THE MODERN MOTOR-DRIVEN WOODWORKING SHOP VOL. III

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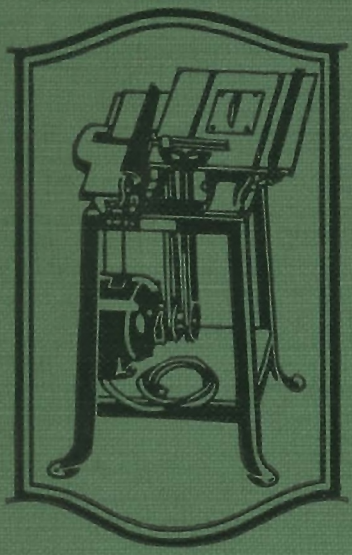

How to **PLAN - OPERATE**
and get the most out of it

The Modern Motor-Driven Woodworking Shop

HOW TO PLAN, OPERATE AND GET THE MOST OUT OF IT

BY
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AND
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With
204 Working Drawings, Diagrams,
and Illustrations

VOLUME III

WOODWORKERS EDUCATIONAL DEPARTMENT
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INTRODUCTION

The need for a book dealing with the practical problems encountered in making various articles in the workshop has long been evident, for, while many woodworkers have the technical skill to insure success with hand tools, many more have neither the time or patience to learn by experimenting the more accurate and efficient methods of using motor-driven tools. There are others, again, completely inexperienced in woodworking, whose work is greatly handicapped by the lack of complete instructions for work of this kind. This book, therefore, is intended to supply, in simple and usable form, such information and illustrations as the woodworker needs.

Instead of giving the extremely brief instructions and illustrations which would be necessary if the book dealt with the construction of many projects, it was thought better to limit the book to a few well-chosen pieces, and to explain the work involved in such minute detail so as to initiate even the novice into the manner and method of successfully understanding and carrying to completion any other work.

The operations involved in the construction of these pieces are many and varied, and are typical of the procedure to be followed in the making of any other high-grade piece of work.

In the matter of operations and processes, there are many different opinions and practices, and not all, by any means, are agreed as to the best methods, and to the best practices in executing them. The chief aim, therefore, has been to give up-to-date and proved practical instructions as to materials and processes; using methods that are well within the range of skill of even the most inexperienced.

If the reader does not know where to buy the materials or supplies to make the articles described, he may secure this information from the publishers of this book.

Milwaukee, Wis.
July, 1931.

Woodworkers Educational Department
(Division of Delta Mfg. Co.)

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Fig. No. 446

CHAPTER XIX

THE GRANDFATHER CLOCK

The construction of a small sized grandfather clock has a special appeal to the average craftsman, for it combines utility with beauty, is never out of style and fits splendidly into the decorative scheme of house, bungalow, or apartment. A grandfather clock may be designed to fit any room, regardless of size or ceiling height, and to harmonize with any style of furniture.

Movements for grandfather clocks have been improved and reduced in size so that a very large case is no longer necessary. The new electric movements require very little space in the case, and even with the chimes there is plenty of room in the hood for all the parts.

Small size or miniature grandfather clocks are often called grandmother clocks.

A good clock case is not hard to make in the small workshop, especially now that motor-driven tools enable the craftsman to do accurate work, even though he has had no previous experience on work of this kind.

The worker will find it a pleasure to build a clock case and he will not only have something of value when it is finished, but also a useful article that will last many years. It is more than an article of furniture or a timepiece, for it has a peculiar claim upon the craftsman's sentiment and his affection, especially if he makes it himself.

Clocks of this kind are quite expensive to buy complete and they make excellent subjects for the home workshop. When completed the craftsman will not only have saved enough to pay him for his spare time work but, in addition, a neat sum can be considered as a return on his investment in motor-driven tools.

The tall clock case made its appearance about the middle of the seventeenth century and later became a subject for elaborate ornamentation. The tall case was first made for the purpose of concealing the weights and pendulum, which, before that time, had hung in full view from a mechanism and dial supported by a bracket.

The first cases were made with square-shaped hoods or bonnets. Later models were often made with movements which had moving figures of boats, or a miniature moon in its different phases. To make room for these extra parts the arched top was added.

The early grandfather clocks were quite tall and massive, some being ten feet in height. The rooms of the homes in which they were used were quite large and had high ceilings, therefore the tall clock harmonized with its surroundings. The rooms of homes at present are smaller, and the ceilings lower, so the clock case should be smaller in proportion in order that it may harmonize with the other furniture in the home.

The clock case shown in Figure 446 is a composite design, with details of several periods. It may be made from walnut, mahogany, birch, gum or any other wood which is suitable for cabinet work. It is well to make it of the same wood which is used for the furniture in the room where it is to be placed. Usually it is best to use a high-grade cabinet wood even though the first cost of the material is a little more, because the time spent in making an article is usually the same or greater with a poor cabinet wood as with a good one, and the finished article will not be as rich in value as if woods like walnut and mahogany are used.

CHAPTER XX

SELECTING THE MATERIAL FOR THE CLOCK CASE

The large parts of the clock case can be made of plywood and the mouldings of solid lumber, or the entire case can be made of solid wood. Also, if desired, the case can be made of plywood such as walnut or mahogany, and the mouldings of birch or gum, but a much richer appearance will be produced if the mouldings are made from the same kind of wood as the case.

It will be assumed that the case is to be made of solid lumber, either walnut or mahogany. If your lumber dealer does not carry the kind of lumber you want he will be glad to get it for you, or you may order it from some supply house. As no long or wide pieces are required the lumber will not be difficult to obtain.

Selecting the Lumber

Care should be exercised in selecting the lumber for figure, color, texture of grain and blemishes or defects. As the parts of the clock case are not large the figure of the wood should not be large. For instance, if mahogany is used a narrow-striped wood will make a clock case of better appearance than a wide-striped wood. The color of the different pieces of lumber should be uniform, not one light-colored board and one dark. This is important on a wood like walnut, which is often finished in its natural color without any staining.

The texture of the grain of the wood should be as uniform as possible in all the pieces. It will be found that some pieces of lumber have a coarse grain with large open pores, and others have a fine grain with small pores. Select lumber having the same general texture.

Examine the lumber closely for blemishes or defects, such as checks, splits, worm holes, knots, mineral or pitch streaks and wind breaks. A wind break is caused by the wind swaying or twisting the tree. The break is usually across the grain, and is often not very noticeable until stain is applied. Wind breaks are more often found on mahogany than on walnut, probably because mahogany trees grow to a greater height.

The amateur should know something of the way in which lumber is measured for sale. The universal unit of measurement used in computations, for the sale of lumber is the board foot. This is the equivalent of a board 12 inches long, 12 inches wide and 1 inch thick. The amateur will

have little to do with the actual use of board measure, except that he will be charged for so many board feet when he purchases his lumber.

Of more importance to the amateur is the fact that the sizes of lumber, as listed in the dealer's stock, are merely nominal. If one were to buy a piece of rough lumber, say a 2 by 4-inch piece, the measurements of the board would be close to 2 inches by 4 inches. Actually, however, lumber is practically never sold in the rough, but is always dressed at the mill. The rough sizes have been retained in listing the lumber, however, so that our piece, while it would actually measure about 1¾ inches by 3¾ inches, is still called a "two by four." This variation between the actual and the nominal sizes exists for all sizes and thicknesses of lumber, at least so far as the amateur is concerned. This means that he must remember that 1-inch lumber always means an actual thickness of about 13/16 inch, when dressed and seasoned to proper moisture content.

On 2-inch lumber the slightly greater shrinkage and greater requirements for dressing reduces the thickness by from ¼ to ½ inch, although the standard official thickness for "2-inch" dressed lumber is 1⅝ inches, when surfaced on one side and one edge.

The widths of dressed lumber, too, are always less than the nominal sizes. This variation runs from slightly less than ¼ inch to ⅝ inch, depending on the region in which the boards are produced, but the uniform practice in the principal producing regions is to make the widths narrower than the nominal sizes by slightly less than ⅜ inch on boards up to 7 inches wide; over this width the boards are ½ inch narrower than the nominal sizes. This means that a "6-inch" board will actually be close to 5⅝ inches wide, while a 10-inch board will be close to 9½ inches wide.

These two simple facts should always be borne in mind when lumber is to be ordered for any job.

When ordering lumber, certain abbreviations may be used, and these are familiar to all lumber dealers. Lumber that is to be dressed to size, surfaced or machine planed on two sides is marked S-2-S; if on four sides, the abbreviation is S-4-S. For kiln-dried lumber the abbreviation K. D. is added to the description. The abbreviation for feet is ′, and for inches ″. Thus a cutting bill marked 6′ 6″ means the piece is to be 6 feet 6 inches long. The word "net" means actual finished sizes, so a piece marked ½″ by 6″ net means that it is to be delivered dressed to those exact sizes.

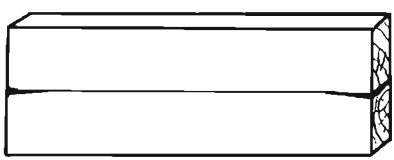


Fig. No. 447. Result of Using Lumber Not Dry

Lumber used for cabinet work should be well-seasoned, and preferably kiln-dried. Kiln-dried lumber usually contains between 6 and 10 per cent moisture, unless otherwise specified. If one could be sure of getting exactly what one wanted, it would be well to specify the upper and lower limits of moisture content when ordering lumber. Practically, however, the worker ordering but small amounts must take what the dealer has in stock, and

the only practical thing to do is to deal with a reliable firm, tell them what you want, and treat the wood properly after you receive it.

If wood is drier than the air in the shop or house, it will absorb moisture from the air until a balance has been reached. If the air is drier than the wood it will rob the wood of a portion of its moisture, which is one of the reasons why the hot, dry atmosphere of most houses in the winter time is destructive to woodwork and furniture. This effect is always present during the life of the wood, although it is obvious that the exchange of moisture between air and wood is greatly retarded by any finish on the wood, and that wood "in the white," or unfinished, will lose or gain moisture at a much greater rate than wood which is protected by several good coats of paint, enamel, lacquer or varnish.

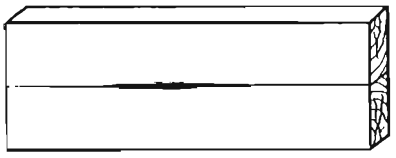


Fig. No. 448. Result of Using Lumber Too Dry

Figure 447 shows what happens when lumber is not dry enough. The joint is open at each end showing ends have dried out and shrunk. Figure 448 represents what happens when lumber is too dry. The ends absorb moisture faster than the center and consequent expansion makes a split or open joint at the center. Many wrongly think this is due to under drying.

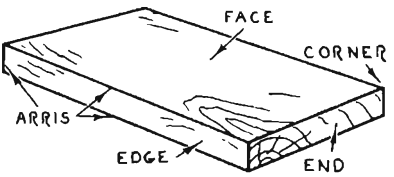


Fig. No. 449. Names of Surfaces and Their Intersections on a Board

Bill of Material

A bill of material for any job contains a list of the separate parts, and other materials necessary for its construction. The bill of material for the clock case is given on page 272.

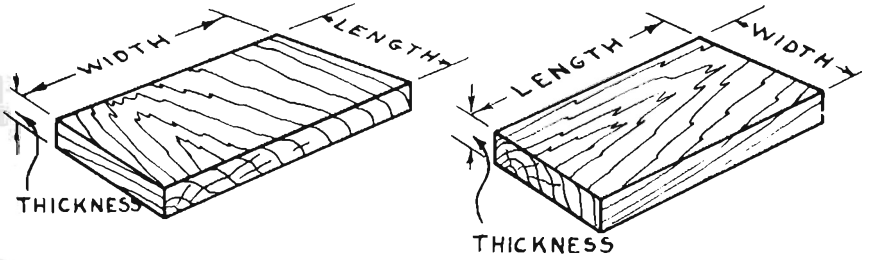


Fig. No. 450. The Thickness and Width are Always Measured Across the Grain and the Length with the Grain

The finished stock list is made up directly from the working drawings.

The rough stock bill can be made up directly from the finished stock list, by adding at least ¼ inch to the width and ½ inch to the length of each piece for final squaring up and fitting.

BILL OF MATERIAL

PART NO.	ITEM AND REMARKS	PIECES REQ'D	THICKNESS	WIDTH	LENGTH	WOOD
1	FRONT OF PLINTH	1	13/16"	13"	16"	WALNUT OR MAHOGANY
2	SIDES OF PLINTH	2	13/16"	8"	16"	"
3	BOTTOM BOARD OF PLINTH	1	13/16"	8 1/8"	12 3/4"	OPTIONAL
4	BACK PANEL OF PLINTH (3-PLY)	1	1/4"	12 1/8"	16"	"
5	FILLING FOR WAIST (FRONT)	1	1 13/16"	3"	11 1/4"	"
6	FILLING FOR WAIST (SIDES)	2	1 13/16"	3"	5 5/8"	"
7	BASE FRONT (MITERED-BOTH ENDS)	1	13/16"	4"	14 5/8"	WALNUT OR MAHOGANY
8	BASE SIDES (MITERED-ONE END)	2	13/16"	4"	8 7/8"	"
9	WAIST SIDES	2	13/16"	5 1/4"	37 1/2"	"
10	WAIST BACK CROSS RAILS	2	13/16"	2 1/8"	9"	"
11	WAIST FRONT CROSS RAIL (TOP)	1	13/16"	2 1/8"	9"	"
12	WAIST FRONT CROSS RAIL (BOTTOM)	1	13/16"	5 1/8"	9"	"
13	WAIST DOOR STILES (DOWEL-MITERED)	2	3/4"	1 3/4"	30 1/16"	"
14	WAIST DOOR RAILS (DOWEL-MITERED)	2	3/4"	1 3/4"	9"	"
15	WAIST BOTTOM (3 PLY G.1.S.)	1	1/4"	4 3/4"	8"	"
16	WAIST DOOR PANEL (3 PLY G.2.S)	1	1/4"	6 1/4"	27 5/16"	"
17	WAIST BACK PANEL (3 PLY G.1.S.)	1	1/4"	8 1/16"	30 1/4"	"
18	PLINTH TOP BEAD MO (3 PCS.)	1	1/2"	2 3/8"	36"	"
19	PLINTH TOP OVOLO MO. (3 PCS.)	1	13/16"	1 15/16"	32"	"
20	PLINTH TOP COVE MO. (3 PCS.)	1	13/16"	15/16"	30"	"
21	WAIST TOP BEAD MO (3 PCS.)	1	1/2"	1 7/8"	33"	"
22	WAIST OVOLO MO (3 PCS.)	1	13/16"	1 5/8"	32"	"
23	WAIST COVE MO (3 PCS.)	1	13/16"	15/16"	28"	"
24	HOOD SIDES	2	1/2"	6 3/4"	12 5/8"	"
25	HOOD BOTTOM	1	13/16"	6 3/4"	11"	"
26	HOOD TOP	1	13/16"	6 3/4"	11"	"
27	DIAL FRAME CLEATS	2	13/16"	1"	11"	OPTIONAL
28	DIAL FRAME CLEATS	2	13/16"	1"	9"	"
29	DIAL FRAME (MITERED)	4	5/8"	1 3/8"	11"	WALNUT OR MAHOGANY
30	HOOD DOOR STILES (DOWEL-MITERED)	2	3/4"	1 3/4"	12 1/2"	"
31	HOOD DOOR RAILS (DOWEL-MITERED)	2	3/4"	1 3/4"	12"	"
32	HOOD DOOR GLASS MO. (MITERED)	1	1/4"	1/4"	39"	"
33	HOOD TOP MO. (3-PCS.)	1	13/16"	2 5/8"	33"	"
34	HOOD BACK DOOR (PLY WOOD)	1	1/2"	10 15/16"	10 15/16"	OPTIONAL
35	PEDIMENT FRONT (MITERED)	1	13/16"	4 1/8"	12	WALNUT OR MAHOGANY
36	PEDIMENT SIDES (MITERED)	2	13/16"	15/16"	7 1/2"	"
37	PEDIMENT TURNING	1	1 5/8"	1 5/8"	8"	"
38	PEDIMENT ROSETTES	2	3/8"	1 1/2"	1 1/2"	"
39	HOOD BACK DOOR STOPS	4	3/8"	3/8"	11	OPTIONAL

SELECTING THE MATERIAL FOR THE CLOCK CASE

The lumber bill is the list of the lumber necessary to make the project. It is made out from the rough stock bill. Group all the parts of the same kind of wood having the same thickness and select boards of sufficient width and length to make all these parts.

The terms face, edge, end, corner, arris, thickness, width and length will be used frequently and it is well to note their meaning by referring to Figure 449. The thickness and width of a board are invariably measured across the grain and the length with the grain as indicated in Figure 450.

The length in the finished stock list usually is given in inches, rather than feet and inches.

A chart or "layout" can be made similar to the one shown in Figure 451. This is given only as a guide, as the widths and lengths given may not be carried by your dealer. If you prefer you may find out what widths and lengths he has on hand, then make up a chart and buy the amount needed. The chart will also be of help when cutting up the material to rough sizes in your shop.

When making up a layout chart be sure to allow several inches for waste at each end of each board, because the ends of lumber are almost always a little bit cracked, checked or discolored. It will be noticed on the sample chart that at several places extra pieces are marked. This is usually needed to allow for slight defects, mistakes in cutting, and trial cuts especially to arrive at the correct moulding shapes. If you must send some distance for your material it would be well to order a few extra feet of lumber in order to avoid delay should you cut a piece wrong.

Sometimes lumber dealers have short lengths of lumber which are not easy to sell. As the parts for the clock case are not large they may be cut from this short lumber and the dealer will probably be glad to sell this short stuff at a reduction from the regular price of long lumber. If short pieces are bought, however, they should be carefully selected for uniformity of color and texture of grain.

Hardware

14	Flat-head	wood	screws	1¾″	No.	12
7	"	"	"	1¼″	No.	10
10	"	"	"	1½″	No.	8
22	"	"	"	1½″	No.	8
8	"	"	"	1¼″	No.	8
14	"	"	"	⅜″	No.	2

4 Loose-pin hinges, 1¼″ Long, 1⅛″ wide, ⅜″ Screws to fit
2 Butt hinges, ¾″ Long, ¾″ wide, ⅜″ Screws to fit
4 Ball catches and strike plates
3 Knobs for doors, ½″
4 Glides for base, ¾″
1 Glass, 9″ x 9½″
1 Clock movement with square dial, 8½″ x 8½″

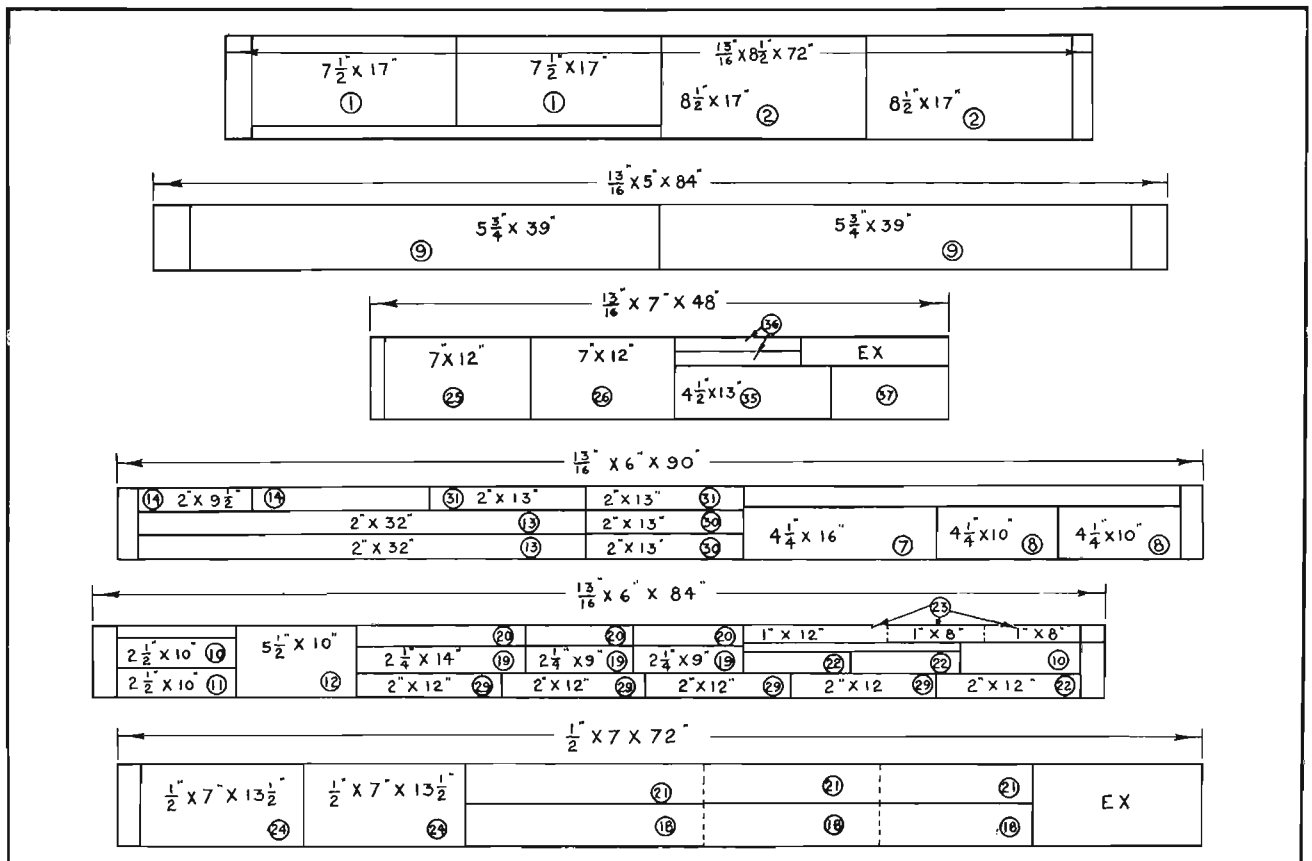


Fig. No. 451. A Layout Chart

Finishing Materials

Sometimes the hardware dealer does not carry finishing materials in stock and the manufacturer of these materials usually does not sell supplies in small quantities. There are a number of supply houses who specialize in providing the craftsman with materials that are not usually carried in stock by the local dealer. It is not the purpose of this book to advertise any particular supply house, but if the builder of these projects is interested in knowing where materials may be purchased for making the articles described in this book the publishers will supply this information.

Laying Out the Parts

When the lumber is delivered to your workshop keep it in a dry place. Do not stand or lay it on the floor in the basement or it will take up moisture from the floor even though the floor appears dry.

Correct Incorrect

Fig. No. 452

Place the lumber on a pair of carpenters' horses and lay out the various parts so that they may be cut to the rough sizes first. Use a square for laying out the parts and number each part according to the numbers used in the bill of materials. A circle can be drawn around each part number. The saw cut will remove about $\frac{1}{8}$ inch at each marked line.

Parts which are to be glued together or which are to match should be laid out on the same board; thus the texture of grain, color, etc., will match better than if they were laid out on different boards. For example, it will be noticed that the door frames are laid out on the same board in the sample layout chart. It is a good plan to carry this method out wherever possible.

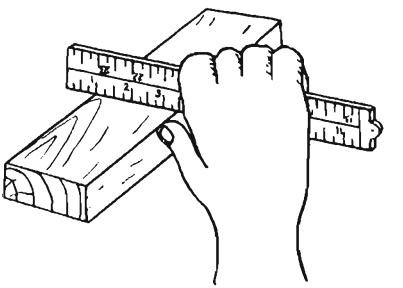


Fig. No. 453

Lay the rule or square on edge for measuring so that the divisions on the side touch the wood as shown at A in Figure 452. This method, of course, does not apply to a rule with the scale on a beveled edge.

For short measurements use any divisions on the rule rather than the end, for the end is likely to be worn and inaccurate, and is hard to place exactly on the line or edge. Figure 453 shows the correct method. When

squaring across a board hold the square in the manner shown in Figure 454, with the stock of the square in contact with the edge of the board.

On rough lumber use the straightest edge of the board for the guide. It is necessary to hold the handle of the square firmly against the edge to insure a line at right angles. Place the blade of the square in line with the mark and draw the line to coincide exactly with the mark. Use a pencil for a rough layout or where a knife line would mar the finished surface. Use a knife for a fine layout.

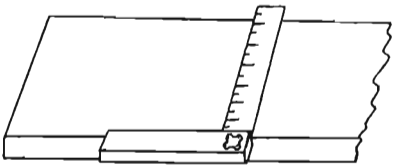


Fig. No. 454. Squaring a Board

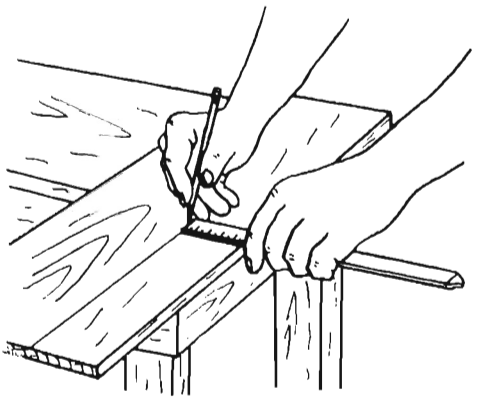


Fig. No. 455. Gaging with Rule and Pencil

A good way to lay out the pieces is to thumb-gage for width. This is shown in Figure 455. The pencil is held against the end of the rule and the whole is pulled toward the worker. The thumbnail of the left hand on the rule at the desired point acts as a gage head. This method should be used only for the rough layout.

When the edge of a board is not straight enough for rule-and-pencil gaging, use a board with a straight edge to lay out the desired parallel lines.

CHAPTER XXI

MAKING THE CLOCK CASE

Cutting the Lumber

It will be assumed that the prospective woodworker will have the use of the various motor driven machines, consisting of: The circular saw; upon which the dado head and moulding cutter can be used; the jointer; the boring, mortising and routing machine or attachment; the 36″ lathe; the band saw and the scroll saw. A solid workbench is needed, equipped with a carpenter's or cabinet maker's vise.

Cross-Cutting the Lumber to Rough Length

The first operation on the machines is to cut as many of the parts as possible to rough length. This can only be done where the layout lines extend clear across the boards. Where the layout lines extend only part way across the board it will be necessary to rip some of the parts off before they can be cut to length. The parts which are to be shaped for making the mouldings should be left as long as possible until after the moulding operation, to make this operation easier.

Joint the Edges

When all the parts have been cut, start the jointer and joint one edge of all the parts. Advance the pieces over the jointer so that the knives will cut with the grain of the wood —not against the grain. The correct way is shown in Figure 197, Volume I. Mark the jointed edge and the working face of each piece with a V mark or X as shown in Figure 456. Use a soft-lead pencil for marking. Do not use a wax crayon, because the wax will fill the pores of the wood and will be difficult to sand out. It may even show after the finish is applied.

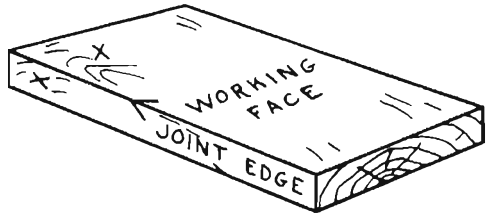


Fig. No. 456. Mark the Face Side and Jointed Edge

Ripping to Rough Width

Select the pieces which are to be used to make part No. 1, which is the front of the plinth, and rip these pieces to a width of 7½ inches.

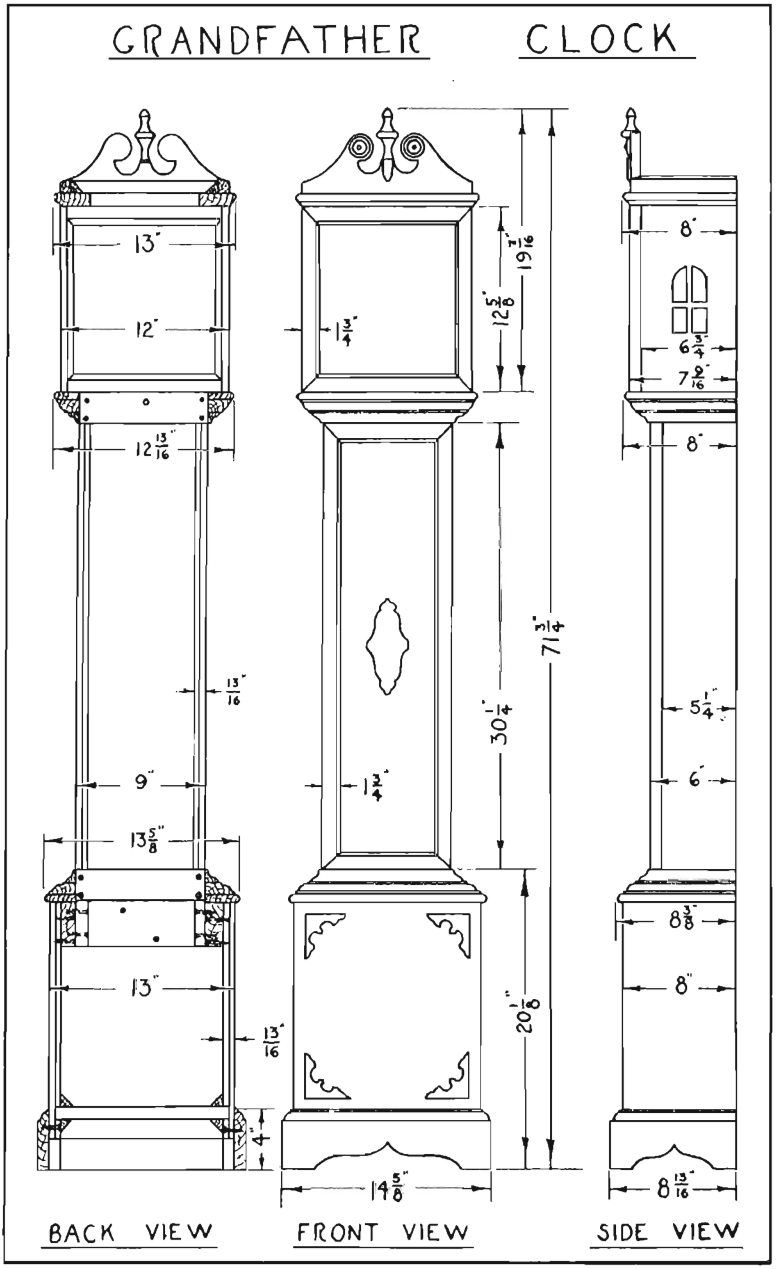

GRANDFATHER CLOCK
13"
12"
12 13/16"
13/16"
9"
13 5/8"
13"
13/16"
4"
1 3/4"
1 3/4"
1 3/4"
12 5/8"
19 1/16"
30 1/4"
20 1/8"
71 3/4"
14 5/8"
8"
6 3/4"
7 2/16"
8"
5 1/4"
6"
8 3/8"
8"
8 13/16"
BACK VIEW
FRONT VIEW
SIDE VIEW

Fig. No. 457

This is wider than needed in the finished sizes but this front will be bevel ripped to exact size after gluing. As most small saw tables are not large enough to rip a piece 7½ inches wide by placing the wide part against the gage, these wide pieces may be ripped by measuring the total width of the board and subtracting the width desired from the total width, then set the rip gage so that when the narrow piece is ripped off, the required wide piece will be obtained from the piece farthest from the gage.

Rip the two pieces for the sides of the plinth; parts No. 2. These should be ripped 8½ inches wide, as these also are to be bevel ripped later.

Auxiliary Table for Ripping Wide Boards

Wide boards or panels can be ripped to size on a saw having a small table by making and using an auxiliary table as shown in Figure 458. This table can be attached or removed in a few seconds. The woodworker

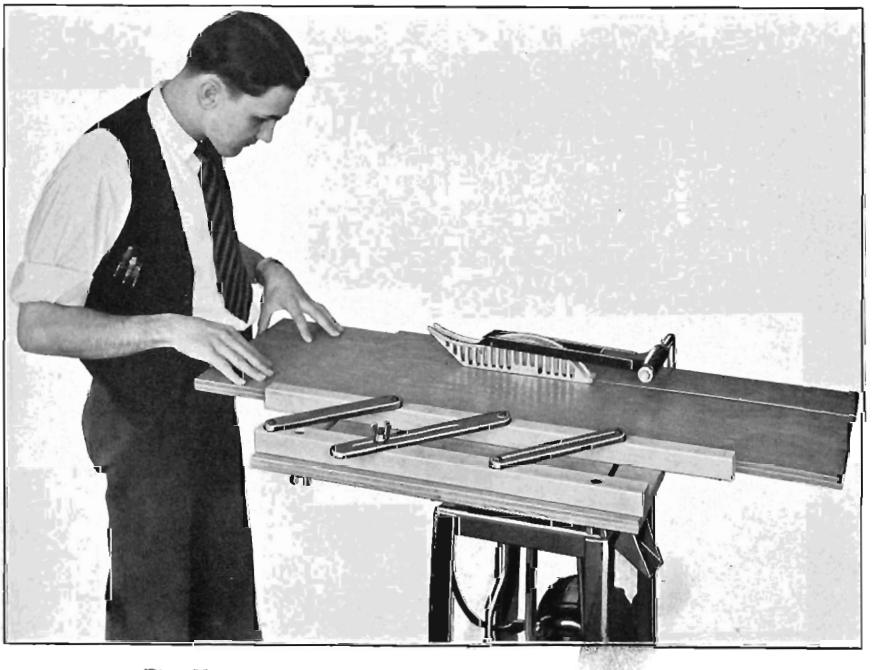


Fig. No. 458. Using Auxiliary Table to Rip Wide Boards

will find it well worth while to make a table of this kind for the small circular saw. The table shown in Figure 458 will permit ripping to the center of a 28 in. panel, to make pieces 14 inches wide. The saw itself must be well designed and the slide grooves in the table accurately machined to get good results with an auxiliary table.

