers, fruit and draperies.

49 Spiral Leg. Flat serpentine stretcher rail.

The Dutch influence appeared in the high-backed chairs, which were elaborately carved with cane-filled back and seat, or upholstered with silks or velvets. (Fig. 393.) Chests of drawers evolved out of the chest. These were rectangular in shape with turned bun feet, veneered and extensively decorated with marquetry or inlaid scrolls and floral designs. Other articles were introduced to add more comfort to the home—day beds, small tables and stands, wing chairs, sofas and writing bureaux. Some pieces for the king's court were made from solid silver.



51 Leg. Foot. Flemish Scrolls.

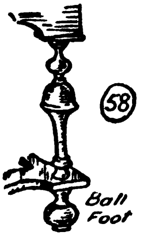
The importation of works of art from China and Japan influenced craftsmen to produce lacquered cabinets (decorated with paintings, gold and silver) with elaborately carved and modelled gilt stands.

Brass handles, knobs and escutcheons, etc., became the fashion late in the period, but unlike their French contemporaries, English cabinet makers did not overload their work with these metal fittings.

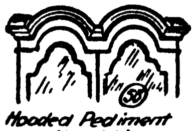
52 Crown Cresting & Scrolls-Chair

(c) *William and Mary, 1688-1702.* "Age of Walnut."

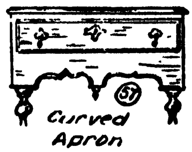
With the accession of William and Mary, English furniture design and decoration was greatly influenced by the Dutch and continental styles. Many new pieces appeared, due to more thought being given to home comforts. Instead of the dresser serving many purposes, special articles, such as china cabinets, book cases and small tea tables, became popular.



58 Ball Foot. Inverted Cup & Trumpet Leg



56 Hooded Pediment (Double).



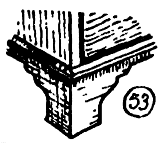
57 Curved Apron

This period is part of a transitional stage in furniture construction, when pieces gradually changed from the rectangular, straight line form (framed construction) of the Jacobean styles, to the development of highly curved forms of the Queen Anne and Early Georgian styles.

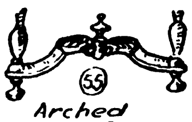
The elaborate furniture of the Restoration style gave way to simpler styles which were smaller, lighter and more suitable for the home than for the courts of kings. This change was assisted by greater use of veneered constructions.

William and Mary pieces were rectangular in shape, with curves introduced for cabinet tops, aprons, legs and arms and underbracing rails, etc. Walnut predominated and was used in the solid for the frame work of chairs, cabinet stands, etc., and as highly polished veneers (burl, light, dark, or bleached) for large surfaces on oak groundwork. Some plain surfaces were painted, lacquered or ornamented with marquetry designs.

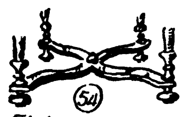
Although plain or baluster and spiral turnings were used, the characteristic legs of stands (for writing desks, tables, china cabinets, book cases, small tea tables and chests of drawers, etc.) were trumpet shaped with an inverted cup at the top. The rails or aprons of these stands were usually shaped and veneered. (Figs. 396 and 397.) The legs, which terminated in ball or bun feet, were strengthened by flat shaped or serpentine stretcher rails a few inches from the floor. The Flemish scroll leg (which later developed into the cabriole leg), square tapering and octagonal legs and bracket feet were also used on some W & M pieces. The backs of chairs were usually pierced and elaborately carved, and sometimes cane-filled (Dutch influence). (Fig. 398.) The carved front stretcher rail and arched underbracing of chairs was borrowed from Italian and Dutch sources.



Bracket Foot



Arched Under-Bracing



Flat, Crossed, Serpentine Stretcher Rails

Ornament consisted mainly of veneering in figured walnut; marquetry (stars, fans, birds, and floral designs); seaweed marquetry was characteristic, consisting of interlacing inlay designs based on marine plant life; carving, using Flemish scrolls, shells, acanthus leaves, Cupids, gadroons (convex curves usually carved on bulbous turnings).

Christopher Wren, a distinguished architect and designer of the day, followed Italian styles.

(d) Queen Anne, 1702-1714, 17th Century. "Age of Walnut."

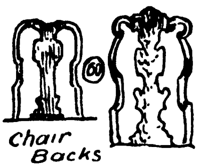
During the reign of Queen Anne English taste began to assert itself, although the Dutch inspiration was still evident in some pieces, due to the activities of Dutch craftsmen who came to England during the reign of William of Orange.

Walnut, although sometimes used in the solid for small articles, was exclusively used for veneering over oak and other woods. Walnut veneers were applied to almost all articles of furniture, including the backs and frames of chairs. On cabinets, drawer fronts, etc., figured veneers were often surrounded by cross-bands (framed by strips of veneer with the grain running across its width).

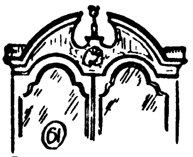
The desire for more comfort in the home led to furniture being well constructed on simple lines. The pieces were more refined than the William and Mary furniture, especially the cabriole leg, which appeared late in the 17th century; it lost its heaviness and became more slender and graceful. Ornament was restrained, carving being confined to delicate shell, acanthus and husk forms on the cabriole knees, seat rails and the crest of chair backs, and to carved hoof, ball, Dutch pad and paw feet. Marquetry lost favour. Cabinet makers valued the beauty of the grain markings of the wood veneers and depended on well proportioned curves to beautify their work.

Chairs were elegant and comfortable, with lower backs (with plain or pierced fiddle-shaped central splat), some curved arm rests, and cabriole legs terminating in ball or paw feet. (Figs 399 and 400.) As technical knowledge in construction developed, stretcher rails gradually disappeared (about 1710). The cabriole leg,

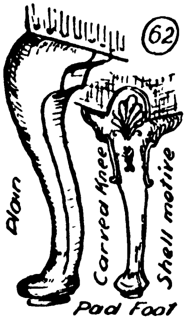
Veneered and Cross-banded Drawer Front. 59



60 Chair Backs



61 Broken Pediment



62 Pad Foot Cabriole Leg.

characteristic of Queen Anne furniture, was particularly suited to the curved outline of "bell" seats and frames. It was applied to nearly all pieces, cabinets, dining tables, tea tables, card tables, bureaux, tallboys, beds, etc. Easy chairs and sofas became popular. (Fig. 402.) The easy chairs had low seats, arms and high winged backs, all parts being stuffed with horse-hair or wool, and covered with fabrics.

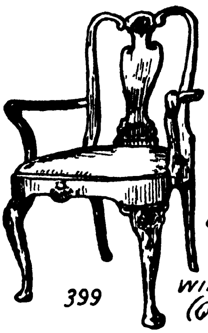
Towards the end of the period mahogany was used for a few small articles.

(e) Georgian 1714-1806, 18th Century. "Age of Mahogany."

(i) First half of 18th century. The Early Georgian period marks the beginning of the "Age of Mahogany," although many pieces of furniture were still made of walnut.

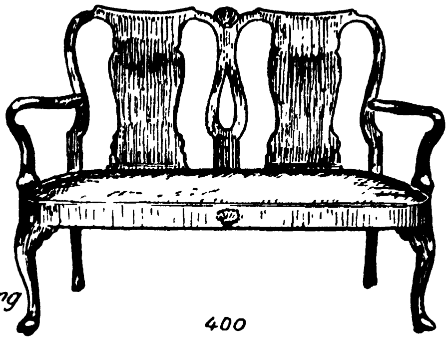
Mahogany was imported from the West Indies. At first only a few important pieces were made of this new wood, owing to its high price, due to heavy import duties. It was not until about 1733, when the import tax was lifted, that mahogany gradually superseded walnut and became the universal timber. It was used not only for furniture making, but also for exterior woodwork.

The use of mahogany involved a change in constructional details; it was used in the solid, requiring a revival of panelled construction. Walnut had been almost exclusively used for veneered work, the grain of the veneer being enough decoration. The early mahogany had rather a plain grain, and required some added ornamentation, hence panelled doors, mouldings and carvings were used.



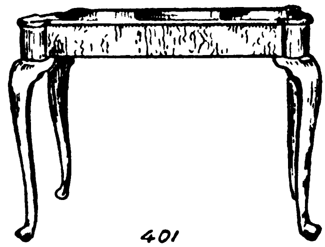
399

Arm Chair
Hoop back-
Cabriole legs
decorated
with shell carving
(Queen Anne)



400

Chair-back Settee with plain
Cabriole legs (after Dutch Style)
(Queen Anne)

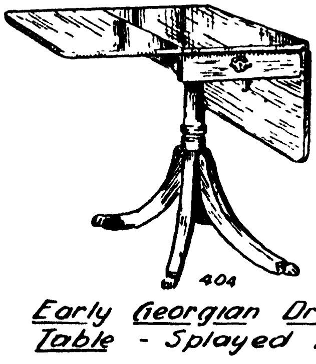


401

Queen Anne Side Table
Veneered

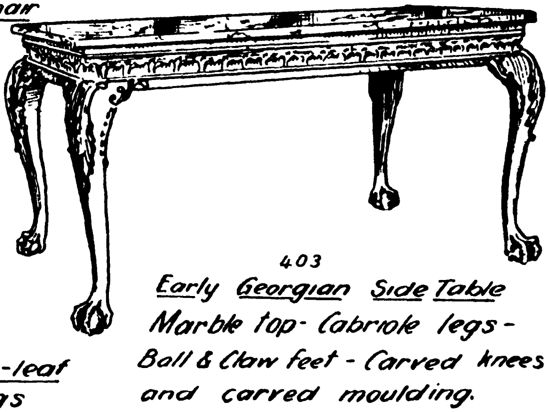
(Embroidered
covering) 402

Queen Anne Winged Easy Chair
Cabriole legs - Ball & Claw feet



404

Early Georgian Drop-leaf
Table - Splayed legs



403

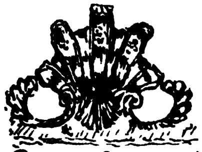
Early Georgian Side Table
Marble top - Cabriole legs -
Ball & Claw feet - Carved knees
and carved moulding.

⑤-FURNITURE STYLES - Early 18th. C.

Figs 399-404

PLATE 82

Early pieces of this period were similar to the Queen Anne styles, but as the use of mahogany increased in popularity, furniture became heavier and the proportions larger, using architectural details—pediments, columns, etc. It was at times very elaborate, due to the increased use of carving decoration, using motifs of the Rococo and Baroque style (often Louis XIV inspiration), such as mythical forms, lion masks, complicated rock and shell forms, acanthus and foliated scrolls.

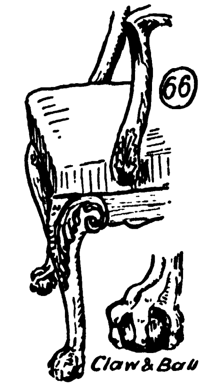


Rococo Ornament Shell & acanthus. Scroll forms (64)

Rococo Carving - Chair seat rail. (63)

The cabriole leg, used on chairs and tables, etc., was stouter, with a more pronounced curve, terminating generally in some carved detail—ball foot, or claw foot or lion's paw. (Fig. 403.) The knee was often carved to resemble a lion's head, a shell or an acanthus leaf. The arms of chairs and settees often ended in some form of mask or carved head, generally the heads of lions or eagles carved in full relief.

(65) Lion Head on Cabriole Knee.



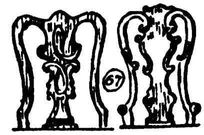
(66) Claw & Ball

Carved Leg & Arm-Acanthus.

Curved lines of construction still continued from the previous period. Some of the Louis XIV French pieces were copied—carved, painted and gilded.

To avoid the heavy appearance of the work, large surfaces were broken up with mouldings and panelled shapes. Pierced or fretted designs were introduced for the same purpose, e.g., the solid splat in chair backs was usually violin-shaped and ornamented with open pierced designs.

William Kent is associated with Early Georgian furniture. He was an architect who designed furniture to suit the houses he built. His designs were more of an architectural character (influenced by Italian styles) with elaborate carvings, scrolled legs and heavy classical mouldings. The latter were generally applied to the tops of cabinets, book cases, china cabinets, etc. Much of Kent's work was painted or gilded.



(67) Chair Backs Pierced - Carved.

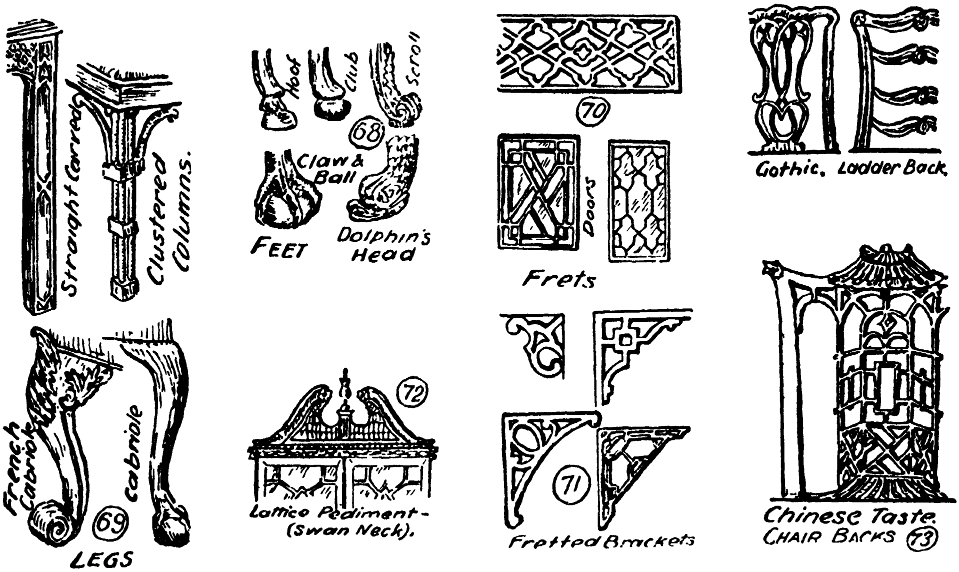
(ii) Second half of 18th Century. Leading designers and craftsmen during this period were Thomas Chippendale (1718-79), the Adam brothers (Robert Adam, 1728-92), George Hepplewhite (d1786) and Thomas Sheraton. These men were more or less leaders of different schools of furniture styles.

Chippendale School. (Period of greatest activity, 1745-1780.) The Chippendale School is sometimes referred to as the Middle Georgian style.

Thomas Chippendale is possibly the best-known of the 18th century designers and cabinet makers. He was a skilful designer, draughtsman and a master in the art of carving. Although he designed and manufactured all articles of furniture, he was most successful as a designer of chairs.

Chippendale's work is characterised by strong but graceful lines, good proportions and sound construction, although many of his designs appear heavy and massive, and at times a little over-ornate with excessive elaborate carving.

The early work of the Chippendale school continued and developed the Early Georgian style. It was refined, richly decorated with carving—claw and ball feet and Rococo scrolls.



Later designs were not altogether original. They were eclectic, that is, designs made up of details borrowed and modified from previous styles. Chippendale showed complete mastery in the art of adapting and combining details copied from Dutch, French, Chinese and Gothic sources. In this way furniture which had wide appeal was produced. Some pieces were simple and plain, while others were complicated constructions and elaborately carved.

Most of Chippendale's work was carried out in solid mahogany, but he also used walnut, rosewood, beech and fine grained pine for some of his carvings. The latter wood was usually japanned or gilded. He never used inlay as a type of decoration for his own designs, but depended on carving and fretwork (pierced designs) to give the necessary ornamentation.

Chippendale is famed for his chair designs, for which he used both the cabriole leg and the straight square leg. The cabriole leg was lighter and more refined than the Early Georgian, using the hoof foot, club foot, claw and ball or bear's paw as terminals. The knees were carved in low relief, using acanthus leaf, fruit, birds and flowers as motifs. The straight square legs were either plain, or moulded, and sometimes lightly carved, with the inside edges chamfered off to make them lighter. The solid splat in the backs of chairs of the Queen Anne and Early Georgian styles was replaced with beautifully carved, fretted or pierced designs, resembling interlacing ribbons (borrowed from Louis XV Rococo style), scrolled straps and leaves, Gothic tracery, etc. Some chairs had elaborate fretted lattice work backs with pagoda-like tops and straight fretted legs and brackets. (See figs. 405-408.)

The use of fret worked designs and overlays and corner brackets of tables, chairs

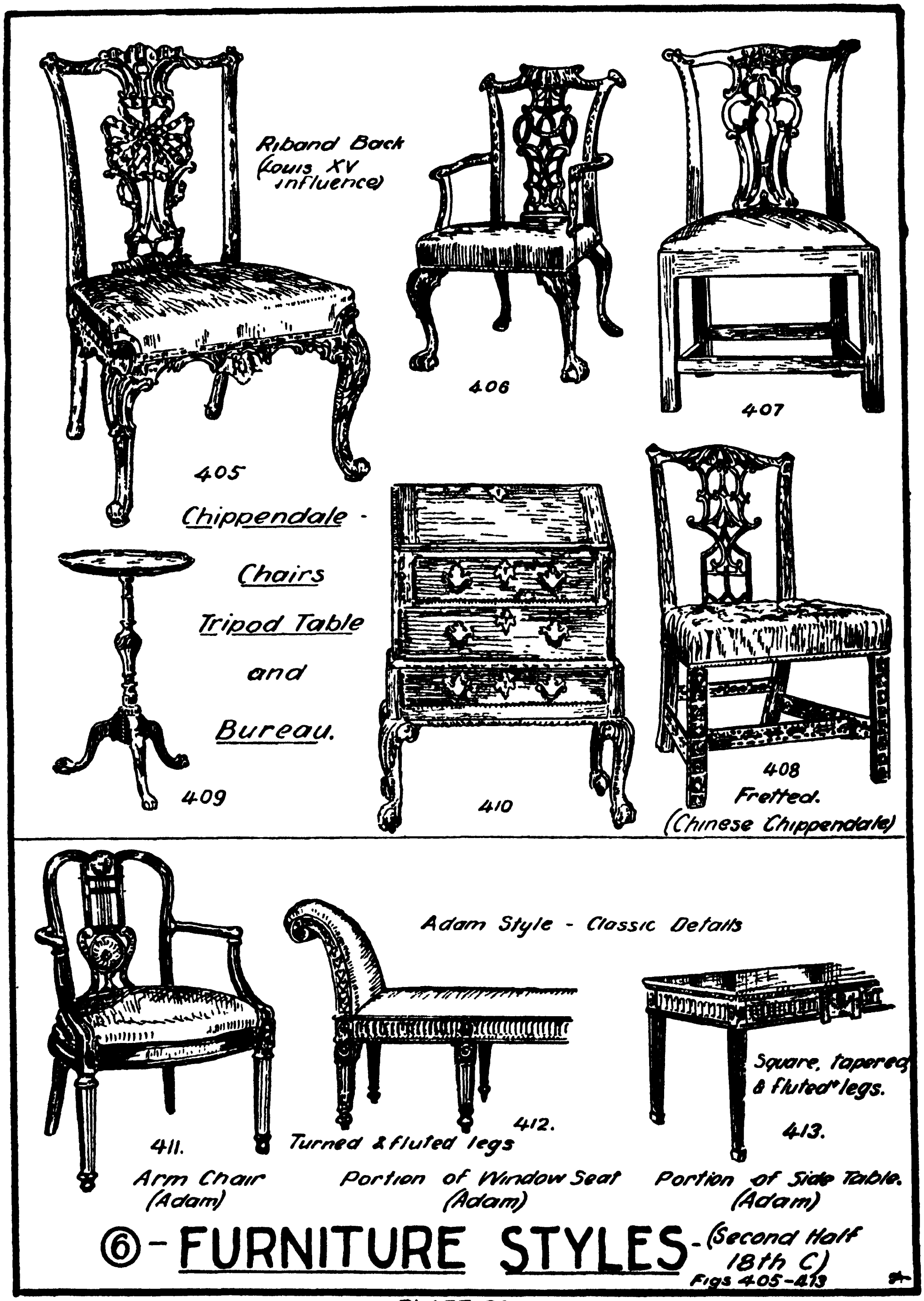

Riband Back (Louis XV influence)
405
406
407
Chippendale - Chairs Tripod Table and Bureau.
409
410
408
Fretted. (Chinese Chippendale)
Adam Style - Classic Details
411.
Arm Chair (Adam)
Turned & fluted legs
412.
Portion of Window Seat (Adam)
Square, tapered & fluted legs.
413.
Portion of Side Table. (Adam)
⑥ - FURNITURE STYLES - (Second Half 18th C)
Figs 405-413

PLATE 83.

and cabinets led to the idea of gluing together several pieces of wood, each piece with its grain at right angles to the next to give added strength. Thus plywood was introduced.

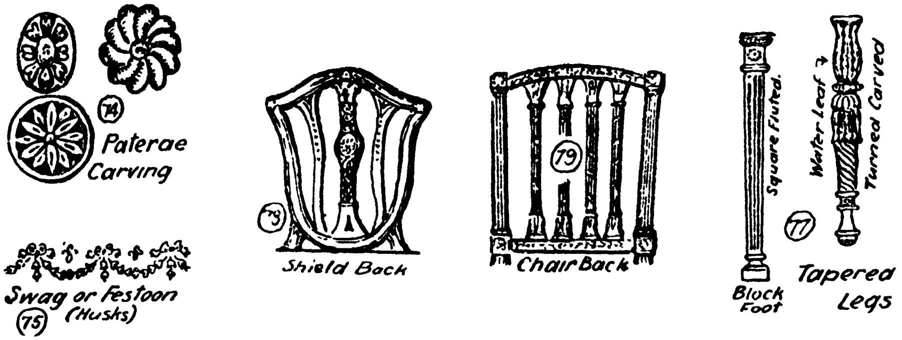
The increased popularity of tea parties led to many designs of small tea tables, the tripod table being one of them, consisting of a turned centre pillar and three radiating legs, the top was usually circular, with a slightly raised edge, often referred to as a "pie crust" edge. (Fig. 409.)

Adam School. (Period of Activity, 1760-1792)—Classical Revival.
—Introduction of Satinwood.

Robert Adam was the leader of the four brother partnership. He was an architect, not a cabinet maker. The "Adam" designs were passed on to cabinet makers, who constructed their work under the personal guidance of the Adam brothers. Chippendale is known to have made some of Adam creations in his workshops.

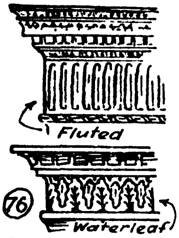
Robert Adam spent a number of years in Italy studying the ancient architecture and arts unearthed at Pompeii and Heculaneum. The Adam style of architecture and furniture design definitely portrays an intensive study of the antique classics. These classical details were refined and adapted to English needs in such a way as to form a new style, which is sometimes known as the "Adam Classical Style."

Both the interior and exterior of Adam houses were designed as a complete unit, everything harmonising down to the smallest detail. Even carpets, curtains, chair coverings, lamps, paintings, table silver, ceiling, wall and floor decorations, etc., were designed to harmonise with the articles of furniture. Thus many of the pieces were not suited to the average home, and could only be seen to advantage in the large rooms for which they were designed.



The Rococo forms of the Chippendale School were displaced by the classical influences. In construction the Adam pieces were a refined Early Georgian style, inspired by Classical Roman forms—of rectangular and square lines with occasional curves for table tops, chairs, sofas, commodes, etc. Tapering, square or turned legs were used in preference to scroll and cabriole forms. These straight legs were usually reeded, fluted, inlaid or decorated with low relief carving.

Ornamentation consisted of inlaying, marquetry, extensive use of composition ornament (gilded, silvered or painted) called stucco or gesso work, coloured painting and paterae (small round or oval carved ornaments). Motifs for designs were strictly classical—swags of drapery, husks or shell, delicate acanthus scrolls, wreaths, painted plaques, finely scaled mouldings carved with geometric patterns, heads of rams, goats and lions, winged sphinxes, fans, and architectural columns, pilasters, arches, etc. These decorations were carefully applied so as not to overload the articles, thus spoiling the simple, graceful lines.



(76) Ornamented Classic Mouldings

Early Adam pieces were constructed of walnut, but later satinwood became popular, enriched with marquetry, inlaid and painted designs. Ebony, rosewood, tulipwood, walnut, holly, poplar, pear and cherry woods were used for inlay and marquetry.

The Adam sideboard, consisting of a table with separate pedestal cupboards at each end, was evolved from the side table, and was intended to give extra accommodation for table linen, cutlery and crockery. Tables often had marble tops inlaid with coloured cement designs, the rectangular wooden framework being delicately carved with pendants, fringes or small ornamented panels, and often gilded or painted. (See fig. 413.)

In general the Adam pieces were rectangular, strong, light and elegant, with ornament inspired by the ancient classical forms.

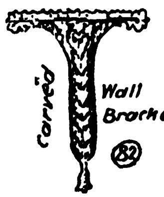
Hepplewhite School. (Period of Activity, 1790-1810). Greater use of Satinwood.

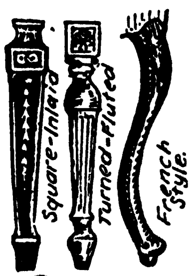
George Hepplewhite (a cabinet maker) was a contemporary of Chippendale, Robert Adam and Sheraton. Little is known of George Hepplewhite or actual Hepplewhite pieces. The main source of information regarding his style and designs has been obtained from his book, "The Cabinet Maker and Upholsterer's Guide," first published in 1788.

The Hepplewhite style is based on simplicity of line, rectangular shapes with occasional curves, and restrained ornament.

In general form and ornamentation, his designs were inspired by the Adam School and Louis XVI styles. He ignored the grand, formal style of Adam, designing pieces which were smaller, lighter and more suited to the middle-class home. Graceful curves (circular, oval and serpentine shapes) were applied to chair, and sofa backs and arms, fronts of sideboards, chests of drawers, commodes, tables, etc. The legs of these pieces were usually straight and tapered, ending in spade feet, although the French form of the cabriole (Louis XV) and the turned reeded legs (Louis XVI) were sometimes used. Thin stretcher rails were often used to strengthen the sinuous legs. The slender tapered legs of tables and chairs, etc., were often inlaid with fine stringing halfway down, and sometimes a band of holly or satinwood was inlaid round the legs about four inches up from the foot.


(82) Serpentine Front (Chest of Drawers)

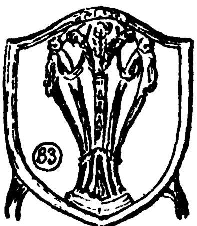




(81) LEGS

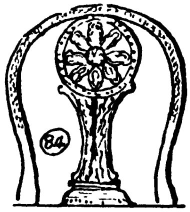
The Hepplewhite sideboard was one complete unit. The separate pedestals introduced by the Adam School now became part of the table, making it a more useful article of furniture, with roomy drawers and cupboards. Thomas Shearer, who collaborated with Hepplewhite, is usually credited with the new sideboard design.

Hepplewhite is famous for his chair designs, which may be distinguished by their characteristic shaped backs, especially the shield back. Other typical shapes being heart, wheel or hoop backs. The central splat consisted of delicate pierced designs, lightly carved to represent the three Prince of Wales feathers, ears of wheat or ribbons. (See figs. 414 and 415.)



Shield Back
Carved Feathers

Ornament consisted of light delicate carving, fine inlay, elaborate decorative painting, japanning and gilding. Motifs for decorative designs were based on swags of husks, flowers and drapery, wheat, three feathers and inlaid or painted classic designs.



Hoop Back

The Sheraton School. (Period of Activity, 1790-1810.) Classical Revival—Continued. "Age of Satinwood."

Thomas Sheraton was the last of the 18th century designers. His early work was somewhat influenced by his contemporaries Hepplewhite and Adam and also by the French Classical style of Louis XVI. Sheraton's name is often linked with Hepplewhite's owing to the similarity in general form and decoration of his larger pieces. His later designs were poor imitations of the French Directoire and Empire styles.

Sheraton made few pieces himself, as he spent most of his time writing books dealing with furniture design and construction. He continued the pursuit of lightness commenced by Hepplewhite, but combined it with excellent construction, making his pieces more substantial. His style is characterised by simple, sound construction based on straight lines, rectangular forms, refined curves and restrained, graceful classic ornament.

Satinwood was the popular timber for most articles, although mahogany was still used extensively. Inlay was more freely used, especially for the many flat surfaces, using imported coloured woods. This form of surface decoration was carried out to such an extent on some pieces, such as trays and table tops, that it resembled marquetry. Carving in low relief was sparingly used and applied in such a way as not to interfere with the lines of construction. Painting, using classical motifs, japanning and gilding, were also forms of decoration used by Sheraton. Motifs for ornamentation were chiefly drawn from the ancient classics—circular and oval shapes, classic urns, acanthus scrolls, lyre, fan, floral and drapery swags, bows and knots, etc. Later pieces adopted the Empire style of ornament, using applied metal mounts carved or chased to resemble eagles, lions, etc.

