PROBLEMS IN WOOD-TURNING

BY FRED D. CRAWSHAW

THE MANUAL ARTS PRESS
Peoria, Illinois

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FOREWORD.

WOOD-TURNING doubtless is an art. However, if the statements which follow in this text are facts, the subject comprises some of the elements of a science. The art of wood-turning is the ability of the operator to skilfully handle the tools in making the several wood-turning cuts. The science in wood-turning is found in the mathematical principles discovered when these cuts are analyzed.

The following are some of the elements in a course in spindle wood-turning which should receive considerable emphasis: skill in handling the tools; geometrical principles involved; the application of these principles in objects which have a utilitarian value; and design. There is little possibility of making the subject as applied in face-plate and chuck turning one of essential interest or benefit except in two particulars: first, the study of good form, and second, the study of technical principles to be applied in making useful objects.

This book on wood-turning has been prepared for the following particular reasons:

First, to help students of wood-turning—especially those who are working under the supervision of a teacher. It is, therefore, a text-book.

Second, to simplify the subject as treated in the average text on wood-turning.

Third, to show the *reason* for handling the tool in a particular way for each cut.

Fourth, to offer by good mechanical drawings a series of problems which, it is hoped, are superior in many ways to those usually found in books on this subject. These drawings are not arranged as a course of study, but their order suggests a logical progression in thought and application of principles.

The *point of view* used in this text is this: A classification of all necessary cuts used in wood-turning with a geometrical basis for the handling of the tool for each cut. The usual point of view has been a classification or grouping of models with a description of how to turn each model.

The author is indebted to the many teachers of manual training who have helped him by offering suggestions and furnishing designs which have made this book possible. He wishes especially to recognize aid from "Vorlagen für den Handfertigkeits-Unterrecht," published in Strassburg, Germany, by Ludolf Beust, and from notes which were furnished by Professor Charles A. Bennett, Editor of the Manual Training Magazine.

F. D. CRAWSHAW.

CONTENTS.

FORM AND PROPORTION.

This section of the text might be headed Design except that it is believed such a heading should be reserved for a place where both construction and decoration are more prominent than they are in wood-turning. Nevertheless, there is need of carefully considering form and proportion in turned work. Inasmuch as wood-turning, perhaps more than any other subject in woodworking, has been taught by following a set course of exercises, it seems that new interest may be given the subject by introducing a consideration of the elements of design. It should be understood in this connection that the formal exercises, such as Plates 1, 2, and 3, presented in this book are preliminary to some application of the cuts, such as are shown in Plates 5 to 12. The exercises should be made only so long as the operator feels uncertain in the control of the tool. Inasmuch as the application of the cuts in useful articles is of chief importance, some general suggestions may be given as a guide for the study of wood-turning profiles in both their form and proportion.

Students of manual training have been told during the past few years that they must inject into their work the principles underlying the work of the artist and designer. When one attempts to do this, he is at once confronted with a mass of theory, from which it is difficult to select principles to be applied in the shop. It is hoped that the student of wood-turning may be helped by the selection herein made. This text is written with the idea that brevity and clearness should go hand in hand, and with this idea in mind, the following generally accepted principles are rather dogmatically laid down to control the form and proportions in designs for turning.

It is safe to say that the use to which an object is to be put should be the principal factor in determining its general shape. (Fig. 1.) This fact does not destroy the possibility of securing what is often called harmony in measurements. By this

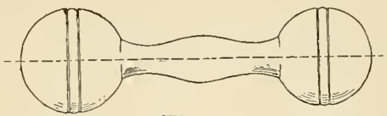

Fig. 1.

term one means the arrangement of varying diameters and distances to be agreeable to the eye. There are degrees of visual agreeableness, however, and it is sometimes helpful in making a design to use a unit of measure in securing the most agreeable forms. The quarter-inch squared paper is satisfactory to use for this purpose. It should not be supposed that all distances and measurements must be exact multiples of this unit. The unit is selected only as a means to an end, viz: pleasing form and proportion.

The selection of a unit measurement is of little importance if it is not accompanied by two other measurement selections, viz: a dominant measure and a measure sequence. (Fig. 2.) There should be some parts of the design which should act as a starting point from which all other parts are planned, both as regards outline and dimensions. This part need not be an extreme in the scale of size, but often the smallest or largest part is the design base for other parts. Also, there should be a uniform gradation in dimensions from the dominant form upward or downward. (Fig. 2.) This means a constant increasing or decreasing ratio in diameters and distances. In other words, difference in profile must accompany difference in lengths or distances. Such uniform change in ratios is called measure sequence.

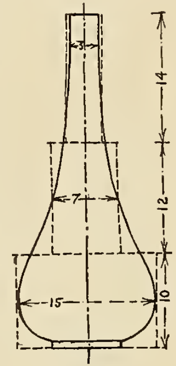

Fig. 2.

The three principles involved in the last two paragraphs make for what we most need in any design, turning included—unity. By this term we mean a holding together of all parts, or a common purpose in the design of all parts. A quotation which is apropos here is, "Each for all and all for each." The word re-echo, perhaps somewhat abused, has a meaning which illustrates rather well the idea of recurring lines which makes for unity. There must be no confusion between unity and uniformity. Unity is necessary. Uniformity is deadening. In unity there is harmonious relation. In uniformity there is monotonous sameness. (Fig. 3.)

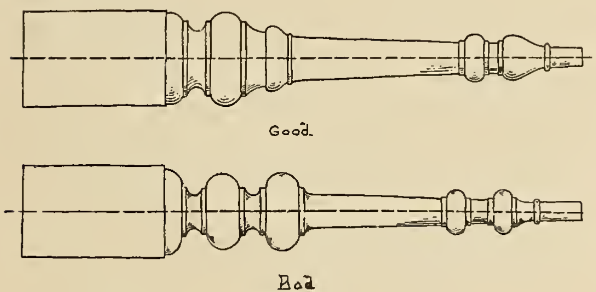

Fig. 3.

I have intimated that clearness is a paramount consideration in the work of the designer. The best guide for the attainment of clearness is sometimes said to be common sense, but our common sense is largely the product of public opinion,

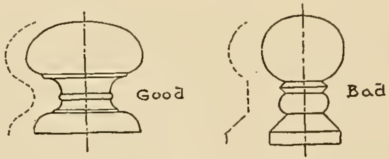

Fig. 4.

which in turn follows in the wake of the views of experts. It will be well, therefore, in addition to the above general principles to enumerate some very specific and practical ones which form a veritable code for designers:

A profile should be bold and flowing, not harsh and broken. It should not contain too many straight lines, if disagreeable, angular results are to be avoided. (Fig. 4.)

A profile, on the other hand, must not be made up of soft, weak outlines characterized by the curve "that wanders"; neither starting nor stopping with a definite purpose. A profile must have both grace and vivacity. (Fig. 5.) It is usually safe

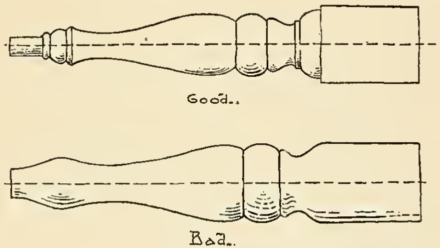

Fig. 5.

to use the circle, ellipse, ovoid, and echinus in turning outlines. (Fig. 6.) When these forms

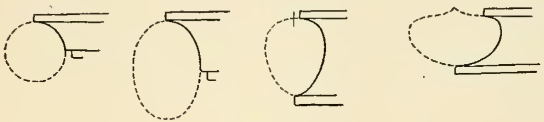

Fig. 6.

are either connected or broken the change in outline is made by introducing a fillet or bead at the point of change.

Ordinarily all curves are joined by some severe change in direction which may be considered either as continuous or contrasting. (Fig. 7.) A continuous change is one where the successive parts of an outline are concentric, or parallel, but are offset by some line which stops the curve of each part. A contrasting change is one where the tangents to the curves at the point of change approximate ninety degrees. (Fig. 7.) Sharp and acute arcs should be rejected as much as possible. The compasses should be used with great hesitation. The decoration of turned objects should be confined to small concave and convex cuts or their combination at carefully selected points.

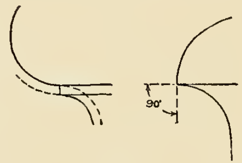

Fig. 7.

The three general principles laid down at the beginning of this chapter and some of the more definite ones succeeding them may be combined in the following conclusions:

(a) As a rule either one, two or three individual and related parts may be used in any object, which is considered as a unit mass, and unity will be preserved. (Fig. 8.) If, however, more than three parts are placed in combination, unity is lost unless the parts are duplicates one of another. In this case, the series is considered a unit. (Fig. 9.)

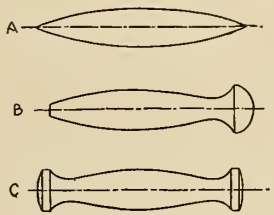

Fig. 8.

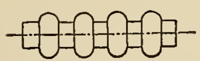
Fig. 9.

(b) In an object of one part there is absolute unity.

(c) In an object of two parts there is unity if the parts are of equal size, because of harmony coming through symmetry. (Fig. 10.) If the two parts are of unequal size unity is the result of a direct subordination. (B, Fig. 8.)

(d) In an object of three parts there is unity if the parts are of unequal size because one is dominant and the other two are regarded subordinate. (Fig. 11.) If the three parts are equal they form the beginning of a series and may be used as a unit in a two or three part combination. (Fig. 12.)


Fig. 10.


Fig. 11.

(e) If more than three parts are put in combination then some natural, logical grouping resolves the number into a group of three or less, (A, B, C, Fig. 12), unless the parts are similar, in which case a series is formed (b, Fig. 12).

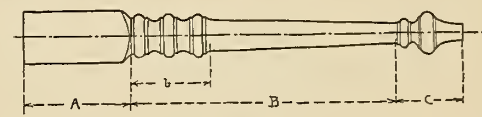

Fig. 12.

THE CARE OF WOOD-TURNING CHISELS.

There is a saying among mechanics, "A poor tool is worse than none," which if accompanied by the old saw, "A stitch in time saves nine," would make a satisfactory subject for an important lesson in any line of mechanical work. For no class of mechanics, however, would there be greater need of emphasis upon either part than for wood-turners. Wood cannot be turned satisfactorily with dull tools and the only reasonable time to sharpen a tool is when it *first begins* to get dull.

The cutting edge of the gouge should be formed by a ground surface making about twenty degrees with the cylindrical surface of the gouge blade at the cutting edge. When looking down upon the blade, as it is held on the rest for cylindrical work, the cutting edge should appear as a semi-circle.

The skew chisel is ground equally from each side of the blade, and the angle between the ground surfaces should be about twenty to thirty degrees.

The "skew," or angle which the cutting edge makes with the edge of the blade to form the toe or acute-angled corner of the skew chisel should be from forty-five to sixty degrees, depending upon the importance of a pointed tool in the work which the skew chisel is to do.

In all cases the ground surfaces forming the cutting edge of the skew chisel should be straight when tested by placing a straight-edge on the surface in a position at right angles to the cutting edge. The ground surfaces forming the cutting edge should be geometrical planes. In testing the ground surface on the gouge the straight-edge should take a position at right angles to a tangent to the curve of the cutting edge at a point where the straight-edge crosses it.

To sharpen other tools in the wood-turner's kit, one needs to be familiar only with the principles set forth above.

Spindle turning comprises all work which is turned between the head and tail stocks of a lathe. It is the class of work in which students first become acquainted with the wood-turning lathe and by which they learn the proper use of wood-turning tools.

The stock used for all spindle turning should be approximately square in cross-section (Fig. 13), except for pieces to turn three or four inches in diameter. In these the square corners should be cut off, to make the stock octagonal. To center it in the lathe the operator draws diagonals on the ends of the piece of wood and drives it onto the spur center at the point of intersection of the diagonals. (Fig. 14.) Sometimes it is found convenient to saw on the diagonals to allow the spur center to enter the wood freely. When the spur center is set the tail-stock is drawn up to within two inches of the other end of the piece and fastened firmly to the bed of the lathe. The tail center or dead center is then screwed firmly against this second end of the piece to be turned, the sharp point of the center entering the wood on the point of intersection of the diagonals. (Fig. 15.) Before the

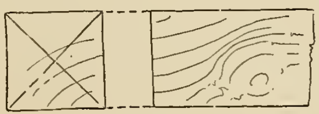

Fig. 13.

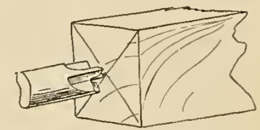

Fig. 14.

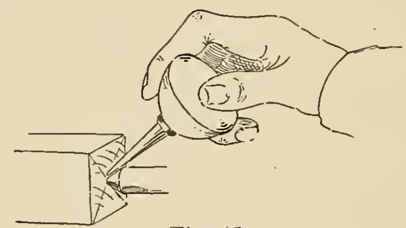

Fig. 15.

dead center is fastened in position a little oil, preferably hard oil, should be placed on its end to reduce friction.

It might be added as a precaution that a drop of good machine oil (or better sperm oil) should occasionally be used on the bearings of the head-stock. A wood-turning lathe revolves at a speed of from twelve hundred to three thousand revolutions per minute and should be kept well lubricated.

The tool rest for all wood-turning should be raised to such a height that the operator may take a comfortable position in his work. For the person of average height the tool rest for most cuts will be kept a little below the level of the line of centers of the lathe. (Fig. 16.) It should always be kept as near the revolving stock as possible, to avoid the possibility of the tool catching and being drawn down between the rest and the revolving wood. This would doubtless cause a "bite." A bite is a gouging cut that the tool takes out of the stock.

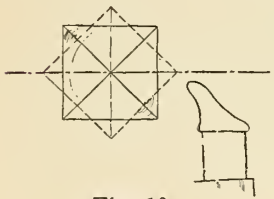

Fig. 16.

Wood-Turner's Kit.

The ordinary wood-turner's kit of tools consists of two gouges, three skew chisels, one cutting-off tool, and one round-nose. The gouges should be about 1¼ in. and ⅝ in. in width. The skew chisels 1¼ in., ⅝ in. and ¼ in., and the round nose about ½ in. or ⅝ in. wide. Besides these tools there should be in each kit a pair of six-inch outside and a pair of six-inch inside calipers; also a good slip-stone and a brass-edged, two-fold foot rule.

