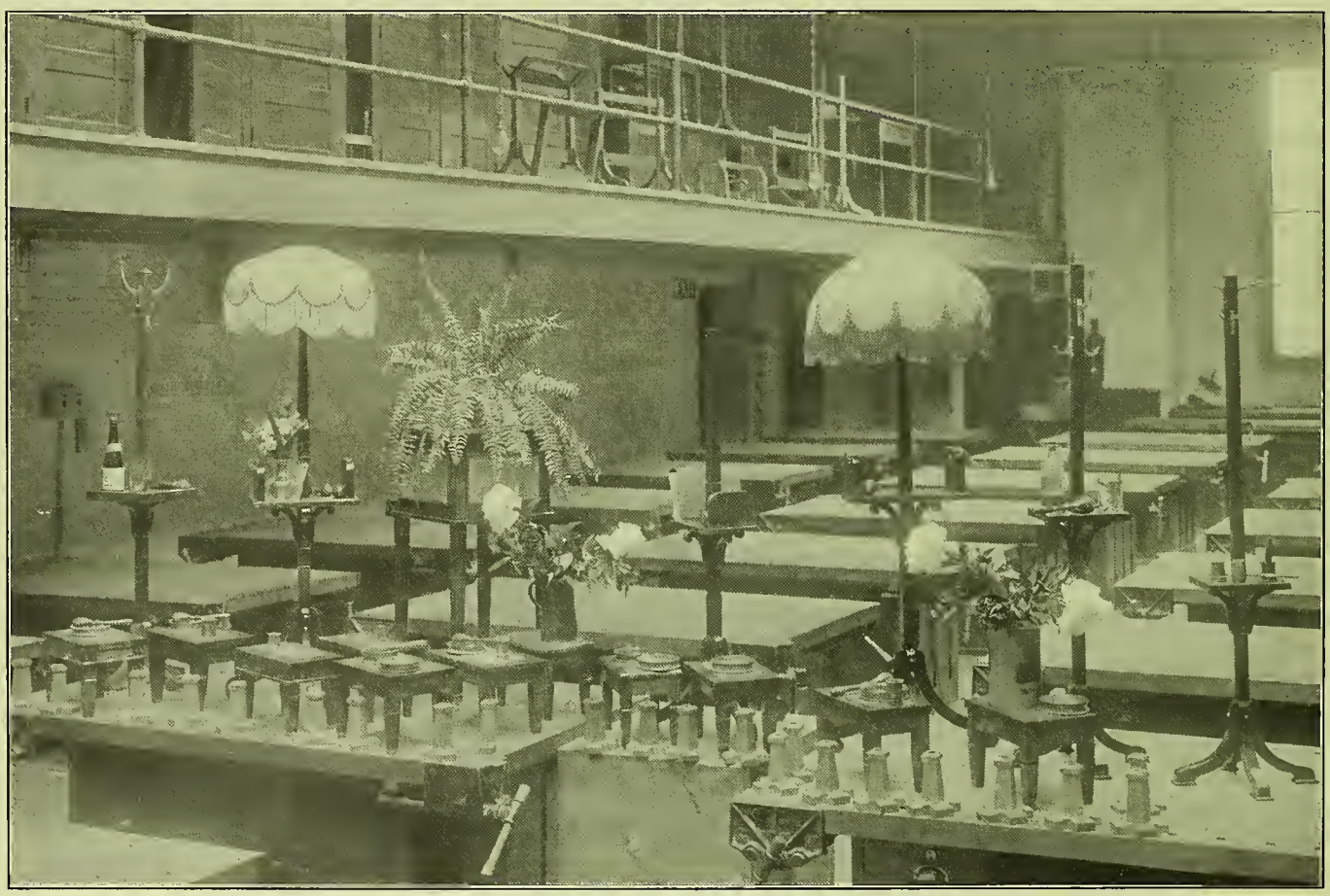
PRACTICAL DRAWING

HARRY WILLIAM TEMPLE

D.C. HEATH & COMPANY



ALL THIS WORK WAS BUILT IN THE AUTHOR'S CLASSES BY HIS BOYS

PRACTICAL DRAWING

BY

HARRY WILLIAM TEMPLE

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"The value of drawing as an educational agency is simply incalculable. It is the first step in manual training. It brings the eye and the mind into relations of the closest intimacy, and makes the hand the organ of both. It trains and develops the sense of form and proportion, renders the eye accurate in observation, and the hand cunning in execution."

CHARLES H. HAM

"Drawing is a language — the language in which art records the discoveries of science. It is not German, it is not French, it is not English — it is universal — common to all draughtsmen. The face of the student exhibits vivid flashes of intelligence as the picture reveals itself under his hand. Each line is a word, an angle completes the sentence; with a curve and a little delicate shading we have a paragraph. The picture begins to grow with thought. The student's face flushes, his heart beats quick and his hand trembles. But he restrains himself, and adds more lines, more angles and curves, more shading, and the picture is complete. It stands out in bold relief, and looks like a real thing. If the student knows the story of the brazen statue of Albertus Magnus he half expects his picture of a locomotive to move. He listens for the sound of the hissing steam, and a smile lights up his face as the illusion vanishes. Presently he will take his drawing to the shop, and at the bench, the lathe, the anvil, and the forge, reproduce it in iron and steel, and actually vitalize it with steam."

CHARLES H. HAM

INTRODUCTION BY SUPERVISOR R. M. SMITH

The purpose of this book is to give the pupils in the upper grades and in the junior high school facility in the reading and rendering of working drawings.

Logically a printed text in the hands of the pupils is essential to the right teaching of Mechanical Drawing in our schools.

Technical schools for years have used textbooks in Mechanical Drawing, but they are much too advanced and too highly technical for school use.

The course as outlined by the author consists of several groups of theoretical and practical problems which have been carefully selected, arranged progressively, and presented simply and clearly.

Each problem is accompanied by explicit directions. Principles and their practical application have been emphasized through the course.

Isometric drawing, or practical perspective, as it is sometimes called, is growing in popular usefulness, not only in the drafting room but for illustrations in technical papers as well. Its convenience and adaptability are being recognized. Both the trained draftsman and the shop man who wants to talk "the language of the shop" find it useful and practicable. The author shows very clearly "how to make isometric drawings" without going into too many details.

From the standpoint of good teaching the book is excellent. The language is simple and the explanations and directions clear.

The pupil is gradually led to rely more and more upon the text and less on the teacher and thereby self-help is promoted in the pupil.

The author has brought to his task a large and varied experience as a teacher in the rural schools as well as several years' successful experience as a teacher in the elementary, high, and technical high schools of the city.

R. M. SMITH,

Supervisor Manual Training,
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Chicago, Ill.

AUTHOR'S INTRODUCTION

The purpose of the first part of this course is to give eighth grade pupils such a thorough drill that by the time they complete this grade they will be able not only to make practical working drawings, but also to read blue prints intelligently.

Heretofore, the high school course in Mechanical Drawing has not given the boy sufficient drill in making and reading drawings until late in the first year.

Pupils have entered high school with only a limited knowledge of working drawing and in order to handle their shop-work properly the shop teacher has been compelled to devote an undue proportion of the shop time to teaching practical drawing.

Owing to this lack of preparation in the grades, the high school drawing teacher has been obliged to begin with the most elementary phases of the subject. He has been unable to give his pupils sufficient drill in making and reading practical drawings until late in the freshman year, and during this time the pupils have needed this skill to help them in their work in the shops. The purpose and scope of this course as outlined are as follows:

1. Pupils are prepared to begin shop-work in the high school without further preliminary shop drawing.

2. The high school teachers of Mechanical Drawing may begin at a more advanced stage in their drawing course. The student will thereby have covered more ground and reached a higher degree of proficiency at the end of his course than has been possible under former methods.

3. To the majority of pupils who do not enter high school this course will give a degree of proficiency that will compensate in large measure for what is denied them through lack of high school advantages.

This book meets admirably the needs of the junior high school. It offers a three-year course, covering the seventh and eighth grades, and the first year of high school.

This book contains material for a course in practical working drawing to begin in the eighth grade, shop problems for pupils in the eighth grade, and in the first year of high school. It may be used as a text in a combination course in drawing and shop in the junior high school, or the drawing may be omitted and the book used as a text in cabinet making, wood turning, first year pattern making, concrete work, and stenciling.

CONTENTS

THINGS THE PUPIL SHOULD KNOW ABOUT DRAWINGS WHEN HE LEAVES THE EIGHTH GRADE

1. How to use and care for the common drawing instruments.
2. How to make a clear, well-appearing working drawing.
3. He should know the difference between tracing paper and tracing cloth.
4. He should know how to make a tracing.
5. He should know how to make a blue print.
6. He should be able to read simple drawings and blue prints made by others.
7. He should be able to do good lettering and should know its value to a drawing.
8. He should be familiar with the simple geometrical problems, such as how to bisect a straight line, an angle, how to draw a square, pentagon, hexagon, octagon, etc.
9. How to make isometric sketches of simple objects.
10. He should be prepared to begin with projections and be able to draw intelligently.
11. He should understand the scale and be able to use it.
12. That the T square is not a hammer.
13. The difference between the 45 and 30–60 degree triangles.
14. How to sharpen his drawing pencils.
15. How to clean a drawing.
16. How to correct a drawing.
17. How to make out stock bills.
18. How to fasten his paper to the drawing board.
19. How to trim a drawing.
20. That drawing is a language.

WHAT A PUPIL SHOULD KNOW WHEN HE LEAVES THE WOOD SHOP

1. How to read a rule, not ruler.
2. How to add and subtract fractions of an inch.
3. That sandpaper is graded numerically.
4. That a sandpaper block should always be made of soft wood.
5. That sanding should not be done until all tool work is finished.
6. That worn sandpaper becomes useful later.
7. To call a bit by name and size.
8. That a bit is not a "bore."
9. That a bit is not a drill.
10. That the figure 4 on a bit means 4/16", and not No. 4.
11. That a bit brace is not an "auger" or "borer."
12. That bits should be filed by the teacher.
13. That usually the direction should not be reversed when drawing out the bit.
14. That holes are usually measured from center to center.
15. That a file should not do the work of the plane, spokeshave, or scraper.
16. That a file cuts only one way.
17. That grinding without water destroys the temper.
18. That to sharpen does not mean to grind.
19. That the flat side of the chisel and plane bit should never be ground.
20. That the flat side of a chisel and of a plane bit should never be raised when whetting.
21. That the plane should be laid on its side to avoid dulling the blade and cutting the bench when not in use.
22. That the cap iron should be set about 1/16" back of the bit.
23. That it is impossible to do good work with dull tools.
24. That the sharpening of the scraper should be done by the teacher.
25. How a rip-saw differs from a cross-cut saw.
26. That the number on a saw indicates the number of teeth to the inch, and does not indicate the kind of saw.
27. That the rip-saw is not always No. 8 and that the cross-cut is not always No. 10.

28. That a back-saw should be used for close work.
29. That but few pencil lines are to be used.
30. That no time or labor is saved by sawing around or from both edges or ends of a board.
31. That it is dangerous to stand near a running machine.
32. That the discipline in a shop should be no different from that in any other schoolroom, barring the necessary tool noise.
33. How to make and read a simple blue print.
34. How to make working drawings to scale.
35. How to care for his tools and keep them in their places.
36. That the shop is not the place to eat during class time.
37. That there is more to manual training than tool work.
38. That the shop is not a place to have a good time.
39. That too much glue is worse than no glue.
40. That the glue-pot should be kept clean.
41. That the try-square is a testing tool and should not be used as a rule.
42. He should know the names of the two common planes and their parts.
43. He should know that it is poor practice to build furniture without first hand-planing the lumber.
44. He should know how to square a block.
45. He should know that knife lines are better to work to than lead pencil lines.
46. He should know why water is placed on the grindstone, and why oil is put on the oilstone.
47. He should know that he is wasting time and effort in going to and from the teacher every two or three minutes.

INSTRUMENTS AND THEIR USES

It is hard to do good work with poor instruments.

An experienced draftsman or workman may be able to accomplish a fair degree of good work with poor, ill-kept instruments, but the person beginning to draw will find it hard enough to do creditable work without being hindered by having to use such instruments. Therefore, purchase good instruments, and keep them in the best working condition.

Drawing instruments should be handled with care and well wiped with a soft cloth or chamois skin before being put away.

PENCILING

Drawings should be made in pencil first and afterward inked or traced, as desired.

The purpose of penciling is to locate all lines, making them exactly the length required, etc.

An accurate drawing is one that has been penciled accurately first. The beginner is apt to overlook this important fact, and thus becomes careless in penciling, thinking, perhaps, that it will be an easy matter to correct inaccuracies and add to or change the drawing when it is being inked. This is a great mistake and should by all means be avoided.

The beginner should use a 4H drawing pencil, and draw very fine light lines.

The pencil should be sharpened on both ends, one end like the cutting edge of a chisel and the other sharp like the point of a needle.

A softer pencil (3H), sharpened round like the point of a needle, should be used in making letters, figures, and arrow points, and in sketching.

COMPASSES

The compass should be used with one hand and held so that the legs are about vertical; thus the needle point will make a very small hole in revolving and both nibs of the pen will then press equally on the paper.

Lean the compass slightly in the direction of revolution and put a slight pressure on the pencil or pen end, holding it loosely between the thumb and forefinger.

The lengthening bar is used when it is necessary to draw large circles and arcs; then both hands are required, one to steady the needle point, the other to describe the circle or arc.

Use the small bow compass for all small work,

adjusting the needle point to about the same length as that of the pencil or pen end.

DIVIDERS

The dividers are used as spacers for measuring distances and for laying off measurements from the scale or from one drawing to another.

It is impossible to ink neatly over holes in the paper; therefore, press very lightly on the dividers when they are being used.

T SQUARE

The T square should be used with the head against the left end of the drawing board.

If the person is left-handed place the square on the right end of the drawing board.

There are times when it is not practical to use the T square in these positions.

Always use the upper edge of the T square as a guide for the pencil or pen.

Do not draw vertical lines with the T square unless it saves time or the lines are long, and then the board must be square.

TRIANGLES

The 45-degree and the 30–60-degree triangles are used for drawing vertical lines, 45-degree lines, 60-degree lines, and 30-degree lines.

In drawing these lines the triangle is placed against the upper edge of the T square, the edge of the triangle being used as a guide for the pencil or pen.

The head of the T square must be pressed firmly against the board with the left hand, and the triangle in turn must be held firmly against the upper edge of the T square.

The triangles are also used with each other and with the T square as a guide for the pencil in drawing parallel lines, lines of 15 and 75 degrees, etc.

SCALES

Most drawings are made smaller than the finished object, otherwise a full size drawing would require a piece of paper too large for convenience in drawing.

Measurements are reduced by means of a tool called a scale.

The drawing may be made 1/2, 1/4, 1/8, 1/16, etc. in size, depending upon the size required and the size of paper to be used.

A drawing made 1/4 size means that three inches on the drawing represents one foot on the object.

It is necessary to represent inches and fractions of an inch. This is done by dividing the three inches into twelve equal parts, and each part will represent one inch on the object.

If each of the twelve parts is subdivided into 2, 4, or 8 parts, each part will represent 1/2, 1/4 or 1/8 of an inch on the object.

This is usually indicated on the drawing as the scale to which it has been drawn, namely, 3 inches equal 1 foot, or 1/4 size.

On the scale one inch equals one foot.

The unit, one inch, is divided into 12 parts to represent inches as before.

Thus, to make the scale of any unit to one foot, it is necessary simply to divide that unit into 12 parts to represent inches, subdividing these parts as far as needed to represent fractions of an inch.

If the smallest division on the scale represents 1/8 inch on the object, the scale is said to read to 1/8 of an inch.

The student will find on his triangular scale ten different scales, namely, 3/32, 1/8, 3/16, 1/4, 3/8, 1/2, 3/4, 1, 1 1/4, and 3 inches to the foot, reading to 2, 1, 1, 1, 1, 1/2, 1/2, 1/4, 1/4, and 1/8 inches respectively.

The double prime (") over a number or fraction means inches. Thus, $3'' = 3$ inches.

The single prime (') means feet; $3' = 3$ feet.

Never under any circumstances use a scale as a ruler to guide the pencil or pen in drawing lines.

IRREGULAR CURVE

The irregular curve is a tool to be used as a guide for the pencil or pen in penciling or inking curves that cannot easily be drawn with the compasses.

THUMB TACKS

Thumb tacks are used to fasten the drawing paper to the drawing board.

INKING PEN

The inking or drawing pen is one of the most important drawing instruments and therefore it should be of good quality and well kept.

Place the ink between the nibs with the quill, brush, or strip of paper.

Do not dip the pen in the ink.

Before beginning to ink, see that there is no ink on the outside of the nibs.

The pen should be held so that both nibs touch the paper and are inclined to the right or in the direction of the line, with the flat side against the triangle or T square.

Press the pen only lightly against the tool being used as a guide for the pen, or the lines will be uneven in thickness.

Draw the lines with the pen from the left to the right with reference to the person and not the drawing.

Never ink backwards over a line.

The pen should be cleaned frequently with a strip of thin copper covered with a soft cloth, with a toothpick dipped in clean water, or with a piece of soft cloth.

If the pen is not cleaned often the ink will dry between the nibs and thereby prevent the free flow of the ink.

The point of the pen must be kept a little away from the triangle or T square to prevent the ink flowing against, and under, the tool, and thus making a blot.

Clean and dry the pen carefully before putting it away.

TO CORRECT AND CLEAN A DRAWING

Remove all pencil lines with the rubber eraser.

Remove all ink lines—mistakes in inking, blots, and changes — with the ink eraser.

It requires more rubbing to erase with the ink eraser than it does to erase with the pencil eraser.

Ink lines may be removed with the edge of a sharp knife. Do not use the point of the knife, as V-shaped holes are made which will always show.

After erasing an ink line, the surface which has been made rough by scratching with the knife should be rubbed with some hard, clean, rounded instrument before inking other lines over it.

Brush off all erasings with a soft, clean cloth.

Dry bread crumbs are often used in cleaning a drawing. Rub the crumbs over the drawing with the palm of the hand.

Art gum is generally used in cleaning a drawing.

Keep the drawing as clean as possible and but little dirt will have to be removed.

While drawing, cover all parts of the paper not being used.

There is a liquid tracing cloth cleaner on the market which is excellent for removing pencil marks, dirt, and grease spots from tracings. It has no effect on waterproof ink and does not injure the surface for inking.

There is another preparation on the market called Inkoff for erasing black waterproof drawing ink lines and figures without injury to the tracing cloth.

TO INK A DRAWING

It may appear at first thought as though it would be an easy matter to ink a drawing.

The ability to make a good ink line comes to a large per cent of students but slowly, and often after much hard practice.

Use good quality black waterproof India ink.

The drawing should be inked according to the following plan, to save the pupil's time and effort:

1. Circles and arcs.
2. Horizontal lines from the top.
3. Vertical lines from the left.
4. Oblique lines.
5. Center lines.
6. Extension and dimension lines.
7. Arrowpoints.
8. Dimension figures and notes.
9. Hatching.
10. Border line.
11. Title.

If the ink does not take to the tracing linen, sprinkle a little French chalk on the cloth and brush off with a soft, clean cloth.

Dust collects on linen and on the edges of the tools used as guides for the pen. Blow this dust off the linen frequently and wipe off the edges of the T square and triangles. By so doing you may save yourself time and trouble in correcting blots, etc.

LIST OF DRAWING INSTRUMENTS REQUIRED

1 set German Silver Drawing Instruments.
1 Drawing Board, 16 × 22 inches, Pine.
1 T-Square, 25 inches, Pear Wood.
1 Scale, 12 inches, Triangular, Boxwood.
1 Triangle, 30 degrees × 60 degrees, 8 inches, Transparent.
1 Triangle, 45 degrees, 6 inches, Transparent.
1 Irregular Curve, Pearwood.
1 doz. Steel Thumb Tacks, 3/8 inch.
1 Drawing Pencil, Hyperion, 4H.
1 Drawing Pencil, Hyperion, 3H.
1 Bottle Black Waterproof India Drawing Ink.
1 Ink and Pencil Eraser.
Drawing paper, 15 inches × 20 inches, Cream or White.
3 No. 506-F Ball Pointed Pens.
3 No. 506-EF Ball Pointed Pens.
6 No. 25 Spencerian Pens.
1 Emery Pencil Pointer.
1 Cube of Art Gum.
1 Tracing Cloth.
1 Scribbling Pad.
1 Scribbling Pencil.

PLATES

HOW TO LAY OUT

The plates are to be 9" × 12" inside the border lines, with a 1/2" trim line at the top, bottom, and right end.

The left end trim line is 1 1/4" to the left of the border line, to allow for binding the plates.

The finished plate will be 10" × 13 3/4".

The plate number, pupil's name, and the name of the school are to be printed in capital letters between two lines 1/8" spaced, at the left of the drawing.

The line nearest to the left border line is 1/4" to the left of the left border line.

The plate number is to be printed at the top, the pupil's name in the middle, and the name of the school at the bottom.

The pencil guide lines for this lettering are not to be inked.

TO FASTEN THE PAPER TO THE DRAWING BOARD

Lay the paper on the board so that the length will be with the length of the drawing board and to the right and left near the center of the board.

Place a thumb tack in the upper left corner of the paper.

Lay the T square on the board with its head at the left end, slide it up until its upper edge is in line with the upper edge of the drawing paper.

Hold the T square with the left hand and move the paper up or down with the right hand until it is parallel with the edge of the T square.

Hold the paper tight — do not let it slip — and insert a tack in the lower right-hand corner.

Now move the hand from the center across the paper toward the lower left-hand corner and insert another tack.

In the same manner place a tack in the upper right-hand corner.

Lay out and draw all trim and border lines.

If the plates are not to be bound, the left trim line is to be 1/2" to the left of the left border line, thus making the marginal space the same.

In this event the lettering will have to be moved 1/8" nearer to the left border line.

PLATE 1 —LETTERING

HOW TO LETTER

Draftsmen are obliged to letter fairly well, but drafting does not, as many claim, depend wholly on good lettering.

All that is required to-day is lettering that is intelligible.

Of course, good lettering adds greatly to the appearance of a drawing.

Lettering should be done free-hand in pencil first and then inked.

Use No. 506–F, or 506–EF, ball-pointed lettering pen for the large capital letters.

Use No. 25 Spencerian pen for the small capital letters.

All the lettering in this course is to be in capital letters.

Do not omit the pencil guide lines.

For the large capitals space the guide lines 1/8".

For the small capitals space the guide lines 3/32".

All letters slant to the right about 15°.

Do not use a vertical style.

Lay out the plate according to the directions for laying out plates.

Use care and make your work look well.

This plate is to be inked.

Do not ink dimensions and guide lines on which the lettering was done.

Clean the plate, and trim on the trim lines.

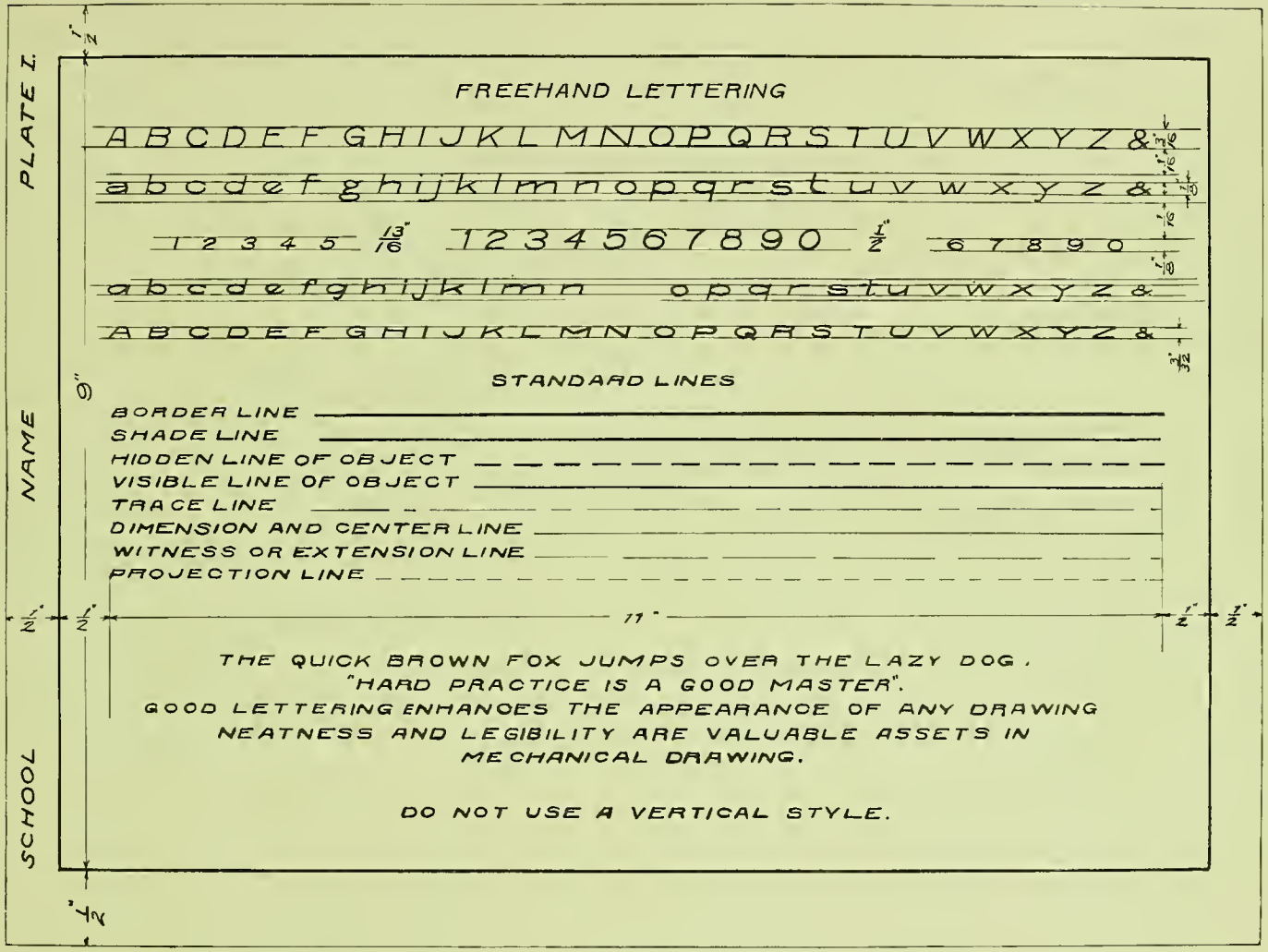


PLATE I.
NAME
SCHOOL
FREEHAND LETTERING
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z &
a b c d e f g h i j k l m n o p q r s t u v w x y z &
1 2 3 4 5 13/16 1234567890 1/2 6 7 8 9 0
a b c d e f g h i j k l m n o p q r s t u v w x y z &
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z &
STANDARD LINES
BORDER LINE
SHADE LINE
HIDDEN LINE OF OBJECT
VISIBLE LINE OF OBJECT
TRACE LINE
DIMENSION AND CENTER LINE
WITNESS OR EXTENSION LINE
PROJECTION LINE
9"
11"
THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG.
"HARD PRACTICE IS A GOOD MASTER".
GOOD LETTERING ENHANCES THE APPEARANCE OF ANY DRAWING
NEATNESS AND LEGIBILITY ARE VALUABLE ASSETS IN
MECHANICAL DRAWING.
DO NOT USE A VERTICAL STYLE.

PLATE 1

PLATE 2 — PRACTICE PLATE

HOW TO DRAW

Lay out the plate, following the directions given for laying out the plates.

Lay out the space inside the border lines according to the dimensions given on Plate 2.

Beginning with the oblong in the upper left-hand corner and using the scale, lay off the 1/4" spaces from top to bottom.

Pencil through these points just measured the horizontal lines, using the upper edge of the T square as a guide for the pencil and working toward the bottom.

The pencil should be well sharpened and held about vertical.

In laying off spaces with the scale, do not move the scale unless it cannot be avoided.

The oblong in the upper right-hand corner is to be spaced for horizontal lines 1/8" apart and lines drawn as they were drawn in the first space.

The lines should all be of the same thickness and if care is exercised there will be no noticeable difference in their spacing.

The oblong in the lower left-hand corner is to be laid out from left to right with the scale.

The spaces are 1/6" apart.

The lines are to be drawn vertically by placing the triangle against the upper edge of the T square and using the left edge of the triangle as a guide for the pencil.

Do not move the drawing board; do not move to the right end of the board in drawing this plate.

See to it that the head of the T square is touching the drawing board and that the triangle in turn is held securely against the square.

Do not move the T square, but slip the triangle to the right along its edge.

Draw the lines at the left edge of the triangle as it is moved along the T square.

Pencil the last space on the plate according to the note printed in the space.

The plate number, pupil's name, and the name of the school are to be printed after all other drawing on the plate has been done.

The plate is to be inked leaving out all center lines, construction lines, and dimensions.

Clean the plate and trim on the trim lines with a sharp knife.

If the T square is used as a guide or straight edge for the knife in trimming, turn it over so that the flat side lies on the paper and use its lower edge — which is now the upper edge — as a guide for the knife.

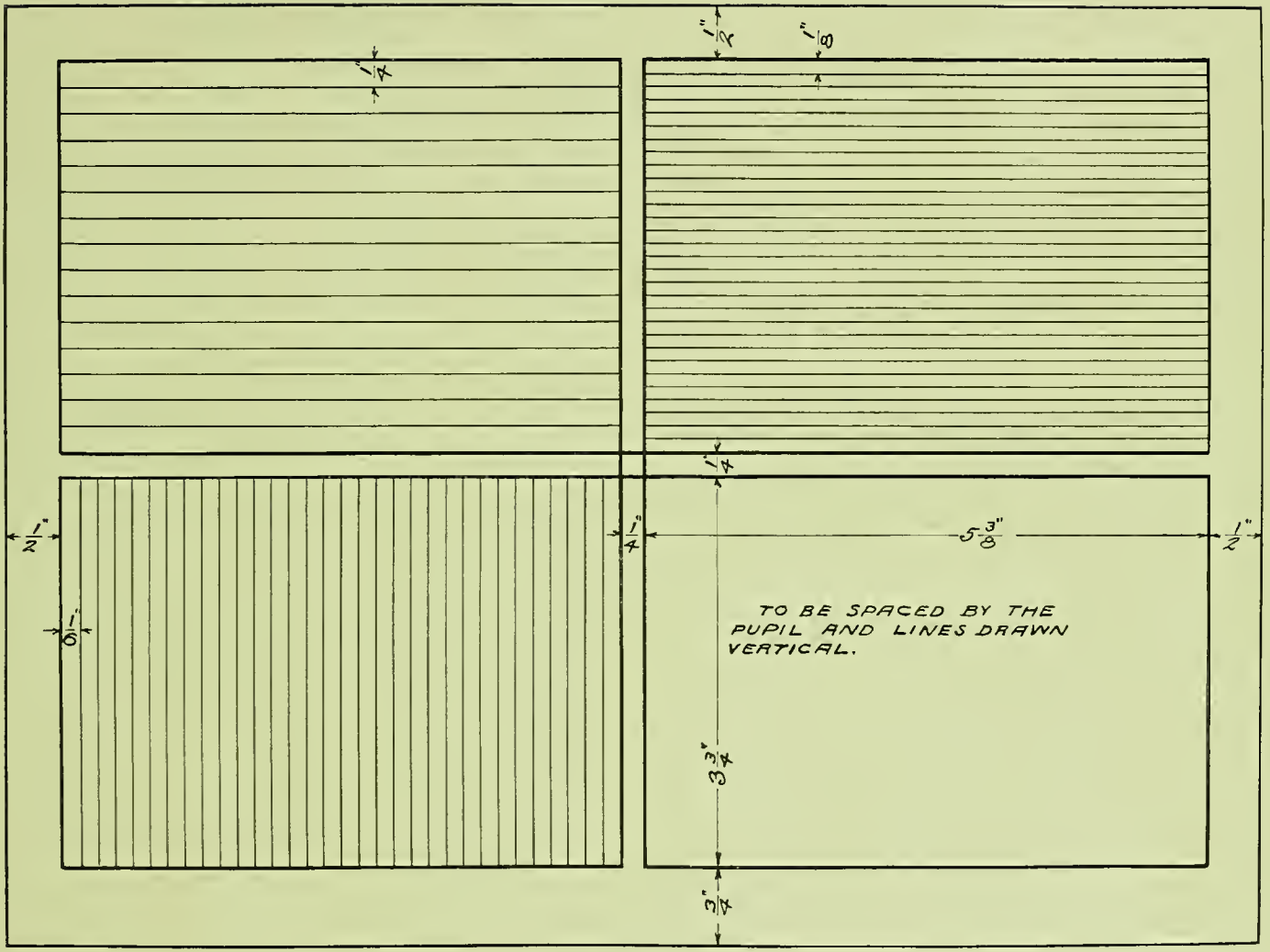

1" 1/2
1" 8
1" 4
1" 4
1" 2
1" 4
5-3" 8
1" 2
1" 6
TO BE SPACED BY THE PUPIL AND LINES DRAWN VERTICAL.
3" 3/4
3" 4

PLATE 2

PLATE 3—PRACTICE PLATE

HOW TO DRAW

The 9 × 12 inch space on this plate is to be divided into four equal oblongs, 4 1/2" × 6", using the two lines as center lines in laying out the correct shape of the spaces in which the drawings are to be done.

From the two center lines and the border lines, lay out the five spaces and pencil their outlines heavier than the center lines.

Begin with the space in the upper left corner and pencil the horizontal lines first, then the vertical lines.

Remember that this is a practice plate and should look better than Plate 2.

The space in the upper right corner is to be penciled with lines drawn 30 degrees to the horizontal, both to the right and left, spaced 3/8" with the horizontal lines, beginning at point *A* and spacing to the right and left far enough to catch the last line in corners *C* and *D*. Thus the line of points will be to the right on line *AB* produced lightly.

The 30-degree lines are not to be drawn from the points, but the points or dots are to be used as places on which the triangle is to be placed.

Hold the triangle on the dot and begin to draw the line on the outline of the space to be lined.

Do not pass any line outside the space *ABCDE*.

The two lower spaces are to be spaced and lined in the same manner except that the spacing is done on the lower line, produced, and the lines are 45 degrees in one and 60 degrees in the other. The vertical and horizontal lines pass through the intersection of the 60-degree lines.

The circle shown is filled in with small circles after spacing up and down and to the right and left of the center lines, lines spaced 1/2", using their points of intersection as centers of the small circles.

Do not move the scale in laying out these spaces.

The lines making the centers will have to be extended in all directions in order to locate the centers of parts of the small circles around the circumference of the large circle.

Print the plate number, pupil's name, and name of the school in their proper places.

Ink the plate, leaving out all construction and dimension lines.

Clean the plate carefully and trim.