Sheraton's designs covered all known articles of furniture, including many and varied designs for occasional pieces, such as tea caddies, knife boxes, sewing tables, washstands, fire screens, toilet mirrors, small cabinets and desks, wine coolers, card

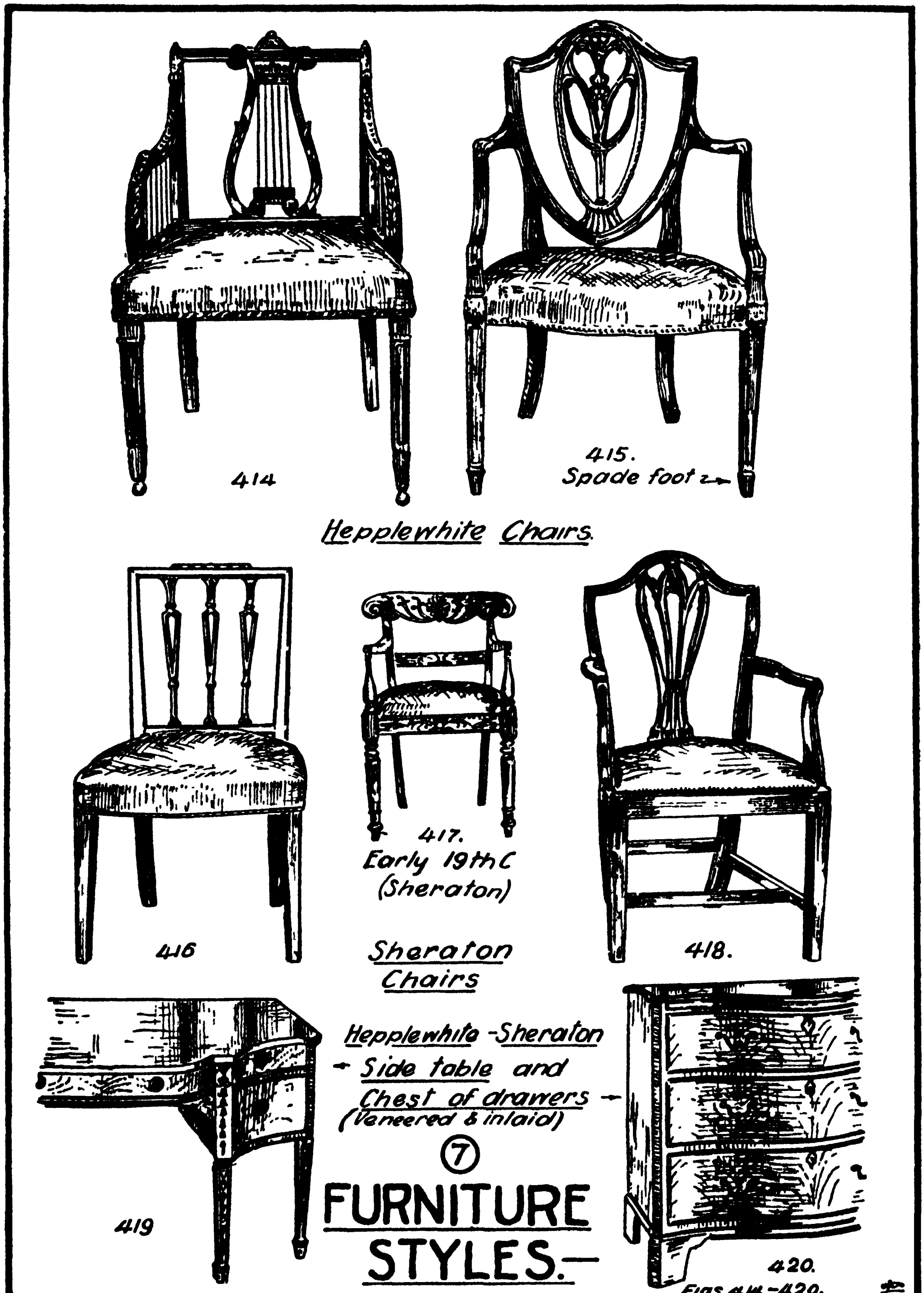
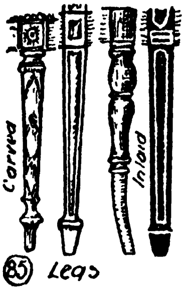
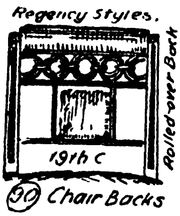

414
415.
Spade foot
Hepplewhite Chairs.
416
417.
Early 19th C
(Sheraton)
418.
Sheraton
Chairs
419
Hepplewhite-Sheraton
Side table and
Chest of drawers
(Veneered & inlaid)
7
FURNITURE
STYLES.—
420.
Figs 414-420.

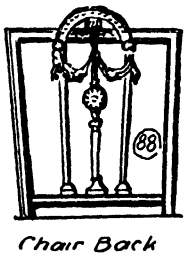
PLATE 84

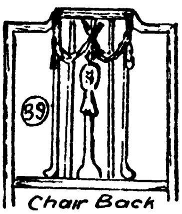
tables, tripod stands, folding beds, etc. Many of his designs contained elaborate mechanical devices which operated secret drawers and hidden compartments, folding beds and card tables, etc. His chairs showed some originality in designs. He generally used a lower square type of back with mortised and tenoned top and bottom rails. The legs were usually square or turned and tapered. The turned legs were slightly moulded and reeded or fluted. Numerous designs were used for filling the chair backs—five vertical splats with a wide centre splat decorated by pierced or inlaid designs; diamond shaped latticework; delicately turned vertical splats, single middle horizontal splat. Later types in the Empire style had rolled-over backs. (See figs. 416-418.)

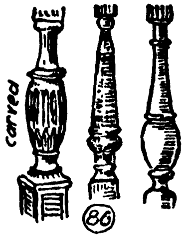


Sheraton's later work lost much of its elegance and beauty, owing to his unsuccessful efforts to copy the Empire style or form.









Vase shaped arm supports

(f) 19th Century.

(i) The Regency or Empire style. Early 19th century.

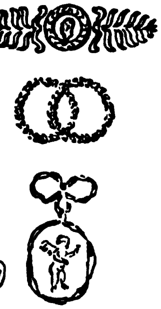
The influence of the French Empire style of Napoleon produced a gradual but marked change in English furniture and interior decoration during the early 19th century.

The work of the Adam School, which had derived its inspiration from the study of ancient classical Pompeiian discoveries, declined towards the end of the 18th century. This classical style was replaced in France by the Empire style based on the use of details obtained from Roman, Greek and Egyptian archeological models.

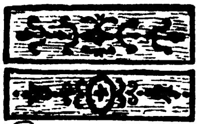
The French Empire furniture designs gradually found their way to England, and with slight changes, the style became known as the Regency style. This was the style which prevailed during the Regency of the Prince of Wales (1811-1820) before he became King George IV in 1820.

This new style was evident during the second half of the Sheraton period. Articles became heavy and stiff, losing the lightness and graceful lines characteristic of late 18th century furniture.

Ornamentation was inspired by the ancient art and architecture of Rome, Greece and Egypt—use of heavy carvings which were often gilded; applied cast metal mounts (chiefly brass); brass columns; cast brass lion-paw feet and lion-head handles; elaborate brass designs inlaid in veneered surfaces. Outward curving legs became popular for chairs, settees and tables. Tripod supports for tables, etc., were also used. (See figs. 421-424.)



(91) Metal Mounts

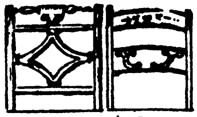


(92) Inlay Designs

Mahogany, rosewood and satinwood were the chief timbers used.

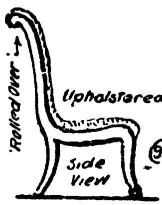
Greatest exponents of the Regency style were Thomas Hope and Sir John Soane.

(ii) Victorian Styles. Mid and Late 19th Century.



Chair Backs (Rolled-Over)
(93)

Furniture during the long Victorian period was of poor quality, and lacked creative taste. The period consisted of unsuccessful attempts to revive earlier styles, such as Gothic, Greek, Italian, Turkish, Egyptian, Louis XV, etc. There seems to be no definite style. The poor workmanship and designs was possibly due to the greater use and gradual perfection of woodworking machinery. The steam lathe was introduced about 1815 and the circular saw about 1825. Previously the construction was done by hand, which enabled individual tastes in design and ornamentation to be applied, and naturally the amount of furniture was limited to the speed at which craftsmen could work. But with machinery articles could be mass produced and the amount limited only by demand. Also firms manufacturing furniture tried to excel each other in producing novelties in design.



(94) Chair

Manufacturers ignored artistic beauty of line and form. Furniture became covered with meaningless scroll work and ornate mouldings which were easily produced by machines. Legs of tables were turned, reeded or fluted and moulded, chairs had outward curving legs and scrolled arms. Comfortable easy chairs were produced—large and well padded. The art of veneering gradually declined. (See figs. 425-427.)

The production of small articles (novelties), such as trays, boxes, small cabinets, inkstands, etc., from papier mache became popular. (Papier mache is a material made from pulped paper mixed with stiffening ingredients.) These articles were usually lacquered (black) and painted with flowers, landscapes, coats of arms, etc., and often inlaid with mother-of-pearl. They were very attractive, light and gaily coloured.

Towards the end of the century William Morris (poet, architect and artist), in 1862, led a movement which helped to banish the cheap, vulgar showiness of the earlier Victorian furniture, and awakened an interest in old designs of simple and elegant construction. Earlier period styles were copied. Veneering was once again employed.

Chief timbers: Mahogany, black walnut, maple, ash, cherry, and beech.

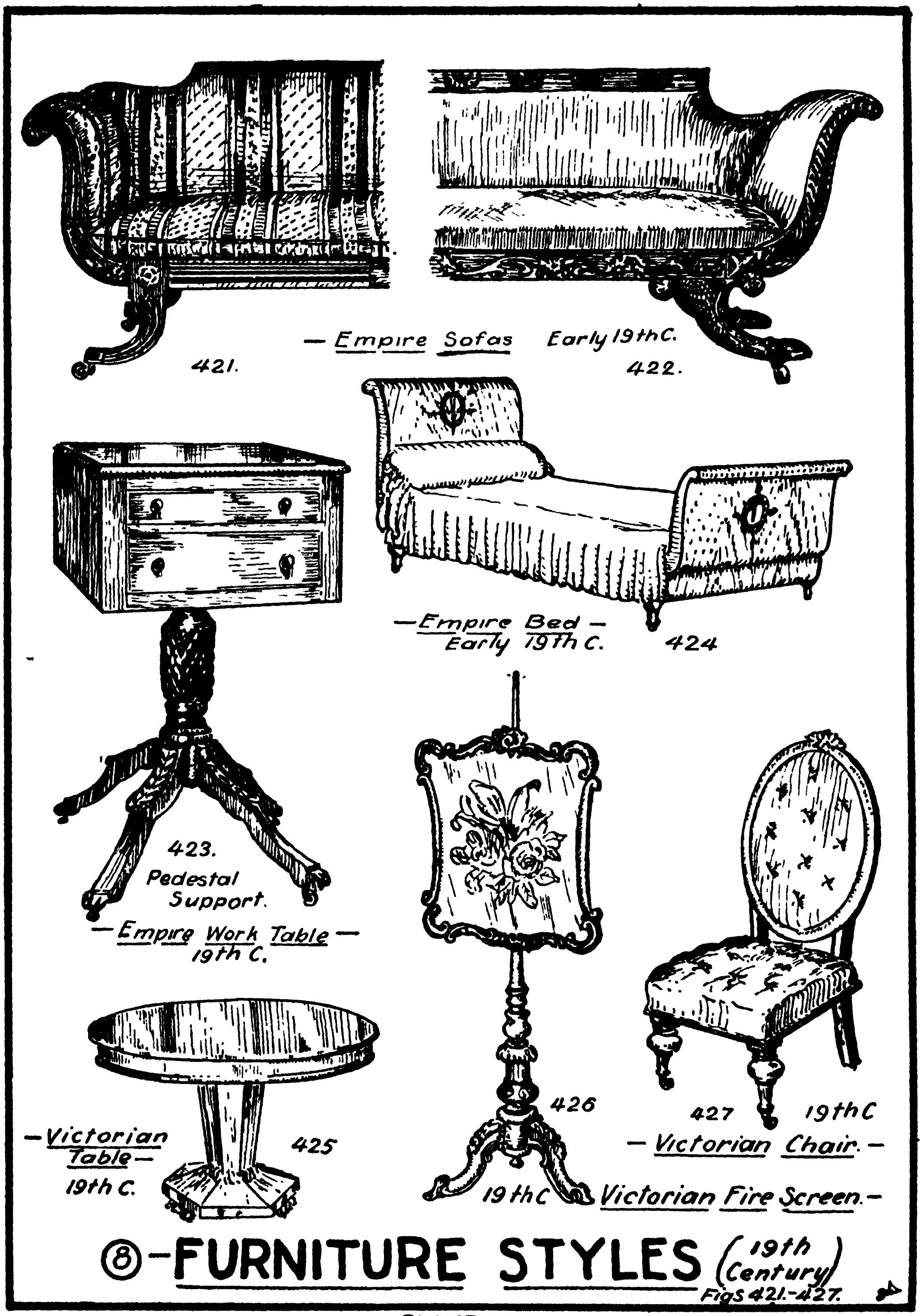

— Empire Sofas Early 19th C.
421.
422.
—Empire Bed —
Early 19th C.
424
423.
Pedestal
Support.
— Empire Work Table —
19th C.
—Victorian
Table—
19th C.
425
426
19th C Victorian Fire Screen.—
427 19th C
— Victorian Chair.—
⑧-FURNITURE STYLES (19th Century)
Figs 421.-427.

PLATE 85.

(g) 20th Century. Modern Styles.

At the close of the 19th century and the beginning of the 20th century there was a short-lived style known as "L'art Nouveau"—new art. It was a style of no artistic merit and of the simplest construction, which never became popular. Articles were made of oak, which was fumed or stained various shades of brown, grey and green, finished with wax or shellac.

After the first World War a so-called "Modern Style" evolved, its characteristics being simplicity of form, plain smooth surfaces, absence of ornamentation (other than grain of the wood), solidity in construction, contrast in colour, general lightness in appearance and ease in upkeep. The improved methods of veneer cutting and laying made possible greater use of plywoods and various methods of core-stocks, both flat and curved, for furniture construction, the articles being lighter, yet stronger, many exotic woods being used for face veneers. Walnut and mahogany are still the most popular woods.

During recent years tubular steel frames for chairs and tables, etc., have more or less become popular. Plastics are being used for some small articles.

Binstead .. .. Furniture Styles (Pitman & Sons).
Gould .. .. .. The Period Furniture Handbook (Dodd-Mead Co.).
Hayward .. .. English Period Furniture (Evans).
Hodgson .. .. Practical Cabinet Maker and Furniture Designer (Frederick Drake & Co.).
Litchfield .. .. How to Collect Old Furniture (Bell & Son).
Moore .. .. .. The Old Furniture Book (Tudor Publishing Co.).

QUESTIONS.

ITALIAN.

1. What do you understand by the term "furniture?"
2. What type of decoration was used on early Italian furniture?
3. During the 16th and 17th centuries a new type of ornamentation became popular in Italy. Describe the form it took.
4. What was possibly the most important article of 16th century Italian furniture? Describe it.
5. Describe an Italian 17th century chair.
6. What was the general form and line of the Italian 17th century furniture?
7. What forms of decoration were applied to late 17th century furniture?
8. In what way did Italian furniture alter during the 18th and 19th centuries? What possibly caused the change in style?
9. What do you understand by the terms "rococo" and "gesso?"
10. State briefly how Italian designs influenced other countries.

FRENCH.

11. Briefly describe the characteristics of the early French styles.
12. Describe the forms of decoration during the 16th century.
13. Why was early French furniture very similar to Italian Renaissance styles?
14. Briefly describe the characteristics of the early 17th century furniture style.
15. In what way did the reign of Louis XIV influence French furniture?

16. The name "Boulle" is often applied to some 17th century pieces. Why is this name important?

17. It is sometimes said that 18th century French furniture is extravagant and overdone. Why might this be true?

18. What changes took place in French furniture during the reign of Louis XVI?

19. Name two men associated with the Louis XVI style.

20. Describe the French Empire style of furniture.

ENGLISH.

21. In what way did the Renaissance influence English furniture design?

22. Why do we refer to the 16th and early 17th centuries as the "Age of Oak?"

23. Briefly describe some of the characteristics of the late 16th century furniture.

24. Sketch an early Jacobean chair. In what way did chairs differ from earlier styles?

25. What forms of decoration were chiefly used during the 17th century?

26. When was the gate-leg table introduced? Describe its construction.

27. Towards the end of the 17th century a new timber was introduced and soon became popular. Name the timber. In what way did it affect the construction of articles of furniture?

28. In what way did the accession of William and Mary affect furniture styles?

29. Sketch two types of legs which became popular late in the 17th century.

30. Sketch a cabriole leg. When did this type of leg become popular in England?

31. Briefly describe early 18th century styles.

32. What timber was chiefly used during the 18th century? How was it used during the time of Queen Anne?

33. In what way did this new timber affect construction of early 18th century furniture?

34. Name four leading schools of design during the second half of the 18th century.

35. Briefly describe the characteristics of the Chippendale School.

36. In what way did the Adam School differ from the Chippendale styles?

37. Why are the names of Hepplewhite and Sheraton often linked together?

38. Show how the French Empire styles had a marked effect on English furniture during the early part of the 19th century. What name was given to the new style in England?

39. Briefly describe modern trends in furniture designs.

40. What type of construction is invariably used in modern furniture manufacture?

II. FURNITURE DESIGN AND CONSTRUCTION.

In general there are three stages in the making of most articles, namely:—1. The Design; 2. The Making of Workshop Drawings, and 3. The Construction.

1. THE DESIGN.

Note: Timber grows straight, and in general it is converted by straight saws into straight pieces of suitable sizes. The pieces have to be fixed together by straight or angle joints. The tools designed for use on wood generally have to deal with straight edges and flat surfaces. It must therefore be understood from the above that the design of wood articles is rigidly limited by the nature of the material, and in the main the constructions are confined to a straight and square quality. So we must keep in mind the nature of the material we have to use when designing the structural details.

The following points must be considered in the designing of a job:—

(a) *Utility.*—The design usually starts off as an idea in the mind, that is, a picture of some article required for a definite functional purpose, therefore the usefulness of the article forms a basis for its design.

(b) *Sizes.* .....

Fitness.—The sizes must be suited to the uses of the article to ensure that it has its maximum utilitarian value.

Proportion.—The members of the job must be of suitable sizes to ensure the maximum strength required for the article to carry out its special uses.

Economy.—It is important for economical reasons to see that the sizes are suited to the material on hand, keeping in mind the commercial sizes of solid timber, plywood, veneered panels, etc., so that there is little waste.

(c) *Structural Details and Materials.*

Timber.—The type of timber should be selected according to the use of the article. E.g., it may have to match other pieces of furniture; it may require strength and durability, figured grain, etc. If the job has to be painted or veneered a cheap plain wood may be used.

Joints.—The job must be soundly constructed, using joints most suited to its requirements so that it will stand up to any wear and tear to which it may be subjected. The joints must be selected carefully so that the strength of the timber is not impaired. Remember also that the job has to be put together and the combinations of joints may be such that they make it impossible to assemble all the parts.

Ornamentation.—In many cases ornamentation is used to emphasise the outline of the job. It may only be the figure of the timber used, or it may be added in the form of carvings, inlays, veneers, overlays, etc. Whatever it is, the ornament should not interfere with the usefulness of the article.

2. THE WORKSHOP DRAWING.

During the designing stage several rough sketches may be made before all the requirements of design have been fulfilled. From these sketches a working drawing is made up. This final drawing should show clearly all the necessary details and dimensions to enable the worker to construct the job. Detailed full-size sketches of joints and shaped parts, such as mouldings, etc., should be included.

The working drawing may be a freehand perspective sketch or a scale drawing (fully dimensioned), or it may be a full-size drawing (on which dimensions are usually omitted). The full-size drawing may be done on paper or on a strip of timber called a "Working Board" or "Rod." The full-size drawing has an added advantage in that the sizes, positions of joints, etc., can be marked and checked directly from the drawing.

The Rod is a board upon which drawings of the job are set out full size. It should be large enough to take full size horizontal and vertical sections. For most jobs a board 6″ to 12″ is usually wide enough to show sufficient constructional details. Both sides of the rod may be used if necessary; a sectioned plan on one side, and sectioned elevations on the other side.

The rod is used for setting out the various members of the job preparatory to construction. The work is placed on the rod, and lengths, positions of joints, etc., are marked directly from the drawing, and may be checked from time to time. It may also be used for compiling the cutting sizes and list of the material required. Often a cutting list is set out at one end of the rod.

The drawings may be set out on the rod, using the rule and pencil as a thumb or pencil gauge for drawing lines parallel to the edge, the try square being used for lines at right angles to the edge.

The working rod is a more permanent form of drawing of the work, and may be stored for future use. It is particularly useful where a number of articles are required of the same design.

The pencil lines will show up more clearly if white chalk is first rubbed into the board. Examples of "rods" are shown in plates 94, 95 and 97.

3. **THE CONSTRUCTION.** (A general procedure which can be followed for most jobs.)

NOTE: Before the construction of any job, a detailed working drawing (see above) must be made from which ALL SIZES and DETAILS can be obtained. Also from the drawing a cutting list of timber sizes should be compiled, including the type of timber required for each member.

STEPS IN CONSTRUCTION.

Step 1.—**Preparation:**

Prepare all pieces to the required sizes. Mark face sides and edges. Where possible a little waste should be left on the ends for protection against damage.

Step 2.—**Setting Out:**

(a) Set out all pieces to required shape according to the drawing or the rod.
(b) Set out positions and shapes of joints, rebates, grooves, etc., marking waste with crosses. Clearly indicate the positions of members with distinguishing marks.

Step 3.—**Cutting Out:**

(a) Cut all pieces to their required shape.
(b) Cut waste from joints, rebates, etc.

Step 4.—**Trial Assembly:**

Make a trial assembly of the job without glue, making any necessary adjustments.

Step 5.—**Final Assembly:**

(a) Carefully clean up all members with smoothing plane, scraper and glass paper.
(b) Assemble with glue, nails, or screws as required.

Step 6.—**Finishing.**

(a) Prepare the surfaces and edges for finishing with glass paper, etc.
(b) Stain, fill and polish, paint or lacquer as required.

NOTE: If possible, it is best to stain and polish prior to assembling.

QUESTIONS.

1. Briefly set out the points to be remembered when designing a piece of work.
2. Why must we be careful, when using wood, to see that our constructional details are suited to timber?
3. What is the working rod? State its uses.
4. What tools are used for the setting out of the working rod?
5. Set out the steps in the general procedure of constructing models.

III. EXAMPLES OF PRACTICAL WOODWORK. (Plates 86-99).

Plates 86 to 99 show working drawings, and in some cases setting out of working boards or rods, for examples of practical woodwork projects.

1. BOOK ENDS (Plate 86).

Material required.—Hoop pine, Silky oak or Queensland maple.
Cutting List.—A....2/7″ x 5″ x ½″.
B ...2/4″ x 2″ x ½″.
C... 2/4″ x 2½″ x ½″.
10 ..1″ x 4 Countersunk Screws.
(Refer to Plate 27, Boring for Screws in a Softwood.)

CONSTRUCTION (for one Book End).

Step 1.—**Preparation:**

Prepare material (for one Book End) in one length to 5″ wide by ½″ thick. Shoot both ends.

Step 2.—**Setting Out:**

(a) Set out the shapes on the prepared piece of timber as shown in diagram (plate 86).
(b) Set out with pencil lines the assembling positions as indicated by broken lines in the setting out sketch.
(c) Mark positions of screw holes.

Step 3.—**Cutting Out:**

(a) Bore and countersink holes for No. 4 countersunk screws.
(b) Using coping saw, bow saw or jig saw, cut out the various shapes, being careful to saw just on the waste sides of the lines.
(c) Clean up the sawn edges with a smooth file. (Safe edge.)

Step 4.—**Trial Assembly:**

(a) Screw together pieces "A" and "C," being careful to keep the side of piece "C" flush with the end of piece "A."
(b) Screw piece "B" in place.

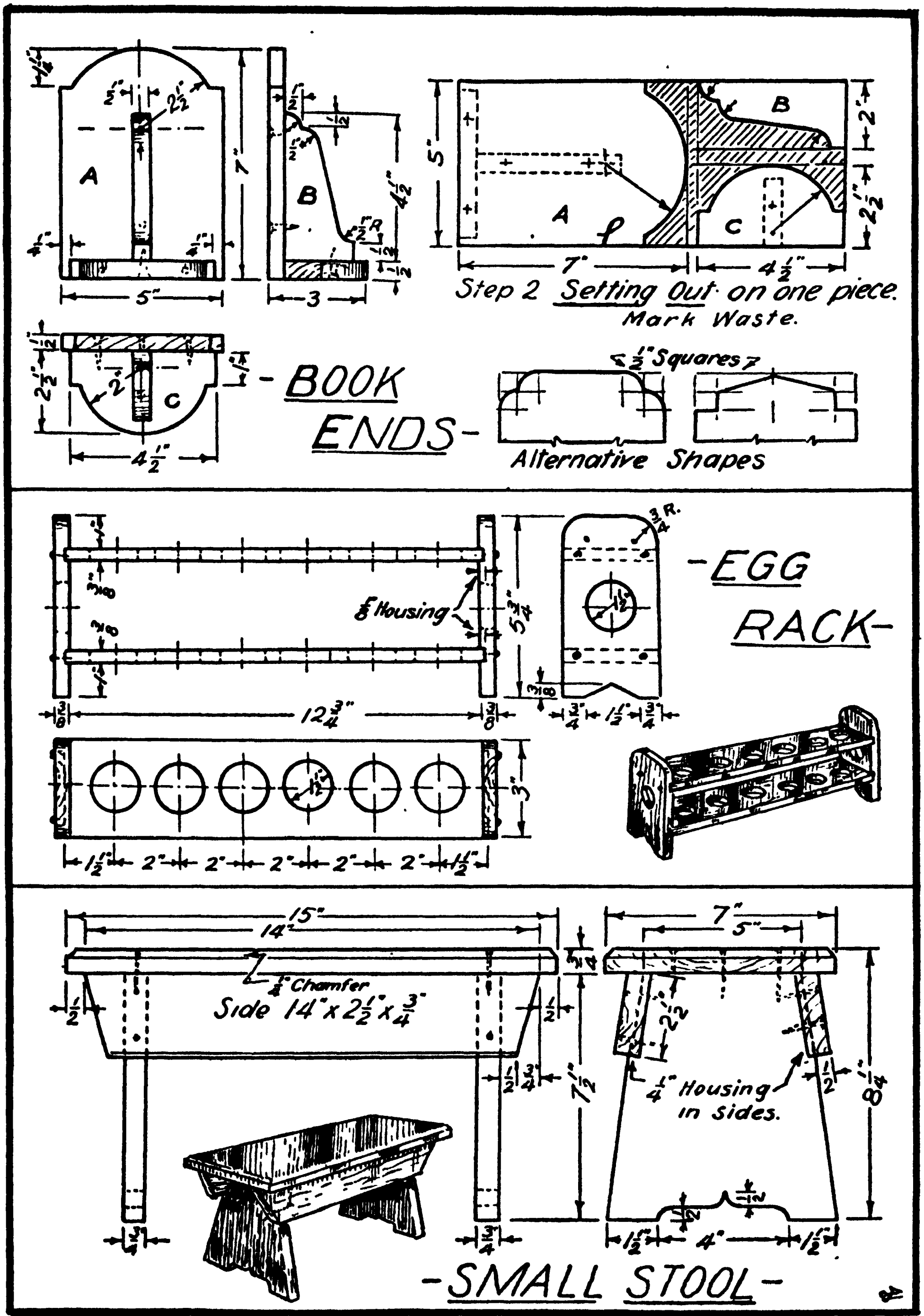

Step 2 Setting Out on one piece.
Mark Waste.
- BOOK
ENDS -
½" Squares
Alternative Shapes
- EGG
RACK -
⅜ Housing
- SMALL STOOL -
¼" Chamfer
Side 14" x 2½" x ¾"
¼" Housing
in Sides.

PLATE 86.

Step 5.—Final Assembly:

Separate the pieces and clean them up with smoothing plane and glass paper. Assemble with glue and screws.

Step 6.—Finishing:

The job may be lacquered in one, two or three colours, or it may be varnished or stained and polished. A piece of brass sheet about 5″ x 5″ may be secured on the bottom to project under the books.

2. EGG RACK (Plate 86).

Material Required.—Hoop pine.
Cutting List.—Shelves... 2/13″ x 3″ x ⅜″.
Ends..... 2/5¾″ x 3″ x ⅜″.
8—1″ x 16 panel pins OR 8—¾″ x 4 brass roundhead screws.
(Refer to plate 39, Construction of Housed Joines.)

CONSTRUCTION.

Step 1.—Preparation:

The timber may be prepared to width and thickness in two lengths, each piece being long enough to cut one shelf and one end. Shoot each end square. The pieces need not be separated until after the holes and trenches have been cut.

Step 2.—Setting Out:

(a) Set out lengths by measuring 13″ from one end and 5¾″ from the other end of each piece.
(b) Set out shape of feet.
(c) Set out positions of trenches, gauging them ⅛″ deep from the working face.
(d) Set out positions of 1½″ holes in shelves and ends.
(e) Set out ¾″ quadrants on ends.
(f) Mark positions of screw holes (if required) ½″ from ends of trenches.

Step 3.—Cutting Out:

(a) Check size of trenches, saw sides and pare out waste down to gauge lines.
(b) Saw shape of feet on ends.
(c) Bore holes, using 1″ centre bit, boring from both sides.
(d) Bore holes for screws.
(e) Separate the pieces, shoot ends and pare off waste of rounded corners (as shown at No. 5, plate 20).

Step 4.—Trial Assembly:

Make a trial assembly with screws, but without glue.

Step 5.—Final Assembly:

Clean up all pieces with smoothing plane and glass paper and assemble with glue and screws (or nails).

Step 6.—Finishing:

Lacquer desired colour.

3. SMALL STOOL (Plate 86).

Material Required.—Hoop pine.
Cutting List.—Top.....1/15" x 7" x $\frac{3}{4}$".
Ends ...2/7$\frac{1}{2}$" x 7" x $\frac{3}{4}$".
Sides . 2/14" x 2$\frac{1}{2}$" x $\frac{3}{4}$".
1$\frac{1}{2}$" x 12 diamond head wire nails.
(Refer to plate 39, Construction of Housed Joints.)

CONSTRUCTION.

Step 1.—**Preparation:**
(a) Prepare top to required sizes.
(b) The legs may be prepared in one piece to required width and thickness. Shoot both ends.
(c) Plane sides to the required width and thickness.

Step 2.—**Setting Out:**
(a) Set out $\frac{1}{4}$" chamfer round top with pencil lines.
(b) Set out the length and shape of ends.
(c) Set out shape of sides and position of trenches $\frac{1}{4}$" deep.

Step 3.—**Cutting Out:**
(a) Plane chamfer round top.
(b) Separate the ends and cut them to shape.
(c) Check the size of trenches, saw sides and pare out waste.
(d) Cut ends of sides to shape and shoot ends.

Step 4.—**Trial Assembly:**
Assemble sides and ends temporarily with nails and plane top of sides flush with tops of ends.

Step 5.—**Final Assembly:**
Clean up all pieces with smoothing plane and glass paper. Assemble sides and ends with glue and nails. Nail top in position.

Step 6.—**Finishing:**
Stop up all nail holes with putty, then give two coats of lacquer.

4. TURNED POT STAND (Plate 87).

Material Required.—Hoop pine.
Cutting List.—1 piece 5$\frac{1}{2}$" x 5$\frac{1}{2}$" x $\frac{5}{8}$".
(Refer to plates 100 and 101, Woodturning.)

CONSTRUCTION.

Step 1.—**Preparation:**
(a) Plane a face side perfectly flat. This side to be screwed to the face plate.
(b) Find the centre of the face side and set out a circle the size of the face plate to be used.

(c) If the stand is to be octagonal, set out an octagon and cut off waste corners. Shoot edges.