The Gouge Used as a Roughing Tool.

The gouge is the first tool used to turn off the corners of the square stock and enough more to produce a cylinder slightly larger than the finished diameter desired. (Fig. 17.) For this work the lathe should be started on slow speed. High speed should be used only after a cylinder

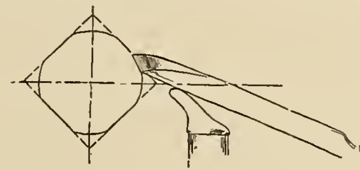

Fig. 17.

is formed. In holding the gouge, one stands firmly on the floor with the left hand resting on

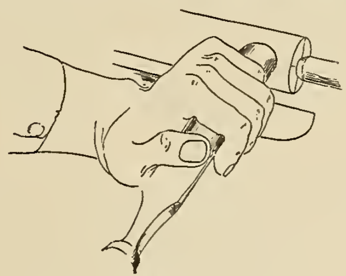

Fig. 18.

the tool and the wrist dropped (Fig. 18) to allow the hand while guiding the tool back and forth to be held against the rest. The body is turned slightly, so that the left side is nearer the work than the right (if the operator is right-handed) and the right hand holds the handle of the tool as one ordinarily grasps a hammer handle. (Fig. 19.) The tool, as it touches the revolving stock, is run back and forth over the rest from end to end, taking off a uniform amount of wood. This is possible because the hand in its position acts as a guide, thus making the process somewhat mechanical. It is customary to have the tool rolled slightly on the rest as it moves back and forth with its handle at

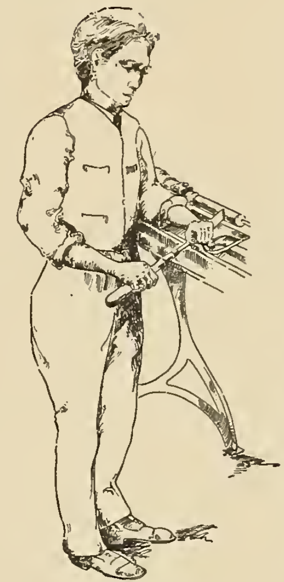

Fig. 19.

right angles to the center line of work (Fig. 20). The rolling is in the direction of the tool's motion and is done to throw the chips away from the operator. This is a matter of little consequence, however, except for the convenience of the workman, so long as the rolling is only slight. Rolling the tool very much would interfere with its work in cutting.

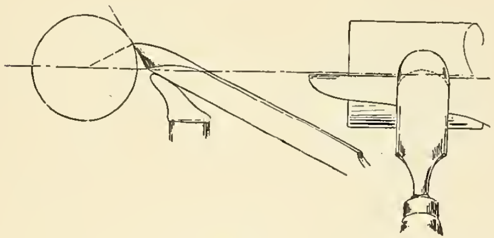

Fig. 20.

The chief thing which needs attention in the use of the gouge as a roughing tool is this: The surface of the gouge, which is ground to form the cutting edge, must always be kept approximately a tangent surface to the revolving cylinder. This is necessary in order that the tool will *cut* (Fig. 21) and not *scrape*. (Fig. 22.) By scraping one means the wearing off of the wood by the tool because it is not held in this tangent or cutting position.

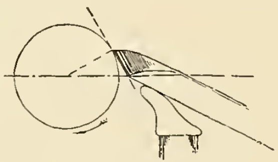

Fig. 21.

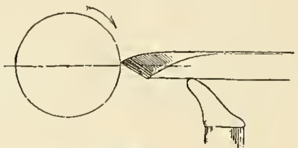

Fig. 22.

Turning with the gouge may be continuous from the time one starts to cut with it until the desired diameter is obtained (except for stopping to test diameters with the calipers). By pushing the tool through the left hand, thus keeping it continually in contact with the revolving stock as the cylinder decreases in diameter, it may be pushed first to the right and then to the left without stopping. The tool should be held rather firmly but not rigidly.

One may become quite expert in turning a smooth and accurately dimensioned cylinder with the gouge by allowing the tool to move slowly, but with a regular motion, back and forth over the rest. It is well to remember to allow the left hand to act as a guide by dropping the wrist so that the palm of the hand is in practically a vertical position. One may become ambidextrous in the use of the gouge and in fact with all wood turning tools. It is questionable whether this is wise or not; it is certainly unnecessary.

The Skew Chisel Used to Turn a Cylinder.

After the gouge has been used to turn the stock to cylindrical dimensions slightly larger than the finished diameter, the large skew chisel replaces it. This is held the same as the gouge, as previously described, except that the wrist of the left hand is not dropped; it may be, but greater freedom will be obtained by holding the palm of the hand flat on the blade of the skew

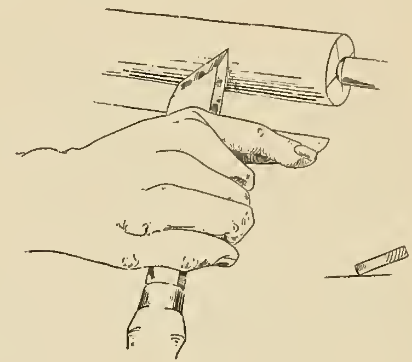

Fig. 23.

chisel and allowing only the fleshy part of it and the little finger to rub on the rest (Fig. 23), thus forming an arch over the tool. The blade is first laid flat upon the revolving cylinder and the rest.

It is then drawn down toward the operator (Fig. 24) sliding underneath the left hand until the heel of the tool drops to allow the lower ground surface, which forms the cutting edge, to come in contact with the revolving surface. When this happens the flat surface of the tool blade will no longer remain in contact with the lathe rest. The blade will be in contact with it only on one edge. (Fig. 23.) A very slight continuation of the motion of the tool toward the operator will bring the center of the cutting edge in contact with the cylindrical surface, when the tool will begin to cut. The tool should now be held steadily on the rest in this last contact position with the wood, and moved toward the end of the revolving piece nearest the heel of the tool. The stroke is continued past the end of the wood.

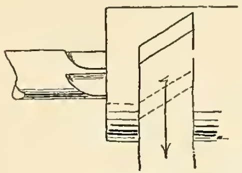

Fig. 24.

The above operation is repeated, alternately reversing the direction of the tool until the required diameter of stock is reached. The tool should never be started from the end and run toward the center of the stock but always from the center and run toward the ends. This suggestion is given in order that the tool may not catch, as it enters upon its cut, on the end of the stock, resulting in a bite.

The geometrical analogy of the relation of the tool to the revolving cylinder of wood is that of a plane tangent to a cylinder. The lower surface forming the edge of the tool is the tangent plane and this surface cannot have any other relation to the revolving cylinder except that of a tangent plane, and allow the edge to cut.

The Skew Chisel Used to Square the Ends of a Piece.

After the cylinder is turned it is usually necessary to square the ends to procure a definite length. This is done with the toe of the skew chisel. The blade of the chisel is rested on its edge upon the lathe rest and turned enough out of the position perpendicular to the center line of the revolving stock to allow the ground surface of the tool, which is nearest to the stock and which forms the cutting edge, to be perpendicular to the line of centers. (Fig. 25.) The right hand holds the handle and the left hand grasps the blade of the tool and the lathe-rest together by having the thumb on the rest and against the left surface of the blade. (Fig. 25.) The forefinger is placed under the rest and the last three fingers of the hand go under the blade and rest on the right side of it. The toe of the chisel is now "hinged" into the revolving stock by keeping the blade in contact with the rest and raising the handle of the tool. As this is done, two things must be kept in mind. First, the cutting edge must always point toward the center of revolution. (Fig. 26). Second, the ground surface above referred to must be kept approximately perpendicular to the center line of revolution. If this latter condition is not maintained and the cutting edge of the tool is allowed to turn (even slightly) into the stock, a run will be the result.

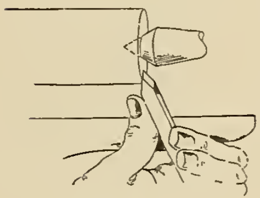

Fig. 25.

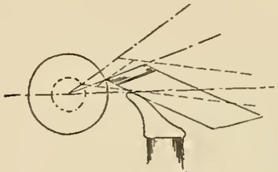

Fig. 26.

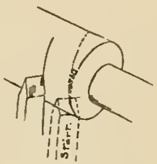

Fig. 27.

(Fig. 27). A run is a spiral cut made by a turning tool and caused by the operator's losing control of the tool, so as to permit it to catch in the wood. A run is always started by allowing the cutting edge to come in contact with the end of the piece when only the toe or heel should have contact.

In case the end is to be formed at some little distance from the lathe centers, the tool must be used alternately as above described to form the new end, and as follows to clear away the stock: After the first end cut (as above described) is made, by hinging the toe of the tool into the

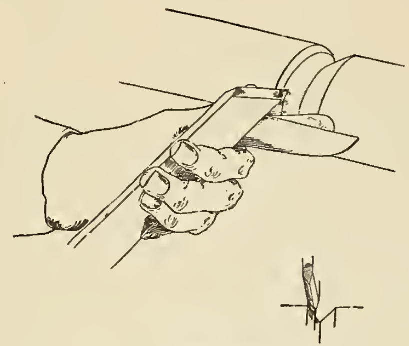

Fig. 28.

stock, the blade is tipped on the rest and at the same time turned on the rest to permit of two things: First, the ground surface nearest the lathe center to take the tangent position to a slant cut or conical surface toward the bottom of the end cut just made, which will produce with the end cut a right V; second, to turn the tool out of the position perpendicular to the center line of stock enough to allow the lower ground surface forming the cutting edge to be tangent to the conical surface of the V cut. (Fig. 28.) In the conical cut, as well as in the end cut, forming this right V, the toe is the point of contact and must be moved inward, keeping the cutting edge pointing toward the center line. (Fig. 29.)

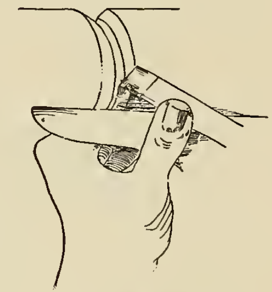

Fig. 29.

The Skew Chisel Used to Make a Long V or Taper Cut.

There is only one difference between using the skew chisel to cut a cylinder and using it to cut a taper or a long cone. As has been said the center of the cutting edge is used to make the cylindrical cut. It is also used to make the taper cut (or may be) except at the point where the taper begins. At this point the heel should be used. Keeping in mind the very essential point with reference to tangency, we will immediately appreciate the necessity of tipping the blade of the skew chisel on the lathe rest in order to make the lower ground surface of the blade, forming the cutting edge, a tangent plane to the taper, or cone to be formed. This tipping of the tool will give it a contact on the rest only on one edge of the blade, and consequently should the operator start the cut with the center of the cutting edge there would be a leverage produced which would almost certainly result in a backward movement of the tool. This would cause a slight gouging of the stock back of the desired starting point of the taper. For this reason the taper is started with the heel, and as the tool runs down the taper it may be drawn toward the operator to allow the center point of the cutting edge to cut, as in the case of a cylinder. However, it is quite as satisfactory to let the heel continue to be the point of contact and the cutting point on the cutting edge for the entire cut. If this is done care must be taken not to tip the tool enough to gouge the

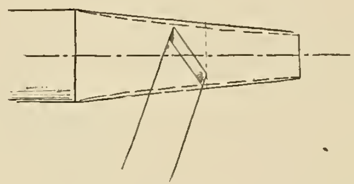

Fig. 30.

stock or make a "scooped" taper, as indicated by dotted lines. (Fig. 30.) It is very easy in making the taper cut with the heel of the tool to tip the tool too much, thereby cutting too deeply into the stock and destroying the taper desired.

The Skew Chisel Used to Make Inside Square Corners.

The skew chisel is used much the same in making an inside square corner as it is in making the long taper, except that the tool is not tipped on the lathe rest. After the stock is turned down to the diameter of the largest part of the finished piece it is laid off for the lengths of parts by using a sharp pencil (or the point of a knife) and a ruler held against the stock as it revolves. The cutting-off tool may be used to determine the approximate diameters of the smaller parts of the finished piece by hinging it into the wood and keeping the lower ground surface tangent to the revolving stock at all times. (Fig.31.) This cutting-off cut should be made far enough away from the lines made with the pencil or knife, when laying out, to allow the ends of the large parts or steps to be finished with the toe of the skew chisel as described under "The Skew Chisel Used to Square the Ends of a Piece."

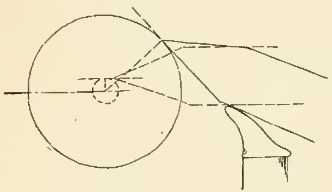

Fig. 31.

After the cut has been made with the cutting-off tool, to determine the small diameters, all superfluous stock on the small parts may be roughed off with a gouge. (Fig. 32.) The finishing cut on these parts should be made with a skew chisel. As in using the skew chisel to cut a cylinder, the skew for this work is drawn down toward the operator and held firmly on the lathe rest and revolving stock until the heel drops to

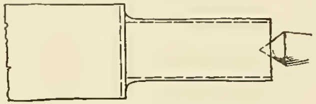

Fig. 32.

allow the lower ground surface, which forms the cutting edge, to come in contact with the wood as a tangent plane. Instead of continuing to draw the tool downward, it is stopped when the heel becomes the contact point and the tool is

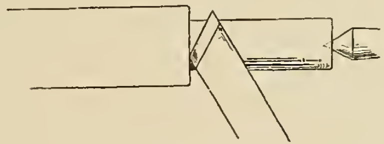

Fig. 33.

moved toward the large part of the stock. (Fig. 33.) By this means the heel does the cutting, and one is able to make a clean cut into the corner which would not be possible if any other point on the cutting edge was the cutting, or contact point. Of course the tool is placed on the rest at first with the heel nearest the large part of the stock.

The Small Skew Chisel Used to Make V Cuts.

