PROBLEMS IN ELEMENTARY WOODWORKING

GRADED FOR INSTRUCTION BY THE GROUP METHOD

BY HUGO J. P. VITZ

THE SOUTHERN PUBLISHING COMPANY
DALLAS, TEXAS.

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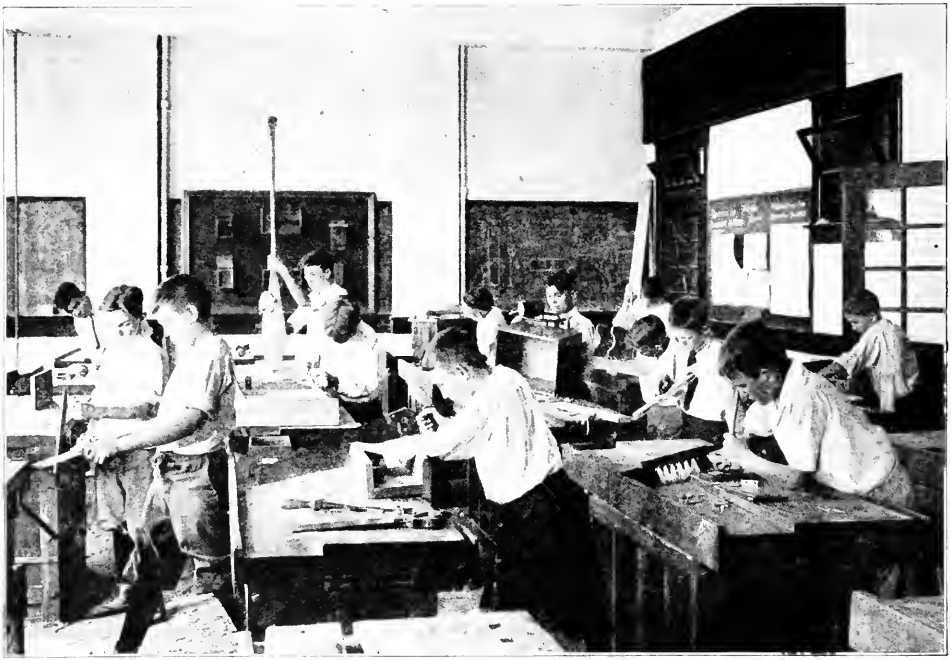

BOYS IN THE SHOP

PROBLEMS IN
ELEMENTARY WOODWORKING

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INSTRUCTION BY THE GROUP METHOD

BY

HUGO J. P. VITZ

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PREFACE

IN view of the lack of satisfactory textbooks that give a course of problems covering the use of tools, tool processes, and general principles that govern the design of a course in woodworking, frequent requests from former students have come to the author to put in concrete form a course of problems embodying the principles given to the students in his method classes. This book is the result and the reply to such a request.

This course is not perfect by any means, nor is it intended to be the last word on the subject. However, considerable care has been taken in the design and arrangement of the problems. Old standard, proven problems have been re-designed to fit the groups in which they have been placed. A number of new problems have been included which ought to give new life to the work. Some deviations and additions have been made which will add to the flexibility of the course without sacrificing fundamental principles.

It is hoped that the use of grouped problems, permitting selection from a large variety of designs involving the same tools and processes, the pictures of the models preceding the group of drawings, the outline of tools and processes under the respective groups, and the arrangement for individual designs will help to bring about an increased interest on the part of the pupil. This plan will satisfy pupils who have different tendencies and interests, increase the knowledge and control of fundamental tools and processes, without which an attempt at advanced processes will prove a failure, and it will result in greater efficiency in class instruction.

ACKNOWLEDGMENTS

Valuable assistance to the author in the preparation of the manuscript of "Elementary Woodworking" is hereby acknowledged as follows:

To Miss Mary Musgrave, Teacher of Elementary Woodworking, Ft. Worth Public Schools for line work, working drawings and the construction of a number of models; to Messrs. S. J. McGinis, Director of Trade Extension, University of Texas, J. M. Hinton, Manual Training Department, Diamond Hill Public Schools, and G. B. Trimble, Teacher of Manual Training, Central High School, Ft. Worth, for assistance rendered in the construction of the more difficult models for several pictures; to Mr. Homer Wright, Manual Training Department, Bonham High School and to Mr. R. P. Curry, Manual Training Department Honey Grove High School for special assistance in line work; and to many others of the author's pupils and former students, and to friends who have given valuable assistance and suggestions, the author hereby wishes to express his most grateful appreciation.

Hugo J. P. Vitz

SUGGESTIONS TO TEACHERS

I. Selection. The problems that require the same tools and processes are grouped. This permits selection by the pupil (under the supervision of the teacher, which selection furnishes motive as an incentive) without the sacrifice of class instruction. Class instruction can be successful only in so far as the pupils can be kept near the same level of progress and attainment. By having the problems grouped the instructor can suggest the selection of a more difficult problem to the more adept pupil while the slow pupil should be urged to select an easier problem in the group.

A number of models having the same utility are designed to fit several groups and are so placed. To illustrate: In one group there will be found the foot stool and taboret. The pupil desires to make both, and yet has time to make only one piece in that group. Since the taboret, differing in design, may be found in a later group, the pupil selects the foot stool first. In this manner selection from among standard models is made possible.

It is suggested that at the beginning of the course the pupils be required to look over the problems listed and make a tentative selection of those that he prefers to make, selecting one as a first choice and another as second choice from each group. This gives the pupil a bird's-eye view of what he is expected to do in order to complete the course. It should be made clear that the construction of the models he has selected will depend upon his ability to keep up with the class.

To facilitate this selection for beginning pupils, pictures of the models (the drawings of which follow) are shown preceding Groups I, II, III, and IV of Part I and Group I of Part II. The pictures thus grouped make it easier to make a selection. It helps the boy to visualize the piece he expects to make and the better to understand the working drawing.

By permitting choice, having tools and processes grouped, the pupil not only learns the processes, but by observation, by contact, learns how the same principles and processes are applied in different ways and in pieces of different utility. This gives him a breadth of knowledge not obtained where either slight or no selection is permitted.

Again where a pupil is far beyond the rest of the class in the completion of his model in that group he may be permitted to make another piece in the same group. This gives him a different application of the processes involved and emphasizes the processes already given in his previous piece. His time is not wasted; his interest is maintained and yet he is kept in line of progress with the class as a whole.

II. Design. The problems listed are suggestive. Initiative in design should be encouraged. Whenever the pupil wishes to make a model, the construction of which fulfills the conditions and requisites of the group, other things being equal, he should be permitted to do so. For this purpose cross-sectioned sheets are placed following the working drawings of each group. The pupil should first furnish a pencil sketch (free-hand mechanical drawing) with all dimensions satisfactory to the instructor. This should be carefully drawn in pencil on a cross-sectioned sheet, under the proper group, using a scale of one division, or two divisions, etc., to the inch, depending upon the size of the piece to be drawn. This should be checked by the instructor before actual work is begun.

III. Notes. This book is primarily a course of problems logically graded. By experience and observation the author has found that each teacher trains his pupils by methods with which he is most familiar. Each teacher has some "pet" methods of construction or presentation, etc. For this reason, to permit the insertion of notes given to the pupil in class a suitable note book should be prepared, permitting related material and information to be kept with each respective group.

IV. Reading Working Drawings. The teaching to read working drawings should be a part of every course in manual training. In teaching the usual subjects, the aim is to go from the easy to the difficult. So, in presenting working drawings of the models, slightly more than half are shown with the grain of the wood represented as well as some shading. Such a drawing, of course, is not a practical working drawing, but it leads there. This has a two-fold advantage. First, the pupil learns by example the direction in which the grain of the wood should run when laying out his work. Second, he can the easier understand the working drawing. By eliminating some of the difficulties in the beginning, he readily learns to read drawings. Later these helps are omitted, bringing him into direct contact with standard, practical working drawings. His ability to read is thus brought about step by step.

V. Exercises. This textbook is divided into two parts. It will be noted that each part begins with the same exercises. The author has found that it pays to start a class with a simple exercise either inaugurating the fundamental tools and processes, or as a quick review of these fundamentals when a new year's work is begun. If, however, sufficient time is allotted to shop work so that Parts I and II can be completed in one year, then the exercise preceding Part II may be omitted.

Part II introduces joints other than butt joints. It will be noted that each of these groups is preceded by an exercise of the joint used in that group. This exercise should be made by each pupil before he begins work on his model. In other words, beginning with Part II the course consists of first an exercise, then its application in a model,—another exercise and its application, etc. By such a combination the drawbacks of the old Russian system are eliminated and yet the good points are retained. The pupil gets concentrated tool processes without loss of interest. Many pupils can make the exercise in one shop period.

VI. Size of Pieces. The models given under the groups are relatively small. The construction of small pieces cuts down the cost of time and materials. Small pieces eliminate much planing and thus permit more time for other tools and processes, and "finish" which is the weak part of many courses in manual training.

There are some processes, such as taking care of warping, fitting long pieces, use of jointer plane, framing square, etc. which can be taught only in a practical way by making large pieces. To make allowance for this, and as a special incentive to the pupil for good work and speed, the last part of each course (Group V in Parts I and II respectively) are devoted to the construction of a school project, or anything else the pupil is capable of making and which embodies any or all tools and processes that he has previously used.

TABLE OF CONTENTS

PART ONE

TABLE OF CONTENTS—CONTINUED

PART TWO

INTRODUCTION

(A preliminary exercise executed by all pupils.)

The usual practice in elementary manual training has been to omit all strictly exercise pieces. However, the author's experience has been that a preliminary exercise embracing the fundamental tools and processes at the beginning of a course, while the interest is naturally fresh, is very helpful, insuring far better work than when it is omitted. In fact, the exercise here given has been used by the author with splendid results at the beginning of every year in every course in hand woodworking, whether the pupil had previous experience or not. To say the least, a good exercise is a splendid brief review of tools and processes which form the basis for all later work.

The definitions of, names of parts, comments, etc., should be given of each tool or process as the pupil comes to it in the course of the construction of the exercise. Explanations telling the steps to be taken should be placed in some permanent form on the blackboard or wall.

A knife line should be used where accuracy is essential. This is especially true where the line drawn represents the end that will fit against another piece, as in joints. Since practice in making knife lines is essential to gaining skill in their use, it is recommended that the method taught in the exercise be followed as far as possible throughout the course. For some work, as in the case of irregular shapes, curves, preliminary layout of joints, nothing but pencil lines should be used.

Tools placed into the hands of the pupils in the beginning should be SHARP. Then the instructor should see to it that they are KEPT SHARP. The practice of using dull tools is a most devitalizing factor, against which the instructor should be forever on guard.

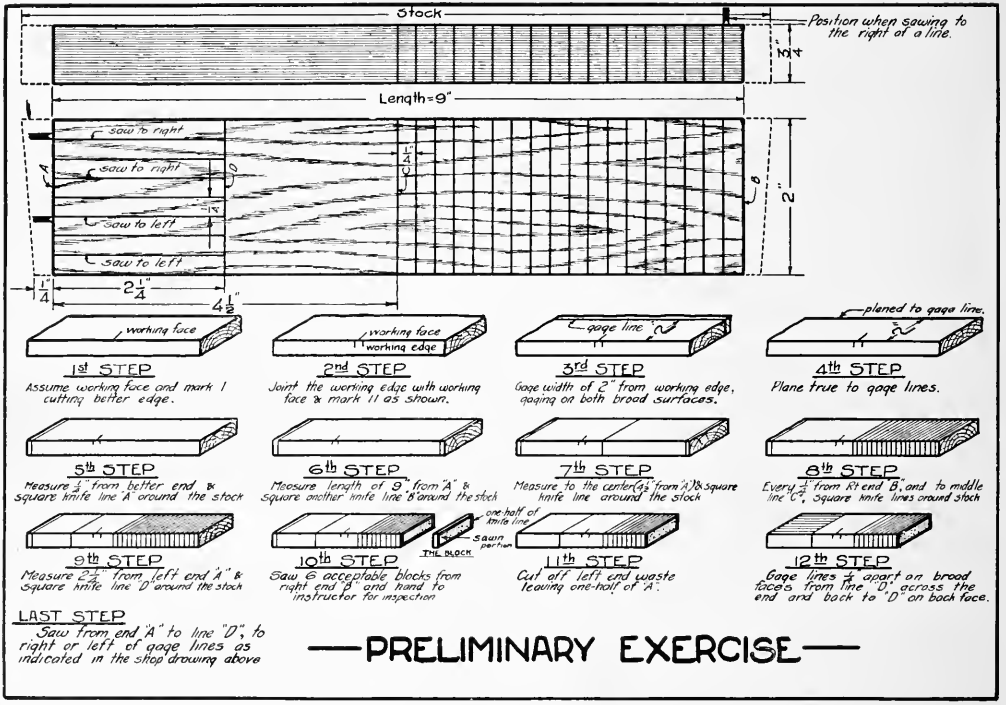
NEW TOOLS AND PROCESSES

1. Jack Plane.....Edge planing.
2. Try Square.....Testing surfaces.
3. Rule.....Measuring.
4. Gage.....Setting and gaging.
5. Try Square.....
6. Knife.....} Squaring knife lines.
7. Bench Hook.....For holding work in cross cutting.
8. Back Saw.....Sawing to knife lines.
9. Back Saw.....Sawing to gage lines.

PROBLEMS

An Exercise

(The broad faces and thickness are assumed true.)


Stock
Position when sawing to the right of a line.
3/4"
Length=9"
saw to right
saw to right
saw to left
saw to left
A
B
1/4"
1 1/4"
2"
1/4"
2 1/4"
4 1/2"
working face
working face
working edge
gage line
planed to gage line.
1st STEP
Assume working face and mark 1 cutting better edge.
2nd STEP
Joint the working edge with working face & mark 11 as shown.
3rd STEP
Gage width of 2" from working edge, gaging on both broad surfaces.
4th STEP
Plane true to gage lines.
5th STEP
Measure 1/4" from better end & square knife line A around the stock
6th STEP
Measure length of 9" from "A" & square another knife line "B" around the stock
7th STEP
Measure to the center(4 1/2") from A) & square knife line around the stock
8th STEP
Every 1/4" from Rt end B and to middle line C, square knife lines around stock
9th STEP
Measure 2 1/4" from left end A" & square knife line D around the stock
10th STEP
Saw 6 acceptable blocks from right end B and hand to instructor for inspection
one half of knife line
sawn portion
THE BLOCK
11th STEP
Cut off left end waste leaving one-half of A.
12th STEP
Gage lines 1/4" apart on broad faces from line "D" across the end and back to "D" on back face.
LAST STEP
Saw from end A" to line "D", to right or left of gage lines as indicated in the shop drawing above
—PRELIMINARY EXERCISE—

GROUP I

(The problem to be selected by the pupil under the guidance of the teacher.)

SIMPLE STRUCTURES—Unjoined Pieces

In this group, as in those that follow, the pupil is permitted to select one of the problems listed. Or the pupil may be permitted to design a problem that will meet the requirements of the group. For such purpose cross-section paper has been added at the end of each group.

The Problems having different utility, will at times vary slightly in minor processes, such as in fastening hardware, etc. In such cases slight, special, individual instruction will be necessary.

The sizes of stock differ in the various problems. For this reason pupils should learn how to get out their own stock. This may not be feasible when the class is first organized. In such case the instructor should furnish the pieces cut out before class work has begun. Later, however, each pupil should be taught to get out his own stock. This should be a part of every course.

Since this group only introduces the auger bit in a small way, a thorough representation should be made by the teacher as to the correct method of boring,—how bits are numbered, etc. This, together with the pupil's use of the bits of various sizes as they occur in future problems, should give him the needed familiarity without special consideration in a group of boring problems.

NEW TOOLS AND PROCESSES

GETTING OUT STOCK

1. PENCIL.....Marking lines.
2. FRAMING SQUARE..Measuring and squaring lines.
3. RULE.....Pencil gaging.
4. HAND CROSS CUT SAW.....Cutting out stock across the grain.
5. HAND RIP SAW....Cutting out stock with the grain.

THE PROBLEM

1. JACK PLANE..... Planing broad surfaces.
2. BLOCK PLANE.....End planing.
3. BRACE AND AUGER BIT.....Boring.
4. PENCIL GAGE.....Laying off chamber.
5. CHAMFERING.....Planing oblique surfaces.
6. SMOOTH PLANE....Smoothing surfaces.
7. SANDPAPERING.....Use of sandpapering block.
8. VARNISHING.....Brush finish,—two coats.

FOURTEEN PROBLEMS

SPIRAL PAN RACK
BROOM HOLDER
CALENDAR
THERMOMETER
HAT AND COAT RACK
FLOWER POT BIRD HOUSE
RING TOSS
IRONING STAND
MATCH SCRATCH
KITCHEN ORDER PAD
KEY RACK
SWING BOARD
SPOOL HOLDER

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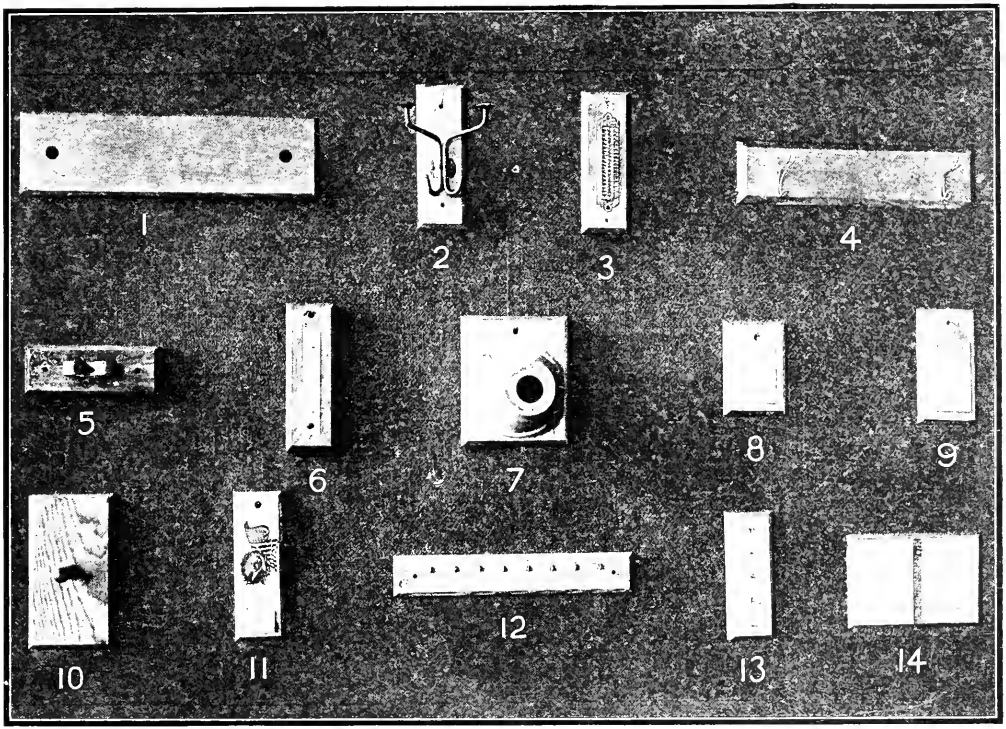
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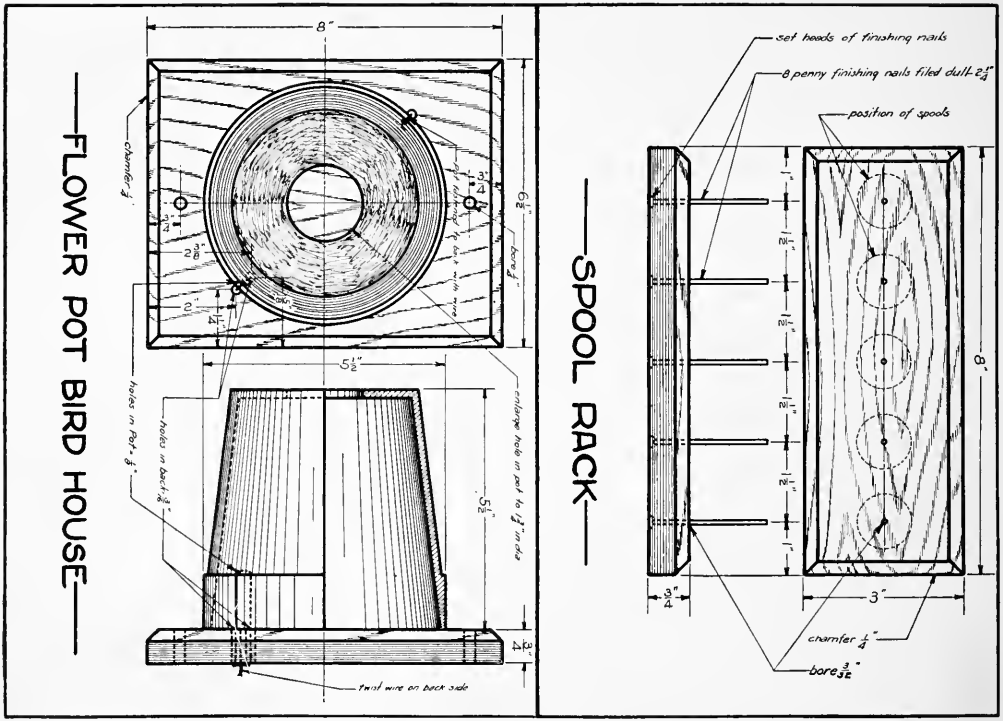
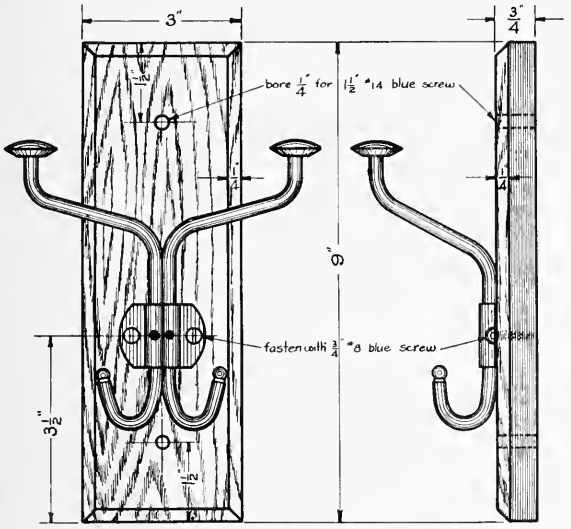
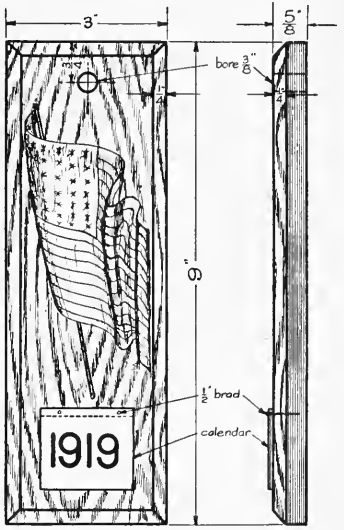

FLOWER POT BIRD HOUSE
8"
chamfer $\frac{1}{4}$"
$6\frac{1}{2}$"
bore $\frac{3}{4}$"
$1\frac{3}{4}$"
$2\frac{3}{8}$"
2"
$5\frac{1}{2}$"
holes in Pot $\frac{3}{4}$"
holes in back $\frac{3}{4}$"
enlarge hole in pot to $\frac{3}{4}$" dia
$5\frac{1}{2}$"
$\frac{1}{4}$"
twist wire on back side
SPOOL RACK
set heads of finishing nails
8 penny finishing nails filed dull $2\frac{1}{4}$"
position of spools
8"
$\frac{3}{4}$"
3"
chamfer $\frac{1}{4}$"
bore $\frac{3}{8}$"



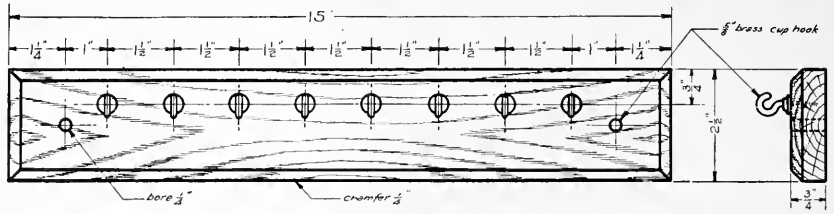
NOTE - *For the above metal rack, ask for Copper Bronze Hat & Coat Rack #619-0C - Simmons Hdw. Co. St Louis, Mo.*