Step 2.—Screw to face plate and set up lathe.

Step 3.—**Cutting or Turning.**

(a) Turn to the required shape. A scraping cutting action is used. DO NOT use gouges for Face Plate Turning.
(b) Smooth with glass paper.

Step 4.—**Finishing:**

Stop up screw holes and lacquer desired colour.

5. TURNED DARNING AID (Plate 87).

Material Required.—Hoop pine, coachwood, maple or sassafras.
Cutting List.—1/6¼" x 2½" x 2½". (Extra is allowed for turning.)
(Refer to plates 100 and 101, Woodturning.)

CONSTRUCTION.

Step 1.—**Preparation:**

Find centres of ends and set up in lathe for turning between centres. See fig. 116, plate 25, showing method of marking ends for turning.

Step 2.—**Cutting or Turning:**

(a) Turn to 2¼" diameter.
(b) Measure lengths of the head, the groove and the handle.
(c) Turn handle to shape.
(d) Turn head to shape.
(e) Cut groove (if required).
(f) Smooth up with glass paper and cut off waste ends with parting tool.

Step 3.—**Finishing:**

Lacquer or varnish.

6. BREAD BOARD (Plate 87).

Material Required.—Hoop pine.
Cutting List.—1/11½" x 11½" x ¾". (Extra allowed for turning.)
(Refer to plates 100 and 101, Woodturning.)

CONSTRUCTION.—See notes on Turned Pot Stand, job No. 4.

7. ROLLING PIN (Plate 87).

Material Required.—Hoop pine.
Cutting List.—1/18" x 2¼" x 2¼". (Extra allowed for turning.)
(Refer to plates 100 and 101, Woodturning.)

CONSTRUCTION.

Step 1.—**Preparation:**

Find centres of ends as shown in fig. 116, plate 25, and set up in lathe for turning between centres.

Step 2.—**Cutting or Turning:**

(a) Turn down to 2¼″ diameter.
(b) Mark length of body, and turn ends down to 1¼″ diameter for handles.
(c) Mark length of handles and turn down to shape.
(d) Clean up with glass paper and part off waste ends.

Step 3.—**Finishing:**

Give handles two coats of lacquer.

8. TURNED TABLE LAMP (Plate 87).

Material Required.—Silky oak, maple, blackwood, cedar or sassafras, etc.
Cutting List.—Pillar....1/12″ x 2½″ x 2½″.
Base.....1/6″ x 6″ x 2″. Base may be built up with pieces glued together.
Brass nipple about 1″ long for securing lamp holder.
(Refer to plates 100 and 101, Woodturning.)

CONSTRUCTION.

Step 1.—**Preparation:**

Prepare base by gluing together two or three pieces to make up the required thickness. A pleasing effect is obtained if they are glued with alternate pieces at right angles. Cut to a circle of 6″ diameter. Prepare pillar for turning between centres. Bore hole ⅜″ diameter for flex.

Step 2.—**Cutting or Turning:**

(a) Turn up base on face plate to desired shape. Bore 1″ or 1¼″ diameter hole to take end of pillar.
(b) Turn pillar to desired shape and turn end to fit into hole in base.

Step 3.—**Assembling.**

Glue end of pillar into base, smooth up with fine glass paper.

Step 4.—**Finishing.**

Stain, fill and polish in lathe. A very slow speed is best for polishing. Bore hole for flex from edge of base ⅜″ diameter to meet up with hole in pillar. Alternatively three or four small feet may be screwed or glued to base.

9. NUT BOWL AND FRUIT BOWL (Plate 87).

Material Required.—Maple, silky oak, blackwood or any figured timber.
Cutting List.—8¼″ x 8¼″ x 2½″. (This allows a little waste for turning.)
(Refer to plates 100 and 101, Woodturning.)

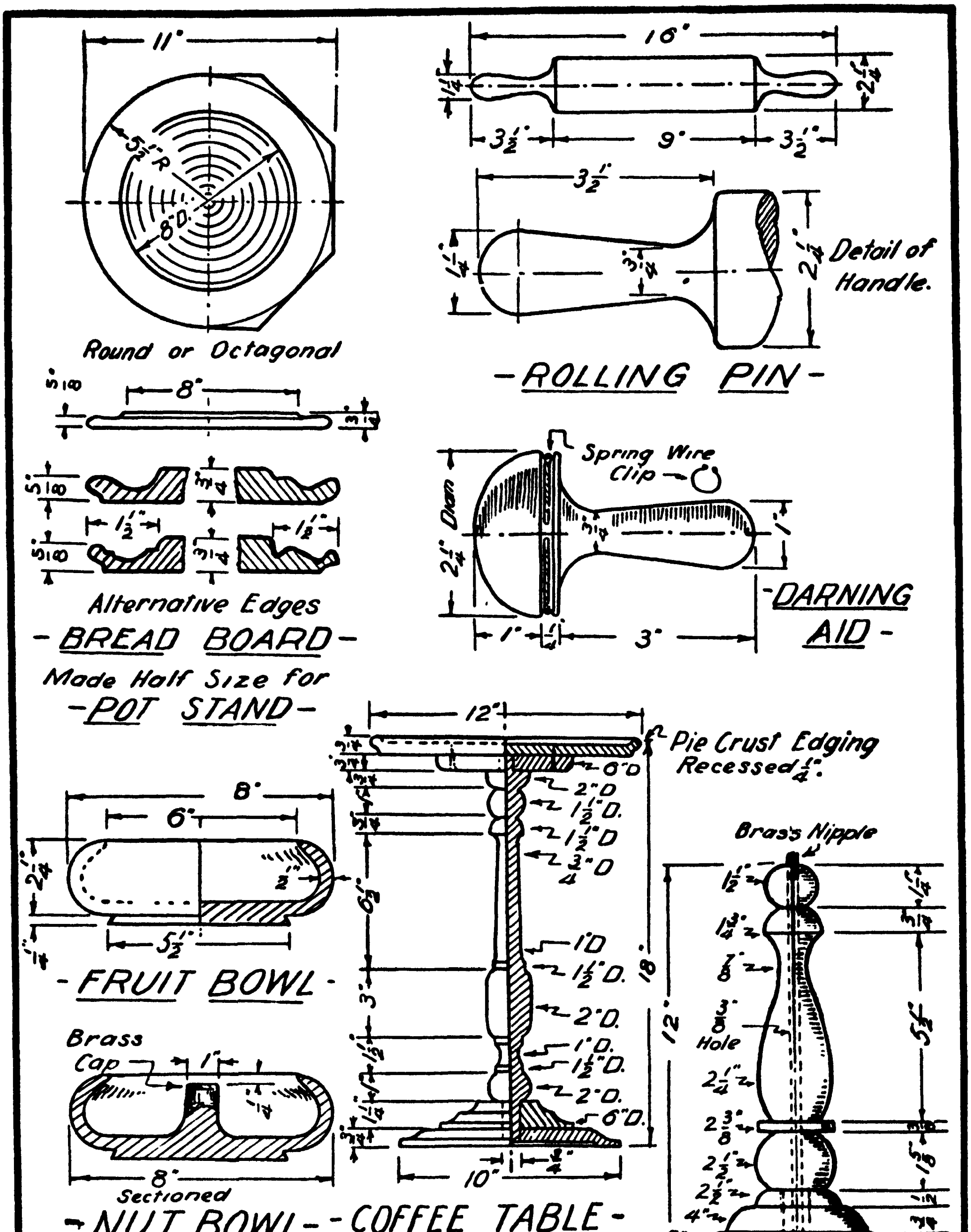

Round or Octagonal
Alternative Edges
-BREAD BOARD-
Made Half Size for
-POT STAND-
-ROLLING PIN-
Detail of Handle.
Spring Wire Clip
-DARNING AID-
Pie Crust Edging Recessed 1/4".
-FRUIT BOWL-
Brass Cap
Sectioned
-NUT BOWL-
-COFFEE TABLE-
Brass Nipple
Hole
6" Diam
-SUGGESTIONS FOR TURNED JOBS-
-TABLE LAMP-

PLATE 87.

CONSTRUCTION.

Step 1.—**Preparation:**

Plane a face side on the timber and set out an 8″ diameter circle and a circle equal to the diameter of the face plate to be used. Saw off as much waste as possible from 8″ circle. Secure face plate and set up lathe for turning.

Step 2.—**Cutting or Turning:**

(a) Turn up outside of bowl, using spear point chisel or skew chisel.
(b) Turn out inside to required shape (for fruit bowl or nut bowl), using round nose chisel.
(c) Smooth up with glass paper.

Step 3.—**Finishing:**

Stain, fill and polish.
For the nut bowl it is necessary to make a brass cap, which may be secured by means of a screw.

10. TURNED COFFEE TABLE (Plate 87).

Material Required.—Silky oak, maple or blackwood.

Cutting List.—Top	1/12″ x 12″ x $\frac{3}{4}$″.	(These sizes are neat: a little waste should be allowed for turning.)
Support for top	1/6″ x 6″ x $\frac{3}{4}$″.	
Pillar	1/17″ x 2″ x 2″.	
Base (top piece)	1/6″ x 6″ x $1\frac{1}{4}$″.	
Base (bottom piece)	1/10″ x 10″ x $\frac{3}{4}$″.	

(Refer to plate 101, Woodturning.)

CONSTRUCTION.

Step 1.—**Preparation:**

Prepare all pieces for turning. Find centres, etc.

Step 2.—**Turning.**

(a) Turn base to required shape.
  i. Secure top side of base to face plate and turn out recess on underside about $\frac{1}{4}$″ deep.
  ii. Reverse the base, screwing face plate in recess, and turn to desired shape. Bore or turn out hole for pillar $\frac{3}{4}$″ diameter.
(b) Turn pillar to desired shape, finishing with glass paper. Turn ends for gluing into holes in base and support under top.
(c) Turn piece for supporting top, bore hole for pillar and holes for screws.
(d) Turn top to required shape, smooth with glass paper.

Step 3.—**Assembling and Finishing:**

(a) Glue supporting piece for top to pillar.
(b) Glue base to pillar.
(c) Stain, fill and polish all parts. The top is polished separately.
(d) Secure top by three or four screws through the supporting piece.
Feet similar to those on the Turned Light Standard, plate 99, may be added if desired.

11. HOUSEHOLD STEPS (Plate 88).

Material Required.—Mountain ash, hoop pine, coachwood or oregon.

Cutting List.—Sides .... $2/37\frac{1}{2}'' \times 3'' \times \frac{3}{4}''$.
Treads .... $3/15'' \times 3\frac{1}{2}'' \times \frac{3}{4}''$.
Top step........ .. $1/19'' \times 6'' \times \frac{3}{4}''$.
Back Board .... $1/16'' \times 4\frac{1}{2}'' \times \frac{3}{4}''$.
Stiles for strut . .. $2/31\frac{1}{2}'' \times 2\frac{1}{2}'' \times \frac{3}{4}''$.
Rails for strut . . $2/13\frac{1}{2}'' \times 2\frac{1}{2}'' \times \frac{3}{4}''$.
$1\frac{1}{4}'' \times 10$ C.S. screws for treads.
$\frac{3}{4}'' \times 10$ C.S. screws for hinges.
2—2″ back flap hinges.

(Refer to plates 44 and 45, Construction of M & T Joints, and plate 39, Construction of Housed Joints.) See plate 8, fig. 35a, Bead Plane.

CONSTRUCTION.

Step 1.—**Preparation:**

Prepare all pieces to the required width and thickness. The treads, top step, back board and strut rails may be cut and shot to required length.

Step 2.—**Setting Out:**

(a) The sides of the steps are set out as a pair. Set sliding bevel to the required angle and mark the position of the trenches for treads and the angle of the ends. Gauge depth of trenches $\frac{1}{4}''$.
(b) Mark positions of screw holes on sides, top step and back board.
(c) Mark positions of stopped trenches on underside of top step to fit over ends of sides. Gauge $\frac{1}{4}''$ chamfer round the top step.
(d) Set out position of mortises on stiles of strut.
(e) Mark length of tenons $1\frac{1}{4}''$ on ends of rails of strut.
(f) Gauge thickness of mortises and tenons, gauging from the face side of each piece.

Step 3.—**Cutting:**

(a) Cut trenches and cut ends of sides to shape.
(b) Plane $\frac{1}{4}''$ bead on inside front edges of sides. Bore and countersink holes for screws.
(c) Round off front edges of treads.
(d) Chop out stopped trenches in top step, and plane $\frac{1}{4}''$ chamfer.
(e) Chop out stopped mortises in stiles $1\frac{1}{4}''$ deep.
(f) Cut stub tenons on ends of rails.

Step 4.—**Trial Assembly:**

Make a trial assembly without glue, using screws where required.

Step 5.—**Final Assembly:**

(a) Carefully clean up all pieces with smoothing plane and glass paper and assemble with glue and screws.
(b) Secure hinges in position with screws.

Step 6.—**Finishing.**

Varnish or lacquer.

12. SMALL BOOK SHELVES (Plate 88).

Material Required.—Silky oak or Queensland maple.

Cutting List.—Sides .... 2/20$\frac{5}{8}$" x 7" x $\frac{3}{4}$".
Top .... 1/16$\frac{1}{2}$" x 7" x $\frac{3}{4}$".
Shelf .... 1/15$\frac{1}{2}$" x 7" x $\frac{3}{4}$".
Bottom .... 1/15$\frac{1}{2}$" x 6$\frac{1}{4}$" x $\frac{3}{4}$".
Plinth .... 1/15" x 1$\frac{1}{2}$" x $\frac{3}{4}$".
Glue Blocks . . . 7/2" x $\frac{3}{4}$" x $\frac{3}{4}$".

(Refer to plate 39, Housed Joints.)

CONSTRUCTION.

Step 1.—**Preparation:**

Prepare all members to the required sizes.

Step 2.—**Setting Out:**

(a) Using cutting gauge, set out rebates on ends of top—care being taken to see that the distance between the shoulders of the rebates is 15".
(b) Set out positions of stopped trenches for shelf and bottom.
(c) Set out notches on ends of shelf to fit stopped trenches.
(d) Gauge groove on plinth (mortise gauge) and on sides with cutting gauge.

Step 3.—**Cutting:**

(a) Pare ends of rebates down to required depth and then plane rebates with a sash fillister plane, which is provided with a spur.
(b) Saw sides of trenches and chop out waste.
(c) Saw off waste of notches on ends of shelf to fit stopped trenches.
(d) Carefully cut grooves in sides and plinth, using a plough plane or scratch stock. (The scratch is illustrated in plate 71, fig. 331.)

Step 4.—**Trial Assembly:**

Make a trial assembly, temporarily nailing top in position with panel pins.

Step 5.—**Final Assembly:**

Clean up all members with smoothing plane and glass paper, and assemble with glue, panel pins and glue blocks as required.

Step 6.—**Finishing:**

Stop up nail holes with plastic wood, stain, fill and polish.
If hoop pine is used the job may be lacquered desired colour.

13. OCCASIONAL TABLE (Plate 88).

Material Required.—Maple, silky oak, or hoop pine.

Cutting List.—Top round .... 1/18" x 18" x $\frac{1}{2}$" or square 14" x 14" x $\frac{1}{2}$".
Legs .... 4/18" x 2$\frac{1}{2}$" x 1".
Cross Rails ...... 2/13$\frac{1}{2}$" x 2$\frac{1}{2}$" x 1".
4—metal plates 3" x $\frac{3}{4}$" x $\frac{1}{8}$".
8—$\frac{1}{2}$" x 6 C.S. screws, for securing top to plates.
4—1$\frac{1}{4}$" x 10 C.S. screws, for securing plates to legs.

(Refer to plate 45, Haunched M & T Joint; plate 38, Rubbed Glued Joint; plate 41, Cross Halving Joint.)

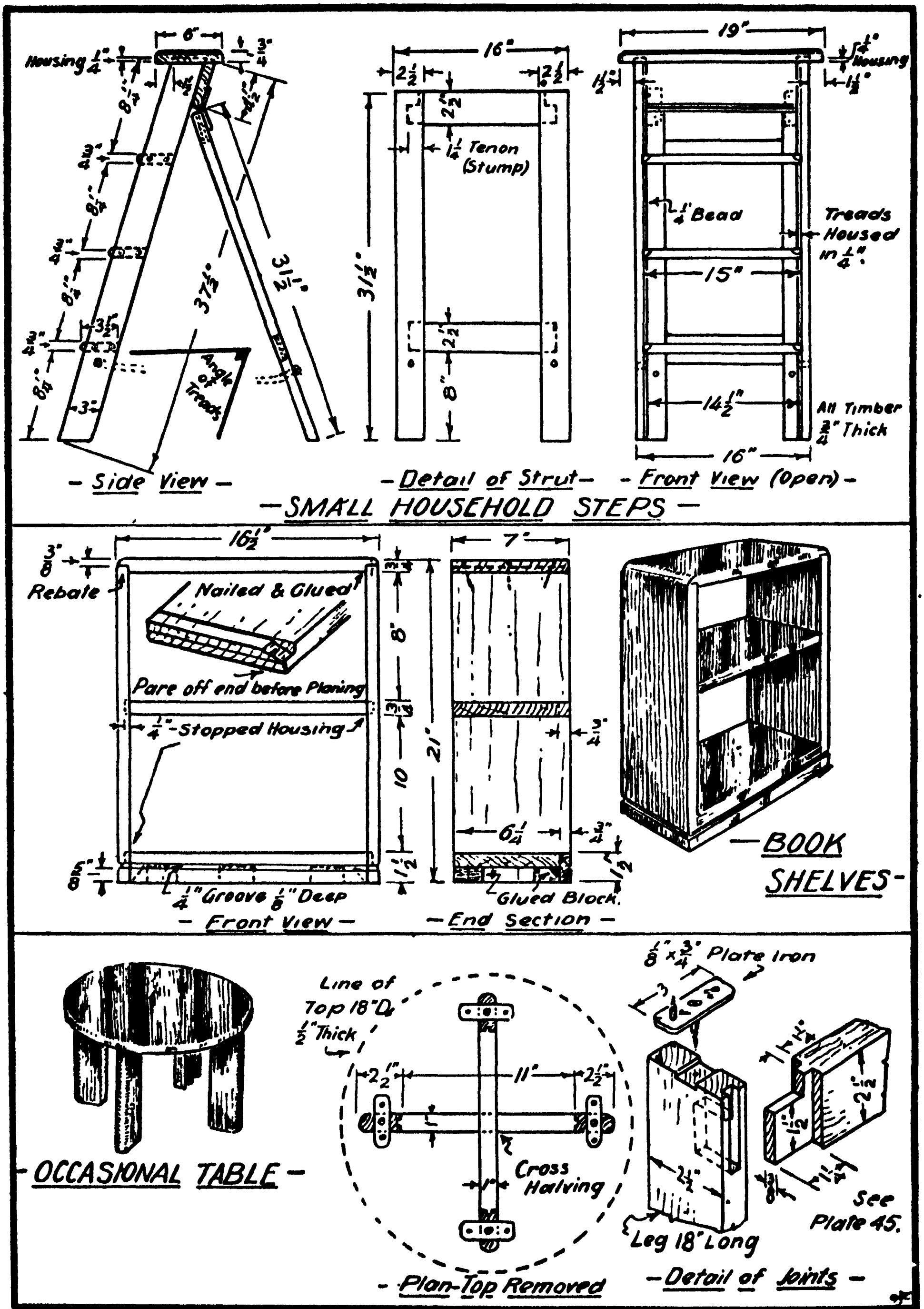

Housing $\frac{1}{4}$"
6"
$\frac{3}{4}$"
8$\frac{1}{4}$"
$3\frac{1}{2}$"
Angle of Treads
$37\frac{1}{2}$"
$31\frac{1}{2}$"
3"
- Side View -
16"
$2\frac{1}{2}$"
$1\frac{1}{4}$ Tenon (Stump)
$31\frac{1}{2}$"
8"
- Detail of Strut -
19"
$\frac{1}{4}$" Housing
$1\frac{1}{2}$"
$\frac{1}{4}$" Bead
Treads Housed in $\frac{1}{4}$".
15"
$14\frac{1}{2}$"
All Timber $\frac{3}{4}$" Thick
16"
- Front View (Open) -
- SMALL HOUSEHOLD STEPS -
$16\frac{1}{2}$"
$\frac{3}{8}$"
Rebate
Nailed & Glued
Pare off end before Planing
$\frac{1}{4}$"-Stopped Housing
$\frac{5}{8}$"
$\frac{1}{4}$" Groove $\frac{1}{8}$" Deep
- Front View -
7"
$\frac{3}{4}$
8"
10
21"
$1\frac{1}{2}$
$6\frac{1}{4}$"
$\frac{3}{4}$"
Glued Block.
- End Section -
- BOOK SHELVES -
- OCCASIONAL TABLE -
Line of Top 18" D. $\frac{1}{2}$" Thick
$2\frac{1}{2}$"
11"
1"
Cross Halving
- Plan-Top Removed
$\frac{1}{8}$" x $\frac{3}{4}$" Plate Iron
3
$2\frac{1}{2}$"
Leg 18" Long
- Detail of Joints -
See Plate 45.

PLATE 88

CONSTRUCTION.

Step 1.—**Preparation:**

NOTE: The top may have to be built up of two or more pieces edge glued together. See plate 45. (⅝″ thick stuff would be best if jointing is required.)

(a) After gluing, prepare the top to the required thickness.
(b) Prepare legs to width and thickness.
(c) Prepare rails to required sizes.

Step 2.—**Setting Out:**

(a) Set out 18″ diameter circle on top, or for square top 13″ or 14″ square.
(b) Set out tenons, allowing for haunch, and gauge thickness equal to ⅜″ chisel.
(c) Mark length of legs and positions of mortises, gauge thickness of mortises.
(d) Set out recesses for metal plates. Gauge ⅛″ deep.
(e) Set out cross halving joint in centre of rails.

Step 3.—**Cutting:**

(a) Saw waste off top, using jig, bow, or compass saw, and plane with compass plane or spokeshave. If a lathe is available, the top may be turned to shape, using the left hand end of spindle.
(b) Chop out mortises.
(c) Rip sides and saw shoulders of tenons.
(d) Saw sides and remove waste of halving joint.
(e) Saw sides of recesses for plates and pare out waste.

Step 4.—**Assembling:**

(a) Clean up all inside edges of rails and legs and assemble with glue.
(b) When dry, clean up sides and round off outside edges of legs.
(c) Screw metal plates to top of legs.
(d) Assemble cross halving joint dry and secure top with screws.

Step 5.—**Finishing:**

NOTE: If the job is to be polished it will be found easier to apply the polish to the various parts whilst separated.

(a) Separate the parts and clean them up with glass paper, then stain, fill and polish.
(b) Assemble, adding glue to the cross halving joint.
If the table is made of hoop pine and is to be lacquered, it may be assembled with glue prior to lacquering.

Suitable colours: Cream with bright red edges; cream and light blue; orange and light green; biscuit and royal blue, or light green and mauve edges.

14. **BOOK TROUGH** (Plate 89).

Material Required.—Silky oak, maple, blackwood or hoop pine.
Cutting List.—Ends........2/8″ x 7″ x ¾″.
Shelves......2/15″ x 3¼″ x ⅜″.

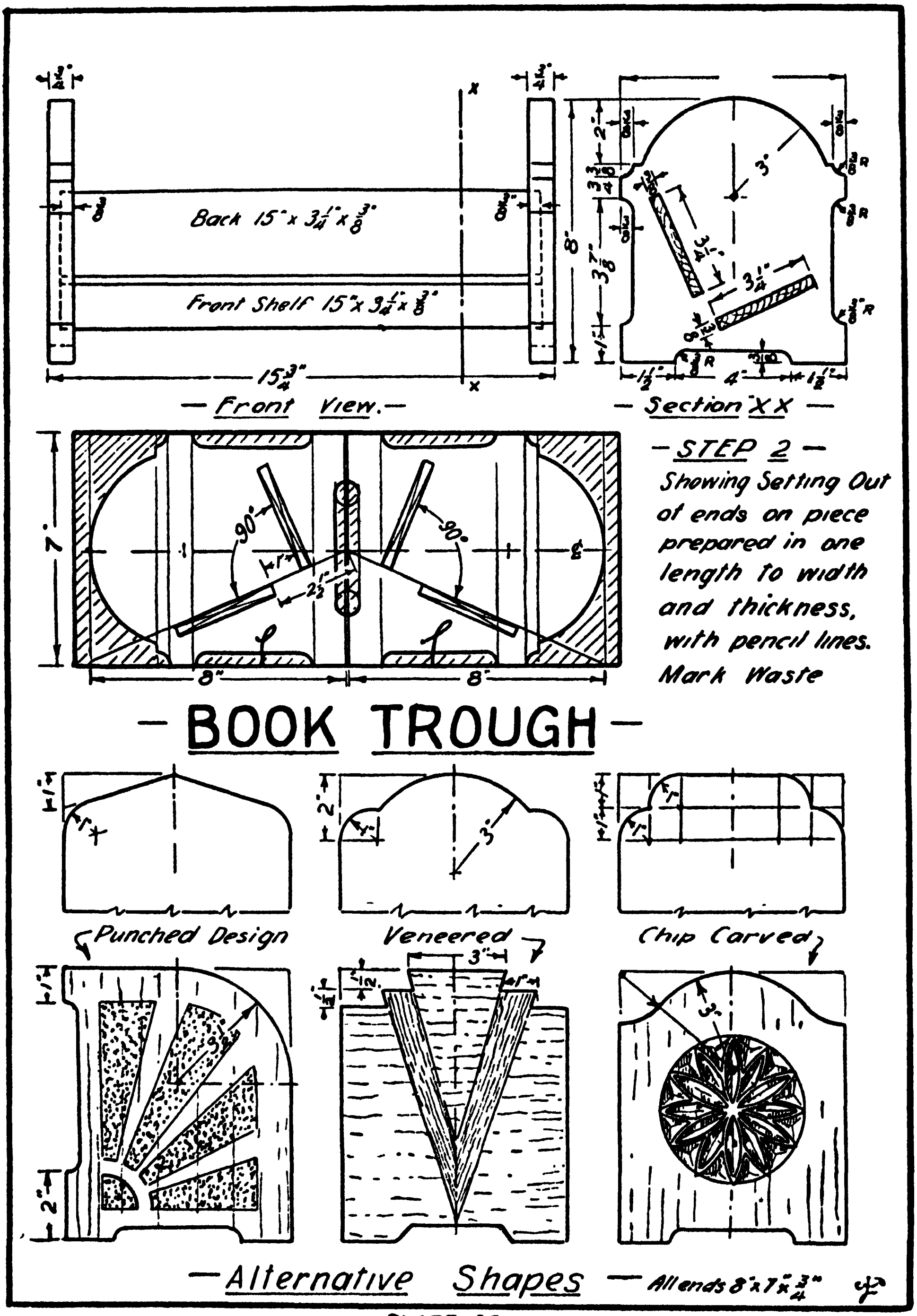

Back 15" x 3¼" x ⅜"
Front Shelf 15" x 3¼" x ⅜"
15¾"
— Front View. —
— Section XX —
— STEP 2 —
Showing Setting Out of ends on piece prepared in one length to width and thickness, with pencil lines. Mark Waste
- BOOK TROUGH -
Punched Design
Veneered
Chip Carved
— Alternative Shapes — All ends 8" x 7" x ¾"

PLATE 89

CONSTRUCTION.

Step 1.—**Preparation:**

(a) Prepare shelves to sizes.
(b) Ends may be prepared to width and thickness in one length.

Step 2.—**Setting Out:**

Set out piece for ends as shown in diagram "Step 2," plate 89. NOTE: The ends are set out as a pair.

Step 3.—**Cutting Out:**

(a) Check size of trenches with shelves. Chop out waste of trenches. The sides are carefully cut with a wide chisel on the waste side of the lines and the waste chopped out with a $\frac{1}{4}''$ or $\frac{3}{8}''$ mortise chisel. A router should be used to ensure all trenches are of uniform depth.
(b) Bore holes at each end of the setting out for feet with $\frac{3}{4}''$ centre bit, boring from both sides.
(c) Separate the pieces and cut to shape with bow or jig saw, finish with files and glass paper. Keep all edges flat and at right angles to the face side.

Step 4.—**Finishing:**

(a) Any ornamentation should be carried out before assembling.
(b) It will be found easier to polish, etc., before assembling.

Step 5.—**Assembling.**

Assemble with a little glue in each of the trenches.

15. **PAPER TRAY** (Plate 90).

Material Required.—Maple, silky oak, or hoop pine.

Cutting List.—Bottom ...... 1/14″ x $9\frac{3}{4}''$ x $\frac{1}{4}''$.
Sides .. 2/13″ x $2\frac{1}{2}''$ x $\frac{3}{8}''$.
Back . 1/$9\frac{1}{4}''$ x $2\frac{1}{2}''$ x $\frac{3}{8}''$.
9—$\frac{1}{2}''$ x 4 C.S. screws.

(Refer to plate 51, Construction of Common or Through Dovetail Joint.)

CONSTRUCTION.

Step 1.—**Preparation:**

Prepare all pieces to the required sizes. An $\frac{1}{8}''$ waste may be left at ends to be joined; this is cut off after gluing and assembling joints.

Step 2.—**Setting Out:**

(a) Set out the dovetails and shape of sides on one side only as seen in side view of job. The two sides may be pinned together through the waste and cut to shape in one operation. See plate 63, Drawer Making, which shows dovetails being cut on two pieces from one setting out.
(b) Set out position of pins on ends of back.
(c) Set out shape of bottom of tray and gauge $\frac{1}{8}''$ chamfer all round (pencil lines).
(d) Mark positions of screw holes: three along each side and three along back.

Step 3.—**Cutting Out:**

(a) With sides pinned together, saw sides of dovetails and cut front ends to shape.
(b) Set out shape of pins from dovetails on ends of back. Cut sides of pins.
(c) Remove waste between dovetails and between pins.
(d) Cut bottom to shape and plane chamfers, the curved chamfer being cut with the spokeshave.

Step 4.—**Trial Assembly:**

Assemble sides and back without glue and check positions of screw holes. Bore and countersink screw holes.

Step 5.—**Final Assembly:**

(a) Clean up inside face of back and sides with smoothing plane and glass paper. Assemble with glue. When dry, clean up outside faces and edges.
(b) G cramp frame to bottom and secure bottom with screws.

Step 6.—**Finishing:**

If the job is to be stained and polished, remove the bottom and polish each part separately. If it is to be lacquered or varnished it may be finished while assembled.

16. HANDKERCHIEF BOX AND ATTACHE CASE (Plate 90).

Material Required.—Maple, silky oak, rose mahogany, red cedar or any figured timber.