The method of using the skew chisel to make the V cut has been partly described under the head, "The Skew Chisel Used to Square the Ends of a Piece," where the method of forming a finished end some distance from the first end of stock was discussed. After the width dimensions of the V's have been laid off, the toe of the skew chisel is "hinged" into the stock at the center of each V as though this center point marked the end of the finished piece. The tool cannot be hinged far into the stock, however, without being burned. To avoid this and to produce a clean cut, the "clearance" cut must be taken. This is made by tipping the tool on the rest enough to allow the lower ground surface, which forms the cutting edge, to take a position parallel to the required side of the V. The tool is held in this relative position to the revolving stock, and successive "hinge" cuts are taken with the toe traveling toward the center line. By alternating these cuts and the vertical cuts on the center line of the V one-half of the V will be completed.

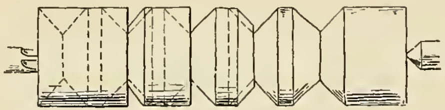

Fig. 34.

(Fig. 34.) The other half is made by taking the successive "hinge" cuts above referred to but in the opposite direction and on the other side of the V.

The Skew Chisel Used to Make the Convex or Bead Cut.

The convex or bead cut is usually considered the hardest of all wood-turning cuts. It is made with the heel of the skew chisel and the method used is, in a sense, a combination of the methods used in the taper and the square end cuts already described. The stock is first laid off and cut or turned into consecutive large and small cylinders, the large cylinders to the diameter and width of the beads and the small cylinders to the diameter and width of the stock between the beads. This is done with the cutting-off tool and small skew chisel, as described under "The Skew Chisel Used to Make Inside Square Corners."

The convex or bead cut is made on this series of large cylinders as follows: The heel of the skew chisel is placed at the center of the large cylinder in the position taken to cut an inside square corner. (Fig. 35.) This means that the lower ground surface, forming the cutting edge of the tool, is tangent to the revolving stock and that the heel is the point of contact. The tool is tipped on the rest and the handle moved toward the left

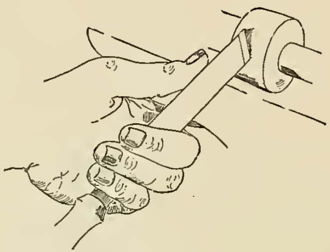

Fig. 35.

or the right (to the left if the left side of the bead is being cut, and to the right if the right side of the bead is being cut), and "hinged" into the stock with the heel traveling toward the center line until the bottom of the bead is reached. The position of the tool at the end of the cut is similar to the one taken when the square end cut is made, except that in this the heel is in contact with the stock instead of the toe. (Fig. 36.) A continuous cut should be taken from the top to the bottom of the bead.

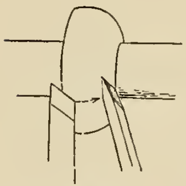

Fig. 36.

Besides the condition of continually having the heel traveling toward the line of centers, two other points must be kept in mind in making this cut: First, the lower ground surface, forming the cutting edge of the tool, must be at all times tangent to the revolving stock at the point of contact, and tangent also to the curve of the bead; second, a free and easy stroke must be made with the tool from the beginning to the end of the cut, in which the tool continuously keeps changing position in two particulars: one, the center line of the tool keeps changing its angle with the line of centers; and, two, the surface of the blade keeps changing its angle with reference to the revolving surface.

The Gouge Used to Make the Concave Cuts.

For many the concave cut is more difficult at first than the convex cut, but almost without exception it is an easier cut to make after one has once mastered the principles involved. As in the case of the convex cut, the stock is laid off and roughed out before the gouge is used to make the finishing cut. The gouge (preferably a medium-sized one) is placed upon the rest having its concave side up, with the forefinger of the left hand under the rest and the thumb on top of the blade of the tool. Held in this position it is "hinged" into the stock at the middle points of the concave cuts enough to make an opening for the tool to be used as below described.

The gouge is placed on edge on top of the rest in such a position that the center line of the ground surface, forming the cutting edge, is perpendicular to the line of centers, and the center

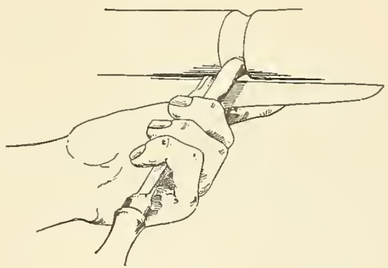

Fig. 37.

line of the tool is pointing toward the center line of the revolving stock. (Fig. 37.) The tool in this position is pushed into the stock and immediately rolled on the rest. Care must be taken, however, not to roll the tool too rapidly. At the same time the handle of the tool is gradually dropped and moved in the direction to make the handle perpendicular to the line of centers. These three motions: rolling, dropping the handle, and moving it toward the perpendicular position, are continued until the tool is flat upon the rest and in the position taken when the roughing cut is made to form an opening for the tool to take the cut just described. The end of the cut should bring the gouge out at the top of the stock. (Fig. 38.) This is important, for, unless this condition prevails, the operator will not be dropping the handle of the tool sufficiently to allow the ground surface, forming the cutting edge, to be tangent at all times to the revolving cylinder.

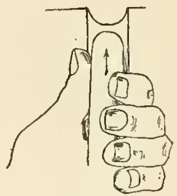

Fig. 38.

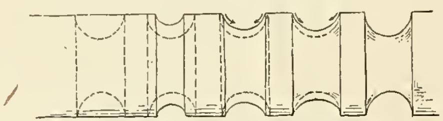

Fig. 39.

It is advisable to alternate the cuts from left to right (Fig. 39) and always toward the bottom of the cut to avoid the possibility of the sides of the cutting edge of the tool catching and causing a "bite." Also in grasping the blade of the tool, besides having the forefinger under the rest and the thumb on top of the blade, it is well to grip the tool onto the rest tightly enough to avoid a run. If the center line of the tool is pointing directly toward the line of centers a run is impossible, but it is difficult to determine this position exactly; hence, the desirability of the grip above spoken of.

The Gouge Used to Make Convex Cuts.

Ordinarily the skew chisel is used for convex cuts, as described under that head, but the gouge may also be used for this purpose. This is especially true if the convex surface has a long curvature such as is found in a chisel handle.

The blade of the tool is gripped with the thumb and forefinger onto the rest, and the tool is turned on the rest considerably to point in the direction in which the tool is about to move. (Fig. 40.) The ground surface forming the cutting edge is kept tangent to the revolving surface and the center point of the cutting edge is kept the contact point. As the diameter of the stock decreases, the handle of the tool is raised to allow the cutting point to drop as it approaches the line of centers. The tool is brought into the position perpendicular to the line of centers as it swings around and approaches the end of the curve. (Fig. 41.) It finally passes this perpendicular position and at the end of the cut takes the position described in making the concave cut, when the tool is first put in position for the finishing cut.

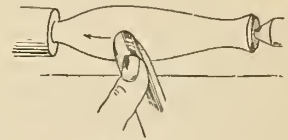

Fig. 40.

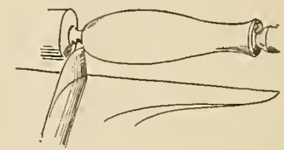

Fig. 41.

The cuts described for spindle turning together with the tools used may be classified as follows:

	Cuts	*Tools*
1.	Cylinder Cut	Gouge and skew
2.	Taper Cut	Gouge and skew
3.	Inside Square Corners	Heel of skew
4.	Squaring Ends	Toe of skew
5.	V Cut	Toe of skew
6.	Convex Cut (short)	Heel of skew
7.	Convex Cut (long)	Gouge
8.	Concave Cut	Gouge

FACE-PLATE AND CHUCK TURNING.

In general only two classes of tools are used for face-plate and chuck turning, viz.: round-nose tools and skew chisels. It has been observed no doubt, in the discussion on spindle turning, that all cuts are made with a view to producing a *shaving*. In other words, in spindle turning the several tools are used to cut the wood. In face-plate and chuck turning, on the other hand, the tools are used as scrapers only. For this reason spindle turning is generally considered more suitable than face-plate and chuck turning for purely educational purposes. Face-plate and chuck turning is practised in the schools because of its application in the trades and technical processes, such as pattern-making. It should be considered valuable because it teaches the operator methods of handling the wood on the lathe. Spindle turning teaches him more particularly methods of handling the tool. Stress, therefore, should be laid upon the scientific handling of *tools* in spindle turning, and in face-plate and chuck turning upon the best methods of manipulating the *wood* to produce the required results.

There are two classes of face-plates used for face-plate turning. One, the center-screw face-plate, in which the screw may be either fast or loose, and the other, the outside or surface-screw face-plate. The first of these two should be used to fasten onto the lathe blocks of wood which do not need deep cutting at the center. The surface-screw face-plate should be used to fasten all large blocks to the lathe—such as chuck blocks and blocks from which large objects are to be turned.

Center Screw Face-Plate Turning.

A good example of the class of work handled on the center-screw face-plate is illustrated by the darning block and its ring. (Plate 18.) A block is fastened onto the center screw by holding it in the right hand against the face-plate screw while the left hand turns the head-stock

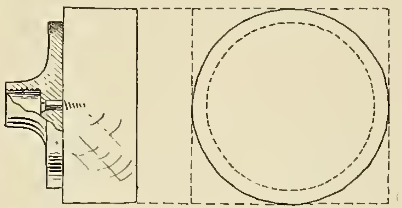

Fig. 42.

spindle until the block comes in contact with the surface of the face-plate. (Fig. 42.) This contact surface of the block should first be planed to a level and a hole bored with an auger-bit for the screw. The diameter of the bit used for this purpose should be the approximate diameter of the root of the screw thread at the center of the screw. Before the block is placed in position the corners should be sawed off to make it approximately round. (Fig. 42.) For this purpose either a hand turning-saw or a band-saw is serviceable. For all face-plate and chuck turning the lathe rest should be placed in height just enough below the center of revolution to allow the lathe tool to come in contact with the wood on a level with the center.

The cylindrical surface is roughed off by using the toe of the skew chisel as the cutting point and pushing the skew chisel squarely toward the face-plate over the top of the lathe rest, which is fastened onto the lathe at right angles to the ways, and directly in front of the revolving block. (Fig. 43.) This surface may be smoothed by scraping it with the round-nose chisel. For this purpose the lathe rest is fastened in the usual position for spindle turning.

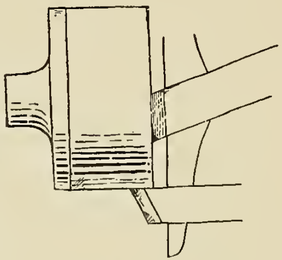

Fig. 43.

The flat surface of the block is roughed off with the round-nose chisel and smoothed by using the skew chisel on the rest, when it is fastened to the lathe at right angles to the ways and in front of the revolving block. (Fig. 43.) In fact any desired form may be obtained by using the different sizes of round-noses and skew chisels as scraping tools. They should be placed flatly on top of the lathe rest, which is placed close to the revolving surface in the most convenient positon for using the tool. In general the skew chisel is used to scrape convex surfaces, the round nose to scrape concave surfaces and the toe of the skew chisel to cut square corners and cylindrical surfaces inside the block. (Fig. 44.)

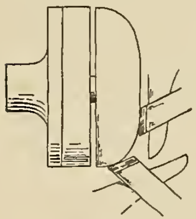

Fig. 44.

Whenever the skew chisel in turning the cylindrical surface of a face-plate block, is liable to run against the iron face-plate upon which the block is fastened, the block should be backed up with a thin board about one-fourth inch thick. In other words, a thin board should be placed between the block and the iron face-plate.

The ring for the darning block above referred to will be cut out of a circular block of wood by first turning it to the size of the outside diameter of the ring, and then cutting out the interior of the block by using the skew chisel and round-nose over the rest. For this purpose the rest should be placed at right angles to the ways. The ring should be cut loose from the block by using the cutting-off tool as in spindle turning, and making the last cuts by holding the tool with the right hand and turning the lathe with the left. It will be desirable finally to sever the ring from this block by using the toe of the skew chisel next to the ring in the corner of the cut made by the cutting-off tool.

To fasten the block, out of which the ring is cut, onto the lathe, the outside-screw face-plate should be used. This is done to hold the stock firmly and to avoid the possibility of the stock turning on the center screw, should the center-screw face-plate be used.

FACE-PLATE AND CHUCK TURNING COMBINED.

A very good illustration of combined face-plate and chuck turning is given in the towel ring, Plate 17. A block is fastened to the lathe either on the center-screw face-plate or the outside or surface-screw face-plate, faced off and turned to the size of the outside diameter of the ring. If the block is thick enough to allow the screws of the surface-screw face-plate to enter their full length without entering the ring to be turned, it will be preferable to the center-screw face-plate for this piece of turning, because all of the center part of the ring need not be turned out. However, the center-screw face-plate may be used, but it will not hold the stock as well as the outside-screw face-plate.

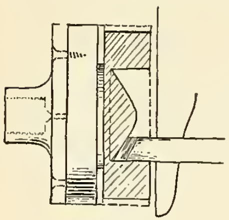

Fig. 45.

After the block is surfaced and sized, the cutting-off tool should be used to cut a groove in the block at a distance from the front surface of the block a little greater than the thickness of the ring. (Fig. 45.) The round-nose is next used to cut away the stock to form the hole in the ring.

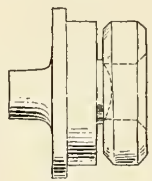

Fig. 46.

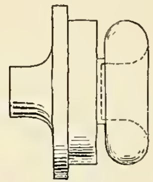

Fig. 47.

The toe of the skew chisel is used to make a straight inside cut determining the inside diameter of the ring. (Fig. 45.) There will now be blocked out a ring whose cross section is a square. The three outside corners of this ring may be cut off to make three of the sides of an octagonal cross sectioned ring. (Fig. 46.) From this the circular cross-sectioned ring may be obtained by rounding the corners of the octagonal form. (Fig. 47.) The ring thus far completed may now be sandpapered and finished. When this is

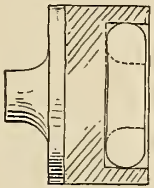

Fig. 48.

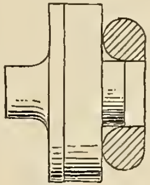

Fig. 49.

done it should be cut off as described in the case of the ring for the darning block.

The sharp corner on the ring, left after cutting the ring from the block, must be turned down by reversing the work and placing it *in* or *on* a chuck. The cup chuck (Fig. 48) is most suitable for this particular piece of work, although a pin chuck (Fig. 49) might be used.