The auxiliary table is made from a 5-ply panel ⅝ inch thick and 24

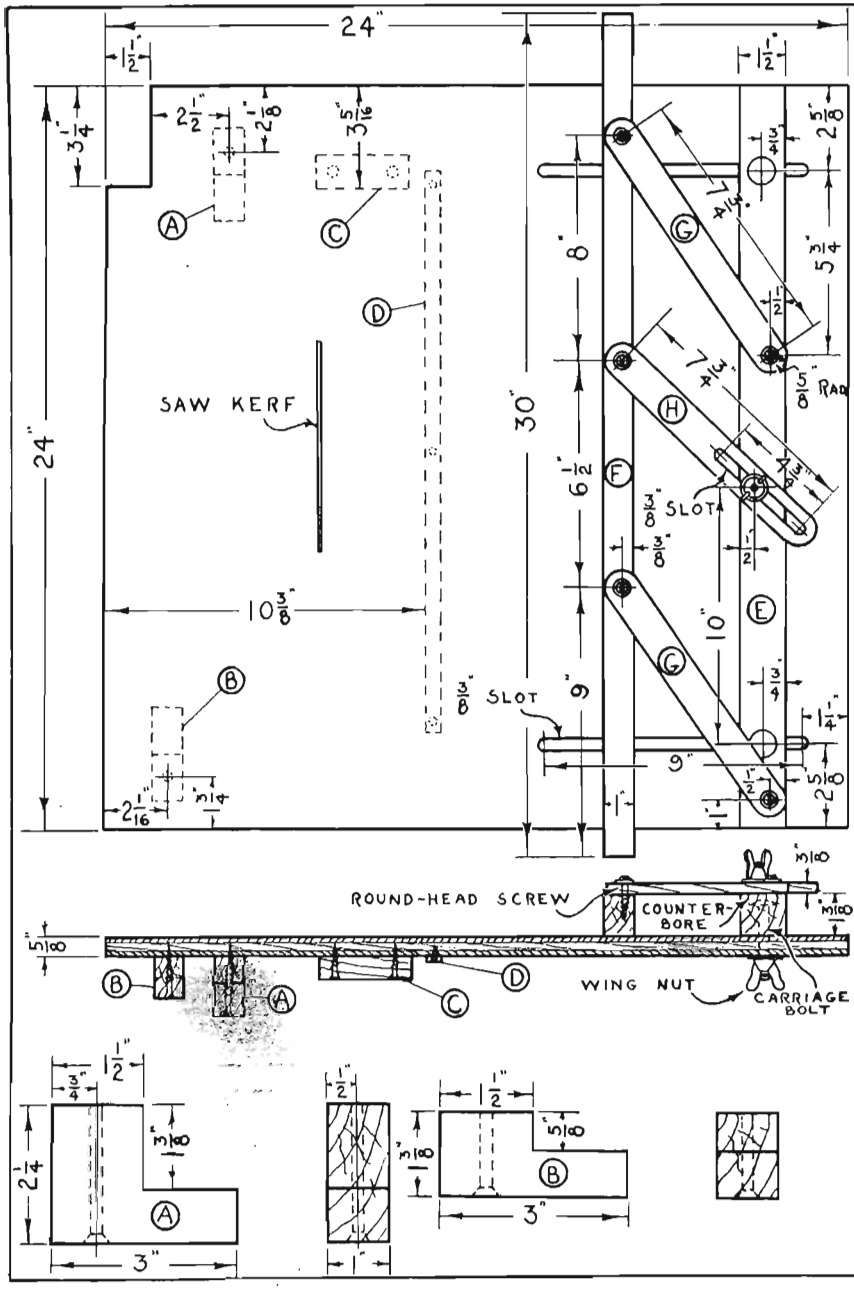


Fig. No. 459. Auxiliary Circular Saw Table

inches square. It should be straight, and all edges square. To make the table shown in Figure 459, cut a notch in what will be the rear left hand corner to make room for the saw guard post. A piece of cold rolled steel is screwed to the bottom of the special table, so that it fits snugly in the right hand miter-gage groove in the saw table. In this way the auxiliary table will always be in perfect alignment with the blade when it is in place. The steel bar is 3/16 inch thick, 1/2 inch wide and 18 inches long. It should be set 10 3/8 inches from the left edge of the table as shown at D in Figure 459.

Cut two slots 3/8 inch wide and 9 inches long, starting 1 1/4 inches from the right hand edge as shown in Figure 459. The centers of the slots are 2 5/8 inches from the table ends. These slots can be made on the boring machine, using the router bit or boring bit.

The block C is a stop block screwed to the underside of the auxiliary table as shown in Figure 459. Its purpose is to prevent the table from moving toward the front of the machine. Its front edge should be 3 5/16 from the back edge of the table.

Blocks A and B form turnbuttons and hook under the saw table, thus holding the auxiliary table tight in place. The dimensions of these blocks and their positions are shown in Figure 459.

The outer guide fence piece E can be used separately or a quick adjusting arrangement can be used with it as shown in Figure 459. Part E is a piece of stock 1 1/8 inches wide and 24 inches long. The top face is slightly beveled so that when the center wing nut is tightened it will draw the inner guide fence tight on the table. The outer fence E is bored so the bolt heads will not project above the top edge. The centers of these holes are 2 5/8 inches from each end as shown in Figure 460.

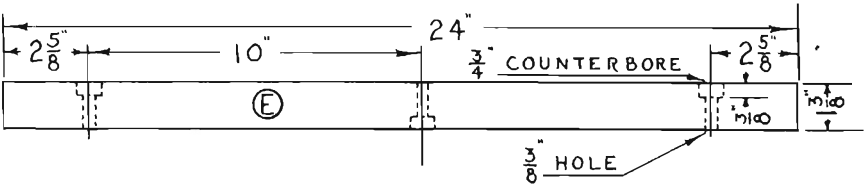


Fig. No. 460. Detail of Outer Guide Fence

The hole for the bolt which controls the inner fence is bored 12 5/8 inches from the front end of part E. This hole is counterbored from the bottom. A 5/16 inch carriage bolt 2 inches long should be inserted from the bottom.

Place the piece E on the table and insert 2 1/2 inches carriage bolts through the holes near the ends and through the slots in the table. Place washers and wing-nuts on these bolts and tighten the nuts. The guide fence F is a piece of stock 1 inch thick 1 1/8 inches wide and 30 inches long.

The three connecting arms should be made of hardwood such as maple. Three pieces are needed 3/8 inch thick, 1 1/8 inches wide and 9 inches long. The end arms are bored on 7 3/4 inch centers for 1 1/4 inch No. 12 round head screws.

The center arm is bored at one end for the same size screws. A 3/8 inch slot 4¾ inches long should be made near the other end as shown in Figure 459.

The pilot holes for the screws must be bored very accurately in pieces E and F or the two parts will not remain parallel at all times. Place washers on the screws and screw the arms in place. Place a washer and wing-nut on the bolt near the center, and the construction of the guide fence is completed.

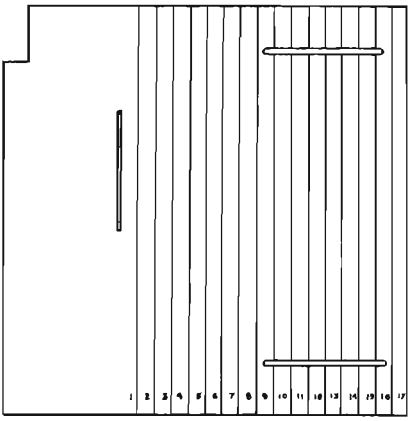


Fig. No. 461

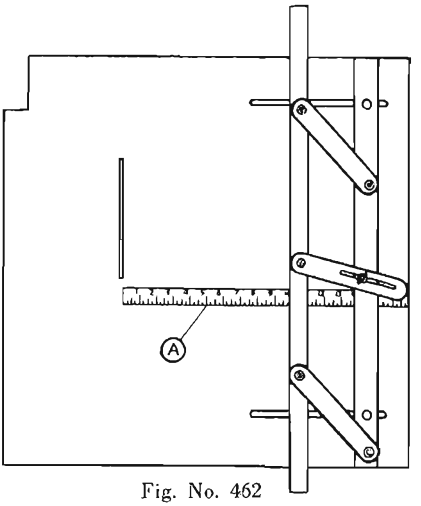


Fig. No. 462

The purpose of the slots in the auxiliary table will now be apparent. Since the range of movement of the quick-adjusting fence is only about 7 inches, naturally it will not follow work right up to the saw if the back fence were fixed in place. By moving the rear fence, however, the full range of the auxiliary table can be utilized, and the advantages of the quick-adjusting feature retained at the same time.

Raise the saw table to its highest position so the saw blade does not project above the table. Place the auxiliary table in place and turn the turn buttons which hold it to the regular table. See that the stop block C at the rear is against the edge of the regular table. Start the saw and lower the table slowly. The saw blade will cut its own opening in the auxiliary table.

A rule can be placed against the blade and marks made on the wood table every half inch. These marks can be drawn the full length of the table by placing a square with one edge against the front edge of the table and the other on a mark. The inch marks can be made with a black pencil and the half inch marks with a red pencil. These marks will aid in setting the guide fence for various widths. See Figure 461. A rule can be inlaid in the table top if desired as shown in Figure 462.

The table and guide fence should be given several coats of shellac.

Fig. No. 463. Bevel Ripping with Auxiliary Table

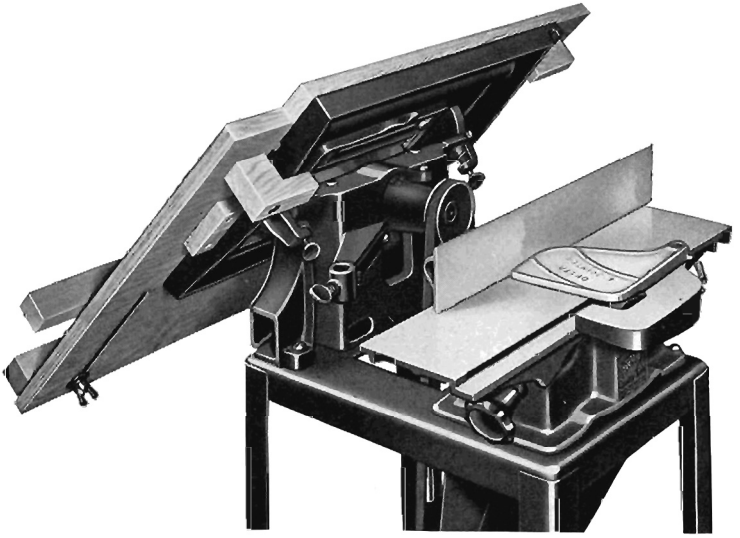


Fig. No. 464. Back View Showing Auxiliary Table in Position

Figure 463 shows the table in use for bevel ripping wide parts. Figure 464 shows the opposite side of the machine when set for bevel ripping.

Ripping Other Parts

Part number 3 which is the bottom board of the plinth should be ripped $8\frac{1}{8}$ inches wide.

Parts 7 and 8 which form the base or feet should be ripped about $\frac{1}{32}$ inch wider than the finished size to permit jointing the edges, after which these parts should measure 4 inches wide. The waist sides, parts 9, should be ripped next. The waist cross rails to make parts 10 and 11 should be ripped $2\frac{1}{8}$ inches wide and the front bottom rail, part 12, should be ripped $5\frac{1}{8}$ inches wide.

Next rip the hood bottom and top parts 23 and 24, $6\frac{3}{4}$ inches wide. The hood sides, which are $\frac{1}{2}$ inch thick, should be ripped $6\frac{3}{4}$ inches wide.

It would be well for the beginner to leave the other ripping operations until later so that if any mistakes are made in working up the parts they can be replaced by using some of the material which was originally intended for the smaller parts.

Squaring the Ends

Remove the rip gage from the saw table and place the miter gage in one of the grooves in the saw table to square one end of the parts. It is a good plan to screw a straight board to the faces of two miter gages as shown in Figure 96 in Volume I. When cutting off the wide parts the gage can be reversed and the pieces held against it.

Cut off about $\frac{1}{4}$ inch from one end of each piece which has been ripped to the required width. Test the first piece cut to see that the gage is properly

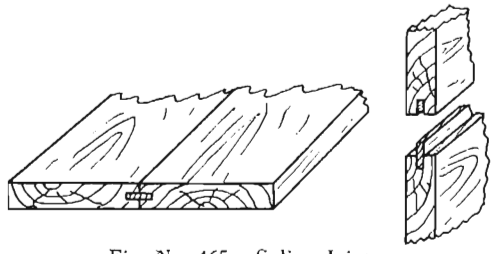


Fig. No. 465. Spline Joint

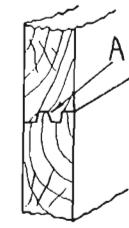


Fig. No. 466
A Tongue and Groove Joint

set to make a square cut. Make a pencil mark on the squared end of each piece, to distinguish the squared end from the other end.

Cutting to Finished Length

When all the pieces which have been ripped are squared on one end, clamp a stop block to the cut-off gage 16 inches from the saw blade so that parts 1 and 2 can be cut off to the finished length. Try the cut on a piece of scrap wood or edging to see that the pieces will be exactly 16 inches long.

When cutting the parts to the finished length be sure to place the end which has been squared against the stop block.

When changing from one length to another always make a trial cut in a piece of scrap wood after the stop block has been clamped in position. Measure the piece to see that the stop block is set at the correct distance from the saw blade. This precaution will prevent spoiling the good pieces. When parts 1 and 2 have been cut off to the finished length, set the stop block 12¾ inches from the saw blade and cut off the bottom board.

Cut off the waist cross rails 9 inches long (these are parts 10-11-12).

The hood sides should be cut off 12⅝ inches long. The hood bottom and top are cut 11 inches long.

The waist sides, parts 9, should be cut to 37½ inches in length.

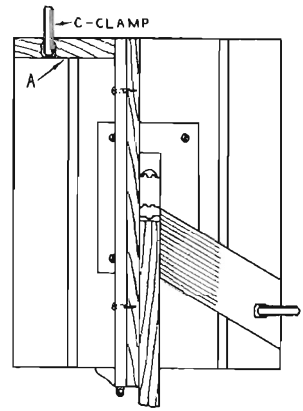


Fig. No. 467. Spring Clamped to Saw Table

Making the Glue Joint in the Plinth Front

The next operation is to make the glue joint for the plinth front part 1. A spline joint may be made as shown in Figure 465 or a matched joint may be made by using a set of joint knives in the moulding cutter, which will produce a joint as shown in Figure 466. A full description of the correct way of setting the machine to make this joint is given on page 102 of Volume I. If a spring is properly set as shown in Figure 467 it will aid in holding the work against the guide fence and a perfect joint will be produced. When using a spring it is likely to exert enough pressure to push the end of the guide fence over slightly at the end where it is not clamped to the table. To overcome this it is well to clamp a block to the table to support the end of the fence as shown at A in Figure 467.

Make trial cuts in two pieces of scrap wood of the same thickness as the stock to be used. Reverse one piece and hold the two shaped edges together. The joint should fit perfectly as shown in Figure 466. When a perfect joint is produced place the face side of one of the good pieces against the guide fence and move it slowly over the cutter head. The second part should be shaped with the back side of the piece against the guide fence.

Gluing the Plinth Front

The next operation is to glue and clamp these parts together. It would be well to refer to Chapter 24 which deals with the various kinds of glues in common use. Apply the glue to one of the edges and then clamp the two parts together. Be sure to see that the ends of the pieces are even. Figure 468 shows a method of clamping which gives good results. The long clamps are held in position hy two wood supports which are notched out to receive and hold the clamps. The C clamps prevent the pieces from

rising. Paper should be placed between the part being glued and the clamp blocks to avoid gluing the blocks to the good part as some of the glue will squeeze out at the joint. Figure 469 shows a method of clamping by using a jig and wedges.

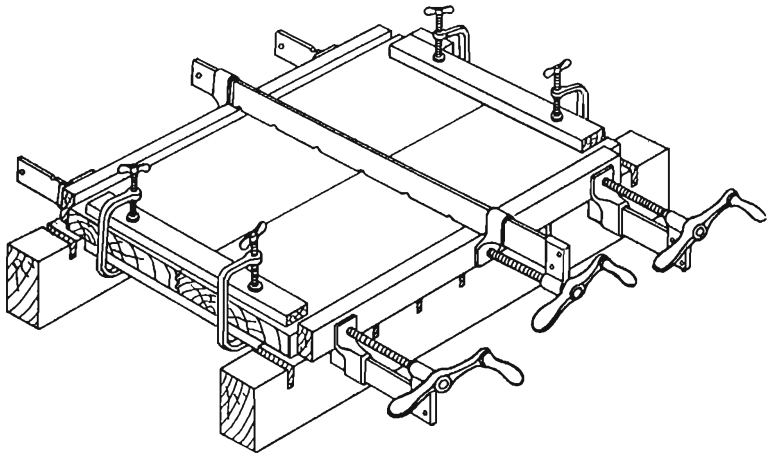


Fig. No. 468. Clamping Stock Edge to Edge

Part 1 should remain in the clamps about four hours. The front should not be sanded or any other work done on it for at least twelve hours.

Shaping the Top Edge of the Base

While the glue is drying on part No. 1, the parts 7 and 8 which form the feet or base can be shaped on the top edge. Use a set of style A knives in the moulding cutter head. Advance the pieces so that the knives will be cutting with the grain. This will insure a smooth cut requiring little sanding. If the pieces are advanced so that the knives cut against the grain they are liable to tear the wood and it will take a great deal of hand work to correct this defect. The shaped edge is shown in Figure 470.

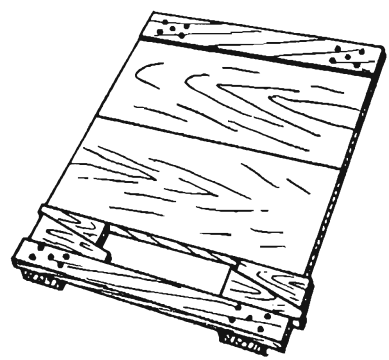


Fig. No. 469. An Arrangement for Clamping Stock

Making Dado Cuts in the Waist Sides

A dado can be cut in each waist side to admit the waist bottom panel. If the two outside cutters of the dado head cut a wider groove than the thickness of the panel it would be well to use only one outside cutter and after cutting a narrow dado in both side pieces move the stop block and

run the pieces over the cutter again to make a slightly wider groove. Figure 471 shows where to make the dado cut. Groove the back cross rail to admit the panel also. This is shown in Figure 472.

The back edges of the waist sides should be cut out so that the cross rails will fit even with the back edges of the sides. The dado head can be used for this operation. Figure 471 shows the ends cut out.

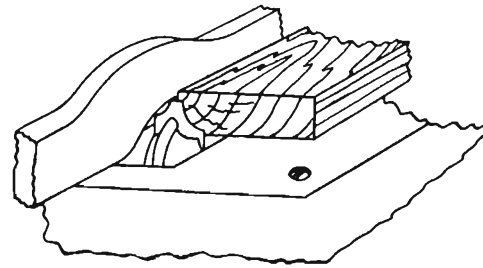


Fig. No. 470. Edge of Base Shaped

Bevel Ripping Plinth Sides

The plinth sides, part 2, can be bevel ripped as shown in Figure 473 or 463. It would be well to use the hollow-ground blade for this work. The saw table should be tilted to exactly 45 degrees for this operation.

A good way to set the table accurately where no graduations are marked to show the angle of tilt is to cut a piece of short lumber about 3 inches wide to a 45 degree angle, using the miter gage to cut this piece. Lower the table to its lowest position. Then tilt the table and hold this piece on edge on the table as shown in Figure 474. The table can be set very well in this manner but in addition it would be well to make a test for accuracy by cutting two pieces of scrap wood and then place the two parts together and hold a square against them to see that a perfectly square joint is being made.

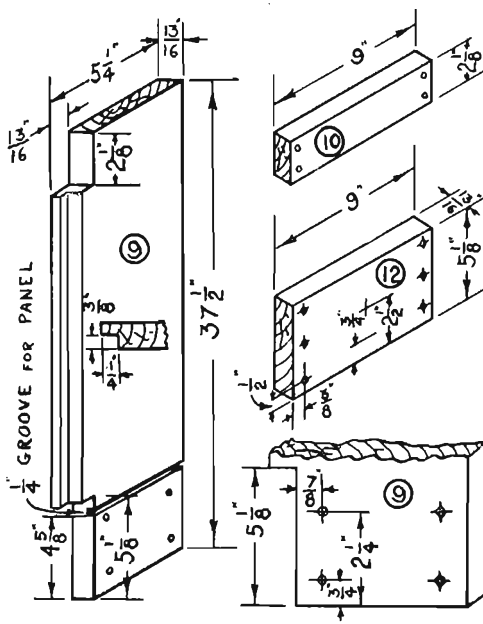


Fig. No. 471. Waist Side and Cross Rails

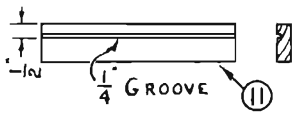


Fig. No. 472

When the machine is properly set, bevel rip the two pieces which are to make the plinth sides.

The bevel can be made smooth on the jointer if necessary, but before jointing the good pieces, set the fence for a 45 degree angle, and joint the scrap pieces which were bevel ripped. Place

these pieces together and hold a square on them to see if the joint is tight when both pieces are held against the square. When the proper adjustments have been made, pass the good pieces over the jointer, taking very light cuts.

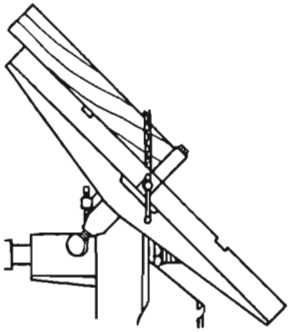


Fig. No. 473. Bevel Ripping

Beveling the Plinth Front

Bevel rip one edge of part 1 by using the same method that was used for part 2. The glue joint should be in the center of the front, when completed, therefore, it is necessary to remove an equal amount from each edge when bevel ripping. If the bevels are to be jointed to make them smooth the front should be bevel ripped to 13 1/16 inches wide. This will allow 1/32 inch to be jointed from each edge. It is important that the front be 13 inches wide when finished or the moulding will not have the same margin on the sides as it will have on the front.

Cutting Grooves for the Splines

The next operation will be to cut the grooves for the splines. The saw table should remain in the tilted position as shown in Figure 475. If pieces of the 1/4 inch plywood are to be used for the splines, cut the

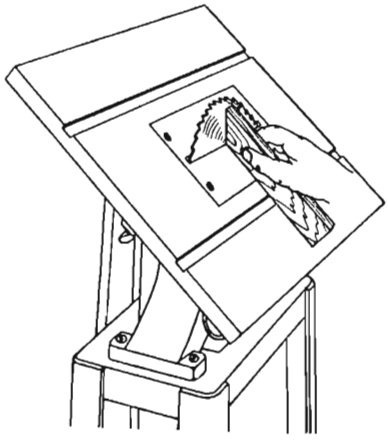


Fig. No. 474. Adjusting Saw Table

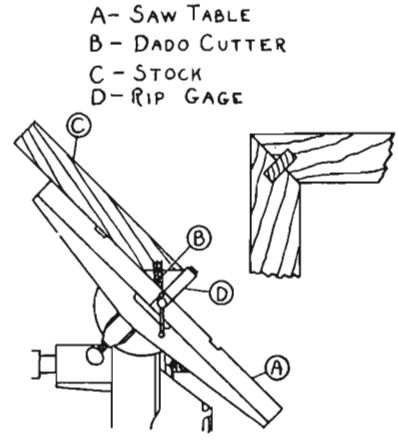


Fig. No. 475. Bevel Grooving

grooves 1/4 inch wide with the dado head. The inside cutters of a dado head will cut very well without using the outside cutters when cutting lengthwise of the grain of the wood if the stock is fed slowly, however, when cutting across the grain, always use the outside cutters to prevent tearing of the wood.

The groove should be made so that the spline can be easily moved with the hands. If it is too tight it may split the piece when glued and if it is too loose it will not hold well. If the dado will not make the groove

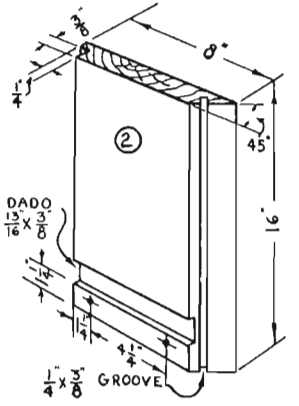


Fig. No. 476. Plinth Side

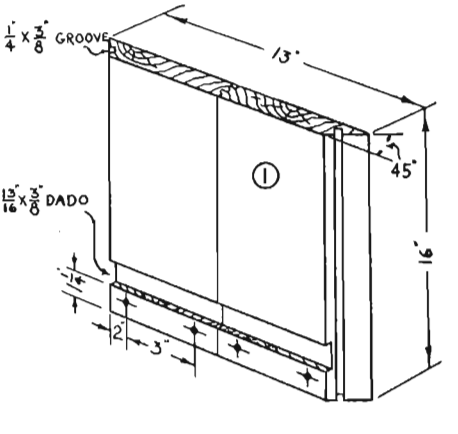


Fig. No. 477. Plinth Front

the proper width, use the saw blade. Make one cut on all three pieces and then move the guide fence over slightly to cut a wider groove. The table will need adjusting up or down in order to allow the saw to cut the same depth as before. Figures 476 and 477 show the spline grooves.

Cutting Dado for the Plinth Bottom

The next operation is dadoing the front and sides of the plinth for the bottom. As the bottom is 13/16 inch thick the dado must be about 1/64 inch wider. As most dado heads will only cut 3/4 inch in width it will be necessary to set the rip gage 2 1/16 inches from the head and cut the dado on all three parts then move the fence so that the required width of dado will be cut when the pieces are run the second time.

Rabbeting the Plinth and Waist Sides

When the dados have been cut in all three pieces, the sides (parts number 2) should be ripped to the finished width, which is 8 inches. They should then be rabbeted on the inside edge for the back panel as shown in Figure 476. This rabbet is 3/8 inch wide and 1/4 inch deep. The rabbeting may be done on the jointer as shown in Figure 202 or a straight set of knives may be placed in the moulding cutter head and the rabbet made as shown in Figure 478. If desired the rabbet may be sawed by cutting in from both sides.

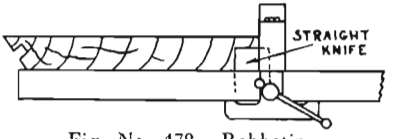


Fig. No. 478. Rabbeting

Care should be taken not to rabbet the wrong edges. It is well to mark both ends of each piece with a pencil indicating the point where the cut is to be made. This is shown at A in Figure 479.

The waist sides, parts number 9, should be rabbeted at this time, because the rabbet is the same as for the base back panel. See Figure 471.

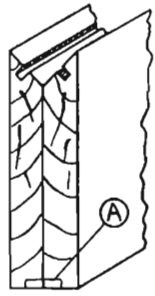


Fig. No. 479

Boring Holes for Screws

When the rabbet cuts have been completed, set up the boring machine or the drill press to bore the screw holes in parts 1 and 2. Use a 3/16 inch bit in the drill chuck for boring these holes. Figures 476 and 477 show the positions of the holes clearly. When the holes are bored they should be countersunk on the inside surfaces of the parts so that the heads of the screws will set even with the surface of the wood.

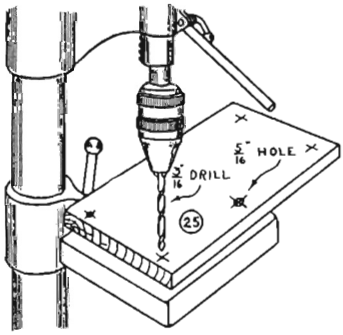


Fig. No. 480. Boring on the Drill Press

Bore and countersink the holes in parts 10-11 and 12 as shown in Figure 471.

Bore and countersink the holes near the bottom end of the waist sides as shown in Figure 471.

Bore the screw holes in part number 25 as shown in Figure 480.

Making the Splines

The splines should be made next. They should be cut across the grain of the wood otherwise the splines might split and cause an open joint. If the grooves were cut 1/4 inch wide and 3/8 inch deep, the splines should be 1 1/16 inch lengthwise of the grain and 16 inches crosswise of the grain. The splines may be made of several pieces if desired.

Gluing the Plinth

The plinth base is now ready to be glued together. Spread the glue in the grooves of the side pieces number 2, also spread glue on the beveled surface. Slip a spline in each groove just glued. Spread glue in the grooves of part 1. Press the

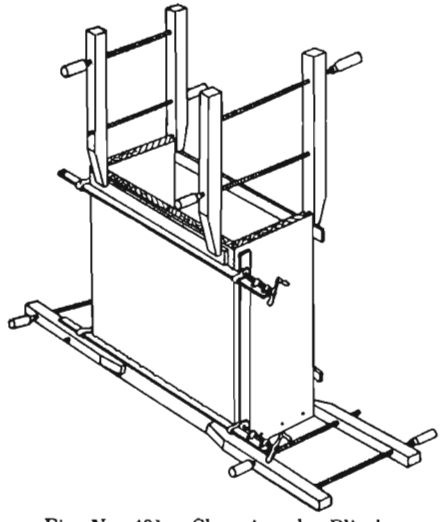


Fig. No. 481. Clamping the Plinth

parts together and clamp them snugly in place as shown in Figure 481. See that the top edges are even. Test the assembled parts for squareness and if they are not square, adjust the clamps to draw the parts in proper position. A cleat can be tacked to the back as shown in Figure 481. This will aid in squaring up and holding the sides in place. The parts should remain in the clamps until the glue is thoroughly set. Some glues set slower than others, therefore it would be well to leave the clamps in place at least four hours, and preferably overnight.

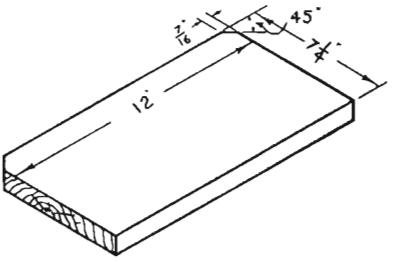


Fig. No. 482. Plinth Bottom

The two front corners of part number 3 which is the bottom board, should be cut off so the corners will not come in contact with the splines. This operation can be done on the circular saw by setting the miter gage for 45 degrees and sawing off the two front corners as shown in Figure 482.

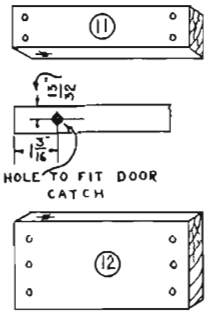


Fig. No. 483
Front Cross Rails

Boring Holes for Door Catches

The holes should be bored in the top edges of the cross rail number 12 and in the bottom edge of rail number 11, for the ball catches. It is much easier to bore these holes before assembling the parts. The size of the hole required will be determined by the size of catch purchased. The centers of the holes should be 3/8 inch from the inside edge of the rail as shown in Figure 483. The holes should be countersunk slightly after boring.

On some ball catches the bottom end of the ball part moves down below the shell when the top is pressed down. This type of catch requires a deeper hole than the shell to provide clearance for the bottom end. The holes for the catches should be bored so the shell fits snugly and will not fall out.

Bore Holes for Electric Cord

Bore a 5/16 inch hole in the center of part number 10. A bushing will be placed in this hole later for the electric cord. While the 5/16 inch bit is in the boring machine bore the hole in part number 25. This hole is for the electric cord also and its location is shown in Figure 484.

Saw part number 15, which is the waist bottom, to the finished size. This is 1/4 inch thick, 4 3/4 inches wide and 8 1/8 inches long. This completes the machine operations on the waist parts for the present.

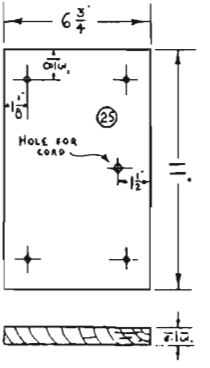


Fig. No. 484
Hood Bottom

Sand the Parts

Before assembling the waist, sand all the parts which are to show on the inside and outside, also the edges. Sand with number ½ garnet paper, first, followed with 2/0 and finally with 3/0. Always sand with the grain to avoid scratches that would show on the finished article. A sheet of garnet paper should be torn into either four or six pieces and stretched over a block which has been properly dimensioned. A regular sanding block with the paper fitted tightly over its base is recommended rather than the use of scrap pieces of stock.

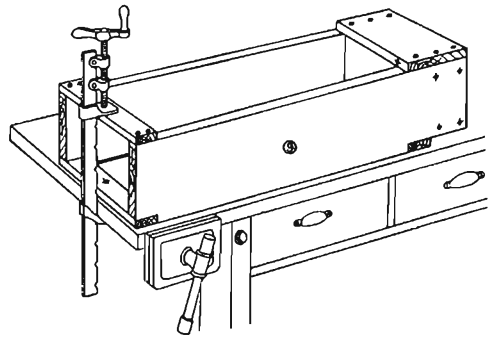
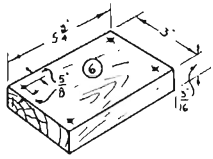


Fig. No. 485. Assembling the Waist



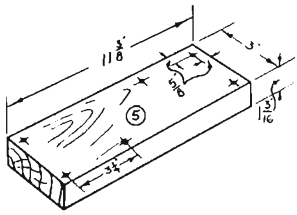


Fig. No. 486. Filler Blocks

Cork makes a good block for fine work. Solid cork, felt, or rubber blocks will not mar the raised portions or shaped edges due to an accidental bump. A block of wood can be faced with cork, felt, rubber or leather.

Assembling the Waist

The waist can now be assembled. Place the parts on the work bench as shown in Figure 485. A hand screw or bar clamp can be used to hold the parts in position until the screws are properly placed. Before placing the screws in the cross rails, 3/32-inch pilot holes should be bored for the screws in the edges of the sides. These holes can be bored with a hand drill. The screws should be 1½ inch No. 8 flat head wood screws. A little soap or beeswax placed on the threads of the screws will make them easier to drive. Be sure the ends of the sides and rails are even and square before driving the screws.

When the top front cross rail is screwed in place release the clamp, reverse the waist, and clamp the wide bottom front rail to the sides. Again see that all parts are square, then bore the pilot holes in the sides and

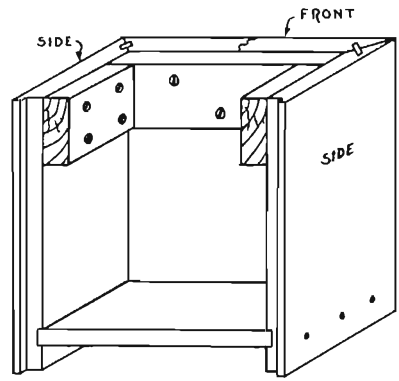


Fig. No. 487. Back View of the Plinth

insert the screws. Turn the waist over so that the back side is up. Insert the bottom panel. Clamp the rail in place, see that the rail is square with the sides, bore the pilot holes and drive the screws in this part.

Screw the top back rail in place, using the same methods that were used for the other rails. This completes the assembly of the waist.

Glue Bottom Board in the Plinth

Place the bottom board part 3, in the grooves in the plinth and slip it in place. If it fits too tightly do not force it in place as this may break the joints apart, but remove it and plane a little off the edges until it will slide in place. Then remove it and spread glue in the grooves and again slide the bottom in place.

Fig. No. 488. Mitering the Base

Fit the Filling Blocks in the Plinth

The filling pieces should be 1$\frac{3}{16}$ inches thick and 3 inches wide. One piece should be 11$\frac{1}{4}$ inches long and two pieces 5$\frac{1}{4}$ inches long. Bore these pieces for 1$\frac{3}{4}$ inch No. 12 screws as indicated in Figure 486. Clamp the long piece to the inside of the front of the plinth then bore the pilot holes and screw it to the front. Put the short pieces on the sides in like manner. The plinth will then appear as shown in Figure 487.

Mitering the Base

Sand the plinth in the same manner that the waist was sanded. The next operation is to miter the base to form the feet. Tilt the table to 45 degrees and place a piece of scrap lumber which is the same as the base, flat on the table, hold one edge against the miter gage and bevel cut off the end. Do the same with another piece of the same thickness, then place the miter joint together and see that the pieces are square when the joint is tight. If any adjustments are necessary they should be made before

cutting the good pieces. Bevel cut one end of the long piece for the front first. A sturdy guide fence which will support the ends of the lumber is shown in Figure 488.

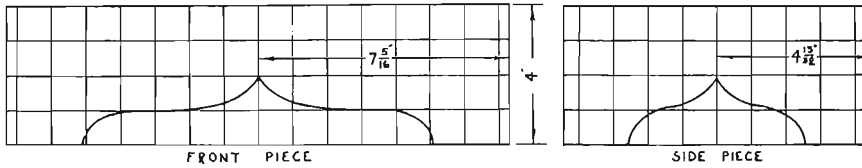


Fig. No. 489. Base Parts Marked on 1 inch Squares

Bevel cut the other end by making a pencil mark on the inside edge equal in distance from the inside of the miter to the width of the base. This distance will be 13 inches if the plinth was properly made. Place a stop block on the cut off gage so the saw blade will start to cut on the mark then start the saw and cut this end as shown in Figure 488. Hold or clamp this front piece to the plinth front to see that the part has been cut the correct length. As this base is to lap over the bottom edge of the plinth 2 inches it is well to make a light pencil mark on the sides and front 2 inches from the bottom. The base front can then be clamped in the correct position, but do not glue it yet.

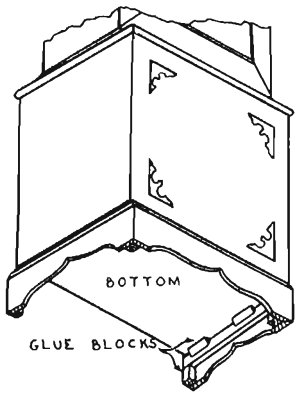


Fig. No. 490

Cut the miter on one end of each side piece and clamp them in place. Mark the length on the side pieces while they are clamped, remove the clamps and return the saw table to a level position and cut the side pieces to the required length.