—HAT & COAT RACK—

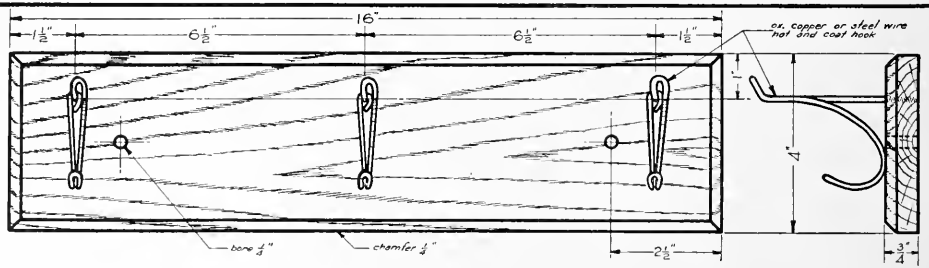


NOTE:- *Calendars to be attached may be gotten at art or book stores.*

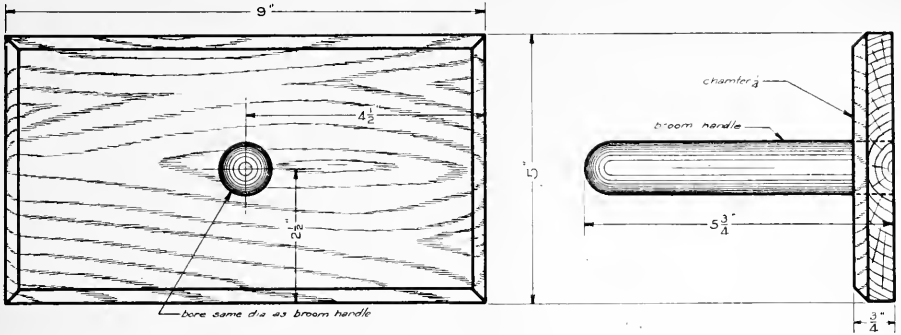
—CALENDAR—



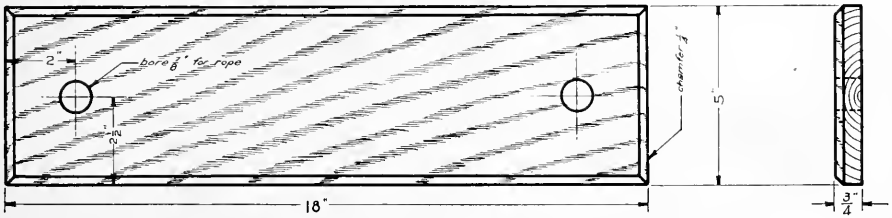
KEY RACK



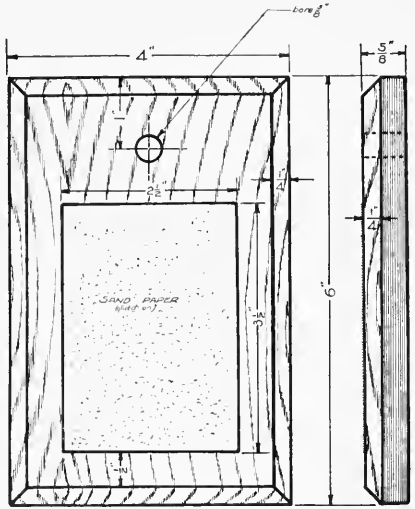
HAT & COAT RACK



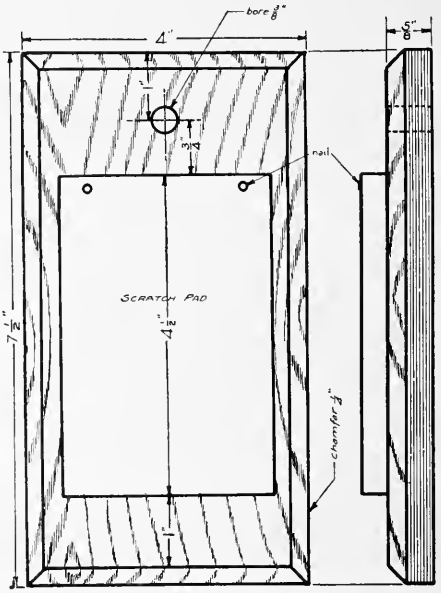
—RING TOSS—



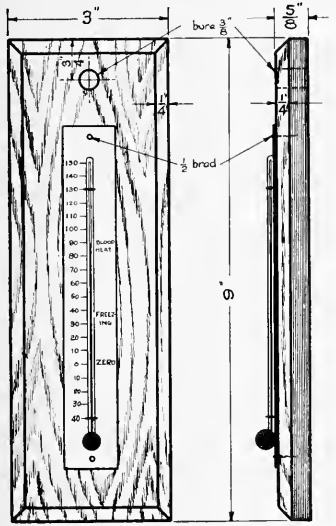
—SWING BOARD—



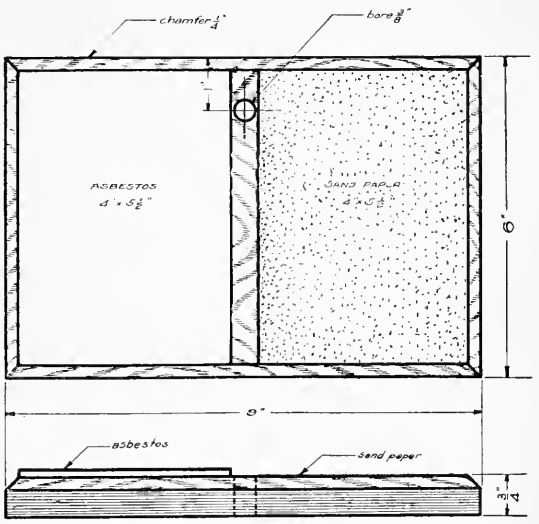
—MATCH SCRATCH—



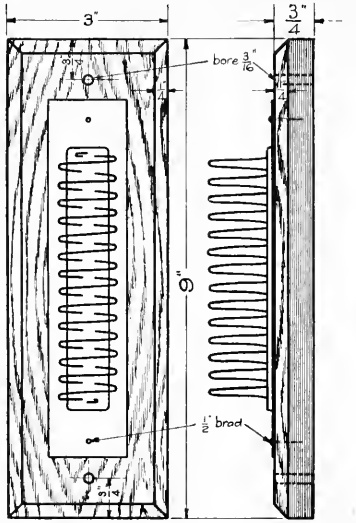
—KITCHEN ORDER PAD—



—THERMOMETER—

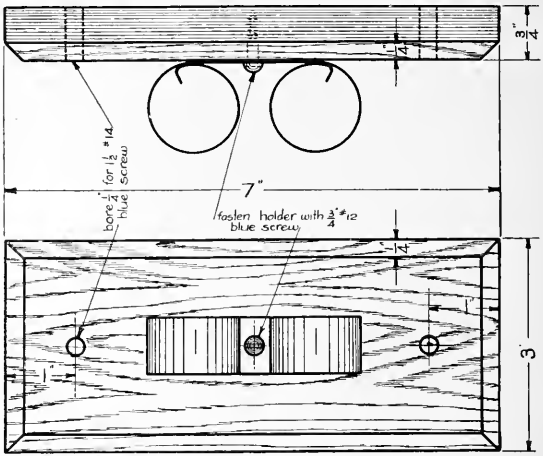


—IRONING STAND—



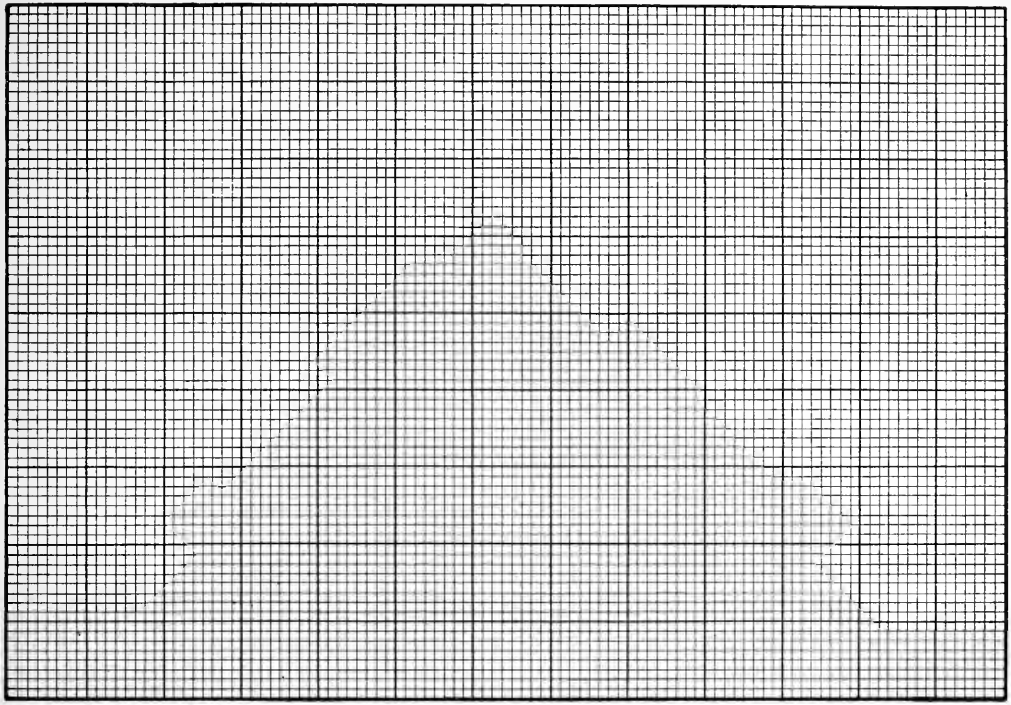
NOTE:- *The metal spiral may be gotten from KIMPTON HAUPT & CO., New York.*

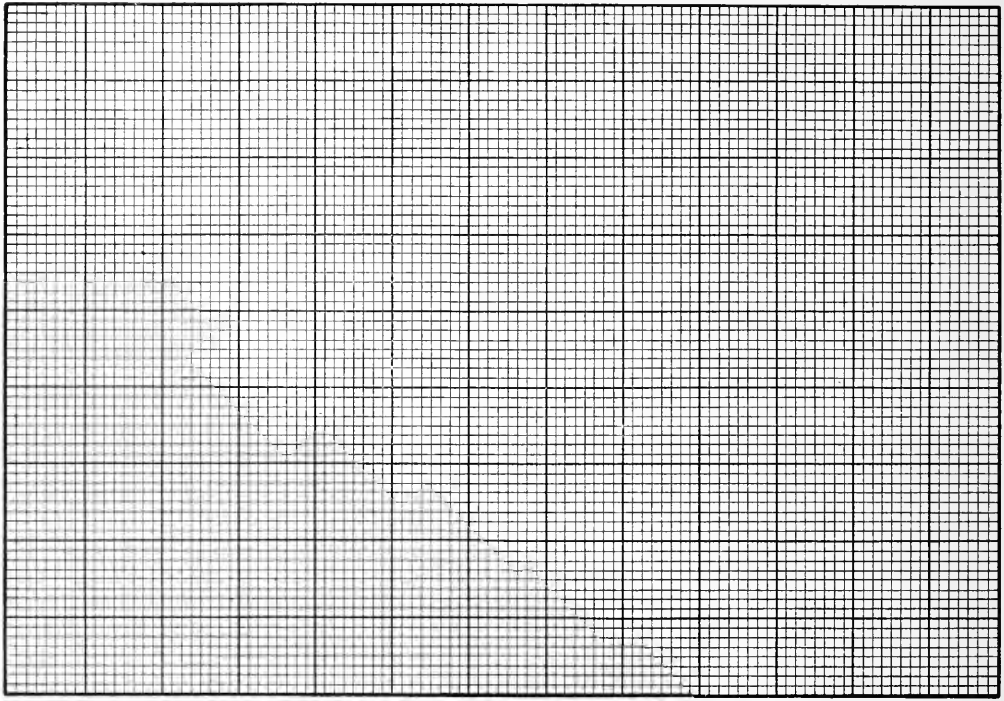
—SPIRAL PEN RACK—

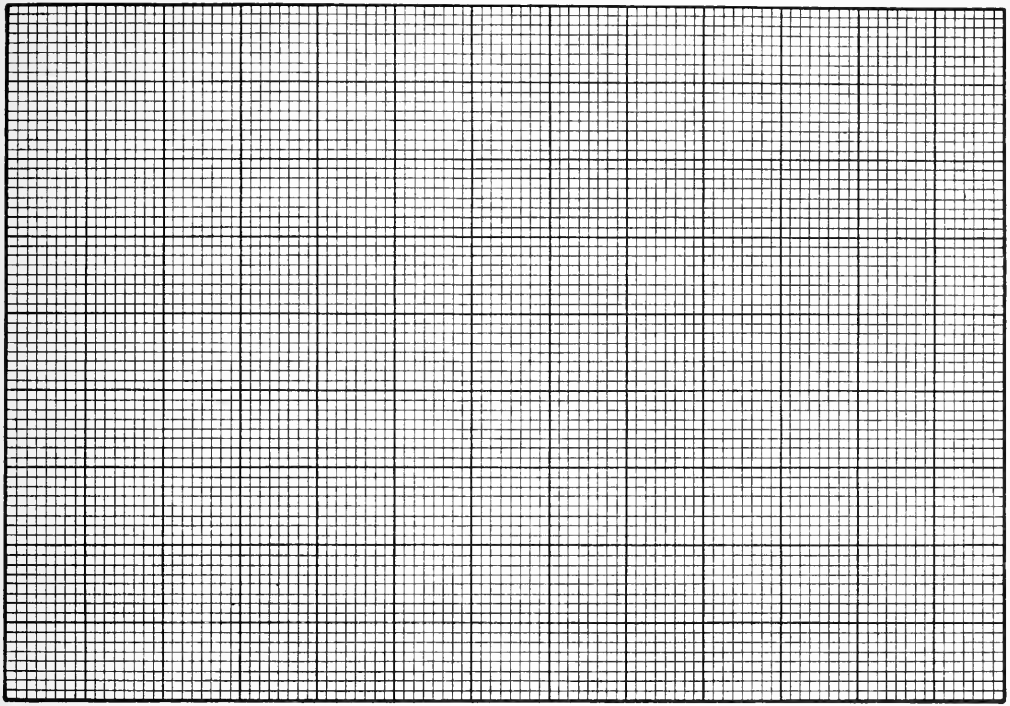


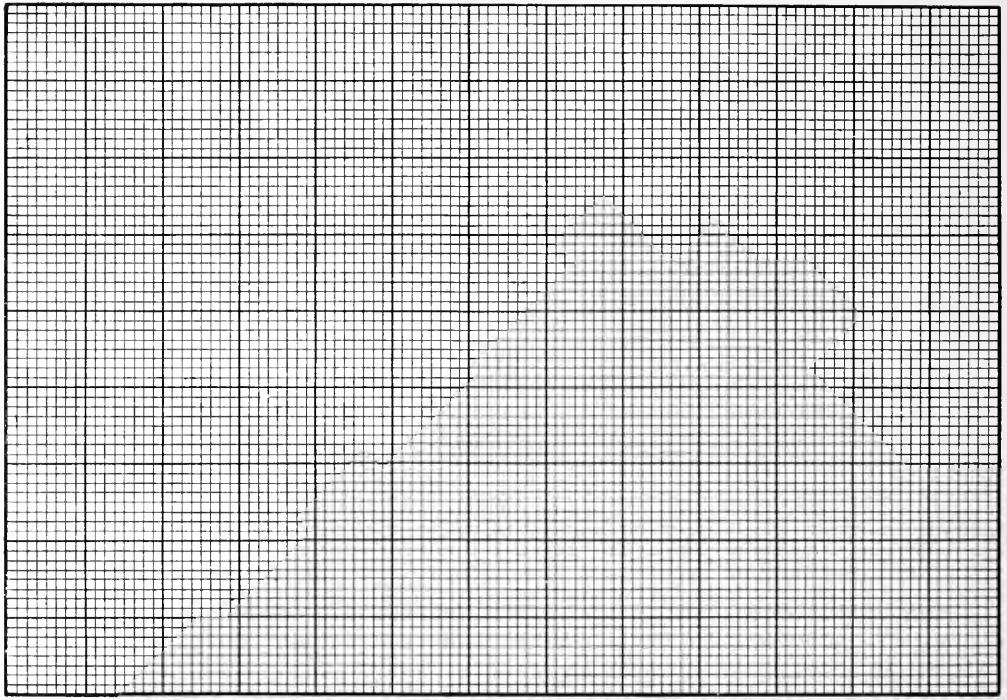
NOTE:- *The metal broom holder may be gotten from the STAMPING AND TOOL CO. LaCross, Wis.*

—— BROOM HOLDER ——









GROUP II

(The problem to be selected by the pupil under the guidance of the teacher.)

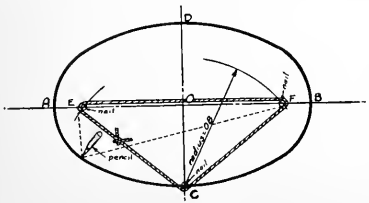
SIMPLE STRUCTURES—Unjoined Pieces

The eclipse should be laid off on a piece of stiff paper (full size),—then trimmed to pencil line, and then used as a pattern. By using a pattern, instead of laying off directly upon the wood, nail holes will be avoided in the finished piece. The string method is suggested,—it makes a natural appeal to the pupil.

The draw-knife may not be needed in all problems, yet, because it is used somewhat like a spokeshave except for rougher work, a thorough discussion and demonstration should be made.

In using the turning (or coping) saw, one should saw *to* a pencil line and not *through* it. Such sawing will avoid irregularities and consequently much smoothing.

The file is a *scraping* tool, *not* a cutting tool. It should be used only in smoothing round corners and irregularly shaped edges and *never* to make one piece fit against another. If used carefully, it will be satisfactory in finishing the edges of curves before sandpaper is applied.



THE ELLIPSE DRAWN BY THE STRING METHOD

1. Draw center lines at right angles to each other,
2. Lay off major and minor axes AB and CD,
3. With C as a center and radius OB, draw arc cutting the major axis at E and F,
4. Drive small nails at E, F, and C, and tie string as shown,
5. Replace nail C with pencil and move as shown by dotted line.

NEW TOOLS AND PROCESSES

1. ELLIPSE.....Using the string method.
2. COMPASS.....For locating nail positions. (Foci of the ellipses.)
3. PATTERN.....Outlining form on stock with pencil.
4. TURNING SAW..Or coping saw—sawing to curved lines.
5. DRAW-KNIFE...Removing the rougher and larger portions.
6. SPOKESHAVE...For cutting smoothly to middle of pencil line.
7. WOOD-FILE....For "touching up" curly places just before sandpaper is applied for surface finish.

NOTE:—Use same finish as that used for Group I, namely Brush finish—two coats.

TEN PROBLEMS

SLING SHOT	COAT HANGER
TABLE MAT	HORN AND HOOK RACK
BROOM HOLDER	CANOE PADDLE
BREAD BOARD	BOW AND ARROW
SLEEVE BOARD	TOWEL RACK

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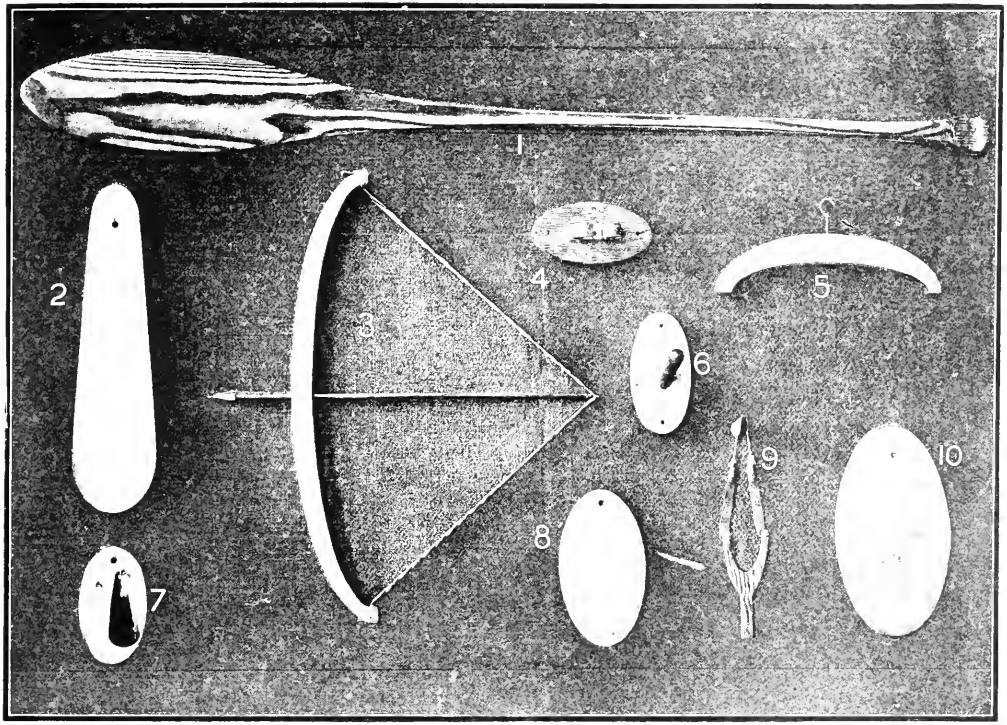
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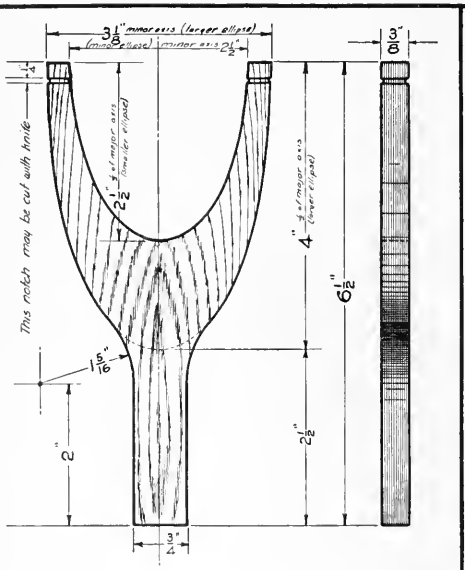
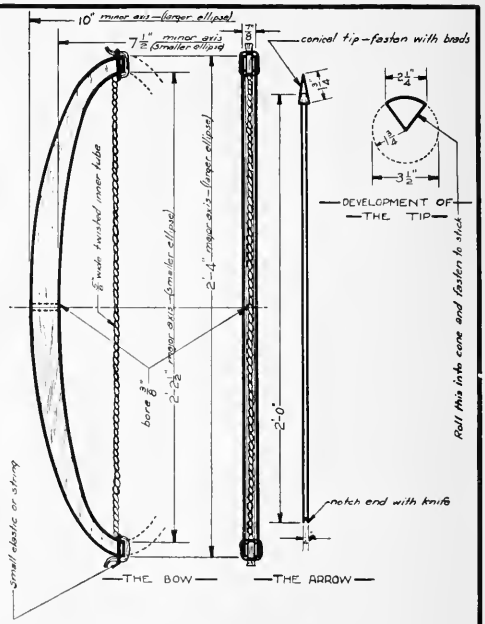


—FORK FOR SLING SHOT—

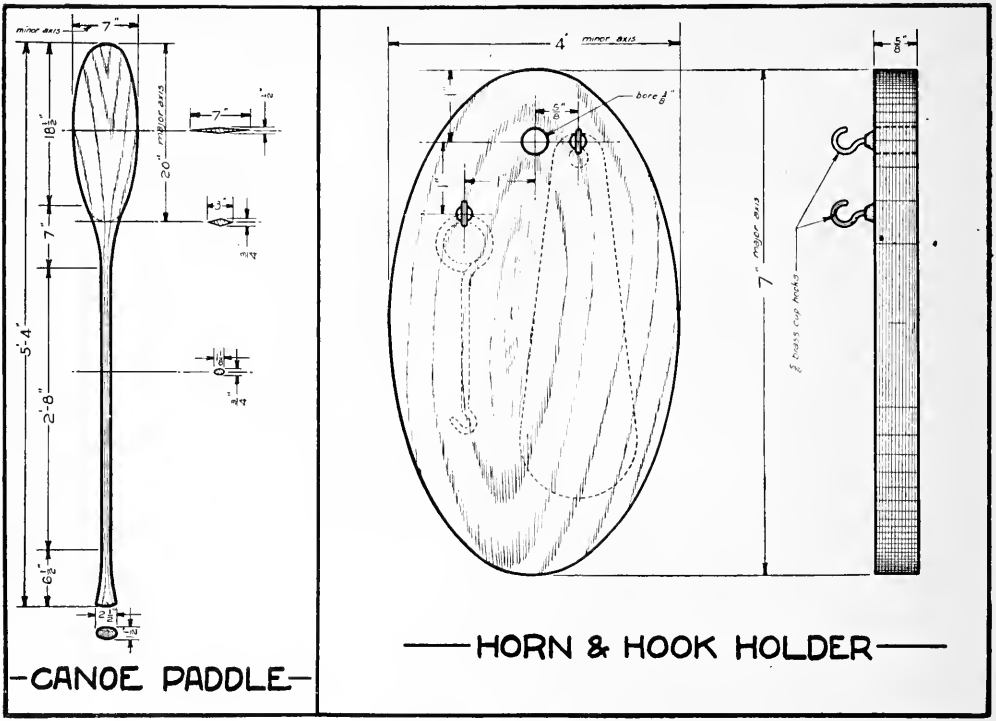


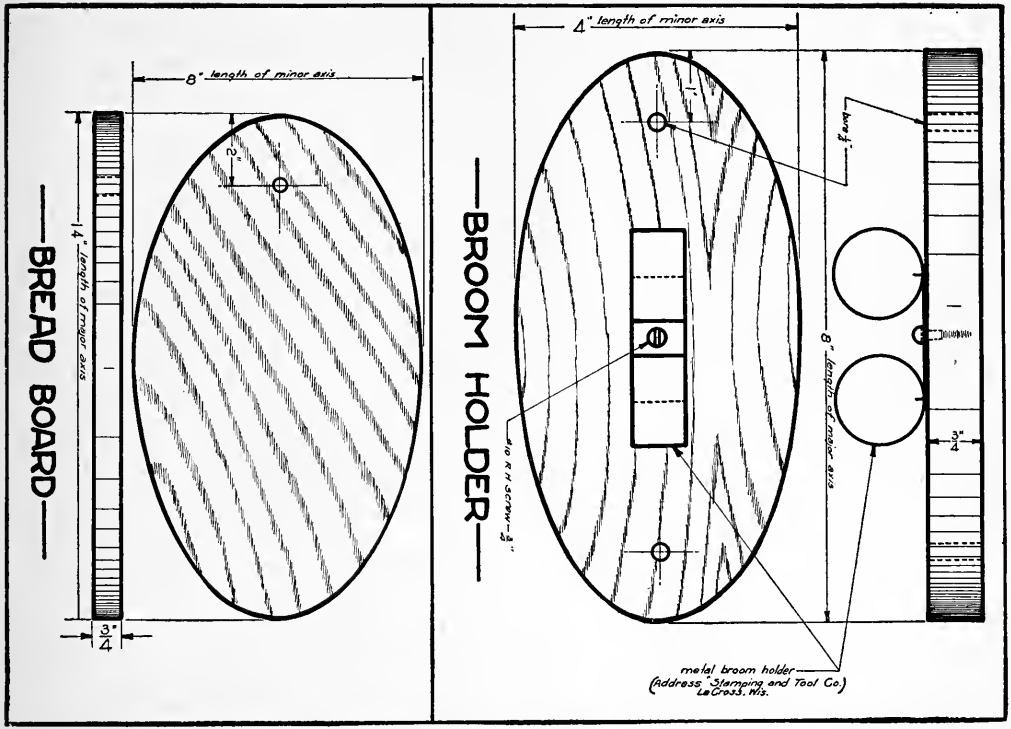
—BOW & ARROW—

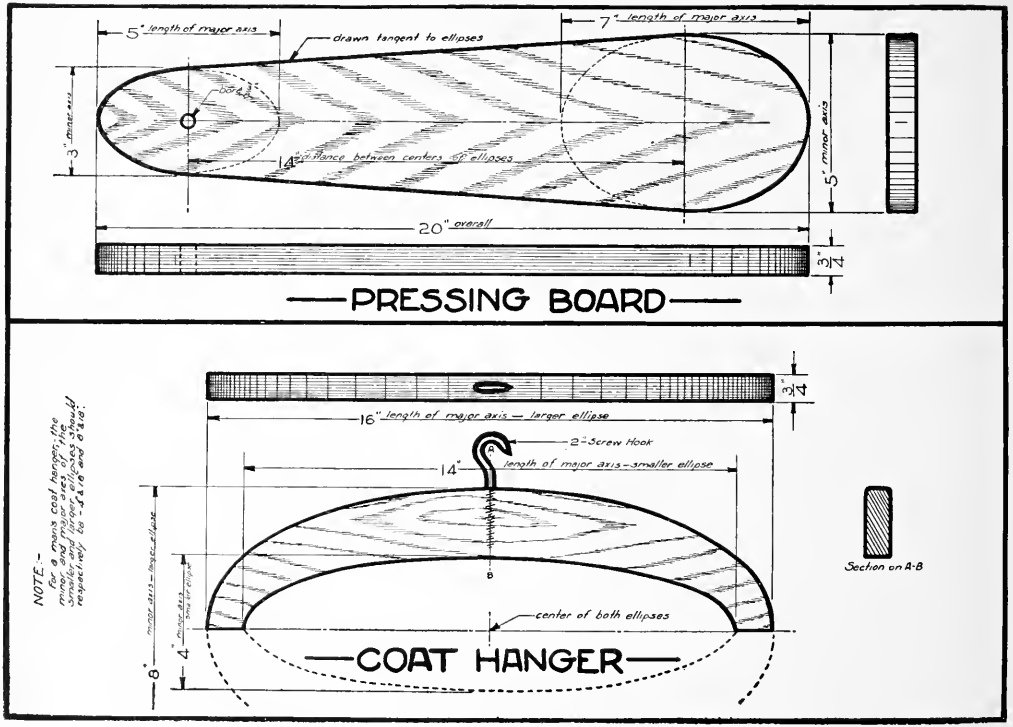
—TOWEL HOLDER—

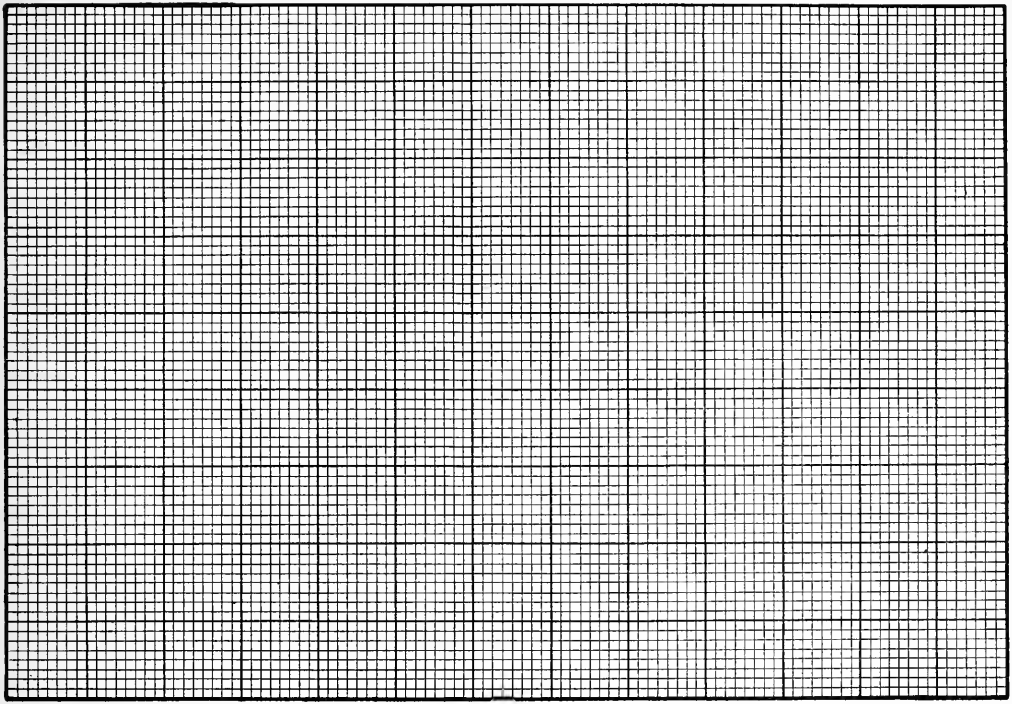
—ELLIPTICAL TABLE MAT—

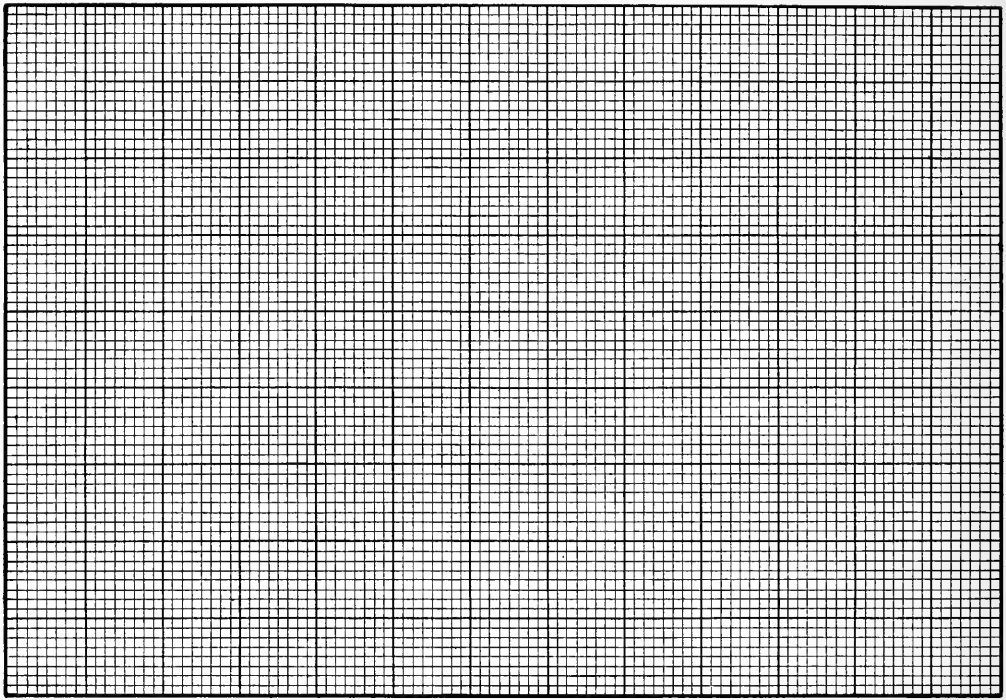
Note—Larger mats having similar proportion, have their major and minor axes respectively—{12" x 7"; 14" x 8"}