A cup chuck is a block of wood—preferably soft pine—fastened to a face-plate and turned to receive a piece of turning by cupping out the surface of the block to the size of the outside diameter of the piece it is to receive. A pin chuck is a block fastened to the face-plate on which a cylinder is turned. The piece of turning is slipped over this cylinder. In either case the fit should be a light driving one.

After the ring is put on or in the chuck, as the case may be, the sharp corner may be turned off to produce a ring of circular cross-section. (Fig. 50.) The portion last turned may now be sandpapered and finished the same as that part of the ring which was finished before it was cut from the original block. In placing the work in or on a chuck its grain should run at right angles to the grain of the chuck.

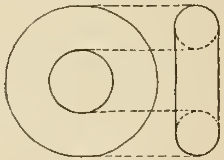

Fig. 50.

The two illustrations given in this part of the text serve the purpose of explaining the use of the tools in face-plate and chuck turning, and, in a general way, handling stock on the lathe for face-plate and chuck work.

As was stated in the introduction, one of the purposes of this book is to simplify the text on turning and to give the use of the tools for different classes of turning. It is hoped both of these things have been done. The author believes that a careful following of the directions herein given will enable one to turn any desired form in spindle or face-plate and chuck turning.

FINISHING AND POLISHING.

I venture to say that the average teacher of wood-turning permits the use of sandpaper on all turned work except on those pieces which are for the specific purpose of showing tool skill. It may be practical and sensible from the economic point of view to do this, but an article successfully turned in accordance with the cutting principles herein emphasized is finished superior to one which is sandpapered subsequent to the turning process.

If the cutting tool has left irregularities in the turned contour, very old or fine sandpaper may be used before applying the finishing material.

If a high polish is unnecessary, a very satisfactory finish can be secured by applying hot boiled linseed oil and thoroughly rubbing it down by allowing a soft cloth to press against the turned work as it revolves. A light application of thin shellac may follow this operation when all surface oil has been absorbed or evaporated. This should be rubbed down in the same manner as was the oil.

A high polish can be secured by pressing a soft cotton cloth, which has had a very little thin shellac placed upon it, against the revolving work. The cloth should be moved backward and forward over the work with uniform speed and under light uniform pressure. This operation is similar to the one known as "French polishing" and requires considerable practice before the best results can be obtained.

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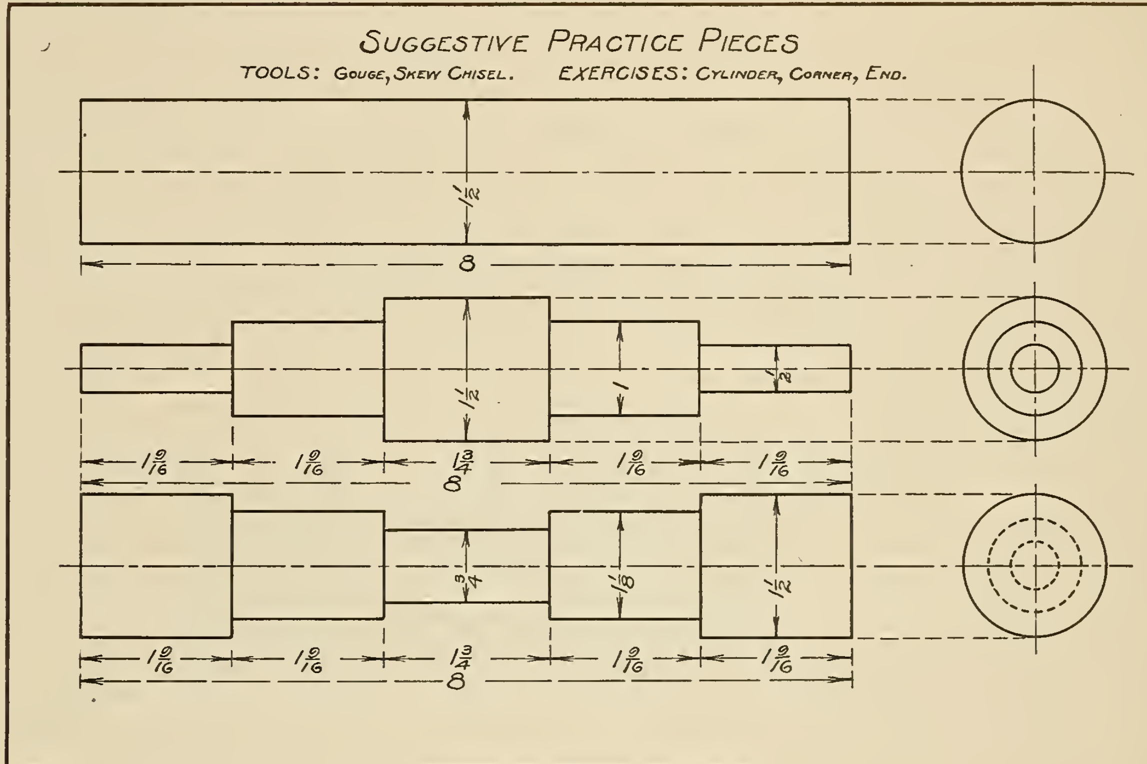

PLATE 1.

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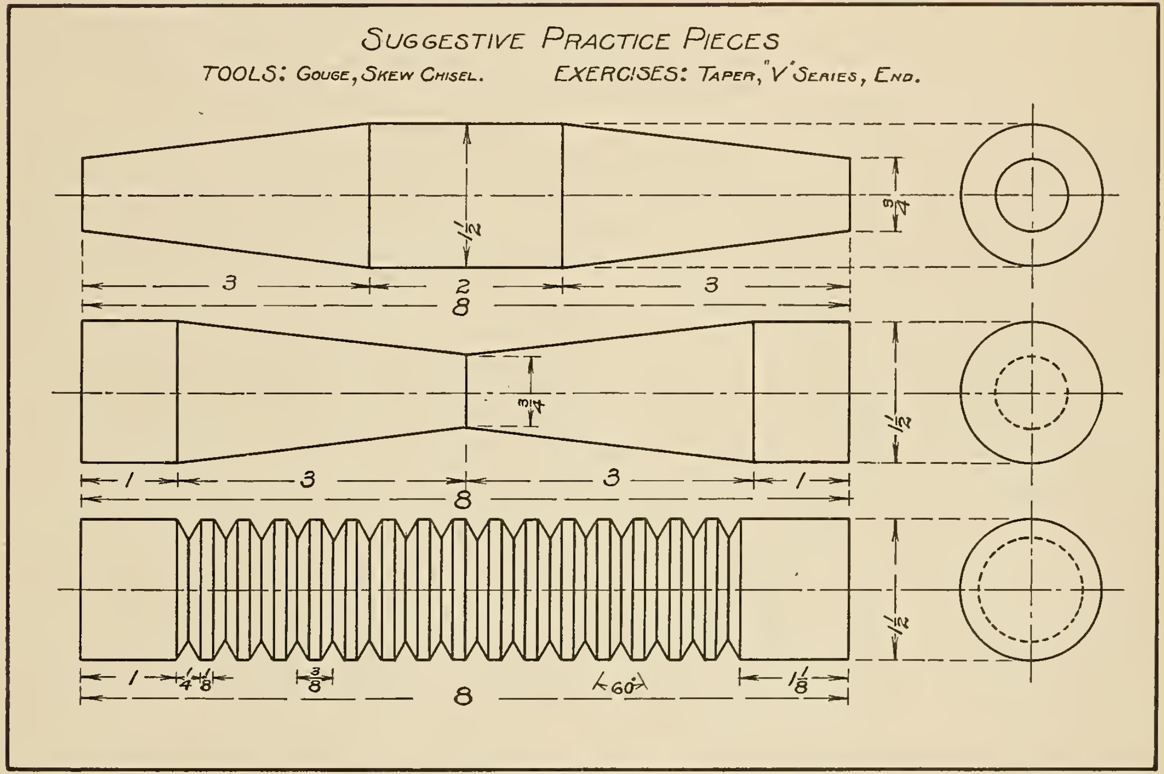

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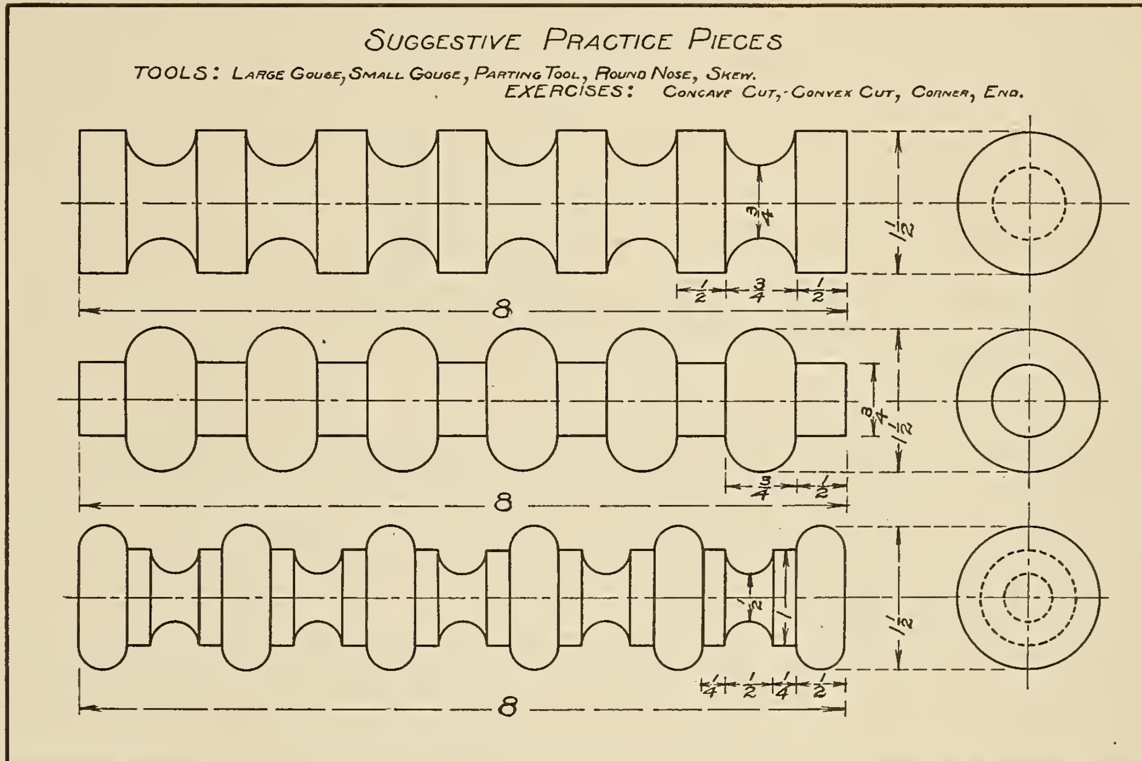

PLATE 3.

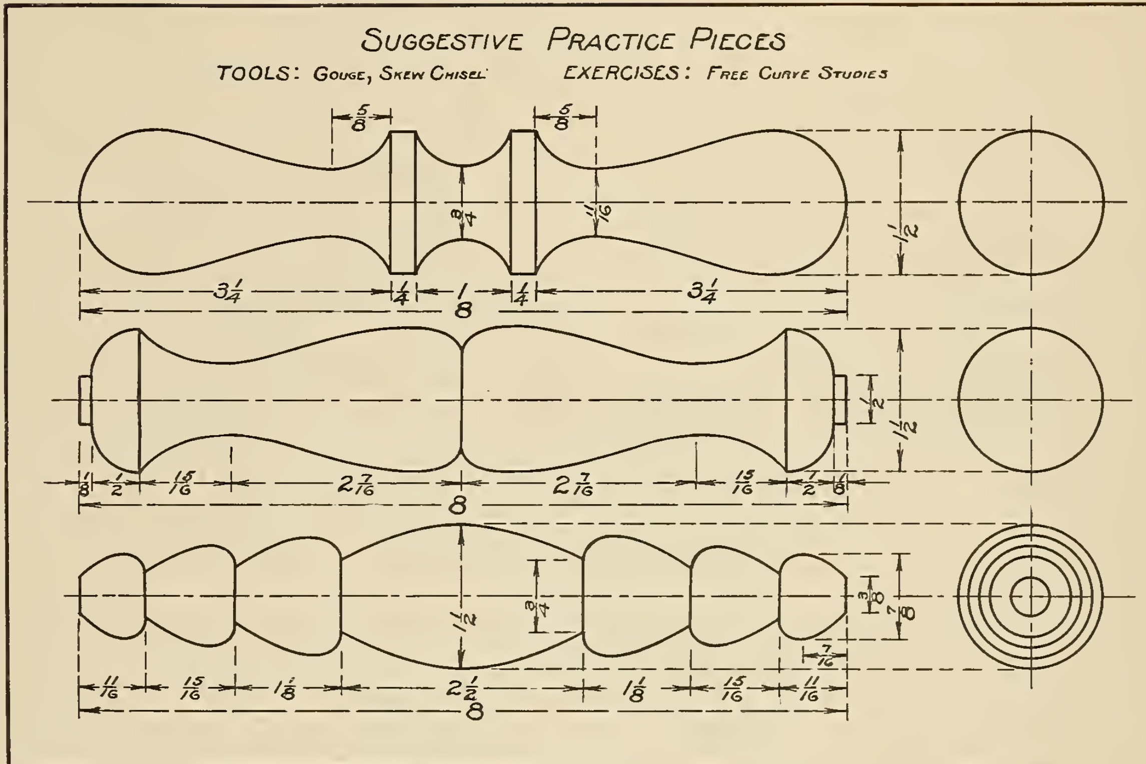

PLATE 4.

From "PROBLEMS IN WOODTURNING"
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Suggestive Practice Tests

EXERCISE: Finish Both Pieces of Each Pair on One Spindle; Cut in Two and Fit Together.