Band-Sawing the Base

The base parts should then be marked and band-sawed, using the patterns shown in Figure 489. Sand the shaped edges before gluing.

Gluing the Base to the Plinth

Glue and clamp the base parts to the plinth, and then bore the pilot holes and turn the screws in place. The screws used should be 1¼ inch number 10 flat head screws.

The bottom corners of the base should be reinforced with glue blocks. These can be seen

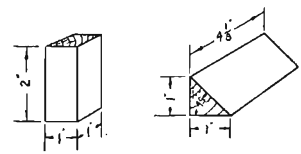


Fig. No. 491. Glue Blocks

in Figure 490. The size of the corner blocks is given in drawing A in Figure 491. Triangular glue blocks as shown at B in Figure 491 should be glued in place as shown in Figures 490 and 492.

Fastening the Waist to the Plinth

When the filler blocks have been screwed in place slip the waist in place to make a trial fit. If it fits too tightly do not force it in place, as this may split the base, but remove the filler blocks and joint them slightly. If the waist fits too loosely it would be best to make new filler blocks a trifle thicker.

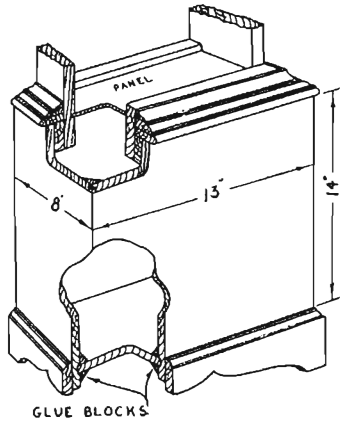


Fig. No. 492

Hold a square against the base top as shown in Figure 493 to test the top edge for squareness. These edges must be square with the sides and front or the moulding will not fit properly.

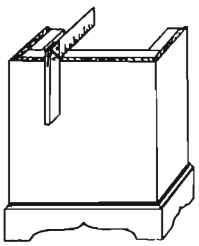


Fig. No. 493
Squaring the Edge of the Plinth

The waist may now be fastened to the plinth. The bottom end of the waist extends into the plinth a distance of 3 inches. Square a line all around the bottom end of the waist 3 inches from the end, to act as a guide when setting the waist in place.

These parts can be assembled on the work bench. Clean off the bench and brush off all chips, etc. Place two short pieces of 2x4 on the bench to support the waist, as in Figure 494. Place several narrow pieces of corrugated paper on the top of the waist supports and a large piece under the plinth. This will prevent the parts from becoming scratched or marred. Level the parts and see that the line around the waist is even with the top of the plinth. Place clamps on each side to hold the parts together. Short pieces of smooth lumber placed under the outside jaw of the clamps will prevent clamp marks on the plinth.

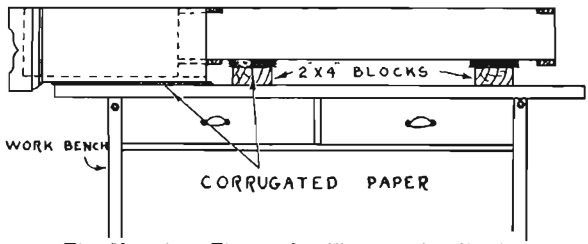


Fig. No. 494. Fitting the Waist to the Plinth

See that the parts are square with each other. Screw the fronts of the parts together first, using 1½ inch No. 10 flat-head wood screws. Remove one side clamp if necessary and screw the side to the plinth, then do likewise with the opposite side.

Cutting the Grills in the Hood Sides

The sides for the hood as well as the top and bottoms have been cut to the finished sizes. The next step is to scroll saw the grills in the sides. Remove all pencil marks from the sides where the designs are to be placed. Lay out and draw the pattern accurately on each side piece as shown in Figure 495. Bore several small holes in each part that is to be removed to make it easier to cut out the openings. Care should be exercised in boring the holes. They should be bored a little inside the lines. Awl holes will aid in starting the drill at the right points. A 3/16 drill will make the holes large enough for scroll sawing this design. The holes can be bored on the boring machine or drill press as shown in Figure 496. Better results will be obtained if the design in each side is cut separately than if the two sides are tacked together and cut at one time. See Figure 497.

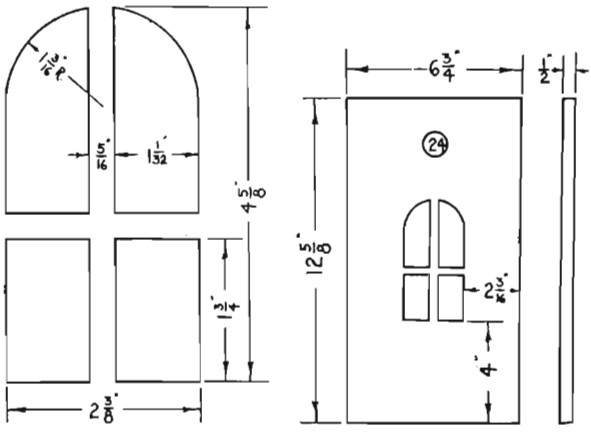


Fig. No. 495. The Hood Side Grills

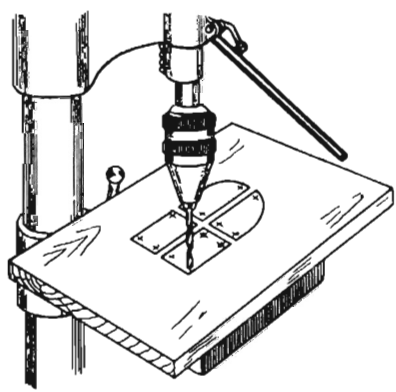


Fig. No. 496. Boring the Holes

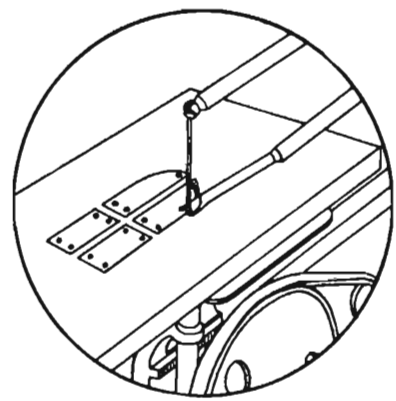


Fig. No. 497. Scroll-Sawing the Grills

Sanding the Hood Sides

When the grills have been sawed out, sand the edges smooth, also sand the flat bottom of the hood. Do not sand the ends of these parts.

Bore the holes in the bottom as indicated in Figure 484.

If a pendulum clock movement is to be used the opening can be made by boring four holes with the ½-inch bit and scroll-sawing the opening.

Assembling the Hood

The sides of the hood may now be glued to the top and bottom as shown in Figure 498. Test the assembly for squareness, and see that the front edges are even with the ends of the sides.

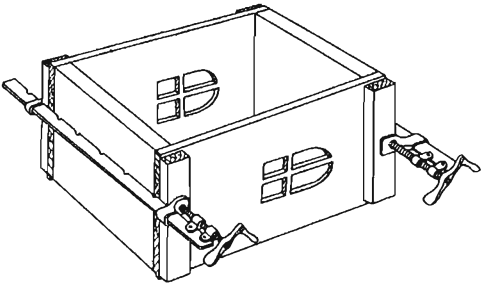


Fig. No. 498. Clamping the Hood

Making the Dial-Frame Cleats

While the glue is drying, cut the dial-frame cleats to size. These are to support the dial frame, which is to be glued to them later, and may be made of any kind of lumber or scrap wood, which must be dry. Two pieces are needed, 13/16 inch thick, 1 inch wide and 11 inches long, and two pieces the same thickness and width but 9 inches long. The location of the screw holes is shown in Figure 499.

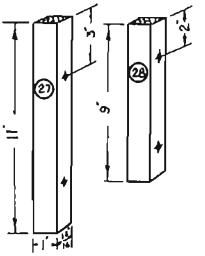


Fig. No. 499. Dial Frame Cleats

Cutting the Lumber for the Mouldings

The pieces to make the mouldings, doors, dial frame and pediment can be cut next. The mouldings at the bottom and top of the waist are made up of three parts to make the 2⅛ inch thickness. The construction is shown in Figures 500 and 501.

The moulding number 18, shown in Figure 500, is made from lumber ½ inch thick. It should be ripped 2¾ inches wide, then jointed on the best edge, which

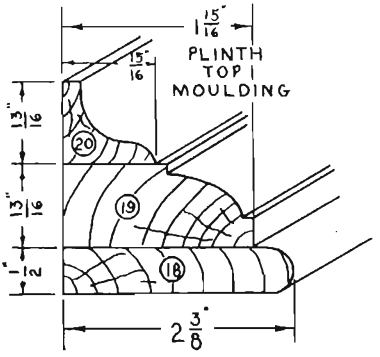


Fig. No. 500

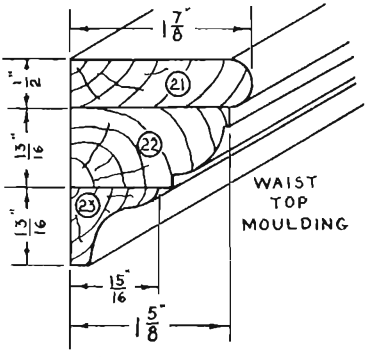


Fig. No. 501

will be shaped or moulded later. It will be ripped to the finished width after shaping. A piece about 36 inches long will be sufficient to make the front and side mouldings.

Moulding number 21, as shown in Figure 501, is also ½ inch thick. It is ripped 2¼ inches wide and jointed on one edge. A piece 33 inches long will be needed.

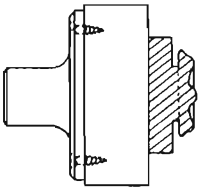


Fig. No. 502. Turning a Rosette Using Faceplate

Moulding number 19, shown in Figure 500, is made from the 13/16 inch stock. It is ripped 2¼ inches wide and then jointed on one edge. A piece about 32 inches long will be sufficient. These mouldings can be made of short pieces if necessary. For example moulding number 19 may be made of one piece 14 inches long for the front and two pieces 9 inches long for the sides.

Moulding number 22, is made from the 13/16 inch stock. This should be ripped 2 inches wide and jointed on one edge. A piece about 32 inches long will make enough.

Mouldings number 20 and number 23 are the same. This moulding will be easier to shape if it is ripped 2¾ inches wide and jointed on both edges so that both edges can be shaped, after which the mouldings can be ripped to the finished size. A piece 30 inches long will make enough of this moulding.

Before shaping any of this moulding it would be well to rip the other parts while the saw blade is in place.

The hood top, moulding number 32, shown in Figure 524 is ripped 3 inches wide, then jointed on the best edge. A piece 33 inches long will be needed.

The dial frame number 29 shown in Figure 543 is ripped 1½ inches wide. It will take a piece 48 inches long, or two pieces 24 inches long, or four pieces 12 inches long. As this frame is to be ⅝ inch thick, it should be planed down to this thickness on the jointer. By running the pieces over the jointer the same number of times there should be no variation in the thickness of the pieces. After planing the stock to thickness, joint one edge straight and smooth.

The stock for the top door stiles and rails should be ripped 2 inches wide. The four pieces are made from a piece 52 inches long, or they may be made up in single or double lengths depending on the material at hand. The top door and the waist door stiles and rails are ¾ inch thick and 2 inches wide, therefore it would be well to rip the material for the waist door next. Two pieces 31 inches long are needed for the stiles, and two pieces 10 inches long for the top and bottom rails.

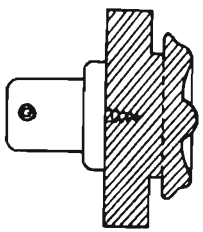


Fig. No. 503. Turning a Rosette Using Screw Center

The stiles and rails for both doors should be planed on the jointer to ¾ inch in thickness. Joint one edge straight and smooth, then rip to 1 13/16 inches wide. The parts for the pediment can be ripped at this time.

The front piece will be band sawed later. The front piece should be 4⅛ inches wide and 13 inches long; the side pieces 1¼ inches wide, and two pieces are needed about 9 inches long, so as to make them 8 inches long when mitered and cut to length.

The pieces number 37 to make the turning at the center of the pediment should be ripped 1⅝ inches wide. Two pieces are needed about 8 inches long, which are glued together to make a 1⅝-inch square section.

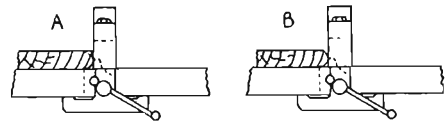


Fig. No. 504. Shaping the Bead Moulding

The pieces from which the rosettes are to be made can be cut 2 inches square from odd pieces not needed for other parts. These can be glued to blocks, which are later fastened to the faceplate, as shown in Figure 502, or the screw center only can be used to hold the pieces while turning as shown in Figure 503. One method is to glue thin paper between the rosette piece and the faceplate block; then the rosettes are easily parted from the blocks and the paper scraped off after turning.

Shaping the Mouldings

The moulding cutter head can now be used to shape the mouldings. This cutter can be used on the circular saw arbor or the shaper spindle.

A set of style A knives can be used to shape mouldings number 18 and 21. If the moulding cutter is used on the circular saw the table and guide fence should be set as shown at A in Figure 504. The knives will then cut one half of the bead. Be sure to place the jointed edge of each piece against the guide fence. Place the other flat surface on the table and run the piece over the cutters, a second time, as shown at B in Figure 504. This will shape the bead on mouldings 18 and 21.

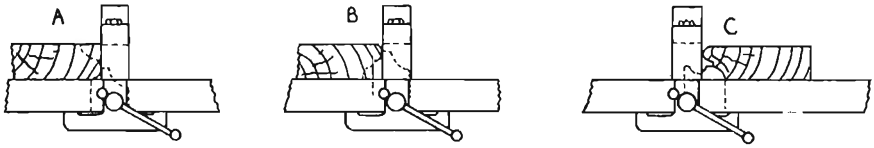


Fig. No. 505. Shaping the Top Moulding

While the machine is still set up for these mouldings, shape one edge of the top moulding number 33 as shown at A in Figure 505. Make this cut on all the pieces needed to make this moulding, also shape a piece of scrap wood of the same thickness, which will be needed to make a trial cut, after lowering the table to cut the other half of the bead. Lower the table until the left side of the knife projects ⅜ inch above the table when the knife is at its highest point. The guide fence should not be moved. Make a cut part way in the trial piece, stop the machine and see if the proper shape is being made. Make any adjustments necessary and again make a cut in the trial piece. When the machine is properly set, run all

the good pieces over the cutterhead as shown at B, Figure 505. A set of style E knives is used to make the cove in this moulding, as shown at C, Fig. 505, but, as a set of style A knives are in the cutterhead it

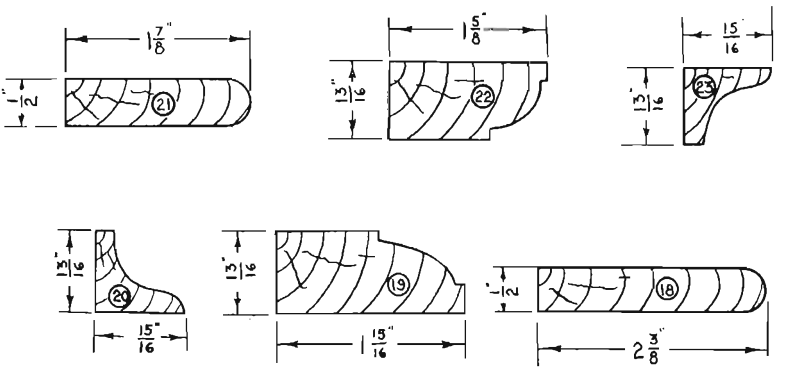


Fig. No. 506. Finished Mouldings

would be better first to shape all other parts which require the style A knives.

Moulding number 22 shown in Figure 506 may be shaped as shown in Figure 507. When shaping a moulding, regardless of the type of cutter or machine being used, always observe the grain of the wood and turn it if possible so that the cutters will cut with the grain. If the work must be fed so that the knives cut against the grain, feeding the work past the cutters slowly will prevent tearing the edges to some extent.

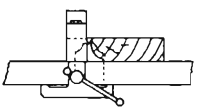


Fig. No. 507

The door stiles and rails may be shaped with the style A cutters. The waist door stiles and rails are shaped on both inside edges. The grooves for the panel can be cut later. Figure 508 shows the two shaping operations. The hood door stiles and rails are shaped only on the front inside edge, while the back will be rabbeted later for the glass and glass moulding.

Shape the glass moulding as shown in Figure 509. The dial frame parts can be shaped as shown in Figure 510.

Moulding number 19, shown in Figure 506, can be made with a set of B knives. Figure 511 shows the set-up for shaping this moulding on the circular saw, using the cutterhead.

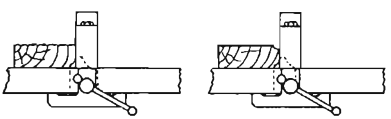


Fig. No. 508. Shaping the Door Stiles and Rails

The hood top moulding, number 33, which has been partly shaped with the style A knives can now be finished with a set of style E knives, as shown at C in Figure 505.

Making the Dowels

This same set of knives can be used to make the dowels for the doors, as the stiles and rails are put together with doweled miter joints. The dowels made with these knives are ⅜ inch in diameter, and may be made

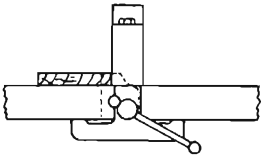


Fig. No. 509

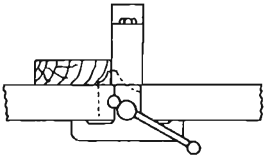


Fig. No. 510

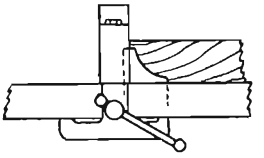


Fig. No. 511

of any hardwood which is dry. The making of dowels is described and shown on page 99 in Volume I.

Shaping the Cove Moulding

The pieces to make mouldings number 20 and 23 were ripped wide enough so that both edges could be shaped and then the moulding ripped to the required width. The finished mouldings are shown in Figure 506. To make this moulding use a set of knives which will cut a ½ inch radius (style C). After shaping the moulding as shown at A in Figure 512 another set of knives (style A) can be used to complete the shape as shown at B.

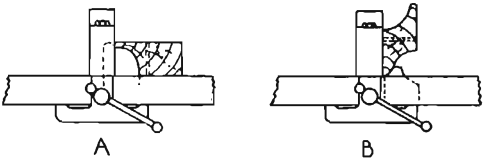


Fig. No. 512. Shaping the Cove Mouldings

Grooving the Waist Door Stiles and Rails

The waist door stiles and rails should be grooved on the inside edge for the panel. The two outside cutters of the dado head will usually cut a groove slightly wider than ¼ inch, so if the panel is fully ¼ inch thick these two cutters may be used to cut the grooves as shown at A, in Figure 513. It should be remembered, however, that a ¼-inch panel is usually a little less

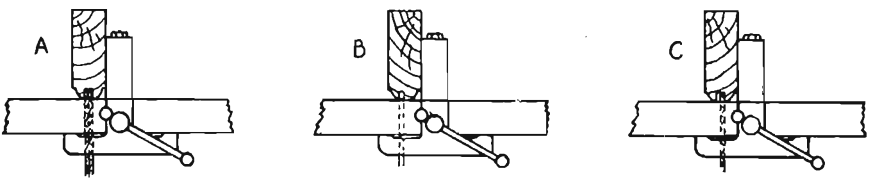


Fig. No. 513. Grooving the Waist Door Stiles and Rails

than ¼ inch thick when it is sanded on both sides. The panel must fit the grooves snugly, not too loose or too tightly. One of the outside dado cutters or the circular-saw blade can be used to cut these narrow grooves by cutting

a kerf in the edge of a piece as shown at B, in Figure 513, then resetting the guide fence and cutting another kerf at the side of the one just made as shown at C in Figure 513. Place the same side of the pieces against the guide fence for both operations. Make trial cuts in a piece of scrap wood, then try the panel in the groove in the scrap wood and make any necessary adjustments before grooving the good pieces.

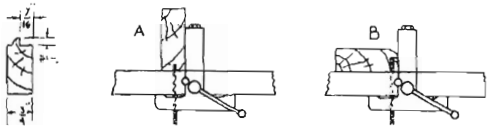


Fig. No. 514

Rabbeting the Hood Door Stiles and Rails

The rabbet cuts can be made in the hood door stiles and rails for the glass in several ways. It is important that the edges be not torn out because the inside of the door will show when the door is open. If the pieces show any cross grain it would be well to saw out the rabbets, using the hollow ground blade. This method will prevent any tearing or slivering along the edges of cross-grained places in the wood. Figure 514 shows the first cut at A; after making this cut in all the pieces the machine can be set as shown at B to make the second cut.

Cut the Mouldings to Finished Width

Moulding number 18 should now be ripped 2⅜ inches wide; moulding number 21, 1⅞ inches wide; moulding number 19, 1 15/16 inches wide; moulding number 23, 1⅝ inches wide; mouldings number 20 and 23, 15/16 inch wide as shown in Figure 515. The mouldings should be ripped a trifle full in width so that the edges can be smoothed on the jointer, taking a light cut.

The hood-top moulding number 33 should be ripped 2⅝ inches wide, and the dial-frame parts number 29, 1 5/16 inches wide.

Both door stiles, number 13 and 30, and the rails number 14 and 31 should be ripped 1 13/16 inches wide. These parts will be jointed after the doors are assembled.

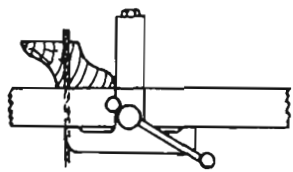


Fig. No. 515. Ripping the Cove Mouldings

Sand all the flat surfaces as well as the shaped edges of all the mouldings, door stiles and rails.

Fasten the Hood to the Waist

The hood should now be screwed to the waist. It should be even with the waist at the back and should project 1½ inches on each side of the waist. Clamp the hood to the waist to hold it in position, then set 1½ inch No. 8 wood screws in the screw holes and tighten the screws.

Place the Dial Cleats in the Hood

The cleats may now be fastened to the inside of the hood. The dial frame will be glued to these cleats later. They are set in 13/16 inch from the front

edge of the hood. A line marked around the inside of the hood 13/16 inch from the front edge will aid in placing them properly. One of the long cleats should be placed on the hood bottom first. Spread a thin coating of glue on the bottom edge of this cleat, then clamp it in position, with the front edge of the cleat on the mark previously made on the hood. While clamped in position, the 1¼ inch No. 8 screws should be inserted and tightened. The clamp can then be removed. The cleat on the inside of the top should be placed next in the same manner. The side cleats can then be fastened in the same way with glue and screws. It must be remembered that the sides of the hood are only ½ inch thick and if any long screws are used they will extend through and spoil the side. If the worker prefers he may glue the side cleats and omit the screws but a good job of gluing must be done. Figure 516 shows the cleats in place.

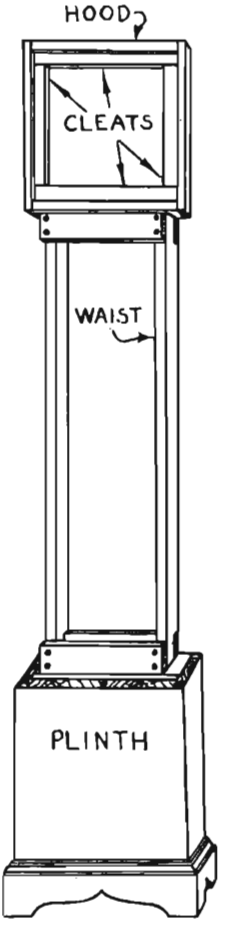


Fig. No. 516

Mitering the Moulding

The next operation is to miter the moulding for the top of the plinth. As this moulding is made up of the three parts numbers 18, 19 and 20, they can be glued together and then mitered as one solid piece of moulding, but unless the parts are kept in perfect alignment when gluing, they will not fit well. The home craftsman will have better success if each part is mitered and glued on separately. In using the latter method, moulding number 18 should be mitered first. Before cutting the miters it would be well to read the article on miters starting near the bottom of page 75 in Volume I.

Making a Mitering Jig

The average woodworker has a great deal of mitering to do and unless the miters fit perfectly a poor looking joint will result. As most of the miters are cut at an angle of 45 degrees the woodworker will find it well worth while to make a jig for the circular saw like that shown in Figure 517 which will insure cutting perfect miters and at the same time save the time required for setting the miter gage accurately. A mitering jig can only be used on a well designed machine having accurate slide grooves, but it is easy to make and can be slipped on the table when needed, then, without any adjusting, it can be used to cut the miters accurately.

The sliding table of the jig is made of a piece of plywood, ¾ inch thick, 24 inches wide and 27 inches long. The reason this piece should be plywood is because it is less liable to warp, swell or shrink which would cause the

miters to be inaccurate. A piece of cold rolled steel is needed, to fit the slide grooves in the saw table. For this machine a piece 3/16 inch or 1/8 inch thick, 1/2 inch wide and 24 inches long, was used. Bore and countersink 4 holes in the steel so that it can be screwed to the underside of the plywood table. To set the slide bar correctly draw a line down the center of the plywood

Fig. No. 517. Using a Mitering Jig

panel. Measure the distance from the saw blade to the slide groove in the saw table. Mark this distance from the line on the plywood panel, measuring to the right of the center line. Screw the slide bar to the plywood panel, keeping the left edge on the mark.

The back fence or yoke shown at B in Figure 518 is made from a piece of lumber 1 1/4 inches thick, 2 1/4 inches wide and 12 3/4 inches long. Band saw it to the shape shown in Figure 518. Screw it to the top with the back edge even. Insert the screws from the bottom. This part is to hold the two parts in place after the saw cut is made. Do not place a screw at the center as the saw blade is to cut a kerf at this point.

The part C is made 13/16 inch thick, 1 inch wide, and 3 inches long. This piece is screwed to the underside of the plywood top, at the front and even with the edge. Its purpose is to act as a stop. When it comes in contact with the edge of the regular saw table the jig cannot be advanced farther; this will prevent the jig from being cut all the way through the center.

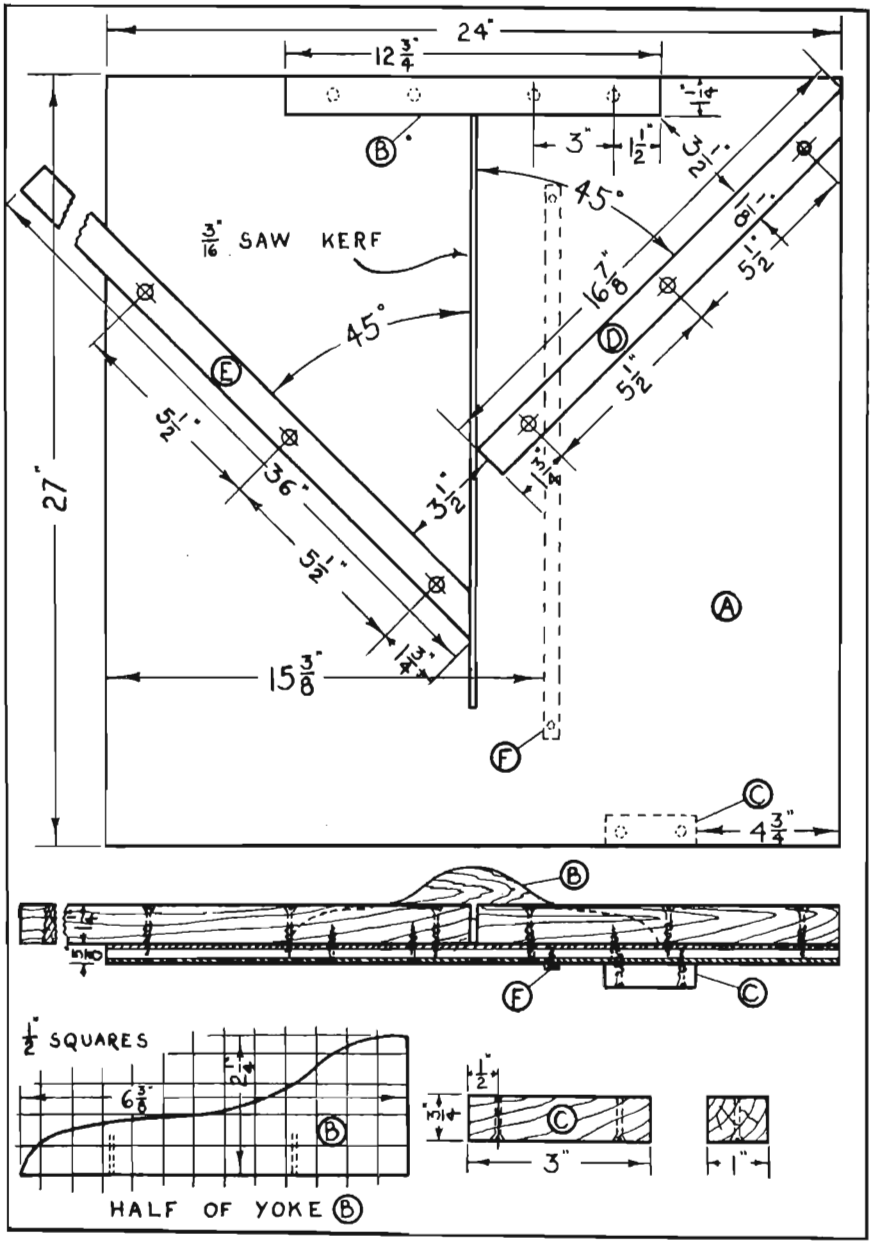


Fig. No. 518. A Mitering Jig for the Circular Saw

Adjust the saw table so the blade projects about 1½ inches above the table. Start the saw and place the jig on the front of the saw table so that the steel slide bar is in the right hand groove in the saw table. Slide the mitering board forward until part C strikes the front end of the saw table. The saw blade will cut a kerf in the center of the mitering board.

The fence D is 1⅛ inches thick, 1¼ inches high and 16⅞ inches long. Fence E is 1⅛" x 1¼" x 36". Measure the location of the two guide fences on the board. The miter gage, set to 45 degrees may be used to mark the angles on the board. This can be done by setting the miter gage slide bar even with the saw kerf, then drawing a line on the board by sliding a pencil

Fig. No. 519. Making the Second Miter Cut

along the face of the gage. This line can be extended by using a square or a straightedge. Set the miter gage so the pointer is on the 45 degrees mark on the opposite side and mark the angle for the other guide fence.

Place part E on the mark on the right-hand side and drive a nail through one end into the miter board. Clamp the other end of this piece to the board. Select two pieces of scrap wood about 3 inches wide and make trial cuts. Miter one end of each piece and place these ends together. Hold a square against them to see if the joint is tight when both parts are tight against the square. If the miter is not perfect loosen the clamp and swing the guide fence slightly, clamp it tight and cut the same pieces again.

When perfect miters can be cut leave it clamped in place and set the other guide fence in the same manner. Then cut one miter using one guide fence and the other miter using the other guide fence. Place these cuts together and again test for squareness, correcting any slight error. When perfect miters can be made, bore the screw holes in the fences and screw them securely to the board. Remove the clamps and the board is completed. Several coats of shellac will seal the wood from moisture and will make the table slide easily.

Sawing the Miters

Always use a sharp saw blade for mitering, preferably a hollow-ground blade. To miter moulding number 18, place the shaped edge against the right guide fence and push the miter board forward as shown in Figure 517. The piece in front should be mitered first, as the waist is 9 inches wide the front moulding must be 9 inches long on its short edge. Make a mark with a sharp pencil or a knife blade on the edge of the moulding 9 inches from the inside of the miter. Place the piece against the left guide fence so the saw will "split" the mark and set a stop block at the end as shown in Figure 519, then saw the miter. Place the piece on the front of the plinth and see if it is the correct length. If too long move the stop block nearer the saw blade and make another cut. If it is too short it can be used for the side moulding and another piece must be mitered for the front. If the measurement is made accurately and the stop block set properly, the miter will be cut off to the correct length.

The mouldings for the sides can be mitered next and it is well to leave them about ¼ inch longer than necessary until they are fitted. Place the front piece in position and drive 1-inch brads through it so the brads just pierce the wood below and the front moulding cannot be shifted. Hold the end pieces in place to see how the miters fit. If they fit perfectly, mark the exact length on the side pieces at the back ends and saw these off square.

Gluing the Moulding

Remove the front piece and spread glue on the underside, keeping the glue about ¾ inch away from the front edge. Put it in place again and drive the brads down tight. Spread glue on the undersides and miter joints of the side pieces and brad them down.

Mitering and Gluing the Ovolo Moulding

Cut moulding number 19 the same way, resetting the stop block to cut the front piece. When this moulding is mitered it can be glued and nailed down with 1½ inch finishing nails. Screws may be used instead of nails if desired. Holes should be bored in the parts to admit the nails or screws to prevent splitting.

Mitering and Gluing the Cove Moulding

Cut moulding number 20 in the same manner. It would be better to glue and clamp this moulding in place than to use brads. If brads are used they must be sunk and the holes filled. If clamped, lay dowels in the cove of the moulding to protect the moulding from clamp marks.

Fitting the Mouldings at the Base of the Hood

The mouldings 21, 22 and 23 should be mitered and put in place by using the same methods as were used in fitting the other mouldings, the only exception being that the front part of moulding number 21 must be bored to take the ball catch for the top door. This is bored after the piece is mitered and before it is glued down. Figure 520 shows the location of the hole. These mouldings can be placed easier if the clock case is stood on a clean board, with the top end down.

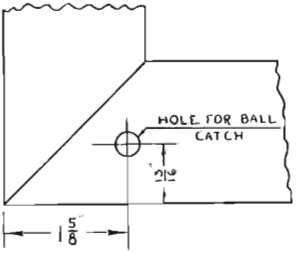


Fig. No. 520. Hole for Top Door Catch

Fitting the Back Door Stops

The hood back door stops should be placed in the hood next. The pieces are ⅜ inch square and four pieces are needed 11 inches long as shown in Figure 521. The ends are mitered. The stops are set in from the back edge of the hood a distance equal to the thickness of the back door. If the door is ½ inch thick, scribe lines ½ inch from the back of the edge of the hood and glue and brad the stops in place as shown at A in Figure 522. The glue blocks, about 4 inches long, can be placed inside the hood as shown at B in Figure 522. These glue blocks will not require clamping but are spread with glue and rubbed tight into place.

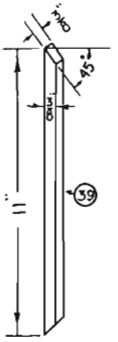


Fig. No. 521 Back Door Stop

Fitting the Hood Top Moulding

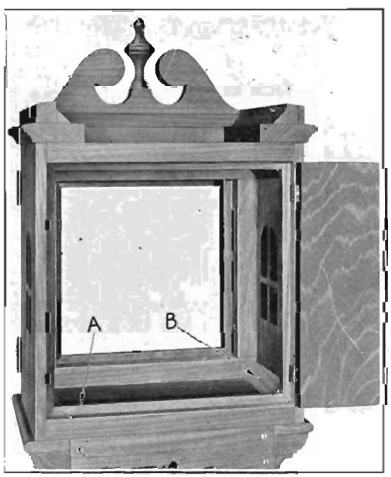


Fig. No. 522. Back of Hood

The hood top moulding, part number 33, can be mitered next. The piece for the front is mitered to a length of 13⅛ inches on the shaped edge, and should extend over the edge of the hood top a distance of 15/16 inch as shown in Figure 523. This extension is to cover the top of the door. When the door is closed the margin of the moulding should be the same in front as it is on the sides of the hood. Miter the pieces which are to be placed at the sides. Clamp the moulding in place and mark the position of the parts carefully. Mark the side pieces for length and cut them off so that they will he even with the back edge of the

hood. The miters should be bored for the dowels as shown in Figure 524.