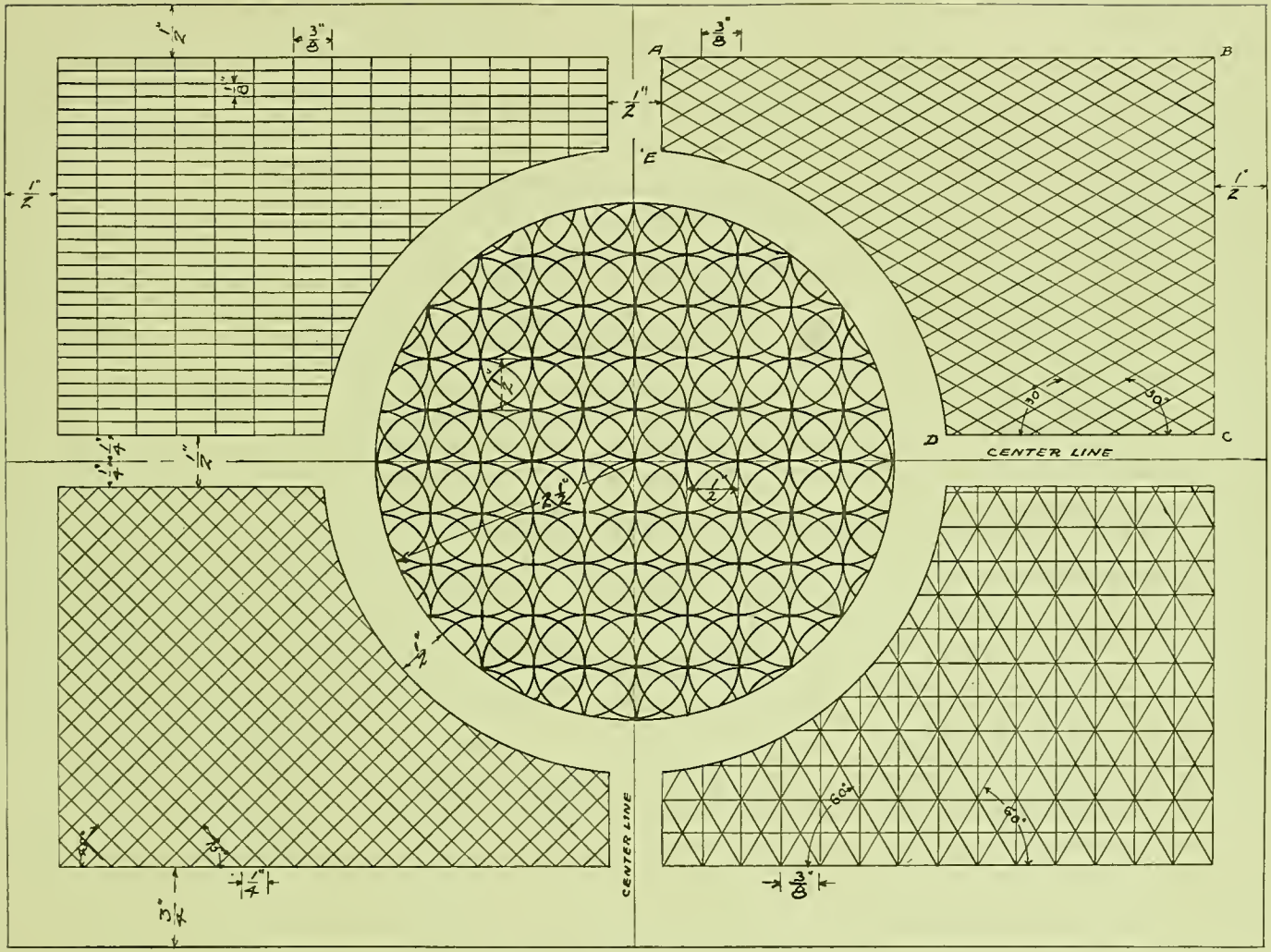


PLATE 3

PLATE 4—PRACTICE PLATE

HOW TO DRAW

Lay out the plate with as little aid from anyone as possible.

Locate and draw all center lines, extending them far enough in each direction to catch all necessary centers.

Pencil all circles and arcs first.

Do not change the compass until all circles and arcs having the same radii have been drawn.

Connect the ends of the arcs with straight lines, lifting the pencil to show lines passing under.

Ink the plate, showing nothing but the figure.

Begin with the circles and arcs, leaving the straight lines until last.

Clean and trim the plate.

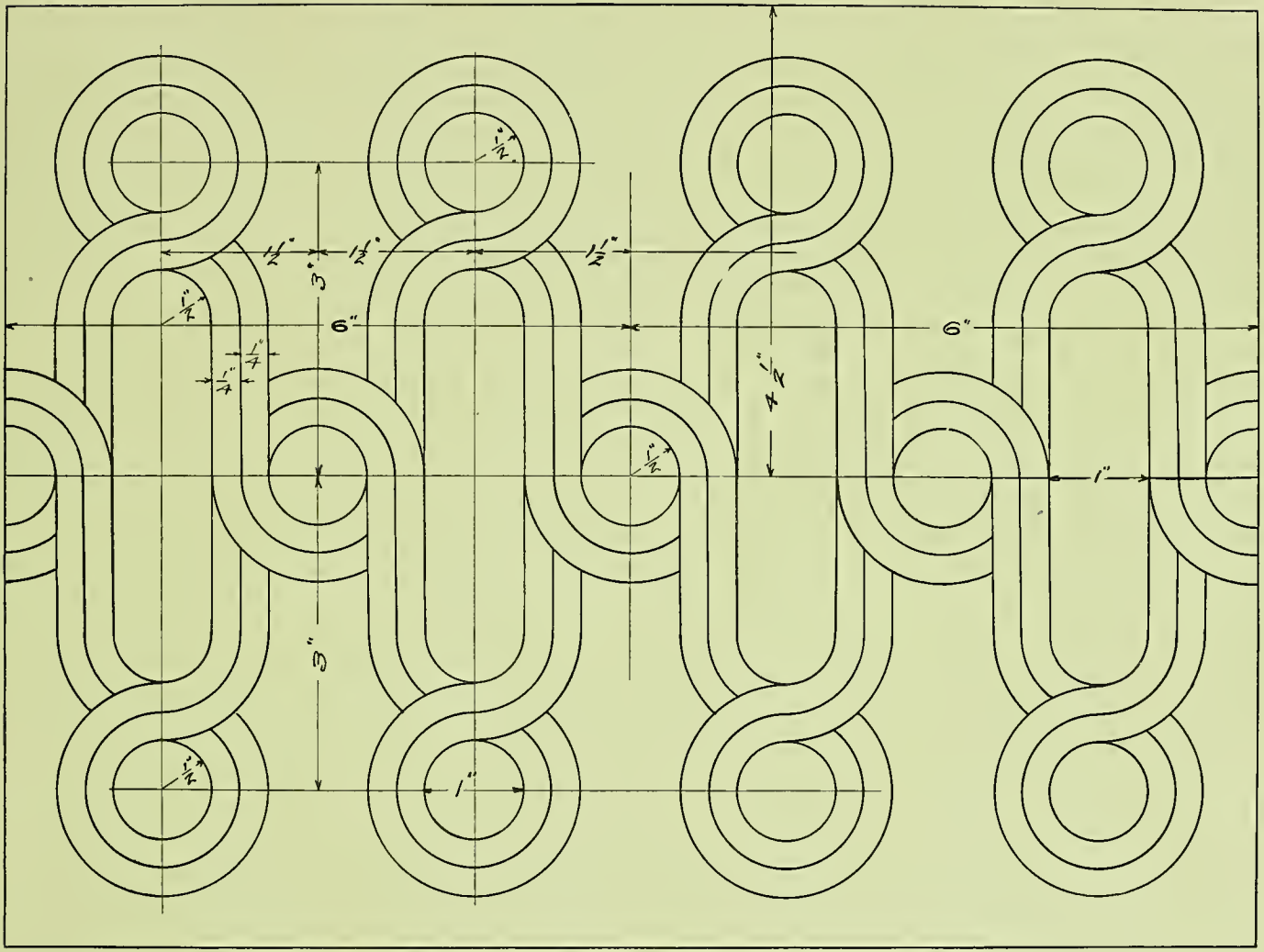


PLATE 4

PLATE 5

PROBLEM 1

To bisect a straight line *AB*, or the arc of a circle *AFB*.

With *A* and *B* as centers and any radius greater than 1/2 *AB*, draw arcs intersecting in *C* and *D*.

Join *CD*. *CD* is perpendicular to *AB*, and *E* and *F* are the middle points required.

PROBLEM 2

From a point C outside a straight line *AB*, to draw a perpendicular to the line.

With C as a center and any convenient radius, cut *AB* in the points *A* and *B*.

With *A* and *B* as centers and any radius greater than 1/2 *AB*, draw arcs intersecting in *D*.

Join *C* and D. *CD* is the perpendicular required.

PROBLEM 3

To draw a perpendicular to a line *AB* from a point *C* nearly or quite over its end.

Draw a line from C to meet *AB* in any point *B*.

Bisect *BC* in *D* by problem 1.

With *D* as a center and radius *DC*, draw the arc *CAB* meeting *AB* in *A*.

Join *A* and *C*. *AC* is the perpendicular required.

PROBLEM 4

To draw a perpendicular to a line *AB* from a point *A* at or near its end.

With *A* as a center and any radius, draw the arc *CD*.

With center *D* and the same radius, cut *CD* in *C*.

With *C* as a center and the same radius, draw an arc over *A*.

Draw a line through *D* and *C*, producing it to meet this arc in *E*. Join *A* and *E*.

AE is the perpendicular required.

PROBLEM 5 — *Another method*

With center *A* and any radius, draw an arc *CDE*.

With center *C* and the same radius, cut this arc in *D*.

With center *D* and the same radius, draw arc *EF*.

With center *E* and the same radius, draw arc intersecting *EF* in *F*. Join *A* and *F*.

AF is the perpendicular required.

PROBLEM 6

Through a given point *C*, to draw a line parallel to a given line *AB*.

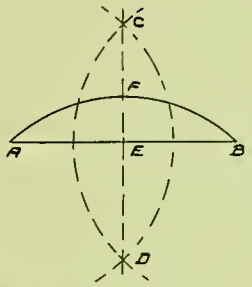
From *C* as a center and any radius, draw the arc *AD*. From *A* as a center, with the same radius, draw the arc *BC*.

With *BC* as a radius and *A* as a center, draw an arc cutting the arc *AD* in *D*.

Join *D* and *C*. *DC* is the line required.

TO BISECT A STRAIGHT LINE AB, OR ARC OF A CIRCLE AFB.

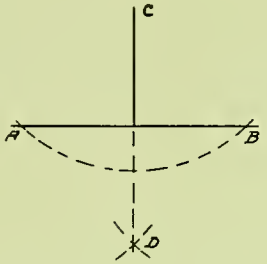
4"



PROBLEM 1

FROM A POINT C OUTSIDE A STRAIGHT LINE AB TO DRAW A PERPENDICULAR TO THE LINE.

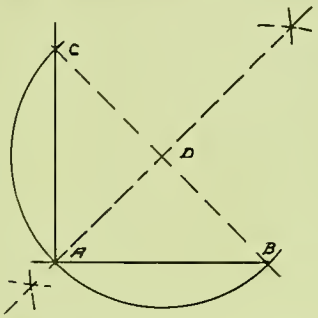
4"



PROBLEM 2.

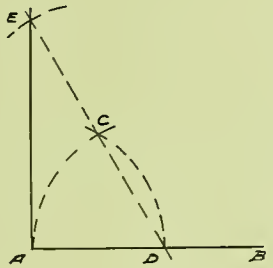
TO DRAW A PERPENDICULAR TO A LINE AB FROM A POINT C NEARLY OR QUITE OVER ITS END.

4"



PROBLEM 3.

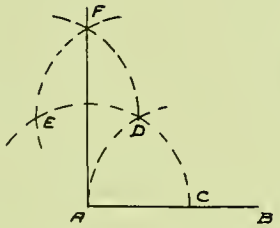
TO DRAW A PERPENDICULAR TO A LINE AB FROM A POINT A AT ITS END.



PROBLEM 4.

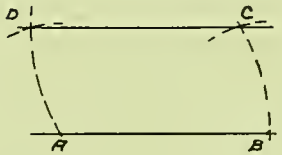
ANOTHER METHOD.

4"



PROBLEM 5.

THRU A GIVEN POINT C TO DRAW A LINE PARALLEL TO A GIVEN LINE AB.



PROBLEM 6.

PLATE 5

PLATE 6

PROBLEM 7

To draw a line parallel to a given line *AB* at a given distance *CD* from it.

From any two points *A* and *B* on the line as centers, and with *CD* as a radius, draw arcs *E* and *F*.

At *A* and *B* erect perpendiculars to meet the arcs in *E* and *F*.

Draw a line through *E* and *F*, which is the line required.

PROBLEM 8

To bisect a given angle *BAC*.

With *A* as a center and any radius, draw the arc *BC*, cutting the sides of the angle in *B* and *C*.

With centers *B* and *C* and any radius, draw arcs intersecting in *D*.

Draw *AD*, which will bisect the angle.

PROBLEM 9

To trisect a right angle *CAB*.

With center *A* and any radius, draw the arc of the quadrant cutting the sides in *C* and *B*.

With centers *C* and *B* and the same radius, cut the arc in points 1 and 2.

Join *A*1 and *A*2.

PROBLEM 10

To divide a given line *AB* into any number of equal parts (say seven).

From *A*, draw an indefinite line *A*1, 2–6 at any angle with *AB*.

At *B* draw *B*7 — 12, making the angle *AB* 12 equal to the angle *BA* 6.

With any distance as a unit, lay off on the lines from *A* and *B* as many equal spaces as the number of parts required, less one.

Join 1, 12 and 2, 11, etc.

The places where these lines intersect *AB* are the points of division required.

PROBLEM 11 — Another method (say six parts)

Draw *A*1 — 6 at any angle to *AB*.

Lay off on it six equal spaces, using any convenient unit.

Join 6*B* and through the points 1, 2, 3, 4, 5 draw lines parallel to *B*6, meeting *AB* in points 7, 8, 9, 10, 11 which are the points of division required.

PROBLEM 12

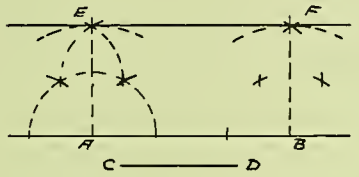
On a given side *AB*, to construct a square.

Draw *BD* at right angles to *AB* and equal to *AB* (Prob. 5).

With *A* and *D* as centers and radius *AB*, draw arcs intersecting in *C*.

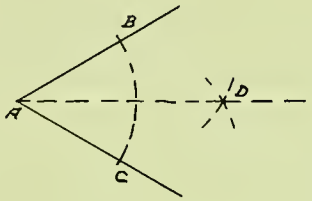
Join *AC* and *CD*.

TO DRAW A LINE PARALLEL TO A GIVEN LINE AB AT A GIVEN DISTANCE CD FROM IT.



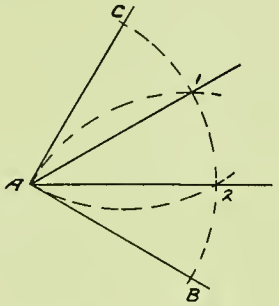
PROBLEM 7.

TO BISECT A GIVEN ANGLE BAC.



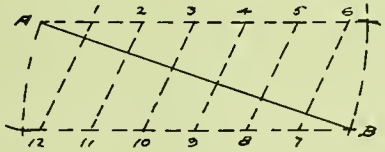
PROBLEM 8.

TO TRISECT A RIGHT ANGLE CAB.



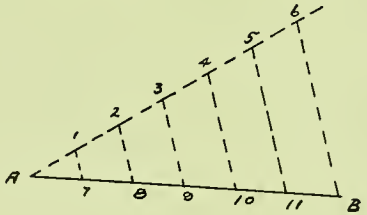
PROBLEM 9.

TO DIVIDE A GIVEN LINE AB INTO ANY NUMBER OF EQUAL PARTS. (IN THIS CASE 7.)



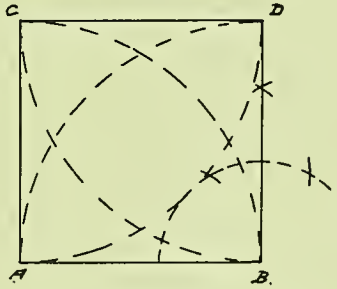
PROBLEM 10.

ANOTHER METHOD. IN THIS CASE SIX EQUAL PARTS.



PROBLEM 11

ON A GIVEN SIDE AB TO CONSTRUCT A SQUARE.



PROBLEM 12.

PLATE 6

PLATE 7

PROBLEM 13

On a given base *AB*, to construct a regular pentagon.

With centers *A* and *B* and radius *AB*, draw arcs intersecting in 1 and 2.

With center 2 and same radius, draw the arc 3*A*5*B*4, giving points 3 and 4.

Draw the line 3 5 to *C* and 4 5 to *E*.

With centers *C* and *E* and radius *AB*, draw arcs intersecting in *D*. Draw *BCDEA*.

PROBLEM 14

To construct a regular hexagon on given side *AB*.

With *A* and B as centers and radius *AB*, draw arcs intersecting in *0*.

With *0* as center and radius *AB*, draw a circle and lay off *BC*, etc., each equal to *AB*.

Join the points *B*, *C*, *D*, *E*, *F*, and *A*.

PROBLEM 15

On a given base *AB*, to construct a regular octagon.

At *A* and *B* erect perpendiculars (by Prob. 5) to *AB*, and bisect the exterior right angles, making the bisectors *AC* and *BD* each equal to *AB*.

Draw *CD*, cutting the perpendiculars in *E* and *F*.

Lay off *EF* from *E* to *G* and from *F* to *H*.

Draw an indefinite line through *GH*.

Make *GK*, *GL*, *HN*, and *HM* each equal to *CE* or *FD*. Connect *C*, *K*, *L*, *M*, *N*, and *D*.

PROBLEM 16

On a given base *AB*, to construct a regular polygon of any number of sides (say seven).

With center *A* and radius *AB*, draw a semicircle and divide it at points 1, 2, 3, 4, etc., into as many equal parts as there are sides in the required polygon.

Draw a line from the second point of division 2 to *A*. 2*A* is one side of the required polygon.

Bisect *AB* and *A*2 by perpendiculars by Prob. 1, meeting in *D*. With *D* as a center and radius *DA* draw the circle *BA*2, etc.

Apply *AB* as a chord to the circle as many times as there are sides in the polygon.

PROBLEM 17

To construct a regular octagon within a square *ABCD*.

Draw the diagonals *AC* and *BD*.

With *A*, *B*, *C*, and *D* as centers and half of the diagonal of the square as a radius, draw the arcs *EF*, *GH*, *KL*, and *MN*.

Join the points *MG*, *FL*, *HN*, and *KE*.

PROBLEM 18

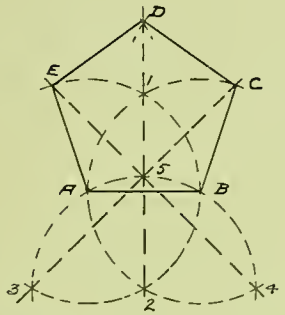
On a given diagonal *AB*, to construct a square.

Bisect *AB* in *0* (Prob. 1).

With center *0* and radius *0A*, draw a circle to cut the bisecting line in *C* and *D*.

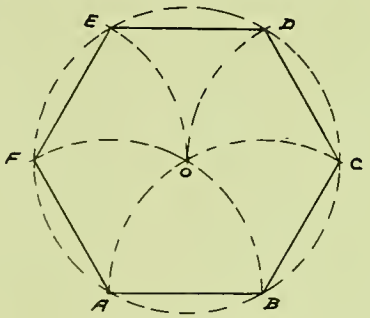
Draw *AC*, *CB*, *BD*, and *DA*.

ON A GIVEN BASE AB TO CONSTRUCT A REGULAR PENTAGON.



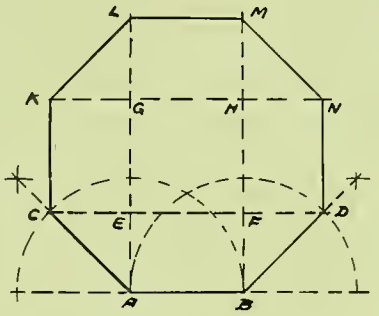
PROBLEM 13.

TO CONSTRUCT A REGULAR HEXAGON OF GIVEN SIDE AB.



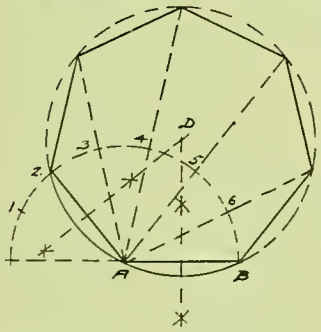
PROBLEM 14.

ON A GIVEN BASE AB TO CONSTRUCT A REGULAR OCTAGON.



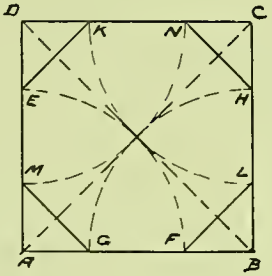
PROBLEM 15.

ON A GIVEN BASE AB TO CONSTRUCT A REGULAR POLYGON OF ANY NUMBER OF SIDES. IN THIS CASE SEVEN.



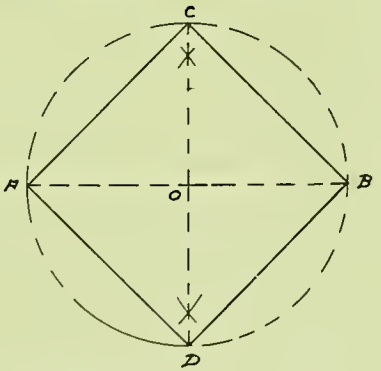
PROBLEM 16.

TO CONSTRUCT A REGULAR OCTAGON WITHIN A SQUARE ABCD.



PROBLEM 17.

ON A GIVEN DIAGONAL AB TO CONSTRUCT A SQUARE.



PROBLEM 18.

PLATE 7

PLATE 8—ISOMETRIC DRAWINGS

An isometric drawing is one which shows three faces of an object, not as they appear, but as they are.

The vertical lines of the object are drawn vertical to a horizontal line. The lines making right angles to the vertical lines are drawn at an angle of 30 degrees to the horizontal.

The top of an object is known as the plan or top view. The front of an object is known as the elevation or front view. The end of the object is known as the end or end elevation.

HOW TO DRAW

The lines on this plate are vertical and 30 degrees to the horizontal. Lines to use:

1. Object line.
2. Hidden object line.
3. Border line.
4. Dimension line.
5. Center line.
6. Extension line.

Divide the paper into four equal oblongs 4 1/2" by 6".

If your drawing board is square, draw both lines by placing the T square at the end, top, or bottom of the board as a guide for the pencil.

The drawing board must be square.

Draw line *AJ*, Fig. 1, 3/8" above the center division line. Measure from the left border line toward the right, on *AJ*, 2 9/16" and place point *B*.

Do not pencil a line.

Using the triangle and the T square, pencil an object line from *B* up 1 3/4", lettering the upper end of this line *C*.

Place the 30-60 degree triangle against the upper edge of the T square and pencil lines 30 degrees to line *AJ* to the right from *B* and C, 2 1/2" long.

These lines are parallel. Letter the ends of the lines thus drawn *D* and *E* respectively.

Connect *D* and *E* as you did *B* and *C*.

Draw lines *BF* and *CG* reversing the triangle and making the lines 1 1/2" long. Connect *F* and *G*.

Finish the drawing by penciling lines *GH* and *HE*.

Do not measure these lines, use the 30–60 degree triangle and T square.

Place dimension lines with their dimensions on the drawing as shown on Fig. 1.

The dimension lines for 30 degrees are drawn with the compass, with *B* as a center, breaking the lines to receive the figures.

Complete the plate by drawing Figs. 2, 3, and 4, placing all dimensions on each drawing, as in Fig. 1, and adding all extra dimensions not given.

Ink all lines except *AJ*, *KL*, and *MN*, leaving out their dimensions, namely: 3/8", 2 9/16" and 3 7/16". Print the names of the faces visible on each face parallel with the face.

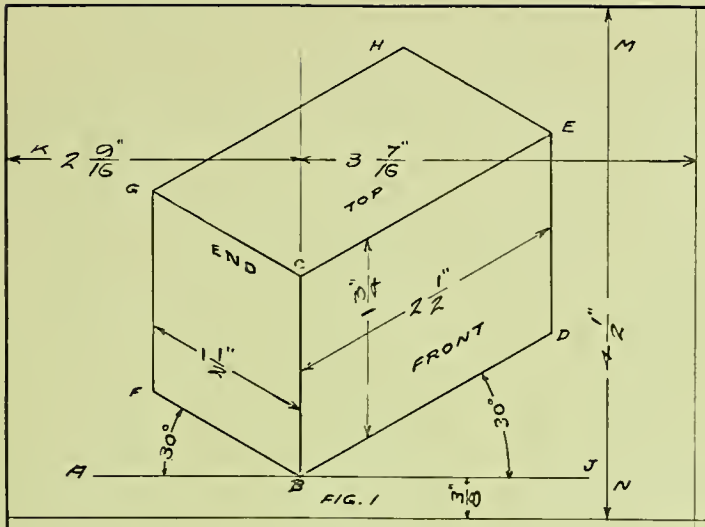


FIG. 1

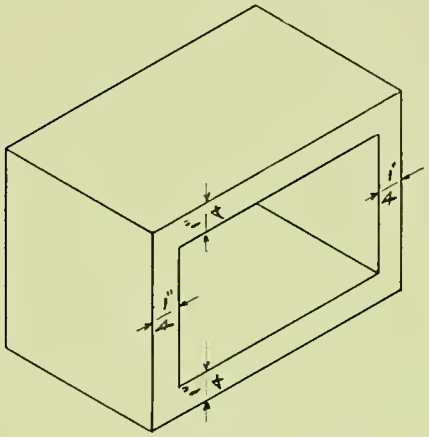


FIG. 2

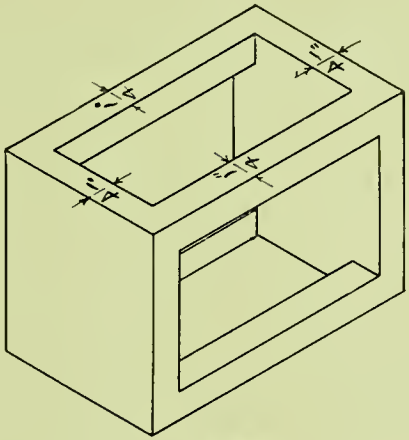


FIG. 3

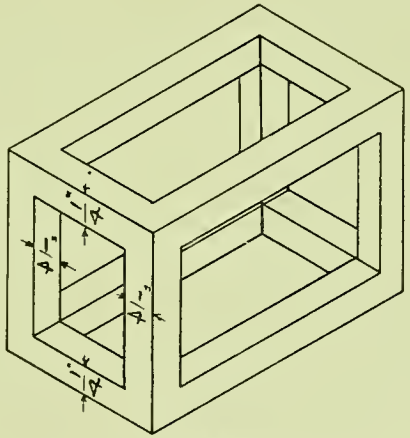


FIG. 4

PLATE 8

PLATE 9 — WORKING DRAWINGS

A working drawing is a drawing, or drawings, showing three (sometimes more) faces or views of an object — the top, front, and end views in their relation one to the other, and to the whole.

Figures 1, 2, 3, and 4, plate 9, are the working drawing of Figures 1, 2, 3, and 4, Plate 8, drawn to a smallers scale.

Compare the two plates.

The world wants men who can put on paper intelligent rough sketches and drawings which can be sent into the drafting room as a source of first information, sufficient and accurate, for the making of working drawings from which blue prints may be made and sent into the shops where the work is to be done.

These crude sketches need not be pleasing to the eye, but the correct information must be clearly shown. Many times the drawings are isometric penciled sketches showing dimensions and notes explaining parts, with but little attempt at proportion.

The dimensions must be clearly indicated.

A well-planned working drawing, fully dimensioned, neatly detailed, traced, and blue printed, requires time and expense.

Sometimes these crude sketches are sent direct to the shop to be used as working information. Therefore, the man who is of most value to his employer and to himself is the man who can hand in, in pencil, the first correct working information from which the well-appearing, properly dimensioned, working drawing may be made.

Place the block of wood or cardboard made for Plate 8 directly in front of the eye, so that only the front of the object is seen; this is the front view.

Do not move the block, but place yourself at the right end of the block, keeping the eye, with reference to the block, in the same position as it was when looking at the front; you now see the end view.

Now move back into the seat and raise the body until the eye is immediately over the center of the top of the block; this is the top view.

These three principles must be kept constantly in mind while making a working drawing.

Train yourself to see these three views without having to move either your body or the object.

HOW TO DRAW

Lay out the paper as you did for Plate 8.

The drawings are to be 1/2 size.

Fig. 1. Locate and draw line *CB*, the top line of the front view, which is 2" above the center line.

It is not necessary to get the line exactly 2 1/2" long; in fact it is a time saver to make the line longer than necessary.

Locate and draw line *AB* long enough for *EF*.

At the point of intersection of lines *CB* and *AB*, measure from *B* toward the left on line *CB* 2 1/2" and locate point *C* in its proper place.

Likewise, measure from *B* down 1 3/4" on *AB* and locate point *A*, the correct distance from *B*.

Draw lines parallel and the same length to *CB* and *AB* respectively, locating *D* at their intersection, and the front view of the block is complete.

The end and top views are 3/4" to the right and above the front view.

Measure to the right from *AB* 3/4" and place a dot; through the dot draw line *LM*.

Do not measure its length.

Place the T square on line *CB* and draw a line from *L* toward the right.

Repeat this on line *AD*, drawing from *M* to the right.

Take the dividers and set the points the proper distance apart on the scale for 1 1/2", reduced to scale, and set this distance off on *LK* from *L*.

Drop a line down from *K* to meet line *MJ*, and the end view is finished.

Proceed with the top view, in the same manner, transferring the length of line *LK* to *EF*.

No measuring is to be done except to locate and draw the front view, depth, and spaces between the views.

Place all dimensions of the object on the drawing, omitting all others as well as their lines.

The dimension lines should be about 3/8" away from the object lines.

It is necessary at times to place many dimensions on the drawing as in Figs. 2, 3, and 4.

Break the lines to receive the figures.

Draw Figs. 2, 3, and 4 in the order in which they come.

The hidden parts of the object are represented by dotted lines, all of which must be drawn on each figure.

Do not omit the dimensions.

Tracing is inking on tracing paper or linen which is placed over the pencil drawing.

Place the tracing paper or linen, whichever is to be used, over the pencil drawing, dull side up, and trace over the pencil work.

Use black India ink.

Do not trace any parts except those you would ink. From the tracing blue prints are made.

HOW TO MAKE BLUE PRINTS

Purchase or make a blue print frame.

Place the tracing in the frame, ink side to the glass.

Place blue print paper on the tracing, chemical or green side next to the tracing.

Place the pad, if it is not glued to the lid, on these.

Place the lid on next, and fasten securely.

Expose to the sunlight as per the directions on the blue print paper.

If the sun is very bright, about one minute is sufficient.

Take the print out and wash it through several changes of clear cold water. Do not use hot water.

Hang it up to dry.

When dry trim the print and it is ready for use.

Carefully lay the tracing away. Do not get it wet or soiled and it will last until worn out from use.

Line *CB* is the same as line *HE*, *EF* is the same as *LK*, etc. Why?

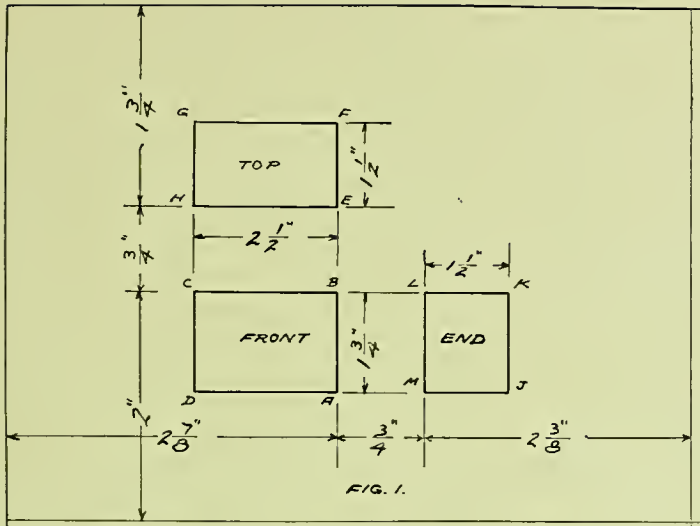


FIG. 1.

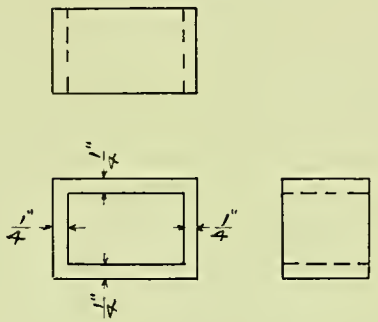


FIG. 2.

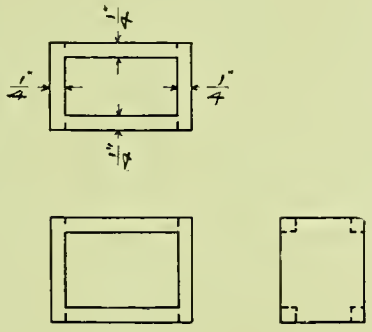


FIG. 3.

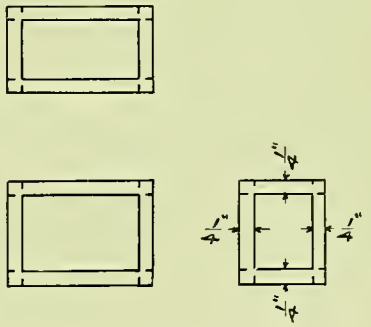


FIG. 4.

PLATE 9

PLATE 10—ISOMETRIC AND CABINET DRAWINGS

This plate shows the two positions of an isometric drawing, Figs. 1 and 2, and the difference between isometric and cabinet drawings.

DEFINITION

A cabinet drawing is one showing three views of the object not as they appear but as they are.

One face of the drawing is the same as it would be in a working drawing, or as nearly so as possible.

The lines forming right angles with the vertical lines in the object are drawn at 45 degrees to the horizontal instead of 30 degrees as in the isometric, measuring 1/2 the depth only, for their length.

HOW TO DRAW

Lay out the plate as you did Plates 8 and 9.

Locate point *A*, Fig. 1, which is on the line 7/16" above the center line and 3 5/16" to the left of the vertical center line.

Fig. 2 is placed in the opposite direction to the drawing in Fig. 1, and is easily drawn after locating the beginning point *A*.

The dimensions not appearing on the drawing are the same as similar dimensions in Fig. 1.

Note that in Figs. 1, 2, and 4 all hidden lines of the object are shown as dash and space lines.

These lines must be drawn.

Figs. 3 and 4 are cabinet drawings, and should be located in the space in which they are to be drawn so that they will appear well, beginning with the front view.

Remember that the 3" distance back, or the depth, is to be 1 1/2", which is 1/2 the actual depth, but the dimension 3" is to appear on the face, the lines being 45° to the horizontal.

Ink the plate, leaving out all construction lines.

Dimensions belonging to the object must be inked, all others omitted.

Trace and blue print.

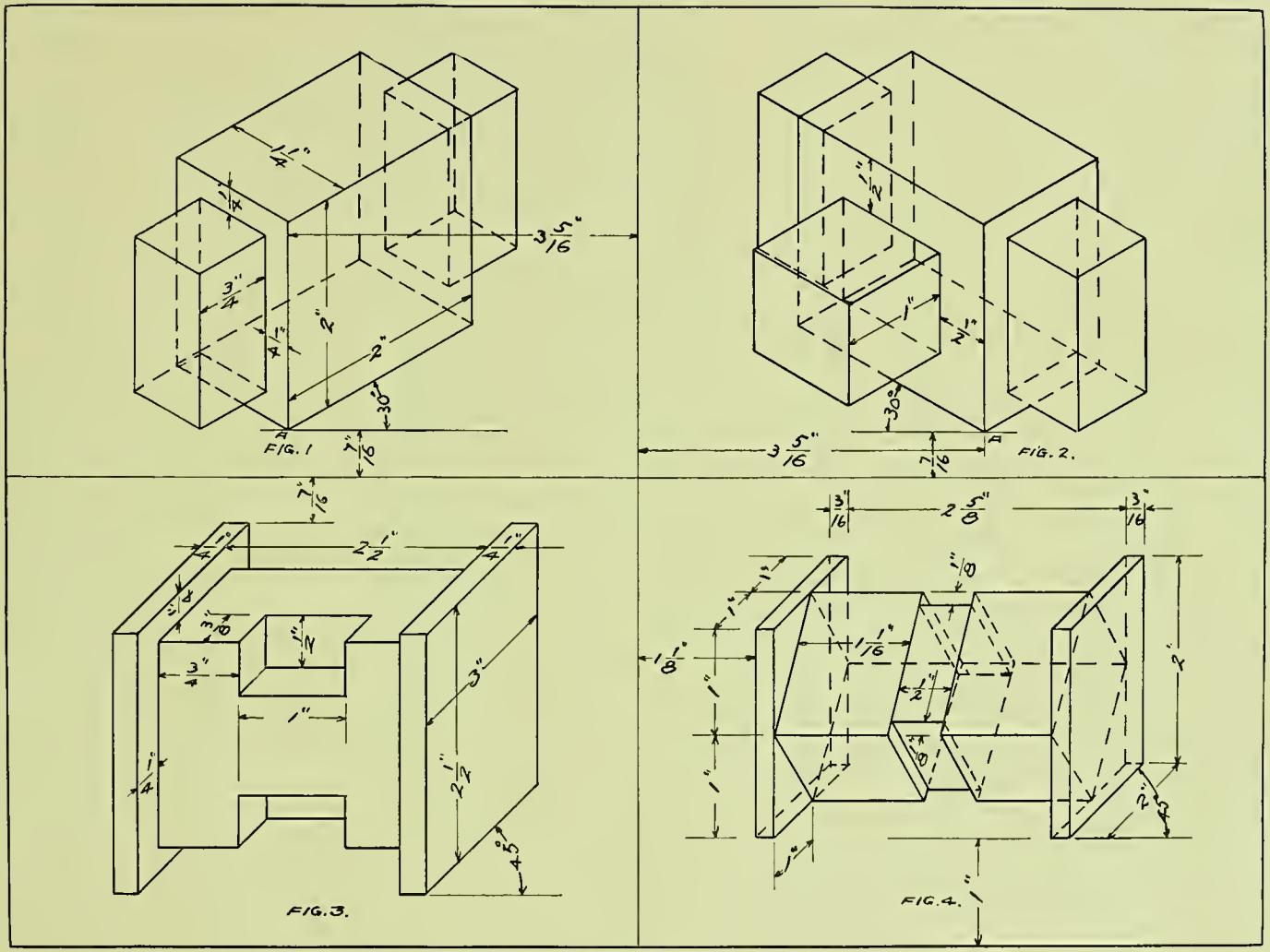


PLATE 10

PLATE 11 — WORKING DRAWINGS

HOW TO DRAW

The drawings on this plate are to be made 1/2 size or on the scale of 1/2" equals 1".