Cutting List for Box—
- Sides .... $2/7\frac{1}{4}'' \times 2\frac{3}{4}'' \times \frac{3}{8}''$
- Front and back, $2/7\frac{1}{4}'' \times 2\frac{3}{4}'' \times \frac{3}{8}''$.
- Top and bottom, $2/7\frac{1}{4}'' \times 7\frac{1}{4}'' \times \frac{3}{8}''$.
- Feet .... $4/1'' \times 1'' \times \frac{1}{4}''$.
- 2—$\frac{3}{4}''$ narrow butt brass hinges.

Cutting List for Attache Case—
- Sides ..... $2/10'' \times 3\frac{3}{4}'' \times \frac{3}{8}''$.
- Top and bottom, $2/14'' \times 10'' \times \frac{3}{8}''$.
- Front and Back, $2/14'' \times 3\frac{3}{4}'' \times \frac{3}{8}''$.
- Plus case fittings.

(Refer to plate 51, Common Dovetail; plate 96, Sawing off Lid; plate 28, Hinging.)

NOTE: The procedure in the construction of the Attache Case is similar to the Box.

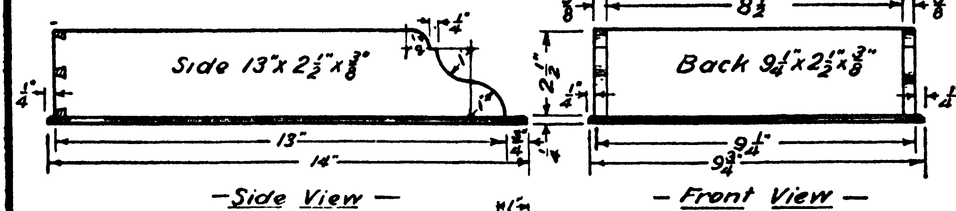
CONSTRUCTION OF HANDKERCHIEF BOX.

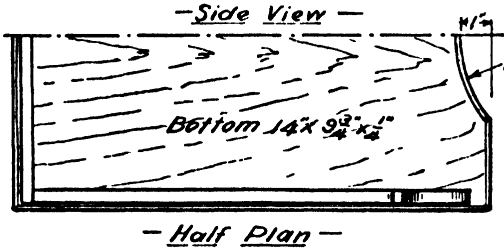
Step 1.—**Preparation:**

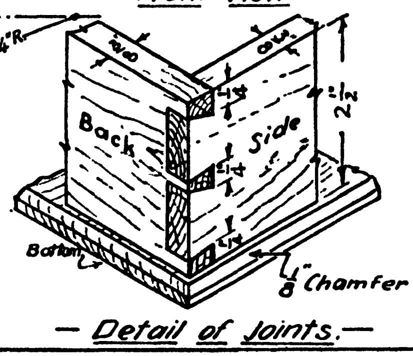
Prepare all pieces to the required width and thickness. The sides may be cut to length, allowing about 1/16" waste at each end. The top and bottom may be cut to length.

Step 2.—**Setting Out:**

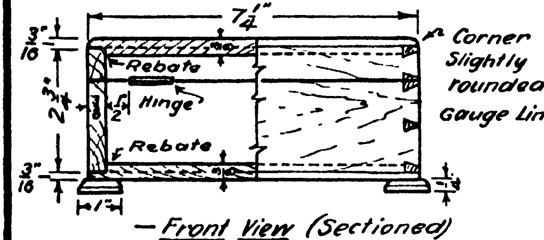
(a) Gauge rebates on top and bottom, 3/16" down edges and on $\frac{3}{8}''$ sides.
(b) Mark positions of all joints with pencil lines, allowing the required waste. Make sure the distance between joints is $6\frac{3}{4}''$.
(c) Place all pieces in respective positions and indicate ends to be joined with suitable location marks. Place pieces with face sides outside and face edges up.

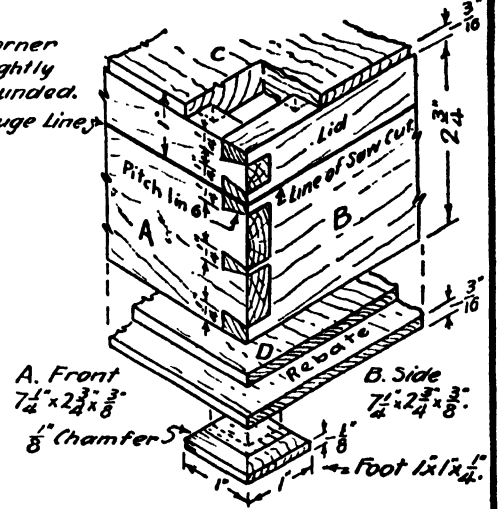


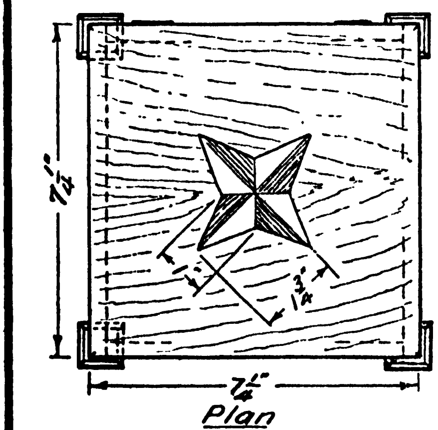




- PAPER TRAY -







Top "C" & Bottom "D" are rebated and glued in place before sawing off lid.

—Showing Details of Corner Joints.—

See Plate 96 showing Sawing Lid.
See Plate 28. Method of Hinging.
See Plate 71. Method of Making Inlay.

-HANDKERCHIEF BOX-

PLATE 90

(d) Set out the dovetails on one end of the front. Cramp front and back together and cut both sets of dovetails at once. After cutting one end, turn one piece end for end, keeping the face edges together, and saw remaining dovetails, using the previous saw kerfs as guides.

NOTE: For the Attache Case it would be to advantage to set out and cut the dovetails on the side pieces instead of the front and back, as mentioned above for the Box.

(e) Mark shape of pins from respective dovetails.

Step 3.—**Cutting Out:**

(a) Saw sides of pins and cut out waste.
(b) Remove waste between dovetails.
(c) Plane ⅛" chamfer on feet.

Step 4.—**Trial Assembly:**

Assemble the joints without glue and check position of rebates on top and bottom. Plane rebates.

Step 5.—**Final Assembly:**

(a) Clean up inside faces and glue together all dovetail joints.
(b) Clean up inside faces of top and bottom and glue to box frame.
(c) After the glue has set and dried, clean up outside faces of box and gauge for lid.
(d) Saw off lid and smooth sawn edges.
(e) Fit hinges.

Step 6.—**Finishing:**

Stain, fill and polish.

NOTE: Inlay may be built up and inserted prior to polishing.

17. **WALL MIRROR** (Plate 91).

Material Required.—Maple, silky oak, sassafras, hoop pine, etc.

Cutting List.—Stiles............. 2/13½" x 1½" x ¾".
Top rail........... 1/10" x 2" x ¾".
Bottom rails........ 1/10" x 3" x ¾".
Shelf.............. 1/10" x 3" x ⅝".
Bracket .... 1/2¾" x 2" x ⅝".
4—1¼" x 8 C.S. screws.

(Refer to plate 46, Long and Short Shouldered M & T Joint.)

CONSTRUCTION.

Step 1.—**Preparation:**

Prepare all pieces to the required sizes.

Step 2.—**Setting Out:**

(a) Gauge rebates on face edges of pieces for frame.
(b) Set out positions of mortises on face edges of stiles.

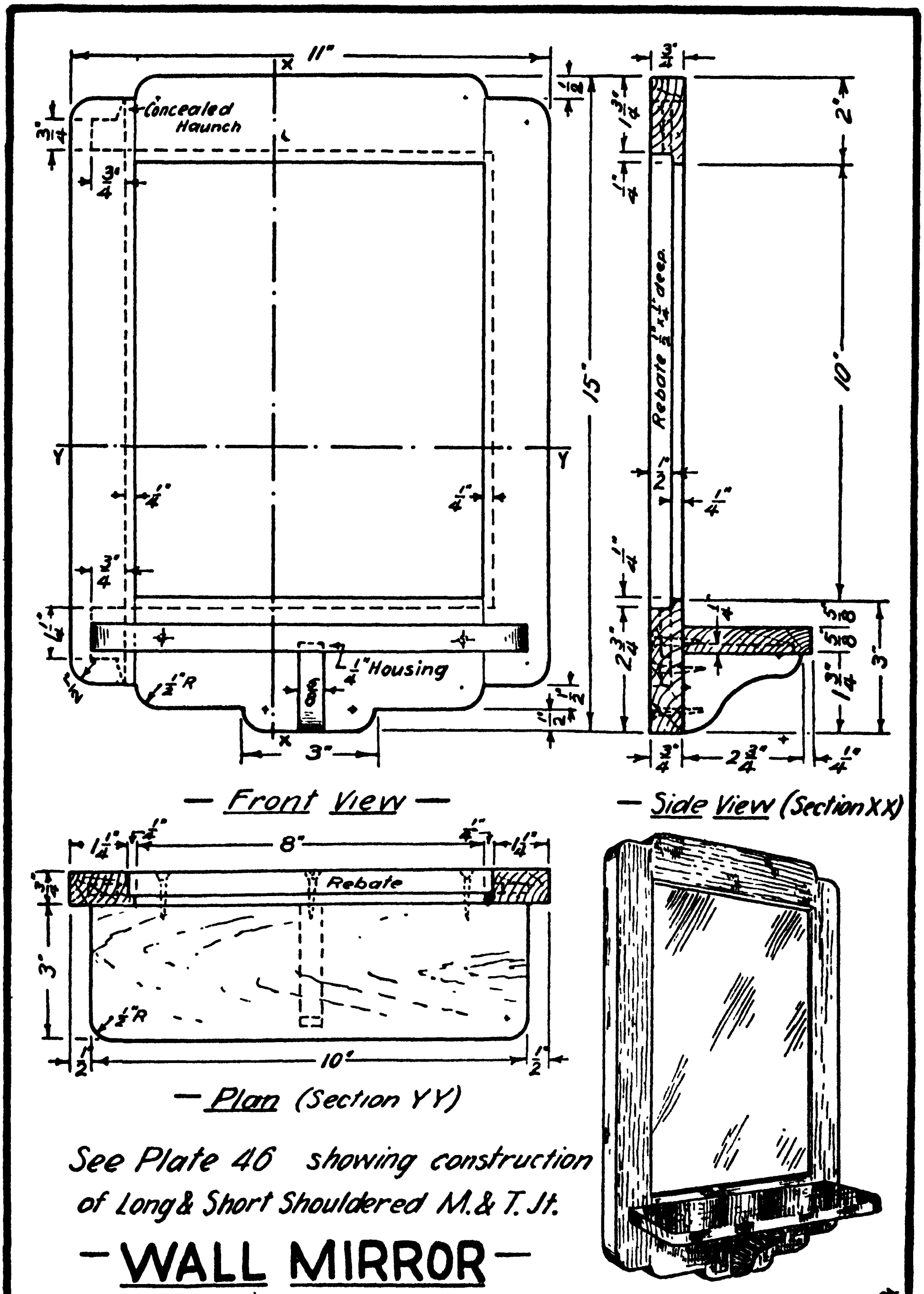

11"
X
Concealed Haunch
Y
Y
X
1/4" Housing
1/2"R
3"
— Front View —
Rebate 1/2" x 1/4" deep.
15"
10"
2"
3"
— Side View (Section XX)
8"
Rebate
10"
— Plan (Section YY)
See Plate 46 showing construction
of Long & Short Shouldered M. & T. Jt.
— WALL MIRROR —

PLATE 91

(c) Mark positions of tenons on ends of rails.
(d) Set mortise gauge to mortise chisel and gauge for mortises and tenons.
(e) Set out quadrants and shape of top and bottom rails. Mark positions of screw holes.
(f) Set out position of stopped trench on shelf and ½″ quadrants.
(g) Set out shape of bracket.

Step 3.—**Cutting Out:**

(a) Chop out mortises—note concealed haunchings.
(b) Cut tenons (see plate 46).
(c) Rebate all pieces for frame with sash fillister plane.
(d) Round off quadrants.
(e) Cut stopped trench in shelf. Round off corners of shelf.
(f) Cut bracket to shape.
(g) Bore and countersink holes for No. 8 screws.

Step 4.—**Assembling:**

(a) Clean inside edges of rails and stiles and assemble with glue. When dry, clean up outside faces and edges.
(b) Glue bracket to shelf and assemble shelf and bracket with screws.

Step 5.—Polish or lacquer.

18. COFFEE TABLE (Plate 92).

Material Required.—Silky oak, maple, hoop pine, etc.

Cutting List.—Top	1/12″ x 12″ x ½″.
Legs	4/18″ x 1¼″ x 1¼″.
Rails	4/12″ x 2″ x ¾″.
Buttons	8/1½″ x 1″ x ½″.
	8—¾″ x 4 C.S. screws.

(Refer to plate 47, Construction of Barefaced M & T Joint.)

CONSTRUCTION.

Step 1.—**Preparation:**

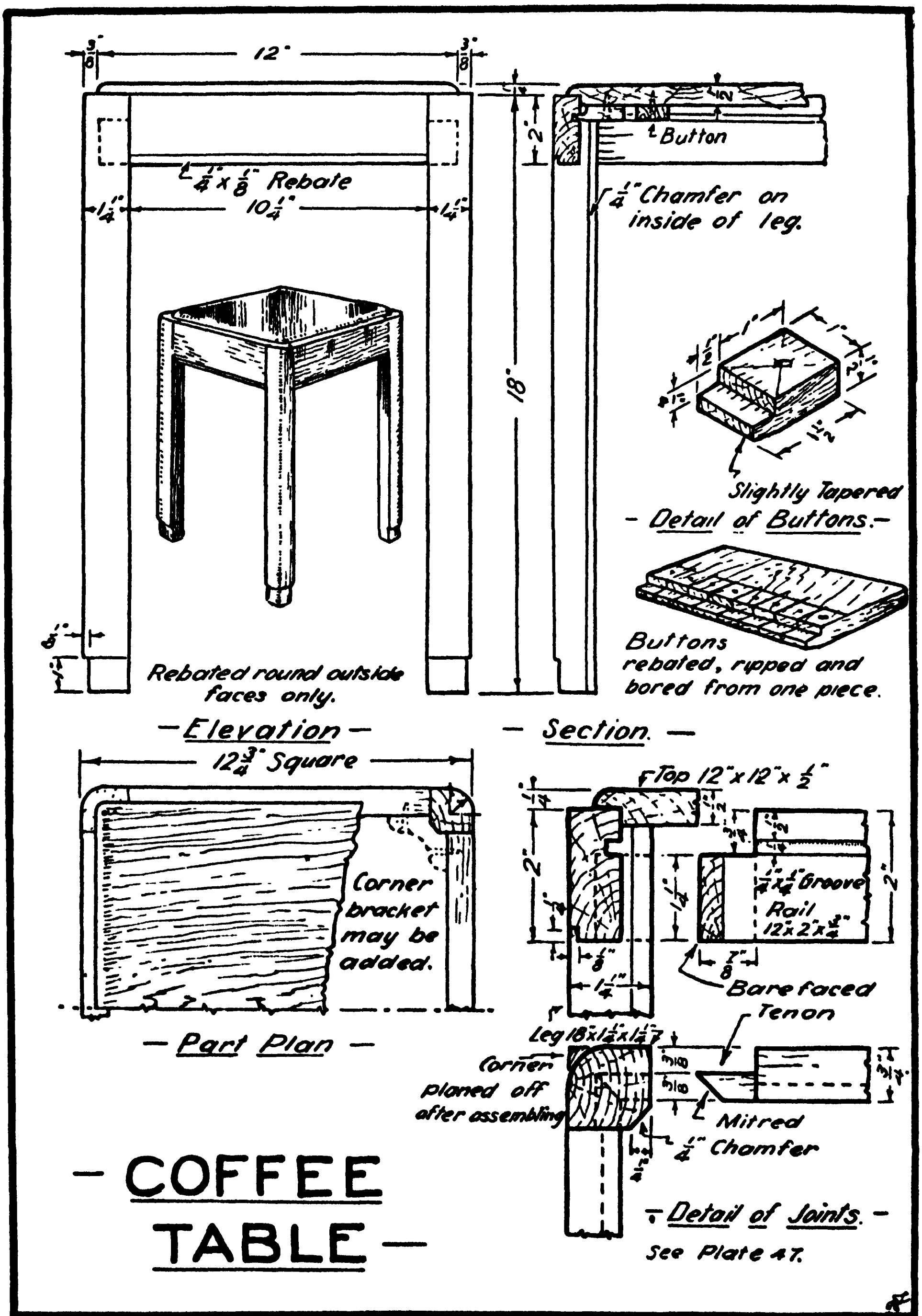
Prepare all pieces to the required sizes. The buttons as shown in plate 92.

Step 2.—**Setting Out:**

(a) Place legs and rails in respective positions and mark corners to be joined with suitable location marks.
(b) Gauge grooves, rebates and chamfers as required on all members.
(c) Mark length of tenons on end of rails, making sure to check the distance between shoulders. It is advisable to set out one rail and mark the others from it.
(d) Mark positions of mortises.
(e) Gauge thickness of tenons and gauge mortises. (See plate 47.)

Step 3.—**Cutting Out:**

(a) Plane grooves, rebates and chamfers.
(b) Chop out mortises and cut tenons. (Note tenons are mitred.)
(c) Cut buttons to shape, bore and countersink screw holes.



12"
3/8"
1/4" x 1/8" Rebate
1 1/4"
10 1/4"
1/4" Chamfer on inside of leg.
Button
2"
18"
1"
1/2"
1 1/2"
Slightly Tapered
- Detail of Buttons. -
Buttons rebated, ripped and bored from one piece.
1/8"
Rebated round outside faces only.
- Elevation -
- Section. -
12 3/4" Square
Corner bracket may be added.
- Part Plan -
Top 12" x 12" x 1/2"
1/4" x 1/4" Groove
Rail 12" x 2" x 3/4"
Bare faced Tenon
Leg 18" x 1 1/4" x 1 1/4"
Corner planed off after assembling
Mitred
1/4" Chamfer
- Detail of Joints. -
See Plate 47.
- COFFEE TABLE -

PLATE 92.

Step 4.—**Assembling:**

(a) Clean up inside surfaces of rails and legs. Assemble opposite pairs of legs. Check for squareness with rails and for winding. When dry, complete assembly of frame.
(b) Clean up and plane rails flush with legs. Round off outside corners of legs and carefully prepare rebates for feet on outside faces of legs.
(c) Round off edges of top and check out corners to fit over legs. Assemble with buttons.

Step 5.—**Finishing:**

(a) Remove top, stain, fill and polish all parts. If made of pine the table may be lacquered in one or two colours.

19. VENEERED BOOK RACK ENDS OR BOOK ENDS (Plate 93).

Material Required.—For core or ground, hoop pine; veneers, cedar, walnut, maple, mahogany, etc. (offcuts).
Cutting List.—For core, 8″ x 7″ x ⅝″ or ¾″. Smaller sizes may be used for book ends.
(Refer to plates 76 and 77, Veneering.)

CONSTRUCTION.

Step 1.—**Preparation:**

The core should be prepared and cut to required shape.
Roughen the outside surfaces and edges by lightly scraping with a dovetail saw or toothing plane so as to provide a good key for the glue.

Step 2.—Set out designs on cores, marking the position of veneer joints.

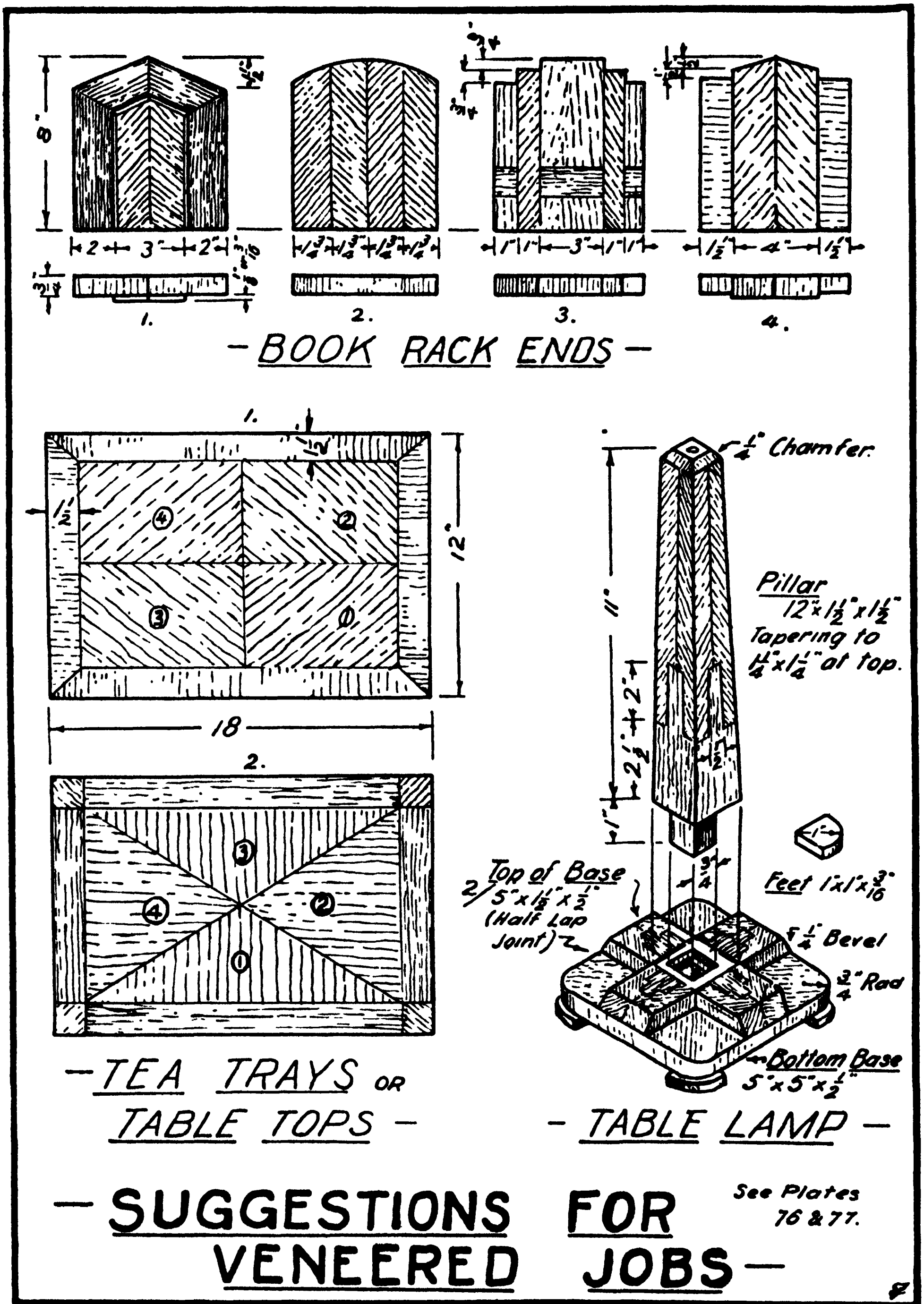
Step 3.—Cut veneers to suit patterns, allowing a little waste to overhang at edges. The pieces are temporarily pinned over the design on the core and taped with gummed paper. (See fig. 369, plate 77.) In the case of ends 1 and 4 the veneers for the raised parts are prepared in this way.

Step 4.—**Veneering:**

The caul method may be used for ends 2 and 5 and for the centres of 1 and 4. It is advisable to glue the veneers to the heart side of the cores.
Make sure all tools and materials for the veneering operation are in readiness; e.g., cauls (heated if for hot glue), bearers, cramps, waste paper and small panel or veneer pins.

(a) Apply an even spread of glue to the core and pin veneer pattern in position.
(b) Cover with two sheets of paper and press between cauls.
(c) Allow to dry for about 6 hours and remove gummed paper.
(d) Carefully trim off waste edges with a sharp knife.

For END No. 1.—The inlay strings at edges of centre are cut and glued, and held in place with panel pins driven along the edges into the core and bent over the inlay string. The pins are removed after the glue has set and dried.
The outside bands on Nos. 1 and 4 may be hammer veneered, using hot glue, or caul veneered, using cold glue.



8"
2" 3" 2"
1.
2.
3.
4.
- BOOK RACK ENDS -
1.
1½
12"
18
2.
1/4" Chamfer
Pillar
12"x1½"x1½"
Tapering to
1¼"x1¼" at top.
11"
2"
2½"
1"
Top of Base
2/5"x1½"x½"
(Half Lap
Joint)
3/4
Feet 1"x1"x3/16"
1/4" Bevel
3/4" Rad
Bottom Base
5"x5"x½"
- TEA TRAYS OR
TABLE TOPS -
- TABLE LAMP -
- SUGGESTIONS FOR
VENEERED JOBS -
See Plates
76 & 77.

PLATE 93

In the case of End No. 1, the mitred corners may be cut in a manner similar to fig. 371, plate 77, i.e., for hammer veneering. Trim up waste edges.

(e) The edges of the cores may be hammer veneered. The end grain should be first given two or three coats of glue size (thin glue) before applying veneers.

Step 5.—**Finishing.**

(a) Carefully scrape and paper all surfaces and edges.
(b) Stain, fill and polish.

NOTE: If any joints are to be cut for shelves, these should be set out and cut before veneering and assembled after veneering.

The cross pein of the warrington hammer may be used as a veneer hammer for laying the outside bands of Nos. 1 and 4, and also for the veneering of the edges.

20. VENEERED TEA TRAYS (Bases) (Plate 93).

Material Required.—¼″ plywood for cores or grounds, and suitable veneers.
Cutting List.—1/18″ x 12″ x ¼″ plywood. Larger sizes if desired.
(Refer to plates 76 and 77, Veneering.)

CONSTRUCTION OF TRAY NUMBER ONE.

Step 1.—**Preparation:**

(a) Set out veneer pattern of design on core.
(b) Cut veneers for panels No. 1 and No. 2 slightly over size and shoot the edges to be jointed between the two panels. Pin the veneers to the core and tape the joint. Cut along the short centre line drawn on the core.
(c) Fit panels No. 3 and No. 4 in the same way.
(d) NOTE: If cold glue is to be used the borders should be jointed and taped along the edges of the panels.

Step 2.—**Gluing:**

Have cauls, paper, etc., ready and apply the glue to the core. Lay veneers in position and apply the cauls, etc.

If HOT glue is to be used, glue the centre panels only, using the cauls method. When dry, remove the cauls and cut off the surplus veneer from the centre panels, using a cutting gauge from the edge of the core. The veneers for the border are cut and fitted, and laid with hot glue with a veneer hammer or the cross pein of the warrington hammer.

Step 3.—**Finishing:**

(a) Place the whole panel face down on a flat board and trim off the waste edges of the veneers with a sharp knife or veneer saw.
(b) Scrape and paper surface of the veneer. Use the glass paper in the direction of the grain.
(c) Stain, fill and polish.

CONSTRUCTION OF TRAY NUMBER TWO.

Step 1.—**Preparation:**

(a) Set out design on the base or core.

(b) Cut triangles 1 and 2 so that the outside edges are at right angles to the grain of the veneer. Allow about ½″ waste on outside edges. Joint the edges, pin the pieces to the core and tape the edges between the two triangles.
(c) Treat triangles 3 and 4 in the same way, then place the two sets of triangles together and shoot the edges. Pin to core and tape the joint. Cut off waste edges and fit pieces for border, and tape joints with centre panel.

Step 2.—**Gluing.**

Have all material for caul veneering in readiness. Apply glue, either hot or cold, lay veneer pattern in position and cramp between cauls.

Step 3.—**Finishing.**

When dry, remove cauls and trim up edges. Scrape and paper along the grain of the veneers. Stain, fill and polish.

21. VENEERED TABLE LAMP (Plate 93).

Material Required.—Hoop pine for ground and suitable veneers.
Cutting List.—Pillar .... 1/12″ x 1½″ x 1½″.
Top of base........ 2/5″ x 1½″ x ½″.
Bottom base........ 1/5″ x 5″ x ½″.
Feet. . . .. 4/1″ x 1″ x 3/16″.
(Refer to plates 76 and 77, Veneering; plate 41, Cross Halving Joint.)

CONSTRUCTION.

Step 1.—**Prepare Timber and Set Out.**

(a) Set out taper and tenon on pillar.
(b) Set out cross halving joint on pieces for top part of base, and position of mortise through the joint. Set out bevels on ends with pencil lines.
(c) Set out quadrants on bottom base and position of mortise.
(d) Set out feet to required shape.

Step 2.—**Cutting:**

(a) Plane taper and cut tenon on pillar.
(b) Cut and assemble halving joint with glue. When dry, chop out mortise and shoot bevels on ends.
(c) Cut mortise in bottom base and round off corners.
(d) Cut feet to shape.
(e) Bore ⅜″ hole for light flex through pillar.

Step 3.—**Veneering:**

(a) Set out position of joints of veneers with pencil lines on parts of the lamp core.
(b) Cut pieces of veneer to fit required pattern, allowing a little waste to overhang at the edges. Carefully tape all joints.

NOTE: Veneer each section of the job separately before assembling.

(c) Apply veneers with glue to two opposite sides of pillar, using veneer hammer or cauls. When dry, trim off overhanging edges and veneer remaining sides.

(d) Veneer edges and ends of top section of base, and trim edges. Apply veneers to the upper sides of the top base, applying pressure with hammer or cauls. Trim off waste edges. The inside edges may be left to be covered by the bottom shoulders of the pillar.
(e) Apply veneers to corners of the bottom section of base. The veneers may be allowed to overlap all pencil lines. When dry, cut off waste edges. The inside edges may be cut to fit by assembling the job (without glue) and running a sharp veneer knife along the edges of the upper section of the base.
(f) Veneer edges of the bottom base and trim off waste edges.

Step 4.—**Finishing and Assembling:**

All parts may be stained, filled and polished separately and then assembled with glue. The two sections of the base are screwed together with screws from underneath. The feet are secured with glue and panel pins.

22. TRAYMOBILE (Plate 94).

Material Required.—Silky oak, maple, hoop pine as required to match Coffee Table, Job No. 18.

Cutting List.—Shelves .... 2/27¼" x 17¼" x ⅜".
Long Rails .... 4/27¼" x 2" x ¾".
Short Rails......... 4/17¼" x 2" x ¾".
Buttons.......... 20/1½" x 1" x ½".
Handles...... . 2/12" x 1¼" x 1¼".
20—¾" x 6 C.S. screws for buttons.
6—1¼" x 8 C.S. screws for securing handles.