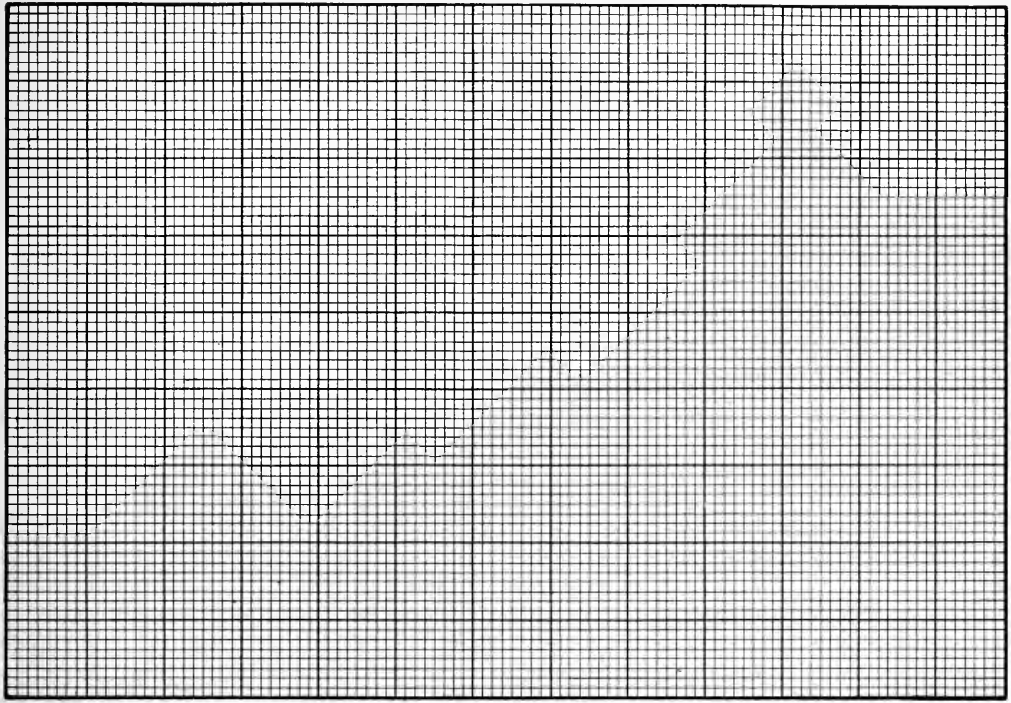

minor axis
7"
5'-4"
18½"
20" major axis
7"
2'-8"
6½"
3"
CANOE PADDLE
4" minor axis
bore ⅜"
7" major axis
2 brass cup hooks
HORN & HOOK HOLDER

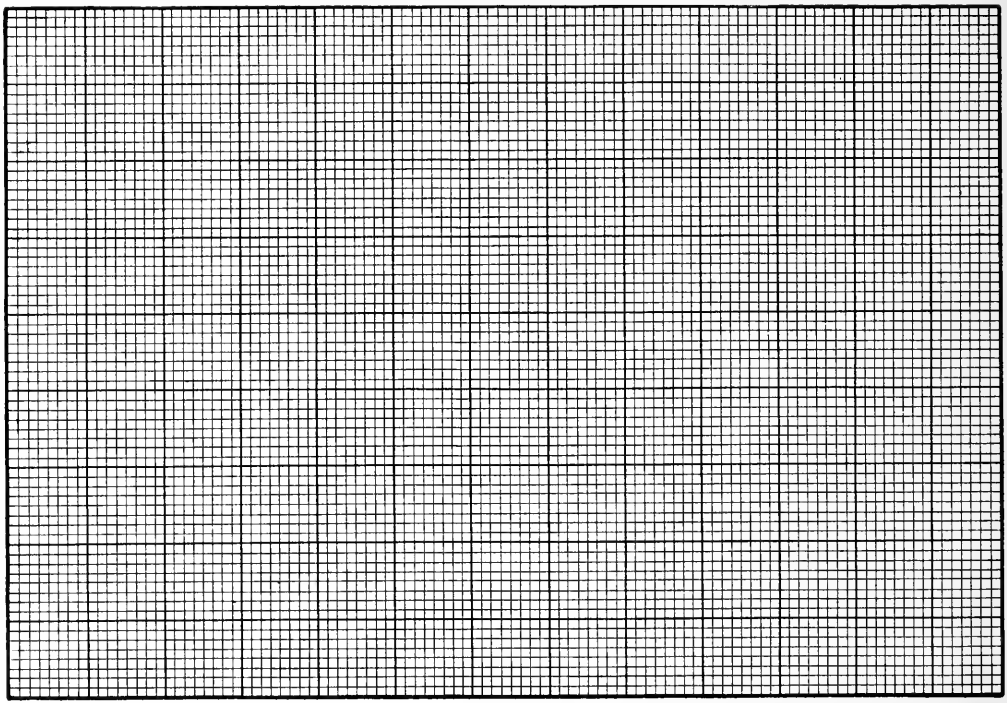

—BREAD BOARD—
8" length of minor axis
14" length of major axis
2"
3/4"
—BROOM HOLDER—
4" length of minor axis
8" length of major axis
3/4"
metal broom holder
(address "Stamping and Tool Co.)
La Crosse, Wis.


5" length of major axis
drawn tangent to ellipses
7" length of major axis
3" minor axis
1 1/4"
1 1/4" distance between centers of ellipses
5" minor axis
20" overall
3/4"
PRESSING BOARD
NOTE:-
For a mans coat hanger, the major and minor axes of the smaller ellipse should respectively be 5" & 6" and 6" & 8".
3/4"
16" length of major axis — larger ellipse
2" Screw Hook
14"
length of major axis - smaller ellipse
8" major axis = larger ellipse
4" minor axis = smaller ellipse
center of both ellipses
Section on A-B
COAT HANGER









GROUP III

(The problem to be selected by the pupil under the guidance of the teacher.)

BOARD STRUCTURES—Butt Joints (Fastening with Nails)

Particular attention should be given to marking knife lines at an angle with the edge using the T-bevel. Special precautions should be taken when slanting lines are drawn on opposite faces of a piece, that the face of the T-bevel is placed upon the same edge, otherwise the slant will not be in the same direction and the work will be ruined.

It is important that the pupil learns the correct principle of spacing nails in regard to grain, how nails should be driven and how withdrawn, etc.

Heretofore, the suggestion for finish has been merely to give two (2) coats of flat varnish,—just a brush finish. The color has been left "natural."

In this group, it is suggested that a lesson be given in finishing. Each pupil should be given a small piece, say ¾″ x 2″ x 8″, which he should smooth plane, sandpaper, dust off with a cloth, stain, fill with one coat of natural liquid woodfiller (Sherwin-Williams is good), sandpaper with No. 0 sandpaper, give two coats of quick-drying varnish, permitting at least 24 hours between coats. Let this be a "Brush Finish."

An exercise piece as suggested, will result in a beautiful finish, and prove to the pupil that the piece will look one hundred percent better when proper care is taken than when it is just "slapped on".

One of the greatest criticisms of the work of young teachers and in which respect the majority "fall down", is in regard to the finish. No matter how well the work has been done, how accurate every point may fit, a poor job in the finish will spoil the piece of many hours of labor. Since the finish is of such vital importance, considerable care should be taken in the beginning, when habits of neatness, when pride in good workmanship, pride in the beautiful, is most easily molded in the life of the child.

The pupil should be shown how putty should be applied to nail holes. If the work is stained, how the putty should be colored with dry colors to match the stain. Colored putty should be applied to nail holes after the work has been stained.

NEW TOOLS AND PROCESSES

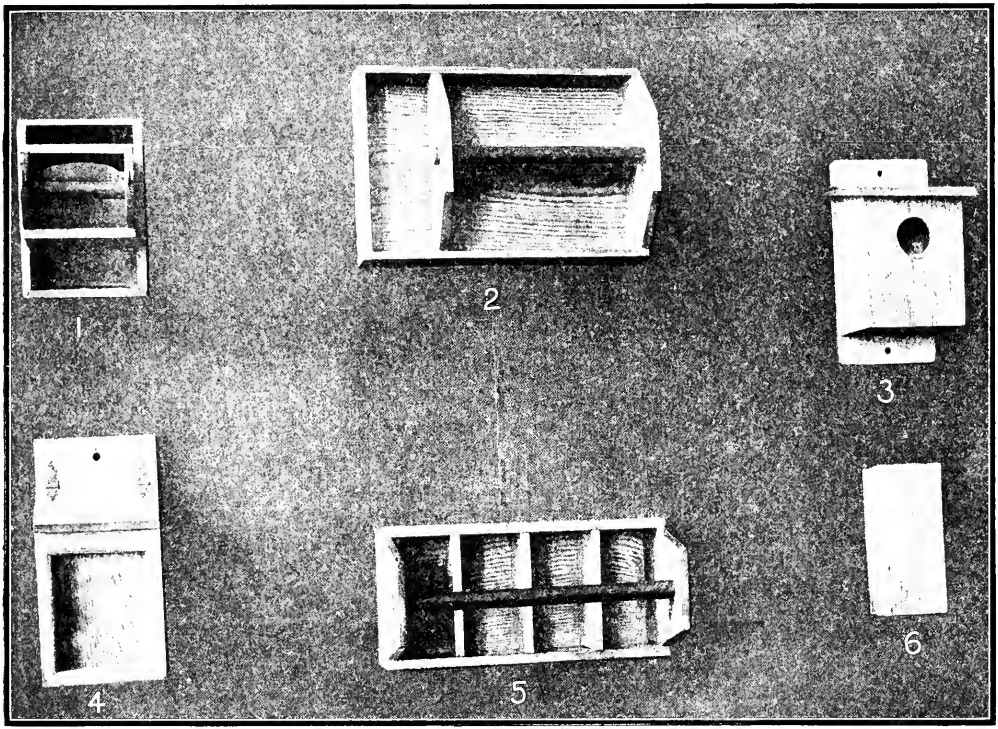
1. T-BEVEL.....Laying off at an angle.
2. NAILS.....Kinds, uses, and sizes.
3. HAMMER.....Nailing, principles as to grain, angle, etc.
4. NAIL SET.....The setting of nail heads.
5. PUTTY.....Filling nail holes.
6. STAIN.....Preparation and application.
7. FILLER.....Application of light liquid woodfiller.

NOTE:—For further information in regard to finish see notes on Finish, page 123.

TWELVE PROBLEMS

MAIL BOX
MARBLE BOX
CLOTHES PIN HOLDER
NAIL BOX
KNIFE, FORK, AND SPOON-TRAY
BIRD HOUSE
MITRE BOX
BOY'S CART
CLOTHES PIN WINDER
SHOE POLISHING BOX
KITCHEN STOOL
FOOT STOOL

INDEX TO PICTURES ON PAGE 41


1
2
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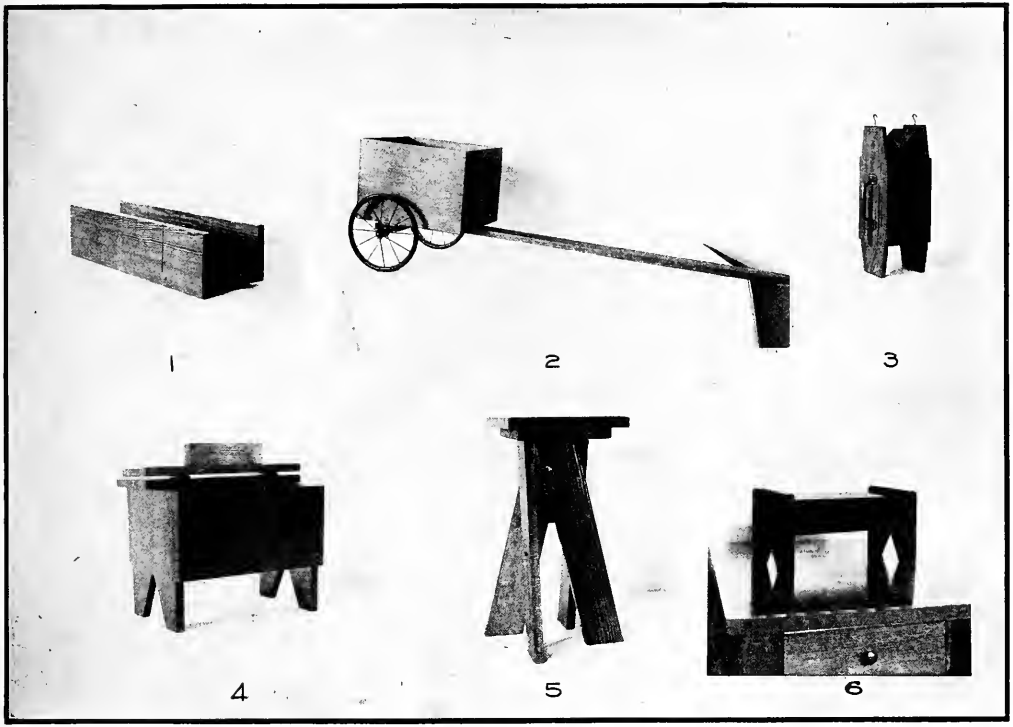
INDEX TO PICTURE, PAGE 43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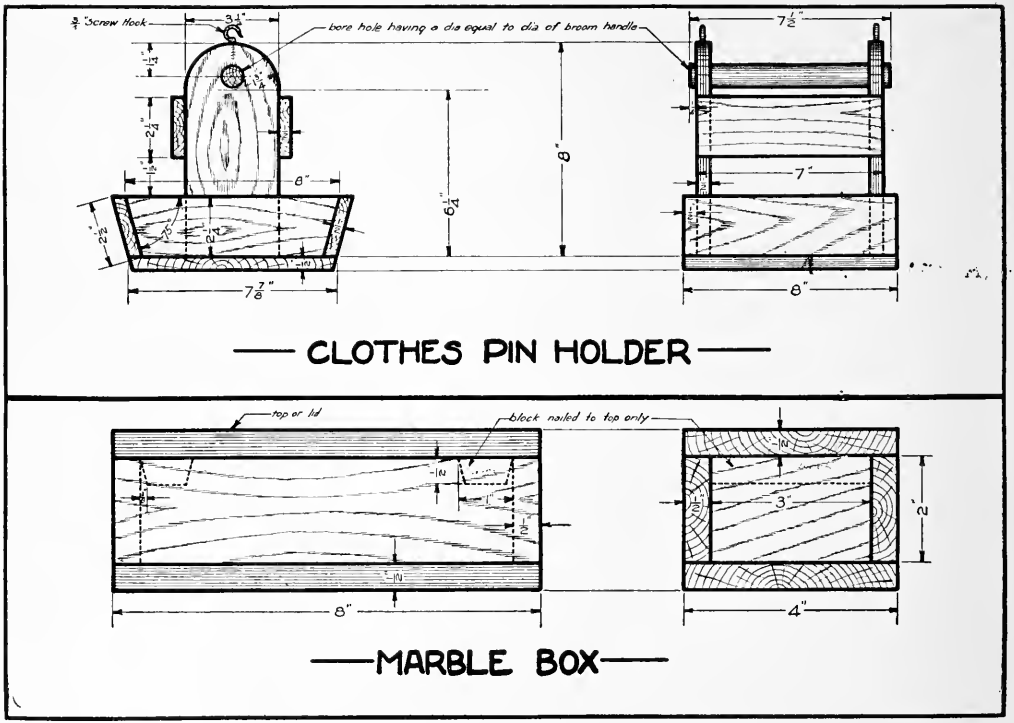
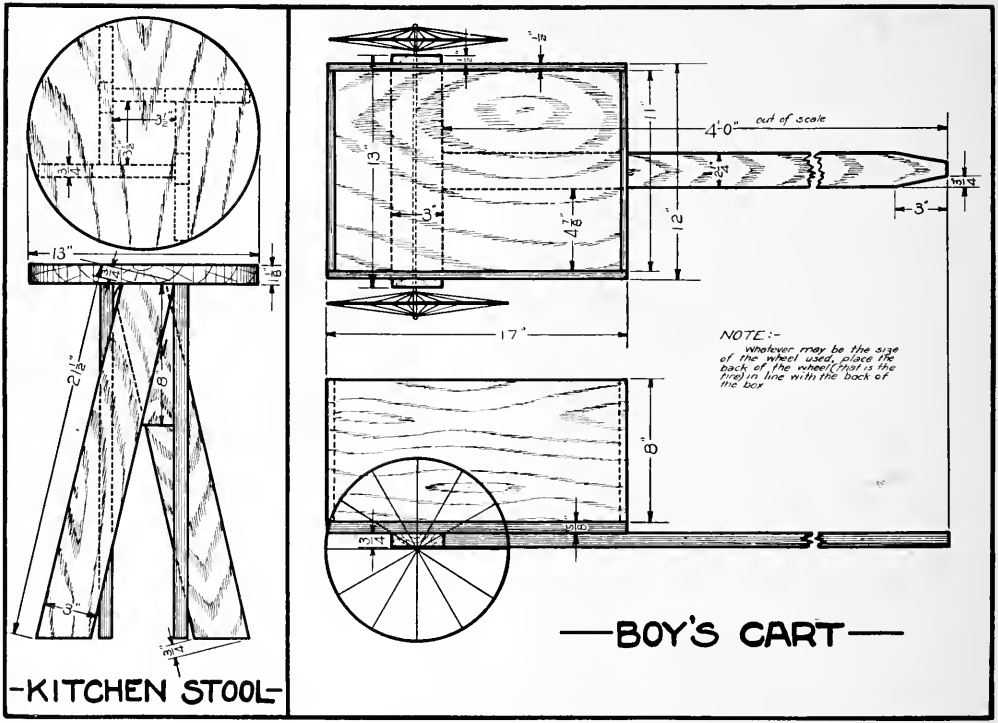
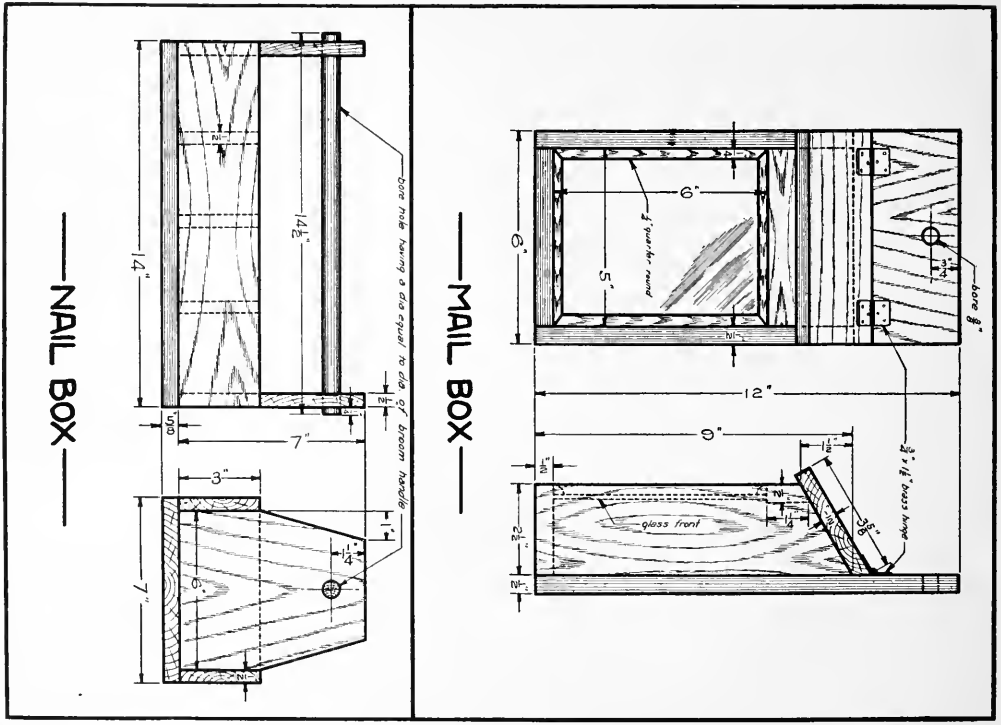

¾" Screw Hook
3¼"
bore hole having a dia equal to dia of broom handle
7½"
8"
6¼"
8"
7"
8"
7⅞"
CLOTHES PIN HOLDER
top or lid
block nailed to top only
8"
3"
2"
4"
MARBLE BOX

—FOOT STOOL—
14" overall
12½"
8½"
7½"
bore 2"
3"
2"
—CLOTHES PIN HOLDER & LINE WINDER—
14"
7"
5" bar sash lift for hands
brad
trap door
screw hook
surface hinge
corner knob
3"
8"
4"
5"
6"


13"
2'-10"
3"
-KITCHEN STOOL-
4'-0" out of scale
3"
17"
NOTE:-
Whatever may be the size of the wheel used, place the back of the wheel (that is the tire) in line with the back of the box
8"
-BOY'S CART-

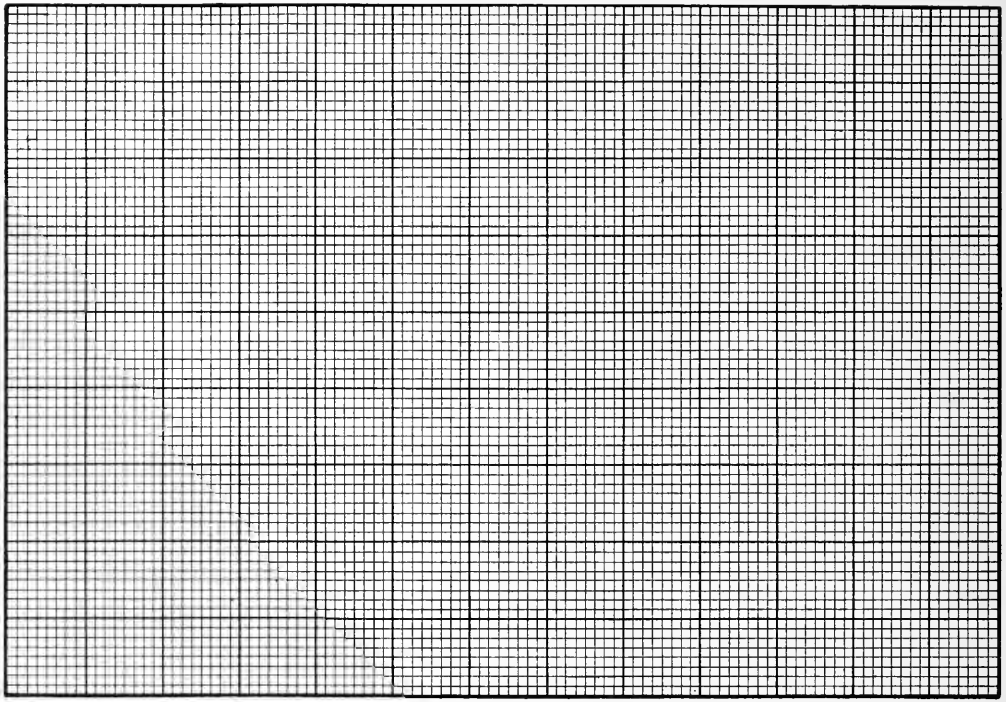
—KNIFE, FORK & SPOON TRAY—
broom handle
10"
11½"
14½"
9¾"
4¾"
2½"
2¼"
1"
3⅜"

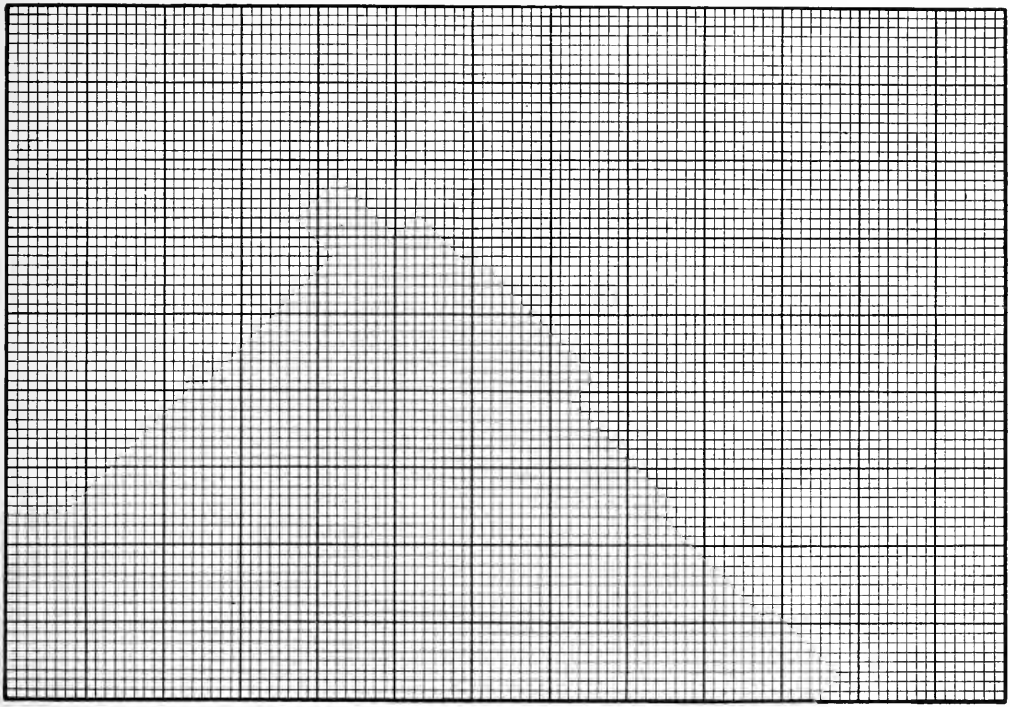
—SHINE BOX—
2¾"
2¼ ox copper surface hinge
17"
14"
15½°
6"
12"
7½"
5¼"
12"
6¾"
4"
bore ¾
2"

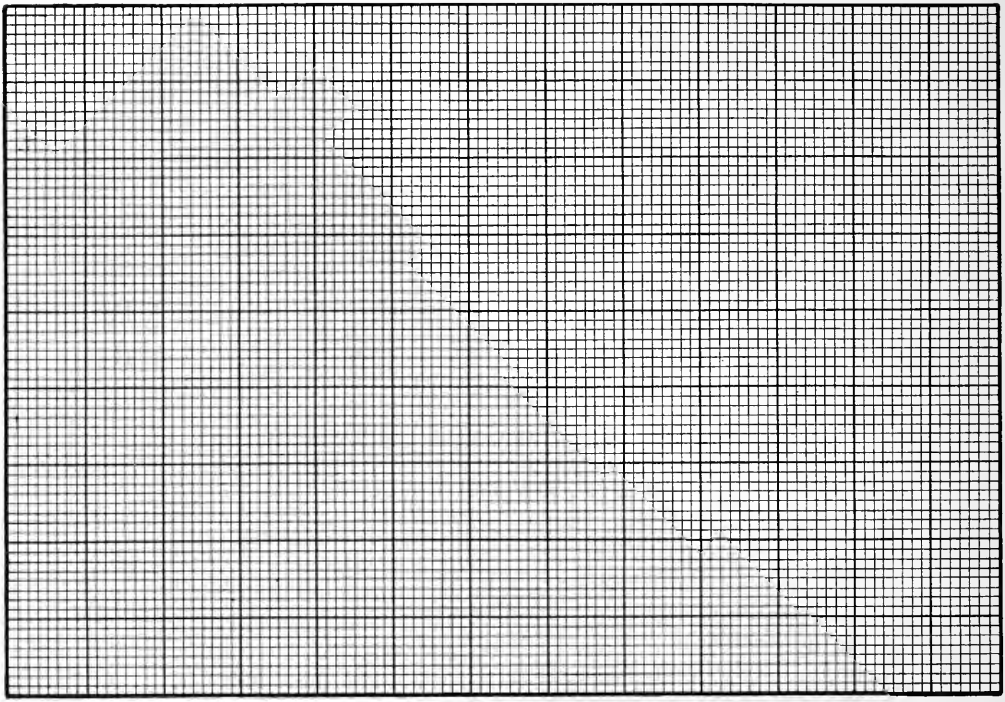

MAIL BOX
glass front
NAIL BOX
bore hole large enough to clasp of broom handle

BIRD HOUSE

MITRE BOX







GROUP IV

(The problem to be designed by the pupil under the direction of the teacher.)

BOARD STRUCTURES—Butt Joint (Fastening with Screws)

Particular attention should be given to the method of boring with gimlets in preparing holes for screws. The hole in the piece to be fastened, should be of such size as to permit the screw to slip through snugly, yet easily. In other words the hole should have the *same diameter* as the *shank of the screw*. The hole in the piece to which above is to be fastened should have a diameter equal to the diameter of the body of the screw at the *root of the threads*. The classification and sizes of screws should receive attention at this time.