SUGGESTED QUESTIONS FOR DISCUSSION

1. What is a working drawing?
2. Why is it necessary to show three views of an object?
3. Can you picture in your mind these objects by looking at two views? Why?
4. What is meant by drawing to scale?
5. In Fig. 1, 3 1/2" is the length. If you measure this length it is less. Why?
6. Which is the top view? the front view? the end view? Could the top view be the front, or the end view the top? Why?
7. Are lines *AB* and *CD* the same? Why?
8. Figs. 3 and 4 show hidden parts. Why are there none shown in Figs. 1 and 2?
9. How would you build the articles, using wood?

Work out the drawings on the plate.

The plate should look well in every detail.

Do not ink reference letters.

Trace and blue print.

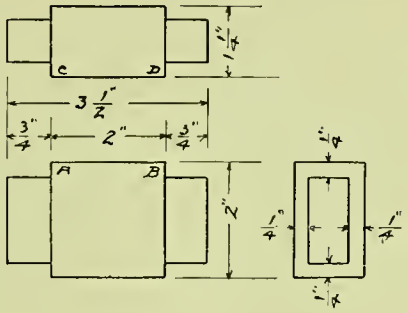


FIG. 1.

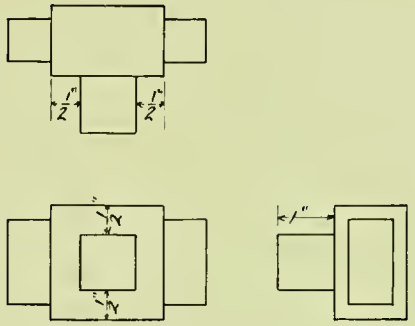


FIG. 2

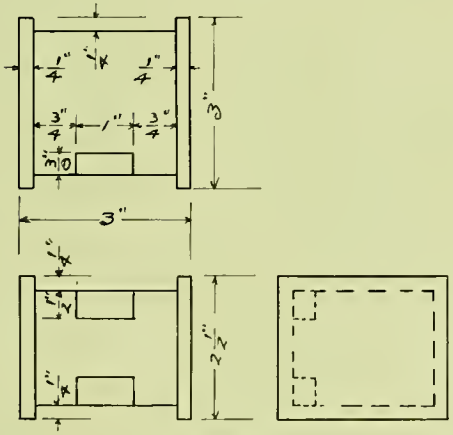


FIG. 3.

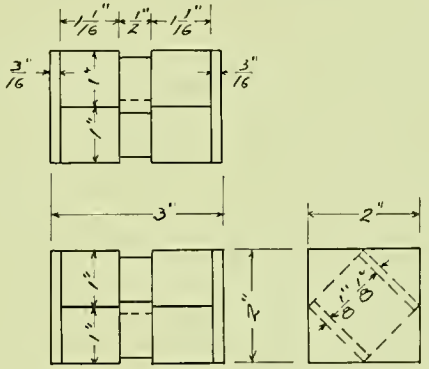


FIG. 4.

PLATE 11

PLATE 12—BLOCK AND JOINTS

HOW TO DRAW

The drawings on this plate represent practical articles to be built in the shop.

They have been carefully selected and drawn, both for the drawing and as exercises for the wood shop.

The ends of visible pieces in the joints have been hatched or lines drawn free-hand to represent the annual rings, and checks in the wood, thus giving the drawings somewhat the appearance of a picture.

Pencil and ink the plate, following previous instructions.

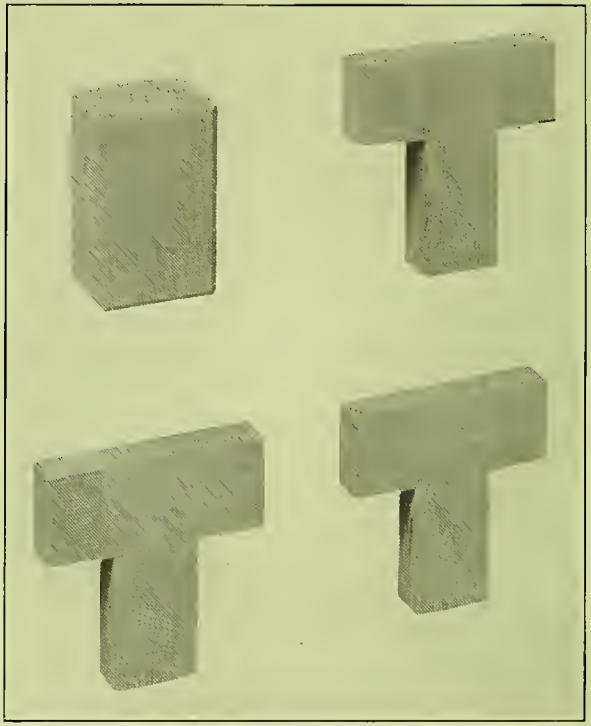
See to it that the plate looks well—even better than the other plates drawn.

Print the name of each object in the upper left-hand corner of the space in which it is drawn.

Show all necessary dimensions on each drawing.

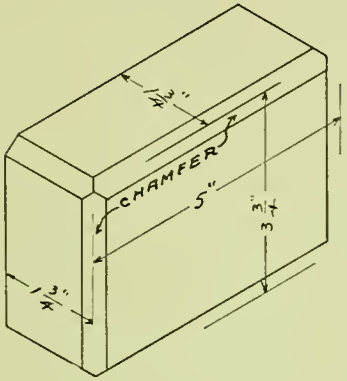
The dimensions not shown are the same as those on similar parts of the other problems on the plate.

Trace and blue print.

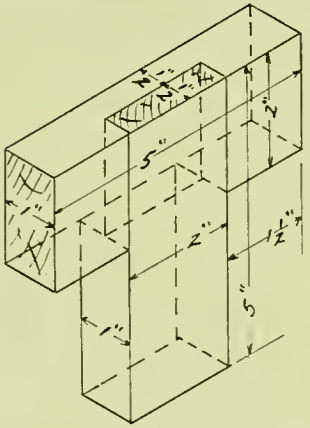


BLOCK AND JOINTS

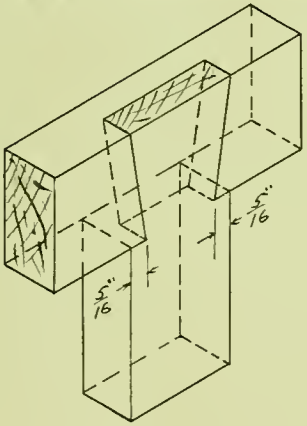
BLOCK



HALF LAP JOINT



HALF LAP DOVETAIL JOINT.



SLIP MORTISE AND TENON JOINT

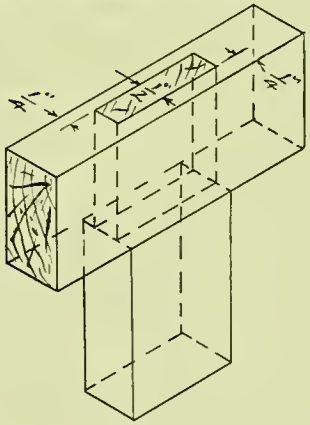


PLATE 12

PLATE 13 — WORKING DRAWINGS

HOW TO DRAW

These drawings are shop or working drawings of the projects on Plate 12.

Note that they are placed on different parts of the plate.

Block in the lower right corner.

Half lap joint in the upper left corner.

Dovetail joint in the upper right corner.

Mortise and tenon joint in the lower left corner.

The end view of each joint shows a sectional view through the object on line *AB*.

Each piece is hatched, showing its position in the joint.

Hatching consists of 45-degree lines spaced 1/16" apart.

Each piece is hatched in the opposite direction.

The pupil should find but little trouble, if any, in figuring out where to place each view of the object.

The drawings are to be made 1/2 size.

State this another way. What does it mean?

The plate is to be traced carefully after completing all the pencil work.

Ink all dimensions, hatching, and line *AB*.

The name of each object is to be printed in the upper right corner.

Clean the tracing and trim.

The tracing is to be used in making the blue print, which is to be sent into the shop as a working drawing from which the objects are to be built.

HOW TO BUILD

Make the block first.

Stock. Select a clear piece of pine or poplar, 2" × 4" × 5 1/2".

"Clear" means free from knots, checks, etc.

Plane one face straight, using the try-square with which to test the surface. Mark this planed surface X.

Square one edge to the surface or face X, and mark it XX.

Square one end to face X and edge XX.

Now measure the length and cut a line around the block with a sharp knife, the first line to pass through the point indicating the 5" length.

The lines must meet on all the long edges.

Do not use a lead pencil.

Plane this end down to the knife lines just drawn.

If there is more than 1/8" of stock, saw it off with the back saw to within about 1/16" of the knife lines, and then plane down to the lines.

Test the end with the square.

Do not stop work on the end until it is square.

Now measure and lay off the width, using the marking gauge, and gauging from face XX, passing the line around the block with the grain of the wood.

Plane off this extra material and test for squareness.

Be careful not to plane below the gauge line.

Measure the thickness and gauge a line around the block with the grain, gauging from face X.

Plane the stock off down to the gauge line, keeping the face square with the other faces of the block.

Hand your work to the teacher for his O.K. before taking up the different steps in squaring the block.

The 1/4" chamfers around the top and end edges are to be laid out with a sharp lead pencil.

The pencil lines will be on the top surface as well as on the sides and ends.

Do not use the marking gauge in laying out a chamfer.

The gauge will cut into the wood and after the stock has been planed off the lines will be visible unless you plane more than 1/4" away.

Sandpaper is not to be used.

There are several methods of squaring the ends of a piece of wood.

1. Chamfer the back edge.
2. Place a block behind the work.
3. Plane toward the center of the end from each side.

The last method is perhaps the best, although one will find the other two methods in everyday use in a large percentage of the school shops.

HALF LAP JOINT

Stock. 1 piece white pine or poplar 1 1/4" × 2 1/4" × 10 1/2".

Measure and square the block to thickness and width.

The ends are to be squared.

Do not measure off any length.

Do not saw the block in two pieces.

In planing the ends, do not get the length less than 10 1/4".

Pencil a center line around the center of the length of the block, using the square as a guide for the pencil.

Now measure from each squared end toward the center of the block 5" and make a knife cut.

Through these knife cuts, cut lines with a sharp knife, cutting across and around the block, using the try-square as a guide for the knife.

Hold the try-square straight in order to have the knife cuts true.

Do not use a lead pencil.

Saw the block in two pieces with the back saw, sawing on the lead pencil center line.

Hold the saw securely with one hand and do not press down hard or the lower edges of the block will split off as the saw passes through.

Plane the two sawed ends to the knife lines.

Test with the square.

The two blocks should be square and the joint laid out as follows:

Place a knife cut on the center of one long edge of block *C*, and on the center of one of the width edges of block *D*. Do not use a pencil.

Place *C* and *D* so that the two knife cuts meet and the edge face on *C* and the end face on *D* are even and lie in the same plane.

Hold the blocks tightly in this position and make knife cuts into *C* where the lower edges of *D* rest on *C*.

Take block *D* off and cut lines through these cuts on block *C*, cutting across the grain the full width of the face, across the edge 1/2 the thickness only.

Turn the block around and cut from the other ends of the lines 1/2 the thickness of the other edge.

Connect these lines on both edges with lines drawn with the marking gauge.

Using the back saw, saw 1/16" away toward the center from the face lines on block *C*, down to, but not beyond, the gauge lines on the edges.

Saw several times between the two saw kerfs.

Now chisel this material out to the gauge lines from both sides and back to the knife lines.

Do not cut below or back of the lines.

Sandpaper and wood files are not to be used.

Have the chisels sharp and do the work well.

Be sure you are right and then go ahead; if you are in doubt, consult your teacher.

The other piece, *D*, is to be halved out to fit snugly in *C* on an open tenon.

Lay out the tenon in the same manner, *D* fitting into *C*, 1/2 its thickness.

Fit the pieces together, getting the edge and end even.

Turn the blocks over and place a knife cut on *D* where the lower edge of *C* rests on *D*.

Cut a knife line through this cut and half way down each edge.

From the end of one of the lines on the edge,

HALF LAP JOINT

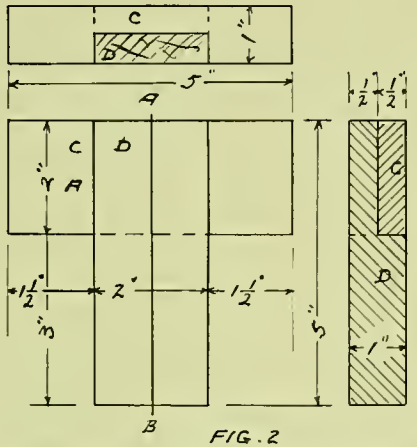


FIG. 2

HALF LAP DOVE TAIL JOINT

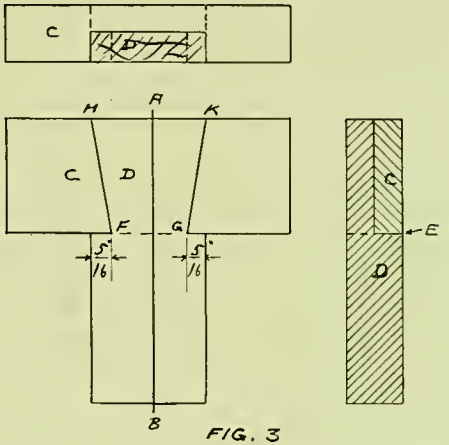


FIG. 3

SLIP MORTISE AND TENON JOINT

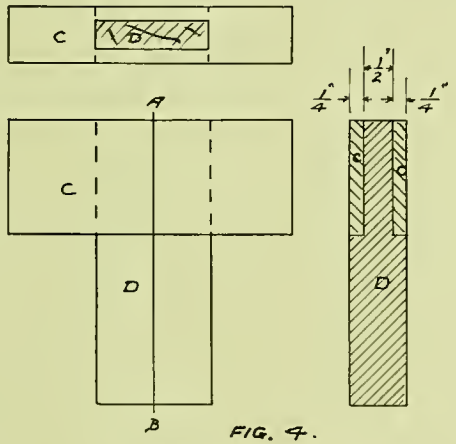


FIG. 4.

BLOCK

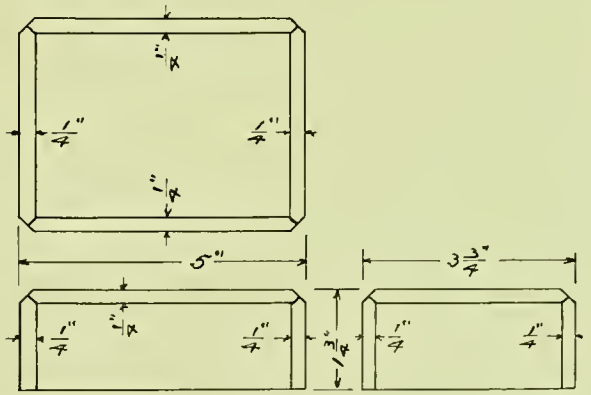


FIG. 1.

PLATE 13

gauge a line toward the near end, across the end, and down the other edge to meet the end of the edge line.

Now take the back saw and saw down with the grain to the lines cut on the edges of *D*.

Saw across the face of *D* to within 1/16" of the line.

Chisel the extra stock out with a sharp chisel.

Fit the blocks together and plane top edge and the two faces smooth.

Hold the pieces together in the vise.

Do not use a file or sandpaper.

HALF LAP DOVETAIL JOINT

The stock is the same as was used in making the half lap joint.

Measure and square the block as you did for the half lap joint.

Saw in two pieces, and square the ends.

The tenon on *D* is to be made first and it is laid out, and stock worked out, the same as though you were making a half lap joint.

Cut the line representing the shoulder of the tenon *E*, end view, across both edges on *D*.

Measure back on the opposite face of *D*, 5/16" from each edge, and place a cut with the knife at *F* and *G*.

From *F* and *G* lines are to be cut to the corners or edges *H* and *K* on *D*.

Saw these 5/16" lines, allowing for chiseling, and chisel from *H* and *K* toward *F* and *G*.

Cut the shoulders to the knife lines on both sides.

This joint is a little harder to make than the half lap, but if the tenon is carefully laid out and the stock pared out with a sharp chisel there is no reason why it should not be correct.

The open mortise on *C* is laid out by placing the tenon of *D* on *C*, getting the centers of each piece even, and cutting light lines *HF* and *KG* on *C*, holding the two pieces tightly together so they will not slip.

The lines may be drawn by using the T bevel.

Work out the mortise in *C* to the depth of the tenon on *D*.

Finish with the plane as was done in finishing the half lap joint.

Do not use a file or sandpaper.

SLIP MORTISE AND TENON JOINT

After squaring up the block, which is the same as was used in making the other joints, make the tenon first.

Cut a knife line 2" down around *D* and across the grain.

Take the marking gauge and gauge a line 1/4", gauging from the line just cut, on the edge of *D* up and across the end and down the other edge to meet the first line.

Gauge from both faces or, if the block is a little off, gauge from one face, setting the gauge 3/4" for the second line.

After sawing, cut out the 1/4" pieces with the chisel.

Lay out the mortise on both edges of *C* with the gauge and knife, having one-half on either side of the center line.

The stock is to be cut out with a 1/4" bit boring from both edges.

Trim the sides and ends of the open mortise with the chisel, working from both edges toward the center.

Care should be taken, when placing the work in the vise, not to screw the jaws of the vise too tightly, or they will cut into the wood and thus give a bad appearance to the finished work.

Smooth off the finished joint with the plane.

The tenon should fit snugly but not too tightly, and it should be pushed into place with the hand.

Do not use a file or sandpaper.

Find out some of the uses made of these joints.

Discuss the good and bad features for each use suggested.

Discuss methods of fastening joints together, etc.

There is really more than one joint in the articles: for instance, in the half lap there are eight joints; find them.

PLATE 14—CANED TOP STOOL

HOW TO DRAW

There is a vast amount of training obtained by laying out a plate, figuring from the dimensions of the object where the different views are to be placed with reference to the border lines, space between the views, etc.

But many times it is not practical and it is a waste of time to draw the border line first.

It is practical and in everyday use to make drawings giving one view the proper space from the other, and drawing the border lines after the drawings have been completed.

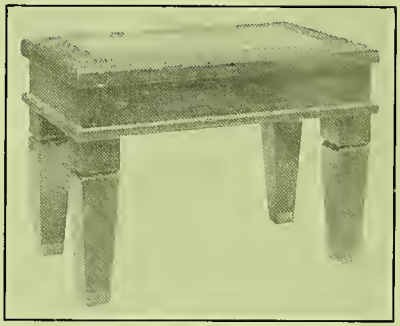
This method may add a little to the cost of material, but time is of more value than the added cost of paper.

Place the drawings so that they will appear well on the paper, beginning with the front view, next the end view, and then the top view.

It is not always practical to begin with the front view. Sometimes the draftsman finds it necessary to draw two or more views at once.

The pupil must learn by practice when he should not begin with the front view.

Note that each view shows the outside as well as the inside construction, which is practical,



BOY'S WORK

economical, and does away with extra sketches to show details.

In some drawings, however, it is necessary to make extra detail drawings.

The legs are square with small 1/8" V-groove chisel exercises.

Scale 1/4 size. Print the scale on the drawing.

The new feature in the drawing is that the two parts of each view show outside as well as inside finish or construction, hatching, etc.

Drawings showing parts such as caning, screws, nails, etc., whose dimensions would be too small to draw on reduced drawings to scale, are merely drawn to show their position with reference to the finished work, giving but little attention to actual size.

The pupil should train himself, however, to know something of the actual sizes of these details, and should be able to estimate approximately their proportional sizes when drawing them on the plate.

Pieces that are cut to show sections are usually hatched as shown at X on the front and end views.

The uncovered ends of the legs in the top view are also hatched.

This plate and all the plates that follow require a stock bill.

No working drawing is really complete without some sort of a stock bill worked out.

It is necessary because it saves the workman's time, prevents mistakes, and reduces the cost by avoiding waste.

A stock bill should include all materials necessary for the finished product, allowing in each item for waste in working to size, etc.

STOCK BILL FOR PLATE 14

4 pieces K.D. White Oak, 1 3/4" × 1 3/4" × 8 1/2" for legs.

2 pieces 1" × 2 1/4" × 10 1/2" K.D., Q.S., W.O., S2S for the side rails.

2 pieces 1" × 2 1/4" × 6 1/2" K.D., Q.S., W.O., S2S, for end rails.

2 pieces 1" × 2 1/2" × 5 1/2" K.D., Q.S., W.O., S2S, for end of top frame.

2 pieces 1" × 2 1/4" × 12 1/2" K.D., Q.S., W.O., S2S, for sides of top frame.

1 piece 1/4" × 1/4" × 50" W.O., for strips around stool.

9 Strands Fine Fine Cane Peel for caning top of stool.

8 No. 12 Flat-head Wood Screws 1 1/2" long, to fasten top to frame of stool.

Stain, Filler, Shellac, Varnish.

The plate is to be traced and blue printed.

The stock bill should be printed on the plate if there is room, otherwise a separate sheet will be necessary.

Print the scale at the end of the stock bill.

HOW TO BUILD

Work the four legs down with the plane to 1 1/2" square.

Lay off the 8" length with the knife and square both ends.

Locate the upper line of the V-grooves and lay the grooves out with a sharp knife, on the four legs.

Do not use a pencil.

The knife line will give the chisel a hold or place

to begin the cut. It would be hard to hold the chisel straight on a pencil line.

Take the back saw and saw a kerf straight across the face of the leg and down toward the center of the post on the center line not more than 1/16" on the four faces of each leg.

Now take a sharp chisel commencing near the saw kerf and work back to the knife line.

Do all the chiseling from one side on each face of each leg, reverse the ends and work the other side of the grooves. Do not use a hammer or mallet.

If this work is done carefully with a sharp chisel, no marks need be left on the work.

Do the work so well with the chisel that there is nothing left for the file or sandpaper to do.

The depth of the grooves should be 1/2 the distance across on a 45-degree slant.

Take the marking gauge and gauge a line 1/4" from each face on the bottom of the legs.

Draw pencil lines from the ends of a pencil line, about 1/2" below the V-grooves, to the ends of the gauge lines which you made on the bottom of the legs.

You have now laid out the taper for each leg. Now plane the taper on each leg.

Take the two pieces provided for the end rails and work them to thickness and width but not length.

Do not take time to square the ends.

Now take these two end rails and place them together so that the 7/8" edges are up and even.

Have the ends about even.

Take your knife, which must be sharp, and the try-square.

Measure about 3/4" on the upper edge and from one end.

Place the square on this 3/4" dot and cut a neat straight line across both edges. Do not use a pencil.

Measure from this knife line toward the other end of the pieces 4 1/2", and cut another line across the two pieces.

Now from the ends of the two lines just cut, lines should be cut and continue around the blocks or pieces. Be sure that the lines meet in every case.

Do not bear hard on the knife; press lightly and cut more than once in the same place, if necessary.

Next lay out the width of the tenon.

A tenon is the projecting part of a piece of wood left after paring away a portion, which is to be inserted into another piece.

Gauge a line 1/4" on each end of each piece, gauging with the wide face.

Set the gauge to 5/8", and gauge another line parallel to each of the lines just gauged, starting from

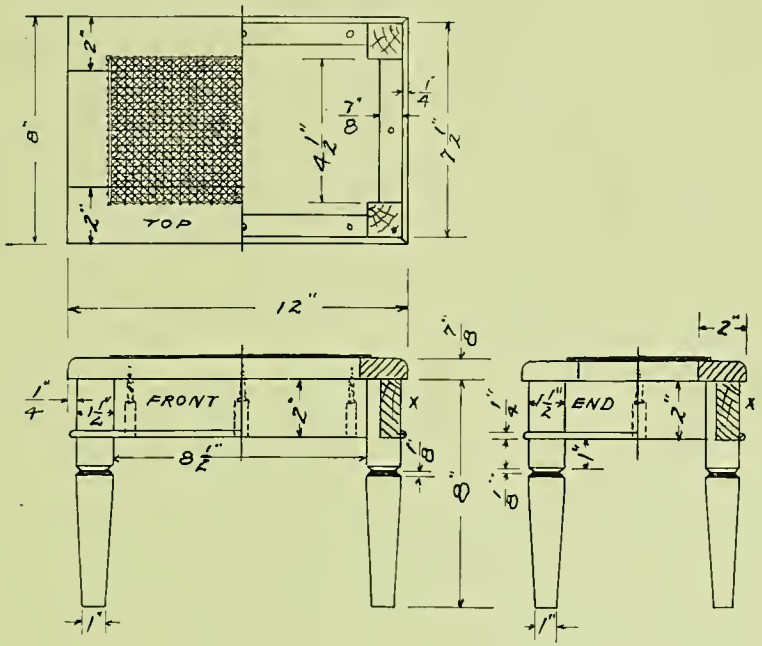


PLATE 14— CANED TOP STOOL

the same face in each case. This will keep the lines parallel in case the pieces have not been properly squared.

Take the back saw and saw down and in from the faces, allowing a little less than 1/16" for chiseling across the grain.

Allow nothing to be chiseled with the grain.

Do not use a file or sandpaper in working out the tenons.

Smooth the shoulder of the tenons, or the part where you sawed across the grain, with a sharp chisel.

Sandpaper or a file is not to be used.

After selecting the edge of each piece that you expect to have at the top, saw out about 1/4" on each end of the upper edges of the tenons and smooth square with the shoulders of each tenon. This will prevent having holes in the tops of the legs, thereby weakening them.

These two end pieces are now ready to frame or mortise into the posts.

A mortise is a hole or cavity cut into a piece of wood to receive a tenon.

LAYING OUT THE MORTISE

Mark out with the marking gauge lines 1/4" and 5/8" respectively from one face of each leg, beginning at the top end and the same length, 2".

Connect the lower ends with a knife line, using the square as a guide for the knife.

Connect the lines at the top 1/4" below the top of the posts.

Be careful to mark the lines so that by laying the two legs together the mortises that you have laid out will coincide.

Take a No. 4 bit and bore out the wood inside the four lines about 3/4" or 1" deep.

Smooth the ends and sides of the mortise with a sharp chisel.

Fit the tenon into the mortise.

The tenon should not fit too tightly, neither should it be loosely fitted into the leg.

Work out the mortise in the other leg and fit the two legs on the tenons.

Place a hand screw on the work and see whether or not the shoulders fit snugly against each leg. If they do, put glue on the tenons and in the mortises, clamp up and set aside until the next day.

Be careful not to use too much glue.

Work the other end piece and the two legs in the same manner.

The next day after gluing up the ends, take the hand screws off and plane up the outside faces of each, being careful how they are handled for fear the glued

joints will be broken loose or the pieces bruised from the vise.

The outside face of the rail and the corresponding faces of the posts must be even and form parts of the same plane or surface.

Next lay out and make the tenons on the side rails.

Lay out the mortises on the posts, being careful to get them on the correct sides.

Handle the work with care or the glued joints will work loose.

Fit the side rails into place and clamp the parts of the stool together.

If they fit well and all corners are right angles, take the clamps off and clean the pieces with the plane, scraper, and sandpaper.

The frame is now ready to be glued.

Remember that too much glue is worse than no glue.

Glue and clamp the frame together, leaving the clamps on over night.

Lay out and make the frame for the top, which is built in every respect as you built the framework of the stool.

Glue the frame up and place a handscrew on each end.

Place the frame and handscrews on the stool and clamp to the stool. This will keep the frame straight while the glue is setting.

Leave the work in the clamps over night.

Take the clamps off the work and plane the bottom side of the frame smooth.

Locate and bore the screw holes in the rails.

Use a No. 8 bit and bore in far enough to let the head of the screw into the rail so the other end will project through about 1/2", finishing the hole with a No. 4 bit.

Remember the large hole is bored first, that it does not go through the rail, and that it is on the under side.

These holes could be bored before assembling, but the legs are short and will permit the brace to be turned without using a ratchet.

Soap placed on wood screws enables one to drive them with ease.

Soap your screws and fasten the top to the base.

If the top does not fit as it should, take it off and plane the high places off so that it will.

Do not use a file.

You may plane up the top and round off its corners and edges while it is fastened on the stool, or you may take it off and do the planing.

If you smooth it off while fastened to the stool, you run less risk of breaking its glued joints.

Saw the long 1/4" strip the correct lengths to fit the ends and sides.

The corners are to be mitered.

Glue and nail them on with small wire brads.

Measure back 3/8" from the inside edges of the top frame and gauge a pencil line parallel to the inside edges, thus making a line for the centers of the cane holes.

Drill the holes with a 3/16" drill or bit spaced 1/2".

If the line of centers is exactly a certain number of 1/2 inches long, there is no trouble in spacing the holes.

There must be a hole in each corner where the lines intersect.

If the lines of centers do not measure an exact number of 1/2 inches on a side, the second hole at each end must be 1/2 the excess and the other holes will then space equally 1/2".

Mark out the two sides and the two ends for the holes in the same manner.

The holes must be opposite and the same number on opposite parallel sides, but there need not be the same number on all four sides.

Sandpaper and scrape the stool, leaving the top frame on.

Sponge the work with water, and sand it down after it dries.

The water raises the grain of the wood and therefore it is necessary to treat the wood in this way before a water stain is used.

If the work is not finished carefully all bruises, plane marks, scratches, etc. will show dark after the wood is stained and filled.

The stool is now ready to be filled.

Use a filler stained the same color as that chosen for the stool.

Put sufficient filler on to cover the wood, brushing it across the grain.

When the filler begins to dry, rub it off with fine shavings or a soft cloth, rubbing across the grain.

Clean out all corners and V-grooves with a sharp, pointed, soft wood stick.

Set the stool away until the next day to allow the filler to set or dry.

Sandpaper the stool to even up the filler and to work out any scratches or blemishes you may notice.

If by sandpapering you have lightened the color, stain the work with stain the same color as the filler, wiping it off as it is brushed on with a soft cloth or a bit of waste.

Now give the stool an even coat of thin white shellac and set away over night to allow the shellac to set.

CANED TOP STOOL

Rub the stool with a piece of fine sandpaper, using a little oil on the paper.

Do not use a block.

The stool is now ready to be caned.

Take the frame off the stool and do the caning according to the instructions on caning, page 123.

After the top has been caned, fasten the frame back on the stool.

Do not use glue.

Give the stool and caning a thin coat of white shellac.

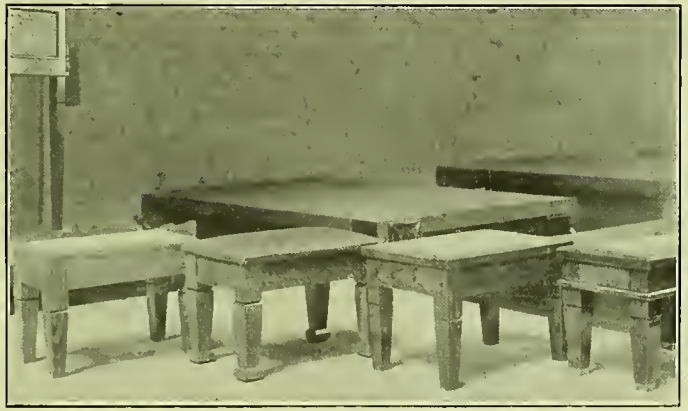
The next day rub with very fine sandpaper and oil.

Now give the stool a coat of quick-drying varnish.

Remember the caning must be varnished too, on both sides.

This is to be sanded after drying 24 hours, and a second, heavier coat of varnish applied.

The stool should look well and not cost more than 25 or 30 cents.



BOY'S WORK

PLATE 15—WASTE PAPER BOXES

HOW TO DRAW

No. 1. Lay the plate out for two drawings, dividing the 9" × 12" space into two spaces 6" × 9", the long way of the division line to be in the direction of the nine-inch length.

Scale 1/4 size.

The front view shows the side construction and method of fastening the bottom into the side panels.

The top view does not show a section. Why?

Why is there no end view?

Locate the center line and work to the right and left of it.

The design in the sides of the box and the shape of the top and bottom have been left for the pupil to work out.

No. 2. Begin to draw from a center line as in No. 1. Scale 1/4 size.

Why is it necessary to show a section of the top view as well as of the front view?

The pupil should have no trouble in drawing this plate.

Make out a stock bill for each drawing.

A and B No. 2 are metal caster rings.

Trace and blue print.

HOW TO BUILD

No. 1. Get out the four posts 1" square and 15 1/2" long, well finished.

Plane the four sides, lay out the shape at the top and bottom, mark out the designs for the holes at the top, and saw out on the band and turning saws.

Saw a 1/4" × 1/4" dado 3/4" above the lower ends of each side, and chisel out to receive the bottom.

The sides are doweled to the posts with four 1/4" dowels.

Dowel one side to two posts.

Fit and dowel the other two posts to one side.

Set the two glued sides away to dry over night.

Fasten the remaining two sides to the two pieces already glued, and fit the bottom in place, notching it to fit the corners of posts.

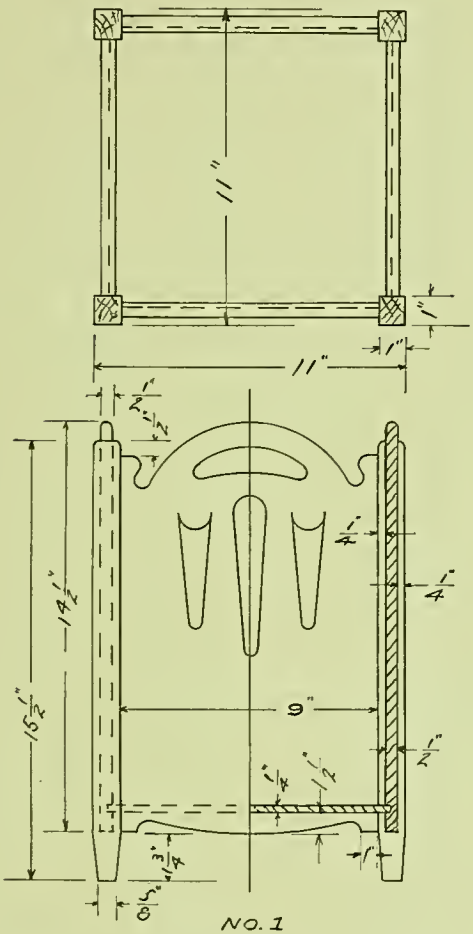
If the parts fit, take them apart and glue them.

The bottom must not be too tight.

Care should be taken in clamping, or the box will twist.

Take the clamps off the next day and clean your work with the plane, scraper, and sandpaper.

Handle the box with care or the joints will come loose.



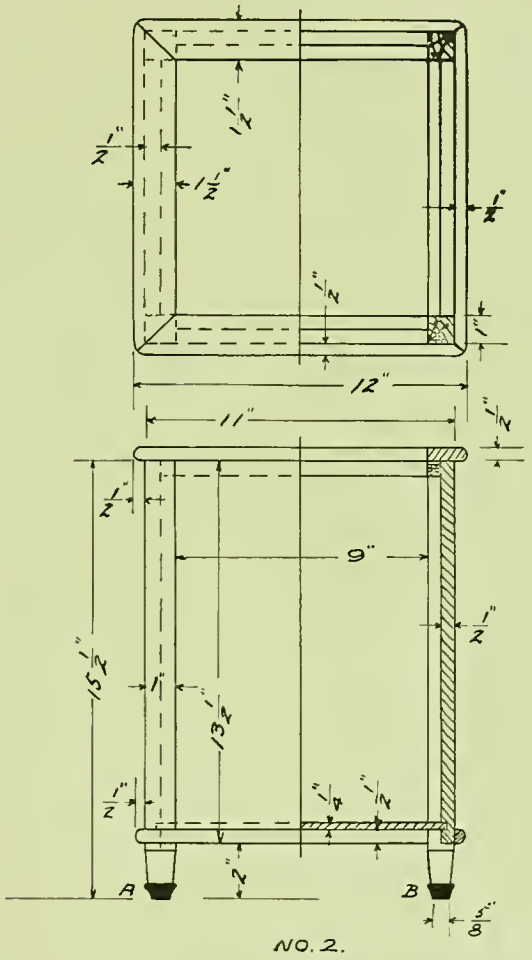


PLATE 15— WASTE PAPER BOXES

If built of oak, finish in every detail as per directions for Plate 14.