(Refer to plate 47, Construction of Barefaced M & T Joint, and plate 92, Coffee Table.)

CONSTRUCTION.

Step 1.—**Preparation:**

(a) Set out a full size "board or rod" as illustrated at foot of plate 94.
(b) Prepare all members to the required sizes. (If plywood is available the shelves may be of ¼" or ⅜" plywood.) Solid shelves may require jointing. (See plate 38.)

Step 2.—**Setting Out.—From ROD.**

(a) Mark length of legs and positions of rails and width of mortises from the rod. Number all mortises. NOTE: Face sides and edges of legs are inside.
(b) Mark lengths of rails and tenons from the ROD, and number the tenons to correspond with the numbers of the mortises. NOTE: Face sides of rails are inside and the face edges are up. Set out width of tenons to suit mortises.
(c) Gauge thickness of mortises and tenons.
(d) Set out all chamfers, grooves and rebates.
(e) Set out buttons as shown on plate 92.
(f) Set out shape of handles.

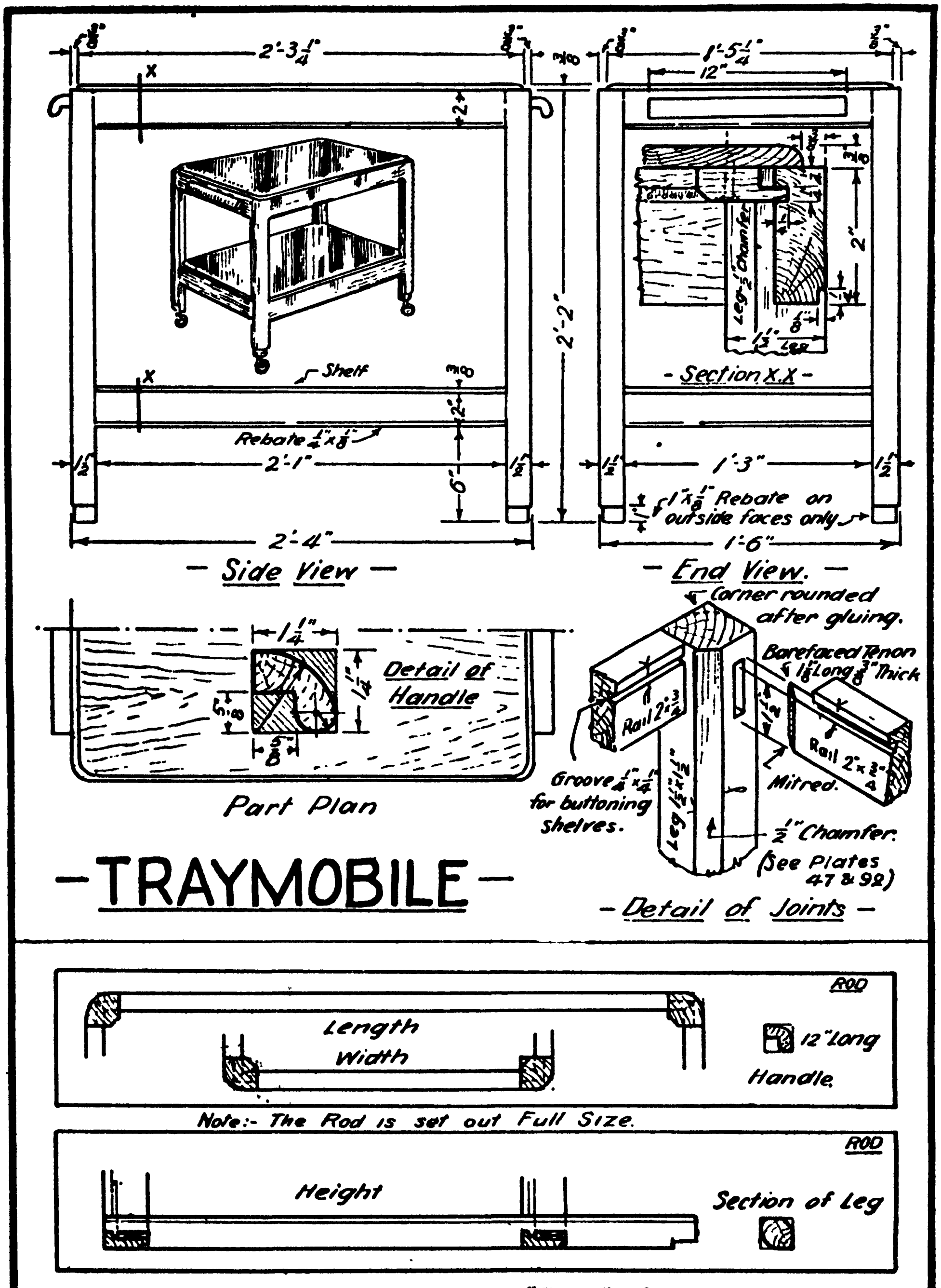

-TRAYMOBILE-
- Side View -
- End View. -
Shelf
Rebate $\frac{1}{4}$"x$\frac{1}{8}$"
2'-$3\frac{1}{4}$"
2'-1"
2'-4"
2'-2"
$1'$-$5\frac{1}{4}$"
12"
1'-3"
1'-6"
$\frac{1}{4}$"x$\frac{1}{8}$" Rebate on outside faces only
- Section X.X -
Leg $\frac{1}{2}$" Chamfer
$1\frac{1}{2}$" Leg
Part Plan
Detail of Handle
Corner rounded after gluing.
Barefaced Tenon $1\frac{1}{8}$" Long $\frac{3}{8}$" Thick
Rail $2''\times\frac{3}{4}''$
Mitred.
Groove $\frac{1}{4}$"x$\frac{1}{4}$" for buttoning shelves.
$\frac{1}{2}$" Chamfer.
(See Plates 47 & 92)
- Detail of Joints -
ROD
Length
Width
12" Long
Handle.
Note:- The Rod is set out Full Size.
Height
Section of Leg
- Showing setting out on "ROD" (Both sides used)

PLATE 94

Step 3.—**Cutting Out:**
(a) Chop out mortises.
(b) Rip tenons only.
(c) Plane chamfers, grooves and rebates.
(d) Saw shoulders of tenons.
(e) Cut handles to shape.
(f) Cut buttons to shape, bore and countersink screw holes.
(g) Round off edges of shelves.
NOTE: The legs are not rounded off after assembling.

Step 4.—**Trial Assembly:**
Make a trial assembly and check out corners of bottom shelf to fit.

Step 5.—**Final Assembly:**
(a) Clean up inside faces of legs and chamfers, also inside face and edges of rails.
(b) Assemble long rails and legs. Check for squareness and winding.
(c) When dry, assemble short rails to legs.
(d) After glue dries, round off outside corners of legs and cut rebates to form feet.
(e) Screw handles in position and secure shelves with buttons.

Step 6.—**Finishing:**
Remove shelves, stain both sides, fill tops and polish. Stain, fill and polish frame. Handles may be finished separately. Stain buttons and re-assemble. Rubber-tyred castors may be fitted by boring holes for the pegs of sleeves in the legs. The castors are illustrated in plate 32.
Small rails may be added to shelves if desired, being secured by screws through the shelves.

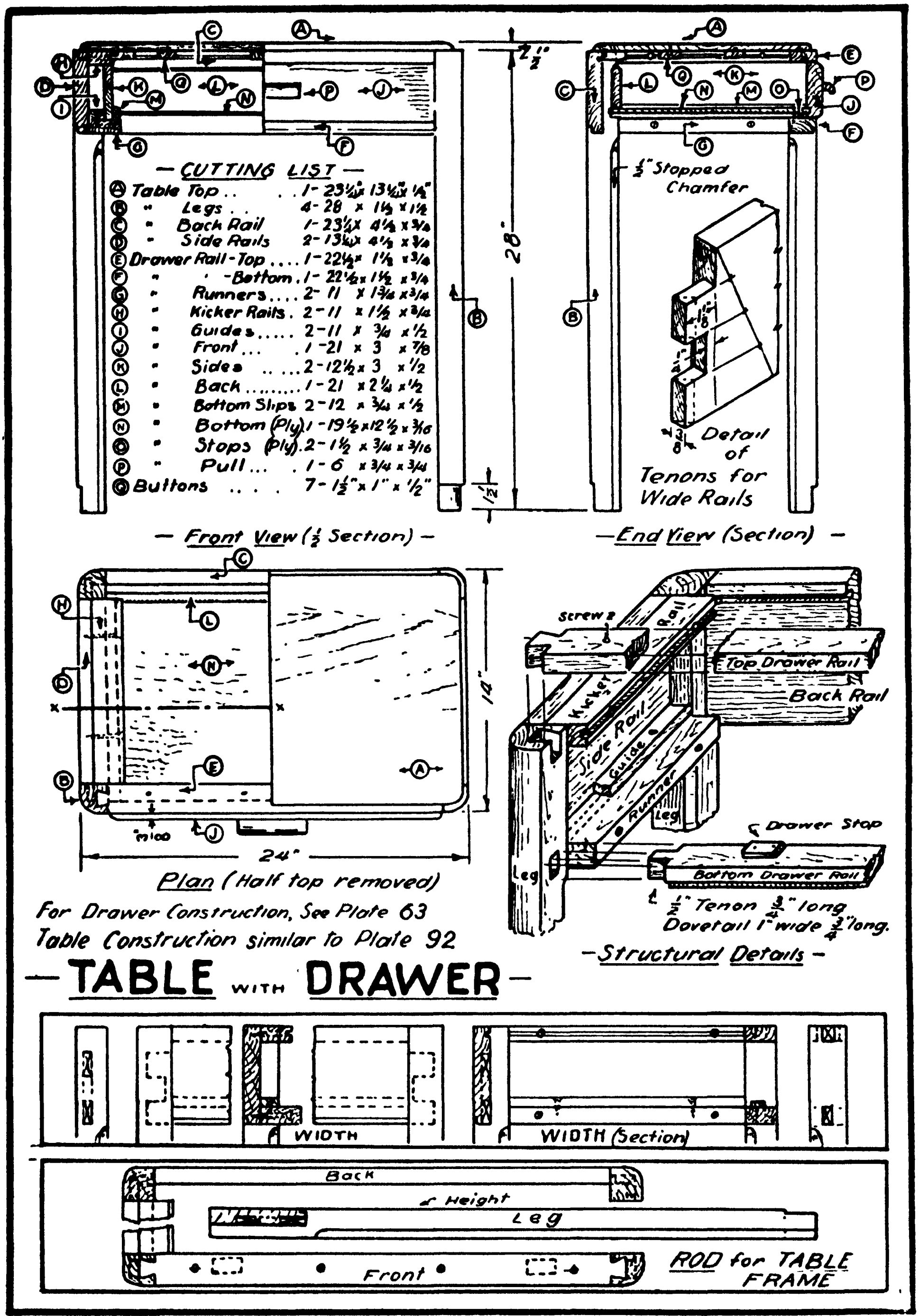
23. **TABLE WITH DRAWER.** (Suitable for a Telephone Table or Typing Table.) (Plate 95.)
Material Required.—Silky oak, maple, etc., to match Coffee Table and Traymobile.
Cutting List.—Shown on plate 95.
(Refer to plate 63, Drawer Making. The general construction of the table frame is similar to that of the Coffee Table, plate 92.)

CONSTRUCTION OF TABLE.

Step 1.—**Preparation:**
(a) Prepare a working rod for the table. The drawer may be included on the rod.
(b) Prepare all pieces to the required sizes.

Step 2.—**Setting Out:**
(a) Set out lengths of all members and position of joints from the rod.
(NOTE: Details of joints for wide rails, and the joints for the drawer rails.)
(b) Mark positions of rebates, grooves, chamfers, rounded edges and screw holes.

Step 3.—**Cutting Out:**
(a) Chop out waste of mortises and sockets for single dovetails.
(b) Rip thickness of tenons.
(c) Cut dovetails of top drawer rail.
(d) Bore and countersink holes for screws.



— CUTTING LIST —
A Table Top . . . . 1- 23¼ x 13¼ x ¾
B " Legs . . 4- 28 x 1½ x 1½
C " Back Rail 1- 23¼ x 4¼ x ¾
D " Side Rails 2- 13¼ x 4¼ x ¾
E Drawer Rail-Top . . . . 1- 22½ x 1½ x ¾
F " " -Bottom . 1- 22½ x 1½ x ¾
G " Runners . . . . 2- 11 x 1¾ x ¾
H " Kicker Rails . 2- 11 x 1½ x ¾
I " Guides . . . . . 2- 11 x ¾ x ½
J " Front . . . . 1- 21 x 3 x ⅞
K " Sides . . . . 2- 12½ x 3 x ½
L " Back . . . . 1- 21 x 2¼ x ½
M " Bottom Slips 2- 12 x ¾ x ½
N " Bottom (Ply) 1- 19½ x 12½ x 3/16
O " Stops (Ply) 2- 1½ x ¾ x 3/16
P " Pull . . . . 1- 6 x ¾ x ¾
Q Buttons . . . . 7- 1½" x 1" x ½"
2½"
28"
1½"
½" Stopped Chamfer
Detail of Tenons for Wide Rails
— Front View (½ Section) —
— End View (Section) —
14"
24"
Plan (Half top removed)
For Drawer Construction, See Plate 63
Table Construction similar to Plate 92
Screw
Rail
Top Drawer Rail
Back Rail
Kicker
Side Rail
Guide
Runner
Leg
Leg
Drawer Stop
Bottom Drawer Rail
½" Tenon ¾" long
Dovetail 1" wide ¾" long.
— Structural Details —
— TABLE WITH DRAWER —
WIDTH
WIDTH (Section)
Back
Height
Leg
Front
ROD for TABLE FRAME

PLATE 95

(e) Plane all grooves, rebates, etc., and round off edges of table top.
(f) Saw shoulders of tenons.

NOTE: The legs are not rounded off until after assembling with glue.

Step 4.—**Assembling:**

(a) Clean up inside surfaces and edges of rails and legs. Assemble short rails and legs.
(b) When dry, assemble remaining rails.
(c) Round off outside corners of legs and cut rebates for feet.
(d) Screw drawer runners, drawer guides and kicker rails in position.
(e) Secure table top with screws to top drawer rail and with buttons to back and sides.

Step 5.—**Construct Drawer:**

(a) Fit drawer front to drawer opening, and fit drawer sides between runner and kicker rails.
(b) Set out drawer joints. (See plate 63 for details of joints.)
(c) Cut joints and assemble dry, then check fitting in drawer space.
(d) Clean up inside faces and assemble with glue. If desired it may be immediately inserted in drawer space so that it assumes the exact shape. Care must be taken to prevent any glue adhering to the table frame—oiled pieces of paper will prevent the drawer sticking.
(e) Make drawer bottom slips, glue and pin to drawer sides.
(f) Clean up outside faces and round off edges of drawer front.
(g) Fit plywood bottom and secure with screws or pins to drawer back.
(h) Make and screw drawer pull to drawer front.
(i) Glue and pin drawer stops to drawer bottom rails.

Step 6.—**Finishing:**

Stain, fill and polish all visible parts to match Coffee Table and Traymobile.

NOTE: The drawer sides, drawer back, drawer bottom and slip, drawer runners, guides and slips may be made of hoop pine, coachwood or sassafras.

24. VENEERED BOX (Plate 96).

Material Required.—Hoop pine for groundwork and suitable veneers.
Cutting List—for groundwork.

Top and bottom	2/8¾" x 5¾" x ⅜".	These sizes apply to a box made using the rebated butt joint as illustrated.
Sides	2/9" x 3" x ⅜".	
Ends	2/5¾" x 3" x ⅜".	

Alternative corner joints for the box may be used, e.g., common dovetail, rebated and mitred or plain mitred, strengthened with keys, as illustrated in plate 35. If these joints are used the ends will need to be 6" long. The width of the sides and ends allows an ⅛" for sawing off lid.

(Refer to plates 76 and 77, Veneering, and plate 28, Hinging.)

CONSTRUCTION.

Step 1.—Construct the box, using any one of the joints mentioned above. Do not cut off lid until after veneering.

Step 2.—Prepare the top and sides for veneering by "toothing" them to form a key for the glue.

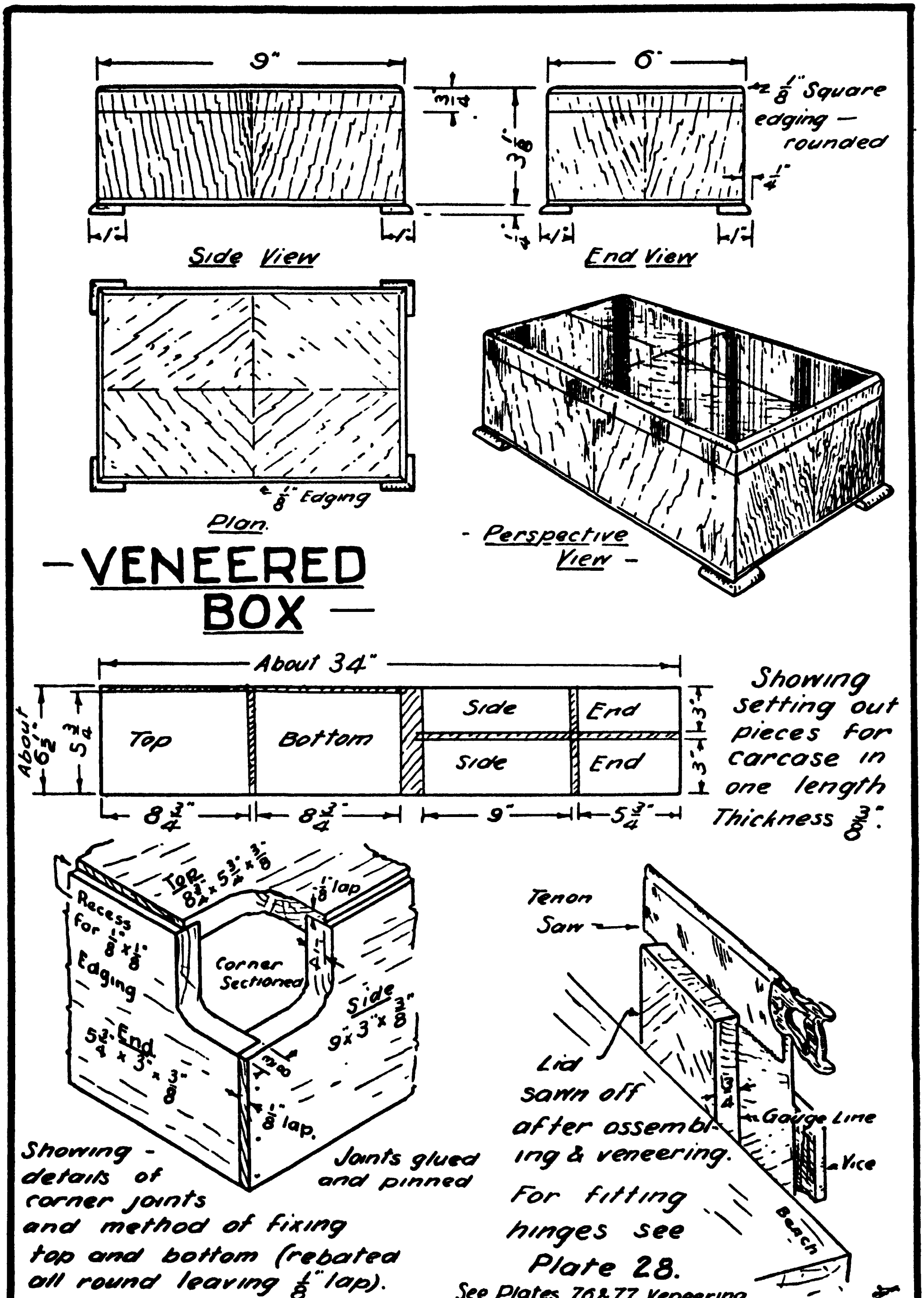

9"
6"
1/8" Square edging — rounded
3 1/8
3/4
1/4"
1/2
1/2
1/4
1/2
1/2
Side View
End View
1/8" Edging
Plan.
- Perspective View -
—VENEERED BOX —
About 34"
About 6 1/2"
5 3/4
Top
Bottom
Side
Side
End
End
3"
3"
8 3/4"
8 3/4"
9"
5 3/4"
Showing setting out pieces for carcase in one length Thickness 3/8".
Top 8 3/4 x 5 3/4 x 3/8
1/8 lap
Recess for 1/8 x 1/8 Edging
Corner Sectioned
1/4
Side 9" x 3" x 3/8"
5 3/4 End x 3" x 3/8"
3/8
1/8 lap.
Showing - details of corner joints and method of fixing top and bottom (rebated all round leaving 1/8" lap).
Joints glued and pinned
Tenon Saw
Lid sawn off after assembling & veneering.
3/4
Gauge Line
Vice
Bench
For fitting hinges see Plate 28.
See Plates 76 & 77 Veneering

PLATE 96

Step 3.—**Veneering.**

(a) Mark box with pencil lines to correspond with the joints of the veneers.
(b) Cut the veneers to suit the designs for top, sides and ends, allowing about $\frac{1}{4}''$ waste to overhang the surfaces being veneered. Tape all joints.
(c) Apply the veneers, using the veneer hammer. (See notes on Hammer Veneering.)
  i. Veneer top and trim off waste edges:
  ii. Veneer sides and trim off waste edges.
  iii. Veneer ends and trim off waste edges.
  iv. Clean up rebates for veneer strings with bull nose rebate plane.
  v. Cut veneer strings to fit rebates and glue in place, applying pressure by tightly winding string round the box.
(d) Carefully scrape and paper up surfaces and apply a brush coat of polish to preserve the cleaned surfaces.

Step 4.—Saw off lid and smooth sawn edges. Fit a pair of 1″ brass butt hinges. Make and secure feet with glue and panel pins.

Step 5.—Stain, fill and polish.

25. SMALL BOOK CASE (Plate 97).

Material Required.—Similar to that of the Coffee Table, Traymobile, Table with Drawer, etc.

Cutting List.—Top	$1/17\frac{1}{2}'' \text{ x } 8\frac{3}{4}'' \text{ x } \frac{1}{2}''$.
Sides	$2/29\frac{1}{2}'' \text{ x } 9'' \text{ x } \frac{3}{4}''$.
Bottom	$1/17\frac{1}{2}'' \text{ x } 8\frac{3}{4}'' \text{ x } \frac{3}{4}''$.
Top Front Rail	$1/17\frac{1}{2}'' \text{ x } 1\frac{3}{4}'' \text{ x } \frac{3}{4}''$.
Top Back Rail	$1/17\frac{1}{2}'' \text{ x } 1\frac{1}{2}'' \text{ x } \frac{3}{4}''$.

NOTE: Instead of using a solid piece for bottom, two rails similar to the top rails may be used and a $\frac{1}{4}''$ plywood bottom fitted $\frac{7}{8}''$ back from the edge of the front rail; this would also act as a door stop.

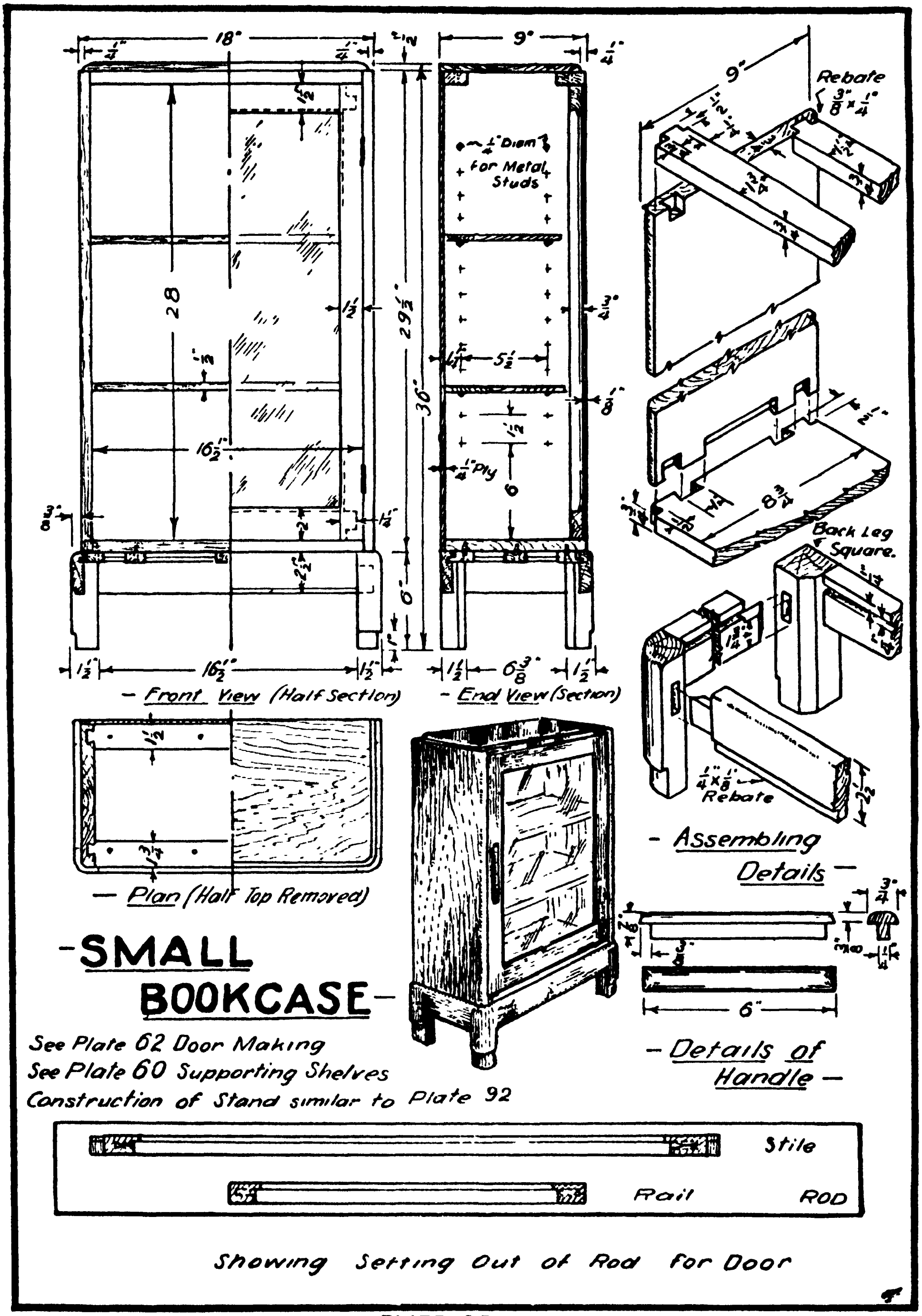
Legs for stand	$4/6'' \text{ x } 1\frac{1}{2}'' \text{ x } 1\frac{1}{2}''$.
Front and back rails	$2/18'' \text{ x } 2\frac{1}{2}'' \text{ x } \frac{3}{4}''$.
Side rails	$2/8\frac{1}{4}'' \text{ x } 2\frac{1}{2}'' \text{ x } \frac{3}{4}''$.
Buttons	$8/1\frac{1}{2}'' \text{ x } 1'' \text{ x } \frac{1}{2}''$.
Stiles for door	$2/28'' \text{ x } 1\frac{1}{2}'' \text{ x } \frac{3}{4}''$.
Top rail for door	$1/16'' \text{ x } 1\frac{1}{2}'' \text{ x } \frac{3}{4}''$.
Bottom rail for door	$1/16'' \text{ x } 2'' \text{ x } \frac{3}{4}''$.
Door handles	$1/6'' \text{ x } \frac{7}{8}'' \text{ x } \frac{3}{4}''$.
Shelves for Cabinet	2 or $3/16\frac{1}{2}'' \text{ x } 7\frac{1}{2}'' \text{ x } \frac{1}{2}''$.
Back for Cabinet	$1/19\frac{1}{2}'' \text{ x } 17\frac{1}{4}'' \text{ x } 3/16''$ or $\frac{1}{4}''$ plywood.

(Refer to plate 62, Door Making; plate 46, Construction of Long and Short Shouldered M & T Joint; plate 60, Method of Supporting Shelves; plate 28, Hinging.)

CONSTRUCTION OF CABINET CARCASE.

Step 1.—**Preparation:**

(a) **Set out a working rod showing a vertical section and a plan with top removed.**
(b) **Prepare all pieces to the required sizes.**



- Front View (Half Section)
- End View (Section)
- Plan (Half Top Removed)
-SMALL BOOKCASE-
See Plate 62 Door Making
See Plate 60 Supporting Shelves
Construction of Stand similar to Plate 92
- Assembling Details -
Rebate
Back Leg Square.
Rebate
- Details of Handle -
1/4" Diam for Metal Studs
1/4" Ply
Stile
Rail
ROD
Showing Setting Out of Rod for Door

PLATE 97.

Step 2.—**Setting Out:**

(a) Gauge rebates along back inside edges of sides for plywood back.
(b) Mark positions of holes for studs for adjustable shelves.
(c) Set out position and shape of dovetails on ends of top rails. Cut them to shape and trace shape of dovetail sockets on top ends of sides.
(d) Set out dovetails on ends of bottom, cut away waste (coping or bow saw) and trace shape of joints on bottom ends of sides.
(e) Mark position of screw holes on rails for securing top.

Step 3.—**Cutting Out:**

(a) Plane rebates with side fillister.
(b) Bore holes for shelf supporting studs.
(c) Chop out waste for dovetails on both ends of sides.

Step 4.—**Assembling.**

(a) Clean up inside surfaces and assemble with glue. Secure back with panel pins or screws.

CONSTRUCTION OF STAND.—See construction of frame for Coffee Table, plate 92. Note that the back legs of stand are not rounded.

CONSTRUCTION OF DOOR.

Set out a rod as shown at bottom of plate 97 and construct according to plate 62.
(b) Secure stand to carcase with buttons.
(c) Hang door with 2″ narrow butt hinges. NOTE: The door is recessed an ⅛″.
(d) Make and secure handle to door with screws through the door stile.
(e) One of the following catches may be fitted:—Double ball, "Gripper" spring, or Roller bolt mortise catch.

Step 5.—**Finishing:**

It will be found easier to remove the door and stand to stain, fill and polish each section separately. The interior of the cabinet and shelves should be stained and polished to match the exterior.

26. SMALL CABINET (Plate 98).

Material Required:—Maple, silky oak, or hoop pine. May be made to match Table with Drawer and Bookcase, etc.