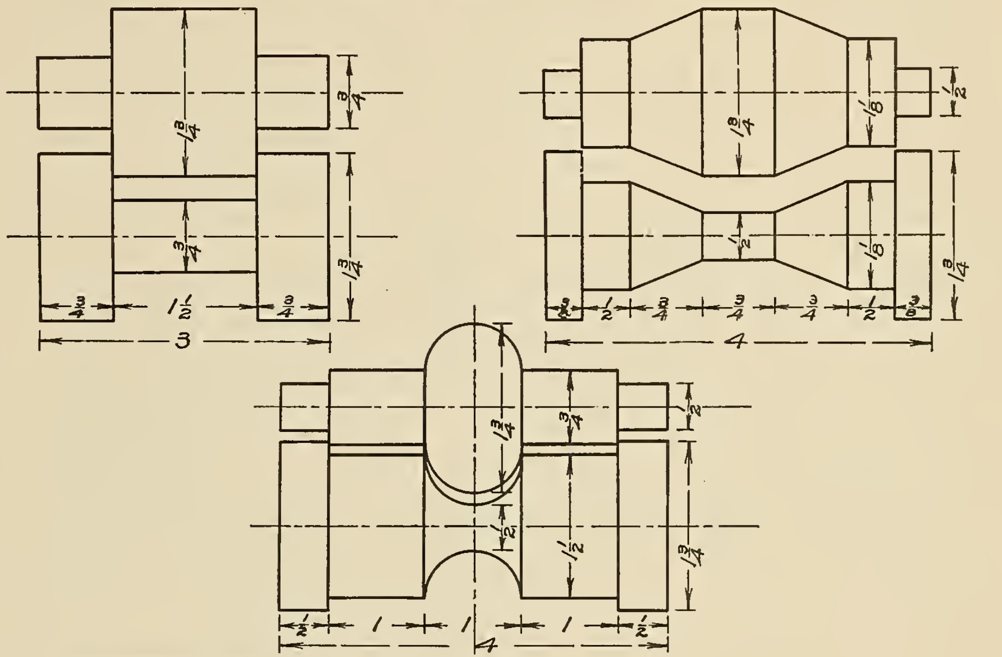

Plate 5.

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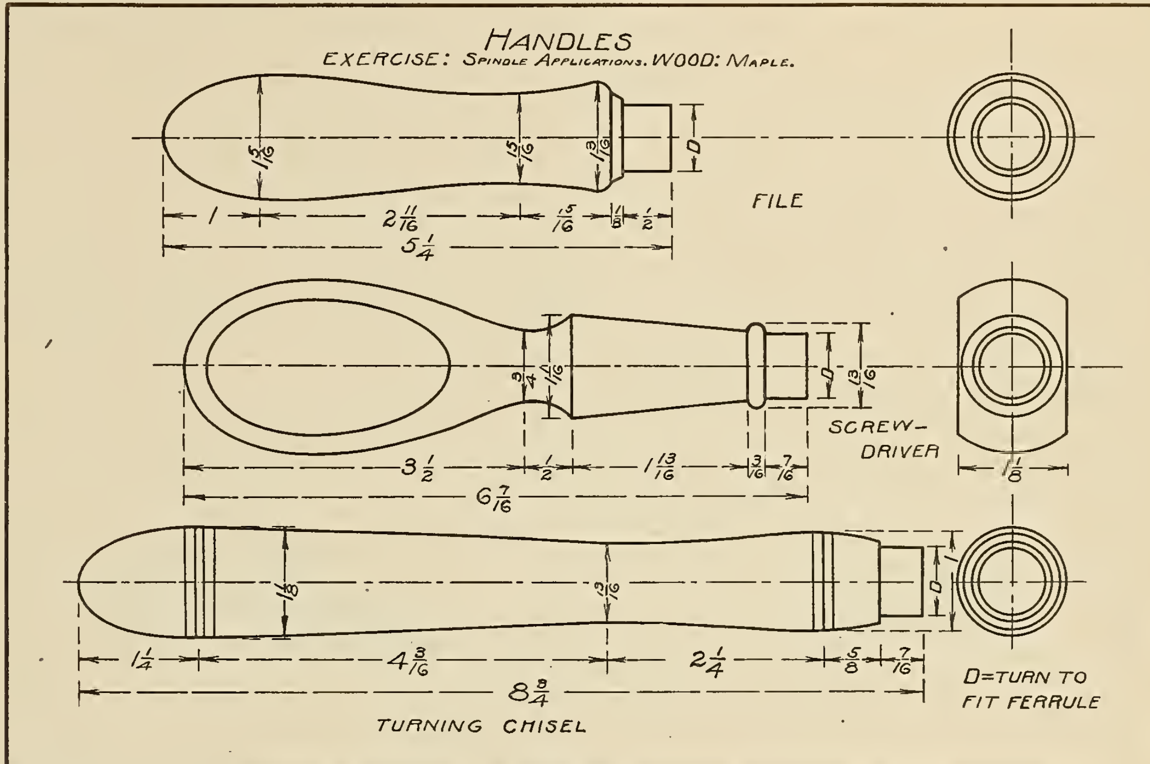

PLATE 6.

From "Problems in Woodturning"
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Spindle Projects

EXERCISES: Free Curves, Fitting, Arbor Turning. WOOD: Poplar, Hard Maple.

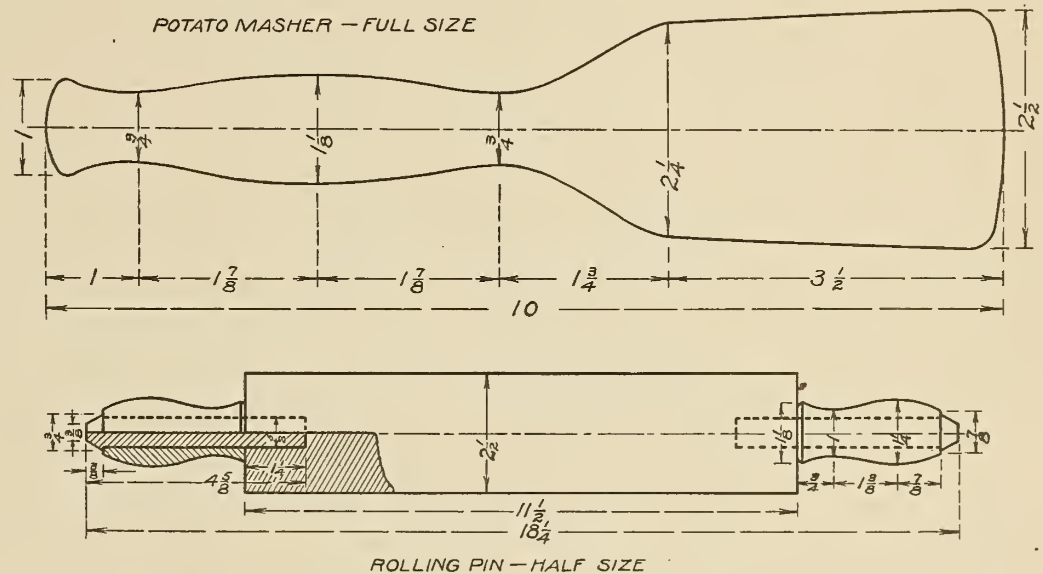

Plate 7.

From "Problems in Woodturning"
By Fred D. Crawshaw.
Published by The Manual Arts Press, Peoria, Ill.

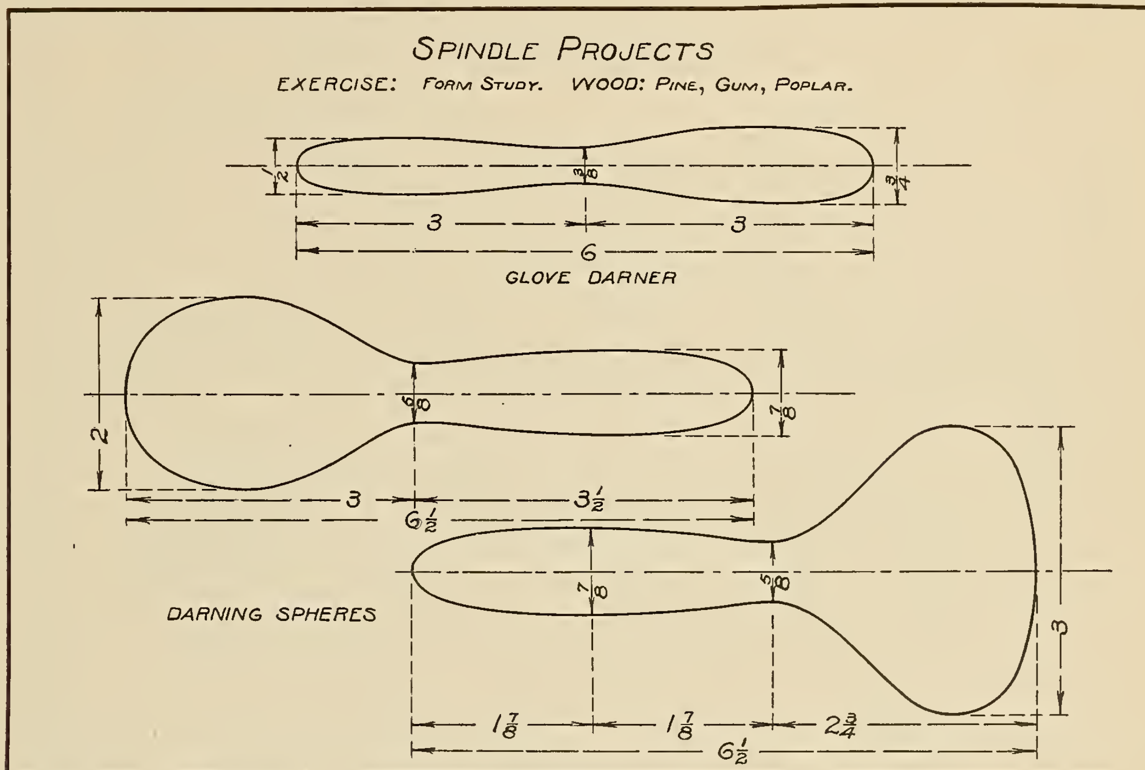

PLATE 8.

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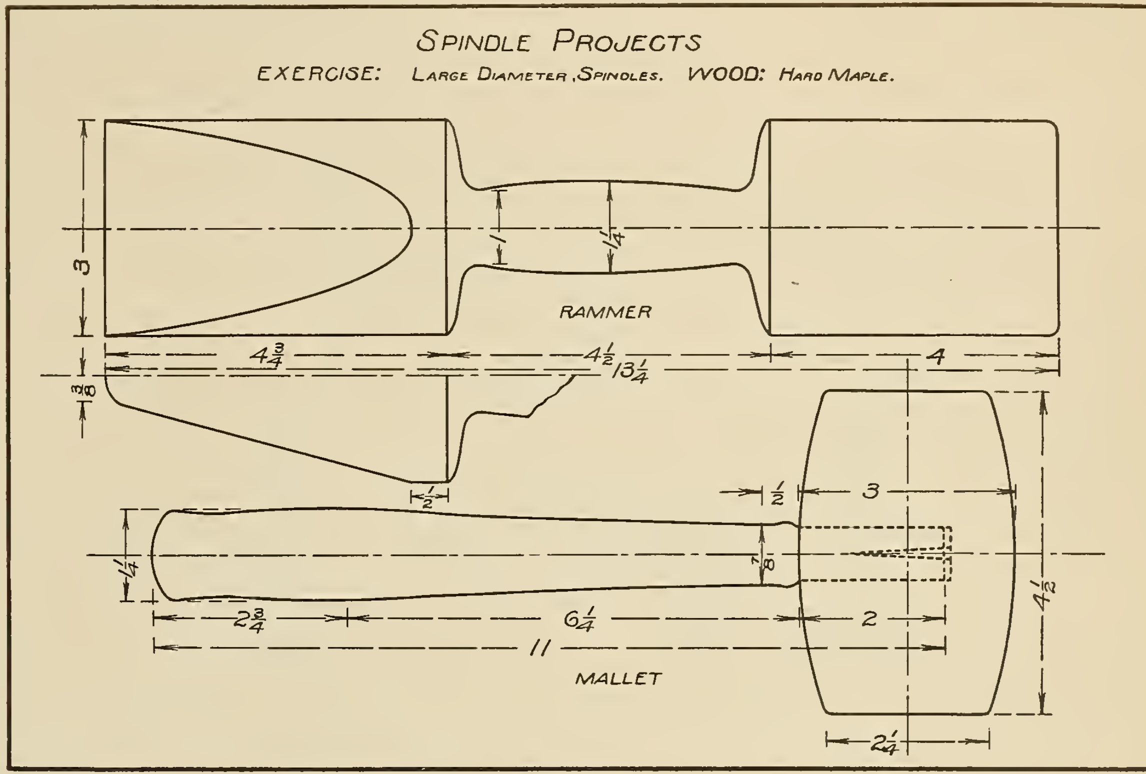

PLATE 9.

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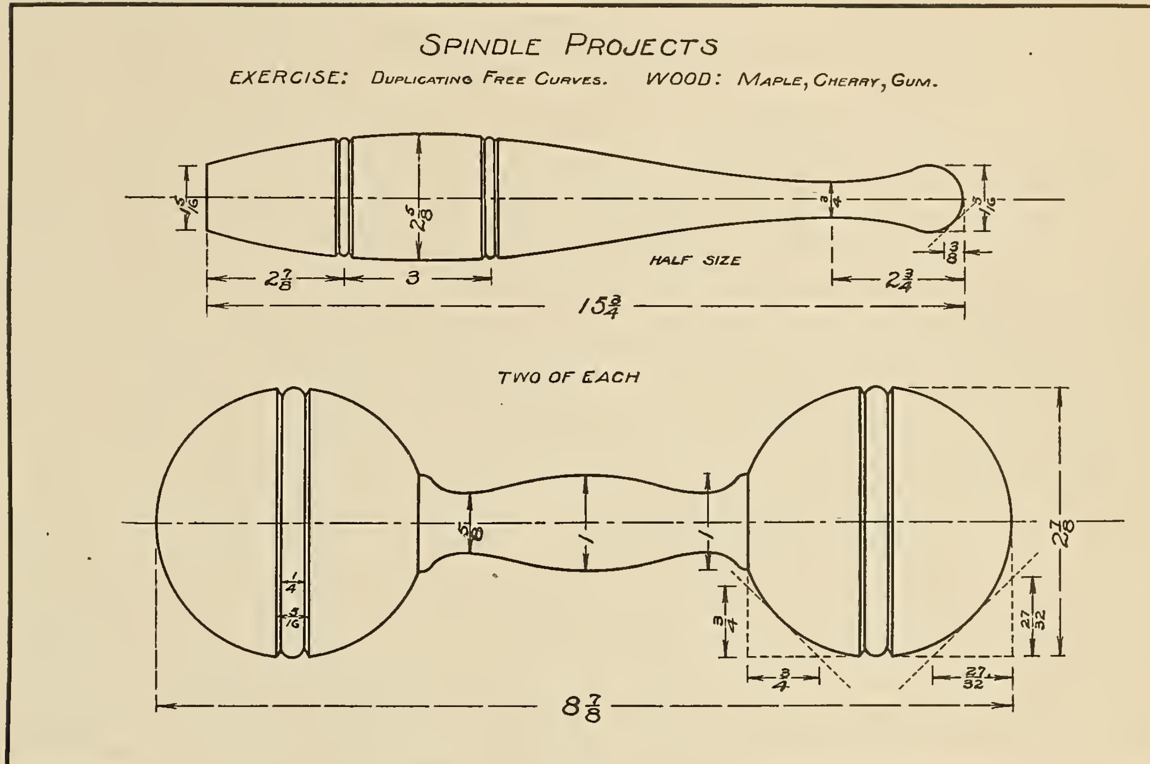

Plate 10.