If built of soft wood, stain, shellac, and varnish.

No. 2. Get out the four posts and work to size, 1" × 1" × 15 1/2".

The sides are plain and doweled to the posts as in No. 1.

The bottom is set into the sides 1/4" and 1/2" above the lower ends.

A 1/2" × 1/2" soft wood strip should be glued around the inside at the top ends of the sides before gluing to the posts. Why?

After working the side pieces down to size, 9" × 13 1/2", sawing the dado for the bottom, and gluing the strip to the top, dowel and glue up the same as was done in No. 1.

The 1/2" × 1/2" strip around the outside at the bottom is mitered at the corners, and rounded slightly on both outside edges and the corners.

Glue the strip on and nail with small wire brads.

The 1/2" × 1 1/2" pieces for the frame on the top are also mitered, glued, and nailed to the top of sides and posts. Be sure to have the top of the box squared up properly before fastening on the frame.

Round off the outside edges and corners.

Clean the box with the plane, scraper, and sandpaper.

If hard wood is used, stain, fill, shellac, and varnish.

If soft stock is used, stain, shellac, and varnish.

Fit the bottom of posts with caster rings.

PLATE 16—PLANT STANDS

HOW TO DRAW

Scale 1/8 size.

Divide the paper the same as you did for Plate 15.

Locate a center line and work to the right and left of it.

The pupil should be able to complete both drawings with but little aid from the teacher.

The stock bill must be made out for both articles.

The caning for the articles should be 12" wide, unless it is to be hand woven.

Dimensions on both objects are about the same.

Trace and blue print.

HOW TO BUILD

No. 1. Work out the posts to size and length.

Lay out the V-grooves and chisel out as per directions for caned top stool.

Taper the posts to 1" at the bottom from a point 2" below the V-grooves.

Get out the four top and the four bottom rails, allowing for 3/4" tenons, and carefully work them to thickness and width. Do not square the ends.

Lay out the tenons on the top and bottom rails with a sharp knife, each set clamped together.

The lines must be cut around all the pieces and on both ends.

BOYS' AND TEACHER'S WORK

Work out the tenons to size.

Cut out 1/4" of the tenons on both ends of the

upper edges of the top rails as was done in working out the tenons for the stool.

Lay out the mortises in the posts, fit the tenons into place, and glue up.

Be sure that the work is square.

Make four frames out of 7/8" soft wood to fit the 6 1/2" × 11" opening on each side.

The frames are to be 1" wide with a 1/4" × 1/4" rabbet cut out of the outside edge.

The rails and posts form one side, thus making the rabbet a groove which is to receive the caning.

The frames may be mitered, tenoned, or put together on half-lap joints.

They should fit tight in the opening.

Stain, glue, and nail the frames in place.

The front faces of the frames are to be even with the outside faces of the posts.

Get out and fasten in the strips inside at the bottom.

The bottom could be made 15" × 15", notching the corners to fit the posts, and fastening to the lower rails with screws.

Smooth the projecting edges with the plane.

The 1/2" strips would then cover the edges, thus making the work stronger and saving time and material.

Get out the 1/2" × 2" strip for the top, miter the corners, and fasten on with glue and wire brads.

Set the nails in with a nail set and fill the holes with the same kind of wood and glue.

Clean the work with the plane, scraper, and sandpaper. Fill and sand down after filler has set.

If the color has been changed, stain and give the work a coat of thin white shellac.

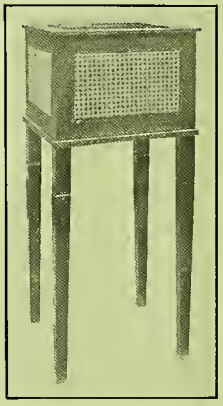
The caning is to be done next. (See page 123.)

When the caning is finished sand the work down a little and apply another coat of shellac.

Give the work two coats of varnish.

Fit the posts with small casters and caster rings to match.

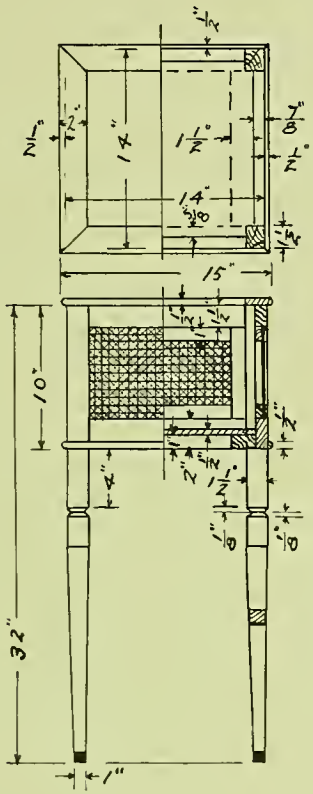
No. 2. *Stock:* Soft wood with white enamel finish.



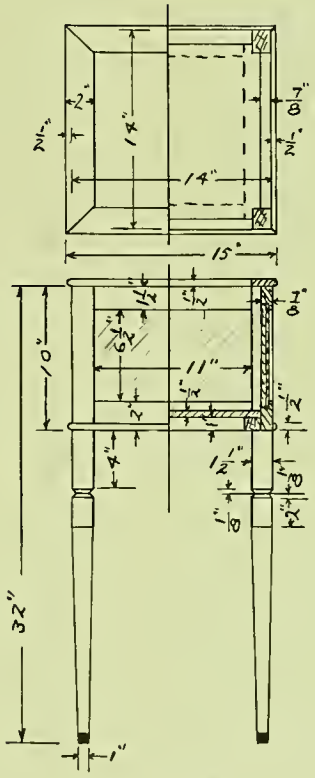
BOY'S WORK

Same construction as No. 1, except rails and posts must be rabbeted on inside to receive the glass panels.

The back of the glass is to be painted the desired color and a 1/4" piece of wood fitted against it to protect the inside. If caning or glass is not desired, fit into the opening narrow slats.



NO. 1.



NO. 2.

PLATE 16— PLANT STANDS

PLATE 17 — TABOURETS

HOW TO DRAW

BOY'S WORK

Scale 1/8 size.

The drawing on this plate is similar to that on Plate 16.

The two added features are the solid tops and the ornament on the bottom rail of No. 1.

No. 2 has three 1/2" strips, two around the bottom rail and one around the lower edge of the top rail.

The top projects 1/2".

Aside from this, the drawing is the same as No. 1.

Print the names and work out stock bills.

Trace and blue print.

HOW TO BUILD

No. 1. Get out the four legs to size, chisel the V-grooves, taper to 1" at the bottom.

Get out the top and bottom rails, allowing 3/4" for tenons.

Lay out and make the tenons on the rails.

Mark the posts for the mortises, work out, and fit the tenons into place.

Glue the two sides first, allow the glue to set.

Fit and glue the other rails into place.

Be sure that you get the work square and that it does not become twisted.

Make, stain, and fit the cane frames into place.

Fasten these frames with glue and nails.

Fasten the 1" × 1" soft wood strips around the inside at the top, through which screws should be driven to hold the top down against the rails and posts.

These strips should be about 1/8" below the upper edge of the top rail. Why?

Round the top off as shown.

The ornaments fastened to the under side of the lower rails are built out of two pieces.

The upper piece *A* is screwed to the rail, the round turned end is doweled to piece *A*. These may be left off if the builder does not care to use them.

Clean the work, fill, sand down after drying, and shellac.

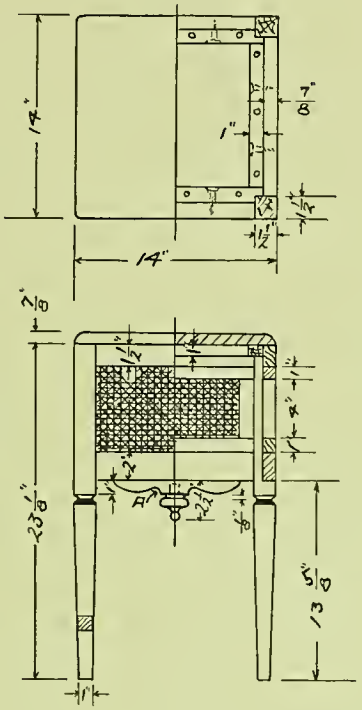
Finish with varnish and rub the top down.

No. 2. *Stock:* Soft wood.

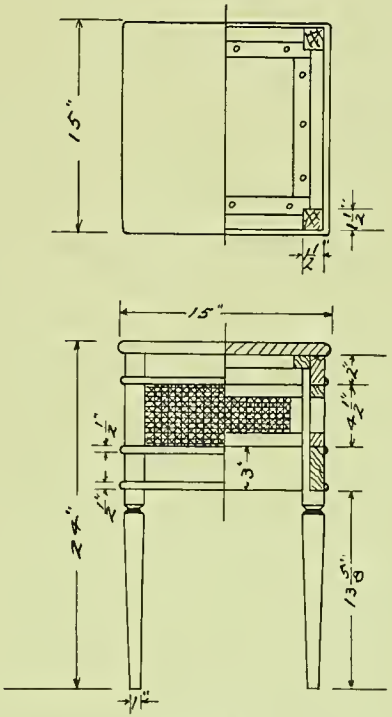
Proceed in every detail as you did with No. 1.

If cane is not desired, panels of wood or glass will look well.

To be finished in white enamel.



NO. 1.



NO. 2.

PLATE 17 — TABOURETS

PLATE 18—DRESSING TABLE BENCH

HOW TO DRAW

Why are there three views for the drawing of this problem? Would two views have been enough?

If so, which two?

What is the purpose of putting in the 1" × 1" stretchers between the end legs and under the seat?

Would the seat give good service if these stretchers were left out?

What change would be necessary to convert the bench into a piano bench?

Scale 1/8 size.

The spaces between the three views should be the same.

The spaces at each end near the border lines should be equal.

Allow a little more space at the top than at the bottom.

Print the name at the top.

Print the stock bill to the right of the top view. (Make out the stock bill on a separate sheet of paper before printing on the plate.)

The end view shows the caning as it looks from the inside.

What change would be necessary to show it as it looks from the outside?

Complete the drawing, trace, and blue print.

Do not forget the stock bill.

HOW TO BUILD

Get out the posts to length and square to 1 1/2".

Work out the V-grooves, taper the bottom to 1" and the inside of the top to 1".

Get out the two side and end rails next, allowing 3/4" for tenons on each end of each piece, work to size but do not square the ends.

Lay out the tenons on the two end rails, work them to size, and frame them into the two end posts.

The outside surface of these two rails as well as the two long rails are set in 1/4" from the outside faces of the posts.

The stretcher at the top and the one below the end seat rail must have been fitted into the posts before gluing up the ends.

If these pieces fit snugly when in place, under the pressure of the clamps, take apart and glue up.

See to it that the work is not twisted.

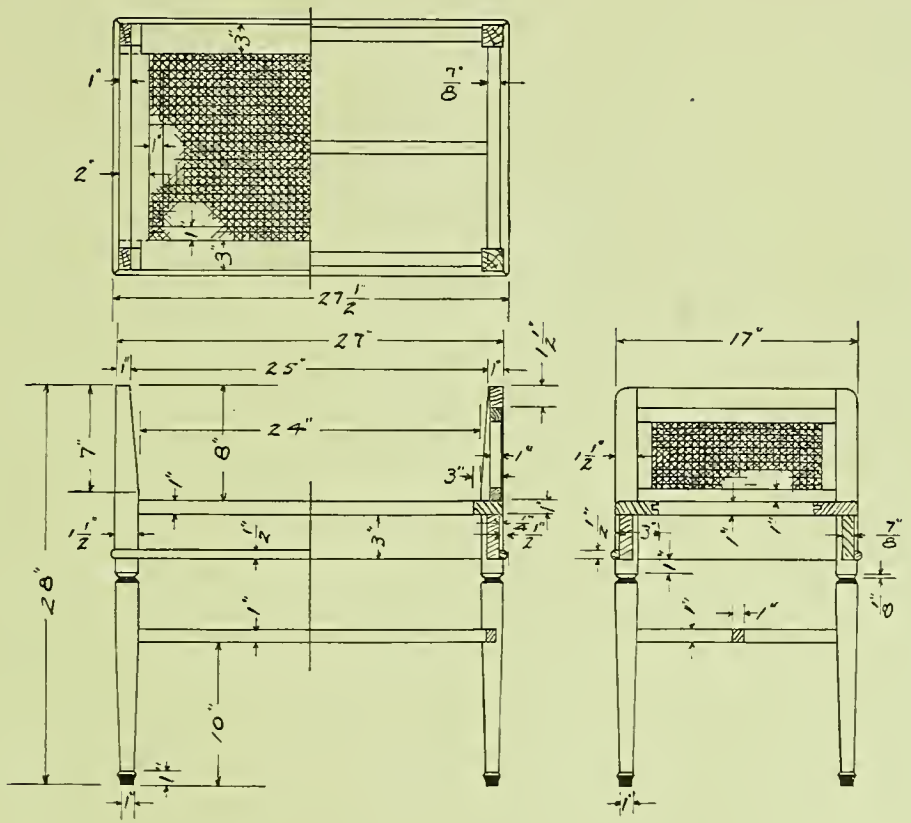


PLATE 18— DRESSING TABLE BENCH

Cut the tenons on the side rails next, and frame them into the posts.

Be careful to get the top edges even with the top edges of the end rails.

If the long stretcher is used, get it out next and frame it into the two end stretchers on a single mortise and tenon joint, the tenon to have a shoulder on the four sides.

The tenon should not pass through the end stretchers.

Next make the frame for the top.

The side pieces of this frame are tenoned into the posts, and the end pieces of the frame are tenoned into the side pieces, being notched to fit the corners of the posts.

When these parts, namely, side rails, bottom stretcher, and seat frame are ready, neatly fitted, and all parts are square when clamped up, glue the bench and clamp.

See that the bench is not twisted.

Fasten the frame to the rails by driving screws through the rails and by using glue blocks.

If screws are used, counterbore for the heads.

Next fit on the 1/2" strip.

The corners are to be mitered.

Clean the work with the plane, scraper, and sandpaper.

Fill, stain, and sandpaper after the filler sets.

Give the work a coat of thin white shellac, let it set, and sand down with fine sandpaper and oil.

Get out the frames for the caning, stain and fasten securely in place with glue and nails.

Do the caning next. (See page 123.)

After caning, give the bench another coat of thin white shellac, and after it has set sand down with fine sandpaper and oil.

Apply a coat of quick drying varnish.

After drying rub down with No. 00 sandpaper and oil.

Give another heavier coat of varnish.

Fit the posts with caster rings and small casters to match.

If the caning is not desired, make a solid top and fit slats in the ends or leave open.

PLATE 19—GATE-LEG SERVING TABLE

HOW TO DRAW

Scale 1/8 size.

Space the drawings so they will appear well on the plate. They must not look crowded.

Make out the stock bill, and print above the right end view.

Trace and blue print.

HOW TO BUILD

Get out six legs and work down to 1" square. Two are 29" long and four 27" long, with a 1" tenon on the lower ends, making them 28" long.

Get out the top and bottom rails for the ends, allowing a 5/8" tenon on each.

Work to size and make the tenons.

Work out the mortises in the legs and fit the tenons into them.

The outside faces of the rails and posts must be even.

Cut tenons on the bottom of the four short posts or legs.

Get out the shaped base next.

This base piece is 1 1/4" × 2" × 8", with a 1/2" piece sawed out on the under edge.

The upper corners are round.

Measure and cut out mortises to receive the tenons cut on the legs.

If the work has been well done and each joint fits as it should under the pressure of the clamps, take apart and glue up.

See to it that the work does not twist under the clamps.

Get out the four side rails next, allowing for 5/8" tenons on each piece.

Work the tenons to size and frame them into legs, which have already been glued to the end rails and base piece.

Get out and frame the stretcher in place at the bottom.

Clamp the framework of the table and if all the joints fit well take the pieces apart and glue up.

Test for squareness and see that the work is not twisted.

Get out the piece for the top, and also the two leaves.

The top is fastened to the rails with screws by driving the screws through the rails from the under side, slanted toward the outside.

Glue blocks may be used.

Gouge out the hole a little to receive the head of the screws.

Use No. 12, 1 1/2" flat-head wood screws.

Do not use any glue to hold the top on.

The two gates are to be made next. These require the two long legs and the two short (9") legs.

Get out the two short legs as well as the four stretchers.

Allow for the 5/8" tenons on these and frame them into the long and short legs.

The center of these stretchers must be in the center of the legs into which they are framed.

Glue and clamp.

The finished gates are hung on 1 1/2" × 1 1/2" steel butt hinges, two on each gate.

One gate swings to the right and the other to the left.

The two leaves are also hung on butt hinges.

Fasten the hinges to the under side.

When the gates are closed the leaves should drop down against the gates, thus holding them closed.

The top should be straight when opened.

Clean the table and smooth it down with the scraper and sandpaper.

Fill, stain, shellac, and varnish.

If the cane panels are used, make the cane frames next.

Stain, fasten the frames in place, and cane according to instructions for caning, page 123.

Varnish the caning.

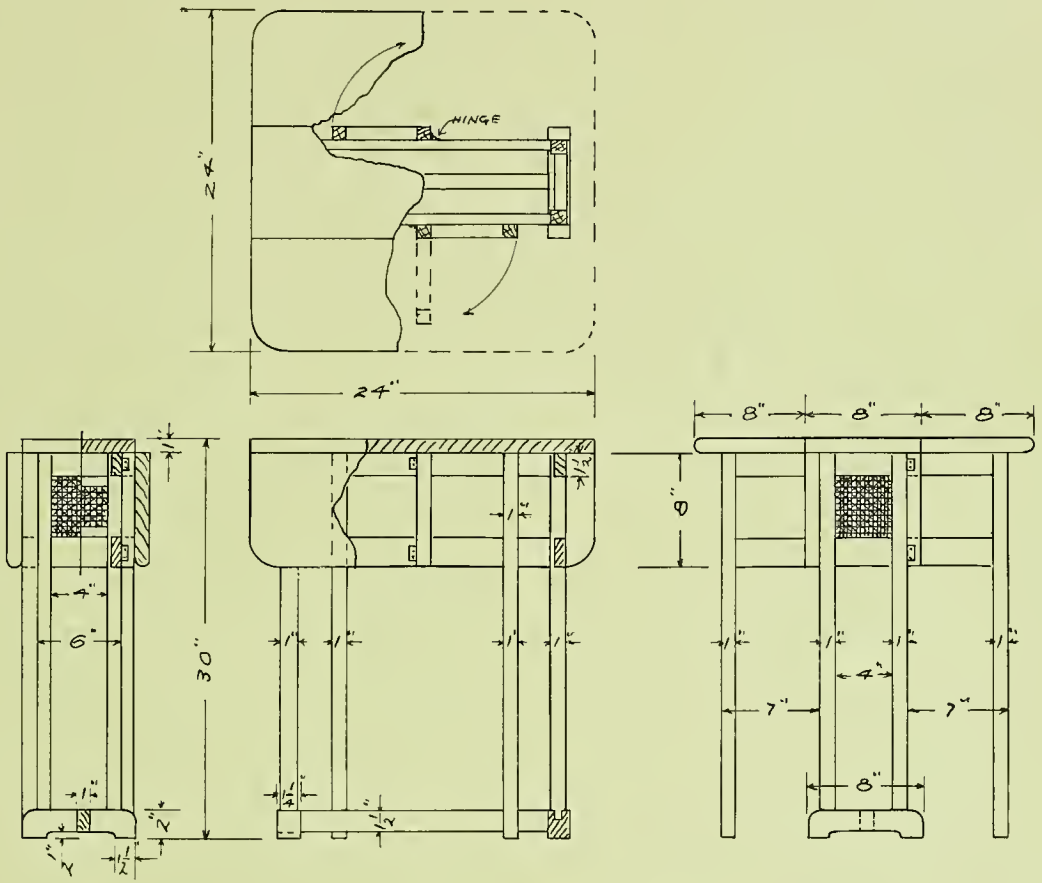


PLATE 19— GATE-LEG SERVING TABLE

PLATE 20—CLOTHES HAMPER

HOW TO DRAW

Should a clothes hamper have provision made for the free passage of air?

Why is the caning practical in this case?

Was it necessary to show four views?

Can you see the finished object by looking at the drawing?

How is the back put in?

How is the bottom fastened into place?

How is the top built and fastened to the base?

Should there be casters in the posts?

How are casters fastened to the posts?

Suppose one does not care for a clothes hamper; could the article be used for any other purpose?

What changes would be necessary?

Scale 1/8 size.

Draw the four views, work out the stock bill, and blue print.

HOW TO BUILD

Get out the four posts 1 1/2" square and 29 1/4" long, and taper to 1" at the bottom, beginning at a point 3" up the posts.

The two end upper rails and the two end lower rails are to be worked out, allowing for 3/4" tenons on each piece.

After making the tenons, lay out the mortises, work them out and fit the tenons into place.

There is a piece 3/4" × 1 1/2" × 20 1/4" plus 1 1/2" allowed for the tenons, which divides the opening into two equal spaces 5 3/4" × 20 1/4".

Make this piece next and tenon it into the top and bottom rails.

There is a good reason for having this piece in the ends. What is it?

There is a 2" strip in the front and in the back.

Why are they necessary?

Put the ends together and clamp.

If the joints fit well, take the clamps off and glue.

Be careful that the clamps do not twist the work.

Small soft wood blocks placed between the clamps and the work will protect the wood.

Get out the other end pieces and glue.

Remember that all parts are to be laid out with a sharp knife. No lead pencil is to be used.

Get out the two top and the two bottom rails next, one each for the front and back.

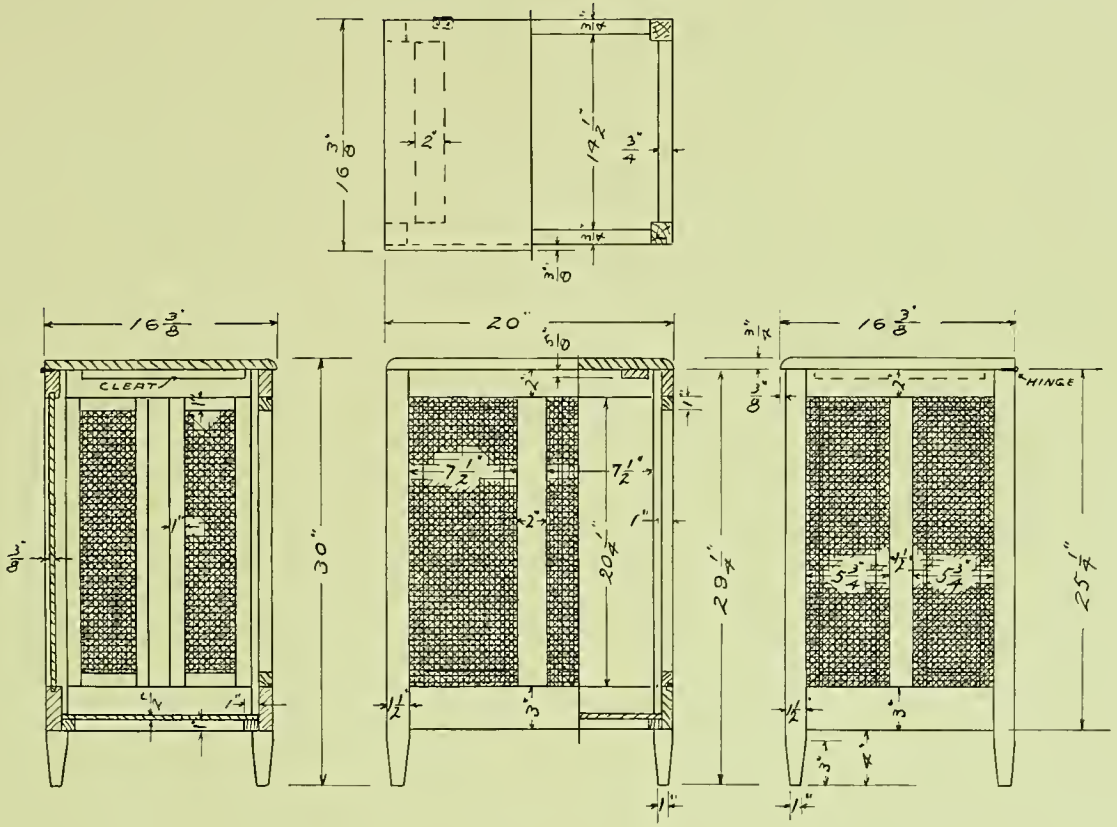


PLATE 20— CLOTHES HAMPER

Do not forget to allow for the 3/4" tenons.

All stock for the back is to be soft wood.

Work these rails to size and tenon into posts.

The outside surfaces of the rails and posts are even.

Now get out the 2" center pieces, one for the front, the other for the back.

Tenon these into the rails.

Before gluing the work, cut out 3/8" grooves in each of the back posts, in the under edge of the back upper rail, in the upper edge of the lower rail, and in each edge of the 2" strip, into which 3/8" soft wood panels are to be fitted.

Fit the back and front framework into the posts and clamp.

If the work is square and the joints fit well, take the clamps off and glue the work.

Keep the work square and watch out for twisting.

Fasten 1" × 1" soft wood strips around the inside at the bottom.

The soft wood bottom is fastened to these strips.

Square the top.

Clean the outside with the plane, scraper, and sandpaper.

Fill, stain, and shellac.

Make the cane frames, stain, and fasten into place.

Do the caning next, according to instructions for caning on page 123.

Glue the top, plane, and scrape down to a smooth even surface.

The underside of the top has two cleats. Why?

The top projects to the front 3/8" to give a hold when lifting.

The top is hinged on with two 1 3/4" × 3" brass butts.

Varnish the top and rub down.

Fit the posts with casters and caster rings to match.

Bore a few 1/4" holes in the bottom. Why?

PLATE 21 — CANED BOOK TROUGH

HOW TO DRAW

The new feature in this drawing is the shaped pieces for the feet and braces.

The curves can be drawn with the compass.

The student may change the design of these eight pieces if he cares to.

The design at the base, however, must not have less than a 12" width — a little more, perhaps, would add to the appearance and make the trough more rigid when finished.

Name several purposes for which an article of this kind could be used.

If the trough were to be placed a little away from the wall, would casters add to its usefulness?

Why?

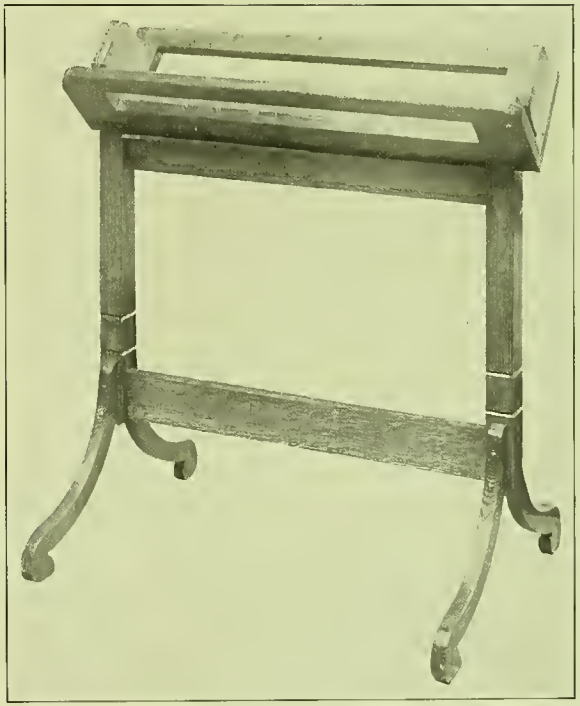
Does the design, considering its use, appeal to you?

If you were to build the trough, which, in your opinion, is the hardest part? Why?

What are the 2" × 5" pieces for on the long or back part of the caned trough?

Why should the inside of the trough be 90 degrees?

What would a piece of furniture built as designed cost if purchased through a first-class furniture dealer?



BOY'S WORK

Suppose the trough were built of two solid pieces instead of two frames, would it appear as well?

Scale 1/8 size.

Make out stock bill, trace, and blue print.

HOW TO BUILD

Get out the square posts 1 1/2" × 1 1/2" × 18 3/4" long.

Chisel the V-grooves in each.

Chamfer the lower ends to a point 3/4" back.

Cut a 45-degree groove in the top of each.

Get out the top and bottom stretchers next, allowing for 1" tenons on the ends of each.

Frame these stretchers into the posts.

The center of each stretcher should be in the center of the post.

The upper stretcher is to have its top edge even with the lower part of the groove cut in the top of the posts.

The lower edge of the bottom stretcher is to be even with the line of the 3/4" chamfer.

Test for squareness under the pressure of the clamps. If the joints are square and the work is not twisted, take the clamps off and glue.

After the glue has set, clean the work, fill, stain, and shellac.

Design the legs and lay them out with a templet.

Keep the grain of the wood with the length of the legs, as nearly as possible.

Saw these out on the band saw, or if a band saw is not at hand use the turning saw.

Work out the braces in the same manner.

The outside edges of the legs or feet and the braces should be slightly rounded, and the straight face which makes the butt joint should be planed straight. A file is not to be used.

Use the spokeshave and file on the other parts.

Fasten on the feet with No. 10, 1 3/4" round-head, blue screws, after filling, staining, and coating with shellac.

Use a little glue in each joint.

The trough is built of two frames. The parts of each frame are put together with mortise and tenon joints.

The inside edges of the frames have a 1/4" rabbet worked out into which a 1/4" piece of wood is fitted, thus making the inside surface of the trough smooth.

Thus the caning is necessary only on the under side.

The frame for the caning is built and fastened into the back piece only.

Instead of making a cane frame for the front

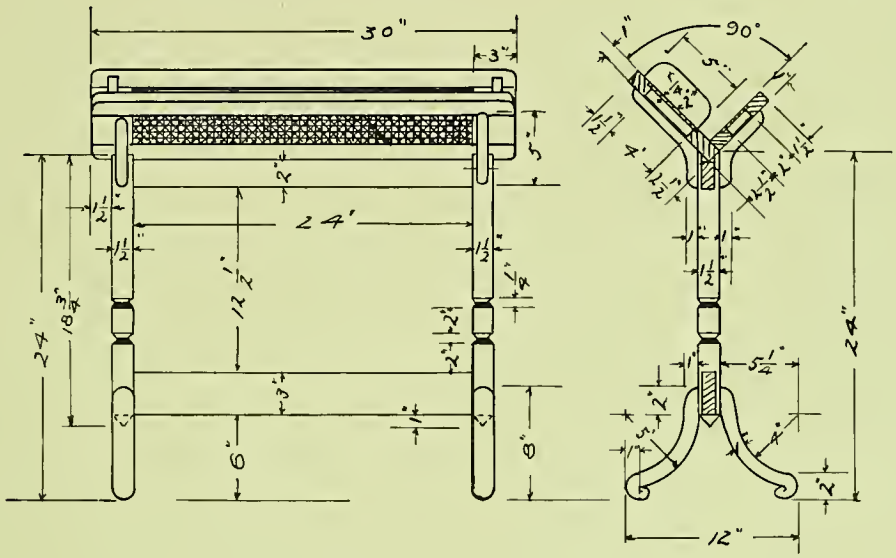


PLATE 21— CANED BOOK TROUGH

piece, work out a solid piece of soft wood, rabbet it on the under outside edges, and fasten securely into place.

The space is too small to receive a frame.

Fill, stain, shellac, and fasten the trough together with screws driven from the back.

Either round or flat-head screws may be used.

If flat-head screws are used, counterbore and plug.

The two end book braces may be put in after the other construction has been done, or before fastening together.

Fasten the braces to the posts with round-head screws and set the trough in position.

If it fits well screw the braces to it.

Rub with fine sandpaper and oil.

Cane according to instructions for caning on page 123.

Varnish.

PLATE 22—CEDAR CHEST

HOW TO DRAW

Why are chests of this character usually built of red cedar?

Why is white cedar not used?

Scale 1/8 size.

The small pieces used as feet can be laid out with the compass or dividers.

The design may be changed.

The curve on the 2" shaped front pieces will have to be drawn by the aid of the irregular curve, or a templet made and the pieces laid out from it.

The design of these two pieces also may be changed if desired.

In the event of the design being changed in any respect, the appearance and balance of the chest must not be destroyed.

Work out stock bill, trace, and blue print.

HOW TO BUILD

Glue the stock for the two sides and ends, allowing for waste in working to size.

The two end pieces are rabbeted to the front and back as shown in the drawing.

Glue and nail these pieces together, setting the nails with the nail set.

Be careful to get the framework square.

Glue the stock for the 1/2" bottom and work to size, say about 21 1/2" × 43", planing the upper surface smooth.

Nail and glue it to the bottom of the frame.

Screws may be used instead of nails if desired.

Work the projecting parts down to 1/2" on the ends and back, and to about 3/4" in front.

Slightly round off the edges.

Make four three-cornered soft wood glue blocks, one for each inside corner, 12" long and about 1 1/2" on the 90-degree faces.

Glue the two back inside corner glue-blocks in place.

Get out the shaped feet and fasten them on with glue and flat-head wood screws.

The two front shaped pieces for ornament are to be worked out and glued.

Drive flat-head wood screws through the front of the chest from the inside into these shaped pieces before gluing the front glue blocks in position.

Countersink the heads of the screws a little below the surface of the wood, in order to allow the glue blocks to fit snugly against the surface of the front side.

Glue the stock for the top next.

Notice that the top has three 2" cleats fastened to the under side. Why?

These cleats are to be fastened with glue and flat-head wood screws, countersinking for the heads.

There is a 1/2" × 1 1/2" strip fastened to the ends and front of the lid after it has been hinged to the box.

Use three 1 1/2" × 3" tight-pin brass butt hinges for the top.

Plane, scrape, and sand down to a smooth, even surface.

Shellac and varnish.

The inside is to be left natural. Why?

Handles of some description are to be fastened to the ends.

Fit the feet with casters.

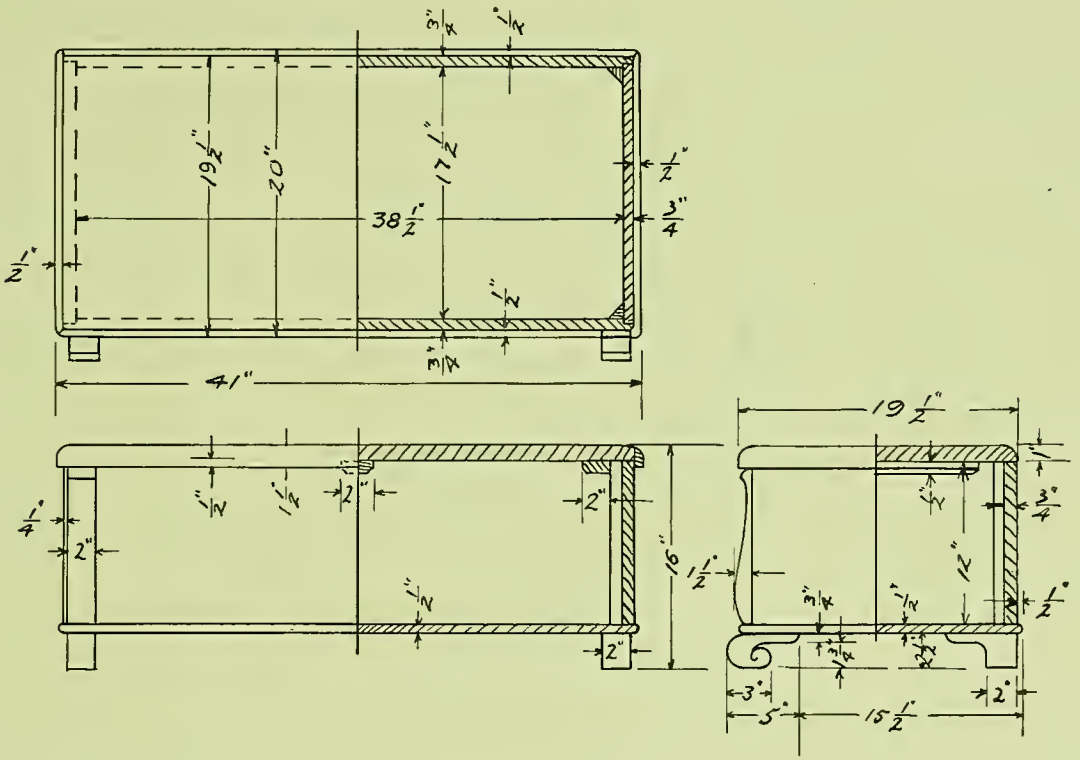


PLATE 22— CEDAR CHEST

PLATE 23—PIANO BENCH

HOW TO DRAW

Scale 1/8 size.