All the finish given thus far has been a "Brush" Finish. At this place it is suggested that a finer finish be inaugurated, namely a "rubbed" finish.

As in the preceding group, a piece of stock should be furnished the pupil. The steps mentioned are the same as before with the following exceptions:

1. Three coats of varnish should be given instead of two. Harrison's Floor Varnish, which is dust proof in four hours, heel proof and waterproof, is an excellent varnish, especially in shops where it is difficult to keep away from the dust.

2. The first two coats, after drying hard in from 12 to 24 hours, are each smoothed down with No. 00 steel wool, and then the dust and small particles removed with a slightly dampened cloth before the next coat is applied.

3. The third and last coat is first rubbed down to a smooth surface with pumice stone and lubricating oil. That is, pumice is mixed with the oil to make a paste, which is applied lightly over the surface. When this has been removed with an oily rag so that all pumice has been removed, the entire surface is gone over and polished with lubricating oil alone. This gives an excellent smooth velvety finish, smooth and hard and most pleasant to the touch. Pupils who have once put on a finish like this will never be satisfied with anything less.

NEW TOOLS AND PROCESSES

1. GIMLETS. . . . . How numbered and used.
2. SCREWS. . . . . The method of fastening.
3. SCREW DRIVER. . . . The proper shape of bit and how to use it.
4. STEEL WOOL. . . . . Used after each of first two coats.
5. PUMICE STONE. . . Used with lubricating oil on third coat of varnish.
6. LUBRICATING OIL. . Used as the final finish.
7. COUNTERSINK. . . . . Note that although this will not be used in all problems, yet its use and purpose should be fully explained and demonstrated.

FOURTEEN PROBLEMS

4 TABORETS	1 UMBRELLA STAND
2 FOOT STOOLS	1 WALL SHELF
2 MAGAZINE RACKS	1 ENVELOPE HOLDER
2 BOOK TROUGHS	1 BROOM HOLDER

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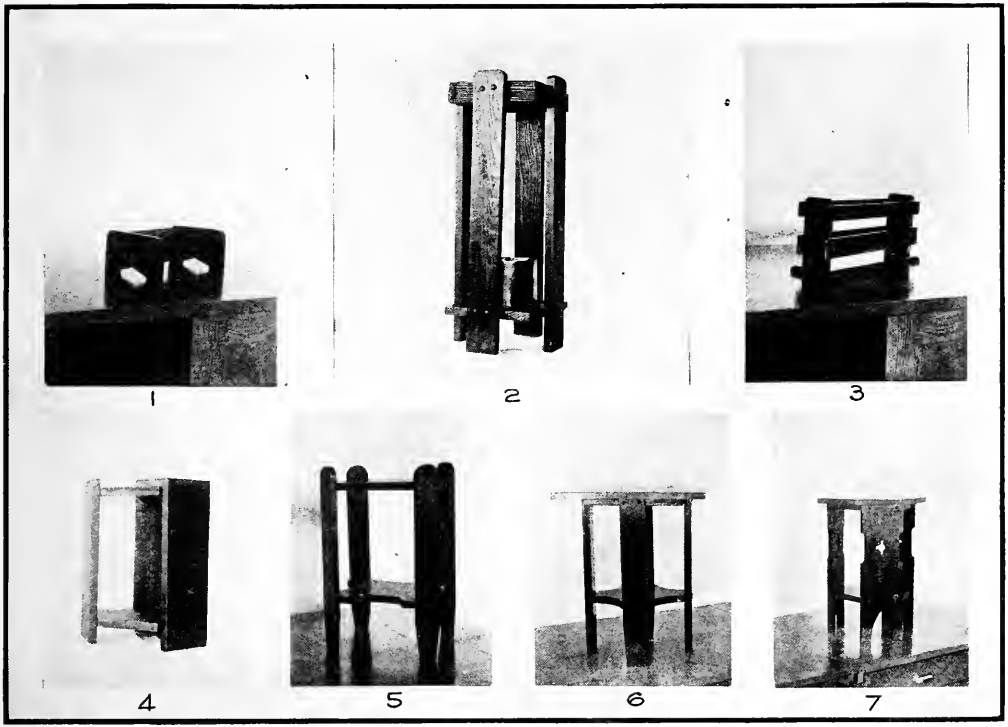
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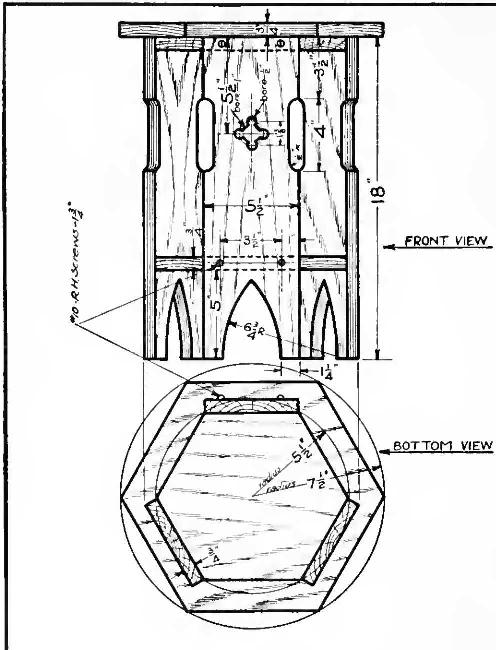
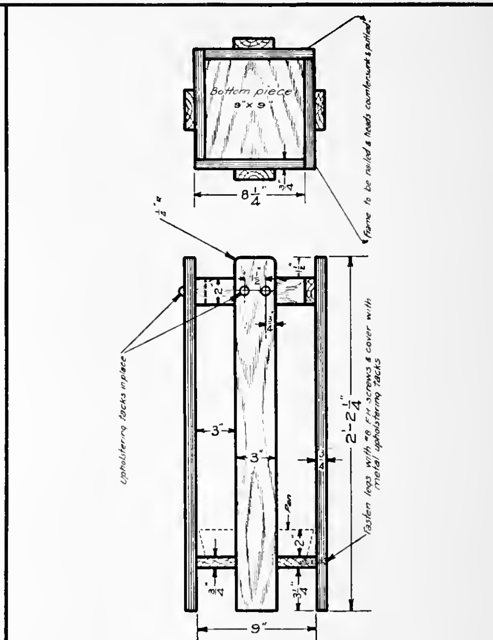
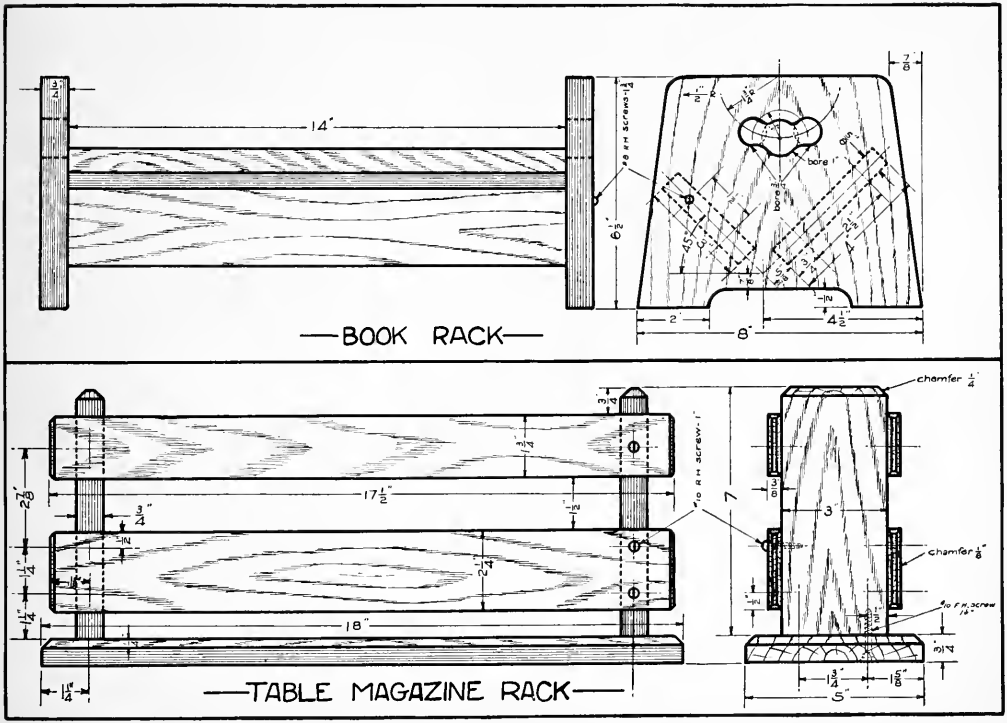
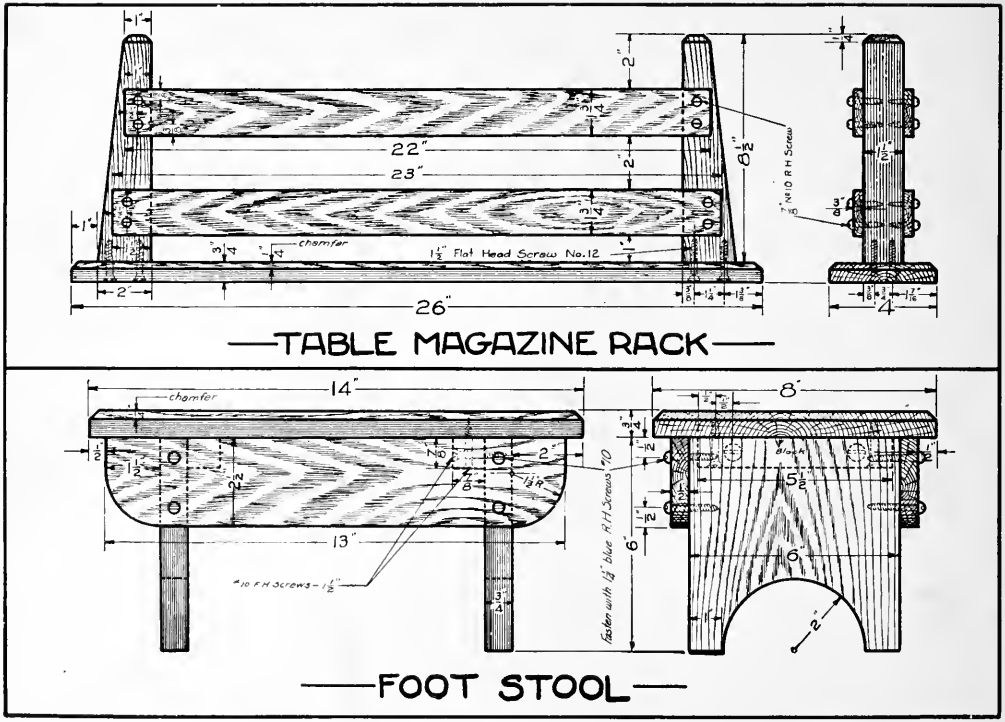


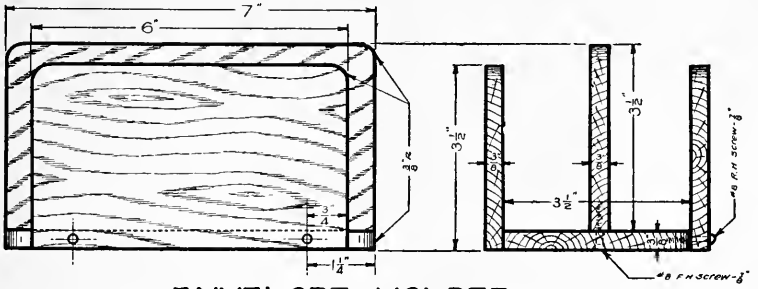
—TABORET—



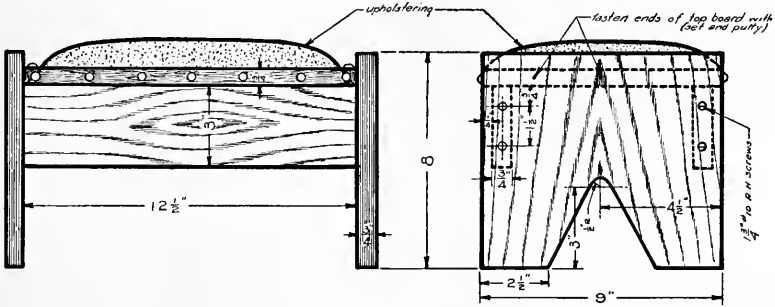
—UMBRELLA STAND—


14"
6½"
bore 1"
bore ¾"
45°
8"
—BOOK RACK—
17½"
18"
2¾"
7
chamfer ¼"
chamfer ⅛"
3
5"
—TABLE MAGAZINE RACK—

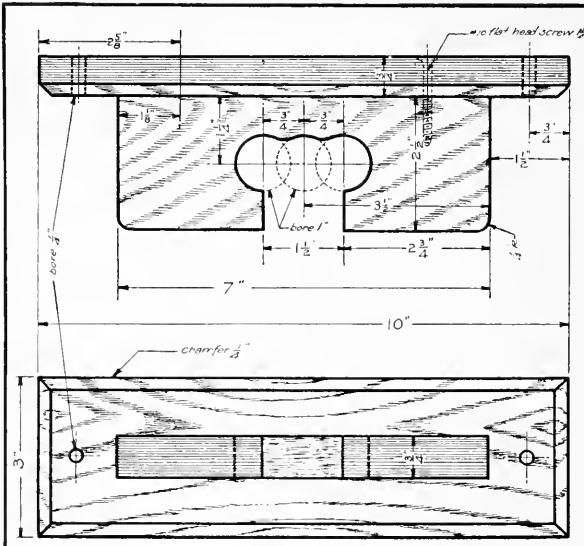

22"
23"
26"
2"
8½"
chamfer
1½" Flat Head Screw No. 12
TABLE MAGAZINE RACK
14"
13"
8"
6"
5½"
2"
FOOT STOOL



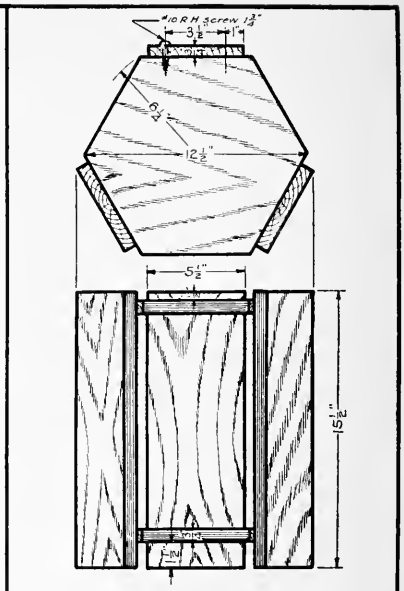
—ENVELOPE HOLDER—



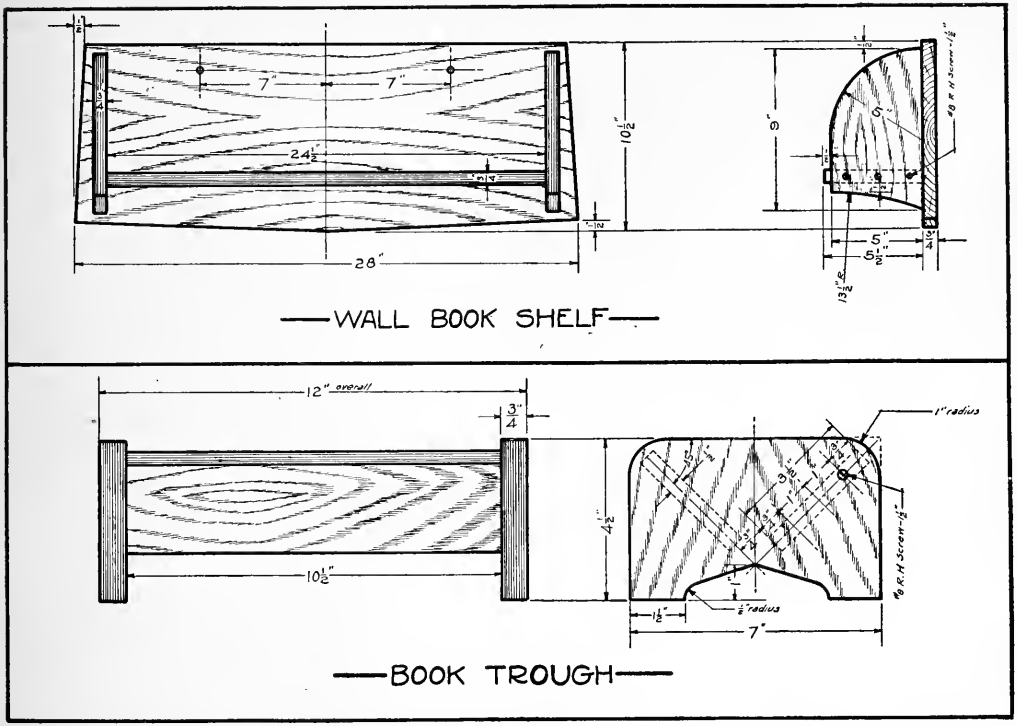
—FOOT STOOL—

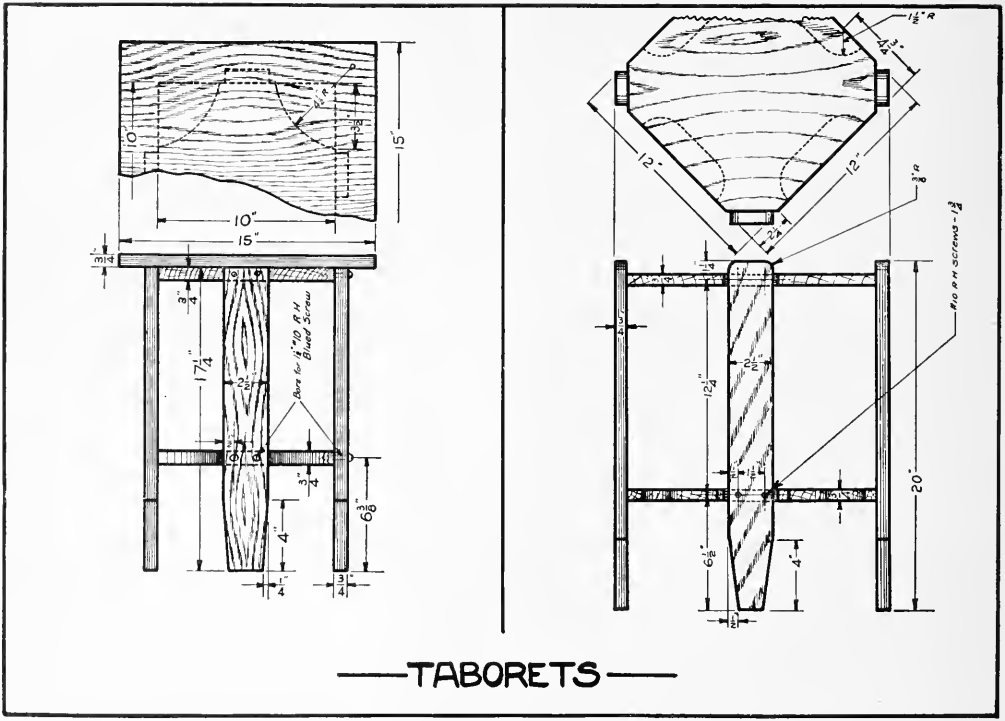


—BROOM HOLDER—

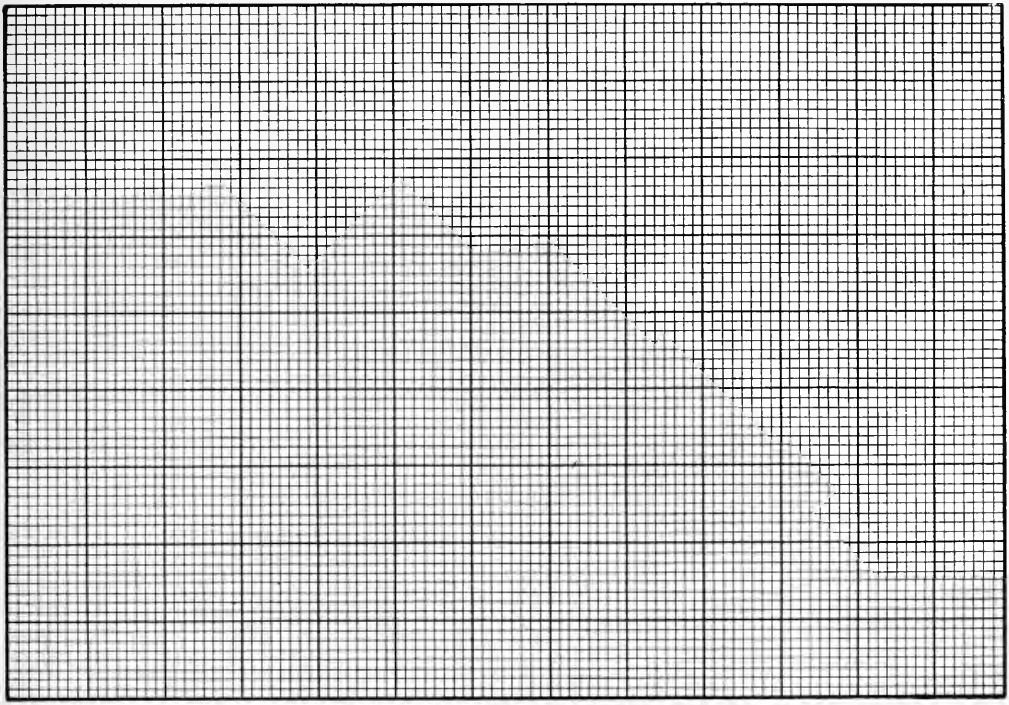


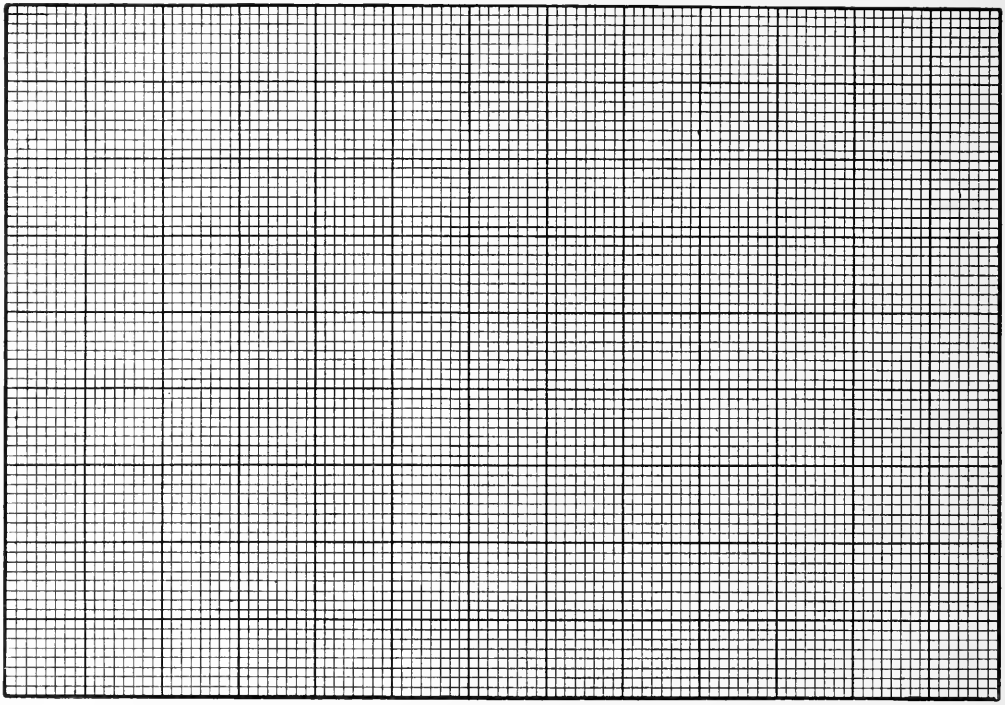
—TABORET—

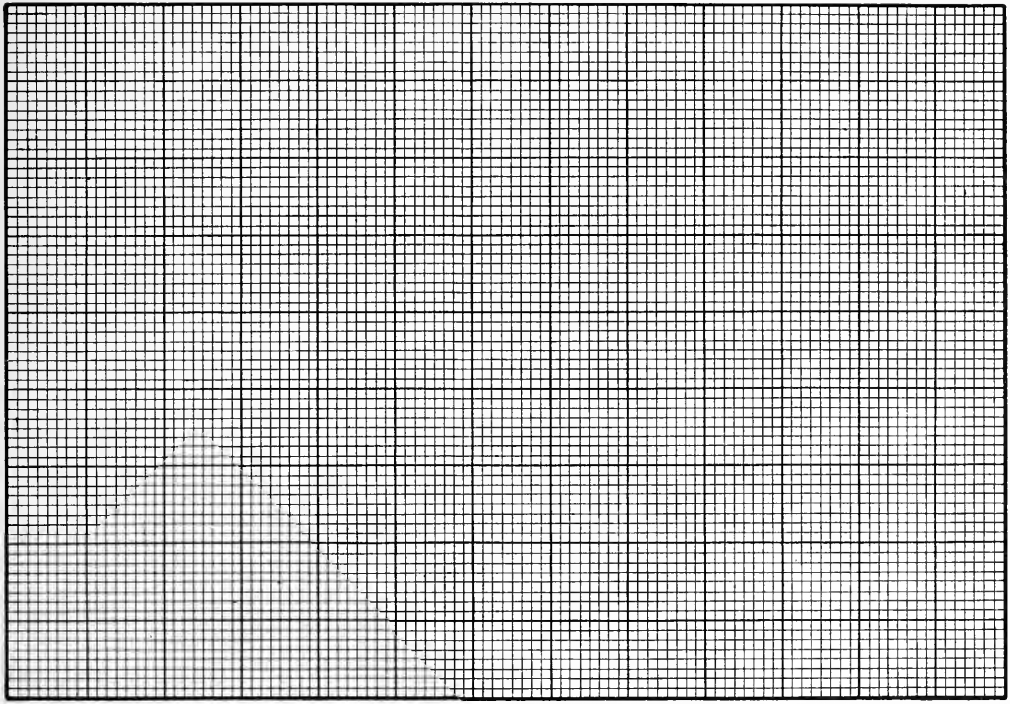

7"
7"
24½"
10½"
28"
9"
#8 R.H. Screw-1½"
5"
5½"
WALL BOOK SHELF
12" overall
¾"
10½"
4½"
1" radius
#8 R.H. Screw-1½"
1½"
7"
BOOK TROUGH

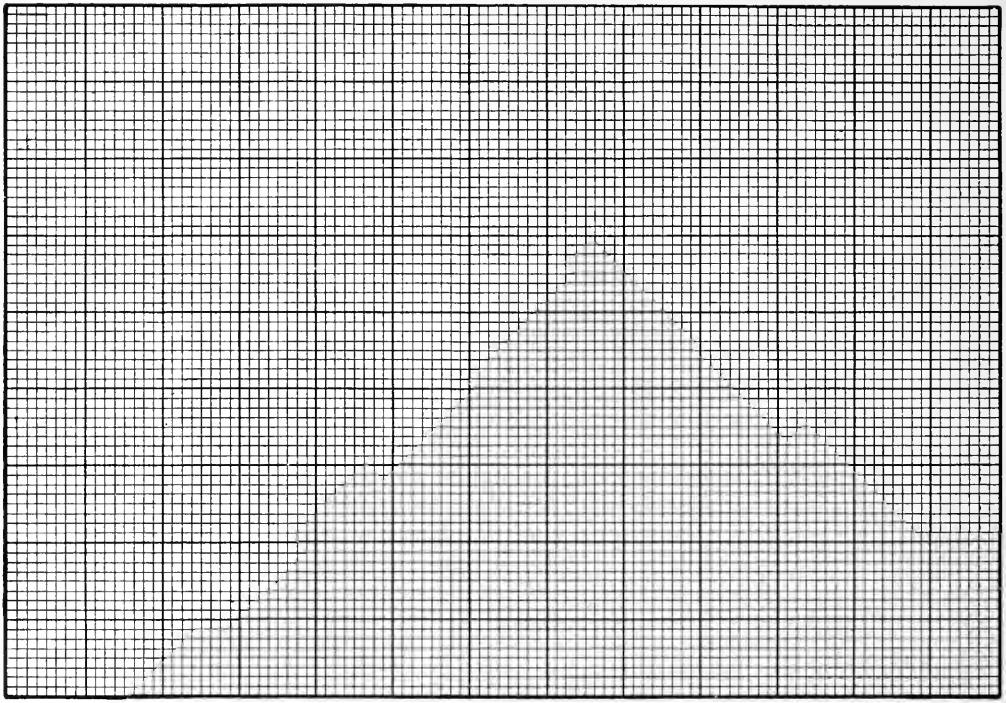

10"
15"
10"
15"
3/4"
3/4"
17 1/4"
2 1/2"
Two to a "10 R.H. Brass Screw
3/4"
4"
63/8"
4"
1/4"
1/4"
1 1/4" R
4 3/4"
12"
12"
2"
3/4"
1/4"
Two R.H. Screws - 1 1/2"
12 1/4"
20"
6 1/2"
4"
1/2"

TABORETS









GROUP V

(The problem to be designed by the pupil under the direction of the teacher.)