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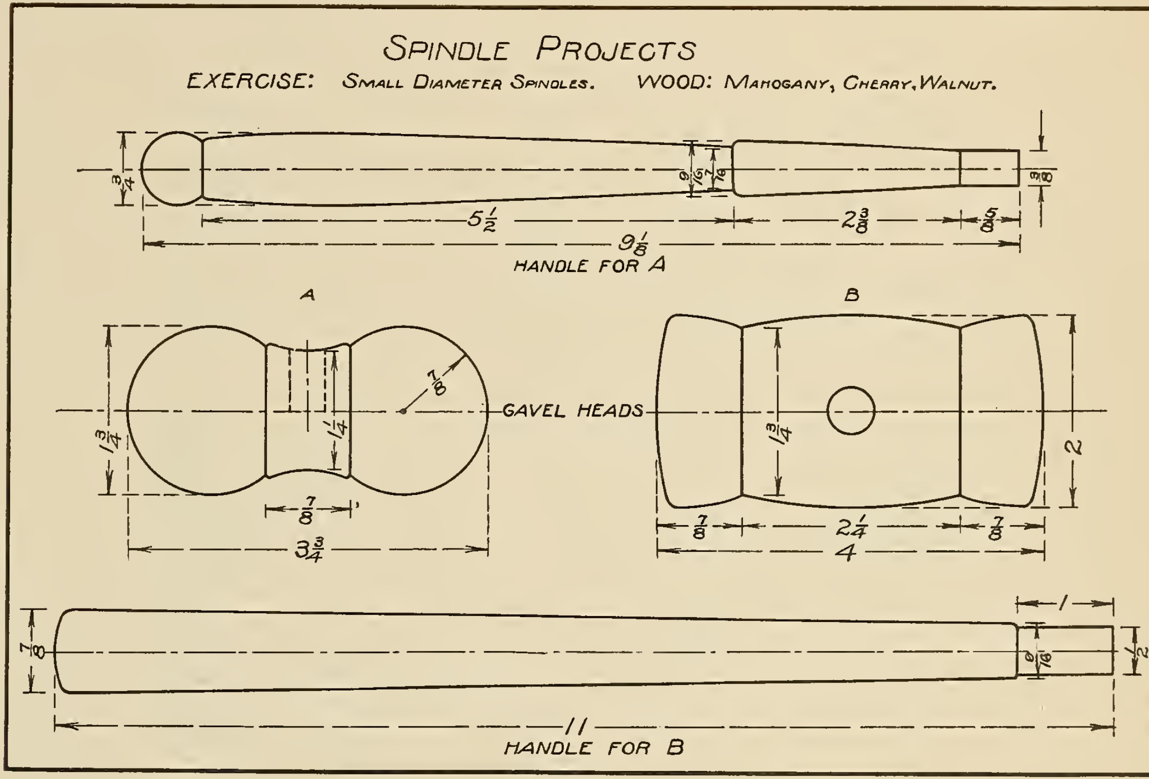

PLATE 11.

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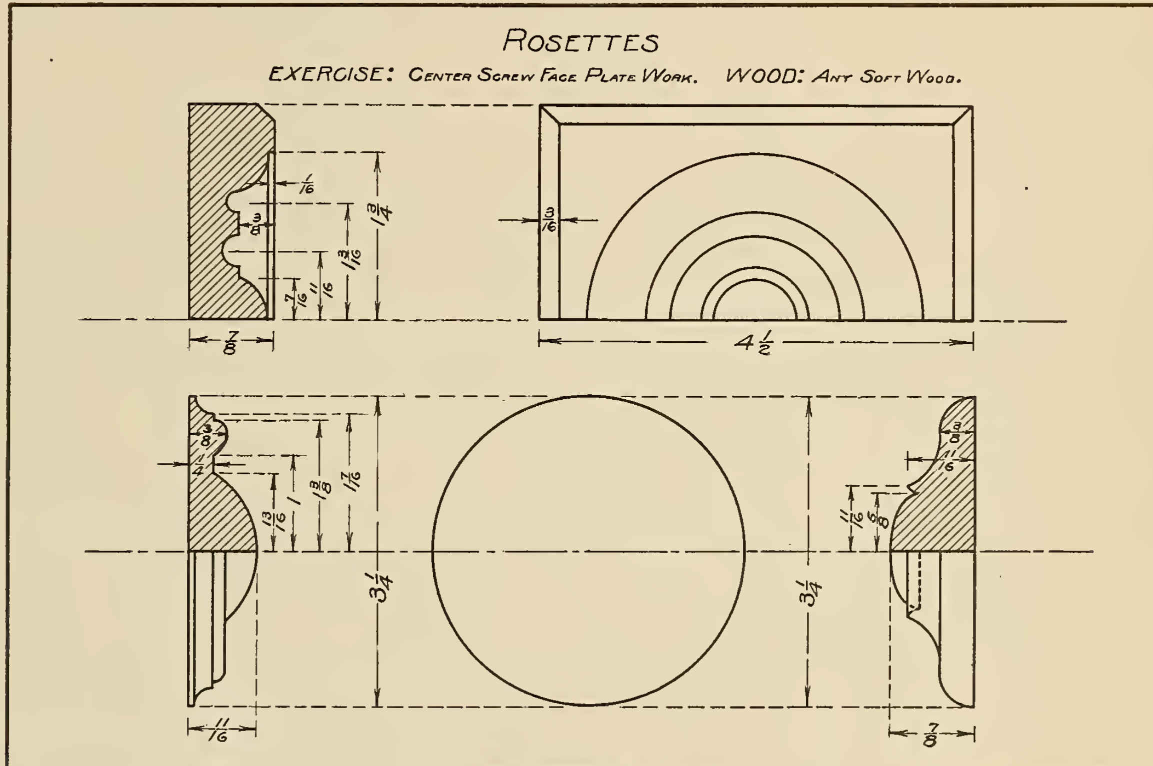

Plate 12.

From "Problems in Woodturning"
By Fred D. Crawshaw.
Published by The Manual Arts Press, Peoria, Ill.

Pin Tray

EXERCISE: Center Screw Face Plate Work. WOOD: Poplar, Cherry.

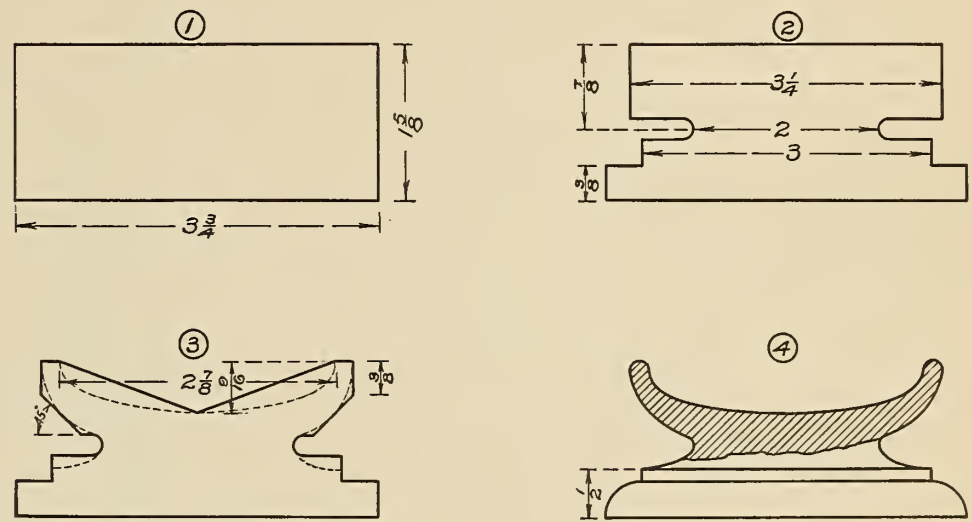

Plate 13.

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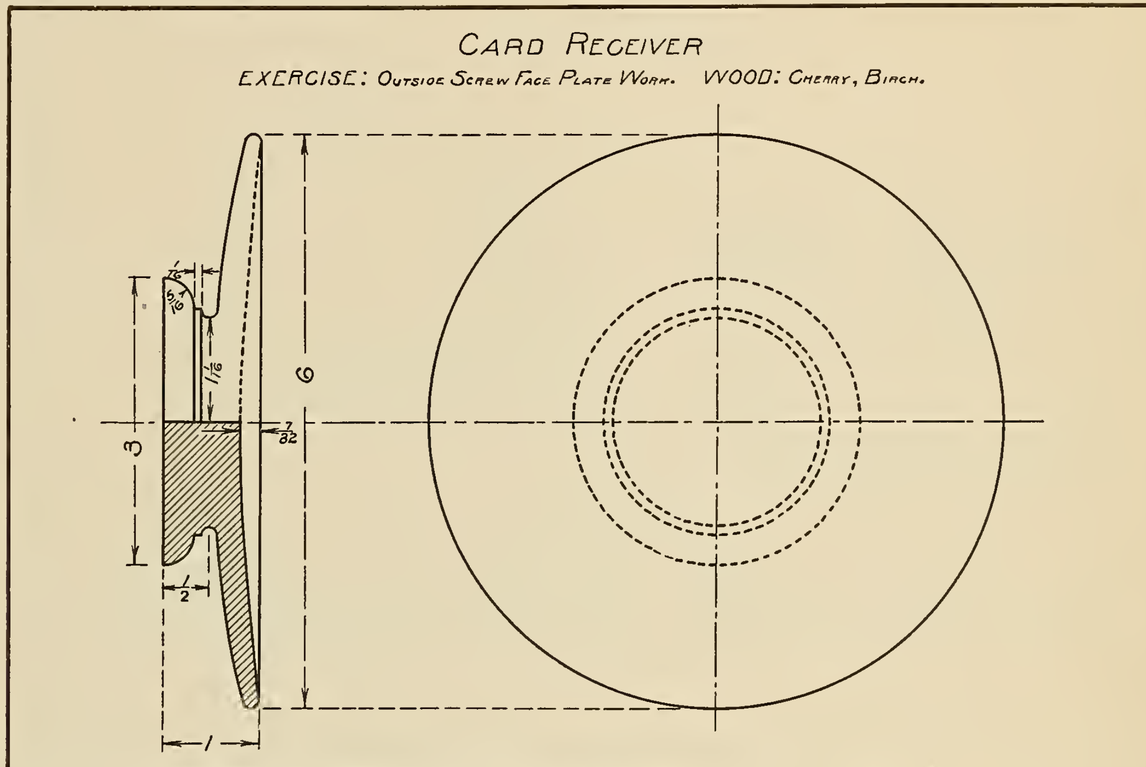

PLATE 14.

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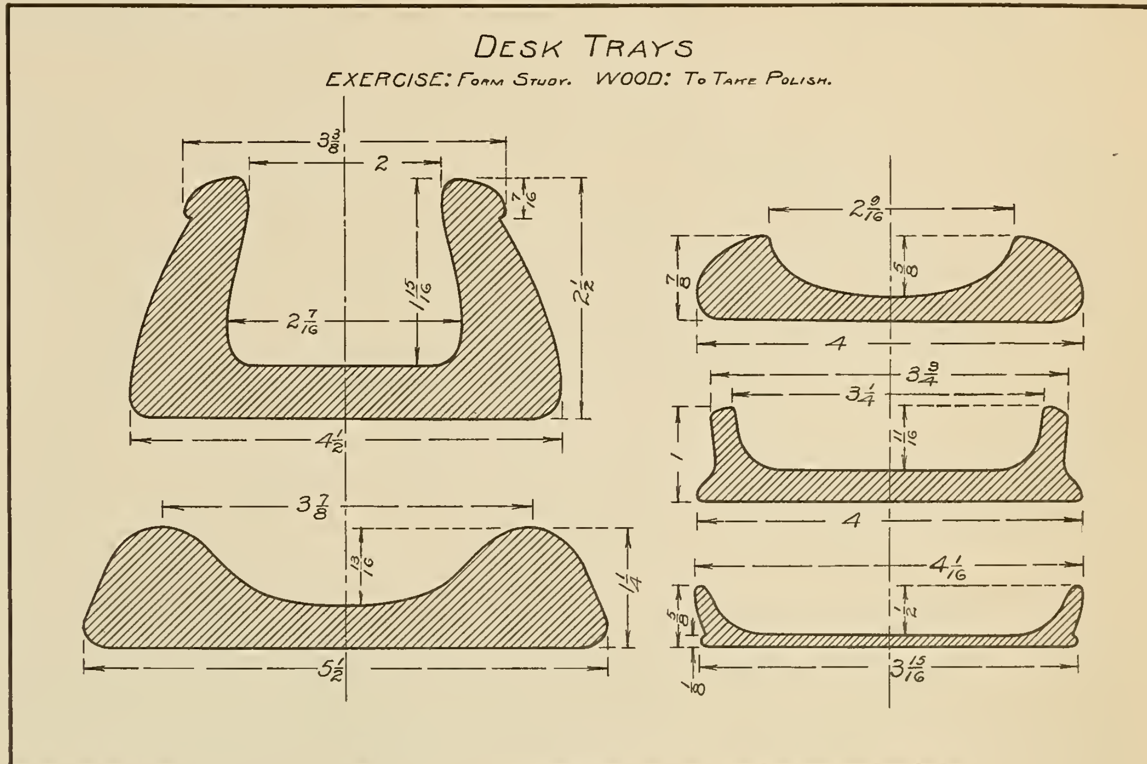

PLATE 15.