The posts are square with two V-grooves in each one.

How is the top to be built?

Is it a good method?

Criticize the drawing.

The design of the feet may be changed, but do not change any other part of the bench.

Complete the drawing.

Make out stock bill, trace, and blue print.

HOW TO BUILD

Get out the four posts 1 1/2" square and 16 1/8" long.

Work out the V-grooves in each one.

The two end rails are 7/8" × 3" × 12" plus 3/4" on the ends for tenons.

Get these rails out next and make the tenons, allowing a 1/4" shoulder on the top edge of each.

The two side rails are made of the same size stock, but they must be 28" long plus the 1 1/2" tenons.

Get out these and make the tenons as you did on the other two rails.

Get out two pieces 1 1/2" square and 13 1/2" long for the bottom stretchers.

These are to be framed into the lower ends of the posts parallel with the end rails on double mortise and tenon joints.

Glue the end, keeping your work square and free from twist.

Frame up the other end in the same manner.

Now work out the side rails and glue them to the framed-up ends.

The 7/8" × 2" stretcher must be framed into the two end stretchers before gluing up the bench.

Notice that the bottom is fastened to the under side of the rails, after having notched the corners to fit the posts.

The bottom should be 1/2" × 15" × 31" when finished.

Plane and sand the upper surface before fastening in place.

Any projecting ends or edges must be planed off before fastening the trim strips in place.

Get out the 1/2" × 1/2" trim strips next.

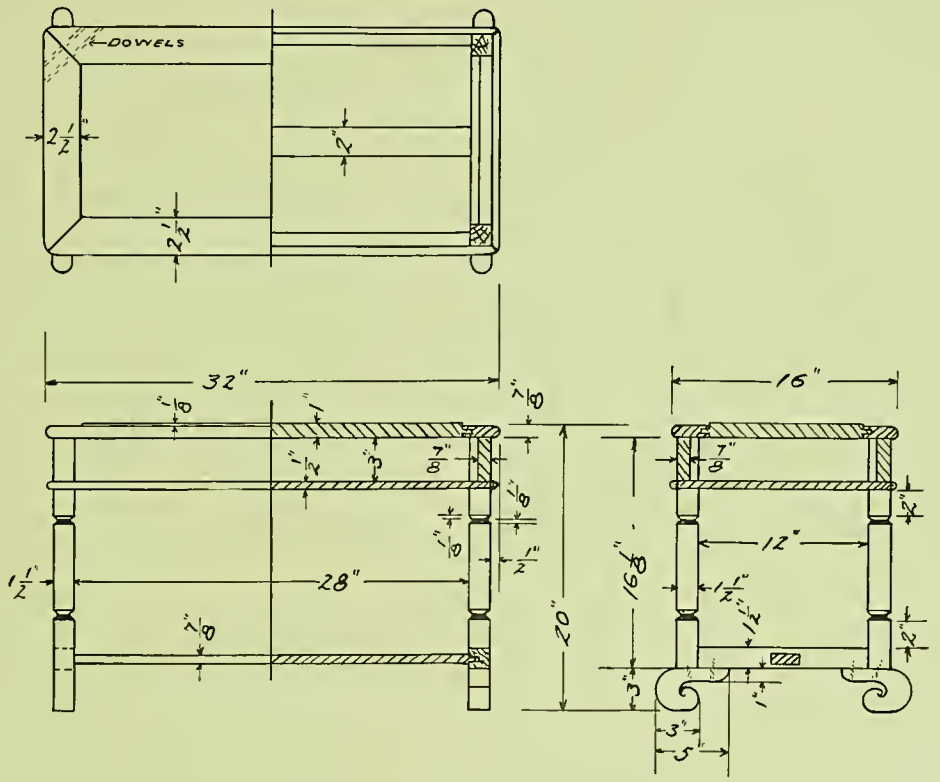


PLATE 23—PIANO BENCH

Fasten these on with small wire brads and a little glue. The corners are mitered.

Slightly round off the edges and corners.

There are five pieces to the top, the four pieces of which the frame is made and the panel.

Get out the frame first, working out a 3/8" × 5/8" groove in the edge of each piece.

Do not miter the corners at this time.

Make the panel for the center next, using 1" stock.

Cut out a tongue from the under surface to fit into the grooves that you worked out in the parts of the frame.

The under surfaces of the pieces for the frame and panel must be even.

The top of the panel will project 1/8" above the frame.

Take the two end pieces for the frame, miter the ends, and fit them to the panel, holding them securely in position with clamps.

Miter and fit the two side frame pieces to the sides of the panel, taking care to have the miter joints of the frame fit well.

Clamp these pieces securely, placing the clamps on the opposite side from the other clamps.

If your work is well done and the panel and joints fit neatly, take the two clamps holding the side pieces off, place glue on the miter joints, and clamp up again.

Do not place glue on the panel.

The panel must be a little loose.

The work must be square and free from twist.

Keep the clamps about two inches away from the ends. Place small hand screws on each corner.

After the glue has set, glue two 1/4" dowels through each corner, using the same kind of stock that you used in building the frame.

Clean the bench with the plane, scraper, and sandpaper.

Sponge the wood with clean water, and sand down when dry.

Fume or finish with fumed stain, then shellac, sand down, shellac again, sand down using a little oil, varnish, rub down, give another coat of varnish, and polish with rottenstone and oil.

The top fastens on with three 1 1/2" × 2 1/2" tight-pin, brass butts.

Drive in a small rubber-headed tack on each under corner on the top or in the posts.

The inside should be finished and the lid fitted with desk supports to prevent it from falling back and thus breaking the wood where the hinges are fastened to the rails.

PLATE 24—BEDSIDE TREES

HOW TO DRAW

The objects on this plate are not costumers. They are much shorter and the base of each is narrower, the purpose being to furnish a convenient place to hang the clothes, when retiring, or to use in case of sickness.

The small shelf adds a new feature, and the value of the tree is increased many fold.

In case of sickness towels may be hung on the hooks, medicine and a glass of water may be placed on the shelf.

They also provide a serviceable convenience for the mother and the babe.

Sandpaper could be glued to the under side of the shelf and the stand used as a smoking stand with a convenient place to hang the hat or cap.

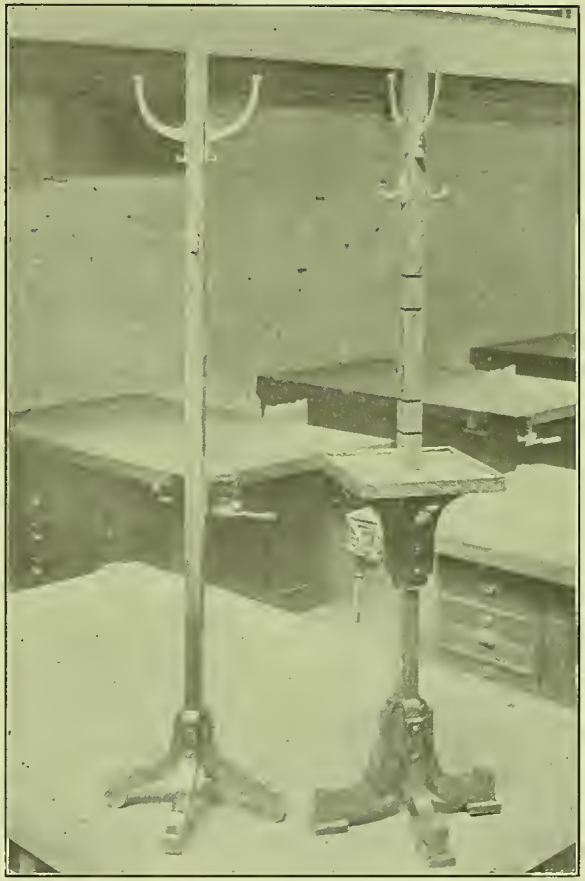
They are light, occupy but little space, are easily moved about, and look well.

Scale 1/8 size.

Divide the paper into three equal parts 4" × 9".

Draw the 9" line vertical.

Locate and draw a vertical center line in each space and work to the right and to the left of the line.



BOY'S WORK

The tree on the left in the plate is to be drawn according to the dimensions given.

The design of the feet on the tree in the middle may be changed.

The tree on the right in the plate is to be drawn without any changes.

Use the irregular curve in drawing the curves on the feet.

Work out the stock bill, trace, and blue print.

HOW TO BUILD

Get out the post for the first tree 1 1/4" square and 48" long.

Chamfer the ends to a point 5/8" back, and work out the V-grooves.

Make a templet for the feet.

Mark out the feet and saw with the band saw or with a turning saw.

Smooth the feet with the plane, spokeshave, and file.

Do not use a file on the part making the butt joint.

The feet may be doweled or fastened to the post with round-head screws.

Use glue in either case.

The bottom is to be loaded in order to move the center of gravity near the base.

Build the middle tree similar to the first one, following the drawing.

The difference between the one on the right and the others is in the construction of the shelf.

The shelf is a square piece with a square hole worked out in the center, and is slipped down over the post from the top. It rests on a piece of molding fastened to the post on miter joints.

Small braces to match the feet may be substituted for the molding.

The shelf is held in place with a little glue.

The hooks should not be too large.

The finishing (stain, etc.) is left to the taste of the builder.

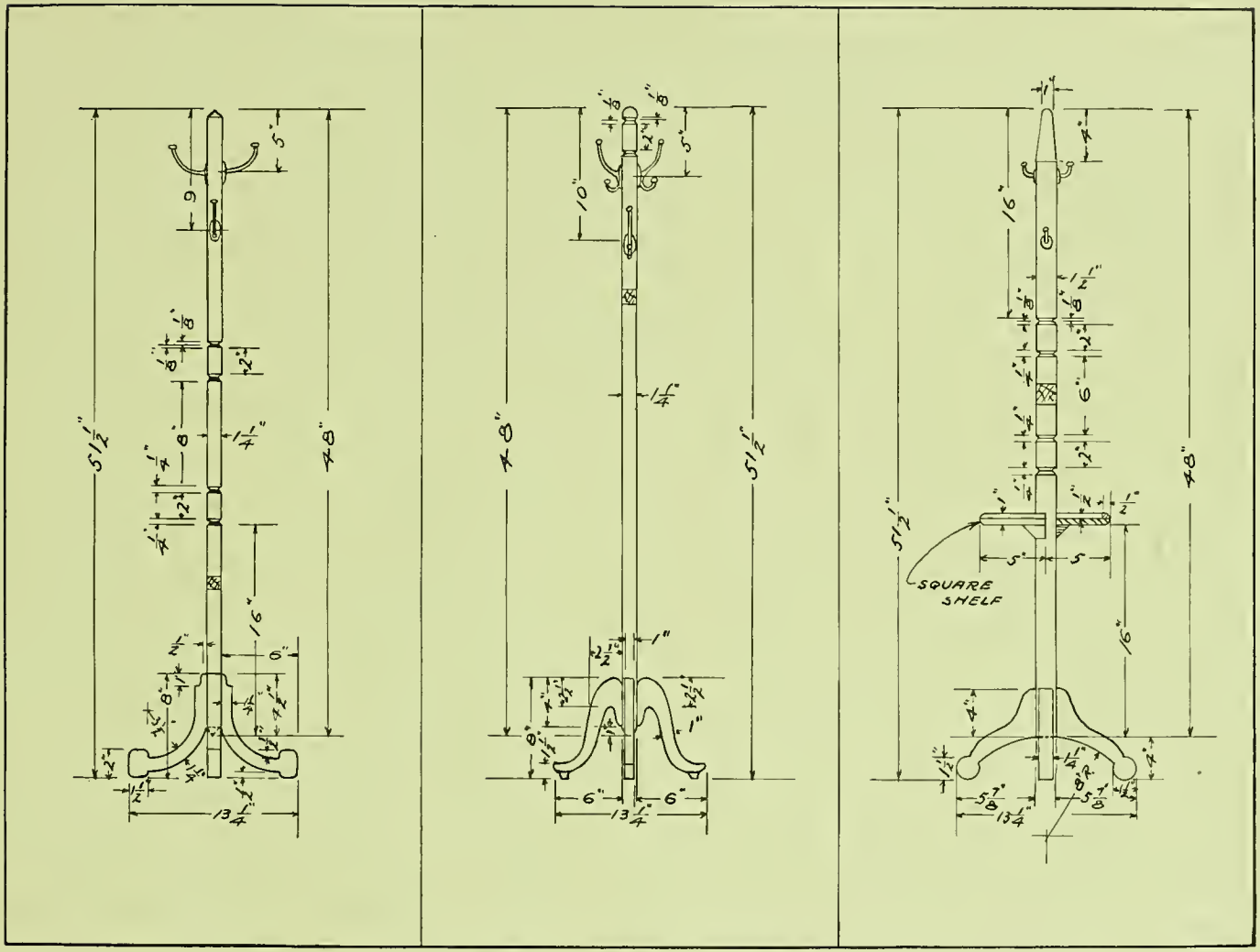


PLATE 24— BEDSIDE TREES

PLATE 25—READING LAMPS

HOW TO DRAW

The lamps are not high, and have been designed for convenience when reading.

Scale 1/8 size.

Do not change the design of the lamp at the left.

The one to the right may be changed.

Make out stock bill, trace, and blue print.

HOW TO BUILD

Work out the post as you did for the bedside tree on Plate 24, tapering it to 1" square at the top.

A templet is to be worked out for the feet and braces under the book rack.

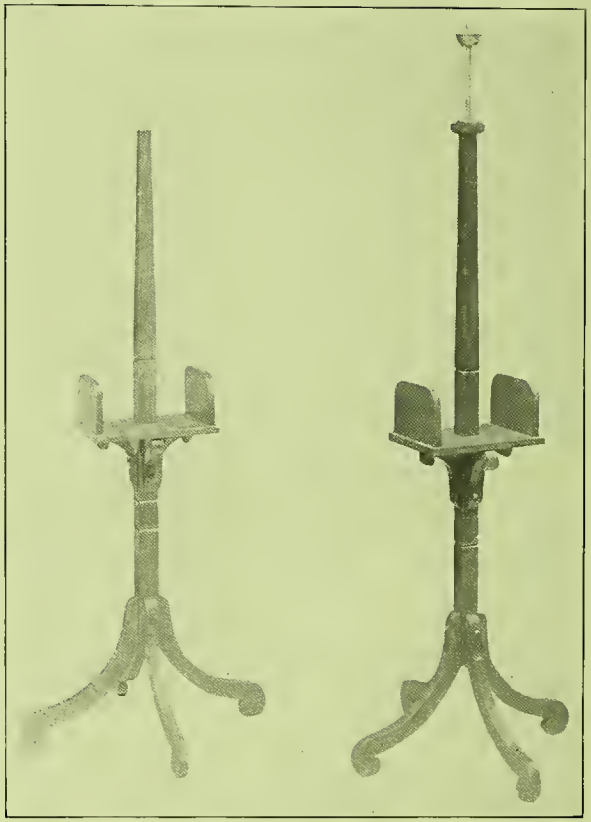
Get these out and fasten to the post with dowels or round-head wood screws. Use glue.

Build the trough or book rack as per the drawing, cutting a square hole in the center to fit the post.

Slip the rack on from the top of the post.

The hole for the cord may be sawed out full length on the circular saw, gluing a strip into the groove deep enough to leave a 3/8" hole.

Plane the strip even with the surface of the post when the glue has set.



BUILT IN THE AUTHOR'S CLASSES BY HIS PUPILS

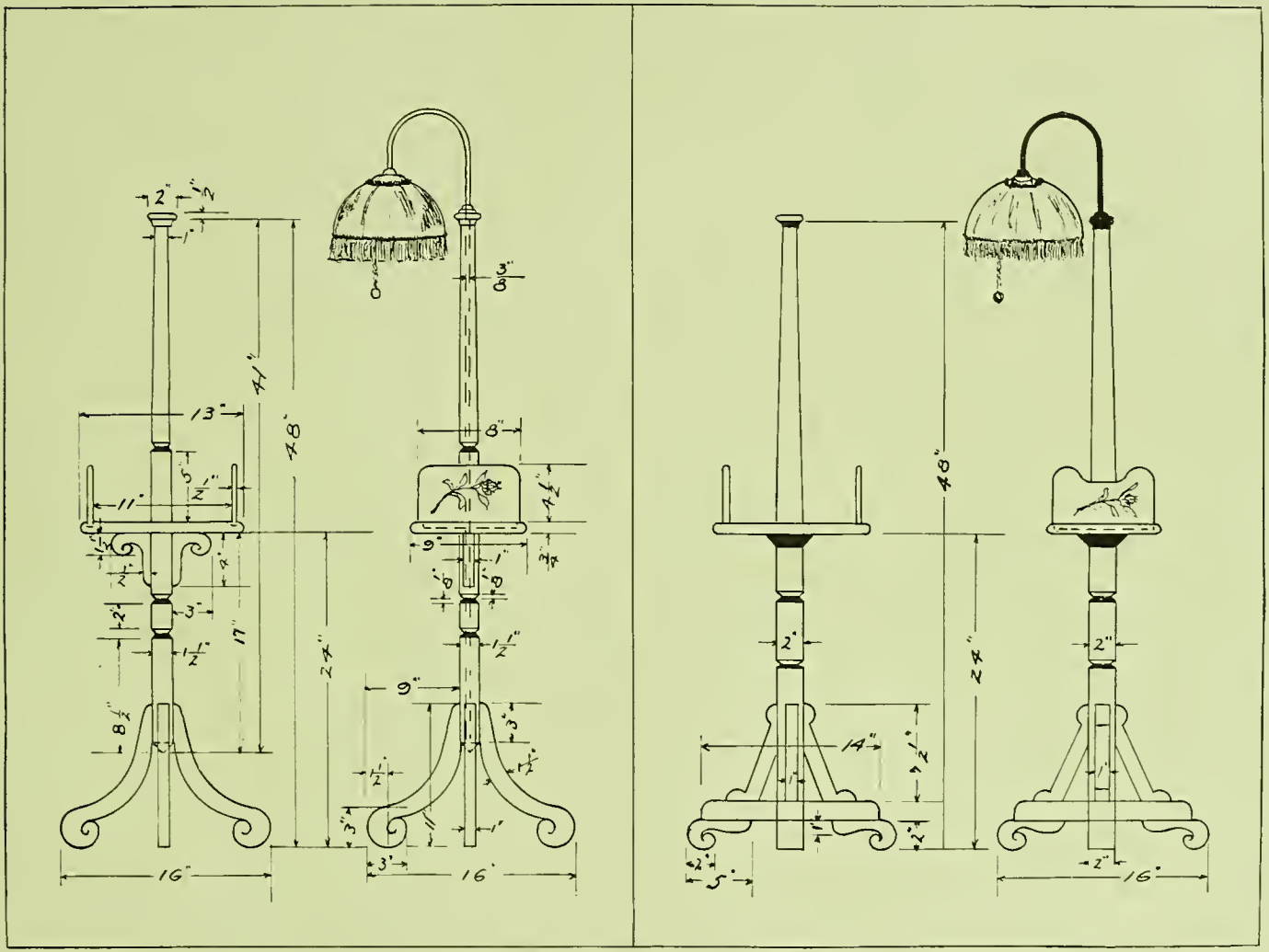


PLATE 25—READING LAMPS

If it is not convenient to make the hole in the post in this manner, and you have no means of drilling a hole, take a No. 6 auger bit and bore in from the top the full length of the bit.

From one face bore a 3/8" hole in to meet the lower end of the first hole.

Thus the cord will come out 6 or 8 inches below the top of the post, which will not look bad.

The top of the post is fitted with a 2" block to which the metal fixture is fastened.

If all the parts have been worked out and are well finished, stained, and filled before gluing in place, time and labor will have been saved.

The straight metal fixture may be substituted for the goose neck. The lamp on the right is built in the same manner as the first one.

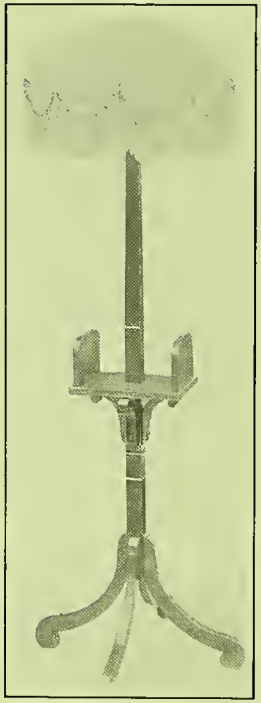


PLATE 26—TELEPHONE TABLE

HOW TO DRAW

Do four views add to the understanding of the drawing?

Name and explain the different views.

Criticize the design.

How is the swinging bracket for the 'phone fastened to the table?

Is the construction good?

How is the bottom put in place?

How would a drawer look?

How far from the floor is the under side of the bottom?

What do the arrow points on the top view indicate?

Do the round corners and edges add to the appearance of the table?

Scale 1/8 size.

Locate and draw a vertical center line and work to the right and left of it.

Make out stock bill, trace, and blue print.

How would you like to build a table just like the one in the drawing?

Could you use it in your home? Do you think your mother would like to have one?

HOW TO BUILD

Get out two posts or legs 36" long, and two 31 1/8" long, work out the V-grooves, and taper as per the drawing.

The two end rails are 7/8" × 4 1/2" × 15" plus 1 1/2" for the tenons.

Get these out and make the tenons.

Work out the mortises in the legs and fit the rails into place.

Glue and clamp your work if it is square and the joints fit well.

Get out the back rail, which should be of soft wood.

The 1 1/2" front rail is to be the same kind of stock as that of the end rails.

Get this piece out and frame it as well as the back rail into the posts.

The top 1 1/2" stretcher must be worked out and framed into the posts before the table is glued up.

Clamp the table up and if everything is square and has been well fitted take it apart and glue it.

Test for squareness and twist.

Get out and glue the top.

After the glue has set, fasten the top to the table

by driving screws through the front rail on a slant, and through the end and back rails from the inside.

Use a few glue blocks.

The two back corners of the top must have been notched to fit the posts.

Now make the 1/2" soft wood bottom and fasten to the under edges of the rails with glue and screws, notching the corners to fit the posts.

Fasten on the small 1/2" trim strip next; this will cover the exposed edges of the bottom.

The pieces at the corners are to be mitered.

Round off the edges and corners.

The bracket for the 'phone is built of two pieces, the circular piece for the 'phone, and the arm.

The circular piece is to be turned up on the lathe.

Fasten it to the arm with screws driven from the top or from the under side of the arm.

The arm is doweled to the back of the table with a 1/4" or 3/8" dowel, by boring a hole through the stretcher, through the arm, and down into the top of the table.

Clean the table with the plane, scraper, and sandpaper.

Stain, fill, and varnish.

Glue a piece of green felt inside the circular piece on which the 'phone rests.

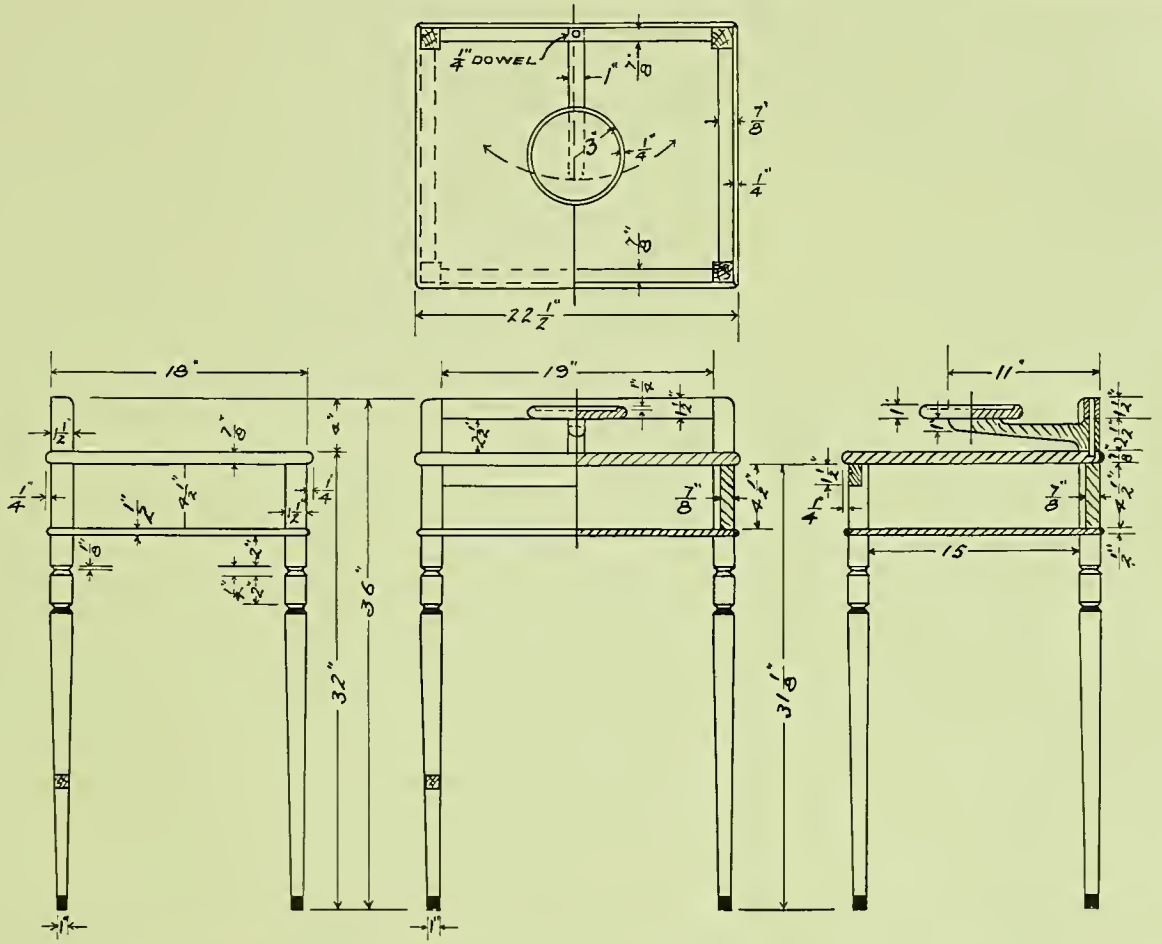


PLATE 26— TELEPHONE TABLE

PLATE 27 — TELEPHONE-TABLE CHAIR

HOW TO DRAW

Scale $\frac{1}{8}$ size.

This chair is to go with the table.

From the drawing can you determine how the upholstering is to be done?

Do caning and upholstering go well together?

How would a chair similar to this one do for the dressing table?

Make out stock bill, trace, and blue print.

HOW TO BUILD

Lay out the back legs and saw both at the same sawing, by nailing together.

Next make the two front legs.

All the seat rails are to be of soft wood.

Get out the top back rail, the front seat rail, and the back seat rail and frame them into the legs.

The side seat rails and the side stretchers come next. Frame these into the legs.

The middle stretcher at the bottom is to be framed into the side stretchers.

Notice that the two side rails and stretchers do not fit the posts at right angles.

Lay these out from a center line passing from the front of the chair to the back.

Set and use the T level.

If the joints fit, glue up the chair and clamp.

Keep the chair straight with the center line drawn through the chair from front to back.

Do not let the work twist under the clamp.

Glue and screw 1" strips around the inside seat rails, the top edge of these pieces being 3/4" below the top edges of the seat rails.

The bottom is a solid piece which rests on the 1" strips. Fasten the bottom to the strips from the top or bottom.

Saw a hole, as indicated on the drawing, in the center of the bottom and save the piece sawed out.

Clean the chair, stain, fill, and varnish.

Make the cane frame next; stain and fasten it into place.

Fasten the upholstering material by driving tacks in the under edge of the seat rails, except at the back.

Now through the hole in the bottom push hair back even with the edges of the rails until the seat has been well filled.

Push the round piece you sawed out up into the hole and nail or screw a 1/2" piece over this to hold it in place. If the upholstering material does not lie close to the top of the seat rails, put in a row of upholstering tacks about 1" down from the top of the rails.

The caning is to be done next. See page 126.

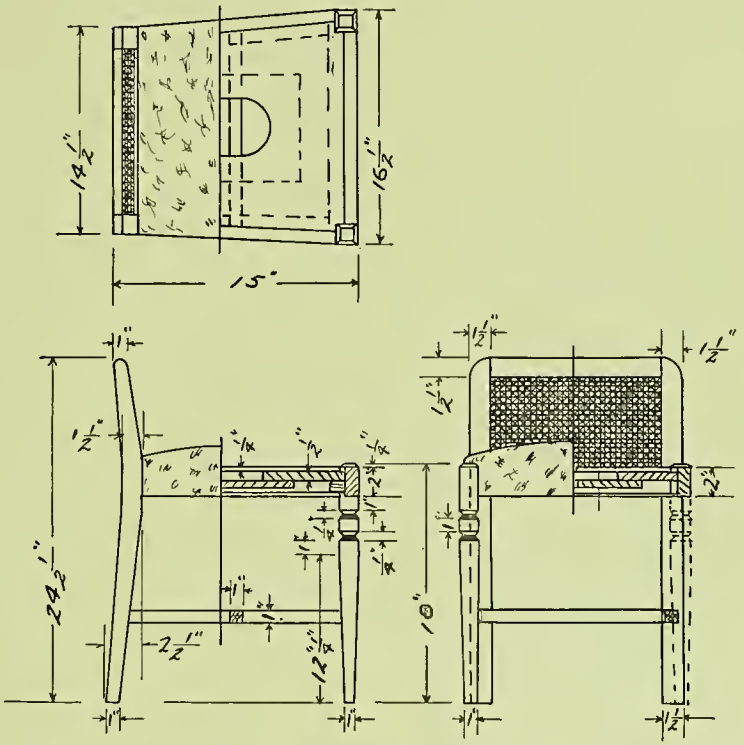


PLATE 27 — TELEPHONE-TABLE CHAIR

PLATE 28—UMBRELLA STAND

HOW TO DRAW

Criticize the drawing.

Suppose one would like to have coat hooks on the stand, where would be the best place to fasten them and not cover the mirror?

How is the bottom held in place?

The mirror frame swings on toilet screws.

Describe them.

Get one or two and bring to the class.

There is a cheaper method of fastening swinging frames of this character. Ask a furniture dealer to show you some other methods.

What would be a fair price to pay for a suitable mirror for this piece of cabinet work?

Scale 1/8" size.

Make out stock bill, trace, and blue print.

HOW TO BUILD

Get out two posts 1 1/2" square and 60" long, cut the V-grooves, and taper the outside surface of each as shown on the drawing.

The two front posts are 1 1/2" square and 29" long. Get these out.

There is a 1" × 2 1/2" × 3 1/2" block fastened to the bottom of each front post and rounded off on both sides and in front.

Get out these blocks next.

Get out the four side rails and frame them into the posts.

Glue and clamp these together.

The two front and the two back rails are to be framed into the framed-up sides next.

The two back rails are to be of soft wood.

If the open back is not desired, frame a 2" center piece into the top and bottom back rails and fit 3/8" panels into the openings.

Glue and clamp the stand together.

See to it that the work is square and not twisted.

The bottom rests loosely on two 1/2" × 1 1/2" soft wood strips fastened to the side bottom rails.

Get out these and fasten them in place.

Cut a hole in the bottom to receive the umbrella pan. (Purchase the pan before cutting the hole. Cut the hole to fit the pan rather than get a pan to fit the hole.)

Fasten a 3/4" × 3/4" soft wood strip around the top, inside edge of the top rails as shown.

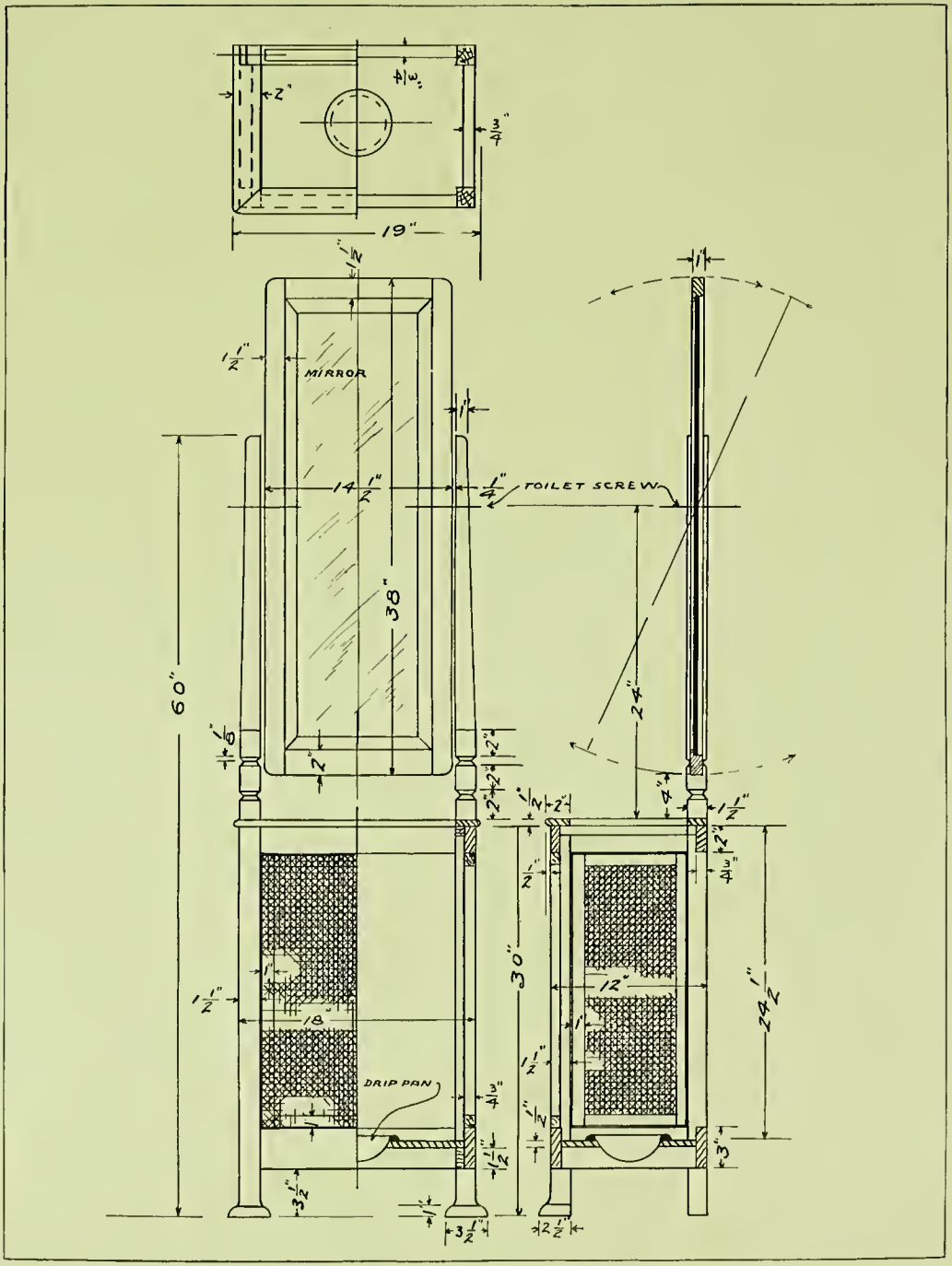


PLATE 28— UMBRELLA STAND

Get out the 1/2" × 2" strip for the frame around the top.

This frame is mitered at the corners.

Get out the frame for the mirror next.

Work out a 1/4" × 3/8" rabbet to within 1/4" of the front surface to receive the mirror.

The frame is put together with mortise and tenon joints, and the corners are rounded off. Do not round the corners off too far back or you will work into the mortise and leave the corner looking poorly finished.

Cover the back of the mirror with heavy cardboard, holding it in place with thin strips of wood.

Glue a piece of thick paper over these.

Clean all your work well and finish to suit your taste.

The mirror frame swings on two toilet screws that are placed a little above the center of the frame as shown.

Get out the cane frames and cane.

Burlap or leather may be tacked on the back instead of framing in wood panels.

Slats would look well.

PLATE 29—BLUE PRINT FRAME

HOW TO DRAW

Scale 1/2 size.

There are two new features in this drawing. What are they?

The pupil is to make a working drawing showing three views, a section of the frame to be hatched on each view.

Make out stock bill, trace, and blue print.

How many parts are there to a blue print frame?

Criticize the drawing.

Can you suggest a better method for constructing the lid?

What is the purpose of the steel springs?

Could any other material be substituted for the steel or brass springs?