Cutting List.—Sides of cabinet...... 2/18″ x 8″ x ½″
Top of cabinet ....1/12″ x 8″ x ½″.
Bottom............... 1/22″ x 8″ x ½″.
Outside shelves........2/10″ x 7″ x ½″.
Inside shelf........... 1/11″ x 7″ x 3/16″ plywood.
Fillets for supporting inside shelf.........2/7″ x ½″ x ⅜″.
Handle................1/6″ x ½″ x ½″.
Feet................. 4/1″ x 1″ x 1″
Door................. 1/17″ x 11″ x ½″. May be plywood.
Turned pillar......... 1/15¼″ x 1″ x 1″. May be added if desired.

(Refer to plate 51, Construction of Common Dovetail Joint.)

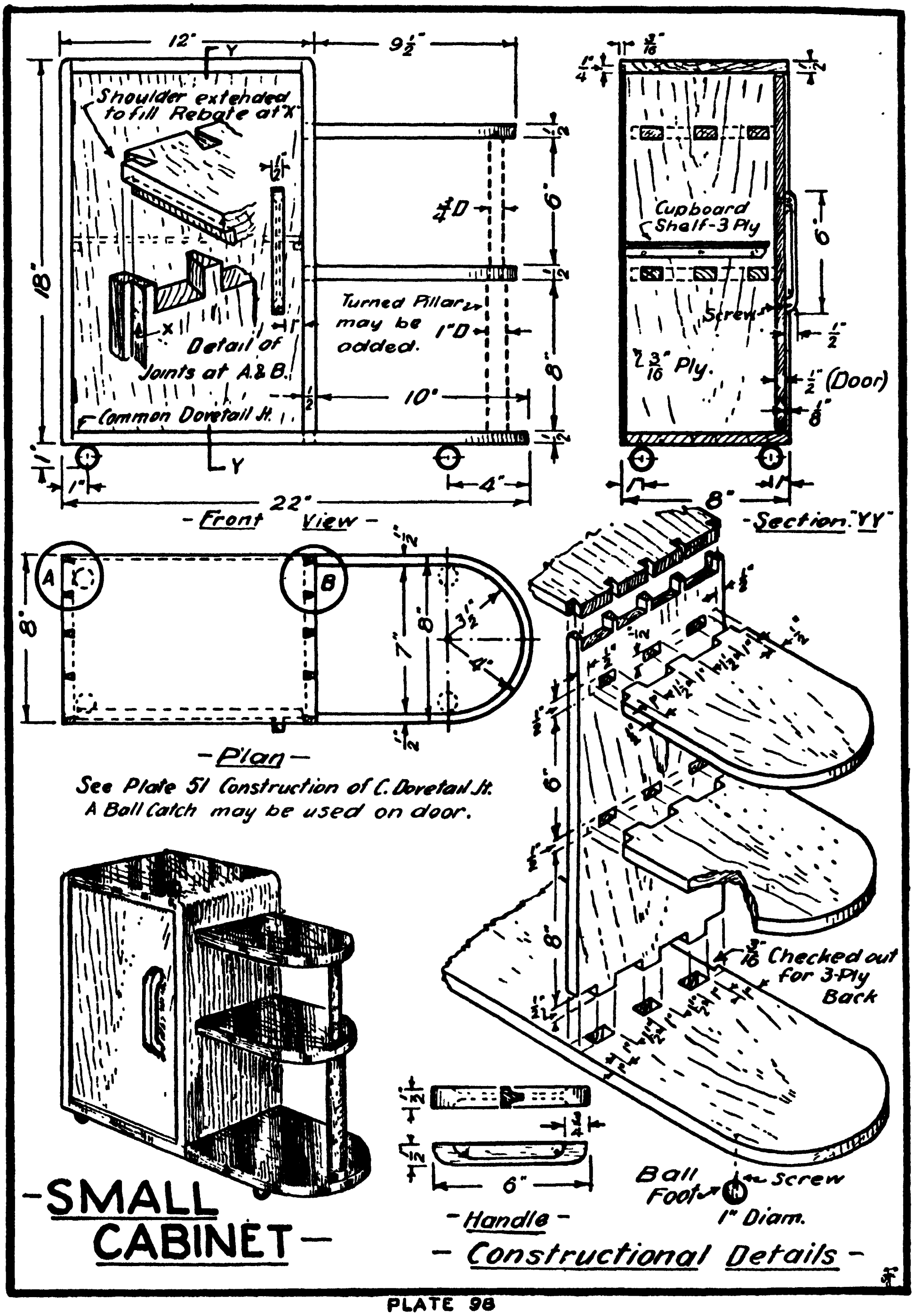

12"
9½"
18"
Shoulder extended to fill Rebate at "X"
¾"D
6"
Turned Pillars may be added.
1"D
Detail of Joints at A & B.
10"
8"
Common Dovetail Jt.
22"
4"
- Front View -
Cupboard Shelf - 3 Ply
Screws
½" (Door)
3/16" Ply.
8"
- Section "YY" -
- Plan -
See Plate 51 Construction of C. Dovetail Jt.
A Ball Catch may be used on door.
3½"
7"
4"
3/16" Checked out for 3-Ply Back
- Handle -
6"
Ball Foot
Screw
1" Diam.
- SMALL CABINET -
- Constructional Details -

PLATE 98

Step 1.—**Preparation:**

Prepare all pieces to the required width and thickness—about $\frac{1}{8}''$ waste may be left at ends to be joined.

Step 2.—**Setting Out:**

(a) Set out positions of joints.
(b) Gauge position of rebates for plywood back on top and sides.
(c) Set out shape of dovetails on ends of top and end of bottom.
NOTE: The shoulders on the back dovetails are extended to fill in the space produced by the rebates along the sides.
(d) Saw sides of dovetails and trace shape of pins from them.
(e) Mark positions of mortises and tenons for carcase joints (for shelves).
(f) Gauge width of mortises and mark width of tenons from respective mortises.
(g) Gauge recess on bottom to take plywood back.

Step 3.—**Cutting Out:**

(a) Plane rebates along edges of top and sides for plywood back.
(b) Saw sides of dovetail sockets and tenons.
(c) Chop out waste of mortises, and waste between tenons, dovetails and pins. Saw shoulders on end tenons and dovetails.
(d) Round off ends of outside shelves and bottom.
(e) Saw out waste of recess for back along bottom.
(f) Set out and cut handle to shape.
(g) Turn feet to shape and bore holes for securing with screws to bottom.

Step 4.—**Assembling:**

(a) Make a trial assembly and make any necessary adjustments.
(b) Clean up all members. Assemble cabinet with glue, checking for squareness. The back may be fitted to keep cabinet square.
(c) Round off top corners of cabinet and glue outside shelves in place.
(d) Secure feet with glue and screws.
(e) Screw fillets and fit shelves inside cabinet.
(f) Hang door with $1\frac{1}{4}''$ butt hinges.
(g) Secure handle to door with screws through the door.
(h) Fit ball catch in edge of door near handle.

Step 5.—**Finishing.**

Stain, fill and polish to match Book Case.

27. TURNED TRIPOD TABLE (Plate 99).

Material Required.—Maple, silky oak, walnut or any figured timber.

Cutting List.—	Top	1/15″ x 15″ x $\frac{3}{4}''$.	Allowance should be made for turning.
	Support under top	1/6″ x 6″ x $\frac{3}{4}''$.	
	Pillar	1/15″ x $2\frac{1}{2}''$ x $2\frac{1}{2}''$.	
	Legs	3/9″ x 3″ x $\frac{7}{8}''$.	

(Refer to plate 101, Woodturning.)

CONSTRUCTION.

Step 1.—**Preparation:**

Prepare pieces for turning and prepare pieces for legs to the required thickness.

Step 2.—**Setting Out:**

Set out shape of legs.

Step 3.—**Cutting Out and Turning:**

(a) Turn all pieces to required shape.
(b) Slightly flatten three sides of bottom of pillar for fitting to legs.
(c) Cut legs to shape and bore holes for dowels in legs and pillar.

Step 4.—**Finishing:**

The turned members may be stained, filled and polished in the lathe prior to assembling. It will be found easier to polish the legs before assembling.

Step 5.—**Assembling:**

Glue top supporting piece to pillar. Glue dowels and legs to pillar. Secure top with screws through supporting piece.

28. TURNED SMOKER'S STAND (Plate 99).

Material Required.—Maple, silky oak, blackwood or any figured timber.

Cutting List.—Pillar	1/23$\frac{1}{2}''$ x 1$\frac{1}{2}''$ x 1$\frac{1}{2}''$	All sizes given here are neat. Allowance for waste when turning should be added.
Base (built up of three pieces).	9″ x 9″ x 2$\frac{1}{4}''$	
Top shelf	1/7″ x 7″ x $\frac{3}{4}''$	
Support under top	1/4″ x 4″ x $\frac{3}{4}''$	
Middle shelf	1/12″ x 12″ x $\frac{3}{4}''$	
Support under shelf	1/6″ x 6″ x $\frac{3}{4}''$	

(Refer to plate 101, Woodturning.)

CONSTRUCTION.

Step 1.—**Preparation:**

Prepare all pieces for turning. The pieces for the base may be turned separately and then glued together, OR they may be glued and screwed together first and then turned in one operation. (See base of Turned Coffee Table, plate 87.)

Step 2.—**Cutting or Turning:**

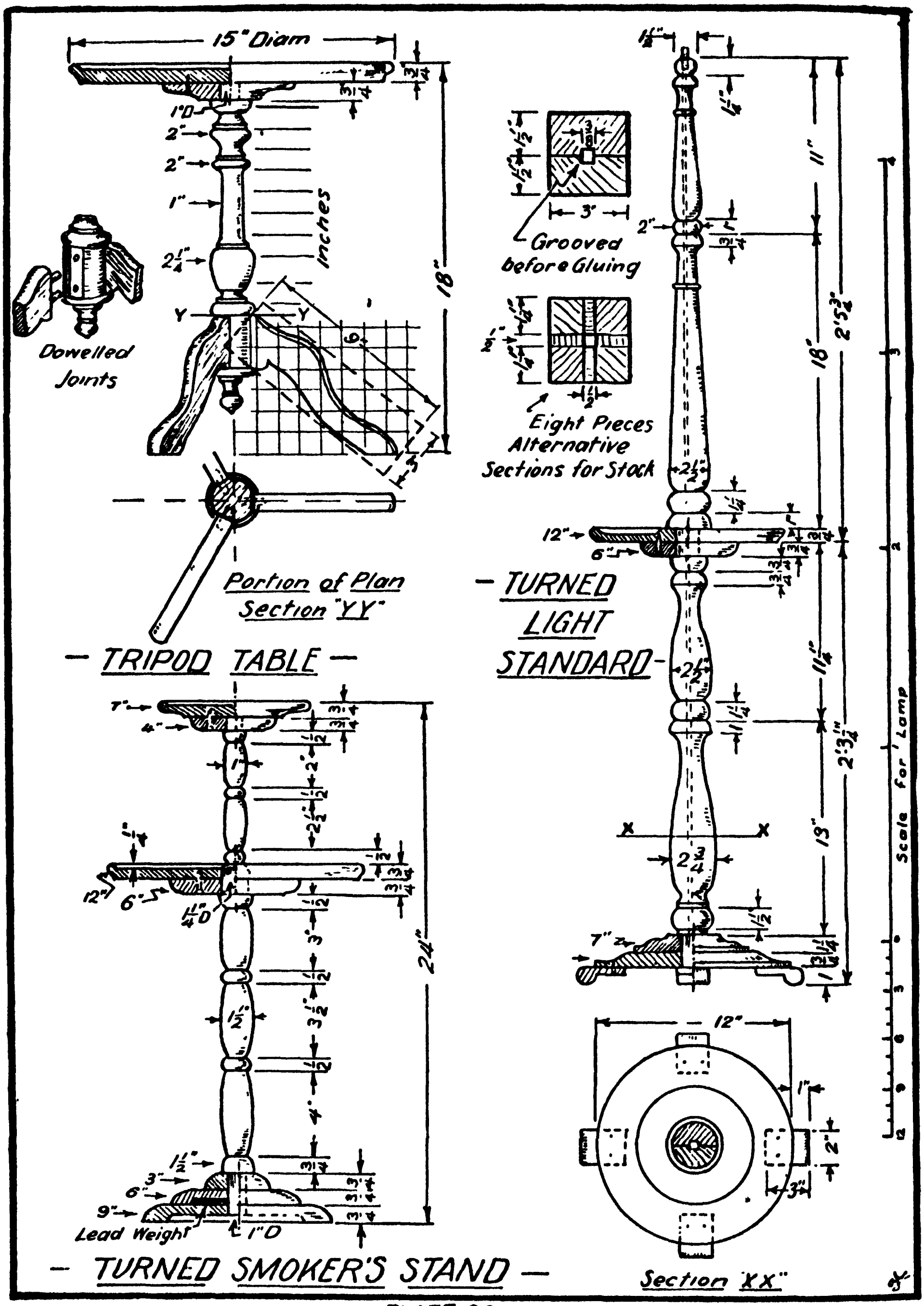
(a) Turn pillar to required shape. NOTE: The top section of the pillar is turned to a smaller diameter, leaving a small shoulder on the fourth segment up from the bottom to allow the middle shelf to be fitted.
(b) Turn base, shelves and supports to required shapes.

Step 3.—**Finishing:**

All parts may be stained, filled and polished in the lathe.

Step 4.—**Assembling:**

All pieces are secured to the pillar by means of glue, screws being added through the supporting pieces to hold the shelves.



15" Diam
Dowelled Joints
Inches
Portion of Plan Section "YY"
- TRIPOD TABLE -
Grooved before Gluing
Eight Pieces Alternative Sections for Stock
- TURNED LIGHT STANDARD -
Scale for Lamp
Lead Weight
- TURNED SMOKER'S STAND -
Section "XX"

PLATE 99.

29. TURNED STANDARD LAMP (Plate 99).

Material Required.—Any figured timber may be used. Where the stock for the pillar is built up of eight pieces contrasting strips may be used.

Cutting List.—	Pillar or post (top section) ...	1/29¾" x 2½" x 2½".
	„ „ (bottom section) ..	1/26¼" x 2½" x 2½".
	Base	12" x 12" x 2".
	Shelf	1/12" x 12" x ¾".
	Support under shelf	1/6" x 6" x ¾".
	Feet	4/3" x 2" x 1".

NOTE: (i) Two methods of building up the stock for the pillar are shown. These illustrate methods of leaving a hole for the light flex. The whole pillar may be built up in one length and cut into two sections for turning.

(ii) The shelf is glued to the top section of the pillar and the support for the shelf is glued to the bottom section of the pillar. Both sections are held together by three or four screws through the support into the shelf.

(iii) When turning, it is advisable to have the lower end of each section at the head stock end of the lathe. This may enable the base and the shelf to be glued to each section before finishing in the lathe.

CONSTRUCTION.

Step 1.—Preparation:

Prepare the stock for the pillar. Prepare base, shelf and supporting piece for face plate turning.

Step 2.—Turning:

(a) Turn the two sections of the pillar to required shape.
(b) Turn base, shelf and supporting piece to shape. Bore holes for screws.
(c) Set out and cut feet to shape, bore holes for screws.

Step 3.—Finishing:

If the lathe will take 12" diameter, the base, shelf and support may be glued to their respective sections and stained, filled and polished together with the pillar. Assemble the two sections with screws through the support into the shelf. Polish and secure the feet to the base with screws.

IV. EXAMINATION QUESTIONS.

Some of the following questions are taken from Intermediate Examination papers set by the N.S.W. Department of Education.

1. Suitable for First Year.

(A) *Questions on Woodworking Tools.*

1. (a) Classify the tools used in woodworking.
   (b) Name three tools in each group.
2. Name the woodworking tools you would classify under the following headings:—Geometrical, Holding and Supporting, Paring and Shaving Cutting Tools.
3. Classify and briefly describe the uses of the following tools:—Tenon saw, jack plane, trysquare, firmer chisel and marking gauge.

4. Make sketches of two of the following, naming all parts, and state the uses of the tools drawn:—(a) Firmer chisel, (b) jack plane, (c) marking gauge.
5. What is the difference between glass paper and garnet paper? Describe the uses and method of using glass paper.

(B) *Questions on Materials.*

6. (a) Sketch and describe the uses of the following nails:—Jolt head, flat head, panel pin, escutcheon pin.
   (b) What do you understand by dovetail or oblique nailing? Illustrate your answer.
7. (a) What materials are used in the manufacture of nails?
   (b) Why are some nails galvanised? Name and describe the uses of two nails which are galvanised.
8. (a) How do nails obtain their holding power?
   (b) How is the size of nails determined? Give two examples.
   (c) How are nails sold?
9. (a) State how hide glues are prepared for use.
   (b) What precautions would you take when heating and using hide glues?
   (c) State two reasons why glue holds?
10. (a) State the characteristics of hide glues.
    (b) Sketch a glue pot and state its uses.

(C) *Questions on Timber and Timbers.*

11. (a) Make a neat sketch of the cross cection of a tree trunk and name the parts that can be seen in this section.
    (b) What is meant by medullary ray, sapwood, truewood and cambium?
12. (a) Sketch a block of wood and on it show end grain. Indicate by arrows the direction you would plane a face side and a face edge.
    (b) On another sketch show end grain and the direction you would smooth up the surface with glass paper. Describe how the glass paper should be used.
13. Describe fully the distribution, characteristics and uses of two of the following timbers:—Hoop pine, Queensland maple, Pacific maple, silky oak.
14. (a) What do you understand by the term medullary rays?
    (b) Name and describe the characteristics and uses of a timber with distinct medullary rays.
15. (a) What timbers would you use for the following jobs:—Kitchen table, bread board, small polished table, a polished book case?
    (b) State why you would use these timbers for the articles named.

(D) *Questions on Operations, Joints, etc.*

16. Describe fully the steps involved in preparing a piece of timber to 4″ wide by ¾″ thick. What tests would you apply to your work to ensure accuracy?
17. What do you understand by the terms: Planing, shooting, sawing, chamfering? Describe how you would set out and plane a ¼″ through chamfer.
18. Sketch a stopped chamfer and a through trench. Describe how each is set out and produced.
19. (a) Sketch three types of joints which could be used to joint the edges of boards required to make a table top.
    (b) Describe fully how to joint the boards together with a plain glued edge joint.

20. (a) State the uses of the following:—Housed joints, halving joints, dowelled joints, and rubbed glue joint.
    (b) Show by a sketch the setting out of a piece of timber for making the "T" halved joint.
21. (a) Show by sketches the difference between the through and stopped housed joints.
    (b) Describe fully the steps involved in setting out and cutting a stopped trench.
22. Make a workshop drawing of one of the following jobs:—Egg rack or small stool. Describe the procedure in constructing the article drawn.
23. Make a working drawing of a job suitable for turning in a lathe. Describe how you would set it up in the lathe and turn it to shape.
24. Make a table book rack involving the use of housed joints. Insert sizes for making the rack. Describe how you would make the job.
25. Make a freehand working sketch of a small pot stand. Name the timber to be used and set out clearly the steps in making it.

2. Suitable for Second Year.

(A) *Questions on Woodworking Tools.*

1. (a) Name the different types of bench planes with which you are familiar and state their uses.
   (b) Describe how you would sharpen and set a jack plane iron.
2. (a) Name the different kinds of chisels with which you are familiar and state their uses.
   (b) Describe how you would sharpen a firmer chisel.
3. Explain the reasons for having a back iron on each of the three principal bench planes. Name these planes.
4. Name and describe the uses of two curve cutting planes. Describe how you would sharpen a spokeshave cutting iron. (Illustrate your answer.)
5. Name the two groups into which saws may be divided. Describe the following saws and state their special uses:—Rip, cross-cut, panel, tenon, bow.
6. (a) Classify the tools used in woodwork.
   (b) Name and describe five bits.
   (c) Briefly describe how you would sharpen a centre bit.
7. Name the bits most suitable for boring:—
   (a) A shallow hole $1\frac{1}{2}''$ in diameter.
   (b) A deep hole $\frac{1}{2}''$ in diameter bored in end grain.
   (c) A cleanly cut hole of $\frac{1}{2}''$ diameter bored at right angles to the grain of a softwood.
   (d) A hole for a number 8 screw.
   (e) A hole for a nail near the edge of a piece of timber.
8. (a) Name the different boring bits with which you are familiar and state their uses.
   (b) Sketch and state the special uses of the ratchet brace.
9. Name two types of screw-drivers. Sketch one type and show by sketches a good fitting screw-driver.
10. Describe fully how you would sharpen the following:—Firmer chisel, firmer gouge, blade of a wooden spokeshave, a centre bit.

(B) *Questions on Materials, etc.*

11. (a) Name the different kinds of screws with which you are familiar, and state their uses.
    (b) State when you would use screws in preference to nails.
    (c) Show by sketches how you would bore for countersunk screws in softwood and in hardwoods.
12. Make a neat sketch of a countersunk head screw and name its parts. How are screws sold? Name some of the materials used in the manufacture of screws. Why are these used, and why are different finishes applied to screws.
13. (a) Name two different kinds of glues used in woodwork.
    (b) Describe the manufacture of casein glues.
14. (a) State the special uses of casein glue.
    (b) Compare the characteristics of casein glues and hide glues.
15. (a) Briefly describe how casein glues are prepared for use.
    (b) What methods are used for applying casein glues?
    (c) What precautions should be taken when using casein glues?

(C) *Questions of Timber and Timbers.*

16. (a) Briefly describe the structural difference between hardwoods and softwoods.
    (b) Which of the following are pored woods:—Hoop pine, Queensland maple, scented satinwood, cypress pine, spotted gum, Queensland kauri?
    (c) Describe the characteristics and uses of two of the above timbers.
17. (a) What do you understand by the terms: Medullary ray, cambium, pored woods?
    (b) What factors determine the durability and strength of timbers?
18. (a) Define the terms "texture" and "grain."
    (b) In what way do the above terms affect figure in timber?
    (c) Name two close textured woods and two straight grained woods.
19. (a) Name the timbers you would use for the following:—Polished flooring, office furniture, parquetry flooring, mallet heads, axe handles, for building constructions on termite infested areas.
    (b) Give your reasons for the selection of the timber for the particular job.
20. (a) Describe fully the habitat, characteristics and uses of an imported timber.
    (b) In what ways do the following timbers differ:—Tallowwood, cypress pine?

(D) *Questions on Operations, Joints, etc.*

21. (a) Show by sketches the meaning of the following:—Rebate, trench, dowelling, keying.
    (b) How is each produced?
    (c) State their uses.
22. (a) What is the difference between mitring and scribing? Illustrate.
    (b) Describe two methods of strengthening mitred joints.
23. Describe how you would do the following:—
    (a) Square up a piece of rough timber.
    (b) Fit a shelf in a book stand.
    (c) Work a rebate on the edge of a piece of timber.
    (d) Set out the positions for boring holes for dowels when making a dowelled widening joint.
    Illustrate your answers.

24. (a) Name five common types of mortise and tenon joints and state their special uses.
    (b) Describe the steps in setting out and cutting a common mortise and tenon.
25. (a) Sketch the M & T joint that would be suitable for joining the top rail and stile of a door for a small cupboard. Show the members separated and name the different parts of the joint.
    (b) Describe the construction of the joint.
26. (a) Show by sketches the difference between the C M & T and "T" bridle joints.
    (b) Describe the construction of the "T" bridle joint.
27. (a) Make a working sketch of a job suitable for turning in the lathe.
    (b) Briefly describe the turning of the job.
28. (a) Make a workshop drawing of a set of book shelves.
    (b) Name the timber used and set out a cutting list of the material required.
29. (a) Make a neat dimensioned sketch of a table book rack or trough.
    (b) Describe the steps involved in constructing it.
30. (a) Make a detailed drawing of a job, using a mortise and tenon joint.
    (b) Illustrate the details of the joint as it is to be used.
    (c) Describe the construction and finishing of the job.

3. Suitable for Third Year.

(A) *Questions on Woodworking Tools.*

1. (a) Classify the following tools and state their special uses:—Cutting board, sliding bevel, spokeshave, ratchet brace, plough plane.
   (b) Briefly describe the difference between the uses of the sash fillister and side fillister planes.
2. (a) Classify the tools used in woodwork.
   (b) Describe the holding and supporting tools.
3. (a) Name the three groups into which cutting tools may be divided.
   (b) Name the three kinds of planes.
   (c) Name and describe the uses of three special purpose planes.
4. (a) What tools are required for putting a gapped cutting iron into good working order?
   (b) Briefly describe the grinding and sharpening tools.
5. (a) Describe the grinding and sharpening operations for chisels and plane irons.
   (b) Why should water be used on the grindstone?
   (c) What type of oil should be used on oilstones? Why is oil used?
6. (a) Discuss the advantages and disadvantages of emerywheels over grindstones.
   (b) Describe how gouges are sharpened. What tools are required?
7. Describe fully with the aid of sketches the uses and sharpening of a cabinet scraper.
8. Sketch a woodturning lathe and name its parts. Briefly describe the uses of four lathe appliances.
9. (a) Sketch and describe the uses of the following lathe appliances:—Face plate, ball-bearing centre, right-angle tool rest, turning gouge, parting tool.
   (b) Describe with the aid of sketches how you would prepare a piece of stock for turning between centres.

10. What is the difference between scraping and cutting as applied to woodturning? What method should be used for face plate work? Describe the method of preparing and setting up work for face plate turning.

(B) *Questions on Timber and Timbers, etc.*

11. (a) What is shrinkage?
    (b) Describe with the aid of sketches how boards shrink.
12. (a) What is seasoning or drying as applied to timber?
    (b) Describe two methods of seasoning timber.
13. (a) Why is it necessary to season timber?
    (b) What precautions should be taken during the seasoning of timber?
    (c) What factors govern the time taken to season timber?
14. (a) What do you understand by the following terms:—Baulk, plank, batten, boards, scantling?
    (b) What is meant by superface?
    (c) How many superfeet are there in the following list:—3/10′, 10″ x $1\frac{1}{2}$″; 4/8′, 3″ x 3″; 2/12′, 12″ x 1″?
15. (a) What is meant by "rough," "dressed" and "milled" timber?
    (b) How is timber sold?
16. (a) What is the difference between pored woods and non-pored woods?
    (b) Name and describe the characteristics and uses of two pored cabinet woods, and two non-pored woods.
17. (a) What do you understand by the following:—Rays, growth rings, vessels, fibres, texture.
    (b) Describe fully the characteristics of two timbers suitable for heavy constructional work.
18. (a) Name and describe two imported timbers. State their habitat, properties and uses.
    (b) Name the timbers suitable for ladders, bent work, flooring, tool handles.

(C) *Questions on Operations, Joints, etc.*

19. (a) Name two methods of polishing timber.
    (b) Briefly describe the staining, filling and polishing of a tea tray base.
20. (a) What is shellac?
    (b) What is french polish?
    (c) Describe how french polish is applied to the work.
21. (a) What do you understand by the following terms:—Marquetry, parquetry, veneering, inlaying?
    (b) Describe how you would insert an inlay in a tea tray base.
22. (a) Describe how jobs may be ornamented with chisel and gouge cuts.
    (b) Draw the cross-sections of two mouldings suitable for picture frames. Briefly describe how to construct the mouldings.
23. (a) Describe with the aid of sketches the meaning of the following:—Haunch, countersinking, slot screwing, wedging.
    (b) Show by sketches how to bore for countersunk head screws in softwoods and hardwoods.
24. Make a sketch of a common dovetail joint containing three dovetails. Show by a sketch the setting out of the dovetails. What is the average pitch of the sides of the dovetails.

25. (a) Name the common types of dovetailed joints with which you are familiar and state their special uses.
    (b) Sketch and describe the construction of one of them.
26. Make sketches of three methods of joining the corners of a small box to be made of timber 4″ wide by $\frac{3}{8}$″ thick. State which joint you consider to be the best method, giving your reasons.
27. (a) Make a detailed workshop drawing of a job involving the use of a long and short shouldered M & T joint.
    (b) Describe the setting out and cutting of the joint used.
28. (a) Make a workshop drawing of a useful article made of wood, using a common dovetailed joint.
    (b) Set out the steps involved in constructing the job.
    (c) Make up a cutting list of the material required.
29. (a) Make a dimensioned working drawing of a turned table lamp.
    (b) Describe how to set up the lathe for turning the lamp.
    (c) Describe the turning operations required.
    (d) Briefly describe the finishing of the job with stains and polish, etc.
30. (a) Make a workshop drawing (freehand) of a small table, using barefaced M & T joints.
    (b) Describe the setting out and construction of the joints.
    (c) Describe a method of securing the top.

4. Suitable for Fourth Year.

(A) *Questions on Woodworking Tools.*

1. (a) Name the bench saws with which you are familiar. State their uses.
   (b) Briefly describe the operations involved in sharpening cross cutting saws.
2. (a) Describe and state the special uses of the following saws:—Rip, Panel, tenon, bow coping, keyhole.
   (b) Show by sketches the difference between the teeth of the rip and panel saws.
3. Describe with the aid of sketches the difference between the cutting action of saws used for cross cutting and ripping.
4. Describe with the aid of sketches what is meant by the following:—Set on a saw, jointing saws, open and closed handles for saws. Briefly describe how the teeth of cross cutting saws are produced.

(B) *Questions on Materials.*

5. (a) Name and illustrate three types of catches with automatic opening and closing actions.
   (b) Describe how you would fit a ball catch to the door of a small cupboard.
6. (a) Name and sketch three common types of hinges and state their uses.
   (b) Describe how you fit and secure a butt hinge to the lid of a box.
7. (a) What points must be mentioned and kept in mind when ordering fittings?
   (b) Briefly describe how you fit a drawer lock.

(C) *Questions on Timber and Timbers, etc.*

8. (a) What do you understand by the term "conversion of timber?"
   (b) Show by sketches two methods of converting logs.
9. (a) Describe with the aid of sketches what is meant by the following:—Medullary ray, quarter sawn, back sawn, shrinkage.

(b) Name two timbers in each of the following groups:—
  (i) Those with distinct medullary rays.
  (ii) Those with distinct growth rings.
  Show by sketches how boards with the above properties are cut to produce the desired grain markings.

10. (a) What is a defect in timber?
  (b) Show by named sketches five common defects in timber.
  (c) What precautions might be taken to prevent the defects named?
11. (a) What is decay in timber?
  (b) Describe how timber is preserved against decay.
12. Describe two methods commonly used to preserve timber from the attacks of termites and fungi.
13. Name two figured cabinet woods and describe their characteristics and uses. Describe a method of preserving the beauty of the figure of the timbers.