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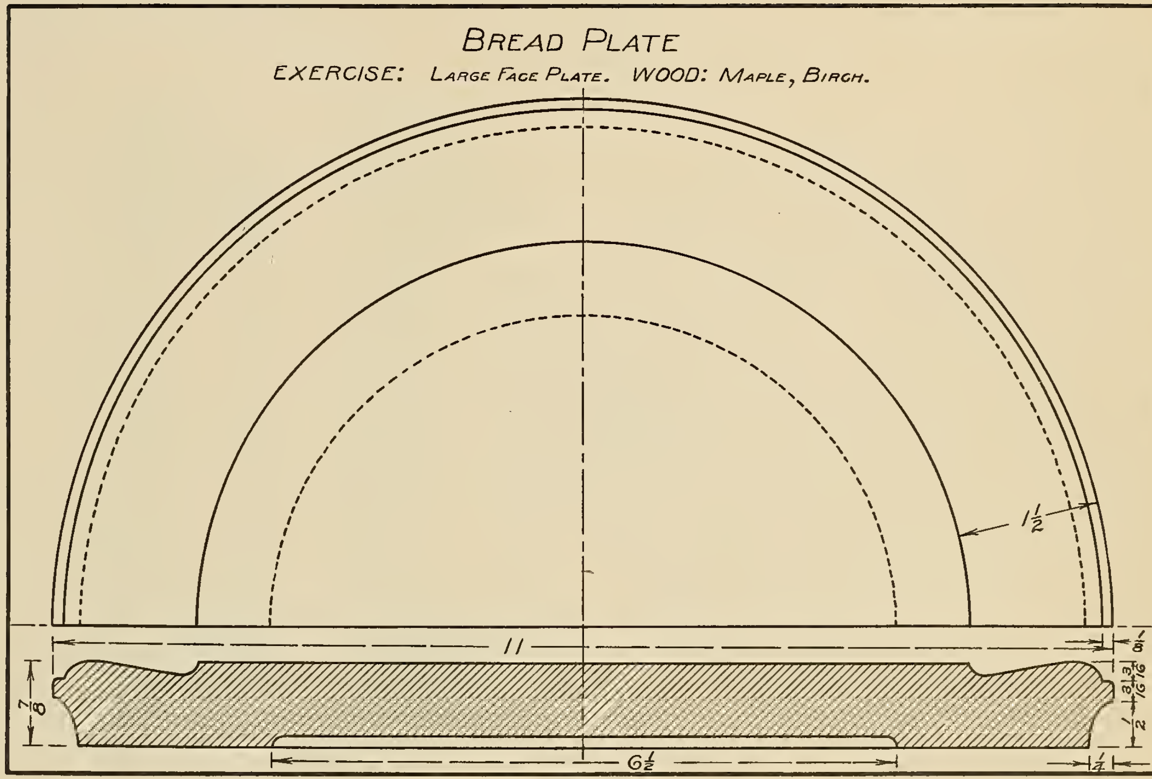

PLATE 16.

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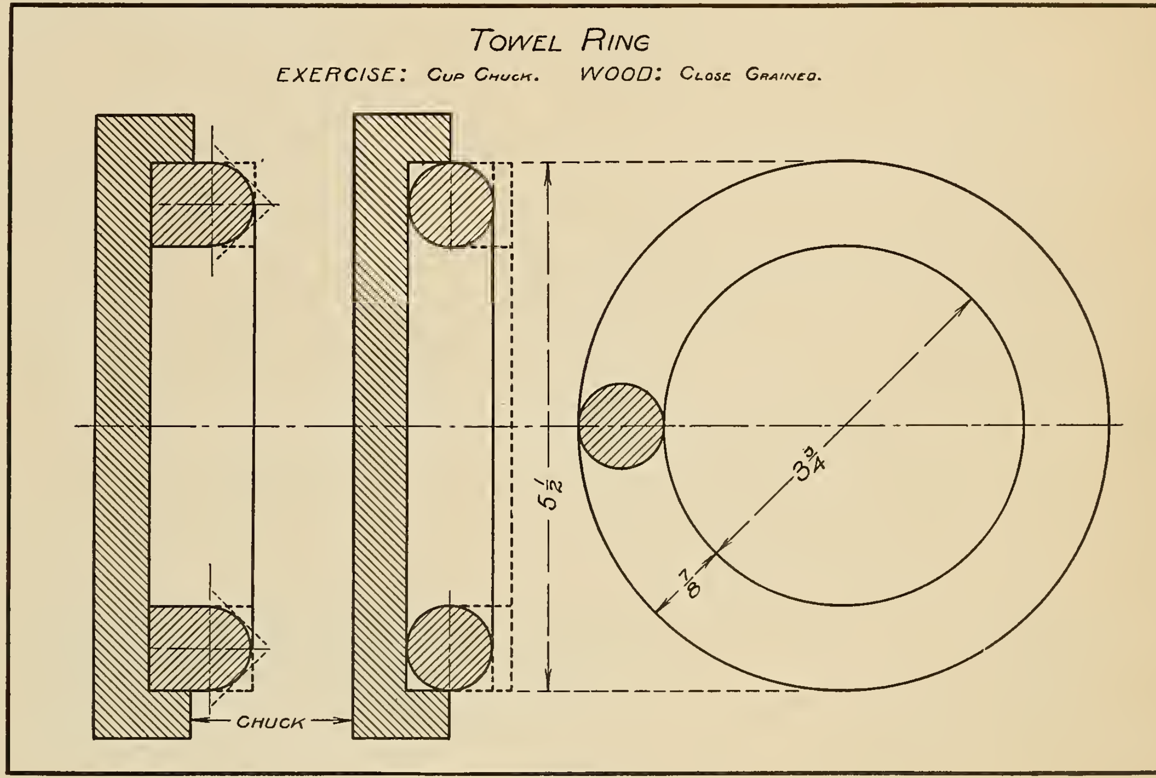

PLATE 17.

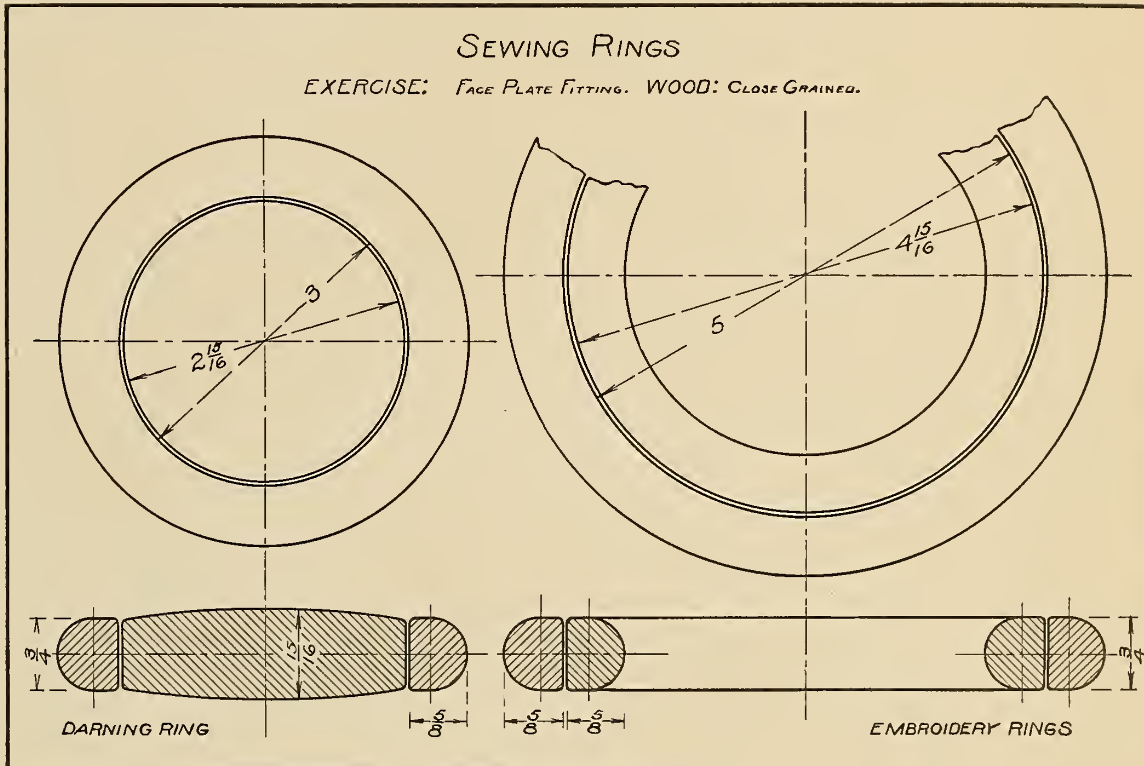

PLATE 18.

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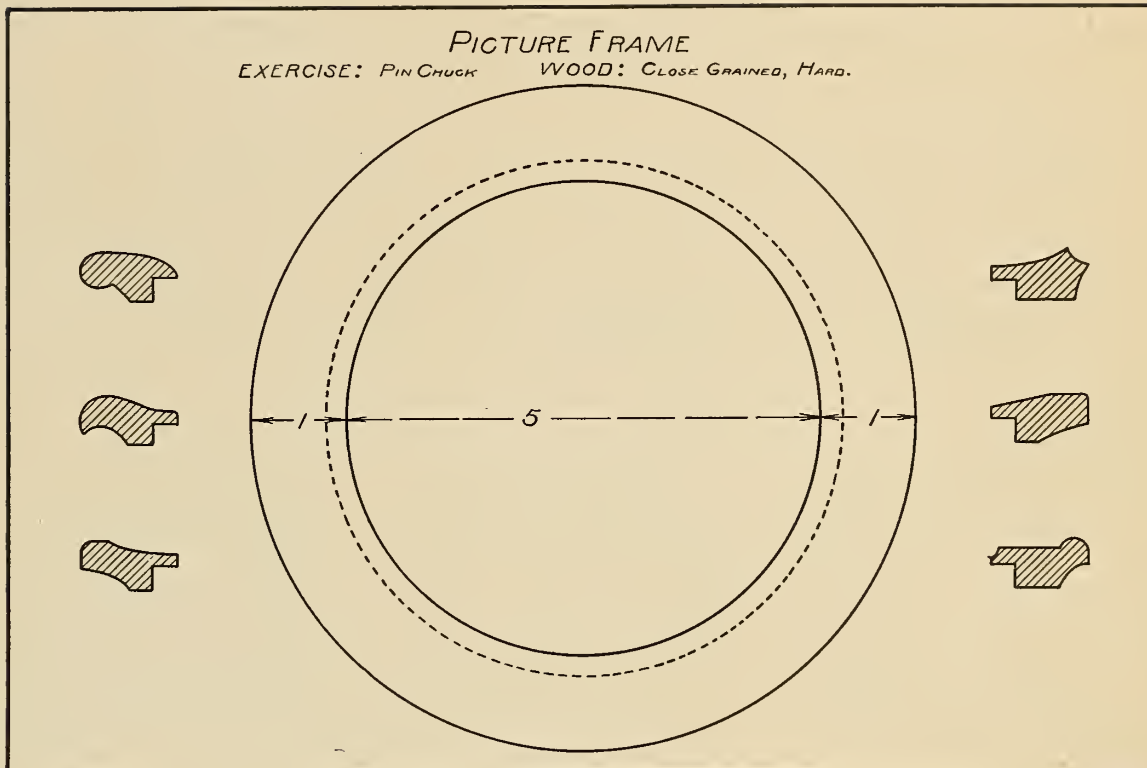

PLATE 19.

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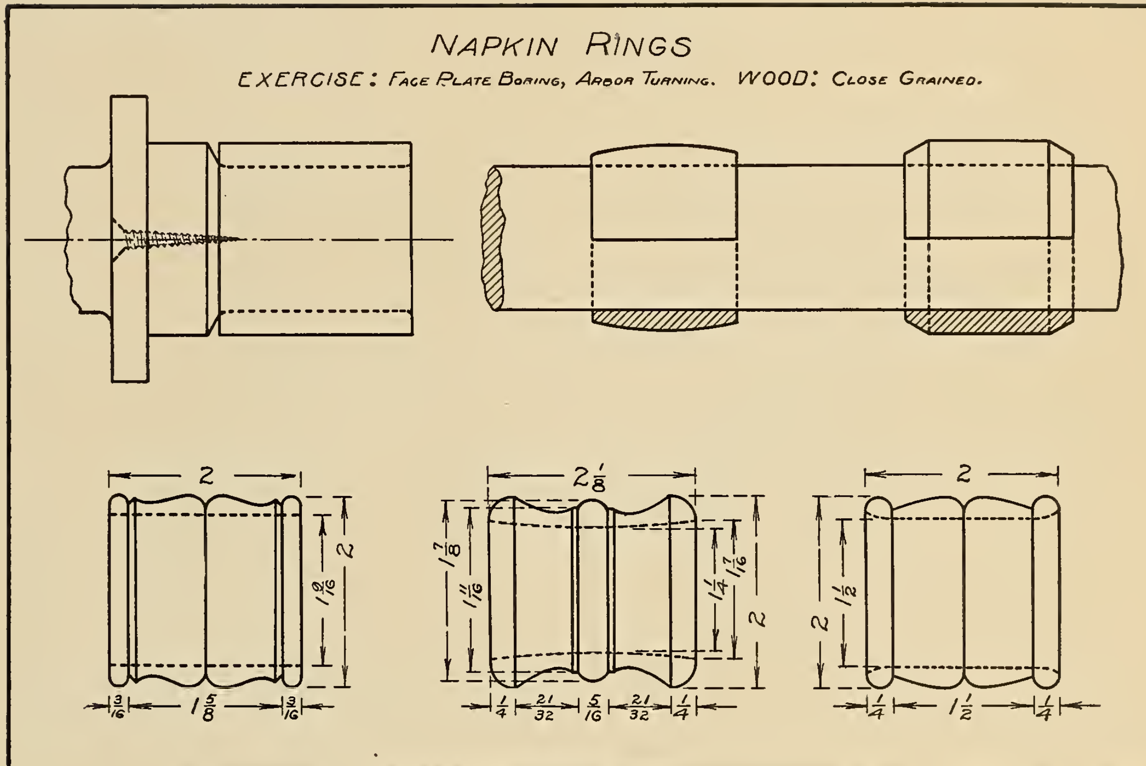

Plate 20.