What is a fair price to pay for a frame like the one shown?

How much would it cost to build one?

HOW TO BUILD

The drawing shows the side and end pieces 1/2 size fully dimensioned.

Get the pieces out as per the drawing and glue them together.

See to it that the joints fit well and that the frame is square and not twisted.

Get out the two pieces for the lid.

Hinge these two pieces together with brass butt hinges.

Fasten the springs on with small bolts or rivets.

Do not use screws.

A small knob or handle of some description fastened to each end of the lid will be helpful in taking it off and placing it on the frame.

The outside corners of the frame could be bound with copper or brass, thus adding to the strength of the frame.

A piece of clear glass 10 1/2" × 14 1/2" is required.

The glass fits loosely in the frame and is held in place by the lid.

A pad of felt must be provided.

This pad may be glued to the under side of the lid or it may fit loosely on the glass.

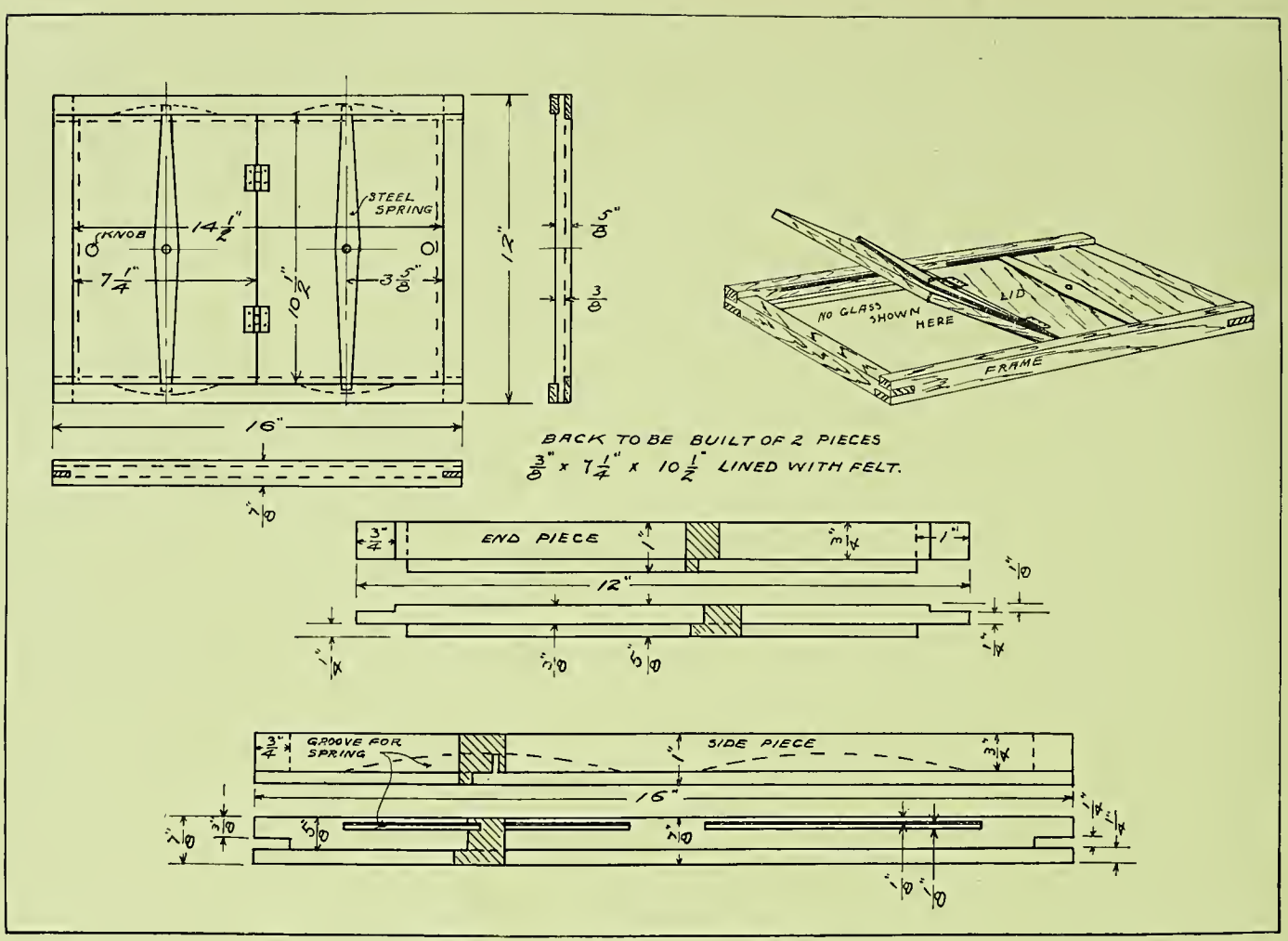
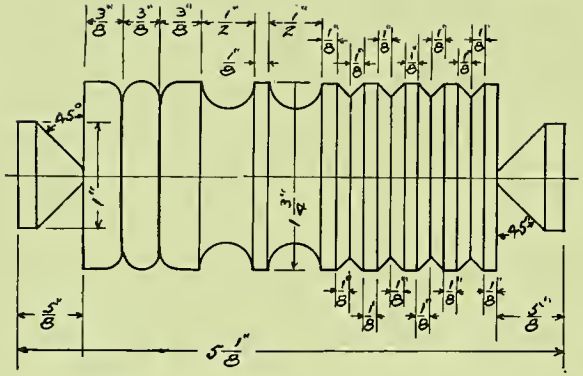


PLATE 29— BLUE PRINT FRAME $10\frac{1}{2}'' \times 14\frac{1}{2}''$

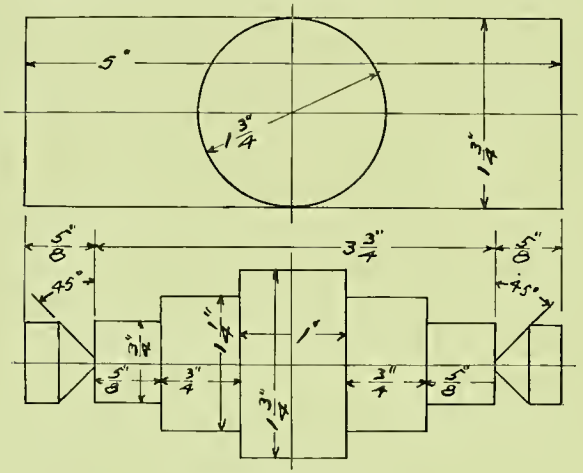
WOOD TURNING PROJECTS

1. Beads, Hollows and V-Grooves
2. Stepped Cylinder
3. Stocking Darner
4. Rolling Pin
5. Potato Masher
6. Pin Tray
7. Holder for Ink Bottle
8. Toothpick Holder
9. Jewel Cup, Card Receiver
10. Candlestick
11. Powder Boxes
12. The Gavel
13. Small Box
14. Bowl



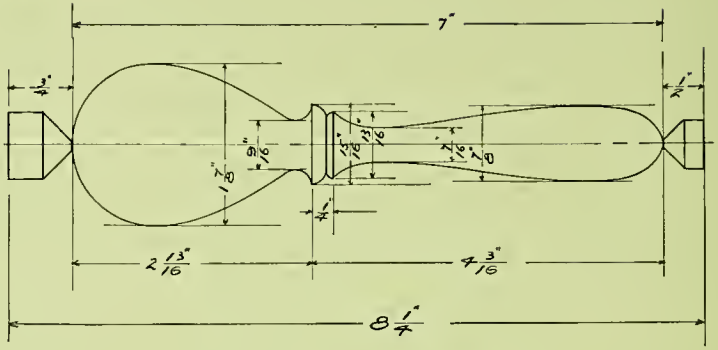
BEADS, HOLLOWS, AND V-GROOVES

Turn cylinder first. Cut ends as shown. Use gouge and skew only. Do not use sandpaper.

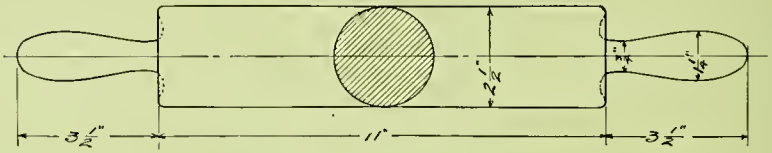


STEPPED CYLINDER

Use gouge, skew, and square scraper.

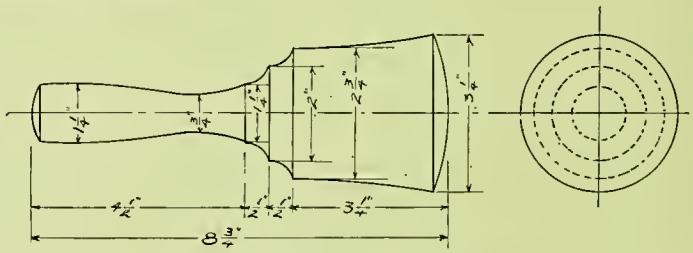


STOCKING DARNER



ROLLING PIN

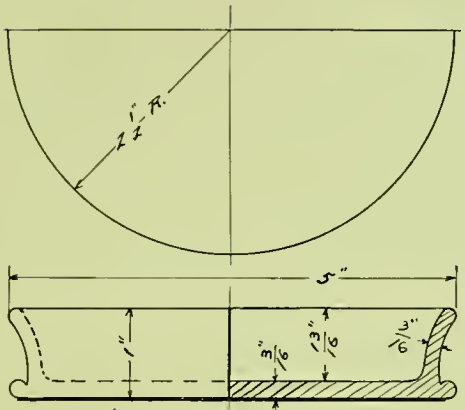
Material, maple. Finish with sandpaper. No oil or varnish to be used. Finish ends at bench.



POTATO MASHER

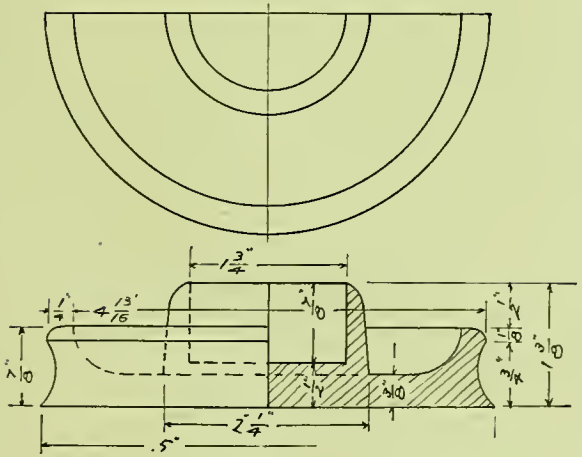
Material, maple. All cutting may be done with gouge and chisel. Finish with sandpaper. No oil or varnish to be used. Remove from lathe and trim at bench.

WOOD TURNING PROJECTS

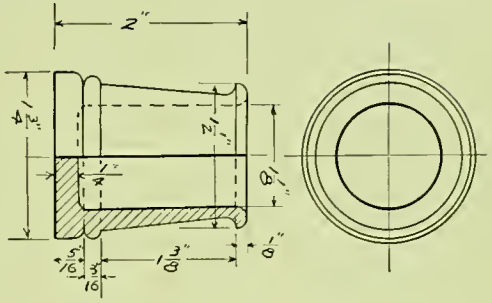


PIN TRAY

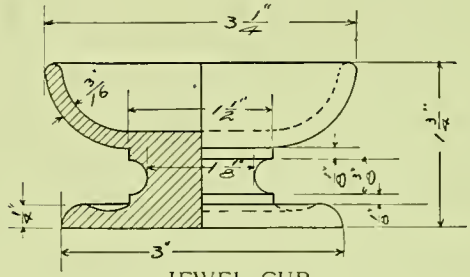
Glue red or green felt to bottom.



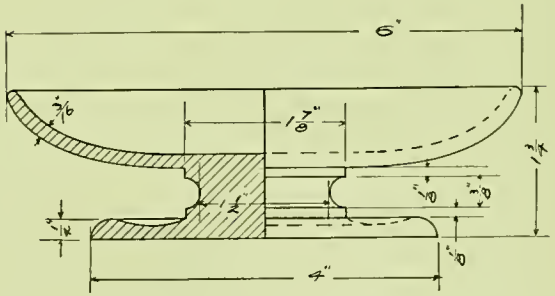
HOLDER FOR INK BOTTLE



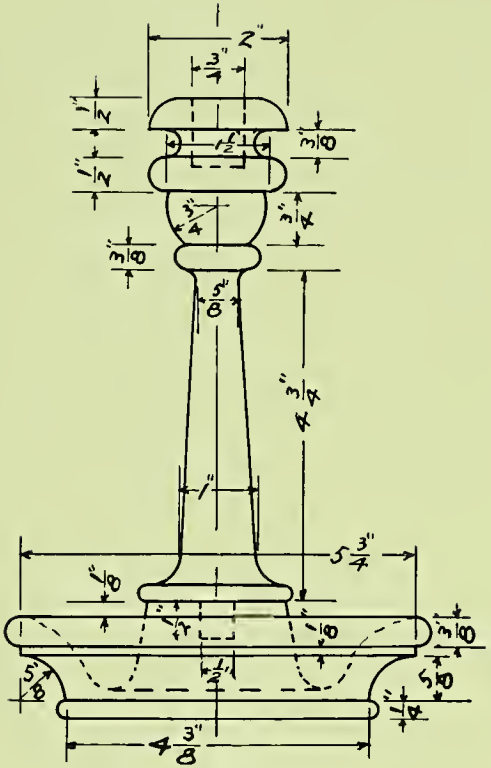
TOOTHPICK HOLDER



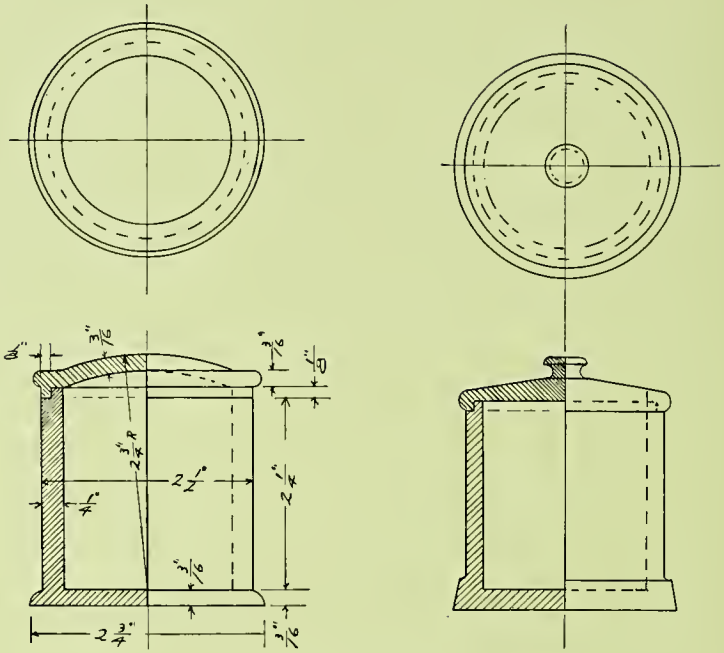
JEWEL CUP



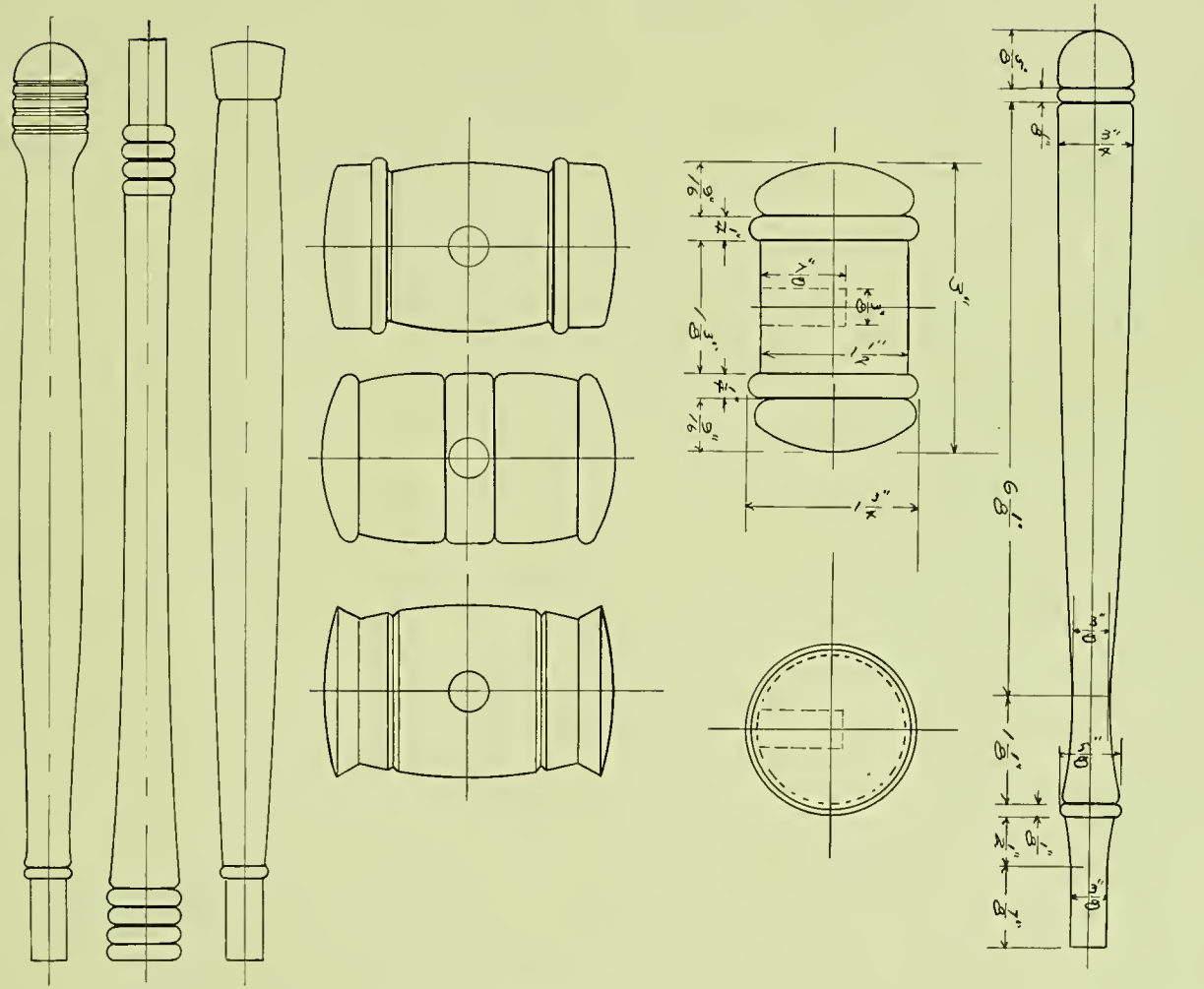
CARD RECEIVER

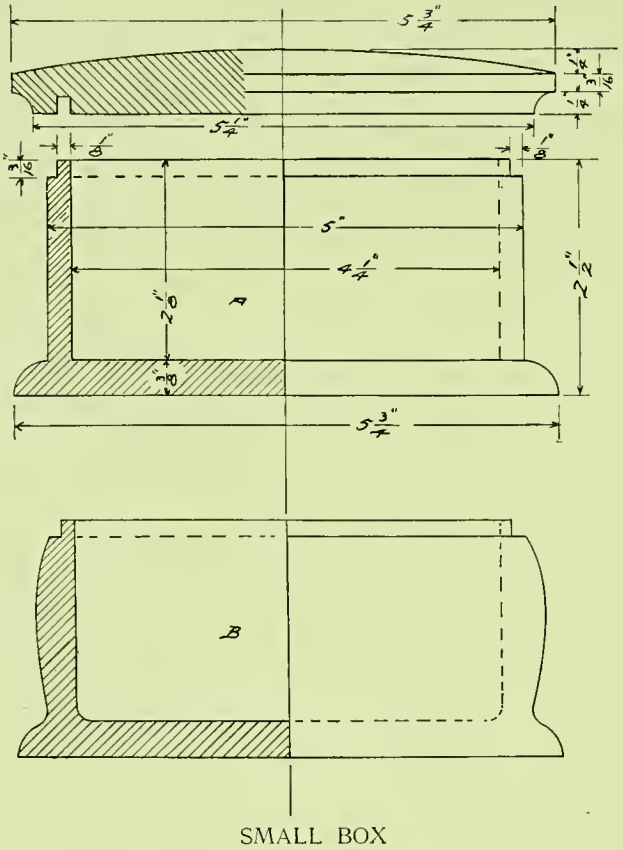


CANDLESTICK

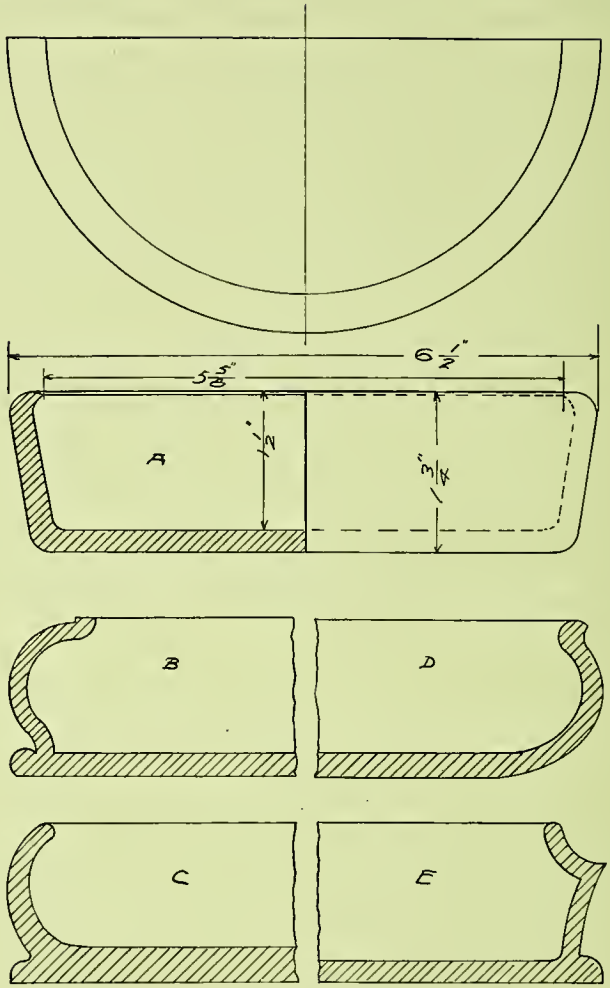


POWDER BOXES





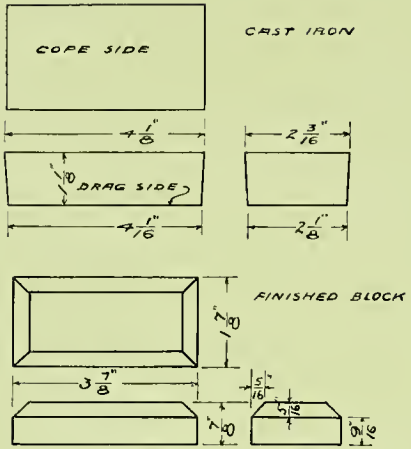
SMALL BOX



BOWL

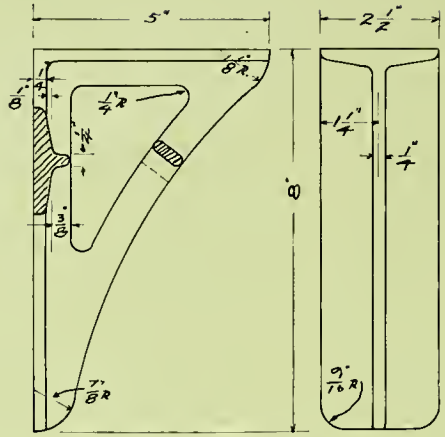
WOOD PATTERN PROJECTS

1. Chipping Block.
2. Right Hand Crank.
3. Wall Bracket.
4. Left Hand Crank.
5. Iron "C" Clamp.
6. Bracket.
7. "T" for 1″ Gas Pipe.
8. Bearing.
9. Milling Machine Gear Blanks.
10. Webbed Pulley.
11. Hand Wheel.
12. Brass Oil Cup and Core Box.
13. Angle Iron and Core Box.
14. Return Bend for 1″ Pipe.
    Core Print for Return Bend for 1″ Pipe.
    Core Box for Return Bend for 1″ Pipe.
15. "T" Rest for 10″ Lathe.
    Pattern for "T" Rest for 10″ Lathe.
16. Casting for Pillow Block.
    Pattern for Pillow Block.
    Core Box for Small Core Prints for Pillow Block.
    Core Box for Large Prints for Pillow Block.
17. Brass Candlestick.

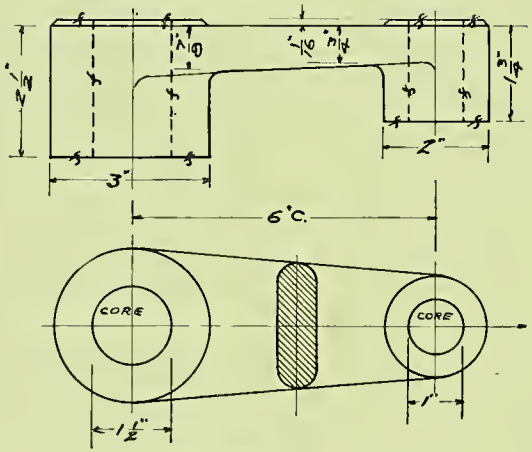


CHIPPING BLOCK

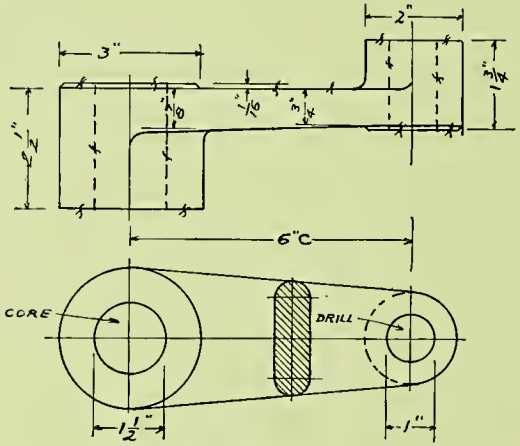
Finish all over.



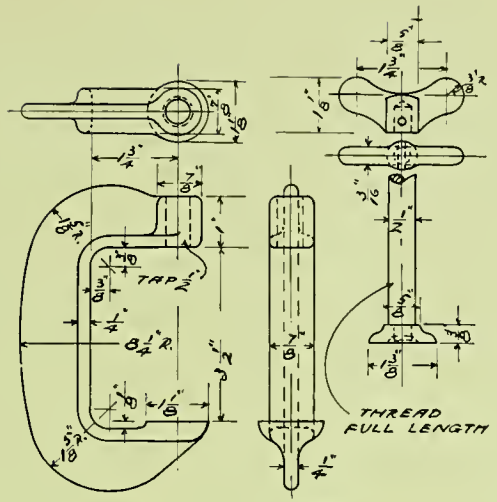
WALL BRACKET



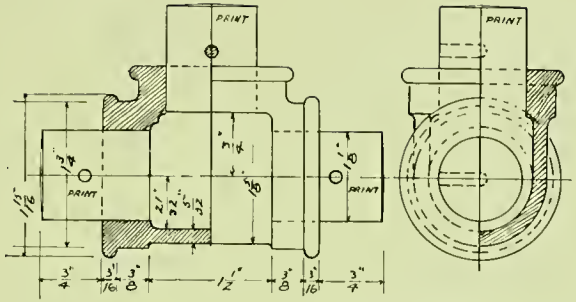
RIGHT HAND CRANK



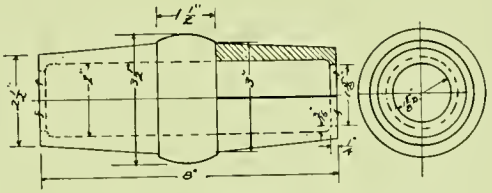
LEFT HAND CRANK



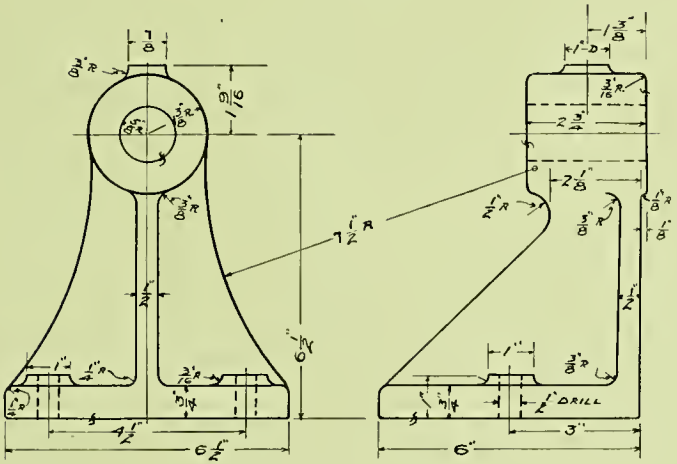
IRON "C" CLAMP



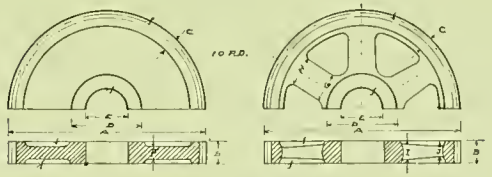
"T" FOR ONE-INCH GAS PIPE



BEARING

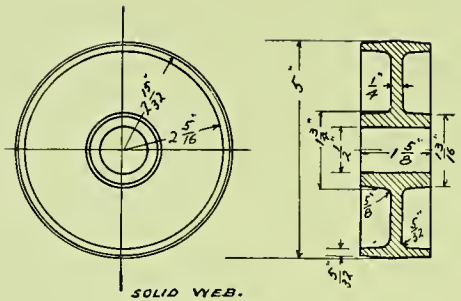


BRACKET

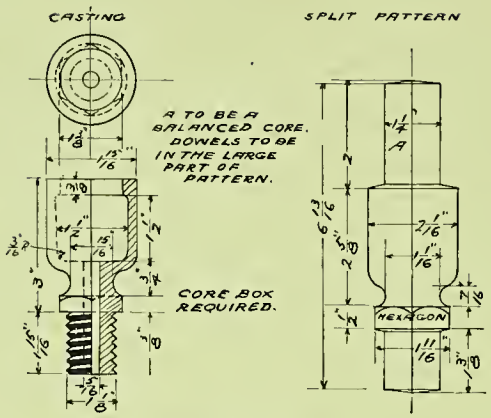


Without Arms A	*With Arms A*	*No. Teeth*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
5.2″		50	5″	1″	21″	13″	3″	15″	13″	1″	3″
5.6″		54	"	"	"	"	"	16	16	"	8
	5.8″	56	"	"	"	"	"	"	"	"	"
	6.2″	60	"	"	"	"	"	"	"	"	"
	6.8″	66	"	"	"	"	"	"	"	"	"
	7.0″	68	"	"	"	"	"	"	"	"	"
	7.2″	70	"	"	"	"	"	"	"	"	"
	7.6″	74	"	"	"	"	"	"	"	"	"
	8.0″	78	"	"	"	"	"	"	"	"	"

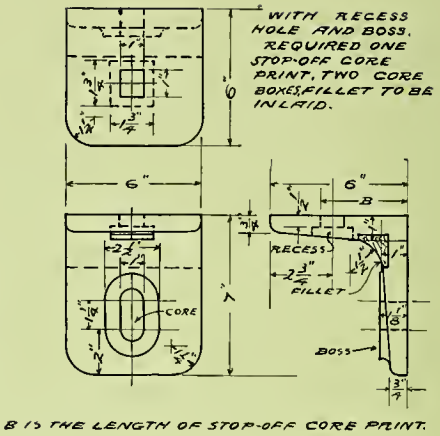
MILLING MACHINE GEAR BLANKS



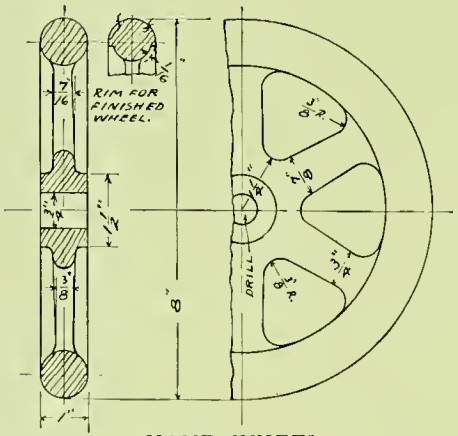
WEBBED PULLEY



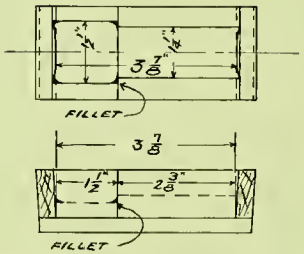
BRASS OIL CUP



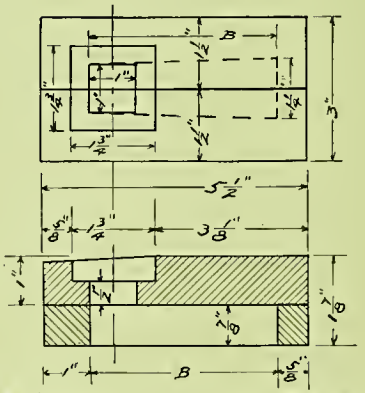
ANGLE IRON
Cast Iron.



HAND WHEEL

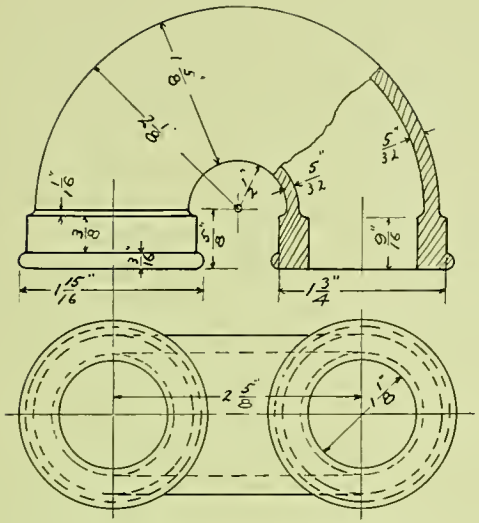


CORE BOX FOR BRASS OIL CUP

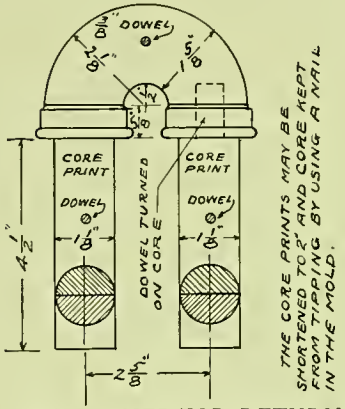


CORE BOX FOR ANGLE IRON
Split Box.

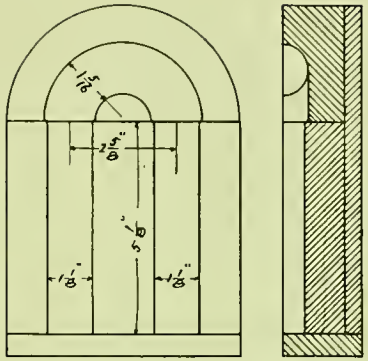
WOOD PATTERN PROJECTS



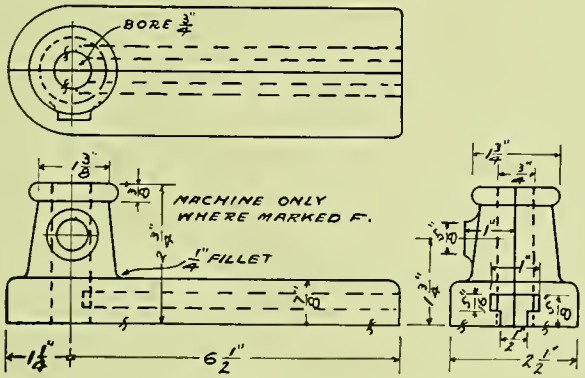
RETURN BEND FOR 1-INCH PIPE



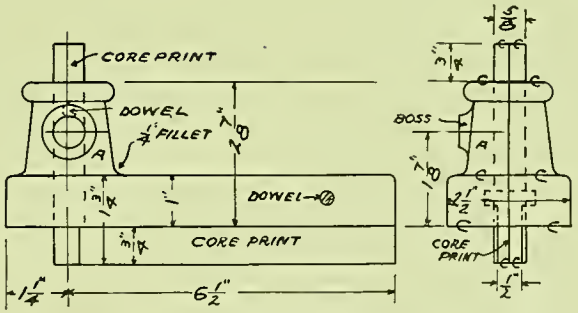
CORE PRINTS FOR RETURN BEND FOR 1-INCH PIPE



CORE BOX FOR RETURN BEND FOR 1-INCH PIPE

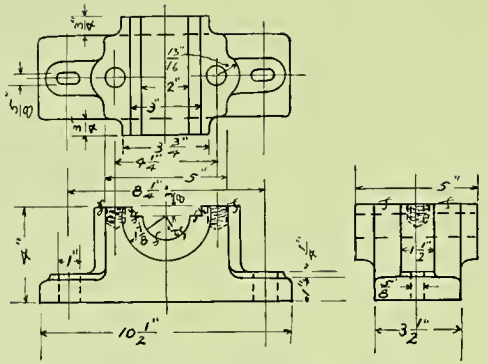


T-REST FOR 10-INCH LATHE



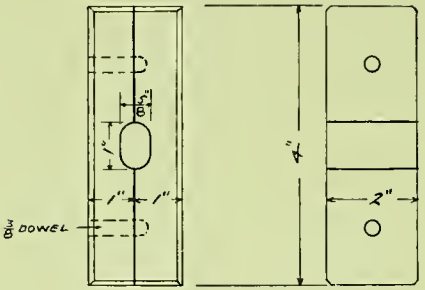
BASE OF T-REST FOR 10-INCH LATHE

Draft is not shown. Allow draft at places marked *C*. Turn small core prints on both ends of *A*—one $\frac{3}{4}$", the other $1\frac{3}{4}$" long.