BOARD STRUCTURES—General Applications and Review of Part I

The course with regard to tools and tool processes in Part One really closes with Group IV. The work through Group IV must be completed by the pupil in order to pass the subject. This is the minimum requirement. Group V has been added to take care of the exceptional pupils as well as to permit the construction of one special piece which may or may not fit any previous group. However, the design must not include tools which have not been previously treated in any of the groups. Again, the problem may be a community or school piece, something to be used either in the school building itself or somewhere in the community. Part V may be held out to the pupil as a special incentive,—a reward for good work. It may be considered the "rounding out" group, the group for gathering "loose ends" of the course and where applications may be more general than that permitted in the special groups.

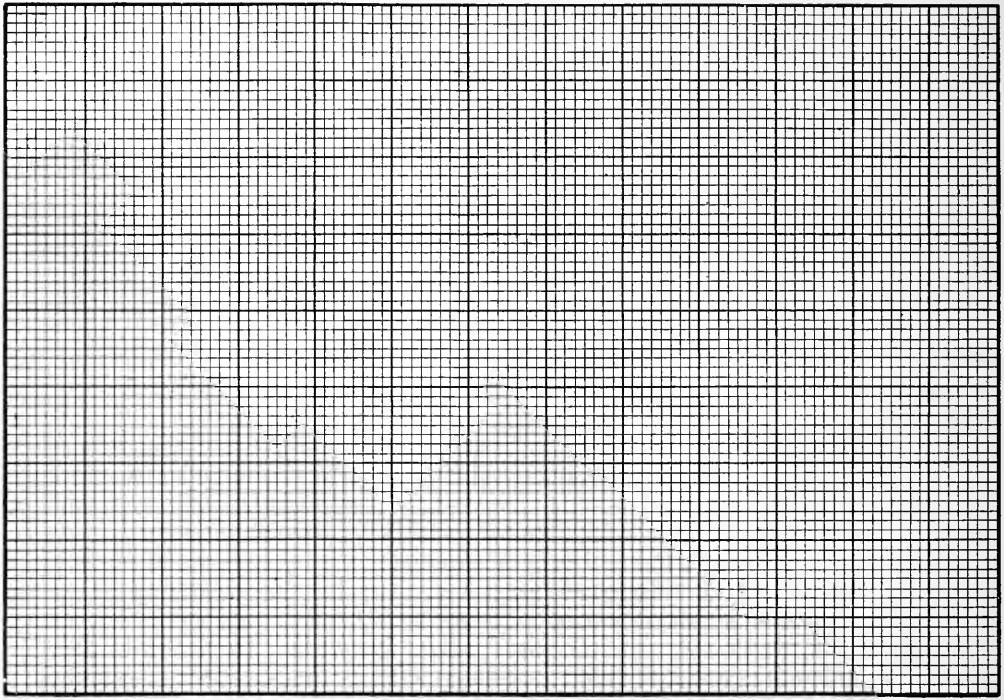
This group will require more individual instruction. During the time devoted to this group, the instructor should review the tools and processes covered by Part One, assign questions for review, and in general shape instruction with a general examination of Part One in view. It is during this time that false impressions of tool processes, etc., which may have persisted, should be finally corrected.

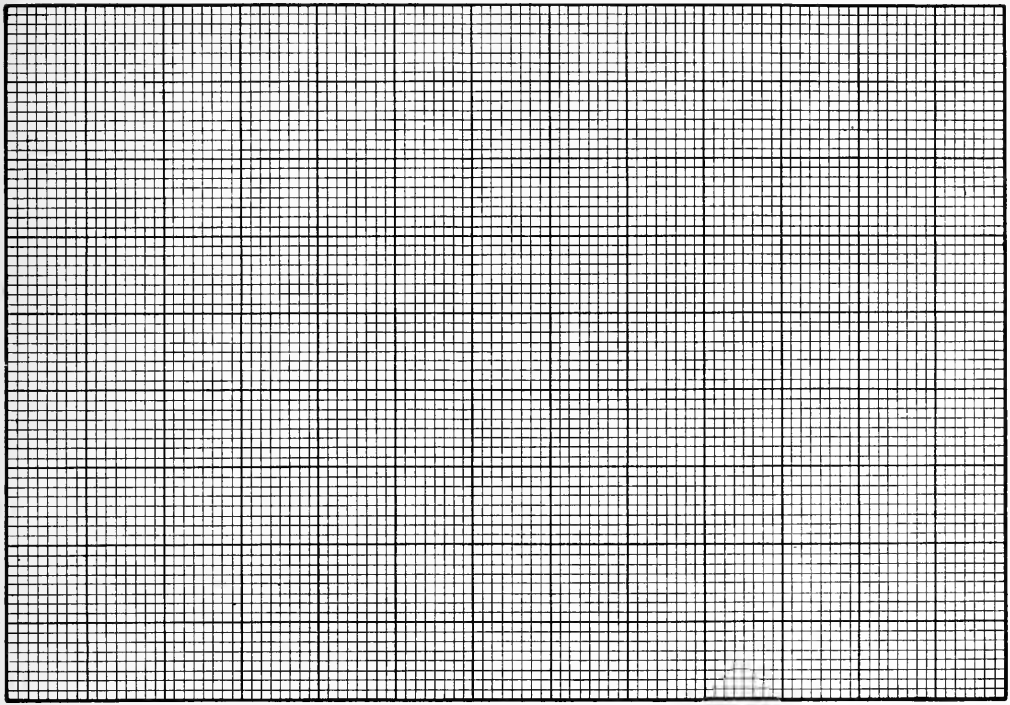
NEW TOOLS AND PROCESSES

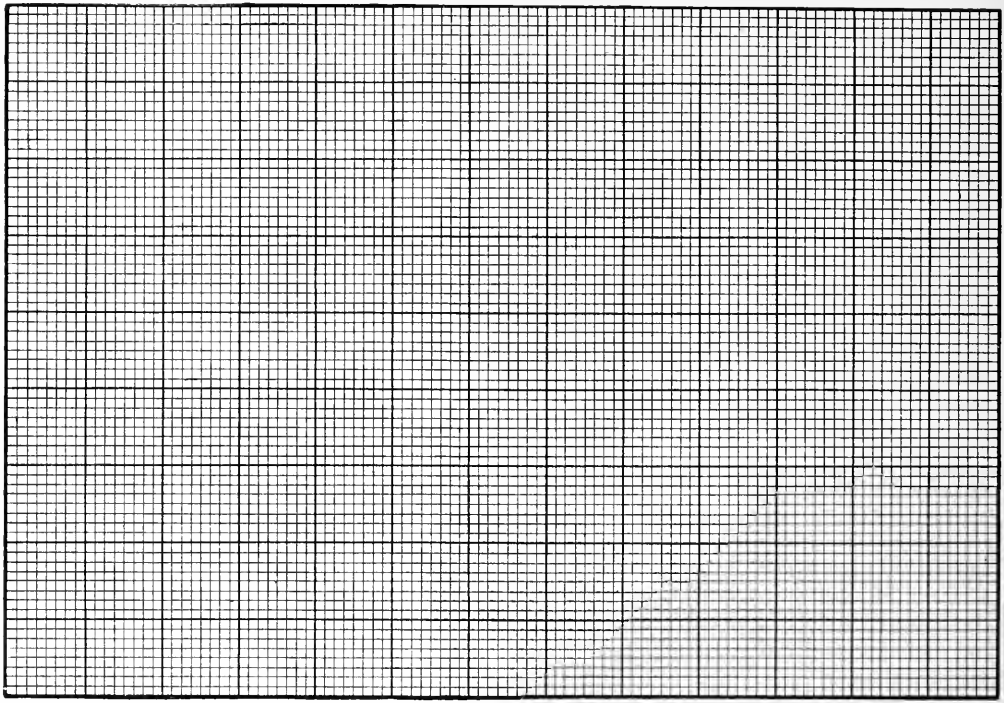
No new tools should be used here. However, there may be slight deviations permissible in tool processes where the pupil has shown marked ability.

PROBLEMS

List here the problem to be designed by the pupil, together with the page number of the cross-sectioned sheet on which he will have finally drawn the piece he expects to make.







INTRODUCTION

ELEMENTARY JOINERY

The problems in Part One consisted of Simple and Board structures, there being no other but plain butt joints. In Part Two, the pieces that fit together are especially shaped. There are many different kinds of joints which may be placed or grouped in about eight classes. In Part Two, three different types of joints are used, namely, Lap-Joints, Doweled Edge Joints, and Doweled Butt Joints. The other classes of joints are left for advanced woodworking, involving more difficult tool processes. So in Part Two the models constructed involve only the use of the simpler elementary joints mentioned above.

Since the success of joinery depends largely upon the skill with which the joints are laid out, cut and shaped by the fundamental tools,—the same introductory exercise is here inserted, preceding the regular work of the group. This is especially necessary where no work has been done for some time such as at the beginning of school, after several months' vacation. The exercise given involving the fundamental tools will not take long and yet gives the pupil a quick concentrated review of fundamentals. If, however, enough time is given to shop work so that Part One and Part Two may both be given during the same school year, the exercise may be omitted if necessary. If possible it should be given.

A quick review and demonstration by the teacher before his class with these fundamental tools will do much to gather the loose ends which the pupils may have forgotten.

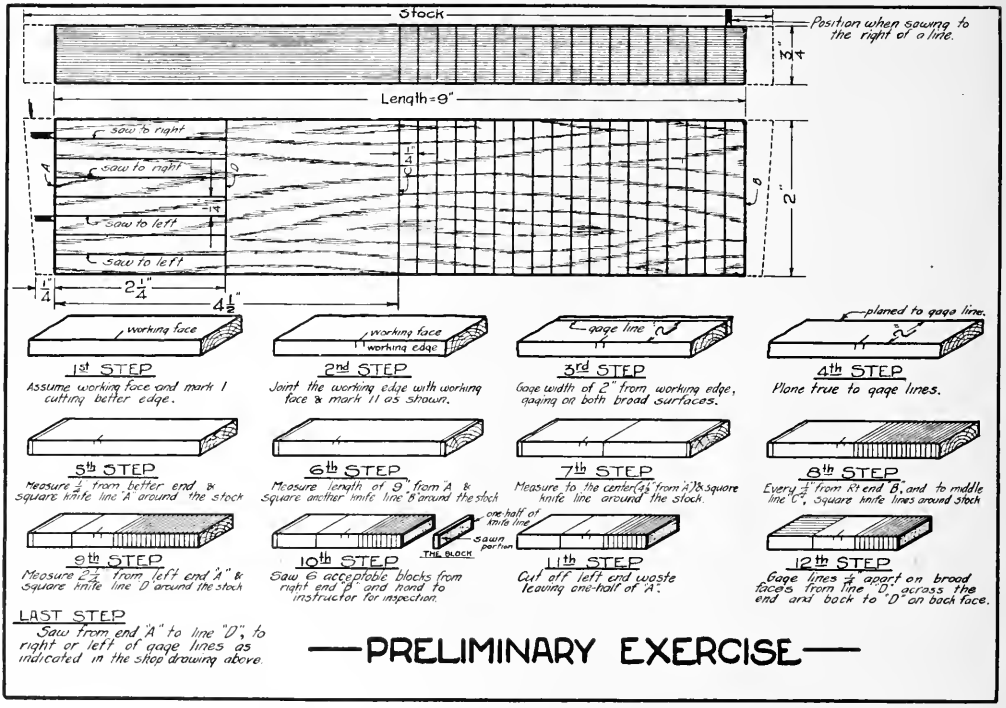
REVIEW OF FUNDAMENTAL TOOLS AND PROCESSES

1. The Plane . . . Manipulation and adjustment.
2. Try Square . . . Its applications and use.
3. Rule . . . . . Measuring using a common starting point.
4. Gage . . . . . Setting and manipulation.
5. Knife . . . . . Correct sharpening and use for marking.
6. Bench Hook . . Holding work for cross-cutting.
7. Back Saw . . . . Sawing to knife lines. (Cross-cutting.)
8. Back Saw . . . . Sawing to gage lines. (Rip-sawing.)

ONE PROBLEM

AN EXERCISE—See Page 74

This exercise to be executed by all pupils.

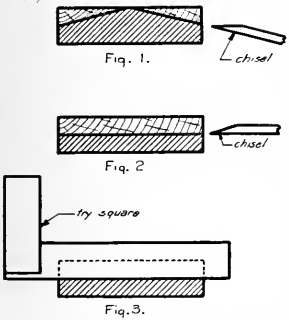

Stock
Position when sawing to the right of a line.
3/4
Length=9"
saw to right
saw to right
saw to left
saw to left
A
D
1/4
2"
1/4
2 1/4"
4 1/2"
working face
working face
working edge
gage line
planed to gage line.
1st STEP
Assume working face and mark I cutting better edge.
2nd STEP
Joint the working edge with working face & mark II as shown.
3rd STEP
Gage width of 2" from working edge, gaging on both broad surfaces.
4th STEP
Plane true to gage lines.
5th STEP
Measure 1/4 from better end & square knife line 'A' around the stock
6th STEP
Measure length of 9" from A & square another knife line 'B' around the stock
7th STEP
Measure to the center(4 1/2" from A)& square knife line around the stock.
8th STEP
Every 1/4" from A & end B, and to middle line 'C', square knife lines around stock
9th STEP
Measure 2 1/2" from left end 'A' & square knife line 'D' around the stock
10th STEP
Saw 6 acceptable blocks from right end 'B' and hand to instructor for inspection.
one half of knife line
sawn portion
THE BLOCK
11th STEP
Cut off left end waste leaving one-half of 'A'.
12th STEP
Gage lines 1/4 apart on broad faces from line 'D' across the end and back to 'D' on back face.
LAST STEP
Saw from end 'A' to line 'D', to right or left of gage lines as indicated in the shop drawing above.
—PRELIMINARY EXERCISE—

GROUP I

(The problem to be selected by the pupil under the guidance of the teacher.)

BOARD STRUCTURES—Dado Joint (Fastening with Glue)

In laying off the dado, special care must be taken to make good knife lines across the surface (working face). These should be extended on both edges with a sharp pencil line. The depth of the dado should then be gaged between these pencil lines. Then mark knife lines right over the pencil lines but only as far as the gage line, thus completing the knife line for the whole dado joint. By using this method, unnecessary knife lines on exposed surfaces will be avoided. The pupil should be careful to saw to the waste side of the line so that the dado will not be larger than that laid off in the beginning.



In chiseling this joint, the flat side of the chisel should be down. The dado should be chiseled from the outside toward the middle, as shown in the section in Fig. 1, and then finished to the gage line as shown in Fig. 2.

In order to be certain that the dado has been cleaned out in a straight line to the correct depth all the way through, the blade of the try square should be placed in the dado as shown in Fig. 3. After the pupil's judgment has been better developed, he may just use the edge of the chisel as a straight edge for this testing. Again it is permissible to make the part between the ends of the dado very slightly deeper (1/128th of an inch) which will insure that the joint at the edge will make a perfect fit when pressed together either with clamps or by the pull of the screws or nails used in fastening.

In addition to the glue, it is recommended that as a rule either screws or nails be used for fastening. In some types of construction glue alone will be satisfactory. In the latter case the parts should be kept under pressure of clamps for 24 hours.

Since both screws and nails are used in this group a review is recommended. A review of the use of the countersink should also be given.

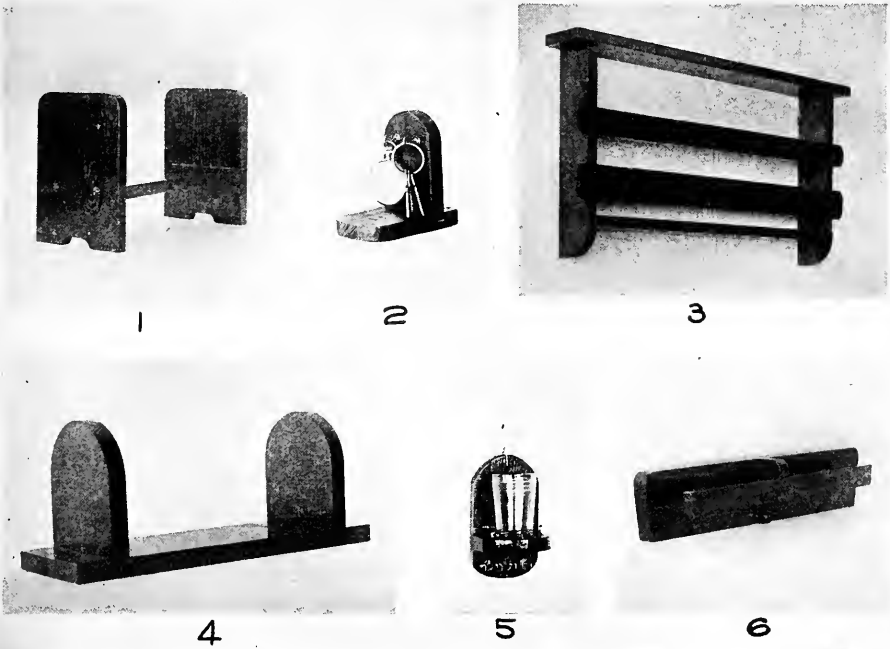
NEW TOOLS AND PROCESSES

1. DADO JOINT. . . Classified as a modified half-lap joint.
2. CHISEL. . . . . Chiseling across grain to gage line.
3. GLUE. . . . . On Dado before fastening with screws.

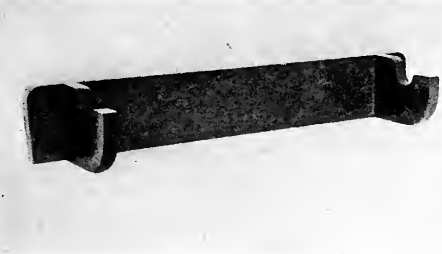
TEN PROBLEMS

WATCH AND KEY RACK	NECK TIE RACK
BOOK RACK	TOOTH BRUSH RACK
BOOK AND DESK RACK	GUN RACK
CHILD'S STOOL	WALL PAPER RACK
FLOWER BOX	SLIPPER BOX

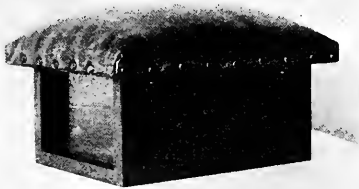
INDEX TO PICTURE ON PAGE 77


1
2
3
4
5
6

INDEX TO PICTURE ON PAGE 79



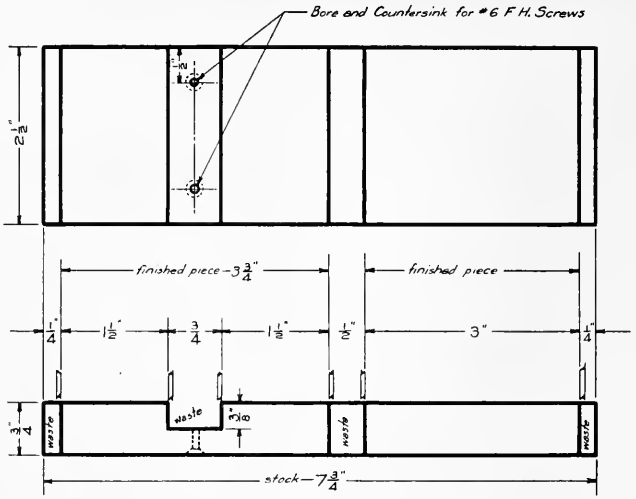
1



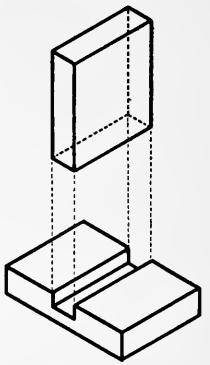
2

3

4



DETAILS – ONE WANTED



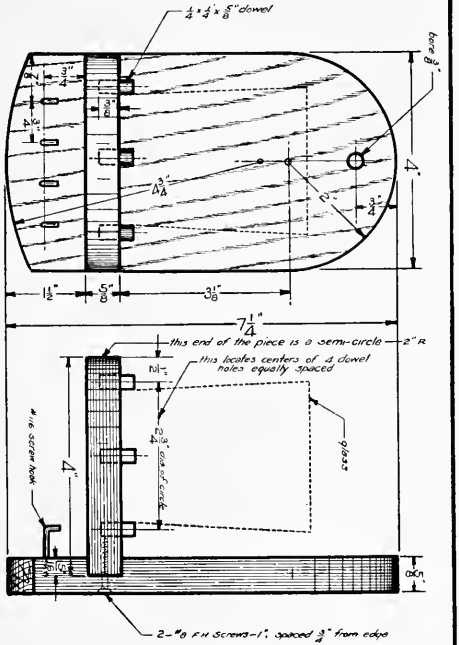
CUT – READY TO FIT

(Glue and fasten with #6 F.H. screws – 1¼")

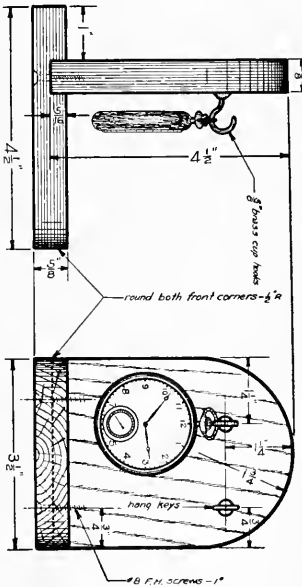
NOTE:– No sandpaper should be used on this exercise. The pieces should be left just as shaped with the cutting tools.

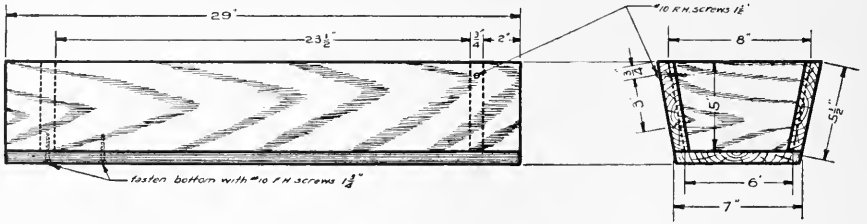
— PRELIMINARY EXERCISE – DADO JOINT —

TOOTH BRUSH RACK

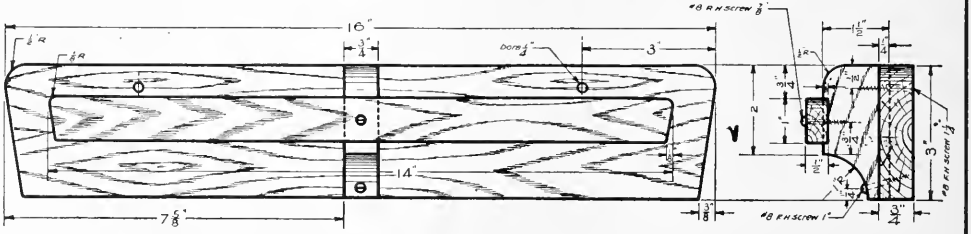


WATCH AND KEY RACK





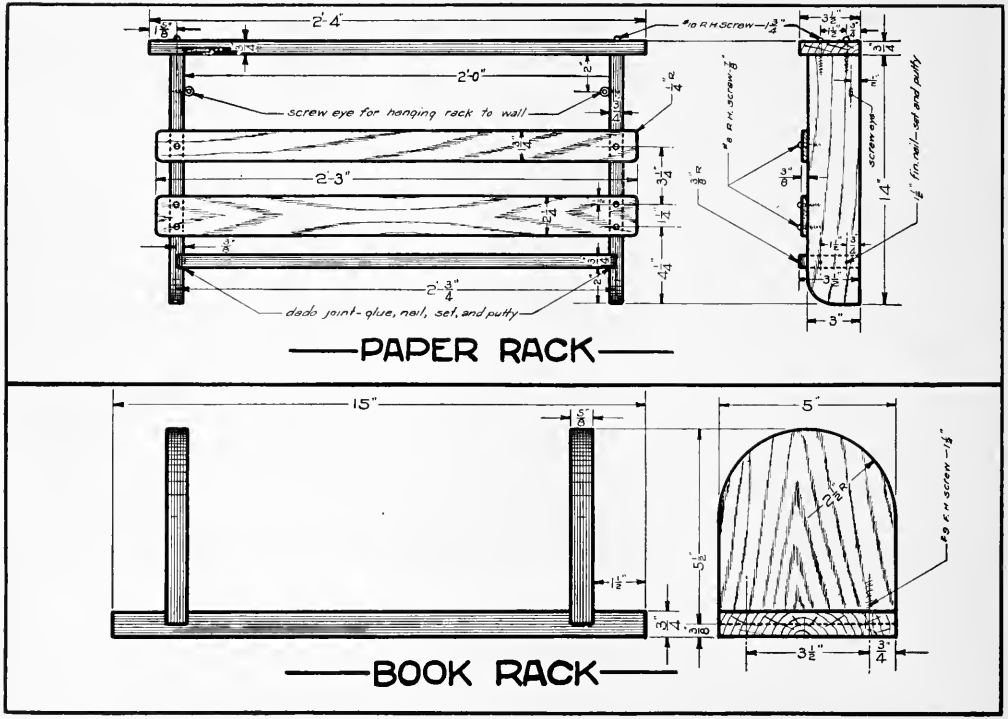
FLOWER BOX

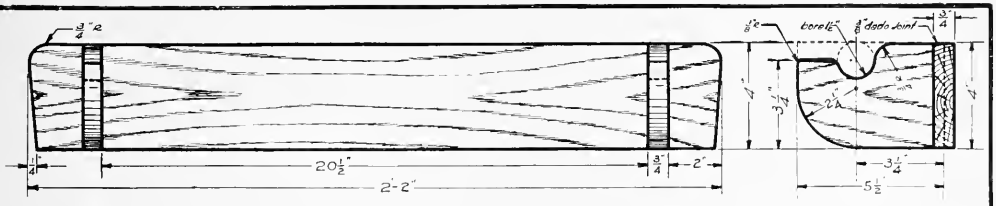


NECKTIE RACK

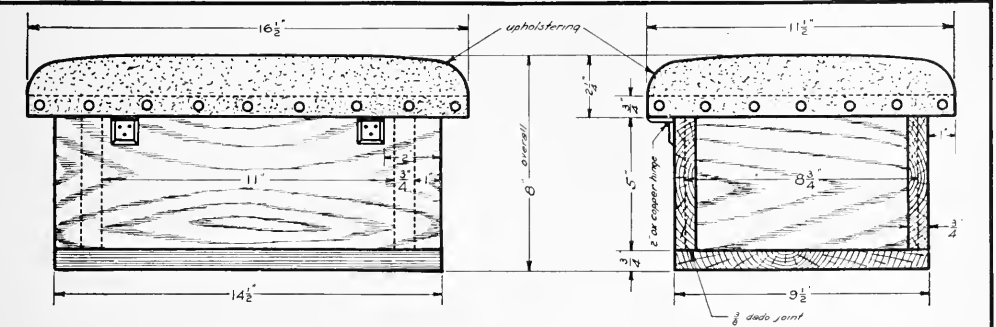
BOOK & DESK RACK
3
14"
pencil holders - bore ⅜"
Corner Brace
2"
3"
10"
#10 R.H. Screw-1⅛"
4"
6"
2½"

CHILD'S STOOL
13¾"
13"
2"
2"
5¾"
2½"
4"
13"
#10 R.H. Screw-1¼"
#10 R.H. Screw-1⅛"
9½"
8"
3"
2½"
3½"
5¼"

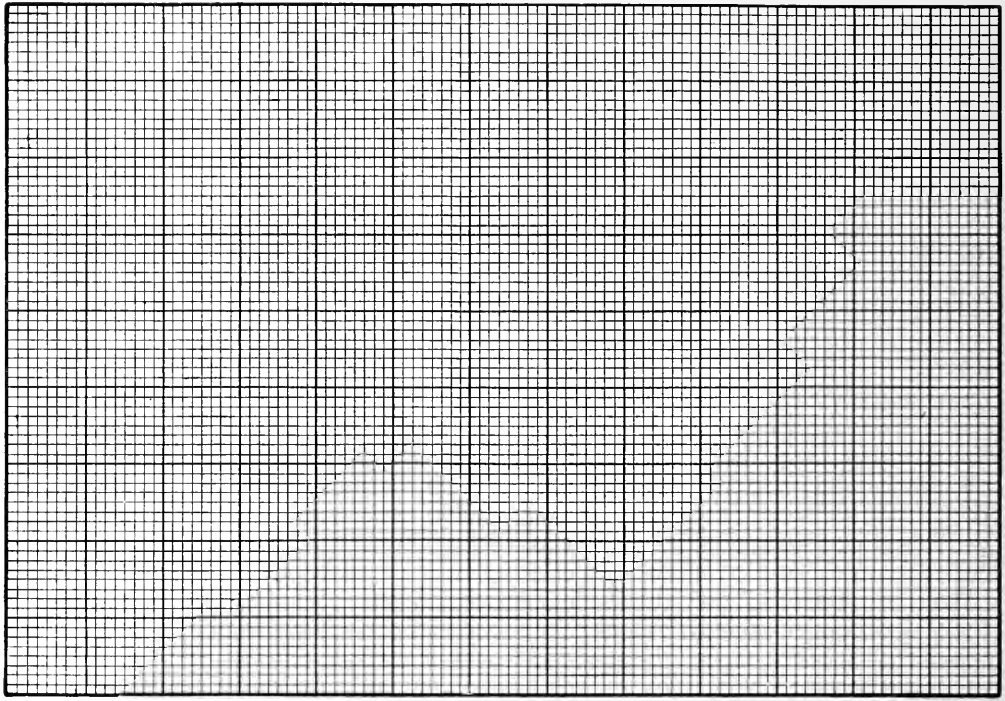

2'-4"
#10 R.H. screw—1 3/4"
2'-0"
screw eye for hanging rack to wall
2'-3"
2'-3 3/4"
dado joint - glue, nail, set, and putty
#8 R.H. screw—1"
screw eye
1/4" fin. nail—set and putty
3"
PAPER RACK
15"
5"
#8 R.H. screw—1"
BOOK RACK