Spread glue on the underside of the front piece but remember this piece extends over the edge of the front, therefore, do not spread glue near the front edge. A margin of about 1¼ inch should be left dry. Spread glue on the undersides of the side pieces leaving about ½ inch dry along the front edges. Spread glue on the miter joints and in the dowel holes. Slip the dowels in place and place the side pieces in place. Lay this frame in position on the hood top and clamp the front part first, then clamp the sides to the hood top.

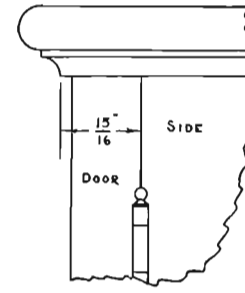


Fig. No. 523

Mitering the Door Stiles and Rails

Cut the waist door panel to the finished size. Miter the waist door stiles to a length of 30⅜ inches. Miter the waist door rails to a length of 9⅛ inches. It will be noticed that the door will be about ⅛ inch longer and ⅛ inch wider than required. This extra width and length is needed for final fitting.

If any variations have been made in the dimensions of the clock case be sure to make the necessary corrections in the door sizes.

The hood door stiles should be mitered to a length of 12⅜ inches and the rails 12⅛ inches.

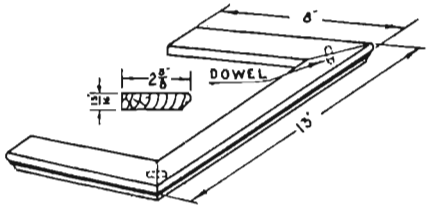


Fig. No. 524. Top Moulding

Boring the Door Stiles and Rails

The next operation is boring the dowel holes in the door stiles and rails. The position of the dowels is shown in Figure 525. One method of boring the holes for doweled miter joints is shown on page 225 in Volume II. Another method is shown in Figure 526. The latter method has several advantages, the most important of which is that a stop block at the outer end of the special guide fence prevents the piece being bored from sliding back.

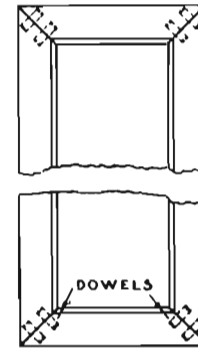


Fig. No. 525. Doweled Miter Joints

Making a Special Guide Fence

The special guide fence is 1¼ inches thick, 2¼ inches wide and 36 inches long. Bore ⅜ inch holes in the guide fence for the bolts which hold the fence to the table and for the hold-down rod castings. The holes for the hold-down rod castings must be counterbored on the bottom so that the bolt heads will not come in

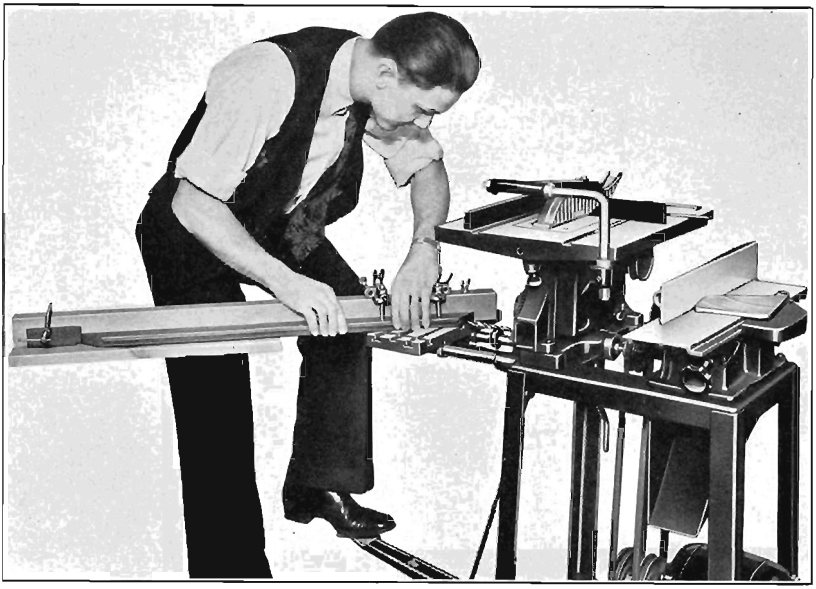


Fig. No. 526. Boring Holes For a Doweled Miter Joint

contact with the table. Figure 527 shows the location of the holes. Screw a piece of lumber ½ inch thick, 5 inches wide and 18 inches long to the bottom edge of the guide fence. This piece is placed at the outer end of the fence, and supports the end of the long door stiles while they are being bored; it extends on both sides, so that it will support the work on either side of the fence.

Setting the Boring Machine

To determine the correct position for the guide fence, and to set the table

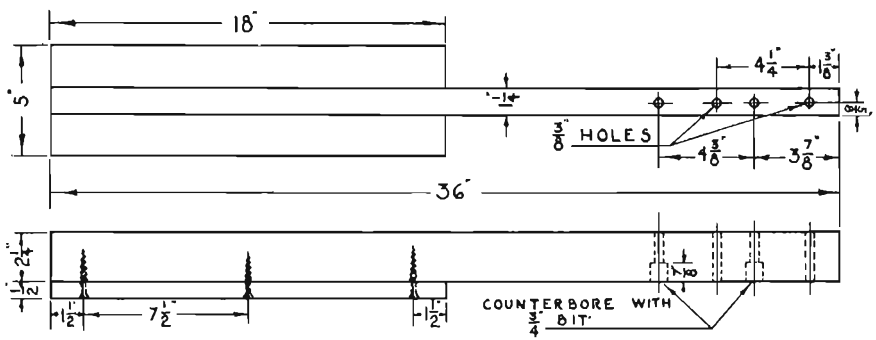


Fig. No. 527. Detail of a Special Guide Fence For the Boring Machine

at the correct height, mark the location of the holes on one end of one of the pieces to be bored as shown in Figure 528. Place a 3/8 inch bit in the spindle of the boring machine. Lay the marked piece on the table and adjust the table bracket so the bit point will just touch one of the center marks.

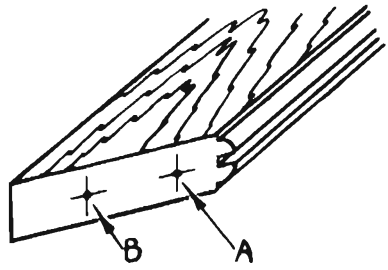


Fig. No. 528. Location of Dowel Holes

The special guide fence can be set at the correct angle by using a bevel square set to a 45 degree angle as shown in Figure 529 or the miter gage can be used as shown in Figure 530. The front end of the piece to be bored should be even with the front edge of the table. Set the guide fence so that the hole A can be bored first as shown in Figure 531. A spacer can be used between the fence and piece to be bored to bore hole B, as shown in Figure 532.

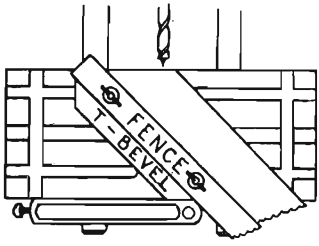


Fig. No. 529. Setting the Fence

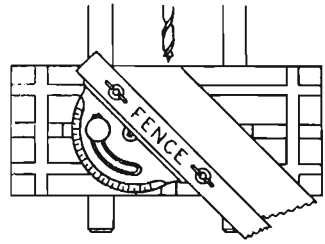


Fig. No. 530. Setting the Fence

A special stop block is used in order to keep the front ends of the pieces to be bored even with the front edge of the table, which will permit both holes to be bored the same depth without changing the stroke of the table.

A stop block is made from a piece of lumber 13/16 inch thick, 1 1/4 inches wide, and 6 inches long. A notch is cut at one end to support the end of the pieces being bored when the spacer is used. The notch should be cut accurately according to the sizes given in Figure 533 if a 5/8 inch spacer is used.

If a straight block is used instead of a notched block it will be necessary to re-set the stop block or the stop collar after boring the first set of holes, because using a spacer behind the work with a straight stop block will move the work forward a little, and thus make the second holes deeper.

If a notched stop block is used, it will not be necessary to make any changes in the setting of the stop block or the stop collar except for boring pieces of different length. See figures 531 and 532.

The spacer should be 5/8 inch square and about 29 inches long for

the long stiles. Several short pieces can be used for spacers for the short stiles and rails.

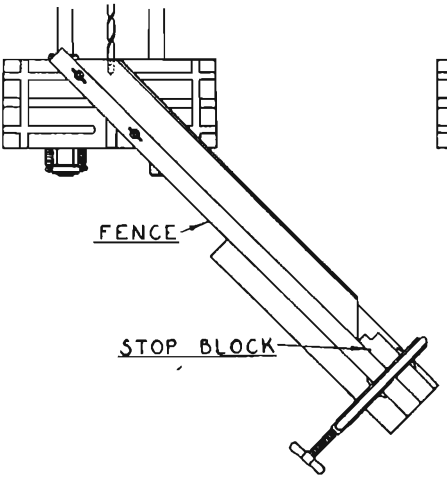


Fig. No. 531. Boring the First Hole

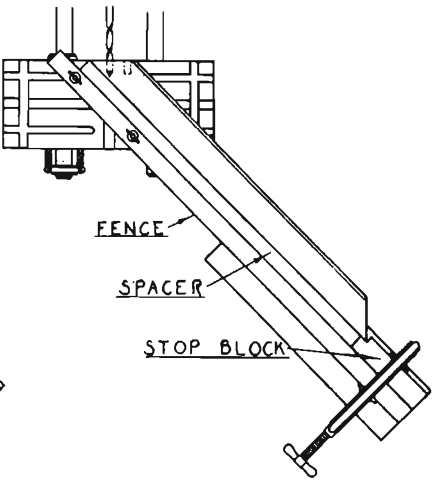


Fig. No. 532. Boring the Second Hole

Set the stop collar on the table slide so that the bit will extend 5/8 inch over the table when the table is moved forward.

Clamp the stop block to the guide fence so that when it is against the outer end of the door stile the front end of the stile is even with the front edge of the table. This is shown clearly in Figure 531.

Bore the first hole as shown in Figure 531. Place the spacer between the guide fence and the door stile and bore the second hole as shown in Figure 532. Turn the piece and bore the other end in the same manner. Bore both long stiles, then re-set the stop block and bore each rail. Re-set the stop block and bore the hood door stiles. Again set the stop block and bore the hood door rails.

It must be observed that the table must be set so the bit will bore exactly in the center of the thickness of the parts, as any error is doubled when the parts are turned over, and any carelessness in setting will be seen very quickly when the pieces are assembled.

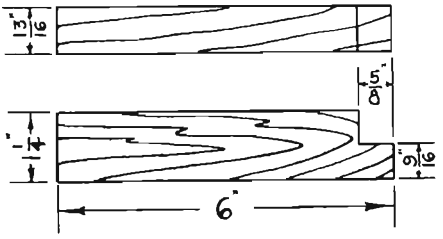


Fig. No. 533. Stop Block

The dowels should be cut 1¼ inches long. It is safer to cut these off with the band saw than it is with the circular saw. 16 dowels will be needed for the doors. Chamfer both ends of each dowel.

The waist-door panel, which has been cut to its finished size should be sanded perfectly smooth. Remove all fine scratches on the panel before it is assembled in the door.

Gluing the Doors

The parts for the waist door should be assembled first without gluing to see that all parts fit properly. Assemble the parts as shown in Figure 534. A good way to clamp mitered parts together is to fasten cleats at right angles to each other to a straight board or plank, and drive double wedges between the frame and two of the cleats as shown in Figure 535. This method makes it easier to keep the parts square than if clamps are used. Place paper between the door and the board to prevent sticking when the glue is applied. Mark or number the pieces at the joints so that the same joints can be placed together when gluing. Remove the door from the clamps and take the door apart so that the parts can be glued. Spread glue on the mitered joints and in the dowel holes. Put the dowels in the holes. Do not spread glue in the panel grooves or on the edges of the panel as the panel is not to be glued. A door panel should be free to expand or contract. Clamp the parts together as quickly as possible after applying the glue.

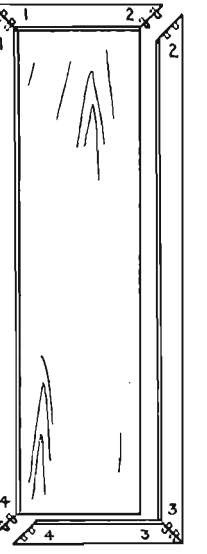


Fig. No. 534
Assembling the Door

Test the parts for squareness. Correct any part out of square by applying a clamp diagonally. Also test for flatness and twist by placing a steel square across the rails and glue joints. Correct any unevenness by clamping with a hand screw or by clamping pieces across the door. Clean off any glue that may squeeze out on the face sides or edges, using a cloth moistened with warm water, to prevent marks that may show later, when finishing. Leave the door clamped until the glue is thoroughly dry.

The hood door can be glued and clamped in the same manner. When

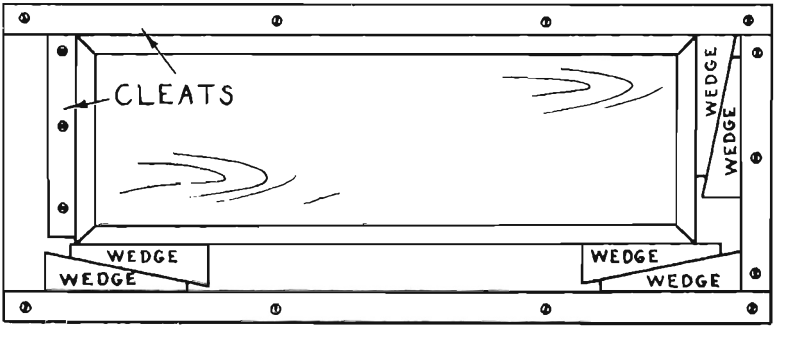


Fig. No. 535. A Method of Clamping a Mitered Door

the doors are removed from the clamps, clean off the surplus glue with a chisel or scraper, also use a cloth moistened with warm water.

Cutting the Overlays

Cut out the overlays for the waist door and the base. The overlays can be made of any veneer which is lighter in color than the wood used for the case. Veneer ⅛ of an inch thick is suitable for the overlays. If it is inconvenient to buy the veneer, saw a thin piece from a piece of lumber on the circular saw. Material for overlays can easily be made in this way. Sometimes beautiful pieces of birch or maple veneer which can be used for making overlays can be found on grape baskets or other containers.

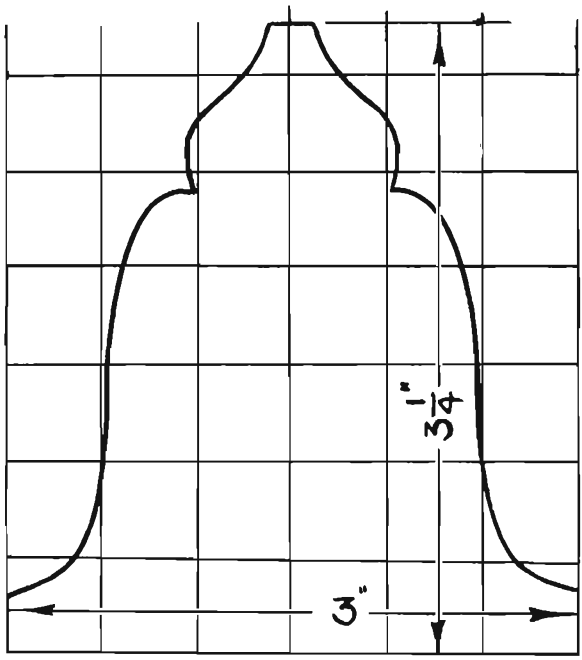


Fig. No. 536. Full Size Drawing of Half the Overlay For the Door

The designs shown in Figures 536 and 537 should be drawn full size on paper first. The paper should then be glued or pasted to a thin piece of lumber or plywood about ¼ inch thick and about 1 inch longer and 1 inch wider than the design. Another piece the same size is needed for the bottom. Cut the veneer the same size and place the veneer between the two ¼ inch pieces. Then drive brads to hold them together while sawing. The brads should be driven in at points that will be cut away as waste. Figures 538

and 539 show how the overlays are prepared for sawing. The designs can then be cut out on the scroll saw or band saw. Only one piece of veneer is needed for the door overlay, but for the base overlay, 4 pieces can be sawed at one time.

Gluing the Overlays

Before gluing the door overlay in place mark its position in the center of the door panel. Hold it in position and mark around its edge, making a very light pencil mark on the panel.

Two blocks are needed to put under the jaws of the hand screws when the overlay is glued. These blocks should be straight and smooth and about 4 inches wide and 8 inches long. They should not be thinner than $^{13}/_{16}$ of an inch.

Two pieces of cardboard 4 inches wide and 8 inches long will be needed to place between the clamp blocks and the door panel. The cardboard will prevent the top block from sticking to the panel and both blocks from pressing into and marring the panel.

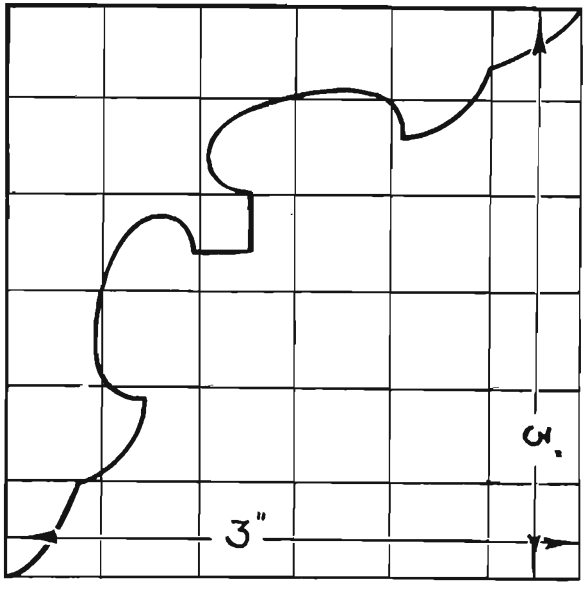


Fig. No. 537. Full Size Drawing of Overlay For the Plinth

Set the hand-screws so that the jaws are about the right distance apart for the work before spreading the glue on the overlay.

Lay the ends of the door on two horses or boxes so the hand-screws can be placed easily.

When everything is in readiness, spread the glue on the underside of the overlay. Use a very thin coating of glue. Place a little glue at the center first, and spread it out towards the edges, leaving about $^{1}/_{16}$ inch dry around the edges.

The glue will squeeze out enough to glue the edges tight when it is clamped. Place the overlay in position on the panel. Moisten strips of gummed paper and paste them across the overlay as shown in Figure

540 to prevent slipping. Lay the cardboard and block on the overlay. Hold the lower block and cardboard against the underside of the panel and clamp the blocks tight with the hand-screw as shown in Figure 541.

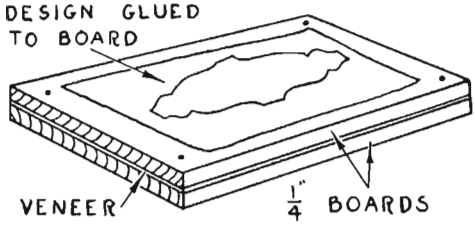


Fig. No. 538

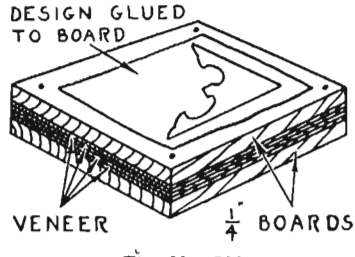


Fig. No. 539

The overlays for the base can be glued in much the same manner. Their positions should be carefully marked on the base before gluing. The clamp arrangement is shown in Figure 542.

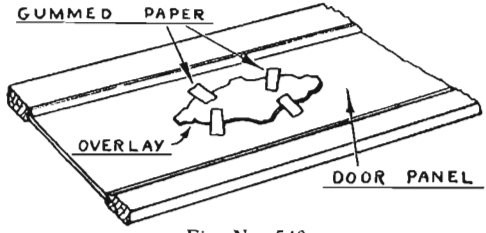


Fig. No. 540

Fitting the Dial Frame

The dial frame shown in Figure 543 can be mitered and glued in place next. The miters can be cut by using the same methods that were used to miter the door stiles and rails. Fit them in place without any glue at first. Sand the front faces and shaped edges also before gluing. Glue and clamp the parts in place as shown in Figure 544.

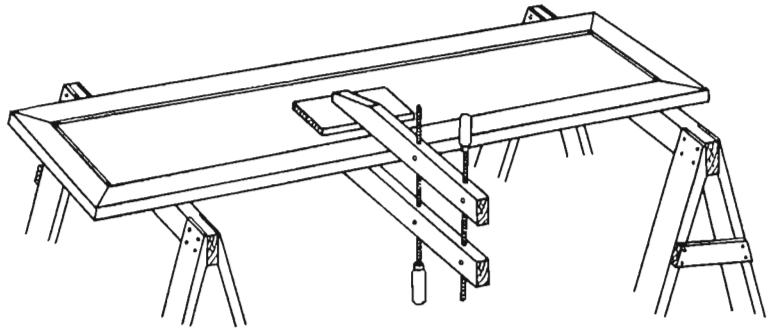


Fig. No. 541. Clamping the Overlay

Making the Pediment

Draw the pediment front design shown in Figure 545 on part number 35, and band saw it, as shown in Figure 546. The edge can be sanded with the sanding drum, mounted on the lathe as shown in Figure 547. Some hand sanding must be done on the inside of the scrolls. Use a coarse garnet paper first, then follow with a finer grit paper. The piece can be held in the vise while hand sanding the edge. If the vise jaws are not lined with felt to prevent marring the work, place cardboard between the vise jaws and the piece being held. Sand the flat surfaces also.

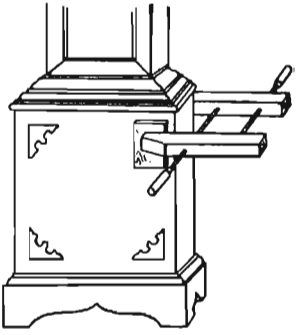


Fig. No. 542. Clamping an Overlay

Make a miter cut on each end of the pediment front piece next. The piece should be 12 inches long when mitered and the center must come in line with the center of the case. Make a mark at the center of the bottom, front edge of the piece. Measure and make a mark 6 inches each way from this center line. The miter cuts should be on these lines. When the miters have been cut clamp the front in place with hand screws, without gluing so the side pieces can be fitted.

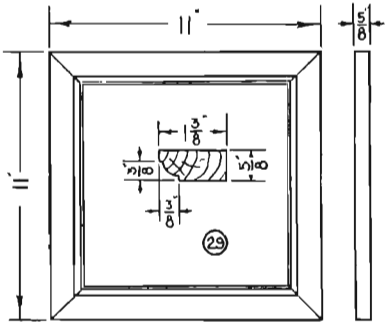


Fig. No. 543. Dial Frame

Miter cut the pieces for the pediment sides. Hold or clamp them in place. If they extend higher than the front at the miter joint, they should be jointed until they are even. They should then be cut to the finished length. Glue and clamp these side pieces in place. Remove the clamps from the front piece. Spread glue on the bottom edge and the mitered ends and clamp it in place. Place felt or thick cardboard between the clamp jaws and the sanded parts to prevent clamp marks.

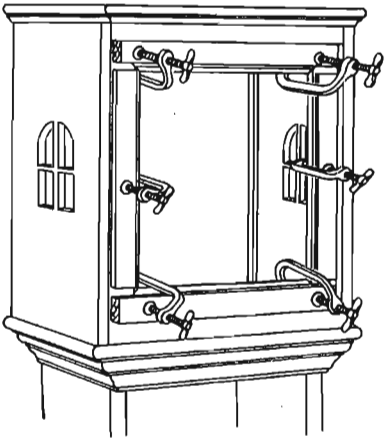


Fig. No. 544. Clamping the Dial Frame

Fitting the Doors

The doors can be fitted next. The length of each door should be about 3/16 of an inch less than the opening where it is to fit. This will give 3/32 of an inch of clearance at each end which is needed for the catches. The waist

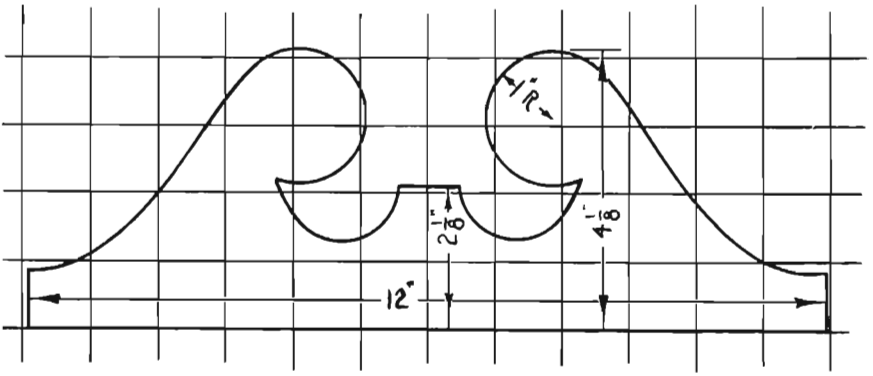


Fig. No. 545. Pediment Front Laid Out on One Inch Squares

Fig. No. 546. Band Sawing Pediment

door stiles should fit even with the sides of the waist and the hood door stiles should fit even with the hood sides.

The edges of the doors may be planed to fit by jointing the edges on the jointer. Hold a block against the back edge when jointing to prevent the knives from chipping the wood at the corner.

When the doors are trimmed to the proper size, sand them smooth and clean.

Fitting the Hinges

Some woodworkers prefer to fit the

hinges on the doors after the finishing coats have been applied, while others cut the gains for the hinges before finishing. If the hinges are fitted and the doors hung before finishing, there is less danger of scratching the finish when fitting the hinges and any inaccuracy in fitting can be corrected much easier.

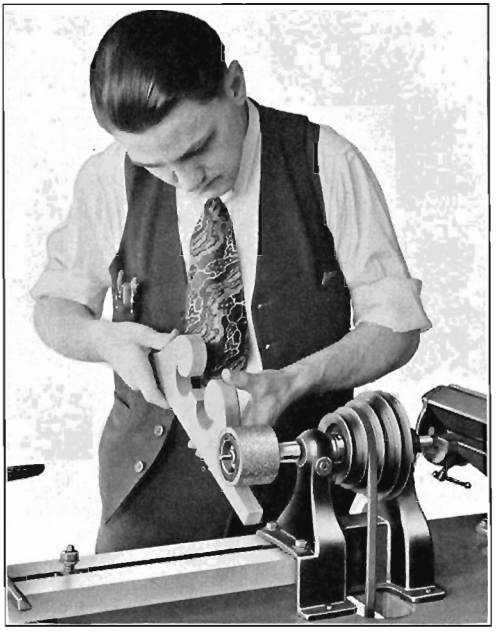


Fig. No. 547. Sanding the Pediment

Accuracy is essential in laying out and cutting the gains for the hinges. If a door is to close properly, the hinges must be set accurately. The hinges most commonly used are known as "butts." In the tight-pin butt hinge the pin is riveted in place, while the loose pin butt allows the pin to be removed. Upright doors are usually hung with loose-pin butts. The size of a butt hinge is the over-all dimensions in inches with the leaves open. The hinges for the clock case front doors are loose-pin butts 1¼ inches long and 1⅛ inches wide when the leaves are open.

The waist door hinges are set 3 inches from each end as shown in Figure 548. Make marks on the edge of the door where the hinges are to be placed. A knife point should be used to make the mark as shown in Figure 550. Place the door in its opening and place small wedges at the top and bottom ends so that the clearance is equal at each end. Then mark the waist side for the hinges, using the marks on the door as guides. Be accurate in marking the location of the hinges.

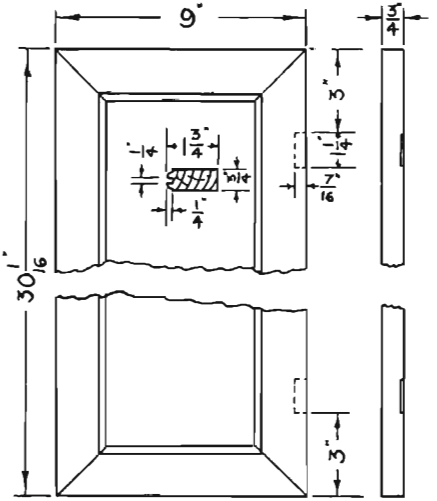


Fig. No. 548. Waist Door

One leaf of each hinge is to set flush with the door and the other flush with the waist edge. Lay the door on the work-bench and place the hinge in position to lay out the lines for the length of the gain. The width and depth are usually laid out with a marking gage as shown in Figure 551. Set the gage to mark the width about 1/16 inch less than the width of the leaf. Lay out and mark for the length and width of the gains for both hinges on the door and the edge of the waist side. Then set the marking gage for the depth of the gains by setting it to mark a depth equal to the thickness of the leaf. Mark all the gains for depth.

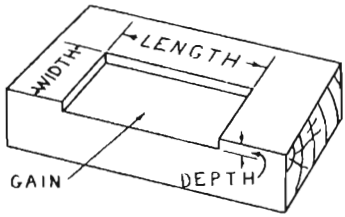


Fig. No. 549. A Hinge Gain

Chisel the outline of the gain very carefully by making a small V cut on the inside of the lines marked. Score the ends of the gain first, and then make a series of shallow chisel cuts within the V cuts as shown in Figure 552. The depth of the scores should be slightly less than the depth of the gain. Remove the surplus wood by chiseling carefully across the grain with the bevel side of the chisel up as shown in Figure 553. The bottom of the gain should be true and smooth. Insert the hinge in the gain to test for fit. Remove any imperfection with a chisel.

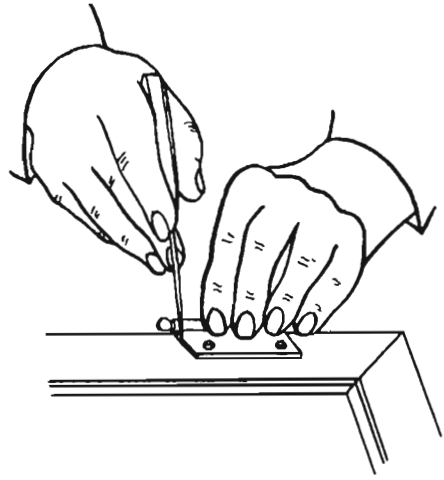


Fig. No. 550. Marking the Length of a Gain For a Hinge

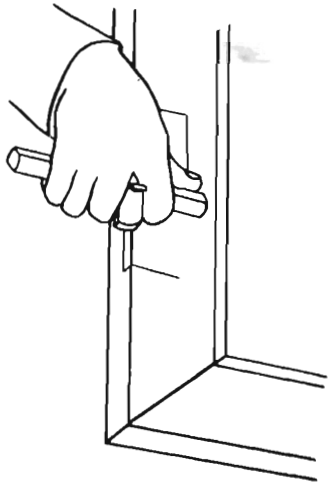


Fig. No. 551. Marking With a Gage

Place the hinges in position and bore for the screws with a push drill or a brad-awl. Bore the holes slightly toward the back of the gain so that the screws will pull the hinge tightly in place. Fasten one leaf of each hinge to the door with

⅜ inch, No. 3, flat-head, brass wood screws. When fastening loose-pin hinges be sure to set the hinge so the head of the pin is up or the pins will fall out when the door is in place.

After fastening the hinges to the door, remove the pins and fasten the other leaf to the edge of the waist. Place the door in position, and insert the pins.

Test the door by opening and closing it. If there is a wide opening between the edge of the door and the waist, remove the hinges and chisel the gains deeper. If the edge of the door and waist come too close together, so that the door will spring back or will not close, the gains are too deep. In this case, remove the hinges, and place pieces of heavy paper or cardboard under the hinges.

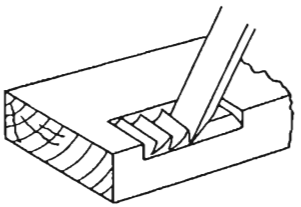


Fig. No. 552. Chiseling a Gain

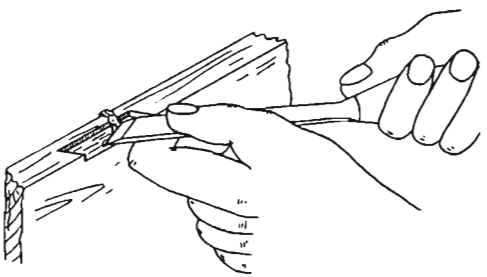


Fig. No. 553. Paring a Gain

The gains for the hinges for the hood front door are shown in Figure 554. The same size hinges are used for both doors. The same methods can be used for making the gains and setting the hinges as used for the waist door. Figure 555 shows the case with the doors opened.

The ball catches can be inserted after the last finishing coat is applied. The doors should be removed and the hinges taken off until the clock case is finished.

The hood back door can be hinged in place also before finishing if desired. Small hinges ¾ inch long and ¾ inch wide may be used. This door is shown in Figures 556 and 557.

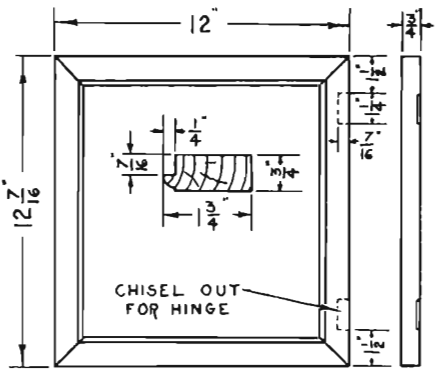


Fig. No. 554. Hood Door

Making the Rosettes

The turnings for the top can be made next. The dimensions for the

rosettes are shown in Figure 558. The pieces from which the rosettes are to be made can be mounted on the screw center plate as shown in Figure 503. or on the faceplate as shown in Figure 502. Faceplate turning is described on page 162, Volume 2.

When the rosettes have been turned they should be glued and clamped in place on the pediment.

Fig. No. 555. Clock Case with Doors Open

Making the Pediment Turning

The turning at the center can be made next. The dimensions for this turning are given in Figure 559. Chapter 10 on page 149 of Volume 2 describes the methods used in making spindle turnings. It will be noticed that the turning extends over the front end of the pediment. The turning is cut out at the bottom end as shown at B in Figure 559, to fit on top of the pediment and extend over its front edge.

When making the turning leave a square section at each end so that the turning can be held easily while cutting the bottom end. The end can be cut on the band saw as indicated in Figure 560. Mark the turning for sawing very accurately. Saw in at the end first, following the line very carefully. Place a block under the turning to support it where the cross cut meets the end cut. This will prevent the turning from dropping at one end when the cuts meet. Then saw in at the side. The square section at the top end can be sawed off, and the end of the turning sanded smooth.

Try the turning on the pediment to see how it fits. It should fit perfectly. If it does not, sand lightly with garnet paper stretched over a block. When it fits perfectly, glue and clamp it in place.

The alternate turning shown in Figure 561 may be used if desired.

Figure 563 shows the hood construction

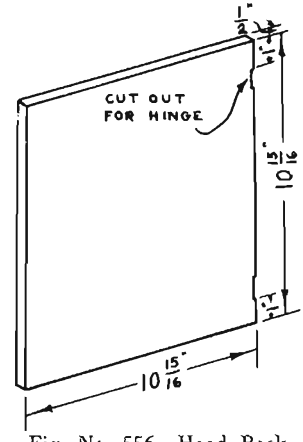


Fig. No. 556. Hood Back Door

in detail. Figure 562 is a top view of a cross-section of the hood.