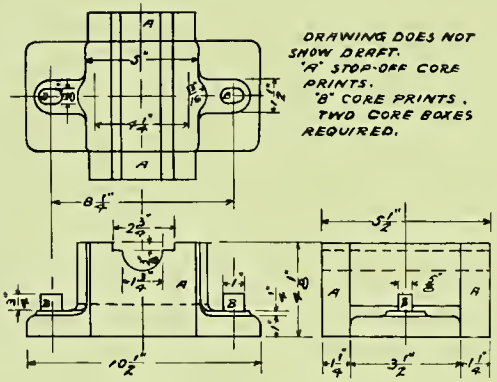


CASTING FOR PILLOW BLOCK

Cast iron. To be molded in the drag. No loose pieces.

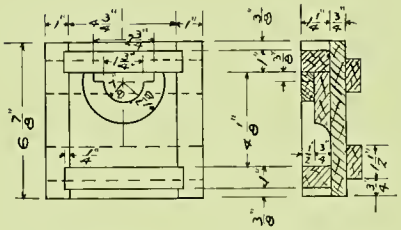


CORE BOX FOR "B" CORE PRINTS



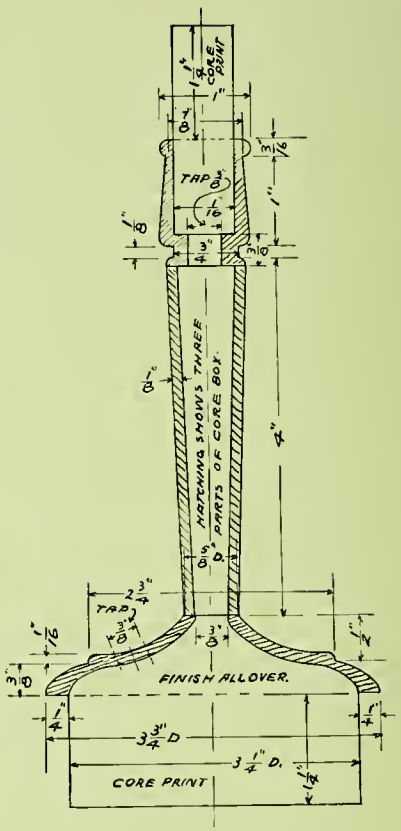
PATTERN FOR PILLOW BLOCK

To be molded in the drag. No loose pieces.



CORE BOX FOR "A" STOP-OFF CORE PRINTS

Draft is not shown.

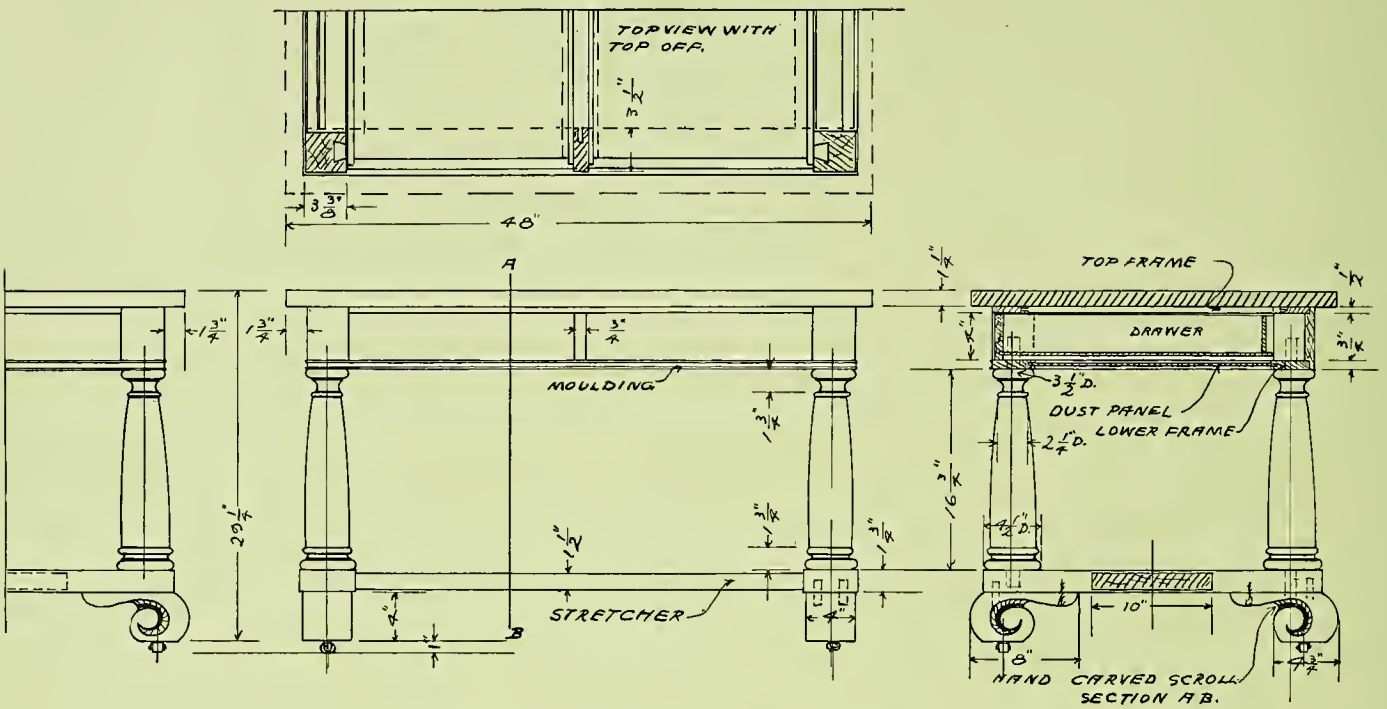


BRASS CANDLESTICK

Core box to be built in three pieces. Large part to be turned. Pattern to be turned in two parts. May be used as an electric lamp.

ADVANCED CABINET PROJECTS

1. Colonial Library Table with Column Posts
2. Library Table with Leather Top
3. Sewing Cabinet
4. Drawer Construction
5. Shields
6. Library Chair
7. Serving Table
8. Desk
9. Sheraton Telephone Cabinet
10. Magazine Rack with Book Trough
11. Chafing Dish Stand
12. Aquarium and Fernery Combined
13. Chiffonier

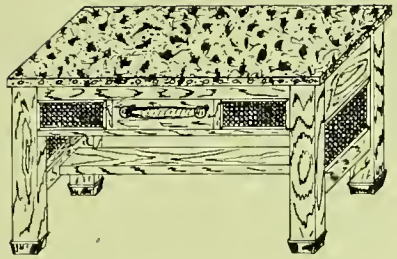


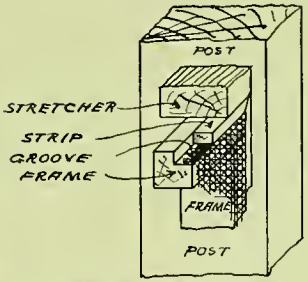
COLONIAL LIBRARY TABLE WITH COLUMN POSTS

All joints to be mortise and tenon. Drawer slides to be framed. Leave 1″ dowels on each end of turned posts. Band saw the scroll feet and fasten on with dowels and screws. Groove the back and end rails on the inside $\frac{1}{2}$″ from the top edge with a $\frac{3}{8}$″ × $\frac{3}{8}$″ groove. Also rabbet the inside lower edge of these rails $\frac{3}{4}$″ × $\frac{3}{8}$″ to receive the bottom frame.

The molding on the outside of lower frame may be put on with headless nails and glue, using miter joints. Bore and counterbore holes for casters. Fill and shellac the under side of the top before screwing it in position. Use metal drawer pulls. Finish to suit.

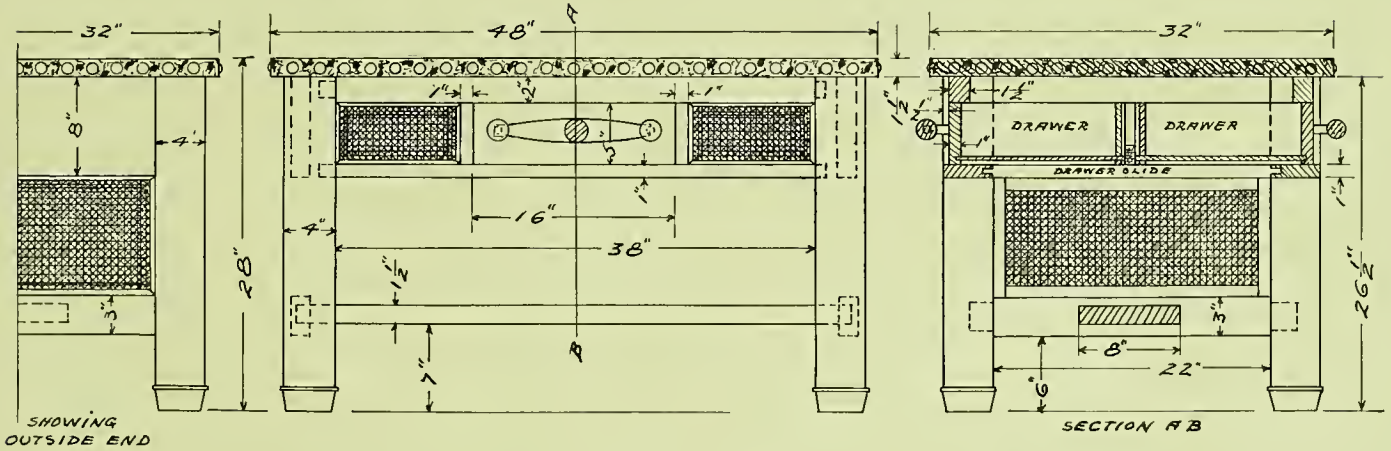
ADVANCED CABINET PROJECTS





DETAIL OF CANING.

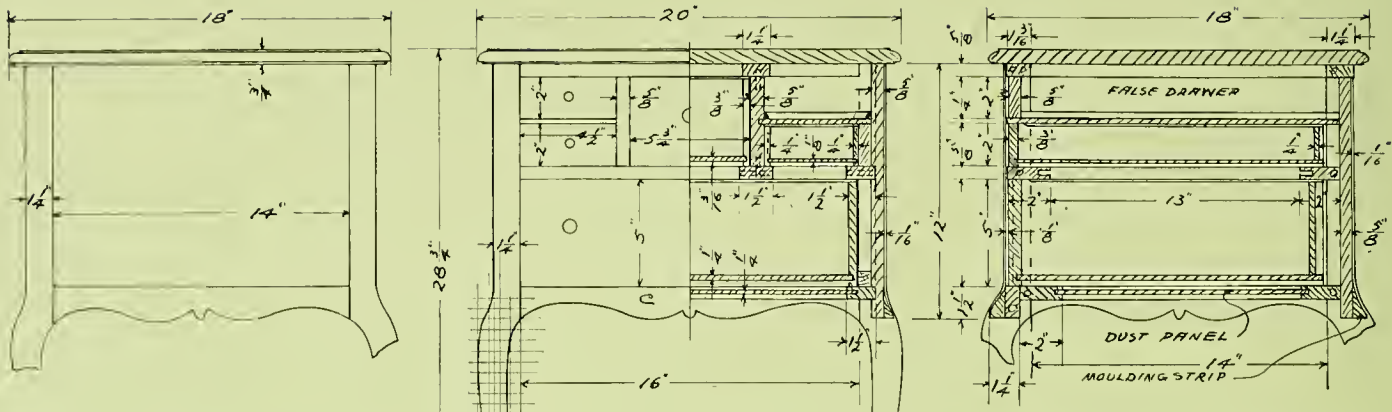
All joints to be mortise and tenon. Top to be built of soft wood and covered with leather, fastened on with metal fasteners. Posts to be built of soft wood and veneered on four sides. Posts to be fitted with heavy caster rings and sliding furniture shoes. One large turned drawer pull for each drawer, about 12" long. Use any good drawer construction.



LIBRARY TABLE

All cane work to be done on frame. Work out a groove in frame about ¼" wide and ⅜" deep. Cut the caning a little larger than space to be caned. Put glue in groove, wet caning, and force it into groove with blunt end of piece of soft wood. After caning is in groove on four sides, glue small strip of wood or reed in groove over caning. If reed is used, do not wet it. When the caning dries it will be tight.

Caning to be done after all construction is complete. Stain frame before caning. Put leather on the last thing. Drawer slides to be framed in.



Glue a strip for molding on the bottom of ends and back; work to shape. At the same time shape the molded bottom front rail C. Finish these moldings with gouge, molding scraper, and sandpaper.

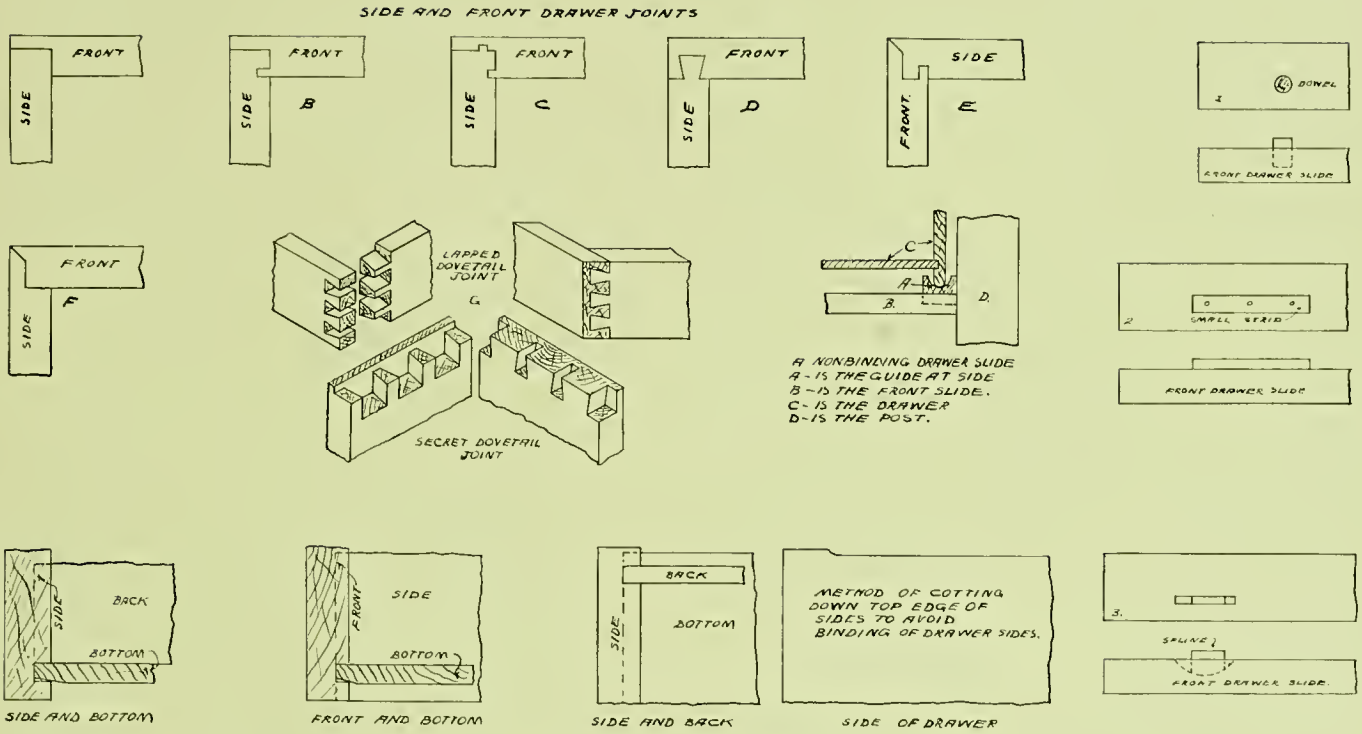
Leather pockets or sheaths in which scissors may be kept should be fastened to the under side of the top.

Secure the top with butt hinges. To keep the top in upright position when open, two brass chains may be used. Either wooden knobs or metal pulls would be appropriate on the drawers. Fittings for the small drawers should be, among other things, pin trays and needle trays. Spool holders should be placed in one of the false drawers.

SEWING CABINET

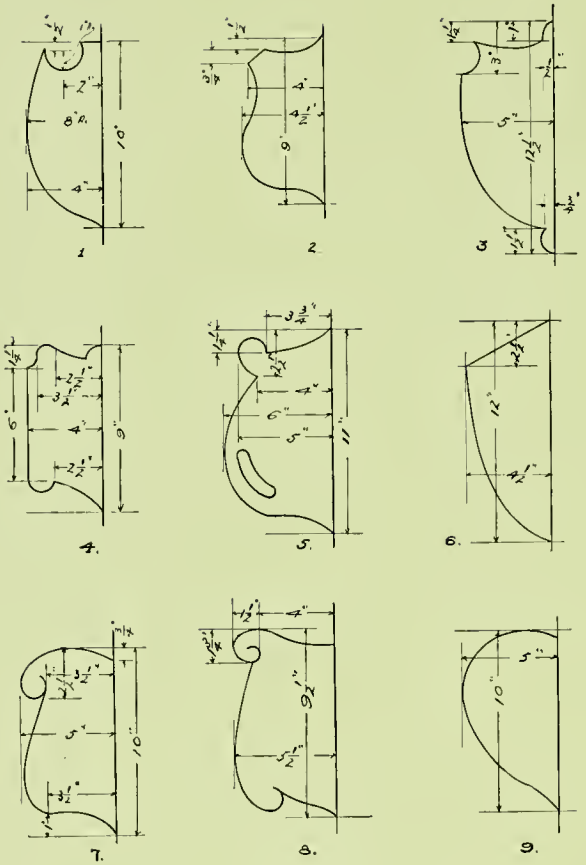
Block out the legs to required size for curves. Make template and trace around it on lumber prepared for legs, and saw out on the band saw. Smooth the band sawed surfaces with a spoke shave. The spoon foot should be laid out and finished with a carving chisel. The outer edge of the entire leg is round. All joints to be mortise and tenon so far as possible. Legs may be fitted with small casters. The squares on which the legs are laid out are $\frac{1}{2}$".

ADVANCED CABINET PROJECTS

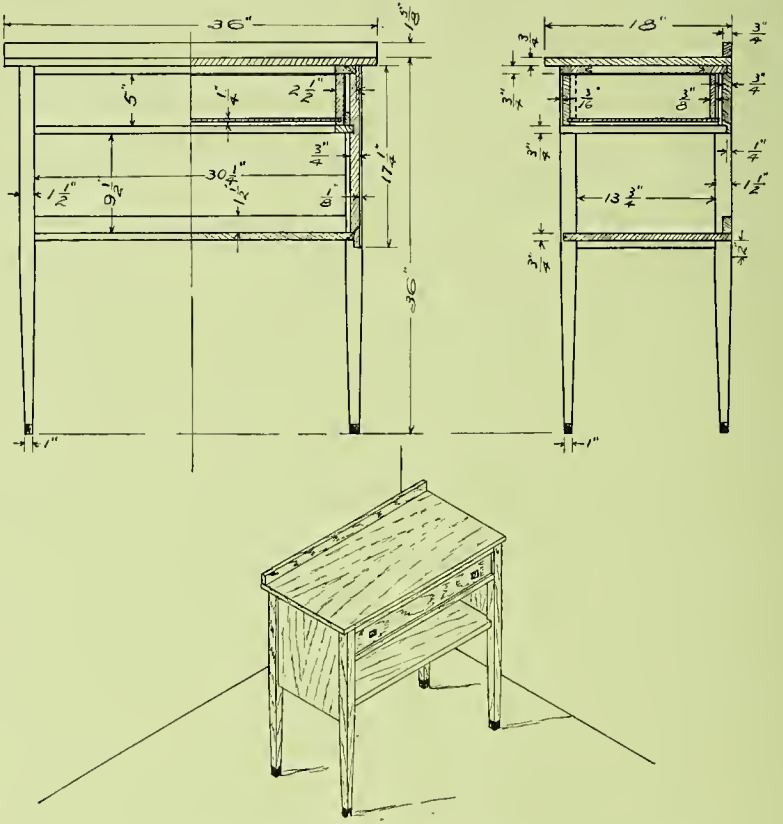


DRAWER CONSTRUCTION

Nos. 1, 2, and 3 at the right are methods of putting in drawer stops in the front slide or crosspiece. The above is only suggestive. One should be able to build a good drawer by using any of the joints.

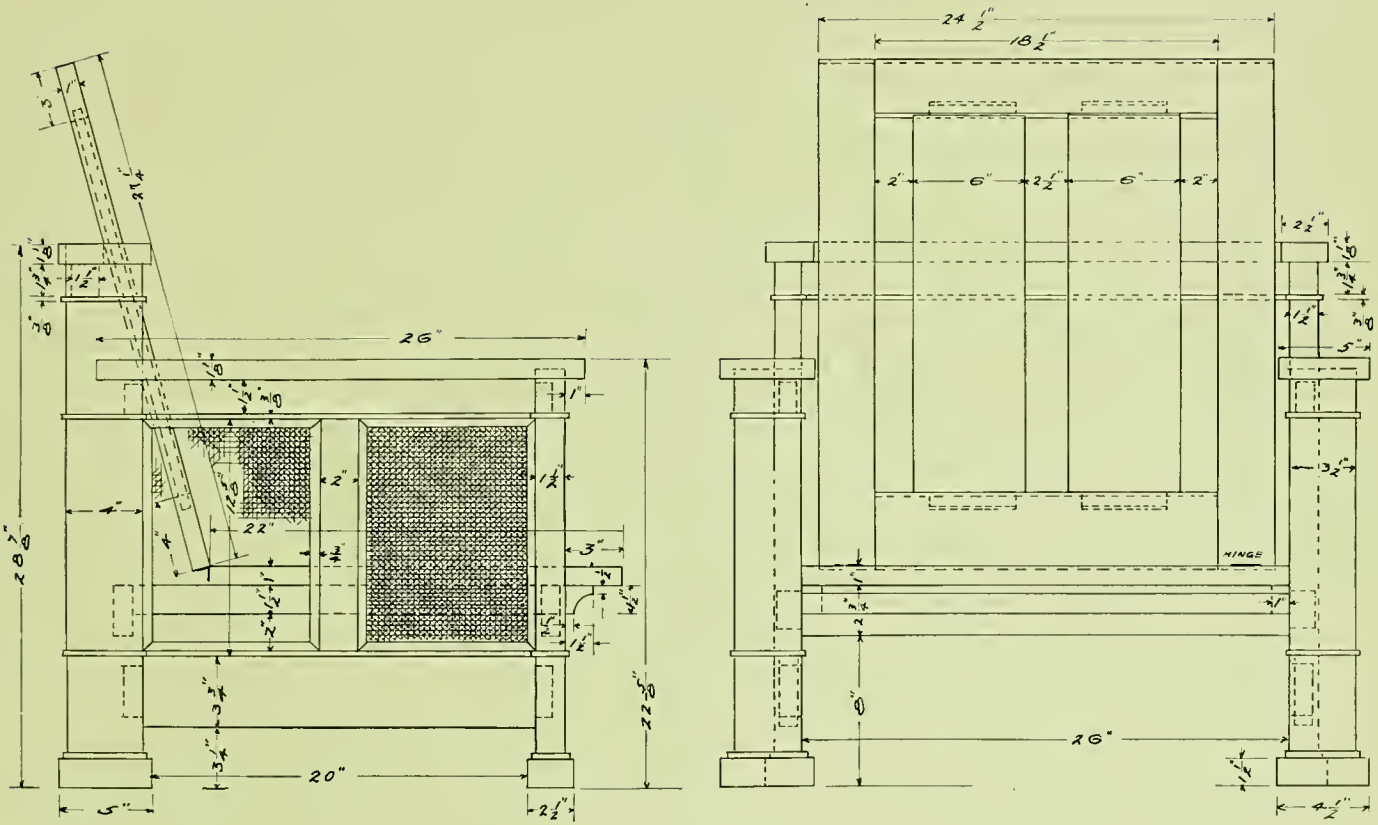


SHIELDS



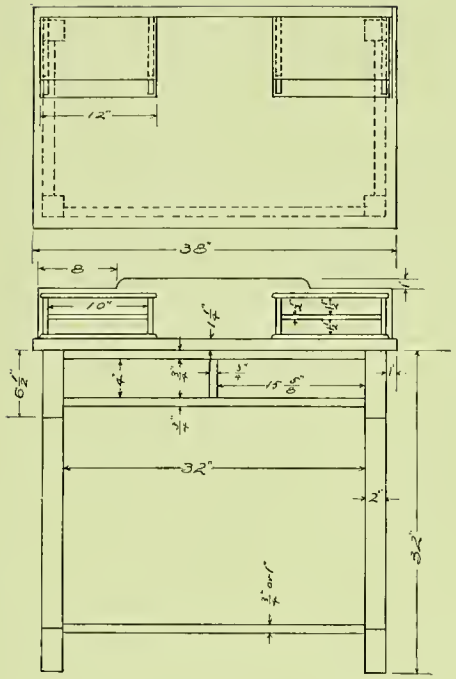
SERVING TABLE

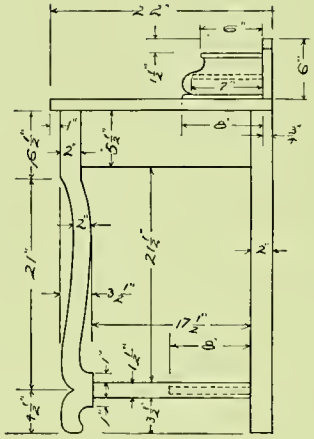
Dowel or mortise and tenon joints may be used. Taper legs to 1" at bottom and fit with open caster rings. Use a fumed and waxed finish.



LIBRARY CHAIR

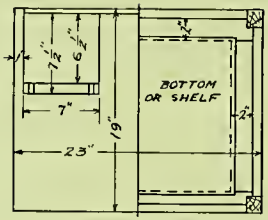
All joints to be mortise and tenon. Sides of chair to be caned as shown. Cane work to be done on frame $\frac{3}{4}$" wide. Holes to be spaced $\frac{1}{2}$". Back may be caned. Bottom may be upholstered or cushion used.

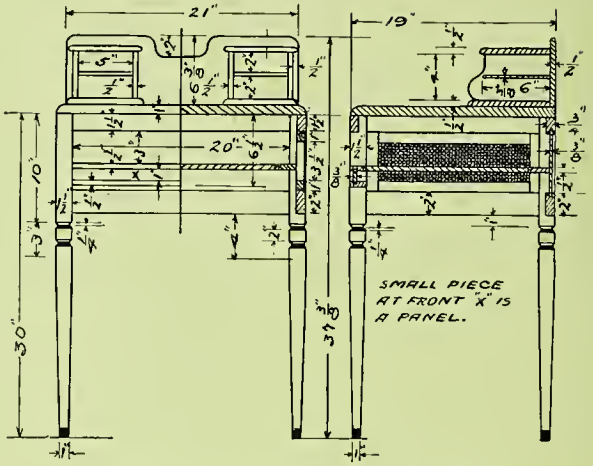




DESK

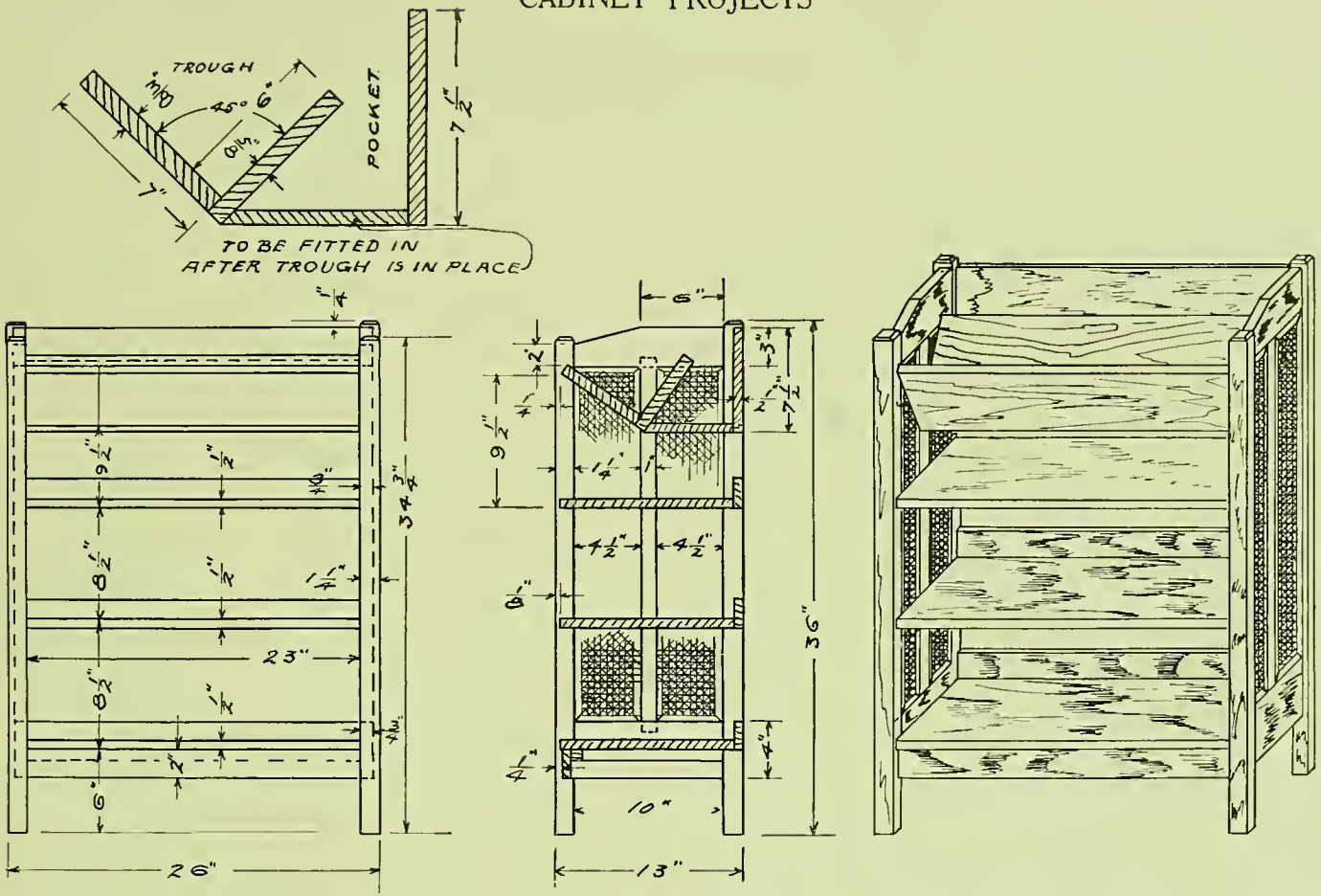
Stock, any hard wood. Front legs to be shaped. Joints to be mortise and tenon. Front of drawers to be slightly round on top and lower edges. If casters are to be used, shorten legs 1½". Fasten pigeon-holes on with dowels.





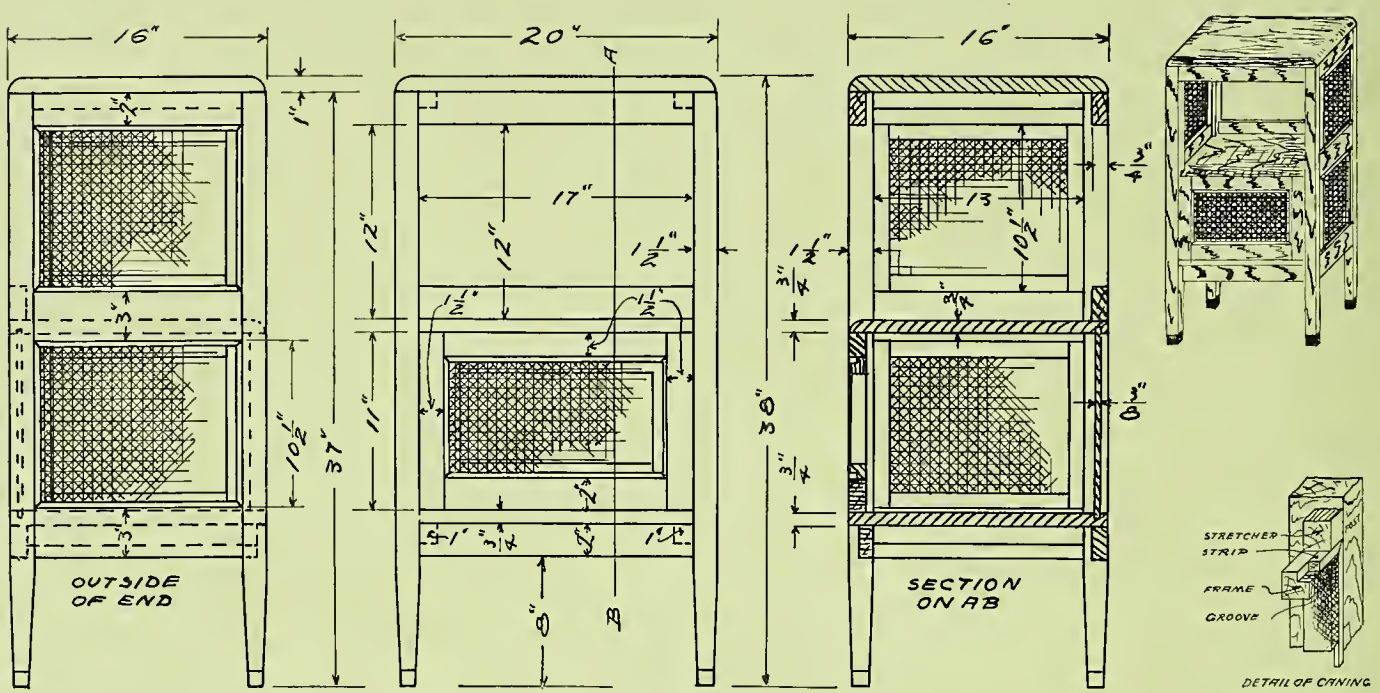
SHERATON TELEPHONE CABINET

Joints to be mortise and tenon. V-grooves in legs to be done with chisel. Caning to be put in on frame. Fine fine cane to be used. Back to be a ⅜" panel. Pigeon-holes on top may be fitted with small drawers. Fit bottom of legs with 1" open caster rings and casters to match. Use a fumed oak stain. Fill, varnish, and rub dull.