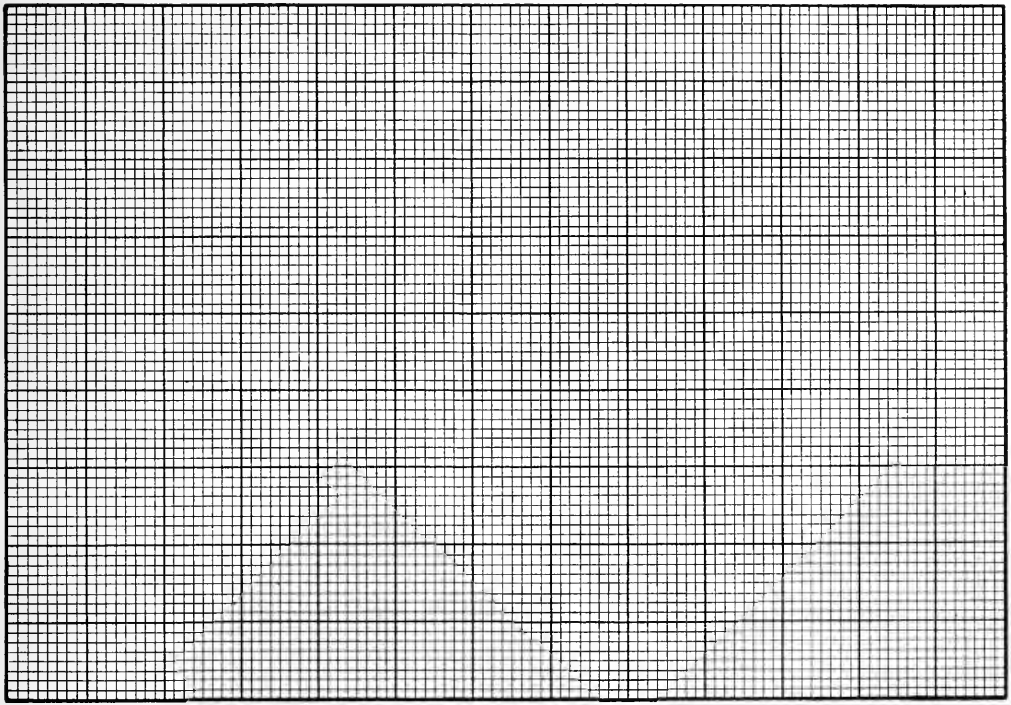


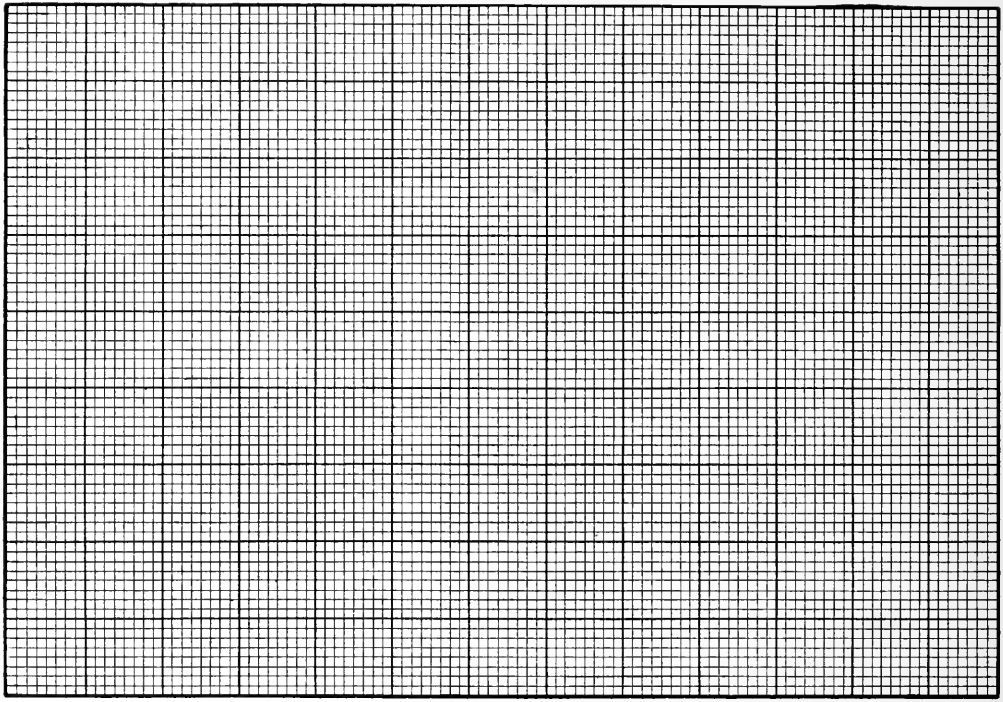
—GUN RACK—



—SLIPPER BOX—







GROUP II

(The problem to be selected by the pupil under the guidance of the teacher.)

BOARD AND FRAME STRUCTURES—Face Cross-Lap Joint

The difference between a face cross-lap joint and an edge cross-lap joint is mainly in the difference in the proportions of the joint. The face cross-lap means a greater width for chiseling, a less depth for sawing, while the edge cross-lap is just the reverse. The general principles however are the same, though the face cross-lap is usually a little more difficult for beginners than the edge cross-lap. For this reason the edge cross-lap joint has been placed with the doweled edge joint in the next group.

If the student has learned the fundamentals of the last group, the dado joint group, then he ought to master the face cross-lap very easily. The difference between the face cross-lap and the dado joint is that in the dado only one of the pieces is sawed and chiseled, while in the face cross-lap both pieces to be joined are chiseled. Again the face cross-lap is wider and more difficult to chisel than the dado which is narrower.

The instructor should see that the fundamental principles illustrated in the last group are re-emphasized under the slightly changed conditions.

Various methods of fastening face cross-laps are used. Glue, brads, flat head screws, corrugated fasteners are used, but special precaution should be taken that the brads, screws and fasteners are driven in on the unexposed surfaces only. Glue alone is often entirely satisfactory if properly heated and applied, though a better job is done when a metal fastener is used in addition to the glue.

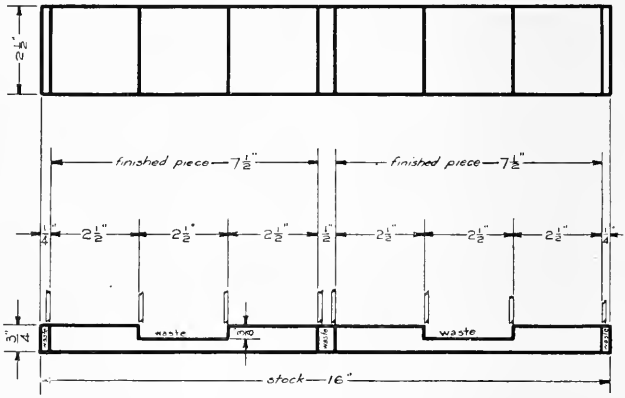
The importance of accuracy in making knife lines, the correct sawing to such lines, should be particularly emphasized.

NEW TOOLS AND PROCESSES

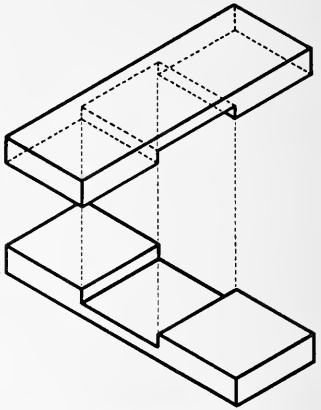
FACE CROSS-LAP JOINT....The usual half-lap joint.
CHISEL.....Chiseling over a larger surface running with the grain.

NOTE:—In chiseling a piece with an oblique grain, the chisel should be started so that a possible split would come in the waste portion of the joint.

TEN PROBLEMS



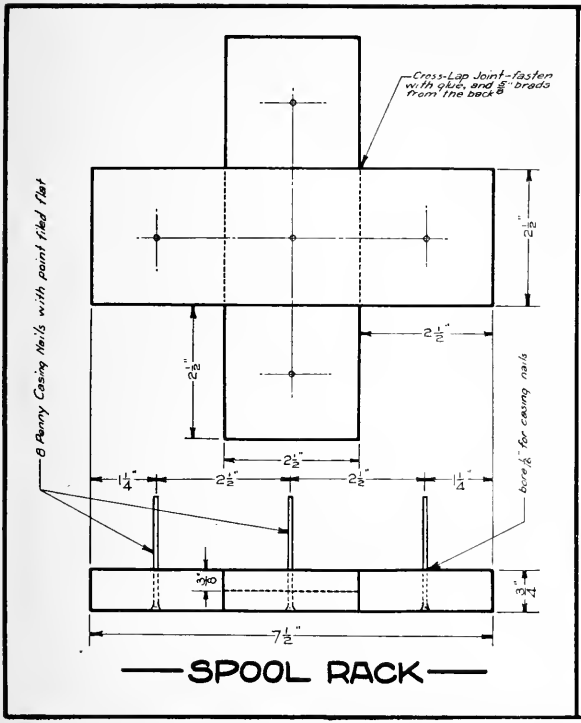
DETAILS — ONE WANTED



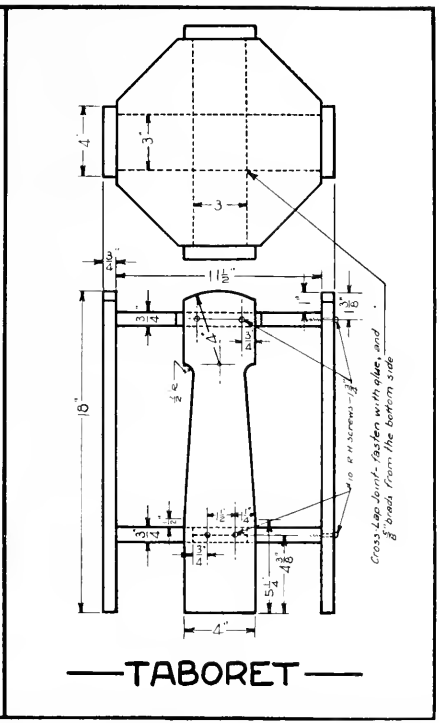
CUT — READY TO FIT
(Glue and fasten with ⅝" brads)

NOTE:— No sandpaper should be used on this exercise. The pieces should be left just as shaped with the cutting tools.

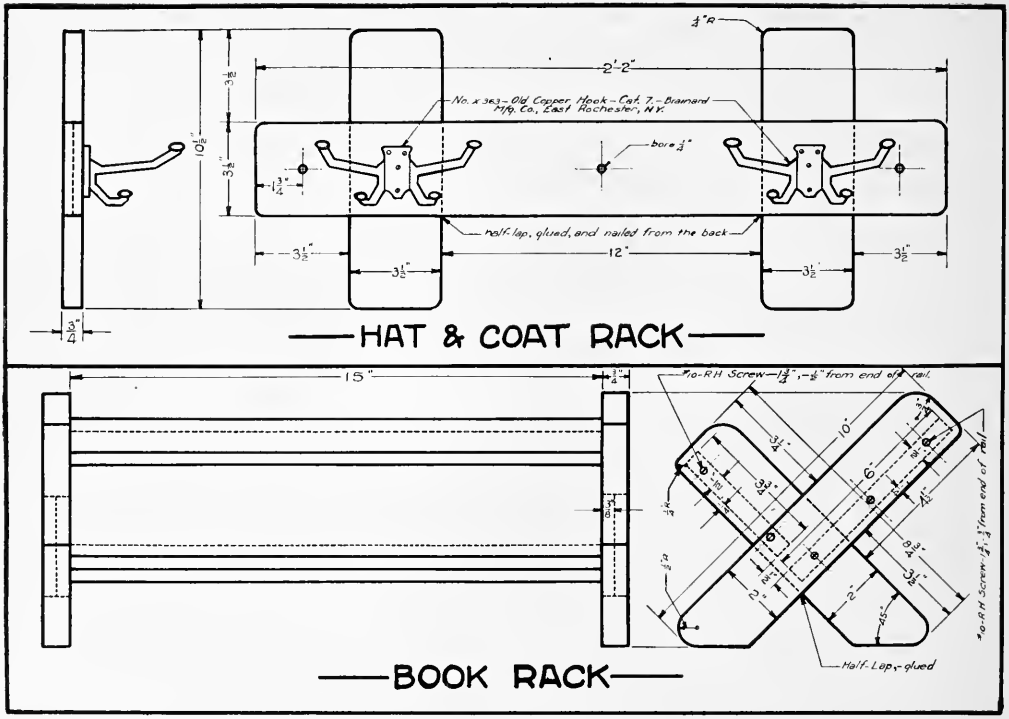
— PRELIMINARY EXERCISE — FACE CROSS-LAP JOINT —



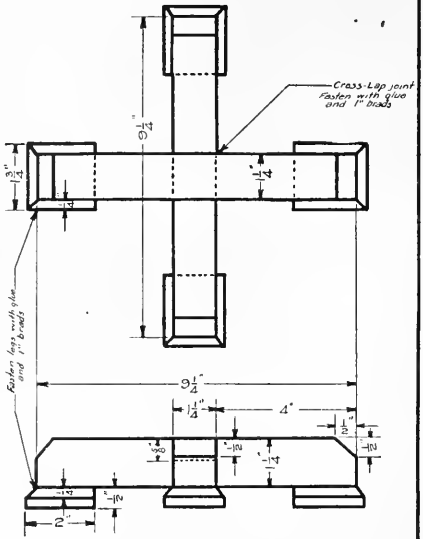
SPOOL RACK



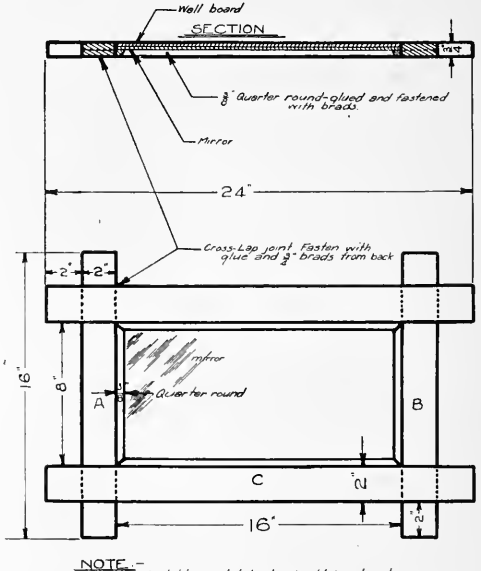
TABORET


HAT & COAT RACK
No. X 363 - Old Copper Hook - Cat. 7 - Brainard Mfg. Co., East Rochester, N.Y.
bore 1/4"
half-lap, glued, and nailed from the back
2'-2"
12"
BOOK RACK
15"
No. R.H. Screw - 1 1/2" - 5/8" from end of rail.
Half-Lap - glued
No. R.H. Screw - 1" - 3/4" from end of rail

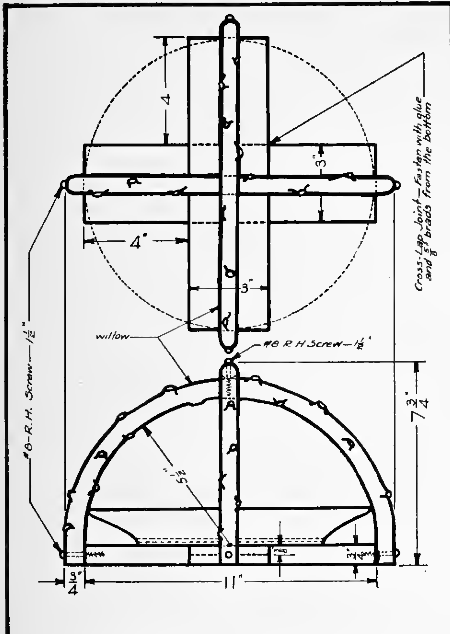
WIND MILL VANE
WIND MILL WHEEL
DETAIL OF BLADE
2-WANTED
chamfer ⅛"
bore ⅝" - ¼" deep
bore ⅝"
6 F.H. Screws - ¾"
#10 R.H. Sc. - ¾" Washer
This distance is found by adjusting the mill after the wheel has been fastened.
out of scale
Bore ⅜" after cap has been glued & fastened with ¼" blocks
Fasten to vane with #4 - 2¼" R.H. Screws. Place washer under head of screw



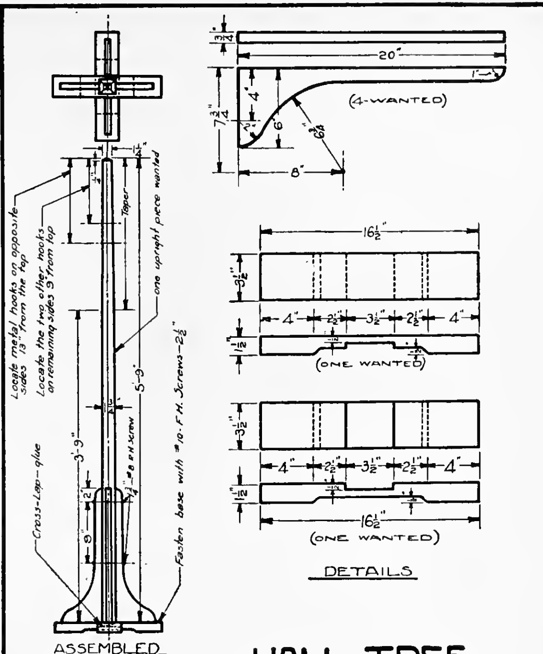
FLOWER STAND



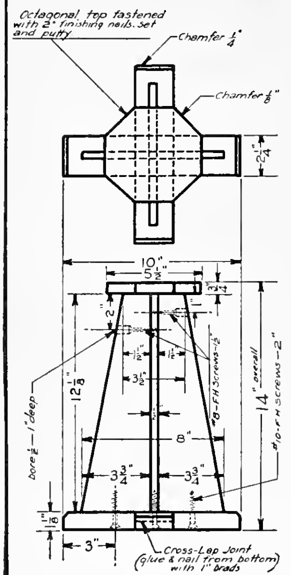
HALL HAT RACK



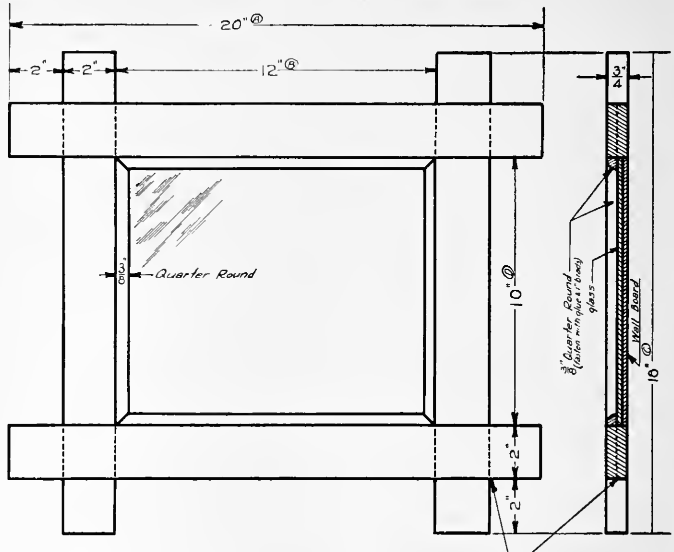
—FRUIT BASKET—



—HALL TREE—

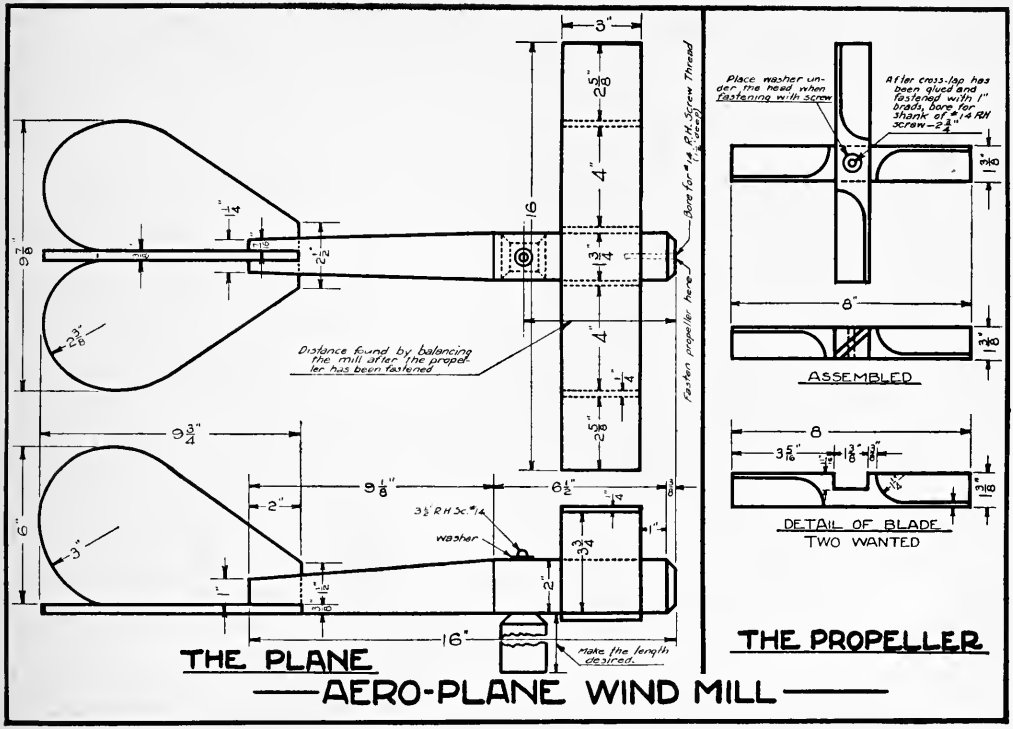


—PLANT STAND—

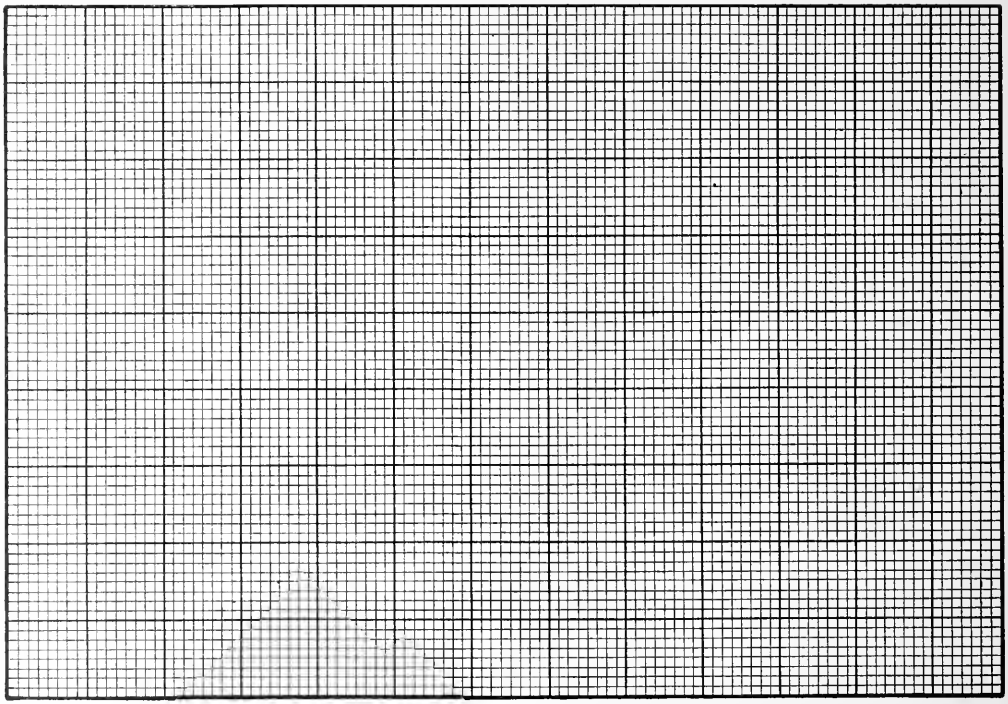


NOTE:- The pupil should change the dimensions Ⓐ, Ⓑ, Ⓒ, & Ⓓ to sizes required for picture he may wish to frame

—PICTURE FRAME—



—AERO-PLANE WIND MILL—



GROUP III

(The problem to be selected by the pupil under the guidance of the teacher.)

BOARD AND FRAME STRUCTURES—Edge Cross-Lap and Doweled Edge Joint

The difference between the Edge and the Face Cross-lap joints, as well as their similarity should be again pointed out to the pupil as explained in the previous group.

Edge Cross-Lap joints are usually fastened with glue alone. Sometimes where a good joint has been made no fastener is used though this is not advisable. Good, fresh, hot glue should always be used.

In discussing the dowel edge joint, the instructor should point out the principle in design of such a joint. Each dowel should support the same amount of the edge joint. For example, if two dowels are used in an edge joint 9″ long, then each dowel should support 4½″ of the edge. In other words each dowel should be 2¼″ from their respective end, which places them in the middle of their portion of 4½″. Again if three dowels are used in an edge joint of 24″, then in order that each supports its share of the joint, the dowels should be respectively 6″ apart, while the outside dowels are 3″ away from their respective end. An examination of the drawings in this group that show the position of the dowels will illustrate this point.

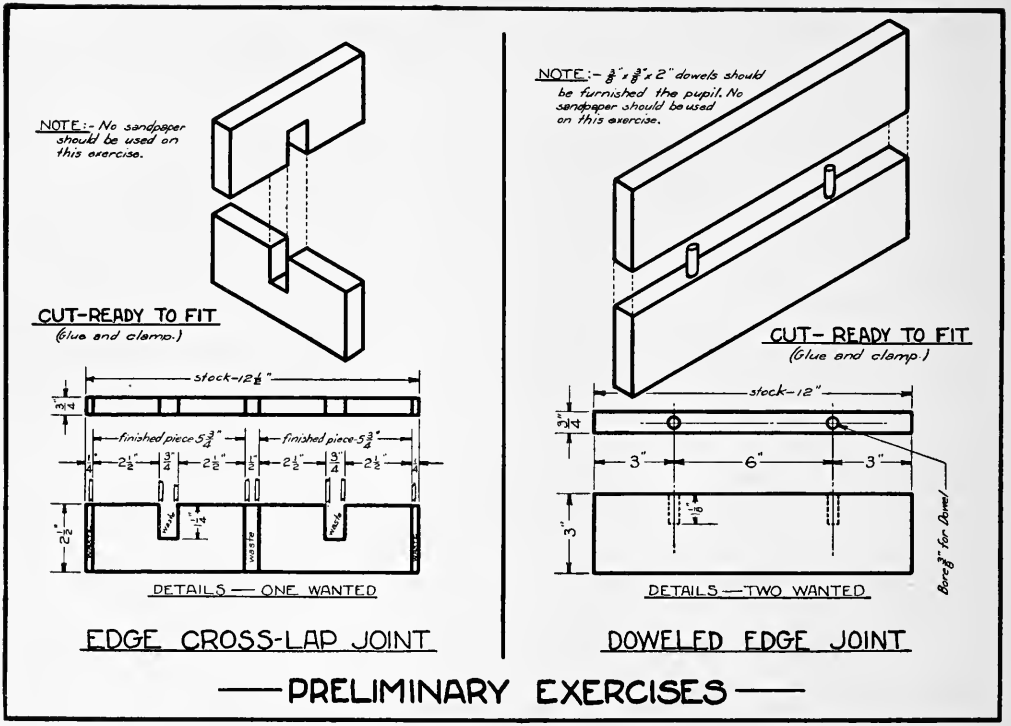
A dowel joint well made is strong. If poorly made, it is worse than if the edges of the boards were simply glued together. The hole bored should always be deeper —from $\frac{1}{16}$″ to $\frac{1}{8}$″—than one half of the dowel used. If the hole is made exactly the length of the half dowel, then when shrinkage takes place in the board, while no shrinkage takes place in the dowel along the length of its grain, the dowel will force the edge apart. This should be well emphasized.