Fitting the Pediment Glue Blocks

The glue blocks which reinforce the pediment and which are to be placed around the inside edge of the pediment should be made and glued in position as shown in Figure 522. As these glue blocks are on the outside of the case it would be well to miter them so that they have the appearance of a moulding. Glue and rub them tight in position. If brads are used in addition to the glue to hold them in place bore the brad holes before the glue is applied. Be careful when driving the brads down not to strike heavy blows with the hammer, as the shock may loosen the outside pediment parts.

Fitting the Back Panels

The back panels for the waist and the base can be cut to size and the screw holes bored so that they can be screwed in place. These are shown in Figure 564. Fit them in place but the screws can be driven in place after the finishing coats are applied.

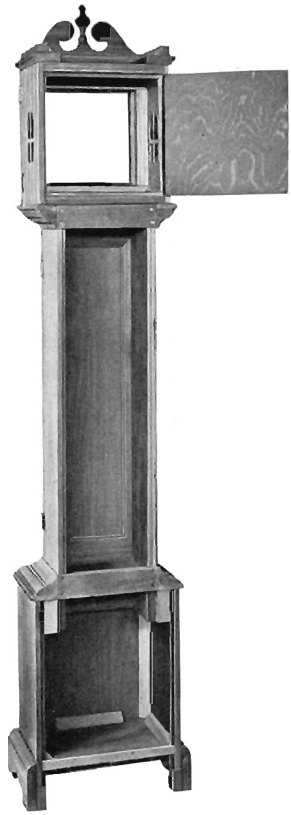


Fig. No. 557. Back View of Clock Case

Final Cleaning and Sanding

Look over the entire clock case and see that all brads are properly sunk and the holes filled. Any cracks should also be filled. If only a small crack or hole is to be filled you may use a filler made by mixing some fine sawdust from the wood you are using into a thick paste with ordinary glue and fill the hole or crack, being careful not to allow the glue to spread over the wood which surrounds the hole. There are excellent fillers manufactured for this purpose in various colors. If a large piece of wood has been broken from the surface, the only practicable way to fill it is to insert a piece of wood to match that of the rest of the work.

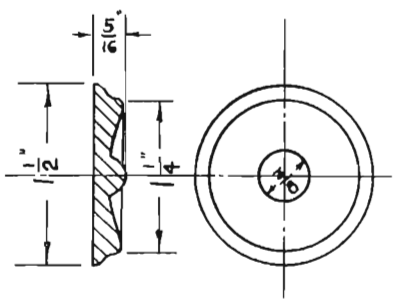


Fig. No. 558. A Rosette

Remove all traces of glue with sandpaper or a scraper, care being

taken not to injure or scratch the surface of the wood. If glue has run out over the surface of the work it must be removed not only from the surface but also from the pores of the wood. Glue acts as a filler and prevents the

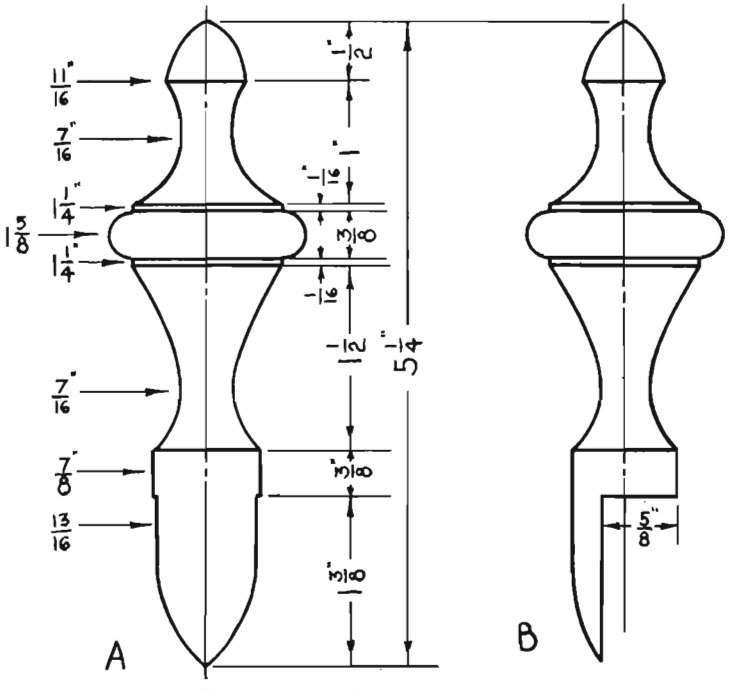


Fig. No. 559. Pediment Turning

stain and filler from entering the wood. It may be taken out of the wood by applications of a cloth which has been wrung out of hot water.

Remove any small dents by applying warm water to the dent and letting it soak in and dry. If the dent is deep, wring a piece of cloth out of water, lay several thicknesses of it over the dent, and apply a hot

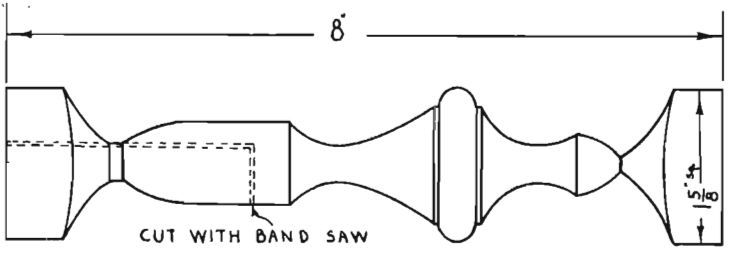


Fig. No. 560

pressing iron or a piece of heated metal to it, so that the steam will enter the wood. Repeat this process until the dent is removed.

Grease and oil spots or discoloration may usually be taken out by rubbing the surface with a cloth or sponge dipped in benzine.

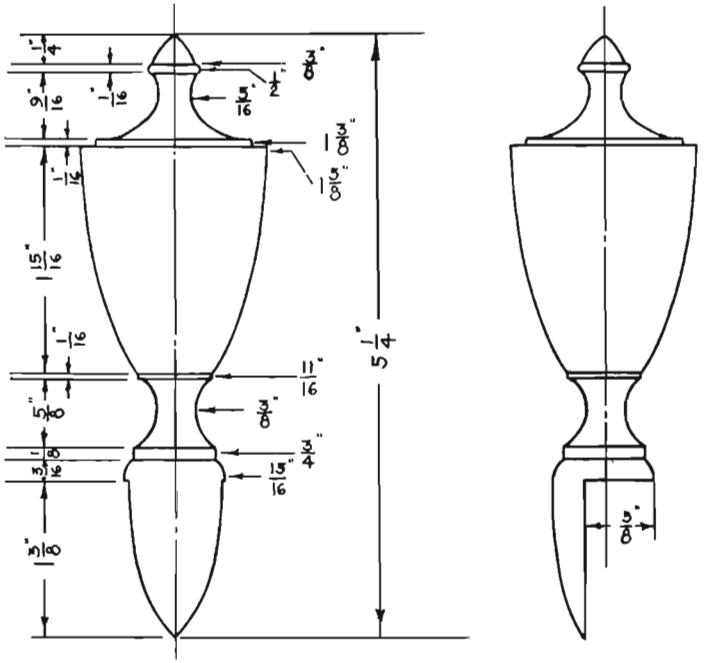


Fig. No. 561. Alternate Pediment Turning

When the surfaces have been leveled off, and all holes have been filled, the work is ready for a final smoothing. The whole final appearance of the piece is dependent upon the care exercised in the final sanding. The reason for this is, that unless the surface is as smooth as it can be made the rougher parts will absorb more stain and filler than the smoother and therefore will show

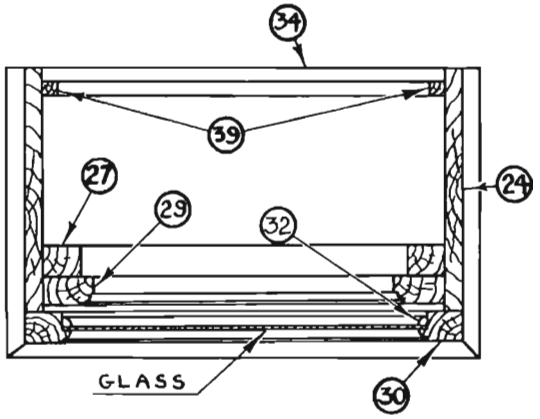


Fig. No. 562. Cross Section of Hood

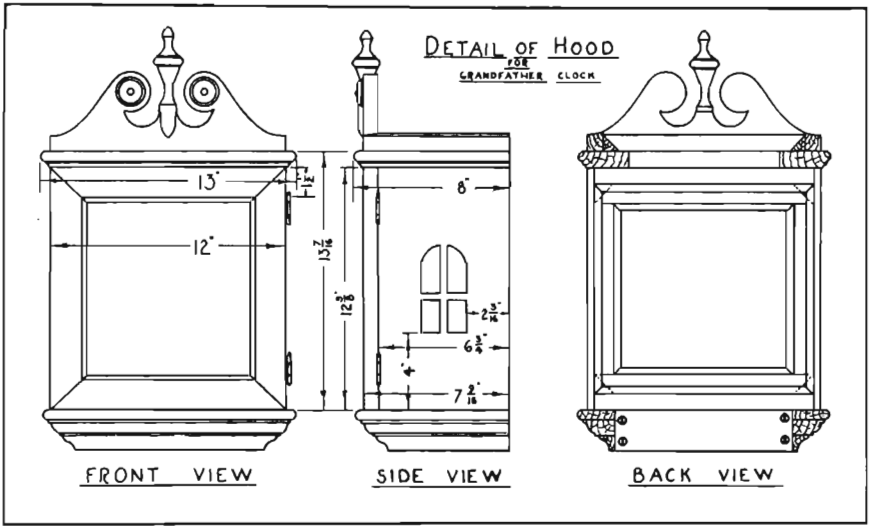


Fig. No. 563

darker. Sand all the parts with No. 000 garnet paper. Always sand in the direction of the grain, except when working on the ends of wood. Should you rub across the grain, the garnet paper will invariably cut small lines in the wood. These may not show until the stain is applied, but they will become apparent in some part of the finishing process.

After sanding a scratch or blemish out at one spot, sand the entire area around that part taking as long strokes as possible. This will even up the surface so that a hollow place will not show where the blemish was removed.

Round the sharp edges and corners with fine garnet paper and the sanding block, but do not overdo this part of the work. The edges should only be rounded slightly so that the finishing coats will not be too thin at these edges.

Brush and dust off the work and examine all parts again for defects. A few minutes spent at this time to see that all parts are clean and smooth may save hours of work and disappointment later.

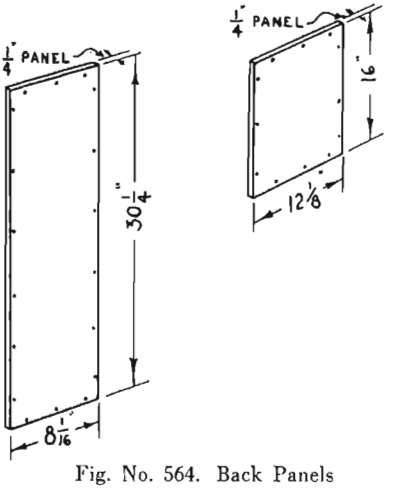


Fig. No. 564. Back Panels

CHAPTER XXII

WOOD FINISHING

Wood finishing is not a mystic art. Anyone who is willing to read the principles of wood finishing and to do his work carefully, step by step, may obtain excellent results. Anyone should be able to finish or refinish tables, chairs, interior woodwork, and small articles of furniture to his taste and at his convenience.

It would take a large book to describe the almost innumerable processes of wood finishing. The instructions given in this book are for the purpose of helping the beginner who wishes to finish articles made of wood. Only the simplest and most common processes will be described in this volume. A little reasoning and experimenting will enable the amateur to obtain good results on any work.

A stain or natural finish which hides any of the natural beauty in the wood before finishing is not the best kind of finish, but sometimes sacrifices must be made to gain durability by using varnish coatings which are not completely transparent.

The purposes of staining are to produce a soft and agreeable color and to bring out in varying degrees of depth the natural beauty of the wood which may in its unfinished state be unpleasant to the eye.

Stains

Stains may be classified according to the solvents used in their manufacture. There are three principal kinds of stain namely, water stain, oil stain, and spirit stain. Some woods have such natural beauty of color, or grain as to make staining unnecessary or undesirable. Black walnut, birds-eye maple and aromatic red cedar are examples.

Water Stains

Water stains are made by dissolving powdered water soluble aniline colors in hot water. Water stains penetrate much more deeply into the wood than do either oil or spirit stains. They are very durable and will not fade so easily. More transparent, clear effects can usually be secured with water stains than any other kind. The greatest possible variety of colors, shades and tints is obtainable in water colors since water-soluble aniline dyes have become widely used. Stain powder for mixing with water can now be secured in practically any shade of color desired for making water stain.

Water stains are cheaper because the solvent, water, costs less than turpentine, alcohol, and other solvents used to dissolve oil and spirit stains.

Brushes and containers are more easily cleaned and taken care of when water stain is used, because they can be washed out with water.

The chief objection to the use of water stains is that they raise the grain of the wood. This is overcome by sponging the wood with water and sanding it again after drying, before the stain is applied. This will minimize the effects of the rising grain.

Water stains made from coal-tar dyes frequently have an acid re-action and, therefore, should be kept in glass or earthenware containers when in a liquid form. Brushes with hard rubber ferrules are best because metal bindings on brushes may be affected by the acids.

Sapwood streaks are apt to take up too much stain and on some of the lighter kinds of wood, they may become darker than desired. This trouble can largely be avoided by sponging the wood with water, thus weakening the absorbing power of that part of the wood. The stain is then quickly applied evenly over the whole surface. Another method is to use a weaker solution of stain on the sapwood. Woods with strong contrast between the sapwood and the heart wood, such as walnut, or woods that are not very porous, usually require an entirely different treatment. In such cases the sapwood requires more stain than the remainder of the wood. A coat of stain is applied to the light streaks first and after it is dry, the entire surface may be stained. Stain also may be applied on the sapwood streaks after the object has been stained as a whole. Blending by dampening the line at the edge of the sapwood is helpful in securing a soft lap.

Water stains in powder form of any color can be obtained from any wood-finishing supply house. The most important point for the inexperienced finisher to remember is that few stains of the same colors from different houses are of the same strength. Accurate tests for strength of color can be made by dissolving a given amount of color (say one ounce) into from one quart to one gallon of hot water. The water should be hot but not boiling. Mix the powder in the water slowly then allow the stain to stand until cool.

If you are in doubt as to the final color of your stain, test it on a smoothly sanded block of the same kind of wood as was used in making the project. Treat this piece in exactly the same manner as you intend to treat your work, finishing it with equal care. Do not be discouraged at the dull appearance that most woods have just after the stain is dry. It will brighten up wonderfully when finished.

If the stain is too light, add another coat or mix a small amount of powder in hot water, making a stronger solution, and add this to the stain already mixed. If the stain is too dark, add a little warm water.

General Directions for Applying Water Stain

A rather soft brush will do good work in staining a close grained wood, but, for wood with large open pores, a stiff bristle-brush is superior, as the bottoms of the pores are reached and covered to a better advantage. A soft brush, if used on wood with large pores leaves light specks in the

cell cavities because the stain thus applied does not penetrate sufficiently into the small openings.

A fitch-brush about 2½ inches wide, set in rubber, is frequently used. A brush having Polar-bear bristles, which should be set in rubber are also preferred for some kinds of work. Brushes should not be kept standing in water stain, because this will cause the bristles to become too soft for good work. They can be washed in water and dried, and thus kept in good condition for future use.

Brushes used in applying the water stains should not be dripping wet, but merely contain enough stain to flow over the work steadily. After dipping the brush into the stain, it is best to get rid of any excess wetness by wiping one side of the brush against the rim of the container, or on a drip-wire placed across the top for that purpose. Work rapidly if you expect to get an even color.

The most important surfaces should always he stained last if possible. The parts to stain first are the bottom, back and under portions, which are less seen that the front or top of most articles.

Water stains dry rapidly, and unless a rather wet brush, full of stain is used the edge of one brush stroke of stain may dry before the next is put on adjacent to it. The brush strokes should be made lengthwise of the grain whenever possible.

Immediately after a water stain has been applied to a surface, wipe the brush practically dry on the edge of the container, and pick up the surplus stain. Even up the color with light feathering strokes of the brush.

The work should be allowed to dry about twelve hours. The final appearance of a surface colored with water-stain is not brought out until shellac or varnish has been applied. Overlays are usually made of wood lighter in color than the main wood used on the project. If they are made of a porous wood a weaker solution of stain should be used on them. If no stain is needed on the overlays they may be given a light coat of thin shellac. The stain will not penetrate through the shellac.

If a piece of furniture contains walnut, dark gum and birch and an American walnut finish is desired, a great deal of testing will be necessary to get an exact match. The walnut has open pores, the gum and birch small pores. The same stain will penetrate further in the walnut, while the birch is very light in color and will need a darker strength of stain than either the gum or walnut. The best procedure is to stain the walnut first to the exact shade desired, increasing the strength for the gum and still more for the birch.

Of course, care must be exercised in the trial of these colors, before using them, and the method of shellacking over a small portion in strong light to test the color, must be used to insure proper results. Be careful always in adding black to other colors, for little is required.

In many cases no stain is used on walnut wood and little on gum. The filler gives the proper shade to these dark woods especially when they are light in tone. Of course, in such woods as birch, where the grain is very close and little filler is taken into the pores, a stain is usually necessary.

One thing to remember is that the filler will not change the color materially, but merely give it a deeper tone, and if your woods match in color before you apply the filler, there should be no material difference after its application. A little more color may be added to the filler, if desired, when filling the woods with a closer grain. The filler is made with a tone of the same stain color of a little darker shade. Factories have a standard stain color for the different woods and a standard shade of filler for each finish.

Water stain made from aniline dyes should always be used under a lacquer finish to prevent the bleeding of the stain by the lacquer.

When staining carvings or recesses of any kind, it is better to use a little less stain than customary, so that no surplus will be left when through brushing. If you get a surplus on any recess, pick it up quickly with waste or some absorbent material, or with a dry brush.

Both sides of a flat piece, like a door or shelf, should not be stained at the same time, unless special racks are provided for them. Stain one side, then allow at least one hour to dry before staining the other side.

Oil Stain

Oil stain is made by mixing an oil-soluble color in turpentine, benzine, naptha or similar solvents. It dries more slowly than water stain and so does not show lap or brush marks. It does not raise the grain of the wood. This eliminates the necessity for sponging and sanding the surface before applying the stain.

Oil stain is not used extensively in industries because it tends to fade in strong light, does not give as transparent a color as water stain, requires a sealing coat of thin shellac if lacquer is to be applied, and is more expensive than water stain. Oil stain may be purchased ready mixed or may be prepared by the finisher.

Oil and spirit stains are inflammable. Keep them away from fire. Oily rags often cause fires. Place all rags in covered fire-proof cans.

One pint of stain covers about 25 square feet. Try out the stain on a piece of scrap wood of the kind used on the project. The trial piece should be carefully sanded. Apply a coat of oil stain, allow it to penetrate the wood for some time, and then wipe off with a cloth. A given stain will produce different effects on different woods. In case the stain is too dark, reduce it with turpentine or benzine until the desired shade is obtained. If the stain is too light, it may be darkened by adding a similar stain of a darker shade.

Applying Oil Stain

Oil stains like others are applied directly to the wood with a brush. Apply it as directed for water stains. Allow it to penetrate into the wood. The length of time to let it soak in before wiping off varies according to the solvent used in the stain and the kind of wood upon which it is applied. Brush some on a trial piece and allow it to stand ten minutes before wiping it off. Observe the result and allow more or less time to obtain the best time to remove the surplus stain.

Sap streaks in walnut show up lighter than heartwood when stained. These may require additional coats in order to secure an even shade.

After the stain has been applied on the project, allow it to penetrate into the wood a considerable length of time. Wipe off the surplus with a clean cotton rag to produce an even shade.

Spirit Stains

Any color that is soluble in alcohol will make a spirit stain. For particular work you will do well to buy them ready for use. These stains penetrate well and give a brilliant color. They also dry more quickly than water stains and oil stains. The use of spirit stains has several disadvantages. It is more difficult to obtain an even color with them than with water stains, because they dry so quickly. The colors are often a little too metallic to be suitable for wood, and they frequently fade out under strong light. In cases where water stains cannot be used, such as over any surface that has been oiled to darken it, or over a surface that has at one time been filled or polished, these stains are quite serviceable. Their use is not recommended for beginners.

Wash Coats

After the stain coat has dried thoroughly, then, *without sanding*, apply a wash coat of thin shellac. This should be prepared from one part of 4-lb. shellac, reduced with seven parts of alcohol. The wash coat of shellac should never be heavier than this, as otherwise it will clog the pores, and will prevent the filler from doing its work thoroughly. This thin coat of shellac will stiffen the fibers raised by the stain so that the fuzz will be cut off clean and sharp when sanded with fine paper. In sanding this thin coat care must be taken not to cut through the shellac, so use little pressure to prevent the wash coat from being cut through.

This procedure is especially desirable when water stains are used, because, even if the wood is sponged and sanded before the stain is applied, the stain will always raise the grain some more, and if the wood is sanded after staining, without a wash coat, the little fibers will just be "squeezed" down, without being cut off clean. Even where oil stains are employed, which raise the grain only slightly, the thin wash coat will be found to produce a smoother and better finish.

Shellac of a 4-lb. cut is the regular commercial quality, in which 4 lbs. of shellac are dissolved in a gallon of alcohol, and it should always be diluted for wash coats as specified above.

Fillers

There are two principal kinds of wood fillers, namely paste fillers and liquid fillers. Paste fillers are needed for the purpose of filling the pores and producing a perfectly level and smooth surface, in open-grain woods such as oak, ash, mahogany, and walnut. It is manufactured in various colors. The paste should be thinned with turpentine or benzine at the time

it is to be used. One pound of paste filler will cover about 40 square feet of surface.

Applying Filler

Place the desired amount of paste filler in a container and add a very small amount of benzine (turpentine, or naptha may be used). Mix thoroughly to a smooth paste with a putty knife, or with a wooden paddle. Gradually stir in more benzine until the filler will work freely under the brush. The consistency of the filler will be determined by the size of the pores of the wood on which it is to be used. It should brush freely and yet be fairly thick. The filler should be thinner for woods with small pores. Try out the filler on some out of the way place or on a small sample of the wood you are going to finish.

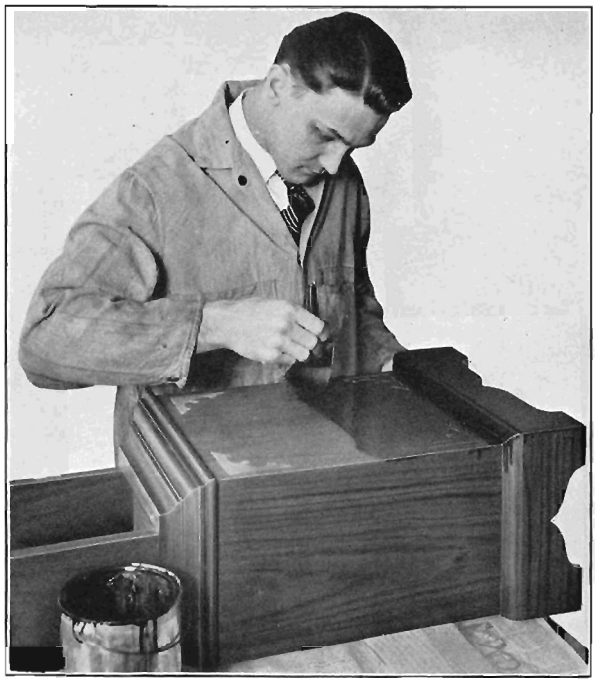


Fig. No. 565. Applying Filler

Coat the surface freely with the filler using a stiff brush to rub the filler well into the wood. The important thing in the application of filler is to force it down into the pores, and drive the air bubbles out, thereby preventing specks or pinholes. This can be accomplished by working the filler into the pores by spreading it lengthwise of the grain, and by going over it crosswise. So far as possible, all surfaces should be filled in a horizontal position.

Some finishers apply filler lengthwise of the grain only, while others apply it by brushing crosswise as shown in Figure 565. Paste filler does not set quickly and there is no danger of spoiling the finish by brushing the surface over and over. It is important that the filler goes as deeply into the pores as possible and that the pores are completely filled.

Paste fillers contain ingredients that readily settle to the bottom of the container, therefore the mixture should be stirred thoroughly, at least once in every three to five minutes.

Removing the Surplus Filler

After applying the filler to the work allow it to set until the surface becomes dull. The time required will vary from 10 to 30 minutes, depending upon the composition of the filler and the kind of thinner used. If the work is rubbed too soon the filler will pull out of the pores and if let stand too long, it will harden and will not come off unless softened with turpentine or benzine. Filler should be rubbed soon after it has dulled and no longer looks wet.

When the filler has been brushed into the surface and has set flat, it is ready to wipe. Cocoanut hair, sea moss, or burlap may be used for wiping off the filler. Remove all hard particles such as bits of wood, sand or grit from the material used in wiping, to prevent scratching the surface.

Fig. No. 566. Wiping Off the Filler

The wiping must be done across the grain of the wood as shown in Figure 566 and in such a way as will not lift the filler out of the pores but will cut off sharp and level with the top of the wood fibers. Rub one surface after another crosswise with considerable pressure, taking more material as soon as that in the hand becomes too wet or full of filler.

After wiping over a surface with the coarse material to remove most of the surplus filler, wipe over it again with clean cotton cloths. Do not use rags which leave lint. The commonest difficulty that will be encountered by the beginner is in removing the surplus filler from corners, scrolls, overlays and the like. The best method of doing this is with a picking stick covered with cloth. Remember that all the filler must be removed from the surface and corners or your finish will appear patchy and unsightly.

Picking sticks about $\frac{3}{8}$ inch in diameter and 6 inches long may be made from a dowel rod. They can be made with one wedge-shaped end for

scraping the filler out of corners and other places where it can not be rubbed off. The other end can be whittled to a sharp point, as shown in Figure 567. A narrow strip of cotton cloth is frequently held tightly over the wedge-shaped end of the picking tool when removing the filler. If the filler becomes too hard, it may be necessary to dampen the cloth with turpentine when scraping out the corners where the filler has dried too hard. Usually one coat of filler is sufficient, but if the pores are large as in Philippine Mahogany (Indoako wood), a second coat is sometimes necessary. Allow 24 hours for the filler to dry before applying other finishing coats, then sand lightly with No. 000 finishing paper. Place all used wiping rags, etc., in covered fire-proof cans at once and burn them outside. Oily rags often cause a fire from spontaneous combustion.

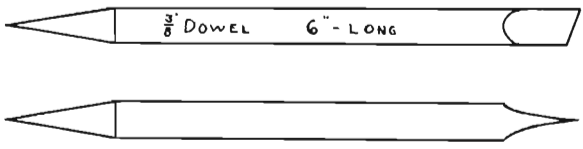


Fig. No. 567. Filler Picking Stick

Liquid Fillers

Close grained woods, such as maple, birch, pine, whitewood, poplar, basswood, ebony, cypress and gum, can be treated with a liquid filler. Pure white shellac which is bought in a prepared state is too thick for good work. It should be thinned by adding 3 parts of denatured alcohol to 1 of the prepared shellac. If one coat does not fill the pores, rub down with 4/0 sand paper or fine steel wool and apply a second coat.

After the work has been filled, dried and sanded, it is ready for the first finishing coats. Many finishers give the work a sealing coat of thin shellac before applying the other finishing materials. This method usually gives very good results.

Applying Shellac With a Brush

When applying shellac with a brush use a brush of the right size for the work and one having bristles set in rubber. For the average work either a two or a three inch soft brush with medium length bristles should be used.

Shellac dries very quickly, therefore it must be brushed on rapidly. Cover narrow strips the entire length of the surface as quickly and evenly as possible. If small spots are missed, do not attempt to touch them up. The next coat will cover them. Be careful not to let the shellac run on the edges. Pick up such runs immediately with an almost dry brush. The brush strokes should always be with the grain. Doors and drawers should be removed and shellacked separately.

In brushing shellac near the frames of panels or other abutments, the brush must be set down against the abutment and pulled away quickly to the center, then set the brush against the opposite edge and pull quickly to the center, lapping at the center before either has a chance to dry. Allow

the shellac coat to dry from 2 to 4 hours, and then rub down with No. 2/0 steel wool or No. 5/0 dry garnet finishing paper. Steel wool is preferred because it does not gum up as readily.

After rubbing down the work, it should be cleaned and dusted off before applying the second coat of shellac. A second coat usually improves the work regardless of the kind of finish to be used.

Finishing Coats

At this point in the finishing process it is necessary to choose one of the many finishing coats which may be applied.

Shellac Finish

The shellac finish is beautiful, hard and durable, but somewhat difficult to apply by hand methods. By making the shellac thin, applying many coats and working rapidly, this difficulty is overcome to a great extent. No dust-proof room is necessary as shellac dries quickly.

Lacquer Finish

Lacquer finish does not check or crack easily. It dries with a medium luster. It is hard and durable and does not mar easily. It dries quickly and therefore no dust-proof room is needed. It is rather difficult to apply with a hand brush. The best methods of application is by using a spray gun. It can not be applied directly over oil stain, oil filler, varnish or paint containing linseed oil, because the lacquer solvent acts like a varnish remover. Use a water stain if lacquer is to be used and apply one or two coats of shellac over the filler before applying the lacquer. Even with this precaution the lacquer will sometimes cut through the shellac and cause a poor job, therefore its use is not recommended for the inexperienced finisher.

Varnish Finish

The varnish finish is very clear, lustrous, and beautiful, but it is very easily marred, cracks and becomes dull with age. It is easy to apply but the work must be done in a dust-proof room because it dries very slowly and any fine particles of dust will spoil the finish.

Wax Finish

Wax polishing is one of the oldest and best ways of finishing wood. It is too, perhaps the easiest of all methods. It imparts to the wood a beautiful satin luster, it brings out the grain of dark woods beautifully, and although it may be easily injured, it is easily repaired, and does not show scratches to such an extent as varnish. It seems particularly well adapted to finishing certain woods, such as oak, mahogany, and walnut, and always adds the charm of antique appearance to any wood on which it is used. The wax finish is not very durable but it can readily be renewed without stripping off the old finish.

In addition to being beautiful the wax finish is one which may easily be applied in the small workshop, because no dust-proof room is required, and it can be applied easily by hand.

To Apply a Shellac Finish

After the wood has been stained and filled in the usual way, apply a coat of thin shellac. For the first coat, alcohol should be added to the prepared shellac so that the mixture consists of one part of prepared shellac to three parts of alcohol. The brushing on of shellac is described on page 334. After applying a coat of shellac always allow several hours for drying and rub down with No. 2/0 steel wool or fine sandpaper used dry.

Apply succeeding coats in the same manner. After three or four coats the final rubbing down is done with F F F powdered pumice stone and paraffine oil, rubbing with the grain to avoid scratches. Clean off the work with cotton waste and benzine. Do not use water as a lubricant to rub a shellacked surface because it will cause the shellac to turn white.

Applying a Varnish Finish

Much of the success in varnishing is due to correct and suitable conditions. The work should be stained, filled and given one or two coats of thin shellac. Sand between the coats of shellac and before the first coat of varnish. Varnishing should be done in a dust-proof room where the temperature is about 70 to 75 degrees Fahrenheit. Brush the dust from your clothing before entering the varnish room, and also dust and clean the work to be varnished before it is taken into the room. Sprinkle water on the floor to prevent dust from rising.

Use a high grade rubbing varnish and a good brush. Varnish is easy to apply, because it dries slowly, but it must be spread evenly to prevent piling up, runs and sags. After flowing on the varnish over the surface, in the direction of the grain, wipe off the brush on the edge of the container, and level off the varnish by brushing across the grain, wiping the brush occasionally on the can. Finally complete the coat by brushing lightly in the direction of the grain. Varnish should not be applied direct from the can. Pour out a sufficient quantity at a time into a tin cup, replace the cover on the can to exclude particles of dust, and apply the varnish from the cup. Wipe out the cup with a clean rag before re-filling it.

Allow the first coat to dry at least 48 hours and then sand it with No. 5/0 or 6/0 waterproof finishing paper.

After dusting carefully the second coat may be applied. Proceed the same as for the first coat. Two or three coats are usually required for good work.

If a satin finish is desired rub the last coat with F F F powdered pumice stone and water.

If a higher polish is desired rub with rottenstone and oil. Clean the work with a piece of cheesecloth, or cotton waste to remove the oil and rottenstone, and then rub the surfaces with another clean piece of cloth until the work is dry and clean.

CHAPTER XXIII

FINISHING THE GRANDFATHER CLOCK

The grandfather clock described in this book was made of walnut and was given a wax finish. Instead of staining the wood it was given a coat of boiled linseed oil thinned with turpentine. The mixture was composed of three parts of boiled linseed oil to 1 part of turpentine. Oil has a beautifying and darkening effect upon dark wood, but upon walnut its enrichening power is best seen. It adds a depth to the wood, throwing the figure of the wood into beautiful relief.

The work bench was cleaned off and several pieces of corrugated paper were placed on the bench so that the clock case would not become marred. The clock case was then placed with the front side down on the bench. The oil was then brushed in the bottom inside of the base and the edges of the waist. The back panels and doors had previously been removed. The inside of the hood need not be oiled. The oil was then wiped off with a dry, clean cloth, beginning with the part where the oil was first applied. Rub the work hard and vigorously until the part is dry.

The side of the case was then turned up, and oiled, followed by the other side, then the front. The doors and back panels were then oiled and rubbed. The case was allowed to dry twelve hours.

If walnut has sap streaks they must be stained before oiling. In that case sponge the sapwood, allow it to dry about two hours, then sand with 3/0 garnet paper, stain the sapwood with water stain, allow it to dry about 12 hours, then sand it lightly. The work can then be oiled as described before.

The case was given a wash coat of thin shellac composed of seven parts of alcohol to one part of prepared shellac. This coat was allowed to dry three hours then rubbed very lightly with No. 0 steel wool.

Filling

After the work dried, about twelve hours after oiling and rubbing, it was filled. Regular dark walnut paste filler was used, thinned with benzine. About ½ pound of the paste will make enough filler for the clock case. The filler was brushed on the work as shown in Figure 565 and described on page 332. The filler should be brushed on the surfaces which are in a horizontal position so that the filler will enter the pores of the wood. After the filler was brushed well into the pores it was allowed to dry until it turned dull. It was then rubbed across the grain of the wood as shown in Figure 566, and wiped off, lengthwise of the grain, with a clean rag. The filler in all corners and along the mouldings was removed with a picking

stick covered with a cloth. The surfaces were then wiped clean with a soft clean cloth. The clock case was then turned and the filler applied to the horizontal surfaces, let dry and wiped off as before. All parts were treated in the same manner.

Shellacking

After the work had dried about twenty-four hours after filling and rubbing it was wiped off clean and given a coat of thin white shellac. The shellac was thinned by adding one part of alcohol to two parts of prepared shellac.

The shellac coat was allowed to dry four hours and then rubbed down lightly with No. 2/0 steel wool. (5/0 garnet finishing paper can be used instead of steel wool if desired.) The steel wool does not clog up like sand paper and it is also easier to use on the mouldings.

The work was then dusted and wiped off and another coat of thin shellac applied. This was allowed to dry four hours and was then rubbed down lightly with steel wool.

A third coat of thin shellac was brushed on, allowed to dry and rubbed down as described before.

Applying Wax

The wax used in polishing may be obtained from any paint or hardware store. Any good prepared furniture wax may be used. A good way to apply paste wax to a surface is to wrap some of it in one or two layers of cloth and rub it briskly over the surface of the work. This will distribute the wax evenly. Do not put too much on at a time.