(D) *Questions on Operations, etc.*

14. Briefly describe three methods of finishing interior woodwork.
15. Describe three kinds of stains. Why are stains applied to wood?
16. Describe fully the staining, filling and polishing of a table top.
17. Describe the steps involved in fitting a drawer lock, or fitting a butt hinge.
18. Describe two methods of plugging walls for securing brackets for shelves. What tools are necessary to carry out the job of plugging?
19. (a) Make a working sketch of small door with a grooved-in panel.
  (b) Describe the steps in making the joints between the stiles and rails.
20. (a) Name two methods of veneering.
  (b) Describe fully a method of laying veneers.
21. (a) What is veneering?
  (b) Describe fully how to veneer the top, edges and ends of a small table top.
22. (a) Name and state the uses of six tools used for veneering.
  (b) Show by sketches four different methods of matching veneers.
23. Describe fully the steps in veneering a book end or tea tray base.
24. (a) What is cross-banding?
  (b) What are the advantages of a cross-banded core for veneering?
  (c) Show by a sketch how to joint two edges of a cross-band when laying it by the hammer method of veneering.
25. State the uses of the following as required for veneering:—Flat iron, gummed tape, cauls, veneer pins, veneer hammer and veneer knife. Illustrate your answers.
26. (a) Name the glues used in veneering; state their special properties.
  (b) Describe how you would veneer a drawer front with a centre panel built up of four matching pieces of veneer and surrounded by a veneered border.
27. (a) Show by a sketch how you would set out a working rod for a small table or traymobile.
  (b) Describe the steps in making the article from the working rod.
28. Make a workshop drawing of a turned coffee table and describe fully its construction.
29. Make a pictorial freehand sketch of portion of a table, showing an opening for a drawer. Name all the parts seen and state their uses.

30. Make a workshop drawing of a dovetailed drawer. Name the joints used and the parts of the drawer. Briefly describe the construction of the drawer.

5. Suitable for Fifth Year.

(A) *Questions on Furniture Styles.*

1. In what way does modern furniture design differ from that of English furniture styles of the second half of the 18th century?
2. Name three prominent 18th century furniture designers. Describe the styles of furniture produced by one of them.
3. What do you understand by the terms:—Marquetry, veneering, rococo? Describe the work of Andre-Charles Boulle.
4. Compare and contrast the furniture styles of the Adam and Chippendale Schools of design.
5. Describe the changes in furniture styles in France of about 1800. What name was applied to the new style? Name an English designer whose work was influenced by the new French style.
6. What changes were produced in furniture styles by the accession of William and Mary? Briefly describe the furniture of the late 17th century.

(B) *Questions on Materials, etc.*

7. (a) What is veneer?
   (b) Show by sketches what is meant by side to side, end to end, herring-bone and diamond matching of veneers.
   (c) Describe two methods of manufacturing veneers.
8. State four advantages of veneered constructions over solid constructions. Describe fully how rotary peeled veneers are produced.
9. (a) From what parts of a tree are the following figured veneers obtained:—Butt or stump, crotch and burl?
   (b) Briefly describe how veneers are laid.
10. (a) What is plywood?
    (b) State the advantages of plywood over solid timber.
    (c) State some of the common uses of plywood.
11. (a) Why are veneers dried after peeling or slicing?
    (b) Briefly describe the manufacture of plywood.
    (c) Name and state the special properties of two glues used in plywood making.
12. (a) What is solid core stock? State the uses of solid core stock.
    (b) Briefly describe the making and veneering of a door panel suitable for a small cabinet.
13. (a) What is caul veneering?
    (b) Describe how to veneer the outside face of a curved rail for a circular table.
14. (a) What are fibre boards? Briefly state their uses.
    (b) Describe the manufacture of "Masonite."
15. Describe the manufacture and uses of "Cane-ite."

(C) *Questions on Operations, Joints, etc.*

16. (a) What is furniture?
    (b) What points must be kept in mind when designing furniture?

17. (a) What is the purpose of a workshop drawing?
    (b) Describe three types of drawings which may be used in the workshop.
18. Describe fully the general procedure which might be followed for the construction of most jobs.
19. (a) Set out a working rod (to scale) for a single panelled door with rebated members.
    (b) Describe the construction of the door.
20. (a) What do you understand by the term "working of wood?"
    (b) Describe with the aid of a sketch how a table top may be secured to allow for "working" of the top.
    (c) What type of top could be secured firmly to the rails of the table?
21. Describe two methods of fitting shelves in a cabinet and two methods of fixing table tops. Illustrate your answers.
22. (a) What do you understand by the following terms:—Moulding, carcase, member, plinth, cornice, skirting, architrave?
    (b) Sketch two sections of mouldings suitable for cornices, architraves, picture frames.
23. (a) What are mouldings? Briefly state their origin.
    (b) Name four groups into which mouldings may be divided.
    (c) Sketch and name six basic mouldings.
24. (a) In what way do Grecian mouldings differ from Roman mouldings?
    (b) Sketch the following mouldings:—Cavetto, ovolo, bead, scotia.
25. Make a workshop drawing of veneered box and describe how you would veneer it.
26. (a) Name two methods of veneering.
    (b) Sketch a simple table lamp or clock case suitable for veneering and describe how you would veneer it.
27. (a) Show by a sketch how you would set out a working rod for a small bookcase or cabinet.
    (b) Briefly describe the steps in construction of the job from the rod.
28. (a) State the uses of the woodturning lathe.
    (b) Make a workshop drawing of one of the following:—Turned standard lamp, turned smoker's stand or turned occasional table.
    (c) Describe the turning operations involved when turning the article drawn.
29. Describe the construction of the carcase for a small floor cupboard having a door and a drawer. The details of the door and drawer are not required.
30. State how you would do the following:—
    (a) Select and prepare the core for a veneered table top 2ft. square by $\frac{3}{4}$in. thick.
    (b) Cut and prepare the veneer for veneering the surface in diamond pattern.
    (c) Veneer the surface and edges, and smooth off ready for polishing.
31. Describe how you would veneer a panel with a quartered pattern and a cross banded border.
32. Make a dimensioned sketch (give two elevations) of a bedside cabinet, also sketches of the more important constructional details.

SECTION EIGHT

WOODWORKING MACHINE TOOLS

During recent years the development of small bench and portable woodworking machines has led to increased use of machines in the workshop. Woodworking machines are labour-saving devices which have been developed from hand tools during the last century. In industry they are primarily intended to reduce the use of hand tools to a minimum.

It must be remembered, however, that the operation of machines can be dangerous, especially if careless methods are used, and every care and caution must be exercised in their use. Manufacturers have endeavoured to reduce the danger hazard by inventions and improvements such as self-contained direct motor drive, improved bearings, safer guards, enclosed gears, safety switches and improved cutting tools.

Before attempting to use any machine, it is wise, if not essential, that the operator should know and understand the parts and various adjustments of the machine to ensure its perfect running. In the following notes brief descriptions and common operations are given of the lathe, band saw, jig saw and circular saw. No attempt is made to describe the numerous jigs and attachments which may be made or obtained to assist the operator to carry out more complicated work. The reader is advised to obtain further information from books dealing with woodwork machines.

A. THE WOODTURNING LATHE AND ITS APPLIANCES. Plates 100 and 101.

THE LATHE (fig. 1, plate 100).

USES: For giving circular or rotary motion to parts of the job while being operated on by the various cutting tools to produce cylindrical or moulded shapes.

PARTS: A wood-turning lathe, in the main, consists of the following par

1. **Bed** consists of two pieces of hardwood or cast iron fixed parallel on a convenient stand or base. It supports the Head Stc Tool Rests.

2. **Head Stock** is fixed permanently to the left hand end of up of a set of cone pulleys running on a spindle. The right ha (or mandrel nose) is threaded to take chucks, etc., and is hollc centre for driving the work.

3. **Tail Stock** is a movable centre which may be fixed to t distance from the Head according to the length of the work centres." Its spindle is hollow to take the cup or ball-bear

4. **Tool Rest** is held in a movable bracket which may in the required position between the Head and Tail Stock

5. **Chucks** are appliances for holding the work to be turned, and are threaded to screw onto the spindle nose.

(i) *Prong Chuck or Spur Centre* is fixed to the mandrel or spindle nose and used in conjunction with the Tail Stock centre for "turning between centres," (fig. 1). Such articles as table and chair legs are turned between centres, using the spur centre to drive the work. Fig. 8 illustrates one type of Spur Centre which is tapered to fit into the hollow spindle nose. Fig. 1, No. 13, shows a cup centre fitted into the spindle of the tail stock. This type of centre should be slightly oiled to allow the work to rotate freely. A better type of centre for the tail stock is the ball-bearing centre (fig. 9) (which may be fitted with a cup centre), which will hold the job more firmly with less friction.

(ii) *Cup Chuck* (fig. 6) is a hollow chuck used where turning between centres (or parallel turning) is impossible. The mouth of the cup chuck is slightly tapered so that the end of the job can be driven in and held while turning. The grain of the job is usually parallel to the axis of the chuck. Used for turning small vases, egg cups, drawer and door knobs, etc. (See fig. 18, Use of Cup Chuck.)

(iii) *Screw Chuck* (fig. 7), used for holding small work not "between centres," has a screw point in the centre which is enough to hold small work.

(iv) *Face Plate* (fig. 5) is a flat circular plate which screws on to the mandrel nose. The plate has screw holes drilled in it so that the job can be screwed on for turning. Used for turning work where the grain is at right angles to the axis of the lathe, such as small table tops, bases for stands, plates, fruit bowls, etc. (See fig. 19, plate 101, Use of Face Plate.)

WOOD-TURNING TOOLS.

1. **Turning Gouges**—Fig. 11. These are ground and sharpened on the convex or outside surface with a convex cutting edge. Sizes: $\frac{1}{4}''$ to $1\frac{1}{2}''$. They are used for taking off the rough surface quickly, scraping or cutting, and for turning hollows, etc. (See figs. 20, 21 and 22, plate 101.)

2. **Turning Chisels** (called Skew or Side Chisels)—Fig. 10. These chisels have a skewed cutting edge ground and sharpened on both surfaces. Sizes: $\frac{1}{4}''$ to
1½" Used for taking off the grooves made by the roughing gouge, surfacing
... for cutting beads, etc. The toe or heel of the cutting edge can be
... the positions of hollows and beads, etc., and for squaring ends.
...1 and 22, plate 101.)

—Fig. 12. Usually about $\frac{1}{8}''$ wide at the cutting edge. Chiefly
pieces and marking lengths, etc. (See fig. 24, plate 101.)

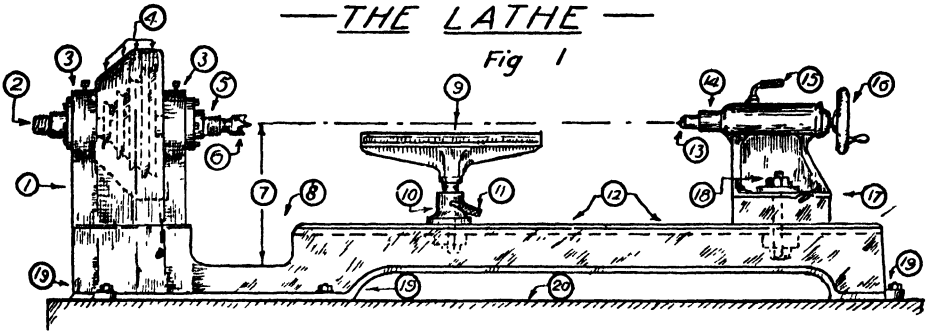
...hisel—Fig. 13. Ground and sharpened on one side only.
...lows, etc., by scraping the wood away, also for hollowing out

...sel—Fig. 14. Ground and sharpened on one side only to
...or scraping beads, squaring ends and surfacing flat surfaces
sometimes called a diamond point chisel.

...sel—Fig. 15. Ground and sharpened on one side only,

— THE LATHE —

Fig 1



1. Headstock (Fixed to bed).
2. Hollow spindle, both ends thread ed to take Face Plates etc.
3. Ball bearings.
4. Four-step pulley beneath guard
5. Spindle or Mandrel Nose, threaded for face plates etc. & Tapered for spur centres etc.
6. Spur centre (Live centre).
7. Half swing or capacity–distance between spindle centre and bed.
8. Gap in bed for large face plate work
9. Tool-rest (12" adjustable)
10. Tool-rest bracket (adjustable)
11. Tool-rest clamp lever
12. Bed.
13. Cup centre (Dead centre)
14. Tailstock spindle morse tapered.
15. Binding lever
16. Spindle feed wheel.
17. Tailstock (adjustable along bed)
18. Tailstock clamping nut & bolt.
19. Bed bolted to bench or stand
20. Bench or lathe stand

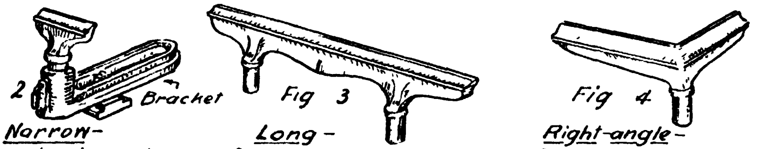


Fig 2 — Narrow – for short work

Fig 3 — Long – for long work

Fig 4 — Right-angle – for face plate work

— TOOL RESTS —

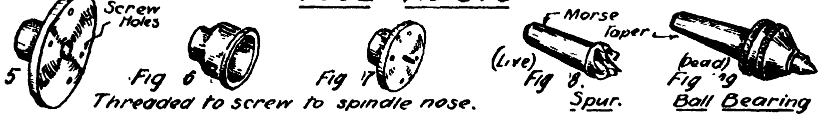


Fig 5 — Face Plate

Fig 6 — Cup Chuck

Fig 7 — Screw Chuck

Threaded to screw to spindle nose.

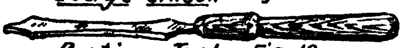
Fig 8. Spur. Fig 9 Ball Bearing — Centres

Skew Chisel Fig 10.

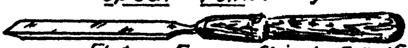
Round Nose. Fig 13

Gouge Chisel. Fig 11

Spear Point. Fig 14



Parting Tool. Fig 12



Flat or Facing Chisel. Fig 15

-WOOD TURNING LATHE & ACCESSORIES-

PLATE 100

similar to an ordinary chisel. Used for scraping cylinders, beads, etc. Particularly useful for surfacing work on the face plate.

7. **Pin Gauges.** These are gauges made for particular jobs where it is necessary to make several pieces alike. The Gauge consists of panel pins driven into a piece of wood (with the heads of the pins filed to points) so as to mark the positions of the various shapes along the job, when the gauge is pushed against the work. Fig. 23 shows the Pin Gauge and its uses. (Plate 101.)

8. **Calipers.** Inside and outside calipers are necessary for checking inside and outside diameters respectively. (See figs. 12 and 13, plate 3, and fig. 17, plate 101.)

9. **Wing Compasses** are necessary for setting out diameters, and can be used for setting out distances on short work. (See fig. 11, plate 3, and fig. 17, plate 101.)

NOTE.—1. When "turning between centres" always put a spot of oil on the point of the tail stock centre or oil the ball-bearing centre to reduce friction.

2. Adjust the tool rest so that it is as close to the work as possible and level with centre of the work for parallel turning, and about $\frac{1}{8}''$ below for face plate work.

WOOD-TURNING OPERATIONS—Plate 101.

There are two methods of reducing the timber to shape when turning:—

1. **Cutting** (see figs. 17 and 20 and fig. 22, Nos. 2 and 4). Cutting is a difficult method for the beginner as it requires a considerable amount of practice, but it produces a smooth surface. The cutting method can only be used when the grain of the work runs in the direction of the centres or the axis of the lathe (i.e., parallel to the bed of the lathe). Cutting does not require much finishing with glass paper.

2. **Scraping** (see fig. 21 and fig. 22, Nos. 3 and 5) is a simple method for removing the waste. When the grain of the work runs across the axis of the lathe, as is usual when working with the face plate, the work is scraped and the chisel is held horizontal and pushed into the job. The surface produced requires a fair amount of papering. Gouges cannot be used for face plate work when turning hollows, etc., the round nose chisels must be used.

IMPORTANT.—It is impossible to expect good work if the cutting tools are at all dull; they must be kept sharp all the time. One of the chief faults of the beginner is to keep the cutting tool held on the job too long; this overheats the tool and softens the cutting edge. Stop cutting for a second or two frequently to allow the cutting tool to cool off. (See plate 101A—Grinding Angles for Lathe Tools.)

SPEED OF LATHE. Stock up to 3″ diameter can be run at 3,000 r.p.m., which is about the highest speed of a four-speed lathe; up to 6″ diameter about 2,000 r.p.m. (second speed); over 6″ diameter slower; and for papering and polishing the slowest speed possible. NOTE: Run square stock at a low speed until it is rounded off and running true before using a high speed. This reduces the danger of the work being thrown out of the lathe due to vibration.

The speed may be calculated using the following formula:—Revolutions of motor x diameter of motor pulley=revolutions of spindle x diameter of spindle pulley. *Example*:—Calculate speed of lathe spindle. Motor 1,740 r.p.m., diam. of motor pulley 4″, diam. of spindle pulley 2″.

Speed of spindle = r.p.m. of motor x diam. of motor pulley ÷ diam. of spindle pulley.

$$= 1740 \times 4 \div 2$$
$$= 3480 \text{ r.p.m.}$$

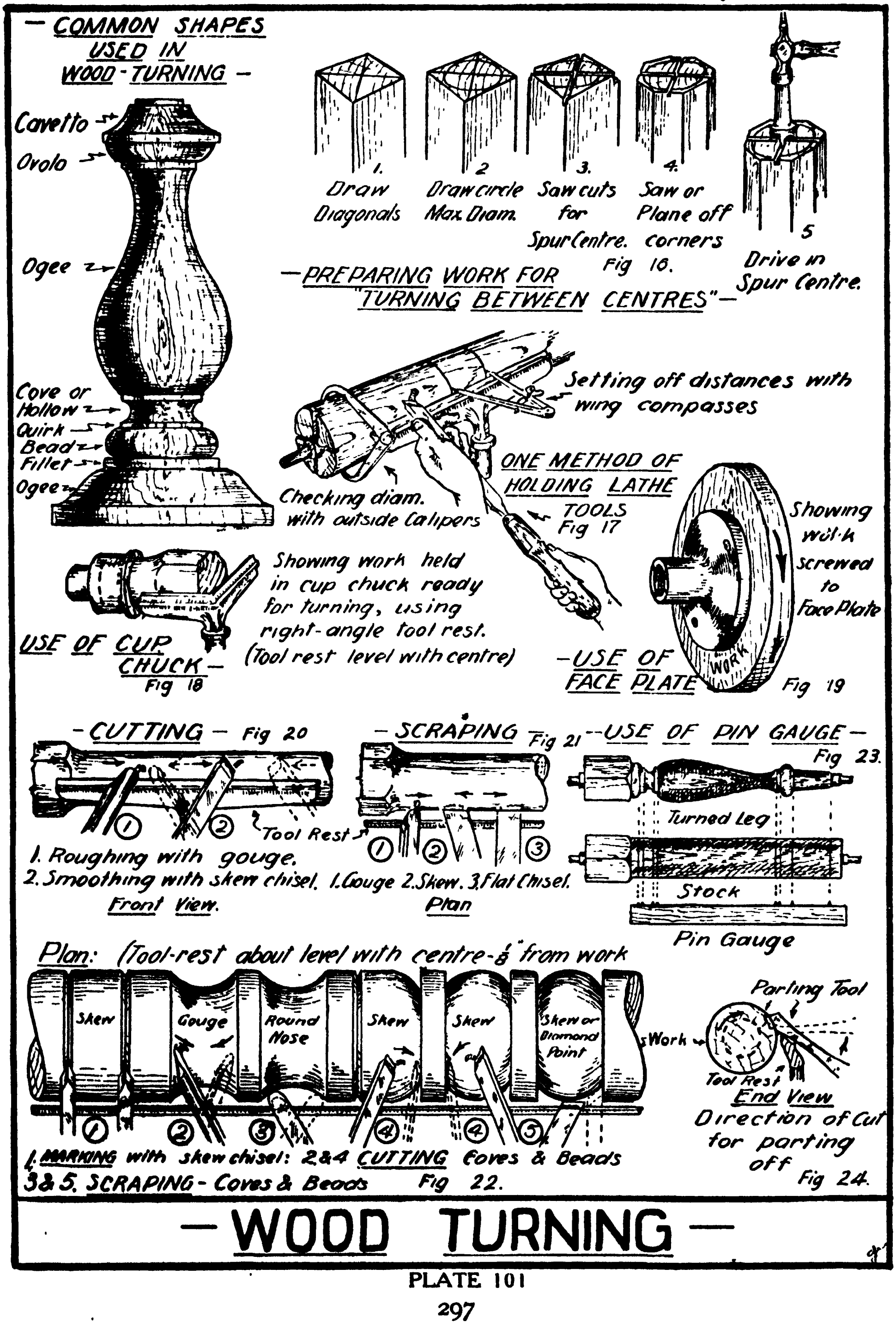

— COMMON SHAPES USED IN WOOD-TURNING —
Cavetto
Ovolo
Ogee
Cove or Hollow
Quirk
Bead
Fillet
Ogee
1. Draw Diagonals
2 Draw circle Max. Diam.
3. Saw cuts for Spur Centre.
4. Saw or Plane off corners
Fig 16.
5 Drive in Spur Centre.
—PREPARING WORK FOR "TURNING BETWEEN CENTRES"—
Setting off distances with wing compasses
Checking diam. with outside Calipers
ONE METHOD OF HOLDING LATHE TOOLS Fig 17
Showing work held in cup chuck ready for turning, using right-angle tool rest. (Tool rest level with centre)
USE OF CUP CHUCK— Fig 18
Showing work screwed to Face Plate
WORK
—USE OF FACE PLATE
Fig 19
-CUTTING — Fig 20
Tool Rest
1. Roughing with gouge.
2. Smoothing with skew chisel.
Front View.
-SCRAPING Fig 21
1. Gouge 2. Skew. 3. Flat Chisel.
Plan
--USE OF PIN GAUGE— Fig 23.
Turned Leg
Stock
Pin Gauge
Plan: (Tool-rest about level with centre-⅛" from work
Skew
Gouge
Round Nose
Skew
Skew
Skew or Diamond Point
Work
1. MARKING with skew chisel: 2&4 CUTTING Coves & Beads
3&5. SCRAPING - Coves & Beads Fig 22.
Parting Tool
Tool Rest
End View
Direction of Cut for parting off Fig 24.
—WOOD TURNING—

PLATE 101

Fig. 16 shows a method of preparing the work for turning between centres; a similar setting out is necessary to centre the work on the tail stock centre.

Fig. 17 illustrates a method of holding the lathe tools for cutting and scraping. Another method is to hold the tool down on the tool rest, with the palm of the left hand over the top of the cutting tool.

Fig. 24 shows an end view of the job and the method of using the parting tool for cutting off. The handle of the parting tool is lifted as the parting off proceeds.

Polishing Turned Work.—Stain, and fill the grain, then polish with a polishing rubber while the job is turning at a slow speed.

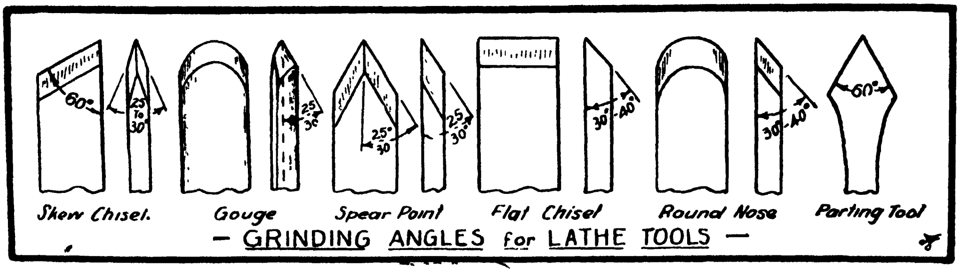


PLATE 101A

QUESTIONS.

1. Name and describe three cutting tools used in conjunction with the lathe.
2. What do you understand by "turning between centres?"
3. What is the use of the Spur Centre?
4. Describe the uses of (a) Face Plate, (b) Ball-bearing Centre. Where are each fitted on the lathe?
5. What use are calipers put to in wood turning?
6. Briefly describe the difference between "cutting" and "scraping" as applied to wood turning.
7. Show by sketches a method adopted for preparing work for "turning between centres."
8. What is a "pin gauge" and when is it advisable to use one?
9. Show by a sketch the common shapes or mouldings used in wood turning.
10. Why is it necessary to use a spot of oil or grease on the "dead centre"?

B. THE BAND SAW. Fig. 25, Plate 102.

A band saw using narrow blades for curve cutting is often referred to as a Band Scroll Saw.

USES: The band saw is used extensively by chair and cabinet makers, pattern makers, brush manufacturers, wheelwrights, motor body and carriage builders and boat builders for cutting curves, some straight cutting and, to a lesser extent, joint construction. Half-lap joints, tenons, bridle joints, mitre joints and the tails of dovetailed joints may be sawn on the band saw.

Band saws for cutting wood are referred to as high speed saws; some of these are

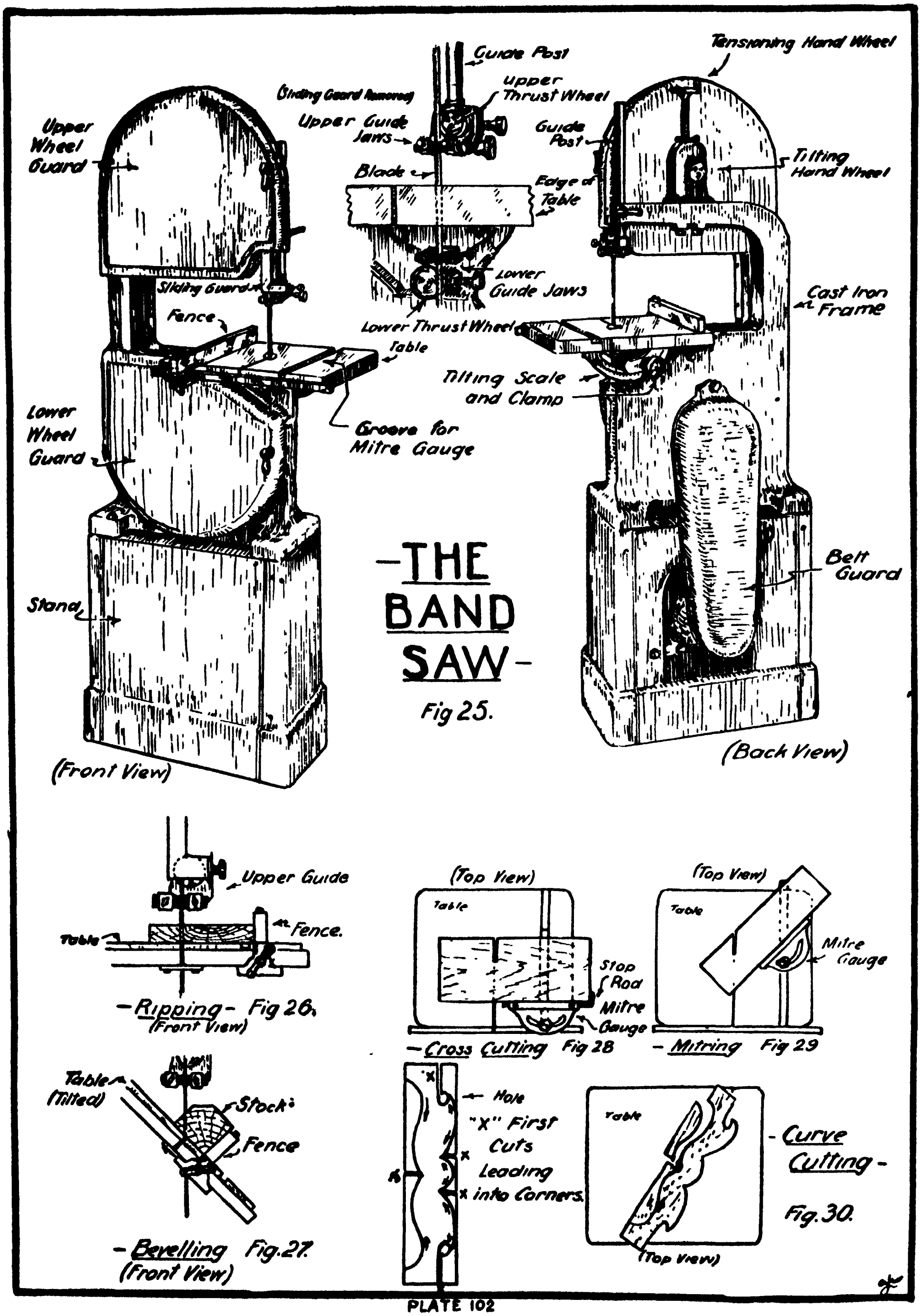

-THE BAND SAW-
Fig 25.
Upper Wheel Guard
Sliding Guard
Fence
Table
Lower Wheel Guard
Groove for Mitre Gauge
Stand
(Front View)
Guide Post
(Sliding Guard Removed)
Upper Thrust Wheel
Upper Guide Jaws
Blade
Edge of Table
Lower Guide Jaws
Lower Thrust Wheel
Tensioning Hand Wheel
Guide Post
Tilting Hand Wheel
Cast Iron Frame
Tilting Scale and Clamp
Belt Guard
(Back View)
Upper Guide
Table
Fence.
-Ripping- Fig 26.
(Front View)
Table (Tilted)
Stock
Fence
-Bevelling Fig.27.
(Front View)
(Top View)
Table
Stop Rod
Mitre Gauge
-Cross Cutting Fig 28
(Top View)
Table
Mitre Gauge
-Mitring Fig 29
Hole
"X" First Cuts Leading into Corners.
Table
(Top View)
-Curve Cutting-
Fig.30.

PLATE 102

provided with 'back gears,' which reduce the speed of the machine and can be used with special metal cutting blades for sawing metals.

CONSTRUCTION AND PARTS. Briefly the band saw consists of an endless, flexible saw blade running over two vertical wheels, one above the other. A table is provided between the wheels to support the work while sawing. All the parts are mounted and supported on a cast iron frame. Power is usually supplied by an electric motor, $\frac{1}{8}$ to $\frac{1}{2}$ h.p. See fig. 25, plate 102

1. **The Frame.** The frame on which all the parts of the band saw are mounted is usually made of cast iron and cast in one piece. It must be strong and rigid and firmly fixed on a stand or to the floor, so that vibration is reduced to a minimum. The height of the table should be about "elbow height."