From "Problems in Woodturning"
By Fred D. Crawshaw.
Published by The Manual Arts Press, Peoria, Ill.

Covered Boxes

EXERCISE: Face Plate, Chuck, Fitting. WOOD: Maple, Mahogany, Cherry.

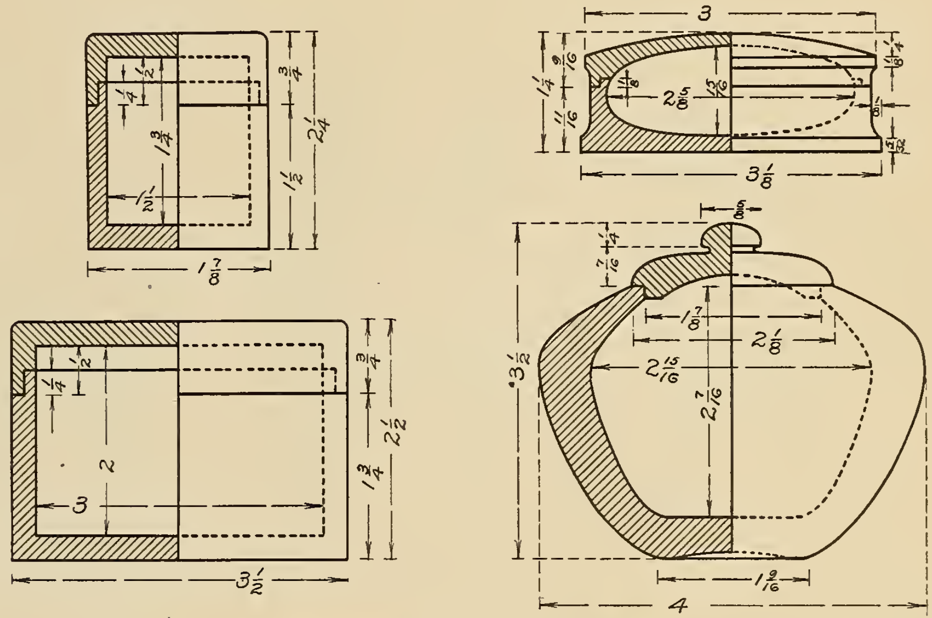

Plate 21.

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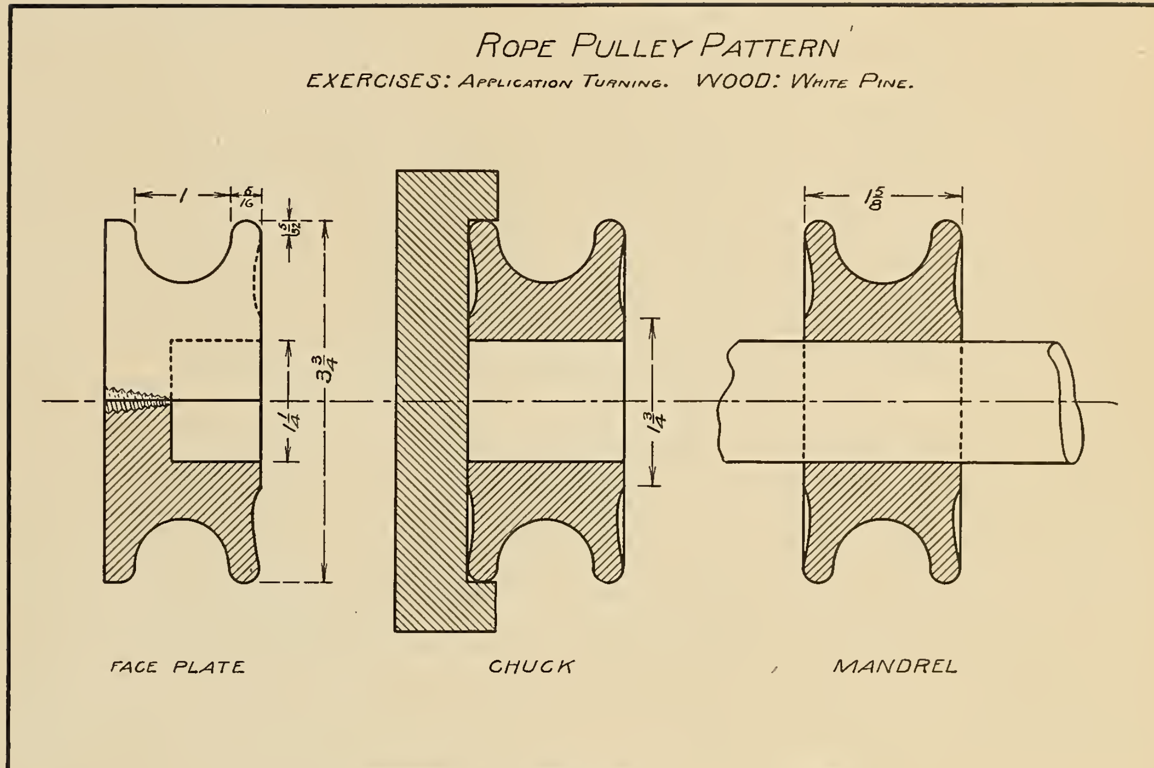

Plate 22.

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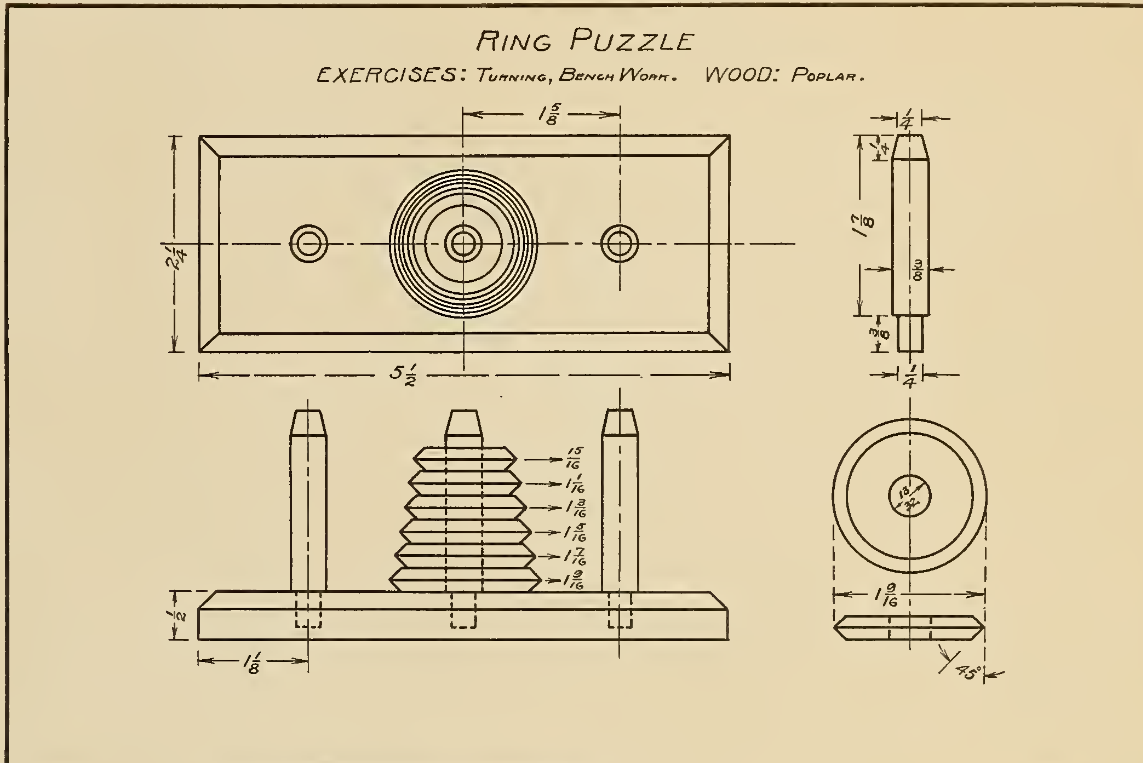

PLATE 23.

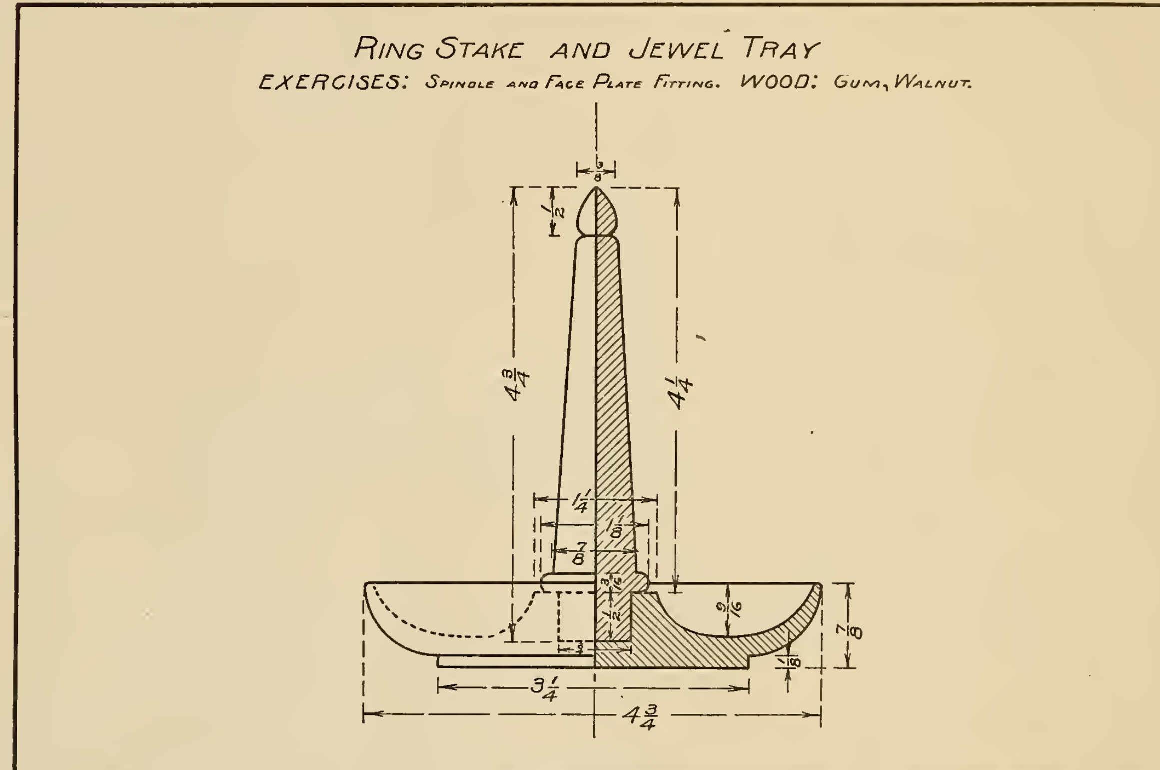

PLATE 24.

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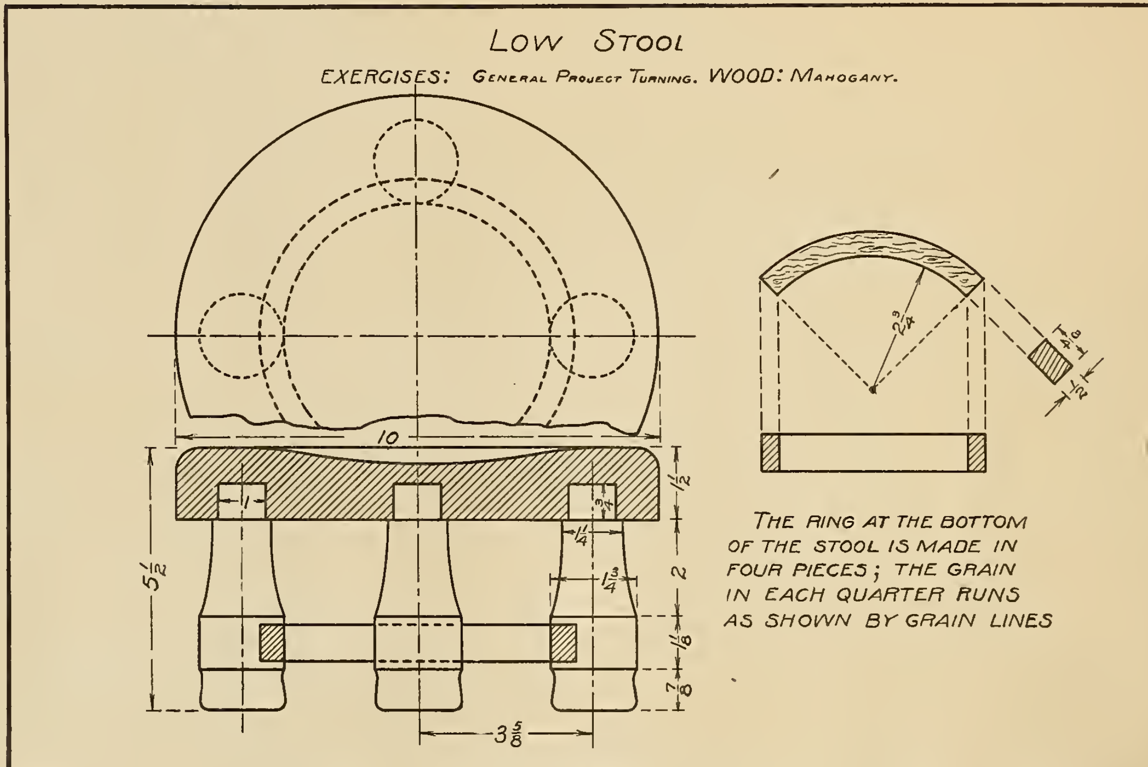

PLATE 25.