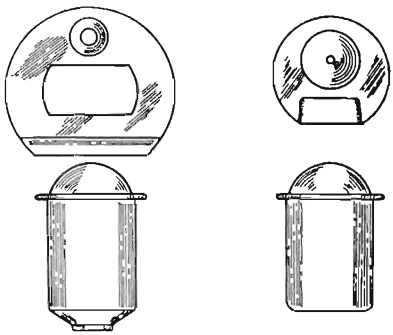


Fig. No. 568. Two Types of Ball Catches

The wax was only spread on a small surface at one time. At first it was spread on the base side, this was allowed to dry a few minutes and then rubbed first across the grain and then with the grain with a clean cloth. Another clean cloth was used to do the final rubbing with the grain of the wood. Plenty of brisk rubbing is necessary to bring out a good luster. A cloth stretched over the picking stick was used to remove the surplus wax from around the overlays and along the edges of the mouldings.

The wax was applied to all surfaces of the clock case in the same manner. There can be no definite number of coats of wax given as a minimum or maximum. If a higher luster is desired, a second coat may be applied after an interval of one to two hours.

This completed the finishing process on this clock case. The hardware, clock movement, etc., were then put in place.

Fitting the Hardware

After the work has been finished, the hardware can be fitted in place. If the hinges were fitted before finishing it will be necessary to clean the gains for the hinges. Scrape out all the gains clean. Screw the hinges to the doors and then screw the other half of the hinges to the sides.

The ball catches should be slipped in place after cleaning the holes of all finishing material. A short piece of brass tubing which just fits over the ball is useful when driving the catches in the holes. Figure 568 shows two types of ball catches.

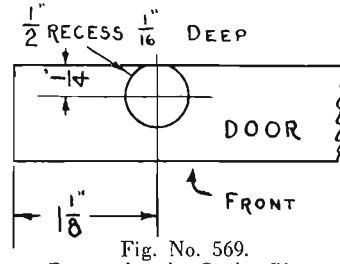


Fig. No. 569.
Recess for the Strike Plate

By opening and closing the doors the ball catches will mark the location of the strike plates on the edges of the doors. The strike plates should usually be sunk slightly. A bit of the size of the plates can then be used to bore a shallow recess for the strike plates. The recesses should be bored so that the edges of the plates are near the inside edges of the doors as shown in Figure 569. The plates can then be fastened in place.

Try the doors to see that they work properly. If the catches hold the doors too tightly so that it is difficult to open the doors, it will be necessary to sink the ball catches or the strike plates deeper.

The hood side grills should be covered with silk or similar material. This should be glued to the inside surfaces of the sides over the openings. Spread glue carefully around the openings, stretch the silk over the openings and press it down with the fingers.

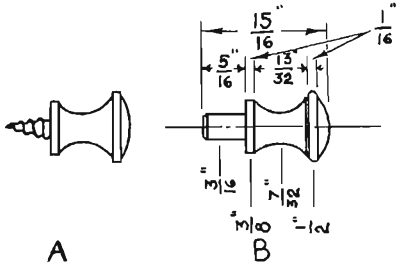


Fig. No. 570. Door Knobs

Fit the hood back door in the same manner.

Remove the hood front door by removing the pins from the hinges and fit the glass in place. Put the glass moulding in place and drive fine brads through the pieces into the door stiles and rails so the glass will not fall out. The door can then be placed back in position on the case. The knobs can then be placed on the doors. Screw knobs can be used as shown at A in Figure 570, or small knobs, as shown at B may be turned on the lathe. Place dome glides on the bottom corners of the base.

The clock dial can be screwed to the inside of the dial frame moulding. The electric movement can be placed in position. If an electric movement is used tap the holes in the back of the cross rail and the hood bottom so that rubber bushings can be screwed in the holes. The electric cord can be threaded through the bushings and spliced to the wires on the movement. Tape the splices to prevent short circuits and injury to the movement.

Screw the back panels in place and the clock is completed.

CHAPTER XXIV

GLUES AND THEIR USES

To woodworkers in general a good understanding of glue and the best methods of using it is essential for the production of reliable work. Good glued work with seasoned wood will last many years. A glued joint well made is as strong as the solid wood. In many cases, however, poor results are obtained, due to the wood being insufficiently seasoned, indifferent workmanship, careless gluing, and poor quality of glue.

Kinds of Glues

There are a number of different kinds of glues. Those most commonly used in the average workshop are animal glues, cold liquid glues, vegetable and casein glues. Each has its advantages, since each glue possess certain properties which make it valuable for certain purposes and kinds of work.

Animal Glues

Animal glues are made from the hoofs, hides, horns, bones, fleshings of animals, mostly cattle. These glues come in dry form in sheets, flakes or powder, and must be mixed with water and heated.

Glues are graded with reference to quality. The highest grade glues give more strength and are recommended for the most satisfactory work.

It is advisable to prepare only the quantity needed for a day's job, since reheating of glue has a tendency to reduce its strength. The proportional amount of water necessary for soaking any animal glue is determined by the grade of glue and the work on which it is to be used. This proportion varies from 1¼ to 2½ parts of water by weight to 1 part of dry glue.

Always soak the glue in cold water before heating. Flake glue should be soaked twelve hours. Ground glue should be soaked from 30 minutes to 2 hours, according to the fineness of the powder.

The glue should be melted in a double-boiler glue pot. Never boil glue. Temperatures higher than 150 degrees F will begin to rapidly destroy the strength of the glue. The glue also should not have a temperature less than 120 degrees F when it is used. Pieces to be glued together with animal glue should be warmed to a temperature of at least 80 to 90 degrees F. Cold material will chill the glue and it will not penetrate into the pores of the wood. The room temperature should not be below 72 degrees F and no draught should be present in the room while gluing.

Glue can be spread with a brush by hand or with a mechanical spreader.

Clamp the joint while the glue is hot. Proper clamping will aid in producing good joints.

Animal glue will not stain the wood. It is not water resistant.

Cold Liquid Glues

Liquid glues are commonly made from the heads, skins, bones and bladders of fish. Some liquid glues are made from animal glue and other materials. They come in prepared form ready for immediate use. They are used cold, on warm or cold stock. Directions for their use are given by the manufacturers. Some brands are equal in strength to good animal glues.

Vegetable Glues

Vegetable glues are made from starches, usually cassava starch and other ingredients. For factory use they are sold in powdered form. They may be mixed cold with water, and alkali, but heat is commonly used in their preparation. Some vegetable glues come prepared ready for use. This glue can be spread with a brush and can be used cold on cold stock. It makes very strong joints. It dries in about the same time required for a good grade of animal glue. Vegetable glues are usually more water resistant than animal or fish glues, but they are not strictly water proof. They remain in good working condition free from decomposition for many days.

Casein Glues

Casein glues are generally made from ground casein, calcium hydrate, and some form of caustic soda. Other ingredients are sometimes added. It is sold in powdered form to be mixed with cold water. Manufacturers of casein glues always furnish special directions for mixing their product. Read and follow such instructions carefully.

When casein glue is properly mixed it can be spread with a brush. The property most featured is its high water-resistant, which makes it suitable for gluing articles to be used under moist conditions. Not all casein glues are water-resistant, however.

Among the disadvantages of casein glues are their tendency to stain the wood when used on tannin bearing woods such as oak, walnut and mahogany. This trouble has been largely overcome by greater care in the application of the glue, enough being applied to make good joints, but on the other hand, avoiding such an excess that more than a mere trace is extruded, upon the application of pressure. Usually casein glues remain in a fluid state only a few hours, therefore mix only enough glue for the immediate job.

Selecting the Glue for the Work

Generally speaking, animal, vegetable, and casein glues are veneer and joint glues. Liquid fish glues are joint glues. To choose between animal, vegetable and casein glues for joint work, if freedom from staining is important animal glue is preferable, if water-resistance is of importance, then a casein glue should be selected. If it is difficult to heat the animal glue and warm the stock to be glued, it would be well to use a prepared vegetable glue or other prepared glue.

Fig. No. 571

CHAPTER XXV

MAKING A TEA WAGON

A tea wagon, such as that shown in Figure 571, is almost indispensable for serving light refreshments or lunches, whether they are served in the rooms of the home or on the porch in summer. When the leaves are raised, a convenient table is formed, with ample room to serve six persons.

In addition to being a useful as well as beautiful article of furniture, it is an interesting piece to make, and the worker will feel more than repaid for his efforts in the varied experience gained.

The tea wagon shown is designed after the Sheraton style, and the construction offers no difficulties which cannot be mastered by the average craftsman who has motor-driven machines of the proper kind in his workshop.

The worker who has never constructed a wheel might imagine this to be a difficult task. It is not nearly so difficult as one might at first suppose, and the construction of the wheels affords the worker a wonderful opportunity to demonstrate his skill in a fine example of woodworking that he will be proud of and will take great pride in making. When the wheels are made, their presence will spur him on to complete the tea wagon in record time. Of course, these wheels can be purchased at many manual-training supply houses, but the craftsman will be well repaid for his efforts in making them, for then he can say he made the whole piece himself.

Ordering and Selecting the Material

The first step is to buy the material. The same policy can be followed that is described in Chapter 20, which deals with the selecting of material for a job. The bill of material gives a complete list of the materials needed. It would be well to specify a solid-lumber center ply when ordering the plywood for the top and leaves of the table. This lumber core stock should be a close-grained wood like poplar or gum, so that the edges will look well when shaped.

Some supply houses will not sell veneered panels in odd sizes. The standard sizes usually are 12 in. x 24 in., 24 in. x 48 in., 24 in. x 72 in., etc. Where this is the case one panel $1\frac{3}{16}$ in. x 24 in. x 72 in. can be bought. This size will make the top and leaves and leave enough extra material to make the top rails of plywood instead of solid lumber. Figure 572 shows a layout for carrying out this plan.

BILL OF MATERIAL FOR TEA WAGON

PART No.	ITEM AND REMARKS	PCS. REQD	THICK	WIDTH	LENGTH	MATERIAL
1	TABLE TOP (5 PLY)	1	13/16"	17"	27"	MAHOGANY
2	TABLE LEAVES (5 PLY)	2	13/16"	12"	27 1/2"	"
3	LEGS (LONG) GLUED	2	1 5/8"	1 3/8"	22 5/8"	"
4	LEGS (SHORT) GLUED	2	1 3/8"	1 3/8"	21 9/16"	"
5	TOP END RAILS	2	13/16"	2 1/4"	14 1/8"	"
6	TOP SIDE RAILS	2	13/16"	2 1/4"	24 5/8"	"
7	SHELF END RAILS	2	1 1/16"	1 1/16"	14 1/8"	"
8	SHELF SIDE RAILS	2	1 1/16"	1 1/16"	24 5/8"	"
9	SMALL WHEELS	2	5/8"	2 7/8"	2 7/8"	"
10	SMALL WHEEL FORKS	1	1 7/16"	2 1/2"	11"	"
11	SMALL WHEEL AXLES	2	5/8"	5/8"	1 3/4"	"
12	SMALL WHEEL BUTTONS	1	5/8"	5/8"	1 3/4"	"
13	LARGE WHEEL HUBS	2	2 3/4"	2 3/4"	2 3/8"	"
14	LARGE WHEEL SPOKES	16	13/16"	13/16"	6"	"
15	WHEEL RIM	12	1/4"	7/2"	31/4"	"
16	" "	12	1/4"	3 1/4"	11 1/2"	"
17	LARGE WHEEL AXLE SUPPORT	1	13/16"	1 1/2"	14 5/8"	"
18	HANDLE BRACKETS	2	13/16"	4 3/4"	10"	"
19	HANDLE BRACKET CLEATS	2	13/16"	1 1/4"	3 5/8"	"
20	HANDLE TURNING	1	1 1/8"	1 1/8"	9 11/16"	"
21	HANDLE TURNING ENDS	2	7/8"	7/8"	1 3/16"	"
22	TRAY MOULDING ENDS	2	1 5/16"	1 3/8"	17"	"
23	TRAY MOULDING SIDES	2	1 5/16"	1 3/8"	26 1/2"	"
24	TRAY HANDLES	2	1/2"	1 3/8"	7"	"
25	TRAY PANEL (3 PLY; MAHG. ON 1 SIDE)	1	1/4"	15 1/2"	25 1/4"	"
26	SHELF PANEL (3 PLY; MAHG ON 1 SIDE)	1	1/4"	13 3/4"	24 3/16"	"
27	INLAY BANDING (ABOUT 30 LINEAL FEET)					STRIPED SATINWOOD

Hardware and Supplies

- 4 Table leaf hinges, 1½ x 3⅛ in.
- 2 Table leaf supports; length, open, 8 in.
- 10 Steel table top fasteners, ¾ in. wide.
- 2 Butt hinges, 1½ in. x 1½ in., for handle supports.
- 1 Glass for tray, 14¾ x 24⅜ in. grade A.
- 4 Screws for tray handles, 1½ in. No. 10 round head.
- 34 Screws for tray and shelf, ⅝ in. No. 5 flat head.
- 1 Piece of round rod iron for axle, ⅜ in. x 19⅜ in.
- 4 Washers for axle, ⅜ in. hole.
- 2 Pieces brass tubing for wheel bearings, ⅜ in. x 2 1/16 in.

4 Screws for axle support, 1¼ in. No. 8 flat head.
2 Screws for axle, 1 in. No. 12 round head.
2 Nickel-plated sliding casters with three prongs for wheel hub caps, 1⅛ inch in diameter.
10 ft. Rubber for tires, ½ in. diameter.
2 Cotter pins, 1 in. long.
2 Screen door hooks, 2 in. long.

The dealer is usually willing to cut the plywood to rough sizes to make them easier to ship or handle. If a panel is ordered 24 in. x 72 in., specify that two pieces are required from this 24 in. x 28 in., and that he may cut the large panel for shipping.

If a piece of plywood ¹³⁄₁₆ in. x 24 in. x 60 in. is ordered, it will make the top, leaves and side rails for the tea wagon. The end rails can be made from solid lumber.

The worker can buy thick lumber to make the legs, tray moulding, wheel forks, etc., or he may glue pieces of the ¹³⁄₁₆ inch lumber together to make these parts. A layout chart is shown in Figure 574, which is given only as a guide in making out your own lay-out, because you may have reasons for buying other sizes than those given. In following this chart, the thick parts are to be made by gluing two or more pieces together.

The large wheel rims or felloes are made from lumber (not plywood) ¼ inch thick. Three thicknesses of this stock are glued together to make the rims. The joints are staggered to prevent any weakness at the joints. It would be well to study the construction of the wheels before ordering the ¼-inch lumber. See Figures 576 and 577.

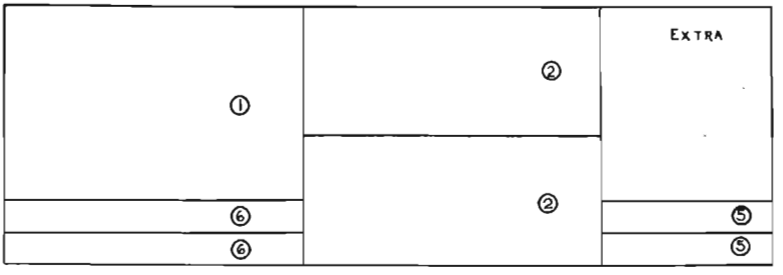


Fig. No. 572. Parts Laid Out on Plywood 24 in. x 72 in.

When the lumber and plywood are delivered to the workshop, they should be stored very carefully in a dry place. The plywood should be placed in a flat position on a level surface, where it will not warp or become scratched.

Laying Out the Parts

Lay out and mark the lumber for the various parts so they can be cut to rough size. Number each part in the same manner that the parts for the clock case were marked and numbered.

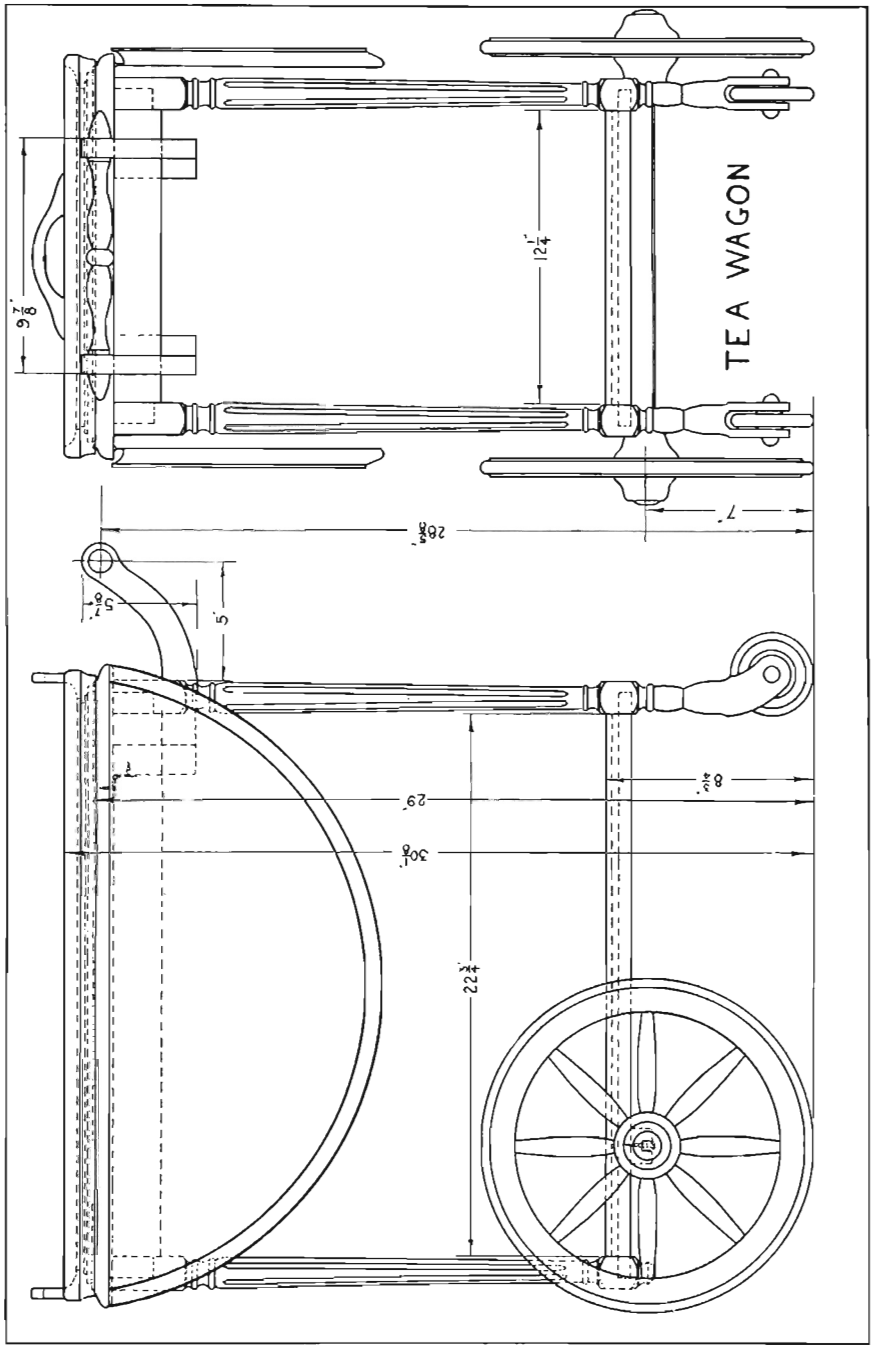


Fig. No. 573

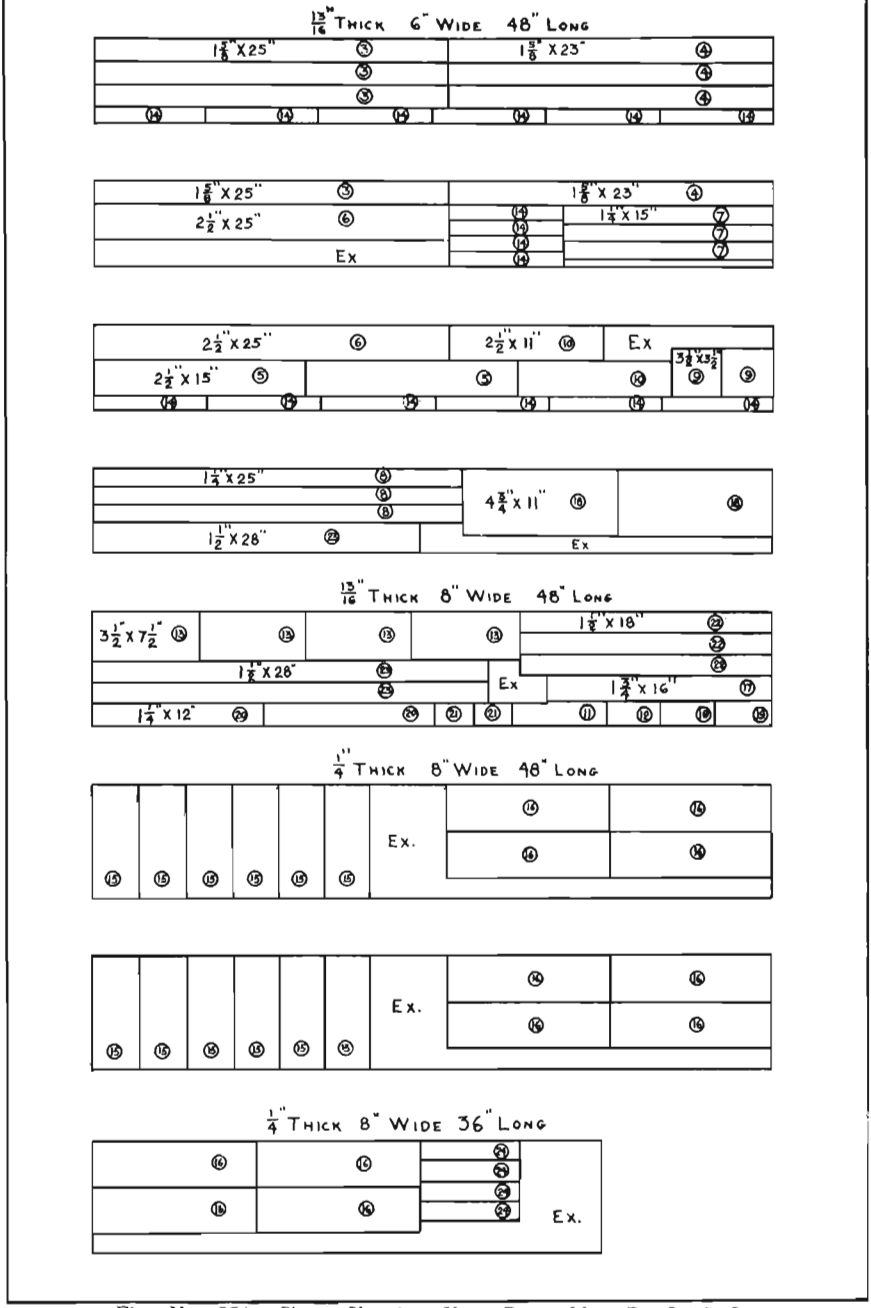


Fig. No. 574. Chart Showing How Parts May Be Laid Out

Preparing the Stock for the Wheel Rims

It is well to cut the parts to make the large wheel rims first. These wheel rims can be made in several ways. Two ways will be described and illustrated and the worker can use the one he prefers.

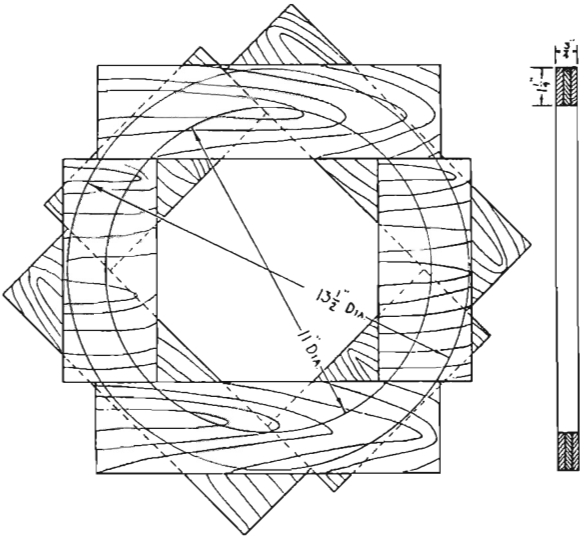


Fig. No. 575. A Method of Constructing a Wheel

One method of making the wheel rims is shown in Figure 575. It will be noticed in this illustration that the rim is made of three layers of segments, the joints coming at different places to prevent any weak places. Four segments are required for a single layer, two 11½ in. long and two 7½ in. wide.

The short segments should be cut across the grain so that when the pieces are assembled, the grain of the wood will be the same in both the long and the short pieces at the points where they are joined together. Figure 575 shows this clearly.

Cut the long segments 3⅝ in. wide and joint one edge smooth to a width of 3¼ inches. Cut them to a length of 11½ inches.

Rip the board from which the short segments are to be made to a width of 7⅝ in. and joint both edges to a finished width of 7½ inches. Cut the short segments to a length of 3¼ inches. Twelve pieces are needed of each size.

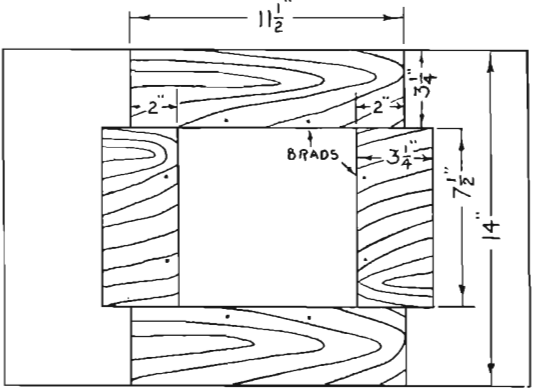


Fig. No. 576. One Layer Placed on a Board

Gluing the Wheel Rims

It is well to lay the parts on a board or piece of plywood about 14 in. wide when gluing. This

will permit the clamps or handscrews to be placed at both edges of the board when gluing the three layers together to form each rim.

Lay a piece of paper on the board so the glue will not come in contact with it. Mark the long segments at the points where the inside edges of the short pieces are to meet the edges of the long segments. Make the pencil marks two inches from each end as shown in Figure 576.

The parts are now ready to be glued together. Place two long and two short segments on the board as shown in Figure 576. Glue the joints and press the pieces together. Brads ½ in. long can be driven through each segment into the board below to prevent slipping. The brads must be driven at the extreme edges where the saw will not come in contact with them when sawing the rims to a circular shape.

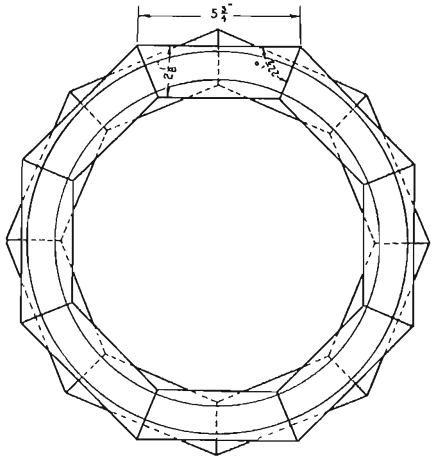


Fig. No. 577. Another Method of Making a Wheel Rim

Spread glue on the top surface of the first layer, then add the next layer, being careful to arrange the segments so the joints come at different places. The third layer can be glued in the same manner after which the layers are clamped together with clamps or handscrews until the glue has hardened.

If hot glue is to be used it would be well to warm the wood slightly before gluing so as to prevent the glue from setting before the pieces are clamped together.

Another Method of Making the Segments

Another method of making the rims of the large wheels is to make each layer out of eight segments as illustrated in Figure 577. For this construction, forty-eight segments of equal size are needed for the two wheels. Rip the ¼ in. lumber to a width of 2⅛ inches. Set the miter gage to an angle of 22½ degrees and cut one end, then turn the piece over and make the second cut so that the segment will be exactly 5¾ in. long. Figure 578 shows the saw set up to make the second cut on a segment. A stop block can be clamped to the miter gage so that all the segments will be cut exactly the same length. Cut eight segments and fit

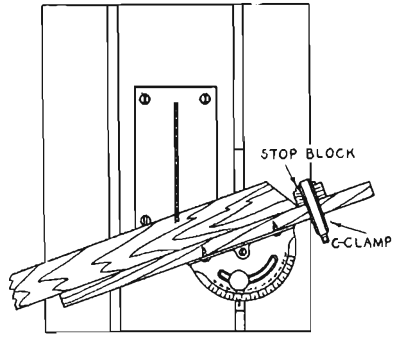


Fig. No. 578. Mitering a Segment

them together to see that they are being cut at an angle of exactly 22½ degrees. A better way to make a trial fit would be to rip a piece of scrap lumber to a width of 2⅛ in., then miter eight pieces to the correct length and fit them together. If any adjusting is necessary, it can be done before cutting any of the good pieces. When all of the segments have been cut to the correct size, they are ready to be glued together to make the wheel rims. If hot glue is to be used the pieces should be warmed. Lay eight segments on a flat board about 14 in. wide which has been covered with a piece of paper. Place one of the segments near one edge of the board and drive several ½ in. brads through it into the board below. The brads are to prevent slipping and they should be driven near the outside edge where the band or scroll saw blade will not strike them. Spread glue on the end of another segment and press it in place against the end of the first one. Drive brads through the second segment to hold it in place. Continue in this manner until the first layer of the rim is fitted properly.

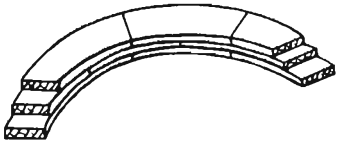


Fig. No. 579. Section of Wheel Rim.

Spread glue on the flat surface of the first segment of the second layer and place it in position as shown in Figure 577. Brad it in place also. Spread glue on the flat surface and end of the next segment. Glue and brad it in place. Continue in this manner until the second layer is completed.

The third layer can be made up in the same way. The joints should be opposite the joints in the first layer as shown in Figure 579 so that when the spokes are placed in position each spoke will be in the middle of each segment.

When the third layer has been fitted, place a sheet of paper over the top layer, then place short pieces of scrap lumber on the rim and clamp the parts together. The pieces of lumber under the clamp jaws will equalize the pressure and aid in making better glue joints than if no blocks are used.

It would be well to permit the rims to dry at least twenty-four hours before turning them.

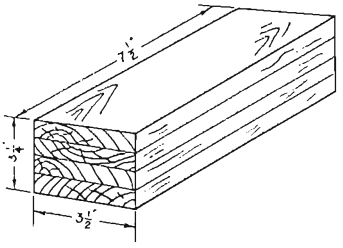


Fig. No. 580

Preparing the Stock for the Hubs

The hubs are made up of four layers of 13/16-in. lumber glued together to make a square section for turning as shown in Figure 580. Rip the four pieces, which are parts number 13, to a width of 3½ in. and cut them off to a length of 7½ inches. Glue them together on their flat surfaces. Let this part dry about 12 hours before jointing and turning.

Preparing the Stock for the Spokes

The pieces for the spokes, which are parts number 14, can be cut $^{13}/_{16}$ in. thick, $^{13}/_{16}$ in. wide and 8 inches long. The spokes should not be turned until the rims and hubs have been turned. In this way, any slight variation in the size of the hubs or rims can be compensated for by making the spokes longer or shorter to insure a perfect fit.

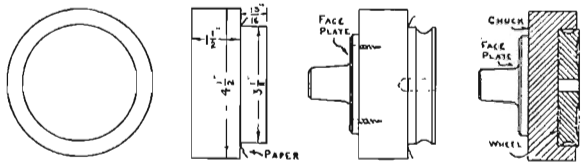


Fig. No. 581. Turning the Small Wheels

Preparing the Stock for the Table Legs

The stock for the legs can be bought in squares large enough for the turnings or thinner lumber may be glued to make the thickness. The two long legs, which are parts number three, can be made by cutting four pieces of $^{13}/_{16}$ in. lumber, two pieces for each leg, to a width of $1^{5}/_{8}$ in. When the glue is dry, joint the pieces to a thickness of $1^{7}/_{16}$ in.

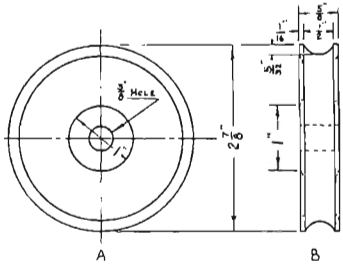


Fig. No. 582. A Small Wheel

Preparing the Stock and Turning the Small Wheels

To prepare the stock for the small wheels, band saw two disks $3^{1}/_{2}$ in. in diameter from the $^{13}/_{16}$-in. lumber. Cut two backing pieces $4^{1}/_{2}$ in. in diameter from $1^{1}/_{4}$ in. or $1^{1}/_{2}$ in. lumber.

The pieces for the small wheels can be held while turning by gluing each piece to a thick piece of lumber with a piece of paper between the layers. The faceplate can be screwed to the backing piece as shown in Figure 581. The backing pieces will be used as chucks for turning one side of the wheels, therefore they should be larger than the wheel pieces.

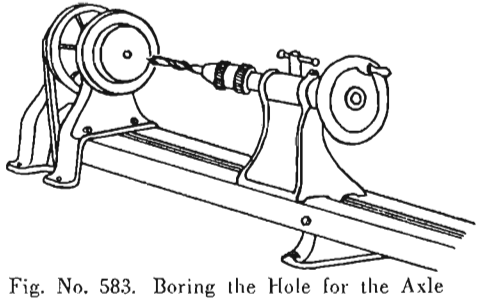


Fig. No. 583. Boring the Hole for the Axle

Glue each wheel disk to a backing piece, but glue a piece of paper between so they can be split apart after one side has been turned to the required shape. Center the wheel disks carefully on the backing pieces when gluing.

After the glue has dried, mount one of the disks on the faceplate of the

lathe as shown at C in Figure 581. True up the face of the wheel first, then mark the diameter and reduce the turning to a diameter of 2⅞ inches.

Shape the face of the wheel as indicated by the dotted lines in drawing B in Figure 582. Set the tool rest parallel with the lathe bed, and cut the groove for the tire.

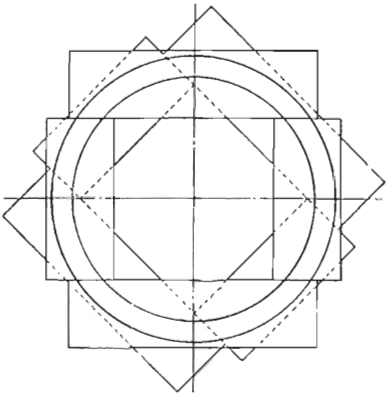


Fig. No. 584. Mark the Rims for Sawing

The hole for the axle can be bored while the piece is mounted on the faceplate. Place a ⅜ in. bit in the drill chuck and mount it on the tailstock spindle. Tighten the tailstock to the lathe bed. Start the lathe and bore the hole for the axle as shown in Figure 583. The bit is advanced by turning the hand wheel.

When one side of the wheel has been turned and sanded, it can be removed from the backing piece by placing the edge of a chisel in the glue joint and tapping it lightly. This will split the paper in the glue joint.

Cut a recess in the backing piece so that it can be used as a chuck. The recess should be ⅝ in. deep and 2⅞ inches in diameter. The wheel should fit snugly in this chuck, and the wheel can be completed while held in it. Both wheels are made in the same manner.

Marking the Large Wheel Rims for Sawing

The large wheel rims which have been glued should be marked so they can be band sawed on the outside to remove some of the surplus wood and scroll sawed on the inside so the rims will fit on the chuck for turning. The rims can be marked while they are still on the board which was used to lay them on while gluing.