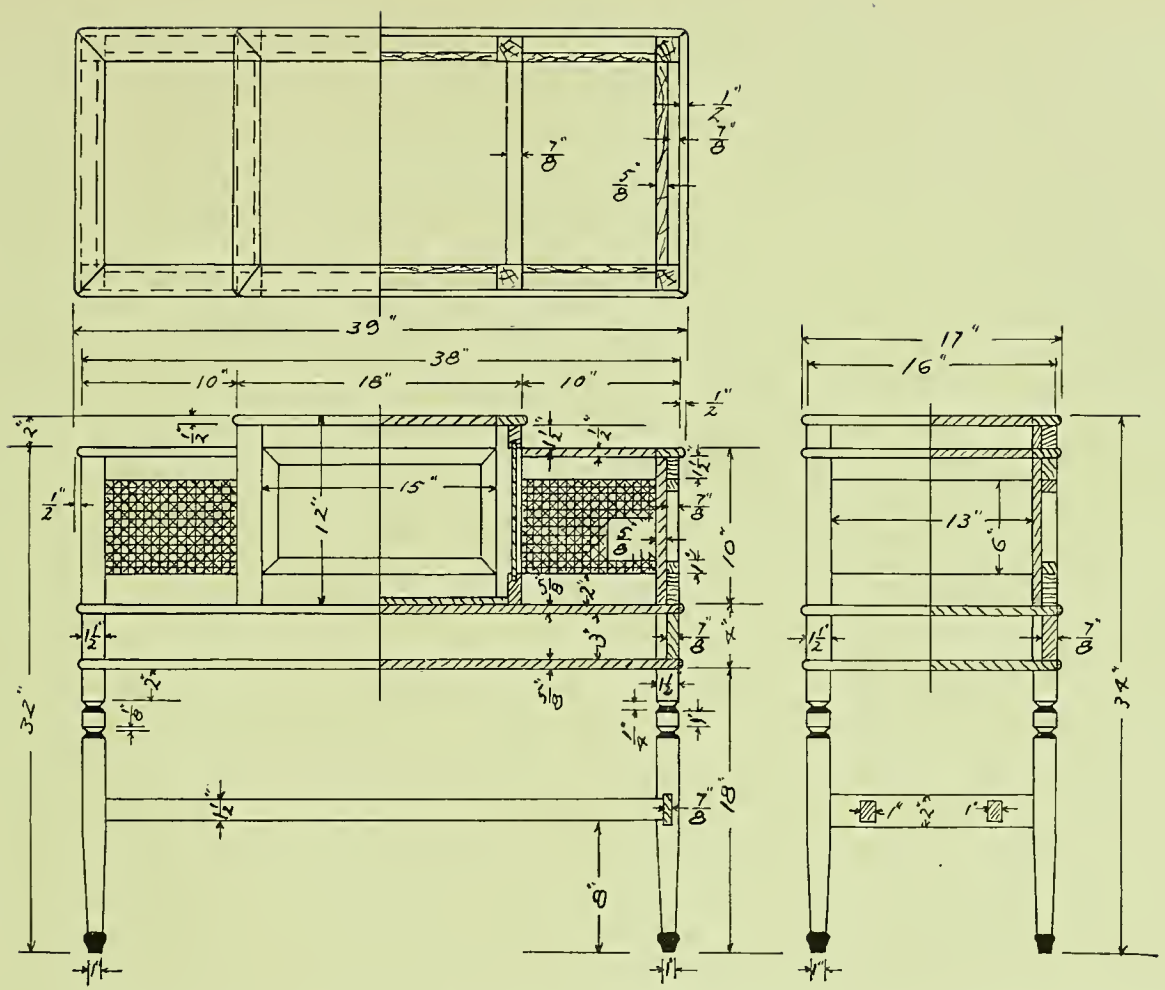
MAGAZINE RACK WITH BOOK TROUGH

Joints to be mortise and tenon so far as possible. Two cane panels on each side. Caning to be done on frame. Holes spaced ½". If cane is not desired, make 1 slat 3" or 4" wide or 3 1" slats. All end framing to be flush with inside. Shelves to be doweled or fastened with screws and holes plugged. The 4 pieces at back frame into posts and are screwed to shelves from back.



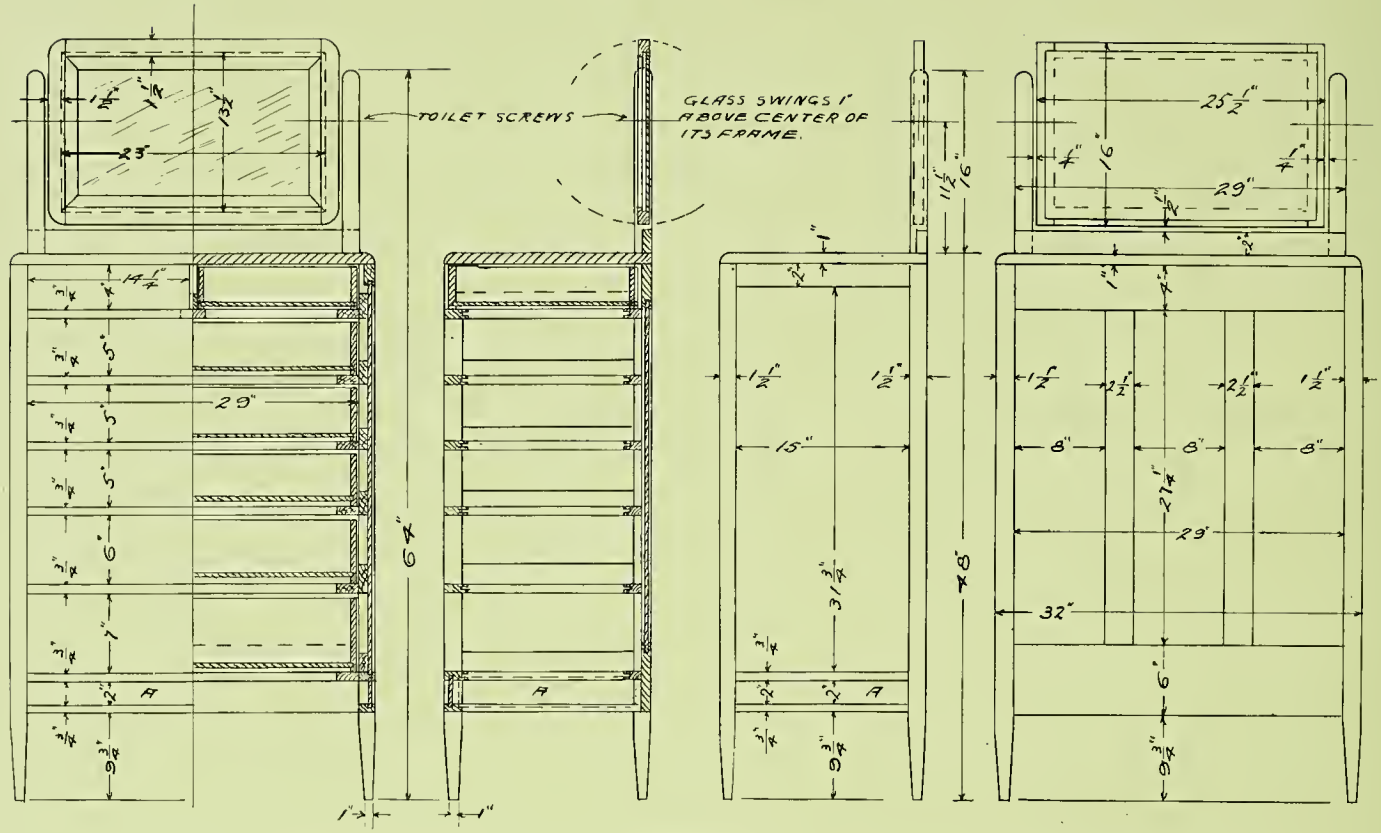
CHAFING DISH STAND

All joints to be mortise and tenon. Caning may be hand or purchased. If hand, drill $\frac{3}{16}$" holes $\frac{1}{2}$" spaced in frame. If manufacturing cane is used, the frame will have to be grooved. Cut caning larger than space to be caned. Put glue in groove. Wet caning and force down into groove with blunt end of piece of soft wood. A small strip of wood or reed glued into groove over caning holds caning in place. If reed is used it must not be wet. Hang caned door with the Soss invisible hinge. Use knob on door with lock and key if desired. Back is to be left open at top. Small wood panel at bottom.



AQUARIUM AND FERNERY COMBINED

All joints to be mortise and tenon so far as possible. Posts are square with V-grooves worked out with chisel and fitted with 1" caster rings. Box provided with glass on sides only. The two sides and outside ends of fern boxes to be caned with fine fine cane. Metal boxes to be set into fern boxes.



CHIFFONIER

Stock to be selected by builder. Any good drawer construction for drawers. Legs to taper as shown and to be fitted with caster rings and casters to match. All hardware should match. Mirror to be French plate with $1\frac{1}{2}$" bevel. Pieces marked *A* are panels set $\frac{3}{16}$" back. Drawers should slide $\frac{1}{8}$" back of front face of front posts. All joints to be mortise and tenon. Frame in which mirror frame swings to be fastened to body with cleats.

CANING

Cane is the name applied to many plants that are possessed of long, slender, reed-like stems.

Properly it should apply only to a class of palms known as rattans.

The plants are found throughout the Indian Archipelago, Malay Peninsula, China, India, and Ceylon.

They are described as growing in dense forests into which sunlight rarely penetrates, forming spiny bushes, making passage difficult or impossible.

They frequently grow to the tops of the trees, fall over and trail on the ground; in fact it is their nature to trail.

The stem is covered with green foliage, grows to a length of from one hundred to three hundred feet, and is rarely over one inch in diameter.

For export the stems are cut into lengths of from ten to twenty feet.

The outer bark or peel is stripped off into widths varying from one-sixteenth of an inch to three-sixteenths of an inch and put into bundles or hanks of one thousand linear feet each.

Cane from India has very glossy peel while that from other places is usually dull in appearance.

The first step in hand caning, after the frames have been built, is to make the holes.

These are spaces 1/2" apart for fine cane peel and up to 3/4" for the coarser peel.

There should be an equal number of holes on opposite sides, but they need not be equal on all sides.

One hole must be at each corner or in the point of intersection of the lines of centers (Plate 14, page 51).

The holes should be 3/16" in diameter and from 1/4" to 1/2" back from the inner or the outside edges of the frames, making a straight row parallel with the edge of the frame.

The cane peel should be soaked in water before using.

This prevents the peel from breaking and makes it easier to handle. It will pull taut when dry.

A sponge should be kept at hand while weaving, dipped in clean water, and the peel pulled through it often, to prevent the strand of cane from drying out.

The weaving is done as shown in the drawing, 1, 2, 3, 4, 5, 6, page 125.

The six strands which make up the weave are woven in the order shown.

Numbers 1, 2, and 3 should be a little loose or at least not pulled tight.

Number 4 together with the drying will take up the slack.

A needle about 16" to 20" long, like the one in the drawing, is best for weave Number 4.

The needle is pushed through the strands over and under across the panel.

The cane is then threaded into the eye and the needle pulled back.

By turning the needle over when pulling through and pulling back, the small bent point works over and under the strands to good advantage.

Number 4 should be pulled taut.

Number 5, the first cross weave, should be started very carefully, noticing the fact that it always crosses in the loose corner or so that it slips between the two cross weaves and does not bind.

Number 6 travels the same on the opposite side from Number 5.

Each time that one goes over the other goes under.

Cane is held while starting by little soft wood pegs pushed into the holes over the cane peel.

When the first loop on the under side is made in going from one hole to another, the end is slipped under it and thus fastened, and the peg is then removed.

The work is to be bound around the edges through the holes.

See method of binding hand caning, page 125.

The binder is a straight piece of cane peel, larger than the peel used for the weave. It is laid over the row of holes and fastened down with another piece, the same size as the weave, that is brought up through each hole over the binder and down through the same hole, then up and down through the next, and so on to the end.

The last hole requires a peg on the under side with a little glue on it.

Caning should be varnished or shellacked to prevent stretching in damp weather.

The frames for caning should be built of soft wood mitered, tenoned, or with half-lap joints.

A and *B* show two methods of preparing the frames for hand caning, page 125.

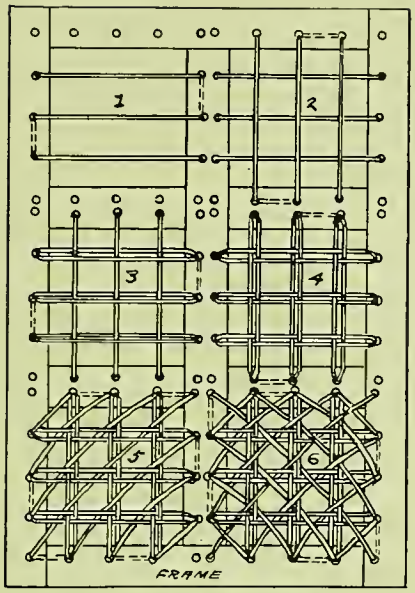
A requires cane peel binder, while in *B* the holes are covered with a strip of wood.

The frame in *B* has a 3/16" rabbet worked out on each side to within 1/4" of the back edge.

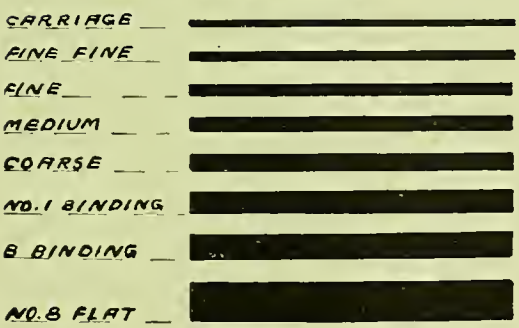
C and *D* show two methods of building the frames for factory caning.

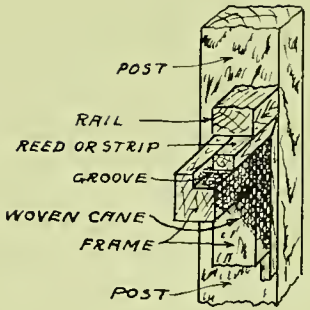
The binder in *C* is a 1/4" reed.

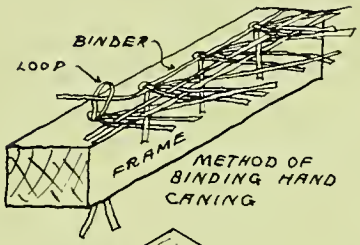
D shows the reed covered with a thin strip of wood.



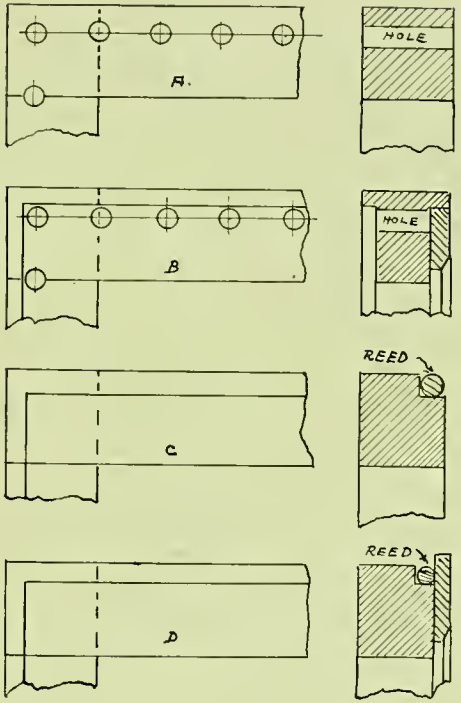
FULL SIZE CANE

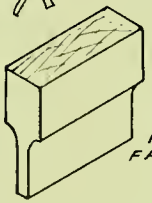






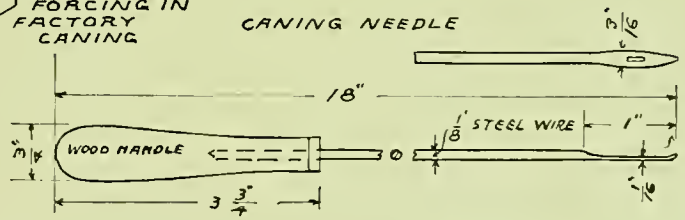
METHOD OF BINDING HAND CANING





BLOCK FOR FORCING IN FACTORY CANING

CANING NEEDLE



The sketch shows the caning held in place by a strip of wood instead of a reed.

The factory caning is easily put in and saves time.

Prepare the frames working out the rabbet 1/4" × 5/16" before making the corner joints.

The frames must be fitted tightly into the opening provided.

Stain the frames.

Cut the caning about 1/2" larger all around than is required to fill the panel.

Steam the caning or soak it in hot water.

Place glue in the grooves.

Lay the caning over the opening to be caned.

Be careful to keep the line of holes in the caning parallel with the cane frame.

Drive a few very fine wire brads on the sides through the strands of cane peel, just far enough to hold the caning from slipping.

Take a piece of soft wood, say 1/2" × 3" × 6", and work it down to look like the sketch, page 125.

The small part at the end must be a little smaller than the groove into which the caning is to be forced.

Take the hammer and force the caning down into the groove with this piece of soft wood.

Begin on one of the long sides first, take the other side next, the two ends last.

As each side and end is finished fasten the binder in place.

If reed is used do not wet it.

The corners of the binder are mitered and held in place with fine wire brads.

Trim the exposed ends of the caning with a very sharp knife. Dry in the open air if possible.

STENCILING

A stencil pattern is a design cut in a heavy sheet of oiled paper.

The stencil pattern is laid flat upon the cloth or material and the color is then brushed over its surface.

Thus the design formed by the openings in the paper is applied to the material beneath.

With proper care a stencil will last indefinitely.

There are two kinds of stencils:

1. The Solid Stencil is that in which the whole pattern is cut out and which produces a complete design. See *A*, page 129.

2. The Outline Stencil is only the drawing or the outline, as the name implies, of the decoration. See *B*.

A solid stencil decoration may be produced in one or more colors with one or more stencils.

An outline stencil does not give a finished or completed decoration, but requires the additional work of filling in by hand after the outline is applied to the surface and is dry.

The outline stencil is used more for wall decoration.

HOW TO MAKE THE STENCIL PATTERN

Trace or draw the pattern on the stencil-board or oiled paper.

Heavy manila paper may be used.

Place a piece of transfer paper between the stencil-board and the drawn pattern.

Fasten the pattern down firmly upon the stencil-board with thumb tacks.

Trace with care.

Do not press too hard on the lines which make up the pattern.

Repeat parts of the design at each end to allow for matching. See *C.D.*

If heavy manila paper is used, the paper should be oiled with sweet oil on both sides after the tracing or redrawing has been done.

Allow a few minutes for the oil to penetrate, and then wipe off any surplus oil remaining on the paper.

The oil weakens the fiber of the paper, thus making it easy to cut and less likely to tear.

If the pattern is not to be traced, it will be necessary to draw it directly on the stencil-board, which is a little hard.

It is better for the beginner to make the drawing on another piece of paper and trace or transfer the pattern to the stencil-board.

TO CUT THE STENCIL

Place the stencil-board on the table or on a drawing-board, and slide a piece of blotting paper under the stencil.

The blotter does not need to be the same size as the pattern, as it can be moved about as required.

Fasten tightly with thumb tacks.

Take the stencil knife or any sharp-pointed knife, hold it at right angles to the paper, and cut through the stencil-board with each stroke.

Aim to cut each curve with one sweep by a slow, firm movement.

Make the corners and angles clear and clean and make the curved lines run harmoniously.

The edges must not be left rough.

When the parts of the pattern are all cut out, take the paper away from the board, and if you used manila paper or intend to use dye on the stencil-board, give each side a coat of thin white shellac.

Hang the stencil up to dry.

After drying it is ready for use.

Care must be exercised when cutting and small connecting parts must be left uncut, thus preventing portions of the design from falling out. See *G.H.* on page 129.

HOW TO USE THE STENCIL

The stencil should be held firmly against the surface to be decorated.

Use thumb tacks to hold the stencil securely in place.

Apply the colors through the openings in the stencil to the exposed surface, holding the brush at right angles to this surface.

Use a regular stencil brush and work the color into the surface with a circular motion, making the brush help hold down the stencil while it is applying the color.

A small stencil can easily be held in position with one hand.

THE BRUSH

A regular stencil brush should always be used.

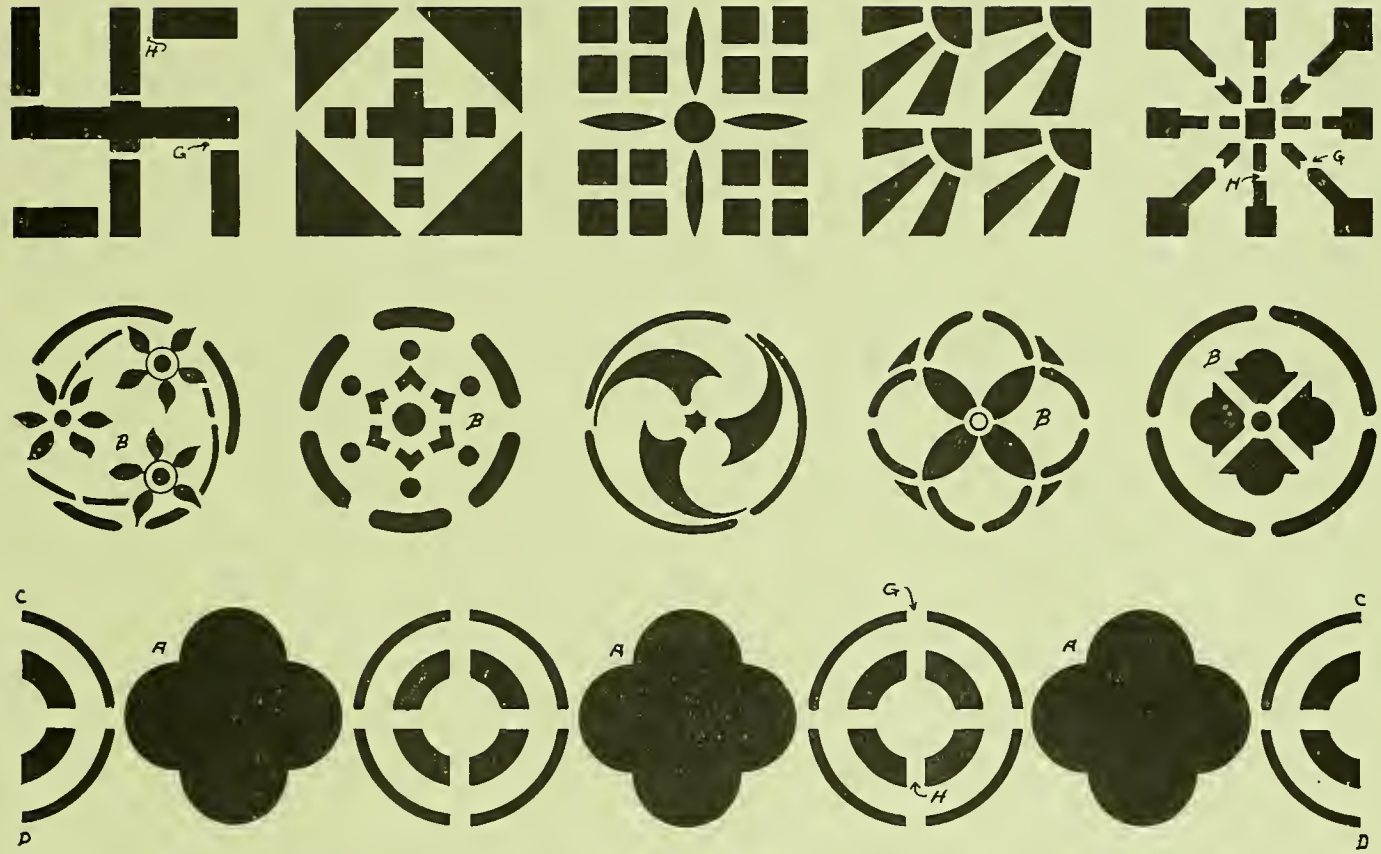
It should be clean and in good working condition.

A short bristle brush is best as the color can be worked into the material without having the bristles spread or work under the edges of the stencil.

Stencil brushes are made in various sizes, the smaller size being more suitable for the smaller size stencil patterns.

THE COLOR

Oil colors are a very satisfactory medium, and are recommended for general work.



STENCIL PATTERNS

The different colors to be used are squeezed out of the tube on a glass slab or plate and a few drops of turpentine are added as required.

The following companies put on the market splendid colors in tubes for stenciling:

A. H. Abbott & Co., Chicago.

The Sherwin Williams Co., Cleveland, Ohio.

American Color Co., Indianapolis, Ind.

Abbott & Co. recommend the oil colors.

Sherwin Williams Co. recommend their Flat-Tone Glaze and Stencil Colors for oil painted stencils.

The American Color Co. recommend their E-Z-Dye.

Any of these companies will furnish free instructions regarding the use of their stencil colors.

TO PREPARE THE COLORS

The colors used for the stencil must be neither too thin nor too thick.

If the color is too thick it will not give the clear, even tone, but will work out darker and heavier in spots.

If the color is too thin it will work under the edges of the stencil and blur the outline when drying.

MIXING THE COLOR

Even though the stencil paints are made up in a splendid line of colors, it is often necessary to mix two or more colors to secure the desired shade.

It is necessary at times to add stencil white to the color or mixed colors.

A uniform shade is thus secured, and as sufficient color for the completion of the one border can be mixed at one time, a more even tone will be obtained.

The addition of white is not always advised, for a clear, pure color is often necessary.

REDUCING THE COLOR

The strength of the color used may be reduced as follows:

1. By adding white.
2. Thinning with "Glazed Liquid."
3. Thinning with turpentine.

Too much liquid of any kind should be avoided when thinning the color.

Always try out the brush, either on the palette or stencil-board, to find if the color is working properly.

Many colors lose their richness when white is added.

Therefore, use Glazed Liquid.

Substitute turpentine for the Glazed Liquid if the former cannot be obtained.

SETTING THE COLORS

Sherwin Williams use a Stencil Medium, about one-tenth part, well mixed with the color to make washing possible.

If E-Z-Dye is used, place a wet cloth over the finished stencil work and steam it well with a hot iron. This makes the colors absolutely fast for washing.

The materials, patterns, and colors should be carefully selected with relation to each other.

If a border design is to be applied, keep the margin even.

A chalk line, basting thread, or crease will make a good guide.

STENCILING ON FABRICS

Such fabrics as are used for curtains and table covers, including muslin, scrim, denim, linen, taffeta, and even velvet and chiffon can be treated with stencil colors.

The end of the brush should be filled with color, wiping off any superfluous color before putting the brush on the fabric.

The article to be stenciled should be laid over a sheet of white blotting paper on an even, flat surface, and the stencil firmly tacked in place.

The purpose of the blotter is to provide a good working surface and absorb any surplus color that may penetrate the cloth.

Use a separate brush for each color.

The tendency with the beginner is to apply more color than is desirable.

The fabric should be stained rather than painted.

When the first impression has been finished, lift the stencil carefully, and if, through carelessness, any surplus color has collected on the under side of the stencil, remove it gently with a soft cloth, and place the stencil in position for the next impression.

Some make a pad of several layers of cloth torn from something which has been made soft through having been laundered a number of times.

Place the pad in a saucer, then with the brush lift part of the dye which has been prepared to the pad.

Add a few drops of warm salt water to the mixture on the pad and rub in well with the brush.

When you are ready to stencil, take the color from the pad with the stencil brush.

This is better than using the dish, as it helps to prevent getting too much paint or dye unevenly on the brush.

MATERIALS AND TOOLS

1 Large stencil brush
1 Small stencil brush
1 Medium stencil brush
1 Bottle turpentine
1 Glass color slab (Piece of window glass)
12 Thumb tacks
12 Well selected, Standard Oil stencil colors
1 Bottle stencil dryer
1 Bottle "Glazed Liquid"
1 Bottle sweet oil
Stencil-board, or manila paper
Transfer paper

Stencil-board may be purchased at Bradner Smith & Co., 175 West Monroe Street, Chicago.

The three color-supply houses mentioned above furnish complete lines of colors and stencil supplies and outfits as well as prepared stencils ready for use, and will make special prices to schools.

Stenciling for barrels, boxes, and on ground plot markers is usually done with stencils made of thin sheet metal.

They may be worked out in the same manner as described above, using stencil-board.

Have the wood clean and smooth and painted white before applying the black color over the stencil.

Use the stencil brush and apply the black color.

Use any black substance such as stencil black, quick drying black paint, etc.

Thin with turpentine.

In drawing letters leave connecting portions of the stencil-board in order to hold the parts forming the letters in place. See *G.H.*, page 129.

THINGS TO REMEMBER

A fair knowledge of drawing is absolutely necessary if one makes his own stencil patterns.

Provide a separate stencil brush for each color.

Use turpentine very sparingly.

Use a good sharp stencil knife for cutting out the stencil.

If dye is to be used the stencil must be coated on each side with white shellac.

Use stencil-board for the stencil pattern.

Keep the stencil straight when repeating the stencil unit.

Be sure that you set the color before washing.

Apply the color sparingly and smoothly.

If the fabric is heavy more color is required.

Always plan the spacing for the design before beginning to stencil the colors.

Experience is not necessary but it is a good asset.

STENCILING

Stenciling is not difficult to learn.

Ways and means for each step readily suggest themselves to the beginner.

Ground plot markers should be painted white before stenciling.

The upper row of stencil designs represent single units on the straight line order, each design making a single unit. (Page 129.)

The middle row represents single units drawn with the compass.

The lower design represents a complete drawing for a stencil.

Note that at each end the necessary parts have been repeated for matching (see *C.D.*, page 129).

The drawings on the plate are only suggestive.

Leaves, fruit, flowers, birds, animals, Turkish designs, Arabic designs, Greek weave and border, Oriental designs, etc., may be worked out and used to good advantage.

The art of stenciling is not new, in fact it is very old.

CONCRETE WORK

The beginning of the twentieth century has witnessed rapid strides in the use of concrete. It is not difficult to determine the cause. The scarcity of timber and lumber is the principal cause outside of all consideration of concrete in its value as constructive material. The shortage of lumber simply has brought the world to a realization of its utility sooner than would otherwise have been the case.

DEFINITION OF TERMS USED

Aggregate — Crushed stone, gravel, or other substance used in concrete and joined in one mass by cement.

Concrete — A building or constructive material made of aggregate, sand, and cement.

Activity — The chemical action of cement when water is applied.

Voids — The spaces between the parts of aggregate.

Tamping — The pounding of cement to reduce voids and force the aggregate as closely together as possible into a compact mass.

Crystallization — The chemical action of cement when coming in contact with water, commonly called setting of the cement.

Efflorescence — The formation of a white crust on the surface of stone, brick, etc.

Soakage — The absorption of water by brick, concrete, etc.

Soundness — The non-expansive quality of cement.

Molds — Frames used to shape concrete into forms.

Ramming — The beating or pounding of concrete to force out the water and compress the mass.

Screeds — Levels used for guiding, leveling, and ruling off.

Reinforcing — The use of steel rods and wire to increase the strength.

Waterproofing — A dense coating of cement mortar over concrete surfaces to prevent the absorption of moisture into the interior of the mass.

Core — The mold used to form the hollowed-out part of cement or concrete work.

KINDS OF CEMENT

Natural Cement. — In various parts of the United States there is a natural rock from which the so-called natural cement is produced. The temperature used to produce it in its manufacture is not as high as that required for producing Portland cement.

Portland Cement. — Portland cement is produced by intimately mixing one part of limestone, marl, or chalk with three parts of cement rock, clay, shale, or slag, burning the two elements to semi-fusion and grinding the resulting clinker to an impalpable powder. The feature that distinguishes Portland cement from all others is the intense heat at which the pulverized raw materials are calcined and the accurate proportioning of the essential elements entering into its composition. These elements are lime, silica, alumina, and oxide of iron and there must be in the finished product not less than 1.7 times as much lime by weight as of the other elements.

Pozzuolana Cement. — The cement used by the Romans was known as Pozzuolana cement. It was made from lime and volcanic dust.

Things to Remember. — Do not purchase cement or stone till you know exactly what you are going to do and how you are going to do it.

Familiarity with the rules governing the mixing and the proportions and quantities are absolutely essential to success.

Do not guess at the measurements.

Do not use less cement than any formula calls for.

Mix thoroughly, and a little more.

Put the concrete in place at once.

Use clean water and clean stone, gravel, and sand.

When working in concrete in the open air, cover the work with burlap or any light cloth to protect the work from air drafts and from the sunlight.

Never use cement that has once set.

Never redampen a mixture that has commenced hardening. If you have such a mixture let it harden and then crush it, using it again as you would use crushed stone in the aggregate.

Never neglect sprinkling. The more nearly like a mist the spray is the better for the work.

While your work is in the plastic state it must be handled with extreme care.

The best and quickest way to mend artificial stone is to make the stone over again.

To ignore any of the above means failure; to follow them to the letter makes success certain.

Formula.—Portland cement, one part; sand, three parts. The sand should be suitable silicious material, passing the one-fourth inch sieve, clean, gritty, and free from impurities.

Mixing. — Thorough and vigorous mixing is absolutely necessary.

The cement and sand in correct proportions shall first be perfectly mixed dry.

Add the water carefully and slowly and work it thoroughly into and throughout the resultant mortar.

Molding. — Due care shall be used to secure density and uniformity in the work by tamping or other suitable means of compression.

Tamped work shall not be finished by simply striking off with a straight edge, but after striking off the top, surface shall be trowelled or otherwise finished to secure density and a sharp and true edge.

Curing. — Every precaution shall be taken to prevent the drying out of the finished work during the initial set and first hardening.

A sufficiency of water shall first be used in the mixing to perfect the crystallization of the cement, and after molding the work shall be carefully protected from wind currents, sunlight, dry heat, or freezing for at least five (5) days, during which time additional moisture shall be supplied by approved methods, and occasionally thereafter until ready for use.

Sand. — Only clean, sharp, and gritty sand, graded in size from fine to coarse and free from impurities, can be depended upon for the best results. Soil, earth, clay, and fine sand are injurious and at times dangerous.

The so-called clean, very fine sand has caused much trouble in cement work and should always be avoided, but if impossible to obtain better sand the proportion of cement should be increased.

It is easy to determine clean sand. Sand which soils the hands when rubbed between them should not be used.

Drop a quantity of sand into a pail of clear water. If in two minutes the water is clear enough to enable one to see the sand at the bottom, the sand is clean.

Water. — None but pure, clean water should be used.

Fresh cement requires more water than cement that is stale.

Do not use warm water.

Use as much water as possible without causing the work to stick to the forms or to sag out of shape on removing the forms.

Work made from material that is too dry is soft and weak.

On the other hand, if too much water is used the material will stick to the forms.

Coloring. — Mix the coloring material with the dry cement.

This method assures a thorough coloring and a uniform shade throughout.

Care in Tamping. — The satisfactory building of basins, troughs, flourboxes, etc. requires great care especially in tamping, to make the work water-tight and frost-proof. The voids also must be reduced to the lowest possible minimum by the use of various sized particles of sand in the aggregate. Mix the composition slightly damper than for ordinary tamp work; especial care must be taken not to jar or disturb the work after the tamping is completed.

Forms. — In the making of forms material should always be used that is thick enough to make it certain that there will be no warping. Timber that has not been seasoned is preferable to dry material, which is apt to warp when brought into contact with the wet cement.

Unless the work is to have a finishing coat, it is the usual practice to grease the forms or line them with paper.

The bracing should be ample to stand all pressure.

The longer the forms are left in place the better it will be for the concrete.

It may be said as a general rule that not more than four inches of concrete should be placed in a form at one time, and each layer should be tamped thoroughly.

The cuts represent concrete work done at the Agassiz Summer School, Chicago, under the supervision of Mr. J. W. Thompson.

Dirt cores were made in forms or swept into shape with a sweep designed and built by the pupils in Mr. Thompson's classes.

When the form cores were used another form larger and deeper than the core form was placed over the dirt core, braced and nailed, and the concrete tamped in place and over the bottom. When the concrete set the form was removed and the dirt core removed.

The swept cores were covered with cement and swept into shape with another larger sweep shaped to form the outside of the work.

By using the earth cores one saves time, labor, and expense. Use clean dirt.

The earth cores must be tempered with water so that when a handful of the mass is grasped and pressed together it will hold its shape when the hand is opened. It must be neither too wet nor too dry. If it is too wet the dirt will stick to the hand; if too dry it will fall apart. The concrete should be mixed to same consistency.

A careful study of the cuts will enable one to make small pieces of concrete work, using his own ideas of shapes, forms, etc.

BOYS MAKING A DIRT CORE

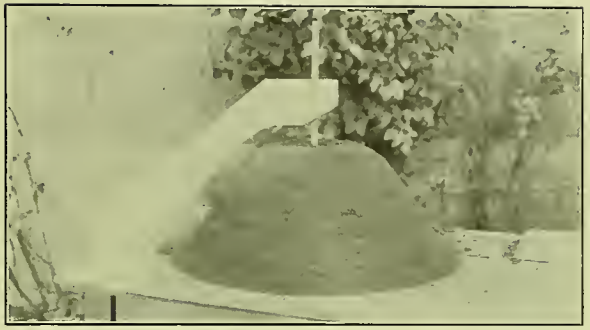
THE FORM REMOVED, SHOWING THE DIRT CORE

COMPLETED WINDOW BOX OR WATER TROUGH

SWEEPING A DIRT CORE

SECTION THROUGH DIRT CORE

Showing method of placing sweep.



SWEEP IN PLACE

To sweep the concrete after it is put on the dirt core.

COMPLETED CONCRETE WORK

COMPLETED CONCRETE WORK