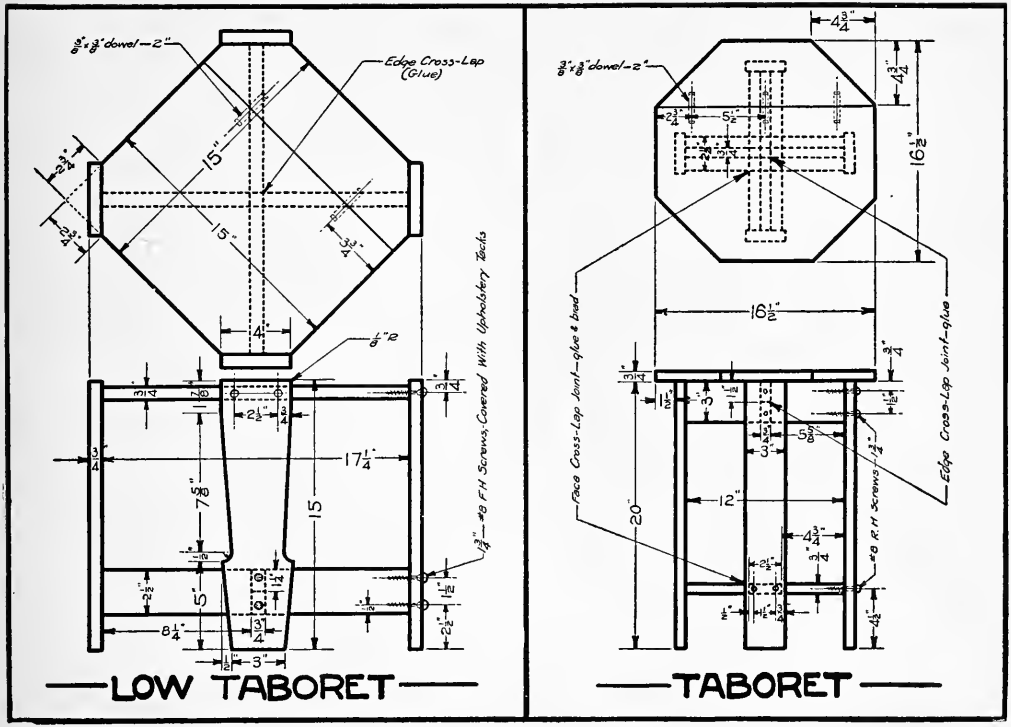
Again in gaging the middle of the edge, for the position of the dowel, care should be taken that the gaging is done from the sides that will lie in the same plane when the piece has been glued together. This gaging, together with the cross lines, should be done while the pieces are clamped in the vise, edges side by side, and the working faces to the outside.

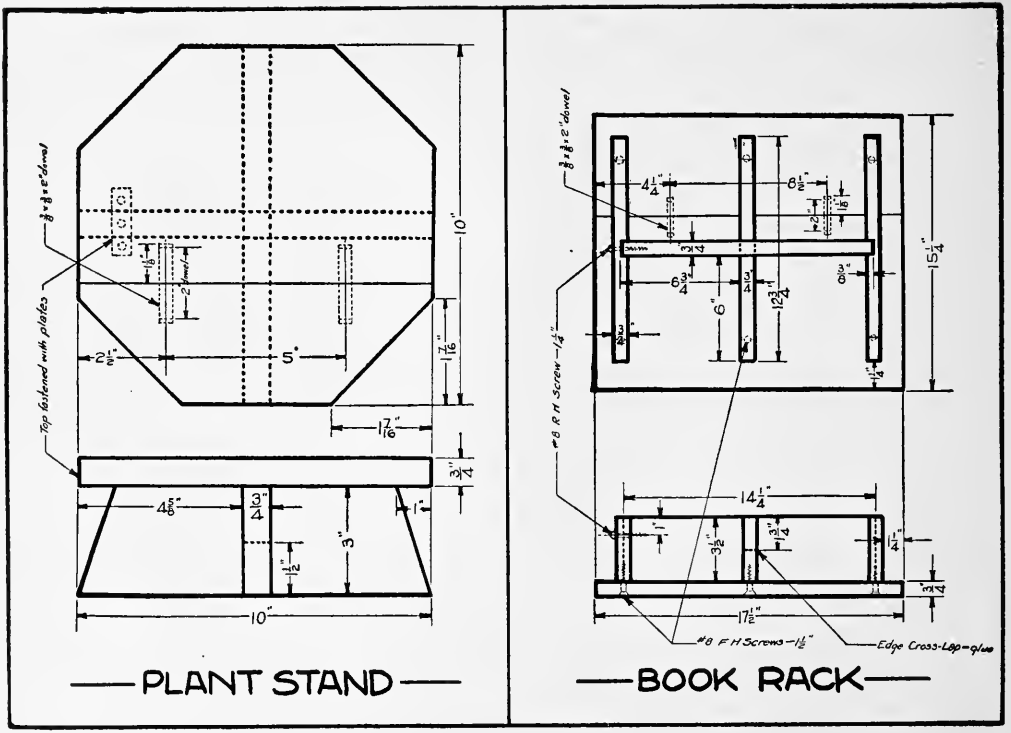
NEW TOOLS AND PROCESSES

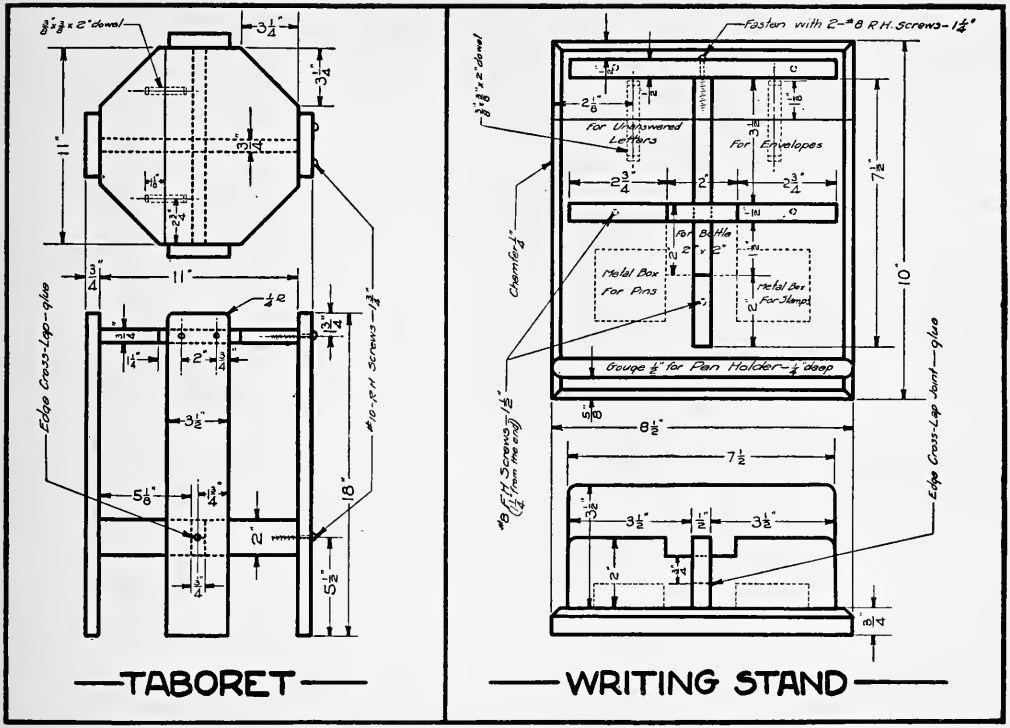
BORING FOR DOWELS..Getting the holes perpendicular and in line.
BIT GAGE.....Getting a uniform depth.
DOWELS.....Having groove on the sides for the escape of surplus glue.
HAND SCREWS.....Clamping small pieces.
STEEL CLAMPS.....Drawing up and clamping edge joints.

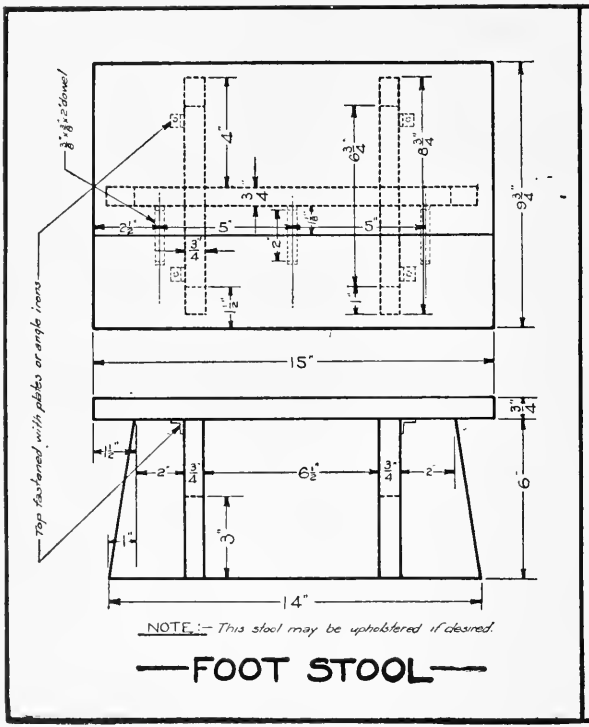
TEN PROBLEMS

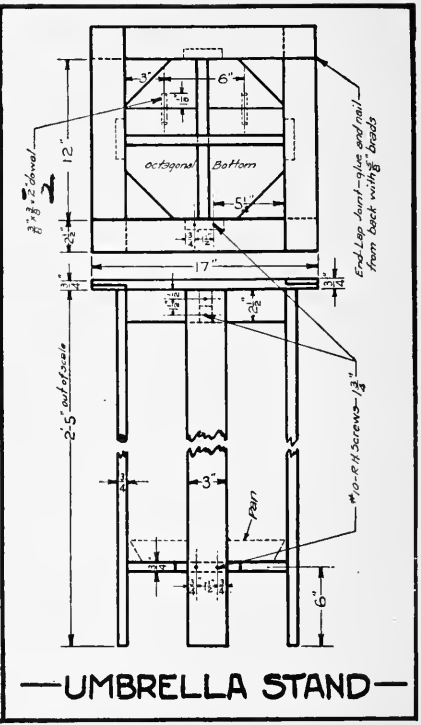

NOTE:- No sandpaper should be used on this exercise.
CUT-READY TO FIT
(Glue and clamp.)
stock-12½"
finished piece-5¾"
finished piece-5¾"
waste
DETAILS — ONE WANTED
EDGE CROSS-LAP JOINT
NOTE:- ⅜" x ⅜" x 2" dowels should be furnished the pupil. No sandpaper should be used on this exercise.
CUT- READY TO FIT
(Glue and clamp.)
stock-12"
3"
6"
3"
Bore ⅜" for Dowel
DETAILS — TWO WANTED
DOWELED EDGE JOINT
PRELIMINARY EXERCISES

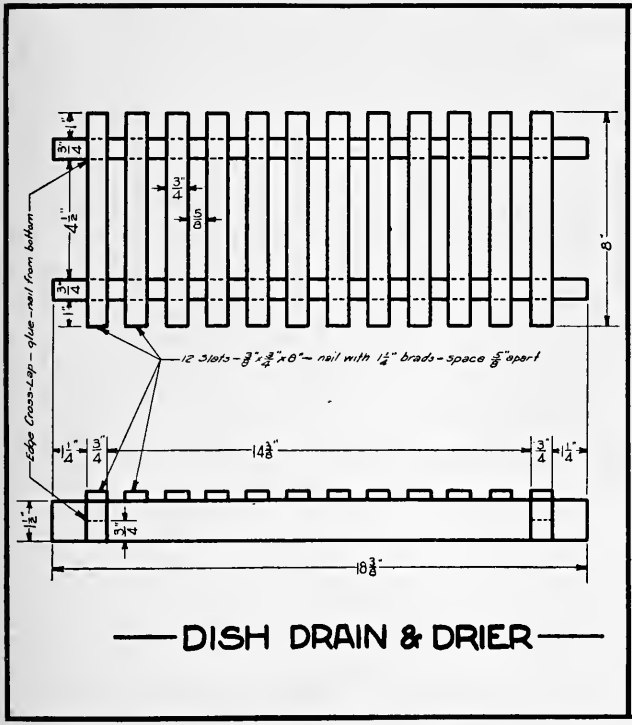

3/8"x3/8" dowel—2"
Edge Cross-Lap (Glue)
15"
15"
4"
1/8" R
Upholstery Tacks
17 1/4"
7 5/8"
15"
5"
8 1/4"
3"
#8 F.H. Screws, Covered With
LOW TABORET
3/8"x3/8" dowel—2"
4 3/4"
16 1/2"
16 1/2"
Face Cross-Lap Joint—glue & bind
Edge Cross-Lap Joint—glue
20"
12"
#8 R.H. Screws
TABORET


3/8 x 3/8 x 2" dowel
Top fastened with plates
10"
1 7/16"
2 1/8"
5"
1 7/16"
3/4"
4 5/8"
3/4"
1"
1/2"
3"
10"
PLANT STAND
3/8 x 3/8 x 2" dowel
#8 R H Screw - 1/4"
4 1/4"
8 1/2"
2"
1/8"
3/4"
6 3/4"
6"
12 3/4"
Ø 1/4"
1/4"
15 1/4"
14 1/4"
1"
3 1/2"
3/4"
4"
3/4"
17 1/2"
#8 F H Screws - 1 1/2"
Edge Cross-Lap - glue
BOOK RACK

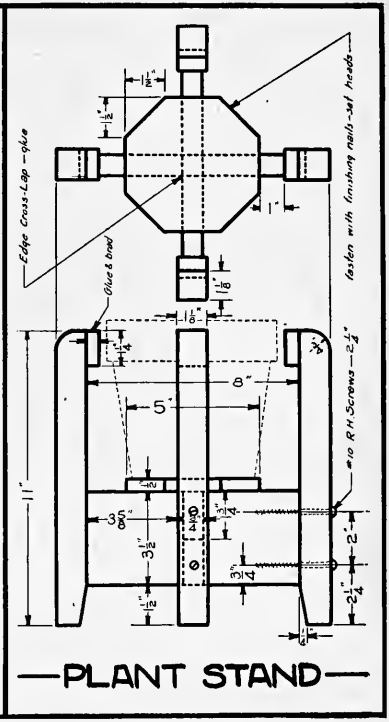

TABORET
WRITING STAND
Edge Cross-Lap-glue
Edge Cross-Lap Joint—glue
Fasten with 2-#8 R.H. Screws-1¼"
Chamfer
For Unanswered Letters
For Envelopes
Metal Box For Pins
Metal Box For Stamps
Gouge ¼" for Pen Holder—¼ deep
#8 F.H. Screws 1¼" (¼ from the end)
#10 R.H. Screws-1¾"
11"
18"
10"
7½"
8½"
7½"


Top fastened with plates or angle irons
15"
14"
6"
NOTE:- This stool may be upholstered if desired.
FOOT STOOL

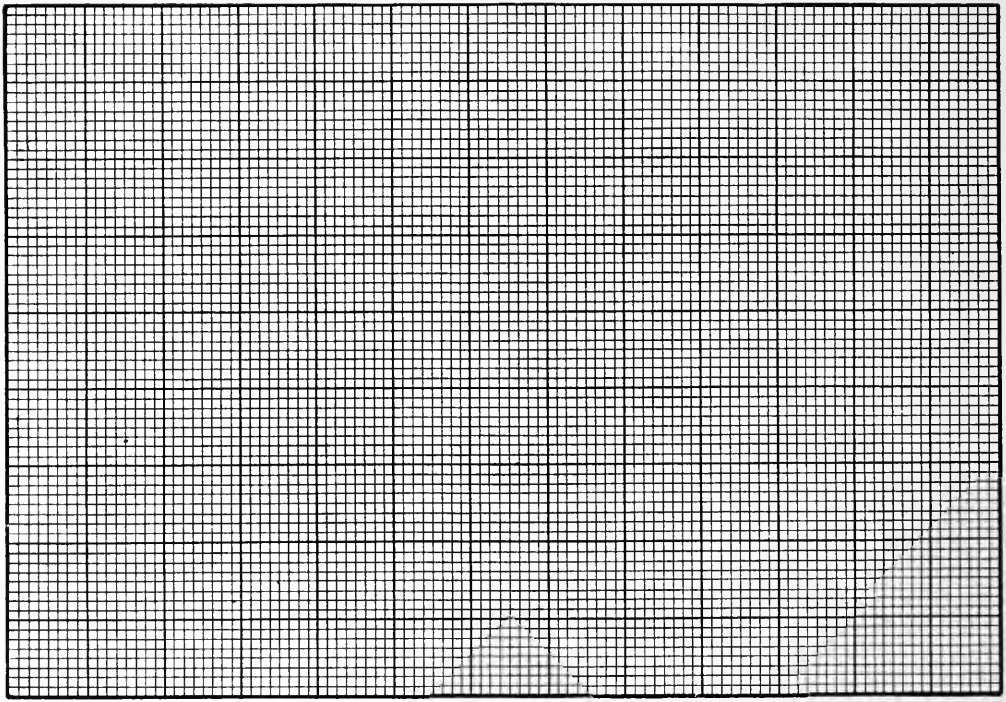

octagonal Bat Horn
17"
2'5" out to out
End Lap dovetail glue and nail from back with 8d brads
M10-R.H. Screws-1 3/8"
Pan
6"
UMBRELLA STAND

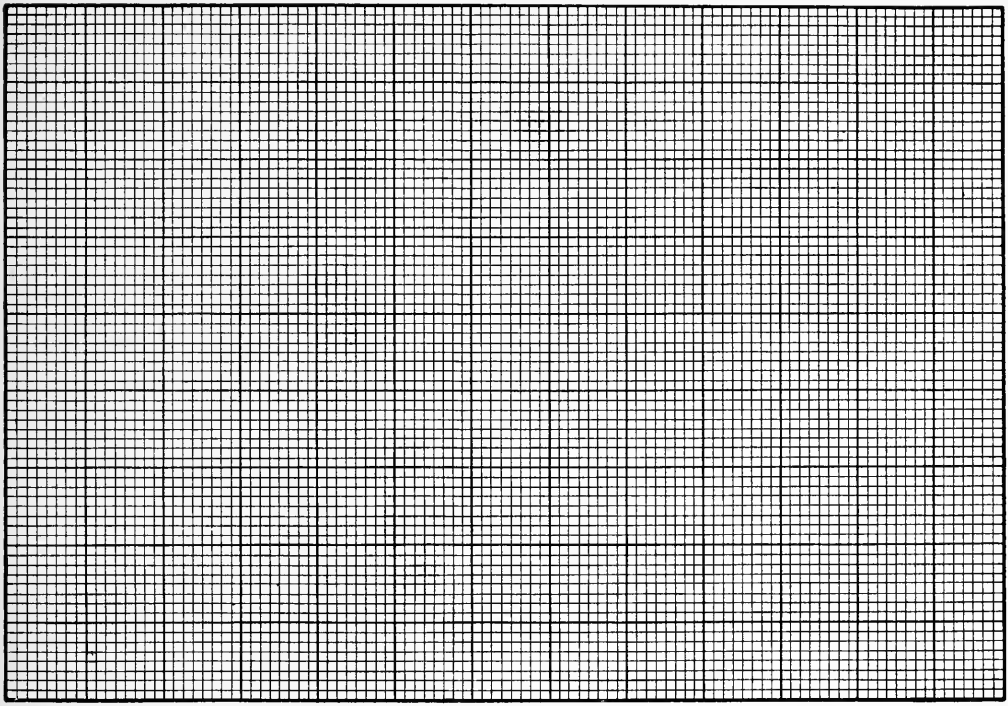


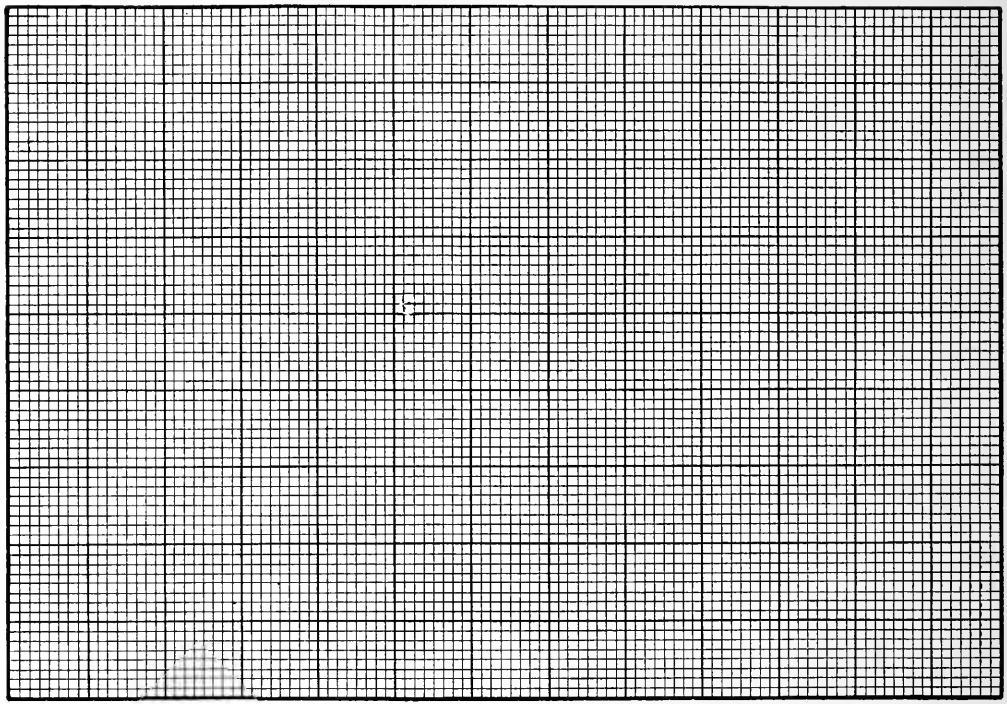
DISH DRAIN & DRIER



PLANT STAND







GROUP IV

(The problem to be selected by the pupil under the guidance of the teacher.)

FRAME STRUCTURES—Doweled Butt Joint

It is very important in this group that the butt joints are carefully laid out and the pieces cut square. Care must be exercised in the layout of the centers for the dowels as well as in the boring of the holes.

The instructor should review the principles of doweling an edge joint, since edge joints again have a prominent part in this group. Also the principles for determining the depth of the holes to be bored and the use of the bit gage.

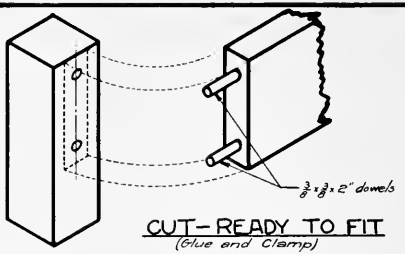
The use of steel clamps, the squaring of the work when gluing, should again receive prominent mention.

It should be pointed out that a dowel joint, though a good joint where the work is well done, is not as good as what is known as the mortise and tenon joint, which they will get in their advanced work. That as far as outward appearances is concerned, one can not tell if the joint is doweled or mortised. That the best furniture is always made with mortise and tenon joints. That doweled joints should rarely be used for large pieces, especially where there is considerable strain.

NEW TOOLS AND PROCESSES

Doweled Butt Joint	Layout, Boring, Gluing.
Steel Clamps	Clamping pieces square.
Mitre Box	Cutting butts.

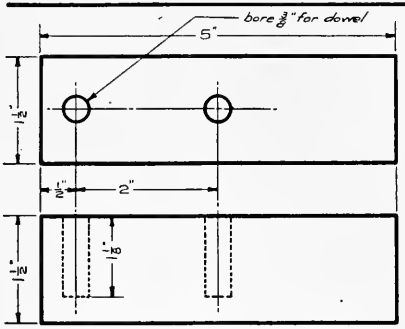
TEN PROBLEMS



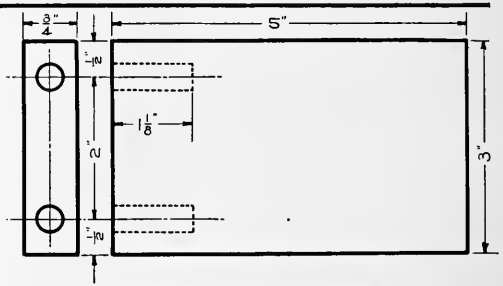
CUT—READY TO FIT
(Glue and Clamp)

NOTE ON DOWELS

The dowel used should have two grooves on its opposite sides to permit the escape of the superfluous glue when driven in. If this groove is omitted, the dowel acts like a piston, and in being driven, may force the glue to break out thru the side of the piece.



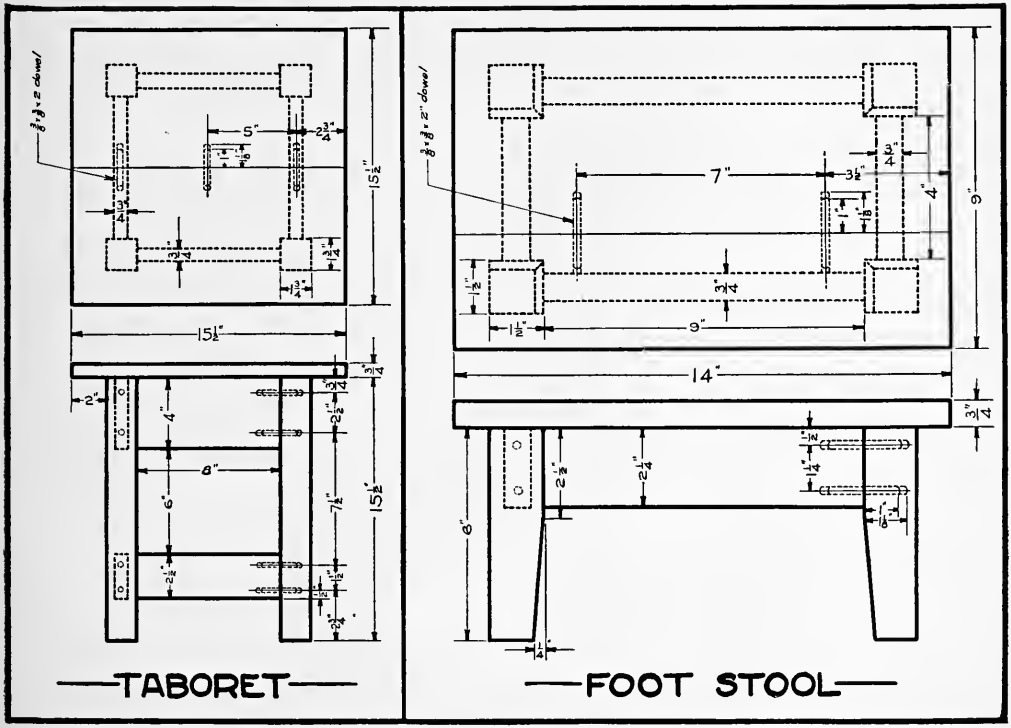
DETAILS— ONE WANTED

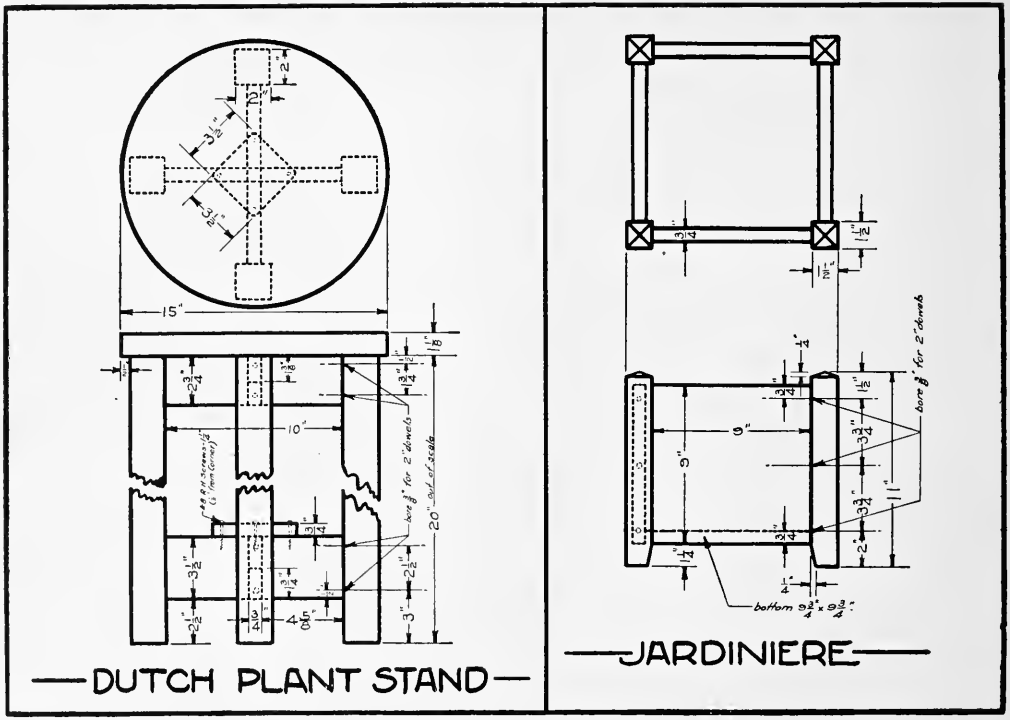


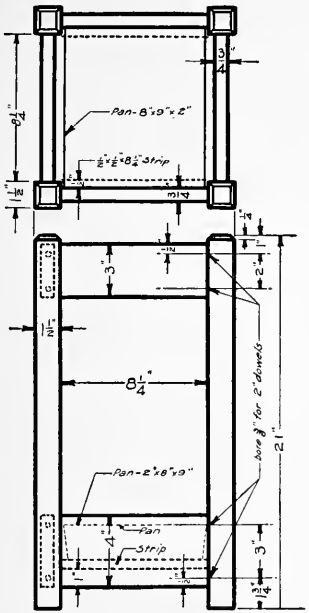
DETAILS—ONE WANTED

NOTE :— *The instructor should furnish pupils with the dowels.— This exercise should not be sandpapered.*