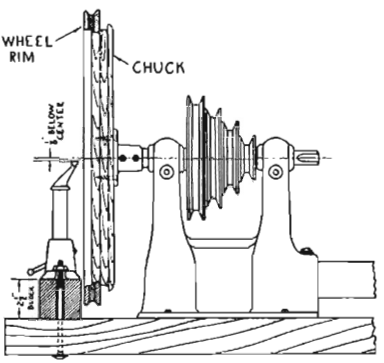


Fig. No. 585. Making Large Faceplate Turnings

To determine the center point to set the compasses or dividers, draw lines connecting opposite segment points. Set the compasses or dividers for a 6¾ in. radius and draw the outside diameter. Reset the dividers for a 5½ in. diameter and mark the inside diameter. Each wheel rim should be marked with each setting of the dividers. See Figure 584.

It will be noticed that the inside diameter is less and the outside

diameter is greater than the finish sizes. This is needed to true the rims and turn them to the correct sizes.

After marking the rims they should be sawed on the marked lines. The outside diameter can be sawed on the band saw or the scroll saw. The inside can be sawed with the scroll saw.

Making a Chuck for Turning the Wheel Rims

As the rims are to be mounted on a chuck for turning it will be necessary to make this first. The chuck can be made from a piece of lumber 1 in. thick and 12 in. square. Draw a circle 12 inches in diameter and saw this out on the bandsaw. Mount this disk on the faceplate of the lathe by inserting screws through the faceplate.

When making faceplate turnings of large diameter, the faceplate can be mounted on the left end of the headstock spindle, as shown in Figure 585.

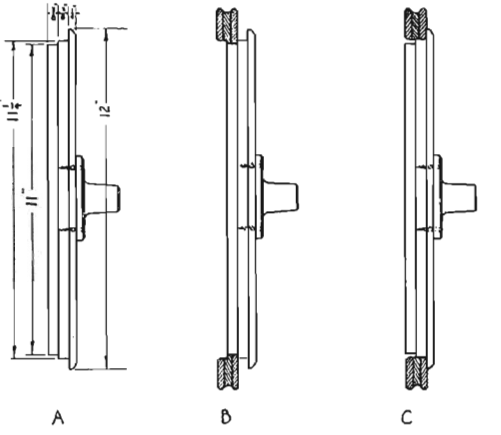


Fig. No. 586. A Chuck is used to Hold the Rims

It will be necessary to block up the tool rest support so that the top of the tool rest will reach to within ⅛ in. of the center of the turning. A bolt through the block and tool rest support will hold the tool rest rigid when the nut is tightened. This is shown in Figure 585.

The first operation on the lathe, when everything is ready, is to true up the face of the chuck. This can be done with the square-nose chisel.

Set the dividers and mark diameters of 11 in. and 11¼ in. on the face of the chuck. Remove the wood outside the 11¼ in. diameter, to a depth of ¾ in., then remove the wood outside the 11-in. diameter to a depth of ⅜ inch. This completes the chuck and it will appear as shown at A in Figure 586.

Turning the Wheel Rims

One of the rims can be slipped over the 11 in. diameter of the chuck. It should fit snugly, but not too tightly. If the fit is a little loose a thickness of paper can be placed around the ledge of the chuck and the rim slipped over the paper. One side of the rim should rest against the ledge on the chuck as shown at B in Figure 586.

Start the lathe, using the first or second speed. True up the side face of the rim first. Mark the finish diameters with a pair of dividers. These diameters are 11¼ in. and 13¼ inches.

Set the tool rest parallel to the edge of the rim and reduce the rim to the final outside diameter. While the tool rest is in this position, cut the groove for the rubber tire.

Set the tool rest parallel to the side of the rim. True up the inside diameter of the rim and remove the wood to the 11 in. diameter mark. The turning tool should cut only to a depth even with the face of the chuck.

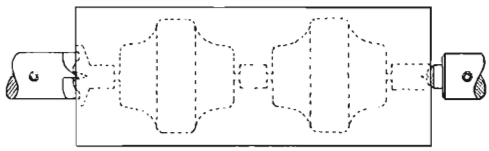


Fig. No. 587. Turning the Hubs

The outside and inside edges can now be rounded as shown at B in Figure 586. It would be well to sand the exposed surfaces at this time by holding a piece of 3/0 garnet paper against the revolving surfaces.

The rim can be removed from the chuck and turned around so the other side can be turned. It should fit on the second ledge of the chuck. True up the side of the rim by placing a square-nose chisel in position on the tool rest and advancing it slowly so that it will remove any unevenness.

Set the dividers to mark a 11¼ in. circle and mark the inside diameter on the face of the rim. True up the inside of the rim and remove the wood up to the marked diameter. Round the edges to correspond with the edges on the opposite rim face as shown at C in Figure 586.

Sand the exposed surfaces smooth. This completes the turning of one rim, and the second rim can be turned on the same chuck.

Turning the Hubs

Both hubs for the large wheels can be turned from the one piece as shown in Figure 587, or the piece may be cut and each hub turned separately. The stock should be jointed 3¼ in. square. The corners can be removed for turning by running them over the jointer with the fence tilted to an angle of 45 degrees. The shape and dimensions of the finished turnings for the hubs are given in Figure 588.

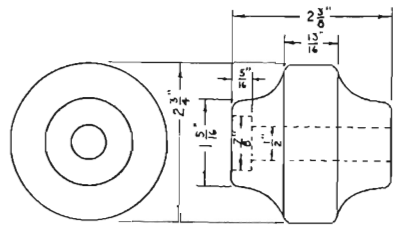


Fig. No. 588

Boring the Holes in the Hubs

A recess is necessary at the center of the outer end of each hub to enclose the ends of the axle as shown in Figure 588. This recess is ⅞ inch in diameter and 5/16 in. deep. This may be bored by placing a ⅞ in. bit in the drill press chuck and boring the recess, or the hub can be held in a chuck on the lathe faceplate as shown in Figure 589 and the recess cut with a square-nose chisel.

The axle for the large wheels is a ⅜ in. iron rod. A bearing is formed by inserting a short piece of ⅜ in. brass tubing in the hub. A hole should be bored through the hub for the bushing so that it will fit snugly. It would

be well to buy the tubing first and bore the hole the correct size so it will fit tightly.

The holes for the spokes are 3/8 inch in diameter. Divide the circumference of the hub into eight equal parts with a pair of dividers. The points of the dividers will mark the location of centers for boring the holes.

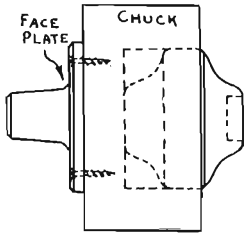


Fig. No. 589. Hub Mounted in a Chuck

A block can be cut out as shown in Figure 590, so that the hub will fit in it when boring the spoke holes.

Center the block perfectly on the boring machine table and mark the hub edge with a pencil above each divider mark on the hub circumference. Also make a center mark on the block. Set the table the correct height and the stop collar so the bit will bore a hole 3/4 in. deep, using a 3/8-in. bit. Adjust the hub so that one of the marks on it is in line with the center line on the block. The bit point should enter one of the holes made by the dividers when the boring table is advanced to the revolving bit.

Bore one hole, then move the hub so that another mark is in line with the center line on the block and bore the second hole. Continue in this manner until all the holes are bored.

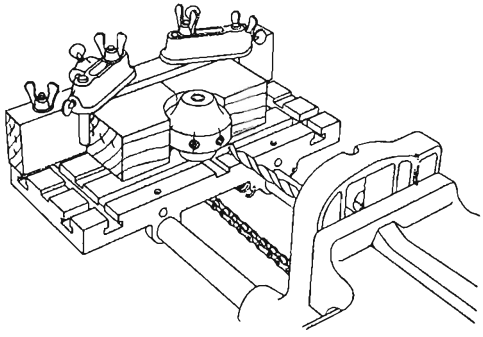


Fig. No. 590. Boring the Spoke Holes in a Hub

Turning the Spokes

The spokes can be turned next. It would be well to make a full sized drawing of a spoke on a piece of 1/4 in. plywood, then saw out a template to fit against the spoke while turning. The edge of the template can be rubbed with chalk or crayon. When this is held against the revolving spoke, the high points on the turning will be colored. These can be turned down until the template fits the turning at all points. This method will aid in turning all the spokes to the same shape.

A 3/8 in. tenon 5/8 in. long should be turned at the large end of each spoke as shown in Figure 591. The length of the spoke from the shoulder of the tenon to the small end must be very accurate. If the rim and hub have been accurately made, this distance should be 4 1/4 in.

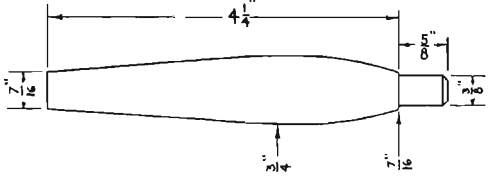


Fig. No. 591. Detail of a Spoke

However, the spokes must be made to fit the rims of the wheels you have made and it may be necessary to make them longer or shorter to fit snugly.

Turn two spokes, then fit them in opposite holes in the hub and make a trial fit inside one of the wheel rims. The trial will show whether it is necessary to make the spokes longer or shorter. When the exact length is determined turn all the spokes and sand them while they are in the lathe.

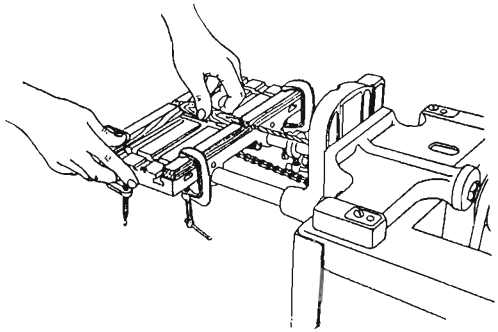


Fig. No. 592. Boring a Dowel Hole in a Spoke

Boring the Dowel Holes in the Ends of the Spokes

The dowel holes in the ends of the spokes can be bored on the boring machine as shown in Figure 592.

It is important that the center of the spoke be parallel with the top of the boring table, therefore, a jig for supporting the spoke can be used.

To make this jig place a $\frac{3}{8}$ in. bit in the boring machine and bore a hole on a center 1 in. from the edge of a short piece of lumber. Then place a $\frac{1}{2}$ in. bit in the machine and without changing the height of the table bore a hole in another piece of lumber. Rip these pieces off 1 in. wide, the saw blade cutting through the centers of the holes.

The piece which was bored with the $\frac{3}{8}$-in. bit can be clamped even with the back edge of the boring table to support the tenon end of the spoke. The piece which was bored with the $\frac{1}{2}$ in. bit can be clamped at the front edge of the table as shown in Figure 592.

To bore the holes in the spokes place a spoke in the jig and chuck a $\frac{1}{4}$ in. bit in the boring machine. Adjust the table so the bit will center at the exact center of the spoke, and set the stop collar so the bit will bore a hole $\frac{3}{4}$ in. deep. The machine may then be started and the hole bored. All the spokes can be bored in the same manner.

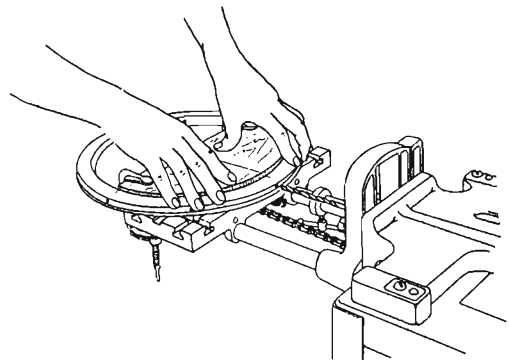


Fig. No. 593. Boring the Rim

Boring the Rims for the Spoke Dowels

Holes should be bored in the rims for the $\frac{1}{4}$ in. dowels which pass through the edge of the rims into the spoke ends. Figure 593 shows how the holes are bored on the boring machine.

Lay out and mark the position of the holes with a pair of dividers. Make a special guide fence by sawing out a half circle from a piece of lumber so it will fit inside the rims. The special guide fence should be clamped to the table so that a line drawn across the center of the fence will be in the center of the table.

Adjust the table to the correct height and set the stop collar so the bit will bore through the edge of the rim.

One of the marks on the rim should be placed in line with the point of the bit, and the first hole bored. The rim can then be moved to the correct position for boring the next hole. All the holes can be bored in the same manner.

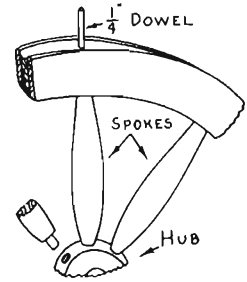


Fig. No. 594. Section of a Wheel

The ¼ in. dowels may be purchased or they may be made as described on page 99 of Volume I. Sixteen dowels 1⅝ in. long will be needed for both wheels. Chamfer one end of each dowel on the sanding disc.

Assembling the Large Wheels

The spokes can be glued in the hubs by spreading glue in the holes and inserting the spokes. Press them tightly in place so the tenon shoulders touch the hub.

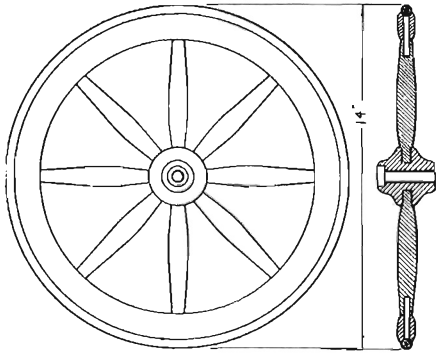


Fig. No. 595. A Completed Wheel

The rim can then be slipped carefully over the spokes. The ends of the spokes should fit over the holes in the rim. Spread glue in the holes and insert the dowels through the edges of the rim into the ends of the spokes as shown in Figure 594. The outside ends of the dowels should not extend outside the edge of the rims. The glue should be allowed to dry, then the wheels can be cleaned up and sanded with 3/0 garnet paper. Figure 595 shows a completed wheel.

Turning the Legs

The stock which was glued to make the turned legs can be jointed 1⅜ in. square. The legs can be turned in the usual manner according to the dimensions given in Figures 596 and 597.

Do not cut off the ends of the turnings if the legs are to be fluted because the center marks are needed when centering the legs in the fluting jig.

Fluting the Legs

The flutes can be cut in the legs by mounting them in a fluting jig and using a ¼ in. router bit in the boring machine as shown in Figure 598.

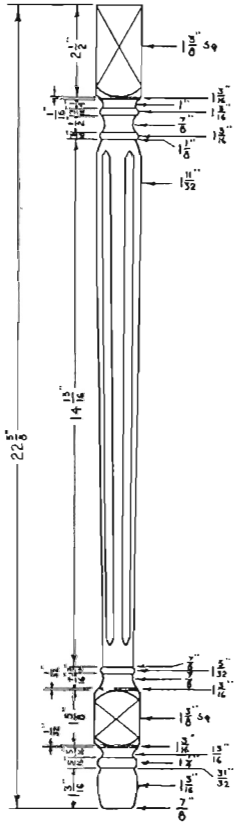


Fig. No. 596

A fluting jig is not difficult to make and it is very useful in the workshop. It can be used when fluting any turning within its capacity, regardless of the shape of the turning, either on the horizontal boring machine or the shaper.

The turning is held between centers, as if it were in a lathe. A template of thin plywood can be sawed out on the band or scroll saw and tacked to the jig under the turning.

If the router bit is used in the boring machine to cut the flutes, a guide arm or rod can be made and inserted in the hole in the front edge of the table. The guide arm is bent as shown in Figure 599, so that when it is in place on the table the end will be directly under the bit. In use the template rides against the guide arm and the bit cuts the flute, therefore, the template must be cut so that the jig will be pushed away from the bit where the flutes are to end.

If a router bit is used to cut the flutes, round off the cutting end to make the flutes of the proper semicircular shape.

The bit will cut easier by starting at the right end of the turning and pushing the jig to the right as shown in Figure 598. When one flute has been cut, lift the pin at the left end of the jig and turn the spacer wheel until the pin drops into the next hole. Another flute can then be cut.

Detailed drawings for making a fluting jig are given in Figure 600. The same lathe centers can be used on the lathe to make the turnings and on the jig for fluting them. The headstock is made of a block 1⅝ in. thick, 3¾ in. wide and 2¾ in. long. Bore a ½ in. hole in this block for the spindle, on a center 1⅞ in. from the bottom edge of the block.

A piece of ½ in. diameter rod iron 6½ in. long forms the spindle shown at A in Figure 600.

The spacer wheel shown at B can be made by screwing the lathe faceplate to a hardwood block 1⅛ in. thick and 3¾ in. square, and turning it on the lathe in the usual manner to a diameter of 3½ inches. Remove the faceplate and "wheel" from the lathe and drill a ½-in. hole through the center of the faceplate and wheel.

Part D can be made from a piece of iron ⅜ in. thick, ⅞ in. wide and 4 in. long. Drill 2 holes 3/16 inch in

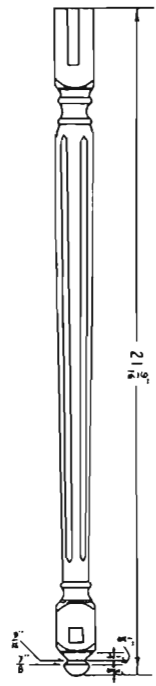


Fig. No. 597

diameter for the spacer pin C and two holes for the screws for fastening it

The spacer wheel can be marked off and bored to space any required number of flutes. In the illustration shown in Figure 600, one set of holes can be used to cut six flutes and the other set to cut eight flutes.

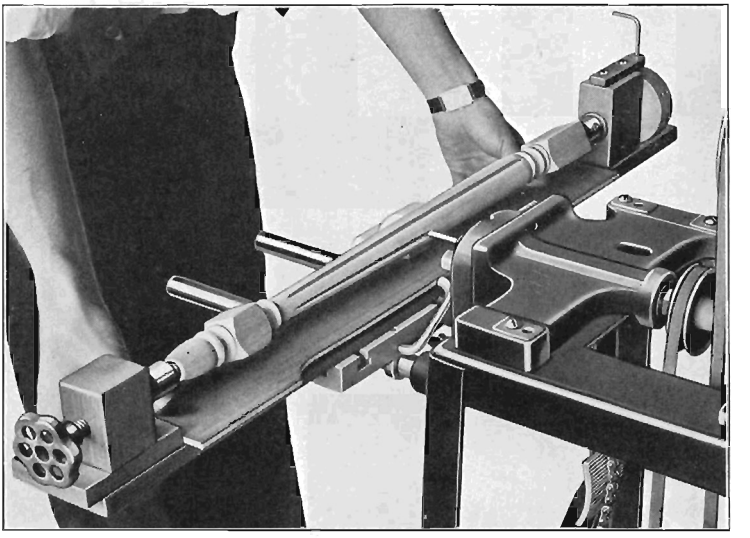


Fig. No. 598. Cutting the Flutes

Bore a 7/16-in. hole in the tailstock block and screw a 1/2-in. bolt into the hole as shown at K. The hole for the bolt must be bored so the headstock and tailstock centers will be exactly the same distance from the mounting board F. In the drawing this distance is 1 7/8 inches.

The lathe dead center can be fastened to the inside end of the bolt K and a knob or wheel as shown at J can be used to turn the bolt when mounting a turning in the jig.

The headstock and tailstock can be mounted on a board 3/4 in. x 3 3/4 in. x 36 in. as shown in the drawing.

The tailstock can be moved to a new position for turnings of various lengths.

When all of the flutes have been cut they should be sanded smooth. The legs can be held while sanding the flutes by mounting them in the lathe or the fluting jig.

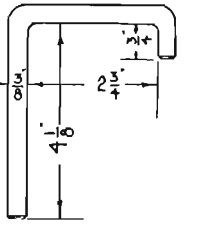


Fig. No. 599

Making the Mortises in the Legs

The mortises for the top rails can be cut by using the hollow-chisel mortising attachment on the boring machine as shown in Figure 601. The size of the mortises and their location are given in Figure 603. It would be

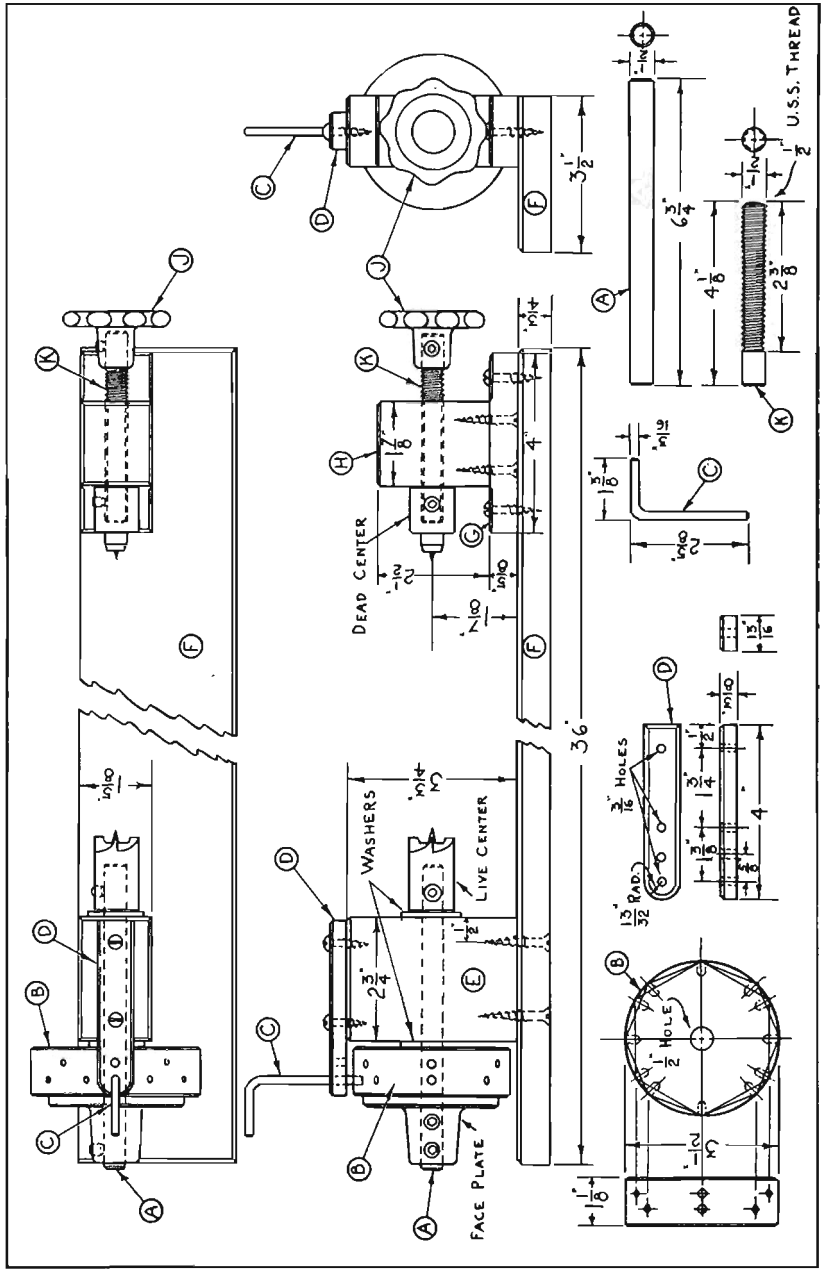


Fig. No. 600. Detail Drawing of Fluting Jig

well to lay out the position of the mortises on each leg in order to prevent any error.

The mortises are 3/8 in. wide, 13/16 in. deep and 2 in. long. A boring machine which is designed and constructed so that a hollow-chisel mortising tool can be mounted and used on the machine is ideal for work of this kind.

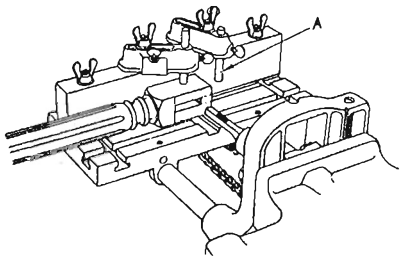


Fig. No. 601. Mortising a Leg

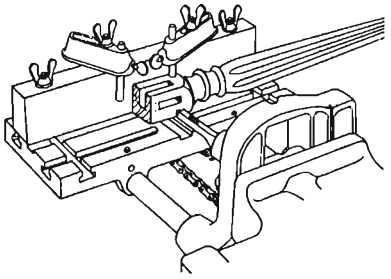


Fig. No. 602

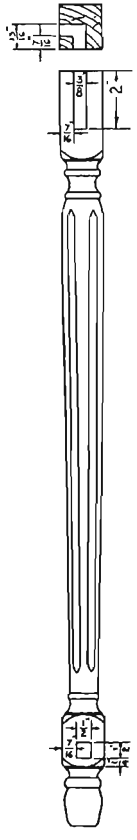


Fig. No. 603

A 3/8 in. mortising chisel and bit can be mounted on the machine and the mortises cut on one side of each leg as shown in Figure 601. One hold-down rod shown at A is used as a stop. The end of the leg should be placed against this stop rod to make the first cut. The leg is moved to the right of the operator for each following cut until the mortise is cut to the end of the leg.

Make a mortise in one side of each leg as shown in Figure 601. Make the other mortise in each leg with the table set in the same position but with the hold-down arms changed so the leg will be in the position shown in Figure 602.

When all the mortises have been made for the top rails make the mortises for the shelf rails. These mortises are 1/2 in. square and 15/16 in. deep. Their location is shown in Figures 603 and 597. They are made with the 1/2 in. mortising chisel and bit.

It is necessary to bore a hole in the bottom ends of each long leg to admit the dowel on the small wheel fork. Use a 1/2 in. bit in the boring machine and bore the holes 2 1/4 in. deep as indicated in Figure 604.

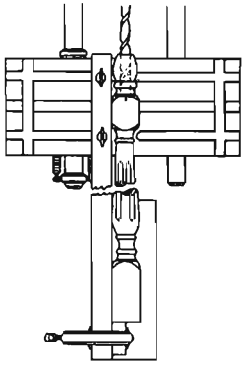


Fig. No. 604

Making the Top Rails

The top end rails, which are parts number 5 and the top side rails parts number 6 should be ripped 2 1/2 in. wide.

Joint one edge smooth and straight on the jointer, then rip them to a finished width of 2¼ in. Square one end of each piece on the circular saw and cut the side rails to a length of 24⅜ inches.

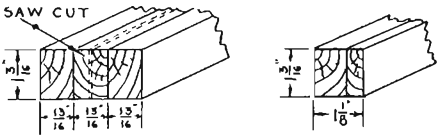


Fig. No. 605

The end rails should be cut off to a length of 13⅞ inches.

Preparing the Shelf Rails

The pieces from which the shelf rails are to be made should be 1⅛ in. thick and 1⅛ in. wide. If thick lumber was not bought for making them, they can be made by gluing the ¹³⁄₁₆ in. lumber.

To prepare the lumber for gluing, cut three pieces of the ¹³⁄₁₆ in. lumber 1³⁄₁₆ in. wide and 15 in. long, also three pieces 1³⁄₁₆ in. wide and 25 in. long. Glue the three 15-in. pieces together on their flat surfaces as shown in Figure 605. Glue the long pieces together also.

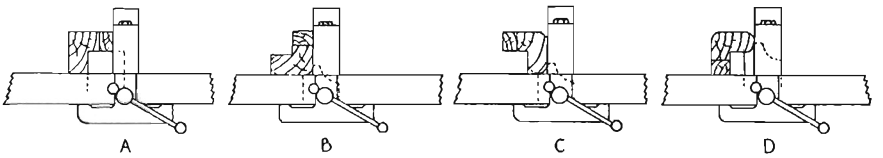


Fig. No. 606. Rabbeting and Shaping the Shelf Rails

When the glue has thoroughly dried, rip the pieces through the center. The pieces will then be about 1⅛ in. thick and 1³⁄₁₆ in. wide. As these rails should be 1⅛ in. square before they are shaped, they should be jointed perfectly straight on two adjoining surfaces and then ripped to 1⅛ inches, keeping the jointed edges against the rip gage when ripping.

Rabbeting and Shaping the Shelf Rails

The rabbet in the shelf rails for the shelf panel can be made in several ways. They may be cut out with the circular saw or with the moulding cutter, using a set of straight knives. The rabbets are to be ⅝ in. wide and ⅜ in. deep. If they are to be cut by using the moulding cutter, set the guide fence so that ⅝ in. of the straight knives are exposed at the side of the guide fence. Adjust the saw table so that the knives will cut ⅜ in. deep. Start the machine and make a trial cut in a piece of scrap wood. Measure the cut and make any adjustments that may be necessary, then rabbet all the good pieces. Figure 606 at A shows how the machine may be set for cutting the rabbets, using the moulding cutterhead on the circular-saw arbor.

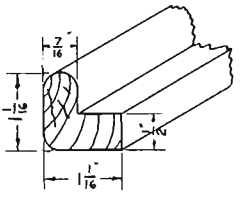


Fig. No. 607

The shaped edges can be made by using a set of style-A knives in the moulding cutterhead. The first cut can be made as shown at B in Figure 606.

After shaping all the pieces in this manner the second corner can be rounded as shown at C. The final shaping operation is shown at D. The shape and dimensions of a rail are shown in Figure 607.

The end rails can be cut to a length of 14⅛ in. and the side rails to a length of 24⅝ inches.

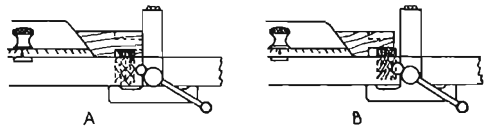


Fig. No. 608. Cutting Tenons with the Dado Head

Tenoning the Top Rails

The tenons on the top rails should be ⅜ in. thick, 2 in. wide and 1⅜16 in. long. The tenons may be cut with the circular saw as described on page 80 in Volume I, or the dado head may be used as described on page 82. The dado head does not make as smooth a cut as the circular-saw blade but the tenons can be made much quicker. The worker can use the method he prefers.

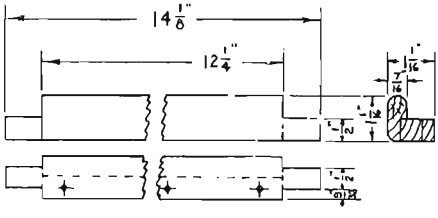


Fig. No. 609. Shelf End Rail

If the dado head is used set the rip gage to the right of the dado head and 1⅜16 in. from the left edge of the dado head.

Adjust the machine so that 7⁄32 in. of the dado head projects above the table. Place the cut-off gage in the left hand groove in the saw table. Select a piece of scrap lumber the same thickness as the top rails so that a sample tenon can be made and tried in the mortises before tenoning the good pieces.

Place the trial piece against the cut-off gage and the end against the rip gage and make the first cut as shown at A in Figure 608. Move the piece to the left and make the second cut as shown at B. Turn the other side down and make the same cuts in that side. Try this tenon in one of the mortises in the legs.

If it fits too loosely adjust the machine so the blade does not extend quite so high above the table. If it fits too tightly adjust the machine so the blade projects a little more above the table.

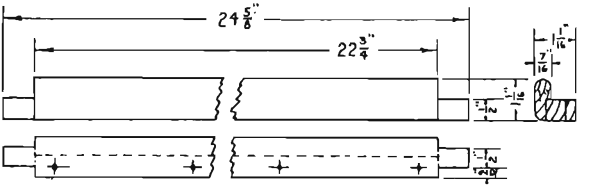


Fig. No. 610. Shelf Side Rail

After either adjustment cut a complete new tenon and make a trial fit. When the machine has been properly adjusted cut the tenons on all the top rails.

When making wide tenons it is well to use a gage block between the end of the stock and the rip gage, so that the end of the stock will be free by the time the saw or dado head begins to cut.

The shoulder cut on the bottom edge of each tenon can be made by adjusting the machine so the dado head cuts ¼ in. deep. The bottom edge of a rail can be placed on the table and the cut made with the rip gage at the same position.

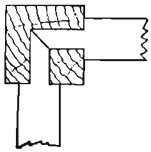


Fig. 611

Tenoning the Shelf Rails

If the dado head was used to cut the tenons on the top rails it can be used to cut the tenons on the shelf rails by changing the position of the guide fence so that the tenons will be 15/16 in. long.

The table should be adjusted so the head will cut 9/32 in. from each side of the rails. If the rails were cut exactly 1 1/16 in. thick, a tenon ½ in. thick will be made. Make the side cuts on all the pieces and then set the saw table so the head will make a cut 9/16 in. deep. Place the top side of the rails down on the table and make the final cuts which will complete the tenons. See Figure 609.

Mitering the Rails

The tenons on both the top and shelf rails should be mitered as shown in Figure 611 to give a greater gluing surface. These miters may be cut by tilting the saw table to an angle of 45 degrees as shown in Figure 488.

Clamp a stop block to the cut-off gage to hold the ends of the rails against while mitering.

It should be remembered that the rails have been cut to the correct length, therefore, the outside of the tenon should remain the same length after mitering. See Figures 610 and 612.

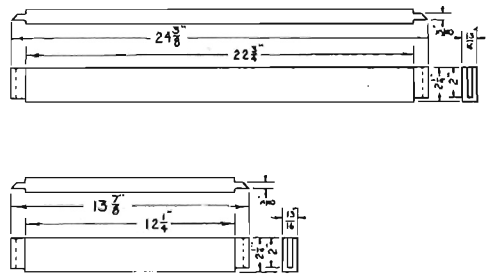


Fig. No. 612. Top Rails

Cutting the Grooves in the Top Rails for the Top Fasteners

There are several types of table top fasteners. If metal fasteners are to be used, make a saw cut ¼ in. deep on the top inside edge of the rails ½ in. from the top edge. One end of the fasteners are to fit into this saw kerf and the other is screwed to the table top as shown at B in Figure 613.

Fig. No. 613. Table Top Fasteners

If wood fasteners are to be used as shown at A in Figure 613, the dado head can be used to cut the groove or the router bit may be used to cut short recesses in the rails at points where the fasteners are to be placed.

Boring the Shelf Rails

The holes in the bottom of the shelf rails to admit the screws for the shelf panel may be bored on the drill press or boring machine, using a ⅛ in.

drill. Four holes are needed in each side rail and three in each end rail. The location of the holes is shown in Figures 609 and 610.

Table Leaf Supports

The tea wagon shown in Figure 571 has metal leaf supports which are made especially for this purpose. When the table leaves are raised to their highest position the support springs in place and holds the leaves level with the table top. These are inexpensive and they can be bought from many supply houses. They can be had in several lengths. The eight inch size was used on this tea wagon. Figure 614 shows one of the supports in place.

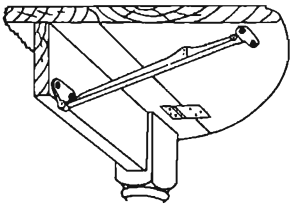


Fig. No. 614. Table Leaf Held by Support

If the worker prefers he may cut out the top side rails and make supports of wood which can be turned on pivots to support the leaves. Figure 615 shows how this type of support may be used.

Sanding the Rails and Legs

The rails and legs should be sanded perfectly smooth before they are assembled. It should be remembered that if a fine finish is desired, the work must be sanded very smooth. All saw or knife marks, all scratches and blemishes should be sanded out.

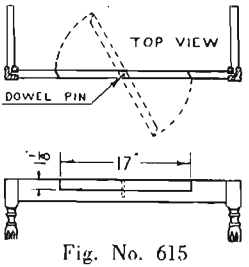


Fig. No. 615

If the wagon is to be stained with a water stain, the parts should be sanded with 3/0 garnet paper, then sponged with warm water. When the parts have dried thoroughly, sand the parts again with 4/0 garnet paper.

Assembling the Legs and Rails

The short rails and legs should be assembled first. A method of clamping these parts together is shown in Figure 616. It would be well to set the clamps and make a trial fit before spreading any glue in the joints.

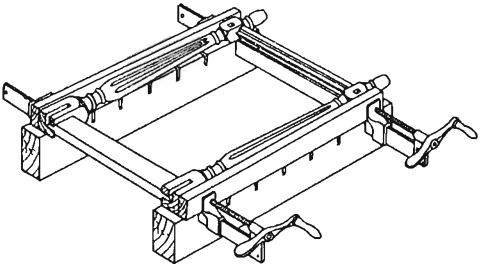


Fig. No. 616. A Method of Clamping

The shoulders of the rails should fit tight against the table legs. If the tenons are too long for the mortises it will be necessary to miter cut a little off the ends of the tenons.