2. **The Wheels or Pulleys,** which run on ball bearings, should be suitably covered with strong guards. Each wheel is fitted with a rubber tyre or band (ground slightly convex) to preserve the set on the saw teeth and provide friction for driving the blade.

The *lower wheel* is the driving wheel and not adjustable. It is driven by an individual electric motor. The motor may be connected direct to the wheel shaft or coupled by means of a belt and pulleys.

The *upper wheel* or pulley is adjustable. This pulley is carried on an adjustable slide which allows it to be raised or lowered vertically to provide tension to the saw blade and to enable new blades or rebrazed broken saws to be fitted. It can also be tilted backward or forward so that the "tracking" of the saw blade can be adjusted, i.e., the blade can be made to run near the edges or on the centre of the rims to give uniform wear to the tyres. The whole upper wheel mechanism is supported on a cushion spring to absorb shocks in starting and sawing, and to allow for expansion and contraction of the saw blade, thus reducing breakages.

3. **The Tilting or Canting Table** is usually heavily ribbed for strength and carefully machined. It can be tilted and locked at any angle to 45° in one direction and 5° to 10° in the other. A scale and pointer beneath the table shows the exact degree of the tilt. The height of the table should be from 39″ to 42″ above the floor. A soft aluminium throat or insert is usually fitted where the saw passes through the table; this prevents damage to the teeth of the saw in case of breakages. Generally a ripping fence and a mitre gauge is provided to assist accurate ripping and cross cutting, the mitre gauge sliding in a groove machined in the table.

4. **Band Saw Blades.** The *width* of band saw blades used for curved cutting range from $\frac{1}{8}''$ to $1\frac{1}{2}''$, common sizes being $\frac{1}{8}''$ to $\frac{3}{4}''$ wide. The radius of curvature of the cut depends upon the width of the blade and the set on the teeth, e.g., an $\frac{1}{8}''$ saw will cut a curve of $\frac{1}{2}''$ radius and a $\frac{3}{4}''$ blade about 5″ radius. The *thickness or gauge* of the blade depends upon the diameter of the wheels of the machine and to a certain extent on the width of the blade. Saw blades used on 10″ diameter pulleys should be of thinner gauge than those used on larger pulleys. An allowance of about .001″ for each inch in the diameter of the pulley may be used as a guide for determining the thickness of the saw. A band saw with pulleys 14″ diameter should use blades of about No. 25 to No. 28 Birmingham Wire Gauge. Two types of blades are available, "plain" and "bevel back." The latter is thinner on the back edge and gives more clearance for fine curve cutting. The *teeth* are of the rip saw type, filed square across

and having about 5° to 15° hook, and from .001″ to .010″ set. The number of teeth per inch depends to a certain extent upon the width of the blade, ranging from 6-7 teeth per inch for $\frac{1}{8}''$ blades to 3-5 for $\frac{3}{4}''$ blades.

The *speed* of the saw should be about 2,500 to 3,000 feet per minute, calculated by multiplying the circumference of the pulley in feet by its revolutions per minute.

The *tension* of the saw blade is largely a matter of experience, unless the machine is provided with a tension gauge. Wide blades will take more tension than narrow ones. The blade should be drawn tight without straining.

5. The Saw Guides. Two guides are provided to keep the saw running true, one above the table, the other below. The *upper guide* is fixed to a sliding *guide post,* which can be adjusted according to the thickness of the stock being sawn. Each guide consists of two steel or bronze blocks or *jaws,* which prevent the blade wobbling or twisting in the cut, and a ball-bearing *thrust wheel* behind the jaws to support the back of the blade while sawing. The jaws should be adjusted to allow enough space for the blade to run freely without actually rubbing them. The front edges of the jaws should be level with the gullets of the saw teeth. The blade should just clear the guide wheels when not sawing. The upper guide is adjusted by means of the guide post so that it is about $\frac{1}{8}''$ to $\frac{1}{4}''$ above the work being sawn.

THE SIZE OF BAND SAW MACHINES is determined by the diameter of the wheels or pulleys, e.g., a 14″ band saw has 14″ diameter pulleys.

FITTING A BAND SAW BLADE. (1) Open up guide jaws. (2) Slide guide wheels back. (3) Place saw on pulleys, apply tension and check tracking by revolving the wheels by hand. (4) Adjust the guide jaws, allowing slight clearance. (5) Move jaws until front edges are level with gullets of teeth. (6) Move guide wheels forward until they are within 1/64″ of the back of the blade. (7) Revolve the saw by hand and check all settings. (8) Make sure all guards are in place and properly secured.

BAND SAWING OPERATIONS.

NOTE: Before using the saw always check all adjustments and settings and guards. See that the upper guide is just a little above the work. While sawing, stand in front of the saw and not at the side. Keep the floor clear of scraps to ensure a firm footing. Don't wear loose clothing or loose sleeves which may become caught in the machine.

1. **Ripping and Re-sawing.** Ripping refers to cutting a board narrower in width. Re-sawing is a term applied to the cutting of the board along its width, while standing on edge, to make it thinner. These operations may be carried out using the ripping fence as a guide. For re-sawing a wide board, auxiliary cuts made on both edges with the circular saw will ensure straighter cutting. It is advisable to use a wide blade with large teeth for ripping operations, and it should be in perfect order and properly tracking over the wheels. When ripping oblique cuts, such as bevels and large chamfers, using the fence with the table tilted, place the fence on the lower side of the saw. This method can be used for removing the corners of square stock in preparation for turning on the lathe. See figs. 26 and 27.

2. **Cross Cutting.** This operation may be carried out using the mitre gauge to support the work. Some mitre gauges are provided with stop rods, which may be

adjusted to facilitate the cutting of a number of pieces to the same length. For a number of short lengths, e.g., dowels, the mitre gauge may be used in conjunction with the fence. Mitres across the width of the stock are cut with the gauge set to the required angle. Mitres and bevels across the thickness of the material may be cut after tilting the table. See figs 28 and 29.

3. **Curve Cutting.** Use a blade suitable for the smallest curve. Always feed the work slowly and evenly, keeping the line advancing straight towards the edge of the saw. Saw as close to the line as possible without cutting it away, thus reducing the amount of hand finishing afterwards. The saw should not be backed out of a curved cut, as there is a danger of pulling the blade off the wheels. It is sometimes an advantage to make a series of leading straight cuts into the line of a sharp curve to enable the waste pieces to come away as the cutting of the curve progresses. Where two curves meet to form a corner, a straight cut from the edge of the work should be made into the corner prior to cutting the curve. Fig. 30.

4. **Cutting Circles.** Circles may be cut freehand in the same manner as when cutting curves. If a number of similar circular discs are required, a jig may be used. Numerous types of jigs may be made for this purpose. They consist of a pivot point, fixed at the required radius at right angles to the blade, on which the work is revolved while the circle is sawn.

QUESTIONS.

1. Name the main parts of a band saw.
2. Describe how to fit a new band saw blade.
3. Describe the uses of the ripping fence and mitre gauge.
4. How is the size of the band saw determined?
5. What do you understand by the terms "ripping" and "re-sawing" on a band saw?

C. THE JIG SAW, sometimes called a Scroll Saw. Fig.31, Plate 103.

USES: The jig or scroll saw is used by woodworkers, sign makers, printers, etc., for sawing all kinds of interior and exterior curves in wood, plastics, veneers or metals. Its narrow blade enables the cutting of very sharp curves. Special sanding attachments and files may be used in the jig saw for smoothing the edges of the work.

CONSTRUCTION AND PARTS. Bench jig saws generally consist of a cast iron base or bed, to which a cast iron horizontal "gooseneck" arm is bolted. A table is provided between the arm and the base to support the work. The saw blade is held in a chuck on the driving mechanism which is mounted on the base below the table. When in use the blade moves up and down through a hole in the table and cuts the work on the downward stroke. Power is usually supplied by an electric motor ($\frac{1}{4}$ to $\frac{1}{8}$ h.p.) with a belt and cone pulleys.

1. **The Frame** consists of a strong base and an arm made of cast iron. The motor, the driving mechanism (which transmits the reciprocating motion to the blade) and the table are secured to the base. The arm is fixed to the frame by means of a bolt or screw. It may be removed or swung to the side, if required, when sawing large work. The upper guide head is attached to the end of the arm.

2. **The Driving Mechanism** consists of an electric motor (about 1,730 r.p.m.)

coupled to a cranking device by a belt and cone pulleys to provide four speeds ranging from about 600 to 1750 r.p.m. The cranking device converts the circular movements of the pulleys to the reciprocating motion required by the lower guide head which holds the blade.

3. **The Lower Guide Head** is beneath the table and consists of a plunger which works up and down, carrying a chuck or vice into which the saw blade is clamped.

4. **The Upper Guide Head** is used to support and guide narrow thin blades. It consists of a plunger attached to a coil spring enclosed in a tube. The whole mechanism may be raised or lowered to accommodate blades of different lengths. The purpose of the spring is to provide constant tension to thin saw blades. The plunger may also act as a pump to provide a stream of air to blow the sawdust away from the work.

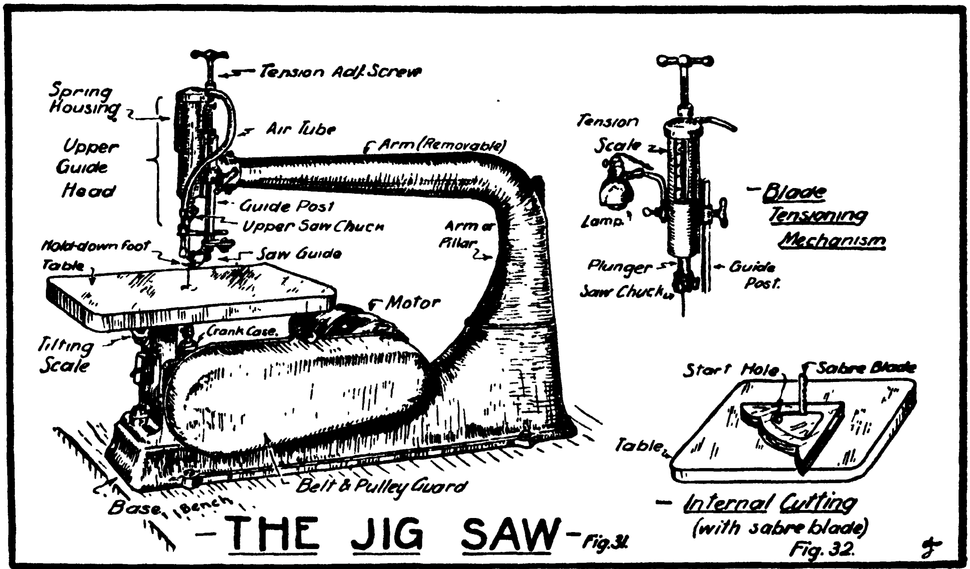


PLATE 103.

5. **The Saw Guide** is attached to a guide post which is adjustable vertically for different thicknesses of material. Various types of guides are used, their purpose being to prevent lateral movement of the saw blade and support the back of the blade while cutting. A spring "hold down" foot is usually secured beneath the guide to hold down the work and prevent it being lifted on the upward stroke of the saw blade.

6. **The Table** is mounted on the base of the machine. It can be tilted and locked at any angle to 45° on the right or left of the blade when required for bevel cutting.

7. **Jig Saw Blades** are fitted in the machine so that the teeth cut on the downward stroke. Blades vary in length, width, thickness and number of teeth per inch. Width and thickness are usually stated in decimals of an inch, e.g., (i) fine blades for

cutting quick curves in veneers and plywood—.045″ wide, .010 thick with 20 teeth per inch; (ii) for general purpose sawing—.110″ wide x .020″ thick with 10 to 15 teeth per inch; (iii) for thick stock—.187″ to .312″ wide x .040″ thick with 8 to 10 teeth per inch. Narrow blades, sometimes called "jeweller's blades," used for cutting sharp curves, are held in both upper and lower chucks—tension to the blade being necessary. Wide blades, known as "saber blades," used for straight cutting and slow curves, may be gripped in the lower chuck only, the blade itself being stiff enough without extra tension.

THE SIZE OF JIG SAW MACHINES is usually determined by the size of the throat opening, i.e., the distance between the blade and the front edge of the arm support. The depth of cut possible on the saw is also often stated. A 24″ jig saw is 24″ from the blade to the front of the support for the arm and will cut up to about 2½″ stock using 6″ blades.

FITTING JIG SAW BLADES. Narrow blades, which are gripped in both chucks, should be securely clamped in the chucks, and the upper guide head raised until the blade is under tension. Narrow blades require greater tension than wide blades. NOTE: The blade is inserted in the machine so that it cuts on the downward stroke. The saw guides are then carefully adjusted. Use a side guide suitable to the thickness of the blade. The back support should be adjusted so that the blade just clears it when not sawing. Saber blades should be carefully secured in the lower chuck so that the blade is vertical. This may be checked with a trysquare, and when vertical, adjust the guides as above.

JIG SAWING OPERATIONS. The jig saw is used in much the same way as the band saw. Adjust the hold-down foot so that it lightly bears on the surface of the work and saw, close to the line on the waste side, keeping the line advancing straight towards the saw blade.

1. **Straight Cutting.** It is advisable, though not essential, to use a wide blade (especially when cutting thick stock) to ensure a straight cut.

2. **Curve Cutting.** External curves are cut following the same procedure as for the band saw. Internal cuts for pierced work are made by first boring a small hole through the waste close to the line, then passing the blade through the hole, cutting as close to the line as possible. Fig. 32. NOTE: If jeweller's blades are used it will be necessary to re-clamp them in the upper chuck after passing through the start hole. When the work has both internal and external curves, it is advisable to saw the internal curves first. When sawing veneers for marquetry and inlay designs, use a very fine blade and the slowest speed of the machine; saw as carefully as possible. If several veneers are being cut they should be pinned together with pieces of plywood above and below the veneers.

QUESTIONS.

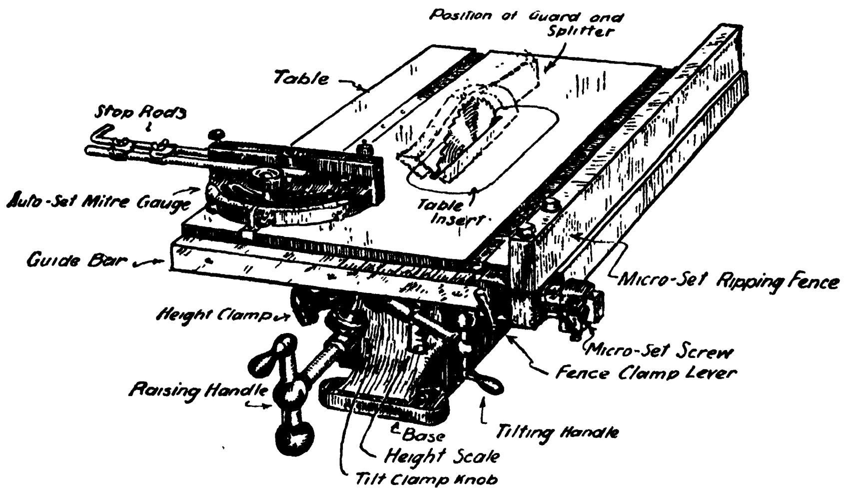
1. State the uses of the jig saw.
2. Briefly describe how a jig saw works. Sketch a jig saw and name its parts.
3. Describe the types of jig saw blades and their uses.
4. Describe how you would cut the figure eight from ½″ plywood.
5. What adjustments are necessary when fitting and using jig saw blades?

D. THE CIRCULAR SAW. Fig. 33, Plate 104.

USES: The circular saw is possibly the most useful of all the woodworking machines. It can be used for cross cutting, ripping, mitring, bevelling, chamfering, grooving and trenching. Some saws may have moulding heads and special cutters fitted for producing small shaped mouldings.

CONSTRUCTION AND PARTS. There are many varieties and sizes for circular saws, ranging from small bench circular saws to large heavy industrial machines. In brief, they all consist of a heavy cast-iron frame or base which supports (i) the saw arbor or spindle (which carries the circular blade); (ii) the table or bench (which holds the ripping fence and cross cutting mitre gauge); (iii) the electric motor (which provides the power for driving the blade).

NOTE: In general there are two ways of adjusting circular saws. (i) *Adjusting depth of cut.* Depending on the type of machine, either the saw blade itself may be raised or lowered, or the table may be raised or lowered. (ii) *Tilting for bevel cutting.* Again this adjustment depends on the make of saw, the saw arbor may be tilted, leaving the table horizontal, or the table may be tilted to the desired angle.



-THE CIRCULAR SAW- Fig. 33

PLATE 104

In the following notes the rising and tilting table type of bench circular saw is described. The average bench saw in small workshops takes up to 10″ blades.

1. **The Base** consists of a heavy casting which may extend to the floor or be mounted on a strong steel stand or mounted on a work bench. The saw arbor, adjustable table and motor are mounted on the base.

2. **The Saw Arbor** runs on ball bearings attached to the base. It may be coupled directly to an electric motor or indirectly by a belt and pulleys. A $\frac{3}{4}$ h.p. to 1 h.p.

motor should be used giving 7,000 to 10,000 feet per minute to the saw teeth when using saw blades of 10″ diameter. NOTE: The speed depends upon the make of saw blade, as blades are tensioned to run at certain speeds. The saw blade is held between two collars which are clamped together on the end of the arbor by means of a nut with a left hand thread.

3. **The Table or Saw Bench** is mounted above the base and carried on trunnions which enable it to be tilted and clamped at any angle to 45° for bevel sawing. A scale is provided beneath the table to indicate the degree of tilt. The table may also be raised or lowered to adjust depth of cut when sawing different thicknesses of stock or when grooving and rebating, etc. A removable throat plate on the side of the slot for the saw blade permits changing of saw blades and use of thick grooving blades and moulding heads.

4. **The Mitre Gauge** is used to guide and hold work when cross cutting and mitring. The gauge slides in grooves or ways machined in the table on each side of a saw. The stop of the gauge can be adjusted to cut angles from 30° to 135°. Stop rods can sometimes be fitted to the gauge to assist in cutting a number of pieces to the same length.

5. **The Ripping Gauge or Fence** can be clamped on either side of the saw. It is generally used on the right hand side. The ripping fence is used for guiding the stock when ripping boards lengthwise to the required width, and when grooving, rebating, bevelling, and chamfering. NOTE: The fence should be checked occasionally to see that it is exactly parallel with saw blade. On some saws the fence itself can be tilted to enable bevel cutting without having to adjust the table of saw. When the fence is used on a tilted table clamp it on the lower side of the saw.

6. **The Saw or Safety Guard and Splitter.** These are provided with all saws and should be adjusted and used whenever possible to prevent accidental contact with the saw blade. The splitter is fixed immediately behind the guard; its purpose is to keep the saw cut open and prevent the work binding on the sides of the blade. The splitter is sometimes provided with anti-kick-back pawls or fingers to prevent the work being thrown back towards the operator.

7. **Saw Blades.** Although many types of blades are available for specialised sawing, three types of blades are usually sufficient for general work: (i) the rip-saw, (ii) the crosscut and (iii) the mitre saw. The first two saws have teeth (which are set and filed) similar in shape to those of the corresponding hand saws. The mitre saw has both crosscut and ripsaw teeth which are not set; instead the blade is hollow ground, being thinner at the centre than at the edge. It can be used for both ripping and crosscutting. Another type of blade in common use is the combination blade which can be used for general sawing, ripping or crosscutting. Its teeth are similar to the rip saw, differing to the extent that they are slightly bevelled on the back to produce points which will sever the fibres when cross cutting.

Blades used for grooving and trenching are usually obtainable in sets of six blades, called "dado heads." The set consists of two circular saw blades each $\frac{1}{8}$″ thick and four inside chisel-like cutters, one $\frac{1}{4}$″ thick, two $\frac{1}{8}$″ thick and one 1/16″ thick. These may be set up to cut grooves from $\frac{1}{8}$″ to 13/16″ wide. Fig 41.

THE SIZE OF CIRCULAR SAWS is based on the largest diameter blade which can be used in the saw.

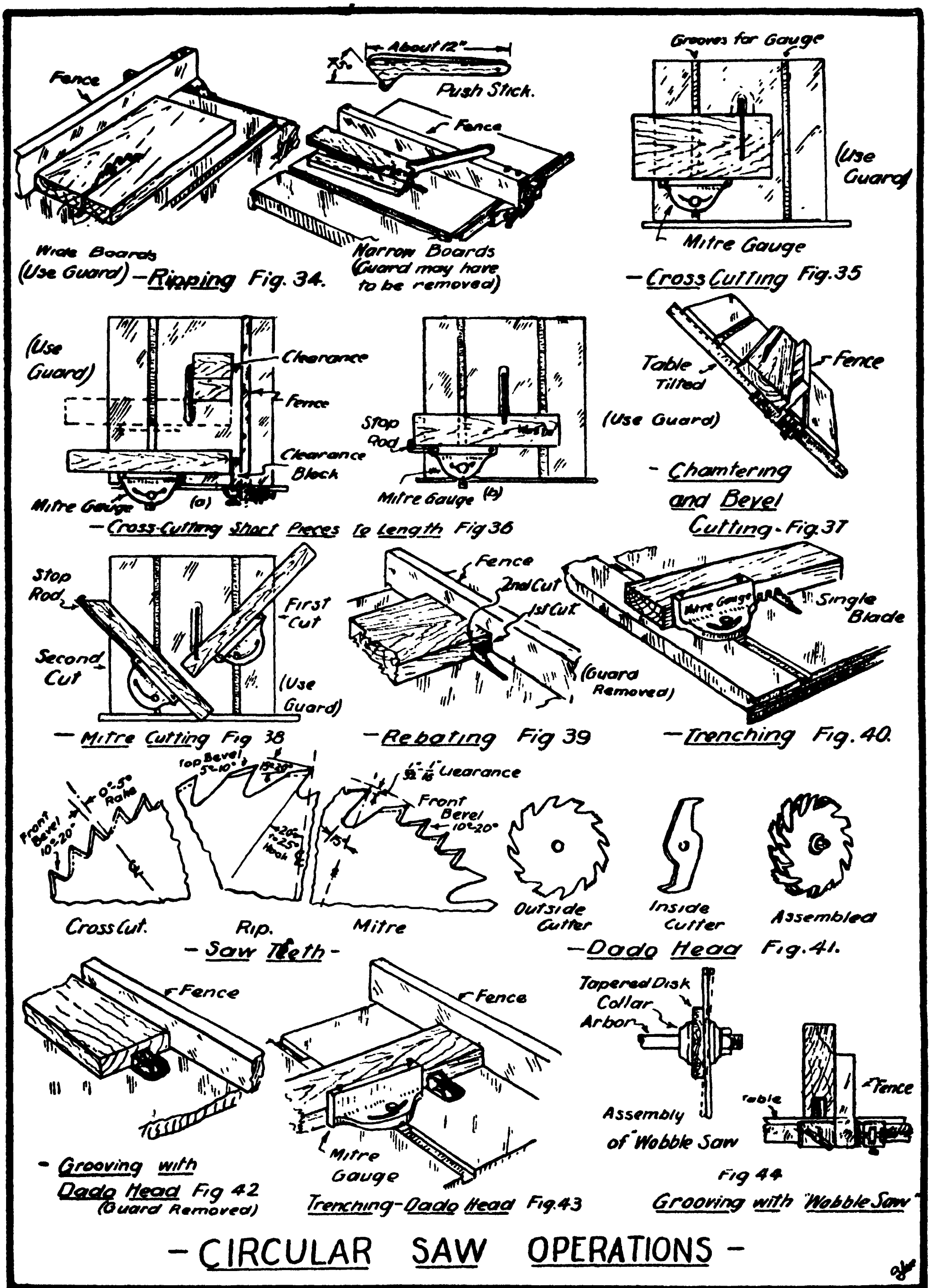

Fence
About 12"
Push Stick.
Fence
Wide Boards (Use Guard)
Narrow Boards (Guard may have to be removed)
— Ripping Fig. 34.
Grooves for Gauge
(Use Guard)
Mitre Gauge
— Cross Cutting Fig. 35
(Use Guard)
Clearance
Fence
Clearance Block
Mitre Gauge (a)
Stop Rod
Mitre Gauge (b)
— Cross-Cutting Short Pieces to Length Fig 36
Table Tilted
Fence
(Use Guard)
- Chamfering and Bevel Cutting. Fig. 37
Stop Rod
First Cut
Second Cut
(Use Guard)
— Mitre Cutting Fig 38
Fence
2nd Cut
1st Cut
(Guard Removed)
— Rebating Fig 39
Mitre Gauge
Single Blade
— Trenching Fig. 40.
Front Bevel 10°-20°
0°-5° Rake
Top Bevel 5°-10°
20°-25° Hook
Clearance
Front Bevel 10°-20°
Cross Cut.
Rip.
Mitre
- Saw Teeth -
Outside Cutter
Inside Cutter
Assembled
— Dado Head Fig. 41.
Fence
- Grooving with Dado Head Fig 42 (Guard Removed)
Fence
Mitre Gauge
Trenching - Dado Head Fig. 43
Tapered Disk
Collar
Arbor
Assembly of Wobble Saw
Table
Fence
Fig 44
Grooving with "Wobble Saw"
- CIRCULAR SAW OPERATIONS -

PLATE 105

SAFETY RULES.

1. See that the blade is properly fitted and tightened to the arbor.
2. Make any adjustments and see that all screws and clamps are properly tightened before switching on.
3. Adjust the blade so that it projects about $\frac{1}{4}''$ above the stock being sawn and see that it runs free before switching on.
4. Make sure the guard and splitter are firmly secured in the correct position.
5. Only use saws which are properly sharpened and set.
6. Keep your clothing tidy, sleeves rolled up, tie tucked in, your apron or coat securely done up, and never lean or reach over the saw blade.
7. Keep the floor and table clear of scraps so that there is no danger of slipping.
8. Never stand directly in line with the blade; stand slightly to one side so that should there be any "kick-back" there is less danger of being struck, and don't allow anyone else to stand in line with the saw while you are operating it.
9. Always use flat stock for sawing. See that the stock has one straight edge which can be supported against either the ripping fence or the mitre gauge. Never saw "freehand," i.e., without the fence or gauge.
10. Don't use the fence as a stop when cross cutting unless a clearance block is fixed on the near end of the fence and the mitre gauge is used to support the stock. See (a) Fig. 36.
11. Use a forked push stick when ripping narrow pieces, say pieces less than two inches wide.

CIRCULAR SAW OPERATIONS. There are numerous attachments or jigs which may be obtained or made to assist the worker to carry out many complicated operations. The list of operations below may be successfully carried out, using the standard equipment usually supplied with the machine.

1. **Ripping** is the operation of cutting the timber lengthwise along the grain, using the ripping fence as a guide. Fig 34. Set the fence at the required distance away from the blade and raise or lower the table so that the blade (a rip saw or combination saw) projects about $\frac{1}{4}''$ above the surface of the stock. The fence is usually fixed on the right hand side of the saw. See that the guard and splitter are in place. Keeping the stock pressed against the fence, slowly push it with an even pressure through the saw. If narrow boards are being ripped, either saw halfway through from both ends by reversing the work (keep the same edge against the fence), or use a forked pusher stick to push the final end past the saw. When "re-sawing," i.e., ripping a board along its width to make two thin boards, adjust the table so that the saw blade is projecting above the table a little more than half the width of the stock. Make two cuts, reversing the work for the second cut, and make sure that the same side is pressed against the fence. If the stock is too wide to be cut completely through with the two cuts, the remainder of the cut may be finished with a hand rip saw or on the band saw.

2. **Cross-cutting.** Set the blade so that it projects about $\frac{1}{4}''$ above the stock. Remove the fence and use the mitre gauge to support and push the work through the saw. Use a cross cut saw blade, a mitre saw or a combination saw. **(Fig. 35.)** For wide boards, the mitre gauge may be reversed and the board pushed against the gauge. A number of pieces may be cut to the same length, using the mitre

gauge in conjunction with the ripping fence to which a small block has been attached. The fence plus the block is set at the required distance from the saw and the work supported in the gauge with its end against the block. Immediately the gauge and the work is pushed towards the saw, the end becomes free and when cut off, is clear of the fence and will not kick-back. (Fig. 36.)

3. **Chamfer and Bevel Sawing.** Tilt the table at the desired angle and use the fence on the lower side of the saw when ripping. When cutting an end bevel, the mitre gauge is used to support the work. (Fig. 37.) The gauge is usually placed on the lower side of the blade.

4. **Mitre Cutting** is carried out with the table horizontal and using the mitre gauge set at the required angle. The work must be held very firmly to prevent the saw creeping away from the line and spoiling the desired angle. (Fig. 38.)

5. **Rebating** is carried out using the ripping fence and with the table adjusted to the required depth of cut. Two cuts and two settings are required to remove the waste to form the rebate. The guard has to be removed for this operation. (Fig. 39.)

6. **Grooving** may be done using a ripping blade and making several cuts until the required width of groove is produced. Or a "dado head" may be fitted to cut the required groove. (Fig. 42.) In each case the table is set to give the required depth of cut and the work is pressed against the ripping fence.

7. **Trenching.** When cutting trenches or dadoes across the grain, the stock is held against the mitre gauge. Several cuts may be made with a cross-cut blade or one cut using the dado head. (Figs. 40 and 43.)

NOTE: Grooves and trenches are sometimes cut using an ordinary saw blade which is mounted on the saw arbor so that it will "wobble" and make a cut wider than its own thickness. To make the "wobble" or "drunken" saw, fit a thin wooden disc, slightly tapered in thickness (tapered according to amount of wobble required). on the arbor and tighten the saw blade against it. For cuts more than $\frac{1}{4}''$ wide use a tapered disc on each side of the blade. (Fig. 44.)

8. **Cutting Tenons.** Cut the shoulders first, having the fence set at the length of tenon, and using the mitre gauge to support the work. Tenons may be ripped, using a pair of blades of the same diameter, separated by a wooden or metal spacing collar, or two separate cuts may be made with a single saw blade. In each case it is advisable to use some kind of jig to hold the stock upright and firmly against the ripping fence, especially if the work is under 4" wide. Another method of cutting tenons is to use the dado head. Set the fence to the required length of tenon and place the wood flat on the bench against the mitre gauge. All that is required is to make several passes over the saw to remove the waste from one side of the tenon, the gauge keeping the stock square and the ripping fence fixing the position of the shoulders. In each operation the saw is adjusted for required depth of cut.

QUESTIONS.

1. Sketch a circular saw and name the parts.
2. State five precautions you would take when using the circular saw.
3. Why should the stock being cut be flat and have a straight edge?
4. How far above the work should the saw project when sawing?
5. Briefly describe three sawing operations which may be carried out on the circular saw.

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