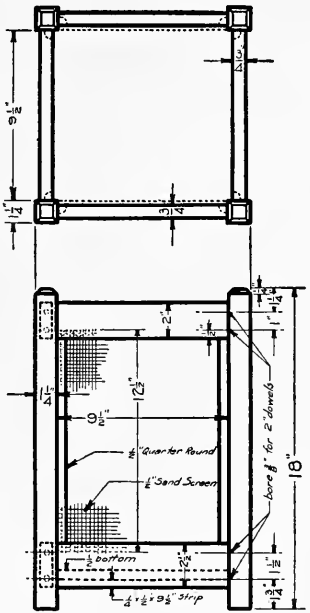
—PRELIMINARY EXERCISE— DOWELED BUTT JOINT—


TABORET
FOOT STOOL

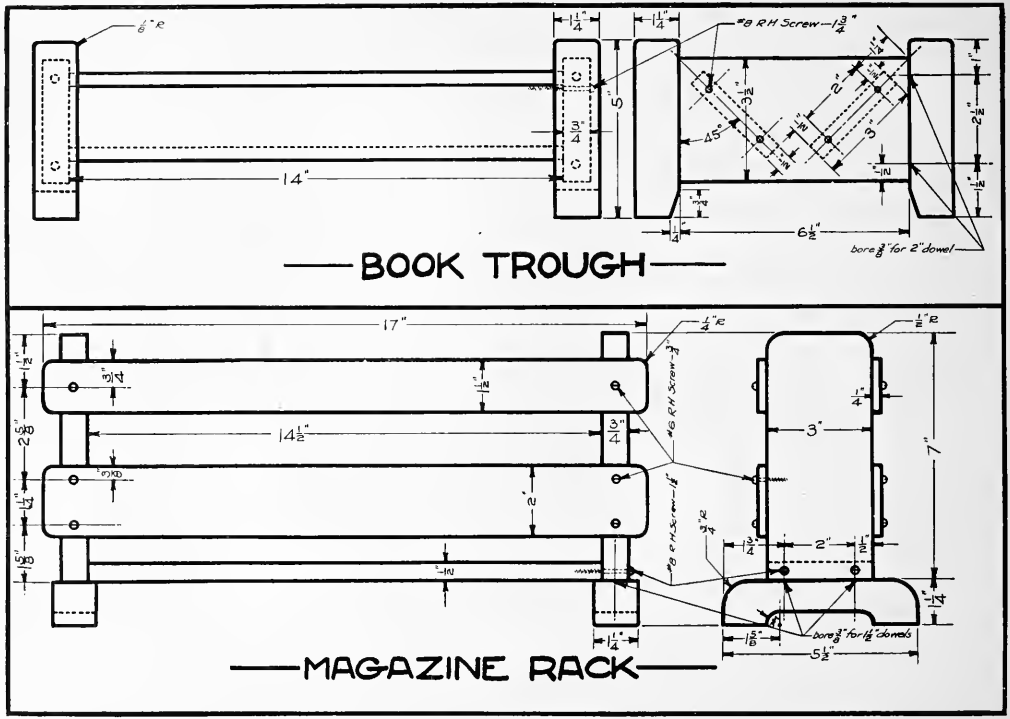

15"
10"
20" out of stock
bore ⅜" for 2" dowels
bore ⅜" for 2" dowels
bottom 9¾" × 9¾"
DUTCH PLANT STAND
JARDINIERE

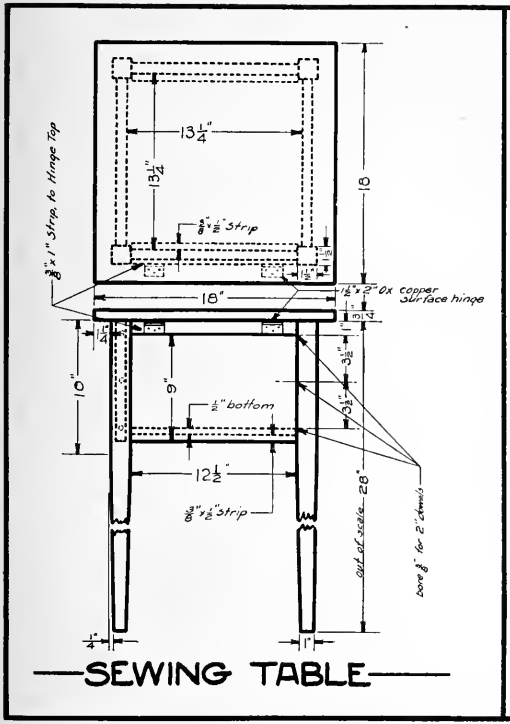


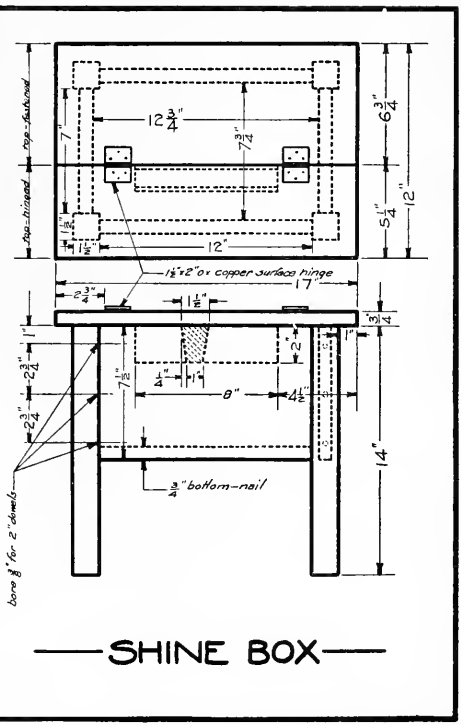
UMBRELLA STAND

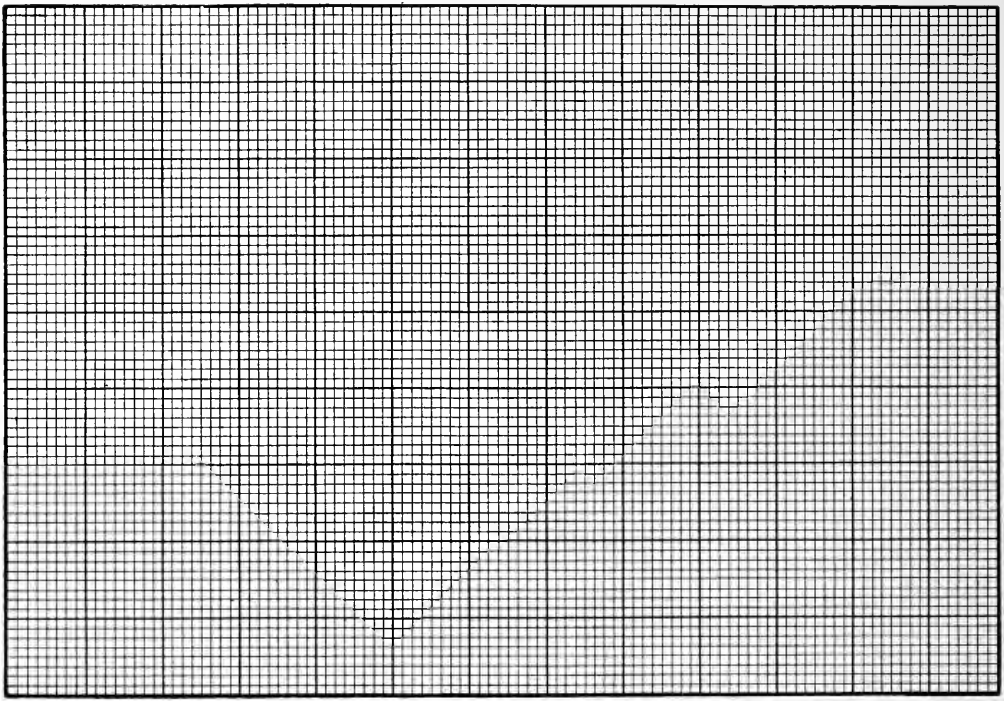


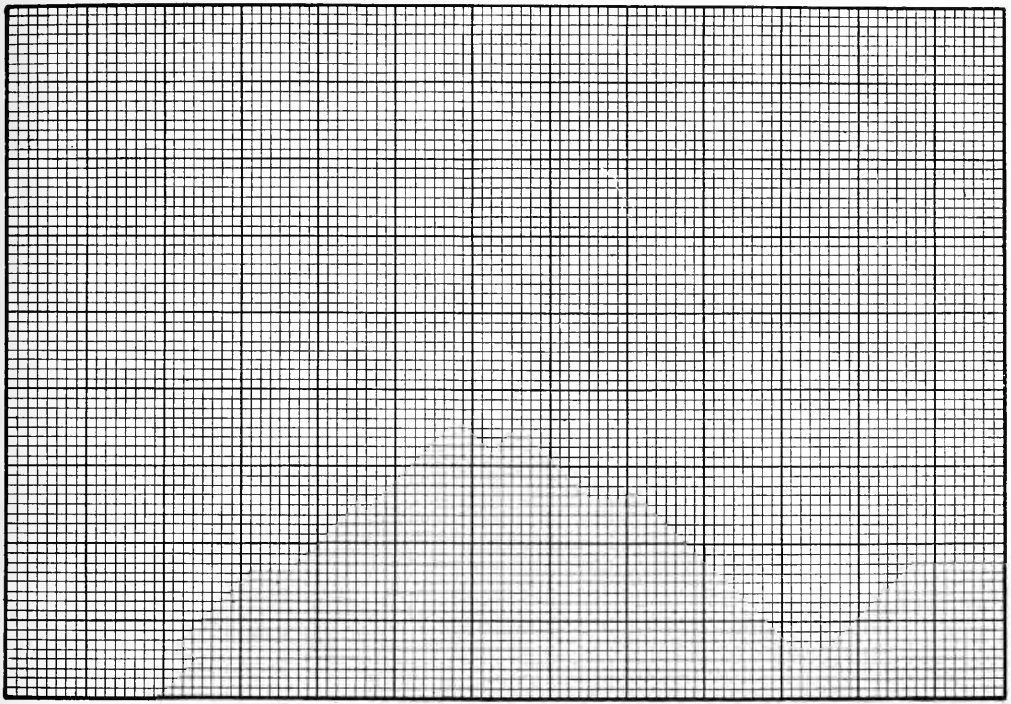
WASTE BASKET

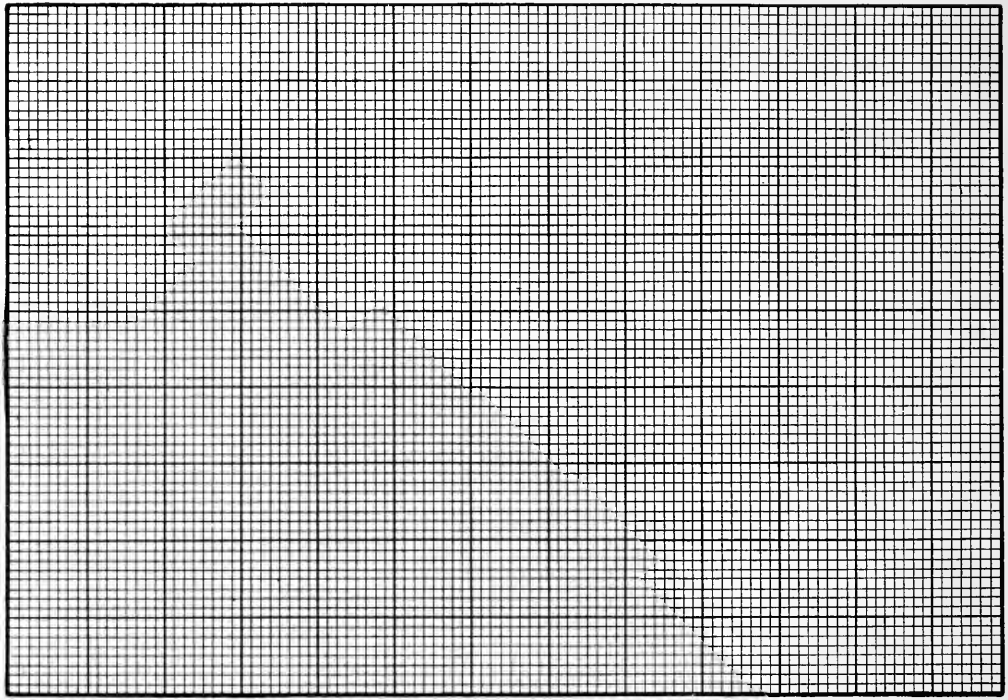

BOOK TROUGH
14"
5"
#8 RH Screw—1¾"
45°
6½"
bore ⅜" for 2" dowel
MAGAZINE RACK
17"
14½"
2"
3"
7"
5½"
#8 R.H. Screw—1"
bore ⅜" for 1½" dowels


13¼"
13¼"
18
⅞" x 1" Strip to Hinge Top
⅞" x ½" Strip
18"
1½" x 2" Ox copper Surface hinge
10"
9"
½" bottom
12½"
⅞" x ½" Strip
out of sight 28"
bore ⅜" for 2" dowels
SEWING TABLE


Axe-hinged
Axe-hinged
12¾"
7¾"
7"
6¾"
5¼"
12"
1½"
12"
1½" x 2" Ox copper surface hinge
17
2¾"
1½"
¾"
1"
2"
2¾"
2¾"
7½"
¼"
8"
4½"
14"
¾" bottom-nail
bore ⅜" for 2" dowels
SHINE BOX







GROUP V

(*The problem to be selected by the pupil under the guidance of the teacher.*)

BOARD AND FRAME STRUCTURES—General Applications and Review of Part II

Just as in Part One,—Group V of Part Two gives opportunity for selection of everything that has gone before, the opportunity for design and execution of problems that may take in different combinations of tools and processes than those listed in the groups, opportunity for review of tools and processes and the gathering of loose ends, the correction of false impressions and executions that may have persisted.

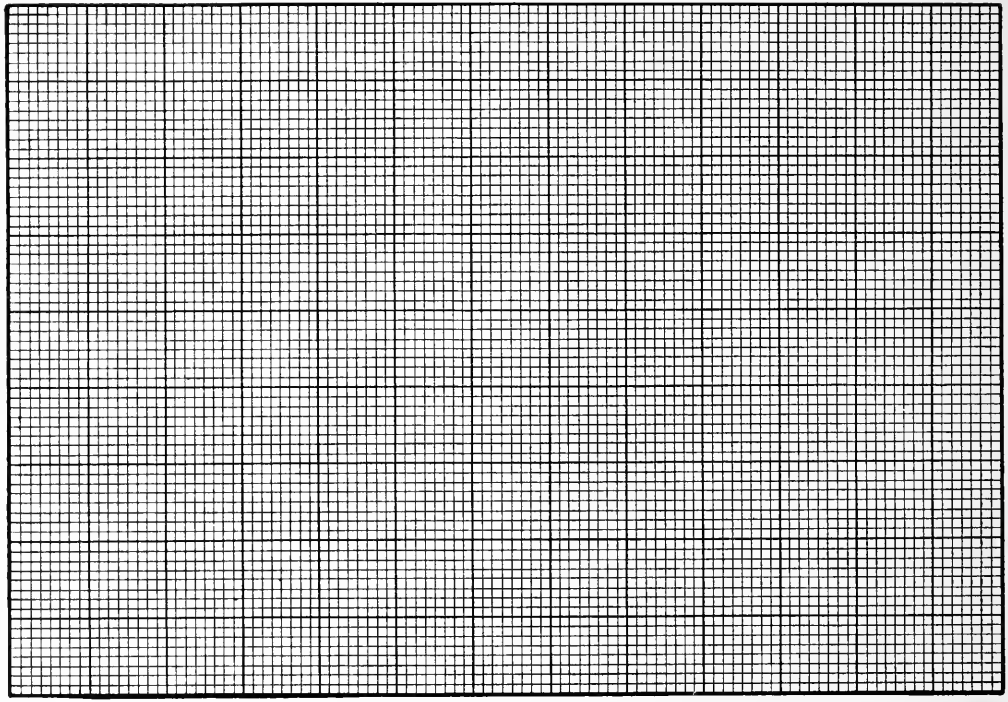
Just as in the review of Part One, the instructor should devote a few minutes daily to the review of tools and processes covered in Part Two, being careful that none are omitted. It has been found very helpful to furnish the pupils with a set of questions, say from 50 to 100, which cover the entire work of the course. Having something definite to work toward, the pupils show greater interest in preparation for the general examination that is to follow. In fact, the better plan would be to give sets of questions for each group of problems as the work progresses. If this is done the general review of the Part will be much easier. An additional advantage in giving sets of questions is that it helps the teacher to know that the vital parts of his instruction are not omitted. It is well for the teacher to check questions and topics he has taken up with the class. It is self evident that the pupil should not be tested on work which has not been presented in the recitation or demonstration.

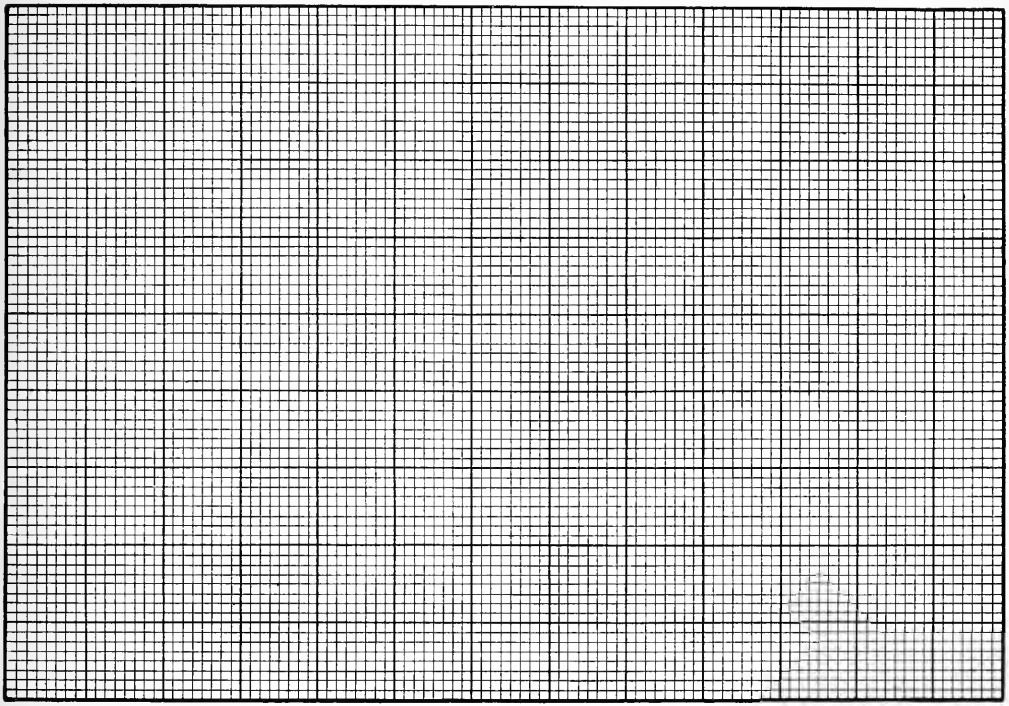
NEW TOOLS AND PROCESSES

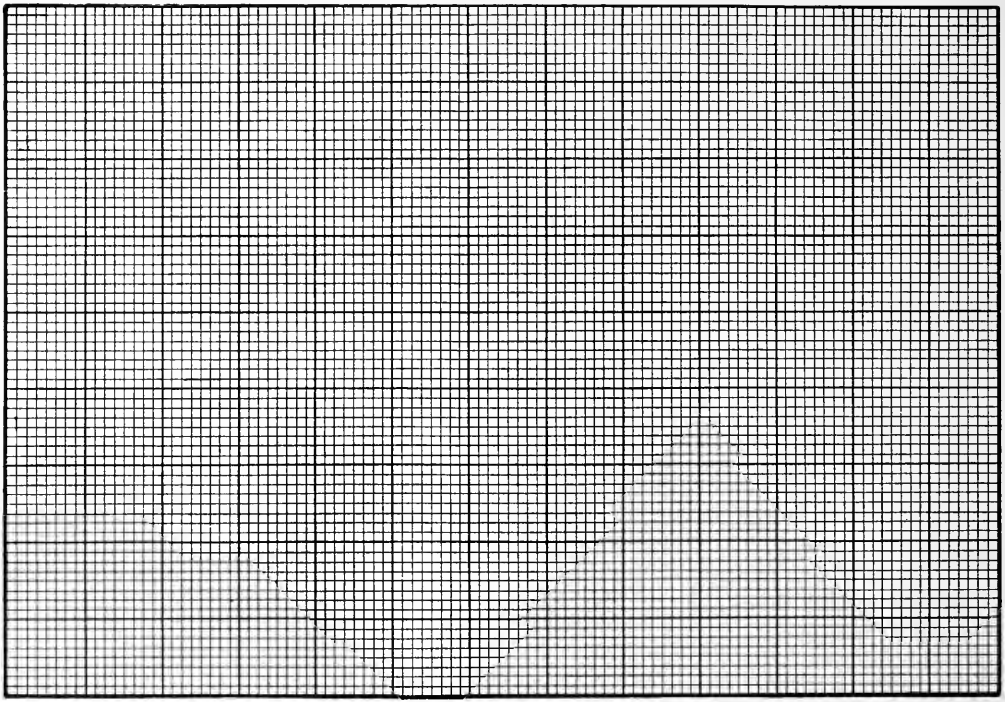
As a general rule, no new tools should be permitted here. At least no new tools or processes should be here presented to the class as a whole. However, where a pupil has shown marked ability and consistency in his work throughout, individual instruction in modified joints, processes, etc., would be permissible.

PROBLEMS

The problems to be designed should be listed here together with the page number of cross section sheet on which it is to be drawn. The size and type of problem to be constructed ought to depend entirely upon the time available, and the proficiency the pupil has shown in his previous work.







FINISHING

The "Finish" of a piece of furniture consists of two separate and distinct parts, namely: 1. The finish of the wood surface. 2. The finish as regards color and coating.

1. The finish of the wood consists of:
   a. Smoothplaning c. Sanding
   b. Scraping d. Filling

2. The finish as regards color and coating consists of:
   a. Staining b. Coating

The process of staining consists of the application of the stain with a brush, applied across the grain, after which the surplus stain is removed with a piece of waste cloth. There are different kinds of stains which will be treated separately later.

Coatings which are used as a "covering" may be either:

1. A Wax Finish 2. A Varnish Finish

Varnish finishes are of two kinds:

1. A Brush Finish, or 2. A Rubbed Finish.

In a Brush Finish just as many coats of varnish are applied as desired, each coat being left to dry thoroughly before the next coat is applied.

In a Rubbed Finish, each coat of varnish after being thoroughly dried, is rubbed down with steel wool. The final coat of varnish is rubbed down with pumice stone and oil, and finally with oil alone. Light lubricating oil is satisfactory.

When the staining or coloring is omitted, that is, if the color is left the same as the natural color of the wood, such a finish is called a natural finish. The process of finishing is exactly the same except that the staining has been omitted.

Finishes of all kinds may be applied to both soft and hard woods, with the exception that the filler used is different and is differently applied. Soft woods have a very close grain, while the harder woods usually have a more open grain. Pine and oak are examples of each.

STAINS

There are five different kinds of stains,—five, if we include commercial stains which are prepared by the trade. They are:

1. Water Stains—which are cheap and unsatisfactory,
2. Oil Stains—which are good,
3. Spirit Stains—which are expensive and difficult to apply,
4. Chemical Stains—also expensive and difficult to apply,
5. Commercial Stains—ready mixed as a rule—sometimes in powders.

Only the oil and commercial stains, which are entirely sufficient in the usual manual training shops, will be treated here.

A. **OIL STAINS** are cheap, easily applied and, though sometimes producing a muddy effect, are usually satisfactory. Oil stains are made from pigments that are ground in linseed oil. Though usually ground in oil they may be obtained ground dry. These pigments are thinned with benzine or turpentine, the quantity depending upon the shade desired. A little addition of linseed oil will give more body to the stain as well as give a slight lustre to the finished surface.

Some of the pigments used for oil stains are:

Van Dyke Brown	Brown Stain
Burnt Umber	Dark Brown Stain
Raw Umber	Light Brown Stain
Burnt Sienna	Light Red Stain
Raw Sienna	Light Reddish Brown Stain
Drop Black	Black Stain
Chrome Green	Green Stain
Chrome Yellow	Yellow Stain

Combinations may be made with the above. For example, the green may be made with two parts of drop black and one part of medium chrome yellow. Mix this well and thin with benzine or turpentine to suit.

B. **COMMERCIAL STAINS** are furnished by the trade, the various shades of colors being usually given a trade name, as golden oak, forest green, etc. When buying, the colors shown by sample applications will tell you what trade name to call for.

A commercial stain that is very satisfactory, very cheap, and which gives the various shades of colors from very light yellow to a nice deep brown, is black asphaltum. When buying be sure to get the best grade of black asphaltum. The shade you get depends upon the amount of turpentine you mix with it.

All these stains are applied with a brush across the grain, and then wiped clean with a waste piece of cloth. The longer the stain is left on the surface, the darker will be the color, since the stain soaks into the grain deeper.

FILLERS

Fillers are of two kinds—

1. Liquid Fillers—Used upon close grain or soft woods.
2. Paste Fillers—Used upon open grain or hard woods.

Liquid fillers are applied with a brush just like varnish and then allowed to dry for 24 hours. As in the application of varnish, the brush should be stroked with the grain.

Paste filler is applied with the brush, then allowed to stand a few minutes until it begins to set. This is noticed by the filler beginning to "dull." When the filler begins to set, it should be rubbed into the open pores with either excelsior or burlap by using a rotary motion. When the surplus has been removed, the final strokes with the burlap should be light and with the grain.

Liquid fillers can be bought ready prepared. Ask for light liquid wood filler which can be used on natural or stained work because it is transparent.

Paste fillers can be bought ready prepared, except that they must be thinned down to the consistency of cream before applied to the wood surface. If used on stained work the paste filler should first be stained with dry colors or pigments mentioned under stains.

There is another kind of filler called crack filler, but it is not used for filling the pores of the wood. It is used more like a putty for covering countersunk nail head, etc.

In order that the steps may be more easily understood and followed, they are here given.

STEPS IN APPLYING A RUBBED VARNISH FINISH ON SOFT WOODS

STAINED FINISH

1. Smoothplaning the wood surface.
2. Scraping the wood surface.
3. Sandpapering the wood surface.
4. Staining the wood surface.
5. Applying the light liquid woodfiller.
6. Varnish—First coat.
7. Smoothing first coat with steel wool No. 0.
8. Varnish—Second coat.
9. Smooth second coat with steel wool No. 00.
10. Varnish—Third coat.
11. Smooth third coat with paste of pumic stone and oil.
12. Rub and polish same coat with oil only.

NATURAL FINISH

If a natural finish is desired step four is omitted

These steps are explained as follows—

1. **Smoothplaning.** The first step in finishing is the surface, which should be carefully gone over with the smooth plane, taking a "fuzz" cut.

2. **Scraping.** When the more marked places have been removed with the smooth plane, the surface should be further smoothed with a steel scraper.

3. **Sanding.** Sandpapering follows the scraper. If sandpaper is first used, the small particles of sand left in the surface will dull the edge of the scraper.

4. **Staining.** If the surface is to be colored, then follow sanding with staining as previously explained. Otherwise it is omitted.

5. **Filling.** For the soft woods, the light liquid wood filler should now be applied. (If for hard woods, the paste filler should be used.) The application has been previously explained. Before the varnish is applied, this filled surface should first be well sanded with No. ½ sandpaper, and well dusted and wiped with a cloth. A very fine liquid light wood filler is made by the Sherwin-Williams Co. Apply like varnish with a brush.

6. **Varnishing.** It is advisable in the ordinary wood shop to use a quick drying, dust proof varnish. An excellent varnish is "Vitrolae" for floors made by Harrison Bros. Co. of Chicago. This is a floor varnish, but makes a fine finish. It is dust proof in four hours, dries hard over night, is water and heel proof. If simply a brush finish is desired, "Vitrolae" Flat by the same Company is very good.

7. **Steel Wool.** Do not use sandpaper for smoothing varnish. Use steel wool. Numbers 0 or 00 are the best size to use. A small hand full, or a "big pinch" of the steel wool should be taken and rubbed lightly over the surface. Steel wool cuts through very fast, so special care should be taken not to rub the varnish off. Just the rough places should be slightly reduced and the entire surface gone over so that it looks slightly dulled. Special care must be taken that all the particles of steel wool are removed before a new coat of varnish is applied. Otherwise the work will be entirely ruined.

Steps 8, 9 and 10 are alternated as 6 and **7.**

11. **Pumice and Oil.** Pumice stone should be bought in a finely powdered form. This should be mixed with oil to make a paste. This is applied to the surface (last coat of varnish) with a cloth. Pumice also cuts through very fast. If it is cutting too fast, the cloth should be soaked with more oil. If the paste dries before it can be removed, an oily rag should be used to remove it.

12. **Oil Polish.** When the entire surface has been properly rubbed with pumice and oil, and this has all been removed, the surface should be given a rubbing with oil alone. Finally, the oil should be removed with a soft cloth, and the job is done.

NOTE. If hard wood is to be finished, the steps are the same except that a paste filler is used with no coloring added if the finish is to be natural, while the same colored dry pigment should be mixed with it if it is to be applied to a stained surface.