When the parts fit properly, spread glue in the mortises where the end rail tenons are to fit. Do not spread glue in the mortises where the side rail tenons are to fit, at this time.

Fit the end rails in place and clamp the parts together. Narrow pieces of smooth lumber or small blocks should always be placed between the clamp jaws and the work to prevent the clamp jaws from marring the parts.

See that the assembled parts are square with each other. Leave the parts clamped until the glue has set, then clean any surplus glue out of the mortises where the side rails are to fit.

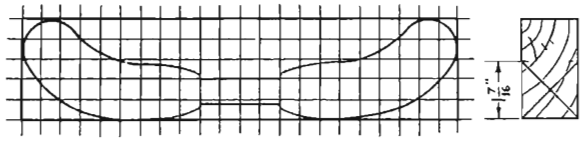


Fig. No. 617. Small Wheel Forks Laid Out on ½ Inch Squares

Make a trial fit of the side rails by clamping the parts together without any glue. Mark or number the parts with a pencil so they can be assembled again in the same places quickly. Four clamps are needed to clamp the parts together, two for the top rails and two for the shelf rails. The clamps should be long enough to clamp parts at least 26 in. long.

Fig. No. 618

When everything is ready, spread the glue in the mortises and assemble the parts. Clamp the parts together. Try the parts for squareness and if necessary a board or strip of plywood can be tacked diagonally across the top rails to aid in holding the parts square.

Making the Small Wheel Forks

The top ends of the forks are turned on the lathe so that the ends will look well where they meet the ends of the long legs. Instead of turning the dowel which fits into the end of the legs on the forks, it would be well to bore the forks and glue maple on birch dowels in place. As these dowels form the swivel, it is necessary that they be quite strong.

Both forks can be made from a piece of lumber 1 7/16 in. thick, 2½ in.

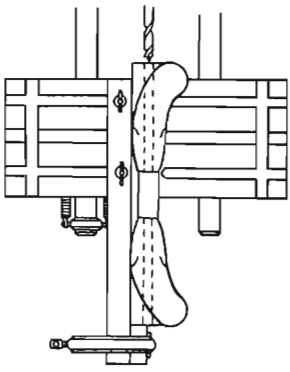


Fig. No. 619

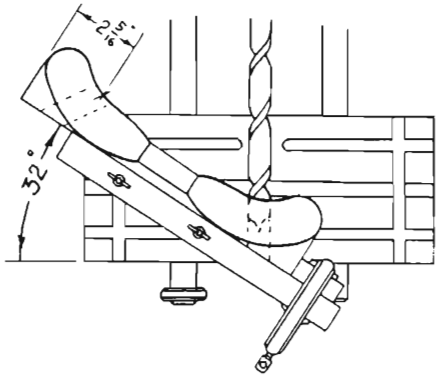


Fig. No. 620

wide, and 11 in. long. Lay out and draw the forks on one side of the wood as shown in Figure 617. Bandsaw the one side as indicated in Figure 618, but do not cut the ends or the bottom edge. The ends must remain square so that the piece can be mounted in the lathe as shown in Figure 618.

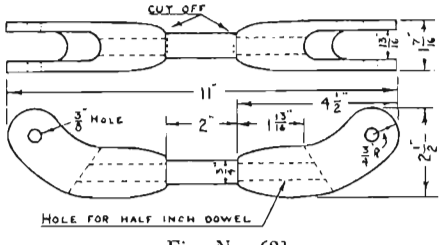


Fig. No. 621

The piece should be centered in the lathe very carefully as shown in Figure 618. The centers can be laid out and marked as indicated in the end view in Figure 617. An awl or punch can be used to make small holes for the lathe centers. Use a slow or medium speed on the lathe for turning these parts.

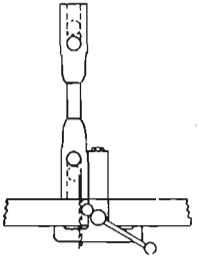


Fig. No. 622
Sawing the Forks

After making the turned section on the forks and before bandsawing the remainder of the curved part, the holes for the dowels can be bored. A ½-in. bit can be placed in the boring machine and the guide fence set as shown in Figure 619. The marks made by the lathe centers will act as guide marks when setting the table and guide fence. The holes should be bored clear through each fork.

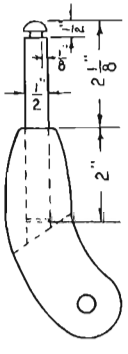


Fig. No. 623

By boring a ¾-in. hole in the edge of each piece before sawing out the end for the wheel, the opening will have a nice rounded end. Figure 620 shows how the holes may be bored.

A ⅜-in. hole should be bored in each fork for the axle. Figure 621 shows the location of the holes.

The ends can be cut out for the wheels by making saw cuts in each end, using the hollow-ground blade. As the forks are 1 7/16 in. thick, and the opening is to be 1 3/16 in. wide the thickness of each prong of the forks should be 5/16 in. Set the rip gage 5/16 in. from the saw blade and adjust the saw table so the blade projects 1¾ in. above the table. Stand the fork on end on the table and with one flat side against the rip gage, push the piece past the revolving blade as shown in Figure 622. Turn the piece around and cut the other side. The other fork can be cut in the same manner. A small part will remain uncut but this can be removed with the band saw.


Fig. No. 624

The square ends which were left on the piece can be bandsawed off, giving each fork its final shape, and the two forks cut apart on the circular saw.

The dowels which form the swivels can now be cut and glued into the forks. Maple or birch dowels ½ inch in diameter and 4⅛ in. long should

be used. They should project 2⅛ in. above the top end of the fork. The dowels should fit snugly in the holes, and be glued in place with a good glue.

When the glue has dried hard, round off the ends of the dowels as shown in Figure 623, and make a trial fit in the holes which were bored in the ends of the long table legs. It may be necessary to sand the dowels a little with fine garnet paper so they can be turned easily.

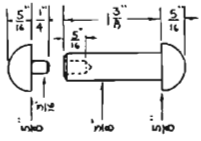


Fig. No. 625

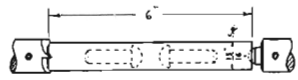


Fig. No. 626

The weight of the table should rest on the end of the dowel, therefore, there should be a little clearance between the end of the leg and the turned part of the fork as shown in Figure 624, to permit the fork to turn easily.

A small screw is inserted at a point 1⅞ in. from the end of the leg and at the inside corner where it will not be seen. Place the forks in place and insert a ⅜ in. No. 4 wood screw in place. The point of the screw will make a mark on the dowel. Loosen the screw, remove the fork and cut a groove ¼ in. wide and 3/16 in. deep around the dowel at the point marked with the screw. See that the fork turns easily when the screw is in place. The end of the screw can be filed down if it is too long.

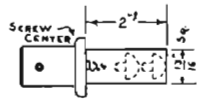


Fig. No. 627

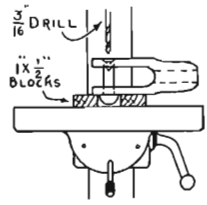


Fig. No. 628

Turning the Small Wheel Axles

Both small wheel axles can be turned from a piece of wood 1 3/16 in. square and 6 in. long as shown in Figure 626. The dimensions of the axles are given in Figure 625.

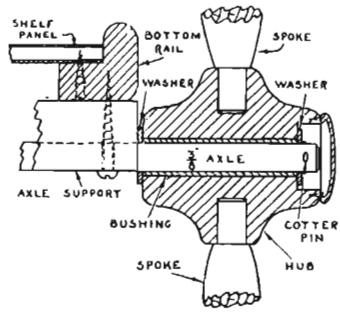


Fig. No. 629

The small wheel axle caps can be turned from a piece 1 3/16 in. square and 2½ in. long. This piece is mounted on the screw center plate on the lathe, and, after turning one cap, it is cut off and the second one turned. See Figure 627.

Bore a 3/16 in. hole in the end of each axle for the dowel on each cap. These small dowel holes can be bored on the drill press by inserting a dowel in position in the fork and placing two blocks under the fork to level it on the table. This will hold the dowel upright and the hole can be bored straight. See Figure 628.

The Large Wheel Axle and Bearings

The axle for the large wheels is a piece of iron rod 3/8 inch in diameter and 19 3/8 in. long. The wheels are held on the axle by small cotter pins passing through the axle near the ends as shown in Figure 629. The holes for the cotter pins can be drilled with a 1/16 in. drill centered 3/16 in. from the ends of the axle. The holes may be drilled on the drill press, boring machine, or lathe.

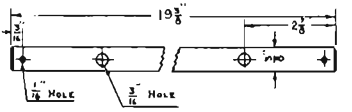


Fig. No. 630. Axle

Two screw holes are needed in the axle so that it can be fastened to the axle support. Drill these holes 3/16 inch in diameter, 2 7/8 in. from each end of the axle as shown in Figure 630.

The brass or bronze bushings which form the bearings in the hubs should now be fitted in the hubs of the wheels. These should be 2 1/16 in. long and should fit tightly so they will not turn in the hub. They should fit even with the inside end of each hub as shown in Figure 629.

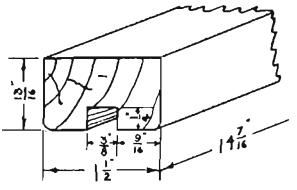


Fig. No. 631. Axle Support

Making the Axle Support

The axle support should be cut and jointed to a finished size of 13/16 in. thick, 1 1/2 in. wide and 14 5/8 in. long.

Cut a groove lengthwise in the support 3/8 in. wide and 1/4 in. deep for the axle as shown in Figure 631. The dado head can be used to cut this groove.

Bore and countersink two holes, 3/16 inch in diameter, near each end of the support so that it can be screwed to the bottom of the shelf side rails.

Sand the support smooth and screw it in place 4 1/4 in. from the inside edge of the end rail. Use 1 1/4 in. No. 8, flat head, wood screws to fasten it to the side rails.

Temporary Fitting of the Tires on the Wheels

In order to make the tea wagon easier to handle while fitting the other parts and to prevent marring the edges of the wheel rims, it would be well to fit the tires on the rims temporarily at this time so that the wheels can be put in place. The tires must be removed when applying the finishing coats.

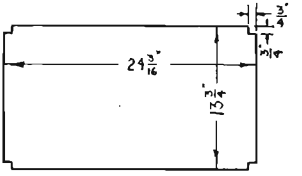


Fig. No. 632. Shelf Panel

The rubber can be cut to length, fitted in the grooves and the ends tacked down to the rims with 5/8 in. wire brads.

The large wheels should be placed on the axle before the axle is fastened to the support. When placing a large wheel on the axle, put a washer on the axle first, then the wheel, then another washer. Place a small cotter pin in the end of the axle and spread the points. Place the other wheel on the axle in the same manner.

Place the axle in the groove in the support. See that both wheels turn freely, but without much end movement. Insert the screws through the axle and tighten them into the support.

The small wheels can be placed in the forks and the fork dowels slipped into the ends of the legs.

The wagon can be now turned over and stood on the wheels.

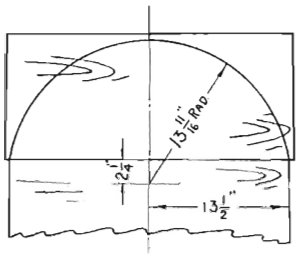


Fig. No. 633

Cutting and Fitting the Shelf Panel

The shelf panel should fit snugly inside the shelf rails, therefore, the sizes should be taken by measuring the width and length inside the bead on the rails on the tea wagon you are making. Cut the panel 1/16 in. wider and longer than necessary and joint the edges so the panel will fit properly.

The corners can be cut out on the circular saw where they fit against the legs. Clamp a stop block to the cut-off gage 3/4 in. from the outside of the saw blade. Adjust the saw table so the blade projects 3/4 in. above the table and with the end against the stop block, make one cut. Turn the panel and make the other cut. This completes one corner. The other corners can be cut in the same manner. See Figure 632.

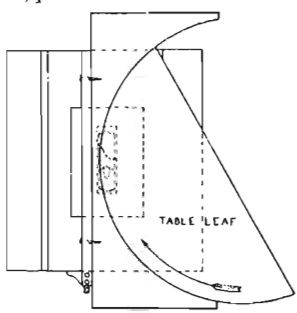


Fig. No. 634. Shaping a Table Leaf

Cutting the Table Top and Leaves

The plywood table top should be sawed and jointed to a width of 17 in. and sawed to a length of 27 inches. The leaves should be sawed and jointed 12 in. wide and sawed 27 1/2 in. long.

To lay out and mark the leaves for band-sawing, place the top and leaves on a level surface. Place the edges together where the rule joint is to be made and clamp the parts down to prevent slipping. Draw a center line on the top as shown in Figure 633.

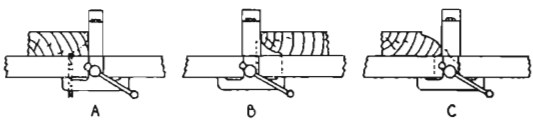


Fig. No. 635

The compasses or dividers can be set for a radius of 13 11/16 in. Place one end of the dividers on the center line on the top at a point 2 1/4 in. from the edge of the top as shown in Figure 633. The curved outline of the leaves can then be drawn with the dividers.

Band-Sawing the Leaves

The leaves are now cut on the band saw. Cut outside the marked line carefully so the edge can be sanded smooth to the line on the sanding disc.

Do not destroy the waste pieces for one of them can be used as a templet when shaping the edges as shown in Figure 634, and in routing for the inlays as shown in Figure 639.

After bandsawing both leaves, sand the edges on the sanding disc. This will remove any imperfections and saw marks along the edges.

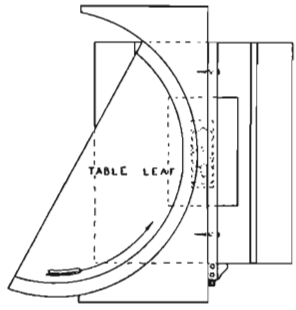


Fig. No. 636

Shaping the Table Top and Leaves

The edges of the table can be shaped with the moulding cutter on the circular saw arbor or on the shaper.

If a shape is to be made like the thumb moulding shown at C in Figure 635, it would be well to make a saw cut through the veneer first to prevent the knives from chipping the end grain of the veneer. As the ledge on the moulding shape is ¾ in. from the edge of the top, the rip gage should be set ¾ in. from the *outside* edge of the saw blade. The blade should not project more than 1/16 in. above the table.

The table top should be cut across the ends only. The leaves should be cut along the curved edges only.

When making the saw cuts near the curved edges of the leaves, the good edge will be clean and smooth but the side which will be shaped away later will be uneven due to the fact that the leaf is advanced in a circular direction over the saw blade.

To shape the edges with the moulding cutter, use a set of style B knives as shown at B in Figure 635.

Set the guide fence so that ¾ in. of the knives are exposed at the side of the guide fence. The table should be adjusted so the knives will cut ⅛ in. deep at the point where the saw cut was made.

Shape the ends of the table top only at this time as shown at B in Figure 635.

The leaves can be shaped with the same set-up but the pieces can be guided more steadily by fastening one of the waste pieces to the guide fence as shown in Figure 634.

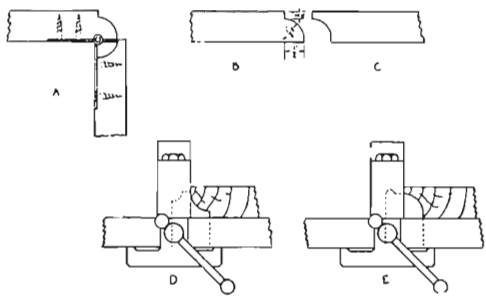


Fig. No. 637. Making the Rule Joint

Use a set of style A knives in the cutterhead to complete the shape. Figure 636 shows the set-up for the leaves and drawing C in Figure 635 shows the machine set for shaping the top ends.

Shaping for the Rule Joint

The rule joint as shown at A in Figure 637 is to be used where the leaves are hinged to the table top, the side edges of the table top being shaped as shown at B in Figure 637.

On veneered tops it would be well to make a saw kerf 1/8 in. deep and 1/2 in. from the edge of the top before shaping. Use a set of style A knives in the cutterhead which will cut a radius of 1/2 inch. Set the guide fence so that 1/2 in. of the knives are exposed at the side of the fence. Shape both side edges of the top as shown at D in Figure 637.

The table leaves are shaped as shown at E with a set of style C knives having a radius of 1/2 inch.

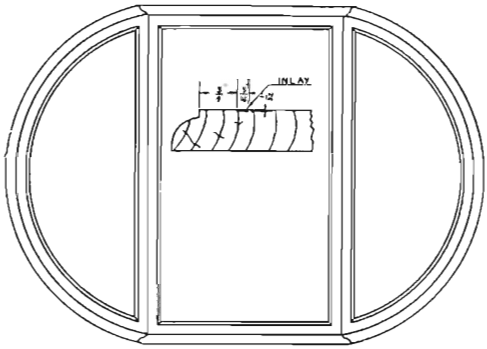


Fig. No. 638. Table Top

Fitting the Hinges

Hinges made especially for table leaves should be used to make the rule joint. Place the top and leaves face down on the workbench. Fit the edges together.

The hinges can be placed 4 in. from the ends of the table, the center of the hinge knuckle being located 1/2 in. from the edge of the top. A marking gage can be used to scratch a line 1/2 in. from the edge. The knuckles of the hinges should be placed on this line. Mark the location of the hinges with a knife or scratch awl. Cut a recess to admit each hinge so it will be flush with the surface of the wood. This can be done with a chisel or the router bit in the drill press. It will be necessary to cut a deeper recess for the knuckles of the hinges. Bore the pilot holes and screw the hinges in place.

The proper setting of the hinges is very important. If they are not set properly the joint will be open or it may bind. For the beginner, it would be well to shape the edges of two boards of the same thickness as the top, then fit a pair of hinges to these pieces. A trial of this kind may prevent patching the good pieces if a mistake would be made. Read the article on this type of joint on page 99 in Volume I.

Making the Grooves for the Inlays

The hinges should be removed from the top before cutting the grooves for the inlays. The grooves for the latter are 1/32 in. deep, 3/16 in. wide and are 3/4 in. from the shaped edges of the top and leaves as shown in Figure 638.

Draw a line 3/4 in. from the edges, where the inlays are to be made, to aid in determining where to start and stop the cuts.

Place a 3/16 in. router bit in the boring machine and adjust the table so the groove will be cut the correct distance from the edge.

Screw a wide board to the guide fence to make it easier to hold the top against. If the veneer for the inlays is ⅛ in. thick, set the stop collar so the bit will cut to a depth of only 1/32 inch.

Start the machine and make a trial cut on a piece of scrap wood of the same thickness to see that all adjustments are correct. Cut the grooves in the table top by starting the cut on the mark at the right end and feeding the work to the right. When the bit has reached the mark at the corner, release the foot lever. Turn the next edge down and cut the groove on that side. Proceed in this manner until the grooves have been cut in the top.

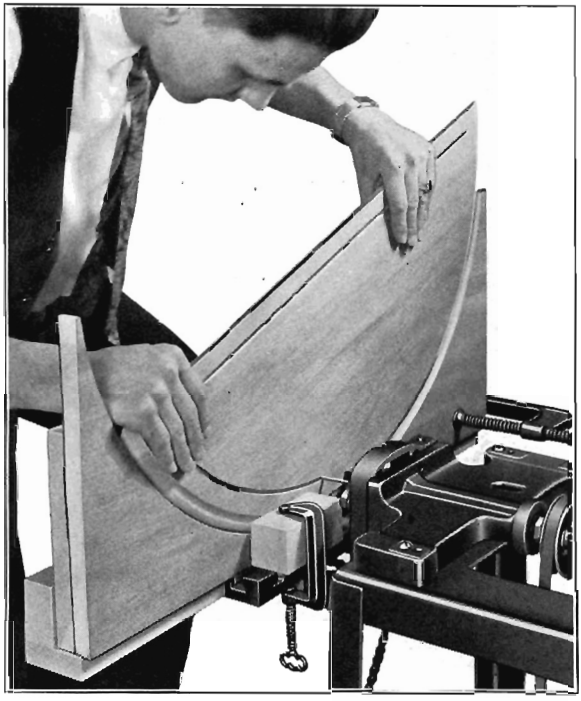


Fig. No. 639. Routing a Table Leaf for the Inlay

The straight grooves near the rule joint on the table leaves are made with the machine set as for the top.

The grooves around the circular edges of the leaves are cut as shown in Figure 639. One of the waste pieces which was made when bandsawing the leaves can be clamped to the guide fence to act as a guide when routing these grooves, and can be clamped to the machine table to prevent tipping the table leaves while the grooves are being cut. Adjust the machine table so the bit will cut the groove the same distance from the edge as the other grooves.

All the grooves can be cut on the drill press instead of the boring machine if desired.

It will be necessary to cut the outside corners of the grooves square with a sharp chisel.

Cutting the Veneer for the Inlays

Band inlays can be bought in various widths and patterns or they may be made by the worker.

MAKING A TEA WAGON

Satinwood veneer 1/28 in. thick was used for the inlays on this mahogany tea wagon. It was cut across the grain into narrow strips to fit the grooves. The veneer was 10 in. wide and the strips or bands were cut on the circular saw, using a hollow-ground blade.

Set the rip gage 3/16 in. from the blade and the table so the blade projects 5/16 in. above the table. Place a sheet of the veneer between two pieces of 1/4 in. plywood. Place the edges of the plywood and veneer against the rip gage, start the machine and advance the pieces past the blade. The blade will cut through the bottom piece of plywood and also the veneer. The veneer will be cut very smooth if the blade is sharp.

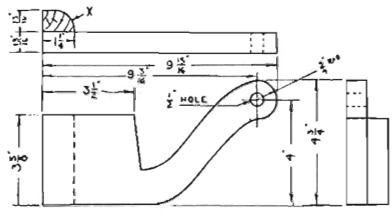


Fig. No. 640. Handle Bracket

Try the band in one of the grooves, where it should fit perfectly. Make any adjustments that are necessary, and cut enough pieces to make all the inlays.

Gluing the Inlays

The bands should be mitered where the inlays meet at the corners, which can be done with a sharp chisel.

Animal glue, which can be used hot, is best for inlaying, although prepared liquid glue may be used, but do not use a glue that will stain the wood.

The bands can be glued in several ways. One method is to spread glue in the groove a distance equal to the length of the band. Place the band in the groove, place a piece of paper over the band, place a short board or block, which has been warmed, over the band, and clamp it tight.

Another method is to spread glue in the groove, insert a band, moisten the outside of the band with glue or water and rub the band with the smooth head of a hammer or a rubbing stick made from a piece of hardwood. The rubbing should continue until the glue has set enough to hold the band tight in place. Good results can be obtained with this method if carefully done. The glue should not be too thick or too thin and it should have a temperature of about 150 degrees Fahrenheit if animal glue is used.

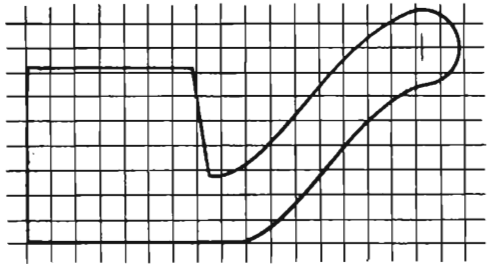


Fig. No. 641. Bracket Laid Out on ½ Inch Squares

Start gluing the inlays at one corner and continue until the next corner of the top is reached. As the veneer is thin and the bands are not long, the pieces will bend enough to fit into the circular grooves in the table leaves.

Sanding the Top After Inlaying

When all the inlays are glued in the table top and leaves, the glue should dry 24 hours or longer before sanding them smooth. If the inlays are sanded before they have dried properly, they will sink below the surrounding surface.

Sand the inlays level with the top with 2/0 garnet paper. Remove the glue from the pores of the wood surrounding the inlays by rubbing the surface with a sponge or rag which has been saturated with warm water. Remove every trace of glue from the surfaces. Sponge the entire top and leaves and allow the parts to dry thoroughly, then sand with 3/0 or 4/0 garnet paper.

Fastening the Table Top to the Rails

Fit the hinges on the table top and leaves again. Put a thick layer of papers on the work bench to form a cushion and to prevent scratches when the top of the table is placed on the bench. Screw the hinges in place.

The top of the rails should be leveled off with a plane if there is any unevenness.

While the table top is on the bench fasten it to the rails. To do this, turn the wagon upside down and place it in position on the table top. Measure the margin carefully and clamp the parts to the bench to prevent slipping. Insert the fasteners and screw them tight. Three fasteners can be placed in each side rail and two in each end rail.

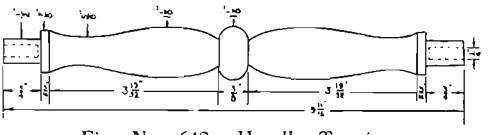


Fig. No. 642. Handle Turning

Fitting the Table Leaf Supports

While the tea wagon is upside down on the bench, the metal support for the leaves can be fitted in place as shown in Figure 614. The long part should be screwed in place on the rail first, then screw the short end to the table leaf. Figure 614 shows a support in place.

Making the Handle Brackets

The brackets which support the handle for the tea wagon are hinged to the underside of the table top so that when the tea wagon is used as a serving table, the handle can be swung under the table. When the handle is needed, it can be hooked in place with two hooks similar to those used on screen doors. The large part of the brackets can be cut from two pieces of lumber $^{13}/_{16}$ in. thick, $4^{3}/_{4}$ in. wide and $9^{15}/_{16}$ in. long as shown in Figure 640. Draw the shape of the bracket on the pieces and band saw them to shape. Figure 641 can be used as a guide when drawing the pattern. It is laid out on $^{1}/_{2}$ in. squares.

Band saw the parts, then bore a $^{1}/_{2}$ in. hole in the small ends for the turned handle.

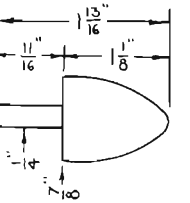


Fig. No. 643

Cleats should be glued to the back end of each bracket to make these ends thicker so the hinges can be screwed to these ends as shown in Figure 644. The bracket cleats can be made from a piece of lumber $^{13}/_{16}$ in. thick, $1\frac{1}{4}$ in. wide and 8 in. long. One arris can be shaped round with the moulding cutter. The pieces can be cut to a length of $3\frac{5}{8}$ inches. Glue and clamp them to the brackets as shown at X in Figure 640. When the glue is dry sand the brackets smooth.

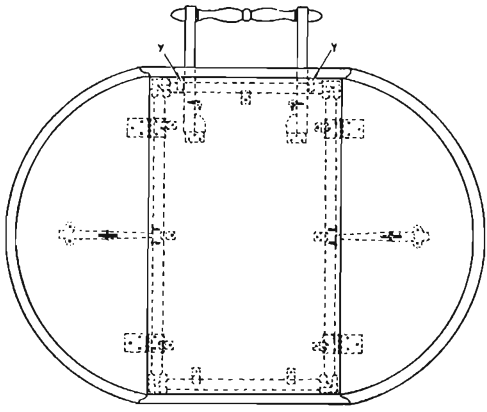


Fig. No. 644. Top View of Tea Wagon

Turning the Handle

The handle may be turned from a piece of lumber $1\frac{1}{4}$ in. square and 12 in. long. Two pieces may be glued together to make the thickness, if necessary. Figure 642 gives the shape and dimensions of this turning. It can be turned on the lathe in the usual manner.

Each end of this turning is to fit into the $\frac{1}{2}$ in. holes in the ends of the brackets.

Two end turnings or caps should be made as shown in Figure 643. These are to fit into the ends of the handle as shown in Figure 644.

Each block from which an end turning is to be made can be mounted on the screw center on the lathe for turning.

Bore a $\frac{1}{4}$ in. hole $\frac{3}{4}$ in. deep in each end of the handle to admit the dowel on the caps. Bore the holes on the boring machine.

Assembling the Handle and Brackets

Glue the handle in the brackets. Keep the bottom edges of the brackets on a level surface until the glue is dry so the brackets will be parallel and fit level under the table top. Glue the caps to the ends of the handle.

When the glue is dry, fasten the hinges to the ends of the brackets. The knuckles of the hinges should be even with the top edge of the brackets. Screw the other halves of the hinges to the underside of the table top as shown in Figure 644.

The hooks can also be fitted in place as shown in Figure 644.

Small blocks should be screwed to the end rail after the finishing coats have been applied as shown at Y in Figure 644. These are to prevent any side movement of the brackets. The edges of these blocks should be covered with felt to prevent scratching the finish.

Making the Tray

The tray should fit on the table top so it will not become displaced when the tea wagon is moved. The material from which the tray moulding is to be

made, should be 1⅜ in. thick and 1⅜ in. wide. If thick stock is not available, rip three pieces of ¹³⁄₁₆ in. lumber 1½ in. wide, glue the flat surfaces together; and when the glue has dried, rip the pieces in the center, joint them straight, rip to a width and thickness of 1⁷⁄₁₆ in. and joint the ripped edges so the pieces are 1⅜ in. square.

Shaping the Tray Moulding

Three rabbets are necessary on the under side of the tray moulding as shown in Figure 645. The top rabbet is for the glass, the middle one for the panel, and the bottom rabbet is to fit over the edge of the table top.

These cuts can be made with a set of straight knives in the moulding cutterhead which can be mounted on the circular saw arbor.

The successive operations are shown at A, B and C in Figure 646.

The tray moulding can be shaped with the moulding cutter-head mounted on the circular saw arbor or with the vertical spindle shaper. The operations are shown at D, E and F in Figure 646, where the moulding cutter-head is used on the circular saw arbor.

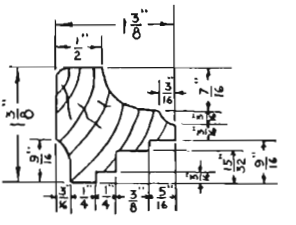


Fig. No. 645. Tray Moulding

Mitering the Tray Moulding

The tray should fit on the table top loosely so that felt can be placed on the underside, after finishing, to prevent scratching the top. About 1/16 in. on each side and end will provide enough clearance.

Miter cut one end of each piece, then clamp a stop block to the miter gage, cut the other ends to the required length.

If all sizes were followed accurately the end pieces can be miter cut to a length of 17 inches and the side pieces to a length of 26½ inches. However, the tray should fit the top which you have made, and, therefore, it would be well to determine the sizes from the top itself.

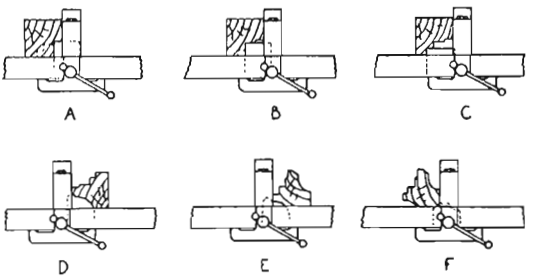


Fig. No. 646. Shaping the Tray Moulding with the Moulding Cutter-Head on the Circular Saw

Sand the mouldings perfectly smooth before they are glued.

Gluing the Tray Frame

Slip feather joints can be used to reinforce the mitered joints of the frame.

A slip feather joint is described and shown on page 78 of Volume I. The saw cuts should be made in the center of the edge so that the inlays will cover the splines.

Cutting the Tray Panel and Routing for the Inlays

The tray panel sizes should be taken from the tray itself in order to avoid any errors. Cut it to a width and length so it will fit in the tray properly.

The grooves for the inlays should be 1½ in. from each edge. Draw lines on the panel 1½ in. from the edges and cut the grooves with the router bit in the boring machine or the drill press in the same manner that the grooves in the table top were cut.

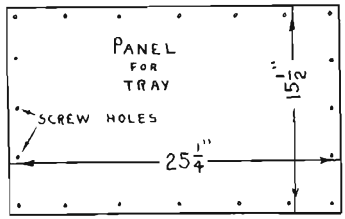


Fig. No. 647

Bore and countersink ⅛ in. holes in the tray panel for the screws as shown in Figure 647.

Glue the inlays in the tray panel.

Cutting the Grooves for the Inlays in the Tray Frame

The grooves for the inlays on the edges of the tray frame should also be 3/16 in. wide and 1/32 in. deep. These grooves may be cut on the circular saw, using a rip saw blade. The rip saw blade will cut a groove which is flatter on the bottom than one cut with the hollow ground blade.

Glue the inlays in place. Allow the glue to dry at least 24 hrs. before sanding the inlays.

Making the Tray Handles

The tray handles can be made from stock ½ in. thick, 1⅜ in. wide, and 7 in. long. Two pieces are needed. The handles should be quite strong but they should not be cumbersome. If two pieces ¼ in. thick are glued together to make the ½ in. thickness, good-looking handles, which are very strong, can be made.

Figure 648 shows a pattern laid out on ½ in. squares. Draw the pattern on one piece, tack the two pieces together and bandsaw both handles at one time.

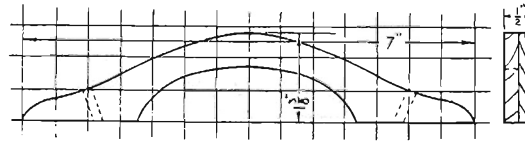


Fig. No. 648. Tray Handle Laid Out on ½ Inch Squares

Bore the holes in the handles for the screws at an angle as shown in Figure 648, so the heads of the screws will lie flat against the edge of the handles when the screws are tight in place. Sand the handles perfectly smooth. The edges can be sanded on the sanding drum, using fine garnet paper.

Assembling the Tray

Sand the frame and panel smooth then fit the panel in place. Bore the pilot holes in the bottom of the frame for the ⅝ in. No. 5 screws.

The glass can be fitted in place after finishing.

The tray handles may be screwed in place for trial, then removed until after finishing.

CHAPTER XXVI

FINISHING THE TEA WAGON

It will be best to remove the top from the tea wagon for finishing. Also remove the leaves, all hardware, the wheels and tires.

If water stain is to be used, sponge all the parts with warm water to raise the grain. Sand all parts when dry with 4/0 garnet paper. It will be necessary to shellac the inlays before staining to prevent the inlays from being stained, if a water stain is to be used. This work must be done very carefully and accurately. A fine round brush should be used for this work.

Fig. No. 649. The Completed Tea Wagon

If oil stain is used, the inlays need not be shellacked if the stain is wiped off quickly after applying it, but oil stain fades in strong light. The water stain finish requires a little more work, but the color will be more lasting.

FINISHING THE TEA WAGON

If the tea wagon was made of walnut, it will not be necessary to stain it, except on the shaped edges, or other places where other woods are exposed. Stain these parts and allow to dry at least 10 hours. The entire tea wagon can then be given a coat of boiled linseed oil and turpentine as described on page 337. This will bring out the grain in the walnut wood beautifully and will not harm or stain the inlays.

The filling and finishing methods given in Chapter 22, can be followed according to the finish desired.

After the final finishing coat has dried properly, the parts can be placed back in their original positions. The parts must be handled carefully to prevent scratches.

The tires can be fastened in the grooves in the wheels with bicycle cement.

The small wheels should be placed in the forks and the axles glued so they will be held tightly in place, but the wheels should turn on the axles freely. Glue the caps in the end of the small-wheel axles.

The sliding casters which act as hub caps for the large wheels can be driven in place, but it would be well to file the prongs to long, slim points or bore small holes in the hubs to admit the prongs, to prevent splitting the hubs.

The tray glass should be washed clean and placed in the frame. Screw the tray panel in place. Glue strips of thin felt or billiard cloth to the under side of the tray panel to prevent scratching the top. Also glue felt to the ledge of the tray which fits over the table top. Fasten the tray handles in place.

The handle bracket hinges should be screwed in place and the hooks and eyes inserted to hold the handle.

This completes the construction of two high grade pieces of work, and whether you make the clock case or the tea wagon you will have something of which you may feel justly proud.

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